Horsley Witten Group
Sustainable Environmental Solutions
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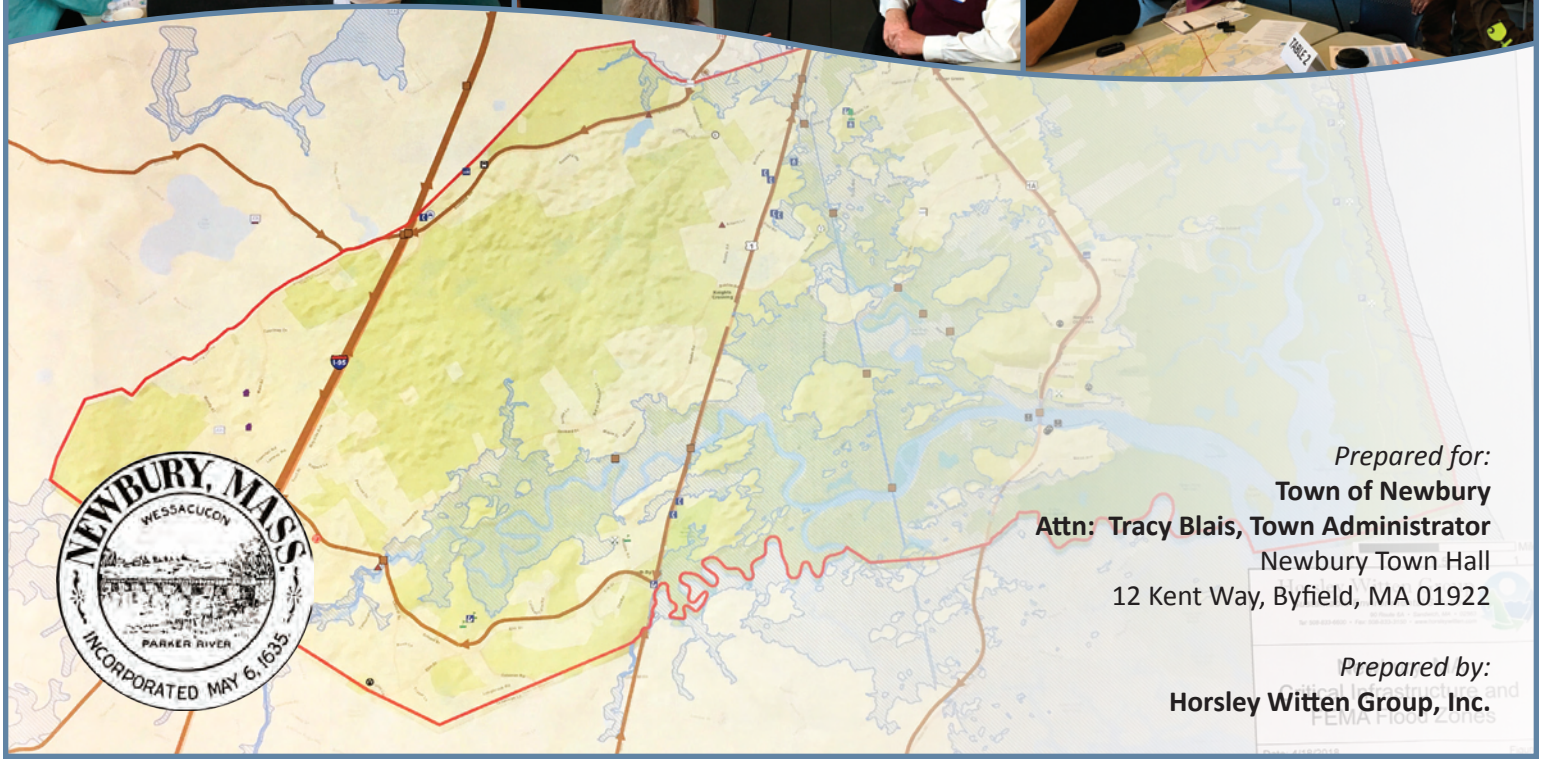
Summary of Findings

Newbury Municipal Vulnerability Preparedness Workshop

Newbury, Massachusetts

June 8, 2018



Prepared for:
Town of Newbury
Attn: Tracy Blais, Town Administrator
Newbury Town Hall
12 Kent Way, Byfield, MA 01922

Prepared by:
Horsley Witten Group, Inc.

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Newbury Municipal Vulnerability Preparedness Workshop
Summary of Findings

Acknowledgements:

Funding to support the Newbury 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 Town of Newbury during the fiscal year of July 2017 through June 2018.

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

The workshop venue was generously provided to the Town of Newbury by the Parker River National Wildlife Refuge.

Suggested Citation:

Town of Newbury. 2018. Newbury Municipal Vulnerability Preparedness Workshop Summary of Findings. Prepared by the Horsley Witten Group, Inc. Exeter, NH.

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Newbury Municipal Vulnerability Preparedness Workshop
Summary of Findings

Executive Summary

On May 1, 2018, the Town of Newbury held a Municipal Vulnerabilities Preparedness (MVP) workshop. The workshop's goal was to identify hazards that Newbury faces that are being exacerbated by climate change, and to prioritize actions the Town 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. Thirty-seven community members attended the workshop, representing a wide cross section of town officials, emergency response partners, and other interested parties.

During discussion, participants concluded that the four categories of hazards most relevant to Newbury were sea level rise, severe storms, extreme temperatures, and flooding. In four small discussion groups, participants identified features of Newbury 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 seven action items listed below. A common theme throughout the discussions was the idea that Newbury should work to collaborate with neighboring communities, in particular Newburyport and Salisbury, as well as with regional organizations and state and federal agencies, to tackle issues related to Plum Island and the Great Marsh at a regional scale for more impact.

- Great Marsh/Coastal Habitat: Restoration to improve resiliency, invasive species control, channel stabilization, erosion/hydrology management (including removal of impediments to stormwater and tidal flow), ditch assessment and remediation, water quality management, and continued protection efforts (Including the consideration of thin layer deposition).

- Power Supply: Consider alternative means of power generation and supply in emergencies, including green energy, generators at private service stations, and large generators to support services on Plum Island.

- Key Access Roads: Identify state funding and prepare plans to reduce flooding and improve access on emergency evacuation routes and key access roads, including Plum Island Turnpike, Northern Boulevard, Hanover Street, and Pine Island Rd. On Plum Island Turnpike, and other

roads as applicable, consider raising the bridge and road both to allow water to flow freely below the road and to provide safe dry emergency access. Also, on Plum Island, complete engineering and seek funding for an emergency access route through existing rights of way North of Plum Island Center (e.g., 14th and 16th Streets) and improve signage for evacuation routes.

- Emergency Preparedness: Develop a database or registry of vulnerable populations, and a comprehensive plan for emergencies, such as power outages.

- Plum Island Barrier Beach: Dune nourishment, planting, management, access, stabilization, continued measurement of accretion and erosion, and innovative restoration and stabilization approaches (e.g., sand mining), in cooperation with Newburyport, Salisbury, the Merrimack River Beach Alliance (MRBA) and the Army Corps of Engineers and other federal and state agencies.

- Permitting: Work with the state to review regulations and policies that impede ecological protection and restoration of marshes, beaches and dunes.

- Local Regulations and By-Laws: Review and improve local zoning by-laws and development regulations, including in particular the Plum Island Overlay District, to be more sensitive to environmental conditions and changes. On Plum Island, encourage Newburyport to collaborate to create consistency across communities with respect to the standards, interpretation and enforcement of the local by-laws and regulations (zoning and wetlands protection).

These action items will be incorporated into ongoing municipal planning efforts and will inform the MVP core team and the Town as a whole as it works to take action to improve the Town'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 Town is also initiating its certification as an MVP Certified Community, which enables the Town 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 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. Newbury 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 Town employees were identified to serve as a core organizing team. Team members included the following individuals, and were assisted by Ellie Baker of the Horsley Witten Group (HW), Newbury's MVP Provider:

- Michael Reilly: Police Chief
- Martha Taylor: Town Planner
- John O'Connell: Local Engineer, Stormwater Committee
- Tracy Blais: Town Administrator
- Deborah Rogers: Health Agent
- Doug Packer: Conservation Agent
- Geoffrey Walker: Newbury Selectman
- James Sarette: Public Works Director
- Kristen Grubbs: IRWA, Great Marsh CAP
- Douglas Janvrin, Jr.: Fire Chief
- Sam Joslin: Building Commissioner, Zoning Enforcement officer

Team members met on February 6, February 27, and March 20, 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

Newbury's MVP workshop was held on May 1, 2018 at the Parker River National Wildlife Refuge. A total of 55 stakeholders were invited to the workshop and 37 stakeholders attended. Participants represented a wide cross section of the Town's stakeholders and decision-makers, including the Police and Fire Chiefs, local farmers, school administrators and staff, local business owners, regional planning agency staff, and a wide variety of municipal department staff and volunteers from local boards and

commissions, among other residents. See Attachment A for a full list of invited stakeholders, including their organizational affiliation and whether they attended the May 1 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 Town plans, including the 2017 Great Marsh Coastal Adaptation Plan and the 2016 Merrimack Valley Region Multi-Hazard Mitigation Plan Update (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 Parker River 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 Newbury demographic data (see Attachment B)
- Newbury base map showing critical infrastructure and FEMA floodplain data (see Attachment C)
- Newbury base map showing projected floodplains for the year 2070 prepared by the Woods Hole Group for the Great Marsh Coastal Adaptation Plan (see Attachment C)

The Workshop Process

Following introductions and an overview of the MVP Program and workshop agenda, workshop participants listened to two presentations, one by Newbury business owner and Storm Surge member Michael Morris[1] and one by MVP Certified facilitator Ellie Baker, HW, about climate change projections and their current and potential future impacts on Newburyport. The presentations discussed specific infrastructural and environmental challenges facing the Town in the light of climate change. Challenges discussed included the impact of sea level rise on Plum Island, flooding after severe rain events, and 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 four small discussion groups. Groups were made up of a facilitator (an HW staff member, member of the core planning team, or volunteer from the Merrimack Valley Planning Commission), a note taker, and about 10 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 6 and 13 features for each category, along with information about their location, ownership, and if they are a strength or vulnerability for the Town. They also marked specific locations on the base map provided at the table, as appropriate.

[1] Michael Morris is also a member of the Newburyport Resilience Committee and provided a similar presentation at the Newburyport MVP Workshop several weeks earlier.

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 a way to better utilize one of Newbury's strengths. Common action items included enlarging culverts, securing emergency evacuation routes, and preserving salt marsh and dune ecosystems. Throughout small group discussion, the workshop's lead facilitator circulated between groups to ask questions and provide guidance.

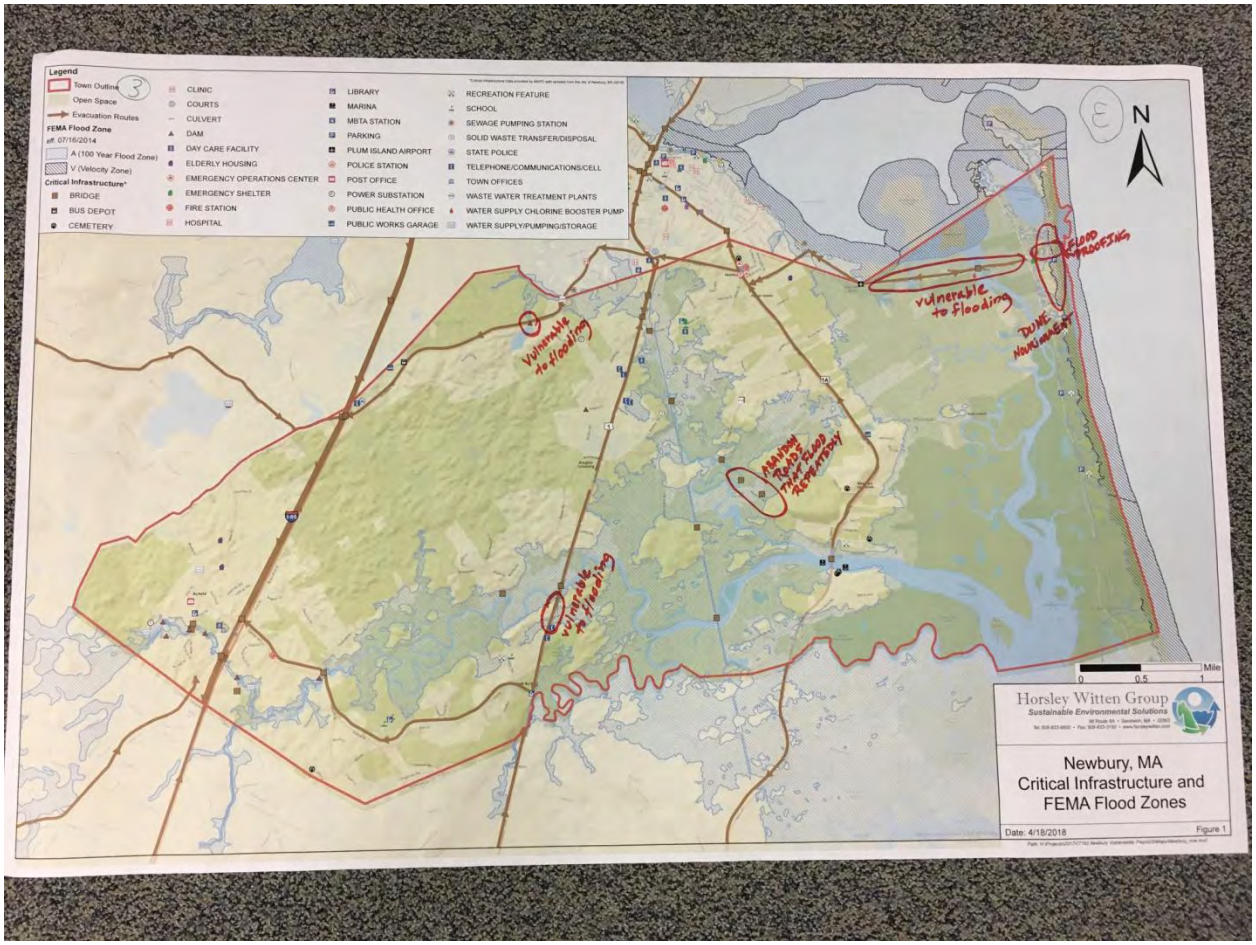

Photo 1 Groups annotated maps to highlight vulnerable infrastructure, flood zones, and community resources**.**

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 item 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 between five and seven 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 Town of Newbury 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 four discussion groups. Attachment E includes a matrix presenting a compilation of the recommended high priority actions from the four 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 four discussion groups.

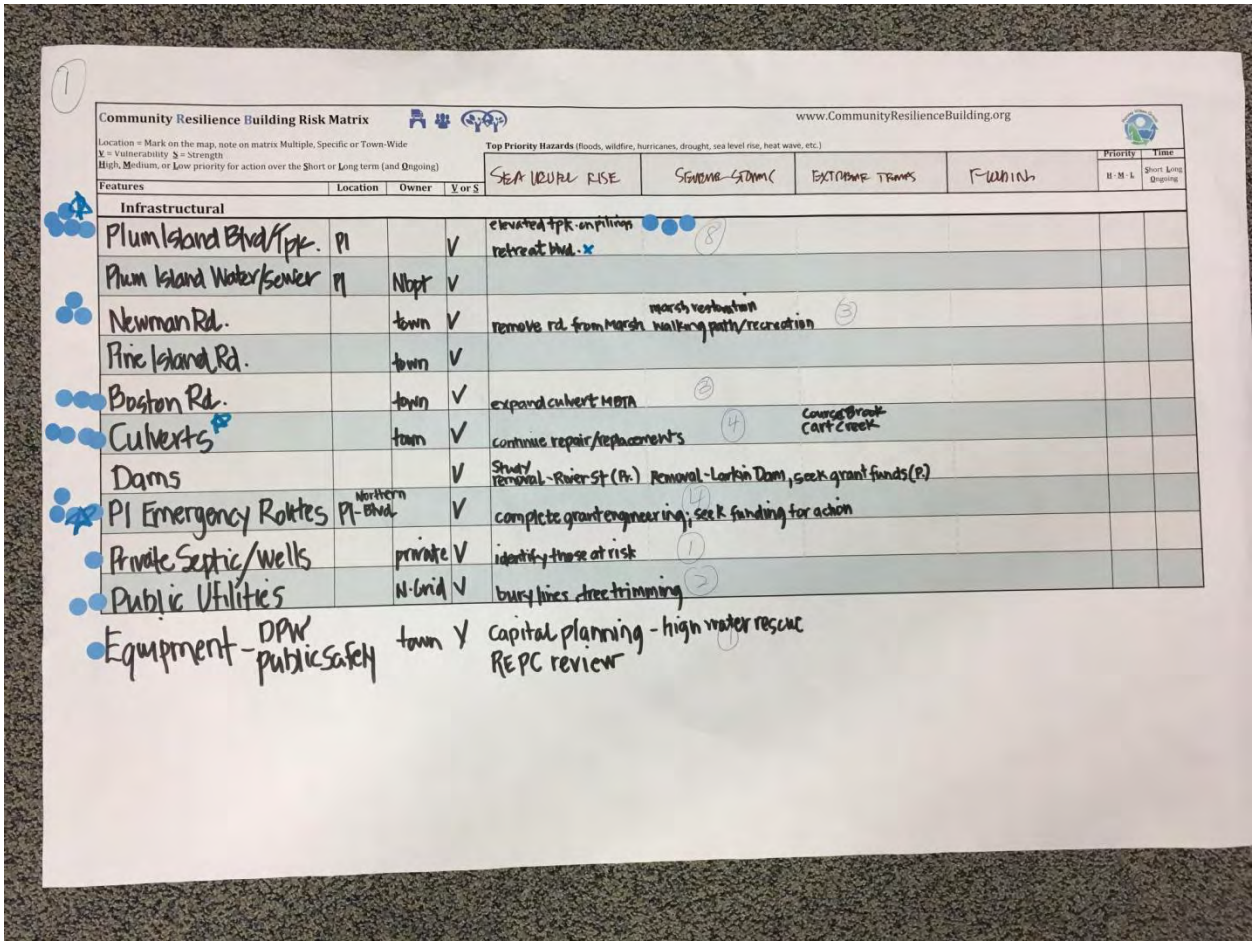

Photo 2 An example completed risk matrix. Colored dots indicate the small group member voting to prioritize each action.

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:

- Hurricanes/ Nor' Easters
- Wind Events
- Intense Rain and Inland Flooding
- Precipitation
- Coastal Flooding/ Storm Surge
- Extreme Temperature
- Sea Level Rise
- Salt Water Intrusion
- Drought
- Higher Tides/ Storms/ Flooding Intersection
- Heavy Snow Storms

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 Newbury:

- Sea Level Rise
- Severe Storms (Including Hurricanes and Nor' Easters)
- Extreme Temperatures and Drought
- Inland and Coastal Flooding

3. Current Concerns and Challenges Presented by Hazards

Newbury 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. 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 Town 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, Newbury and the northeast as a region experienced a severe drought that stressed the Towns' rivers and the supply of water to the local residents, including those with private wells and those on a public water supply. Over the past several years, Plum Island has experienced severe erosion at different rates in different locations on the island's dunes and beaches; as well as significant flooding events, which have threatened private property as well as the island's water and sewer infrastructure provided via the City of Newburyport. Houses have been undermined and land lost due to erosion, and the sewer system has suffered shutdowns and experienced backflows into residential homes due to flood, snow and subfreezing temperatures. In addition, many roadways in the community have been flooded due to storm surge and surcharged stormwater drainage systems, or in some cases, both.

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

- Coastal flooding due to heavy rains and storm surge: Coastal, tidally influenced flooding occurs on Plum Island and at properties along the Parker River, including homes and a few businesses. Newburyport's newly upgraded wastewater treatment facility, which serves portions of the Town of Newbury, is located within the Merrimack River coastal floodplain, and key elements of the facility are at risk of failure due to flooding.

- Beach and dune erosion: The beaches and dunes along Plum Island have experienced severe erosion and accretion over the past several decades, putting homes and infrastructure at risk. There have been numerous efforts by Plum Island residents, the Town, and Newburyport to the north, to replenish the dunes, protect private property, and consider a range of mechanisms to mitigate the risk to public infrastructure and private property.

- Power outages: Winter snow storms and wind events experienced in the early months of 2018 caused widespread power outages across Newbury and the region, and drew significant attention to the risks to the power grid from future severe weather events. Much of Newbury's electrical wires are above ground, and many suffered damage from trees and limbs during the storm events.

- Inland flooding: Several areas of Newbury experience inland flooding caused by precipitation events, often combined with localize drainage problems. Roadways and residential neighborhoods experience flooding during heavy rain events, which can be exacerbated by high tides and undersized culverts in the Parker River watershed that hinder drainage.

- Emergency preparedness, response and recovery after a storm event: The flooding and power outages described above further raised concern about preparations and impacts to emergency response personnel and access to vulnerable populations. The Town provides staffed emergency response services (fire, police, and ambulance) and has a Code Red communications system. However, strengthening these systems and the Town's ability to provide these services was a common concern.

- Drought: The Town experienced a severe drought in 2016-2017 that challenged the public water supply as well as private wells. Workshop participants identified the quantity and quality of drinking water in Newbury as a concern, and plan to pursue an additional source of water supply along with the Newburyport and Byfield Water Districts.

- Salt Marsh Health: Salt Marsh ecosystems in Newbury serve important ecological functions, but are experiencing increased pressures from sea level rise and invasive species. Additionally, marshes have been impacted by hydrological modifications caused by development within the watershed and coastal areas.

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 Town. These include:

Infrastructural:

- Recent progress on infrastructure improvements has increased the capacity of the Town's culverts to manage intense rain events and tidal flood flows.
- The existing Stormwater By-Law and Stormwater Management Program are effective in limiting impervious cover and managing stormwater.
- The Town has identified locations for potential emergency shelters and warming shelters.
- Public Safety and Department of Public Works facilities are in safe locations outside of flood zones.

Societal:

- Shelters are available for community members during emergency situations. The emergency shelter in the Town is in the Newbury Elementary School and the mass inoculation site is located at Triton Regional High School.
- Town citizens, as well as members of nearby towns, are engaged in climate change adaptation efforts and hazard mitigation planning, and work in a collaborative spirit.
- Farm land provides local food sources as well as sites for community connection and engagement with the environment.
- Emergency communications systems in the Town, including the Town website, Code-Red, and Connect-Ed systems, can provide for expedient notification of Town members during emergencies.
- Municipal government is open to further education and is responsive to community members' questions and suggestions regarding climate change mitigation.
- Conservation partners are active and engaged participants in environmental preservation projects in the Newbury area.

Environmental:

- Dunes and beaches of Plum Island are attractive features that encourage tourism to the area, and provide flood protection for homes and thoroughfares on the Island and on the mainland.
- The large extent of salt marshes mitigates damage from flooding and provide habitat for a variety of wildlife.
- The significant extent of conservation land in Town, including the Common Pasture and other protected open space, provides flood storage, habitat, and recreational opportunities, and also limits the extent of land conversion and impervious cover in the Town.

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. A common theme throughout the discussions was the idea that Newbury should work to collaborate with neighboring communities, in particular Newburyport and

Salisbury, as well as with regional organizations and state and federal agencies, to tackle issues related to Plum Island and the Great Marsh at a regional scale for more impact. Seven action items were chosen as the highest priority for the Town and are listed below.

- Great Marsh/Coastal Habitat: Restoration to improve resiliency, invasive species control, channel stabilization, erosion/hydrology management (including removal of impediments to stormwater and tidal flow), ditch assessment and remediation, water quality management, and continued protection efforts (Including the consideration of thin layer deposition).

- Power Supply: Consider alternative means of power generation and supply in emergencies, including green energy, generators at private service stations, and large generators to support services on Plum Island.

- Key Access Roads: Identify state funding and prepare plans to reduce flooding and improve access on emergency evacuation routes and key access roads, including Plum Island Turnpike, Northern Boulevard, Hanover Street, and Pine Island Rd. On Plum Island Turnpike, and other roads as applicable, consider raising the bridge and road both to allow water to flow freely below the road and to provide safe dry emergency access. Also, on Plum Island, complete engineering and seek funding for an emergency access route through existing rights of way North of Plum Island Center (e.g., 14th and 16th Streets) and improve signage for evacuation routes.

- Emergency Preparedness: Develop a database or registry of vulnerable populations, and a comprehensive plan for emergencies, such as power outages.

- Plum Island Barrier Beach: Dune nourishment, planting, management, access, stabilization, continued measurement of accretion and erosion, and innovative restoration and stabilization approaches (e.g., sand mining), in cooperation with Newburyport, Salisbury, the Merrimack River Beach Alliance (MRBA) and the Army Corps of Engineers and other federal and state agencies.

- Permitting: Work with the state to review regulations and policies that impede ecological protection and restoration of marshes, beaches and dunes.

- Local Regulations and By-Laws: Review and improve local zoning by-laws and development regulations, including in particular the Plum Island Overlay District, to be more sensitive to environmental conditions and changes. On Plum Island, encourage Newburyport to collaborate to create consistency across communities with respect to the standards, interpretation and enforcement of the local by-laws and regulations (zoning and wetlands protection).

6. Conclusion and Next Steps

Newbury will continue the MVP certification process by presenting and distributing this report to the public at a formal public information and listening session scheduled for June 18 at 7 PM at the Newbury Municipal Office. This session will provide an opportunity for any member of the interested public to learn, ask questions, and provide feedback about the May 1, 2018 MVP Workshop and the recommended highest priority actions that emerged from that workshop.

Priorities identified during the May 1, 2018 MVP Workshop will be integrated into existing and near future municipal planning efforts. The Town will also consider pursuing grant funding to implement the priority actions identified through the MVP Workshop process to continue to improve the Town's resilience to climate change.

Attachment A: List of Participants

Newbury MVP Workshop, May 1, 2018

Participants

FIRST	LAST	ROLE/AFFILIATION
Ron	Barrett	President, Plum Island Taxpayers and Associates
Tracy	Blais	Town Administrator
David	Chatfield	Newburyport MVP/Resilience Committee
J.R.	Colby	Newbury Selectman/Local Farmer
Bub	Colby	Local Farmer
Karen	Conard	Director, Merrimack Valley Planning Commission (MVPC)
Steve	DeSalvo	Plum Island Foundation
Bethany	Dorau	Historic New England - Spencer Pierce Little Farm
Brian	Forget	Superintendent, Triton Regional School District
Ann	Giblin	Director, Marine Biological Lab
Kathryn	Glenn	MA CZM, Northeast
Kristen	Grubbs	Ipswich River Watershed Association, Newbury resident
Lon	Hachmeister	Newbury Historical Commission/Storm Surge
John	Hartnett	Local Site Contractor/ Former Conservation Commissioner
Russ	Hopping	Trustees of Reservations, Ecology Director
Doug	Janvrin, Jr.	Fire Chief
Tony	Komornick	MVPC Transportation Manager
Dan	Maguire	Byfield Water District
Maggie	Malley	Director, Council on Aging
Stephen	Mangion	Plum Island resident
Mike	Morris	Storm Surge, Newbury business owner
John	O'Connell	Local Engineer, Stormwater Committee
Doug	Packer	Conservation Agent
Bill	Peterson	Parker River National Wildlife Refuge Manager

FIRST	LAST	ROLE/AFFILIATION
Peter	Phippen	MVPC and 8 Towns and the Great Marsh
Peter	Pinciaro	The Trustees of Reservations
Peter	Quimby	Governor's Academy Headmaster
Mike	Reilly	Police Chief
Mary	Rimmer	Rimmer Environmental, LLC
James	Sarette	Public Works Director
Martha	Taylor	Town Planner
Fred	Thurlow	Master Plan Committee/Parker River area resident
David	Vine	Retired Coastal Engineer
Geof	Walker	Newbury Selectman
Chris	Walsh	Facilities Manager, Triton Regional School District
John	Weis	Chair of the Planning Board
Tom	Woodruff	Governor's Academy Facilities Manager

Attachment B: Workshop Handouts

Agenda

Prior Recommendations

Climate Change Projections

Example Vulnerabilities and Strengths

Demographics

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Newbury Municipal Vulnerability Preparedness (MVP) Workshop

Tuesday, May 1, 2018, 8:30 am - 4:00 pm

Parker River National Wildlife Refuge

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
10:00 AM	**DISCUSSION #1: Large Group** Identify top 4 Climate Change Hazards facing Newbury
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

Horsley Witten Group
Sustainable Environmental Solutions

Newbury Municipal Vulnerability Preparedness (MVP) Grant Project:

RECOMMENDATIONS FROM EXISTING PLANS

RECOMMENDATION	HAZARD	Existing Plans	
		CAP	HMP
Plum Island Turnpike (Joppa Flats Audubon Center to Sunset Drive) • Short-term: Safety improvements (e.g., warning system for residents, reflectors on road), increase data recording during flooding events • Long-term: Raise road elevation	Flooding	✓	
Plumbush Downs • Short-term: Property owner education on benefits of freeboard and floodproofing, consider municipal freeboard incentive • Long-term: Consider planned retreat	Flooding	✓	
Low-lying Houses on Bayside of Plum Island • Short-term: Property owner education on benefits of freeboard and floodproofing, consider municipal freeboard incentive • Long-term: Incorporate climate projections into long-term planning, consider rolling easements to facilitate planned retreat, assist residents in applying for elevation and land acquisition grants	Flooding	✓	✓
Emergency Access to/from Plum Island • Long-term: Complete design and construction of emergency access route on Plum Island north of PI Center	All hazards		✓
Plum Island (barrier beach and dunes) • Short-term: Reconstruct dunes, plant dune grass and install dune fencing (enlist volunteers from UNH), coordinate with Newburyport to reduce foot traffic on dunes, explore regulatory options such as freeboard incentives and zoning changes • Long-term: Incorporate climate projections into long-term planning, consider rolling easements to facilitate planned retreat, assist residents in applying for elevation and land acquisition grants	Flooding, erosion	✓	✓
Beach Nourishment • Long-term: Seek state and federal funding to dredge sand from nearby rivers and streams for Plum Island Beach nourishment	Erosion		✓
Sewage Pumping Station on Plum Island (Webbers Ct & Olga Way) • Short-term: Retrofit station via sealing conduits and/or elevating utilities, install backup generator, plant vegetated berm around station, explore alternatives sites • Long-term: Consider planned shutdown in times of emergency/evacuation until flooding recedes, consider relocation	Flooding	✓	
Marsh Habitat Restoration • Short-term: Reduce storm vulnerability and increase resiliency through restoration of Great Marsh habitat by eliminating invasive species, studying water and sediment flow patterns, and assessing and prioritizing barriers that can affect river flow	Flooding, storm damage		✓
Newburyport Turnpike (Route 1 at Parker River) • Short-term: Develop warning system for residents, increase communication with MA DOT, coordinate evacuation planning, increased data recording when flooded • Long-term: Design, fund, and construct drainage improvements (e.g., raise road)	Flooding	✓	✓

RECOMMENDATION	HAZARD	Existing Plans	
		CAP	HMP
Newman Road (between Old Town Hill Reservation and Hay St) • Short-term: Develop warning system for residents, increase data recording during flooding events • Long-term: Raise road	Flooding	✓	
Hay Street at Quill Pond and South of Newman Road • Long-term: Design, fund, and construct drainage improvements	Flooding		✓
Larkin Road at Bridge • Long-term: Design, fund, and construct drainage improvements	Flooding		✓
Scotland Road at Wolf Brook, Highfield Street, and Pikul Field • Long-term: Design, fund, and construct drainage improvements	Flooding		✓
Hanover Street at Little River • Short-term: Relocate elementary school emergency shelter currently, explore costs and benefits of raising the road or installing a bridge • Long-term: Design, fund, and construct drainage improvements	Flooding	✓	✓
Little River Tributary Crossings on Middle Road and Highfield Street • Short-term: Replace undersized culverts, assess need to replace culvert under Rt. 1 • Long-term: Perform regular maintenance and monitoring of upgraded culverts	Flooding	✓	
Parker River Tributary Crossing on Orchard Street (north of Central St) • Short-term: Replace undersized culvert • Long-term: Perform regular maintenance and monitoring of upgraded culvert	Flooding	✓	
Parker River Tributary Crossings on Elm Street, School Street, and Coleman Road • Short-term: Replace undersized culvert • Long-term: Perform regular maintenance and monitoring of upgraded culvert	Flooding	✓	
Watershed Study of Little River • Short-term: Conduct study of Little River, in coordination with Newburyport, to identify causes of flooding in Business Park and develop a plan to mitigate flooding	Flooding		✓
Public Safety Building • Long-term: Build new Public Safety Facility to replace under capacity structure	All hazards		✓
DCR Fire Wise Program • Long-term: Use DCR Fire Wise Program in heavily forested areas and neighborhoods	Brushfires		✓
Larkin Mill Dam on Parker River • Long-term: Breach/partial removal of dam to prevent uncontrolled failure and allow sediment transport downstream to enhance marsh habitat	Flooding, dam failure		✓
Additional Non-Structural Recommendations • Participate in NFIP's Community Rating System to enhance floodplain management • Incorporate hazard mitigation in local policies, plans and programs (e.g., Capital Improvement Program, Master Plan, Open Space & Recreation Plan) • Incorporate climate change/SLR adaptation consideration in future hazard planning • Develop stormwater management plan for maintenance of town stormwater facilities • Finalize Highway Operations and Safety Manual outlining roadway maintenance practices and procedures to be followed for stormwater management	All hazards		✓

EXISTING HAZARD PLANS:

CAP: Schottland, T., M. Merriam, C. Hilke, K. Grubbs, and W. Castonguay, 2017. *Great Marsh Coastal Adaptation Plan*. National Wildlife Federation Northeast Regional Office, Montpelier, VT. 237 p.

HMP: Merrimack Valley Planning Commission, 2016. *Merrimack Valley Region Multi-Hazard Mitigation Plan Update.* April. 420 p.

Horsley Witten Group
Sustainable Environmental Solutions

Newbury Municipal Vulnerability Preparedness (MVP) Grant Project:

CLIMATE CHANGE PROJECTIONS[1]

TEMPERATURE

HIGHLIGHTS:

- ✓ Temperature increases could make Newbury feel like present-day New Jersey 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 more than 9 times as many.
- ✓ We will have far fewer days with temperatures below freezing.
- ✓ We will have to expend less energy on heating in winter, and far more on air conditioning in 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

Parker Basin Climate Parameter	Baseline (1971-2000)	Mid-Century (2050s)	End of Century (2090s)
Average Annual Temperature (°F)	49.2	52.1 – 55.5	52.9 – 60.1
Maximum Annual Temperature (°F)	59.4	62.1 – 65.5	62.8 – 70.2
Minimum Annual Temperature (°F)	38.9	42.0 – 45.3	42.9 – 49.9
Annual Days with Max Temp over 90°F	8	17 – 38	21 – 75
Annual Days with Min Temp below 32°F	133	89 - 114	65 – 109
Annual Heating Degree-Days (Base 65°F)	6,361	4,803 – 5,633	3,883 – 5,388
Annual Cooling Degree-Days (Base 65°F)	583	867 – 1,302	981 – 2,072
Annual Growing Degree-Days (Base 50°F)	2,599	3,158 – 3,804	3,316 – 5,017

[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 Parker Basin, which includes the majority of the land area of Newbury.

[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 Newbury will increase up to 12% by 2050 and up to 17% 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

Parker Basin Climate Parameter	Baseline (1971-2000)	Mid-Century (2050s)	End of Century (2090s)
Total Precipitation (inches):			
Annual	45.4	45.6 – 51.0	46.2 – 53.0
Winter	11.5	11.7 – 14.0	12.0 – 15.4
Spring	11.6	11.5 – 13.8	11.8 – 14.3
Summer	10.1	9.4 – 11.7	8.6 – 11.7
Fall	12.3	11.1 – 13.7	10.8 – 13.8
Annual Days with Precipitation over 1 inch	8	8 – 11	9 – 11
Annual Days with Precipitation over 2 inches	1	1 – 1	1 – 2
Annual Days with Precipitation over 4 inches	0	0 – 0	0 – 0
Annual Consecutive Dry Days	16	15 – 18	16 – 19

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

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

Horsley Witten Group
Sustainable Environmental Solutions

Newbury Municipal Vulnerability Preparedness (MVP) Grant Project:

SELECTED DEMOGRAPHIC DATA[1]

Demographic Parameter	Result
Population	6,666 people
Age	0-19 = 21% 20-34 = 13% 35-64 = 48% 65+ = 18%
Household Income	<$40K = 20% $40-60K = 10% $60K+ = 70%
% Below Poverty Line	4%
Race	White = 96% Black = 2% Asian = 1% Other = 1%
Ethnicity	Hispanic = 1% Not Hispanic= 99%
% Population in an Environmental Justice Neighborhood	0.0%
% Population Over 65 Living Alone	4.4%
Asthma Emergency Department Visits	27.6 (per 10,000 people)
Pediatric Asthma Prevalence	7.3% of all children enrolled in grades K-8
Heat Stress Emergency Department Visits	0.0 (per 10,000 people)

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

Attachment C: Base Map

Legend

- Town Outline
- Open Space
- Evacuation Routes

FEMA Flood Zone

eff. 07/16/2014

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

Critical Infrastructure*

- BRIDGE
- BUS DEPOT
- CEMETERY
- CLINIC
- COURTS
- CULVERT
- DAM
- DAY CARE FACILITY
- ELDERLY HOUSING
- EMERGENCY OPERATIONS CENTER
- EMERGENCY SHELTER
- FIRE STATION
- HOSPITAL
- LIBRARY
- MARINA
- MBTA STATION
- PARKING
- PLUM ISLAND AIRPORT
- POLICE STATION
- POST OFFICE
- POWER SUBSTATION
- PUBLIC HEALTH OFFICE
- PUBLIC WORKS GARAGE
- RECREATION FEATURE
- SCHOOL
- SEWAGE PUMPING STATION
- SOLID WASTE TRANSFER/DISPOSAL
- STATE POLICE
- TELEPHONE/COMMUNICATIONS/CELL
- TOWN OFFICES
- WASTE WATER TREATMENT PLANTS
- WATER SUPPLY CHLORINE BOOSTER PUMP
- WATER SUPPLY/PUMPING/STORAGE

*Critical Infrastructure Data provided by MAPC with updates from the city of Newbury, MA (2018)

N

Mile
0 0.5 1

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Newbury, MA
Critical Infrastructure and FEMA Flood Zones

Date: 4/18/2018 Figure 1

Path: H:\Projects\2017\17153 Newbury Vulnerability Prep\GIS\Maps\Newbury_now.mxd

Legend

- Town Outline
- Evacuation Routes

Projected Probability of Flooding 1/year (2070)

Source: Famely et al. 2016

- 1% (100-yr. flood)
- 25% (4-yr. flood)
- 50% (2-yr. flood)
- 100% (1-yr. flood)

Critical Infrastructure*

- BRIDGE
- BUS DEPOT
- CEMETERY
- CLINIC
- COURTS
- CULVERT
- DAM
- DAY CARE FACILITY
- ELDERLY HOUSING
- EMERGENCY OPERATIONS CENTER
- EMERGENCY SHELTER
- FIRE STATION
- HOSPITAL
- LIBRARY
- MARINA
- MBTA STATION
- PARKING
- PLUM ISLAND AIRPORT
- POLICE STATION
- POST OFFICE
- POWER SUBSTATION
- PUBLIC HEALTH OFFICE
- PUBLIC WORKS GARAGE
- RECREATION FEATURE
- SCHOOL
- SEWAGE PUMPING STATION
- SOLID WASTE TRANSFER/DISPOSAL
- STATE POLICE
- TELEPHONE/COMMUNICATIONS/CELL
- TOWN OFFICES
- WASTE WATER TREATMENT PLANT
- WATER SUPPLY CHLORINE BOOSTER PUMP
- WATER SUPPLY/PUMPING/STORAGE

*Critical Infrastructure Data provided by MAPC with updates from the city of Newbury, MA (2018)

N

0 0.5 1 Mile

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Newbury, MA
Critical Infrastructure and Projected Flooding (2070)

Date: 4/18/2018 Figure 2

Path: H:\Projects\2017\17153 Newbury Vulnerability Prep\GIS\Maps\Newbury_now.mxd

Attachment D: Discussion Matrices from the Four 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	Sea Level Rise	Severe Storms (Hurricane, Nor' Easters, Wind, Precipitation)	Extreme Temperatures (Long Heat, Drought)	Flooding (Inland, Coastal, Precipitation)	Priority H - M - L	Time Short Long Ongoing
Infrastructural									
Plum Island Boulevard and Turnpike	Plum Island		V	Elevate turnpike on pilings Retreat Boulevard					
Plum Island water and sewer	Plum Island	Newburyport	V						
Newman Road		Town	V	Remove road from marsh, marsh restoration to a walking path and recreation					
Pine Island Road		Town	V						
Boston Road		Town	V	Expand culvert with MBTA					
Culverts		Town	V	Continue repair and replacements (e.g., Courser Brook, Cart Creek)					
Dams			V	Study removal- River Street (Private) removal, Larkin Dam, seek grant funds (Public)					
Plum Island emergency routes	Plum Island- Northern Boulevard		V	Complete grant engineering, seek funding for action					
Private septic and wells		Private	V	Identify those at risk					
Public utilities		National Grid	V	Bury lines, tree trimming					
Equipment (DPW and public safety)		Town	V	Capital planning- high water rescue Regional Emrgency Planning Committee (REPC) review					

Societal						
Private Residences (Plum Island, Pine Island, Cottage Road, Plum Bush)		Private	V	Incentives for flood prevention beyond code, FEMA program education and coordination Eligibility for freeboard programs, outreach to eligible participants		
Schools		Public and Private	V			
Elderly Housing		Private	V			
Shellfish Industry			V	Water quality monitoring		
Farming (Scotland Road)		Private	V			
Tourism and Recreation	Plum Island	Public and Private	V			
Seasonal vs. Year Round	Plum Island	Private	V			
Regional Collaboration	Town and Newburyport		S/V	Plum Island emergency planning		
Public Health Issues			V	Public education		
Emergency Response	Plum Island		V			
Education and Attitudes			S/V			

Environmental						
Salt marsh	town-wide	Public and Private	V/S	Ditch remediation and restoration at Old Town Hill, Salt marsh expansion and migration. Invasive species management. Update estuary plans.		
Plum Island dunes	Plum Island	Public and Private	V/S	Beach nourishment, fencing, and planting dune grass. Private property, living shore line, state/local/private cooperation		
Wildlife and habitat			V	Native landscaping and conservation. Minimize insecticides.		
Pests and disease			V			
Topography			V			
Open space		Public and Private	S/V			
Parker river			S/V			
Invasive species			V			
Water supply		Public and Private	V	Stormwater management Best Management Practices		

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
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	Sea Level Rise	Severe Storms (Hurricane, Nor' Easters, Wind, Precipitation)	Extreme Temperatures (Long Heat, Drought)	Flooding (Inland, Coastal, Precipitation)	Priority H - M - L	Time Short Long Ongoing
Infrastructural									
Sewerage treatment station and pump stations (both Plum Island and Newburyport locations)				Assess and improve flood proofing of Plum Island pump station Partner with Newburyport to evaluate options at wastewater treatment plant				L L	L L
Development on Plum Island		Public	V	See environmental matrix					
Power grid	across town	National Grid	V	Advocate for improvements with National Grid and the State (including micro grids and studies)				M	O
Plum Island Turnpike			V	Feasibility studies, prioritization, elevating roads, address culverts. Get funding for these projects.				H	S
Newman Road and Route 1	Near Parker River		V						
Pine island			V						
Middle Road			V						
Vulnerable emergency access routes and evacuation	Plum Island		V	Plum Island alternate emergency access and evacuation around Plum Island center (note: this is underway) Better signage for evacuation routes, including emergencies on beach itself				H	S
Undersides culverts (and Boston Road)	Scotland Rd/ Little River		V	See above					
Stormwater management, local bylaws, codes, and regulations	New development		S	Continue to implement, consider implementing MS4 regulations across town (not just in MS4 area)					
Hanover St. at Little River			V						
Good progress on infrastructure improvements	Town-wide		S	Continue progress on culvert improvements					
Water system on Plum Island			V	Review of SOPs					

Societal						
Elderly Housing		3 private housing areas	V	Equipment and plan for emergencies and power outages		
Farmland capacity- local food is available yet threatened			S and V	Seek conservation restrictions and encourage smart development (e.g., cluster/OSRD)		
Strong regional awareness and collaboration			S			
Emergency Communications and outreach (on website)	With Newburyport		S	Continue to strengthen emergency communication		O
Seasonal population (more education)			V			
Evacuation routes and signage need improvement			V	Educate tourists as well as residents on Plum Island on vulnerabilities, shelters, evacuation routes, etc. Implement evacuation signage. Have a pamphlet for realtors, renters, Air- BnBs, Blue (an inn).		
Emergency shelters (generators)	PITA, NES, TRITON		S	Develop a database or registry and a comprehensive plan for emergencies (especially power outages)		
Records of individuals at risk (elderly or disabled people) for emergency communications			V			
Environmental						
Dunes-keeping them healthy			S	Putting beach fencing up and keeping it up. Dune grass planting. Measure the beach so as to get access to sand renourishment.	H	S+ O
(Re)development on Plum Island			V	Work with Newburyport to review and improve regulations- zoning, building ordinances, plum island overlay district (e.g., raising/ elevating structures and utilities)	H	L L
Common pasture flood storage	Scotland Rd area		S	Control and manage development for impervious cover, and protect more land using conservation easements	H	L L
Regulations that control impervious cover			S			
Salt Marsh, the Great Marsh			S			
Consistent approach for keeping marshes healthy (SOPs)			V			
Regional environmental partners			S	Support and enhance regional partnerships- Great Marsh Coalition, PIE, Rivers Partnership (with the town)	H	O
Water supply availability and quality		Multiple suppliers	V	Explore and develop new water supply with Newburyport (water) or Byfield Water District	H	L
Stormwater and pollution from Merrimack River			V	Join with regional efforts (MVPC) to protect Merrimack and reduce pollution that ends up on Plum Island	H	O
Larkin Dam and Central Street Dam			V	Remove Larkin Dam- seek funding to do so (feasibility has been done)	H	S

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
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	Sea Level Rise	Severe Storms (Hurricane, Nor' Easters, Wind, Precipitation)	Extreme Temperatures (Long Heat, Drought)	Flooding (Inland, Coastal, Precipitation)	Priority H - M - L	Time Short Long Ongoing
Infrastructural									
Water	T	Both	V	Expanding existing municipal systems. Light impact development.					
Sewer/ septic	T	B	V	Flood-proofing vulnerable areas					
Roads	T	M	V and S	Elevate culverts to equalize flow advancements					
Shelters	Sp.	M	S and V	Action plans, move towards self-sufficiency Access during event, facilitate efficient egress					
Power supply and fuel	T	B	V	Move towards green energy, encourage private fuel for generators, generator for PI					
Dams	T	B	V						
Bridges	T	M	V	Replace Plum Island bridge. Design bridge replacement to accommodate water flow.					
Societal									
Vulnerable population	T		V	Emergency evacuation plans. Identify vulnerable populations and their needs.					
Health and illness (Pest borne)	T	B	V	Remediate pests. Education					
Financial and economic impact	T	B	V	Municipal funding plan Private citizen incentives					
Public outreach	T	B	S	Continue website, code red, connects-ed					
Food supply	T	P	V	Land conservation, agricultural incentives, farming incentives					
Resources	T	B	V	Continue to stockpile equipment, continue sand stockpile (locally and regionally)					
Public engagement and education	T	M	V and S	Promote cable government access television, youth engagement, social media					
Municipal government	T	M	S	Educate government and staff to answer questions					

Environmental						
Salt Marsh	Specific	Municipal and private	V+S	Control invasive species, ditch remediations, thin layer deposition. Remove impediments to tidal flows		
Dams	Town	Both	V	Dam removal		
Groundwater recharge	Town	Both	V	LID techniques/ conservation		
Dunes	Specific	Both	S+V	Make more environmentally sensitive regulations for buildings Removing impediments to tidal flows		
Dynamic ecosystem and tolerance	Town	Both	V	Zoning		
Human population, development	Town		V	Building regulations, continued support of MRBA, Plum island Overlay review		
Invasive species	Town	Both	V			
Migratory patterns	Town	Both	V			
Tick and Mosquito population	Town	Both	V	Pest control measures		

Community Resilience Building Risk Matrix

Group 4

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	Sea Level Rise	Severe Storms (Hurricane, Nor' Easters, Wind, Precipitation)	Extreme Temperatures (Long Heat, Drought)	Flooding (Inland, Coastal, Precipitation)	Priority H - M - L	Time Short Long Ongoing
Infrastructural									
Dams (built and natural)		Both	V				Conduct an inventory/ inspection (evaluation of structure/ ID locations of beaver dams)	M	
Emergency access roads		Public	V	Apply for CZM planning grants for public evacuation routes PI turnpike, Northern Boulevard, Hanover St., Pine Island				H	
Plum island Infrastructure		Public	V	Study PI turnpike (raise it up) Strategic plan w/ NBPT				H	
Problem- flooded roads		Public	V				Culvert Assessment- prioritize and apply for funding	H/M	
Elementary school (as a shelter)		Public	V/S		Enlarge/ increase backup power			M	
Triton Regional		Public	S						
Rail line		+	V						
Wastewater treatment plant	Newburyport	Newburyport	V/S				Formally define Newbury's role	M	
Highway department		Public	S	ID planning and notification protocol				M	
Public safety buildings		Public	S	ID planning and notification protocol				M	
Power grid/ national grid		Private	V	Coordination with National Grid Identify point of contact					
Societal									
Agricultural uses	See map	Private	S	Preservation policy				L	
Vulnerable populations	Newbury Village Oak Ridge Quaker Hill	Both	V	Coordinate with property owners, assessment of needs				M	
Schools/ transportation		Public	V	Coordinate emergency management notification Follow infrastructure recommendations to improve access routes				H	
Triton outside populations	Rowley Salisbury	Public	V						
Public health issues	Turnout	Both	V	ID potential threats, conduct outreach to public, adapt programs as needed				M/H	
Tourism/ recreation		Both	S/V	Protect PI as a recreational resources (see infrastructure) Develop user fee to offset cost of maintenance tied to recreation				M	

Environmental						
Great marsh		Private	V/S	Restoration to improve resiliency- invasive control, channel stabilization, erosion/ hydrology management	H	
Plum Island barrier beach		Both	V/S	Dune nourishment/ planning/ management/ access/ stabilization). Joint planning with (NBPT, MRBS, ACOE) to support and fund efforts	H	
Coastal habitat		Both	V/S	Maintain the High Marsh Platform, perform ditch assessment, continue efforts for protection Water quality management	H	
Groundwater		Both	V/S	Prepare plan for groundwater replenishment Assessment for saltwater intrusion and potential for public water supply expansion Septic system assessment	M/H	
Native vegetation and Invasive		Both	V/S	Management and evaluation of natural areas/ ID appropriate species	L	
Parker, Merrimack, and Little Rivers		Both	V/S	Dam removal assessment Enlarge/ replace undersized culverts and bridges	H	
Permitting				Review regulatory impediments/ policies that impede restoration	H	

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	Sea Level Rise	Severe Storms (Hurricane, Nor' Easters, Wind, Precipitation)	Extreme Temperatures (Long Heat, Drought)	Flooding (Inland, Coastal, Precipitation)	Group 1-4	Priority H - M - L	Time Short Long Ongoing
Infrastructural										
Plum Island Boulevard and Turnpike	Plum Island		V	Elevate turnpike on pilings Retreat Boulevard				1		
Culverts		Town	V	Continue repair and replacements (e.g., Courser Brook, Cart Creek)				1		
Plum Island emergency routes	Plum Island-Northern Boulevard		V	Complete grant engineering, seek funding for action				1		
Plum Island Turnpike			V	Feasibility studies, prioritization, elevating roads, address culverts. Get funding for these projects.				2	H	S
Vulnerable emergency access routes and evacuation	Plum Island		V	Plum Island alternate emergency access and evacuation around Plum Island center (note: this is underway) Better signage for evacuation routes, including emergencies on beach itself				2	H	S
Roads	T	M	V and S	Elevate culverts to equalize flow advancements				3		
Power supply and fuel	T	B	V	Move towards green energy, encourage private fuel for generators, generator for PI				3		
Emergency access roads		Public	V	Apply for CZM planning grants for public evacuation routes PI turnpike, Northern Boulevard, Hanover St., Pine Island				4	H	
Plum island Infrastructure		Public	V	Study PI turnpike (raise it up) Strategic plan w/ NBPT				4	H	
Societal										
Emergency shelters (generators)	PITA, NES, TRITON		S	Develop a database or registry and a comprehensive plan for emergencies (especially power outages)				2		
Schools/ transportation		Public	V	Coordinate emergency management notification Follow infrastructure recommendations to improve access routes				4	H	

Environmental

Salt marsh	town-wide	Public and Private	V/S	Ditch remediation and restoration at Old Town Hill. Salt marsh expansion and migration. Invasive species management. Update estuary plans.	1		
Plum Island dunes	Plum Island	Public and Private	V/S	Beach nourishment, fencing, and planting dune grass. Private property, living shore line, state/local/private cooperation	1		
Dunes-keeping them healthy			S	Putting beach fencing up and keeping it up. Dune grass planting. Measure the beach so as to get access to sand renourishment.	2	H	S+ O
(Re)development on Plum Island			V	Work with Newburyport to review and improve regulations- zoning, building ordinances, plum island overlay district (e.g., raising/ elevating structures and utilities)	2	H	L L
Water supply availability and quality		Multiple suppliers	V	Explore and develop new water supply with Newburyport (water) or Byfield Water District	2	H	L
Salt Marsh	Specific	Municipal and private	V+S	Control invasive species, ditch remediations, thin layer deposition. Remove impediments to tidal flows	3		
Human population, development	Town		V	Building regulations, continued support of MRBA, Plum island Overlay review	3		
Dunes	Specific	Both	S+V	Make more environmentally sensitive regulations for buildings Removing impediments to tidal flows	3		
Great marsh		Private	V/S	Restoration to improve resiliency- invasive control, channel stabilization, erosion/ hydrology management	4	H	
Plum Island barrier beach		Both	V/S	Dune nourishment/ planning/ management/ access/ stabilization). Joint planning with (NBPT, MRBS, ACOE) to support and fund efforts	4	H	
Parker, Merrimack, and Little Rivers		Both	V/S	Dam removal assessment Enlarge/ replace undersized culverts and bridges	4	H	
Permitting				Review regulatory impediments/ policies that impede restoration	4	H	

Attachment F. Annotated Maps from Discussion Groups

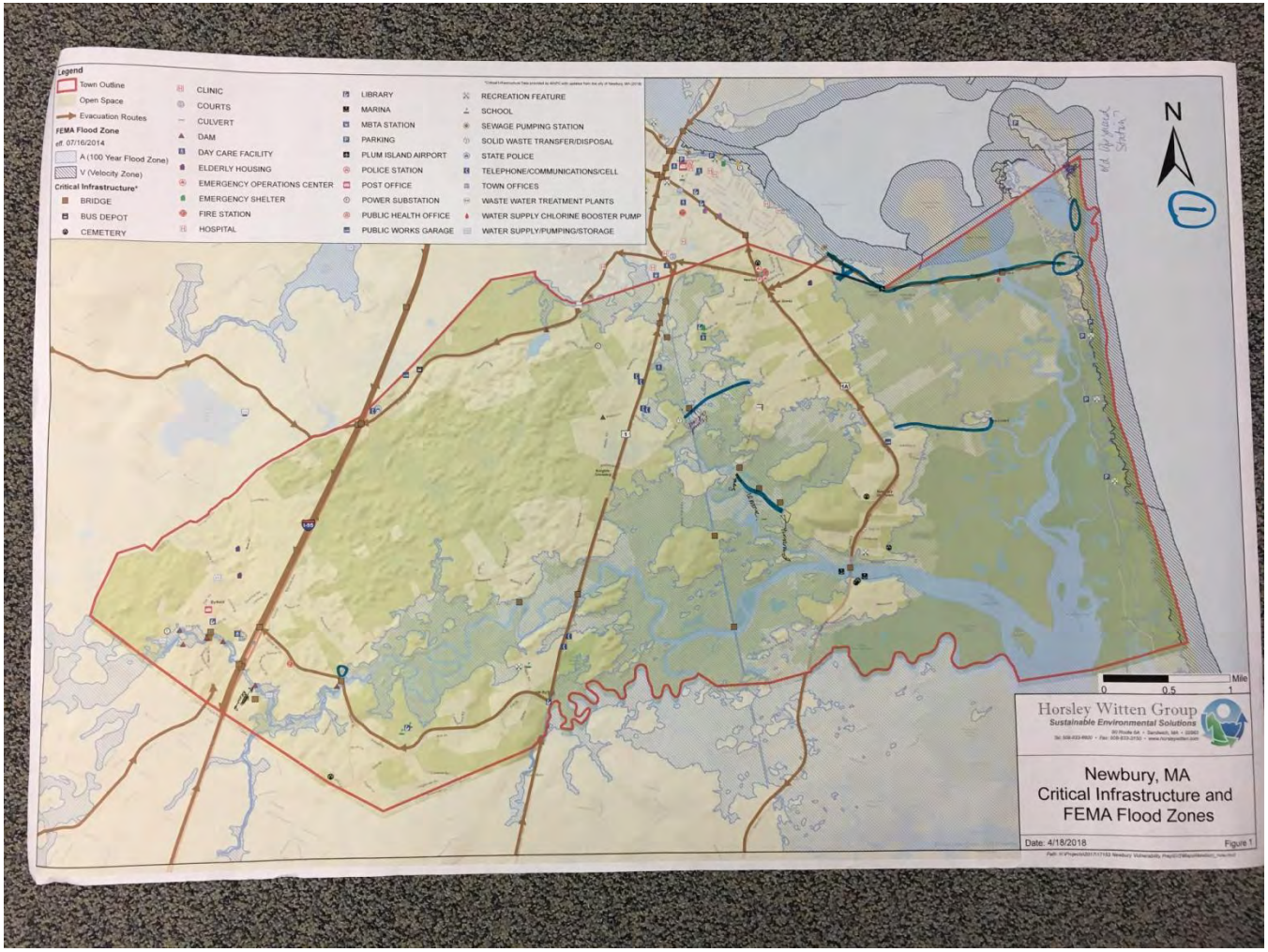

Photo 1 Map annotated by small Group 1 highlighting potential areas of dam removal or other infrastructure improvements.

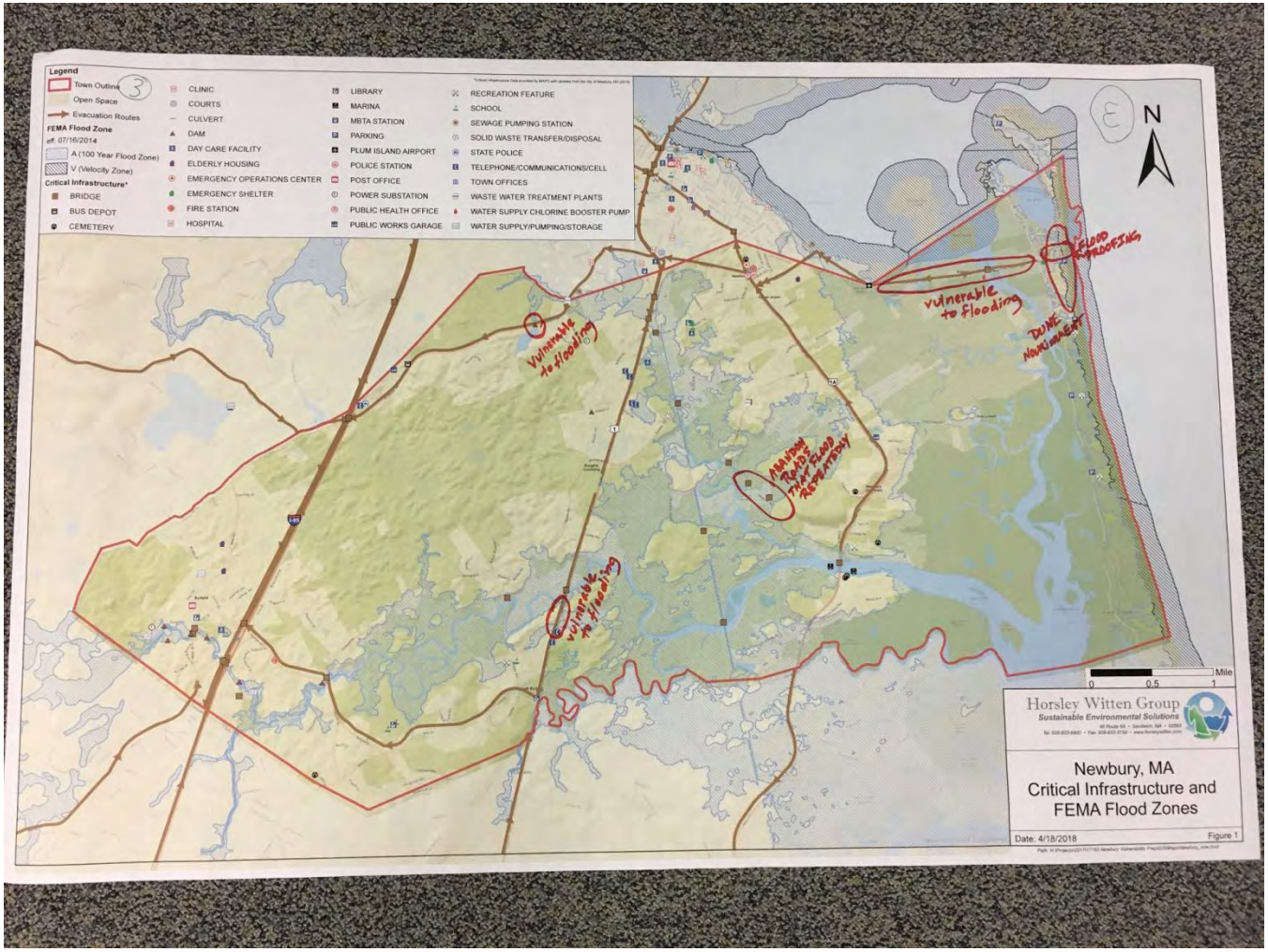

Photo 2 Map annotated by Group 3 showing roadways vulnerable to flooding and sites of prioritized dune re-nourishment.

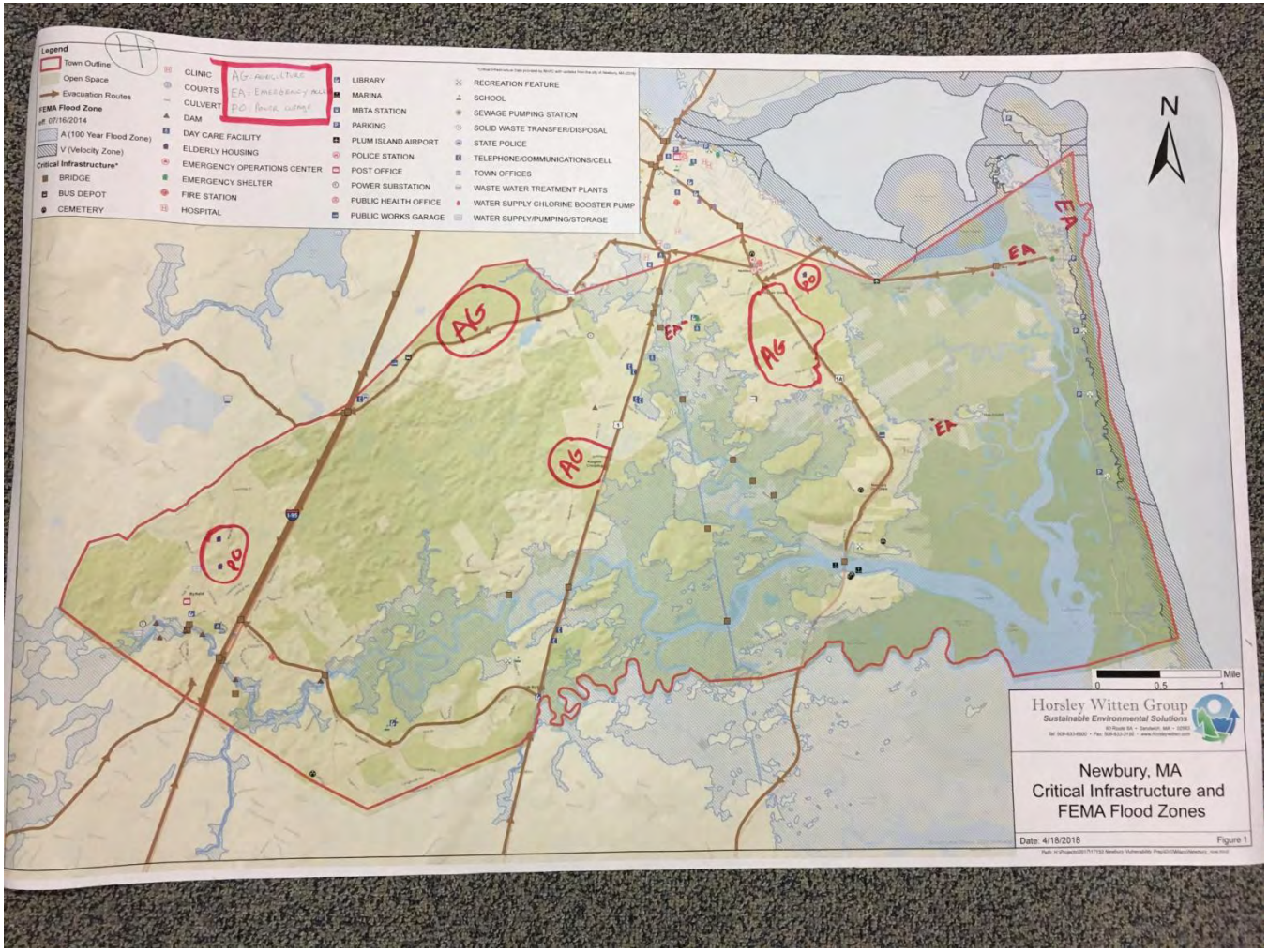

Photo 2 Map annotated by Group 4 showing agricultural, emergency access and power outage zones within the Town.