Horsley Witten Group
*Sustainable Environmental Solutions*
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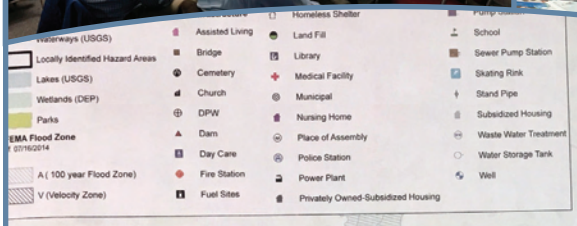
## Summary of Findings

# Peabody Municipal Vulnerability Preparedness Workshop

Peabody, Massachusetts

June 7, 2018





*Prepared for:*
**City of Peabody**
Attn: Brendan Callahan, Assistant Director of Planning
Department of Community Development and Planning
24 Lowell Street, Peabody, MA 01960

*Prepared by:*
**Horsley Witten Group, Inc.**

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# Peabody Municipal Vulnerability Preparedness Workshop
# *Summary of Findings*

**Acknowledgements:**

Funding to support the Peabody Municipal Vulnerability Preparedness (MVP) Workshop was provided by the Massachusetts Executive Office of Energy and Environmental Affairs through an MVP Planning Grant, issued to the City of Peabody during the fiscal year of July 2017 through June 2018.

The City of Peabody contracted with the Horsley Witten Group, Inc., to provide MVP certified staff to support the City in planning and facilitating the workshop.

The workshop venue and lunch were generously donated to the City of Peabody by the Northshore Mall, under the management of Mark Whiting, Simon Company, and the mall tenants Burton's Grill, Not Your Average Joe's and the Cheesecake Factory.

**Suggested Citation:**

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# Peabody Municipal Vulnerability Preparedness Workshop
# *Summary of Findings*

## Executive Summary

On April 11, 2018, the City of Peabody held a Municipal Vulnerabilities Preparedness (MVP) workshop. The workshop's goal was to identify hazards that Peabody faces that are being exacerbated by climate change, and to prioritize actions the City can take to prepare for identified hazards. This workshop, planned by a core team of organizers and the Horsley Witten Group, Inc. was a step towards MVP certification, which allows certified communities access to additional state grants for projects related to climate change resiliency. Twenty-four community members attended the workshop, representing a wide cross section of city officials, response partners, and other interested parties.

During discussion, participants concluded that the four categories of hazards most relevant to Peabody were intense rain and flooding; drought and fire; extreme heat and cold; and storms and sea level rise. In three small discussion groups, participants identified features of Peabody that are either vulnerable to climate change or could help strengthen the community's ability to cope with climate related hazards. Small groups then listed actions that could be taken to protect or mitigate the impact of prioritized hazards on the features they had identified. Following small and large group discussion and voting, participants prioritized the following seven action items:

- Evaluate and assess alternatives for managing commonly flooded areas and flood-impacted public safety concerns located throughout the City, including along the North River Canal, within the Lawrence Brook Watershed, in the downtown area, and along various brook channels.
- Improve emergency preparedness by evaluating alternative shelter locations for sustainable systems, planning for shelter upgrades, increasing education and outreach efforts, increasing emergency response certification levels, and planning for emergency management staffing and CERT Team. Specifically, acquire a generator for the senior center and work to increase the center's capacity to serve as a shelter.
- Improve wetlands protection by revising the Wetland Protection Ordinance to include limits on the allowable area of disturbance within the wetland and wetland buffers, and change the Conservation Commission's default of allowable disturbance to no disturbance.
- Evaluate and revise the City's land development and stormwater regulations to reduce impervious cover, reduce flooding, and improve stormwater detention, infiltration and treatment in the City (e.g., review parking requirements, road design requirements, utility requirements, and impervious cover limits). More specifically, work to reduce flooding in the North River Watershed by enhancing stormwater regulation and management.

- Flood-proof and upgrade sewer pump stations, including the station on Russell Street and others vulnerable to flooding.
- Conduct a public buildings assessment to evaluate their capacity for withstanding hazard events.
- Identify, evaluate and secure alternate sources of water to mitigate water supply impacts during drought conditions.

These action items will be incorporated into ongoing municipal planning efforts and will inform the MVP core team and the city as a whole as it works to take action to improve the City's resilience. Actions identified in this process are eligible for future grant funding under the MVP Action Grants program administered by the MA Executive Office of Energy and Environmental Affairs (EEA). By undertaking the MVP workshop and preparing this report, the City is also initiating its certification as an MVP Certified Community, which enables the City to apply for future MVP Program grants and elevates the scoring profile for related project proposals to other state grant programs.

# Table of Contents

# 1. Introduction

The Municipal Vulnerabilities Preparedness (MVP) Program is a Massachusetts state program designed to increase municipality-level resilience to natural hazards being exacerbated by climate change. This program is designed to help municipalities identify their vulnerabilities and strengths along with as opportunities to take action to reduce risk and build resilience. Workshops utilize the Community Resilience Building (CRB) Framework, a system of discussions and note taking developed by The Nature Conservancy and prescribed by the MVP Program. Peabody received a grant to participate in the MVP program in order to build on its prior resiliency planning efforts and develop a list of priority actions to focus on in the immediate future.

## Workshop Planning and Core Team

Following the award of the technical assistance grant, several city employees were identified to serve as a core organizing team. Team members included the following individuals, and were assisted by Ellie Baker and Craig Pereira, of the Horsley Witten Group (HW), Peabody's MVP Provider:

- Brendan Callahan, Assistant Director of Planning
- Curt Bellavance , Director of Community Development and Planning
- Steve Pasdon , Chief of Fire Department
- Christopher C. Ryder, Chief of Staff for Mayor Bettencourt
- David Terenzoni, Director of the Department of Public Service

Team members met on February 1 and March 1, 2018 and communicated via email and telephone as needed. Responsibilities of the core team included planning workshop logistics; reviewing workshop agenda; providing reference material, context and background for the MVP effort; reviewing maps and reference materials for use in workshop discussion groups; identifying a diversity of representative stakeholders to invite to the workshop; reaching out to invitees to encourage attendance; and participating in the workshop as discussion facilitators, note takers and stakeholders.

## Workshop Attendees and Materials

Peabody's MVP workshop was held on April 11, 2018 at the North Shore Mall conference room. A total of 42 stakeholders were invited to the workshop and 24 stakeholders attended. Participants represented a wide cross section of the City's stakeholders and decision-makers, including Mayor Edward Bettencourt, representatives from the Peabody Municipal Light Plant, a member of the school board, a representative of Cataldo ambulance, a representative from Salem Sound Coastwatch, a local high school student, a member of the City Council, and a wide variety of municipal department staff and volunteers from local boards and commissions, among others. See Attachment A for a full list of invited stakeholders, including their organizational affiliation and whether they attended the April 11 workshop.

On the day of the workshop, participants were provided with a copy of the agenda for the day (see Attachment B) and a handout summarizing climate change resiliency measures that have been

previously identified and recommended in recent city plans, including the Peabody 2015 Hazard Mitigation Plan (see Attachment B). The following additional informational materials were located on each small group's table to be shared in order to encourage communication and collaboration throughout the workshop:

- Summary of climate projections for the North Coastal Basin provided by EEA and prepared by the Northeast Climate Science Center (see Attachment B)
- Example vulnerabilities and strengths excerpted from the CRB guidance document (see Attachment B)
- Summary of Peabody demographic data (see Attachment B)
- Peabody base map showing critical infrastructure and FEMA floodplain data (see Attachment C)

## The Workshop Process

Following introductions and an overview of the MVP Program and workshop agenda, workshop participants listened to a presentation by MVP Certified facilitator Ellie Baker, HW, about climate change projections and their current and potential future impacts on Peabody. The presentation discussed specific infrastructural and environmental challenges facing the City in light of climate change. Challenges discussed included the flooding that occurs after severe rain events, the connection to coastal flooding that occurs downstream of Peabody, and the potential for increasing drought severity. Following this introduction, HW led a large group discussion in which participants honed in on four primary climate change hazards to frame the discussions for the remainder of the workshop.

The remainder of the workshop was conducted in three small discussion groups. Groups were made up of a facilitator (either a HW staff member or member of the core planning team), a note taker, and about 8 workshop participants. Small group discussions began by listing environmental, societal, and infrastructural features that represent either vulnerabilities or strengths of the community in the face of anticipated climate change hazards. Features were marked on the base maps and listed on the risk matrix, a framework for note taking developed as a part of the CRB framework. Each group listed between 10 and 18 features for each category, along with information about their location, ownership, and if they are a strength or vulnerability for the City. They also marked specific locations on the base map provided at the table, as appropriate.

Following a lunch break, groups moved on to discussing action items that either mitigate the threats posed by the priority hazards or enhance the strengths identified. Action items could either be a way to protect a vulnerable feature from a negative impact or how to better utilize one of Peabody's strengths. Common action items listed included raising or increasing flood protection for critical infrastructure, increasing emergency shelter capacity, and constructing and maintaining green infrastructure. Throughout small group discussion, the workshop's lead facilitator circulated between groups to ask questions and provide guidance.

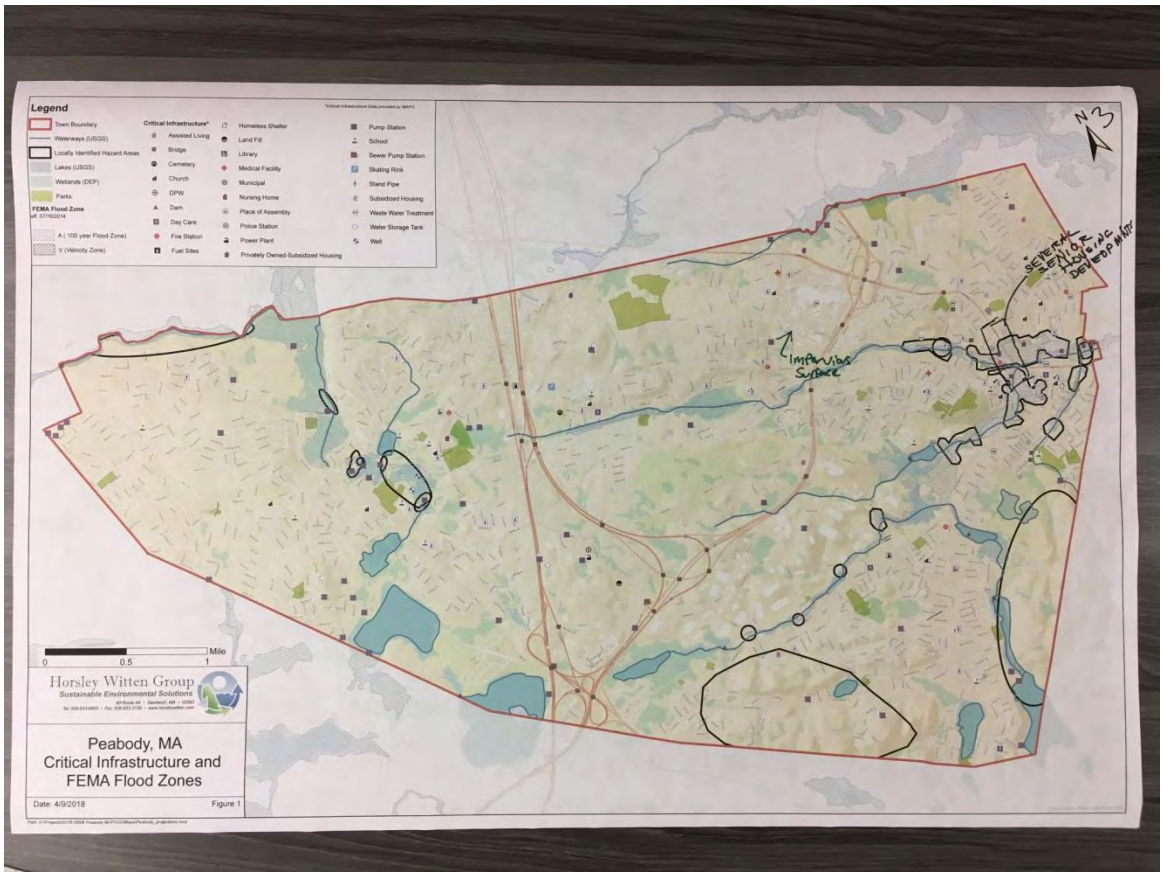


**Photo 1** Groups annotated maps to highlight vulnerable infrastructure, flood zones, and community resources**.**

Once complete lists of action items to address infrastructural, environmental, and societal vulnerabilities had been compiled, groups began the process of prioritizing actions. Groups completed this process in different ways, with some identifying the priority level for each suggested action items and others only determining which were of the highest priority. Groups prioritized items by discussion and/or by dot voting, in which each participant was given several dot stickers to place next to ideas they wished to prioritize.

After all groups had identified its top six priority action items, a representative of the group reported out to the full workshop, describing the prioritized items and presenting a brief summary of their group's discussion. Following the presentation of each group's priorities, workshop participants together with the workshop facilitator combined duplicative suggestions to create a final list of priority actions that the city of Peabody should embark upon to increase the resilience of the community in the face of anticipated climate change impacts. Through this process, the group identified seven overall priority action items.

The results of each stage of the workshop discussions are presented in the subsequent sections of this report. Attachment D includes a transcription of the summary matrices produced by each of the three discussion groups. Attachment E includes a matrix presenting a compilation of the recommended high priority actions from the three discussion groups. Action items prioritized during small or large group

discussion are indicated with underlined font. Attachment F includes the maps that contain notations from each of the three discussion groups.

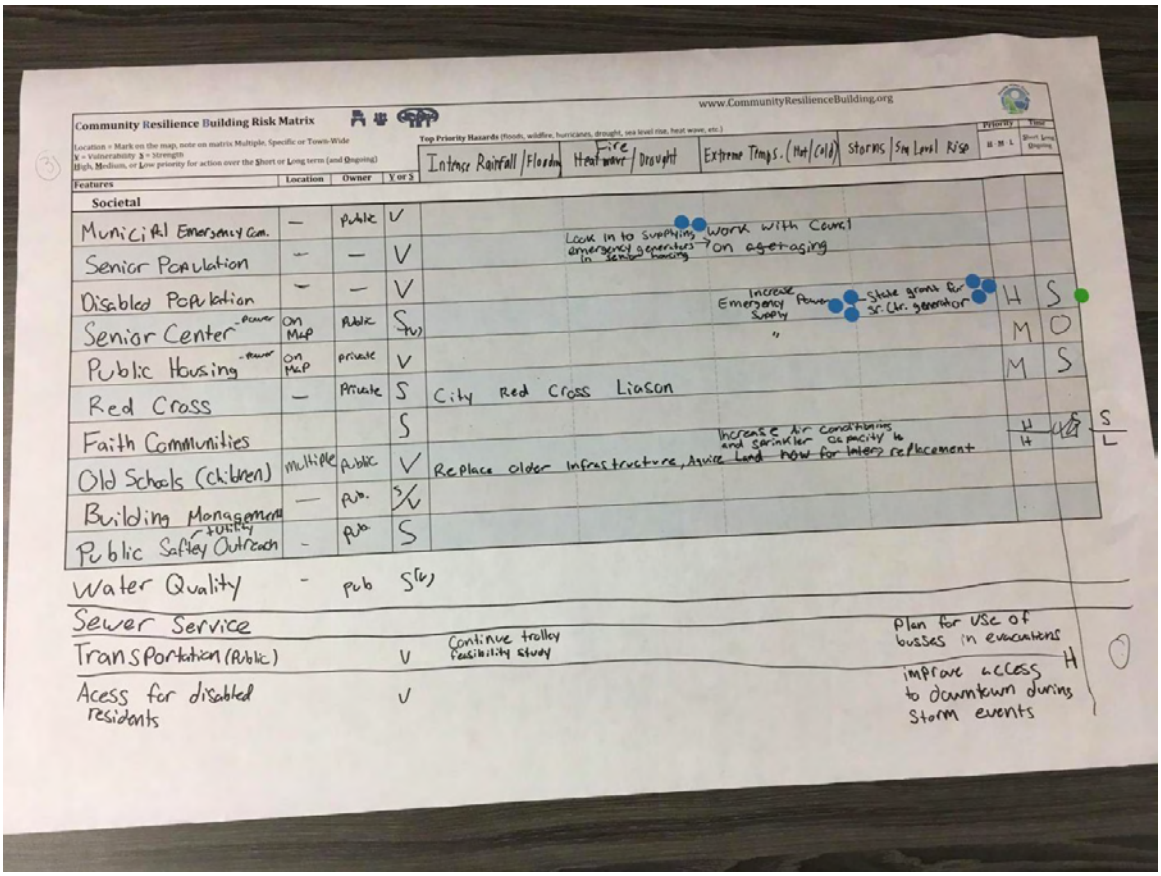


**Photo 2** An example completed risk matrix. Colored dots indicate the small group member voting to prioritize each action.

## 2. Top Hazards of Concern

The discussion of hazards tended to include both the hazard events as well as the impacts from those events, because the term hazard can be a bit confusing in its use; 'hazard' can refer to the cause and the impact. The presentation by HW included a list of hazards for consideration, as follows:

- Intense rain/flooding
- Wind events
- Hurricanes or Nor'Easters
- Winter Storms (snow, wind, cold)
- Extreme cold
- Heat waves, extreme heat
- Fire
- Drought
- Coastal flooding, Storm surge
- Sea level rise

Following discussion among the full group of workshop participants, several hazards were combined together based on the common impacts expected from the hazards. Workshop participants came to consensus that the following climate-change related hazards were the highest priority for Peabody:

- Intense Rain and Flooding
- Drought and Fire
- Extreme Heat and Cold
- Storms and Sea Level Rise

## 3. Current Concerns and Challenges Presented by Hazards

Peabody has experienced a number of climate- and weather-related challenges in recent years, and can expect to experience more severe events in the years to come due to climate change. Flooding is a major concern for the city of Peabody. The city is located at the confluence of three significant streams, Proctor Brook, Goldthwaite Brook and Strongwater Brook, which flow together into the North River and the City of Salem, and then into Salem Harbor. These streams, one of which is located in the City center, frequently flood during moderate and severe rain events, disrupting transportation, businesses, and residents' daily lives. Three winter storms in March, 2018 caused severe flooding due to rainfall and storm surge coinciding with seasonal high tides. These storms also brought heavy snow and wind that caused power outages lasting multiple days in many areas of the City and the region as a whole. This was a major disruption to commerce, government, schools, transportation, emergency response and life in general. In 2016 – 2017, Peabody and the northeast in general experienced a severe drought that challenged the City's water supply (water from the Ipswich River stored in municipal reservoirs) and caused the City to place restrictions on public water use and draw on a special permitted connection to the Massachusetts Water Resources Authority water supply via neighboring Lynnfield.

The biggest challenges, concerns and vulnerabilities that were raised in the breakout discussions at the MVP workshop included:

- *Inland flooding:* Many areas of Peabody experience inland flooding caused by precipitation events. This issue is worsened by the high level of impervious cover in some areas of the City combined with undersized, old, damaged or clogged drainage infrastructure. Roadways, businesses, and residences within the downtown area and near the city's brooks experience flooding during significantly large or intense rain events. Flooding occasionally occurs in areas known to contain contaminated waste or sediment, which is mobilized by the inundation of water.
- *Extreme heat and cold:* Peabody has experienced several instances of extreme heat and cold in the past several years. Due to the relatively high number of elderly residents, extreme temperature events can pose an increased threat to the city. Peabody's rate of emergency department visits related to heat stress is 22.1 per 10,000 residents per year, and could be expected to increase with climate change, indicating a potential need to better manage residents' heat exposure.

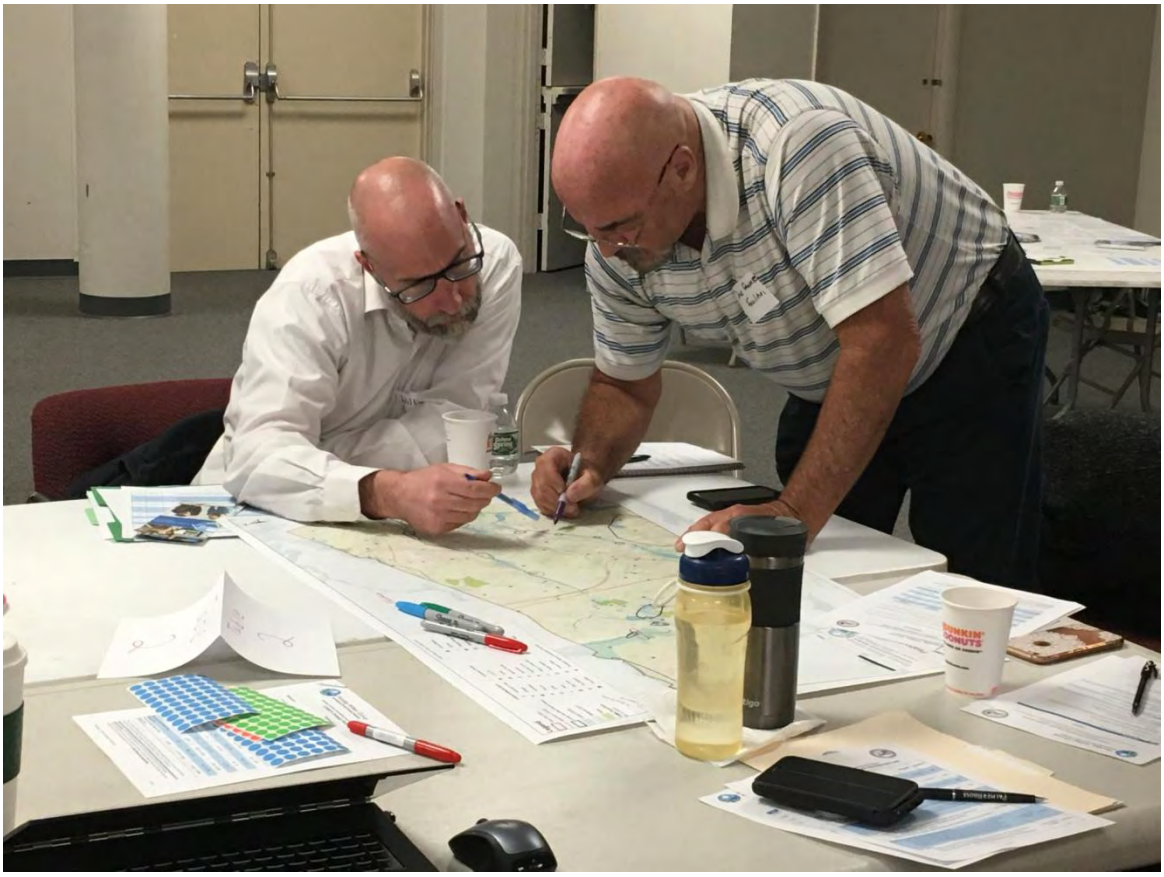

Photo 3 **Participants marked the locations of inland flooding on the map during their discussion of vulnerabilities.**

- *Emergency shelter availability:* The availability of shelters for both daytime and nighttime use was a concern for workshop participants. Current shelter provisions do not have emergency power supply, making them unsuitable for long term use or use during extreme temperature events.
- *Emergency preparedness, response and recovery after a storm event:* The flooding and weather extremes described above further raised concern about preparations and impacts to emergency response personnel and access to vulnerable populations. The City provides full-time emergency response services (fire, police, and ambulance), has a Code Red communications system, and staffs an emergency management operations center during emergency events. However, strengthening these systems and the city's ability to provide these services was a common concern.
- *Drought:* The state of Massachusetts experienced a severe drought in 2016-2017 that challenged the public water supply systems throughout the state. The city of Peabody's water supply, which consists of reservoirs filled from the neighboring Ipswich River. Drought pressure was not as severe in Peabody as it was in much of the rest of the state, but the City has experienced issues with algal growth in reservoirs being linked to taste and odor complaints Community members remain interested in increasing the sustainability of their water supply.

## 4. Current Strengths and Assets

Among the discussion groups at the workshop, a number of strengths were also identified among the infrastructural, societal and environmental assets of the city. These include:

Infrastructural:

- The facilities of Peabody Municipal Light Plant (PMLP) are of high quality and are highly resilient, and managed well by PMLP staff. Specifically substations, communications procedures, and emergency response methods are considered very strong.
- The presence of Lahey Clinic, a leading regional hospital, outside of the floodplain and near major thoroughfares, provides quality medical care.
- Recently improved stormwater infrastructure improves flood control. Improved infrastructure includes improved detention basins and enlarged culverts, including specifically the upsized culvert under Peabody Road.
- The location of Peabody at the intersection of major highways facilitates transportation in the region.
- The availability and use of Spring Pond as a drinking water reservoir provides water for the city.
- The presence of generators at utility stations and utility stations that have been raised above the floodplain increase utility resiliency.
- The installation and updates of sewer lines throughout the community increase wastewater service's reliability.

Societal:

- The presence of organizations like the YMCA and faith communities allows the structure necessary for emergency planning and response.
- The presence of the Red Cross within the community may improve emergency response outcomes in the city.
- The city's emergency communications procedures and public safety outreach may increase the speed of response efforts.
- The city's senior center can provide shelter during extreme weather events.

Environmental:

- Open space, including the two working farms within the city, can provide flood protection and local food supply.
- The aquifer underlying the Rousselot wells may provide an additional drinking water source for the city in the future.
- Maintenance and protection of trees and wetlands can serve an important role in flood mitigation.
- The city's lake health initiative is proactively working towards improved water quality in the city.

## 5. Top Recommendations to Improve Resilience

Following the presentation of each group's priorities, workshop participants, along with the workshop facilitator, combined duplicative suggestions to create a final list of suggestions. These suggestions were then further prioritized using dot voting. Seven action items were chosen as the highest priority for the City and are listed below.

- Evaluate and assess alternatives for managing commonly flooded areas and flood-impacted public safety concerns located throughout the City, including along the North River Canal, within the Lawrence Brook Watershed, in the downtown area, and along various brook channels.
- Improve emergency preparedness by evaluating alternative shelter locations for sustainable systems, planning for shelter upgrades, increasing education and outreach efforts, increasing emergency response certification levels, and planning for emergency management staffing and CERT Team. Specifically, acquire a generator for the senior center and work to increase the center's capacity to serve as a shelter.
- Improve wetlands protection by revising the Wetland Protection Ordinance to include limits on the allowable area of disturbance within the wetland and wetland buffers, and change the Conservation Commission's default of allowable disturbance to no disturbance.
- Evaluate and revise the City's land development and stormwater regulations to reduce impervious cover, reduce flooding, and improve stormwater detention, infiltration and treatment in the City (e.g., review parking requirements, road design requirements, utility requirements, and impervious cover limits). More specifically, work to reduce flooding in the North River Watershed by enhancing stormwater regulation and management.
- Flood-proof and upgrade sewer pump stations, including the station on Russell Street and others vulnerable to flooding.
- Conduct a public buildings assessment to evaluate their capacity for withstanding hazard events.
- Identify, evaluate and secure alternate sources of water to mitigate water supply impacts during drought conditions.

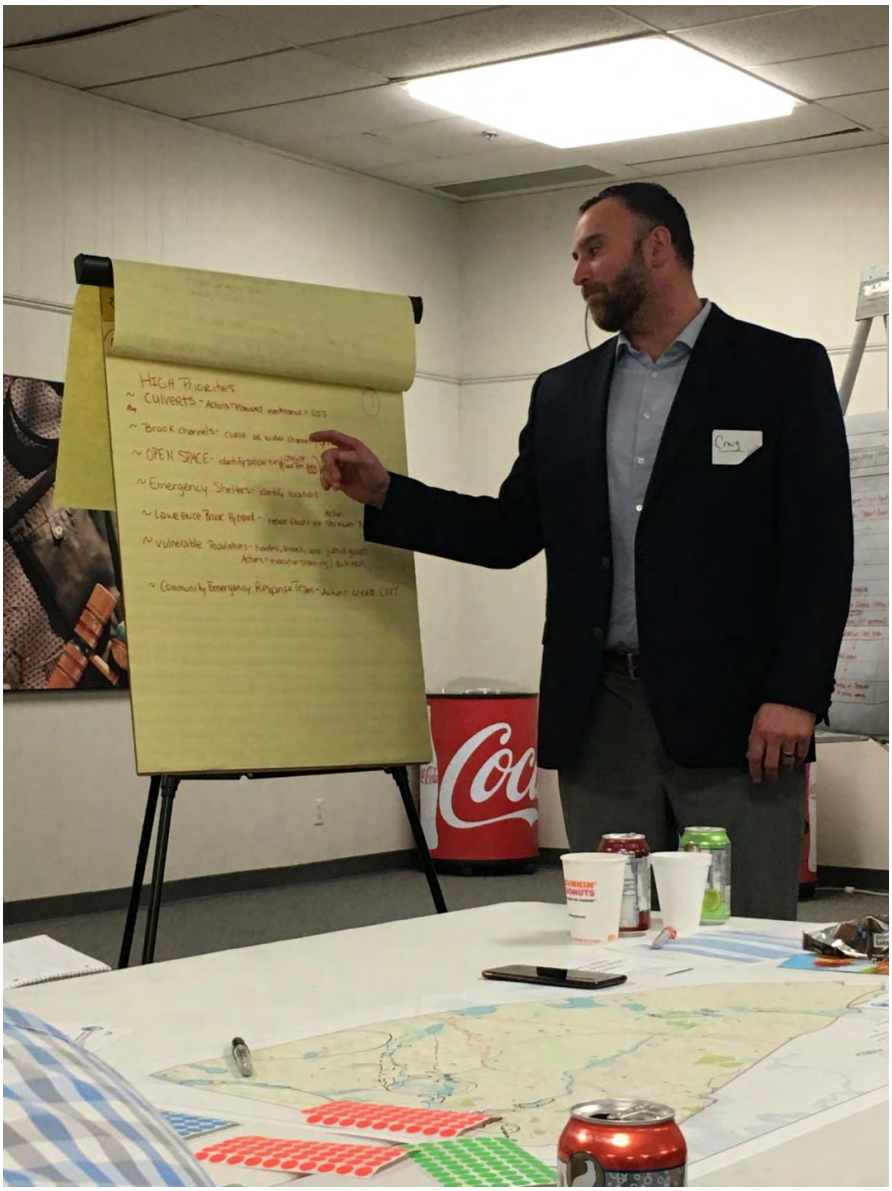


**Photo 4** A workshop participant presents Group 1's prioritized action items.

## 6. Conclusion and Next Steps

Peabody will continue the MVP certification process by presenting and distributing this report to the public at a formal public information and listening session before the City Council (exact date is yet to be determined). This session will provide an opportunity for any member of the interested public to learn, ask questions, and provide feedback about the April 11, 2018 MVP Workshop and the recommended highest priority actions that emerged from that workshop.

Priorities identified during the April 11, 2018 MVP Workshop will be integrated into existing municipal planning efforts. The City will also continue to pursue grant funding to implement the priority actions identified through the MVP Workshop process to continue to improve the City's resilience to climate change.

# Attachment A: List of Invitees and Participants

**Peabody MVP Workshop, April 11, 2018**
**Invitees and Participant**

| Attended? | FIRST | LAST | ROLE |
|---|---|---|---|
| | Brian | Abcunas | Peabody Municipal Light Plant |
| X | Curt | Bellavance | Director of Community Development & Planning |
| | Thomas | Bettencourt | Planning Board Chairperson |
| X | Edward | Bettencourt, Jr. | Mayor |
| | Tim | Brown | Business Community |
| | Dave | Burckhard | YMCA Representative |
| X | Brendan | Callahan | Assistant Director of Planning |
| X | Sharon | Cameron | Health Department Director |
| | Ed | Charest | City Council President |
| | Jenna | Coccimiglio | Peabody Chamber of Commerce |
| X | Lucia | DelNegro | Conservation Agent |
| X | Stephen | Farrell | School Department |
| | Peter | Gamache | JRM Hauling and Recycling |
| X | David | Gamache | Facilities Department |
| | Tom | Gould | City Councilor |
| | Dave | Harrison | Centennial Business Park |
| | Timothy | Healy | Peabody Facilities Manager |
| | Jarod | Hochman | School Committee |
| | Dan | Hoffenberger | Atlantic / Cataldo Ambulance |
| X | Bryan | Howcroft | Peabody Municipal Light Plant |
| X | Kevin | Hurley | Homeless Committee |
| | Corey | Jackson | Citizen's Inn, Haven for Hunger |
| | Bob | Langley | Director of Engineering |
| X | Stewart | Lazares | Conservation Commission |
| | Laura | MacNeil | North Shore Community Action |
| X | Vanessa | Martarano | Student, Peabody Public Schools |
| X | Pete | McGinn | City Councilor |
| | Father John | McInnis | Clergy Association |
| | Cara | Murtagh | School Department |
| X | Beth | O'Donnell | Americans with Disabilities Act Manager, Peabody |
| | Jimmy | Palmer | Peabody Access Telecommunications |

| Attended? | FIRST | LAST | ROLE |
|---|---|---|---|
| X | Steve | Pasdon | Chief of Fire Department |
| X | Will | Paulitz | City Engineer |
| | Michael | Rizzo | Conservation Commission Chairperson |
| | Chassea | Robinson | Health Department Nurse |
| | Robin | Rossignoll | Lahey Hospital Medical Center |
| X | Chris | Ryder | Chief of Staff, Mayor's Office, MBTA Advisory Board Liaison |
| | Davis | Scribber | Water Treatment Plant |
| X | Al | Talarico | Building Department |
| X | Dave | Terenzoni | Director of Department of Public Services |
| | Dan | Terenzoni | Building Department |
| X | Glenn | Trueira | Peabody Municipal Light Plant |
| X | Barbara | Warren | Salem Sound Coastwatch |
| X | Craig | Welton | Resident |
| X | Robert | White | Atlantic / Cataldo Ambulance |
| | Carolyn | Wynn | Council On Aging |

# Attachment B: Workshop Handouts

Agenda

Prior Recommendations

Climate Change Projections

Example Vulnerabilities and Strengths

Demographics

Horsley Witten Group
*Sustainable Environmental Solutions*

**Peabody Municipal Vulnerability Preparedness (MVP) Workshop**

Wednesday, April 11, 2018, 8:30 am - 4:00 pm

North Shore Mall Meeting Room (Enter Service Door 10, between Sears and Legal Seafoods)

**AGENDA**

| TIME | ACTIVITIES |
|---|---|
| 8:30 AM | Registration and Refreshments |
| 9:00 AM | Welcome |
| 9:10 AM | Introductions and Overview of the Workshop |
| 9:20 AM | **Overview Presentation** on Science, Past Planning Efforts and Outcomes, and Data Resources<br>Review recent climate related events.<br>Present summary of anticipated climate changes.<br>Present summary of recent/existing planning efforts |
| 9:50 PM | **DISCUSSION #1: Large Group**<br>Identify top 4 Climate Change Hazards facing Peabody |
| 10:30 AM | 15 MINUTE BREAK |
| 10:45 AM | **DISCUSSION #2: Small Group**<br>Identify Features that are Vulnerabilities and Strengths |
| 12:20 PM | 40 MINUTE LUNCH |
| 1:00 PM | **DISCUSSION #3: Small Group**<br>Identify Actions to address Vulnerabilities or protect Strengths.<br>Discuss timeframe, responsibility, funding, as time allows.<br>Prioritize top 5-6 Actions |
| 2:25 PM | 15 MINUTE BREAK |
| 2:40 PM | **DISCUSSION #4: Small Groups Report Out**<br>Each group reports out top 5-6 Priority Actions |
| 3:10 PM | **FINAL DISCUSSION: Large Group**<br>Select top 5-6 Priority Actions for Municipal Climate Resilience<br>Discuss timeframe, responsibility, funding |
| 3:50 PM | **Wrap Up and Closing Remarks** |
| 4:00 PM | Adjourn |

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**Peabody Municipal Vulnerability Preparedness (MVP) Grant Project:**

# KEY RECOMMENDATIONS FROM 2015 HAZARD MITIGATION PLAN

| RECOMMENDATION | HAZARD | PRIORITY |
|---|---|---|
| **Increase Funding for Flood Preparedness and Response**<br>• Consider creating a stormwater utility | Flooding | High |
| **Downtown Traffic Management Plan**<br>• Plan would route traffic around expected flood areas with signage and public outreach | Flooding | High |
| **Stormwater Management Ordinance**<br>• Adopt and implement the draft ordinance | Flooding | High |
| **Floodplain Management**<br>• Continue to enforce Floodplain Zoning District, update to be consistent with FEMA<br>• Maintain maps of most recent FEMA floodplain updates | Flooding | High |
| **Acquisition of Vacant Flood Prone Land**<br>• Acquire priority open space parcels in floodplain to maintain flood storage and infiltration capacity<br>• Land acquisition or conservation restrictions also listed as an objective of the City's Recreation and Open Space Plan (2015), including space adjacent to Lower Spring Pond and "environmentally sensitive" parcels | Flooding | High |
| **Emergency Management Upgrades**<br>• Upgrade all emergency power generators and provide alternative fuel sources<br>• Complete and implement the Hazardous Materials Assembly Plan<br>• Update radio repeater units as needed<br>• Upgrade Peabody Municipal Light Company communications and security system | All hazards | High |
| **Regulatory and Public Outreach Improvements**<br>• Improve wetlands ordinance enforcement (e.g., wetlands encroachment issues)<br>• Develop public outreach program on wetlands, flooding, and stormwater<br>• Consider updating stormwater and drainage standards for Site Plan Review, Development Impact Statements, and Subdivision Control Regulations<br>• Include a section on Climate Change Preparedness in Master Plan Update | Flooding, all hazards | Medium |
| **Dam Safety**<br>• Update and implement Dam Emergency Action Plans for all City-owned dams<br>• Conduct follow-up seismic dam analysis study for City's reservoir dams<br>• Create and implement a regular dam maintenance plan for City-owned dams | Dam safety, flooding | Medium |

| RECOMMENDATION | HAZARD | PRIORITY |
|---|---|---|
| **Winter Storm Preparedness** (medium priority recommendations)<br>• Acquire new plow/sander truck and sidewalk plow<br>• Develop partnership between utilities and DPS to document known hazards<br>• Maintain snow removal equipment and adequate supplies of de-icing materials | Winter storms | Medium |
| **Brushfire Preparedness**<br>• Develop and maintain a database to track brushfire events<br>• Include brushfire risk and mitigation in major City planning efforts | Brushfires | Medium |
| **Severe Wind Preparedness** (e.g., hurricanes, strong nor'easters, tornadoes)<br>• Develop and maintain a GIS database to track vulnerability to severe wind and map high risk areas based on different wind speeds<br>• Use HAZUS to estimate potential losses from hurricane winds<br>• Work with utilities to ensure preventative actions are taken related to: tree maintenance, utility pole inspection, use of designed-failure mode for power lines, installing redundancies and loop feeds<br>• Require and/or encourage construction of tornado safe rooms<br>• Provide public outreach materials about risk from tree failure (Low Priority) | Severe wind | Medium |
| **Wetlands Mapping**<br>• Develop a wetlands mapping database to include local wetland delineations | Flooding | Low |
| **Landslide Preparedness**<br>• Complete an inventory and maintain a database of steep slopes where buildings and infrastructure may be vulnerable to landslides | Landslides | Low |
| **Winter Storm Preparedness** (low priority recommendations)<br>• Retrofit public building roofs to prevent roof collapse due to snow<br>• Use snow fences or "living snow fences" to limit snow drifting onto roadways<br>• Identify at-risk populations that may be vulnerable during long power outages | Winter storms | Low |
| **Drought Preparedness**<br>• Incorporate use of native species in development landscape regulations<br>• Promote use of permeable driveways and surfaces to promote infiltration and reduce stormwater runoff | Drought | Low |
| **Extreme Temperature Preparedness**<br>• Promote green buildings and parking areas through tree planting, use of green roofs and cool roof products<br>• Create a database to track people vulnerable to extreme heat conditions, such the elderly and homeless | Extreme heat | Low |

**SOURCE:** Metropolitan Area Planning Council, 2016. *City of Peabody Hazard Mitigation Plan, 2015 Update*. Adopted March 10, 2016. 149 p.

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**Peabody Municipal Vulnerability Preparedness (MVP) Grant Project:**

# CLIMATE CHANGE PROJECTIONS[1]

## TEMPERATURE

### HIGHLIGHTS:

- ✓ Temperature increases could make Peabody feel like present-day Maryland by 2050 and present-day North Carolina by 2100.[2]
- ✓ By 2050, we could have more than 4 times as many very hot days (over 90°F) than we do today. By 2100, we could have almost 9 times as many.
- ✓ We will have far fewer days with temperatures below freezing.
- ✓ We will have to expend less energy on heating in the winter, and far more on air conditioning in the summer.
- ✓ The growing season will increase by almost 50% by 2050 and could almost double by the end of the century.

**Table 1: TEMPERATURE PROJECTIONS**

| North Coastal Basin Climate Parameter | Baseline (1971-2000) | Mid-Century (2050s) | End of Century (2090s) |
|---|---|---|---|
| Average Annual Temperature (°F) | 49.7 | 52.4 – 55.9 | 53.2 – 60.5 |
| Maximum Annual Temperature (°F) | 59.2 | 61.7 – 65.2 | 62.4 – 69.9 |
| Minimum Annual Temperature (°F) | 40.2 | 43.1 – 46.6 | 44.0 – 51.1 |
| Annual Days with Max Temp over 90°F | 8 | 15 – 34 | 18 – 70 |
| Annual Days with Min Temp below 32°F | 121 | 77 – 103 | 55 – 98 |
| Annual Heating Degree-Days (Base 65°F) | 6,194 | 4,677 – 5,502 | 3,793 – 5,265 |
| Annual Cooling Degree-Days (Base 65°F) | 590 | 866 – 1,321 | 961 – 2,099 |
| Annual Growing Degree-Days (Base 50°F) | 2,635 | 3,174 – 3,863 | 3,324 – 5,084 |

[1] Source: Northeast Climate Science Center, 2018. *Massachusetts Climate Change Projections*. University of MA Amherst. Published by MA Executive Office of Energy and Environmental Affairs. January. 213 p. Available at: http://www.massclimatechange.org/resources/resource::2152/massachusetts-climate-change-projections-statewide-and-for-major-river-basins. Data is for the North Coastal Basin, which includes the majority of the land area of Peabody.

[2] NOAA National Centers for Environmental Information, Climate at a Glance: Statewide Mapping, Average Temperature, published March 2018, retrieved on March 22, 2018 from http://www.ncdc.noaa.gov/cag/.

## PRECIPITATION

**HIGHLIGHTS:**

- ✓ Average annual precipitation in Peabody will increase up to 12% by 2050 and up to 16% by 2100.
- ✓ The largest increases in precipitation will occur in winter.
- ✓ The greatest increase in consecutive dry days will occur in fall.

**Table 2: PRECIPITATION PROJECTIONS**

| North Coastal Basin Climate Parameter | Baseline (1971-2000) | Mid-Century (2050s) | End of Century (2090s) |
|---|---|---|---|
| Total Precipitation (inches): | | | |
| Annual | 45.3 | 45.3 – 50.8 | 46.1 – 52.5 |
| Winter | 11.7 | 11.9 – 14.1 | 12.2 – 15.8 |
| Spring | 11.5 | 11.4 – 13.6 | 11.6 – 14.2 |
| Summer | 10.1 | 9.5 – 12.0 | 8.4 – 11.9 |
| Fall | 12.1 | 11.0 – 13.5 | 10.3 – 13.3 |
| Annual Days with Precipitation over 1 inch | 8 | 8 – 11 | 9 – 12 |
| Annual Days with Precipitation Over 2 inches | 1 | 1 – 2 | 1 – 2 |
| Annual Days with Precipitation Over 4 inches | 0 | 0 – 0 | 0 – 0 |
| Annual Consecutive Dry Days | 17 | 17 – 20 | 17 – 20 |

## SEA LEVEL RISE

**Table 3: SEA LEVEL RISE PROJECTIONS**

| Year | Emissions Scenario | Boston Likely Range (feet relative to mean sea level in 2000) | Seavey Island, ME Likely Range (feet relative to mean sea level in 2000) |
|---|---|---|---|
| 2050 | Medium | 0.8 to 1.4 | 0.6 to 1.2 |
| | High | 0.8 to 1.5 | 0.7 to 1.4 |
| 2100 | Medium | 1.5 to 3.1 | 1.2 to 2.8 |
| | High | 2.0 to 4.0 | 1.7 to 3.7 |

Horsley Witten Group
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**Peabody Municipal Vulnerability Preparedness (MVP) Grant Project:**

# SELECTED DEMOGRAPHIC DATA[1]

| Demographic Parameter | Result |
|---|---|
| Population | 51,251 people |
| Age | 0-19 = 21%<br>20-34= 18%<br>35-64 = 41%<br>65+ = 20% |
| Income | <$40K = 32%<br>$40-60K = 17%<br>$60K+ = 50% |
| % Below Poverty Line | 9% |
| Race | White = 89%<br>Black = 3%<br>Asian = 2%<br>Other = 7% |
| Ethnicity | Hispanic = 9%<br>Not Hispanic = 91% |
| Environmental Justice | 21.6% |
| % Population Over 65 Living Alone | 6.8% |
| Heart Attack Hospitalizations | 30.8 (age-adjusted rate per 10,000 people) |
| Asthma Emergency Department Visits | 72.8 (age-adjusted rate per 10,000 people) |
| Pediatric Asthma Prevalence | 7.3% of all children enrolled in grades K-8 |
| Heat Stress Emergency Department Visits | 22.1 (age-adjusted rate per 10,000 people) |

[1] Source: MA Dept of Public Health, 2018. MA Environmental Public Health Tracking Community Profile for Peabody. Report Created on March 14, 2018. 10 p.

Horsley Witten Group
*Sustainable Environmental Solutions*

**Newburyport Municipal Vulnerability Preparedness (MVP) Grant Project:**

# EXAMPLES of VULNERABILITIES and STRENGTHS[1]

## INFRASTRUCTURE

Examples of Vulnerabilities:

- Main road floods during storms, blocking emergency response.
- Power outages during heat waves lead to health concerns.
- Wildfire and high winds resulting in supply chain interruptions.
- Sewer pump stations become submerged and inoperable.
- Compromised rail system due to heat-related warping of tracks.

Examples of Strengths:

- Critical road elevated and passable by emergency management
- Hurricane roof installed at school with improved sheltering capacity.
- Hardened utility lines reduce outages due to ice storms.
- Undersized culvert replaced to reduce flooding in key intersection.
- Improvement to communication systems during extreme weather.

## SOCIETAL

Examples of Vulnerabilities:

- Senior housing without backup generators during heat waves.
- Residents without access to transportation during hurricane evacuation.
- Household contamination and sewage mobilization during flooding.
- Limited areas of refuge in elementary schools during tornados.

Examples of Strengths:

- Reliable communications protocols across departments for all employees.
- "Neighbor-helping-neighbor" program aligned with emergency operations.
- Well-supported volunteer organizations (fire, ambulance, CERTs).
- Faith-based and civic groups with hazard preparedness plans.

## ENVIRONMENTAL

Examples of Vulnerabilities:

- Beachfront development reducing protection provided by dunes.
- Proliferation of subdivisions in wildfire and flood prone areas.
- Lack of urban tree canopy increasing heat island effect.

Examples of Strengths:

- Oyster reefs and tidal wetlands help reduce wave damage to property.
- Forested watersheds maintain drinking water supply during droughts.
- Native, vegetated slopes remain stable after intense 24hr rain events.
- Floodplains provide stormwater storage and downstream flood reduction.

[1] Source: Community Resilience Building Workshop Guide, communityresiliencebuilding.com

# Attachment C: Base Map

## Legend

- Town Boundary
- Waterways (USGS)
- Locally Identified Hazard Areas
- Lakes (USGS)
- Wetlands (DEP)
- Parks

**FEMA Flood Zone**
eff. 07/16/2014

- A ( 100 year Flood Zone)
- V (Velocity Zone)

**Critical Infrastructure***

- Assisted Living
- Bridge
- Cemetery
- Church
- DPW
- Dam
- Day Care
- Fire Station
- Fuel Sites
- Homeless Shelter
- Land Fill
- Library
- Medical Facility
- Municipal
- Nursing Home
- Place of Assembly
- Police Station
- Power Plant
- Privately Owned-Subsidized Housing
- Pump Station
- School
- Sewer Pump Station
- Skating Rink
- Stand Pipe
- Subsidized Housing
- Waste Water Treatment
- Water Storage Tank
- Well

*Critical Infrastructure Data provided by MAPC

N

0 0.5 1 Mile

Horsley Witten Group
Sustainable Environmental Solutions
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# Peabody, MA
# Critical Infrastructure and FEMA Flood Zones

Date: 4/9/2018

Figure 1



Path: H:\Projects\2018\18006 Peabody MVP\GIS\Maps\Peabody_projections.mxd

# Attachment D: Discussion Matrices from the Three Discussion Groups

## Community Resilience Building Risk Matrix

## Group 1

www.CommunityResilienceBuilding.org

Location = Mark on the map, note on matrix Multiple, Specific or Town-Wide
**V** = Vulnerability **S** = Strength
Type of Feature = **I**nfrastructural, **S**ocietal, or **E**nvironmental
**H**igh, **M**edium, or **L**ow priority for action over the **S**hort or **L**ong term (and **O**ngoing)

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

| Features | Location | Owner | V or S | Intense Rain and Flooding | Drought and Fire | Extreme Heat and Cold | Storms and Sea Level Rise | Priority H - M - L | Time Short Long Ongoing |
|---|---|---|---|---|---|---|---|---|---|
| **Infrastructural** | | | | | | | | | |
| Substation (new station being built) | W. Peabody, bike path | PMLP | S | | | | | | |
| Roadways/culverts<br>Flooding issues/ drainage clogged | All | Private/public | V | Planned maintenance program/ GIS mapping/ Mobile capabilities | | | | H | |
| Brook channel/ weird turns | Downtown | Varies | V | Curve channels (90-45°); widen/ studies *Walnut priority*, development restrictions and control | | | | H | |
| Drinking water storage | SW Peabody | City | V | | Emergency supply investigations, water restriction enforcement, coordination with MWRA; public outreach | | | | |
| SESD pump station | Walnut St. | | V | Coordinate with SESD to identify issues | | | | | |
| Lahey clinic | Andover St. | Private/public | S | | | | | | |
| Public transportation | Downtown | MBTA | V | Downtown evacuation planning and route | | | | | |
| Public buildings (fire and police stations) | Allen's lane Lowell | City | S/V | Flooding protection/ mitigation study using future modeling | | | | M | |
| Open space flood capacity (conservation restrictions) | Citywide | City | S/V | Prioritize and identify properties to acquire, update conservation database; strategy for acquiring; public outreach | | | | H | |
| Emergency shelters | Citywide | City | V/S | Identification of Long-term emergency shelters based on qualifiers (e.g., above flood zones), set agreements | | | | H | |
| Senior housing | Citywide | Varies | V/S | Evacuation planning | | Formal welfare check system | | | |
| Low income housing | | | | Restrictions on location; evacuation plan | | Public outreach | | | |
| New housing in flood plain | | | | Restrictions on location; evacuation plan | | Public outreach | | | |
| Dams | Varies | Public | V | Training/ exercises on ERP | | Dredging of "Reservoirs" to increase capacity | | | |
| Water pressure | Varies (Brooksby Farm, W. Peabody) | | | | Investigations | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Societal** | | | | | | |
| Homeless | Downtown | | V | Emergency evacuation plan (EI seniors), formalized homeless population outreach plan (with consideration to extreme heat) community emergency preparedness- CERT Development | H | |
| Seniors | Citywide | | V | | | |
| Environmental justice neighborhoods | | | V | Outreach | H | |
| Schools and students | Welch in floodplain | Public | V | Flow risk assessment; egress issues | | |
| Downtown | Walnut Foster | | V | | | |
| YMCA | Lynnfield | Private | S | | | |
| Emergency communication | Nixle CodeRed | | S | | | |
| Businesses | Downtown | Varies | V | | | |
| Detours during incidents | Downtown | Public | V | | | |
| Health concerns | Downtown | | V | Public outreach about walking in flood waters | | |
| **Environmental** | | | | | | |
| Flood plains (existing gas stations and USTs) | Downtown crowing area | Private land | | Risk assessment | | |
| Flood plain (existing housing) | Downtown | Varies | | Open space in the future | | |
| Waterways/ rivers | All confluence | Varies | | Stream cleanups, public outreach | | |
| Aquifer at Rousselot wells | Allen's Lane Area | Private | | Watershed protections; contamination remediation options<br>Regulatory reform, LID, enforcement of conservation commission with "no disturb zones" | M | L |
| Other wetlands | Citywide | Varies | | Regulatory reform, LID, enforcement of conservation commission with "no disturb zones" | | |
| Trees | Citywide | Varies | | Regulatory reform, LID, enforcement of conservation commission with "no disturb zones" | | |
| Wildlife | Citywide | Varies | | Regulatory reform, LID, enforcement of conservation commission with "no disturb zones" | | |
| Water quality | Citywide | Varies | | Increase stormwater storage, reduce flooding/ LID<, greenscapes (reduced eutrophication) | | |
| Lawrence brook watershed | | | | Stormwater regulations to reduce flooding | H | O |

## Community Resilience Building Risk Matrix

## Group 2

www.CommunityResilienceBuilding.org

Location = Mark on the map, note on matrix Multiple, Specific or Town-Wide
**V** = Vulnerability **S** = Strength
Type of Feature = **I**nfrastructural, **S**ocietal, or **E**nvironmental
**H**igh, **M**edium, or **L**ow priority for action over the **S**hort or **L**ong term (and **O**ngoing)

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

| Features | Location | Owner | V or S | Intense Rain and Flooding | Drought and Fire | Extreme Heat and Cold | Storms and Sea Level Rise | Priority H - M - L | Time S Short L Long O Ongoing |
|---|---|---|---|---|---|---|---|---|---|
| **Infrastructural** | | | | | | | | | |
| Flooding-multiple sites (Lalikos-routine, Russell-extreme) | Multiple | Public | V | Increase pipe capacity in Lawrence Brook watershed- implement the study, rehab south side North River Canal wall<br>Studies of targeted high frequency flooding area<br>Coordinate with Salem and Army Corps on North River holding and flow (Project 3)<br>Revisit upstream storage requirements (regulatory change to city bylaws) | | | | H<br>M | S |
| Sewer pumping station | Northfield Rd<br>Multiple<br>Russell St. | Public | V | Flood proof Russell Street Station and create bypass and elevate equipment, generator upgrade, upgrade injector stations<br>Purchase backup generators | | | | H | S |
| Peabody Rd- Upsized culvert | Peabody Rd.<br>Centennial Park<br>Multiple | Public | S | | | | | | |
| Power- few outages | Multiple | Public | S/V | Annual reporting requirement to ensure future planning | | | | | |
| Dams | Elginwood | Public | V | | | | | | |
| Water supply, Spring pond-stormwater management | Multiple | | V/S | Limit development around drinking water supplies | | | | | |
| Structural capacity of schools (roofs)<br>Aging facilities/ location of critical facilities | Multiple | Public | V | Public buildings assessment for withstanding hazard events | | | | | |
| Sewer lines | Jordan Acres | Public | S | Continue to implement sewer lines project | | | | H | O |
| Generators and raised utilities at Police and Fire | Police/ Fire | Public | S | | | | | | |
| Hospital | Lahey, Salem | Private | S/V | | | | | | |
| Utilize sustainable materials in construction | Multiple | Public/private | V | | | | | | |
| New middle school- green building | Higgins | Public | S | Expand municipal LEED certified buildings | | | | | |
| Transportation network-state highways<br>Transportation network-public option | Public | Public | S<br>V | | | | | | |
| Capacity of retention basins | Multiple | Public/private | V | | | | | | |
| Aging infrastructure (water and sewer) | Multiple | Public | V | Consider stormwater utility study | | | | | |
| Inc. costs for road maintenance- pothole | Multiple | Public | V | | | | | | |
| Hydrants- maintenance | Multiple | Public | V | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Societal** | | | | | | |
| Shelters inaccessible and without backup power siting for various hazards | Multiple | Public | V | Investigate alternative shelter options, including sustainable system for heating and cooling | | |
| Mobile home vulnerability, evacuation, structural standards | Multiple | Private | V | | | |
| High density residential units in flood zones, are utilities elevated? | Multiple | Private | V | Regulatory: modify development standards with management companies and include an EMP, restrict siting of new facilities | | |
| Air conditioning for seniors | Multiple | Private/ public | V | | | |
| Community engagement to reach vulnerable populations | Citywide | Private/ public | V | Create central system for community education and awareness | | |
| Code Red- other languages? | Citywide | Public | V | Research options for multilingual messaging | | |
| Cooling assistance programs | Citywide | Private/ public | V | Evaluate cooling assistance programs | | |
| Faith resources, other non profits (Haven, NSOAP, Red Cross) | Citywide | Private | S | Identify community leaders to help share information to their constituents | | |
| **Environmental** | | | | | | |
| Water supply- algae blooms | Multiple | Public | V | Monitor and treat as necessary | | |
| Tree canopy (species) | Multiple | Public/ private | V | Update list of tree options and strengthen requirements | | |
| Land clearing- clear cut and replacement | Multiple | Public/ private | V | Regulatory charges with percent limitations | | |
| Invasive management | Multiple | Public/ private | V | Investigate partnerships with environmental groups for stewardship | | |
| Economic impact to farming (Brooksby Farm) | Brooksby/ Tillie's | Public | V | | | |
| Development in wetland areas and flood zones | Multiple | Public/ private | V | Regulatory- expand wetland bylaw to include fee for disturbance | | |
| Impervious surfaces (regulations) | Multiple | Public/ private | V | Regulatory- evaluate requirements for max/min posting, incentives to reduce impervious sites | | |
| Identify easements and opportunities for land purchase | Multiple | Public | | Coordinate with open space plan recommendations | | |
| Impacts to wildlife habitat | Multiple | Public/ private | V/S | Look at 50 years plan to manage wildlife | | |
| Wildlife management | Multiple | Public/ private | V | | | |
| Standards for building materials and vent systems (below grade construction), including the maintenance of systems and changing systems to operate at different temperatures | Multiple | Public/ private | V | Incorporate maintenance plan for facility maintenance | | |
| Brownfields- hazardous materials | Multiple | Public/ private | V | | | |
| Satellite parking for cars in flood zones | Multiple | Public | V | Incorporate in to emergency management plan | | |
| Increased pesticide and fertilizer use | Multiple | Public/ private | V | Education | | |
| Eight sites with hazardous materials storage | Multiple | Public/ private | V | Address in city's and facility's emergency operation plan | | |

## Community Resilience Building Risk Matrix

## Group 3

www.CommunityResilienceBuilding.org

Location = Mark on the map, note on matrix Multiple, Specific or Town-Wide
**V** = Vulnerability **S** = Strength
Type of Feature = **I**nfrastructural, **S**ocietal, or **E**nvironmental
**H**igh, **M**edium, or **L**ow priority for action over the **S**hort or **L**ong term (and **O**ngoing)

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

| Features | Location | Owner | V or S | Intense Rain and Flooding | Drought and Fire | Extreme Heat and Cold | Storms and Sea Level Rise | Priority H - M - L | Time S Short L Long O Ongoing |
|---|---|---|---|---|---|---|---|---|---|
| **Infrastructural** | | | | | | | | | |
| Downtown | Specific | Multiple | V | Targeted plans | | | Traffic management plan | H | O |
| Culverts (downtown) | Multiple | Public | S | Develop and follow maintenance plan | | | | H | O |
| River walls (downtown) | Along Rivers | Public/private | V | Fix and enforce | | | | H | O |
| Detention basins | Scout Woods | Public | S | City review of basins | | | | | |
| Private property's stormwater | Multiple | Private | V | Increase public outreach about maintenance and new technology (like green roofs) | | | | | |
| Lower Spring Pond | On map | Public | V | Increase flood detention capacity | Increase drinking water supply | | | | |
| Electric Infrastructure | Multiple | Public | V/S | Continue ongoing infrastructure improvements | | | | | |
| PMLP | Peabody | Public | S | | | | | | |
| Sheltering capacity | Multiple | | V | Develop a plan for emergency shelter and shelter upgrades | | | | H | S |
| Roadways | Multiple | Public | S (v) | Ongoing maintenance | | | | | |
| Communications infrastructure | | | S (v) | Leverage strength of PMLP to continue improvements | | | | H | O |
| Impervious surfaces at the mall | | | V | | | | | | |
| Central Street improvements | | | S | | | | | L | |
| Limited water supply | | | | | Plan for and enhance water preservation<br>Track water use/loss on public and private mains | | | M | L |

| **Societal** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Municipal emergency communications | | Public | V | | | | | | |
| Senior population | | | V | Look in to supplying emergency generators in senior housing- work with council on aging | | | | | |
| Disabled population | | | V | | | | | | |
| Senior center | On map | Public | S (v) | | | Increase emergency power supply | State grant for senior center generator | H | S |
| Public housing | On map | Private | V | | | | | M | O |
| Red Cross | | Private | S | City Red Cross liaison | | | | M | S |
| Faith Communities | | | S | | | | | | |
| Old Schools (children) | Multiple | Public | V | Replace older infrastructure, increase air conditioner and sprinkler capacity<br>Acquire land now to be used later for replacement | | | | H<br>H | S<br>L |
| Building management | | Public | S/V | | | | | | |
| Public safety and utility outreach | | Public | S | | | | | | |
| Water quality | | | S (v) | | | | | | |
| Sewer service | | | | | | | | | |
| Transportation | | | V | Continue trolley feasibility study | | | Plan for use of busses in evacuation | H | O |
| Access for disabled residents | | | V | | | | Improve access to downtown during storm events | H | O |

| **Environmental** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Open land in floodplain | Multiple | Public | S | Continue plan of purchasing open space | | | | | |
| Creating flood management techniques | Multiple | Public | S | | | | | | |
| Low lying town square | On map | Multiple | V | Building code elevation requirement | | | | | |
| Lake health | On map | Multiple | V (s) | Continue city's lake health initiative | | | | | |
| Convergence of three rivers | Under court house | Public | V | Investigate and potentially improve underground infrastructure | | | | | |
| Farms | Multiple | Public/ private | S | Create and maintain long term plans | | | | | |
| Dense development | Multiple | Public/private | V | Redevelopment stormwater standard or grant | | | | | |
| Trees | Multiple | Multiple | V | | | | Replace and remove older trees | | |
| Public rights of way | Multiple | Public | S | Rain gardens | | | | | |
| Bugs and Rodents | Multiple | N/A | V | | Public outreach and education<br>Better trash management | | | | |
| Environmental data availability | | | V | Investigate LiDAR data | | | | | |
| Contaminated sites | | | V | Necessary mitigation during infrastructure improvement | | | | | |

# Attachment E: Master Matrix of High Priority Actions Reported out by Each Discussion Group

## Community Resilience Building Risk Matrix

## Recommended

www.CommunityResilienceBuilding.org

Location = Mark on the map, note on matrix Multiple, Specific or Town-Wide
**V** = Vulnerability **S** = Strength
Type of Feature = **I**nfrastructural, **S**ocietal, or **E**nvironmental
**H**igh, **M**edium, or **L**ow priority for action over the **S**hort or **L**ong term (and **O**ngoing)

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

| Features | Location | Owner | V or S | Intense Rain and Flooding | Drought and Fire | Extreme Heat and Cold | Storms and Sea Level Rise | Group 1-4 | Priority H - M - L | Time Short Long Ongoing |
|---|---|---|---|---|---|---|---|---|---|---|
| **Infrastructural** | | | | | | | | | | |
| Roadways/culverts<br>Flooding issues/ drainage clogged | All | Private/public | V | Planned maintenance program/ GIS mapping/ Mobile capabilities | | | | 1 | H | |
| Brook channel/ weird turns | Downtown | Varies | V | Curve channels (90-45°); widen/ studies *Walnut priority*, development restrictions and control | | | | 1 | H | |
| Emergency shelters | Citywide | City | V/S | Identification of Long-term emergency shelters based on qualifiers (e.g., above flood zones), set agreements | | | | 1 | H | |
| Flooding-multiple sites (Lalikos-routine, Russell-extreme) | Multiple | Public | V | Increase pipe capacity in Lawrence Brook watershed- implement the study, rehab south side North River Canal wall<br>Studies of targeted high frequency flooding area<br>Coordinate with Salem and Army Corps on North River holding and flow (Project 3)<br>Revisit upstream storage requirements (regulatory change to city bylaws) | | | | 2 | H<br>M | S |
| Sewer pumping station | Northfield Rd<br>Multiple<br>Russell St. | Public | V | Flood proof Russell Street Station and create bypass and elevate equipment, generator upgrade, upgrade injector stations<br>Purchase backup generators | | | | 2 | H | S |
| Structural capacity of schools (roofs)<br>Aging facilities/ location of critical facilities | Multiple | Public | V | Public buildings assessment for withstanding hazard events | | | | 2 | | |
| Downtown | Specific | Multiple | V | Targeted plans | | | Traffic management plan | 3 | H | O |
| Private property's stormwater | Multiple | Private | V | Increase public outreach about maintenance and new technology (like green roofs) | | | | 3 | | |
| Sheltering capacity | Multiple | | V | Develop a plan for emergency shelter and shelter upgrades | | | | 3 | H | S |
| **Societal** | | | | | | | | | | |
| Environmental justice neighborhoods | | | V | Outreach | | | | 1 | H | |
| Shelters inaccessible and without backup powers, siting for various hazards | Multiple | Public | V | Investigate alternative shelter options, including sustainable system for heating and cooling | | | | 2 | | |
| Senior population | | | V | Look in to supplying emergency generators in senior housing- work with council on aging | | | | 3 | | |

**Environmental**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Flood plain (existing housing) | Downtown | Varies | | Open space in the future | 1 | H | |
| Development in wetland areas and flood zones | Multiple | Public/ private | V | Regulatory- expand wetland bylaw to include fee for disturbance | 2 | | |
| Impervious surfaces (regulations) | Multiple | Public/ private | V | Regulatory- evaluate requirements for max/min posting, incentives to reduce impervious sites | 2 | | |
| Trees | Multiple | Multiple | V | Replace and remove older trees | 3 | | |
| Bugs and Rodents | Multiple | N/A | V | Public outreach and education<br>Better trash management | 3 | | |

# Attachment F. Annotated Maps from Discussion Groups


Photo F-1 Map annotated by small Group 1 highlighting vulnerable infrastructure, flood zones, reservoirs, and other community resources.

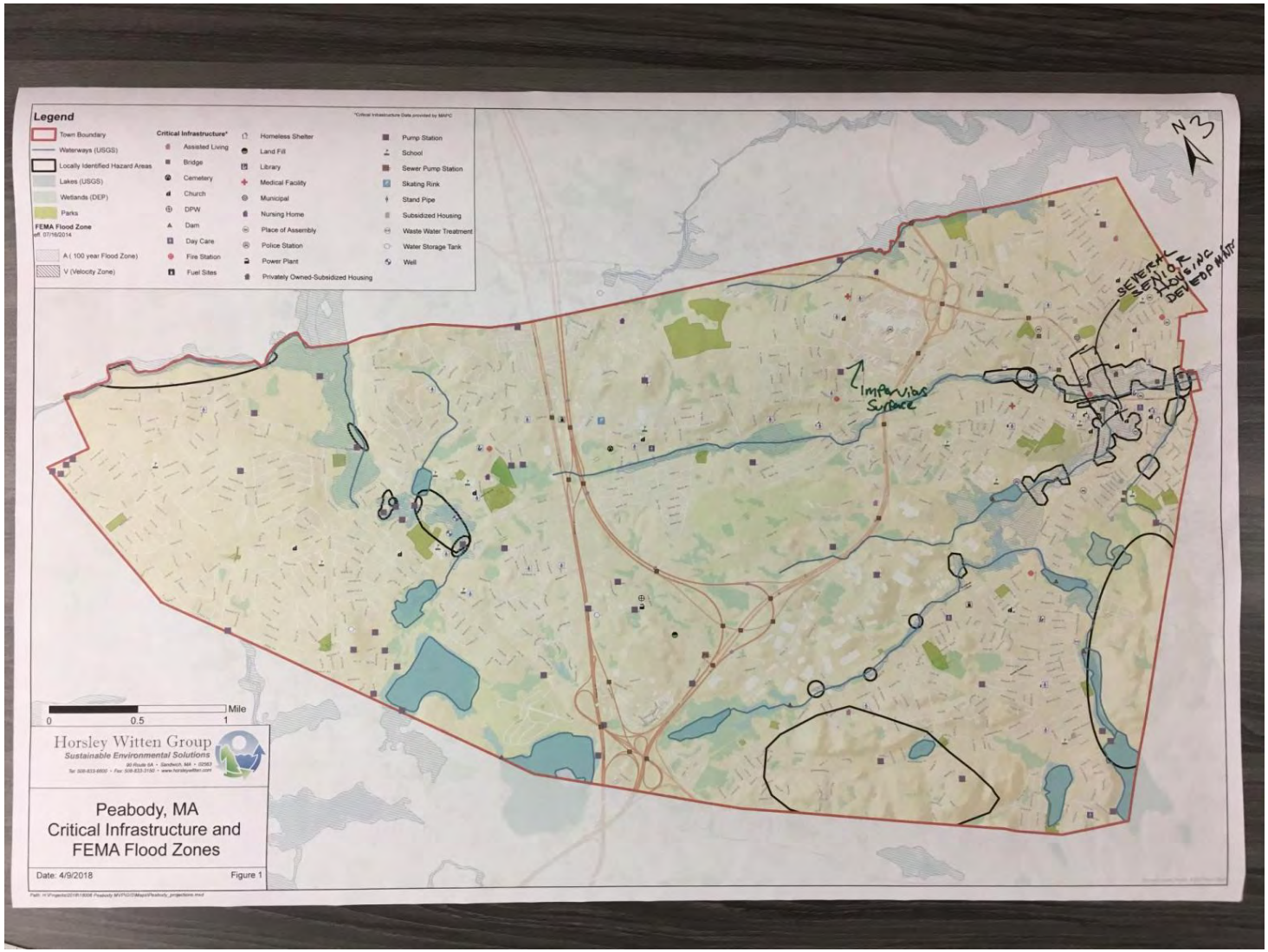


Photo F-2 Map annotated by small Group 2 showing areas of concentrated development, flooding areas, and other community elements.


Photo F-3 Map annotated by Group 3 showing societal and infrastructure features in black and flood zones in pink.