



## TABLE OF CONTENTS

	PAGE
1.0 INTRODUCTION .....	1-1
1.1 Land Use and Critical Facilities.....	1-1
1.2 Demographics in Northborough .....	1-2
1.3 Current Hazard Mitigation and Climate Adaptation Measures .....	1-3
2.0 COMMUNITY RESILIENCE BUILDING WORKSHOP: SUMMARY OF FINDINGS.....	2-1
2.1 Core Team Meetings .....	2-1
2.2 Community Resilience Building Workshop .....	2-1
2.3 Listening Session.....	2-2
3.0 TOP HAZARDS AND AREAS AT RISK.....	3-1
3.1 Top Hazards .....	3-1
3.2 Areas at Risk.....	3-2
4.0 VULNERABILITIES .....	4-1
4.1 Specific Categories of Concerns and Challenges.....	4-1
4.1.1 Infrastructural .....	4-1
4.1.2 Societal .....	4-1
4.1.3 Environmental .....	4-2
5.0 CURRENT STRENGTHS AND ASSETS.....	5-1
5.1 Summary of Strengths from Matrices.....	5-1
5.1.1 Infrastructural .....	5-1
5.1.2 Societal .....	5-1
5.1.3 Environmental .....	5-2
6.0 TOP RECOMMENDATIONS TO IMPROVE RESILIENCE .....	6-1
6.1 Highest High Priorities .....	6-1
6.2 Highest Priorities.....	6-1
6.3 Other Priorities .....	6-2
7.0 REFERENCES .....	7-1
7.1.1 Core Team.....	7-1
7.1.2 Local Chairs of Elected & Appointed Boards and Town Staff .....	7-1
7.1.3 State and Regional .....	7-2
7.2 Citation .....	7-2
7.3 Workshop Project Team.....	7-2
7.3.1 Town of Northborough, Municipal Leadership: .....	7-2
7.3.2 Facilitators from Weston & Sampson:.....	7-3
7.4 Acknowledgements .....	7-3
8.0 REFERENCES .....	8-1

**LIST OF FIGURES**

Figure 1. Old Farm Birdsong Trail (Northborough Conservation Commission)..... 1-1

Figure 2. Town of Northborough CRB Workshop (W&S, 2019)..... 2-1

Figure 3. Northborough Public Listening Session Attendees ..... 2-2

Figure 4. Assabet Park (Weston & Sampson) ..... 4-2

Figure 5. Senior Center (Town of Northborough) ..... 5-1

Figure 6. Farm in Northborough (Open Space and Recreation Plan, 2010)..... 5-2

**LIST OF TABLES**

Table 1. Northborough Land use by Year ..... 1-2

Table 2. Demographics in Northborough..... 1-3

Table 3. Areas Vulnerable to Climate Related Factors ..... 3-2

LIST OF APPENDICES

APPENDIX A .....CORE TEAM MEETING MATERIALS

APPENDIX B ..... COMMUNITY RESILIENCE BUILDING WORKSHOP MATERIALS

APPENDIX C ..... ANNOTATED MAPS AND PARTICIPANT RISK MATRICES

APPENDIX D ..... PUBLIC LISTENING SESSION MATERIALS

## 1.0 INTRODUCTION

The Northborough Hazard Mitigation Plan Update (HMP) in 2018 identified the Municipal Vulnerability Preparedness (MVP) program as a potential funding for implementation and observed that many of the planning objectives were likely to overlap. The HMP identified several natural hazards as potential threats, including flooding, severe weather events (such as Nor'easters and severe snowstorms), wildfires, drought, and extreme temperatures, all of which, are expected to worsen with climate change. Stormwater flooding from intensified runoff, inadequate drainage, and problematic culverts was of mentioned as a frequent problem. Riverine flooding along the Assabet River and the risk of dam failure were also at the forefront of concerns. In addition, wind and ice/snow conditions from major storms such as Nor'easters and hurricanes have caused significant damage in previous events. The MVP process in Northborough was strategic and assessed the Town's land uses, critical facilities, demographics, and current hazard mitigation/climate adaption capacity.

### MVP OBJECTIVES

- Increase resilience of community
- Raise awareness of climate threats
- Identify priority actions to move forward
- Create implementation pathways

The MVP process followed the guidance provided from the Massachusetts Executive Office of Energy and Environmental Affairs, which included convening a core team, hosting a Community Resilience Building (CRB) Workshop, and engaging the public in a listening session. The process is further explained in Section 2. The following sections of the report describe the results of the CRB Workshop and listening session, including the Top Hazards (Section 3), Vulnerabilities (Section 4), Current Strengths and Assets (Section 5), and Top Priorities (Section 6). Additional information regarding the involvement of stakeholders is provided in Section 7.

### 1.1 Land Use and Critical Facilities

The Northborough landscape is characterized by a series of rolling hills interspersed with streams, with generally higher elevations in the western half of the community and gently sloping terrain in the eastern half of Town. Elevations vary from a low of 250 feet above sea level to a high of 715 feet at the top of Mount Pisgah (Open Space and Recreation Plan, 2010). According to the United States Census Bureau, the town has a total area of 18.76 square miles, of which, 18.53 square miles of it is land and 0.23 square miles of it is water (2018). The Northborough Recreation and Open Space Plan (OSRP) 2010, contains an analysis of the change in land use over time. The analysis was based upon aerial



Figure 1. Old Farm Birdsong Trail (Northborough Conservation Commission)

photo interpretation from flights taken in 1971, 1985, 1999, and 2005 as determined by the University of Massachusetts, Department of Forestry. Based on this analysis, residential land use has increased modestly while both farmland and forested areas decreased. Some of the agricultural land is preserved through the State Agricultural Preservation Restriction (APR) Program.

*Table 1. Northborough Land use by Year*

Land Use	1971	1985	1999	2005
Cropland /Pastureland/ Orchard /Nursery	10%	7%	6%	5%
Forests	58%	54%	47%	45%
Residential	15%	20%	28%	23%
Waterbodies /Open Public Land / Recreation	8%	7%	8%	8%
Transportation /Waste Disposal	2%	2%	2%	2%
Industrial /Commercial	2%	4%	5%	4%
Wetlands	6%	6%	5%	13%

(Northborough Recreation and Open Space Plan, 2010)

With urbanization and more intensified rainfall, the Town of Northborough has started to see an increase in the amount of stormwater flooding. The topography and land cover also make Northborough more vulnerable to riverine flooding, rising groundwater, and invasive or noxious species.

The Northborough HMP identified a range of critical facilities, which were reviewed and updated during the MVP process (Appendix B). The critical facilities are comprised of emergency response facilities, non-emergency response facilities, dams, and facilities that serve vulnerable populations. The critical facilities were mapped and discussed throughout the process as described in Section 2. Many of the critical facilities are maintained or operated by the Town. For example, approximately 79 miles of public roads are maintained by the town in addition to bridges, dams, and communication networks. The critical facilities' strengths and vulnerabilities were discussed during the MVP process. The Town's roadways provide evacuation routes, link Northborough to regional resources, and provide accessibility to the residents. However, roadways are vulnerable to road closures due to flooding, downed trees, or ice.

Approximately 80% of Northborough is serviced by a Town water distribution system relying on supplies from the Massachusetts Water Resources Authority (MWRA). The exceptions are located in the north and west sections of Town (Ball Hill, Bartlett Hill and Tomblin Hill areas), which rely on private wells. Approximately 30% to 35% of town area or approximately 45% of the population is served by municipal sewer connections. The Town does not have its own sewage treatment plant. All residential and industrial sewage within the sewered areas of town is pumped to the Marlborough Westerly Treatment Plant located on Boundary Street in Marlborough (OSPR, 2010).

## 1.2 Demographics and Social Services in Northborough

The needs of vulnerable populations should be carefully considered when planning for climate change. Vulnerable populations can include the elderly, the infirm, residents with language barriers, residents with special needs, and residents with low or moderate income. Census data for the Town of Northborough shows that the Town has a comparative demographic to the state with a significant population of seniors and youth. Many of the

residents with limited English speak are Brazilian and speak Portuguese. Demographic information for the Town of Northborough is summarized below (US Census Bureau, 2018).

*Table 2. Demographics in Northborough*

<i>Population</i>	Northborough	Massachusetts
2010	14,155 residents	6,547,790 residents
2018	15,101 residents	6,902,149 residents
<b>Age</b>		
Under 18 years	23%	20%
65+ years	16%	17%
<b>Education</b>		
Bachelor's degree or higher	65%	42%
<b>Additional Information</b>		
Median household income	\$111,875	\$74,167
Persons in poverty	4%	11%
With a disability (under 65)	5%	8%
Language other than English spoken at home	15%	23%

Northborough is served by the Worcester Regional Transit Authority, although, ridership is low. The Town of Northborough also has a fuel assistance program and food pantry. Anecdotally, these resources may also be underutilized by immigrant populations who face language, cultural, and political barriers to accessing these resources. The Town has a very active Senior Center and numerous youth programs. The Town has a relationship with the local grocery store to supply food during emergencies among other aid agreements with surrounding towns.

### 1.3 Current Hazard Mitigation and Climate Adaptation Measures

The Town is currently engaged in numerous activities that promote resilience. The Town regularly updates and enforces the stormwater policies and maintains stormwater infrastructure. The Town has a list of priority culverts for replacement that would be prime candidates for upgrading to account for climate change. The Town is currently updating the Master Plan (forthcoming, 2020) and recently updated the Hazard Mitigation Plan (2018). Both consider climate change. Northborough has started to purchase dehumidifiers as a low-cost solution compared to air conditions for the schools. The Town has ongoing efforts to monitor and model groundwater and maintains three flood control systems.

## 2.0 COMMUNITY RESILIENCE BUILDING WORKSHOP: SUMMARY OF FINDINGS

The MVP planning process engaged municipal leaders, key stakeholders and the general public to inform the Summary of Findings Report.



### 2.1 Core Team Meetings

The Town of Northborough convened a Core Team of municipal staff to guide the MVP planning process. Members of the Core Committee are listed in Section 7. Core Team members provided local expertise and feedback to ensure the [Community Resilience Building Process](#) considered the uniqueness of Northborough. The Core Team met on September 10th, 2019 to discuss the MVP process, to provide information about past hazard events, and other pertinent information related to natural hazards and climate change impacts. The Core Team developed the invitation list for the Community Resilience Building Workshop described below. The Core Team was provided an opportunity to comment on the final priority action items to ensure local priorities were captured.

### 2.2 Community Resilience Building Workshop

Municipal staff, town boards and committees, local organization, regional partners, state agencies, and adjacent towns were invited to participate in the CRB Workshop. Over 20 participants were able to join throughout the day. The CRB workshop utilized a Risk Matrix to complete the objectives of the day in small groups. The CRB workshop's central objectives were to:

- Define top local natural and climate-related hazards of concern;
- Identify existing and future vulnerabilities;
- Develop prioritized actions for the Community;
- Identify immediate opportunities to collaboratively advance actions to increase resilience.



Figure 2. Town of Northborough CRB Workshop (W&S, 2019)

The completed matrices are available in Appendix C. A list of Workshop participants is included in Section 7.1 of this report.

### 2.3 Listening Session

As part of the CRB process, the Town convened a public listening session at the Northborough Free Library. Fourteen people attended. To promote the event, the Core Team were asked to promote the listening session through their departmental networks. A flyer and informational page were developed for the Town webpage and the event was placed on the Town calendar. The listening session presented an overview of the MVP planning process, climate impacts in Northborough, existing capacity to respond within the Town, and priority action items moving forward. The listening session was setup to allow participants to engage with the material and to provide feedback through open dialogue. The summary of the input is provided in Appendix D and was integrated throughout the plan.



Figure 3. Northborough Public Listening Session Attendees

### 3.0 TOP HAZARDS AND AREAS AT RISK

Northborough has already started to experience the effects of climate change. Climate hazards in Northborough include extreme temperatures, heavy precipitation, strong winds, intensified flooding, drought, as well as snow and ice. Dam failure was also identified as a top hazard in Northborough.

#### 3.1 Top Hazards

The initial presentation at the CRB workshop provided an overview of potential climate risks to the town. In subsequent discussion, the large group identified four top hazards to focus small group discussion. Infrastructural, societal and environmental vulnerabilities and strengths associated with these hazards were discussed and priority action items were identified. The top hazards identified by participants during the workshop include:



**Riverine and storm  
water flooding**



**Extreme  
temperatures**



**Extreme storms;  
including wind, ice,  
and Nor'easters**



**Dam Failure**

##### 3.1.1 Extreme Precipitation and Flooding

Precipitation is expected to increase marginally on an annual basis. However, precipitation is projected to occur during larger, more intense rainfall events rather than fewer periodic events. Across the northeast, we have already started to experience this change. Precipitation during heavy events increased by more than 70% between 1958-2010 (MA EEOEEA, resilientma.org 2018). The frequency of intense rainfall is supported through federal rainfall frequency data. Between 1961 and 2015, the 24-hour, 100-year rain event increased from 6.5 inches to 8.4 inches (US Weather Bureau, 1961; US NOAA, 2015). More intense rainfall will exacerbate the risk of flooding and dam failure. With fewer periodic events, drought will be more likely to occur and could impact water supply; local rivers, streams, and wetlands; and the crops on local farmlands.

##### 3.1.2 Extreme Temperatures

Extreme temperatures include both very low and very high temperatures. Average annual temperatures in the Sudbury-Assabet-Concord watershed is projected to increase around 5°F by mid-century and by 7.33°F by the end of the century (MA EEOEEA, resilientma.org 2018). On the ground, this will be experienced as more days that rise above 90°F in the summer and days that do not drop below 32°F in the winter. Massachusetts is expected to see up to 24 days above 90°F by mid-century, which is much higher than the current average of six days. By mid-century Massachusetts is also projected to only experience 114 days under 32°F, when we typically currently experience 145 days.

##### 3.1.3 Extreme Storms

Besides heavy rainfall, extreme storms such as thunderstorms and Nor'easters, produce strong winds, snow, and ice. High winds and ice can cause disruptions and property damage. Heavy blizzards are among the most costly and disruptive weather events in Massachusetts (MA EEOEEA SHMCAP,

2018). Nor'easters along the Atlantic coast are also increasing in frequency and intensity (USGCRP, 2017). The North Atlantic hurricane activity is in an upward trend in since 1970. The Halloween Storm in 2011 caused major power outages and damages.

### 3.1.4 Dam Failure

Dam failure is of significant concern in Northborough. There are 16 dams located in Northborough. Two are classified as high hazard dams by the Massachusetts Office of Dam Safety (Cold Harbor Brook Dam and Hop Brook Dam). One is classified as a significant hazard (Assabet River Dam). The town also owns a dam located on the Shrewsbury-Boylston border, which is significant hazard dam in poor condition (Reservoir Dam, MA01234). High and significant hazard dams have the potential to cause substantial damage if breached. Condition ratings provide the level of integrity of the dam. Dam condition is very important as storms become larger with climate change. Dams must have the ability to withstand the pressure of additional water and potential overtopping.

## 3.2 Areas at Risk

Vulnerable areas in Northborough identified as part of the FEMA flood mapping, the development of the Northborough Hazard Mitigation Plan, and MVP Process are shown below:

*Table 3. Areas Vulnerable to Climate Related Factors*

Area	Risk	Impact
West Street Rice Ave Main St near culvert Cherry Street US-20/MA-9 Fay Lane & Lower Boundary St to Town Line Pleasant Street Tomblin Hill Road	Stormwater Flooding	Disrupted emergency response and transportation
Cold Harbor Brook Dam Hop Brook Dam Reservoir Dam	Downstream Flooding	Risk of loss of life and property damage
Town-wide Northern Part of Town is particularly vulnerable (Howard, Green, Whitney Streets)	Severe Snowstorms, Ice Storms, Nor'easter	Disrupted emergency response and transportation Tree damage and power outages
Town-wide	Extreme Temperatures	Health risk to vulnerable populations, increase vector borne disease, impact on ecosystems and agriculture
Town-wide	Drought	Increased risk of wildfire and impact on ecosystems and agriculture
Northern Part of Town	Wildfire	Risk of property damage and loss of life
Downstream of Dams	Dams	Risk of loss of life and property damage

## 4.0 VULNERABILITIES

The participants in the CRB workshop focused both on the challenges at hand and the changes that are anticipated. Participants also expressed the need to plan for the rippling effects of climate hazards and ensuring preparation was robust in both depth and breadth. Discussion within the larger group revolved around concern of failing dams, the uptick in calls regarding vector borne illnesses and heat-related illnesses, and the need to address stormwater concerns. After discussing the vulnerabilities as a large group, three small groups formed to explore vulnerabilities to the top hazards discussed in Section 3 in greater detail. The outcome of this discussion is captured below.

### 4.1 Specific Categories of Concerns and Challenges

The vulnerabilities were grouped within the following three categories or “features:” infrastructural, societal, and environmental.

#### 4.1.1 *Infrastructural*

Workshop participants identified key infrastructural features in Northborough that are most vulnerable to natural hazards and climate change impacts or may be so in the future. Roads were the most cited infrastructural area of concern. Participants discussed the need to protect transportation routes, including West Street, Cherry Street, Fray Lane and lower Pleasant Street, Tomblin Hill Road, US-20 (Main Street), and State Route 9 interchange. Other infrastructure features of concern include:

- Inadequate culverts at several locations that result in local flooding
- Dams, particularly the Northborough Reservoir Dam and others not used for flood control, impact of over topping and financial liability
- Emergency communication systems
- Water supply and the need for redundancy
- Fortifying powerlines
- Protecting public buildings
- Improving stormwater features
- Basement flooding
- Buildings during severe windstorms
- Need for local energy storage

#### 4.1.2 *Societal*

Workshop participants discussed the impact of climate change to vulnerable populations and essential services, which included:

- Elderly populations, senior centers, and critical care facilities and ensuring reliable backup power, adequate cooling systems, and proper communication
- Youth populations and ensuring adequate care during hazard events
- People with limited English and providing appropriate emergency communications
- Commuters and providing transportation during emergencies
- Suppliers of basic needs and ensuring they are accessible and secure (healthcare, food supply, energy, water, housing)
- Losing power in critical facilities and in homes without back up power

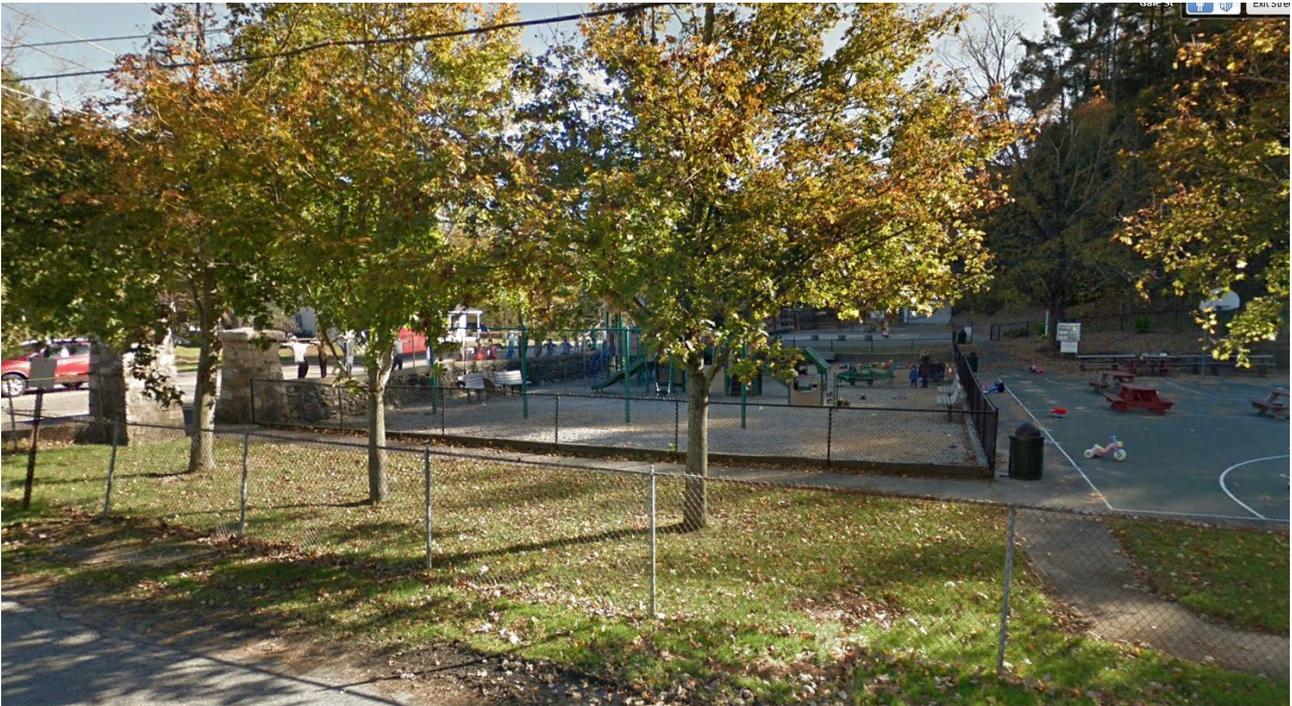


Figure 4. Assabet Park (Weston & Sampson)

#### 4.1.3 Environmental

Workshop participants identified those key environmental features in Northborough that are most vulnerable to natural hazards and climate change impacts. They are:

- Increased flooding and summer low flow conditions of the Assabet River (tributary to the Concord River)
- Increased risk of insect damage and fire in forested areas
- Management of the tree canopy to reduce heat and reduce damages from fallen limbs
- Increased risk of vector borne diseases (ticks and mosquitos), invasive species, and wildlife nuisances (beavers)
- Encouraging smart development patterns
- Securing hazardous materials
- Surface water quality
- Groundwater rising
- Air quality
- Tree damage from wind

## 5.0 CURRENT STRENGTHS AND ASSETS

Many workshop participants felt Northborough's greatest assets were the volunteers, sense of community, trail system, and collaboration between Town staff, all of which advance the Town's priorities and build the community's resilience. The Town has also engaged in numerous initiatives to improve the quality of life and to protect the public health and safety of the residents. The Town replaces infrastructure as funding is available and has most recently replaced culverts on Fisher, Rice Ave, and Church Street. The Town has placed dehumidifiers in schools and provides both warming and cooling centers. The Town has mutual aid agreements with surrounding towns, partnerships with some local providers, and collaborates with State agencies. The participants discussed the strengths and assets in Town in small groups using the CRB Risk Matrix and the results of the discuss are below.

### 5.1 Summary of Strengths from Matrices

#### 5.1.1 *Infrastructural*

Workshop participants identified those key infrastructural features in Northborough that provide strength against natural hazards and climate change impacts. They are

- Buildings that are currently adequate for use as shelters during emergencies
- Existing cooling centers
- The power grid and communication systems
- Sewage collection in key areas
- Bridges, roadways, stormwater system, and culverts
- Public buildings and municipal services, including the Police and the Fire Station
- MWRA as the Town water source and backup wells
- Flood control systems
- Comprehensive culvert assessment

#### 5.1.2 *Societal*

Workshop participants identified those key societal features in Northborough that provide strength against natural hazards and climate change impacts. They are:

- An engaged population
- Elderly residents and their local knowledge
- Diverse ideas and culture
- Youth's energy and capacity to contribute
- Access to local services
- CodeRed



Figure 5. Senior Center (Town of Northborough)

### 5.1.3 Environmental

Workshop participants identified those key environmental features in Northborough that provide strength against natural hazards and climate change impacts. They are

- Public open space, like trails and parks
- Landscape features that help manage stormwater and mitigate extreme temperatures, like tree canopy
- Tree management program
- Local farmland and soils
- Development and economic interests
- Waterbodies
- Stretch code and other energy efficiency possibilities, such as the LED upgrades in the Police Station



*Figure 6. Farm in Northborough (Open Space and Recreation Plan, 2010)*

## 6.0 TOP RECOMMENDATIONS TO IMPROVE RESILIENCE

After identifying the Town's top hazards and listing vulnerabilities and strengths, participants brainstormed possible actions to address vulnerabilities to fortify strengths. Participants then ranked action items as a low, medium or high priority. Each group was then asked to report out the "highest high" priorities. A summary of findings from the group matrices are below.

### 6.1 Highest High Priorities

- Remove dams and restore streams, prioritizing Northborough Reservoir Dam
- Protect roads - strategies could include:
  - Evaluate and rank projects impacting flood prone streets/areas
  - Improve drainage and culverts
  - Collaborate with MassDOT to address flooding on State roadways
- Include climate change in the Town's stormwater management tasks and address areas with ongoing stormwater challenges, such as Tomlin Hill and the Southwest Cutoff
- Maintain and improve emergency services for vulnerable populations such as seniors, which could require increasing emergency transportation options (rideshare options), diversifying communications, expanding planning, and ensuring reliable power
- Educate the public and evaluate management of disease carrying insects and other public health related concerns
- Update local regulations to include climate change, such as encouraging or requiring stormwater controls on site for new development
- Evaluate climate change impacts to the drinking water system including; updating risk assessment and emergency response plans to meet AWIA requirements, studying additional water supply interconnection with MWRA for redundancy and fortify and monitor backup wells

### 6.2 Highest Priorities

- Provide critical municipal facilities (such as town hall, senior center, and library) with backup power to provide heating and cooling in extreme conditions
- Protect municipal buildings and services against flooding and provide adequate staffing and training
- Prepare communication plan and practice emergency protocols to ensure adequate staffing and equipment, spread knowledge of evacuation routes and services, and stock the materials needed to sustain evacuated residents
- Install dehumidifiers in schools
- Educate residents about stormwater management and water quality
- Implement the Town's Hazard Mitigation Plan priorities that further climate adaptation
- Implement the Town's Master Plan priorities that further climate adaptation, such as:
  - Develop updates to land use planning tools such as zoning and subdivision regulations, and conservation commission regulations
  - Conserve, through purchase or restriction, properties that would expand and improve flood control/hazard mitigation
  - Develop a stormwater management bylaw
  - Develop a program and plan for green infrastructure in the downtown
  - Increased protection of floodplains
  - Incorporate renewable energy into municipal buildings and amenities
  - Ensure Town departments have sustainable capital assets

### 6.3 Other Priorities

- Improve communication before, during, and after extreme events, including a tailored notification plan, training, and emergency management planning
- Protect public health by conducting water quality monitoring and conduct public education to minimize non-point source pollution of surface water in association with the Town's MS4 program
- Increase tree plantings in urbanized areas and large parking areas such as Northborough Crossing
- Control invasive species and vegetation along roadways to improve sightlines
- Educate children to prepare the next generation to continue addressing climate change
- Utilize partners to communicate to vulnerable populations and broader audiences (schools, healthcare system, churches, etc.)
- Add a second language to the CodeRed system
- Establish alternative energy sources
- Protect underground utilities like gas, water, and sewers through redundancy and back-up power

## 7.0 ADDITIONAL PROCESS INFORMATION

### 7.1 CRB Workshop Participants

The CRB Workshop was attended by municipal staff, local board members, and regional organizations. Below is the full list of invited participants and a check mark designates their participation in the workshop.

#### 7.1.1 Core Team

	Invitee	Title
✓	Kathy Joubert	Town Planner
✓	Mia McDonald	Conservation Agent
✓	John Coderre	Town Administrator
✓	David Parenti	Fire Chief
	Jason Little	Finance Director/ Town Accountant
✓	June David-Fors	Director
✓	Casey Mellin	Director
✓	Kelly Burke	Director
✓	Scott Charpentier	Director
✓	Fred Litchfield	Town Engineer
	Kim Foster	Assistant Town Administrator

#### 7.1.2 Local Chairs of Elected & Appointed Boards and Town Staff

	Invitee	Title
✓	Joe Galvin	Lieutenant, Police Department
✓	Gregory Martineau/	Superintendent, Northborough-Southborough School District
✓	Jason Perreault	Chair, Board of Selectmen
✓	Kerri Martinek	Chair, Planning Board
✓	Adrienne Cost	Chair, Council on Aging
✓	Janet Sandstrom (half day) Tony Pini (half day)	Chairs, Earthwork Board
✓	Joan Frank	School Committee
	Allison Lane	Director, Recreation Department
	John Campbell	Chair, Open Space Committee
	Kathleen Howland	Member, Regional School Committee
	John Meader	Chair, Water and Sewer Commission
	Lynne Trembley	Director, Housing Authority
	Brad Blanchette	Chair, Zoning Board of Appeals
	Sue Lawrence	Chair, School Committee
	Sandra Scott	Chair, Youth Commission
	Glenn French	Chair, Board of Health

Michael Borowiec	Hazardous Materials Assistant, Local Emergency Planning Committee
Norm Corbin	Chair, Historic District Commission
Gregory Young	Chair, Conservation Commission
Elaine Kelly	Chair, Appropriations Committee
David Devries	Chair, Financial Planning Committee
Jane Walsh	Chair, Recycling Committee
David Kane	Director, MIS/GIS Department

### 7.1.3 State and Regional

	Invitee	Title
✓	James B. Eldridge	Senator, MA State Senate
✓	Janet Pierce (half day) Trish Settles (half day)	Central Massachusetts Regional Planning Commission, Executive Director and Deputy Director
✓	Jeffrey Zukowski	MEMA
✓	Don Burn/Alison Field-Juma	OARS
✓	Hillary King	EEA, MVP Regional Coordinator
	Harriette L. Chandler	Massachusetts Senate
	Jim McGovern	US House of Representatives
	Harold Naughton, Jr.	Massachusetts House of Representatives
	Alan Peterson	U.S. Environmental Protection Agency
	Katelyn Rainville	Army Corps of Engineers
	Mary Jude Pigsley	MA Department of Environmental Protection
	Priscilla Geigis or Dan Driscoll	MA Department of Conservation and Recreation
	Karen Chapman	Corridor Nine Area Chamber
	Anne Slugg	Sudbury, Assabet & Concord Wild & Scenic River Stewardship Council

## 7.2 Citation

Town of Northborough. 2019. *Community Resilience Building Workshop Summary of Findings*. Prepared by Weston & Sampson. Northborough, Massachusetts.

## 7.3 Workshop Project Team

### 7.3.1 Town of Northborough, Municipal Leadership:

- John W. Coderre, Town Administrator
- Scott Charpentier, Project Manager and Public Works Director
- Core Team Members:
- John W. Coderre, Town Administrator

- Scott Charpentier, Public Works Director
- June David-Fors, Director of Family and Youth Services
- Mia McDonald, Conservation Agent
- Jason Little, Finance Director
- David Parenti, Fire Chief
- Casey Mellin, Health Department Director
- Fred Litchfield P.E., Town Engineer
- Lieutenant Joe Galvin, Police Department

#### 7.3.2 Facilitators from Weston & Sampson:

- Amanda Kohn, Project Manager/Facilitator
- Lindsey Adams, Table Facilitator
- Rob Almy, Table Facilitator

#### 7.4 Acknowledgements

We'd like to recognize the Core Team members and the Town Administrator for leading by example throughout the MVP planning process. A special thanks to the Massachusetts Executive Office of Energy and Environmental Affairs for providing the grant funding to conduct the MVP process and to the Nature Conservancy for providing the Community Resilience Building Guidebook. Additional thanks to all the participants and to the Workshop Project Team for a successful event and to the Public Library for generously providing the space.

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**APPENDIX A**

Core Team Meeting Materials



## TOWN OF NORTHBOROUGH

### Municipal Vulnerability Preparedness Planning Grant Project Core Team Meeting

Selectmen's Meeting Room  
Tuesday, September 10, 2019  
10:00 am – 11:30 am

## AGENDA

- |  |            |
|--|------------|
| Introductions  | 5 minutes  |
| Project Overview   | 10 minutes |
| 1. MVP Program Overview  |            |
| a. Brief Introduction to Climate Change in Town  |            |
| b. MVP Planning Process  |            |
| c. MVP Action Grants   |            |
| Core Team Role   | 5 minutes  |
| 1. Develop/approve list of stakeholders  |            |
| 2. Active participants in the Community Resilience Building Workshop   |            |
| 3. Promote the listening session/attend listening session  |            |
| 4. Inform community priorities/Determine how decisions from Workshop will be used  |            |
| Data Sources   | 5 minutes  |
| 1. Interviews with municipal officials   |            |
| 2. Applicable reports and materials  |            |
| a. Hazard Mitigation Plan 2016 Update (MAPC, 2016)   |            |
| b. Open Space and Recreation   |            |
| c. Critical assets and infrastructure  |            |
| d. Demographics  |            |
| 3. Ask:  |            |
| a. Other ongoing efforts?  |            |
| b. Local hazards/experiences to highlight? - previous flood events, issue areas  |            |
| <br><i><b>W&amp;S Action Item:</b></i> Review materials and incorporate into Workshop and Report(s)<br><i><b>Northborough Action Item:</b></i> Identify and provide any additional resources |            |
| Community Resilience Building Workshop and Review of Materials   | 45 minutes |
| 1. Goal of workshop, specific objectives   |            |
| 2. Core Team Role at Workshop  |            |
| 3. MVP Risk Matrix   |            |
| a. Discuss hazards and key features (infrastructure, society, environment)   |            |
| 4. Review map of key resources/assets  |            |
| 5. Prioritization Process MVP Key Actions  |            |

6. Workshop Schedule
  - a. One 8-hour or two 4-hour meetings
  - b. Weekday or weekend
  - c. Day or evening
7. Presentation Feedback

**W&S Action Item:** Finalize Workshop materials based on Core Team input  
**Northborough Action Item:** Help to fill mapping and PowerPoint gaps

Workshop Participants 15 minutes

1. Respond to a list of workshop invitees

**W&S Action Item:** Draft invitation to stakeholders

**Northborough Action Item:** Finalize list of invitees; send invitation and track RSVPs, assign participants to tables

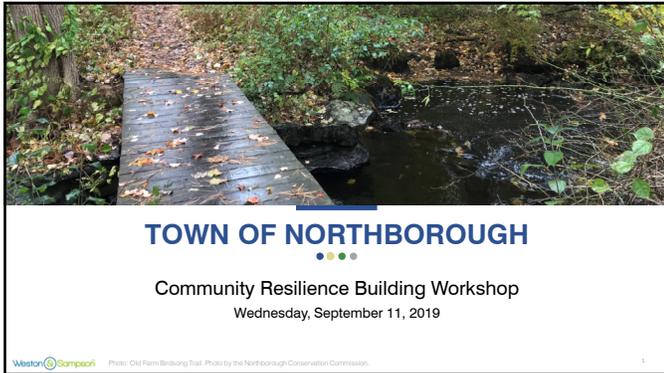
Wrap Up and Next Steps 5 minutes

1. Confirm draft schedule



Municipal Vulnerability Preparedness Planning Grant Project  
Tuesday, September 10, 2019 10:00 am – 11:30 am

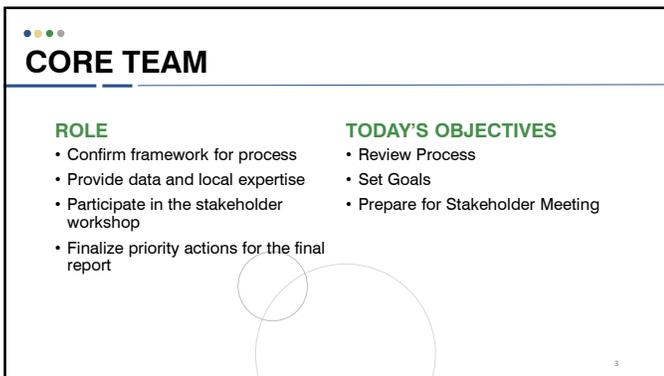
Name	Present- Mark with X or Sign
Kelly Burke	<i>Kelly Burke</i>
Scott Charpentier	<i>[Signature]</i>
John Coderre	X
June David-Fors	<i>June David-Fors</i>
Kim Foster	
Kathy Joubert	<i>K. Joubert</i>
Fred Litchfield	<i>Fred Litchfield</i>
Jason Little	
Bill Lyver	X
Mia McDonald	X
Casey Mellin	X
<del>David Parenti</del>	
Justin Sousa	
DAN BRILLHART	<i>Dan</i>
Frank Ochipinti	<i>Frank Ochipinti</i>
Amanda Kohn	<i>Amanda Kohn</i>



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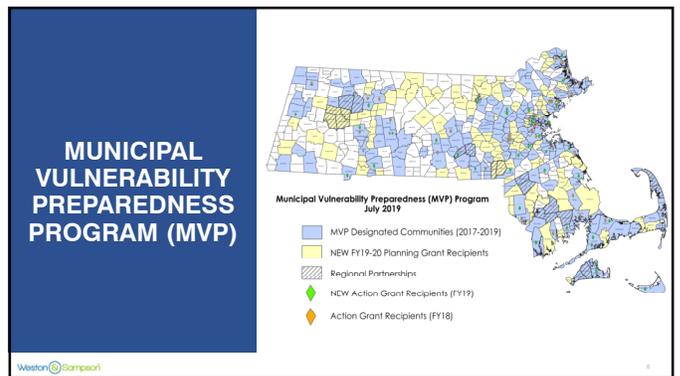
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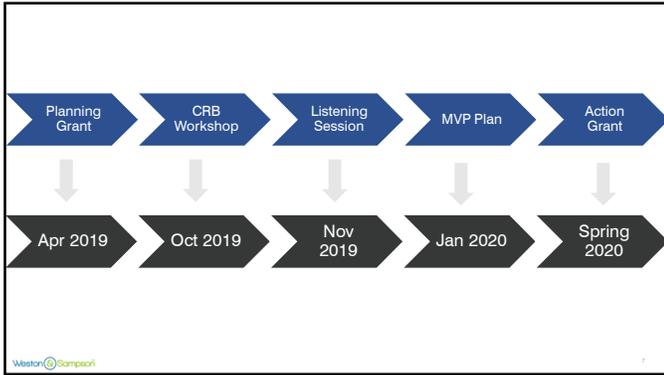
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7

### WORKSHOP OUTLINE

**PRESENTATION:**

- Overview of Science & Data
- Characterization of Hazards

**- BREAK -**

**INDIVIDUAL TABLES:**

- Identify Community Features

**- LUNCH -**

**INDIVIDUAL TABLES:**

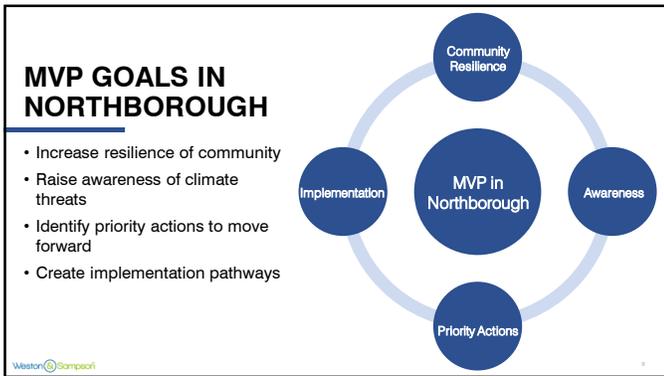
- Identify and Prioritize Actions

**- BREAK -**

**LARGE GROUP DISCUSSION:**

- Determine Overall Priorities

8



9

### DATA RESOURCES

#### In Northborough and Massachusetts

<p> Massachusetts Climate Change Projections (NECSC, 2018)</p> <p> Massachusetts Climate Change Adaptation Report (MA EEA, 2011)</p> <p> Input from Municipal Officials</p>	<p> Northborough Hazard Mitigation Plan Update, 2018</p> <p> Northborough Master Plan, Presented February 2019</p> <p> Northborough Stormwater Management Plan, 2018</p>
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10



11

### EXTREME TEMPERATURES

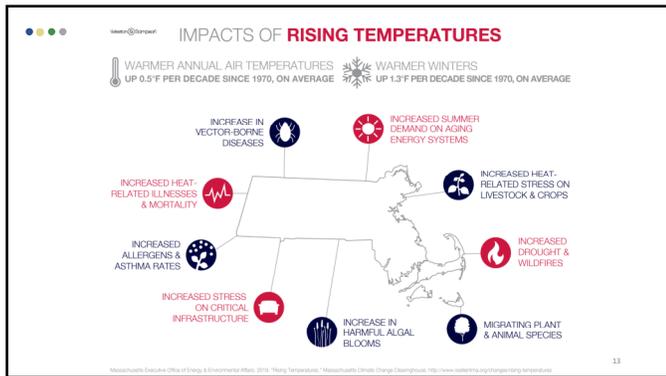
WARMER ANNUAL AIR TEMPERATURES

UP 0.5°F PER DECADE SINCE 1970, ON AVERAGE

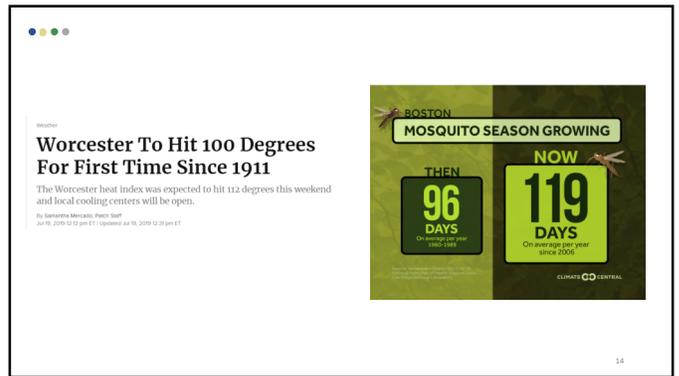
WARMER WINTERS

UP 1.3°F PER DECADE SINCE 1970, ON AVERAGE

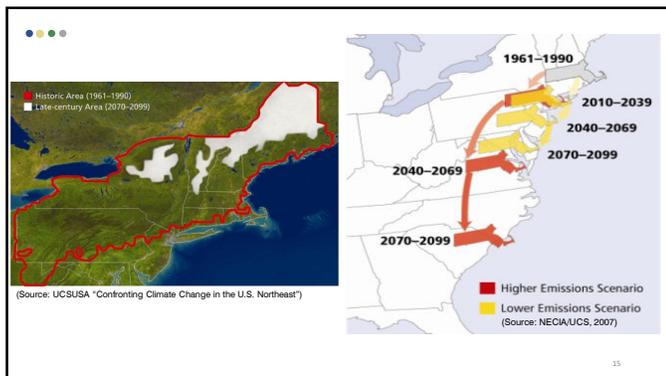
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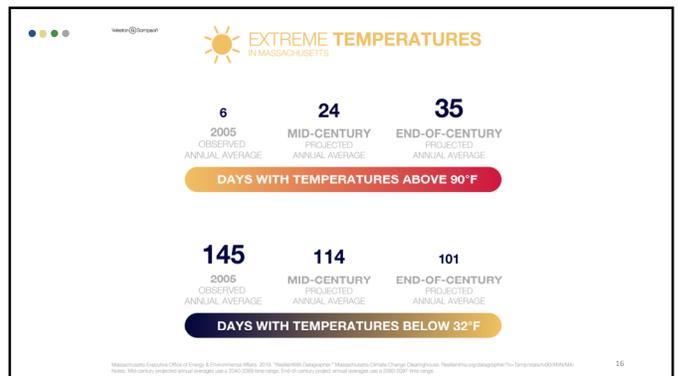
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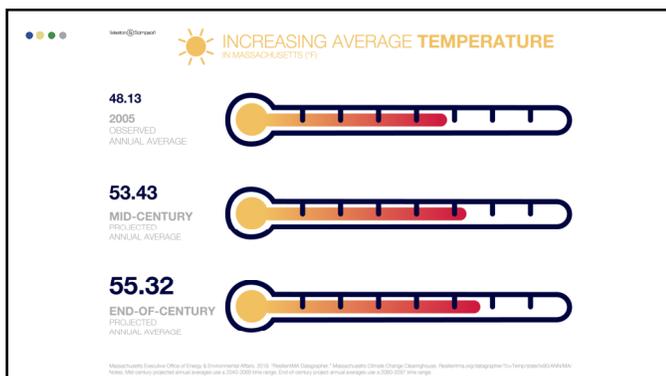
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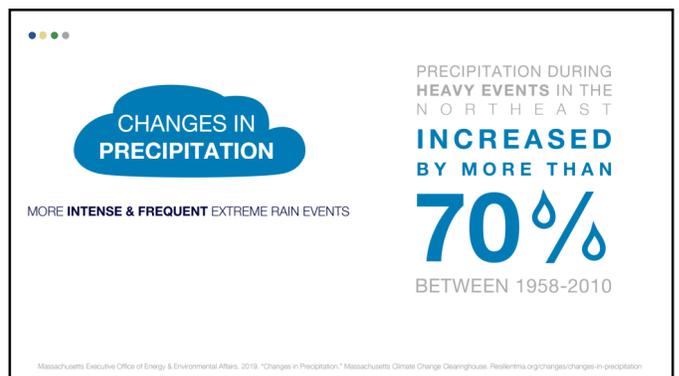
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16



17



18

## CHANGE IN PRECIPITATION

6-hour, 10-year event	24-hour, 100-year event
1961 = 3.2 inches	1961 = 6.5 inches
2015 = 3.35 inches	2015 = 8.40 inches

Source: NOAA TP-40 (1961) and NOAA Atlas Volume 30 (2015)

19

## IMPACTS OF CHANGING PRECIPITATION

HIGHER AVERAGE ANNUAL PRECIPITATION INCREASED BY ABOUT 10% IN THE NORTHEAST IN THE LAST 50 YEARS

- WETTER SPRINGS DELAY PLANTING & REDUCE YIELD
- DECREASED SUMMER PRECIPITATION COULD INCREASE EPISODIC DROUGHTS
- DROUGHTS CAN WEAKEN TREE ROOT SYSTEMS
- DROUGHTS CAN REDUCE LOCAL WATER SUPPLY
- CROP DAMAGE FROM INTENSE RAINFALL
- INCREASED ROAD POLLUTANTS IN WATERBODIES
- NEW STRESSES FOR ECOSYSTEMS

20

## Northeast and Midwest seasonal patterns

**2016**  
The most notable recent drought event was in

The occurrence of droughts lasting 1 to 3 months could go up by as much as **75% over existing conditions** by the end of the century, under the high emissions scenario

Image credit: Northeast Climate Science Center, University of Maryland Center for Environmental Science

21

## EXTREME PRECIPITATION

**8%** Increase in extreme precipitation events by midcentury

**13%** Increase in extreme precipitation events by 2100

22

## FLOODING

ZONE	ANNUAL CHANCE	FLOODPLAIN
A, AE, A1-A30	1% ANNUAL CHANCE	100-YEAR FLOODPLAIN
X	0.2% ANNUAL CHANCE	500-YEAR FLOODPLAIN

**“By 2050, Boston could experience the current 100-year riverine flood every two to three years on average”**

23

## FLOODING: PREVIOUS OCCURRENCES

- West Street
- Cherry Street
- Fay Lane & Lower Pleasant Street
- Tomblin Hill Road
- US-20/MA-9
- Boundary Street

	100 Year flood event
<b>Building Characteristics</b>	
Estimated total number of buildings	5,412
Estimated total building replacement value (2014 \$)	\$ 2,132,000,000
<b>Building Damages</b>	
# of buildings sustaining minor damage (1-10%)	21
# of buildings sustaining moderate damage (11-40%)	17
# of buildings sustaining severe damage (41-50%)	0
# of buildings destroyed	0
<b>Population Needs</b>	
# of households displaced	157
# of people seeking public shelter	182
<b>Debris</b>	
Building debris generated (tons)	N/A
# of truckloads to clear building debris	N/A
<b>Value of Damages</b>	
Total property damage (buildings and content)	\$ 26,260,000
Total losses due to business interruption	\$ 190,000

Source: Central Massachusetts Regional Planning Commission, 2016. "Northwest" Hazard Mitigation Plan Update, 10-15, 34

24

## REPETITIVE LOSS STRUCTURES



- Defined as an NFIP-insured structure that has had at least 2 paid flood losses of more than \$1,000 each in any 10-year period since 1978;
- Northborough has no repetitive loss structures;
- There have been no loss claims by FEMA NFIP participants in Northborough.

Above: a portion of the FEMA Flood Insurance Rate Map (FIRM) for Northborough.

1. Federal Emergency Management Agency (FEMA), 2019. "Definitions." Accessed August 28, 2019 & FEMA.gov/national-flood-insurance-program/definitions/1  
2. Central Massachusetts Regional Planning Commission, 2018. "Northborough Hazard Mitigation Plan Update," 15.

Weston Sampson

25

## STORMWATER FLOODING

Areas with:

- Poor drainage
- High amounts of impervious surface
- Undersized culverts



26

## EROSION

Caused by riverine flow & stormwater

Increased precipitation, including winter rains, could increase erosion

Drier soils will reduce resistance to erosion



Source: MA Climate Change Adaptation Report 2013

27

## PROJECTED CHANGES IN PRECIPITATION

**ANNUAL TOTAL PRECIPITATION IN MASSACHUSETTS (IN INCHES)**

<b>56.51</b> 2005 OBSERVED ANNUAL AVERAGE	<b>58.70</b> MID-CENTURY PROJECTED ANNUAL AVERAGE	<b>59.71</b> END-OF-CENTURY PROJECTED ANNUAL AVERAGE
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**EXTREME RAIN EVENTS WITH MORE THAN 2" OF RAIN PER DAY IN MASSACHUSETTS**

<b>&lt;1</b> DAY/YEAR CURRENT	<b>0.9-1.5</b> DAYS/YEAR 2100
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Massachusetts Executive Office of Energy & Environmental Affairs, 2019. "WeatherMA Dashboard." Massachusetts Climate Change Clearinghouse. <https://www.mass.gov/info-details/massachusetts-climate-change-clearinghouse-weatherma-dashboard>.  
\*Note: Mid-century projection based on scenario SSP2-RCP4.5. End-of-century projection based on scenario SSP5-RCP8.5.

28

## SEVERE STORMS



ESTIMATED DAMAGES FROM A TORNAO

**\$13,382,900**

Southern New England typically experiences



**10-15**  
DAYS PER YEAR  
with severe thunderstorms

Source: Central Massachusetts Regional Planning Commission, 2018. "Northborough Hazard Mitigation Plan Update," 10-13, 24.

29

## SNOWSTORMS

**IMPACT**

- Snowstorms have been particularly impactful to the north part of town (Howard, Green, Whitney)
- Tree damage and power outages
- Roof loads and building damage

**PREVIOUS OCCURRENCES**

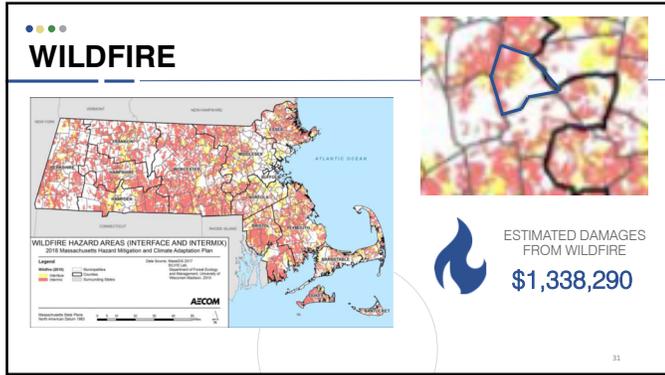
- Winter Storm **Grayson** (January 3, 2018)
- Winter Storm **Riley** (March 5, 2018)
- Winter Storm **Skyler** (March 11, 2018)

Heavy blizzards are among the **most costly and disruptive weather events** for Massachusetts communities.

The blizzard of 2013 left nearly **400,000 Massachusetts residents without power**

Source: Central Massachusetts Regional Planning Commission, 2018. "Northborough Hazard Mitigation Plan Update," 16-18.

30



31

## DAMS

There are **16 dams** located in Northborough

- Two are **High Hazard** (Cold Harbor Brook Dam and Hop Brook Dam)
- One is a **Significant Hazard** (Assabet River Dam)
- The town also owns a **Significant Hazard** poor condition dam (Reservoir Dam, MA01234) located in Shrewsbury/Boylston

Source: Central Massachusetts Regional Planning Commission, 2018, "Northborough Hazard Mitigation Plan Update," 39-41.

32

## HURRICANES AND EARTHQUAKES

### ESTIMATED DAMAGES FROM HURRICANES

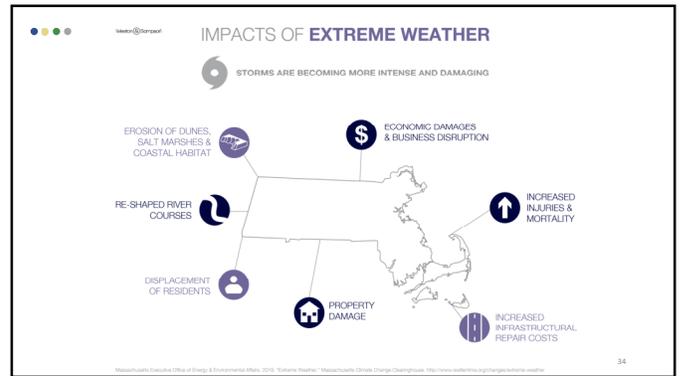
Building Characteristics	100 Year	500 Year
Estimated total number of buildings	5,413	
Estimated total building replacement value (2019 \$)	\$ 3,132,000,000	
<b>Building Damages</b>		
# of buildings sustaining minor damage	105	788
# of buildings sustaining moderate damage	5	87
# of buildings sustaining extensive damage	0	4
# of buildings destroyed	0	2
<b>Population Needs</b>		
# of households displaced	0	16
# of people seeking public shelter	0	4
<b>Debris</b>		
Building debris generated (tons)	2,049	6,163
Tire debris generated (tons)	3,118	9,636
# of truckloads to clear building debris	15	49
<b>Value of Damages (thousands of dollars)</b>		
Total property damage (building and content)	\$ 11,084.45	\$37,100.25
Total losses due to business interruption	\$ 27.70	\$205.13

### ESTIMATED DAMAGES FROM EARTHQUAKE

Building Characteristics	Magnitude 5.0
Estimated total number of buildings	5,000
Estimated total building replacement value (2014 \$)	\$ 2,311,000,000
<b>Building Damages</b>	
# of buildings sustaining slight damage	1,591
# of buildings sustaining moderate damage	483
# of buildings sustaining extensive damage	239
# of buildings completely damaged	62
<b>Population Needs</b>	
# of households displaced	120
# of people seeking public shelter	63
<b>Debris</b>	
Building debris generated (tons)	60,000
# of truckloads to clear debris (at 25 tons/truck)	2,500
<b>Value of Damages (dollars)</b>	
Total property damage	\$260,510,000
Total losses due to business interruption	\$56,700,000

Source: Central Massachusetts Regional Planning Commission, 2018, "Northborough Hazard Mitigation Plan Update," 32, 37-38.

33



34

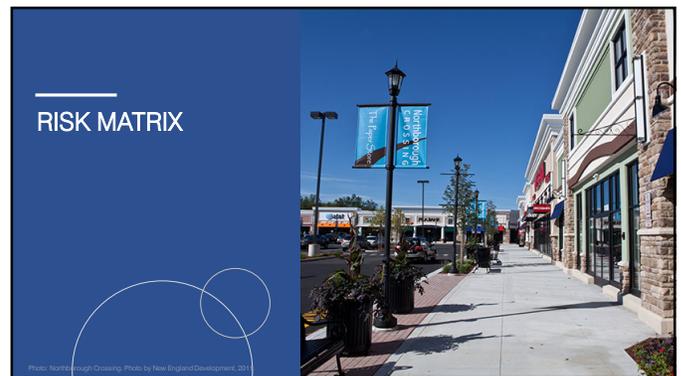
## As an FYI: Boston Sea Level Rise Projections (ft)

Increased coastal flooding  
 Permanently inundated low-lying coastal areas  
 Increased shoreline erosion

Emission Scenario	2030	2050	2070	2100
Intermediate	0.7	1.4	2.3	4.0
Intermediate-High	0.8	1.7	2.9	5.0
High	1.2	2.4	4.2	7.6
Extreme	1.4	3.1	5.4	10.2

Source: Northeast Climate Adaptation Science Center

35



36



### RISK MATRIX: FEATURES

Community Resilience Building Risk Matrix

Features	Location (Ownership) V or S	Vulnerability	Strength
Infrastructural			
Societal			
Environmental			

43

### RISK MATRIX: FEATURES

Features	Location (Ownership) V or S
Infrastructural	
Societal	
Environmental	

44

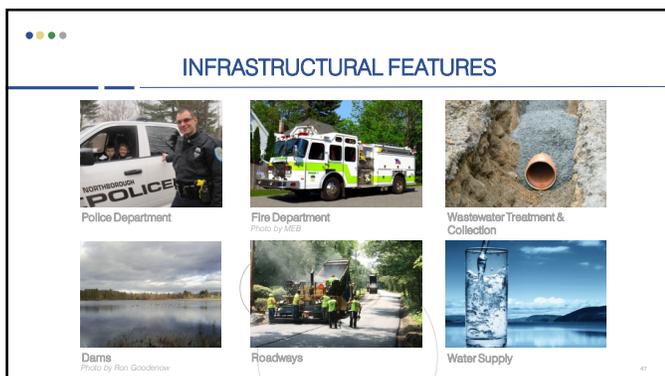
### RISK MATRIX: FEATURES

FEATURES	LOCATION	OWNERSHIP	VULNERABILITY OR STRENGTH
Infrastructural	Town wide	State	Vulnerability
Societal	Multi- vs. Single-neighborhood	Town	Strength
Environmental	Specific location	Private Shared	Both

45



46



47

- ### INFRASTRUCTURAL FEATURES
- Primary Evacuation Routes:**

  - I-290
  - Belmont Street/ MA-9
  - Church Street
  - Main Street
  - West Main Street
  - Southwest Cutoff/US-20
  - South Street/MA-135

**Critical Bridges, Intersections, and Sites:**

  - Bridge, 27 Allen Street
  - Bridge, 10 Church Street
  - Bridge, 55 Lyman Street
  - Bridge, 12 Rice Avenue
  - Bridge, 429 Whitney Street
  - Bridge, 418 Davis Street
  - Bridge, I-290 Overpass, 202 Brewer St.
  - Bridge, MA-135, 370 South St. at Davis St.
  - Bridge, US-20, 410 Main Street
  - Church St. & I-290
  - Hudson Street at Marlborough boundary
  - Hudson Street & Solomon Pond Rd
  - US-20 at Marlborough boundary
  - MA-135 & West Main Street
  - US-20 & West Main Street
  - MA-135 at Westborough boundary
  - Solomon Pond Road & I-290
  - West Main Street at Shrewsbury boundary
  - 68 Otis Street
  - Crawford Street & Stone Bridge
  - MA-135 at Town line
  - I-290 overpass at Whitney Street

48

### INFRASTRUCTURAL FEATURES



**Reservoir Dam, MA 01234**

49

### SOCIETAL FEATURES

Population
2010: 14,155 residents
2018: 15,101 estimated residents
Age
Under 18 years: 23% of residents
65+ years: 16.3% of residents
Education
Bachelor's degree or higher: 55.3% of residents
Additional Information
Median household income: \$111,875
Persons in poverty: 3.7% of residents
With a disability: 4.8% of residents under age 65
Language other than English spoken at home: 15.2% of residents



Assisted Living and Senior Centers

Source: U.S. Census Bureau, 2019

50

### ENVIRONMENTAL FEATURES



Forest



Streams



Trails

51

### ENVIRONMENTAL FEATURES



**18.8**  
square miles  
total area



**47%**  
is estimated to  
be the land is  
forested

**Mostly moderate-density  
suburban pattern**

Source: Central Massachusetts Regional Planning Commission, 2018, "Northborough Hazard Mitigation Plan Update," 28-30.

52

### ENVIRONMENTAL FEATURES

Approximately **80%** of Northborough residents and businesses are served by municipal water through the MWRA

The remaining **20%** source water from private wells. In recent years, there have been no reports of wells running dry.

The most notable recent drought event was in **2016**, though the Northborough area has been spared the most severe impacts in each case.



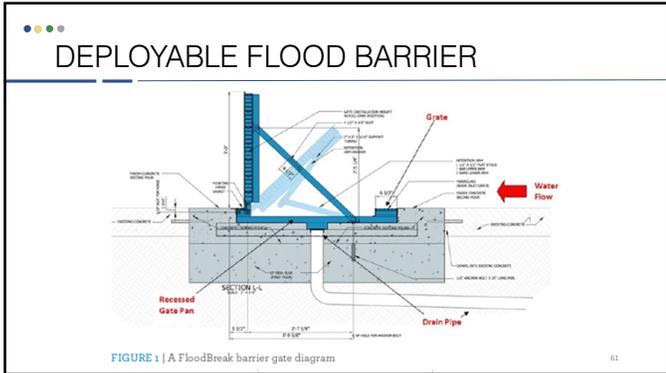
Source: Central Massachusetts Regional Planning Commission, 2018, "Northborough Hazard Mitigation Plan Update," 42.

53

## LUNCH

54

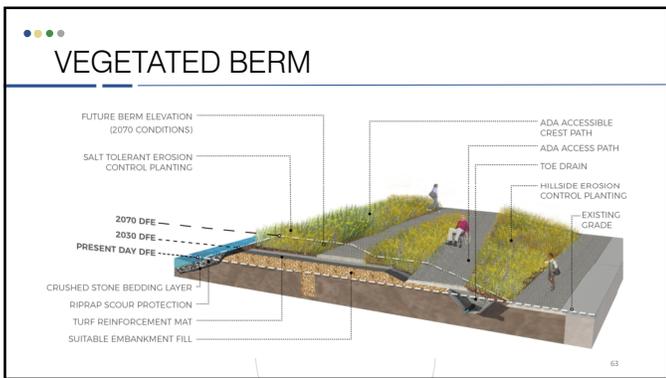




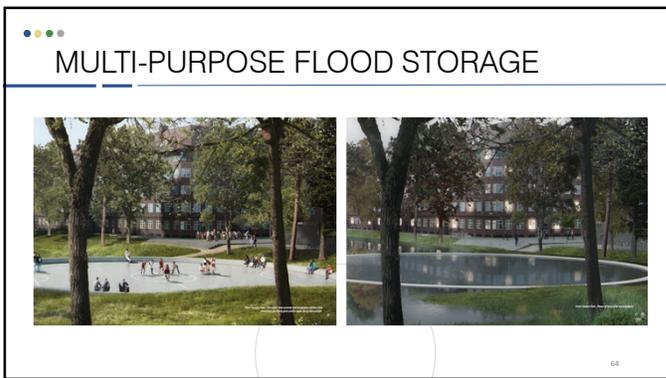
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62



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64



65



66

### STREET TREES & TREE BOX FILTERS

67

### STREET TREES & TREE BOX FILTERS

Rain Garden in a median strip of a townhouse project. Please note the depressed curb and grate inlet structure.

68

### STORMWATER DETENTION & RETENTION

69

### CULVERT WIDENING TO IMPROVE HABITAT & FLOW

70

### CLOUDBURST STREETS

71

### REDUCE IMPERVIOUS AREAS

Surface Type	Evapotranspiration	Runoff	Shallow Infiltration	Deep Infiltration
Natural Ground Cover	40%	10%	25%	25%
10%-20% Impervious Surface	38%	20%	21%	21%
35%-50% Impervious Surface	36%	30%	20%	15%
75%-100% Impervious Surface	30%	66%	10%	0%

72

### GREEN ROOFS

The diagram shows a cross-section of a green roof system with five layers: Substrate (top), Drainage/Filter Layer, Evolution, Waterproof Barrier, and Roof (bottom). To the right is a photograph of a modern building with a lush green roof.

73

### COOL ROOFS

The diagram compares a dark roof that reflects 20% of sunlight with a cool roof that reflects 80%. The cool roof is shown reflecting significantly more sunlight. An inset image shows two thermometers, with the one on the right (representing a cool roof) showing a lower temperature than the one on the left (representing a dark roof).

74

### COOLING CENTERS

A photograph of a building entrance with a sign that reads "COOLING CENTER". A person is standing near a car parked in front of the building.

75

### RENEWABLE MICRO-GRIDS

The diagram illustrates a renewable micro-grid system. It includes components such as Diesel Generation, Wind energy, Solar energy (PV), Li-ion energy storage, and a Microgrid controller. The system is connected to various sectors: Residential, Commercial, Industrial, and Public services. A utility transmission tower is also shown.

76

### LANDSCAPE DESIGN TO ACCOMMODATE WATER

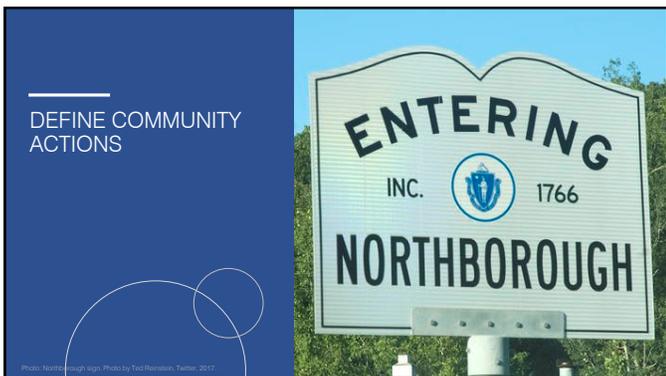
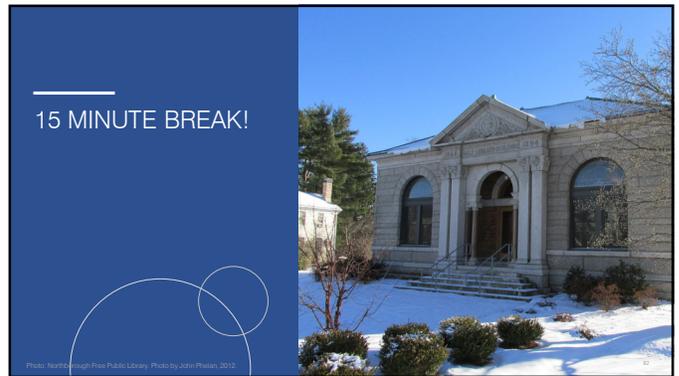
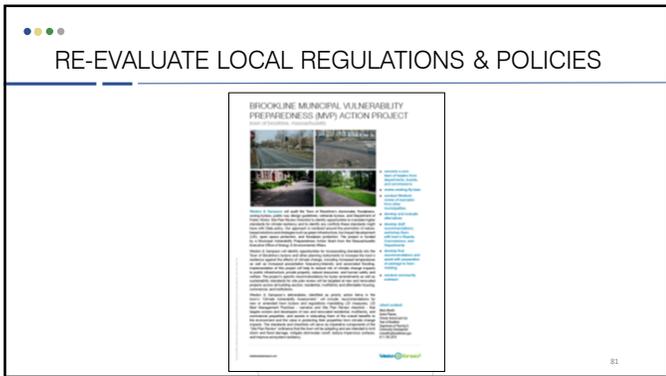
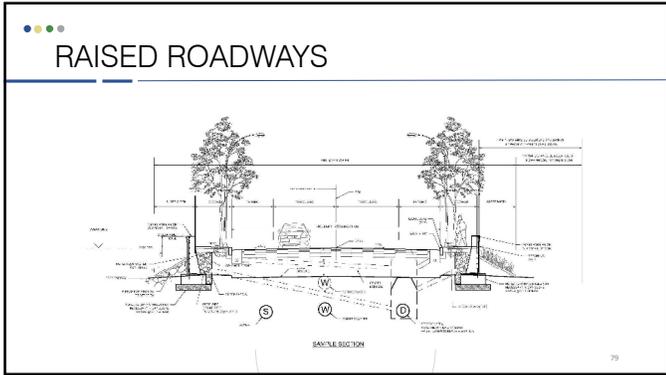
An aerial site plan diagram for Draw Seven Park. A large circular area is highlighted in blue, representing a water feature. The diagram includes a north arrow and a scale bar.

77

### LANDSCAPE DESIGN TO ACCOMMODATE WATER

An aerial site plan diagram for Draw Seven Park, similar to slide 77. It shows a water feature with a legend in the bottom right corner. The legend indicates "WATER" (blue) and "ROCK" (grey).

78





85



86

Mitigation Measures:

- Green communities
- OSP and Recreation Plan in Fall
- Complete inventory of culverts
- Final public pres. End of October
- 12 year I/I groundwater modeling
- 3 flood control systems

Rising ground water → tree damage (pine groves)

Mosquitos and ticks

Poison ivy and invasive species → roadway vegetation

Urganizatoion → impervious cover

Few farms in town; kill freeze in march killed peaches

Storms in 2011 – 2012 in October, leaves still on trees caused major damage from ice and storm

Stormwater flooding:

- Rice Ave
- Culvert on Main Street

Hot days – hot schools: helped by dehumidifiers in schools

**Map Edits**

Update Culverts:

We classified Priority 1 as culverts in the Assabet tributary to observed to be in poor condition. Priority 2 culverts were also poor condition culverts in the Assabet tributary, but on the extreme upstream end of the tributary.

(shown in excel file & on priority culvert map from Town)

Other Edits from Town:

1. Zoom out to include a dam owned by the Town—it's on the border of Boylston and Shrewsbury, above Northborough Reservoir
2. Add Areas Prone to Stormwater Flooding
  - West St
  - Rice Ave
  - Main St near culvert
  - Cherry St
  - Fay Lane & Lower Pleasant St
  - US-20 / MA-9
  - Boundary St to the Town line
3. Primary Evacuation Routes
  - I-290

- Belmont Street/MA-9
- Church Street
- Main Street
- West Main Street
- Southwest Cutoff/US-20
- South Street/MA-135

**APPENDIX B**

Community Resilience Building Workshop Materials

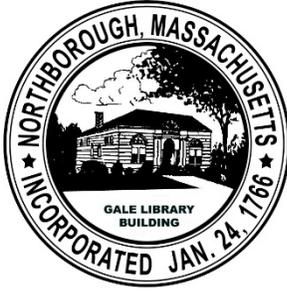


## TOWN OF NORTHBOROUGH

Municipal Vulnerability Preparedness Planning Grant Project  
Community Resilience Building Workshop

Large Conference Room, Northborough Public Library  
Tuesday, October 29, 2019  
11:30 am – 7:30 pm

- 11:30 am – 11:45 am    **Registration and Refreshments**
- 11:45 am – 12:00 pm    **Welcome and Introductions**
- 12:00 pm – 12:15 pm    **MVP Workshop Purpose and Overview**
- MVP Program Background
  - Purpose, Desired Outcomes, Objectives, Expectations
  - Review Agenda
  - Logistics
- 12:15 pm – 1:00 pm    **Data Resources and Overview of Science**
- Hazards
  - Existing Climate Change
  - Projected Climate Change
  - Recent Planning Efforts
  - Overview of Data and Maps Being Used During Workshop
- Risk Matrix**
- Hazards
  - Features
    - Infrastructure, Societal, Environmental
    - Vulnerability or Strength
    - Location
    - Ownership
  - Actions
- 1:00 pm – 1:15 pm    **Large Group Exercise #1**
- Identify Major Hazards in Community
  - Prioritize Top Four Hazards
- 1:15 pm – 1:30 pm    **BREAK**
- 1:30 pm – 1:50 pm    **Small Group Exercise #1**
- Infrastructure and Buildings Features: Vulnerability or Strength, Location, Ownership
- 1:50 pm – 2:10 pm    **Small Group Exercise #2**
- Societal Features: Vulnerability or Strength, Location, Ownership
- 2:10 pm – 2:30 pm    **Small Group Exercise #3**
- Environmental Features: Vulnerability or Strength, Location, Ownership



## TOWN OF NORTHBOROUGH

Municipal Vulnerability Preparedness Planning Grant Project  
Community Resilience Building Workshop

Large Conference Room, Northborough Public Library  
Tuesday, October 29, 2019  
11:30 am – 7:30 pm

2:30 pm – 3:00 pm

### **MVP Community Actions**

- Infrastructure
- Nature-Based Solutions

3:00 pm – 3:15 pm

### **BREAK**

3:15 pm – 4:00 pm

### **Small Group Exercise #4**

- Infrastructure and Buildings Features
- Define MVP Community Actions

4:00 pm – 4:45 pm

### **Small Group Exercise #5**

- Societal Features
- Define MVP Community Actions

4:45 pm – 5:15 pm

### **Small Group Exercise #6**

- Environmental Features,
- Define MVP Community Actions

5:15 pm – 6:15 pm

### **Dinner**

6:15 pm – 7:15 pm

### **Large Group Exercise #2**

- Identify MVP Priority Actions

7:15 pm – 7:30 pm

### **Wrap-up and Closing Remarks**

TOWN OF NORTHBOROUGH  
Municipal Vulnerability Preparedness Planning Grant Project  
Tuesday, October 29, 2019, 11:30 am – 7:30 pm  
Stakeholder Workshop Sign-In Sheet

Name	Affiliation	Email Address	Table
✓ Adrienne Cost	Council on Aging	<a href="mailto:cost0544@gmail.com">cost0544@gmail.com</a>	1
Bruce Augusti	MEMA		1
✓ Casey Mellin	Health Department	<a href="mailto:cmellin@town.northborough.ma.us">cmellin@town.northborough.ma.us</a>	2
✓ David Parenti	Fire Department	<a href="mailto:dparenti@town.northborough.ma.us">dparenti@town.northborough.ma.us</a>	1
✓ Fred Litchfield	Engineering Department	<a href="mailto:flitchfield@town.northborough.ma.us">flitchfield@town.northborough.ma.us</a>	3
✓ Gregory Martineau	Northborough-Southborough School District	<a href="mailto:gmartineau@nsboro.k12.ma.us">gmartineau@nsboro.k12.ma.us</a>	3
✓ James B. Eldridge	Massachusetts Senate	<a href="mailto:James.eldridge@masenate.gov">James.eldridge@masenate.gov</a>	
✓ Janet Pierce	Central Massachusetts Regional Planning Commission	<a href="mailto:jpierce@cmrpc.org">jpierce@cmrpc.org</a>	3
✓ Janet Sandstrom	Earthworks Board	<a href="mailto:Groversfrontpaw@gmail.com">Groversfrontpaw@gmail.com</a>	1
Jason Little	Finance Department	<a href="mailto:jlittle@town.northborough.ma.us">jlittle@town.northborough.ma.us</a>	2
✓ Jason Perreault	Board of Selectmen	<a href="mailto:jperreault@town.northborough.ma.us">jperreault@town.northborough.ma.us</a>	3
✓ Jeff Zukowski	MEMA	<a href="mailto:Jeffrey.zukowski@state.ma.us">Jeffrey.zukowski@state.ma.us</a>	1



TOWN OF NORTHBOROUGH  
Municipal Vulnerability Preparedness Planning Grant Project  
Tuesday, October 29, 2019, 11:30 am – 7:30 pm  
Stakeholder Workshop Sign-In Sheet

Name	Affiliation	Email Address	Table
✓ Joe Galvin	Police Department	<a href="mailto:jgavin@town.northborough.ma.us">jgavin@town.northborough.ma.us</a>	2
✓ John Coderre	Administration	<a href="mailto:jcoderre@town.northborough.ma.us">jcoderre@town.northborough.ma.us</a>	3
✓ June David-Fors	Family and Youth Service	<a href="mailto:Jdavid-fors@town.northborough.ma.us">Jdavid-fors@town.northborough.ma.us</a>	1
✓ Kathy Joubert	Planning Department	<a href="mailto:kjoubert@town.northborough.ma.us">kjoubert@town.northborough.ma.us</a>	1
✓ Kelly Burke	Senior Center	<a href="mailto:kburke@town.northborough.ma.us">kburke@town.northborough.ma.us</a>	2
✓ Kerri Martinek	Planning Board	<a href="mailto:kkmartinek@verizon.net">kkmartinek@verizon.net</a>	1
✓ Mia McDonald	Conservation Commission	<a href="mailto:Mmcdonald@town.northborough.ma.us">Mmcdonald@town.northborough.ma.us</a>	2
✓ Scott Charpentier	Department of Public Works	<a href="mailto:scharpentier@town.northborough.ma.us">scharpentier@town.northborough.ma.us</a>	2
✓ Trish Settles	Central Massachusetts Regional Planning Commission	<a href="mailto:tsettles@cmrpc.org">tsettles@cmrpc.org</a>	1
✓ Alison Field - <i>Sumner</i> Don Burn	OARS	<a href="mailto:office@oars3rivers.org">office@oars3rivers.org</a>	3
✓ Hillary King	EEA	hillary.king@mass.gov	





**TOWN OF NORTHBOROUGH**

Community Resilience Building Workshop  
Tuesday, October 29, 2019

WestonCampson | Photo: Old Farm Birding Trail. Photo by the Northborough Conservation Commission.

1



**WELCOME CORE TEAM**

Scott Charpentier	Jason Little
Kathy Joubert	June David-Fors
Mia McDonald	Casey Mellin
John Coderre	Kelly Burke
David Parenti	Fred Litchfield

WestonCampson | Photo: Traskville Stone Aqueduct. Photo from Northborough Historical Society.

2



**WELCOME W&S**

Amanda Kohn  
Lindsey Adams  
Robert Almy

WestonCampson | Photo: Aqueduct Bridge. Photo by Winter Wind Photography.

3



**WELCOME PARTICIPANTS**

Your name  
Organization/Relationship to Northborough  
Favorite thing about Northborough

WestonCampson | Photo: Aqueduct Bridge. Photo by Winter Wind Photography.

4

**WORKSHOP OUTLINE**

*PRESENTATION:*

- Overview of Science & Data
- Characterization of Hazards

**- BREAK -**

*INDIVIDUAL TABLES:*

- Identify Community Features

**- LUNCH -**

*INDIVIDUAL TABLES:*

- Identify and Prioritize Actions

**- BREAK -**

*LARGE GROUP DISCUSSION:*

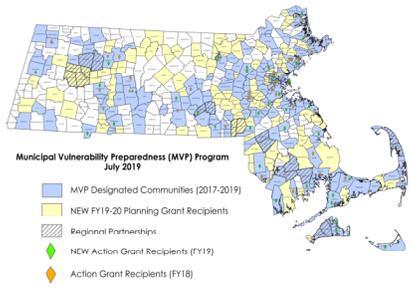
- Determine Overall Priorities



Photo:

5

**MUNICIPAL VULNERABILITY PREPAREDNESS PROGRAM (MVP)**

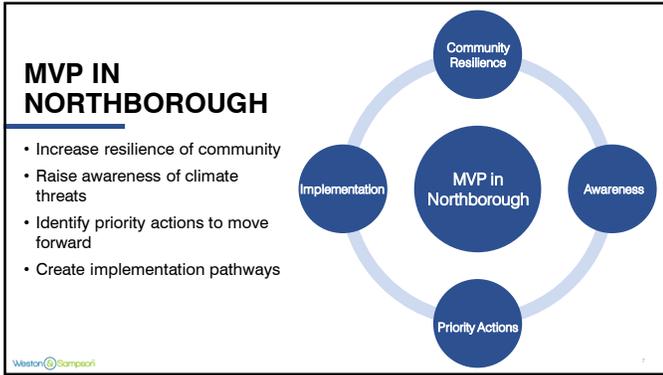


**Municipal Vulnerability Preparedness (MVP) Program July 2019**

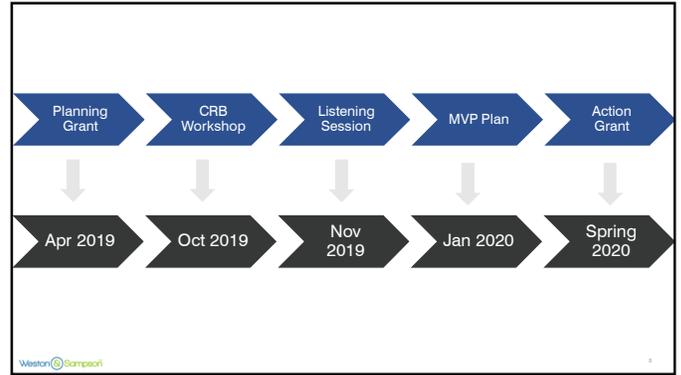
- MVP Designated Communities (2017-2019)
- NEW FY19-20 Planning Grant Recipients
- ▨ Regional Partnerships
- ◆ NEW Action Grant Recipients (FY19)
- ◆ Action Grant Recipients (FY18)

WestonCampson

6



7



8

### CORE TEAM

<p><b>ROLE</b></p> <ul style="list-style-type: none"> <li>• Confirm framework for process</li> <li>• Provide data and local expertise</li> <li>• Participate in the stakeholder workshop</li> <li>• Finalize priority actions for the final report</li> <li>• Interviews</li> </ul>	<p><b>TODAY'S OBJECTIVES</b></p> <ul style="list-style-type: none"> <li>• Review Process</li> <li>• Set Goals</li> <li>• Prepare for Stakeholder Meeting</li> </ul>
---	---

9

### GREENHOUSE GASES (GHG)

- Naturally occurring
- Act as a blanket
- Examples: carbon dioxide and methane

*Climate mitigation ensures there is less to adapt to and is a key component of our community's resilience*

10

### MASSACHUSETTS GHG GOALS

- Established by the Global Warming Solutions Act (GWSA) of 2008
- 25% reduction in GHG emissions by 2020
- 80% reduction in GHG emissions by 2050
- 1990 is the baseline year

FIGURE 3 | TRENDS OF GROWTH IN GSP, VMT, AND POPULATION WHILE GHG EMISSIONS ARE DECREASING AND ENERGY USE HAS BEEN STABLE

11

### DATA RESOURCES

**In Northborough and Massachusetts**

- Massachusetts Climate Change Projections (NECSC, 2018)
- Northborough Hazard Mitigation Plan Update, 2018
- Massachusetts Climate Change Adaptation Report (MA EEA, 2011)
- Northborough Master Plan, Coming this Fall
- Input from Municipal Officials
- Northborough Stormwater Management Plan, 2018

12

## HAZARDS IN NORTHBOROUGH

Weston Sampson | Source: Central Massachusetts Regional Planning Commission, 2018. "Northborough Hazard Mitigation Plan Update." 8

13

## EXTREME TEMPERATURES

**WARMER ANNUAL AIR TEMPERATURES**  
 UP 0.5°F PER DECADE SINCE 1970, ON AVERAGE

**WARMER WINTERS**  
 UP 1.3°F PER DECADE SINCE 1970, ON AVERAGE

14

## IMPACTS OF RISING TEMPERATURES

**WARMER ANNUAL AIR TEMPERATURES**  
 UP 0.5°F PER DECADE SINCE 1970, ON AVERAGE

**WARMER WINTERS**  
 UP 1.3°F PER DECADE SINCE 1970, ON AVERAGE

Massachusetts Office of Energy & Environmental Affairs, 2019. "Energy Transition: Massachusetts Climate Change Impacts." <https://www.mass.gov/info-details/massachusetts-climate-change-impacts>

15

## Worcester To Hit 100 Degrees For First Time Since 1911

The Worcester heat index was expected to hit 112 degrees this weekend and local cooling centers will be open.

By Samantha Mercado, Patch Staff  
 Jul 19, 2019 12:32 pm ET | Updated Jul 19, 2019 12:32 pm ET

**Local Experience:**  
 Poison Ivy and Invasive Species in Roadway Vegetation

CLIMATE CENTRAL

16

■ Higher Emissions Scenario  
■ Lower Emissions Scenario  
 (Source: NECA/UCS, 2007)

17

17

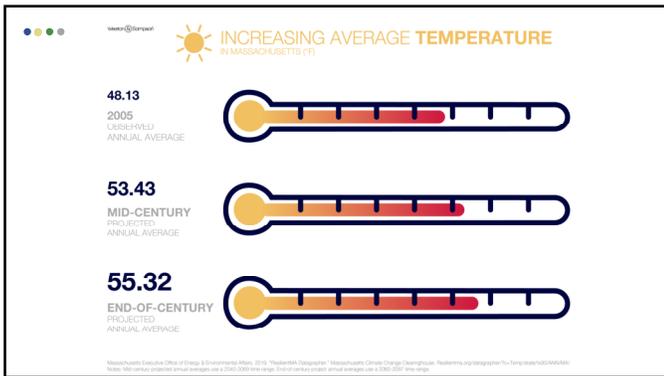
## EXTREME TEMPERATURES IN MASSACHUSETTS

<b>6</b>	<b>24</b>	<b>35</b>
2005 OBSERVED ANNUAL AVERAGE	MID-CENTURY PROJECTED ANNUAL AVERAGE	END-OF-CENTURY PROJECTED ANNUAL AVERAGE
<b>DAYS WITH TEMPERATURES ABOVE 90°F</b>		
<b>145</b>	<b>114</b>	<b>101</b>
2005 OBSERVED ANNUAL AVERAGE	MID-CENTURY PROJECTED ANNUAL AVERAGE	END-OF-CENTURY PROJECTED ANNUAL AVERAGE
<b>DAYS WITH TEMPERATURES BELOW 32°F</b>		

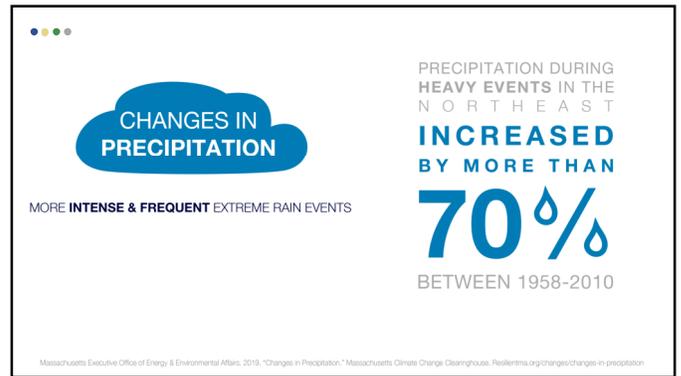
Massachusetts Office of Energy & Environmental Affairs, 2019. "Energy Transition: Massachusetts Climate Change Impacts: Projections and Adaptation for the Commonwealth." <https://www.mass.gov/info-details/massachusetts-climate-change-impacts>  
 Note: Projections include annual average data for 2005, 2050, and 2100. For information on the annual average data, see 2005, 2050, and 2100.

18

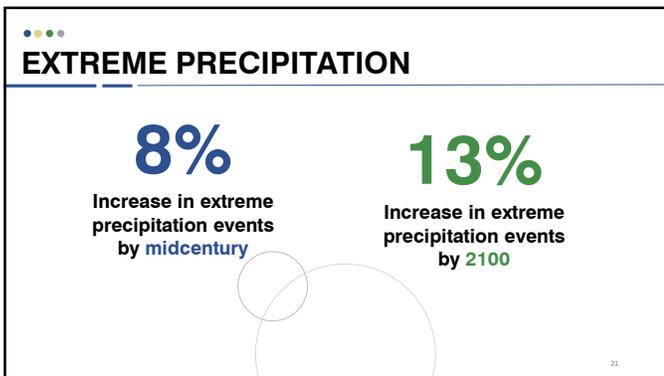
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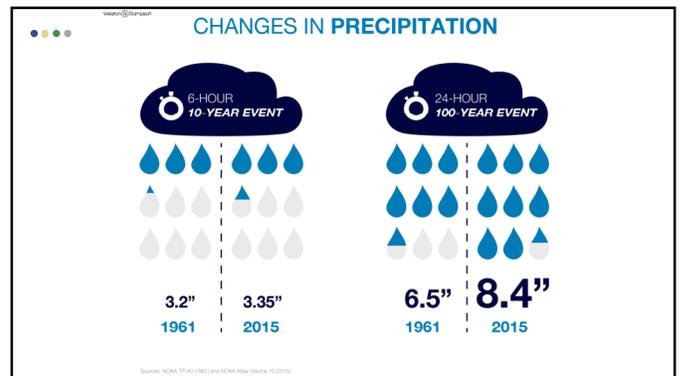
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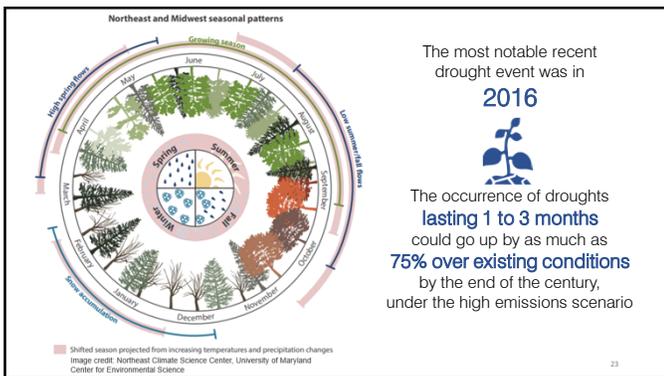
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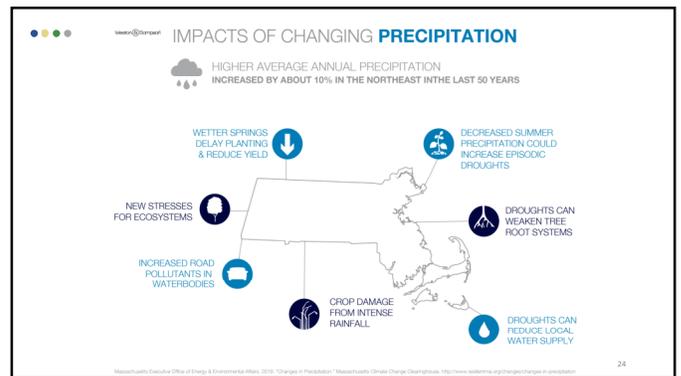
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23



24

## FLOODING

ZONE	ANNUAL CHANCE	FLOODPLAIN
A, AE, A1-A30	1% ANNUAL CHANCE	100-YEAR FLOODPLAIN
X	0.2% ANNUAL CHANCE	500-YEAR FLOODPLAIN

*“By 2050, Boston could experience the current 100- year riverine flood every two to three years on average”*

25

## FLOODING: PREVIOUS OCCURRENCES

- West Street
- Cherry Street
- Fay Lane & Lower Pleasant Street
- Tomblin Hill Road
- US-20/MA-9
- Boundary Street

	100 Year flood event
<b>Building Characteristics</b>	
Estimated total number of buildings	5,412
Estimated total building replacement value (2014 \$)	\$ 2,132,000,000
<b>Building Damages</b>	
# of buildings sustaining minor damage (1-10%)	21
# of buildings sustaining moderate damage (11-40%)	17
# of buildings sustaining severe damage (41-50%)	0
# of buildings destroyed	0
<b>Population Needs</b>	
# of households displaced	157
# of people seeking public shelter	182
<b>Debris</b>	
Building debris generated (tons)	N/A
# of truckloads to clear building debris	N/A
<b>Value of Damages</b>	
Total property damage (buildings and content)	\$ 26,260,000
Total losses due to business interruption	\$ 190,000

Source: Central Massachusetts Regional Planning Commission, 2018. "Northborough Hazard Mitigation Plan Update," 12-13, 24.

26

## REPETITIVE LOSS STRUCTURES



- Defined as an NFIP-insured structure that has had at least 2 paid flood losses of more than \$1,000 each in any 10-year period since 1975.
- Northborough has no repetitive loss structures.
- There have been no loss claims by FEMA NFIP participants in Northborough.

Source: FEMA Flood Insurance Rate Map (FIRM) for Northborough

1. Federal Emergency Management Agency (FEMA), 2019. "Definitions." Accessed August 29, 2019. <https://www.fema.gov/national-flood-insurance-program/definitions>

2. Central Massachusetts Regional Planning Commission, 2018. "Northborough Hazard Mitigation Plan Update," 13.

27

## STORMWATER FLOODING

Areas with:

- Poor drainage
- High amounts of impervious surface
- Undersized culverts
- Urbanization

Areas Prone to Stormwater Flooding:

- West St
- Rice Ave
- Main St near culvert
- Cherry St
- Fay Lane & Lower Pleasant St
- US-20 / MA-9
- Boundary St to the Town line

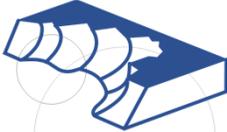
28

## EROSION

Caused by riverine flow & stormwater

Increased precipitation, including winter rains, could increase erosion

Drier soils will reduce resistance to erosion



29

## PROJECTED CHANGES IN PRECIPITATION

ANNUAL TOTAL PRECIPITATION IN MASSACHUSETTS (IN INCHES)

Year	Annual Average
2005 Observed	56.51
Mid-Century Projected	58.70
End-of-Century Projected	59.71

EXTREME RAIN EVENTS WITH MORE THAN 2" OF RAIN PER DAY IN MASSACHUSETTS

Year	Days per Year
<1 Day/Year Current	~1
0.9-1.5 Days/Year 2100	~1.2

30

## SEVERE STORMS



Southern New England typically experiences

**10-15**  
DAYS PER YEAR  
with severe thunderstorms

ESTIMATED DAMAGES FROM A TORNADO  
**\$13,382,900**

Source: Central Massachusetts Regional Planning Commission, 2018, "Northborough Hazard Mitigation Plan Update," 12-13, 24.

31

## SNOWSTORMS

**IMPACT**

- Snowstorms have been particularly impactful to the north part of town (Howard, Green, Whitney)
- Tree damage and power outages
- Roof loads and building damage

Heavy blizzards are among the **most costly and disruptive weather events** for Massachusetts communities.

The blizzard of 2013 left nearly **400,000 Massachusetts residents without power**

Source: Central Massachusetts Regional Planning Commission, 2018, "Northborough Hazard Mitigation Plan Update," 16-18. State Climate Hazard Adaptation and Mitigation Plan.

32

## SNOWSTORMS

**PREVIOUS OCCURRENCES**

- Winter Storm **Grayson** (January 3, 2018)
- Winter Storm **Riley** (March 5, 2018)
- Winter Storm **Skyler** (March 11, 2018)

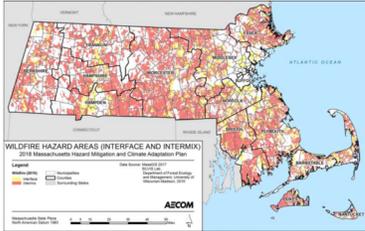
**LOCAL IMPACTS**

- 2011 October Storm caused major damage to trees and powerlines
- March kill freeze impacted peach farms

Source: Central Massachusetts Regional Planning Commission, 2018, "Northborough Hazard Mitigation Plan Update," 16-18. State Climate Hazard Adaptation and Mitigation Plan.

33

## WILDFIRE



ESTIMATED DAMAGES FROM WILDFIRE  
**\$1,338,290**

Source: Central Massachusetts Regional Planning Commission, 2018, "Northborough Hazard Mitigation Plan Update," 16-18. State Climate Hazard Adaptation and Mitigation Plan.

34

## DAMS

There are **16 dams** located in Northborough

- Two are **High Hazard** (Cold Harbor Brook Dam and Hop Brook Dam)
- One is a **Significant Hazard** (Assabet River Dam)
- The town also owns a **Significant Hazard** poor condition dam (Reservoir Dam, MA01234) located in Shrewsbury/Boylston

Source: Central Massachusetts Regional Planning Commission, 2018, "Northborough Hazard Mitigation Plan Update," 28-41.

35

## HURRICANES AND EARTHQUAKES

**ESTIMATED DAMAGES FROM HURRICANES**

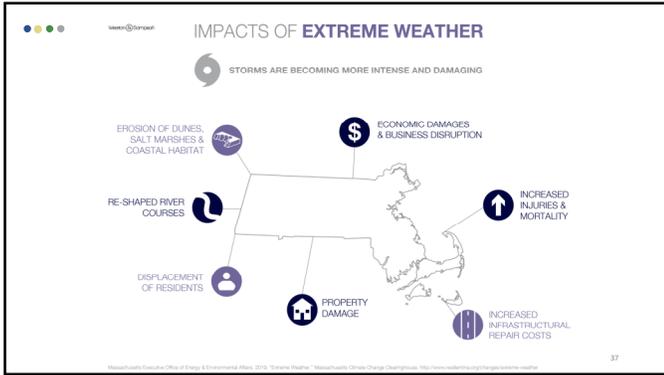
	100 Year	500 Year
<b>Building Characteristics</b>		
Estimated total number of buildings	4,473	4,473
Estimated total building replacement value (2012 \$)	\$ 3,137,000,000	\$ 3,137,000,000
<b>Building Damages</b>		
# of buildings sustaining minor damage	102	708
# of buildings sustaining moderate damage	5	43
# of buildings sustaining severe damage	0	2
# of buildings destroyed	0	2
<b>Population Needs</b>		
# of households displaced	0	10
# of people seeking public shelter	0	4
<b>Debts</b>		
Building debts generated (dollars)	2,040	6,107
Tree debts generated (dollars)	3,018	9,026
# of roads/tracks to clear building debris	15	40
<b>Value of Damages (thousands of dollars)</b>		
Total property damage (buildings and contents)	\$ 11,406.42	\$37,190.23
Total losses due to business interruption	\$ 297.01	\$2,016.15

**ESTIMATED DAMAGES FROM EARTHQUAKE**

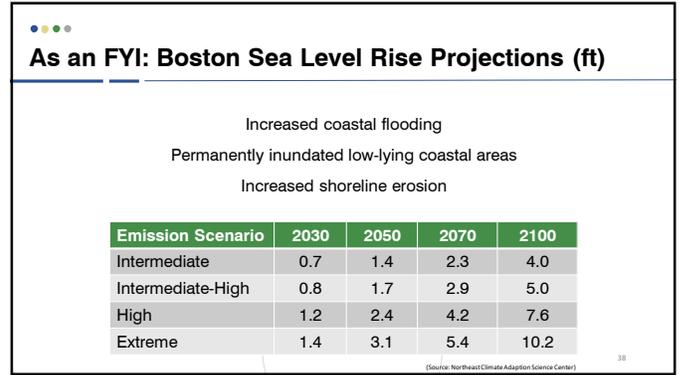
	Magnitude 5.6
<b>Building Characteristics</b>	
Estimated total number of buildings	4,000
Estimated total building replacement value (2012 \$)	\$ 3,137,000,000
<b>Building Damages</b>	
# of buildings sustaining slight damage	1,591
# of buildings sustaining moderate damage	803
# of buildings sustaining extensive damage	239
# of buildings completely damaged	62
<b>Population Needs</b>	
# of households displaced	239
# of people seeking public shelter	63
<b>Debts</b>	
Building debts generated (dollars)	60,000
# of roads/tracks to clear debris (60-25 tons track)	2,200
<b>Value of Damages (dollars)</b>	
Total property damage	\$259,510,000
Total losses due to business interruption	\$58,700,000

Source: Central Massachusetts Regional Planning Commission, 2018, "Northborough Hazard Mitigation Plan Update," 22, 37-38.

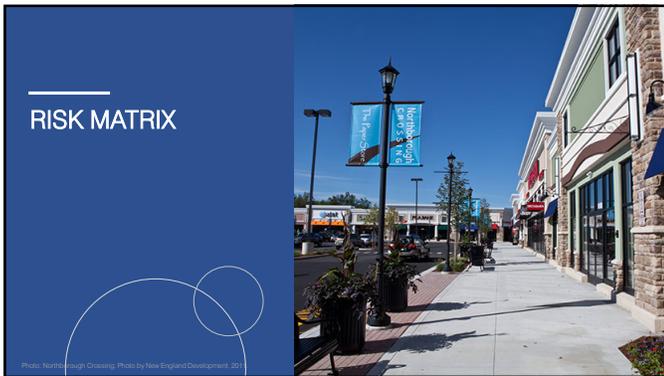
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37



38



39

### RISK MATRIX

Community Resilience Building Risk Matrix

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

Location	Location	Ownership	Vulnerability	Priority	Time
<b>Infrastructure</b>					
<b>Social</b>					
<b>Environmental</b>					

40

40

### RISK MATRIX: HAZARDS

Community Resilience Building Risk Matrix

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

Location	Location	Ownership	Vulnerability	Priority	Time
<b>Infrastructure</b>					
<b>Social</b>					
<b>Environmental</b>					

41

41

### RISK MATRIX: HAZARDS

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

				Priority	Time
				H - M - L	Short Long Drifting

42

42



43

### Hazards in Northborough

Hazard	Location of Occurrence	Probability of Future Events	Impact
Flooding	Small	Low	Minor
Severe Snowstorms, Ice Storms, Nor'easter	Large	Very High	Limited
Severe Thunderstorms, Winds, Tornadoes	Small	Moderate, Moderate, Very Low	Minor, Limited, Limited
Hurricanes	Large	Low	Limited
Wildfire, Brushfire	Small	Moderate	Minor
Earthquakes	Large	Very Low	Minor
Dam Failure	Small	Moderate	Limited
Drought	Large	Very Low	Minor
Extreme Temperatures	Large	Moderate	Limited

Source: Central Massachusetts Regional Planning Commission, 2018. "Northborough Hazard Mitigation Plan Update", 11. <http://www.northborough.com>

44



45

### RISK MATRIX: FEATURES

Community Resilience Building Risk Matrix [www.CommunityResilienceBuilding.com](http://www.CommunityResilienceBuilding.com)

By Risk & priority for action over the Short or Long term (and Mitigation) Top Priority Hazards (roads, floods, wildfires, hurricanes, earthquake, drought, sea level rise, heat waves, etc.)

Features	Location	Ownership	V or S
Infrastructural			
Societal			
Environmental			

46

### RISK MATRIX: FEATURES

By Risk & priority for action over the Short or Long term (and Mitigation) Top Priority Hazards (roads, floods, wildfires, hurricanes, earthquake, drought, sea level rise, heat waves, etc.)

Features	Location	Ownership	V or S
Infrastructural			
Societal			
Environmental			

47

### RISK MATRIX: FEATURES

FEATURES	LOCATION	OWNERSHIP	VULNERABILITY OR STRENGTH
Infrastructural	Town wide	State	Vulnerability
Societal	Multi- vs. Single-neighborhood	Town	Strength
Environmental	Specific location	Private Shared	Both

48



FEATURES IN NORTHBOROUGH

49

### INFRASTRUCTURAL FEATURES

Police Department

Fire Department  
Photo by MEB

Wastewater Treatment & Collection

Dams  
Photo by Ron Goodenow

Roadways

Water Supply

50

### INFRASTRUCTURAL FEATURES

**Primary Evacuation Routes:**

- I-290
- Belmont Street/ MA-9
- Church Street
- Main Street
- West Main Street
- Southwest Cutoff/US-20
- South Street/MA-135

**Critical Bridges, Intersections, and Sites:**

- Bridge, 27 Allen Street
- Bridge, 10 Church Street
- Bridge, 55 Lyman Street
- Bridge, 12 Rice Avenue
- Bridge, 429 Whitney Street
- Bridge, 418 Davis Street
- Bridge, I-290 Overpass, 202 Brewer St.
- Bridge, MA-135, 370 South St. at Davis St.
- Bridge, US-20, 410 Main Street
- Church St. & I-290
- Hudson Street at Marlborough boundary
- Hudson Street & Solomon Pond Rd
- US-20 at Marlborough boundary
- MA-135 & West Main Street
- US-20 & West Main Street
- MA-135 at Westborough boundary
- Solomon Pond Road & I-290
- West Main Street at Shrewsbury boundary
- 68 Otis Street
- Crawford Street & Stone Bridge
- MA-135 at Town line
- I-290 overpass at Whitney Street

Source: Central Massachusetts Regional Planning Commission, 2018, "Northborough Hazard Mitigation Plan Update," 146

51

### SOCIETAL FEATURES

Population
2010: 14,155 residents
2018: 15,101 estimated residents
Age
Under 18 years: 23% of residents
65+ years: 16.3% of residents
Education
Bachelor's degree or higher: 55.3% of residents
Additional Information
Median household income: \$111,875
Persons in poverty: 3.7% of residents
With a disability: 4.8% of residents under age 65
Language other than English spoken at home: 15.2% of residents

Source: Town of Northborough

Source: U.S. Census Bureau, 2019

52

### ENVIRONMENTAL FEATURES

Forest

Streams

Trails

53

### ENVIRONMENTAL FEATURES

**18.8**  
square miles  
total area

**47%**  
is estimated to  
be the land is  
forested

**Mostly moderate-density suburban pattern**

Source: Central Massachusetts Regional Planning Commission, 2018, "Northborough Hazard Mitigation Plan Update," 28-30

54

## ENVIRONMENTAL FEATURES

Approximately **80%** of Northborough residents and businesses are served by municipal water through the MWRA

The remaining **20%** source water from private wells. In recent years, there have been no reports of wells running dry.

The most notable recent drought event was in **2016**, though the Northborough area has been spared the most severe impacts in each case.



Source: Central Massachusetts Regional Planning Commission, 2018, "Northborough Hazard Mitigation Plan Update," 42.

55

## LUNCH



Photo: WMAZ.com, Photo by Alan Jung, Daily News Staff Photo, 2016.

56

## ADAPTATION STRATEGIES



Photo: An urban field in Northborough. Photo by Mary Jo, Teller, 2019.

57

## EXISTING HAZARD PROTECTION

- National Flood Insurance Program (NFIP)
- Stormwater management policy and regulations in place
- Local Open Space and Recreation Plan
- Separated stormwater and sewer collection systems
- Drainage system maintenance and repair program
- Tree trimming
- Culvert maintenance and replacement
- Comprehensive Emergency Management Plan
- Master Plan is scheduled to be completed in 2019
- Planning Board regulates development in Town

Westerly | Simpson Source: Central Massachusetts Regional Planning Commission, 2018, "Northborough Hazard Mitigation Plan Update," 6, 65-67, 79.

58

## CLIMATE RESILIENCE MEASURES

- Dehumidifiers in Schools
- Green Communities Participant
- Open Space and Recreation Plan Update
- Complete Inventory of Culverts
- Update of Master Plan
- 12 Years of Ongoing Monitor and Model of Groundwater
- 3 Flood Control Systems

Westerly | Simpson Source: One Team Kickoff Meeting.

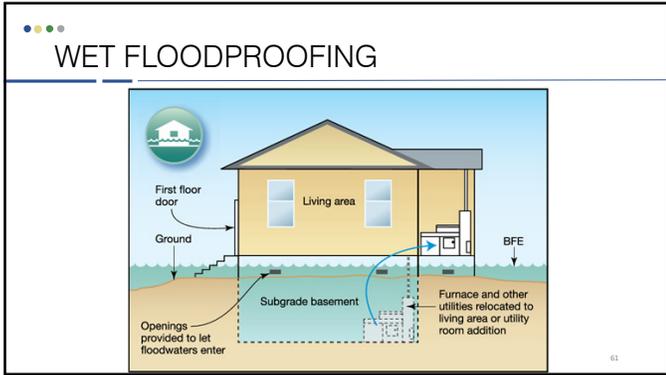
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## COMMUNITY ACTIONS



60

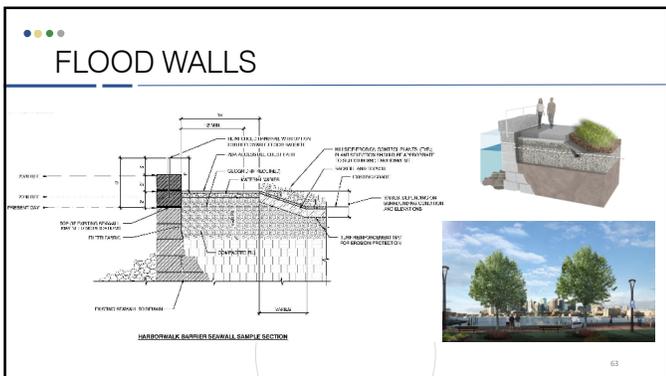
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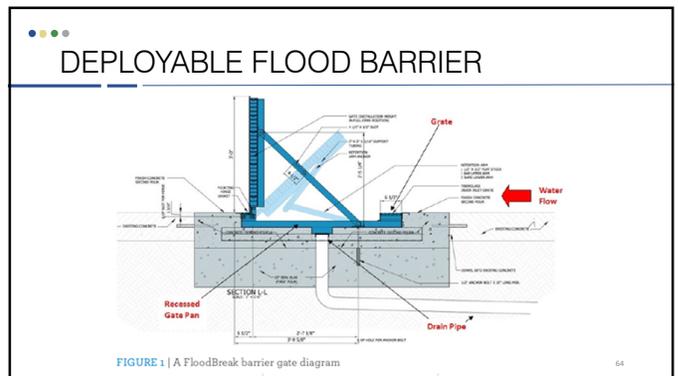
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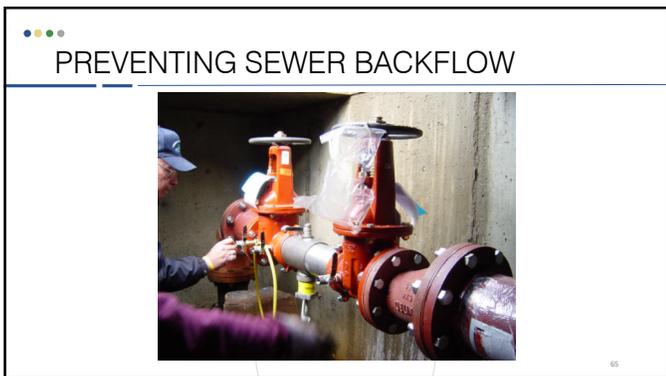
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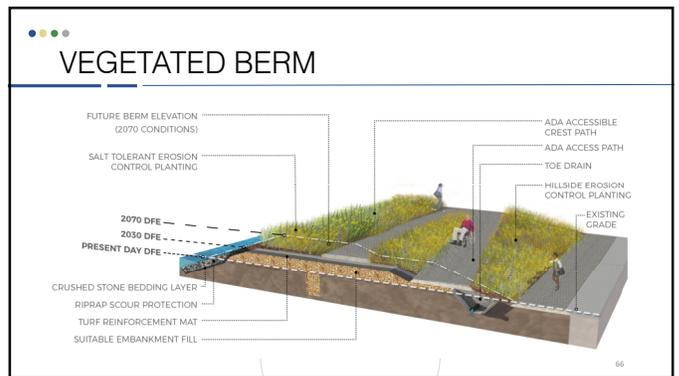
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64



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66

MULTI-PURPOSE FLOOD STORAGE

67

LOW IMPACT DEVELOPMENT (LID)

68

POROUS ASPHALT & PERMEABLE PAVERS

69

STREET TREES & TREE BOX FILTERS

70

STREET TREES & TREE BOX FILTERS

Rain Garden in a median strip of a townhouse project. Please note the depressed curb and grate inlet structure

71

STORMWATER DETENTION & RETENTION

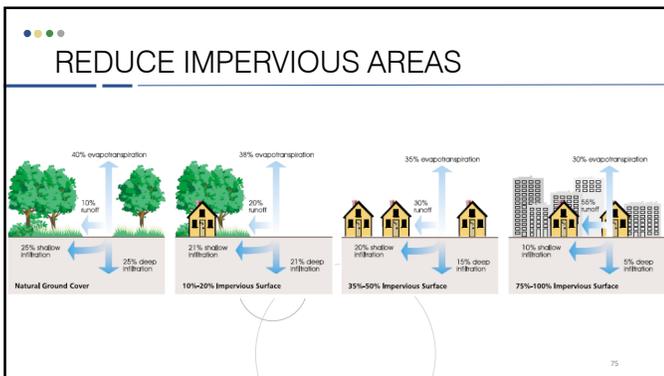
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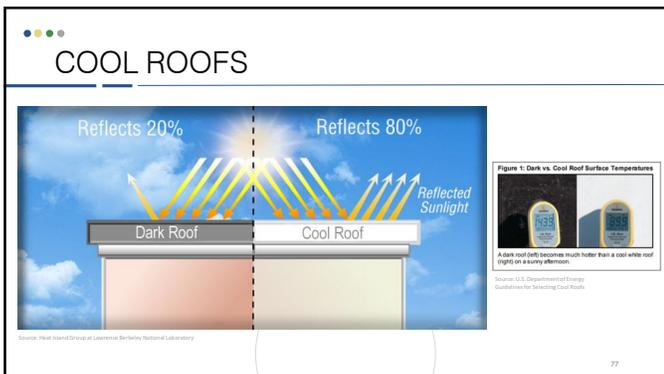
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75



76



77



78

### RENEWABLE MICRO-GRIDS

Li-ion energy storage takes microgrids to the next level

79

79

### LANDSCAPE DESIGN TO ACCOMMODATE WATER

CONCEPT #1 - CROWD DIAGRAM  
DRAW SEVEN PARK

80

80

### LANDSCAPE DESIGN TO ACCOMMODATE WATER

CONCEPT #1 - INUNDATION DIAGRAM  
DRAW SEVEN PARK

81

81

### RAISED ROADWAYS

SECTION

82

82

### RETROFITTED FLOODPROOF DOORWAYS

83

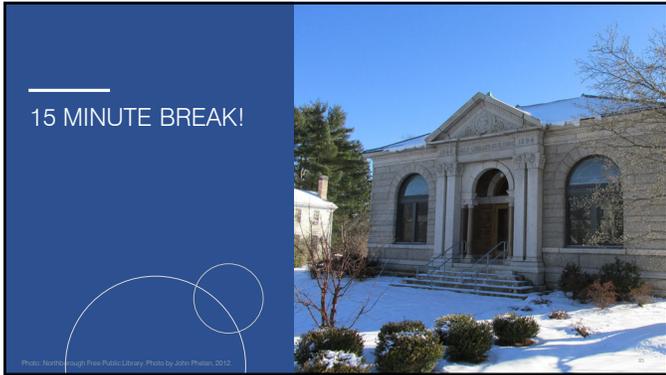
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### RE-EVALUATE LOCAL REGULATIONS & POLICIES

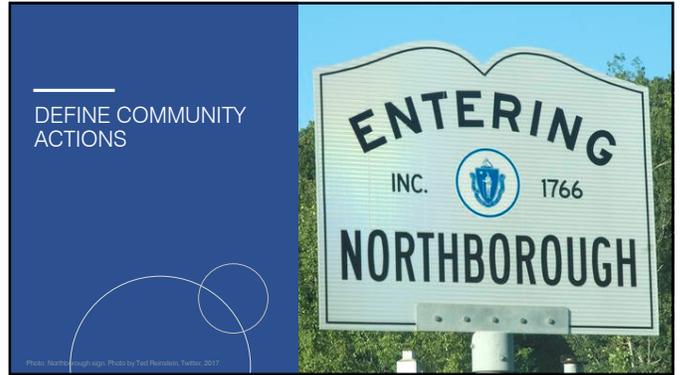
BROOKLINE MUNICIPAL VULNERABILITY PREPAREDNESS (MVP) ACTION PROJECT

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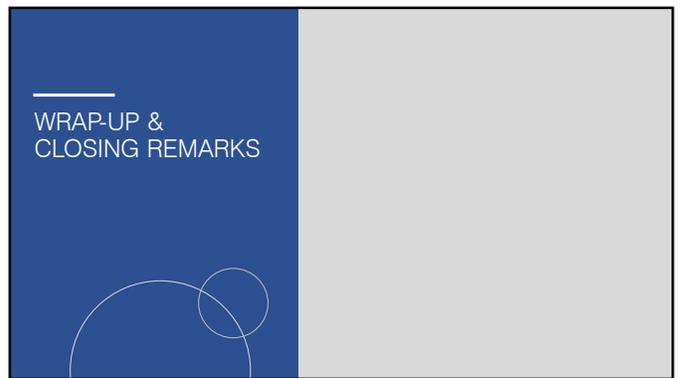
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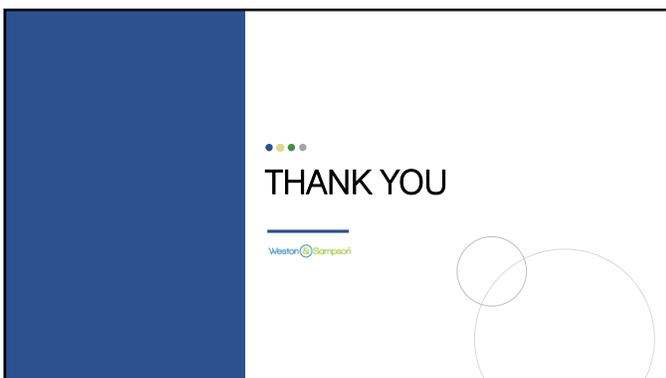
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87



88



89

# CRITICAL FACILITIES and VULNERABLE POPULATIONS

A Critical Facility is defined as a building, structure, or location which:

- Is vital to the hazard response effort.
- Maintains an existing level of protection from hazards for the community.
- Would create a secondary disaster if a hazard were to impact it.

Critical facilities in the Town of Northborough have been identified with help from knowledgeable Town staff, MassGIS data, and existing Town and Regional Plans.

Critical facilities and vulnerable populations have been broken into four categories: Emergency Response, Non-Emergency Response, Dangerous/Hazard Materials and Facilities, and Facilities and Populations to Protect.

## Category 1 – Emergency Response Facilities

Emergency response facilities that are necessary for the Town in the event of a disaster.

### 1. Emergency Operations Center/Police Station/Emergency Support

Police Dept./EOC	211 Main Street
Melican Middle School/Emergency Shelter	145 Lincoln Street
Wegman's (food provider to shelter)	9102 Shops Way

### 2. Fire Station

Fire Department	11 Pierce Street
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### 3. Communications Facilities

Police/Fire Receiver/Repeater	9000 Shops Way Tower
Radio	79 Bartlett Street
Voter – Radio	300 Ball Street
Voter	300 West Main Street
Tower – Government	25 Gale Street
Tower	348 Church Street, generator
Tower – Rooftop	456 Main Street
Tower	386 West Main Street
Cell Site	4 West Main Street
Cell Site	40 Church Street
Cell Tower	211 Main Street
Verizon	125 High St. Oliver Tower Fl 2, Shrewsbury
Crown Castle	273 Southwest Cutoff

### 4. Highway Department

DPW	63 Main Street
DPW Barn	190 Main Street
DPW Water Barn	200 School St at Brigham Street

MA Highway Depot

138 Lawrence Street

## 5. Primary Evacuation Routes

I-290

Belmont Street/MA-9

Church Street (impacted by culvert flooding)

Main Street

West Main Street

Southwest Cutoff/US- 20

South Street/MA-135 (impacted by culvert flooding)

## 6. Critical Bridges, Intersections, and Sites

Bridge 27 Allen Street

Bridge 10 Church Street

Bridge 55 Lyman Street

Bridge 12 Rice Avenue

Bridge 429 Whitney Street

Bridge 418 Davis Street

Bridge - I-290 overpass 202 Brewer Street

Bridge - MA- 135 370 South Street at Davis Street

Bridge – US- 20 410 Main Street Church St & I-290

Hudson Street at Marlborough boundary Hudson Street & Solomon Pond Rd

US-20 at Marlborough boundary MA- 135 & West Main Street US-20 & West Main Street

MA-135 at Westborough boundary Solomon Pond Road & I-290

West Main Street at Shrewsbury boundary 68 Otis Street

Crawford Street & Stone Bridge MA-135 at Town line

I-290 overpass at Whitney Street MA-9 & Southwest Cutoff

## 7. Urgent Care

MedPost

10002 Shops Way

Carewell

333 Southwest Cutoff

## Category 2 – Non-Emergency Response Facilities

The Town has identified these facilities as non-emergency facilities; however, they are considered essential for the everyday operation of Northborough.

### 1. Water Supply

MWRA Interconnection 292 Cedar Hill Street

Assabet Hill 3.5MG Storage Tank 25 Gale Street

Edmunds Hill 1MG Storage Tank 16 Edmunds Way

DPW Water Barn 200 School Street at Brigham Street

Public Water Supply

(Former MWRA connection)	177A Hudson Street
Well – Public	200 Brigham Street
Well – Public	108 Crawford Street
Well – Public	87 Howard Street
Well – Public	40 Lyman Street
Cistern, out of service	52 Moore Lane
Cistern, out of service	277 Green Street
Cistern	60 Old Colonial Road
Cistern, not used	241 Southwest Cutoff
Draft Site	32 Colburn Street
Draft Site	222 Green Street
Draft Site	4 Hillside Road
Draft Site	109 Howard Street
Draft Site	424 Howard Street
Draft Site	5 Howe Lane
Draft Site	38 Lyman Street, Westborough
Draft Site	90 Maynard Street
Draft Site	320 Newton Street
Draft Site	2 Tomblin Hill Road
Draft Site	261 West Street
Draft Site	2 Smith Road
Draft Site	37 Fisher Street
Draft Site	309 Ball Street
Draft Site	55 Bearfoot Road
Draft Site	65 West Street/Pond at Roadside
Draft Site	257 West Street/Pond 625ft from West Street

Aqueduct – Hultman

Aqueduct – Wachusett Cosgrove

## 2. Town Facilities

Town Hall	63 Main Street
Senior Center	119 Bearfoot Road
Cable TV Access	79 Bartlett Street, ARHS
Gale Library	34 Main Street

## 3. Utilities

CSX Rail Line	360 Cedar Hill St. at Marlborough City line
Railroad dock – private	66 Lyman Street
CSX Rail Line crossing	175 Bearfoot Road
CSX Rail Line crossing	100 Brigham Street
CSX Rail Line crossing	15 Main Street

CSX Rail Line crossing	31 Pierce Street
CSX Rail Line crossing	50 School Street
Crown Castle	119 Colburn Street
Verizon	11 School Street
National Grid Service Center	55 Bearfoot Road
National Grid Woodside	193 Hudson Street
National Grid Distribution Center	1152 Main Street
Wastewater Pump Station	79 Bartlett Street
Wastewater Pump Station	119 Bearfoot Road
Wastewater Pump Station	11R Church Street
Wastewater Pump Station	30 Forbes Road
Wastewater Pump Station	282 Hudson Street
Wastewater Pump Station	76 Lincoln Street
Wastewater Pump Station	75 Otis Street
Wastewater Pump Station	306 Southwest Cutoff
Wastewater Pump Station	101 Wesson Terrace
Booster Pump Station	Church Street at Autumn Lane
Booster Pump Station	Southwest Cutoff at Shops Way
Sewer Station	235 West Main Street

#### 4. Natural Resources and Natural Resource Protection Organizations

Assabet	
River	
Hop	
Brook	
Stirrup	
Brook	
SUASCO Project Cold Harbor Brook	North Church Street at I-290
SUASCO Project Hop Brook	Northwest Main Street at Shrewsbury border Central
MA Mosquito Project	111 Otis Street
Bartlett Pond	
Smith Pond	
Little Chauncey Pond (state owned Great Pond)	
Solomon Pond (state owned Great Pond)	
Bearfoot Brook Flood Control Facility	

#### 5. Misc.

U.S. Post Office	235 West Main Street
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### Category 3 – Dangerous/Hazardous Materials and Facilities

#### 1. Dams

Bartlett Pond Dam  
 Assabet River Dam  
 Cold Harbor Brook Dam  
 Hop Brook Dam  
 Smith Pond Dam  
 Wallace Pond Dam  
 Old Saw Mill Pond Dam  
 Old Adams Pond Dam  
 Small Pond Dam  
 Ellis Pond Dam  
 Storage Pond Dam  
 Cider Mill Pond Dam  
 Old Mill Pond Dam  
 Farm Pond Dam  
 West Meadow Country Club Pond Dam  
 Old Mill Pond Dam

**2. Landfill**

Tradebe Treatment & Recycling	345 West Main Street Closed
Landfill	Southwest Cutoff

**3. Fuel and Hazardous Materials (Tier II Site)**

Natural Gas Line	Belmont Street
Osterman Propane	998 Church Street
Northborough Oil Co.	247 W Main Street
Lakeside Oil Co	244 Main Street

**Category 4 – Vulnerable Populations and Community Facilities**

**1. Housing Authority Properties**

Coleman House	112 West Main Street
Heritage Village	5 to 19 Center Drive
Rutland Rd 2 Rutland Road	
Colonial Village 26 Village Drive	

**2. Elderly Housing/Assisted Living**

Coleman House	112 West Main Street
Whitney Place	238 West Main Street

**3. Special Needs Facilities**

The Bridge of Central Mass	59 Main Street
----------------------------	----------------

**4. Youth Services**

Teamworks, Inc.	185 Otis Street
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**5. Schools/Daycares**

Melican Middle School	145 Lincoln Street
Algonquin Regional High School	79 Bartlett Street
Fitzgerald Institute	261 Main Street
Lincoln St School	76 Lincoln Street
Peaslee School	31 Maple Street
Proctor School	26 Jefferson Road
St. Bernadette's School	266 Main Street
Zeh School	33 Howard Street
Cornerstone Academy	5 Oak Avenue
Goddard School	10 Davis Street
AMEGA	71 Lyman Street
Skribbles Learning Center, LLC	348 Main Street Skribbles
Learning Center, LLC	325 West Main Street Nativity
Nursery School	45 Howard Street ARHS –
Tiny Tomahawks	79 Bartlett Street

**6. Religious Center**

Church of Christ	456 West Main Street
Church of the Nativity	45 Howard Street
First Parish Unitarian Church	40 Church Street
Jehovah Witness Church	419 Main Street
Rice Memorial Baptist Church	85 Lincoln Street
Seventh Day Adventist Church	30 Brigham Street
Shri Gurusthan Sai Temple	107 Otis Street
St. Bernadette's Church	266 Main Street
St. Rose of Lima Church	244 West Main Street
Trinity Church	23 Main Street

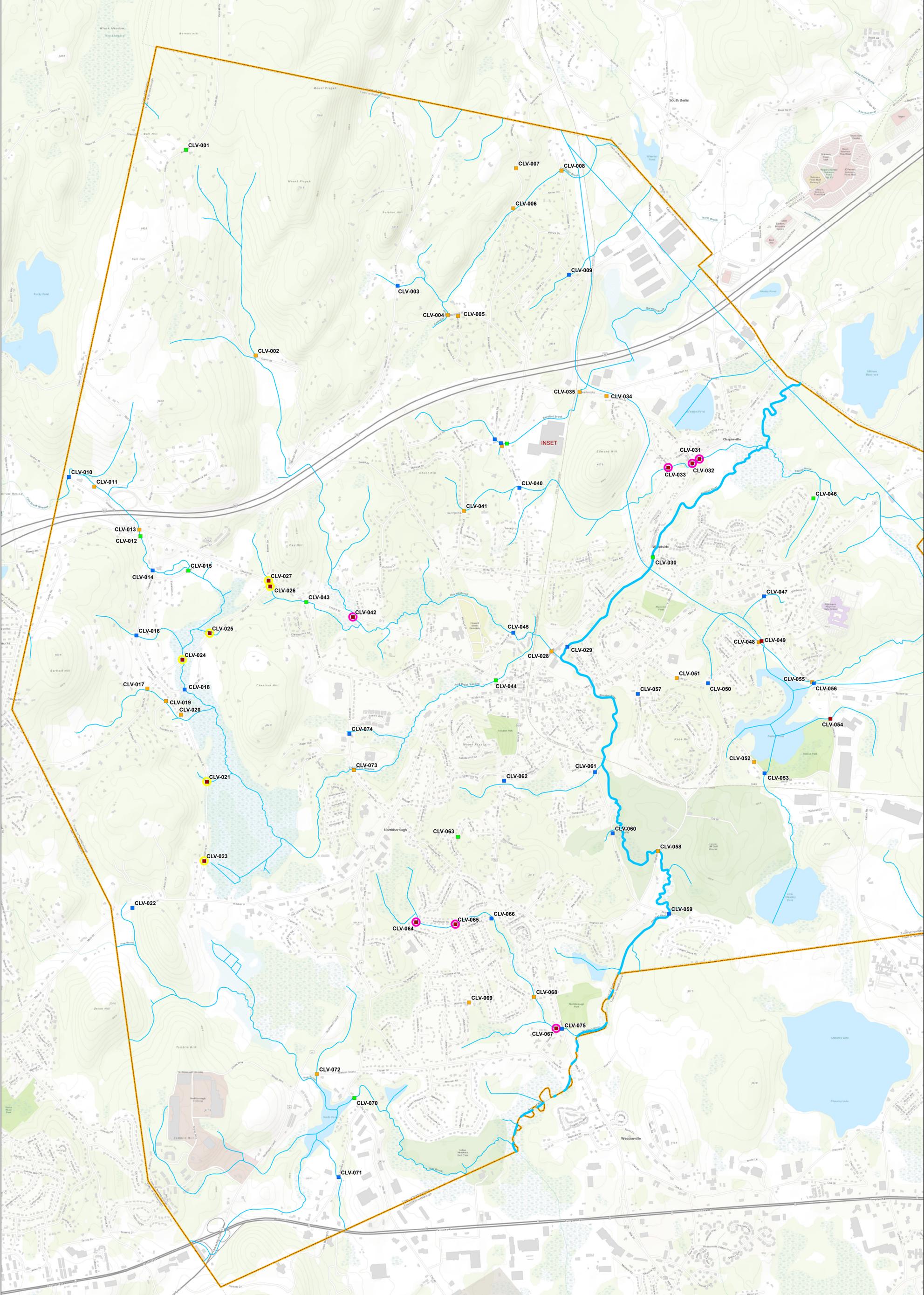
**7. Economic Infrastructure**

Wegmans	Shops Way
Worcester Polytechnic Institute	Avalon Drive
Metso Automation USA Inc	Bearfoot Road #3
Saint-Gobain Ceramic Materials	Goddard Road
Zoo Cable	Otis Street
Aspen Aerogels Inc	Forbes Road #B
Bigelow Nurseries Inc.	W. Main Street
Boston Group	SW Cutoff #100
Home Instead Senior Center	W. Main Street #14
Bartlett Crossing	291 Main Street
Juniper Hill Golf Course	202 Brigham Street

Cold Harbor Mall	369 West Main Street Northborough
Shopping Plaza	265 West Main Street Post Road
Marketplace	318 Main Street
Shopping Center	292 Main Street
Shopping Center (2)	276 West Main Street
Times Square Plaza	299 West Main Street
Iron Mountain	171 Bearfoot Road
Wegmans	9102 Shops Way
BJ's Wholesale Club #211	6102 Shops Way
Advocates, Inc	152 East Main Street
Econolodge	380 Southwest Cutoff Motel 6 Boston-
Westborough	115 Lawrence Street
A. Duie Pyle Inc.	210 Bartlett Street
FedEx Freight, Inc	300 Bartlett Street
Aspen Aerogels	30 Forbes Road
NewCorr Pkg., LTD	66 Lyman Street
St. Gobain R & D Center	9 Goddard Road
Steris AST	435 Whitney Street
Trelleborg Sealing Solutions	10 Forbes Road Sanofi Genzyme Op
Centre, Inc.	11 Forbes Road
Walmart	200 Otis Street
Northborough Crossing Mall	1000-9116 Shops Way
Bigelow Nurseries, Inc.	455 West Main Street
BJ's Wholesale Club, gas station	1106 Shops Way
Cumberland Farms	15 Main Street
Northborough Center Mobil	36 West Main Street
Northborough Sunoco	7 Belmont Street
Peterson – Northboro (Irving)	23 Belmont Street
Speed Energy	48 W Main Street
Top Energy	345 W Main Street

8. Census Tracts with 25% of people who are >65

9. Census Tracts with 25% of people who are <18



**Priority Culverts**

Northborough, MA

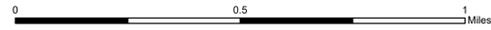
Northborough Boundary

Culvert Location

- Observed Condition
- Excellent
- Fair
- Good
- Poor

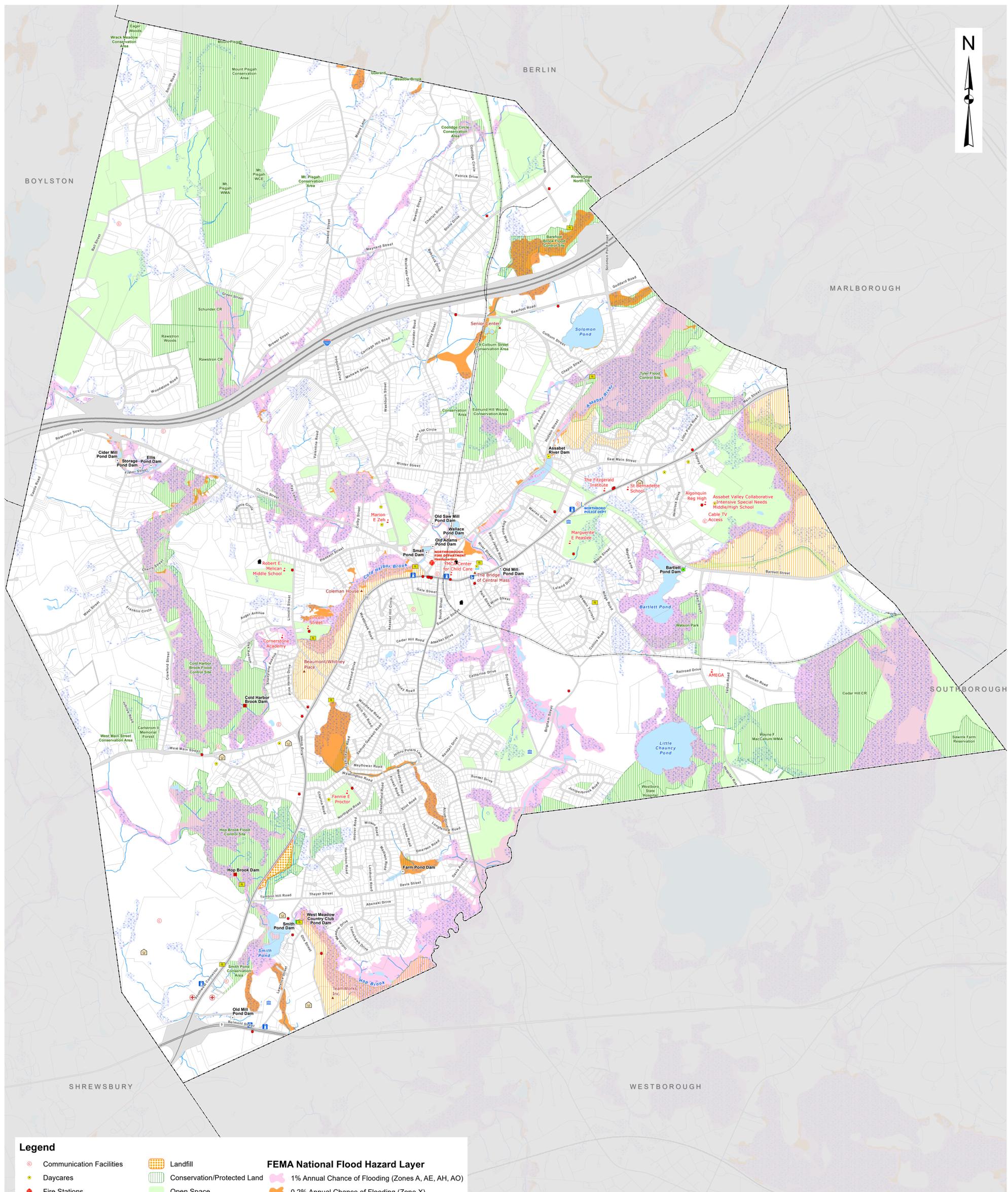
Culvert Priority Ranking

- Priority 1
- Priority 2



Project #: 0228295.13  
Map Created: February 2018

Third Party GIS Disclaimer: This map is for reference and graphical purposes only and should not be relied upon by third parties for any legal decisions. Any reliance upon the map or data contained herein shall be at the users' sole risk. Data Sources:



**Legend**

- |  |   |   |
|--|---|---|
| <ul style="list-style-type: none"> <li>● Communication Facilities</li> <li>● Daycares</li> <li>● Fire Stations</li> <li>● Food Stores</li> <li>● Gas Stations</li> <li>● Highway Department</li> <li>● Housing Authority Properties</li> <li>● Police Department</li> <li>● Public Library</li> <li>● Schools</li> <li>● Sewer Pump Stations</li> <li>● Town Hall</li> <li>● Underground Storage Tanks</li> <li>● Urgent Care</li> <li>● Vulnerable Population Services</li> </ul> | <ul style="list-style-type: none"> <li>■ Landfill</li> <li>■ Conservation/Protected Land</li> <li>■ Open Space</li> <li>■ Median Age 65+</li> </ul> <p><b>Dams</b></p> <ul style="list-style-type: none"> <li>■ High Hazard</li> <li>■ Significant Hazard</li> <li>■ Low Hazard</li> <li>□ N/A</li> </ul> | <p><b>FEMA National Flood Hazard Layer</b></p> <ul style="list-style-type: none"> <li>■ 1% Annual Chance of Flooding (Zones A, AE, AH, AO)</li> <li>■ 0.2% Annual Chance of Flooding (Zone X)</li> </ul> <p><b>Waterways</b></p> <ul style="list-style-type: none"> <li>— Rivers, Streams, and Brooks</li> <li>■ Marsh/Bog/Wooded Marsh</li> <li>■ Lakes, Ponds, Reservoirs</li> </ul> <p><b>Transportation</b></p> <ul style="list-style-type: none"> <li>— Interstate</li> <li>— U.S. Highway/State Route</li> <li>— Railroads</li> </ul> |
|--|---|---|

**FIGURE 1**  
**TOWN OF NORTHBOROUGH, MASSACHUSETTS**

**MUNICIPAL VULNERABILITY  
PREPAREDNESS HAZARD  
AND FEATURE MAP**

SEPTEMBER 2019 SCALE: NOTED

# Community Resilience Building Risk Matrix



www.CommunityResilienceBuilding.org

H-M-L priority for action over the Short or Long term (and Ongoing)  
 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 Temps	Intense Storms	Dam Failure	Priority	Time
								H - M - L	Short Long Ongoing
<b>Infrastructural</b>									
●● Roadways (Main Arterials)	All Over	Varies	Both	●●●●● prioritize areas/roadways from flooding and possible solutions (Debris and pavement mgmt) collaborating with MassDOT on flood mitigation projects			- south street - higher level of service	H	L
Public Buildings	All Over	Town	Both	new buildings-passive corling	consider climate resilience - fire station generator @ library for cooling and heating higher capacity generator at senior center- improve geothermal		flood control redundancy	H	0
● Dams (Small one on Assabet - private, Cold W. and N.B Reservoir - Town)	All Over	Private (few public)	Both	●● Dam in shrewsbury - removal - n.reservoir - assessment of impact downstream disconnecting sewer from waterbodies, rehabilitation of dams				H	0
Water/Supply/Wells	All Over	Town and Private	Both				well on crawford street - fortifying and monitoring back up wells and redundancy in hookups	H	0
● Communications - PHS	All Over	Town	Both				redundancy of comms burying electric lines educate on personal communication strategies	H	0
●● Stormwater	All Over	Town	Both	●●●● Tanilin Hill and SW cutoff - no drainage - onsite drainage - regrading roadway west side of cherry st - raising roadways-chrus st main st south st edu on chipping ice away and taking care of leaves				M	0
<b>Societal</b>									
●● senior/assisted living	specific (see list)	private housing authority	Both		HVAC and generators		ride sharing system	H	0
● youth-youth programming	schools	private and public	Both		● educate with youth and set up system to build community resilience-generators and dehumidifiers for schools			H	0
non-native english speakers	throughout		Both	communicate with MSBA about need			look into second language on code red more interpreters	M	0
healthcare	specific	Private	Both				educate on disaster preparedness, self-resilience redundancy on criical info-need more communication	M	0
● food supply/security	wegmans food pantry	Private	Both				food pantry agreement w private organizations and w farms and wegmans municipapl staff/EOC	M	0
energy access- national grid	throughout/specif cific building	Private	Both				do gas stations have backup electricity? Alternative energy sources	M	0
<b>Environmental</b>									
●● Waterbodies	Various	agencies, public	Both	● educate on reducing pollutant load and on fertilizer on lawns, septic system solutions				H	S/O
● Conservation/Tree Canopy	All over	state and town-owned	Both		● add more trees-urban areas- northborough crossing			M	S/O
● Invasives/Ticks/Mosquitos	All over		V		●● educate on mosquitos/ticks - MCD sprays Goats-management program for invasives			H	S
● Hazardous Materials	All over & specific	mostly private, some public	V	relocating hazardous materials away from floodplain			compliance and enforcement of protection and inspections and energy plan coordinator	H	0
●● Development Patterns	All over	reg-town dev-private	Both				regulatory parking lots and other areas to improve onsite stormwater and tree coverage	M	0
Agricultural Soils	All over(nw of town or sw of town)	private	S		look at agriculture in OSD, many already are in APR		● -reduce parking -shared..?	M	0







## TOWN OF NORTHBOROUGH

Municipal Vulnerability Preparedness Planning Grant Project  
Community Resilience Building Workshop Notes

Tuesday, October 29, 2019



55 Walkers Brook Drive, Suite 100, Reading, MA 01867  
Tel: 978.532.1900

### WELCOME PARTICIPANTS

Favorite things about Northborough:

- Trails
- Trails Community/Volunteer Program
- Junior Women's Program
- Sense of Community
- Collaboration between Departments

### TOP HAZARDS IN NORTHBOROUGH

- Flooding
- Heat
- Extreme Storms (High Winds, Ice, Snow)
- Dam Failure

### EXISTING HAZARD PROTECTION AND CLIMATE RESILIENCE MEASURES

- State acquired land for flood control:
  - Carnie Park
  - Hop Brook
- Tree trimming program with National Grid
- Warming centers, cooling station (don't use cooling station often)
- Generators in town facilities and adding them to pump stations
- Backup generators
- Relationship with the Y and Wegmans (provide food)
- Emergency Shelter at Middle School
- Senior center for "non-emergency" shelter – generator for emergency lights, van for senior transportation
- Replaced culverts on Fisher, Rice Ave, Church Street
- Dehumidifier in school
- Aware of where elderly population is located, able to selectively target individuals during hazard
- Replacing boilers
- Code Red for emergencies extends to surrounding towns
- Have mutual aid, staff, and equipment for brushfires
- Adopted stretch code for green buildings
- Chapter 90 funds for road, infrastructure, drainage
- National grid calls for fuel assistance
- Bartlett Pond has invasive species, treated every three years
- Communication through schools, from kids to adults

### PRIORITY ITEMS (in no particular order)

- Failing Dams (should be removed):
  - Northborough Dam
  - Aluminum City Dam (Old Sawmill Dam)
  - Dam in Shrewsbury
- Flooding, roadway assessment:
  - Cherry Street
  - Church Street
  - Main Street
  - West Main Street

- State bridge with weight restriction (6000 lb) leading to an industrial factor
- Facilities in town rely on emergency responders, need to be more self sufficient
- Communities with vulnerable populations, esp. elderly → getting help to everyone
- Plant growth in river
- Invasives management – gypsy moths, millfoil
- Pest management
- After school program – air conditioning concern
- All communication servers are at Town Hall

#### ACTION ITEMS

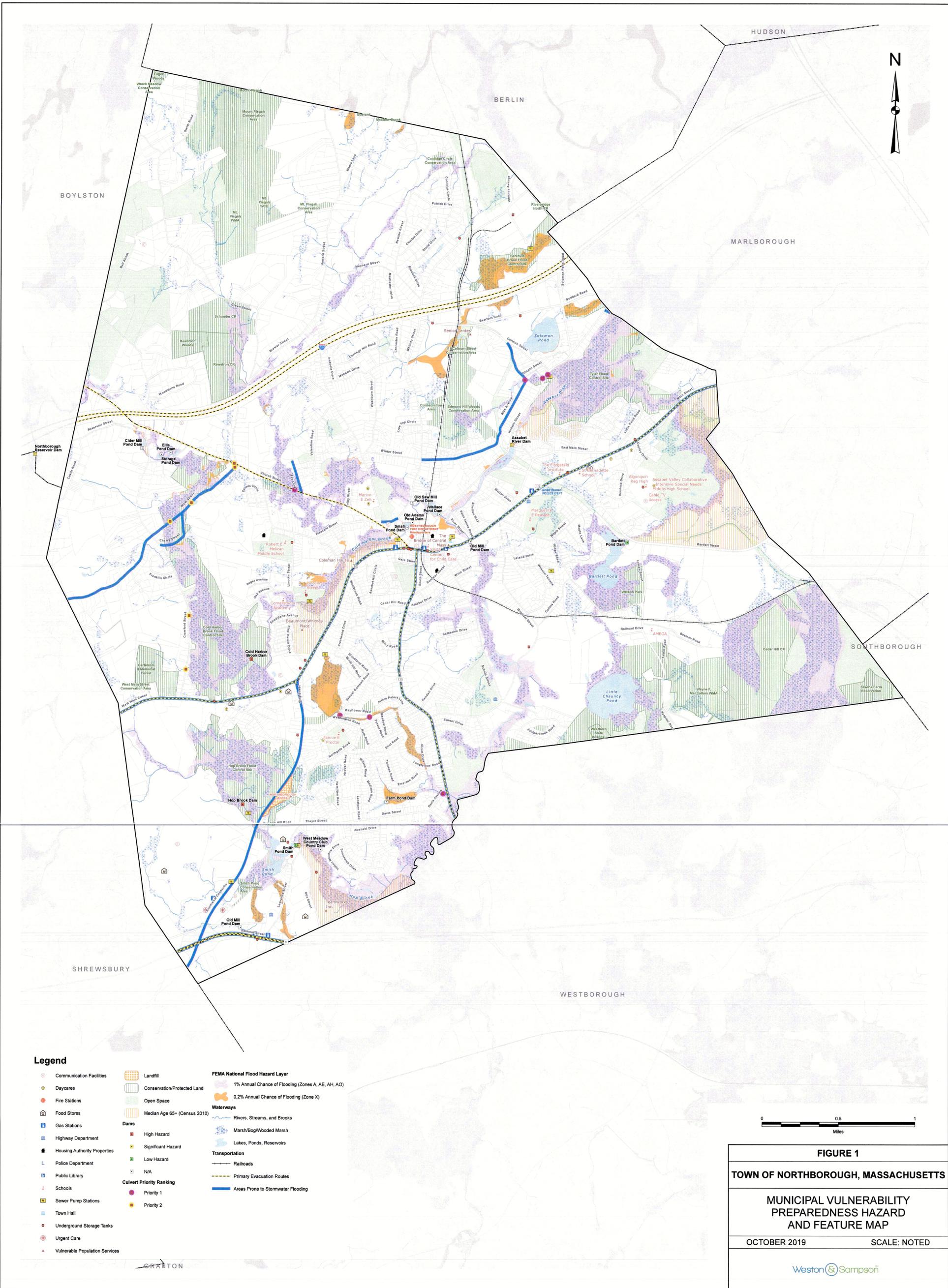
- Replace culverts and drainage; education on storm drain cleanout and LID
- Remove Northborough Dam
- Communication with vulnerable populations, especially elderly
- Assessment of flooding roadways
- Pest management, vector borne diseases – EEE, ticks

#### NOTES

- Large Brazilian population
- Fear is a barrier for some residents who are eligible for SNAP benefits, don't sign up
- Food pantry – cultural differences (there is a food pantry, but food is not always culturally appropriate)
- Arsenic leaked into brook in Town and fish died off
- Areas vulnerable to wildfire – interface of development and undeveloped
- Northborough crossing is a vulnerable area – look into this
- Worcester Regional Transit Authority – underutilized
- MWRA, and two backup wells that they could use
- Had a problem with childhood obesity, created an afterschool gardening committee
- Main water connection Cherry Hill Road
- Look at agricultural section in open space plan- many farms are in APR (preservation restriction?)
- Groundwater regulations and contamination

**APPENDIX C**

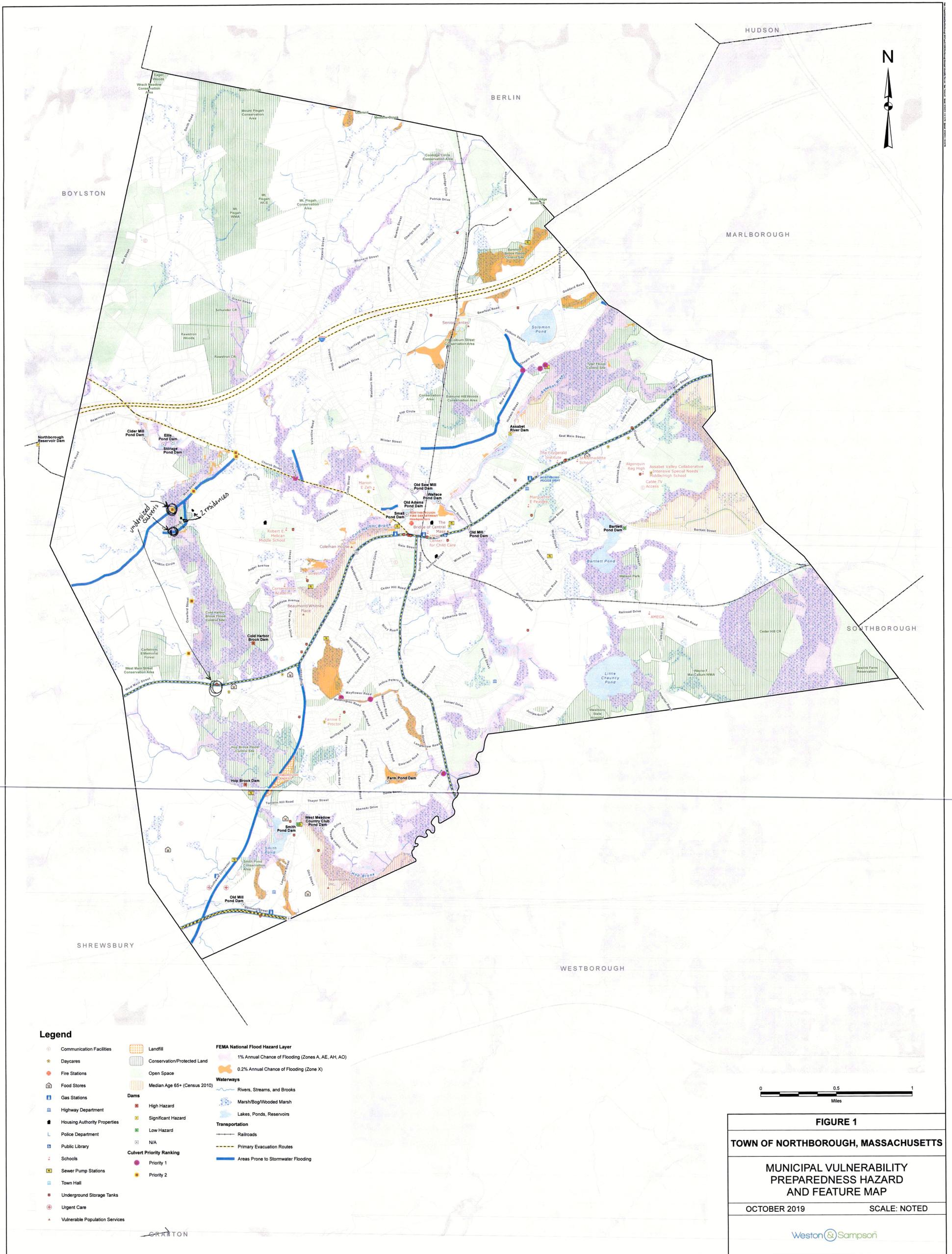
Annotated Maps and Participant Risk Matrices



**Legend**

- Communication Facilities
- Daycares
- Fire Stations
- 🏠 Food Stores
- ⛽ Gas Stations
- 🚚 Highway Department
- 🏠 Housing Authority Properties
- 👮 Police Department
- 📖 Public Library
- 🎓 Schools
- 🏗️ Sewer Pump Stations
- 🏛️ Town Hall
- 🏘️ Underground Storage Tanks
- 🏥 Urgent Care
- 👴 Vulnerable Population Services
- 🗑️ Landfill
- 🌳 Conservation/Protected Land
- 🌿 Open Space
- 👴 Median Age 65+ (Census 2010)
- Dams**
- 🔴 High Hazard
- 🟡 Significant Hazard
- 🟢 Low Hazard
- ⚪ N/A
- Culvert Priority Ranking**
- 🔴 Priority 1
- 🟡 Priority 2
- FEMA National Flood Hazard Layer**
- 🟡 1% Annual Chance of Flooding (Zones A, AE, AH, AO)
- 🟠 0.2% Annual Chance of Flooding (Zone X)
- Waterways**
- 🌊 Rivers, Streams, and Brooks
- 🌿 Marsh/Bog/Wooded Marsh
- 🌊 Lakes, Ponds, Reservoirs
- Transportation**
- 🚂 Railroads
- 🛣️ Primary Evacuation Routes
- 🌊 Areas Prone to Stormwater Flooding

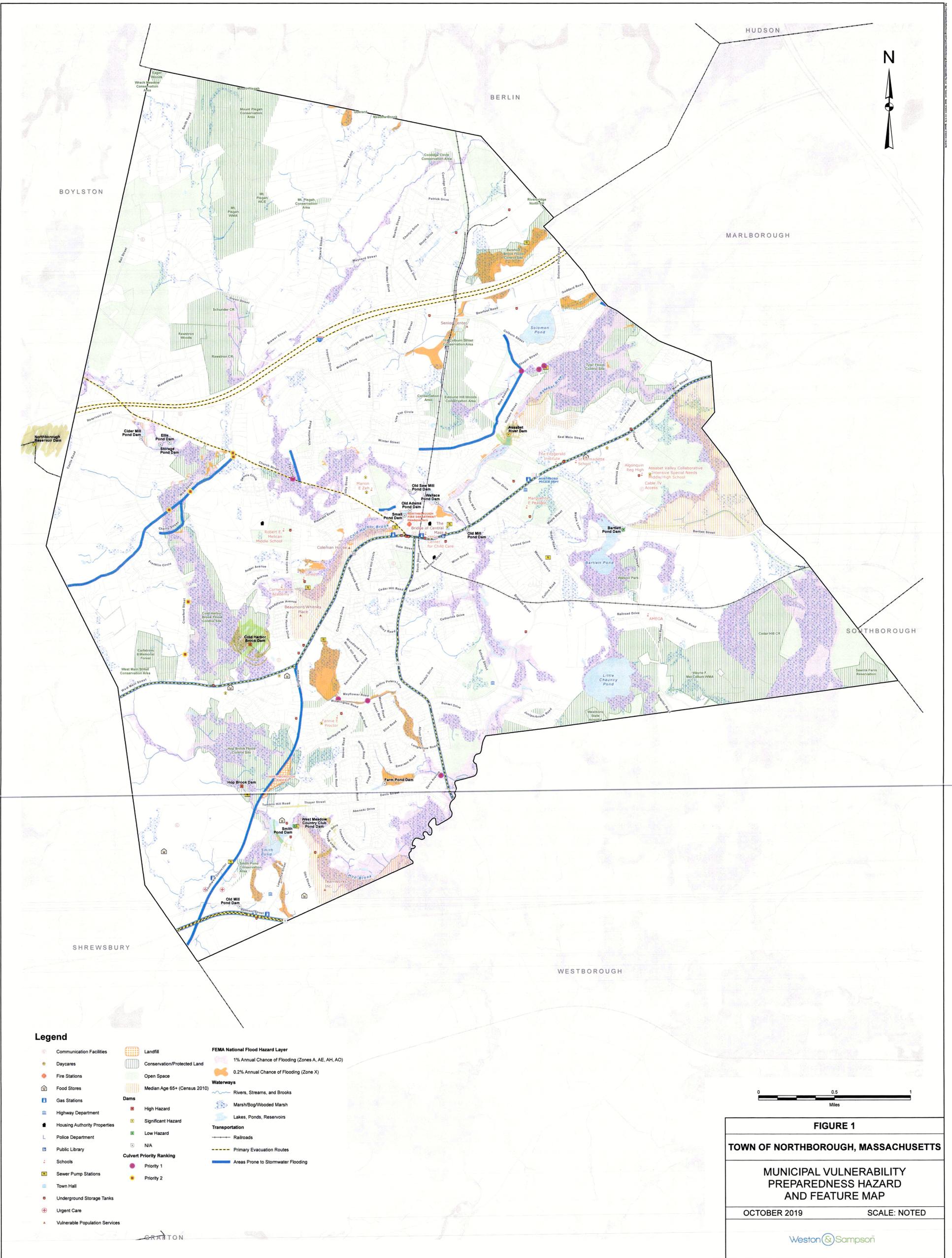
**FIGURE 1**  
**TOWN OF NORTHBOROUGH, MASSACHUSETTS**  
**MUNICIPAL VULNERABILITY PREPAREDNESS HAZARD AND FEATURE MAP**  
 OCTOBER 2019 SCALE: NOTED  
 Weston & Sampson



**Legend**

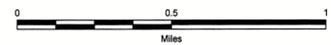
- Communication Facilities
- Daycares
- Fire Stations
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- Vulnerable Population Services
- Landfill
- Conservation/Protected Land
- Open Space
- Median Age 65+ (Census 2010)
- Dams
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  - Priority 1
  - Priority 2
- FEMA National Flood Hazard Layer
  - 1% Annual Chance of Flooding (Zones A, AE, AH, AO)
  - 0.2% Annual Chance of Flooding (Zone X)
- Waterways
  - Rivers, Streams, and Brooks
  - Marsh/Bog/Wooded Marsh
  - Lakes, Ponds, Reservoirs
- Transportation
  - Railroads
  - Primary Evacuation Routes
  - Areas Prone to Stormwater Flooding

**FIGURE 1**  
**TOWN OF NORTHBOROUGH, MASSACHUSETTS**  
**MUNICIPAL VULNERABILITY PREPAREDNESS HAZARD AND FEATURE MAP**  
 OCTOBER 2019      SCALE: NOTED



**Legend**

- Communication Facilities
- Daycares
- Fire Stations
- Food Stores
- Gas Stations
- Highway Department
- Housing Authority Properties
- Police Department
- Public Library
- Schools
- Sewer Pump Stations
- Town Hall
- Underground Storage Tanks
- Urgent Care
- Vulnerable Population Services
- Landfill
- Conservation/Protected Land
- Open Space
- Median Age 65+ (Census 2010)
- Dams
  - High Hazard
  - Significant Hazard
  - Low Hazard
  - N/A
- Culvert Priority Ranking
  - Priority 1
  - Priority 2
- FEMA National Flood Hazard Layer
  - 1% Annual Chance of Flooding (Zones A, AE, AH, AO)
  - 0.2% Annual Chance of Flooding (Zone X)
- Waterways
  - Rivers, Streams, and Brooks
  - Marsh/Bog/Wooded Marsh
  - Lakes, Ponds, Reservoirs
- Transportation
  - Railroads
  - Primary Evacuation Routes
  - Areas Prone to Stormwater Flooding



**FIGURE 1**  
**TOWN OF NORTHBOROUGH, MASSACHUSETTS**  
**MUNICIPAL VULNERABILITY PREPAREDNESS HAZARD AND FEATURE MAP**  
 OCTOBER 2019      SCALE: NOTED  
 Weston & Sampson

# Community Resilience Building Risk Matrix



www.CommunityResilienceBuilding.com

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

H-M-L priority for action over the Short or Long term (and Ongoing)  
 V = Vulnerability S = Strength

Features	Location	Ownership	V or S	Flooding	Extreme Temps	Intense Storms	Dam Failure	Priority	Time
				H-M-L	Short	Long	Ongoing		
<b>Infrastructural</b>									
Roadways (Main Arterials) <sup>-290</sup>	All Over	Varies	L	Cloud burst Streets prioritize areas/roadways from flooding + possible solutions Collaborating with DOT on flood mitigation projects	Pavement Management + emergency repair Generator @ Library for cooling + heating La higher capacity gen @ Senior Center → look at	Delays Management	- South Street - Higher level of service - Treated	H	Long-term
Public Buildings		Town		New buildings consider passive cooling	Generator @ Library for cooling + heating La higher capacity gen @ Senior Center → look at	Flood control redundancy	improving geomorphological impact down stream	H	0
Dams (old W. + NB Reservoir - Town)		Private - Few Public		Dam in Shrewsbury	Removal - N. Reservoir - Assessment of reuniting sewer from waterbodies	rehabilitation of dams		H	0
Water/Supply/Wells		Town + Private		Well on Crawford St	Fortifying +	Monitoring back-up wells + redundancy in hookups		H	0
Communications - PHS		Town			redundancy of comms	- buying electric lines - edu on personal communication strategies		H	0
Stormwater		Town	L	Carlin Hill + SW cutoff - no drainage - on-site drainage - regrading roadway West St + Cherry St → raising roadways - Church St. Main St. South Street edu on chipping ice away and taking care of drains	↓ preventing maintenance			M	0
<b>Societal</b>									
Senior Living / Assisted Living	Specific See list	Private Housing District	Bahn X		Senior HVAC + generators	Ride sharing system		H	0
YOUTH - Youth Programming	Schools →	Private (Private)			Edu w/ youth and setup system to build community resilience	generators for schools		H	0
Non-native English Speakers	Throughout	Public		- communicate w/ MSBA about need	LOOK INTO 2nd language on code red	More interpreters more	add dehumidifiers and fans	M	0
Healthcare	Specific	Private			Edu on disaster preparedness	Redundancy on critical info	Self-resilience	M	0
Food Supply/Security	Wegmans Food Pantry	Private			Food pantry agreement w/ farms + Wegmans	Alternative energy sources	w/ private orgs and municipal staff / EOC	M	0
Energy Access - National Grid	Throughout + Specific Building Marking	Private			MSBA (Do gas stations have backup electricity?)	Alternative energy sources		M	0
<b>Environmental</b>									
Waterbodies	Various	Agencies Public	B		Edu on reducing pollution → load and on fertilizer on lawns, septic system solutions			H	S/O
Conservation/Tree Canopy	All Over	State + Town - outnd	B		Add more trees → urban areas - North St. Crossing			M	S/O
Invasives + Trees + Mosquitoes		X	L		Edu on mosquito/tricks - MCP songs			H	S
Hazardous Material	specific too	Mostly Private Some Public	L		Relocating hazardous materials away from flood plain	Compliance + enforcement of protections + inspections + emergency plans coordination		H	0
Development Patterns		Reg - town DW - Private	B			Regulatory parking lots + other areas to improve on-site stormwater and tree coverage		M	0
Agriculture/Soils	NW of town + SW of town	Private	S			→ reduce parking mess - shared parking		M	0

Brazil - many families in school  
 Child Quality / Grant used for many

GW loss + containment  
 Cedar Hill Rd Water Connection  
 Look @ agricultural in OSD - Advocate for Conservation Preserve  
 Many are already in APR  
 Preservation Restriction 2...  
 Disposition Rules





**APPENDIX C**

Public Listening Session Materials



Municipal Vulnerability Preparedness Planning Grant  
Listening Session

Free Public Library  
2/18/2020  
6:00 pm – 7:30 pm

**Introductions** 5 minutes

**Municipal Vulnerability Preparedness (MVP) Program Overview** 10 minutes

- Purpose, intent, and objectives
- Introduction to additional components

**Climate Change in Northborough** 15 minutes

- Brief Overview
- Interactive Discussion
  1. What hazard most concerns you? Why do these hazards concern you the most? What memories of climate hazards do you have?

**Strengths in Northborough** 15 minutes

- Summary of Outcomes from Workshop
- Interactive Discussion
  1. What are some of Northborough's greatest strengths considering climate resilience? How can the Town's greatest strengths help prepare it for climate change impacts?

**Vulnerabilities in Northborough** 15 minutes

- Summary of Outcomes from Workshop
- Interactive Discussion
  1. What features are our greatest vulnerability regarding climate hazards? What group or asset are you most worried about being impacted by climate hazards? What are some of the Town's other climate-related weaknesses?

**Priorities in Northborough** 25 minutes

- Interactive Discussion Part 1
  1. What services, initiatives, or mitigation measures are you aware the town is taking? How can the Town improve its public education and outreach to better share this information? What steps have you already taken? What resources do you need to feel more prepared?
- Summary of Existing Mitigation Measures
- Summary of Outcomes from Workshop

- Interactive Discussion Part 2
  1. How should Northborough prioritize climate adaptation measures?
    - a. Based on funding
    - b. Time frame
    - c. Asset type (i.e., infrastructure, buildings, or natural systems)
    - d. Impact on public safety
  2. Which of the following priority action items would you rank as a top priority?

## Wrap-up

5 minutes

- What we've heard
- Next steps

# ARE WE PREPARED?

Help us plan for a  
future with a changing  
climate

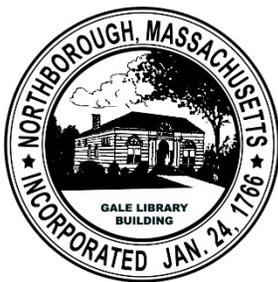
MUNICIPAL VULNERABILITY  
PREPAREDNESS PROGRAM



LISTENING  
SESSION

TUESDAY  
FEB  
18

6:00-  
7:30PM



Weston & Sampson  
transform your environment

## Northborough Free Library

Meeting Room

34 Main Street

Northborough, MA 01532

The Town of Northborough was awarded a grant from the [Commonwealth's Municipal Vulnerability Preparedness \(MVP\) Program](#) to create a list of priority action items to advance the community's resilience to projected climate change impacts.

In October, a group of stakeholders met to identify strengths, vulnerabilities, and options on how to move forward. We'll be reporting the results of this workshop and seeking public feedback at an upcoming Listening Session.

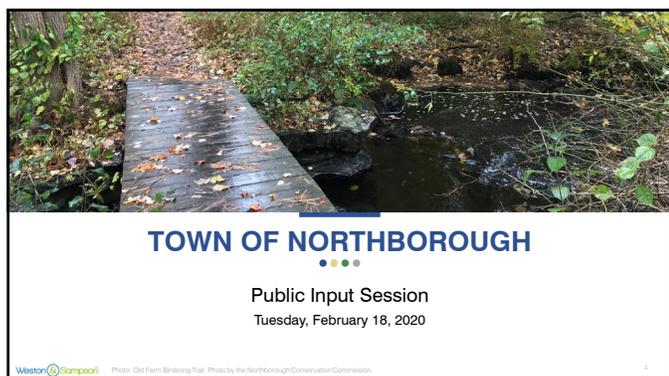


## **LISTEN SESSION**

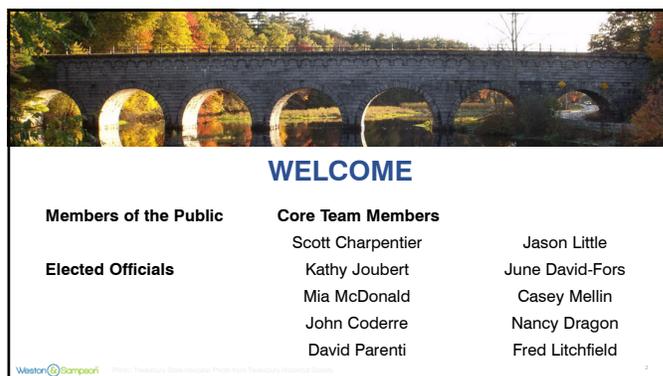
February 18th from 6:00-7:30

Northborough Library

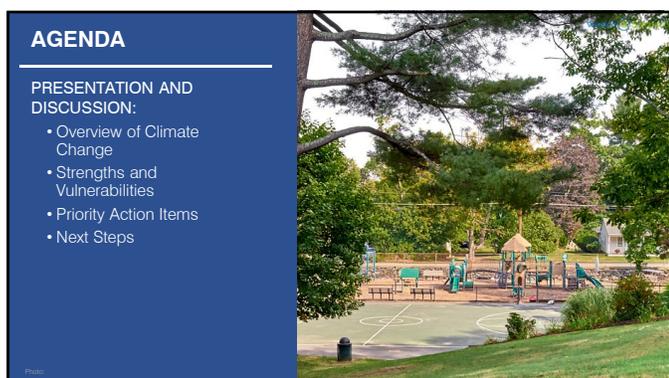
The Listening Session is structured as a facilitated large group dialogue, which will include a series of brief presentations followed by discussion. The input from this session will be captured in the final MVP report.



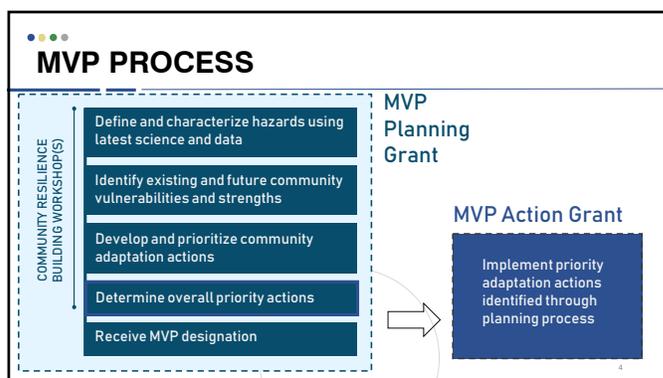
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4



5

- MVP ACTION GRANT PROJECT TYPES**
- Detailed Vulnerability and Risk Assessment
  - Community Outreach and Education
  - Local Regulation and Bylaws Updates
  - Redesigns and Retrofits
  - Nature-Based Solutions
    - Flood Protection
    - Drought Mitigation
    - Water Quality and Water Infiltration Techniques
    - Reduce Vulnerability to Extreme Heat and Poor Air Quality
  - Ecological Restoration and Habitat Management to Increase Resiliency
  - Energy Resiliency
  - Chemical Safety
  - Land Acquisition for Resilience
  - Subsidized Low-Income Housing Resilience Strategies
  - Mosquito Control Districts

6

## COMMUNITY RESILIENCE BUILDING WORKSHOP

Focus on 4 Hazards

Identify:

- Vulnerabilities
- Strengths
- Priority Action Items

Across 3 Categories

- Infrastructure
- Societal
- Environmental



7

## CLIMATE CHANGE IN NORTHBOROUGH



Photo: Northborough Crossing. Photo by New England Development, 2011

8

## TOP HAZARDS IN NORTHBOROUGH



Riverine and storm water flooding



Extreme temperatures



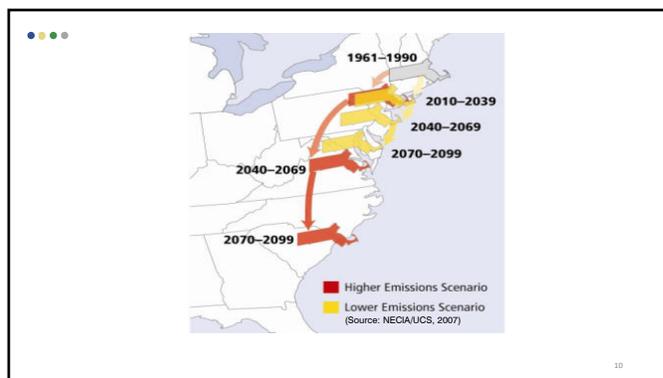
Extreme storms; including wind, ice, and Nor'easters



Dam Failure



9



10

## EXTREME TEMPERATURES



WARMER ANNUAL AIR TEMPERATURES  
UP 0.5°F PER DECADE SINCE 1970, ON AVERAGE



WARMER WINTERS  
UP 1.3°F PER DECADE SINCE 1970, ON AVERAGE

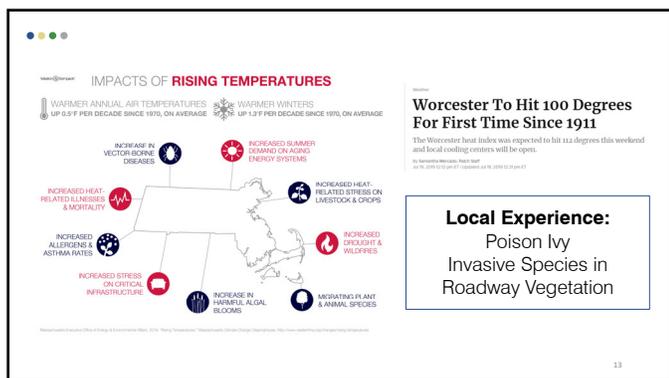
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## EXTREME TEMPERATURES IN MASSACHUSETTS

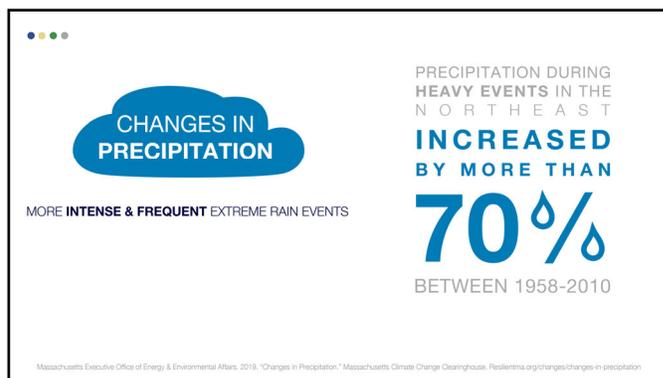
<p><b>6</b></p> <p>2005 OBSERVED ANNUAL AVERAGE</p>	<p><b>24</b></p> <p>MID-CENTURY PROJECTED ANNUAL AVERAGE</p>	<p><b>35</b></p> <p>END-OF-CENTURY PROJECTED ANNUAL AVERAGE</p>
<p>DAYS WITH TEMPERATURES ABOVE 90°F</p>		
<p><b>145</b></p> <p>2005 OBSERVED ANNUAL AVERAGE</p>	<p><b>114</b></p> <p>MID-CENTURY PROJECTED ANNUAL AVERAGE</p>	<p><b>101</b></p> <p>END-OF-CENTURY PROJECTED ANNUAL AVERAGE</p>
<p>DAYS WITH TEMPERATURES BELOW 32°F</p>		

Massachusetts Council on Energy & Environmental Affairs, 2018. "Massachusetts Climate Change Impacts: Projections and Adaptation for the Transportation Sector." Report No. 2018-01. Available at: <https://www.mass.gov/info-details/massachusetts-climate-change-impacts-projections-and-adaptation-for-the-transportation-sector>

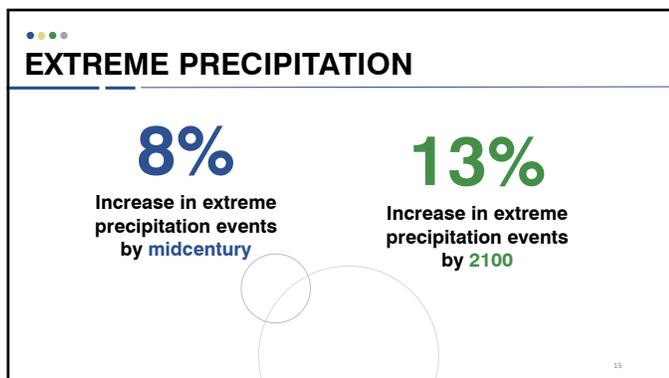
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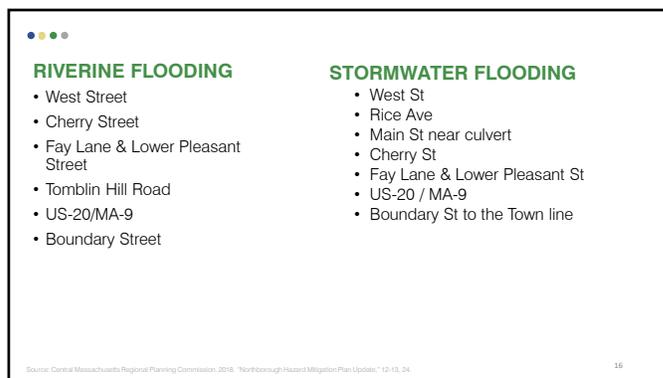
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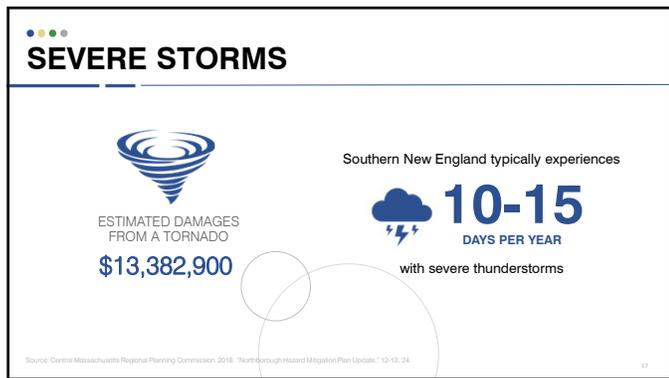
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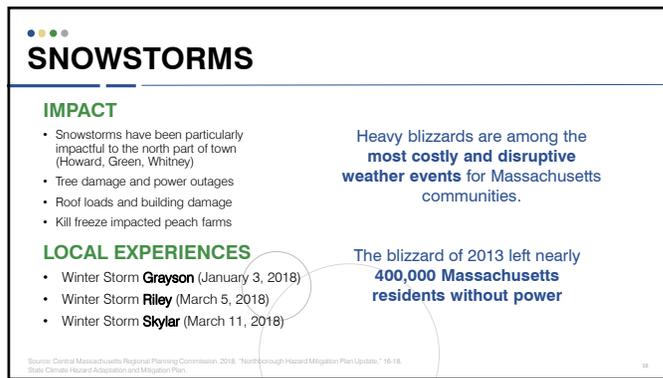
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18

## DAMS

There are **16 dams** located in Northborough

- Two are **High Hazard** (Cold Harbor Brook Dam and Hop Brook Dam)
- One is a **Significant Hazard** (Assabet River Dam)
- The town also owns a **Significant Hazard** poor condition dam (Reservoir Dam, MA01234) located in Shrewsbury/Boylston

Source: Central Massachusetts Regional Planning Commission, 2018, "Northborough Hazard Mitigation Plan Update," 39-41.

19

## IMPACTS OF EXTREME WEATHER

STORMS ARE BECOMING MORE INTENSE AND DAMAGING

EROSION OF DUNES, SALT MARSHES & COASTAL HABITAT

ECONOMIC DAMAGES & BUSINESS DISRUPTION

INCREASED INJURIES & MORTALITY

INCREASED INFRASTRUCTURAL REPAIR COSTS

PROPERTY DAMAGE

DISPLACEMENT OF RESIDENTS

RE-SHAPED RIVER COURSES

Massachusetts Executive Office of Energy & Environmental Affairs, 2018, "Extreme Weather," Massachusetts Climate Change Observatory, <http://www.massclimate.org/changes/extreme-weather/>

20

Intensity of Winter Storms and Thunder/Severe Storms

Flash or Episodic Droughts

Vulnerability to Wildfire

Sea Level Rise

21

## What hazards are the most concerning to you?

22

## INFRASTRUCTURE FEATURES

### STRENGTHS

- Buildings that are currently adequate for use as shelters during emergencies
- Existing cooling centers
- The power grid and communication systems
- Sewage collection in key areas
- Bridges, roadways, stormwater system, and culverts
- Public buildings and municipal services, including the Police and the Fire Station
- MWRA as the Town water source and backup wells
- Flood control systems

23

## SOCIETAL FEATURES

### STRENGTHS

- An engaged population
- Elderly residents and their local knowledge
- Diverse ideas and culture
- Youth's energy and capacity to contribute
- Access to local services

24

**ENVIRONMENTAL FEATURES**

**STRENGTHS**

- Public open space, like trails and parks
- Landscape features that help manage stormwater and mitigate extreme temperatures, like tree canopy
- Tree management program
- Local farmland and soils
- Development and economic interests
- Waterbodies



Assabet Park (Middle) & Salspury

25

**What features are our greatest strength regarding climate hazards?**

26

**INFRASTRUCTURE FEATURES**

**VULNERABILITIES**

- Inadequate culverts at several locations that result in local flooding
- Dams, particularly the Northborough Reservoir Dam
- Emergency communication systems
- Water supply and the need for redundancy
- Fortifying powerlines
- Protecting public buildings
- Improving stormwater features



Source: Town of Northborough

27

**SOCIETAL FEATURES**



**VULNERABILITIES**

- Elderly populations, senior centers, and critical care facilities and ensuring reliable backup power, adequate cooling systems, and proper communication
- Youth populations and ensuring adequate care during hazard events
- People with limited English and providing appropriate emergency communications
- Commuters and providing transportation during emergencies
- Suppliers of basic needs and ensuring they are accessible and secure (healthcare, food supply, energy, water, housing)

28

**ENVIRONMENTAL FEATURES**

**VULNERABILITIES**

- Increased flooding and summer low flow conditions of the Assabet River
- Increased risk of vector borne diseases, invasive species, and wildlife nuisances
- Increased risk of insect damage and fire in forested areas
- Management of the tree canopy
- Encouraging smart development patterns
- Securing hazardous materials
- Surface water quality
- Groundwater rising
- Air quality



**47%**  
Of Northborough is estimated to be forested

29

**What features are our greatest vulnerability regarding climate hazards?**

30

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## What services, initiatives, or mitigation measures are you aware the Town is taking?

31

31

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## EXISTING HAZARD PROTECTION

- National Flood Insurance Program (NFIP)
- Stormwater management policy and regulations in place
- Local Open Space and Recreation Plan
- Separated stormwater and sewer collection systems
- Drainage system maintenance and repair program
- Tree trimming
- Culvert maintenance and replacement
- Comprehensive Emergency Management Plan
- Master Plan is scheduled to be completed in 2019
- Planning Board regulates development in Town

WesterlyCompassion Source: Central Massachusetts Regional Planning Commission, 2018, "Northborough Hazard Mitigation Plan Update," 6, 65-67, 79

32

32

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## CLIMATE RESILIENCE MEASURES

- Dehumidifiers in Schools
- Green Communities Participant
- Open Space and Recreation Plan Update
- Complete Inventory of Culverts
- Update of Master Plan
- 12 Years of Ongoing Monitor and Model of Groundwater
- 3 Flood Control Systems

WesterlyCompassion Source: Core Team Kickoff Meeting

33

33

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## How prepared do you feel the Town is for future extreme events?

34

34

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## HIGHEST HIGH PRIORITIES

- Remove dams and restore streams
- Evaluate and rank roadway projects on flood prone streets
- Improve drainage and culverts
- Include climate change in the Town's stormwater management tasks
- Maintain and improve emergency services for vulnerable populations
  - increasing emergency transportation options (rideshare options)
  - diversifying communications
  - expanding planning
  - ensuring reliable power
- Educate the public and evaluate management of disease carrying insects and other public health related concerns
- Update local regulations to include climate change

35

35

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## HIGH PRIORITIES

- Provide critical municipal facilities with backup power to provide heating and cooling
- Protect municipal buildings and services against flooding
- Provide adequate staffing and training
- Improve water supply interconnection with MWRA and fortify and monitor backup wells
- Prepare communication plan and practice emergency protocols
- Install dehumidifiers in schools
- Educate residents about stormwater management and water quality
- Implement the Town's Hazard Mitigation Plan priorities that further climate adaptation
- Implement the Town's Master Plan priorities that further climate adaptation

36

36

**MEDIUM PRIORITIES**

- Improve communication before, during, and after extreme events, including a tailored notification plan, training, and emergency management planning
- Protect public health by conducting water quality monitoring
- Conduct public education to minimize non-point source pollution of surface water
- Increase tree plantings in urbanized areas and large parking areas such as Northborough Crossing
- Control invasive species and vegetation along roadways to improve sightlines
- Educate children to prepare the next generation to continue addressing climate change
- Utilize partners to communicate to vulnerable populations and broader audiences
- Add a second language to the CodeRed system
- Establish alternative energy sources
- Protect underground utilities like gas, water, and sewers through redundancy and back-up power

37

**How should Northborough prioritize climate adaptation measures?**

**FOR EXAMPLE:**

- Based on funding
- Time frame
- Asset type (i.e., infrastructure, buildings, or natural systems)
- Impact on public safety

38

**Which of the following priority action items would you rank as a top priority?**

1. Remove dams and restore streams
2. Evaluate and rank roadway projects on flood prone streets
3. Improve drainage and culverts
4. Include climate change in the Town's stormwater management tasks
5. Maintain and improve emergency services for vulnerable populations
6. Educate the public and evaluate management of disease carrying insects and other public health related concerns
7. Update local regulations to include climate change

39

**PUBLIC COMMENTS**

- **COMMENTS ACCEPTED UNTIL FEB. 26TH**  
<https://www.town.northborough.ma.us/home/news/listening-session-municipal-vulnerability-preparedness-program>
- **PLEASE SEND COMMENTS TO:**  
 Scott Charpentier  
[scharpentier@town.northborough.ma.us](mailto:scharpentier@town.northborough.ma.us)  
 Director of Public Works  
 Town of Northborough  
 508-393-5030

40

**THANK YOU**

Weston@Scamposoft

41



Municipal Vulnerability Preparedness Planning Grant Project - Listening Session  
Tuesday, February 18, 2020 6:00 pm - 7:30 pm

Name	Affiliation	Email Address
Scott D. Charpentier	Town of Northborough	scharpentier@town.northborough.ma.us
Joseph Galva	Police Dept	jgalva@town.northborough.ma.us
LESLIE MARRISSON	CITIZEN	LM1MARRISSON@CHARPENTER.NET
GREG ROODY	"	GPR@CHARTER.NET
Emily Rost	Resident	mehelopark501@verizon.net
Julianne Hish	select man	mikejule@verizon.net
David Parati	Fire chief / ems	dparat@town.northborough.ma.us
William Lyner	Police Dept	wlyner@town.northborough.ma.us
Leslie Foston	Board of Selectmen	leslie.foston@charter.net
Cady Miller	Town Health Officer	Cmiller@town.northborough.ma.us
Mia McDonald	Conservation Commission	mcdonald@town.northborough.ma.us
Janet Cason	Resident	janet@cason@verizon.net <small>This letter is a lower case name</small>
Jeanne Cahill		jmczahill@gmail.com
Ernie Wolshin	Resident	ewolshin@gmail.com

in the word "quick" !!



## Municipal Vulnerability Preparedness Planning Grant Listening Session

Free Public Library  
2/18/2020  
6:00 pm – 7:30 pm

### Hazards

- Stormwater flooding is occurring more frequently and more intensely
- More basement flooding
- Protecting buildings from severe storms
- High winds are a big threat
- Halloween storm in 2011 caused major power outages
- Hurricane of 1938 knocked down church steeples and many trees. What will it do to our cell towers and buildings now?

### Vulnerabilities

- Much of the Town is not on sewer so groundwater rising is another concern
- Methane leaks
- Mosquito and tick population increasing
- Older adults during heat
- Financial liability of dams and dam failure
- Invasive species (plants, insects, animals)
- Schools during hot days
- Tree trimming on private property
- Need more bike paths—addressed in master plan
- Availability of gas for generators—need generators at gas stations
- Route 20, Route 9, and other evacuation routes are vulnerable (bridge floods and Tomlin Hill)
- Otis/I35 in Westborough flood and that provides access to major roads
- Capacity to clear roads
- North Reservoir Dam does not provide flood control and is only a threat, potential for extreme damage
- Local energy storage

### Strengths

- Better off water wise than many other communities, we have a healthy aquifer, back up wells, and connection to MWRA
- Some of the dams do provide flood mitigation
- Tree canopy and open space
- Code Red

- MS4 work
- LED light bulbs at police station and high efficiency boiler
- Stretch code
- Culvert assessment

### **Actions**

- Boy scouts looking for climate related projects
  - Zoning and bylaw updates
- Emergency plan for senior center and communications
- Evaluate and rank roadways and coincide with planned updates