Volume I

Tompkins County Hazard Mitigation Plan

2021 Update

Prepared By:
Tetra Tech, Inc.
6 Century Drive, Suite 300
Parsippany, NJ 07054

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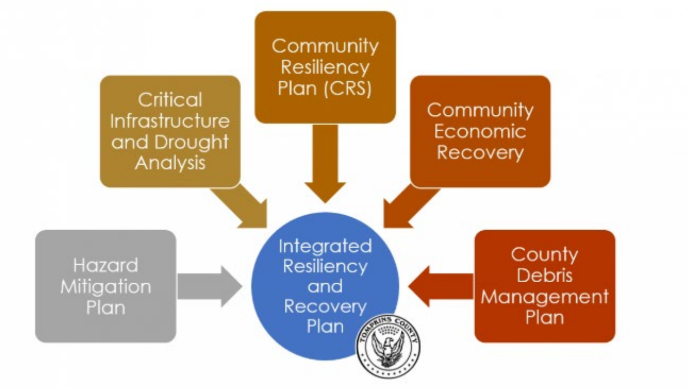
SECTION 1. INTRODUCTION

1.1 BACKGROUND



Through grants from the Federal Emergency Management Agency (FEMA) and the New York State Department of State (DOS), the Tompkins County Department of Planning and Sustainability is leading the development of a countywide Resiliency and Recovery Plan. The overall plan not only focuses on hazard mitigation, but will take a more comprehensive approach to resilience and recovery, which makes this Tompkins County plan unique to other county plans in New York State. This plan includes each of the municipalities in Tompkins County along with a broad group of stakeholders in an effort to better reduce risk associated with hazards and the changing climate as well as to better prepare for long-term recovery from disaster events. By integrating resilience and recovery into the county's general planning practices, municipal and county governments will be able to focus on strategies to address community resilience. In other words, an integrated Resiliency and Recovery Plan will outline key actions that local governments, agencies, and businesses can take to build community resiliency (Tompkins, 2020).

The Hazard Mitigation Plan (HMP) is one component of the overarching resiliency plan and represents the five-year regulatory update of the 2014 Tompkins County HMP.

> ***Hazard Mitigation*** is any sustained action taken to reduce or eliminate the long-term risk and effects that can result from specific hazards.
>
> FEMA defines a ***Hazard Mitigation Plan*** as the documentation of a state or local government evaluation of natural hazards and the strategies to mitigate such hazards.

In accordance with the requirements of the Disaster Mitigation Act of 2000 (DMA 2000), Tompkins County and the municipalities located therein have developed this HMP. The DMA 2000 amends the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act) and is designed to improve planning for, response to, and recovery from disasters by requiring state and local entities to implement pre-disaster mitigation planning and develop HMPs. FEMA has issued guidelines for HMPs. The New York State Division of Homeland Security and Emergency Services (NYS DHSES), formerly the NYS Office of Emergency Management (NYSOEM), also supports plan development for jurisdictions in New York State and issued the NYS DHSES Hazard Mitigation Planning Standards for HMPs developed with NYS DHSES-administered funds.

Specifically, the DMA 2000 requires that states, with support from local governmental agencies, develop and update HMPs on a five-year basis to prepare for and reduce the potential impacts of natural hazards. The DMA 2000 is intended to facilitate cooperation between state and local authorities, prompting them to work together. This enhanced planning better enables local and state governments to articulate accurate needs for mitigation, resulting in faster allocation of funding and more effective risk reduction projects.

Tompkins County has been included in 27 FEMA (major and emergency) declarations.

A Hazard Mitigation Plan is a living document that communities use to reduce their vulnerability to hazards. It forms the foundation for a community's long-term strategy to reduce disaster losses and creates a framework for decision making to reduce damage to lives, property, and the economy from future disasters. Examples of mitigation projects include home acquisitions or elevations to remove structures from high-risk areas, upgrades to critical public facilities, and infrastructure improvements. Ultimately, these actions reduce vulnerability, to support communities' ability to recover more quickly from disasters. Tompkins County has demonstrated its commitment to reducing disaster losses by initially developing its multi-jurisdictional HMP in 2014, compiling information upon which to base a successful mitigation strategy to reduce the impacts of natural disasters and to increase the resiliency of its communities.

1.1.1 DMA 2000 Origins -The Stafford Act

In the early 1990s, a new federal policy regarding disasters began to evolve. Rather than reacting whenever disasters strike communities, the federal government began encouraging communities to first assess their vulnerability to various disasters and proceed to take actions to reduce or eliminate potential risks. The logic is that a disaster-resistant community can rebound from a natural disaster with less loss of property or human injury, at much lower cost, and, consequently, more quickly. Moreover, these communities minimize other costs associated with disasters, such as the time lost from productive activity by business and industries.

The DMA 2000 provides an opportunity for states, tribes, and local governments to take a new and revitalized approach to mitigation planning. The DMA 2000 amended the Stafford Act by repealing the previous mitigation planning provisions (Section 409) and replacing them with a new set of requirements (Section 322). Section 322 sets forth the requirements that communities evaluate natural hazards within their respective jurisdictions and develop an appropriate plan of action to mitigate those hazards, while emphasizing the need for state, tribal, and local governments to closely coordinate mitigation planning and implementation efforts.

The amended Stafford Act requires that each local jurisdiction identify potential natural hazards to the health, safety, and well-being of its residents and identify and prioritize actions that the community can take to mitigate those hazards — before disaster strikes. To remain eligible for hazard mitigation assistance from the federal government, communities must first prepare and then maintain and update an HMP.

Responsibility for fulfilling the requirements of Section 322 of the Stafford Act and administering the FEMA Hazard Mitigation Program has been delegated to the State of New York, specifically to NYS DHSES. FEMA also provides support through guidance, resources, and plan reviews.

1.1.2 Benefits of Mitigation Planning

The planning process helps prepare citizens and government agencies to better respond when disasters occur. Also, mitigation planning allows Tompkins County, and participating municipalities, to remain eligible for mitigation grant funding for projects that will reduce the impact of future disaster events. Eligible projects include property acquisition and structure demolition, structure elevation, localized flood risk reduction projects, infrastructure retrofit, soil stabilization, wildfire mitigation, post-disaster code enforcement, wind retrofit for one- and two-family residences, and planning-related activities. The long-term benefits of mitigation planning include the following:

National Benefit-Cost Ratio (BCR) Per Peril *BCR numbers in this study have been rounded	Beyond Code Requirements	Federally Funded
Overall Hazard Benefit-Cost Ratio	$4:1	$6:1
Riverine Flood	$5:1	$7:1
Hurricane Surge	$7:1	Too few grants
Wind	$5:1	$5:1
Earthquake	$4:1	$3:1
Wildland-Urban Interface Fire	$4:1	$3:1

Source: FEMA 2018; Federal Insurance Mitigation Administration 2018

Note: Natural hazard mitigation saves $6 on average for every $1

- An increased understanding of hazards faced by Tompkins County and its inclusive municipalities.
- Building more sustainable and disaster-resistant communities.
- Increasing education and awareness of hazards and their threats, as well as their risks.
- Developing implementable and achievable actions for risk reduction in the county and its jurisdictions.
- Financial savings through partnerships that support planning and mitigation efforts.
- Focused use of limited resources on hazards that have the biggest impact on the community.
- Reduced long-term impacts and damage to human health and structures.
- Reduced repair costs.

1.1.3 Organizations Involved in the Mitigation Planning Effort

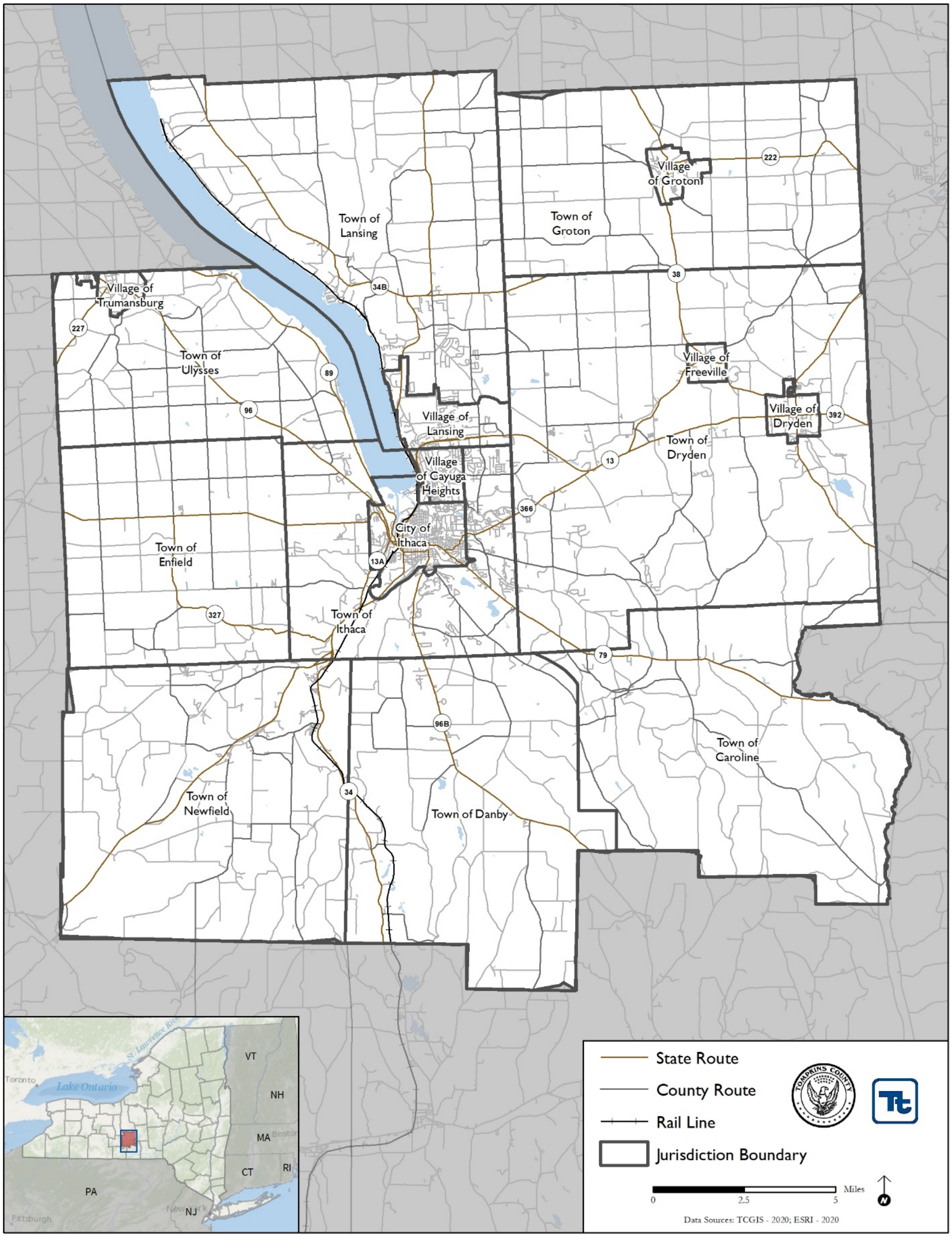
Tompkins County and the participating jurisdictions intend to implement this HMP with full coordination and participation of county and local departments, organizations and groups, and relevant state and federal entities. Coordination helps to ensure that stakeholders have established communication channels and relationships necessary to support mitigation planning and mitigation actions included in Section 6 (Mitigation Strategy) and in the jurisdictional annexes in Section 9 (Jurisdictional Annexes).

In addition to Tompkins County, all 16 municipal governments in the county have participated in the Tompkins County HMP update planning process as indicated in Table 1-1 below. A map of the Tompkins County HMP planning area is provided in Figure 1-1 following the table.

Table 1-1. Participating Tompkins County Jurisdictions

Jurisdictions	
Tompkins County	
Caroline (T)	Groton (V)
Cayuga Heights (V)	Ithaca (T)
Danby (C)	Ithaca (C)
Dryden (T)	Lansing (T)
Dryden (V)	Lansing (V)
Enfield (T)	Newfield (T)
Freeville (T)	Trumansburg (V)
Groton (T)	Ulysses (T)

Figure 1-1. Tompkins County, New York Mitigation Plan Area



1.1.3.1 Multiple Agency Support for Hazard Mitigation

Primary responsibility for the development and implementation of mitigation strategies and policies lies with local governments. However, local governments are not alone; various partners and resources at the regional, state, and federal levels are available to assist communities in the development and implementation of mitigation strategies. Within New York State, NYS DHSES is the lead agency providing hazard mitigation planning assistance to local jurisdictions. NYS DHSES provides guidance to support mitigation planning. In addition, FEMA provides grants, tools, guidance, and training to support mitigation planning.

Additional input and support for this planning effort was obtained from a range of agencies and through public involvement (as discussed in Section 3). The Tompkins County Department of Planning and Sustainability, with support from the Tompkins County Hazard Mitigation Plan Steering Committee (Steering Committee), provided project management and oversight of the planning process. While participating municipalities were asked to identify a primary and alternate local Point of Contact (POC), broad participation by municipal representatives was encouraged and supported throughout the planning process. A list of Steering Committee and municipal POCs is provided in Section 3 (Planning Process), while Appendix B (Participation Matrix) provides further documentation of the broader level of municipal involvement.

This HMP was prepared in accordance with the following regulations and guidance:

- FEMA Local Mitigation Planning Handbook, March 2013.
- FEMA Integrating Hazard Mitigation into Local Planning, March 1, 2013.
- FEMA Plan Integration: Linking Local Planning Efforts, July 2015.
- Local Mitigation Plan Review Guide, October 1, 2011.
- DMA 2000 (Public Law 106-390, October 30, 2000).
- 44 Code of Federal Regulations (CFR) Parts 201 and 206 (including: Feb. 26, 2002, Oct. 1, 2002, Oct. 28, 2003, and Sept. 13, 2004 Interim Final Rules).
- FEMA How-To Guide for Using HAZUS-MH for Risk Assessment FEMA Document No. 433, February 2004.
- FEMA Mitigation Planning How-to Series (FEMA 386-1 through 4, 2002), available at: http://www.fema.gov/fima/planhowto.shtm.
- FEMA Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards, January 2013.
- NYS DHSES Hazard Mitigation Planning Standard, 2017.
- NYS DHSES Hazard Mitigation Planning Standard Guide, 2017.
- NYS Hazard Mitigation Plan, 2019.

Table 1-2 summarizes the requirements outlined in the DMA 2000 Interim Final Rule and provides the section where each is addressed in this HMP.

Table 1-2. FEMA Local Mitigation Plan Review Crosswalk

Plan Criteria	Primary Location in Plan
Prerequisites	
Adoption by the Local Governing Body: §201.6(c)(5)	Section 2; Appendix A
Planning Process	
Documentation of the Planning Process: §201.6(b) and §201.6(c)(1)	Section 3
Risk Assessment	
Identifying Hazards: §201.6(c)(2)(i)	Section 5.2
Profiling Hazards: §201.6(c)(2)(i)	Section 5.4
Assessing Vulnerability: Overview: §201.6(c)(2)(ii)	Section 5.4
Assessing Vulnerability: Identifying Structures: §201.6(c)(2)(ii)(A)	Section 4 Section 5.4
Assessing Vulnerability: Estimating Potential Losses: §201.6(c)(2)(ii)(B)	Section 5.4
Assessing Vulnerability: Analyzing Development Trends: §201.6(c)(2)(ii)(C)	Section 4; Section 9 Annexes
Mitigation Strategy	
Local Hazard Mitigation Goals: §201.6(c)(3)(i)	Section 6; Section 9 Annexes
Identification and Analysis of Mitigation Actions: §201.6(c)(3)(ii)	Section 6; Section 9 Annexes
Implementation of Mitigation Actions: §201.6(c)(3)(iii)	Section 6; Section 9 Annexes
Multi-Jurisdictional Mitigation Actions: §201.6(c)(3)(iv)	Section 6; Section 9 Annexes
Plan Maintenance Process	
Monitoring, Evaluating, and Updating the Plan: §201.6(c)(4)(i)	Section 7
Incorporation into Existing Planning Mechanisms: §201.6(c)(4)(ii)	Section 7; Section 9 Annexes
Continued Public Involvement: §201.6(c)(4)(iii)	Section 7

1.1.4 Organization

The Tompkins County HMP update is organized as a two-volume plan. Volume I provides information on the overall planning process and natural hazard profiling and vulnerability assessments, which serve as a basis for understanding risk and identifying appropriate mitigation actions. As such, Volume I is intended for use as a resource for on-going mitigation analysis. Volume II provides an annex dedicated to each participating jurisdiction. Each annex summarizes the jurisdiction's legal, regulatory, and fiscal capabilities; identifies vulnerabilities to natural hazards; records status of past mitigation actions; and presents an individualized mitigation strategy. The annexes are intended to provide an expedient resource for each jurisdiction for implementation of mitigation projects and future grant opportunities, as well as a place for each jurisdiction to record and maintain its local version of the countywide plan.

1.1.4.1 Mission Statement

A mission statement or guiding principle describes the overall duty and purpose of the planning process and serves to identify the principal message of the plan. It focuses or constrains the range of goals and objectives identified. This is not a goal because it does not describe outcomes. During the 2021 planning process, the

Steering Committee created a mission statement to provide direction for the planning process and an overarching framework for the goals of the plan.

The mission of the Tompkins County Hazard Mitigation Plan is to develop a pathway, using an integrated and comprehensive approach, to increase capacity for all individuals, communities, municipalities, institutions, businesses, and systems within the county, to adapt and thrive in the face of chronic stresses and acute shocks as a result of natural hazard events in Tompkins County.

1.1.4.2 Goals and Objectives

The planning process included a review and update of the prior mitigation goals and the addition of all new objectives as a basis for the planning process and to guide the selection of appropriate mitigation actions addressing all hazards of concern. Further, the goal development process considered the mitigation goals expressed in the New York State HMP, as well as other relevant county and local planning documents, as discussed in Section 6 (Mitigation Strategy).

Tompkins County 2021 HMP Update Goals

1. *Improve the Resiliency of Systems that Support Public Health and Sustainable Development*
2. *Increase Partnerships that Improve Hazard Risk Knowledge and Mitigation*
3. *Protect and Restore Natural Ecosystems to Reduce Flood Risk*
4. *Enhance Mitigation Collaboration and Coordination Among Emergency Service Agencies to Further Support Life Safety and Economic Resiliency*
5. *Promote and Strengthen Healthy and Equitable Environments for all Residents with Special Considerations for Those Who are Socially and Physically Vulnerable*

1.1.4.3 Hazards of Concern

Tompkins County and participating jurisdictions reviewed the natural hazards that caused measurable impacts based on events, losses, and information available since the development of the Tompkins County HMP (2014) and the New York State Hazard Mitigation Plan - 2019 Update. Tompkins County and participating jurisdictions evaluated the risk and vulnerability due to each of the hazards of concern on the assets of each participating jurisdiction. While the overall hazard rankings were calculated for the county and each participating municipality, the overall hazard rankings displayed in each annex reflect municipal input. The hazard risk rankings were used to focus and prioritize individual jurisdictional mitigation strategies.

Drought and Wildfire	Harmful Algal Bloom (HABs)
Disease Outbreak	Invasive Species
Extreme Temperature	Severe Storm
Flood	Severe Winter Storm

1.1.4.4 Plan Integration into Other Planning Mechanisms

Effective mitigation is achieved when hazard awareness and risk management approaches and strategies become an integral part of public activities and decision-making. Within the county there are many existing plans and programs that support hazard risk management, and thus it is critical that this HMP integrates, coordinates with, and complements those mechanisms. Comprehensive plans, codes and ordinances, local watershed plans are among the sources of information to update the county and municipal capabilities, to identify mitigation strategies, and to develop integration actions.

The "Capability Assessment" section of Section 6 (Mitigation Strategy) provides a summary and description of the existing plans, programs and regulatory mechanisms at all levels of government (federal state, county, and local) that support hazard mitigation within the county. Within each jurisdictional annex in Section 9 (Jurisdictional Annexes), the county and each participating jurisdiction identified how they have integrated hazard risk management into their existing planning, regulatory and operational/administrative framework ("existing integration"), and how they intend to promote this integration ("opportunities for future integration").

A further summary of these continued efforts to develop and promote a comprehensive and holistic approach to hazard risk management and mitigation is presented in Section 9 (Jurisdictional Annexes).

Additionally, as previously mentioned, Tompkins County will build off the HMP to create a countywide resilience and recovery plan. This HMP will serve as a foundation increase the resiliency of the county through this plan. This integrated planning effort will include:

- Analysis of critical infrastructure vulnerability to flooding and drought
- Development of a plan for local community involvement in FEMA's Community Rating System (CRS)
- Development of a debris management plan, and
- Development of key community recovery tools.

1.1.5 Implementation of Prior and Existing Local Hazard Mitigation Plans

Section 6 (Mitigation Strategy) and Section 9 (Jurisdictional Annexes) of the plan present the status of the mitigation projects identified in the 2014 Tompkins County HMP. Numerous projects and programs have been implemented that have reduced hazard vulnerability to assets in the planning area. The county and municipal annexes, as well as plan maintenance procedures in Section 7 (Plan Maintenance), were developed to include specific, implementable activities. Future actions include integrating hazard mitigation goals into the resiliency plan as well as comprehensive plan updates; reviewing the HMP during updates of codes, ordinances, zoning, and development; and ensuring a more thorough integration of hazard mitigation, with its related benefits, will be completed within the upcoming five-year planning period.

1.1.6 Implementation of the Planning Process

The planning process and findings are required to be documented in local HMPs. To support the planning process in developing this HMP, Tompkins County and the participating jurisdictions have accomplished the following:

- Developed a Steering Committee and countywide planning partnership with municipalities and stakeholders.
- Reviewed the 2014 *Tompkins County Hazard Mitigation Plan Update*.
- Identified and reviewed those natural hazards that are of greatest concern to the community (hazards of concern).
- Profiled the relevant natural hazards.
- Estimated the inventory at risk and potential losses associated with the relevant hazards.
- Reviewed and updated the hazard mitigation goals and added new objectives.
- Reviewed mitigation strategies identified in the 2014 Tompkins County HMP.
- Developed new mitigation actions to address reduction of vulnerability of hazards of concern.
- Involved a wide range of stakeholders and public in the plan process.
- Developed mitigation plan maintenance procedures to be executed after obtaining approval of the plan from NYS DHSES and FEMA.

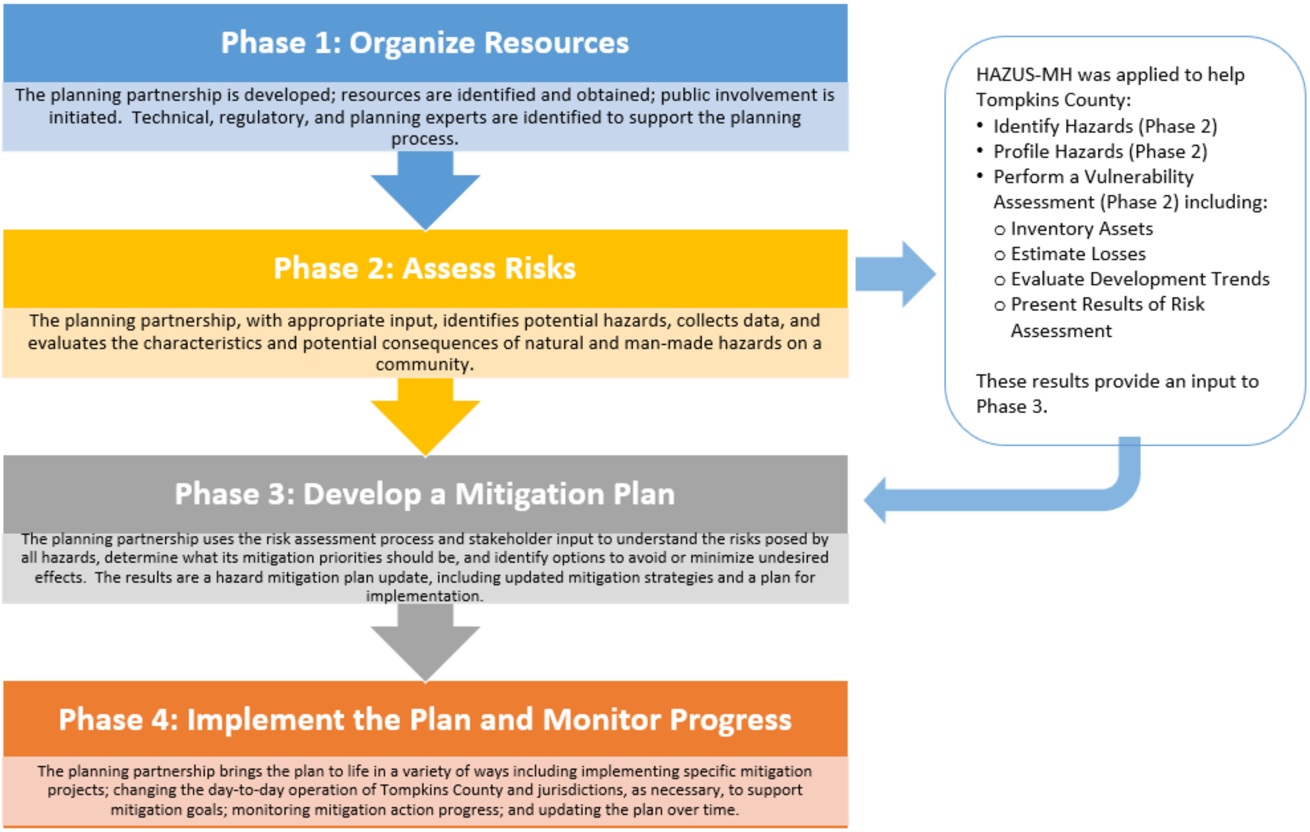
As required by the DMA 2000, Tompkins County and participating jurisdictions have provided multiple opportunities for public comment and input. Numerous agencies and stakeholders have participated as core or support members by providing input and expertise throughout the planning process. Refer to Appendix D (Public and Stakeholder Outreach) for copies of public service announcements, newspaper articles, and social media posts.

This HMP update documents the process and outcomes of Tompkins County and the jurisdictions' efforts. Section 2 (Plan Adoption) includes documentation that the prerequisites for plan approval have been met. Section 3 (Planning Process) includes additional information on the process to develop this plan.

1.1.7 Organization of This Mitigation Plan

This HMP is organized in accordance with FEMA and NYS DHSES guidance. The structure of this HMP follows the four-phase planning process recommended by FEMA and summarized in Figure 1-3.

Figure 1-2. Tompkins County Hazard Mitigation Planning Process



As noted earlier, the HMP is organized into two volumes: Volume I includes all information that applies to the entire planning area (Tompkins County) and Volume II includes participating jurisdiction-specific information.

Volume I of this Plan includes the following sections:

Section 1: Introduction: Overview of participants and planning process.

Section 2: Plan Adoption: Information regarding the adoption of the HMP by Tompkins County and each participating jurisdiction.

Section 3: Planning Process: A description of the HMP methodology and development process; Steering Committee, Planning Committee and stakeholder involvement efforts; and a description of how this HMP will be incorporated into existing programs.

Section 4: County Profile: An overview of Tompkins County, including: (1) general information, (2) economy, (3) land use trends, (4) population and demographics, (5) general building stock inventory, and (6) critical facilities.

Section 5: Risk Assessment: Documentation of the hazard identification and hazard risk ranking process, hazard profiles, and findings of the vulnerability assessment (estimates of the impact of hazard events on life, safety and health; general building stock; critical facilities and the economy); description of the status of local data; and planned steps to improve local data to support mitigation planning.

Section 6: Mitigation Strategies: Information regarding the mitigation goals and objectives identified by the Steering Committee in response to priority hazards of concern and the process by which county and local mitigation strategies have been developed or updated.

Section 7: Plan Maintenance Procedures: System established by the Steering Committee to continue to monitor, evaluate, maintain and update the HMP.

Volume II of this plan includes the following sections:

Section 8: Planning Partnership: Description of the planning partnership, their responsibilities, and jurisdictional annexes.

Section 9: Jurisdictional Annexes: A jurisdiction-specific annex for Tompkins County and each participating jurisdiction containing their hazards of concern, hazard risk ranking, capability assessments, mitigation actions, action prioritization specific only to Tompkins County or that jurisdiction, progress on prior mitigation activities (as applicable), and a discussion of prior local hazard mitigation plan integration into local planning processes.

List of Appendices:

Appendix A: Resolutions of Plan Adoption: Resolutions from the county and each jurisdiction will be included as they formally adopt the HMP update.

Appendix B: Participation Matrix: A matrix is presented to give a broad overview of who attended meetings and when input was provided to the HMP update. Letters of Intent to Participate as described in Section 3 are also included in this appendix.

Appendix C: Meeting Documentation: Agendas, attendance sheets, minutes, and other documentation (as available and applicable) of planning meetings convened during the development of the plan.

Appendix D: Public and Stakeholder Outreach Documentation: Documentation of the public and stakeholder outreach effort including webpages, informational materials, public and stakeholder meetings and presentations, surveys, and other methods used to receive and incorporate public and stakeholder comment and input to the plan process.

Appendix E: County Profile and Risk Assessment Supplementary Data: Details regarding critical facilities from Section 4 (County Profile) and vulnerability assessments conducted for the hazards of concern (Section 5 – Risk Assessment).

Appendix F: Critical Facilities: Critical facilities included in the risk assessment.

Appendix G: FEMA Plan Review Tools: Examples of plan review templates available to support annual plan review.

Appendix H: Tompkins County Mitigation Catalog: Documentation of the broad range of actions identified during the mitigation process.

Appendix I: Linkage Procedure: Procedure to define the requirements established by the Tompkins County Steering Committee and all planning partners for dealing with the increase or decrease in planning partners included in this plan.

Appendix J: Plan Review Matrix: Summary of plans reviewed, including documentation of content relevant to the mitigation planning process.

1.2 The Plan Update – What is Different?

Tompkins County's initial HMP was approved by FEMA and adopted by participating jurisdictions in 2006. The plan was subsequently updated, approved by FEMA, and adopted by participating jurisdictions in 2014. The 2021 update builds on the 2014 plan and specifically includes the following changes or enhancements. This plan differed from its predecessor for a variety of reasons:

- This plan was prepared in accordance with the 2017 NYS DHSES guidance, which provided a framework for a more concise, focused, and implementable mitigation plan.
- Updated data and tools provided for a more detailed and accurate risk assessment. Building footprint data was now available to provide a more accurate flood vulnerability assessment. The risk assessment was prepared to better support future grant applications by providing risk and vulnerability information that would directly support the measurement of "cost-effectiveness" required under FEMA mitigation grant programs.
- There was a strong desire on the part of Tompkins County for this plan to be a user-friendly document that is understandable to the general public and not overly technical and provide images and text that can easily be used as tools to better communicate local hazard risk.
- The plan identified implementable actions rather than strategies, with enough information to serve as the basis for policy and funding decisions and represent measurable impacts on resiliency and mitigation progress.

Table 1-3. Plan Changes Crosswalk

44 CFR Requirement	2014 Plan	2021 Updated Plan
Requirement §201.6(b): In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include: • *An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval;* • *An opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia and other private and non-profit interests to be involved in the planning process; and* • *Review and incorporation, if appropriate, of existing plans, studies, reports and technical information.*	The 2014 plan followed an outreach strategy utilizing multiple media developed and approved by the Steering Committee. This strategy involved the following: • Public participation on an oversight Steering Committee. • Establishment of a plan informational website. • Stakeholders were identified and coordinated with throughout the process.	The 2021 planning effort deployed a multi-faceted public engagement methodology. The plan included the following enhancements: • Using social media. • Web-deployed surveys for stakeholders, neighboring counties, and residents. • Informational brochure. • The outreach materials identified key stakeholders and coordinated with them throughout the process. • A comprehensive review of relevant plans and programs was performed by the planning team.
§201.6(c)(2): The plan shall include a risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.	The risk assessment was based on exposure of assets to natural and man-made hazards of concern with vulnerability calculated based on extrapolation of historical damage data.	The 2021 plan includes a comprehensive risk assessment of natural hazards of concern. Risk was defined as (probability x impact), where impact is the impact on people, property, and economy of the planning area. All planning partners ranked risk as it pertains to their jurisdiction. The potential impacts of climate change are discussed for each hazard.
§201.6(c)(2)(i): [The risk assessment] shall include a] description of the … location and extent of all-natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.	The 2014 plan presented a hazard profile and risk assessment of each hazard of concern. The hazard profiles included: • General hazard description that included the location and extent of the hazard in the county; • Historical hazard occurrences;	The 2021 plan uses a new format, incorporating updated data. Each section of the risk assessment includes the following: • Hazard profile, including maps of extent and location, previous occurrences, and probability of future events. • Climate change impacts on future probability using the

44 CFR Requirement	2014 Plan	2021 Updated Plan
	• History costs and damage estimates; and • Future potential impacts of the hazard including impacts from climate change; The risk assessment included: • Identification of assets; • Damage potential; and • Development trends.	best available data for New York State. • Vulnerability assessment includes: impact on life, safety, and health, general building stock, critical facilities, and the economy, as well as future changes that could impact vulnerability. • The vulnerability assessment also includes changes in vulnerability since the 2014 plan. • Identified issues have been documented in each hazard profile.
§201.6(c)(2)(ii): [The risk assessment] shall include a] description of the jurisdiction's vulnerability to the hazards described in paragraph (c)(2)(i). This description shall include an overall summary of each hazard and its impact on the community.	Results from the HIRA-NY were used to identify the hazards of concern and to inform the relative risk for each hazard. The risk assessment was based on exposure of assets to hazards of concern with vulnerability calculated based on extrapolation of historical damage data to provide a quantitative estimate of the people and property that may be susceptible to a particular hazard event. The damage potential for housing within Tompkins County was estimated using housing characteristics and housing values reported by the U.S. Census Bureau's American Fact Finder.	The methodology from the 2014 plan was enhanced for the 2021 update and HAZUS-MH was used for the severe storm, earthquake, and flood hazards. These were Level 2 analyses using county data. Site-specific data on county-identified critical facilities were entered into the HAZUS-MH model. HAZUS-MH outputs were generated for other hazards by applying an estimated damage function to an asset inventory extracted from HAZUS-MH.
§201.6(c)(2)(ii): [The risk assessment] must also address National Flood Insurance Program insured structures that have been repetitively damaged floods.	A summary of NFIP insured properties was included in the plan.	The same methodology was deployed for the 2021 plan update using new and updated data.
Requirement §201.6(c)(2)(ii)(A): The plan should describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure and critical facilities located in the identified hazard area.	An inventory of the numbers and types of buildings exposed was generated for each hazard of concern.	Based on an updated inventory of general building stock and critical facilities, both exposure and impacts of the hazards of concern were generated for existing assets as well as anticipated development.

44 CFR Requirement	2014 Plan	2021 Updated Plan
Requirement §201.6(c)(2)(ii)(B): [The plan should describe vulnerability in terms of an] estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(i)(A) and a description of the methodology used to prepare the estimate.	-	Hazus-MH provided quantifiable results for the flood and wind hazards.
Requirement §201.6(c)(2)(ii)(C): [The plan should describe vulnerability in terms of] providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.	There is a summary of anticipated development in Section 6.3 (Development Trends) of the 2014 plan.	The same methodology was deployed for the 2021 plan update using new and updated data.
§201.6(c)(3): [The plan shall include a mitigation strategy that provides the jurisdiction's blueprint for reducing the potential losses identified in the risk assessment, based on existing authorities, policies, programs and resources, and its ability to expand on and improve these existing tools.]	Each planning partner in the 2014 plan identified actions that could be implemented within their capabilities. The actions were jurisdiction-specific and strove to meet multiple goals. Each planning partner completed an assessment of its planning, regulatory, technical, and financial capabilities.	A new methodology for setting goals, objectives, and actions was applied to the 2021 plan update. The Steering Committee developed a mission statement, and updated goals, and objectives for the plan. Each planning partner used the progress reporting from the plan maintenance and evaluated the status of actions identified in the 2014 plan. Actions that were completed or no longer considered to be feasible were removed. The remaining actions were carried over to the 2021 plan, and in some cases, new actions were added to the action plan.
Requirement §201.6(c)(3)(i): [The hazard mitigation strategy shall include a] description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.	The Steering Committee reviewed the goals of the 2006 plan and updated, as needed, for the 2014 plan. The goals supported the actions identified in the plan.	The Steering Committee reviewed and updated goals and identified objectives to frame the mitigation strategy. These supported the development of relevant and implementable actions as applied to the 2021 plan update. The Steering Committee reviewed the goals, to include a focus on increased resiliency. This resulted in the finalization of five goals and 34 objectives to frame the plan.

44 CFR Requirement	2014 Plan	2021 Updated Plan
Requirement §201.6(c)(3)(ii): [The mitigation strategy shall include a] section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with emphasis on new and existing buildings and infrastructure.	A discussion of the mitigation strategy was included In Section 7.2 of the 2014 plan.	A mitigation catalog was developed using input from the Steering Committee and stakeholders. This catalog has is included in the 2021 plan to represent the comprehensive range of alternatives considered by each planning partner. The table with the analysis of mitigation actions was used in jurisdictional annexes to the plan.
Requirement: §201.6(c)(3)(ii): [The mitigation strategy] must also address the jurisdiction's participation in the National Flood Insurance Program, and continued compliance with the program's requirements, as appropriate.	All municipal planning partners that participate in the NFIP identified an action stating their commitment to maintain compliance and good standing under the program.	Ongoing participation in the NFIP for municipalities was included in ongoing capabilities.
Requirement: §201.6(c)(3)(iii): [The mitigation strategy shall describe] how the actions identified in section (c)(3)(ii) will be prioritized, implemented and administered by the local jurisdiction. Prioritization shall include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs.	A qualitative cost-benefit analysis was completed for each proposed mitigation action and used to prioritize the actions.	A revised methodology based on the Social, Technical, Administrative, Political, Legal, Economic, and Environmental (STAPLEE) criteria and using new and updated data was used for the 2021 plan update.
Requirement §201.6(c)(4)(i): [The plan maintenance process shall include a] section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle.	The 2014 plan provides a description of the method and schedule to monitor, evaluate, and update the mitigation plan in Section 9 (Plan Maintenance Process).	The 2021 plan provides a more detailed plan maintenance strategy to support the improved use, benefits, and implementation of the plan.
Requirement §201.6(c)(4)(ii): [The plan shall include a] process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms such as comprehensive or capital improvement plans, when appropriate.	The 2014 plan provides recommendations for incorporating the plan into other planning mechanisms in Section 9 (Plan Maintenance Process).	The 2021 plan details recommendations for incorporating the plan into other planning mechanisms such as the following: • Comprehensive Plan. • Emergency Response Plan. • Capital Improvement Programs. • Municipal Code.
Requirement §201.6(c)(4)(iii): [The plan maintenance process shall include a] discussion on how the community will	The 2014 plan provides a strategy for continuing public involvement in Section 9 (Plan Maintenance Process).	An updated plan maintenance strategy is included in the 2021 plan. In addition, the county will use an online tool to support the annual

44 CFR Requirement	2014 Plan	2021 Updated Plan
continue public participation in the plan maintenance process.		progress reporting of mitigation actions.
Requirement §201.6(c)(5): [The local hazard mitigation plan shall include] documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval of the plan (e.g., City Council, County Commissioner, Tribal Council).	16 planning partners and the county participated in the 2014 planning process.	The 2021 plan achieves DMA compliance for 16 planning partners and the county. Resolutions for each partner adopting the plan will be found in Appendix A of this plan.

SECTION 2. PLAN ADOPTION

2.1 Overview

This section contains information regarding adoption of the plan by Tompkins County and each participating jurisdiction.

2.1.1 Plan Adoption by Local Governing Bodies

Adoption by the local governing bodies such as the county legislature, city council, or town/village board demonstrates the commitment of Tompkins County and each participating jurisdiction to fulfill the mitigation goals and strategies outlined in the plan. Adoption of the plan via a municipal resolution legitimizes the HMP and authorizes responsible agencies to execute their responsibilities.

In addition to being required by DMA 2000, adoption of the plan is necessary because:

- It lends authority to the plan to serve as a guiding document for all local and state government officials.
- It gives legal status to the plan in the event it is challenged in court.
- It certifies the program and grant administrators that the plan's recommendations have been properly considered and approved by the governing authority and jurisdictions' citizens.
- It helps to ensure the continuity of mitigation programs and policies over time because elected officials, staff, and other community decision-makers can refer to the official document when making decisions about the community's future.

Source: FEMA. 2003. *How to Series: Bringing the Plan to Life* (FEMA 386-4).

The county and all participating jurisdictions will proceed with formal adoption proceedings when FEMA has completed review of the plan and provides conditional approval of this HMP update, known as Approval Pending Adoption (APA).

Following adoption or formal action on the plan, the jurisdiction must submit a copy of the resolution showing formal adoption (acceptance) of the plan to the Tompkins County Hazard Mitigation Coordinator in the Tompkins County Department of Planning and Sustainability. Tompkins County will forward the executed resolutions to NYS DHSES after which they will be forwarded to FEMA for record. The jurisdictions understand that FEMA will transmit acknowledgement of verification of formal plan adoption and the official approval of the plan to the Tompkins County Hazard Mitigation Coordinator.

The resolutions issued by each jurisdiction to support adoption of the plan will be included in Appendix A.

SECTION 3. PLANNING PROCESS

This section includes a description of the 2021 planning process used to update the 2014 *Tompkins County Hazard Mitigation Plan*, including how it was prepared, who was involved in the process, and how the public was involved.

3.1 Introduction

In general, to ensure that a plan meets the requirements of the DMA 2000 and that the planning process has the broad and effective support of the participating jurisdictions, regional and local stakeholders, and the public, an approach to the planning process and plan documentation is developed to achieve the following:

- The plan should be multi-jurisdictional and include all municipalities in the county. In the case of Tompkins County, all 16 local municipal governments in the county participated in the 2021 planning process as indicated in Table 3-1. It is important to note that any jurisdictions that did not meet participation requirements during this process would not be able to seek FEMA or NYS DHSES approval at the time of plan submittal nor would they be eligible to obtain FEMA mitigation grant funding. Fortunately, all 16 municipal governments in Tompkins County have met those thresholds.

Table 3-1. Participating Tompkins County Jurisdictions

Jurisdictions	
Tompkins County	
Caroline (T)	Groton (V)
Cayuga Heights (V)	Ithaca (T)
Danby (C)	Ithaca (C)
Dryden (T)	Lansing (T)
Dryden (V)	Lansing (V)
Enfield (T)	Newfield (T)
Freeville (T)	Trumansburg (V)
Groton (T)	Ulysses (T)

- The plan will consider natural hazards of concern facing the area, thereby satisfying the natural hazards mitigation planning requirements specified in DMA 2000.
- The plan will be developed following the process outlined by DMA 2000, FEMA regulations, prevailing FEMA guidance, and the 2017 NYS DHSES hazard mitigation planning standards. Following this process ensures that all the requirements are met and support HMP review.

This section of the plan describes the mitigation planning process, including

(1) Organization of the Planning Process;

(2) Stakeholder Outreach and Involvement;

(3) Incorporation of Existing Plans, Studies, Reports, and Technical Information;

(4) Integration with Existing Planning Mechanisms and Programs

(5) Continued Public Involvement

The Tompkins County HMP update was written using the best available information obtained from a wide variety of sources. Throughout the HMP update process, a concerted effort was made to gather information from municipal and regional agencies and staff, as well as stakeholders, federal and state agencies, and Tompkins County residents. The HMP Steering Committee solicited information from local agencies, academics, and individuals with specific knowledge of certain natural hazards, past historical events, and climate science. In addition, the Steering and Planning Committees took into consideration planning and zoning codes, ordinances, and recent land use planning decisions. The hazard mitigation strategies identified in this HMP update were developed through an extensive planning process involving local, county and regional agencies, residents, and stakeholders.

3.2 Organization of the Planning Process

This section of the plan identifies how the planning process was actually implemented and organized with the many planning partners involved and outlines the major activities that were conducted in the development of this HMP update.

3.2.1 Organization of Planning Partnership

Tompkins County applied for and was awarded $93,750 in Hazard Mitigation Grant Program Federal funds administered by NYS Department of Homeland Security and Emergency Services to conduct the plan update. The county further obtained $160,000 from the NYS Department of State to develop the related Tompkins County Resiliency and Recovery Plan.

Project management and grant administration has been the responsibility of the Tompkins County Department of Planning and Sustainability. As the Southern Tier region prepares for and adapts to the changing climate, Tompkins County will be creating an integrated Resiliency and Recovery Plan that not only addresses potential hazards, but further prepares communities for future disasters while also increasing the economic recovery process to mitigate loss post disaster. The Resiliency and Recovery Plan will address multiple topics including inventorying and assessment of critical assets in floodplains; conducting a local drought impact analysis; developing education programs and tools for post-disaster recovery planning; developing a local debris management plan; and providing support to interested municipalities to enroll in FEMA's Community Rating System (CRS). As a pilot project that has not previously been conducted, the county and state look to create an integrated plan that connects municipal and county planning efforts and documentation to reduce redundancy and streamline the process of hazard mitigation and resiliency (Tompkins County Legislature, 2019).

Building Resilient Infrastructure and Communities (BRIC) will support states, local communities, tribes, and territories as they undertake hazard mitigation projects, reducing the risks they face from disasters and natural hazards. BRIC is a new FEMA pre-disaster hazard mitigation program that replaces the existing Pre-Disaster Mitigation program.

The BRIC program guiding principles are supporting communities through capability- and capacity-building; encouraging and enabling innovation; promoting partnerships; enabling large projects; maintaining flexibility; and providing consistency.

Source: FEMA, 2020

A contract planning consultant (Tetra Tech, Inc. referred herein as *Tetra Tech*) was selected to guide the county and participating jurisdictions through the HMP update process. A contract between Tetra Tech and Tompkins County was executed in 2020. Specifically, Tetra Tech, as the *contract consultant*, was tasked with the following:

- Assist with organization of a Steering Committee and Planning Partnership.
- Support the public and stakeholder outreach program.
- Collect data.
- Facilitate and attend meetings (Steering Committee, Planning Committee, municipal, stakeholder, and public meetings).
- Review and update hazards of concern, hazard profiles, and risk assessment.
- Support the review and updating of mitigation planning goals and objectives.
- Reviewing past mitigation strategies progress.
- Screening and identifying appropriate mitigation actions.
- Assist with prioritization of mitigation actions.
- Compose draft and final plan documents.

In early 2020, Tompkins County notified all municipalities within its jurisdictional borders of the pending planning process via email and invited them to formally participate. Jurisdictions were asked to formally notify the County of their intent to participate (via a Letter of Intent to Participate) and to identify planning POCs to facilitate municipal participation and represent the interests of their respective communities through active participation in the *Planning Committee*, the group having at least one municipal representative from each community. Completed Letters of Intent to Participate are provided as Appendix B (Participation Matrix).

To facilitate plan development, Tompkins County developed a smaller Steering Committee to provide guidance and direction to the HMP update effort and to ensure the resulting document will be embraced both politically and by the constituency within the planning area (refer to Table 3-2). All municipalities participating in the plan update through the Planning Committee authorized the Steering Committee to perform certain activities on their behalf, via the Letter of Intent to Participate (FEMA mitigation planning *combination model*). Specifically, the Steering Committee was charged with the following:

- Provide guidance and oversight of the planning process on behalf of the general Planning Committee.
- Attend and participate in Steering Committee meetings.
- Assist with the development and completion of certain planning elements, including:
  - Reviewing and updating the hazards of concern
  - Developing a public and stakeholder outreach program
  - Assuring that the data and information used in the plan update process are the best available
  - Reviewing and updating the hazard mitigation goals
  - Identifying and screening appropriate mitigation strategies and activities
- Review and comment on plan documents prior to submission to NYS DHSES and FEMA.

The Steering Committee provided guidance and leadership, oversight of the planning process, and acted as the point of contact for all participating jurisdictions and the various interest groups in the planning area.

Table 3-2. Tompkins County Hazard Mitigation Plan Steering Committee Members

Affiliation	Name	Title
Tompkins County Department of Planning & Sustainability	Scott Doyle	Associate Planner
	Katie Borgella	Commissioner of Planning and Sustainability
Tompkins County Health Department	Patricia Mason	Preparedness Coordinator
Tompkins County Emergency Response	Jessica Verfuss	Deputy Director
City of Ithaca Public Works	Michael Thorne	Superintendent
Town and Village of Dryden	David Sprout	Code Enforcement Officer
Town of Lansing	C.J. Randall	Director of Planning
Cornell University Office of Emergency Management	Dan Maas	Associate Director
Tompkins County Soil and Water Conservation District	Jon Negley	District Manager
Ithaca College	Tim Ryan	Associate Director

Each municipality received a copy of the *Planning Partner Expectations*, outlining the responsibilities of the participants and the agreement of the partners to authorize the Steering Committee to represent the jurisdiction in the completion of certain planning elements as noted above. Table 3-3 lists the current municipal members of the Planning Committee at the time of this HMP's publication. Together, the Steering Committee and Planning Committee form the *Planning Partnership*. This *Planning Partnership* (Steering and Planning Committees) were charged with the following:

- Represent their jurisdiction throughout the planning process.
- Assure participation of all departments and functions within their jurisdiction that have a stake in mitigation (e.g., planning, engineering, code enforcement, police and emergency services, public works).
- Assist in gathering information for inclusion in the HMP update, including the use of previously developed reports and data.
- Support and promote the public involvement process.
- Report on progress of mitigation actions identified in prior or existing HMPs, as applicable.
- Identify, develop, and prioritize appropriate mitigation initiatives.
- Report on progress of integration of prior or existing HMPs into other planning processes and municipal operations.
- Develop and author a jurisdictional annex for their jurisdiction.
- Review, amend, and approve all sections of the plan update.
- Adopt, implement, and maintain the plan update.

Table 3-3. Tompkins County Hazard Mitigation Planning Partnership Members

Jurisdiction	Primary Point of Contact	Title	Alternate Point of Contact	Title
Tompkins County	Scott Doyle	Associate Planner	Katie Borgella	Commissioner of Planning & Sustainability
Caroline, T	Mark Witmer	Supervisor	Barry Goodrich	Caroline Stormwater Coalition Representative
Cayuga Heights, V	Brent Cross	Village Engineer	Jerry Wright	Police Chief
Danby, T	Steve Cortright	Code Enforcement Officer	Matt Ulinski	Councilperson/ Deputy Supervisor
Dryden, T	David Sprout	Code Enforcement Officer	Nancy Munkenbeck	Conservation Board
Dryden, V	Mike Murphy	Mayor	Paul Sabin Jr.	Superintendent of Public Works
Enfield, T	Beth McGee	Supervisor	Ellen Woods	Town Clerk
Freeville, V	Jason Cuykendall	Deputy Mayor	David Fogel	Mayor
Groton, T	Donald Scheffler	Town Supervisor	Dan Carey	Agricultural Advisory Committee
Groton, V	Chris Neville	Mayor	Nancy Niswender	Village Clerk

Jurisdiction	Primary Point of Contact	Title	Alternate Point of Contact	Title
Ithaca, C	Michael Thorne	Superintendent of Public Works	Julie Holcomb	City Clerk
Ithaca, T	Dan Thaete	Town Engineer	Susan Ritter	Director of Planning
Lansing, T	C.J. Randall	Director of Planning	Ed LaVigne	Town Supervisor
Lansing, V	Michael Scott	CEO	Dan Hartill	Mayor
Newfield, T	Mike Allinger	Supervisor	Christine Laughlin	Deputy Supervisor
Trumansburg, V	Rordan Hart	Mayor	Tammy Morse	Village Clerk
Ulysses, T	John Zepko	Planner	Michelle Wright	Deputy Supervisor

The jurisdictional Letter of Intent to Participate identifies the above *Planning Partner Expectations* as serving to identify those activities comprising overall participation by jurisdiction throughout the planning process. The jurisdictions in Tompkins County have differing levels of capabilities and resources available to apply to the plan update process, and further, have differing exposure and vulnerability to the natural hazard risks being considered in this plan. Tompkins County's intent was to encourage participation by all-inclusive jurisdictions and to accommodate their specific needs and limitations while still meeting all intents and purposes of the plan update participation. Such accommodations have included the establishment of a Steering Committee, engaging a contract consultant to assume certain elements of the plan update process, and the provision of additional mechanisms to meet the mitigation planning purposes.

Ultimately, jurisdictional participation is evidenced by completed, detailed municipal annexes to the HMP (Section 9) wherein jurisdictions have individually identified their planning POCs; evaluated their risk to the hazards of concern; identified their capabilities to effect mitigation in their community; identified and prioritized an appropriate suite of mitigation initiatives, actions, and projects to mitigate their hazard risk; and eventually, adopted the updated plan via resolution.

All municipalities in the County actively participate in the National Flood Insurance Program (NFIP) and have a designated NFIP Floodplain Administrator (FPA). All FPAs were informed of the planning process, reviewed the plan documents, and provided direct input to the plan update. Local FPAs are identified in the *Points of Contact* and *Administrative and Technical* portions of the jurisdictional annexes in Section 9.

Appendix B (Participation Matrix) identifies those individuals who represented the municipalities during this planning effort and indicates how they contributed to the planning process.

3.2.2 Planning Activities

Members of the municipal and county planning partnership (individually and as a whole), as well as key stakeholders, convened and/or communicated regularly to share information and participated in workshops to identify hazards; assess risks; review existing inventories of and identify new critical facilities; assist in updating and developing new mitigation goals and strategies; and provide process continuity to ensure that natural hazards vulnerability information and appropriate mitigation strategies were incorporated. All members of the Planning Partnership had the opportunity to review the draft plan, interact with other stakeholders, and assist with public involvement efforts.

A summary of Planning Partnership (Steering Committee and Planning Committee) meetings held, and key milestones met, during the development of the HMP update is included in Table 3-4 that also identifies which DMA 2000 requirements the activities satisfy. Documentation of meetings (agendas, sign-in sheets, minutes, etc.) are in Appendix C (Meeting Documentation). Table 3-4 identifies only the formal meetings held during plan development and does not reflect the planning activities conducted by individuals and groups throughout the planning process. In addition to these meetings, a great deal of communication took place between the county, committee members, and the contract consultant through individual remote meetings via Microsoft Teams and Zoom (due to COVID-19 restrictions), email, and phone.

After completion of the HMP update, implementation and ongoing maintenance will become a function of the *Planning Partnership* (Steering and Planning Committees) as described in Section 7. The *Planning Partnership* is responsible for reviewing the HMP and soliciting and considering public comment as part of the five-year mitigation plan update.

This table summarizes a list of mitigation planning activities and meetings and their respective participants. A more detailed list of participants for each meeting is provided in Appendix C. Refer to DMA 2000 (Public Law 106-390) for details on each of the planning requirements (https://www.fema.gov/media-library-data/20130726-1524-20490-1790/dma2000.pdf).

Table 3-4. Summary of Mitigation Planning Activities / Efforts

Date	DMA 2000 Requirement	Description of Activity	Participants
May 18, 2020	1b, 2	Steering Committee #1 Planning process, data collection, review of hazards of concern, public outreach strategy.	NYS DOS, NYS DHSES, Tompkins County Department of Planning & Sustainability, Tompkins County Department of Emergency Response, Tompkins County Health Department, Town of Dryden Code Enforcement, Town of Lansing Planning, Cornell University Emergency Management, Ithaca College Emergency Services, Tompkins County Soil and Water Conservation District, and the City of Ithaca Department of Public Works, Tetra Tech
July 31, 2020	1b, 2	Planning Committee #1 – Kick-Off Planning process, data collection, hazards of concern ID.	Tompkins County Department of Planning & Sustainability, Mayor of Dryden Village, Village of Dryden Trustee, Village of Groton, Town of Caroline, Village of Cayuga Heights, Cornell University, Town of Groton, City of Ithaca, Town of Ulysses Planning, Deputy Supervisor Ulysses, Town of Enfield, Village of Lansing, Dryden CEO, Village of Trumansburg, Town of Caroline, Tompkins County Health Department, Town of Ithaca,

Date	DMA 2000 Requirement	Description of Activity	Participants
			Village of Freeville, Town of Newfield, Village of Trumansburg, Town of Enfield, Town of Danby CEO, Town of Lansing, County Emergency Response, NYSDHSES, SWCD, Ithaca College, Town of Dryden, Tetra Tech
June 30, 2020	1b, 2	Steering Committee #2 Strengths, Weaknesses, Obstacles and Opportunities (SWOO), goals and objectives	Tompkins County Department of Planning & Sustainability, Tompkins County Health Department, Town of Lansing Planning, City of Ithaca DPW, Tompkins Emergency Response, Town/ Village of Dryden, NYSDHSES, Tetra Tech
September 16, 2020	1b, 2, 3a, 3b, 3c, 3d, 3e	Planning Committee #2 Risk Assessment presentation, risk ranking input, mitigation problem statement development	Tompkins County Department of Planning & Sustainability, Town of Groton Supervisor, Tompkins County Health Dept., City of Ithaca Clerk, Tompkins Dept. of Emergency Response, Town of Ulysses Planning, NYSDHSES, Village of Groton Clerk, Town of Newfield Supervisor, Village of Lansing CEO, Town of Caroline Supervisor, Town of Enfield Supervisor, Town of Danby Supervisor, Village of Dryden Mayor, Village of Lansing Deputy Mayor, Village of Trumansburg Mayor, Village of Lansing Mayor, Town of Dryden, Village of Cayuga Heights Engineer, Town of Lansing Planning, City of Ithaca Public Works, Cornell University EHS, Town of Enfield Deputy Supervisor, Tetra Tech
August 24, 2020	1b, 2, 3a, 3b, 3c, 3d, 3e	Steering Committee #3 Finalize goals and objectives, Strengths, Weaknesses, Obstacles and Opportunities (SWOO) wrap-up, risk ranking overview	Tompkins County Department of Planning & Sustainability, Town of Lansing, Town of Dryden, Deputy Director of County Emergency Response, NYS Department of Homeland Security and Emergency Services, , Tompkins Health Department, Town of Dryden, City of Ithaca DPW, Tompkins County Planning, Tetra Tech
October 22, 2020	1b, 2, 4a, 4b, 4c	Mitigation Workshop	Tompkins County Department of Planning & Sustainability, Cayuga Heights Engineering Dept., Village of Cayuga Heights Mayor, Town of Dryden, Cornell University, Town of Ithaca Engineering, Town of Ulysses Planning , Tompkins SWCD, Town of Danby Supervisor, Town of Caroline Clerk, Town of Lansing Planning, Tompkins County Planning, City of Ithaca Clerk, Village of Groton, Town of Dryden, Mark Witmer, Town of Caroline , Town of Groton Supervisor, Trumansburg Village Mayor , Village of Lansing Deputy Mayor, Town of Ithaca, NYS DHSES, Village of Lansing CEO , Town of Ithaca, City of Ithaca, Town of Enfield, Town of Newfield, Village of Dryden, Tetra Tech
October 2020 (multiple dates)	2, 4a, 4b, 4c	Local Support Meetings Annex and mitigation strategy development and finalization	Tompkins County Department of Planning & Sustainability, individual municipalities, Tetra Tech
November 19, 2020	1b, 2, 3, 4, 5	Draft Plan Review/Review of Maintenance Procedures	Tompkins County Department of Planning & Sustainability, Tompkins County Department of Emergency Response, City of Ithaca DPW, Town of

Date	DMA 2000 Requirement	Description of Activity	Participants
			Lansing Planning, Town of Dryden Planning, Cornell University, Tetra Tech
April, 2021	1b	Public Review of Draft Plan	During the 30-day public review period, comments and feedback was received from 10 members of the public and/or stakeholders. Each comment was reviewed by the Tompkins County Department of Planning & Sustainability and the consultant to determine how best to incorporate the comments into the plan. As a result of the feedback, additional information was included in Volume 1 sections to clarify hazard characteristics and impacts, and additional projects were included in municipal annexes.
September, 2021	-	Approved pending adoption by FEMA	–

Note: TBD = to be determined.
Each number in column 2 identifies specific DMA 2000 requirements, as follows:
1a – Prerequisite – Adoption by the Local Governing Body
1b – Public Participation
2 – Planning Process – Documentation of the Planning Process
3a – Risk Assessment – Identifying Hazards
3b – Risk Assessment – Profiling Hazard Events
3c – Risk Assessment – Assessing Vulnerability: Identifying Assets
3d – Risk Assessment – Assessing Vulnerability: Estimating Potential Losses
3e – Risk Assessment – Assessing Vulnerability: Analyzing Development Trends
4a – Mitigation Strategy – Local Hazard Mitigation Goals
4b – Mitigation Strategy – Identification and Analysis of Mitigation Measures
4c – Mitigation Strategy – Implementation of Mitigation Measures
5a – Plan Maintenance Procedures – Monitoring, Evaluating, and Updating the Plan
5b – Plan Maintenance Procedures – Implementation through Existing Programs
5c – Plan Maintenance Procedures – Continued Public Involvement

3.3 Stakeholder Outreach and Involvement

This section details outreach to and involvement of the many agencies, departments, organizations, non-profits, districts, authorities, and other entities that have a stake in managing hazard risk and mitigation, commonly referred to as *stakeholders*.

Diligent efforts were made to assure broad regional, county, and local representation in this planning process. To that end, a comprehensive list of stakeholders was developed with the support of the Steering and Planning Committees. Stakeholder outreach was performed early and throughout the planning process. This HMP update includes information and input provided by these stakeholders where appropriate, as identified in the references.

The following is a list of the various stakeholders that were invited to participate in the development of this plan, along with a summary of how these stakeholders participated and contributed. This summary discusses the various stakeholders that were invited to participate in the development of this HMP update and how they contributed to the HMP.

It should be assumed that this summary does not include every single stakeholder that was aware of and contributed to this HMP update, as outreach efforts were being made, both formally and informally, throughout the process by the many planning partners involved in the effort, and documentation of all such efforts is impossible. Furthermore, a host of other community partners will be involved in the connection with the Resiliency and Recovery Plan being developed upon HMP implementation. Instead, this summary is intended to demonstrate the scope and breadth of the stakeholder outreach efforts made during the plan update process.

3.3.1 Federal, State, and County Agencies

The following describes the various departments and agencies that were involved during the planning process.

3.3.1.1 Federal Agencies

FEMA Region II: Provided updated planning guidance, summarized and detailed NFIP data for planning area, attended meetings, conducted a Mitigation Strategy Workshop, provided information on potential grant funding for the county and municipalities, and conducted plan review.

Information regarding hazard identification and the risk assessment for this HMP update was requested and received or incorporated by reference from the following agencies and organizations:

- National Climatic Data Center (NCDC)
- National Hurricane Center (NHC)
- National Oceanic and Atmospheric Administration (NOAA)
- National Weather Service (NWS)
- Storm Prediction Center (SPC)
- U.S. Army Corps of Engineers (USACE)
- U.S. Census Bureau

3.3.1.2 State Agencies

NYS DHSES: Headquarters and Region II: Administered planning grant and facilitated FEMA review, provided updated planning guidance, project management support, attended meetings, and provided review of draft and final HMP.

New York State Department of Environmental Conservation (NYSDEC): Provided data and information. Information regarding high hazard dam risk as well as inundation mapping was provided via access to online resources as well as from available Emergency Action Plans.

3.3.1.3 Tompkins County Departments

Several county departments were represented on the Steering Committee and involved in the HMP update planning process. Appendix B (Participation Matrix) provides further details regarding regional and local stakeholder agencies. All responses to the stakeholder surveys are in Appendix D (Public and Stakeholder Outreach).

Tompkins County Department of Planning and Sustainability: Scott Doyle, an Associate Planner from the Tompkins County Department of Planning and Sustainability, was identified as the ongoing Tompkins County Hazard Mitigation Coordinator in Section 7 (Plan Maintenance) and served in this role throughout the planning process. In addition, the Department of Planning and Sustainability provided critical data, assisted with the update of events and losses in the county, updated the previous mitigation strategy, facilitated outreach to stakeholders, contributed to the county's capability assessment and updated mitigation strategy, and reviewed draft sections of the HMP.

Tompkins County ITS Department: The Information Technology Services (ITS) Department creates and maintains the County's geospatial data inventory. ITS provided critical facility inventory data and all other relevant GIS data throughout the planning process.

Tompkins County Department of Emergency Response: The Department of Emergency Response (DOER) coordinates the county's efforts to prepare for and respond to emergency situations. In an emergency, DOER works with other county departments and external agencies to respond to the needs of citizens by helping to protect lives and property, assist those injured or whose normal lives have been disrupted by events, and to provide for the rapid restoration of normal services.

The County Emergency Response Deputy Director, Jessica Verfuss, served on the Steering Committee throughout the plan as well. Tompkins County DOER provided data, reviewed sections, and contributed to the mitigation strategy.

Tompkins County Health Department: The Health Department provides various services throughout the County around community health needs and provided valuable insight into how the County needs to conduct its activity before, during, and after a hazard event. The department also provided information on how the County has been preparing in response to COVID-19 and other public health hazards that have or are currently occurring in the County and Finger Lakes Region.

Tompkins County Soil and Water Conservation District: The County Soil and Water Conservation District (SWCD) works on natural resource, agricultural, and conservation efforts within Tompkins County. As a result, the entity is an important asset during the process of emergency management and resilience and provided information around existing land use related problems as well as hazard the County faces with the Agricultural Industry. As the SWCD works closely with the Highway Department for the County, SWCD is also knowledgeable and provided useful information around current flood zones and infrastructure erosion.

The SWCD District Manager served on the Steering Committee throughout the plan as well.

3.3.1.4 Regional and Local Stakeholders

Appendix B (Participation Matrix) provides further details regarding regional and local stakeholder agencies. The stakeholders listed below were directly contacted by Tompkins County to take a stakeholder survey, which included the identification of specific mitigation actions and projects and/or review of the draft HMP. Results of the surveys are in Appendix D (Public and Stakeholder Outreach). Feedback was reviewed by the Steering Committee and integrated where appropriate in the plan.

Academia

School districts and higher education in the County were provided with the stakeholder survey, invited to provide input, and notified of the draft HMP review period. The following have provided input to the planning process via the County online stakeholder survey:

- **Tompkins Cortland Community College** – offers community college classes and certificate programs.
- **NYS Water Resources Institute at Cornell (NYSWRI)** – NYSWRI supports robust science and dialogue between researchers, managers, policymakers, and the general public to improve water management.
- **Cornell University - Department of City & Regional Planning**- graduate and undergraduate education program in city & regional planning; research in multiple aspects of urban and regional planning, including resilience.
- **Cornell Cooperative Extension** – the mission of Cornell Cooperative Extension is to enable people to improve their lives and communities through partnerships that put experience and research knowledge to work. Extension staff and trained volunteers deliver education programs, conduct applied research, and encourage community collaborations.

Hospitals and Healthcare Facilities

Hospitals and healthcare facilities located in Tompkins County did not participate in the stakeholder survey but were invited to review the plan review.

Highway and Public Works

State, county, and local highway and public works departments were provided with the stakeholder survey and invited to provide input on the draft HMP. In addition, many of the participating municipalities had representatives from their highway and public works departments representing them on the *Planning Partnership*. The following agency further provided input to the planning process via the County online stakeholder survey:

- Village of Freeville Highway and Sewer Department

Emergency Services

State, county and local emergency service providers (police, fire, and EMS) were notified of the stakeholder survey and invited to provide input on the draft HMP. The following agency provided input to the planning process via the County online stakeholder survey:

- Cornell University Office of Emergency Management

Utilities

Utility providers in the County were notified of the stakeholder survey and invited to provide input on the draft HMP. The following agency provided input in the planning process via the County online stakeholder survey:

- Avangrid (Parent company for NYSEG) Central Region – Community Outreach & Development Manager

Business and Commercial Interests

Businesses and commercial enterprises in Tompkins County were notified of the stakeholder survey and invited to provide input on the draft HMP. The following entities were provided input to the planning process via the County online stakeholder survey:

- **Tompkins Insurance Agencies Inc.** – offers flood insurance for commercial and residential buildings.
- **STREAM Collaborative** - an architecture and landscape architecture firm working primarily in Tompkins County.

Additional Stakeholders

The following stakeholders were informed by the Tompkins County Department of Planning and Sustainability that the draft HMP was available for review and comment:

- **Ithaca-Tompkins County Transportation Council (ITCTC)** - The ITCTC is the Metropolitan Planning Organization for the Ithaca-Tompkins County area. It plans for and manages the programming of federal surface transportation funds. The ITCTC does not operate any transportation service, nor is it the lead agency in the maintenance and construction of infrastructure. The ITCTC is guided by a 20-year Long-Range Transportation Plan and works with municipalities and other partners in programming and implementing initiatives and projects that support the goals of the plan. Additionally, the ITCTC has helped fund maintenance and construction of numerous bridges in Tompkins County.
- **Human Services Coalition** – convenes community planning conversations regarding local homeless response system, conducts the annual point in time count, tracks all data using the

Homeless Management Information System (HMIS), and implements coordinated entry into supportive housing.

- **Family and Children Services of Ithaca** – provides community outreach to vulnerable populations, including homeless.
- **Ithaca Urban Renewal Agency** – provides funding for affordable housing, community facilities, and economic development.
- **City of Ithaca Office of Economic Development** – provides direct technical assistance to businesses and property owners in the City of Ithaca, economic development program administration, etc.
- **High Hazard Dam Owners** – comply with regulatory maintenance and safety protocols. The Tompkins County Department of Planning & Sustainability contacted each dam owner to gather information and to advise that these assets would be included in this HMP.

Adjacent Counties

Tompkins County has made an effort to keep surrounding counties and municipalities apprised of the project and opportunities to provide input to this planning process. Specifically, the following adjoining and nearby counties were contacted in August 2020 to inform them about the availability of the project website, draft plan documents, and surveys, and to invite their representatives to provide input to the planning process.

- Broome County, NY*
- Cayuga County, NY
- Chemung County, NY*
- Cortland County, NY
- Schuyler County, NY*
- Seneca County, NY
- Tioga County, NY*

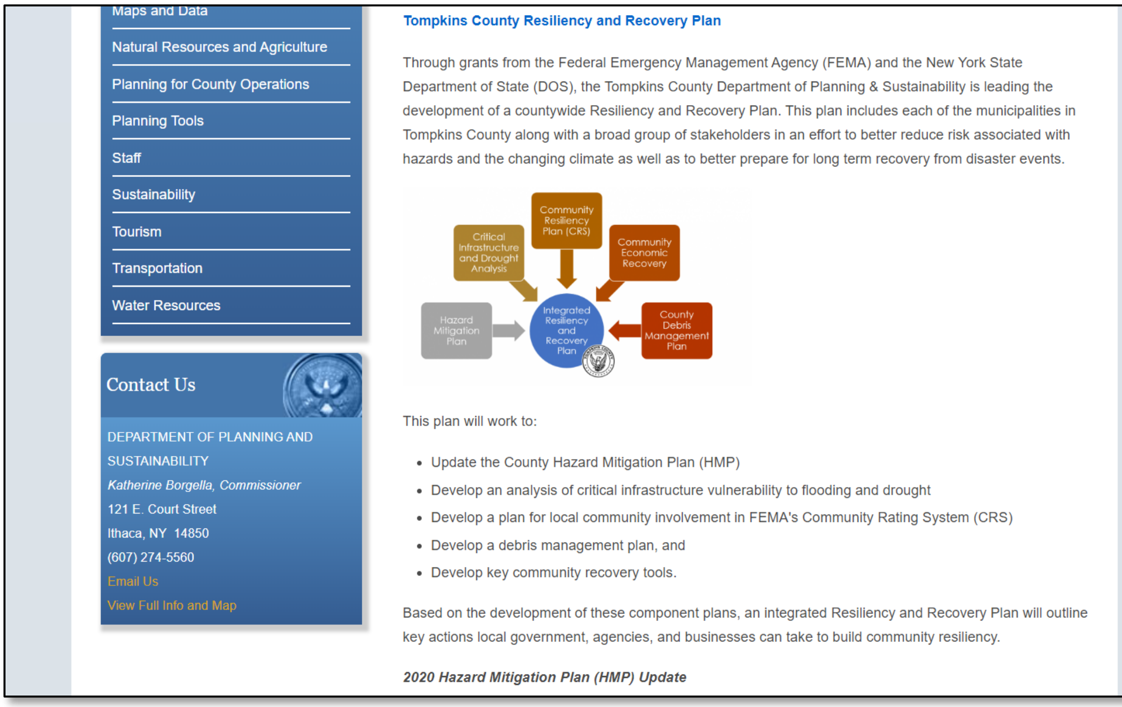
County indicated by an asterisk (*) provided input to the planning process via the county online stakeholder survey. A summary of survey results is provided in the next section.

3.3.1.5 Public Outreach

The Steering Committee and Planning Committee have made the following efforts toward public participation in the development and review of the HMP:

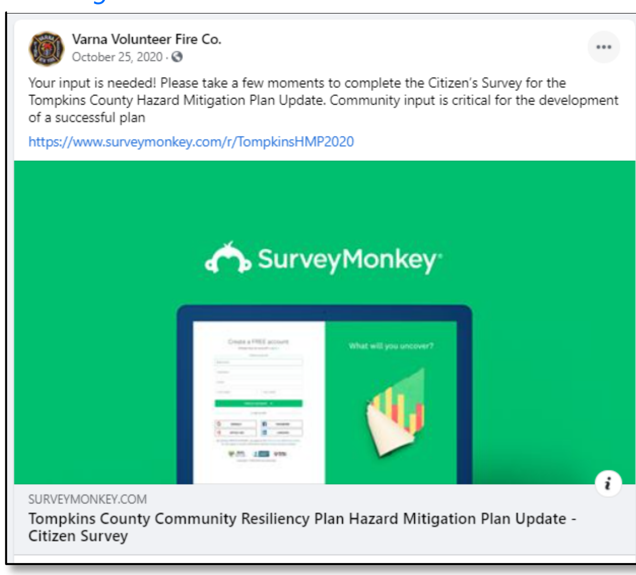
- A public project website was developed and is being maintained to facilitate communication between the Steering Committee, planning partnership, public and stakeholders (https://tompkinscountyny.gov/planning/climate-adaptation). The public website contains a project overview, meeting agendas and notes, county and local contact information, access to the citizen's survey and various stakeholder surveys, and sections of the HMP for public review and comment (see Figure 3-1).

Figure 3-1. Tompkins County HMP Webpage



- All hazard mitigation planning meetings that were open to the public were advertised on the Tompkins County website.
- All participating municipalities were encouraged to distribute the mitigation planning brochure and post the links to the project website and citizen and stakeholder surveys. In addition, all participating municipalities were requested to advertise the availability of the project website via local homepage links, and other available public announcement methods (e.g., Facebook, Twitter, email blasts). The following are examples of outreach provided:
    - Varna Volunteer Fire Co. posted a link on their Facebook page to complete the citizen survey on October 25, 2020 (Figure 3-2).

Figure 3-2. Varna Volunteer Fire Co. Post



- On October 20, 2020, the Town of Dryden posted a link on their municipal website asking residents to complete the citizen survey (http://dryden.ny.us/2020/10/20/tompkins-county-hazard-mitigation-plan-update/).
- The Town of Danby, on November 5, 2020, added a summary of the HMP on their news page and asked residents to complete the survey (https://towndanby.digitaltowpath.org:10768/content/News/View/135).
- On October 22, 2020, the Town of Enfield asked for community input on the HMP and requested residents complete the citizen survey (http://townofenfield.org/enfield-share-your-voice/). During the November 4th Planning Board meeting, the HMP was an agenda item and the town provided links to various resources about the HMP including links to the presentations, initial hazard ranking, and the brainstorming worksheet for the Town.

Figure 3-3. Town of Enfield Planning Board Meeting Agenda


Planning Board Meeting 11/4/20 7:00pm
October 30, 2020

There will be a meeting of the
Town of Enfield Planning Board
Wednesday, November 4, 2020
at 7 pm
via the Zoom Online Meeting Platform

Join Zoom Meeting
https://us02web.zoom.us/j/86306286687
Or call 1-646-876-9923
Meeting ID: 863 0628 6687
Passcode: 14850

Planning Board Agenda 11/4/2020
- Discussion of Process for Review of the Solar Project
- Hazard Mitigation/Resiliency Plan
  - Tompkins Mitigation Workshop
  - Tompkins Initial SWOO Results
  - Tompkins County Hazard Mitigation Minutes
  - Enfield Hazard Ranking and Results
  - Enfield Mitigation Project Brainstorming Worksheet

- On November 20, 2020, the Town of Lansing circulated the citizen survey to the Lansing Central School District's Parent Teacher Student Organization email listserv as well as the town's Conservation Advisory Council, Planning Board, and Town Board.

- An online natural hazards preparedness citizen survey was developed to gauge household preparedness relevant to hazards in Tompkins County and to assess the level of knowledge of tools and techniques to assist in reducing risk and loss of those hazards. The questionnaire asks quantifiable questions about citizen perception of risk, knowledge of mitigation, and support of community programs. The survey also asks several demographic questions to help analyze trends. The survey was posted on the county public website on October 13, 2020, and available for two months to facilitate public input, garnering 132 responses. The survey results were sorted by municipality and provided to the Steering and Planning Partnership members to use to identify vulnerabilities and develop mitigation strategies. A summary of survey results is provided below and a copy of the survey and the results are provided in Appendix D (Public and Stakeholder Outreach) of this plan.

> Over 130 Tompkins County residents, and over 15 agencies provided feedback and input via the citizen and agency surveys.

- The draft plan was posted for a period of 30 days on the Tompkins County Department of Planning and Sustainability website, Climate Adaptation/Mitigation Plan website (https://tompkinscountyny.gov/planning/climate-adaptation) to enable access to the public for review, comment, and input. Social media blasts including announcements on the Count website and Facebook provided broad distribution of the message that the plan was available for review. A survey link facilitated direct feedback to the Hazard Mitigation Plan Steering Committee who reviewed and incorporated comments as appropriate to various sections of the plan including the municipal annexes.

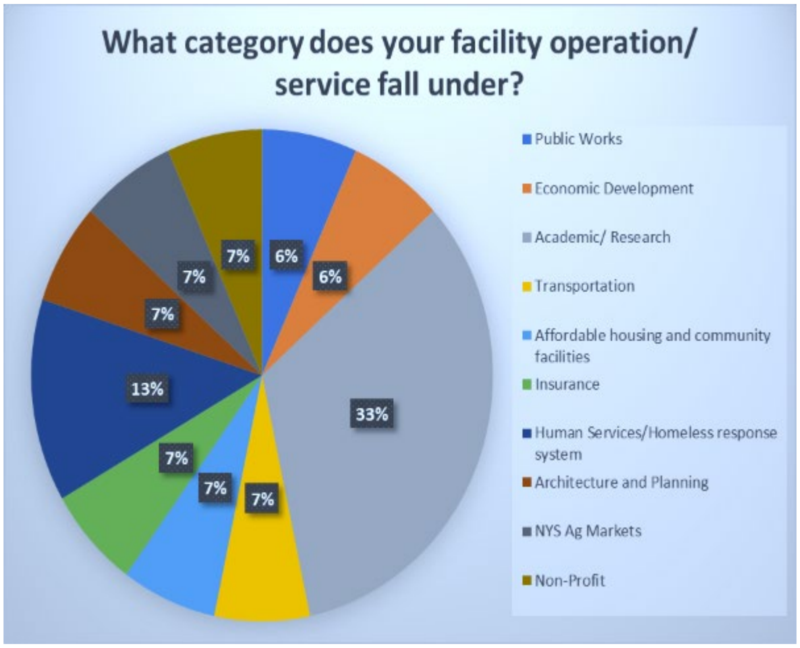
3.3.2 Survey Summaries

The following provides a summary of the results and feedback received by stakeholders who completed the survey. Three surveys were deployed, tailored to gather information from 1) stakeholders, 2) neighboring counties, and 3) the general public. Feedback was reviewed by the Steering Committee and integrated where appropriate in the plan.

3.3.2.1 Stakeholder Survey

The stakeholder survey was designed to help identify general needs for hazard mitigation and resiliency within Tompkins County from your perspective, as well as to identify specific projects that may be included in the mitigation plan. It was distributed to identified stakeholders, including the various county and municipal departments and agencies in the County. As of December 15, 2020, 15 stakeholders completed the survey, with nearly one-third of respondents coming from the academic/research sector. Figure 3-4 provides an overview of the respondent operational category.

Figure 3-4. Stakeholder Respondent Category



When asked if the organization maintains or manages anything within their designated service area, a majority said no they do not manage any facilities. For those that did answer, they indicated the following facilities: Buildings, roads, bridges, water/ sewer plants, stormwater infrastructure; buildings; buildings, roads, stormwater infrastructure; and buildings, roads, bridges, water/ sewer plants, stormwater infrastructure, central energy plant (steam, electricity, chilled water).

The Stakeholder Survey was broken down into 4 sections: Hazard and Damage Identification, Community Preparedness, Project Identification, and COVID-19, each detailed below. Survey results were shared with the Steering Committee and Planning Partnerships in scheduled meetings for consideration in the development of mitigation strategies.

Hazard and Damage Identification

Less than half of survey respondents (33.3%) identified that buildings and facilities belonging to their organization have been impacted by a natural hazard, specifically flooding. Areas near rivers and streams, areas located down slope, and infrastructure like bridges were identified as vulnerable to flooding due to erosion and weakening from heavy water flow. Flooding, drought, and winter ice storms were also identified as common occurrences in the County.

In addition to asking about whether or not their facilities were damaged, they were also asked what areas they believe to be the most vulnerable to natural hazards. The respondents provided the following areas:

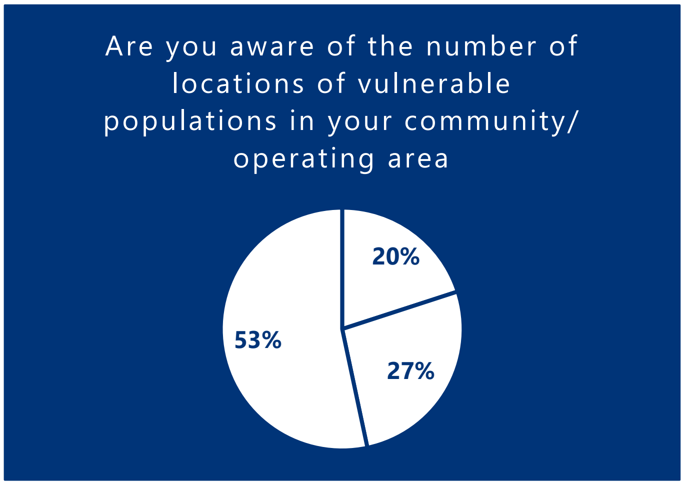
- Built environment - primarily, and a variety of natural hazards including: flooding, increased precipitation, more severe precipitation and storm events (including wind-driven rain and wind-borne objects/falling trees), utility disruption, increase in temperatures leading to higher cooling loads, contaminated water supply from sewer overflow, drought, other.
- Streams, creeks, fields, tributaries and associated flooding of such
- Neighborhoods near streams that flood, particularly ice jams and winter ice storm events
- Lack of a safe, clean, heated place to hang out during hazard events is concern for the homeless population
- University water supply due to drought
- Outside utility services vulnerable to severe weather (ice storms, high winds, etc.) and flooding.
- Bridges - most vulnerable to erosion and scouring during flood events.
- All buildings near creeks in the City of Ithaca and many near streams and tributaries leading to the City
- Tompkins Cortland Community College Athletic Building - has had some storm water drainage issues. It has two large volumes (gymnasium and fieldhouse) whose east sides are down slope from the large hill on the campus. Storm water drainage structures were included with their construction but can be overwhelmed by heavy flows of storm water.

As facilities have been previously impacted by hazard events, most respondents (40%) indicated that they did not know if their facilities and transportation infrastructure are adequately prepared for withstanding natural disasters. This compares to a third of respondents (33.3%) who believe their facilities and transportation infrastructure are prepared for withstanding natural disasters. Two respondents (16.7%) did not believe their utility infrastructure and service were adequately equipped to withstand disasters and have the ability to provide interrupted service to the facilities. The majority (86.7%) of survey participants indicated that they were aware of the number and location of vulnerable populations in their community, but of those respondents, the majority (61.5%) indicated a desire for additional information about these populations.

Community Preparedness

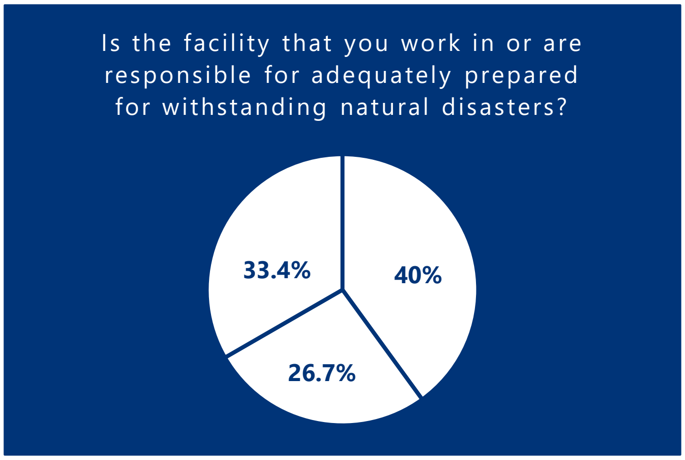
The majority of respondents (60%) did not know if the local public education and awareness programs are effective at informing residents about disasters and preparedness and reducing personal risk. A small subset (20.0%) of respondents think that the public, particularly vulnerable populations are aware of, understand, and take advantage of emergency warning systems, while 40% did not know. Figure 3-5 provides insight on the awareness of the locations of vulnerable populations.

Figure 3-5. Vulnerable Population Awareness



The majority (53.3%) of respondents do not believe that local government understands, supports, and possesses adequate resources for hazard risk reduction efforts in their community. For most of respondents (64.3%), private businesses play a direct role in daily operations. Less than half (46.7%) of respondent's organizations are part of, or have their own, Emergency Response Plan, with each organization having a direct role or responsibility within the plan, while another 46.7% do not know. Less than half (21.4%) responding organizations are part of a Continuity of Operations Plan and 35.7% are part of an Emergency Operations Plan. None are part of a Continuity of Government Plan. Figure 3-6 indicates the respondents' feedback on the adequacy of preparedness of facilities regarding natural hazard events.

Figure 3-6. Facility Preparedness for Natural Disasters



Half (50.0%) of participants also indicated that their organization is equipped and resilient enough to handle a natural disaster.

Project Identification

Respondents identified the following projects or programs that could reduce their organization's vulnerability to damages, including operation of service:

- Improve flood management practices, including enhanced plans and storm water drainage systems.
- Utilize data services and cloud-based software, with multiple servers, to bolster connectivity during major hazard events.
- Enhance capacity and interconnectedness between water systems to provide better back up water sources.
- Establish resources, including shelter, sanitation, and other services, for homeless individuals during disaster events.

The following were identified as recently implemented projects that reduced vulnerabilities to hazard events:

- Cornell University's response to COVID-19.
- Waste management options and sanitation stations provided to homeless populations.
- Transferring power transmission mains from overhead to buried lines at Cornell University.
- "Check truck brakes" initiative prior to entering Ithaca initiated
- Installation of backflow protectors on storm drains near Six Mile Creek, Fire Dept.
- Regular housing code inspection of rental housing in Ithaca.

COVID-19

Respondents were also asked to detail how their organization has been involved in response to the ongoing COVID-19 pandemic. Respondents detailed the following:

- Mask distribution.
- Considerable amount of work with agriculture and food security.
- Extensive involvement in economic response and recovery through establishment of new emergency and recovery business loan programs, creation of public awareness campaigns around COVID safety.
- The College developed a Pandemic Response Plan. It is also part of the SUNY system which provides guidance on pandemic issues.
- Shift to remote work and coordination of transportation providers' response to COVID.
- Not directly involved operationally but has directed federal grant funds to City to assist small businesses, tenants, daycare centers, and persons experiencing homelessness who have been adversely impacted by the pandemic.
- Made sure customers had access and get help with their insurance and banking.
- Usage of 211, which has had an integral role in pandemic response. Additionally I coordinate the enhanced street outreach efforts that have taken place during COVID.
- Working remotely.
- Cornell University has been directly affected and responding to the pandemic since the outbreak in Wuhan, and also in Italy, and has formulated a major restructuring of operations and educational approaches in response.

- Outreach and coordination related to risks associated with surface water contact; as well as wastewater surveillance of SARS-CoV-2.
- Coordination of campus response to the pandemic and support during University reopening activities.
- Food coordination, and coordination with other providers
- Furloughs, work stoppages, reduced funding, etc.

Respondents also answered with the following about how they believe the COVID-19 pandemic will reshape their organization's practices and business framework:

- Masks, glass up when meeting public.
- Remote work and remote meetings will continue for some time. Remote education - teaching classes over Zoom has been significantly more successful at reaching more people.
- More work for home; probably permanent layoffs and related reductions in services; virtual meetings likely to continue for some time; core economic development activities to focus on supporting businesses through recovery for some time; fundamental reshaping of transportation patterns and related impacts on City services like parking, transportation demand management, etc; changes in occupancy/vacancy in retail and office leading to new programs and initiatives to respond to changing economic development landscape.
- The College is requiring students, faculty and staff to wear masks in campus buildings. Hand washing is encouraged, and hand sanitizer dispensers have been installed throughout the main building. Working remotely has been encouraged in some instances. In-person classes are being offered with reduced density and social distancing.
- Staff will follow COVID prevention protocols. Remote work will last indefinitely depending on progress of the pandemic.
- Control of human flow in the building and sanitation stations.
- Social distancing.
- Reinforce outreach needs.

The following services and infrastructure needs were identified by respondents as needing to be built or improved upon within their communities in order to mitigate damages experienced by the pandemic:

- Universal, reliable, low- or no-cost internet service.
- More robust bike and walking infrastructure to give residents without private vehicles safe modes of travel as an alternative to TCAT.
- Better nodal development for services and essential shopping within walking distance.
- Better access to nature - connections to trails and beautiful spaces that are essential for mental health and that also enable safer gathering.
- More open air, protected, outdoor spaces for gathering - I found it difficult that our parks stopped allowing pavilion rental/use just at the time that those open-air spaces would have allowed safer gathering.

- Re-thinking public space/streets to accommodate walking & biking and outdoor community life, dining, entertainment, etc.
- Provision of dedicates bicycling infrastructure in the urbanized area. Bicycling offers a low cost, environmentally smart and healthy transportation option. Over 50% of trips in Tompkins County are less than 2 miles in length. Increasing the modal share of bicycling would provide multiple equity and economic benefits, and would help alleviate transportation challenges exacerbated by the pandemic; e.g. reduced transit service, high cost of car dependency, etc. The long-range transportation plan includes a recommended complete street plan for the urbanized area.
- Disaster planning on many levels needs to be built, for pandemic, flood, earthquake, rioting etc.

Respondents also identified the following challenges and obstacles their organization is facing due to the COVID-19 pandemic:

- Tracking information
- Availability of MERV-13 air filters
- Receiving accurate information regarding current situation/resources available
- Access to community officials; frustration with DMV access and inability to reach government agencies
- Clear messaging, contingency/back-up plan for staffing; and access to community officials
- Receiving accurate information regarding current situation/resources available
- Availability of personal protective equipment
- Waste disposal
- More COVID testing, and an ability to do so downtown.

3.3.2.2 Neighboring County Survey

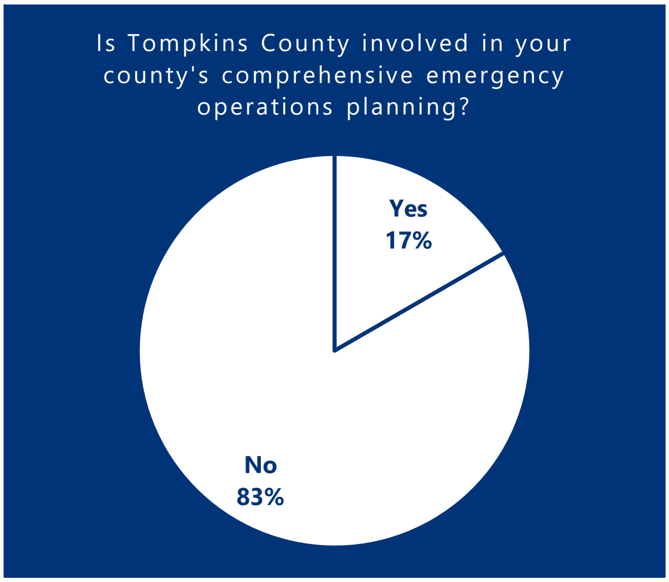
The Neighboring County Survey was sent to the counties surrounding Tompkins due to their proximity and because the effects of hazard events that impact Tompkins County would be similar to that of its neighbors. As of December 15, 2020, six responses were received (Tioga, Broome, Schuyler, Chemung Counties).

The survey was broken down into five sections: Emergency Operations and Continuity of Operations Planning; Risk and Vulnerability; Evacuation and Sheltering; Information Sharing; and Projects, Grants, Education and Outreach, each detailed below.

Emergency Operations and Continuity of Operations Planning

The majority (83.3%) of respondents indicated that Tompkins County has no involvement in their own county's comprehensive emergency operations, continuity of operations planning, nor their own involvement in Tompkins County's emergency operations planning or continuity of operations planning. Additionally, five respondents indicated that Tompkins County provide intercounty coordination of continuity of emergency operations planning or continuity of operations planning.

Figure 3-7. Involvement in Comprehensive Operations Planning



The survey asked respondents to explain how emergency operations is communicated between the counties. A majority of the respondents indicated that communication is done between emergency management personnel or between 911 call centers.

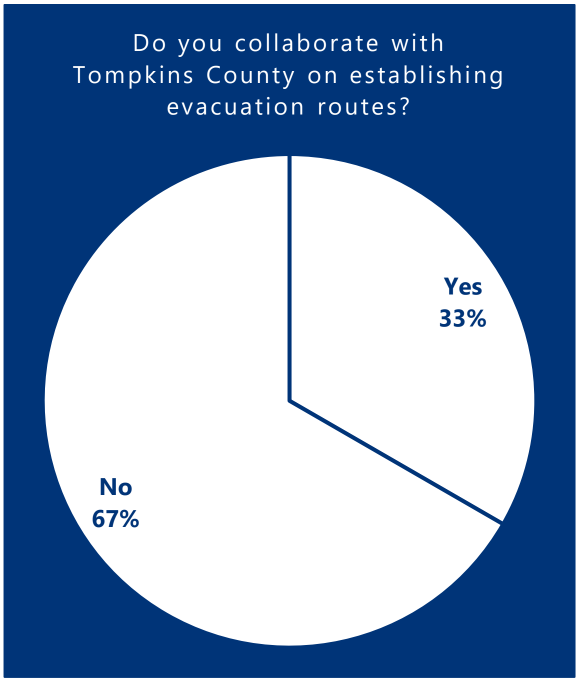
Risk and Vulnerability

Most (66.7%) of participants responded that their county does share risk and vulnerability assessments, including flood mapping, and HAZUS data, with Tompkins County. One county indicated that if Tompkins County was to request data from another count (e.g. GIS layers), they would provide it if they had it. Chemung County stated that they updated their HMP and coordination was done across counties during the planning process. Another county stated that if Tompkins County was to request risk/vulnerability assessment information, they would share due to their similar geographic areas.

Evacuation and Sheltering

The majority (66.7%) of respondents indicated that there is no collaboration with Tompkins County on establishing evacuation routes and alternative evacuation routes. However, most (80%) of participants indicated that Tompkins County and themselves consult each other before making evacuation decisions, most likely occurring between the emergency management offices. Less than half (40%) of respondents believe that evacuation routes are not maintained to the same level of protection across county lines, while most (66.7%) of respondents indicate that there is no collaboration with Tompkins County on establishing shelters, sheltering decisions, or temporary housing locations. Before making sheltering decisions, several respondents indicated that this is discussed between county emergency managers. The majority (66.7%) of respondents said that their county and Tompkins County does not currently coordinate space for temporary housing. However, one respondent commented saying that locations such as arenas, schools and local government buildings could be shared between counties.

Figure 3-8. Evacuation Routes Collaboration



Information Sharing

All respondents indicated that they have access to contact information for Tompkins County Emergency Operations Centers. Information is shared between emergency management coordinators and the Soil and Water Conservation Districts. Information is shared through monthly regional emergency management meetings, conversations between staff, 911 centers, and other county departments (e.g. Planning and Soil and Water Conservation Districts). When asked if information regarding mitigation is shared during the planning and implementation phases of mitigation projects, 60% said that information is shared.

Projects, Grants, Education and Outreach

Respondents identified the following projects as requiring cross-collaboration between county boundaries:

- Watershed projects or planning
- Floodplain projects or planning
- Natural infrastructure restoration
- Outreach (education and outreach campaigns, Programs for Public Information, etc.)

Respondents provided comments about their answer to cross-collaboration projects and indicated that Tompkins County and Tioga County are members of the Upper Susquehanna Coalition, and both Soil and Water Conservation Districts work together on numerous projects that cross county boundaries.

The majority (83.3%) of respondents indicated that they have not previously collaborated with Tompkins County on grant applications. However, Tioga County indicated that they have collaborated on a grant application through the USC and various agricultural grants. Respondents also indicated that the Red Cross, Emergency Management, USC, and CCE provide education and outreach regarding natural hazards in both their own, and Tompkins County.

There were no responses to the question regarding mutual aid agreements between their own and Tompkins County.

Lastly, it was asked what types of opportunities or ideas would optimize cooperation with Tompkins County on emergency management operations and hazard mitigation projects. Answers to this question included monthly regional meetings and individual discussions between emergency managers, and communication/coordination between emergency service entities.

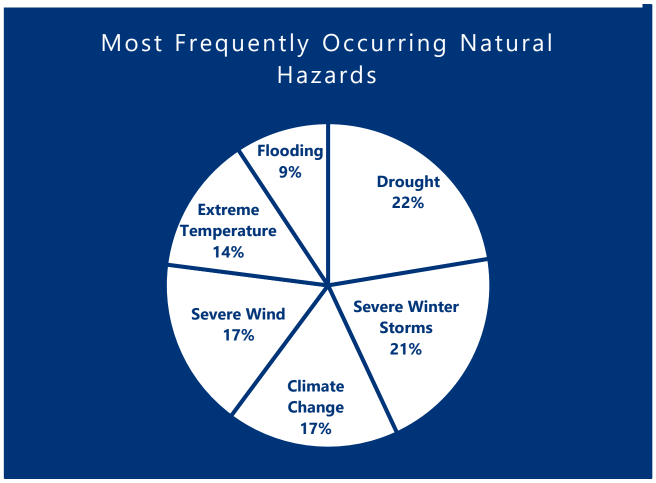
3.3.2.3 Citizen Survey Summary

Those that live and work in Tompkins County were given the opportunity to be involved in the planning process. One opportunity was the citizen survey. As stated above, the survey was developed to assess the level of knowledge of tools and techniques to assist in reducing risk and loss of those hazards. It asked quantifiable questions about citizen perception of risk, knowledge of mitigation, and support of community programs. The County advertised the survey on their website pushed it out through various social media accounts. As of November 28, 2020, the survey received 132 responses.

Demographically, survey respondents were from 15 municipalities within Tompkins County, the majority (48.5%) have lived in the County for 20 years or more, and nearly all (96.1%) own their own home. Over half (52.4%) of respondents self-identified as being over the age of 61. The majority (78%) of respondents receive general news and information about Tompkins County through email, text messages, or local news. Almost half of respondents (49%) receive information through Facebook. Other news outlets residents use include: the Ithaca Voice, Ithaca Times, Ithaca Journal, Tompkins County alerts, municipal websites, mass notification systems, and radio.

Survey respondents identified the following as the most frequently occurring natural hazard events within Tompkins County as noted in Figure 3-9.

Figure 3-9. Most Frequently Occurring Natural Hazards



The highest hazards of concern (>30% of respondents reporting concerned, very concerned, or extremely concerned) include drought and severe winter storms.

- Work on improving the damage resistance of utilities (electricity, communications, water/wastewater facilities etc.) (60%)
- Retrofit infrastructure, such as elevating roadways and improving drainage systems (51%)
- Replace inadequate or vulnerable bridges and causeways (47%)
- Enhance stream maintenance programs/projects (38%)
- Improve access to information about hazard risks and high hazard areas (35%)

3.3.2.4 Public Review of Draft Plan

Throughout the mitigation planning process, staff from Tompkins County provided multiple reports to groups including the Tompkins County Legislature's Planning, Energy and Environmental Quality Committee, the Tompkins County Planning Advisory Board, and committees of the citizen-based Tompkins County Environmental Management Council. These updates took the form of presentations on the mitigation plan process and further provided the opportunity for feedback and questions. There were at least six of these meetings that were held as these groups expressed interest in mitigation planning and how it connects to other connected County priorities.

Connecting with successful social media outreach on the citizen mitigation survey, Tompkins County continued a wide variety of social media outreach on the draft plan review. That was regularly provided via Facebook and Twitter (see example screen shot below) among other formats. Several community members expressed appreciation for this continued engagement and plan updates. Refer to Appendix D (Public and Stakeholder Outreach) for screenshots of outreach performed during the public review period.

Tompkins County staff further discussed the mitigation plan update process, along with connected initiatives such as the update of local flood maps with the Ithaca Board of Realtors and individual real estate firms (Warren Real Estate). Much of the interest from these groups center on flood hazard mitigation and how that affects the local real estate market.

During the 30-day public review period, comments and feedback was received from 10 members of the public and/or stakeholders. Each comment was reviewed by the Tompkins County Department of Planning & Sustainability and the consultant to determine how best to incorporate the comments into the plan. As a result of the feedback, additional information was included in Volume 1 sections to clarify hazard characteristics and impacts, and additional projects were included in municipal annexes.

3.4 Incorporation of Existing Plans, Studies, Reports and Technical Information

The Tompkins County HMP update strives to use the best available technical information, plans, studies, and reports throughout the planning process to support hazard profiling; risk and vulnerability assessment; review and evaluation of mitigation capabilities; and the identification, development, and prioritization of county and local mitigation strategies.

The asset and inventory data used for the risk and vulnerability assessments are presented in the County Profile (Section 4). Details of the source of this data, along with technical information on how the data was used to develop the risk and vulnerability assessment, are presented in the Hazard Profile and Risk Assessment (Section 5), specifically within Section 5.1 (Data and Methodology), as well as throughout the hazard profiles in Section 5.4 (Hazard Profiles). Further, the source of technical data and information used can be found within the References Section.

Plans, reports, and other technical information were identified and provided directly by the County, participating jurisdictions, and numerous stakeholders involved in the planning effort, as well as through independent research by the planning consultant. The County and participating jurisdictions were tasked with updating the inventory of their Planning and Regulatory capabilities in Section 9 (Capability Assessment of each jurisdictional annex) and providing relevant planning and regulatory documents, as applicable. Relevant documents, including plans, reports, and ordinances were reviewed to identify the following:

- Existing municipal capabilities.
- Needs and opportunities to develop or enhance capabilities
    - May be identified within the County or local mitigation strategies.
- Mitigation-related goals or objectives considered
    - Section 6 (Mitigation Strategy).
- Proposed, in-progress, or potential mitigation projects, actions, and initiatives
    - Incorporated into the updated county and local mitigation strategies.

The following local regulations, codes, ordinances, and plans were reviewed during this process to develop mitigation planning goals, objectives, and strategies that are consistent across local and regional planning and regulatory mechanisms to accomplish complementary and mutually supportive strategies:

- Comprehensive/Master Plans
- Building Codes
- Zoning and Subdivision Ordinances
- NFIP Flood Damage Prevention Ordinances

- Site Plan Requirements
- Local Waterfront Revitalization Plans
- Stormwater Management Plans
- Emergency Management and Response Plans
- Land Use and Open Space Plans
- Capital Plans
- New York State Standard Multi-Hazard Mitigation Plan, 2019

A partial listing of the plans, reports, and technical documents reviewed in the preparation of this plan is included in Table 3-5.

Table 3-5. Record Review (Municipalities) - Record of the review of existing programs, policies, and technical documents for participating jurisdictions (all)

Existing plan, program or technical documents	Date	Jurisdictional Applicability (Owner)
Comprehensive Plan	2006	Caroline, T
Comprehensive Emergency Management Plan	2003	Caroline, T
Comprehensive Plan	2014	Cayuga Heights, V
Zoning Law	2018	Cayuga Heights, V
Comprehensive Plan	2011	Danby, T
Zoning Ordinance	2017	Danby, T
Sustainable Hamlets Revitalization Plan	2009	Danby, T
Community Housing Needs Assessment	2020	Danby, T
Jennings Pond Dam Emergency Action Plan	1/8/2018	Danby, T (NYS)
Natural Resources Conservation Plan	2017	Dryden, T
Agriculture and Farmland Protection Plan	2017	Dryden, T
Comprehensive Plan	2005	Dryden, T
Virgil Creek Watershed Floodwater Dam Emergency Action Plan	1/31/2020	Dryden, T (Town and Village of Dryden, and Tompkins County)
Montgomery Park Revitalization Plan	2015	Dryden, V
Comprehensive Plan	2006	Dryden, V
Comprehensive Plan	2019	Enfield, T
Comprehensive Plan	2013	Freeville, V
Joint Comprehensive Plan	2005	Groton, T
Joint Comprehensive Plan	2005	Groton, V
Comprehensive Plan	2015	Ithaca, C
Cayuga Lake Waterfront Plan	2004	Ithaca, C
Economic Development Plan	1998	Ithaca, C

Existing plan, program or technical documents	Date	Jurisdictional Applicability (Owner)
Energy Action Plan	2012	Ithaca, C
Bicycle Plan	1997	Ithaca, C
Master Plan, Inventory, & Arboricultural Guidelines for the Public Trees of the City of Ithaca, New York	2014	Ithaca, C
Northside Neighborhood Plan	2003	Ithaca, C
Southwest Area Land Use Plan	1994	Ithaca, C
Strategic Housing and Neighborhoods Plan	1987	Ithaca, C
West Hill Master Plan	1992	Ithaca, C
Consolidated Plan	2019	Ithaca, C
Greater Southside Neighborhood Plan	2018	Ithaca, C
Waterfront Plan	2019	Ithaca, C
Cayuga Lake Watershed Restoration and Protection Plan	2017	Ithaca, C
Local Flood Hazard Analysis	2020	Ithaca, C
Flood Inundation Maps	2018	Ithaca, C
Wetland Protections Plan	2008	Ithaca, C /Tompkins County
Comprehensive Plan	2014	Ithaca, T
Park, Recreation and Open Space Plan	1997	Ithaca, T
Treman Lake Dam Emergency Action Plan	12/22/2017	Ithaca, T
Beebe Lake Dam Emergency Action Plan	9/1/2013	Ithaca, T
30 Foot Dam (Sixmile Creek Dam) Emergency Action Plan	1/10/2019	Ithaca, T (Ithaca, C)
60 Foot Dam (Ithaca Reservoir; Potters Falls Dam) Emergency Action Plan	1/10/2019	Ithaca, T (Ithaca, C)
Beacon Hills Village Dam (Chase Pond) Emergency Action Plan	1/24/2020	Ithaca, T
South Hill Pond Dam Emergency Action Plan	1/22/2020	Ithaca, T
Land Use Ordinance	2015	Lansing, T
Comprehensive Plan	2018	Lansing, T
Agriculture and Farmland Protection Plan	2015	Lansing, T
Comprehensive Plan	2015	Lansing, V
Comprehensive Plan	2013	Newfield, T
Comprehensive Plan	2008	Trumansburg, V
Comprehensive Plan	2009	Ulysses, T
Agriculture and Farmland Protection Plan	2013	Ulysses, T

Existing plan, program or technical documents	Date	Jurisdictional Applicability (Owner)
Cayuga Inlet Sediment Assessment Sediment Reduction Report	2016	Tompkins, County
Agriculture and Farmland Protection Plan	2015	Tompkins, County
Long Range Transportation Plan	2019	Tompkins, County
Regional Sustainability Plan	2013	Tompkins, County
Tools to Promote and Regulate the Deployment of Renewable Energy Systems	2017	Tompkins, County
Energy Strategy	2019	Tompkins, County
Comprehensive Plan	2015	Tompkins, County
Housing Strategy	2017	Tompkins, County
Habitat Connectivity Strategy	2018	Tompkins, County
Conservation Plan Part I	2007	Tompkins, County
Conservation Plan Part II	2010	Tompkins, County
Conservation Strategy	2012	Tompkins, County
Comprehensive Emergency Management Plan	2018	Tompkins, County
Talanoa Dialogue	2018	Tompkins, County

Notes:
** = this document may or may not include all jurisdictions*
T = Town
V = Village

3.5 Integration with Existing Planning Mechanisms and Programs

Effective mitigation is achieved when hazard awareness and risk management approaches and strategies become an integral part of public activities and decision-making. Within Tompkins County, there are many diverse, existing plans and programs that support hazard risk management, and thus it is critical that this hazard mitigation plan integrate, coordinate with, and complement, those existing plans and programs.

The *Capability Assessment* section of Chapter 6 (Mitigation Strategy) provides a summary and description of the existing plans, programs and regulatory mechanisms at all levels of government (federal, state, county and local) that support hazard mitigation within the County. Within each jurisdictional annex in Section 9, the County and each participating jurisdiction identified how they integrated hazard risk management into their existing planning, regulatory and operational/administrative framework ("integration capabilities") and how they intend to promote this integration ("integration actions").

A further summary of these continued efforts to develop and promote a comprehensive and holistic approach to hazard risk management and mitigation is presented in Section 7 (Plan Maintenance).

3.6 Continued Public Involvement

Tompkins County and participating jurisdictions are committed to the continued involvement of the public in the hazard mitigation process. This HMP update and its supporting documents will continue to be posted online at https://tompkinscountyny.gov/planning/climate-adaptationand municipalities will be encouraged to maintain links to the plan website. Further, the County will make hard copies of the HMP available for review at public locations as identified on the website.
A notice regarding annual updates of the plan and the location of plan copies will be publicized annually after the Planning Committee's annual evaluation and posted on the public website at https://tompkinscountyny.gov/planning/climate-adaptation.

Each jurisdiction's governing body shall be responsible for receiving, tracking, and filing public comments regarding this plan.

The public will have an opportunity to comment on the plan as a part of the annual mitigation planning evaluation process and the next five-year mitigation plan update. The HMP Coordinator is responsible for coordinating the plan evaluation portion of the meeting, soliciting feedback, collecting and reviewing the comments, and ensuring their incorporation in the five-year plan update as appropriate; however, members of the Planning Committee will assist the HMP Coordinator. Additional meetings may be held as deemed necessary by the Planning Committee. The purpose of these meetings would be to provide the public an opportunity to express concerns, opinions, and ideas about the plan and its implementation.

Further details regarding continued public involvement are provided in Section 7 (Plan Maintenance).

After completion of this plan, implementation and ongoing maintenance will continue to be a function of the Planning Committee. The Planning Committee will review the plan and accept public comment as part of an annual review and as part of five-year mitigation plan updates.

A notice regarding annual updates of the plan and the location of plan copies will be publicized annually after the HMP Committee's annual evaluation and posted on the public web site.

Mr. Scott D. Doyle is identified as the Tompkins County HMP Coordinator in Section 7 (Plan Maintenance), and is responsible for receiving, tracking, and filing public comments regarding this plan. Contact information is:

Scott D. Doyle, AICP, Associate Planner
Tompkins County Department of Planning & Sustainability

Daniel D. Tompkins Building
121 East Court Street Ithaca, New York 14850
(607) 274-5560 | Email: sdoyle@tompkins-co.org

SECTION 4. COUNTY PROFILE

This profile provides general information for Tompkins County (physical setting, past county-wide hazard event history, population and demographics, general building stock, and land use and population trends) and lifeline critical facilities located within the County. Analyzing this information leads to an understanding of the study area, including economic, structural, and population assets at risk, and concerns that could be related to hazards analyzed later in this plan (e.g., low lying areas prone to flooding, high percentage of vulnerable persons in an area).

4.1 Physical Setting

This section presents the physical setting of the County, including location, hydrography and hydrology, topography and geology, climate, and land use/land cover.

4.1.1 Location

Tompkins County is located in Upstate New York along the southern portion of Cayuga Lake between Binghamton and Syracuse. Tompkins County is bordered by Cayuga County to the north, Cortland County to the east, Tioga County to the south, Chemung County to the southwest, Schuyler County to the west, and Seneca County to the northwest.

The City of Ithaca serves as Tompkins County's county seat. Tompkins County is home to both Ithaca College and Cornell University. Ithaca is situated near the center of the County.

The County includes one City, nine Towns, six Villages, and 31 Hamlets and shown in Figure 4-1. Tompkins County consists of a total land area of 474.6 square miles and a total water area of 16.9 square miles (2010 Census Gazetteer files, 2012). In terms of total area, the Town of Dryden is the largest jurisdiction within Tompkins County, totaling 94.2 square miles. This equates to almost 20 percent (20%) of the total area of the County. The Town of Ithaca is the smallest Town in Tompkins County, totaling 30.3 square miles in area, which represents only six percent of the total area of Tompkins County. Table 4-1 provides the total areas (in square miles) for each jurisdiction included within Tompkins County.

Table 4-2 provides the political jurisdictions encompassed by the County and in the designated planning area of this hazard mitigation plan.

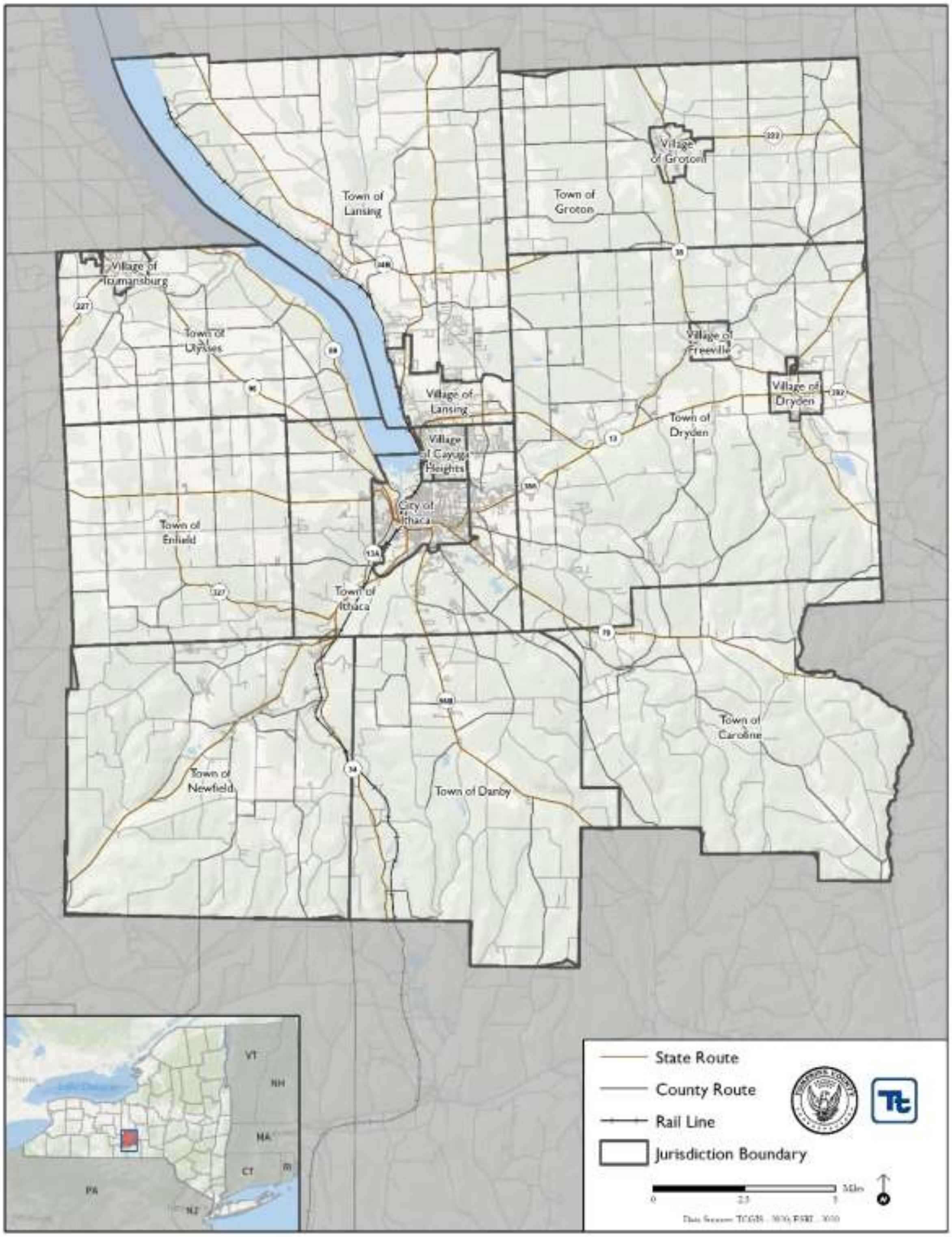
Table 4-1. Approximate Areas for Jurisdictions Within Tompkins County (City Data, 2011)

Jurisdiction	Total Area (square miles)	Total Land (square miles)	Total Water (square miles)	% of Total Area in County
Tompkins County	491.6	474.6	16.9	100.00%
Caroline (Town)	55.1	55.0	0.1	11.2%
Danby (Town)	53.7	53.5	0.2	10.9%
Dryden (Town)	94.2	93.9	0.3	19.2%
Enfield (Town)	36.9	36.9	0.0	7.5%
Groton (Town)	49.6	49.5	0.1	10.0%
Ithaca (Town)	30.3	29.1	1.2	6.2%
Ithaca (City)	6.1	5.5	0.6	1.2%
Lansing (Town)	69.9	60.7	9.2	14.2%
Newfield (Town)	59.0	58.9	0.1	12.0%
Ulysses (Town)	36.8	33.0	3.9	7.5%
Cayuga Heights (Village)	1.8	1.8	0.0	-
Dryden (Village)	1.7	1.7	0.0	-
Freeville (Village)	1.1	1.1	0.0	-
Groton (Village)	1.7	1.7	0.0	-
Lansing (Village)	4.6	4.6	0.0	-
Trumansburg (Village)	1.2	1.2	0.0	-

Table 4-2. Tompkins County Political Jurisdictions

Towns		Villages	City
Caroline Danby Dryden Enfield Groton	Ithaca Lansing Newfield Ulysses	Cayuga Heights Dryden Freeville Groton Lansing Trumansburg	Ithaca

Figure 4-1. Location of Tompkins County, New York



4.1.2 Topography and Geology

Tompkins County has a diverse terrain that is relatively gentle in the north and more varied and having higher topographic relief in the south. Elevations range from approximately 400 feet above mean sea level (msl) to greater than 2,000 feet above MSL. The highest topographic point in the County, Connecticut Hill, is located in the Town of Newfield. Connecticut Hill reaches an elevation of 2,200 feet above MSL. The lowest elevation within the County is recorded to be 382 feet above MSL, which is the surface water level of Cayuga Lake (2014 County HMP).

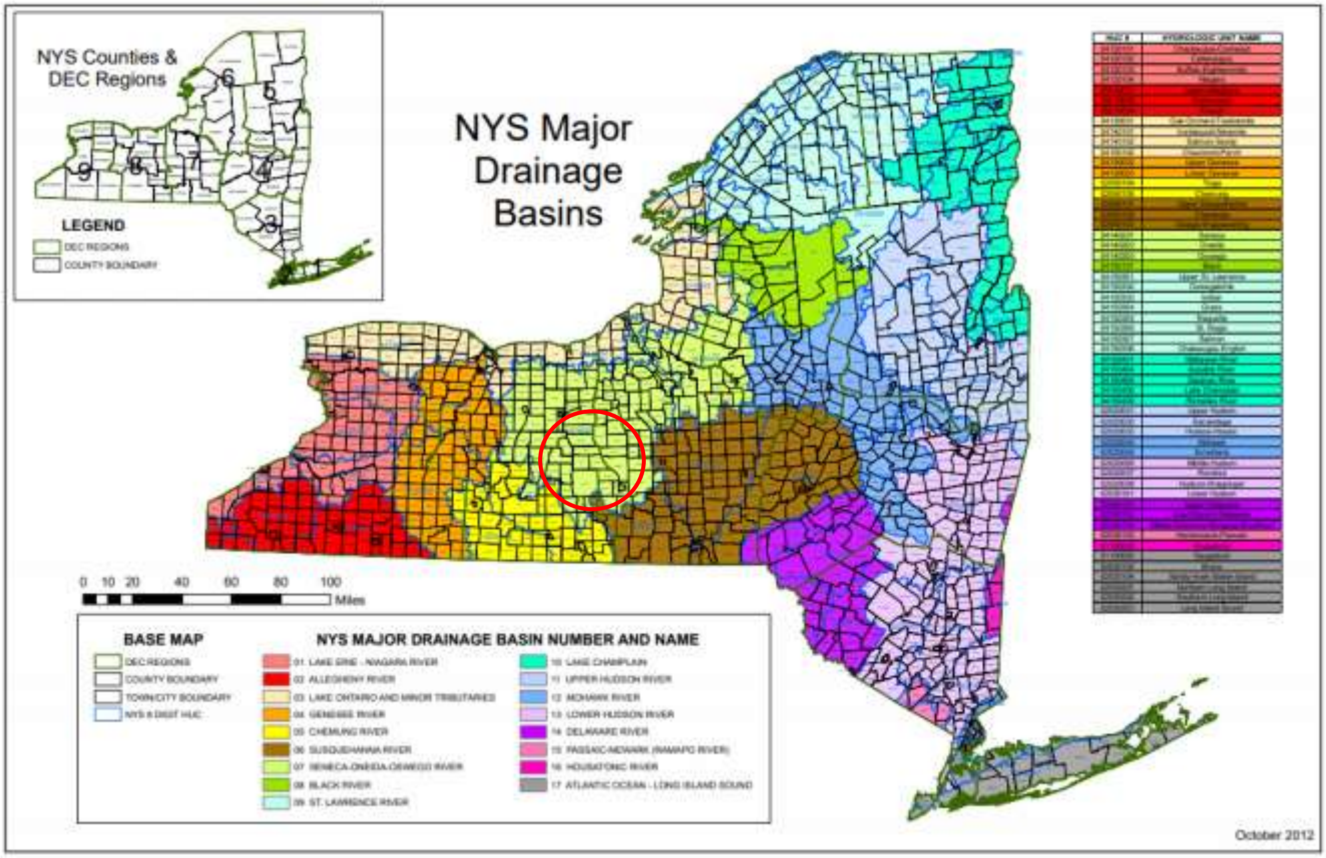
Tompkins County's topography is shaped by glacial features and uplifting events that carved deep gorges now known as the Finger Lakes. Approximately 200 million years ago, drainage flowed south to the Susquehanna instead of north to Lake Ontario. Lakes changed the region's drainage and provided the lifeblood for the area's development (Tompkins County Comprehensive Plan 2015).

4.1.3 Hydrography and Hydrology

Cayuga Lake, one of New York's eleven Finger Lakes, is Tompkins County's most prolific water feature. The County accounts for half of the Lake's watershed, with 80% of the County draining into the lake. As the widest and longest of the Finger Lakes, water takes 10 years to fully cycle throughout the lake. From Cayuga Lake, water flows north to Lake Ontario through the Seneca and Oswego Rivers. In the southern portion of the County, water drains to Chesapeake Bay through Susquehanna River tributaries such as the West Branch Oswego River or the Cayuta Creek (Tompkins County Comprehensive Plan 2015).

Figure 4-2. below shows the major drainage basins of New York State. With Tompkins County being located along a watershed divide, the County is part of drainage basin 6 (Susquehanna River) and basin 7 (Seneca-Oneida-Oswego River).

Figure 4-2. Drainage Basins of New York State

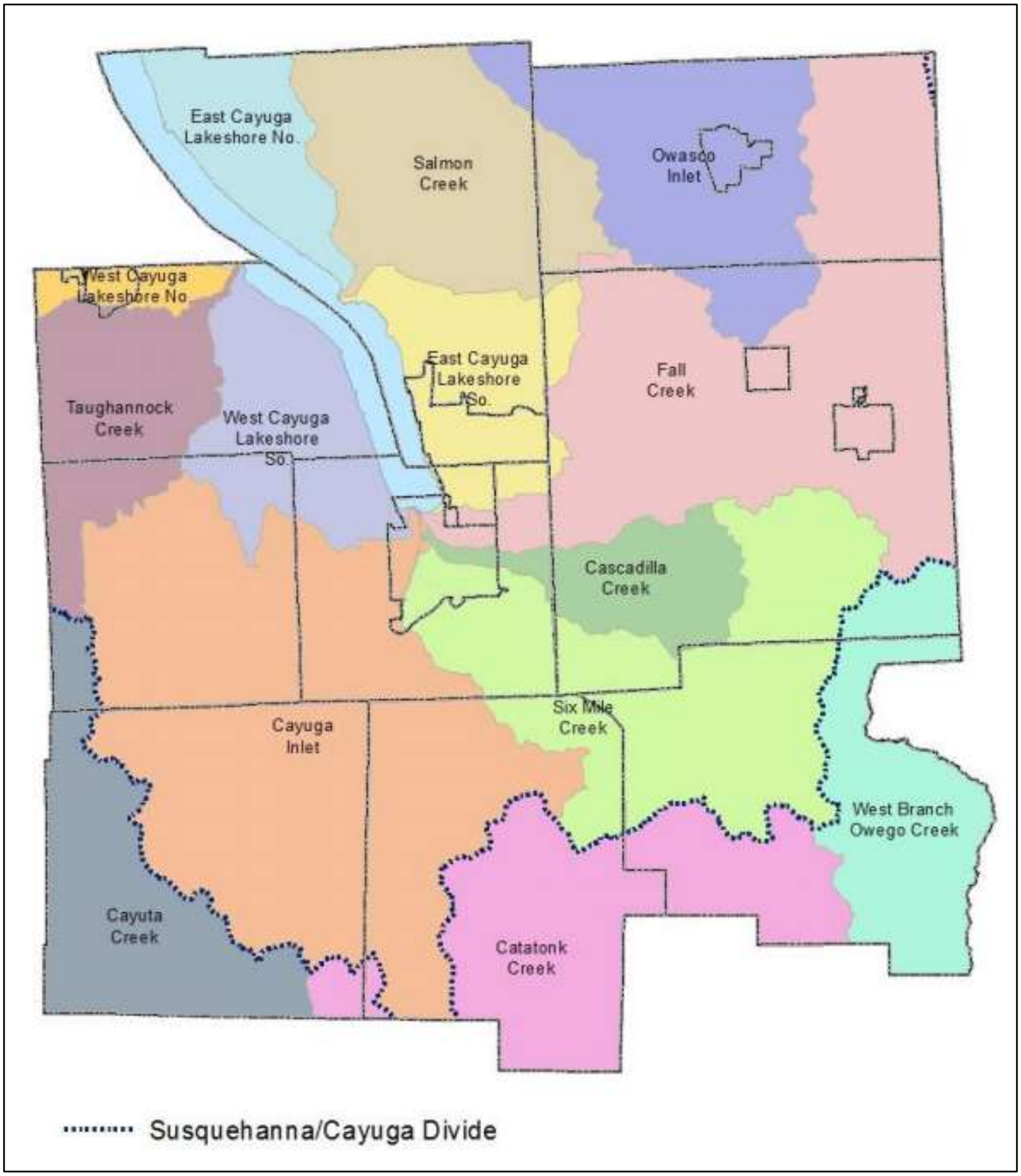


Source: NYSDEC 2012; Note: The circle indicates the approximate location of Tompkins County.

The Oswego/Finger Lakes watershed comprises 8,896 miles of creeks and streams. The watershed flows from headwaters in the southwestern Adirondacks to Lake Ontario. The Finger Lakes are within this watershed and along with smaller lakes together comprise approximately seven percent of all surface area in the watershed. The watershed includes more than 5,000 square miles of land within the State, including much of Tompkins County (NYS DEC).

The Susquehanna River Basin is the largest east of the Mississippi Rivers. The river and its tributaries drain 4,520 square miles of land within New York State and drain to the Chesapeake Bay, encompassing over 8,185 miles of freshwater rivers and streams. The major tributaries to the Susquehanna River in Tompkins County include Owego Creek, the western branch of which passes through the southeast portion of the County (NYS DEC). Figure 4-3 indicates the location of watersheds in Tompkins County.

Figure 4-3. Watersheds of Tompkins County, New York



Source: Tompkins County Comprehensive Plan, 2015

Potable water in Tompkins County is derived from both surface water sources (55%) and groundwater sources (45%). The Villages of Dryden, Groton, Trumansburg and hamlets of Newfield and West Danby utilize groundwater sources and also have municipal water systems. Private wells number in the thousands and are found throughout the County. Surface water sources in Tompkins County include Cayuga Lake, Fall Creek, and

Six Mile Creek. The City of Ithaca, Southern Cayuga Lake Intermunicipal Water Commission (Bolton Point), and Cornell University operate water treatment plants that utilize these surface waters. In addition, several homes along Cayuga Lake withdraw water from the lake. Sodium and arsenic levels as well as the preponderance of septic tanks in areas not served by centralized wastewater systems are major water quality concerns (Tompkins County Comprehensive Plan 2015).

4.1.4 Climate

The climate of New York State (including Tompkins County) is very similar to most of the Northeast United States and is classified as Humid Continental. Differences in latitude, topography, and the presence of large bodies of water impact climate across New York State. Precipitation during the warm, growing season (April through September) is characterized by convective storms that generally form in advance of an eastward moving cold front or during periods of local atmospheric instability. Occasionally, tropical weather systems will move up from southern coastal areas and produce significant quantities of rain. Both types of storms typically are characterized by relatively short periods of intense precipitation that produce substantial surface runoff and little recharge (Cornell Date, n.d.).

The cool season (October through March) is characterized by large, low-pressure systems that move northeastward along the Atlantic coast or the western side of the Appalachian Mountains. Storms that form in these systems are characterized by prolonged periods of steady precipitation in the form of rain, snow, or ice, and tend to produce less surface runoff and more recharge than the summer storms because they have a longer duration and occasionally result in snowmelt (Cornell Date, n.d.)

Tompkins County generally experiences seasonable weather patterns characteristic of the Northeast United States. The average precipitation for Tompkins County is approximately 37 inches, most of which occurs between April and November. The average snowfall amounts for the County is 64 inches. Average summer temperatures typically range from 60 degrees Fahrenheit (°F) to 68°F, with average daily highs up to 80 degrees in July. Winter high temperatures are between 31°F and 36°F, with minimum temperatures dipping to 15°F (Northeast Regional Climate Center).

4.1.5 Land Use and Land Cover

Tompkins County has been inhabited since the Stone Age and was more recently home to the Cayuga Nation who represented one of the six tribes (Mohawks, Oneidas, Onondagas, Cayugas, and Senecas) of the Haudenosaunee Confederacy. After the Revolutionary War, the Cayuga Nation were forced from their land and the County was somewhat sparsely settled as an agricultural area by former American soldiers.

Trade expanded in the region after the opening of the Ithaca-Oswego Turnpike and the Erie and Seneca canals. Industrialization in the early twentieth century brought major industries, and by 1959 a pattern of dispersed residential settlement was noted and broached as a planning concern. The late twentieth century saw the addition of highways, malls, and higher density housing outside of the established centers, such as the City of Ithaca (Tompkins County Comprehensive Plan 2015).

In terms of land use, Tompkins County continues to be a predominantly agricultural county with over 21 percent of the total acreage consisting of farmland. Farming operations within the County are quite diverse, including dairy, grain, livestock, hay, tree farms, vegetables, horticulture, aquaculture, poultry, vineyards, and orchards. Table 4-4 and Figure 4-4 provide the relative magnitudes of land use in the County as well as the land use trends during the period from 1995 to 2015. The increase in commercial, residential and recreation uses and decrease of agricultural land use are indicated by the data.

4.1.6 Major Past Hazard Events

Presidential disaster declarations are typically issued for hazard events that cause more damage than state and local governments can handle without assistance from the federal government, although no specific dollar loss threshold has been established for these declarations. A presidential disaster declaration puts federal recovery programs into motion to help disaster victims, businesses and public entities. Some of the programs are matched by state programs. Review of presidential disaster declarations helps establish the probability of reoccurrence for each hazard and identify targets for risk reduction. FEMA disaster declarations (Major Disaster Declarations (DR)) are declared when the President decides a disaster has caused damage of such severity that it is beyond the combined capabilities of state and local governments to respond. Broad ranging federal funds for a DR can be used to address the emergency but also larger infrastructure rebuilding; Emergency Declarations (EM) are also declared by the President to but are dedicated to the emergency event and total assistance does not exceed $5M) that included Tompkins County through 2020 (records date back to 1954).

Table 4-3. History of Hazard Events in Tompkins County, New York

Disaster Number	Incident Duration	Declaration Date	Incident Type	Title
DR-4480	January 20, 2020-- Ongoing	March 20, 2020	Biological	COVID-19 Pandemic
EM-3434	January 20, 2020— Ongoing	March 13, 2020	Biological	COVID-19 Pandemic
DR-4322	March 14-- March 15, 2017	July 12, 2017	Snow	Severe Winter Storm and Snowstorm
EM-3351	October 27-- November 8, 2012	October 28, 2012	Hurricane	Hurricane Sandy
DR-4031	September 7-- September 11, 2011	September 13, 2011	Severe Storm(s)	Remnants of Tropical Storm Lee
DR-1650	June 26-- July 10, 2006	July 1, 2006	Severe Storm(s)	Severe Storms and Flooding

Disaster Number	Incident Duration	Declaration Date	Incident Type	Title
EM-3262	August 29-- October 1, 2005	September 30, 2005	Hurricane	Hurricane Katrina Evacuation
DR-1534	May 13-- June 17, 2004	August 3, 2004	Severe Storm(s)	Severe Storms and Flooding
EM-3186	August 14-- August 16, 2003	August 23, 2003	Other	Power Outage
DR-1391	September 11, 2001	September 11, 2001	Fire	Fires and Explosions
EM-3155	May 22-- November 1, 2000	October 11, 2000	Other	West Nile Virus
DR-1335	May 3-- August 12, 2000	July 21, 2000	Severe Storm(s)	Severe Storms and Flooding
DR-1233	June 25-- July 10, 1998	July 7, 1998	Severe Storm(s)	Severe Storms and Flooding
DR-1148	November 8-- November 15, 1996	December 9, 1996	Severe Storm(s)	Severe Storms, High Winds, Rains, and Flooding
DR-1095	January 19-- January 30, 1996	January 21, 1996	Flood	Severe Storms and Flooding
EM-3107	March 13-- March 17, 1993	March 17, 1993	Snow	Severe Blizzard
DR-515	July 21, 1976	July 21, 1976	Flood	Severe Storms and Flooding
DR-487	October 2, 1975	October 2, 1975	Flood	Storms, Rains, Landslides, and Flooding
DR-338	June 23, 1972	June 23, 1972	Flood	Tropical Storm Agnes
DR-290	July 22, 1970	July 22, 1970	Flood	Heavy Rains & Flooding

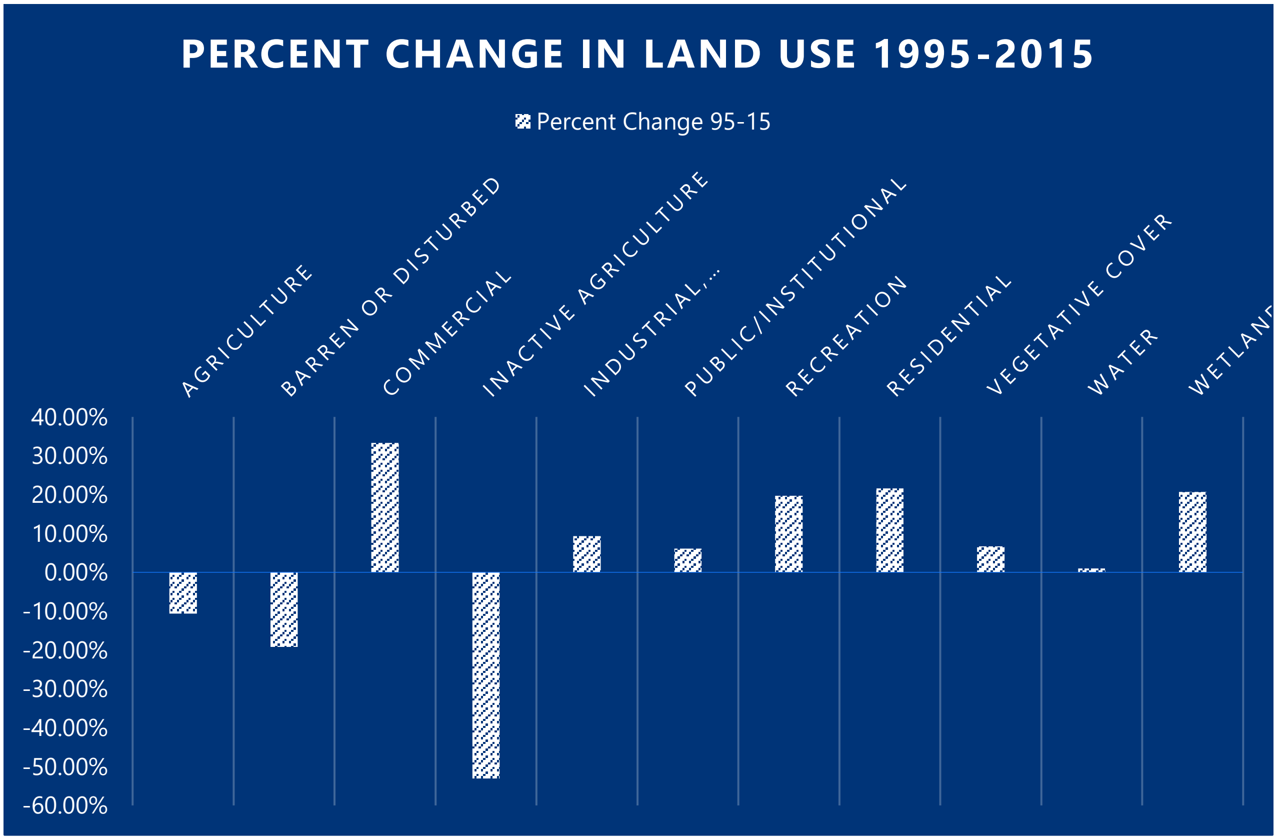
Table 4-4. Land Use (2015) in Tompkins County, New York

Land Use and Cover	Total Acreage	Total Area (sq. mi.)	Percent of County (%)
Agriculture	68,187	106.5	21.6
Barren or Disturbed	921	1.4	0.3
Commercial	1,772	2.8	0.6
Inactive Agriculture	9,237	14.4	2.9
Industrial, Transportation, Transmission	2,587	4.0	0.8
Public/Institutional	1,900	3.0	0.6
Recreation	2,689	4.2	0.9
Residential	26,675	41.7	8.5
Vegetative Cover	17,8625	279.1	56.7
Water	10,951	17.1	3.5

Land Use and Cover	Total Acreage	Total Area (sq. mi.)	Percent of County (%)
Wetlands	11,585	18.1	3.7

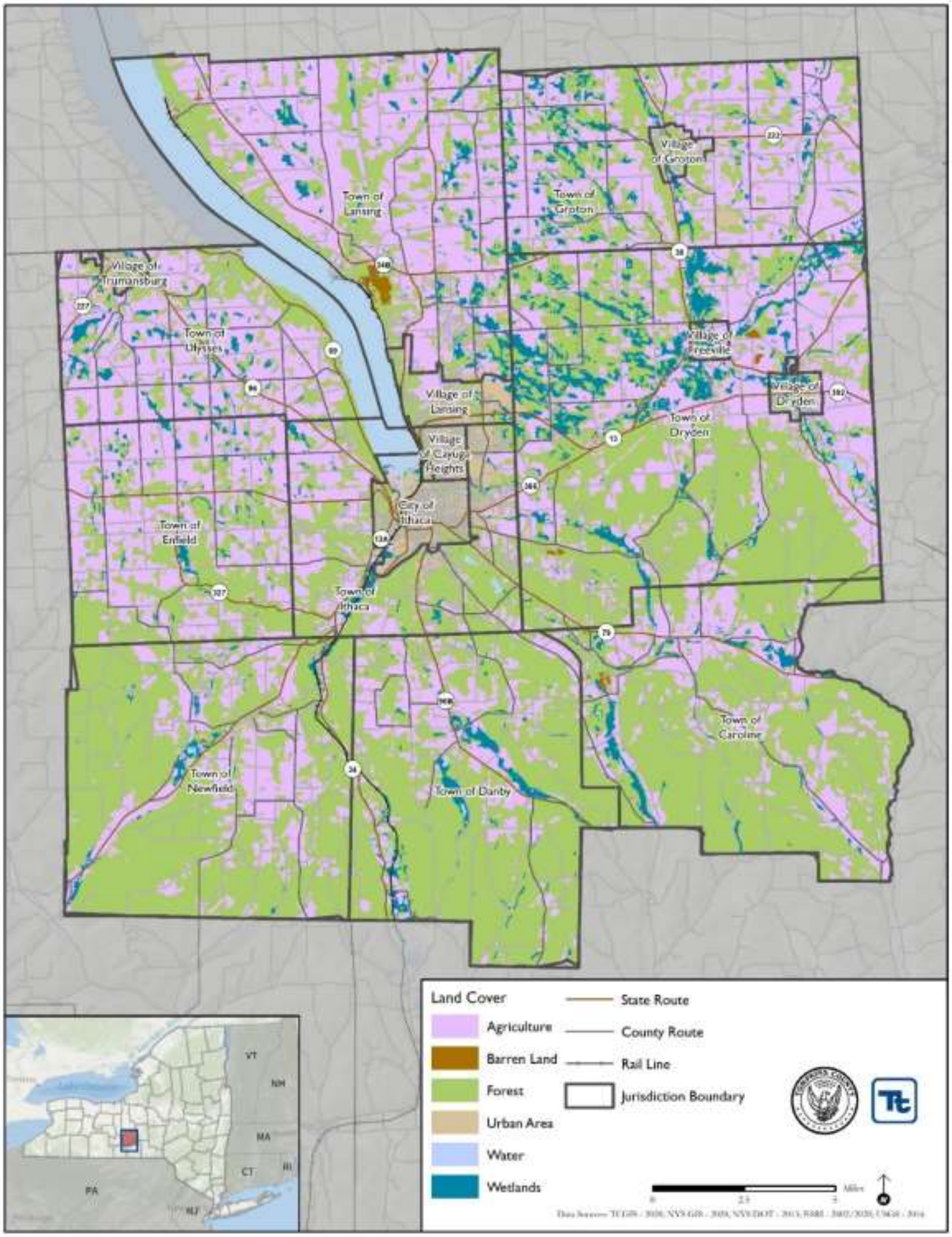
Source: Tompkins County, 2020

Figure 4-4 Tompkins County Land Use Trend (1995 – 2015)



Source: Tompkins County, 2020

Figure 4-5. 2016 Land Use in Tompkins County, New York



4.2 Population and Demographics

An understanding of the Tompkins County population characteristics provides a foundation for deciphering the impacts of natural hazards in the County. As noted in Section 5.1 (Methodology) of this plan, modeling of the impacts of natural hazards on the population was performed using FEMA's Hazards U.S. Multi-Hazard (HAZUS-MH) in which the available population information includes the 2010 U.S. Decennial Census data, which indicates a county population of 101,564 residents. However, more current data, according to U.S. Census Bureau, 2018 American Community Survey 5-Year Estimate, estimates a county population of approximately 102,962 residents. This represents a slight increase in population since 2010. A detailed population table for the 2010 Census is shown below in Table 4-5. A detailed table for the 2018 American Community Survey is included in Appendix E.

Various Census Bureau products were used as sources for the population trends section. The Decennial Census is the official population count taken every 10 years. American Community Survey 5-Year Estimates are used to show annual population changes, but it is not an official population county. 5-Year Estimates are used because they are the most accurate form of American Community Survey with the largest sample size which allows for greater accuracy at smaller geographic areas. The American Community Survey 5-Year Estimate products were used to establish annual changes in population. The numbers provided are not official census counts, but are official estimates provided to communities so that they may have a greater understanding in population changes within their jurisdictions.

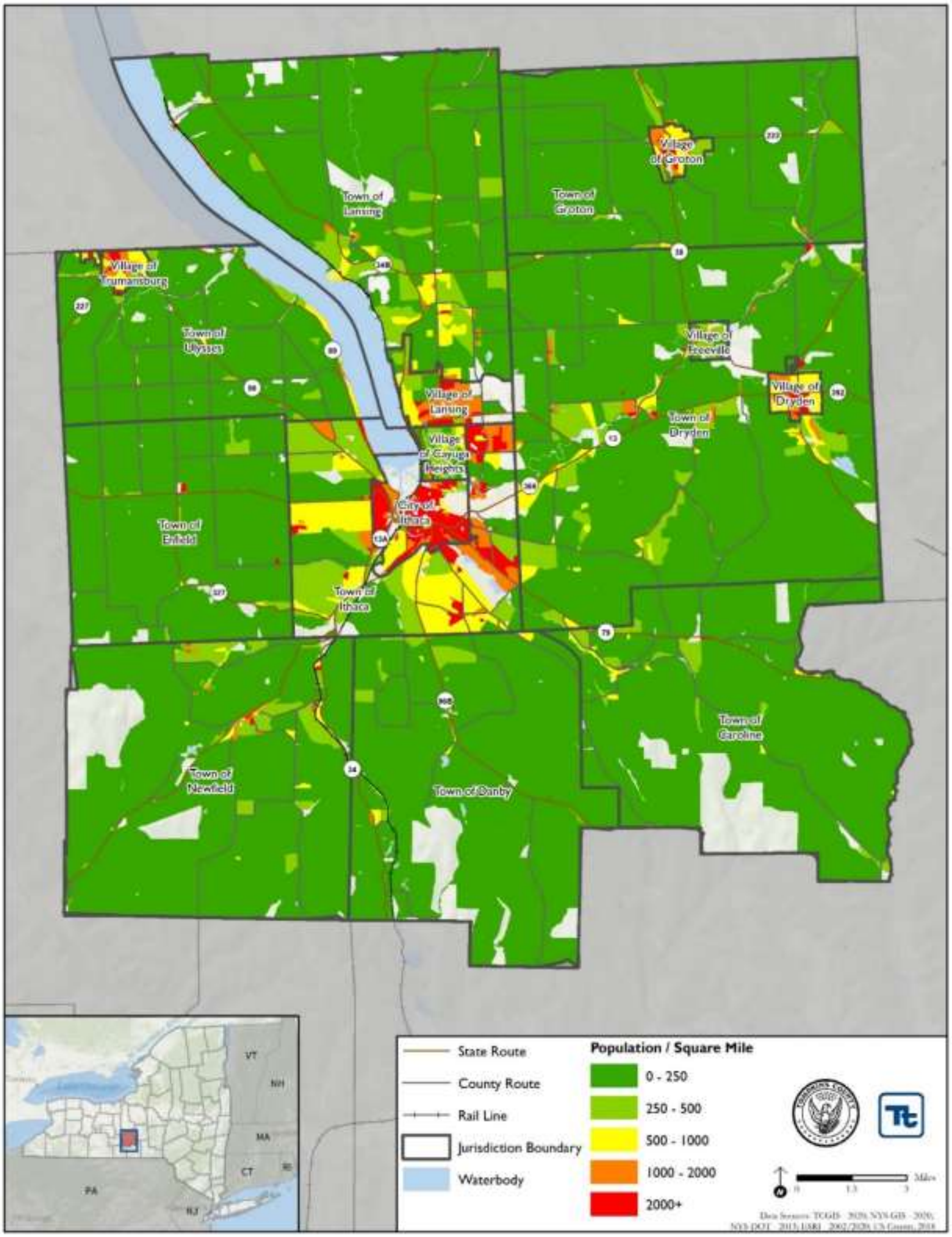
Table 4-5 provides the population of each municipality as a total percentage of the County population. Figure 4-6 shows the distribution of the 2010 U.S. Census general population density (persons per square mile) by census block. Both sets of statistics are provided for context, but for the purposes of this plan, the data available in HAZUS-MH v4.2 are used (representing 2010 data) to support the analysis so the more recent data does not significantly skew the analysis.

Table 4-5. Population Statistics in Tompkins County, New York

	U.S. Census 2010							2014-2018 American Community Survey (ACS)										
Municipality	**Total**	**Over 65**	**Percent Over 65**	**Population Under 5**	**Percent Under 5**	**Low Income**	**Percent Low Income***	**Total**	**Over 65**	**Percent Over 65**	**Under 5**	**Population Percent Under 5**	**Below Poverty Level**	**Percent Below Poverty Level**	**Non-English Speaking**	**Percent Non-English Speaking**	**Persons with Disability**	**Percent Persons with Disability**
Caroline (T)	3,282	391	11.9%	193	5.9%	207	6.3%	3,362	388	11.5%	191	5.7%	206	6.13%	68	2.0%	410	12.2%
Cayuga Heights (V)	3,729	737	19.8%	131	3.5%	267	7.2%	3,674	880	24.0%	129	3.5%	265	7.2%	476	13.0%	298	8.1%
Danby (T)	3,329	440	13.2%	185	5.6%	156	4.7%	3,438	668	19%	149	4.3%	529	15.39%	113	3.3%	409	11.9%
Dryden (T)	12,025	1,308	10.9%	655	5.4%	1,422	11.8%	12,311	1,855	15.1%	675	5.5%	2,093	17.0%	906	7.4%	1,343	10.9%
Dryden (V)	1,890	259	13.7%	90	4.8%	178	9.4%	1,832	131	7.2%	79	4.3%	150	8%	163	8.9%	205	11.2%
Enfield (T)	3,512	432	12.3%	226	6.4%	467	13.3%	3,541	610	17.2%	209	5.9%	261	7.4%	87	2.5%	392	11.1%
Freeville (V)	520	74	14.2%	32	6.2%	44	8.5%	501	66	13.2%	22	4.4%	43	8.6%	14	2.8%	57	11.4%
Groton (T)	3,587	454	12.7%	196	5.5%	220	6.1%	3,685	664	18.0%	204	5.5%	344	9.34%	204	5.5%	469	12.7%
Groton (V)	2,363	378	16.0%	137	6%	121	5%	2,287	434	19%	121	5%	114	5%	66	0.0%	308	13%
Ithaca (C)	30,014	1,769	5.9%	700	2.3%	8,721	29.1%	30,568	2,021	7%	546	1.8%	9,631	32%	6,551	21.4%	2,258	7.4%
Ithaca (T)	16,201	1,813	11.2%	665	4.1%	1,688	10.4%	16,233	2,029	12.5%	655	4.0%	1,924	11.9%	2,631	16.2%	1,287	7.9%
Lansing (T)	7,504	1,021	13.6%	379	5.1%	307	4.1%	7,912	1,414	17.9%	480	6.1%	609	7.7%	742	9.4%	488	6.2%
Lansing (V)	3,529	381	10.8%	194	5.5%	359	10.2%	3,417	328	9.6%	291	8.5%	349	10.2%	922	27.0%	195	5.7%
Newfield (T)	5,179	627	12.1%	305	5.9%	455	8.8%	5,218	879	17%	408	7.8%	594	11%	180	3.4%	567	10.9%
Trumansburg (V)	1,797	323	18.0%	96	5.3%	101	5.6%	1,760	311	17.7%	35	2.0%	99	5.6%	70	4%	221	12.6%
Ulysses (T)	3,103	522	16.8%	138	4.4%	236	7.6%	3,223	883	27.4%	60	1.9%	289	9.0%	90	2.8%	378	11.7%
Tompkins County (Total)	**101,564**	**10,929**	**10.8%**	**4,322**	**4.3%**	**14,949**	**14.7%**	**102,962**	**13,561**	**13.2%**	**4,254**	**4.1%**	**17,500**	**17.0%**	**13,283**	**12.9%**	**9,285**	**9.0%**

Source: U.S. Census Bureau, Census 2010; HAZUS-MH; American Community Survey (ACS) 2014-2018
Note (1): The town populations exclude all associated villages within the town in the ACS estimates.
Pop. = Population, V = Village, T = Town, % = Percent
** Low income population from HAZUS-MH v4.2 is the total of individuals with income $0-$10,000 and $10,000-$20,000 and $20,000-$30,000/year.*

Figure 4-6. Distribution and Density of General Population for Tompkins County, New York

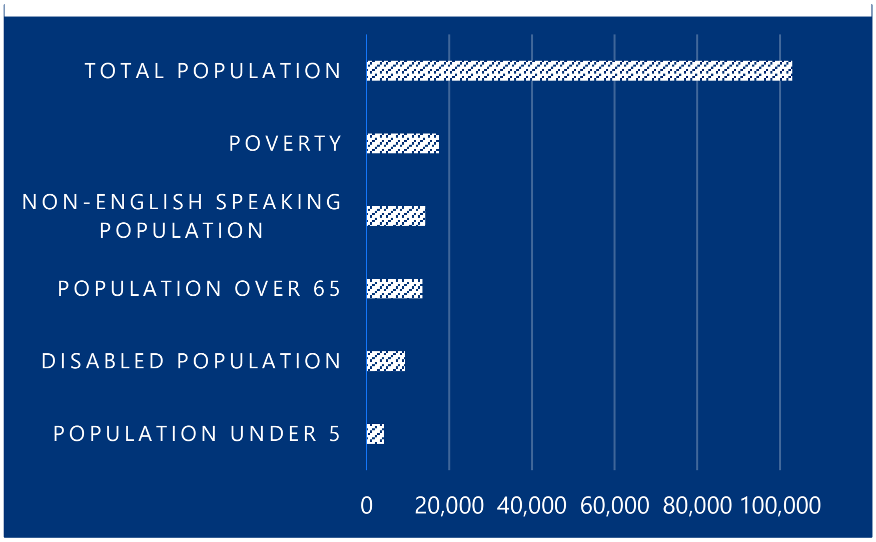


4.2.1 Vulnerable Populations

DMA 2000 requires that HMPs consider socially vulnerable populations. These populations can be more susceptible to hazard events based on many factors, including their physical and financial ability to react or respond during a hazard and the location and construction quality of their housing. The vulnerable populations with particular focus for this plan include (1) the elderly (persons aged 65 and over) and (2) those living in low-income households. In the current plan, additional vulnerable populations are identified including: the physically or mentally disabled, and non-English speakers. Identifying concentrations of vulnerable populations can assist communities in advancing preparedness, response, and mitigation actions.

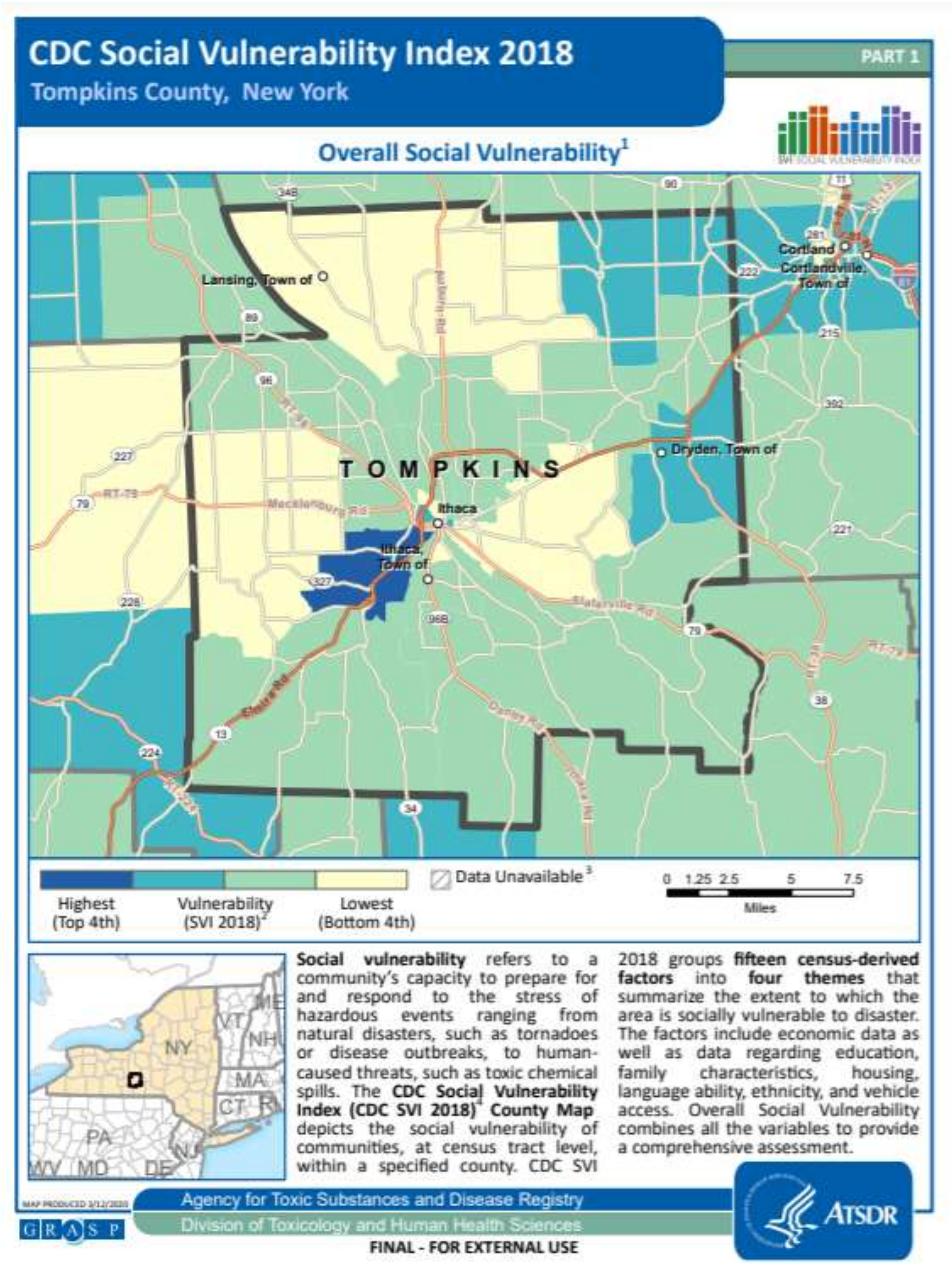
Populations with a higher level of vulnerability can be more seriously affected during the course of an emergency or disaster. Vulnerable populations have unique needs that need to be considered by public officials to help ensure the safety of demographics with a higher level of risk. Figure 4-7 provides Tompkins County Vulnerable Population Statistics.

Figure 4-7. Vulnerable Population Statistics in Tompkins County, New York



The Centers for Disease Control and Prevention's (CDC) 2016 Social Vulnerability Index (SVI) ranks U.S. Census tracts on socioeconomic status, household composition and disability, minority status and language, and housing and transportation. An indication of the distribution of socially vulnerable populations is provided in Figure 4-8. Being aware of the County's overall ranking can help inform how the communities may react to a natural disaster upon available resources.

Figure 4-8. Tompkins County Social Vulnerability Index



Source: CDC 2021

4.2.1.1 Age

Children are considered vulnerable to hazard events because they are dependent on others to safely access resources during emergencies and may experience increased health risks from hazard exposure. The elderly (65 and over) are more likely to have difficulty accessing the physical and economic resources necessary for response to hazard events and are more likely to suffer health-related consequences. Those living on their own may have more difficulty evacuating their homes. The elderly are also more likely to live in senior care and living facilities where emergency preparedness is at the discretion of facility operators. According to the 2018 American Community Survey 5-Year Estimates, the median age in Tompkins County was 30.9 years. The lower age is likely due to the demographic influence of Cornell University, home to approximately 15,000 undergraduates (https://www.cornell.edu/about/facts.cfm) and Ithaca College and Tompkins County Community College.

HAZUS-MH reports 4.3 percent of the 2010 Tompkins County population is under the age of 5 and 10.8 percent is over the age of 65. Of the 2018 population, 4.1 percent is under the age of 5 and 13.2 percent is over the age of 65. Table 4-5 and Figure 4-9. shows the distribution of persons over 65 and under the age of 16 throughout Tompkins County.

4.2.1.2 Income

The 2018 American Community Survey 5-Year Estimates provides that the median household income in Tompkins County was $58,743 and the per capita income was $32,261. The U.S. Census Bureau identifies households with two adults and two children with an annual household income below $25,465 per year as *low income* (U.S. Census 2018). The 2018 American Community Survey 5-Year Estimates indicates a total of 14.1 percent of people live below the poverty level within the County. Again, these figures are impacted by the large presence of college students in the community.

The spatial U.S. Census data for household income provided in HAZUS-MH includes two ranges (less than $10,000 and $10,000-$20,000/year) that were totaled to provide the *low-income* data used in this study. This does not correspond exactly with the *poverty* thresholds established by the 2016 U.S. Census Bureau data. This difference is not believed to be significant for the purposes of this planning effort; therefore, for the exposure and loss estimations in the risk assessment, the 2010 U.S. Census data in HAZUS-MH is reported. Refer to Figure 4-9 below which illustrates the low-income population density in Tompkins County.

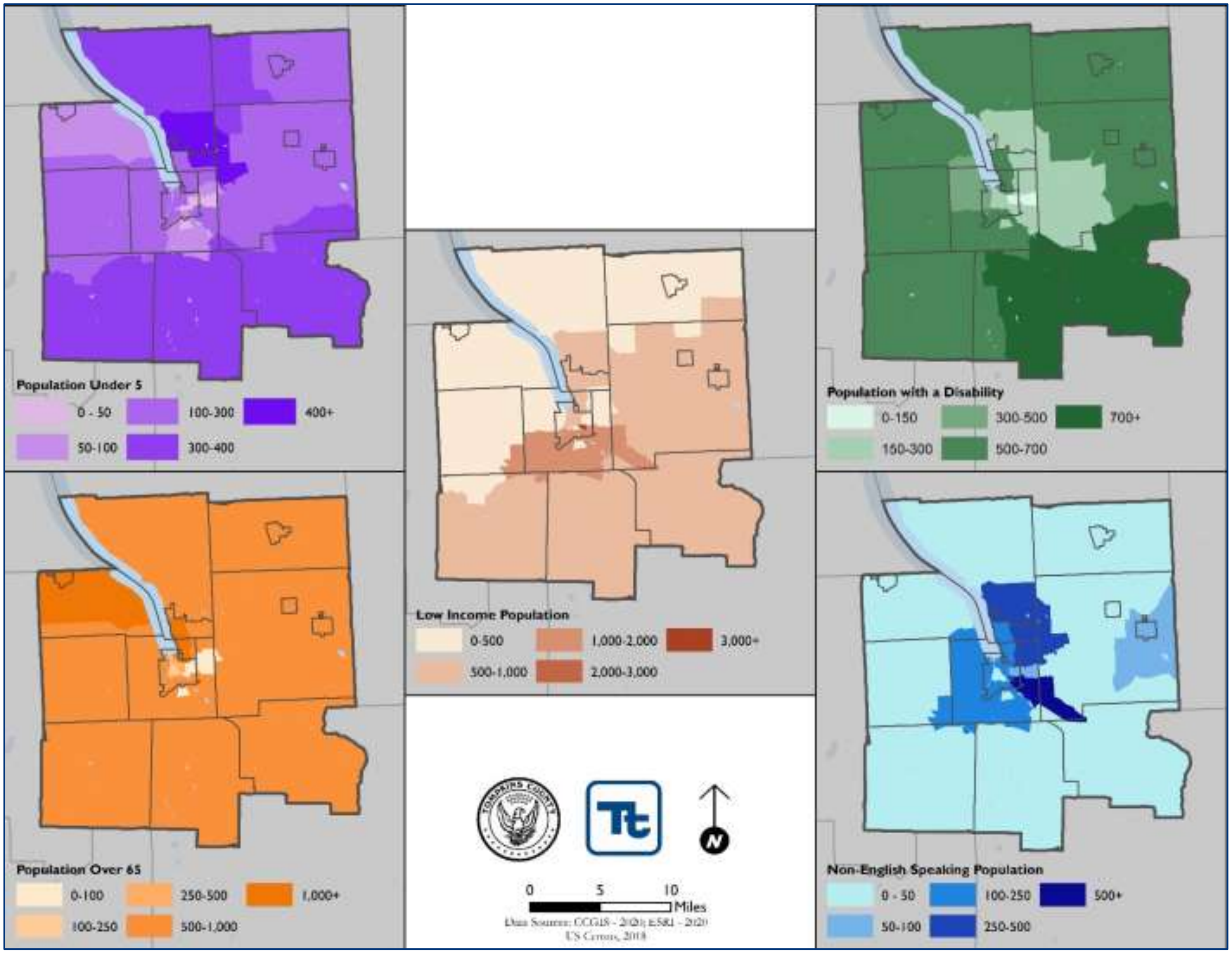
4.2.1.3 Physical or Mental Disabilities

According to the Centers for Disease Control, "Persons with a disability include those who have physical, sensory, or cognitive impairment that might limit a major life activity (Centers for Disease Control 2015)." Cognitive impairments can increase the level of difficulty that individuals might face during an emergency and reduce an individual's capacity to receive, process, and respond to emergency information or warnings. Individuals with a physical or sensory disability can face issues of mobility, sight, hearing, or reliance on specialized medical equipment. According to the 2018 American Community Survey, 9,285 of 102,962 people, that is 9.1 percent of residents in Tompkins County are living with a disability. Figure 4-9 shows the geographic distribution of disabled individuals throughout Tompkins County, including individuals living with hearing, vision, cognitive, ambulatory, self-care, and independent living difficulties.

4.2.1.4 Non-English Speakers

Individuals who are not fluent or working proficiency in English are vulnerable because they can have difficulty with understanding information being conveyed to them. Cultural differences also can add complexity to how information is being conveyed to populations with limited proficiency of English (Centers for Disease Control 2015). According to the 2018 American Community Survey, 14.4 percent of the County's population over the age of 5 primarily speaks a language other than English at home. Within that group, approximately 6,835 individuals are reported as speaking English "less than very well." Of the County's households, 8.5 percent speak Asian and Pacific Islander languages, 5.5 percent speak other Indo-European languages, and 2.8 percent speak Spanish. Figure 4-9 shows the geographic distribution of individuals who speak English less than "very well."

Figure 4-9. Distribution of Socially Vulnerable Populations in Tompkins County, New York



4.2.2 General Building Stock

The 2018 American Community Survey data identifies 39,326 households in Tompkins County. The 2018 American Community Survey data estimate that the majority of housing units (50.8 percent) in Tompkins County are single-family, detached units. The U.S. Census Bureau defines household as all the persons who occupy a housing unit and a housing unit as a house, an apartment, a mobile home, a group of rooms, or a single room that is occupied (or if vacant, is intended for occupancy) as separate living quarters. The median price of a single-family home in Tompkins County was estimated at $199,400 in 2018 (American Community Survey 2018).

For this update, the default general building stock in HAZUS-MH v4.2 was updated and replaced with a custom-building inventory for Tompkins County. The building inventory was developed using the most recent Tompkins County tax parcels, Real Property System tax data, and building footprints provided by Tompkins County ITS. Tetra Tech calculated the replacement cost values (structure and contents) using RSMeans 2019 construction cost data. Generally, contents for residential structures are valued at about 50 percent of the building's value. For non-residential facilities, the value of the content is generally about equal to the building's structural value.

The updated building inventory contains 55,648 buildings with a total building replacement value (structure and content) of greater than $71 trillion. This inventory was incorporated into HAZUS-MH at the structure and aggregate level. Approximately 78.7-percent of the buildings (approximately 43,800 buildings) and 40.3-percent of the building stock replacement value are associated with residential housing. Commercial buildings make up the second building classification at approximately 12.7-percent of the total building replacement value. The Town of Dryden has the greatest number of structures (8,515) and the Village of Freeville has the smallest number of structures (409). Table 4-6 illustrates the percentage of total building replacement value by occupancy.

Table 4-6. Build Replacement Value by Occupancy in Tompkins County, NY

	All Occupancies				Residential		Commercial		Industrial	
Municipality	Count	Replacement Cost Value (Structure Only)	Replacement Cost Value (Contents Only)	Total Replacement Cost Value (Structure + Contents)	Count	Total Replacement Cost Value (Structure + Contents)	Count	Total Replacement Cost Value (Structure + Contents)	Count	Total Replacement Cost Value (Structure + Contents)
Caroline (T)	3,257	$1,487,983,728	$1,035,124,619	$2,523,108,347	2,403	$1,358,577,326	488	$522,037,081	9	$5,223,808
Cayuga Heights (V)	1,183	$988,872,975	$559,792,934	$1,548,665,909	1125	$1,287,240,123	36	$97,858,115	0	$0
Danby (T)	3,008	$1,283,019,129	$905,435,192	$2,188,454,321	2262	$1,132,751,811	602	$658,664,565	3	$2,740,830
Dryden (T)	8,518	$4,907,823,127	$3,833,082,976	$8,740,906,102	6,628	$3,224,220,454	1252	$2,249,129,019	38	$406,854,476
Dryden (V)	1,022	$666,257,304	$468,851,796	$1,135,109,100	886	$592,216,526	110	$424,696,715	4	$17,720,823
Enfield (T)	3,559	$1,570,072,362	$1,166,395,869	$2,736,468,231	2,738	$1,211,029,479	477	$665,584,455	2	$2,285,444
Freeville (V)	409	$207,286,264	$149,413,031	$356,699,295	294	$173,619,699	41	$48,310,505	1	$4,351,018
Groton (T)	3,610	$1,603,681,200	$1,201,120,142	$2,804,801,342	2,557	$1,207,683,173	532	$553,733,210	11	$58,870,604
Groton (V)	1,205	$706,329,422	$496,841,768	$1,203,171,190	1,059	$628,462,960	110	$470,116,968	5	$14,329,050
Ithaca (C)	7,450	$10,958,043,807	$8,754,261,867	$19,712,305,674	6,280	$6,611,345,821	795	$7,258,972,188	31	$325,010,374
Ithaca (T)	6,080	$6,086,221,207	$4,781,960,379	$10,868,181,586	4,919	$3,912,782,485	393	$1,044,784,625	15	$121,899,166
Lansing (T)	6,010	$3,596,528,415	$2,673,662,618	$6,270,191,033	4,706	$2,768,597,390	706	$1,738,318,397	69	$463,367,469
Lansing (V)	1,055	$1,952,464,025	$1,483,579,611	$3,436,043,635	813	$1,406,653,242	204	$1,566,545,224	14	$209,803,783
Newfield (T)	4,669	$2,180,669,291	$1,667,535,382	$3,848,204,673	3,638	$1,539,401,729	650	$1,110,380,232	6	$51,659,570
Trumansburg (V)	1,061	$721,251,257	$520,298,713	$1,241,549,970	950	$602,857,632	77	$416,067,237	1	$1,598,098
Ulysses (T)	3,552	$1,918,550,903	$1,453,593,545	$3,372,144,448	2,542	$1,394,872,075	620	$795,052,612	11	$14,470,124
Tompkins County (Total)	55,648	$40,835,054,415	$31,150,950,440	$71,986,004,856	43,800	$29,052,311,925	7,093	$19,620,251,148	220	$1,700,184,636

Source: Tompkins County GIS 2019, RS Means 2019
Notes: T = Town, V = Village

Appendix E presents Building Stock Statistics by Occupancy Class for Tompkins County based on HAZUS-MH provided data.

Figure 4-10 through Figure 4-12 show the distribution and exposure density of residential, commercial, and industrial buildings in Tompkins County. Exposure density is the dollar value of structures per unit area, including building content value. Generally, contents for residential structures are valued at about 50 percent of the building's value. For commercial facilities, the value of the contents is generally about equal to the building's structural value. The densities are shown in units of $1,000 ($K) per square mile.

Viewing exposure distribution maps, such as Figure 4-10 through Figure 4-12 can assist communities in visualizing areas of high exposure and in evaluating aspects of the study area in relation to the specific hazard risks.

Figure 4-10. Distribution of Residential Building Stock and Value Density in Tompkins County, New York

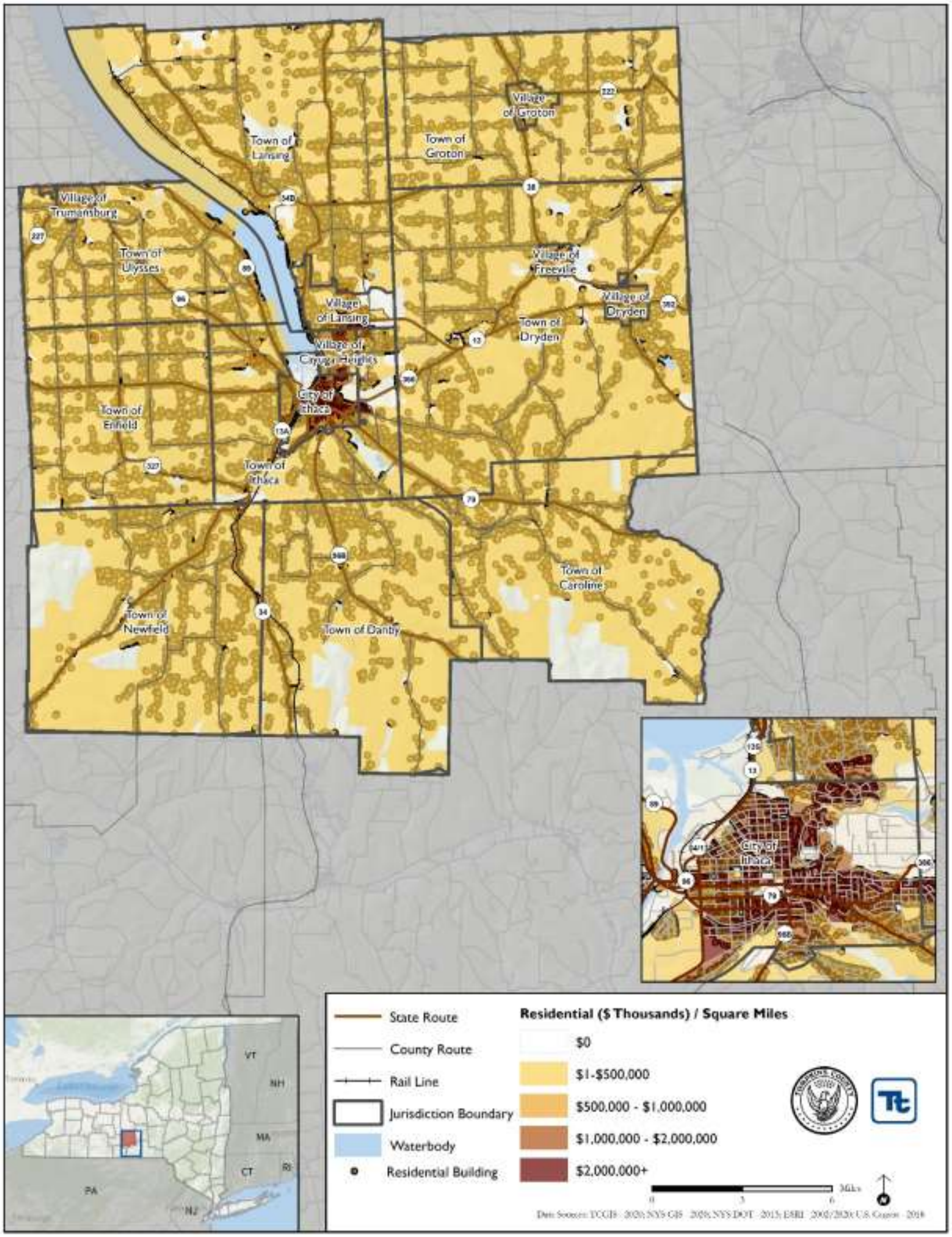


Figure 4-11. Distribution of Commercial Building Stock and Exposure Density in Tompkins County, New York

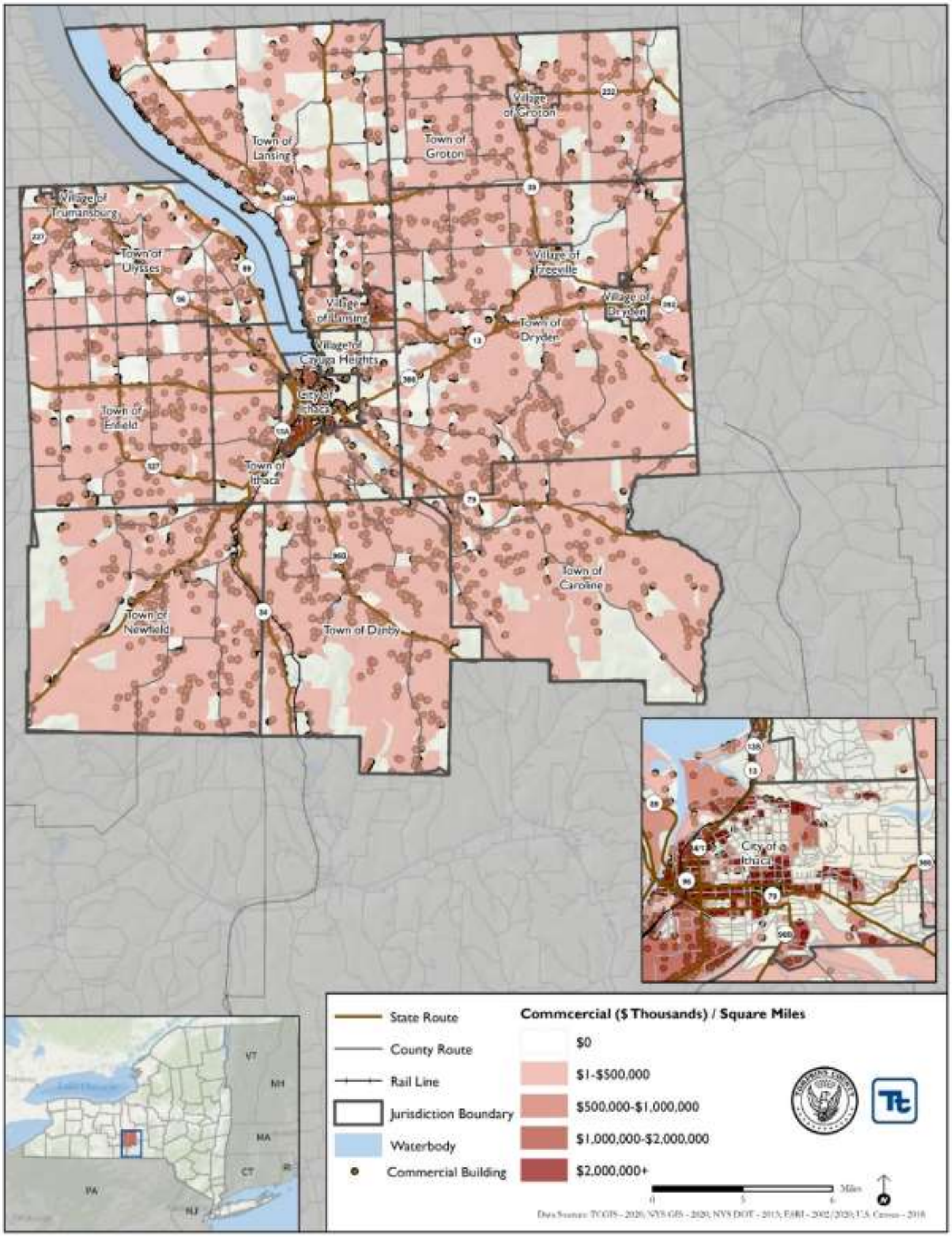


Figure 4-12. Distribution of Industrial Building Stock and Value Density in Tompkins County, New York

4.3 Land Use and Population Trends

Land use regulatory authority is vested in New York State's towns, villages, and cities. However, many development and preservation issues transcend location political boundaries. DMA 2000 requires that communities consider land use trends, which can impact the need for and prioritization of mitigation options over time. Land use trends significantly impact exposure and vulnerability to various hazards. For example, significant development in a hazard area increases the building stock and population exposed to that hazard.

This plan provides a general overview of population, land use, and types of development occurring within the study area. An understanding of these development trends can assist in planning for further development and ensuring that appropriate mitigation, planning, and preparedness measures are in place to protect human health and community infrastructure.

4.3.1 Land Use Trends

According to the Tompkins County Comprehensive Plan, the County has a development pattern that consists of a spectacular natural landscape, a vibrant college-town urban center, and a diversity of developed landscapes that reflect urban, suburban, and rural development typologies (Tompkins County Comprehensive Plan 2015). The following sections present an overview of the County economy.

4.3.1.1 Economy

The U.S. Census Bureau's County Business Pattern provides an annual series of sub-national economic data by industry covering. This Census includes majority of the country's economic activity. According to the 2017 Tompkins County Business Pattern, the County was home to 2,377 business establishments employing 48,258 people. The role of Cornell University as a major direct and indirect employer is significant in addition to other institutions in the "Education Services" sector. Based on included data, it is anticipated that this accounts for up to nearly 20,000 jobs and $800 million in payroll. Absent Education Services as the potentially largest employment sector, Tompkins County's largest industries by size include the Healthcare and social assistance sector (6,112 employees and $256 million in payroll) followed by the accommodation/food services and retail industries, each employing between 4,500 and 5,000 people and supporting $92 million and $122 million in annual payroll, respectively.

Table 4-7. provides 2017 industry and employment information in Tompkins County.

Table 4-7. 2017 Economic Census for Tompkins County, New York

Sector	Number of establishments	Number of employees	Annual payroll ($1,000)
Total for all sectors	**2,377**	**48,258**	**$ 1,925,760.00**
Agriculture, forestry, fishing, and hunting	6	286	$ 11,407.00
Mining, quarrying, and oil and gas extraction	4	c	S
Utilities	3	c	S
Construction	188	973	$ 43,641.00
Manufacturing	88	2,919	$ 147,021.00
Wholesale trade	45	591	$ 27,255.00
Retail trade	348	4,958	$ 122,777.00
Transportation and warehousing	42	552	$ 24,320.00
Information	66	977	$60,478.00
Finance and insurance	99	1,167	$82,428.00
Real estate and rental and leasing	127	713	$ 26,575.00
Professional, scientific, and technical services	291	2,191	$ 135,119.00
Management of companies and enterprises	8	539	$ 48,028.00
Administrative and support and waste management and remediation services	115	746	$22,236.00
Educational services	38	18,014	S
Health care and social assistance	284	6,112	$ 256,722.00
Arts, entertainment, and recreation	62	598	$ 12,506.00
Accommodation and food services	334	4,646	$ 92,232.00
Other services (except public administration)	228	1,295	$38,062.00

Source: U.S. Census, County Business Pattern 2017
** = This number only includes paid employees*
C = 100-249 employees
J = high noise infusion
S = Withheld

4.3.1.2 Agriculture

Tompkins County is home to a robust agriculture industry. With about 523 farms on at least 91,227 acres, agriculture comprises between one-quarter and one-fourth of land cover in the County. The total value of agricultural products sold in 2017 was $64.7 million, a four percent decrease from 2012. Net cash farm income has increased significantly in recent years to $16.8 million. Crops comprise one-quarter of sales, whereas livestock, poultry, and related products totaled three-quarters of sales. In terms of use, 68% of land is used for cropland, 16% is used as woodland, and seven percent is used as pastureland (U.S. Department of Agriculture National Agricultural Statistics Service 2017).

The vast majority of farm sales in Tompkins County are derived from dairies ($41.1 million). This is followed by cattle and calves ($6.4 million) and grains, oilseeds, dry beans, and dry peas ($5.1 million). The County ranks third in the State and 78th nationally for sales of cultivated Christmas trees and short rotation woody crops. In terms of acreage, most crops in the County are forage such as hay. Of the 523 farms in the County, 93 are family farms and at least seven farm organically.

4.3.1.3 Corridors and Gateways

Though no interstates pass through Tompkins County, the region has a robust road network connecting it to the region and surrounding counties. Access to the nearest interstate – Interstate 81 – is through NYS Route 13 via Cortland or NYS Route 79 via Lisle and Whitney Point. Access to I-86 is provided via NYS Route 13 through Horseheads. The Principal Arterial Expressway in the County is NYS Route 13 between Hanshaw Road in the Town of Ithaca and Hancock Street in the City of Ithaca. NYS Routes 13 and 79 are both considered Principal Arterials alongside major roadways such as Fulton Street, South Meadow Street, West Seneca Street, and West Green Street.

Other major routes in the County include Minor Arterials such as those listed below. The City of Ithaca has several Minor Arterials passing through the City. These roads include:

- Route 13A
- Route 34
- Route 38
- Route 79
- Route 96
- Route 366
- Elmira Road
- Pine Tree Road
- Pleasant Grove Road
- Triphammer Road
- Warren Road

Figure *4-13* illustrates the transportation corridors in Tompkins County.

Figure 4-13. *Transportation Corridors of Tompkins County, New York*

4.3.2 Population Trends

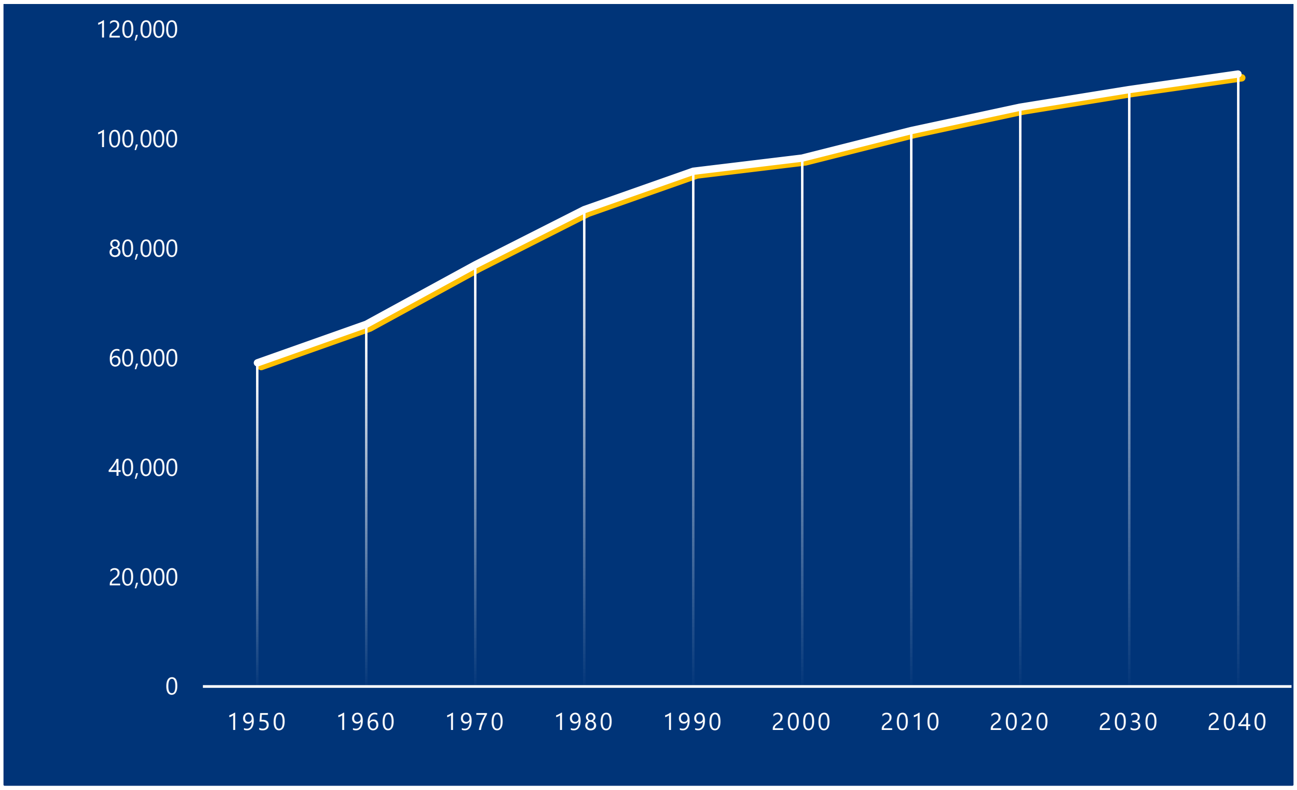
Tompkins County has seen a slight population increase as illustrated. Two Census Bureau products were used in the population trends section. The 2010 Census is the official population count of a municipality which is performed every ten years. The American Community Survey is performed on a more frequent basis to provide updated population and demographics information to communities.

All but three counties have seen population increases between the 2010 and 2018 American Community Surveys. Based on historical data, population projections have been created which show Tompkins County's population to continue to increase over time. However, even as the County's total population has grown, the number of residents under the age of five has decreased by 2.2 percent, while the population of those over the age of 65 has increased by 28.6%.

Cornell University has a large influence on the demographics of the County. With more than 23,000 students and nearly 9,900 employees, the University generates a significant amount of economic activity and provides socioeconomic diversity. Ithaca College, with more than 5,800 students and over 1,700 employees, and TC3 with 5500 students, and over 200 employees also contribute to this influence on demographics. Because the U.S. Census is calculated based on residence on April 1, students at Cornell University and Ithaca College are counted as local residents. This effect is most pronounced in the median age for the City of Ithaca, which is 21.9 years compared to the County-wide median age of 30.9 years (American Factfinder).

The U.S. Census Bureau estimates that Tompkins County's population in 2018 was 102,962 (American Factfinder), a 1.3 percent increase from 2010 population of 101,564 (U.S. Census). The County's population has been increasing steadily since 1950, as shown in Figure 4-14 on the following page. Though 2017-2018 saw a slight decline in the estimated population, the overall trend has been towards population growth and continued growth for the future. Figure E-1 in Appendix E (Supplementary Data) illustrates the municipal population change over this period.

Figure 4-14. Population Change 1950 to 2040 in Tompkins County, New York



Source: U.S. Census Bureau

4.3.3 Future Growth and Development

Compared to most Upstate New York communities, Tompkins County is experiencing high rates of new development, particularly along major arterials such as State Route 13, 96, and 79. Much of this development is centered around the Town and City of Ithaca, as well as Cornell University which stretches in to neighboring municipalities including parts of Lansing and Dryden. These new developments include commercial, residential, mixed use, utility (solar energy and communication development), and industrial projects. In part due to its location amidst the Finger Lakes , the County also has a relatively active tourism sector and thus development centered around agricultural production, processing, and distribution.

Historically, general development patterns in Tompkins County have were more similar to other communities across Upstate New York. Since the second half of the 20th century, development in Tompkins County has been dominated by suburban sprawl from urban into rural areas. The urban sprawl around the City of Ithaca and its urban sprawl has had major impacts on all its surrounding communities especially the Town of Lansing and Dryden which has seen significant development along the Route 13 corridor (Tompkins County Comprehensive Plan, 2015). Tompkins County annually tracks the type and scale of development that is referred for review subject to NYS General Municipal Law 239. This information in combination of its regular Land-Use Land Cover analysis gives a good sense of where development is occurring throughout the county.-

Due to concerns regarding urban sprawl's negative effect on the existing natural systems and its effects on climate change, the County has been focusing on increasing nodal development that is oriented toward pedestrians and multiple transportation alternatives, rather than dependent on private automobiles. While suburban sprawl had been the norm for sixty-plus years, in recent years most new development has occurred within the County's urban center (which includes the City of Ithaca, much of the Town of Ithaca and the Villages of Cayuga Heights and Lansing). During the earlier trend, roughly two-thirds of new development had occurred in the county's villages and city. That trend has reversed, with two-thirds of new development occurring within the urban core.

While the County does not have direct land use regulatory authority, it has proposed a Development Focus Area Strategy to help encourage development where infrastructure can support it. Such recommendations include infill development within existing urban centers that can accommodate denser development and increased development within existing community nodes across the County. It is the general goal and aspiration of the County to decrease suburban sprawl and develop interconnected communities to increase sustainability and decrease vulnerability to climate change (Tompkins County Comprehensive Plan, 2015).

An indication of development since the 2015 Tompkins County HMP is provided on a municipal basis in each of the Section 9 annexes of this plan wherein each participating jurisdiction has provided a list of permits for major development since 2015 as well as anticipated development within its boundaries. The annex maps display the identified recent and anticipated development in each community and their location to hazard areas (e.g. flood hazard area and WUI).

4.4 Housing and Relocation

Tompkins County and its municipalities recognize the need to identify potential sites for temporary housing during and after a disaster event and relocation of structures out of hazard areas.

4.4.1.1 Temporary Housing

During the planning process, each municipality was asked to identify potential locations for temporary housing in the event of an emergency. The locations identified by the municipalities are documented in Section 9 (Jurisdictional Annexes). Communities discussed and documented a wide range of temporary housing locations. Those that could identify temporary housing locations agreed that those areas should be located well outside of high hazard areas, namely outside mapped Special Flood Hazard Areas. Several of the Villages had very little safe, vacant land outside of these areas, and as such identified the need to coordinate with the surrounding Town for a good location for temporary housing. Fortunately, Tompkins County does have a wide variety of options that would vary based on the situation and need. Communities discussed a range of locations for potential temporary housing including unoccupied residence halls in and around Ithaca at Cornell University, Ithaca College and in Dryden at Tompkins-Cortland Community College; State Park Land including cabins, campgrounds and bathrooms at each of the 4 State Parks in the County (some of these parks serve as the historic temporary housing for the Civilian Conservation Corps); municipal park land were also identified by many as locations where campers or trailers could be located over the short-term; the wide range of hotels and motels that normally supports academic and tourist activity could be repurposed for temporary housing as has been the case in supporting positive COVID cases; and various large vacant land was flagged as potential location. While a range of safe locations were identified they would certainly need to be further investigated and formalized in a given hazard situation.

4.4.1.2 Long-Term Housing

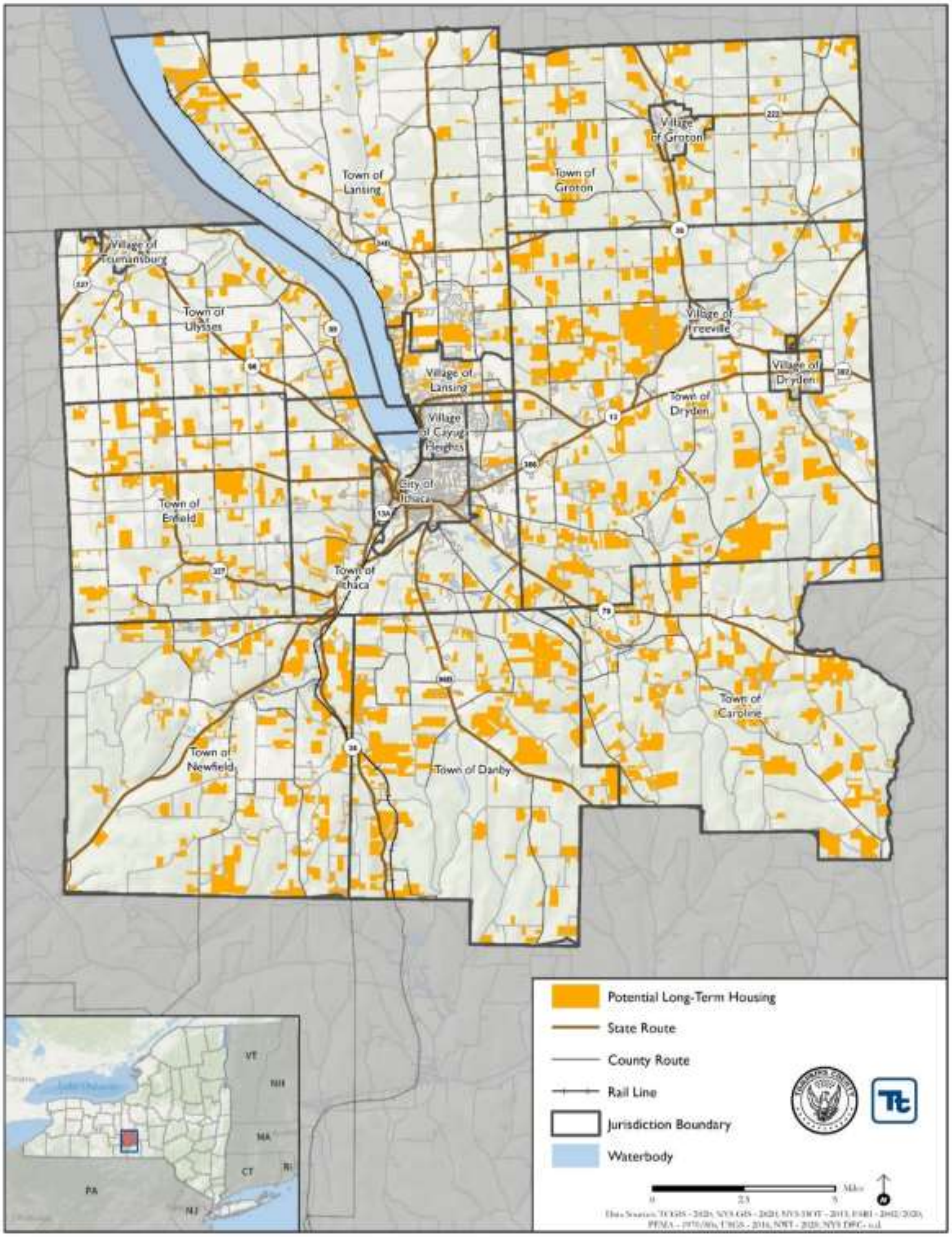
To support identification of potential sites suitable for relocating houses out of hazard areas (i.e., the floodplain) or building new homes once properties in hazard areas or the floodplain are acquired, the County performed a buildable parcel analysis. The analysis identified potential areas for post-disaster development in accordance with the 2017 NYSDHSES Hazard Mitigation Planning Standards Guide requirement "to identify long-term housing options for relocating displaced residents to maintain post-disaster social and economic stability". The County analysis provides an indication of vacant land suitable for development. In this case, vacant land is defined as a parcel that is classified as vacant and is located outside the following hazard areas:

1) FEMA floodplain.
2) Mapped wetlands.
3) Federal, state and county park land.
4) Land that has steep slopes (>20% gradient) without consideration of ownership or availability.

Each municipality has additionally identified the specific location where increased housing density would be appropriate in their individual Comprehensive Plans. In all but three municipalities, the location where long-term housing has further been articulated in their local zoning codes.

Figure 4-15 provides a buildable land analysis to identify potential long-term housing locations in Tompkins County. A more in-depth analysis of the appropriateness of long-term housing is done by each municipality and focuses in on areas that best align with broad ranging community goals.

Figure 4-15. Potential Long-Term Housing Locations in Tompkins County, New York



4.4.1.3 Anticipated Evacuation Routes

As part of the planning process, Tompkins County has unofficially identified potential evacuation routes and procedures in the event of a disaster that would warrant an evacuation, as shown in Figure 4-16. At the time of the plan development, evacuation routes have not been formally identified by the County. Thus it was necessary for the consultant and County to develop a general definition for potential evacuation routes. Due to the overall unpredictable nature of the hazards identified in Tompkins County, evacuation routes can vary depending on type and overall magnitude of event. Therefore the overall practicality of establishing evacuation routes is lacking and further studies and discussion would need to be conducted in order to fully understand the purpose of evacuation routes in Tompkins County.

For the general definition, the County has determined that all State Routes entering and exiting the County are the primary evacuation routes for all municipalities. Each municipality in Tompkins County has at least one State Route crossing through it. Therefore, it is reasonable to assume that this list of routes would be relevant to all municipalities:

- New York State Route 96 (Ulysses, Enfield, Trumansburg)
- New York State Route 79 (Caroline, Ithaca, Enfield)
- New York State Route 34/13 South (Ithaca, Newfield, Enfield)
- New York State Route 13 North (Ithaca, Village of Lansing, Village of Cayuga Heights, Dryden)
- New York State Route 34 North (Ithaca, Lansing)
- New York State Route 96B (Ithaca, Danby)
- New York State Route 38 (Freeville, Groton (T/V))

Care should be taken to ensure evacuation routes work around mapped Special Flood Hazard Areas as this is the area most likely to be affected in a flood hazard event. As flood maps are updated the County will further refine evacuation routes around those areas and develop a strategy for outreach to those residents and employees in this frequently impacted areas. In areas of lower flood risk, there is less of a need for clarification of evacuation routes.

Note all routes are centered around Ithaca and branch out in all directions into all municipalities. Thus, for the City and Town of Ithaca, residents may determine the best route based on their circumstances and location within the City/ Town of Ithaca. Note that because Ithaca is one of the lowest in elevation compared to the surrounding municipalities, in case of flooding, communities that are not in Ithaca are encouraged to head in the opposite direction of Ithaca. At time of any specific emergency, Tompkins County Department of Emergency Response will help to clearly communicate through its Swift911 system and through other formats to the public the safest evacuation route.

Figure 4-16. Potential Evacuation Routes in Tompkins County

4.5 CRITICAL FACILITIES AND COMMUNITY LIFELINES

Critical facilities and infrastructure are essential to the health and welfare of the population and provide services that support the continuation of operations and essential services. The importance of these facilities is realized in the wake of any hazard event. Critical facilities typically include police and fire stations, schools, and emergency operations centers. Critical infrastructure can include the roads and bridges that provide ingress and egress and allow emergency vehicles access to those in need and the utilities that provide water, electricity, and communication services to the community. Also included are Tier II facilities[i] (hazardous materials) and rail yards; rail lines hold or carry significant amounts of hazardous materials with a potential to impact public health and welfare in a hazard event.

Lifelines enable the continuous operation of critical business and government functions and are essential to human health and safety or economic security.

Critical Facilities are those facilities considered critical to the health and welfare of the population and that are especially important following a hazard. As defined for this HMP, critical facilities include essential facilities, transportation systems, lifeline utility systems, high-potential loss facilities, and hazardous material facilities.

Essential facilities are a subset of critical facilities that include those facilities that are important to ensure a full recovery following the occurrence of a hazard event. For the County risk assessment, this category was defined to include police, fire, EMS, schools/colleges, shelters, senior facilities, and medical facilities.

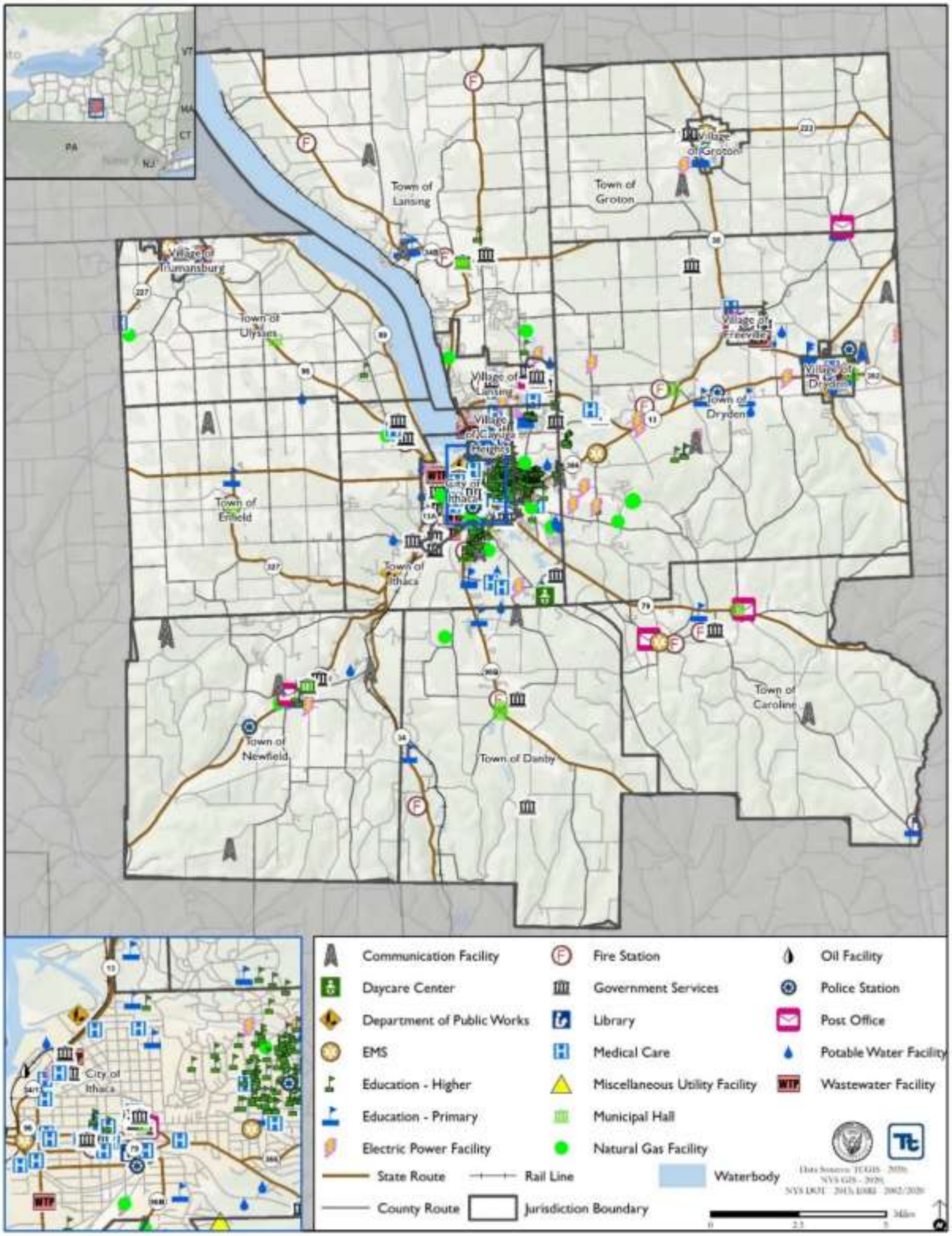
Beginning in 2017, FEMA developed a new construct to increase effectiveness for disaster operations and position response to catastrophic incidents. This construct, known as "**community lifelines**", represents the most fundamental services in the community and for sake of this plan includes critical facilities and infrastructure, that, when stabilized, enable all other aspects of society. Following a disaster event, intervention is required to stabilize community lifelines. Community lifelines are divided by FEMA into seven categories:

- Safety and Security
- Food, Water, Shelter
- Health and Medical
- Energy (Power and Fuel)
- Communications
- Transportation
- Hazardous Materials

To facilitate consistency with the National Response Framework, FEMA Strategic Plan, and guidance for the Building Resilient Infrastructure and Communities grant program, critical facilities in Tompkins County are categorized under the seven lifeline categories. In order to do so, a comprehensive inventory of lifelines and critical facilities in Tompkins County was developed from various sources, including existing inventories of utility facilities, public assets, emergency management facilities, transportation lines/ facilities, and datasets that contain facilities that provide essential services. Additional guidance and input were provided by the Steering and Planning Committees. The County provided a list of critical facilities to each participating jurisdiction for their review and lifeline identification.

The inventory of community lifelines and critical facilities presented in this section represents the current state of this effort at the time of publication of the HMP and used for the risk assessment in Section 5 (Risk Assessment). The number and type of community lifelines and critical facilities identified for this plan are indicated in Figure 4-17 and summarized in Appendix E (Supplemental Data). A complete listing of the inventory used for analysis in this plan is provided in Appendix F (Critical Facilities).

Figure 4-17. Tompkins County Community Lifelines



4.5.1 Safety and Security

This section provides information on Safety and Security lifelines. Critical facilities in this lifeline category include law enforcement/security, fire service, search and rescue, government services (e.g. EOCs, government offices, schools), and community safety (e.g. dams).

4.5.1.1 Emergency Facilities

Emergency facilities in Tompkins County includes police, fire, EMS, and medical care facilities. Figure 4-18 shows the location of the different emergency facilities located in Tompkins County. The figure shows police, fire, EMS, and medical care facilities.

The Tompkins County Department of Emergency Response is responsible for the following countywide services:

- Oversees emergency dispatch and communications system that allows residents to dial 911 to receive emergency medical, fire, police, or other emergency help from any phone in the County;
- Implements County Mutual Aid and Disaster Plans, which provide fire, emergency medical, and other agency assistance when local services have exceeded their local equipment and personnel resources; and
- Provides emergency medical personnel training in coordination with Tompkins-Cortland Community College and fire training with the NYS Office of Fire Prevention and Control.

Tompkins County emergency information is posted on the TompkinsREADY website (www.tompkinsready.org). Disaster and emergency information is also broadcast from local radio stations: 870AM WHCU, 97.3FM WYXL, and 91.7FM WICB. Tompkins County utilizes a mass notification system, Swift911. Residents can register online to receive important information and announcements (Tompkins County Department of Emergency Response 2020).

Figure 4-18. Emergency Facilities in Tompkins County, New York

4.5.1.2 Schools

Tompkins County is home to seven public school districts, a public charter school, several smaller private schools, and three institutions of higher education, including Cornell University and Ithaca College (NYSED 2020). As of the 2018-2019 school year, the County had 10,484 public school students. This represents a slight decrease from 2012-2013, when there were 10,988 students enrolled in the district. Figure 4-19 shows the locations of public primary schools and schools of higher education throughout the County.

Figure 4-19. Public School Owned Properties in Tompkins County, New York

4.5.1.3 Dams and Levees

Dams

A summary of the dams in the County is presented in this section to provide an awareness of the number and types of these structures within the County and how flood hazards impact these resources. For the purposes of this hazard mitigation plan, dams are not considered critical facilities, as the Steering and Planning Committees recognize that these facilities are covered by other regulatory instruments. These may be further addressed in other components of the Tompkins County Resiliency and Recovery Plan.

According to the NYSDEC Division of Water Bureau and Flood Protection and Dam Safety, there are three hazard classifications of dams in New York State. The dams are classified in terms of potential for downstream damage if the dam were to fail. The hazard classifications are as follows:

- *Low Hazard (Class A)* is a dam located in an area where failure will damage nothing more than isolated buildings, undeveloped lands, or township or county roads and/or will cause no significant economic loss or serious environmental damage. Failure or operation problems would result in no probable loss of human life. Losses are principally limited to the owner's property.
- *Intermediate Hazard (Class B)* is a dam located in an area where failure could damage isolated homes, main highways, and minor railroads; interrupt the use of relatively important public utilities; and cause significant economic loss or serious environmental damage. Failure or operation problems would result in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or impact other concerns. Class B dams often are located in predominantly rural or agricultural areas but also can be located in areas with population and significant infrastructure.
- *High Hazard (Class C)* is a dam located in an area where failure might cause loss of human life; serious damage to homes, industrial, or commercial buildings; important public utilities; main highways or railroads; and extensive economic loss. This is a downstream hazard classification for dams in which excessive economic loss (urban area including extensive community, industry, agriculture, or outstanding natural resources) would occur as a direct result of dam failure.

The New York State Inventory of Dams, identifies 96 dams in Tompkins County: 26 low hazard, 4 Class B intermediate hazard dams, 5 Class C high hazard[ii], 11 negligible or no hazard classification, and 51 with an unknown classification (NYS DEC 2021). Figure 4-20 shows the location of dams in the County. Table 4-8 provides the list of dams located in Tompkins County and associated information.

Each of the regularly updated Emergency Action Plans (EAPs) for the High Hazard Dams are filed in the office of the Tompkins County Department of Emergency Response. Each of 5 High Hazard dams have similar concerns, regular tracking of maintenance needs to ensure they operate as intended. Regular maintenance issues are identified and addressed through the New York State Department of Environmental Conservation's [Inspection and Maintenance] requirements. An issue of recent concern relates to the historic silt build up at dams and their related infrastructure. The City of Ithaca's dams most notably now require a significant amount of dredging to return them to their intended function. The City most likely will need to seek outside funding to help dredge the Silt Dam that feeds the 60' dam and the City's drinking water. Due to the importance of this critical infrastructure and the heavy financial burden associated with their operation and maintenance the City, County and Town of Danby (Jennings Pond) to integrate policies to support maintenance and upkeep of dams into both the mitigation plan and connected community planning efforts. The Inundation Maps associated with each of the High Hazard Dam EAPs are a part of confidential Appendix K.

Figure 4-20 Location of Dams within Tompkins County

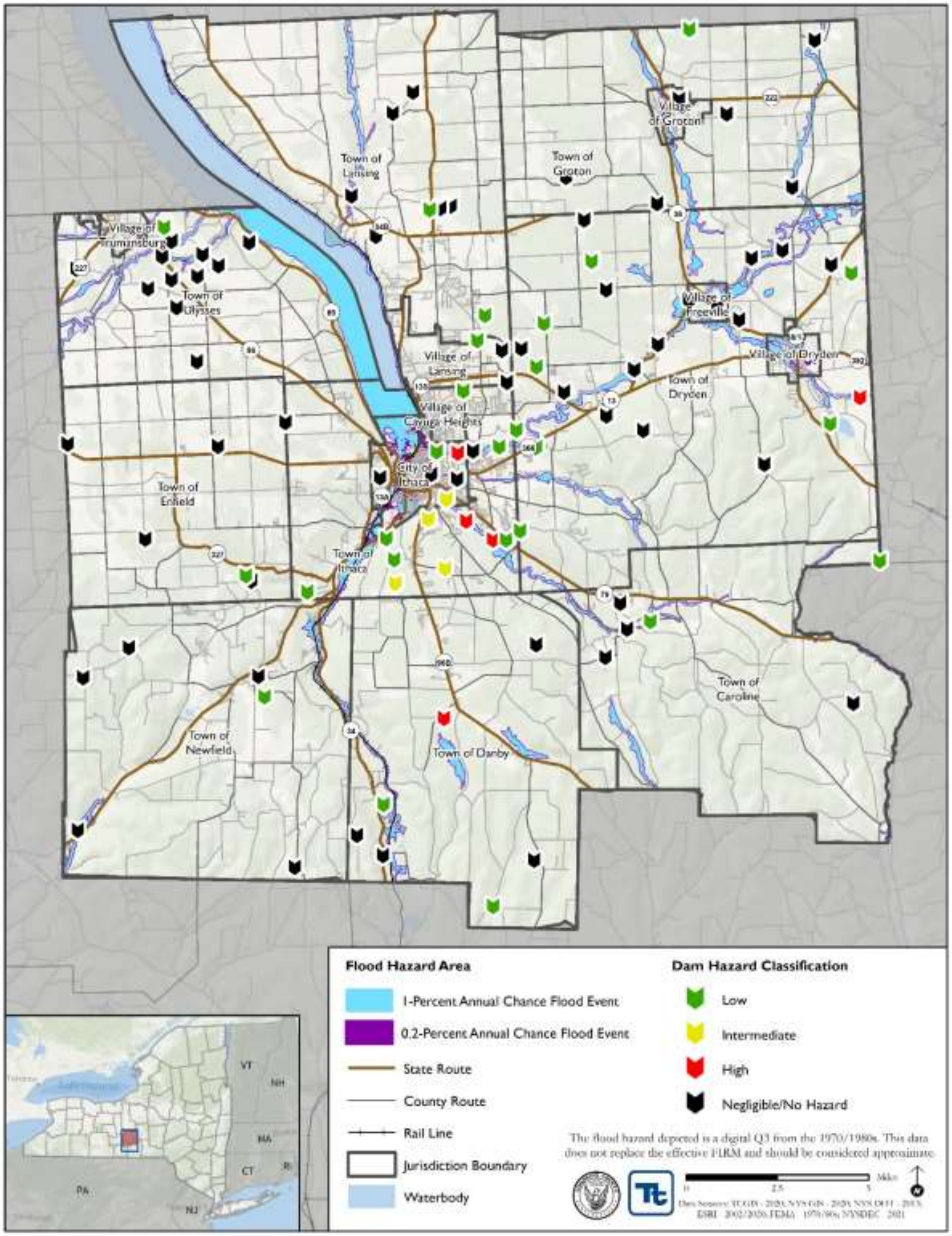


Table 4-8. Dams in Tompkins County

Dam Name	Location	Owner	Purpose	Classification	EAP?	Last Inspected	Condition
R C Swartwood Pond Dam	Town of Danby	D JACKSON COLEMAN	Recreation	Class A - Low Hazard	None	9/21/1987	Not Rated
R.h. Tremans Dam	Not Found	NYS PARKS & RECREATION FINGER LAKES	Recreation	Class A - Low Hazard	None	10/4/1995	Not Rated
Dave Austin Pond Dam	Not Found	DAVID AUSTIN	Recreation	Class A - Low Hazard	None	4/27/1999	Not Rated
Lower Buttermilk Dam	Not Found	MRS N VANORMAN	Other	Class A - Low Hazard	None	12/31/1901	Not Rated
Buttermilk Falls State Park Dam	Not Found	NYS PARKS & RECREATION FINGER LAKES	Recreation	Class A - Low Hazard	None	11/18/1976	Not Rated
Enfield Glen Dam	Town of Enfield	NYS PARKS & RECREATION FINGER LAKES	Recreation	Class A - Low Hazard	None	10/19/1989	Not Rated
Groton Water Supply Dam	Not Found	VILLAGE OF GROTON	Water Supply - Secondary	Class A - Low Hazard	None	5/9/1984	Not Rated
Moseley Cider Press Dam	Not Found	OTTIS MOSELEY	Hydroelectric	Class A - Low Hazard	None	11/19/1976	Not Rated
Cornell University Wildlife Pond #1 Dam	Not Found	CORNELL UNIVERSITY	Other	Class A - Low Hazard	None	7/31/1980	Not Rated
Halseyville Road Pond Dam	Village of Trumansburg	ROBERT BROWN	Recreation	Class A - Low Hazard	None		Not Rated
Camp Badger Dam	Town of Danby	EMPIRE STATE SPEECH & HEARING CLINIC	Recreation	Class A - Low Hazard	None	7/23/1991	Not Rated
College Of Agriculture Cornell Dam	Not Found	CORNELL UNIVERSITY	Other	Class A - Low Hazard	None	9/19/1969	Not Rated
Tompkins County Dam	Not Found	TOMPKINS COUNTY	Recreation	Class A - Low Hazard	None	12/31/1901	Not Rated
Fall Creek Dam	City of Ithaca	CITY OF ITHACA	Other	Class A - Low Hazard	None	11/27/2019	Not Rated
Dryden Lake Outlet Dam	Not Found	NYS DEC - DIVISION OF FISH AND WILDLIFE	Recreation	Class A - Low Hazard	None	8/13/2020	Not Rated
Dwyer Dam	Not Found	CORNELL UNIVERSITY	Other	Class A - Low Hazard	None	7/31/1980	Not Rated
Ithaca Dam	Not Found	CITY OF ITHACA	Other	Class A - Low Hazard	None	10/16/2001	Not Rated
Fred A Annis Dam	Town of Caroline	FRED A ANNIS	Hydroelectric	Class A - Low Hazard	None	11/19/1976	Not Rated

Dam Name	Location	Owner	Purpose	Classification	EAP?	Last Inspected	Condition
Roger A Morse Dam	Not Found	ROGER A MORSE	Other	Class A - Low Hazard	None	12/31/1901	Not Rated
Cornell University Dam	Not Found	CORNELL UNIVERSITY	Water Supply - Primary	Class A - Low Hazard	None	12/31/1901	Not Rated
Arthur Prince Dam	Not Found	ARTHUR PRINCE	Recreation	Class A - Low Hazard	None	10/29/1968	Not Rated
Varna Pond Dam	Not Found	Not Found	Other	Class A - Low Hazard	None	6/23/1998	Not Rated
Cornell University Pond #2 Dam	Not Found	CORNELL UNIVERSITY	Other	Class A - Low Hazard	None	11/19/1976	Not Rated
Robert Carrier Dam	Not Found	ROBERT CARRIER	Recreation	Class A - Low Hazard	None	12/31/1901	Not Rated
Lansing Residential Facility Dam	Not Found	NY State Dam Limited Partnership	Other	Class A - Low Hazard	None		Not Rated
Tri-County Pond Dam	Town of Caroline	NYS DEC DIVISION OF LANDS & FORESTS	Recreation	Class A - Low Hazard	None	7/3/2009	Not Rated
Treman Lake Dam	Town of Ithaca	NYS PARKS & RECREATION FINGER LAKES	Recreation	Class B - Intermediate Hazard	On File	11/26/2018	Unsound - More Analysis needed
Van Natta Dam	Town of Ithaca	CITY OF ITHACA	Other	Class B - Intermediate Hazard	None	7/13/2017	Unsound - More Analysis needed
Beacon Hills Village Dam	Town of Ithaca	HOSPICARE FOUNDATION	Recreation	Class B - Intermediate Hazard	On File	7/13/2017	Not Rated
South Hill Pond Dam	Town of Ithaca	ITHACA COLLEGE	Flood Control and Storm Water Management	Class B - Intermediate Hazard	On File	7/13/2017	No deficiencies noted
Jennings Pond Dam	Town of Danby	NYS PARKS & RECREATION FINGER LAKES	Recreation	Class C - High Hazard	On File	11/26/2018	Unsound - Fair
Beebe Lake Dam	Town of Ithaca	CORNELL UNIVERSITY	Hydroelectric, Recreation	Class C - High Hazard	On File	9/1/1983	Not Rated
30 Foot Dam	Town of Ithaca	CITY OF ITHACA	Recreation	Class C - High Hazard	On File	11/26/2018	Unsound - More Analysis needed
60 Foot Dam	Town of Ithaca	CITY OF ITHACA	Water Supply - Primary	Class C - High Hazard	On File	11/26/2018	Unsound - Deficiency Recognized
Virgil Creek Watershed Floodwater Dam	Town of Dryden	TOMPKINS COUNTY DEPARTMENT OF PLANNING, Town of Dryden, Village of Dryden	Flood Control and Storm Water Management	Class C - High Hazard	On File	11/26/2018	No deficiencies noted

Dam Name	Location	Owner	Purpose	Classification	EAP?	Last Inspected	Condition
Newfield Mills Dam	Town of Newfield	JENNIE DOANE	Other	Class D - Negligible or No Hazard	None	11/16/1976	Not Rated
Owasco Inlet Dam	Not Found	OTTO PETERMANN	Recreation	Class D - Negligible or No Hazard	None	12/31/1901	Not Rated
Mclean Mill Dam	Not Found	MCLEAN MILLING COMPANY	Other	Class D - Negligible or No Hazard	None	11/18/1976	Not Rated
Red Mill Dam	Not Found	WILLIAM REYNOLDS	Other	Class D - Negligible or No Hazard	None	11/18/1976	Not Rated
Howser Dam	Not Found	Not Found	Other	Class D - Negligible or No Hazard	None	11/18/1976	Not Rated
Cayuga Rock Salt Company Inc Dam	Not Found	CAYUGA ROCK SALT COMPANY INC	Hydroelectric	Class D - Negligible or No Hazard	None	1/7/2003	Not Rated
Halseyville Dam	Not Found	W W STEBBINS	Irrigation	Class D - Negligible or No Hazard	None	10/1/1976	Not Rated
Saw Mill Dam	Town of Newfield	CHARLES SWARTWOOD	Other	Class D - Negligible or No Hazard	None	11/16/1976	Not Rated
White Mill Dam	Town of Caroline	JOHN M WHITE	Hydroelectric	Class D - Negligible or No Hazard	None	11/19/1976	Not Rated
C W Vohris Dam	Town of Caroline	Not Found	Other	Class D - Negligible or No Hazard	None	11/19/1976	Not Rated
Upper Brookton Dam	Not Found	Not Found	Other	Class D - Negligible or No Hazard	None	11/18/1976	Not Rated
Henry Welch Pond Dam	Town of Enfield	HENRY WELCH	Other	Unknown	None	12/31/1901	Not Rated
Artificial Breeders Assoc Dam	Not Found	ARTIFICIAL BREEDERS ASSOCIATION	Other	Unknown	None	12/31/1901	Not Rated
Delmar Hammond Pond Dam	Town of Ulysses	DELMAR HAMMOND	Other	Unknown	None	12/31/1901	Not Rated
Connecticut Hill Pond #2 Dam	Town of Newfield	NYS DEC	Recreation	Unknown	None	12/31/1901	Not Rated
Art Manninen Pond Dam	Town of Newfield	ART MANNINEN	Recreation	Unknown	None	12/31/1901	Not Rated

Dam Name	Location	Owner	Purpose	Classification	EAP?	Last Inspected	Condition
Connecticut Hill Pond #3 Dam	Town of Newfield	NYS DEC	Recreation	Unknown	None	12/31/1901	Not Rated
R C Bald Pond Dam	Town of Enfield	R C BALD	Recreation	Unknown	None	12/31/1901	Not Rated
Don Makie #5 Pond #2 Dam	Town of Danby	DON MAKIE	Recreation	Unknown	None	12/31/1901	Not Rated
Campfire Girls Dam	Town of Enfield	CAMPFIRE GIRLS	Recreation	Unknown	None	12/31/1901	Not Rated
Enfield Falls Dam	Town of Enfield	NYS PARKS & RECREATION FINGER LAKES	Other	Unknown	None	11/17/1976	Not Rated
Ithaca Flood Control Dam	Not Found	CITY OF ITHACA	Flood Control and Storm Water Management	Unknown	None	12/31/1901	Not Rated
Clarence Becker Dam	Town of Danby	CLARENCE BECKER	Other	Unknown	None	12/31/1901	Not Rated
Langdon & Son Dam	Not Found	M LANGDON & SON	Hydroelectric	Unknown	None	12/31/1901	Not Rated
Groton Reservoir Dam	Not Found	VILLAGE OF GROTON	Water Supply - Secondary	Unknown	None	12/31/1901	Not Rated
Ray L Teeter Dam	Not Found	RAY L TEETER	Hydroelectric	Unknown	None	12/31/1901	Not Rated
Freeville Dam	Not Found	VILLAGE OF FREEVILLE	Other	Unknown	None	12/31/1901	Not Rated
Martin Beck Pond Dam	Not Found	MARTIN BECK	Recreation	Unknown	None	12/31/1901	Not Rated
Robert Burbridge Pond Dam	Not Found	ROBERT BURBRIDGE	Other	Unknown	None	12/31/1901	Not Rated
Howard Adams Pond Dam	Not Found	HOWARD ADAMS	Recreation	Unknown	None	12/31/1901	Not Rated
Kingdom Pond Dam	Not Found	Not Found	Other	Unknown	None	12/31/1901	Not Rated
Gira Mill Dam	Not Found	SAM LANE	Other	Unknown	None	12/31/1901	Not Rated
Nys Electric & Gas Company Dam	Town of Ulysses	NEW YORK STATE ELECTRIC & GAS CORPORATION	Other	Unknown	None	12/31/1901	Not Rated
Halsey Farms Pond Dam #2	Town of Ulysses	HALSEY FARMS	Other	Unknown	None	12/31/1901	Not Rated
R D Murphey Pond Dam	Town of Ulysses	R D MURPHEY	Other	Unknown	None	12/31/1901	Not Rated

Dam Name	Location	Owner	Purpose	Classification	EAP?	Last Inspected	Condition
Rolf Holtkamp Pond Dam	Town of Ulysses	ROLF A HOLTKAMP	Other	Unknown	None	12/31/1901	Not Rated
Halsey Farms Pond Dam #1	Town of Ulysses	HALSEY FARMS	Other	Unknown	None	12/31/1901	Not Rated
Halsey Farms Pond Dam #3	Town of Ulysses	HALSEY FARMS	Other	Unknown	None	12/31/1901	Not Rated
Arthur Millspaugh Pond Dam	Town of Ulysses	ARTHUR MILLSPAUGH	Recreation	Unknown	None	12/31/1901	Not Rated
H D Besemer Dam	Not Found	H D BESEMER	Other	Unknown	None	12/31/1901	Not Rated
James Stevenson Pond Dam	Town of Ulysses	JAMES STEVENSON	Other	Unknown	None	12/31/1901	Not Rated
Max Furman Pond Dam	Town of Ulysses	MAX FURMAN	Recreation	Unknown	None	12/31/1901	Not Rated
B W Bloom Pond Dam	Not Found	B W BLOOM	Recreation	Unknown	None	12/31/1901	Not Rated
College Of Agriculture Cornell Dam	Not Found	CORNELL UNIVERSITY	Other	Unknown	None	12/31/1901	Not Rated
Dr Joseph Frost Dam	Not Found	THOMAS B KEANE	Other	Unknown	None	12/31/1901	Not Rated
Cornell University Pond #4 Dam	Not Found	CORNELL UNIVERSITY	Other	Unknown	None	12/31/1901	Not Rated
Cornell University Pond #5 Dam	Not Found	CORNELL UNIVERSITY	Other	Unknown	None	12/31/1901	Not Rated
State Land Tompkins #4 Dam	Town of Caroline	NYS DEC	Other	Unknown	None	12/31/1901	Not Rated
Walter Arsenault Pond Dam	Town of Caroline	WALTER ARSENAULT	Recreation	Unknown	None	12/31/1901	Not Rated
Margaret Baker Dam	Not Found	MARGARET BAKER	Fire Protection, Stock, Or Small Farm Pond	Unknown	None	12/31/1901	Not Rated
Barton Miller Farms Dam	Not Found	D W BARTON	Other	Unknown	None	12/31/1901	Not Rated
Etna Dam	Not Found	ROLLER MILLS	Hydroelectric	Unknown	None	12/31/1901	Not Rated
H J Bool Co Dam	Not Found	H J BOOL COMPANY	Water Supply - Primary	Unknown	None	12/31/1901	Not Rated
William Hazlett Smith Dam	Not Found	WILLIAM HAZLETT SMITH	Other	Unknown	None	12/31/1901	Not Rated

Dam Name	Location	Owner	Purpose	Classification	EAP?	Last Inspected	Condition
Sapsucker Woods Pond Dam	Not Found	CORNELL UNIVERSITY	Other	Unknown	None	12/31/1901	Not Rated
Hemmo Huttunen Dam	Town of Danby	HEMO HUTTUNEN	Recreation	Unknown	None	12/31/1901	Not Rated
James E Johnson Jr Dam	Town of Danby	JAMES E JOHNSON	Recreation	Unknown	None	12/31/1901	Not Rated
John Lopinto Pond Dam	Not Found	JOHN LOPINTO	Recreation	Unknown	None	12/31/1901	Not Rated
Groton Rod & Gun Club Pond Dam	Not Found	GROTON ROD & GUN CLUB	Recreation	Unknown	None	12/31/1901	Not Rated
George Junior Republic Dam	Not Found	GEORGE JUNIOR REPUBLIC	Recreation	Unknown	None	12/31/1901	Not Rated
Ben Gebhart Pond Dam	Not Found	BEN GEBHART	Recreation	Unknown	None	12/31/1901	Not Rated
Kingdom Farm Dam	Not Found	Not Found	Other	Unknown	None	12/31/1901	Not Rated

Source: NYS DEC 2021

Levees

Within Tompkins County, there is one NYSDEC levee and floodwall system in place intended to reduce flood risk in historically flood vulnerable areas. Basic information on the systems in the County was gathered to integrate components of the levee accreditation process with this HMP and identify ways the hazard mitigation process can help to establish a path forward for the levee accreditation process. The system in Ithaca County is the City of Ithaca's Ithaca Flood Damage Reduction Project located on the Cayuga Inlet. The system provides three miles of improved channel and was constructed in the late-1960s. The project was then rectified in 1977-1978 and rehabilitated in 1997. Dredging is currently planned in the flood control channel and Inlet in order to maintain the levee's accreditation that it performs its flood control function as is designed.

Information from a combination of the National Levee Database (NLD), FEMA Flood Mapping Products website, NYSDEC Region 7 project details and maps website, and the United States Geological Survey StreamStats website was compiled and presented in the following tables that present summaries of the levee system features and associated risks. Table 4-8 through Table 4-10 data about levee systems collected from the NLD and FEMA. Figure 4-21 shows levee locations as well as the area which benefits from some degree of protection from the system, or the levee area.

Table 4-9. Levee System Feature Information from the NLD in Tomkins County, New York

System	Year Complete	Levee (miles)	Floodwall (miles)	Pump Stations (#)	Gravity Drains (#)	Closures (#)
Ithaca Flood Damage Reduction Project	1970	0.86	0	N/A	N/A	2 (Left bank) N/A

Source: U.S. Army Corps of Engineers, 2020

Table 4-10. Levee System Risk Information from the NLD in Tompkins County, New York

System	LSAC*	Overtopping ACE**	People at Risk	Structures at Risk	Property Value
Ithaca Flood Damage Reduction Project	Low	0.0002	621	132	$57.5M

Source: U.S. Army Corps of Engineers, 2020. Includes both left and right bank projects.
*** LSAC - Levee Safety Action Classification Rating by the U.S. Army Corps of Engineers*
***ACE - Annual Chance Exceedance*

Table 4-11. Levee System FEMA Accreditation in Tompkins County, New York

Levee System Name	Effective FIS ID	Total Length (miles)	Leveed Area (sq. miles)	Levee System Summary in NLD	Levee System Accreditation Status*
Ithaca Flood Damage Reduction Project	360851V000	0.86	0.34	YES	Accredited

** Based on data from the National Levee Database*

Figure 4-21. Levees in the City and Town of Ithaca

4.5.2 Food, Water, and Shelter

This section provides information on Food, Water, and Shelter lifelines. Critical facilities of this lifeline category include food (e.g. commercial food distribution and supply chain, food distribution programs), water (e.g. water utilities, wastewater systems), shelter, and agriculture.

4.5.2.1 Potable Water

Potable water in Tompkins County is derived from the County's surface and ground water resources. Figure 4-21 shows the distribution of potable water supplies across Tompkins County.

Surface Water

More than half of County residents obtain water from three facilities that draw from the surface waterways of Cayuga Lake, Fall Creek, and Six Mile Creek. Drinking water for approximately 55 percent of Tompkins County residents comes from the three water treatment facilities that rely on surface water: Bolton Point, which draws its water from Cayuga Lake; the Cornell Water Filtration Plant, which draws from Fall Creek; and the City of Ithaca Water Treatment Plant, which uses water from Six Mile Creek. Many homes also withdraw their drinking water directly from Cayuga Lake for their personal use. Private wells number in the thousands and are found throughout the County. There are eight municipal water supply systems in the County—three of which supply water to municipalities outside of the respective municipal boundary. The Southern Cayuga Lake Intermunicipal Water Commission manages Bolton Point and is owned by a five-municipality consortium of the Towns of Lansing, Ithaca, Dryden, and the Villages of Cayuga Heights and Lansing (Tompkins County Comprehensive Plan 2015).

Ground Water

While more than half of County residents rely on surface water sources, about 45 percent of County residents rely on groundwater sources. The Villages of Dryden, Groton, Trumansburg and hamlets of Newfield and West Danby utilize groundwater sources and have municipal water systems (Tompkins County Comprehensive Plan 2015). There are approximately 150 public water systems that use groundwater. Note that some of these water systems are cross jurisdictional and are not necessarily owned by each individual municipality.

4.5.2.2 Wastewater Facilities

Source: Tompkins County Planning Department

Households and businesses in Tompkins County are served by both municipal sewer and, privately-owned septic systems. As of 2015, approximately 60~~%~~ percent of households are served by municipal sewer and 40 percent are served by privately-owned septic systems. The County is home to seven municipal wastewater treatment facilities serving 11 municipalities. Three systems serve customers outside of municipal boundaries. One system, the Ithaca Area Wastewater Treatment Facility, is owned, operated, and serves the City and Town of Ithaca and the Town of Dryden. Treatment wastewater is discharged to the various waterways in the County, including Trumansburg Creek, Owasco Inlet, Fall Creek, Six Mile Creek and Cayuga Lake. All discharges are regulated by the New York State Pollutant Discharge Elimination System. Table 4-11 includes the different sewer service areas located in the County and Figure 4-22 shows the location of potable water facilities in the County and Figure 4-23 shows the location of wastewater facilities in the County.

Table 4-12. Sewer Service Areas in Tompkins County, New York

Area Name	Wastewater Treatment Plant	Area (Acres)
City of Ithaca/ Town of Ithaca/ Town of Dryden	Ithaca Waste Water Treatment	NA
Cayuga Heights	Cayuga Heights Sewage Plant	NA
Trumansburg	Trumansburg Sewage Treatment	NA
Dryden (V)	Dryden Village Sewage Treatment	NA
Groton (V)	Groton Sewer Treatment Plant	NA
Newfield	Newfield Sewage Treatment Plant	NA

Source: Tompkins County Comprehensive Plan

Figure 4-22. Potable Water Facilities in Tompkins County

Figure 4-23. Wastewater Facilities in Tompkins County

4.5.2.3 Shelters

Due to the variable nature of hazard events and associated sheltering needs within the County, Tompkins County relies on real-time outreach methods to inform the public of pending and active evacuations, and available sheltering resources. Outreach methods include variable message sign boards, media (radio, television, and newspapers), social media, and Swift911 emergency mass notification system. The American Red Cross is responsible for emergency shelter operations in Tompkins County and maintains a list of potential shelter facilities. What facility is used as a shelter will depend on the type of event and sheltering needs. To prevent confusion during a disaster event, a list of American Red Cross shelters is not provided in the plan, however an updated list is maintained by the Department of Emergency Response and as updated is shared with the Hazard Mitigation Coordinator. As FEMA FIRMs are updated in 2021-22 and floodplain boundaries are identified this shelter list will be examined against those boundaries. If appropriate changes to shelter locations or mitigations to specific buildings may be proposed. Furthermore, each shelter will be examined in detail with the American Red Cross to ensure the space is accessible to a broad range of users, in particular those most vulnerable.

In addition to the American Red Cross shelters, each municipality specified designated areas that would provide temporary shelter in the case of an emergency. Many of these include heating and cooling centers. Please refer to each municipality's capability assessment (Section 9 – Jurisdictional Annexes) for further information on detailed sheltering provisions within Tompkins County.

4.5.3 Health and Medical

This section provides information on Health and Medical community lifelines. Critical facilities included in this lifeline include medical care (e.g. hospitals, pharmacies, long-term care facilities), patient movement (e.g. EMS), fatality management, public health, and medical supply chain.

Tompkins County's public health preparedness vision is to be a community resilient to the health impacts of emergencies and disasters.

4.5.3.1 Hospitals and Medical Centers

There is a broad base of hospitals and medical centers located throughout Tompkins County to serve the needs of our residents. In addition to two primary emergency receiving hospitals, there are multiple local walk-in urgent care centers and satellite hospital facilities that provide services in a more regionally based approach to medical care. In today's changing medical services environment, large health care networks and group medical practices provide the majority of services needed by our population of nearly 102,000 residents, plus Tompkins County is home to three institutions of higher education: Cornell University, Ithaca College and Tompkins Cortland Community College with a combined population of just over 27,000 students.

Cayuga Medical Center, 101 Dates Dr, Ithaca, NY 14850, is an acute-care medical center housing 212 beds. Cayuga Medical Center at Ithaca, 2333 N Triphammer Rd # 302, Ithaca, NY 14850, is an acute-care medical center.

Cayuga Medical Center is a New York State Department of Health certified Stroke Center. They are designated as a Comprehensive Community Cancer Center by the National Cancer Institute and have received the prestigious Patient Safety Award from the NYS Department of Health. Their corporate membership includes representatives from over 100 community organizations and is affiliated with 24 teaching institutions.

4.5.3.2 Emergency Medical Services

Bangs Ambulance is an Advanced Life Support Service responding to emergency calls in Ithaca and many other communities within Tompkins County. They provide emergency inter-facility transports, non-emergency ambulance calls, paramedic "Fly Car" intercept, EMS coverage for events, and public education. They operate as a fee-for-service practice.

4.5.3.3 Volunteer Ambulance Services

Some towns within Tompkins County have their own ambulance services to better serve the emergent medical needs of their community. They are, Groton Fire & Ambulance Dept; Dryden Ambulance; and Trumansburg Ambulance who provides EMS protection services to Village of Trumansburg, the Town of Ulysses, the Town of Covert, and parts of the towns of Hector. These volunteers are trained as Basic Life Support (BLS) or Advanced Life Support (ALS) through New York State protocols. Mutual aid and air ambulance services are also available through our 911 system, when needed.

4.5.3.4 Mental Health

Tompkins County offers an extensive range of Mental Health Services, with two Behavioral Services units at Cayuga Medical Center. The Tompkins County Health Department will coordinate the response to community mental health needs during emergencies and disasters.

4.5.3.5 Emergency Support Function (ESF) #8

Public Health and Medical Services Core Capabilities in the Emergency Operations Center (EOC): Public Health, Healthcare, and Emergency Medical Services, Fatality Management Services, Mass Care Services, Critical Transportation, Public Information and Warning, Environmental Response/Health and Safety, Logistics and Supply Chain Management Coordinates the mechanisms for assistance in response to an actual or potential public health and medical disaster or incident. Functions include but are not limited to: • Public health • Medical surge support including patient movement • Behavioral health services • Mass fatality management.

4.5.3.6 Fatality Management Services

Cayuga Medical Center (CMC) has a morgue capacity of eight, plus there are forty-one funeral homes, each with cooler capacity. Other options, such as refrigerated trailers, would be considered if necessary. Tompkins County has two medical examiners, Beth Plocharczyk, MD, MPH, FCAP, and Daniel Sudilovsky, MD, FCAP. Currently, a Mass Fatality Plan for Tompkins County is being created.

4.5.3.7 Medical Supply Chain

During day-to-day normal activities, EMS, hospitals, and other departments and agencies have their own medical supplier to fill their requests. During times of great need, such as a pandemic, departments and agencies may need to request Personal protective equipment (PPE) and other supplies from logistics in the Tompkins County EOC.

4.5.4 Energy (Power and Fuel)

This section provides information on Energy community lifelines. Critical facilities included in this lifeline include power grid (e.g. generation systems, transmission systems) and fuel (e.g. fuel storage, pipelines). Figure 4-24 shows the energy lifelines throughout Tompkins County.

4.5.4.1 Energy Resources

Electric power for Tompkins County is primarily provided by New York State Electric & Gas (NYSEG), however, NYSEG electric service is provided via overhead transmission lines with minimal undergrounding of lines. Cornell University's Combined Heat and Power (CHP) and Cooling Plant provides Cornell's Ithaca campus with efficient heating, cooling, and electricity. A 7.5 MW campus CHP plant has delivered heating and electricity to campus buildings since 1922. In 2000, Cornell's Lake Source Cooling system draws water from Cayuga Lake through a closed loop system and provide cooling options to many campus facilities. In 2008, the campus completed an expansion of its existing CHP facility, adding 30 MW of additional capacity and replacing coal with natural gas as the primary fuel. Beyond the CHP plant at Cornell, there are no in-county electricity generating plants beyond those that produce renewable energy, such as solar installations. Groton is served by a Municipal Utility for electric service. New York State Electric & Gas provides natural gas service throughout the entirety of the County.

NYSEG provides natural gas service throughout the entirety of the County, where pipelines exist. In rural areas where there are no pipelines, residents rely on propane and fuel oil for space and water heating. Safe, reliable access to these fuels is important to maintain for much of the population during hazard events. Figure 4-24 shows the location of electric power facilities within Tompkins County

There are a total of 175 pipeline stream crossings in Tompkins County that carry either combustible gas, combustible liquids, or non-hazardous liquids. Reduced integrity of these pipelines can sometimes result in water supply contamination. This concern was identified in the 2014 HMP, and as such, the 2016 Tompkins County Inventory of Erosion Hazards at Pipeline Crossings, was developed with funding from the US Department of Transportation Pipeline and Hazardous Material Safety Administration (PHMSA). 19 of the pipelines of greatest concern have been reviewed and 5 crossings were selected for active tracking and mitigation solutions. Based on subsequent field visits in 2020, pipeline owners constructed the recommended mitigation solution on one those crossings. The remaining 4 crossings appear stable and will continue to be monitored for exposure.

In addition, Dominion Energy owns and operates a natural gas network with a natural gas main traversing the Town of Dryden.

Figure 4-24. Electric Power Facilities within Tompkins County

4.5.5 Communications

This section provides information on Communication lifelines. Critical facilities that fall under this lifeline include infrastructure (e.g. wireless, broadcast, cable systems); alerts, warnings and messages (e.g. local alert/warning ability, access to IPAWS); finance; and 911 and dispatch. Figure 4-25 shows the location of communication lifelines throughout Tompkins County.

Access to telecommunications services vary widely throughout Tompkins County. Existing density requirements for broadband, set by the New York State Public Service Commission, complicate efforts to provide extensions of telecommunication services to less-populated areas of the County. In particular, the southern and northern sections of the County (including large sections of Newfield, Danby, and Caroline) lack broadband altogether. A 2012 survey of underserved households in the County found that nearly 43% of households lack broadband. A current County study is underway to further clarify broadband coverage in Tompkins County. Where broadband is available, it is typically provided by Charter Spectrum, Haefele. Fiber is available in the vicinity of the City of Ithaca. The Ontario & Trumansburg Telephone Companies also provide internet and fiber service to portions of the County, including Trumansburg.

Figure 4-25. Communication Facilities within Tompkins County

4.5.6 Transportation Systems

This section provides information on Transportation lifelines. Critical facilities under this category include: highway/roadway/motor vehicle; mass transit; railway; aviation; and maritime. Tompkins County has a robust transportation network consisting of 1,400 miles of roadways, 200 bridges, and various services to connect destinations within the County as well as those outside the County. Figure 4-26 shows the transportation facilities in Tompkins County.

4.5.6.1 Highway, Roadways and Associated Systems

The New York State Department of Transportation maintains 15 state highways that pass through the County. The County does not have U.S. highways or interstates that pass through the County. Major routes include Route 13 (which roughly bisects the County diagonally and connects Ithaca to Cortland), Route 79 which traverses the County to Trumansburg via Route 96, and Route 34 (which travels the boundary in a north-south direction, connecting south to Spencer and north to Auburn. The closest interstate is Interstate 81, which passes just outside of the County boundary through adjacent Cortland County. The Tompkins County Department of Public Works is responsible for maintaining more than 300 miles of County roads.

4.5.6.2 Airports and Heliports

Tompkins County has six public and private airports as of March 2020. The County's major public airport is the Ithaca Tompkins (ITH) International Airport. In 2020, the airport is anticipated to begin receiving international general aviation flights following a $34.8 million upgrade. The airport receives flights from American Airlines, United Airlines, and Delta Airlines. American Airlines provides non-stop service to Philadelphia, United Airlines provides nonstop service to Washington-Dulles International Airport, and Delta Airlines provides service to Detroit.

4.5.6.3 Bus and Other Transit Facilities

Greyhound, Shortline, Ourbus, Cornell's Campus-to-Campus (Ithaca-NYC) service and other regional transit partners provide bus service to and from the County. According to the 2040 Long Range Transportation Plan, W, Tompkins Consolidated Area Transit (TCAT) provides robust bus service for 4.1 million riders as of 2013 and operates in every town in Tompkins County. TCAT contracts with GADABOUT Transportation Services, Inc. for demand responsive paratransit service required by the Americans with Disabilities Act (ADA paratransit). Nearly 62% of Tompkins County residents live within one quarter (¼) mile of a bus route, with 88% for urban and 31% for rural populations. TCAT uses approximately 53 buses to operate service on 33 routes (including one summer-only route and one 'demand and response' route) with a diverse range of schedules for academic year, summer, and yearlong service. TCAT changes its service three times per year and continually analyzes ridership, route timings and service change requests. The principal activity nodes are Downtown Ithaca, Collegetown, Cornell University, and the Shops at Ithaca Mall. TCAT continues to face funding shortfalls for timely bus replacement and operations.

4.5.6.4 Railroad Facilities

The Ithaca Central Railroad is a 48.8-mile long (78.5 km) shortline railroad operating in New York and Pennsylvania that is owned by Norfolk Southern Railway and leased for operations to Watco Transportation Services. The Ithaca Central Railroad extends from Sayre, PA (Norfolk Southern interchange), to Ludllowville, NY (Town of Lansing). Watco began railroad operations on the Ithaca Central Railroad on December 8, 2018, serving its primary customer, the Cargill Cayuga Rock Salt Mine, in Lansing, NY. Watco expects this rail line to handle about 12,000 carloads of freight annually. The railroad has the capability to haul various commodities such as salt, coal, plastics, and magnesium chloride (https://www.watco.com/service/rail/ithaca-central-railroad-ithr/).

Figure 4-26. Transportation Features in Tompkins County, New York

4.5.7 Hazardous Materials

This section provides information on Hazardous Materials lifelines. Critical facilities under this category include: facilities and HAZMAT, pollutants and contaminants. For this 2021 update, hazardous material facilities in Tompkins County includes Superfund, Toxic Release Inventory (TRI) facilities, and NYSDEC bulk storage facilities. Figure 4-27 shows the bulk storage facilities in Tompkins County.

4.5.7.1 HAZMAT Facilities

Superfund is a program administered by the U.S. Environmental Protection Agency (EPA) to locate, investigate, and clean-up hazardous waste sites in the United States. According to EPA, there are no Superfund locations in Tompkins County.

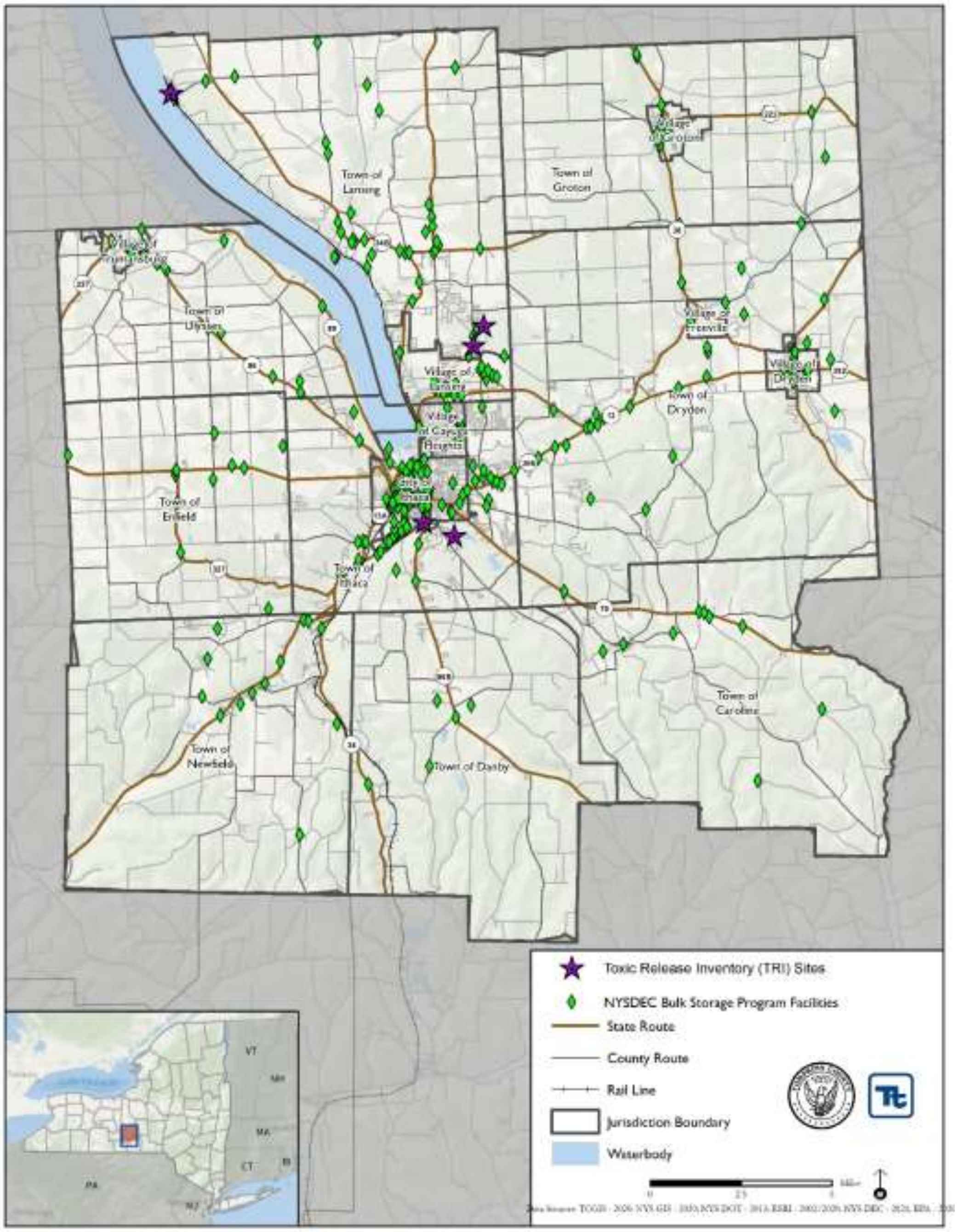
TRI tracks the management of over 650 toxic chemicals that pose a threat to human health and the environment. Facilities in the United States in certain industry sectors that manufacture, process, or otherwise use these chemicals in amounts above established levels must report how each chemical is managed through recycling, energy recovery, treatment, and releases to the environment. A “release” of a chemical means that it is emitted to the air or water or placed in some type of land disposal. The information submitted by facilities to the EPA and states is compiled annually as the Toxics Release Inventory or TRI, and is stored in a publicly accessible database in Envirofacts (https://enviro.epa.gov/enviro/em4ef.home). There are five TRI facilities in Tompkins County.

In addition to the hazardous waste sites listed by the EPA, there are hazardous facilities throughout Tompkins County cataloged by the NYSDEC’s Bulk Storage Program Database. The Bulk Storage Program includes three types of facilities; Petroleum Bulk Storage), Major Oil Storage Facilities, and Chemical Bulk Storage that require registration with NYSDEC for all facilities with a total storage capacity of petroleum products of the following:

- Petroleum Bulk Storage One or more tank systems that are designed to store a combined capacity of more than 1,100 gallons or more of petroleum in aboveground and/or underground storage tanks; or
- One or more underground tank systems that are designed to store 110 or more gallons of petroleum.
- Chemical Bulk Storage An aboveground storage tank larger than 185 gallons;
- Any size underground storage tank; or
- In a container that can store 1,000 kg or more for a period of 90 consecutive days or more.
- Major Oil Storage Facilities Applies to facilities that store a total of 400,000 gallons or more of petroleum in aboveground and underground storage tanks.

As of January 2021, there are 71,270 sites listed in the NYSDEC’s Bulk Storage Program Database, of which, 333 are located in Tompkins County, New York (NYSDEC 2021). This includes 25 chemical bulk storage sites, 2 major oil storage facilities, and 306 petroleum bulk storage sites. A listing of these facility by locality is shown in the figure below.

Figure 4-27. Bulk Storage Facilities in Tompkins County, New York



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[i] As required by Section 312(g), EPA has published two emergency and hazardous chemical inventory forms, Tier I and Tier II, for facilities to report information on hazardous chemicals. The Tier I form contains general information on hazardous chemicals at the facility. The Tier II form contains specific information on hazardous chemicals present at the facility. (NYSDHSES 2021)

[ii] Although the NYDEC database notes that there are 5 high hazard dams in Tompkins County, including the Lake Beebe Dam, according to the Army Corps of Engineers database accessed on June 3, 2021, the Lake Beebe Dam is considered a significant, not high hazard dam. For the purposes of this plan, that dam is included in the inventory as a high hazard dam.

5.1 METHODOLOGY AND TOOLS

2021 HMP Changes

- The Tompkins County Hazard Mitigation Plan will serve as the foundation for the larger, connected Tompkins County Resiliency and Recovery Plan.
- The Tompkins County Hazard Mitigation Plan risk assessment was updated using best available information.
  - New methodology and approaches for the flood and severe storm hazard were employed using Hazus Level 2 analysis to quantify estimated damages as described below.
  - 2014-2018 American Community Survey 5-year estimates were utilized.
  - Building footprints provided by Tompkins County ITS, updated parcels and tax assessor information from the 2019 New York State Public Parcel dataset created by NYS Office of Information Technology Services GIS Program Office (GPO) and NYS Department of Taxation and Finance's Office of Real Property Tax Services (ORPTS), tax assessor information provided by Tompkins County, and RS Means 2019-dollar values were used to develop a structure-level building inventory and estimate replacement cost value for each building.
  - A critical facility list was generated and reviewed by the Steering Committee and Planning Committee (Planning Partnership) which included all County jurisdictions.
  - Lifeline facilities were identified by each jurisdiction to align with FEMA's lifeline categories to enable prioritization of projects that address the protection of these facilities.
  - Hazus was used to estimate potential impacts from the hazards due to flooding and high-wind (severe storm) events.
  - Best available hazard data was used as described in this section.

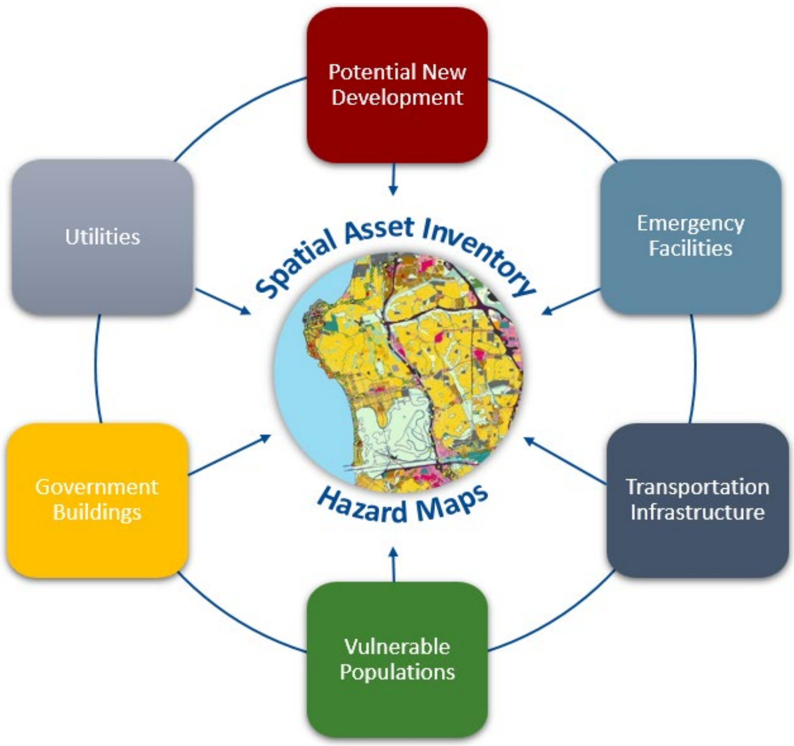
The following summarizes the asset inventories, methodology and tools used to support the risk assessment process.

5.1.1 Asset Inventories

The risk assessment included the collection and use of an expanded and enhanced asset inventory to estimate hazard exposure and vulnerability.

Tompkins County assets were identified to assess potential exposure and loss associated with the hazards of concern. For the HMP update, Tompkins County assessed exposure vulnerability of the following types of assets: population, buildings and critical facilities/infrastructure, new development, and the environment. Some assets may be more vulnerable because of their physical characteristics or socioeconomic uses. To protect individual privacy and the security of critical facilities, information on properties assessed is presented in aggregate, without details about specific individual personal or public properties.

5.1.1.1 Population



Total population statistics from the 2014-2018 American Community Survey 5-year estimate were used to estimate the exposure and potential impacts to the County's population instead of the 2010 U.S. Census block estimates. Population counts at the jurisdictional level were averaged among the residential structures in the County to estimate the population at the structure level. The population statistics from the 2014-2018 American Community Survey 5-year estimates were modified for population exposure to reflect the total population reported for the county of Tompkins; village populations were subtracted from towns populations. This estimate is a more precise distribution of population across the County compared to only using the Census block or Census tract boundaries. Limitations of these analyses are recognized, and thus the results are used only to provide a general estimate for planning purposes.

As discussed in Section 4 (County Profile), research has shown that some populations are at greater risk from hazard events because of decreased resources or physical abilities. Vulnerable populations in Tompkins County included in the risk assessment include children, elderly, population below the poverty level, non-English speaking individuals, and persons with a disability.

5.1.1.2 Buildings

The building stock inventory was updated using County and jurisdiction spatial data. To develop the building inventory, parcels from the Tompkins County ITS and 2019 Tax Assessor data from the NYS GIS Program Office, NYS Department of Taxation and Finance's Office of Real Property Tax Services (ORPTS) were used. Attributes provided from the tax assessor data were used to further define each structure in terms of occupancy class, construction type, year built, foundation type, etc. Default information was used to fill in the gaps for buildings that could not be assigned attributes from the assessor's data or from the data provided by the County and jurisdictions. The centroid of each building footprint was used to estimate the building location. If a building footprint was not located due to limited spatial data, parcels that had assessor's information supporting the presence of a building were given a centroid to represent the location of a structure. Structural and content replacement cost values (RCV) were calculated for each building utilizing available assessor data and RS Means 2019 values; a regional location factor for Tompkins County was applied (0.99 for residential structures and 1.00 for all other structure types). Replacement cost value is the current cost of returning an asset to its pre-damaged condition, using present-day cost of labor and materials. Total replacement cost value consists of both the structural cost to replace a building and the estimate value of contents of a building. The occupancy classes available in Hazus were condensed into the following categories (residential, commercial, industrial, agricultural, religious, governmental, and educational) to facilitate the analysis and the presentation of results. Residential loss estimates address both multi-family and single-family dwellings.

5.1.1.3 Critical Facilities/Community Lifelines

A critical facility inventory, which includes critical essential facilities, community lifelines, utilities, transportation features and user-defined facilities was provided by the Tompkins County ITS Office and was reviewed by the Planning Partnership and County jurisdictions. The review involved an evaluation for accuracy, additions or deletions of new/moved critical assets, identification of backup power for each asset (if known) and whether the facility is considered a lifeline in accordance with FEMA's definition (see inset); refer to Appendix E (Risk Assessment Supplement). To protect individual privacy and the security of assets, information is presented in aggregate, without details about specific individual properties or facilities.

> A **lifeline** provides indispensable service that enables the continuous operation of critical business and government functions, and is critical to human health and safety, or economic security (FEMA).

5.1.1.4 Environment and Land Use Area

National land use land cover data created by the U.S. Geological Survey (USGS) in 2016 was used to assess land use characteristics of the County. This dataset was converted from a raster to a vector polygon, which informed spatial areas of residential, non-residential, and natural land use areas. Residential land-use types incorporated all classes listed as developed land use, except for those identified as vacant (i.e., Developed – Low Intensity, Developed – Medium Intensity, Developed – High Intensity). Non-residential land-use types included all other classes. Within non-residential land-use types, natural land areas were extracted into a new category, which includes barren land, forest, water, and wetlands. The natural land areas were referenced to calculate the total acres of natural land area exposed to hazard areas of concern.

5.1.1.5 New Development

In addition to summarizing the current vulnerability, Tompkins County examined some of the recent and anticipated new development that can affect the County's vulnerability to hazards. Identifying these changes and integrating into the risk assessment ensures they are considered when developing the mitigation strategy to reduce these vulnerabilities in the future. An exposure analysis was conducted using anticipated and recent new development provided by each jurisdiction for the flood hazard. The development is presented in Section 9, as a table in each annex.

5.1.2 Methodology

To address the requirements of the Disaster Mitigation Act of 2000 (DMA 2000) and better understand potential vulnerability and losses associated with hazards of concern, Tompkins County used standardized tools, combined with local, state, and federal data and expertise to conduct the risk assessment. Three different levels of analysis were used depending upon the data available for each hazard as described below. Table 5.1-1 summarizes the type of analysis conducted by hazard of concern.

1. **Historic Occurrences and Qualitative Analysis** – This analysis includes an examination of historic impacts to understand potential impacts of future events of similar size. In addition, potential impacts and losses are discussed qualitatively using best available data and professional judgement.
2. **Exposure Assessment** – This analysis involves overlaying available spatial hazard layers, or hazards with defined extent and locations, with assets in GIS to determine which assets are located in the impact area of the hazard. The analysis highlights which assets are located in the hazard area and may incur future impacts.
3. **Loss estimation** — The FEMA Hazus modeling software was used to estimate potential losses for the following hazards: flood, earthquake, hurricane. In addition, an examination of historic impacts and an exposure assessment was conducted for these spatially-delineated hazards.

Table 5.1-1. Summary of Risk Assessment Analyses

Hazard	Population	General Building Stock	Critical Facilities	New Development
Disease Outbreak	Q	Q	Q	Q
Drought	Q	Q	Q	Q
Extreme Temperature	Q	Q	Q	Q
Flood	E, H	E, H	E, H	E
Harmful Algal Bloom	Q	Q	Q	Q
Infestation and Invasive Species	Q	Q	Q	Q
Severe Storm	E, H	E, H	E, H	Q
Severe Winter Storm	Q	Q	Q	Q

E – Exposure analysis; H – HAZUS analysis; Q – Qualitative analysis

5.1.1.6 Hazards U.S. – Multi-Hazard (HAZUS)

In 1997, FEMA developed a standardized model for estimating losses caused by earthquakes, known as Hazards U.S. or Hazus. Hazus was developed in response to the need for more effective national-, state-, and community-level planning and the need to identify areas that face the highest risk and potential for loss. Hazus was expanded into a multi-hazard methodology, Hazus with new models for estimating potential losses from wind (hurricanes) and flood (riverine and coastal) hazards. Hazus is a Geographic Information System (GIS)-based software tool that applies engineering and scientific risk calculations, which have been developed by hazard and information technology experts, to provide defensible damage and loss estimates. These methodologies are accepted by FEMA and provide a consistent framework for assessing risk across a variety of hazards. The GIS framework also supports the evaluation of hazards and assessment of inventory and loss estimates for these hazards.

Hazus uses GIS technology to produce detailed maps and analytical reports that estimate a community's direct physical damage to building stock, critical facilities, transportation systems and utility systems. To generate this information, Hazus uses default Hazus provided data for inventory, vulnerability, and hazards; this default data can be supplemented with local data to provide a more refined analysis. Damage reports can include induced damage (inundation, fire, threats posed by hazardous materials and debris) and direct economic and social losses (casualties, shelter requirements, and economic impact) depending on the hazard and available local data. Hazus' open data architecture can be used to manage community GIS data in a central location. The use of this software also promotes consistency of data output now and in the future and standardization of data collection and storage. More information on Hazus is available at http://www.fema.gov/Hazus.

In general, modeled losses were estimated in the program using user-defined flood depth grids for the flood analysis and probabilistic analyses were performed to develop expected/estimated distribution of losses (mean return period losses) for hurricane wind and seismic hazards. Hazus serves simply as a starting point for assessing community risk. The probabilistic model generates estimated damages and losses for specified return periods (e.g., 100- and 500-year). Table 5.1-2 displays the various levels of analyses that can be conducted using the Hazus software.

Table 5.1-2. Summary of HAZUS Analysis Levels

Hazus Analysis Levels	
Level 1	HAZUS provided hazard and inventory data with minimal outside data collection or mapping.
Level 2	Analysis involves augmenting the HAZUS provided hazard and inventory data with more recent or detailed data for the study region, referred to as "local data"
Level 3	Analysis involves adjusting the built-in loss estimation models used for the hazard loss analyses. This Level is typical done in conjunction with the use of local data.

5.1.1.7 Disease Outbreak

Unsurprisingly as this update was prepared during the COVID-19 pandemic, disease outbreak was identified as a new hazard of concern in the 2021 update for Tompkins County. All of Tompkins County is exposed to disease outbreak events. A qualitative assessment was conducted for the disease outbreak hazard. Research from the Centers for Disease Control and Prevention, New York State Department of Health, Tompkins County Health Department, New York Department of Environmental Conservation, Cornell University, and the U.S. Census Bureau were referenced to assess the County's vulnerability to disease outbreak events.

5.1.1.8 Drought

To assess the vulnerability of Tompkins County to drought and its associated impacts, a qualitative assessment was conducted. The United States Department of Agriculture (USDA) Census of Agriculture 2017 was used to estimate economic impacts. Information regarding the number of farms, land area in farms, etc. was extracted from the report and summarized in the vulnerability assessment.

The associated wildfire hazard is included in the drought hazard. Therefore, the Wildland-Urban Interface (Interface and Intermix) obtained through the SILVIS Laboratory, Department of Forest Ecology and Management, University of Wisconsin – Madison, was referenced to delineate wildfire hazard areas. The University of Wisconsin – Madison wildland fire hazard areas are based on the 2010 Census and 2006 National Land Cover Dataset and the Protected Areas Database. For this risk assessment, the high-, medium-, and low-density interface areas were combined and used as the "Interface" hazard area, and the high, medium-, and low-density intermix areas were combined and used as the "Intermix" hazard areas.

Asset data (population, building stock, critical facilities, and new development) were used to support an evaluation of assets exposed and potential impacts and losses associated with this hazard. To determine what assets are exposed to wildfire, GIS data were overlaid with the hazard area; Assets with their centroid located in the hazard area were totaled to estimate the totals and values exposed to a wildfire event.

Additional resources from the Centers for Disease Control and Prevention, the 2019 New York State Hazard Mitigation Plan, Responding to Climate Change in New York State (ClimAID Report), the Northeast Regional Climate Center and the National Oceanic and Atmospheric Administration were further used to assess the potential impacts to the population from a drought event.

5.1.1.9 Extreme Temperatures

All of Tompkins County is exposed to extreme temperature events. A qualitative assessment was conducted for the extreme temperatures hazard. Information from the Centers for Disease Control and Prevention, the U.S. Fire Administration, the 2019 New York State Hazard Mitigation Plan, Responding to Climate Change in New York State (ClimAID Report), the Northeast Regional Climate Center and the U.S. Geological Survey were used to assess the potential impacts extreme temperature events have on the County's assets.

5.1.1.10 Flood

The 1-percent annual chance flood event was examined to evaluate the County's risk from the flood hazard. This flood event boundary (Special Flood Hazard Area) is generally considered by planners and evaluated under federal programs such as the NFIP. In general, structural impacts include damage to building frames as well as building content.

The following data was used to evaluate exposure and determine potential future losses for this plan update:

- Tompkins County does not yet have Digital Flood Insurance Rate Maps (DFIRMs). Q3 datasets are often used for communities without DFIRM datasets to assess risk. Q3 data from FEMA for Tompkins County dated from the 1970s/1980s was used for this analysis.
- The 1-percent annual chance flood depth grid for the whole county was generated by combining an existing depth grid for the City of Ithaca generated as a part of the City of Ithaca's recent Flood Inundation Study along with the Q3 FEMA data and a Digital Elevation Model generated from contour lines.

The resulting depth grid was integrated into ESRI ArcGIS v10.5.1 for an exposure analysis and the Hazus v4.2 riverine flood model for a loss analysis. This analysis used the Q3 flood boundary, updated general building stock inventory, identified new development, updated critical facility inventory, updated population data using the American Community Survey 5-Year Population Estimates (2014-2018), and the 2010 U.S. Census population data to estimate exposure and losses caused by the 1-percent annual chance flood event. Assets (population, building stock, critical facilities, new development) with their centroid in the floodplain were totaled to estimate the numbers and values exposed to a flooding event. To estimate potential losses, a Level 2 Hazus riverine flood analysis was performed for the 1-percent annual chance flood event. The updated building and critical facility inventories were incorporated into Hazus. Hazus calculated the estimated potential losses to the population (sheltering needs) using the 2010 U.S. Census population data and potential damages to the general building stock and critical facility inventories based on the depth grid generated and the default Hazus damage functions in the flood model.

Flood induced ground failure is also included in the flood hazard. To assess the vulnerability of ground failure Tompkins county a quantitative assessment was conducted using ESRI ArcGIS v10.5.1 and a Karst Layer from United States Geological Survey. To estimate potential exposure to ground failure areas, assets (population, building stock, critical facilities, new development) with their centroid in the hazard areas were totaled to estimate the numbers and values exposed to the ground failure hazard boundary.

Information from the 2019 New York State Hazard Mitigation Plan, Responding to Climate Change in New York State (ClimAID Report), the Northeast Regional Climate Center and the U.S. Geological Survey were used to assess the potential impacts flood events have on the County's assets.

5.1.1.11 Harmful Algal Blooms

Due to the range of environmental, health and economic concerns related to the increased preponderance of Harmful Algal Blooms, it was identified as a new hazard of concern in the 2021 update for Tompkins County. Those assets located closest to water resources are at greatest risk to being impacted by harmful algal bloom events. A qualitative assessment was conducted for the harmful algal blooms hazard. Resources from the Centers for Disease Control and Prevention, Community Science Institute, Cornell University Water Resources Institute, Tompkins County, and the Environmental Protection Agency were referenced to assess the County's risk to harmful algal bloom events.

5.1.1.12 Infestation and Invasive Species

All of Tompkins County is exposed to infestation and invasive species. Resources from the New York State Department of Environmental Conservation, 2019 New York State Hazard Mitigation Plan, Responding to Climate Change in New York State (ClimAID Report) and the Northeast Regional Climate Center data were referenced to assess the potential impacts to the County's assets.

5.1.1.13 Severe Storm

All of Tompkins County is exposed to a range of different severe storm events. In general, structural impacts include damage to roofs and building frames, rather than building content. A Hazus probabilistic analysis was performed to analyze the wind hazard losses for Tompkins County for the 100- and 500-year mean return period events. The probabilistic Hazus hurricane model activates a database of thousands of potential storms that have tracks and intensities reflecting the full spectrum of Atlantic hurricanes observed since 1886 and identifies those with tracks associated with Tompkins County. Hazus contains data on historic hurricane events and wind speeds. It also includes surface roughness and vegetation (tree coverage) maps for the area. Surface roughness and vegetation data support the modeling of wind force across various types of land surfaces. Default demographic and updated building and critical facility inventories in Hazus were used for the analysis. Although damages are estimated at the census tract level, results were presented at the municipal level. Since there are multiple census tracts that contain more than one jurisdiction, the general building stock inventory was leveraged to extract the percent of each tract that falls within individual jurisdictions. The percentage was multiplied against the results calculated for each tract and summed for each jurisdiction.

For this HMP the severe storm hazard includes thunderstorms, lightning, hail, tornadoes, high winds, and hurricanes/tropical storms. Information from the 2019 New York State Hazard Mitigation Plan, Responding to Climate Change in New York State (ClimAID) Report, and the Northeast Regional Climate Center data were used to assess the potential impacts severe storm events have on the County's assets.

5.1.1.14 Severe Winter Storm

All of Tompkins County is exposed and vulnerable to the winter storm hazard. In general, structural impacts include damage to roofs and building frames, rather than building content. Current modeling tools are not available to estimate specific losses for this hazard. A percentage of the custom-building stock structural replacement cost value was utilized to estimate damages that could result from winter storm conditions (i.e., 1-percent, 5-percent, and 10-percent of total replacement cost value). The potential losses for this hazard provide a conservative estimate for losses associated with winter storm events as quantitative data on losses are not available for this hazard. Information from the 2019 New York State Hazard Mitigation Plan, Responding to Climate Change in New York State (ClimAID) Report, and the Northeast Regional Climate Center data were used to assess the potential impacts severe winter storm events, including ice storms, have on the County's assets.

5.1.1.15 Considerations for Future Plan Updates

The following items are to be discussed for considerations for the next plan update to enhance the vulnerability assessment:

- All Hazards
  - Utilize updated and current demographic data. If 2020 U.S. Census demographic data is available at the U.S. Census block level during the next plan update, use the census block estimates and residential structures for a more precise distribution of population, or the current American Community Survey 5-Year Estimate populations counts at the Census tract level.
- Flood
  - Utilize any formal updates to the Flood Insurance Rate Map (FIRM)
  - The general building stock inventory can be updated to include attributes regarding first floor elevation and foundation type (basement, slab on grade, etc.) to enhance loss estimates.
  - Conduct Hazus analysis for anticipated updated DFIRMs when available.
  - Conduct a Hazus loss analysis for more frequent flood events (e.g., 10 and 50-year flood events).
  - Use FEMA's Flood Assessment Structure Tool (FAST) tool for a quicker, simpler flood analysis at the structure level.
  - Further refine the repetitive loss area analysis.
  - Continue to expand and update urban flood areas to further inform mitigation
- Drought
  - General building stock inventory can be updated to include attributes such as roofing material or fire detection equipment or integrate distance to fuels as another measure of wildlife vulnerability.
- HABs
  - Closely track developing HABs analysis and strategies at NYSDEC and incorporate applicable information and mitigation strategies into plan update.
- Extreme Temperatures
  - Track extreme temperature data for injuries, deaths, shelter needs, pipe freezing, agricultural losses, and other impacts to determine distributions of most at risk areas.
- Severe Storm Events
  - The general building stock inventory can be updated to include attributes regarding protection against strong winds, such as hurricane straps, to enhance loss estimates.
  - Estimate storm surge related losses using the Hazus flood model, if the data is available.
  - If available during the next plan update, update the risk assessment using a comprehensive coastal erosion hazard area map and updated sea level rise inundation areas.
  - Collect data on historic costs incurred to reconstruct buildings, cultural resources and/or infrastructure due to coastal erosion impacts.

- Integrate evacuation route data that is currently being developed.

5.1.3 Data Source Summary

Table 5.1-3 summarizes the data sources used for the risk assessment for this plan.

Table 5.1-3. Risk Assessment Data Documentation

Data	Source	Date	Format
Population data	U.S. Census Bureau; American Community Survey 5-Year Estimates	2010; 2018	Digital (GIS) format
Building footprints	Tompkins County	2019/2020	Digital (GIS) format
Tax Assessor data	NYS Office of Information Technology Services GIS Program Office (GPO), NYS Department of Taxation and Finance's Office of Real Property Tax Services (ORPTS), and Tompkins County Tax Assessor	2019	Digital (GIS/Tabular) format
Critical facilities	Tompkins County Steering Committee and Planning Committee	2019/2020	Digital (GIS) format
Q3 Flood Mapping	Tompkins County GIS	1970/1980	Digital (GIS) format
Landslide Susceptibility (Karst Topography)	USGS	2014	Digital (GIS) format
1-Percent Annual Chance Depth Grid	Tetra Tech	2020	Digital (GIS) format
Wildfire Fuel Hazard	University of Wisconsin - Madison	2010	Digital (GIS) format
2-Meter Resolution Digital Elevation Model	Tompkins County	2008	Digital (GIS) Format
Flood Inundation Map for Ithaca	USGS	2018	Digital (GIS) Format
New Development Data	Tompkins County Planning Department	2020	Digital (GIS) Format
NY County Boundaries (Basemap)	ESRI	2002	Digital (GIS) Format
NY Railroads (Basemap)	New York State Department of Transportation (NYS DOT)	2013	Digital (GIS) Format
NY Road Centerlines (Basemap)	New York State Geospatial Information Systems (NYS GIS)	2020	Digital (GIS) Format
NY Hydrography (Basemap)	New York State Office of Cyber Security (NYS OCS)	2008	Digital (GIS) Format

5.1.1.16 Limitations

Loss estimates, exposure assessments, and hazard-specific vulnerability evaluations rely on the best available data and methodologies. Uncertainties are inherent in any loss estimation methodology and arise in part from incomplete scientific knowledge concerning natural hazards and their effects on the built environment. Uncertainties also result from the following:

1) Approximations and simplifications necessary to conduct such a study
2) Incomplete or dated inventory, demographic, or economic parameter data
3) The unique nature, geographic extent, and severity of each hazard
4) Mitigation measures already employed by the participating municipalities
5) The amount of advance notice residents have to prepare for a specific hazard event
6) Uncertainty of climate change projections

These factors can result in a range of uncertainty in loss estimates, possibly by a factor of two or more. Therefore, potential exposure and loss estimates are approximate. These results do not predict precise results and should be used to understand relative risk. Over the long term, Tompkins County will collect additional data to collect additional data, update and refine existing inventories, to assist in estimating potential losses.

Potential economic loss is based on the present value of the general building stock utilizing best available data. The County acknowledges significant impacts may occur to critical facilities and infrastructure as a result of these hazard events causing great economic loss. However, monetized damage estimates to critical facilities and infrastructure, and economic impacts were not quantified and require more detailed loss analyses. In addition, economic impacts to industry such as tourism and the real-estate market were not analyzed.

5.2 IDENTIFICATION OF HAZARDS OF CONCERN

To provide a strong foundation for mitigation actions considered in Sections 6 (Mitigation Strategy) and 9 (Jurisdictional Annexes), Tompkins County considered a full range of hazards that could impact the area and then identified and ranked those hazards that presented the greatest concern. This work included:

- The hazard of concern identification process incorporated input from the county and participating jurisdictions; review of the New York State Hazard Mitigation Plan (NYS HMP 2019);
- The 2013-14 Tompkins County HMP (Tompkins County HMP 2014); the 2017 Tompkins County CEPA; and
- The review of the research and local, state, and federal information.

Information extracting included the frequency, magnitude, and costs associated with the various hazards that have previously, or could feasibly, impact the region. This further included the qualitative or anecdotal information regarding natural hazards and the perceived vulnerability of the study area's assets to them. Table 5.2-1 documents the process of identifying the natural hazards of concern for further profiling and evaluation. Specific hazards not identified as a hazard of concern for Tompkins County will not be further discussed in detail.

5.2.1 Changes from 2014 Hazard Mitigation Plan

The 2021 Tompkins County Hazard Mitigation plan re-evaluated the hazards that face the County. The 2021 plan addresses a broad range of hazards and has combined several associated hazards to simplify and prioritize actions in the plan. While the 2014 plan included a number of hazards of concern related to man-made, and technological hazards, the DMA 2000 regulations do not require consideration of such hazards in a FEMA-approved hazard mitigation plan, hence the Steering Committee deemed natural hazards to be the focus of the update. Therefore technological (e.g., hazardous material incidents) and man-made hazards (e.g., terrorism, man-made dam breaches/failures) are not addressed in this planning process as stand-alone hazards. These non-natural hazards are addressed by other regional planning efforts including comprehensive emergency management plans, cyber security plans, etc. However, many of the man-made hazards included in the 2014 plan are incorporated as associated or cascading hazards in this update. Details on how these man-made hazards were addressed in the 2021 updated plan are as follows:

- Civil Unrest – Not included in the plan update as this issue is addressed as a separate concern by the Tompkins County Department of Emergency Response and local law enforcement under the Tompkins County Comprehensive Emergency Management Plan.

- Fire (Urban and Wild)- Wildfire is included as a cascading impact of drought and discussed in Section 5.4.2 (Drought). Urban fire is not included in this plan as it is addressed by the County in its Comprehensive Emergency Management Plan as well as municipal fire department planning efforts , (in particular by the City of Ithaca Fire Department).
- Fuel Shortage - While it is acknowledged that a reliable fuel supply supports the health and welfare of communities, this has not been included as a stand-alone hazard, to be addressed by continuity of operations plans separately. However, as relevant, this may be included as a cascading hazard to identified hazards of concern. Stresses to fuel shortages will further be relieved by continued transition away from the reliance on fossil fuels.
- Hazardous Materials in Transit- Fixed hazardous material (Tier II) sites have been included in the risk analysis of this plan and identified as critical facilities; however, hazardous materials in transit are not included, but rather addressed by county in its Comprehensive Emergency Management Plan. Much of the concern in the 2014 plan was the potential adverse impact related to gas drilling. That threat potential no longer exists.
- Terrorism - This has not been included in this plan but rather is addressed by separate emergency management policies.
- Transportation Accident - This has not been included in this plan but rather is addressed by separate emergency management policies and long-range transportation planning. Much of the concern in the 2014 plan was the potential adverse impact related to high-volume hydraulic fracturing (HVHF) gas drilling related truck traffic. That threat potential no longer exists.
- Utility Failure - this is acknowledged as a cascading hazard in the Severe Storm and Flood hazards. Numerous mitigation actions related to utility failure are included in the County and municipal mitigation strategies to address the need for a reliable power supply to support resilient communities.
- Water Supply Contamination-This is partially addressed in the Flood hazard as a cascading hazard of concern and has not been included as a stand-alone hazard.

Regarding additional hazards addressed in the 2021 update, this plan includes disease outbreak and harmful algal bloom, both not included in the 2014 plan. During the update process, members of the Steering Committee identified theses as hazards of concern for the 2021 Hazard Mitigation Plan update. In addition, the 2021 plan addresses invasive species as a hazard of concern rather than solely infestation as included in the 2014 plan to address invasive plants, animals, inspects, and insect borne diseases that can be a risk to the welfare of the public.

The 2021 Tompkins County Hazard Mitigation Plan Update includes best available data throughout the plan to present an updated understanding Tompkins County's risk.

5.2.2 Hazard Categories

For this plan, the Steering Committee categorized hazards based on the similarity of hazard events, typical concurrence or impacts, consideration of how hazards have been grouped in Federal Emergency Management Agency (FEMA) guidance documents (*FEMA 386-2 Understanding Your Risks, Identifying Hazards and Estimating Losses*; *Multi-Hazard Identification and Risk Assessment – The Cornerstone of the National Mitigation Strategy*; *Local Mitigation Planning Handbook*. Brief descriptions of the hazards are provided below.

Detailed descriptions are provided in each hazard profile in the following sections of the plan.

Disease Outbreak addresses mosquito borne disease (West Nile, Eastern Equine Encephalitis, St. Louis Encephalitis, La Crosse Encephalitis), tick borne disease (Lyme Disease), respiratory viruses (Influenza and Coronavirus), Ebola, Measles, Tuberculosis, and Hepatitis A.

Drought includes drought events that occur and are likely to occur in the future in Tompkins County or had a considerable economic or safety impact on the county. In addition, associated wildfires that occur during drought conditions is included in this hazard.

Extreme Temperature addresses periods of extreme temperature (both extreme hot and cold) that occurred in Tompkins County or had a considerable impact on the county.

Flood includes riverine flooding, flash flooding, shallow flooding, ice jam flooding, and dam failure flooding. Inclusion of the various forms of flooding under a general *Flood* hazard is consistent with that used in FEMA's *Multi-Hazard Identification and Risk Assessment* guidance and the NYS HMP. In addition, flood related ground failure due to instability of saturated soils is included in this hazard.

Invasive Species addresses invasive species that impacts the built environment and public infrastructure in Tompkins County and surrounding region.

Harmful Algal Bloom addresses significant colonies of algae that produce toxins or have harmful health effects. For this HMP, main areas of concern regarding Harmful Algal Bloom are larger waterbodies such as Cayuga Lake, and generally not smaller waterbodies.

Severe Storm includes windstorms that often entail a variety of other influencing weather conditions, including thunderstorms, hail, lightning, windstorms, and tornadoes. Tropical disturbances (hurricanes, tropical storms and tropical depressions) are often identified as a type of severe storm. For this HMP update *Severe Storm* includes thunderstorms, hailstorm, lightning, tornadoes, hurricanes, and tropical storms.

Severe Winter Storm includes heavy snowfall, blizzards, freezing rain/sleet, ice storms, ice jams, and Nor'Easters. This category is consistent with the NYS HMP.

Table 5.2-1. Evaluation of Natural Hazards of Concern for Tompkins County

Hazard	Is this a hazard that may occur in Tompkins County?	If yes, does this hazard pose a significant threat to Tompkins County?	Why was this determination made?	Source(s)
Avalanche	No	No	• The NYS HMP does not identify avalanche as a hazard of concern in Tompkins County. • Avalanches can occur in any situation where snow, slope and weather conditions combine to create proper conditions. About 90 percent of all avalanches start on slopes of 30 to 45 degrees and about 98 percent of all avalanches occur on slopes of 25 to 50 degrees. The topography in Tompkins County is steep with the gorges, however, this does not lead to avalanche conditions. • New York State, in general, has a very low occurrence of avalanche events based on statistics provided by National Avalanche Center – American Avalanche Association (NAC-AAA) between 1998 and 2020.	• NYS DHSES • NAC-AAA
Coastal Erosion	No	No	• The NYS HMP identifies coastal erosion as a hazard of concern for New York State. Erosion can impact all of the state's coastal counties along: Lake Erie and the Niagara River, Lake Ontario and the St. Lawrence River, Atlantic Ocean and Long Island Sound, Hudson River south of the federal dam in Troy, the East River, the Harlem River, the Kill van Kull and Arthur Kill, and all connecting waterbodies, bays, harbors, shallows and wetlands. • Tompkins County is not surrounded by coastal waters; therefore, based on its inland location and input from the Planning Partnership, coastal erosion is not considered a hazard of concern for the County.	• NYS DHSES • Input from Planning Partnership
Dam Failure	Yes	Yes	• The 2019 NYS HMP identifies dam failure as a hazard of concern for New York State and includes it in the Flood hazard profiles. • According to the NYS DEC there are 96 dams are within Tompkins County, as shown in Section 4. Of these 96 dams in Tompkins County: 25 low hazard, 4 intermediate hazard, 5 high hazard, and 11 negligible, and 51 with an unknown classification (NYS DEC 2020). • Due to the number of dams and input from the Steering Committee, dam failure is identified as a hazard of concern for the County and included in the Flood hazard profile.	• NYS DHSES • Input from Planning Partnership • NYSDEC • NYS GIS
Disease Outbreak	Yes	Yes	• The 2019 NYS HMP does not identify disease outbreak as a hazard of concern for New York State, however due to the large student population	• NYS DHSES • NYS DEC

Table 5.2-1. Evaluation of Natural Hazards of Concern for Tompkins County

Hazard	Is this a hazard that may occur in Tompkins County?	If yes, does this hazard pose a significant threat to Tompkins County?	Why was this determination made?	Source(s)

			and migratory nature of the county population, this hazard has been ranked as a hazard of concern for the County.
			• Recent statistics related to this hazard includes:
			  ○ As of 10/21 there were 553 positive Covid-19 cases reported; 477 of which had recovered.
			  ○ Known disease outbreaks in the county include Hepatitis A, Lyme Disease, Tuberculosis, West Nile Virus, lab confirmed Influenza, Encephalitis (Non-WNV), Covid-19 (2014-present).
				• Input from Planning Partnership

Drought	Yes	Yes	• The NYS HMP identifies drought as a hazard of concern for the state. Tompkins County has been impacted by several drought events that have occurred in New York State.
			• Drought conditions can cause shortages in water for human consumption, impact agricultural production, and lead to reduced local firefighting capabilities. The population of Tompkins County relies on groundwater and surface water for their potable water. Droughts can impact groundwater resources significantly, limiting the availability of drinking water to county residents.
			• New York State was included in one FEMA drought-related disaster declaration, which did not include Tompkins County.
			• Tompkins County was included in two recent drought-related USDA disaster declarations:
			  ○ S4023 August 2016
			  ○ S4031 September 2016
			• According to the NRCC, Tompkins County is in the Eastern Plateau Climate Division. This division has been impacted by periods of severe and extreme drought 27 times from 1895 to 2002.
			• Based on previous occurrences, the existence of significant agricultural assets in the county, and input from the Planning Partnership, drought is identified as a hazard of concern for Tompkins County.
				• NYS DHSES
				• FEMA
				• USDA
				• Input from Planning Partnership
				• NOAA-NCEI
				• NRCC

Earthquake	No	No	• The NYS HMP identified earthquake as a hazard of concern for the state.	• NYS DHSES

Table 5.2-1. Evaluation of Natural Hazards of Concern for Tompkins County

Hazard	Is this a hazard that may occur in Tompkins County?	If yes, does this hazard pose a significant threat to Tompkins County?	Why was this determination made?	Source(s)
			• Tompkins County has a PGA below 3%g. According to the FEMA document "Understanding Your Risks: Identifying Hazards and Estimating Losses", areas with 3%g should conduct a risk assessment for earthquakes. • New York State was included in one FEMA earthquake-related disaster declaration (DR-1415); Tompkins County was not included in this declaration. • According to the NYS HMP, between 1973 and 2012, there were 189 earthquakes epicentered in the state. Of those 189 events, none had an epicenter in Tompkins County. • Since earthquakes have historically not been a significant hazard in Tompkins County and New York State, the Steering Committee did not identify earthquakes as a concern and thus will not be including this factor in the assessment.	• Input from Planning Partnership • USGS – Earthquake Hazards Program, Review of USGS Seismic Maps
Expansive Soils	Yes	No	• The NYS HMP identified expansive soils as a hazard of concern for New York State but does not identify this as a significant hazard in Tompkins County. In limited areas Ithaca and Tompkins County tend to have geological characteristics that make its communities prone to expansive soils, especially in lower elevation areas near the lake have potential for unstable conditions which can lead to structural damage. However, the Steering Committee did not identify this a significant county-wide hazard of concern.	• NYS DHSES • Input from Steering Committee • Review of USGS 1989 Swelling Clays Map of the Conterminous United States
Extreme Temperature	Yes	Yes	• The NYS HMP identified extreme temperatures as a hazard of concern for New York State. • Tompkins County was included in five recent USDA disaster declarations related to extreme temperature events: • S3249 – March 2012 – Frosts and freezes • S3427 – June 2012 – Excessive heat (also included drought) • S3746 – February 2014 – Freeze • S4023 – August 2016 – Heat, excessive heat (also included drought)	• NYS DHSES • Input from Steering Committee • NOAA-NCEI • USDA

Table 5.2-1. Evaluation of Natural Hazards of Concern for Tompkins County

Hazard	Is this a hazard that may occur in Tompkins County?	If yes, does this hazard pose a significant threat to Tompkins County?	Why was this determination made?	Source(s)
			• S4031 – September 2016 – Heat, excessive heat (also included drought) • The Planning Partnership identified extreme temperature as a hazard of concern for Tompkins County.	
Flood (riverine, lake, ice jam, dam failure and flash)	Yes	Yes	• The NYS HMP identified flooding as a hazard of concern for New York State. • Between 1954 and 2020, Tompkins County was included in 5 FEMA flood-related declarations. • DR-290 (Heavy Rains and Flooding) - 1970 • DR-338 (Tropical Storm Agnes) - 1972 • DR-487 (Storm Rain Landslides and Flooding) – 1975 • DR-515 (Severe Storms and Flooding) -1976 • DR-1095 (Severe Storms and Flooding) - 1996 • The Cornell Cooperative Extension Flood Taskforce considers erosion and sediment control to be a specific topic of concern in Tompkins County. • Ice Jams have also been a significant problem in Tompkins County. According to the US Army Core of Engineers NYS has the second highest number of ice jams annually, with Tompkins County reporting 27 events since 1937. • As these historical occurrences have and continue to be a major issue for the region, Tompkins County steering committee has designated flooding as a potential hazard for the county.	• NYS DHSES • Input from Steering Committee • FEMA • NOAA-NCEI • USACE CRREL Ice Jam Database • Cornell Cooperative Extension
Hailstorm	Yes	Yes	• Please see Severe Storm	
Harmful Algal Bloom	Yes	Yes	• The New York State DEC identified HABs as a critical issue that needs to be addressed for all of the Finger Lakes. • Four Harmful Algal Blooms have been recorded in Cayuga Lake just for 2020 (6/25 Stewart Park, 7/6 Ithaca Yacht Club, 7/9 Taughannock Falls State Park, 8/24 Stewart Park Boat Dock) and have been increasing over the years. • HABs have been identified and recorded 2 times in Dryden Lake	• NYSDEC HABs Mapper • Tompkins County Health Department • NYS Cayuga Lake Action Plan

Table 5.2-1. Evaluation of Natural Hazards of Concern for Tompkins County

Hazard	Is this a hazard that may occur in Tompkins County?	If yes, does this hazard pose a significant threat to Tompkins County?	Why was this determination made?	Source(s)
			• Harmful Algal Blooms have been observed at various locations in Cayuga Lake, including in Tompkins County, during the summers since 2017. • Lake nutrient and phosphorous levels have been increasing in Cayuga Lake due to increased contaminated runoff from agricultural, industrial, and commercial/ residential properties.	
Hurricane	Yes	Yes	• Please see Severe Storm	
Ice Jams	Yes	Yes	• Please see Flood	
Ice Storm	Yes	Yes	• Please see Severe Winter Storm	
Infestation	Yes	No	• Please see invasive species	
Invasive Species	Yes	Yes	• The 2019 NYS HMP does not identify invasive species as a hazard of concern for New York State. • New York State has been affected by various instances of invasive ticks and mosquitos. • The NYS DEC has identified Tompkins County to be located within the emerald ash borer restricted zone and identified several known locations of the emerald ash borer within the county. • In addition to the emerald ash borer, several species of animals, insects, and plants have impacted the county. The Tompkins County Steering Committee and Planning Partnership identified invasive species as a hazard of concern due to previous occurrences of invasive species within Tompkins County.	• NYS DEC • Input from Planning Partnership
Land Subsidence	Yes	No	• NYS HMP indicates New York State is vulnerable to land subsidence; however, this hazard is “extremely localized” and poses a “very low risk to population and property”, according to the 2014 NYS HMP. • The Planning Partnership did not identify land subsidence as a hazard of concern for Tompkins County.	• NYS DHSES • Input from Planning Partnership • USGS
Landslide	Yes	No	• Landslides are included and discussed in the flood section.	• NYS DHSES • Input from Steering Committee

Table 5.2-1. Evaluation of Natural Hazards of Concern for Tompkins County

Hazard	Is this a hazard that may occur in Tompkins County?	If yes, does this hazard pose a significant threat to Tompkins County?	Why was this determination made?	Source(s)
				• FEMA
Nor'Easters	Yes	Yes	• Please see Severe Winter Storm	
Severe Storm (windstorms, thunderstorms, lightning, hurricanes / tropical storms, hail and tornadoes)	Yes	Yes	• The NYS HMP identified severe storm as a hazard of concern for New York State; however, for the state HMP, the hazards were profiled in individual sections thunderstorms, lightning, hail, tornadoes, high winds, and hurricanes/tropical storms. For the Tompkins County HMP, the hazards were combined into one profile. • Between 1954 and 2018, Tompkins County was included in 11 FEMA severe storm-related declarations. ○ DR-290 (Heavy Rains and Flooding) - 1970 ○ DR-338 (Tropical Storm Agnes) - 1972 ○ DR-487 (Storm Rain Landslides and Flooding) – 1975 ○ DR-515 (Severe Storms and Flooding) -1976 ○ DR-1095 (Severe Storms and Flooding) - 1996 ○ DR-1148 (Severe Storms, High Winds, Rain, and Flooding) -1996 ○ DR-1233 (Severe Storms and Flooding) -1998 ○ DR-1335 (Severe Storms and Flooding) -2000 ○ DR-1534 (Severe Storms and Flooding) -2004 ○ DR-1650 (Severe Storms and Flooding) -2006 ○ DR -4031 (Remnants of Tropical Storm Lee) 2011 ○ DR-3262 (Hurricane Katrina Evacuation) – 2005 • DR -3351 (Hurricane Sandy) - 2012 • Based on previous occurrences and input from the Planning Partnership, severe storms are identified as a hazard of concern for Tompkins County.	• NYS DHSES • FEMA • NOAA-NCEI • SPC • Input from the Planning Partnership
Severe Winter Storm (heavy snow, blizzards, ice	Yes	Yes	• The NYS HMP identified severe winter storm as a hazard of concern for New York State. According to the National Oceanic and Atmospheric Administration, Tompkins County's annual average snowfall ranges between 50 to 100 inches with an average of 64.4 inches and their total historic county-wide property damage is $670,000	• NYS DHSES • FEMA • NOAA-NCEI

Table 5.2-1. Evaluation of Natural Hazards of Concern for Tompkins County

Hazard	Is this a hazard that may occur in Tompkins County?	If yes, does this hazard pose a significant threat to Tompkins County?	Why was this determination made?	Source(s)
storms, ice jams, and Nor'easters)			• FEMA included Tompkins County in two winter storm-related disaster declarations: ○ FEMA-EM-3107 (Severe Blizzard) – March 1993 ○ FEMA-DR-4322 (Severe Winter Storm and Snowstorm) – March 2017 • Based on previous occurrences and input from the Planning Partnership, severe winter storms are identified as a hazard of concern for Tompkins County.	• Input from the Planning Partnership
Tornado	Yes	Yes	Please see Severe Storm	
Tsunami	No	No	• Tsunami is not identified as a hazard of concern in the NYS HMP. Due to its inland location, Tompkins County does not experience tsunamis. Therefore, the Planning Partnership did not identify tsunami as a hazard of concern for Tompkins County.	• NYS DHSES • Input from the Planning Partnership
Volcano	No	No	• The NYS HMP did not identify volcano as a hazard of concern for New York State. There are no active volcanos located in Tompkins County; therefore, the Planning Partnership does not identify volcano as a hazard of concern for Tompkins County.	• NYS DHSES • Input from the Planning Partnership
Wildfire	Yes	No	• The NYS HMP identified wildfire as a hazard of concern for New York State. • Tompkins County was not included in any FEMA wildfire-related disaster declarations. The Planning Partnership identified wildfire as a hazard of concern associated with drought conditions; therefore, wildfire is discussed in the drought hazard profile.	• NYS DHSES • Input from Planning Partnership • FEMA
Windstorm	Yes	Yes	• Please see Severe Storm	

CRREL Cold Regions Research and Engineering Laboratory
DR Presidential Disaster Declaration Number
EM Presidential Disaster Emergency Number
FEMA Federal Emergency Management Agency
NCEI National Centers for Environmental Information
NRCC Northeast Regional Climate Center
NYS DEC New York State Department of Environmental Conservation
NYS DHSES New York State Division of Homeland Security and Emergency Services

NYS HMP	*New York State Hazard Mitigation Plan*
PGA	*Peak ground acceleration*
SPC	*Storm Prediction Center*
USDA	*U.S. Department of Agriculture*
USGS	*United States Geologic Survey*

5.2.3 Summary of Hazards of Concern

In summary, a total of eight natural hazards of concern were identified as significant hazards affecting the entire planning area, to be addressed at the county level in this plan (shown here in alphabetical order):

- Disease Outbreak
- Drought (including wildfire)
- Extreme Temperature
- Flood (riverine, flash, stormwater, lakeshore, landslide, dam failure, and ice jam)
- Infestation and Invasive Species
- Harmful Algal Bloom (HAB)
- Severe Storm (thunderstorm, lightning, hail, wind, tornado, and hurricane/tropical storm)
- Severe Winter Storm

5.3 HAZARD RANKING

As discussed in Section 5.2 (Identification of Hazards of Concern), a comprehensive range of natural hazards that pose a significant risk to Tompkins County were selected and considered during development of this plan; however, each community in Tompkins County has differing levels of exposure and vulnerability to each of these hazards. It is important for each community participating in this plan to recognize those hazards that pose the greatest risk to their community and direct their attention and resources accordingly to most effectively and efficiently manage risk and reduce losses. The hazard ranking for the County and each participating jurisdiction can be found in their jurisdictional annexes in Volume II, Section 9 of this plan.

To this end, a hazard risk ranking process was conducted for Tompkins County and its municipalities using the method described below. This method includes four risk assessment categories—probability of occurrence, impact (population, property, and economy), adaptive capacity, and changing future conditions (climate change). Each were assigned a weighting factor to calculate an overall ranking value for each hazard of concern. Depending on the calculation, each hazard was assigned a high, medium, or low ranking. Details regarding each of these categories is described below.

5.3.1 Hazard Ranking Methodology

The methodology used to rank the hazards of concern for Tompkins County is described below. Estimates of risk for the County were developed using methodologies promoted by FEMA's hazard mitigation planning guidance, generated by FEMA's HAZUS-MH risk assessment tool, and input from Tompkins County and participating jurisdictions. The ranking includes a factor to evaluate capacity of the participating jurisdiction regarding ability to address the hazard through plans, policies, and mitigation strategies.

shows the four risk assessment categories' values for each of Tompkins County's hazards. Details for each category are further described below.

Table 5.3-1. Summary of Hazard Ranking Approach

Category	Level / Category	Degree of Risk / Benchmark Value	Numeric Value	Weighted Value
Probability of Occurrence	Unlikely	A hazard event is not likely to occur or is unlikely to occur with less than a 1% annual chance probability.	0	30%
	Rare	Between 1 and 10% annual probability of a hazard event occurring.	1	

Category		Level / Category	Degree of Risk / Benchmark Value	Numeric Value	Weighted Value
		Occasional	Between 10 and 100% annual probability of a hazard event occurring.	2	
		Frequent	100% annual probability; a hazard event may occur multiple times per year.	3	
Impact (Sum of all 3)	Population (Numeric Value x 3)	Low	14% or less of population is exposed to a hazard with potential for measurable life safety impact due to its extent and location.	1	30%
		Medium	15% to 29% of population is exposed to a hazard with potential for measurable life safety impact due to its extent and location.	2	
		High	30% or more of population is exposed to a hazard with potential for measurable life safety impact due to its extent and location.	3	
	Property (Numeric Value x 2)	Low	Property exposure is 14% or less of the total number of structures for community.	1	
		Medium	Property exposure is 15% to 29% of the total number of structures for community.	2	
		High	Property exposure is 30% or more of the total number of structures for community.	3	
	Economy (Numeric Value x 1)	Low	Loss estimate is 9% or less of the total replacement cost for community.	1	
		Medium	Loss estimate is 10% to 19% of the total replacement cost for community.	2	
		High	Loss estimate is 20% or more of the total replacement cost for community.	3	
Capability		Low	Weak/outdated/inconsistent plans, policies, codes/ordinances in place; no redundancies; limited to no deployable resources;	3	30%

Category	Level / Category	Degree of Risk / Benchmark Value	Numeric Value	Weighted Value
		limited capabilities to respond; long recovery.		
	Medium	Plans, policies, codes/ordinances in place and meet minimum requirements; mitigation strategies identified but not implemented on a widespread scale; county/jurisdiction can recover but needs outside resources; moderate county/jurisdiction capabilities.	2	
	High	Plans, policies, codes/ordinances in place and exceed minimum requirements; mitigation/protective measures in place; county/jurisdiction has ability to recover quickly because resources are readily available, and capabilities are high.	1	
Climate Change	Low	No local data is available; modeling projects are uncertain on whether there is increased future risk; confidence level is low (inconclusive evidence).	1	10%
	Medium	Studies and modeling projections indicate a potential for exacerbated conditions due to climate change; confidence level is medium to high (suggestive to moderate evidence).	2	
	High	Studies and modeling projections indicate exacerbated conditions/increased future risk due to climate change; very high confidence level (strong evidence, well-documented and acceptable methods).	3	

5.3.1.1 Probability of Occurrence

The probability of occurrence is the likelihood of a hazard event occurring in any given year. A review of historic events assists with this determination. Each hazard of concern is rated in accordance with the numerical ratings and definitions described in

Table 5.3-2. The probability of occurrence is given a weighted value of 30%.

Table 5.3-2. Probability of Occurrence Ranking Factors

Numeric Value	Probability Category	Definition
0	Unlikely	A hazard event is not likely to occur or is unlikely to occur with less than a 1% annual chance probability.
1	Rare	Between 1 and 10% annual probability of a hazard event occurring.
2	Occasional	Between 10 and 100% annual probability of a hazard event occurring.
3	Frequent	100% annual probability; a hazard event may occur multiple times per year.

5.3.1.2 Impact

The impact of each hazard is considered in three categories: impact on population, impact on property (general building stock including critical facilities), and impact on the economy. Based on documented historic losses and individual assessments by each participating municipality, an impact rating of high, medium, or low is assigned with a corresponding numeric value for each hazard of concern. In addition, a weighting factor is assigned to each impact category: 3 for population, 2 for property, and 1 for economy. This gives the impact on population the greatest weight in evaluating the impact of a hazard. The total of each category is assigned a weighted value of 30%. Table 5.3-3 presents the numerical rating, weighted factor and description for each impact category.

Table 5.3-3. Numerical Values and Definitions for Impacts on Population, Property and Economy

Category	Weighted Value	Low Impact* (1)	Medium Impact (2)	High Impact (3)
Population	3	14% or less of population is exposed to a hazard with potential for measurable life safety impact, due to its extent and location.	15% to 29% of population is exposed to a hazard with potential for measurable life safety impact, due to its extent and location.	30% or more of population is exposed to a hazard with potential for measurable life safety impact, due to its extent and location.
Property	2	Property exposure is 14% or less of the total number	Property exposure is 15% to 29% of the total number	Property exposure is 30% or more of the total

Category	Weighted Value	Low Impact* (1)	Medium Impact (2)	High Impact (3)
		of structures for community.	of structures for community.	number of structures for community.
Economy	1	Loss estimate is 9% or less of the total replacement cost for community.	Loss estimate is 10% to 19% of the total replacement cost for community.	Loss estimate is 20% or more of the total replacement cost for community.

Note: A numerical value of zero is assigned if there is no impact.
** For the purposes of this exercise, "impacted" means exposed for population and property and loss for economy.*

5.3.1.3 Additional Impacts

Along with impacts on population, property, and economy, the overall risk ranking looks at two additional impacts that impact the County's vulnerability: capability and climate change. Table 5.3-4 presents the numerical rating and description for each category.

Capability

Capability refers to a jurisdiction's ability to protect the community from or withstand a hazard event. Mitigation measures are already in place, including codes/ordinances, plans, and procedures to withstand hazards due to design or location, deployable resources, or plans and procedures in place to respond to an event. The capability category has a weighted factor of 30%.

Climate Change

Climate change refers to the impact that climate change projections have on increasing or decreasing the severity and frequency of a hazard. The climate change category has a weighted factor of 10%.

Table 5.3-4. Numerical Values and Definitions for Adaptive Capacity and Changing Future Conditions

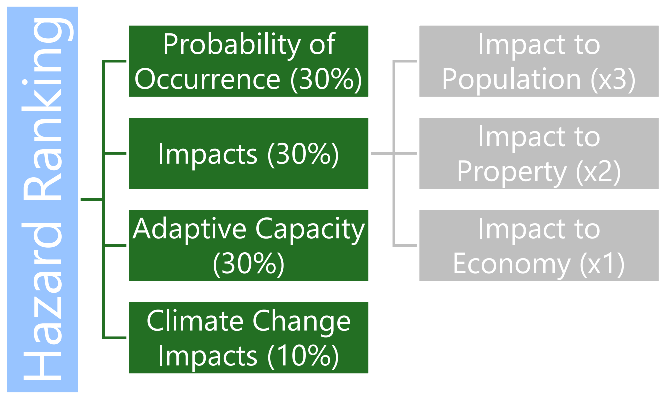
Category	Low Impact*	Medium Impact	High Impact
Capability	Weak/outdated/inconsistent plans, policies, codes/ordinances in place; no redundancies; limited to no deployable resources; limited capabilities to respond; long recovery.	Plans, policies, codes/ordinances in place and meet minimum requirements; mitigation strategies identified but not implemented on a widespread scale; county/jurisdiction can recover but needs outside resources; moderate county/jurisdiction capabilities.	Plans, policies, codes/ordinances in place and exceed minimum requirements; mitigation/protective measures in place; county/jurisdiction has ability to recover quickly because resources are readily available, and capabilities are high.
Climate Change	No local data is available; modeling projects are uncertain on whether there is increased future risk;	Studies and modeling projections indicate a potential for exacerbated conditions due to climate change; confidence level is medium to high	Studies and modeling projections indicate exacerbated conditions/increased future risk due to climate change; very

Category	Low Impact*	Medium Impact	High Impact
	confidence level is low (inconclusive evidence).	(suggestive to moderate evidence).	high confidence level (strong evidence, well-documented and acceptable methods).

Note: *Low impact for adaptive capacity means the jurisdiction does not have the capability to effectively respond, which increases vulnerability; whereas high impact for adaptive capacity means the jurisdiction does have the capability to effectively respond, which decreases vulnerability.*

5.3.1.4 Risk Ranking Value

Each impact was then weighted and the risk ranking for each hazard is then calculated using the following formula.



Based on the total for each hazard, a priority ranking is assigned to each hazard of concern (high, medium, or low). The rankings were categorized as follows: Low = values less than 3.5; Medium = values between 3.5 and 4.5; High = values greater than 4.5.

Example Risk Ranking Equation

Risk Ranking = [(Impact on Population x 3) + (Impact on Property x 2) + (Impact on Economy x 1) x 30%] + [Capability x 30%] + [Climate Impact x 10%] + [Probability of Occurrence x 30%]

5.3.2 Hazard Ranking Results

Using the process described above, the risk ranking for the identified hazards of concern was determined for Tompkins County. The hazard ranking for Tompkins County is detailed in the subsequent tables that present the step-wise process for the ranking. The Countywide risk ranking includes the entire planning area and might not reflect the highest risk indicated for any of the participating jurisdictions. The resulting ranks of each municipality indicate the differing degrees of risk exposure and vulnerability. The results support the appropriate selection and prioritization of initiatives to reduce the highest levels of risk for each municipality. Both the County and the participating jurisdictions have applied the same methodology to develop the Countywide risk and local rankings to ensure consistency in the overall ranking of risk, jurisdictions had the ability to alter rankings based on local knowledge and experience in handling each hazard.

This hazard ranking exercise serves four purposes:

1. To describe the probability of occurrence for each hazard;
2. To describe the impact each would have on the people, property, and economy;
3. Evaluate the capabilities a community has with regards to natural hazards; and
4. To consider changing future conditions (i.e., climate change) in Tompkins county.

Estimates of risk for Tompkins County were developed using methodologies promoted by FEMA's hazard mitigation planning guidance, generated by FEMA's HAZUS-MH risk assessment tool and input from the County and participating municipalities. Table 5.3-5 shows the probability ranking assigned for likelihood of occurrence for each hazard.

Table 5.3-5. Probability of Occurrence Ranking for Hazards of Concern for Tompkins County

Hazard of Concern	Probability	Numeric Value
Disease Outbreak	Occasional	2
Drought	Occasional	2
Extreme Temperatures	Frequent	3
Flood	Occasional	2
Invasive Species	Occasional	2
Harmful Algal Bloom	Occasional	2
Severe Storm	Frequent	3
Severe Winter Storm	Frequent	3

Table 5.3-6 shows the impact evaluation results for each hazard of concern, including impact on property, structures, and the economy on the County level. It is noted that several hazards that have a high impact on the local jurisdictional level can have a lower impact when analyzed countywide. Jurisdictional ranking results are presented in each local annex in Section 9 (Jurisdictional Annexes) of this plan. The weighting factor results and a total impact for each hazard also are summarized.

Table 5.3-6. Impact Ranking for Hazards of Concern for Tompkins County

Hazard of Concern	Population			Property			Economy			Total Impact Rating (Population + Property + Economy)
	Impact	Numeric Value	Multiplied by Weighing Factor (3)	Impact	Numeric Value	Multiplied by Weighing Factor (2)	Impact	Numeric Value	Multiplied by Weighing Factor (1)	
Disease Outbreak	Medium	2	6	Low	1	2	Medium	2	2	10
Drought	Low	1	3	High	3	6	Medium	2	2	11
Extreme Temperatures	Medium	2	6	Low	1	2	Low	1	1	9
Flood	Medium	2	6	Medium	2	4	Medium	2	2	12
Invasive Species	Low	1	3	Medium	2	4	Medium	2	2	9
Harmful Algal Bloom	Medium	2	6	Low	1	2	Medium	2	2	10
Severe Storm	High	3	9	Low	1	2	Low	1	1	12
Severe Winter Storm	Medium	2	6	Low	1	2	Low	1	1	9

Table 5.3-7 shows the additional impact rankings for the hazards of concern. This includes the overall capabilities of the County and municipalities and the consideration of changing future conditions, such as climate change.

Table 5.3-7. Additional Impact Ranking for Hazards of Concern for Tompkins County

Hazard of Concern	Adaptive Capacity	Numeric Value	Climate Change	Numeric Value
Disease Outbreak	2	0.6	2	0.2
Drought	2	0.6	3	0.3
Extreme Temperatures	2	0.6	3	0.3
Flood	2	0.6	3	0.3
Invasive Species	2	0.6	2	0.2
Harmful Algal Bloom	2	0.6	2	0.2
Severe Storm	2	0.6	3	0.3
Severe Winter Storm	1	0.3	2	0.2

Table 5.3-8 presents the total calculations for each hazard ranking value for the hazards of concern.

Table 5.3-8. Total Hazard Ranking Values for the Hazards of Concern for Tompkins County

Hazard of Concern	Probability x 30%	Total Impact x 30%	Adaptive Capacity x 30%	Climate Change x 10%	Total Risk Ranking Value
Disease Outbreak	0.6	3.0	0.6	0.2	4.4
Drought	0.6	3.3	0.6	0.3	4.8
Extreme Temperatures	0.9	2.7	0.6	0.3	4.5
Flood	0.6	3.6	0.6	0.3	5.4
Invasive Species	0.6	2.7	0.6	0.2	4.1
Harmful Algal Bloom	0.6	3.0	0.6	0.2	4.1
Severe Storm	0.9	3.6	0.6	0.3	5.4
Severe Winter Storm	0.9	2.7	0.3	0.2	4.1

Low = values less than 3.5 (yellow); Medium = values between 3.5 and 4.5 (amber); High = values greater than 4.5 (red).

Table 5.3-9 presents the jurisdictional hazard ranking for each hazard. An evaluation of the total risk ranking score determined ranking categories that were grouped into three categories, low, medium, and high. It also includes input by the municipalities. The rankings were categorized as follows: Low = values less than 3.5 colored yellow; Medium = values between 3.5 and 4.5 colored amber; High = values greater than 4.5 colored red.

These rankings have been used as one of the bases for identifying the jurisdictional hazard mitigation strategies included in Section 9 (Jurisdictional Annexes) of this plan. The summary rankings for the County reflect the results of the vulnerability analysis for each hazard of concern and can vary from the specific results of each jurisdiction. For example, the severe storm hazard may be ranked low in one jurisdiction, but due to the exposure and impact countywide, it is ranked as a high hazard and is addressed in the County mitigation strategy accordingly.

Table 5.3-9. Summary of Preliminary Overall Ranking of Natural Hazards by Jurisdiction

Tompkins County Municipalities	Disease Outbreak	**Drought**	**Extreme Temperature**	**Flood**	**Invasive Species**	Harmful Algal Bloom	**Severe Storm**	**Severe Winter Storm**
Caroline, T	Medium	High	Medium	High	Medium	Low	High	Medium
Cayuga Heights, V	Medium	Medium	Medium	Medium	Medium	Medium	High	Medium
Danby, T	Medium	High	Medium	Low	Medium	Low	High	Medium
Dryden, T	Medium	High	Medium	High	Medium	Medium	High	Medium
Dryden, V	Medium	Medium	Medium	High	Medium	Medium	High	Medium
Enfield, T	Medium	High	Medium	Low	Medium	Low	High	Medium
Freeville, V	Low	Medium	Medium	High	Low	Low	High	Medium
Groton, T	Medium	High	Medium	High	Medium	Low	High	Medium
Groton, V	Medium	Medium	Medium	High	Medium	Low	High	Medium
Ithaca, C	Medium	Medium	Medium	High	Medium	Medium	High	Medium
Ithaca, T	Medium	High	Medium	High	Medium	Medium	High	Medium
Lansing, T	Medium	High	Medium	High	Medium	Medium	High	Medium
Lansing, V	Medium	Medium	Medium	Medium	Medium	Medium	High	Medium
Newfield, T	Medium	High	Medium	High	Medium	Low	High	Medium
Trumansburg, V	Medium	Medium	Medium	Low	Medium	Low	High	Medium
Ulysses, T	Medium	High	Medium	Low	Medium	Medium	High	Medium
Tompkins County	Medium	High	Medium	High	Medium	Medium	High	Medium

Low = Values less than 4; Medium = Values between 4 and 5; High = Values greater than 5.1.

5.4.1 Disease Outbreak

This section provides a hazard profile and vulnerability assessment of the disease outbreak hazard for the Tompkins County Hazard Mitigation Plan (HMP).

The hazard profile is organized as follows:	The vulnerability assessment is organized as follows:
• Description • Extent • Previous Occurrences and Losses • Probability of Future Occurrences • Climate Change Impacts	• Impact on Life and Safety • Impact on General Building Stock • Impact on Community Lifelines • Impact on Economy • Impact on Environment • Cascading Impacts on Other Hazards • Future Change that may Impact Vulnerability • Changes Since 2014 HMP • Identified Issues

5.4.1.1 Hazard Profile

This section presents information regarding the description, extent, location, previous occurrences and losses, and probability of future occurrences for the disease outbreak hazard. The disease outbreak hazard includes **viral** (including those with pandemic potential) and **bacterial**, as well a **mosquito** and **tick-borne** diseases.

Description

For the purpose of this HMP update, the following diseases have been identified as the main disease of concern in Tompkins County and thus will be discussed in further detail as both **Viral/Bacterial Disease** or **Tick-Borne/Mosquito Based Disease**.

> *A disease outbreak is the occurrence of disease cases in excess of normal expectancy. The number of cases varies according to the disease-causing agent, and the size and type of previous and existing exposure to the agent. Disease outbreaks are usually caused by an infection, transmitted through person-to-person contact, animal-to-person contact, or from the environment or other media* (WHO 2020).

Viral/Bacterial Disease

An outbreak or an epidemic occurs when new cases of a certain disease, in a given population, substantially exceed what is expected. An epidemic may be restricted to one locale, or it may be more widespread, at which point it is called a pandemic. Pandemic is defined as a disease occurring over a wide geographic area and affecting a high proportion of the population. A pandemic can cause sudden, pervasive illness in all age groups on a local or global scale. A pandemic will cause both widespread and sustained effects and is likely to stress the resources of both the State and federal government (NJOEM

2019). The most recent occurrence of a pandemic is the novel Coronavirus, also known as COVID 19 which has severely impacted communities across the world.

Most disease outbreaks occur due to respiratory viruses. A respiratory virus with pandemic potential is a highly contagious respiratory virus that spreads easily from person to person and for which there is little human immunity. This hazard may strain the healthcare system, require school or business to closure, cause high rates of illness and absenteeism that could undermine critical infrastructure across the county, and decrease community trust due to social distancing measures interfering with personal movement and being perceived as being ineffectual. Previous events that exemplify this hazard include the 1918 ("Spanish flu") and 2009 ("Swine flu") influenza pandemics and the 2003 SARS outbreak, which had pandemic potential (NYC Emergency Management 2019).

In addition to respiratory viruses, diseases with new or emerging features can challenge control. Emerging diseases are difficult to contain or treat and present significant challenges to risk communication since mechanics of transmission, laboratory identification, and effective treatment protocols may be unknown (NYC Emergency Management 2019).

Added detail on the main disease concerns are as follows:

Coronavirus

Coronavirus disease (COVID-19) is an infectious disease first identified in 2019. The virus rapidly spread into a global pandemic by spring of 2020 that is still an active issue at time of plan development. It has now been detected across the world, including in the United States and New York State. Older people, and those with underlying medical problems, like cardiovascular disease, diabetes, chronic respiratory disease, and cancer, are more likely to develop serious illness (WHO 2020). With the virus being relatively new, information regarding transmission and symptoms of the virus is still new and a vaccine is still under development as of 2020. The COVID-19 virus spreads primarily through droplets of saliva or discharge from the nose when an infected person coughs or sneezes. Reported illnesses have ranged from mild symptoms to severe illness and death. Reported symptoms include trouble breathing, persistent pain or pressure in the chest, new confusion or inability to arouse, and bluish lips or face. Symptoms may appear 2-14 days after exposure to the virus (based on the incubation period of MERS-CoV viruses) (CDC 2020).

In an effort to slow the spread of the virus, New York State has urged the public to avoid touching of the face, properly wash hands often, wearing masks, and use various social distancing measures such as avoiding mass gatherings and maintaining a 6 feet distance between each other. Based on observations thus far, most cases are clustered in highly populated urban centers. At the time of this plan update, there are no specific vaccines for COVID-19 and treatments continue to be developed and improved upon. There are many ongoing clinical trials evaluating potential vaccines (WHO 2020). At the same time, in order contain the virus spread, active contact tracing and testing has been underway in Tompkins County and individuals who have been in contact with or have traveled out of state are required to self-quarantine.

Influenza

Based on the number of reported cases between 2017 and 2021, Tompkins County typically saw an average of 3,770 cases of flu per year. The risk of a global influenza pandemic has increased over the last several years. Influenza and pneumonia rank among the deadliest illnesses in the United States. Influenza also known as the flu, is caused by a virus, with symptoms including coughing, fatigue, and fever. An influenza pandemic has the ability to reduce the health, safety, and welfare of the essential services workforce; immobilize core infrastructure; and induce fiscal instability. Based on national historic trend, the US has seen an overall decline in the number of deaths between 1999 and 2017 due to the increasing advancement in technology and medical systems (NYS Health Department, 2020).

Pandemic influenza is different from seasonal influenza (or "the flu") because outbreaks of seasonal flu are caused by viruses that are already among people. Pandemic influenza is caused by an influenza virus that is new to people and is likely to affect many more people than seasonal influenza. In addition, seasonal flu occurs every year, usually during the winter season, while the timing of an influenza pandemic is difficult to predict. Pandemic influenza is likely to affect more people than the seasonal flu, including young adults (Barry Eaton District Health Department 2013).

At the national level, the CDC's Influenza Division has a long history of supporting the World Health Organization (WHO) and its global network of National Influenza Centers (NIC). With limited resources, most international assistance provided in the early years was through hands-on laboratory training of in-country staff, the annual provision of WHO reagent kits (produced and distributed by CDC), and technical consultations for vaccine strain selections. The Influenza Division also conducts epidemiologic research including vaccine studies and serologic assays and provided international outbreak investigation assistance (CDC 2010).

Ebola Virus

Although never reported in Tompkins County and only four times in the United States, Ebola is known for causing hemorrhagic fever and is a rare and deadly disease caused by infection with one of the Ebola virus strains. While this virus is known to have caused significant outbreaks throughout the world, toe main countries that have seen the largest number of cases include Guinea, Liberia, and Sierra Leone, and other parts of West Africa. The virus is most known to be transmitted through blood or bodily fluids of an affected person or though objects (i.e. needles) that have been contaminated by the fluids. However, this EVD is not a food, water or airborne illness and cannot be transmitted through coughs or sneeze. Symptoms of EVD include fever, headaches, joint and muscle aches, abdominal pain, weakness, excessive secretion of body fluids, swelling, and difficulty of breathing and can last anywhere between 2 and 21 days (CDC 2014).

Measles

Measles is a growing concern with many NYS and national outbreaks in 2019. During the last outbreak, there were 426 confirmed cases in the State, with no cases reported in Tompkins County. It is a highly contagious respiratory disease that lives in the nose and throat mucus of an infected person. It can spread to others through coughing and sneezing. Also, measles virus can live for up to two hours in an airspace where the infected person coughed or sneezed. If other people breathe the contaminated air or touch the infected surface, then touch their eyes, noses, or mouths, they can become infected. Measles is so contagious that if one person has it, 90% of the people close to that person who are not immune will also become infected (CDC 2017). On average, most people are infected for about 10 to 12 days. In some extreme cases, some individuals could react in a violent way by experiencing brain infection and or permanent brain damage and need to be hospitalized.

Tuberculosis

Tuberculosis (TB) is caused by a bacterium called Mycobacterium tuberculosis. The bacteria usually attack the lungs, but TB bacteria can attack any part of the body such as the kidney, spine, and brain. Not everyone infected with TB bacteria becomes sick. As a result, two TB-related conditions exist: latent TB infection (LTBI) and TB disease. If not treated properly, TB disease can be fatal (CDC 2016).

TB bacteria are spread through the air from one person to another. The TB bacteria are put into the air when a person with TB disease of the lungs or throat coughs, speaks, or sings. People nearby may breathe in these bacteria and become infected (CDC 2016).

Symptoms of TB disease depend on where in the body the TB bacteria are growing. TB bacteria usually grow in the lungs (pulmonary TB). TB disease in the lungs may cause symptoms such as a bad cough that lasts three weeks or longer, pain in the chest, and coughing up blood or sputum (phlegm from deep inside the lungs). Other symptoms of TB disease include weakness or fatigue, weight loss, no appetite, chills, fever, and sweating at night (CDC 2016).

Hepatitis A

Hepatitis A is a vaccine-preventable, communicable disease of the liver caused by the hepatitis A virus (HAV). It is usually transmitted person-to-person through the fecal-oral route or consumption of contaminated food or water. Hepatitis A is a self-limited disease that does not result in chronic infection. Most adults with hepatitis A have symptoms, including fatigue, low appetite, stomach pain, nausea, and jaundice, that usually resolve within 2 months of infection; most children less than 6 years of age do not have symptoms or have an unrecognized infection. Antibodies produced in response to hepatitis A infection last for life and protect against reinfection. The best way to prevent hepatitis A infection is to get vaccinated (CDC 2019).

Tick-Borne/Mosquito Based Diseases

Ticks and mosquitos can spread diseases through bites from infected insects. These arthropod-borne viruses, also known as arboviruses, are viruses that are maintained in nature through biological transmission between hosts (mammals such as deer and dogs) and blood-feeding arthropods (mosquitos and ticks). These infections usually occur during warm weather months, when mosquitoes and ticks are active (NYS Department of Health 2017). However, with climate change these diseases are becoming more year-round in nature.

Tick-Borne Diseases

Tick-borne diseases are bacterial illnesses that spread to humans through infected ticks. These types of diseases rely on ticks for transmission. Ticks become infected by micro-organisms when feeding on small infected mammals (mice and voles). Different tick-borne diseases are caused by different micro-organisms, and it is possible to be infected with more than one tick-borne disease at a time. Anyone who is bitten by an infected tick may get a tick-borne disease. People who spend a lot of time outdoors have a greater risk of becoming infected. The three types of ticks in New York that may carry disease-causing micro-organisms are the Blacklegged Tick (Ixodes scapularis) (also known as Deer Tick), Lone Star Tick (*Amblyomma americanum*), and the American dog tick (*Dermacentor variabilis*) (NYS Department of Health 2019). Pathogens that are transmitted from the Black Legged Tick is not just Lyme Disease, according to the CDC, but can include others including Anaplasmosis, Babesiosis, Ehrlichiosis, Southern tick-associated rash illness (STARI), and Tularemia. More information on these specific pathogens can be found through the CDC website: https://www.cdc.gov/ticks/diseases/index.html.

Lyme Disease

Lyme disease is a growing concern in Tompkins County, with 58 reported cases in 2018 (most current statistics). It is an infection caused by the bacteria Borrelia burgdorferi and is spread to humans through the bite of infected blacklegged ticks (or deer ticks). The infection can cause a variety of symptoms and, if left untreated, can be severe. While it is commonly known that deer ticks are the carriers of Lyme, that is not always the case given not all deer ticks carry the virus. Immature ticks become infected by feeding on infected white-footed mice and other small mammals. Deer ticks can also spread other tick-borne diseases. Anyone who is bitten by a tick carrying the bacteria can become infected (NYS Department of Health 2017). In general, it takes approximately 36 to 48 hours for the tick to stay attached and transmit the virus, while it takes 3 to 30 days for symptoms to show, which can include a circular bulls eye rash around the bite, chills and fever, headache, fatigue, stiff neck, and muscle/ joint pain. If went untreated these symptoms can worsen and lead to heart and central nervous system problems (Tompkins Health Department, 2020).

Mosquito Based Diseases

Mosquito-borne diseases are spread through the bite of an infected female mosquito. In general, Eastern equine encephalitis (EEE, "triple E") is a very rare but serious virus that can infect people, horses, and other mammal, as well as birds, reptiles and amphibians. In the US, about 5-10 EEE cases are reported each year and in New York State a total of 5 cases have been reported since 1971, according to the New York State Health Department. All five of these cases occurred in 1971, 1983, 2009, 2010, and 2011 in nearby Oswego and Onondaga Counties. Each one of these cases reported death.

West Nile Virus

Based on existing data provided by the New York State Department of Health, 2019 records show that 571 WNV-positive mosquito pools have been identified while 13 human cases, 1 equine, and 1 presumptive viremic donor has been reported to the CDC (NYS DOH, 2020).

West Nile Virus (WNV) encephalitis is a mosquito-borne viral disease, which can cause an inflammation of the brain. WNV is commonly found in Africa, West Asia, the Middle East and Europe. West Nile virus was first found in New York State in 1999. Since 2000, 490 human cases and 37 deaths of WNV have been reported statewide along with 37 deaths (NYS Department of Health 2019). Note that WNV is separate from Eastern equine encephalitis or EEE, which is a much more serious illness that is more likely to result in death, even though they are both transmitted through mosquitos. Also, EEE has common symptoms as WNV including a fever, headache, body aches, and skin rash/ swollen glands (Tompkins Health Department, 2020). In a small number of cases, WNV has been spread by blood transfusion, which has resulted in the screening of blood donations for the virus in the US, or by organ transplantation. WNV can also be spread from mother to baby during pregnancy, delivery, or breast-feeding in a small number of cases. The symptoms of severe infection (West Nile encephalitis or meningitis) can include headache, high fever, neck stiffness, muscle weakness, stupor, disorientation, tremors, seizures, paralysis, and coma. Unfortunately, as of 2020, there are no specific treatments for WNV and as already noted, depending on the individual body reaction can cause serious illness, and in some cases, death, if not permanent brain damage. Usually, symptoms occur from 3 to 14 days after being bitten by an infected mosquito (Tompkins Health Department, 2020).

Eastern Equine Encephalitis

Based on existing data provided by the New York State Department of Health, 2019 records show that 66 EEE Virus positive mosquito pools have been identified while 0 human and 8 equine cases, 1 caprine and 1 ratite case has been reported (NYS DOH, 2020)

Eastern equine encephalitis (EEE), sometimes confused with West Nile Virus due to its similar symptoms, is a virus disease of wild birds that is transmitted to horses and humans by mosquitoes. It is a rare but serious viral infection. EEE is a rare but serious and often fatal infection that causes encephalitis or inflammation of the brain (NYS Department of Health 2016). EEE is most common in the eastern half of the U.S. and is spread by the bite of an infected mosquito. EEE can affect humans, horses, and some birds. The risk of getting EEE is highest from late July through September. People at the greatest risk of developing severe disease are those over 50 years of age and younger than 15 years of age (NYS Department of Health 2019). Based on records of individuals who have been infected by the eastern equine encephalitis since 1971, a total of 5 cases have been reported for the years of 1971, 1983, 2009, 2010, and 2011 in Oswego and Onondaga Counties, all of which resulted in death. Like WNV, there are no specific treatments available for EEE, other than supportive therapy such as hospitalization, respiratory support, and IV fluids.

St. Louis Encephalitis

Although St. Louis Encephalitis (SLE) has never been reported in Tompkins County, it has been found in the United States. It is a rare but serious viral infection. It is transmitted to humans by the bite of an infected mosquito. Most cases of SLE disease have occurred in eastern and central states. Most persons infected with SLE have no apparent illness. Initial symptoms of those who become ill include fever, headache, nausea, vomiting, and tiredness. Severe neuroinvasive disease (often involving encephalitis, an inflammation of the brain) occurs more commonly in older adults (CDC 2019).

Extent

Viral/Bacterial Disease

The exact size and extent of an infected population depends on how easily the illness is spread, the mode of transmission, and the amount of contact between infected and uninfected individuals. The transmission rates of pandemic illnesses are often higher in more densely populated areas. The transmission rate of infectious diseases will depend on the mode of transmission of a given illness.

It is important to note that, unlike many other counties in New York State, Tompkins County, especially the City of Ithaca, is unique in that a large portion of the population is highly mobile between regions due to the high student population, especially those with connection to larger urban centers from New York, to Los Angeles, to international cities like Hong Kong. As a result, Tompkins County is especially vulnerable to disease outbreak, and requires close monitoring between its local and student population in order to contain outbreaks.

Coronavirus, Influenza and Ebola

Interpandemic Phase New virus in animals, no human cases	Low risk of human cases	1
	Higher risk of human cases	2
Pandemic Alert New virus causes human cases	No or very limited human-to-human transmission	3
	Evidence of increased human-to-human transmission	4
	Evidence of significant human-to-human transmission	5
Pandemic	Efficient and sustained human-to-human transmission	6

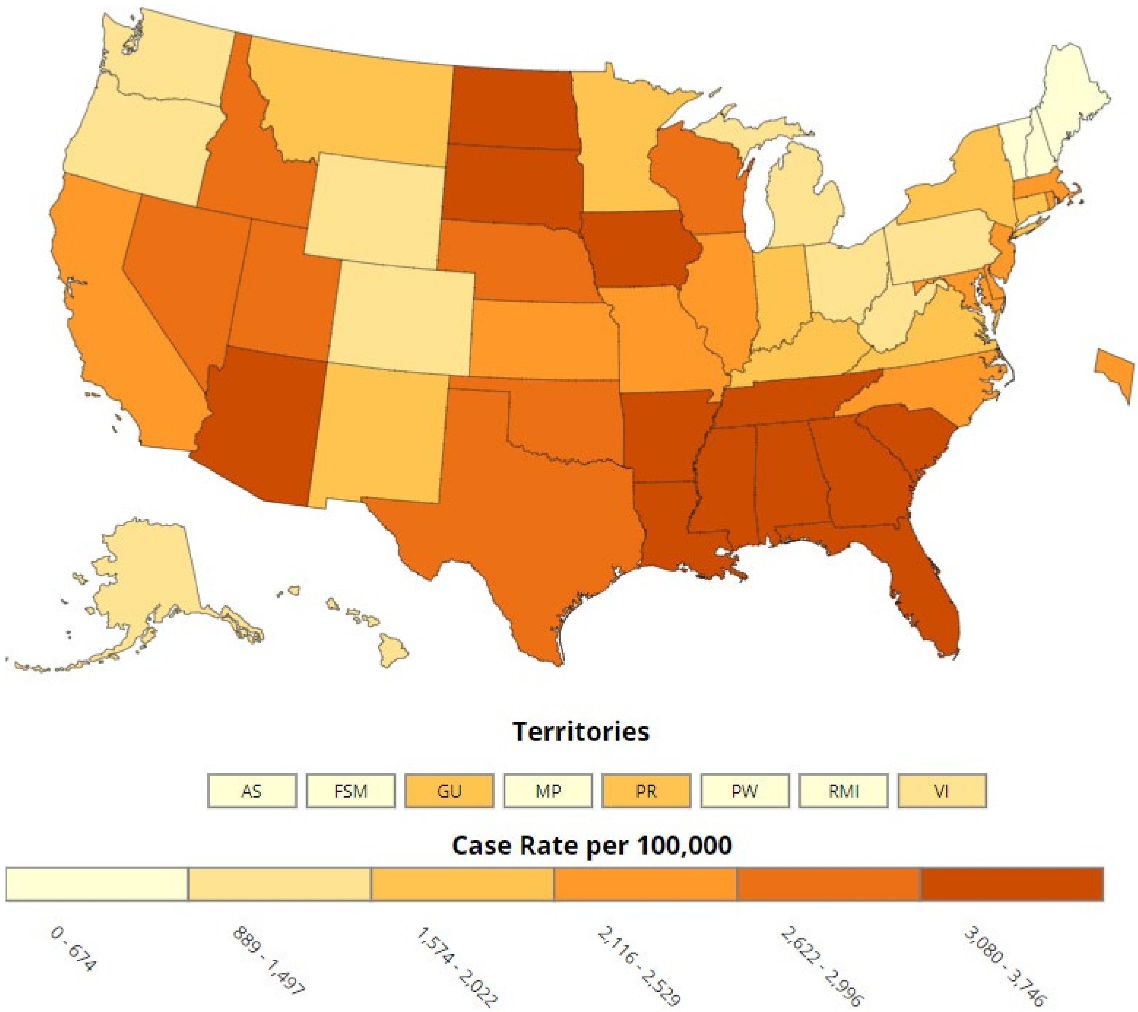
As noted above, the exact size and extent of an infected population depends on how easily the illness is spread, the mode of transmission, and the amount of contact between infected and uninfected individuals. The transmission rates of pandemic illnesses are often higher in more densely populated areas. The transmission rate of infectious diseases will depend on the mode of transmission of a given illness. The Ebola virus is spread to others through direct contact; it is not spread through the air like influenza. The severity and length of the next pandemic cannot be predicted; however, experts expect that its effect on the United States could be severe.

In 1999, the WHO Secretariat published guidance for pandemic influenza and defined the six phases of a pandemic. Updated guidance was published in 2005 to redefine these phases. This schema is designed to provide guidance to the international community and to national governments on preparedness and response for pandemic threats and pandemic disease. Compared with the 1999 phases, the new definitions place more emphasis on pre-pandemic phases when pandemic threats may exist in animals or when new influenza virus subtypes infect people but do not spread efficiently. Because recognizing that distinctions between the two interpandemic phases and the three pandemic alert phases may be unclear, the WHO Secretariat proposes that classifications be determined by assessing risk based on a range of scientific and epidemiological data (WHO 2009).

In New York, activities to be undertaken by pandemic period, use the World Health Organization's classification system. The Pandemic Influenza Plan describes activities which are designated as to whether they are the role of the state health department, local health department and/or providers and public health partners (NYS Department of Health 2006).

As the entire world is in the midst of the Coronavirus pandemic, New York State and Tompkins County have taken extensive measures to measure the number of cases contracted day by day. Because the number of cases continue to grow at this time, the extent cannot be shown. However, based on existing data, the average number of cases per 100,000 individuals has been recorded and depicted in the following CDC map.

Figure 5.4.1-1. Average Number of COVID-19 Cases Per 100,000 Individuals



Measles

From 2014 to 2018, there were no reported cases of Measles in Tompkins County (NYS Department of Health 2020).

Tuberculosis

From 2014 to 2018, there were 12 confirmed cases of Tuberculosis in Tompkins County (NYS Department of Health 2020).

Hepatitis A

From 2014 to 2018, there was one confirmed case of Hepatitis A in Tompkins County (NYS Department of Health 2020).

Tick-borne and Mosquito Based Disease

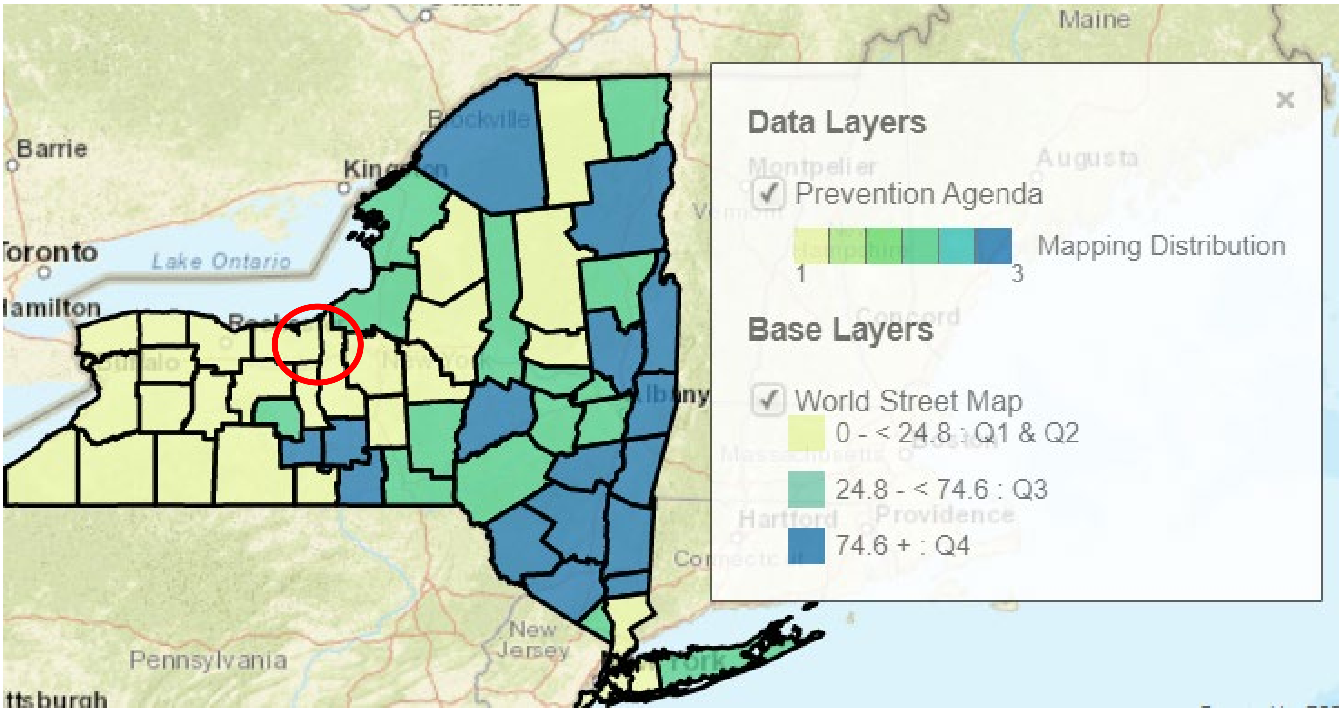
The extent and location of disease outbreaks depends on the preferred habitat of the species, as well as the species' ease of movement and establishment. The magnitude of disease outbreaks species ranges from nuisance to widespread. The threat is typically intensified when the ecosystem or host species is already stressed, such as periods of drought. The already weakened state of the ecosystem causes it to more easily be impacted to an infestation. The presence of disease-carrying mosquitoes and ticks has been reported throughout most of New York and Tompkins County.

Lyme Disease

Lyme disease is the most commonly reported vector borne illness in the U.S. Between 2014 and 2018, there were 716 confirmed cases of Lyme disease in Tompkins County (NYS Department of Health 2020) including 319 cases in 2018 alone. Figure 5.4.1 2 shows the risk of Lyme disease in New York State. The figure indicates that Tompkins County has some of the highest incidence of the disease, with a rate of 116.7 persons per 100,000 people between 2014-2016. While this is not the highest frequency, it is relatively a County with a higher incident of Lyme, compared to the State-wide average.

The CDC Division of Vector Borne Diseases (DVBD) indicated in 2018 that New York was the state with the third-highest number of confirmed Lyme disease cases, totaling approximately 2,886 cases (CDC 2019).

Figure 5.4.1-2. Lyme Disease Incidence Rate per 100,000

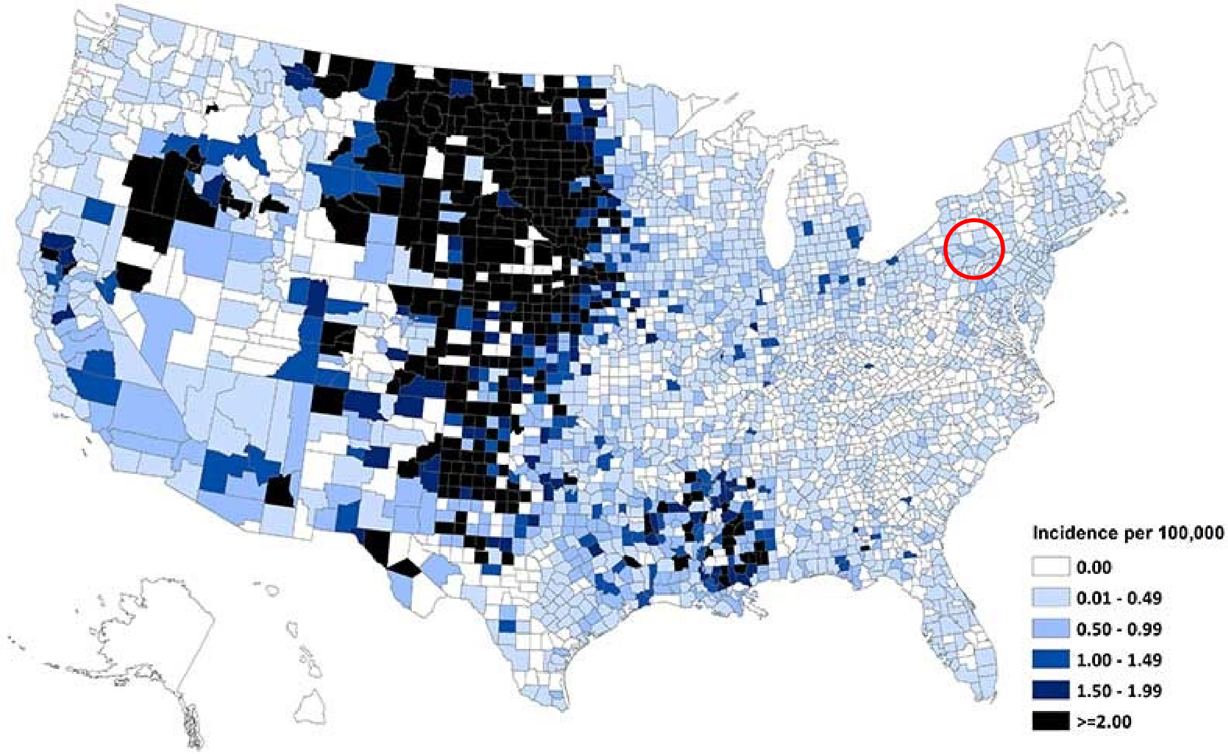


Source: Health Data NY
Note: The red circle indicates the approximate location of Tompkins County.

West Nile Virus

Since it was discovered in the western hemisphere, WNV has spread rapidly across North America, affecting thousands of birds, horses and humans. WNV swept from New York State in 1999 to almost all of the continental U.S., seven Canadian provinces and throughout Mexico and parts of the Caribbean by 2004. Since 2000, 490 human cases and 37 deaths of WNV have been reported statewide. Based on existing data provided by the New York State Department of Health, 2019 records show that 571 WNV-positive mosquito pools have been identified while 13 human cases, 1 equine, and 1 presumptive viremic donor has been reported to the CDC (NYS DOH, 2020). Figure 5.4.1-3 illustrates WNV activity in the U.S. from 1999-2018.

Figure 5.4.1-3. Average Annual Incidence of West Nile Virus Neuroinvasive Disease Reported to CDC by County, 1999-2018



Source: CDC 2019
Note: The circle indicates the approximate location of Tompkins County.

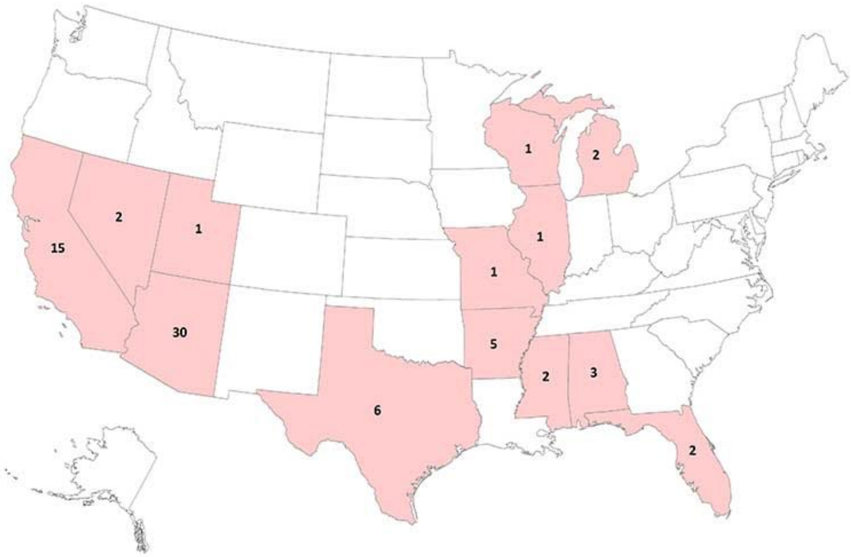
Eastern Equine Encephalitis

In New York State, there has been five cases of EEE, reported for the years 1971, 1983, 2009, 2010, and 2011, occurring in Oswego and Onondaga Counties. Based on existing data provided by the New York State Department of Health, 2019 records show that 66 EEE Virus positive mosquito pools have been identified while 0 human and 8 equine cases, 1 caprine and 1 ratite case has been reported (NYS DOH, 2020)

St. Louis Encephalitis

In New York State, there have been no cases of St. Louis Encephalitis from 2009-2018. However, nearby states have reported cases as shown in the map below (CDC 2019).

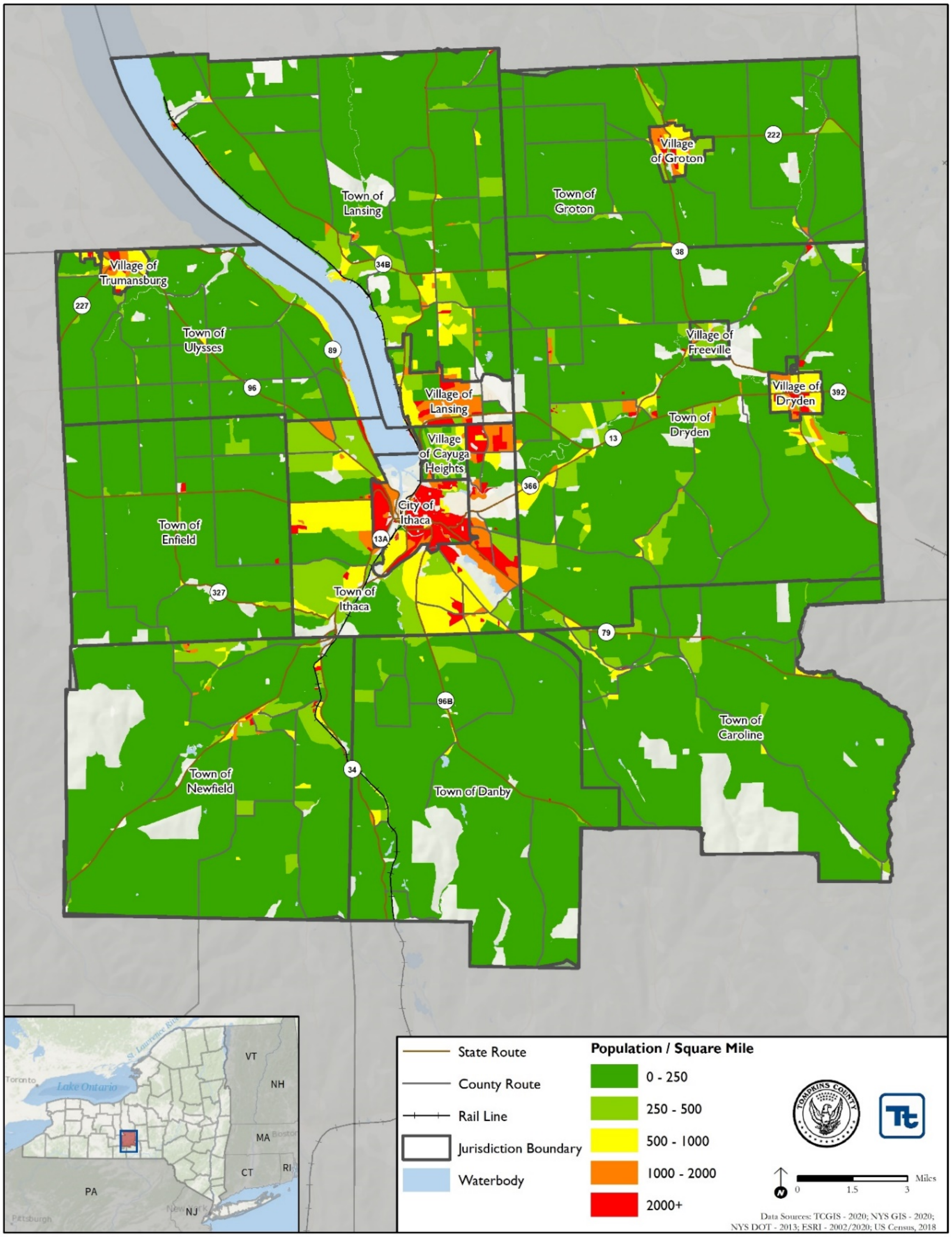
Figure 5.4.1-4. St. Louis encephalitis Virus Neroinvasive disease cases reported by state of residence 2010-2019



Location

Tompkins County is located in a relatively rural setting. The closest large urban centers in the region are Syracuse, Rochester, and Binghamton, all of which are 50 miles or more away. However, unlike most upstate communities, Ithaca and Tompkins County are particularly vulnerable to visitor exposure due to thriving tourism industry and large college student populations. College student populations include those attending Cornell University, Ithaca College, and Tompkins Cortland Community College, all of which total approximately 30,000 people. This means that during the school year, the population of Ithaca, which is also around 30,000, doubles in size. While not all of these individuals are from large cities, a vast majority of these students, as well as staff and faculty, travel between larger urban centers. As a result, while geographically isolated, Ithaca acts as a unique international node that has particularly high exposure to large urban centers, thus placing Tompkins County in high vulnerability to disease exposure.

Figure 5.4.1-5. Tompkins County Population Density



Previous Occurrences and Losses

Many sources provided historical information regarding previous occurrences and losses associated with disease outbreak events throughout New York and Tompkins County. With so many sources reviewed for the purpose of this HMP, loss and impact information for many events could vary depending on the source. Therefore, the accuracy of monetary figures discussed is based only on the available information identified during research for this HMP.

FEMA Major Disasters and Emergency Declarations

Between 1954 and 2020, the State of New York was included in two disease outbreak-related emergency (EM) declarations; one for West Nile Virus and one for the coronavirus pandemic. The State was also included in a disaster (DR) declaration for the coronavirus pandemic. Generally, these disasters cover a wide region of the State; therefore, they may have impacted many counties. However, not all counties were included in the disaster declarations. Tompkins County was included in all three of these declarations (FEMA 2020).

Table 5.4.1-1. Disease Related FEMA Declarations for Tompkins County, 1954 to August 2020

Date(s) of Event	FEMA Declaration Number	Event Type
May 22-November 1, 2000	EM-3155	New York Virus Threat (West Nile Virus)
January 20, 2020 and continuing	EM-3434	New York Covid-19
January 20, 2020 and continuing	DR-4480	New York Covid-19 Pandemic

Source: FEMA Data Visualization. Accessed 10/12/ 2020

Previous Occurrences

For this 2020 HMP update, known disease outbreak events that have impacted Tompkins County between 2014 and 2020 are identified in Table 5.4.1-2.

Table 5.4.1-2. Disease Outbreak Events in Tompkins County, 2014 to 2020

Date(s) of Event	Disease Type	FEMA Declaration Number (if applicable)	Tompkins County Designated?	Description
2014	Hepatitis A	N/A	N/A	The New York State Health Department reported a single case of Hepatitis A in Tompkins County in 2014.
2014	Lab Confirmed Influenza	N/A	N/A	The New York State Health Department reported 267 cases of Lab Confirmed Influenza in Tompkins County in 2014.
2014	Lyme Disease*	N/A	N/A	The New York State Health Department reported 103 cases of Lyme Disease in Tompkins County in 2014.
2014	Tuberculosis	N/A	N/A	The New York State Health Department reported 4 cases of Tuberculosis in Tompkins County in 2014.
2014	West Nile Virus	N/A	N/A	The New York State Health Department reported a single case of Tuberculosis in Tompkins County in 2014.
2015	Lab Confirmed Influenza	N/A	N/A	The New York State Health Department reported 368 cases of Lab Confirmed Influenza in Tompkins County in 2015.
2015	Lyme Disease*	N/A	N/A	The New York State Health Department reported 135 cases of Lyme Disease in Tompkins County in 2015.
2015	Tuberculosis	N/A	N/A	The New York State Health Department reported 2 cases of Tuberculosis in Tompkins County in 2015.
2016	Encephalitis (NON-WNV)	N/A	N/A	The New York State Health Department reported 2 cases of Encephalitis (Non-WNV) in Tompkins County in 2016.
2016	Lab Confirmed Influenza	N/A	N/A	The New York State Health Department reported 430 cases of Lab Confirmed Influenza in Tompkins County in 2016.
2016	Lyme Disease*	N/A	N/A	The New York State Health Department reported 129 cases of Lyme Disease in Tompkins County in 2016.

Date(s) of Event	Disease Type	FEMA Declaration Number (if applicable)	Tompkins County Designated?	Description
2016	Tuberculosis	N/A	N/A	The New York State Health Department reported 2 cases of Tuberculosis in Tompkins County in 2016.
2017	Encephalitis (NON-WNV)	N/A	N/A	The New York State Health Department reported 4 cases of Encephalitis (Non-WNV) in Tompkins County in 2017.
2017	Lab Confirmed Influenza	N/A	N/A	The New York State Health Department reported 663 cases of Lab Confirmed Influenza in Tompkins County in 2017.
2017	Lyme Disease*	N/A	N/A	The New York State Health Department reported 185 cases of Lyme Disease in Tompkins County in 2017.
2017	Tuberculosis	N/A	N/A	The New York State Health Department reported 2 cases of Tuberculosis in Tompkins County in 2017.
2018	Encephalitis (NON-WNV)	N/A	N/A	The New York State Health Department reported 4 cases of Encephalitis (Non-WNV) in Tompkins County in 2018.
2018	Lab Confirmed Influenza	N/A	N/A	The New York State Health Department reported 1041 cases of Lab Confirmed Influenza in Tompkins County in 2018.
2018	Lyme Disease*	N/A	N/A	The New York State Health Department reported 164 cases of Lyme Disease in Tompkins County in 2018.
2018	Tuberculosis	N/A	N/A	The New York State Health Department reported 3 cases of Tuberculosis in Tompkins County in 2018.
Spring 2020 and ongoing	Coronavirus	EM 3434, DR-4480	Yes	Spread of novel coronavirus (COVID-19) led to an emergency declaration and disaster declaration, New York State social distancing requirements, shutdown of non-essential businesses, and the declaration of a global pandemic by the World Health Organization. As of October 12th, 2020, 254,532 tests yielded 475 cases of coronavirus. 433 individuals were noted as recovered from the virus. The majority of

Date(s) of Event	Disease Type	FEMA Declaration Number (if applicable)	Tompkins County Designated?	Description
				cases were found in the City of Ithaca (202), and the Town of Ithaca (58), and the Town of Dryden (32) By summer 2020, new coronavirus cases and associated deaths were decreasing in New York State and Tompkins County and restrictions were eased. However, in fall 2020, cases across New York State and the nation were increasing with projections indicating a second wave of infections was likely in the late fall and winter months.

Source: New York Department of Health 2019; FEMA 2020, WHO 2020, TCHD and Cayuga Health System 2020
N/A Not Available
WNV West Nile Virus
**The number has been extrapolated based on 30 laboratory results.*
With disease outbreak documentation for New York and Tompkins County being so extensive, not all sources have been identified or researched. Therefore, Table 4.3.13-3 may not include all events that have occurred in the County. 2019 statistics were not available at the time of the plan update. Statistics from the 2020 Coronavirus pandemic were subject to change day to day.

Probability of Future Occurrences

It is difficult to predict when the next disease outbreak will occur and how severe it will be because viruses are always changing. The United States and other countries are constantly preparing to respond to pandemic. The Department of Health and Human Services and others are developing supplies of vaccines and medicines. In addition, the United States has been working with the WHO and other countries to strengthen detection of disease and response to outbreaks. Preparedness efforts are ongoing at the national, State, and local level (NYSDOH 2019).

In Tompkins County, the probability for a future disease outbreak event is dependent on several factors. One factor that influences the spread of disease is population density. Populations that live close to one another are more likely to spread diseases. As population density increases in the County, so too will the probability of a disease outbreak event occurring.

All of the critical components necessary to sustain the threat of mosquito-borne disease in Tompkins County have been clearly documented. Instances of the WNV have been generally decreasing throughout the Northeast because of aggressive planning and eradication efforts, but some scientists suggest that as global temperatures rise and extreme weather conditions emerge from climate change, the range of the virus in the United States will grow. Therefore, based on all available information and available data regarding mosquito populations, it can be presumed that mosquito-borne diseases will continue to be a threat to Tompkins County.

Disease-carrying ticks will continue to inhabit the northeast, including Tompkins County, creating an increase in Lyme disease and other types of infections amongst the county population if not controlled or prevented. Ecological conditions favorable to Lyme disease, the steady increase in the number of cases, and the challenge of prevention predict that Lyme disease will be a continuing public health concern. Personal protection measures, including protective clothing, repellents or acaricides, tick checks, and landscape modifications in or near residential areas, may be helpful. However, these measures are difficult to perform regularly throughout the summer. Attempts to control the infection on a larger scale by the eradication of deer or widespread use of acaricides, which may be effective, have had limited public acceptance. Deer management is advocated by a wide range of conservation partners in Tompkins County, including the Finger Lakes Land Trust and Cornell Natural Areas. New methods of tick control, including host-targeted acaricides against rodents and deer, are being developed and may provide help in the future (Steere, Coburn, and Glickstein 2004). However, it is important to note that, based on existing localized trends and projections documented by the Cornell Cooperative Extensions, the warmer winters are likely to contribute to the increasing population of ticks in general, as they would be less likely to die with warmer winters (Tompkins Health Department/ Cooperative Extensions Tompkins County, 2020)

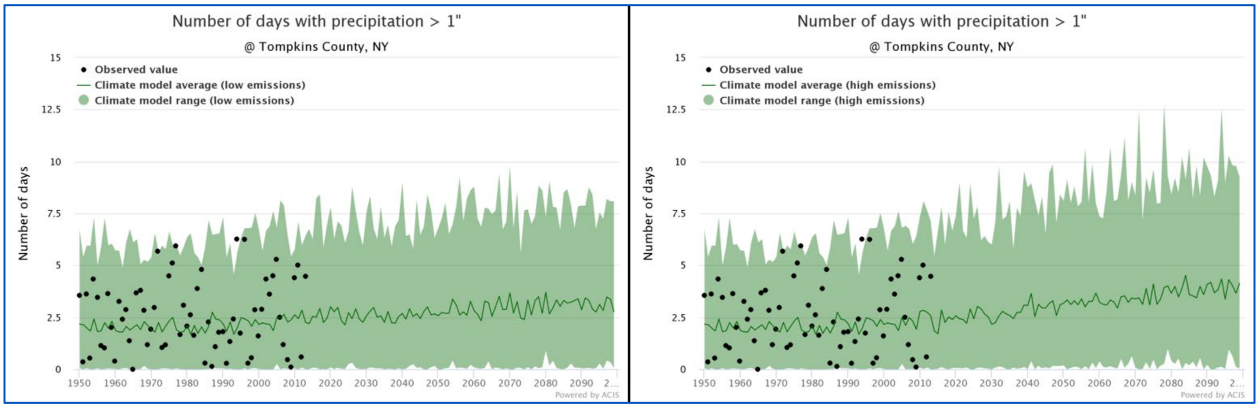
Control of Lyme disease will depend primarily on public and physician education about personal protection measures, signs and symptoms of the disease, and appropriate antibiotic therapy. Regional organizations such as Cornell Cooperative Extension will need to further develop and expand their efforts around tick borne illnesses in Tompkins County (Cornell Cooperative Extension, 2020). Based on available information and the ongoing trends of disease-carrying tick populations, it is anticipated that Lyme disease infections and other tick-borne diseases will continue to be a threat to Tompkins County.

In Section 5.3, the identified hazards of concern for Tompkins County were ranked. The probability of occurrence, or likelihood of the event, is one parameter used for hazard rankings. Based on historical records and input from the Steering and Planning Committees, the probability of occurrence for disease outbreaks in the County is considered 'Occasional'.

Climate Change Impacts

Climate change is beginning to affect both people and resources in New York State, and these impacts are projected to continue growing. Each region in New York State, as defined by ClimAID, has attributes that will be affected by climate change. Tompkins County is part of Region 3, Elmira. In Region 3, it is estimated that temperatures will increase by 3.5ºF to 5.5ºF by the 2050s and 4.5ºF to 8.5ºF by the 2080s (baseline of 46 ºF, mid-range projection). Precipitation totals will increase between 0 and 10% by the 2050s and 5 to 10% by the 2080s (baseline of 38 inches, mid-range projection) (NYSERDA 2014). The heaviest 1% of daily rainfalls have increased by approximately 70% between 1958 and 2011 in the Northeast (Horton et al. 2015). Based on data provided by the New York Paleontological Research Institute located in Ithaca, model projections from the Climate Smart Farming Tool for both high and low emissions scenarios state that by the end of the 21st century in Tompkins County, the mean of model results for days per year with rainfalls above 1 inch in a 24 hour period is about *1 more day per year* for a low emissions scenario, and about *2 more days per year* for a high emissions scenario, compared with the period 1996-2005 (shown in graph below).Increased rainfall and heavy rainfalls increase the chances of standing water where mosquitos breed.

Figure 5.4.1-6 Low and High Emission Scenario Precipitation Projections



**(1) High Emissions: Under this scenario, greenhouse gas emissions and concentrations increase considerably over time, with no mitigation. This is also known as RCP8.5, as defined by the Intergovernmental Panel on Climate Change (IPCC).*

(2) Low Emissions: Under this scenario, greenhouse gas emissions peak at year 2040 and then level off. This is also known as RCP4.5, as defined by the IPCC.

The relationship between climate change and increase in infectious diseases is difficult to predict with certainty, there are scientific linkages between the two. As warm habitats that host insects such as mosquitoes increase, more of the population becomes exposed to potential virus threats (The Washington Post 2017). The notion that rising temperatures will increase the number of mosquitoes that can transmit diseases such as WNV among humans (rather than just shift their range) has been the subject of debate over the past decade. Some believe that climate change may affect the spread of disease, while others are not convinced. However, many researchers point out that climate is not the only force at work in increasing the spread of infectious diseases into the future (NJOEM 2019). Other factors such as land use, development, agricultural practices, and industrial contamination are also at play in contributing to the increasing prevalence of disease outbreak and insect borne diseases.

5.4.1.2 Vulnerability Assessment

To understand risk, a community must evaluate what assets are exposed or vulnerable to the identified hazard. The following discusses Tompkins County's vulnerability, in a qualitative nature, to the disease outbreak hazard.

Impact on Life, Health and Safety

The entire population of Tompkins County is vulnerable to the disease outbreak hazard. Due to a lack of quantifiable loss information, a qualitative assessment was conducted to evaluate the assets exposed to this hazard and the potential impacts associated with this hazard.

Healthcare providers and first responders have an increased risk of exposure due to their frequent contact with infected populations. Areas with a higher population density also have an increased risk of exposure or transmission of disease to do the closer proximity of population to potentially infected people.

Individuals most vulnerable to disease outbreak include: healthcare providers, first responders, over 65, long-term care facility residents, and those with underlying medical conditions.

Most recently with COVID-19, the Centers for Disease Control and Prevention have indicated that persons over 65 years, persons living in a nursing home or long-term care facility, and persons with underlying medical conditions such as diabetes, severe obesity, serious heart conditions, etc. are at a higher risk of getting severely ill (CDC 2020). Population data from the 2018 5-year American Community Survey indicates that 13,561 persons over 65 years old in Tompkins County would be considered at risk for getting severely ill from the COVID-19 virus. While the statistics of this virus are subject to change during the publication of this HMP, the New York Department of Health dashboard shows that there is a higher percent of illnesses within the mentioned age group and Tompkins County is within the top 30 counties for number of cases that tested positive for the COVID-19 virus in the state of New York (NYSDOH 2020).

Impact on General Building Stock

No structures are anticipated to be directly affected by disease outbreaks.

Impact on Community Lifelines

No critical facilities or infrastructure are anticipated to be affected by disease outbreaks. Hospitals and medical facilities will likely see an increase in patients, but it is unlikely that there will be damages or interruption of services. However, large rates of infection may result in an increase in the rate of hospitalization which may overwhelm hospitals and medical facilities and lead to decreased services for those seeking medical attention. The COVID-19 pandemic has led to overwhelmed hospitals in numerous hotspots. The importance of other community lifelines particularly food providers have been particularly stressed and valued from the recent COVID-19 pandemic.

Impact on Economy

The impact disease outbreaks have on the economy and estimated dollar losses are difficult to measure and quantify. Costs associated with the activities and programs implemented to conduct surveillance and address disease outbreaks have not been quantified in available documentation. Instead, activities and programs implemented by the County to address this hazard are described below, all of which could impact the local economy.

In Tompkins County, pest management and control services are available for the communities to control ticks, mosquitos, and reduce the annoyance and threat of disease carried by these insects. The County recommends residents to contact the State Health Department for questions and concerns about pests in their community (Tompkins County 2020). Most recently, the Health Department has played an active role in maintaining and controlling COVID-19 protocols across the state. This activity requires additional costs from the State and County to manage COVID-19 in the communities. Further, there has been secondary economic impact of closing non-essential facilities to reduce the spread of the virus. The final costs of this virus are still to be determined.

Impact on Environment

Disease outbreaks may have an impact on the environment if the outbreaks are caused by invasive species. Invasive species tend to be competitive with native species and their habitat and can be the major transmitters of disease like Zika, dengue, and yellow fever (Placer Mosquito and Vector Control District 2019). Secondary impacts from mitigating disease outbreaks could also have an impact on the environment. Pesticides used to control disease carrying insects like mosquitos have been reviewed by the EPA and the New York Department of Environmental Conservation. If these sprays are applied in large concentrations, they could potentially leach into waterways and harm nearby terrestrial species. As a result, pesticides must be registered before they can be sold, distributed, or used in the state (New York Department of Environmental Conservation 2020).

Cascading Impacts on Other Hazards

There are no known cascading impacts that disease outbreaks can cause to other hazards of concern for Tompkins County.

Future Changes that May Impact Vulnerability

Understanding future changes that may impact vulnerability in the county can assist in planning for future development and ensuring that appropriate mitigation, planning, and preparedness measures are in place. The county considered the following factors that may affect hazard vulnerability:

- Potential or projected development.
- Projected changes in population.
- Other identified conditions as relevant and appropriate, including the impacts of climate change.

Projected Development

As discussed in Section 4, areas targeted for future growth and development have been identified across the County. Any areas of growth could be potentially impacted by the disease outbreak hazard because the entire planning area is exposed and vulnerable. Additional development of structures in close proximity to waterbodies or areas with high population density are at an increased risk. Please refer to the specific areas of development indicated in tabular form and/or on the hazard maps included in the jurisdictional annexes in Volume II, Section 9 of this plan.

Projected Changes in Population

According to population projections from the Cornell Program on Applied Demographics, Tompkins County will experience a continual population increase from 2020 through 2040 (over 6,040 people in total by 2040). The U.S. Census Bureau also shows that the population in Tompkins County has increased 0.6-percent between 2010 and 2019 (U.S. Census Bureau 2020). An increase in the population throughout Tompkins County and changes in the density of population when households move throughout the County could influence the number of persons exposed to disease outbreaks. Higher density jurisdictions are not only at risk of greater exposure to disease outbreak, density may also reduce available basic services provided by critical facilities such as hospitals and emergency facilities for persons that are not affected by a disease. Refer to Section 4 (County Profile), for additional discussion on population trends.

Climate Change

As discussed earlier in this section, the relationship between climate change and increase in infectious diseases is difficult to predict with certainty, however there may be linkages between the two. Changes in the environment may create a more livable habitat for vectors carrying disease as suggested by the Centers for Disease Control and Prevention (CDC n.d.). Localized changes in climate and human interaction may also be a factor in the spread of disease.

The notion that rising temperatures will increase the number of mosquitoes that can transmit malaria among humans (rather than just shift their range) has been the subject of debate over the past decade. Some believe that climate change may affect the spread of disease, while others are not convinced. However, many researchers point out that climate is not the only force at work in increasing the spread of infectious diseases into the future. Other factors, such as expanded rapid travel and evolution of resistance to medical treatments, are already changing the ways pathogens infect people, plants, and animals. As climate change accelerates it is likely to work synergistically with many of these factors, especially in populations increasingly subject to massive migration and malnutrition (NYS DEC 2020).

Change of Vulnerability Since the 2014 HMP

In the Tompkins County's 2014 Hazard Mitigation Plan, the County assessed human driven epidemic events as a hazard of concern. Disease outbreak is a counterpart to this original hazard of concern, which uses updated population information and more recent research of disease outbreaks to assess the County's change in risk to this hazard of concern. Overall, the entire County is still considered vulnerable to disease outbreaks.

Identified Issues

- Ithaca and Tompkins County are particularly vulnerable to visitor exposure due to a thriving tourism industry and large college student populations. During the school year, the population of Ithaca doubles in size. While not all of these individuals are from large cities, a vast majority of these students, as well as staff and faculty, travel between larger urban centers, with significant numbers traveling from international locations. As a result, while geographically isolated, Ithaca acts as a unique international node that has particularly high exposure to large urban centers, thus placing Tompkins County in high vulnerability to disease exposure.
- From 2004 to 2016, Lyme disease cases in the United States doubled from 22,000 to 48,000 and accounted for 82 percent of tick-bone diseases. Since 2000, the number of reported cases in Tompkins County has steadily increased. This increase can be related to an increase in state and local health department reporting, new tick species, and changing climate patterns, (CDC 2019).
- The elderly population is more susceptible to the effects of certain diseases because they are at higher risks of acquiring infection, more disease-related complications, and increased risk of disease-related deaths.
- The impact of climate change on disease outbreaks is unknown; however, could accelerate the spread of an infectious disease.
- During an outbreak, any localities, including the County, can experience a shortage of proper personal protective equipment (PPE) for essential personnel, increasing risk of spread and other diseases among residents and essential personnel.

5.4.2 Drought

This section provides a hazard profile and vulnerability assessment of the drought hazard for Tompkins County.

The hazard profile is organized as follows:	The vulnerability assessment is organized as follows:
• Description • Extent • Previous Occurrences and Losses • Probability of Future Occurrences • Climate Change Impacts	• Impact on Life and Safety • Impact on General Building Stock • Impact on Community Lifelines • Impact on Economy • Impact on Environment • Cascading Impacts on Other Hazards • Future Change that may Impact Vulnerability • Changes Since 2014 HMP • Identified Issues

5.4.2.1 Hazard Profile

This section presents information regarding the description, extent, location, previous occurrences and losses, and probability of future occurrences for the drought hazard. In addition, as wildfire is considered a cascading impact of drought conditions, it will be discussed in this section.

Description

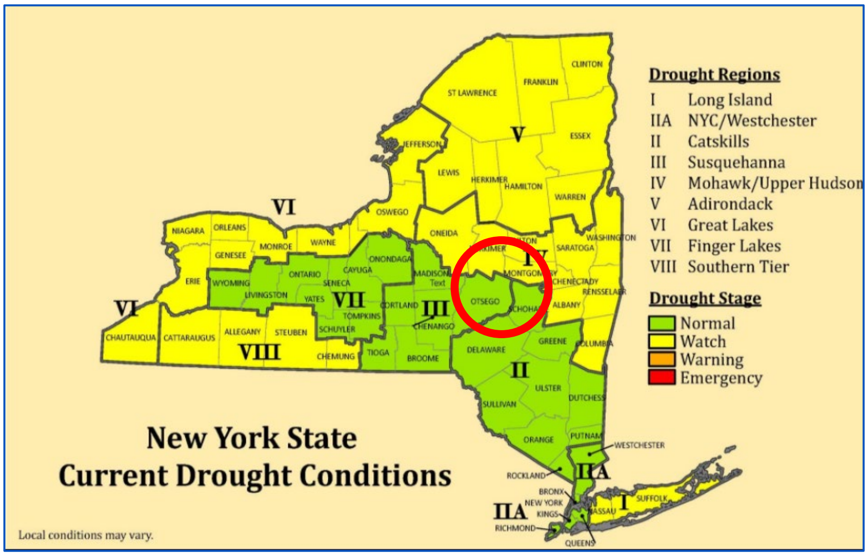
Drought is a period of time characterized by long durations of below-normal precipitation levels. It is a temporary irregularity that differs from aridity (permanent low rainfall). Drought conditions occur in virtually all climatic zones., but drought characteristics vary significantly by region. Drought adversely affects agriculture, water supply, aquatic ecology, wildlife, and plant life.

Droughts can be a contributing factor to wildfire/brush fire risk due to dry vegetation providing fuel for fires. Wildfire can spread rapidly especially during periods of dry weather and droughts. It is defined as an uncontrolled fire spreading through natural or unnatural vegetation that can threaten lives and property if not contained. Wildfire can also be referred to as forest fire, brush fire, grass fires, wildland urban interface (WUI) fire, range fire, or ground fire (NYS DHSES 2019).

Extent

Drought

Figure 5.4.2-1. NYSDEC Region Map



The severity of a drought depends on the degree of moisture deficiency, the duration of the event, and the size and location of the affected area. The longer the duration of the drought and the larger the area impacted, the more severe the potential impacts. New York State applies two methodologies to identify the different drought stages - the Palmer Drought Severity Index (PDSI) and the State Drought Index (SDI). The two indices show us different things about drought. The Palmer Index, with its emphasis on soil moisture, helps us understand agricultural impacts. The State Index helps assess the impact on human welfare and the regional economy (NYSDEC 2020).

State Drought Index (SDI)

The New York State Department of Environmental Conservation (NYSDEC) divides New York State into nine drought management regions, with divisions roughly following drainage basin contours and county lines. Tompkins County is located within the Finger Lakes Drought Region (Region VII). NYSDEC monitors precipitation, stream flow, lake and reservoir levels, and groundwater levels at least monthly in each region and more frequently during periods of drought. NYSDEC uses these data to assess the condition of each region through the SDI, which can range from *normal* to *drought* disaster.

Figure 5.4.2-2. NYSDEC Drought Stages

Drought Stage	Description
Drought Watch	The least severe of the stages, a drought watch is declared when a drought is developing. Public water suppliers begin to conserve water and urge customers to reduce water use.
Drought Warning	Voluntary water conservation is intensified. Public water suppliers and industries update and implement local drought contingency plans. Local agencies make plans in case of emergency declaration.
Drought Emergency	The Governor may declare emergency. The Disaster Preparedness Commission coordinates response. Mandatory local/county water restrictions may be imposed. Communities may need to tap alternative water sources to avoid depleting water supplies, protect public health and provide for essential uses.
Drought Disaster	Disaster plans are implemented. Water use is further restricted. The Governor may declare disaster and request federal disaster assistance. Emergency legislation may be enacted. The state provides equipment and technical assistance to communities.

The SDI compares four parameters to historic or "normal" values to evaluate drought conditions: stream flows, precipitation, lake and reservoir storage levels, and groundwater levels. New York's Drought Management Task Force uses those factors as well as water use, duration of the dry period, and season to assess drought in different parts of the state. (NYSDEC 2020).

Palmer Drought Severity Index

The Palmer Drought Severity Index (PDSI) is primarily based on soil conditions calculated by the National Weather Service. Soil with decreased moisture content is the first indicator of an overall moisture deficit. Table 5.4.2-1 lists the PDSI classifications. At the one end of the spectrum, 0 is used as normal and drought is indicated by negative numbers. For example, -2 is moderate drought, -3 is severe drought, and -4 is extreme drought. The PDSI can reflect excess precipitation using positive numbers; however, this is not shown in the table. The PDSI is commonly converted to the Palmer Drought Category (National Drought Mitigation Center [NDMC] 2013). As a reference point, the drought experienced in late summer early fall 2020 in Tompkins County was D1 (Moderate Drought).

Table 5.4.2-1. Palmer Drought Category and Palmer Drought Index Descriptions

Category	Description	Possible Impacts	Palmer Drought Index
D0	Abnormally Dry	Going into drought: short-term dryness slowing planting and growth of crops or pastures; fire risk above average. Coming out of drought: some lingering water deficits; pastures or crops not fully recovered.	-1.0 to -1.99
D1	Moderate drought	Some damage to crops and pastures; fire risk high; streams, reservoirs, or wells low; some water shortages developing or imminent; voluntary water-use restrictions requested.	-2.0 to -2.99
D2	Severe drought	Crop or pasture losses likely; fire risk very high; water shortages common; water restrictions imposed.	-3.0 to -3.99
D3	Extreme drought	Major crop or pasture losses; extreme fire danger; widespread water shortages or restrictions.	-4.0 to -4.99
D4	Exceptional drought	Exceptional and widespread crop/pasture losses; exceptional fire risk; shortages of water in reservoirs, streams, and wells, creating water emergencies.	-5.0 or less

Source: NDMC 2013

Wildfire

Wildfire events can range in size and intensity; much of which depends on weather and human activity. Wildfire severity depends on the interaction of fuel, weather, and topography. There is no universal scale to measure the extent or severity of a wildfire, but the acreage burned can be calculated to determine the size of the fire (NYS DSHES 2019).

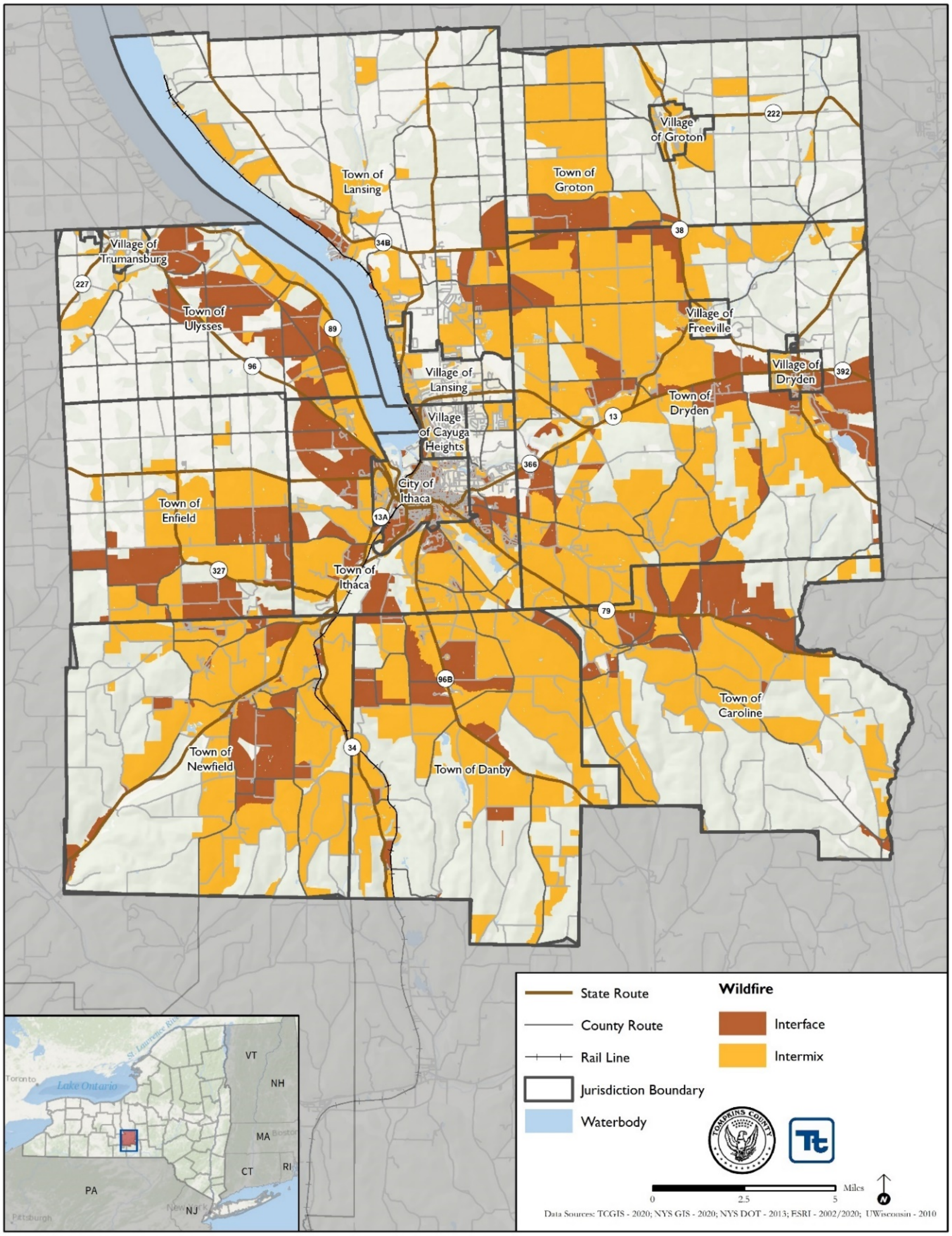
The ***Fire Danger Rating*** in New York State is established using information from the National Fire Danger Rating System (NFDRS) and takes into account current and antecedent weather, fuel types, and both live and dead fuel moisture. This information is provided by local station managers (USFS, n.d.) in each of the 10 regions of New York State. The NFDRS is particularly utilized in those areas in Tompkins County adjacent State Forest Land. Tompkins County is located in Region 7, as shown in Figure 5.4.2-1. Details about this rating system can be found online: https://www.dec.ny.gov/lands/68329.html

Location

Droughts are a regional phenomenon that have the potential to directly or indirectly impact every person in Tompkins County. In general, droughts can occur at any given time of the year in Tompkins County, though most often occurs late summer to early fall. When compared to other parts of the country, this hazard is relatively less likely to occur in this region and most of New York State (NYSDHSES 2019).

Wildfires can occur anywhere; however, they are more common in forested areas. In Tompkins County, areas that are heavily forested or contain large tracts of brush or shrubs are susceptible to fires. During drought conditions, drier vegetation can increase the probability of wildfire occurrences throughout the County. The wildland-urban interface (WUI) is the area where houses and wildland vegetation meet and where wildfire problems are most pronounced (Radeloff et al 2018). Intermix WUI are areas where housing and vegetation intermingle; interface WUI are areas with housing in the vicinity of contiguous wildland vegetation. Approximately 38-percent of the County's land area is within the WUI interface and 34-percent of the County's land is within the WUI intermix. Figure 5.4.2-3 shows the WUI areas throughout Tompkins County. During a drought, these areas may be more susceptible to wildfires.

Figure 5.4.2-3. Wildland-Urban Interface and Intermix Hazard Area in Tompkins County



Previous Occurrences and Losses

Tompkins County does not typically experience severe or extreme drought due to its proximity to the Finger Lakes and overall proximity to the Great Lakes and Atlantic Ocean. Based on available historical records, Tompkins County communities are however still susceptible to drought events and should mitigate to an extent of moderate drought.

FEMA Disaster Declarations

Between 1954 and 2020, Federal Emergency Management Agency (FEMA) declared that New York State experienced one drought-related disaster declaration that was classified as a water shortage. Tompkins County was however not included in that disaster declaration.

USDA Agricultural Disaster Declarations

The U.S. Department of Agriculture (USDA) keeps different drought records which are specific to agricultural disasters. In 2012, USDA Agricultural Disasters S3427 and S3441 were declared for drought. In 2016, USDA Agricultural Disasters S4023, S4031, and S4062 were declared for drought. The USDA-reported crop losses provide another indicator of previous events. The USDA records indicate that Tompkins County has not experienced crop losses from drought events from 2014 to 2020. Crop losses prior to 2014 were unavailable.

Previous Events

Table 5.4.2-2 lists known drought events between 2012 and 2020 that have affected Tompkins County and its municipalities based on all sources researched.

Table 5.4.2-2. Drought and Wildfire Events in Tompkins County, 2012 to 2020

Date(s) of Event	Event Type*
July 17–October 23, 2012	According to the PDSI , conditions were classified at D1, or ***moderate drought*** status across Tompkins County from July 17–October 23, 2012.
July 10th, 2012 - December 18th 2020	According to the PDSI, conditions were classified at D0, or ***abnormally dry*** status across Tompkins County from July 10–December 18, 2012.
January 27–June 2, 2015	According to the PDSI, conditions were classified at D0, or ***abnormally dry*** status across Tompkins County from January 27–June 2, 2015.
September 8 – September 29, 2015	According to the PDSI, conditions were classified at D0, or ***abnormally dry*** status across Tompkins County from September 8 – September 29, 2015.
June 7, 2016–February 21, 2017	According to the PDSI, conditions were classified at D0, or ***abnormally dry*** status across Tompkins County from June 7–June 28, 2016; D1 or ***moderate drought*** status from June 28–July 12, 2016; D2 or ***severe drought*** from July 12–August 16, 2016; D3 or ***extreme drought*** status from August 16–October 18, 2016; D2 or ***severe drought*** status from October 18, 2016–November 22, 2016; D1 or ***moderate drought*** status from November 22–February 7, 2017; and D0 or ***abnormally dry*** from February 7 – February 21, 2017. Surveying of New York farmers showed significant crop losses and pastures were dry. Apples were reported as being smaller and sweeter and grapes were slightly small and less acidic throughout the state. New York dairy farmers and Christmas tree farms struggled. Discolored water was reported in Ithaca, NY from June 20–September 17, 2016. Shallow wells in the Northeast went dry. A drought watch and warning was issued for New York in

Date(s) of Event	Event Type*
	July. Drought resulted in shallow marshes, negatively impacting duck and goose hunting in the state. Many of the gorges and streams throughout Ithaca were recorded dry.
September 26–October 24, 2017	According to the PDSI, conditions were classified at D0, or ***abnormally dry*** status across Tompkins County from October 3–October 24, 2017.
July 3, 2018–July 24, 2018	According to the PDSI, conditions were classified at D0, or ***abnormally dry*** status across Tompkins County from June 26, 2018–July 24, 2018.
September 24- October 1, 2019	According to the PDSI, conditions were classified at D0, or ***abnormally dry*** status across Tompkins County from September 24, 2019–October 1, 2019.
June 23, 2020 – October 6th 2020	According to the PDSI, conditions were classified at D0, or ***abnormally dry*** status across Tompkins County from June 23, 2020 – August 11th. 2020 and D1 or ***moderate drought*** between August 18th, 2020 – October 6th, 2020 (as of October 13th, 2020)

Sources: USDA 2020; NDMC 2020

** Many sources were consulted to provide an update of previous occurrences and losses; event details and loss/impact information may vary and has been summarized in the above table*

Probability of Future Occurrences

In the past, Tompkins County has experienced a range of drought conditions from *abnormally dry* to *extreme*, or D0 to D3, in accordance with the PDSI. In contrast, records of wildfires in the region are less frequent. Based on the historic record and climate projections for the region, it is anticipated that Tompkins County will continue to experience added, regular drought events in the future. By the end of this century, the number of droughts is likely to increase, as the effect of higher temperatures on evaporation is likely to outweigh the increase in precipitation, especially during the warm months (NYSERDA). Along with drier weather will likely follow a potential increase in wildfires. According to the New York Climate Smart Farming (http://climatesmartfarming.org/), while projections show that overall precipitation levels are likely to increase over time, the patterns will shift to more intense and infrequent storms, as depicted in the curve graph below. Subsequently, the number of days without any precipitation will likely increase and could increase drought and wildfire in the region (Caroline Climate Vulnerability Assessment, 2020). Refer to Section 5.3 for additional information on the hazard ranking methodology and probability criteria.

Climate change can contribute to increased chances of drought and its secondary impacts such as decreased water supply and higher threat of wildfires. Temperatures and precipitation amounts are expected to increase within the Southern Tier region. Precipitation totals will change between 4 and 10 percent by the 2050s and between 6 and 14 percent by the 2080s (baseline of 35 inches). Table 5.4.2-3 lists projected seasonal precipitation changes within the Southern Tier ClimAID Region (NYSERDA 2014). These projections have the potential to create conditions more favorable to droughts and also leading to increased risk of wildfires in Tompkins County.

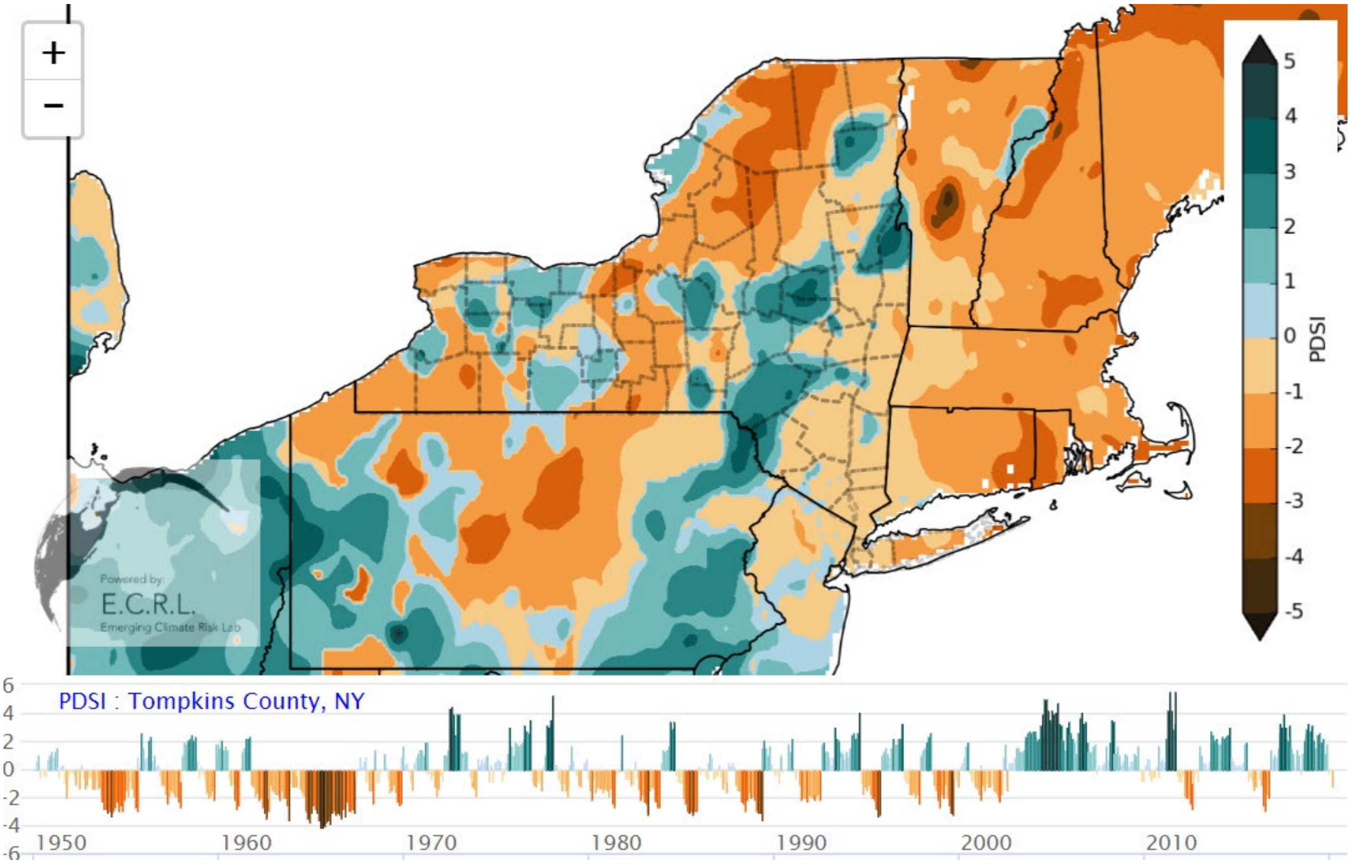
Table 5.4.2-3. Projected Seasonal Precipitation Change in Region 3, 2050s (percent change)

Winter	Spring	Summer	Fall
5 to +15	0 to +10	-5 to +5	-10 to +5

Source: NYSERDA 2014

Current trends also show an increase in precipitation over time, based on historic data, as noted below.

Figure 5.4.2-4. Precipitation Projection Trends for New York State



Based on research conducted by Cornell Cooperative Extension, these precipitation events are likely to intensify, thus leading to higher levels of precipitation during a shorter period of time. The trend between 1950 and 2020 shows an increase in precipitation and there have been intensifying storms over the course of 70 years (Cornell, 2020). As projections show, increased precipitation intensity may be coupled with a higher number of droughts and wildfire events.

5.4.2.2 Vulnerability Assessment

To understand risk, a community must evaluate what assets are exposed or vulnerable to the identified hazard. The following discusses Tompkins County's vulnerability, in a qualitative nature, to the drought hazard.

Impact on Life, Health and Safety

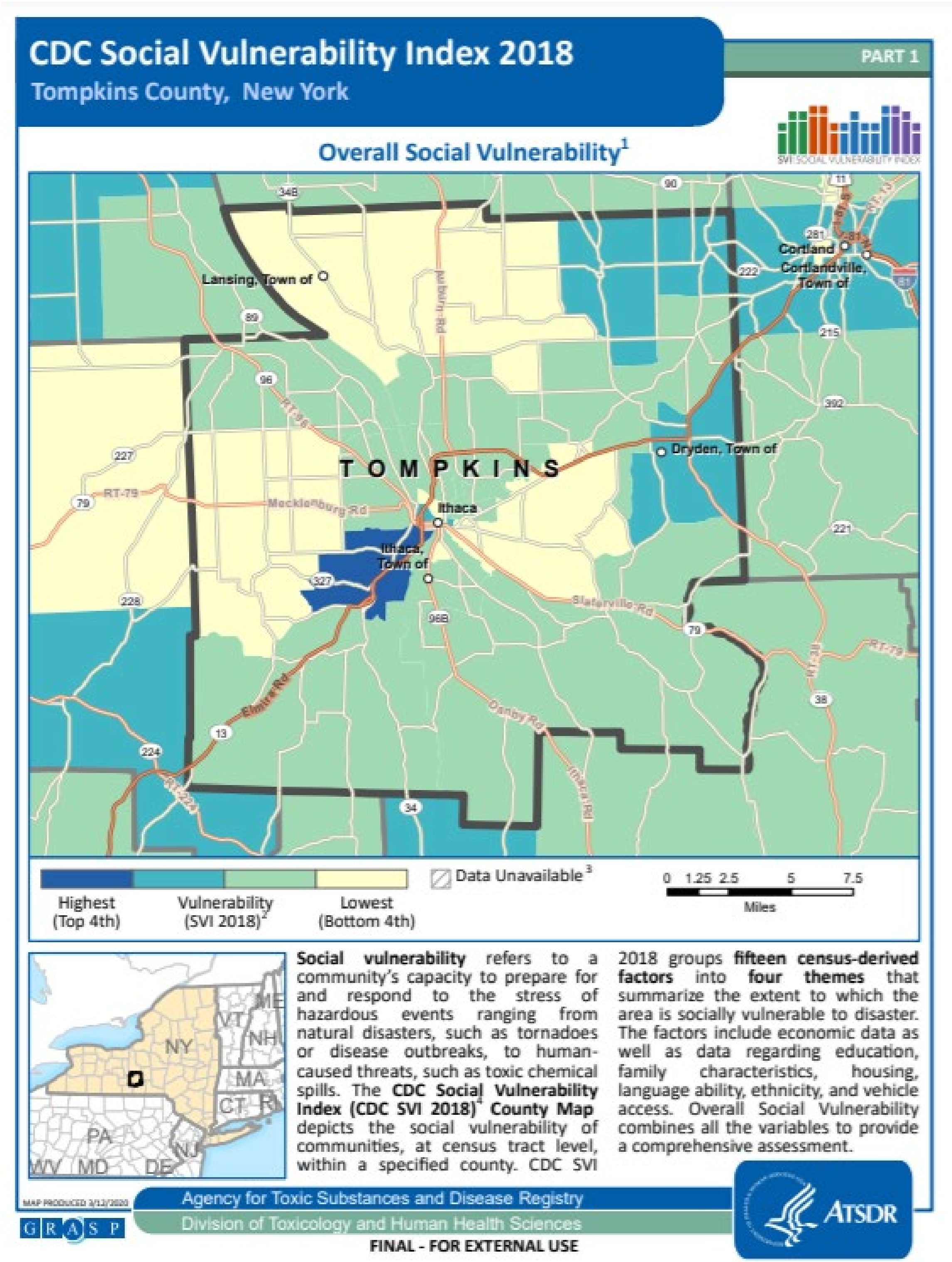
The entire population of Tompkins County is exposed to drought events (population of 102,962 people, according to the 2014-2018 American Community Survey population estimates). Drought conditions can cause a shortage of potable water in both urban and rural areas for human consumption, both in quantity and quality. An increase in drought will result in a disproportionate burden on agricultural producers in the county.

Individuals most vulnerable to drought include those over 65, with underlying medical conditions, with mobility concerns.

Public health impacts may include an increase in heat-related illnesses, waterborne illnesses, recreational risks, and reduced food availability. Vulnerable populations could be particularly susceptible to the drought hazard and cascading impacts especially those over 65, those with underlying health conditions, and those limited ability to mobilize to shelter, cooling and medical resources. Other possible impacts to health due to drought include increased recreational risks; effects on air quality; diminished living conditions related to energy, air quality, and sanitation and hygiene; compromised food and nutrition; and increased incidence of illness and disease. Overall, the health implications of drought are numerous. Some drought-related health effects are short-term while others can be long-term (CDC 2020).

The Centers for Disease Control and Prevention's (CDC) 2016 Social Vulnerability Index (SVI) ranks U.S. Census tracts on socioeconomic status, household composition and disability, minority status and language, and housing and transportation. An indication of the distribution of socially vulnerable populations is provided in Figure 5.4.2-5. Being aware of the County's overall ranking can help inform how the communities may react to a drought event based upon available resources. Areas with low to moderate vulnerability may experience minor issues responding to drought events.

Figure 5.4.2-5 Tompkins County Social Vulnerability Index



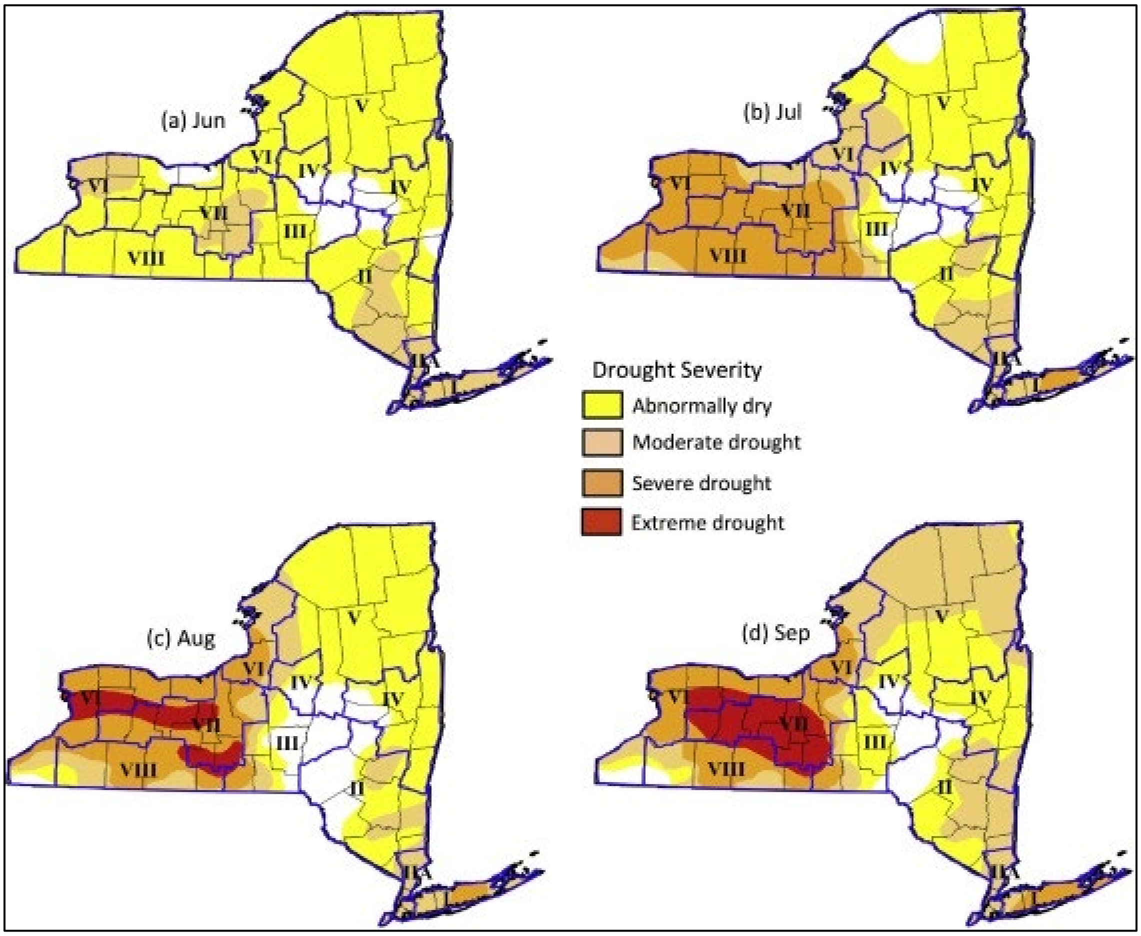
Source: CDC, 2021

In addition to those noted vulnerable groups, local water suppliers are of course vulnerable to drought. There are 98 community water supply systems, 46 non-community transient water supply systems, and 9 non-transient, non-community water supply systems in Tompkins County (New York State Department of Health 2019). Additionally, there are at least 464 water wells in Tompkins County (New York State Department of Environmental Conservation 2014).

Regarding wildfires, according to ClimAID, it can be difficult to predict how the number of these events will change over time, as Tompkins County and most of the northeast region has historically been known for relatively damp weather. This trend is not expected to change significantly over time. However, there are regions within the state that are more prone to wildfires. Based on the 2016 summer drought, Tompkins County and much of the Finger Lakes region was subject to severe droughts as indicated in the map below, which depicts the stages of the drought between June and September (New York Climate Change Science Clearinghouse). Tompkins County experienced drought like conditions early on, compared to surrounding regions and as a result had 2 reported wildfire events. These events were not major when comparing the event to a national wildfire events, however these were more than the region was used to. It is likely that Tompkins County is more vulnerable to wildfires than other parts of upstate New York. There is no direct evidence of the cause of wildfires in Tompkins County, however some potential factors could include immature landcover, increased development/land use change, agriculture, and higher levels of careless recreational activity in forested regions.

Projections from the County Comprehensive Plan indicate that water demand will continue to increase for the communities in Tompkins County, which could be further strained during a drought event. Generally, surface water supplies are affected more quickly during droughts than groundwater supplies; however, groundwater supplies generally take longer to recover. Increasing diverse, redundant water supplies throughout the county could help to protect and mitigate against the impacts of drought events.

Figure 5.4.2-6. Drought Severity in New York State



Impact on General Building Stock

No structures are anticipated to be directly affected by a drought event. However, droughts contribute to conditions conducive to wildfires and reduce fire-fighting capabilities. Risk to life and property is greatest in those areas where forested areas adjoin urbanized areas (high density residential, commercial and industrial) also known as the wildland-urban interface and wildland-urban intermix hazard areas (WUI). Therefore, all assets in and adjacent to, the WUI zone, including population, structures, community lifelines, and businesses are considered vulnerable to wildfire.

Table 5.4.2-4. Number of Buildings Located Within the WUI

Municipality	Number of Buildings – WUI	Percent of Total	RCV of Buildings – WUI	Percent of Total
Caroline (T)	1,016	31.2%	$843,977,508	33.4%
Cayuga Heights (V)	104	8.8%	$91,215,787	5.9%
Danby (T)	671	22.3%	$469,159,299	21.4%
Dryden (T)	2,083	24.5%	$1,477,992,753	16.9%

Municipality	Number of Buildings – WUI	Percent of Total	RCV of Buildings – WUI	Percent of Total
Dryden (V)	655	64.1%	$712,425,186	62.8%
Enfield (T)	807	22.7%	$432,750,638	15.8%
Freeville (V)	95	23.2%	$62,477,398	17.5%
Groton (T)	166	4.6%	$108,323,384	3.9%
Groton (V)	0	0.0%	$0	0.0%
Ithaca (C)	6,181	83.0%	$12,107,220,542	61.4%
Ithaca (T)	1,858	30.6%	$4,635,260,118	42.6%
Lansing (T)	459	7.6%	$403,246,778	6.4%
Lansing (V)	6	0.6%	$3,056,388	0.1%
Newfield (T)	1,145	24.5%	$827,497,313	21.5%
Trumansburg (V)	0	0%	$0	0%
Ulysses (T)	950	26.7%	$786,678,885	23.3%
Tompkins County (Total)	**16,196**	**29.1%**	**$22,961,281,977**	**31.9%**

Impact on Community Lifelines

Water supply facilities may be affected by short supplies of water. As mentioned, drought events generally do not impact buildings; however, droughts have the potential to impact agriculture-related facilities and community lifelines that are associated with potable water supplies. Also, those facilities in and adjacent to the WUI zone are considered vulnerable to wildfire.

Table 5.4.2-5. Community Lifelines Located in the WUI

Facility Name	Jurisdiction	Hazard Zone
WOOD ST PUMP STATION	Ithaca (C)	Wildfire Urban Interface
CAYUGA HEIGHTS SEWAGE PLANT	Ithaca (T)	Wildfire Urban Interface
CITY WATER AND SEWER DIV	Ithaca (C)	Wildfire Urban Interface

Impact on Economy

Drought can produce a range of impacts that span many economic sectors and can reach beyond an area experiencing physical drought. Water withdrawals are not only used for potable water but for use in the commercial/industrial/mining sectors and power generation. When a state of water emergency is declared by the State (when a potential or actual water shortage endangers the public health, safety and welfare), the New York Department of Environmental Conservation may impose mandatory water restrictions and require specific actions to be taken by water suppliers.

A prolonged drought can have serious direct and indirect economic impacts on a community. As noted in the 2019 New York State Hazard Mitigation Plan, Tompkins County does not have reported damages from previous drought events (NYS DHSES 2019). However, economic impacts that could occur include the following:

- Decreased land prices

- Loss to industries directly dependent on agricultural production (e.g., machinery and fertilizer manufacturers, food processors, dairies, etc.)
- 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 and tourism
- Fewer agricultural producers (due to bankruptcies, new occupations)
- Rural population loss.
- Short term water use restrictions for businesses and thus underperformance of respective businesses operation.

When a drought occurs, the agricultural industry is most at risk for economic impact and damage. A large majority of the state's agriculture is rain-fed without irrigation; however, summer precipitation currently is not sufficient to fully meet crop water needs during most years (NYSERDA 2011). Based on information from the 2017 Census of Agriculture, 523 farms were present in Tompkins County, encompassing 91,277 acres of total farmland. The average farm size was 175 acres. Products sold from Tompkins County farms had a total market value of $64.7 million ($41 million: milk from cows, $6.4 million: cattle and calves, $5.1 million: grains, oilseeds, dry beans, dry peas, averaging $123,713 per farm (USDA 2017). It is worth noting, however, based on community input that Tompkins County is unique in that a vast number of communities have access to Cayuga Lake for water supply, while smaller inland municipalities that only have a single source of water, that is ground water, are more susceptible to droughts.

If the average production (dollar value) per crop type could be identified on a per-acre basis, loss estimates could be developed based on assumed percent damage that could result from a drought. If a drought impacted 40-percent of the agricultural products sold from Tompkins County farms, losses would be estimated at $25.8 million based on 2017 market values.

As for Wildfires, effects can be more immediate and severe, contrast to drought. Effects of these wildfires can be catastrophic including property losses, decreased tourism, even changes in the long-term structure of the local economy (US Forest Service, 2020). As a result, mitigation measures include the protection of existing property and investment in direct response to wildfires, including investments in the important and regularly strained volunteer fire departments. The sooner fire departments can respond, the lesser the economic impact.

Impact on Environment

Drought can impact the environment because it can trigger wildfires, increase insect infestations, and exacerbate the spread of disease (NOAA 2020). Drought can also impact water resources that are relied upon by aquatic and terrestrial species. Ecologically sensitive areas, such as wetlands, can be particularly vulnerable to drought periods because they are dependent on steady water levels and soil moisture availability to sustain growth. As a result, these types of habitats can be negatively impacted after long periods of dryness. As a cascading effect of these droughts, wildfires can also have detrimental effects on the environment, including pollution from the smoke of the fire, ecological damage and loss of habitat, and water contamination due to damaged/ burnt vegetative cover (US Forestry Service, 2020).

Cascading Impacts on Other Hazards

As discussed in earlier sections, drought can lead to increasing temperatures and evaporation of moisture, which are ideal dry conditions for wildfire events to occur. Dry, hot, and windy weather combined with dry vegetation is more susceptible to sparking wildfires when met with a spark created by humans or natural events, such as lightning (National Integrated Drought Information System 2020).

Future Changes that May Impact Vulnerability

Understanding future changes that impact vulnerability in the County can assist in planning for future development and ensuring that appropriate mitigation, planning, and preparedness measures are in place. The County considered the following factors to examine potential conditions that may affect hazard vulnerability:

- Potential or projected development.
- Projected changes in population.
- Other identified conditions as relevant and appropriate, including the impacts of climate change

Projected Development

Any areas of growth could be potentially impacted by the drought hazard as the entire County is exposed and vulnerable to droughts. On the other hand, wildfires are more likely to occur in areas where vegetative cover is young, and greenspace isolated from waterbodies with low-lying brush is an ideal setting for a wildfire to occur. Future growth and development could impact the amount of potable water available due to a drain on the available water resources. An increased use of water resources would not only impact the County's population, but it would also exacerbate impacts to other areas of the County as discussed above, including agriculture and recreational facilities. Refer to Sections 4 and 9 (Jurisdictional Annexes) for a discussion on potential new development.

Projected Changes in Population

According to population projections from the Cornell Program on Applied Demographics, Tompkins County will experience a continual population increase from 2020 through 2040 (over 6,040 people in total by 2040). The U.S. Census Bureau also shows that the population in Tompkins County has increased 0.6-percent between 2010 and 2019 (U.S. Census Bureau 2020). An increase in the population throughout Tompkins County will increase the number of persons exposed to drought events and may put more stress on the available water supplies in the County. Refer to Section 4 (County Profile), for additional discussion on population trends.

Climate Change Impact

As discussed above, most studies project that the State of New York will see an increase in average annual temperatures. Additionally, the State is further projected to experience more frequent droughts which may affect the availability of water supplies, primarily placing an increased stress on the population and their available potable water. A decrease in water supply, or increase in water supply demand, may increase the county's vulnerability to structural fire and wildfire events. Critical water-related service sectors may need to adjust management practices and actively manage resources to accommodate for future changes.

Droughts can cause deficits in surface and groundwater used for drinking water. The New York State Water Resources Institute at Cornell University (https://wri.cals.cornell.edu/) conducted a vulnerability assessment of drinking water supplies and climate change. To assess water supplies in New York State, it was assumed that long-term average supply will remain the same, but the duration and/or frequency of dry periods may increase. Both types of water supplies, surface water and groundwater, were divided into three categories: sensitive to short droughts (two to three months), sensitive to moderate and longer droughts (greater than six months), and relatively sensitive to any droughts. Major reservoir systems are presumed to have moderate sensitivity to drought because there is a likelihood of decreases in summer and fall water availability (NYSERDA 2014). The greatest likelihood of future water shortages is likely to occur on small water systems.

Change of Vulnerability Since the 2014 HMP

For this HMP update, a qualitative assessment was conducted using data from the 2017 USDA Census of Agriculture to assess potential economic impacts. According to the American Community Survey 2018 Population Estimates, the population of Tompkins County has increased slightly since the 2010 Census; therefore, the number of people exposed to the drought hazard has increased. The number of farms however has decreased by 6-percent but the total acreage of farmland has slightly increased by 1-percent since the 2012 USDA Census of Agriculture reports; therefore, an increased area of agricultural land is exposed to the drought hazard. Overall, the entire County will continue to be exposed and vulnerable to drought events. As for wildfires, wooded land is relatively young in Tompkins County and as private and public land preservation efforts continue to increase with increased local conservation efforts to protect mature woodland it may result in less vulnerability to drought and wildfires.

Identified Issues

- Due to the history of drought events, some municipalities within the County (Town of Caroline, Town of Ulysses) are investigating how diverse water supplies can help protect and mitigate against the impacts of drought events.
- Droughts contribute to conditions conducive to wildfires, reduce fire-fighting capabilities, and have negative impacts on agriculture throughout the County.
- Per the FEMA Mitigation Ideas guidance, in order to mitigate drought impacts communities may develop drought emergency plans, develop criteria for triggers for drought-related actions, develop a

drought communication plan and early warning protocol, develop agreements for secondary water sources to be used during drought conditions, or to establish an agricultural water usage schedule to support recharge of ground water. (FEMA, 2013).

- Agricultural producers and rural homeowners continue to be on the front lines of drought risk due to their reliance on precipitation and groundwater. Strategies to help these communities combat these stresses are important.

5.4.3 Extreme Temperature

This section provides a profile and vulnerability assessment for the extreme temperature hazard for Tompkins County.

The hazard profile is organized as follows:	The vulnerability assessment is organized as follows:
• Description • Extent • Previous Occurrences and Losses • Probability of Future Occurrences • Climate Change Impacts	• Impact on Life and Safety • Impact on General Building Stock • Impact on Community Lifelines • Impact on Economy • Impact on Environment • Cascading Impacts on Other Hazards • Future Change that may Impact Vulnerability • Changes Since 2014 HMP • Identified Issues

5.4.3.1 Hazard Profile

This section provides profile information including description, extent, location, previous occurrences and losses, and the probability of future occurrences for the extreme temperatures hazard.

Description

In Tompkins County, extreme temperature includes both heat and cold events, which can have a significant impact to human health, commercial/agricultural businesses and primary and secondary effects on infrastructure (e.g., burst pipes and power failure). What constitutes *extreme cold* or *extreme heat* can vary across different areas of the country, based upon what the population is accustomed. According to the Northeast Regional Climate Center (NRCC), the hottest day on record in Tompkins County was 103°F in 1936 and the coldest temperature on record in the County was -25°F in 1961. Looking at data from the last 10 years (2010 to 2020), the warmest temperature recorded as 98°F in 2011 and the coldest temperature recorded was -22°F in 2015 (NRCC 2020).

Extreme heat is defined as temperatures which hover 10 degrees or more above the average high temperature for a region and that last for several weeks (CDC 2016). Extreme hot days in New York State are defined as individual days with maximum temperatures at or above 90°F or at or above 95°F. Heat waves are defined as three consecutive days with maximum temperatures above 90°F (NYS DHSES 2019).

Extreme cold events are when temperatures drop well below normal in an area. Although no specific definition exists for Extreme Cold, temperatures at or below zero degrees for an extended period of time characterize an Extreme Cold event in New York State (NYS DHSES 2019).

Extent

Extreme Cold

The extent (severity or magnitude) of extreme cold temperatures generally is measured through the Wind Chill Temperature (WCT) Index. The WCT Index uses advances in science, technology, and computer modeling to provide an accurate, understandable, and useful formula for calculating the dangers from wind chill. For details regarding the WCT Index, refer to: http://www.nws.noaa.gov/om/winter/windchill.shtml. The WCT Index is presented in Figure 5.4.3-1.

Wind Chill
At a Glance

The wind chill is how cold it actually feels on your skin when the wind is factored in. It may also be referred to as the "feels-like" temperature. Bitterly cold wind chills increase your risk of developing frostbite and hypothermia.

Source: The Weather Channel (2019)

Figure 5.4.3-1. NWS WCT Index

WIND CHILL CHART (Source: NWS)

Temperature (°F)

Wind (mph) / Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45	26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55	25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60	25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

Frostbite Times: 30 minutes; 10 minutes; 5 minutes

Where, T= Air Temperature (°F) V= Wind Speed (mph)
Wind Chill (°F) $= 35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$

Source: NYS DHSES, 2019

The National Weather Service (NWS) provides alerts when Wind Chill indices approach hazardous levels. Table 5.4.3-1 explains these alerts.

Table 5.4.3-1. National Weather Service Alerts for Extreme Cold

Alert	Criteria
Wind Chill Advisory	NWS issues a wind chill advisory when seasonably cold wind chill values, but not extremely cold values are expected or occurring.

Alert	Criteria
Wind Chill Watch	NWS issues a wind chill watch when dangerously cold wind chill values are possible.
Wind Chill Warning	NWS issues a wind chill warning when dangerously cold wind chill values are expected or occurring.

Source: NWS 2018

Extreme Heat

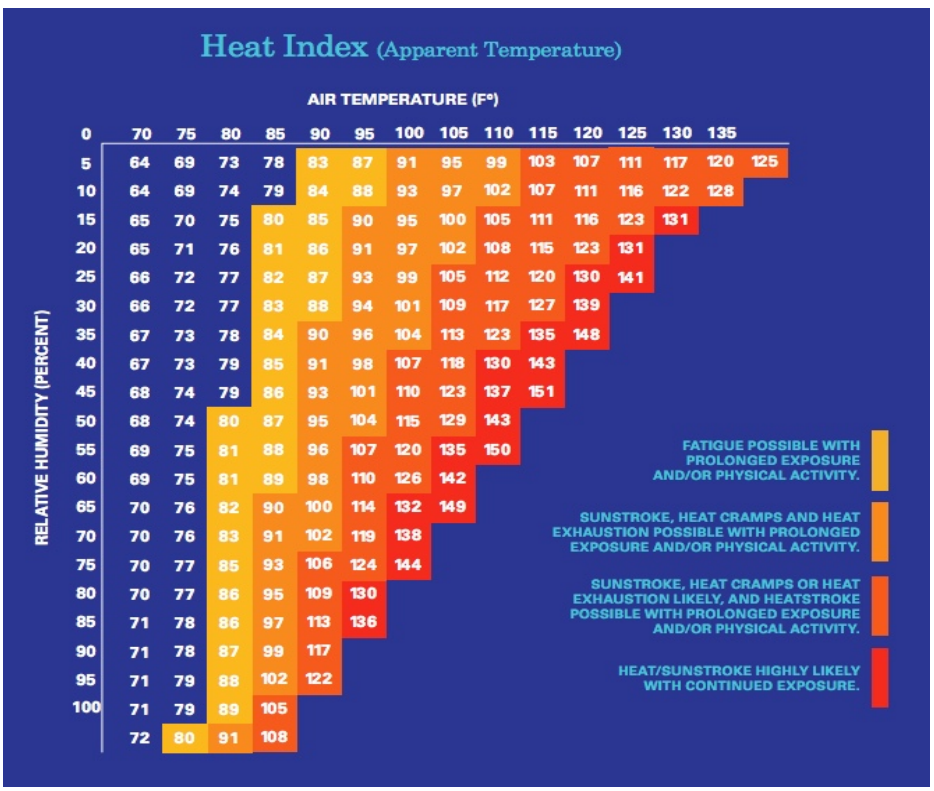
The extent of extreme heat temperatures is measured through the Heat Index, identified in Figure 5.4.3-2. The Heat Index was created by the NWS to accurately measure apparent temperature of the air as it increases with the relative humidity. Temperature and relative humidity are needed to determine the Heat Index. This provides a measure of how temperatures feel; however, the values are devised for shady, light wind conditions. Exposure to full sun can increase the index by up to 15 degrees (NYS DHSES 2019).

Relative Humidity
At a Glance

Relative humidity is the amount of moisture in the air at a certain temperature compared to what the air can "hold" at that temperature…it is measured as a percentage or ratio of the amount of water vapor in a volume of air RELATIVE to a given temperature and the amount it can hold at that given temperature. Warm air can hold more moisture than cold air.

Source: M°lekule.com, 2018

Figure 5.4.3-2. Heat Index Chart



Source: NYS DHSES, 2019

The NWS provides alerts when Heat Indices approach hazardous levels. Table 5.4.3-2 explains these alerts.

Table 5.4.3-2. National Weather Service Alerts

Alert	Criteria
Heat Advisory	Criteria for a Heat Advisory in New York 95-104 °F. The heat index has to remain at or above criteria for a minimum of 2 hours. Heat advisories are issued by county when any location within that county is expected to reach criteria.
Excessive Heat Watch	Issued when Heat Warning criteria is possible (50-79%) 1 to 2 days in advance
Excessive Heat Warning	Criteria for an Excessive Heat Warning is a heat index of 105 °F or greater that will last for 2 hours or more. Excessive Heat Warnings are issued by county when any location within that county is expected to reach criteria.

Source: NWS, 2020

Location

According to the New York State Hazard Mitigation Plan (2019), excessive temperatures can occur anywhere within the State of New York, including Tompkins County. Excessive heat incidents are widespread, even if there are localized cooler areas. The State has varied summers. Warmer conditions are experienced in the south, whereas more mild conditions experienced elsewhere in the State. Extreme cold temperatures occur throughout the County, typically during the winter months.

The Town of Caroline, Danby, and Newfield have higher levels of forest cover, compared to Lansing, Enfield, Groton, and Ulysses which have increased levels of active agricultural land with less forest cover (Tompkins County Comprehensive Plan). Municipalities with less tree cover tend to experience warmer weather, regardless of levels of urban/ rural

The State is divided into 10 different climate divisions: Western Plateau, Eastern Plateau, Northern Plateau, Coastal, Hudson Valley, Mohawk Valley, Champlain Valley, St. Lawrence Valley, Great Lakes, and Central Lakes. Tompkins County is located within the Central Lakes Climate Division. Within the Central Lakes Climate Division, Tompkins County varies greatly in climate and temperatures. The northern portion of the county is located along Cayuga Lake and experiences a relatively warm and drier climate whilst the southern portion of the county which tends to be more rough, forested terrain and as such has damper and cooler characteristics.

Previous Occurrences and Losses

Extreme temperature events occur each year in Tompkins County. Between 1954 and May 2020, New York State was not included in any major disaster (DR) or emergency (EM) declarations due to extreme temperatures (heat or cold). However, during the same time period, FEMA included Tompkins County in two winter storm-related declarations which included severe winter storm, snowstorm, snow, ice storm, winter storm, or blizzard (Table 5.4.3-3.). Extreme cold temperatures are often associated with these disaster types.

Table 5.4.3-3. Winter Storm Related Disaster (DR) and Emergency (EM) Declarations 1954-2020

Disaster Number	Incident Duration	Declaration Date	Incident Type	Title
DR-4322	March 14-- March 15, 2017	7/12/2017	Snow	Severe Winter Storm and Snowstorm
EM-3107	March 13-- March 17, 1993	3/17/1993	Snow	Severe Blizzard

Source: FEMA 2020
DR Major Disaster Declaration (FEMA)
EM Emergency Declaration (FEMA)
FEMA Federal Emergency Management Agency

The Secretary of Agriculture from the U.S. Department of Agriculture (USDA) is also authorized to designate counties as disaster areas to make emergency loans available to agricultural producers suffering losses. Between 2012 and 2020, Tompkins County was included in the following seven USDA declarations involving extreme temperatures:

- S3249 – March 2012 – Frosts and Freezes
- S3252 – April 2012 – Excessive Snow and Freezes
- S3594 – May 2013 – Freeze and Frost
- S3666 – December 2013 – Freeze
- S3672 – March 2014 – Freeze
- S3886 – January 2015 -- Frost, Freeze, and Excessive Snow
- S4052 – February 2016 – Unseasonably Warm

Information regarding specific details of extreme temperature in Tompkins County is scarce; therefore, previous occurrences and losses associated with extreme temperature events are limited. To identify the events in the county, the National Oceanic and Atmospheric Administration (NOAA) National Centers for Environmental Information (NCEI) Storm Events database was queried for events that occurred between 2012 and 2020. The database records and defines extreme temperature events as follows:

- Cold/Wind Chill is reported in the NOAA-NCEI database when a period of low temperatures or wind chill temperatures reach or exceed locally or regionally defined advisory conditions (typical value is negative 18 °F or colder).
- Excessive Heat is reported in the NOAA-NCEI database whenever heat index values meet or exceed locally or regionally established excessive heat warning thresholds.
- Extreme Cold/Wind Chill is reported in the NOAA-NCEI database when a period of extremely low temperatures or wind chill temperatures reaches or exceeds locally or regionally defined warning criteria (typical value around negative 35 °F or colder).
- Heat is reported in the NOAA-NCEI database whenever heat index values meet or exceed locally or regionally established advisory thresholds.

Table 5.4.3-4 summarizes extreme temperature events that occurred in Tompkins County between 2012 and 2020. For events prior to 2012, refer to Appendix E (Supplementary Data).

Table 5.4.3-4. Extreme Temperature Events in Tompkins County, 2012 to 2020

Dates of Event	Event Type	FEMA Declaration Number (if applicable)	County Designated?	Event Details
March 17, 2012	Heat	N/A	N/A	Central New York experienced record warm temperatures as a result of a jet stream pushing farther north than typical. Binghamton and Syracuse climate record stations saw the warmest March on record by more than 12 degrees. In Tompkins County, temperatures were in the 70s and reached the 80s in warmer valley locations.

Source(s): NYS DHSES 2019; FEMA 2020; NWS 2020; NOAA-NCEI 2020
Note: Many sources were consulted to provide an update of previous occurrences and losses; event details and loss/impact information may vary and has been summarized in the above table.
FEMA Federal Emergency Management Agency
NOAA-NCEI National Oceanic Atmospheric Administration – National Centers for Environmental Information
NWS National Weather Service
NYSDHSES New York State Department of Homeland Security and Emergency Services
N/A Not Applicable

Climate Change Impact

Heat Waves, defined as extreme temperature heat events with three or more consecutive days with maximum temperatures at or above 90 ˚F, are expected to increase in duration and frequency (Table 5.4.6-10). Extreme cold events, defined both as the number of days per year with minimum temperature at or below 32 ˚F and those at or below 0 ˚F, are expected to decrease as average temperatures rise (NYSERDA 2014). With the increase in temperatures, heat waves will become more frequent and intense, increasing heat-related illness and death and posing new challenges to the energy system, air quality and agriculture. Table 5.4.3-5 displays the projected changes in these events and includes the minimum, central range and maximum days per year.

Table 5.4.3-5. Changes in Extreme Events in NYSERDA Region 3 (Elmira) – Heat Waves and Drought Conditions

Event Type (2020s)	Low Estimate (10^{th} Percentile)	Middle Range (25th to 75^{th} Percentile)	High Estimate (90^{th} Percentile)
Days over 90 degrees Fahrenheit (°F) (10 days)	15	17-21	23
# of Heat Waves (1 heat waves)	2	2 to 3	3
Duration of Heat Waves (4 days)	4	4 to 5	5
Days below 32°F (155 days)	119	122 to 130	134

Source: NYSERDA 2014

Probability of Future Occurrences

Tompkins County will continue to experience extreme temperatures annually that could coincide with or induce secondary hazards, such as human health impacts, hail, snow, ice or wind storms, thunderstorms, drought, and utility failures. These events include significant presidentially declared events as well as others reported and documented by NOAA.

Table 5.4.3-6 shows the annual number of events, recurrence interval, annual probability, and annual percent chance of occurrence for the hazards associated with extreme temperatures and reported in the NOAA-NCEI Storm Events Database. These events include significant presidentially declared events as well as others reported and documented by NOAA.

Table 5.4.3-6. Probability of Occurrences of Extreme Temperature Events

Hazard Type	Number of Occurrences Between 1996 and 2020	Rate of Occurrence or Annual Number of Events (average)	Recurrence Interval (in years) (# Years/Number of Events)	Probability of Event in any given year	% chance of occurrence in any given year
Cold/Wind Chill	12	0.50	2.08	0.48	48%
Excessive Heat	1	0.04	25.00	0.04	4%
Extreme Cold/Wind Chill	2	0.08	12.50	0.08	8%
Heat	3	0.13	8.33	0.12	12%
TOTAL	**18**	**0.75**	**1.39**	**0.72**	**72%**

Source: NOAA NCEI 2020
Note: Probability was calculated using the available data provided in the NOAA-NCEI storm events database. For extreme temperature events, reporting begins at 1996.

Based on historical records and input from the Planning Partnership, the probability of occurrence for extreme temperatures in Tompkins County is considered high. Historical data from the Cornell Climate Smart Farming tool indicates that the general pattern with extreme heat days is unclear, as depicted below. Rather than a gradual increase since 1950, the histogram shows a wave-like pattern, where the years with extreme heat days increases and decreases approximately every 30 years. However, general projections show that, under projections where emissions continue to rise, the current number of days over 90F hovering between 0 and 20 can increase to 50 to 75 days a year.

Figure 5.4.3-3 Climate Projections based on High Emissions Scenario

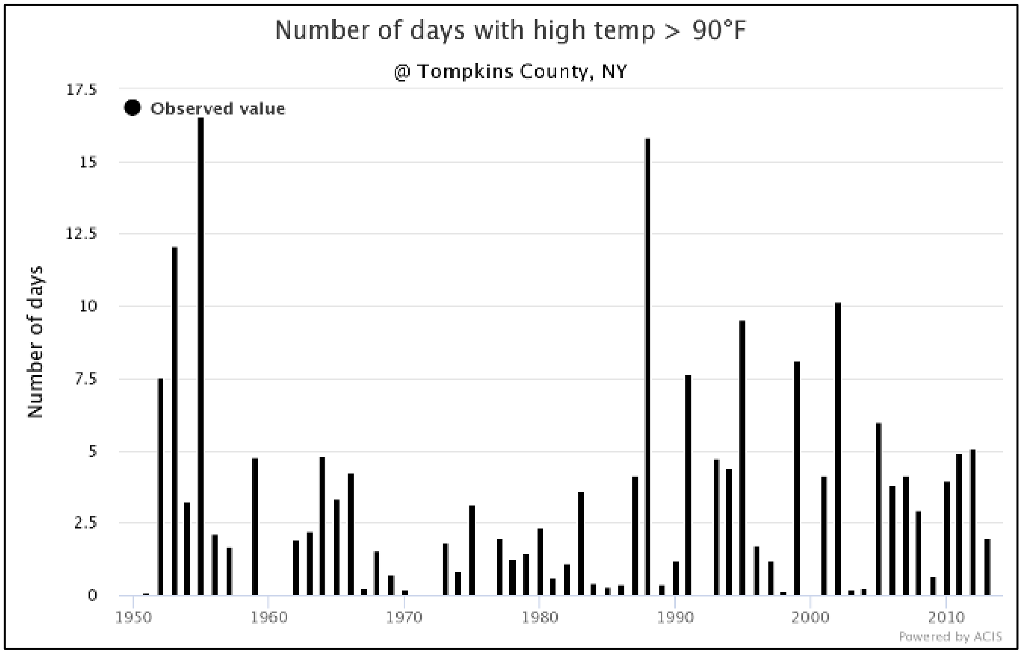
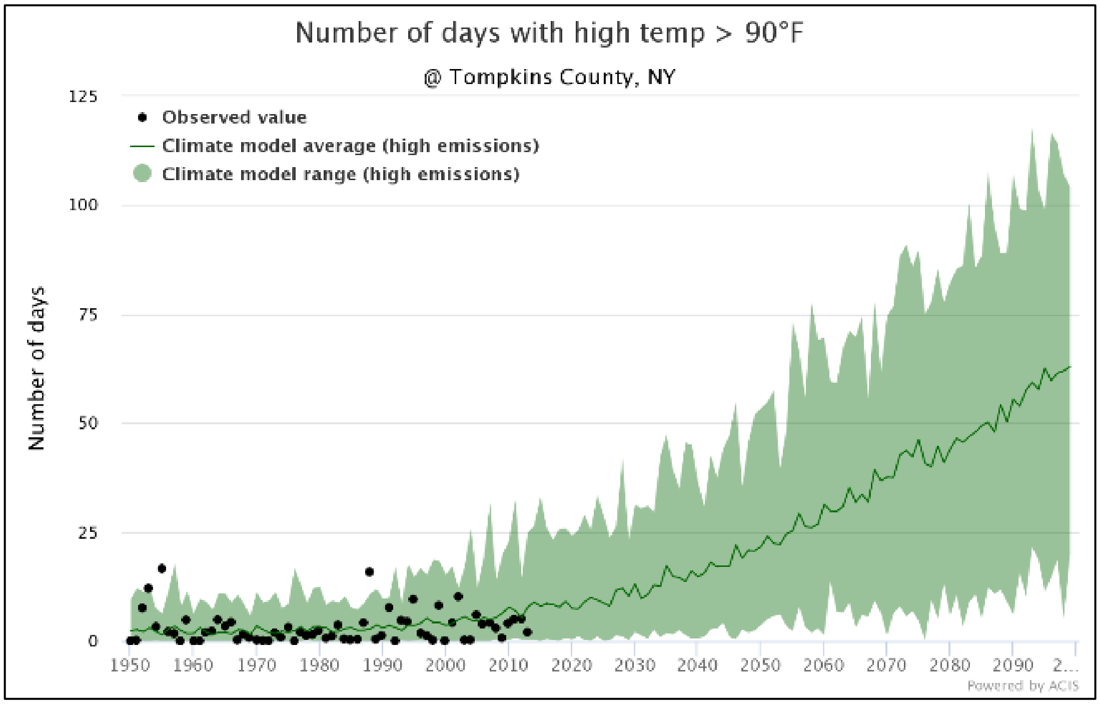


Figure 5.4.3-4 Historical Number of Days over 90°F



5.4.3.2 Vulnerability Assessment

To understand risk, a community must evaluate what assets are exposed and vulnerable to the identified hazard. The following discusses Tompkins County's vulnerability, in a qualitative nature, to the extreme temperature hazard.

Impact on Life, Health and Safety

The entire population of Tompkins County is exposed to extreme temperature events (population of 102,962 people, according to the 2014-2018 American Community Survey population estimates). Extreme temperature events have potential health impacts including injury and death.

According to the 2018 ACS 5-Year Population Estimate, persons that are most vulnerable to extreme temperature events are those over 65-years old (The Town of Ithaca has the greatest number of people over the age of 65, i.e., 2,029 people total. The Town of Ulysses has the greatest concentration of people over the age of 65, i.e., 27.4-percent of its total population) under 5-years old, those of low-income that cannot afford proper heating and cooling or have difficulty accessing transportation and medical care; and those with a disability. The homeless and residents of low-income whose housing may be less able to withstand extreme temperatures (e.g., homes with poor insulation and inefficient heating). There are a total of 17,500 persons living in poverty in the County (ACS 2018). In Tompkins County, areas with the highest concentration of population below the poverty level, with potentially fewer resources to protect against extreme temperatures are located in the Town of Dryden (17-percent of its total population). The City of Ithaca has the greatest number of persons living below the poverty level (9,631 persons total). Other groups vulnerable to extreme temperatures include individuals with underlying medical conditions, those that have a difficulty in communicating, including non-native speakers and those with intermittent internet and cellular service and also and the general public who may overexert during work or exercise during extreme heat events or experience hypothermia during extreme cold events (CDC 2020).

Individuals most vulnerable to extreme weather events include those: Over 65 years old, under 5 years old, with low-income, homeless, with a disability, with underlying medical conditions, with difficulty communicating.

Overall, the CDC 2016 Social Vulnerability Index (SVI) ranks U.S. Census tracts on socioeconomic status, household composition and disability, minority status and language, and housing and transportation. Tompkins County's overall score is 0.3493, indicating that its communities have low to moderate vulnerability (CDC 2016). This score indicates that most County residents will have enough resources to respond to extreme temperature events. Refer to Section 4 (County Profile) that displays the densities of all the vulnerable populations in Tompkins County.

In addition to vulnerable populations, 30-percent of all deaths caused by fire occur in the winter months. Cooking and heat sources too close to combustible materials are leading factors in winter home fires (U.S. Fire

Administration 2018). Homeless encampments in greater Tompkins County report a high rate of cooking/heating fires in the colder months. Furthermore, power outages occur more frequently during extreme cold events. Individuals powering their homes with generators are subjected to carbon monoxide poisoning if proper ventilation procedures are not followed (NYC 2019). Improperly connected portable generators are capable of 'back feeding' power lines which may cause injury or death to utility workers attempting to restore power and may damage house wiring and/or generators.

Meteorologists can accurately forecast extreme heat and cold event development and the severity of the associated conditions with several days of lead time. These forecasts provide an opportunity for public health and other officials to notify vulnerable populations (through a range of methods), implement short-term emergency response actions, and focus on surveillance and relief efforts on those at greatest risk. Adhering to extreme temperature warnings can significantly reduce the risk of temperature-related deaths.

Impact on General Building Stock

All buildings are exposed to the extreme temperature hazard a noted in Section 4 (County Profile), which summarizes the building inventory in Tompkins County. Extreme heat generally does not impact buildings; however, elevated summer temperatures increase the energy demand for cooling. Losses can be associated with the overheating of heating, ventilation, and air conditioning (HVAC) systems. Extreme cold temperature events can damage through freezing/bursting pipes and freeze/thaw cycles, as well as increasing vulnerability to home fires. Additionally, manufactured homes (mobile homes) and antiquated or poorly constructed facilities can have inadequate capabilities to withstand extreme temperatures.

The 2019 New York City Hazard Mitigation Plan states that older buildings following less stringent building codes are more vulnerable to drafts during extreme cold events due to cracks and leaks in the walls (NYC 2019). Roof damage can also occur due to excessive snow fall and extreme temperature change. Extreme heat may also be damaging to older structures. Further, structures with glass exposed to sunlight and structures exposed to heat on all four sides are more susceptible to damages, including interior damages from overheating (NYC 2019).

Impact on Community Lifelines

All community lifeline critical facilities in the County are exposed to the extreme temperature hazard. Impacts to critical facilities that are buildings will experience similar issues as described for general building stock. Additionally, it is essential that critical facilities remain operational during natural hazard events. Extreme heat events can sometimes cause short periods of utility failures, commonly referred to as *brown-outs*, due to increased usage from air conditioners and other energy-intensive appliances. Similarly, heavy snowfall and ice storms, associated with extreme cold temperature events, can cause power interruption. Backup power is recommended for critical facilities and infrastructure.

The 2019 New York City Hazard Mitigation Plan indicates that transportation infrastructure may experience damages from extreme temperature events. This is particularly the case with ground transportation systems at risk of cracking, buckling, or sagging due to high temperatures (NYC 2019). This can cause disruptions to essential services that travel along these routes to provide services to the community.

Impact on Economy

Extreme temperature events also impact the economy, including loss of business function and damage to and/or loss of business inventory. Business-owners can be faced with increased financial burdens due to unexpected repairs caused to the building (e.g., pipes bursting), higher than normal utility bills, or business interruption due to power failure (i.e., loss of electricity or telecommunications). Disruptions in public transportation service will also impact the economy for both commuters and customers alike.

Impact on the Environment

Extreme temperature events can have a major impact on the environment. For example, freezing and warming weather patterns create changes in natural processes. An excess amount of snowfall and earlier warming periods may affect natural processes such as flow within water resources (USGS 2020). Likewise, rain-on-snow events also exacerbate runoff rates with warming winter weather. Extreme heat events can have particularly negative impacts on aquatic systems, contributing to fish kills, aquatic plant die offs, and increased likelihood of harmful algal blooms.

Cascading Impacts to Other Hazards

Extreme temperature events can exacerbate the drought hazard and increase the potential risk of wildfires for the County. For example, extreme heat events may accelerate evaporation rates, drying out the air and soils. Extreme heat can also dry out terrestrial species, making them more susceptible to catching fire. Refer to Sections 5.4.2 and 5.4.10 for more information about the impacts of drought and wildfires, respectively.

Future Changes that May Impact Vulnerability

Understanding future changes that impact vulnerability in the County can assist in planning for future development and ensuring that appropriate mitigation, planning, and preparedness measures are in place. The county considered the following factors to examine potential conditions that may affect hazard vulnerability:

- Potential or projected development
- Projected changes in population
- Other identified conditions as relevant and appropriate, including the impacts of climate change

Projected Development

As discussed in Section 4, areas targeted for future growth and development have been identified across Tompkins County. The ability of new development to withstand extreme temperature impacts lies in sound land use practices, building design considerations (e.g. Leadership in Energy and Environmental Design [LEED]), and consistent enforcement of codes and regulations for new construction. New development will change the landscape where buildings, roads, and other infrastructure potentially replace open land and vegetation. Surfaces that were once permeable and moist are now impermeable and dry. These changes cause urban areas to become warmer than the surrounding areas forming (heat islands as described above). Specific areas of recent and new development are indicated in tabular form and/or on the hazard maps included in the jurisdictional annexes in Volume II, Section 9 (Jurisdictional Annexes) of this plan.

Projected Changes in Population

According to population projections from the Cornell Program on Applied Demographics, Tompkins County will experience a continual population increase from 2020 through 2040 (over 6,040 people in total by 2040). The U.S. Census Bureau also shows that the population in Tompkins County has increased 0.6-percent between 2010 and 2019 (U.S. Census Bureau 2020). An increase in the population throughout Tompkins County will also increase the number of persons exposed to extreme temperature events. Refer to Section 4 (County Profile), for additional discussion on population trends.

Change of Vulnerability Since the 2014 HMP

Overall, extreme temperature events will continue to impact the entire County. As existing development and infrastructure continue to age, they can be at increased risk to failed utility and transportation systems if they are not properly maintained and do not adapt to the changing environment.

Identified Issues

- While extreme temperatures affect vulnerable populations as noted in this section, it is noted that urban areas may be inordinately affected not only due to the density of the elderly, youth, and low income population less equipped to address potential health impacts, but furthermore, urban areas may experience profound economic consequences due to the effect of extreme temperatures on not only infrastructure but on the economy of the area.
- Prolonged extreme heat events can lead to drought conditions and impact the drinking water supply for residents.
- Extreme temperature events can damage aging infrastructure and buildings as highways and roads are damaged by excessive heat as the asphalt softens, and roadways can be damaged from extreme cold temperatures causing frost heaving of road infrastructure.
- The increase in population in the rural areas might strain utility systems in affected portions of the County due to larger demand.

- The number of homeless in Tompkins County could pose an increased health risk to those without proper shelter during extreme temperature events. In order to quantify the number of homeless.
- A review of available tax assessor data may inform policy makers of areas where the age of housing may indicate areas in need of updated insulation and efficient heating and cooling measures.

5.4.4 Flood

The following section provides the hazard profile and vulnerability assessment for the flood hazard in Tompkins County.

The hazard profile is organized as follows:	The vulnerability assessment is organized as follows:
• Description • Extent • Previous Occurrences and Losses • Probability of Future Occurrences • Climate Change Impacts	• Impact on Life and Safety • Impact on General Building Stock • Impacts on Land Use • Impact on Community Lifelines • Impact on Economy • Impact on Environment • Cascading Impacts on Other Hazards • Future Change that may Impact Vulnerability • Changes Since 2014 HMP • Identified Issues

5.4.4.1 Hazard Profile

This section provides information regarding the description, extent, location, previous occurrences and losses, climate change projections and the probability of future occurrences for the flood hazard.

Hazard Description

Floods are one of the most common natural hazards in the U.S. They can develop slowly over a period of days or develop quickly, with disastrous effects that can be local (impacting a neighborhood or community) or regional (affecting entire river basins, coastlines and multiple counties or states) (FEMA 2007). As defined in the NYS HMP (NYS DHSES 2019), flooding is a general and temporary condition of partial or complete inundation on normally dry land as a result of the following:

- Riverine overbank flooding
- Flash floods
- Alluvial fan floods
- Mudflows or debris floods
- Dam- and levee-break floods
- Local draining or high groundwater levels
- Fluctuating lake levels
- Ice-jams
- Coastal flooding

For the purpose of this HMP and as deemed appropriate by the Planning Partnership, riverine (inland), stormwater, ice jam, lakeshore, landslides associated with flooding, and dam/levee failure are the main flood types of concern for the County. These types of flood are further discussed below.

Riverine (Inland) Flooding

Riverine flooding is the natural process that occurs when water levels rise over the top of riverbanks due to excessive rain from tropical systems making landfall, strong thunderstorms that bring heavy rainfall, combined rainfall and snowmelt event, or an ice jam (National Severe Storms Laboratory [NSSL] 2020). Inland flooding occurs when moderate precipitation accumulates over several days, intense rainfall over a short period of time, or a river overflows due to an ice or debris jam or dam failure (NSSL 2020).

Flash Flooding

Flash floods are defined by the National Weather Service as, "A flood caused by heavy or excessive rainfall in a short period of time, generally less than 6 hours. Flash floods are usually characterized by raging torrents after heavy rains that rip through riverbeds, urban streets, or mountain canyons sweeping everything before them. They can occur within minutes or a few hours of excessive rainfall. They can also occur even if no rain has fallen, for instance after a levee or dam has failed, or after a sudden release of water by a debris or ice jam." (National Weather Service [NWS], n.d.).

Stormwater Flooding

Stormwater flooding described below is due to local drainage issues and high groundwater levels. Locally, heavy precipitation may produce flooding in areas other than delineated floodplains or along recognizable channels. If local conditions cannot accommodate intense precipitation through a combination of infiltration and surface runoff, water may accumulate and cause flooding problems. During winter and spring, frozen ground and snow accumulations may contribute to inadequate drainage and localized ponding. Flooding issues of this nature generally occur in areas with flat gradients and generally increase with urbanization which speeds the accumulation of floodwaters because of impervious areas. Shallow street flooding can occur unless channels have been improved to account for increased flows (FEMA 1997).

High groundwater levels can be a concern and cause problems even where there is no surface flooding. Basements are susceptible to high groundwater levels which is a regular occurrence in Tompkins County. Seasonally high groundwater is common in many areas, while elsewhere high groundwater occurs only after long periods of above-average precipitation (FEMA 1997).

Urban drainage flooding is caused by increased water runoff due to urban development and drainage systems. Drainage systems are designed to remove surface water from developed areas as quickly as possible to prevent localized flooding on streets and other urban areas. They make use of a closed conveyance system that channels water away from an urban area to surrounding streams. This bypasses the natural processes of water filtration through the ground, containment, and evaporation of excess water. Since drainage systems reduce the amount of time the surface water takes to reach surrounding streams, flooding in those streams can occur more quickly and reach greater depths than prior to development in that area (FEMA 2007).

Types of Ice Jams

- ✓ Freeze-up jams occur when floating ice may slow or stop due to a change in water slope as it reaches an obstruction to movement.
- ✓ Breakup jams occur during periods of thaw, generally in late winter and early spring.

Ice Jam Flooding

An ice jam occurs when pieces of floating ice are carried with a stream's current and accumulate behind any obstruction to the stream flow. Obstructions may include river bends, mouths of tributaries, points where the river slope decreases, as well as dams and bridges. The water held back by this obstruction can cause flooding upstream, and if the obstruction suddenly breaks, flash flooding can occur as well (NOAA 2013). The formation of ice jams depends on the weather and physical condition of the river and stream channels. They are most likely to occur where the channel slope naturally decreases, in culverts, and along channelized shallows that may freeze solid. Ice jams and resulting floods can occur during at different times of the year: fall freeze-up from the formation of frazil ice; mid-winter periods when stream channels freeze solid, forming anchor ice; and spring breakup when rising water levels from snowmelt or rainfall break existing ice cover into pieces that accumulate at bridges or other types of obstructions (USACE 2002).

Lakeshore Flooding

Factors such as rain, snowmelt, drought, or groundwater level changes cause water levels in surface water bodies like lakes to vary throughout the year. Lake levels can be actively managed, thereby allowing human actions to directly impact the flow of water into and out of a lake. Natural or unnatural changes in lake levels can cause several impacts, including erosion, flooding, and limited use of lakes (Minnesota Department of Natural Resources, 2020). In the context of flooding, the shoreline and outlying areas surrounding lakes can be designated as areas of special flood hazard, with inundations expected for various return periods. Flood maps can show a base flood elevation (BFE) for lakes in the Summary of Stillwater Elevations that appears in a Flood Insurance Study. Lakeshore flooding caused by high lake levels can cause flood damage by inundating structures that are typically dry. Marinas, beaches, piers, and other waterfront facilities can also be rendered unusable from lakeshore flooding. Additionally, lakeshore flooding can lead to both upstream and downstream flooding impacts.

Flood Induced Landslides

A landslide is the process that results in downward and outward movement of slope-forming materials. Landslide materials can consist of natural rock, soil, artificial fill, or any combination of these materials. The materials move by falling, toppling, sliding, spreading, or flowing (NYS DHSES 2019).

Landslides are caused by one or more of the following factors: change in slope of the terrain, change in water content, groundwater movement, frost action, increased load on the land, shocks and vibrations, weathering of rocks, and removal or change in type of vegetation covering slopes. Landslide hazard areas exist where the land has characteristics that contribute to risk of downhill movement of material, such as the following:

> Landslides can be triggered by natural changes in the environment, including heavy rain, rapid snow melt, steepening of slopes caused by construction or erosion, earthquakes, and changes in groundwater levels. Areas generally prone to landslide hazards include previous landslide areas, bases of steep slopes, bases of drainage channels, developed hillsides, and areas recently burned by forest and brush fires (NYS DHSES 2019).

- A slope greater than 33 percent
- A history of landslide activity or movement during the last 10,000 years
- Stream or wave activity that has caused erosion, undercut a bank, or cut into a bank to cause the surrounding land to be unstable
- Presence or potential for snow avalanches
- Presence of an alluvial fan, indicating vulnerability to flow of debris or sediments
- Presence of impermeable soils, such as silt or clay, which are mixed with granular soils such as sand and gravel.

Dam and Levee Failure Flooding

A dam or a levee is an artificial barrier that has the ability to impound water, wastewater, or any liquid-borne material for the purpose of storage or control of water (FEMA 2007). They are built for the purpose of power production, agriculture, water supply, recreation, and flood protection. Dam failure is any malfunction or abnormality outside of the design that adversely affects a dam's primary function of impounding water (FEMA 2007). Levees typically are earthen embankments constructed from a variety of materials ranging from cohesive to cohesionless soils (USBR 2012). Dams and levees can fail for one or a combination of the following reasons:

- Overtopping caused by floods that exceed the capacity of the dam (inadequate spillway capacity due to uncontrolled release or exceedance of design);
- Prolonged periods of rainfall and flooding;
- Deliberate acts of sabotage;
- Structural failure of materials used in dam construction;
- Movement and/or failure of the foundation supporting the dam;
- Settlement and cracking of concrete or embankment dams;
- Piping and internal erosion of soil in embankment dams;
- Inadequate or negligent operation, maintenance and upkeep;
- Failure of upstream dams on the same waterway; or
- Earthquake (liquefaction / landslides) (FEMA 2010).

Flood Control Measures

Figure 5.4.4-1. Cayuga Inlet Levee System

According to the current FEMA Flood Information Study, there is one flood control structure in the County - the levee system found along both banks of the Cayuga Inlet. This levee system was completed in 1970 and directs flow to the left bank. Nearly three miles of straightened Inlet channel and interior drainage protect a 212-acre area home to approximately 621 people and 132 structures valued at $57 million. The protected area includes the Nate's Floral Estates manufactured home community and major commercial developments on the north and western side of Route 13. The system cost $20.3 million and high water has reached more than 1.5 feet (25%) up the levee once (US Army Corps of Engineers 2020). Due to a lack of dredging this system is not currently certified to provide the level of protection it was originally designed for.

There are also unofficial levee systems, or channelized flood walls, along Fall Creek and Six Mile Creek in the City of Ithaca, that currently provide flood protection to several neighborhoods. In addition, the Dr. Donald H. Crispell Flood Control Project or the Virgil Creek Dam, funded by the US Department of Conservation was completed in 1998 to provide flood protection to downstream assets.

The numeropus stormwater detension ponds throughout the County provide localized flood control throughout but are not documnented as flood control structures.

Extent

The severity of a flood event is typically determined by a combination of several factors including stream and river basin topography along with physiography; precipitation and weather patterns; recent soil moisture conditions; and degree of vegetative clearing and impervious surface. Generally, floods are long-term events that may last for several days. Severity of a flood also depends on the land's ability to manage this water. Sizes of rivers and streams in an area and infiltration rates are significant factors. During rain events, soil acts as a sponge. When land is saturated or frozen, infiltration rates decrease and any more water that accumulates must flow as runoff (Harris 2001).

Regarding the riverine flood hazard, once a river reaches flood stage, flood extent or severity categories used by the NWS include minor flooding, moderate flooding, and major flooding. Each category is based on property damage and level of public threat (NWS 2011).

Minor Flooding	Minimal or no property damage, but possibly some public threat or inconvenience
Moderate Flooding	Some inundation of structures and roads near streams. Some evacuations of people and/or transfer of property to higher elevations are necessary
Major Flooding	Extensive inundation of structures and roads. Significant evacuations of people and/or transfer of property to higher elevations

Flood Induced Landslides

Extent of a landslide hazard is determined by identifying affected areas and assessing probability of a landslide occurring within a time period. Natural variables that contribute to overall extent of potential landslide activity in any particular area include soil properties, topographic position and slope, and historical incidence. Predicting a landslide is difficult, even under ideal conditions. As a result, the landslide hazard is often represented by landslide incidence and susceptibility, defined as follows:

- **Landslide incidence** is categorized by percentage of a given geographic area that has undergone landslides. High incidence means greater than 15 percent of a given area has been involved in landsliding, medium incidence means that 1.5 to 15 percent of an area has been involved, and low incidence means that less than 1.5 percent of an area has been involved. (Radbruch-Hall, Dorothy H. et al. 1982).
- **Landslide susceptibility** is defined as the probable degree of response of geologic formations to natural or artificial cutting, to loading of slopes, or to unusually high precipitation. Assumedly, unusually high precipitation or changes in existing conditions can initiate landslide movement in areas where rocks and soils have been involved with landslides in the past. Landslide susceptibility depends on slope angle and geologic material underlying the slope. Landslide susceptibility applies only to areas potentially affected, and does not imply a time frame within which a landslide might occur. High, medium, and low susceptibility are delimited by the same percentages used for classifying incidence of landsliding (Radbruch-Hall, Dorothy H. et al. 1982).

Dam Failure

According to the NYS DEC Division of Water Bureau of Flood Protection and Dam Safety, the hazard classification of a dam is assigned according to the potential impacts of a dam failure pursuant to 6 New York Codes, Rules, and Regulations (NYCRR) Part 673.3 (NYS DEC 2009). Dams are classified in terms of potential for downstream damage if the dam were to fail. These hazard classifications are identified and defined below:

- *Low Hazard (Class A)* is a dam located in an area where failure will damage nothing more than isolated buildings, undeveloped lands, or township or county roads and/or will cause no significant economic loss or serious environmental damage. Failure or mis-operation would result in no probable loss of human life. Losses are principally limited to the owner's property

- *Intermediate Hazard (Class B)* is a dam located in an area where failure may damage isolated homes, main highways, minor railroads, interrupt the use of relatively important public utilities, and/or will cause significant economic loss or serious environmental damage. Failure or mis-operation would result in no probable loss of human life, but can cause economic loss, environment damage, disruption of lifeline facilities, or impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.
- *High Hazard (Class C)* is a dam located in an area where failure may cause loss of human life, serious damage to homes, industrial or commercial buildings, important public utilities, main highways or railroads and/or will cause extensive economic loss. This is a downstream hazard classification for dams in which excessive economic loss (urban area including extensive community, industry, agriculture, or outstanding natural resources) would occur as a direct result of dam failure.
- *Negligible or No Hazard (Class D)* is (1) a dam that has been breached or removed, or has failed or otherwise no longer materially impounds waters, or (2) a dam that was planned but never constructed. Class "D" dams are considered to be defunct dams posing negligible or no hazard. The department may retain pertinent records regarding such dams.

Dam failures cause serious downstream flooding either because of partial or complete dam collapse. Failures are usually associated with intense rainfall and prolonged flood conditions; however, dam breaks may occur during dry periods as a result of progressive erosion of an embankment. The greatest threat from a dam break is to areas immediately downstream. Dam failures may or may not leave enough time for evacuation of people and property, depending on their abruptness. Seepages in earth dams usually develop gradually, and if the embankment damage is detected early, downhill residents have at least a few hours or days to evacuate. Failures of concrete or masonry dams tend to occur suddenly, sending a wall of water and debris down the valley at more than 100 mph. Survival would be a matter of having the good fortune not to be in the flood path at the time of the break. Dam failures due to the overtopping of a dam normally give sufficient lead time for evacuation.

The environmental impacts of a dam or levee failure can include significant water-quality and debris-disposal issues. Flood waters can back up sanitary sewer systems and inundate wastewater treatment plants, causing raw sewage to contaminate residential and commercial buildings and the flooded waterway. The contents of unsecured containers of oil, fertilizers, pesticides, and other chemicals get added to flood waters. Hazardous materials may be released and distributed widely across the floodplain. Water supply and wastewater treatment facilities could be offline for weeks. After the flood waters subside, contaminated and flood-damaged building materials and contents must be properly disposed of. Contaminated sediment must be removed from buildings, yards, and properties. In addition, severe erosion is likely; such erosion can negatively impact local ecosystems.

Flood Mitigation Needs Assessments

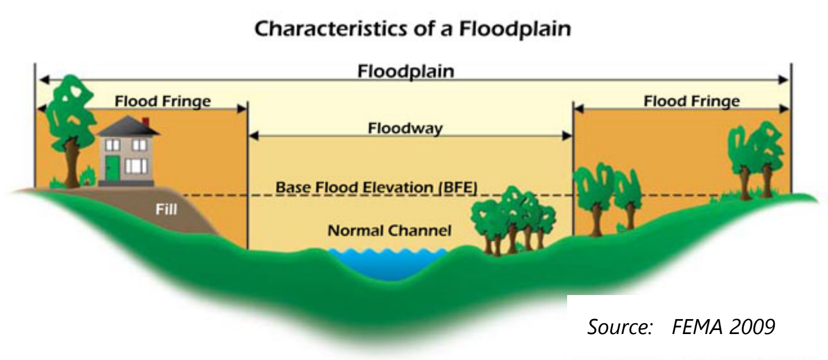
In 2005, Tompkins County undertook a Flood Mitigation Needs Assessment that examined flooding in Six Mile Creek, Salmon Creek, Fall Creek, and Cayuga Inlet as part of a Countywide Flood Hazard Mitigation Program effort that periodically funds assessments and flood mitigation projects. The assessments notes issues associated with sedimentation, debris-filled channels, erosion, and the lack of more detailed flood studies. Since 2005, the County has completed needs assessments for Taughannock Creek and Buttermilk Creek. The intent of these efforts is to gain a better understanding the complexity and interrelationships of factors that influence flooding; prioritize flood-related projects; and evaluate recommendations for the program. Several projects identified in these assessments have been implemented.

Location

Flooding potential is influenced by climatology, meteorology, and topography (elevations, latitude, and water bodies and waterways). Flooding potential for each type of flooding that affects Tompkins County is described in the subsections below.

Floodplains

A floodplain is defined as the land adjoining the channel of a river, stream, ocean, lake, or other watercourse or water body that becomes inundated with water during a flood. In Tompkins County, floodplains line the rivers and streams of the County. The boundaries of the floodplains are altered as a result of changes in land use, the amount of impervious surface, placement of obstructing structures in floodways, changes in precipitation and runoff patterns, improvements in technology for measuring topographic features, and utilization of different hydrologic modeling techniques.



Source: FEMA 2009

Flood Map Terms

- Flood hazard areas identified on the Flood Insurance Rate Map are identified as a Special Flood Hazard Area (SFHA).
- SFHA = the area that will be inundated by the flood event having a 1-percent chance of being equaled or exceeded in any given year.
- 1-percent annual chance flood = the base flood or 100-year flood.
- SFHAs are labeled as Zone A, Zone AO, Zone AH, Zones A1-A30, Zone AE, Zone A99, Zone AR, Zone AR/AE, Zone AR/AO, Zone AR/A1-A30, Zone AR/A, Zone V, Zone VE, and Zones V1-V30.
- Zone B or Zone X (shaded) = Moderate flood hazard areas and are the areas between the limits of the base flood and the 0.2-percent-annual-chance (or 500-year) flood.
- Zone C or Zone X (unshaded) = Areas of minimal flood hazard, which are the areas outside the SFHA and higher than the elevation of the 0.2-percent-annual-chance flood, are labeled Zone C or Zone X (unshaded).

Flood hazard areas are identified as Special Flood Hazard Area (SFHA). SFHA are defined as the area that will be inundated by the flood event having a 1 percent chance of being equaled to or exceeded in any given year. The 1 percent annual chance flood is also referred to as the base flood or 100-year flood. A 100-year floodplain is not a flood that will occur once every 100 years rather the designation indicates that a flood that has a 1-percent chance of being equaled or exceeded each year. Thus, the 100-year flood could occur more than once in a relatively short period of time. Similarly, the moderate flood hazard area (500-year floodplain) will not occur every 500 years but is an event with a 0.2-percent chance of being equaled or exceeded each year (FEMA 2018). The 1-percent annual chance floodplain or SFHA establishes the area that has flood insurance and floodplain management requirements.

As Tompkins County does not yet have Digital Flood Insurance Rate Maps (DFIRM), locations of flood zones were provided as Q3 data generated by FEMA back in the 1970s and 1980s. The Q3 date provides information on the extent, but not the depth of flooding. During this HMP update, the County Q3 data was digitized and provided for the 1-percent and 0.2-percent annual chance flood event (refer to Figure 5.4.44). The total land area in the floodplain, inclusive of waterbodies, is summarized in Table 5.4.4-1. Refer to Section 9 for a map of each jurisdiction depicting the floodplains. Flood hazard zones occur throughout the County, predominantly along County waterways. The Q3 data provided by FEMA for Tompkins County show the following flood hazard areas:

- 1-Percent Annual Chance Flood Hazard: Areas subject to inundation by the 1-percent-annual-chance flood event. This includes Zone A and Zone AE. Mandatory flood insurance requirements and floodplain management standards apply. Base flood elevations are provided in Zone AE. Zone A has no determined flood depths.

- 0.2-Percent Annual Chance Flood Hazard: Area of minimal flood hazard, usually depicted on FIRMs as the 500-year flood level or Shaded X Zone.

Tompkins County flood map data is currently being reviewed and updated by FEMA and NYS DEC. Final Flood map updates are anticipated in 2022. In addition, flood depth grids generated by the USGS was incorporated to refine the exposure analysis.

Table 5.4.4-1. Total Area of Tompkins County Exposed to the 1-Percent and 0.2-Percent Annual Chance Flood Event Hazard Areas

Jurisdiction	Total Area (acres)	Total Area Exposed to the 1-Percent Annual Chance Flood Event		Total Area Exposed to the 0.2-Percent Annual Chance Flood Event	
		Area Exposed (acres)	Percent of Total	Area Exposed (acres)	Percent of Total
Caroline (T)	35,243	464	1.3%	464	1.3%
Cayuga Heights (V)	1,121	0	0.0%	0	0.0%
Danby (T)	34,511	551	1.6%	551	1.6%
Dryden (T)	58,487	1,697	2.9%	1,698	2.9%
Dryden (V)	1,116	179	16.0%	209	18.7%
Enfield (T)	23,622	0	0.0%	0	0.0%
Freeville (V)	698	112	16.0%	112	16.0%
Groton (T)	30,580	629	2.1%	630	2.1%
Groton (V)	1,065	78	7.4%	105	9.9%
Ithaca (C)	3,891	767	19.7%	1,340	34.4%
Ithaca (T)	18,249	1,268	6.9%	1,356	7.4%
Lansing (T)	41,868	797	1.9%	797	1.9%
Lansing (V)	2,910	2	0.1%	2	0.1%
Newfield (T)	37,836	373	1.0%	373	1.0%
Trumansburg (V)	890	28	3.2%	28	3.2%
Ulysses (T)	22,697	2,974	13.1%	2,974	13.1%
Tompkins County (Total)	**314,785**	**9,921**	**3.2%**	**10,640**	**3.4%**

Source: Tompkins County GIS 2019/2020
Notes: V = Village, C = City, T = Town

Flood Gages

The USGS National Water Information System (NWIS) collects surface water data from more than 850,000 stations across the country. The time-series data describes stream levels, streamflow (discharge), reservoir and lake levels, surface water quality, and rainfall. The data is collected by automatic recorders and manual field measurements at the gage locations.

There are five USGS stream gages in the County, of which two have defined flood and action stages. Two gages are found in Ithaca (at Cayuga Lake and Fall Creek), and the remainder are found along Six Mile Creek and Salmon Creek.

The Owasco Lake Watershed Inspection Division is currently implementing a pilot project to deploy up to 4 water level monitoring gauges affixed to bridges in that watershed to provide an additional level of information regarding water levels. These gauges are not integrated into the USGS system.

Figure 5.4.4-2. USGS Stream Gages in Tompkins County

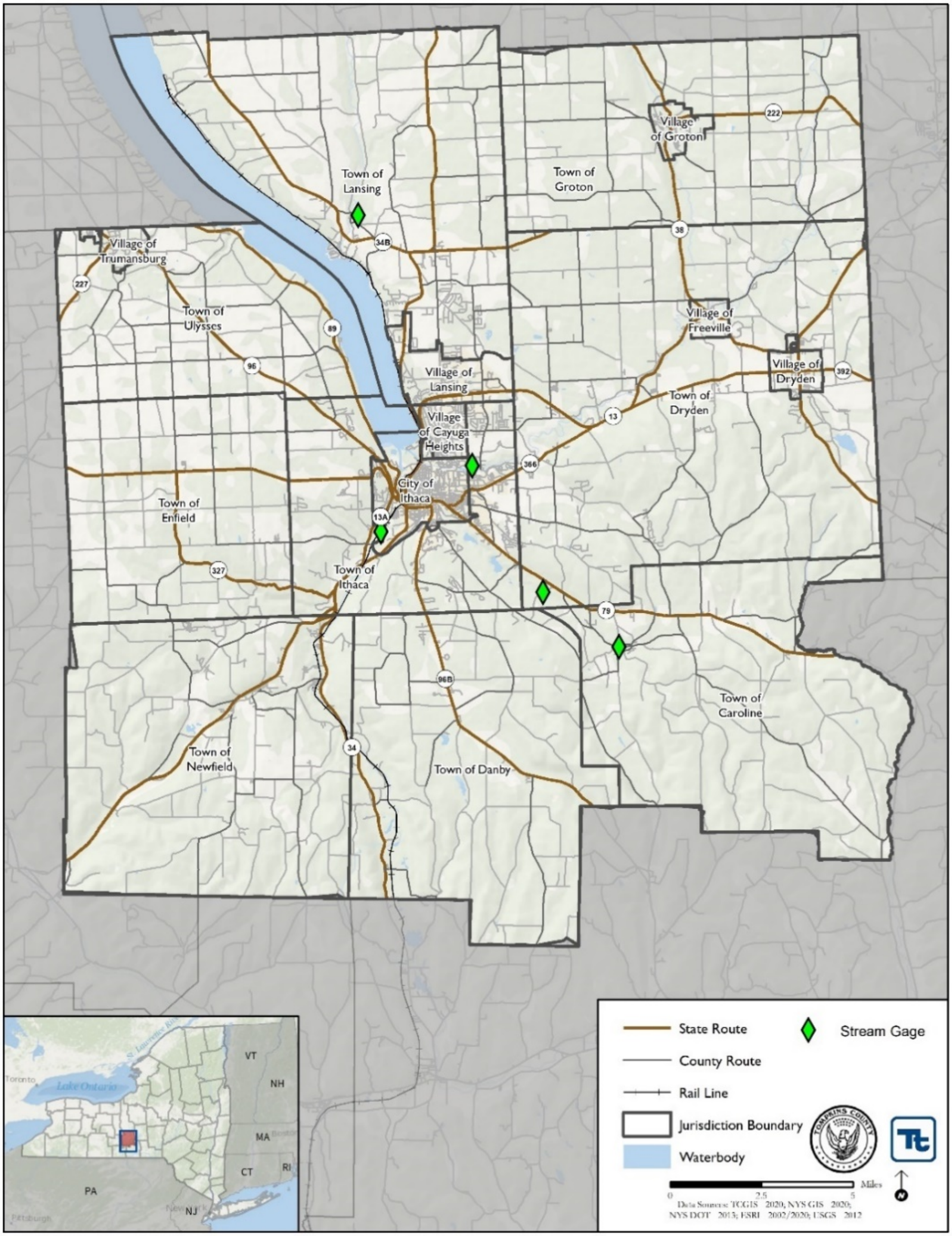


Table 5.4.4-2 shows the gages in the County with their determined flood stage and their record flood event. The USGS website provides details about each of the gages (https://waterwatch.usgs.gov/index.php) and the gage heights of flooding events. The NWS provides the different flood stages for the gages (https://water.weather.gov/ahps/).

Table 5.4.4-2. Stream Gage Statistics for Tompkins County

Gage Site Number	Site Name	Action Stage (feet)	Minor Flood Stage (feet)	Moderate Flood Stage (feet)	Major Flood Stage (feet)	Record Flood*
04233255	Cayuga Lake at Ithaca	383	383.5	384	385	386.5 in April 1993
04234000	Fall Creek at Ithaca	5.0	6.0	6.5	7.0	11.16 on February 21, 1971
04233300	Six Mile Creek at Bethel Grove	Undefined				9.78 feet, on Jan. 19, 1996
04233286	Six Mile Creek at Brooktondale	Undefined				5.38 feet, on Sept. 8, 2011
0423401815	Salmon Creek near Ludlowville, NY	Undefined				5.01 feet, on March 30, 2014

**Gage NGVD datum as noted on website*
Source: USGS 2020

Water Level Data

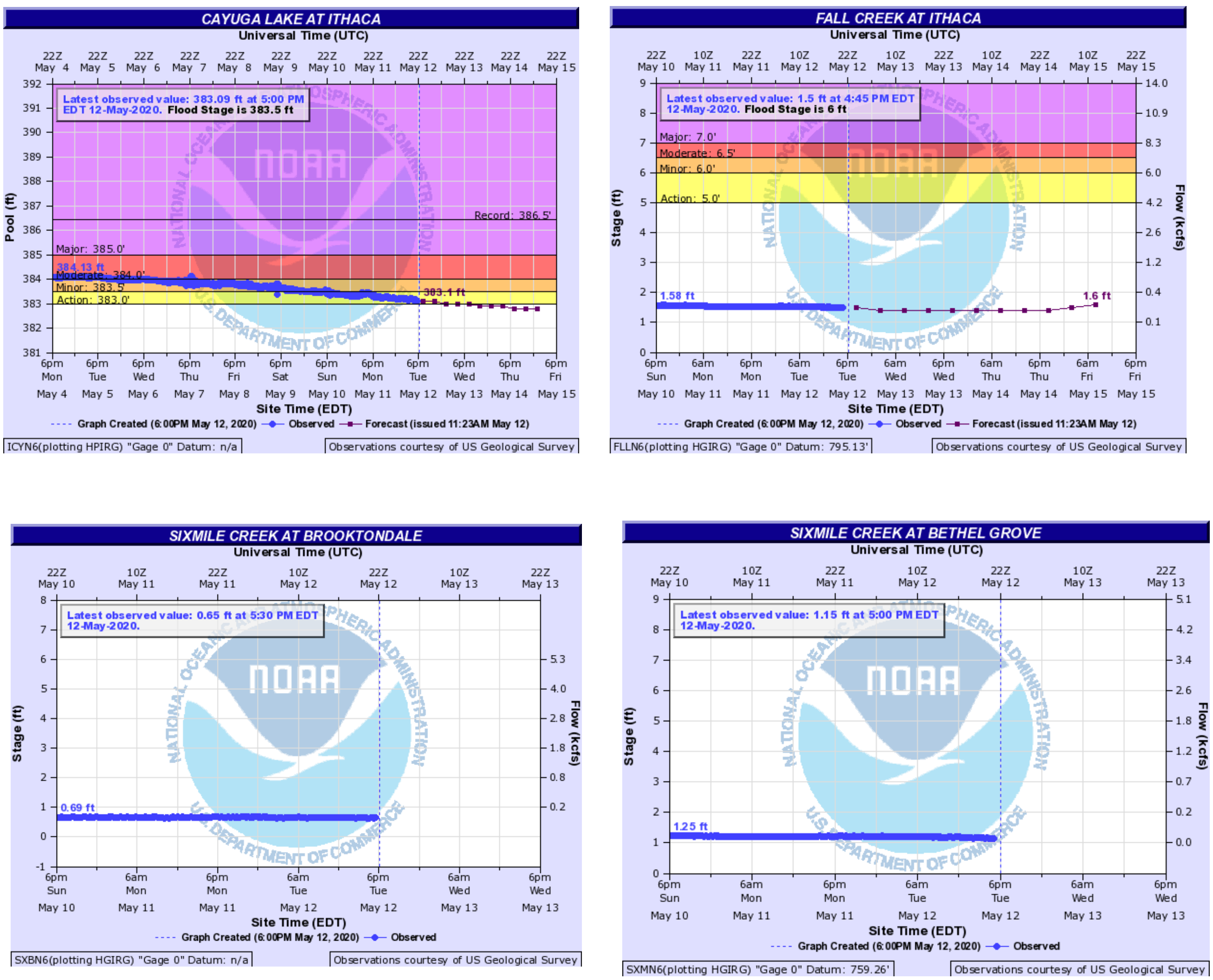
A hydrograph shows how a water level changes over time at a specific location to enable a review of historic water levels which are useful in floodplain management planning. In Tompkins County, of the five stream gages, two provide the probabilistic and deterministic forecast for specific bodies of water. These forecast hydrographs are useful to reference when flooding is expected or to determine the observed water level for the past few days. The hydrographs for Cayuga Lake at Ithaca and Fall Creek at Ithaca provide water levels for the action, minor flooding, moderate flooding, and major flooding stages. They also display the flood of record (or the highest recorded water level) for the specific gage. These stages are defined as follows:

- Action Stage - the stage which; when reached by a rising stream, lake, or reservoir represents the level where the NWS or a partner/user needs to take some type of mitigation action in preparation for possible significant hydrologic activity.
- Minor Flooding - minimal or no property damage, but possibly some public threat.
- Moderate Flooding - some inundation of structures and roads near stream. Some evacuations of people and/or transfer of property to higher elevations.
- Major Flooding - extensive inundation of structures and roads. Significant evacuations of people and/or transfer of property to higher elevations.
- Record Flooding - flooding which equals or exceeds the highest stage or discharge at a given site during the period of record keeping.

(*https://water.weather.gov/ahps2/pdf/hydrograph_terminology.pdf*).

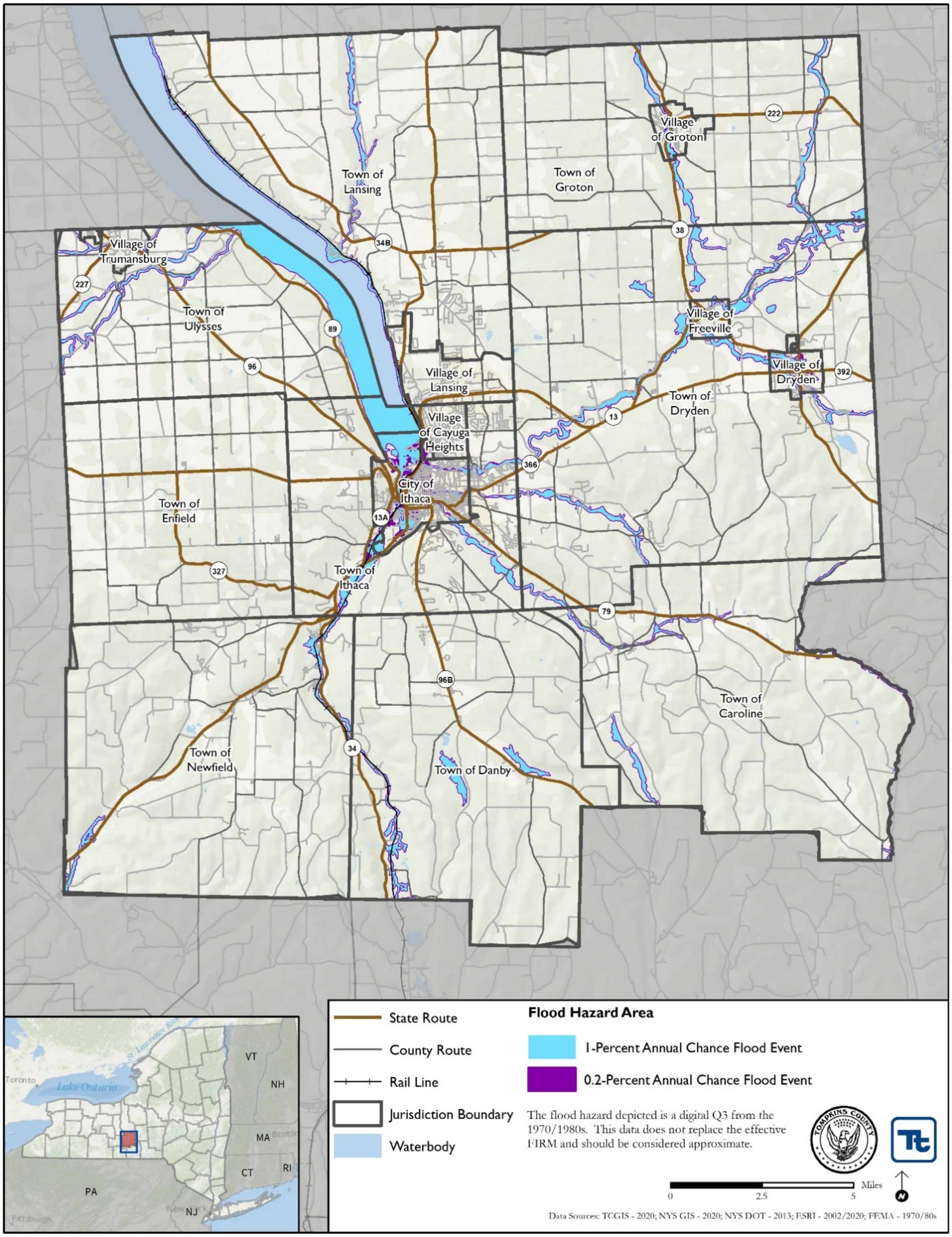
To illustrate the data available, screenshots of the gages are provided in Figure 5.4.4-3. The first hydrograph in the figure provides data collected at the *Cayuga Lake at Ithaca* gage as captured on May 20, 2020. It indicates that high water level of record is 386.5 feet, Action Stage is 383 feet, Minor Stage is 383.5 feet, Moderate Stage is 384 feet and Major Stage is 385 feet with the actual water height recorded as 383,1 feet at 6:00 pm on that day. This information is useful for local officials, emergency managers, and citizens to inform preparedness and response planning and activities to reduce potential impacts of flooding. It is important that funding to continue operating gages continues to help further understand risk.

Figure 5.4.4-3. Flood Hydrographs for the Gages in Tompkins County



Source: NWS 2020

Figure 5.4.4-4. Tompkins County 1-Percent and 0.2-Percent Annual Flood Event Hazard Areas



Riverine/Flash Flooding/Stormwater Flooding

Tompkins County has faced frequent flood issues owing to its prolific waterways, particularly Cayuga Lake. The County is located along a major waterway drainage divide, with the southern section of the County draining to the Susquehanna River and the northern section draining to the Seneca-Oneida-Oswego River through Cayuga Lake. According to FEMA Q3 data, the County's flood zones are found in isolated areas along its major waterways, including Six Mile Creek, Taughannock Creek, Cayuga Inlet, and Fall Creek. The southern shore of Cayuga Lake and the areas immediately adjacent to the Inlet in the City and Town of Ithaca contain larger flood zones. A 500-year flood zone surrounds the core city area.

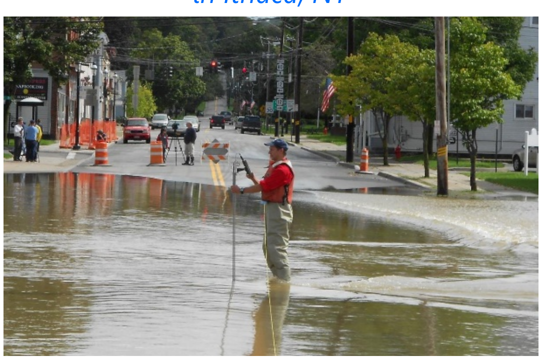
Figure 5.4.4-5. Ice jam at Cascadilla Creek near the Adams Street pedestrian bridge in Ithaca.

Source: WHCURadio.com

FEMA's Flood Insurance Studies for Tompkins County currently consist of paper Flood Insurance Rate Maps (FIRMs) that date to the mid-1980s. Separate Flood Insurance Studies are available for the Village of Dryden, Village of Groton, City of Ithaca, Town of Ithaca, Town of Lansing, Village of Lansing, and the Town of Ulysses. Currently, FEMA is developing new Flood Insurance Rate Maps which are scheduled to be finalized in 2022.

In Dryden, the FIS notes that the majority of stream reaches in the village have small main channels. This results in flooding in low, flat flood plains. The FIS notes that the lack of long-term gaging station prevents the collection of data about major floods. In the Village of Groton, floods can occur along the Owasco Inlet. The Village was hard-hit by an October 1981 flood that caused more than $3 million in damages and resulted in four feet of water in the center of the Village (Environmental Management Council, 2018). While Dryden does have the Virgil Creek Dam to help control some flooding to the Village of Dryden, the Village of Groton does not have flood control structures.

Figure 5.4.4-6. USGS Staffer tracking flow in Ithaca, NY



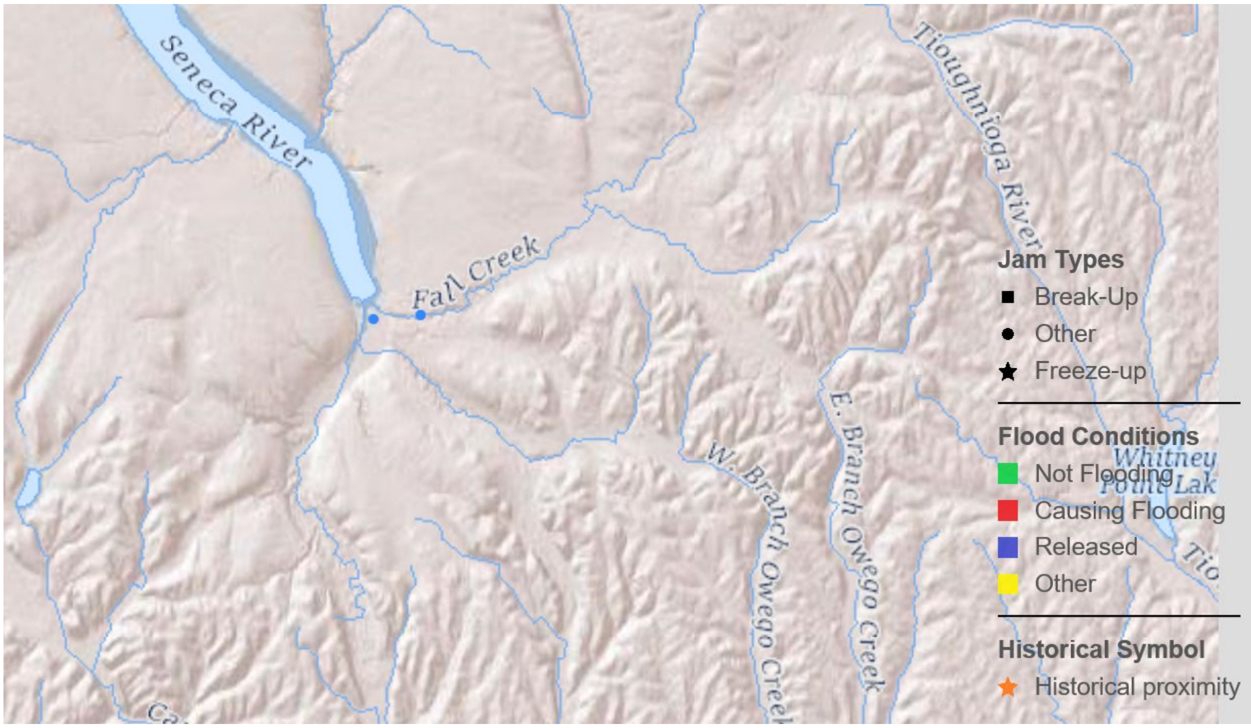
Source: USGS

The City of Ithaca faces flood vulnerability due to its location vis-à-vis Cayuga Lake and Cayuga Inlet. Low-lying areas flood during summer thunderstorms and wave action on the lake in the wintertime forces ice up the Fall Creek, blocking flow. The FIS notes that most streams in the City have some sort of channel improvement and that the Army Corps of Engineers had constructed a flood protection project along the Inlet. Lack of dredging has reduced effectiveness of this project, however dredging is currently planned to allow this project to function as designed. The Town of Ithaca also experiences flooding, predominantly due to Cayuga Inlet and from localized creek flooding during strong storms.

Both the Village and Town of Lansing experience flooding owing to high water levels in Cayuga Lake. Neither are protected by structural flood control projects, though some flood control structures, like that in Ludlowville have been recently built and provide localized stormwater protection during high precipitation events. The Town of Ulysses is similarly impacted by high lake levels.

Ice Jam Flooding

Ice jams can occur along Tompkins County's streams and rivers. Two reported incidents were reported in the Army Corps' ice jam database- one event at Fall Creek/Beebe Lake in March 2003, and one break-up event along Cascadilla Creek in January 2014. The NOAA database reported an additional ice-related flooding event in January 2005.



Lakeshore Flooding

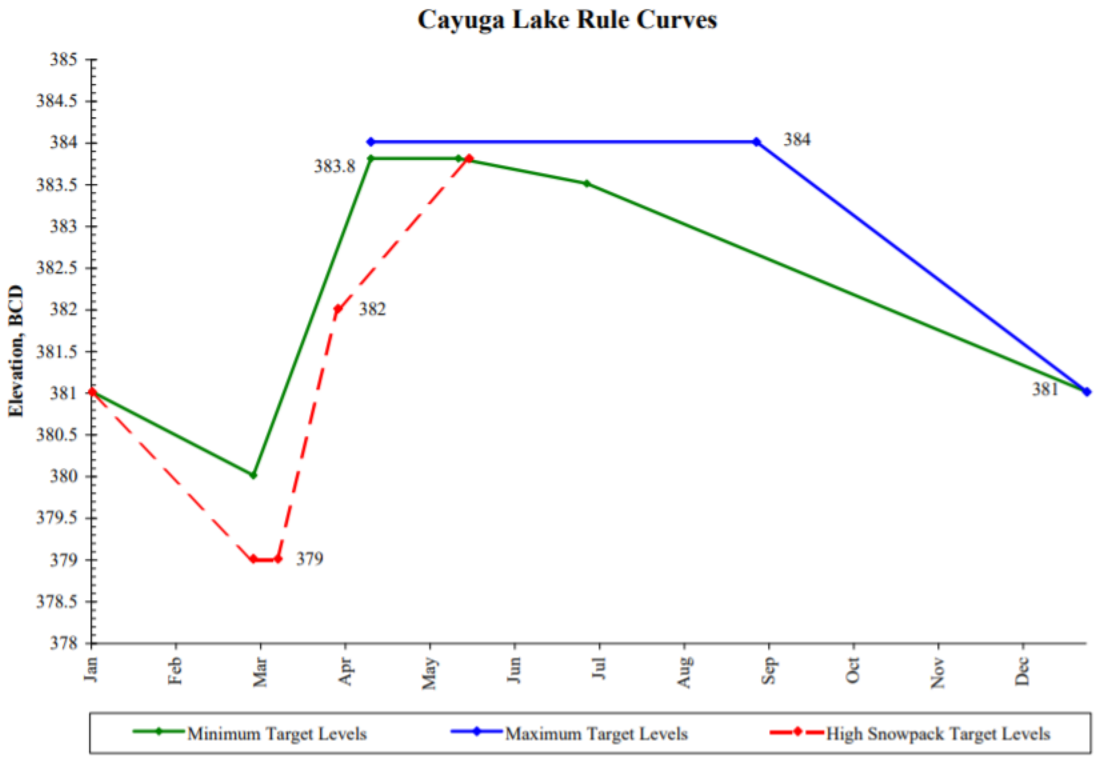
Tompkins County is impacted by lakeshore flooding, particularly along Cayuga Lake. The lake has a targeted elevation range of between 382.7 and 384 feet. Target levels for a variety of conditions change slightly throughout the year, as seen in Figure 5.4.4-7. The lake's hydrology is complicated and managing water levels requires a delicate balancing of needs between upstream and downstream residents.

The New York State Canal Corporation is responsible for maintaining water levels of the Oswego River Basin canal system for navigational purposes. As a result, the Corporation operates the dam at Mud

Lock. However, because Cayuga Lake drains into the Seneca River, managing water levels in the lake is difficult. During flooding conditions, lowering Cayuga Lake can damage properties along the Seneca River (Cayuga Lake Watershed Network, 2020).

A notable lakeshore flooding event occurred in June 1972, when rains from the remnants of Hurricane Agnes raised the lake level and flooded yards and basements (Environmental Management Council, 2018).

Figure 5.4.4-7: Cayuga Lake Rule Curves



**BCD = Barge Canal Datum; conversion to NGVD: subtract 1.3 feet; conversion to NAVD: subtract 1.9 feet*
Source: NYS Canal Corporation, 2020

Figure 5.4.4-8: Cayuga Lake Water Levels in 2020

**BCD = Barge Canal Datum; conversion to NGVD: subtract 1.3 feet; conversion to NAVD: subtract 1.9 feet*
Source: NYS Canal Corporation, 2020

Cayuga Lake experiences flooding somewhat regularly. In early May 2020, the National Weather Service issued a flood warning as lake levels exceeded 0.6 feet above flood stage, which causes expected flood impacts to Stewart Park, Allan H. Treman State Marine Park, and the Titus Towers area along Route 13 in Ithaca. Lakeside houses in the Towns of Ulysses and Lansing and Village of Trumansburg are also susceptible to flooding (14850.com, 2020). According to an archive of National Weather Service warnings, Flood Warnings have been issued to the City of Ithaca eleven times since 2005 (Iowa State University, 2020). The Flood Impacts based on water levels in the lake are as follows:

Figure 5.4.4-9: NWS Flood Impacts by Lake Water Level

Water Level	Description
386.5	This is the approximate level during the April 1993 record snowmelt flood.
386.3	This is approximately the lake level during the June 1972 Hurricane Agnes major flood.
385	Significant flooding occurs around the lake. This level is approximately the same as the April 1916 and March 1936 floods. Wind waves will cause unusual land erosion and damage docks.

Water Level	Description
384	Water will affect some properties along the lake shore in the towns of Ulysses, Trumansburg and Lansing. No homes are flooded at this level. Parks near the lake may flood. Wind waves may cause unusual land erosion and damage docks.
383.5	The lake level is high enough to flood normally dry areas along the shoreline and may affect some paths, or roads nearest the shore.

Source: NWS, 2020

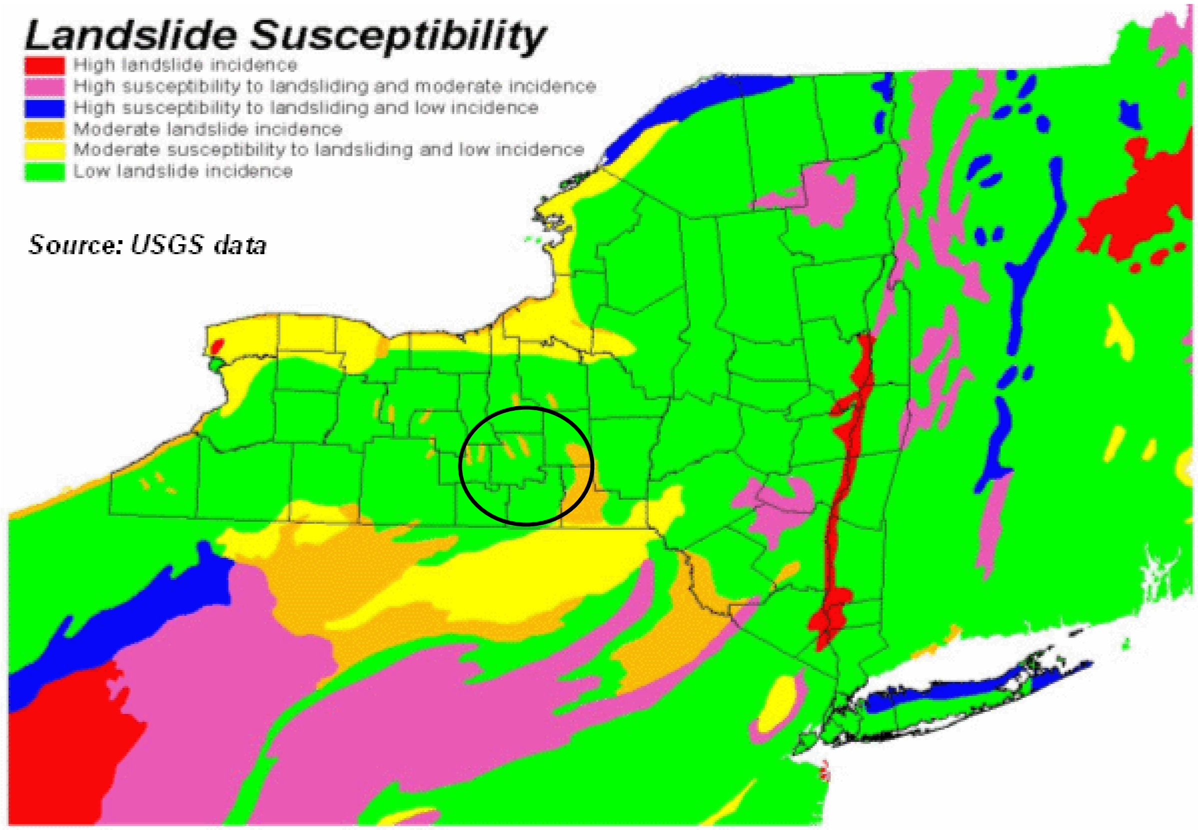
Flood Induced Landslides

Due to the topographic characteristics of Tompkins County, several municipalities are vulnerable to landslides due to flash flood events, particularly in the Towns of Dryden, Groton, Caroline, the City of Ithaca, and the Villages of Freeville and Groton. Cornell University has also reported multiple landslide events on their properties, which have resulted from flash flooding (Tompkins County HMP 2014).

Landslides have occurred in several areas of Tompkins County. The most recent landslides have occurred along creeks in the County, particularly Six Mile Creek and Fall Creek. Though there has been limited private property damage, the landslides have resulted in significant damage to roadways and public infrastructure. According to the 2020 HMP Steering Committee, there are a number of vulnerable areas within the City of Ithaca, specifically the Cascadilla and Fall Creek Gorge that are vulnerable to erosion, especially during intense precipitation events. Taughannock Falls and properties located along the gorge have also been identified as areas that are vulnerable to landslides and erosion. However, because of the slow nature of these hazards and the limited actions the County can consider for mitigation, this hazard has not been designated as a standalone hazard of concern.

Figure 5.4.4-10 shows landslide incidence and susceptibility in New York State based on known incidents and geologic data. The figure shows that there are two moderate incidence locations in the County that correspond to areas surrounding Cayuga Lake and areas located within the Pleasant Valley area.

Figure 5.4.4-10. Landslide Susceptibility in Tompkins County



Source: NYSDHSES:
Note: Circle indicates the approximate location of Tompkins County.

Dam Failure

NYS DEC maintains an inventory of dam failure data. Hazard classification, location, volume, elevation, and condition information for each dam in Tompkins County that has a federal identification number is included in the inventory. The New York State Inventory of Dams identifies 97 dams in Tompkins County: 26 low hazard, 4 intermediate hazard, 5 high hazard, 10 negligible or no hazard classification, and 51 with an unknown classification (NYS DEC 2021).

Levee Failure

Levees protect portions of the City of Ithaca. The two levee systems, found along the left and right bank of the Cayuga Inlet, together protect 621 people, 132 structures, and $57.5 million in property. As of May 2016, the Army Corps of Engineers rates the levee at a low risk for failure, which it classifies as "Likelihood of inundation due to breach and/or system component malfunction in combination with loss of life, economic, or environmental consequences results in low risk." Unofficial levees along Fall Creek and Cascadilla Creek also protect neighborhoods from flood damage, however, these levees are not regularly inspected by State or Federal agencies.

Previous Occurrences and Losses

Tompkins County has been subject to historic flooding, some of which has been alleviated by the Cayuga Inlet project. The worst storms in Ithaca occurred in 1857, 1935 and 1937 (Ithaca Voice). More recent disruptive flood conditions occurred in 1993 and 2014. In the 1993 storm, a rapid thaw resulted in flooding in the City of Ithaca. Fish were reported to be seen swimming in the Wegmans parking lot (Environmental Management Council, 2018).

Figure 5.4.4-11. The Ithaca Journal Article on 1937 Flooding

Britain Demands 'Full Satisfaction' for Wounding of Envoy

The Weather

U. S. Weather Bureau forecast:
Fair tonight and Saturday; not much change in temperature.
For detailed report, see Page 5.

THE ITHACA JOURNAL

MEMBER OF THE ASSOCIATED PRESS, THE GREATEST NEWSGATHERING ORGANIZATION IN THE WORLD

Wise Spending

No matter on what you're thinking of spending money — watch the changing ads in the classified section for the offer that suits you—and spend it wisely.

122nd YEAR—No. 205 EIGHTEEN PAGES ITHACA, N. Y., FRIDAY EVENING, AUGUST 27, 1937 PRICE THREE CENTS

FLOOD STRIKES ITHACA

Chinese Declare Foes Beaten Near Shanghai

London—(AP)—Authoritative quarters said the British government's demand for "full satisfaction" for the wounding of its ambassador to China was presented today to the Japanese ambassador to London.

The demand was understood to have been made by Foreign Secretary Anthony Eden to Shigeru Yoshida, the Japanese envoy, when the latter called at the foreign office to tender officially Japan's regrets.

Sir Hughe Montgomery Knatchbull-Hugessen, Britain's ambassador, was gravely wounded Thursday when shot by Japanese airmen on the road between Nanking and Shanghai.

Crowd Masses Outside

Ambassador Yoshida spent half an hour with the foreign secretary. Indicating the public interest in the tension in Anglo-Japanese relations, a crowd gathered at the Downing Street entrance to the foreign office to witness the Japanese envoy's arrival and departure.

Earlier in the day Quo Tai-Chi, the Chinese ambassador, had visit-

Shanghai—(AP)—A Chinese communique declared today that a major Japanese offensive to split the ring around Shanghai had been defeated after a furious 30-hour battle at Lotien and said the enemy was in full retreat to the Yangtze River.

Three thousand Japanese were killed and wounded in the desperate fighting 12 miles northwest of Shanghai, the army communique asserted.

While the battle raged for the vital Yangtze landing stages, the British ambassador to China, wounded by an attack from Japanese warplanes, lay dangerous close to death in the Shanghai country hospital. His recovery, and perhaps the whole future of relations between Japan and Great Britain, depended on the success of a blood transfusion from a United States sailor.

Envoy Is Improving

Doctors attending Sir Hughe Montgomery Knatchbull-Hugessen said in mid-afternoon that the envoy was continuing a gradually slow improvement. His back was broken and his right side pierced

Death Comes To Mellon, Noted Financier

Southampton—(AP)—Andrew W. Mellon, who built one of the world's greatest fortunes out of banking, oil and aluminum and who spent his late years in the nation's service as secretary of the Treasury and as ambassador to Great Britain, has passed from the American scene.

The shy, diffident, white haired financier, whose 11 years of service under three presidents was surpassed only by one of his predecessors as head of the Treasury Department, died peacefully Thursday night in his 83rd year.

He died in the home of his daughter, Mrs. David K. E. Bruce, after a month's illness from uremia and bronchial pneumonia. At his bedside as life ebbed away were his son-in-law and the financier's two pals and playmates, his son Paul and his daughter Ailsa, Mrs. Bruce.

The death of Pittsburgh's most powerful figure and one of the nation's unostentatious philanthropists was not unexpected. He had been under the physician's care for

Scenes as Flood Waters Again Visit Ithaca

REPTILE REFUGE

Fair Washed Out As Rain Causes Widespread Loss

Torrents of water rushed down on Ithaca and vicinity from all directions today to create the worst flood conditions since July, 1935. Although no lives were lost, widespread property damage was reported.

The Island and southwest sections of the city were completely inundated shortly after 7 a. m., as rising waters of the Inlet overflowed the banks to the south. A few families evacuated their homes.

Highways Under Water

The Tompkins County Fair was completely washed out during the early hours of the day, but several hundred head of cattle were rescued before the rising waters engulfed them. Smaller animals were freed from their pens to shift for themselves until captured later.

Highways were blocked in three directions out of Ithaca. The new Inlet Valley highway was under several feet of water near Meadow Street, while tons of stone and silt covered the Five Mile Drive just south of the city. The road was passable, but dangerous.

Mecklenburg Road Blocked

The Mecklenburg highway was blocked between Kennedy's and Applegate's Corners as the result of a bridge washout. Raging waters undermined Taughannock Boulevard in several places between Ithaca and Glenwood. These same

also routed over the main line from Sayre via Geneva and Trumansburg. The Ithaca Post Office sent trucks to Trumansburg for it.

Considerable damage was caused by flood waters in the vicinity of Glenside again, when Coy Glen Creek went on a rampage.

Numerous sources provided historical information regarding previous occurrences and losses associated with flood events in Tompkins County. According to NOAA-NCEI Storm Events Database, National Performance of Dams Program (NPDP), and Cold Regions Research and Engineering Laboratory (CRREL) databases, Tompkins County has been impacted by 55 flood events, including ice jams and landslides, from 1954 to June 2020. Table 5.4.4-3 summarizes historical flood events (including ice jams) from 1954 to May 2020.

Table 5.4.4-3. Historic Flood Events 1954-2020

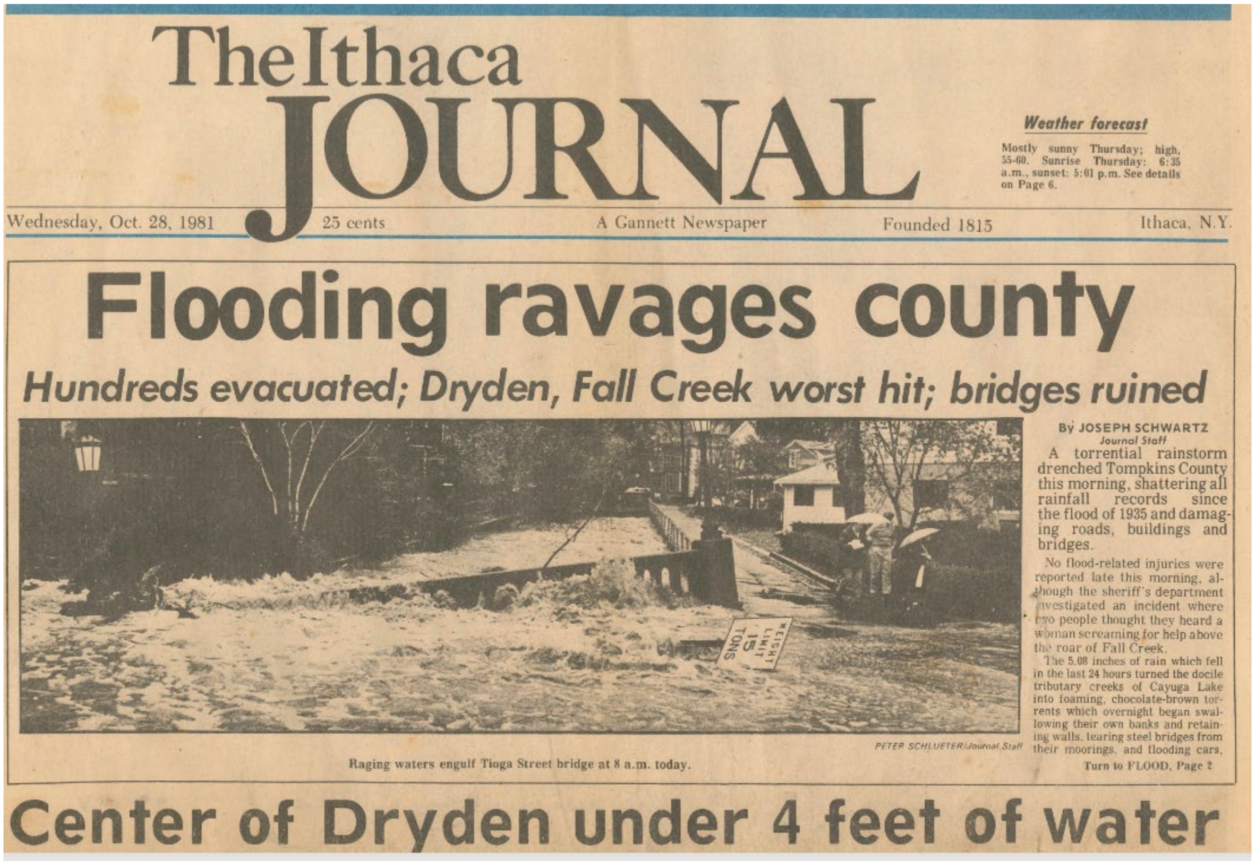
Hazard Type	Number of Occurrences Between 1954 and 2020	Total Fatalities	Total Injuries	Total Property Damage ($)	Total Crop Damage ($)
Riverine/ Flash Flood/ Stormwater Flood	18	0	0	$23.19 M	$0
Lakeshore Flood	0	0	0	$0	$0
Landslides	10	-	-	-	-
Dam Failure	0	0	0	$0	$0
Ice Jam	14	-	-	$60,000	-
Levee Failure	0	0	0	0	$0
TOTAL	**42**	**0**	**0**	**$23.2 M**	**$0**

Source: NOAA-NCEI 2020; CRREL 2020, International Levee Performance Database 2020

Notes: CRREL data does not include information on total fatalities, injuries, property damages, or crop damages; One event is counted both as a flood and as an ice jam.

M Million.

Figure 5.4.4-12. The Ithaca Journal Article on 1981 Flooding



The Ithaca JOURNAL

Weather forecast

Mostly sunny Thursday; high, 55-60. Sunrise Thursday: 6:35 a.m., sunset: 5:01 p.m. See details on Page 6.

Wednesday, Oct. 28, 1981 | 25 cents | A Gannett Newspaper | Founded 1815 | Ithaca, N.Y.

Flooding ravages county

Hundreds evacuated; Dryden, Fall Creek worst hit; bridges ruined

PETER SCHLUETER/Journal Staff

Raging waters engulf Tioga Street bridge at 8 a.m. today.

By JOSEPH SCHWARTZ
Journal Staff

A torrential rainstorm drenched Tompkins County this morning, shattering all rainfall records since the flood of 1935 and damaging roads, buildings and bridges.

No flood-related injuries were reported late this morning, although the sheriff's department investigated an incident where two people thought they heard a woman screaming for help above the roar of Fall Creek.

The 5.08 inches of rain which fell in the last 24 hours turned the docile tributary creeks of Cayuga Lake into foaming, chocolate-brown torrents which overnight began swallowing their own banks and retaining walls, tearing steel bridges from their moorings, and flooding cars,

Turn to FLOOD, Page 2

Center of Dryden under 4 feet of water

Between 1954 and May 2020, FEMA included New York State in 88 flood-related major disaster (DR) or emergency (EM) declarations classified as one or a combination of the following disaster types:

severe storms, flooding, hurricane, tropical depression, heavy rains, landslides, ice storm, high tides, nor'easter, tornado, snowstorm, severe winter storm, and inland/coastal flooding. Generally, these disasters cover a wide region of the State; therefore, they may have impacted many counties. Tompkins County was included in 12 of these flood-related declarations; refer to Table 5.4.4-4.

Table 5.4.4-4. Flood-Related FEMA Declarations for Tompkins County, 1954 to 2020

Disaster Number	Incident Duration	Declaration Date	Incident Type	Title
EM-3351	October 27-- November 8, 2012	10/28/2012	Hurricane	Hurricane Sandy
DR-4031	September 7-- September 11, 2011	9/13/2011	Severe Storm(s)	Remnants of Tropical Storm Lee
DR-1650	June 26-- July 10, 2006	7/1/2006	Severe Storm(s)	Severe Storms and Flooding
DR-1534	May 13-- June 17, 2004	8/3/2004	Severe Storm(s)	Severe Storms and Flooding
DR-1335	May 3-- August 12, 2000	7/21/2000	Severe Storm(s)	Severe Storms and Flooding
DR-1233	June 25-- July 10, 1998	7/7/1998	Severe Storm(s)	Severe Storms and Flooding
DR-1148	November 8-- November 15, 1996	12/9/1996	Severe Storm(s)	Severe Storms, High Winds, Rains, and Flooding
DR-1095	January 19-- January 30, 1996	1/24/1996	Flood	Severe Storms and Flooding
DR-515	July 21, 1976	7/21/1976	Flood	Severe Storms and Flooding
DR-487	October 2, 1975	10/2/1975	Flood	Storms, Rains, Landslides, and Flooding
DR-338	June 23, 1972	6/23/1972	Flood	Tropical Storm Agnes
DR-290	July 22, 1970	7/22/1970	Flood	Heavy Rains & Flooding

Source: FEMA 2020

For this update, flood events were summarized from 1996 to 2020. Known flood events, including FEMA disaster declarations, which have impacted Tompkins County between 1996 and 2020 are identified in Table 5.4.4-5. Not all sources have been identified or researched due to the quantity of available data. Therefore, Table 5.4.4-5 might not include all events that have occurred in the County. For events prior to 2012, refer to Appendix E (Supplementary Data). For detailed information on damages and impacts to each municipality, refer to Section 9 (Jurisdictional Annexes).

Table 5.4.4-5. Flood Events in Tompkins County, 2012 to 2020

Dates of Event	Event Type	FEMA Declaration Number (if applicable)	County Designated?	Event Details
August 8, 2013	Heavy Rain	N/A	N/A	A stationary front generated slow-moving clusters of thunderstorms across New York. Up to one foot of water crossed Route 89 near Taughannock Falls near Trumansburg. Near Waterburg, Harvey Hill and Fish Roads

Dates of Event	Event Type	FEMA Declaration Number (if applicable)	County Designated?	Event Details
				were closed due to flooding. Near Enfield, the bridge at the intersection of Route 327 and Harvey Hill Road was washed out. North of Ithaca, Routes 96 and 89 were covered in flood waters. Altogether, the County saw more than $150,000 in property damage.
August 3, 2014	Flash Flood	N/A	N/A	The City of Ithaca experienced $100,000 in damage after water covered several roadways and entered a residence. The northeastern section of the City was hit hardest.
June 5, 2015	Flash Flood	N/A	N/A	A stalled warm front brought repeated clusters of thunderstorms and widespread flooding in the County. Near Newfield, homes were flooded to the first floor and the Shelter Valley mobile home park was evacuated. Altogether, $1.5 million in damage was reported.
July 9, 2015	Flash Flood	N/A	N/A	Near Ludlowville, flood waters covered Ridge Road and Route 34B following a torrential rainfall. Roads from Groton to Trumansburg were flooded, with more severe flooding seen along Pease Road. Reported damage exceeded $70,000.
July 13, 2017	Flash Flood	N/A	N/A	Central New York experienced heavy rainfall in thunderstorms resulting from a stationary cold front. Route 41 and 41A saw closures due to flooding.
July 24, 2017	Flash Flood	N/A	N/A	A stationary front caused torrential rainfall stretching from Lansing to Dryden. Approximately $75,000 in damage was recorded.
August 15, 2019	Flash Flood	N/A	N/A	Danby saw road closures due to flooding following a stationary boundary over the region that produced slow-moving thunderstorms and caused $40,000 in damage. Steam Mill Road was reported to be completely washed away at Danby Creek.
April 30, 2020	Heavy Rain and Flooding	N/A	N/A	Heavy rainfall led to rapid and enhanced flooding in Tompkins County. In Trumbulls Corners (Town of Newfield), several creeks overflowed their banks along Route 13. In Caroline Center (Town of Caroline), water was moving across several properties. Total property damage was estimated at $7,000.

Sources: FEMA 2020; NOAA-NCEI 2020; NYS HMP 2019; SPC 2018; International Levee Performance Database 2019

FEMA Federal Emergency Management Agency
HMP Hazard Mitigation Plan
Mph Miles Per Hour
NCDC National Climatic Data Center
NOAA National Oceanic and Atmospheric Administration
NYS New York State
N/A Not Applicable
SPC Storm Prediction Center

Note: Many sources were consulted to provide an update of previous occurrences and losses; event details and loss/impact information may vary and has been summarized in the above table.

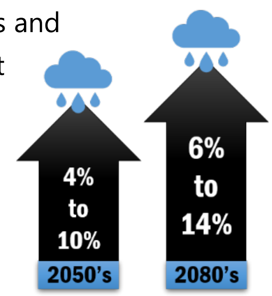
Climate Change Impact

In the Southern Tier region, it is estimated that precipitation totals will increase between 4 and 10 percent by the 2050s and 6 to 14 percent by the 2080s (baseline of 35.0 inches, middle range projection). Table 5.4.46 displays the projected seasonal precipitation change for the Southern Tier ClimAID Region (NYSERDA 2014).

Table 5.4.4-6. Projected Seasonal Precipitation Change in Region 3, 2050s (% change)

Winter	Spring	Summer	Fall
+5 to +15	0 to +15	-10 to +10	-5 to +10

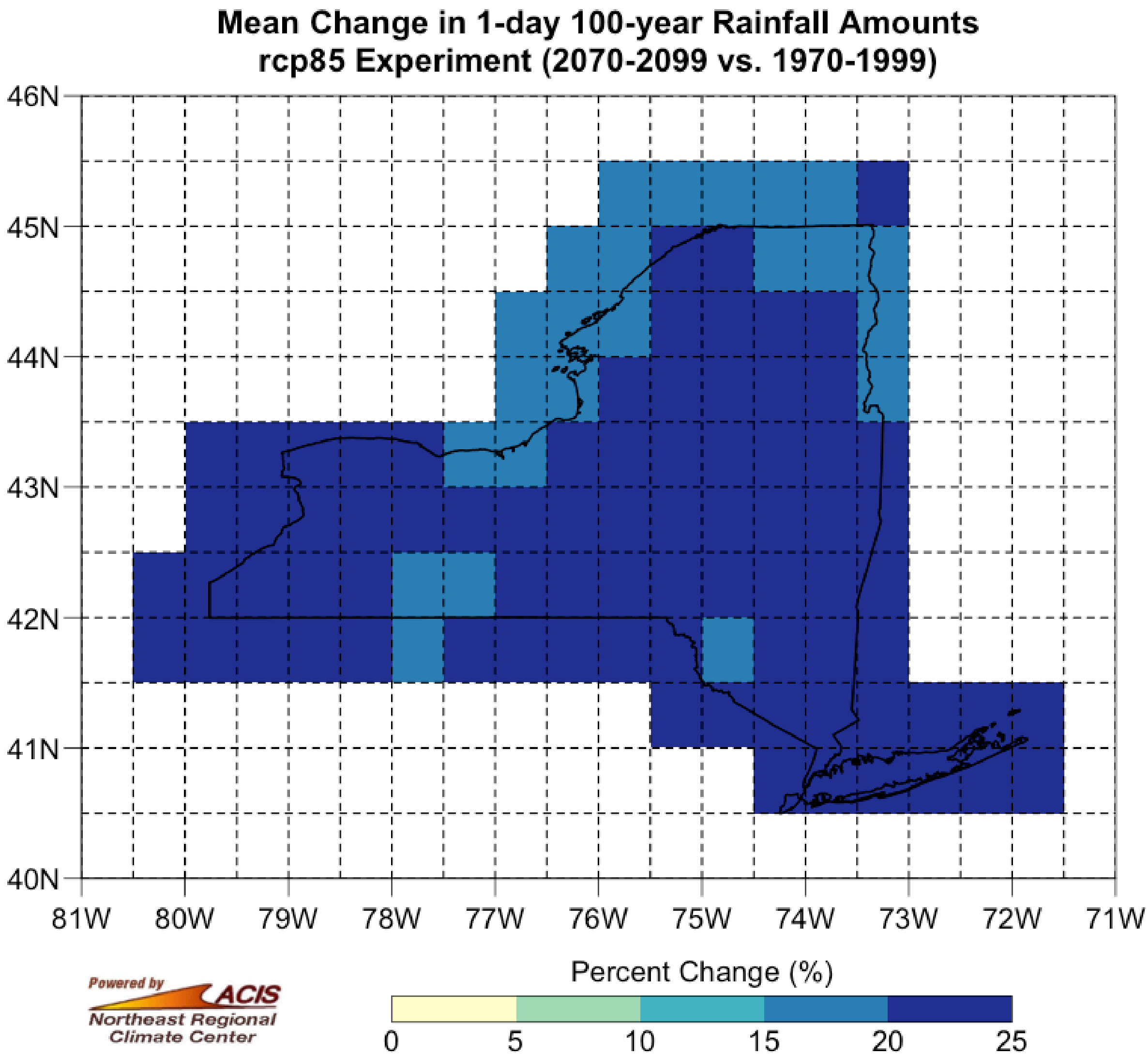
Source: NYSERDA 2011



The projected increase in precipitation is expected to fall in heavy downpours and less in light rains. The increase in heavy downpours has the potential to affect drinking water; heighten the risk of riverine flooding; flood key rail lines, roadways and transportation hubs; and increase delays and hazards related to extreme weather events (NYSERDA 2011).

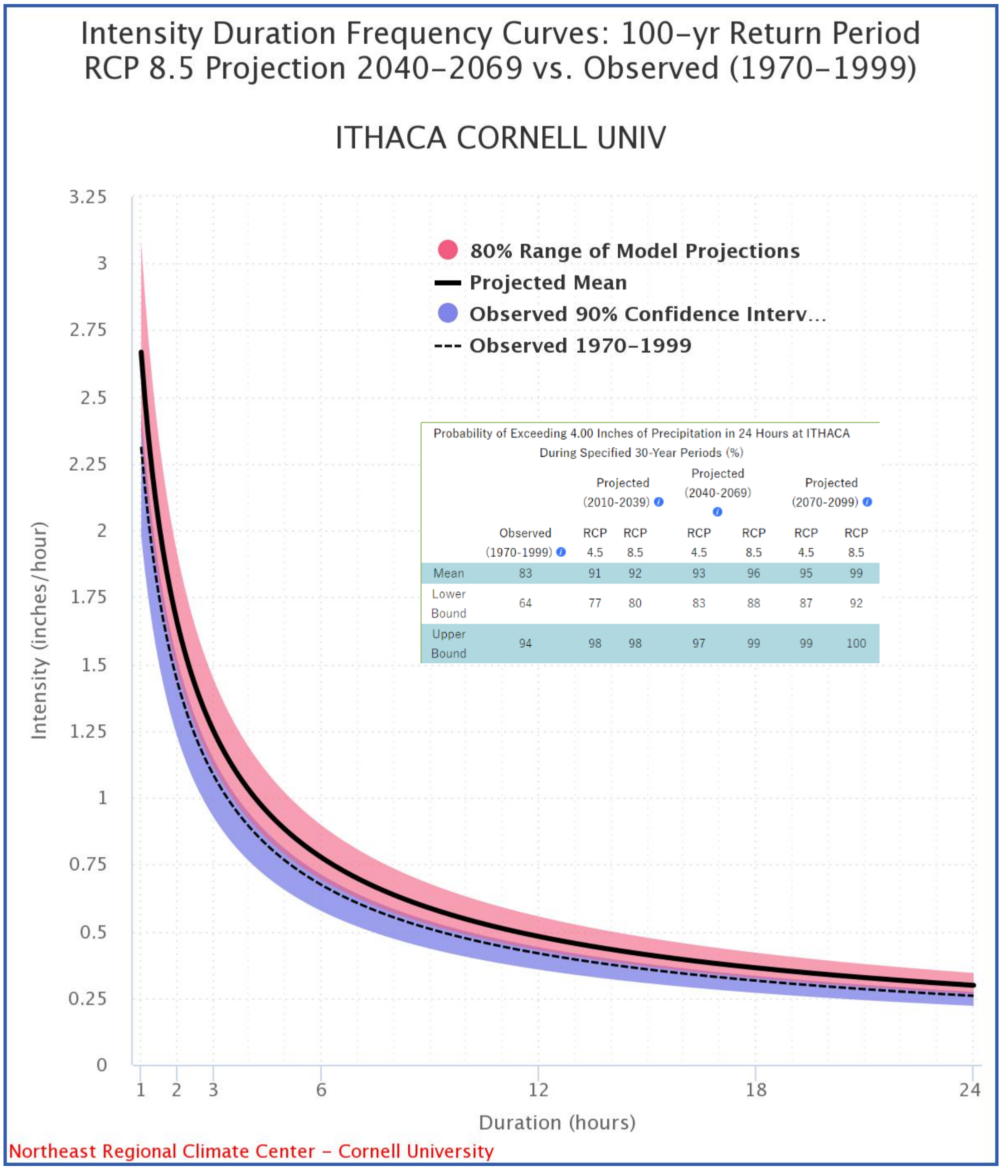
Increasing air temperatures intensify the water cycle by increasing evaporation and precipitation. This can cause an increase in rain totals during events with longer dry periods in between those events. These changes can have a variety of effects on the State's water resources (NYSERDA 2011). The amount of rain fall in a 100-year event is projected to increase, while the number of years between such storms (return period) is projected to decrease. Rainstorms will become more severe and more frequent (NYSERDA 2011).

Figure 5.4.4-13. Projected Mean Change in 100 Year Rainfall Amounts between 2070 and 2099



Source: NRCC, 2020

Figure 5.4.4-14. Intensity Duration Frequency Curves



Source: Northeast Regional Climate Center – Cornell University

NOTE: This curve is inconsistent with aforementioned historical data between 1970 and 1999 versus 1954 and 2020. The rainfall intensity–duration–frequency (IDF) curves are graphical representations of the probability that a given average rainfall intensity will occur within a given period of time. In this case, it is likely that within a 6 hour period that an average of 0.75 inches of rain will fall each hour. The red section and line are the projected changes versus the purple/ dash line are historical averages.

Dams are designed partly based on assumptions about a river's flow behavior, expressed as hydrographs. Changes in weather patterns can significantly affect the hydrograph used for the design of a dam. If the hygrograph changes, the dam conceivably could lose some or all designed margin of safety, also known as freeboard. Loss of designed margin of safety increases possibility that floodwaters would overtop the dam or create unintended loads, which could lead to a dam failure.

Probability of Future Occurrences

Based on the historic and more recent flood events in Tompkins County, and the future climate projections for this region, the County has a high probability of future flooding. Tompkins County will likely continue to experience direct and indirect impacts of flooding events annually that may induce secondary hazards such as infrastructure deterioration or failure, utility failures, power outages, water quality and supply concerns, and transportation delays, accidents and inconveniences.

As defined by FEMA, geographic areas within the 1-percent annual chance flood area (or Special Flood Hazard Area) in Tompkins County are estimated to have a 1-percent chance of flooding in any given year. A structure located within a 1-percent annual chance flood area has a 26 percent chance of suffering flood damage during the term of a 30-year mortgage. Similarly, the 0.2-percent annual chance flood has a 6 percent chance of occurring during a 30-year time period.

Dam failure events are infrequent and usually coincide with events that cause them, such as earthquakes, landslides, and excessive rainfall and snowmelt. However, the risk of such an event increases for each dam as the dam's age increases and/or frequency of maintenance decreases.

According to the NOAA National Centers for Environmental Information (NCEI) and the CRREL database, Tompkins County experienced 55 flood events between 1954 and 2020, including 4 floods, 14 flash floods, 10 landslides, 14 ice jams, and no dam or levee failures. The table below shows these statistics, as well as the annual average number of events and the percent chance of these individual flood hazards occurring in Tompkins County in future years based on the historic record (NOAA NCDC 2020).

Table 5.4.4-7. Probability of Future Occurrence of Flooding Events

Hazard Type	Number of Occurrences Between 1954 and 2020	Rate of Occurrence	Recurrence Interval (in years)	Probability of event Occurring in Any Given Year	% Chance of Occurring in Any Given Year
Riverine/ Flash Flood/ Stormwater Flood	18	0.27	3.67	0.27	27.27
Lakeshore Flood	0	0	NA	0	0
Landslides	10	0.15	6.70	0.15	14.93
Dam Failure	0	0.00	0	0	0
Ice Jam	14	0.21	4.79	0.21	20.90
Levee Failure	0	0.00	-	0	0
TOTAL	**42**	**0.83**	**1.22**	**0.82**	**82.09**

Source: NOAA-NCEI 2020; CRREL 2020; NPDP 2020

Climate change is expected to increase the severity and frequency of heavy rain events in Tompkins County. This will likely lead to an increase in flooding events, dam failure events, and levee failure events.

In Section 5.3, the identified hazards of concern for Tompkins County were ranked. The probability of occurrence, or likelihood of the event, is one parameter used for hazard rankings. Based on historical records and input from the Planning Committee, the probability of occurrence for flood in the County is considered 'frequent' (hazard event has 100% annual probability and may occur multiple times per year).

5.4.4.2 Vulnerability Assessment

To assess Tompkins County's risk to the flood hazard, a spatial analysis was conducted using the best available spatially-delineated flood hazard areas. The 1-percent and 0.2-percent annual chance flood events were examined to determine the assets located in the hazard areas and to estimate potential loss using the FEMA Hazus-MH v4.2 model. These results are summarized below. Refer to Section 5.1 (Methodology and Tools) for additional details on the methodology used to assess flood risk.

Impact on Life, Health and Safety

The impact of flooding on life, health and safety is dependent upon several factors including the severity of the event and whether adequate warning time is provided to residents. Exposure represents the population living in or near floodplain areas that could be impacted should a flood event occur. However, exposure is not limited to persons who reside in a defined hazard zone, but includes all individuals who may be affected by the effects of a hazard event (e.g., people are at risk while traveling in flooded areas, or their access to emergency services is compromised during an event). The degree of that impact will vary and is not strictly measurable.

Based on the spatial analysis, there are an estimated 1,807 people in Tompkins County living in the 1-percent annual chance flood event hazard area and an estimated 10,579 people located in the 0.2-percent annual chance flood event hazard area (refer to Table 5.4.4-8). These residents may be displaced due to their homes flooding, requiring them to seek temporary shelter with friends and family or in emergency shelters. The Village of Dryden and the City of Ithaca has the greatest percentage of its population located in the 1-percent and 0.2-percent annual chance flood event hazard areas, respectively. The Village of Dryden has approximately 8.6-percent of its population exposed to the 1-percent annual chance flood event. The City of Ithaca has approximately 2.4-percent of its population exposed to the 1-percent annual chance flood event. Overall, the City of Ithaca has the greatest number of persons exposed to the 1-percent and 0.2-percent annual chance flood event hazard areas; approximately 730 persons and 9,375 persons, respectively. For this project, the potential population exposed is used as a guide for planning purposes.

Table 5.4.4-8. Number of Persons Exposed to the 1-Percent and 0.2-Percent Annual Chance Flood Event Hazard Areas

Jurisdiction	Population (American Community Survey 5-Year 2014 - 2018)	Population Exposed to 1-Percent Annual Chance Flood Event		Population Exposed to 0.2-Percent Annual Chance Flood Event	
		Number of Persons	Percent of Total	Number of Persons	Percent of Total
Caroline (T)	3,362	42	1.2%	42	1.2%
Cayuga Heights (V)	489	0	0.0%	0	0.0%
Danby (T)	3,438	3	0.1%	3	0.1%
Dryden (T)	12,158	150	1.2%	152	1.3%
Dryden (V)	2,092	158	7.6%	215	10.3%
Enfield (T)	3,541	0	0.0%	0	0.0%
Freeville (V)	394	11	2.7%	11	2.7%
Groton (T)	3,922	106	2.7%	106	2.7%
Groton (V)	2,050	23	1.1%	48	2.4%
Ithaca (C)	30,568	730	2.4%	9,375	30.7%
Ithaca (T)	19,418	178	0.9%	221	1.1%
Lansing (T)	7,794	234	3.0%	234	3.0%
Lansing (V)	3,535	4	0.1%	4	0.1%
Newfield (T)	5,218	70	1.3%	70	1.3%
Trumansburg (V)	1,805	8	0.4%	8	0.4%
Ulysses (T)	3,178	90	2.8%	90	2.8%
Tompkins County (Total)	**102,962**	**1,807**	**1.8%**	**10,579**	**10.3%**

Source: Tompkins County GIS 2019/2020, American Community Survey 2018
Notes: V = Village, C = City, T = Town

Regarding dam failure, impacts depend on several factors including severity of the event and whether or not adequate warning time is provided to residents. The population living in or near the inundation areas are considered exposed to the hazard. However, exposure should not be limited only to those who reside within a defined hazard zone, but everyone who may be affected by a hazard event (e.g., people are at risk while traveling in flooded areas, or their access to emergency services is compromised during an event); the degree of that impact varies and is not strictly measurable. Dam failures could have a severe impact to life and property in Tompkins County. Areas downstream of dams at a lower elevation are the most vulnerable to losses associated with a dam failure. Inundation maps have been prepared for the high hazard dams in Tompkins County and presented in Appendix K (Dam Supplementary Data).

As with other hazards, research has shown that some populations, while they may not have more hazard exposure, may experience exacerbated impacts and prolonged recovery if/when impacted. This is due to many factors including their physical and financial ability to react or respond during a hazard.

> Individuals most vulnerable to flood events include those: Over 65 years old, low-income, homeless, with a disability, with difficulty communicating.

The population over age 65 is also more vulnerable because they are more likely to seek or need medical attention that may not be available due to isolation during a flood event, and they may have more difficulty evacuating. Within

Tompkins County, there are approximately 13,561 persons over the age of 65. Low-income persons may also be more vulnerable to economic disruptions associated with flooding or may have difficulty accessing transportation and medical care. 17,500 persons in Tompkins County live below the poverty level. Other groups particularly vulnerable to flood events are the homeless who reside in high exposure areas and those that have a difficulty in communicating, including non-native speakers and those with intermittent internet and cellular service.

The CDC 2016 Social Vulnerability Index (SVI) ranks U.S. Census tracts on socioeconomic status, household composition and disability, minority status and language, and housing and transportation. Tompkins County's overall score is 0.3493, indicating that its communities have low to moderate vulnerability (CDC 2016). This score indicates that most, but not all, County residents will have enough resources to respond to flood events.

Estimated Potential Displaced Population and Sheltering Needs

Using 2010 U.S. Census data, Hazus-MH v4.2 estimates the potential sheltering needs as a result of a 1-percent annual chance flood event. For the 1-percent flood event, Hazus-MH v4.2 estimates 4,619 households will be displaced and 270 people will seek short-term sheltering. These statistics, by jurisdiction, are presented in Table 5.4.4-9. The estimated displaced population and number of persons seeking short-term sheltering differs from the number of persons exposed to the 1-percent annual chance flood, because the displaced population numbers take into consideration that not all residents will be significantly impacted enough to be displaced or to require short-term sheltering during a flood event.

Table 5.4.4-9. Estimated Population Displaced or Seeking Short-Term Shelter From the 1-Percent Annual Chance Flood Event Hazard Area

Jurisdiction	Population (American Community Survey 5-Year 2014 - 2018)	1-Percent Annual Chance Flood Event	
		Displaced Population*	Persons Seeking Short-Term Sheltering*
Caroline (T)	9,452	41	0
Cayuga Heights (V)	443	0	0
Danby (T)	162,968	3	0
Dryden (T)	12,089	186	2
Dryden (V)	681	171	2
Enfield (T)	2,008	0	0
Freeville (V)	3,069	42	0
Groton (T)	448,342	91	0
Groton (V)	0	168	16
Ithaca (C)	18,685	3,577	248
Ithaca (T)	1,034	88	0
Lansing (T)	1,945	112	2
Lansing (V)	1,463	0	0

Jurisdiction	Population (American Community Survey 5-Year 2014 - 2018)	1-Percent Annual Chance Flood Event Displaced Population*	Persons Seeking Short-Term Sheltering*
Newfield (T)	189,840	78	0
Trumansburg (V)	1,366	25	0
Ulysses (T)	3,345	37	0
Tompkins County (Total)	**326,416**	**4,619**	**270**

Source: American Community Survey 2018, Hazus-MH v4.2
Notes: V = Village, C = City, T = Town
** HAZUS v4.2 uses 2010 Census data for displacement estimates. These numbers may be underestimated compared to the American Community Survey 2018 5-year estimates data.*

Potential Life Safety Impacts

Total number of injuries and casualties resulting from typical riverine and tidal flooding are generally limited based on advance weather forecasting, blockades, and warnings. Injuries and deaths generally are not anticipated if proper warning and precautions occur. In contrast, warning time for flash flooding is limited. These events are frequently associated with other natural hazard events such as earthquakes, landslides, or severe weather, which limits their predictability and compounds the hazard. Populations without adequate warning of the event, as noted above, are highly vulnerable to this hazard.

Additionally, the impact of dam failure on life, health, and safety is dependent on several factors such as the area that the dam is protecting, the location, capacity, structural integrity, and the proximity of structures, infrastructure, and critical facilities downstream of the failure inundation area. According to the US Army Corps of Engineers, the level of impact that a dam failure would have can be predicted based upon the hazard potential classification (USACE 2020). Table 5.4.4-10 outlines the recommended hazard classifications.

Table 5.4.4-10. United States Army Corps of Engineers Hazard Potential Classification for Dams

Urgency of Action	Actions for Dams in This Class	Characteristics of This Class
Very High (1)	Take immediate action to avoid failure. Communicate findings to sponsor, local, state, Federal, Tribal officials, and the public. Implement interim risk reduction measures, including operational restrictions. Ensure the emergency action plan is current and functionally tested for initiating event. Conduct heightened monitoring and evaluation. Expedite investigations to support remediation using all resources and funding necessary. Initiate intensive management and situation reports.	Critically near failure: Dam is almost certain to fail under normal operations to within a few years without intervention. OR Extremely high incremental risk: Combination of life or economic consequences with likelihood of failure is very high. USACE considered this level of life-risk to be unacceptable except in extraordinary circumstances.
High (2)	Communicate findings to sponsor, local, state, Federal, Tribal officials, and the public. Implement interim risk reduction measures,	Failure initiation foreseen: For confirmed and unconfirmed dam safety issues, failure could begin during normal operations or be

Urgency of Action	Actions for Dams in This Class	Characteristics of This Class
	including operational restrictions as warranted. Ensure the emergency action plan is current and functionally tested for initiating event. Conduct heightened monitoring and evaluation. Expedite confirmation of classification. Give very high priority for investigations to support the need for remediation.	initiated as the consequence of an event. The likelihood of failure from one of these occurrences, prior to remediation, is too high to assure public-safety. OR Very high incremental risk: the combination of life or economic consequences with likelihood of failure is high. USACE considered this level of life-risk to be unacceptable except in extraordinary circumstances.
Moderate (3)	Communicate findings to sponsor, local, state, Federal, Tribal officials, and the public. Implement interim risk reduction measures, including operational restrictions as warranted. Ensure the emergency action plan is current and functionally tested for initiating event. Conduct heightened monitoring and evaluation. Prioritize investigations to support the need for remediation informed by consequences and other factors.	Moderate to high incremental risk: For confirmed and unconfirmed dam safety issues, the combination of life, economic, or environmental consequences with likelihood of failure is moderate. USACE considers this level of life-risk to be unacceptable except in unusual circumstances.
Low (4)	Communicate findings to sponsor, local, state, Federal, Tribal officials, and the public. Conduct elevated monitoring and evaluation. Give normal priority to investigations to validate classification, but do not plan for risk reduction measures at this time.	Low incremental risk: For confirmed and unconfirmed dam safety issues, the combination of life, economic, or environmental consequences with likelihood of failure is low to very low and the dam may not meet all essential USACE guidelines. USACE considers this level of life-risk to be in the range of tolerability but the dam does not meet all essential USACE guidelines.
Normal (5)	Continue routine dam safety activities and normal operations, maintenance, monitoring, and evaluation.	Very low incremental risk: The combination of life, economic, or environmental consequences with likelihood of failure is low to very low and the dam meets all essential USACE guidelines. USACE considers this level of life-safety risk to be tolerable.

Source: USACE 2020

As mentioned in the earlier sections, most notably in the Community Profile, dam failure can cause in the most extreme case, loss of life and extensive property damage, or in the least extreme case, no loss of life or significant property damage. Dam failure can cause persons to become displaced if flooding of structures occurs. Dam failure may mimic flood events, depending on the size of the dam reservoir and breach. Understanding potential outcomes of flooding for each dam in Tompkins County would require intensive hydraulic modeling. Appendix K includes a summary of the High Hazard Dam Inundation Maps.

Cascading impacts of flooding and dam failure inundation may also include exposure to pathogens such as mold. After flood events, excess moisture and standing water contribute to the growth of mold in buildings. Flooding in basements is a regular complaint of many Tompkins County residents. Mold may present a health risk to building occupants, especially those with already compromised immune systems such as infants, children, the elderly and pregnant women. The degree of impact will vary and is not strictly measurable. Mold spores can grow in as short a period as 24-48 hours in wet and damaged areas of buildings that have not been properly cleaned. Very small mold spores can easily be inhaled, creating the potential for allergic reactions, asthma episodes, and other respiratory problems. Buildings should be properly cleaned and dried out to safely prevent mold growth (CDC 2019).

Molds and mildews are not the only public health risk associated with flooding. Floodwaters can be contaminated by pollutants such as sewage, human and animal feces, pesticides, fertilizers, oil, asbestos, and rusting building materials. Common public health risks associated with flood events also include:

- Unsafe food
- Contaminated drinking and washing water and poor sanitation
- Mosquitos and animals
- Carbon monoxide poisoning
- Secondary hazards associated with re-entering/cleaning flooded structures
- Mental stress and fatigue

Current loss estimation models such as Hazus-MH v4.2 are not equipped to measure public health impacts. The best level of mitigation for these impacts is to be aware that they can occur, educate the public on prevention, and be prepared to deal with these vulnerabilities in responding to flood events.

Impact on General Building Stock

Exposure to the flood hazard includes those buildings located in the flood zone. Potential damage is the modeled loss that could occur to the exposed inventory measured by the structural and content replacement cost value. There are an estimated 1,011 buildings located in the 1-percent annual chance flood event hazard area with a replacement cost value of approximately $1.8 billion. This represents approximately 2.5-percent of the County's total general building stock inventory replacement cost value (approximately $72 billion). Additionally, there are 3,169 buildings located in the 0.2-percent annual chance flood event hazard area with a replacement cost value of approximately $5 billion, or 7-percent of the County's total replacement cost value.

The Village of Dryden and the City of Ithaca has the greatest proportion of its buildings located in the 1-percent and 0.2-percent annual chance flood event hazard areas, respectively. Approximately 9.3-percent of buildings in the Village of Dryden are exposed to the 1-percent annual chance flood event and approximately 30.8-percent of buildings in the City of Ithaca are exposed to the 0.2-percent annual chance flood event. The City of Ithaca has the greatest number of buildings and highest replacement cost value exposed to both the 1-percent and 0.2-percent annual chance flood event hazard areas. Approximately 220 buildings in the City of Ithaca, or $853 million of total replacement cost value, is located in the 1-percent annual chance flood event hazard area and approximately 2,291 buildings in the City of Ithaca, or $3.9 billion of total replacement cost value, is located in the 0.2-percent annual chance flood event hazard area. Refer to Table 5.4.4-11 for a summary of 1-percent flood inundation area exposure results for all occupancies by jurisdiction. Table 5.4.4-13 and Table 5.4.4-15 break down the 1-percent annual chance flood event hazard area exposure results for residential structures and commercial structures, respectively. Refer to Table 5.4.4-12, Table 5.4.4-14, and Table 5.4.4-16 for the building flood exposure analysis results for the 0.2-percent annual chance flood event hazard area by jurisdiction for all occupancies, residential structures only, and commercial structures only, respectively.

Furthermore, Hazus-MH v4.2 estimates approximately $317.7 million in building and content damage as a result of the 1-percent annual chance flood event (or 0.4-percent of the total building stock replacement cost value). Of the $317.7 million in potential loss, approximately $119 million is estimated to be residential structures. Refer to Table 5.4.4-17 through Table 5.4.4-19 for the potential losses from the 1-percent annual chance flood event by jurisdiction for all occupancies, residential structures only, and commercial structures only.

Table 5.4.4-11. Estimated General Building Stock Exposure to the 1-Percent Annual Chance Flood Event – All Occupancies

Jurisdiction	Total Number of Buildings	Total Replacement Cost Value	Total Exposure (All Occupancies) 1-Percent Annual Chance Flood Event			
			Number of Buildings	Percent of Total	Replacement Cost Value	Percent of Total
Caroline (T)	3,257	$2,523,108,347	44	1.4%	$40,539,979	1.6%
Cayuga Heights (V)	1,183	$1,548,665,909	0	0.0%	$0	0.0%
Danby (T)	3,008	$2,188,454,321	4	0.1%	$63,314,094	2.9%
Dryden (T)	8,518	$8,740,906,102	108	1.3%	$202,144,314	2.3%
Dryden (V)	1,022	$1,135,109,100	95	9.3%	$134,014,552	11.8%
Enfield (T)	3,559	$2,736,468,231	0	0.0%	$0	0.0%
Freeville (V)	409	$356,699,295	12	2.9%	$10,685,304	3.0%
Groton (T)	3,610	$2,804,801,342	82	2.3%	$39,666,677	1.4%
Groton (V)	1,205	$1,203,171,190	34	2.8%	$130,781,735	10.9%
Ithaca (C)	7,450	$19,712,305,674	220	3.0%	$853,040,250	4.3%
Ithaca (T)	6,080	$10,868,181,586	68	1.1%	$108,141,225	1.0%
Lansing (T)	6,010	$6,270,191,033	177	2.9%	$114,671,345	1.8%
Lansing (V)	1,055	$3,436,043,635	2	0.2%	$1,342,126	<0.1%
Newfield (T)	4,669	$3,848,204,673	66	1.4%	$27,106,658	0.7%
Trumansburg (V)	1,061	$1,241,549,970	5	0.5%	$2,599,287	0.2%
Ulysses (T)	3,552	$3,372,144,448	94	2.6%	$103,176,446	3.1%
Tompkins County (Total)	**55,648**	**$71,986,004,856**	**1,011**	**1.8%**	**$1,831,223,994**	**2.5%**

Source: Tompkins County GIS 2019/2020; RS Means 2019
Notes: V = Village, C = City, T = Town, % = Percent, < = Less Than

Table 5.4.4-12. Estimated General Building Stock Exposure to the 0.2-Percent Annual Chance Flood Event – All Occupancies

Jurisdiction	Total Number of Buildings	Total Replacement Cost Value	Total Exposure (All Occupancies) 0.2-Percent Annual Chance Flood Event			
			Number of Buildings	Percent Total	Replacement Cost Value	Percent Total
Caroline (T)	3,257	$2,523,108,347	44	1.4%	$40,539,979	1.6%
Cayuga Heights (V)	1,183	$1,548,665,909	0	0.0%	$0	0.0%
Danby (T)	3,008	$2,188,454,321	4	0.1%	$63,314,094	2.9%
Dryden (T)	8,518	$8,740,906,102	109	1.3%	$202,372,708	2.3%
Dryden (V)	1,022	$1,135,109,100	122	11.9%	$151,337,473	13.3%
Enfield (T)	3,559	$2,736,468,231	0	0.0%	$0	0.0%
Freeville (V)	409	$356,699,295	12	2.9%	$10,685,304	3.0%
Groton (T)	3,610	$2,804,801,342	82	2.3%	$39,666,677	1.4%
Groton (V)	1,205	$1,203,171,190	69	5.7%	$231,795,404	19.3%
Ithaca (C)	7,450	$19,712,305,674	2,291	30.8%	$3,937,393,678	20.0%
Ithaca (T)	6,080	$10,868,181,586	92	1.5%	$135,409,269	1.2%
Lansing (T)	6,010	$6,270,191,033	177	2.9%	$114,671,345	1.8%
Lansing (V)	1,055	$3,436,043,635	2	0.2%	$1,342,126	0.0%
Newfield (T)	4,669	$3,848,204,673	66	1.4%	$27,106,658	0.7%
Trumansburg (V)	1,061	$1,241,549,970	5	0.5%	$2,599,287	0.2%
Ulysses (T)	3,552	$3,372,144,448	94	2.6%	$103,176,446	3.1%
Tompkins County (Total)	**55,648**	**$71,986,004,856**	**3,169**	**5.7%**	**$5,061,410,449**	**7.0%**

Source: Tompkins County GIS 2019/2020; RS Means 2019
Notes: V = Village, C = City, T = Town, % = Percent

Table 5.4.4-13. Estimated General Building Stock Exposure to the 1-Percent Annual Chance Flood Event – Residential Structures Only

Jurisdiction	Total Number of Buildings (Residential Structures Only)	Total Replacement Cost Value (Residential Structures Only)	Total Exposure (Residential Structures Only) 1-Percent Annual Chance Flood Event			
			Number of Buildings	Percent of Total	Replacement Cost Value	Percent of Total
Caroline (T)	2,403	$1,358,577,326	30	1.2%	$21,023,528	1.5%
Cayuga Heights (V)	1,125	$1,287,240,123	0	0.0%	$0	0.0%
Danby (T)	2,262	$1,132,751,811	2	0.1%	$2,252,094	0.2%
Dryden (T)	6,628	$3,224,220,454	82	1.2%	$42,823,334	1.3%
Dryden (V)	886	$592,216,526	67	7.6%	$32,950,788	5.6%
Enfield (T)	2,738	$1,211,029,479	0	0.0%	$0	0.0%
Freeville (V)	294	$173,619,699	8	2.7%	$3,345,889	1.9%
Groton (T)	2,557	$1,207,683,173	69	2.7%	$31,582,953	2.6%
Groton (V)	1,059	$628,462,960	12	1.1%	$73,316,114	11.7%
Ithaca (C)	6,280	$6,611,345,821	150	2.4%	$311,494,946	4.7%
Ithaca (T)	4,919	$3,912,782,485	45	0.9%	$17,034,636	0.4%
Lansing (T)	4,706	$2,768,597,390	141	3.0%	$66,779,927	2.4%
Lansing (V)	813	$1,406,653,242	1	0.1%	$252,684	<0.1%

Jurisdiction	Total Number of Buildings (Residential Structures Only)	Total Replacement Cost Value (Residential Structures Only)	Total Exposure (Residential Structures Only) 1-Percent Annual Chance Flood Event			
			Number of Buildings	Percent of Total	Replacement Cost Value	Percent of Total
Newfield (T)	3,638	$1,539,401,729	49	1.3%	$12,327,794	0.8%
Trumansburg (V)	950	$602,857,632	4	0.4%	$1,836,392	0.3%
Ulysses (T)	2,542	$1,394,872,075	72	2.8%	$34,609,297	2.5%
Tompkins County (Total)	**43,800**	**$29,052,311,925**	**732**	**1.7%**	**$651,630,375**	**2.2%**

Source: Tompkins County GIS 2019/2020; RS Means 2019
Notes: V = Village, C = City, T = Town, % = Percent, < = Less Than

Table 5.4.4-14. Estimated General Building Stock Exposure to the 0.2-Percent Annual Chance Flood Event – Residential Structures Only

Jurisdiction	Total Number of Buildings (Residential Structures Only)	Total Replacement Cost Value (Residential Structures Only)	Total Exposure (Residential Structures Only) 0.2-Percent Annual Chance Flood Event			
			Number of Buildings	Percent of Total	Replacement Cost Value	Percent of Total
Caroline (T)	2,403	$1,358,577,326	30	1.2%	$21,023,528	1.5%
Cayuga Heights (V)	1,125	$1,287,240,123	0	0.0%	$0	0.0%
Danby (T)	2,262	$1,132,751,811	2	0.1%	$2,252,094	0.2%
Dryden (T)	6,628	$3,224,220,454	83	1.3%	$43,051,727	1.3%
Dryden (V)	886	$592,216,526	91	10.3%	$44,980,458	7.6%
Enfield (T)	2,738	$1,211,029,479	0	0.0%	$0	0.0%
Freeville (V)	294	$173,619,699	8	2.7%	$3,345,889	1.9%
Groton (T)	2,557	$1,207,683,173	69	2.7%	$31,582,953	2.6%
Groton (V)	1,059	$628,462,960	25	2.4%	$79,890,611	12.7%
Ithaca (C)	6,280	$6,611,345,821	1,926	30.7%	$1,235,320,797	18.7%
Ithaca (T)	4,919	$3,912,782,485	56	1.1%	$21,315,108	0.5%
Lansing (T)	4,706	$2,768,597,390	141	3.0%	$66,779,927	2.4%
Lansing (V)	813	$1,406,653,242	1	0.1%	$252,684	<0.1%
Newfield (T)	3,638	$1,539,401,729	49	1.3%	$12,327,794	0.8%
Trumansburg (V)	950	$602,857,632	4	0.4%	$1,836,392	0.3%
Ulysses (T)	2,542	$1,394,872,075	72	2.8%	$34,609,297	2.5%
Tompkins County (Total)	**43,800**	**$29,052,311,925**	**2,557**	**5.8%**	**$1,598,569,260**	**5.5%**

Source: Tompkins County GIS 2019/2020; RS Means 2019
Notes: V = Village, C = City, T = Town, % = Percent, < = Less Than

Table 5.4.4-15. Estimated General Building Stock Exposure to the 1-Percent Annual Chance Flood Event – Commercial Structures Only

Jurisdiction	Total Number of Buildings (Commercial Buildings Only)	Total Replacement Cost Value (Commercial Buildings Only)	Total Exposure (Commercial Structures Only) 1-Percent Annual Chance Flood Event			
			Number of Buildings	Percent of Total	Replacement Cost Value	Percent of Total
Caroline (T)	488	$522,037,081	11	2.3%	$18,959,127	3.6%
Cayuga Heights (V)	36	$97,858,115	0	0.0%	$0	0.0%

Jurisdiction	Total Number of Buildings (Commercial Buildings Only)	Total Replacement Cost Value (Commercial Buildings Only)	Total Exposure (Commercial Structures Only) 1-Percent Annual Chance Flood Event			
			Number of Buildings	Percent of Total	Replacement Cost Value	Percent of Total
Danby (T)	602	$658,664,565	1	0.2%	$54,176,000	8.2%
Dryden (T)	1,252	$2,249,129,019	18	1.4%	$91,650,260	4.1%
Dryden (V)	110	$424,696,715	22	20.0%	$44,041,056	10.4%
Enfield (T)	477	$665,584,455	0	0.0%	$0	0.0%
Freeville (V)	41	$48,310,505	4	9.8%	$7,339,416	15.2%
Groton (T)	532	$553,733,210	4	0.8%	$2,460,121	0.4%
Groton (V)	110	$470,116,968	22	20.0%	$57,465,621	12.2%
Ithaca (C)	795	$7,258,972,188	61	7.7%	$461,813,278	6.4%
Ithaca (T)	393	$1,044,784,625	16	4.1%	$12,865,592	1.2%
Lansing (T)	706	$1,738,318,397	33	4.7%	$25,731,418	1.5%
Lansing (V)	204	$1,566,545,224	1	0.5%	$1,089,442	<0.1%
Newfield (T)	650	$1,110,380,232	16	2.5%	$13,561,250	1.2%
Trumansburg (V)	77	$416,067,237	1	1.3%	$762,896	0.2%
Ulysses (T)	620	$795,052,612	11	1.8%	$3,922,157	0.5%
Tompkins County (Total)	**7,093**	**$19,620,251,148**	**221**	**3.1%**	**$795,837,634**	**4.1%**

Source: Tompkins County GIS 2019/2020; RS Means 2019
Notes: V = Village, C = City, T = Town, % = Percent, < = Less Than

Table 5.4.4-16. Estimated General Building Stock Exposure to the 0.2-Percent Annual Chance Flood Event – Commercial Structures Only

Jurisdiction	Total Number of Buildings (Commercial Buildings Only)	Total Replacement Cost Value (Commercial Buildings Only)	Total Exposure (Commercial Structures Only) 0.2-Percent Annual Chance Flood Event			
			Number of Buildings	Percent of Total	Replacement Cost Value	Percent of Total
Caroline (T)	488	$522,037,081	11	2.3%	$18,959,127	3.6%
Cayuga Heights (V)	36	$97,858,115	0	0.0%	$0	0.0%
Danby (T)	602	$658,664,565	1	0.2%	$54,176,000	8.2%
Dryden (T)	1,252	$2,249,129,019	18	1.4%	$91,650,260	4.1%
Dryden (V)	110	$424,696,715	24	21.8%	$44,822,074	10.6%
Enfield (T)	477	$665,584,455	0	0.0%	$0	0.0%
Freeville (V)	41	$48,310,505	4	9.8%	$7,339,416	15.2%
Groton (T)	532	$553,733,210	4	0.8%	$2,460,121	0.4%
Groton (V)	110	$470,116,968	41	37.3%	$142,462,992	30.3%
Ithaca (C)	795	$7,258,972,188	323	40.6%	$2,402,707,504	33.1%
Ithaca (T)	393	$1,044,784,625	20	5.1%	$15,672,757	1.5%
Lansing (T)	706	$1,738,318,397	33	4.7%	$25,731,418	1.5%
Lansing (V)	204	$1,566,545,224	1	0.5%	$1,089,442	<0.1%
Newfield (T)	650	$1,110,380,232	16	2.5%	$13,561,250	1.2%
Trumansburg (V)	77	$416,067,237	1	1.3%	$762,896	0.2%
Ulysses (T)	620	$795,052,612	11	1.8%	$3,922,157	0.5%
Tompkins County (Total)	**7,093**	**$19,620,251,148**	**508**	**7.2%**	**$2,825,317,415**	**14.4%**

Source: Tompkins County GIS 2019/2020; RS Means 2019

Notes: V = Village, C = City, T = Town, % = Percent, < = Less Than

Table 5.4.4-17. Estimated General Building Stock Potential Loss to the 1-Percent Annual Chance Flood Event – All Occupancies

Jurisdiction	Total Replacement Cost Value (RCV)	Total Losses (All Occupancies) 1-Percent Annual Chance Flood Event	
		Estimated Loss (Replacement Cost Value)	Percent of Total
Caroline (T)	$2,523,108,347	$5,052,984	0.2%
Cayuga Heights (V)	$1,548,665,909	$0	0.0%
Danby (T)	$2,188,454,321	$2,191,175	0.1%
Dryden (T)	$8,740,906,102	$5,327,817	0.1%
Dryden (V)	$1,135,109,100	$2,806,948	0.2%
Enfield (T)	$2,736,468,231	$0	0.0%
Freeville (V)	$356,699,295	$2,060,378	0.6%
Groton (T)	$2,804,801,342	$8,633,027	0.3%
Groton (V)	$1,203,171,190	$1,167,025	0.1%
Ithaca (C)	$19,712,305,674	$210,925,178	1.1%
Ithaca (T)	$10,868,181,586	$33,637,255	0.3%
Lansing (T)	$6,270,191,033	$20,189,662	0.3%
Lansing (V)	$3,436,043,635	$0	0.0%
Newfield (T)	$3,848,204,673	$2,308,491	0.1%
Trumansburg (V)	$1,241,549,970	$318,586	<0.1%
Ulysses (T)	$3,372,144,448	$23,078,672	0.7%
Tompkins County (Total)	**$71,986,004,856**	**$317,697,199**	**0.4%**

Source: Tompkins County GIS 2019/2020; RS Means 2019; Hazus-MH v4.2
Notes: V = Village, C = City, T = Town, % = Percent, < = Less Than

Table 5.4.4-18. Estimated General Building Stock Potential Loss to the 1-Percent Annual Chance Flood Event – Residential Structures Only

Jurisdiction	Total Replacement Cost Value (Residential Only)	Residential Losses Only 1-Percent Annual Chance Flood Event	
		Estimated Loss (Replacement Cost Value)	Percent of Total
Caroline (T)	$1,358,577,326	$1,220,006	0.1%
Cayuga Heights (V)	$1,287,240,123	$0	0.0%
Danby (T)	$1,132,751,811	$1,023,766	0.1%
Dryden (T)	$3,224,220,454	$726,783	<0.1%
Dryden (V)	$592,216,526	$2,202,837	0.4%
Enfield (T)	$1,211,029,479	$0	0.0%
Freeville (V)	$173,619,699	$788,619	0.5%
Groton (T)	$1,207,683,173	$7,449,524	0.6%
Groton (V)	$628,462,960	$644,120	0.1%
Ithaca (C)	$6,611,345,821	$84,954,182	1.3%
Ithaca (T)	$3,912,782,485	$1,666,793	<0.1%
Lansing (T)	$2,768,597,390	$9,932,657	0.4%
Lansing (V)	$1,406,653,242	$0	0.0%
Newfield (T)	$1,539,401,729	$892,586	0.1%
Trumansburg (V)	$602,857,632	$318,586	0.1%

Jurisdiction	Total Replacement Cost Value (Residential Only)	Residential Losses Only 1-Percent Annual Chance Flood Event Estimated Loss (Replacement Cost Value)	Residential Losses Only 1-Percent Annual Chance Flood Event Percent of Total
Ulysses (T)	$1,394,872,075	$7,277,685	0.5%
Tompkins County (Total)	**$29,052,311,925**	**$119,098,144**	**0.4%**

Source: Tompkins County GIS 2019/2020; RS Means 2019; Hazus-MH v4.2
Notes: V = Village, C = City, T = Town, % = Percent, < = Less Than

Table 5.4.4-19. Estimated General Building Stock Potential Loss to the 1-Percent Annual Chance Flood Event – Commercial Structures Only

Jurisdiction	Total Replacement Cost Value (Commercial Only)	Commercial Losses Only 1-Percent Annual Chance Flood Event Estimated Loss (Replacement Cost Value)	Commercial Losses Only 1-Percent Annual Chance Flood Event Percent of Total
Caroline (T)	$522,037,081	$3,714,500	0.7%
Cayuga Heights (V)	$97,858,115	$0	0.0%
Danby (T)	$658,664,565	$511,339	0.1%
Dryden (T)	$2,249,129,019	$191,607	<0.1%
Dryden (V)	$424,696,715	$604,111	0.1%
Enfield (T)	$665,584,455	$0	0.0%
Freeville (V)	$48,310,505	$1,271,759	2.6%
Groton (T)	$553,733,210	$390,798	0.1%
Groton (V)	$470,116,968	$522,905	0.1%
Ithaca (C)	$7,258,972,188	$116,005,836	1.6%
Ithaca (T)	$1,044,784,625	$1,008,330	0.1%
Lansing (T)	$1,738,318,397	$5,206,785	0.3%
Lansing (V)	$1,566,545,224	$0	0.0%
Newfield (T)	$1,110,380,232	$1,232,041	0.1%
Trumansburg (V)	$416,067,237	$0	0.0%
Ulysses (T)	$795,052,612	$279,008	<0.1%
Tompkins County (Total)	**$19,620,251,148**	**$130,939,020**	**0.7%**

Source: Tompkins County GIS 2019/2020; RS Means 2019; Hazus-MH v4.2
Notes: V = Village, C = City, T = Town, % = Percent, < = Less Than

NFIP Statistics

FEMA Region 2 provided a list of NFIP policies, past claims, and repetitive loss properties (RL) in Tompkins County. According to FEMA, a RL property is a NFIP-insured structure that has had at least two paid flood losses of more than $1,000 in any 10-year period since 1978. A SRL property is a NFIP-insured structure that has had four or more separate claim payments made under a standard flood insurance policy, with the amount of each claim exceeding $5,000 and with the cumulative amount of such claims payments exceeding $20,000; or at least two separate claims payments made under a standard flood insurance policy with the cumulative amount of such claim payments exceed the fair market value of the insured building on the day before each loss (FEMA 2020).

Table 5.4.4-20 summarizes the NFIP policies, claims and repetitive loss statistics for Tompkins County. Note that specific locations of repetitive loss properties were not made available for this Plan.

Table 5.4.4-20. Repetitive Loss Properties and NFIP Data for Tompkins County

Jurisdiction	Number of Repetitive Loss Properties	Number of Policies	Number of Claims	Total Losses Claimed
Caroline (T)	4	14	21	$72,531
Cayuga Heights (V)	2	2	4	$15,791
Danby (T)	0	4	0	$0
Dryden (T)	2	23	9	$93,330
Dryden (V)	2	27	20	$114,915
Enfield (T)	0	0	0	$0
Freeville (V)	1	7	4	$17,760
Groton (T)	0	10	7	$23,919
Groton (V)	0	6	14	$620,881
Ithaca (C)	7	148	103	$249,490
Ithaca (T)	0	37	20	$36,215
Lansing (T)	22	35	56	$466,075
Lansing (V)	0	7	5	$6,589
Newfield (T)	2	9	6	$52,254
Trumansburg (V)	0	3	3	$902
Ulysses (T)	0	19	3	$5,798
Tompkins County (Total)	**42**	**351**	**275**	**$1,776,450**

Source: FEMA Region 2, 2020
Note: NFIP = National Flood Insurance Program, V = Village, T = Town, C = City

Impact on Land Uses

An exposure analysis was completed to determine the acres of residential and non-residential land use types located in the flood hazard areas. To estimate exposure for residential and non-residential land use types to the 1-percent and 0.2-percent annual chance flood event hazard areas, the floodplain boundaries were overlaid upon the national land use land cover data. Refer to Table 5.4.4-21 for a complete summary of this analysis.

Table 5.4.4-21. Land Use Types Exposed to the 1-Percent and 0.2-Percent Annual Chance Flood Event Hazard Areas

Land Use Type	Total Acres for County	Land Area Exposed to the 1-Percent Annual Chance Flood Event		Land Area Exposed to the 0.2-Percent Annual Chance Flood Event	
		Acres	Percent of Total	Acres	Percent of Total
Residential Land	8,100	381	4.7%	860	10.6%
Non-Residential Land	296,155	5,643	1.9%	5,877	2.0%
Natural Area Land	163,079	4,322	2.7%	4,411	2.7%
Tompkins County (Total)*	**304,255**	**6,024**	**2.0%**	**6,737**	**2.2%**

Source: Tompkins County GIS 2019/2020; NLCD 2016
Notes: V = Village, C = City, T = Town, % = Percent
Assumed Natural Land includes barren land, forests, and wetlands; This analysis does not include any areas of water

Non-Residential area = Agriculture, Barren, Developed – Open Space, Forest, Wetlands; This analysis does not incorporate areas delineated as water; Residential parcels = Developed – low intensity, Developed – medium intensity, and Developed – high intensity

**The total area is a summation of the residential land and non-residential land. Natural land area is a sub-set of non-residential land use types.*

Impact on the Economy

Flood and dam failure events can significantly impact the local and regional economy. This includes but is not limited to general building stock damages and associated tax loss, impacts to utilities and infrastructure, business interruption, and impacts on tourism. In areas that are directly flooded, renovations of commercial and industrial buildings may be necessary, disrupting associated services. Refer to the 'Impact on Buildings' subsection earlier which discusses direct impacts to buildings in Tompkins County.

Flooding can cause extensive damage to public utilities and disruptions to delivery of services. Loss of power and communications may occur and drinking water and wastewater treatment facilities may be temporarily out of operation. As presented in Table 5.4.4-22, 22 critical facilities are exposed and potentially vulnerable to the 1-percent annual chance flood event.

Table 5.4.4-22. Estimated Debris Generated from the 1-Percent Annual Chance Flood Event

Jurisdiction	Debris Generated by the 1-Percent Annual Chance Flood Event			
	Total (tons)	Finish (tons)	Structure (tons)	Foundation (tons)
Caroline (T)	284	120	91	73
Cayuga Heights (V)	0	0	0	0
Danby (T)	20	9	6	5
Dryden (T)	475	184	147	144
Dryden (V)	128	128	0	0
Enfield (T)	0	0	0	0
Freeville (V)	67	49	10	8
Groton (T)	920	311	319	290
Groton (V)	248	222	15	11
Ithaca (C)	9,604	6,349	1,710	1,544
Ithaca (T)	1,188	372	452	365
Lansing (T)	698	237	255	206
Lansing (V)	0	0	0	0
Newfield (T)	705	140	265	300
Trumansburg (V)	214	134	46	35
Ulysses (T)	176	75	55	45
Tompkins County (Total)	**14,728**	**8,331**	**3,371**	**3,026**

Transportation routes are vulnerable to dam inundation and have the potential to be wiped out, creating isolation issues and significant disruption to travel, including all roads, railroads and bridges in the path of the dam inundation. Those that are most vulnerable are those that are already in poor condition and would not be able to withstand a large water surge. Utilities such as overhead power lines, cable and phone lines in the inundation zone could also be vulnerable. If phone lines were lost, significant communication issues may occur in the planning area due to limited cell phone reception in many areas. In addition, emergency response would be hindered due to the loss of transportation routes as well as some protective-function facilities located in the inundation zone. Recovery time to restore many critical functions after an event may be lengthy, as wastewater, potable water, and other community facilities are located in the dam inundation zone.

Impact on the Environment

As Tompkins County and its jurisdictions grow, flood events may increase in frequency and/or severity as land use changes, more structures are built, and impervious surfaces expand. Furthermore, flood extents for the 1-percent and 0.2-percent annual flood events will continue to evolve alongside natural occurrences such as sea level rise, climate change, and/or changes in the severity of extreme weather events. These flood events will inevitably impact Tompkins County's natural and local environment.

Furthermore, the environmental impacts of a dam failure can include significant water-quality and debris-disposal issues. Flood waters can back up sanitary sewer systems and inundate wastewater treatment plants, causing raw sewage to contaminate residential and commercial buildings and the flooded waterway. The contents of unsecured containers of oil, fertilizers, pesticides, and other chemicals get added to flood waters. Hazardous materials may be released and distributed widely across the floodplain. Water supply and wastewater treatment facilities could be offline for weeks. After the flood waters subside, contaminated and flood-damaged building materials and contents must be properly disposed of. Contaminated sediment must be removed from buildings, yards, and properties. In addition, severe erosion is likely; such erosion can negatively impact local ecosystems.

Overall, the acreage of natural, pervious areas makes up 53.6-percent of the County's total land area. Natural, pervious areas often play an import role in detaining and absorbing water that reduces flood impacts. Formalized protection of these areas is important to ensure they maintain these functions. Severe flooding can however also influence the habitat of these natural land areas, it can be disruptive to species that reside in these natural habitats. Table 5.4.4-21 summarizes the number of acres that natural area land use types are exposed to the 1-percent and 0.2-percent annual chance flood inundation areas. Approximately 2.7-percent of natural land areas are exposed to both the 1-percent and 0.2-percent annual chance flood event hazard areas.

Cascading Impacts on Other Hazards

Flood events can exacerbate the impacts of disease outbreak, harmful algal blooms, and infestations and invasive species. Flooding may further increase the transmission of water-borne diseases such as typhoid fever, cholera, and hepatitis A (World Health Organization 2020). Flooding that causes contamination of drinking water facilities, including groundwater drinking water sources, may enhance the risk of disease outbreaks based on the number of persons that come in contact with these resources, particularly those with open wounds. Standing water that occurs as a result of a flood event may become a breeding site for vector-borne diseases, like West Nile virus (World Health Organization 2020). Runoff from flood events may also exacerbate the chemical and waste discharge that contribute to harmful algal bloom outbreaks. More information about these hazards of concern can be found in Section 5.4.1 (Disease Outbreak), Section 5.4.5 (Harmful Algal Blooms), and Section 5.4.6 (Infestations and Invasive Species).

Flooding may also affect the hazard of water supply contamination through by way of damaged pipelines at stream crossings. Reduced integrity of these pipelines can sometimes result in water supply contamination. This concern was identified in the 2014 HMP, and as such, the 2016 Tompkins County Inventory of Erosion Hazards at Pipeline Crossings, was developed with funding from the US Department of Transportation Pipeline and Hazardous Material Safety Administration (PHMSA). The report identified a total of 175 pipeline stream crossings in Tompkins County that carry either combustible gas, combustible liquids, or non-hazardous liquids. 19 of those pipelines of greatest concern have been reviewed and 5 of those crossings were selected for active tracking and mitigation solutions. Based on subsequent field visits in 2020, pipeline owners constructed the recommended mitigation solution on one those crossings. The remaining 4 crossings appear stable and will continue to be monitored for exposure. Should concerns develop regarding these crossings, pipeline owners will be contacted and provided guidance documents on the recommended mitigation measures.

Impact on Community Lifelines

It is important to determine the community lifeline critical facilities and infrastructure that may be at risk to flooding, and who may be impacted should damage occur. Critical services during and after a flood event may not be available if critical facilities are directly damaged or transportation routes to access these critical facilities are impacted. Roads that are blocked or damaged can isolate residents and can prevent access throughout the planning area to many service providers needing to reach vulnerable populations or to make repairs.

Critical facility exposure to the flood hazard was examined. In addition, Hazus-MH v4.2 was used to estimate the flood loss potential to critical facilities located in the FEMA mapped floodplains. Hazus-MH v4.2 results can be found in Volume II, Jurisdiction Annexes. Table 5.4.4-23 and Table 5.4.4-24 summarize the number of critical facilities exposed to the 1-percent and 0.2-percent flood inundation areas by jurisdiction, respectively. Additionally, Table 5.4.4-25 and Table 5.4.4-26 show the distribution of critical facilities in the 1-percent and 0.2-percent annual chance flood event boundaries, respectively. Of the 22 critical facilities located in the 1-percent annual chance flood event boundary, 13 were identified as lifelines for the County. In the 0.2-percent annual chance flood event boundary, 18 critical facilities out of the 50 that are within the flood boundary are medical offices.

Table 5.4.4-23. Number of Community Lifelines Located in the 1-Percent Annual Chance Flood Event Hazard Area

Jurisdiction	Total Critical Facilities	Total Lifelines	Total Community Lifelines Exposed to the 1-Percent Annual Chance Flood Event			
			Number of Critical Facilities Exposed	Percent of Total	Number of Other Lifelines Exposed	Percent of Total
Caroline (T)	16	11	1	6.3%	0	0.0%
Cayuga Heights (V)	18	11	0	0.0%	0	0.0%
Danby (T)	12	9	0	0.0%	0	0.0%
Dryden (T)	69	40	2	2.9%	2	5.0%
Dryden (V)	19	10	3	15.8%	2	20.0%
Enfield (T)	6	4	0	0.0%	0	0.0%
Freeville (V)	7	4	0	0.0%	0	0.0%
Groton (T)	8	6	2	25.0%	2	33.3%
Groton (V)	16	10	3	18.8%	3	30.0%
Ithaca (C)	202	73	3	1.5%	2	2.7%
Ithaca (T)	236	67	8	3.4%	2	3.0%
Lansing (T)	20	15	0	0.0%	0	0.0%
Lansing (V)	31	17	0	0.0%	0	0.0%
Newfield (T)	22	14	0	0.0%	0	0.0%
Trumansburg (V)	20	11	0	0.0%	0	0.0%
Ulysses (T)	5	4	0	0.0%	0	0.0%
Tompkins County (Total)	**707**	**306**	**22**	**3.1%**	**13**	**4.2%**

Source: Tompkins County GIS 2019/2020
Notes: V = Village, C = City, T = Town, % = Percent

Table 5.4.4-24. Number of Community Lifelines Located in the 0.2-Percent Annual Chance Flood Event Hazard Area

Jurisdiction	Total Critical Facilities	Total Lifelines	Total Community Lifelines Exposed to the 0.2-Percent Annual Chance Flood Event			
			Number of Critical Facilities Exposed	Percent of Total	Number of Other Lifelines Exposed	Percent of Total
Caroline (T)	16	11	1	6.3%	0	0.0%
Cayuga Heights (V)	18	11	0	0.0%	0	0.0%
Danby (T)	12	9	0	0.0%	0	0.0%
Dryden (T)	69	40	2	2.9%	2	5.0%
Dryden (V)	19	10	3	15.8%	2	20.0%
Enfield (T)	6	4	0	0.0%	0	0.0%
Freeville (V)	7	4	0	0.0%	0	0.0%
Groton (T)	8	6	2	25.0%	2	33.3%

Jurisdiction	Total Critical Facilities	Total Lifelines	Total Community Lifelines Exposed to the 0.2-Percent Annual Chance Flood Event			
			Number of Critical Facilities Exposed	Percent of Total	Number of Other Lifelines Exposed	Percent of Total
Groton (V)	16	10	3	18.8%	3	30.0%
Ithaca (C)	202	73	30	14.9%	20	27.4%
Ithaca (T)	236	67	9	3.8%	3	4.5%
Lansing (T)	20	15	0	0.0%	0	0.0%
Lansing (V)	31	17	0	0.0%	0	0.0%
Newfield (T)	22	14	0	0.0%	0	0.0%
Trumansburg (V)	20	11	0	0.0%	0	0.0%
Ulysses (T)	5	4	0	0.0%	0	0.0%
Tompkins County (Total)	**707**	**306**	**50**	**7.1%**	**32**	**10.5%**

Source: Tompkins County GIS 2019/2020
Notes: V = Village, C = City, T = Town, % = Percent

Table 5.4.4-25. Distribution of Community Lifeline Critical Facilities in the 1-Percent Annual Chance Flood Event Hazard Area by Type and Jurisdiction

Jurisdiction	Critical Facilities Exposed to the 1-Percent Annual Chance Flood Event							
	Dam	Education - Higher	Electrical Power Grid	Fire Station	Government	Medical Office	Post Office	Wastewater Pump Station
Caroline (T)	0	0	0	0	1	0	0	0
Cayuga Heights (V)	0	0	0	0	0	0	0	0
Danby (T)	0	0	0	0	0	0	0	0
Dryden (T)	1	0	0	1	0	0	0	0
Dryden (V)	0	0	0	1	1	1	0	0
Enfield (T)	0	0	0	0	0	0	0	0
Freeville (V)	0	0	0	0	0	0	0	0
Groton (T)	0	0	0	1	0	0	1	0
Groton (V)	0	0	0	0	0	3	0	0
Ithaca (C)	0	1	1	0	0	0	0	1
Ithaca (T)	3	3	0	0	1	0	0	1
Lansing (T)	0	0	0	0	0	0	0	0
Lansing (V)	0	0	0	0	0	0	0	0
Newfield (T)	0	0	0	0	0	0	0	0
Trumansburg (V)	0	0	0	0	0	0	0	0
Ulysses (T)	0	0	0	0	0	0	0	0
Tompkins County (Total)	**4**	**4**	**1**	**3**	**3**	**4**	**1**	**2**

Source: Tompkins County GIS 2019/2020
Notes: V = Village, C = City, T = Town

Table 5.4.4-26. Distribution of Community Lifeline Critical Facilities in the 0.2-Percent Annual Chance Flood Event Hazard Area by Type and Jurisdiction

Jurisdiction	Critical Facilities Exposed to the 0.2-Percent Annual Chance Flood Event													
	Dam	Education - Higher	Education - Primary	Electrical Power Grid	Electrical Substation	Fire Station	Fire/EMS	Government	Medical Office	Oil Facility	Post Office	Potable Water Tank	Wastewater Pump Station	Wastewater Treatment Facility
Caroline (T)	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Cayuga Heights (V)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Danby (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dryden (T)	1	0	0	0	0	1	0	0	0	0	0	0	0	0
Dryden (V)	0	0	0	0	0	1	0	1	1	0	0	0	0	0
Enfield (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Freeville (V)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Groton (T)	0	0	0	0	0	1	0	0	0	0	1	0	0	0
Groton (V)	0	0	0	0	0	0	0	0	3	0	0	0	0	0
Ithaca (C)	0	3	1	1	1	0	1	5	14	1	0	1	1	1
Ithaca (T)	3	3	0	0	0	0	0	1	0	0	0	1	1	0
Lansing (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lansing (V)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Newfield (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trumansburg (V)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ulysses (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tompkins County (Total)	**4**	**6**	**1**	**1**	**1**	**3**	**1**	**8**	**18**	**1**	**1**	**2**	**2**	**1**

Source: Tompkins County GIS 2019/2020
Notes: V = Village, C = City, T = Town

Table 5.4.4-27 displays the major roadways that may be impacted by the 1-percent annual chance flood event inundation area. Out of the 1,855 miles of major transportation routes in the County, 29.4 miles are exposed to the 1-percent annual chance flood event. Most of the roadways exposed to the flood hazard are local and private roadways. Bridges washed out or blocked by floods or debris also can cause isolation. This can be an issue for the commuter community that relies on these transportation routes to enter or leave the County after work.

Table 5.4.4-27. Major Roadways Exposed to the 1-Percent Annual Chance Flood Event Hazard Area

Road Type	Total Miles for County	Miles of Roadway Exposed to the 1-Percent Annual Chance Flood Event	
		Miles	Percent of Total
Local and Private Roads	1,202	20.1	1.7%
County Roads	412	4.6	1.1%
State Routes	241	4.7	2.0%
Tompkins County (Total)	**1,855**	**29.4**	**1.6%**

Source: Tompkins County GIS 2019/2020; NYS GIS 2020; NYS DOT 2013
Notes: V = Village, C = City, T = Town, % = Percent

Further, community lifeline critical facilities that are near an area where frequent urban flooding occurs are also vulnerable to the flood hazard. Urban flooding is defined by FEMA as flooding caused by rain that falls on densely populated areas that have increased amounts of impervious surfaces, which overwhelms the capacity of drainage systems (Natural Resources Defense Council 2019). This type of flooding can be exacerbated by riverine flooding within the County.

Debris from flood events may also affect culverts and sewer systems by creating bottlenecks in the wastewater system, which could not only cause or exacerbate localized urban flooding, but also cause wastewater to spill into homes and neighborhoods or contaminate local rivers and streams.

In cases where short-term functionality is impacted by a hazard, other facilities of neighboring municipalities may need to increase support response functions during a disaster event. Mitigation planning should consider means to reduce impact to critical facilities and ensure sufficient emergency and school services remain when a significant event occurs. Actions addressing shared services agreements are included in Section 9 (Mitigation Strategies) of this plan.

Future Changes that May Impact Vulnerability

Understanding future changes that impact vulnerability in the County can assist in planning for future development and ensuring that appropriate mitigation, planning, and preparedness measures are in place. The County considered the following factors to examine potential conditions that may affect hazard vulnerability:

- Potential or projected development
- Projected changes in population

- Other identified conditions as relevant and appropriate, including the impacts of climate change

Projected Development

As discussed in Section 4, areas targeted for future growth and development have been identified across the County. Any areas of growth located in the flood inundation areas could be potentially impacted by flooding. It is recommended that the County and municipal partners implement design strategies including an emphasis on utilizing green infrastructure and land use tools including zoning that mitigate against the risk of riverine flooding. Development should be directed outside of these high risk areas, and impacts of development to surrounding properties should always be properly assessed as is required by most local flood damage prevention laws. It should be noted that many of these local laws the implementation a minimum standards. Laws should be reviewed to provide more resilient requirements.

Projected Changes in Population

According to population projections from the Cornell Program on Applied Demographics, Tompkins County will experience a continual population increase from 2020 through 2040 (over 6,040 people in total by 2040). The U.S. Census Bureau also shows that the population in Tompkins County has increased 0.6-percent between 2010 and 2019 (U.S. Census Bureau 2020). Not only does the increasing population change the flood exposure risk throughout the County, persons that are already located in the County may also move into locations that are more susceptible to flooding than others. This includes areas that are directly impacted by flood events and those that are indirectly impacted (i.e., isolated neighborhoods, flood-prone roadways, etc.). Refer to Section 4 (County Profile), for additional discussion on population trends.

Climate Change Impacts

As discussed above, most studies project that the State of New York will see an increase in average annual temperatures and precipitation. Annual precipitation amounts in the region are projected to increase, primarily in the form of heavy rainfalls, which have the potential to increase the risk to flash flooding and riverine flooding, and flood critical transportation corridors and infrastructure. Increases in precipitation may alter and expand the floodplain boundaries and runoff patterns, resulting in the exposure of populations, buildings, and critical facilities and infrastructure that were previously outside the floodplain. This increase in exposure would result in an increased risk to life and health, an increase in structural losses, a diversion of additional resources to response and recovery efforts, and an increase in business closures affected by future flooding events due to loss of service or access.

Existing dams may not be able to retain and manage increases in water flow from more frequent, heavy rainfall events. Heavy rainfalls may result in more frequent overtopping of these dams and flooding of the County's assets in adjacent inundation areas. However, the probable maximum flood used to design each dam may be able to accommodate changes in climate.

Change of Vulnerability Since the 2014 HMP

The 2014 HMP assessed flood impacts based on the old FEMA's Q3 flood data and the 2011 Tompkins County tax assessor data. The 2014 analysis was performed using a parcel exposure analysis. Since the 2014 analysis, population statistics have been updated using the 5-year 2014-2018 American Community Survey Population Estimates. Additionally, this updated analysis estimated exposure and losses at the structure level with updated building stock data. The general building stock was updated using building stock data provided by the County to update the user-defined facility inventory and community lifeline: critical facility inventory dataset. The replacement cost value of these structures was updated using RS Means 2019 building valuations. Last, an updated version of FEMA's Hazus-MH flood module v4.2, incorporating updated depth grids for the City of Ithaca developed by USGS, was used to estimate potential losses for the 1-percent annual chance flood event.

Overall, this vulnerability assessment uses a much more accurate and updated building inventory which provides more accurate estimated exposure and potential losses for Tompkins County.

Identified Issues

The following issues were identified for the flood hazard:

- A potable water pipeline that services the City of Ithaca is known to be located in a landslide susceptible slope area; no back-up service main is currently in operation. A slope failure in this area has resulted in infrastructure damage to the pipeline and caused interruptions in water service in part due to added water testing requirements.
- Communities will not only need to continue to steer new development away from SFHAs but also will need to develop mitigation strategies for the existing commercial and residential properties in these areas including the update and enforcement of land use tools including zoning to direct development away from floodplains and stream corridors.
- Significant changes to the SFHA may occur with the update of FIRM maps in 2021-22. Communities should plan for broad ranging educational campaigns for municipalities, businesses and landowners regarding what those changes may mean.
- Diverse outreach methods for notifying those living in and traveling through SFHAs should be explored.
- Investments in large scale mitigation measures in the City of Ithaca's flood control structures and green infrastructure investments should be explored to ensure they continue to perform as designed or are retrofitted to address climate change impacts.

5.4.5 Harmful Algal Bloom

This section provides a profile and vulnerability assessment of the harmful algal bloom (HAB) hazard for Tompkins County.

The hazard profile is organized as follows:	The vulnerability assessment is organized as follows:
• Description • Extent • Previous Occurrences and Losses • Probability of Future Occurrences • Climate Change Impacts	• Impact on Life and Safety • Impact on General Building Stock • Impact on Community Lifelines • Impact on Economy • Impact on Environment • Cascading Impacts on Other Hazards • Future Change that may Impact Vulnerability • Changes Since 2014 HMP • Identified Issues

5.4.5.1 Profile

The profile contains a description of the HAB hazard, extent, location, previous occurrences and losses, climate change projections and the probability of future occurrences.

Hazard Description

Cyanobacteria were among the first life on the planet and were responsible for the oxygen-rich atmosphere. However, some cyanobacteria also produce toxins that threaten humans and animals. Because of their color, cyanobacteria are also referred to as blue-green algae, and when they form colonies, are called harmful algal blooms (HAB), though not all are harmful.

Algae are a diverse group of aquatic organisms that have the ability to photosynthesize. They can be found in a wide range of environments, include lakes, ponds, oceans, hot springs, and land (Live Science 2020). Most algae are harmless and are considered an important component of the food web. Certain types of algae can grow rapidly, forming blooms, and covering all or portions of a lake. There are some species of algae that produces toxins which can be harmful to humans and animals. Algae blooms that produce toxins are referred to as harmful algal blooms (HABs) (NYSDEC 2020). More than 40 cyanobacterial species are confirmed or suspected to produce toxins (Graham and Wilcox 2000).

HABs are usually trigged by a combination of water and environmental conditions, including excess nutrients (phosphorus and nitrogen), excessive sunlight, low-water or low-flow conditions, still waters, and warm temperatures. The timeframe of HABs depends on weather conditions and characteristics of the lake. They can last for a few hours (short-lived) to several weeks or longer (long-lived) (NYSDEC 2020).

Identifying Harmful Algal Blooms

The appearance of HABs can vary greatly. According to the NYSDEC, colors can include shades of green, blue-green, yellow, brown, red, or white. The physical appearance of these blooms can include floating dots or clumps and streaks on the water's surface as illustrated in Figure 5.4.5-1. Some blooms can also resemble spilled paint on the water's surface or change the appearance of water to that of pea soup (NYSDEC 2017a).

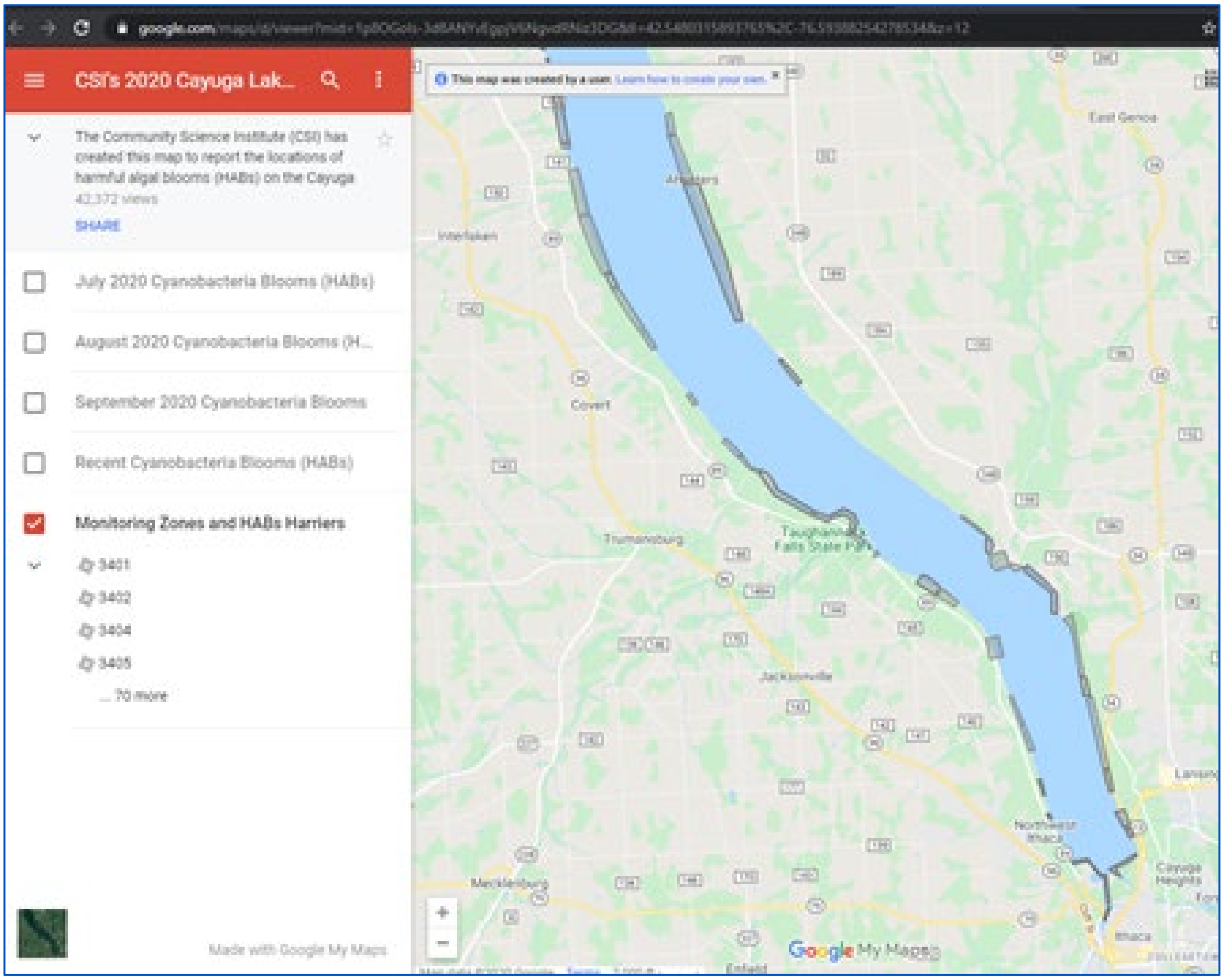
Figure 5.4.5-1. Examples of Harmful Algal Bloom Visual Appearance

Source: NYSDEC 2016

The NYSDEC Lake Classification and Inventory Program, Citizen Statewide Lake Assessment Program volunteers, and partner HAB monitoring programs collect and report information about the status of waterbodies in New York that may be impacted by HABs (NYSDEC 2018). NYSDEC maintains a statewide interactive map on HABs reports.

On a more local Level, the Community Science Institute located in Ithaca is a non-for-profit organization that has a volunteer-based HABs monitoring program for Cayuga Lake. Figure 5.4.5-2 shows the Cayuga Lake shoreline sections in Tompkins County regularly monitored by volunteers in 2020.

Figure 5.4.5-2.Cayuga Lake Monitoring Program Map



Source: Community Science Institute

The presence of HABs will trigger official beach closures, drinking water restrictions, advisory signs, press releases, and notifications on websites such as the NYSDEC Harmful Algal Blooms Notifications Page and the Tompkins County Department of Health. Children and animals should be kept away from waters suspected of containing HABs, and fishing or eating fish should be prohibited.

Location

Tompkins County has significant exposure and vulnerability to the HAB hazard, as described below.

- Shorelines of the Tompkins County waterbodies with documented HABs are publicly accessible, which can increase the chance of exposure. Many of the county's waterbodies, primarily Cayuga Lake, are popular recreation lakes and have an abundance of lake users, tourism and shoreline development. While DEC guidance requires the public to close the swimming facilities when blooms are detected, there is still a significant risk of exposure for public that might not be familiar with HABs where the water is accessible from locations other than regulated swimming beaches, such as private residences and boats in the water.

- HABs are currently being experienced throughout the entire Finger Lakes region which can have a significant negative impact on the tourism and local businesses which rely on that tourism.
- Land use changes (residential and commercial development and changes in agricultural practices) are known to be connected to water quality pollutants, which could lead to increased occurrences of HABs. Such development can be the increase of impervious surfaces, agricultural development, and the degradation of existing riparian buffers.
- Because Tompkins County has a major agricultural sector, farm runoff that may contain nutrients directly enters the streams and lakes and provides the nutrients for excessive plant and cyanobacteria growth.
- Locations that rely on surface water intake for drinking water are most exposed to the impacts of HABs, and the three main water purveyors in the County have their own HABs plans. Most of the County residents that are not on municipal water rely on groundwater from deep wells.

In recent years, NYS DEC records have documented HABs on two main and several smaller waterbodies in Tompkins County. The two main waterbodies, Cayuga Lake and Dryden Lake, have a combined 166.5 miles of shoreline of which 51.5 miles are in Tompkins County. Table 5.4.5-1 breaks down the total shoreline miles per lake and the shoreline miles per lake in Tompkins County.

Table 5.4.5-1. Shoreline of Major Waterbodies in Tompkins County with Documented HABs in recent years

Lake	Shoreline Miles (total)	Shoreline Miles (in Tompkins County)	Surface Area (Acres)
Cayuga Lake*	165	50	42,612
Dryden Lake	1.5	1.5	40
Total	**166.5**	**51.5**	**42,652**

Source: NYS GIS
*Note: * - Indicates drinking water source.*

While most HAB contact occurs along shorelines of Cayuga and Dryden Lakes, blooms can take place anywhere in the waterbody, as well as on smaller waterbodies, such as ponds. According to the Tompkins County Natural Resource Inventory, 6.42% of Tompkins County is made up of surface water, that is, streams, lakes, and wetlands.

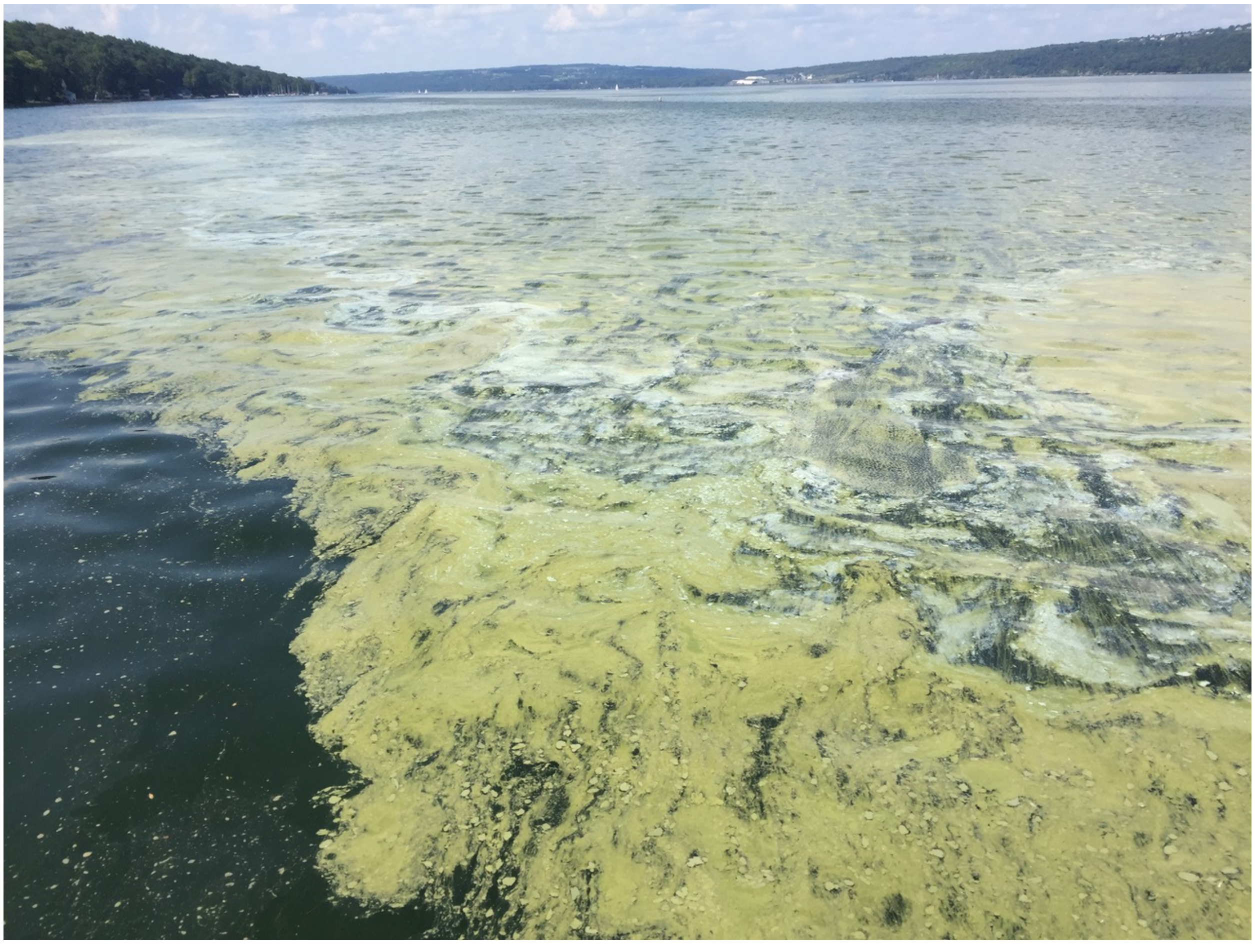
Extent

The NYSDEC uses visual observations, photographs, and laboratory sampling results to determine if blooms are comprised of cyanobacteria or other types of algae. Figure 5.4.5-3 is a photograph of a cyanobacteria bloom at Cayuga Lake. NYS DEC staff will set bloom statuses for waterbodies that are being investigated for harmful algal blooms:

- **Suspicious Bloom**: NYSDEC staff have determined that conditions fit the description of a cyanobacteria HAB based on visual observations and/or digital photographs. Laboratory analysis has not been conducted to confirm whether this suspicious bloom is a HAB. It is not known if toxins are present in the water.
- **Confirmed Bloom**: Water sampling results have confirmed the presence of a cyanobacteria HAB, which may produce toxins or other harmful compounds.
- **Confirmed with High Toxins Bloom**: Water sampling results have confirmed that toxins are present in enough quantities to potentially cause health effects if people and animals come in contact with the water through swimming or drinking (NYSDEC 2018).

Suspicious blooms are reported to NYSDEC, local health departments, or the NYSDOH (NYSDOH 2017).

Figure 5.4.5-3. Cyanobacteria Bloom in Cayuga Lake, Tompkins County



Source: The Cayuga Lake Watershed Network, 2020

The NYSDEC has previously identified HABs in two major and several smaller waterbodies in Tompkins County. There is a possibility for HABs occurring in waterbodies in Tompkins County not subject to monitoring and on private property. The extent of a harmful algal bloom is an estimate of the area of the waterbody that is impacted. The NYSDEC has four categories to classify extent within their monitoring program (NYSDEC 2018):

- **Small Localized**: Bloom affects a small area of the waterbody, limited from one to several neighboring properties.
- **Large Localized**: Bloom affects many properties within an entire cove, along a large segment of the shoreline, or in a specific region of the waterbody.
- **Widespread/Lakewide**: Bloom affects the entire waterbody, a large portion of the lake, or most to all the shoreline.
- **Open Water**: Sample was collected near the center of the lake and may indicate that the bloom is widespread, and conditions may be worse along shorelines or within recreational areas. Special precautions should be taken in situations when a "Confirmed with High Toxins Bloom" is reported with an open water extent because toxins are likely to be even higher in shoreline areas.

Wind currents can play a large role in the concentrations of algae that float at or near the water surface. Between 2006 and 2017 during the months of June through November, stronger prevailing winds out of the northwest and southeast have influenced the flow and current of the water resulting in driving water borne nutrients and cyanobacteria towards the northern and southern portions of Cayuga Lake. As the water drains north and takes approximately 10 years to enter and exit the lake (also known as water retention time) the water that enters from the south and the 140 tributaries that contribute to the water supply of Cayuga Lake determine the overall quality of the water. Most of these tributaries are small and intermittent and can drastically vary in terms of water quality based on season and amount of precipitation leading to the constant fluctuation in the lake's water quality.

Previous Occurrences and Losses

For this HMP update, HAB events were researched from 1972 to 2020. The NYSDEC began HAB testing and issuing notifications for New York waterbodies in 2012. The 2018 DEC Lake Monitoring Program includes the Lake Classification and Inventory Survey (LCI), the Citizens Statewide Lake Assessment Program (CSLAP) and several individual lake sampling programs. Table 5.4.5-2 lists events identified by the NYSDEC HAB Program between 2012 and 2019. This table includes events specific to Tompkins County as well as events listed for neighboring counties but on a shared waterbody, keeping in mind that cyanobacteria blooms can spread on waterways.

Table 5.4.5-2. Harmful Algal Bloom Events in Tompkins County or Lakes Bordering Tompkins County, 2012 to 2019

	2012	2013	2014	2015	2016	2017	2018	2019
Cayuga Lake	None	None	C	None	C	HT	HT	HT
Dryden Lake	None	None	None	None	HT	C	S	S
S (Suspicious Bloom): DEC staff determined that conditions fit the description of a cyanobacteria HAB based on visual observations and/or digital photographs								

	2012	2013	2014	2015	2016	2017	2018	2019
C (Confirmed Bloom): Water sampling results have confirmed the presence of a cyanobacteria HAB which may produce toxins or other harmful compounds HT (Confirmed with High Toxins Bloom): Water sampling results confirmed that there were toxins present in quantities to potentially cause health effects if people or animals came in contact with the water								

Source: NYSDEC 2020

Probability of Future Events

HABs appear to be a recent occurrence in Tompkins County or have only recently been officially reported and recorded. Even with these blooms becoming increasingly common, season and year-to-year fluctuations make predicting their occurrence difficult (U.S. Environmental Protection Agency [EPA] 2017). Despite this uncertainty, the impact of HABs on the environment, human health, and local economies cannot be discounted, especially in the Finger Lakes Region where tourism and agriculture are the primary economic drivers.

Table 5.4.5-3 lists probabilities of occurrences of documented HAB events in waterbodies in the county. The information used to calculate probabilities of occurrences is based on NYSDEC database records that only date back to 2012. It is possible that HABs were present in waterbodies before 2012 but were not identified or monitored. It is also possible that events have taken place in waterbodies that went unreported.

Table 5.4.5-3. Probability of Occurrence of Harmful Algal Bloom-Related Events

Hazard Type	Number of Occurrences Between 2012 and 2019	Percent Chance of Occurrence in Any Given Year
Harmful Algal Bloom	58	100%

Sources: NYS DEC 2020
Note: Probabilities were calculated from years 2012 to 2019. NYS DEC data only included harmful algal bloom events back to 2012.

During the Tompkins Steering Committee and Planning Committee meetings, the occurrence of harmful algal blooms was discussed. In Section 5.3, the identified hazards of concern for Tompkins County were ranked. Probability of occurrence, or likelihood of the event, is one parameter used for hazard rankings. Based on historical records and input from the Planning Partnership, the probability of occurrence of HAB in Tompkins County is considered “frequent” (hazard event has 100% annual probability and may occur multiple times per year).

Climate Change Impacts

Increases in temperature may result in increased frequency of HABs. Most HABs take place during the summer months when water temperatures are warmest. Different species of cyanobacteria are dominant at different times of the summer months. When lakes are at their warmest, mixing of the water column is less likely. When lakes are stagnant, cyanobacteria are able to grow thicker and faster. In addition, the lower density of warm water allows algae to float to the surface faster. As they grow and reproduce, cyanobacteria absorb more sunlight at the surface, further increasing the lake temperature and promoting more blooms (EPA 2017a).

Annual average precipitation is projected to increase by up to five percent by the 2050s and by up to 10 percent by the 2080s. During the winter months, additional precipitation will most likely occur, in the form of rain, and with the possibility of slightly reduced precipitation projected for the late summer and early fall. Northern parts of New York State are expected to see the greatest increases in precipitation (NYSERDA 2014).

The projected increase in precipitation is expected to occur via heavy downpours and less in the form of light rains. Rising air temperatures intensify the water cycle by increasing evaporation and precipitation, which can cause an increase in rain totals during storm events, with longer dry periods between those events. Thus, it is important to note that while projected droughts are indicated to decrease over time, that does not necessarily mean wetter seasons. Rather, it is expected that while overall volume of precipitation is not expected to increase drastically, the patterns will be more extreme, and the volume of precipitation/ hour is going to increase to a significant degree. Alternating periods of drought and heavy rainfall increase the likelihood of nutrient runoff into waterways, which can fuel algal blooms (EPA 2017a).

Warmer temperatures could lead to an increase of the length of the growing season and increase the likelihood of HABs. In addition to warmer temperatures and heavy precipitation events, carbon dioxide levels are forecast to continue to increase. Higher levels of carbon dioxide in the atmosphere and water can lead to increased algal growth, particularly for cyanobacteria that float at the surface (EPA 2017a).

5.4.5.2 Vulnerability Assessment

To understand risk, a community must evaluate assets that are exposed and vulnerable to the identified hazard. All assets surrounding and relying on the waterways and water in the County are exposed to the harmful algal bloom hazard. The following text evaluates and estimates the potential impact of the harmful algal bloom hazard on the County.

Impact on Life, Health, and Safety

Impacts of harmful algal blooms on life, health, and safety depend on several factors, including the severity of the event and whether citizens and tourists have become exposed to waters suspected of containing toxins associated with cyanobacteria. Routes of exposure include consumption, inhalation, and dermal exposure. The population living near or visiting waterbodies is at risk for exposure as well as those that use those waterbodies for recreation, fishing, and water supply. Contact with water containing harmful algal blooms can cause various health effects including diarrhea, nausea or vomiting; skin, eye, or throat irritation; and allergic reactions or breathing difficulties (CDC 2020).

Individuals most vulnerable to HABs events include those relying on surface water intake for drinking water exposed to HABs

Populations in Tompkins County that rely on surface water intake for drinking water are most exposed to the impacts of harmful algal blooms. Cayuga Lake, Fall Creek, and Six Mile Creek are surface water resources that provide drinking water within Tompkins County. According to the 2018 American Community Survey 5-Year Population Estimates, Tompkins County has 102,962 persons living in its communities. Although not all residents rely on these surface water resources for drinking water, these waterbodies are also used for recreational activities. The Tompkins County Department of Health updates their website with beach closures, including links to NYS Parks.

Impact on Community Lifelines

The typical impact harmful algal blooms have on community lifeline critical facilities are shutdowns of water intakes from the surface waters that are impacted by blooms and their toxins. Water treatment plants can remove variable amounts of microcystin from drinking water depending on the active removal process used by the water treatment plant (EPA 2020). However, applying the wrong treatment process at a specific state in treatment could damage the facility and release cyanotoxins rather than remove them. The EPA has summarized the effectiveness of treatment options for harmful algal blooms (refer to Table 5.4.5-4).

Fall Creek supplies drinking water to Cornell University, and because the water intake is run-of-the-river, HABs are unlikely to form and be a threat to the drinking water. The City of Ithaca uses Six Mile Creek for its drinking water. The intake is located in a reservoir that could, but has not, experience HABs. The City has a Cyanotoxin Management Plan and performs regular monitoring and testing. Bolton Point, which provides water to residents in its five member municipalities as well as other customers, has its water intake in Cayuga Lake. In 2019 Bolton Point developed a cyanotoxin treatment plan should toxins appear in the raw water.

Table 5.4.5-4. Assessment of Treatment Options for HABs

Treatment Process	Relative Effectiveness
Intracellular Cyanotoxins Removal (Intact Cells)	
Pre-treatment oxidation	Oxidation often stresses or lyses cyanobacteria cells releasing the cyanotoxin to the water. If oxidation is required to meet other treatment objectives, consider using lower doses of an oxidant less likely to lyse cells. If oxidation at higher doses must be used, sufficiently high doses should be used to not only lyse cells but also destroy total toxins present (see extracellular cyanotoxin removal).
Coagulation/ Sedimentation/ Filtration	Effective for the removal of intracellular toxins (cyanobacteria cells). Ensure that captured cells accumulated in sludge are removed frequently to release toxins. Ensure that sludge supernatant is not returned to the supply after sludge separation.
Membranes	Effective for removal of intracellular cyanotoxins (cyanobacteria cells). Microfiltration and ultrafiltration are effective when cells are not allowed to accumulate on membranes for long periods of time. More frequent cleaning may be required during a bloom event.

Treatment Process	Relative Effectiveness
Flotation	Flotation processes, such as Dissolved Air Flotation (DAF), are effective for removal of intracellular cyanotoxins since many of the toxin-forming cyanobacteria are buoyant.
Extracellular (Dissolved) Cyanotoxins Removal	
Membranes	Depends on the type of cyanotoxin, membrane material, membrane pore size distribution, and influent water quality. Nanofiltration is generally effective in removing extracellular microcystins. Reverse osmosis filtration is generally applicable for removal of microcystins and cylindrospermopsin. Cell lysis is highly likely. Further research is needed to characterize performance.
Potassium Permanganate	Effective for oxidizing microcystins and anatoxins. Further research is needed for cylindrospermopsin. Not effective for oxidizing saxitoxin.
Ozone	Very effective for oxidizing microcystins, anatoxin-a, and cylindrospermopsin. Not effective for oxidizing saxitoxin.
Chloramines	Not effective.
Chlorine dioxide	Not effective at doses typically used in drinking water treatment.
Free Chlorine	Effective for oxidizing microcystins as long as the pH is below 8. Effective for oxidizing cylindrospermopsin and saxitoxin. Not effective for oxidizing anatoxin-a.
UV Radiation	UV radiation alone is not effective at oxidizing microcystins and cylindrospermopsin at doses typically used in drinking water treatment. When UV radiation is coupled with ozone or hydrogen peroxide (called "advanced oxidation"), the process is effective at oxidizing anatoxin-a, cylindrospermopsin, and with high UV doses, microcystins.
Activated Carbon Adsorption	Powdered activated carbon (PAC): Effectiveness of PAC adsorption varies based on type of carbon, pore size, type of cyanotoxin, and other water quality parameters such as natural organic matter (NOM) concentration. Wood-based activated carbons are generally the most effective at microcystins adsorption. More research is needed to evaluate PAC's effectiveness at adsorbing cylindrospermopsin, anatoxin-a, and saxitoxin, however the limited research has demonstrated promising results. Doses in excess of 20mg/L may be needed for complete toxin removal, especially if NOM concentrations are high. Granular activated carbon (GAC): Effectiveness of GAC adsorption varies based on type of carbon, pore size, type of cyanotoxin, and other water quality parameters such as NOM concentration. GAC is effective for microcystins, and likely effective for cylindrospermopsin, anatoxin-a and saxitoxin. The condition of the carbon is an important factor in determining GAC's effectiveness for cyanotoxin removal. GAC may need to be regenerated more frequently to ensure adequate adsorption capacity for HAB season.

Source: EPA 2020

Impact on the Economy

Economic impacts from harmful algal bloom events are difficult to quantify in Tompkins County. Nationally, these events have caused significant economic loss. For example, the Centers for Disease Control and Prevention estimates that the fishing industry loses as much as $34 million a year in sales due to contamination (CDC 2020). Recreation and tourism industries also lose millions of dollars each year because of beach closures and presence of HABs in waterbodies. Further, monitoring and management programs can cost states and local governments millions of dollars each year.

Overall, Tompkins County may experience the greatest economic impact in its tourism sector if HABs events continue for long periods of the summer months. News of a closure of a body of water or beach can result in tourists avoiding the area and the numerous events that rely on local waterbodies, especially Cayuga Lake. Even after closures are lifted, negative public reaction can persist and continue to impact tourism revenue and property values.

Impact on the Environment

Harmful algal blooms can release toxins that lead to fish and invertebrate kills. Animals that prey on fish and invertebrates in surface waters, such as birds and mammals including dogs, may be affected if they ingest impacted prey. Both harmful and non-harmful algal blooms can have drastic impacts on oxygen levels in surface waters. When algae begin to die off following a bloom, bacteria begin to decompose the organic material. This decomposition consumes dissolved oxygen and releases carbon dioxide. If the bloom and die off is large enough, dissolved oxygen levels in aquatic systems can rapidly crash. Anoxic conditions connected to algal blooms have resulted in large fish and invertebrate kills (CDC 2020).

Cascading Impacts on Other Hazards

Harmful algal blooms can exacerbate the impacts of disease outbreak. Species and persons that are exposed to cyanobacteria may become poisoned, experience gene alterations, or disease (EPA 2020). More information about disease outbreaks can be found in Section 5.4.1 (Disease Outbreak).

Future Changes that May Impact Vulnerability

Understanding future changes that impact vulnerability in the county can assist in planning for future development and ensuring that appropriate mitigation, planning, and preparedness measures are in place. The county considered the following factors to examine potential conditions that may affect hazard vulnerability:

- Potential or projected development
- Projected changes in population
- Other identified conditions as relevant and appropriate, including the impacts of climate change.

Projected Development

As discussed in Section 4, areas targeted for future growth and development have been identified across the county. Harmful algal blooms could impact any areas of growth located near waterbodies that are vulnerable to harmful algal blooms. As increased development is often associated with stormwater and runoff issues, harmful algal blooms may become more likely in areas of increased development. The specific areas of development are indicated in tabular form and/or on the hazard maps included in the jurisdictional annexes in Volume II, Section 9 of this plan.

Projected Changes in Population

According to population projections from the Cornell Program on Applied Demographics, Tompkins County will experience a continual population increase from 2020 through 2040 (over 6,040 people in total by 2040). The U.S. Census Bureau also shows that the population in Tompkins County has increased 0.6-percent between 2010 and 2019 (U.S. Census Bureau 2020). As a result, an increase in the population could also change the number of persons at risk of becoming exposed to a harmful algal bloom event.

Climate Change

Tompkins County will see an increase in both temperature and precipitation amounts as a result of climate change. As discussed above, a warming climate will allow for an extended growing period for algal blooms. Additionally, increases in precipitation will generate more stormwater runoff, which can lead to increased nutrient loads entering waterways from leached nutrients in the soil or fertilizers on agricultural lands. Warmer temperatures and increased nutrient loads will allow for algal blooms to grow and spread more rapidly. These changes will increase the County's overall vulnerability to harmful algal blooms.

Change of Vulnerability Since the 2014 HMP

Harmful algal blooms are a new hazard of concern for Tompkins County.

Identified Issues

- In Tompkins County, the primary threat from HABs is economic impact to the surrounding region. While public health problems caused by HABs is the initial concern for the county, because Tompkins County is a large tourist destination, park closures and water contamination can cause a more serious and chronic economic impact on local businesses. For preventative measures, the County would not only have to focus on HABs in Tompkins County, but also need to collaborate with neighboring counties in order to reduce the treats caused by HAB.
- There is a need to track and identify harmful algal blooms incidence and to continue to build relationships with lake committees to communicate information about HABs.
- Develop a HABs Strategy to formulate mitigation options for harmful algal blooms range from expensive structural projects (e.g. replacement of septic systems with community to wastewater) to minor projects such as the installation of aerators, or maintenance projects such as dredging legacy chemicals found in lake sediments and road ditch improvements.

5.4.6 Infestation and Invasive Species

This section provides a hazard profile and vulnerability assessment of the infestation and invasive species hazard for the Tompkins County Hazard Mitigation Plan (HMP).

The hazard profile is organized as follows:	The vulnerability assessment is organized as follows:
• Description • Extent • Previous Occurrences and Losses • Probability of Future Occurrences • Climate Change Impacts	• Impact on Life and Safety • Impact on General Building Stock • Impact on Community Lifelines • Impact on Economy • Impact on Environment • Cascading Impacts on Other Hazards • Future Change that may Impact Vulnerability • Changes Since 2014 HMP • Identified Issues

5.4.6.1 Hazard Profile

This section presents information regarding the description, extent, location, previous occurrences and losses, and probability of future occurrences for the infestation and invasive species hazard.

Description

Invasive Species

According to the New York State Department of Environmental Conservation, invasive species are non-native plant and animal species that can cause harm to the environment, to the economy, or to human health (NYSDEC 2018). Invasive species originate in many parts of the world and can be found in the form of aquatic or terrestrial species. Invasive species are one of the greatest threats to New York State's biodiversity. They can cause or contribute to:

- Habitat degradation and loss
- The loss of native fish, wildlife and tree and plant species
- The loss of recreational opportunities and income
- Impact water quality
- Crop damage and diseases in humans and livestock
- Risks to public health and safety (NYSDEC 2018).

Thousands of species have been introduced in the U.S., posing serious threats to agriculture, human health, and the integrity of land and water. New York State is vulnerable to damages from these invasive species. The following list contains the names of invasive species found in New York State. This list does not include all plant species that are invasive or potentially invasive in the State. Jurisdictions in Tompkins County and the Tompkins County Soil and Water Conservation District are devoting resources to help control the invasive plant species populations, along with adopting codes and guidelines to help regulate and control the planting of different plant species. An invasive plant can thrive and spread aggressively outside its native range. A naturally aggressive plant may be especially invasive when it is introduced to a new habitat (USDA 2017). Invasive plants include invasive aquatic plants. Invasive aquatic plants are introduced plants that have adapted to living in, on, or next to water, and can grow either submerged or partially submerged in water (USDA 2017). Invasive plants often are introduced to a new area for ornamental gardening.

Infestation

An infestation is defined as a state of being invaded or overrun by parasites that attack plants, animals, and humans. Insect, fungi, and parasitic infestations can result in destruction of various natural habitats and cropland, impact human health, and cause disease and death among native plant, wildlife, and livestock. An infestation is the presence of a large number of pest organisms in an area or field, on the surface of a host, or in soil. They result from when an area is inhabited or overrun by these pest organisms, in numbers or quantities large enough to be harmful, threatening, or obnoxious to native plants, animals and humans. Pests are any organism (insects, mammals, birds, parasite/pathogen, fungi, non-native species) that are a threat to other living species in its surrounding environment. Pests compete for natural resources or they can transmit diseases to humans, crops, and livestock. Human populations are generally impacted by insect or animal infestations that can result in health impacts and can lead to potential epidemics or endemics. New York State has been impacted by insect borne diseases such as West Nile Virus, Lyme disease, Eastern Equine Encephalitis, La Crosse Encephalitis, Powassan Virus, St. Louis Encephalitis, Western Equine Encephalitis. These diseases are discussed in the disease outbreak profile, Section 5.4.1.

New York State has been impacted by various past and present infestations including Asian longhorned beetles; and hemlock woolly adelgid. Other infestations that have impacted the State include: Emerald Ash Borer, and Sirex Woodwasp. Some infestations, like hemlock wooly adelgid and Emerald Ash Borer, have already occurred in Tompkins County. The following infestations listed below, will further be discussed in this section.

The following table provides the animal and pathogen species that currently affect or may soon affect the natural areas of Tompkins County.

Figure 5.4.6-1. Animals, Plants, Insects, and Pathogens Impacted Natural Areas of Finger Lakes Region

Name	Species Type	Name	Species Type
Agriculture Weeds	Plant	Japanese Barberry	Plant
Akebia	Plant	Japanese hedgeparsley	Plant
Alewife	Fish	Japanese Stiltgrass	Plant
Amur River, California, Common privet	Plant	Kudzu (Not yet in region)	Plant

Name	Species Type	Name	Species Type
Amur cork-tree	Plant	Leafy Spurge	Plant
Asian bittersweet	Plant	Lesser celandine	Plant
Asian Clam	Fish	Lily-of-the-valley	Plant
Asian Longhorned Beetle (Not yet in region)	Insect	Mile-a-Minute	Plant
Asian Maple	Plant	Moneywort, creeping jenny	Plant
Autumn Olive	Plant	Mugwort	Plant
Balsam Woolly Adelgid (Not yet in region)	Insect	Multiflora Rose	Plant
Bittersweet nightshade	Plant	Norway Maple	Plant
Black locust	Plant	Norway Spruce	Plant
Black swallowwort	Plant	Oriental Bittersweet	Plant
Brittle Naiad (water nymph)	Plant	Pale swallowwort	Plant
Brazilian Elodea/waterweed (Not yet in region)	Plant	Periwinkle	Plant
Brown/Black Knapweed	Plant	Pondweed (Curly-leaf, Giant, Japanese)	Plant
Buckthorn (and Alder)	Plant	Porcelain-berry	Plant
Burning Bush/Winged euonymus	Plant	Purple Loosestrife	Plant
Callery Pear	Plant	Quagga Mussel	Mollusk
Canada Thistle	Plant	Reed canary grass	Plant
Common Crane Fly	Insect	Rocket	Plant
Common Reed Grass/Phragmites	Plant	Round Goby	Fish
Crabapple	Plant	Sheep sorrel	Plant
Creeping bellflower	Plant	Sirex (European Woodwasp)	Insect
Creeping Thistle	Plant	Slender Falsebrome	Plant
Crownvetch	Plant	Spiny Waterflea	Zooplankton
Daylily	Plant	Spotted Knapweed	Plant
Emerald Ash Borer	Insect	Spotted Wing Drosophila	Insect
English Ivy	Plant	Starry Stonewort	Plant
Eurasian Boar	Animal	Stilt-grass	Plant
Eurasian Watermilfoil	Plant	Swallow-worts	Plant
European black alder	Plant	Swede Midge	Insect
European barberry	Plant	Sycamore maple	Plant
European Crane Fly	Insect	Tree of heaven/ailanthus	Plant
European dewberry	Plant	Variable-leaf Watermilfoil	Plant
European Frog-bit	Plant	Water Chestnut	Plant
Evergreen bittersweet	Plant	White bedstraw	Plant
Fanwort	Plant	Wild Chervil	Plant
Fishhook Waterflea	Zooplankton	Wild onion/onion-grass	Plant
Flowering Rush	Plant	Wild Parsnip	Plant
Forget-me-not	Plant	Wineberry	Plant
Garlic Mustard	Plant	Wisteria	Plant
Giant Hogweed	Plant	Yellow-flag iris	Plant

Name	Species Type	Name	Species Type
Goutweed, bishop's weed	Plant	Yellow Floating Heart	Plant
Hairy cress	Plant	Yellow Iris	Plant
Hedge Maple	Plant	Zebra Mussel	Mollusk
Hemlock Wooly Adelgid	Plant		
Honeysuckle (Japanese, Maack's, Tartarian)	Plant		
Hydrilla	Plant		

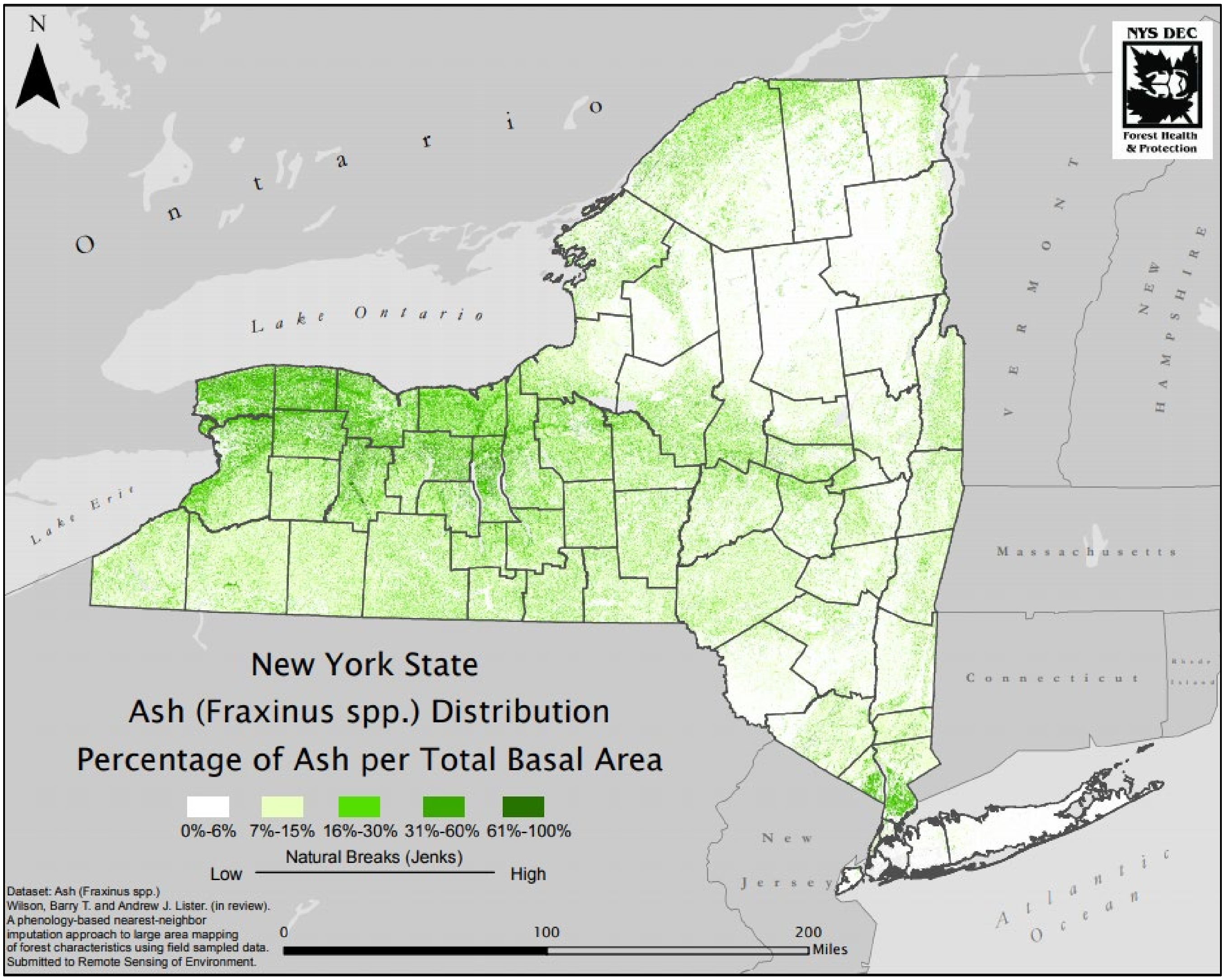
Source: Finger Lakes PRISM, 2020; Tompkins County Environmental Management Council 2018

For this HMP Update, the following non-native species will be discussed in further detail for Tompkins County:

Garlic Mustard is a species that has spread across the United State over the past 150 years. The plant can often be found in the undergrowth of disturbed woodlots and forest edges but can also be found in pristine areas. The plant was originally introduced to the united states as a medicinal plan but then started spreading uncontrollably across the nation and into Canada. The plant is biennial and takes 2 years to fully mature but during growth, tends to cluster in dense packs and stifle any other existing plants (NYSDEC, 2020). Generally, Garlic Mustard is considered one of the invasive plant species that has the lowest impact and the recommended approach to managing is to leave it alone.

Emerald Ash Borer (EAB) is a wood boring beetle native to Asia that feed on and kill all native ash tree species. The beetle was first found in 2002 near Detroit, Michigan and has since spread to 13 states and 2 Canadian provinces, killing many millions of ash Trees in both urban and rural settings. In New York State, a quarantine zone was created to contain the spread of this beetle, of which Tompkins County is included. In general Ash is a common tree found throughout most of New York State and comprises nearly 8% of all trees within the state. As the tree is a common food source and is commonly used in lumber, the effect of the EAB in New York State can be significant. A map below provided by NYSDEC shows the general population of ash. Increased woodpecker activity is often the first sign of an EAB infestation and most tree die within 2 to 4 years after being infected. The population of EAB is increasing quickly across the state, however, DEC is not actively pursuing management of this invasive species currently (NYSDEC, 2020). There is a biocontrol being pursued at the federal level by USDA and releases of the biocontrol are beginning to occur in New York State.

Figure 5.4.6-2. General Population of Ash Trees in New York State



Hydrilla is an invasive water weed, also known as "water thyme" and is one of the world's most invasive aquatic plants (NYSDEC, 2020). Signs of this species has been document in Cayuga Lake and Tompkins County as early as 2011 and was originally found in Orange County NY in 2008. The weed can grow up to an inch per day and as a result produces dense mats of vegetation that can prevent sunlight from entering the waters and absorbs oxygen, causing uninhabitable aquatic environments. Waterfront communities, like Tompkins County are vulnerable to potential economic impacts as well since this species can degrade the overall waterbody and devalue waterfront property and hinder tourism activity. Due to this weed having effects across the nation, Hydrilla has been designated as a federally listed noxious weed which prohibits any movement between states and other countries. While the DEC has its own preventative measures in place, Tompkins County has also created a taskforce under the Tompkins County Soil & Water Conservation District to eradicate or control Hydrilla in local waterways (Cornell Cooperative Extension, 2020). The taskforce cooperates with the Buffalo office of the Army Corps of Engineers to treat hydrilla annually. The adjacent map shows treatment efforts documented in Tompkins County by the ACOE in 2020.

Figure 5.4.6-3. Hydrilla Treatment Areas, Cayuga Lake, Ithaca, NY

Sirex Woodwasp (SW) is an invasive insect that attacks pine species, including Scots Pine and Red Pine. It was found in Oswego County in 2004 and since then has spread throughout much of New York State. It is known for causing severe tree mortality as it lays its nests and inserts a fungus into destressed trees, which ultimately lead to the trees wilting and rotting, however thus far it has not been negatively impacting pine species as bad as initially thought.

Giant Hogweed is a perennial plant and a member of the carrot family. It is a garden ornamental from southwest Asia that is naturalizing in North America and has over time become a widespread issue in New York State. Giant hogweed has the potential to spread readily and grows along roadsides, ditches, and streams. It invades old fields and native habitats such as open woodlands. Brushing against or breaking the plant releases sap that, combined with sunlight and moisture, can cause a severe burn within 24 to 48 hours. Giant hogweed is a Federally listed noxious weed and NYS law prohibits its possession with the intent to sell, import, purchase, transport, introduce or propagate (NYSDEC, 2020). Giant hogweed has been spotted in Caroline, Danby, Dryden, Enfield, Hector, Lansing, Newfield, Trumansburg, and Ulysses. Dryden and Trumansburg are new additions as of 2018, though the plant is relatively under control (Cornell Cooperative Extensions, 2020). New York State has a Giant Hogweed eradication program that is active in the Finger Lakes region.

Wild Parsnip is an invasive plant from Europe and Asia that has become naturalized in North America. The plant can grow up to five feet tall and has a hollow grooved stem. The plant can easily be mistaken for plants such as goldenrod or other flowering yellow plants that can be found in the northeast region. It is well suited for the northeast climate and can be found in a broad range of habitat, especially along roads, in field and pastures, and along rivers or streams. The plant contains a chemical called furanocoumarins which cause human skin to become vulnerable to UV and thus cause swelling and inflammation. The burn can last between 24 and 48 hours and in severe cases cause discoloration of the skin. Tompkins County and its associated organizations such as Cornell Cooperative Extension and SWCD are actively monitoring the species and have been providing education and outreach around the potentially hazardous plant (Cornell Cooperative Extension, 2020)

White Tailed Deer is a native species to North America, however the population in New York has become quite abundant today. Changes to the natural landscape created by humans provide an abundant and ideal deer habitat, which in return has increased the deer population in the State. Substantial deer populations are not only a by-product of agriculture, but the result of greenways and large building lot sizes common in the suburban and rural areas of the State The overpopulation of white tailed deer is reducing the ability of forests to regenerate, resulting higher vehicle collisions and incidence of Lyme disease. New York State DEC encourages active deer management through a number of its programs.

Figure 5.4.6-4 NYSDEC, 2020

Hemlock Woolly Adelgid (HWA) is an invasive, aphid-like insect that attacks North American hemlocks. HWA are originally from Asia and is very small and hard to see underneath the branches around the needles. HWA develop by connecting at the base of needles and being feeding on the tree's stored starches which depletes the tree of nutrients and destroys the canopy due to the inability for adequate nutrients to be delivered to the twigs and needles. The tree dies within 4 to 10 years if not addressed immediately. While all hemlock species are vulnerable, most often HMA can be found on eastern (most common in NYS) and Carolina hemlocks. In addition to direct effects on hemlock, the decline of the species health can cascade to affecting black bears, salamanders, and migrating birds, as well as unique lichen and plant communities that all depend on the unique dense canopy of the hemlock. Hemlocks are the dominant species on the steep slopes surrounding our headwater tributaries. The loss of hemlocks will lead to more erosion in those streams which will have downstream impacts on infrastructure. The lack of hemlocks will also expose the stream to more sun, heating the water. The increased heat and sediment will negatively impact native brook trout and other species.

Asian Longhorned Beetles (ALB) are exotic pests native to parts of Asia, threatening a wide variety of hardwood trees in North America, particularly in New York State, New Jersey, and Chicago. The beetle is believed to have arrived in New York City in the 1980s, in wooden packing material used in cargo shipments from China. The ALB can infest certain hardwood trees, eventually destroying them. They are threat to public, private, and commercial hardwood trees. The U.S. Department of Agriculture (USDA) believes this beetle can probably survive and reproduce in most sections of the country where suitable host trees exist.

This insect is native to the southeastern United States but has been expanding its range up the Eastern Seaboard in recent years. Warming of extreme winter temperatures has most likely contributed to this expansion. While this species has not yet been documented in Tompkins County, according to DEC, with changing weather patterns and increasing temperatures, the Finger Lakes region will likely start encountering this species in the near future. The USDA APHIS eradication measure have helped to keep this pest from spreading.

Spotted lanternfly (Lycorma deliculta) is an Asian plant hopper. The adults are quite colorful with a black head, grayish black spotted forewings, and reddish black spotted hind wings (see Figure 1). Adults are approximately 1" in length and a 1/2" in width and are present from mid-July through the fall. During this time, SLF adults are mating and laying eggs. Egg masses are laid on smooth surfaces and appear like a patch of mud. The spotted lanternfly has major adverse impacts to wineries. It was recently spotted in 2020 in the City of Ithaca.

Regulations

The Invasive Species Council is a statutory body created in 2008 by Title 17, Section 9 of the Environmental Conservation Law (ECL). It was created to coordinate among multiple state entities and partners in addressing the environmental and economic threats of invasive species. The legislation defines invasive species as "a species that is non-native to the ecosystem under consideration and whose introduction causes or is likely causing economic or environmental harm or harm to human health". The Council is co-led by the NYSDEC and the Department of Agriculture and Markets (NYSDAM) and consists of nine members: the Commissioners of the NYSDEC; NYSDAM; Transportation; Education; the Office of Parks, Recreation and Historic Preservation; the Secretary of State, the Chairperson of the New York State Thruway Authority, the Director of the New York State Canal Corporation, and the Chairperson of the Adirondack Park Agency (NYSDEC, 2020).

The NYSDEC, in cooperation with the Department of Agriculture and Markets, has proposed invasive species regulations (6 NYCRR Park 575). The proposed regulation includes a list of prohibited species which shall be unlawful to knowingly possess with the intent to sell, import, purchase, transport or introduce; a list of regulated species which shall be legal to possess, sell, purchase, propagate, and transport, but may not be knowingly introduced into a free-living state; and require a permit for education, research, and other approved activities involving prohibited species and release of regulated species into a free-living state. The regulation also specifies the criteria used in making such classifications and a means for future classification of species. The regulation establishes grace periods for certain prohibited species to allow businesses to plan the management of existing stock (NYSDEC, 2020).

Extent and Location

The extent and location of infestations and invasive species depends on the preferred habitat of the species, as well as the species' ease of movement and establishment. However, each of these threats can impact most areas of New York State, including Tompkins County.

Giant Hogweed

The species has been documented across the state including Tompkins County. The plant grows along streams and rivers and in fields, forests, yards, and roadsides. It prefers open sites with abundant light and moist soils, though it can grow in partially shaded habitats, too. The species is often found as a standalone plant, unlike many invasive species that cluster together. The map depicts the extent to which giant hogweed has been documented, and the adjacent map shows the sites that have been treated and the species was successfully exterminated.

Figure 5.4.6-5 2020 NYSDEC Giant Hogweed Eliminated Plant Sites

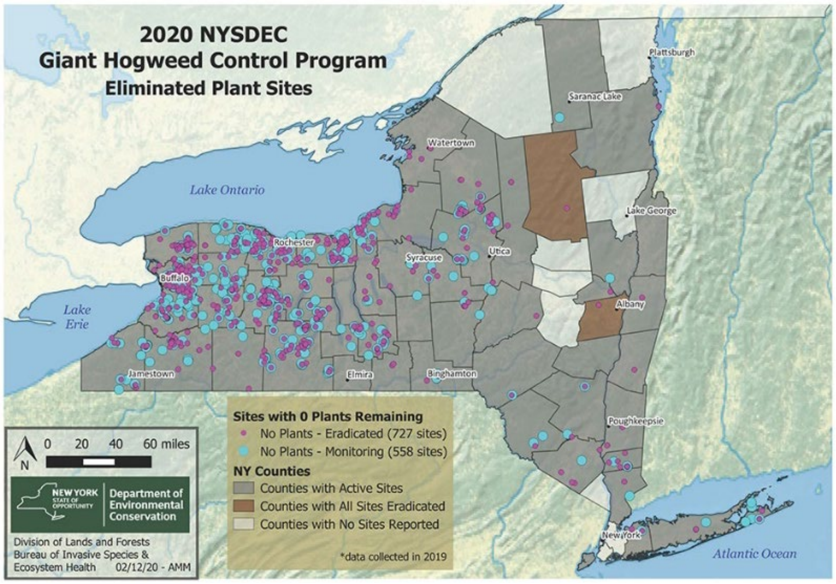
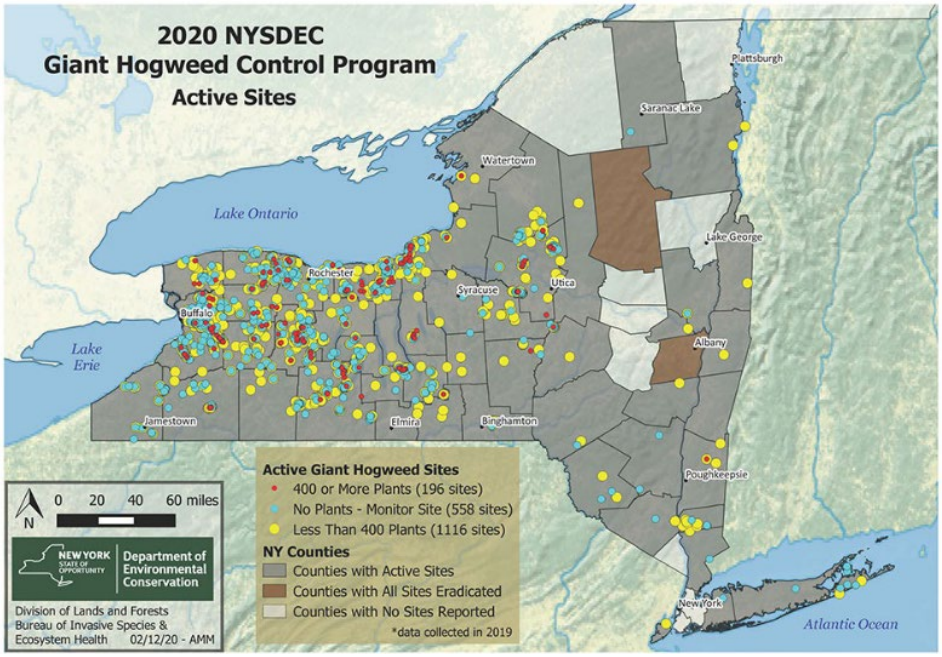


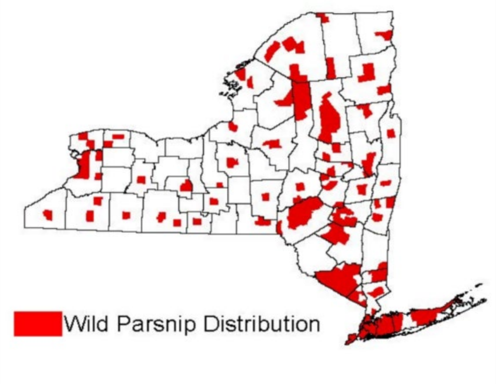
Figure 5.4.6-6 2020 NYSDEC Giant Hogweed Active Sites



Wild Parsnip

The species, like many other invasive plants can be found in large clusters along the side of the roads and can be especially prevalent during the summer months. The plant can be found in most of Upstate New York Counties including Tompkins County. The plant is most likely to be found in areas where sunlight is fully accessible and therefore not in shady areas such as forests. The adjacent map shows the distribution of the wild parsnip in New York State.

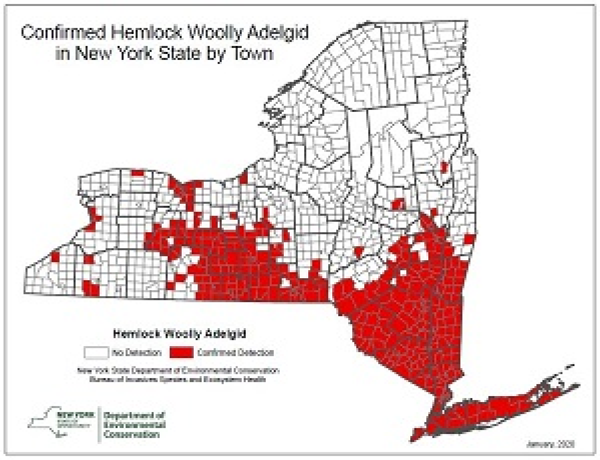
Figure 5.4.6-7 Wild Parsnip Distribution



Hemlock Woolly Adelgid (HWA)

HWA was originally introduced to North America in the 1920s. Ever since, it has spread along the east coast from Georgia to Maine and now occupies nearly half of the eastern range of native hemlocks. It was documented in New York State around 1985 in the Lower Hudson Valley and Long Island and continued upward toward the Capital Region. The species has spread over the years across the state and in 2008 has been documented in Tompkins County (Tompkins County, 2020). The adjacent map shows the extent to which HWA has been documented in New York State (NYS DEC).

Figure 5.4.6-8 Confirmed Hemlock Woolly Adelgid Locations



*Emerald Ash Borer (EAB)*As previously mentioned, EAB can be found across the state and have been identified in much of Upstate New York including Tompkins County. However, no active mitigation measure is in place at this time (NYSDEC, 2020).

Garlic Mustard (GM)

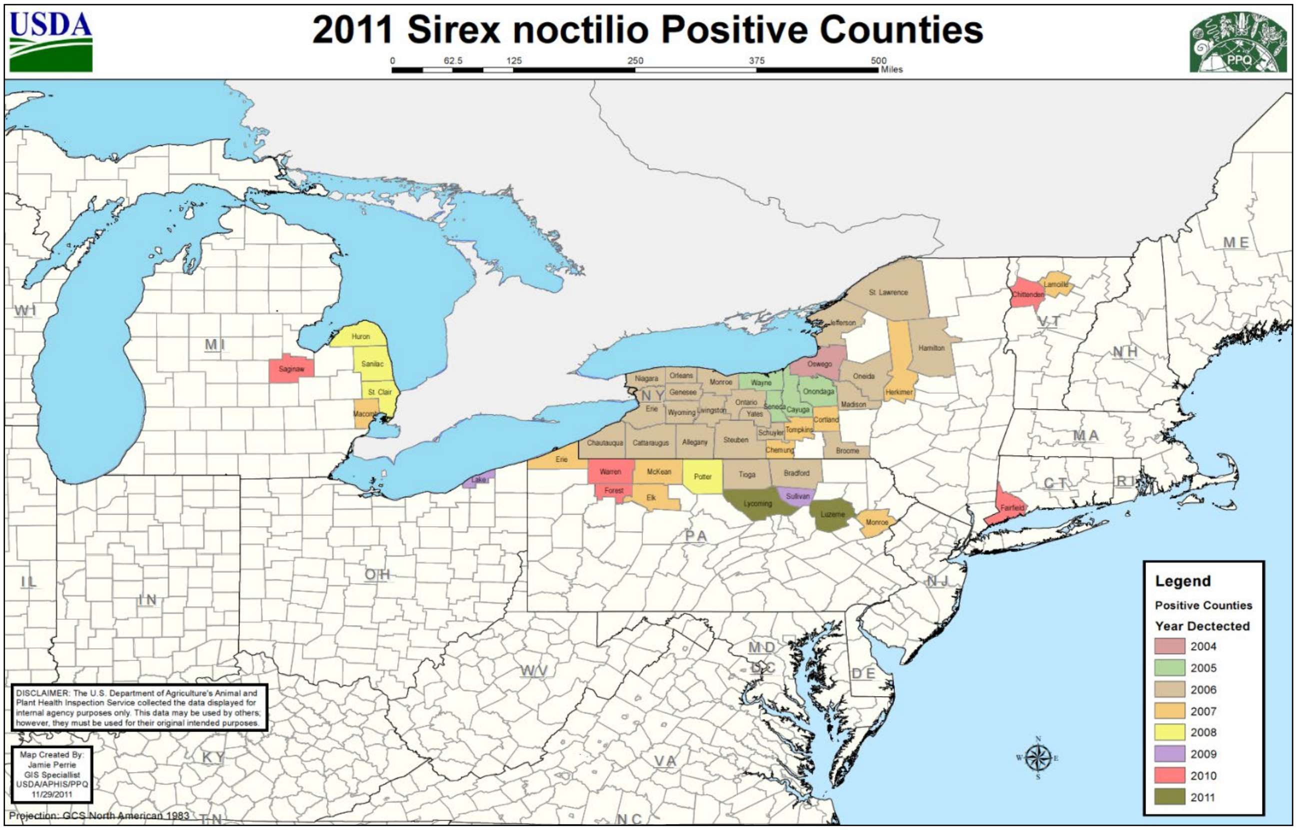
The plant Is ubiquitous in Tompkins County and readily established in recently distrubed areas.

Sirex Woodwasp (SW)

The species is native to Europe, Asia, and North Africa. It can now be found within the northeast U.S. ranging from Michigan to New Hampshire. In New York State, the most affected species are scots pine, Austrian pine, and red pine from plantations dating to the mid-1900s. The damage to the underperforming trees has a minimal economic effect to the state (NYIS, 2019). It was found in Oswego County in 2004 and since then has spread throughout much of New York State, including Tompkins County. The USDA Forest Service ranks Tompkins County as having a medium to very high introduction potential, establishment potential, and susceptibility potential for Sirex Woodwasp infestations (USDA Forest Service, 2006).

Figure 5.4.6 9 shows the positive counties in New York State where Sirex Woodwasp has been detected. According to this figure, as of 2011, Sirex Woodwasp has been documented in Tompkins County. Available information regarding the identification of the species in Tompkins County is provided below.

Figure 5.4.6-9. Sirex Woodwasp in New York State.



Source: New York State Invasive Species Clearinghouse, 2019

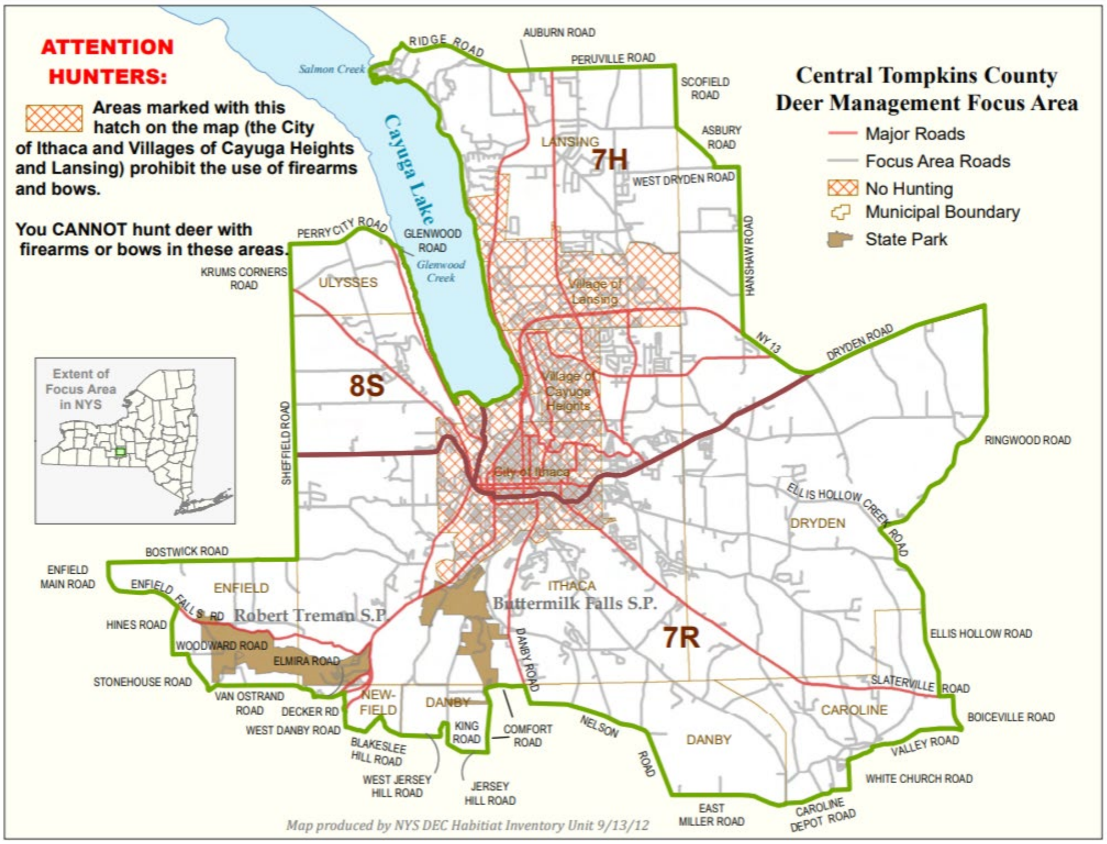
Spotted Lanternfly

Spotted Lanternfly was just recently found in the fall of 2020 in Tompkins County, in the City of Ithaca's Fall Creek neighborhood. The New York State DEC is proactive in combatting the species and has established a protective zone that includes the following counties: Bronx, Broome, Chemung, Chenango, Delaware, Dutchess, Greene, Kings, Nassau, Orange, Otsego, Putnam, Queens, Richmond, Rockland, Suffolk, Sullivan, Tioga, Ulster and Westchester. This zone was established to actively monitor communities near the Pennsylvania and New Jersey boundary and eradicate any reported cases of the spotted lanternfly.

White-Tailed Deer (WTD)

Tompkins County has faced substantial deer issues, with communities such as Cayuga Heights, the Town of Ithaca, and Cornell University convening leaders to discuss deer management solutions. In suburban areas, deer populations have been increasing due to land development and opposition to hunting. The impacts of deer overabundance can be shown by the number of deer/automobile collisions, destruction of residential flower and shrub plants, damage to agricultural crops, and increased risks of contracting wildlife-transmitted diseases such as Lyme disease (discussed in Section 4.3.2, Disease Outbreak).

Figure 5.4.6-10: Deer Management Focus Areas

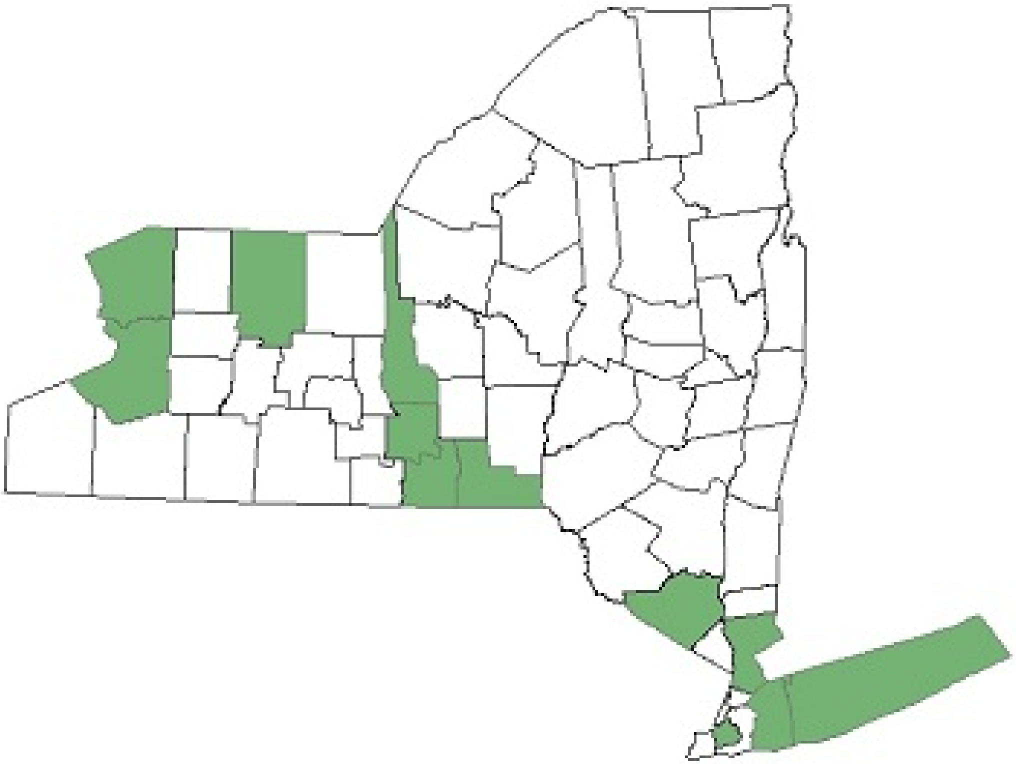


Source: NYSDEC 2020

Hydrilla

The species is only found in aquatic environments and can be documented in several waterbodies in New York State. More commonly it is misidentified and sold as Elodea. It has been us intentionally as an aquarium plant; however, the state actively prohibits the distribution or sale of this species to prevent the spread. As of 2011, based on NYSDEC data, Hydrilla has been documented in Tompkins County, specifically Cayuga Lake at the King Ferry and Finger Lakes Marinas, Village of Aurora, Merrill Sailing Center, Stewart Park, and locations along the south east and west shore, as well as in the lower section of Fall Creek and the Cayuga Inlet and active mitigation measures are being developed by various municipal and non-for-profit entities to reduce the spread of this invasive species (Cornell Cooperative Extension, 2020). DEC began development of one management plan for the various treatment efforts in the area in 2020. DEC will provide leadership in coordinating the various efforts in 2021. DEC is also planning to hire a strike team for monitoring and rapid response. The adjacent map depicts the counties in which Hydrilla has been documented in New York State.

Figure 5.4.6-11. Current Known Distribution of Hydrilla in New York State



Previous Occurrences and Losses

Many sources provided historical information regarding previous occurrences and losses associated with infestation events throughout New York State and Tompkins County. With so many sources reviewed for the purpose of this HMP, loss and impact information for many events could vary depending on the source. Therefore, the accuracy of monetary figures discussed is based only on the available information identified during research for this HMP.

Between 1954 and 2020, FEMA declared that New York State experienced one infestation-related emergency (EM) classified as a virus threat. Generally, these disasters cover a wide region of the State; therefore, they may have impacted many counties. However, not all counties were included in the disaster declarations. Tompkins County was included in this declaration (FEMA, 2020).

In addition, because invasive species can sometimes go unrecorded and the number of occurrences can be unclear, it can be easier to understand the time in which the identified species was first documented in the region.

Table 5.4.6-1. Identified Invasive Species in Tompkins County

Species	Status
Hydrilla	Identified
Giant Hogweed	Increasing number of occurrences in county
Spotted Lantern Fly	Recently Documented in City of Ithaca (2020)
Sirex Woodwasp	Documented in Otsego in 2004
Garlic Mustard	Originally Documented in 2015
Emerald Ash Borer	Documented in Tompkins County
Hemlock Woolly Adelgid	Originally documented in region in 2008
Wild Parsnip	Increasing number of occurrences in County
Asian Longhorned Beetles	Not Yet Documented in Tompkins County

Asian Longhorned Beetle (ALB)

The spread of ALB to other tree populations should be preventable if USDA quarantine restrictions are followed with the ongoing monitoring of area trees for rapid detection of beetle infestations. According to the USDA APHIS, surveys, regulatory measures, and control that the ALB problem can and should be eradicated. However, the USDA also indicates that if this beetle continues to spread, potential damage is significant throughout the U.S., including New York State.

Sirex Woodwasp

The USDA Forest Service ranks Tompkins County as having a medium to very high introduction potential, establishment potential, and susceptibility potential for Sirex Woodwasp infestations (USDA Forest Service, 2006).

Garlic Mustard (GM)

This species has been continuing to infest the Finger Lakes region and, according to DEC, the species is under strict monitoring. Climate Change could change the overall conditions and lead to spreading of this species.

Wild Parsnip

This species has been continuing to infest the Finger Lakes region and, according to DEC, the species is under strict monitoring. Proper education and outreach will need to be conducted, as with climate change eradication of this species is unlikely.

Hydrilla

Tompkins County has been proactive in combatting and implementing strict guidelines to decrease hydrilla. Current efforts could lead to decreased levels of this species. However, at the same time, with changing climate and land use patterns, there is no guarantee that the existing mitigation measures will continue to a decline in hydrilla. The lack of effective boat spread control will lead to a significant problem. With projected changes, the probability occurrence for hydrilla will likely increase.

Giant Hogweed

This species has been continuing to infest the Finger Lakes region and, according to DEC, the species is under strict monitoring. Proper education and outreach will need to be conducted, as the prevalence of this species and its spreading will likely increase.

White-Tailed Deer

Current white-tailed deer levels have been improving over time in Tompkins County and New York State, as the DEC and county have been proactive in species management. With continued measures, the region will likely see a drop in the number of white-tailed deer (NYS DEC, 2020).

Spotted Lantern Fly

At this time, the species is still spreading across the state and whether the species will continue to increase is still unknown. However, if current trends continue, Tompkins County will likely see an increased presence of this species over time (NYS DEC, 2020).

Emerald Ash Borer

Currently there are some County-wide mitigation measures in place to combat this species spread. Also, Cornell University is proactively treating with biocontrol releases, inventorying, and culling ash trees to manage the impact of the thousands of on- and off-campus trees that have succumbed to this insect and could become a life-safety concern as they fail. (Cornell Chronicle, 2020). This program could provide a basis for a larger, regional program. Unless mitigation actions are taken by the state and County, the species will likely continue to increase its presence in Tompkins County and the Finger Lakes Region.

Hemlock Woolly Adelgid

The HWA has been rapidly spreading across the State and there are no signs of this decreasing. While New York State is currently actively trying to mitigate the spread of this species, with climate change this species will likely continue to increase and reach northern counties over the years (NYSDEC, 2020).

The New York State Invasive Species Program is made up of several components:

- **Environmental Protection Fund:** The invasive species line item is the lifeline supporting the infrastructure of the statewide invasive species program, first described in the 2005 NYS Invasive Species Task Force Report and outlined below. Many of the components are administered as contracts through the NYS Department of Environmental Conservation (Finger Lakes PRISM 2019).
- **New York Invasive Species Council:** Nine state agencies, co-chaired by NYS Department of Environmental Conservation and NYS Department of Agriculture and Markets.
- **New York State Invasive Species Advisory Committee:** Twenty-five representative stakeholders including environmental, academic, and industry groups (Finger Lakes PRISM 2019).
- **Invasive Species Coordination Unit:** Two coordinating staff at the NYS Department of Environmental Conservation housed within the Division of Lands and Forests (Finger Lakes PRISM 2019).

- **Partnerships for Regional Invasive Species Management (PRISMs):** Eight regional public-private partnerships established across New York to coordinate invasive species prevention and management and deliver on-the-ground programming. (Finger Lakes PRISM 2019).
- **iMapInvasives:** Web-based database and mapping system that stores and displays statewide invasive species occurrence, treatment, and assessment information for agencies and citizens alike (Finger Lakes PRISM 2019).
- **New York Invasive Species Clearinghouse**: Web-based gateway to access timely, accurate, scientific, and policy information and information on upcoming invasive species events and invasive species news of interest (Finger Lakes PRISM 2019).
- **New York Invasive Species Education Program:** Education program integrated within the Cornell Cooperative Extension Network that provides high quality science-based educational programs and cutting-edge research-based information regarding invasive species of major concern (Finger Lakes PRISM 2019).
- **New York Invasive Species Research Institute:** Virtual institute that serves the scientific research community, natural resource and land managers, and state offices by promoting information-sharing and developing recommendations and implementation protocols for research, funding, and management to improve the scientific basis of invasive species management (Finger Lakes PRISM 2019).
- **Additional Components:** The State of New York's invasive species program also leads special projects as needed, and as resources and capacity allow, such as offering an Invasive Species Eradication Grant Program; preparing a NYS Invasive Species Management Strategy; coordinating and streamlining regulatory processes; implementing regulatory and encouraging non-regulatory approaches to prevention; supporting invasive species research, and responding to new species introductions to the state, among other initiatives (Finger Lakes PRISM 2019).

Probability of Future Occurrences

Based on historical documentation, increased incidences of infestation throughout New York and the overall impact of changing climate trends, it is estimated that Tompkins County and all its jurisdictions will continue to experience infestation events that may induce secondary hazards and health threats to the County population if infestations are not prevented, controlled or eradicated effectively. The lack of enforcement and regulatory approaches to stop the spread poses a significant concern. The Planning Partnership views this as a "frequent" hazard of concern (hazard event that occurs from once in 10 years to once in 100 years) and will lead to cascading hazard impacts.

Climate Change Impacts

Climate change is beginning to affect both people and resources in New York State, and these impacts are projected to continue growing. Impacts related to increasing temperatures and sea level rise are already being felt in the State. ClimAID: the Integrated Assessment for Effective Climate Change in New York State (ClimAID) was undertaken to provide decision-makers with information on the State's vulnerability to climate change and to facilitate the development of adaptation strategies informed by both local experience and scientific knowledge (New York State Energy Research and Development Authority [NYSERDA], 2011). Added resources are also available from the NE Regional Invasive Species and Climate Change Management network: https://www.risccnetwork.org/.

Temperatures and precipitation amounts are expected to increase throughout the State, as well as in Region 3. It is anticipated that by the 2020s, the State's temperature will rise between 1.5 and 3ºF; 3 to 5.5ºF by the 2050s; and 4 to 9ºF by the 2080s. The lower ends of these ranges are for lower greenhouse gas emissions scenarios and the higher ends for higher emission scenarios (NYSERDA, 2011).

In Region 3, it is estimated that temperatures will increase by 3.5ºF to 5.5ºF by the 2050s and 4.5ºF to 8ºF by the 2080s (baseline of 46ºF). Precipitation totals will increase between 0 and 10% by the 2050s and 5 to 10% by the 2080s (baseline of 38 inches). While precipitation totals will increase they will likely also be highly variable resulting in more flooding and drought. Table 5.4.8-6 displays the projected seasonal precipitation change for the Southern Tier ClimAID Region (NYSERDA, 2011).

Table 5.4.6-2. Projected Seasonal Precipitation Change in Region 3, 2050s (% change)

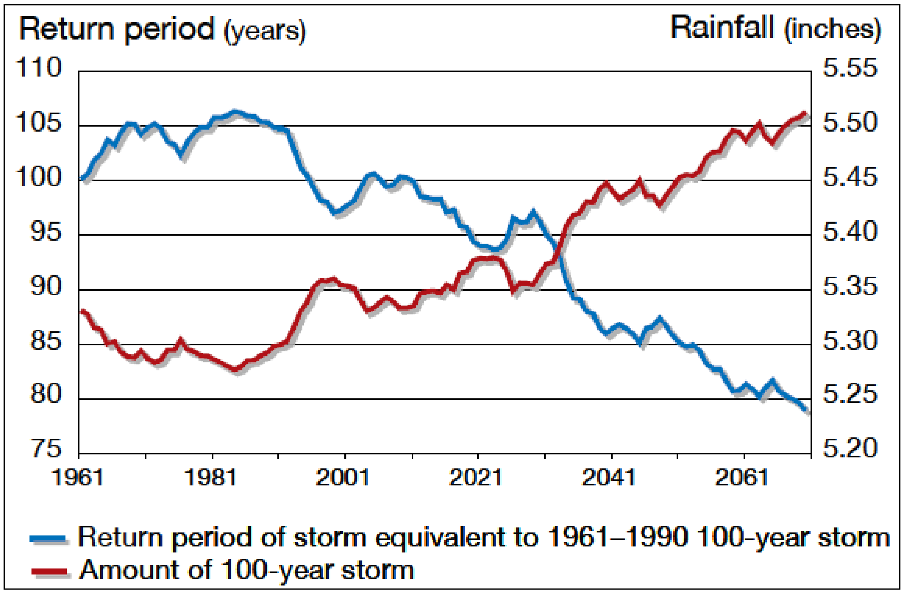
Winter	Spring	Summer	Fall
+5 to +15	0 to +15	-10 to +10	-5 to +10

Source: NYSERDA, 2011

Since the start of the twentieth century, annual temperatures in New York State have been rising. State-average temperatures have increased by approximately 0.6°F since 1970, with winter warming exceeding 1.1°F per decade. Extreme heat events are likely to increase throughout New York State and short-duration warm season droughts will become more common.

Figure 5.4.8-11 displays the project rainfall and frequency of extreme storms in New York State. The amount of rain fall in a 100-year event is projected to increase, while the number of years between such storms (return period) is projected to decrease. Rainstorms will become more severe and more frequent (NYSERDA, 2011).

Figure 5.4.6-12. Projected Rainfall and Frequency of Extreme Storms



Source: NYSERDA, 2011

Total precipitation amounts have slightly increased in the Northeast U.S., by approximately 3.3 inches over the last 100 years. There has also been an increase in the number of two-inch rainfall events over a 48-hour period since the 1950s (a 67-percent increase). The number and intensity of extreme precipitation events are increasing in New York State as well. More rain heightens the danger of localized flash flooding, streambank erosion and storm damage (Cornell University College of Agriculture and Life Sciences, 2011).

With the projection of temperature and rainfall increase due to climate change, there is evidence that climate change may be a factor in the expansion of infectious diseases in the U.S. Mosquitos capable of carrying and transmitting diseases now live in at least 28 states. As temperatures increase and rainfall patterns change, these insects can remain active for longer seasons and in wider areas. Lyme disease could expand throughout the U.S. and northward into Canada, as temperatures warm, allowing ticks to move into new regions. Warmer temperatures, heavy rainfall and high humidity have reportedly increased the rate of human infection of WNV (Natural Resources Defense Council 2013).

5.4.6.2 Vulnerability Assessment

To understand risk, a community must evaluate what assets are exposed and vulnerable. For the infestation and invasive species hazard, the entire County is exposed. Therefore, the following sections discuss Tompkins County's vulnerability, in a qualitative nature, to the infestation and invasive species hazard.

Impact on Life, Health and Safety

Of that vulnerable population, the elderly population and people with suppressed immune systems are most susceptible to the effects of things like Lyme Disease which is exacerbated by infestation and invasive species. The ACS has identified that there are 13,561 persons over the age of 65 in Tompkins County.

As discussed earlier, infestations can have an impact on agricultural commodities. The NYSDEC has indicated that agricultural commodities are at risk of becoming infested with invasive species, such as the spotted lanternfly, gypsy moth, and hemlock wooly adelgid (NYSDEC 2020, NYSDEC 2020b, NYSDEC 2020c, NYSDEC 2020d, NYSDEC 2020e, NYSDEC 2020f). Agricultural goods and services may include consumable resources sold to persons throughout the County. Not only can the livelihood of farmers become affected by crops that are infested, consumers of the goods and services that are infested will also be impacted.

The entire population of Tompkins County is vulnerable to infestation and invasive species outbreaks. Individuals most vulnerable to Infestation and Invasive Species include those: Over 65 years old, with suppressed immune

Impact on General Building Stock

No structures are anticipated to be directly affected by infestation or invasive species; however, the emerald ash borer and hemlock wooly adelgid (impacts many hemlocks along ravines and in gorges) may cause a catastrophic loss of ash trees throughout the County, which could result in stream bank instability, erosion, and increased sedimentation, impacting ground stabilization and possibly cause foundation issues for nearby structures. Additionally, with an increased number of dead trees, there is an increased risk of trees falling on roadways, power lines, and buildings.

Some invasive plants have been shown to destabilize soil due to high densities and shallow root systems, negatively impacting nearby buildings and septic systems. Other invasive plant species have been known to clog culverts and streams, increasing flooding risk.

Impact on Community Lifelines

Water treatment plants could be impacted by infestation and invasive species (and Harmful Algal Blooms as identified as a separate hazard) because of similar issues that the general building stock may experience. Water that becomes polluted due to increased sedimentation and erosion will require additional treatment. If the system becomes clogged with these pollutants, the ability of water treatment plants to operate may become impaired. Additionally, soil that becomes unstable due to decaying vegetation can impact critical facilities that are built on or around these soils.

Impact on Economy

Impacts of invasive species and infestations on the economy and estimated dollar losses are difficult to measure and quantify. Costs associated with activities and programs implemented to conduct surveillance and address invasive species and infestations have not been quantified in available documentation. However, since 2016, the Department of Environmental Conservation (DEC) Invasive Species Grant Program has awarded approximately $6.5 million to 114 municipalities, non-profit, and academic institutions to address the issue of invasive species including measures of control, removal, additional research, and prevention techniques (NYDEC 2020). Infestation and invasive could further adversely impact tourism, property values, and outdoor recreation opportunities.

In 2018, DEC and the NYS Department of Agriculture and Markets (DAM) developed a Final Invasive Species Comprehensive Management Plan (NYDEC 2020f). This plan highlights some of the major programs that have been established for invasive species control for the State. According to the plan, up to $13.3 million has been raised to manage the impacts of invasive species by the NYS Environmental Protection Fund (NYSDEC 2018b). While helpful, this level of funding is insufficient to effectively managing these issues.

Impact on the Environment

As previously discussed, Tompkins County's parks, forests and neighborhood trees are vulnerable to gypsy moth, spotted lanternfly, hemlock wooly adelgid and the emerald ash borer. In addition, a high population density of deer and the amount of browsing can have detrimental effects on the forest communities in the County, including County owned forest land. Other broad ranging impacts can be had on aquatic species and fish communities.

Invasive species can cause eventual destabilization of soil, such as invasive insects that destroy plants or invasive plants that outcompete native vegetation but have less effective root systems, can increase runoff into waterbodies. This can lead to increased harmful algal blooms and negative impact on drinking water supplies. Soil destabilization can also increase the likelihood of mudslides in areas with a steep slope. Aquatic invasive species alter the food web and can disrupt fisheries and degrade water quality.

Cascading Impacts to Other Hazards

Infestation and invasive species outbreaks could exacerbate the impacts of harmful algal blooms and erosion events within the County's karst topographic regions. Soil destabilization caused by destruction of roots and plants can increase the runoff into Cayuga Lake. This may also create erosion along the lake's banks and gorges. Refer to Section 5.4.5 and Section 5.4.7 for more information about the harmful algal bloom and flood hazards of concerns, respectively.

Future Changes that May Impact Vulnerability

Understanding future changes that impact vulnerability in the County can assist in planning for future development and ensuring that appropriate mitigation, planning, and preparedness measures are in place. The County considered the following factors to examine potential conditions that may affect hazard vulnerability:

- Potential or projected development.
- Projected changes in population.
- Other identified conditions as relevant and appropriate, including the impacts of climate change.

Projected Development

As discussed in Sections 4 (County Profile) and 9 (Jurisdictional Annexes), areas targeted for future growth and development have been identified across Tompkins County. Changes in land use have the potential to render some habitats more susceptible to invasive species, such as clearing the land and providing opportunities for invasive species to inhabit the area. Clearing the land may also reduce the habitat for predator species that could manage the spread of invasive species naturally. The specific areas of development are indicated in tabular form and/or on the hazard maps included in the jurisdictional annexes in Volume II, Section 9 of this plan.

Projected Changes in Population

According to population projections from the Cornell Program on Applied Demographics, Tompkins County will experience a continual population increase from 2020 through 2040 (over 6,040 people in total by 2040). The U.S. Census Bureau also shows that the population in Tompkins County has increased 0.6-percent between 2010 and 2019 (U.S. Census Bureau 2020). Any growth can create changes in density throughout the County, which can affect the location of future development projects. As a result, habitat changes can impact the distribution of natural wildlife to mitigate against infestation and invasive species.

Furthermore, infestation to cropland can have a wider impact on persons outside of Tompkins County if the farmers within the County supply resources to neighboring communities. Being aware of trends occurring around the County may reveal that infestations within agricultural commodities provided by the County impacts a greater number of persons.

Climate Change

Climate change could exacerbate the impacts of these species in the County. As mentioned above, changing weather patterns could create a change in the migration patterns for when these species move into and out of Tompkins County. If the species have a more prolonged existence in the County, there may also be a greater number of infestation events or a higher value of loss tied to infestation.

Change of Vulnerability Since the 2014 HMP

In the Tompkins County's 2014 Hazard Mitigation Plan, the County assessed agricultural driven epidemic events as a hazard of concern. The infestation and invasive species hazard of concern is a counterpart to the agricultural driven epidemic hazard. This updated hazard mitigation plan uses more recent population information and research of infestation and invasive species to assess the County's change in risk to this hazard of concern. Overall, the entire County continues to remain vulnerable to the infestation and invasive species hazard.

Identified Issues

- The potential impacts insect-borne diseases to the elderly population can be substantial. The elderly population and young children are the most susceptible to the effects of WNV and EEE and make up over 17 percent of the county's total population. Lyme disease is widespread in the county and can have severe health impacts.
- Invasive species can further cause devastating impacts to the agricultural industry in Tompkins County, leading to crop losses. EAB is also very common in the county and is killing the ash trees throughout. Unstable slopes in areas of infected hemlock trees may lead to a higher risk to impacts from ground failure for buildings and infrastructure downslope and have negative impacts on water quality due to soil erosion, which could have significant impacts on drinking water sources. Dead trees from both EAB and Woolly Hemlock Adelgid pose a threat to the utility lines and infrastructure as well as public safety from falling branches and trees.
- Some invasive plants have been shown to destabilize soil due to high densities and shallow root systems, negatively impacting nearby buildings and septic systems. Other invasive plant species such as phragmites and purple loosestrife have been known to clog culverts and streams, increasing flooding risk. In severe occurrences, utilities may be interrupted by invasive plants, such as hydrilla, blocking the water intakes of treatment plants and power generation facilities.
- All invasive species present a risk to natural ecosystems and may have cascading ecological impacts ranging from the ouster of natural species to reduction in available nutrients for plants and oxygen for aquatic species. These impacts further threaten aspects of local tourism.
- The current Cornell University Ash Tree Program which includes a phased approach to monitor, inventory, treat, harvest, and replant trees may provide a basis for a regional program address the cascading safety issues presented by the infestation of Emerald Ash Borers.

5.4.7 Severe Storms

The following section provides the hazard profile and vulnerability assessment for the severe storm hazard in Tompkins County.

The hazard profile is organized as follows:	The vulnerability assessment is organized as follows:
• Description • Extent • Previous Occurrences and Losses • Probability of Future Occurrences • Climate Change Impacts	• Impact on Life and Safety • Impact on General Building Stock • Impact on Community Lifelines • Impact on Economy • Impact on Environment • Cascading Impacts on Other Hazards • Future Change that may Impact Vulnerability • Changes Since 2014 HMP • Identified Issues

5.4.7.1 Hazard Profile

This section presents information regarding the description, extent, location, previous occurrences and losses, climate change projections and probability of future occurrences for the severe storm hazard.

Description

For this HMP the severe storm hazard includes thunderstorms, lightning, hail, tornadoes, high winds, and hurricanes/tropical storms, which are defined below.

Thunderstorms

> Thunderstorms can lead to flooding, landslides, strong winds, and lightning. Roads could become impassable from flooding, downed trees or power lines, or a landslide. Downed utility poles can lead to utility losses, such as electricity, phone, and water (from loss of pumping and filtering capabilities).

A thunderstorm is a local storm produced by a cumulonimbus cloud and accompanied by lightning and thunder (NWS 2009). A thunderstorm forms from a combination of moisture, rapidly rising warm air, and a force capable of lifting air, such as a warm and cold front.. Thunderstorms form from the equator to as far north as Alaska. Although thunderstorms generally affect a small area when they occur, they have the potential to become dangerous due to their ability in generating tornadoes, hailstorms, strong winds, flash flooding, and lightning.

Lightning

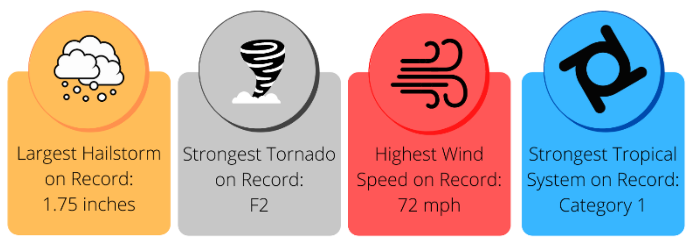
Lighting is a bright flash of electrical energy produced by a thunderstorm. The resulting clap of thunder is the result of a shock wave created by the rapid heating and cooling of the air in the lightning channel. All thunderstorms produce lightning and are very dangerous. Lightning ranks as one of the top weather killers in the United States, killing approximately 50 people and injuring hundreds each year. Lightning can occur anywhere there is a thunderstorm. Lightning can be cloud to air, cloud to cloud, and cloud to ground.

Lightning can damage homes and injure people. In the United States, an average of 300 people are injured, and 80 people are killed by lightning each year. Typical thunderstorms are 15 miles in diameter and last an average of 30 minutes. An estimated 100,000 thunderstorms occur each year in the United States, with approximately 10 percent of them classified as severe. During the warm season, thunderstorms are responsible

Hailstorms

Hail forms inside a thunderstorm where there are strong updrafts of warm air and downdrafts of cold water. If a water droplet is picked up by the updrafts, it can be carried well above the freezing level. Water droplets freeze when temperatures reach 32 °F or colder. As the frozen droplet begins to fall, it might thaw as it moves into warmer air toward the bottom of the thunderstorm, or the droplet might be picked up again by another updraft and carried back into the cold air to re-freeze. With each trip above and below the freezing level, the frozen droplet adds another layer of ice. The frozen droplet, with many layers of ice, falls to the ground as hail. Figure 5.4.7-3 indicates global recorded event record extremes for storm events.

Figure 5.4.7-1. Recorded Event Records



High Winds

Wind begins with differences in air pressures. It is rough horizontal movement of air caused by uneven heating of the earth's surface. Wind occurs at all scales, from local breezes lasting a few minutes to global winds resulting from solar heating of the earth (Rosenstiel School of Marine & Atmospheric Science 2005). High winds are often associated by other severe weather events such as thunderstorms, tornadoes, hurricanes, and tropical storms.

Tornadoes

A tornado appears as a rotating, funnel-shaped cloud that extends from a thunderstorm to the ground with whirling winds that can reach 250 miles per hour (mph). Damage paths can be greater than 1 mile wide and 50 miles long. Tornadoes typically develop from either a severe thunderstorm or hurricane as cool air rapidly overrides a layer of warm air. Tornadoes typically move at speeds between 30 and 125 mph and can generate combined wind speeds (forward motion and speed of the whirling winds) exceeding 300 mph. The lifespan of a tornado rarely is longer than 30 minutes (FEMA 1997). Tornadoes can occur at any time of the year, with peak seasons at different times for different states (NSSL 2013).

Hurricanes/Tropical Storms

A tropical storm system is characterized by a low-pressure center and numerous thunderstorms that produce strong winds of 39 to 73 mph and heavy rain. A hurricane is a tropical storm that attains hurricane status when its wind speed reaches 74 mph or higher. Tropical systems can develop in the Atlantic between the Lesser Antilles and the African coast or in the warm tropical waters of the Caribbean Sea and Gulf of Mexico. These storms can move up the Atlantic coast of the United States, impacting the eastern seaboard, or move into the United States through the states along the Gulf Coast, bringing wind and rain as far north as New England before moving eastward offshore.

Tompkins County is located far inland from coastlines but can still experience impacts from hurricanes. (NYS DHSES 2019). Hurricanes and tropical storms can impact Tompkins County from June to November, the official eastern U.S. hurricane season; however, late July to early October is the most likely period for hurricanes and tropical storms to impact the County, due to the cooling of the North Atlantic Ocean waters (NYS DHSES 2014).

Location

Tompkins County is also exposed and vulnerable to thunderstorms, lightning, hail, high winds, tornadoes, and hurricanes/tropical storms. According to the FEMA Winds Zones of the United States map, Tompkins County is located in Wind Zone III, where wind speeds can reach up to 200 mph.

Extent

The extent (severity or magnitude) of a severe storm is largely dependent upon the most damaging aspects of each type of severe weather. This section describes the extent of thunderstorms, lighting, hail, windstorms, tornadoes, hurricanes, and tropical storms in Tompkins County.

Thunderstorms

Severe thunderstorm watches and warnings are issued by the local NWS office and the Storm Prediction Center (SPC). The NWS and SPC will update the watches and warnings and notify the public when they are no longer in effect. Figure 5.4.7-3 presents the severe thunderstorm risk categories, as provided by the SPC.

Figure 5.4.7-2. Storm Weather Category Thresholds

Severe Thunderstorm Warning

Issued when there is evidence based on radar or a reliable spotter report that a thunderstorm is producing, or forecast to produce, wind gusts of 58 mph or greater, structural wind damage, or hail one inch in diameter or greater.

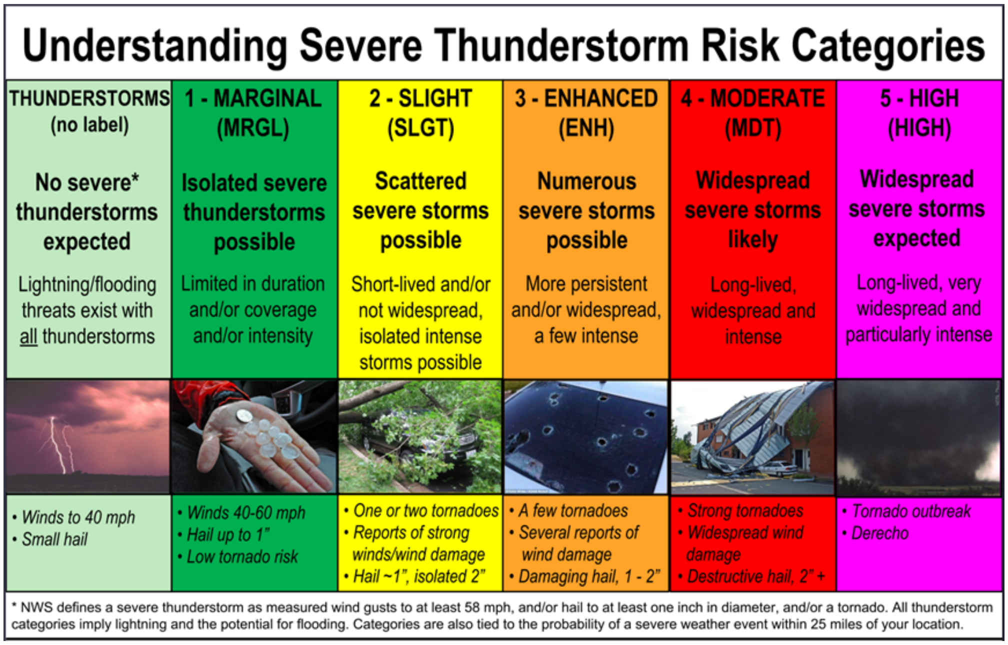
Severe Thunderstorm Watch

Issued by the SPC when conditions are favorable for the development of severe thunderstorms over a larger-scale region for a duration of at least three hours. Tornadoes are not expected in such situations, but isolated tornado development can also occur. Watches are normally issued well in advance of the actual occurrence of severe weather.

Special Weather Statement

Issued by the SPC when conditions are favorable for the development of severe thunderstorms over a larger-scale region for a duration of at least three hours. Tornadoes are not expected in such situations, but isolated tornado development can also occur. Watches are normally issued well in advance of the actual occurrence of severe weather.

Figure 5.4.7-3. Severe Thunderstorm Risk Categories

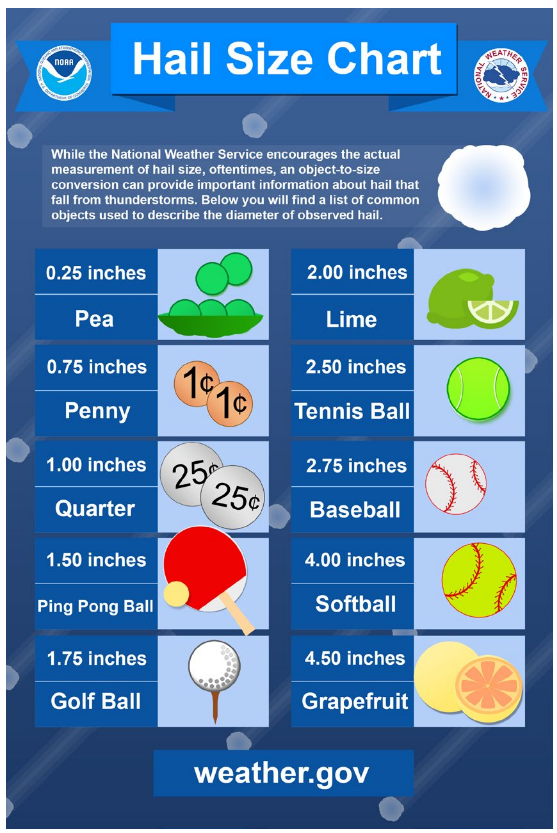


Source: NOAA SPC 2017

Lightning

Lightning is most often associated with moderate to severe thunderstorms. The severity of lightning refers to the frequency of lightning strikes during a storm. The New York City Office of Emergency Management notes that lightning strikes occur with moderate frequency in the State of New York, with 3.8 strikes occurring per square mile each year. Multiple devices are available to track and monitor the frequency of lightning (NYC Emergency Management, 2020).

Figure 5.4.7-4. Hail Size Chart



Hailstorms

The severity of hail is measured by duration, hail size, and geographic extent. Most hail stones from hailstorms are made up of variety of sizes. Only the very largest hail stones pose serious risk to people, if exposed (NYS DHSES 2019). The size of hail is estimated by comparing it to a known object. The Tornado and Storm Research Organization (TORRO) Hailstorm Intensity Scale (H0 to H10) relates typical damage and hail sizes. Refer to Appendix E (Supplementary Data) for a table that outlines the TORRO scale.

High Winds

The following table provides the descriptions of winds and their associated sustained wind speed used by the NWS during wind-producing events. The Beaufort wind scale, developed in 1805, is also used today to classify wind conditions, and is provided in Appendix E (Supplementary Data).

Table 5.4.7-1. NWS Wind Descriptions

Descriptive Term	Sustained Wind Speed (mph)
Strong, dangerous, or damaging	≥40
Very Windy	30-40
Windy	20-30
Breezy, brisk, or blustery	15-25
None	5-15 or 10-20
Light or light and variable wind	0-5

Source: NWS 2010
mph miles per hour

The NWS issues advisories and warnings for winds. Issuance is normally site-specific. High wind advisories, watches, and warnings are products issued by the NWS when wind speeds can pose a hazard or are life threatening. The criterion for each of these varies from state to state. According to the NWS (2018), wind warnings and advisories for New York State are as follows:

- *High Wind Warnings* are issued when sustained wind speeds of 40 mph or greater lasting for one hour or longer or for winds of 58 mph or greater for any duration or widespread damage are possible.
- *Wind Advisories* are issues when sustained winds of 30 to 39 mph are forecast for one hour or longer, or wind gusts of 46 to 57 mph for any duration.

Tornadoes

The magnitude or severity of a tornado is categorized using the Enhanced Fujita Tornado Intensity Scale (EF Scale). This is the scale now used exclusively for determining tornado ratings by comparing wind speed and actual damage. Figure 5.4.7-5 illustrates the relationship between EF ratings, wind speed, and expected tornado damage.

Figure 5.4.7-5. Explanation of EF-Scale Ratings

EF Rating	Wind Speeds	Expected Damage
EF-0	65-85 mph	'Minor' damage: shingles blown off or parts of a roof peeled off, damage to gutters/siding, branches broken off trees, shallow rooted trees toppled.
EF-1	86-110 mph	'Moderate' damage: more significant roof damage, windows broken, exterior doors damaged or lost, mobile homes overturned or badly damaged.
EF-2	111-135 mph	'Considerable' damage: roofs torn off well constructed homes, homes shifted off their foundation, mobile homes completely destroyed, large trees snapped or uprooted, cars can be tossed.
EF-3	136-165 mph	'Severe' damage: entire stories of well constructed homes destroyed, significant damage done to large buildings, homes with weak foundations can be blown away, trees begin to lose their bark.
EF-4	166-200 mph	'Extreme' damage: Well constructed homes are leveled, cars are thrown significant distances, top story exterior walls of masonry buildings would likely collapse.
EF-5	> 200 mph	'Massive/incredible' damage: Well constructed homes are swept away, steel-reinforced concrete structures are critically damaged, high-rise buildings sustain severe structural damage, trees are usually completely debarked, stripped of branches and snapped.

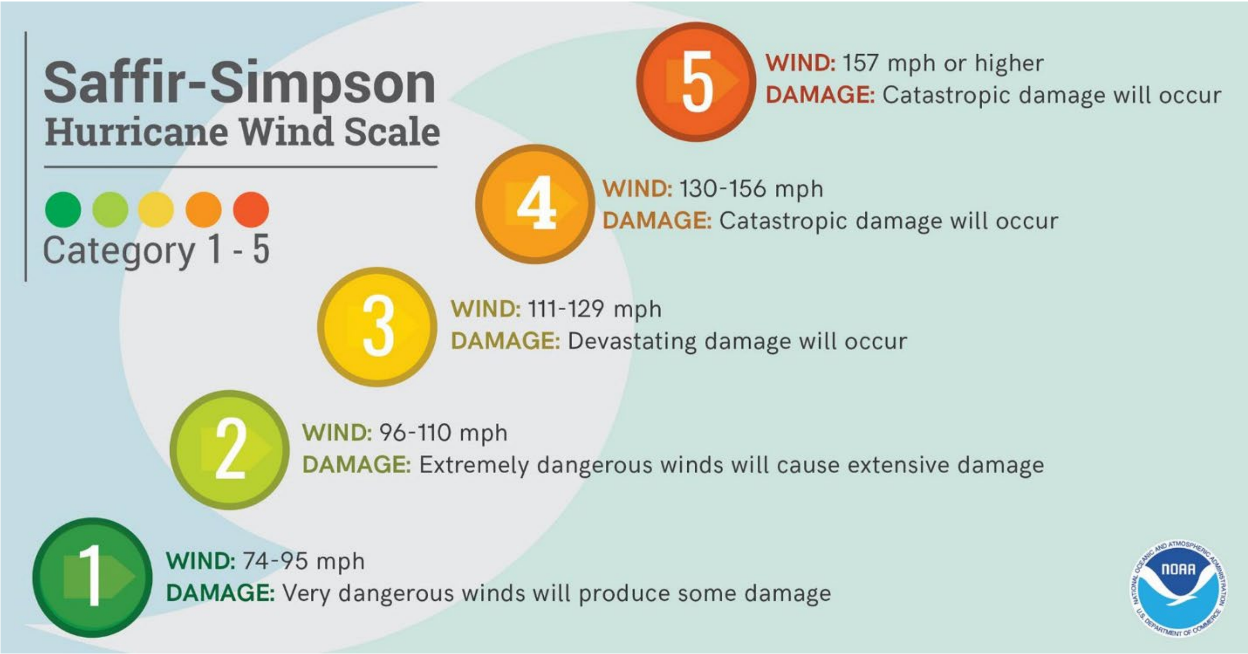
Source: Cornell University 2018

Tornado watches and warning are issued by the local NWS office. A tornado watch is released when tornadoes are possible in an area. A tornado warning means a tornado has been sighted or indicated by weather radar. The current average lead time for tornado warnings is 13 minutes. Occasionally, tornadoes develop so rapidly, that little, if any, advance warning is possible (FEMA 1997).

Hurricanes/Tropical Storms

The extent of a hurricane or tropical storm is commonly categorized in accordance with the Saffir-Simpson Hurricane Wind Scale, which assigns a designation of tropical storm for storms with sustained wind speeds below 74 mph and a hurricane category rating of 1–5 based on a hurricane's increasing 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. Tropical Storms and Category 1 and 2 storms are still dangerous and require preventative measures (NOAA 2013). Figure 5.4.7-6 presents this scale, which is used to estimate the potential property damage and flooding expected when a hurricane makes landfall.

Figure 5.4.7-6. The Saffir-Simpson Scale

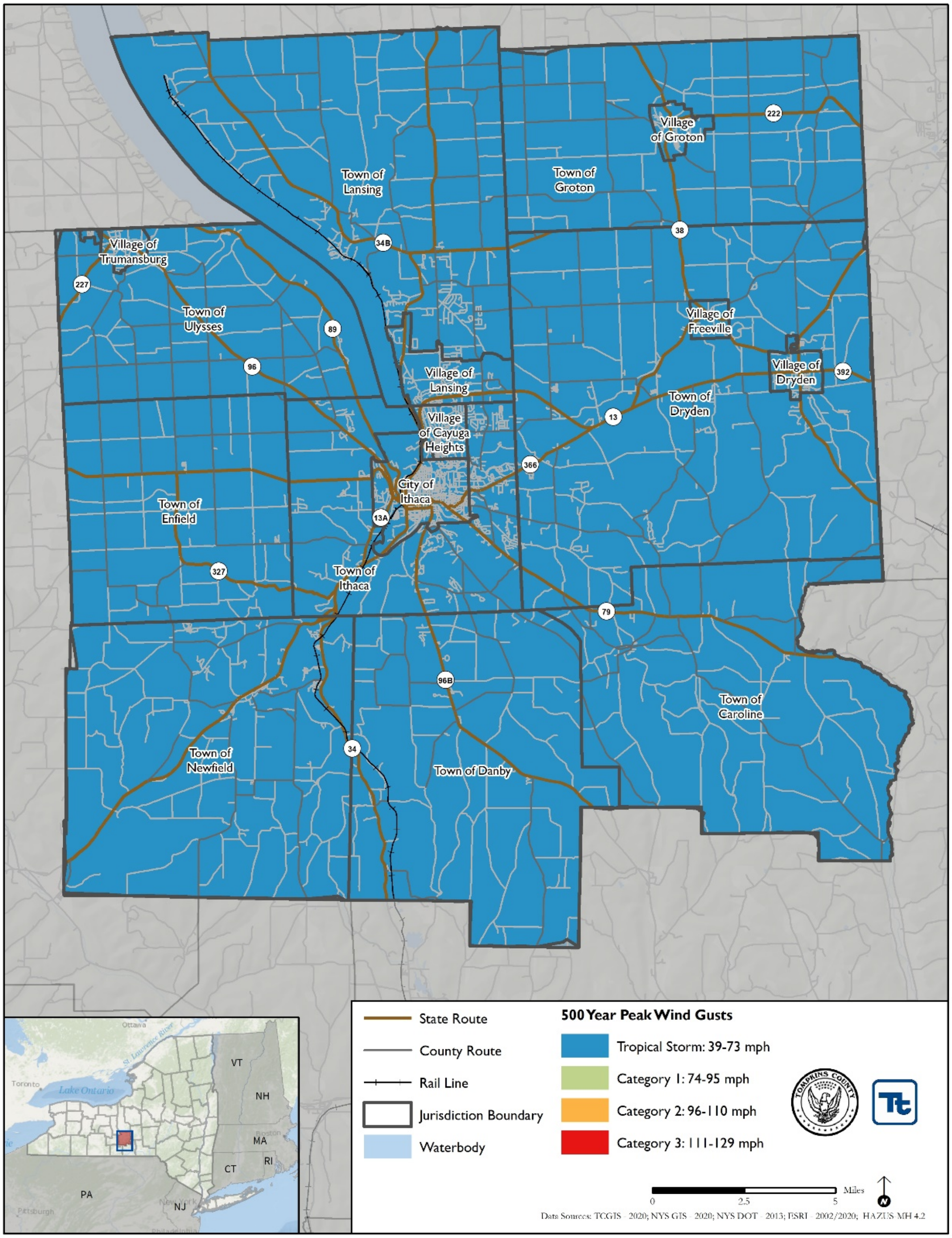


Source: Disaster Readiness Portal 2017

Peak wind speed projections were generated using Hazus-MH v4.2, which estimated the maximum 3-second gust wind speeds for Tompkins County to be below 39 mph for the 100-year MRP event and not strong enough to be considered a tropical storm. The maximum 3-second gust wind speeds for Tompkins County range from 51 to 55 mph for the 500-year MRP event (tropical storm). Figure 5.4.7-7 shows the estimated maximum 3-second gust wind speeds that can be anticipated in the study area associated with the 500-year MRP events.

Hazus-MH v4.2 did not generate the hurricane track for the 100- and 500-year probabilistic events. The associated impacts and losses from these 100-year and 500-year MRP hurricane event model runs are reported in the Vulnerability Assessment.

Figure 5.4.7-7. Wind Speeds for the 500-Year MRP Hurricane Wind Event in Tompkins County



Previous Occurrences and Losses

Numerous sources have provided historical information regarding previous occurrences and losses associated with severe storm events in Tompkins County. According to NOAA-NCEI Storm Events Database, Tompkins County has been impacted by 332 severe storm events that caused no fatalities, two injuries, $4.16 million in property damage, and no crop damage.

Table 5.4.7-2. Severe Storm Events 1950-2020

Hazard Type	Number of Occurrences Between 1950 and 2020	Total Fatalities	Total Injuries	Total Property Damage ($)	Total Crop Damage ($)
Funnel Cloud	1	0	0	$0	$0
Hail	95	0	0	$1,085,000	$0
Heavy Rain	20	0	0	$0	$0
High Wind	8	0	0	$362,330	$0
Hurricane*	4	0	0	$0	$0
Lightning	7	0	2	$119,000	$0
Strong Wind	2	0	0	$10,000	$0
Thunderstorm Wind	188	0	0	$1,681,000	$0
Tornado	6	0	0	$927,500	$0
Tropical Depression*	0	0	0	$0	$0
Tropical Storm*	1	0	0	$0	$0
TOTAL	**332**	**0**	**2**	**$4,159,000**	**$0**

Source: NOAA-NCEI 2020; NHC 2020
**As shown on the Historical Hurricane Tracks mapper by NOAA*
Note: Incidents in multiple parts of the County occurring on the same day within the same time period are counted as a single event.
M: Million, K: Thousand

Between 1954 and 2020, New York State was included in 68 FEMA declared severe storm-related major disaster declarations (DR) or emergencies (EM) classified as one or a combination of the following hazards: coastal storm, high tides, heavy rain, flooding, hurricane, ice storm, severe storms, thunderstorms, tornadoes, tropical storm, straight-line winds, and landslides. Of those declarations, Tompkins County was included in eight declarations (FEMA 2018) all occurring between 1996 and 2012. Table 5.4.7-3 lists FEMA DR and EM declarations for Tompkins County.

Table 5.4.7-3. Severe Storm-Related FEMA Declarations for Tompkins County, 1954 to 2020

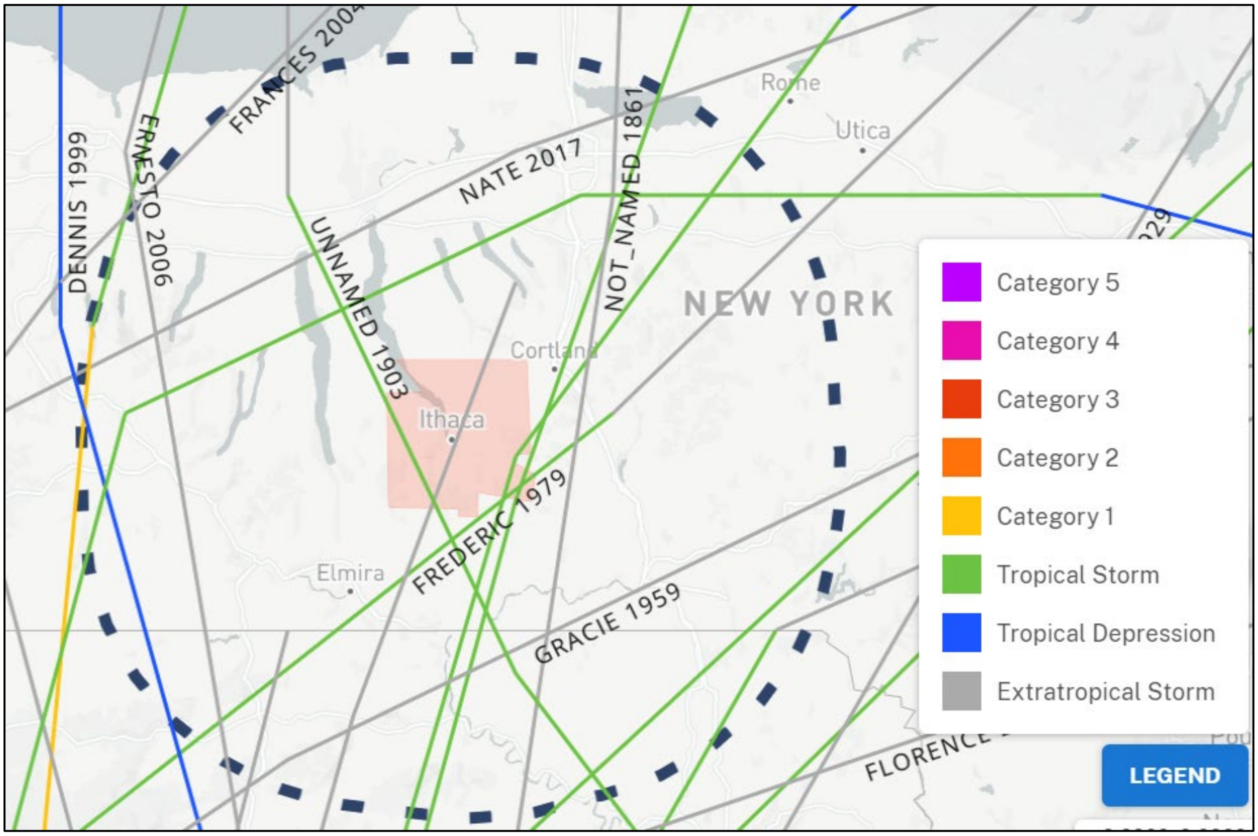
Disaster Number	Incident Duration	Declaration Date	Incident Type	Title
EM-3351	October 27-- November 8, 2012	10/28/2012	Hurricane	Hurricane Sandy
DR-4031	September 7-- September 11, 2011	9/13/2011	Severe Storm(s)	Remnants of Tropical Storm Lee

Disaster Number	Incident Duration	Declaration Date	Incident Type	Title
DR-1650	June 26-- July 10, 2006	7/1/2006	Severe Storm(s)	Severe Storms and Flooding
DR-1534	May 13-- June 17, 2004	8/3/2004	Severe Storm(s)	Severe Storms and Flooding
DR-1391	September 11, 2001	9/11/2001	Fire	Fires and Explosions
DR-1335	May 3-- August 12, 2000	7/21/2000	Severe Storm(s)	Severe Storms and Flooding
DR-1233	June 25-- July 10, 1998	7/7/1998	Severe Storm(s)	Severe Storms and Flooding
DR-1148	November 8-- November 15, 1996	12/9/1996	Severe Storm(s)	Severe Storms, High Winds, Rains, and Flooding

Source: FEMA 2020

Figure 5.4.7-8 illustrates storm tracks between 1842 and 2020 within 65 miles of Tompkins County as recorded in the NOAA Historical Hurricane Tracker. Tompkins County is not frequently impacted by hurricanes, tropical storms, or tropical depressions but has experienced the direct and indirect landward effects associated with hurricanes and tropical storms.

Figure 5.4.7-8. Historical Hurricane Tracks within 65 Miles of Tompkins County, 1878 to 2020



Source: NOAA Historical Hurricane Tracks 2020 (names of storms will be added when available)

The NOAA National Centers for Environmental Information (NCEI) Storm Events database records severe storm events. For this HMP update, known severe storm events that have impacted Tompkins County between 2012 and May 2020 are identified in Table 5.4.7-4. Not all sources have been identified or researched due to the quantity of available data. Therefore, Table 5.4.7-4 might not include all events that have occurred in the County. For events prior to 2012, refer to Appendix E (Supplementary Data). For detailed information on damages and impacts to each municipality, refer to Section 9 (Jurisdictional Annexes).

Table 5.4.7-4. Severe Storm Events in Tompkins County, 2012 to May 2020

Dates of Event	Event Type**	FEMA Declaration Number (if applicable)	County Designated?	Event Details*
5/3/2012	Hail	N/A	No	An upper level disturbance moving through upstate New York produced strong thunderstorms throughout the region. Near South Hill, the storm resulted in $1 million in damage after the two-inch diameter hail dented more than 1,000 cars. The Town of Newfield similarly experienced two-inch-diameter hail and more than $50,000 in damage. Communities across the County experienced hail in excess of one-inch diameter.
8/9/2012	Hail	N/A	No	The City of Ithaca experienced 0.75-inch-diameter hail following severe thunderstorms in the region.
9/6/2012	Hail	N/A	No	The region saw between 0.75 and 2 inches of hail ahead of a cold front that swept through the region and produced severe conditions. Village of Trumansburg and McKinney's Point each saw $10,000 in damage.
6/24/2013	Hail	N/A	No	1.75-inch-diameter wide hail was reported in the Town of Newfield during severe thunderstorms that swept through the area.
7/10/2013	Thunderstorm Wind	N/A	No	A strong cold front from the west led to strong winds that blew down trees and wires. Near McKinney's Point, 57 mph winds were reported.
8/8/2013	Hail	N/A	No	Severe thunderstorms moved through Central New York, causing 0.75-inch-wide hail near Town of Groton and 57 mph winds near McLean and the Town of Groton.
9/2/2013	Thunderstorm Wind/Hail	N/A	No	A significant cold front triggered severe thunderstorm in the region, blowing down trees near Hangar Theater, Cass Park, and the Cornell University area.
5/22/2014	Hail	N/A	No	Severe thunderstorms caused one-inch-diameter hail near the Town of Enfield and the Town of Newfield.
6/17/2014	Thunderstorm Wind	N/A	No	A 79.4 mph wind gust was recorded, and trees were blown down near the Village of Freeville following the arrival of unstable air to the region. 62.1 mph winds were recorded near the Village of Dryden.
7/2/2014	Thunderstorm Wind	N/A	No	Moist, unstable air resulting from a stalled frontal boundary caused severe thunderstorms in the region, bringing 57.5 mph winds and downed trees to the Town of Groton and 0.88-inch hail to the Town of Danby. 57.5 mph winds blew down trees and wires on Ellis Hollow Road in the City of Ithaca and bear Brooktondale.

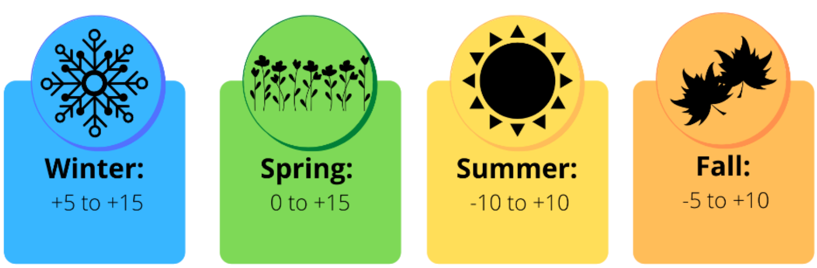
Dates of Event	Event Type**	FEMA Declaration Number (if applicable)	County Designated?	Event Details*
7/8/2014	Thunderstorm Wind	N/A	No	Severe thunderstorms and tornadoes appeared in the region due to a strong upper-level system moving through New York. Large trees were toppled near the Village of Trumansburg and the Village of Freeville.
8/5/2014	Hail	N/A	No	Severe thunderstorms moving through Central New York brought 1.75-inch-diameter hail to the Town of Newfield and 50 knot winds to Cayuga Heights.
8/21/2014	Hail	N/A	No	One-inch-diameter hail appeared near Willow Creek during a severe thunderstorm that produced effects throughout the County.
10/25/2014	Hail	N/A	No	Ithaca saw 0.88-inch-diameter hail during isolated severe storms in the region.
6/8/2015	Thunderstorm Wind	N/A	No	Organized thunderstorms developed along a cold front advancing on the region. The thunderstorms became severe and caused 57.5 mph winds that toppled trees on East Shore Drive in the City of Ithaca.
6/10/2015	Thunderstorm Wind	N/A	No	Severe thunderstorms moving across the Finger Lakes produced 74.8 mph winds that toppled trees near the Town of Groton.
6/12/2015	Thunderstorm Wind	N/A	No	A southward-moving air mass caused severe thunderstorms in Tompkins County, knocking down trees in the City of Ithaca, the Town of Newfield and the Town of Caroline. Wind speeds reached 57.5.
4/16/2017	Thunderstorm Wind	N/A	No	Severe thunderstorms brought 59.8 mph winds and some damage to Trumansburg, Peruville, and Myers.
6/18/2017	Thunderstorm Wind	N/A	No	Damage was reported in Ithaca following a severe thunderstorm that produced 69 mph winds.
7/20/2017	Thunderstorm Wind	N/A	No	The combination of a weak cold front and unstable environment produced thunderstorms (some of which became severe) that produced 69 mph winds near the City of Ithaca.
8/22/2017	Thunderstorm Wind	N/A	No	Two lines of showers and thunderstorms moving through the region produced thunderstorms causing 63.3 mph winds that toppled trees and wires near the Town of Groton and McKinney's Point.
10/15/2017	Thunderstorm Wind	N/A	No	Near the Town pf Dryden, 57.8 mph winds were recorded which knocked over trees and powerlines.
5/4/2018	Thunderstorm Wind	N/A	No	A low-pressure system arriving off the Great Lakes caused 57.8 mph winds that blew down trees on Cayuga Heights Road. Wires and trees were also downed in the City of Ithaca and Slaterville Springs. Altogether this caused approximately $25,000 in damage.
5/28/2018	Thunderstorm Wind	N/A	No	Severe thunderstorms with 57.5 mph winds blew down trees in the Town of Dryden.
6/13/2018	Thunderstorm Wind	N/A	No	A strong low-pressure system shared electric poles in Lansingville and toppled power poles in Peruville.

Dates of Event	Event Type**	FEMA Declaration Number (if applicable)	County Designated?	Event Details*
6/20/2019	Thunderstorm Wind	N/A	No	A slow low-pressure system and slowing frontal boundary resulted in strong thunderstorm winds that brought down wires in the City of Ithaca.
7/16/2019	Thunderstorm Wind	N/A	No	In the Village of Freeville and the Town of Lansing, 57.5 mph winds from a strong thunderstorm downed trees.
7/28/2019	Hail	N/A	No	A mid-level shortwave moving through the County produced three-quarter-inch hail near the Town of Dryden.
7/30/2019	Thunderstorm Wind	N/A	No	Severe thunderstorms moving through the region caused 57.5 mph winds that downed wires near Newfield Station, the Town of Dryden, and Ithaca. All lanes of Route 366 were closed after winds brought down a tree and wires near the Village of Freeville.
8/8/2019	Thunderstorm Wind	N/A	No	Wind speeds up to 59.8 mph were reported near Town of Groton as a line of severe thunderstorms was passing through. In the City of Ithaca, winds downed poles and trees.
8/15/2019	Thunderstorm Wind	N/A	No	In the City of Ithaca, 57.5 mph wind speeds brought down wires and poles on Updike Road.
8/17/2019	Thunderstorm Wind	N/A	No	Severe thunderstorms brought down trees near a nature center in the City of Ithaca.

Source(s): FEMA 2020; NOAA-NCEI 2020; NYS HMP 2019
** Many sources were consulted to provide an update of previous occurrences and losses; event details and loss/impact information may vary and has been summarized in the above table*
FEMA Federal Emergency Management Agency
HMP Hazard Mitigation Plan
NCDC National Climatic Data Center
NOAA National Oceanic and Atmospheric Administration
NWS National Weather Service
NYS New York State

Climate Change Impacts

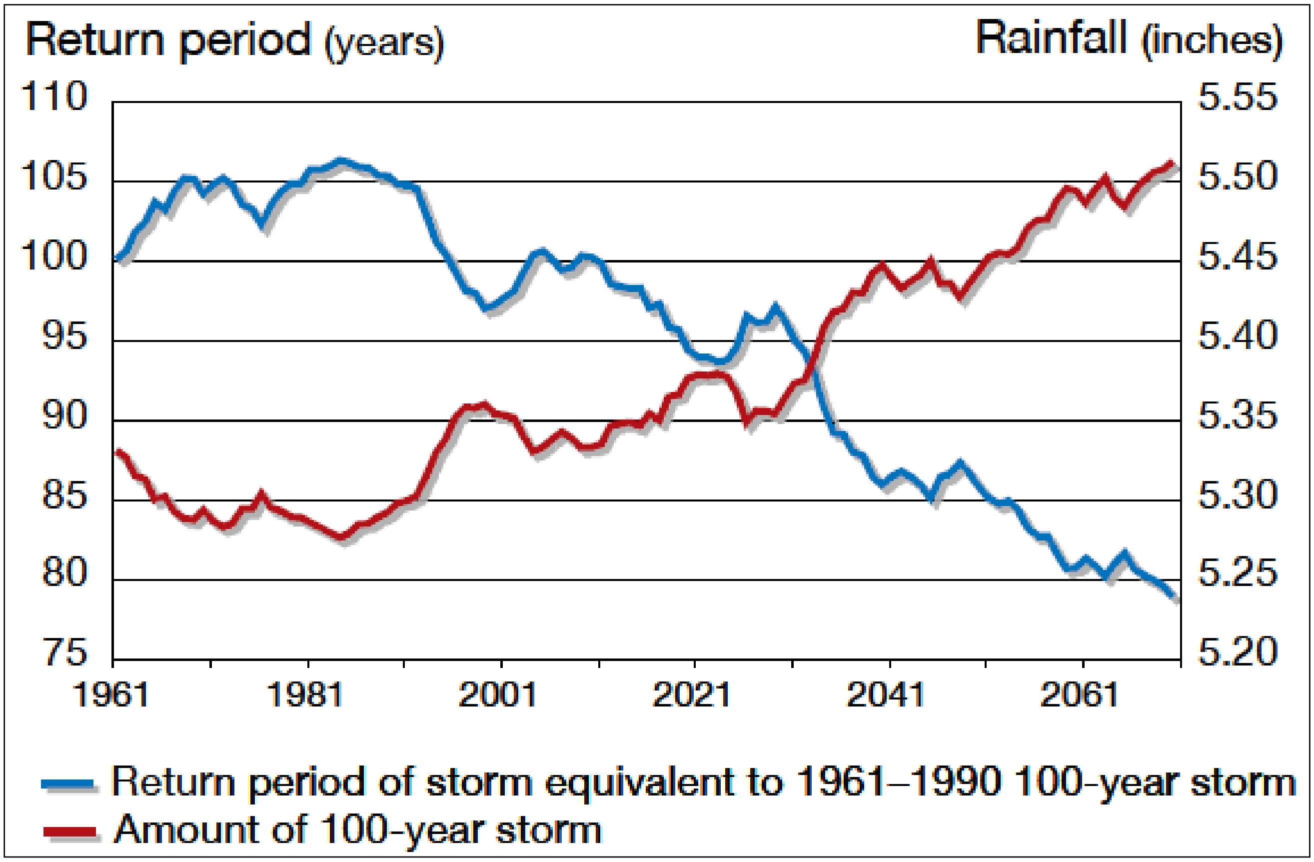
Figure 5.4.7-9. Projected Seasonal Precipitation Change in Region 3, 2050s (% change)



The anticipated increase in precipitation is expected to fall in heavy downpours and less in light rains. Downpours are very likely to increase in frequency and intensity, a change that has the potential to affect drinking water through flooding contaminating wells; heighten the risk of riverine flooding; flood rail lines, roadways, and transportation hubs; and increase delays and hazards related to extreme weather events (NYSERDA 2011). Less frequent rainfall during the summer months can the ability of water supply systems to provide water. Increasing water temperatures in rivers and streams will affect aquatic health and reduce the capacity of streams to assimilate effluent wastewater treatment plants and industrial discharges (NYSERDA 2011). The projected seasonal precipitation change in the County (NYSERDA Region 3) is illustrated in Figure 5.4.7-10.

Figure 5.4.7-1 displays the projected rainfall and frequency of extreme storms in New York State. The amount of rainfall in a 100-year event is projected to increase, while the number of years between such storms (return period) is projected to decrease. Rainstorms will become more severe and more frequent (NYSERDA 2011).

Figure 5.4.7-11. Projected Rainfall and Frequency of Extreme Storms



Source: NYSERDA 2011

Total precipitation amounts have slightly increased in the Northeast U.S., by approximately 3.3 inches over the last 100 years. There has also been an increase in the number of two-inch rainfall events over a 48-hour period since the 1950s (a 67-percent increase). The number and intensity of extreme precipitation events are increasing in New York State as well. More rain heightens the danger of localized flash flooding, streambank erosion and storm damage (Cornell University College of Agriculture and Life Sciences 2011).

NASA scientists suggest that the U.S. will face more severe thunderstorms in the future, with deadly lightning, damaging hail and the potential for tornadoes in the event of climate change (Borenstein, 2007). A recent study conducted by NASA predicts that smaller storm events like thunderstorms will be more dangerous due to climate change. As the climate changes, temperatures and the amount of moisture in the air will both increase, thus leading to an increase in the severity of thunderstorms which can lead to derechos and tornadoes. Studies have shown that an increase in greenhouse gases in the atmosphere would significantly increase the number of days that severe thunderstorms occur in the southern and eastern United States (NASA 2005).

Probability of Future Occurrences

Table 5.4.7-5 summarizes data regarding the probability of occurrences of severe storm events in Tompkins County based on the historic record. Thunderstorm events are the most common in Tompkins County, followed by hail events. The information used to calculate the probability of occurrences is based solely on NOAA-NCEI storm events database results.

Table 5.4.7-5. Probability of Future Occurrence of Severe Storm Events

Hazard Type	Number of Occurrences Between 1954 and 2020	% chance of occurrence in any given year
Funnel Cloud	1	1.5%
Hail	95	100%
Heavy Rain	20	29.8%
High Wind	8	11.9%
Hurricane*	4	5.9%
Lightning	7	10.4%
Strong Wind	2	2.9%
Thunderstorm Wind	188	100%
Tornado	6	8.9%
Tropical Depression*	0	0%
Tropical Storm*	1	1.5%
TOTAL	**332**	**100%**

Source: NOAA-NCEI 2020; NHC 2020
**As shown on the Historical Hurricane Tracks mapper by NOAA*
Note: *Hazard occurrences include federally declared disasters since the 1950 Federal Disaster Relief Act. Due to limitations in data, not all severe storm events occurring between 1954 and 1996 are accounted for in the tally of occurrences. As a result, the number of hazard occurrences is underestimated*

Tompkins County is expected to continue experiencing direct and indirect impacts of severe storms annually. These storms may induce secondary hazards such as flooding and utility failure. In Section 5.3 (Hazard Ranking), the identified hazards of concern for Tompkins County were ranked. The probability of occurrence, or likelihood of the event, is one parameter used for hazard rankings. Based on historical records and input from the Planning Partnership, the probability of occurrence for severe storms in the County is considered *frequent* (event has 100 percent annual probability and might occur multiple times per year).

5.4.7.2 Vulnerability Assessment

A probabilistic assessment was conducted for the 100-year and 500-year MRP hurricane wind event through a Level 2 analysis in Hazus-MH v4.2 to analyze the severe storm hazard and provide a range of loss estimates due to wind impacts. Refer to Section 5.1 (Methodology and Tools) for additional details on the methodology used to assess the severe storm risk.

Impact on Life, Health, and Safety

The impact of a severe weather and wind event on life, health and safety is dependent upon several factors including the severity of the event and whether adequate warning time was provided to residents. For the purposes of this hazard mitigation plan, all of Tompkins County is considered vulnerable to a severe weather event and wind impacts (i.e. 102,962 persons total, American Community Survey 2018). Hazus-MH v4.2 estimates that zero persons will be displaced from their homes or will seek shelter during a 100-year or 500-year MRP hurricane wind event. Secondary impacts caused by extreme wind events include downed trees, damaged buildings, and debris carried by high winds, which can lead to injury or loss of life.

Individuals most vulnerable to severe storm events include those: Over 65 Years Old, Infants and Children, With Underlying Medical Conditions, Homeless, With Difficulty Communicating

Socially vulnerable populations are most susceptible to severe weather events, based on a number of factors including their physical and financial ability to react or respond during a hazard and the location and construction quality of their housing. The population over the age of 65 is more vulnerable and, physically, they may have more difficulty evacuating. They may require extra time or outside assistance during evacuations and are more likely to seek or need medical attention which may not be available due to isolation during a storm event. According to the 5-Year 2018 American Community Survey Population Estimates, there are 13,561 persons over 65.

Infants and children and individual with underlying medical conditions are vulnerable in severe storm events due to potential disruptions in care needs. Also, those that have difficulty communicating, including non-native speakers and those with intermittent internet and cellular service are vulnerable because of potential missed warning messages. Lastly, people located outdoors (i.e., recreational activities, farming, homeless) are considered most vulnerable to hailstorms, thunderstorms and tornadoes. This is because there is little to no warning and shelter may not be available. Moving to a lower risk location will decrease a person's vulnerability. Refer to Section 4 (County Profile) for population statistics for each participating jurisdiction.

Impact on General Building Stock

Damage to buildings is dependent upon several factors, including wind speed, storm duration, and path of the storm track. Building construction also plays a major role in the extent of damage resulting from a severe storm and wind event. Due to differences in construction, residential structures are generally more susceptible to wind damage than commercial and industrial structures. Wood and masonry buildings, in general, regardless of their occupancy class, tend to experience more damage than concrete or steel buildings. Furthermore, high-rise buildings are also very vulnerable structures.

To better understand these risks, Hazus-MH v4.2 was used to estimate the expected wind-related building damages. Table 5.4.7-6 summarizes the definition of the damage categories. In summary, the specific types of wind damage categories include: no damage/very minor damage, minor damage, moderate damage, severe damage, and total destruction. Hazus-MH v4.2 estimates that no structures will experience damages during the 100-year MRP hurricane wind event. Further, Hazus-MH v4.2 estimates that 24 structures would experience minor damage during a 500-year MRP hurricane wind event (refer to Table 5.4.7-6). Additionally, Hazus-MH v4.2 estimated damages for the 500-year MRP hurricane wind event are summarized by general occupancy classes in Table 5.4.7-8. Hazus-MH v4.2 estimates that all the damages caused by severe wind will occur to residential structures in the County for the 500-year MRP wind events; approximately $803,794.

Table 5.4.7-6. Description of Damage Categories

Qualitative Damage Description	Roof Cover Failure	Window Door Failures	Roof Deck	Missile Impacts on Walls	Roof Structure Failure	Wall Structure Failure
No Damage or Very Minor Damage Little or no visible damage from the outside. No broken windows, or failed roof deck. Minimal loss of roof over, with no or very Limited water penetration.	≤2%	No	No	No	No	No
Minor Damage Maximum of one broken window, door or garage door. Moderate roof cover loss that can be covered to prevent additional water entering the building. Marks or dents on walls requiring painting or patching for repair.	>2% and ≤15%	One window, door, or garage door failure	No	<5 impacts	No	No
Moderate Damage Major roof cover damage, moderate window breakage. Minor roof sheathing failure. Some resulting damage to interior of building from water.	>15% and ≤50%	> one and ≤ the larger of 20% & 3	1 to 3 panel s	Typically 5 to 10 impacts	No	No
Severe Damage Major window damage or roof sheathing loss. Major roof cover loss. Extensive damage to interior from water.	>50%	> the larger of 20% & 3 and ≤50%	>3 and ≤25%	Typically 10 to 20 impacts	No	No
Destruction Complete roof failure and/or, failure of wall frame. Loss of more than 50% of roof sheathing.	Typically >50%	>50%	>25%	Typically >20 impacts	Yes	Yes

Source: Hazus-MH Hurricane Technical Manual

Table 5.4.7-7. Damage State Categories for Buildings During a 500-Year MRP Hurricane Wind Event in Tompkins County

Occupancy Class	Total Number of Buildings in Occupancy	Severity of Expected Damage	500-year Building Count	500-year Percent Buildings in Occupancy Class
Residential Exposure (Single and Multi-Family Dwellings)	43,800	None	43,788	100.0%
		Minor	12	<0.1%
		Moderate	0	0.0%
		Severe	0	0.0%
		Complete Destruction	0	0.0%
Commercial Buildings	7,093	None	7,084	99.9%
		Minor	9	0.1%
		Moderate	0	0.0%
		Severe	0	0.0%
		Complete Destruction	0	0.0%
Industrial Buildings	220	None	219	99.7%
		Minor	1	0.5%
		Moderate	0	0.0%
		Severe	0	0.0%
		Complete Destruction	0	0.0%
Government, Religion, Agricultural, and Education Buildings	4,535	None	4,533	99.9%
		Minor	2	<0.1%
		Moderate	0	0.0%
		Severe	0	0.0%
		Complete Destruction	0	0.0%

Source: Hazus-MH v4.2

Table 5.4.7-8. Expected Building Damage for All Occupancies and General Occupancy Types for the 500-Year MRP Hurricane Wind Event for Tompkins County

Jurisdiction	Total Replacement Cost Value (All Occupancies)	Estimated Total Damages 500-Year	Percent of Total Replacement Cost Value 500-Year	Estimated Residential Damages 500-Year	Estimated Commercial Damages 500-Year	Estimated Damages for All Other Occupancies 500-Year
Caroline (T)	$2,523,108,347	$129,139	0.0%	$129,139	$0	$0
Cayuga Heights (V)	$1,548,665,909	$0	0.0%	$0	$0	$0
Danby (T)	$2,188,454,321	$117,097	0.0%	$117,097	$0	$0
Dryden (T)	$8,740,906,102	$164,691	0.0%	$164,691	$0	$0
Dryden (V)	$1,135,109,100	$42,688	0.0%	$42,688	$0	$0
Enfield (T)	$2,736,468,231	$17,035	0.0%	$17,035	$0	$0
Freeville (V)	$356,699,295	$1,155	0.0%	$1,155	$0	$0
Groton (T)	$2,804,801,342	$8,878	0.0%	$8,878	$0	$0
Groton (V)	$1,203,171,190	$2,973	0.0%	$2,973	$0	$0

Jurisdiction	Total Replacement Cost Value (All Occupancies)	Estimated Total Damages 500-Year	Percent of Total Replacement Cost Value 500-Year	Estimated Residential Damages 500-Year	Estimated Commercial Damages 500-Year	Estimated Damages for All Other Occupancies 500-Year
Ithaca (C)	$19,712,305,674	$70,429	0.0%	$70,429	$0	$0
Ithaca (T)	$10,868,181,586	$85,463	0.0%	$85,463	$0	$0
Lansing (T)	$6,270,191,033	$11,402	0.0%	$11,402	$0	$0
Lansing (V)	$3,436,043,635	$718	0.0%	$718	$0	$0
Newfield (T)	$3,848,204,673	$146,370	0.0%	$146,370	$0	$0
Trumansburg (V)	$1,241,549,970	$1,082	0.0%	$1,082	$0	$0
Ulysses (T)	$3,372,144,448	$4,675	0.0%	$4,675	$0	$0
Tompkins County (Total)	**$71,986,004,856**	**$803,794**	**0.0%**	**$803,794**	$0	**$0**

Sources: Hazus-MH v4.2; Tompkins County GIS 2020; Microsoft 2018; RS Means 2019
Note: C = City; T = Town; V = Village; % = Percent

Impact on Community Lifelines

Community lifeline critical facilities are at risk of being impacted by high winds associated with structural damage, or falling tree limbs/flying debris, which can result in the loss of power. Power loss can greatly impact households, business operations, public utilities, and emergency personnel. For example, vulnerable populations in Tompkins County are at risk if power loss results in interruption of heating and cooling services, stagnated hospital operations, and potable water supplies. Emergency personnel such as police, fire, and EMS will not be able to effectively respond in a power loss event to maintain the safety of its citizens.

Hazus-MH v4.2 estimates the probability that those community lifeline critical facilities (i.e., medical facilities, fire/EMS, police, EOC, schools, and user-defined facilities such as shelters and municipal buildings) may sustain damage as a result of the 100-year and 500-year MRP hurricane wind events. Additionally, Hazus-MH v4.2 estimates the loss of use for each facility in number of days. Overall, Hazus-MH v4.2 estimates that none of the critical facilities in Tompkins County will experience damage or loss of functionality due to a 100-year or 500-year MRP hurricane wind event.

Impact on Economy

Severe storm events can have short- and long-lasting impacts on the economy. When a business is closed during storm recovery, there is lost economic activity in the form of day-to-day business and wages to employees. Overall, economic impacts include the loss of business function (e.g., tourism, recreation), damage to inventory, relocation costs, wage loss and rental loss due to the repair/replacement of buildings.

Impacts to transportation lifelines affect both short-term (e.g., evacuation activities) and long-term (e.g., day-to-day commuting and goods transport) transportation needs. Utility infrastructure (power lines, gas lines, electrical systems) could suffer damage and impacts can result in the loss of power, which can impact business operations and can impact heating or cooling provision to the population.

Hazus-MH v4.2 estimates the total economic loss associated with the 100-year and 500-year MRP hurricane wind events (direct building losses and business interruption losses). Direct building losses are the estimated costs to repair or replace the damage caused to the building. This is reported in the "Impact on General Building Stock" section discussed earlier. Business interruption losses are the losses associated with the inability to operate a business because of the wind damage sustained during the storm or the temporary living expenses for those displaced from their home because of the event. Hazus-MH v4.2 estimates that there are no economic losses for Tompkins County caused by the 100-year or 500-year MRP hurricane wind event.

Debris management can be costly and may also impact the local economy. Hazus-MH v4.2 estimates the amount of building and tree debris that may be produced as result of the 100-year and 500-year MRP hurricane wind events. Because the estimated debris production does not include flooding, this is likely a conservative estimate and may be higher if multiple impacts occur. According to the Hazus-MH Hurricane User Manual, estimates of weight and volume of eligible tree debris consist of downed trees that would likely be collected and disposed at public expense. Refer to the User Manual for additional details regarding these estimates. Hazus-MH v4.2 estimates that the 100-year and 500-year MRP hurricane wind event will not cause any debris for Tompkins County.

Impact on the Environment

The impact of severe weather events on the environment varies, but researchers are finding that the long-term impacts of more severe weather can be destructive to the natural and local environment. National organizations such as USGS and NOAA have been studying and monitoring the impacts of extreme weather phenomena as it impacts long term climate change, streamflow, river levels, reservoir elevations, rainfall, floods, landslides, and erosion (USGS 2020). For example, severe weather that creates longer periods of rainfall can erode natural banks along waterways and degrade soil stability for terrestrial species. Tornadoes can tear apart habitats causing fragmentation across ecosystems. Researchers also believe that a greater number of diseases will spread across ecosystems because of impacts that severe weather and climate change will have on water supplies (CDC 2020). Overall, as the physical environment becomes more altered, species will begin to contract or migrate in response, which may cause additional stressors to the entire ecosystem within Tompkins County.

Cascading Impacts on Other Hazards

Severe storms can escalate the impacts of flooding, harmful algal blooms, and wildfire events. For example, severe weather may carry extreme rainfall that could exacerbate flooding. These flood waters may be saturated in chemicals and nutrients that cause harmful algal blooms. Furthermore, lightning from severe weather events may strike a wooded part of Tompkins County, consequentially setting the habitat on fire putting the environment at risk for a wildfire event. More information about flooding, harmful algal blooms, and wildfire events can be found in Section 5.4.4, Section 5.4.5, and Section 5.4.10, respectively.

Future Changes that May Impact Vulnerability

Understanding future changes that affect vulnerability in the County can assist in planning for future development and ensure establishment of appropriate mitigation, planning, and preparedness measures. Changes in the natural environment and built environment and how they interact can also provide insight about ways to plan for the future.

Projected Development

Any areas of growth could be potentially impacted by the severe storm hazard because the entire County is exposed and vulnerable to the wind hazard associated with severe storms. However, due to increased standards and codes, new development may be less vulnerable to the severe storm hazard compared to the aging building stock in the County.

Projected Changes in Population

According to population projections from the Cornell Program on Applied Demographics, Tompkins County will experience a continual population increase from 2020 through 2040 (over 6,040 people in total by 2040). The U.S. Census Bureau also shows that the population in Tompkins County has increased 0.6-percent between 2010 and 2019 (U.S. Census Bureau 2020). An increase of the population indicates that the number of persons vulnerable to a severe weather and severe wind event is also increasing for Tompkins County. Refer to Section 4 (County Profile) for additional discussion on population trends.

Climate Change

As displayed in Figure 5.4.7-1, the entire State of New York is projected to experience an increase in the frequency and severity of extreme storms and rainfall. Refer to Section 5.4.4 (Flood) for a discussion related to the impact of climate change due to increases in rainfall. An increase in storms will produce more wind events and may increase tornado activity. Additionally, an increase in temperature could provide more energy to produce storms that generate tornadoes. With an increased likelihood of strong winds and tornado events, all of the County's assets will experience additional risk for losses as a result of extreme wind events.

Changes Since the 2014 HMP

The 2014 analysis was performed using a parcel exposure analysis. Since the 2014 analysis, population statistics have been updated using the 5-year 2014-2018 American Community Survey Population Estimates. Additionally, this updated analysis estimated exposure and losses at the structure level with updated building stock data. The general building stock was updated using building stock data provided by the County to update the user-defined facility inventory and critical facility inventory dataset. The replacement cost value of these structures was updated using RS Means 2019 building valuations. Last, an updated version of FEMA's Hazus-MH flood module v4.2 was used to estimate potential losses for the 100-year and 500-year MRP hurricane wind events.

Overall, this vulnerability assessment uses a more accurate and updated building inventory which provides more accurate estimated exposure and potential losses for Tompkins County.

Identified Issues

- Severe storms occur frequently in Tompkins County, leading to power outages and disruptions to life, economy and government operations in the County. Power outages due to downed trees as a serious hazard impacting communities. Critical facilities without a source of backup power may not function have the ability to properly or provide the necessary needs to the County during power outages.
- Older building stock in the County, which is quite extensive, could be more vulnerable to severe storm events, such as windstorms, as they may have been built to low or no code standards.
- The impacts of drought and invasive species might lead to dead or dying trees. These trees are more susceptible to falling during severe storm events. This can cause power outages, close roadways, and damage buildings and property.
- Not all municipalities have debris management, tree inventories or tree maintenance plan in place. Debris from downed trees must be addressed, as it can impact the severity of severe storm events, requires coordination efforts, and could require additional funding.

5.4.8 Severe Winter Storm

The following section provides the hazard profile (hazard description, location, extent, previous occurrences and losses, probability of future occurrences, and impact of climate change), and vulnerability assessment for the severe winter storm hazard in Tompkins County.

The hazard profile is organized as follows:	The vulnerability assessment is organized as follows:
• Description • Extent • Previous Occurrences and Losses • Probability of Future Occurrences • Climate Change Impacts	• Impact on Life and Safety • Impact on General Building Stock • Impact on Community Lifelines • Impact on Economy • Impact on Environment • Cascading Impacts on Other Hazards • Future Change that may Impact Vulnerability • Changes Since 2014 HMP • Identified Issues

5.4.8.1 Hazard Profile

Hazard Description

A winter storm is a weather event in which the main types of precipitation are snow, sleet, or freezing rain. They can be a combination of heavy snow, blowing snow, and dangerous wind chills. According to the National Severe Storms Laboratory (n.d.), the three basic components needed to make a winter storm include the following:

Some winter storms are large enough to immobilize an entire region while others might only affect a single community. Winter storms typically are accompanied by low temperatures, high winds, freezing rain or sleet, and heavy snowfall. The aftermath of a winter storm can have an impact on a community or

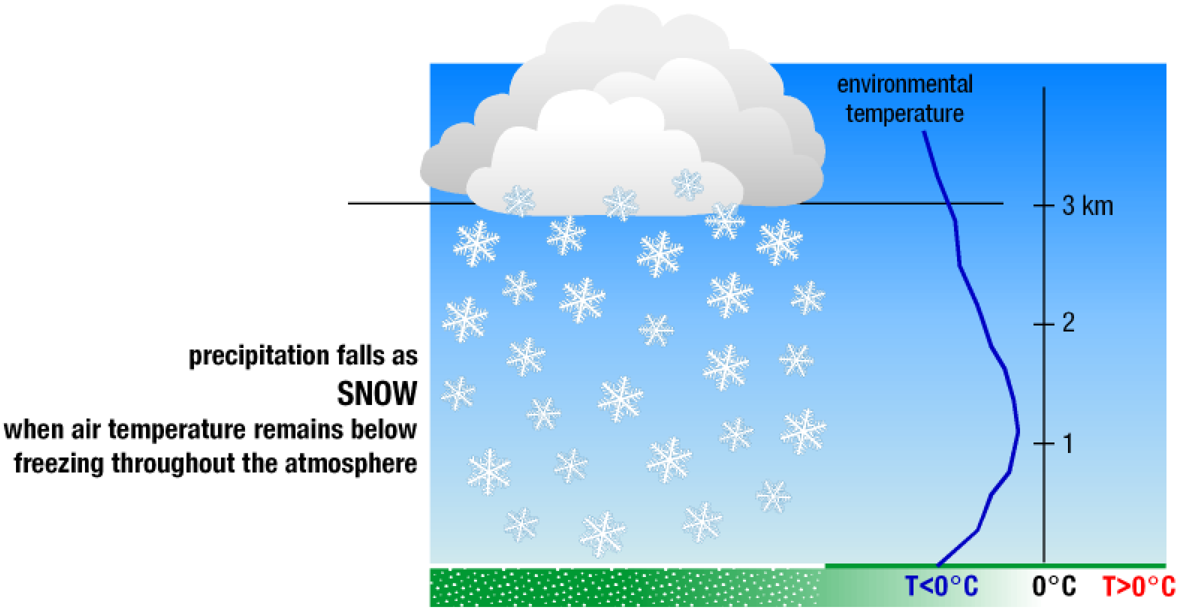
- Below freezing temperatures (cold air) in the clouds and near the ground to make snow and ice.
- Lift, something to raise the moist air to form clouds and cause precipitation, such as warm air colliding with cold air and being forced to rise over the cold dome or air flowing up a mountainside (oliographic lifting).
- Moisture to form clouds and precipitation, such as air blowing across a large lake or the ocean.

In Tompkins County, winter storms include blizzards, Nor'Easters, snowstorms, and ice storms.

Heavy Snow

According to the National Snow and Ice Data Center (NSIDC), snow is precipitation in the form of ice crystals. It originates in clouds when temperatures are below the freezing point (32 °F) and water vapor in the atmosphere condenses directly into ice without going through the liquid stage. Once an ice crystal has formed, it absorbs and freezes additional water vapor from the surrounding air, growing into snow crystals or a snow pellet, which then falls to the earth. Snow falls in different forms: snowflakes, snow pellets, or sleet. Snowflakes are clusters of ice crystals that form from a cloud. Figure 5.4.8-1 depicts snow creation.

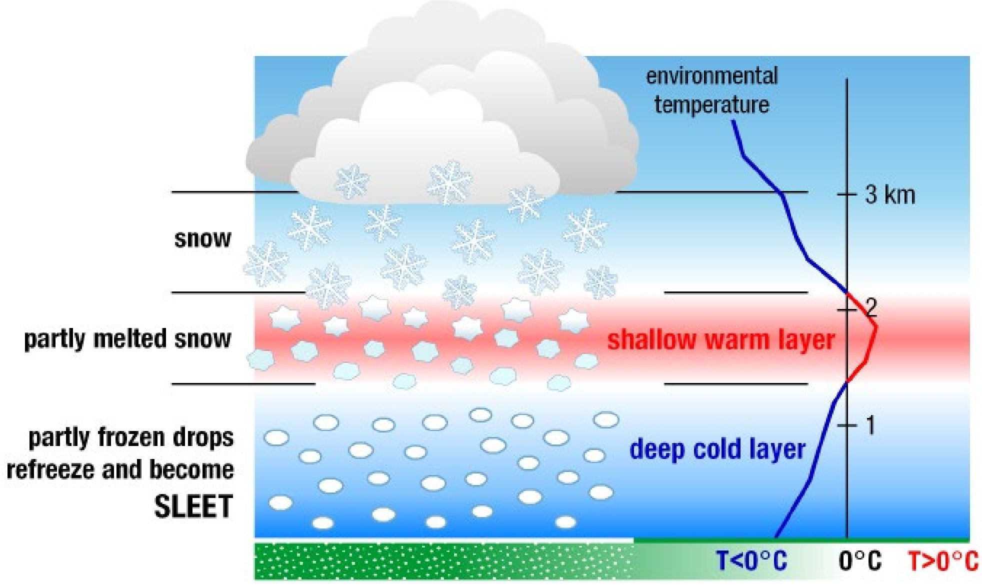
Figure 5.4.8-1. Snow Creation



Source: NOAA-NSSL, 2015

Snow pellets are opaque ice particles in the atmosphere. They form as ice crystals fall through super-cooled cloud droplets, which are below freezing but remain a liquid. The cloud droplets then freeze to the crystals. Sleet is made up of drops of rain that freeze into ice as they fall through colder air layers. They are usually smaller than 0.30 inches in diameter (NSIDC 2013). Figure 5.4.8-2 indicates the process of sleet creation.

Figure 5.4.8-2. Sleet Creation



Source: NOAA-NSSL 2015

Nor'easters

Nor'easters are storms that occur along the East Coast of North America and thus have been named accordingly based on the winds which are typically from the northeast. While these storms may occur at any given time of the year, they are most frequent and violent between the months of September and April. Some notable Nor'easter events include the New England Blizzard of 1978, the 1993 Superstorm, and the 2015 Boston snowstorm. These severe snow events have been responsible for billions of dollars in damage, and have caused significant economic, transportation and human disruption. In some instances, these events have also led to coastal flooding and subsequent damages.

These extreme snow events are triggered by polar jets from the north moving south towards the Atlantic and colliding with warm air from the Gulf of Mexico which the creates heavy amounts of precipitation along the East Coast. As a result of this collision, the coastal waters are relatively mild during the winter, which in turn helps warm the cold winter air over the water.

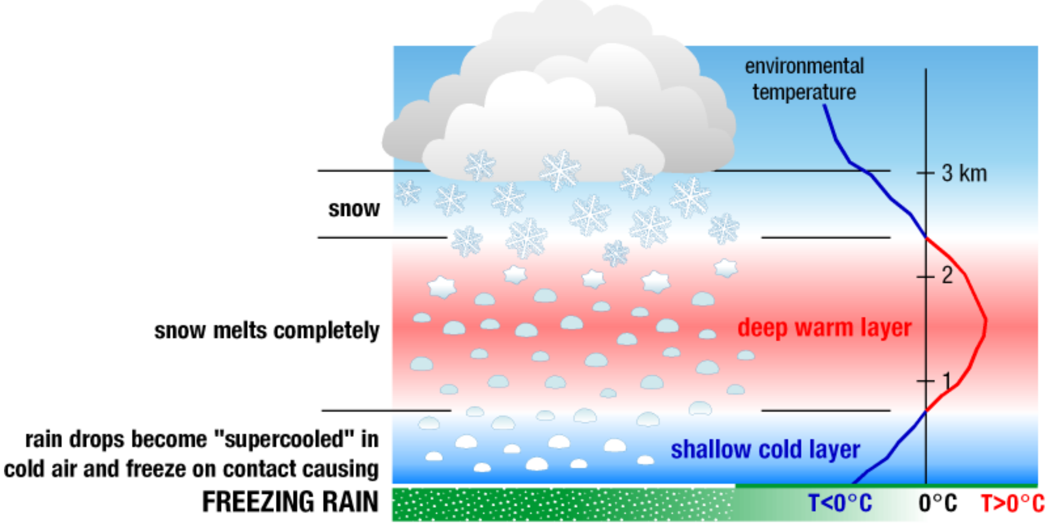
Blizzards

A blizzard is a winter snowstorm with sustained or frequent wind gusts of 35 miles per hour (mph) or more, accompanied by falling or blowing snow reducing visibility to or below 0.25 mile, as the predominant conditions over a 3-hour period. Extremely cold temperatures often are associated with blizzard conditions but are not a formal part of the definition. The hazard, created by the combination of snow, wind, and low visibility, significantly increases when temperatures are below 20 °F. A severe blizzard is categorized as having temperatures near or below 10 °F, winds exceeding 45 mph, and visibility reduced by snow to near zero. Storm systems powerful enough to cause blizzards usually form when the jet stream dips far to the south, allowing cold air from the north to clash with warm, moister air from the south. Blizzard conditions often develop on the northwest side of an intense storm system. The difference between the lower pressure in the storm and the higher pressure to the west creates a tight pressure gradient, resulting in strong winds and extreme conditions caused by the blowing snow (The Weather Channel 2012).

Ice Storms

An ice storm describes those events when damaging accumulations of ice are expected during freezing rain situations. Significant ice accumulations typically are accumulations of 0.25-inches or greater (NWS 2013). Heavy accumulations of ice can bring down trees, power lines, utility poles, and communication towers. Ice can disrupt communications and power for days. Even small accumulations of ice can be extremely dangerous to motorists and pedestrians (NWS 2008). Figure 5.4.8-3 shows the process of freezing rain creation,

Figure 5.4.8-3. Freezing Rain Creation



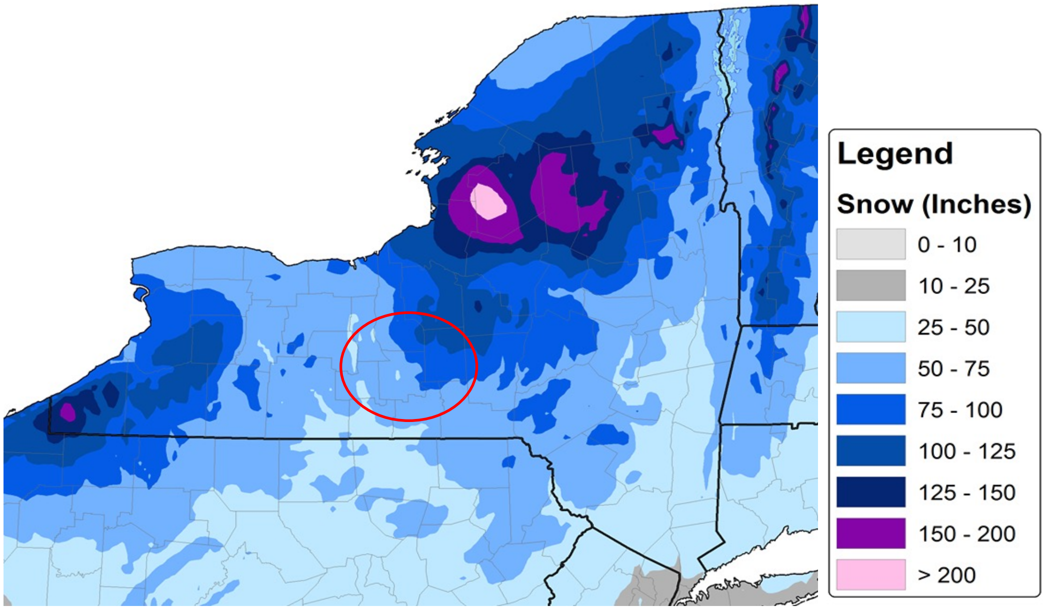
Source: NOAA-NSSL 2015

Location

Snow and Blizzards

Snowfall in New York State is highly variable. The inland regions of the State see an average seasonal amount of 40 inches or more, whereas the coastal regions typically see 25 to 35 inches. More than half of New York State’s land area sees more than 70 inches of snow each season (NDC 2016). According to data from Cornell University, snowfall in Tompkins County averages between 50 and 100 inches a year. The Southern Tier and Hudson Valley region of the State generally receives less snowfall than the northern and lakeshore portions. Much of the northern and western parts of the State (particularly those in higher elevations and near the lakes) can experience in excess of 125 inches per year. Figure 5.4.8-4 provides the historical annual average snowfall in New York State through 2012.

Figure 5.4.8-4. New York Annual Average Snowfall, 1960-2012



Source: Cornell University, NYSkiBlog.com
Note: The red circle indicates the location of Tompkins County.

Ice Storms

The Northeast United States is a prime area for freezing rain and ice storm events. These events can occur anytime between November and April, with most events occurring during December and January. Based on data from 1948 to 2000, the average annual number of days with freezing rain for Tompkins County is six to seven days, and the average annual number of hours with freezing rain is between nine and twenty-one (Midwest Regional Climate Center 2020).

Nor'easters

Based on historical records, there was one event in 2014 that was categorized as a Nor' Easter, according to NOAA.

Extent

The magnitude or severity of a severe winter storm depends on several factors, including a region's climatological susceptibility to snowstorms, snowfall amounts, snowfall rates, wind speeds, temperatures, visibility, storm duration, topography, time of occurrence during the day and week (e.g., weekday versus weekend), and time of season.

The extent of a severe winter storm can be classified by meteorological measurements and by evaluating its societal impacts. The National Oceanic and Atmospheric Administration's (NOAA's) National Climatic Data Center (NCDC) is currently producing the Regional Snowfall Index (RSI) for significant snowstorms that impact the eastern two-thirds of the United States. The RSI ranks snowstorm impacts on a scale from 1 to 5 and is based on the spatial extent of the storm, the amount of snowfall, and the interaction of the extent and snowfall totals with population (based on the 2000 Census) as noted in Table 5.4.8-1. The NCDC has analyzed and assigned RSI values to over 500 storms since 1900 (NOAA 2015).

Table 5.4.8-1. Regional Snow Index (RS)I Ranking Categories

Category	Description	RSI Value
1	Notable	1–3
2	Significant	3–6
3	Major	6–10
4	Crippling	10–18
5	Extreme	18.0+

Figure 5.4.8-5. Winter Storm Category Thresholds

Heavy Snowstorm	Accumulations of 4 inches or more of snow in a 6-hour period, or 6 inches of snow in a 12-hour period.
Sleet Storm	Significant accumulations of solid pellets that form from the freezing of raindrops or partially melted snowflakes causing slippery surfaces, posing a hazard to pedestrians and motorists.
Ice Storm	Significant accumulation of rain or drizzle freezing on objects (trees, power lines, roadways) as it strikes them, causing slippery surfaces and damage from sheer weight of ice accumulations.
Blizzard	Wind velocity of 35 mph or more, temperatures below freezing, considerable blowing snow with visibility frequently below one-quarter mile prevailing over an extended period.
Severe Blizzard	Wind velocity of 45 mph, temperatures of 10 °F or lower, a high density of blowing snow with visibility frequently measured in feet prevailing over an extended period.

The NWS operates a widespread network of observing systems, such as geostationary satellites, Doppler radars, and automated surface observing systems that feed into the current state-of-the-art numerical computer models to provide a look into what will happen next, ranging from hours to days. The models are then analyzed by NWS meteorologists who then write and disseminate forecasts (NWS 2013). According to NWS (2018), the magnitude of a severe winter storm can be qualified into five main categories by event type listed in

Figure 5.4.8-5

Figure 5.4.8-6. Winter Storm Warning Thresholds

Additionally, the NWS uses winter weather watches, warnings, and advisories to help people anticipate what to expect in the days and hours prior to an approaching storm as noted in Figure 5.4.8-7.

Previous Occurrences and Losses

Based on a review of historic weather events and losses, Tompkins County was found to have frequent winter storm occurrences. According to the NOAA-NCEI storm events database, Tompkins County has been impacted by 71 winter weather events between 1996 and April 2020, including 42 heavy snow events, 7 ice storms, 3 lake effect snow events, 16 winter storms, and 3 winter weather events. Table 5.4.8-2 summarizes these statistics. Note that these also account for previous Nor'easter occurrences which are categorized under Winter Storm.

Table 5.4.8-2. Severe Winter Events 1996-May 2020

Hazard Type	Number of Occurrences Between 1996 and 2020	Total Fatalities	Total Injuries	Total Property Damage ($)	Total Crop Damage ($)
Blizzard	0	0	0	$0	$0
Heavy Snow	42	3	2	$650,000	$0
Ice Storm	7	0	0	$105,000	$0
Lake Effect Snow	3	0	0	$0	$0
Sleet	0	0	0	$0	$0
Winter Storm	16	0	0	$30,000	$0
Winter Weather	3	0	0	$20,000	$0
Total	**71**	**3**	**2**	**$775,000**	**$0**

Source: *NOAA-NCEI 2020*
Note: *NOAA-NCEI database includes winter-related events starting in 1996. Events that occurred prior to 1996 are not included in the table.*

FEMA Disaster Declarations

Between 1954 and April 2020, FEMA included New York State in 26 winter storm-related major disaster (DR) or emergency (EM) declarations classified as one or a combination of the following disaster types: severe winter storm, snowstorm, snow, ice storm, winter storm, blizzard, and flooding. Generally, these disasters cover a wide region of the state; therefore, they may have impacted many counties. Tompkins County was included in two of these declarations.

Table 5.4.8-3. FEMA Major Snow-Related Disasters and Emergency Declarations in Tompkins County since 1953

Disaster Number	Incident Duration	Declaration Date	Incident Type	Title
DR-4322	March 14-- March 15, 2017	7/12/2017	Snow	Severe Winter Storm and Snowstorm
EM-3107	March 13-- March 17, 1993	3/17/1993	Snow	Severe Blizzard

Source: FEMA 2020
DR Major Disaster Declaration (FEMA)
EM Emergency Declaration (FEMA)
FEMA Federal Emergency Management Agency

USDA Disaster Designations

The Secretary of Agriculture from the U.S. Department of Agriculture (USDA) is authorized to designate counties as disaster areas to make emergency loans to agricultural producers suffering losses in those counties and in counties that are contiguous to a designated county. Between 2012 and 2020, Tompkins County was included in 2 USDA declarations related to severe winter weather, and 7 severe frosts/ freezes.

The USDA crop loss data provide another indicator of the severity of previous events. Additionally, crop losses can have a significant impact on the economy by reducing produce sales and purchases. Such impacts may have long-term consequences, particularly if crop yields are low the following years as well. Fortunately, USDA records indicate that Tompkins County has not experienced crop loss from severe winter storm events between 2000 and 2020.

Previous Events

Table 5.4.8-4 identifies the known severe winter storm events that impacted Tompkins County between 2012 and 2020. For events prior to 2012, refer to Appendix E (Supplementary Data). For detailed information on damages and impacts to each municipality, refer to Section 9 (Jurisdictional Annexes).

Table 5.4.8-4. *Severe Winter Weather Events in Tompkins County, 2012 to 2020*

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Event Details*
January 13-14, 2012	Heavy Snow	N/A	No	A low-pressure system coming from Lake Ontario brought a cold front to the region. Snowfall totals in Tompkins County ranged from four to twelve inches. Groton saw nearly a foot of snow, whereas Etna saw 7.4 inches.
December 26-27, 2012	Winter Storm	N/A	No	Six to eight inches of snow fell in Tompkins County following a low-pressure system coming across the Tennessee Valley to off of the New Jersey coast.

Table 5.4.8-4. *Severe Winter Weather Events in Tompkins County, 2012 to 2020*

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Event Details*
December 29-30, 2012	Winter Storm	N/A	No	A low-pressure system coming from the Mid-West brought five to eight inches of snow to the county.
February 8-9, 2013	Heavy Snow	N/A	No	A coastal storm merged with a system coming from the north, resulting in five to ten inches of snow, including nearly 10 inches in Groton, 9.5 inches in Etna, and nine inches in Dryden.
January 1-3, 2014	Winter Storm	N/A	No	Eight to thirteen inches of snow fell in the county due to a stalled frontal boundary. Winds exacerbated the winter storm conditions.
February 5, 2014	Winter Storm	N/A	No	Snowfall between six and ten inches fell across Tompkins County, with the highest amount recorded in North Lansing.
December 9-11, 2014	Winter Storm	N/A	No	A low-pressure system developing over the East Coast brought significant snowfall to the area. Tompkins County saw between six and 17 inches of snow, with the highest amount seen in Groton.
February 1-2, 2015	Heavy Snow	N/A	No	A winter storm originating from the Central Plains brought snow to Central New York, including Tompkins County where between five to nine inches of snow fell.
November 19-22, 2016	Lake-Effect Snow	N/A	No	A strong cold front entering the region encountered moist air from the Great Lakes and brought unusually high snowfall to the Southern Tier region. In Tompkins County, snowfall generally ranged between eight and sixteen inches of snow. Caroline, in the southeastern corner of the County, saw 28 inches of snow.
March 14-15, 2017	Heavy Snow	DR-4322	Yes	A northeast-moving storm that developed off of North Carolina brought blizzard conditions to parts of the State and strong winter storm conditions to Tompkins County. The highest amounts of snow were seen in the southeastern section of the county, whereas the county overall saw between one and two feet of snow.
March 13-15, 2018	Heavy Snow	N/A	No	Central New York and northeastern Pennsylvania were impacted by unseasonably cold and moist air that led to five to nine inches of snow in Tompkins County.
November 15-16, 2018	Heavy Snow	N/A	No	A heavy early-season snowstorm impacted much of the Southern Tier region, bringing up to one foot of snow to the county.
January 19-20, 2019	Heavy Snow	N/A	No	A low-pressure system approaching from the southeast brought 10 to 14 inches of snow to Tompkins County.

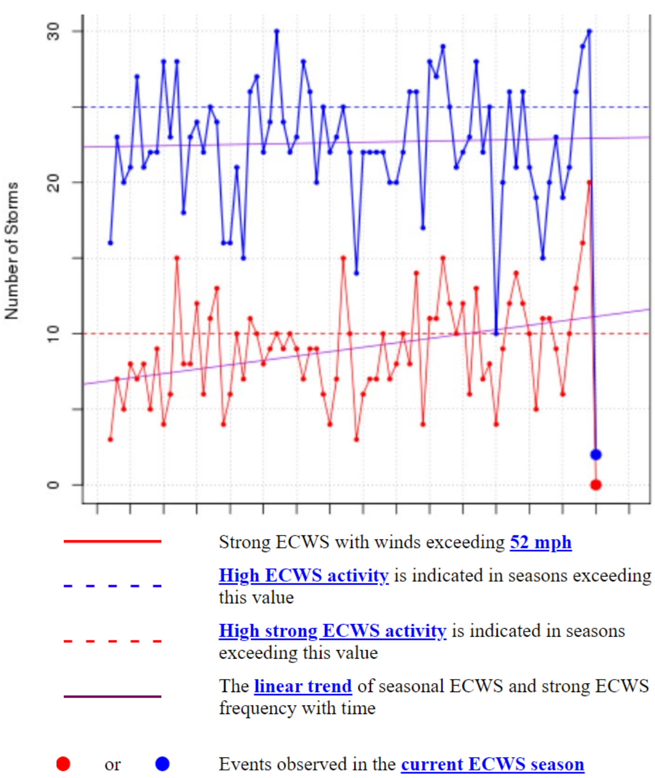
Table 5.4.8-4. *Severe Winter Weather Events in Tompkins County, 2012 to 2020*

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Event Details*
December 1-2, 2019	Heavy Snow	N/A	No	A complex winter storm event resulted in mixed precipitation events to the Southern Tier and Central New York region. In Tompkins County, snow accumulate between nine and thirteen inches.
February 6-7, 2020	Heavy Snow	N/A	No	An intensifying winter storm developed along a frontal boundary brought eight to fourteen inches of snow to the county.

Sources: FEMA 2020; NOAA-NCEI 2020; SPC 2020
** Many sources were consulted to provide an update of previous occurrences and losses; event details and loss/impact information may vary and has been summarized in the above table*
DR Major Disaster Declaration (FEMA)
FEMA Federal Emergency Management Agency
Mph Miles per Hour
NCEI National Centers for Environmental Information
NOAA National Oceanic and Atmospheric Administration
N/A Not Applicable

Climate Change Impacts

Figure 5.4.8-7 Severe Winter Storm Trends



Climate change is affecting both people and resources in New York State, and these impacts are likely to increase. The impacts related to increasing temperatures and sea level rise are already causing complications in the state. *ClimAID: The Integrated Assessment for Effective Climate Change in New York State (ClimAID)* was undertaken to provide decision-makers with information on the state's vulnerability to climate change and to facilitate the development of adaptation strategies informed by both local experience and scientific knowledge (NYSERDA 2011).

According to NRCC, in Tompkins County and its surrounding region, overall weather is expected to become warmer. In general, that means milder winters on average. However, based on historical trends (Figure 5.4.8-8 the blue depicts the overall number of winter storms that are expected to stay constant, while the number of severe winter storms is projected to increase (red line). Therefore, in Tompkins County, while overall winter weather is expected to become warmer and milder, the number of severe winter storms is also projected to increase.

Temperatures in New York State are warming, with an average rate of warming over the past century of 0.25° F per decade. Average annual temperatures are projected to increase across New York State by 2–3.4 °F by the 2020s, 4.1–6.8 °F by the 2050s, and 5.3–10.1 °F by the 2080s. By the end of the century, the greatest warming is projected to be in the northern section of the state (NYSERDA 2014).

Each region in New York State, as defined by ClimAID, has attributes that will be affected by climate change. Tompkins County is part of Region 3, the Southern Tier, where temperatures are estimated to increase by 4.4–6.3 ºF by the 2050s and 5.7–9.9 ºF by the 2080s (baseline of 47.5 ºF, middle range projection) as indicated. Precipitation totals are estimated to increase between 4–10 percent by the 2050s and 6–14 percent by the 2080s (baseline of 35.0 inches, middle range projection).

New York State already is experiencing the effects of climate change during the winter season. Winter snow cover is decreasing, and spring comes, on average, about a week earlier than it did a few years ago. Nighttime temperatures are measurably warmer, even during the colder months. Overall winter temperatures in New York State are almost 5 degrees warmer than in 1970 (NYSERDA 2011; NYSDEC, n.d.). The state has experienced a decrease in the number of cold winter days (below 32 °F) and can expect to see a decrease in snow cover by as much as 25–50 percent by end of the next century. The lack of snow cover may jeopardize opportunities for skiing, snowmobiling, and other types of winter recreation; and natural ecosystems will be affected by the changing snow cover (Cornell University College of Agriculture and Life Sciences 2011). As the century progresses, snowfall is likely to become less frequent, with the snow season decreasing in length. It is uncertain if there will be changes in the intensity of snowfall during each storm; however, it is possible that higher temperatures in colder parts of New York State could support higher snowfall totals during snowstorm events (NYSERDA 2014).

Some climatologists believe that climate change could play a role in the frequency and intensity of Nor'Easters. Two ingredients are needed to produce strong Nor'Easters and intense snowfall: (1) temperatures which are just below freezing and (2) massive moisture coming from the Gulf of Mexico. When temperatures are far below freezing, snow is less likely. As temperatures increase in the winter months, they will be closer to freezing rather than frigidly cold. Climate change is expected to produce more moisture, thus increasing the likelihood that these two ingredients (temperatures just below freezing and intense moisture) will cause more intense snow events.

Probability of Future Occurrences

Table 5.4.8-5 summarizes data regarding the probability of occurrences of severe winter storm events in Tompkins County based on the historic record. In Tompkins County, heavy snowstorms are the most common event, following by winter storms. The information used to calculate the probability of occurrences is based solely on NOAA-NCEI storm events database results.

Table 5.4.8-5. Probability of Future Occurrence of Severe Winter Weather Events in Tompkins County

Hazard Type	Number of Occurrences Between 1954 and 2018	% chance of occurrence in any given year
Blizzard	0	0
Heavy Snow	42	62.7%
Ice Storm	7	10.5%
Lake Effect Snow	3	4.5%
Sleet	0	0%
Winter Storm	16	23.9%
Winter Weather	3	4.5%
Total	71	100%

Source: NOAA-NCEI 2020
Note: Disaster occurrences include federally declared disasters since the 1950 Federal Disaster Relief Act (Public Law 81-875) and selected severe winter storm events since 1996. Due to limitations in data, not all severe winter storm events occurring between 1954 and 1996 are accounted for in the tally of occurrences. As a result, the number of hazard occurrences is underestimated.

Based on historical data from NYSERDA (2011), it is expected that the following will occur at least once per 100 years:

- Up to four inches of freezing rain in the ice band near central New York State of which between 1–2 inches of accumulated ice will occur over a 24-hour period.
- Up to two feet of accumulated snow in the snow band in northern and western New York State over a 48-hour period.

Based on geography, location, past event history, and climate projections, Tompkins County will continue to experience winter storm events. The probability of occurrence, or likelihood of the event, is one parameter used for hazard rankings; refer to Section 5.3 (Hazard Ranking) for additional information on the hazard ranking methodology and probability criteria. The probability of occurrence for severe winter storms in the county is considered *frequent* (event has a 100 percent annual probability and might occur multiple times in the same year).

5.4.8.2 Vulnerability Assessment

To understand risk, a community must evaluate what assets are exposed or vulnerable in the identified hazard area. For the severe winter storm hazard, all of Tompkins County has been identified as the hazard area. Therefore, all assets in the County (population, structures, critical facilities and lifelines), as described in the County Profile (Section 4), are vulnerable to a winter storm event.

Impact on Life, Health and Safety

The entire population of Tompkins County (102,962 people) is exposed to severe winter storm events (American Community Survey 2018). According to the NOAA National Severe Storms Laboratory (NSSL); every year, winter weather indirectly and deceptively kills hundreds of people in the U.S., primarily from automobile accidents, overexertion and exposure. Winter storms are often accompanied by strong winds creating blizzard conditions with blinding wind-driven snow, drifting snow and extreme cold temperatures and dangerous wind chill. They are considered deceptive killers because most deaths and other impacts or losses are indirectly related to the storm. People can die in traffic accidents on icy roads, heart attacks while shoveling snow, or of hypothermia from prolonged exposure to cold (NSSL 2020).

> Individuals most vulnerable to severe winter storm events include those: Over 65 years old and homeless

The homeless and elderly are considered most susceptible to this hazard. The homeless and residents below the poverty level may not have access to housing or their housing could be less able to withstand cold temperatures (e.g., homes with poor insulation and heating supply). Residents with low incomes might not have access to housing or their housing can be less able [illegible]mes with poor insulation and heating supply). In Tompkins Cou[illegible]hest concentration of population below the poverty level (i.e., 17-percent). Refer to Section 4 (County Profile) that displays the densities of low-income populations in Tompkins County.

The elderly are also considered susceptible to this hazard due to their increased risk of injuries and death from falls and overexertion and/or hypothermia from attempts to clear snow and ice. According to the 2018 American Community Survey 5-Year population estimate, there are 13,561 persons over 65 years old that reside in the County that are considered vulnerable to severe winter weather. In addition, severe winter storm events can reduce the ability of these populations to access emergency services.

Impact on General Building Stock

The entire general building stock inventory is exposed and vulnerable to the severe winter storm hazard. In general, structural impacts include damage to roofs and building frames, rather than building content. Current modeling tools are not available to estimate specific losses for this hazard. As an alternate approach, this plan considers percent damages that could result from severe winter storm conditions. This allows planners and emergency managers to select a range of potential economic impact based on an estimate of the percent of damage to the general building stock. Table 5.4.8-6 below summarizes the estimated loss based on 1-, 5-, and 10-percent losses. Given professional knowledge and the currently available information, the potential loss for this hazard is many times considered to be overestimated because of varying factors (building structure type, age, load distribution, building codes in place, etc.). Therefore, the following information should be used as estimates only for planning purposes with the knowledge that the associated losses for severe winter storm events vary greatly.

Table 5.4.8-6. General Building Stock Exposure and Estimated Losses from Severe Winter Storm Events

Jurisdiction	Total Replacement Cost Value (RCV)	1-Percent Exposure/Loss	5-Percent Exposure/Loss	10-Percent Exposure/Loss
Caroline (T)	$2,523,108,347	$25,231,083	$126,155,417	$252,310,835
Cayuga Heights (V)	$1,548,665,909	$15,486,659	$77,433,295	$154,866,591
Danby (T)	$2,188,454,321	$21,884,543	$109,422,716	$218,845,432
Dryden (T)	$8,740,906,102	$87,409,061	$437,045,305	$874,090,610
Dryden (V)	$1,135,109,100	$11,351,091	$56,755,455	$113,510,910
Enfield (T)	$2,736,468,231	$27,364,682	$136,823,412	$273,646,823
Freeville (V)	$356,699,295	$3,566,993	$17,834,965	$35,669,929
Groton (T)	$2,804,801,342	$28,048,013	$140,240,067	$280,480,134
Groton (V)	$1,203,171,190	$12,031,712	$60,158,560	$120,317,119
Ithaca (C)	$19,712,305,674	$197,123,057	$985,615,284	$1,971,230,567
Ithaca (T)	$10,868,181,586	$108,681,816	$543,409,079	$1,086,818,159
Lansing (T)	$6,270,191,033	$62,701,910	$313,509,552	$627,019,103
Lansing (V)	$3,436,043,635	$34,360,436	$171,802,182	$343,604,364
Newfield (T)	$3,848,204,673	$38,482,047	$192,410,234	$384,820,467
Trumansburg (V)	$1,241,549,970	$12,415,500	$62,077,498	$124,154,997
Ulysses (T)	$3,372,144,448	$33,721,444	$168,607,222	$337,214,445
Tompkins County (Total)	**$71,986,004,856**	**$719,860,049**	**$3,599,300,243**	**$7,198,600,486**

Source: Tompkins County GIS 2020; RS Means 2019

A specific area that is vulnerable to the severe winter storm hazard is the floodplain. Severe winter storms can cause flooding through blockage of streams or through snow melt. At-risk residential infrastructures are presented in the flood hazard profile (Section 5.4.4 Flood). Generally, losses resulting from flooding associated with severe winter storms should be less than that associated with the 1-percent annual chance flood.

Impact on Community Lifelines

Full functionality of critical facilities lifelines such as police, fire and medical facilities is essential for response during and after a severe winter storm event. These structures are largely constructed of concrete and masonry; therefore, they should only suffer minimal structural damage from severe winter storm events. Because power interruption can occur, backup power is recommended. Infrastructure at risk for this hazard includes roadways that could be damaged due to the application of salt and intermittent freezing and warming conditions that can damage roads over time. Severe snowfall requires the clearing roadways and alerting citizens to dangerous conditions; following the winter season, resources for road maintenance and repair are required (NSSL 2020).

Further, heavy accumulations of ice can bring down trees, electrical wires, telephone poles and lines, and communication towers. Communications and power can be disrupted for days while utility companies work to repair the extensive damage. Even small accumulations of ice may cause extreme hazards to motorists and pedestrians. Bridges and overpasses are particularly dangerous because they freeze before other surfaces (NSSL 2020).

Impact on Economy

The cost of snow and ice removal and repair of roads from the freeze/thaw process can drain local financial resources. According to Tompkins County, the Towns of Lansing, Groton, Dryden, Caroline, Danby, Ithaca, and Ulysses all assist in snow and ice maintenance on County roads (Tompkins County 2020). The Tompkins County 2020 Budget indicates that snow and ice removal in 2019 was t budgeted at $665,000 (Tompkins County Administration 2019). This budget has increased every year since 2017 and is expected to increase to $782,000 for the 2020 fiscal year. Further, severe winter weather affects the ability of persons to commute into and out of the area for work or school. The loss of power and closure of roads prevents the commuter population traveling to work within and outside of the County and may cause a loss in economic productivity.

Impact on the Environment

Severe winter storms can have a major impact on the environment. Not only does severe winter storms create changes in natural processes, the residual impacts of a community's methods to maintain its infrastructure through winter weather maintenance may also have an impact on the environment. For example, an excess amount of snowfall and earlier warming periods may affect natural processes such as flow within water resources (USGS 2020). Rain-on-snow events can also exacerbate runoff rates with warming winter weather. Consequentially, these flow rates and excess volumes of water can erode banks, tear apart habitat along the banks and coastline, and disrupt terrestrial plants and animals.

Furthermore, chemically based winter maintenance practices have its own effect on the natural environment. Melting snow and ice that carry deicing chemicals and salt onto vegetation and into soils can contaminate the local waterways. Elevated salt levels may hinder vegetation from absorbing nutrients, slowing plant growth.

Cascading Impacts on Other Hazards

As noted , severe winter weather events may exacerbate flooding. As discussed, the freezing and thawing of snow and ice associated with winter weather events can create major flooding issues in the county. Maintaining winter weather hazards through snow and ice removal could minimize the potential risk of flooding during a warming period. Refer to Section 5.4.4 (Flood) for more information about the flood hazard of concern.

Future Changes That May Impact Vulnerability

Understanding future changes that impact vulnerability in the county can assist in planning for future development and ensuring that appropriate mitigation, planning, and preparedness measures are in place.

The county considered the following factors to examine potential conditions that may affect hazard vulnerability:

- Potential or projected development
- Projected changes in population
- Other identified conditions as relevant and appropriate, including the impacts of climate change.

Projected Development

As discussed in Section 4, areas targeted for future growth and development have been identified across the County. Any areas of growth located could be potentially impacted by severe winter weather events. Current New York State land use and building codes incorporate standards that address and mitigate snow accumulation. Some local municipalities in the State have implemented the following activities to eliminate loss of life and property and infrastructure damages during winter storm events:

- Removal of snow from roadways
- Removal of dead trees and trim trees/brush from roadways to lessen falling limbs and trees
- Ensure proper road signs are visible and installed properly
- Bury electrical and telephone utility lines to minimize downed lines
- Removal of debris/obstructions in waterways and develop routine inspections/maintenance plans to reduce potential flooding
- Replace substandard roofs of critical facilities to reduce exposure to airborne germs resulting from leakage
- Purchase and install backup generators in evacuation facilities and critical facilities to essential services to residents
- Install cell towers in areas where limited telecommunication is available to increase emergency response and cell phone coverage (NYS HMP 2019, NYS DHSES 2020)

Projected Changes in Population

According to population projections from the Cornell Program on Applied Demographics, Tompkins County will experience a continual population increase from 2020 through 2040 (over 6,040 people in total by 2040). The U.S. Census Bureau also shows that the population in Tompkins County has increased 0.6-percent between 2010 and 2019 (U.S. Census Bureau 2020). Any growth can create changes in density throughout the County, which may impact the ability of persons in the County to mobilize or receive essential services during severe winter storm events. Historically, winter weather events with associated snowfall and ice accumulation have severely impacted transportation corridors as well as infrastructure. Refer to Section 4 (County Profile), which includes a discussion on population trends for the County.

Climate Change Impacts

As discussed above, most studies project that the State of New York will see an increase in average annual temperatures and precipitation. Annual precipitation amounts in the region are projected to increase, primarily in the form of heavy rainfalls, which have the potential to freeze into heavy snowfall and icing. This increase in snow and ice could result in an increased risk to life and health, an increase in structural losses, a diversion of additional resources to response and recovery efforts, and an increase in business closures affected by severe winter events due to loss of service or access.

Change of Vulnerability Since 2014 HMP

Since the 2014 analysis, population statistics have been updated using the 5-Year 2014-2018 American Community Survey Population Estimates. Additionally, this updated analysis estimated exposure and losses at the structure level with updated building stock data. The general building stock was updated using building stock data provided by the County to update the user-defined facility inventory and critical facility inventory dataset. The replacement cost value of these structures was updated using RS Means 2019 building valuations.

Overall, the vulnerability assessment in this plan update uses a more accurate and updated building inventory which provides more accurate estimated exposure and potential losses for Tompkins County.

Identified Issues

- Important issues associated with a severe winter storm in the planning area include the following:
- Windblown snow can create challenges in maintain open travel routes in areas where there are limited natural or man-made wind breaks to limit the accumulation of drifting snow on roadways.
- Older building stock in the County might be more vulnerable to aftermath of a winter storm event. Heavy snow loads on the roofs of buildings might not be able to withstand the extra weight.
- Ice and freezing temperatures can lead to frost heaving and damage to roads, bridges, buildings, home foundations, and railroad tracks.
- During snowstorms, the homeless population is exposed and vulnerable to the health impacts of such events.
- The impacts of drought and invasive species can lead to dead or dying trees. These trees are more susceptible to falling during winter storm events from the weight of snow and ice causing power outages, closed roadways, and damage to buildings and property.
- Downed power lines from the weight of snow and ice lead to power outages, leaving many homes without a source of heat.

SECTION 6. CAPABILITY ASSESSMENT AND MITIGATION STRATEGIES

This section presents mitigation strategies for Tompkins County to help reduce potential exposure and losses identified as concerns in the Risk Assessment portion of this plan. The Planning Partnership reviewed the Risk Assessment to identify and develop these mitigation actions, which are presented herein.

Hazard mitigation reduces the potential impacts of, and costs associated with, emergency and disaster-related events. Mitigation actions address a range of impacts, including impacts on the population, property, the economy, and the environment.

Mitigation actions can include activities such as: revisions to land-use planning, training and education, and structural and nonstructural safety measures.

This section includes:

1. Background and Past Mitigation Accomplishments
2. General Mitigation Planning Approach
3. Review and Update of Mitigation Goals and Objectives
4. Capability Assessment
5. Mitigation Strategy Development and Update

6.1 Background and Past Mitigation Accomplishments

In accordance with the requirements of the Disaster Mitigation Act of 2000, detailed on Page 1-1 in Section 1 (Introduction), a discussion regarding past mitigation activities and an overview of past efforts is provided as a foundation for understanding the mitigation goals, objectives, and activities outlined in this plan update. Tompkins County, through previous and ongoing hazard mitigation activities, has demonstrated that it is proactive in protecting its physical assets and citizens against losses from natural hazards. Examples of previous and ongoing actions and projects include the following:

- The County facilitated the development of the original and 2020 update of the Tompkins County Hazard Mitigation Plan. The current planning process represents the required five-year plan update process, which includes participation of the County, all municipal governments in the County, and key county and regional stakeholders.
- All municipalities (except the Town of Enfield) participating in this HMP update also participate in the NFIP, which requires the adoption of FEMA floodplain mapping and certain minimum standards for building within the floodplain. The Town of Enfield is currently considering becoming an NFIP participant.
- In February 2019, the County received a grant from FEMA to update its multi-jurisdictional hazard mitigation plan.

- In 2016, HMGP funds were approved for a shoreline stabilization project along Buffalo Road in the Town of Caroline.
- Multiple municipalities have actively participated in available mitigation grant funding opportunities to implement mitigation projects, as identified in their jurisdictional annexes in Section 9 (Jurisdictional Annexes). Non-participants stated their lack of engagement was primarily due to lack of capacity.
- Reports, plans, and studies relating to or including information on natural hazards or natural hazard policies affecting Tompkins County have been reviewed and incorporated into this plan update as appropriate, as discussed in Section 3 (Planning Process and References).
- The Tompkins County Comprehensive Plan (2015) incorporates various smart land planning and mitigation strategies to decrease effects of climate change and vulnerability throughout the County.
- The County has worked with municipalities to help solve any flood issues or any other related vulnerability that is not solvable by the affected municipality. The County has helped to fund a range of large and small mitigation projects across the county through its previously existing Flood Hazard Mitigation and Stream Corridor Restoration Program.
- The County has received Silver Climate Smart Communities Designation, the highest level attainable by the NYSERDA program. In order to attain this level of certification, the community needs to complete numerous actions to reduce GHG emissions, increase sustainability, and boost overall resilience.
- Municipalities in Tompkins County actively participate in the Municipal Separate Storm Sewer System (MS4) program which is meant to track existing stormwater systems and provide a baseline standard for all stormwater infrastructure.
- Tompkins County is an active participant in the Cayuga Lake Watershed Intermunicipal Organization and has its own Water Resources Council and Environmental Management Council that provide guidance on environmental, water resource and climate adaptation issues faced by the County.
- The County has developed its own Natural Resource Inventory and has developed programs and systems to monitor, maintain, and protect natural resources that are vulnerable to climate change and human activity.
- The County provides its municipalities with hazard mitigation consultation and mapping services.
- The County manages and implements an active Natural Infrastructure Capital Program that actively works to formally protect natural systems that provide hazard mitigative services.
- Enfield in collaboration with the county is currently working with the NY Rural Water Association to help assess local water quality and quantity issues associated with groundwater. Free support to develop water quality plans and may result in water protection ordinance. Uses DoH test well information to assess demand and have developed survey to determine what % town is dealing with water issues.

6.2 General Mitigation Planning Approach

The overall approach used to update the county and local hazard mitigation strategies are based on FEMA and NYS regulations and guidance regarding local mitigation plan development, including the following:

- DMA 2000 regulations, specifically 44 CFR 201.6 (local mitigation planning).
- FEMA *Local Mitigation Planning Handbook*, March 2013.
- FEMA *Local Mitigation Plan Review Guide*, October 1, 2011.
- FEMA *Integrating Hazard Mitigation into Local Planning*, March 1, 2013.
- FEMA *Plan Integration: Linking Local Planning Efforts*, July 2015.
- FEMA *Mitigation Planning How-To Guide #3, Identifying Mitigation Actions and Implementing Strategies* (FEMA 386-3), DATE.
- FEMA *Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards*, January 2013.
- NYS DHSES *New York State Hazard Mitigation Planning Standards*, 2017.
- NYS DHSES *New York State Hazard Mitigation Planning Standards Guide*, 2017.

The mitigation strategy update approach includes the following steps that are further detailed in later subsections:

- Section 6.3 Review and update mitigation goals and objectives.
- Section 6.4 Identification of mitigation capabilities and evaluation of their capacity and effectiveness to mitigate and manage hazard risk.
- Section 6.5 Preparation of an implementation strategy, including:
    - Identify progress on previous County and local mitigation strategies.
    - Develop updated County and local mitigation strategies.
    - Prioritize projects and initiatives in the updated mitigation strategy.

6.3 Review and Update of Mitigation Goals and Objectives

This section documents the County's efforts to develop hazard mitigation goals and objectives that are established to reduce or avoid long-term vulnerabilities to the identified hazards.

6.3.1 Mission Statement

Per FEMA guidance (386-1), a mission statement or guiding principle describes the overall duty and purpose of the planning process and serves to identify the principle message of the plan. It focuses or constrains the range of goals and objectives identified. This is not a goal because it does not describe outcomes, rather it is broad in scope, and provides a direction for the HMP update.

To provide context for this plan in relation to its support of County-wide resiliency, the Steering Committee created an over-arching mission statement to inform the overall County efforts regarding it pro-active efforts to create a resilient and disaster resistant community.

The mission statement, amended goals, and the more specific mitigation objectives are provided below. As part the of the 2021 HMP update process, the Tompkins County Steering Committee developed the following mission statement:

The mission of the Tompkins Hazard Mitigation Plan is to develop a pathway, using an integrated and comprehensive approach, to increase capacity for all individuals, communities, municipalities, institutions, businesses and systems within the County, to adapt and thrive in the face of chronic stresses and acute shocks as a result of natural hazard events in Tompkins County.

6.3.2 Goals and Objectives

According to CFR 201.6(c)(3)(i): "The hazard mitigation strategy shall include a description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards." The mitigation goals were developed based on the risk assessment results, discussions, research, and input from the committee, existing authorities, polices, programs, resources, stakeholders, and the public.

For the purposes of this plan, goals and objectives are defined as follows:

Goals are general guidelines that explain what is to be achieved. They are broad, long-term, policy-type statements that represent global visions. Goals help define the benefits that the plan is trying to achieve. The success of the plan, once implemented, should be measured by the degree to which its goals have been met (that is, by the actual benefits in terms of hazard mitigation).

Objectives are short-term aims, which when combined form a strategy or course of action to meet a goal. Unlike goals, objectives are specific and measurable.

FEMA defines ***Goals*** as general guidelines that explain what should be achieved. Goals are usually broad, long-term, policy statements, and represent a global vision.

FEMA defines ***Objectives*** as strategies or implementation steps to attain mitigation goals. Unlike goals, objectives are specific and measurable, where feasible.

During the 2021 plan update process, the Steering Committee reviewed the goals and objectives established in the 2014 HMP in consideration of the hazard events and losses since the 2014 plan, the updated hazard profiles and vulnerability assessment, the goals and objectives established in the New York State 2019 HMP, and county and local risk management plans. The update incorporates direct input for how the County and municipalities need to move forward to best manage their hazard risk. Amendments include additions and edits to goals and objectives to express the planning partnership's interests in integrating this plan with other planning mechanisms/programs and to support mitigation through the protection and preservation of natural systems, including particular reference to certain goals and objectives in the New York State 2019 HMP update, as identified in the Table.

Table 6-1. 2021 HMP Update Goals and Objectives

Goals and Objectives	
Goal 1: Improve the Resiliency of Systems that Support Public Health and Sustainable Development	
Objective 1-1	Promote resilient and sustainable land use practices to increase overall natural resilience.
Objective 1-2	Develop and maintain sustainable and resilient utility services that serve the County's population and businesses.
Objective 1-3	Develop continuity plans to decrease potential local economic losses.
Objective 1-4	Promote higher building standards and sustainable design to resist impacts of natural hazards.
Objective 1-5	Develop a strategy to address recurring property loss due to natural hazards in the County.
Objective 1-6	Pursue federal and state assistance toward the improvement of facilities and infrastructure.
Objective 1-7	Protect and maintain community lifelines including critical facilities and infrastructure.
Objective 1-8	Improve detection, warning and communication systems.
Objective 1-9	Promote and enhance the enforcement of ordinances, regulations and other mechanisms that facilitate resilient and sustainable construction standards.
Objective 1-10	Integrate risk reduction concepts, policies, and projects into existing local and regional planning and engagement efforts.
Objective 1-11	Work with private dam owners to rebuild/ retrofit any high-risk dams that are privately owned, located within Tompkins County.
Objective 1-12	Increase public awareness around high hazard dams and the potential vulnerability posed to residents living in close proximity to such sites.
Objective 1-13	Support the retrofit and or rebuild all publicly owned dams to decrease risk classification.
Goal 2: Increase Partnerships that Improve Hazard Risk Knowledge and Mitigation	
Objective 2-1	Enhance the capabilities of the County and communities by implementing actions that support the development of data and information to better understand the effects of hazard events to support the projects to increase resiliency.
Objective 2-2	Develop government-led initiatives to assist communities in implementing mitigation activities.
Objective 2-3	Share information and best practices with property owners and encourage property owners to take preventive actions in areas that are especially susceptible to hazards.
Goal 3: Protect and Restore Natural Ecosystems to Reduce Flood Risk	
Objective 3-1	Protect and preserve natural systems to reduce long-term costs due to damages caused by natural hazard events.
Objective 3-2	Incorporate hazard mitigation into land-use planning and natural resource management
Goal 4: Enhance Mitigation Collaboration and Coordination Among Emergency Service Agencies to Further Support Life Safety and Economic Resiliency	
Objective 4-1	Enhance collaborative efforts to support improved natural hazard mitigation management and disaster response to promote resiliency.

Goals and Objectives	
Objective 4-2	Engage a broad range of public agencies, citizens, neighborhood groups, non-profit organizations, businesses, and industries to equitably implement mitigation actions.
Objective 4-3	Encourage shared services in acquiring, emergency services and equipment.
Objective 4-4	Coordinate and integrate hazard mitigation actions into emergency operations plans.
Objective 4-5	Develop a strategy to ensure continuity of governmental operations, emergency services, and essential facilities and lifelines at the local level during and immediately after disaster and hazard events.
Objective 4-6	Support County Emergency Management's efforts related to community preparedness requirements and response.
Goal 5: Promote and Strengthen Healthy and Equitable Environments for all Residents with Special Considerations for Those Who Are Socially and Physically Vulnerable	
Objective 5-1	Develop and implement additional education and outreach programs to increase public awareness of hazard areas and impacts.
Objective 5-2	Educate the public on specific, individual and household preparedness and recovery activities.
Objective 5-3	Work to identify those individuals and groups most physically and socially vulnerable to local hazard risk.
Objective 5-4	Work with vulnerable groups and individuals to clarify needs in relation to hazard events and design solutions with them to reduce risks
Objective 5-5	Identify residents and business living and operating in high-risk areas prone to negative impacts by disasters and provide targeted outreach.

6.4 Capability Assessment

According to FEMA's *Mitigation Planning How-To Guide #3*, a capability assessment is an inventory of a community's missions, programs, and policies and an analysis of its capacity to carry them out. This assessment is an integral part of the planning process. The assessment process enables identification, review, and analysis of current local and state programs, policies, regulations, funding, and practices that could either facilitate or hinder mitigation.

During the original planning process, the County and participating municipalities identified and assessed their capabilities in the areas of existing programs, policies, and technical documents. By completing this assessment, each jurisdiction learned how or whether they would be able to implement certain mitigation actions by determining the following:

- Limitations that could exist in undertaking actions.
- The range of local and state administrative, programmatic, regulatory, financial, and technical resources available to assist in implementing their mitigation actions.
- Actions deemed infeasible, as they are currently outside the scope of capabilities.

- Types of mitigation actions that could be technically, legally (regulatory), administratively, politically, or fiscally challenging or infeasible.
- Opportunities to enhance local capabilities to support long term mitigation and risk reduction.

During the plan update process, all participating jurisdictions were tasked with developing or updating their capability assessment, paying particular attention to evaluating the effectiveness of these capabilities in supporting hazard mitigation, and identifying opportunities to enhance local capabilities.

County and municipal capabilities in the Planning and Regulatory, Administrative and Technical, as well as Fiscal arenas can be found in the Capability Assessment section of each jurisdictional annex in Section 9 (Jurisdictional Annexes). Within each annex, participating jurisdictions identified integration of hazard risk management into their existing planning, regulatory, and operational/administrative framework ("integration capabilities") and intended integration promotion (*integration actions*). A further summary of these continued efforts to develop and promote a comprehensive and holistic approach to hazard risk management and mitigation is presented in Section 7 (Plan Maintenance).

A summary of the various federal, state, county, and local planning and regulatory, administrative and technical, and fiscal programs available to promote and support mitigation and risk reduction in Tompkins County are presented below.

6.4.1 Planning and Regulatory Capabilities - County and Local

6.4.1.1 Municipal Land Use Planning and Regulatory Authority

The County and municipalities have various land use planning mechanisms that can be leveraged to mitigate flooding and support natural hazard risk reduction. Specific County and local planning and regulatory capabilities are identified in their jurisdictional annexes in Section 9 (Jurisdictional Annexes). The Tompkins County Department of Planning & Sustainability implements the County's Comprehensive Plan, provides stakeholder engagement and technical assistance, supports economic development and sustainability initiatives, and provides planning services for the County government.

Section 239 of New York State General Municipal Law requires the referral of certain local planning actions to county planning departments for the examination of possible inter-municipal impacts, including those impacts to known hazard areas including floodplains. The department conducts reviews and renders advisory opinions on land use proposals in the County.

The County has completed a range of connected planning efforts including:

- The Cayuga Inlet Sediment Assessment/Sediment Reduction Report 2016 - Reduce sands, silts and clays from reaching the Flood Control Channel.
- Agriculture and Farmland Protection Plan 2015 - Area farmland protection plan which includes analysis of changing climate on agriculture.
- 2040 Long Range Transportation Plan - Promotion of land development patterns that enable the efficient and equitable provision of multimodal transportation services.
- Cleaner Greener Southern Tier: Regional Sustainability Plan 2013 - Minimize flood losses by preserving and enhancing floodplains and wetlands, and by limiting development in flood-prone areas.
- Tools to Promote and Regulate the Deployment of Renewable Energy Systems - Promote and Regulate the Deployment of Renewable Energy Systems – solar and wind.
- Energy Strategy 2019 - Reduce greenhouse gas emissions to reach a minimum 80 percent reduction from 2008 levels by 2050 and reduce reliance on fossil fuels across all sectors.
- Comprehensive Plan 2015 – Make the County a place where the entire community is prepared for the economic, environmental, and social impacts of climate change.
- Housing Strategy 2017 - Support new development of housing where total costs, including utility and transportation expenses, are affordable to households with a range of incomes.
- Habitat Connectivity Strategy 2018 - Maintain large, intact patches of important native vegetation by preventing fragmentation of those patches by development.
- Comprehensive Emergency Management Plan 2018 - Provide a framework for coordinated response and recovery activities during an emergency.

6.4.1.2 Tompkins County Comprehensive Emergency Management Plan (CEMP)

The Comprehensive Emergency Management Plan (CEMP) is an all-hazards plan that describes how Tompkins County will organize and respond to emergencies and disasters throughout the County. Tompkins County's CEMP is currently in the process of being updated. It is consistent with Federal, New York State and Tompkins County laws as well as other applicable plans, and policies, including the National Response Framework and the New York State Comprehensive Emergency Management Plan. The CEMP is one component of the County's emergency management program designed to address all phases of emergency management including mitigation and prevention, preparedness, response and recovery.

Tompkins County understands emergency management planning as a continuous process linked closely with training and exercises to establish a comprehensive preparedness agenda and organizational culture that prioritizes increased disaster resiliency. The Tompkins County Department of Emergency Response will maintain the CEMP through a program of continuous improvement, including ongoing involvement of County departments and of agencies and individuals with responsibilities and interests in this plan and its supporting documents.

6.4.1.3 Local Waterfront Revitalization Program

The Waterfront Revitalization of Coastal Areas and Inland Waterways Act offers local governments the opportunity to participate in the state's Coastal Management Program (CMP) on a voluntary basis by preparing and adopting a Local Waterfront Revitalization Program (LWRP) and providing more detailed implementation of the state's CMP through use of such existing broad powers as zoning and site plan review (New York State Division of Planning 2018).

When an LWRP is approved by the New York State Secretary of State, state agency actions are required to be consistent with the approved LWRP to the maximum extent practicable. When the federal government concurs with the incorporation of an LWRP into the CMP, federal agency actions must be consistent with the approved addition to the CMP. Title 19 of NYCRR Part 600, 601, 602, and 603 provide the rules and regulations that implement each of the provisions of the Waterfront Revitalization of Coastal Areas and Inland Waterways Act including but not limited to the required content of an LWRP, the processes of review and approval of an LWRP, and LWRP amendments (New York State Division of Planning 2018).

An LWRP consists of a planning document prepared by a community and the program established to implement the plan. An LWRP could be comprehensive and address all issues that affect a community's entire waterfront, or it might address the most critical issues facing a significant portion of its waterfront. An approved LWRP reflects community consensus and provides a clear direction for appropriate future development. It establishes a long-term partnership among local government, community-based organizations, and the state. Also, funding to advance preparation, refinement, or implementation of LWRP is available under Title 11 of the New York State Environmental Protection Fund LWRP, among other sources (New York State Division of Planning 2018).

Any village, town, or city located along the state's coast or designated inland waterway can prepare a new or amend an existing LWRP. However, only communities located along a waterway designated in Executive Law are eligible for grants from the Environmental Protection Fund Local Waterfront Revitalization Program for its preparation and implementation. Municipalities are encouraged to address local revitalization issues in a broader context, aligned with regional economic development strategies and regional resource protection and management programs (New York State Division of Planning 2018).

As of the date of this plan update, there are no municipalities in the County with an approved Local Waterfront Revitalization Plan. In 2004, the County and several waterfront municipalities did however complete the Cayuga Lake Waterfront Plan to guide development and coordinate planning along the shores of Cayuga Lake. The Waterfront Revitalization Area Boundary includes portions of the City of Ithaca, Town of Ithaca, Town of Lansing, Village of Lansing, the Village of Cayuga Heights, and the Town of Ulysses.

6.4.2 Planning and Regulatory Capabilities – State and Federal

6.4.2.1 National Flood Insurance Program (NFIP)

The U.S. Congress established the NFIP with the passage of the National Flood Insurance Act of 1968 (FEMA's 2002 National Flood Insurance Program (NFIP): Program Description). The NFIP is a federal program enabling property owners in participating communities to purchase insurance as a protection against flood losses in exchange for state and community floodplain management regulations that reduce future flood damages. Please refer to the Flood Hazard Profile in Section 5.4.2 (Flood) for information on recent legislation related to reforms to the NFIP.

There are three components to the NFIP: flood insurance, floodplain management, and flood hazard mapping. Communities participate in the NFIP by adopting and enforcing floodplain management ordinances to reduce future flood damage. In exchange, the NFIP makes federally backed flood insurance available to homeowners, renters, and business owners in these communities. Community participation in the NFIP is voluntary. Flood insurance is designed to provide an alternative to disaster assistance to reduce the escalating costs of repairing damage to buildings and their contents caused by floods. Flood damage in the United States is reduced by nearly $1 billion each year through communities implementing sound floodplain management requirements and property owners purchasing flood insurance. Additionally, buildings constructed in compliance with NFIP building standards suffer approximately 80 percent less damage annually than those not built-in compliance (FEMA 2008).

Municipal participation in, and compliance with the NFIP, is supported at the federal level by FEMA Region II and the Insurance Services Organization, at the state-level by the New York State Department of Environmental Conservation (NYSDEC) and New York State Office of Emergency Management (NYS DHSES). Additional information on the NFIP program and its implementation throughout the County can be found in the flood hazard profile in Section 5.4.2 (Flood).

The state and municipalities within the NFIP could adopt higher regulatory standards when implementing the provisions of the NFIP. Specifically identified are the following:

Freeboard: By law, NYS requires Base Flood Elevation plus 2 feet (BFE+2) for all construction. When there is a base flood elevation available, the lowest floor including any basement, must be at or above the base flood elevation (plus two feet beginning in 2007). Elevation could be by means of properly compacted fill, a solid slab foundation, or a *crawl space* foundation, which contains permanent openings to let flood waters in and out. Non-residential structures might be flood proofed in lieu of elevation. Where a local floodplain administrator has information to estimate a base flood elevation, such as historic flood records or a hydraulic study, that elevation must be used. If the development consists of more than 5 acres or more than 50 lots, the permit applicant must develop a base flood elevation and build accordingly (NYSDEC 2018). Communities could go beyond this requirement, providing for additional freeboard. In most New York communities, new structures must have the lowest floor three feet or more above the highest adjacent grade.

Cumulative Substantial Improvements/Damages: The NFIP allows improvements valued at up to 50 percent of the building's pre-improvement value to be permitted without meeting the flood protection requirements. Over the years, a community could issue a succession of permits for different repairs or improvement to the same structures. This can greatly increase the overall flood damage potential for structures within a community. The community might wish to deem *substantial improvement* cumulatively so that once a threshold of improvement within a certain length of time is reached, the structure is considered to be substantially improved and must meet flood protection requirements.

6.4.2.2 NFIP Community Rating System (CRS)

As an additional component of the NFIP, the Community Rating System (CRS) is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements. As a result, flood insurance premium rates are discounted to reflect the reduced flood risk resulting from the community actions meeting the three goals of the CRS: (1) reduce flood losses, (2) facilitate accurate insurance rating, and (3) promote the awareness of flood insurance (FEMA 2012). Municipalities, and the County as a whole, could expect significant cost savings on premiums if enrolled in the CRS program.

As of May 2020, there are no communities in Tompkins County actively participating in the CRS program. The County will be assessing local community participation in CRS as a part of the companion resiliency and recovery planning effort.

6.4.2.3 U. S. Army Corps of Engineers

Under Section 404(e) of the Clean Water Act, the U.S. Army Corps of Engineers (USACE) can issue general permits to authorize activities that have only minimal individual and cumulative adverse environmental effects. A nationwide permit (NWP) is a general permit that authorizes activities across the country, unless a district or division commander revokes the nationwide permit in a state or other geographic region. There are 54 nationwide permits, and they authorize a wide variety of activities, including: linear transportation projects, bank stabilization activities, residential development, commercial and industrial developments, aids to navigation and certain maintenance activities (USACE 2020). Details on each NWP can be found here: https://www.nan.usace.army.mil/Missions/Regulatory/Regional-General-Permits/

There are three types of USACE permits: standard, nationwide (described above), and regional. Standard permits are individual permits that involve full public interest review of an individual permit application and includes the issuance of a public notice for any project that does not meet the terms and conditions of an NWP or a Letter of Permission (LOP). Regional general permits are for small, specialized projects. In New York

State, there are six regional general permit categories (see https://www.lrb.usace.army.mil/Missions/Regulatory/New-York-Permit-Information/).

6.4.2.4 New York State Floodplain Management

The following two departments have statutory authorities and programs that affect floodplain management at the local jurisdiction level in New York State: the NYSDEC and the Department of State's Division of Code Enforcement and Administration (DCEA). DCEA is detailed in Section 6.4.4 (Administrative and Technical Capabilities - State and Federal).

The NYSDEC is charged with conserving, improving, and protecting the state's natural resources and environment, and preventing, abating, and controlling water, land, and air pollution. Programs that have bearing on floodplain management are managed by the Bureau of Flood Protection and Dam Safety, which cooperates with federal, state, regional, and local partners to protect lives and property from floods, coastal erosion, and dam failures. These objectives are accomplished through floodplain management and both structural and nonstructural means.

The Dam Safety Section is responsible for "reviewing repairs and modifications to dams and assuring [sic] that dam owners operate and maintain dams in a safe condition through inspections, technical reviews, enforcement, and emergency planning." The Flood Control Projects Section is responsible for reducing flood risk to life and property through construction, operation, and maintenance of flood control facilities.

The Floodplain Management Section is responsible for reducing flood risk to life and property through management of activities, such as development in flood hazard areas, and for reviewing and developing revised flood maps. The section serves as the NFIP State Coordinating Agency and in this capacity, is the liaison between FEMA and New York communities that elect to participate in the NFIP. The section provides a wide range of technical assistance.

6.4.3 Administrative and Technical Capabilities - County and Local

6.4.3.1 Tompkins County Department of Planning & Sustainability

The Tompkins County Department of Planning & Sustainability works to implement the County's Comprehensive Plan which presents a long-term vision for the future of the community. The plan is based on three overarching principles that the County should be a place where the needs of current and future generations are met without compromising the ecosystems upon which they depend; all levels of government work cooperatively to address regional issues; and taxpayer dollars are invested in public infrastructure and facilities in the most efficient manner possible.

Many of the Department's specific work activities have been identified in a series of short-term strategies for working toward achieving the Comprehensive Plan's vision. These strategies have been prepared to address housing, land conservation, energy, tourism, and development.

The Department provides a number of functions and methods to implement its planning efforts. The Department is involved with broad ranging activities including, providing support advisory boards, provides technical support to local governments, facilitates resiliency and recovery planning work, provides support for affordable housing development efforts, and provides technical and financial support for local sustainability initiatives. The Department also undertakes a range of projects that protects the County's water and natural resources.

6.4.3.2 Tompkins County Department of Emergency Response

The Department of Emergency Response (DOER) oversees Countywide emergency dispatch and communications systems that allow residents to dial 9-1-1 to receive emergency medical, fire, police, or other emergency help from any phone within Tompkins County. The 9-1-1 system, through the use of Countywide communications and Computer-Aided Dispatch (CAD) systems, is able to locate callers' addresses and phone information while communicating with fire, police, and medical personnel in the field.

> Tompkins County DOER keeps Emergency Action Plans (EAPs) for dams located in the County. Additionally, all NYSDEC Dam Safety inspection reports are sent to DOER as well.

The Department implements County Mutual Aid/Disaster Plans, which provide County fire, emergency medical, and other agency assistance when local services have exceeded their local equipment and personnel resources.

In coordination with Tompkins-Cortland Community College (TC3), the Department provides training of emergency medical personnel. The Department also provides training for 16 fire departments through the Office of Fire Prevention and Control (OFPC) of New York State.

Citizens requesting Emergency Preparedness information are encouraged to visit the Tompkins Ready webpage.

6.4.3.3 Tompkins County Soil and Water Conservation District (SWCD)

The mission of the Tompkins County SWCD is to "to provide assistance to citizens and units of local government in making sound decision on the management of soil, water and related natural resources based on their needs. The SWCD will further assist in the implementation of decisions by seeking and coordinating technical and financial assistance from federal, state, and local governments, and private sources."

The Tompkins County SWCD is one of 58 such districts in New York State. These districts provide services and fund projects related to the conservation of soil and water resources, the improvement of water quality, the control and prevention of soil erosion and the prevention of floodwater and sediment damage. SWCD offers several programs in the areas of agriculture environmental management, stormwater pollution prevention, water quality improvement, and aquatic invasive species control. They actively work with regional organizations such as Cornell University, the Cornell Cooperative Extension of Tompkins County, and the New York Water Resources Institute to facilitate the implementation of new management and conservation methods that can add to the effectiveness and efficiency of the District's work. SWCD also works in close connection with the highway department and provides technical advisement as needed.

6.4.3.4 Tompkins County Highway Department

The Department maintains more than 300 miles of roadway and 109 bridges in the County. The mission of the Highway Department is to provide highway and bridge construction, maintenance, and emergency services safely, effectively, and efficiently for our local and traveling public customers, while promoting self-esteem and growth as individuals.

Road Maintenance staff construct, maintain, and repair roads, maintain intersections and roadside drainage, eliminate roadside hazards, and repair guiderails. The Tompkins County Highway Department also maintains more than 4,500 signs. The highway department works with the County SWCD to conduct stormwater maintenance and stream management to increase efficiency and streamline working collaboration between departments.

6.4.4 Administrative and Technical Capabilities - State and Federal

6.4.4.1 New York State Division of Homeland Security and Emergency Services (NYS DHSES)

For more than 50 years, NYS DHSES (formerly New York State Office of Emergency Management) and its predecessor agencies have been responsible for coordinating the activities of all state agencies to protect New York's communities, the state's economic well-being, and the environment from natural and man-made disasters and emergencies. NYS DHSES routinely assists local governments, voluntary organizations, and private industry through a variety of emergency management programs, including hazard identification, loss prevention, planning, training, operational response to emergencies, technical support, and disaster recovery assistance.

NYS DHSES administers the FEMA mitigation grant programs in the state and supports local mitigation planning in addition to developing and routinely updating the State Hazard Mitigation Plan. NYS DHSES prepared the current State Hazard Mitigation Plan, working with input from other state agencies, authorities and organizations. The plan was approved by FEMA in 2019 and enables New York to remain eligible for recovery assistance in all Public Assistance Categories A through G and Hazard Mitigation assistance in each of the Unified Hazard Mitigation Assistance Program's five grant programs. For example, the 2008-2011 State Mitigation Plan allowed the state and its communities to access nearly $57 million in mitigation grants to prepare plans and carry out projects. The 2019 New York State HMP was used as guidance in completing the Tompkins County HMP Update. The state HMP can be found here: https://mitigateny.availabs.org/ .

6.4.4.2 New York State Department of Environmental Conservation (NYSDEC) – Region 7

Within the NYSDEC – Region 7 Central New York State and includes Broome, Cayuga, Chenango, Cortland, Madison, Onondaga, Oswego, Tioga and Tompkins counties. The Region 7 office is located in Syracuse, NY. DEC is headed by a Commissioner, who is assisted by executive managers. The department has 24 divisions and offices and is further organized into bureaus to fulfill the functions and regulations established by Title 6 of New York Codes, Rules and Regulations (6NYCRR) NYSDEC staff have two main areas of responsibility: natural resource management and environmental quality protection. As part of natural resource management staff oversee state fish and wildlife resources, as well as state forests.

It is the Mission of the DEC "To conserve, improve and protect New York's natural resources and environment and to prevent, abate and control water, land and air pollution, in order to enhance the health, safety and welfare of the people of the state and their overall economic and social well-being."

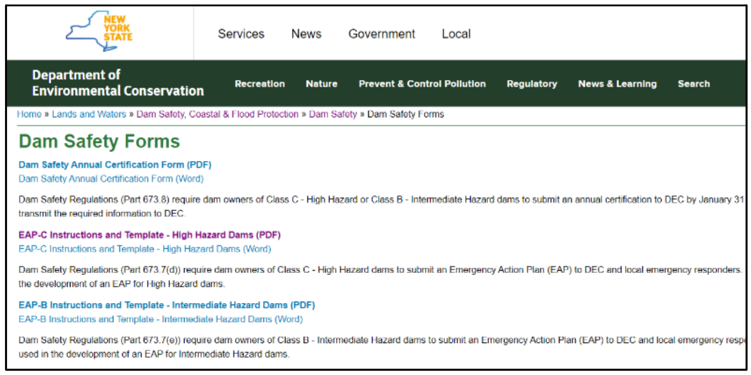
DEC's goal is to achieve this mission through the simultaneous pursuit of environmental quality, public health, economic prosperity and social well-being, including environmental justice and the empowerment of individuals to participate in environmental decisions that affect their lives.

6.4.4.3 New York State Department of Environmental Conservation (NYSDEC) – Division of Water - Bureau of Flood Protection and Dam Safety

Within the NYSDEC – Division of Water, the Bureau of Flood Protection and Dam Safety (https://www.dec.ny.gov/chemical/290.html#Bureaus) cooperates with federal, state, regional, and local partners to protect lives and property from floods, coastal erosion and dam failures through floodplain management and both structural and non-structural means; and, provides support for information technology needs in the Division. The Bureau consists of there sections as described below.

Dam Safety

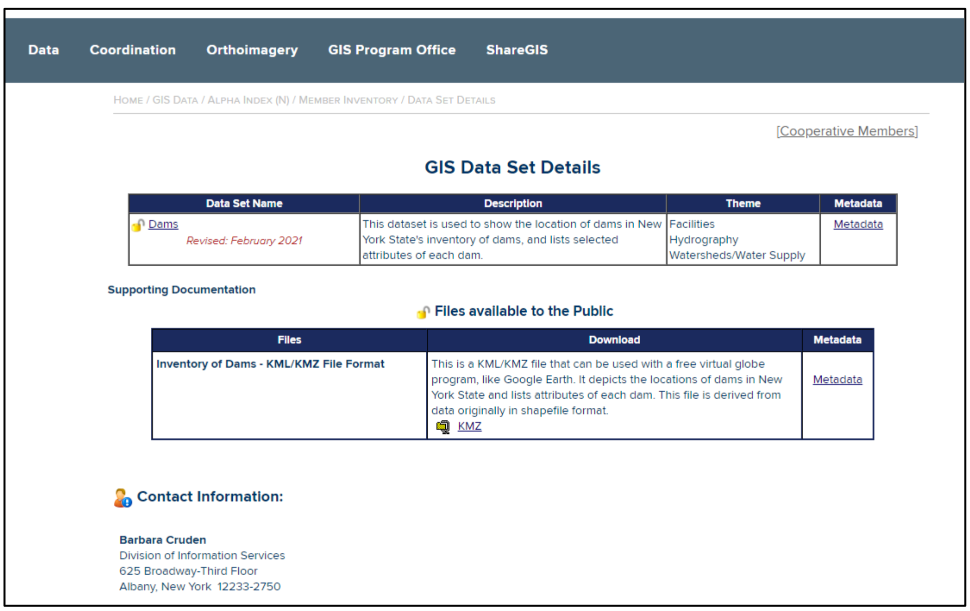
Figure 6-1. Dam Safety Forms



NYSDEC has the regulatory power over dams across the State. The functions of the Dam Safety Section include: safety inspection of dams; technical review of proposed dam construction or modification; monitoring of remedial work for compliance with dam safety criteria; and emergency preparedness.

To provide support and assistance to dam owners and operators, the NYSDEC website contains information that can help. This includes dam safety forms, Emergency Action Plan (EAP) instructions and guidance, documents for dam owners, and a complete inventory of dams for the State. This can all be found on their website: https://www.dec.ny.gov/lands/311.html. Counties and municipalities can access the NYS DEC Inventory of Dams on the State's GIS data site (https://gis.ny.gov/gisdata/inventories/details.cfm?DSID=1130).

Figure 6-2. New York State GIS Data – Inventory of Dams



Coastal Erosion and Flooding

The Coastal Erosion branch of this section works to reduce coastal erosion and storm damage to protect lives, natural resources, and properties through structural and non-structural means. The Floodplain Management branch is responsible for reducing flood risk to life and property through proper management of activities including development in flood hazard areas, and review and development of revised flood maps.

Flood Protection and Floodplain Management

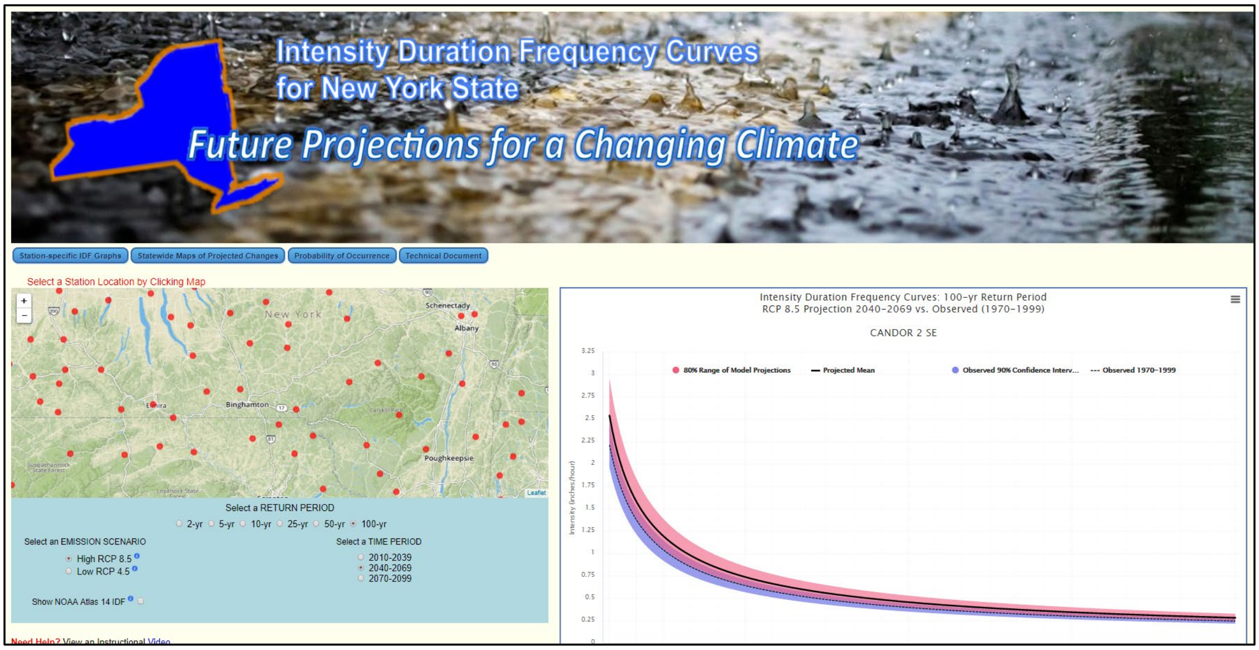
This section is responsible for reducing flood risk to life and property through construction, operation and maintenance of flood control facilities. NYSDEC works with communities throughout the State to find ways to reduce or protect against physical and property damage caused by flooding. The Department works on: structural flood damage reduction projects to prevent flood water from damaging communities; helps communities establish sustainable floodplain management programs to mitigate flooding; and works with communities participating in the NFIP to administer local regulations and building standards for flood damage prevention (NYSDEC Division of Water 2020).

6.4.4.4 Northeast Regional Climate Center

The Northeast Regional Climate Center (NRCC), based out of Cornell, partnered with the New York State Energy Research and Development Authority (NYSERDA) to compare various methods of downscaling global climate model (GCM) output and create extreme precipitation projections for New York State. These projections will ultimately be incorporated into climate change adaptation planning. In 2009 alone, 175 total flooding events in New York State led to $32.82 million in property damage. The state is also still recovering from the $42 billion toll of Superstorm Sandy. Climate change is resulting in an increase in the frequency of heavy rainfall events. To help New York State communities plan for effects of climate change, new graphics are now available showing the increased likelihood of heavy precipitation events. These graphs, called Intensity Duration Frequency (IDF) curves, show anticipated increases of storm events from 2- to 100-year intervals and are projected into the future as far as 2099. These products are designed for use by municipal officials, researchers, planners, highway departments, and other decision-makers who need to take storm events into account. These IDF curves display how precipitation events are being affected by New York State's rapidly changing climate (NRCC 2015).

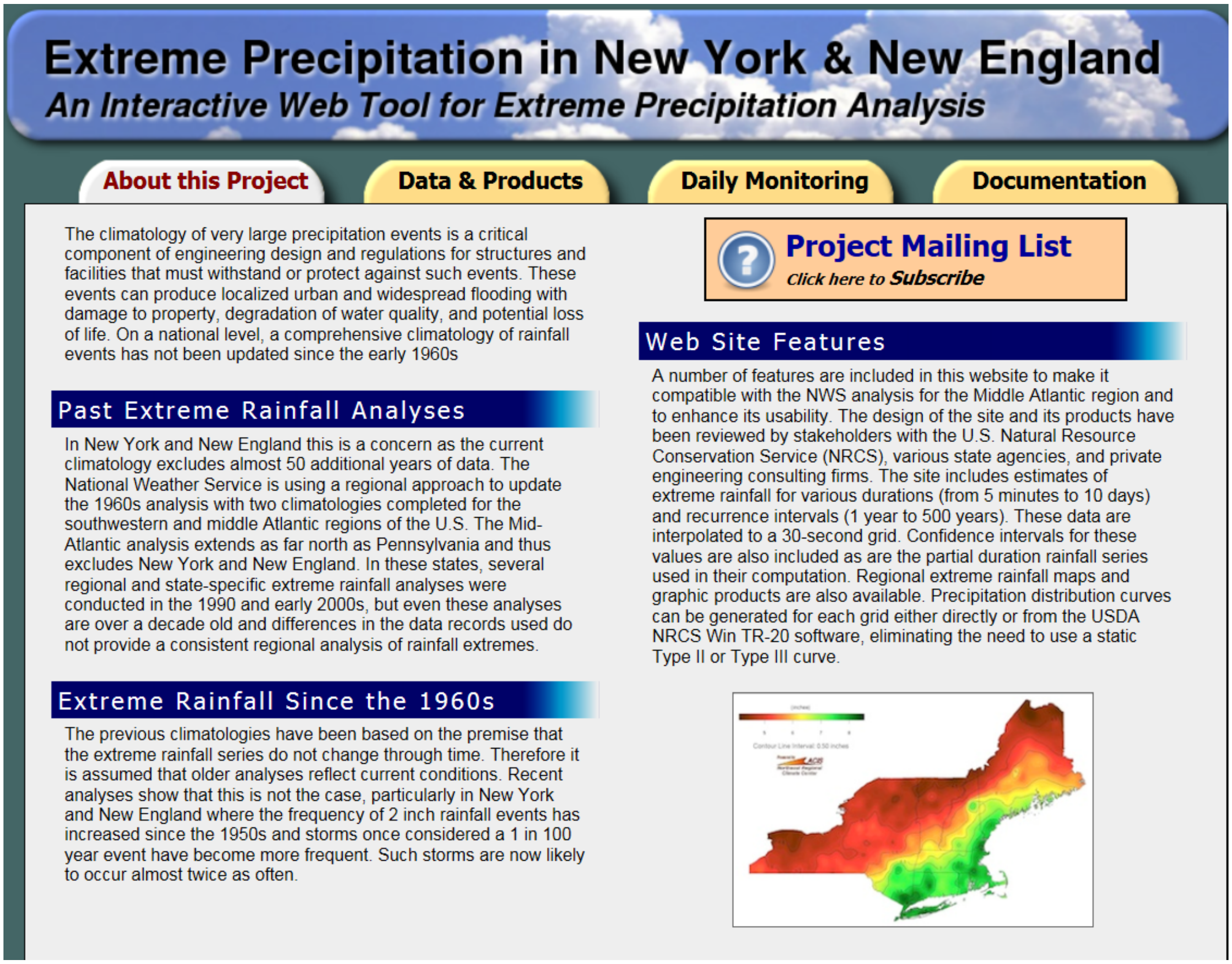
Projections for Tompkins County are discussed in Section 5 (Risk Assessment). To help New York State communities plan for effects of climate change, new graphics are now available showing the increased likelihood of heavy precipitation events (NRCC 2020). The projections are provided at: http://www.nrcc.cornell.edu/ Figure 6-3 displays the screenshot of the website.

Figure 6-3. Screenshot of the IDF Curves for New York State



NRCC also maintains the Extreme Precipitation in New York & New England website, an interactive tool for extreme precipitation analysis. The site includes estimates of extreme rainfall for various durations (5 minutes to 10 days) and recurrence intervals (1 year to 500 years). This data is interpolated to a 30-second grid. Confidence intervals for these values are included as are the partial duration rainfall series used in their computation. Regional extreme rainfall maps and graphic products are available. Precipitation distribution curves can be generated for each grid either directly or from the USDA NRCS Win TR-20 software, eliminating the need to use a static Type II or Type III curve (NRCC 2018). This tool can be used by municipalities to assist them in the design and feasibility assessment of future projects and allow them to see the future intensity and frequency of rain events. Figure 6-4 shows a screenshot of the website.

Figure 6-4. Screenshot of the Extreme Precipitation in New York & New England website



6.4.4.5 Department of State's Division of Code Enforcement and Administration (DCEA)

Technical Bulletins for the Codes of New York State

The DCEA publishes technical bulletins for its building codes. TB-1004 came into effect in October 2017 and addressed Flood Venting in Foundations and Enclosures in Flood Areas. The bulletin clarifies definitions and requirements with regard to Residential and Building Construction (19NYCRR 1220 and 1221). Bulletins also address requirements for critical facilities such as fire stations, requirements for fire extinguishers, and other hazards.

Forms and Publications

The DCEA posts several model reporting forms and related publications on its webpage. The Building Permit Application requests the applicant to indicate whether the site is or is not in a floodplain and advises checking with the jurisdiction's clerk or NYSDEC. The General Residential Code Plan Review form includes a reminder to "add 2' freeboard." Sample Flood Hazard Area Review Forms, including plan review checklists and inspection checklists for Zone A and Zone V, are based on the forms in Reducing Flood Losses through the International Code Series published by International Code Council and FEMA (2008).

6.4.4.6 New York Rural Water Association

New York Rural Water Association (NYRWA) is the largest membership organization representing small water/wastewater systems in the state. The system members include villages, towns, municipal water and sewer districts, county authorities, state and federal institutions/facilities, schools and colleges, investor-owned water utilities, homeowner associations, and privately owned systems such as mobile home parks.

NYRWA assists communities and systems to comply with complex regulations and to protect the public health and environment. NYRWA also offers specialized training to industry professionals at regional meetings and our statewide annual technical conference. And finally, NYRWA acts as a liaison between the state and federal government, local communities, and rural water and wastewater systems.

Enfield and Tompkins County is currently working with the NY Rural Water Association to help assess local water quality and quantity issues associated with groundwater. Free support to develop water quality plans and may result in water protection ordinance. Uses DoH test well information to assess demand and have developed survey to determine what % town is dealing with water issues.

6.4.5 Fiscal Capabilities – County and Local

6.4.5.1 Municipal Fiscal Capabilities

Tompkins County municipalities' fund mitigation projects largely though existing local budgets, local appropriations (including referendums and bonding), but also supplement this a variety of federal and state loan and grant programs. Many municipalities noted throughout the planning process that they are faced with increasing fiscal constraints, including decreasing revenues, budget constraints, and tax caps. In an effort to overcome these fiscal challenges, municipalities continue to leverage the sharing of resources and combining available funding with grants and other sources. Many however noted limited capacity to be able to take advantage of funding opportunities and noted that inter-municipal cooperation would be beneficial in obtaining funding.

6.4.6 Fiscal Capabilities – State and Federal

The 2019 New York State Hazard Mitigation Plan provides information pertaining to the various funding sources available for mitigation projects which can be found at: https://mitigateny.availabs.org/strategies/funding. Furthermore, the New York Mitigation Resource Guide (https://www.fema.gov/sites/default/files/2020-09/fema_region-03_mitigation-funding-resource-guide_new-york-09-24-2020.pdf) provides added information on a range of creative funding sources for mitigation.

As noted on the FEMA hazard mitigation assistance (HMA) website (https://www.fema.gov/hazard-mitigation-assistance), FEMA HMA has four, core grant programs: Hazard Mitigation Grant Program (HMGP), Flood Mitigation Assistance (FMA) Program, HMGP Post Fire Grant, and Building Resilient Infrastructure & Communities (BRIC) (formally PDM).

Table 6-2 provides an overview of program funding eligibility and cost share.

Table 6-2. FEMA HMA Grant Cost Share Requirements

Programs	Cost Share (Percent of Federal / Non-Federal Share)
HMGP	75 / 25
FMA – insured properties and planning grants	75 / 25
FMA – repetitive loss property(2)	90 / 10
FMA – severe repetitive loss property(2)	100 / 0
BRIC	75 / 25
BRIC – subrecipient is small and impoverished community	90 / 10

Source: FEMA HMA Guidance 2015; Regulations.gov 2020; FEMA 2020

(1) Subapplicants should consult their State Hazard Mitigation Officer (SHMO) for the amount of percentage of HMGP subrecipient management cost funding their State has determined to be passed through subrecipients.

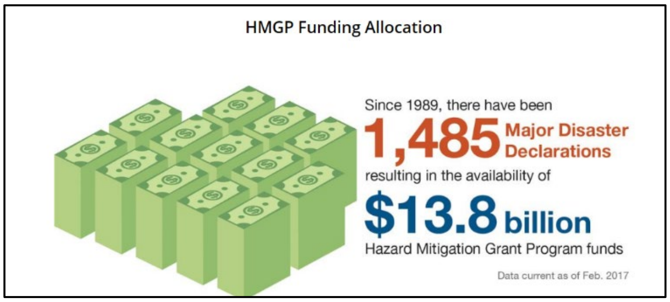
(2) To be eligible for an increased federal cost share, a FEMA-approved state or tribal (standard or enhanced) mitigation plan that addressed repetitive loss properties must be in effect at the time of award, and the property is being submitted for consideration must be a repetitive loss property. The RL or SRL designation is based on the FMA definition for RL or SRL properties.

6.4.6.1 Federal Hazard Mitigation Funding Opportunities

Federal mitigation grant funding is available to all communities with a current HMP (this plan); however most of these grants require a “local share” in the range of 10-25 percent of the total grant amount. Details about grant programs and further descriptions of these opportunities can be found at: https://www.fema.gov/hazard-mitigation-assistance. The FEMA mitigation grant programs are described below.

Hazard Mitigation Grant Program (HMGP)

Figure 6-5. FEMA HMGP Funding Allocation

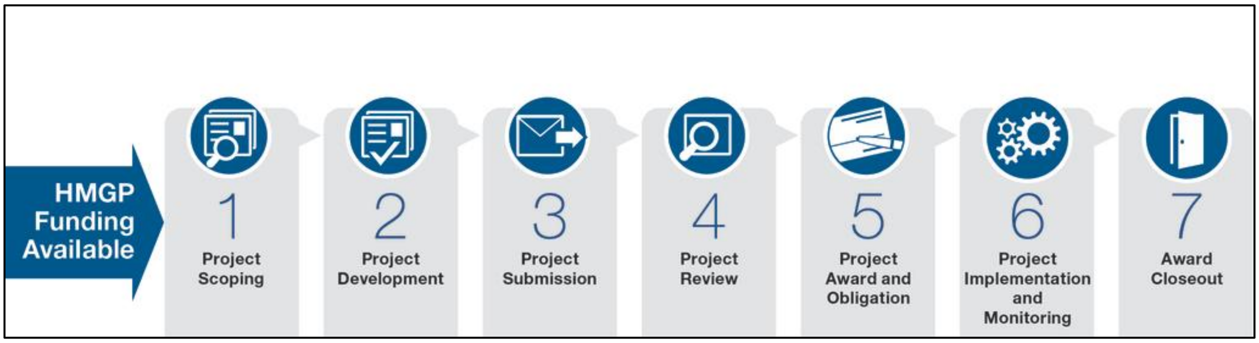


Source: FEMA 2018

The HMGP is a post-disaster mitigation program. FEMA makes these grants available to states by after each federal disaster declaration. The HMGP can provide up to 75 percent funding for hazard mitigation measures and can be used to fund cost-effective projects that will protect public or private property or that will reduce the likely damage from future disasters in an area covered by a federal disaster declaration. Examples of projects include acquisition and demolition of structures in hazard prone areas, flood-proofing or elevation to reduce future damage, minor structural improvements, and development of state or local standards. Projects must fit into an overall mitigation strategy for the area identified as part of a local planning effort. All applicants must have a FEMA-approved HMP (this plan).

Applicants who are eligible for the HMGP are state and local governments, certain nonprofit organizations or institutions that perform essential government services, and Indian tribes and authorized tribal organizations. Individuals or homeowners cannot apply directly for the HMGP; a local government must apply on their behalf. Applications are submitted to NYS DHSES, placed in rank order for available funding, and submitted to FEMA for final approval. Eligible projects not selected for funding are placed in an inactive status and could be considered as additional HMGP funding becomes available. Additional information regarding the HMGP is available on the FEMA website: https://www.fema.gov/hazard-mitigation-grant-program.

Figure 6-6. FEMA HMGP Applicant/Subapplicant Process



Source: *FEMA 2018*

Flood Mitigation Assistance (FMA) Program

The FMA program combines the previous Repetitive Flood Claims and Severe Repetitive Loss Grants into one grant program. The FMA provides funding to assist states and communities in implementing measures to reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other structures insurable under the NFIP. The FMA is funded annually; no federal disaster declaration is required.

Only NFIP insured homes and businesses are eligible for mitigation in this program. Funding for FMA is very limited and, as with the HMGP, individuals cannot apply directly for the program. Applications must come from local governments or other eligible organizations. The federal cost share for an FMA project is at least 75 percent. For the nom-federal share, at most 25 percent of the total eligible costs must be provided by a non-federal source; of this 25 percent, no more than half can be provided as in-kind contributions from third parties. At minimum, a FEMA-approved local flood mitigation plan is required before a project can be approved. The FMA funds are distributed from FEMA to the state. The NYS DHSES serves as the grantee and program administrator for the FMA program.

The FMA program is detailed on the FEMA website: https://www.fema.gov/flood-mitigation-assistance-grant-program

6.4.6.2 Building Resilient Infrastructure and Communities

BRIC provides funding to states, local communities, tribes and territories (SLTTs) for pre-disaster mitigation activities. BRIC is replacing the existing Pre-Disaster Mitigation (PDM) program (FEMA 2020). The BRIC priorities include:

- Incentivize public infrastructure projects;
- Incentivize projects that mitigate risk to one or more lifelines;
- Incentivize projects that incorporate nature-based solutions; and,
- Incentivize adoption and enforcement of modern building codes (FEMA 2020).

Like the other HMA grants, a cost share is required for all subapplicants of the BRIC program. The non-federal cost share can include one or a combination of cash, donated or third-party in-kind services, and/or materials. FEMA will provide 100 percent federal funding for management costs (FEMA 2020). The cost share for this program is as follows:

- Generally, the cost share for this program is 75 percent federal/25 percent non-federal.
- Small impoverished communities are eligible for cost share up to 90 percent federal/10 percent non-federal.
- For insular areas, including American Samoa, Guam, the Northern Mariana Islands, and the U.S. Virgin Islands, FEMA waives the non-federal cost share for the recipient when the non-federal cost share for the entire award is under $200,000. The recipient can request the waiver in its application (FEMA 2020).

6.4.6.3 Extraordinary Circumstances

For FMA project subawards, the FEMA Region might apply extraordinary circumstances when justification is provided and with concurrence from FEMA Headquarters (Risk Reduction and Risk Analysis Divisions) prior to granting an exception. If this exception is granted, a local mitigation plan must be approved by FEMA within 12 months of the award of the project subaward to that community. Further clarification from FEMA concerning the applicability of extraordinary circumstances with respect to BRIC funding.

For HMGP and FMA, extraordinary circumstances exist when a determination is made by the applicant and FEMA that the proposed project is consistent with the priorities and strategies identified in the State (Standard or Enhanced) Mitigation Plan and that the jurisdiction meets at least one of the criteria below. If the jurisdiction does not meet at least one of these criteria, the region must coordinate with FEMA Headquarters (Risk Reduction and Risk Analysis Divisions) for HMGP; however, for FMA the region must coordinate and seek concurrence prior to granting an exception. The criteria are as follows:

- The jurisdiction meets the small impoverished community criteria (see Part VIII, B.2 of HMA Unified Guidance).
- The jurisdiction has been determined to have had insufficient capacity due to lack of available funding, staffing, or other necessary expertise to satisfy the mitigation planning requirement prior to the current disaster or application deadline.
- The jurisdiction has been determined to have been at low risk from hazards because of low frequency of occurrence or minimal damage from previous occurrences as a result of sparse development.
- The jurisdiction experienced significant disruption from a declared disaster or another event that impacts its ability to complete the mitigation planning process prior to award or final approval of a project award.
- The jurisdiction does not have a mitigation plan for reasons beyond the control of the state, federally recognized tribe, or local community, such as Disaster Relief Fund restrictions that delay FEMA from granting a subaward prior to the expiration of the local or tribal mitigation plan.

6.4.6.4 Federal and State Disaster and Recovery Assistance Programs

Following a disaster, various types of assistance could be made available by local, state, and federal governments. The types and levels of disaster assistance depend on the severity of the damage and the declarations that result from the disaster event. The following sections detail the general types of assistance that might be provided should the President of the United States declare the event a major disaster.

Individual Assistance (IA)

IA provides help for homeowners, renters, businesses, and some non-profit entities after disasters occur. This program is largely funded by the U.S. Small Business Administration. For homeowners and renters, those who suffered uninsured or underinsured losses could be eligible for a Home Disaster Loan to repair or replace damaged real estate or personal property. Renters are eligible for loans to cover personal property losses. Individuals are allowed to borrow up to $200,000 to repair or replace real estate, $40,000 to cover losses to personal property, and an additional 20 percent for mitigation. For businesses, loans could be made to repair or replace disaster damages to property owned by the business, including real estate, machinery and equipment, inventory, and supplies. Businesses of any size are eligible. Non-profit organizations, such as charities, churches, and private universities are eligible. An Economic Injury Disaster Loan provides necessary working capital until normal operations resume after a physical disaster but are restricted by law to small businesses only. IA is detailed on the FEMA website: https://www.fema.gov/individual-disaster-assistance.

Public Assistance (PA)

PA provides cost reimbursement aid to local governments (state, county, local, municipal authorities, and school districts) and certain non-profit agencies that were involved in disaster response and recovery programs or that suffered loss or damage to facilities or property used to deliver government-like services. This program is largely funded by FEMA with both local and state matching contributions required. PA is detailed on the FEMA website: https://www.fema.gov/public-assistance-local-state-tribal-and-non-profit.

Small-Business Administration (SBA) Loans

SBA provides low-interest disaster loans to homeowners, renters, business of all sizes, and most private nonprofit organizations. SBA loans can be used to repair or replace the following items damaged or destroyed in a declared disaster: real estate, personal property, machinery and equipment, and inventory and business assets.

Homeowners could apply for up to $200,000 to replace or repair their primary residence. Renters and homeowners could borrow up to $40,000 to replace or repair personal property-such as clothing, furniture, cars, and appliances that were damaged or destroyed in a disaster. Physical disaster loans of up to $2 million are available to qualified businesses or most private nonprofit organizations. Additional information regarding SBA loans is available on the SBA website: https://www.sba.gov/managing-business/running-business/emergency-preparedness/disaster-assistance.

Social Services Block Grant Program (SSBG)

To address the needs of critical health and human service providers and the populations they serve, the State of New York received a total of $235.4 million in federal Superstorm Sandy SSBG funding. The state will distribute $200,034,600 through a public and transparent solicitation for proposals and allocate $35.4 million in State Priority Projects, using the SSBG funding. SSBG resources are dedicated to covering necessary including social, health, and mental health services for individuals, and for repair, renovation, and rebuilding of health care facilities, mental hygiene facilities, childcare facilities, and other social services facilities. Additional information regarding the SSBG program is available on the website: https://www.acf.hhs.gov/ocs/programs/ssbg.

Department of Homeland Security Grant Program (HSGP)

The HSGP plays an important role in the implementation of the National Preparedness System by supporting the building, sustainment, and delivery of core capabilities essential to achieving the National Preparedness Goal of a secure and resilient nation. The FY 2020 HSGP supports efforts to build and sustain core capabilities across the Prevention, Protection, Mitigation, Response, and Recovery mission areas. This includes two priorities: building and sustaining law enforcement terrorism prevention capabilities; and maturation and enhancement of state and major urban area fusion centers (HSGP 2020). HSGP is comprised of three interconnected grant programs including the State Homeland Security Program (SHSP), Urban Areas Security Initiative (UASI), and the Operation Stonegarden (OPSG). Together, these grant programs fund a range of preparedness activities, including planning, organization, equipment purchase, training, exercises, and management and administration. Additional information regarding HSGP is available on the website: https://www.fema.gov/homeland-security-grant-program.

Community Development Block Grants (CDBG)

CDBG are federal funds intended to provide low and moderate-income households with viable communities, including decent housing, a suitable living environment, and expanded economic opportunities. Eligible activities include community facilities and improvements, roads and infrastructure, housing rehabilitation and preservation, development activities, public services, economic development, and planning and administration. Public improvements could include flood and drainage improvements. In limited instances and during the times of “urgent need” (e.g., post disaster) as defined by the CDBG National Objectives, CDBG funding could be used to acquire a property located in a floodplain that was severely damaged by a recent flood, demolish a structure severely damaged by an earthquake, or repair a public facility severely damaged by a hazard event. Additional information regarding CDBG is available on the website: https://www.hudexchange.info/programs/cdbg-entitlement/.

U.S. Economic Development Administration

The U.S. Economic Development Administration (USEDA) is an agency of the U.S. Department of Commerce that supports regional economic development in communities around the country. It provides funding to support comprehensive planning and makes strategic investments that foster employment creation and attract private investment in economically distressed areas of the United States. Through its Public Works Program, USEDA invests in key public infrastructure, such as traditional public works projects, including water and sewer systems improvements, expansion of port and harbor facilities, brownfields, multi-tenant manufacturing and other facilities, business and industrial parks, business incubator facilities, redevelopment technology-based facilities, telecommunications facilities, and development facilities. Through its Economic Adjustment Program, USEDA administers its Revolving Loan Fund Program, which supplies small businesses and entrepreneurs with the gap financing needed to start or expand their business in areas that have experienced or are under threat of serious structural damage to the underlying economic base. Additional information is available on the USEDA website: https://www.eda.gov/.

Federal Highway Administration - Emergency Relief

The Federal Highway Administration Emergency Relief is a grant program that can be used for repair or reconstruction of Federal-aid highways and roads on Federal lands which have suffered serious damage as a result of a disaster. NYS is serving as the liaison between local municipalities and FHWA. $30 Million in funding was released in October-November of 2012 for emergency repair work conducted in first 180 days following Hurricane Sandy. Another $220 Million in additional funding became available February 2013. For information regarding the FHWA Emergency Relief Program, please refer to: https://www.fhwa.dot.gov/programadmin/erelief.cfm

Federal Transit Administration - Emergency Relief

The Federal Transit Authority Emergency Relief is a grant program that funds capital projects to protect, repair, reconstruct, or replace equipment and facilities of public transportation systems. Administered by the Federal Transit Authority at the U.S. Department of Transportation and directly allocated to MTA and Port Authority, this transportation-specific fund was created as an alternative to FEMA PA. Currently, a total of $5.2 Billion has been allocated to NYS-related entities. Additional information regarding the FTA Emergency Relief Program is available on the website: https://www.transit.dot.gov/funding/grant-programs/emergency-relief-program/emergency-relief-program.

Empire State Development

Empire State Development offers a wide range of financing, grants, and incentives to promote business and employment growth and real estate development throughout the state. Several programs address infrastructure construction associated with project development, acquisition, and demolition associated with project development and brownfield remediation and redevelopment. Additional information regarding Empire State Development is available on the website: https://esd.ny.gov/.

New York State Department of Transportation (NYSDOT)

Scour Critical/Floodprone Bridge Program

The Scour Critical/Flood Prone Bridge Program is an initiative developed to harden New York State's at-risk bridges to withstand extreme weather events. In the past three years, the state has suffered 9 presidentially declared disasters due to extreme weather, many involving severe flooding (NYSDOT 2014).

For this initiative, 105 scour critical/flood prone bridges throughout New York State were identified as most at-risk from repeated flooding and are located in the Capital District, Long Island, Mid-Hudson, Mohawk Valley, North Country, Finger Lakes, Central/Western and Southern Tier regions. The locations encompass 78 communities within 30 counties across the State (NYSDOT 2014). Currently, there are no scour critical/flood prone bridges in Tompkins County. Additional information of the list of bridges is available on the website: https://www.dot.ny.gov/main/business-center/cbow/repository/CBOW_list_2014.pdf.

This program aims to increase the state's resiliency and mitigate the risks of loss and damage associated with future disasters. The total cost of the program, including all 105 bridges across the state, is $518 million. It will be paid for with a mix of funding from FEMA and the U.S. Department of Housing and Urban Development. No state funding will be required (NYSDOT 2014).

Emergency Watershed Protection Program

The purpose of the Emergency Watershed Protection Program (EWP) was established by Congress to respond to emergencies created by natural disasters. The EWP Program is designed to help people and conserve natural resources by relieving imminent hazards to life and property caused by floods, fires, drought, windstorms, and other natural occurrences. The U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS) administers the EWP Program, EWP-Recovery, and EWP–Floodplain Easement. Additional information regarding the EWP is detailed below and available on the website:
https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/landscape/ewpp/.

EWP – Recovery Program

The EWP Program is a recovery effort program aimed at relieving imminent hazards to life and property caused by floods, fires, windstorms, and other natural occurrences. Public and private landowners are eligible for assistance but must be represented by a project sponsor that must be a legal subdivision of the state, such as a city, county, township, or conservation district, and Native American Tribes or Tribal governments. NRCS will pay up to 75 percent of the construction cost of emergency measures. The remaining 25 percent must come from local sources and can be in the form of cash or in-kind services.

EWP work is not limited to any one set of measures. It is designed for installation of recovery measures to safeguard lives and property as a result of a natural disaster. NRCS completes a Damage Survey Report, which provides a case-by-case investigation of the work necessary to repair or protect a site.

Watershed impairments that the EWP Program addresses are debris-clogged stream channels, undermined and unstable streambanks, jeopardized water control structures and public infrastructures, wind-borne debris removal, and damaged upland sites stripped of protective vegetation by fire or drought.

EWP - Floodplain Easement (FPE)

Privately-owned lands or lands owned by local and state governments might be eligible for participation in EWP-FPE. To be eligible, lands must meet one of the following criteria:

- Lands that have been damaged by flooding at least once within the previous calendar year or have been subject to flood damage at least twice within the previous 10 years.
- Other lands within the floodplain are eligible, provided the lands would contribute to the restoration of the flood storage and flow, provide for control of erosion, or that would improve the practical management of the floodplain easement.
- Lands that would be inundated or adversely impacted as a result of a dam breach.

EWP-FPE easements are restored to the extent practicable to the natural environment and can include both structural and nonstructural practices to restore the flood storage and flow, erosion control, and improve the practical management of the easement.

Structures, including buildings, within the floodplain easement must be demolished and removed or relocated outside the 100-year floodplain or dam breach inundation area.

6.4.6.5 FEMA National Dam Safety Program

The National Dam Safety Program (NDSP) is administered by FEMA with the primary purpose of providing financial assistance to states to strengthen their dam safety programs. Funds from this program are used for the following types of activities:

- Dam safety training for state personnel
- Increase in the number of dam inspections
- Increase in the submittal and testing of Emergency Action Plans
- More timely review and issuance of permits
- Improved coordination with state emergency preparedness officials
- Identification of dams to be repaired or removed
- Conduct dam safety awareness workshops and creation of dam safety videos and other outreach materials

In 2016, the President signed the Water Infrastructure Improvements for the Nation Act (WIIN Act) which added a new grant program under the NDSP. Section 5006 of the Act, Rehabilitation of High Hazard Potential Dams, provides technical, planning, design, and construction assistance in the form of grants for rehabilitation of eligible high hazard potential dams.

Rehabilitation of High Hazard Potential Dams (HHPD) Program

A state or territory with an enacted dam safety program, the State Administrative Agency, or an equivalent state agency, is eligible to apply for the HHPD grant. Each eligible state may submit only one HHPD grant application. Nonfederal dams that (i) are in a state or territory with a state or territorial dam safety program; (ii) are classified as having "high hazard potential" by the dam safety agency in the dam's state or territory; (iii) have an emergency action plan approved by the state or territory's dam safety agency; and (iv) the state or territory in which the dam is located determines either of these criteria – the dam fails to meet minimum dam safety standards public. An "eligible high hazard potential dam" does not include: (i) a licensed hydroelectric dam; or (ii) a dam built under the federal authority of the Secretary of Agriculture. For additional information regarding the HHPD program, please refer to: https://www.fema.gov/emergency-managers/risk-management/dam-safety/grants/resources.

In New York State, the NYSDEC applies for HHPD funding on behalf of the State. In April 2021, it was announced that $650,000 is available in the State to support eligible dam repairs. Funding is available to local government and non-profit owners of high-hazard dams.

Figure 6-7. NYSDEC HHPD Funding Announcement

Department of Environmental Conservation | Recreation | Nature | Prevent & Control Pollution | Regulatory | News & Learning | Search

Home » Public Involvement and News » Press Releases » DEC Announces $650,000 in Grant Funding Now Available to Support Eligible Dam Repairs

For Release: Thursday, April 1, 2021

DEC Announces $650,000 in Grant Funding Now Available to Support Eligible Dam Repairs

Funding Available to Local Government and Non-Profit Owners of 'High Hazard' Dams for Pre-Construction Activities

New York State Department of Environmental Conservation (DEC) Commissioner Basil Seggos today announced $650,000 in grant funding is now available to assist eligible dam owners with infrastructure repair costs. Funding is provided through the Federal Emergency Management Agency's (FEMA) High Hazard Potential Dam (HHPD) grant program. Of the dozens of states that applied to this federal program, New York was one of two states that received the maximum amount of funding. DEC is now accepting applications for grants to assist with technical, planning, design, and other pre-construction activities associated with the rehabilitation of eligible dams classified as High Hazard dams.

"Ensuring dam safety is a top priority for DEC and we encourage eligible dam owners to take advantage of this important funding," **said Commissioner Seggos.** "The grants announced today will support pre-construction engineering and design activities as part of an overall program to help municipal and non-profit owners of High Hazard dams make necessary repairs and improve public safety."

New York State's High Hazard dam classification refers to the potential for damage upon a dam's failure, not its likelihood of failure. A High Hazard (or Class C) dam is classified where failure may result in widespread or serious damage to homes, main highways, industrial or commercial buildings, railroads, and/or important utilities, including water supply, sewage treatment, fuel, power, cable, or telephone infrastructure, or substantial environmental damage, such that the loss of human life or widespread substantial economic loss is likely. New York State has 425 dams classified as High Hazard.

Local governmental entities and municipalities, including but not limited to counties, cities, towns, and villages, and not-for-profit corporations with dam projects in New York State are eligible to apply. Projects must be in a county with an approved hazard mitigation plan. Projects and applicants must meet additional eligibility criteria as described in the Request for Applications. A total of $650,000 in grants is available, with awards up to $100,000 per project.

The deadline for applications is June 11, 2021. Requests for Applications (RFAs) are available online through the NYS Grants Gateway. The Grants Gateway is a web-based grant management system that streamlines the way grants are administered by the State of New York. All grant applicants, including government agencies and not-for-profit corporations, must be registered in the NYS Grants Gateway to be eligible to apply for any state grant opportunity. Not-For-Profit applicants are required to "prequalify" in the Grants Gateway system. For more information about Grants Gateway, please visit the Grants Management website or contact the Grants Gateway Team at: grantsgateway@its.ny.gov.

DEC's High Hazard Dam Rehabilitation program is funded through FEMA's HHPD grant program. A future round of grants will make funding available for eligible dam construction projects.

Source: NYSDEC 2021

6.4.6.6 New York State Department of Environmental Conservation (NYSDEC) Climate Smart Communities (CSC) Program

The CSC program is jointly sponsored by the following six New York State agencies: NYSDEC; Energy Research and Development Authority; Public Service Commission; Department of State; NYSDOT; and the Department of Health. The program encourages municipalities to minimize the risks of climate change and reduce long-term costs through actions which reduce greenhouse gas emissions and adapt to a changing climate. The program offers free technical support on energy and climate and guidance tailored to New York State communities. As of May 2020, more than 304 communities, representing 8.7 million New Yorkers in every region of the state, have committed to acting on climate through New York State's Climate Smart Communities program.

Benefits of participating in the program include saving taxpayer dollars, improving operations and infrastructure, increasing energy independence and security, demonstrating leadership, and positioning for economic growth. Registered Climate Smart Communities receive notification of state and federal assistance that they can leverage to help adopt low-carbon technologies and of programs and support for efficiency improvements and energy conservation. Further, those communities receive an advantage in accessing some state assistance programs, can call on the help of other local governments that already have adopted climate smart practices and policies, and receive statewide recognition for their climate-smart accomplishments. Key elements of the Climate Smart Communities program are described below.

Additional information regarding the CSC program is available on the website: http://www.dec.ny.gov/energy/50845.html.

Climate Smart Communities Certification (CSC) Program

The CSC program enables high-performing registered communities to achieve recognition for their leadership. Designed around the existing ten pledge elements, the certification program recognizes communities achieving any of over 102 total possible actions through a rating system leading to four levels of award: Certified, Bronze, Silver, and Gold. Recertification of completed actions is required every five years. Details of the program and the specific documentation required for each action are described in the CSC Certification Manual at http://www.dec.ny.gov/docs/administration_pdf/certman.pdf.

At the time of this plan update, Tompkins County has seen significant participation in the program. The County itself is Silver Certified. The Town of Ulysses, Town of Ithaca, City of Ithaca, Town of Dryden, and Town of Caroline are certified bronze. The Village of Lansing, Village of Cayuga Heights, Town of Lansing, and Town of Danby are registered in the program.

Any city, town, village or county in New York can join the program by adopting the Climate Smart Communities Pledge. To become a registered Climate Smart Community, the municipality's governing body must adopt a resolution that includes all ten elements of the pledge and inform DEC of the passage of the resolution. The required ten elements of the pledge are as follows:

- Pledge to be a Climate Smart Community.
- Set goals, inventory emissions, plan for climate action.
- Decrease community energy use.
- Increase community use of renewable energy.
- Realize benefits of recycling and other climate-smart solid waste management practices.

- Reduce greenhouse gas emissions through use of climate-smart land-use tools.
- Enhance community resilience and prepare for the effects of climate change.
- Support development of a green innovation economy.
- Inform and inspire the public.
- Commit to an evolving process of climate action.

Climate Smart Communities Grant Program

In April 2016, DEC announced an expansion of the Environmental Protection Fund to support communities ready to reduce greenhouse gas emissions and prepare for the effects of climate change. Climate Smart Community Implementation grants support mitigation and adaptation projects and range from $100,000 to $2 million. Competitive grants ranging from $25,000 to $100,000 will provide support for local governments to become certified Climate Smart Communities. All counties, cities, towns, and villages of the State of New York are eligible to receive funding. The CSC grant program will provide 50/50 matching grants for eligible projects in the following categories.

Funding is available for **implementation projects** that advance a variety of climate adaptation and mitigation actions, including the following:

- Construction of natural resiliency measures.
- Relocation or retrofit of climate-vulnerable facilities.
- Conservation or restoration of riparian areas and tidal marsh migration area.
- Reduction of flood risk.
- Clean transportation.
- Reduction or recycling of food waste.

Funding is also available for **certification projects** that advance several specific actions aligned with Climate Smart Communities Certification requirements, including the following:

- Right-sizing of government fleets.
- Developing natural resource inventories.
- Conducting vulnerability assessments.
- Developing climate adaptation strategies.
- Updating hazard mitigation plans to address changing conditions and reduce climate vulnerability.

In scoring grant applications, increasing points are awarded to communities who have already taken the CSC pledge and to those that have achieved certification status. All grant recipients must take the Climate Smart Communities Pledge within the term of their grant contract. For climate mitigation projects, grant recipients must provide a report of estimates of emissions reduction. Certification actions must adhere to the requirements and standards described in the Climate Smart Communities Certification Manual that is available on the website:

http://www.dec.ny.gov/energy/96511.html. For implementation projects involving property (construction, improvements, restoration, rehabilitation), grant recipients that do not have ownership of the property must obtain a climate change mitigation easement.

The *Climate Smart Communities Toolkit* was developed to educate New York communities on recommended practices that will help to reduce greenhouse gas emissions and adapt to the effects of climate change, specifically in the areas of land-use, transportation policy, green buildings, infrastructure investment, green infrastructure, housing policy, adaptation, and resilience. The *Climate Smart Communities Guide to Local Action* contains overviews of possible community actions, how-to's and case studies to help communities implement the CSC pledge. The Climate Smart Communities Land Use Toolkit allows New York communities to find recommended practices that will help to reduce greenhouse gas emissions in the areas of land use, transportation policy, green building, infrastructure investment, green infrastructure, and housing policy.

6.4.6.7 Added New York State Department of Environmental Conservation (NYSDEC) Funding Opportunities

Water Quality Improvement Project (WQIP) Program

The WQIP program is a competitive, reimbursement grant program that funds projects that directly address documented water quality impairments. The competitive, statewide grant program is open to local governments and not-for-profit corporations. Grant recipients can receive up to 75 percent of the project costs for high priority wastewater treatment improvement, non-agricultural nonpoint source abatement and control, land acquisition for source water protection, aquatic habitat restoration, and municipal separate storm sewer system projects; up to 50 percent for salt storage projects; and up to 40 percent for general wastewater infrastructure improvement projects. Additional information regarding this program are available on the website: https://www.dec.ny.gov/pubs/4774.html. Eligible activities for the WQIP Program include the following:

- Wastewater treatment improvement.
- Non-agricultural nonpoint source abatement and control.
- Land acquisition for source water protection.
- Salt storage.
- Aquatic habitat restoration.
- MS4s.

Tompkins County has utilized WQIP to advance a number of local mitigation efforts including the Ludlowville Stormwater Control Project.

New York State DEC/ Environmental Facilities Corporation (EFC) Wastewater Infrastructure Engineering Planning Grant (EPG)

NYSDEC, in conjunction with the New York State EFC, offers grants to municipalities to help pay for the initial planning of eligible Clean Water State Revolving Fund (CWSRF) water quality projects.

The Wastewater Infrastructure EPG assists municipalities with the engineering and planning costs of CWSRF-eligible water quality projects. Eligible municipalities have a median household income (MHI) of $65,000 or less in the Regional Economic Development Council (REDC) regions of Capital District, Southern Tier, North Country, Mohawk Valley, Central NY, Finger Lakes, or Western NY OR an MHI of $85,000 or less in REDC regions of Long Island, New York City, or Mid-Hudson. Grants with a 20 percent required local match could finance activities, including engineering and consultant fees for engineering and planning services for the production of an engineering report.

The goal of the EPG program is to advance water quality projects to construction, so successful applicants can use the engineering report funded by the grant to seek financing through the CWSRF program, WQIP program, or other funding entities to further pursue the identified solution. Details regarding this program can be found on the website: https://www.dec.ny.gov/pubs/81196.html. Funding priorities go to projects that have one of the following qualities:

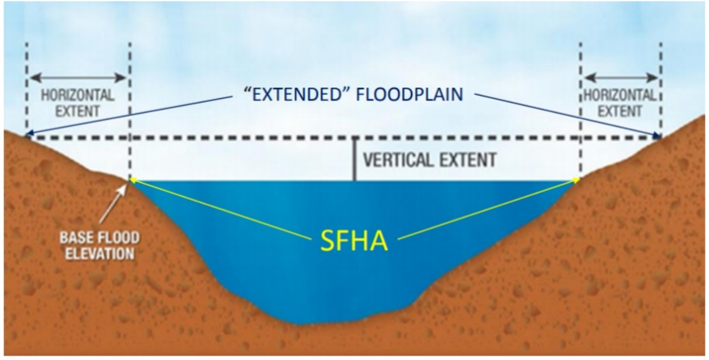
- Required by an executed Order on Consent.
- Required by a draft or final State Pollutant Discharge Elimination System (SPDES) permit.
- Upgrading or replacing an existing wastewater system.
- Constructing a wastewater treatment and/or collection system for an area with failing onsite septic systems.
- Identified in a Total Maximum Daily Load (TMDL) Implementation Plan.

6.4.6.8 Added New York State Department of Transportation (NYSDOT) Funding Opportunities

BRIDGE NY

The BRIDGE NY program, administered by the NYSDOT, is open to all municipal owners of bridges and culverts. Projects are awarded through a competitive process and support all phases of project development. Projects selected for funding under the BRIDGE NY Initiative are evaluated based on the resiliency of the structure, including such factors as hydraulic vulnerability and structural resiliency; the significance and importance of the bridge, including traffic volumes, detour considerations, number and types of businesses served, and impacts on commerce; and the current bridge and culvert structural conditions. Information regarding the program can be found on the website: https://www.dot.ny.gov/BRIDGENY.

6.4.6.9 Community Risk and Resiliency Act (CRRA)



On September 22, 2014, Governor Andrew Cuomo signed bill A06558/S06617-B, the CRRA. The purpose of the bill is to ensure that certain state monies, facility-siting regulations, and permits include consideration of the effects of climate risk and extreme-weather events. According to NYSDEC (2018), CRRA's five major provisions include the following:

- Official Sea-level Rise Projections—CRRA requires the NYSDEC to adopt science-based sea-level rise projections into regulation.
- Consideration of Sea-Level Rise, Storm Surge and Flooding—CRRA requires applicants for permits or funding in a number of specified programs to demonstrate that future physical climate risk due to sea-level rise, storm surge, and flooding have been considered and that NYSDEC considered incorporating these factors into certain facility-siting regulations.
- Smart Growth Public Infrastructure Policy Act Criteria—CRRA adds mitigation of risk due to sea-level rise, storm surge, and flooding to the list of smart-growth criteria to be considered by state public-infrastructure agencies.
- Guidance on Natural Resiliency Measures—CRRA requires NYSDEC, in consultation with the Department of State, to develop guidance on the use of natural resources and natural processes to enhance community resiliency.
- Model Local Laws Concerning Climate Risk—CRRA requires the Department of State, in cooperation with NYSDEC, to develop model local laws that include consideration of future risk due to sea-level rise, storm surge, and flooding. These model local laws must be based on available data predicting the likelihood of extreme-weather events, including hazard-risk analysis.

CRRA requires NYSDEC, in consultation with the Department of State, to prepare guidance on implementation of the statute. To meet its obligation to develop guidance for the implementation of CRRA, DEC is proposing a new document, State Flood Risk Management Guidance (SFRMG). The SFRMG is intended to inform state agencies as they develop program-specific guidance to require that applicants demonstrate consideration of sea-level rise, storm surge, and flooding, as permitted by program-authorizing statutes and operating regulations. The SFRMG incorporates possible future conditions, including the greater risks of coastal flooding presented by sea-level rise and enhanced storm surge and of inland flooding expected to result from increasingly frequent extreme-precipitation events (NYSDEC 2018). Additional details on the CRRA are provided on the website: [https://www.dec.ny.gov/energy/102559.html.](https://www.dec.ny.gov/energy/102559.html)

6.4.7 Mitigation Funding Source Summary

While it is important to recognize the mitigation strategies for each jurisdiction to help achieve the mitigation goals and objectives of the HMP, it is also important to provide sources for funding to implement these strategies. The table below provides a list of programs, descriptions, and links for those seeking funding sources. Please note that this table is not intended to be a comprehensive list, but rather a starting point to help identify potential sources of funding for the identified mitigation strategies. For additional resources, refer to the FEMA 2020 *New York Mitigation Resource Guide* (https://www.fema.gov/sites/default/files/2020-09/fema_region-03_mitigation-funding-resource-guide_new-york-09-24-2020.pdf).

Table 6-3. Mitigation Funding Sources

Program	Description	Lead Agency	Website
Federal			
Hazard Mitigation Assistance (HMA)	Grants to provide funding for eligible mitigation activities that reduce disaster losses and protect life and property from future disaster damages – includes FMA, HMGP, PDM	FEMA	https://www.fema.gov/hazard-mitigation-assistance
Flood Mitigation Assistance (FMA)	Program Grants to States and communities for pre-disaster mitigation planning and projects to help reduce or eliminate the long-term risk of flood damage to structures insurable under the National Flood Insurance Program	FEMA	https://www.fema.gov/flood-mitigation-assistance-grant-program
Hazard Mitigation Grant Program (HMGP)	Grants to States and communities for planning and projects providing long-term hazard mitigation measures following a major disaster declaration	FEMA	https://www.fema.gov/hazard-mitigation-grant-program
Pre-Disaster Mitigation (PDM) Competitive Grant Program	Grants to States and communities for planning and projects that provide long-term hazard pre-disaster mitigation measures	FEMA	https://www.fema.gov/pre-disaster-mitigation-grant-program
Building Resilient Infrastructure and Communities (BRIC) Grant Program	Grants to States and communities for planning and projects that provide long-term hazard pre-disaster mitigation measures	FEMA	https://www.fema.gov/bric
Public Assistance: Hazard Mitigation	Hazard mitigation discretionary funding available under Section 406 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act	FEMA	https://www.fema.gov/news-release/2017/05/03/4309/fema-hazard-mitigation-grants-404-and-406

Program	Description	Lead Agency	Website
Funding Under Section 406	following a Presidentially declared disaster		
Assistance to Firefighters Grant Program	The primary goal of the Assistance to Firefighters Grants (AFG) is to enhance the safety of the public and firefighters with respect to fire-related hazards by providing direct financial assistance to eligible fire departments, nonaffiliated Emergency Medical Services organizations, and State Fire Training Academies. This funding is for critically needed resources to equip and train emergency personnel to recognized standards, enhance operations efficiencies, foster interoperability, and support community resilience.	FEMA	https://www.fema.gov/welcome-assistance-firefighters-grant-program
Disaster Housing Program	Emergency assistance for housing, including minor repair of home to establish livable conditions, mortgage and rental assistance	HUD	https://www.hud.gov/program_offices/public_indian_housing/publications/dhap
HOME Investment Partnerships Program	Grants to local and state government and consortia for permanent and transitional housing, (including financial support for property acquisition and rehabilitation for low income persons)	HUD	https://www.hud.gov/program_offices/comm_planning/affordablehousing/programs/home/
HUD Disaster Recovery Assistance	Grants to fund gaps in available recovery assistance after disasters (including mitigation)	HUD	https://www.hud.gov/info/disasterresources
Section 108 Loan Guarantee	Enables states and local governments participating in the Community Development Block Grant (CDBG) program to obtain federally guaranteed loans for disaster-distressed areas	HUD	https://www.hudexchange.info/programs/section-108/

Program	Description	Lead Agency	Website
Smart Growth Implementation Assistance (SGIA) program	The SGIA program focuses on complex or cutting-edge issues, such as stormwater management, code revision, transit-oriented development, affordable housing, infill development, corridor planning, green building, and climate change. Applicants can submit proposals under 4 categories: community resilience to disasters, job creation, the role of manufactured homes in sustainable neighborhood design or medical and social service facilities siting.	EPA	https://www.epa.gov/smartgrowth
Partners for Fish and Wildlife	Financial and technical assistance to private landowners interested in pursuing restoration projects affecting wetlands and riparian habitats	U.S. Fish and Wildlife Service	https://www.fws.gov/partners/
FHWA Emergency Relief Program	Fund for the repair or reconstruction of Federal-aid highways that have suffered serious damage as a result of (1) natural disasters or (2) catastrophic failures from an external cause	U.S. Department of Transportation (DOT)	https://www.fhwa.dot.gov/programadmin/erelief.cfm
Transportation Investment Generating Economic Recovery (TIGER)	Investing in critical road, rail, transit and port projects across the nation	U.S. DOT	https://www.transportation.gov/tags/tiger-grants
Community Facilities Direct Loan & Grant Program	This program provides affordable funding to develop essential community facilities in rural areas. An essential community facility is defined as a facility that provides an essential service to the local community for the orderly development of the	USDA	https://www.rd.usda.gov/programs-services/community-facilities-direct-loan-grant-program

Program	Description	Lead Agency	Website
	community in a primarily rural area, and does not include private, commercial or business undertakings.		
Emergency Loan Program	USDA's Farm Service Agency (FSA) provides emergency loans to help producers recover from production and physical losses due to drought, flooding, other natural disasters or quarantine	USDA	https://www.fsa.usda.gov/programs-and-services/farm-loan-programs/emergency-farm-loans/index
Emergency Watershed Protection (EWP) program	Provide assistance to relieve imminent hazards to life and property caused by floods, fires, drought, windstorms, and other natural occurrences	NRCS	https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/landscape/ewpp/
Financial Assistance	Financial assistance to help plan and implement conservation practices that address natural resource concerns or opportunities to help save energy, improve soil, water, plant, air, animal and related resources on agricultural lands and non-industrial private forest land	NRCS	https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/
Emergency Management Performance Grants (EMPG) Program	Assist local, tribal, territorial, and state governments in enhancing and sustaining all-hazards emergency management capabilities	U.S. DHS	https://www.fema.gov/emergency-management-performance-grant-program
Land & Water Conservation Fund	Matching grants to states and local governments for the acquisition and development of public outdoor recreation areas and facilities (as well as funding for shared federal land acquisition and conservation strategies)	National Park Service	https://www.nps.gov/subjects/lwcf/index.htm
State			

Program	Description	Lead Agency	Website
Local Government Records Management Improvement Fund (LGRMIF) Disaster Recovery Grants	Grants for disaster recovery projects related to damage caused by a sudden, unexpected event involving fire, water, man-made or natural phenomena where a timely response is necessary to prevent the irretrievable loss of vital or archival records, or to ensure reasonable, timely access to vital records	New York State Archives / New York State Education Department	http://www.archives.nysed.gov/grants/grants_lgrmif.shtml
The New York State Emergency Services Revolving Loan	Repair of firefighting apparatus, ambulances, or rescue vehicles; Renovation, rehabilitation, or repair of facilities that house firefighting equipment, ambulances, rescue vehicles, and related equipment	NYS DHSES	http://www.dhses.ny.gov/ofpc/services/loan/
Environmental Protection Fund (EPF)	Matching grants for the acquisition, planning, development, and improvement of parks, historic properties	New York State Parks, Recreation & Historic Preservation (NYSOPRHP)	https://www.dec.ny.gov/about/92815.html
Recreational Trails (RTP)	Program Matching grants for the acquisition, development, rehabilitation and maintenance of trails and trail-related projects	NYSOPRHP	https://parks.ny.gov/grants/recreational-trails/default.aspx
Environmental Protection & Improvement Grants	Competitive grants for environmental protection and improvement; available for municipalities, community organizations, not-for-profit organizations and others	New York State Department of Environmental Conservation	https://www.dec.ny.gov/about/92815.html
Volunteer Fire Assistance Grants	The grant is a 50/50 matching funds program. Its purpose is to make funds available to rural fire companies for the purchase of wildland firefighting equipment such as portable backpack pumps, Nomex protective clothing,	NYSDEC	https://www.dec.ny.gov/regulations/2364.html

Program	Description	Lead Agency	Website
	hand tools, hard hats, hose, portable radios and dry hydrants.		
Clean Water Act Section 604(b) Water Quality Planning Grants	Provide funding to implement regional comprehensive water quality management planning activities as described in Section 604(b) of the federal Clean Water Act. 604(b) funds are to be used for water quality management planning activities, including tasks to determine the nature, extent and causes of point and nonpoint source water pollution problems, and to develop plans to resolve these problems.	NYSDEC	https://www.dec.ny.gov/lands/53122.html
Water Quality Improvement Project (WQIP) Program	The Water Quality Improvement Project (WQIP) program is a competitive, reimbursement grant program that funds projects that directly address documented water quality impairments. Applications are typically available each spring through the Consolidated Funding Application.	NYSDEC	https://www.dec.ny.gov/pubs/4774.html
New York State DEC/EFC Wastewater Infrastructure Engineering Planning Grant (EPG)	The New York State Department of Environmental Conservation (DEC), in conjunction with the New York State Environmental Facilities Corporation (EFC), will offer grants to municipalities to help pay for the initial planning of eligible Clean Water State Revolving Fund (CWSRF) water quality projects. The ultimate goal of the EPG program is to advance water quality projects to construction, so successful applicants can use the engineering report funded by the grant to seek financing through the	NYSDEC	https://www.dec.ny.gov/pubs/81196.html

Program	Description	Lead Agency	Website
	CWSRF program, Water Quality Improvement Project program, or other funding entities to further pursue the identified solution.		
Climate Smart Communities Grant Program	The CSC Grant program was established in 2016 to provide 50/50 matching grants to cities, towns, villages, and counties (or boroughs of New York City) of the State of New York for eligible climate adaptation and mitigation projects.	NYSDEC	https://www.dec.ny.gov/energy/109181.html
BRIDGE NY	The State is making funding available for local governments to rehabilitate and replace bridges and culverts statewide.	NYS DOT	https://www.dot.ny.gov/BRIDGENY

6.5 Mitigation Strategy Development and Update

6.5.1 Update of Municipal Mitigation Strategies

To evaluate progress on local mitigation actions, each jurisdiction was provided with a Mitigation Action Plan Review Worksheet, pre-populated with those actions identified for their jurisdiction in the prior (2015) plan. For each action, municipalities were asked to indicate the status of each action (*No Progress/Unknown*, *In Progress/Not Yet Complete*, *Ongoing*, *Completed*, *Discontinued*) and provide review comments on each. Municipalities were requested to quantify the extent of progress and provide reasons for the level of progress or why actions were discontinued. Each jurisdictional annex in Section 9 (Jurisdictional Annexes) provides a table identifying the jurisdiction's prior mitigation strategy, the status of those actions and initiatives, and their disposition within their updated strategy.

Local mitigation actions identified as *Complete*, and those actions identified as *Discontinued*, were removed from the updated strategies. Those local actions that municipalities identified as *No Progress/Unknown*, *In Progress/Not Yet Complete, or* certain actions/initiatives identified as *Ongoing* were carried forward in their local updated capability assessment. Actions considered ongoing capabilities were marked as *Discontinued* and included in the plan as ongoing capabilities. Municipalities were asked to provide further details on these projects to help better define the projects, identify benefits and costs, and improve implementation.

At the Kick-Off Meeting and during subsequent Planning Partnership meetings, all participating municipalities were further surveyed to identify mitigation activities completed, ongoing, and potential/proposed. As new additional potential mitigation actions, projects, or initiatives became evident during the plan update process, including as part of the risk assessment update and as identified through the public and stakeholder outreach process detailed in Section 3 (Planning Process), communities were made aware of these either through direct communication (local meetings, email, phone) or via their draft municipal annexes.

To help support the selection of an appropriate, risk-based mitigation strategy, each annex provided a summary of hazard vulnerabilities identified during the plan update process, either directly by municipal representatives or through review of available county and local plans and reports, and through the hazard profiling and vulnerability assessment process.

Beginning in February 2020, members of the Steering Committee and contract consultants worked directly with each jurisdiction (phone, email, local support meetings via Zoom and socially distanced in person) to assist with the development and update of their annex and include mitigation strategies, focusing on identifying well-defined, implementable projects with a careful consideration of benefits (risk reduction, losses avoided), costs, and possible funding sources (including mitigation grant programs).

Concerted efforts were made to assure that municipalities develop updated mitigation strategies that included activities and initiatives covering the range of mitigation action types described in recent FEMA planning guidance (FEMA *Local Mitigation Planning Handbook* March 2013). The primary types of mitigation actions to reduce long-term vulnerability are described in Table 64.

Table 6-4. Types of Mitigation Actions

Mitigation Type	Description	Examples
Local Plans and Regulations	These actions include government authorities, policies, or codes that influence the way land and buildings are developed and built.	• Comprehensive plans • Land use ordinances • Subdivision regulations • Development review • Building codes and enforcement • NFIP Community Rating System • Capital improvement programs • Open space preservation • Stormwater management regulations and master plans
Structure and Infrastructure Projects	These actions involve modifying existing structures and infrastructure to protect them from a hazard or remove them from a hazard area. This could apply to public or private structures as well as critical facilities and infrastructure. This type of action also involves projects to construct manmade structures to reduce the impact of hazards. Many of these types of actions are projects eligible for funding through the FEMA Hazard Mitigation Assistance program.	• Acquisitions and elevations of structures in flood prone areas • Utility undergrounding • Structural retrofits • Floodwalls and retaining walls • Detention and retention structures • Culverts • Safe rooms
Natural Systems Protection	These are actions that minimize damage and losses and also preserve or restore the functions of natural systems.	• Sediment and erosion control • Stream corridor restoration • Forest management • Conservation easements • Wetland restoration and preservation
Education and Awareness Programs	These are actions to inform and educate citizens, elected officials, and property owners about hazards and potential ways to mitigate them. These actions may also include participation in national programs, such as StormReady or Firewise Communities. Although this type of mitigation reduces risk less directly than structural projects or regulation, it is an important foundation. A greater understanding and awareness of hazards and risk among local officials, stakeholders, and the public is more likely to lead to direct actions.	• Radio or television spots • Websites with maps and information • Real estate disclosure • Presentations to school groups or neighborhood organizations • Mailings to residents in hazard-prone areas • StormReady • Firewise Communities

A mitigation strategy workshop then was conducted on August 26, 2020 with all 16 participating jurisdictions. This event was done in part to support the development of focused problem statements based on the impacts of the identified natural hazards in the county. These problem statements are intended to provide a detailed description of the problem area, including impacts to the jurisdiction, past damages, and loss of service. An effort was made to include the street address of the property/project location, adjacent streets, water bodies, and well-known structures, as well as a brief description of existing conditions (topography, terrain, hydrology) of the site. These problem statements form a bridge between the hazard risk assessment, which quantifies impacts to each community, with the development of actionable mitigation strategies.

A strong effort has been made to better focus local mitigation strategies to clearly defined, readily implementable projects and initiatives that meet the definition or characteristics of mitigation. Annexes do however also honor and incorporate the diverse, creative mitigation solutions that communities identified that may fall outside of traditional actions.

Certain continuous or ongoing strategies that represent programs that are fully integrated into the normal operational and administrative framework of the community have been identified within the Capabilities section of each annex and removed from the updated mitigation strategy.

At least two mitigation projects per jurisdiction have been documented with an Action Worksheet, as per the 2017 New York State Hazard Mitigation Planning Standards Guide.

As discussed within the Hazard Profiles in Section 5.4, the long-term effects of climate change are anticipated to exacerbate the impacts of weather-related hazards including flood, severe storm, severe winter storm, and wildfire. By way of addressing these climate change-sensitive hazards within their local mitigation strategies and integration actions, communities are working to evaluate and recognize these long-term implications and potential impacts, and to incorporate in planning and capital improvement updates.

Municipalities included mitigation actions to address vulnerable critical facility lifelines. These actions were proposed in consideration of protection against 500-year events, or worst-case scenarios. It is recognized, however, that in the case of projects being funded through federal mitigation programs, the level of protection can be influenced by cost-effectiveness, as determined through a formal benefit-cost analysis. In the case of "self-funded" projects, municipal discretion must be recognized. Further, the County and municipalities have limited authority over privately-owned critical facility lifeline owners regarding mitigation at any level of protection.

6.5.2 Update of County Mitigation Strategy

The update of the County-level mitigation strategies included a review of progress on the actions/initiatives identified in the 2014 HMP using a process similar to that used to review municipal mitigation strategy progress. The County, through their various department representatives, was provided with a Mitigation Action

Plan Review Worksheet identifying all County-level actions and initiatives from the 2014 plan. The County reviewed each action and provided progress. For each action, relevant County representatives were asked to indicate the status of each action (*No Progress/Unknown*, *In Progress/Not Yet Complete*, *Ongoing*, *Completed*, or *Discontinued*), and provide review comments on each.

Projects/initiatives identified as "*Complete*", as well as those actions identified as *Discontinued*, have been removed from this plan update. Those actions the County has identified as *No Progress/Unknown*, *In Progress/Not Yet Complete,* or *Continuous* have been carried forward in the County's updated mitigation strategy. Actions considered ongoing capabilities were marked as *Discontinued* and included in the plan as ongoing capabilities.

Throughout the course of the plan update process, additional regional and County-level mitigation actions were identified by the following processes:

- Review of the results and findings of the updated risk assessment.
- Review of available regional and County plans reports and studies.;
- Direct input from County departments and other agencies, and:
- Input received through the public and stakeholder outreach process.

As discussed within the Hazard Profiles in Section 5.4 (Risk Assessment), the long-term effects of climate change are anticipated to exacerbate the impacts of weather-related hazards including drought, flood, severe storm, and severe winter storm. The County has included mitigation actions and initiatives, including continuing and long-term planning and emergency management support, to address these long-term implications and potential impacts.

The Tompkins County Department of Emergency Response, Department of Health, and Highway Department and Facilities Department also included some mitigation actions to address vulnerable critical facility lifelines. These actions were proposed in consideration of protection against 500-year events, or worst-case scenarios.

It is recognized, however, that in the case of projects being funded through federal mitigation programs, the level of protection can be influenced by cost-effectiveness, as determined through a formal benefit-cost analysis. In the case of "self-funded" projects, local government authority can affect the ability to implement. Further, the County has limited authority over privately-owned critical facility owners regarding mitigation at any level of protection.

6.5.3 Mitigation Strategy Evaluation and Prioritization

The County and participating municipalities utilized a modified STAPLEE (Social, Technical, Administrative, Political, Legal, Economic, and Environmental) mitigation action evaluation methodology based on a set of evaluation criteria suited to the purposes of hazard mitigation strategy evaluation. This method provides a systematic approach that considers the opportunities and constraints of implementing a specific mitigation action.

> Section 201.c.3.iii of 44 CFR requires an action plan describing how the actions identified will be prioritized.

The Steering Committee applied an action evaluation and prioritization methodology, which includes an expanded set of 14 criteria to include the consideration of cost-effectiveness, availability of funding, anticipated timeline, and if the action addresses multiple hazards. The 14 evaluation/prioritization criteria used in the 2021 update process are the following:

1. Life Safety—How effective will the action be at protecting lives and preventing injuries?
2. Property Protection—How significant will the action be at eliminating or reducing damage to structures and infrastructure?
3. Cost-Effectiveness—Are the costs to implement the project or initiative commensurate with the benefits achieved?
4. Technical—Is the mitigation action technically feasible? Is it a long-term solution? Eliminate actions that, from a technical standpoint, will not meet the goals.
5. Political—Is there overall public support for the mitigation action? Is there the political will to support it?
6. Legal—Does the municipality have the authority to implement the action?
7. Fiscal—Can the project be funded under existing program budgets (i.e., is this initiative currently budgeted for)? Would it require a new budget authorization or funding from another source such as grants?
8. Environmental–What are the potential environmental impacts of the action? Will it comply with environmental regulations?
9. Social—Will the proposed action adversely affect one segment of the population? Will the action disrupt established neighborhoods, break up voting districts, or cause the relocation of lower income people?
10. Administrative—Does the jurisdiction have the personnel and administrative capabilities to implement the action and maintain it? Will outside help be necessary?
11. Multi-hazard—Does the action reduce the risk to multiple hazards?
12. Timeline—Can the action be completed in less than 5 years (within our planning horizon)?
13. Local Champion—Is there a strong advocate for the action or project among the jurisdiction's staff, governing body, or committees that will support the action's implementation?
14. Other Local Objectives—Does the action advance other local objectives, such as capital improvements, economic development, environmental quality, or open space preservation? Does it support the policies of other plans and programs?

Participating jurisdictions were asked to use these criteria to assist them in evaluating and prioritizing mitigation actions identified in the 2021 update. Specifically, for each mitigation action, the jurisdictions were asked to assign a numeric rank (-1, 0, or 1) for each of the 14 evaluation criteria, defined as follows:

- 1 = Highly effective or feasible

- 0 = Neutral
- -1 = Ineffective or not feasible

Further, jurisdictions were asked to provide a summary of the rationale behind the numeric rankings assigned, as applicable. The numerical results were totaled and then used by each jurisdiction to help prioritize the action or strategy as *Low*, *Medium*, or *High*. Actions that had a numerical value between 0 and 4 were categorized as *low*; actions with numerical values between 5 and 9 were categorized as *medium*; and actions with numerical values between 10 and 14 were categorized as *high*. While this provided a consistent, systematic methodology to support the evaluation and prioritization of mitigation actions, jurisdictions might have additional considerations that could influence their overall prioritization of mitigation actions.

It is noted that jurisdictions might be carrying forward mitigation actions and initiatives from prior mitigation strategies that were prioritized using a different, but not inherently contrary, approach. Mitigation actions in the prior (2014) Tompkins County HMP were "qualitatively evaluated against the mitigation goals and objectives and other evaluation criteria. They were then prioritized into three categories: high, medium, and low." At their discretion, jurisdictions carrying forward prior initiatives were encouraged to re-evaluate their priority, particularly if conditions that would affect the prioritization criteria had changed.

For the plan update there has been an effort to develop more clearly defined and action-oriented mitigation strategies. These local strategies include projects and initiatives that are seen by the community as the most effective approaches to advance their local mitigation goals and objectives within their capabilities. In addition, each municipality was asked to develop problem statements. Overall, municipalities were able to develop action-oriented and achievable mitigation strategies. Many of the initiatives in the updated mitigation strategy were ranked as *High* or *Medium* priority, as reflective of the community's clear intent to implement, available resources not-withstanding. In general, initiatives that would have had *low* priority rankings were appropriately screened out during the local action evaluation process.

6.5.4 Benefit/Cost Review

Section 201.6.c.3iii of 44 CFR requires the prioritization of the action plan to emphasize the extent to which benefits are maximized according to a cost/benefit review of the proposed projects and their associated costs. Stated otherwise, cost-effectiveness is one of the criteria that must be applied during the evaluation and prioritization of all actions comprising the overall mitigation strategy.

The initial benefit/cost review applied in for the evaluation and prioritization of projects and initiatives in this plan update process was qualitative; that is, it does not include the level of detail required by FEMA for project grant eligibility under the Hazard Mitigation Assistance (HMA) grant programs. For all actions identified in the local strategies, jurisdictions have identified both the costs and benefits associated with project, action or initiative.

Costs are the total cost for the action or project, and could include administrative costs, construction costs (including engineering, design and permitting), and maintenance costs.

Benefits are the savings from losses avoided attributed to the implementation of the project, and could include life-safety, structure and infrastructure damages, loss of service or function, and economic and environmental damage and losses.

When available, jurisdictions were asked to identify the actual or estimated dollar value for project costs and associated benefits. Having defined costs and benefits allows a direct comparison of benefits versus costs and a quantitative evaluation of project cost-effectiveness. Often, however, numerical costs and/or benefits have not been identified or might be impossible to quantitatively assess.

For the purposes of this planning process, jurisdictions were asked to identify the benefits that implementing the project will provide. If dollar amounts were known, they were asked to include them. If dollar amounts were unknown or unquantifiable, the jurisdictions were asked to describe the losses that will be avoided. This could be done by providing a rating or high, medium, or low, as defined in Table 6-5.

Table 6-5 provides the qualitative cost and benefit ratings definitions when quantitative estimates of costs and benefits were not available.

Table 6-5 Qualitative Cost and Benefit Ratings

Costs	
High	Existing funding levels are not adequate to cover the costs of the proposed project, and implementation would require an increase in revenue through an alternative source (e.g., bonds, grants, and fee increases).
Medium	The project could be implemented with existing funding but would require a re-apportionment of the budget or a budget amendment, or the cost of the project would have to be spread over multiple years.
Low	The project could be funded under the existing budget. The project is part of or can be part of an existing, ongoing program.
Benefits	
High	Project will have an immediate impact on the reduction of risk exposure to life and property.
Medium	Project will have a long-term impact on the reduction of risk exposure to life and property or will provide an immediate reduction in the risk exposure to property.
Low	Long-term benefits of the project are difficult to quantify in the short term.

Using this approach, projects with positive benefit versus cost ratios (such as high over high, high over medium, medium over low) are considered cost-effective.

For some of the Tompkins County initiatives identified, the Planning Partnership might seek financial assistance under FEMA's HMA programs. These programs require detailed benefit/cost analysis as part of the application process. These analyses will be performed when funding applications are prepared, using the FEMA benefit/cost analysis model process. It is suggested that Tompkins County and its partners update and refine their understanding of this important process to better equip themselves for preparing competitive applications. The Planning Partnership is committed to implementing mitigation strategies with benefits that exceed costs. For projects not seeking financial assistance from grant programs that require this sort of analysis, the Planning Partnership reserves the right to define "benefits" according to parameters that meet its needs and the goals and objectives of this plan.

SECTION 7. PLAN MAINTENANCE PROCEDURES

This section details the formal process that will ensure that the HMP remains an active and relevant document and that the Planning Partnership maintains their eligibility for mitigation funding. The plan maintenance process includes developing an annual schedule for monitoring and evaluating the plan annually and producing an updated plan every five years. In addition, this section describes how public participation will be integrated throughout the plan maintenance and implementation process. It explains how the mitigation strategies outlined in this plan update will be incorporated into existing planning mechanisms and programs, such as comprehensive land use planning processes, capital improvement planning, and building code enforcement and implementation. The plan's format allows sections to be reviewed and updated when new data become available, resulting in a plan that will remain current and relevant.

The plan maintenance matrix shown in Table 7-1 provides a checklist of key actions to take each year to support plan monitoring, evaluation, and update, which are discussed in further detail in the sections below.

Table 7-1. Plan Maintenance Checklist

2021	2022	2023	2024	2025
Month 1 • Municipal adoption resolutions • Confirm planning partnership	**Month 1** • Annual HMP status meeting with County Planning	**Month 1** • Annual HMP status meeting with County Planning	**Month 1** • Annual HMP status meeting with County Planning	Update the 2021 HMP
Month 2-12 • Review the status of previous actions; update status via the BATool℠	**Month 2-12** • Review the status of previous actions; update status via the BATool℠	**Month 2-12** • Review the status of previous actions; update status via the BATool℠	**Month 2-12** • Review the status of previous actions; update status via the BATool℠	
Month 11 • Prepare status updates and action implementation tracking as part of the annual progress report submittal	**Month 11** • Prepare status updates and action implementation tracking as part of the annual progress report submittal	**Month 11** • Prepare status updates and action implementation tracking as part of the annual progress report submittal	**Month 11** • Prepare status updates and action implementation tracking as part of the annual progress report submittal	
Month 12 • Generate and distribute annual progress report	**Month 12** • Generate and distribute annual progress report • ***Apply for funding for next plan update***	**Month 12** • Generate and distribute annual progress report	**Month 12** • Generate and distribute annual progress report	

7.1 Monitoring, Evaluating and Updating the Plan

The procedures for monitoring, evaluating, and updating the plan are provided below.

The HMP Coordinator is assigned to manage the maintenance and update of the plan during its performance period. The HMP Coordinator will chair the Planning Partnership and be the prime point of contact for questions regarding the plan and its implementation as well as to coordinate incorporation of additional information into the plan.

The Planning Partnership shall fulfill the monitoring, evaluation and updating responsibilities identified in this section which is comprised of a representative from each participating jurisdiction. Each jurisdiction is expected to maintain a representative on the Planning Partnership throughout the plan performance period (five years from the date of plan adoption). As of the date of this plan, primary and secondary mitigation planning representatives (points-of-contact) are identified in each jurisdictional annex in Section 9 (Jurisdictional Annexes).

Regarding the composition of the committee, it is recognized that individual commitments change over time, and it shall be the responsibility of each jurisdiction and its representatives to inform the HMP Coordinator of any changes in representation. The HMP Coordinator will strive to keep the committee makeup as a uniform representation of planning partners and stakeholders within the planning area.

Currently, the Tompkins County HMP Coordinator is designated as:

Scott D. Doyle, AICP, Associate Planner
Tompkins County Department of Planning & Sustainability
Daniel D. Tompkins Building
1st Floor
121 East Court Street
Ithaca, New York 14850
(607)274-5560
sdoyle@tompkins-co.org

7.1.1 Monitoring

The Planning Partnership shall be responsible for monitoring progress on, and evaluating the effectiveness of, the plan, and documenting annual progress. Each year, beginning one year after plan development, Tompkins County and local Planning Partnership representatives will collect and process information from the departments, agencies and organizations involved in implementing mitigation projects or activities identified in their jurisdictional annexes (Section 9) of this plan, by contacting persons responsible for initiating and/or overseeing the mitigation projects.

In the first year of the performance period, this will be accomplished by utilizing an online performance progress reporting system, the BATool^{SM} which will enable municipal and county representatives of directly access mitigation initiatives to easily update the status of each project, document successes or obstacles to implementation, add or delete projects to maintain mitigation project implementation. It is anticipated that all participating partners will be prompted by the tool to update progress on a quarterly basis, providing an incentive for participants to refresh their mitigation strategies and to continue implementation of projects. It is expected that this reporting system will support the submittal of an increased number of project grant fund applications due to the functionality of the system which facilitates the sorting and prioritization of projects.

In addition to progress on the implementation of mitigation actions, including efforts to obtain outside funding; and obstacles or impediments to implementation of actions, the information that Planning Committee representatives shall be expected to document, as needed and appropriate include:

- Any grant applications filed on behalf of any of the participating jurisdictions,
- Hazard events and losses occurring in their jurisdiction,
- Additional mitigation actions believed to be appropriate and feasible,
- Public and stakeholder input.

Plan monitoring for years 2 through 4 of the plan performance periods will be similarly addressed via the BATool^{SM} or manually.

7.1.2 Integration Process of the HMP into Municipal Planning Mechanisms

Hazard mitigation is sustained action taken to reduce or eliminate the long-term risk to human life and property from natural hazards. Integrating hazard mitigation into a community's existing plans, policies, codes, and programs leads to development patterns that does not increase risk from known hazards or leads to redevelopment that reduces risk from known hazards. The Tompkins County Planning Partnership was tasked with identifying how hazard mitigation is integrated into existing planning mechanisms. Refer to Section 9 (Jurisdictional Annexes) for how this is done for each participating municipality. During this process, many municipalities recognized the importance and benefits of incorporating hazard mitigation into future municipal planning and regulatory processes.

The Planning Partnership representatives will incorporate mitigation planning as an integral component of multiple aspects of daily government operations. Planning Partnership representatives will work with local government officials to integrate the newly adopted hazard mitigation goals and actions into the general operations of government and partner organizations. Further, the sample adoption resolution (Section 2 – Plan Adoption) includes a resolution item stating the intent of the local governing body to incorporate mitigation planning as an integral component of government and partner operations. By doing so, the Planning Partnership anticipates that:

1. Hazard mitigation planning will be formally recognized as an integral part of overall planning and emergency management efforts;
2. The Hazard Mitigation Plan, Comprehensive Plans, Comprehensive Emergency Management Plans and other relevant planning mechanisms will become mutually supportive documents that work in concert to meet the goals and needs of County residents.

During the HMP annual review process, each participating municipality will be asked to document how they are utilizing and incorporating the Tompkins County HMP into their day-to-day operations and planning and regulatory processes. Additionally, each municipality will identify additional policies, programs, practices, and procedures that could be modified to accommodate hazard mitigation actions and include these findings and recommendations in the Annual HMP Progress Report. The following checklist was adapted from FEMA's Local Mitigation Handbook (2013), Appendix A, Worksheet 4.2. This checklist will help a community analyze how hazard mitigation is integrated into local plans, ordinances, regulations, ordinances, and policies. By completing the checklist, it will help municipalities identify areas that integrate hazard mitigation currently and where to make improvements and reduce vulnerability to future development. In this manner, the integration of mitigation into municipal activities will evolve into an ongoing culture within the county and its municipalities.

Table 7-2. Safe Growth Check List

Planning Mechanisms	Do you Do This? Yes	No	Notes: How is it being done or how will this be utilized in the future?
Operating, Municipal and Capital Improvement Program Budgets			
• When constructing upcoming budgets, hazard mitigation actions will be funded as budget allows. Construction projects will be evaluated to see if they meet the hazard mitigation goals.			
• Annually, during adoption process, the municipality will review mitigation actions when allocating funding.			
• Do budgets limit expenditures on projects that would encourage development in areas vulnerable to natural hazards?			
• Do infrastructure policies limit extension of existing facilities and services that would encourage development in areas vulnerable to natural hazards?			
• Do budgets provide funding for hazard mitigation projects identified in the County HMP?			
Human Resource Manual			
• Do any job descriptions specifically include identifying and/or implementing mitigation projects/actions or other efforts to reduce natural hazard risk?			
Building and Zoning Ordinances			
• Prior to, zoning changes, or development permitting, the municipality will review the hazard mitigation plan and other hazard analyses to ensure consistent and compatible land use.			
• Does the zoning ordinance discourage development or redevelopment within natural areas including wetlands, floodways, and floodplains?			
• Does it contain natural overlay zones that set conditions?			
• Does the ordinance require developers to take additional			

Planning Mechanisms	Do you Do This? Yes	No	Notes: How is it being done or how will this be utilized in the future?
actions to mitigate natural hazard risk?			
• Do rezoning procedures recognize natural hazard areas as limits on zoning changes that allow greater intensity or density of use?			
• Do the ordinances prohibit development within, of filling of, wetlands, floodways, and floodplains?			
Subdivision Regulations			
• Do the subdivision regulations restrict the subdivision of land within or adjacent to natural hazard areas?			
• Do the subdivision regulations restrict the subdivision of land within or adjacent to natural hazard areas?			
• Do the regulations provide for conservation subdivisions or cluster subdivisions in order to conserve environmental resources?			
• Do the regulations allow density transfers where hazard areas exist?			
Comprehensive Plan			
• Are the goals and policies of the plan related to those of the County HMP?			
• Does the future land use map clearly identify natural hazard areas?			
• Do the land use policies discourage development or redevelopment with natural hazard areas?			
• Does the plan provide adequate space for expected future growth in areas located outside natural hazard areas?			
Land Use			
• Does the future land use map clearly identify natural hazard areas?			
• Do the land use policies discourage development or redevelopment with natural hazard areas?			
• Does the plan provide adequate space for expected future growth in			

Planning Mechanisms	Do you Do This? Yes	No	Notes: How is it being done or how will this be utilized in the future?
areas located outside natural hazard areas?			
Transportation Plan			
• Does the transportation plan limit access to hazard areas?			
• Is transportation policy used to guide growth to safe locations?			
• Are transportation systems designed to function under disaster conditions (e.g. evacuation)?			
Environmental Management			
• Are environmental systems that protect development from hazards identified and mapped?			
• Do environmental policies maintain and restore protective ecosystems?			
• Do environmental policies provide incentives to development that is located outside protective ecosystems?			
Grant Applications			
• Data and maps will be used as supporting documentation in grant applications.			
Municipal Ordinances			
• When updating municipal ordinances, hazard mitigation will be a priority			
Economic Development			
• Local economic development group will take into account information regarding identified hazard areas when assisting new businesses in finding a location.			
Public Education and Outreach			
• Does the municipality have any public outreach mechanisms / programs in place to inform citizens on natural hazards, risk, and ways to protect themselves during such events?			

7.1.3 Mitigation Plan Evaluation

The evaluation of the mitigation plan is an assessment of whether the planning process and actions have been effective, if the HMP goals are being achieved, and whether changes are needed. The HMP will be evaluated on an annual basis to determine the effectiveness of the programs, and to reflect changes that could affect mitigation priorities or available funding.

The status of the HMP will be discussed and documented at an annual plan review meeting of the Planning Partnership, to be held either in person or via teleconference approximately one year from the date of local adoption of this update, and successively thereafter. At least two weeks before the annual plan review meeting, the Tompkins County HMP Coordinator will advise Planning Partnership members of the meeting date, agenda and expectations of the members.

The Tompkins County HMP Coordinator will be responsible for calling and coordinating the annual plan review meeting and Soliciting input regarding progress toward meeting plan goals and objectives. These evaluations will assess whether:

- Goals and objectives address current and expected conditions.
- The nature or magnitude of the risks has changed.
- Current resources are appropriate for implementing the HMP and if different or additional resources are now available.
- Actions were cost effective.
- Schedules and budgets are feasible.
- Implementation problems, such as technical, political, legal or coordination issues with other agencies are presents.
- Outcomes have occurred as expected.
- Changes in county, city, town or village resources impacted plan implementation (e.g., funding, personnel, and equipment)
- New agencies/departments/staff should be included, including other local governments as defined under 44 CFR 201.6.

Specifically, the Planning Partnership will review the mitigation goals, objectives, and activities using performance-based indicators, including:

- New agencies/departments
- Project completion
- Under/over spending
- Achievement of the goals and objectives
- Resource allocation
- Timeframes

- Budgets
- Lead/support agency commitment
- Resources
- Feasibility

Finally, the Planning Partnership will evaluate how other programs and policies have conflicted or augmented planned or implemented measures, and shall identify policies, programs, practices, and procedures that could be modified to accommodate hazard mitigation actions ("Implementation of Mitigation Plan through Existing Programs" subsection later in this section discusses this process). Other programs and policies can include those that address:

- Economic development
- Environmental preservation
- Historic preservation
- Redevelopment
- Health and/or safety
- Recreation
- Land use/zoning
- Public education and outreach
- Transportation

The Planning Partnership should refer to the evaluation forms, Worksheets #2 and #4 in the FEMA 386-4 guidance document, to assist in the evaluation process (see Appendix G – Plan Review Tools). Further, the Planning Partnership should refer to any process and plan review deliverables developed by the county or participating jurisdictions as a part of the plan review processes established for prior or existing local HMPs within the county.

The Tompkins County HMP Coordinator shall be responsible for preparing an Annual HMP Progress Report for each year of the performance period, based on the information provided by the local Planning Partnership members, information presented at the annual Planning Partnership meeting, and other information as appropriate and relevant. These annual reports will provide data for the five-year update of this HMP and will assist in pinpointing any implementation challenges. By monitoring the implementation of the HMP on an annual basis, the Planning Partnership will be able to assess which projects are completed, which are no longer feasible, and what projects should require additional funding.

The Annual HMP Progress Report shall be posted on the Tompkins County Department of Planning & Sustainability website to keep the public apprised of the plan's implementation (https://tompkinscountyny.gov/planning/haz_mit). Additionally, the website provides details on the HMP update planning process. For communities who might choose to join the NFIP CRS program, this report will also be provided to each CRS participating community in order to meet annual CRS recertification requirements. To meet this recertification timeline, the Planning Partnership will strive to complete the review process and prepare an Annual HMP Progress Report by October 14th of each year.

The HMP will also be evaluated and revised following any major disasters, to determine if the recommended actions remain relevant and appropriate. The risk assessment will also be revisited to see if any changes are necessary based on the pattern of disaster damages or if data listed in the Section 5.4 (Hazard Profiles) of this plan has been collected to facilitate the risk assessment. This is an opportunity to increase the community's disaster resistance and build a better and stronger community.

7.1.4 Updating

44 CFR 201.6.d.3 requires that local hazard mitigation plans be reviewed, revised as appropriate, and resubmitted for approval in order to remain eligible for benefits awarded under DMA 2000. It is the intent of the Tompkins County HMP Planning Partnership to update this plan on a five-year cycle from the date of initial plan adoption.

To facilitate the update process, the Tompkins County HMP Coordinator, with support of the Planning Partnership, shall use the second annual Planning Partnership meeting to develop and commence the implementation of a detailed plan update program. The Tompkins County HMP Coordinator shall invite representatives from NYS DHSES to this meeting to provide guidance on plan update procedures. This program shall, at a minimum, establish who shall be responsible for managing and completing the plan update effort, what needs to be included in the updated plan, and a detailed timeline with milestones to assure that the update is completed according to regulatory requirements.

At this meeting, the Planning Partnership shall determine what resources will be needed to complete the update. The Tompkins County HMP Coordinator shall be responsible for assuring that needed resources are secured.

Following each five-year update of the mitigation plan, the updated plan will be distributed for public comment. After all comments are addressed, the HMP will be revised and distributed to all planning group members and the New York State Hazard Mitigation Officer.

7.1.5 Grant Monitoring and Coordination

Tompkins County recognizes the importance of having an annual coordination period that helps each planning partner become aware of upcoming mitigation grant opportunities identifies multi-jurisdiction projects to pursue. Grant monitoring will be the responsibility of each municipal partner as part of their annual progress reporting. The Tompkins County HMP Coordinator will regularly keep the planning partners apprised of Hazard

Mitigation Assistance grant openings and assist in developing Letters of Intent (LOIs) for grant opportunities when practicable.

Tompkins County intends to be a resource to the Planning Partnership in the support of project grant writing and development. The degree of this support will depend on the level of assistance requested by the partnership during open windows for grant applications. As part of grant monitoring and coordination, Tompkins County intends to provide the following:

- Notification to Planning Partnership about impending grant opportunities.
- A current list of eligible, jurisdiction-specific projects for funding pursuit consideration.
- Notification about mitigation priorities for the fiscal year to assist the planning partners in the selection of appropriate projects.

Grant monitoring and coordination will be integrated into the annual progress report or as needed based on the availability of non-HMA or post-disaster funding opportunities.

7.2 Implementation of Mitigation Plan through Existing Programs

Effective mitigation is achieved when hazard awareness and risk management approaches and strategies become an integral part of public activities and decision-making. Within the county there are many existing plans and programs that support hazard risk management, and thus it is critical that this hazard mitigation plan integrate and coordinate with, and complement, those existing plans and programs.

The "Capability Assessment" section of Section 6 (Mitigation Strategy) provides a summary and description of the existing plans, programs and regulatory mechanisms at all levels of government (federal, state, county and local) that support hazard mitigation within the county. Within each jurisdictional annex in Section 9 (Jurisdictional Annexes), the county and each participating jurisdiction identified how they have integrated hazard risk management into their existing planning, regulatory and operational/administrative framework ("existing integration"), and how they intend to promote this integration ("opportunities for future integration").

It is the intention of Planning Partnership representatives to incorporate mitigation planning as an integral component of daily government operations. Planning Partnership representatives will work with local government officials to integrate the newly adopted hazard mitigation goals and actions into the general operations of government and partner organizations. Further, the sample adoption resolution (Section 2 – Plan Adoption) includes a resolution item stating the intent of the local governing body to incorporate mitigation planning as an integral component of government and partner operations. By doing so, the Planning Partnership anticipates that:

1. Hazard mitigation planning will be formally recognized as an integral part of overall emergency management efforts;
2. The Hazard Mitigation Plan, Comprehensive Plans, Comprehensive Emergency Management Plans and other relevant planning mechanisms will become mutually supportive documents that work in concert to meet the goals and needs of county residents.

Other planning processes and programs to be coordinated with the recommendations of the hazard mitigation plan include the following:

- Emergency response plans
- Training and exercise of emergency response plans
- Debris management plans
- Recovery plans
- Capital improvement programs
- Municipal codes
- Community design guidelines
- Water-efficient landscape design guidelines
- Stormwater management programs
- Water system vulnerability assessments
- Community Wildfire Protection Plans
- Comprehensive Flood Hazard Management Plans
- Resiliency and Adaptation plans
- Community Development Block Grant-Disaster Recovery action plans
- Public information/education plans

Some action items do not need to be implemented through regulation. Instead, these items can be implemented through the creation of new educational programs, continued interagency coordination, or improved public participation.

During the annual plan evaluation process, the Planning Partnership representatives will identify additional policies, programs, practices, and procedures that could be modified to accommodate hazard mitigation actions and will aim to include these findings and recommendations in the Annual HMP Progress Report.

7.3 Continued Public Involvement

Tompkins County and participating jurisdictions are committed to the continued involvement of the public in the hazard mitigation process. This HMP update will continue to be posted on-line (https://www2.tompkinscountyny.gov/planning/climate-adaptation). In addition, public outreach and dissemination of the HMP will include:

- Links to the plan on municipal websites of each jurisdiction with capability.
- Continued utilization of existing social media outlets (Facebook, Twitter) to inform the public of natural hazard events, such as floods and severe storms. Educate the public via the jurisdictional websites on how these applications can be used in an emergency situation.
- Development of annual articles or workshops on flood hazards to educate the public and keep them aware of the dangers of flooding.
- Other diverse, creative outreach methods.

Planning Partnership representatives and the Tompkins County HMP Coordinator will be responsible for receiving, tracking, and filing public comments regarding this HMP. The public will have an opportunity to comment on the plan via the hazard mitigation website at any time. The HMP Coordinator will maintain this website, posting new information and maintaining an active link to collect public comments.

The public can also provide input at the annual review meeting for the HMP and during the next five-year plan update. The Tompkins County HMP Coordinator is responsible for coordinating the plan evaluation portion of the meeting, soliciting feedback, collecting and reviewing the comments, and ensuring their incorporation in the five-year plan update as appropriate. Additional meetings might also be held as deemed necessary by the planning group. The purpose of these meeting would be to provide the public an opportunity to express concerns, opinions, and ideas about the mitigation plan.

The Planning Partnership representatives shall be responsible to assure that:

- Public comment and input on the plan, and hazard mitigation in general, are recorded and addressed, as appropriate.
- Copies of the latest approved plan (or draft in the case that the five-year update effort is underway) are available for review, along with instructions to facilitate public input and comment on the Plan.
- Appropriate links to the Tompkins County Hazard Mitigation Plan website are included on municipal websites.
- Public notices are made as appropriate to inform the public of the availability of the plan, particularly during Plan update cycles.

The Tompkins County HMP Coordinator shall be responsible to assure that:

- Public and stakeholder comment and input on the plan, and hazard mitigation in general, are recorded and addressed, as appropriate.
- The Tompkins County HMP website is maintained and updated as appropriate.
- Copies of the latest approved plan are available for review at appropriate county facilities along with instructions to facilitate public input and comment on the plan.
- Public notices, including media releases, are made as appropriate to inform the public of the availability of the plan, particularly during plan update cycles.

%	Percent
ACOE	Army Corps of Engineers
ACS	American Community Survey
ADA	Americans with Disabilities Act
AFG	Assistance to Firefighters Grants
ALB	Asian Longhorned Beetles
AM	Ante Meridiem
ANSS	Advanced National Seismic System
APA	Approval Pending Adoption
ARC	American Red Cross
ASFPM	Association of State Floodplain Management
BCA	Benefit Cost Analysis
BC IDA	Business Development Corporation and Industrial Development Agency
BCEGS	Building Code Effectiveness Grading Schedule
BFE	Base Flood Elevation
BOCES	Board of Cooperative Educational Services of New York State
BRIC	Building Resilient Infrastructure and Communities
CBS	Chemical Bulk Storage
CAC	Community Assistance Contact
CAV	Community Assisted Visit
CC	Cortland County
CDBG	Community Development Block Grant
CDBG-DR	Community Development Block Grant Disaster Recovery
CDC	Centers for Disease Control
CDMS	Comprehensive Data Management System
CEAS	Critical Environmental Area
CEMP	Comprehensive Emergency Management Program
CEO	Chief Executive Officer
CEPA	County Emergency Preparedness Plan
CFM	Certified Facility Manager
CFR	Code of Federal Regulations
CHIPS	Consolidated Local Street and Highway Improvement Program
CMP	Coastal Management Program

COOP/COG	Continuity of Operations/Continuity of Government
CRRA	Community Risk and Resilience Act
CRREL	Cold Regions Research and Engineering Laboratory
CRS	Community Rating System
CEO	Chief Executive Officer
CERCLIS	Comprehensive Environmental Response, Compensation and Liability Information System
CFR	Code of Federal Regulations
CHP	Combined Heat and Power
COVID	Corona Virus Disease
CRRA	Community Risk and Resiliency Act
CSLAP	Citizens Statewide Lake Assessment Program
CSC	Climate Smart Communities (NYSDEC)
CSD	Central School District
CWSRF	Clean Water State Revolving Fund
DEC	Department of Environmental Conservation
DFIRM	Digital Flood Insurance Rate Map
DHS	Department of Homeland Security
DHSES	Department of Homeland Security and Emergency Services
DI	Damage Indicators
DMA	Disaster Mitigation Act
DMA 2000	Disaster Mitigation Act of 2000
DOD	Degree of Damage
DOF	Depends on Funding
DOH	Department of Health
DOS	New York State Department of State
DPW	Department of Public Works
DCEA	Division of Code Enforcement and Administration
DPC	Disaster Preparedness Commission
DR	Major Disaster Declaration (FEMA)
DVBD	Division of Vector Borne Diseases
EAB	Emerald Ash Borer
EAP	Education and Awareness Program

EEE	Eastern Equine Encephalitis
EF	Enhanced Fujita Scale
EFC	Environmental Facilities Corporation
EHP	Environmental/ Historic Preservation Issues
EM	Emergency Declaration (FEMA)
EMPG	Emergency Management Performance Grants
EMS	Emergency Medical Services
EMT	Emergency Medical Technician
EOC	Emergency Operation Center
EPA	Environmental Protection Agency
EPF	Environmental Protection Fund
EPG	Engineering Planning Grant
ERO	Emergency Response Office
ES	Emergency Services
ESF	Emergency Support Function
ESRI	Environmental Systems Research Institute
EWP	Emergency Watershed Protection Program
FAST	Flood Assessment Structure Tool
FCC	Federal Communications Commission
FD	Fire Department
FD HQ	Fire Department Headquarters
FDPO	Flood Damage Prevention Ordinance
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FIRM	Flood Insurance Rate Map
FHWA	Federal Highway Administration
FMA	Flood Mitigation Assistance
FPA	Floodplain Administrator
FPE	Floodplain Easement
FSA	Farm Service Agency
FTA	Federal Transit Authority
FY	Fiscal Year
GAC	Granular Activated Carbon

GHG	Greenhouse Gas
GIS	Geographic Information System
GM	Garlic Mustard
GSN	Global Seismographic Network
HAB	Harmful Algal Bloom
HAV	Hepatitis A
HAZMAT	Hazardous Materials
HAZUS	Hazards U.S.
HAZUS-MH	Hazards U.S. Multi-Hazard
HIRA-NY	Hazard Identification and Risk Assessment - NY
HMA	Hazard Mitigation Assistance
HMGP	Hazard Mitigation Grant Program
HMP	Hazard Mitigation Plan
HSGP	Homeland Security Grant Program
HT	High Toxins
HUD	U.S. Department of Housing and Urban Development
HVAC	Heating, Ventilation, and Air Conditioning
HWA	Hemlock Woolly Adelgid
IA	Individual Assistance
ID	Identification
IDA	Industrial Development Agency
IDF	Intensity Duration Frequency
IEEP	Independent Energy Efficiency Program
IPCC	Intergovernmental Panel on Climate Change
ITCTC	Ithaca-Tompkins County Transportation Council
LCSN	Lamon-Doherty Cooperative Seismographic Network
LEED	Leadership in Energy and Environmental Design
LEPC	Local Emergency Planning Committee
LGRMIF	Local Government Records Management Improvement Fund
LPR	Local Plans and Regulations
LWRP	Local Waterfront Revitalization Program
MCI	Mass Casualty Incident
MOSF	Major Oil Storage Facilities

MH	Multi- Hazards
MHI	Median Household Income
MPC	Mitigation Planning Committee
MRP	Mean Return Period
MSL	Mean Sea Level
MTA	Metropolitan Transportation Authority
MW	Mega Watt
N/A	Not Applicable
NA	Not Available
NAC-AAA	National Avalanche Center – American Avalanche Association
NASA	National Aeronautics and Space Administration
NCEI	National Centers for Environmental Information
NDMC	National Drought Mitigation Center
NEHRP	National Earthquake Hazards Reduction Program
NFIP	National Flood Insurance Program
NFPA	National Fire Protection Association
NHC	National Hurricane Center
NIC	National Influenza Centers
NID	National Inventory of Dams
NOAA	National Oceanic and Atmospheric Administration
NOM	Natural Organic Matter
NP	Not Participating
NPL	National Priorities List (EPA)
NR	Natural Resources Protection
NRCC	Northeast Regional Climate Center
NRCS	Natural Resources Conservation Service
NSP	Natural Systems Protection
NSSL	National Severe Storms Library
NSIDC	National Snow and Ice Data Center
NWS	National Weather Service
NY	New York
NYC	New York City
NYCEM	New York City Emergency Management

NYCOEM	New York City Office of Emergency Management
NYCRR	New York Codes, Rule, and Regulations
NYS	New York State
NYS DHSES	New York State Division of Homeland Security and Emergency Services
NYS GIS	New York State Geographic Information System
NYSOPRHP	New York State Parks, Recreation & Historic Preservation
NYSDAM	Department of Agriculture and Markets
NYSDEC	New York State Department of Environmental Conservation
NYSDHSES	New York State Department of Homeland Security and Emergency Services
NYSDOH	New York State Department of Health
NYSDOT	New York State Department of Transportation
NYSDPC	New York State Disaster Preparedness Commission
NYSEG	New York State Electric and Gas
NYSERDA	New York State Energy Research and Development Authority
NYSHMP	New York State Hazard Mitigation Plan
NYSOCS	New York State Office of Cyber Security
NYSOEM	New York State Office of Emergency Management
OEM	Office of Emergency Management
ORPTS	Office of Real Property Tax Services
PA	Pennsylvania
PA	Public Assistance
PAC	Powdered Activated Carbon
PBS	Petroleum Bulk Storage
PCDA	Property Condition Disclosure Act
PCMHAB	Prevention, Control, and Mitigation of Harmful Algal Bloom
PD	Police Department
PDM	Pre-Disaster Mitigation Program
PDSI	Palmer Drought Severity Index
PERMA	Public Entity Risk Management Authority
PI	Public Information
PGA	Peak Ground Acceleration
PHMSA	US Department of Transportation Pipeline and Hazardous Material Safety Administration
PM	Post Meridiem

POC	Point of Contact
Pop.	Population
PP	Property Protection
PR	Preventative Measures
PRISM	Partnership for Regional Invasive Species Management
PW	Public Works
RCV	Replacement Cost Value
REDC	Regional Economic Development Council
RL	Repetitive Loss
RTE	Route
RTP	Recreational Trails
SARA	Superfund Amendments & Reauthorization Act
SBA	Small Business Administration
SEMO	State Office of Emergency Management
SEQRA	State Environmental Quality Review Act
SD	Sewer District
SDI	State Drought Index (NYSDEC)
SF	Square Feet
SFHA	Special Flood Hazard Area
SFRMG	State Flood Risk Management Guidance
SGIA	Smart Growth Implementation Assistance
SHMO	State Hazard Mitigation Officer
SHSP	State Homeland Security Program
SIP	Structure and Infrastructure Project
SLF	Spotted lanternfly
SOG	Standard Operating Guideline
SP	Structure Flood Control Projects
SPC	Storm Prediction Center
SPDES	State Pollutant Discharge Elimination System
SUNY	State University of New York
Sq. Mi.	Square mile
SR	State Road
SRL	Severe Repetitive Loss

SSBG	Social Services Block Grant
STAPLEE	Social, Technical, Administrative, Political, Legal, Economic, and Environmental
SVI	Social Vulnerability Index
SW	Sirex Woodwasp
SWCD	Soil and Water Conservation District
SWOO	Strengths, Weaknesses, Obstacles and Opportunities
SWPPP	Stormwater Pollution Prevention Plan
TB	Tuberculosis
TBA	To Be Announced
TBD	To Be Determined
TCAT	Tompkins Consolidated Area Transit
THIRA	Threat & Hazard Identification & Risk Assessment
TL	Town of Lapeer
TM	Town of Marathon
TMDL	Total Maximum Daily Load
TORRO	Tornado and Storm Research Organization
TRI	Toxic Release Inventory
UASI	Urban Areas Security Initiative
UNAS	Unique Natural Areas
USACE	U.S. Army Corps of Engineers
USBR	United States Bureau of Reclamation
USDA	U.S. Department of Agriculture
USEDA	U.S. Economic Development Administration
USGS	U.S. Geological Survey
UV	Ultra Violet
WHO	World Health Organization
WCT	Wind Chill Temperature
WQIP	Water Quality Improvement Project
WNV	West Nile Virus
WTD	White-Tailed Deer
WUI	Wildland/Urban Interface
WW	Wastewater
WWPS	Wastewater Pump Station

WWTP	Wastewater Treatment Plant
ZBA	Zoning Board of Appeals

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