Horsley Witten Group
Sustainable Environmental Solutions
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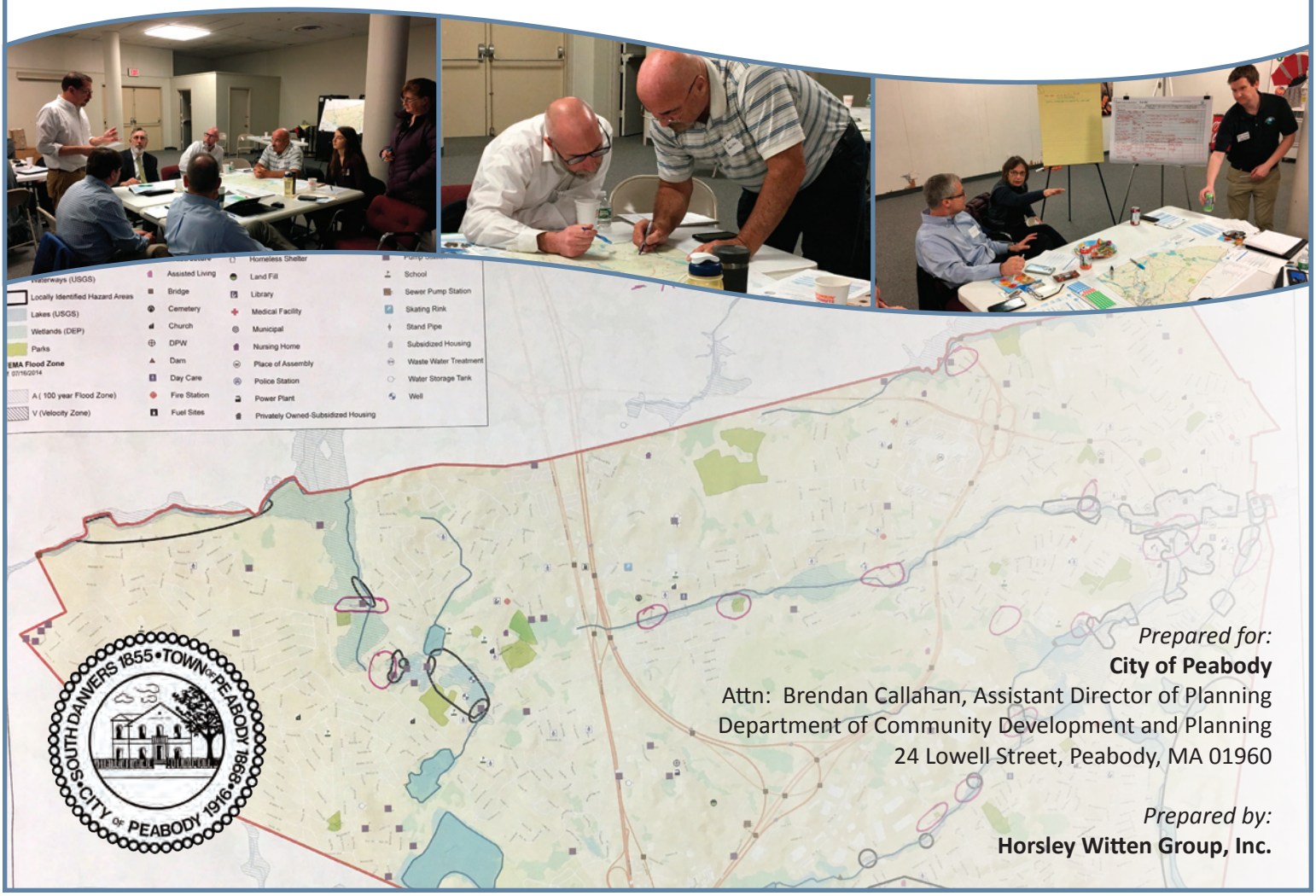
Summary of Findings

Peabody Municipal Vulnerability Preparedness Workshop

Peabody, Massachusetts

June 7, 2018



Prepared for:
City of Peabody
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Prepared by:
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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.

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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.

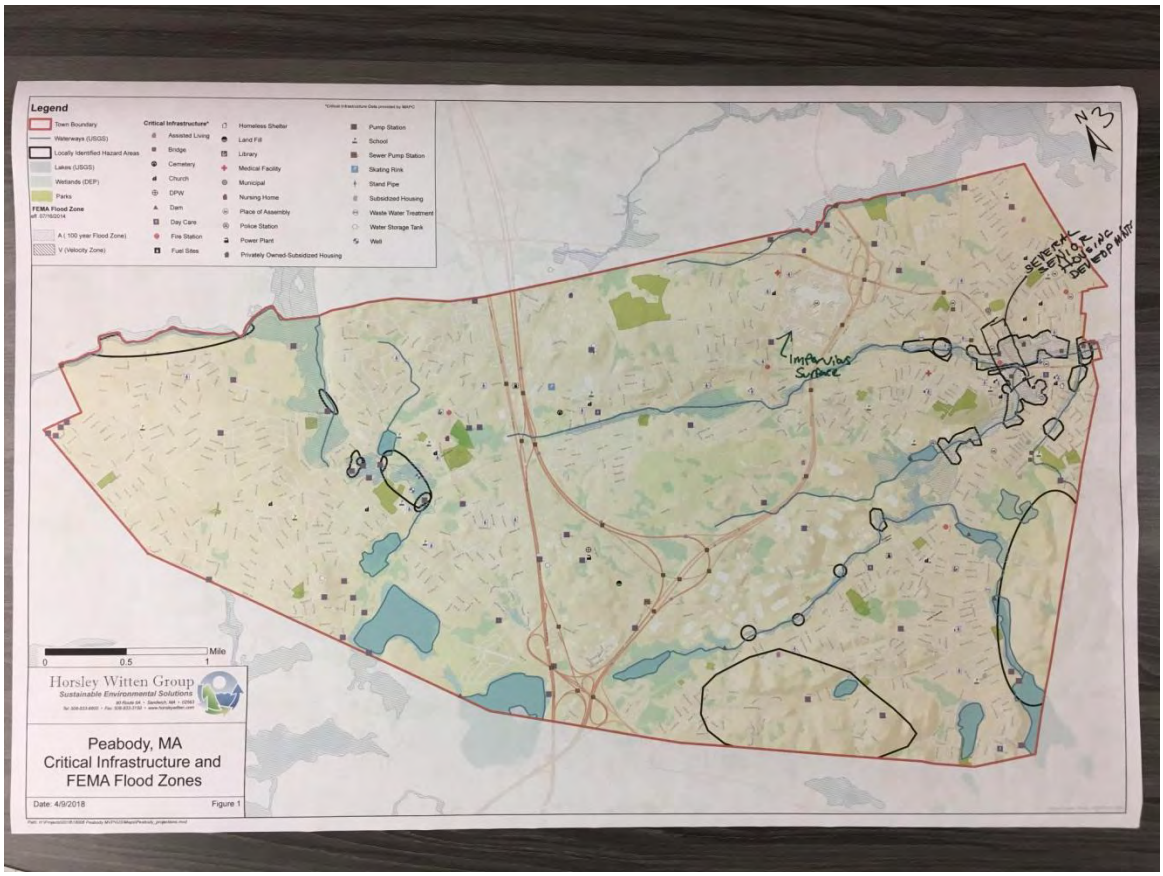

Photo 1 Groups annotated maps to highlight vulnerable infrastructure, flood zones, and community resources**.**

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.

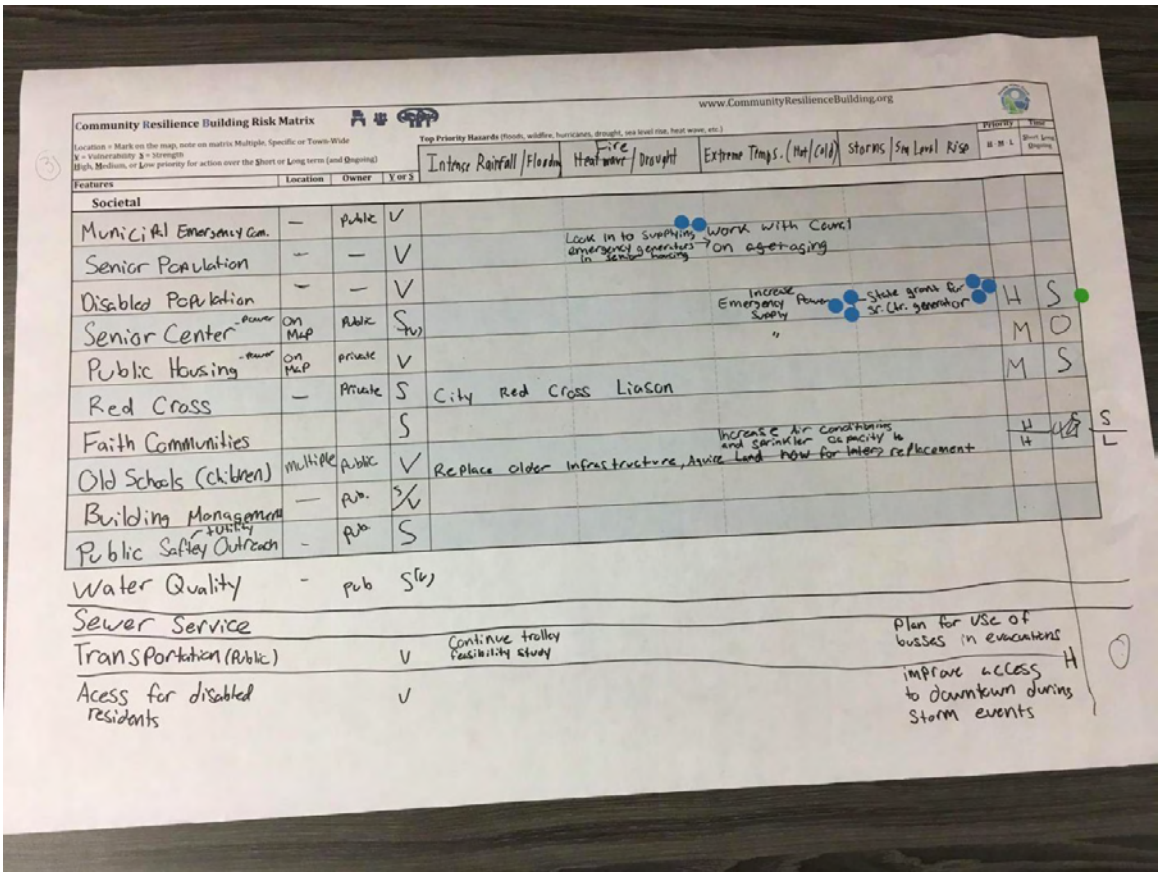

Photo 2 An example completed risk matrix. Colored dots indicate the small group member voting to prioritize each action.

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.

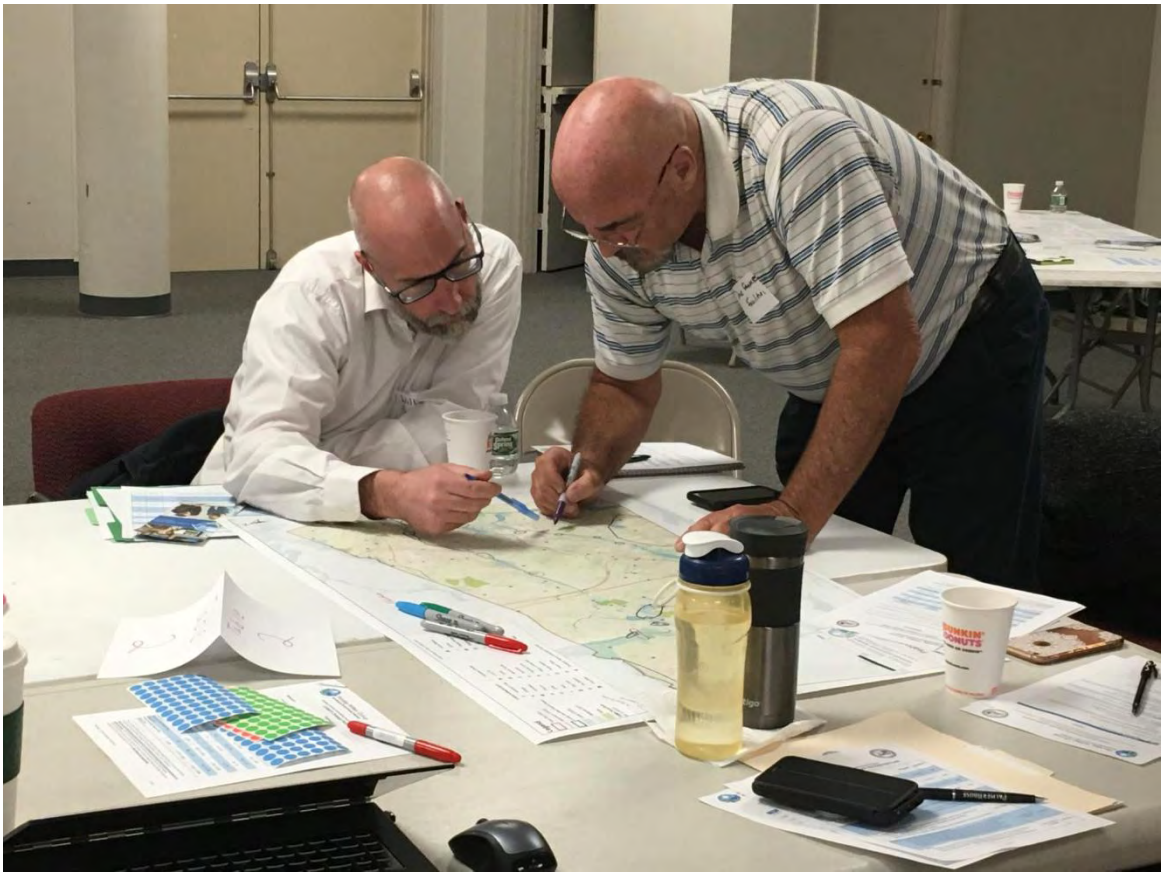

Photo 3 **Participants marked the locations of inland flooding on the map during their discussion of vulnerabilities.**

- *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.

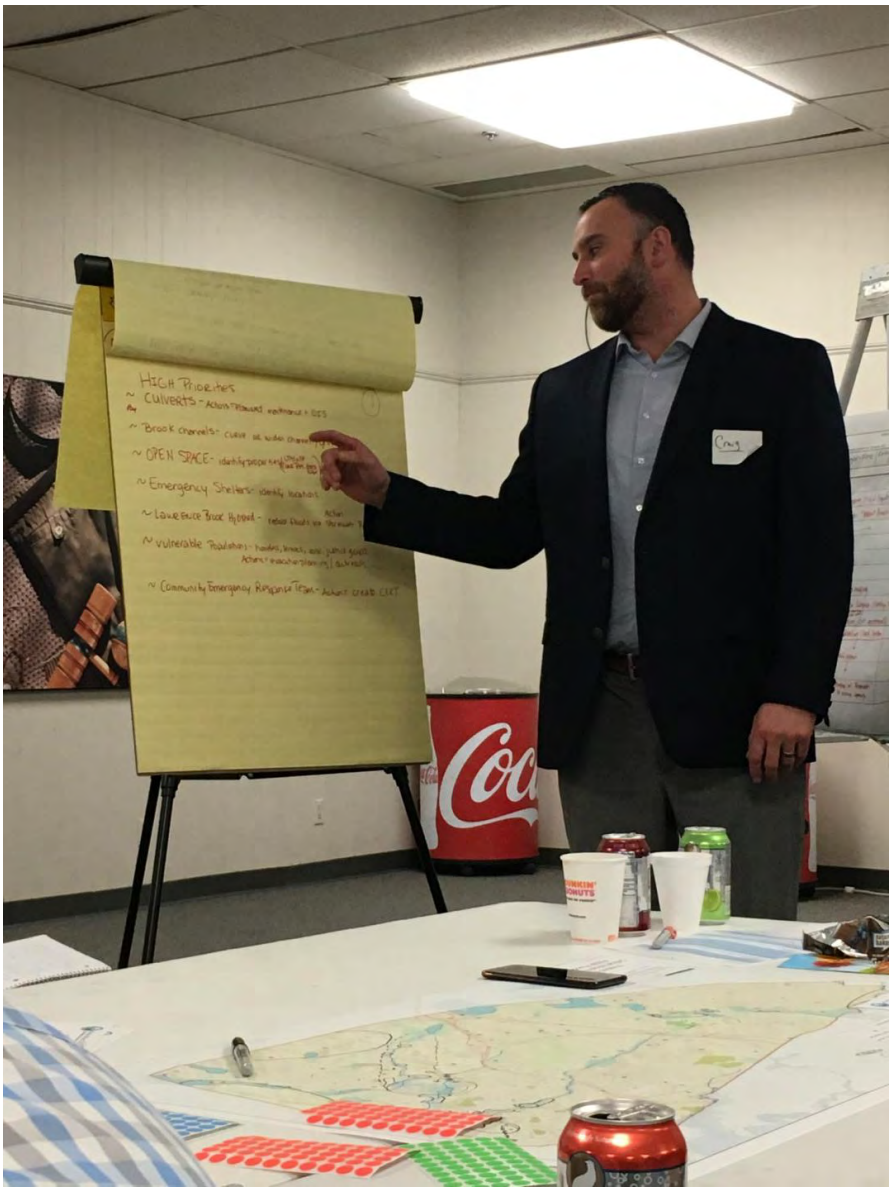

Photo 4 A workshop participant presents Group 1's prioritized action items.

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
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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 Review recent climate related events. Present summary of anticipated climate changes. Present summary of recent/existing planning efforts
9:50 PM	**DISCUSSION #1: Large Group** Identify top 4 Climate Change Hazards facing Peabody
10:30 AM	15 MINUTE BREAK
10:45 AM	**DISCUSSION #2: Small Group** Identify Features that are Vulnerabilities and Strengths
12:20 PM	40 MINUTE LUNCH
1:00 PM	**DISCUSSION #3: Small Group** Identify Actions to address Vulnerabilities or protect Strengths. Discuss timeframe, responsibility, funding, as time allows. Prioritize top 5-6 Actions
2:25 PM	15 MINUTE BREAK
2:40 PM	**DISCUSSION #4: Small Groups Report Out** Each group reports out top 5-6 Priority Actions
3:10 PM	**FINAL DISCUSSION: Large Group** Select top 5-6 Priority Actions for Municipal Climate Resilience 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 • Consider creating a stormwater utility	Flooding	High
Downtown Traffic Management Plan • Plan would route traffic around expected flood areas with signage and public outreach	Flooding	High
Stormwater Management Ordinance • Adopt and implement the draft ordinance	Flooding	High
Floodplain Management • Continue to enforce Floodplain Zoning District, update to be consistent with FEMA • Maintain maps of most recent FEMA floodplain updates	Flooding	High
Acquisition of Vacant Flood Prone Land • Acquire priority open space parcels in floodplain to maintain flood storage and infiltration capacity • 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 • Upgrade all emergency power generators and provide alternative fuel sources • Complete and implement the Hazardous Materials Assembly Plan • Update radio repeater units as needed • Upgrade Peabody Municipal Light Company communications and security system	All hazards	High
Regulatory and Public Outreach Improvements • Improve wetlands ordinance enforcement (e.g., wetlands encroachment issues) • Develop public outreach program on wetlands, flooding, and stormwater • Consider updating stormwater and drainage standards for Site Plan Review, Development Impact Statements, and Subdivision Control Regulations • Include a section on Climate Change Preparedness in Master Plan Update	Flooding, all hazards	Medium
Dam Safety • Update and implement Dam Emergency Action Plans for all City-owned dams • Conduct follow-up seismic dam analysis study for City's reservoir dams • 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) • Acquire new plow/sander truck and sidewalk plow • Develop partnership between utilities and DPS to document known hazards • Maintain snow removal equipment and adequate supplies of de-icing materials	Winter storms	Medium
Brushfire Preparedness • Develop and maintain a database to track brushfire events • Include brushfire risk and mitigation in major City planning efforts	Brushfires	Medium
Severe Wind Preparedness (e.g., hurricanes, strong nor'easters, tornadoes) • Develop and maintain a GIS database to track vulnerability to severe wind and map high risk areas based on different wind speeds • Use HAZUS to estimate potential losses from hurricane winds • 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 • Require and/or encourage construction of tornado safe rooms • Provide public outreach materials about risk from tree failure (Low Priority)	Severe wind	Medium
Wetlands Mapping • Develop a wetlands mapping database to include local wetland delineations	Flooding	Low
Landslide Preparedness • 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) • Retrofit public building roofs to prevent roof collapse due to snow • Use snow fences or "living snow fences" to limit snow drifting onto roadways • Identify at-risk populations that may be vulnerable during long power outages	Winter storms	Low
Drought Preparedness • Incorporate use of native species in development landscape regulations • Promote use of permeable driveways and surfaces to promote infiltration and reduce stormwater runoff	Drought	Low
Extreme Temperature Preparedness • Promote green buildings and parking areas through tree planting, use of green roofs and cool roof products • 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
Sustainable Environmental Solutions

Peabody Municipal Vulnerability Preparedness (MVP) Grant Project:

SELECTED DEMOGRAPHIC DATA[1]

Demographic Parameter	Result
Population	51,251 people
Age	0-19 = 21% 20-34= 18% 35-64 = 41% 65+ = 20%
Income	<$40K = 32% $40-60K = 17% $60K+ = 50%
% Below Poverty Line	9%
Race	White = 89% Black = 3% Asian = 2% Other = 7%
Ethnicity	Hispanic = 9% 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:

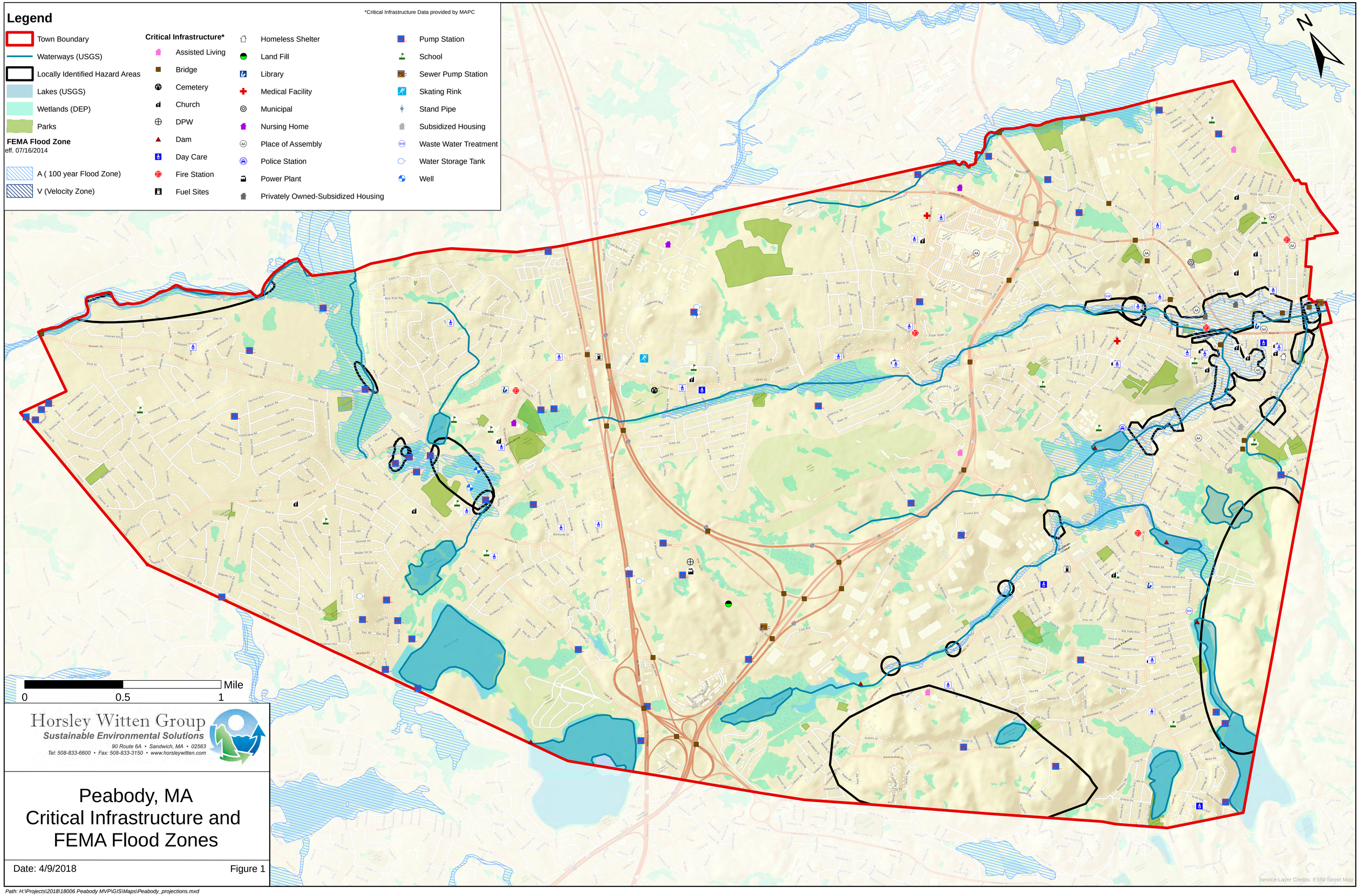
- Beachfront development reducing protection provided by dunes.
- Proliferation of subdivisions in wildfire and flood prone areas.
- Lack of urban tree canopy increasing heat island effect.

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



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
High, **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 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 (EJ 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 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 = Infrastructural, Societal, or Environmental
High, Medium, or Low priority for action over the Short or Long term (and Ongoing)

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									
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 Studies of targeted high frequency flooding area Coordinate with Salem and Army Corps on North River holding and flow (Project 3) Revisit upstream storage requirements (regulatory change to city bylaws)				H M	S
Sewer pumping station	Northfield Rd Multiple Russell St.	Public	V	Flood proof Russell Street Station and create bypass and elevate equipment, generator upgrade, upgrade injector stations Purchase backup generators				H	S
Peabody Rd- Upsized culvert	Peabody Rd. Centennial Park 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) 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 Transportation network-public option	Public	Public	S 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 = Infrastructural, Societal, or Environmental
High, Medium, or Low priority for action over the Short or Long term (and Ongoing)

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									
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 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 Acquire land now to be used later for replacement				H H	S 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 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
High, **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 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 Studies of targeted high frequency flooding area Coordinate with Salem and Army Corps on North River holding and flow (Project 3) Revisit upstream storage requirements (regulatory change to city bylaws)				2	H M	S
Sewer pumping station	Northfield Rd Multiple Russell St.	Public	V	Flood proof Russell Street Station and create bypass and elevate equipment, generator upgrade, upgrade injector stations Purchase backup generators				2	H	S
Structural capacity of schools (roofs) 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 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.

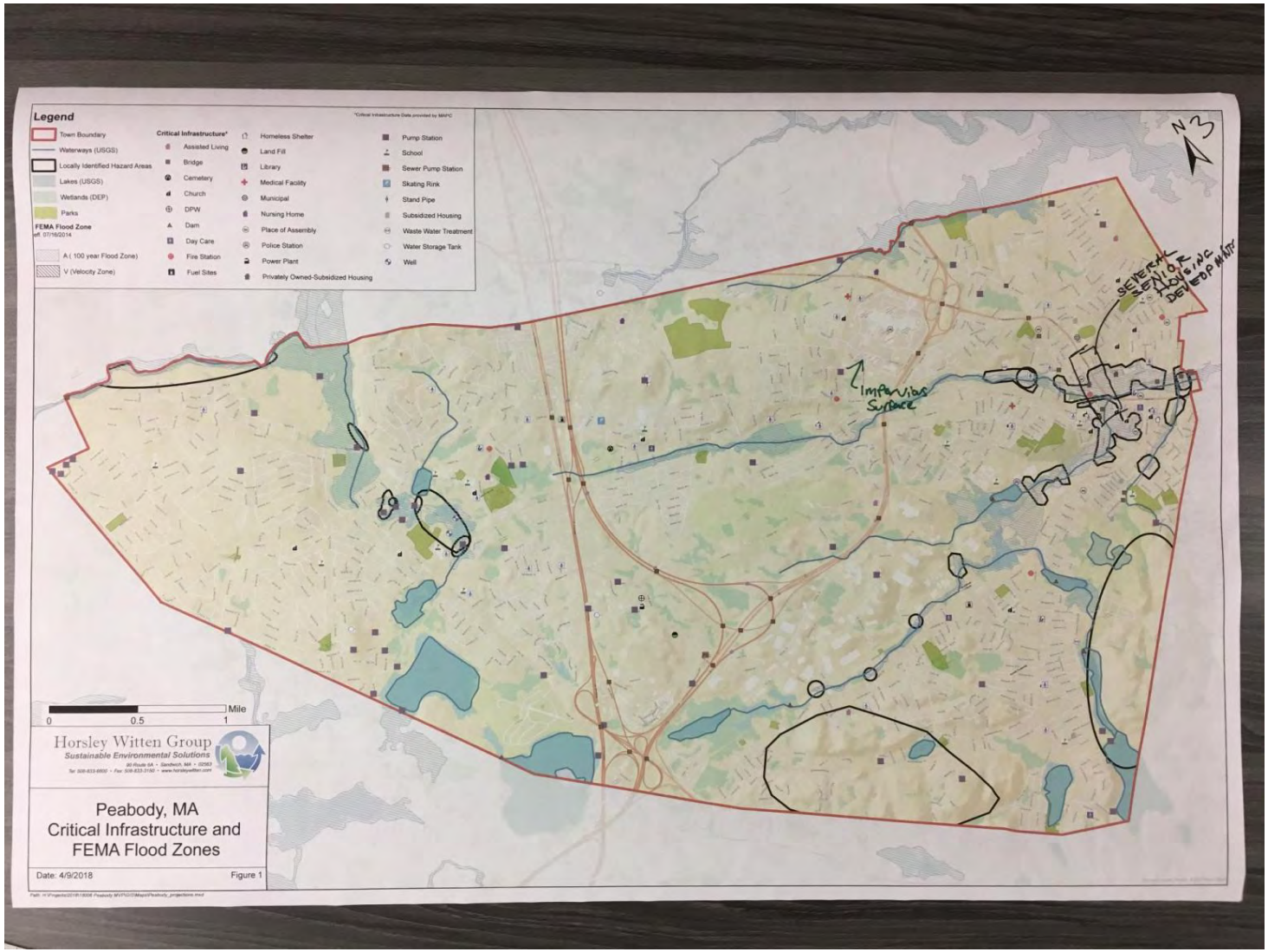


Photo F-2 Map annotated by small Group 2 showing areas of concentrated development, flooding areas, and other community elements.

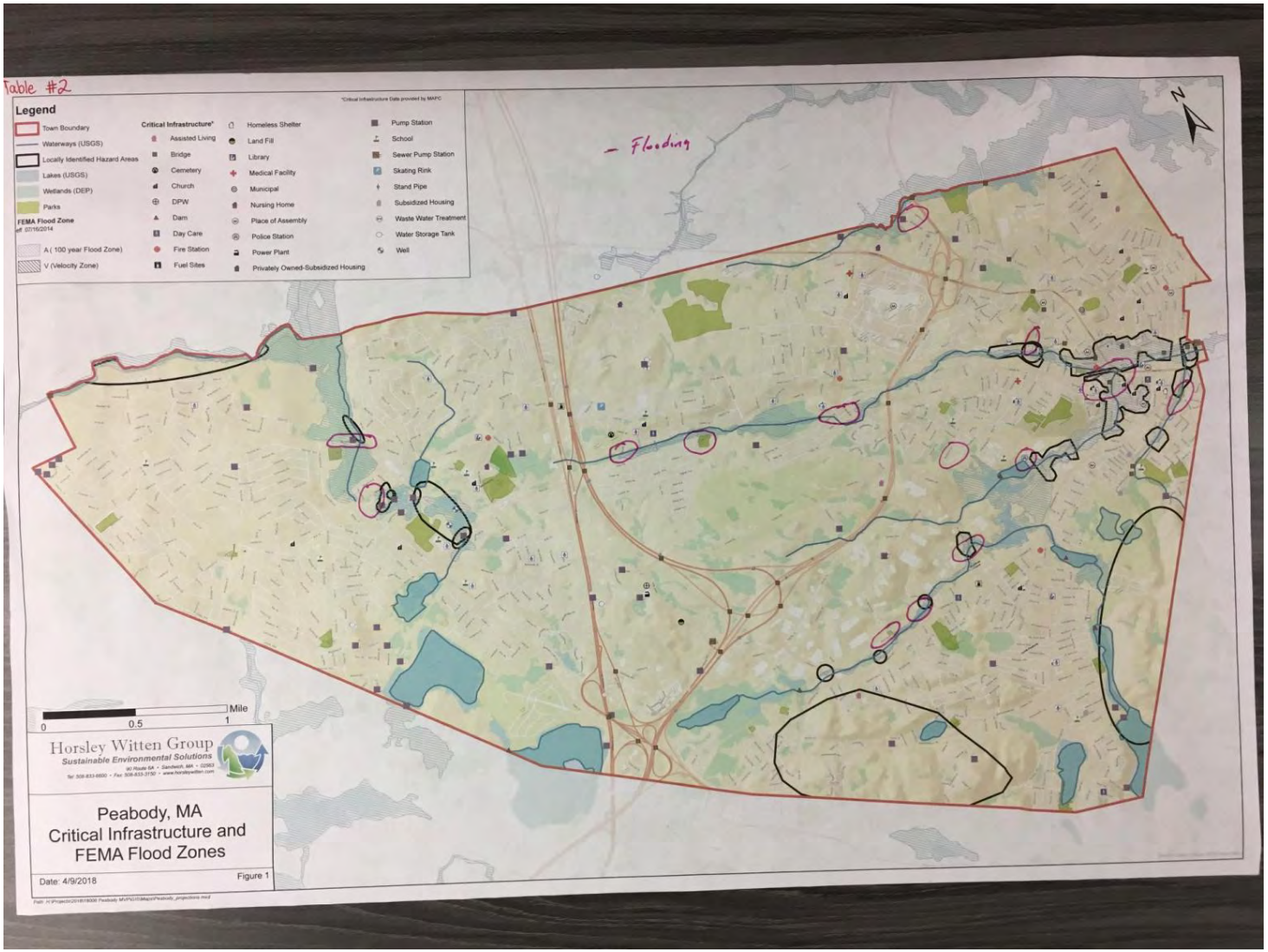


Photo F-3 Map annotated by Group 3 showing societal and infrastructure features in black and flood zones in pink.