

Climate Vulnerability Assessment

CITY OF ONEONTA

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INTRODUCTION

CLIMATE CHANGE

Climate change refers to sustained alterations in the average weather patterns that define global, regional, and local climates. Physical effects include heatwaves, sea-level rise, intense rainfall, and the resulting impacts on communities and the environment, such as floods and droughts. While some changes occur naturally due to fluctuations in the Earth's temperature, these shifts have historically taken place over long periods. Throughout the past million years, the Earth has undergone cycles of cooling and warming, leading to ice ages and subsequent warming periods. Each of these natural cycles typically lasted around 100,000 years.

However, the present climate is experiencing a more rapid transformation due to human activities, particularly the release of greenhouse gas emissions from burning fossil fuels, deforestation, wetland loss, and other human-induced factors. These activities are causing the Earth's average temperature to rise much faster than natural variations would permit.

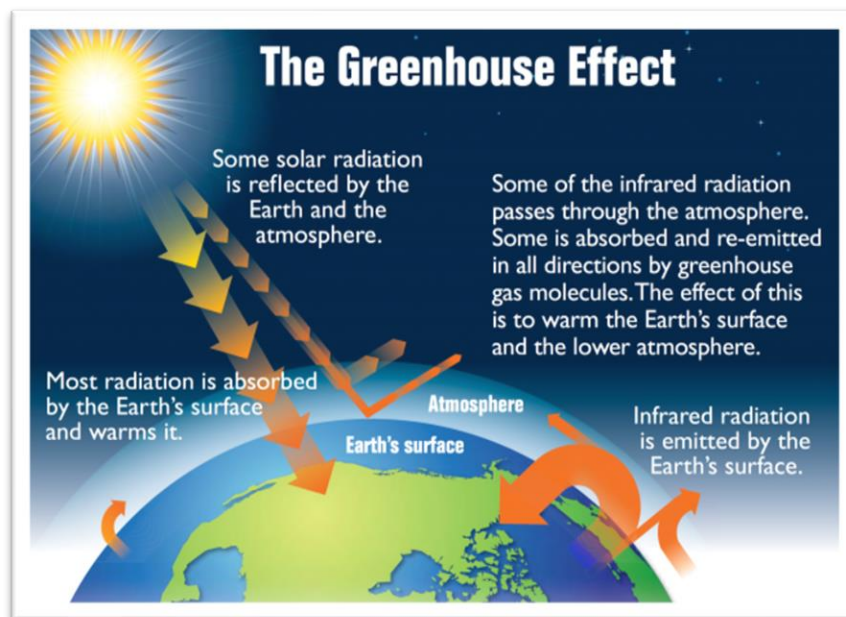


Figure 1: Greenhouse Effect. Source: [EPA.gov/climatechange-science](https://www.epa.gov/climatechange-science)

The ClimAID report (2011, 2014) by New York State, the National Climate Assessment (2018), DEC's Observed and Projected Climate Change in NYS, and other climate impact assessment reports provide extensive evidence of various climate change impacts already observed in the northeastern United States, including New York State. These scientific reports unequivocally demonstrate that significant climate change effects are underway. Without adequate actions to adapt to the unfolding impacts of climate change and its projected intensification, people,

plants, wildlife, and ecosystems will face an uncertain future. It is imperative to swiftly and significantly reduce greenhouse gas (GHG) emissions and ultimately eliminate them to prevent the increasingly harmful consequences of climate change in the coming decades.

CLIMATE SMART COMMUNITIES

The Climate Smart Communities (CSC) program is an initiative developed by New York State that assists local governments in acting against climate change and promoting sustainable practices. The program provides resources, guidance, and technical support for communities to reduce greenhouse gas emissions, adapt to climate change impacts, and build resilience. Participating communities can work on 10 high-impact categories of actions, including energy, transportation, waste management, and land use planning. Actions include adopting energy-efficient practices, increasing renewable energy generation, promoting sustainable transportation options, improving infrastructure resilience, and enhancing community engagement. By implementing these measures, the CSC program aims to create more sustainable and resilient communities while also contributing to statewide climate goals. The program emphasizes collaboration, knowledge-sharing, and innovation to empower local governments and communities in combating climate change and building a more sustainable future.



PURPOSE OF A VULNERABILITY ASSESSMENT

The Climate Vulnerability Assessment is a CSC priority action as it is a critical starting point for the enhancement of community resilience to climate change. By understanding the risks posed by climate change and identifying community vulnerabilities, a local government can effectively prioritize actions that mitigate these risks. Developing this assessment involves the identification, analysis, and prioritization of climate hazards and risks which can include events such as flooding, heat waves, and drought.

TERMINOLOGY

Exposure: Whether an asset or system is located in an area that is likely to experience the effects of a climate change hazard now or in the future.

Sensitivity: How an asset or system fares when exposed to a climate hazard.

Adaptive capacity: The ability of an asset or system to adjust to actual or expected climate stresses.

Vulnerability: The characteristics and circumstances of a community, system, or asset that makes it susceptible to the damaging effects of a hazard

Resilience: Ability of a system, community, or society exposed to hazards to resist, absorb, accommodate to, and recover from the effects of a hazard in a timely and efficient manner

Climate change adaption: The process of adjusting to the effects of climate change, including altering behavior, systems, and ways of life.

Climate change mitigation: The action to limit climate change through reducing and avoiding greenhouse gas emissions.

Climate hazard: A physical event or trend that can impact specific segments of a population, entire community, particular areas, assets, systems, the local economy, and industries.

METHODOLOGY

This vulnerability assessment was conducted to assess the City of Oneonta's potential vulnerability to future impacts from climate change. The city compiled relevant studies and materials on climate change projections to identify hazards that may apply to the community. Sources included national, regional, and state-wide studies. The documents were reviewed and summarized in this document. Potential hazards were found to involve temperature changes, heat waves, increased precipitation, riverine flooding, and higher winds.

Using these identified climate hazards, the city assessed the potential impacts on assets and systems in the community using criteria such as exposure, sensitivity, and adaptive capacity. The vulnerable systems include critical facilities (schools, police stations, etc.), energy, transportation, water supply, ecosystems, public health, and the local economy.

Next, the city identified vulnerable populations that may be more affected by current and future climate hazards, considering groups such as black, indigenous, and people of color

(BIPOC), immigrants, people who speak English as a second language, low-income residents, the elderly, people with disabilities or chronic health conditions, individuals experiencing homelessness, youth, seniors, rural and urban residents, and LGBTQ+ residents.

How to Prioritize Vulnerable Systems:

- Their exposure and sensitivity to the effects of climate hazards and their adaptive capacity
- How critical they are in respect to the functioning and prosperity of the community
- Their ability to reduce vulnerabilities and risks in the community, and to vulnerable populations in particular

From these findings, the report was developed to include climate hazards and effects, as well as an analysis of the risk and vulnerability to community assets.

STUDY AREA: CITY OF ONEONTA

GEOGRAPHY

Oneonta, also known as the City of the Hills, is located along the Susquehanna River in the northern foothills of the Catskill Mountains in Central New York. It is located between Albany and Binghamton and readily accessible from the east and west by Interstate 88, a major highway that runs along the southern boundary of the city, and by NY State Route 23, which becomes Main Street within the City limits and continues to West Oneonta. NY State Routes 7, 28, and 205 connect Oneonta to other municipalities in the region. The city is completely encompassed by the Town of Oneonta.

The city is situated in the Upper Susquehanna River Basin, which ultimately drains into the Chesapeake Bay in Maryland. With a length of 444 miles, the Susquehanna River is the 2nd longest in the Northeast and carries an estimated 22 billion gallons of water daily. This waterway serves as a prime location for various recreational activities, including fishing, boating, and more. Anglers can enjoy a diverse range of fish species, such as muskie, walleye, smallmouth bass, panfish, catfish, and carp. In addition to the Susquehanna River, the city is also surrounded by other streams and creeks, including Silver, Oneonta, and Otego Creeks. Within city limits, there are several wetland areas, such as ON-7 and ON-9, located south of Chestnut Street on the former site of the Canadian Pacific railyard, as well as ON-6, situated on the eastern tip of the city.

ECONOMY

Oneonta serves as the primary urban center for communities within a 30-mile radius, providing most of the goods and services for residents of the city's rural surroundings. The city is located at least 60 miles from any other major city which provides Oneonta with a locational advantage by reducing competition with other cities for jobs, businesses, and investment.

The local economy has a focus on education, health care, and tourism, but has yet to reach the full potential of its workforce. The city's major employers include two higher education institutions, the State University of New York at Oneonta and Hartwick College, and A.O. Fox Hospital, part of the Bassett Healthcare Network. Baseball is one of the region's biggest attractions and drives the sports tourism market. Regional data indicates that more than 300,000 people visit the area each year, largely due to families of college students and baseball camp participants.

DEMOGRAPHICS

Oneonta is a vibrant city with a population of 13,079, as of the 2020 Decennial Census. The city's median age of 21.8, is influenced by the presence of college students from SUNY Oneonta and Hartwick College. These educational institutions attract a significant number of young individuals to the city and contribute to a lively and dynamic atmosphere. Alongside the student population, Oneonta maintains a diverse demographic makeup, with a non-white population accounting for 18% of its residents. In terms of employment, the city boasts a relatively healthy rate of 47.6%, indicating a robust job market. However, there is still progress to be made in terms of economic equality, as 18.4% of the population falls below the poverty level. Despite this, Oneonta's household median income of \$58,499 reflects a reasonable standard of living for many residents. The city also demonstrates a strong commitment to the well-being of its citizens, with a low rate of 3.9% lacking health insurance coverage. Additionally, Oneonta has a notable population of senior citizens, with 13.4% aged 65 years and over.

CLIMATE PROFILE

New York State exhibits regional diversity, encompassing both densely populated metropolitan areas and vast expanses of ecologically and agriculturally significant regions. For much of the year, prevailing westerly winds transport air masses from the North American interior, occasionally bringing harsh winter conditions. The presence of the jet stream, often positioned over or near the region in winter, leads to frequent storm systems, cloudy skies, gusty winds, and precipitation.

In Oneonta, July is the warmest month with an average high temperature of 78 degrees Fahrenheit, while January is the coldest month with an average low of 12.1 degrees Fahrenheit. Freezing temperatures occur approximately 157.1 nights each year in Oneonta. In terms of precipitation, the city experiences rain, snow, sleet, or hail, on approximately 146 days per year. Oneonta receives an average of 42 inches of rain per year, slightly higher than the US average of 38 inches. Autumn is the wettest season, accounting for 29% of the yearly precipitation, while spring is the driest season, with 20% of the precipitation. Oneonta also experiences an average of 83 inches of snowfall per year, significantly higher than the US average of 28 inches. In terms of sunshine, Oneonta has an average of 160 sunny days per year, significantly lower than the US average of 205.

Due to unique geographic features, the state is prone to a range of extreme events, including floods, droughts, heatwaves, hurricanes, nor'easters, and snow and ice storms. Otsego County has faced a variety of natural disasters over the years. Records from the Federal Emergency Management Agency (FEMA) show that there have been 33 disasters declared in the county since 1953, the first occurring in 197 which indicates a rise in the rate of natural disasters (Figure 2). Referring to Figure 3, the most frequent climate-related disasters are severe storms

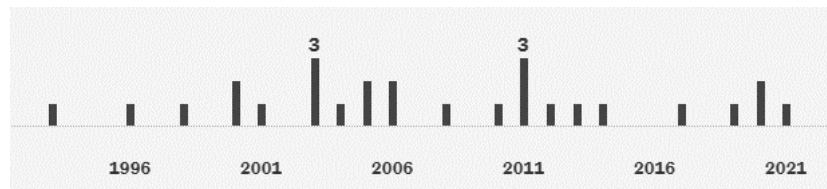


Figure 2: Disaster(s) by Year in Otsego County. Source: FEMA.gov/Data-Visualization

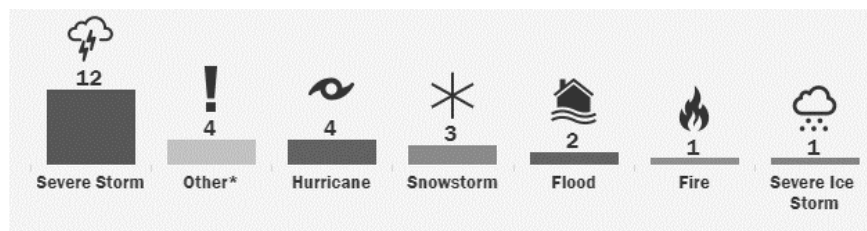


Figure 2: Climate-related Disasters in Otsego County. Source: FEMA.gov/Data-Visualization.

CLIMATE PROJECTIONS AND POTENTIAL CLIMATE HAZARDS

FEMA NATIONAL RISK INDEX

The Federal Emergency Management Agency developed the National Risk Index as an interactive tool to show communities what natural hazards they may be at risk of and to what extent. The index represents a community's score as a percentile compared to all US counties, including factors such as expected annual loss, social vulnerability, and community resilience. Figure 4 indicates Otsego County's risk scores of potential hazards.

$$\text{Risk Index} = \text{Expected Annual Loss} \times \text{Social Vulnerability} \div \text{Community Resilience}$$

$$\text{Expected Annual Loss} = \text{Exposure} \times \text{Annualized Frequency} \times \text{Historic Loss Ratio}$$

Hazard	Risk Score	Expected Annual Loss	Annualized Frequency
Cold Wave	89.4	\$136,587	1.5
Earthquake	40.8	\$88,722	.026%
Hail	26.0	\$34,018	2.9
Heat Wave	23.4	\$9,018	.1
Hurricane	61.9	\$594,772	0
Ice Storm	63.8	\$130,172	.5
Landslide	88.0	\$154,839	0
Lightning	53.9	\$120,845	28.7
Riverine Flooding	89.4	\$3,827,815	1.5
Strong Wind	32.5	\$213,863	1.4
Tornado	41.3	\$855,108	.2
Wildfire	44.2	\$28,888	.001%
Winter Weather	11.0	\$7,375	6

Figure 4: Otsego County Hazard Risks. Source: FEMA.gov

Risk Index: 49.5 (49.5% of US counties have a lower risk of climate hazards)

Expected Annual Loss: 52.3 (52% of US counties have a lower expected annual loss)

Composite Expected Annual Loss: \$5,807,927.49

Rising temperatures in New York are already having a significant impact on communities and ecosystems and will continue to escalate, posing challenges to native plants, insects, and wildlife.

Region 3 (Elmira) – Temperature

Baseline (1971-2000) 47.5 °F	Low Estimate (10th Percentile)	Middle Range (25th to 75th Percentile)	High Estimate (90th Percentile)
2020s	+ 1.8 °F	+ 2.3 to 3.3 °F	+ 3.8 °F
2050s	+ 3.6 °F	+ 4.4 to 6.3 °F	+ 7.1 °F
2080s	+ 4.2 °F	+ 5.7 to 9.9 °F	+ 11.6 °F
2100	+ 4.5 °F	+ 6.3 to 11.7 °F	+ 13.8 °F

Figure 6: Projected Increase of Average Temperature in Region 3. Source: ClimAID Report, 2014

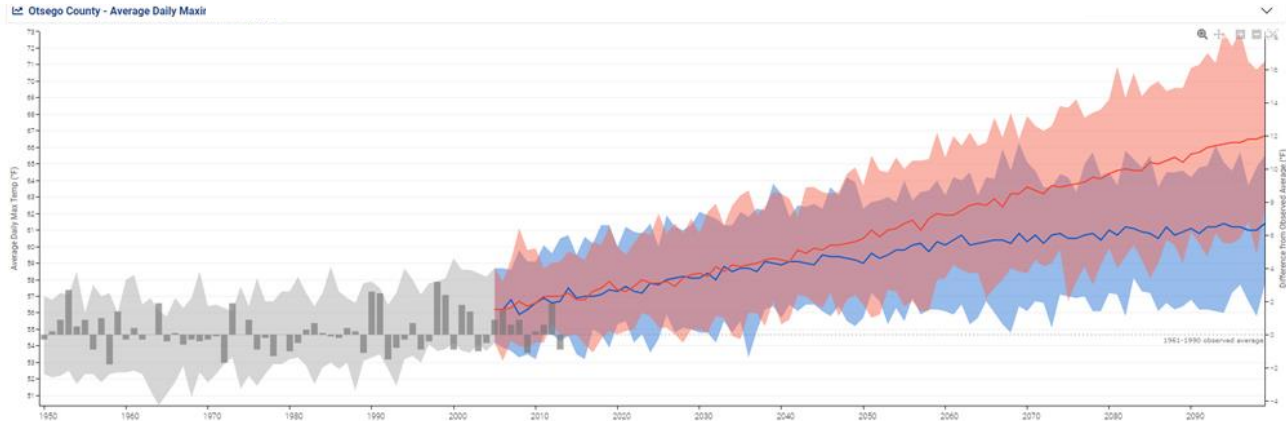


Figure 7: Otsego County Projected Average Daily Maximum Temperature. Source: crt-climate-explorer-nemac.org

INCREASING FREQUENCY AND DURATION OF HEAT WAVES

Heat waves are expected to increase in frequency, intensity, and duration in the Northeast while cold air outbreaks decrease. A heat wave is defined as three or more consecutive days where the heat index meets or exceeds 90°F.

Heat waves will pose significant challenges to the community's ability to cool down and stay safe, affecting energy consumption, public health, integrity of infrastructure, and ecosystems.

DAYS OVER 90°F Baseline: 10 days (2000-2004)	Low Estimate (10th Percentile)	Middle Range (25th to 75th Percentile)	High Estimate (90th Percentile)
2020	15	17-21	23
2050	22	26-41	47
2080	28	33-67	79
NUMBER OF HEAT WAVES Baseline: 1 (2000-2004)	Low Estimate (10th Percentile)	Middle Range (25th to 75th Percentile)	High Estimate (90th Percentile)
2020	2	2-3	3
2050	3	3-6	6
2080	3	4-9	9
DURATION OF HEAT WAVES Baseline: 4 days (2000-2004)	Low Estimate (10th Percentile)	Middle Range (25th to 75th Percentile)	High Estimate (90th Percentile)
2020	4	4-5	5
2050	5	5	5
2080	5	5-6	7

Figure 8: Projected Changes of Heat Waves in Region 3. Source: ClimAID Report, 2014

INCREASING INTENSITY OF PRECIPITATION

New York can expect precipitation events to become more frequent, intense, and prolonged. Since 1958, precipitation has increased in all seasons. Furthermore, extreme precipitation events, defined as the top 1% of all daily events, have increased by 60% in the Northeast which is more than anywhere else in the United States.

According to projections, the average regional precipitation in New York State (NYS) will rise between 4 and 15 percent by the 2080s, the majority anticipated during the winter months. By the end of the century, Region 3 will experience up to a 26% increase in precipitation. These trends align with the global consensus that higher temperatures contribute to increased water vapor in the atmosphere, leading to more intense precipitation events.



Figure 9: Total Precipitation in Otsego County. Source: crt-climate-explorer.nemac.org

Region 3 (Elmira) – Precipitation

Baseline (1971-2000) 35.0 inches	Low Estimate (10th Percentile)	Middle Range (25th to 75th Percentile)	High Estimate (90th Percentile)
2020s	- 4 percent	+ 1 to + 7 percent	+ 9 percent
2050s	+ 2 percent	+ 4 to + 10 percent	+ 15 percent
2080s	+ 3 percent	+ 6 to + 14 percent	+ 16 percent
2100	- 2 percent	+ 5 to + 20 percent	+ 26 percent

Figure 10: Projected Precipitation in Region 3 Source: NYSERDA ClimAID report, 2014.

These projected changes in precipitation patterns will require the community of Oneonta to prepare for potential impacts, such as increased flooding risks, changes in water resource management, and the need for resilient infrastructure and planning to adapt to this new reality.

INCREASING FREQUENCY AND SEVERITY OF RIVERINE FLOODING

Oneonta is projected to experience an increased frequency and severity of flooding, posing significant risks to the community. Flooding is the primary natural hazard in New York State, affecting both inland and coastal areas. Even properties outside mapped flood hazard zones can be susceptible to flooding, highlighting the widespread vulnerability to this hazard.

In Oneonta alone, there are 661 properties with a greater than 26% chance of being severely affected by flooding over the next 30 years, representing 29% of all properties in the area. This indicates a major risk of flooding, which will likely impact day-to-day life within the community.

The increasing risk of flooding is driven by altered precipitation patterns and the potential for more frequent and prolonged heavy rainfall events. Flooding can have wide-ranging and significant impacts on communities, affecting wildlife, property, infrastructure, human health, and safety. Furthermore, flooding is one of the most costly natural disasters in the United States, causing huge economic losses from damage to infrastructure and properties.

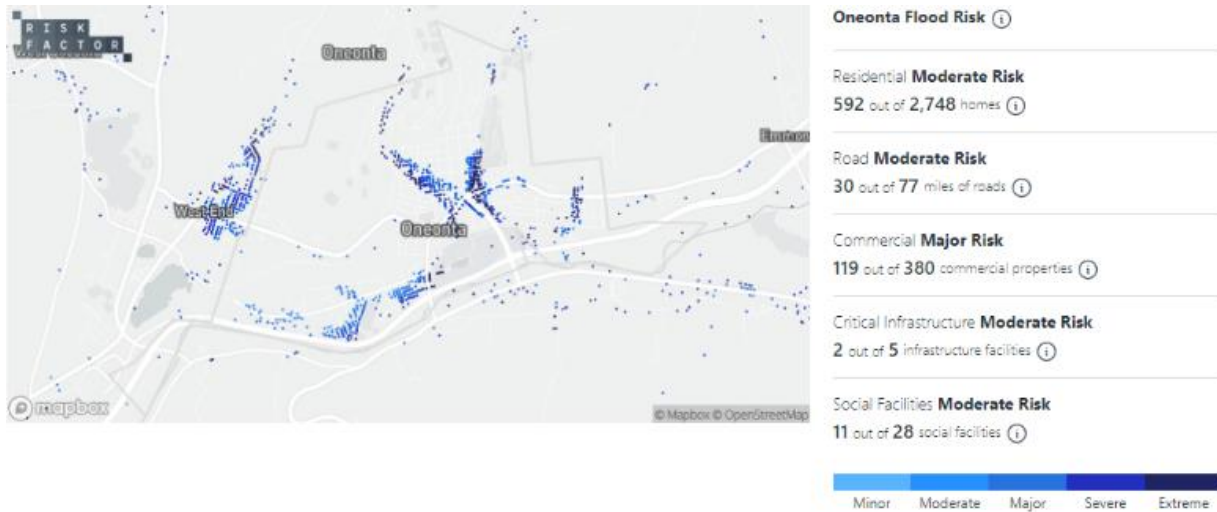


Figure 11: Flood Risk in Oneonta, NY. Source: Riskfactor.com

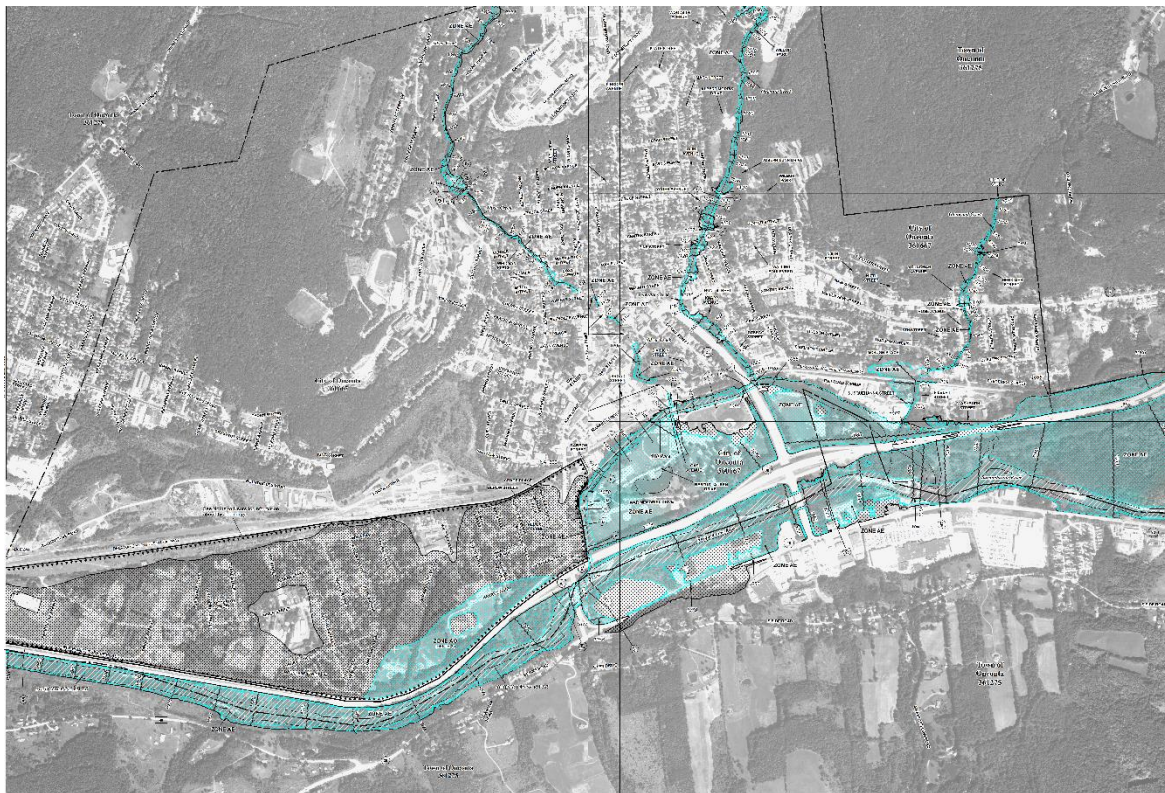


Figure 12: Flood Map of Oneonta, NY. Source: FEMA.gov

INCREASING FREQUENCY AND SEVERITY OF WIND-RELATED DAMAGE

Oneonta, NY is projected to experience an increased frequency and severity of wind damage, particularly from tropical storm winds and severe storms. The average maximum wind speeds in Oneonta have increased compared to 30 years ago, and approximately 60% of homes in the area face some level of risk. These events can lead to the toppling of trees and the scattering of debris, potentially causing harm to individuals outdoors during the event. Furthermore, they can disrupt access to utilities, emergency services, and transportation.

VULNERABLE SYSTEMS

INFRASTRUCTURE

CRITICAL FACILITIES

Critical facilities are structures from which essential services and functions for victim survival, continuation of public safety actions, and disaster recovery are performed or provided. These include facilities such as hospitals, fire and police stations, libraries, schools, shelters, waste facilities, and water supply. Within the city limits, there are 5 healthcare facilities, 1 police station, 1 fire station, 1 library, 6 schools, 3 shelters, 6 waste facilities, and 2 potable water pumps.

As mentioned previously, flood events have the potential to severely disrupt and cause damage to facilities like these, as well as homes and neighborhoods. The flood map developed by FEMA shows what properties would be at risk from a flooding event. At risk properties include the Otsego County Chamber of Commerce, City of Oneonta Housing Authority, US Social Security Administration, Riverside Elementary School, UHS Pediatrics, Basset Dermatology, Angels Daycare, Opportunities for Otsego, Otsego Dental Care, and Neahwa Park.

It is crucial to prioritize flood mitigation and resilience strategies to mitigate these wide-ranging impacts and protect communities from the adverse consequences of flooding.

ENERGY SYSTEM

An energy system can be defined as all infrastructure that is needed to collect, produce, distribute, store, and consume power. New York State is divided into 11 electricity load zones,

which are managed by the New York Independent System Operator (NYISO). These zones are drawn by primarily administrative boundaries and do not reflect unique geographic or operating characteristics. Oneonta falls under Zone E, whose peak load for the entire zone averages about 1,388 MWp as of 2008, which had grown 9.45% since 2002.

Natural gas is the most commonly used source of heating fuel in buildings around the state. The vast majority of the state's natural gas supply is obtained from the large national natural gas distribution system, which has several large feeders crossing the state. New York State Electric and Gas Corporation (NYSEG) is responsible for natural gas and electricity distribution throughout the city.

Global climate change is expected to alter both average climate and the frequency and intensity of extreme weather events in New York State, affecting energy demand, system efficiency, power supply potential, and overall prices. This is critical to analyze as we depend on our energy system to remain stable.

The primary climate risk to Oneonta's energy system is increasing temperatures. The energy system is most vulnerable during the summer due to high-temperature levels that impact power levels. The use of air conditioning during the summer places a strain on the power system which will only rise as climate change worsens. This leads to stress on power supplies, distribution, efficiency of power plants, and electricity transmission. Based on heat projections for this year, the use of air conditioning is estimated to lead to increased energy consumption for 128 days annually. This number is expected to rise to 141 days per year in the next 30 years, resulting in a substantial 25.30% increase in Oneonta's electricity usage for cooling purposes. This will make it more difficult to ensure the adequacy of power supplies during peak loads. Furthermore, increased frequency and severity of extreme weather events may cause more frequent transformer failures and widespread outages.

With climate change, energy systems will only become more vulnerable. In 2022, US energy prices were volatile largely due to extreme weather events including winter storms and heatwaves. Natural gas, reaching its highest price since 2008, is often the highest-cost fuel for generating electricity and therefore is a significant driver of wholesale electricity prices. To prevent this from worsening, the city should work on transitioning from fossil fuels to renewable energies to make the community stronger and more resilient. Renewable energies are typically the cheapest power source, save consumers and businesses money, as well as create jobs, and drive economic growth.

TRANSPORTATION SYSTEM

The transportation system in the City of Oneonta encompasses various modes of travel. The streets follow a traditional grid pattern commonly found in older cities, although portions of

the grid have been disrupted due to Urban Renewal initiatives and the city's steep topography. For pedestrians and cyclists, the Oneonta Susquehanna Greenway offers a partially completed off-road multi-use trail. Although there are some existing bike lanes, the hilly terrain of the city and narrow historic streets pose challenges to establishing a comprehensive bike network. Oneonta Public Transit operates bus routes throughout the city as well as transportation between Oneonta and Cooperstown. The main terminal is located at 104 Main Street, providing convenient access to various parts of the city through multiple bus routes. An inter-network terminal can also be found at 47 Market Street, facilitating transportation connections.

Flooding is a large risk to transportation infrastructure. Heavy rains have the potential to trigger flooding and mudslides, impacting vital infrastructure such as highways, railways, bridges, and roadways. Local flooding can weaken roadway materials and cause traffic congestion. Consequently, individuals may have difficulties reaching their homes, schools, stores, medical appointments, and more.

Elevating temperatures also pose a significant risk to the integrity of transportation networks. This encompasses potential rail track deterioration, the emergence of cracks on road surfaces, and the compromise of safety for both transportation personnel and travelers alike.

When considering the composition of paved roadways, typically fashioned from materials like asphalt or concrete, the impact of heat becomes dramatically evident. Asphalt, being inherently temperature-sensitive, takes on a clay-like softness under the duress of extreme heat. Furthermore, it experiences accelerated aging at elevated temperatures, leading to a reduced lifespan in warmer conditions. Similarly, concrete's susceptibility to heightened heat can result in expansion, thereby presenting challenges to roadways. While concrete pathways are designed to accommodate the natural expansion and contraction of the material, excessive temperatures coupled with inadequate maintenance can lead to the accumulation of debris within the expansion spaces. This scenario can eventually culminate in instances of concrete pavement blowouts or buckling.

The concern also extends to railways, where the expansion of steel in response to heat becomes a pertinent issue. If conditions reach a point where expansion is constrained, the consequences can manifest in the buckling of train tracks. It's worth noting that the threshold at which these materials succumb to these impacts is location-specific. Infrastructure is meticulously designed based on the historical climate conditions of a particular area, signifying that sustained periods of extreme heat beyond past norms can push physical infrastructure to a tipping point.

WATER SUPPLY

The City of Oneonta utilizes multiple water sources to cater to its residents' needs. The primary sources include Wilber Lake and the Catella Park Well. To ensure consistent water pressure for multistory sprinkler systems, the city has recently embarked on upgrading its water mains. The public water supply serves a population of 15,954 individuals within the City of Oneonta and neighboring areas of the Town of Oneonta, as reported in a 2013 study. Although some community members rely on domestic wells for their water supply, the majority are connected to the public system. Oneonta, strategically positioned in the Susquehanna River valley, intersects with three significant valleys: Charlotte Creek, Schenevus Creek, and Otego Creek, spanning approximately 112 square miles. The city's primary water supply, Wilber Lake, was established in 1887 after a period of rapid population growth and a severe drought in 1886. Additionally, there is a smaller reservoir on upper East Street constructed in 1882. The primary reservoir has a storage capacity of 140 million gallons and can meet a daily demand of 3.3 million gallons. It can sustain the city for approximately 117 days without any inflow. Furthermore, the water supply system has a secondary source to enhance reliability.

The water supply of the City of Oneonta will be susceptible to the impacts of climate change. Reservoirs are typically constructed to meet long-term average demand by utilizing high winter and spring runoff to compensate for increased water demand in the summer and autumn. However, reservoir systems are designed to extend supply over a specific dry period and may face stress if there is a downward shift in their long-term average supply or a significant increase in water demand due to factors like population growth, irrigation expansion, or the development of water-dependent industries. While the ClimAID and other climate projections for New York suggest that a downward shift in the long-term average supply is unlikely, it is important to recognize that reservoir systems have finite storage capacities. Moreover, as severe water shortages in western states worsen due to climate change, there is a possibility of population shifts to eastern states like New York, leading to increased demand for water and potential challenges for the city's water supply. These factors highlight the need for proactive management and planning to ensure the resilience and sustainability of Oneonta's water supply in the face of a changing climate.

ECOSYSTEMS

The effects of rising temperatures from climate change can already be seen in the ecosystems of the Northeast. Shifting seasons has ramifications for ecosystems, plant productivity, and forest health. Species differ in their ability to adapt to changes in their environment, meaning that asynchronies may occur that will increase species and ecosystem vulnerabilities.

Warmer winters also influence the transition between winter and spring. This impacts the timing of blooming for trees and flowers crucial for migrating and hibernating wildlife's food sources.

DEER OVERPOPULATION

With increasing temperatures, higher rates of evaporation are expected to decrease the snow coverage during winter and spring which will impact the population of white-tailed deer in Oneonta. Lack of snow coverage will lead to an increase in the deer population and thus degrade more forest understory vegetation. Over browsing of deer in forests can change the composition of a forest as ecologically important species of trees can be reduced or eliminated. Over-abundance of deer can reduce the diversity of plant species found in the forest as deer may completely remove shrub and seedling layers. As deer populations remain above the carrying capacity of the land, they will begin to seriously degrade their habitat and change the forest composition, leading to reduced local biodiversity.

INVASIVE SPECIES

Warmer late-winter and early-spring temperatures can also expand the geographic range and population size of invasive insect species that harm native vegetation. The emerald ash borer is an invasive beetle that threatens the ash tree population in the United States, including Oneonta, already changing forest compositions and causing the loss of billions of dollars. Tree species that could typically replace ash trees will be less successful in the future as climate change worsens. Due to warming, more species of trees will lose substantial habitat and thus will be less suitable as a long-term replacement.

Secondly, the hemlock wooly adelgid is an invasive aphid-like insect that attacks hemlock trees, causing severe damage and death. They can dramatically change ecosystems with the loss of plant and wildlife species. Hemlock wooly adelgids are sensitive to cold temperatures. However, with climate change causing warmer winters, they will continue to move north with better survival rates.

Other invasive species affecting this region include the Asian Long-Horned Beetle, Japanese Lilac Tree, and Japanese Knotweed. Frequent extreme weather events, as well as changes in temperature, humidity, and rainfall, can stress native species which creates more favorable conditions for invasive species to further spread and move in. This will lead to further loss of biodiversity and resilience of ecosystems.

These cumulative impacts underscore the need for proactive measures to mitigate and adapt to the changing climate conditions in New York State to protect from the impact of invasives.

PUBLIC HEALTH

EXTREME HEAT

Climate change will have profound impacts on public health in New York State, particularly concerning extreme heat. As temperatures rise due to climate change, the state will experience more frequent and intense heat waves, as well as an increase in high ozone days. These changes will contribute to a rise in heat-related mortality and premature deaths, posing a significant threat to the well-being of the population.

A notable study conducted in 2011 sheds light on the potential public health effects related to extreme heat in New York State. Focusing on the Binghamton weather region, the study utilized data from 1991 to 2004 as a baseline, where there were 4 excess respiratory admissions attributed to extreme heat during this period. However, the projections for the future paint a worrying picture. From 2046 to 2065, the number of excess respiratory admissions is expected to surge to 35, and by the years 2080 to 2099, the estimate rises even further to 49 excess admissions in the region. The impact is not just in terms of health but will also lead to a substantial economic burden, with an estimated excess cost of \$4,292,682 per year.

High temperatures can pose serious risks to human health and safety. Individuals may experience fatigue, heat stroke, heat exhaustion, and heat cramps during such extreme heat events (Figure 13). Moreover, the "feels like" temperatures during heat waves can reach levels that can lead to hospitalization and, in severe cases, even fatalities, particularly for vulnerable individuals. The community must take proactive measures to address these heat wave impacts, including promoting heat safety awareness, implementing heat mitigation strategies, and providing support to those who are most at risk during these challenging weather conditions.



Figure 13: Heat-Associated Health Risks. Source: RiskFactor.com

AIR QUALITY

As climate change persists, weather patterns will shift, influencing the movement and dispersion of pollutants and impacting air quality. Increasing temperatures, especially heat waves, accelerate chemical reactions that create harmful ground-level ozone pollution. Ozone is most likely to reach unhealthy levels during hot and sunny days in urban environments but can reach dangerous levels even during the winter. Furthermore, it can be transported long distances by wind, meaning that it can reach any type of community. Ozone negatively impacts air quality, causing the risk of respiratory symptoms and illnesses, especially for vulnerable populations. As it is expected to increase, studies estimate up to 300 more ozone-related deaths per year.

A warmer climate with increasing levels of carbon dioxide in the atmosphere will increase the level of airborne allergen pollutants as pollen seasons lengthen and intensify. There has already been an observed increase from 13 to 27 ragweed pollen season days in latitudes above 44°N. These airborne allergens degrade air quality, exacerbating respiratory problems such as asthma, allergies, and wheezing. Indoor air quality will also be affected by climate change as it fosters conditions that grow indoor mold.

More frequent and severe wildfires from climate change also pose a risk to air quality as wildfire smoke can travel hundreds of miles. The intensifying heat and dryness fuel wildfires, allowing them to burn longer, and more severely while pumping out even more smoke. Wildfire smoke contains a tiny particle pollutant called PM_{2.5} which size enables it to get embedded deep in the lungs and absorb into the blood. Studies have revealed that PM_{2.5} from wildfire smoke is more toxic than the smoke from tailpipes and can have a cascade of health effects, from irritated eyes and scratchy throats to respiratory effects like asthma and COPD. Research shows that wildfire exposes approximately 44 million people per year to unhealthy air, with about 677,000 deaths annually.

INFECTIOUS DISEASES

The rise in temperatures may lead to more rapid population growth of disease-carrying vectors like mosquitoes and ticks, potentially elevating the rates of infectious diseases such as West Nile Virus and Lyme Disease. Several studies conducted in the Northeast have connected tick activity and Lyme Disease to climate factors, especially early summer moisture. Furthermore, the West Nile Virus is also linked to climate. Due to increasingly favorable weather conditions, the Asian Tiger Mosquito, which can transmit the virus, is expected to increase in the Northeast from 5% to 16% by the end of the next two decades and up to 49% by the end of the century.

WATER QUALITY

Climate change poses potential challenges to water quality, both directly and indirectly. Higher temperatures can lower water quality. Changes in precipitation patterns, leading to more frequent low-flow periods during the summer, may affect the permitting of point discharges that release pollutants into surface water.

Many older cities, including Oneonta, rely on a combined sewer system that transports both sanitary sewage and stormwater to the wastewater treatment plant. During periods of minimal rainfall, the sewer system and treatment plant can handle the incoming flow. However, during substantial rainfall events, the capacity of the sewer system and treatment plant can be exceeded, resulting in the release of a mixture of sewage and storm runoff into nearby waterways. Studies have shown associations between illnesses and sewage discharge, meaning that more frequent heavy rain events could increase the frequency of waterborne diseases in our community. The city's ongoing efforts to separate sewer and stormwater aim to mitigate these challenges and ensure the preservation of water quality in the face of changing climatic conditions.

Flood events can also impact water quality as they can create unsanitary conditions from water pollution and the release of other contaminants, increasing the risk of waterborne diseases.

LOCAL ECONOMY

As climate change intensifies, the City of Oneonta is poised to face significant economic challenges. Job losses will become more prevalent as extreme weather events worsen due to climate change, leading to supply chain disruptions and interruptions in production sites, machinery, infrastructure, and access to raw materials. With consumer spending decreasing amidst uncertain climate conditions, businesses in Oneonta may experience reduced revenues and profitability. Furthermore, the forced migration of workers who have lost jobs in coastal regions, compelled to seek more stable employment inland, will likely increase competition in the local labor market. Oneonta's economy will likely witness an influx of displaced workers from vulnerable industries like agriculture, construction, transportation, oil production, landscaping, firefighting, and emergency services, further straining the job market and potentially leading to higher unemployment rates. The most vulnerable workers in the city are those employed outdoors, as they will bear the brunt of extreme weather conditions and face increasing risks to their livelihoods. Adaptation and mitigation strategies will be crucial to protect and sustain Oneonta's economy in the face of these climate change-related challenges.

The city will face a loss in the economy due to the changing climate. For instance, more frequent and extreme flooding events will result in property and infrastructure damage. The

costs incurred due to post-flood clean-up and repair of buildings and infrastructure can be substantial, straining local budgets and resources. Flooding can also lead to decreased revenue, with the loss of income, sales, tourism, and property taxes. Businesses may be forced to close or reduce operating hours, resulting in job losses. Extreme weather events and patterns increase rates of hospitalizations and deaths, resulting in another significant economic cost. Furthermore, as there are increased electrical services and telecommunication interruptions, there will be another source of revenue lost.

SOCIOECONOMIC VULNERABILITY

Social Vulnerability: Social vulnerability refers to the potential negative effects on communities caused by external stresses on human health. Such stresses include natural or human-caused disasters or disease outbreaks. Reducing social vulnerability can decrease both human suffering and economic loss.

Social Vulnerability Index: The CDC/ATSDR Social Vulnerability Index uses 16 U.S. census variables to help local officials identify communities that may need support before, during, or after disasters.

SOCIAL VULNERABILITY INDEX RESULTS

SOCIOECONOMIC STATUS	
BELOW POVERTY	18.4%
UNEMPLOYMENT RATE	5.8%
INCOME PER CAPITA	\$23,712
NO HIGH SCHOOL DIPLOMA	5.6%
HOUSEHOLD COMPOSITION AND DISABILITY	
65 AND OLDER	13.8%
17 AND YOUNGER	9.6%
DISABILITY	10.4%
SINGLE PARENT HOUSEHOLD	5.5%
MINORITY STATUS AND LANGUAGE	
MINORITY	17.7%
SPEAKS ENGLISH "LESS THAN WELL"	3.9%
HOUSING TYPE AND TRANSPORTATION	
MULTI-UNIT STRUCTURES	50.4%
MOBILE HOMES	0%

CROWDING	1.3%
NO VEHICLE	1.9%
GROUP QUARTERS	31.2%

Figure 14: City of Oneonta Social Vulnerability Index Status. Source: ATSDR.CDC.gov, 2020.

The City of Oneonta’s overall ranking on the Social Vulnerability Index is .50, meaning that 50% of communities experience less social vulnerability. This is at a higher percentile than the entirety of Otsego County, whose index ranking is 38.5.

Vulnerable individuals generally include the elderly, children, those with cardiovascular and respiratory problems, low-income individuals, those lacking air conditioning, and those with limited mobility. As these complex health risks intertwine, urgent action must be taken in New York State to mitigate climate change and protect public health from these multifaceted challenges.

ENVIRONMENTAL JUSTICE

Environmental Justice: Environmental justice is the fair treatment and meaningful involvement of all people, regardless of race, color, national origin, or income, to develop, implement, and enforce environmental laws, regulations, and policies. This goal will be achieved when everyone enjoys the same degree of protection from environmental and health hazards, and equal access to the decision-making process to live, learn, and work in a healthy environment

Environmental Justice Index: The Environmental Justice Index (EJI) is the first national, place-based tool designed to measure the cumulative impacts of environmental burden through the lens of human health and health equity. The EJI delivers a single score for each community so that public health officials can identify and map areas most at risk for the health impacts of environmental burden. Social factors such as poverty, race, and ethnicity, along with preexisting health conditions may increase these impacts. This tool helps public health officials prioritize action for those communities most in need.

The index scores census tracts using a percentile ranking which represents the proportion of tracts that experience cumulative impacts of environmental burden and injustice equal to or lower than a tract of interest. For example, an EJI ranking of 0.85 signifies that 85% of tracts in the nation likely experience less severe cumulative impacts on health and well-being than the tract of interest, and that 15% of tracts in the nation likely experience more severe cumulative impacts from environmental burden.

ENVIRONMENTAL JUSTICE INDEX RESULTS

AIR POLLUTION	
OZONE	.325
PM _{2.5}	.11
DIESEL PARTICULATE MATTER	.26
AIR TOXIC CANCER RISK	.05
POTENTIALLY HAZARDOUS AND TOXIC SITES	
NATIONAL PRIORITY SITES	0
TOXIC RELEASE INVENTORY SITES	.1599
TREATMENT, STORAGE, AND DISPOSAL SITES	0
RISK MANAGEMENT PLAN SITES	0
COAL MINES	.22
LEAD MINES	0
BUILT ENVIRONMENT	
LACK OF RECREATIONAL PARKS	.45
HOUSES BUILT PRE 1980	.73
LACK OF WALKABILITY	.59
TRANSPORTATION INFRASTRUCTURE	
HIGH VOLUME LOADS	.74
RAILWAYS	.66
AIRPORTS	0

Figure 15: City of Oneonta Environmental Justice Index Status. Source: ASTDR.CDC.gov, 2022.

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