5.4.8 Severe Storms

The following section provides the hazard profile and vulnerability assessment for the severe storm hazard in Chenango County.

5.4.8.1 Hazard Profile

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

Hazard Description

For this HMP the severe storm hazard includes: thunderstorms, lightning, hail, tornadoes, high winds, and hurricanes/tropical storms, which are defined below.

Thunderstorms

A thunderstorm is a local storm produced by a cumulonimbus cloud and accompanied by lightning and thunder (NWS 2009a). A thunderstorm forms from a combination of moisture, rapidly rising warm air, and a force capable of lifting air, such as a warm and cold front, a sea breeze, or a mountain. Thunderstorms form from the equator to as far north as Alaska. Although thunderstorms generally affect a small area when they occur, they have the potential to become dangerous due to their ability in generating tornadoes, hailstorms, strong winds, flash flooding, and lightning. The NWS considers a thunderstorm *severe* only if it produces damaging wind gusts of 58 mph or higher or large hail one-inch (quarter size) in diameter or larger or tornadoes (NWS 2020).

Thunderstorms can lead to flooding, landslides, strong winds, and lightning. Roads could become impassable from flooding, downed trees or power lines, or a landslide. Downed utility poles can lead to utility losses, such as electricity, phone, and water (from loss of pumping and filtering capabilities).

Lightning

Lightning can damage homes and injure people. In the United States, an average of 300 people are injured, and 80 people are killed by lightning each year. Typical thunderstorms are 15 miles in diameter and last an average of 30 minutes. An estimated 100,000 thunderstorms occur each year in the United States, with approximately 10 percent of them classified as severe. During the warm season, thunderstorms are responsible for most of the rainfall.

Lightning is a bright flash of electrical energy produced by a thunderstorm. The resulting clap of thunder is the result of a shock wave created by the rapid heating and cooling of the air in the lightning channel. All thunderstorms produce lightning and are very dangerous. Lightning ranks as one of the top weather killers in the United States, killing approximately 50 people and injuring hundreds each year. Lightning can occur anywhere there is a thunderstorm. Lightning can be cloud to cloud, cloud to air, and cloud to ground.

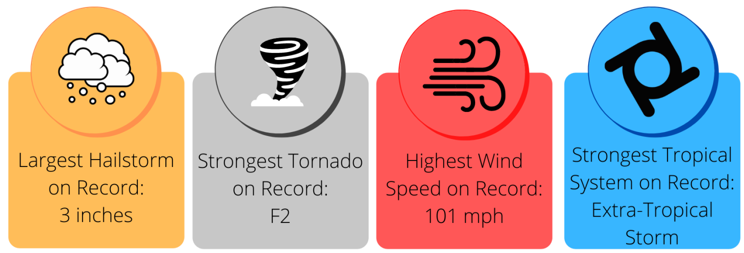
Hailstorms

Hail forms inside a thunderstorm where there are strong updrafts of warm air and downdrafts of cold water. If a water droplet is picked up by the updrafts, it can be carried well above the freezing level. Water droplets freeze when temperatures reach 32 °F or colder. As the frozen droplet begins to fall, it might thaw as it moves into warmer air toward the bottom of the thunderstorm, or the droplet might be picked up again by another updraft and carried back into the cold air to re-freeze. With each trip above and below the freezing level, the frozen droplet adds another layer of ice. The frozen droplet, with many layers of ice, falls to the ground as hail. Most hail is small and typically less than two inches in diameter (NWS 2009).

High Winds

Wind begins with differences in air pressures. It is rough horizontal movement of air caused by uneven heating of the earth's surface. Wind occurs at all scales, from local breezes lasting a few minutes to global winds resulting from solar heating of the earth (Rosenstiel School of Marine & Atmospheric Science 2005). High winds are often associated by other severe weather events such as thunderstorms, tornadoes, hurricanes, and tropical storms.

Figure 5.4.8-1. Recorded Event Records



Tornadoes

A tornado appears as a rotating, funnel-shaped cloud that extends from a thunderstorm to the ground with whirling winds that can reach 250 miles per hour (mph). Damage paths can be greater than 1 mile wide and 50 miles long. Tornadoes typically develop from either a severe thunderstorm or hurricane as cool air rapidly overrides a layer of warm air. Tornadoes typically move at speeds between 30 and 125 mph and can generate combined wind speeds (forward motion and speed of the whirling winds) exceeding 300 mph. The lifespan of a tornado rarely is longer than 30 minutes (FEMA 1997). Tornadoes can occur at any time of the year, with peak seasons at different times for different states (NSSL 2013).

Hurricanes/Tropical Storms

Tropical cyclones are fueled by a different heat mechanism than other cyclonic windstorms, such as Nor'easters and polar lows. The characteristic that separates tropical storms from other cyclonic systems is that at any height in the atmosphere, the center of a tropical storm will be warmer than its surroundings, a phenomenon called *warm core* storm systems (NOAA 2013). Tropical cyclones strengthen when water evaporated from the ocean is released as the saturated air rises, resulting in condensation of water vapor contained in the moist air. Tropical cyclones begin as disturbed areas of weather, often referred to as tropical waves. As the storm organizes, it is designated as a tropical depression.

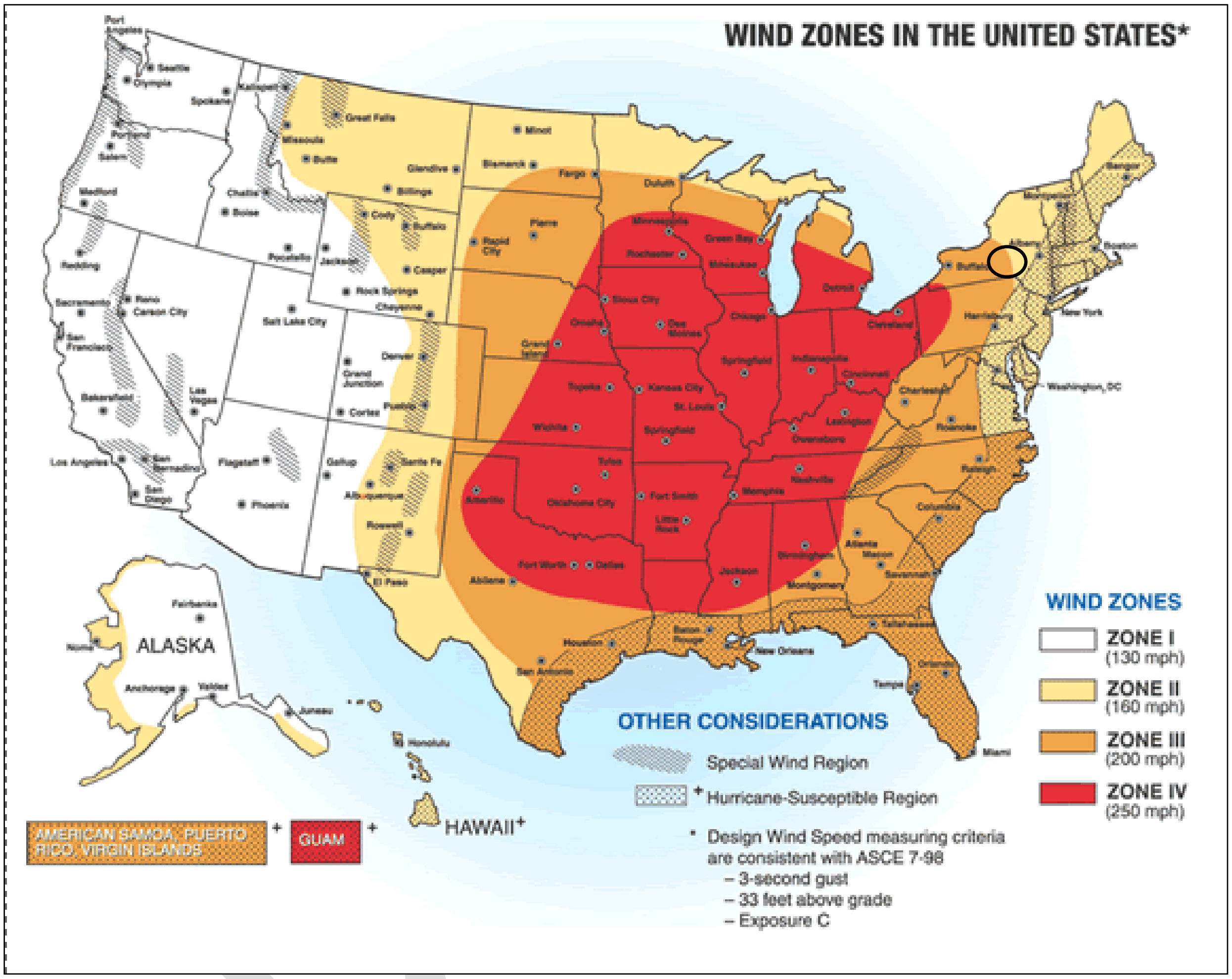
A tropical storm system is characterized by a low-pressure center and numerous thunderstorms that produce strong winds of 39 to 73 mph and heavy rain. A hurricane is a tropical storm that attains hurricane status when its wind speed reaches 74 mph or higher. Tropical systems can develop in the Atlantic between the Lesser Antilles and the African coast or in the warm tropical waters of the Caribbean Sea and Gulf of Mexico. These storms can move up the Atlantic coast of the United States, impacting the eastern seaboard, or move into the United States through the states along the Gulf Coast, bringing wind and rain as far north as New England before moving eastward offshore.

Despite Chenango County being located inland, coastal storms like tropical storms and hurricanes can impact the county (NYS DHSES 2019). Hurricanes and tropical storms can impact Chenango County during the official eastern U.S. hurricane season from June to November. However, late July to early October is the most likely period for hurricanes and tropical storms to impact Chenango County, due to the cooling of the North Atlantic Ocean waters (NYS DHSES 2014).

Location

The totality of Chenango County is exposed to hail, lightning, windstorms, high wind, thunderstorms, tornadoes, hurricanes, and tropical storms. Additionally, all of the county is subject to high winds from severe weather events. According to the FEMA Winds Zones of the United States map, Chenango County is located in both Wind Zones II and III, where wind speeds can reach up to 200 mph. Figure 5.4.8-2 illustrates wind zones across the United States, which indicate the impacts of the strength and frequency of wind activity per region. The information on the figure is based on 40 years of tornado data and 100 years of hurricane data collected by FEMA.

Figure 5.4.8-2 Wind Zones in the United States



Note: The black oval indicates the approximate location of Chenango County.

Extent

The extent (severity or magnitude) of a severe storm is largely dependent upon the most damaging aspects of each type of severe weather. This section describes the extent of thunderstorms, lighting, hail, windstorms, tornadoes, hurricanes, and tropical storms in Chenango County.

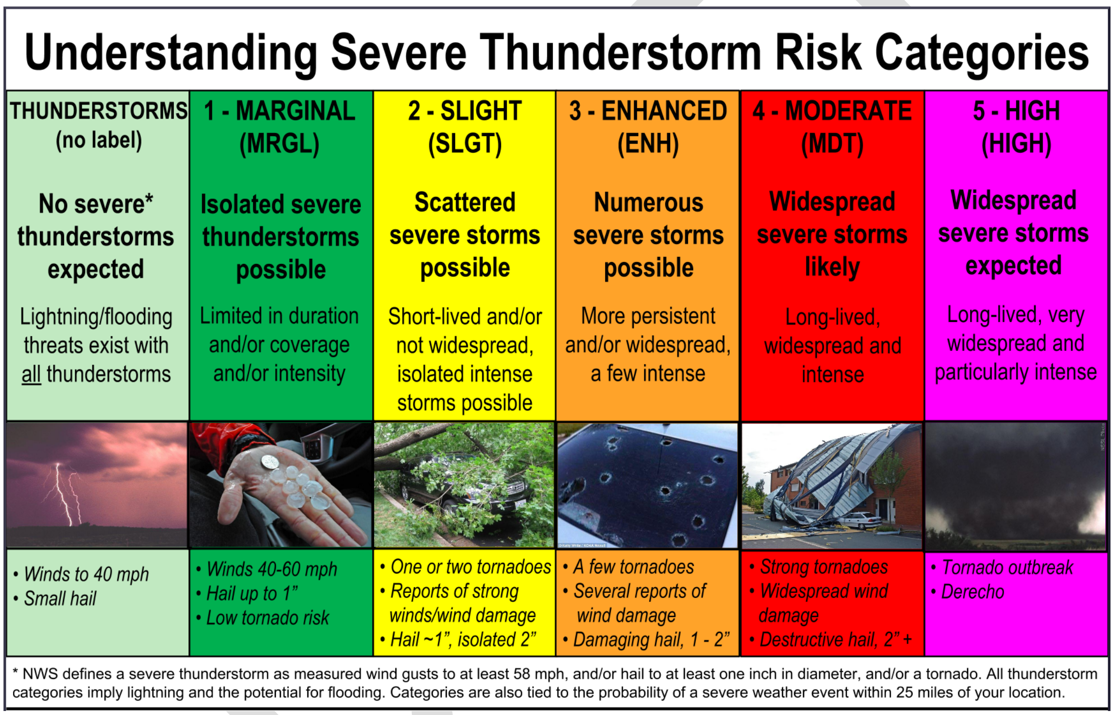
Thunderstorms

Severe thunderstorm watches and warnings are issued by the local NWS office and the Storm Prediction Center (SPC). The NWS and SPC will update the watches and warnings and notify the public when they are no longer in effect. Watches and warnings for tornadoes in New York State are as follows:

- A severe thunderstorm watch is issued by the National Weather Service when there are conditions favorable to severe storm development in the watch area which varies per storm. By definition, a severe thunderstorm is a thunderstorm that produces one inch hail or larger in diameter and/or winds equal or exceed 58 miles an hour. They are usually issued for a duration of 4 to 8 hours. Watches are normally issued in advance of the occurrence of severe weather. (NWS 2020).
- Severe Thunderstorm Warnings are issued when a thunderstorm that can produce hail in excess of one inch and/or winds greater than or equal to 58 mph is indicated by radar. Isolated tornado development can also occur. (NWS 2020).

Special Weather Statements for Near Severe Thunderstorms are issued for strong thunderstorms that are below severe levels but still might have some adverse impacts. Usually, they are issued for the threat of wind gusts of 40 to 58 mph or small hail less than one-inch in diameter (NWS 2009b). Figure 5.4.8-3 presents the severe thunderstorm risk categories, as provided by the SPC.

Figure 5.4.8-3 Severe Thunderstorm Risk Categories



Source: NOAA SPC 2017

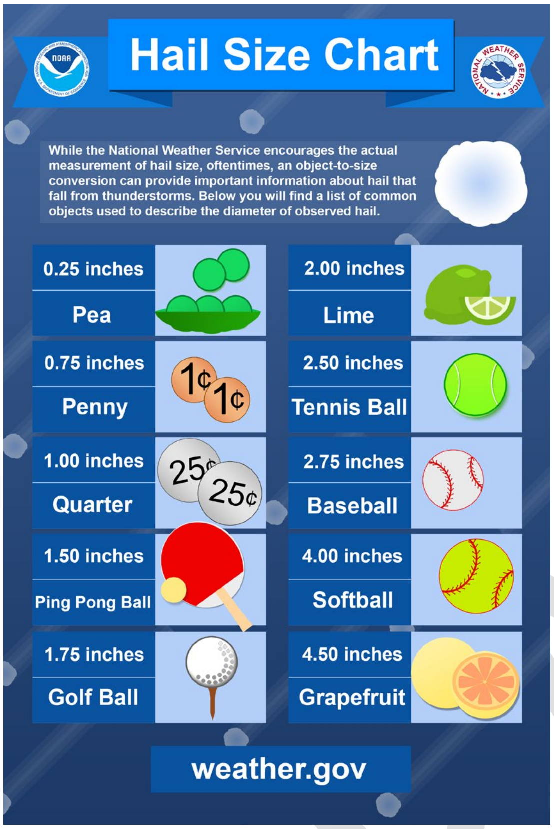
Lightning

Lightning is most often associated with moderate to severe thunderstorms. The severity of lightning refers to the frequency of lightning strikes during a storm. The New York City Office of Emergency Management notes that lightning strikes occur with moderate frequency in the State of New York, with 3.8 strikes occurring per square mile each year. Multiple devices are available to track and monitor the frequency of lightning (NYC Emergency Management, 2020).

Hailstorms

The severity of hail is measured by hail size, duration, and geographic extent. Most hail stones from hail storms vary in size. Most hailstorms produce stones that are the size of a marble or smaller and do not present damage to structures (NYS DHSES 2019). The size of hail is estimated by comparing it to a known object. Figure 5.4.8-4 shows the different sizes of hail and the comparison to real-world objects.

Figure 5.4.8-4 Hail Size



The Tornado and Storm Research Organization (TORRO) has determined ratings typical damage and hail sizes using the Hailstorm Intensity Scale (H0 to H10).

Table 5.4.8-1. TORRO Hailstorm Intensity Scale

TORRO Hailstorm Intensity Scale	Intensity Category	Typical Hail Diameter (mm)	Typical Damage Impacts
H0	Hard Hail	5	No damage
H1	Potentially Damaging	5-15	Slight general damage to plants, crops
H2	Significant	10-20	Significant damage to fruit, crops, vegetation
H3	Severe	20-30	Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored
H4	Severe	25-40	Widespread glass damage, vehicle bodywork damage
H5	Destructive	30-50	Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries
H6	Destructive	40-60	Bodywork of grounded aircraft dented, brick walls pitted
H7	Destructive	50-75	Severe roof damage, risk of serious injuries
H8	Destructive	60-90	Severe damage to aircraft bodywork
H9	Super Hailstorms	75-100	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open
H10	Super Hailstorms	>100	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open

Source: TORRO 2020

High Winds

The following table provides the descriptions of winds and their associated sustained wind speed used by the NWS during wind-producing events. The Beaufort wind scale, developed in 1805, is also used today to classify wind conditions (refer to https://www.spc.noaa.gov/faq/tornado/beaufort.html for details).

Table 5.4.8-2. NWS Wind Descriptions

Descriptive Term	Sustained Wind Speed (mph)
Strong, dangerous, or damaging	≥ 40
Very Windy	30-40
Windy	20-30
Breezy, brisk, or blustery	15-25
None	5-10/ 10-15/ 10-20
Light or light and variable wind	0-5

Source: NWS 2010
mph miles per hour

The NWS issues advisories and warnings for winds. Issuance is normally site-specific. High wind advisories, watches, and warnings are products issued by the NWS when wind speeds can pose a hazard or are life threatening. The criterion for each of these varies from state to state. According to the NWS (2020), wind warnings and advisories for New York State are as follows:

- *High Wind Warnings* are issued when sustained wind speeds of 40 mph or greater lasting for one hour or longer or for winds of 58 mph or greater for any duration or widespread damage are possible.
- *Wind Advisories* are issues when sustained winds of 30 to 39 mph are forecast for one hour or longer, or wind gusts of 46 to 57 mph for any duration.

Tornadoes

The magnitude or severity of a tornado is categorized using the Enhanced Fujita Tornado Intensity Scale (EF Scale). This is the scale now used exclusively for determining tornado ratings by comparing wind speed and actual damage. Figure 5.4.8-5. illustrates the relationship between EF ratings, wind speed, and expected tornado damage.

Figure 5.4.8-5. Explanation of EF-Scale Ratings

EF Rating	Wind Speeds	Expected Damage		
EF-0	65-85 mph	'Minor' damage: shingles blown off or parts of a roof peeled off, damage to gutters/siding, branches broken off trees, shallow rooted trees toppled.		
EF-1	86-110 mph	'Moderate' damage: more significant roof damage, windows broken, exterior doors damaged or lost, mobile homes overturned or badly damaged.		
EF-2	111-135 mph	'Considerable' damage: roofs torn off well constructed homes, homes shifted off their foundation, mobile homes completely destroyed, large trees snapped or uprooted, cars can be tossed.		
EF-3	136-165 mph	'Severe' damage: entire stories of well constructed homes destroyed, significant damage done to large buildings, homes with weak foundations can be blown away, trees begin to lose their bark.		
EF-4	166-200 mph	'Extreme' damage: Well constructed homes are leveled, cars are thrown significant distances, top story exterior walls of masonry buildings would likely collapse.		
EF-5	> 200 mph	'Massive/incredible' damage: Well constructed homes are swept away, steel-reinforced concrete structures are critically damaged, high-rise buildings sustain severe structural damage, trees are usually completely debarked, stripped of branches and snapped.		

Source: Cornell University 2018

Tornado watches and warning are issued by the local NWS office. A tornado watch is released when tornadoes are possible in an area. A tornado warning means a tornado has been sighted or indicated by weather radar. The current average lead time for tornado warnings is 13 minutes. Occasionally, tornadoes develop so rapidly, that little, if any, advance warning is possible (NOAA SPC 2018).

Hurricanes/Tropical Storms

The extent of a hurricane or tropical storm is commonly categorized in accordance with the Saffir-Simpson Hurricane Wind Scale, which assigns a designation of tropical storm for storms with sustained wind speeds below 74 mph and a hurricane category rating of 1–5 based on a hurricane's increasing sustained wind speed. This scale estimates potential property damage. Hurricanes reaching Category 3 and higher are considered *major hurricanes* because of their potential for significant loss of life and damage. Tropical Storms and Category 1 and 2 storms are still dangerous and require preventative measures (NOAA 2013). Figure 5.4.8-6 presents this scale, which is used to estimate the potential property damage and flooding expected when a hurricane makes landfall.

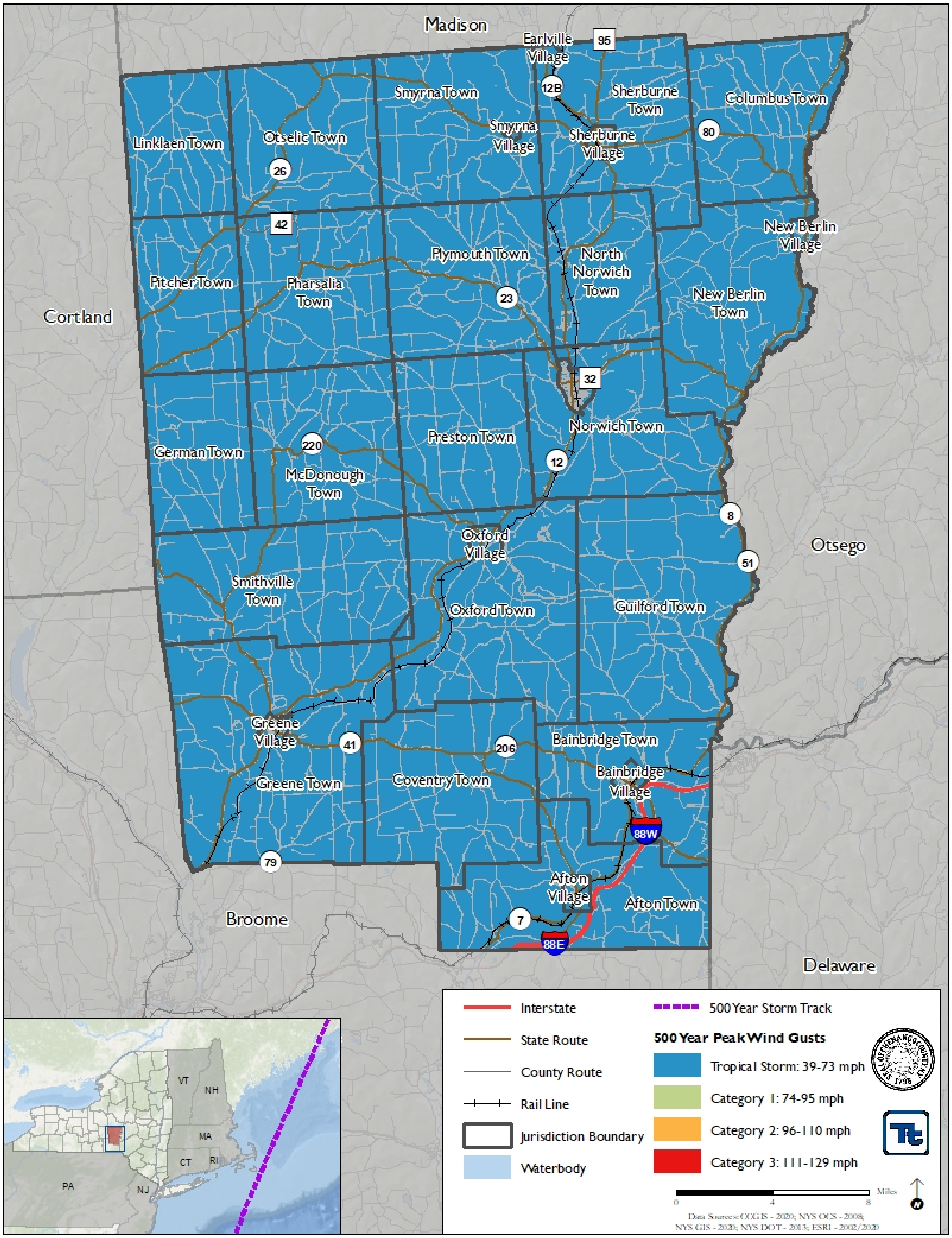
Figure 5.4.8-6. The Saffir-Simpson Hurricane Wind Scale

Source: NOAA, 2020

In evaluating the potential for hazard events of a given magnitude, a mean return period (MRP) is often used. The MRP provides an estimate of the magnitude of an event that might occur within any given year based on past recorded events. The MRP is the average period, in years, between occurrences of a hazard event, equal to the inverse of the annual frequency of exceedance (Dinicola 2009).

Peak wind speed projections were generated using HAZUS-MH v4.2. HAZUS-MH v4.2 estimated the maximum 3-second gust wind speeds for Chenango County to be below 39 mph for the 100-year MRP event and not strong enough to be considered a tropical storm. The maximum 3-second gust wind speeds for Chenango County range from 51 to 64 mph for the 500-year MRP event (tropical storm). The associated impacts and losses from these 100-year and 500-year MRP hurricane event model runs are reported in the Vulnerability Assessment. Figure 5.4.8-7. shows the estimated maximum 3-second gust wind speeds that can be anticipated in the study area associated with the 500-year MRP events.

Figure 5.4.8-7. Wind Speeds for the 500-Year MRP Event



Previous Occurrences and Losses

Many sources have provided historical information regarding previous occurrences and losses associated with severe storm events in Chenango County. According to NOAA-NCEI Storm Events Database, Chenango County has been impacted by 254 severe storm events that caused three fatalities, 10 injuries, $5.2 million in property damage, and $25,000 in crop damage.

Table 5.4.8-3. Severe Storm Events 1950- 2020

Hazard Type*	Number of Occurrences Between 1950 and 2020**	Total Fatalities	Total Injuries	Total Property Damage ($)	Total Crop Damage ($)
Funnel Cloud	2	0	0	$0	$0
Hail	46	0	0	$15,000	$15,000
Heavy Rain	2	0	0	$5,000	$0
High Wind	12	0	0	$589,760	$0
Hurricane	0	0	0	$0	$0
Lightning	5	0	1	$10,000	$0
Strong Wind	2	0	0	$11,000	$0
Thunderstorm Wind	172	1	4	$1.722 million	$2,000
Tornado	13	2	5	$2.82 million	$0
Tropical Depression	0	0	0	$0	$0
Tropical Storm	0	0	0	$0	$0
TOTAL	**254**	**3**	**10**	**$5.207 million**	**$25,000**

Source:NOAA-NCEI 2020; NHC 2018
** Remnants from tropical systems are included in other hazard totals*
***Includes only one occurrence per storm event- excludes multiple listings for the same day*

FEMA Disaster Declarations

Between 1954 and 2020, New York State was included in 65 FEMA declared severe storm-related major disaster declarations (DR) or emergencies (EM) classified as one or a combination of the following hazards: coastal storm, high tides, heavy rain, flooding, hurricane, ice storm, severe storms, thunderstorms, tornadoes, tropical storm, straight-line winds, and landslides. Of those declarations, Chenango County was included in 17 declarations (FEMA 2018). Table 5.4.8-4 lists FEMA DR and EM declarations for Chenango County.

Table 5.4.8-4. Severe Storm-Related FEMA Declarations for Chenango County, 1954 to 2020

Disaster Number	Event Date	Declaration Date	Incident Type	Title
DR-4480	January 20, 2020 -- Ongoing	3/20/2020	Biological	COVID-19 Pandemic
EM-3434	January 20, 2020 -- Ongoing	3/13/2020	Biological	COVID-19
DR-4472	October 31 -- November 1, 2019	12/19/2019	Severe Storm(s)	Severe Storms, Straight-Line Winds, and Flooding
DR-4397	August 13 -- August 15, 2018	10/1/2018	Flood	Severe Storms and Flooding
DR-4322	March 14 -- March 15, 2017	7/12/2017	Snow	Severe Winter Storm and Snowstorms
DR-4129	June 26 -- July 10, 2013	7/12/2013	Flood	Severe Storms and Flooding
EM-3351	October 27 -- November 8, 2012	10/28/2012	Hurricane	Hurricane Sandy
DR-4031	September 7 -- September 11, 2011	9/13/2011	Severe Storm(s)	Remnants of Tropical Storm Lee
EM-3341	September 7 -- September 11, 2011	9/8/2011	Severe Storm(s)	Remnants of Tropical Storm Lee

Disaster Number	Event Date	Declaration Date	Incident Type	Title
DR-1993	April 26 -- May 8, 2011	6/10/2011	Flood	Severe Storms, Flooding, Tornadoes, and Straight-Line Winds
DR-1857	August 8 -- August 10, 2009	9/1/2009	Severe Storm(s)	Severe Storms and Flooding
EM-3299	December 11 -- December 31, 2008	12/18/2008	Severe Storm(s)	Severe Winter Storm
DR-1670	November 16 -- November 17, 2006	12/12/2006	Severe Storm(s)	Severe Storms and Flooding
DR-1650	June 26 -- July 10, 2006	7/1/2006	Severe Storm(s)	Severe Storms and Flooding
EM-3262	August 29 -- October 1, 2005	9/30/2005	Hurricane	Hurricane Katrina Evacuation
DR-1589	April 2 -- April 4, 2005	4/19/2005	Severe Storm(s)	Severe Storms and Flooding
DR-1565	September 16 -- September 24, 2004	10/1/2004	Severe Storm(s)	Tropical Depression Ivan
DR-1534	May 13 -- June 17, 2004	8/3/2004	Severe Storm(s)	Severe Storms and Flooding
EM-3186	August 14 -- August 16, 2003	8/23/2003	Other	Power Outage
DR-1467	April 3 -- April 5, 2003	5/12/2003	Severe Ice Storm	Ice Storm
EM-3184	February 17 -- February 18, 2003	3/27/2003	Snow	Snow
EM-3173	December 25 -- January 4, 2002	2/25/2003	Snow	Snowstorms
DR-1391	11-Sep-01	9/11/2001	Fire	Fires and Explosions
EM-3155	May 22 -- November 1, 2000	10/11/2000	Other	West Nile Virus
DR-1335	May 3 -- August 12, 2000	7/21/2000	Severe Storm(s)	Severe Storms and Flooding
DR-1222	May 31 -- June 2, 1998	6/16/1998	Severe Storm(s)	Severe Storms and Tornadoes
DR-1095	January 19 -- January 30, 1996	1/24/1996	Flood	Severe Storms and Flooding
EM-3107	March 13 – March 17, 1993	3/17/1993	Snow	Severe Blizzard
DR-338	June 23, 1972	6/23/1972	Flood	Tropical Storm Agnes

Source: FEMA 2020

USDA Declarations

Between 2015 and 2020, Chenango County was included in five severe storm-related USDA Disaster Designations; refer to Table 5.4.8-5 below for more information.

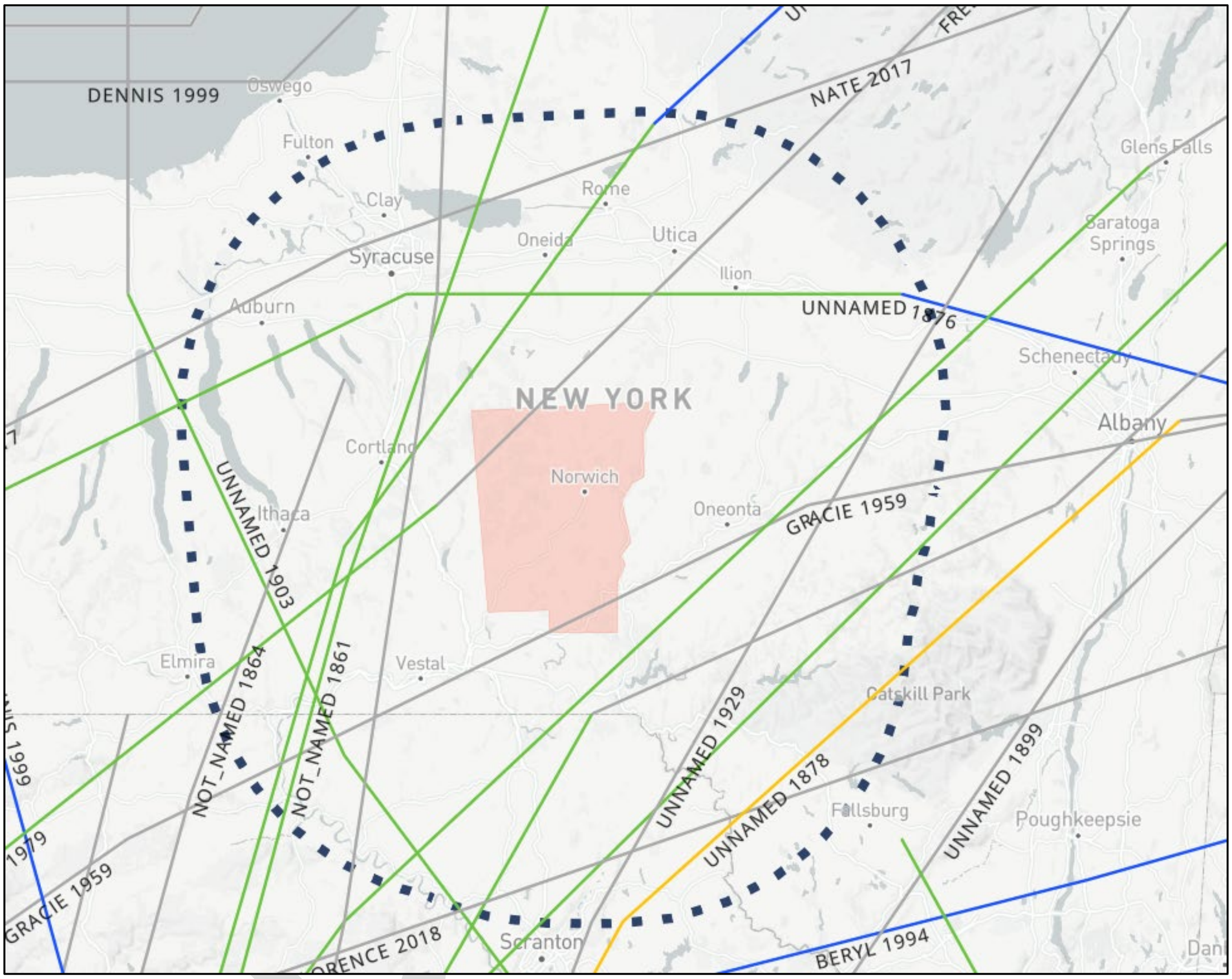
Table 5.4.8-5. USDA Severe Storm Disaster Designations for Chenango County, 2015-2020

Designation Number	Event Date	Declaration Date	Incident Type	Description
S3885	May 1 – July 14, 2015	September 9, 2015	Excessive rain, moisture, humidity; Hail; Wind, High Winds; Tornadoes; Lightning	Excessive Rain, High Winds, Hail, Lightning, and Tornado
S4265	April 1, 2017	December 13, 2017	Excessive rain, moisture, humidity	Excessive Rain
S4479	July 23, 2018	April 10, 2019	Excessive rain, moisture, humidity	Excessive Precipitation
S4622	April 1, 2019	January 29, 2020	Excessive rain, moisture, humidity	Excessive Rain
S4623	April 15, 2019	January 29, 2020	Excessive rain, moisture, humidity; Flood, Flash Flooding	Excessive Rain, Flash Flooding, and Flooding

Previous Events

Figure 5.4.8-8 from the NOAA Historical Hurricane Tracker illustrates the tracks of storms between 1842 and 2020 within 65 miles of Chenango County. Chenango County is rarely impacted by tropical systems but has recently experienced the direct and indirect landward effects associated with hurricanes and tropical storms, including Tropical Storm Lee in 2011 and Superstorm Sandy in 2012.

Figure 5.4.8-8. Historical Hurricane Tracks within 65 miles of Chenango County, 1878 to 2018



Source:NOAA Historical Hurricane Tracks 2020
Note:Category refers to tropical cyclone strength. TS: Tropical Storm, TD: Tropical Depression, ET: Extra-tropical Storm, H1: Category 1 Hurricane, H2: Category 2 Hurricane, H3: Category 3 Hurricane, H4: Category 4 Hurricane.

The NOAA National Centers for Environmental Information (NCEI) Storm Events database records severe storm events. For this HMP update, known severe storm events that have impacted Chenango County between July 2014 and 2020 are identified in Table 5.4.8-6. With severe storm documentation for New York State and Chenango County being extensive, not all sources have been identified or researched. Therefore, Table 5.4.8-6 might not include all events that have occurred in the county. For events prior to 2014, refer to Appendix E (Supplementary Data). For detailed information on damages and impacts to each municipality, refer to Section 9 (Jurisdictional Annexes).

Table 5.4.8-6. Severe Storm Events in Chenango County, July 2014 to 2020

Dates of Event	Event Type	FEMA Declaration Number (if applicable)	County Designated?	Event Details*
July 1, 2014	Thunderstorm Wind	N/A	No	Severe thunderstorms blew down trees on Bartlett Road and Route 23 in South Plymouth, North Road in Plymouth, and took down trees and wires in Norwich.
July 3, 2014	Thunderstorm Wind	N/A	No	A cold front interacting with humid, warm air from a tropical system caused large winds up to 50 knots, resulting in downed trees in Earlville and along Route 12B.
July 7, 2014	Thunderstorm Wind	N/A	No	Severe thunderstorms blew down trees and wires in Oxford.
July 8, 2014	Thunderstorm Wind	N/A	No	In East Pharsalia, severe thunderstorms blew down trees on County Route 7 and poles on County Route 10.
July 9, 2014	Thunderstorm Wind	N/A	No	Severe thunderstorms blew town trees in Norwich
Sept. 2, 2014	Thunderstorm Wind; Tornado	N/A	No	Severe thunderstorms affecting Chenango County blew down trees in McDonough, Preston, North Afton, and formed an EF-1 tornado that touched down near the intersection of Saint Johns Road and Hill Top Drive in Bennettsville.
June 12, 2015	Thunderstorm Wind	N/A	No	Severe thunderstorms resulted in blown-down trees and downed lines near Oxford and blown-down trees near Bainbridge/Afton.
July 15, 2016	Thunderstorm Wind	N/A	No	A thunderstorm resulted in downed trees in New Berlin near the intersection of Route 8 and Turnpike Road.
July 19, 2015	Thunderstorm Wind	N/A	No	Bainbridge saw downed trees resulting from a severe thunderstorm.
August 13, 2015	Thunderstorm Wind	N/A	No	A thunderstorm caused downed trees in New Berlin.
April 16, 2017	Thunderstorm Wind	N/A	No	Severe thunderstorms caused 50 knot winds and downed trees and wires on Route 22 near East McDonough and in Norwich.
May 1, 2017	Thunderstorm Wind	N/A	No	Severe thunderstorms resulted in reported 65 knot winds in Oxford, where trees were uprooted trees, which impacted the intersection of Routes 12 and 80 in Sherburne. Preston, New Berlin, Oxford, and Guilford. A microburst caused wind speeds ranging between 90 and 100 mph and uprooted 100 healthy trees near the Norwich Reservoir.
June 30, 2017	Thunderstorm Wind	N/A	No	Trees and wires were downed by a severe thunderstorm that impacted Preston, Pharsalia, and Willet.
August 4, 2017	Thunderstorm Wind	N/A	No	A severe thunderstorm caused damage to trees and power lines in Bainbridge, Smithville Flats, Oxford, and Sherburne.
August 12, 2017	Thunderstorm Wind	N/A	No	Thunderstorms with wind speeds up to 65 knots knocked over trees in McDonough and Norwich.
May 4, 2018	Thunderstorm Wind	N/A	No	Cortland Street in Norwich experienced downed trees and wires, sparking a grass fire.
June 13, 2018	Thunderstorm Wind	N/A	No	County Route 3A in Greene, Tall Pines Campground in East Guilford, and Brisben each experienced impacts from a thunderstorm that produced wind speeds of up to 50 knots.
February 25, 2019	High Wind	N/A	No	Strong winds up to 50 knots caused impacts to the County and region.
July 19, 2019	Thunderstorm Wind	N/A	No	Afton saw impacts from 50 knot winds resulting from a strong thunderstorm. Winds brought down trees and wires on Long Hill Road.

Dates of Event	Event Type	FEMA Declaration Number (if applicable)	County Designated?	Event Details*
July 30, 2019	Hail	N/A	No	Severe thunderstorms produced hail up to one inch in size (ranking up to H3 on the TORRO intensity scale) in Lincklaen.
August 8, 2018	Thunderstorm Wind	N/A	No	A thunderstorm impacting Central New York brought downed trees to Oxford,
August 18, 2019	Thunderstorm Wind	N/A	No	Severe thunderstorms moved through Central New York and brought down a tree along Route 235 in Coventry.
October 31, 2019	Thunderstorm Wind	N/A	No	Severe thunderstorms with winds up to 50 knots brought down multiple trees near Smyrna and Plymouth.
August 27, 2020	Thunderstorm Wind	N/A	No	A series of severe thunderstorms impacted Chenango County. Damages included downed trees and wires on Williams Road in Greene, causing $10,000 in property damage.
October 7, 2020	Thunderstorm Wind	N/A	No	A series of storms provided widespread tree and powerline damage in Chenango County. In Earlville, winds downed a tree on a car on Thompson Hill Road. In Otselic, Norwich, and McDonough, downed trees blocked a roadway. Overall, the storms caused approximately $35,000 in property damage.

Source(s):FEMA 2020; NOAA-NCEI 2020

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

FEMA Federal Emergency Management Agency

HMP Hazard Mitigation Plan

NCDC National Centers for Environmental Information

NOAA National Oceanic and Atmospheric Administration

NWS National Weather Service

NYS New York State

Climate Change Projections

The projected increase in precipitation is expected to fall in heavy downpours and less in light rains. Downpours are likely to increase in intensity and frequency. That change that has the potential to affect drinking water through flood key rail lines, roadways, and transportation hubs, flooding contaminating wells, heighten the risk of riverine flooding; and increase delays and hazards related to extreme weather events (NYSERDA 2011). Less frequent rainfall during the summer months can impact the ability of water supply systems to provide water. Increasing water temperatures in rivers and streams will affect aquatic health and reduce the capacity of streams to assimilate effluent wastewater treatment plants and industrial discharges (NYSERDA 2011). Figure 5.4.8-9 shows the projected seasonal precipitation changes for Southern Tier ClimAID Region (NYSERDA 2014).

Figure 5.4.8-9. Projected Seasonal Precipitation Change in Region 3, 2050s (% change)

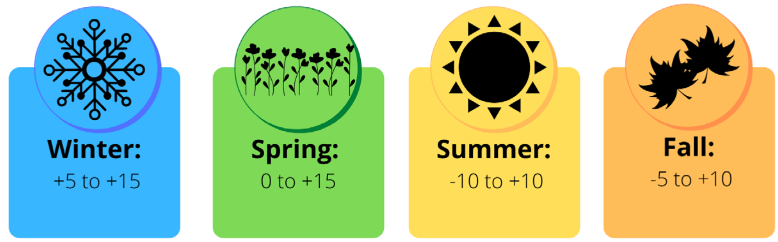
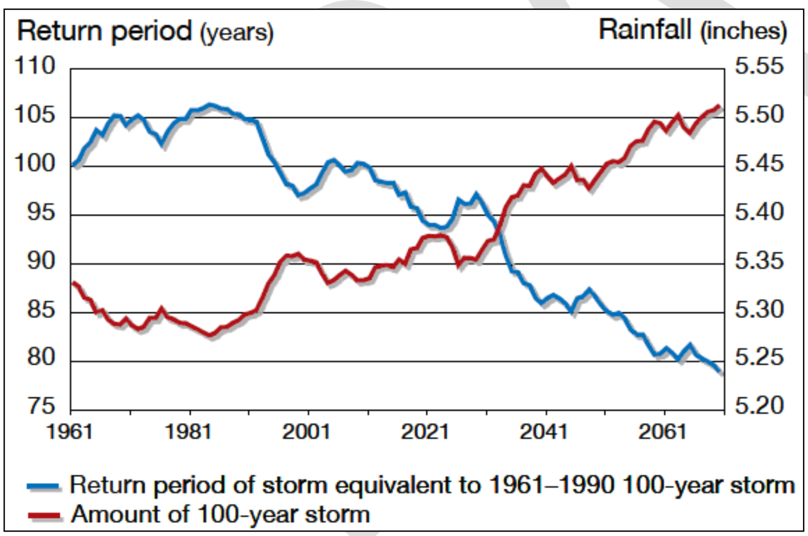


Figure 5.4.8-10 displays the projected rainfall and frequency of extreme storms in New York State. The amount of rainfall in a 100-year event is projected to increase. However, the number of years between such storms (return period) is projected to decrease. Rainstorms will become more severe and more frequent (NYSERDA 2011).

Figure 5.4.8-10. Projected Rainfall and Frequency of Extreme Storms



Source:NYSERDA 2011

Probability of Future Occurrences

Table 5.4.8-7 summarizes data regarding the probability of occurrences of severe storm events in Chenango County based on the historic record. Thunderstorm events are the most common in Chenango County, followed by hail events. The information used to calculate the probability of occurrences is based solely on NOAA-NCEI storm events database results.

Table 5.4.8-7. Probability of Future Occurrence of Severe Storm Events

Hazard Type	Number of Occurrences Between 1954 and 2020	% Chance of Occurring in Any Given Year
Funnel Cloud	2	3.0
Hail	46	68.7
Heavy Rain	2	3.0
High Wind	12	18.0
Hurricane	0	N/A
Lightning	5	7.5
Strong Wind	2	3.0
Thunderstorm Wind	172	100.0
Tornado	13	19.4
Tropical Depression	0	N/A
Tropical Storm	0	N/A
TOTAL	**254**	**100.0**

Source: NOAA-NCEI 2020
Note: Hazard occurrences include federally declared disasters since the 1950 Federal Disaster Relief Act. Due to limitations in data, not all severe storm events occurring between 1954 and 1996 are accounted for in the tally of occurrences. As a result, the number of hazard occurrences is underestimated.

Chenango County is expected to continue experiencing direct and indirect impacts of severe storms annually. These storms may induce secondary hazards such as flooding and utility failure. In Section 5.3 (Hazard Ranking), the identified hazards of concern for 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 severe storms in the county is considered 'frequent' (100% annual chance of occurring; occurring multiple times a year).

5.4.8.2 Vulnerability Assessment

A probabilistic assessment was conducted for the 100-year and 500-year MRP hurricane wind event through a Level 2 analysis in HAZUS-MH v4.2 to analyze the severe storm hazard and provide a range of loss estimates due to wind impacts. Refer to Section 5.1 (Methodology and Tools) for additional details on the methodology used to assess the severe storm risk.

Impact on Life, Health and Safety

The impact of a severe weather event and wind on life, health and safety is dependent upon several factors including the severity of the event and whether adequate warning time was provided to residents. For the purposes of this HMP, all of Chenango County is considered vulnerable to a severe weather event and wind impacts (i.e. 48,438 persons total, American Community Survey 2018). HAZUS-MH v4.2 estimates that no persons will be displaced from their homes or will seek shelter during a 100-year or 500-year MRP hurricane wind event. Secondary impacts caused by extreme wind events include downed trees, damaged buildings, and debris carried by high winds, which can lead to injury or loss of life.

Socially vulnerable populations are most susceptible to severe weather events, based on a number of factors including their physical and financial ability to react or respond during a hazard and the location and construction quality of their housing. Vulnerable populations include homeless persons, elderly (over 65 years old), low income or linguistically isolated populations, people with life-threatening illnesses, and residents living in areas that are isolated from major roads. The population over the age of 65 is also more vulnerable and, physically, they may have more difficulty evacuating. They may require extra time or outside assistance during evacuations and are more likely to seek or need medical attention which may not be available due to isolation during a storm event. Within Chenango County, there are approximately 9,539 people over the age of 65 and 6,826 people below the poverty level (American Community Survey 2018).

Additionally, people located outdoors (i.e., recreational activities and farming) are considered most vulnerable to hailstorms, thunderstorms and tornadoes. This is because there is little to no warning and shelter may not be available. Moving to a lower risk location will decrease a person's vulnerability. Refer to Section 4 (County Profile) for population statistics for each participating jurisdiction.

Impact on General Building Stock

Damage to buildings is dependent upon several factors, including wind speed, storm duration, and path of the storm track. Building construction also plays a major role in the extent of damage resulting from a coastal storm. Due to differences in construction, residential structures are generally more susceptible to wind damage than commercial and industrial structures. Wood and masonry buildings, in general, regardless of their occupancy class, tend to experience more damage than concrete or steel buildings. Furthermore, high-rise buildings are also very vulnerable structures.

To better understand these risks, HAZUS-MH v4.2 was used to estimate the expected wind-related building damages. Table 5.4.8-8 summarizes the definition of the damage categories. HAZUS-MH v4.2 estimates there will be approximately $0 and $2.3 million of replacement cost damages caused by the 100-year and 500-year MRP hurricane wind event, respectively (Table 5.4.8-10). Specific types of wind damages are also summarized in HAZUS-MH v4.2 at the following wind damage categories: no damage/very minor damage, minor damage, moderate damage, severe damage, and total destruction. HAZUS-MH v4.2 estimates that 5 structures would experience minor damage during a 500-year MRP hurricane wind event. HAZUS-MH v4.2 estimates no damages during a 100-year MRP hurricane wind event. Refer to Table 5.4.8-9 for details on damage for all occupancy classes. Furthermore, HAZUS-MH v4.2 estimated damages are summarized by general occupancy classes in Table 5.4.8-10. HAZUS-MH v4.2 estimates that most damages caused by severe wind will occur to residential structures in the County for the 500-year MRP wind events; approximately $2.3 million.

Table 5.4.8-8 Description of Damage Categories

Qualitative Damage Description	Roof Cover Failure	Window Door Failures	Roof Deck	Missile Impacts on Walls	Roof Structure Failure	Wall Structure Failure
No Damage or Very Minor Damage Little or no visible damage from the outside. No broken windows, or failed roof deck. Minimal loss of roof over, with no or very; Limited water penetration.	≤ 2%	No	No	No	No	No
Minor Damage Maximum of one broken window, door or garage door. Moderate roof cover loss that can be covered to prevent additional water entering the building. Marks or dents on walls requiring painting or patching for repair.	> 2% and ≤ 15%	One window, door, or garage door failure	No	<5 impacts	No	No
Moderate Damage Major roof cover damage, moderate window breakage. Minor roof sheathing failure. Some resulting damage to interior of building from water.	> 15% and ≤ 50%	> one and ≤ the larger of 20% & 3	1 to 3 panels	Typically 5 to 10 impacts	No	No

Qualitative Damage Description	Roof Cover Failure	Window Door Failures	Roof Deck	Missile Impacts on Walls	Roof Structure Failure	Wall Structure Failure
Severe Damage Major window damage or roof sheathing loss. Major roof cover loss. Extensive damage to interior from water.	> 50%	> the larger of 20% & 3 and ≤50%	> 3 and ≤ 25%	Typically 10 to 20 impacts	No	No
Destruction Complete roof failure and/or, failure of wall frame. Loss of more than 50% of roof sheathing.	Typically > 50%	> 50%	> 25%	Typically > 20 impacts	Yes	Yes

Source: HAZUS-MH Hurricane Technical Manual

Table 5.4.8-9 Damage State Categories for Buildings During 100-Year and 500-Year MRP Hurricane Wind Event in Chenango County

Occupancy Class	Total Number of Buildings in Occupancy	Severity of Expected Damage	100-year		500-year	
			Building Count	Percent Buildings in Occupancy Class	Building Count	Percent Buildings in Occupancy Class
Residential Exposure (Single and Multi-Family Dwellings)	25,993	None	25,993	100.0%	25,991	99.9%
		Minor	0	0.0%	2	<0.1%
		Moderate	0	0.0%	0	0.0%
		Severe	0	0.0%	0	0.0%
		Complete Destruction	0	0.0%	0	0.0%
Commercial Buildings	2,478	None	2,478	100.0%	2,477	99.9%
		Minor	0	0.0%	1	<0.1%
		Moderate	0	0.0%	0	0.0%
		Severe	0	0.0%	0	0.0%
		Complete Destruction	0	0.0%	0	0.0%
Industrial Buildings	130	None	130	100.0%	129	99.9%
		Minor	0	0.0%	1	<0.1%
		Moderate	0	0.0%	0	0.0%
		Severe	0	0.0%	0	0.0%
		Complete Destruction	0	0.0%	0	0.0%
Government, Religion, Agricultural, and Education Buildings	2,519	None	2,519	100.0%	2,518	99.9%
		Minor	0	0.0%	1	<0.1%
		Moderate	0	0.0%	0	0.0%
		Severe	0	0.0%	0	0.0%
		Complete Destruction	0	0.0%	0	0.0%

Source: HAZUS v4.2

Table 5.4.8-10 Expected Building Damage for 100-Year and 500-Year MRP Hurricane Wind Events for Chenango County

Jurisdiction	Total Replacement Cost Value (All Occupancies)	Estimated Total Damages		Percent of Total Building and Contents Replacement Cost Value (RCV)		Estimated Residential Damages		Estimated Commercial Damages		Estimated Damages for All Other Occupancies	
		100-Year	500-Year	100-Year	500-Year	100-Year	500-Year	100-Year	500-Year	100-Year	500-Year
Afton (T)	$864,699,700	$0	$164,508	0.0%	<0.1%	$0	$164,508	$0	$0	$0	$0
Afton (V)	$1,019,188,804	$0	$54,291	0.0%	<0.1%	$0	$54,291	$0	$0	$0	$0
Bainbridge (T)	$915,529,770	$0	$119,718	0.0%	<0.1%	$0	$119,718	$0	$0	$0	$0
Bainbridge (V)	$584,957,184	$0	$56,992	0.0%	<0.1%	$0	$56,992	$0	$0	$0	$0
Columbus (T)	$862,354,994	$0	$21,196	0.0%	<0.1%	$0	$21,196	$0	$0	$0	$0
Coventry (T)	$703,237,371	$0	$152,497	0.0%	<0.1%	$0	$151,533	$0	$269	$0	$694
Earlville (V)	$87,153,360	$0	$4,131	0.0%	<0.1%	$0	$4,131	$0	$0	$0	$0
German (T)	$203,106,925	$0	$41,269	0.0%	<0.1%	$0	$41,269	$0	$0	$0	$0
Greene (T)	$1,319,736,091	$0	$507,693	0.0%	<0.1%	$0	$502,430	$0	$1,472	$0	$3,792
Greene (V)	$686,754,321	$0	$123,665	0.0%	<0.1%	$0	$122,698	$0	$270	$0	$696
Guilford (T)	$1,010,987,220	$0	$82,523	0.0%	<0.1%	$0	$82,523	$0	$0	$0	$0
Lincklaen (T)	$229,671,722	$0	$39,225	0.0%	<0.1%	$0	$39,225	$0	$0	$0	$0
McDonough (T)	$339,089,552	$0	$83,289	0.0%	<0.1%	$0	$83,289	$0	$0	$0	$0
New Berlin (T)	$778,713,525	$0	$38,804	0.0%	<0.1%	$0	$38,804	$0	$0	$0	$0
New Berlin (V)	$432,605,770	$0	$13,019	0.0%	<0.1%	$0	$13,019	$0	$0	$0	$0
North Norwich (T)	$823,054,726	$0	$21,417	0.0%	<0.1%	$0	$21,417	$0	$0	$0	$0
Norwich (C)	$3,140,959,099	$0	$84	0.0%	<0.1%	$0	$84	$0	$0	$0	$0
Norwich (T)	$2,080,430,801	$0	$33,693	0.0%	<0.1%	$0	$33,693	$0	$0	$0	$0
Otselic (T)	$461,373,250	$0	$73,029	0.0%	<0.1%	$0	$73,029	$0	$0	$0	$0
Oxford (T)	$958,330,880	$0	$110,775	0.0%	<0.1%	$0	$110,775	$0	$0	$0	$0
Oxford (V)	$679,367,779	$0	$49,436	0.0%	<0.1%	$0	$49,436	$0	$0	$0	$0
Pharsalia (T)	$389,863,952	$0	$57,457	0.0%	<0.1%	$0	$57,457	$0	$0	$0	$0
Pitcher (T)	$315,344,531	$0	$60,019	0.0%	<0.1%	$0	$60,019	$0	$0	$0	$0
Plymouth (T)	$510,829,645	$0	$51,126	0.0%	<0.1%	$0	$51,126	$0	$0	$0	$0
Preston (T)	$348,948,426	$0	$46,541	0.0%	<0.1%	$0	$46,541	$0	$0	$0	$0
Sherburne (T)	$1,113,221,738	$0	$39,548	0.0%	<0.1%	$0	$39,548	$0	$0	$0	$0
Sherburne (V)	$768,785,678	$0	$16,284	0.0%	<0.1%	$0	$16,284	$0	$0	$0	$0
Smithville (T)	$690,983,617	$0	$144,102	0.0%	<0.1%	$0	$144,102	$0	$0	$0	$0
Smyrna (T)	$519,858,907	$0	$48,325	0.0%	<0.1%	$0	$48,325	$0	$0	$0	$0
Smyrna (V)	$161,456,951	$0	$2,638	0.0%	<0.1%	$0	$2,638	$0	$0	$0	$0
Chenango County (Total)	**$23,000,596,289**	**$0**	**$2,257,295**	**0.0%**	**<0.1%**	**$0**	**$2,250,102**	**$0**	**$2,011**	**$0**	**$5,181**

Sources: HAZUSv4.2; Chenango County GIS Services 2020; RS Means 2019
Note: T= Town; V= Village; C= City

Impact on Critical Facilities

Critical facilities are at risk of being impacted by high winds associated with structural damage, or falling tree limbs/flying debris, which can result in the loss of power. Power loss can greatly impact households, business operations, public utilities, and emergency personnel. For example, vulnerable populations in Chenango County are at risk if power loss results in interruption of heating and cooling services, stagnated hospital operations, and potable water supplies. Emergency personnel such as police, fire, and EMS will not be able to effectively respond in a power loss event to maintain the safety of its citizens.

HAZUS-MH v4.2 estimates the probability that critical facilities (i.e., medical facilities, fire/EMS, police, EOC, schools, and user-defined facilities such as shelters and municipal buildings) may sustain minor damage as a result of the 100-year and 500-year MRP hurricane wind event. Additionally, HAZUS-MH v4.2 estimates the loss of use for each facility in number of days. Overall, HAZUS-MH v4.2 estimates that no critical facilities in Chenango County will experience damages or loss of functionality due to a 100-year or 500-year MRP hurricane wind event.

Impact on Economy

Severe storm events can have short- and long-lasting impacts on the economy. When a business is closed during storm recovery, there is lost economic activity in the form of day-to-day business and wages to employees. Overall, economic impacts include the loss of business function (e.g., tourism, recreation), damage to inventory, relocation costs, wage loss and rental loss due to the repair/replacement of buildings.

Impacts to transportation lifelines affect both short-term (e.g., evacuation activities) and long-term (e.g., day-to-day commuting and goods transport) transportation needs. Utility infrastructure (power lines, gas lines, electrical systems) could suffer damage and impacts can result in the loss of power, which can impact business operations and can impact heating or cooling provision to the population.

HAZUS-MH v4.2 estimates the total economic loss associated with the 100-year and the 500-year MRP hurricane wind event (direct building losses and business interruption losses). Direct building losses are the estimated costs to repair or replace the damage caused to the building. This is reported in the "Impact on General Building Stock" section discussed earlier. Business interruption losses are the losses associated with the inability to operate a business because of the wind damage sustained during the storm or the temporary living expenses for those displaced from their home because of the event. HAZUS-MH v4.2 estimates that there are no economic losses for Chenango County caused by the 100-year MRP hurricane wind event. Refer to Table 5.4.8-11 for a summary of HAZUS-MH v4.2 estimated economic losses for Chenango County caused by the 100-year and the 500-year MRP hurricane wind events.

Table 5.4.8-11 Estimated Economic Losses for the 100-Year and 500-Year Mean Return Period Hurricane Wind Events

Mean Return Period (MRP)	Inventory Loss	Relocation Loss	Building and Content Losses	Wages Losses	Rental Losses	Income Losses
100-year MRP	$0	$0	$0	$0	$0	$0
500-year MRP	$0	$0	$2,257,300	$0	$0	$0

Source: HAZUS-MH v4.2

Debris management can be costly and may also impact the local economy. HAZUS-MH estimates the amount of building and tree debris that may be produced as result of the 100- and 500-year MRP wind events. Because the estimated debris production does not include flooding, this is likely a conservative estimate and may be higher if multiple impacts occur. According to the HAZUS-MH Hurricane User Manual, estimates of weight and volume of eligible tree debris consist of downed trees that would likely be collected and disposed at public expense. Refer to the User Manual for additional details regarding these estimates. Table 5.4.8-12 summarizes debris production estimates for the 100- and 500-year MRP wind events.

Table 5.4.8-12 Debris Production for 100- and 500-Year Mean Return Period Hurricane-Related Winds

Jurisdiction	Debris Production During a 100-Year and 500-Year MRP Event							
	Brick and Wood (tons)		Concrete and Steel (tons)		Tree (tons)		Eligible Tree Volume (cubic yards)	
	100-Year	500-Year	100-Year	500-Year	100-Year	500-Year	100-Year	500-Year
Afton (T)	0	0	0	0	0	1,142	0	11,426
Afton (V)	0	0	0	0	0	377	0	3,771
Bainbridge (T)	0	0	0	0	0	405	0	4,048
Bainbridge (V)	0	0	0	0	0	211	0	2,109
Columbus (T)	0	0	0	0	0	0	0	0
Coventry (T)	0	1	0	0	0	721	0	7,211
Earlville (V)	0	0	0	0	0	0	0	0
German (T)	0	0	0	0	0	596	0	5,962
Greene (T)	0	8	0	0	0	2,363	0	23,627
Greene (V)	0	1	0	0	0	624	0	6,243
Guilford (T)	0	0	0	0	0	0	0	0
Lincklaen (T)	0	0	0	0	0	698	0	6,983
McDonough (T)	0	0	0	0	0	1,261	0	12,605
New Berlin (T)	0	0	0	0	0	0	0	0
New Berlin (V)	0	0	0	0	0	0	0	0
North Norwich (T)	0	0	0	0	0	0	0	0
Norwich (C)	0	0	0	0	0	0	0	0
Norwich (T)	0	0	0	0	0	0	0	0
Otselic (T)	0	0	0	0	0	1,300	0	13,001
Oxford (T)	0	0	0	0	0	489	0	4,886
Oxford (V)	0	0	0	0	0	503	0	5,031
Pharsalia (T)	0	0	0	0	0	1,023	0	10,229
Pitcher (T)	0	0	0	0	0	1,069	0	10,685
Plymouth (T)	0	0	0	0	0	805	0	8,053
Preston (T)	0	0	0	0	0	669	0	6,688
Sherburne (T)	0	0	0	0	0	0	0	0
Sherburne (V)	0	0	0	0	0	0	0	0
Smithville (T)	0	0	0	0	0	1,076	0	10,755
Smyrna (T)	0	0	0	0	0	632	0	6,316
Smyrna (V)	0	0	0	0	0	0	0	0
Chenango County (Total)	**0**	**11**	**0**	**0**	**0**	**15,963**	**0**	**159,630**

Source: HAZUS-MH v4.2

Impact on the Environment

The impact of severe weather events on the environment varies, but researchers are finding that the long-term impacts of more severe weather can be destructive to the natural and local environment. National organizations such as USGS and NOAA have been studying and monitoring the impacts of extreme weather phenomena as it impacts long term climate change, streamflow, river levels, reservoir elevations, rainfall, floods, landslides, erosion, etc. (USGS 2020). For example, severe weather that creates longer periods of rainfall can erode natural banks along waterways and degrade soil stability for terrestrial species. Tornadoes can tear apart habitats causing fragmentation across ecosystems. Researchers also believe that a greater number of diseases will spread across ecosystems because of impacts that severe weather and climate change will have on water supplies (NOAA 2013). Overall, as the physical environment becomes more altered, species will begin to contract or migrate in response, which may cause additional stressors to the entire ecosystem within Chenango County.

Cascading Impacts on Other Hazards

Severe weather events and severe wind events can escalate the impacts of flooding and severe winter weather. Severe weather may carry extreme rainfall that could exacerbate flooding and could increase the intensity of snow and blizzard events. More information about the flooding and severe winter weather hazards of concern can be found in Section 5.4.4 and Section 5.4.9, respectively.

Future Changes that May Impact Vulnerability

Understanding future changes that effect vulnerability in the County can assist in planning for future development and ensure establishment of appropriate mitigation, planning, and preparedness measures. Changes in the natural environment and built environment and how they interact can also provide insight about ways to plan for the future.

Projected Development

Any areas of growth could be potentially impacted by the severe storm hazard because the entire County is exposed and vulnerable to the wind hazard associated with severe storms. However, due to increased standards and codes, new development may be less vulnerable to the severe storm hazard compared to the aging building stock in the County.

Projected Changes in Population

According to the U.S. Census Bureau, the population in Chenango County has decreased by approximately 4.2-percent between 2010 and 2018 (US Census Bureau 2020). Estimated population projections provided by the 2017 Cornell Program on Applied Demographics indicates that the County's population will continue to decrease into 2040, decreasing the total population to approximately 41,123 persons (Cornell Program on Applied Demographics 2017). The population that remains in the county is vulnerable to severe weather and severe wind events. Refer to Section 4 (County Profile) for additional discussion on population trends.

Climate Change

As displayed in Figure 5.4.8-10 the entire State of New York is projected to experience an increase in the frequency and severity of extreme storms and rainfall. The northeast region of the United States has experienced a greater increase in extreme precipitation than any other region in the U.S. between 1958 and 2010, the Northeast experienced more than 70% increase in the amount of precipitation falling in rain events (NCA, 2020). Refer to Section 5.4.4 (Flood) for a discussion related to the impact of climate change due to increases in rainfall. An increase in storms will produce more wind events and may increase tornado activity. Additionally, thunderstorms and increase in temperature can relate to the strength of a storm resulting in tornadoes (NOAA, 2020). With an increased likelihood of strong winds and tornado events, all of the County's assets will experience additional risk for losses as a result of extreme wind events.

Changes in Vulnerability Since the 2015 HMP

Since the 2015 analysis, population statistics have been updated using the 5-Year 2014-2018 American Community Survey Population Estimates. The general building stock was also updated using RS Means 2019 building valuations that estimated replacement cost value for each building in the inventory. The 2015 critical facility inventory dataset was updated and updated parcel data, tax assessments were provided by Chenango County GIS. The updated building stock inventory was imported into HAZUS-MH v4.2 to complete a hurricane wind analysis for the 100-year and 500-year MRP hurricane wind event. Overall, this vulnerability assessment uses a more accurate and updated building inventory which provides more accurate estimated exposure and potential losses for Chenango County.