5.4.3 Severe Storm

This section provides a hazard profile and vulnerability assessment of the severe storm hazard for the Cattaraugus County Hazard Mitigation Plan (HMP).

5.4.3.1 Hazard Profile

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

Description

For the purpose of this HMP update and as deemed appropriated by Cattaraugus County, the severe storm hazard includes thunderstorms, lightning, hailstorms, windstorms, tornadoes, and hurricanes/tropical storms, which are defined in the sections below.

Thunderstorms

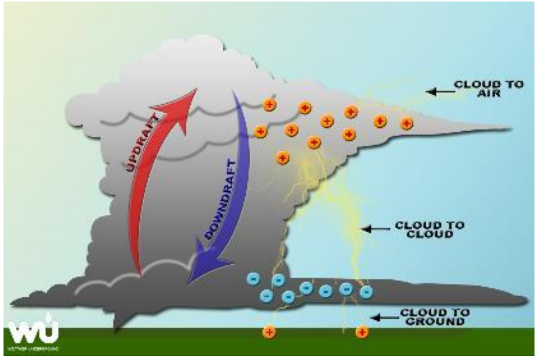
A thunderstorm is a local storm produced by a cumulonimbus cloud and accompanied by lightning and thunder (National Weather Service [NWS] 2009). A thunderstorm forms from a combination of moisture; rapidly rising warm air; and a force capable of lifting air, such as a warm front, cold front, a sea breeze, 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 to generate tornadoes, hailstorms, strong winds, flash flooding, and lightning.

Thunderstorms can lead to heavy rain induced flooding, landslides, strong winds, and lightning. Roads may become impassable from flooding, downed trees or power lines, or a landslide. Downed power lines can lead to loss of utility services, such as water, phone, and electricity. Typical thunderstorms are 15 miles in diameter and last an average of 30 minutes. During the summer, thunderstorms are responsible for most of the rainfall.

Lightning

Lighting is a bright flash of electrical energy produced by a thunderstorm. The resulting clap of thunder is the result of a shock wave created by the rapid heating and cooling of the air in the lightning channel. All thunderstorms produce lightning and are very dangerous. Lightning ranks as one of the top weather killers in the United States, killing approximately 50 people and injuring hundreds each year. Lightning can occur anywhere there is a thunderstorm. Lightning can be cloud to air, cloud to cloud, and cloud to ground. Figure 5.4.3-1 illustrates the variety of lightning types.

Figure 5.4.3-1. Types of Lightning

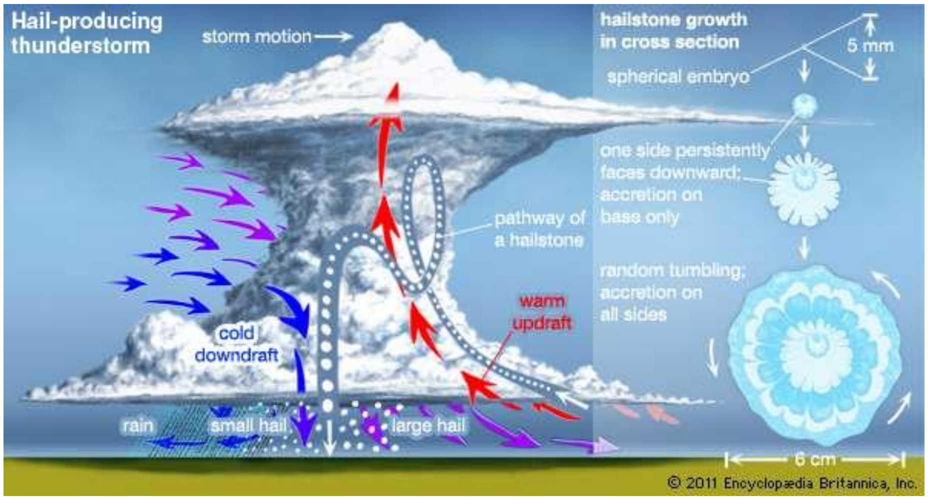


Source: Weather Underground n.d.

Hailstorms

Hail forms inside a thunderstorm or other storms with 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 degrees Fahrenheit (°F) or colder. As the frozen droplet begins to fall, it may thaw as it moves into warmer air toward the bottom of the thunderstorm. However, the droplet may be picked up again by another updraft and carried back into the cold air and 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 2 inches in diameter (NWS 2010). Figure 5.4.3-2 shows how hail is formed within thunderstorms.

Figure 5.4.3-2. Hail Formation in Thunderstorms



Source: Encyclopedia Britannica 2011

Windstorms

Wind begins with differences in air pressures and occurs through 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. High winds are often associated with other severe weather events such as thunderstorms, derechos, tornadoes, nor'easters, hurricanes, and tropical storms (all discussed further in this section).

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 (Federal Emergency Management Agency [FEMA] 1997). Tornadoes can occur at any time of the year, with peak seasons at different times for different states (National Oceanic and Atmospheric Administration [NOAA] National Severe Storms Laboratory [NSSL] 2013).

Hurricanes and Tropical Storms

Tropical cyclones (hurricanes) are fueled by a different heat mechanism than other cyclonic windstorms such as Nor'easters and polar lows. The characteristic that separates a tropical storm from another cyclonic system 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 may develop in the Atlantic between the Lesser Antilles and the African coast, or may develop in the warm tropical waters of the Caribbean and Gulf of Mexico. These storms may move up the Atlantic coast of the United States and impact 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 offshore and heading east.

Despite being an inland county, coastal storms, such as hurricanes and tropical storms, can impact Cattaraugus County (New York State [NYS] Division of Homeland Security and Emergency Services [DHSES] 2014). Hurricanes and tropical storms can impact Cattaraugus County from June to November, the official eastern U.S. hurricane season; however, late July to early October is the most likely period for hurricanes and tropical storms to impact the county due to the cooling of the North Atlantic Ocean waters (NYS DHSES 2014). Although one of the most severe impacts associated with hurricanes is storm surge, due to Cattaraugus County's location, storm surge is not a concern for the county and has not been detailed in this profile.

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, and hurricanes and tropical storms in Cattaraugus County. Historical data presented in Table 5.4.3-1 show the most powerful severe weather records in Cattaraugus County.

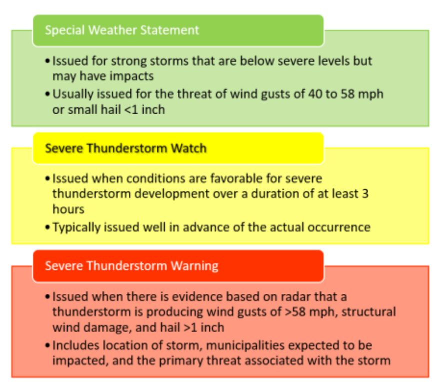


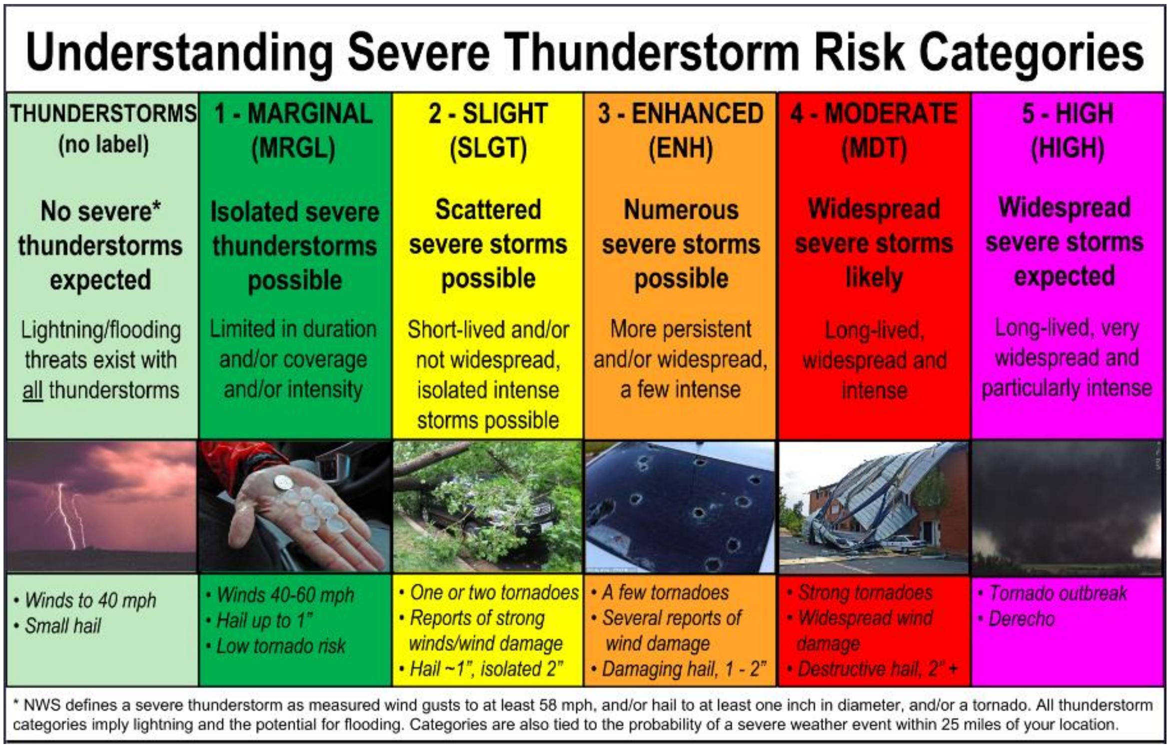
Table 5.4.3-1. Severe Storm Extent in Cattaraugus County

Extent of Severe Storms in Cattaraugus County	
Largest Hailstone on Record	1.75 inches
Highest Wind Speed on Record	100 knots (115 mph)
Strongest Tropical Storm/Hurricane on Record	No events in the county

Thunderstorms

NWS considers a thunderstorm severe if it produces damaging wind gusts of 58 mph or higher, hail 1 inch (quarter size) in diameter or larger, or tornadoes (NWS 2010). Severe thunderstorm watches and warnings are issued by the local NWS office and NOAA's Storm Prediction Center (SPC). NWS and SPC will update the watches and warnings and will notify the public when they are no longer in effect. In addition, the SPC issues severe thunderstorm risk maps based on the likelihood of different severities of thunderstorms. Figure 5.4.3-3 shows the SPC's severe thunderstorm risk categories.

Figure 5.4.3-3. 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 (NYC OEM) 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.

Hail

The severity of a hailstorm is measured by duration, hail size, and geographic extent. Most hail stones from hailstorms are made up of variety of sizes. Only the very largest hail stones pose serious risk to people, if exposed (NYS DHSES 2014). The size of hail is estimated by comparing it to a known object. Table 5.4.3-2 describes the different sizes of hail as compared to real-world objects and lists approximate measurements.

Table 5.4.3-2. Hail Size

Description	Diameter (in inches)		Description	Diameter (in inches)
Pea	0.25		Golf ball	1.75
Marble or mothball	0.50		Hen's egg	2.00
Penny or dime	0.75		Tennis ball	2.75
Nickel	0.88		Baseball	2.75
Quarter	1.00		Tea cup	3.00
Half dollar	1.25		Grapefruit	4.00

Description	Diameter (in inches)		Description	Diameter (in inches)
Walnut or ping pong ball	1.50		Softball	4.50

Source: NYS DHSES 2014

Tornado

The magnitude or severity of a tornado is categorized using the Enhanced Fujita Tornado Intensity Scale (EF Scale). Figure 5.4.3-4 illustrates the relationship between EF Scale ratings, wind speed, and expected tornado damage.

Figure 5.4.3-4. Enhanced Fujita Tornado Intensity Scale Ratings, Wind Speeds, and Expected Damage

Source: NWS 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 2011).

Windstorms

Table 5.4.3-3 provides the NWS descriptions of winds during wind-producing events.

Table 5.4.3-3. 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

Descriptive Term	Sustained Wind Speed (mph)
None	5-15 or 10-20
Light or light and variable wind	0-5

Source: NWS 2015

NWS issues advisories and warnings for winds, which are normally site-specific. High wind advisories, watches, and warnings are issued by the NWS when wind speeds may pose a hazard or may be life threatening. The criterion for each of these varies from state to state. Wind warnings and advisories for New York State are as follows:

- *High Wind Warnings* are issued when sustained winds of 40 mph or greater are forecast for 1 hour or longer, or wind gusts of 58 mph or greater are forecast for any duration.
- *Wind Advisories* are issued when sustained winds of 30 to 39 mph are forecast for one 1 hour or longer, or wind gusts of 46 to 57 mph are forecast for any duration (NWS n.d.).

Hurricanes and 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 to 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 hurricanes are dangerous and require preventative measures (NOAA 2013). Figure 5.4.3-5 presents this scale, which is used to estimate the potential property damage and flooding expected when a hurricane makes landfall.

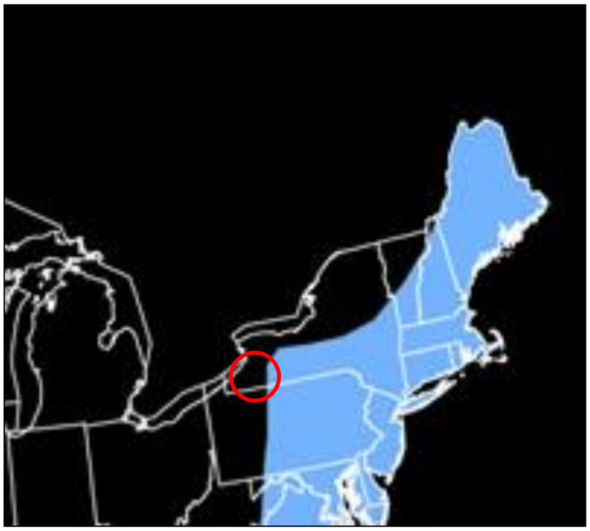
Figure 5.4.3-5. The Saffir-Simpson Hurricane Wind Scale

Source: NOAA - Disaster Preparedness Portal 2017

Mean Return Period

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 may occur within any given year based on past recorded events. 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). Figure 5.4.3-6 shows the number of hurricanes expected for the 100-year MRP in the northeast region. Cattaraugus County is on the edge of the area that could expect 20-40 hurricanes in a 100-year period.

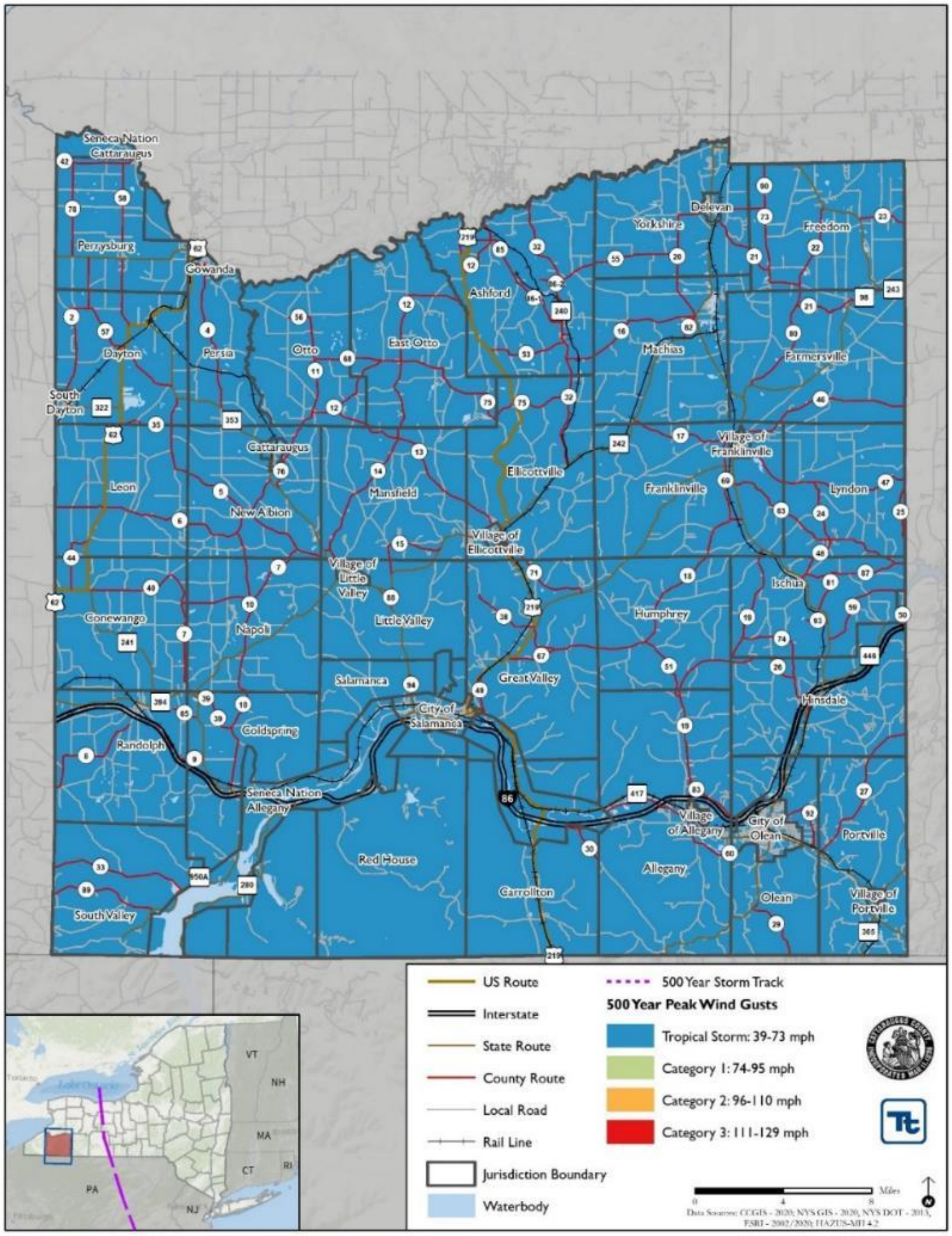
Figure 5.4.3-6. Number of Hurricanes for a 100-year Mean Return Period



Source: U.S. Geological Survey (USGS) 2005
Notes:
Red circle indicates Cattaraugus County's approximate location within the region.
The map shows the number of hurricanes expected to occur during a 100-year mean return period based on historical data using the following scale:
Light blue area: 20 to 40 hurricanes expected in a 100-year period.

Figure 5.4.3-7 shows the estimated maximum 3-second gust wind speeds that can be anticipated in the study area associated with the 500-year MRP event. These peak wind speed projections were generated using Hazards U.S. Multi-Hazard (HAZUS-MH) model runs. HAZUS-MH 4.2 estimated the maximum 3-second gust wind speeds for Cattaraugus 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 Cattaraugus County range from 47.2 to 52.7 mph for the 500-year MRP event, which are wind speeds categorizing this event as a tropical storm. The associated impacts and losses from the 500-year MRP hurricane event modeled event is reported in the Vulnerability Assessment section for this hazard presented below.

Figure 5.4.3-7. Wind Speeds for the 500-Year Mean Return Period Event



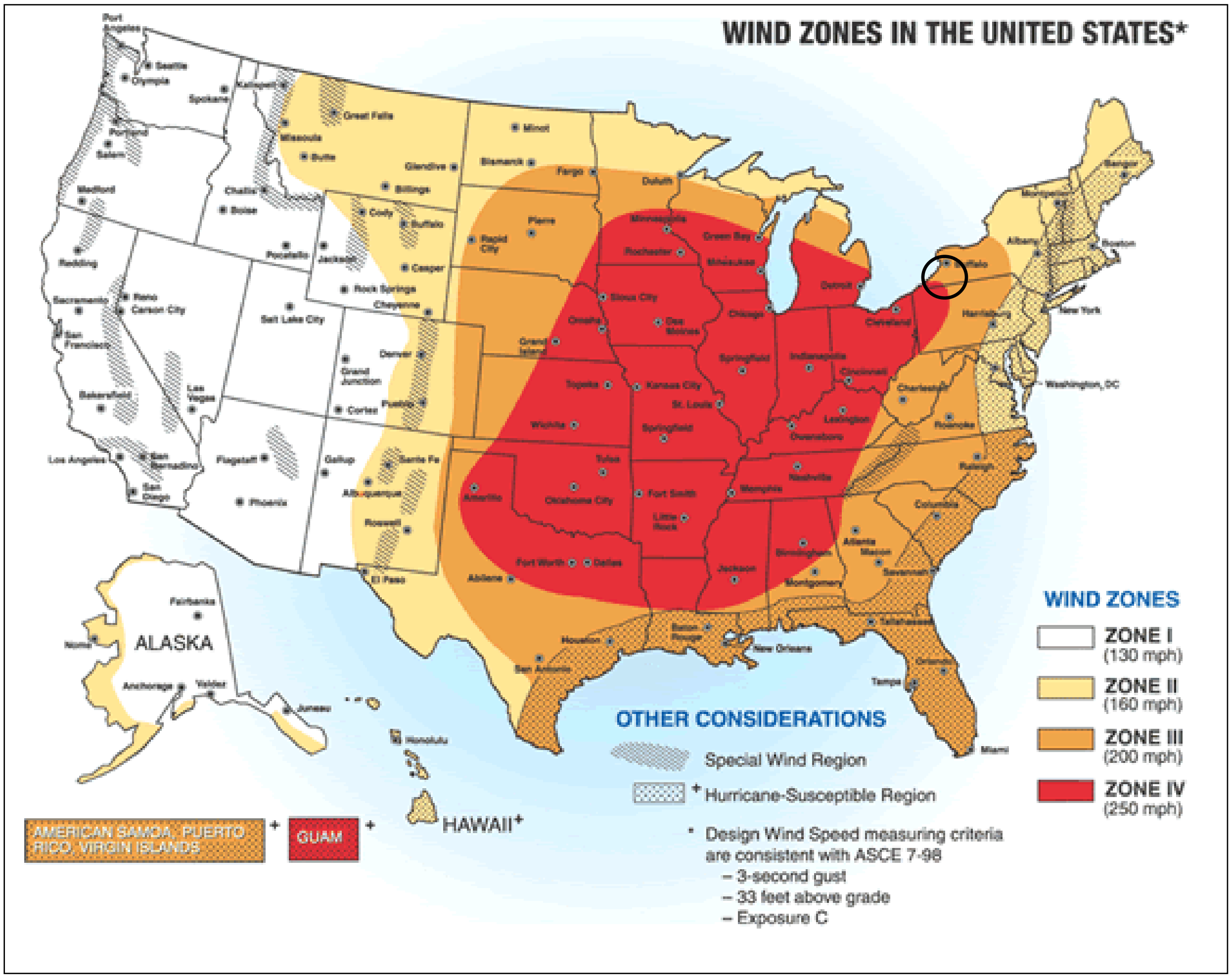
Source: FEMA 2020

Location

All of Cattaraugus County is exposed to hail, lightning, windstorms and high wind, thunderstorms, and hurricanes and tropical storms and all the county is subject to high winds from severe weather events. Cattaraugus County lies at the western edge of the Allegany plateau area. As storm fronts reach these increased elevations, greater amounts of rainfall and winds are experienced. Many times, these storm events are concentrated in isolated watersheds, causing flash flooding, while the adjacent watersheds experience little or no flooding. The locations within the county vary and are randomly disbursed.

According to the FEMA Winds Zones of the United States map, Cattaraugus County is located on the border of Wind Zone III and Wind Zone IV, where wind speeds can reach up to 250 mph. Figure 5.4.3-8 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. Tornadoes are further discussed in Section 5.4.5.

Figure 5.4.3-8. Wind Zones in the United States



Source: FEMA 2012
Note: The black oval indicates the approximate location of Cattaraugus County.

Previous Occurrences and Losses

Many sources provided historical information regarding previous occurrences and losses associated with severe storms throughout New York State and Cattaraugus County; therefore, the loss and impact information for many events varies depending on the source. The accuracy of monetary figures discussed is based on the available information in cited sources.

Between 1954 and August 2020, Cattaraugus County has been included in 10 declarations for severe storm-related events classified as one or a combination of the following disaster types: severe storm, straight-line winds, coastal storm, hurricane/tropical storm, and tornado (FEMA 2020). Table 5.4.3-4 lists these events.

Table 5.4.3-4. Severe Storm-Related FEMA Declarations for Cattaraugus County, 1954 to August 2020

Date(s) of Event	FEMA Declaration Number	Declaration Date	Event Type
October 30, 1967	DR-645	October 30, 1967	Flood: Severe Storms and Flooding
June 23, 1972	DR-338	June 23, 1972	Flood: Tropical Storm Agnes
January 19-30, 1996	DR-1095	January 24, 1996	Flood: Severe Storms and Flooding
June 25-July 10, 1998	DR-1233	July 7, 1998	Severe Storm(s): Severe Storms and Flooding
May 3-August 12, 2000	DR-1335	July 21, 2000	Severe Storm(s): Severe Storms and Flooding
July 21-August 13, 2003	DR-1486	August 29, 2003	Severe Storm(s): Severe Storms, Flooding, and Tornadoes
May 13-June 17, 2004	DR-1534	August 3, 2004	Severe Storm(s): Severe Storms and Flooding
August 13-September 16, 2004	DR-1564	October 1, 2004	Severe Storm(s): Severe Storms and Flooding
August 8-10, 2009	DR-1857	September 1, 2009	Severe Storm(s): Severe Storms and Flooding
October 27-November 8, 2012	EM-3351	October 28, 2012	Hurricane: Hurricane Sandy
May 13-22, 2014	DR-4180	July 8, 2014	Severe Storm(s): Severe Storms and Flooding

Source: FEMA 2020

The Secretary of Agriculture from the U.S. Department of Agriculture (USDA) is authorized to designate counties as disaster areas to make emergency loans to producers suffering losses in those counties and in counties that are contiguous to a designated county. There have been four USDA agricultural disasters since 2013 attributed to severe weather:

- S3593 – 2014 Excessive rain and related flooding, high winds, and hail
- S3747 – 2014 Excessive rain and related flooding, high winds, and hail
- S3885 – 2015 Excessive rain, high winds, hail, lightning, and tornado
- S4465 – 2018 Excessive rain, flash flooding, and flooding

The USDA crop loss data provide another indicator of the severity of previous events. Additionally, crop losses can have a significant impact on the economy by reducing produce sales and purchases. Such impacts may have long-term consequences, particularly if crop yields are low the following years as well. USDA records indicate that Cattaraugus County has experienced crop losses from severe storm events. Table 5.4.3-5 provides details regarding crop losses in Cattaraugus County according to USDA records.

Table 5.4.3-5. USDA Crop Losses from Severe Storms in Cattaraugus County

Year	Crop Type	Cause of Loss	Losses
2013	Wheat	Excess Moisture/Precipitation/Rain	$185
2013	Oats	Excess Moisture/Precipitation/Rain	$7,666
2013	Corn	Excess Moisture/Precipitation/Rain	$107,623
2013	Corn	Wind/Excess Wind	$2,867
2013	Corn	Other (Snow, Lightning, etc.)	$10,472.50
2013	Soybeans	Excess Moisture/Precipitation/Rain	$40,830
2013	Soybeans	Other (Snow, Lightning, etc.)	$22,795
2014	Wheat	Excess Moisture/Precipitation/Rain	$5,245
2014	Oats	Excess Moisture/Precipitation/Rain	$1,133
2014	Corn	Excess Moisture/Precipitation/Rain	$554,311
2014	Corn	Other (Snow, Lightning, etc.)	$453,703

Year	Crop Type	Cause of Loss	Losses
2014	Processing Beans	Excess Moisture/Precipitation/Rain	$88,392
2014	Soybeans	Excess Moisture/Precipitation/Rain	$97,727
2015	Wheat	Excess Moisture/Precipitation/Rain	$6,520
2015	Oats	Excess Moisture/Precipitation/Rain	$7,349
2015	Corn	Excess Moisture/Precipitation/Rain	$359,712.5
2015	Corn	Other (Snow, Lightning, etc.)	$157,784
2015	Processing Beans	Excess Moisture/Precipitation/Rain	$58,950
2015	Soybeans	Excess Moisture/Precipitation/Rain	$120,127.50
2015	All Other Crops	Excess Moisture/Precipitation/Rain	$8,425
2017	Wheat	Excess Moisture/Precipitation/Rain	$12,922
2017	Corn	Excess Moisture/Precipitation/Rain	$482,819
2017	Processing Beans	Excess Moisture/Precipitation/Rain	$25,870
2017	Green Peas	Excess Moisture/Precipitation/Rain	$17,479
2017	Soybeans	Excess Moisture/Precipitation/Rain	$185,447.85
2018	Wheat	Excess Moisture/Precipitation/Rain	$9,053
2018	Corn	Excess Moisture/Precipitation/Rain	$80,548
2018	Processing Beans	Excess Moisture/Precipitation/Rain	$15,810
2018	Soybeans	Excess Moisture/Precipitation/Rain	$547,678.50

Source: USDA 2020

Figure 5.4.3-9, from the NOAA Historical Hurricane Tracker, illustrates the tracks of storms between 1842 and 2020 within 65 miles of Cattaraugus County. Cattaraugus County is not frequently impacted by hurricanes, tropical storms, or tropical depressions but has recently experienced the direct and indirect landward effects associated with hurricanes and tropical storms, including extra-tropical remnants of Frances in 2004 and Nate in 2017.

Figure 5.4.3-9. Historical Hurricane Tracks within 65 miles of Cattaraugus County, 1842 to 2020

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

The NOAA National Centers for Environmental Information (NCEI) Storm Events database records severe storm events. For this 2020 HMP Update, known severe storm events that have impacted Cattaraugus County between 2013 and 2020 are identified in Table 5.4.3-6. With severe storm documentation for New York State and Cattaraugus County being so extensive, not all sources have been identified or researched. Therefore, Table 5.4.3-6 may not include all events that have occurred in the county.

Table 5.4.3-6. Severe Storm Events in Cattaraugus County, 2013-2020

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts
January 20, 2013	High Wind	N/A	N/A	Law enforcement reported trees and wires down in Perrysburg with $15K in property damages reported.
April 29, 2014	High Wind	N/A	N/A	Media reported a silo toppled by strong winds with $35K in property damages reported.
May 13-22, 2014	Severe Storms and Flooding	DR-4180	Yes	A federal disaster declaration was granted for Cattaraugus due to severe storms and flooding from May 13-22.
July 1, 2014	Thunderstorm Wind.	N/A	N/A	Law enforcement reported damages in the following: power lines in Conewango with $15K in property damages; downed trees in New Albion with $15K in property damage; and downed power lines in Otto with $20K in damages.
July 8, 2014	Thunderstorm Wind	N/A	N/A	Law enforcement reported trees and wires down in Leon, Steamburg, Perrysburg, Gowanda, Riceville, Cattaraugus, West Valley, Hinsdale, and Allegany. Law enforcement reported trees down on a house in Dayton. $10K in damages were reported in Leon, $15K in Steamburg, $25K in Dayton, $15K in Perrysburg, $15K in Gowanda, $10K in Riceville, $15K in Cattaraugus, $15K in West Valley, $15K in Hinsdale, and $15K in Allegany.
August 1, 2014	Thunderstorm Wind	N/A	N/A	Law enforcement reported downed trees blocking several roads in Hinsdale and Olean. $10K in property damages were reported in Hinsdale and $15K in Olean.
August 2, 2014	Thunderstorm Wind	N/A	N/A	Law enforcement reported trees and wires down on Nolan Drive in Allegany. $15K in property damages were reported in Allegany.
September 2, 2014	Thunderstorm Wind	N/A	N/A	Law enforcement reported trees and wires down on Nolan Drive in Allegany, trees down on several streets in Olean. Allegany reported $15K in property damages, $60K in property damages,
May 18, 2015	Thunderstorm Wind	N/A	N/A	Law enforcement reported trees and wires downed by thunderstorm winds in Randolph with $15K in property damages. Law enforcement reported trees and wires downed by thunderstorm winds in Little Valley with $15K in property damages. Law enforcement reported trees and wires downed by thunderstorm winds in Ellicottville with $15K in property damages.
June 12, 2015	Thunderstorm Wind	N/A	N/A	Law Enforcement in Conewango reported trees and wires downed by thunderstorm winds with $10K in property damages. Law Enforcement reported trees and wires downed by thunderstorm winds in Cattaraugus with $10K in property damages, Law Enforcement reported trees and wires downed by thunderstorm winds on Route 242 in Ellicottville with $15K in property damages. Law Enforcement reported trees and wires downed by thunderstorm winds in Salamanca with $15K in property damages, Law Enforcement reported trees and wires downed by thunderstorm winds on Maple Avenue in Franklinville with $10K in property damages.

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts
July 14, 2015	Thunderstorm Wind	N/A	N/A	Law enforcement reported trees and wires down by thunderstorm winds in Franklinville with $15K in property damages.
July 19, 2015	Thunderstorm Wind	N/A	N/A	Park Service reported trees and wires down by thunderstorm winds in Quaker Bridge with $20K in property damages.
May 28, 2016	Thunderstorm Wind	N/A	N/A	Law enforcement reported trees and wires downed by thunderstorm winds and reported $15K in property damages in Allegany.
June 5, 2016	Thunderstorm Wind	N/A	N/A	Law enforcement reported trees and wires downed by thunderstorm winds and reported $15K in property damages in Olean. Law enforcement reported wires downed by thunderstorm winds in Portville with $10K in damages.
June 20, 2016	Thunderstorm Wind	N/A	N/A	Law enforcement reported trees down by thunderstorm winds damaging two trailers in Delevan with $35K in property damages. Law enforcement reported numerous trees and lines down by thunderstorm winds in Yorkshire with $15K in property damages.
September 10, 2016	Thunderstorm Wind	N/A	N/A	Downed trees and power lines fell on a house on John Darling Road in Conewango with $15K in property damages. Law enforcement reported trees and wires down by thunderstorm winds in Dayton with $10K in property damages. Trees and wires were downed by thunderstorm winds in Otto with $10K in property damages. Law enforcement reported trees and wires down by thunderstorm winds in South Vandalia with $10K in property damages. Law enforcement reported trees and wires down by thunderstorm winds in Franklinville with $10K in property damages.
March 1, 2017	High Wind	N/A	N/A	Trees were downed by strong winds in Gowanda with $15K in property damages.
March 8, 2017	High Wind	N/A	N/A	$200K in property damages were reported.
May 1, 2017	Thunderstorm Wind	N/A	N/A	Spotters reported trees and wires downed by thunderstorm winds in Versailles with $10K in property damages reported. Trained spotters reported trees and wires downed by thunderstorm winds in Cottage with $10K in property damages reported. Trees and wires were downed by thunderstorm winds in Olean with $15K in property damages.
July 20, 2017	Thunderstorm Wind	N/A	N/A	Law enforcement reported trees and wires down by thunderstorm winds at Beach Tree Road and Highway 240 in Riceville with $12K in property damages. Law enforcement reported trees and wires down by thunderstorm winds on Creek Road in Yorkshire with $15K in property damages.
August 22, 2017	Thunderstorm Wind	N/A	N/A	Law enforcement reported trees down by thunderstorm winds in Leon with $8K in property damages. Law enforcement reported trees downed by thunderstorm winds in Cattaraugus with $10K in property damages. Law enforcement reported trees and wires downed by thunderstorm winds in Machias with $10K in property damages. Law enforcement reported trees downed by thunderstorm winds in Randolph with $10K in property damages. Law enforcement reported trees downed by thunderstorm winds in Little Valley with $10K in property damages. Thunderstorm winds blew siding off a house in Delevan resulting in $15K

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts
				in property damages. Law enforcement reported trees downed by thunderstorm winds in Ellicottville with $10K in property damages.
September 4, 2017	Thunderstorm Wind	N/A	N/A	Law enforcement reported trees and wires downed by thunderstorm winds along Route 39 in Perrysburg with $15K in property damages. Law enforcement reported trees downed by thunderstorm winds in Dayton with $10K in property damages. Law enforcement reported trees downed by thunderstorm winds in Gowanda with $10K in property damages. Thunderstorm winds downed trees along Sawmill Run Road in Onoville with $8K in property damages. Law enforcement reported trees downed by thunderstorm winds in Humphrey with $6K in property damages reported. Law enforcement reported trees downed by thunderstorm winds in Olean with $10K in property damages. Law enforcement reported trees downed by thunderstorm winds in Weston Mills with $10K in property damages.
April 4, 2018	High Wind	N/A	N/A	Multiple trees and wires were reported down throughout the county through the event with $15K in property damages reported.
July 4, 2018	Heavy Rain	N/A	N/A	The region was underneath a large upper level ridge with a subtle frontal boundary near the NY/PA state line. The region was in a warm and very moist air mass with precipitable water values around 1.75 inches. Thunderstorms developed across Allegany County early in the morning. With 700 mb winds less than 10 kits, these storms hardly moved at all. They maintained intensity, eventually dropping a radar estimated 2.5 inches in about an hour. These storms eventually meandered into Northern PA, producing up to 6 inches of rain there.
January 1, 2019	High Wind	N/A	N/A	Trees and wires were reported down across the county with $10K in property damages reported.
February 24-25, 2019	High Wind	N/A	N/A	Many reports were received of trees and wires down throughout the county causing substantial structural damage to homes and businesses. Thousands were reported without power with $10K in property damages reported.
April 14, 2019	Thunderstorm Wind	N/A	N/A	Trees were reported down in Salamanca, Franklinville, Machias. Telephone poles and wires were reported down in Little Valley. Damage was reported to a dairy barn and shed in Lime lake with $10K in property damages reported. Damage was reported to a barn including roof damage and the shifting of the barn off its foundation in Elton with $30K in property damages reported. Trees were reported down in Delevan.
May 25, 2019	Thunderstorm Wind	N/A	N/A	Property damage approximately $13,000
October 31, 2019	Wind	N/A	N/A	Damage estimated $500,000

Sources: *NOAA-NCEI 2020; FEMA 2020*
Notes: *Due to the large number of events present in the NOAA-NCEI database for thunderstorm wind, only events resulting in $15K in property damage or greater have been included.*
FEMA *Federal Emergency Management Agency*
mph *miles per hour*

Table 5.4.3-7 documents the total number of severe storm events that have occurred between 1950 and 2020, based on the NOAA-NCEI database and National Hurricane Center (NHC)records.

Table 5.4.3-7. Severe Storm Events 1950-2020

Hazard Type	Number of Occurrences Between 1950 and 2020	Total Fatalities	Total Injuries	Total Property Damage ($)	Total Crop Damage ($)
Extratropical Storm*	2	-	-	-	-
Funnel Cloud	0	0	0	$0	$0
Hail	44	0	0	$300K	$96K
Heavy Rain	3	0	0	$0	$0
High Wind	38	0	0	$3.4M	$0
Hurricane*	0	0	0	0	0
Lightning	3	0	2	$45K	$0
Strong Wind	0	0	0	$0	$0
Thunderstorm Wind	184	0	0	$3.6M	$100K
Tropical Depression*	0	0	0	0	0
Tropical Storm*	0	0	0	0	0
TOTAL	**274**	**0**	**2**	**$7.345M**	**$196K**

Source: *NOAA-NCEI 2020; NHC 2020*
Notes: *Number of events were collected from NHC and includes events that occurred within 65 nautical miles of Cattaraugus County. K = Thousand;. M = Million*
** Based on NHC historical storm tracks, fatalities, injuries, property damage, and crop damage unavailable.*

Probability of Future Occurrences

Cattaraugus 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. Table 5.4.3-8 summarizes data regarding the probability of occurrences of severe storm events in Cattaraugus County. Based on historic occurrences, thunderstorm events are the most common in Cattaraugus 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 5.4.3-8. Probability of Occurrence of Severe Storm Events in Cattaraugus County

Hazard Type	Number of Occurrences Between 1950 and 2020	Rate of Occurrence	Recurrence Interval (in years)	% Chance of Occurring in Any Given Year
Extratropical Storm	2	0.03	35	2.86
Funnel Cloud	0	0	0	0
Hail	44	0.64	1.59	62.86
Heavy Rain	3	0.04	23.33	4.29
High Wind	38	0.55	1.84	54.29
Hurricane	0	0	0	0
Lightning	3	0.04	23.33	4.29
Strong Wind	0	0	0	0
Thunderstorm Wind	184	2.67	0.38	100.0
Tropical Depression	0	0	0	0
Tropical Storm	0	0	0	0

Hazard Type	Number of Occurrences Between 1950 and 2020	Rate of Occurrence	Recurrence Interval (in years)	% Chance of Occurring in Any Given Year
Total	**264**	**3.83**	**0.27**	**100**

Source: NOAA-NCDC 2020; NHC 2020
Notes: Probability was calculated using the available data provided in the NOAA-NCDC storm events database and the NHC Historical Hurricane Tracks database and includes events that occurred within 65 nautical miles of Cattaraugus County
** Any probability greater than 100 percent was rounded to 100 percent.*

In Section 5.3, the identified hazards of concern for Cattaraugus County were ranked. The probability of occurrence, or likelihood of the event, is one parameter used for ranking hazards. Based on historical records and input from the Planning Partnership, the probability of occurrence for severe storms in the county is considered *frequent* (100-percent annual probability, occurring multiple times a year).

Climate Change Impacts

Climate change is beginning to affect both people and resources in Cattaraugus County, and these impacts are projected to continue growing. 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. Cattaraugus County is part of Region 3, Southern Tier. In Region 3, it is estimated that temperatures will increase by 4.4 ºF to 6.3 ºF by the 2050s and 5.7 ºF to 9.9 ºF by the 2080s (baseline of 47.5 ºF, middle-range projection). Precipitation totals will increase between 4 percent and 10 percent by the 2050s and 6 to 14 percent by the 2080s (baseline of 35.0 inches, middle-range projection). Table 5.4.3-9 displays the projected seasonal precipitation change for Southern Tier ClimAID Region (NYSERDA 2014).

Table 5.4.3-9. Projected Seasonal Precipitation Change in Region 3, 2050s (% change)

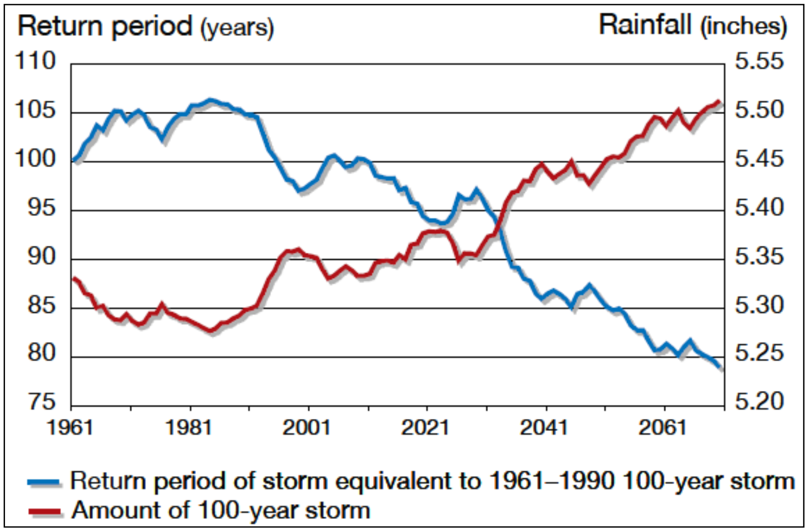
Winter	Spring	Summer	Fall
+5 to +15	0 to +15	-10 to +10	-5 to +10

Source: NYSERDA 2011

The projected increase in precipitation is expected to fall in heavy downpours and less in light rains. Downpours are very likely to increase in frequency and intensity, a change which has the potential to affect drinking water; heighten the risk of riverine flooding; flood key rail lines, roadways and transportation hubs; and increase delays and hazards related to extreme weather events (NYSERDA 2011). Less frequent rainfall during the summer months may impact the ability of water supply systems. Increasing water temperatures in rivers and streams will affect aquatic health and reduce the capacity of streams to assimilate effluent wastewater treatment plants (NYSERDA 2011).

Figure 5.4.3-10 displays the project rainfall and frequency of extreme storms in New York State. The amount of rainfall in a 100-year event is projected to increase, while the number of years between such storms (return period) is projected to decrease. Rainstorms will become more severe and more frequent (NYSERDA 2011).

Figure 5.4.3-10. Projected Rainfall and Frequency of Extreme Storms



Source: NYSERDA 2011

5.4.3.2 Vulnerability Assessment

A probabilistic assessment was conducted for the 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. Section 5.1, Methodology, includes 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 Cattaraugus County is considered vulnerable to a severe weather event and wind impacts (i.e. 76,483 persons total, American Community Survey 2018). HAZUS-MH v4.2 estimates that zero persons will be displaced from their homes or will seek shelter during a 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 several 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. According to the 5-Year 2018 American Community Survey Population Estimates, there are 14,046 persons over 65 and 12,222 persons living in poverty in Cattaraugus County (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. 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, FEMA Hazards U.S.—Multi-Hazards (HAZUS-MH) v4.2 was used to estimate the expected wind-related building damages. Table 5.4.3-10 summarizes the definitions of the damage categories. HAZUS-MH v4.2 estimates there will be $89,611 of replacement cost damages caused by the 500-year MRP hurricane wind event (Table 5.4.3-12). 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 destruction. HAZUS-MH v4.2 estimates that there is only one commercial structure that would experience minor damage during a 500-year MRP hurricane wind event (Table 5.4.3-11). Furthermore, HAZUS-MH v4.2 estimated damages are summarized by general occupancy classes in Table 5.4.3-13. HAZUS-MH v4.2 estimates that all the damages caused by severe wind will occur to residential structures in the county for the 500-year MRP wind events, causing approximately $89,611 in damages.

Table 5.4.3-10. 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
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: FEMA, 2020

Table 5.4.3-11. Damage State Categories for Buildings During 500-Year MRP Hurricane Wind Event in Cattaraugus County

Occupancy Class	Total Number of Buildings in Occupancy	Severity of Expected Damage	500-year MRP Event	
			Building Count	Percent Buildings in Occupancy Class
Residential Exposure (Single and Multi-Family Dwellings)	33,423	None	33,423	100.0%
		Minor	0	0.0%
		Moderate	0	0.0%
		Severe	0	0.0%
		Complete Destruction	0	0.0%
Commercial Buildings	2,620	None	2,619	99.9%
		Minor	1	0.01%
		Moderate	0	0.0%
		Severe	0	0.0%
		Complete Destruction	0	0.0%
Industrial Buildings	197	None	197	100.0%
		Minor	0	0.0%
		Moderate	0	0.0%
		Severe	0	0.0%
		Complete Destruction	0	0.0%
Government, Religion, Agricultural, and Education Buildings	3,259	None	3,259	100.0%
		Minor	0	0.0%
		Moderate	0	0.0%
		Severe	0	0.0%
		Complete Destruction	0	0.0%

Source: HAZUS v4.2

Table 5.4.3-12. Expected Building Damage for All Occupancies for 500-Year MRP Hurricane Wind Events for Cattaraugus County

Jurisdiction	Total Replacement Cost Value (All Occupancies)	Estimated Total Damages	Percent of Total Replacement Cost Value
Allegany (T)	$1,995,224,472	$0	0.0%
Allegany (V)	$754,717,827	$0	0.0%
Ashford (T)	$922,022,498	$0	0.0%
Carrollton (T)	$348,432,403	$0	0.0%
Cattaraugus (V)	$625,337,729	$0	0.0%
Coldspring (T)	$313,395,045	$0	0.0%
Conewango (T)	$1,141,077,674	$0	0.0%
Dayton (T)	$591,736,768	$0	0.0%
Delevan (V)	$348,026,561	$11,593	0.0%
East Otto (T)	$438,642,865	$0	0.0%
Ellicottville (T)	$1,598,675,883	$0	0.0%
Ellicottville (V)	$660,648,036	$0	0.0%
Farmersville (T)	$419,542,828	$0	0.0%
Franklinville (T)	$553,691,738	$0	0.0%
Franklinville (V)	$634,263,362	$0	0.0%
Freedom (T)	$986,939,932	$0	0.0%
Gowanda (V)	$699,071,287	$0	0.0%
Great Valley (T)	$906,431,658	$0	0.0%
Hinsdale (T)	$667,353,019	$0	0.0%
Humphrey (T)	$296,687,949	$0	0.0%
Ischua (T)	$288,127,010	$0	0.0%
Leon (T)	$915,671,381	$0	0.0%
Little Valley (T)	$358,002,270	$0	0.0%

Jurisdiction	Total Replacement Cost Value (All Occupancies)	Estimated Total Damages	Percent of Total Replacement Cost Value
Little Valley (V)	$561,442,185	$0	0.0%
Lyndon (T)	$424,831,663	$0	0.0%
Machias (T)	$880,491,464	$34,331	0.0%
Mansfield (T)	$689,267,836	$0	0.0%
Napoli (T)	$514,455,736	$0	0.0%
New Albion (T)	$471,572,394	$0	0.0%
Olean (C)	$7,169,192,523	$0	0.0%
Olean (T)	$750,434,377	$0	0.0%
Otto (T)	$376,418,830	$0	0.0%
Perrysburg (T)	$642,404,678	$0	0.0%
Persia (T)	$231,207,770	$0	0.0%
Portville (T)	$1,044,666,295	$0	0.0%
Portville (V)	$346,884,521	$0	0.0%
Randolph (T)	$1,284,336,162	$0	0.0%
Red House (T)	$127,341,670	$0	0.0%
Salamanca (C)	$4,706,213,138	$0	0.0%
Salamanca (T)	$177,314,009	$0	0.0%
South Dayton (V)	$244,313,568	$0	0.0%
South Valley (T)	$138,238,926	$0	0.0%
Yorkshire (T)	$1,259,882,782	$43,687	0.0%
Cattaraugus County (Total)	**$38,504,630,718**	**$89,611**	**0.0%**

Sources: HAZUS v4.2; Cattaraugus County Office of Real Property and GIS Services 2020; Cattaraugus County GIS 2020; Microsoft 2018; RSMeans 2019
Notes: % = Percent; C = City; T = Town; V = Village

Table 5.4.3-13. Expected Building Damage by Occupancy Class for 500-Year MRP Hurricane Wind Events for Cattaraugus County

Jurisdiction	Total Replacement Cost Value (All Occupancies)	Estimated Residential Damages	Estimated Commercial Damages	Estimated Damages for All Other Occupancies
Allegany (T)	$1,995,224,472	$0	$0	$0
Allegany (V)	$754,717,827	$0	$0	$0
Ashford (T)	$922,022,498	$0	$0	$0
Carrollton (T)	$348,432,403	$0	$0	$0
Cattaraugus (V)	$625,337,729	$0	$0	$0
Coldspring (T)	$313,395,045	$0	$0	$0
Conewango (T)	$1,141,077,674	$0	$0	$0
Dayton (T)	$591,736,768	$0	$0	$0
Delevan (V)	$348,026,561	$11,593	$0	$0
East Otto (T)	$438,642,865	$0	$0	$0
Ellicottville (T)	$1,598,675,883	$0	$0	$0
Ellicottville (V)	$660,648,036	$0	$0	$0
Farmersville (T)	$419,542,828	$0	$0	$0
Franklinville (T)	$553,691,738	$0	$0	$0
Franklinville (V)	$634,263,362	$0	$0	$0
Freedom (T)	$986,939,932	$0	$0	$0
Gowanda (V)	$699,071,287	$0	$0	$0
Great Valley (T)	$906,431,658	$0	$0	$0
Hinsdale (T)	$667,353,019	$0	$0	$0
Humphrey (T)	$296,687,949	$0	$0	$0
Ischua (T)	$288,127,010	$0	$0	$0
Leon (T)	$915,671,381	$0	$0	$0
Little Valley (T)	$358,002,270	$0	$0	$0
Little Valley (V)	$561,442,185	$0	$0	$0
Lyndon (T)	$424,831,663	$0	$0	$0
Machias (T)	$880,491,464	$34,331	$0	$0

Jurisdiction	Total Replacement Cost Value (All Occupancies)	Estimated Residential Damages	Estimated Commercial Damages	Estimated Damages for All Other Occupancies
Mansfield (T)	$689,267,836	$0	$0	$0
Napoli (T)	$514,455,736	$0	$0	$0
New Albion (T)	$471,572,394	$0	$0	$0
Olean (C)	$7,169,192,523	$0	$0	$0
Olean (T)	$750,434,377	$0	$0	$0
Otto (T)	$376,418,830	$0	$0	$0
Perrysburg (T)	$642,404,678	$0	$0	$0
Persia (T)	$231,207,770	$0	$0	$0
Portville (T)	$1,044,666,295	$0	$0	$0
Portville (V)	$346,884,521	$0	$0	$0
Randolph (T)	$1,284,336,162	$0	$0	$0
Red House (T)	$127,341,670	$0	$0	$0
Salamanca (C)	$4,706,213,138	$0	$0	$0
Salamanca (T)	$177,314,009	$0	$0	$0
South Dayton (V)	$244,313,568	$0	$0	$0
South Valley (T)	$138,238,926	$0	$0	$0
Yorkshire (T)	$1,259,882,782	$43,687	$0	$0
Cattaraugus County (Total)	**$38,504,630,718**	**$89,611**	**$0**	**$0**

Sources: HAZUS v4.2; Cattaraugus County Office of Real Property and GIS Services 2020; Cattaraugus County GIS 2020; Microsoft 2018; RSMeans 2019
Notes: % = Percent; C = City; T = Town; V = Village

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 Cattaraugus 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 emergency medical services (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, emergency operation centers [EOC], schools, and user-defined facilities such as shelters and municipal buildings) may sustain damage as a result of the 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 none of the critical facilities in Cattaraugus County are estimated to experience damage or loss of functionality due to a 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 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 Cattaraugus County caused by the 500-year MRP hurricane wind event.

Debris management can be costly and may also impact the local economy. HAZUS-MH v4.2 estimates the amount of building and tree debris that may be produced as result of the 500-year MRP hurricane wind events. Because the estimated debris production does not include flooding, this is likely a conservative estimate and may be higher if multiple impacts occur. According to the HAZUS-MH Hurricane User Manual, estimates of weight and volume of eligible tree debris consist of downed trees that would likely be collected and disposed at public expense. HAZUS-MH User Manual includes additional details regarding these estimates. HAZUS-MH v4.2 estimates that the 500-year MRP hurricane wind event will not cause any debris for Cattaraugus County.

Impact on the Environment

The impact of severe weather events on the environment varies, but researchers are finding that the long-term impacts of more severe weather can be destructive to the natural and local environment. National organizations such as USGS and NOAA have been studying and monitoring the impacts of extreme weather phenomena as it impacts long term climate change, streamflow, river levels, reservoir elevations, rainfall, floods, landslides, erosion, etc. (USGS 2017). 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 Cattaraugus County.

Cascading Impacts on Other Hazards

Severe weather events and severe wind events can escalate the impacts of flooding and utility failure. Severe winds can be destructive to the functionality of utilities by breaching power lines and disconnecting the utility systems. Severe weather may carry extreme rainfall that could exacerbate flooding. More information about flooding and utility failure can be found in Section 5.4.1 and Section 5.4.5 of this HMP, 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.

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 Cattaraugus County has decreased by approximately 5.3 percent between 2010 and 2019 (U.S. 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, reducing total population to approximately 63,500 persons (Cornell Program on Applied Demographics 2017). While less people will reside in the county, those that remain are still vulnerable to severe weather and severe wind evets. Section 4, County Profile, presents additional discussion on population trends.

Climate Change

As displayed in Figure 5.4.3-10, the entire State of New York is projected to experience an increase in the frequency and severity of extreme storms and rainfall. Major clusters of summertime thunderstorms in North America will grow larger, more intense, and more frequent later this century in a changing climate, unleashing far more rain and posing a greater threat of flooding across wide areas (Center for Science Education 2017). Section 5.4.1, Flood, includes a discussion related to the impact of climate change due to increases in rainfall. An increase in storms will produce more wind events and may increase tornado activity. Additionally, an increase in temperature will provide more energy to produce storms that generate tornadoes (Climate Central 2016). With an increased likelihood of strong winds and tornado events, all the county's assets will experience additional risk for losses as a result of extreme wind events.

Changes in Vulnerability Since the 2014 HMP

Since the 2014 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. Updated 2018 building stock data downloaded from Microsoft were used to update the user-defined facility inventory and critical facility inventory dataset. Parcel information from the Cattaraugus tax assessor was used to update building attributes, such as year built, number of stories, basement type, property class, and square footage. The updated building stock inventory was imported into HAZUS-MH v4.2 to complete a hurricane wind analysis for the 500-year MRP hurricane wind event.

Overall, this vulnerability assessment uses a more accurate and updated building inventory than that used in the 2014 HMP. This information provides more accurate exposure and potential loss estimates for Cattaraugus County.