

Global Climate, Local Resiliency

Climate Vulnerability Assessment for the Town of New Lebanon, New York

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ACRONYMS

CAQDAS – Computer-Assisted Qualitative Data Analysis Software

ClimAID - Integrated Assessment for Effective Climate Change Adaptation Strategies in New York State

CSC – Climate Smart Communities

DEC – Department of Environmental Conservation

DEIJ – Diversity, Equity, Inclusion, Justice

DO – Dissolved Oxygen

DS – NY Department of State

GHG – Greenhouse Gas

GMST – Global Mean Surface Temperature

IPCC – Intergovernmental Panel on Climate Change

MPA – Master of Public Affairs

NYPA – New York Power Authority

NYS – New York State

PE – Pledge Element

UNFCCC – United Nations Framework Convention on Climate Change

USGCRP – United States Global Change Research Program

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EXECUTIVE SUMMARY

PURPOSE AND SCOPE

The science and politics of the climate and subsequent governing policies addressing it are well established and addressed at the global and national levels. But in the United States, meaningful change happens locally. Enacting wide-sweeping national policies at the local level violates the home-rule value of autonomy that Americans hold as vital to the democratic process. Rural Americans need an idea of what to expect of a changing climate in the coming decades, so they can make mitigation and adaptation choices that are right for them.

New Lebanon is a small town of 2,300 people in eastern New York, settled in the forested hills between the Hudson River and the Taconic mountain range. There, residents of quaint, quiet hamlets are unsure of how the surrounding countryside and forests will look even a decade from now. The Cornell Consulting team sought to lay a road map for New Lebanon to follow as it tackles future challenges, fosters climate resilience, and helps set the bar for other towns in the region.

The Cornell Consulting Team worked with the Town of New Lebanon Climate Smart Communities Task Force, and under the guidance of faculty advisor Rebecca Brenner (rjm678@cornell.edu). They began by distilling the existing climate science and associated hazards at the global and national levels down into a local context for the Town of New Lebanon. They then conducted interviews with key personnel in the town, including but not limited to firefighters, Town board members, and maple syrup farmers. This allowed for a determination of important assets and areas that the people of New Lebanon care about and want to protect. Together, this combination of existing climate science and projections, known vulnerabilities, key assets, and recommended actions are wrapped into this comprehensive vulnerability assessment report. This report can be used going forward both as a roadmap for the Town and as a completed action item that contributes towards the New Lebanon CSC Task Force's Road to Silver Certification.

SUMMARY OF FINDINGS

The Cornell Consulting Team combined the qualitative data surrounding existing climate science in the literature review with quantitative data derived from interviews with critical personnel in the Town of New Lebanon to derive the following hazards to prioritize and assets to protect:

PRIORITIZED HAZARDS

TEMPERATURE INCREASES AND HEAT WAVES
EXCESSIVE RAIN AND FLOODING
DROUGHT
SNOW AND ICE STORMS

PRIORITIZED ASSETS

TRANSPORTATION – ROADS AND BRIDGES
ENERGY – POWER LINES
WATER
AGRICULTURE

SUMMARY OF RECOMMENDATIONS

The Cornell Consulting Team has compiled the following recommendations to the Town of New Lebanon, based on an evaluation of existing climate science, quantitative data derived from interviews with critical personnel in the Town of New Lebanon, and the findings for this report:

SHORT TERM PRIORITIES (1-3 YEARS)

CONTINUE DEVELOPING THE CLIMATE SMART COMMUNITIES PROGRAM

The Town of New Lebanon should continue to focus on their NYS CSC Program. The program provides a clear pathway to increase resilience against climate hazards, and provides access to a wide range of resources in the form of technical assistance and grants for the benefit of the Town.

ATTEMPT TO FURTHER UNDERSTAND, RESEARCH, AND UPDATE FLOOD RISKS

There are several parts of the Town which have a high risk of flooding. The Town can mitigate risk by preparing emergency response capacity. In order to do that the Town should have a flood risk analysis done, which shall help in identifying vulnerable areas and prioritize action.

PROTECT CRITICAL ASSETS

The protection of infrastructure for electricity, heating supply, roads, and social assets is critical to the Town.

FURTHER DEVELOP EMERGENCY RESPONSE PLANS

The emergency response capability of the Town is important when considering climate-related crises. The Town needs to improve its preparedness by updating a comprehensive plan of action which will be followed should a disaster strike. The Town should further empower the LVPA to tackle multiple hazards and strengthen coordination for timely action and resource allocation.

LONG TERM PRIORITIES (3+ YEARS)

DEVELOP WATER RESOURCES CONTINGENCY PLAN

The water resources of the Town are a critical asset which need to be effectively protected and managed. It is important that the Town has a contingency plan to ensure availability of water for drinking, agriculture and use by the LVPA. In the long term the town should establish a water storage tank which shall provide necessary backup in drought and other emergencies.

APPLY FOR GRANTS AND INFRASTRUCTURE PROJECTS

Grants are expected to be made available to small towns by the federal government in the near future. The town can avail such grants to build and improve the critical infrastructure necessary for emergency response. New Lebanon needs investment in road infrastructure, power lines, water storage tanks and flood mitigation infrastructure.

ENVIRONMENTAL EDUCATION PROGRAMS

Raising public awareness about climate-based risks is highly recommended for the Town. The Road to Silver requests that the town carry out a certain number of workshop and events to raise public awareness about climate related hazards. Educational programs should be focused on all people, with a special focus on youth and the elderly.

INTRODUCTION + BACKGROUND

1.1 NEW YORK STATE CLIMATE SMART COMMUNITIES PROGRAM

Climate Smart Communities (CSC) is a New York State (NYS) program that supports local governments and municipalities in helping communities to reduce greenhouse gas emissions, adapt to the effects of climate change, and thrive in a green economy. The CSC Program is jointly sponsored by seven NYS Agencies, including the Department of Environmental Conservation (DEC), the Department of State (DS), and the New York Power Authority (NYPA). The CSC Program has seven goals:

1. Reduce greenhouse gas emissions
2. Build resiliency to the impacts of climate change
3. Save taxpayer dollars
4. Increase energy security and reliability
5. Improve community public health and safety
6. Support a green innovation economy
7. Demonstrate leadership

Becoming a CSC Community requires completing and documenting a number of different “Actions” that help the community develop resilience and mitigation measures to climate-based hazards and threats. Climate Smart Communities complete “Mandatory,” “Priority,” and “Optional” actions to contribute towards program goals. Completion of these actions earn points which results in the attainment of certification levels; Bronze (120 points), Silver (300 points), and Gold (points TBA). There are over 350 Climate Smart Communities across NYS as of May 2021. 58 of these communities are certified as Bronze, and seven are certified as Silver. Certification through the NYS CSC Program confers benefit such as better scores on state-sponsored grant applications, and state-level recognition for community climate action work. In “Local municipal climate change action in New York State: Exploring the urban-rural divide,” Allred et al. explores how rural NYS communities find it more difficult to complete these actions (Allred et al., 2021). Actions are nestled within categories known as Pledge Elements, of which there are 12:

- PE #1. Build a Climate Smart Community
- PE #2. Inventory emissions, set goals, and plan for climate action
- PE #3. Decrease energy use
- PE #4. Shift to clean, renewable energy
- PE #5. Use Climate-smart materials management
- PE #6. Implement climate-smart land use
- PE #7. Enhance community resilience to climate change
- PE #8. Support a green innovation economy
- PE #9. Inform and inspire the public
- PE #10. Engage in an evolving process of climate action
- PE #11. Innovation
- PE #12. Performance

In return for completing Pledge Element actions that contribute towards the above goals, Climate Smart Communities receive:

1. Funding for climate change mitigation and adaption projects via the DEC CSC Grant program
2. Reduced cost of clean vehicles and associated charging/fueling stations
3. Free technical assistance for clean energy and climate change initiatives from regional coordinators
4. Online guidance and decision-support tools via webpages
5. Opportunities to learn about best practices through CSC webinars
6. Ability to network with like-minded community leaders at CSC events and workshop

1.2 NEW LEBANON CLIMATE SMART COMMUNITIES TASK FORCE

In April of 2020, the Town of New Lebanon took the CSC Pledge and became a Climate Smart Community. The task force has completed 22 tasks and actions across 8 Pledge Elements and earned 130 points. This contributed towards their certification of Bronze Status in March of 2021. New Lebanon celebrated its achievement of Bronze Certification, and is taking steps and completing actions towards certifying as a CSC Silver community in the future.

1.3 CORNELL CONSULTING'S ROLE; PE7.1 CLIMATE VULNERABILITY ASSESSMENT

New Lebanon is in the process of completing steps and actions that will earn them CSC Silver Certification. The Town of New Lebanon CSC Task Force has earned 130 points. Silver Certification requires 300 points. Pledge Element (PE) 7: Enhance Community Resilience to Climate Change contains many “Priority” and “Mandatory” actions that the Town of New Lebanon CSC Task Force needs to complete in order to earn 300 points and be considered for Silver Certification. Action PE7.1: Climate Vulnerability Assessment, is a Silver Priority Action and counts for 16 points overall. **The role of the Cornell Consulting Team is to assist the Town of New Lebanon CSC Task Force in completing Action PE7.1: Climate Vulnerability Assessment as a part of their “Road to Silver” initiative for the Town of New Lebanon.**

1.3.1 OVERVIEW OF PE7.1 CLIMATE VULNERABILITY ASSESSMENT

The NYS CSC website describes PE7.1 in the following statement:

“Climate resilience begins with understanding hazards posed by a changing climate and identifying community vulnerabilities. Climate change does not affect all assets, systems, operations, or community members equally, so performing a comprehensive assessment of local vulnerabilities and risks helps identify and prioritize actions to reduce risks to the community. In conducting a vulnerability assessment, the local government must consider current and future conditions...The Climate Smart Communities (CSC) program recommends that local governments complete a vulnerability assessment as one of the first and most foundational steps in developing an effective strategy for adapting to climate change at the local level.

Developing a vulnerability assessment involves identifying, analyzing and prioritizing the effects of climate hazards and risks, like flooding, heat stress or short-term drought. A climate hazard is a physical event or trend that could affect a population segment or the entire community, specific areas, assets, or entire systems (for example, transportation or energy infrastructure) including the local economy and industries. A vulnerability assessment process should consider diversity, equity, inclusion and justice (DEIJ) from start to finish since vulnerabilities will likely lead to varying risks across the diverse populations in your community” (NYS CSC, 2020).

Section B of PE7.1 describes the steps that must be taken to complete the action:

1. Research relevant studies: Research relevant studies of climate change projections to identify hazards that apply to the community.
2. Identify hazards: Using your identified climate hazards, assess the potential impacts to assets and systems in the community.
3. Identify vulnerabilities: Identify vulnerable populations and assess how they will be affected by current and future climate hazards.
4. Share a summary of assessment: Share a summary of climate hazards, community assets, systems and vulnerabilities with community residents and other stakeholders via public meetings, surveys, and/or other means.
5. Prioritize assets: Prioritize assets and systems based on the following factors:
 - Their exposure and sensitivity to the effects of climate hazards and their adaptive capacity
 - How critical they are in respect to the functioning and prosperity of the community
 - Their ability to reduce vulnerabilities and risks in the community, and to vulnerable populations in particular
6. Develop findings: Develop a report of vulnerability assessment findings. This should include the climate hazards and effects considered and an analysis of the risk and vulnerability to community assets. Post the report to the municipality's website.
7. Make re-assessment recommendations: Establish a timeline for re-assessing vulnerabilities. Updates should occur at least every 10 years or when a new understanding of hazards occurs (like a major storm) or when updated state climate projections become available.

1.3.2 CORRELATION OF PE7.1 WITH THIS CONSULTING REPORT

Cornell Consulting has completed PE7.1 in cooperation with the Town of New Lebanon CSC Task Force, and included each of the seven steps within the report sections as follows:

| Pledge Element Action 7.1: Climate Vulnerability Assessment | Corresponding Section Within this Report |
|---|--|
| PE7.1 Step 1: Research Relevant Studies | 2: Literature Review |
| PE7.1 Step 2: Identify Hazards | 4.3: Interview Findings |
| PE7.1 Step 3: Identify Vulnerabilities | 4.4: Potential Vulnerabilities in New Lebanon |
| PE7.1 Step 4: Share a Summary of Assessment | 4: Findings |
| PE7.1 Step 5: Prioritize Assets | 4.5: Prioritized Assets Present in New Lebanon |
| PE7.1 Step 6: Develop Findings | 4: Findings |
| PE7.1 Step 7: Make Assessment Recommendations | 5: Recommendations |

LITERATURE REVIEW

2.1 INTRODUCTION

This report summarizes the existing climate science literature and associated hazards at the global and national levels, then details what this means for the Town of New Lebanon in terms of the town's existing vulnerabilities and assets. The existing climate literature is broken down into two levels: "Global/National" and "State/Local." The working terms we will use for "hazard," "vulnerability," and "asset" as they are defined by the NYS CSC Program under Action PE7.1(NYS DEC, 2021) are given below:

1. **Hazard:** "A climate hazard is a physical event or trend that could affect a population segment or the entire community, specific areas, assets, or entire systems (for example, transportation or energy infrastructure) including the local economy and industries."
2. **Vulnerability (Exposure):** "Refers to whether an asset or system is located in an area that is likely to experience the effects of a climate change hazard now or in the future."
3. **Asset:** Anything within an area's limits that holds value or is necessary to the population.

2.2 AN OVERVIEW OF REGIONAL HAZARDS AND HAZARD SELECTION FOR THIS LITERATURE REVIEW

Hazards have been selected according to their establishment in existing literature and relevance to the town of New Lebanon. The consulting team evaluated 24 academic papers and reports on existing climate science, at four scales ranging from large to small: Global, Regional, State, and Local (New Lebanon). Following this, the consulting team selected the seven most relevant hazards which have the potential to affect the Town of New Lebanon, and summarized them at the four scales (Global, Regional, State, and Local) in the following literature review. The seven most relevant hazards are listed below:

| Hazard | Global/Regional Scale: # of Sources | State/Local Scale: # of Sources |
|--|-------------------------------------|---------------------------------|
| 1. Rising Temperatures and Heat Waves | 4 | 9 |
| 2. Excessive Rain and Flooding | 4 | 7 |
| 3. Drought | 1 | 5 |
| 4. Snow and Ice Storms | 0 | 5 |
| 5. Invasive Species and Habitat Degradation | 3 | 4 |
| 6. Hurricanes and Heavy Storms | 2 | 4 |
| 7. Vector-Borne, Chronic, and Mental Illnesses | 2 | 3 |

2.3 HAZARDS

Hazards are detailed below in order of appearance in the existing climate science literature, as detailed in Section 2.2: An Overview of Regional Hazards and Hazard Selection for this Literature Review.

2.3.1. RISING TEMPERATURES AND HEAT WAVES

2.3.1.1. GLOBAL/NATIONAL PROJECTIONS: SCIENCE AND SECTORS IMPACTED

Temperature change is the common expectation when considering climate science today. The Fourth National Climate Assessment asserts that “2014 became the warmest year on record globally; 2015 surpassed 2014 by a wide margin; and 2016 surpassed 2015. Sixteen of the warmest years on record for the globe occurred in the last 17 years” (USGCRP, 2017). The assessment posits that this is now the warmest period in the history of modern civilization (USGCRP, 2017). The United Nations Framework Convention on Climate Change (UNFCCC) concludes that “more than half of the observed increase in global mean surface temperature (GMST) from 1951 to 2010 is very likely due to the observed anthropogenic increase in greenhouse gas (GHG) concentrations” (Christensen et. al, 2013). In the United States, winters are warming three times as quickly as summers, and by 2035 the Northeast is projected to warm at least 3.6°F from preindustrial levels (USGCRP, 2018).

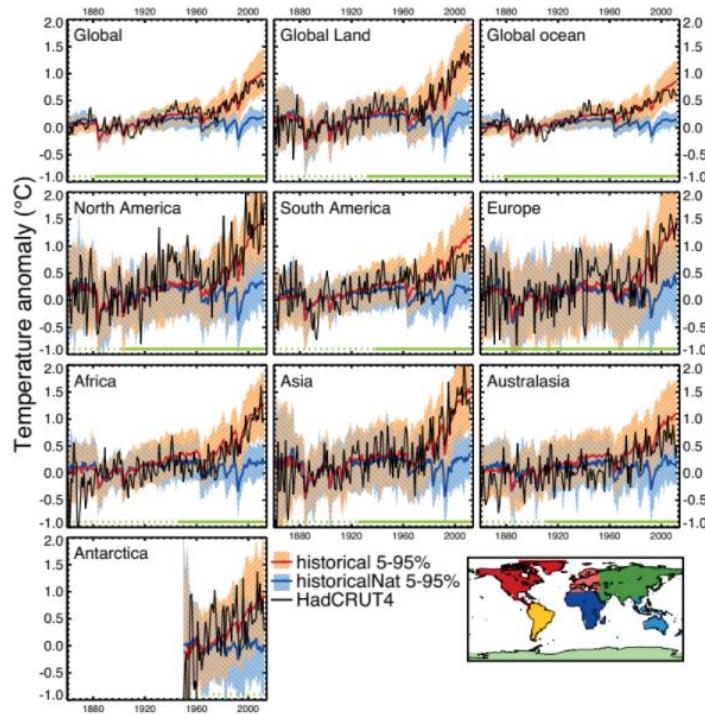


Figure 10.7 | Global, land, ocean and continental annual mean temperatures for CMIP3 and CMIP5 historical (red) and historicalNat (blue) simulations (multi-model means shown as thick lines, and 5 to 95% ranges shown as thin light lines) and for Hadley Centre/Climatic Research Unit gridded surface temperature data set 4 (HadCRUT4, black). Mean temperatures are shown for Antarctica and six continental regions formed by combining the sub-continental scale regions defined by Seneviratne et al. (2012). Temperatures are shown with respect to 1880–1919 for all regions apart from Antarctica where temperatures are shown with respect to 1950–2010. (Adapted from Jones et al., 2013.)

Fig. 1: Annual mean temperatures, 1880–2000AD (Cubasch et. al, 2013)

Globally, temperature has a variety of impacts. A rise in temperature leads to “the expansion of arid climate zones and contraction of polar climate zones” (IPCC, 2019). The IPCC gets more specific for human impacts, stating that “temperature (and, above all, its local averages and extremes) affects agricultural productivity, energy use, human health, water resources, infrastructure, natural

ecosystems, and many other essential aspects of society and the natural environment...Less distinct seasons with milder winter and earlier spring conditions are already altering ecosystems and environments in ways that adversely impact tourism, farming, and forestry" (USGCRP, 2018)"

2.3.1.2. NYS/NEW LEBANON PROJECTIONS: SCIENCE AND SECTORS IMPACTED

Throughout the 20th century historical records indicate an increase in the annual temperature of NYS (ClimAID Report, 2014). According to projections the number of hot days in NYS is expected to increase during this century. Heat waves, which are defined as "three or more consecutive days with maximum temperatures at or above 90 degrees", are expected to increase in frequency and duration as well. In some regions of the state, the frequency and duration of extreme cold events are expected to decrease, while other regions will see an increase in extreme cold events. High-altitude regions such as the Adirondacks are likely to experience an increase in extreme cold events and reduction in extreme heat events. According to Columbia University Center for Climate Systems Research, NYS is projected to experience annual temperature increase of "1.5–3.0 Fahrenheit in the 2020s, 3.0– 5.5 Fahrenheit in the 2050s, and 4.0–9.0 Fahrenheit in the 2080s". The northern parts of the state are expected to be most strongly impacted by this temperature rise due to their lower baseline.

The rising temperatures will affect the water sector – especially drinking water supply. The demand for water shall increase and the water system will be strained (ClimAID Report 2014). The impact of rising temperatures is expected to be most severe on the Northern part of NYS as compared to the South. It will also cause changes in ground water depth which could lead to water depletion and eventually drought. Towns like New Lebanon that rely on wells for drinking water will be greatly impacted. Water supply for agriculture and commercial uses shall also be decreased. The state will have to tap into larger water resources and develop new channels to transport water towards drought affected places. Increase in temperature may also affect aquatic life. Warmer water holds higher level of Dissolved Oxygen (DO) which is not good for aquatic life. The change in temperature will widely impact the ecosystem. This could disrupt the symbiotic relationships between plant species. Maple syrup production will be affected negatively due to changes in sap flow cycles.

Similarly, the rising temperatures could increase the prevalence of invasive and pest species. The habitat of several native species shall be affected possibly causing mass extinction and changing the entire ecosystem. The agriculture industry shall also be affected strongly by increased temperature. The production of dairy products shall reduce and crops will become more vulnerable to pests. Transportation, energy and telecommunication infrastructure will be strained due to increase in temperature and extreme weather in summers and winters. Electricity demand shall increase for both heating and cooling and the reliability of alternative sources of energy (biomass, hydro and solar) shall reduce. From a public health point of view, the increase in temperature shall lead to a decrease in air quality and increase in infectious diseases (USGCRP, 2016).

2.3.2. EXCESSIVE RAIN AND FLOODING

2.3.2.1. GLOBAL/NATIONAL PROJECTIONS: SCIENCE AND SECTORS IMPACTED

Globally, precipitation levels and patterns are expected to fluctuate and change wildly in the next century. Arid regions of the world are expected to continue the process of desertification, while humid regions will become more so (IPCC, 2013). As an established temperate-humid climate, the eastern seaboard of the United States is expected to fall into this latter category. According to a report published by the United States Global Change Research Program, “Heavy rainfall is increasing in intensity and frequency across the United States and globally and is expected to continue to increase. The largest observed changes in the United States have occurred in the Northeast” (USGCRP, 2017).

The literature is less specific when it comes to flooding on a global scale, as precipitation is projected to increase in some places while decreasing in others. The Intergovernmental Panel on Climate Change (IPCC) convenes climate scientists from nearly every country once every six years to evaluate the impacts of a changing climate. As shown in Figure 2 below, on a regional scale we can rely on national data, which states “precipitation increases have been found to strongly influence changes in flood statistics” (USGCRP, 2018).

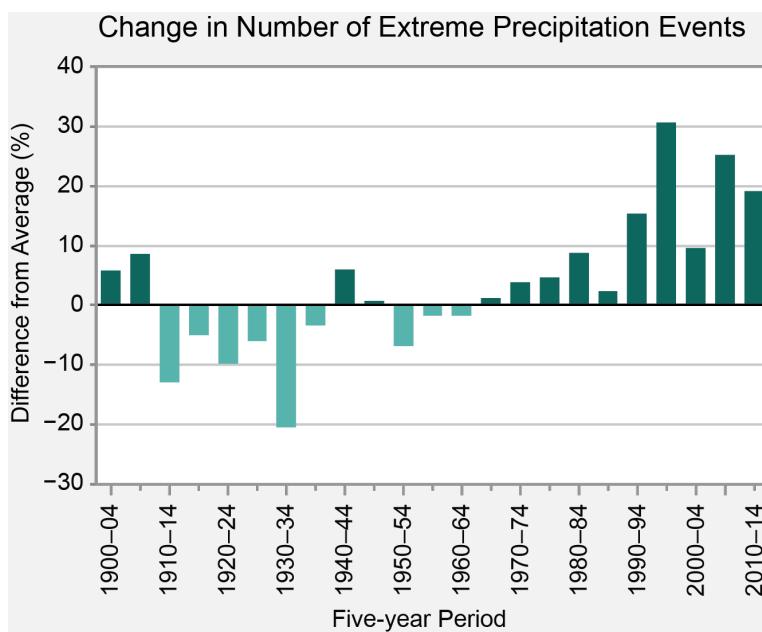


Fig. 2: Change in number of Extreme Precipitation Events (USGCRP, 2016)

Worldwide, the IPCC report on “Impacts, Adaptation, and Vulnerability” states that climate change will “further erode food security, and prolong existing and create new poverty traps, the latter particularly in urban areas and emerging hotspots of hunger (medium confidence). Climate change impacts are expected to exacerbate poverty in most developing countries and create new poverty pockets in countries with increasing inequality, in both developed and developing countries” (IPCC 2014). How does a rise in

precipitation and flooding lead to poverty and food insecurity? In the Northeast it could happen through agriculture. USGCRP anticipates that “Northeast(ern) agriculture, with nearly \$21 billion in annual commodity sales, will benefit from the changing climate over the next half-century due to greater productivity over a longer growing season.” In the same paragraph though, the report states “...increased precipitation can result in soil compaction, delays in planting, and reductions in the number of days when fields are workable” (USGCRP, 2018). When fields are less workable, a loss of food security is possible, even in areas that have not previously experienced such a loss.

2.3.2.2. NYS/NEW LEBANON PROJECTIONS: SCIENCE AND SECTORS IMPACTED

NYS is affected by a wide range of extreme events due to variability in the region. Different extreme events affect the various regions of the state (ClimAid Report, 2014). Although much more frequent in spring season, heavy rain fall in any season can lead to flooding in NYS. The most vulnerable areas include urban centers, steep sloped, and low-lying areas. Flooding caused by intense precipitation in the state can be attributed to small scale thunderstorms, large scale coastal storms and warm-season tropical cyclones. Extreme precipitation can also be triggered because of lake-enhanced snow events especially impacting the western part of NYS, the Tug Hill Plateau, and any mountainous regions (ClimAid Report, 2014).

There have been some significant changes in trends related to precipitation in NYS (ClimAID Report 2014). Annual precipitation levels increased during most of 20th century. However, during last couple of decades of the 20th century there was a -0.92 inches per decade decrease in the precipitation levels. The trend reversed again in early 2000's as a 0.68 inches increase was recorded during the 2000-08 period. The increase and decrease in the precipitation indicate a natural variability, therefore this change cannot be attributed towards climate change. Consistent with the global and national projections, the NYS projections for precipitation level is that the frequency, duration and intensity of extreme events may increase (Meehl et al., 2007).

Increases in precipitation level can impact several sectors. Water can be reduced in quality or contaminated, and excessive flooding caused by precipitation can flood waste-water treatment plants (ClimAID Report, 2014). The increase in turbidity of water can also affect the quality of water for agriculture and commercial use. The increase in precipitation level can also affect water related ecosystems as it will impact the nutrient level in streams. The agriculture sector will be most severely affected by an increase in precipitation level or flooding. Chemical runoff or erosion can cause stress to rooting systems and lead to disease. Increase in precipitation and flooding shall also impact the energy infrastructure as transmission lines will be more vulnerable to damage. The frequency and duration of power outages may increase as a result. There is also potential of structural damage to buildings because of increased precipitation. Similarly, transportation infrastructure shall also become vulnerable due to road and railway damage. The lifespan of transportation infrastructure shall shorten, and the operational and maintenance costs will increase. From a public health standpoint, the increase in flooding and precipitation shall cause more disease and contamination from waterborne illness (USGCRP, 2016).

2.3.3. DROUGHT

2.3.3.1. GLOBAL/NATIONAL PROJECTIONS: SCIENCE AND SECTORS IMPACTED

The compounded effect of increased precipitation and more evaporation due to rising temperatures indicates that occurrence of drought in NYS shall increase in the coming decades (ClimAID Report 2014). According to projections, the impact of rising temperature is going to outweigh the increase in rainfall and the frequency of drought shall throughout the 21st century (Bradbury et al., 2002). However, the projections related to drought have higher degree of uncertainty, since drought is caused by a blend of climate and non-climate factors. Water demand and management is also one of the key factors influencing drought occurrence.

Drought can cause depletion of water reserves for drinking water, agriculture and commercial uses (ClimAID Report 2014). Counties and Towns in NYS like New Lebanon who rely on well water for drinking water may face water shortages as a result of drought. Crop productivity and crop yield shall also be affected leading to higher costs of production.

2.3.4. SNOW AND ICE STORMS

2.3.4.1. GLOBAL/NATIONAL PROJECTIONS: SCIENCE AND SECTORS IMPACTED

Globally focused data on projected snowfall scenarios in the Northern Hemisphere remain sparse, despite the fact that 90% of the global population lives there. The USGCRP states only, “activities that rely on natural snow and ice cover are projected to remain economically viable in only far northern latitudes by end of century under the higher scenario” (USGCRP, 2018).

2.3.4.2. NYS/NEW LEBANON PROJECTIONS: SCIENCE AND SECTORS IMPACTED

NYS is particularly affected by snow and ice storms. Due to its general climate, NYS receives about 40 inches of snow per year (ClimAID Report, 2014). The amount of snow each region within the state receives varies depends on numerous factors such as proximity to large lakes or oceans. Some parts of NYS (e.g., Adirondacks and Tug Hill Plateau) receive as high as 175 inches of snow per year. Due to proximity to the Atlantic Ocean the level of snow in New York City (NYC) remains low (i.e., about 36 inches per year). Observations during the period 1970 and 2007 show a decrease in the annual snow fall in NYS.

Increase level of snow can affect quality of water supply. The increase in turbidity of water shall also affect the quality of water for agriculture and commercial use (ClimAID Report, 2014). Snow and ice storms shall also impact the energy infrastructure as transmission lines will be more vulnerable to be damaged. The frequency and duration of power outages may increase as a result. There is also potential of structural damage to buildings. Similarly, transportation infrastructure shall also become vulnerable due to damage to roads and railway. The lifespan of transportation infrastructure shall shorten, and the operational and maintenance costs will increase.

2.3.5. INVASIVE SPECIES AND HABITAT DEGRADATION

2.3.5.1. GLOBAL/NATIONAL PROJECTIONS: SCIENCE AND SECTORS IMPACTED

The IPCC states in their 5th Working Group II report that “while only a few recent species extinctions have been attributed as yet to climate change (high confidence), natural global climate change at rates slower than current anthropogenic climate change caused significant ecosystem shifts and species extinctions during the past millions of years (high confidence)” (IPCC, 2014). Meanwhile the NYS DEC adds that “other consequences of warming and changes in precipitation include northward expansion of certain invasive species and parasites that threaten native plants, ecosystems, and human beings” (NYS DEC, 2015). With these two pieces of information together it is safe to assume that a changing climate in the future means the possibility of native species die off, and northward expansion of invasive pests that contribute to further degradation of regional ecosystems.

2.3.5.2. NYS/NEW LEBANON PROJECTIONS: SCIENCE AND SECTORS IMPACTED

Higher winter temperatures and an increase in overall precipitation will likely result in growth of pathogens and invasive species. Due to the slow and gradual process of natural adaptation of species, it is likely that the displacement caused by climate change will radically alter the eco-system (Dukes et al., 2009). Several studies in the northern region have documented the changes in pattern of spring arrival of species and widening geographic range caused by climate change, such as the changes in migratory patterns and ranges of bird species.

The ecosystem for agriculture will be the sector most severely impacted by invasive species (ClimAID Report, 2014). Due to the northwards shift of many undesirable pests and species changes in the local eco-system of New Lebanon can be expected (Rustad et al., 2012).

2.3.6. HURRICANES AND HEAVY STORMS

2.3.6.1. GLOBAL/NATIONAL PROJECTIONS: SCIENCE AND SECTORS IMPACTED

Rising global temperatures also fuel stronger hurricanes and storms, especially on the Eastern Atlantic Seaboard. Existing science suggests that since the 1970s there has been an increase in intense storms and hurricanes along the Atlantic coast. A 2005 study reported that the number of Category 4 and 5 hurricanes increased greatly in the 15-year period between 1990-2005 as compared to the same period length between 1975-1990. The overall cost of extreme events for the United States overall exceeds \$1.1 Trillion (USGCRP, 2018). Therefore, understanding and preparing for these new, more intense storms during our transitioning climate is well sanctioned. Hurricanes bring more than just stormy conditions and rain for the East Coast of the United States. Flood effects on the eastern seaboard are shown in Figure 4 below:

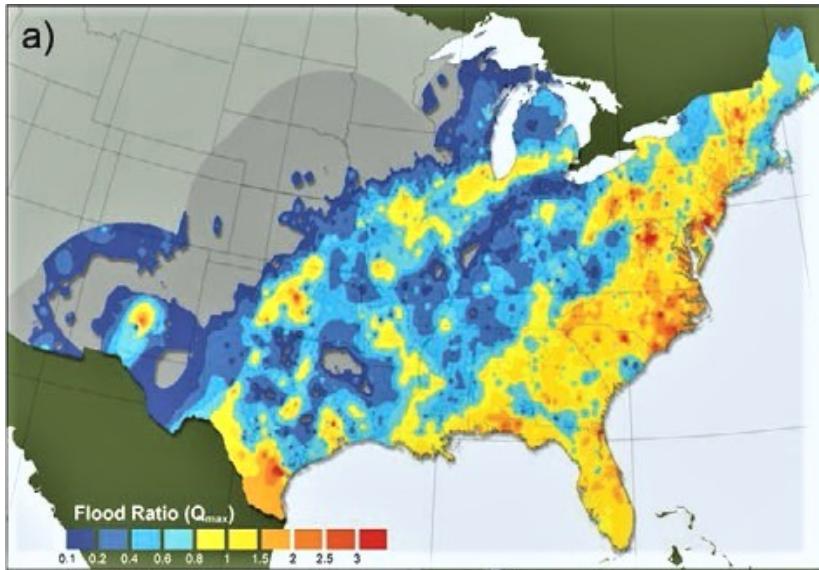


Fig. 3: Average Maximum Flood Effects, Nationwide (Villarini et al., 2014)

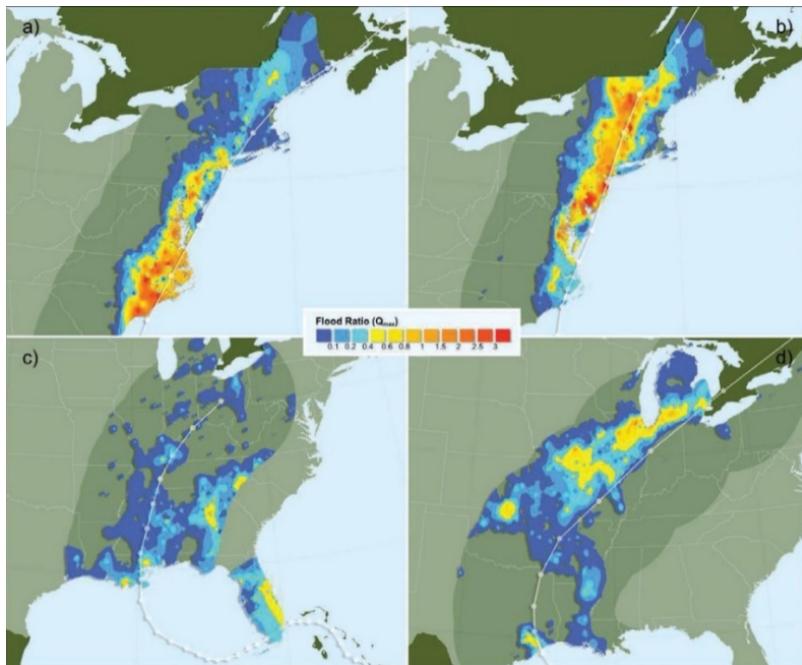


Fig. 4: Hurricane-Induced Flood Effects for (a) Hurricane Floyd (1999), (b) Hurricane Irene (2011), (c) Hurricane Katrina (2004), and (d) Hurricane Ike (2005) (Villarini et al., 2014)

2.3.6.2. NYS/NEW LEBANON PROJECTIONS: SCIENCE AND SECTORS IMPACTED

NYS is vulnerable to extreme events like hurricanes, strong winds, and intense precipitation. Extreme events are supposed to be rare and unpredictable, therefore there is high uncertainty about their forecast. However, because of the rising sea surface temperature it is likely that frequency of extreme events (e.g., hurricanes, extreme winds) will increase. The factors which determine the formation and intensity of extreme events are numerous and cannot be entirely accounted for. Therefore, it is difficult to predict the future trend of extreme events. Also, very little prediction can be made about the trajectory of such extreme events.

All sectors will be impacted by extreme events; however, the most vulnerable sectors include the energy, transportation, telecommunication and building infrastructure (ClimAID Report, 2014). Hurricanes can cause power failure and structural failure of buildings and infrastructure. Low-lying areas are also vulnerable to flooding during a hurricane or storm. Agriculture and ecosystems can also be affected by the extreme events.

2.3.7. VECTOR-BORNE, CHRONIC, AND MENTAL ILLNESS

2.3.7.1. GLOBAL/NATIONAL PROJECTIONS: SCIENCE AND SECTORS IMPACTED

In the next century, climate scientists and national governments predict that a rise in overall temperature, instability, and the effects of an anthropogenically changing climate will have a variety of impacts on overall human health, whether through vector-borne diseases, chronic illness, or overall mental health and wellness.

The IPCC 2014 compilation on Climate Change Impacts, Adaptation and Vulnerability reports that “until mid-century, projected climate change will impact human health mainly by exacerbating health problems that already exist” (IPCC, 2014). Health impacts will vary by age, location, overall health, and individual community characteristics, but presently studies have very conclusively linked a rise in temperature to a higher risk of illness and/or death, especially amongst the elderly, children, and pregnant women (USGCRP, 2016). As shown in Figure 6, one particular risk that is pertinent to the East Coast of the US is that posed by vector-borne diseases such as Lyme Disease and West Nile Virus. As the climate warms, ticks and mosquitoes which carry these diseases may move further into new territory and multiply, raising the risk of disease for everyone (USGCRP, 2016). The United States Climate and Health Assessment also worries, “temperature extremes can also worsen chronic conditions such as cardiovascular disease, respiratory disease, cerebrovascular disease, and diabetes-related conditions” (USGCRP, 2016). Finally, as is known from experience with hot summer days, “extreme heat can also affect mental health and well-being. Higher outdoor temperatures are associated with decreases in subtle aspects of well-being such as decreased joy and happiness and increased aggression and violence” (USGCRP, 2016).

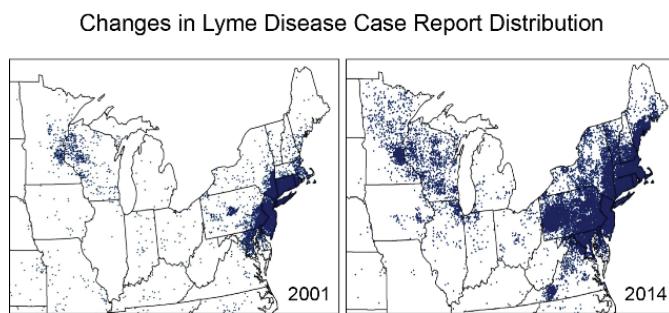


Fig. 5: Changes in Lyme Disease Case Report Distribution (USGCRP, 2016)

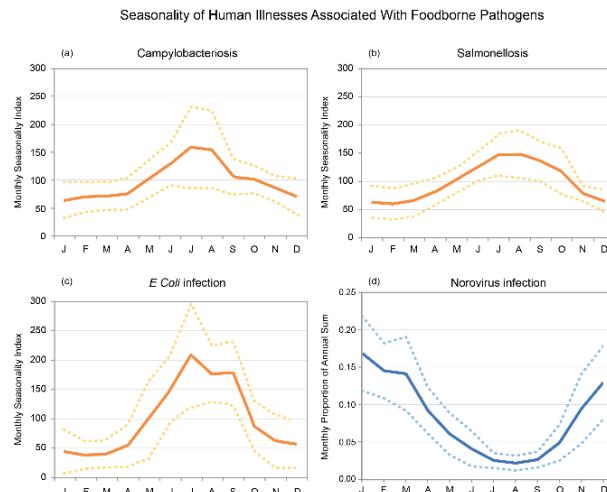


Fig. 6: Seasonality of Human Illnesses Associated with Foodborne Pathogens (USGCRP, 2016)

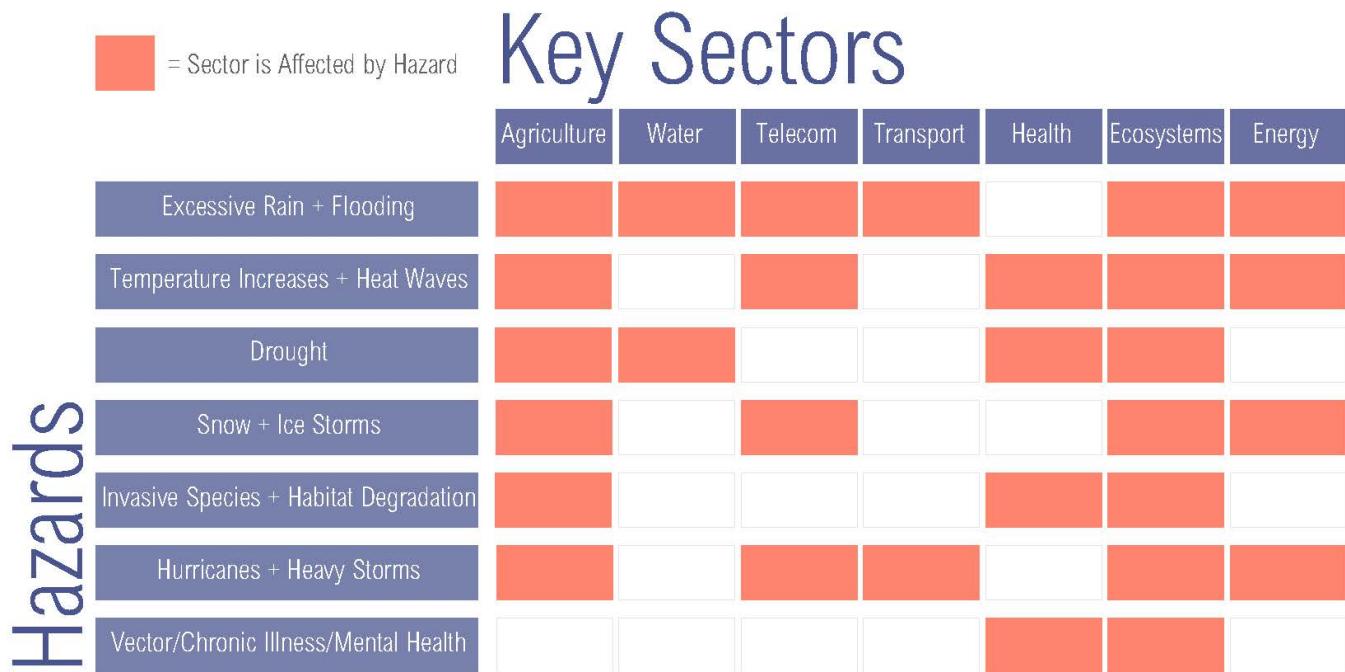
2.3.7.2. NYS/NEW LEBANON PROJECTIONS: SCIENCE AND SECTORS IMPACTED

Vector species (mosquitoes, ticks, midges etc.) are strongly influenced by minor changes in climate. Several diseases like Lyme disease, ehrlichiosis are spreading because of an increase in temperatures. In 2007, white-tailed deer was affected by epizootic hemorrhagic disease (a viral disease) which travelled northward to NYS due to rising temperatures (ClimAID Report 2014).

The increase in vector borne diseases shall affect public health as well as ecosystems (ClimAID Report 2014). During extreme climate events, there is displacement of species which could cause the animal species to catch new diseases and affect the ecosystem. As shown in Figure 7 above, due to warmer temperatures many vector species in the south will be able to migrate to the north causing spread of new disease.

2.4 LITERATURE REVIEW CONCLUSION

Informed by the literature review, the Cornell Consulting Team compiled the findings of this literature review into the following diagram, which details the hazards which are most likely to affect the Town of New Lebanon, the key sectors within the Town which are most likely to be affected by hazards:



There is overwhelming scientific evidence about climate change's potential impact on every aspect of life. We have seen that the impact of climate change is global and it trickles down all the way to local and micro level. Although with varying degrees of certainty, all the hazards explored above are expected to increase in intensity and frequency over this century. Towns like New Lebanon need to adapt their way of life to survive and thrive in the changing climate. Adaptation and mitigation measures are required in all sectors.

DATA COLLECTION AND METHODOLOGY

3.1 SCOPE OF THE RESEARCH

Cornell Consulting Team agreed with the client to bound this project to the following research questions;

1. Identification of the key hazards affecting town of New Lebanon.
2. Identification of critical assets important to the townspeople of New Lebanon.
3. Prioritization of vulnerable assets based on exposure and sensitivity to hazards
4. Developing an inclusive community engagement strategy to raise town awareness about assets. This includes a June 1, 2021 report out to the Town of New Lebanon on the findings of this report.

3.2 DATA COLLECTION

The data collection was conducted through interviews. Nyumba et. al (2018) define interviews as: “a one-to-one, qualitative and in-depth discussion where the researcher adopts the role of an investigator.” Interviews are helpful in getting to the depth of a topic. While conducting the interviews we were attempting to discern how the town of New Lebanon has been historically affected by climate change and what are the current vulnerabilities which require attention.

Over the course of two weeks in April and May of 2021, 11 interviews were conducted with critical personnel in the town. Due to the COVID-19 pandemic, the mode of discussion was online using the interactive video platform Zoom. The interviews were conducted with personnel recommended by the CSC taskforce and Town Supervisor. The intention was to interview people who have in-depth knowledge of the town and understand the connection between climate hazards and other issues (economic, social etc.) affecting the town. Below is a list of the interviewees:

1. 1 member of the New Lebanon Climate Smart Communities Task Force
2. 1 member of the New Lebanon Conservation Advisory Council
3. 1 member of the New Lebanon Town Planning Board
4. 1 businessman/town board member
5. 2 farmers: organic vegetables
6. 1 farmer: large scale cereal crops
7. 1 farmer: maple products
8. 1 farmer: cattle
9. 2 members of the Lebanon Valley Protection Association (sim. to fire department)

3.3 CONDUCTING THE INTERVIEWS

A short presentation on the state of the project's progress so far was presented to the interviewees. The presentation lasted no longer than ten minutes, and on the last slide there were six questions for the interviewee to answer, displayed here in the order in which they were presented:

1. Do you think the seven hazards listed capture the scope of possible hazards which the town of New Lebanon can face?
2. How would you prioritize the top three hazards?
3. Which of these seven sectors are most likely to be vulnerable to climate-related hazards in the Town of New Lebanon?
4. What are some of the specific town assets (socially or infrastructurally) which are vulnerable to climate-related hazards?
5. What are some of the specific community areas which are most vulnerable to climate-related hazards?
6. What are the concerns of townspeople about climate-related hazards?

FINDINGS

4.1 THE RISK EQUATION: EXISTING CLIMATE SCIENCE DATA + QUALITATIVE DATA COLLECTION

This project combines elements of existing and projected climate science, local governments, and disaster risk reduction to determine the risk that a potentially changing climate could pose for the Town of New Lebanon. It was necessary to find a way to help all three categories relate to one another from a more quantitative standpoint. We decided to use a classic risk equation to quantify these connections and help direct our research. The basic risk equation as it pertains to climate-based disasters is:

$$\text{RISK} = \text{HAZARD} \times \text{VULNERABILITY}$$

Exact, cited definitions for “hazard” and “vulnerability” are given in “2. Literature Review.” The literature review determines the relative hazards that exist within a changing climate on Global, National, State and Local scales. In our qualitative research phase, we take a look at vulnerability by discussing the matter at length in interviews with 11 key personnel. The resulting two categories of data have been compiled and presented here in our findings on overall climate risk and vulnerability for the Town of New Lebanon.

4.2 INTERVIEW ANALYSIS: ANALYZING QUALITATIVE DATA WITH NVIVO

Since the data collection is qualitative in nature, we conducted thematic analysis of the data collected using focus groups and interviews. The CAQDAS (Computer-Assisted Qualitative Data Analysis Software) NVIVO was used to facilitate the process. NVIVO can be used to analyze written or oral interviews to determine main themes and patterns that can be applied towards a thesis or inquiry. In the case of this project, the Cornell Consulting team used NVIVO to identify potential vulnerabilities and assets that the people of New Lebanon care about and want to protect. The themes which emerged were analyzed and aligned with the insights obtained from the literature review.

4.3 INTERVIEW FINDINGS

Interviews with critical personnel provided us with a rich understanding of how the town has been affected by climate related hazards in the recent and distant past. The thematic study of the transcripts generated from the interviews provides us clear patterns with which we can prioritize the relevance of the hazards and the related assets which could have been impacted by the hazards. One key observation which emerged from the interviews was that the scope of hazards which we identified from the literature seemed valid. Therefore, the discussion revolved around the seven key hazards. The following sections identify the key findings for each hazard and the asset categories which they can impact.

4.3.1 EXCESSIVE RAIN + FLOODING

Excessive rain came up as one of the top hazards which town people are concerned about. It has been observed that the weather conditions are becoming extreme. During some part of the year the rain is less than what it used to be and in other parts it is raining excessively. Such extreme instances of rain can lead to flooding in low lying areas like the Shaker Swamp where Routes 21 and 22 connect. The community has previously seen some flooding about 10 years ago, caused by Hurricane Irene. The sector most severely affected by excessive rain is agriculture. It affects the natural crop cycle and the farmer community is vulnerable to this hazard. Roads and bridges of the town are also very vulnerable to the excessive rain and flooding. One respondent said the following while referring to floods and rain:

"Some of our roads town roads are, you know, subject to getting washed out when it gets really, really bad."

Excessive rain also affected energy system as it can lead to power outages. Generally excessive rain and flooding can affect any of the key sectors, however most interview respondents pointed out stronger impact on agriculture, transport and energy sector. One respondent identified that a significant portion of the town is in flood zone:

"As you drive down Route 20 pretty much everything on the north side of 20 is either floodplain or just barely above it."

4.3.2 TEMPERATURE INCREASES + HEAT WAVES

At least three people identified temperature increase as another top concern for the town. The townspeople are witnessing extreme weather in both winters and summers. As the temperature increases in summers, low-income people will be unable to arrange necessary housing accommodations and won't be able to adapt to the changing climate. The elderly population of the town shall also be impacted by temperature increases. Temperature increase will therefore strongly impact the health sector. One respondent stated:

"It's the heat and then the cold you know the extremes is really what concerns me, because that's what that's what we're seeing, it's harder to adapt to extremes."

4.3.3 DROUGHT

Drought came up in few of the conversations with the people of the town. It is a concern especially for the farmer community – therefore it has a stronger impact on the agriculture sector and water sector. One person stated the below:

"We've had to change some of our practices around irrigation because we've definitely gone through a really serious periods of dryness or drought..... However, with more drought more things need to be irrigated so we got a portable irrigation system."

Another person stated:

"I'm not a farmer, but I know that drought and things like that are, you know, it's definitely going to affect farm, I mean the way the crops are growing."

The agriculture community will be affected most strongly by the drought which will be caused by climate related changes. Many farmers have already had to start adapting to the possibility of a drought as they have witnessed drought conditions in the near past.

4.3.4 SNOW AND ICE STORMS

Inconsistent or infrequent snow has been a concern for the town. The sector most severely affected by this hazard is transportation. Some of the roads in the town are dirt roads and the snow and ice cause the roads to be regraded again and again. Since public transportation options are limited and many rely on cars in order to get to work, when the road is not in good condition it causes a lot of trouble for the community. The snow and frosty weather is also expected to impact the agriculture sector in the town – especially the growth of grapevines. One person said the following about grapevines:

"Grapevines are blooming a little early and people are worried that due to snow they are not going to have any wine."

While, sometimes the instance of less snow can also be a concern for the agriculture sector. For perennial crops and to keep certain pest species away a certain amount of snow is necessary. One of the interviewees said the following:

"Having less snow on the ground can really affect our crops. More snow is better for installation of crops that are perennial and stay over winter."

The power sector is also very vulnerable to snow and ice storms. Due to ice storms the power lines are disrupted which causes power outage for long duration.

4.3.5 INVASIVE SPECIES + HABITAT DEGRADATION

Invasive species and habitat degradation does not seem to be a top concern for the people of the town. Only a couple of people touched upon this hazard as something which agriculture sector should be concerned about. Invasive species have been a problem for the agriculture sector as certain local trees and plants are vulnerable to them. Ash bore is an invasive beetle from Asia which has migrated into Columbia County and is starting to affect the ash trees. Similarly, maple trees are also vulnerable to various invasive species.

4.3.6 HURRICANES + HEAVY STORMS

The town has been impacted by hurricanes in the past, however they have been rare/infrequent, and it is not much of a high priority concern. However, heavy storms have been a concern as they strongly affect the energy sector. Many power breakdowns have been attributed to heavy storms in the town. One respondent identified hurricane Irene as the last significant hurricane which affected the town. Since Irene many of the houses have permanent water-related damage.

"Irene definitely did something to the aquifer in town.... Irene was pretty disastrous to some of the hills of town."

4.3.7 VECTOR/CHRONIC ILLNESS/MENTAL HEALTH

Due to a confluence of climate related factors (i.e. rising temperatures, excessive rain) the town and surrounding areas are attracting species which cause the spread of vector diseases. Some of these diseases have been noticed in animal species. Ticks which spread Lyme disease are being noticed more and more frequently. This is likely to have severe impact on the health sector of the town.

4.3.8 INTERVIEW SUMMARY

The analysis of the interviews reveals that all the hazards can impact the town in some way or form. The top hazards which were most frequently brought up during the interviews were:

1. Temperature Increase
2. Snow and Ice storms
3. Excessive Rain and Flooding
4. Drought.

Hurricanes have also been brought up, especially in reference to Irene. However, the frequency of hurricanes is low and may not be an eminent hazard. The hazards identified above are eminent in threat and urgency. A diverse group of people from the town were interviewed for this study. The below table lists the people interviewed, their professional occupation and the top hazards and assets which they identified.

The town assets that seem to be most vulnerable to hazards are roads and bridges and power lines. The town has ~52 miles of road, 19 of which are dirt roads. These roads are hard to use for people who walk to work. The town has had to increase road maintenance to keep up with snow and rain. "Mud Season" is longer than it used to be. Power lines have also been affected as storms result in damage. Power outages have happened in the recent past. Water and agriculture are also vulnerable to climate hazards. Farmers are changing their agriculture practices to adapt. Water level in the ponds is reduced the LVPA finds it hard to obtain water for emergency response.

| Occupation | Top Hazards / Assets Identified |
|---|---|
| Rep. on Planning Board | Hazards (Temperature Increase, Snow and Ice Storms) Critical Assets (Agriculture, Transportation) |
| Farmer | Hazards (Excessive Rain and Flooding, Snow and Ice Storms, Drought, Invasives and Habitat Degradation) Critical Assets (Agriculture, Transportation) |
| Rep. County Environmental Management Committee. | Hazards (Excessive Rain and Flooding, Temperature Increase, Drought) Critical Assets (Agriculture, Transportation, Energy) |
| CAC Member / Local Cattle Farmer | Hazards (Excessive Rain and Flooding, Hurricanes and Heavy Storms, Snow and Ice Storms) Critical Assets (Agriculture, Transportation) |
| Farmer | Hazards (Excessive Rain and Flooding, Invasive Species and Habitat Degradation) Critical Assets (Agriculture, Water, Ecosystem) |
| Hardware Business | Hazards (Excessive Rain and Flooding, Hurricanes and Heavy Storms, Drought) Critical Assets (Water, Agriculture, Ecosystem) |
| Farmer | Hazards (Temperature Increase and Heatwaves, Snow and Ice Storms) Critical Assets (Health, Ecosystem, Agriculture) |
| Farmer | Hazards (Temperature Increase and Heatwaves, Snow and Ice Storms) Critical Assets (Health, Ecosystem, Agriculture) |
| LVPA | Hazards (Hurricanes and Heavy Storms, Snow and Ice Storms, Drought) Critical Assets (Energy, Telecommunication) |
| LVPA | Hazards (Hurricanes and Heavy Storms, Snow and Ice Storms, Drought) Critical Assets (Energy, Telecommunication) |
| Comprehensive Plan Team Member | Hazards (Temperature Increase, Invasive Species, Heavy Storms) Critical Assets (Health, Transportation, Agriculture) |

4.4 POTENTIAL VULNERABILITIES PRESENT IN NEW LEBANON

The map below presents the major potential vulnerabilities identified through interviews with the critical personnel of New Lebanon. These assets have been identified for two possible reasons:

1. **Water-based:** The majority of New Lebanon's developed area is in or near flood-prone areas, and especially vulnerable areas have been identified and labeled on this map.
2. **Development-based:** Vulnerable areas that have become vulnerable to natural hazards due to human activity and development.

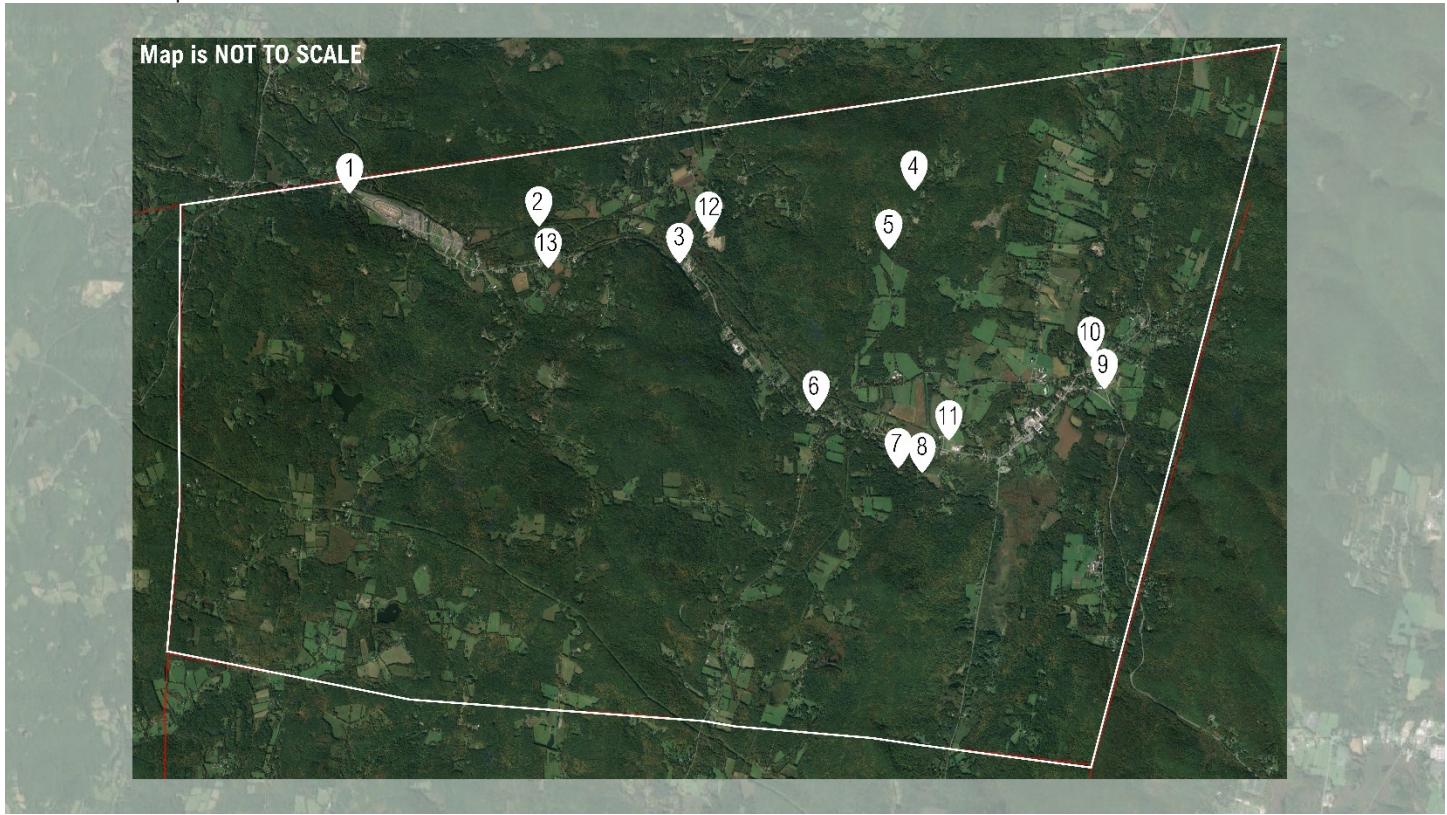


Figure 7: Potential Vulnerabilities Present in New Lebanon (Google, 2021)

Water-Based

1. Easily flooded stream
2. Bus Garage, regularly floods
3. Wyomanock Creek Section, regularly floods
4. Frequent road runoff area
5. West Hill Road, a number of washouts reported here
6. Bridge, washed out 40 years ago
7. Canaan Road Bridge, vulnerable to washouts
8. Canaan Road, a number of washouts reported here
9. LVPA Fire Truck Fillup Pond, vulnerable to drought and drying up

Development-Based

10. New Lebanon Junior/Senior High School, possible asbestos
11. Theatre Barn Area, former superfund cleanup
12. Gravel mine, due to expand another 4 acres
13. Former cleanup site, cannot eat crops that are grown here

4.5 POTENTIAL ASSETS PRESENT IN NEW LEBANON

The map below presents the major potential assets identified through interviews with the critical personnel of New Lebanon. These assets have been identified for three possible reasons:

3. Natural Resources: Ecologically important areas that provide regulating benefits which protect from natural hazards
4. Built Infrastructure: Infrastructure that is important to the town and needs protection and enhancement
5. Historical Sites: Historically or culturally important areas that the people of New Lebanon are interested in protecting.

Natural Resources

1. Hand Hollow Conservation Area
2. Wyonmanock Creek – Certified Trout Stream
3. Shaker Swamp Brook
4. Shaker Swamp
5. Potential Windmill Site (in the past)
6. Wyomanock Creek

Built Infrastructure

7. Former Railroad
8. US Route 20 and NY Route 22 Intersection

Historical Sites

9. Large Concentration of Unimproved Roads
10. Historic Shaker Complex
11. Old Tilden Pharmaceutical Complex
12. Old Tilden Pharmaceutical Complex

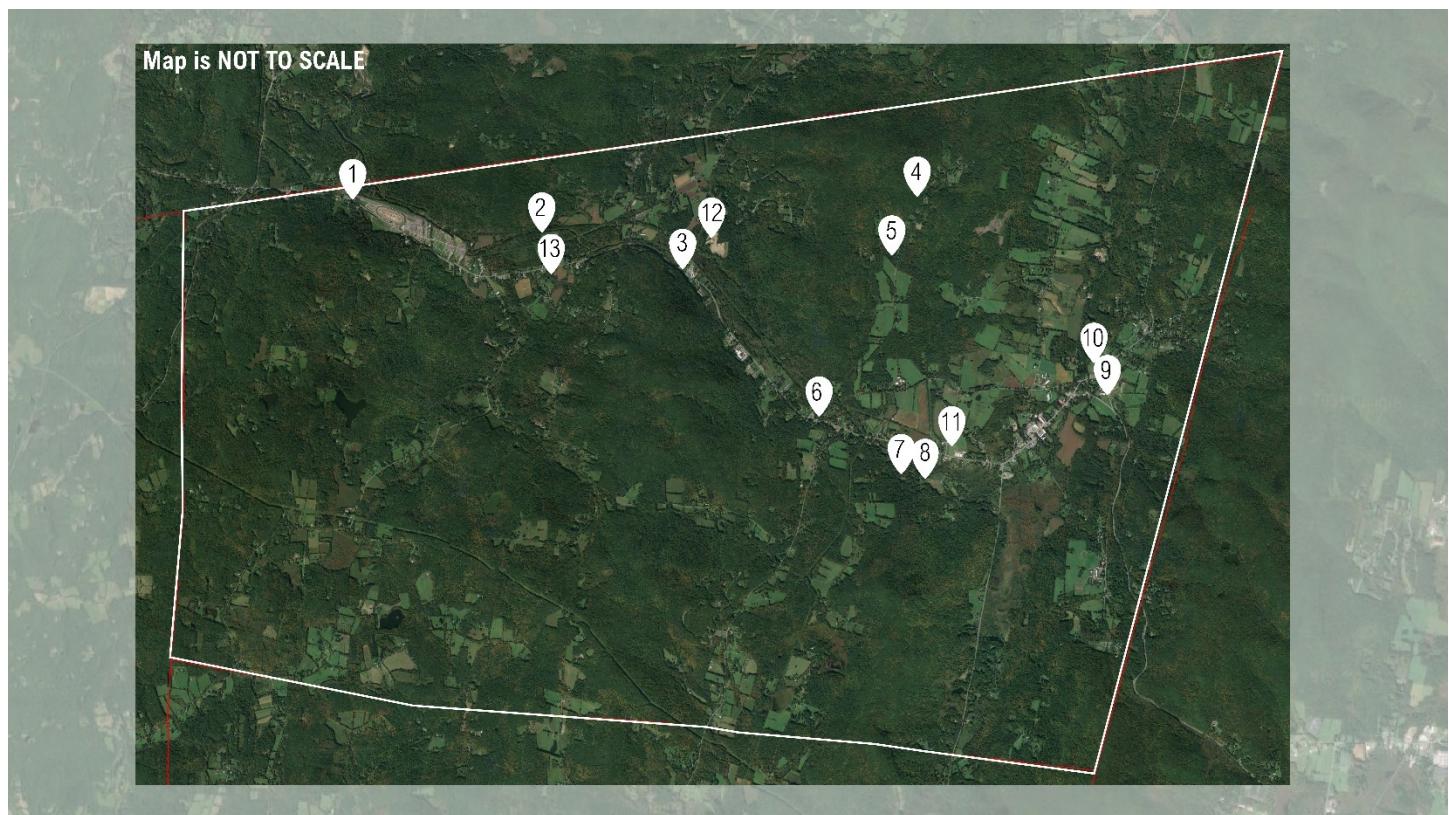


Figure 8: Potential Assets Present in New Lebanon (Google, 2021)

4.6 PRIORITIZED VULNERABLE ASSETS AND SYSTEMS

There are many assets in the town which will be impacted by climate change with varying degree of severity. There are various infrastructure and social assets which are more vulnerable and also have historical significance and environmental significance for the town.

The assets in New Lebanon which are most vulnerable and also critical to the town are as below;

- i. US Route 20 and NY Route 22 Intersection
- ii. Historic Shaker Complex
- iii. Shaker Swamp
- iv. Wyomanock Creek – Certified Trout Stream

From the literature analysis we identified seven key hazards which cover the scope of possible hazards which the town of New Lebanon can face. During the interview process we observed that all the possible hazardous incidents the town can face fall in one of those seven hazard categories. However, four hazards which were the most salient and emerged the most often in our conversations with critical personnel were the below;

- 1- Temperature Increase and Heat Waves
- 2- Excessive Rain and Flooding
- 3- Drought
- 4- Snow and Ice Storms

RECOMMENDATIONS

The Cornell Consulting Team has categorized the following seven (7) recommendations into both short-term and long-term priorities.

5.1 SHORT-TERM PRIORITIES AND ACTIONS]

“Short-term” is defined as an area of time stretching from 1-3 years. The following four short-term recommendations are given below:

5.1.1 CONTINUE DEVELOPING THE CLIMATE SMART COMMUNITIES PROGRAM

The town of New Lebanon should continue to focus on their NYS CSC program. The program provides an intentional and clear pathway to increase resilience against climate hazards. The NYS CSC Program provides access to a wide range of resources in the form of technical assistance and grants which can be leveraged for the benefit of the town. New Lebanon has already achieved Bronze Certification in the program and is on the Road to Silver.

The New Lebanon CSC taskforce is an important body to continue the work of the NYS CSC Program. The New Lebanon CSC Taskforce needs to be further empowered towards carrying out the necessary programs for achieving Silver Certification. It is recommended that the Town of New Lebanon help the New Lebanon CSC Taskforce by sponsoring community-wide awareness activities for climate hazards. Collaboration between the leadership of the New Lebanon CSC Taskforce and the rest of the Town of New Lebanon is essential to make any progress on these crucial steps.

5.1.2 ATTEMPT TO FURTHER UNDERSTAND, RESEARCH, AND UPDATE FLOOD RISKS

There are several parts of the Town which are in low lying areas and have a high risk of flooding in the case of an unusual precipitation event. The Town can mitigate the risk of flooding by taking adaptive steps at this stage and preparing emergency response capacity for likely scenarios. In order to do that the town should have a flood risk analysis done, which shall help in identifying the most vulnerable areas and prioritize necessary action accordingly. The flood risk analysis shall also help the town apply for grants to build necessary infrastructure and further mitigate flood risks. In addition, the town shall have to build in-house capacity to their emergency response department (e.g. LVPA) to respond to any flood risk in a timely and proportional manner.

5.1.3 PROTECT CRITICAL ASSETS

The protection of infrastructure for electricity and heating supply is critical to the Town. Power lines are especially vulnerable to climate hazards. The Town should look into reinforcing existing infrastructure to mitigate risk and ensure that the passage of power lines is clear from objects like trees which can fall over and damage the line. The roads are another critical asset which are necessary for normal functioning of the town. The Town needs to build necessary road infrastructure in order to prevent a need

for re-grading and expensive maintenance, especially when considering the Town's many dirt roads. Lastly, there are social infrastructure assets which also need special attention due to their importance to the Town i.e. Shaker Swamp, Public Library.

5.1.4 FURTHER DEVELOP EMERGENCY RESPONSE PLANS

The emergency response capability of the Town is important when considering climate-related crises.

The Town needs to improve its preparedness by updating a comprehensive plan of action which will be followed in case a disaster strikes. Since the LVPA is looking after emergency response, the Town should further empower the LVPA to tackle multiple hazards. In order to mitigate quickly, communication and coordination amongst personnel is key. The Town board and LVPA should strengthen their coordination in order for timely action and resource allocation. Due to limited availability of resources, the emergency response plan should also leverage the community to be part of any response. A volunteer program should be developed to encourage youth to learn emergency response preparedness skills and the town should invest in providing training for developing community-based response capacity.

5.2 LONG-TERM PRIORITIES AND ACTIONS

“Long-term” is defined as an area of time stretching longer than three years. The following three long-term recommendations are given below:

5.2.1 DEVELOP WATER RESOURCES CONTINGENCY PLAN

The water resources of the Town (e.g. wells and ponds) are another critical asset which need to be effectively protected and managed. As the Town is vulnerable to droughts, it is important that the Town has a contingency plan to ensure availability of water for drinking, agriculture and use by the LVPA. In the long term the town should establish a water storage tank which shall provide necessary backup in drought and other emergencies. In addition, some water resources (i.e. ponds) are currently inaccessible to the LVPA because there isn't a clear passage to them. The town needs to ensure that all potential public water resources are made accessible.

5.2.2 APPLY FOR GRANTS AND INFRASTRUCTURE PROJECTS

As the federal government is pushing for a major American infrastructure bill, grants are expected to be made available to small towns. The town can avail such grants to build and improve the critical infrastructure necessary for emergency response. New Lebanon needs investment in road infrastructure, power lines, water storage tanks and flood mitigation infrastructure. New Lebanon can apply for grants to pave the 19km of dirt roads which are vulnerable due to increased precipitation. A major infrastructure project to ensure access to water for the Town's people is also a potential investment opportunity. The Town can apply for grants to reinforce the power lines or build alternative power resources.

5.2.3 ENVIRONMENTAL EDUCATION PROGRAMS

CONCLUSION

The Town of New Lebanon has made significant strides towards climate adaptability and the achievement of Bronze Certification from NYS Climate Smart Communities is a testament to all the effort put in by CSC taskforce and all stakeholders involved. There are many more milestones on the way which need to be accomplished to make the community climate secure and fully adaptable. The climate risk vulnerability assessment delineated in this report is an outcome of facts-based research, leveraging the current scientific literature as well as the valuable experiences of about a dozen critical personnel in the town of New Lebanon. This report identifies the key hazards and sectors which need the attention of the leadership for adapting to climate change. We have also recommended critical action items in the short and long-term for the town and provided a comprehensive outlook of what risks climate poses for the people of New Lebanon.



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APPENDICES

APPENDIX A: HISTORY OF NEW LEBANON

Nestled in the Berkshire Mountains and bordering the Kinderhook Creek lies the Town of New Lebanon. The area was originally settled by the Mohican people and later by Europeans, who arrived about 1756. The town was incorporated in 1818 when it separated from Canaan, NY. New Lebanon is 24 miles southeast of Albany, NY situated in the northeast corner of Columbia County, NY, bordering Rensselaer County, NY on the north, and Berkshire County, MA, on the east.

The Town of New Lebanon consists of several hamlets: Lebanon Springs, northeast of New Lebanon village on Route 22; New Britain, southwest of the town; New Lebanon, eastern part of the town; New Lebanon Center, west of New Lebanon village; and West Lebanon, northwest part of the town on Route 20. Connecting the Town of New Lebanon to points north, south, east, and west are U.S. Route 20 and NYS Route 22, along with several county and town roads.

New Lebanon was the main spiritual home of the Shakers or the United Society of Believers in Christ's Second Appearance. The Mount Shaker Society set the example for all the Shaker societies that followed both in ideology and architecture. The Shakers were innovators in agriculture and manufacturing. Among inventions credited to the Shakers are the clothes pin, condensed milk, circular saw, flat straw broom, mail-order seed packets, Shaker chairs, wheel-driven washing machine, rotary harrow, threshing machine, metal pens, Shaker tilting chair, Shaker peg, and Shaker Lemon Pie. (digventures) The Mount Lebanon Shaker Society's historic structures are now part of the Shaker Museum/Mount Lebanon and the area is on the National Registry of Historic Places.

The Shaker Society is one among many designations on the National Registry of Historic Places. Included in the list are: The Church of Our Saviour (Episcopal), the Donnelly House, Elisha Gilbert House, Lebanon Springs Union Free School, Bigelow-Finch-Fowler Farm, and the Governor Samuel J. Tilden Monument. Recently the New Lebanon District No. 8 School on U.S. Route 20 in New Lebanon was placed on the New York State Registry of Historic Places and has been placed in nomination to be on the National Registry.

The most prominent citizen of New Lebanon was Governor Samuel Jones Tilden. Tilden was born and grew up in Lebanon, surrounded by political figures of the day, including Martin Van Buren, who were friends with his family. He studied law and was in a firm in New York City where he gained a reputation in handling railroad and corporation law with great skill. Samuel Tilden became a leader in the NYS Democratic Party and was elected to the NYS Assembly and helped to reorganize the NYS Democrats from 1865 and 1875 serving as Chairman of the party. (Britannica) He played a major role in bringing down the Tweed Ring during this time. In 1874 Tilden was elected Governor of NYS, running on a reform ticket. During his tenure he helped to bring

down the Erie Canal Ring, a group that was defrauding the state. Tilden was the Democratic candidate for President of the United States in 1876. Although he won the popular vote, there was a dispute in the Electoral College. A committee was established to review the votes and along party lines, the election was awarded to Rutherford B. Hayes. Tilden's poor health forced him to leave public life. He died in 1886, leaving the bulk of his estate to fund the formation of the New York City Public Library. On his sarcophagus is his lasting legacy, "I still believe in the people."

The prominence of the Tilden family in New Lebanon did not stop with Samuel Tilden. With the fertile agricultural valley and the Shaker Swamp plants, the Tilden Pharmaceutical Company was founded, the first such company in the United States. The richness of the plants and herbs in the valley allowed the company to produce tinctures and powders that were shipped around the world. The company supplied the Union Army with powdered coffee during the Civil War. The company closed its doors in 1963 due to dwindling demand for their product.

Among other notable inventions that had their start in New Lebanon by the Kendall family are the first accurate clinical thermometer manufactured in the United States and the first barometer.

In 1804, as a young man of 15, Jesse Torrey, Jr. founded the first public library in the United States in New Lebanon. Jesse believed in free education and free public libraries for all no matter race, creed, sex, or economic condition. He was a staunch abolitionist and crusaded for all manner of social justice, including prison reform, preventative health measures, the use of medicinal herbs, and reform of medicinal practices through the use of science-based healing.

Approximately 75,000,000 years ago in the late Paleozoic Period, seismic events created the Lebanon Warm Springs. The Mohicans who lived in the area called the springs Montepoale and used its waters to bathe in as a cure for skin irritations and general well-being. In 1756, the first white man to see the springs was Lt. James Hitchcock of the Yorkshire Regiment stationed in Massachusetts. After the Revolution Hitchcock became one of the first permanent settlers of the town and built a home and, for a fee, would allow others the use of the springs. This land was owned by Charles Goodrich who leased it to Hitchcock. In 1790 Goodrich sold the land to William Nichols and had incorporated into the deed the requirement that the waters would..."be free to the Use of the Good People at Large without any Hindrance or Molestation whatsoever." (Ladies Guild, p. 18). In 1794, Nichols built a hotel on the hill by the springs thus beginning the reign of Columbia Hall as a premier vacation and visitation site in the country for the taking of the healing waters. From 1820 on prominent people from around the world visited Columbia Hall including Martin Van Buren, Charles Sumner, Daniel Webster, Teddy Roosevelt, and Charles Dickens. During the 50th Anniversary of the American Revolution in 1825, the Marquis de Lafayette and his son visited the Hall. A reception was held and so many people were in attendance that there was fear the floor would collapse. New Lebanon has been designated as an official site of

the Lafayette Trail which commemorates the Marquis' successful trip to the United States. With the Civil War and the rise of Saratoga Springs, the dominance of the Warm Springs waned. In 1900 the Columbia Hall closed and in 1926 was torn down because of deteriorating conditions. Today the Warm Springs still pumps out its 72° waters at 500 gallons a minute. (Ladies Guild, p. 17) During the winter, steam rises from the holding pond and at one time the waters were piped to the houses in the area. Today, if a house uses the water from the springs, it must have a water purification system attached to the water line.

New Lebanon celebrated its bi-centennial in 2018 with festivals, dances, a town-wide dinner, and banners placed on the poles in town. As the town moves into becoming a greener community, the future holds much promise.

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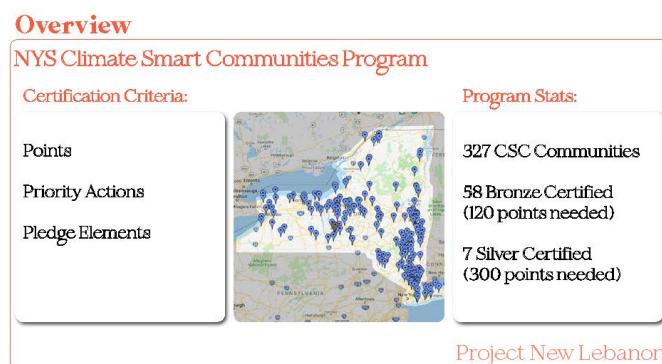
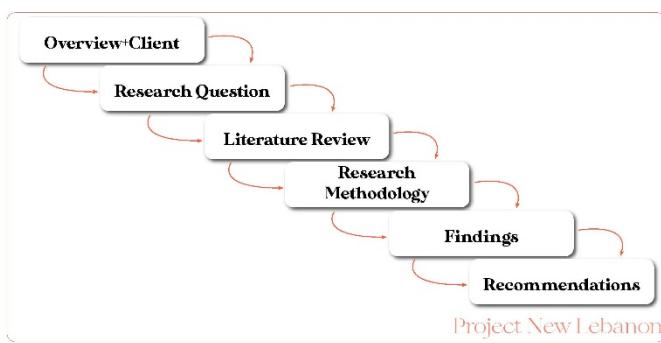
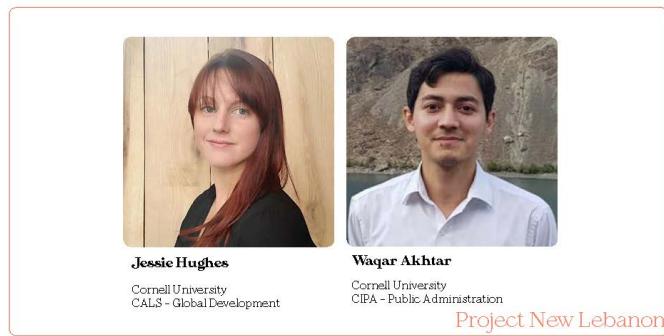
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APPENDIX B: FINAL PRESENTATION



Client

New Lebanon - A Climate Smart Community



April 2020: Became a CSC community

March 2021: Achieved Bronze Status

GOAL: Silver Status



Project New Lebanon

Client

Cornell's Role in New Lebanon

Project Goals:

- Identify key hazards (drought, storms, etc.)
- Identify key assets (roads, schools, etc.)
- Prioritize risks

Complete a Climate Vulnerability Assessment for the New Lebanon CSC Taskforce + help them achieve CSC Silver Status.

Project Deliverables:

- Formal consulting report
- Presentation materials to raise community awareness.

Project New Lebanon

Client

New Lebanon - About



- Settled ~1786
- Population of 2,305 (2010 census)
- 24 miles from Albany at the intersection of US20 & US22.
- Right on the edge of the Taconic Mountains



Project New Lebanon

Client

New Lebanon - Culture



The Shaker Village of Mount Lebanon, N.Y.



Project New Lebanon

Research Question

Identify Critical Assets that are important to New Lebanon.

What are the key climate hazards which can impact critical assets in the town of New Lebanon?

Identify Key Hazards affecting New Lebanon.

Project New Lebanon

Research Question

• Hazard: An external issue

- Quantitative Information
- Addressed in Literature Review

$$\text{Risk} = \text{Hazard} \times \text{Vulnerability}$$

• Vulnerability: An internal issue

- Qualitative Information
- Addressed in Research

Project New Lebanon

Literature Review

About the Review:

- Focus on Hazards
- Assessed at many scales
- Quantitative

Global
Regional
State
Local

Purpose:

Determine the presence and frequency of mentioning in hazard and climate science literature

Project New Lebanon

Literature Review

Key Sectors

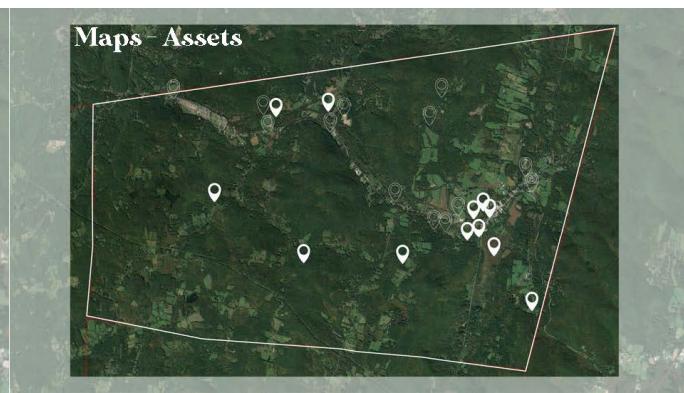
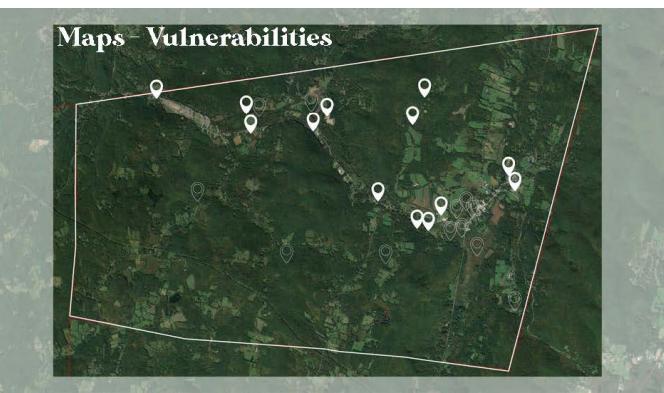
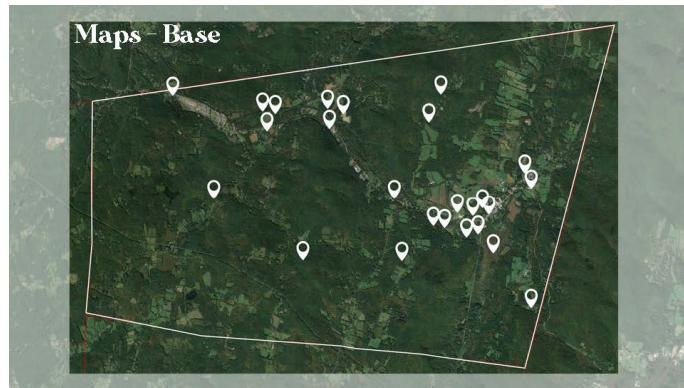
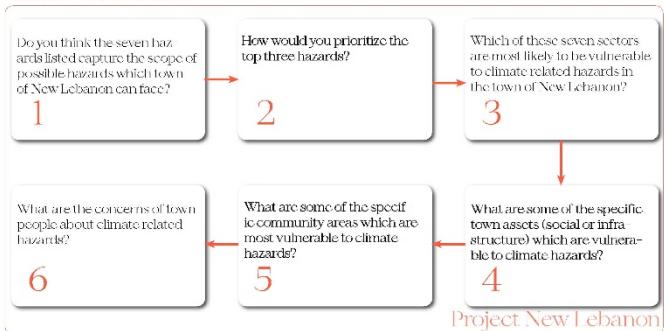
| Hazards | Agriculture | Water | Telecom | Transport | Health | Ecosystems | Energy |
|--|-------------|-------|---------|-----------|--------|------------|--------|
| Excessive Rain + Flooding | ■ | | | | ■ | ■ | ■ |
| Temperature Increases - Heat Waves | ■ | | ■ | | ■ | ■ | ■ |
| Drought | ■ | ■ | | | ■ | ■ | |
| Snow - Ice Storms | ■ | | | | ■ | ■ | ■ |
| Invasive Species - Habitat Degradation | ■ | | | | ■ | | |
| Hurricanes + Heavy Storms | ■ | | ■ | ■ | ■ | ■ | ■ |
| Vector/Chronic Illness/Mental Health | | | | | ■ | ■ | ■ |

Project New Lebanon

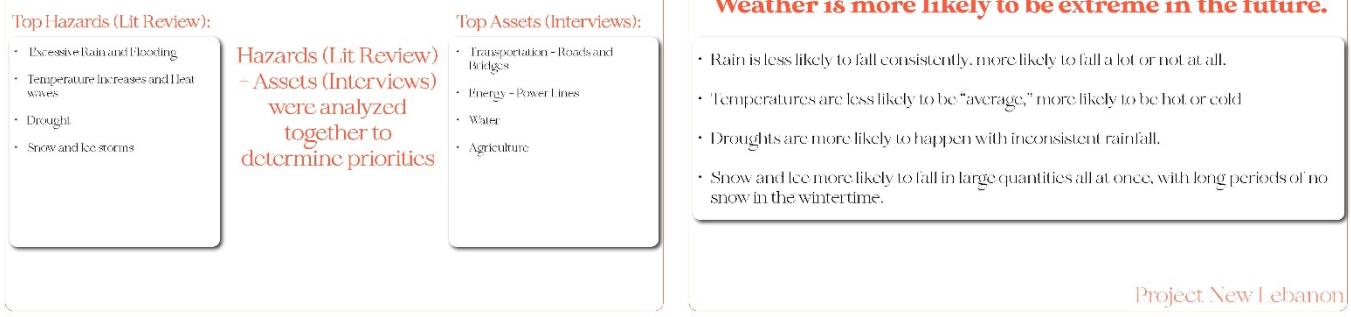
Research Methodology



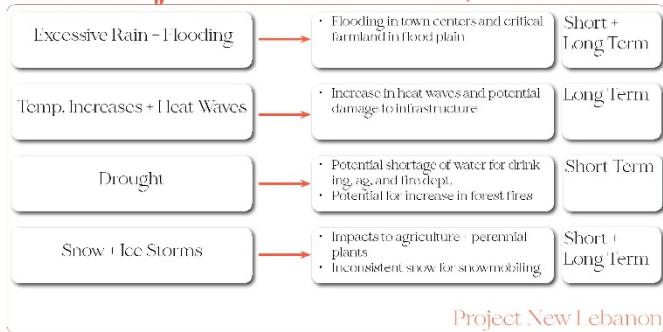
Interview Flow



Findings



Climate Projections + Assets Affected, New Lebanon



Project New Lebanon

Other Notable Findings

- Drought is also linked with water shortage for the fire department. It affects the Emergency Response of the town.
- There are several dumping sites in the town which are also a possible vulnerability and can lead to pollution of water.
- Maple syrup production and sap running has been inconsistent in recent years.

Project New Lebanon

Recommendations

Short Term (1-3 Years):

- Continue developing the Climate Smart Communities Program
- Attempt to further understand, research, and update flood risks
- Research options to diversify, expand, and protect power and heating options and assets
- Further develop emergency response plans (disaster risk reduction)

Long Term (3+ Years):

- Develop a water resources contingency plan
- Apply for grants and infrastructure projects
- Develop environmental education programs geared towards youth AND the elderly together



Project New Lebanon

Thanks!