Climate Vulnerability and Adaptation Report for Canton and Potsdam

2023

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Meeting the challenges of climate change

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EcoAdapt™

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Table of Contents

Introduction

The effects of climate change, which are already being experienced in Canton and Potsdam, NY, will continue for decades to come. These changes include higher average temperatures, particularly in winter; more extreme heat; more frequent and severe droughts; changes in precipitation intensity and seasonal distribution and increased risk of flooding; and decreases in snowfall amounts and length of the snow season. Climate-related impacts, coupled with pre-existing challenges such as lack of affordable housing and older housing stock, demographic shifts including loss of workforce in the agricultural and infrastructure sectors, rising costs of food production and purchasing, and aging infrastructure, have significant implications for the people, infrastructure, and environment of Canton and Potsdam.

The purpose of this report is to improve understanding about local climate change impacts and vulnerabilities and present adaptation responses that can help reduce community vulnerability and/or increase resilience. The report synthesizes the results of a 3-day virtual workshop held in March 2023. This workshop brought together 19 stakeholders from across Canton and Potsdam and from St. Lawrence County to evaluate community vulnerability and develop adaptation strategies for three focus areas of importance to the community: (1) housing, (2) utilities, and (3) agriculture and food security.

The subsequent sections in this report are described below:

- **Project Methods and Workshop Activities** – Provides an overview of the climate adaptation planning process, workshop series, and selection of pre-existing conditions and climate stressors.
- **Overview of Climate Projections and Impacts** – Presents a summary of current and projected climate changes for the community.
- **Vulnerability Assessment and Adaptation Planning Results** – Summarizes vulnerability and adaptation information for each of the three focus areas.
- **Conclusions** – Highlights common concerns, impacts, and adaptation strategies across the different focus areas.

Project Methods and Workshop Activities

Climate Adaptation Planning Overview

Climate change adaptation refers to how we prepare for, respond to, and recover from changes we are already experiencing and/or are expected to experience. *Adaptation*, which focuses on managing the impacts of climate change, can be distinguished from *mitigation*, which refers to efforts intended to decrease the potential for climate change itself (e.g., by reducing greenhouse gas emissions or enhancing carbon sequestration). The adaptation planning process (Figure 1) intentionally integrates the consideration of climate change into plans, programs, projects, and operations and is meant to be iterative.

While there are many different climate adaptation planning frameworks, they generally consist of the same steps: (1) project scoping, (2) assess vulnerability, (3) identify adaptation strategies, (4) implement those strategies, and (5) monitor, evaluate, and adjust strategies, as needed.

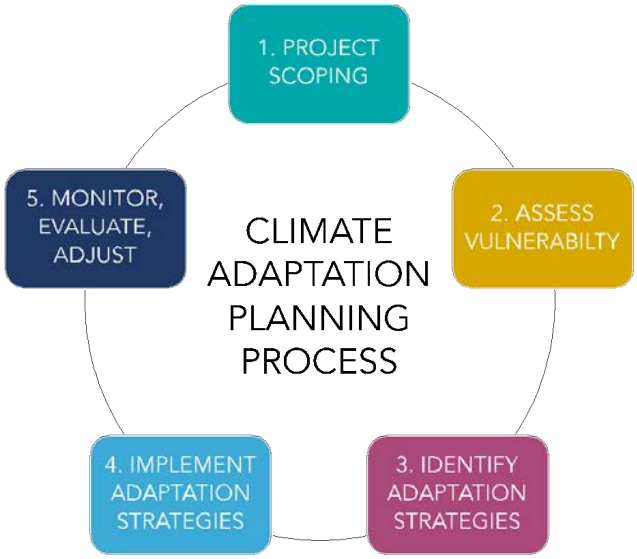

Figure 1. Steps in a Basic Climate Adaptation Planning Process

These steps are described below:

1. **Project scoping**. This step includes identifying goals and desired outcomes of the process, establishing the geographic boundaries and timeframe of interest (i.e., near-term = 0–20 years; mid-term = 25–50 years; long-term = 50+ years), identifying and engaging with key stakeholders and partners, and identifying key

climate stressors and pre-existing conditions (i.e., stressors that already affect a community). Completion of this step is critical to providing the foundation for a clear and efficient adaptation planning process.

2. **Assess Vulnerability**. Vulnerability assessments improve understanding of how climate change is likely to affect a community and its ability to respond to those impacts. Vulnerability assessments include consideration of the likelihood of exposure to climate change, the consequence of that exposure, and the community's capacity to adapt to those impacts. These assessments include consideration of the following three components of vulnerability:

    - **Likelihood** is the degree to which a community is exposed to significant changes in climate and considers both the anticipated direction and magnitude of change.
    - **Consequence** is the degree to which a community is affected by exposure to a changing climate and considers both the anticipated impacts of climate stressors as well as the impacts of pre-existing conditions.
    - **Adaptive capacity** is the ability to adjust to climate change to minimize potential damages, take advantage of opportunities, or cope with consequences.

Likelihood and consequence together give an estimation of risk that, when combined with adaptive capacity, provides an overall picture of vulnerability (Figure 2). It is important to evaluate all three components—likelihood, consequence, and adaptive capacity—to gain a holistic perspective of the factors that are driving vulnerability.

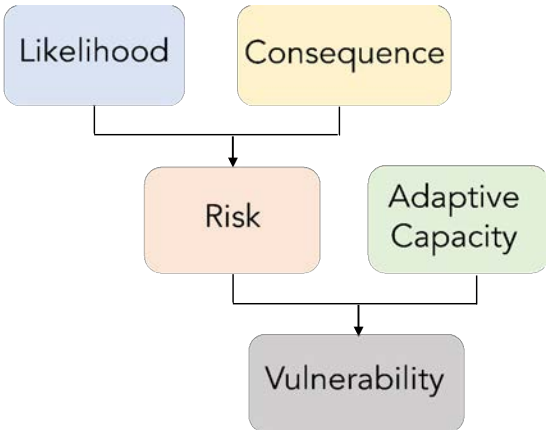

Figure 2. Components of Vulnerability

The vulnerability assessment step of the adaptation planning process includes evaluating the impacts of climate change on a community; characterizing the community's ability to minimize or cope with impacts; assigning likelihood, consequence, and adaptive capacity rankings; and summarizing overall vulnerability based on rankings, impacts, and adaptive capacity information. The

resulting level of vulnerability is assessed using risk matrices that incorporate these components (Figure 3).

RISK CALCULATOR MATRIX

Likelihood	Consequence			
	Negligible	Moderate	Major	Catastrophic
Rare	Low	Low	Low	Low
Unlikely	Low	Moderate	Moderate	High
Likely	Low	Moderate	High	Extreme
Almost Certain	Low	High	Extreme	Extreme

VULNERABILITY CALCULATOR MATRIX

Risk	Adaptive Capacity		
	Low	Moderate	High
Low	Low	Low	Low
Moderate	Moderate	Moderate	Low
High	High	Moderate	Moderate
Extreme	High	High	Moderate

Figure 3. Matrices for Assessing Level of Risk and Vulnerability.

3. **Identify Adaptation Strategies**. Adaptation strategies aim to reduce the negative effects or take advantage of the opportunities provided by climate change. The goal of this step is to identify adaptation strategies that reduce risk (limit exposure or minimize consequence) and/or enhance resilience (increase adaptive capacity). Understanding what drives vulnerability to climate change (likelihood, consequence, adaptive capacity, or some combination of these) provides a good starting point for identifying possible adaptation strategies. General types of adaptation strategies that may be considered include programmatic; capital improvements and infrastructure; coordination and/or collaboration; knowledge and evaluation; and plans, regulations, and policies. To help decide which actions to prioritize for implementation, it can be helpful to articulate co-benefits (e.g., greenhouse gas reduction, public health improvement, water quality improvement, etc.) and conflicts or challenges (e.g., unintended consequences on people or community assets).

4. **Implement Adaptation Strategies**. When a list of adaptation strategies has been generated and prioritized, they must be put into action. Developing an adaptation implementation plan for each prioritized strategy helps communities articulate how and when (e.g., immediately or within the next 5 years) the strategy should be implemented, leads and partners responsible for implementation, existing resources and those that are still needed, and potential barriers to implementation.

5. **Monitor, Evaluate, and Adjust**. Climate change adaptation planning should be an iterative process, and monitoring and evaluation are essential components that allow communities to make progress while also adjusting actions based on project outcomes and new information. For example, post-implementation monitoring of adaptation strategies helps to determine whether the strategies are having their intended effect and when or where adjustments might be needed. Developing a monitoring and evaluation plan is critical to minimize wasted time, money, and effort. These plans should identify desired outcomes, parameters to monitor and the method to do so, thresholds that may signal desired outcomes are not being met, and possible alternative strategies to pursue if these thresholds are crossed.

Tools Used in the Workshop

Climate Change Adaptation Certification Tool

The Climate Change Adaptation Certification Tool (CCAC)[1] is intended for use during regulatory or procedural review processes being carried out as part of routine community functions. The CCAC can be applied to decisions about any project or proposal that will involve the use of public funds, has a life cycle of greater than 5 years, and can affect public good (e.g., fiscal expenditures, capital planning, permitting, infrastructure design, and siting). Applying the CCAC to these decisions allows explicit evaluation of future conditions on project function and longevity, increases understanding of the long-term sustainability of a project at the funding or permitting phase, and considers how to reduce community risk that could arise from actions that become a liability under future conditions. The CCAC process includes three steps:

1. Identification of climate change risk factors
2. Evaluation of climate impact on a project

[1] http://ecoadapt.org/data/documents/EcoAdaptCCAC_UpstateNY_2023.pdf

3. Determination of project review

Rapid Vulnerability and Adaptation Tool

The Rapid Vulnerability and Adaptation Tool (RVAT)[2] for Climate-Informed Community Planning was developed to make climate adaptation planning a simple, direct, and feasible process for communities. The purpose of the tool is to improve understanding of community vulnerability to climate impacts and to develop implementable solutions that reduce vulnerability and/or increase resilience. The RVAT is designed to cover the major steps of a basic climate adaptation planning process, which include the following:

1. Project scoping
2. Vulnerability assessment
3. Adaptation strategy development
4. Adaptation implementation

The RVAT includes step-by-step instructions for completing a vulnerability assessment and provides detailed guidance for helping develop adaptation solutions for any focus area or issue of interest to a community. In this workshop, the RVAT was used to assess vulnerability and solutions for focus areas of particular interest to the Canton and Potsdam communities described below, but it is a tool that can be used broadly for a wide range of issues[3].

Workshop Series Overview

The Canton and Potsdam Climate Change Adaptation Workshop series[4] was held virtually on March 7, 9, and 14, 2023 from 1pm – 5pm each day. The first day of the workshop focused on discussing climate impacts; the second day focused on assessing vulnerability; and the third day focused on developing adaptation strategies. Workshop activities for each day are discussed in more detail below.

Climate Adaptation Workshop Activities: Day 1

The first day focused on orienting participants to the workshop series, introducing climate adaptation planning and the steps involved, identifying and prioritizing pre-existing conditions (i.e., stressors that currently affect the community), presenting

[2] http://ecoadapt.org/data/documents/RVAT_2022_fillable.pdf

[3] See examples of how other communities have used this tool by visiting community workshop pages at https://ecoadapt.org/programs/research-and-innovation/nsf/workshops for additional examples of how the RVAT has been used for a variety of topics.

[4] The workshop support page (http://ecoadapt.org/workshops/CantonPotsdamMarchWorkshop) includes links to presentation slides and all other workshop materials.

climate change projections and discussing impacts, introducing and completing the first step of the CCAC, and completing the first step of the RVAT (project scoping, including prioritizing pre-existing conditions and climate stressors).

Workshop activities were divided between presentations, large group discussions, and breakout group activities. Workshop participants were divided into breakout groups to address three focus areas:

- Group 1 – Housing
- Group 2 – Utilities
- Group 3 – Agriculture and Food Security

Workshop participants, including affiliations and breakout group assignments, can be found in Appendix A.

Project Scoping: Identifying Pre-Existing Conditions and Climate Stressors

As part of the first step of the RVAT (project scoping), workshop participants were asked to identify pre-existing conditions for Canton and Potsdam (i.e., stressors that already affect the community). Participants collectively identified more than 25 pre-existing conditions that, through discussion and ranking in each breakout group, were narrowed down to top priority conditions (bolded items represent top three or four conditions selected by the group):

- Group 1, Housing – **Older and poorer quality housing stock; lack of affordable housing; challenges for new construction and renovation, including rising costs, contractor availability, and difficulty obtaining supplies**; the inability to take advantage of existing programs due to home condition; high proportion of mobile homes; lack of housing code enforcement; lack of education around tenant rights; growing rates of unhoused population; high poverty rates; lack of access to broadband
- Group 2, Utilities – **Aging and inadequate infrastructure, including water supply, stormwater, and wastewater systems; challenges obtaining workforce due to lack of training in needed trades; funding challenges, including the competitive nature, cost-share requirements, and time needed to apply for funding**; lack of redundancy in systems for wastewater treatment; rural customers not on public water or sewer; electricity grid capacity issues and need for upgrades
- Group 3, Agriculture and Food Security: **Loss of farming land and workforce, including changing demographics, workforce shortage, and competition for land use; rising costs for production, transportation, and purchasing of food; food deserts and reliance on imported foods**; short growing seasons;

inadequate transportation options, including public transit and infrastructure quality (though improving); remoteness of communities from purchasing and transportation hubs

Major climate stressors for Canton and Potsdam were identified by workshop facilitators (Appendix B) and included extremes and seasonal shifts in precipitation and flooding; altered precipitation patterns, especially snow-to-rain shifts; increasing and extreme temperatures; and drought.

Climate Adaptation Workshop Activities: Day 2

On Day 2, workshop participants used the pre-existing conditions and climate stressors identified during the first day of the workshop as the basis for initiating the second step of the RVAT (vulnerability assessment).

Conducting the Vulnerability Assessment

Each breakout group explored the intersection of these conditions and climate stressors to identify the impacts of greatest concern for their focus area. For each of these impacts, the groups assessed the primary components of vulnerability:

- *Likelihood* of the impact occurring
- C*onsequence* to the community were the impact to occur
- The consequent *risk* resulting from the product of likelihood and consequence
- *Adaptive capacity* of the community in terms of the staff and resources that the relevant jurisdictional and/or community groups have available to address the impact

These rankings were then used to determine risk (resulting from the intersection of likelihood and consequence) and overall vulnerability for that impact, based on matrices provided within the RVAT worksheets. The results of this vulnerability assessment formed the foundation for the adaptation solutions work during Day 3 of the workshop.

On Day 2, workshop participants were also introduced to a network mapping tool (https://network-mapping-41fb1.web.app/) and given login information to access the tool. This tool, developed by Virginia Tech staff based on registrations and pre-workshop planning, shows participants the existing relationships among local government departments/agencies and/or community organizations and how each links to different focus areas. The tool is designed to help participants think about the connections and partnerships that can support Canton and Potsdam in implementing adaptation

solutions developed in the workshop as well as moving forward on community collaboration for climate change adaptation.

Climate Adaptation Workshop Activities: Day 3

On Day 3, the breakout groups focused primarily on identifying adaptation strategies that would reduce impacts of greatest concern for each focus area and then developing implementation plans for priority strategies (the third and fourth steps of the RVAT, respectively). At the end of these breakout sessions, the group reconvened as a whole to share selected adaptation solutions from each group, including whether individuals or organizations had been identified for lead or partnering roles in solution implementation.

Overview of Climate Projections

The following summaries provided foundational information for the workshops about current and projected future climate changes. A table of observed and projected climatic changes can be found in Appendix B.[5] Appendix B also provides a summary of a range of impacts that may be associated with each of the focus areas, but participants also identified their own set of impacts of importance for each of the focus areas (see Vulnerability Assessment section below).

Air Temperature and Extreme Heat

By the 2050s, average annual daily temperature in St. Lawrence County is projected to increase by 5.4°F above the historical average (1980–2009) of 43.4°F. Average summer temperatures (June–August) are projected to increase by 4.6°F above the historical average of 65.8°F, and winter temperatures are expected to increase by 6.3°F above the historical average of 19.0°F. By the 2090s, annual average temperature is expected to increase by 10.6°F, and summer and winter temperatures are likely to increase by 10°F and 12.2°F, respectively, above historical averages. As winter temperatures increase, the number of nights with temperatures that fall below freezing (e.g., minimum daily temperatures below 32°F, termed "frost days") will also decline, with

[5] Projections for air temperature, extreme heat, annual precipitation, and extreme precipitation were obtained from New York Climate Change Science Clearinghouse Map (https://www.nyclimatescience.org/map), with county-scale temperature and precipitation projections presented as a range from the low-emissions to the high-emissions scenario (Representative Concentration Pathway [RCP] 4.5 to RCP 8.5) for the average of 2040–2059 and 2080–2099 time periods (referred to as the 2050s and 2090s, respectively) compared to the average conditions between 1980 and 2009 (referred to as baseline conditions).

139 frost days occurring by the 2050s and 111 frost days by the 2090s compared to the historical average of 163.5 days.

Extreme heat events are also likely to increase significantly. The number of days with maximum temperatures over 90°F are likely to increase from the historical average from 1980–2009 of 1.4 days per year to 11.7 days per year by the 2050s and just over 41 days per year by the 2090s (representing a 836% and 2,036% increase, respectively).

Precipitation

Changes in annual precipitation in St. Lawrence County are expected to be relatively modest by mid-century, with model projections suggesting increases of 2.4 inches per year by the 2050s, an increase of 6% from the historical average of 40.4 inches per year. By the 2090s, annual precipitation is projected to have increased by 10%, to an additional 4 inches per year. Seasonal shifts in precipitation distribution are expected to be significant, with large increases expected in winter (+37%) and spring (+19%) precipitation by 2100. Rainfall is likely to increase slightly (+4%) in summer and decrease in fall (-6%).

Significant reductions are likely in the frequency of snowfall events and in the length of the snowfall season[6]. Changes are also likely in the intensity of snow events, as well as the frequency and intensity of ice storms and freezing rain, though there is uncertainty in the direction and magnitude of these changes.

Extreme Precipitation and Flooding

Extreme precipitation is likely to increase in terms of both frequency and amount over the coming century. The number of days each year when at least 2 inches of rain falls within 24 hours is expected to increase slightly, from 0.13 day to 0.15 day (+15%) by the 2050s, and to 0.2 day (+54%) by the 2090s[7]. An increase is also projected in the amount of rain falling in a given extreme precipitation event, with rainfall totals within a 20-year storm event expected to increase 13% by 2050 and 22% by 2100.[8]

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[6] R. M. Horton, D. A. Bader, C. Rosenzweig, A. T. DeGaetano, W. Solecki, "Climate Change in New York State: Updating the 2011 ClimAID Climate Risk Information" (Albany, New York, New York State Energy Research and Development Authority 2014). Available at https://www.nyserda.ny.gov/climaid.

[7] New York Climate Change Science Clearinghouse Map (https://www.nyclimatescience.org/map)

[8] D. R. Easterling et al., in Climate Science Special Report: Fourth National Climate Assessment, Volume I, D. J. Wuebbles et al., Eds. (U.S. Global Change Research Program, Washington, DC, 2017; https://science2017.globalchange.gov/chapter/7/), pp. 207–230.

Extreme precipitation events are strongly associated with flood frequency and severity, as well as area vulnerable to flooding, all of which are expected to increase over the coming century as well[9,10]. Although it is difficult to accurately predict how climate change will influence thunderstorms and wind events, at least one study has also found that severe storms are expected to occur more often across a wide range of climate models[11].

Drought

The Canton and Potsdam area is likely to see increases in seasonal late-summer droughts, as warmer temperatures increase evaporation and plant transpiration rates and result in less water remaining within the system. The change in the risk of more prolonged droughts is currently unknown[6].

Vulnerability Assessment and Adaptation Strategies

The following sections summarize the vulnerability and adaptation information for each of the three focus areas addressed in this workshop series: Housing, Utilities, and Agriculture and Food Security. The information presented is based on the discussions and input of workshop participants during breakout group activities.

Housing

The housing breakout group focused on assessing vulnerability of and identifying solutions for impacts of climate change on the housing sector; considering housing availability, including affordable housing; and considering the quality of existing housing stock in the Canton and Potsdam region. The time frame considered for this assessment was approximately 50 years (to approximately 2070).

[9] P. D. Bates et al., Water Resources Research, 57 (2021). https://doi.org/10.1029/2020WR028673.

[10] O. E. J. Wing et al., Nat. Clim. Chang. 12, 156–162 (2022). https://doi.org/10.1038/s41558-021-01265-6.

[11] N. S. Diffenbaugh, M. Scherer, R. J. Trapp, PNAS. 110, 16361–16366 (2013).

VULNERABILITY ASSESSMENT

Summary of observed and/or anticipated effects of pre-existing conditions and climate stressors

Pre-existing Conditions

Older and poor-quality housing stock, lack of affordable housing, and **challenges for renovation and new construction** were identified by participants as primary pre-existing conditions that impact housing.

Older and poor-quality housing typically are inefficient, thus making it more costly for people to heat and cool. Poor quality and older housing also require more repairs and maintenance, which increases financial stress and takes more time and effort. Poor-quality housing can also be associated with health impacts (e.g., mold), which can, in turn, affect other areas (e.g., increased costs of medical care or lost educational opportunities when kids have to stay home from school).

Lack of affordable housing (for both purchase and rental) forces people to choose between paying for housing or other necessities (e.g., food) and may drive people into poorer and older housing, which is associated with a host of impacts to residents as described above. Lack of affordable housing contributes to homelessness, with consequent impacts on education for children in unstable housing situations. There is also a loss of sense of community and increased risk of isolation when people are forced to move frequently due to rapidly rising housing costs. It also becomes harder to attract people to move to the area if there is an inadequate supply of affordable housing.

Challenges for renovation and new construction include supply chain issues and the rising cost of materials, as well as the lack of adequate, trained construction workforce in the area. As a result, people may try to do their own repairs or have few choices for professional help, which can lead to inadequate repairs that in turn may cause problems, increase safety risks, or increase future repair costs. Mortgage costs and barriers to new construction also contribute to reduced housing stock and a lack of affordable housing.

Climate Stressors

Warmer temperatures and extreme heat; extreme precipitation, including storms and flooding; and **drought** were identified by group participants as the climate stressors that have the most significant impacts on housing in Canton and Potsdam.

Warmer temperatures and extreme heat is likely to increase energy costs and may result in health impacts, moisture issues in homes leading to mold problems, and increases in vector-borne diseases.

Extreme precipitation, including storms and flooding, is likely to damage homes and surrounding trees, thus increasing repair costs and potentially also increasing the costs of home insurance. Storm events are likely to also be associated with more power outages, and flooding may also affect the function of septic systems and contribute to water contamination.

Drought is likely to increase the risk of wells running dry and might require more frequent water advisories and restrictions. Severe periods of drought may also concentrate contaminants in the water, decrease septic system function, and cause damage to home foundations. Drought increases wildfire risk and reduces the ability of residents to produce food in home gardens.

Combined Impacts of Pre-existing Conditions and Climate Stressors

Climate change is likely to exacerbate the impacts of or be exacerbated by these pre-existing conditions. Participants identified several ways in which climate stressors and pre-existing conditions can intersect to affect housing:

Warmer temperatures and extreme heat is likely to intersect with pre-existing conditions to exacerbate impacts in several ways, including:

- Older/poor-quality housing stock may not be adequately weatherized, making the space more difficult (and costly) to cool and exacerbating heat stress and other heat-related health impacts.
- Homes that are already in poor condition will degrade even more quickly in higher temperatures, thus increasing the need for maintenance and repairs.
- Increased energy costs associated with cooling will further increase housing-related costs, thus exacerbating financial stress and making existing housing even less affordable.
- Climate impacts on health may make it even more challenging for people to afford housing (i.e., by increasing medical bills and/or limiting their ability to work).

- Heat stress could affect construction workers and reduce the number of days construction can occur, thus making it even more challenging for homeowners to secure contractors and other skilled professionals to repair existing homes or construct new ones.
- Lack of affordable housing is likely to be further exacerbated by climate migration into the area as rising temperatures become even more extreme in other parts of the country.

Extreme precipitation, storms, and flooding are likely to intersect with pre-existing conditions to exacerbate impacts in several ways, including the following:

- Storms and flooding will speed the aging and degradation of homes that are already older and/or of declining quality.
- Damage and loss of housing stock from storms and flooding will exacerbate housing shortages and lack of affordable housing in the area. Damage and loss is likely to be particularly severe in homes where owners have been unable to keep up with maintenance and repair, as well as in mobile homes.
- Increased use of sump pumps further stresses the capacity of stormwater infrastructure and wastewater treatment plants (intersects with the utilities sector).
- Extreme storms and flooding may affect the number of days construction could occur and may divert resources from construction to repair. Supply chain issues resulting from extreme weather (locally or in other areas of the country) may also exacerbate existing issues related to materials required for housing repairs and renovation or construction.
- Lack of affordable housing is likely to be exacerbated by climate migration in response to even more extreme flooding and storm hazards elsewhere.

Drought is likely to intersect with pre-existing conditions to exacerbate impacts in several ways, including as follows:

- Older and poorer quality housing stock is more likely to be associated with shallower or hand-dug wells that are less resilient to changes in the water table resulting from drought.
- Drought in other areas of the country may drive climate migration to the Canton and Potsdam area, which could further exacerbate housing affordability.
- It is possible that drought could positively affect construction activity by increasing the number of days without rain during which construction activity can occur.

Overall vulnerability

Participants selected five impacts of greatest concern for housing in Canton and Potsdam and assessed vulnerability (see Figures 2 and 3 for the vulnerability assessment process) for each of these impacts, as described below. Table 1 presents the assessment results.

Increased stress on housing stock (including affordable housing availability) due to climate migration; increased difficulty of maintaining larger, older homes, particularly over generations and with more people moving around; increased climate-related health impacts that make it more challenging for people to afford housing; and **increased demand for repairs and lack of skilled workforce to accomplish the work** were ranked as having **high vulnerability** due to high to extreme risk and low adaptive capacity to respond to the impact. **Increased risk of wells going dry and becoming contaminated and associated health and sanitation issues** received a **high vulnerability** ranking for the private sector and a **moderate vulnerability** ranking for the municipal sector because, while risk was seen as high to extreme, adaptive capacity was considered low for private wells but high for municipal water supplies.

Table 1. Vulnerability Assessment Ranking Results for Impacts of Greatest Concern for Housing

Effects/Impacts of Greatest Concern	Likelihood	Consequence	Risk	Adaptive Capacity	Vulnerability
Increased stress on housing stock (including affordable housing availability) due to climate migration	Likely	Major	High	Low	High
Increased difficulty of maintaining large older homes due to climate change (particularly over generations and/or with more people moving around)	Almost Certain	Major	Extreme	Low	High
Increased climate-related health impacts (e.g., mold, heat stress) that make it more challenging for people to afford housing (if limits ability to work, etc.)	Almost Certain	Moderate	High	Low	High

Increased demand for repairs, along with greater challenges meeting that demand due to lack of trained workforce, supply chain issues following storms, lack of materials, etc.	Almost Certain	Major	Extreme	Low	High
Increased risk of wells going dry and potential contamination	Almost certain	Moderate to Major	High to Extreme	Low (private) to High (municipal)	High (private) to Moderate (municipal)

PROPOSED ADAPTATION STRATEGIES AND IMPLEMENTATION PLANS

Adaptation strategies for effects of greatest concern

Participants identified several possible adaptation strategies for each of the effects of greatest concern selected for housing (see Table 2). Time limitations meant that co-benefits and unintended consequences were not identified by the breakout group for every effect of concern.

Table 2. Identified Effects of Greatest Concern and Possible Adaptation Strategies for Housing

Effects of Greatest Concern	Adaptation Strategies to Reduce Vulnerabilities
Increased stress on housing sector (and affordable housing availability) due to climate migration	• Ensure that some of the new housing units in Jubilee area of Canton are affordable units (SUNY Canton is involved). • Encourage the transition of existing large single-family homes to multi-units and cooperative housing models. • Revise zoning laws to encourage/support multi-unit development, ADUs, and increased housing density (have this conversation sooner than later so the community can discuss neighborhood characteristics that should be preserved). • Strengthen landlord policies to ensure the community is inviting and the tenants are treated fairly. • Ensure new housing units don't exacerbate stormwater runoff issues. • Review and revise code to require that the Climate Change Adaptation Checklist is used to assess and reduce the potential climate impacts of proposed projects.** • Require that code enforcers are familiar with advancements and techniques/requirements around climate change impacts and are supported to enforce them.

Increased difficulty of maintaining large older homes due to climate change (particularly over generations and/or with more people moving around)	● Encourage transition of existing large homes to multiple units and cooperative housing models.** ● Explore programs for students to live in cooperative housing in exchange for free/reduced tuition, or other incentives, where they would help care for elderly (may require specialized skill set). ● Run classes or training programs for students at local vocational schools where they could learn how to rehabilitate older homes.
Increased climate-related health impacts (e.g., mold, heat stress) that make it more challenging for people to afford housing (if limits ability to work, etc.)	● Create design guidance to ensure that new buildings are better equipped to cope with climate change and keep residents healthy. ● Make community members aware of existing programs that help them address issues in older homes that might be exacerbated by climate change (e.g., NY state programs for weatherization, energy efficiency, etc.), with an emphasis on outreach to vulnerable areas and populations.** ● Create and expand programs focused on protecting the health of vulnerable community members.
Increased demand for repairs, along with greater challenges meeting that demand due to lack of a trained workforce, lack of materials, supply chain issues following storms	● Create a workforce pipeline** o Focus on middle/high school students and getting them excited about opportunities in home repair and construction. o Run classes or training programs for local vocational schools so students can learn how to rehabilitate older homes. o Collaborate with AmeriCorps, Habitat for Humanity, or other programs to give young people an opportunity to learn these skills while receiving other benefits (e.g., student loan assistance). ● Create classes/training opportunities for contractors to better understand climate concerns around mold, air quality, and related health issues.
Increased risk of wells going dry and contamination	● Ensure private well owners understand risks and what to look for (including after a storm or other extreme event) and possibly provide funding for necessary repairs.** ● Create water testing requirements for private wells (and provide cost assistance?), with consideration for specific tests that may become more important in the context of climate change. ● Expand green spaces to collect and filter runoff before it enters stormwater infrastructure and ecosystems. ● Learn more about what might happen! Lots of uncertainty/lack of knowledge.

Starred (**) adaptations were identified as high priorities for implementation.

Implementation Plans for Priority Strategies

The housing breakout group participants selected four priority adaptation strategies and developed implementation plans for each. For the latter two adaptation strategies, there was insufficient time during the workshop to develop details such as leads, partners, and barriers and resources.

1. Make community members aware of existing programs that would help them address issues that might be exacerbated by climate change in older homes (e.g., NY state programs for weatherization, energy efficiency, etc.), with an emphasis on outreach to most vulnerable areas and populations.

***How and when to implement*:** Start yesterday! Steps should include:

- Reach out to partners (St. Lawrence County (SLC), NY Department of Social Services, Office of the Aging, Canton Sustainability Committee (CSC), food pantries, tabling events) to make sure they have information about programs, ensuring existing platforms are more broadly used to disseminate information, including websites, social media, YouTube channel, radio, tabling events (this is already being done by Cornell Cooperative Extension).
- Learn what funding sources are already out there (county Block Grant funds, state, federal tax incentives with Inflation Reduction Act).
- Develop a resource guide specific to climate change, with available resources and qualifying criteria (would need to be updated regularly; need capacity to create it and keep it updated).
- Use information from barrier analysis that is in progress through the Regional Clean Energy hub (North Country) led by Adirondack North Country Association (ANCA).
- Rethink communication strategies. Focus on identifying the most effective message for different populations (e.g., tie messaging to the kinds of events that people are already concerned about, emphasize cost savings on energy bills).

***Leads and partners*:**

Lead: Cornell Cooperative Extension of SLC

Partners: Community Development Program (implements weatherization program), social services and office for the aging, SLC public health, housing council, churches, Canton sustainability committee and climate-smart community committees

Barriers identified: Many people in the region may be resistant to climate change messaging; it is difficult to know how well outreach is working because it isn't possible to track how many people take advantage of state programs; state resources are scattered across many locations and change frequency.

Efficacy: High

Feasibility: High

2. Review and revise code to require that the CCAC is used to assess and reduce potential climate change impacts of proposed projects.

How and when to implement: Begin process ASAP:

- First step – Send resolution proposing integration of the CCAC into project review process to Village and Town. The board would review and pass the resolution, which might call for amending the code, creating an ordinance, etc. (the goal is to introduce this resolution within the next year).
- Code revision in Canton was just completed, so a different process would be needed for this (through code revision or other mechanisms for project review).
- Messaging could include the fact that requiring use of the CCAC would earn climate-smart community points and increase eligibility for grant funding.
- If code revision is difficult, jurisdictions could also create incentives for voluntary use (e.g., fast-tracking of permits, financial incentives, though board would have to approve incentives).
- Support from the Chamber of Commerce could help encourage businesses to use the tool during development/remodel.
- State Environmental Quality Review Act – Consistent with this Act, communities can establish local criteria that have to be met (could create a Type 1 Action that says, "does this project conform to the CCAC", and people would be required to complete it).

Leads and partners:

Leads: Canton sustainability committee and Potsdam climate-smart community committee

Partners: Town code enforcement, Village planning committee, Chamber of Commerce

***Resources and barriers*:** Need to have a primer/how-to guide on how to use the CCAC (for people who are filling it out as well as people who are reviewing it). Potential barrier includes that code revisions can take a lot of time and require lengthy/involved public comments and discussion.

***Efficacy*:** High

***Feasibility*:** High

3. Encourage transition of existing large homes to multiple units and cooperative housing models.

***How and when to implement*:** Revise zoning laws to encourage/support multi-unit development, more condensed housing, allow ADUs, etc. Have this conversation sooner rather than later so people can begin discussions of neighborhood characteristics/aspects of the community that need to be preserved.

4. Create a workforce pipeline.

***How to implement*:**

- Focus on getting middle school and high school students involved and getting them excited about career opportunities in construction, home repair, etc.
- Create classes/training opportunities for contractors to better understand climate concerns around mold, air quality, etc.
- Run classes or training programs for students at local vocational schools to learn how to rehabilitate older homes.

Utilities

The utilities breakout group focused on drinking water, stormwater, and wastewater treatment infrastructure; electrical utilities were also discussed. The group considered a timeframe of 2–10 years for planning cycles and 50+ years for infrastructure lifetimes.

VULNERABILITY ASSESSMENT

Summary of observed and/or anticipated effects of pre-existing conditions and climate stressors

Pre-existing Conditions

Aging and inadequate infrastructure in water supply, stormwater, and wastewater; workforce challenges, including lack of training available for needed trades; and **lack of funding, including the difficulties of finding time to apply, the competitiveness of grants, and cost share requirements,** were identified by group participants as the primary pre-existing conditions that have the most significant impacts on utilities.

Aging and inadequate infrastructure affects utilities because of a lack of redundancy and back-up systems, dead ends in the system, and degradation (e.g., under-road drainage canal).

Workforce challenges are a major concern for utilities because the local workforce is aging; the area is competing for skilled employees with the rest of the state (e.g., not enough certified technicians to install heat pumps); and there is a lack of training and expertise, insufficient funding to hired skilled workers, and a high reliance on volunteers. Technical professionals are not adequately trained to anticipate climate change impacts, and overall, there is a lack of training available for municipal staff on climate change.

Funding is a significant challenge for utilities, including challenges of capacity to even apply for funds, to know where and how to apply, the competitive nature of funding, and that matching requirements can be a big impediment to applying. It was noted that some cities have had to turn down grants because they do not have the capacity to complete the grant administration. The region is rural and distant from larger populations, can get left out of funding conversations, and may be seen as a lower priority in the state than regions with larger populations.

Climate Stressors

Increasing temperatures and extreme heat, altered precipitation patterns (including snow-to-rain shift), and **storms and flooding** were identified by participants as the primary climate stressors that affect utilities.

Increasing temperatures are likely to have impacts on utilities, including impacts to roadways such as frost heave and warmer temperatures that require additional treatment to keep the water supply safe from bacteria and other contaminants.

Precipitation shifts are likely to particularly affect utilities because of an increasing amount of precipitation in the form of ice/rain rather than snow can be damaging to infrastructure, and because it can cause additional drainage problems due to ice blockage, more water running off immediately, etc.

Storms and flooding are likely to cause impacts to the stormwater infrastructure, stormwater and wastewater pipes, and pump capacity, which can lead to overflow during storms.

Combined Impacts of Pre-existing Conditions and Climate Stressors

Climate change is likely to exacerbate the impacts of or be exacerbated by all three pre-existing conditions. Breakout group participants identified the following challenges:

Increasing temperature and extreme heat is likely to intersect with pre-existing conditions to exacerbate impacts in several ways, including the following:

- Rising temperatures will increase demand for water, thus increasing pressure on already aging water system infrastructure and leading to system failures.
- Water quality concerns will increase with higher temperatures and additional treatment of drinking water may be necessary.
- Electrical system demands will increase in both summer and winter, particularly with a shift from gas to electric heating.
- Utility workers may be at increased risk from exposure to extreme heat.
- A lack of skilled technicians is likely to have an even greater impact with increasing demands and repair needs associated with utilities at risk from rising temperatures and greater demands on services.
- Technical professionals are not adequately trained to anticipate the impacts of climate change on long-term designs.

- Training for municipal staff working on utility issues do not currently include climate change.

Altered precipitation patterns and **storms and flooding** are likely to intersect with pre-existing conditions to exacerbate impacts in ways listed below:

- Potsdam's stormwater issues are already severe, with water draining into a buried canal that is collapsing and not adequate for current volume, never mind precipitation shifts that may bring more water in a more concentrated period of time or increased risk of blockages; there aren't sufficient people or financial resources to adequately address this issue.
- The Canton stormwater system doesn't have enough capacity to move water out of the village, nor was it designed to remove contaminants that may increase in association with larger runoff events.
- The area is already dealing with damage from past wind and ice storms, and currently has inadequate backup power, all of which increase vulnerability to future storms and ice, including impacts on wastewater treatment plant operation.
- Flooding impacts roads outside of towns and safety of the highway, which has already led to the purchasing of additional culverts but there are limited funds to upgrade further.
- Utility crews need additional training (e.g., scenario training) for working safely in extreme conditions such as storms and flooding.
- There is already a lack of basic utility system performance and weakness data that hampers regional ability to prepare for and respond to increasing storm and flooding frequency and severity.

Overall vulnerability

Participants selected four impacts of greatest concern for utilities in Canton and Potsdam and assessed vulnerability for each of these impacts (see Table 3), as described below.

Lack of understanding, urgency, and political will around utilities and social vulnerability; inadequate and aging stormwater infrastructure, particularly the failing Potsdam stormwater canal; and **electrical grid distribution resilience issues, including lack of capacity and redundancy,** were ranked as having **high vulnerability** due to extreme risk and low to moderate adaptive capacity. **Lack of baseline data and**

understanding of vulnerability was assigned a **moderate vulnerability** ranking due to high risk and moderate adaptive capacity.

Table 3. Vulnerability Assessment Ranking Results for Effects/Impacts of Greatest Concern for Utilities

Effects/Impacts of Greatest Concern	Likelihood	Consequence	Risk	Adaptive Capacity	Vulnerability
Lack of understanding and urgency around utilities and societal vulnerability to climate change—political will, workforce, funding	Almost Certain	Major	Extreme	Moderate	High
Lack of baseline data and understanding of vulnerabilities (relates partially to lack of urgency)	Almost Certain	Moderate	High	Moderate	Moderate
General stormwater infrastructure aging and inadequate; specifically, stormwater canal in Potsdam is aging and failing.	Almost Certain	Catastrophic	Extreme	Low (esp. funding, staffing)	High
Electrical grid distribution resilience issues; no redundancies, at capacity; inadequate for solar build out (local distribution system is inadequate)	Almost Certain	Major	Extreme	Low	High

PROPOSED ADAPTATION STRATEGIES AND IMPLEMENTATION PLANS

Adaptation strategies for effects of greatest concern

Breakout group participants identified several possible adaptation strategies for utilities. Table 4 summarizes adaptation strategies in response to effects of greatest concern that were explored by breakout group participants.

Table 4. Identified Effects of Greatest Concern and Possible Adaptation Strategies for Utilities

Effects of Greatest Concern	Adaptation Strategies to Reduce Vulnerabilities
Lack of understanding and urgency around utilities and societal vulnerability to climate change—political will, workforce, funding	● Outreach and information tailored for the general public: Get stories into the paper (north country this week)/on the radio - general climate literacy (reduce NIMBY-ism).** ● Work with schools to get students to think about other career options (i.e., trade work). ● Hire more shared staff (grant writers, economic developer, etc.) among the communities; shared resource could allow for hiring based on expertise, so one person doesn't have to be the expert on everything.** ● Request funders to reduce reporting requirements. *Co-benefits:* People are more engaged in local democracy; young people will stay in the community rather than moving away; growth in more and better employment opportunities. *Unintended consequences:* Risk of polarization; more funds requires more time and effort to manage.
Lack of baseline data and understanding of vulnerabilities (relates partially to lack of urgency described above)	● Develop a local spatial database that includes flood maps, water quality data, stormwater system data, and other data that is currently limited in supply.** o Need better flood maps for the area (Federal Emergency Management Agency maps not available for Canton and Potsdam), may need to create maps. o Need better water quality data to use in stormwater management. (NY Dept of Environmental Conservation may have complimentary data?) *Co-benefits:* Benefit to private entities who want to develop property; research opportunities for students at local high schools and colleges
General stormwater infrastructure aging and inadequate; specifically, stormwater canal in Potsdam is aging and failing	● Employ nature-based solutions (NBS) upstream and in town to increase filtration and manage water quality issues.** ● Create a tax on impermeable materials to incentivize permeability and drainage. ● Engineer an infrastructure upgrade to replace canal paired with upstream NBS. *Co-benefits:* NBS could improve water quality, aesthetics, and wildlife habitat. *Unintended consequences:* NBS could affect hydrology and irrigation water and add to the expense of development (may reduce potential size of projects).
Electrical grid distribution resilience issues: no redundancies, at capacity, inadequate for solar build out	● Property level to street level grid infrastructure upgrades are needed ● Canton could negotiate upgrades to infrastructure through a new contract, although this may not be possible with current utility set up.

	• Apply for the "energizing rural communities" prize. • Identify a person or organization with expertise to help the communities understand their current electrical infrastructure and potential, such as a workshop to educate staff, public works.** *Co-benefits:* Joint research projects that support the local communities; upgrades could attract manufacturing *Unintended consequences:* Unknown implications/disagreement for who pays for upgrades; non-equitable distribution of costs

Starred (**) adaptations were identified as high priorities for implementation.

Implementation plans for priority strategies

Participants discussed five of their highest priority adaptation strategies for utilities:

1. Increase outreach and information tailored for the general public, with the goal of improving overall climate literacy.

   ***How to implement*:** Outreach around climate multiple times a year and at community events

   ***Leads and partners*:**

   Leads: CSC task forces

   Partners: Sportsmen's Clubs, Ducks Unlimited, rotary clubs, local colleges, Boards of Cooperative Educational Services

   ***Resources identified*:** CSC webpages, local newspaper, sustainability day, and green living festival were all identified as extant resources.

   ***Efficacy*:** Not identified

   ***Feasibility*:** Not identified

2. Hire more shared staff (grant writer, economic developer, etc.) among the communities to help manage grants.

   ***How to implement*:** Instead of hiring municipal staff, formalize a relationship with local organizations.

   Lead: Not identified

   Partners: Canton Economic Development Consortium

   ***Barriers identified*:** Development staff are hard to come by; confined by 2% tax cap on spending (NY state law; would need to override tax cap to increase spending);

many grants don't allow for overhead; often have to be reimbursed for spending; reporting is tedious.

***Efficacy*:** Not identified

***Feasibility*:** Low

3. Develop a local GIS database that includes flood maps, water quality data, and other data that is currently lacking.

***How to implement*:** Assess what is currently available on the Development Authority of the North County (DANC) platform and identify gaps; add additional data (i.e., importing engineered drawings for utilities, tree inventory), explore regional collaboration for county-level data.

***Leads and partners*:**

Leads: Canton - Village superintendent; Potsdam – individual not identified

Partners: DANC, SLC emergency management office, county planning office

***Resources and barriers*:** Canton and Potsdam can contract with existing DANC GIS platform (not sure what is included, need to dig into this), DANC hosts regular webinars; identified barriers include needing to pay for someone's time to dig through this platform and add data.

***Efficacy*:** High

***Feasibility*:** Medium to High

4. Educate the public and municipal staff on local electrical grid resilience and upgrades.

***How to implement*:** Clean energy team at ANCA takes the lead (Carlie Leary to promote conversation); explore funding and format; climate smart communities task forces could assist with outreach. Begin process in late 2023.

***Leads and partners*:**

Leads: ANCA

Partners: National Grid (Rick Burns), Klaus Proemm (Canton), CSC and its task forces, state-level elected officials and county representatives (if they agree to participate), Cornell Cooperative Extension

***Resources and Barriers*:** Resources include the fact that this solution aligns with ANCA's existing programming and priorities, CSC task forces exist, and Cornell Cooperative Extension is hosting trainings on residential upgrades soon (Nick

Hamilton Honey). Barriers include funding, especially for in-person events; defining the scope and depth of what will happen is a challenge.

***Efficacy*:** Low to Medium

***Feasibility*:** High

5. Employ nature-based solutions upstream and in town to increase infiltration and manage water quality issues.

***How to implement*:** Look at SLC resources as a starting point.

***Leads and partners*:**

Leads: Not identified

Partners: Not identified

***Resources and barriers*:** Extant report from SLC on stormwater (maybe county planning?)

***Efficacy*:** Not identified

***Feasibility*:** Not identified

Agriculture and Food Security

The agriculture and food security breakout group defined their goal as resilience of the food system (both local and comprehensive) and food accessibility. The timeframe for this discussion was 30 to 70 years, while thinking about longer-term processes that are likely to be affected by climate change, including land ownership, agricultural practices, and the broad scope of food supply chain issues.

VULNERABILITY ASSESSMENT

Summary of observed and/or anticipated effects of climate stressors and pre-existing conditions

Pre-existing Conditions

Loss of local farming due to aging population, worker shortages, and competition for land use; rising costs of production, transportation, and purchasing; and **food deserts and reliance on imported foods** were identified by group participants as the primary pre-existing conditions stressors that have the most significant impacts on agriculture and food security.

Loss of farming activity is likely to affect agriculture and food security by reducing access to and amount of food available (from both local and global production), possibly decreasing the availability of healthy food choices, increasing food costs, and hastening the loss of culturally appropriate foods and foods that meet dietary needs. This sector is also affected by complexities and obstacles related to immigration and issues like H-2a visa applications and the seasonal and unstable nature of agricultural work. Competition for land by other uses, including solar projects, affects food production and compounds limitations already in existence, such as geographic limitations in soil and crop productivity.

The rising costs of food affects agriculture and food security because less healthy, subsidized foods become more dominant and small local farms get pushed out by higher prices and competition with big box stores. Access to seeds, equipment, and fuel becomes more limited due to rising costs, and rising transportation costs contribute to lower profitability. Rising wages and lack of workforce also reduce agricultural productivity. These processes may shift products out of the local area to places where farmers can get higher prices for their products, thus leading to a loss of local foods available for purchase.

Food deserts and imported foods have health impacts for people who increasingly need to rely on less healthy, cheaper foods. Lack of local options can also contribute to the loss of culturally appropriate foods. Limitations exist on what can be transported to the community because of supply chain issues, which undermines the food system as a whole. The prevalence of food deserts means that people need to—and sometimes cannot if limited by disability or lack of transportation—travel long distances for food, and this in turn increases the carbon footprint of this sector.

Climate Stressors

Temperature and extreme heat, drought, and **altered precipitation, storms, and flooding** were identified by participants as the primary climate stressors that affect agriculture and food security.

Extreme heat events are likely to increase pests and pathogens that would adversely affect crops and livestock; increase crop loss and change what crops might be successful; affect livestock health; create needs to shift the timing of agricultural processes, including planting, pruning, and harvesting; and increase the need for irrigation and wells.

Drought is similarly likely to increase irrigation needs, add to crop losses, create mismatches of equipment and crop changes, and lead to loss and erosion of topsoil and loss of soil health.

Altered precipitation, storms, and flooding can contribute to crop destruction and loss; changes in crop timing; impacts on soil health and productivity; reduce the ability to tend to crops; drive shifts in planting, pruning, and harvest timing; and increase the time and resources needed to address flood management responses, including increasing drainage infrastructure.

Combined Impacts of Pre-existing Conditions and Climate Stressors

Climate change is likely to exacerbate the impacts of or be exacerbated by all three pre-existing conditions. Breakout group participants identified the following challenges:

Extreme heat and **drought** are likely to intersect with pre-existing conditions to exacerbate impacts in several ways, including the following:

- Lack of access to food may be exacerbated due to the increase in uncertainty of, and/or reduction of, agricultural outputs.
- Pests and pathogens will Increase, which might deter people from both owning and working at farms because of increased risks of exposure to disease by both employers and employees.
- Compounding risks to workers might further affect the stability of agricultural output if workers fall ill, as well as increase costs of health care for treatment and risks to workers if they are uninsured.
- Heat and drought will compound soil health problems, further reducing productivity and amount of fertile agricultural land.
- Competition for solar projects, which may be increasingly attractive, can limit future agricultural solutions.
- Populations that are particularly vulnerable to extreme heat (e.g., the Amish population if they have less access to temperature regulation technology) and may be disproportionately affected.
- Climate migration to the area resulting from larger scale heat and drought events could expand the worker supply.
- Heat and drought may alter what can be grown in the region, which could potentially create new opportunities for different products, but the loss of others (maple syrup emphasized as a particular concern for the region).
- Consequent to the point above, farmers may need to change their infrastructure investments in response to heat, including increased shading and greenhouse regulation, and may need additional crop insurance, leading to increased costs and potentially increased resources devoted to finding and obtaining grants to cover costs.
- The costs of livestock welfare, including costs associated with drinking water for livestock, loss of/increasing costs of winter hay supply, and immunizations, are likely to rise.
- If the local food supply is diminished by heat and drought, reliance on imported foods will continue to increase, reducing health and access to culturally and nutritionally appropriate foods.
- Extreme heat may limit opportunities to visit farmers markets and food banks, particularly populations relying on mass transit who may have a harder time getting to stores, thus affecting both producers and consumers.
- Extreme heat and drought may reduce the short-term storage and viability of products, particularly as food banks have limited capacity to refrigerate and store foods.

Shifts in precipitation, storms, and flooding is likely to intersect with pre-existing conditions to exacerbate impacts in several ways, including:

- Impacts on soil health may compound other forces driving the loss of agricultural land.
- Changes to the types of crops that can be grown can further compound rising costs and lack of access to local foods.
- Increased risks of catastrophic loss due to storm events and flooding could further destabilize agriculture and make farming even less attractive to farmers and workers.
- Concentrated animal feeding operations' manure management may become compromised, thus compounding livestock welfare issues and affecting local water quality.
- Storms and flooding can affect visits to farmers markets by both producers and consumers, particularly for consumers using mass transit who may have a harder time getting to stores and food banks to access food.

Overall vulnerability

Pests and disease risk to agriculture in terms of impacts on crops, livestock, and workers and employees; the impact of heat, drought, and storms on access to and storage of food by both producers and consumers; and **the need for farmers to change investments in infrastructure due to heat and drought** were ranked by breakout group participants as **high vulnerability** due to high extreme risk and low adaptive capacity. Geographic isolation was particularly emphasized as a driver for low adaptive capacity for resources such as animal welfare and vaccinations. **Compounding effects of heat on soil health and fertility and competition of other land uses with agriculture** was ranked as having **moderate to high vulnerability** due to high to extreme risk and moderate adaptive capacity. **Lack of food, compounded by reduction and uncertainty of agricultural outputs,** received a **moderate vulnerability ranking** due to moderate risk and low adaptive capacity. Table 5 summarizes this vulnerability assessment.

Table 5. Vulnerability Assessment Ranking Results for Effects/Impacts of Greatest Concern for Agriculture and Food Security

Effects/Impacts of Greatest Concern	Likelihood	Consequence	Risk	Adaptive Capacity	Vulnerability
Lack of food compounded by reduction and/or additional uncertainty of agricultural outputs	Likely	Moderate	Moderate	Low	Moderate
Pests and disease might increase risks that deter people from owning and working at farms; increased workers compensation and risks to employers and employees; health and economic impacts if uninsured workers fall ill; immunizations, livestock welfare costs rise	Almost Certain	Major	Extreme	Low (geographic distance emphasized)	High
Heat, extreme temperature, and storms affect visits to food outlets by both producers and consumers, and impacts on short-term storage/viability of products	Likely	Major	High	Low	High
Heat will compound soil health problems and reduce amount of fertile agricultural land; solar projects and other land uses competing with agriculture could limit future solutions	Likely to Almost Certain	Major to Catastrophic	High to Extreme	Moderate	Moderate to High
Farmers need to change their infrastructure investments in response to heat (e.g., shading, greenhouse regulation); additional time to pursue grants and funding to cover costs	Likely to Almost Certain	Major to Catastrophic	Extreme	Low	High

PROPOSED ADAPTATION STRATEGIES

Adaptation strategies for effects of greatest concern

Breakout group participants identified several possible adaptation strategies for agriculture and food security. Table 6 summarizes adaptation strategies in response to effects of greatest concern that were explored by the group participants.

Table 6. Identified Effects of Greatest Concern and Possible Adaptation Strategies for Agriculture and Food Security

Effects of Greatest Concern	Adaptation Strategies to Reduce Vulnerabilities
Lack of food compounded by reduction/uncertainty of agricultural outputs	• Promote/incentivize container and home gardens. There are master gardeners and tool lending libraries available. Cooperative extension has a seed to supper program and supports local growing of foods; need a better understanding of home gardens in the area and how much food they are actually providing. • Community gardens were discussed but concerns were raised around maintenance, institutional consistency (but there are successful examples). • Continuing education to share current resources (lack of understanding how widespread awareness is on local foods). Expand on extant resources like the GardenShare newsletter, more distribution to neighborhood centers and via information networks, and identify better ways of getting information to more people.** • NY state law that large-scale food generators have to donate first, compost second, helps drive lower food waste. • Gleaning as a possibility. There are no current formal programs. Could opportunities be shared by social media? • Area does have substantial crop diversity, with farmers finding various niches, though lacking in local grain products. • Questions around where we resupply from when supply chain challenges arise. *Co-benefits:* Increased awareness and use of local foods; build relationships with local farmers and add economic stability by adding wholesale opportunities and other support for their efforts; less siloing, more connectivity among agencies. *Potential challenges/unintended consequences:* Not sure we are prepared for larger-scale food challenges; information overload: there are too many sources and platforms, it can undermine the successful transfer of knowledge and information for this and many other efforts.

Pests and pathogens cause reduction in owned and worked farms and farming; risks to employers and employees; health and economic impacts if uninsured workers fall ill; livestock welfare costs rise	• Evaluate availability of additional vaccines, such as for Lyme disease. • Provide/identify service to support vaccination of livestock and/or workers. • Increase awareness of resources available through Cornell cooperative extension to support knowledge and management of plant pests—how do you learn about these resources if you aren't aware? • Attracting large animal veterinarians and doctors to the area. SUNY Canton has a vet tech program that could be a resource.** • Take advantage of college populations as resources to convince more people to remain locally and assist with information sharing.** • Talk to local farmers about how they are shifting crops and thinking about what changes to make around susceptibility to pests and pathogens, and changes in what crops might grow better.
Heat, extreme temperature, and storms affect visits to any food outlets, for both producers and consumers and short-term storage/ viability of products	• Farmers markets run May–October; heat and wind is also an issue that needs to be considered, as farm equipment is affected. • Potsdam Pavilion offers shade and some protection, could this be replicated for Canton?
Heat will compound soil health problems and reduce amount of fertile agricultural land; solar projects and other land uses competing with agriculture could limit future solutions	• Create policies at a municipal/county level to save agricultural lands, possibly via land bank creation with non-competing renewable energies such as wind, or compatible uses like sheep grazing (agrovoltaics). County planning office as prime agricultural land information resource.** • For smaller solar projects, local jurisdictions' ability to set policy may provide the opportunity to protect/balance local agriculture needs.
Farmers need to change their infrastructure investments in response to heat (e.g., shading, greenhouse regulation); additional time to pursue grants and funding to cover costs	• Work with ANCA to grow capacity for working with farmers and pursuing funding.** • Partner with professors and students at local colleges to support writing grants for local farmers.** • AmeriCorps members, USDA extension fellows, Cornell Cooperative Extension could add capacity.** • SUNY Canton has a small business advising program, and there is a small business incubator in Village of Canton—could they add an agriculture/food products component?

	• There is an extant example of a local composting facility that is now up and running that was a result of a local farmer diversifying their business, supported by NY State law; is this replicable, expandable?

Starred (**) adaptations were identified as high priorities for implementation.

Implementation plans for priority strategies

Breakout group participants discussed five of their highest priority adaptation strategies for natural resources, and four strategies could be further developed in terms of implementation strategies, partners and resources, and barriers.

1. Create policies on municipal/county level to save agricultural lands, possibly creating land banks with non-competing renewable generation such as wind, or compatible uses like sheep grazing (agrovoltaics).

   ***How to implement*:** A first step is soil mapping overlaid with climate vulnerability to identify high-quality agricultural lands that are a priority for conservation.

   ***Leads and partners*:**

   Leads: John Tenbusch, County Planning and Environmental Management Council

   Partners: Renewable energy companies; land trusts; assessor's office; local jurisdictions including code officers; volunteer zoning boards; farmers

   ***Resources and barriers*:** Property tax reduction via assessor's office is a resource; barriers include turnover in local government, lack of constitutional continuity; political power of renewables may limit feasibility.

   ***Efficacy*:** Medium to High

   ***Feasibility*:** Low

2. Planning and zoning that supports development patterns that don't undermine agricultural output as climate conditions change.

   ***How to implement*:** Mapping climate vulnerability in order to identify high quality agricultural lands, as described above in (1); make part of a comprehensive plan update process; if comprehensive plan is underway or recently completed, changes can be operationalized through code updates.

   ***Leads and partners*:**

   Leads: County Planning, Environmental Management Council

Partners: Local jurisdictions, including code officers; volunteer zoning board; farmers

***Resources and barriers*:** Resources include NY state funding for incorporating smart growth principles, which can include climate planning; smaller municipalities may not have comprehensive planning, but Canton Town and Village does, Town of Potsdam does, and the Village of Potsdam is just starting; barriers include turnover in local government, and the dominance of reactive rather than proactive planning.

***Efficacy*:** Medium to High

***Feasibility*:** Medium

3. Task local organizations with supporting farmers with grant writing and related support to address climate vulnerabilities.

***How to implement*:** Advocate for Cornell Cooperative Extension and ANCA to drive this with other institutions supporting; create a conduit for federal funding.

Lead: Cornell Cooperative Extension (houses a local food advisory committee)

Partners: USDA, Natural Resources Conservation Service (cost-sharing opportunities); ANCA: Adam Dewberry contact for farm assistance; GardenShare; Small Business Development (SUNY Canton); Shipley Center at Clarkson; Chamber of Commerce; St. Lawrence County Planning Department (Heidi Ames); St. Lawrence County Industrial Development Agency; farmers

***Resources and barriers*:** Resources: Inflation Reduction Act (IRA) funding via USDA that can fund development of community resilience—they may have staff capacity to assist; NY State has a Consolidated Funding Application process; barriers may include user group inexperience in grant acquisition and lack of capacity.

***Efficacy*:** Medium to High

***Feasibility*:** High

4. Amplify existing channels and organizations to better connect individuals, especially during climate events driving food scarcity.

***How to implement*:** Both by increases in program administration efficiency, and additional outreach to reduce siloing and increase public awareness.

Lead: GardenShare

Partners: Health Initiative

***Resources and barriers*:** Identified barriers include siloing of individual communities that keep them from working together, and grant-driven employment that limits organization capacity to accomplish these goals.

***Efficacy*:** Not identified

***Feasibility*:** Not identified

5. Attract the right workforce to address climate vulnerabilities in agriculture and food security.

   This idea was of interest to the group, with the thought that both higher education and the real estate community would be important partners for this work, but there was not time to develop specifics of implementation further.

Conclusions

This workshop and the resulting report aimed to improve the understanding of how housing, utilities, and agriculture and food security are vulnerable to changing climate conditions in Canton and Potsdam and to develop community ideas for addressing identified vulnerabilities. This report summarizes possible adaptation strategies that were identified and discussed by the breakout groups as well as adaptation implementation plans designed to minimize vulnerabilities and/or increase resilience of the focus areas.

Similarities were found across focus areas in terms of pre-existing conditions and climate stressors, and the combined impacts of these effects emerged across focus areas, including the following:

- *Pre-existing conditions* – Aging and inadequacy of infrastructure and buildings—including stormwater and sewer systems, affordable housing, and inequity of access to resources and services—were among themes discussed in multiple focus areas. An aging and insufficient workforce was identified as a growing challenge given the need to address aging infrastructure, building construction, and maintenance and agriculture. Public health concerns were identified for a variety of populations, including residents, workers in multiple sectors, and vulnerable populations, as well as for concern for increases in disease in livestock and crops. Staffing capacity challenges, particularly in applying for and administering grants and funding, were identified as a common concern across the breakout groups.
- *Climate stressors* – Rising temperatures and extreme heat, shifts in precipitation, and storms and flooding were all identified as major climate impacts for discussion by all three groups.

Combined impacts of pre-existing conditions and climate stressors listed above were also identified across breakout groups as impacts of greatest concern, including the following:

- Impacts of extreme heat and extreme weather on a workforce that already is not adequate to meet local needs in all the focus areas discussed, thus leading to further loss of productivity across multiple sectors.

- Extreme heat will further increase costs to all the sectors considered due to increased needs for water, energy, and equipment for temperature management.
- Aging and inadequate infrastructure, utilities, equipment, and housing stock will be further compromised by climate change impacts, including extreme heat, changes in precipitation and extreme storms.
- Factors such as small rural communities, low staff capacity, and lack of knowledge about available funding make it more difficult for local agencies, organizations, and businesses to pursue and secure grant funding to assist with addressing climate vulnerabilities.

The similarities in impacts of greatest concern also resulted in overlapping and intersecting adaptation strategies, such as:

- Private-public partnerships to bring more resources to bear to a wide variety of adaptation solutions, including renovating and modifying the housing supply, assisting farmers and community organizations with grant applications, improving workforce supply, and providing expertise across an array of issues such as shifting and adapting agricultural systems, weatherization, and electrical system resilience and upgrades
- Public education and outreach to increase public awareness and support for adaptation efforts and to promote access to extant local services that may be increasingly critical during extreme heat and weather events
- Increased connectivity and collaboration with existing regional public agencies and institutions (e.g., Cornell Cooperative Extension for agricultural expertise and funding opportunities and SLC for stormwater planning, soil mapping, and public health resources)
- Leveraging existing resources to support adaptation (e.g., IRA funding for clean energy and agriculture)
- Updating codes and zoning to better address risks and capacity of sectors, including flexibility in housing design and development and protecting high-fertility soils for agricultural production

This report can be used as a reference for decision-makers in Canton and Potsdam as they plan for and commit resources to create a more sustainable and resilient community under climate change. The adaptation strategies that participants have identified during this workshop may present opportunities to leverage resources across multiple focus areas. In addition, there were many adaptation solutions brought

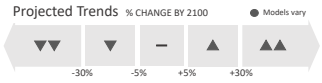
forward by participants that were not developed further due to time limitations but can be a rich source of additional ideas for the community to consider.

Because climate adaptation is an iterative process and new research and modeling on projected climate changes and impacts are regularly released, it is important to revisit and/or revise the vulnerability assessments and adaptation strategies on a regular basis (e.g., every 5 to 10 years), as well as when additional topics of concern become priorities.

Appendix A. Workshop Participants and Breakout Group Assignments

Participant Name	Affiliation
Agriculture and Food Security Focus Group:	
Allyssa Hardiman	Potsdam Town Board
Carlene Doane	GardenShare
Catherine Shrady	Canton Sustainability Committee
Karen Bage	St. Lawrence Health Initiative
Kathleen Stein	League of Women Voters of St. Lawrence County, New York
Michael McQuade	Town of Canton
Housing Focus Group:	
Nick Hamilton-Honey	Cornell Cooperative Extension of St. Lawrence County
Ann Heidenreich	Canton Sustainability Committee
Carol Basford	St. Lawrence County Public Health Department
Jenesse Watson	St. Lawrence County Public Health
John Tenbusch	St. Lawrence County Planning Office
Lynn Hall	Town of Potsdam
Utilities Focus Group:	
Carlie Leary	Adirondack North Country Association (ANCA)
Klaus Proemm	Village of Canton Board
Mark Saltsman	Liberty Utilities
Mary Ann Ashley	Town of Canton Supervisor
Matthew Denner	St Lawrence County Emergency Services
Suna A Stone	St. Lawrence University, Chemistry and EHS
Susan Powers	Clarkson University, Institute for a Sustainable Environment

Appendix B. Climate Changes and Impacts Table for Canton and Potsdam



CLIMATE CHANGES	METRIC	TREND	OBSERVED/PROJECTED CHANGES
Air temperature	Annual temperature AVG DAILY TEMP (°F)	▲	+5.4°F by the 2050s; +10.6°F by the 2090s[1] COMPARED TO BASELINE OF 43.4°F FROM 1980–2009
	Summer temperature AVG DAILY JUN–AUG TEMP (°F)	▲	+4.6°F by the 2050s; +10.0°F by the 2090s[1] COMPARED TO BASELINE OF 65.8°F FROM 1980–2009
	Winter temperature AVG DAILY DEC–FEB TEMP (°F)	▲▲	+6.3°F by the 2050s; +12.2°F by the 2090s[1] COMPARED TO BASELINE OF 19.0°F FROM 1980–2009
	Frost days # OF DAYS WITH MIN TEMP < 32°F	▼	–24.8 days (–15%) by 2050s; –52.8 days (–32%) by the 2090s[1] COMPARED TO BASELINE OF 163.5 DAYS FROM 1980–2009
Extreme heat	Days over 90°F # OF DAYS WITH MAX TEMPS >90°F	▲▲	+11.7 days (+836%) by 2050s; +41.1 days (+2,036%) by 2090s[1] COMPARED TO BASELINE OF 1.4 DAYS FROM 1980–2009
Precipitation	Annual precipitation AVG INCHES PER YEAR	▲	+2.4 in (+6%) by the 2050s; +4.0 in (+10%) by 2100[1] COMPARED TO BASELINE OF 40.4 INCHES PER YEAR FROM 1980–2009
	Seasonality	▲	Significant increase in winter (+37%) and moderate increase in spring (+19%) precipitation; slight increase in summer (+4%) and decrease in fall (6%)[1]
Snow	Frequency & intensity	▼▼	Significant reductions in frequency of snowfall events and shorter season length[2] Uncertain changes in the intensity of individual snow events and frequency/intensity of ice storms and freezing rain[2]
Extreme precipitation	Frequency # OF DAYS WITH 2" RAIN IN 24 HOURS	▲	+0.02 days (+15%) by 2050s; +0.07 days (+54%) by 2090s[1] COMPARED TO BASELINE OF 0.13 DAYS FROM 1980–2009
	Amount 20-YEAR RETURN PERIOD TOTAL	▲	+13% increase in precipitation amount during 20-year events projected by 2050; +22% by 2100[3]
Storms & flooding	Frequency & severity	▲▲	Likely increase in occurrence of severe thunderstorms, including tornadoes[4] Increases in flood frequency, severity, and area vulnerable to flooding[5,6]
Drought	Frequency & severity	▲	Likely increase in the seasonal late-summer droughts; change in multi-year drought risk is currently unknown[2]

[1] New York Climate Change Science Clearinghouse Map (https://www.nyclimatescience.org/map), with county-scale temperature and precipitation projections presented as a range from the low-emissions to the high-emissions scenario (RCP 4.5 to RCP 8.5) for the average of 2040–2059 and 2080–2099 time periods (referred to as the 2050s and 2090s, respectively) compared to the average conditions between 1980 and 2009 (referred to as baseline conditions).
[2] R. M. Horton, D. A. Bader, C. Rosenzweig, A. T. DeGaetano, W. Solecki, "Climate Change in New York State: Updating the 2011 ClimAID Climate Risk Information" (Albany, New York, New York State Energy Research and Development Authority (NYSERDA), 2014), (available at https://www.nyserda.ny.gov/climaid).
[3] D. R. Easterling et al., in Climate Science Special Report: Fourth National Climate Assessment, Volume I, D. J. Wuebbles et al., Eds. (U.S. Global Change Research Program, Washington, DC, 2017; https://science2017.globalchange.gov/chapter/7/), pp. 207–230.
[4] N. S. Diffenbaugh, M. Scherer, R. J. Trapp, PNAS. 110, 16361–16366 (2013).
[5] P. D. Bates et al., Water Resources Research, 57, e2020WR028673 (2021).
[6] O. E. J. Wing et al., Nat. Clim. Chang. 12, 156–162 (2022).

Appendix B cont. Climate Changes and Impacts for Canton and Potsdam: examples of impacts on focus areas

LIKELY IMPACTS ASSOCIATED WITH PROJECTED CLIMATE CHANGES*	
 **Housing**	• Increased risk of damage to housing and critical infrastructure (e.g., utilities) following storms, floods, and extreme heat • Increased heat stress in developed areas, exacerbated by large areas of impervious surfaces and lack of vegetation • Increased energy demand during heat waves, straining electrical grids and potentially resulting in power outages and increased costs • Extreme heat and flooding exacerbate existing patterns of inequity for low-income neighborhoods and other vulnerable communities more likely to experience heat island effect and poor drainage and unable to afford increasing energy bills
 **Utilities**	• Increased stormwater capacity required to cope with precipitation increases and heavier rainfall during extreme events • Damage to critical infrastructure (e.g., wastewater treatment plants) during flood events • Increased energy demand during heat waves combined with greater stress on equipment designed to keep electrical infrastructure from overheating, potentially straining electrical grids and increasing costs for users • Increased concentration of contaminants and increased possibility of harmful algal blooms in water sources during drought periods, reducing effectiveness of water treatment
 **Transportation**	• Damage to transportation infrastructure (e.g., roads, bridges, culverts) following storms, floods, and extreme heat events • Road blockages following extreme events, impacting evacuation routes, emergency access, and critical travel • Loss of electricity due to flooding or heat waves, limiting use of electric vehicles and impacting public transit • Slower travel or road closures due to melting asphalt, overheating engines, and other impacts associated with extreme heat
 **Agriculture & Food Security**	• Increased length of the growing season and potential increases in heat stress, disease, and insect pests, impacting growth and productivity of agricultural crops • Increased presence of weeds and fungi that compete with crops for light, water, and nutrients • Reduced suitability of current crops for changing climate conditions, requiring shifts in crops/varieties and equipment needed for cultivation and processing • Economic impacts of crop failures and damage to agricultural operations following extreme events (e.g., floods), as well as supply chain disruptions that can impact community food accress • Increased food costs as a result of increases in food production and distribution, with disproportionate impacts on low-income populations • Increased health risks for agricultural workers exposed to extreme temperatures, vector-borne diseases, and other hazards

* All icons from the Noun Project: (1) Housing icon created by Carlos Dias; (2) Utilities icon created by Juan Pablo Bravo; (3) Road icon created by Jorge Namos; (4) Agriculture icon created by Vectors Point

Resources:

- New York Climate Change Science Clearinghouse (https://www.nyclimatescience.org/)
- Responding to Climate Change in New York State (ClimAID report: https://www.nyserda.ny.gov/climaid).
- Northeast Chapter of the Fourth National Climate Change Assessment (https://nca2018.globalchange.gov/chapter/18/)
- EPA's Environmental Justice Screening and Mapping Tool (https://ejscreen.epa.gov/mapper/)
- Climate Change and Social Vulnerability in the United States: A Focus on Six Impacts (https://www.epa.gov/cira/social-vulnerability-report)
- Cleveland Racial Equity Tool (helps assess whether adaptation strategies will be equitable: https://www.sustainablecleveland.org/racial-equity)