Town of Hamilton Climate Vulnerability Assessment

Samantha Houston VS *University of Wollongong*
Natalie Kozlowski ‘19 *Environmental Geology*
Joseph Nielsen-Reagan ’20 *Environmental Studies and Spanish*
Isabella Vendramin ‘20 *Environmental Studies*

ENST 390: Community Based Study of Environmental Issues
Professor Ian Helfant
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Executive Summary

The Town of Hamilton, located in Madison County, New York is composed of a collection of small communities including the Villages of Hamilton and Earlville, as well as the hamlets of Poolville, Hubbardsville, and East Hamilton. Based off of recent climate change projections, the Town of Hamilton should expect to experience a 5-15% increase in precipitation and 4.0-8.0 ºF increase in temperature by the 2080s (ClimAID, 2011). It is crucial to understand and initiate climate action concerned with community climate preparedness and the vulnerabilities that the Town of Hamilton faces due to challenges associated with impending climate change. This ensures the continued ability to meet community needs and desires despite these challenges.

Throughout the completion of this report, the three pillars of sustainability (environment, social, economic) were taken into consideration. This framework helped us create a more complete vulnerability assessment, especially since aspects of all three pillars are affected by the changing climate in the Town of Hamilton. While the three pillars are considered throughout the report, it is important to note that the environment and social pillars were focused on primarily due to the scope of the project and availability of information.

Using the New York State's Climate Smart Communities (CSC) program's PE7.1 Climate Vulnerability Assessment guidelines, this report assesses the vulnerabilities of the Town of Hamilton to climate change in order to prioritize assets and improve future community preparedness. Following Step 1 of the PE7.1: Climate Vulnerability Assessment, we researched climate projections at a state-wide scale, then focused upon regional and localised projections, specifically those affecting Madison County and the Town of Hamilton. The impact on agricultural production in the Town of Hamilton is one of the most significant key factors addressed within this report. Damage to infrastructure is another indicator of Hamilton's vulnerability to impending climate change. Flooding and severe storm events are both capable of destroying homes or roads such that they deserve attention in the form of our study. Following Step 2 of the PE7.1 Action outline, we identified the potential impacts due to climate hazards for a broad range of categories provided by the outline. Hazards were ranked as unlikely, fairly likely, and likely for each category. For Step 3 of the PE7.1 Vulnerability Assessment, we identified specific assets for the Town of Hamilton and then, building upon information derived from Step 2 of the assessment, vulnerabilities were identified for each asset and system. Assets identified include: the Agricultural Community, Colgate University, Climate-Aware Local Population, Policies for Resiliency, Emergency Response System, Well-Water and Septic Tank, Intermunicipal Cooperation, Forested Land/Carbon Sink, and County Leadership. Step 4 of the PE7.1 Vulnerability Assessment prioritizes the identified assets and systems. To fulfil this step, the Hamilton Climate Resiliency Workshop, 30th March 2019, combined community efforts to prioritize vulnerable assets within the Town. Participants were limited to identifying three important assets which facilitated climate change discussion and provided information on community perspectives that informed this assessment and guided recommendations for future climate change action.

Based off of our assessment, the vulnerabilities that are currently most damaging and immediate to the area include flooding events, severe storm events, extreme temperatures, drought events, ice storms, and shifts in the timing and length of seasons. Recommendations are categorized into four areas of focus: communication, infrastructure, agriculture, and environment. Actions towards improving community adaptation strategies presented in this assessment help develop a guiding framework for climate change preparedness within the Town of Hamilton and focus upon vulnerable assets and systems. Because climate is constantly changing, in addition to the characteristics and demographics of the Town, this vulnerability assessment shouldn't be considered an end to itself. Depending on future change, this report will likely be applicable for the next five to ten years.

Introduction

Research Question: What are the main vulnerabilities to climate change that the Town of Hamilton faces and how can the community prepare to deal with these challenges?

The Town of Hamilton, located in Madison County, New York has a population of approximately 6,690 people and is composed of a collection of small communities: the Villages of Hamilton and Earlville, as well as the hamlets of Poolville, Hubbardsville, and East Hamilton. Rural landscapes and agricultural land make up a large part of the land classification within the Town. It is crucial to consider and understand the vulnerabilities that the Town of Hamilton faces due to climate change so that the community's needs and desires can continue to be met despite these challenges. The vulnerabilities that are currently most damaging to the area include flooding, severe storm events, extreme temperatures, drought, ice storms, and shifts in the timing of seasons. The average statewide temperature has increased by 2.4 degrees Fahrenheit in New York State since 1970, and since 1900 the average annual precipitation has also been increasing (ClimAID, 2011). This has led to major precipitation variability in which the state is receiving more precipitation in winter months and less in summer months.

The three pillars of sustainability are crucial in recognizing how the economic, social, and environmental vulnerabilities of the town intersect and have the potential to impact the larger community. In our research, we found the main potential economic impacts to be the loss of farming profitability, costs of repairing infrastructure damage, and the growing expense of emergency response services. In terms of the social sphere, we determined stress on farmers, heightened isolation, and the shift away from intergenerational agriculture to be the main impacts. Finally, major environmental harm can be expected in the forms of reduction of forested land, weather conditions unfavorable to crop growth, and the introduction of invasive species.

Determining the vulnerabilities of the Town of Hamilton is relevant to the sustainability of Colgate and the Village because it is crucial that the Colgate community maintains a positive rapport with the Village and the Town. Many residents are dependent on the University and its population for economic success while the surrounding area provides students with opportunities for extracurricular activities and other forms of engagement. It is important that all of the different communities within the Town of Hamilton work toward developing these symbiotic relationships. The Climate Smart Communities (CSC) website states that it is also important to assess the vulnerabilities of a community to climate change because without an assessment, it is not clear which parts of the community will be affected most. In creating a vulnerability assessment, there is a clear evaluation and discussion of which assets of the Town of Hamilton are most at risk in the face of impending climate change. Through this assessment, it is possible to then determine ways in which the Town can adapt to its vulnerabilities to climate change. Lastly, conducting a vulnerability assessment for a rural community like Hamilton is important as these areas are often overlooked in climate change discussions. Typically, there is a strong emphasis on protecting coastal cities and communities, resulting in rural areas not receiving the attention and support they need in order to properly adapt to the changes occurring around them. The Town of Hamilton has already taken steps towards a more sustainable and resilient future; a vulnerability assessment will help continue the community discussion regarding climate change and continue the progress being made.

In pursuit of our project's goals we used various sources and consulted previous climatic studies of New York state and surrounding areas to build a framework for conducting a vulnerability assessment for the Town of Hamilton. In conducting this assessment, the Climate Smart Communities Certification Program for New York state details a number of prioritized actions and pledge elements, including a

vulnerability assessment guidance framework presented in the *PE7.1 Action: Climate Vulnerability Assessment.* The framework consists of five chronological stages:

1. Research relevant studies of climate change projections.
2. Identify potential impacts to the following assets and systems, as appropriate.
3. Identify and assess vulnerabilities of each asset or system (exposure, sensitivity, and adaptive capacity).
4. Prioritize vulnerable assets and systems.
5. Develop report of vulnerability assessment findings.
   (PE7.1 Action: Climate Vulnerability Assessment, 2018).

Background

PE7.1 Action: *Climate Vulnerability Assessment*

The Climate Smart Communities (CSC) program is a New York state initiative that aids local governments in taking action to reduce greenhouse gas emissions and adapt to a changing environment. In pledging to become a Certified Climate Smart Community, local governments gain access to a guiding framework that aims to initiate and sustain climate action whilst enabling state recognition of community leadership. The Certification Portal further serves as an online information sharing platform between communities, local governments, and state leaders, streamlining documentation upload and review, communication, and progress updates. The program highlights vulnerable assets within communities and creates a platform for networking and peer sharing of resources with access to various benefits including potential grant applications such as Department of Environmental Conservation's CSC grants. Registered communities first make a commitment to act through passing the CSC pledge, while certified communities are recognised as having completed and documented actions towards mitigating and adapting to climate change. This system is designed around ten CSC pledge elements and progress is documented through a rating system consisting of three award levels: bronze, silver, and gold. The Town of Hamilton has been a registered CSC since 2016 and is currently working towards its Bronze certification.

In conducting a vulnerability assessment for the Town of Hamilton, the CSC Certification Program details a number of prioritised actions and pledge elements, including a vulnerability assessment guidance framework presented in the *PE7.1 Action: Climate Vulnerability Assessment.* The framework consists of five chronological stages:

1. Research relevant studies of climate change projections:

Identifying scope and relevant supporting data, including a summarised review of local studies if the information is available. If gaps in information prevail, review and summarise relevant national studies.

2. Identify potential impacts to the following assets and systems, as appropriate:

a. Municipal and private facilities and buildings including critical facilities, b. Transportation infrastructure and systems, c. Waste disposal techniques and systems, d. Wastewater treatment infrastructure and systems, including sewer systems, e. Drinking water sources, infrastructure, and systems, f. Stormwater infrastructure, g. Energy sources, infrastructure, and systems, h. Communication systems, i. Economic sectors, j. Social sectors, k. Parks and public land, l. Public health, including the private health care system, m. Agriculture, n. Food supply, o. Natural assets and systems and the services they provide, p. Cultural assets, q. Emergency response systems.

3. Identify and assess vulnerabilities of each asset or system (exposure, sensitivity, and adaptive capacity):

a. Exposure as the degree to which elements of a climate-sensitive asset or system are in direct contact with climate hazards or sensitive to climate variability, and as the degree to which the climate hazard may change over time, b. Sensitivity as the degree to which an asset or system will be affected by a change in climate, either beneficially or detrimentally, c. Adaptive capacity as the ability of an asset or system to adjust to actual or expected climate stresses or to cope with the consequences.

4. Prioritize vulnerable assets and systems:

a. Prioritize assets based on their exposure and sensitivity to the effects of climate hazards and their adaptive capacity.

5. Develop report of vulnerability assessment findings.

(PE7.1 Action: Climate Vulnerability Assessment, 2018).

Through implementing these actions, the CSC program aims to benefit communities through promoting cost efficiency, energy independence and security, accessible urban centres, conservation of green space, reduction of flood risk through climate change adaptation strategies, investment in sustainability and green businesses, and increased engagement with local residents (PE7 Action: Climate Vulnerability Assessment, 2018).

The CSC program recommends the completion of a vulnerability assessment as one of the first foundational steps in becoming a Certified CSC and developing an effective approach to climate change mitigation and adaptation strategies at the local level. An integrated risk assessment, that assesses the magnitude of impact and likelihood of events for both current and future projections, is included within the prioritisation process of the vulnerability assessment. The initial vulnerability assessment may be refined in the future and is subject to data and projection updates, if any new information exists, every five years for recertification (PE7 Action: Climate Vulnerability Assessment, 2018).

Data-Driven Investigation

Methods Used to Collect Data

The majority of the methods used to collect data to inform this assessment involved questionnaires and interviews, as well as a Town of Hamilton wide workshop on March 30th, 2019. After some research and discussion with Colgate's Director of Sustainability, John Pumilio, a list of 4 groups of local farmers was collated in anticipation of gaining insight into local farming conditions as well as local perception of risks faced by farmers. Each farmer was contacted and provided access to a questionnaire that aimed to guide discussion and inform this assessment through the perceived vulnerabilities to the agricultural sector within the town and how climate change might impact it in the near future. The stakeholders contacted include Beth Roy, Sarah Ficken, Asher and Wendy Burkhart-Spiegel, and Johanna Bossard.

Two emails were received in response, from Beth Roy and Asher and Wendy Burkhart-Spiegel, containing significant and insightful information. A meeting was organized with Johanna Bossard at Hamilton School on March 29th. The meeting included a tour of the Agriculture Department and an informal interview with questions and discussion structured similarly to the questionnaire.

On March 30th the Hamilton Climate Resiliency Workshop, which involved stakeholders and local leaders, was facilitated by John Pumilio. The goal of this workshop was to work towards taking the next steps in the CSC process, which is to complete PE7.1 Action: Climate Vulnerability Assessment. Similar communities often complete this workshop in two 5-6 hour meetings. This workshop was completed in one 5-hour session and accomplished steps 2-4 of the CSC vulnerability assessment 5-step process. Participants were separated into different groups organized by the Village of Hamilton, the Town of Hamilton, and Colgate University. Within these groups community members discussed and identified potential impacts to Hamilton's assets and systems, the vulnerabilities of each asset or system (exposure, sensitivity, and adaptive capacity), and then prioritized the vulnerable assets and systems. Most of the information through which this report is built upon was obtained through conversation with stakeholders, local leaders, and other members of the Town of Hamilton community during this workshop. Associated stakeholders are as follows:

Chris Rossi: Town Board of Supervisors Member

As a member of the local community, representing its interests in talks with the rest of Hamilton leadership, Chris was able to help us attain an understanding of the key values for the residents and their willingness to adapt their lifestyles to prepare for impending climate change. She is also up to date on initiatives that have already been pursued by the Town and informed our group on their levels of success or failure as well as the reasons for such outcomes.

Ian Helfant: Associate Professor of Russian & Eurasian Studies and Environmental Studies

Ian M. Helfant holds a joint position in Russian & Eurasian Studies and Environmental Studies at Colgate University. He is also a founding member of Colgate's Sustainability Council and served as its chair from 2005-2010 and 2015-16. As our professor in the course Community-Based Study of Environmental Issues and an active member of the Town of Hamilton community, Ian Helfant has provided us with guidance and resources regarding our project. He has also been able to give us information about the stakeholders who have aided us in our search for data to give us insight into specific vulnerabilities.

John Pumilio: Colgate's Director of Sustainability

John is Colgate University's Director of Sustainability, and thus the head of our school's sustainability efforts. Because of John, Colgate has implemented numerous sustainability programs that have reduced our ecological and carbon footprints. He has played an important role throughout the duration of our project. John is very valuable in the Town of Hamilton's mission for a more sustainable and resilient future. He has helped create a resiliency self-assessment for the Town and has been an invaluable source of information throughout the process of moving closer to certification through a vulnerability assessment.

PE7 Action: Climate Vulnerability Assessment

Step 1: Climate Projections

Following Step 1 of the PE7.1: Climate Vulnerability Assessment, we researched climate projections at a state-wide scale, then focused upon regional and localised projections, specifically those affecting Madison County and the Town of Hamilton. In order to accomplish this, we used two main sources in our research: the NYS 2100 Commission and the New York State ClimAID report (2011 and 2014).

The NYS 2100 Commission was conceived in response to various unprecedented and severe weather events experienced within New York state and surrounding regions in 2012. The Commission examines and evaluates key vulnerabilities concerned with the state's critical infrastructure systems and details recommendations for resilience actions. It aims to mitigate future damages, to both environmental and social systems, and the economy, whilst promoting a robust green technology sector to enhance quality of life. The extent to which communities can maintain resiliency, in response to direct and indirect impacts of rapidly changing climates and other long-term accelerators of change, will continue to shape future livelihoods into the next century. The report recognizes the relative unpredictability of significant climate change risks, demographic pressures associated with increased urbanization, increasing wealth inequalities, and tackling a rapidly growing aging population. Recommendations for mitigation and adaptation strategy are highlighted within the report, centrally focused upon the conservation and development of systems that respond quickly and effectively to extreme, unprecedented change as well as identifying areas of weakness or significant risk within a system. The report presents nine detailed cross-cutting recommendations. We aim to consult these recommendations throughout the vulnerability assessment process for the Town of Hamilton to aid a comprehensive understanding of future consideration and recommendations promoting community resilience. Recommendations include: the promotion, upgrading, and strengthening of existing infrastructural systems concerning both the livability and agricultural production of the Town of Hamilton; the promotion of better options and alternatives for effective structural replacement; encouraging the use of 'green' and 'natural' infrastructure and community spaces; incentive programs to encourage resilient behaviour and a subsequent reduction of vulnerabilities; and the expansion of education, job training, and workforce development opportunities within the Town of Hamilton.

The NYS ClimAID (2011 and 2014) reports provide insight to topics pertaining to impending climate change in New York State and additional environmental concerns for specific regions within the area. The ClimAID reports use global climate model simulations (GCMs) in order to develop projections for future climate change (ClimAID, 2014). GCMs mathematically represents changes in the Earth's climate over time by analyzing sensitivities to concentrations of greenhouse gases and aerosols in the atmosphere. Complimentary to this information, the NYS 2100 Commission details a concentrated focus on the infrastructural aspect of resilience in the face of impending rapid climate change upon both urban and natural ecosystems.

Following an integrated framework, informed by the data provided within these resources, we aim to guide the Town towards completing the PE7 action, earning a further 4-6 points towards the Town of Hamilton's certification as a Climate Smart Community.

Statewide Projections

According to the NYS 2100 Commission, New York State as a whole faces several risks to climate change including sea level rise, changing precipitation, changing temperature, and extreme weather events. Sea level rise is primarily caused by melting of polar glaciers and ocean expansion due to atmospheric warming; the water is expected to rise by as much as six feet in areas of New York City and

Long Island. Rises in sea level can result in increased salinity in drinking water and dangerous storm surges. Over the past 100 years, precipitation has increased by an average of 3.3 inches; most precipitation increases are observed in the winter, while summers are experiencing less precipitation, which can increase the risk of drought and affect water supplies (NYS 2100 Commission, 2012, ClimAID, 2011). It is projected that precipitation will increase by 5-15% by the 2080s. In addition to increases in temperature, New York State is projected to experience an increase in temperature ranging from 4-10ºF by 2100, which will mainly be felt during the winter (NYS 2100 Commission, 2012). Due to this increase in temperature, the farming community in the state will potentially experience a longer growing season (ClimAID, 2011). Lastly, New York State will likely see an increase in extreme weather events such as heat waves and heavy precipitation events, which can increase the risk of flash flooding and the erosion of soils (NYS 2100 Commission, 2012).

In addition to projections regarding a changing climate in New York State, the NYS 2100 Commission report projected that the population of New York will increase from 19.6 to 22 million people between 2011 and 2040 (NYS 2100 Commission, 2012, "New York State", 2011). With this population growth, shifts in demographics are also expected to occur, such as increases in urbanization, suburban poverty, and an aging population. It is important to keep in mind that the population of New York is changing along with a changing climate, and not all demographics will be affected in the same way due to environmental inequities (ClimAID, 2011). This relates to the social pillar of sustainability, because if the Town seeks a more sustainable future, it needs to ensure that all members of the community have equitable opportunities and that there isn't a portion of the population suffering from the impacts of climate change more than others due to their living circumstances.

Regional Projections

As classified by the ClimAID report from 2011, Madison County falls within Region 5: East Hudson and Mohawk River Valleys. Specifically for this region, there is a projected increase in precipitation of 0-5% by the 2050s and 5-10% by the 2080s; for temperature, there is a projected increase of 3.0-5.5ºF by the 2050s and 4.0-8.0ºF by the 2080s (ClimAID, 2011). In the Hudson River, it is projected that the saltwater front will move further north and storm surges will propagate further up the river.

Local Projections

Based off of the Madison County Hazard Mitigation Plan of 2016's Hazard Analysis, hazards were ranked from moderately high danger to low danger. In this ranking, severe storms, transportation accidents, winter storms, and fires were ranked as moderately high dangers. Regarding winter storms, the Town of Hamilton was found to have a greater probability of facing this hazard. Ice storms, flooding, utility failure, tornado, ice jam, infestation, extreme temperatures, epidemic, and drought were ranked as moderately low hazards. The Town of Hamilton has a greater probability of facing ice storms, flooding, ice jam, and drought compared to the surrounding county.

Key Factors/Variables

The impact on agricultural production in the Town of Hamilton is one of the most significant key factors addressed within this report. Consulting yield production levels, we can attempt to determine whether or not the agriculture sector has been affected by climate change in the recent past. This study relates to all three of the pillars of sustainability. The farmers' well-being would be severely harmed by a loss in production, demonstrating the social and economic impact, while the destruction of the land itself connects to the ecological component. Agriculture contributes $4.5 billion to the state's economy and occupies approximately a quarter of the state's land (ClimAID, 2011). The agriculture sector plays a

large role across the state, but plays a particularly important role in the Town of Hamilton. Data pertaining to crop yields in previous years as well as current statistics are paramount to the ability to observe change over time. Interviewing local stakeholders in the agriculture sector also aids qualitative evaluation of the vulnerabilities within and affecting this sector.

Damage to infrastructure will act as another indicator of Hamilton's vulnerability to impending climate change. Flooding and severe storm events are both capable of destroying homes or roads such that they deserve attention in the form of our study. Statewide, transportation contributes $100 billion to the economy (ClimAID, 2011). As such, it is important to maintain the infrastructure that supports this asset and examine the ways that climate change may affect it. Through cooperation and communication, it is important to develop an understanding of how local infrastructure has been affected by environmental hazards in the past and if any changes have been recently observed.

Step 2: Potential Impacts to Assets and Systems

Following Step 2 of the PE7.1 Action outline, we identified the potential impacts due to climate hazards for a broad range of categories provided by the outline. In order to achieve this, we adopted the hazard analysis structure found in the Madison County Hazard Mitigation Plan, which was created in 2016. As previously discussed in the 'Local Projections' section of this report, this Plan ranked each respective hazard on a scale from low to moderately high risk for the county, then related these hazard levels to the Town of Hamilton. Although not all hazards are projected to be very prevalent in the Town of Hamilton, all listed hazards were included since we are analyzing potential impacts. Hazards were ranked as unlikely, fairly likely, and likely for each category, which is shown in Tables 1.1, 1.2, and 1.3.

Table 1.1: Potential Impacts

Legend (Table 1.1):

Unlikely	Fairly likely	Likely

Asset	Hazard				
	Severe Storms	Transportation Accidents	Winter Storms	Fires	Ice Storms
a.					
b.					
c.					
d.					
e.					
f.					
g.					
h.					
i.					
j.					
k.					
l.					
m.					
n.					
o.					
p.					
q.					

*"*a. Municipal and private facilities and buildings including critical facilities, b. Transportation infrastructure and systems, c. Waste disposal techniques and systems, d. Wastewater treatment infrastructure and systems, including sewer systems, e. Drinking water sources, infrastructure, and systems, f. Stormwater infrastructure, g. Energy sources, infrastructure, and systems, h. Communication systems, i. Economic sectors, j. Social sectors, k. Parks and public land, l. Public health, including the private health care system, m. Agriculture, n. Food supply, o. Natural assets and systems and the services they provide, p. Cultural assets, q. Emergency response systems."* (PE7 Action: Climate Vulnerability Assessment, 2018).

Table 1.2: Potential Impacts

Legend (Table 1.2):

Unlikely	Fairly likely	Likely

Asset	Hazard					
	Flood	Utility Failure	Tornado	Ice Jam	Infestation	Extreme Temperatures
a.						
b.						
c.						
d.						
e.						
f.						
g.						
h.						
i.						
j.						
k.						
l.						
m.						
n.						
o.						
p.						
q.						

*"*a. Municipal and private facilities and buildings including critical facilities, b. Transportation infrastructure and systems, c. Waste disposal techniques and systems, d. Wastewater treatment infrastructure and systems, including sewer systems, e. Drinking water sources, infrastructure, and systems, f. Stormwater infrastructure, g. Energy sources, infrastructure, and systems, h. Communication systems, i. Economic sectors, j. Social sectors, k. Parks and public land, l. Public health, including the private health care system, m. Agriculture, n. Food supply, o. Natural assets and systems and the services they provide, p. Cultural assets, q. Emergency response systems."* (PE7 Action: Climate Vulnerability Assessment, 2018).

Table 1.3: Potential Impacts

Legend (Table 1.3):

Unlikely	Fairly likely	Likely

Asset	Hazard							
	Epidemic	Drought	Wildfire	Wave Action	Dam Failure	Hurricane	Earthquake	Blight
a.								
b.								
c.								
d.								
e.								
f.								
g.								
h.								
i.								
j.								
k.								
l.								
m.								
n.								
o.								
p.								
q.								

*"*a. Municipal and private facilities and buildings including critical facilities, b. Transportation infrastructure and systems, c. Waste disposal techniques and systems, d. Wastewater treatment infrastructure and systems, including sewer systems, e. Drinking water sources, infrastructure, and systems, f. Stormwater infrastructure, g. Energy sources, infrastructure, and systems, h. Communication systems, i. Economic sectors, j. Social sectors, k. Parks and public land, l. Public health, including the private health care system, m. Agriculture, n. Food supply, o. Natural assets and systems and the services they provide, p. Cultural assets, q. Emergency response systems."* (PE7 Action: Climate Vulnerability Assessment, 2018).

Step 3: Vulnerabilities to Local Assets

For Step 3 of our PE7.1 Vulnerability Assessment, we identified specific assets for the Town of Hamilton, and then identified vulnerabilities for each asset and system. This differs from Step 2 in that it specifically relates to the Town and considers the probability of hazards occurring, rather than existing as a broad discussion of general hazards which may be less likely to occur. The assets were identified in conjunction with individuals who attended the Hamilton Climate Resiliency Workshop, along with the NY Rising Countywide Resiliency Plan for Madison County, and the information gathered from the previous Steps of this Vulnerability Assessment. We observe four main vulnerabilities for the Town of Hamilton: environmental vulnerability, agricultural fragility, infrastructure damage, and community stress. Keeping these vulnerabilities in mind, we evaluated each asset and how they would be affected by these vulnerabilities.

Agricultural Community

The agricultural community in the Town of Hamilton is considered an asset because it plays such a large role in the local economy and lives of the community members. Hamilton, New York is an area that prides itself for the local food that is produced, which is shown in the farmers markets that occur year-round. In a survey taken in the Town of Hamilton Comprehensive Plan of 2017, 69.5% of 508 people interviewed said that the local agriculture was important to them, while 27.8% said that it was somewhat important. Those who said agriculture was important to them were then asked why agriculture was important to them, and 88.6% of 493 people responded, “agriculture is part of the regional economy”. Additionally, 72.8% said that “agriculture maintains the town’s rural character”. Of the people who participated in the survey, only 8.8% of 502 people were actively engaged in farming in the Town, which shows that it is thought to be important by a wide variety of people in the area, not just those who are directly involved in agriculture. Based off of the attitudes of the local people, it is evident that agriculture is considered an asset in the Town due to its economic value, and due to the role it plays in the Town’s identity.

The largest vulnerability for the agricultural community is the agricultural fragility that is present in the area. This is primarily due to the aging farmer population, an increase in the amount of land that is being developed, loss of profitability within this market, an increase in pests and disease, an increase in the risks to maple trees, crops, and livestock, and an increase in the threat of unusual weather events.

The aging farmer population poses a vulnerability to the agricultural community because the aging population isn’t being replaced by a younger farming population. In the past, farming was a trade that was passed down within families, which allowed for the community to continue its presence within the Town. If this aging farmer population is not being replaced by a younger population, then it will be difficult for this economic sector to continue in the same strength.

The loss of profitability in the agricultural sector is a very concerning vulnerability, as this makes it difficult for families tied to farming to make a living. If these families cannot make a living, then they will face the danger of losing their farm or house. As a result of this, the local food market will be greatly impacted, since there will be less farms providing produce and meat to grocery stores.

An increasing development of agricultural land is also a vulnerability for the agricultural community in the Town. Because the agricultural sector is losing profitability, it may be difficult for this community to withstand pressures from other industry development, such as more commercial businesses, or from housing development sprawl.

An increase in the prevalence of pests, diseases, and unusual weather events directly impacts the agricultural community, as these events can result in crop failure and therefore loss of profitability. Unusual weather events can affect infrastructure as well as crops, resulting in the increased need to

spend more money on risk prevention, such as improved irrigation, hoop houses, and other protective structures and generators.

Another concern that was expressed at the Hamilton Climate Resiliency Workshop was the rising feeling of stress within the farming community, which is displayed through a global increase in suicide rates among farmers, psychological distress, and physical illness (Kumar et *al.* 2015). In most cases, the mental toll is the result of lost profitability making the farmers' lives more difficult. This may become more prevalent if support or solutions are not offered to the farming community. Another source of stress among farmers is the change in regulations that have surfaced over the past few years. This primarily comes in the form of national regulations that lead to higher costs for farmers.

Colgate University

While the presence of Colgate within the Town of Hamilton may divide the people of the community, many people see the presence of Colgate University as an asset. The University's presence encourages more people to visit the local area, generating support of businesses and economy in the Town, while the student and staff population generates social cohesion through volunteerism, employment opportunity, and educated professionals. In addition to increased business activity, many view the presence of Colgate students as a positive presence within the Town, and appreciate the students for participating in organizations such as SOMAC, the Hamilton Fire Department, and other volunteer programs. Colgate student volunteers account for approximately 24 of the volunteers for SOMAC during the academic year and 25% of the 55 members of the Fire Department (Town of Hamilton Comprehensive Plan, 2017). Colgate provides the Colgate Cruiser busing system which is open to the public during the academic year (Town of Hamilton Comprehensive Plan, 2017). The University also brings highly educated residents to the area through its employment of professors. Adding these individuals to the community helps the Town to make informed decisions on relevant issues, including those related to the changing climate.

While Colgate was not particularly focused on for this assessment due to this work being completed by another group of ENST 390 students, a vulnerability of Colgate University and the Town of Hamilton in general that was noted is that it's geographically and socially isolated from surrounding metropolitan areas. This could prove to be an issue if an acute disaster leaves Colgate and the Town incapable of solving this disaster on its own. While this hasn't been apparent yet, if it were to occur, the area may not be prepared to overcome this obstacle.

Climate-Aware Local Population

A unique characteristic of the Town of Hamilton is its environmental awareness of climate-related issues and the steps that need to be taken in order to combat climate change, which was directly shown at the Hamilton Climate Resiliency Workshop. At this workshop, individuals of a variety of backgrounds worked together to discuss climate-related issues that the Town is facing and how they can take action to prevent extensive damage. In the Town of Hamilton Comprehensive Plan survey, 83.2% of 458 people interviewed believe that "the Town of Hamilton should pursue more green energy projects for the town office, garage, and the community". Additionally, 96.7% of 480 people said that the Town of Hamilton's natural environment was important to them. This feat cannot be said for other communities that share similar demographics.

While this asset is directly related to the recognition and acceptance of climate change, climate change also highlights a few vulnerabilities that could prevent its effectiveness in the future. One vulnerability to this asset is posed by the current administration. While the Town may make efforts to work together and prepare the area for climate change, the lack of federal support for this movement could potentially limit the effectiveness of these efforts. While it is difficult to resolve this issue in the near future, it is important to maintain the current momentum of the discussion surrounding this issue.

Policies for Resiliency

In order to remain effective, resiliency policies must contain the most current information and data appropriate for the Town and assets that they serve in climate preparedness. A changing climate and changing conditions to the immediate and surrounding area merit changing or updated policies to better reflect the Town's needs and desires both presently and in the future. Improved communication and cooperation amongst the Town and the Village strengthen policies for resiliency and aid in climate preparedness and planning within the local government.

Vulnerable to the dynamic and varied aspects of a changing future, policies must reflect similarly in their ability to address climate hazards and resolve intensity of risk through climate mitigation and adaptation by providing strong avenues for improving resiliency within the Town. Effective policies cover a broad spectrum of assets and optimally involve numerous representatives, landholders, and stakeholders within the area. An example of effective resiliency policy is found in the Town of Hamilton Comprehensive Plan (2017), which highlights the updating of the Town Zoning law to require a public hearing before the Planning Board for all projects that require site plan review approval as a key strategy. While such efforts are being made, the ability to continually update and manage resiliency policy to avoid redundancy is rather arduous and time intensive. The Climate Smart Communities (CSC) program recognises this and provides a variety of guided actions to be completed in becoming a certified climate smart community that address the need to review and update policy.

Emergency Response System

The emergency response system within the Town of Hamilton is considered to be an asset due to the presence of the Emergency Room at the Community Memorial Hospital (150 Broad Street), the Village of Hamilton fire department (121 Lebanon Street), and the Souther Madison County (SOMAC) Volunteer Ambulance Corp, Inc (86 Lebanon Street). The presence of a hospital and emergency response system in close proximity to a small town such as Hamilton is valuable because without these, the area would be isolated from any source of rapid response.

A vulnerability of the emergency response system in the Town is that the majority of these systems are on a volunteer basis, meaning that they could be susceptible to lack of personnel, which would directly limit their effectiveness. The capabilities of these systems heavily depend on the willingness of the community members, so any drop in participation will impact how well these systems operate.

Another vulnerability of the Town's emergency response system is the potential damage to infrastructure due to climate-related events. Damages to roadways are largely due to the constant freezing and thawing of the infrastructure, which deteriorates the integrity of the infrastructure. If the vehicles of the emergency response systems cannot get to their destination, or cannot get there in a timely manner, then it will be impossible for them to do their job. More frequent power losses during severe storms will also limit the effectiveness of these systems.

Well-Water and Septic Tank

As a rural community, the Town of Hamilton does not have to concern itself with some issues of water management that will plague populations everywhere as flooding and infrastructure damage increase over time. Well-water and septic tanks, after installation, are cheaper methods to provide household services. Well-water and septic tanks are also viewed to be better for the environment and are viewed as the healthier option. Many Town of Hamilton community members view their use of a well and septic tank as an asset, and prefer that over municipal services.

The increase in risk of flooding in the area highlights a major vulnerability of these two services. As a result of flooding, the effectiveness of these services can be greatly compromised. First, the water

within the well system can become contaminated, which results in the danger of becoming sick, and therefore the recommendation to temporarily discontinue use of the well ("Septic Systems", 2017). For septic tank systems, flooding can result in the system backing up into the house's basement. In order to combat these negative effects, it is recommended to stop using the systems altogether once a flood has occurred, which not ideal for the individuals who rely on these services in their homes ("Septic Systems", 2017).

Another vulnerability of these utilities becomes apparent due to the projected increase in more extreme temperatures in the Hamilton area. Both water wells and septic tanks can disfunction when faced with temperatures below freezing. While water wells can't freeze themselves, the cold temperatures can affect the pipes that bring the water into the household. Temperatures well below freezing have recently become more prevalent in the Town, which means that these household services are more vulnerable to this utility failure. If any sort of disfunction does occur, then the owner will have to get the system serviced resulting in an increase in cost.

Intermunicipal Cooperation

As stated in the Climate-Aware Local Population section, the people of Hamilton feel that there is effective cooperation among the Town, Village, and community members. This proves to be an asset for the area, as it makes it easier to work together and achieve mutual goals that benefit all those involved.

While it is believed that there is satisfactory coordination among the Town, Village, and citizens, this coordination could also be improved, and as a result improving the resiliency of the area to climate change. In addition to improving coordination, the communication of this coordination should also be improved so that all community members are on the same page, and are able to continue working together.

Forested Land/Carbon Sinks

As seen in the Town of Hamilton Comprehensive Plan survey, the people of the Town of Hamilton feel a strong connection to their natural environment. Part of this may be contributed to the abundance of forested land and natural environment in the area. While community members feel a general tie to their environment, they also find that these features of the surrounding land are important, as they act as carbon sinks by sequestering carbon from the atmosphere.

More extreme temperatures and greater flooding will put the security of these forests in jeopardy as we move towards future conditions. The growing likelihood of drought also means that we may see forest fires in the area that would reduce the size of these forests, severing the connection to the local residents and putting animal habitats at risk. Another danger of climate change is that of invasive species. The altered conditions of the Town of Hamilton will allow for the entrance of new organisms that may not have been capable of living in the space at an earlier date. With the introduction of the new populations, the current inhabitants will start to struggle for their typical resources and may even be directly harmed by certain newcomers. The forests will have a hard time adapting to the new ecosystem controlled by foreign species.

County Leadership

Madison County has been acting as a leader in sustainability for the last two decades. It was home to some of the earliest commercial wind farms in the eastern half of the United States and has continued its commitment to renewable energies. The county has made an effort to explore the realm of solar power and has even implemented programs to convert methane produced by its landfills into electricity. As a part of the 2010 Climate Change Innovation Program, the county has been taking

inventory of its greenhouse gas emissions. Conducting this research was the first step in reducing emissions.

In addition to these concrete efforts to lessen its carbon footprint, Madison County has acted as a sustainability leader through education. Residents within the county's borders, as well as leaders of the surrounding areas, have benefitted from the work being done by the local government. Through the creation of documents such as The Energy and Sustainability Plan for Madison County, the topic of dealing with climate change has been made far more accessible for New York State communities. Its goal was to provide a simplified walkthrough of the steps to be followed for a county to downsize its contribution to global emissions (Energy and Sustainability Plan).

Step 4: Prioritize Vulnerable Assets and Systems

Step 4 of the PE7.1 Vulnerability Assessment prioritizes the identified assets and systems. This is important when conducting a vulnerability assessment, as it provides a framework for the Town to consult when determining which assets to prioritize first if time and resource constraints affect the ability to protect all assets.

The Hamilton Climate Resiliency Workshop, 30th March 2019, combined community efforts to prioritize vulnerable assets within the Town. Participants were limited to identifying three important assets rather than deciding upon a definitive ranking. One of the two groups representing the Town of Hamilton identified what they saw as its greatest assets. As shown in Table 2, they ranked the agricultural community, Colgate University, the climate aware local population, and emergency services as those most valuable. Lesser assets such as county leadership, intermunicipal cooperation, the clean environment, well-water, and the use of septic tanks were also mentioned. The second Town of Hamilton group placed high value with the community volunteer spirit and services shared with the Village like the fire department or the hospital. They listed open communication between residents, including over social media, and the Town's focus on infrastructure improvements as assets of secondary importance. While the vulnerable assets were prioritized based on value to the community it is important to recognize that all of the vulnerable assets are crucial to consider for the well being of the town. However, some were placed at "Most Value" due to contribution to the community.

Building upon this information we used our own self-informed judgement and knowledge based upon researched climate projections when ranking assets as either moderately valued or of least value. Based upon this knowledge of community perception of valued assets, we combined our knowledge of systems vulnerable to future climate change and produced the following four vulnerable assets. While these assets are prioritized, they are not absolute and intend to guide the Town of Hamilton in conducting complex and thorough vulnerability assessments in the face of climate change. The following table highlights those assets perceived as most valuable to the community.

Table 2: Prioritized Assets

Most Value	Moderate Value	Least Value
Agricultural Community	Emergency Response System	Well-Water and Septic Tank
Colgate University	Highway Department and Road Management	Intermunicipal Cooperation
Climate Aware Local Population	Connected Town and Village Governance	Forested Land/Carbon Sinks
Policies for Resiliency	Focus on Infrastructure Improvements	County Leadership

Table 2 shows the assets that were discussed at the Hamilton Climate Resiliency Workshop, and they are ranked into three categories: most value, moderate value, and least value based off of the thoughts of the participating group members.

Step 5: Report and Recommendations

Step 5 of the PE7.1 Vulnerability Assessment is the report development stage, which is fulfilled by this document. The purpose of creating this report is to share the findings for this vulnerability assessment. In order to provide a basis for the next steps within the CSC program, after the vulnerability assessment, it is crucial to consider what next steps are appropriate to move forward in taking action to reduce greenhouse gas emissions and adapting to a changing environment. In the Hamilton Climate Resiliency Workshop, with the community stakeholders and local leaders, we identified some recommendations that the people of the Town of Hamilton felt were most crucial to consider in order to move forward in establishing a more resilient community, which is shown in Table 3.

Table 3: Categorized Recommendations

Communication	Infrastructure	Agriculture	Environment
Improve municipal coordination	Right-sizing culverts	Communication between local municipalities and Ag. department	Intelligent forest management
Publicize dam safety reports	Underground electric phone lines	Put together Ag. community voting group	Work w/ DEC to encourage more deer hunting
Better phone and broadband coverage	Increase amount of green surfaces		Limit coyote hunting
Publicize administrative decision making	Update zoning laws for stormwater management		

Table 3 shows the recommendations and next steps that were discussed at the Hamilton Climate Resiliency Workshop, and they are categorized into four areas of focus: communication, infrastructure, agriculture, and environment.

It is important to note that this vulnerability assessment is a continuous process, and that this process should be redone in approximately five years. The climate and nature of the Town will continue to change in the future, which means that the Town's vulnerabilities to climate change may also change. In order to mitigate the impacts of climate change, it is necessary to continue reassessing these vulnerabilities in the future and determining ways in which the community can become more resilient to these vulnerabilities. The table above is a starting point from which town leadership can begin the task of ascertaining which proposals are financially realistic and would be most beneficial to Hamilton and its residents.

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Appendix

Questionnaire 1:

Questions we sent out to members of the agricultural community:

1. What do you see as main risks to agriculture production in the face of climate change?

2. How have, if at all, these climate change related pressures already impacted your farming operation or those of other community members?

3. As a member of the community, are there any other hazards or obstacles you have faced/will face that you think are a result of climate change?

4. How well informed do you believe you are on the projected trends of climate change in the Town of Hamilton?

5. Are there any programs supporting farmers you would prefer to see implemented?

6. Any other comments?