Town of Clinton

Community Resilience Building

Summary of Findings

June 2019

Source: Town of Clinton
Clinton Town Hall

BSC GROUP

PREPARED AND PRESENTED BY

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TABLE OF CONTENTS

APPENDIX

Source: Town of Clinton
High Street

EXECUTIVE SUMMARY

The Town of Clinton is a small and compact community of 13,600 residents, located approximately 35 miles west of Boston in northern Worcester County. Established upon the availability of ready water power in the 19th century, the town's hilly topography and riverine lowlands help define the community's distinctive urban form and continue to accommodate a range of industrial, residential, and ecological uses. In light of the potential hazard posed by climate-driven weather events however, these distinctive landscape forms and patterns demand that the community understand its unique vulnerabilities.

Beginning in September 2018, with assistance provided by the Commonwealth of Massachusetts Municipal Vulnerability Preparedness (MVP) program, a Core Team of local officials and stakeholders initiated a planning process that followed the Nature Conservancy's Community Resilience Building (CRB) framework. This framework relies upon community-driven workshops to identify climate-related hazards, community strengths and vulnerabilities, and to develop solutions to address these considerations.

This Findings Report further describes the public process, identifies potential hazards, and evaluates the community's existing assets as well as its vulnerabilities. Importantly, this Report also formulates an action-oriented resilience plan for the community. Completion of this Report and the CRB process enables the Town to seek designation from the Executive Office of Energy and Environmental Affairs (EEA) as an MVP Community; such designation will enable our community to seek grant and funding assistance as we implement the recommendations of the Report.

The Core Team wishes to thank BSC Group for their inestimable guidance through this process.

Source: Town of Clinton
An aerial view of Clinton and the Wachusett Reservoir

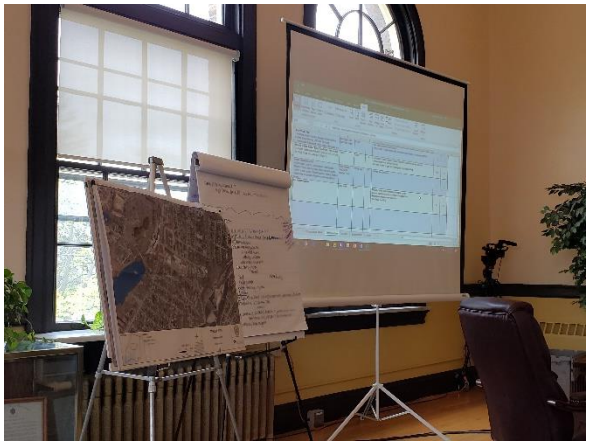
Source: Town of Clinton
Blizzard on Nelson Street

COMMUNITY RESILIENCE BUILDING PLANNING AND WORKSHOPS

The CRB process began with the establishment of a Core Team that included community stakeholders comprised of Town Staff, representatives from the Massachusetts Department of Conservation and Recreation (DCR), and local business leaders. The Core Team held a strategic planning session on November 1, 2018. The Core Team meetings involved the development of a broad understanding of the Hazards, Vulnerabilities, and Strengths that characterize the Town of Clinton, and to identify a list of Preliminary Resilience Actions that the community may consider at the CRB Workshops. The Core Team meeting was also used to identify the goals of the workshop within the context of community interests and needs.

Two Community Resilience Building Workshops were held on the following dates: March 26, 2019 and May 1, 2019. Workshop participants included a diverse set of community stakeholders from municipal departments, local businesses, non-government entities, and local interest groups. Workshop #1 involved an expanded core team working group and involved a refinement of preliminary planning efforts. Workshop #2 involved a group presentation, a group discussion, and interactive hazard mapping on a web based GIS mapping platform. The workshop concluded with a group discussion to prioritize Hazards, Vulnerabilities, Strengths, and Actions developed throughout the CRB engagement process.

Climate resilience planning requires an ongoing effort by community stakeholders. Workshop attendees and other interested stakeholders are encouraged to provide comments, corrections, updates, or additional information of findings transcribed in this report to Phil Duffy at pduffy@clintonma.gov. The success of climate resilience planning in Clinton is contingent upon ongoing participation of community stakeholders



Community Workshop participants brainstorm vulnerabilities within Clinton

DEFINING HAZARDS

The Town of Clinton has several challenges related to establishing resilience to the effects of climate change. For example, according to Clinton's 2015 Hazard Mitigation Plan, approximately 30% of the town is situated within the 100-year floodplain. Critical Facilities, a Railroad Bridge, and over 125 structures are located within the town's floodplain. Further, Clinton has experienced flooding in areas outside of the floodplain due to stormwater infrastructure deficiencies. Climate change is expected to increase the occurrence and intensity of natural-hazard related weather events. Identifying and preparing for the hazards most prevalent within Clinton is the first step to prepare for the effects of climate change.

During the Core Team and CRB planning efforts, stakeholders identified the top natural hazards for the Town of Clinton. Inland riverine flooding from extreme precipitation events was identified as the top hazard among most participants. Extreme temperatures, extreme snow and ice events, extreme heat, and wind (e.g., microbursts, tornadoes) represented the other climate exposure hazards and were highlighted as significant concerns for the Town. Collectively, it was agreed upon by the group that the Town of Clinton's top hazards present ongoing and cumulative adverse impacts on the community's most important infrastructural, societal, and environmental resources.

TOP HAZARDS WITHIN CLINTON

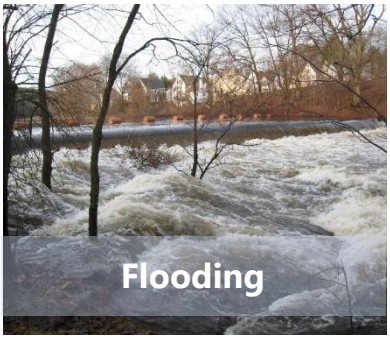


Photo Sources (clockwise from top):
David Mark
Josh Sweeny
Jonathan Wiggs
Mahkeo

CHARACTERIZING A CLIMATE RESILIENT CLINTON MUNICIPAL VULNERABILITIES AND STRENGTHS

The CRB process involves a robust stakeholder engagement effort and can be used to characterize the vulnerabilities and strengths unique to a given community. The Clinton CRB process revealed important characteristics that broadly represent the identity and culture of the community. Collectively, these characteristics provide a snapshot of the community's vulnerabilities and strengths and are an important starting point to identify community features most at risk to the effects of climate change.

The Nashua River – An Important Cultural Resource in Clinton

The Nashua River represents an important cultural and environmental resource within the community. Significant municipal attention and engaged community leadership are committed to the societal and environmental significance of the Nashua River. Water resources in the community, most notably the Wachusett Reservoir, drain to the Nashua River, and therefore Clinton's water management infrastructure (e.g., bridge, culverts, dams) directly affect the river. Other important community features within Clinton are directly associated with the Nashua River for example, recreational facilities, open space, and naturalized areas. Important businesses and residential properties also border on the Nashua River and its associated floodplain. The Nashua River provides important flood storage capacity due to its significant floodplain which simultaneously functions as ecological habitat for wildlife species, and recreational opportunity for town residents. Two dams exist along the length of the Nashua River within Clinton and represent different management and planning challenges with factors related to ownership and/or condition (i.e., hazard status rating). Water quality of the Nashua River remains an important issue for the community, and river flow volumes present additional water quality challenges for municipal planners. Clinton remains concerned about regional Nashua River management and is interested in working with neighboring communities or local watershed organizations to develop regional solutions.

Counterpane Brook

Counterpane Brook is widely recognized among the community as a source of flood vulnerability in downtown Clinton. Similarly, as a direct tributary to the south branch of the Nashua River, Counterpane Brook is acknowledged as an important contributor to the overall water quality of the Nashua River. Counterpane Brook is a stream channel that originates approximately 800-feet downstream of Coachlace Pond Dam where it becomes culverted for a half-mile section that passes beneath publicly and privately-owned properties within downtown Clinton. The culverted portion of Counterpane Brook daylights at a dam located at the Prescott Mill Apartments north of Water Street. From this location, the stream flows in a northern direction for approximately 4,500-feet where it forms a confluence with the Nashua River. The culverted portions of Counterpane Brook flowing beneath the town is characterized by a series of undersized drainage pipes that convey stormwater to the Nashua River. Undersized drainage pipes that convey Counterpane Brook has led to stormwater drainage backups (i.e., tailwater flooding) and flooding issues in downtown Clinton and associated private businesses (e.g., Nypro). Numerous studies have

occurred to better understand the flow dynamics in Counterpane Brook and it is understood that stormwater capacity improvements to the existing drainage system and flow conditions downstream of the Nypro property is necessary to mitigate for future flood conditions. It has also been determined that stormwater diversion to the system or limiting inflow from Coachlace Pond are also viable options to mitigate flooding. Counterpane Brook's most recently extensive flooding event occurred in 2010

Emergency Preparedness and Response – Drawing Upon Established Processes as a Foundation for Climate Resilience

Emergency preparedness and response operations are managed by an established and collaborative effort between the Police Department, Fire Department, Public Works Department and the Clinton Emergency Management Agency (CEMA). CEMA is the liason between local and state emergency management, and were instrumental in holding quarterly emergency planning meetings to prepare for all types of emergencies and disasters. They have responded to several events in recent years, including emergency situations involving floods, ice storms and building evacuations. Other municipal departments such as the Health Department are also called upon to coordinate resources and expertise in an emergency circumstance.

The Town of Clinton has a well-defined and established operational procedure to prepare for the effects of natural hazards and associated response. Emergency preparedness and response systems in Clinton consist of a variety of communication procedures that that have proven effective in past emergency situations. The community recognizes these systems as effective but agrees that improvements to these systems are both appropriate and necessary in the face of changing climate-related hazards.

Building upon the capacity of existing emergency preparedness/notification/response systems was mentioned as an important first step. Expanding upon/formalizing regional partnerships (e.g., neighboring communities) was also recognized as an important approach for increasing the societal resilience of Clinton. Continuing to advance the decision-making processes and operational procedures are important aspects of ongoing climate resilience efforts.

Wachusett Reservoir and other Dams

The Wachusett Reservoir is a conspicuous landscape feature within the community comprising approximately 29% of the Town's land area. Impounded by the Wachusett Dam, the reservoir holds 56 billion gallons of drinking water for Massachusetts Water Resources Authority (MWRA) communities. According to Clinton's Hazard Mitigation Plan, the Wachusett Reservoir Dam and North Dike are each characterized as High Hazard Dams per the DCR dam classification system. Three dams within Clinton (Coachlace Pond Dam, Lancaster Millpond Dam, and Mossy Pond Dam) are characterized as Significant Hazard Dams according to the DCR classification standards. Coachlace Pond Dam is particularly important to the flood resilience challenges within the community because of it's relationship to flows within Counterpane Brook.

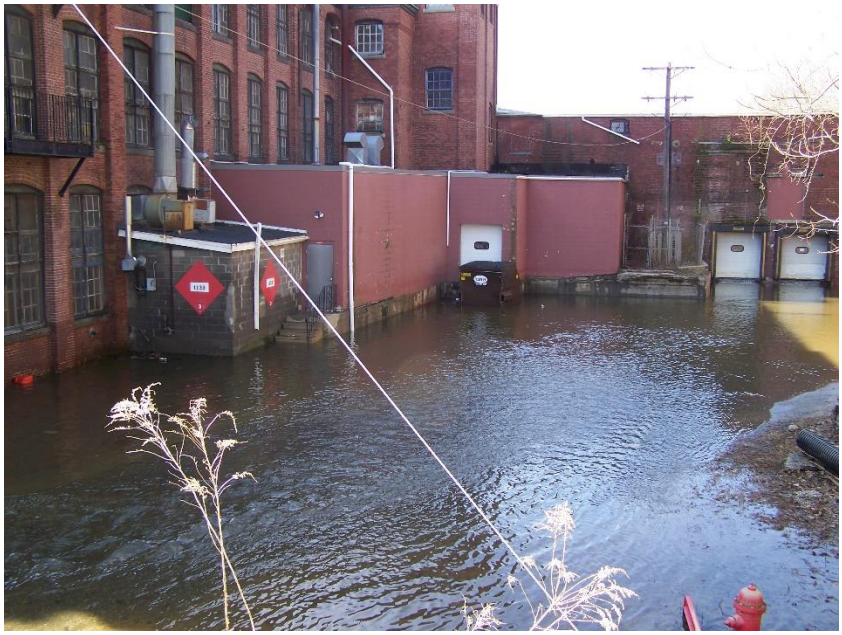
CATEGORIZING CONCERNS AND CHALLENGES

Workshop participants used the CRB process to collaboratively identify and rank action-oriented solutions to address the climate vulnerabilities faced by the Town of Clinton. These actions are organized into six categories based on a combination of community characteristics (i.e., strengths and vulnerabilities) and solutions identified by workshop participants. The diagram below illustrates the category rankings.

During the workshops, emphasis was placed on the interdependence of these categories. Recognizing these interdependencies strengthens the development of climate resilience solutions that span infrastructural, societal, and environmental features. Through this lens, overlapping solutions that provide co-benefits were identified and prioritized. For example, potential impacts associated with Hazardous Materials risks (#3) during extreme storm events can be reduced by addressing both Water and Floodplain Management (#4) and Nashua River Management (#5) by reducing the potential for flooding.

Counterpane Brook

Workshop participants voted the flood related issues associated with Counterpane Brook as the top climate resilience priority for the community. Concerns of more frequent and extreme storm events paired with an aging and undersized drainage network associated with the culverted portion of Counterpane Brook were apparent as a central focus during workshop discussions.



Source: Town of Clinton
Flooding at the Nylco Facility, 2010

Counterpane Brook

Downtown Flood Risk

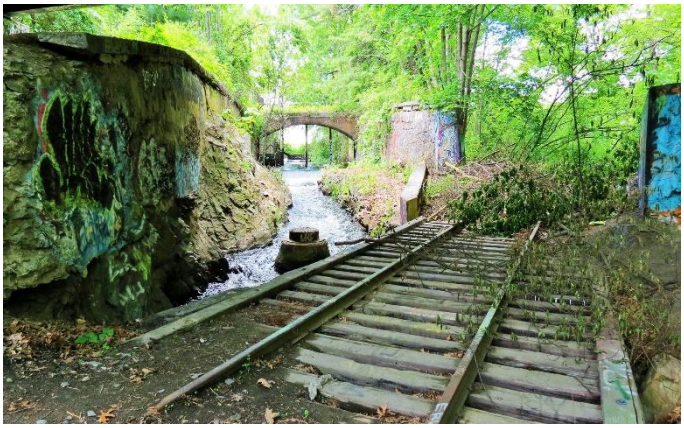
Aging Drainage Infrastructure

Drainage Evaluations

Nature-Based Solutions

Flood Mitigation/Green Infrastructure

Evacuation Routes



Source: Town of Clinton
Coachlace Pond Overflow

Building upon past drainage evaluations was identified as an important first step to identifying climate resilient actions. Placing a focus on increasing the capacity of the drainage system to accept flows from Coachlace Pond, the downtown stormwater drainage system, and increasing the downstream capacity of the natural stream corridor were all discussed as flood mitigation options. The integration of nature-based solutions and/or green infrastructure where appropriate was emphasized.

Emergency Preparedness Response and Recovery

Emergency Preparedness Response and Recovery was a central focus of most of the action items identified by workshop participants. Broadly, Clinton feels that its emergency preparedness planning and operations functions adequately in emergency events, but it was acknowledged that improvements could be made to promote community awareness of the many emergency resources provided by the town. An emergency preparedness community awareness and education initiative was identified as an important first step, and it was noted among stakeholders that a focus should be placed on engaging with community members that are located within the most vulnerable areas (e.g., floodplain). Welcome packets that discuss the hazards related to climate change were identified, while "shelter-in-place" outreach campaigns may be valuable for residents that may be reluctant to move to a shelter during a natural-hazard emergency event.

Source: Telegram & Gazette, https://www.telegram.com/article/20110315/news/103150439,
Rick Sinclair, Staff Photo
Nashua River Flooding,, Town of Clinton

Source: Town of Clinton
Counterpane Brook Blooding, 2010 Historic Flooding, Town of Clinton:

Emergency Preparedness Response and Recovery

- Community Awareness
- Education
- Vulnerable Communities
- New Resident Welcome Packets
- Shelter-In-Place Programs
- Emergency Communication
- Evacuation/Access Routes
- Emergency Shelters

Participants emphasized that the town should expand upon the capacity of its recently implemented emergency communication system to reach a greater number of town residents, notably socially vulnerable populations such as the elderly or linguistically isolated. This was also mentioned during the Public Listening Session. Portions of the town can become cut off from hospital access or emergency response services during a flood event. Informational outreach campaigns should be conducted to educate residents that may be cut off from emergency services about alternative options to access emergency care in the event of a flood.

The Middle School and High School were each identified as locations that serve as Emergency Shelters, but that may also be cut off in flood events because of accessibility issues. Other emergency preparedness issues such as food security was an explicit focus of workshop participants. Engaging with the Department of Public Health's Food Protection Program to coordinate with local food retailers was identified as an immediate priority action item. Identifying whether local supermarkets have an established emergency action plan and increasing the capacity of small local food markets were prioritized.

Hazardous Materials

Workshop participants noted the threat posed by extreme flooding events to release hazardous materials from current industrial locations situated within or adjacent to waterways and associated floodplains. Immediate actions to address the potential for hazardous pollutant discharges to the community include coordination with EEA's Office of Technical Assistance, conduct outreach and education initiatives with hazardous waste facilitates, and to develop an inventory of hazardous materials that exist in the community. Water Quality monitoring should be expanded to ensure incremental releases of hazardous materials aren't currently occurring. Participants also noted that green infrastructure and secondary containment procedures were important to alleviate flood vulnerabilities near industrial facilities and to minimize the overall impacts in the event of an extreme flooding event. Workshop participants conveyed concern with the potential of residual buried hazardous materials from late19th/early 20th century industrial activities within Clinton, but it was widely acknowledged this is a big and costly issue to address and more planning is necessary to begin addressing this issue. Efforts to address the potential for release of hazardous materials should be paired with community outreach, engagement, awareness, and education campaigns. Coordination with emergency management efforts should also occur to make residents aware of the potential of hazardous materials within floodwaters following extreme precipitation events.

Hazardous Materials

Floodplain Erosion

Underground Hazardous Material

Above Ground Hazards

Water Quality

Industrial Facilities

Community Outreach

Community Education

Office of Technical Assistance

Water Management/Floodplain Management

According to the 2015 Hazard Mitigation Plan for Clinton, approximately 30% of the town is within 100-year floodplain. Of this total, just over 4% of the floodplain in developed. Workshop participants identified the floodplain within the community as both as strength and a vulnerability.

Water Management and Floodplain Management

Bank Erosion

Floodplain Regulations

Critical Facilities

Emergency Access

Water Quality

Wetland Protection

Nature-Based Solutions

Source: Town of Clinton
Nashua River Flooding, Vale Street Playground Flooding, 2010

Municipal efforts to minimize development in the floodplain has enhanced the resilience of the community to flood events. However, participants acknowledged that increasingly prevalent flood events in town present adverse impacts to the community. Although most critical facilities are located outside the 100-year floodplain, some critical facilities may become inundated with floodwater in larger flood events. Similarly, potential flood pathways were identified by the community that may cut off portions of the community from important resources and/or emergency services. Regulatory mechanisms such as development assessments within the 500-year floodplain should be evaluated.

Nashua River Management

The South Nashua River officially begins at the outfall of Wachusett Reservoir dam (which is the source of Lancaster Millpond). It flows north through the towns of Clinton and Lancaster. Clinton recognizes that the Nashua River and its associated floodplain is an important cultural and ecological resource within the community. Because of the predominance of the Nashua River and adjacent areas of open space in relation to the community, workshop participants broadly discussed the ongoing efforts to protect this resource and enhance the ecosystem services provided by the Nashua River corridor. Stakeholders insisted on the importance of expanding upon existing river corridor management efforts such as debris cleanup, tree management, invasive species management, and water quality regulatory mechanisms. Partnerships with local organizations such as the Nashua River Watershed Association should develop a Nashua River Corridor Management Plan focused on increasing the resilience of the river corridor to the effects of climate change. Regulatory mechanisms to protect existing structures in the floodplain should be evaluated and new or improved regulation focused on climate resilience within the floodplain should be evaluated.

Nashua River Management

Floodplain Management

Flood Pathways

Stakeholder Engagement

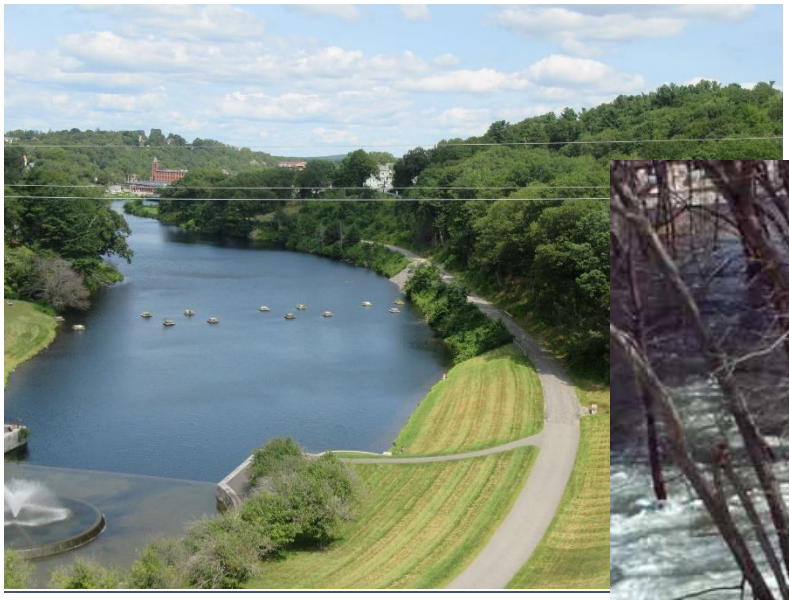
River Corridor Management

Water Quality

Regulatory Mechanisms

Nature-Based Solutions

River Cleanup Efforts



Source: Town of Clinton
The Nashua River

Source: YouTube,
Nashua River Flooding along Route 70, 2010

Renewable Resources/Carbon Mitigation

Workshop participants placed an explicit emphasis on the reduction of carbon emissions within the community through carbon mitigation efforts such as the use of renewable energy sources, sustainable mobility options, and renewable energy awareness, outreach, and education. Participants identified preliminary action items should involve the reinstatement of Clinton's renewable energy committee followed by an assessment of carbon emission sources within the community. Potential reduction strategies or renewable energy incentives should be evaluated as part of this assessment effort. Increasing the capacity for community members to utilize renewable energy sources such as solar panel on residential dwellings and the installation of electric vehicle charging stations throughout the community were identified as ongoing efforts the community should focus on. The landfill in Clinton should be evaluated for a site to establish a large scale solar energy source. Workshop participants also emphasized the importance of finalizing its process of Green Communities Designation.

Renewable Resources/Carbon Mitigation

Reduce Carbon Emissions

Electric Vehicles

Charging Stations

Renewable Energy Outreach

Education

Renewable Incentives

Residential Solar Installations

Green Communities

Source: Town of Clinton
Central Park, Town of Clinton

Climate Resilience Actions to address these concerns were prioritized through workshop activities and coordination with Core Team leadership. These Climate Resilience Actions are organized by High Priority, Medium Priority, and Low Priority Actions.

High Priority Actions

Category	Action
Counterpane Brook	Build upon past planning efforts that focus on culverted portion of Counterpane Brook (e.g., Nypro study); Conduct and assessment of undersized culverts and prioritize culvert in need of replacement; Seek Hazard Mitigation Grant Program (HMGP) Funding through FEMA; Integrate nature-based solutions where feasible.
	Coordinate Nypro efforts with municipal efforts to address Counterpane Brook flooding at culverted portion beneath downtown Clinton; In the process of implementing this work, integrate Nature-based solutions and Low-Impact Development where appropriate.
Emergency Preparedness Response and Recovery	Increase number of critical assets with backup generation within community (e.g., supermarkets, pharmacy, shelters, emergency facilities); Assess critical facility capacity for renewable/ alternative sources of energy; Assess infrastructure/routes for backup fuel delivery (e.g., daily propane deliveries needed for water supply/water treatment plant); Encourage additional renewable energy resources.
	Develop a community outreach program to educate residents about the causes and effects of climate change, how it affects the residents of Clinton, and what they could be doing to help improve the situation (e.g., New Resident Welcome Packet); Update CEMA website; Initiate community information effort to increase participation in the RAVE mass notification system - acquire database from other municipal departments to ensure the list is complete (police, senior center, housing authority, etc.).; Expand upon success of the Police and Fire Department practice of wellness checks during emergencies to expand participation or improve current practices; Develop, distribute and widely promote Sheltering in Place and Disaster Preparedness materials.
	Provide employees and town residents, particularly elderly and vulnerable populations, with better education information on emergency procedures using cable TV ads, signs in public locations, updated websites, and social media; Expand upon successes of Fire Department wellness checks that occur during emergencies; Consider using senior center buses for transportation to and from shelters during emergencies; Complete a feasibility study to improve existing shelters; Consider/assess additional options for shelters, including cooling areas, particularly at the Senior Center; Develop coordinated procedures to keep public updated in the event of an emergency; Provide shelter-in-place support by providing information via social media and town website on guidelines, emergency kits, etc. Outreach and education (e.g., generator safety, etc.); Identify long-term versus short-term based on an established understanding of need paired with changing climate conditions.

High Priority Actions (cont.)

Category	Action
Emergency Preparedness Response and Recovery	Coordinate with the MA Department of Public Health (DPH) Food Protection Program (FPP) to identify food security issues that may existing within Clinton during various climate related hazard/weather events; Coordinate with local supermarkets to obtain a copy of emergency action plans; Integrate climate change planning into food security planning; Increase capacity of small markets to sustain Food products during emergencies; Coordinate with Meals on Wheels programs to do checks on the elderly during heat wave events.
Hazardous Materials	There are no High Priority Action Items identified for this Category.
Water Management /Floodplain Management	Asses potential for future development within existing flood-prone areas and develop regulatory controls (i.e., special permit/site plan approval/ zoning bylaw); Identify structures with floodplain that could be modified to incorporate flood prevention mitigation; Consider future development in terms of the 500-year floodplain.
	Secure funding for additional personnel and equipment to assess and improve efficiency of stormwater management; MS4 Community platform should be used to enhance public outreach.
	Initiate an education campaign focused on the importance of water quality in the context of a changing climate and public health; Improve riparian buffer zones, install green infrastructure/vegetated buffer strips to improve water quality.
	Develop a flood preparedness community awareness and education initiative. Focus on areas where flooding is a known concern for example in residential communities with socially vulnerable populations or where local businesses are situated; Identify locations where flood events may delay response or sheltering efforts.
	Assess the potential for flooding at day care facilities, nursing homes, and neighborhoods with predominantly elderly and/or low-income residents.
Nashua River Management	Complete the cleanout of debris within the Nashua River using existing MA DCR grant funding. Apply for additional funding to maintain this river management effort. Evaluate preventative solutions that are nature-based; integrate with goals of Clinton's Open Space and Recreation Plan (OSRP) 2016-2020; Evaluate potential for hazardous materials migration in flood conditions; Where feasible, increase area of conservation lands along/near river, wetlands and ponds; Improve/restore riparian buffers; Identify flooding associated with beaver dams (e.g., Rigby Road); Assess riparian corridor improvements/restoration; Partner with Nashua River Watershed Association on Nashua River Corridor Management Plan to enhance the river corridor's resilience to the effects of climate change.
Renewable Resources/Carbon Mitigation	There are no Low Priority Action Items identified for this Category.

Medium Priority Actions

Category	Action
Counterpane Brook	There are no Medium Priority Action Items identified for this category.
Emergency Preparedness Response and Recovery	Update dam failure studies for the dams rated as high hazard; secure funding to conduct this assessment. Confirm Emergency Action Plan on file at MA Office of Dam Safety (ODS) and MA Emergency Management Agency (MEMA); Evaluate remediation options and nature-based solutions; Coordinate with DCR to improve communication about when water release events will occur on the Wachusett Reservoir Dam; Coordinate with DCR on their resilience planning to integrate with Clinton efforts, where feasible coordinate with Sterling on Clinton owners and managed dams in Sterling; coordinate with DCR on dam removal assessment and other nature based solutions.
	Coordinate with local, regional, and state partners to evaluate the effects of climate change on public health (Central Region Mosquito Control); Establish a community outreach program to raise awareness of public health risks related to a changing climate and vector borne disease.
	Develop an outreach campaign to inform residents of this flood vulnerability; Develop a welcome packet for new residents to inform them of this flood vulnerability and resources available in an emergency; Designate alternate routes for access during flood event; Expand upon Mutual Aid Agreements with neighboring municipalities.
	Evaluate an incident command protocol or a unified command protocol, and consider establishing a proper emergency operations center.
Hazardous Materials	Evaluate areas that have potential to implement green infrastructure to address flooding issues; Coordinate with office of Technical Assistance; Assess/Monitor Water Quality within areas subject to hazardous materials releases; Develop an outreach/communication/coordination plan with facilities that may be subject to hazardous materials releases during a natural hazard event. Inventory hazardous materials and develop a database of this information; Require/encourage secondary containment procedures.

Medium Priority Actions (cont.)

Category	Action
Water Management/Floodplain Management	Address seasonal issues with algae blooms near the Water Supply Treatment Plant (e.g., clogging infiltration system and backwashing); Continue to coordinate closely with MWRA.
	Conduct a study to determine if sewer pump station by river can be elevated to increase the resilience of this wastewater treatment facility asset.
Nashua River Management	Apply nature based solutions to affected roadway right-of-way; Remove obstructions within Nashua River to improve river flow, - implement river management corridor plans; Decrease impervious surfaces within this area for example at businesses (e.g., Weetabix); Build upon current funding mechanisms to implement ongoing projects/strategies to remediate flooding.
Renewable Resources/ Carbon Mitigation	Assess opportunities for renewable energy, open space, etc.
	Conduct a Tree inventory to assess potential climate impact and implement tree management practices to ensure proper regeneration; Implement a tree planting plan on town properties to reduce heat island in critical areas and replace loss of cultural/historic trees within historic landscapes.

Low Priority Actions

Category	Action
Counterpane Brook	There are no Low Priority Actions identified for this Category.
Emergency Preparedness Response and Recovery	Work with neighboring communities to establish a regionally based Community Emergency Response Team; Identify and establish emergency access routes that avoid flood prone regions within the town or areas that may become flood prone under future climate scenarios.
	Provide employees and town residents, particularly elderly and vulnerable populations, with better education information on emergency procedures using cable TV ads, signs in public locations, updated websites, and social media. Expand upon success of Police and Fire Department practice of wellness checks during emergencies to expand participation or improve current practices.
Hazardous Materials	Replace this culvert with a larger culvert capable of meeting larger more intense and frequent precipitation events. Apply appropriate climate projections when evaluating culvert replacement sizing.
	Conduct a survey of historic resources within the community subject to flooding and more specifically the effects of a climate change related flooding to build upon work previously completed 4 to 5 years ago with MA Historical Commission (MHC) funding.
Water Management/Floodplain Management	Evaluate/ assess carbon reduction/mitigation options; Incentivize/Increase capabilities for electric vehicles/charging station; Reinstate Renewable Energy Committee in Clinton; Evaluate/assess locations for renewable energy (e.g., a solar landfill); Continue to promote efforts to achieve Green Communities Designation and build upon these efforts to advance carbon mitigation and climate adaptation goals.
Nashua River Management	There are no Low Priority Action Items identified for this Category.
Renewable Resources/Carbon Mitigation	There are no Low Priority Action Items identified for this Category.

Community Workshop Participants

The Town is especially grateful to those who participated in the Community Workshop, as listed in the table below. Representatives stimulated an in-depth dialogue between organizations while providing insight that was critical to the success of this process.

Name	Affiliation
Phil Duffy	Community and Economic Development
J.W. Salmon	Building Inspector
Michael P. Lutes	Fire Chief
Chris McGown	Department of Public Works
Kelly Freda	MassDCR, Water Supply Protection
Michael J. Ward	Town Administrator
John McNally	Board of Health
Mark R. Laverdure	Chief of Police
Ron Williams	Nypro
Jodi Breidel	WHEAT Community Connections – United Way
Steve Meyer	Superintendent of Schools
Sean Kerrigan	Selectmen
Frannie Hodge	Clinton Greenway Conservation Trust

Public Listening Session

The Public Listening Session was held on June 19th at Town Hall. To reach the widest possible audience, the session was conducted during a Selectmen's meeting so that it was broadcast on the local cable channel. The following comments noted below were submitted by email in response to the session and have been incorporated into this Findings Report.

- For emergency situations, the town should implement an incident command protocol or a unified command protocol, and consider establishing a proper emergency operations center.
- The Town already has a RAVE Alert system (a mass notification system) and should be using it more.
- Street trees and the planting of trees on town property should be part of a carbon mitigation strategy.
- The Senior Center should be open later during heat waves. Meals on Wheels staff can help reach out to housebound seniors.

Citation

Clinton (2019) Community Resilience Building Workshop Summary of Findings, BSC Group, Inc. and Town of Clinton. Clinton, Massachusetts

MVP Core Team Working Group

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Kelly Freda, Department of Conservation and Recreation, Water Supply
Paul Gagne, Nypro, Inc.
Mike Parker, Clinton Fire Department
Christopher McGown, Clinton Department of Public Works Director
Michael Ward, Town Administrator
Ron Williams, Nypro, Inc., Facilities
Constantino P. Zapantis, Clinton Emergency Management Agency

CRB Workshop Facilitators

Jeffrey T. Malloy, BSC Group, Inc.
Ale Echandi, BSC Group, Inc.
Mary Ellen Radovanic, BSC Group, Inc.

Acknowledgements

This project was made possible through funding from the Massachusetts Executive Office of Energy and Environmental Affairs' Municipal Vulnerability Preparedness (MVP) Grant Program. Thank you for providing the leadership and funds to support this process. The Town of Clinton values your partnership.

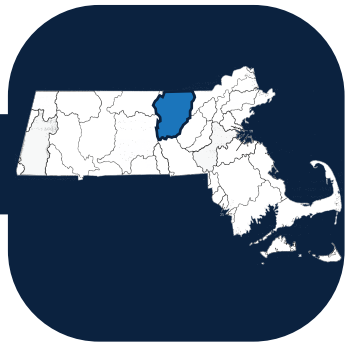
Thank you to the community leaders within Clinton who participated in the Core Committee meetings and the Clinton CRB Workshops. The institutional knowledge provided by participants was essential to the success of this process.

CLIMATE DATA GRAPHIC

CLIMATE CHANGE

Clinton, Massachusetts
Nashua Watershed Basin

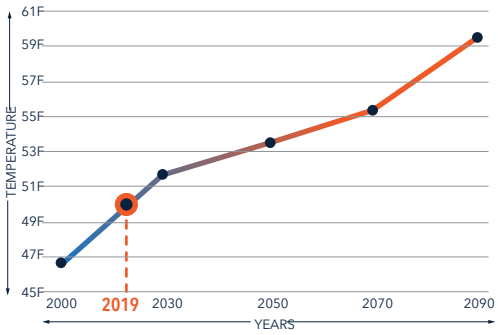
Ashburnham, Ashby, Ayer, Bolton, Boylston, Clinton, Dunstable, Fitchburg, Gardner, Groton, Harvard, Holden, Hubbardston, Lancaster, Leominster, Lunenburg, Paxton, Pepperell, Princeton, Rutland, Shirley, Sterling, Townsend, West Boylston, Westminster, and Worcester



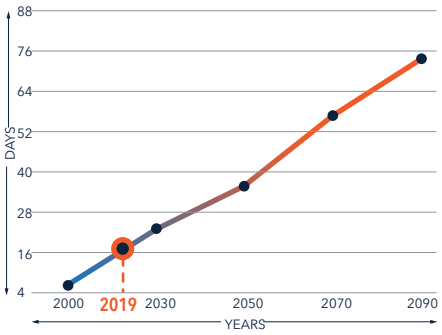
Global warming is caused by the accumulation of greenhouse gases within the atmosphere. Gases that contribute to the greenhouse effect include water vapor, carbon dioxide, methane, and nitrous oxide. On earth, human activities such as burning fossil fuels, land deforestation and wetland loss/conversion have altered the delicate balance of atmospheric conditions that regulate our climate. The effect of these changes cause global climate change that are likely to be significant and to increase over time.

EXTREME TEMPERATURES

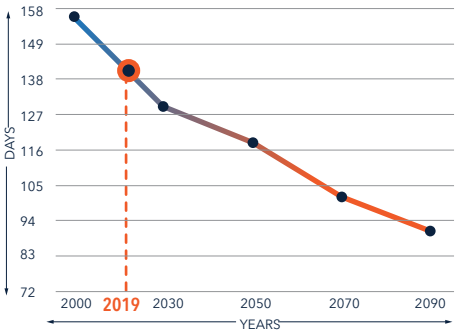
Average Temperatures



Days with Maximum Temperature over 90˚F



Fewer Days Below Freezing

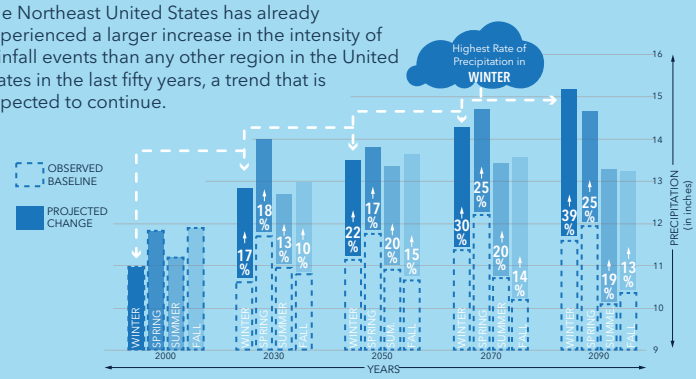


What can CLINTON expect as CLIMATE CHANGES?

Climate change has already had observable effects on the environment. Rising temperatures, changes in precipitation patterns, droughts and heat waves, sea-level rise, and extreme storm events have **altered the distribution of risk and how resources are managed.**

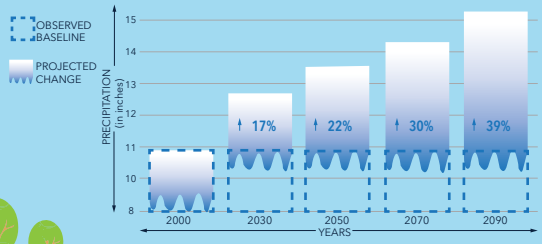
More Annual Precipitation and Inland Flooding

The Northeast United States has already experienced a larger increase in the intensity of rainfall events than any other region in the United States in the last fifty years, a trend that is expected to continue.



Extreme Snow And Ice Events

Total Annual Precipitation is expected to increase within the Nashua Basin over the remainder of the century. Most of this increase is expected to occur during winter months where precipitation will fall as either rainfall or extreme snow or ice events.



Blizzards, Nor'Easters and Hurricanes

Storm events fueled by higher temperatures, increased evaporation, and atmospheric moisture leads to stormy weather of increased duration and intensity.

Wind / Microbursts

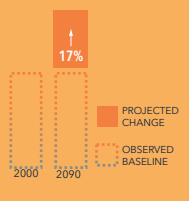
Hazardous wind conditions most commonly accompany extreme storm events. High winds and microburst conditions present unique hazards to infrastructure, public safety and important natural resources.

Heatwaves

Extreme heat events are expected to become more frequent and intense. Socially vulnerable populations are particularly vulnerable to the dangers related to extreme temperature conditions.

Drought Conditions

Due to the combined effects of higher temperatures, reduced groundwater recharge from extreme precipitation events, earlier snowmelt, summer and fall droughts may become more frequent.



Sources: Massachusetts Executive Office of Energy and Environmental Affairs; ResilientMA.org

BSC GROUP

COMMUNITY RESILIENCE BUILDING MATRIX

Community Resilience Building Risk Matrix				CLINTON MA		www.CommunityResilienceBuilding.org			
				Top Priority Hazards (tornado, floods, wildfire, hurricanes, earthquake, drought, sea level rise, heat wave, etc.)					
H-**M**-**L** priority for action over the **S**hort or **L**ong term (and **O**ngoing) **V** = Vulnerability **S** = Strength				Flooding	Extreme Snow and Ice Events	Extreme Heat	Wind	**Priority**	**Time**
Features	**Location**	**Ownership**	**V or S**					**H** - **M** - **L**	**S**hort **L**ong **O**ngoing
Infrastructural									
Counterpane Brook Culvert, Underground portions of Counterpane Brook, Drainage problems and flooding vulnerability downtown/near Nypro due to inadequate culvert size, Stormwater runoff issues with capacity of Counterpane Brook Culvert	Starts ~800' downstream of Coachlace Pond Dam; Ends at Water Street	Runs beneath private and town-owned property	V	Build upon past planning efforts that focus on culverted portion of Counterpane Brook (e.g. Nypro study); Conduct and assessment of undersized culverts and prioritize culvert in need of replacement; Seek HMGP Funding; Integrate nature-based solutions where feasible.				H	S
Floodplain	Town-wide	N/A	V	Asses potential for future development within existing flood-prone areas and develop regulatory controls (special permit/site plan approval/ zoning bylaw); Identify structures with floodplain that could be modified to incorporate flood prevention mitigation; Consider future development in terms of the 500-year floodplain.				H	O
Municipal Stormwater Drainage System	Town-wide	Public	S/V	Secure funding for additional personnel and equipment to assess and improve efficiency of stormwater management; MS4 Community (strength) platform should be used to enhance public outreach.				H	O
Wastewater Treatment Infrastructure, Some sewer pump stations within floodplains have experienced inundation/shutdowns during storm events.	WWTP located in floodplain; pumping stations at Gorham and Berlin Streets	Public	S/V	Conduct a study to determine if sewer pump station by river can be elevated to increase the resilience of this wastewater treatment facility asset.				M	L
Dam Safety, High Hazard Dams (Wachusett Reservoir Dam & Coachlace Pond Dam), Significant Hazard Dams (Wachusett Reservoir North Dike, Wikipiki Dam, Lancaster Mill Pond Dam & Mossy Pond Dam)	Wachusett Reservoir, Coachlace Pond, North Dike, Lancaster Mill Pond, and Mossy Pond Dams	Wachusett Reservoir - DCR; Town of Clinton, Coachlace Pond - TYCA;	S/V	Update dam failure studies for the dams rated as high hazard; secure funding to conduct this assessment. Confirm Emergency Action Plan on file at ODS and MEMA; Evaluate remediation options and nature-based solutions; Coordinate with DCR to improve communication about when water release events will occur on the Wachusett Reservoir Dam; Coordinate with DCR on their resilience planning to integrate with Clinton efforts, where feasible coordinate with Sterling on Clinton owners and managed dams in Sterling; coordinate with DCR on dam removal assessment and other nature based solutions.				M	O
Water Quality, Potential impacts of Mossy Pond on Reservoir due to proximity (Milfoil & Hydrilla), Water Treatment Plan has seasonal issues with algae blooms, Increased demand for salt use during winter storms may adversely impact the reservoir.	Town-wide	Public/Private	S/V	Initiate an education campaign focused on the importance of water quality in the context of a changing climate and public health; Improve riparian buffer zones, install green infrastructure/vegetated buffer strips to improve water quality.				H	O

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Features	**Location**	**Ownership**	**V or S**					**H** - **M** - **L**	**S**hort **L**ong **O**ngoing
Infrastructural									
Backup Power Electricity during Storm Events	Town-wide	Private	V	Increase number of critical assets with backup generation within community; Assess critical facility (supermarkets, pharmacy, shelters, emergency facilities) capacity for renewable/ alternative sources of energy; Assess infrastructure/routes for backup fuel delivery (Propane for water supply/water treatment plant); Encourage additional renewable energy resources.				H	S
Emergency Response, Clinton Fire Station is located within 500Y floodplain, Areas east of the Nashua River may be inaccessible to emergency vehicles during significant flooding events.	Fire Station, East of Nashua River	Public	S/V	Work with neighboring communities to establish a regionally based Community Emergency Response Team; Identify and establish emergency access routes that avoid flood prone regions within the town or areas that may become flood prone under future climate scenarios.				L	O
Rear Nypro Area, Includes Nypro Company, Keyspan Gas Distribution Facility, Group Housing (557-559 Pleasant), Experiences flooding not within mapped floodplain area	Rear Nypro area, 101 Union Street	Private	V	Coordinate Nypro efforts with municipal efforts to address Counterpane Brook flooding issues at culverted portion beneath downtown Clinton; In the process of implementing this work, integrate Nature-based solutions and Low-Impact Development where appropriate.				H	S
Streets within Nashua River Floodplain - Mid-section, Affected streets include Vale St, Green St, end of Branch St, Wittig Court, Elm St, Larch St, Water St	Various	Public	V	Apply nature based solutions to affected roadway right-of-way; Remove obstructions within Nashua River to improve river flow, - implement river management corridor plans; Decrease impervious surfaces within this area for example at businesses (e.g. Wetabix); Build upon current funding mechanisms to implement ongoing projects/strategies to remediate flooding.				M/L	O
South Meadow Culvert, Undersized culvert at South Meadow Road/South Meadow Pond; following high volume rain events, the culvert is not capable of handling flows, creating flooding adjacent to the pond and upstream in South Meadow Brook	South Meadow Road/South Meadow Pond	Private Way	V	Replace this culvert with a larger culvert capable of meeting larger more intense and frequent precipitation events. Apply appropriate climate projections when evaluating culvert replacement sizing.				L	L
Carbon Mitigation, Carbon mitigation efforts should be paired with climate adaptation planning and implementation.	Town-wide	Public	V	Evaluate/ assess carbon reduction/mitigation options; Incentivize/Increase capabilities for electric vehicles/charging station; Reinstate Renewable Energy Committee in Clinton; Evaluate/assess locations for renewable energy (solar landfill); Continue to promote efforts to achieve Green Communities Designation and build upon these efforts to advance carbon mitigation and climate adaptation goals.				L	O

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Features	**Location**	**Ownership**	**V or S**					**H** - **M** - **L**	**S**hort **L**ong **O**ngoing
Societal									
Flood Preparedness within Community, Approximately 30% of the town is located within the 100-year floodplain	town-wide	Public/Private	S/V	Develop a flood preparedness community awareness and education initiative. Focus on areas where flooding is a known concern for example in residential communities with socially vulnerable populations or where local businesses are situated; Identify locations where flood events may delay response or sheltering efforts.				H	O
Social Justice/Potential Flooding in neighborhoods with vulnerable populations		N/A	S/V	Assess the potential for flooding at day care facilities, nursing homes, and neighborhoods with predominantly elderly and/or low income residents.				H	O
Community Awareness	town-wide	N/A		Develop a community outreach program to educate residents about the causes and effects of climate change, how it affects the residents of Clinton, and what they could be doing to help improve the situation (e.g. New Resident Welcome Packet); Update CEMA Website; Initiate community information effort to increase participation (RAVE)- acquire database from other municipal departments to ensure the list is complete (police, senior center, housing authority, etc).; Expand upon success of the Police and Fire Department practice of wellness checks during emergencies to expand participation or improve current practices; Develop, distribute and widely promote Sheltering in Place and Disaster Preparedness materials.				H	O
Emergency Response Communication System	N/A	Town-owned	S	Provide employees and town residents, particularly elderly and vulnerable populations, with better education information on emergency procedures using cable TV ads, signs in public locations, updated websites, and social media; Expand upon success of Police and Fire Department practice of wellness checks during emergencies to expand participation or improve current practices; For emergency				L	O
Historic/Cultural Resources	town-wide	Public/Private	V	Conduct a survey of historic resources within the community subject to flooding and more specifically the effects of a climate change related flooding (build upon work previously completed 4-5 years ago with MHC funding).				L	L

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Features	**Location**	**Ownership**	**V or S**						
Societal									
Vector Borne Disease (Mosquitos, Ticks)	town-wide	N/A	V	Coordinate with local, regional, and state partners to evaluate the effects of climate change on public health (Central Region Mosquito Control); Establish a community outreach program to raise awareness of public health risks related to a changing climate and vector borne disease.				M	O
Emergency Response - Hospital, The hospital is located in an upland area, but given flooding potential, the entire eastern section of town around the Nashua River could be cut off from accessing hospital services.	Clinton Hospital	Private	S/V	Develop an outreach campaign to inform residents of this flood vulnerability; Develop a welcom packet for new residents to inform them of this flood vulnerability and resources available in an emergency; Designate alternate routes for access during flood event; Expand upon Mutual Aid Agreements with neighboring municipalities.				M	L
Emergency Shelters, Middle School and High School both serve as emergency shelters, but are located next to each other and may be inaccessible during a Nashua River flood event. Lack of formal coordination among town employees as personnel take on new roles presents a vulnerability.	Clinton Middle and High Schools	Town-owned	S/V	Provide employees and town residents, particularly elderly and vulnerable populations, with better education information on emergency procedures using cable TV ads, signs in public locations, updated websites, and social media. Expand upon successes of Fire Department wellness checks that occurr during emergencies; Consider using Senior Center buses for transportation to and from shelters during emergencies; Use the Senior Center as a cooling station during heat waves; Complete a feasibility study to improve existing shelters; Consider/assess additional options for shelters, including cooling areas; Develop coordinated procedures to keep public updated in the event of an emergency; Provide shelter-in-place support by providing information via social media and town website on guidelines, emergency kits, etc.; Outreach and education (generator safety, etc); Identify long-term v. short-term based on an established understanding of need paired with changing climate conditions; Utilize existing outreach networks, such as Meals on Wheels, to provide outreach, shelter-in-place support and well checks.				H	O
Emergency Preparedness- Food Supply Shaws, Hannaford, Apple Country, small/local markets				Coordinate with DPH Food Protection Program to identify food security issues that may existing within Clinton during various climate related hazard/weather events; Coordinate with local supermarkets to obtain a copy of emergency action plans; Integrate climate change planning into food security planning; Increase capacity of small markets to sustain Food products during emergencies; coordinate with WHEAT Community Connections/United Way to take advantage of existing resources and food distribution networks.				H	S

Community Resilience Building Risk Matrix

CLINTON MA

www.CommunityResilienceBuilding.org

H-**M**-**L** priority for action over the **S**hort or **L**ong term (and **O**ngoing)

V = Vulnerability **S** = Strength

Top Priority Hazards (tornado, floods, wildfire, hurricanes, earthquake, drought, sea level rise, heat wave, etc.)

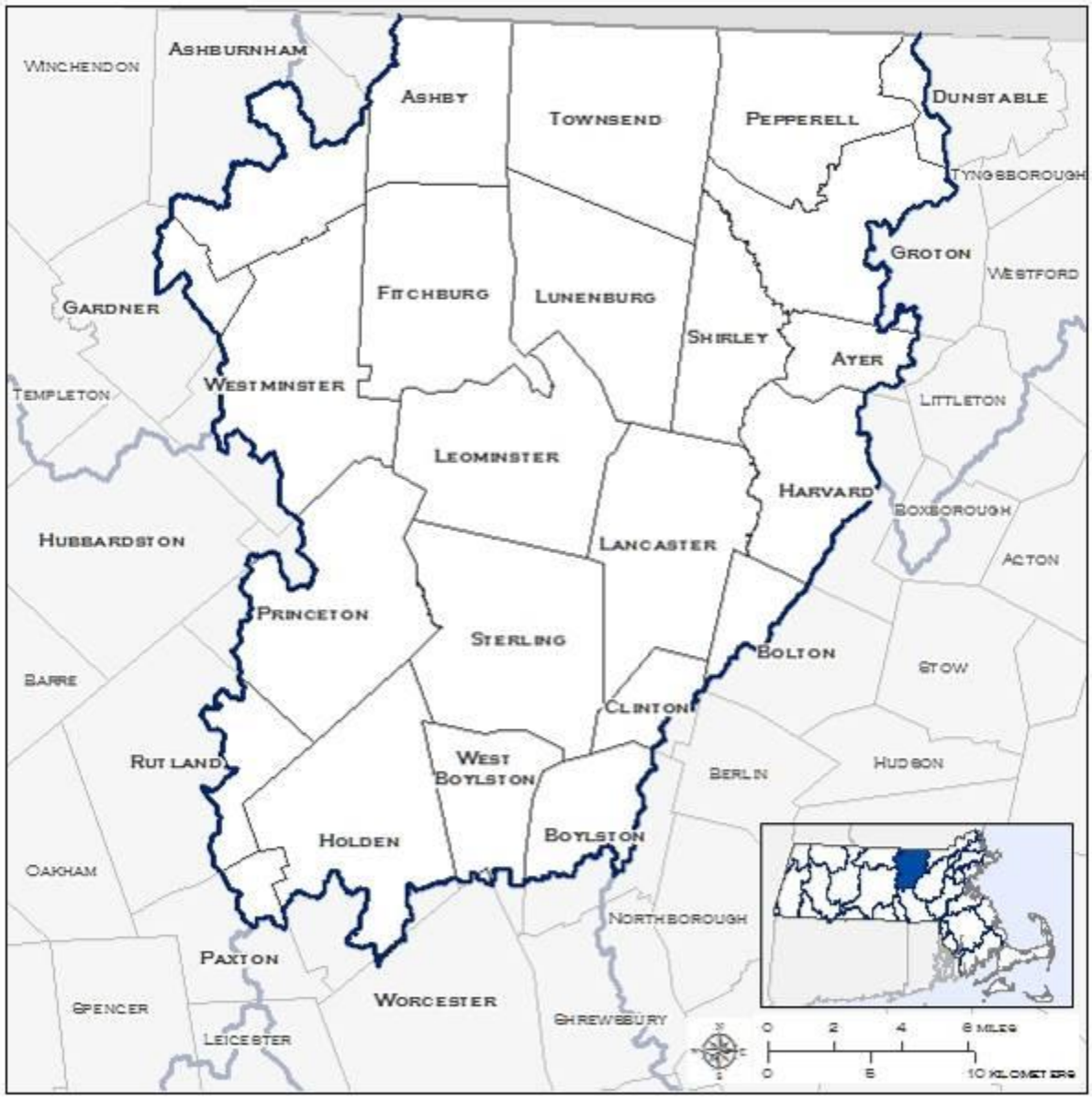
Features	Location	Ownership	V or S	Flooding	Extreme Snow and Ice Events	Extreme Heat	Wind	Priority **H** - **M** - **L**	Time **S**hort **L**ong **O**ngoing
Environmental									
Waterways and Floodplains near Facilities with Hazardous Materials, Flooding has the potential to release hazardous materials from industrial activities within floodplain (Reisner Corp., Atlantic Auto, U-Haul Storage, BP Gas Station, RTN sites)	Town Wide	Public/Private	V	Evaluate areas that have potential to implement green infrastructure to address flooding issues; Coordinate with office of Technical Assistance; Assess/Monitor Water Quality within areas subject to hazardous materials releases; Develop an outreach/communication/coordination plan with facilities that may be subject to hazardous materials releases during a natural hazard event. Inventory hazardous materials and develop a database of this information; Require/encourage secondary containment procedures.				M	O
Nashua River, Wetlands and Ponds, Mid-section: in 2010, flooding backfilled drains and caused sewerage releases, Invasive species, trash, and trees limit the river's capacity to handle increased flows during storm events	Town Wide	Public/Private	V/S	Complete the cleanout of debris within the Nashua River using existing DCR funding. Apply for additional funding to maintain this river management effort. Evaluate preventative solutions that are nature-based; integrate with goals of OSRP 2016-2020; Evaluate potential for hazardous materials migration in flood conditions; Where feasible, increase area of conservation lands along/near river, wetlands and ponds; Improve/restore riparian buffers; Identify flooding associated with beaver dams (Rigby Road, others?); Assess riparian corridor improvements/restoration; Partner with Nashua River Watershed Association on Nashua River Corridor Management Plan to enhance the river corridor's resilience to the effects of climate change.				H	O
Water Treatment Plant	West Clinton	Public	V/S	Address seasonal issues with algae blooms near the Water Supply Treatment Plant (clogging infiltration system and backwashing); Continue to coordinate closely with MWRA.				M	O
Railroad Emergency Procedures, Railroad tracks, PanAm, & CSX run through flood prone areas in town and regularly transport hazardous materials through Clinton	Town Wide	Private	V/S	Develop emergency response plans to be able to respond to a release of hazardous material; Clinton is part of a emergency response mock event at Wachusett Reservoir Associated with a "rail disaster." Adapt "lessons learned" from this effort into a community plan; Coordinate with the rail lines: request Emergency Action Plan (if there is one); Develop community outreach and education materials for distribution to the public.				M	O
Landfill Reuse	Site Specific	Public	V/S	Assess opportunities for renewable energy, open space, etc.				M	O
Tree Health and Sustainability	Town Wide	Public/Private	S/V	Conduct a Tree Inventory to assess potential climate impact and implement tree management practices to ensure proper regeneration; Implement a tree planting plan to reduce heat island in critical areas and replace loss of cultural/historic trees within historic landscapes.				M	O

NASHUA BASIN CLIMATE PROJECTIONS

NASHUA BASIN

MUNICIPALITIES WITHIN NASHUA BASIN:

Ashburnham, Ashby, Ayer, Bolton, Boyslton, Clinton, Dunstable, Fitchburg, Gardner, Groton, Harvard, Holden, Hubbardston, Lancaster, Leominster, Lunenburg, Paxton, Pepperell, Princeton, Rutland, Shirley, Sterling, Townsend, West Boyslton, Westminster, and Worcester



Many municipalities fall within more than one basin, so it is advised to use the climate projections for the basin that contains the majority of the land area of the municipality.

NASHUA BASIN

Nashua Basin		Observed Baseline 1971-2000 (°F)	Projected Change in 2030s (°F)	Mid-Century Projected Change in 2050s (°F)	Projected Change in 2070s (°F)	End of Century Projected Change in 2090s (°F)
Average Temperature	Annual	46.78	+2.20 to +4.44	+2.99 to +6.39	+3.54 to +9.02	+3.90 to +10.95
	Winter	25.2	+2.20 to +5.10	+2.81 to +7.60	+3.65 to +9.22	+3.94 to +10.58
	Spring	44.94	+1.64 to +3.47	+2.51 to +5.53	+2.72 to +7.71	+3.25 to +9.45
	Summer	67.56	+2.24 to +4.55	+3.14 to +7.02	+3.53 to +10.13	+3.98 to +12.60
	Fall	49.01	+2.18 to +5.10	+3.71 to +6.64	+3.58 to +9.54	+4.05 to +11.79
Maximum Temperature	Annual	57.77	+2.06 to +4.26	+2.73 to +6.47	+3.23 to +9.09	+3.55 to +10.95
	Winter	35.13	+1.84 to +4.62	+2.44 to +7.05	+3.02 to +8.41	+3.43 to +9.60
	Spring	56.16	+1.52 to +3.43	+2.35 to +5.51	+2.67 to +7.91	+3.25 to +9.55
	Summer	79.16	+1.97 to +4.68	+2.98 to +7.23	+3.42 to +10.45	+3.87 to +12.93
	Fall	60.19	+2.34 to +4.92	+3.56 to +6.97	+3.45 to +9.79	+3.96 to +12.25
Minimum Temperature	Annual	35.78	+2.33 to +4.78	+3.26 to +6.47	+3.80 to +8.94	+4.24 to +11.00
	Winter	15.26	+2.49 to +5.62	+3.27 to +8.10	+4.23 to +10.02	+4.41 to +11.40
	Spring	33.72	+1.77 to +3.82	+2.66 to +5.92	+2.83 to +7.51	+3.25 to +9.31
	Summer	55.97	+2.46 to +4.60	+3.23 to +7.16	+3.65 to +9.81	+4.12 to +12.27
	Fall	37.83	+1.99 to +5.23	+3.62 to +6.59	+3.68 to +9.27	+4.11 to +11.62

- The Nashua basin is expected to experience increased average temperatures throughout the 21st century. Maximum and minimum temperatures are also expected to increase throughout the end of the century. These increased temperature trends are expected for annual and seasonal projections.
- Seasonally, maximum summer and fall temperatures are expected to see the highest projected increase throughout the 21st century.
    - Summer mid-century increase of 3 °F to 7.2 °F (4-9% increase); end of century increase of 3.9 °F to 12.9 °F (5-16% increase).
    - Fall mid-century increase of 3.6 °F to 7 °F (6-12% increase); end of century increase by and 4 °F to 12.3 °F (7-20% increase).
- Seasonally, minimum winter and fall temperatures are expected to see increases throughout the 21st century.
    - Winter mid-century increase of 3.3 °F to 8.1 °F (21-53% increase); end of century increase by 4.4 °F to 11.4 °F (29-75% increase).
    - Fall mid-century of 3.6 °F to 6.6 °F (10-17% increase); end of century increase of 4.1°F to 11.6 °F (11-31% increase).

NASHUA BASIN

Nashua Basin		Observed Baseline 1971-2000 (Days)	Projected Change in 2030s (Days)	Mid-Century Projected Change in 2050s (Days)	Projected Change in 2070s (Days)	End of Century Projected Change in 2090s (Days)
Days with Maximum Temperature Over 90°F	Annual	4.37	+5.83 to +17.04	+8.93 to +29.98	+10.40 to +49.93	+12.50 to +69.88
	Winter	0.00	+0.00 to +0.00	+0.00 to +0.00	+0.00 to +0.00	+0.00 to +0.00
	Spring	0.24	-0.00 to +0.65	+0.20 to +1.28	+0.21 to +2.51	+0.19 to +4.28
	Summer	3.94	+5.20 to +14.96	+7.81 to +25.88	+9.57 to +42.15	+11.08 to +56.44
	Fall	0.19	+0.32 to +1.41	+0.47 to +3.46	+0.42 to +7.15	+0.67 to +9.96
Days with Maximum Temperature Over 95°F	Annual	0.23	+1.39 to +6.21	+2.17 to +13.14	+2.81 to +26.83	+3.52 to +42.01
	Winter	0.00	+0.00 to +0.00	+0.00 to +0.00	+0.00 to +0.00	+0.00 to +0.00
	Spring	0.00	+0.00 to +0.14	+0.00 to +0.28	+0.00 to +0.72	+0.00 to +1.42
	Summer	0.21	+1.28 to +5.58	+2.00 to +12.11	+2.49 to +23.90	+3.32 to +36.89
	Fall	0.01	+0.03 to +0.43	+0.02 to +0.77	+0.04 to +2.16	+0.07 to +3.48
Days with Maximum Temperature Over 100°F	Annual	0.01	+0.10 to +1.12	+0.18 to +3.25	+0.24 to +8.55	+0.17 to +17.37
	Winter	0.00	+0.00 to +0.00	+0.00 to +0.00	+0.00 to +0.00	+0.00 to +0.00
	Spring	0.00	+0.00 to +0.01	+0.00 to +0.02	+0.00 to +0.10	+0.00 to +0.27
	Summer	0.01	+0.10 to +1.08	+0.15 to +3.17	+0.22 to +8.08	+0.17 to +16.25
	Fall	0.00	+0.00 to +0.06	+0.00 to +0.14	+0.00 to +0.36	+0.00 to +0.84

- Due to projected increases in average and maximum temperatures throughout the end of the century, the Nashua basin is also expected to experience an increase in days with daily maximum temperatures over 90 °F, 95 °F, and 100 °F.
    - Annually, the Nashua basin is expected to see days with daily maximum temperatures over 90 °F increase by 9 to 30 more days by mid-century, and 13 to 70 more days by the end of the century.
    - Seasonally, summer is expected to see an increase of 8 to 26 more days with daily maximums over 90 °F by mid-century.
    - By end of century, the Nashua basin is expected to have 11 to 56 more days.

NASHUA BASIN

Nashua Basin		Observed Baseline 1971-2000 (Days)	Projected Change in 2030s (Days)	Mid-Century Projected Change in 2050s (Days)	Projected Change in 2070s (Days)	End of Century Projected Change in 2090s (Days)
Days with Minimum Temperature Below 0°F	Annual	9.32	-2.91 to -5.69	-3.75 to -6.66	-4.25 to -7.21	-4.24 to -7.76
	Winter	9.03	-2.78 to -5.54	-3.51 to -6.46	-4.02 to -6.94	-4.09 to -7.47
	Spring	0.3	-0.05 to -0.38	-0.09 to -0.39	-0.10 to -0.43	-0.10 to -0.43
	Summer	0.00	-0.00 to -0.00	-0.00 to -0.00	-0.00 to -0.00	-0.00 to -0.00
	Fall	0.02	-0.01 to -0.00	-0.02 to -0.00	-0.02 to -0.00	-0.02 to -0.00
Days with Minimum Temperature Below 32°F	Annual	156.4	-10.61 to -28.20	-18.80 to -38.26	-21.68 to -53.63	-22.97 to -63.67
	Winter	85.3	-1.24 to -5.2	-2.10 to -8.23	-3.27 to -16.04	-3.66 to -20.34
	Spring	40.46	-3.90 to -11.63	-6.35 to -15.66	-8.04 to -20.12	-9.00 to -21.62
	Summer	0.04	-0.15 to -0.00	-0.00 to -0.19	-0.00 to -0.16	-0.00 to -0.13
	Fall	30.54	-5.14 to -12.23	-9.02 to -14.91	-8.88 to -18.95	-9.01 to -22.04

- Due to projected increases in average and minimum temperatures throughout the end of the century, the Nashua basin is expected to experience a decrease in days with daily minimum temperatures below 32 °F and 0 °F.
- Seasonally, winter, spring and fall are expected to see the largest decreases in days with daily minimum temperatures below 32 °F.
    - Winter is expected to have 2 to 8 fewer days by mid-century, and 4 to 20 fewer days by end of century.
    - Spring is expected to have 6 to 16 fewer days by mid-century, and 9 to 22 fewer days by end of century.
    - Fall is expected to have 9 to 15 fewer days by mid-century, and 9 to 22 fewer days by end of century.

NASHUA BASIN

Nashua Basin		Observed Baseline 1971-2000 (Degree-Days)	Projected Change in 2030s (Degree-Days)	Mid-Century Projected Change in 2050s (Degree-Days)	Projected Change in 2070s (Degree-Days)	End of Century Projected Change in 2090s (Degree-Days)
Heating Degree-Days (Base 65°F)	Annual	7091.79	-574.29 to -1223.22	-805.57 to -1700.61	-937.13 to -2246.51	-1053.84 to -2622.98
	Winter	3601.55	-187.35 to -476.29	-247.70 to -697.10	-322.63 to -837.51	-365.72 to -974.31
	Spring	1861.47	-138.32 to -302.13	-215.35 to -473.28	-230.00 to -622.45	-289.72 to -736.02
	Summer	140.64	-48.96 to -83.63	-64.24 to -106.39	-72.51 to -119.59	-74.89 to -123.87
	Fall	1488.15	-169.43 to -399.86	-295.39 to -489.23	-275.83 to -683.30	-296.08 to -784.01
Cooling Degree-Days (Base 65°F)	Annual	432.47	+201.09 to +421.21	+270.66 to +711.61	+324.82 to +1091.32	+372.55 to +1458.24
	Winter	nan	-1.75 to -1.75	+1.46 to +2.51	-0.95 to +0.57	-0.89 to +0.24
	Spring	17.23	+9.26 to +23.64	+15.28 to +48.01	+18.93 to +84.62	+15.21 to +117.63
	Summer	376.56	+163.10 to +334.53	+208.02 to +544.69	+241.40 to +817.45	+275.68 to +1038.01
	Fall	32.88	+23.17 to +77.67	+36.85 to +131.04	+43.60 to +216.44	+62.31 to +296.90
Growing Degree-Days (Base 50°F)	Annual	2270.01	+392.88 to +799.66	+533.36 to +1235.75	+647.26 to +1889.26	+730.02 to +2366.80
	Winter	4.47	-1.32 to +7.50	-0.30 to +10.40	+0.84 to +14.27	+1.85 to +18.63
	Spring	253.78	+58.70 to +127.26	+84.43 to +227.02	+101.03 to +345.92	+106.94 to +452.93
	Summer	1616.56	+206.04 to +417.43	+287.04 to +644.86	+323.12 to +931.16	+364.44 to +1158.27
	Fall	384.19	+108.96 to +283.49	+167.87 to +394.57	+159.46 to +593.10	+206.63 to +750.08

- Due to projected increases in average, maximum, and minimum temperatures throughout the end of the century, the Nashua basin is expected to experience a decrease in heating degree-days, and increases in both cooling degree-days and growing degree-days.
- Seasonally, winter historically exhibits the highest number of heating degree-days and is expected to see the largest decrease of any season, but spring and fall are also expected to see significant change.
    - The winter season is expected to see a decrease of 7-19% (248 -697 degree-days) by mid-century, and a decrease of 10-27% (366 -974 degree-days) by the end of century.
    - The spring season is expected to decrease in heating degree-days by 12-25% (215 -473 degree-days) by mid-century, and by 16-40% (290 -736 degree-days) by the end of century.
    - The fall season is expected to decreases in heating degree-days by 20-33% (295 -489 degree-days) by mid-century, and by 20-53% (296 -784 degree-days) by the end of century.
- Conversely, due to projected increasing temperatures, summer cooling degree-days are expected to increase by 55-145% (208 -545 degree-days) by mid-century, and by 73-276% (276 -1038 degree-days) by end of century.
- Seasonally, summer historically exhibits the highest number of growing degree-days and is expected to see the largest decrease of any season, but the shoulder seasons of spring and fall are also expected to see an increase in growing degree-days.

- The summer season is projected to increase by 18-40% (287 -645 degree-days) by mid-century, and by 23-72% (364 -1158 degree-days) by end of century.
- Spring is expected to see an increase by 33-89% (84 -227 degree-days) by mid-century and 42-178% (107 -453 degree-days) by end of century.
- Fall is expected to see an increase by 44-103% (168 -395 degree-days) by mid-century and 54-195% (207 -750 degree-days) by end of century.

NASHUA BASIN

Nashua Basin		Observed Baseline 1971-2000 (Days)	Projected Change in 2030s (Days)	Mid-Century: Projected Change in 2050s (Days)	Projected Change in 2070s (Days)	End of Century: Projected Change in 2090s (Days)
Days with Precipitation Over 1"	Annual	7.34	+0.25 to +1.96	+0.54 to +3.32	+1.14 to +3.09	+1.05 to +4.00
	Winter	1.76	-0.10 to +0.73	+0.11 to +1.06	+0.23 to +1.55	+0.36 to +1.98
	Spring	1.54	-0.12 to +0.64	-0.16 to +0.88	-0.07 to +1.16	+0.03 to +1.41
	Summer	1.69	-0.21 to +0.51	-0.06 to +0.71	-0.16 to +0.63	-0.24 to +0.72
	Fall	2.33	-0.35 to +0.80	-0.15 to +1.01	-0.21 to +0.92	-0.38 to +1.06
Days with Precipitation Over 2"	Annual	0.7	-0.04 to +0.45	+0.07 to +0.44	+0.10 to +0.55	+0.12 to +0.64
	Winter	0.05	-0.04 to +0.07	-0.04 to +0.09	-0.04 to +0.13	-0.04 to +0.16
	Spring	0.19	-0.04 to +0.12	-0.01 to +0.17	+0.01 to +0.21	+0.02 to +0.31
	Summer	0.16	-0.03 to +0.13	-0.02 to +0.13	-0.06 to +0.13	-0.06 to +0.14
	Fall	0.3	-0.05 to +0.27	-0.03 to +0.27	-0.01 to +0.23	-0.07 to +0.24
Days with Precipitation Over 4"	Annual	0.02	-0.02 to +0.05	-0.03 to +0.06	-0.02 to +0.05	-0.03 to +0.09
	Winter	0.00	+0.00 to +0.00	+0.00 to +0.00	+0.00 to +0.00	+0.00 to +0.00
	Spring	0.00	+0.00 to +0.01	+0.00 to +0.01	-0.00 to +0.01	+0.00 to +0.02
	Summer	0.02	-0.01 to +0.03	-0.01 to +0.03	-0.02 to +0.02	-0.02 to +0.03
	Fall	0.00	-0.03 to +0.05	-0.03 to +0.03	-0.03 to +0.04	-0.03 to +0.04

- The projections for expected number of days receiving precipitation over one inch are variable for the Nashua basin, fluctuating between loss and gain of days.
  - Seasonally, the winter season is generally expected to see the highest projected increase.
  - The winter season is expected to see an increase in days with precipitation over one inch of 0-1 days by mid-century, and of 0-2 days by the end of century.
  - The spring season is expected to see an increase in days with precipitation over one inch of 0-1 days by mid-century, and of an increase of 0-1 days by the end of century.

NASHUA BASIN

Nashua Basin		Observed Baseline 1971-2000 (Inches)	Projected Change in 2030s (Inches)	Mid-Century Projected Change in 2050s (Inches)	Projected Change in 2070s (Inches)	End of Century Projected Change in 2090s (Inches)
Total Precipitation	Annual	45.89	+0.43 to +4.88	+1.15 to +6.29	+2.26 to +7.87	+1.25 to +8.38
	Winter	10.98	-0.30 to +1.90	+0.17 to +2.47	+0.39 to +3.34	+0.63 to +4.29
	Spring	11.82	-0.02 to +2.18	+0.05 to +2.03	+0.47 to +2.98	+0.13 to +2.91
	Summer	11.27	-0.28 to +1.51	-0.34 to +2.20	-0.57 to +2.22	-1.13 to +2.16
	Fall	11.83	-1.11 to +1.13	-1.18 to +1.77	-1.61 to +1.71	-1.44 to +1.52

- Similar to projections for number of days receiving precipitation over a specified threshold, seasonal projections for total precipitation are also variable for the Nashua basin.
    - The winter season is expected to experience the greatest change with an increase of 2-22% by mid-century, and of 6-39% by end of century.
    - Projections for the summer and fall seasons are more variable, and could see either a drop or increase in total precipitation throughout the 21st century.
        - The summer season projections for the Nashua or basin could see a decrease of 0.3 to an increase of 2.2 inches by mid-century (decrease of 3% to increase of 20%) and a decrease of 1.1 to an increase of 2.2 inches by the end of the century (decrease of 10% to increase of 19%).
        - The fall season projections for the Nashua basin could see a decrease of 1.2 to an increase of 1.8 inches by mid-century (decrease of 10% to increase of 15% and a decrease of 1.4 to an increase of 1.5 inches by the end of the century (decrease of 12% to increase of 13%).

Nashua Basin		Observed Baseline 1971-2000 (Days)	Projected Change in 2030s (Days)	Mid-Century Projected Change in 2050s (Days)	Projected Change in 2070s (Days)	End of Century Projected Change in 2090s (Days)
Consecutive Dry Days	Annual	16.21	-0.41 to +1.65	-0.79 to +1.71	-0.75 to +2.13	-0.64 to +2.82
	Winter	11.14	-0.91 to +1.00	-0.63 to +1.42	-1.10 to +1.39	-0.92 to +1.54
	Spring	10.62	-1.04 to +0.74	-1.21 to +1.31	-1.42 to +0.97	-1.55 to +0.75
	Summer	11.6	-1.05 to +1.55	-0.64 to +1.62	-1.12 to +2.53	-1.41 to +2.60
	Fall	11.9	-0.05 to +1.72	-0.13 to +2.55	-0.35 to +3.13	-0.45 to +3.20

- Annual and seasonal projections for consecutive dry days, or for a given period, the largest number of consecutive days with precipitation less than 1 mm (~0.04 inches), are variable throughout the 21st century.
    - For all the temporal parameters, the Nashua basin is expected to see a slight decrease to an increase in consecutive dry days throughout this century.
    - Seasonally, the fall and summer seasons are expected to continue to experience the highest number of consecutive dry days.
        - The fall season is expected to experience an increase of 0-3 days in consecutive dry days by the end of the century.

PUBLIC LISTENING SESSION - FEEDBACK

CLINTON
MASSACHUSETTS

Community Resilience Building

Get on the right path to resilience today...

CLINTON MUNICIPAL VULNERABILITIES PREPAREDNESS PUBLIC LISTENING SESSION:

Held during the Board of Selectmen's Meeting

WHEN: Wednesday, June 19, 2019, 7 PM

WHERE: Clinton Town Hall, Chamber Room, 2nd Floor
242 Church Street
Clinton, MA 01510

Comment #	Participant Comment (Summarized for Clarity)
1	For emergency situations, the town should implement an incident command protocol or a unified command protocol, and consider establishing a proper emergency operations center.
2	The Town already has a RAVE Alert system (a mass notification system) and should be using it more.
3	Street trees and the planting of trees on town property should be part of a carbon mitigation strategy.
4	The Senior Center should be open later during heat waves. Meals on Wheels staff can help reach out to housebound seniors.