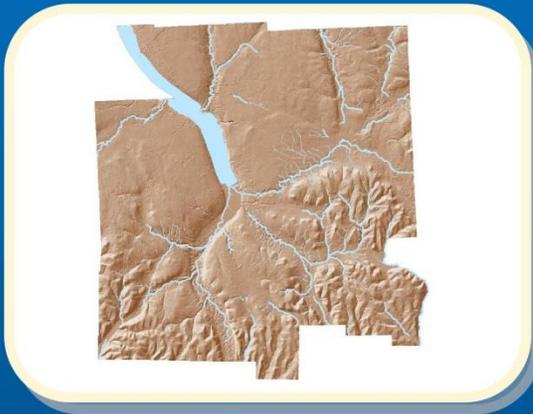


TOMPKINS COUNTY HAZARD MITIGATION PLAN: 2013 UPDATE

December 2013



*A joint effort of Tompkins County, NY municipalities to update the
2006 Multi-Jurisdictional All-Hazard Mitigation Plan.*

Tompkins County
New York

Planning Department

This Multi-Jurisdictional All-Hazard Mitigation Plan Update has been completed by Barton & Loguidice, P.C., under the direction and support of the Tompkins County Planning Department. All jurisdictions within the County participated in this update process. A special thanks to the representatives and various project team members, whose countless time and effort on this project was instrumental in putting together a concise and meaningful document.

Tompkins County Planning Department
121 East Court Street
Ithaca, New York 14850

Tompkins County Department of Emergency Response
Emergency Response Center
92 Brown Road
Ithaca, New York 14850

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Executive Summary

To collectively reduce Tompkins County's hazard risk, each of the 17 jurisdictions in the County worked together in producing this update to the Tompkins County Multi-Jurisdictional All-Hazard Mitigation Plan. The initial mitigation plan was finalized and approved by FEMA in 2006. Having a FEMA-approved hazard mitigation plan allows communities to be eligible for federal pre-disaster mitigation funds. Hazard mitigation is broadly defined as *a method for reducing or alleviating losses prior to a hazard event*. Mitigation should not be confused with the other distinctly different phases of emergency management which include preparedness, response, and recovery. This Plan includes aspects of each of these other phases, though its focus is on mitigation.

There are several aspects of the update which differ from the 2006 Plan. For one, the previous Plan involved just a little over half of the County's jurisdictions, whereas the update includes all 17 jurisdictions. Also, the 2006 Plan analyzed risks associated with just 12 hazards; the Plan update examines 22. The most significant new aspect of the Plan update includes the examination of future hazard risks, specifically as related to climate change and future potential of horizontal hydraulic fractured gas drilling.

The 22 hazards identified were examined based on scope, cascading effect, frequency of occurrence, time of onset, duration and recovery time. A group of community stakeholders utilized these criteria in examining the hazard's relative risk to Tompkins County. Those hazards identified by the group as highest risk were transportation accidents, severe storms, flash floods, and infestations. Infestations are events characterized as an excessive population of plants, insects, rodents, or other animals requiring control measures due to their potential to carry diseases, destroy crops, or harm the environment. The recent regional issues surrounding invasive forest pests and the aquatic invasive, hydrilla, have elevated this hazard risk.

In further examining these hazards, both history and future potential for occurrence were examined. As an example, flash floods, which were distinguished from lake floods, have occurred 24 times over the last 19 years. This flooding has largely occurred within the nearly 10,000 acres of mapped floodplain. The total reported countywide annual losses associated with flash floods are nearly \$47,000. The New York State Energy Research and Development Authority (NYSERDA)'s ClimAid technical report projects that average annual precipitation is projected to increase by up to 5% by the 2020s, 10% by the 2050s and up to 15 percent by the 2080s. These increases would surely affect the frequency and severity of flash flooding events in Tompkins County.

Recognizing that hazard risk does not respect political boundaries, every Town, City and Village, along with Tompkins County, participated in the Plan update. To assist in guiding the update, a Project Team was established and represented by at least one municipal representative from each participating jurisdiction. The team was responsible for assisting in data collection, document review, and coordination efforts. Additionally, a Technical Committee was established. The Technical Committee includes researchers, practitioners, and others, whose task is to aid in guiding and revising the plan based on their various interests and areas of expertise.

The Plan's Project Team identified a number of actions designed to reduce community risk associated with the identified hazards. The proposed actions are varied, but can be grouped into the following six broad categories: prevention, property protection, public education and awareness, natural resource protection, emergency services, and structural projects. Each jurisdiction identified actions pertinent to their specific communities' as well multi-jurisdictional actions. Actions were evaluated based on an initial evaluation of costs and benefits. Of the multi-jurisdictional actions, 15 were noted as high priority requiring implementation over the next five years. High priority actions that were identified include developing a countywide debris management plan, updating the County's flood insurance rate maps, and conducting annual climate science outreach to municipalities and large institutions.

The Plan is designed to be easily updated and implementable. As identified in the Plan Maintenance Section (Section 9.0), the Plan will be evaluated annually by an Implementation Committee which is made up of the participating jurisdictions. The Committee will evaluate a number of aspects related to the Plan, including any issues associated with the implementation of the priority actions.

The Plan update provides the jurisdictions of Tompkins County a path toward a future in which the risks associated with natural, technological and man-made hazards can be collectively reduced.

1.0 Introduction

1.1 Background

What is a Hazard?

A hazard is defined as a situation which poses a level of threat to life, health, property, and/or the environment. A hazard can be natural, technological or human-caused.

What is Hazard Mitigation?

Hazard mitigation is broadly defined as a method for reducing or alleviating property loss, reducing damage to the environment, and reducing the number and severity of injuries that occur from hazard events through long and short-term strategies. Responsibility for implementing mitigation measures runs community wide from individuals to industries, private business and all levels of government.

Hazard Mitigation and the Other Phases of Emergency Management

Hazard mitigation is often considered just one of four phases of emergency management. The other phases include preparedness, response and recovery. Each of these phases relate to and rely upon each other, as illustrated by Figure 1.1.

Figure 1.1 – The Phases of Emergency Management



The overarching goal of all of these emergency management activities is the prevention or minimizing of loss of life and property in disaster situations. The Tompkins County Department of Emergency Response (DOER) serves as the lead local agency in promoting this goal. DOER's responsibilities include:

- Provision of public preparedness information, including sharing of such information with citizens, the private sector, municipalities, and non-governmental organizations (NGOs)

- Participate in planning activities of many types and at many levels (keeper of the County's Comprehensive Emergency Plan) in partnership with other agencies involved in emergency responses ... authoring After Action Reports/Improvement Plans that identify best practices as well as areas for improvement.
- Coordination of fire and Emergency Medical Services (EMS) responses within the County
- 911 Center Operations (Public Safety); communications systems
- Liaison to State and Federal resources in times of disasters
- Operation of the County's Emergency Operations Center during the time of a disaster/emergency; and
- Coordination of recovery efforts after a disaster and liaison with State and Federal agencies involved in this process.

It is important to note that this plan relates to several of these emergency management phases, though its focus is mitigation.

FEMA and Hazard Mitigation

The Federal Emergency Management Agency (FEMA) provides assistance through the Robert T. Stafford Disaster Relief and Emergency Assistance Act to local governments that are recovering from a hazard event. The Federal Disaster Mitigation Act of 2000 (DMA 2000) recognized the importance and cost-effectiveness of mitigation in specifying that local governments must have a FEMA approved natural hazard mitigation plan in order to be eligible for mitigation project funding.

DMA 2000 encourages and rewards local and state pre-disaster planning, promotes conservation and sustainability, and seeks to integrate state and local planning with an overall goal of strengthening statewide hazard mitigation planning. As of November 1, 2004, all local governments were required to have a FEMA approved hazard mitigation plan to receive funding through the Hazard Mitigation Grant Program (HMGP) for specified mitigation projects. Tompkins County was awarded a pre-disaster mitigation grant to update their 2006 Multi-Jurisdictional All-Hazard Mitigation Plan in order to maintain this eligibility.

1.2 Plan Purpose

Why Develop a Hazard Mitigation Plan?

The purpose of this Multi-Jurisdictional All-Hazard Mitigation Plan (HMP) is to effectively reduce future disaster damages, public expenditure, private losses, and community hazard vulnerability. This plan update provides an opportunity for Tompkins County and its municipalities to develop a comprehensive risk assessment and to outline proposed mitigation actions to minimize the costs and impacts of future disaster events.

The intention of this plan update is to meet the New York State and federal hazard mitigation planning requirements established and managed by the New York State Office of Emergency

Management (NYS OEM) and FEMA. Jurisdictions that are participating in this plan update will benefit from the planning and implementation of the mitigation actions proposed and included within. The Pre-Disaster Mitigation Program (PDM) and the Flood Mitigation Assistance Program (FMA) continue to require communities to have an active FEMA-approved multi-hazard mitigation plan in-place prior to requesting project implementation funds. Participating jurisdictions that are granted funds are able to implement and complete positive mitigation actions to minimize impacts to their communities from hazard events. The following resources are key documents which authorize and provided guidance for the preparation of this plan update:

- Section 404 of Robert T. Stafford Disaster Relief and Emergency Assistance Act, Public Law 93-288, as amended by Public Law 100-707;
- Federal Disaster Mitigation Act of 2000;
- Hazard Mitigation Grant Program (HMGP), Pre-disaster Mitigation Program, Flood Mitigation Assistance Program, Repetitive Floodplain Claims Program (RFC), Severe Repetitive Loss Program (SRL);
- Code of Federal Regulations (CFR) – 44 Part 201;
- Hazard Mitigation and Relocation Assistance Act of 1993;
- FEMA – 44 CFR Part 9 – Floodplain Management and Protection of Wetlands and 44 CFR Part 10 – Environmental Considerations;
- New York State Executive Law, Article 2-B, Sections 23 and 28-a; and
- New York State Hazard Mitigation Plan (2011).

The Tompkins County Planning Department (TCPD) organized the effort to update the Tompkins County Multi-Jurisdictional All-Hazard Mitigation Plan that was originally adopted in 2006. The efforts made to update the original plan were made possible by a grant from FEMA that was administered by the Tompkins County Planning Department. The five year plan maintenance period has lapsed and Tompkins County contracted with Barton & Loguidice, P.C., hired through a formal request for qualifications (RFQ) process, to assist in the update effort. In addition to the basic requirements of updating the plan, Tompkins County is seeking the integration of three new features: the involvement of all 17 jurisdictions in Tompkins County, the impacts and risks associated with anticipated **climate change**, and the impacts and risks associated with anticipated widespread shale **gas drilling**. The continued monitoring and evaluation of this updated HMP will be provided by the TCPD.

The development of a HMP update for Tompkins County provides the following benefits:

- eligibility for federal funds to complete pre-disaster mitigation actions;
- development of more sustainable and disaster-resistant communities;
- formation of partnerships that support planning and mitigation efforts;
- reduction in long-term impacts to structures and human-health associated with extreme hazard events which are in some cases exacerbated by changing climactic conditions; and

- increased understanding of the hazards that could potentially impact the County and its municipalities.

Comments or questions about this plan should be addressed to the Tompkins County Planning Department, 121 East Court Street, Ithaca, NY 14850. This office can also be reached by phone at (607) 274-5560 and by email from their website <http://www.tompkins-co.org/planning/staff/contact.htm>.

1.3 Planning Participants

The 2013 HMP Update for Tompkins County includes all 17 jurisdictions located within Tompkins County: Tompkins County, nine towns (Caroline, Danby, Dryden, Enfield, Groton, Ithaca, Lansing, Newfield, and Ulysses), six villages (Cayuga Heights, Dryden, Freeville, Groton, Lansing, Trumansburg), and one city (Ithaca). Figure 1.2 shows the locations of these municipalities within the County limits and the position of Tompkins County within New York State.

The participation of all jurisdictions in the HMP Update process fulfills one of the main goals that Tompkins County had for this effort, and greatly improves the quality and completeness of this planning effort. The original 2006 HMP included only seven participating jurisdictions: Tompkins County and the Towns of Caroline, Danby, Enfield, Groton, Ithaca, Lansing, and Ulysses. The City of Ithaca and Dryden independently fulfilled DMA 2000 requirements through the implementation of single jurisdiction mitigation plans. The historic documentation and risk assessment data included in these single jurisdiction plans will be incorporated into this Multi-Jurisdictional HMP Update.

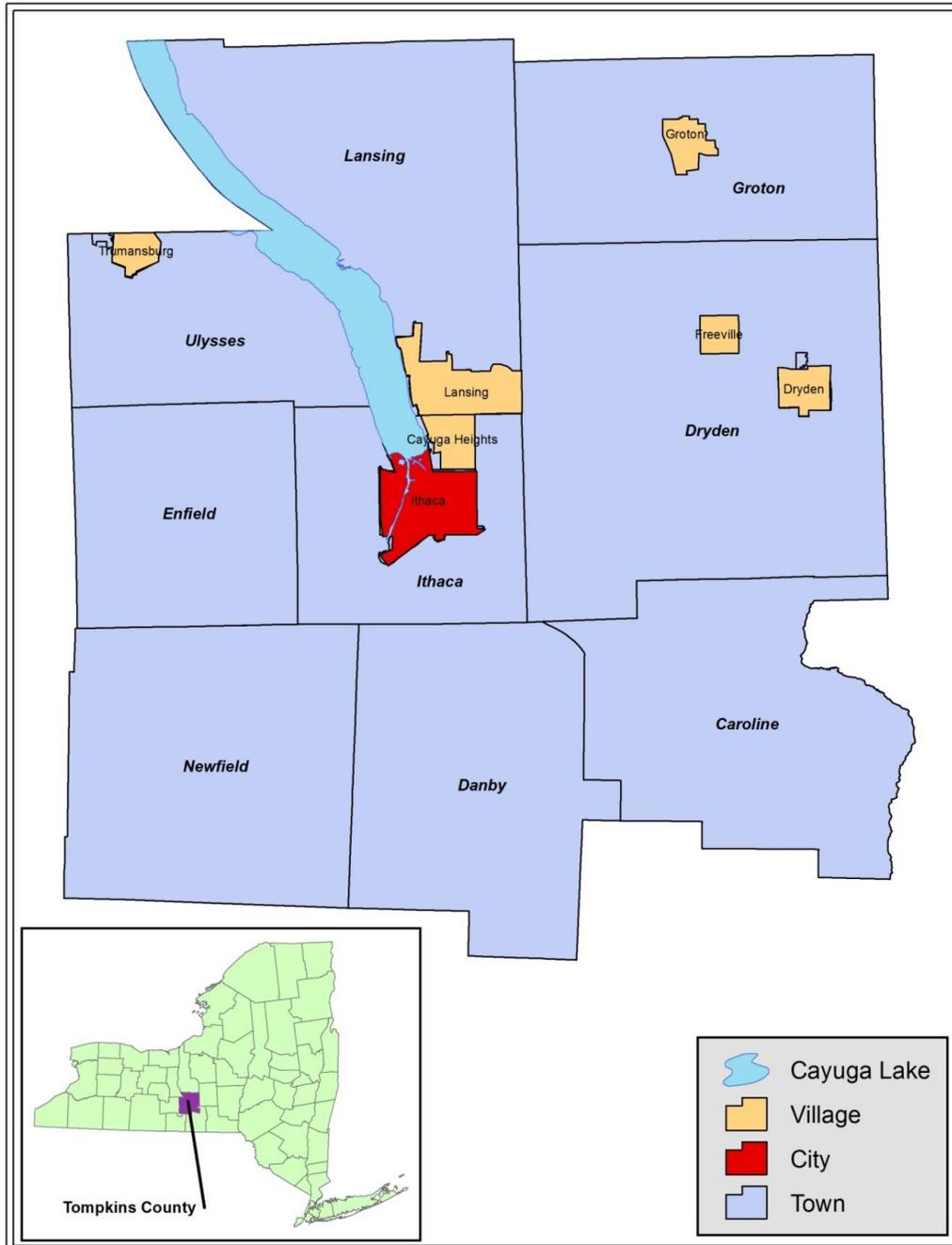
All municipalities within Tompkins County were contacted by the TCPD to participate in the plan update and were invited to attend a variety of meetings held throughout the planning process. Each participating jurisdiction provided updated information about the hazards that have historically occurred within their boundaries, with a focus on post-2006 events. Repair costs and damage estimates associated with such hazard events were also provided. All jurisdictions reviewed the critical facilities within their boundaries and the risk assessment and vulnerability information provided within this Plan Update. TCPD coordinated data collection and information review with jurisdictions and agencies unable to attend scheduled meetings.

A wide variety of additional resources were utilized to gather information concerning historic and recent occurrences of hazard events within Tompkins County, vulnerabilities within the County related to future hazard events, and costs and damages likely to occur as a result of a hazard event. The goals and objectives included in the County's 2006 HMP were reviewed and updated, as appropriate. Goals are created to assist in the formulation of potential mitigation actions that could be implemented to minimize the damage in Tompkins County that could occur to life, property, and/or the environment as a result of hazard events.

Representatives from the participating jurisdictions made up the Project Team. A Technical Committee was also assembled by the TCPD; this committee consisted of representatives from the following agencies, groups, and entities: Town of Ulysses, Cornell University, Tompkins County Department of Health, Tompkins County Soil and Water District, Bolton Point Water

Treatment Plant, City of Ithaca, New York State Electric & Gas (NYSEG), Town of Lansing Highway Department, Tompkins County Department of Emergency Response, and United States Geological Survey (USGS). Technical Committee members were selected and invited to participate in this update process based upon their specialties and fields of interest. Further detail about the Project Team and the Technical Committee are provided in Section 3.0.

Figure 1.2 – Participating Jurisdictions



1.4 Hazard Mitigation Planning Process

As with Tompkins County's original HMP, all participating jurisdictions accomplished the following objectives to support the plan update process:

- Established a knowledgeable planning group to represent all participating jurisdictions;
- Assessed numerous natural, technological, and human-caused hazards to determine those that have the greatest possibility of impacting the County;
- Analyzed and profiled all selected hazards;
- Incorporated recent planning efforts and new updated scientific information into hazard profiles and mitigation activities;
- Updated critical facility mapping within the County;
- Estimated damages and impacts that could occur as a result of various hazard events;
- Developed pre-disaster mitigation strategies and actions for the various types of hazards detailed in this document; and
- Reviewed and revised the plan maintenance procedures associated with this Plan.

DMA 2000 only requires that communities evaluate the impact of natural hazards. Though 14 natural hazards are the focus of this Plan Update, Tompkins County and other participants also chose to assess the County's vulnerability to six technological hazards and two human-caused hazards. All of these hazards are further described and profiled in Section 5 of this Plan Update.

2.0 Tompkins County Profile

This section details the existing environmental features, transportation networks, demographics, history, and available facilities within Tompkins County. A profile of Tompkins County and its existing features and facilities was not included in the original 2006 HMP. Section 2.0 is a new section that has been added to help detail and identify the existing conditions, capabilities, and vulnerabilities of Tompkins County and its 16 participating jurisdictions.

2.1 Geographic Location

Tompkins County is located in Upstate New York, northwest of the City of Binghamton and southwest of the City of Syracuse. Tompkins County is located in the Finger Lakes Region and is geographically positioned near the southern end of Cayuga Lake. Cayuga Lake is approximately 40 miles long, 3.5 miles wide at its widest point, and approximately 435 feet deep at its deepest point. Tompkins County shares government boundaries with six adjacent New York State counties: Cayuga (north), Cortland (east), Tioga (south), Chemung (southwest), Schuyler (west), and Seneca (northwest).

The City of Ithaca serves as the county seat for Tompkins County. The County includes one City, nine Towns, six Villages, and 31 Hamlets. 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 1 provides the total areas (in square miles) for each jurisdiction included within Tompkins County.

Table 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%

Jurisdiction	Total Area (square miles)	Total Land (square miles)	Total Water (square miles)	% of Total Area in County
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	-

The northern portion of the County consists of more gentle terrain associated with moderate to high elevation areas, whereas the southern portion of the County is dominated by the highest elevations and the greatest topographic relief. Overall topography in the County ranges 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 at an elevation of 2,200 feet above msl. The lowest elevation within the County is noted as the surface water level of Cayuga Lake, recorded at 382 feet above msl.

2.2 Climate Change in Tompkins County

The climate of Tompkins County is of the humid continental type, typical of the interior northeastern United States (NYS Climate Office, 2010). Humid continental climates are known for their variable weather conditions, due to their location between the polar and tropic air masses. Polar air masses collide with tropical air masses, causing uplift of the moist tropical air and resulting in precipitation.

Since Tompkins County is far removed from the moderating effects of the ocean, the climate experiences great swings in seasonal temperature (Ritter, 2006). Temperatures average 70°F in July with lows of about 24°F in January, and the year-round average temperature is about 47°F. The average monthly rainfall increases from January (2.0 inches) to July (4.1 inches) and decreases from July (4.1 inches) to December (2.4 inches). Rainfall averages 35.9 inches annually, while annual snowfall exceeds 70.0 inches and provides snow cover for the majority of winter (Weatherbase, 2012). Figures 2.1, 2.2, and 2.3, included in Appendix A, illustrate Tompkins County's climate compared to the rest of New York State. The location of Tompkins County on these figures is indicated by the purple star symbol. Table 2 also shows the average temperatures, precipitation, and seasonal snowfall that have been recorded at the regional National Weather Service Forecast Office in Binghamton between 1951 and 2011.

Table 2 – Annual Temperature, Precipitation, and Snowfall Data Recorded Between 1951 and 2011 and Displayed as Decade Averages (NWS, 2012)			
Years	Average Temperature (°F)	Average Precipitation (inches)	Average Seasonal Snowfall (inches)
2001-2011	46.9	40.97	89.00
1991-2001	46.2	38.90	92.06
1981-1991	46.7	37.84	72.10
1971-1981	45.6	39.23	78.52
1961-1971	45.2	33.93	84.63
1951-1961	46.8	37.28	89.78
Overall Average	46.23	38.03	84.35

The best, most recent, climate science indicates a future of increased temperatures and shifting precipitation patterns for Tompkins County and New York State. Rates are projected to increase much faster than historic natural rates over the coming century, and as a result extreme hazard events may increase in frequency and intensity. The NYSERDA-commissioned report, *ClimAID: the Integrated Assessment for Effective Climate Change Adaptation Strategies in New York State*, released in November 2011, was written by scientists from Cornell University, Columbia University, and the City University of New York. The report and adaptation guidance focus exclusively on climate change adaptation strategies specific to New York State, and is geared to assist local decision-makers in developing and adopting adaptation strategies. The ClimAID report highlights the need for Tompkins County to prepare for the following impacts:

- **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.
- **Summer drought** is projected to increase, affecting water supply, agriculture, ecosystems, and energy production.
- **Heavy downpours** are increasing and are projected to increase further. These can lead to flooding and related impacts on water quality, infrastructure, and agriculture.
- **Major changes to ecosystems** including species range shifts, population crashes, and other sudden transformations could have wide-ranging impacts, not only for natural systems but also for health, agriculture, and other sectors.

The ClimAID report predicts that temperatures will rise across the state, by 1.5 to 3°F by the 2020s, 3 to 5.5°F by the 2050s, and 4 to 9°F by the 2080s, with the lower ends of these ranges expected under lower greenhouse gas emissions and the higher ends for higher emissions scenarios. The report notes that these are not the best and worst cases, just the most likely; sharp cuts in global emissions could result in temperature increases lower than the bottom ends of these ranges, while a continuation of business-as-usual could result in increases higher than the high ends.

The ClimAID report also projects that annual average precipitation will increase by up to 5 percent by the 2020s, up to 10 percent by the 2050s, and up to 15 percent by the 2080s. This will

not be distributed evenly over the course of the year. Much of this additional precipitation is likely to occur during the winter months as rain, with the possibility of slightly reduced precipitation projected for the late summer and early fall. Continuing the observed trend, more precipitation is expected to fall in heavy downpours and less in light rains.

Vulnerabilities specific to Tompkins County that are identified in the ClimAID report are potential flooding increases, milk production losses in a region dominated by dairy, and location at the front line for the state as invasive insects, weeds and other pests move north.

In addition, the report highlights that some areas, including Tompkins County, are vulnerable in other ways: rural areas are more vulnerable to, and have less capacity to cope with, extreme events such as floods, droughts, ice storms, and other climate-related stressors; regions that depend on agriculture and tourism (such as fishing, skiing, and snowmobiling) may be especially in need of adaptation assistance; and low-income urban neighborhoods, especially those within flood zones, are less able to cope with climate impacts such as heat waves and flooding. New York State's 2100 Commission's *Recommendations to Improve the Strength and Resilience of the Empire State's Infrastructure* (2013) identified a need to reduce inland vulnerability to extreme weather events. It is important that the community promote mitigation and adaptation strategies that enable incremental adaptations across sectors and communities over time. Mitigation and Adaptation strategies are described later in this report, specifically in Table 32 and Appendix A – Table 33.

Specific groups of people that are identified in the ClimAID report as being particularly vulnerable include elderly, disabled, and health compromised individuals who are more vulnerable to climate hazards, including floods and heat waves; low-income groups that have limited ability to meet higher energy costs; farm workers who may be exposed to more chemicals if pesticide use increases in response to climate change; asthma sufferers who will be more vulnerable to the decline in air quality during heat waves; and people who depend on public transportation and lack private cars for evacuating during emergencies. Small businesses are also identified as being particularly vulnerable, as they are typically less able to cope with costly climate related interruptions and stresses, such as power and communication service disruptions, than larger businesses. Climate Change projects by hazard are further detailed in the natural hazard profiles included in Section 5.0.

2.3 Historical Overview

The earliest inhabitants of Tompkins County were the Cayugas, one of the five nations of the Iroquois Confederacy. Settlement in the Tompkins County area began in 1792. Early settlers consisted of squatters and others cashing in their Military Tract land allocations. In 1817, Tompkins County was formally established through an act of the New York State Legislature. Soon after, Cornell University was established (1865), bringing solidity to the County's economy by attracting students, faculty, and many new residents. Ithaca College opened almost thirty years later in 1892 in downtown Ithaca. For more historic context, reference Appendix B.

2.4 Demographics

According to the U.S. Census, the population of Tompkins County totaled 101,564 in 2010, reflecting a growth of 5,063 people when compared to the 2000 U.S. Census data (96,501 people). This increase in population over the past decade reflects steady growth within the County. Table 3 provides population data for the County and its Cities and Towns (including respective Villages) over the past decade (2000-2010). Within that time period, City of Ithaca and all Towns within the County have seen positive population growth (2.0% or greater), while growth within Tompkins County is documented at 5.29 percent.

Population age data indicated that 16,659 people were estimated to be under 18 years (16.4%) and 10,929 people were estimated to be over the age of 65 (10.8%) (U.S. Census Bureau, 2010(2)). Overall, Tompkins County has a greater population of individual's between the ages of 18 and 65 than New York State.

The 2010 Census indicates that 82.6 percent (%) of Tompkins County's population was White, 4.0% of the population was Black or African American, 9.0% Asian, 0.4% American Indian and Alaska Native, 1.2% some other race, and 3.2% two or more races. In addition, 4.2% of Tompkins County residents reported themselves as being Hispanic or Latino (of any race) (U.S. Census Bureau, 2010(2)). Figure 2.4 in Appendix A graphs the population diversity of Tompkins County using a pie chart format.

Table 3 – Tompkins County Population Data (U.S. Census Bureau 2009 and U.S. Census 2012)												
Jurisdiction	Data Year											Growth 2000-2010 (%)
	2010	2009	2008	2007	2006	2005	2004	2003	2002	2001	2000	
<i>Tompkins County</i>	<i>101,564</i>	<i>101,779</i>	<i>101,027</i>	<i>100,413</i>	<i>99,997</i>	<i>99,698</i>	<i>99,747</i>	<i>99,203</i>	<i>98,393</i>	<i>97,575</i>	<i>96,662</i>	<i>5.07</i>
Town of Caroline	3,282	3,019	3,007	3,009	3,000	3,001	3,011	2,999	2,980	2,930	2,916	12.55
Town of Danby	3,329	3,261	3,213	3,169	3,148	3,113	3,097	3,060	3,038	3,011	3,008	10.67
Town of Dryden	14,435	14,342	14,084	14,004	13,884	13,854	13,885	13,759	13,683	13,495	13,525	6.73
Town of Enfield	3,512	3,620	3,608	3,570	3,545	3,503	3,481	3,449	3,429	3,388	3,374	4.10
Town of Groton	5,950	5,904	5,864	5,832	5,837	5,820	5,848	5,815	5,805	5,763	5,789	2.78
Town of Ithaca	19,930	20,307	20,210	20,192	19,917	19,827	19,832	19,734	19,090	18,895	18,752	6.28
Town of Lansing	11,033	11,071	10,967	10,885	10,848	10,785	10,773	10,697	10,587	10,537	10,528	4.80
Town of Newfield	5,179	5,225	5,204	5,171	5,152	5,144	5,158	5,125	5,111	5,091	5,105	1.45
Town of Ulysses	4,900	5,017	4,988	4,941	4,910	4,886	4,878	4,826	4,799	4,762	4,773	2.66
City of Ithaca	30,014	30,013	29,882	29,640	29,756	29,765	29,784	29,739	29,871	29,703	28,892	3.88

2.5 Land Use

Land use within Tompkins County is mixed, with the majority of tax parcel use reflected in the following land use categories: agriculture, residential, commercial, and vacant land. Table 4 displays the percent of acreage for each jurisdiction in Tompkins County by land use category.

Jurisdiction	Agriculture	Barren	Commercial	Inactive Agriculture	Industrial	Public/Institutional	Recreation	Residential	Transportation	Vegetative Cover	Water	Wetlands
(C) Ithaca	0%	1%	12%	0%	3%	8%	10%	35%	1%	19%	10%	1%
(T) Caroline	14%	0%	0%	4%	0%	0%	0%	4%	0%	73%	0%	3%
(T) Danby	8%	0%	0%	4%	0%	0%	0%	5%	0%	78%	1%	3%
(V) Dryden	7%	1%	4%	4%	1%	4%	2%	31%	0%	35%	0%	11%
(V) Freeville	25%	0%	1%	0%	0%	4%	1%	15%	0%	40%	3%	10%
(T) Dryden	18%	0%	0%	5%	1%	0%	0%	8%	0%	60%	1%	6%
(T) Enfield	31%	0%	0%	6%	0%	0%	1%	8%	0%	51%	1%	2%
(V) Groton	10%	0%	4%	2%	1%	6%	3%	30%	0%	40%	0%	4%
(T) Groton	37%	0%	0%	7%	0%	0%	1%	7%	0%	42%	0%	5%
(V) Cayuga Heights	0%	0%	2%	0%	0%	5%	2%	71%	1%	19%	0%	0%
(T) Ithaca	15%	1%	1%	3%	1%	3%	3%	19%	0%	49%	4%	1%
(V) Lansing	2%	1%	11%	0%	1%	2%	1%	19%	13%	47%	0%	3%
(T) Lansing	31%	0%	1%	4%	1%	0%	1%	9%	1%	36%	14%	2%
(T) Newfield	11%	0%	0%	3%	0%	0%	0%	6%	0%	78%	0%	1%
(V) Trumansburg	7%	0%	3%	4%	0%	6%	4%	46%	0%	28%	1%	1%
(T) Ulysses	34%	0%	1%	5%	0%	0%	1%	9%	0%	37%	11%	2%

Figure 2.5 in Appendix A displays land use and land cover information for Tompkins County from the Tompkins County Planning Department (2007). This figure illustrates changes in land use and cover between the years 1969, 1995, and 2007. Table 5 shows the changes in land use/land cover categories between 1969, 1995, and 2007 by percentage.

Table 5 – Land Use and Land Cover Change in Tompkins County (Tompkins County Planning Department, 2007)					
Land Use Category	Changes in Land Use (percent, %)				
	1969	1995	% Change	2007	% Change
Agriculture	29.67	24.25	-5.42	21.10	-3.15
Barren or Disturbed	0.26	0.36	+0.11	0.23	-0.13
Commercial	0.27	0.42	+0.15	0.52	+0.10
Inactive Agriculture	16.15	6.25	-9.89	4.42	-1.83
Industrial	0.35	0.50	+0.15	0.53	+0.02
Public/Institutional	0.71	0.57	-0.14	0.59	+0.02
Recreation	1.04	0.71	-0.33	0.78	+0.06
Residential	2.13	6.97	+4.84	8.17	+1.20
Transportation/Transmission	0.30	0.25	-0.05	0.26	0.00
Vegetative Cover	43.75	53.21	+9.47	56.68	+3.47
Water	3.21	3.45	+0.23	3.48	+0.03
Wetlands	2.17	3.05	+0.88	3.24	+0.19

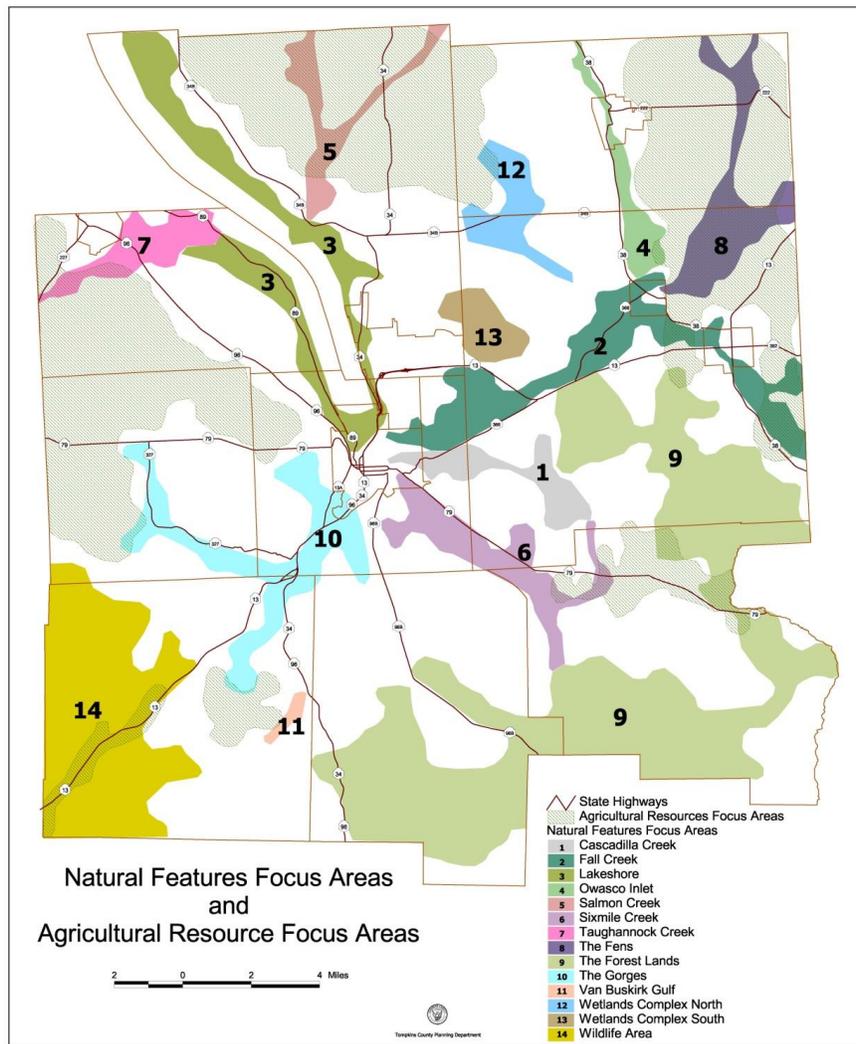
According to Tompkins County's 2004 Comprehensive Plan, up to a third of the total land area in the County consists of farmland. Farming operations within the County are quite diverse, including dairy, grain, livestock, hay, tree farms, vegetables, horticulture, aquaculture, poultry, vineyards, and orchards. Approximately 100,000 acres of land in Tompkins County are owned by farming operations; with about 80,000 acres being actively farmed (Tompkins County Comprehensive Plan, 2004). Over the past three decades, Tompkins County has seen a decrease in total farming operations and cultivated acreage; however, most recently, this reduction has seemed to stabilize locally. Two New York State Agricultural Districts are recognized within Tompkins County; the boundaries of these areas are shown on Figure 2.6 in Appendix A.

Areas of high residential intensity are concentrated within the Villages and around the City of Ithaca. A 2006-2010 estimate by the U.S. Census Bureau indicates that Tompkins County had a vacancy rate of 7.1 percent, representing approximately 2,935 housing units out of 41,381 total units (U.S. Census Bureau, 2006-2010). This vacancy rate is lower than the New York State rate during the same time period.

Aside from Cayuga Lake, Tompkins County also supports 10 major streams: Salmon Creek, Cayuga Inlet, Six Mile Creek, Cascadilla Creek, Fall Creek, Owasco Inlet, Owego Creek, Catatunk Creek, Cayuta Creek, and Taughannock Creek. In terms of land, Table 6 provides an estimate of the total acres of protected natural resources within Tompkins County. Figure 2.7 illustrates the locations of protected lands, perennial streams and areas the County has identified as Natural Feature Focus Areas as well as Agricultural Resource Focus Areas.

Table 6 – Protected Natural Areas (Tompkins County Comprehensive Plan, 2004)	
Owner	Size (acres)
New York State	27,801
Cornell University	6,528
Finger Lakes Land Trust	2,609
City of Ithaca	1,071
Tompkins County	654
The Nature Conservancy	393
Private/other	75
Other local municipalities	30
Total	39,161

Figure 2.7 – Natural Feature and Agricultural Resource Focus Areas
(Tompkins County Planning Department, 2004)



2.6 Economic Characteristics and Employment

The unemployment rate in Tompkins County has increased over the past year to approximately 6.4% (NYS Dept. of Labor, 2012), though it remains lower than the New York State unemployment rate of 7.9%. The increase or decrease in numbers of jobs within different industries between June 2011 and June 2012 is shown in Table 7. The data reported in this table represents the Ithaca Metropolitan Statistical Area (IMSA), which includes all of Tompkins County.

Table 7 – Change Observed in Total Number of Jobs in Different Industries Between June 2011 and June 2012 – Ithaca Metropolitan Statistical Area (<i>NYSDOL, 2012(2)</i>)	
Industry	Change Observed (# of jobs)
Education & Health Service	-500
Manufacturing	0
Trade, Transportation, Utilities	0
Professional & Business Services	+100
Financial Activities	0
Information	-100
Natural Resources, Mining, Construction	0
Leisure & Hospitality	+200
Other Services	0

The top 21 major employers for 2006 (most recent data available) in Tompkins County are listed in Table 8.

Table 8 – Top Major Employers for Tompkins County - 2006 (<i>Cornell University, 2006</i>)	
Company Name	# of Employees
Cornell University	9,480
Ithaca College	1,525
Borg-Warner Automotive	1,500
Ithaca City School District	1,200
Cayuga Medical Center	1,000
County of Tompkins	750
Wegman's Food Markets	570
Emerson Power Transmission	450
Franziska Racker Center	420
Tompkins/Seneca/Tioga BOCES	380

Table 8 – Top Major Employers for Tompkins County - 2006 (Cornell University, 2006)	
Company Name	# of Employees
Dryden Central School District	375
The CBORD Group	250
Therm, Inc.	225
Tompkins County Trust Co.	223
Tompkins Cortland Community College	200
Tops Friendly Markets	170
Thomas Group Architects and Engineers, PC	160
Boyce Thompson Institute	150
Hi-Speed Checkweigher	117
The Ithaca Journal	116
Holiday Inn Executive Towers	100-150 seasonal

Additional economic characteristics for Tompkins County are included as Table 9 in Appendix A.

2.7 Transportation

In Tompkins County, roadway, rail, and air transportation options are available. Tompkins County contains 15 State Routes that are maintained by the NYS Department of Transportation. No Interstate Routes or U.S. Routes are located within Tompkins County. The County highway system is comprised of approximately 88 routes (NYSDOT, 2011). Many of the County Routes overlap with portions of State Routes. The locations of the major roadways in Tompkins County are shown on Figure 2.8.

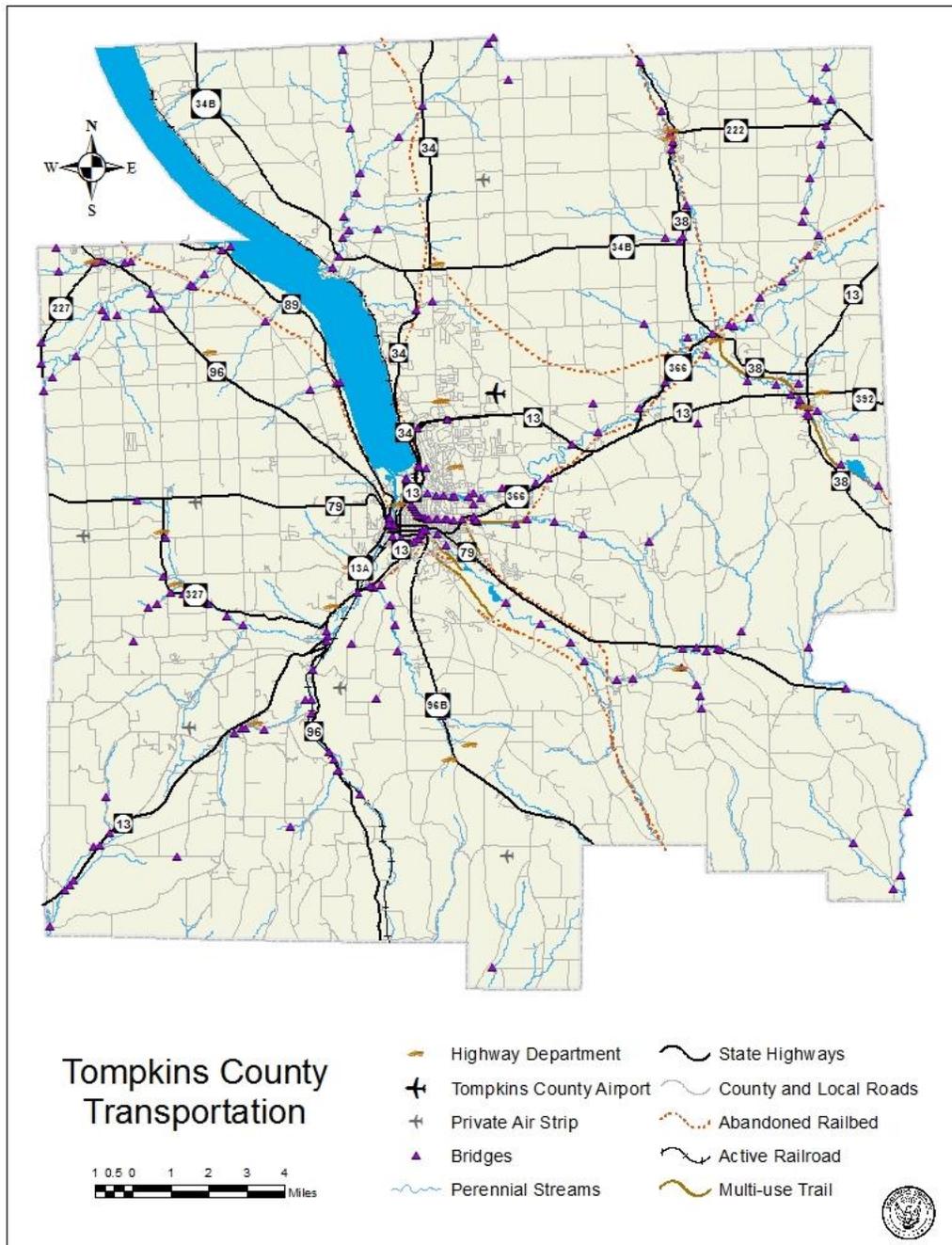
The Tompkins County Department of Public Works maintains more than 300 miles of County roads and more than 100 bridges and is responsible for snow removal, maintaining County buildings and parks, and maintaining the County's vehicle fleet. The Department of Public Works also operates the Tompkins County Regional Airport.

Only one active railroad remains in Tompkins County, the Norfolk Southern Railway Company. Norfolk Southern operates a freight-only line that runs from the mainline of the former Lehigh Valley track at the VanEtten Junction to just south of the former Ithaca station, and then along the east shore of Cayuga Lake to Lake Ridge (HC Lee, 2008). The remaining historic railroad segments have been abandoned and the tracks removed. Locations of active and abandoned railroad segments are depicted on Figure 2.8.

In addition to the County's Highway Department, there are nine Town Highway Departments, one NYSDOT Barn, six Village Highway Departments and one City of Ithaca Department of Streets and Facilities. The locations of these transportation maintenance facilities are denoted on Figure 2.8.

In terms of air transportation, there are six public and private airports in Tompkins County. The Ithaca Tompkins Regional Airport is the sole publicly owned airport in the County (Global Aviation Navigator, 2012). The Ithaca Tompkins Regional Airport is owned and operated by Tompkins County and is a division of the Department of Public Works. The airport has been operated by Tompkins County since 1956. The Ithaca Tompkins Regional Airport recently developed a Sustainable Master Plan and is the first airport to integrate sustainability into its master plan. Table 10 in Appendix A details the active airport facilities within the County, and Figure 2.8 depicts the locations of these airport facilities.

Figure 2.8 – Transportation Facilities in Tompkins County



2.8 Critical Community Facilities

Many of the critical facilities, including hospitals, medical facilities, and educational facilities, identified for each participating jurisdiction, are clustered around the City of Ithaca, and the Villages and Hamlets within the County. Critical facilities identified for hazard planning have been updated significantly since the 2006 Plan. Such facilities include utility infrastructure (water tanks, electric substations, cell towers, etc.) , banks, senior housing, mobile home complexes, boatyards, bus terminals, municipal buildings, community centers, correctional facilities, courthouses, dams, day care centers, schools, emergency operations, fire and police departments, highway facilities, human services, major industrial locations, medical facilities and hospitals, post offices, sports complexes and facilities, and locations of other public facilities. Figure 2.9, included in Appendix A of this document, shows the locations of critical facilities within Tompkins County. The locations of critical facilities were considered during the risk assessment and hazard vulnerability components of this HMP process.

2.9 Tompkins County Department of Emergency Response

The Tompkins County Department of Emergency Response is responsible for the following County-wide 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, 1470 AM, WQNY 103.7 FM, 93.5 FM WVBR and 91.7FM WICB. Tompkins County also participates in NY-Alert, NYS's All-Hazards Alert and Notification System. Participants can elect to receive emergency information such as road closures and weather alerts through their cell phones (call or text message), E-mail, fax, or really simple syndication (RSS) message.

3.0 Planning Process

This planning process section of the plan describes who was involved in the development of this document, what steps were taken to complete all phases of the process, and how public involvement was considered throughout plan development. Throughout the plan development process, information was gathered from participating jurisdictions, as well as state, federal and local agencies and groups, citizens and business owners in the community, and other stakeholders. Project Team and Technical Committee representatives were also tasked with collecting data and information from their respective jurisdictions or areas of expertise. The information included in this plan represents the results of an extensive planning process that involved the input of many jurisdictions and community members.

3.1 Resources and Information Collection

The planning process followed for the development of the Tompkins County Multi-Jurisdiction All Hazard Mitigation Plan Update is consistent with the guidelines provided in the State and Local Mitigation Planning, how-to guides (FEMA Report 386-2) and the Local Multi-Hazard Mitigation Planning Guidance (FEMA, July 1, 2008).

In addition to these references and the original Hazard Mitigation Plan (2006), the following County and municipal documents were also reviewed and considered during the development of this document: Tompkins County Comprehensive Emergency Management Plan (2003), Tompkins County Comprehensive Plan (2004), Tompkins County Comprehensive Plan – Energy and Greenhouse Gas Emissions Element (2008), City of Ithaca Mitigation Plan (2002), Hazard Analysis Report (County and Specified Towns) (2003), and the Town of Dryden – Hazard Analysis Report (1999), Tompkins County Conservation Plan Part 1: A Strategic Approach to Natural Resource Stewardship (2007), Tompkins County Conservation Plan Part II: A Strategic Approach to Agricultural Resource Stewardship (2010), and Tompkins County Conservation Strategy (2012) .

Much of the event-specific information and details came from the members of the Planning Team and Technical Committee. The public and other interested parties were provided numerous opportunities throughout the planning process to provide input and comments. After the approval of Tompkins County’s original HMP in 2006, a Tompkins County Multi-Jurisdictional All-Hazard Mitigation Plan Implementation Committee was formed. This group initially met on an annual basis to review the HMP and discuss implementation efforts, mitigation activity updates, and information distribution and resource updates. Though notes from only 2007 and 2008 were available for review (Appendix C), these details provided important information during the HMP Update process.

3.1.1 Planning Mechanisms and Capabilities

Another important objective of updating the HMP is to incorporate the document into existing and future planning efforts and initiatives throughout the County. Elements of the plan will be considered during municipal and County development and comprehensive planning efforts. The approved HMP will also serve as an important resource for developing and updating emergency

operations plans and procedures throughout Tompkins County. This updated HMP will be incorporated into, considered during, and referenced by future updates and efforts at the County and municipal levels concerning the plans, policies, ordinances, programs, studies, reports, and staff included in Table 11. The following is a list of local planning efforts and regulations which were reviewed for the Plan Update. These resources were seen as critical to refining the key aspects of the Plan. Conversely, pertinent aspects of the Plan Update will be integrated into these resources as they are updated by each associated jurisdiction.

Table 11 – Planning Mechanisms and Capabilities for Each Participating Jurisdiction																	
Plans	Jurisdiction																
	Town of Caroline	Village of Cayuga Heights	Town of Danby	Village of Dryden	Town of Dryden	Town of Enfield	Village of Freeville	Village of Groton	Town of Groton	City of Ithaca	Town of Ithaca	Village of Lansing	Town of Lansing	Town of Newfield	Village of Trumansburg	Town of Ulisses	Tompkins County
Comprehensive/Land Use Plan	'06	*	'03	'06	'05*	'02	'02*	'05	'05	'71*	'93*	'05	'06	*	'09	'09	'04
Economic Development Plan	No	No	No	No	No	No	No	No	No	Yes	Yes	No	No	No	No	No	Yes
Post-disaster Recovery Plan	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	Yes
Flood Mitigation Plan	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Local Waterfront Revitalization Plan	No	No	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes	No	No	Yes	Yes
College Campus Plan	NA	CU	No	No	TC3 CU	No	No	No	No	CU	IC CU	No	No	No	No	No	NA
Emergency Response/Evac Plan	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	Yes
Open Space Plan	No	No	No	No	No	No	No	No	No	No	Yes	No	No	No	No	No	Yes
Watershed Protection Plan	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Capital Improvement Plan	No	No	No	No	No	No	No	No	No	Yes	No	No	No	No	No	No	Yes
Redevelopment Plan	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	Yes
Floodplain Management Plan	Yes	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Comprehensive Emer. Mgmt. Plan	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Policies/Ordinances																	
Building Codes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Zoning/Land Use Codes/Restriction	No	'99	'05	'90	'95*	No	'86	'03	'11	'03	'03	'09	'04	No	'12*	'07	No
Subdivision Regulations	'00	'92	'07	'96	'12*	'06	'86	'86	'70	'89	'96	'75	'04	No	'90	'07	No
Property Set-back Ordinance	No	No	No	No	No	No	No	No	No	No	*	No	No	No	*	Yes	No
Flood Regulations	Yes	No	Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	No
Steep Slope Ordinance	No	No	No	No	No	No	No	No	No	No	*	No	No	No	No	No	No

Table 11 – Planning Mechanisms and Capabilities for Each Participating Jurisdiction																	
Plans	Jurisdiction																
	Town of Caroline	Village of Cayuga Heights	Town of Danby	Village of Dryden	Town of Dryden	Town of Enfield	Village of Freeville	Village of Groton	Town of Groton	City of Ithaca	Town of Ithaca	Village of Lansing	Town of Lansing	Town of Newfield	Village of Trumansburg	Town of Ulysses	Tompkins County
Stormwater Ordinance	Yes	Yes	Yes	No	Yes	No	No	No	No	Yes	Yes	Yes	Yes	Yes	No	Yes	No
Site Plan Review Requirements	No	'92	'05	'06	'96	'96*	'86	'94	'97	'99	'00	Yes	'04	No	'06	'07	No
Agricultural Plan	No	No	No	No	No	No	No	No	No	No	Yes	No	No	No	No	*	Yes
Gas Drilling Prohibition	Yes	No	Yes	Yes	Yes	Yes	No	No	No	No	Yes	No	+	+	Yes	Yes	No
Programs																	
NFIP Participant	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
NFIP CRS Participating Community	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Property Acquisition Program	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Public Education/Awareness Prog.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Stream Maintenance Program	Yes	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	Yes
Storm Drainage Maint. Program	No	No	No	No	No	No	No	No	No	Yes	Yes	No	No	No	No	No	No
Studies/Reports																	
Hazard Analysis/Risk Assessment	Yes	No	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Floodplain Maps/Insurance Studies	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Staff/Development																	
Development Planner	No	No	No	Yes	Yes	No	No	No	No	Yes	Yes	No	No	No	No	Yes	Yes
Building Code Official	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
GIS and/or HAZUS Specialist	No	No	No	No	Yes	No	No	No	No	Yes	Yes	No	No	No	No	No	Yes
Engineer/Public Works Official	No	Yes	No	Yes	Yes	No	No	No	No	Yes	Yes	No	Yes	No	Yes	No	Yes
Local Floodplain Administrator	Yes	No	Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	No
Environmental Cons. Specialist	No	No	No	No	Yes	No	No	No	No	No	Yes	No	No	No	No	Yes	Yes
Public Information Official	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	Yes

* = Draft, in progress
 + = Moratorium in place
 CU = Cornell University
 IC = Ithaca College
 TC3 = Tompkins County Community College

Links and web addresses to many of the Tompkins County resources listed above are located in Appendix D for easy access.

3.2 Planning Team and Technical Committee

Three groups were created to assist in various facets of information collection and document preparation and review: Project Team, Technical Committee, and Key Stakeholders. The Project Team is represented by at least one municipal representative from each participating jurisdiction or agency, and is responsible for assisting in data collection, document review, and coordination efforts. The Technical Committee includes interest group representatives, researchers, educators, and others, whose task is to aid in guiding and revising the plan based on their various interests and areas of expertise. This committee consisted of representatives from the following agencies, groups, and entities: Town of Ulysses, Cornell University, Tompkins County Department of Health, Tompkins County Soil and Water District, Bolton Point Water Treatment Plant, City of Ithaca, New York State Electric & Gas (NYSEG), Town of Lansing Highway Department, Tompkins County Department of Emergency Response, and United States Geological Survey (USGS). The Key Stakeholders group includes various members of the community such as local elected officials, municipal employees, school officials, fire and emergency response personnel, and other interested community members.

Meetings with these three groups of selected and interested individuals were held at strategic points throughout the HMP development process. A County-wide risk assessment review was also held to kick-off the HMP Update process. This event, which many different stakeholders and agency representatives attended, helped set the stage for the remainder of the hazard mitigation planning process. All meetings that were held during the development of the HMP are located in Appendix E, including the notable accomplishments or objectives of each. Participants and representatives that attended every meeting are also listed in Appendix E, along with their affiliation, as it relates to the project.

3.3 Jurisdiction Participation

To be included in the Tompkins County Multi-Jurisdictional All-Hazard Mitigation Plan, all interested jurisdictions needed to express their willingness to be a part of the process and needed to remain an active participant throughout all stages of plan development. Active participation for each jurisdiction was gauged based on the following factors: meeting attendance, information collection and research, plan review and comment, mitigation action submission, public review assistance, and final resolution to adopt the HMP. A jurisdiction did not have to meet all criteria listed to be considered a participating member (for example, meeting attendance), but each jurisdiction did have to show an effort to participate and provide relevant information (for example, email follow-up after a missed meeting to discuss what was missed). Details regarding meetings that were held to support the update of this Plan are included in Appendix E – Hazard Mitigation Plan Update Process Meeting Timeline and Attendees. When municipal partners were unable to attend an important meeting, the Tompkins County Planning Department made a concerted effort to follow-up with each missing entity. In order to warrant participation in the HMP update process, each municipality was required to share information, provide input on the document and during meetings, and show a commitment to intermunicipal hazard mitigation planning. Overall, it was determined that all jurisdictions within Tompkins County met the

participation requirements and are therefore included and considered in this document. All participating jurisdictions have agreed to pass a resolution to adopt the HMP after NYSOEM and FEMA review and approval. These resolutions will be added to Appendix F, as they are adopted. For now, a sample resolution is provided.

3.4 Public Participation

During the Tompkins County Hazard Mitigation Plan Update process, public involvement was included at two levels. At the local level, community input was sought during the hazard vulnerability and assessment phase of the project. Each participating jurisdiction was responsible for making sure their hazard history and vulnerabilities were accurately portrayed in the draft HMP. The collection of this information often times involved individuals aside from those on the Project Team.

The second level of public involvement for the County HMP was provided through two formal public meetings, held at the Dryden Town Hall and Tompkins County Public Library on April 22, 2013, and the solicitation of comments during a publicly requested review of the Draft HMP. Many announcements regarding the issuance of the HMP Update for public review and the scheduling of a County-wide public meeting were included in area newspapers. The public was invited to review the draft document and to provide comments and input on hazards, hazard response, and hazard mitigation during the public meeting and for 30-days afterwards. This meeting also provided a favorable forum in which to answer any questions from the public.

Aside from being available for review in hard copy form during the public meeting and at the Tompkins County Planning Department in the City of Ithaca, the Draft Tompkins County Multi-Jurisdictional All-Hazard Mitigation Plan was also available for review electronically on the website of TCPD at www.tompkins-co.org/planning/haz_mit.htm. Comments received during this public review process included items like the Soil & Water District's concern that the vulnerabilities of creek pipeline crossings were not adequately addressed and the Tompkins County Environmental Management Council's concern over the plan's under emphasis of climate adaptation. All comments received as part of the public review were considered and incorporated into the HMP, as appropriate. In the case of the two specific comments detailed above, the vulnerabilities of utility crossings at streams was emphasized in the water contamination hazard profile section and identified as a specific mitigation action item, and further integration of climate adaptation activities were included in the HMP and were also carried over to the County's Comprehensive Plan update process. A summary of the public meeting participation and plan feedback is included in Appendix E.

3.5 Coordination with Agencies

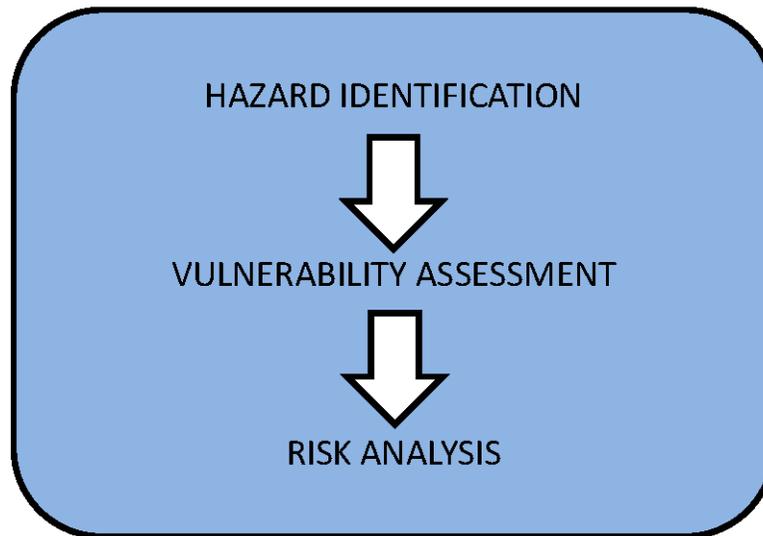
County, regional, state, and federal agencies were consulted for relevant information and recommendations with regard to the Hazard Mitigation Plan Update effort. The contributions from agencies and organizations that supported the update planning process include participation in the HIRA-NY risk assessment, review and comment on portions of the Draft HMP, and the collection and/or dissemination of information or data to be used in the planning process. These agencies that provided the most assistance throughout this process include: FEMA, Tompkins County Department of Emergency Response, NOAA, Tompkins County Planning Department,

Tompkins County Emergency Management Program, National Weather Service, NYSOEM, Tompkins County Soil and Water Conservation District, NYS Electric and Gas Corporation (NYSEG), and the U.S. Geological Survey.

4.0 Risk Assessment

Risk Assessments consist of three phases of analysis: hazard identification, vulnerability assessment and risk analysis.

Figure 4.1 – Three Phases of Risk Assessment



Risk Assessments should generally be conducted in the order identified in Figure 4.1 as each phase utilizes information from previous phases.

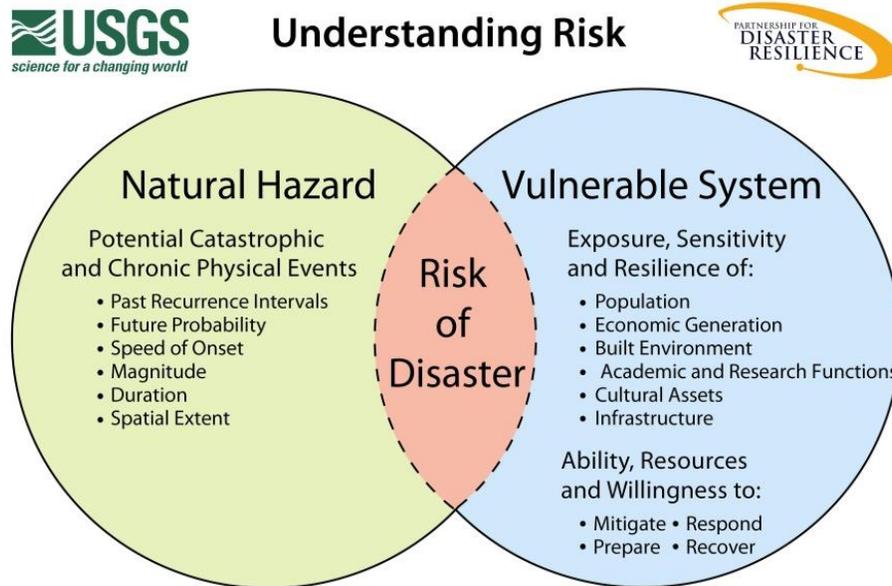
The first phase, *hazard identification*, calls on the community to identify all potential hazards, document their geographic extent, probability of occurrence and anticipated intensity. This phase will also incorporate the best available data on anticipated climate projections and states the intended impacts as they relate to each hazard.

The next phase, *vulnerability assessment*, utilizes the information obtained through the first phase and analyzes it with local information of properties and populations exposed to that hazard. As a part of this phase both current and future development potentials will be analyzed.

The last phase, *risk analysis*, estimates the damage, injuries, and costs likely to occur as a result of that hazard in the community. The picture of risk is broken down into both magnitude and probability of harm occurring. For many hazards this phase of risk assessment will not be realized.

Figure 4.2 was established by the Oregon Partners for Disaster Resilience, an applied research firm which works toward the mission of creating a disaster-resilient and sustainable state, and the United States Geological Society (USGS). This figure depicts the risk assessment process and points out that the goal of hazard mitigation is to “reduce the area where hazards and vulnerable systems overlap.”

Figure 4.2 – The Risk Assessment Process
(Oregon Partnership for Disaster Resilience Research Collaboration and USGS, 2006)



Source: USGS- Oregon Partnership for Disaster Resilience Research Collaboration, 2006

Tompkins County is vulnerable to numerous natural, technological, and human-caused hazards. The historic documentation associated with past hazard events that was included in the County's 2006 HMP has been expanded as part of the risk assessment to include the most recent data available, as well as analysis of identified potential impacts from a changing climate and widespread natural gas drilling in the region. Some of the key revisions that are included in this section of the plan update include: results of Tompkins County's 2012 risk assessment, profiles of new hazards, and the establishment of updated hazard rankings and hazard mitigation planning goals.

4.1 Framing the Risk Assessment Using HIRA-NY

All applicable hazards were evaluated, reviewed, and ranked during a risk assessment session moderated by the New York State Office of Emergency Management (NYSOEM) using the automated Hazard Identification and Risk Assessment (HIRA-NY) program. The selections made in HIRA-NY are based on information entered into preformatted Microsoft Excel spreadsheets recommended by FEMA and NYSOEM. The HIRA-NY risk assessment process helps participating jurisdictions and agencies focus on the hazards that may potentially impact the County and assists in detailing the most prevalent and highest ranking hazards. In order to complete the risk assessment, consideration was given to details such as location or geographic area that could be affected by a given hazard, extent or magnitude of each hazard event, previous hazard occurrences, and probability of future occurrences.

Within the HIRA-NY program, there are five factors in which the answers provided during the risk assessment process directly impact the ultimate hazard rankings. These five factors are denoted and detailed below.

HIRA-NY Factor 1: Scope

This factor looks at two aspects of the overall scope of a hazard: what area or areas in the jurisdiction could be impacted by the hazard, and what are the chances of the hazard triggering another hazard and causing a cascade effect. Once the potential area of impact is determined, the program requires the selection of one of the following impact area options:

<i>A single location</i>	Several hazards can impact a single location
<i>Several individual locations</i>	Many hazards are capable of impacting several individual locations. This does not mean that the hazards occur simultaneously, but that they could occur at one or several locations at the same time.
<i>Throughout a small region</i>	Where a single location or several individual locations comprise a significant area.
<i>Throughout a large region</i>	A larger region would extend for miles and comprise a significant portion of the community being assessed.

The next part of the scope factor is to determine whether the hazard could potentially trigger another hazard. When assessing this factor, the group evaluates various severity levels, including a credible worst-case scenario. The options for the cascading effect potential of a hazard are as follows: *no, highly unlikely; yes, some potential; or yes, highly likely.*

HIRA-NY Factor 2: Frequency

Frequency indicates how often a hazard results in an emergency situation or disaster event. Frequency includes both historic occurrences and the likelihood that it will happen in the future. The frequency of a hazard is not based on the worst-case scenario, but rather how often an event would cause various types of damage within the community that would require activation of emergency response forces. The program provides the following options when deciding the frequency of a hazard event:

<i>A rare event</i>	Occurs less than once every 50 years.
<i>An infrequent event</i>	Occurs between once every 8 years and once every 50 years (inclusive).
<i>A regular event</i>	Occurs between once a year and once every 7 years (inclusive).
<i>A frequent event</i>	Occurs more than once a year.

HIRA-NY Factor 3: Impact

The impact of a hazard is assessed on various severity levels, including a credible worst-case scenario. There are three types of impacts that are included in the HIRA-NY program: impacts on the population, impacts on private property, and impacts on community infrastructure.

Impacts on populations include the ability of a hazard to cause serious injury and/or death to surrounding human populations:

<i>Serious injury or death is unlikely</i>	Serious injuries require immediate medical attention, without which the injured person's life or limb is threatened.
<i>Serious injury or death is likely, but not in large numbers</i>	Applies when the casualties of a hazard can be adequately treated through the normal operation of a community's emergency medical system.
<i>Serious injury or death is likely in large numbers</i>	Applies when the number of casualties requires a full or near full activation of a community's medical facilities' disaster plans.
<i>Serious injury or death is likely in extremely large numbers</i>	This option denotes a catastrophe and applies when the numbers of casualties overwhelms the local emergency medical system, and substantial outside assistance is required.

Impacts on private property includes the potential for a hazard to physically or economically damage private property, including industrial structures, homes and contents, commercial businesses, belongings, and income in a community. The HIRA-NY options to denote a hazard's impact on private property include: *little or no damage; moderate damage; or severe damage.*

The HIRA-NY program also requires the identification of precise types and numbers of properties and structures that have the potential to be impacted. Impacts on community infrastructure is related to the potential for a hazard to specifically cause structural damage to the infrastructure that serves the community, including government buildings, roads, bridges, and public utility lines, plants, and substations. The options provided in HIRA-NY to indicate a hazard's impact on community infrastructure include: *little or no structural damage; moderate structural damage; or severe structural damage.*

As with private property, the above classification of damage should be supported by detailed information regarding the type of public property likely to be impacted.

HIRA-NY Factor 4: Onset

The onset factor is related to the amount of time between the initial recognition of an approaching hazard and when the hazard begins to impact the community. For some hazards, ample warning time is available so that if plans and procedures have not been developed, there is still time to accomplish such tasks before the hazard occurs. Other hazards provide no warning, so the response to a hazard event depends on existing plans, if any. The choices for time of onset are: *no warning; several hours warning; one day warning; several days warning; or a week or more of warning.*

For a few hazards there may be different warning times depending on location. In this case, the HIRA-NY tool suggests using the shortest warning time that is realistic and associated with a credible worst-case event.

HIRA-NY Factor 5: Duration

There are two types of duration analyzed in the HIRA-NY program: 1) how long the hazard remains active and 2) how long emergency operations continue after the hazard event has ended. A third duration addressed in HIRA-NY, but not included in a community's hazard analysis report, is how long it takes the community to fully recover from the hazard event. The recovery process continues until the operations of the community return to normal. The options provided for the duration of the hazard are: *less than one day; one day; two to three days; four days to a week; or more than one week.*

The program offers the following options for recovery time of a community after a hazard event: *less than one day, one to two days, three days to one week, or one week to two weeks.*

4.2 Hazard Identification

In order to ascertain which hazards affect Tompkins County, several resources were accessed and reviewed. Utilized sources included reviews of available reports or plans, consultation with community experts, accessing available information online, and documenting information provided by the public during public meetings.

On the basis of this review, the most prevalent and potentially the most damaging hazards that could affect the County were included in the County's HIRA-NY risk assessment. The chosen hazards are mainly caused by various types of storms, especially those that create cascading effects like power outages, flooding, or structural damage. Other hazards appear to occur on a less frequent basis or normally have an insignificant impact based on the historic data collected. The following hazards are those included in the HIRA-NY program, not just the hazard selected for additional analysis during Tompkins County's recent risk assessment event. These descriptions, which include natural, technological, and human-caused hazards, summarize the types of hazards and their applicability and ability to affect Tompkins County. This section of the plan is mirrored after the step-by-step process outlined in FEMA's publication 386-2 entitled "Understanding Your Risks, identifying hazards and estimating losses."

Air Contamination – Air contamination is indicative of pollution caused by atmospheric conditions such as temperature inversion induced smoggy condition sufficiently serious to create some danger to human health. Given Tompkins County's rural landscapes and a lack of large industrial areas and business parks outside of the City of Ithaca, air contamination is not a concern at this time within the County. This hazard is not profiled further in this plan update.

Avalanche – An avalanche occurs when a significant amount of snow slides off mountainous terrain. Although Tompkins County is subject to significant snow storms, no avalanches were found to be an issue at this time. Therefore, this hazard is not profiled further in this mitigation plan update.

Civil Unrest – Civil unrest is when an individual or collective action causes serious interference with the peace, security, and/or functioning of a community. Due to the presence of two college campuses in the central portion of Tompkins County, civil unrest events are a concern. For this reason, civil unrest is further profiled in Section 5 of this plan update.

Coastal Storm – Coastal storms cause increases in tidal elevations, wind speed, and erosion, caused both by extra-tropical events and tropical cyclones. Tompkins County is a mainland County in New York State; only a portion of the County borders water (Cayuga Lake). Though six (6) Tompkins County municipalities border Cayuga Lake, no portions are adjacent to any tidal waters. Therefore, coastal storms are not recognized as an issue within the County and were not included in the risk assessment.

Dam Failure – Dam failures consist of flood damage specifically caused by the structural failure of a man-made water impoundment structure. Tompkins County has several significant water impoundments that are controlled by dams. This hazard is not evaluated in Section 5 due to its infrequent occurrence and limited impact on communities within the County.

Drought – Drought is the loss of water supply due to the lack of rainfall. The majority of water supply in Tompkins County is obtained from groundwater wells. Groundwater levels are less susceptible to seasonal and droughty conditions than surface waters. None the less, drought events have historically impacted Tompkins County, particularly in the 1960s. No recent drought events have been recorded, though the unpredictability of weather patterns is always a concern for the farming community since they seldom have local irrigation systems. The role that climate change may have on future drought events is also of interest and concern and is further detailed in the drought hazard profile in Section 5.

Earthquake – Earthquakes are described as a shaking or trembling of the earth that is volcanic or tectonic in origin. There is potential for earthquake tremors to be felt within Tompkins County, though no history of such impacts is available. The concerns surrounding this hazard are compounded by the fact that Tompkins County is located approximately 15 miles outside of the 50-mile ingestion pathway for the nuclear power plants in Oswego County. Though this hazard is not likely to cause extensive damage within Tompkins County, because of the County's location within New York State and its adjacency to the nuclear facilities' 50-mile ingestion pathway ring, it is included in the HMP Update risk assessment.

Epidemic – An epidemic is the spreading of a contagious disease on a mass basis. The majority of significant epidemic history within Tompkins County focuses on agricultural epidemics and diseases. The frequency of widespread human epidemics within Tompkins County is not high, though the County's vulnerability to such an event is elevated due to the large national and international college student contingent that seasonally resides within the County. This hazard was included in the risk assessment process and is further detailed in Section 5.

Explosion – Explosions included the rapid burning of material and gases yielding the violent release of energy. There is no known history of explosions within the County. Therefore, this hazard is not analyzed further in regards to its potential impacts on Tompkins County.

Extreme Temperatures – Extreme temperatures include extended periods of excessive hot or cold weather with a serious impact on human and/or animal populations. Cascade effects can include enhanced fire/wildfire potential and drought. In past years, periods of extreme heat have had a greater impact within Tompkins County than extreme cold. Vulnerable populations, such as the elderly, reside within the County, elevating the potential risk of an extreme temperature event. Though this hazard was not assessed in the County’s original HMP, the effect that climate change may have on yearly temperatures is a growing concern. Therefore, this hazard was assessed and is documented in the hazard profile section.

Fire – Fire is the uncontrolled burning of residential, commercial, industrial, institutional, or other property. As is common in many populated areas, structural fires frequently occur within Tompkins County. Because of the potential damage that a large-scale fire could cause in the City of Ithaca, for example, this hazard was included in the HIRA-NY risk analysis. Further details regarding this hazard are included in this Plan Update.

Flash Flood – Flooding is the submergence of lands in the vicinity of rising waterway levels generally adjacent to water bodies and drainage areas. A distinction was made as part of this HMP Update between flash flooding, short-term, rapid flooding events, and lake flooding. Almost all of the documented damage that has occurred in Tompkins County as a result of flooding is related to flash flooding events. Such an event is normally caused by excessive rainfall or rapid thaw of snow packs. Details surrounding this hazard event and how its frequency, onset, and damage potential might change due to climate change are included in the next Section.

Lake Flood – A general flood hazard was profiled in the 2006 HMP for Tompkins County. During the 2012 risk assessment process, this hazard was further broken down into flash flooding and lake flooding, which would be directly associated with Cayuga Lake. During lake flood events, the water levels rise slowly because of the larger surface area of the waterbody. Minimal damage is associated with such water level rises since there is more warning, a slower onset, and the water levels in Cayuga Lake can be altered by the Canal Corporation if they become too high. Historic occurrences and other details associated with lake flooding in Tompkins County are included in the natural hazard profile section, below.

Food Shortage – A food shortage occurs when the normal distribution pattern and/or timely delivery of foodstuffs to retail establishments for normal consumer demand is interrupted for a substantial period of time. There is no historic documentation pointing to a food shortage within Tompkins County; therefore this hazard is not analyzed further in this document.

Fuel Shortage – Similar to the above, a fuel shortage may occur when the normal distribution pattern and/or timely delivery of fuel to retail establishments for normal consumer demand is interrupted for a substantial period of time. The assessment of this hazard focused on potential long-range impacts that could occur as the supply of fuel continues to decrease while the demand increases. Few incidences of a fuel shortage have occurred within Tompkins County; however, these historical events coupled with the hazard assessment assumption that a fuel shortage would impact the entire County, elevated this hazard into the top five (5) highest rated hazards during the risk assessment process. This hazard, which was not included in the 2006 HMP, is further detailed in Section 5.

HAZMAT – Fixed Sites – Hazardous materials at fixed site locations is defined as the discharge of hazardous materials (toxic, flammable or corrosive) into the environment from a facility located at a specific location. Generally, HAZMAT issues from fixed sites in the County are limited in nature and infrequent in occurrence. This hazard is not included in further assessments.

HAZMAT – In Transit – Hazardous materials in transit is the discharge of hazardous materials (toxic, flammable or corrosive) during their transport via a variety of transportation means (motor vehicle, truck, train, boat or plane). Risk assessment discussion surrounding this hazard focused on the potential for hydraulic fracturing operations to be sited within Tompkins County in the future. High numbers of hazmat in transit events have been documented in Pennsylvania associated with hydraulic fracturing operations. Because of the potential for such activities to occur within Tompkins County, this hazard was included in the County’s risk assessment and will be further detailed in Section 5.

Hurricane – A hurricane is a type of tropical cyclone with winds exceeding 74 miles per hour (mph) accompanied by rain, thunder and lightning. High wind events are commonly documented within Tompkins County, but by definition are classified in this Plan Update as severe storm events. Weather patterns that begin as hurricanes are often re-classified as tropical storms or tropical depressions (two other types of tropical cyclones) by the time they reach New York State. Tropical storms are organized systems of strong thunderstorms with a defined circulation and maximum sustained winds of 39 to 73 mph. Tropical depressions are organized systems of clouds and thunderstorms with a defined circulation and maximum sustained winds of 38 mph or less. Despite the numerous definitions, one historic record of a hurricane that affected Tompkins County does exist. Though this hazard has a moderately low potential, it is recommended that it be reviewed as part of the mitigation planning process. Hurricane was included in the County’s risk assessment process and will be further detailed below.

Ice Jam – Ice jams occur when water bodies are clogged with large blocks of ice. The ice is normally formed by the freezing of the water body and becomes dislodged due to hydraulic conditions whereby the ice floats and may jam at sections of the water body that have a limited cross section (i.e., at bridges and natural channel contractions). Ice jam events have been regularly reported throughout the County and are frequently associated with flash flood events in the late winter/early spring. This is a newly added hazard to the Plan, and will receive further detail in the next section.

Ice Storm – Ice storms include freezing rains which cause icing of roads, structures, and vegetation, and can cause structural damages and create hazardous slippery conditions. Ice storms have frequently occurred in the County based upon discussion during the risk assessment. These events routinely cause trees to topple due to the weight of the ice which has the potential to cause structural damage and utility failures. This hazard is profiled further in this plan.

Infestation – An infestation event is characterized by an excessive population of plants, insects, rodents, or other animals requiring control measures due to their potential to carry diseases, destroy crops, or harm the environment. The County is actively dealing with multiple species of invasives, which was the driver behind the top five ranking of this hazard event. Information regarding the occurrence of this hazard and how the effects might change in response to potential

climate changes will be reviewed in the next plan section. Infestation is a new hazard to the 2012 Plan Update and was not included in the original plan document.

Landslide – Landslides are defined as the downward movement of a sloped land mass under the force of gravity. Based upon historic information, landslides have occurred in the County on a localized basis. The potential for this hazard was determined to be low, though the potential for cascading hazards to occur was noted. This hazard, which was not included in the 2006 Plan, is profiled further in Section 5.

Mine Collapse – Mine collapse is the structural failure of an underground mine used to harvest minerals from the earth. There are no known active mines in Tompkins County. Since no historic mine collapse issues have been documented within the County, mine collapse was not included in the risk assessment process.

Oil Spill – Oil spills include the discharge of oil into the environment by a fixed site or mobile site (vehicles). This hazard is similar to what has been mentioned with respect to hazardous material hazards. Historically, it is known that fuel oil spills have resulted due to the lack of maintenance of oil storage facilities or due to damage as a consequence of a cascade effect resulting in the structural damage of an oil containing vessel. Though minor spills occur, large scale oil spills are not a concern within Tompkins County and a lengthy history of such events does not exist. Concerns related to oil spills will be applied to the hazardous materials hazard analyses, as this hazard will not be detailed further in this document.

Radiological – Fixed Site – Radiological materials at fixed sites is defined as the release or threat of release of radioactive material from a nuclear power generating station or research reactor or other stationary source of radioactivity. No nuclear power locations or other radiological facilities exist within Tompkins County; therefore, this hazard is not profiled in the next section of the plan.

Radiological – In Transit – Radiological materials in transit constitutes a release of radioactive material into the environment while in transit due possibly to an accident or malfunction in the container which holds the material. No historical data was available to indicate the release of any radioactive material within the County. As no history of this hazard is documented within Tompkins County, this hazard is not afforded further consideration in this plan.

Severe Storm – A severe storm hazard event includes hail storms, windstorms, and severe thunderstorms (with associated severe wind events such as derechos, gustnados (ground based gust vortex), and downbursts). Severe storm was included in the HIRA-NY risk assessment completed by Tompkins County, ranking second among the highest rating. This hazard frequently occurs within the County and therefore will be detailed further in the next section of this plan.

Severe Thunderstorm – Severe thunderstorms can produce tornados, hail, flooding, or high winds. These three potential side effects of severe thunderstorms are fully described and included under the hazards severe storm (includes hail events and high winds) and tornado. Therefore, this additional hazard will not be analyzed as part of this plan. Severe thunderstorms will be incorporated under the severe storm hazard.

Structural Collapse – Structural collapse is the failure and caving in of a structure. In and of itself, potential for the structural collapse of a structure within the County was not historically found to be an issue, unless it was caused by another hazard. Generally, building code enforcement prevents flagrant issues from arising. In addition, programs for the demolition of abandoned structures have helped to remove abandoned structures before they collapse. Because programs are in place to mitigate this potential hazard, structural collapse is not analyzed in this plan.

Terrorism – Terrorism is the systematic use of violence committed by groups in order to intimidate a population or government into granting their demands. Though no significant locations that may be targeted by large-scale terrorist events exist in the County, when compared to other areas across the Country, smaller scale events could potentially occur. Because of the increased threat of terrorism in the past decade this hazard will be profiled further in this plan.

Tornado – Tornados are violent destructive whirling winds accompanied by a funnel-shaped cloud that progresses in a narrow path over the land. Historic tornados have been recorded within New York State. Though an infrequent event within in Tompkins County, such an event has the potential to cause a large amount of damage. This was not assessed in the 2006 HMP, but has been added to this Plan Update and will be profiled in Section 5.

Tsunami-wave Action – Tsunamis are a series of enormous waves created by an underwater disturbance such as an earthquake, landslide, volcanic eruption, or meteorite. Due to Tompkins County’s distance from the ocean, there is no potential for tsunamis to affect the County. No historic data was uncovered to show otherwise. This hazard is not included further in this plan update.

Transportation Accident – A transportation accident is an unexpected happening causing loss or injury. Historically, minor traffic accidents frequently occur in Tompkins County. Some of these events are due to the cascading effects caused by other hazards such as severe winter weather or ice storms. More severe accidents are fairly common, especially within densely populated areas of the County or on main transportation routes. Transportation accident, the highest rated hazard during the County’s risk assessment process, will be included in Section 5 of this plan.

Utility Failure – Utility failure is defined as the loss of electric and/or natural gas supply, telephone service, or public water supply, as a result of an internal system failure and not by the effects of disaster agents. A few key historic utility failure events were documented during the HIRA-NY analysis; however, the majority of utility failures occur as a cascading effect from another hazard event. Regardless, this hazard was determined to have the potential to impact the County. Further consideration of this hazard will be provided in the next section of this document.

Water Supply Contamination – Water supply contamination includes the contamination or potential contamination of surface or subsurface public water supply by chemical or biological materials that results in restricted or diminished ability to use the water source. Water supply contamination within Tompkins County is infrequently documented, as approximately 50-percent of the County’s population is on public water. Concerns raised for this hazard were

associated with future potential effects from hydraulic fracturing operations. This hazard was included in the County's risk assessment and is detailed further in section 5 to discuss these concerns.

Wildfire – Wildfires are described as the uncontrollable combustion of trees, brush, or grass involving a substantial land area which may have the potential for threatening human life and property. Though some areas of Tompkins County are heavily forested, few historic wildfire events have been documented. Because of the low incidence and low probability of this hazard to occur within the County, it is not included in further assessments.

Winter Storm (severe) – Winter storms include heavy snowfall and extreme cold and can immobilize an entire region. Major snowstorms have occurred in Tompkins County in the past, placing high demands on the Public Works Departments of the County, Towns, and Villages, and adding risks for emergency response personnel. This hazard is included in the County's risk assessment due to its frequent occurrence.

4.3 Results of the Tompkins County HIRA-NY

On March 8, 2012, a group of County staff, local officials, agency/interest group representatives, and technical experts was assembled to complete a HIRA-NY risk assessment process for Tompkins County. Such a risk assessment was previously conducted as part of the County's original 2006 Hazard Mitigation Plan, and was performed again for this Plan Update. NYSOEM Region IV personnel facilitated the March 2012 risk assessment and input the results in the HIRA-NY computer program. Detailed meeting notes were recorded throughout the process by Beth Harrington with the Department of Emergency Response, and reviewed by the project team in subsequent meetings. The following individuals attended this event:

NYSOEM Region IV – Ronald Raymond, Tom M^cCartney
Tompkins County Department of Emergency Response – Lee Shurtleff, Beth Harrington, Jessica Verfuss
Town of Caroline – Irene Weiser
Town of Ithaca – Creig Hebdon
Town of Dryden – David Sprout
Town of Enfield – Larry Stillwell
Town of Danby – Ric Dietrich, Susan Beeners
Town of Newfield – Richard Driscoll
City of Ithaca – Julie Holcomb
Town of Ulysses – Darby Kiley
Tompkins County Planning Department – Scott Doyle, Katie Borgella
Cornell University Horticulture Department – Jonathan Comstock
Cornell University Environmental Health and Safety – Dan Maas, Leah Stoner
Bolton Point Water Treatment Plant – Jack Rueckheim
U.S. Geological Society – Ed Bugliosi
Tompkins County Department of Public Works – Cheryl Nelson
National Weather Service – Dave Nicosia
American Red Cross – Kevin Carpenter
Tompkins County Public Information Office – Marcia Lynch

Tompkins County Sheriff's Department – Bob Lampman
 Tompkins County Administration – Paula Younger
 Tompkins County Health Department – Adam Hartwig
 Tompkins County Assessment Office – Al Fiorille
 Barton & Loguidice – John Condino, Johanna Duffy

Based on the professional knowledge of those present, historical County data, hazard event definitions, history from the National Weather Service, recent scientific reports on anticipated impacts from climate change in New York and likely impacts from widespread natural gas drilling in the region, and discussions that occurred amongst the group, 22 hazards were assessed and ranked using the HIRA-NY program. The County's top three rated hazards identified using the HIRA-NY tool are: transportation accident, severe storm, and flash flood. The hazards that were assessed, their 2012 rankings, and the original 2003 hazard rankings are included in Table 12.

Table 12 – Tompkins County Risk Assessment Hazard Rankings				
<i>Tompkins County's HIRA-NY risk assessment completed on March 8, 2012</i>				
Hazard	2012 Rank (HMP Update)	2012 Risk Assessment Score	2003 Rank (original HMP)	2003 Risk Assessment Score
Transportation accident	1	289	8	217
Severe storm	2	281	4	236
Flash flood	3	232	1	297
Infestation	4	231	N/A	N/A
Fuel shortage	5	212	N/A	N/A
Fire	6	210	7	223
Tornado	7	207	N/A	N/A
Utility failure	8	205	13	180
Ice storm	9	204	5	233
Epidemic	10	197	3	260
Water supply contamination	11	195	6	227
Hazmat in transit	12	194	12	196
Severe winter storm	12	194	10	201
Hurricane	13	193	9	215
Terrorism	14	192	2	295
Extreme temperatures	15	190	N/A	N/A
Ice jam	15	190	N/A	N/A

A total of 22 hazards were analyzed during this risk assessment process: 14 natural hazards, 6 technological hazards, and 2 human-caused hazards. Nine new hazards were assessed during the 2012 HIRA-NY analysis that were not profiled in the 2006 HMP: infestation, fuel shortage, tornado, extreme temperatures, ice jam, drought, lake flood, earthquake, and landslide. The ranks and assessment scores for some of the hazards vary greatly between the 2003 and 2012 risk

assessments. This variation is attributed to that fact that risk assessment participants are more likely to rank recent events and hazards that have recently affected the community higher than others. The individuals present for the County's 2012 risk assessment process determined the severity of impacts for the 22 selected hazards based on the five factors previously discussed: scope, frequency, impact, onset, and duration. Table 13 details the selections that were made for these five factors in relation to each of the analyzed hazards.

Table 13 – HIRA-NY Risk Assessment Rating Characteristics							
<i>Scope, frequency, impact, onset, and duration results for the 22 hazards analyzed as part of Tompkins County's HIRA-NY risk assessment completed on March 8, 2012.</i>							
Hazard	Rating	Scope	Cascade Effects	Frequency	Onset	Hazard Duration	Recovery Time
Transportation accident	289	Throughout a large region	Some potential	A frequent event	No warning	One day	One to two days
Severe storm	281	Throughout a large region	Highly likely	A frequent event	No warning	Less than one day	One to two days
Flash flood	232	Throughout a large region	Highly likely	A regular event	Several hours warning	Less than one day	One to two days
Infestation	231	Throughout a large region	Highly likely	An frequent event	More than a week warning	More than one week	Less than one day
Fuel shortage	212	Throughout a large region	Some potential	An infrequent event	More than a week warning	More than one week	More than two weeks
Fire	210	Throughout a small region	Some potential	An infrequent event	No warning	Two to three days	Three days to one week
Tornado	207	Throughout a large region	Highly likely	An infrequent event	No warning	Less than one day	Three days to one week
Utility failure	205	Throughout a large region	Some potential	An infrequent event	No warning	Less than one day	Less than one day
Ice storm	204	Throughout a large region	Highly likely	An infrequent event	Up to one day warning	Two to three days	Three days to one week
Epidemic	197	Throughout a large region	Some potential	A rare event	More than a week warning	More than one week	More than two weeks
Water supply contamination	195	Throughout a large region	Some potential	An infrequent event	No warning	Two to three days	Less than one day
Hazmat in transit	194	Throughout a large region	Some potential	An infrequent event	No warning	Less than one day	One to two days
Severe winter storm	194	Throughout a large region	Highly likely	A regular event	Up to one week warning	One day	One to two days
Hurricane	193	Throughout a large region	Highly likely	A rare event	Up to one week warning	One day	More than two weeks
Terrorism	192	Several individual locations	Some potential	A rare event	No warning	Less than one day	More than two weeks

Table 13 – HIRA-NY Risk Assessment Rating Characteristics <i>Scope, frequency, impact, onset, and duration results for the 22 hazards analyzed as part of Tompkins County’s HIRA-NY risk assessment completed on March 8, 2012.</i>							
Hazard	Rating	Scope	Cascade Effects	Frequency	Onset	Hazard Duration	Recovery Time
Extreme temperatures	190	Throughout a large region	Some potential	A regular event	Up to one week warning	Two to three days	Less than one day
Ice jam	190	Several individual locations	Some potential	A regular event	Several hours warning	Two to three days	Less than one day
Drought	181	Throughout a large region	Some potential	An infrequent event	More than a week warning	More than a week	Three days to one week
Lake flood	172	Throughout a small region	Highly likely	An infrequent event	Up to one week warning	More than one week	Three days to one week
Earthquake	166	Throughout a large region	Some potential	A rare event	No warning	Less than one day	One to two days
Civil unrest	160	Several individual locations	Some potential	An infrequent event	No warning	Less than one day	Less than one day
Landslide	159	Several individual locations	Highly likely	An infrequent event	No warning	Less than one day	One to two days

The County’s three highest rated hazards, transportation accident, severe storm, and flash flood, have many factors in common, such as little warning, frequent or regular occurrences, and ability to affect a large portion of the County. It is important to understand that the rating scores serve to approximate the risks associated with each hazard. As previously mentioned, the extent of risk varies depending on the group of individuals present during such an exercise and the health and safety issues current at the time the assessment is completed. Based on the highest rated hazards identified by the County HIRA risk assessment event, objectives were suggested and a mitigation plan was formulated to minimize the potential loss and impact of these hazards. These objectives and mitigation strategies are documented later on in this document.

4.4 Presidential Disaster Declaration

After a state has declared a State Disaster Area, as the result of a particular disaster event, that state and its local governments will evaluate recovery options, capabilities, and costs. If the damage from the disaster event is beyond the recovery capabilities of the state, the governor will send a letter to the President, through FEMA, detailing the situation. The president then makes the decision whether to declare a major disaster or emergency. After a presidential declaration is made, FEMA designates the impacted area eligible for assistance and announces the types of assistance available. FEMA provides supplemented assistance for the recovery of state and local governments; the federal share will always be at least 75 percent of the total eligible costs (FEMA, Presidential Disaster Declarations, 2009). According to the NYSOEM (NYSOEM GIS, 2010), damages within Tompkins County that occur from any given hazard event need to meet or exceed \$315,558 for a Presidential Disaster Declaration to be issued. Appendix A - Figure 4.3

shows the total number of Presidential Disaster Declarations that have occurred between 1954 and 2010 for every County in New York State. Tompkins County has had nine (9) declarations within this time period.

One additional Presidential Disaster Declaration has been declared in New York State since 2010 that has included public assistance for Tompkins County. FEMA DR-4031 was issued as a result of Tropical Storm Lee on September 13, 2011.

4.5 Natural Gas Drilling

The potential for natural gas drilling related to the Marcellus and Utica Shale deposits in Tompkins County and throughout the Southern Tier Region of New York State, has created a tremendous amount of concern in some communities regarding the possible environmental effects of the horizontal drilling process. Drilling for natural gas in such shale deposits uses a process termed hydraulic fracturing, also known as hydrofracking or fracking, in which the gas is extracted through a horizontal well drilling technique which is not currently permitted in New York State. Hydrofracking refers to the pumping of a mixture of water, chemical, and sand into the rock formations creating fractures in the shale that allow for the natural gas to escape to a production well where it is extracted and collected. The New York State Department of Environmental Conservation (NYSDEC) has finished compiling a Supplemental Generic Environmental Impact Statement (SGEIS) to review the potential environmental effects of this process. The information in the SGEIS will be used by the NYSDEC to formulate and propose a set of regulations, which the drilling companies will have to abide by to minimize the potential impacts from these drilling activities.

While there are currently no horizontal natural gas wells within Tompkins County, it was estimated in 2011 that 39-percent of the land within the County was leased for potential future gas drilling operations. Tompkins County has established a Council of Governments Gas Drilling Task Force to keep abreast of the latest developments regarding this topic. Concerns within the County surrounding natural gas drilling include: site disturbance, loss of active farmland, increased water consumption, chemical mixture used during drilling process, flowback of water, increased truck traffic and access, and disposal/treatment of utilized water/chemical mixture. Nearly all of jurisdictions within the County have already passed moratorium on the process, or ordinances prohibiting the natural gas drilling within their municipal boundaries.

Many of the HMP planning process participants expressed concerns regarding potential cascading effects that could result from natural gas drilling within their municipalities. While horizontal natural gas drilling is not considered a natural hazard, there was strong concern expressed among several participants that such drilling techniques present the potential to create human-caused environmental impacts such as oil spills, explosions, fire, fixed site and in-transit hazardous material spills, and water supply contamination. The NYSDEC's SGEIS indicates that, "though the potential for severe negative impacts from any one site is low, when all activities in the State are considered together, the potential for negative impacts on water quality, land use, endangered species, and sensitive habitats, increases significantly."

As previously mentioned, natural gas hydrofracturing drilling is currently not permitted within New York State, and the regulations surrounding the process which may be passed one day

cannot be speculated at this time with certainty. As this issue relates to the County's HMP Update, it is premature to attempt to identify and include all potential impacts that could result from the allowance of such drilling techniques, since there is little or no history available regarding such activities within New York State, but it is prudent to consider these potential impacts when evaluating hazards in this document. As this issue continues to progress, it will be tracked and discussed as part of future HMP reviews and 5-year updates. It will be imperative that this section be reviewed and expanded or removed in the future to accommodate future realities.

5.0 Hazard Histories and Future Potential

Based on the information collected during the data review and risk assessment portion of this plan, 22 hazards were determined to have the potential to affect Tompkins County. A summary of these hazards is provided below in Table 14.

Table 14 – Primary Hazards Determined to Affect Tompkins County	
Hazard	Type of Hazard
Severe storm	Natural
Flash flood	
Infestation	
Tornado	
Ice storm	
Epidemic	
Severe winter storm	
Hurricane	
Extreme temperatures	
Ice jam	
Drought	
Lake flood	
Earthquake	
Landslide	
Transportation accident	Technological
Fuel shortage	
Fire	
Utility failure	
Water supply contamination	
Hazmat in transit	
Terrorism	Human-caused
Civil unrest	

The analyses included in Section 4.3 eliminated the need for further discussion on the following hazards: air contamination, avalanche, coastal storm, explosion, food shortage, mine collapse, oil spill, radiological – fixed site, radiological – in transit, severe thunderstorm, hazardous materials – fixed site, dam failure, structural collapse, tsunami-wave action, water supply contamination, and wildfire. Though these hazards are not included in the 2012 HMP Update for Tompkins County, they can be incorporated into future plan updates, as needed. The remaining 22 hazards listed in Table 14 are profiled below because it was determined that they have the potential to impact Tompkins County. These hazard profiles included details of their historic occurrence within the County, County and individual jurisdiction vulnerability and susceptibility, historic

cost damage estimates from previous hazard events, and future potential including their relationship to climate change. Of the 22 identified hazards, the following 15 (Table 15) were noted as having the potential to be more impacted by climate change.

Table 15 –Hazards Identified as Having the Potential to be Impacted by Climate Change
Natural Hazards
Severe Storm
Flash flood
Infestation
Ice storm
Epidemic
Severe winter storm
Hurricane
Extreme temperatures
Ice jam
Drought
Lake flood
Landslide
Technological Hazards
Fire
Utility failure
Water supply contamination

Based on each hazard’s profile and associated details, a qualitative probability of occurrence (i.e., low, medium, or high) was determined for each. The level of detail included for each hazard was limited by the amount of historical data and prior cost and damage estimates available.

5.1 Natural Hazard Profiles

Details associated with historical hazards occurrences were collected using National Climactic Data Center (NCDC) data, technical and project committee knowledge, Tompkins County records, information available through FEMA, and other resources, as appropriate.

5.1.1 Severe Storms and Hurricane

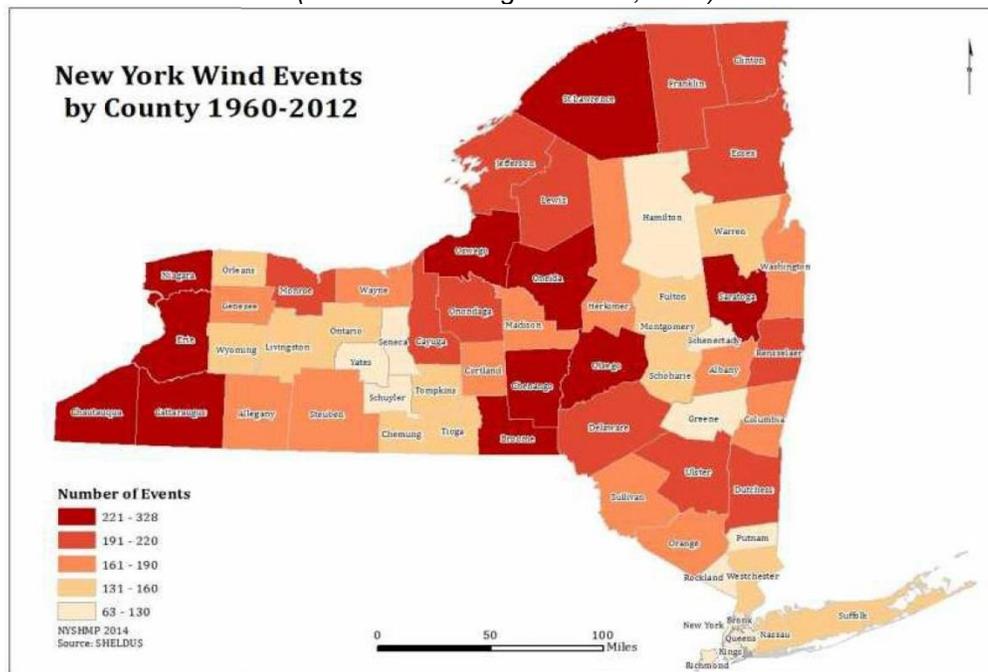
Because of the similarities between the severe storms and hurricane hazard characteristics and definitions, they have been combined into one hazard profile.

General Hazard Description

Severe storms are defined as storms with a tornado and/or surface hail $\frac{3}{4}$ " or greater and wind gusts of 58 mph or greater. They include 1) hailstorms, 2) windstorms, and 3) severe thunderstorms (with associated severe wind events).

- 1) Hailstorms –Typically associated with severe thunderstorms, hailstorms are characterized by balls or irregularly shaped lumps of ice greater than $\frac{3}{4}$ " in diameter. The peak occurrence period for hailstorms is late spring and early summer. Hailstorms can cause extensive damage to agriculture crops, particularly those that are herbaceous and long-stemmed. Severe hailstorms can also cause damage to buildings and automobiles, but rarely cause fatalities or serious injuries. Probability for severe hail to occur in the U.S. is included as Appendix A – Figure 5.1.
- 2) Windstorms – Wind is defined as the motion of air relative to the earth’s surface. Extreme windstorm events are associated with hurricanes, winter cyclones, and severe thunderstorms. Tompkins County is located in wind zone III; winds with a potential speed up to 200 mph are depicted for this zone (Appendix A – Figure 5.2).
- 3) Severe Thunderstorms – According to the National Weather Service (NWS), thunderstorms are considered to be ‘severe’ if they produce hail at least $\frac{3}{4}$ " in diameter, winds of at least 58 mph, or a tornado. NWS estimates that approximately 1,000 severe thunderstorms occur each year on the U.S. mainland. Severe thunderstorms can produce damaging tornadoes, hailstorms, windstorms, lightning and flash floods. Figure 5.3 indicates that Tompkins County experienced 63 to 130 high wind events between 1960 and 2012.

Figure 5.3 - Number of Wind Events for Tompkins County, 1960-2012
(NYS Hazard Mitigation Plan, 2014)



Hurricanes, also termed tropical cyclones, are defined as storms with wind speeds of 74 mph or greater which blow in a large spiral around an “eye” (calm center). Hurricanes are typically downgraded to tropical storms or tropical depressions by the time they reach Tompkins County. This hazard has a high potential to cause other cascading effects and extensive damage to life and property.

Key Severe Storm and Hurricane Findings for Tompkins County:

- Hailstorms – An average of one hailstorm occurs annually (1980-1999).
- Windstorms – There is potential for winds up to 200 mph in Tompkins County (Wind Zone III) (Appendix A – Figure 5.2).
- Severe Thunderstorms – An average of four to five severe thunderstorms occur annually (1980-1999).
- Hurricanes – Tompkins County is not located within a hurricane-susceptible region.

Historical Hazard Occurrence

Hurricane - No hurricane or tropical storm events were noted for Tompkins County, though Hurricane Irene and Tropical Storm Lee had devastating impacts to adjacent counties, which heightened awareness of these types of hazards in Tompkins County. The County’s geographic location within the U.S. and New York State provides protection from full-strength hurricane events. Historically, Tompkins County has however experienced high wind events; the most severe of which are associated with remnants of hurricanes that have tracked up the Atlantic Coast. Hurricane strength and severity generally decreases as the storm continues north and inland to central New York. Therefore, the damage potential is relatively low and is mostly associated with downed trees and interruptions to utility services. A list of hurricane force wind events that have historically been reported within the County is provided below:

- 1935 – high wind event (eight to ten fatalities occurred)
- 1954 (October) – Remnants of Hurricane Hazel
- 1970s – extreme wind gusts
- 2003 – Remnants of Hurricane Isabel
- 2011 – Remnants of Hurricane Irene and Tropical Storm Lee

Severe Storms - NCDC data was queried to obtain records of severe storm events that have occurred over the past six years (fall 2006 – fall 2012). Two reports of high wind events and 31 reports of severe thunderstorm were reported for Tompkins County. The occurrence details and storm damages, if any, are summarized in Appendix A - Table 16.

The most significant severe storm event reported within the last six years occurred on April 28, 2011, in Danby, which included a tornado (detailed in Section 5.1.12). This storm consisted of a straight line of winds of nearly 100 mph that resulted from a storm system that moved east across New York State from the Great Lakes. Significant tree damage was reported as a result of this

storm, as well as multiple reports of roof and siding damage to residential housing. Hail associated with the storm also struck homes and cars in the area. This storm resulted in an estimated \$100,000 in damages.

Historical Cost and Damage Estimates

Based on the NCDC's damage reports, the majority of severe storm events within Tompkins County resulted in \$1,000 to \$2,000 worth of damage. The total damages recorded over the previous six years amount to \$208,000, the majority of which was associated with residential property damage. No fatalities or injuries have been reported over this time period. Based on the NCDC damages included in Appendix A - Table 16, an average of \$35,000 in losses occurred annually between 2006 and 2012. Storms that occur between late spring and early fall have a greater probability of damage to croplands. The majority of reported severe storm events occurred within that window, during summer, from June to August. Impacts to public utilities are commonly reported as a result of severe storm events. Such impacts require an immediate response by utility company personnel and are often fixed quickly. Hail events can cause minimal damage to private property, especially vehicles, but often do not result in an increased need for County emergency services or other resources. After a severe storm event ends, the County and municipal public works departments are sometimes called upon to clean up debris or fix infrastructure damage that may have occurred.

Future Potential Impacts

Based on recent literature related to climate change potential within New York State, including the New York State Energy and Research Development Authority's (NYSERDA) ClimAID Report, weather patterns are projected to change and increase in severity. Annual average precipitation is predicted to increase by up to 5% by the 2020s, up to 10% by the 2050s, and up to 15% by the 2080s (NYSERDA, 2011). The greatest changes are projected to occur in northern New York; however, no area of the state will be spared from climate change effects. The majority of this additional precipitation is expected to fall as rain during winter and an increase in heavy rainfalls is expected, with less incidence of light rain. Due to the projected increase in precipitation and the increase in yearly average temperatures, severe storm events are anticipated to increase in frequency and intensity.

5.1.2 Flash Flood

General Hazard Description

Floods are natural events for rivers and streams where excess water from snowmelt or rainfall accumulates and overflows onto the banks and adjacent floodplains. FEMA has mapped 100-year floodplains, which designates areas that, on average, have a 1-percent chance of flooding in any given year. A large amount of rainfall over a short period of time can result in flash flood conditions. Flash flood damage tends to occur in and around floodplains.

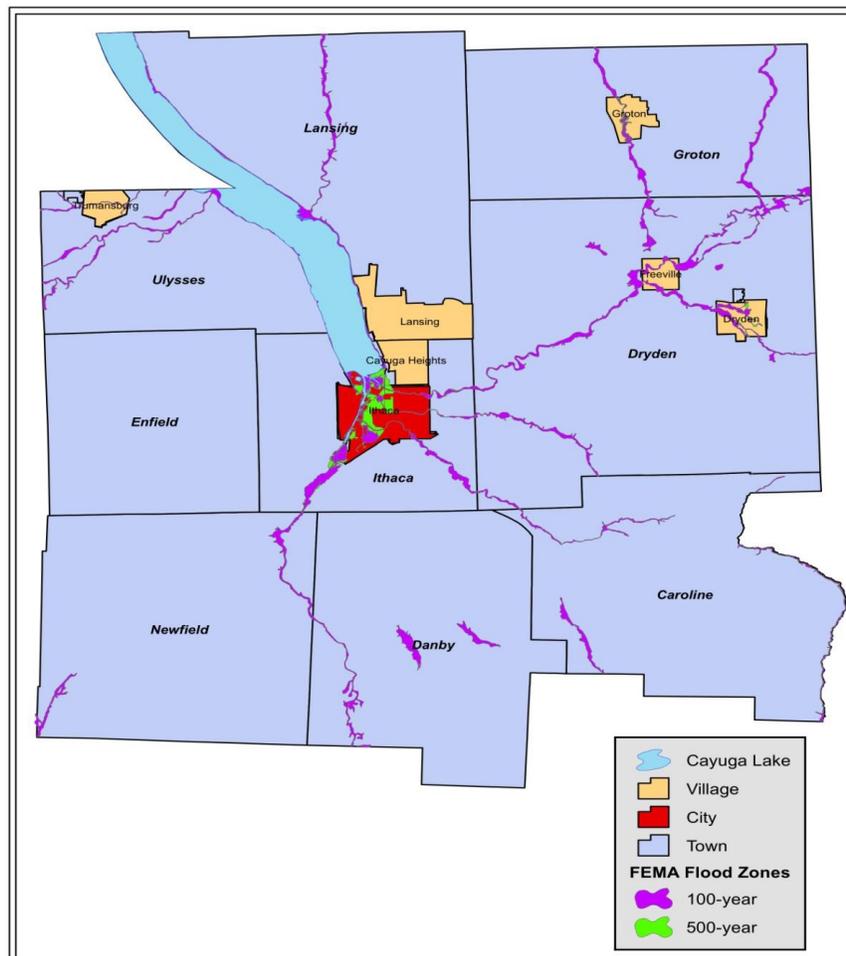
Numerous 100 and 500-year flood zones are recognized within the limits of Tompkins County. These areas, totaling approximately 10,665 acres, are more prone to impacts from flooding events due to their location. FEMA flood maps were last updated in the mid-1980s and are at this point inaccurate in many parts of the County. Direct losses from flash flood events are not

frequently documented unless they occur in association with large flood events or storms with significant flooding as a cascading hazard.

Key Flash Flood Findings for Tompkins County

- Twenty-four (24) flash flood events have been documented over the last nineteen (19) years (National Weather Service).
- Over 10,000 of a total approximate 31,000 acres in Tompkins County fall within either the 100 or 500-year FEMA Flood Insurance Rate Map Flood Zones. An estimated 3,977 tax parcels intersect these flood zones; these areas are classified as follows: commercial (519 parcels), community services (203 parcels), industrial (12 parcels), public services (118 parcels), recreation (61 parcels), and residential (3064 parcels – all occupied).
- 100-year flash flood events have a 1-percent chance of occurring in any given year.
- A total of 8 Presidential Declarations for flooding events have been issued for Tompkins County between 1953 and April 2010 (NYSOEM GIS, 2010).

Figure 5.4 - Shows the FEMA Floodplain Mapping for Tompkins County (FEMA, 2006)



Historical Hazard Occurrences

Due to the topographic characteristics of Tompkins County, several municipalities are vulnerable to flash floods and associated landslides, particularly 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 does not have a history of flood related deaths or serious injuries; however, flash flooding was determined to be a priority hazard event within Tompkins County due to its frequency as well as economic impacts related to property and infrastructure damage.

The NWS reports that twenty-four (24) flash flood events have been documented within Tompkins County over the last nineteen (19) years. Four such occurrences have taken place since the County's initial HMP in 2006. These NCDC records are detailed in Table 17, below.

Table 17 –Tompkins County Flash Flood Events between October 2006 and October 2012 (NOAA, NCDC, Storm Events Search, 2012)						
Location	Date	Event	Deaths (#)	Injuries (#)	Property Damage (\$)	Crop Damage (\$)
Ithaca	11/2006	Flash Flood	0	0	\$25,000	0
McKinneys Point	8/2007	Flash Flood	0	0	\$1,000	0
Ithaca	9/2011	Flash Flood	0	0	\$20,000	0
Ellis Hollow	9/2011	Flash Flood	0	0	\$400,000	0

Tompkins County did not sustain any significant damages associated with October 2012's Hurricane Sandy. The most significant recent flash flooding event was associated with Tropical Storm Lee and Hurricane Irene (September 2011). A record rainfall of six to twelve (12) inches resulted in the flash flooding of creeks in and around the Susquehanna River Basin. Damages associated with this event in New York and Pennsylvania were estimated at close to 1 billion dollars. Other historical occurrences of flash flooding in Tompkins County include Virgil Creek flooding in Dryden, flooding at the Dryden Elementary School, Groton Nursing Home & Senior Citizens building, and localized flooding along Little Egypt Creek and East Shore Drive Plaza.

Historical Costs and Damage Estimates

As illustrated by the NCDC property damage estimates above, a single flash flood event has resulted in \$1,000 - \$400,000 in damage costs. To look at the average annual losses reported for communities that participate in the National Flood Insurance Program (NFIP), flood damage data was reviewed and is included in Appendix A - Table 18. As of 2007, Tompkins County had 299 NFIP policy holders. The Village of Groton reports the highest annual losses from flooding events. The total average annual loss due to flooding in the County is reported as \$46,858.85 based on the NFIP records. This number is conceivably higher during years where a significant flash flooding event occurs. It is always important to remember that not all jurisdictions within Tompkins County participate in the NFIP; therefore, additional losses are assumed to occur every year.

Based on the data depicted in Appendix A - Figure 5.5, approximately 7,860 acres of agricultural lands are within or immediately adjacent to 100-year or 500-year floodplains. This amount of land represents an estimated value of \$16,640,635.00, based on Tompkins County Real Property records. Depending on the time of year and the type of agricultural enterprise, damages to these lands from flash flooding could range from minimal (\$500) to significant (\$1,000,000), though no significant agricultural damages have been recorded as a result of past flash flood events.

Flood events have the potential to quickly impact all structures and facilities. Large flood events often include mandatory evacuations and the establishment of emergency shelters. Residential properties are the property type most often located within mapped floodplains; therefore, impacts to private houses are anticipated to be the largest structural impact that would result from a large flood event. Tompkins County currently has twelve (12) Repetitive Loss properties. A Repetitive Loss (RL) property is any insurable building for which two or more claims of more than \$1,000 were paid by the NFIP within any rolling ten-year period, since 1978. The greatest number of RL properties fall within the Town of Lansing boundaries. Since 1978, a total of \$290,991.02 has been paid to these residents for both building and content damages. Extensive impacts to transportation infrastructure, agricultural lands, and public utilities can also occur from flash flooding.

As noted in the United States Army Corps of Engineers' *Hydraulic Analysis and Impacts of Long Term Shoaling for Flood Risk Management Project, Cayuga Inlet, Ithaca, NY* flooding is most pronounced in the City of Ithaca downstream of Sixmile Creek, between State Street and Cascadilla Creek. In this area flood waters often cross Meadow Street and inundate portions of Adams, Fourth and Fifth streets. Also, Cascadilla Creek water will often back up and flood parts of Lincoln and Dey streets. The report indicates that the flood risk to the residences and businesses in these areas is increased due to the lack of regular maintenance of the Flood Risk Management project on the Cayuga Inlet.

Future Potential Impacts

According to the climate projections noted in NYSEDA's ClimAID technical report, annual average precipitation is projected to increase by up to 5 percent by the 2020s, up to 10 percent by the 2050s, and up to 15 percent by the 2080s. Such increases are sure to affect the frequency and severity of flash flooding events within New York State. It is anticipated that these increases will not be evenly distributed throughout the year. Reports indicate that the bulk of these increases will be realized in the winter months and mainly come in the form of rain. More rain on frozen ground will most likely increase the likelihood of flash flooding. Because Tompkins County is located at the southern end of Cayuga Lake and has numerous freshwater streams within its boundaries, the County will become increasingly vulnerable to potential impacts from flash flooding events as precipitation increases in amount and frequency. Adverse flood impacts in the City of Ithaca in the area mentioned in the Army Corps of Engineers' report will continue if dredging of the Inlet does not occur. To accurately track fluctuations in flood activity to assess future potential impact, existing USGS stream gages should continue to be supported (2 in Sixmile Creek, 1 in Fall Creek, 1 in Cayuga Lake Inlet). Added gages should be considered for installation in Salmon Creek and Owasco Inlet. Due to the multiple benefits of these gages, continued funding should be sought both with and without USGS support.

5.1.3 Earthquake

General Hazard Description

An earthquake is a sudden motion or trembling that is caused by a release of strain accumulated within or along the edge of Earth's tectonic plates. The effects of an earthquake can be felt at distances beyond its actual occurrence, though they are less severe as the distance increases. As Appendix A - Figure 5.6 illustrates, multiple earthquake events have been reported within New York State, primarily in the North Country/Adirondack regions. Effects like ground shaking have been frequently reported within the State even though the earthquake itself occurred outside state borders.

The U.S. Geological Survey (USGS) produces seismic hazard maps. Earthquake probability on these maps is commonly displayed in terms of peak ground acceleration (PGA). PGA measurements indicate the geographic area affected, the probability of an earthquake at different levels of severity, and the strength of ground movement (expressed in acceleration force of gravity, % g). Appendix A - Figure 5.7 shows that Tompkins County is located in an area of low peak acceleration, likely due to a low incidence rate and small maximum magnitude for nearby earthquakes. Any jurisdiction that has a peak ground acceleration value of 3% or higher is required to fully profile the earthquake hazard in order to receive FEMA plan approval. As illustrated in Appendix A – Figure 5.7, Tompkins County's PGA value is between 2% and 3% g. Table 19 shows what PGA values equate to in terms of hazard intensity, damage potential, and magnitude.

Table 19 – Richter Magnitude Scale and Mercalli Intensity Scale Ratings (USGS, Earthquake Hazards Program, 2010 and NYSOEM, State HMP, 2011)				
Acceleration PGA (%g)	Mercalli Intensity Scale	Richter Magnitude Scale	Damage Potential	Intensity Scale Details
<0.17	I	1.0 – 3.0	None	Not felt except by a few persons at rest under favorable conditions
0.17 – 1.4	II – III	3.0 – 3.9	None	Felt only by some at rest – felt noticeably indoors, especially on upper floors
1.4 – 9.2	IV – V	4.0 – 4.9	None	Felt by many indoors, some/many outdoors, minor damage occurs
9.2 - 34	VI – VII	5.0 – 5.9	Light to moderate	Felt by all, damage to inadequate structures, many frightened
34 - 124	VIII – IX	6.0 – 6.9	Moderate to heavy	Considerable damage to many types of structures, structural collapse
>124	X or higher	7.0 and higher	Very heavy	Structures destroyed, bridges and rails bent, objects thrown, line of sight & level distorted

Key Earthquake Findings for Tompkins County

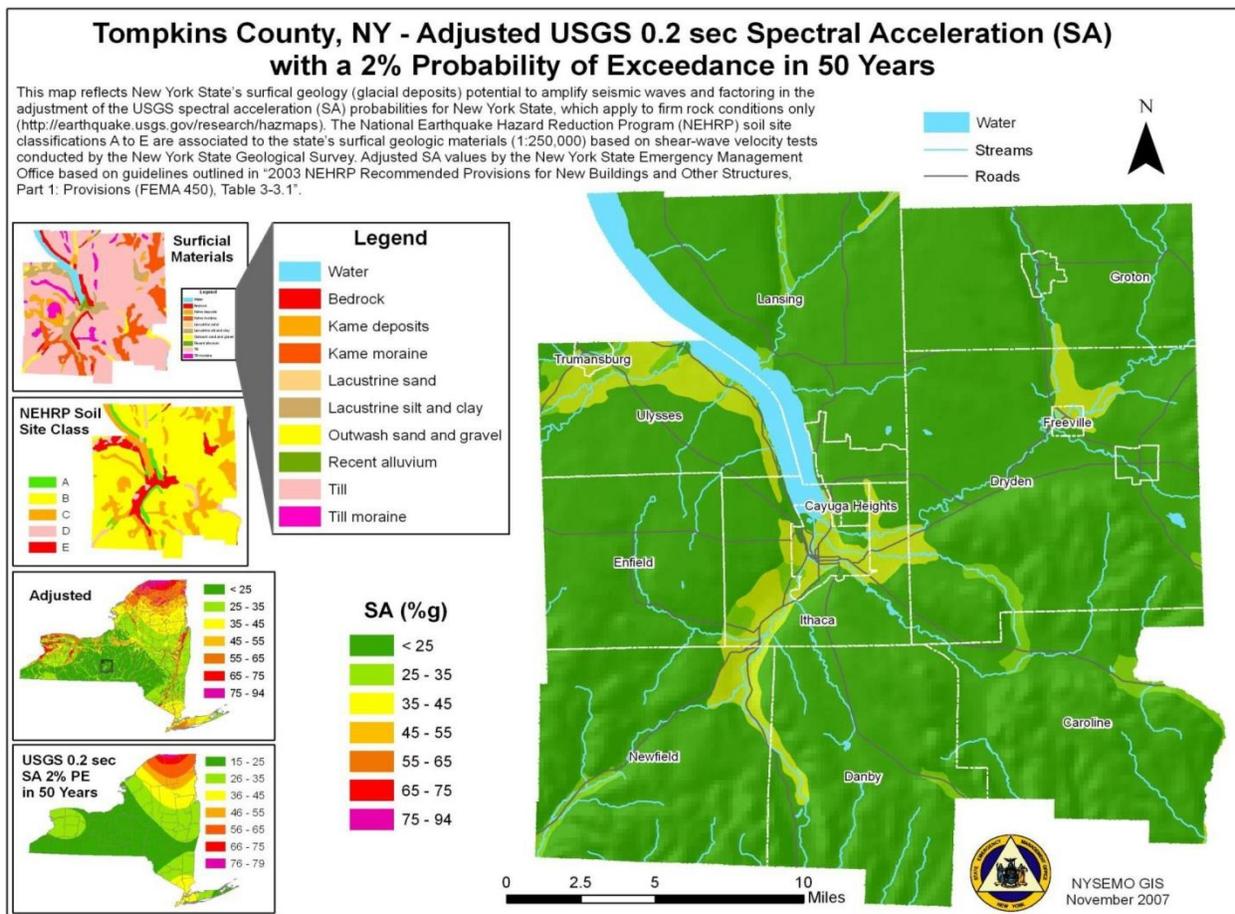
- There is no record of local earthquake occurrences.

- Tompkins County’s PGA value is 2-3% g, which indicates limited seismic activity, which typically results in minor damages.

Historical Hazard Occurrence

Earthquakes are designated as having a moderately low potential to impact Tompkins County. Seismic maps provide the best estimates of earthquake probability expressed in terms of PGA and also spectral acceleration (SA). SA is a measurement that describes the maximum acceleration in an earthquake on an object. Figure 5.8 shows a map produced by the New York State Geological Survey that shows the potential for lands within Tompkins County to accelerate and amplify seismic waves based on surficial geology and soil data.

Figure 5.8 – Spectral Acceleration Data for Tompkins County
(NYSOEM, State Hazard Mitigation Plan-GIS, 2007)



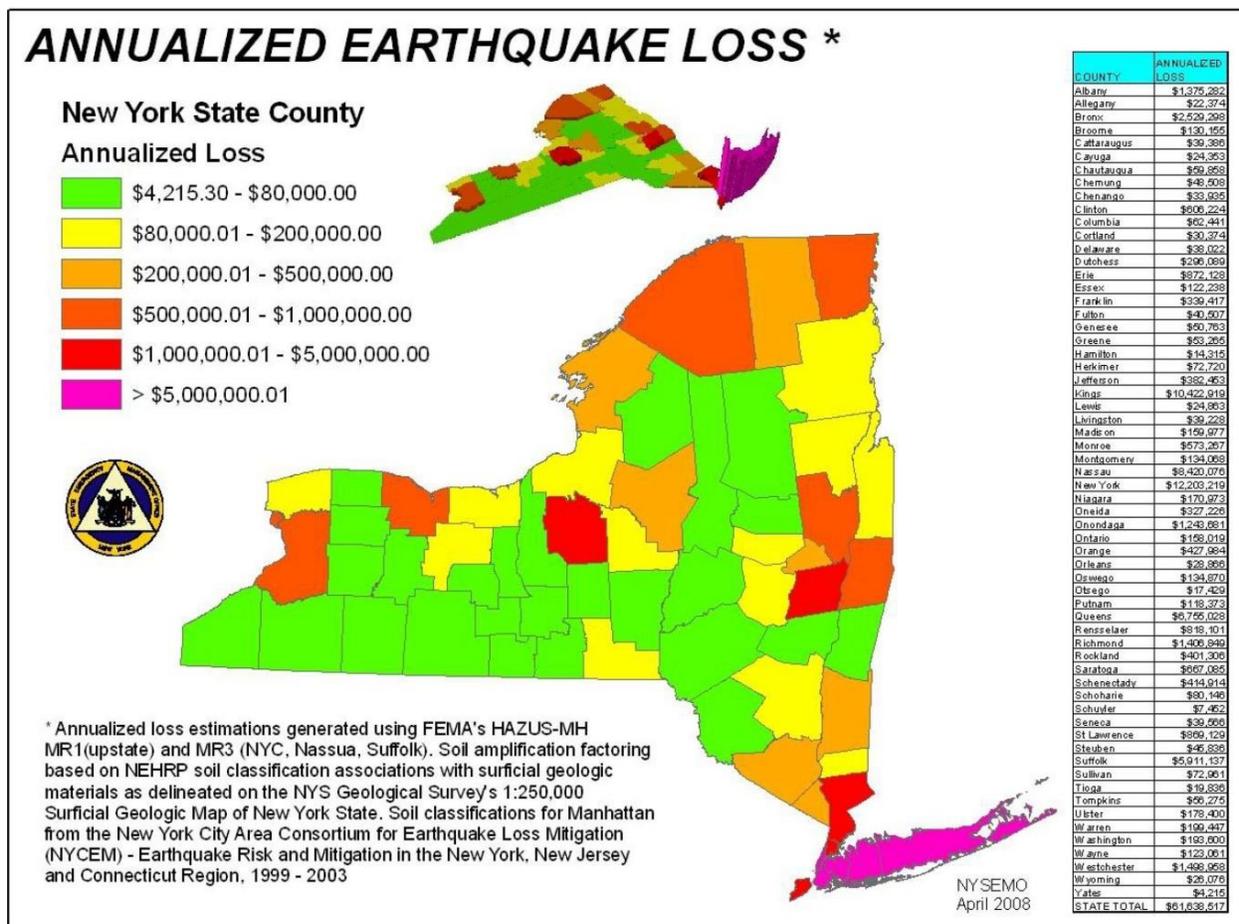
SA is expressed in “g”, which represents the acceleration due to Earth’s gravity. The map represents the ground motion that can be reasonably expected in a 50 year period. The majority of Tompkins County, as shown in the above figure, is located in an area of less than 25% g; however a few areas are mapped within the County that exhibit 25-35% g. All of these values indicate a low potential for seismic activity within the County. There are additionally no historical records of an earthquake occurring within Tompkins County, or of a nearby earthquake event that has significantly impacted the County. Despite this history, it is recommended that

projects involving new infrastructure construction strictly follow the existing New York State Building Code with respect to where and when seismic design practices should be incorporated into a facility design.

Historical Cost and Damage Estimates

The New York State Hazard Mitigation Plan (2011) has modeled potential loss to earthquakes by County. This information, depicted by Figure 5.9, used surficial geology and soils data to estimate earthquake risk and potential loss if such a hazard event were to occur. This mapping illustrates that damages reported within Tompkins County could range from \$4,215.30 to \$80,000.00.

Figure 5.9 – Estimated Annual Earthquake Loss by County
(NYSOEM, State HMP, 2011)



Additional earthquake damage potential and loss estimation data is included in the state plan. Of the 62 counties in the State, Tompkins County ranks 31st in terms of exposure to earthquake hazard events. The value of facilities, infrastructure, and property within the County that is potentially vulnerable to such a hazard event is estimated at \$5,887,685.

Future Potential Impacts

Tompkins County, in its entirety, is vulnerable to an earthquake event because earthquake locations cannot be predicted; however, the potential for an earthquake to occur within the limits of Tompkins County is minimal. Future climate change projections have not focused on changes in the severity and/or frequency of earthquake events. In recent years, a greater frequency of earthquakes is occurring throughout the world which may be due to advances in seismic activity detection. If natural gas drilling moves forward in the State there may be increased potential of earthquakes in the area.

5.1.4 Lake Flood

General Hazard Description

Lake flooding occurs when the water level of Cayuga Lake increases along the shoreline, impacting properties along the lake and backing up water levels in the creeks that outlet to Cayuga Lake. During the risk assessment discussion for this hazard, it was determined that the water level of Cayuga Lake would have to reach an elevation of 387 feet to meet the definition of a lake flood. At this elevation, impacts to the New York State Route 13 corridor begin to occur and residential properties along the shoreline begin to flood. According to the New York State Canal Corps, the entity in charge of adjusting the lake levels, 385 feet represents the flood stage of Cayuga Lake.

Key Lake Flood Findings for Tompkins County

- A lake flood hazard occurs when the water level in Cayuga Lake Exceeds 387 feet.
- Lake flood events occur on average of once a decade, but due to climate change projections, this rate is anticipated to increase in the future.

Historical Hazard Occurrence

The effects from lake flooding are amplified by the topographic characteristics of the County. A notable amount of development within the County occurs along Cayuga Lake's shoreline and the valleys along the main creeks that outlet into the lake. This is most prevalent in the City of Ithaca which is built around the southern end of the lake. Multiple jurisdictions within the County have been susceptible to chronic lake flooding events, which cause the water levels in feeder creeks to drain slowly. These jurisdictions include the towns of Ithaca, Lansing, and Ulysses, Village of Cayuga Heights and the City of Ithaca. Lake flood events that have been documented over the past 50 years include:

- 1972 – Hurricane Agnes
- 1993 – Unspecified storm event
- 2005 – Fall Creek Flooding (\$100,000 in property damage) - connected with ice jam near Ithaca High School

- 2011 – Hurricane Irene, Tropical Storm Lee (Lake water levels were reported at 383/384 feet)

Historical Cost and Damage Estimates

It was estimated that 50-60 houses would be impacted by a lake elevation of 387 feet in the Town and Village of Lansing, specifically the Myers Corners and Ladoga Park areas. The towns of Ulysses and Ithaca, and the City of Ithaca and Village of Cayuga Heights are also located along the shoreline of Cayuga Lake though most of these structures are above this elevation. Because the Canal Corps adjusts the water elevation in the lake at 385 feet, sustained and increasing damage to shoreline and creek side properties in the County are not expected to be an issue. Immediate and short-term damage to property may occur, resulting in around \$50,000 to \$100,000 in damage for a lake flood hazard event. Fatalities and injuries are not anticipated to occur as a result of such events. Lake floods do not pose as high a risk to loss of life and property as flash floods, because they have greater warning times and slower rising water levels.

Future Potential Impacts

Should development continue along the shoreline of Cayuga Lake, lake flooding impacts to developed property will increase. Climate change projections indicate that precipitation levels in the future will increase. Such significant increases in rain and runoff levels will more often raise the water level of the lake, inundating shoreline properties and low-lying areas adjacent to the main creeks within the County. Due to these predicted changes in climate, it can be inferred that more incidents of lake flooding will occur in the future. USGS data has also noted increases in extreme water flows in recent years. To accurately track fluctuations in lake flooding to assess future potential impact, existing USGS stream gages should continue to be supported (2 in Sixmile Creek, 1 in Fall Creek, 1 in Cayuga Lake Inlet). The installation of additional gages should also be considered, including in Salmon Creek and Owasco Inlet. Due to the multiple benefits of these gages, continued funding should be sought both with and without USGS support.

5.1.5 Severe Winter Storm and Ice Storm

General Hazard Description

Severe winter storms are denoted by the accumulation of 12” or more of snow in a 12-hour period.

Ice storms are characterized by freezing rain which accumulates in a substantial glaze layer of ice resulting in serious disruptions of normal transportation and possible downed power lines. An ice storm occurs when ¼” of ice build-up is observed.

Key Severe Winter Storm Findings for Tompkins County

- A severe winter storm occurs on average 3 times a year
- A severe ice storm occurs just once every 3 to 5 years.

Historical Hazard Occurrence

Severe winter storms are annually encountered within Tompkins County. The NWS reports that the County averages 3.3 annual severe winter storms that meet the definition outlined above. Records of severe winter storm events reported by the NCDC are included in Appendix A – Table 20.

Ice storms occur in the County once every 3 to 5 years. An ice storm in January 2003 left thousands of residents without power for several days. A similar event, resulting in up to 0.5 inches of ice, also occurred within Tompkins County in March 2008. According to the NWS, 8 ice storms, resulting in ¼- ½” of ice, have occurred in Tompkins County over the past 19 years.

Historical Cost and Damage Estimates

Severe winter storms result in little or no private property or public infrastructure damage. Ice storm events, or winter storms that have an ice component, can cause much more extensive damage, mostly to utility infrastructure, but moderate damage to private property has been documented. Actual damage costs can range from the thousands to millions, depending upon severity, duration, and nature of the event. Elderly and impoverished populations are typically more vulnerable during severe winter storm or ice storm events, especially if power failure results. For this reason, particular care is provided to these populations including the establishment of emergency and warming shelters during prolonged storm or power outage events.

Future Potential Impacts

Climate change is extremely likely to bring warmer temperatures to most of the state. Total annual precipitation is expected to increase, but mostly in the form of rain, or freezing rain, not snow. The build-up of significant amounts of snow events may be less likely to occur in the future due to the change in seasonal temperatures, however freezing rain and ice may be more frequent. In the short-term, severe winter storms, and ice storms to a lesser degree, will continue to be regular events within Tompkins County. Because of this frequency, the County must continue to provide reliable and well-tested system to keep the County functioning and the residents safe during such hazard events. The likelihood of ice storms in the future should be incorporated into planning for utility and infrastructure needs.

5.1.6 Ice Jams

General Hazard Description

An ice jam is described as a large accumulation of ice in rivers or streams that interrupts the normal flow of water and often leads to flooding conditions and/or damage to nearby structures. Ice jam events are often short-lived and often affect only a localized reach or area of a body of water (U.S. Army CRREL, 2004).

Key Ice Jam Findings for Tompkins County

- Since 1926, 24 ice jam events have occurred, most frequently on Fall Creek, in the City of Ithaca.
- The NWS reports that ice jam events occur twice every 10 years.
- All historic ice jam events have occurred between the months of December and March.

Historical Hazard Occurrence

The NWS reported during the County's 2012 risk assessment exercise that an ice jam has been documented within Tompkins County twice in 10 years. Occurrences of ice jams in the County are commonly associated with flash flooding events that mobilize the ice. The U.S. Army Corps of Engineers' (USACE) Ice Jam Database reports that 24 ice jams have been documented within the City of Ithaca since 1926, the date of the first hazard report. The City of Ithaca is the only Tompkins County location included in this database. The majority of the ice jam reports involve Fall Creek. USACE database records of ice jam events that have historically occurred in Tompkins County are included in Appendix A – Table 21.

Appendix A - Figure 5.10 depicts locations of frequent ice jam incidents within New York State. Fall Creek has the highest rate of ice jam frequency within Tompkins County; 21 reports of ice jam events are listed for this water resource between 1875 and 2007. Salmon Creek also has issues with ice jams that threaten a railroad trestle that is used daily.

Historical Cost and Damage Estimates

Of the 24 historic ice jam reports, only two mentioned potential damage to infrastructure and private property. Potential damage is associated with flooding caused by the ice jam and resulting water level increases. Minor flooding to basements results in minimal damage, estimated at \$1,000 - \$2,000 per affected property. Though no evidence of such major damage exists, a large ice jam event could cause severe damage to highway or railroad bridges that cross the main waterways in the County. The cost to repair a damaged bridge structure is estimated at \$500,000 - \$1,000,000.

Future Potential Impacts

Recent climate change research initiatives, such as ClimAID, reports that increases in air temperature will lead to increases in water temperature over the next handful of decades. Higher water and air temperatures will likely decrease the potential for thick ice to cover water resources within Tompkins County. Even if ice forms on the water surface, an increase in air and water temperatures would quicken the melting process, thus discouraging the build-up of large blocks of ice.

5.1.7 Landslides

General Hazard Description

Landslides are defined as the downward and outward movement of slope-forming materials reacting to the force of gravity. Slide materials may be composed of natural rock, soil, artificial fill, or combinations of these materials. Landslides are activated by storms, earthquakes, volcanic eruptions, fires, freezing/thawing, and steepening of slopes by erosion or human modification.

Key Landslide Findings for Tompkins County

- Ten Landslide events have occurred locally (1837-2007).
- Two locations of moderate landslide incidence are mapped within Tompkins County.

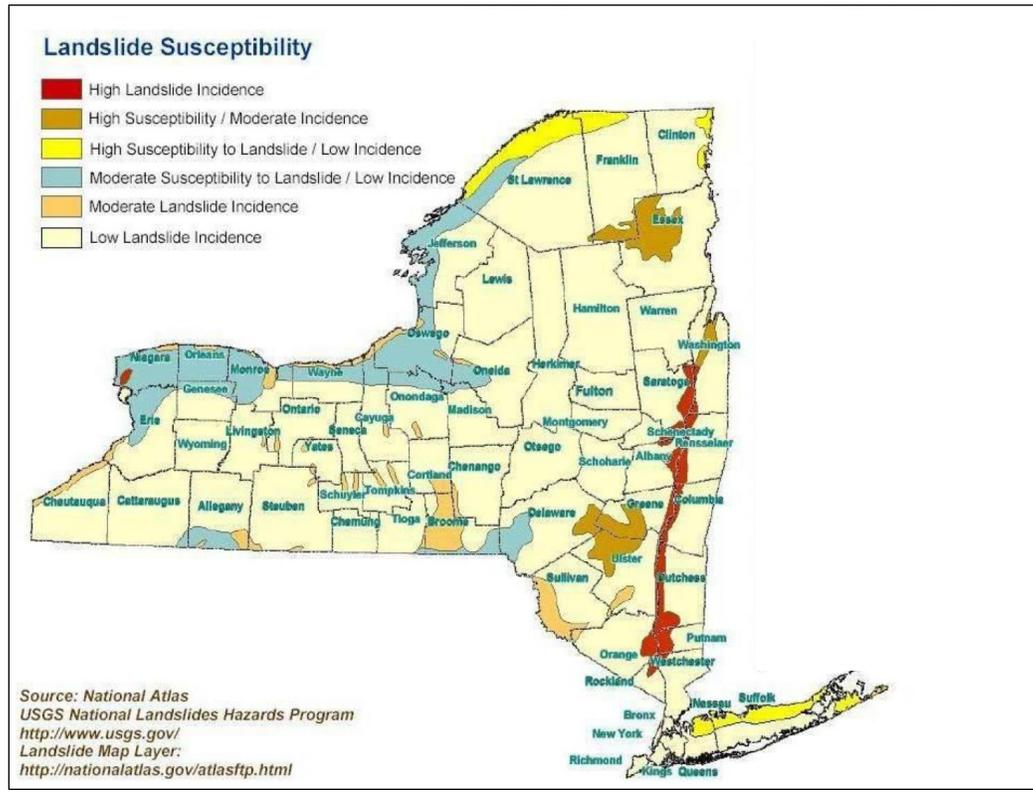
Historical Hazard Occurrence

Historically, landslide events within Tompkins County have been infrequent and are commonly triggered by heavy rainfall events. Multiple occurrences have been noted within the County in recent years, though these events are primarily confined to localized areas adjacent to steep slopes or waterways. Figure 5.11 shows that two locations of moderate landslide incidence are mapped within Tompkins County, while the majority of the County is identified as a low incidence area. The two moderate incidence locations correspond to lands surrounding Cayuga Lake, and lands located within the Pleasant Valley area, extending to the Village of Dryden. According to the data associated with this figure, 8.93 percent of the land area within Tompkins County is represented by the two locations of moderate incidence. According to USGS information included in the State Hazard Mitigation Plan, 10 landslide events have occurred in Tompkins County between 1837 and 2007 (USGS Open File Report 94-615). The County's most active landslide is in the Town of Ulysses on South Street Extension abutting Taughannock Creek. Small scale landslide activity among the region's many gorges has caused adverse impacts to human safety and recreation.

Historical Cost and Damage Estimates

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 the potential to result in infrastructure damage to the pipeline, but also to cause interruptions in water service to many households in the City. Even a short-term service interruption could cost an estimated \$100,000 to repair and cost affected households the inconvenience and additional cost associated with finding a secondary water source (i.e. family member's house, bottled water, etc.). This situation is hypothetical; no damage numbers are available for documented landslide events that have occurred within Tompkins County. Significant costs have additionally been incurred over the years to safely maintain the network of gorge trail infrastructure.

Figure 5.11 – Landslide Susceptibility within New York State
 (USGS, NYS Hazard Mitigation Plan, 2011)



Future Potential Impacts

The majority of landslide incidents within Tompkins County are spurred by heavy rainfall events. These heavy rainfall events are expected to increase in the future, mostly in areas that have historically documented bank failures or slope subsidence. Annual average precipitation in NYS is projected to increase by 5 to 10 percent by 2080 (ClimAID, 2012). With this the frequency of landslides to occur in the County will likely increase. In addition, climate models also project that the frequency of heavy rainfall events will increase. These predicted changes in weather patterns are likely to result in an increase in the frequency of landslides, potentially with greater levels of property damage.

5.1.8 Drought

General Hazard Description

A drought is defined as a prolonged period of limited precipitation affecting the supply and quality of water. An absolute drought consists of a period of at least 15 consecutive days where none of the days experience 0.01 inches of rain or greater. A partial drought is a period of at least 20 consecutive days where the mean daily rainfall does not exceed 0.01 inches. A dry spell consists of a period of at least 15 consecutive days where none of the days experience 0.04 inches or more of rainfall (USGS, 2009). Agricultural drought relates to agricultural impacts that occur as a result of various meteorological characteristics, such as precipitation shortages and

soil water deficits. Hydrological drought relates to the effects that a lack or decrease in precipitation has on surface or subsurface water supplies.

Key Drought Findings for Tompkins County

- Tompkins County's agricultural sector is that which is most vulnerable to drought.
- A 2005 drought event resulted in significant sugar maple die off.

Historical Hazard Occurrence

Periods of drought have had limited and localized impacts in Tompkins County. The largest vulnerability that the County has related to this hazard is its strong agricultural industry. Tompkins County agriculture was responsible for \$60 million in revenue in 2011. A drought event occurred in 2005, resulting in significant sugar maple die-off around the County. That summer is reportedly the driest over the last 130 years. September 1999 was also a recorded dry month that caused major crop failures and some wells to run dry within Central New York. Corn and hay crops were most severely impacted.

Historical Cost and Damage Estimates

Aquifer recharge could potentially be affected by absolute or partial drought events. This may result in impacts to drinking water supplies, since stream fed water systems are affected by groundwater fluctuations. The agriculture industry would experience crop damage and plant fatality as a result of a prolonged drought event. Many farms in the County do not have local irrigation systems, so a lack of water would reduce crop production and survival. Drought conditions also have the potential to impact livestock producers, through effects such as reduced milk production, decreased stock weights, and high cost for feed. Damages from the 1999 drought event were reported to be as high as \$17.7 million in Cayuga County. Specific damage amounts were not available for Tompkins County, but are estimated to have ranged around \$1 million. Over \$60 million in agricultural products are produced annually by Tompkins County farms. Those agencies who assist with agricultural practices will continue to play a key role in mitigating impacts related to drought on farms.

Future Potential Impacts

The frequency and extent of drought conditions are expected to rise in the future due to climate change. Summer drought is projected to affect water supply, agriculture, ecosystems and energy production.

5.1.9 Infestation

General Hazard Description

Infestation is defined as an excessive population of insects, plants, rodents, or other animals requiring control measures due to their potential to carry diseases, destroy crops, or harm the environment.

Key Infestation Findings for Tompkins County

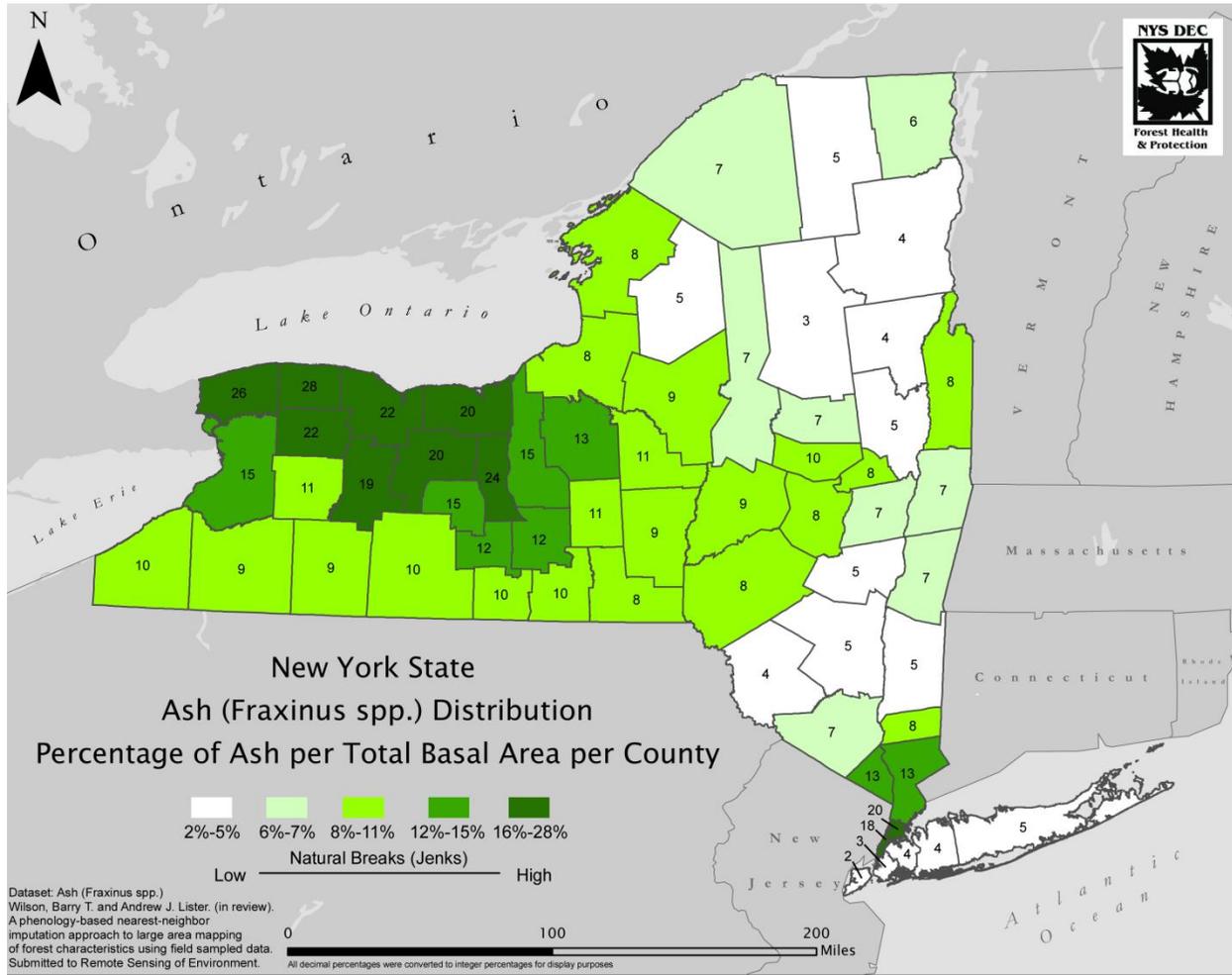
- An increase in property, road and infrastructure damages is anticipated with Emerald Ash Borer.
- Research has indicated that the prevention and eradication of Hydrilla is far cheaper than containment or management.

Historical Hazard Occurrence

Plant populations: Hydrilla is a highly invasive aquatic plant that was first detected in August 2011 in the Linderman Creek area of Cayuga Inlet. Hydrilla is a very aggressive growing plant, which can grow up to a foot a day and can grow underwater of lengths up to 25 feet. It creates a thick mat of vegetation when it grows to the water surface. This mat shades out other plants and clogs waterways in a fashion that has the potential to increase lake flooding. This plant has most immediate impacts to the City of Ithaca, but has far reaching regional impacts. Since discovering Hydrilla in the Cayuga Inlet, extensive efforts have been undertaken to limit the spread of this species into Cayuga Lake.

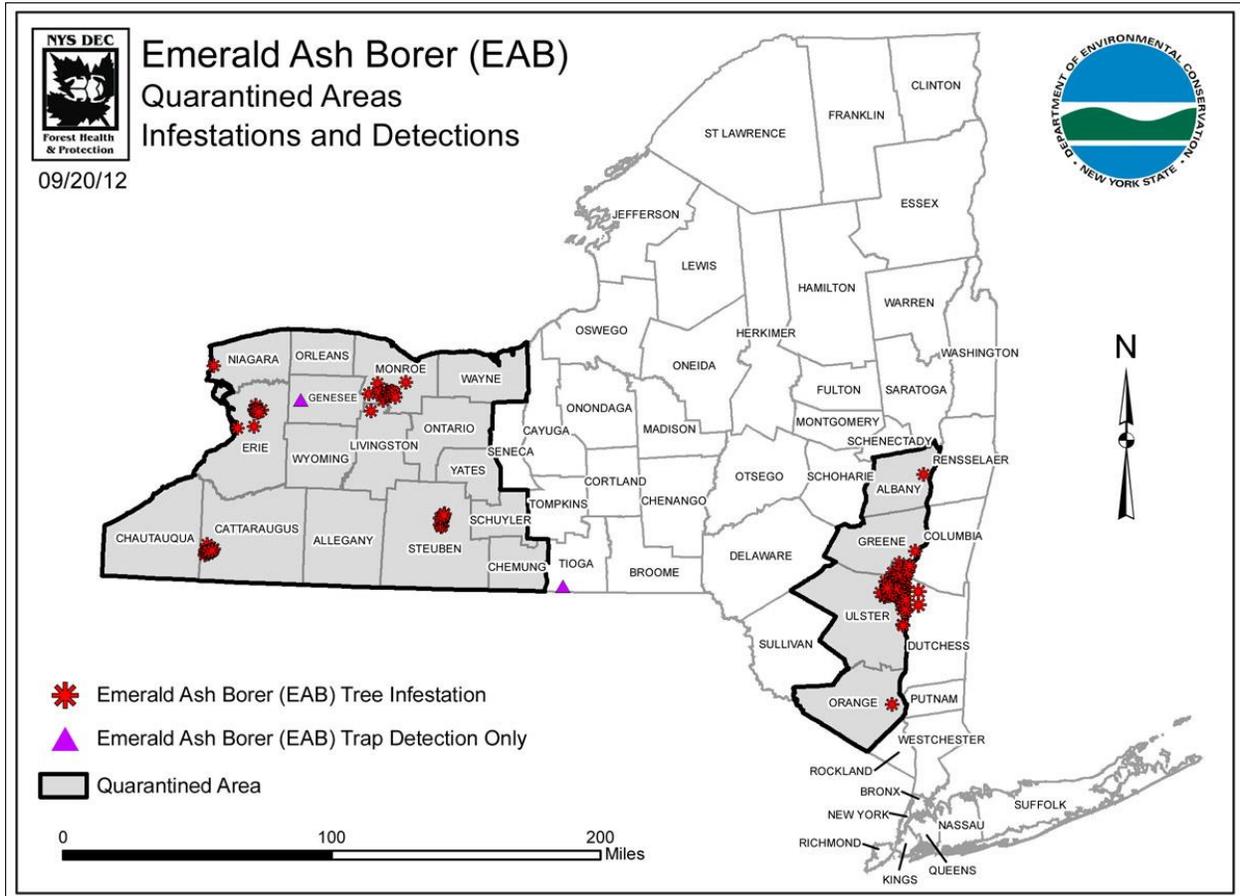
Insect populations: A detailed history of infestation events is not available for Tompkins County; however recent events and concerns have been documented. For one, the emerald ash borer (EAB) is an insect of increasing concern within NYS. This species was first confirmed in NYS on June 17, 2009, but research indicates that it has been present in some areas since the mid 1990s. Tompkins County susceptibility to this species isn't fully documented since the number of ash trees within the area has never been quantified and the areas of greatest ash density are not known. However, U.S. Forest Service (USFS) data estimates that 12 percent of the total tree volume in Tompkins County is ash (Figure 5.12). An accurate inventory of trees in priority, high-traffic areas needs to be completed so that liabilities can be calculated.

Figure 5.12 – Percentage of Ash per Total Basal per County in New York State
 (NYSDEC Forest Health and Protection, 2012)



Based on guidance from the Technical Committee, an EAB infestation can influence a community for 10-20 years after it first descends upon an area. Figure 5.13 shows the currently documented infestation locations of EAB within NYS. As shown, the closest identified infestation is in the Town of Nichols, Tioga County; Tompkins County is located just 16 miles north of this infestation location.

Figure 5.13 – Emerald Ash Borer Infestation, Detection, and Quarantine Locations within New York State
 (NYSDEC, Forest Health and Protection, 2012)



Other invasive insect pests that are documented within NYS and have the potential to impact Tompkins County include hemlock woolly adelgid (HWA) and Asian longhorn beetle (ALB). Asian long-horned beetles weaken the integrity of infected trees, which results in decreased wood quality, structural weakness, and eventual death for the tree. ALB populations attack a variety of tree species representing 15 different plant families. Appendix A - Figure 5.14 depicts locations within the Country that are susceptible to ALB infestations. Hemlock woolly adelgid poses a major threat to eastern hemlock trees, a species which is not overly abundant in Tompkins County. Regardless, changes to ecosystem structure and function could occur in riparian areas and moist sites where hemlocks thrive. It should be noted that significant tree loss will have an aesthetic impact on the County’s many natural areas which may have an impact on the region’s tourism industry. Additional insect populations that aren’t a problem right now when the forests are healthy could become a problem once the forestlands are weakened by an invasive pest.

Historical Cost and Damage Estimates

Plant populations: Ecological and economic impacts of Hydrilla are significant. This includes shading of native plants, oxygen deficits, fish kills, habitat quality change, cyanobacteria outbreaks and toxin production linkage with bald eagle. Due to the wide use of Cayuga Lake, economic impacts to tourism, fishing, swimming, and property values have the potential to be significant. The waterways affect the local economy in three primary ways; through flood protection, property tax revenues and tourism spending, particularly spending associated with recreational boating and water-dependent businesses. Property values in the waterfront are high; although nearly 97% of waterfront properties are tax exempt, annual tax revenues from the remaining 3% is over \$2 million. Finally, water-dependent businesses generated over \$2 million in sales (nearly \$700,000 of which came from docking fees) in 2008. Revenues from facilities specializing in non-motorized boats are not included. The Inlet has four primary facilities catering to non-motorized boaters: Cornell University and Ithaca College Crew facilities, a business that rents and sells canoes and kayaks, and the Cascadilla Boat Club with approximately 175 members with annual membership and training fees of \$60,000 (CCETC, 2012).

Based on the experience in Tompkins County the cost of maintenance associated with Hydrilla is substantial. The local Hydrilla Task Force elected to utilize herbicide treatments of endothall and fluridone to attempt to eradicate Hydrilla. An endothall treatment was applied on June, 26, 2012 and was deemed a success. A fluridone treatment was applied to the Cayuga Inlet area, including Cascadilla Creek and Six Mile Creek, starting July 12, 2012 and ending October 31, 2012. The funding for this effort was received from the New York State Department of Environmental Conservation in the amount of \$800,000. Appendix A – Figure 5.15 shows the specific locations where the fluridone treatment was applied. Currently, the effectiveness of this treatment is being analyzed; additional eradication efforts will likely be needed. Significant staff time of local officials from the City of Ithaca, Cornell University, Tompkins County, Tompkins County Soil and Water District and others have been used in this effort. The effort and funds expended to-date are significant. Not including in-kind contributions, approximately \$130,000 was spent in 2011 and \$460,000 in 2012. The estimate for eradication efforts in future years is approximately \$500,000 per year. Eradication of this species from the waterways of Tompkins County represents a realistic scenario that could occur at any time in association with additional invasive plant species.

Insect populations: EAB damage will very likely result in the death of all untreated ash trees within the County. Infested trees begin to fall in large sections soon after dying, causing a significant potential threat to health, property, and public infrastructure. An increase in property and road maintenance costs would likely occur and an increase in overhead utility service repair requests. Falling ash debris also has the potential to accumulate in waterways and clog culvert locations. Management efforts for the EAB and hemlock woolly adelgid often consist of insecticide treatments and removal of infested trees. Such efforts will prove to be costly, when they are needed in the future. Wood-boring pests in the U.S. cause an estimated \$3.5 billion in damage annually. When infestations are confirmed, state and national funding may be made available to the affected areas to help with the pest management and hazard mitigation. Such funds in other infested areas have ranged from \$20 million to \$65 million.

Future Potential Impacts

Given the steady increase of documented invasive species in the country, reports of new invasive populations within the County are expected to continue. A 2011 study indicated that there is over a 30 percent chance that another damaging wood boring insect will be introduced into the U.S. within the next 10 years. Local government coordination with local property owners and utility providers will be critical in mitigating risks associated with tree fall and debris management. Current climate change projections indicate that long-term temperature increases and other weather changes are likely to create a more satisfactory environment for the establishment and survival of invasive populations. According to climate changes forecasts such as ClimAID, the Southern Tier of New York State, including Tompkins County, will likely be the first area of the state to be affected by invasive plant and animal species.

5.1.10 Extreme Temperatures

General Hazard Description

An extreme temperature event was determined to occur if an event lasted for at least 3 days with a temperature colder than -10 degrees Fahrenheit (cold wave) or hotter than 95 degrees Fahrenheit (heat wave). This hazard is defined by extended periods of excessive cold or hot weather with a serious impact on human and/or animal populations, particularly elderly and/or persons with respiratory ailments. People living in urban environments may be at greater risk from the effects of prolonged heat wave than those living in rural areas due to the “urban heat island effect.” Exposure to extreme temperatures for prolonged periods of time can result in death.

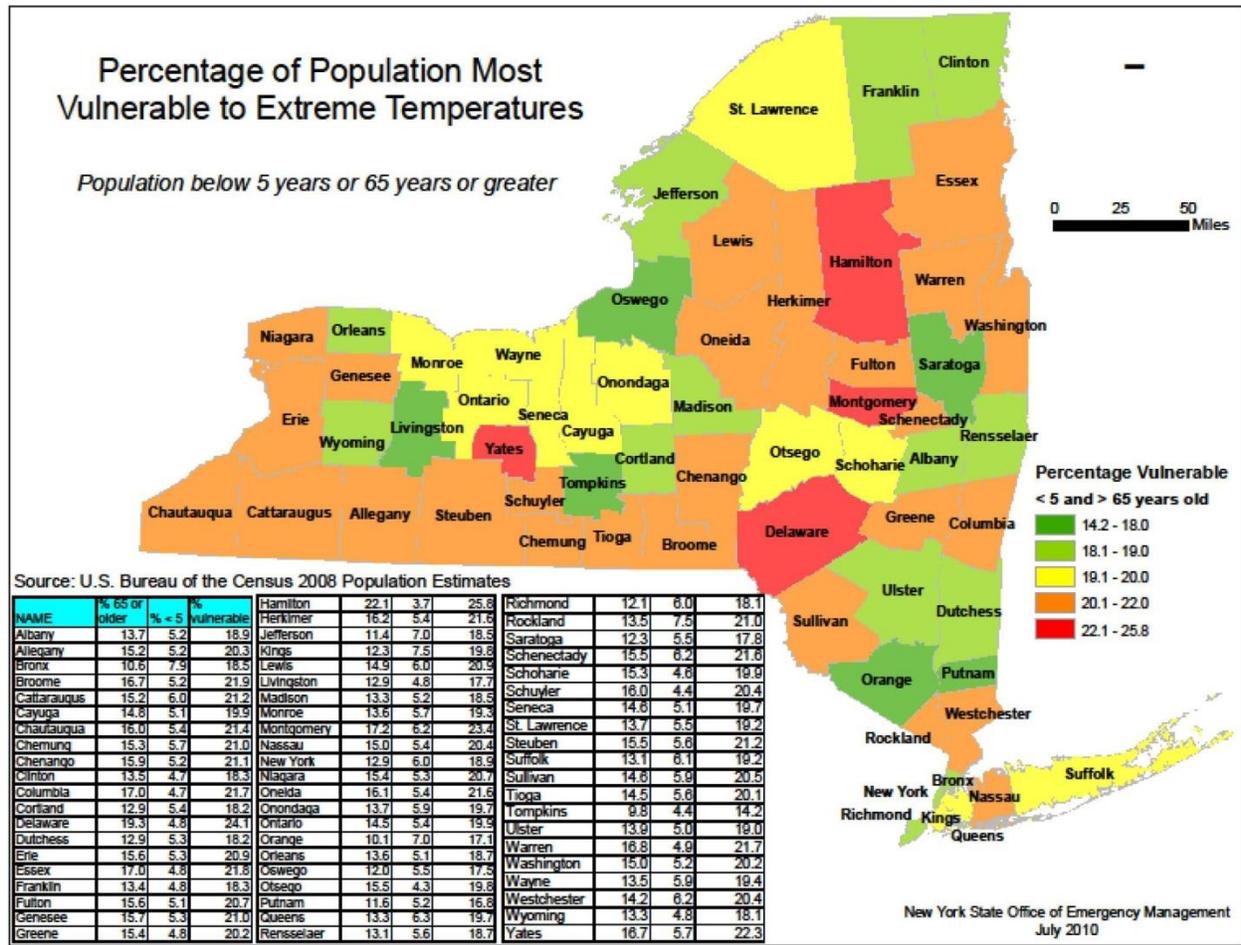
Key Extreme Temperature Findings for Tompkins County

- 45 extreme cold events have occurred over the past 29 years.
- Just 2 Extreme heat events (3 consecutive days with temperatures of 100 degrees Fahrenheit (standard for extreme heat events)) have occurred over the past 29 years.

Historical Hazard Occurrence

According to the NWS, 45 cold events have occurred in Tompkins County over the past 29 years and 2 heat events have occurred in the County over the same time period that have exceeded 100 degrees Fahrenheit for three or more consecutive days. Figure 5.16 depicts the NYS Counties with the highest and lowest rates of vulnerable populations (aged < 5 and > 65 years). Tompkins County exhibits a vulnerable population of 14.2 percent of the total County residents. This number further breaks down to 9.8 percent aged 65 and older and 4.4 percent aged less than 5 years.

Figure 5.16 – Percent of Populations Most Vulnerable to Extreme Temperature Events
(NYS Hazard Mitigation Plan, 2011)



Historical Cost and Damage Estimates

Most concern related to extreme heat events occur when people or animals are overexposed to heat and have over-exercised for their age and/or physical condition. Older adults, young children, and those who are sick or overweight are more likely to experience the adverse effects of extreme heat. Similarly, cold events have a greater potential to affect elderly populations. Historically, Tompkins County has opened cooling centers at Cornell University and elsewhere to provide heat relief to the public, especially vulnerable populations.

Future Potential Impacts

NYSERDA’s ClimAID report states that temperatures will continue to rise over the next several decades, indicating that extreme heat events would increase in frequency and duration. Because of this warming, extreme cold events are not likely to increase in duration and frequency.

5.1.11 Epidemic

General Hazard Description

An epidemic is the occurrence or outbreak of disease to an unusual number of individuals or proportion of the population, human or animal.

Key Epidemic Findings for Tompkins County

- Tompkins County is considered to be notably vulnerable to this hazard because of its significant number of international student populations.
- The County's active role in the H1N1 virus preparations (2009) has provided a framework for epidemic risk reduction.

Historical Hazard Occurrence

There is no extensive record of historic epidemic events within Tompkins County. However, because of the diverse global representation found on the Cornell University and Ithaca College campuses, the County is notably vulnerable to human outbreaks of disease. Recent epidemic events that have been previously documented in Tompkins County include avian flu (2003), influenza A (H1N1) (2009), and severe acute respiratory syndrome (SARS). Agricultural epidemics are also an important component of this hazard in Tompkins County. Historic epidemics that have affected the agricultural community include leucosis, Marek's disease, as well as foot and mouth disease.

Historical Cost and Damage Estimates

A large-scale epidemic event could affect large numbers of people and has the potential to result in mass care and/or mass casualties. Initiatives to quarantine and/or vaccinate residents to prevent the spread of a particular disease would be an expensive, but needed, effort. Because historic records of previous epidemic events are not available, it is difficult to estimate that total damages that could occur from a widespread event. Because the majority of the County's economy relies on agriculture and farming, an increase in agricultural epidemics would also be costly to the area.

Future Potential Impacts

Global trends indicate that pandemics occur in predictable cycles. The last mass pandemic was the 1912 Spanish Flu; experts suggest that the next cycle is approaching and that jurisdictions should begin preparing for this future occurrence. Because diseases are dynamic, it is difficult to predict what types may appear in the future and what the most effective way is to combat these potential events. Agricultural epidemics should also continue to be addressed through both mitigation and response plans. Climate change may increase the likelihood of epidemics due to increased floodwaters contaminating drinking water supplies and increasing temperatures allowing more disease-causing agents and vector-borne diseases to flourish. One of the future goals of Tompkins County, related to epidemic events, is to build partnerships with other agencies and groups to prepare for such events.

5.1.12 Tornado

General Hazard Description

Tornadoes are described as local atmospheric storms, generally of short duration, formed by winds rotating at very high speeds. The vortex of the tornado can be up to several hundred yards wide and is visible to the observer as a whirlpool-like column of winds rotating about a hollow cavity or funnel. Tornado winds have been estimated to be as high as 400 miles per hour. During the County's 2012 risk assessment discussion, it was determined that a credible worst-case scenario for a tornado event is a F2 or F3 magnitude. Tornadoes of these magnitudes commonly exhibit 3-second wind gusts between 110 and 209 mph (Appendix A – Table 22).

Key Tornado Findings for Tompkins County

- Five historic tornado events have been documented for Tompkins County between 1952 and 2009 (57 years).
- The most recent tornado event to impact the County occurred in April 2011 in the Town of Danby.

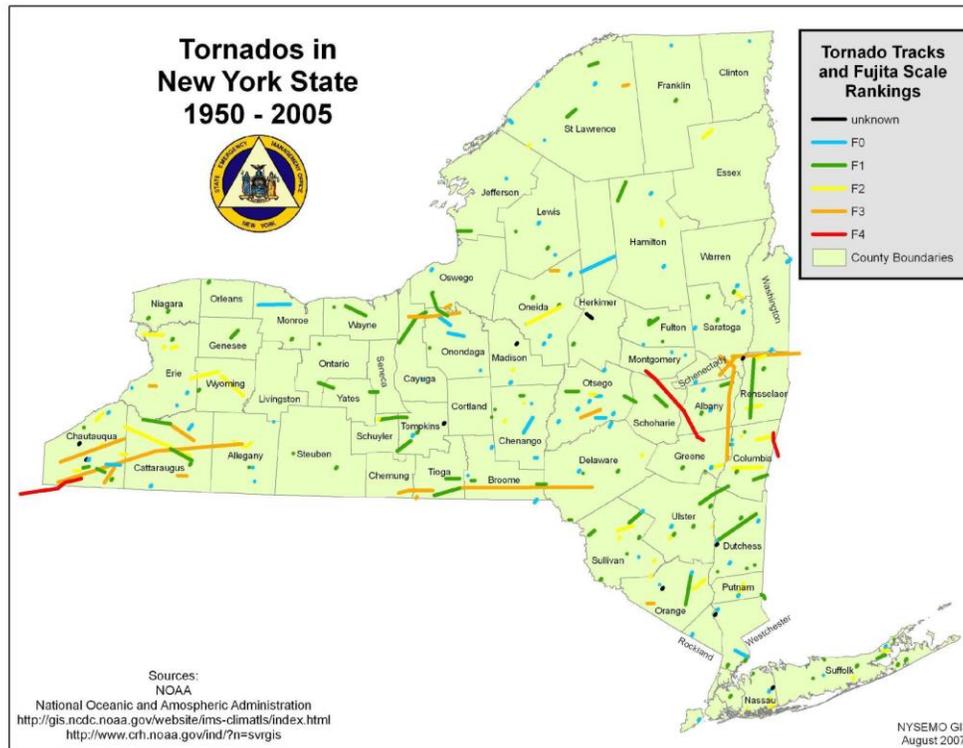
Historical Hazard Occurrence

As indicated by Appendix A - Figure 5.17, Tompkins County is mapped in a light yellow shaded area, denoting that between one and five F3, F4, or F5 tornadoes have occurred within the County for every 3,700 square miles. Appendix A – Figure 5.18 shows that Tompkins County, and the majority of NYS, is not mapped within a high risk area for tornado events.

The State Hazard Mitigation Plan includes five records of tornadoes that occurred in Tompkins County between 1952 and 2009; details of these hazard events are included in Table 23. Tracks of these tornadoes are depicted on Figure 5.19. Anecdotal information indicates that a minor tornado event occurred in Ulysses in the early 1990s, damaging a residence. The most recent tornado recorded for Tompkins County, and the event reported by the NCDC, occurred on April 28, 2011, in the Town of Danby and the Town of Ithaca. The path of this tornado stretched from the northern boundary of the Town of Danby and Route 96B, southwest, to the Town of Ithaca's western boundary. This event resulted in significant tree damage along this hazard route.

Date	Location	Magnitude	Details
08/25/1961	Tompkins Co	F0	\$25,000 in property damage
06/20/1969	Tompkins Co	F1	\$25,000 in property damage
06/18/1977	Tompkins Co	Undetermined	\$3,000 in property damage
08/28/1988	Tompkins Co	F1	\$250,000 in property damage
8/21/1994	Dryden	F0	\$500,000 in property damage

Figure 5.19 – Tornado Tracks within New York State, 1950-2005
(NYS Hazard Mitigation Plan, 2011)



Historical Cost and Damage Estimates

It is difficult to accurately estimate potential damage levels associated with this hazard in Tompkins County because of the limited historic occurrence of tornados in this area. Hundreds of millions of dollars' worth of damages would likely occur if a tornado tracked through the center of the City of Ithaca, while much smaller damage levels can be assumed for tornados in more rural portions of the County. According to the loss estimates reported from the NYS Hazard Mitigation Plan for this hazard, damages have historically ranged between \$3,000 and \$500,000 within Tompkins County. It is estimated that \$627,200 in (public or private) property damage resulted from the 2011 tornado that touched down in the Town of Danby. Therefore, it is reasonable to estimate that an F2 or F3 tornado event would result in over \$1 million in damages within the County.

Future Potential Impacts

Recent climate change projections predict an increase in severe weather events. Such events could include tornado occurrences. The frequency of this hazard occurring in Tompkins County will continue to remain low, despite these severe weather projections. The National Weather Service does have active advisory processes in place to warn residents of potential tornado threats. Pre-disaster warnings such as this will help to minimize the potential damage that could occur within the County as a result of a tornado event. Such warnings are anticipated to at least limit the amount of potential deaths and injuries associated with a tornado event. Impacts could

occur anywhere in the County and affect a wide range of existing infrastructure and properties. The exact path and touchdown locations of a tornado are often difficult to predict.

5.2 Technological and Human-caused Hazard Profiles

Details associated with the eight technological and human-caused hazards profiles in this section were obtained using Geographic Information System (GIS) layers, technical and project committee knowledge, Tompkins County records, NYS OEM and FEMA data and information, and other resources, as appropriate.

5.2.1 Transportation Accident

General Hazard Description

A transportation accident is defined as a mishap involving one or more conveyances on land, sea, and/or in the air, which can result in multiple casualties and/or substantial loss of property.

Key Transportation Accident Findings for Tompkins County

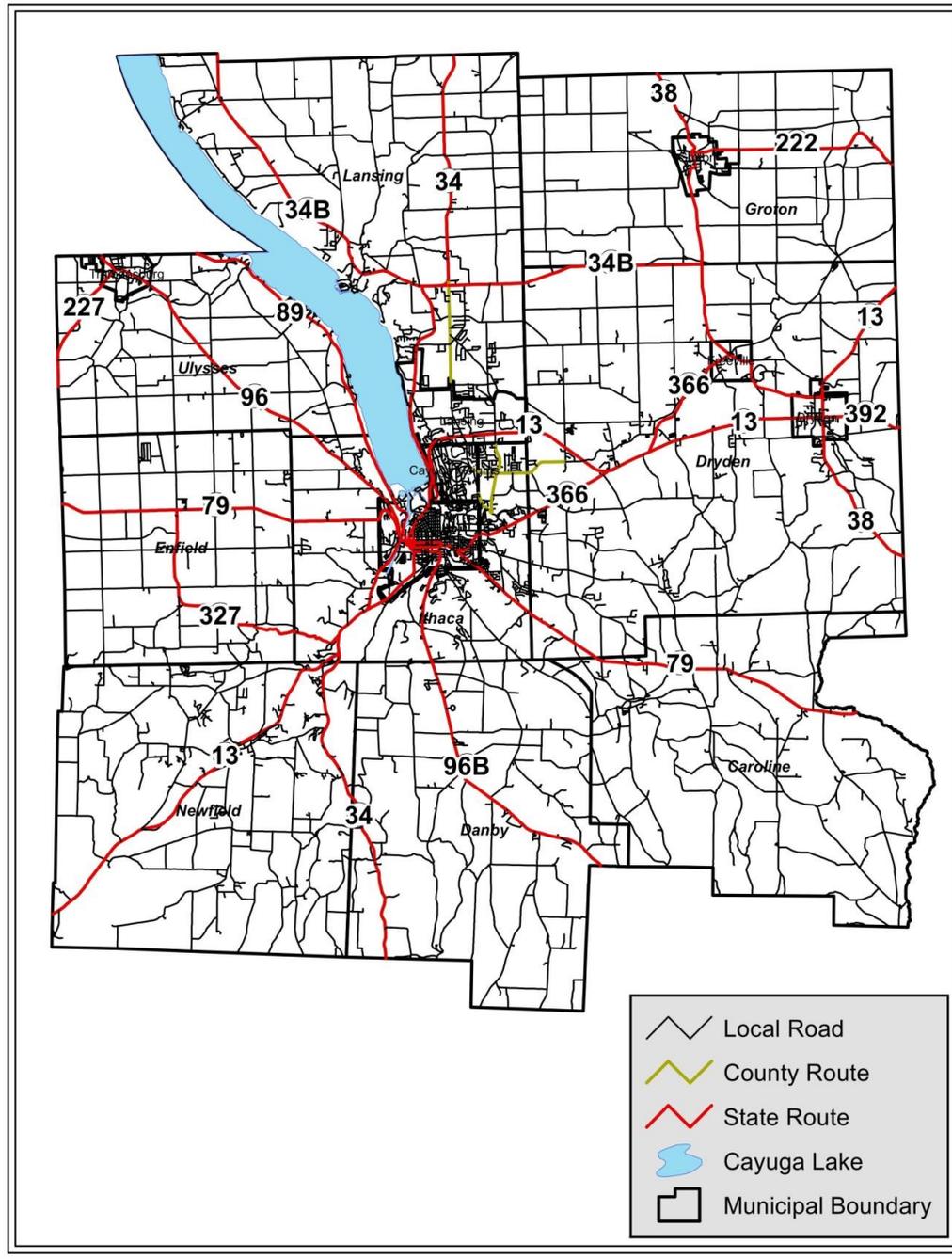
- Approximately 2,500 transportation accidents occur in Tompkins County each year. In 2010, 11 accidents resulted in fatalities, which is slightly above average.
- The City of Ithaca has the highest crash rate within the County, but the lowest deer collision rate.

Historical Hazard Occurrence

Transportation accidents are unpredictable, both in time, location, and frequency. On average, there are less than 10 accidents a year in Tompkins County that result in fatalities (NYSDMV, 2000). The highest accident rates and most severe accidents occur on the State Routes (SR) located within the County. These State Routes total approximately 176.3 miles in length and include the following route numbers: 13, 13A, 222, 227, 327, 34, 34B, 366, 38, 392, 79, 89, 930F, 96, and 96B. The prevalence of accidents along these routes is likely attributed to higher posted speed limits and a greater volume of traffic. Figure 5.20 shows the locations of State Routes within Tompkins County.

Accident information and data for Tompkins County was obtained from the Ithaca-Tompkins County Transportation Council (ITCTC). ITCTC created maps using the NYS Department of Transportation's Accident Location Information System (ALIS) 200-2009 data. The highest crash rate within the County was reported for the City of Ithaca. Numerous roads within the City report having between 9 and 15, or > 15, accidents per million vehicle miles. The severity of accident data looks at the amount of fatalities and injuries per reported accident (severity index). The severity index shows the occurrence of severe accidents throughout all portions of the County, though six roads in particular have a rating >15: Shaffer Road (Town of Newfield), Bostwick Road (Town of Ithaca), Fall Creek Road and West Dryden Road (Town of Dryden), and Ridge Road (SR 34B) and Auburn Road (SR 34) (Town of Lansing). Accident data involving pedestrians and bicyclists were also reviewed. The City of Ithaca had the highest rate of accidents involving a pedestrian or a bicyclist.

Figure 5.20 – State Route Transportation Network in Tompkins County
(NYS DOT, ALIS, 2004)



A healthy deer population in Tompkins County is also a variable linked to transportation accidents. The City of Ithaca has the lowest deer collision rate in the County. In contrast, there are 13 roads in the County where > 25 % of all accidents that occur involve deer collisions: Bundy Road (Town of Ithaca), Ellis Hollow Road (Towns of Ithaca and Dryden), Bostwick Road and Trumbulls Corners Road (Town of Enfield), Perry City Road (Town of Ulysses), Ridge Road and North Triphammer Road (Town of Lansing), Asbury Road and Scofield Road (Towns

of Lansing and Dryden), West Dryden Road (Town of Dryden), and Sovocool Hill Road, Spring Street Extension, and Cobb Street (Town of Groton).

No records of accidents involving other modes of transportation were available or located. During the County's risk assessment, it was estimated that a bus accident occurs about once per year and that runaway truck accidents occur approximately once every other year.

Historical Cost and Damage Estimates

Often times, the damages involved in accidents, particularly vehicular, are the responsibility of the drivers involved. When damage to public infrastructure occurs, the local jurisdictions may be responsible to make repairs. A high frequency of transportation accidents occurs within Tompkins County, but the majority does not result in loss of life or damage to property. According to the New York Department of Transportation's Accident Location Information System (ALIS), the City of Ithaca does historically have the highest number of accidents (1,375 in 2010) though only a small percentage of those accidents result in fatalities (1 in 2010, or 0.1%). Fewer accidents occur in the surrounding rural areas, however of those accidents a higher percentage are fatal. For example, in 2010 the Town of Enfield was noted as having 95 accidents, 20 of which (21.1%) resulted in injuries. Of these 2 (2.1%) resulted in fatalities.

Future Potential Impacts

Transportation accidents, particularly vehicular, will continue to occur within Tompkins County and will be difficult to predict. With the potential of future shale gas drilling, truck traffic is anticipated to increase throughout the region. The New York State Department of Environmental Conservation's Supplemental Generic Environmental Impact Statement (SGEIS) for High-Volume Hydraulic Fracturing notes that truck traffic associated with this practice is two to three times higher than traditional vertical well drilling. This increase is largely due to the need for heavy truck water delivery. The SGEIS notes that a single well may produce nearly 6,000 truck trips. Regional truck traffic would likely increase even if no wells are drilled in Tompkins County. Local roads and minor collectors would likely experience the most level of congestion and potentially accidents. The SGEIS indicates, "An increase in the amount of truck traffic, and vehicular traffic in general, traveling on both higher and lower level local roads would most likely increase the number of accidents and breakdowns in areas experiencing well development" (NYSDEC, 2011).

5.2.2 Fuel Shortage

General Hazard Description

A fuel shortage is defined as a situation in which the normal quantity and/or timely delivery of fuel supplies to distributors and retail establishments are interrupted. As part of this document, the definition was further expanded to assume that a fuel shortage event would occur County-wide.

Key Fuel Shortage Findings for Tompkins County

- Fuel shortage events are limited to the 1973 oil crisis and the 1979 energy crisis.

- The growth of alternative fuels and green living helps to reduce dependence on fuel.

Historical Hazard Occurrence

Two documented occurrences of fuel shortages have historically affected Tompkins County. The 1973 oil crisis resulted in gas rationing across the country, while the 1979 energy crisis caused widespread panic and odd-even gas rationing in NYS.

Historical Cost and Damage Estimates

No cost figures were available to determine how much it cost the County or State to implement and oversee gas rationing during the 1973 or 1979 events. No other fuel shortage events have been recorded in the County, so damage estimates are not available.

Future Potential Impacts

World politics and natural hazards are hard to predict, especially in the long-term, so it is difficult to know when a world event may occur that would threaten the U.S.' supply and acquisition of fuel. Regardless, as economic growth continues to trend toward alternative fuels and alternative transportation options, the demand for fuel may decrease. If this decline is achieved, it is likely to be slow, as alternative fuel use is still in its infancy in the County.

5.2.3 Fire (Urban)

General Hazard Description

Fire is defined as the uncontrolled burning in residential, commercial, industrial, institutional, or other structures in developed areas. It is important to note that fire spreads quickly. Heat and smoke from fire can be more dangerous than the flames themselves. Fire produces poisonous gases that make a person disoriented and drowsy. Asphyxiation is the leading cause of fire deaths. For the purposes of this document, a fire is defined as a block or neighborhood scale event.

Key Urban Fire Findings for Tompkins County

- Fire is defined as a block or neighborhood scale event.
- As storm severity increases, the potential for fire to occur also increases.

Historical Hazard Occurrence

There is no historical evidence of fire events affecting Tompkins County. Numerous smaller scale fires that have been isolated to one or two buildings or properties have occurred in the past; a handful of such events occur within the County annually.

Historical Cost and Damage Estimates

Given that no urban fire events that match the hazard definition have occurred in Tompkins County, damage estimates from such an event were not available. According to the TCPD, the City of Ithaca has the highest full market assessed property value, totaling \$17,701,001,320. The City is home to 5,555 properties. A hypothetical scenario may consist of a block fire in the City that impacts 5 houses at 80% of their total value. This hazard event scenario would result in approximately \$12,745,995 in total damages.

Future Potential Impacts

This hazard received a moderately low ranking due to its infrequent occurrence within the County. As storm events increase in severity and frequency over the coming decades, as is predicted by climate change research, the potential for fire to occur as a cascading hazard increases.

5.2.4 Utility Failure

General Hazard Description

Utility failure includes the loss of electric power supply, telephone service, or public water supply as a result of an internal system failure or by the effects of a natural disaster. A widespread electrical power outage could cause traffic accidents, civil unrest, and failures to other utility infrastructure that relies on electricity.

Key Utility Failure Findings for Tompkins County

- Utility failure impacts every jurisdiction at least once a year.
- The severity and frequency of utility failures are anticipated to increase in the future, as storm occurrence and severity increases.

Historical Hazard Occurrence

For many of the natural disasters previously profiled, utility failure was identified as a cascading hazard, meaning it results from another hazard. The frequency of a power failure is approximately once a year in each jurisdiction, with typical duration of less than a single day (less than 24 hours). Historical documented utility failures in Tompkins County include:

- 2000 – Town of Dryden
- August 2003 – Northeast blackout – power restored by next day
- May 2004 – Town of Dryden – electricity
- June 2005 – Town of Dryden – power restored same day
- May 2012 – Village and Town of Dryden

The most significant regional event listed was the 2003 blackout. Power was restored by the following day; however, thousands of people were impacted. This power outage event was declared a Presidential Disaster, authorizing up to \$5 million in federal funding to reimburse local and state governments that were negatively impacted.

Historical Cost and Damage Estimates

Although accurate figures were not found to assess the cost of power outages, the disruption of services, spoiling of food, and loss of work production could range from the hundreds of thousands to millions of dollars. Since utility failures rarely occur by themselves, and not as a result of another hazard, specific data within Tompkins County is limited. A previous concern revolved around the water treatment plants in the County in the event of a power failure. This is less of a concern given that many of the plants are now installing full size generators in preparation for such occurrences. Residents with private wells would however lose potable water supply during a power failure.

Future Potential Impacts

NYSERDA's climate change research points to an increased severity and frequency of extreme weather events. Extreme weather events and utility failure go hand in hand; therefore, an increase in the severity and frequency of utility failures is presumed.

5.2.5 Water Supply Contamination

General Hazard Description

Water supply contamination is defined as the contamination, or potential contamination, of surface or subsurface public water supply by chemical or biological materials that results in restricted or diminished ability to use the water source. Though single property events will be discussed, this hazard was determined to occur if it affected a large region; the effects were reviewed from a population standpoint and not based on affected geographic area.

Key Water Supply Contamination Findings for Tompkins County

- Water supply contamination concerns are estimated to occur once or twice every 10 years.
- Isolated contamination events are estimated to cause approximately \$25,000 in damages, while a larger scale event could result in millions of dollars in damages.

Historical Hazard Occurrence

Approximately fifty (50) percent of the County's population receives public water; the remaining households are on private well systems. During droughts and dry seasons, some well residents have experienced inadequate water supplies. These wells are susceptible to contamination from spills, herbicide and pesticide run-off, and leaking underground storage tanks. County residents that receive public water are largely supplied by one of three water treatment plants (WTP): Cornell WTP (withdraws from Fall Creek), City of Ithaca WTP (withdraws from Six Mile

Creek), and Bolton Point WTP (withdraws from Cayuga Lake). Other “village systems” serve the Villages of Dryden, Groton and Trumansburg as well as the Hamlet of Newfield.

Documented events of water supply contamination that have occurred in Tompkins County include:

- MTBE and gasoline contamination in the Village of Groton as a result of a Smith Corona spill, which has now been remediated.
- The Town of Newfield’s Shelter Valley Water System has received multiple “do not drink” orders from the County Department of Health in the past.
- Prior to 1981, the City of Ithaca’s and Cornell’s WTPs were shut down on multiple occasions because of high turbidity and nearby fuel oil spills.
- In 1997 a fuel oil spill from a fuel truck resulted in a water supply outage at the Cornell WTP for 6 days.
- On December 4, 2009, an attempted theft of gasoline from the Caroline Highway Facility resulted in 500 gallons of fuel leaking into Six Mile Creek.
- Precautionary shutdown of the City of Ithaca’s water treatment plant occurred as a result of an overturned truck on Burns Road that leaked diesel fuel into the reservoir.

Historical Cost and Damage Estimates

Contamination of the public water supplies within Tompkins County is a concern because of the amount of people that rely on these systems. A history of both fuel and manure spills have occurred in the County which has led to water supply contamination. Even short-term water supply outages can cause hardships on residents. The spill event that occurred in 2009 resulted in \$25,000 in losses and damages. This contamination event represents a realistic hazard scenario and damage estimate for Tompkins County. A larger scale water supply contamination event has the potential to result in millions of dollars in damages due to the number of properties and residents that would be affected.

Future Potential Impacts

Increased flooding expected as a result of climate change is likely to cause an increase in the number of water supply contamination events in the future, beyond the current documented water supply contamination events rate of one to two events every ten (10) years. While numerous safeguards are put in place at the water treatment plants to account for short-term outages or shut downs, it is likely that these safeguards will be relied upon more heavily in the future. As an example, Bolton Point must now monitor for pesticides in their intake and finished water. Another concern that was voiced during the County’s risk assessment was how susceptible private well water supply, as is found in much of the rural areas of the county, would be to contamination due to less predictable precipitation in the future.

One added area of increasing concern is the aging infrastructure of pipelines that cross several of the County’s creeks. These pipelines carry a variety of potentially dangerous materials, including sewage, oil, and natural gas. It is estimated that these pipelines cross at least 60 stream locations in the County, many of which have been observed as being in poor condition. The

rupturing of these pipelines could have immediate adverse impacts to water quality and, in many cases, could put drinking water supplies at risk. More detailed analysis and mitigation should be undertaken by local government, pipeline owners, and local stakeholders to reduce this risk.

5.2.6 *Hazardous Materials in Transit*

General Hazard Description

Hazardous materials in transit events consist of an uncontrolled release of material during transport, which when released can result in death or injury to people and/or damage to property and the environment through the material's flammability, toxicity, corrosiveness, chemical instability, and/or combustibility.

Key Hazardous Materials in Transit Findings for Tompkins County

- Historical hazardous materials in transit events have been minor with limited clean-up needs and no long-term impacts.
- The frequency and severity of hazardous material in transit occurrences may increase if hydraulic fracturing is approved in New York State.

Historical Hazard Occurrence

In addition to rail transport, hazardous materials are transported through Tompkins County on several of the State Routes that traverse the area. Rail car transport is limited to rock salt and coal; no other hazardous materials are transported by rail in the County. These routes are major transport corridors since interstate access to the County is limited. During peak traffic times, it is estimated that over 400 freight trucks pass through the County every two hours. Often times, the materials being transported by trucks or train are unknown, making it more difficult to deal with a hazardous materials situation when it does occur. New York State does not require the registration of vehicles that transport hazardous materials, or require that such vehicles follow a set route; however it is required that federal codes be followed for marking and placarding of such trucks (ITCTC, 2002). Historical hazardous material events noted within the County include:

- 1988: A fuel truck overturned along NYS Route 96 in the Town of Ulysses.
- 1997: A train derailed in the Town of Dryden causing a fuel oil spill that led to the shutdown of the Cornell WTP.

Historical Cost and Damage Estimates

Specific damage reports associated with previous hazardous materials in transit events were not available. In cases of minor fuel oil spills, \$10,000 would cover the cost of clean-up, but larger events involving WTP shutdowns or prolonged road or railroad closures could result in much larger costs.

Future Potential Impacts

Hazardous materials in transit concerns are expected to continue in the future given the frequency of truck and train transportation within Tompkins County. Although prior hazard events were mostly minor with short-term impacts, a growing concern among County residents is the potential for hydraulic fracturing fluids to be transported through the area, especially if such an activity is approved to occur within New York State in the future. As discussed under the Transportation Accident hazard, the number of trucks traveling on roads in the County is expected to rise dramatically if shale gas drilling is approved. The SGEIS for High Volume Hydraulic Fracturing notes that trucks will be transporting potentially hazardous materials and that “additional transport resulting from horizontal drilling poses an additional risk” (NYSDEC, 2011). Tompkins County Department of Emergency response does not anticipate hazardous material transport associated with gas drilling to cause major disruptions, though the Department is preparing a plan to address potential impacts related to drilling operations. This concern is further detailed in Section 4.5.

5.2.7 Terrorism

General Hazard Description

Terrorism is defined as the threat or use of violence to achieve political or social ends usually associated with community disruption and/or multiple injuries or deaths.

Key Terrorism Findings for Tompkins County

- Cornell University received anthrax threats concurrent with the national anthrax episodes post-September 2001.

Historical Hazard Occurrences

A major terrorist event has never been documented within Tompkins County; however, Cornell University and other facilities received anthrax threats concurrent with the national anthrax episodes post-September 2001. Because of the potential for mass casualties to occur as a result of such a terrorist event, the fact that such events occur with no warning, and the concern that such events are likely to increase in the Country in the future, this hazard was assessed as part of Tompkins County’s HMP. Terrorism is determined to have a moderately low potential of occurrence within the County, as there are no significant targets recognized within the area.

Historical Cost and Damage Estimates

Terrorism events can result in a wide range of damages and recovery costs. A small isolated event may result in a minor disruption with low damage and cost implications, while a large-scale event could take years of recovery and cost billions of dollars to clean up and re-build an area. Given the unpredictable nature and variety of terrorist actions, it is difficult for the County and municipalities to be prepared and secure the proper equipment for such an event.

Future Potential Impacts

An isolated terrorist event has a low potential to occur within Tompkins County. Though no nationally significant targets were identified within the County, facilities such as airports, municipal buildings, universities, and water/wastewater treatment plants have a potential of being targeted in Tompkins County. Although occurrences have been relatively minor, agricultural terrorism should continue to be addressed, largely through response plans.

5.2.8 Civil Unrest

General Hazard Description

Civil unrest is defined as an individual or collective action causing serious interference with the peace, security, and/or functioning of a community. This hazard governs major disruptions, not just civil disobedience events.

Key Civil Unrest Findings for Tompkins County

- Incidents of civil unrest within Tompkins County are infrequent and are commonly associated with Cornell University or Ithaca College.
- Civil unrest and public demonstration events in Tompkins County are normally peaceful and focused on a specific cause.

Historical Hazard Occurrences

Although public demonstrations are frequent events in Tompkins County, major incidents of civil unrest are less frequent and are normally associated with Cornell University or Ithaca College students in the City and Town of Ithaca. Campus parties and student activities, including Slope Day at Cornell University and Fountain Day at Ithaca College, often require additional law enforcement, medical services, or fire personnel to become involved. Noise ordinances, particularly the ordinance implemented by the Town of Ithaca, have resulted in the noted decrease in noise related events. The largest civil unrest occurrence in Tompkins County occurred on the Cornell University campus in 1968 when a group of students took over Willard Straight Hall. Other documented events include: a demonstration that blocked traffic on Green Street, the occupying of Immaculate Conception Catholic Church on Seneca Street, and a demonstration in the Town of Dryden on the ethical treatment of animals.

Historical Cost and Damage Estimates

Though civil unrest events have been known to cause property damage and vandalism, this is not the case with the majority of the civil unrest events and public demonstrations in Tompkins County. These events are normally peaceful and focused on a specific cause. The costs related to the extra law enforcement required to deal with large or unruly events is the highest cost associated with this hazard.

Future Potential Impacts

Civil unrest and organized demonstrations are unpredictable, though Tompkins County, with its three institutions of higher education, may be at higher risk than surrounding counties for these types of events to occur.

6.0 Hazard Vulnerability

The Tompkins County HIRA-NY risk assessment was completed to identify the hazards with the highest potential to impact the County and associated jurisdictions. This information was used to guide the subsequent ranking of such hazards in order of the most severe and/or frequently occurring type, to help determine the highest priority of need with respect to implementation of pre-disaster action, and to guide the focus for recommendations and mitigation actions to be included in this HMP Update. After these pertinent hazards were identified and profiled, the vulnerability assessment, as described below, was completed to provide a quantitative estimate of the people and property that may be susceptible to a particular hazard event.

Each Town and Village was asked to provide information concerning the occurrence of hazards in their community and to help identify what areas these hazards affected. This information was combined with information provided by FEMA, via the FEMA website, and from the NYSOEM with respect to relative cost of damages reported for various declared disaster events in New York State.

6.1 Identify Assets

Critical facilities identified within Tompkins County include, but are not limited to, the E-911 Emergency Center, schools, fire departments, hospitals, medical centers, County and Town highway garages, government agencies, Town and Village Halls, police departments, local operational offices for telephone and electrical power utilities, airports, water supply facilities, waste water treatment facilities, etc. These facilities represent the critical assets located within the County. For the purpose of this planning document, lists of these critical facilities were prepared using information provided by the County, Towns, and Villages and are provided as Appendix G. A list of community assets and critical facilities was not identified in the original plan.

6.2 Damage Potential

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. In 2011, 39,000 occupied housing units were identified in Tompkins County; 22,000 (55 percent) were owner occupied and 18,000 (45 percent) were renter occupied. These numbers represent an approximate 7 percent vacancy rate among existing residential structures in the County.

The damage potential for housing within Tompkins County was estimated using 2012 tax parcel data provided by the Tompkins County Department of Assessment. Care was taken to ensure housing types were not consolidated so as to better compare across jurisdictions. Information on the age of mobile homes was not available; therefore, these residential structures were not included in the Table 24 analysis. Tables 24, 25 and 26, below, further detail the housing types and values reported for the participating jurisdictions within Tompkins County.

Table 24 – Housing Types
(Tompkins County Department of Assessment, 2013)

	1 Family Residential	2 Family Residential	3 Family Residential	Apartment	Estate	Manufactured Housing	Manufactured Housings	Manufactured Housing Park	Multiple Residence	Residence with Commercial Use	Rural Residential	Rural Residential & Agriculture	Rural Residential & Recreation	Seasonal Residence	Mobile Home
Town of Caroline	698	58	8	12	0	146	5	2	28	2	0	42	143	19	187
Village of Cayuga Heights	707	147	8	16	1	0	0	0	0	0	0	0	0	0	0
Town of Danby	795	92	3	7	0	53	2	0	16	3	0	54	205	17	103
Village of Dryden	517	44	8	19	0	1	0	0	7	2	0	1	1	0	1
Town of Dryden	795	92	3	7	0	53	0	2	16	3	0	54	205	17	1100
Town of Enfield	551	32	4	16	0	295	36	7	16	3	0	44	111	5	527
Village of Freeville	119	21	2	2	0	2	0	0	2	1	0	0	2	0	0
Village of Groton	541	57	15	20	0	10	1	1	4	1	0	1	2	0	66
Town of Groton	680	19	1	6	0	305	9	1	13	2	0	52	161	0	357
City of Ithaca	2542	868	116	540	0	0	1	1	39	9	1	0	0	0	110
Town of Ithaca	2704	473	11	75	0	0	0	1	31	7	2	8	58	4	64
Village of Lansing	499	50	3	11	1	2	0	0	4	0	0	0	4	0	2
Town of Lansing	1980	114	19	33	1	211	12	5	48	8	1	48	134	27	305
Town of Newfield	866	62	5	20	269	28	0	9	31	5	0	32	168	10	816
Village of Trumansburg	707	147	8	16	1	0	0	0	0	0	0	0	0	0	104
Town of Ulysses	988	45	6	11	41	2	1	1	19	2	49	111	35	0	58
Tompkins County	15689	2321	220	811	314	1108	67	30	274	48	53	447	1229	99	3800

Table 25 – Age of Structures <i>(Tompkins County Department of Assessment, 2013)</i>					
	<1940	1940-1959	1960-1979	1980-1999	2000-2011
Town of Caroline	458	101	230	249	99
Village of Cayuga Heights	255	294	239	113	22
Town of Danby	306	141	293	343	171
Village of Dryden	193	96	195	163	34
Town of Dryden	702	417	952	821	406
Town of Enfield	256	96	172	242	94
Village of Freeville	95	19	27	19	14
Village of Groton	430	42	149	98	26
Town of Groton	485	80	176	190	123
City of Ithaca	2948	390	811	703	128
Town of Ithaca	580	706	1018	990	275
Village of Lansing	39	71	129	296	134
Town of Lansing	603	312	566	759	428
Town of Newfield	366	119	377	307	147
Village of Trumansburg	290	90	99	77	41
Town of Ulysses	467	221	250	304	146
Tompkins County	8473	3195	5683	5674	2288

Table 26 – Housing Values <i>(Tompkins County Department of Assessment, 2013)</i>							
	Less than \$50K	\$50-99K	\$100-149K	\$150-199K	\$200-299K	\$300-499K	\$500K or greater
Town of Caroline	24	100	365	304	264	106	90
Village of Cayuga Heights	0	0	11	46	304	395	122
Town of Danby	29	174	361	318	240	106	17
Village of Dryden	5	59	327	147	57	4	1
Town of Dryden	96	363	946	888	726	260	52
Town of Enfield	104	294	356	193	133	29	13
Village of Freeville	1	23	85	33	7	1	1
Village of Groton	20	272	289	55	14	1	2
Town of Groton	98	443	421	184	81	21	1
City of Ithaca	14	190	793	1251	1209	483	178
Town of Ithaca	3	84	494	1029	1129	552	80
Village of Lansing	2	34	45	66	163	205	58

	Less than \$50K	\$50-99K	\$100-149K	\$150-199K	\$200-299K	\$300-499K	\$500K or greater
Town of Lansing	43	248	619	576	454	486	213
Town of Newfield	65	369	598	281	146	33	13
Village of Trumansburg	2	6	28	66	258	332	94
Town of Ulysses	24	100	365	304	264	106	90
Tompkins County	530	2759	6103	5741	5449	3120	1025

These data reveal that a considerable amount of residential infrastructure in the County was constructed before 1960, of which over two-thirds was built prior to 1940. Older houses are typically more susceptible to impacts or damage from an ice storm, winter storm, windstorm, fire event, etc. Approximately 24-percent of occupied housing in Tompkins County is represented by mobile homes that also are more vulnerable to damage from major disasters. In addition, based on 2011 U.S. Census Bureau data, an estimated 7-percent of all housing within the County remains unoccupied. Vacant structures and properties often fall into a state of disrepair, making them more susceptible to damage from storm events.

The approximate median value of an occupied housing unit in Tompkins County is \$199,000 (U.S. Census Bureau, 2011). If 1 percent (265 units) of the total occupied housing units in Tompkins County were demolished by a severe storm event, a tornado for example, the potential value of damage would amount to \$52,735,000. Granted, natural storm damage does not typically amount to complete destruction of homes in Tompkins County, but this scenario does demonstrate how significant the damage has the potential to be when only a limited amount of total infrastructure within the County is affected. Even if 1 percent of houses in the County each sustained only \$1,000 in minor damage from a storm event, it would still amount to a considerable sum: \$265,000.

The following Table 27 provides an approximate monetary range for losses associated with some of the natural hazards that were profiled in this plan. Costs associated with a hazard's potential to impact people and properties were estimated for the highest ranking natural hazards. The completion of this assessment utilizes estimates and assumptions of damages and costs that have been developed using historic storm damage information for Tompkins County, damage estimates provided by other sources such as the NCDRC, and the use of engineering judgment. Actual hazard events have the potential to incur greater or lesser losses and impacts than what the results of the vulnerability assessment indicate. The cost estimates put together to assess hazard vulnerability are not exhaustive and may not encompass all damages that could occur as a result of a hazard event. To aid in this exercise, information from Section 2.5, Table 4 was considered regarding the number of parcels per land use category for each jurisdiction. Additionally, the total property values of all lands within each jurisdiction were estimated by the Tompkins County Office of Real Property (included in Appendix A - Table 28). This information was helpful during the inventory of assets step of this hazard mitigation planning process and was also considered during this vulnerability assessment. During the compilation of

this document, each jurisdiction was tasked with identifying their vulnerabilities, if any, to the hazards evaluated during the risk assessment process. The significant vulnerabilities for each jurisdiction are included in Table 27, below. Flooding remains the number one hazard of concern among the municipalities within Tompkins County.

Table 27 - Natural Hazards: Range of Potential Damages (\$) to Vulnerable Structures in Tompkins County			
	Damage Potential	Loss of Life Potential	Significantly Vulnerable Jurisdictions
Severe storm/Hurricane	\$1,000 - \$10,000 each event \$35,000 annually	Moderate	All jurisdictions vulnerable
Earthquake	\$4,000 - \$80,000 each event \$0 annually	Moderate	All jurisdictions vulnerable
Landslide	\$0 - \$100,000 each event \$0 annually	Low	Town of Danby, Town of Ithaca, City of Ithaca, Village of Lansing, Town of Ulysses
Flash flood	\$1,000 - \$400,000 each event \$47,000 annually	Moderate	Town of Lansing, Village/Town of Groton, Town/City of Ithaca, Town/Village of Dryden, Town of Caroline, Village Cayuga Heights, Town of Enfield, Village of Freeville, Town of Newfield, Village of Trumansburg,
Lake flood	\$1,000 - \$100,000 each event \$5,000 annually	Low	City of Ithaca, Town /Village of Lansing, Town of Ulysses
Infestation	\$10,000 - \$2,000,000 each event	Low	City of Ithaca
Tornado	\$3,000 - \$1,000,000 each event	Moderate	No significant vulnerabilities identified
Severe winter storm/Ice storm	\$0 - \$1,000,000 each event \$10,000 annually	Moderate	All jurisdictions vulnerable
Epidemic	\$10,000 - \$10,000,000	High	City of Ithaca
Extreme temperatures	\$0 - \$1,000 each event \$0 annually	Moderate	City of Ithaca, Village of Cayuga Heights, Village of Lansing
Drought	\$0 - \$15,000,000 each event	Low	No significant vulnerabilities identified
Ice jam	\$0 - \$1,000,000 each event \$2,000 annually	Low	City of Ithaca, Town of Ithaca

6.3 Development Trends

As stated in the Tompkins County Development Focus Area Strategy, for over half a century new construction in Tompkins County has been located in rural areas, outside of the city and villages, by a ratio of 2 to 1, but conditions have changed and continue to evolve to the point where the majority of development is occurring in the City and Town of Ithaca.

Since adoption of the 2006 Hazard Mitigation Plan, development has continued throughout Tompkins County at a slow, but steady rate. Much development has occurred within the City and Town of Ithaca, though the surrounding Towns and Villages have also seen their share of development.

In the Town of Ithaca, several projects have been built or received approval focused on expanding senior housing options. These projects have occurred on West Hill (Conifer Village Senior Living Community, Conifer West Hill Development), South Hill (Longview Care Facility Addition, Longview Patio Homes), as well as East Hill (Ellis Hollow Senior Apartments). Over this same time period, substantial projects at Cornell University (CU) and Ithaca College (IC), which have considerable portions of their campuses within the Town of Ithaca, have continued to occur. The most substantial development on campus has been the Ithaca College Athletic and Events Center. The facility opened at IC in 2011 and includes a 130,000 square foot field house plus a 47,000 square foot aquatics pavilion. It is anticipated that the center will host some of the largest events in the County. Other major projects at IC have included the building of a new business school, the Peggy Williams Center, the expanded boathouse on Cayuga Inlet and the expansion of the Circle Apartments student housing facility. Projects at CU, within the Town of Ithaca, include the Heat and Power Plant, the Merrill Family Sailing Center on Cayuga Lake, the Physical Sciences building, and the East Hill Office Building. Other noted projects within the Town of Ithaca include an expansion of EcoVillage at Ithaca, Belle Sherman Cottages, Overlook at West Hill, and the approved Holochuck Homes and Holly Creek subdivisions.

The majority of development activity in the County has occurred within the City of Ithaca. In 2007, the City elected to rebuild their century old water treatment plant on its existing site. The new plant, currently in planning stages, will continue to draw water from Sixmile Creek for treatment and distribution throughout the City. The largest project to occur over the last several years in the City is the Collegetown Terraces. The first phase of this project is now complete and includes 80 graduate student apartments and 184 bedrooms. Downtown Ithaca's major projects include the mixed use Cayuga Green II and approvals for the Breckenridge Apartments affordable housing project, the Holiday Inn Expansion, and Seneca Way mixed use building. Projects within the City at CU included Milstein Hall. Approvals were also granted for the CU law school addition as well as a new Computer and Information Services building. Other significant projects in the City include the development of affordable housing on Floral Avenue on the Cayuga Inlet, the Coal Yard Apartments on Maple Avenue, and the College Park Apartments on Eddy Street.

Other notable projects include the development of dormitories in the Town of Dryden at the Tompkins-Cortland Community College, the Poet's Landing affordable housing project in the Village of Dryden, and approved subdivisions in the Town of Lansing, including Lansing

Commons, Woodland Park, and Farm Pond Circle. Near the junction of Routes 34 and 34B in the Town of Lansing, there is also added activity surrounding the new Lansing Market.

6.3.1 Affordable Housing

Housing prices in Tompkins County continue to increase with median housing prices continuing to be 50 to 75 percent higher than in neighboring counties. As stated in the County's Comprehensive Plan (2004), barely half of the homes in the County are owner occupied. With the high price of housing and low vacancy rates, affordable housing continues to be an issue, which several jurisdictions are struggling to deal with and integrate into development proposals. Some of the available "affordable housing" is located in high risk areas such as floodplains.

6.3.2 Development Focus Areas

A number of the new development proposals have occurred in areas identified by Tompkins County as Development Focus Areas. These noted areas have existing public water, public sewer, and transit infrastructure. By continuing to develop mixed-use compact development within these areas, several benefits will be realized, including the improved resilience and adaptation to changing energy markets as well as natural hazard events.