5.4.2 EXTREME TEMPERATURE

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

5.4.2.1 HAZARD PROFILE

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

Description

Extreme temperature includes both heat and cold events, which can have a significant impact to human health, commercial/agricultural businesses and primary and secondary effects on infrastructure (e.g., burst pipes and power failure). What constitutes "extreme cold" or "extreme heat" can vary across different areas of the country, based on what the population is accustomed to.

Extreme Cold: Extreme cold events are when temperatures drop well below normal in an area. In regions relatively unaccustomed to winter weather, near freezing temperatures are considered "extreme cold." Extreme cold temperatures are characterized by the ambient air temperature dropping to approximately 0 degrees Fahrenheit (ºF) or below.

Exposure to cold temperatures, whether indoors or outside, can lead to serious or life-threatening health problems such as hypothermia, cold stress, frostbite or freezing of the exposed extremities such as fingers, toes, nose and ear lobes. Hypothermia occurs when the core body temperature is <95ºF. If persons exposed to excessive cold are unable to generate enough heat (e.g., through shivering) to maintain a normal core body temperature of 98.6ºF, their organs (e.g., brain, heart, or kidneys) can malfunction. When brain function deteriorates, persons with hypothermia are less likely to perceive the need to seek shelter. Signs and symptoms of hypothermia (e.g., lethargy, weakness, loss of coordination, confusion, or uncontrollable shivering) can increase in severity as the body's core temperature drops. Extreme cold also can cause emergencies in susceptible populations, such as those without shelter, those who are stranded, or those who live in a home that is poorly insulated or without heat (such as mobile homes). Infants and the elderly are particularly at risk, but anyone can be affected (Centers of Disease Control and Prevention [CDC], 2013).

Extremely cold temperatures often accompany a winter storm, so individuals may have to cope with power failures and icy roads. Although staying indoors as much as possible can help reduce the risk of car crashes and falls on the ice, individuals may also face indoor hazards. Many homes will be too cold—either due to a power failure or because the heating system is not adequate for the weather. The use of space heaters and fireplaces to keep warm increases the risk of household fires and carbon monoxide poisoning.

During cold months, carbon monoxide may be high in some areas because the colder weather makes it difficult for car emission control systems to operate effectively. Carbon monoxide levels are typically higher during cold weather because the cold temperatures make combustion less complete and cause inversions that trap pollutants close to the ground (USEPA, 2013).

Extreme Heat: Temperatures that hover 10 degrees or more above the average high temperature for the region and last for several weeks are defined as extreme heat (CDC, 2009). An extended period of extreme heat of three or more consecutive days is typically called a heat wave and is often accompanied by high humidity (NWS, 2013). There is no universal definition of a heat wave because the term is relative to the usual weather in a particular area. The term heat wave is applied both to routine weather variations and to extraordinary spells of heat which may occur only once a century (Meehl and Tebaldi, 2004). A basic definition of a heat wave implies that it is an extended period of unusually high atmosphere-related heat stress, which causes temporary modifications in lifestyle and which may have adverse health consequences for the affected population (Robinson, 2000). The Weather Channel uses the following criteria for a heat wave in the U.S.: a minimum of 10 states with greater than or equal to 90°F temperatures and the temperatures must be at least five degrees above normal in parts of that area for at least two days or more (The Weather Channel, 2012).

Depending on severity, duration and location; extreme heat events can create or provoke secondary hazards including, but not limited to, dust storms, droughts, wildfires, water shortages and power outages (CDC, 2009). This could result in a broad and far-reaching set of impacts throughout a local area or entire region. Impacts could include significant loss of life and illness; economic costs in transportation, agriculture, production, energy and infrastructure; and losses of ecosystems, wildlife habitats and water resources (Adams, Date Unknown; Meehl and Tebaldi, 2004; CDC, 2009; NYS DHSES, 2011).

Extent

Extreme Cold Temperatures

The extent (severity or magnitude) of extreme cold temperatures are generally measured through the Wind Chill Temperature (WCT) Index. Wind Chill Temperature is the temperature that people and animals feel when outside and it is based on the rate of heat loss from exposed skin by the effects of wind and cold. As the wind increases, the body is cooled at a faster rate causing the skin's temperature to drop (NWS, 2009).

On November 1, 2001, the NWS implemented a new WCT Index. It was designed to more accurately calculate how cold air feels on human skin. Figure 5.4.2-1 shows the new WCT Index. The Index includes a frostbite indicator, showing points where temperature, wind speed and exposure time will produce frostbite to humans. The chart shows three shaded areas of frostbite danger. Each shaded area shows how long a person can be exposed before frostbite develops (NWS, 2009).

Figure 5.4.2-1. NWS Wind Chill Index

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

Frostbite Times: 30 minutes; 10 minutes; 5 minutes

Source: NWS, 2009

According to the New York State Climate (NYSC) Office of Cornell University, cold winter temperatures prevail over New York State whenever Arctic air masses, under high barometric pressure, flow southward from central Canada or from Hudson Bay. High-pressure systems often move just off the Atlantic coast, become more or less stagnant for several days, and then a persistent airflow from the southwest or south affects the State. This circulation brings the very warm, often humid weather of the summer season and the mild, more pleasant temperatures during the fall, winter, and spring seasons. The highest temperature of record in New York State is 108° at Troy on July 22, 1926. Temperatures of 107° have been observed at Lewiston, Elmira, Poughkeepsie, and New York City. The record coldest temperature is -52° at Stillwater Reservoir (northern Herkimer County) on February 9, 1934 and also at Old Forge (also northern Herkimer County) on February 18, 1979. Some 30 communities have recorded temperatures of -40° or colder, most of them occurring in the northern one-half of the state and the remainder in the Western Plateau Climate Division and in localities just south of the Mohawk Valley (Cornell University, Date Unknown).

Extreme Heat Temperatures

The extent of extreme heat temperatures are generally measured through the Heat Index, identified in Figure 5.4.2-2. Created by the NWS, the Heat Index is a chart which accurately measures apparent temperature of the air as it increases with the relative humidity. The Heat Index can be used to determine what effects the temperature and humidity can have on the population (NYS DHSES, 2011).

Figure 5.4.2-2. Heat Index Chart

Temperature (°F)

Relative Humidity (%)	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	128	136					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity

Caution · Extreme Caution · Danger · Extreme Danger

Source: NWS, 2013

Table 5.4.2-1 describes the adverse effects that prolonged exposure to heat and humidity can have on an individual.

Table 5.4.2-1. Adverse Effects of Prolonged Exposures to Heat on Individuals

Category	Heat Index	Health Hazards
Extreme Danger	130 °F – Higher	Heat Stroke / Sunstroke is likely with continued exposure.
Danger	105 °F – 129 °F	Sunstroke, muscle cramps, and/or heat exhaustion possible with prolonged exposure and/or physical activity.

Category	Heat Index	Health Hazards
Extreme Caution	90 °F – 105 °F	Sunstroke, muscle cramps, and/or heat exhaustions possible with prolonged exposure and/or physical activity.
Caution	80 °F – 90 °F	Fatigue possible with prolonged exposure and/or physical activity.

Source: NYS DHSES, 2011

To determine the Heat Index, one needs to know the temperature and relative humidity. Once both values are known, the Heat Index will be the corresponding number with both values. That number provides a temperature that the body feels. It is important to know that the Heat Index values are devised for shady, light wind conditions. Exposure to full sunshine can increase the Heat Index by up to 15 degrees (NYS DHSES, 2011).

The National Weather Service (NWS) provides alerts when Heat Indices approach hazardous levels. Table 5.4.2-2 explains these alerts. In the event of an extreme heat advisory, the NWS does the following:

- Includes Heat Index values and city forecasts
- Issues special weather statements including who is most at risk, safety rules for reducing risk, and the extent of the hazard and Heat Index values
- Provides assistance to state/local health officials in preparing Civil Emergency Messages in severe heat waves (NYS DHSES, 2013).

Table 5.4.2-2. National Weather Service Alerts

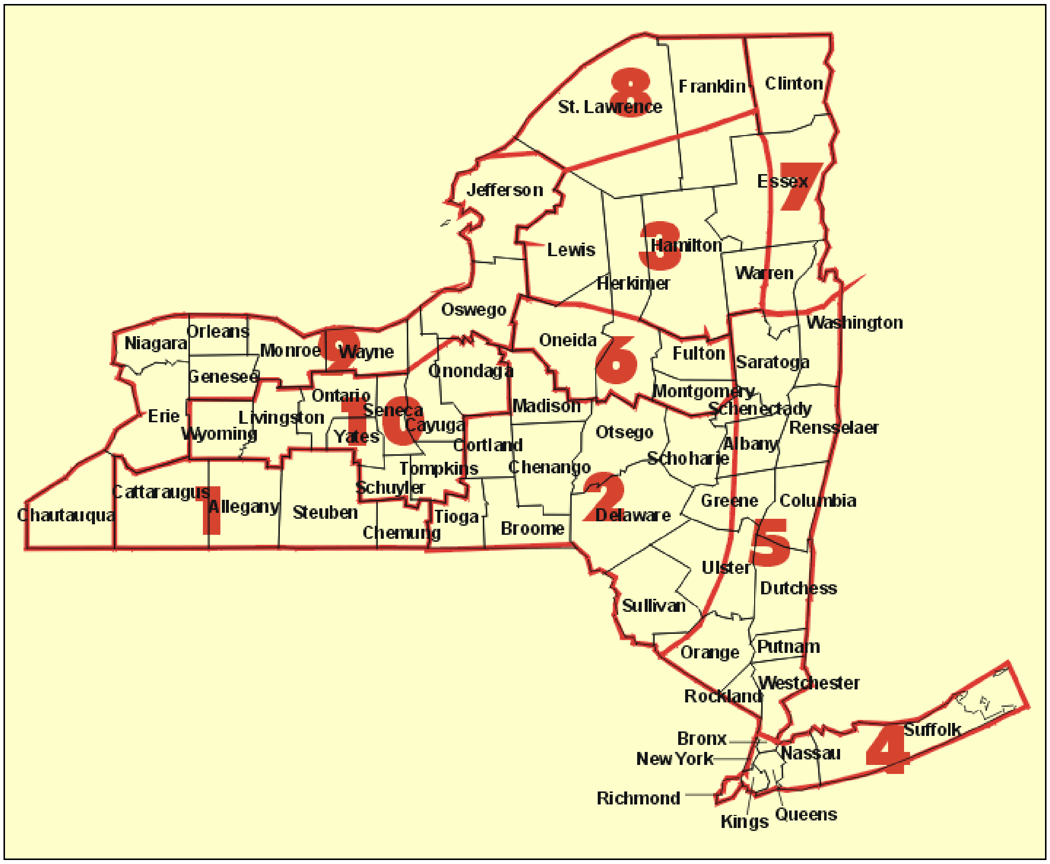
Alert	Criteria
Heat Advisory	Issues 12-24 hours before the onset of the following conditions: heat index of at least 100°F but less than 105°F for at least two hours per day
Excessive Heat Watch	Issued by the NWS when heat indices of 105°F or greater are forecast in the next 24 to 72 hours
Excessive Heat Warning	Issued within 12 hours of the onset of the following criteria: heat index of at least 105°F for more than three hours per day for two consecutive days, or heat index more than 115°F for any period of time

Source: NYS DHSES, 2013

Location

New York State is divided into 10 climate divisions: Western Plateau, Eastern Plateau, Northern Plateau, Coastal, Hudson Valley, Mohawk Valley, Champlain Valley, St. Lawrence Valley, Great Lakes, and central Lakes. According to NCDC, "Climatic divisions are regions within each state that have been determined to be reasonably climatically homogeneous" (CPC, 2005; NCDC, 2012). Chenango County is located within the Eastern Plateau Climate Division. Figure 5.4.2-3 depicts the climate divisions in New York State.

Figure 5.4.2-3. New York State Climate Divisions



Source: CPC, 2005

Note: (1) Western Plateau; (2) Eastern Plateau (Catskill Mountains); (3) Northern Plateau (Adirondack Mountains); (4) Coastal; (5) Hudson Valley; (6) Champlain Valley; (7) St. Lawrence Valley; (8) Great Lakes; and (10) Central Lakes.

Extreme Cold Temperatures

Extreme cold temperatures occur throughout most of the winter season and generally accompany most winter storm events throughout the State. The NYSC Office of Cornell University indicates that cold temperatures prevail over the State whenever arctic air masses, under high barometric pressure, flow southward from central Canada or from Hudson Bay (Cornell University, Date Unknown).

Many atmospheric and physiographic controls on the climate result in a considerable variation of temperature conditions over New York State. The average annual mean temperature ranges from about 40°F in the Adirondacks to near 55°F in the New York City area. In January, the average mean temperature is approximately 16°F in the Adirondacks and St. Lawrence Valley, but increases to about 26°F along Lake Erie and in the lower Hudson Valley and to 31°F on Long Island. The record coldest temperature in New York State is -52°F at Stillwater Reservoir (northern Herkimer County) on February 9, 1934. Approximately 30 communities have recorded temperatures of -40°F or colder, most of them occurring in the northern half of New York State and the remainder in the Western Plateau Climate Division and in localities just south of the Mohawk Valley (Cornell University, Date Unknown).

The winters are long and cold in the Plateau Divisions of New York State (including the Eastern Plateau). In the majority of winter seasons, a temperature of -25°F or lower can be expected in the northern highlands and -15°F or colder in the southwestern and east-central highlands (Cornell University, Date Unknown).

As provided by The Weather Channel, average high and low temperatures during the winter months around Chenango County are identified in Table 5.4.2-3.

Table 5.4.2-3. Average High and Low Temperature Range for Winter Months in Chenango County

Month	Average High	Average Low	Record Low Event(s)
January	32ºF	11ºF	-32ºF in 1968
February	35ºF	13ºF	-29ºF in 1961
March	44ºF	21ºF	-19ºF in 1950
November	48ºF	28ºF	-8ºF in 1938
December	36ºF	18ºF	-26ºF in 1942

Source: The Weather Channel, 2013

Extreme Heat Temperatures

Extreme heat temperatures of varying degrees are existent throughout the State for most of the summer season, except for areas with high altitudes. As provided by The Weather Channel, average high and low temperatures during the summer months around Chenango County are identified in Table 5.4.2-4.

Table 5.4.2-4. Average High and Low Temperature Range for Summer Months in Chenango County

Month	Average High	Average Low	Record High Event(s)
May	69°F	41°F	91°F in 2006
June	77°F	51°F	98°F in 1933
July	81°F	56°F	101°F in 1936
August	79°F	54°F	100°F in 1944
September	72°F	47°F	99°F in 1953

Source: The Weather Channel, 2013

Previous Occurrences and Losses

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

The Midwest Regional Climate Center (MRCC) operates an online annual temperature extremes database of the Continental U.S., otherwise known as "MRCC Cooperative Observer Station Annual Temperature Record Data Set". The data set contains the annual maximum and minimum temperature records for stations in the U.S. Each station has a cooperative observer system i.d. number (coop number), and those examined for this HMP had a running length of more than five years. In New York State, there are 269 stations that were observed; however, only three stations in Chenango County. Not every city, town and/or village in New York State contains a station (MRCC, 2012).

There may be some potential problems with the data collected at the stations. The records were created by MRCC at the request of a user. The values of the all-time records for stations with brief histories are limited in accuracy and could vary from nearby stations with longer records. Although the data sets have been through quality control, there is still a need for more resources to quality control extremes. The record sets are for single stations in the cooperative observer network and are limited to the time of operation of each station under one coop number. The records for a place may need to be constructed from several individual station histories. Some of the data may vary from NWS records due to NWS using multiple stations and additional sources like record books (MRCC, Date Unknown). Based on the data provided by MRCC, Table 5.4.2-5 presents the extreme cold (minimum) and hot (maximum) temperature records for Chenango County from 1893 to 2003.

Table 5.4.2-5. MRCC Temperature Extremes – Chenango County

Station ID	Name	Begin	End	Max (oF)	Max Date	Min (oF)	Min Date	Avg Max	Avg Min
300360	Bainbridge	1936	1992	101	9/3/1953	-27	1/15/1957	49.9	27.1
306085	Norwich	1906	2003	101	7/9/1936	-32	1/15/1957	48.1	26.1
307705	Sherburne	1986	2003	99	7/15/1995	-29	1/6/1996	49.4	26.2

Source: MRCC, 2010
Notes: Begin Year is when the data collection began; End Year is when the data collection stopped.

Between 1954 and 2015, New York State was not included in any FEMA major disaster declarations (DR) or emergency declarations (EM) due to extreme temperatures. Agriculture-related disasters are quite common. The Secretary of Agriculture is authorized to designate counties as disaster areas to make emergency loans (EM) to producers suffering losses in those counties and in counties that are contiguous to a designated county. Table 5.4.2-6 presents USDA declared drought, excessive heat, frosts and freeze events impacting Chenango County.

Table 5.4.2-6. USDA Declared Disasters, 2008 to 2014

Incidence Period	Event Type	USDA Designation Number	County Designated?*	Losses / Impacts
April 28 to May 28, 2008	Frost and Freeze	S2738	No (Chenango a contiguous county)	Production losses
May 16 to May 26, 2009	Frost, freezes, and high winds	S2890	No (Chenango a contiguous county)	Production losses
May 31 to June 2, 2009	Frost and freeze	S2895	No (Chenango a contiguous county)	Production losses
February 15 to May 5, 2010	Frost, freeze, high winds, hail, excessive snow, excessive rain and cold temperatures	S3070	No (Chenango a contiguous county)	Production losses
March 1, 2012 and continuing	Frosts & Freeze	S3249	No (Chenango a contiguous county)	Physical and production losses attributed to frost and freezing temperatures
June 1 to October 24, 2012	Drought and Excessive Heat	S3427	Yes	Production losses were attributed to drought and excessive heat
June 26, 2012 and continuing	Drought	S3441	No (Chenango a contiguous county)	Physical and production losses were attributed to drought

Source: USDA, 2012
**Disaster event occurred within the county.*
M — Presidential Major Disaster Declaration
N — Administrative Physical Loss Notification
S — Secretarial National Disaster Determination
USDA — United States Department of Agriculture

For this 2015 Plan Update, known extreme temperature events that have impacted Chenango County between 2008 and 2015 are identified in Table 5.4.2-7. Information regarding specific details of temperature extremes in Chenango County is scarce; therefore, previous occurrences and losses associated with extreme temperature events are limited. Therefore, Table 5.4.2-7 may not include all events that have occurred in the County.

Table 5.4.2-7. Extreme Temperature Events in Chenango County, 2008 and 2015

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts
January 2-3, 2008	Low Temperatures	N/A	N/A	Cold temperatures impacted the area with temperatures ranged from -3°F to -7°F in Chenango County.
July 21-23, 2011	Excessive Heat	N/A	N/A	High pressure moved off the east coast of the United States, allowing extreme heat that had been building over the central part of the country to move east. For three days, high temperatures across much of central New York rose well up into the 90s, and exceeded 100 degrees in many typically warmer valley locations.
March 17-23, 2012	Heat	N/A	N/A	A period of record warm temperatures was experienced across central New York from March 17th to the 23rd as the jet stream was pushed farther north than is typical for this time of year and persistent southerly flow developed over an unusually large area of the United States. Both of the climate record stations at Binghamton and Syracuse broke records for the warmest March on record. Both locations were over 12 degrees above normal for the monthly mean temperature.
January 6-7, 2014	Arctic Air	N/A	N/A	Between January 6th and 7th, an arctic airmass moved over the Southern Tier, bringing dangerously cold wind chill temperatures as low as -30°F and lower, record cold, and heavy lake effect snow over western and northern New York State. Many schools had a delay or were closed due to the cold temperatures. Parts of the New York State Thruway and I-81 were closed due to high winds, heavy snow, and very low wind chills.

Source: NOAA-NCDC 2015; FEMA 2015; SPC 2015; NWS 2015
Note (1): Monetary figures within this table were U.S. Dollar (USD) figures calculated during or within the approximate time of the event. If such an event would occur in the present day, monetary losses would be considerably higher in USDs as a result of increased U.S. Inflation Rates.
NOAA-NCDC National Oceanic Atmospheric Administration – National Climate Data Center
NWS National Weather Service
NYS New York State
SHELDUS Spatial Hazard Events and Losses Database for the United States

Probability of Future Events

Extreme temperatures are expected to occur more frequently as part of regular seasons. Specifically, extreme heat will continue to impact Chenango County and, based upon data presented, will increase in the next several decades. It is estimated that the County will continue to experience these events annually.

In Section 5.3, the identified hazards of concern for Chenango County were ranked. The probability of occurrence, or likelihood of the event, is one parameter used for hazard rankings. Based on historical records and input from the Planning Committee, the probability of occurrence for extreme temperature events in the County is considered 'frequent' (likely to occur within 10 years).

Climate Change Impacts

Climate change is beginning to affect both people and resources in New York State, and these impacts are projected to continue growing. Impacts related to increasing temperatures and sea level rise are already being felt in the State. ClimAID: the Integrated Assessment for Effective Climate Change in New York State (ClimAID) was undertaken to provide decision-makers with information on the State's vulnerability to climate change and to facilitate the development of adaptation strategies informed by both local experience and scientific knowledge (New York State Energy Research and Development Authority [NYSERDA], 2011).

Each region in New York State, as defined by ClimAID, has attributes that will be affected by climate change. Chenango County is part of Region 3, Southern Tier. Some of the issues in this region, affected by climate change, include: dairy dominates the agricultural economy and milk production losses are projected, Susquehanna River flooding increases, and this region is one of the first parts of the State hit by invasive insects, weeds and other pests moving north (NYSERDA, 2011).

Temperatures in New York State are warming, with an average rate of warming over the past century of 0.25° F per decade. Average annual temperatures are projected to increase across New York State by 2° F to 3.4° F by the 2020s, 4.1° F to 6.8° F by the 2050s, and 5.3° F to 10.1° F by the 2080s. By the end of the century, the greatest warming is projected to be in the northern section of the State (NYSERDA, 2014).

Regional precipitation across New York State is projected to increase by approximately one to eight-percent by the 2020s, three to 12-percent by the 2050s, and four to 15-percent by the 2080s. By the end of the century, the greatest increases in precipitation are projected to be in the northern areas of the State (NYSERDA, 2014).

In Region 3, it is estimated that temperatures will increase by 3.6ºF to 7.1ºF by the 2050s and 4.2ºF to 11.6ºF by the 2080s (baseline of 47.5ºF). Precipitation totals will increase between 2 and 15% by the 2050s and 3 to 16% by the 2080s (baseline of 35 inches). The changes in temperature and precipitation are likely to produce an increase in extreme heat, intense precipitation, and more occurrences of short-duration warm season droughts. Both heavy precipitation events and warm season droughts are projected to become more frequent and intense during this century. Table 5.4.2-8 displays the projected seasonal precipitation change for the Southern Tier ClimAID Region (NYSERDA, 2014).

Table 5.4.2-8. Projected Seasonal Precipitation Change in Region 3, 2050s (% change)

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

Source: NYSERDA, 2011

In Region 3, the frequency of heat waves, cold events, intense precipitation, drought, and flooding are projected to increase. Table 5.4.2-9 displays the projected changes in extreme events and includes the minimum, central range and maximum days per year.

Table 5.4.2-9. Changes in Extreme Events in Region 3 – Heat Waves and Intense Precipitation

Event Type	# Days Per Year	Baseline	2020s	2050s	2080s
Heat Waves	Number of Days per year with maximum temperature exceeding:				
	90°F	10	15 to 23 days	22 to 47 days	28 to 79 days
	Number of heat waves per year	1	2 to 3 events	3 to 6 events	3 to 9 events
	Average duration	4	4 to 5 days	5 to 5 days	5 to 7 days
Intense Precipitation	Number of days per year with rainfall exceeding:				
	1 inch	6 days	6 to 7 days	6 to 8 days	6 to 8 days
	2 inches	0.6 days	0.6 to 1 days	0.7 to 1 days	0.7 to 1 days

Source: NYSERDA 2014

5.4.2.2 VULNERABILITY ASSESSMENT

To understand risk, a community must evaluate what assets are exposed or vulnerable in the identified hazard area. For the extreme temperature events, the entire County has been identified as the hazard area. Therefore, all assets in the County (population, structures, critical facilities and lifelines), as described in the County Profile (Section 4), are vulnerable. The following text evaluates and estimates the potential impact of extreme temperatures on Chenango County including:

- Overview of vulnerability
- Data and methodology used for the evaluation
- Impact on: (1) life, health and safety of residents, (2) general building stock, (3) critical facilities (4) economy and (5) future growth and development
- Effect of climate change on vulnerability
- Change of vulnerability as compared to that presented in the 2008 Chenango County Hazard Mitigation Plan
- Further data collections that will assist understanding of this hazard over time

Overview of Vulnerability

Extreme temperatures generally occur for a short period of time but can cause a range of impacts, particularly to vulnerable populations that may not have access to adequate cooling or heating. This natural hazard can also cause impacts to agriculture (crops and animals), infrastructure (e.g., through pipe bursts associated with freezing, power failure) and the economy.

Data and Methodology

At the time of this Plan, insufficient data is available to model the long-term potential impacts of extreme temperature on Chenango County. Over time, additional data will be collected to allow better analysis for this hazard. Available information and a preliminary assessment are provided below.

Impact on Life, Health and Safety

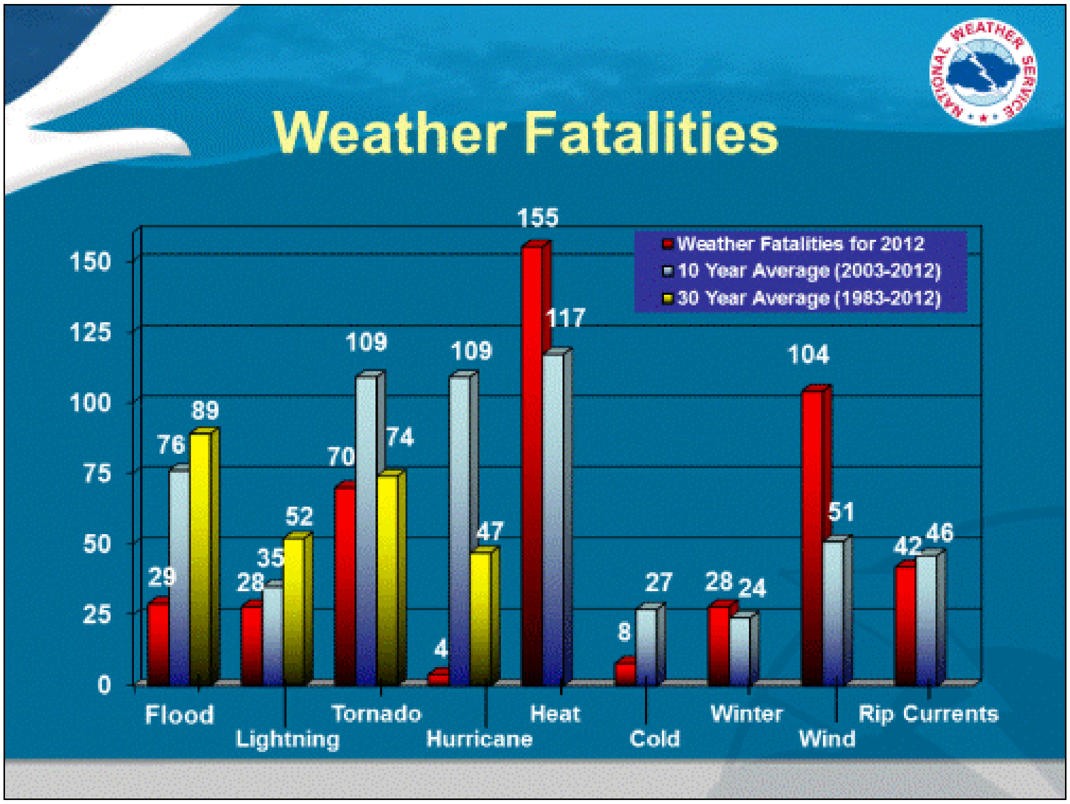
For the purposes of this HMP, the entire population in Chenango County is vulnerable to extreme temperature events. Refer to Section 4 for a summary of population statistics for the County. Extreme temperature events have potential health impacts including injury and death.

According to the Centers for Disease Control and Prevention (CDC), populations most at risk to extreme cold and heat events include the following: 1) the elderly, who are less able to withstand temperatures extremes due to their age, health conditions and limited mobility to access shelters; 2) infants and children up to four years of age; 3) individuals who are physically ill (e.g., heart disease or high blood pressure), 4) low-income persons that cannot afford proper heating and cooling; and 5) the general public who may overexert during work or exercise during extreme heat events or experience hypothermia during extreme cold events (CDC, 2006).

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

Extreme heat is the number one weather-related cause of death in the U.S. On average; more than 110 people die each year from excessive heat. In 2012, New York State reported one heat-related fatality (NWS, 2013). Figure 5.4.2-4 shows the number of weather fatalities based on a 10 year average and 30 year average. Heat has the highest average of weather related fatalities between 2003 and 2012.

Figure 5.4.2-4. Average Number of Weather Related Fatalities in the U.S.



Source: NWS, 2013

Certain populations are considered vulnerable or at greater risk during extreme heat events. These populations include, but are not limited to the following: the elderly age 65 and older, infants and young children under five years of age, pregnant woman, the homeless or poor, the overweight, and people with mental illnesses, disabilities and chronic diseases (NYS DHSES, 2011).

Impact on General Building Stock

All of the building stock in the County is exposed to the extreme temperature hazard. Refer to Section 4 which summarizes the building inventory in Chenango County. Extreme heat generally does not impact buildings. Losses may be associated with the overheating of heating, ventilation, and air conditioning (HVAC) systems. Extreme cold temperature events can damage buildings through freezing/bursting pipes and freeze/thaw cycles. Additionally, manufactured homes (mobile homes) and antiquated or poorly constructed facilities may have inadequate capabilities to withstand extreme temperatures.

Impact on Critical Facilities

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

Impact on Economy

Extreme temperature events also have impacts on the economy, including loss of business function and damage/loss of inventory. Business-owners may be faced with increased financial burdens due to unexpected repairs caused to the building (e.g., pipes bursting), higher than normal utility bills or business interruption due to power failure (i.e., loss of electricity, telecommunications).

The agricultural industry is most at risk in terms of economic impact and damage due to extreme temperature events. Extreme heat events can result in drought and dry conditions and directly impact livestock and crop production. See Section 5.4.1 (Drought) for detailed information regarding the impacts of drought on the economy of the County.

Future Growth and Development

As discussed in Sections 4 and 9, areas targeted for future growth and development have been identified across Chenango County. Any areas of growth could be potentially impacted by the extreme temperature hazard because the entire County is exposed and vulnerable. Please refer to the specific areas of development indicated in tabular form and/or on the hazard maps included in the jurisdictional annexes in Volume II, Section 9 of this plan.

Effect of Climate Change on Vulnerability

Climate change is beginning to affect both people and resources in New York State, and these impacts are projected to continue growing. Impacts related to increasing temperatures and sea level rise are already being felt in the State. ClimAID: the Integrated Assessment for Effective Climate Change in New York State (ClimAID) was undertaken to provide decision-makers with information on the State's vulnerability to climate change and to facilitate the development of adaptation strategies informed by both local experience and scientific knowledge (New York State Energy Research and Development Authority [NYSERDA], 2011).

Each region in New York State, as defined by ClimAID, has attributes that will be affected by climate change. Chenango County is part of Region 3, Southern Tier. Some of the issues in this region, affected by climate change, include: dairy dominates the agricultural economy and milk production losses are projected, Susquehanna River flooding increases, and this region is one of the first parts of the State hit by invasive insects, weeds and other pests moving north (NYSERDA, 2011).

Temperatures in New York State are warming, with an average rate of warming over the past century of 0.25° F per decade. Average annual temperatures are projected to increase across New York State by 2° F to 3.4° F by the 2020s, 4.1° F to 6.8° F by the 2050s, and 5.3° F to 10.1° F by the 2080s. By the end of the century, the greatest warming is projected to be in the northern section of the State (NYSERDA, 2014).

Regional precipitation across New York State is projected to increase by approximately one to eight-percent by the 2020s, three to 12-percent by the 2050s, and four to 15-percent by the 2080s. By the end of the century, the greatest increases in precipitation are projected to be in the northern areas of the State (NYSERDA, 2014).

In Region 3, it is estimated that temperatures will increase by 3.6ºF to 7.1ºF by the 2050s and 4.2ºF to 11.6ºF by the 2080s (baseline of 47.5ºF). Precipitation totals will increase between 2 and 15% by the 2050s and 3 to 16% by the 2080s (baseline of 35 inches). The changes in temperature and precipitation are likely to produce an increase in extreme heat, intense precipitation, and more occurrences of short-duration warm season droughts. Both heavy precipitation events and warm season droughts are projected to become more frequent and intense during this century. Table 5.4.2-8 displays the projected seasonal precipitation change for the East Hudson and Mohawk River Valleys ClimAID Region (NYSERDA, 2014).

Table 5.4.2-10. Projected Seasonal Precipitation Change in Region 3, 2050s (% change)

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

Source: NYSERDA, 2011

The increase in the number of extreme heat days will lead to more heat related illness. Also, with an increase in severe storms there will be an increase in stormwater runoff which may be polluted and sicken individuals (Kaplan and Herb 2012). The effect on public health will likely increase the need for vulnerable population planning and may place heavier burdens on the healthcare system.

Change of Vulnerability

Overall, the County's vulnerability has not changed and the entire County will continue to be exposed and vulnerable to the extreme temperature events.

Additional Data and Next Steps

For future plan updates, the County can track data on extreme temperature events, obtain additional information on past and future events, particularly in terms of any injuries, deaths, shelter needs, pipe freeze, agricultural losses and other impacts. This will help to identify any concerns or trends for which mitigation measures should be developed or refined. In time, quantitative modeling of estimated extreme heat and cold events may be feasible as data is gathered and improved.