

Appendix C: Workshop Material

Overview Slideshow

Climate Change Predictions Slideshow

West Boylston Hazards Slideshow

Workshop Sign-in Sheet

Municipal Vulnerability Preparedness (MVP)

West Boylston Workshop

May 14, 2019



AGENDA

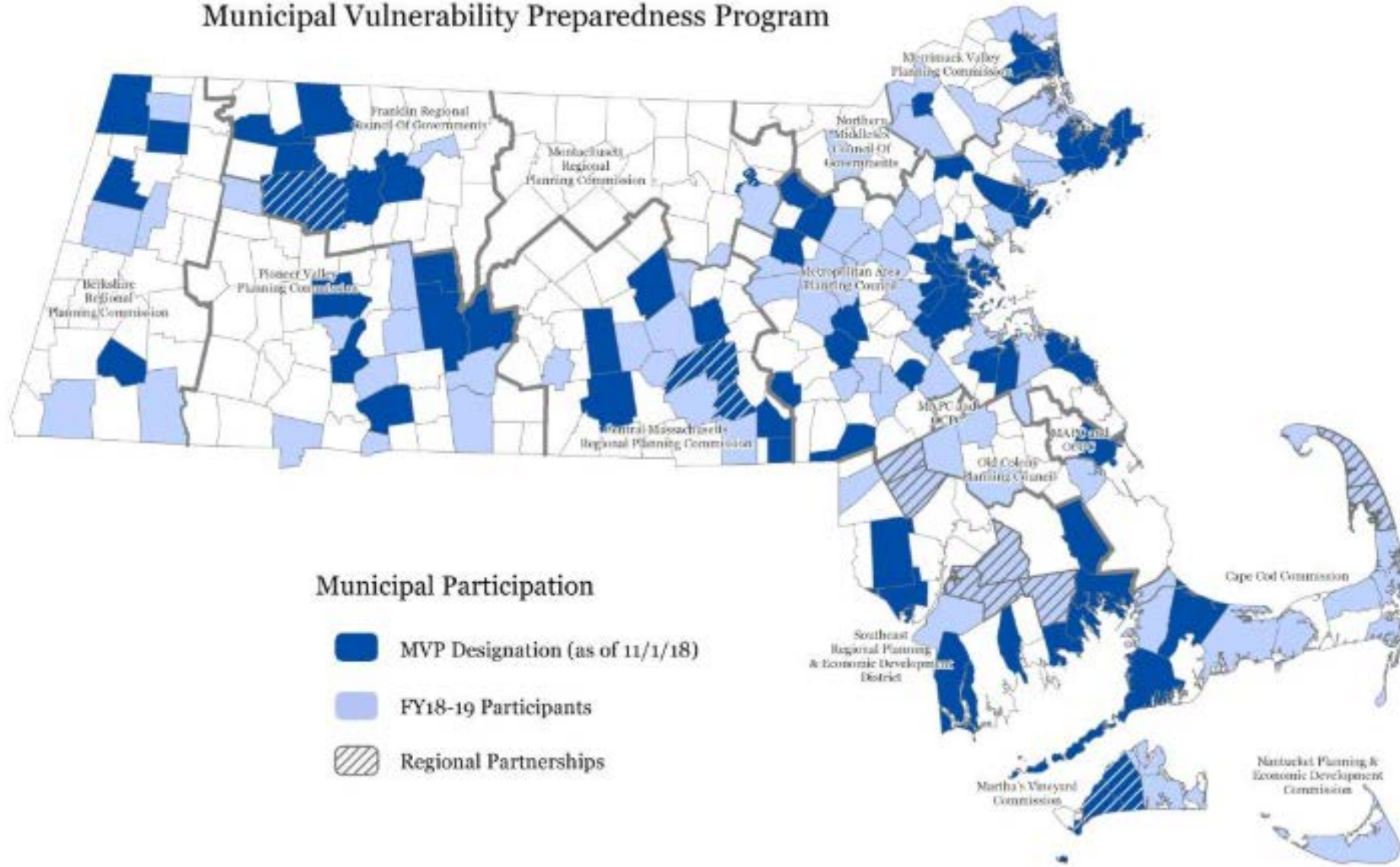
1. Welcome
 2. Introductions – What has drawn you to this meeting? What is your connection?
 3. Workshop Overview (Trish Settles)
 4. Climate Change Projections, Impacts & Mitigation, Nature Based Solutions Eli Goldman (CMRPC)
 5. Profile of Natural Hazards & Critical Infrastructure, Andrew Loew, (CMRPC)
 6. Small Team Exercises Part 1
- LUNCH
7. Small Team Exercises Part 2
 8. Small Teams Report Back
 9. Wrap Up, Next Steps, Closing Remarks



Municipal Vulnerability Preparedness

- ▶ The Municipal Vulnerability Preparedness grant program (MVP) provides support for cities and towns in Massachusetts to begin the process of planning for climate resiliency. Communities who complete the MVP program become certified as an MVP community and are eligible for follow-up grant funding and other opportunities to assist in implementing strategies
- ▶ Based on Community Resilience Building Program as developed by Eli Welch of the Nature Conservancy and National Oceanic and Atmospheric Administration (NOAA)

Municipal Vulnerability Preparedness Program



Be Prepared, Mitigate the Costs!!

- US Natural Disasters in 2017 cost \$306 Billion, the most expensive year since NOAA started keeping track in 1980

National Benefit-Cost Ratio Per Peril *BCR numbers in this study have been rounded		Exceed common code requirements	Meet common code requirements	Utilities and transportation	Federally funded
Overall Hazard Benefit-Cost Ratio		4:1	11:1	4:1	6:1
Savings (\$billion)		\$16 /year	\$13 /year	\$2.5	\$160
 Riverine Flood		5:1	6:1	8:1	7:1
 Hurricane Surge		7:1	Not applicable	Not applicable	Too few grants
 Wind		5:1	10:1	7:1	5:1
 Earthquake		4:1	12:1	3:1	3:1
 Wildland-Urban Interface Fire		4:1	Not applicable	Not applicable	3:1

Hazard Mitigation Planning

- ▶ Excellent synergy with Hazard Mitigation Planning, but MVP is more focused on climate change in the long term
- ▶ West Boylston's Hazard Mitigation was formally accepted by FEMA in February 2018.
- ▶ 5-year plans reviewed and approved by MEMA and FEMA with very specific requirements that make municipalities eligible for mitigation grants if and when there is a disaster declaration.



West Boylston Hazard Mitigation Plan Update



Storm over West Boylston

Adopted by the Board of Selectmen February 21, 2018

Prepared by the Central Massachusetts Regional Planning Commission
2 Washington Square, Union Station
Worcester, MA 01604
www.cmrpc.org

&

Local Hazard Mitigation Team
Town of West Boylston, Massachusetts



Workshop Objectives!

- ▶ Review and define extreme weather, natural and climate-related hazards
- ▶ Identify existing and future vulnerabilities and strengths
- ▶ Develop and prioritize actions for the community and broader stakeholder networks, and
- ▶ Identify opportunities for the community to advance actions to reduce risks and build resilience

Time to Get to Work!!!



First Hazard Identification....

- ▶ Winter Storms
- ▶ Snow
- ▶ Ice
- ▶ Flooding
- ▶ Tsunami
- ▶ Hurricanes
- ▶ Wind Events
- ▶ Tornadoes
- ▶ Drought
- ▶ Earthquakes
- ▶ Riverine Flooding
- ▶ Street Flooding
- ▶ Dust Storms
- ▶ Wild Fires
- ▶ Landslides, Mud Slides
- ▶ Coastal Flooding



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

Top Priority Hazards (tornado, floods, wildfire, hurricanes, drought, heat wave, etc.)

H = M-L priority for action over the Short or Long term (and Ongoing) V = Vulnerability S = Strength				Floods	Winter Storms	Droughts & Wildfires	Priority	Time
Features	Location	Ownership	V or S				H · M · L	Short Long Ongoing
Infrastructural								
Societal								
Environmental								

The Matrix

At the Tables.....

- ▶ Tables of 8 to 10 individuals
- ▶ Table Groups by lens
 - ▶ Societal,
 - ▶ Infrastructure,
 - ▶ Environmental and
 - ▶ Two Mixed (all 3)
- ▶ (If we need to balance the tables we may ask you to join another table.)
- ▶ Tools and Resources
 - ▶ Matrix, Maps, Markers, Dots, & Each Other.

Roles

- ▶ Table Facilitator directs the discussion and keeps the dialogue moving
- ▶ Scribes filling in matrix
- ▶ CMRPC resource person
- ▶ Participants
- ▶ ID Table spokesperson for Report Out

BREAK OUT GROUP Instructions

- Part 1 (Before Lunch)- For each Feature
 - ID category (Environmental, Societal, or Infrastructure)
 - Identify key features – (For Example, Dams, Railroads, Vulnerable Neighborhoods, etc.)
 - Consider ownership

- Part 2 (After Lunch) – For each Feature
 - Identify and Develop Priority Actions
 - ID Priority and Time

The Assignment

- ▶ Identify Hazards (For Example - Flooding, Winter Storms and Drought)
- ▶ Under sector, decide infrastructure, societal, or environmental,
- ▶ Identify location/attribute (nursing home, wetland, airport, public safety building, mill, bridge, communications center)
- ▶ Identify ownership (Public or Private or other)
- ▶ Assess whether the feature is a vulnerability or a strength.
- ▶ Indicate on Base Map
- ▶ Focus mainly on town specific major issues
- ▶ Develop and prioritize action.

Taken from Klientfelder

www.CommunityResilienceBuilding.org



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

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

1

[illegible]

Community Resilience Building Workshop Risk Matrix

Top 4 Hazards (tornado, floods, wildfire, hurricanes, snow/ice, drought, sea level rise, heat wave, etc.)

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

<u>H</u> - <u>M</u> - <u>L</u> priority for action over the <u>S</u> hort or <u>L</u> ong term (and <u>O</u> ngoing) <u>V</u> = Vulnerability <u>S</u> = Strength				Coastal Flooding SLR/Storm Surge	Inland Flooding and Rain Events	Ice and Snow	Wind	Priority	Time
Features	Location	Ownership	V or S					H - M - L	Short Long Ongoing
Societal									
Elderly Citizens (facilities)	Multiple	Private	V	Assess and identify vulnerabilities to determine residents needs during emergencies; Coordinate emergency planning efforts; Conduct routine evacuation drills				H	S
Neighborhood Cooperation	Town-wide	Private	V	Assist associations in identifying and conducting best practices to reduce risk; Advance a "Neighbor helping Neighbor" Program through Community Center training				H	S
Faith-based Organizations	Multiple	Private	V	Coordinate organizations in identifying and conducting best practices amongst members to reduce risk				H	S
Municipal & Regional Tabletop Exercise	Town/Region	Town	V	Need to conduct exercises to maximize readiness; Better regional planning/communication plan to discuss vulnerabilities, share ideas, and resources				H	S
Homeless Population	Town-wide	Town	V	Extreme weather flyers and communications about available services				M	S
Database (locations of vulnerable population)	Town/Region	Town/State	V	Need to improve database to ensure high level responses and safety				M	S
Vulnerable Neighborhoods	South side	Town/Private	V	Identify level and location of vulnerable units; Develop longer term plan to reduce vulnerability				M	L
Coordinated Evacuation Plan	Town-wide	Town/State	V	Reconfigure evacuation routes; Update signage along critical routes				L	S

Report Outs

- ▶ Areas of agreement
- ▶ Areas of unique perspectives

Summary Discussion



Next Steps

- ▶ Summary Public “Listening” session with Board of Selectmen Presentations
- ▶ Report
- ▶ Develop resources and Implement actions.

Questions or Comments on the Workshop



Questions – Contact Us

- ▶ West Boylston Core Team leader, Nancy Lucier nlucier@westboyiston-ma.gov
- ▶ CMRPC Project Leader, – Eli Goldman, egoldman@cmrpc.org
- ▶ Executive Office of Energy and Environmental Affairs –
 - ▶ Margot Mansfield, margot.mansfield@state.ma.us
 - ▶ Vallery Cardoso Vallery.b.cardoso@mass.gov



Thank You



Municipal Vulnerability Preparedness Program

West Boylston

Climate Change Projections

Eli Goldman, CMRPC



Northeast Climate Science Center UMass Amherst

- ▶ NECASC downscaled climate projections for major drainage basins
- ▶ Climate Models from the IPCC Fifth Assessment Report
- ▶ The Historical Data 1971-2000
- ▶ Medium and High Emission Scenarios were Chosen (RCP 4.5 and 8.5)
 - ▶ Medium Scenario Assumes Emissions Peak at Mid-Century
 - ▶ High Scenario Assumes a Continuing Emission Trajectory



Our Climate is Already Changing

- ▶ Temperature:  2.9°F
Since 1895
- ▶ Growing Season:  11 Days
Since 1950
- ▶ Sea Level Rise:  11 inches
Since 1922
- ▶ Strong Storms:  55%
Since 1958

Example Impacts of Climate Change

► **Agriculture**

- More extreme temperature and precipitation can prevent crops from growing.

► **Ecosystems**

- Range shifts can lead to extinction.

► **Energy**

- Warming is likely to increase summer peak electricity demand in most regions of the United States.

► **Forest**

- Warming temperatures generally increase the length of the growing season. It also shifts the geographic ranges of some tree species.

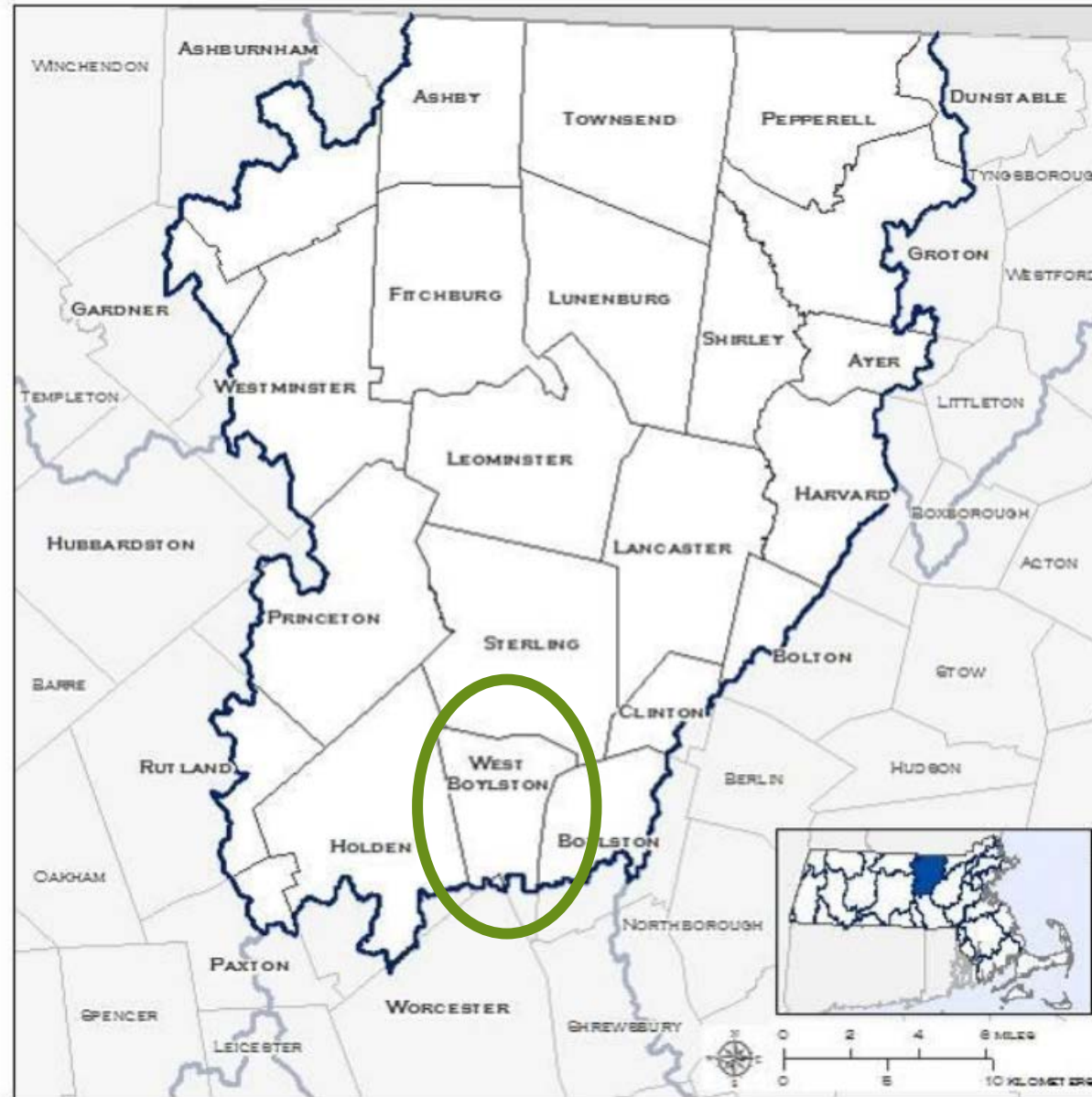
► **Human Health**

- Warmer average temperatures will lead to hotter days and more frequent and longer heat waves. Impacts on vulnerable populations.

► **Transportation**

- Heavy rains may result in flooding, which could disrupt traffic, delay construction activities, and weaken or wash out the soil and culverts that support roads, tunnels, and bridges.

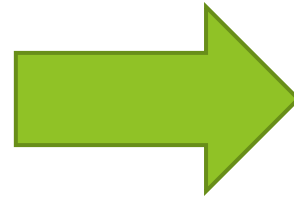
Nashua River Basin



Overview of Presentation

➤ **Climate projections**

- ▶ Precipitation
 - ▶ Annual
 - ▶ Large events
 - ▶ Changes in “___ year storms”
- ▶ Temperature
 - ▶ Consecutive dry days



➤ **Natural Hazards**

- ▶ (1) Winter Storms
- ▶ (2) Heavy Rainfall and Flooding
- ▶ (3) Drought, Wildfire, and Heat

1. Engage
Community

2. Identify CC
impacts and
hazards

3. Complete
assessment of
vulnerabilities
& strengths

4. Develop
and prioritize
actions

5. Take Action

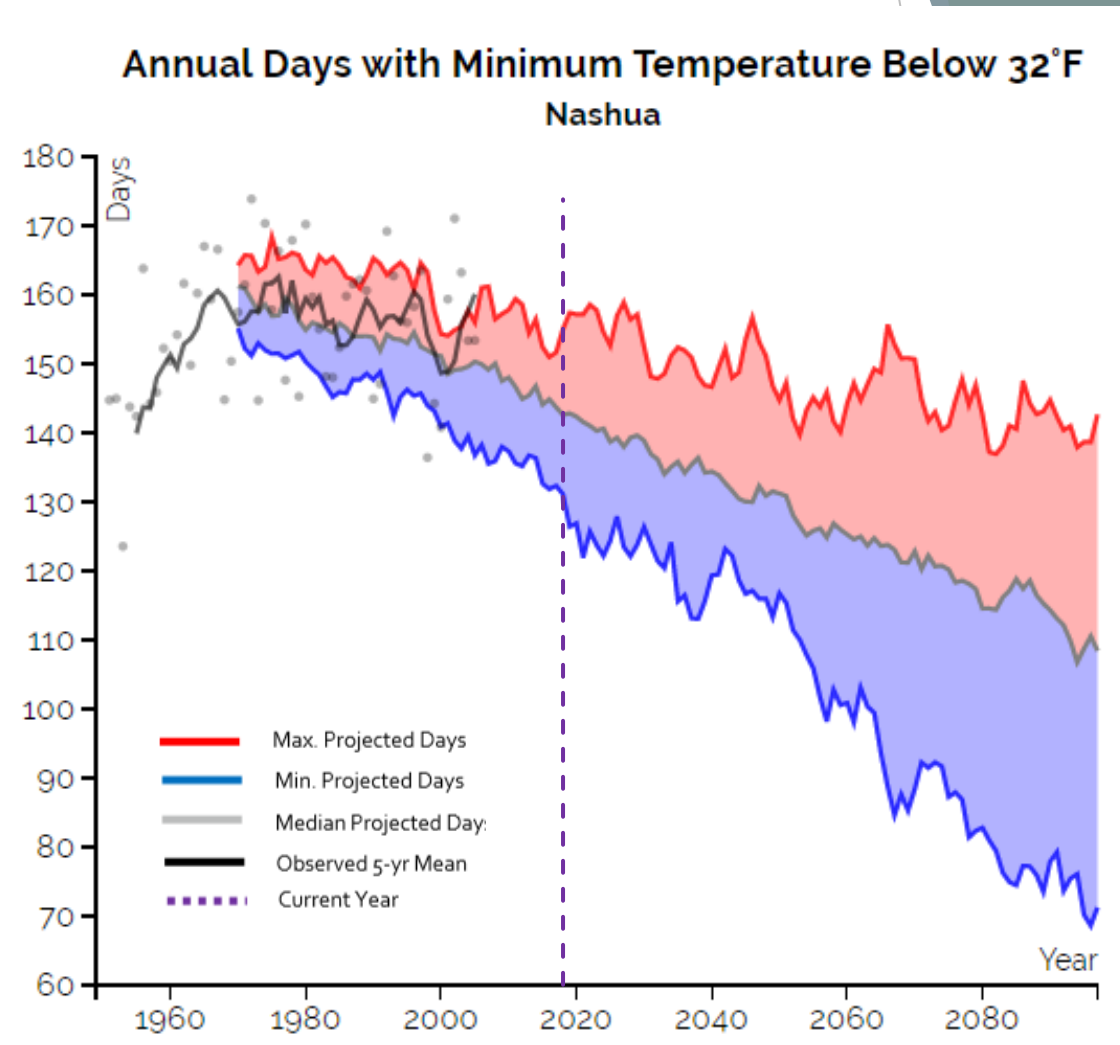
Winter Storms (1)

- ▶ Susceptible to large winter storm events
- ▶ The local geography and proximity to Atlantic Ocean increase risk
 - ▶ Nor'easters



Winter Storms (1)

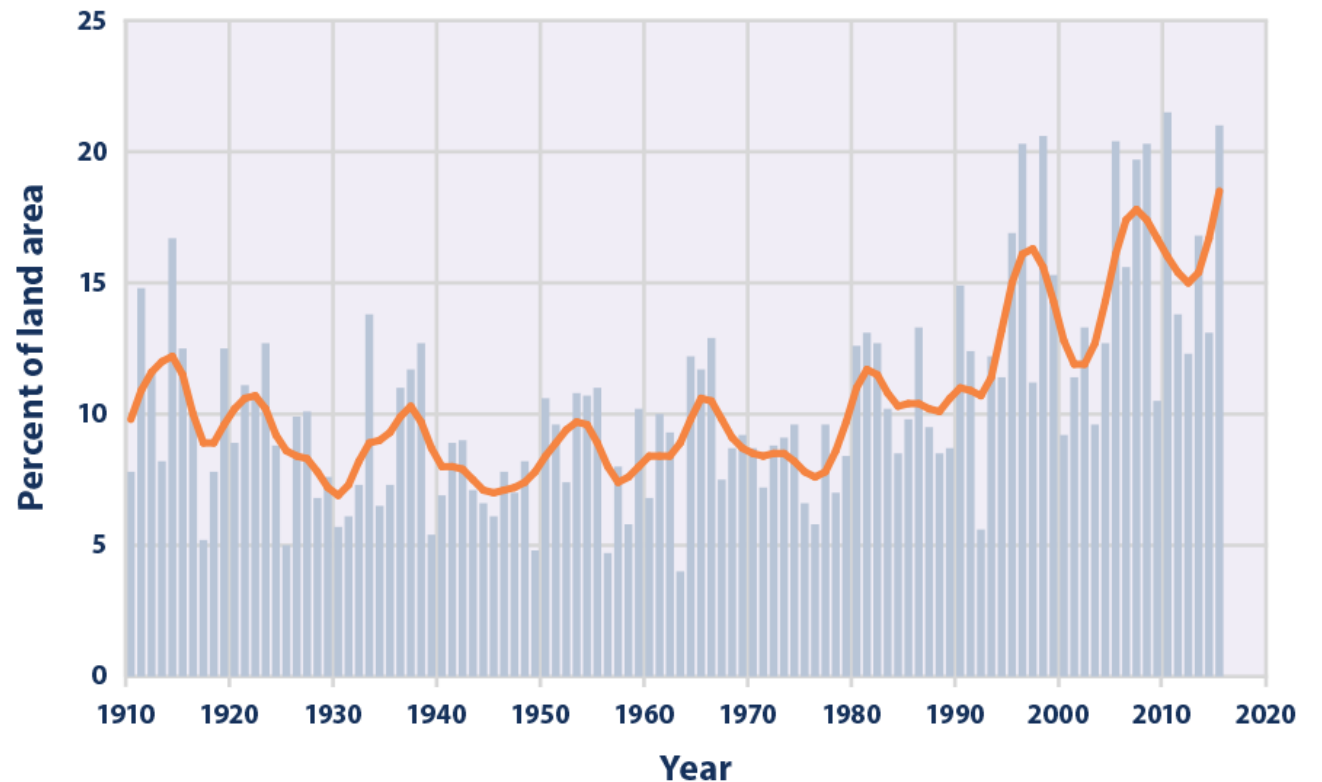
- ▶ Annual days below freezing will decrease over the next 80 years
- ▶ Rising temps → more winter precipitation to fall as rain for freezing rain
- ▶ Lower snowfall accumulation
- ▶ Winter is expected to see the highest projected increase in precipitation
 - ▶ Increase in days with precipitation over 1 inch by 1 day by mid century
 - ▶ Increase in days with precipitation over 1 inch by 2 days by end of century



Heavy Rainfall and Flooding (2)

- ▶ Total annual rainfall will increase
- ▶ Heavy rainfall events will become more frequent
 - ▶ Overbank flooding from rainfall and snowmelt
 - ▶ Piped Infrastructure backup and or failure
- ▶ Water quality
 - ▶ Erosion
 - ▶ Nonpoint source pollution

Extreme One-Day Precipitation Events in the Contiguous 48 States, 1910–2015



Data source: NOAA (National Oceanic and Atmospheric Administration). 2016. U.S. Climate Extremes Index. Accessed January 2016. www.ncdc.noaa.gov/extremes/cei.

For more information, visit U.S. EPA's "Climate Change Indicators in the United States" at www.epa.gov/climate-indicators.

Heavy Rainfall and Flooding (2)

Seasonal

► Winter

- Expected to experience the greatest change with an increase of 2- 22% by mid-century, and 6-39% by end of century.

► Spring

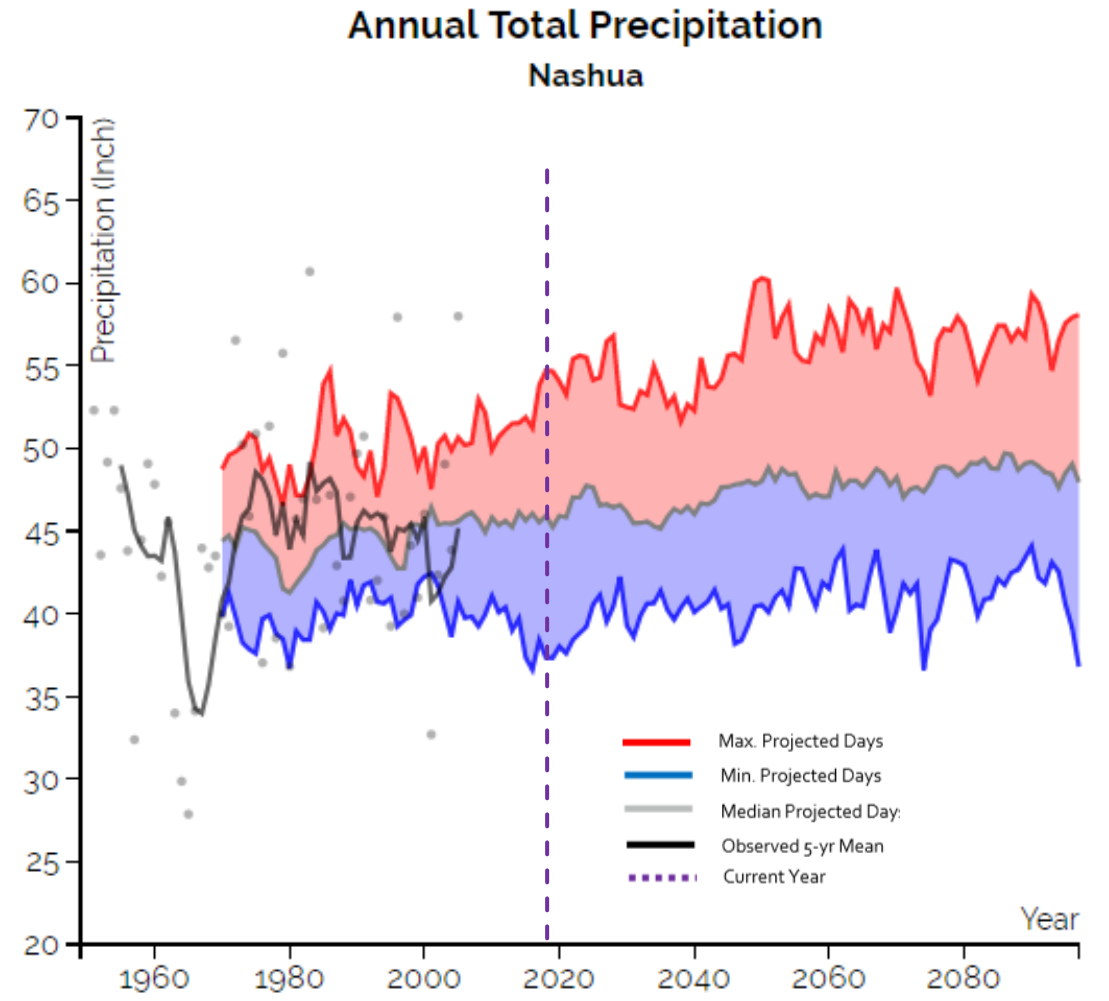
- Expected increase in days with precipitation over one inch of by 1 day by mid-century. Same projection for end of century.

► Summer

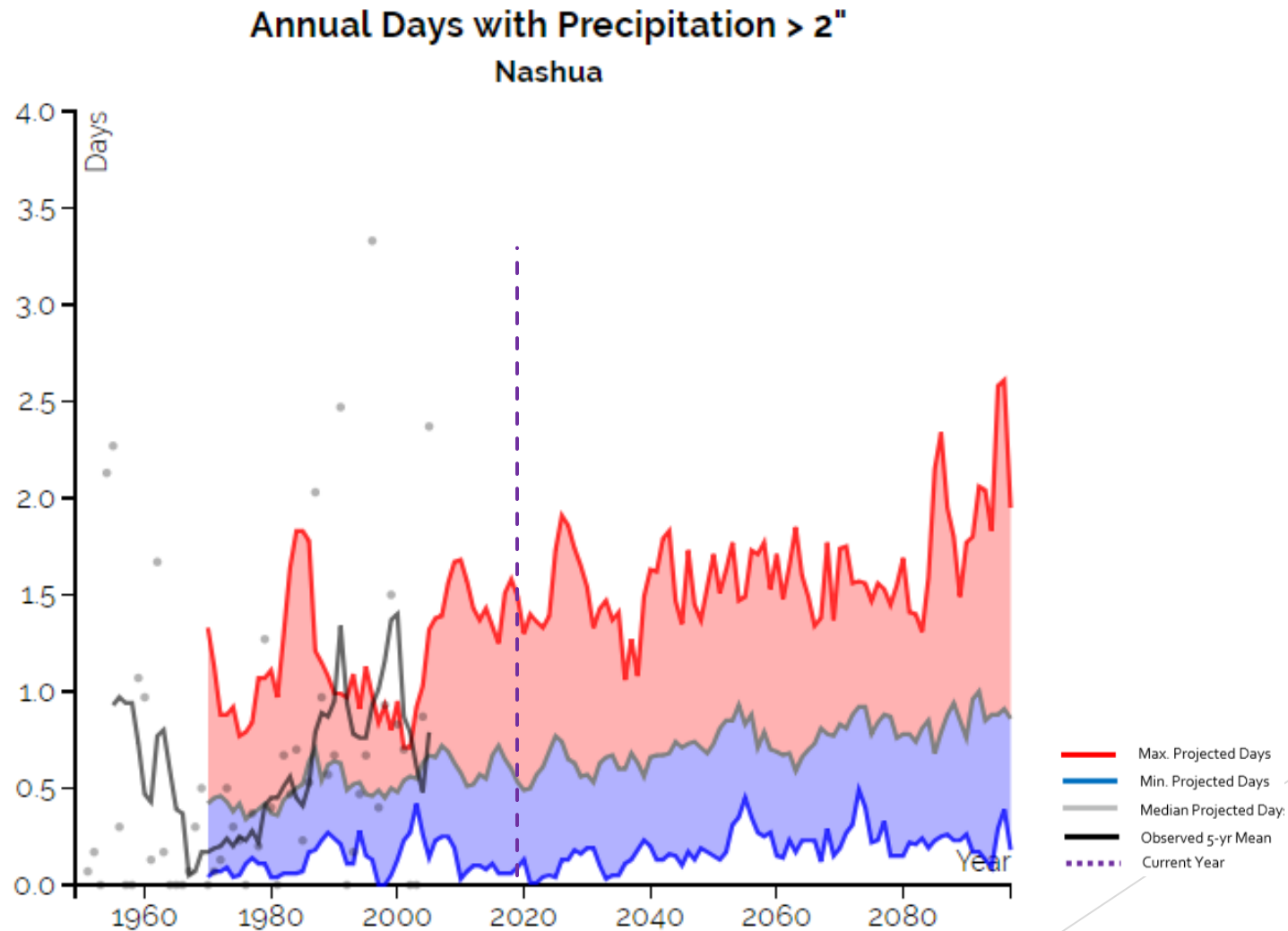
- Expected decrease of 0.3 to an increase of 2.2 inches by mid-century, and a decrease of 1.1 to an increase of 2.2 inches by the end of the century.

► Fall

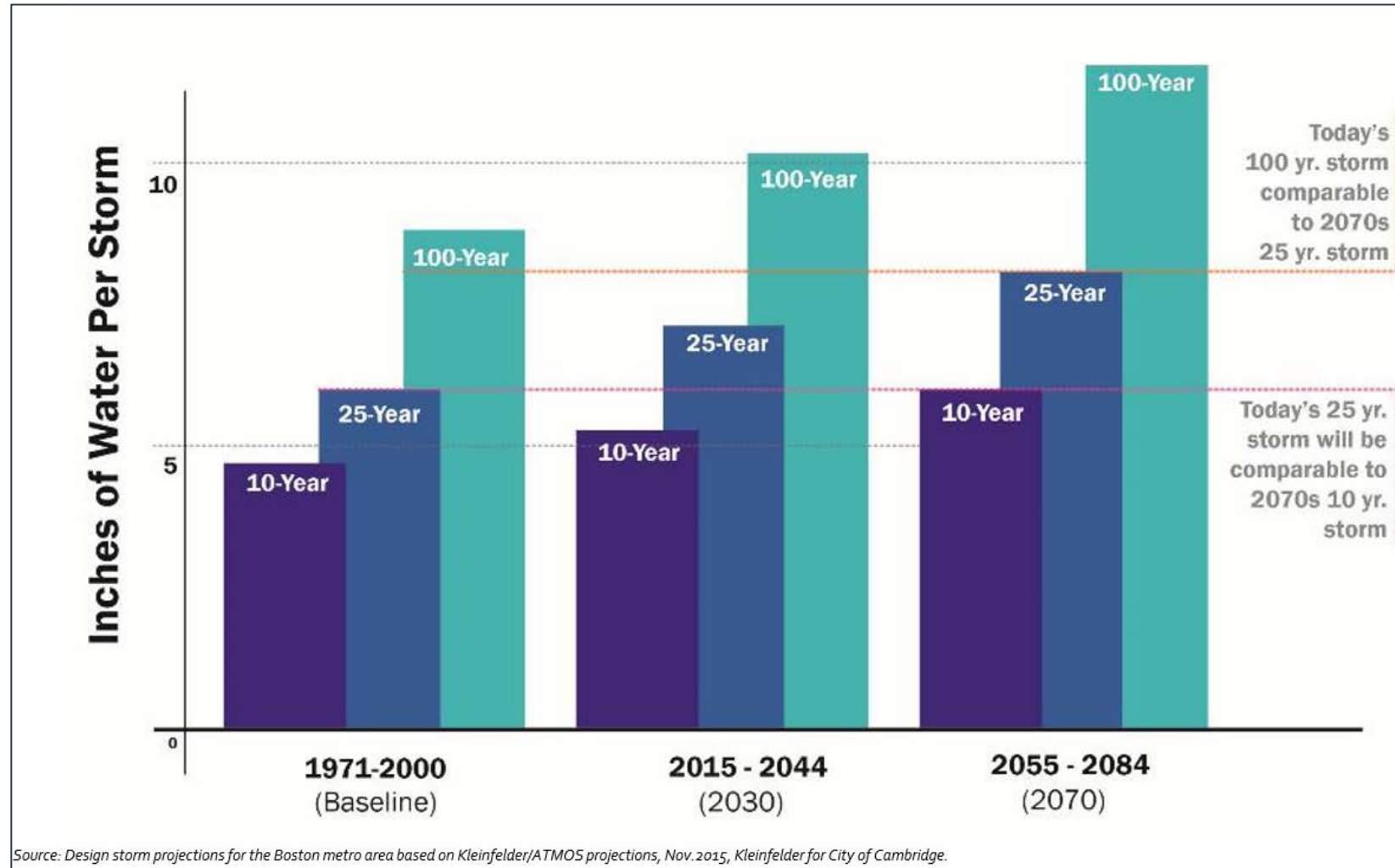
- Expected decrease of 1.2 to an increase of 1.8 inches by mid-century, and a decrease of 1.4 to an increase of 1.5 inches by the end of the century.



Heavy Rainfall and Flooding (2)



Heavy Rainfall and Flooding (2)



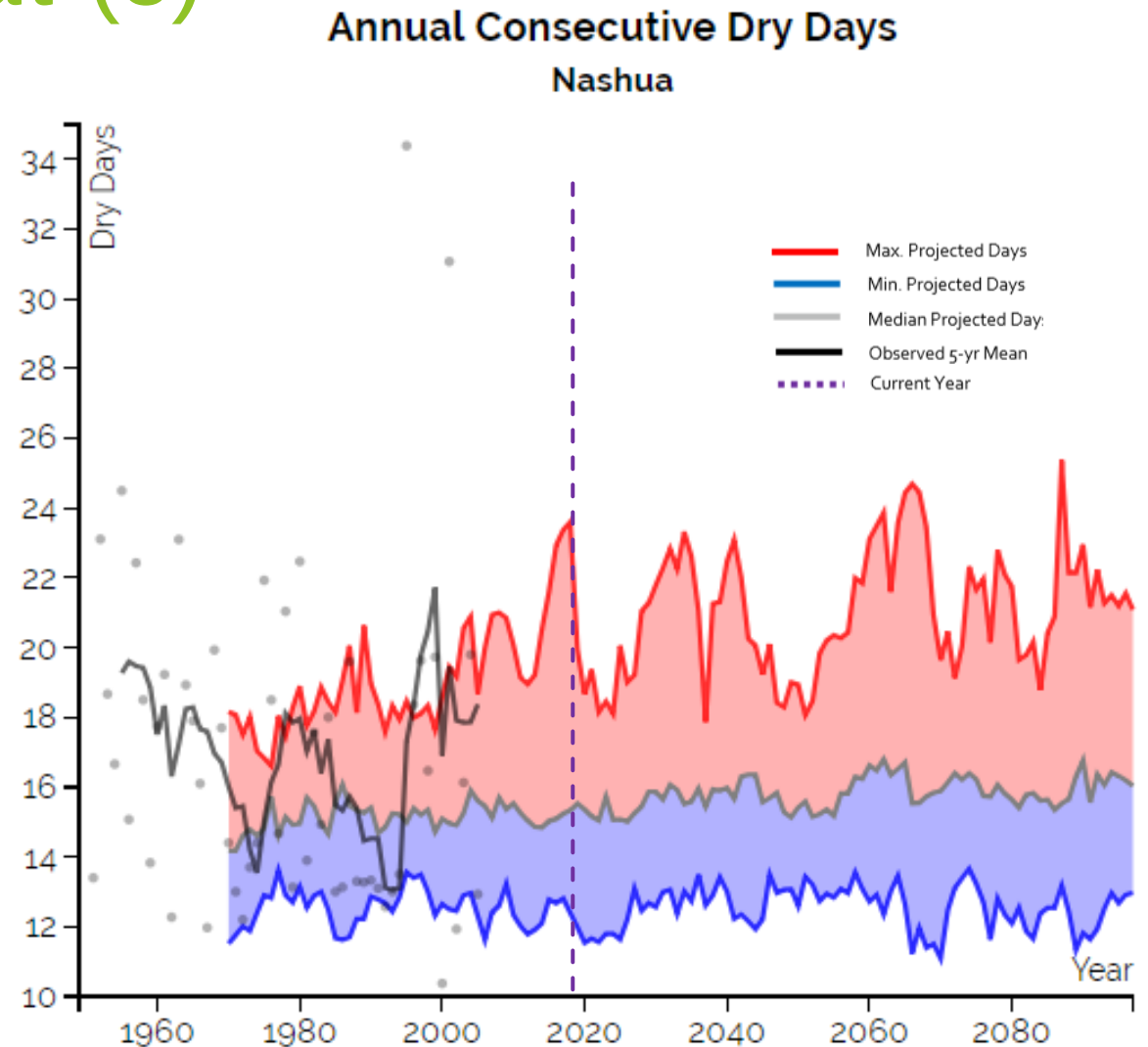
Impacts of Increased Precipitation

- ▶ Frequency of minor but disruptive flooding events especially in areas with undersize SW infrastructure
- ▶ More intense downpours cause inland flooding
 - ▶ Soils become saturated
 - ▶ River flows rise
 - ▶ Capacity of urban SW infrastructure is exceeded
- ▶ Frequency of high-intensity rainfall events trending upward
 - ▶ Impacts to property and critical infrastructure
- ▶ Non-point source pollution
 - ▶ Ecological damage to nearby waterbodies



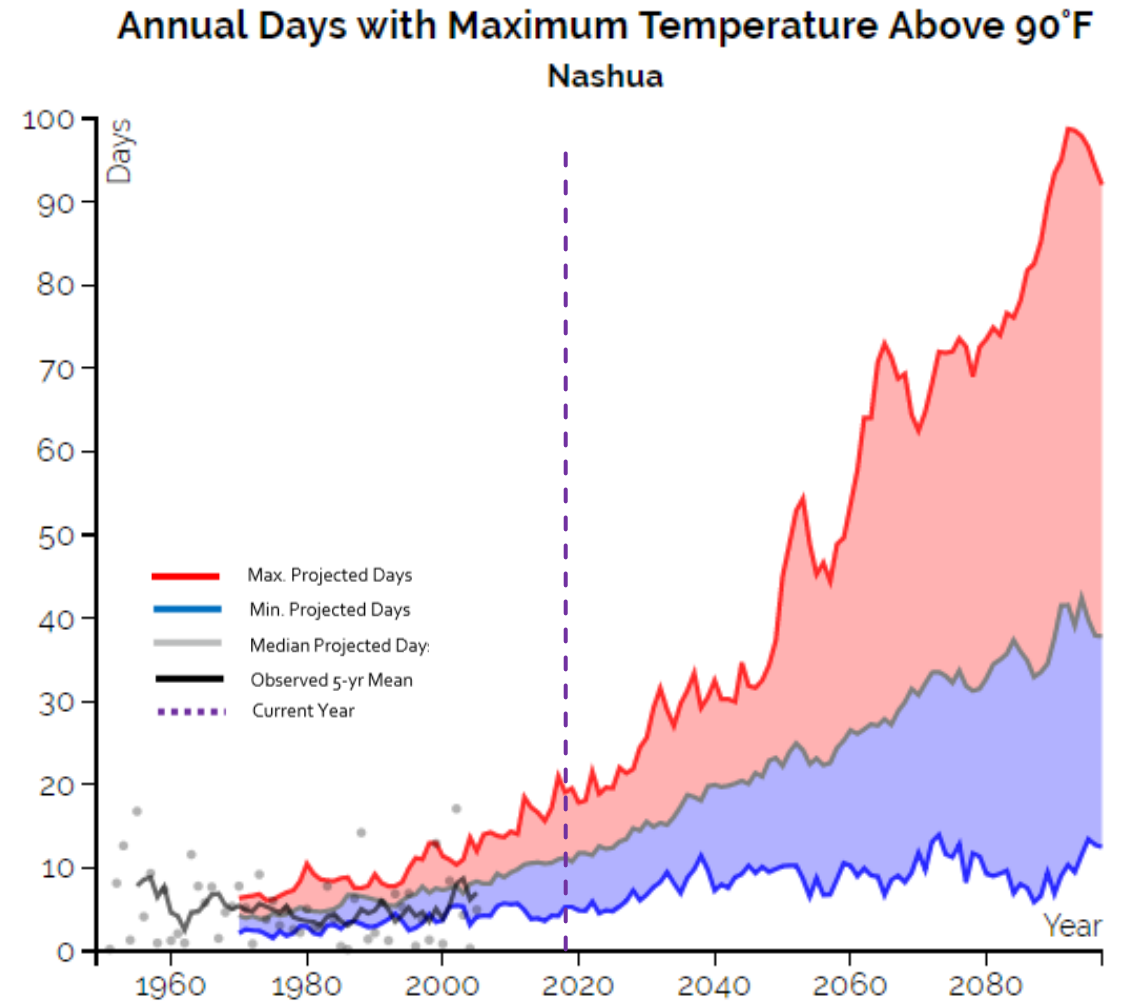
Drought, Wildfire, Heat (3)

- ▶ Consecutive dry days
 - ▶ For a given period, the largest number of consecutive days with precipitation less than 1 mm
- ▶ Fall and summer seasons are expected to experience the highest number of consecutive dry days.
- ▶ Fall and summer expected increase of 3 days in consecutive dry days by the end of the century



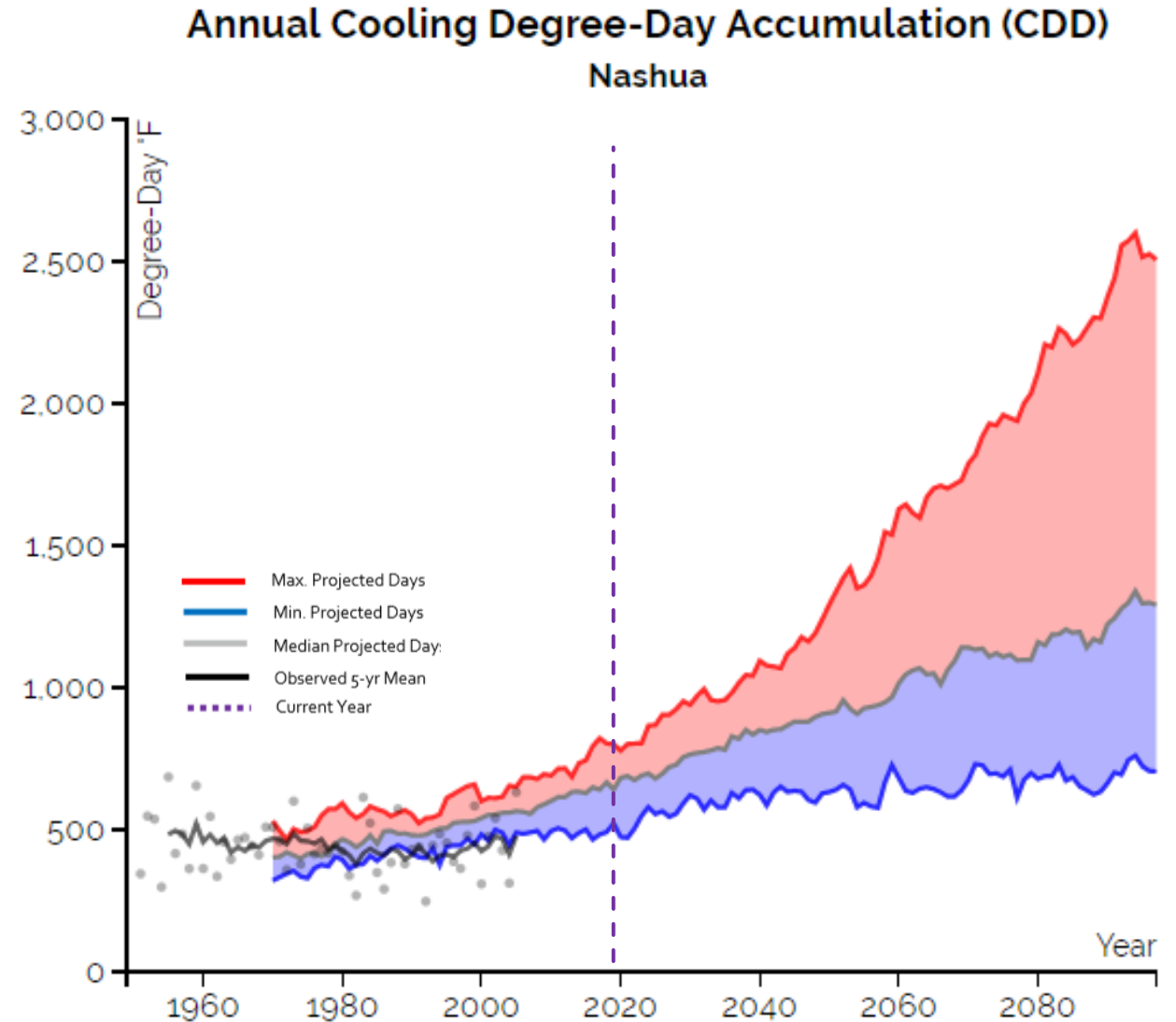
Drought, Wildfire, Heat (3)

- ▶ Projected increase of 9 to 30 days annually with temps over 90 °F by mid century
- ▶ Projected increase of 13 to 70 days annually with temps over 90 °F by end of century
- ▶ Summer is expected to see an increase of 8 to 26 more days with daily maximums over 90 °F by mid-century.
- ▶ Summer is expected to see an increase of 11 to 56 more days with daily maximums over 90 °F by end of century.
- ▶ Heat-related illness and mortality show a marked increase above 90 °F



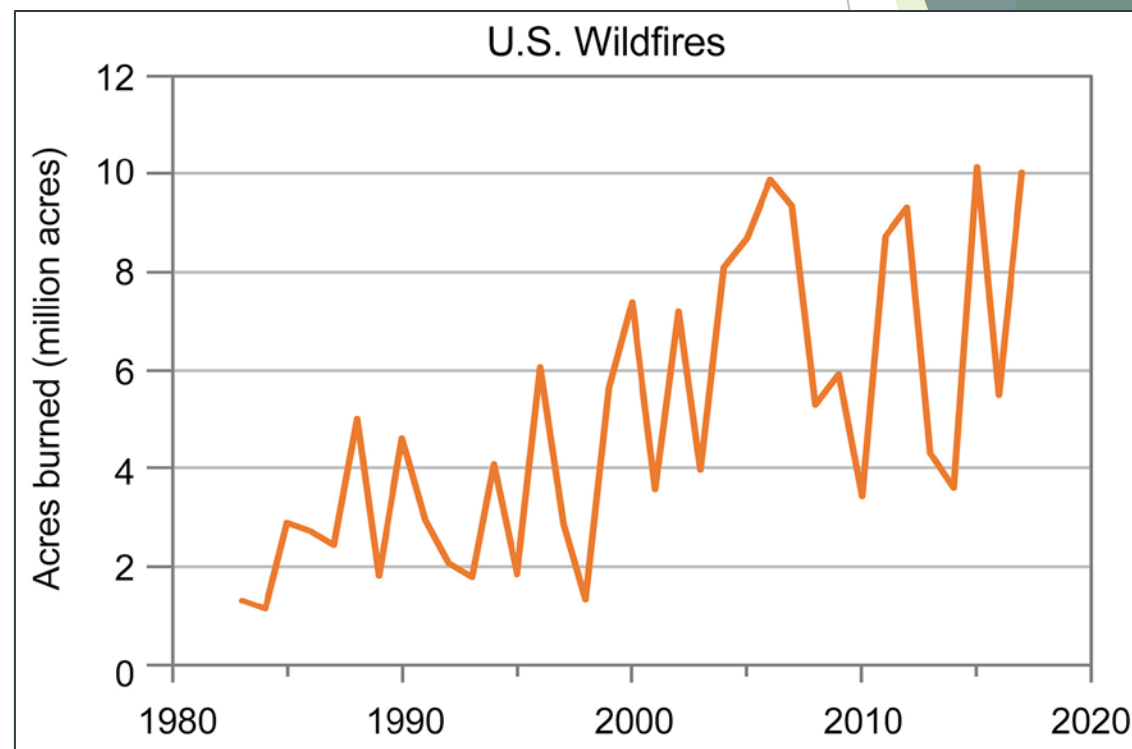
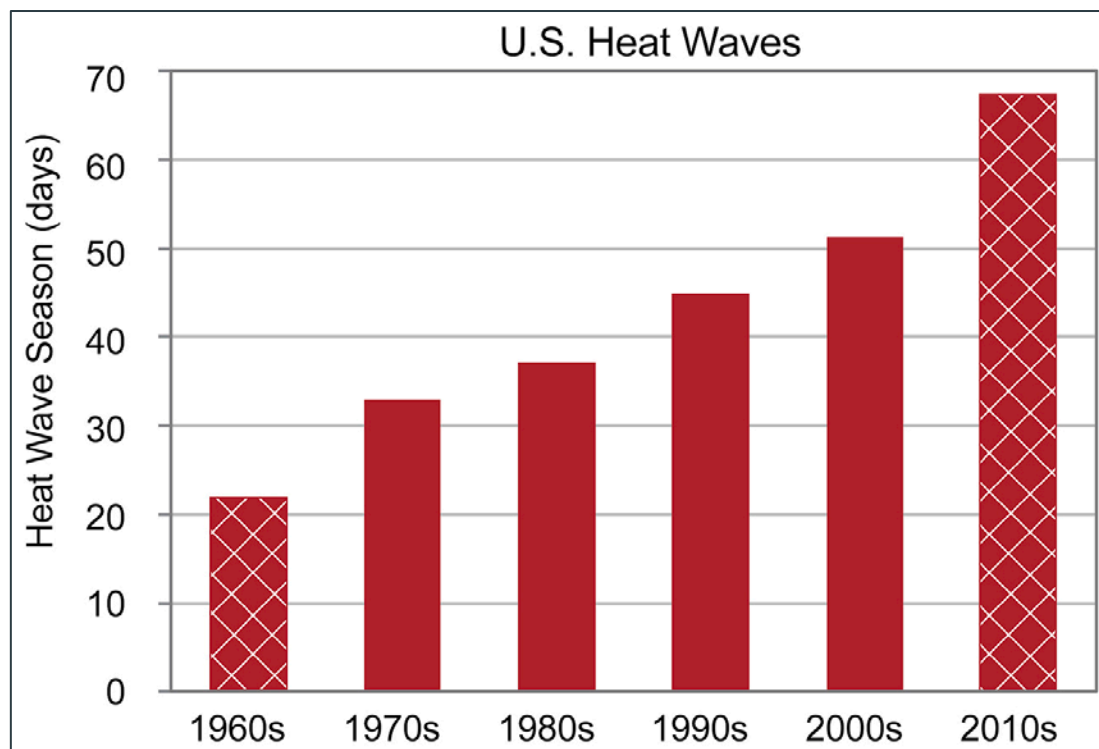
Drought, Wildfire, Heat (3)

- ▶ Projected decrease in heating degree-days and increase in cooling-degree days
- ▶ Winter
 - ▶ 7-19% increase in HDD by mid century
 - ▶ 10-27% increase in HDD by end of century
- ▶ Spring
 - ▶ 12-25% increase in HDD by mid century
 - ▶ 16-40% increase in HDD by end of century
- ▶ Fall
 - ▶ 20-33% increase in HDD by mid century
 - ▶ 20-53% increase in HDD by end of century



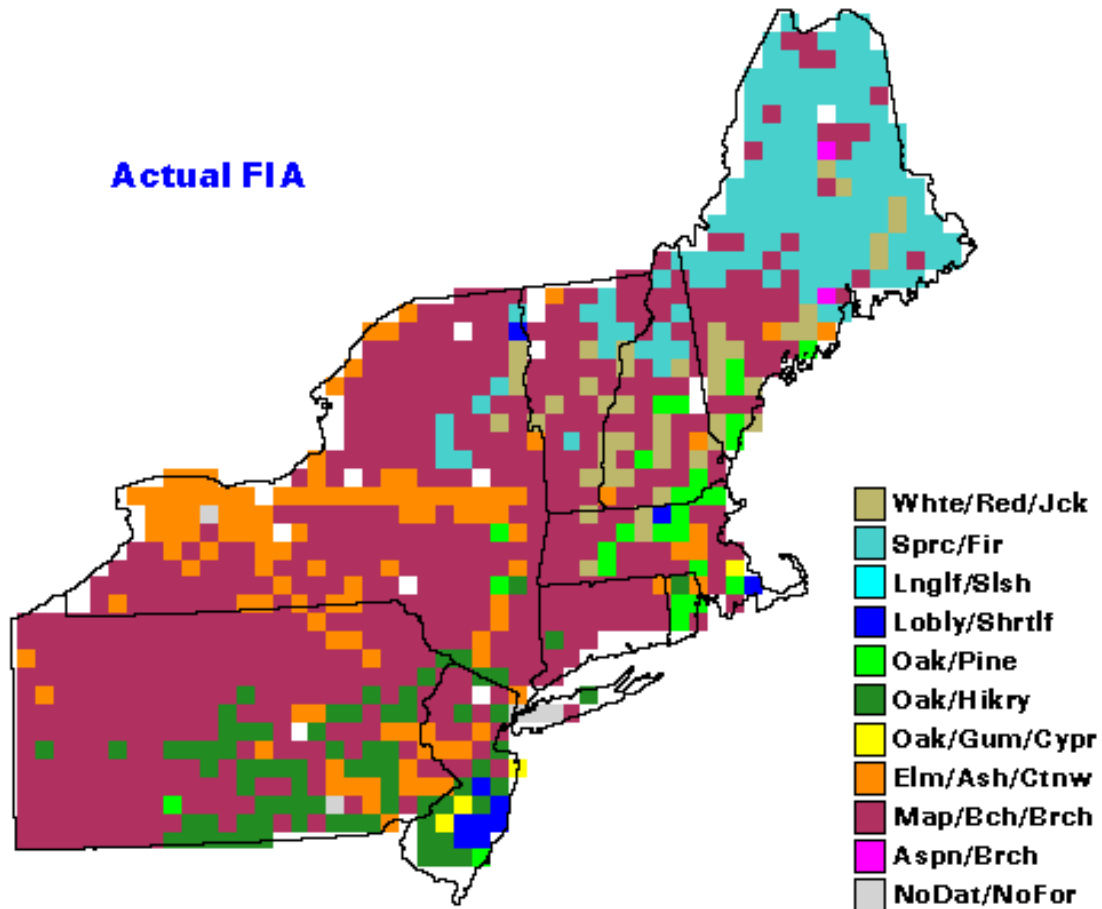
Drought, Wildfire, Heat (3)

Nation-Wide Data

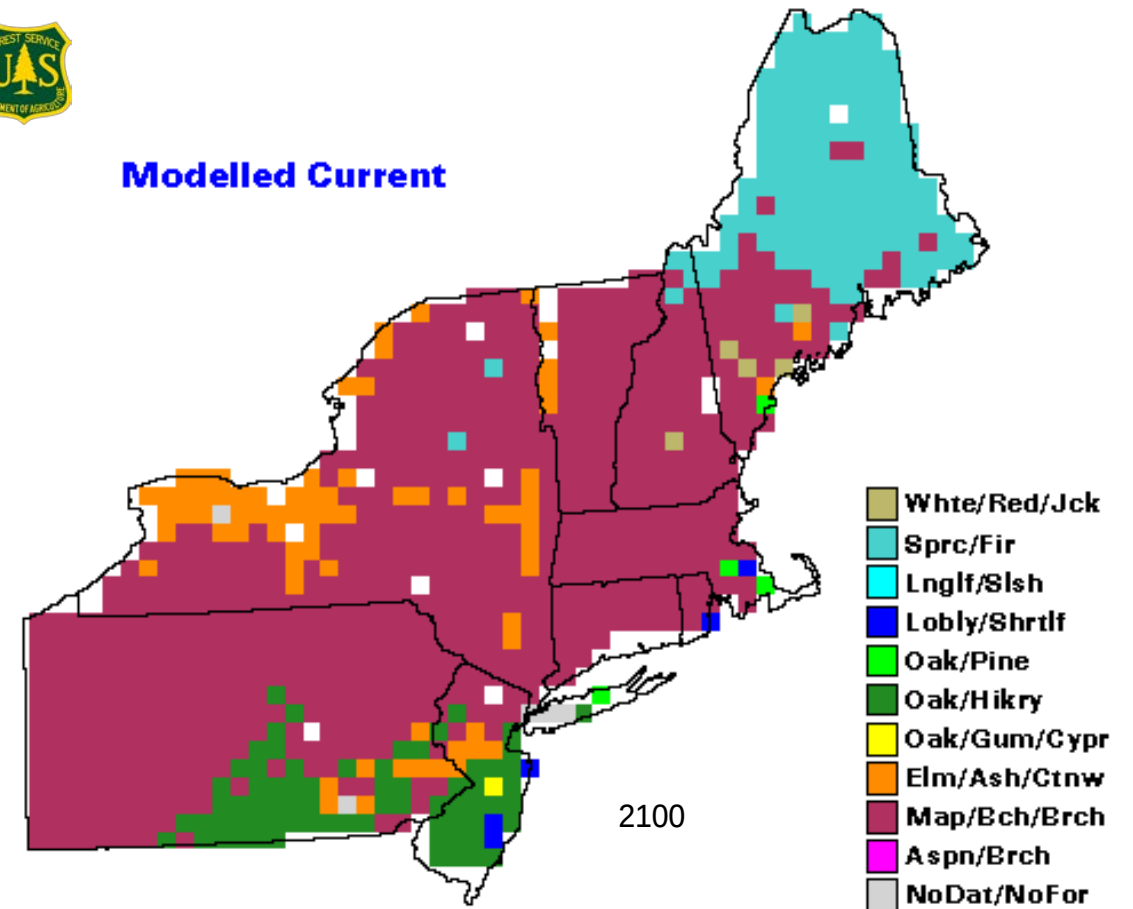


Change in Forest Cover

Actual FIA

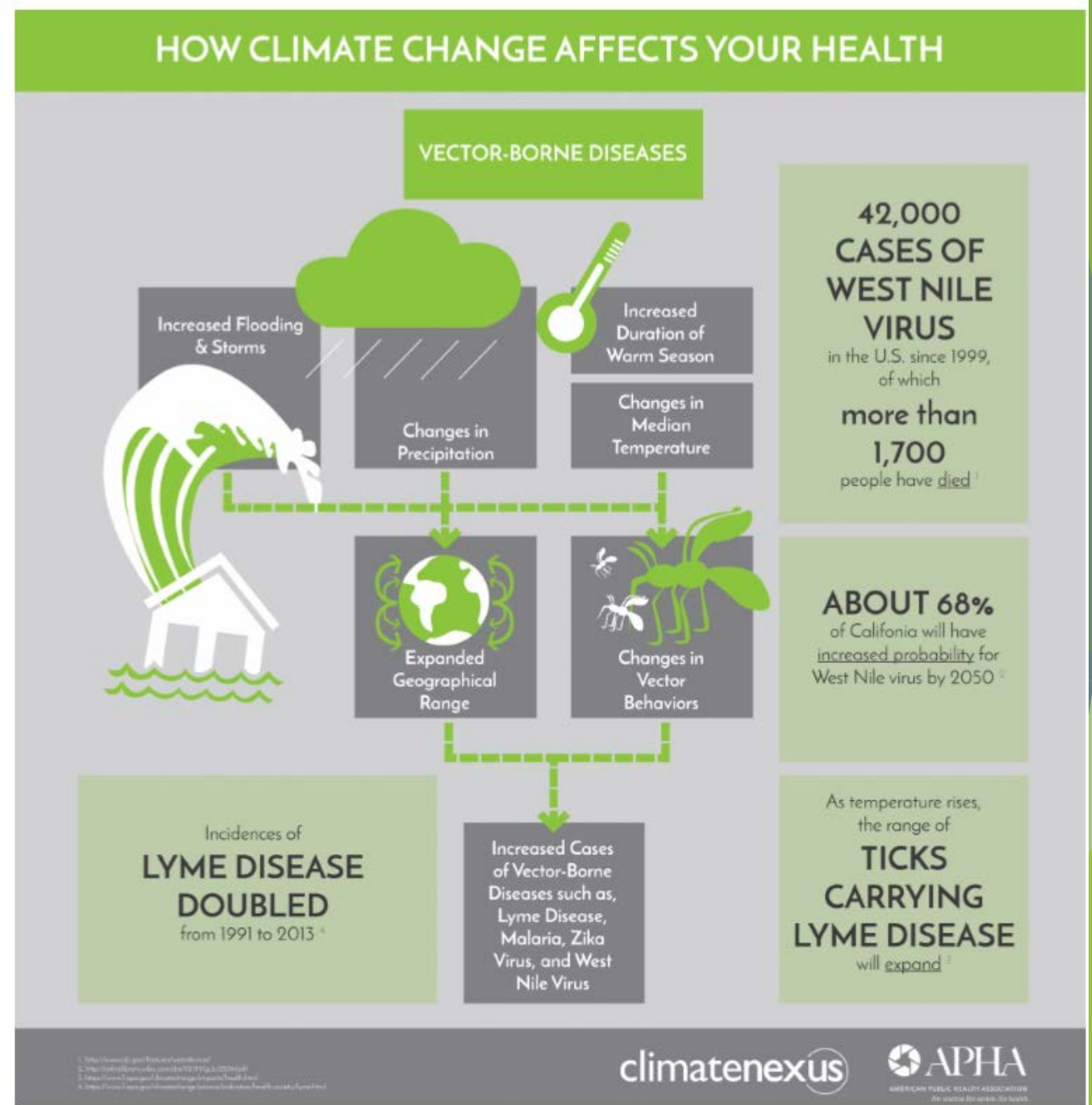


Modelled Current



Impacts of Hotter Temps

- ▶ Health impacts on vulnerable populations
- ▶ Higher cooling costs
- ▶ Urban heat island
- ▶ Detrimental to crops and livestock
- ▶ Impact on native species
- ▶ Impact on invasives and pests



Nature Based Solutions

Natural systems, mimic natural processes, or work in tandem with traditional approaches

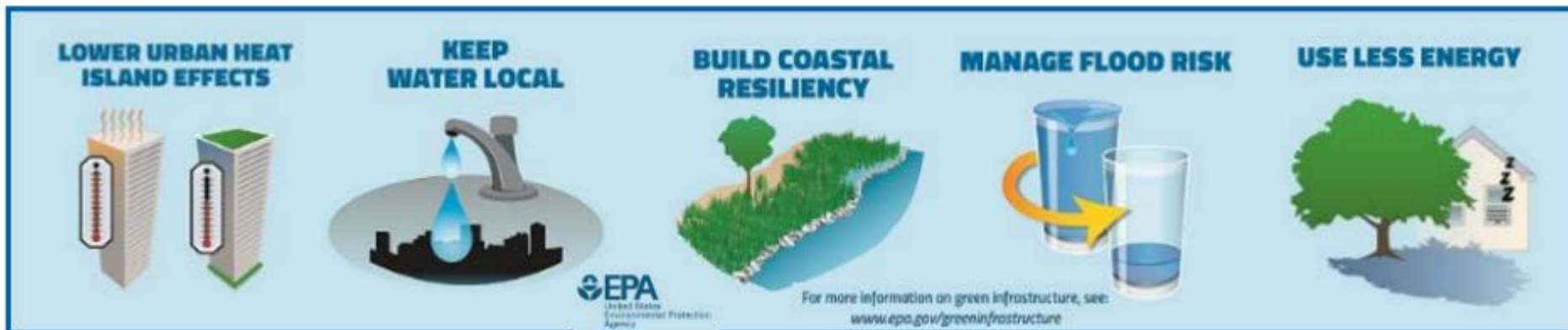


Integrate low impact development (LID) designs into new development at neighborhood scales



Benefits of Green Infrastructure and LID

- ▶ Cost Savings
 - ▶ Reduced development costs for infrastructure and maintenance
 - ▶ Reduced energy costs for residents
- ▶ Public Safety
 - ▶ Reduced flooding
 - ▶ Improved water quality
 - ▶ Increased climate change resiliency
 - ▶ Reduced urban heat island effect
- ▶ Quality of Life
 - ▶ Protect and restore natural features for improved aesthetics
- ▶ Value
 - ▶ Increased property values
- ▶ Regulatory
 - ▶ Assistance in meeting regulatory requirements



Return on Investment Studies in MA

Dept. Ecological Restoration

Traditional Culvert



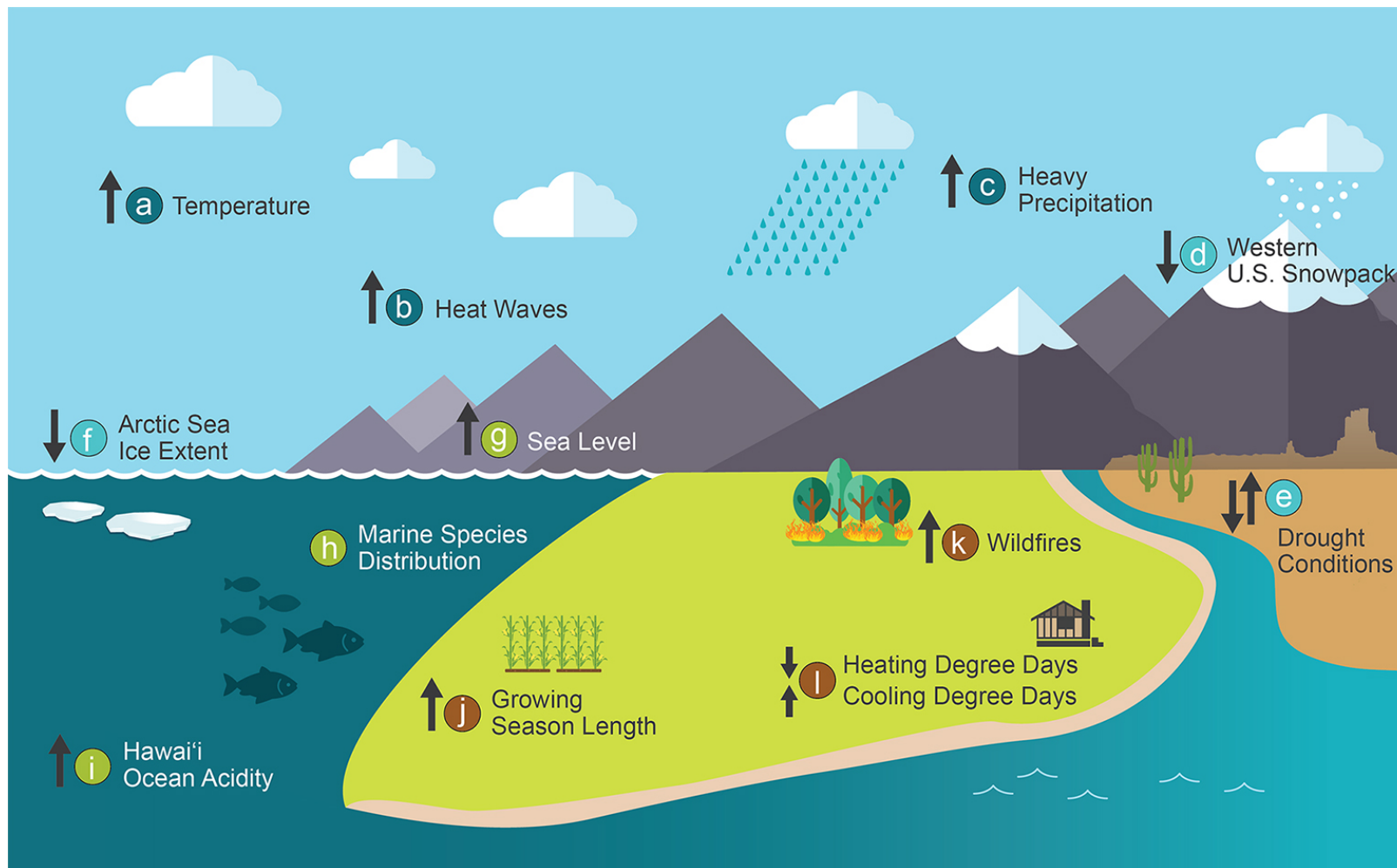
Nature Based Culvert



Culvert and Small Bridge Working Group

- ▶ Seeking Input:
 - ▶ What challenges have you faced in repairing or replacing culverts and/or small bridges in your communities?
 - ▶ What opportunities do you see for improvements to engineering standards, permitting processes, or funding availability for these types of projects?
- ▶ Comments, suggestions, and responses to the above questions regarding culvert or small bridge repair or replacement should be sent to massdotenvironmental@dot.state.ma.us by May 24, 2019. Please include “Culvert Working Group” in the subject line of the email.

Questions?



Eli Goldman
egoldman@cmrpc.org

West Boylston: Natural Hazards, Critical Infrastructure and Facilities, and Vulnerable Populations

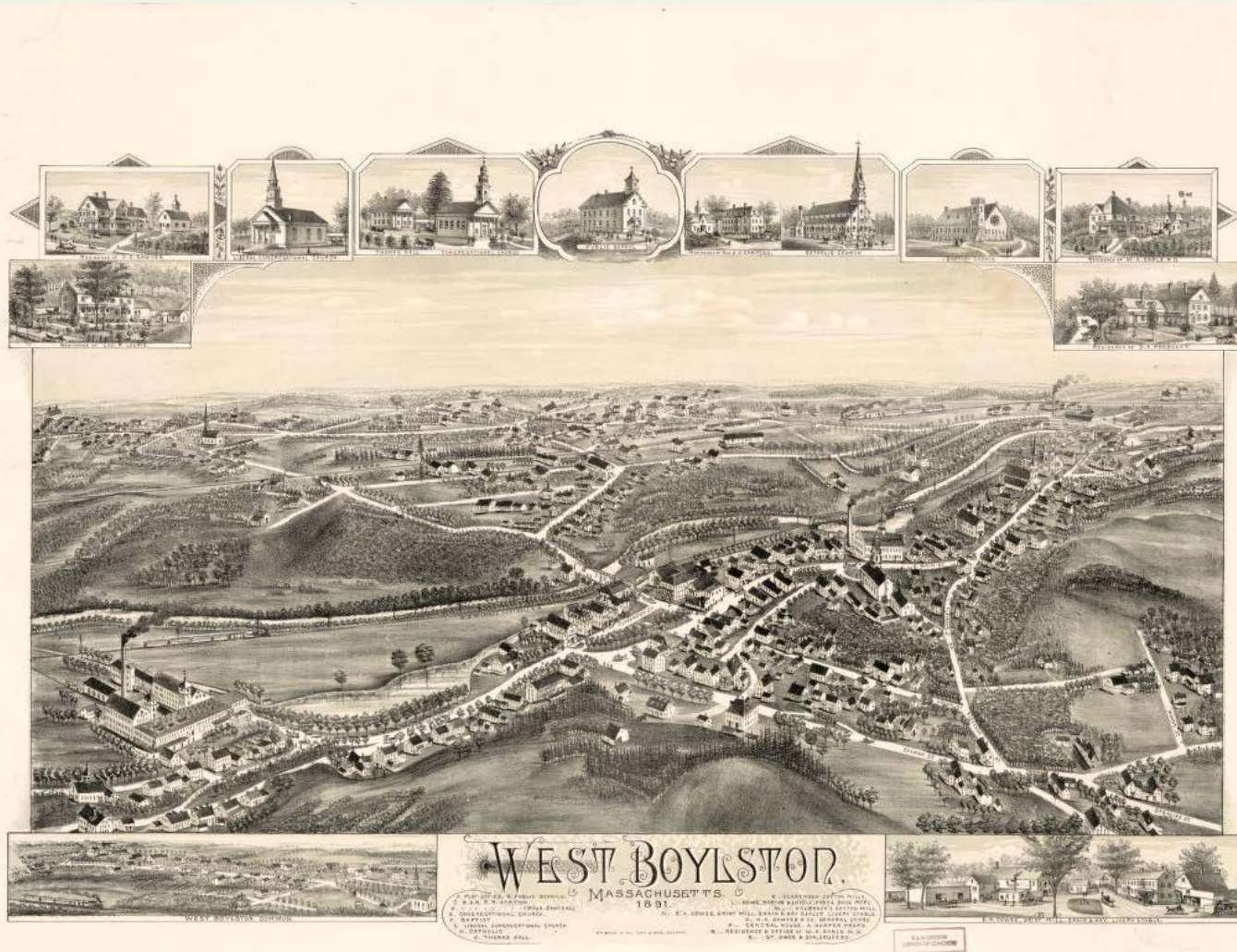
- Natural hazards
 - *Critical infrastructure and facilities*
 - *Vulnerable populations*

Natural Hazards

- Flooding (all types)
- Droughts and wildfires
- Winter storms
- Severe thunderstorms/hurricanes/wind/tornadoes

- Extreme temperatures
- Landslides
- Earthquakes

Natural Hazards: Flood Risks



Images courtesy Library of Congress, Beaman Library



WB bridge destroyed by flood, 1900



WB mill destroyed by flood, 1902

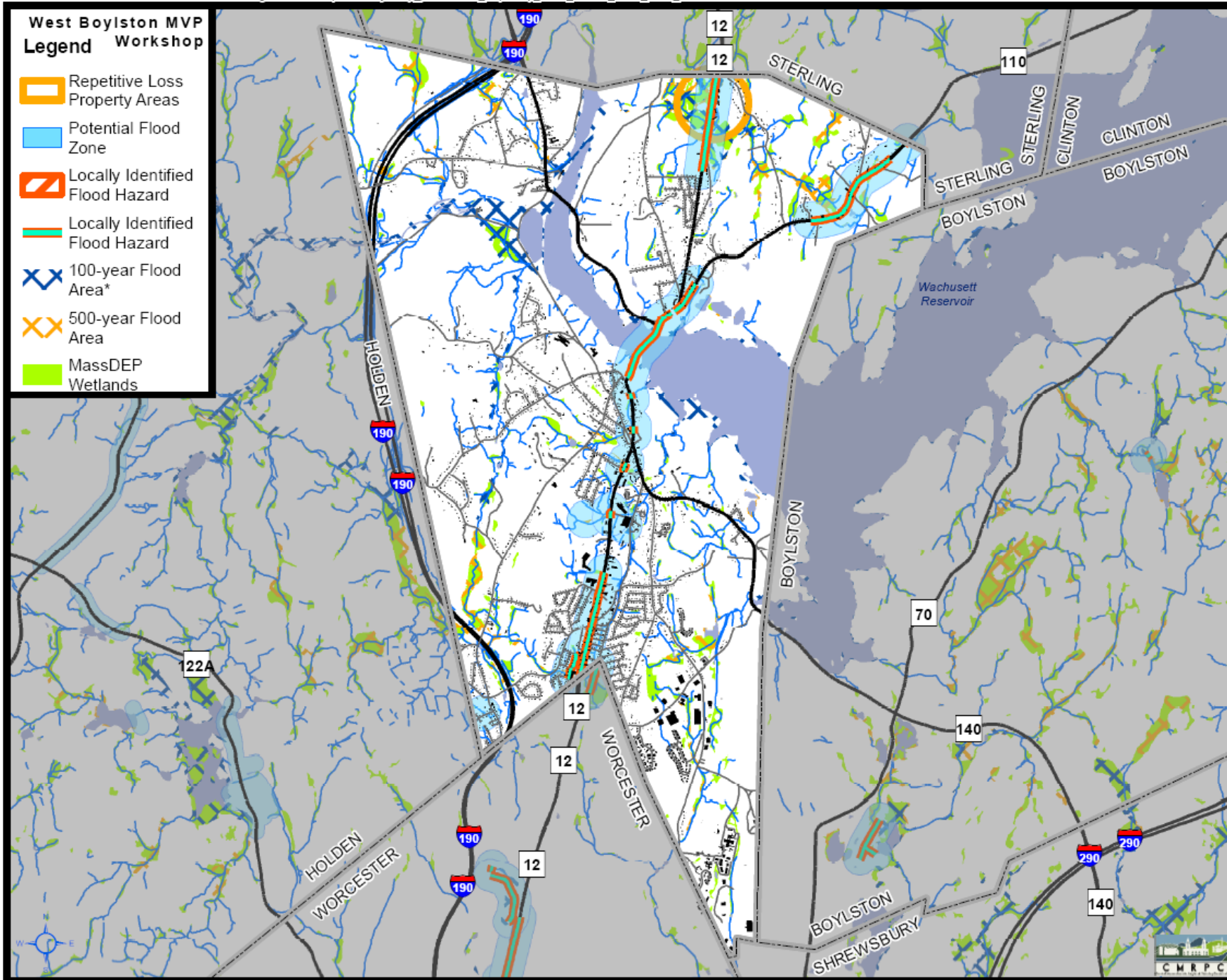


Main St., Clinton, 2010



Natural Hazards: Flood Risks

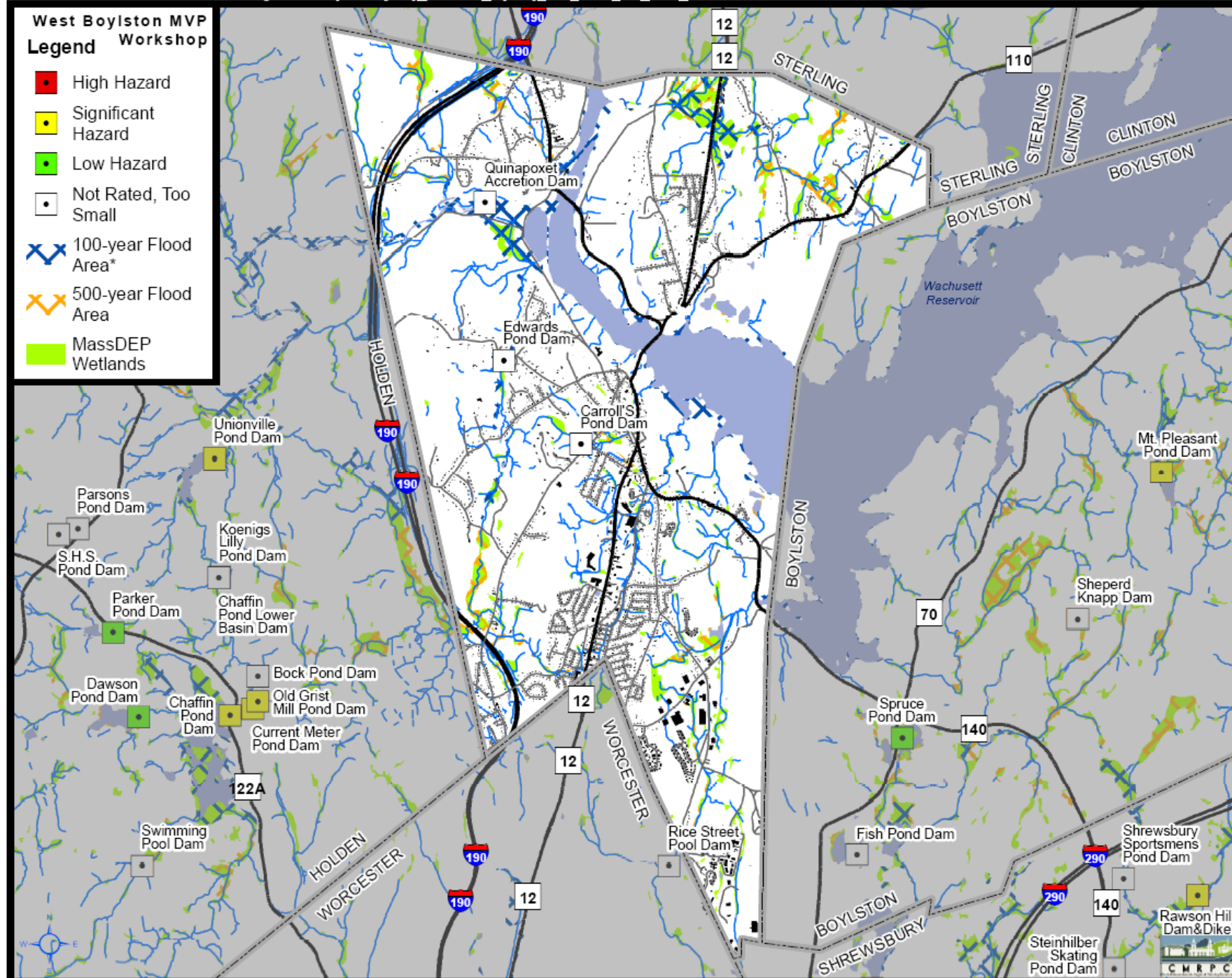
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Source: Data provided by the Town of West Boylston, CMRPC, MassDOT, MassGIS. Information depicted on this map is for planning purposes only.

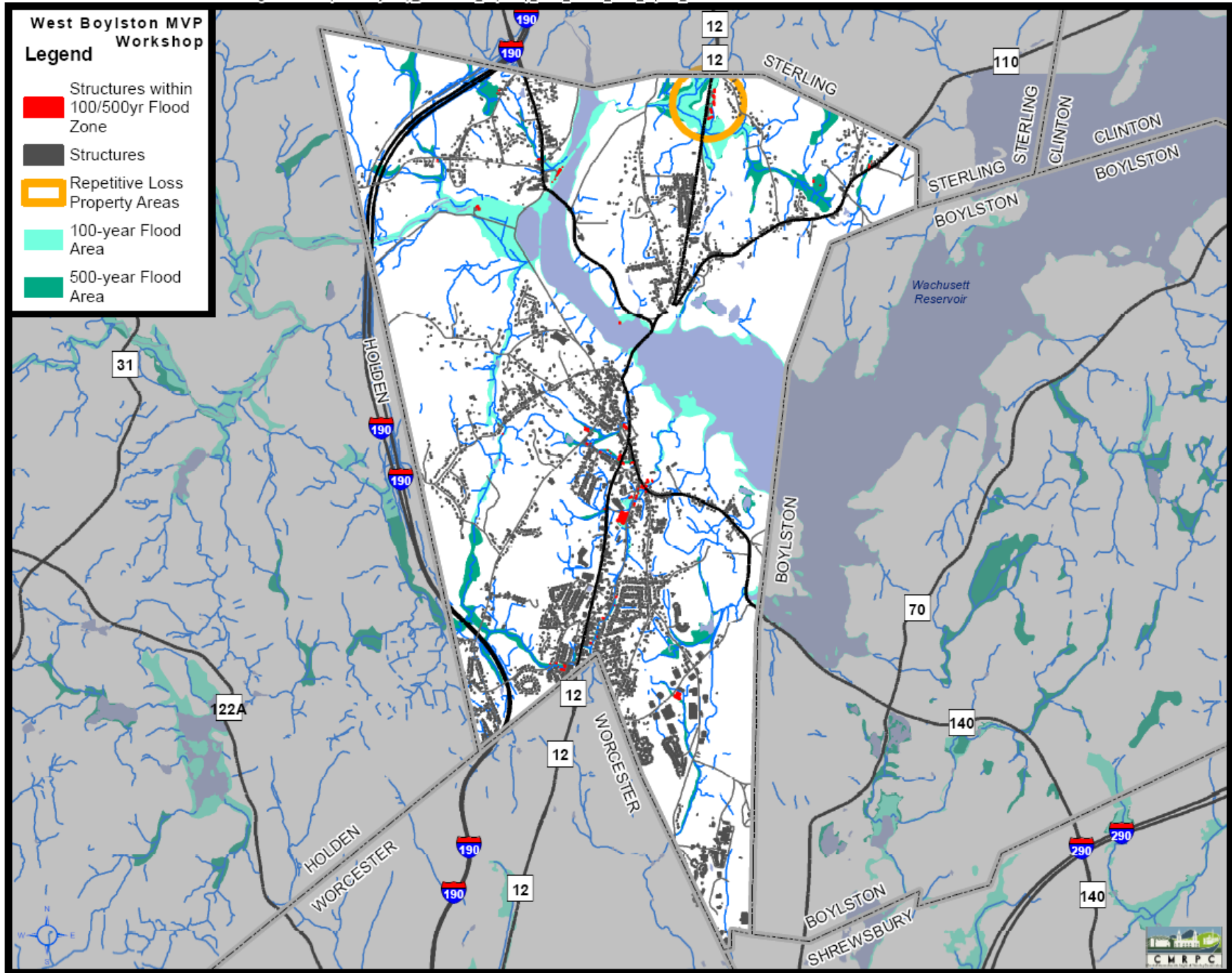
Natural Hazards: Dam Failure Risk

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Natural Hazards: Flood Impacts

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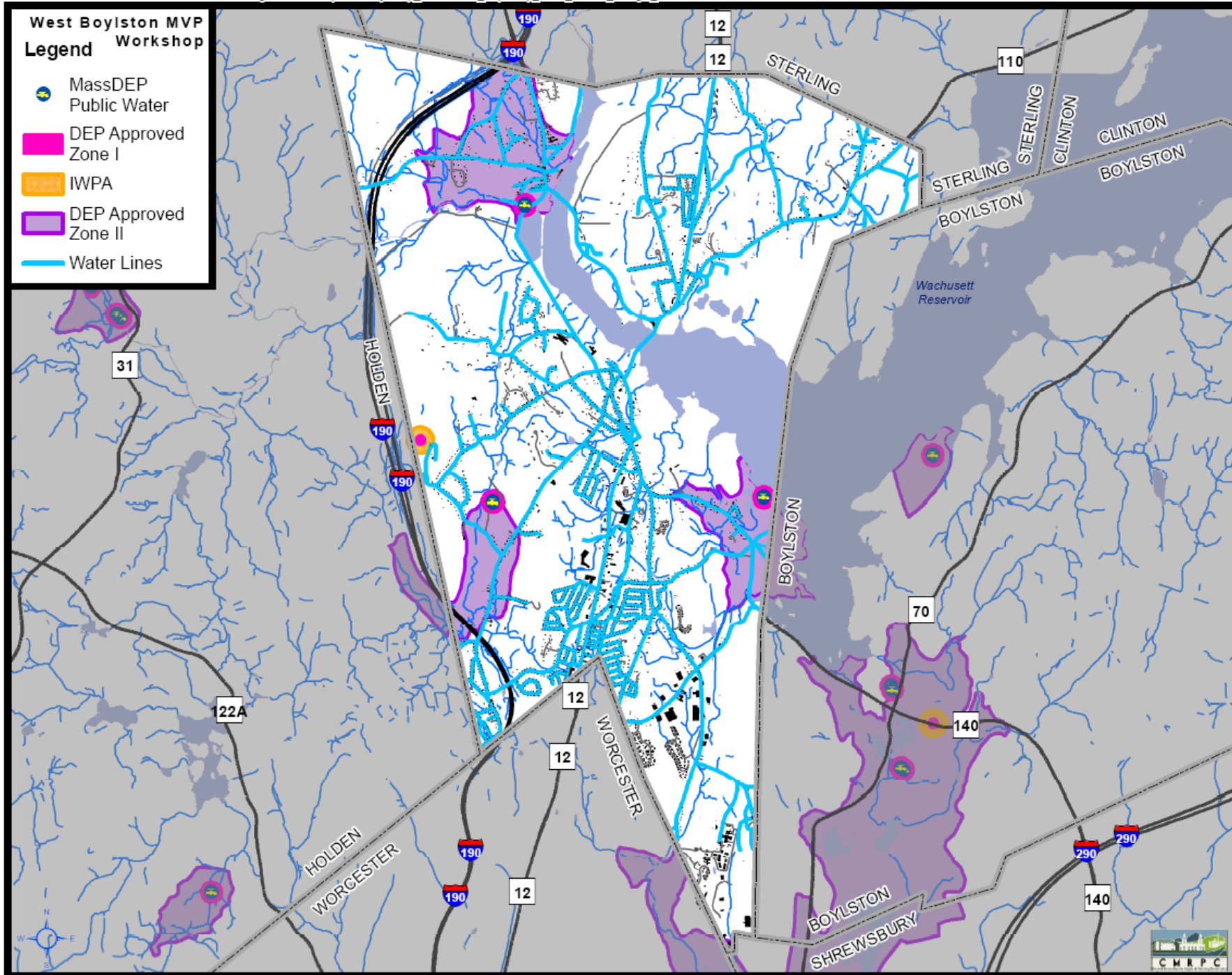


Source: Data provided by the Town of West Boylston, CMRPC, MassDOT, MassGIS. Information depicted on this map is for planning purposes only.



Natural Hazards: Droughts & Water Systems

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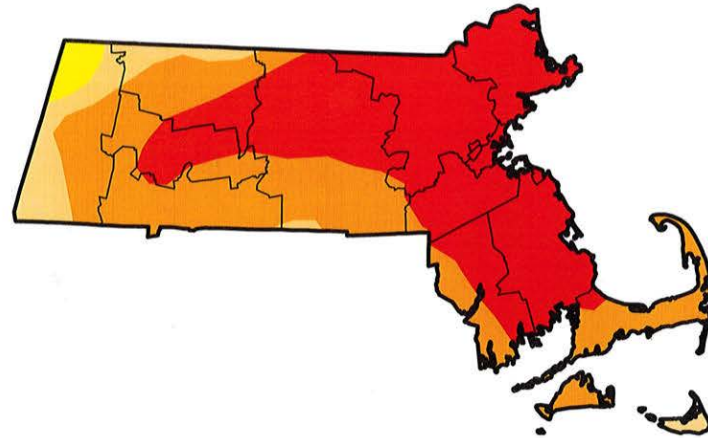


Source: Data provided by the town of West Boylston, CMRPC, MassDOT, MassGIS. Information depicted on this map is for planning purposes only.



Natural Hazards: 2016 Drought

U.S. Drought Monitor Massachusetts



September 13, 2016

(Released Thursday, Sep. 15, 2016)

Valid 8 a.m. EDT

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.00	100.00	98.15	89.95	52.13	0.00
Last Week 9/6/2016	0.00	100.00	94.38	77.38	22.67	0.00
3 Months Ago 6/14/2016	20.09	79.91	13.56	0.00	0.00	0.00
Start of Calendar Year 12/29/2015	22.85	77.15	26.34	0.00	0.00	0.00
Start of Water Year 9/29/2015	12.90	87.10	30.43	0.00	0.00	0.00
One Year Ago 9/15/2015	34.81	65.19	0.23	0.00	0.00	0.00

Intensity:

D0 Abnormally Dry	D3 Extreme Drought
D1 Moderate Drought	D4 Exceptional Drought
D2 Severe Drought	

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Author:

Eric Luebehusen

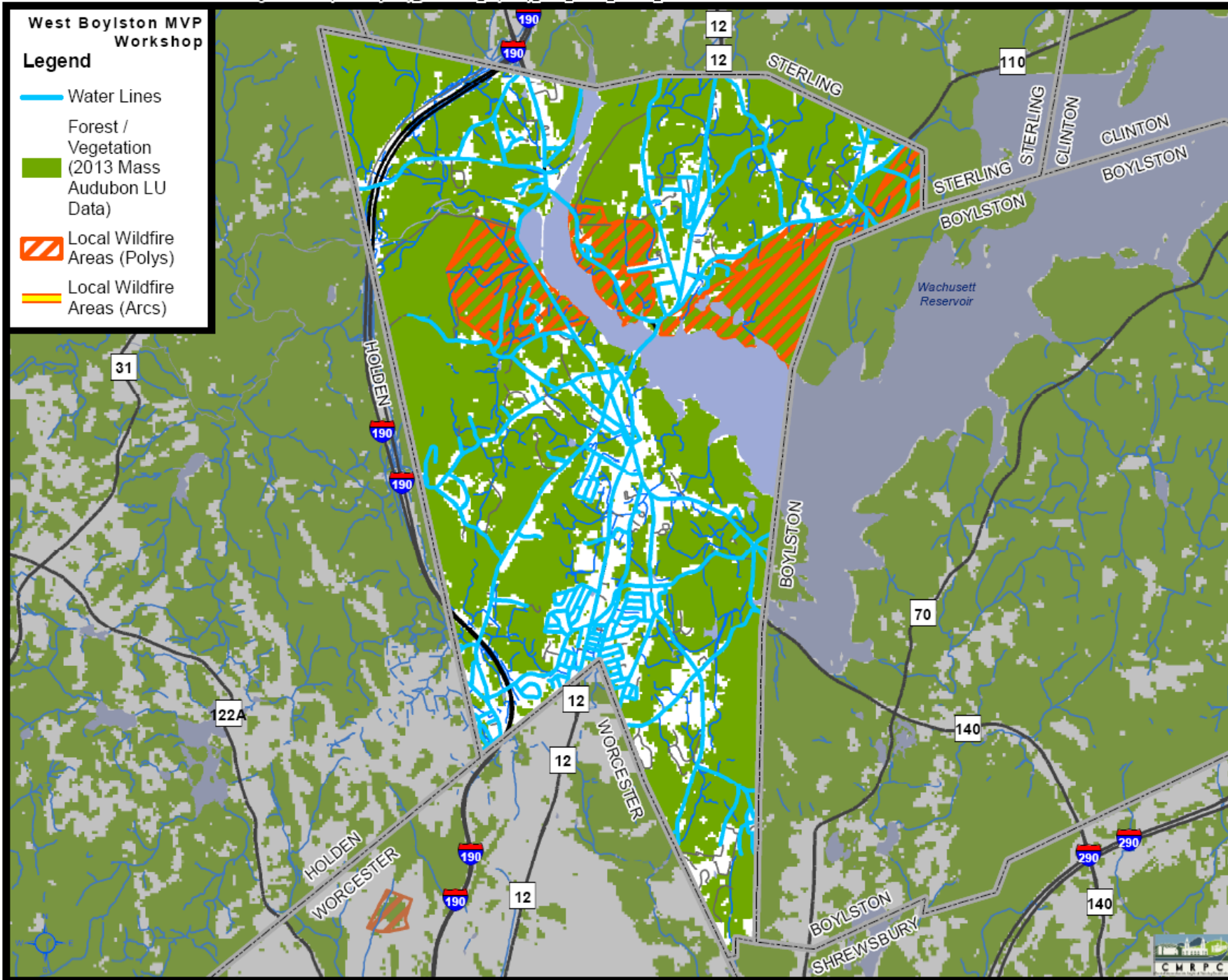
U.S. Department of Agriculture



<http://droughtmonitor.unl.edu/>

Natural Hazards: Wildfires

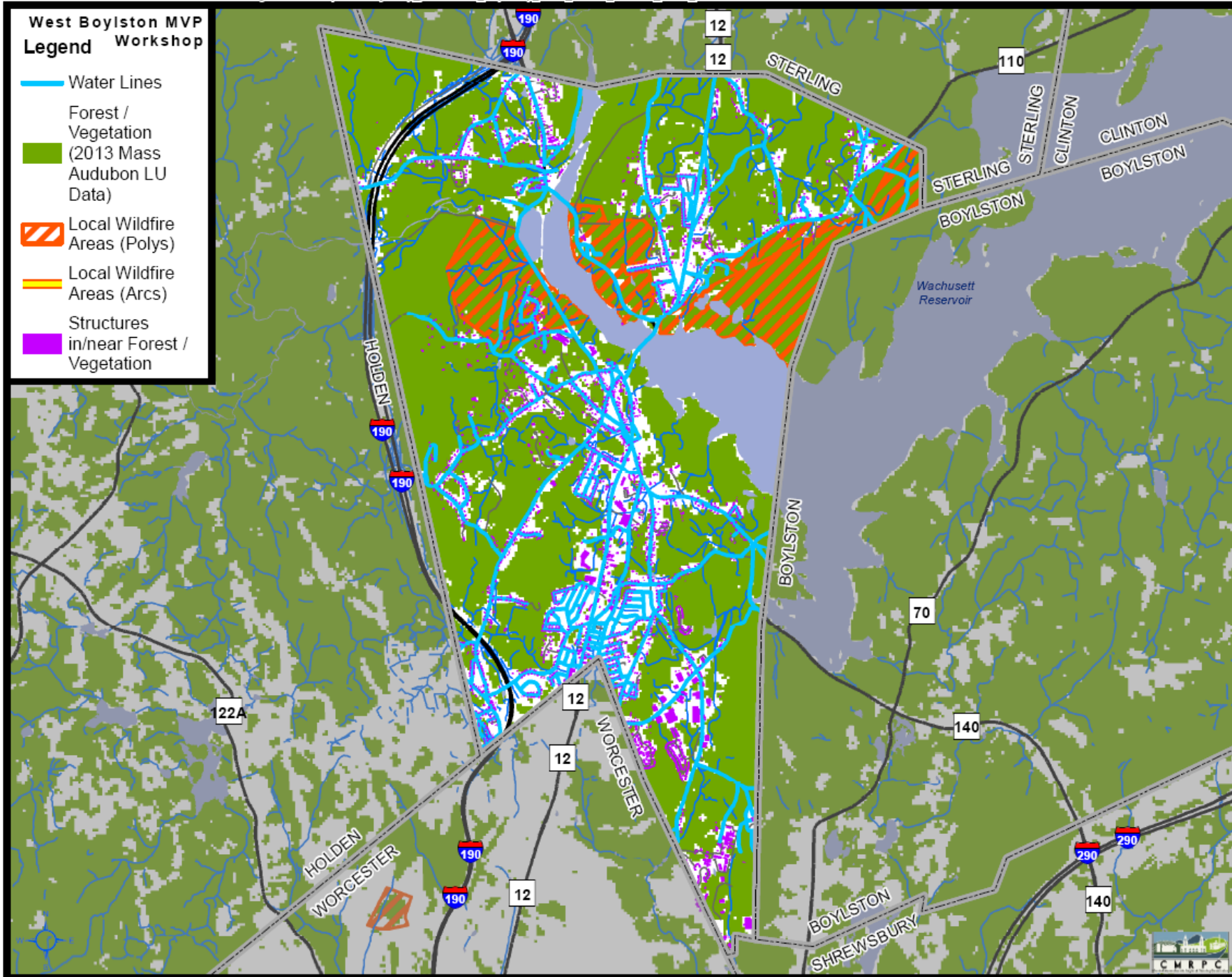
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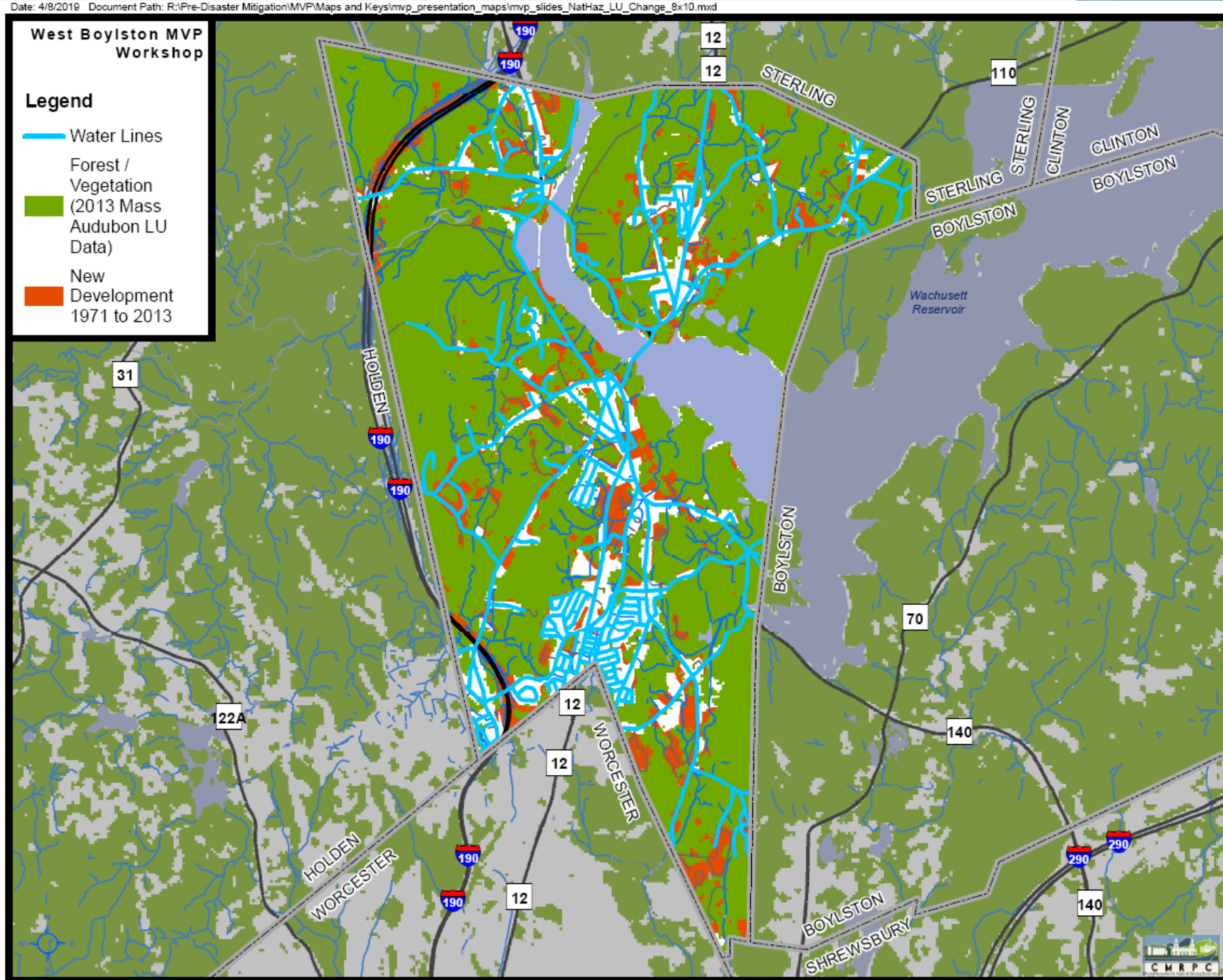
Source: Data provided by the Town of West Boylston, CMRPC, MassDOT, MassGIS. Information depicted on this map is for planning purposes only.

Natural Hazards: Wildland/Urban Interface

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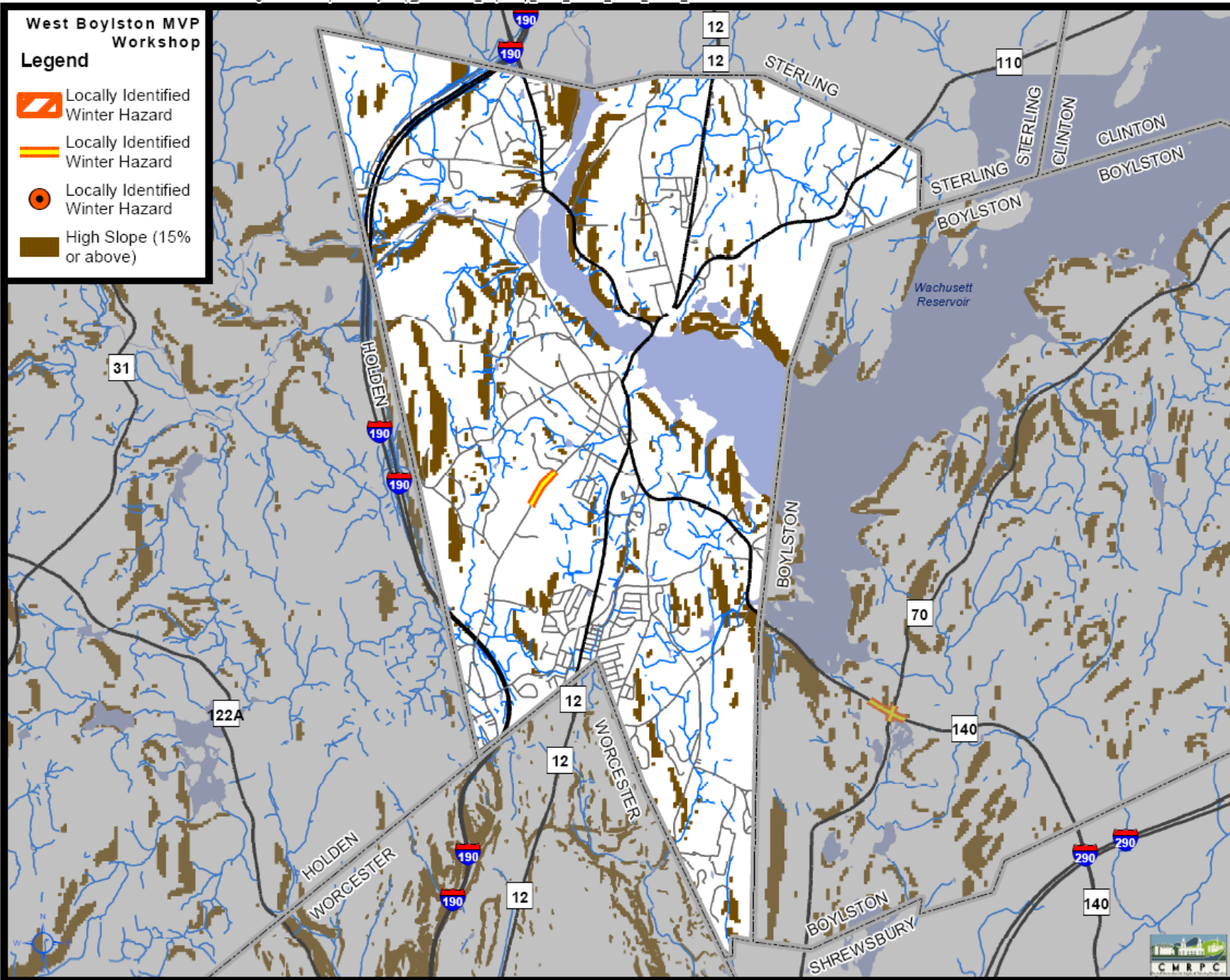


Natural Hazards: Wildfires & New Development



Natural Hazards: Winter Storms

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Source: Data provided by the Town of West Boylston, CMRPC, MassDOT, MassGIS. Information depicted on this map is for planning purposes only.

Natural Hazards: Extreme Storms



Critical Infrastructure & Facilities

- What infrastructure and facilities are critical to the region and its residents? Which do we most need or desire to protect from hazards?
 - Those needed to respond to hazard events or which would exacerbate hazard scenarios, if affected
 - Those needed to perform day-to-day municipal operations and to support basic services and economic activity
 - Major employers and institutions, natural and cultural resources, recreational and historic sites, etc...

Vulnerable Populations

- Vulnerability is not just about utilities, facilities, or businesses
 - Disproportionate populations of potentially vulnerable demographic groups (elderly, children, etc.) or socioeconomic groups (low income households, etc.) living/working in high-risk areas
 - Can be on neighborhood scale, or at specific locations
 - Cultural vulnerability (cultural or language isolation)
 - These will evolve over time, as climate and populations change

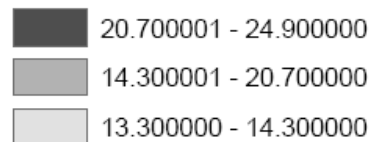
Vulnerable Populations: Seniors

Municipal Vulnerability Preparedness (MVP) Workshop: West Boylston

Percent Seniors 65+

Legend

Percent Seniors 65+



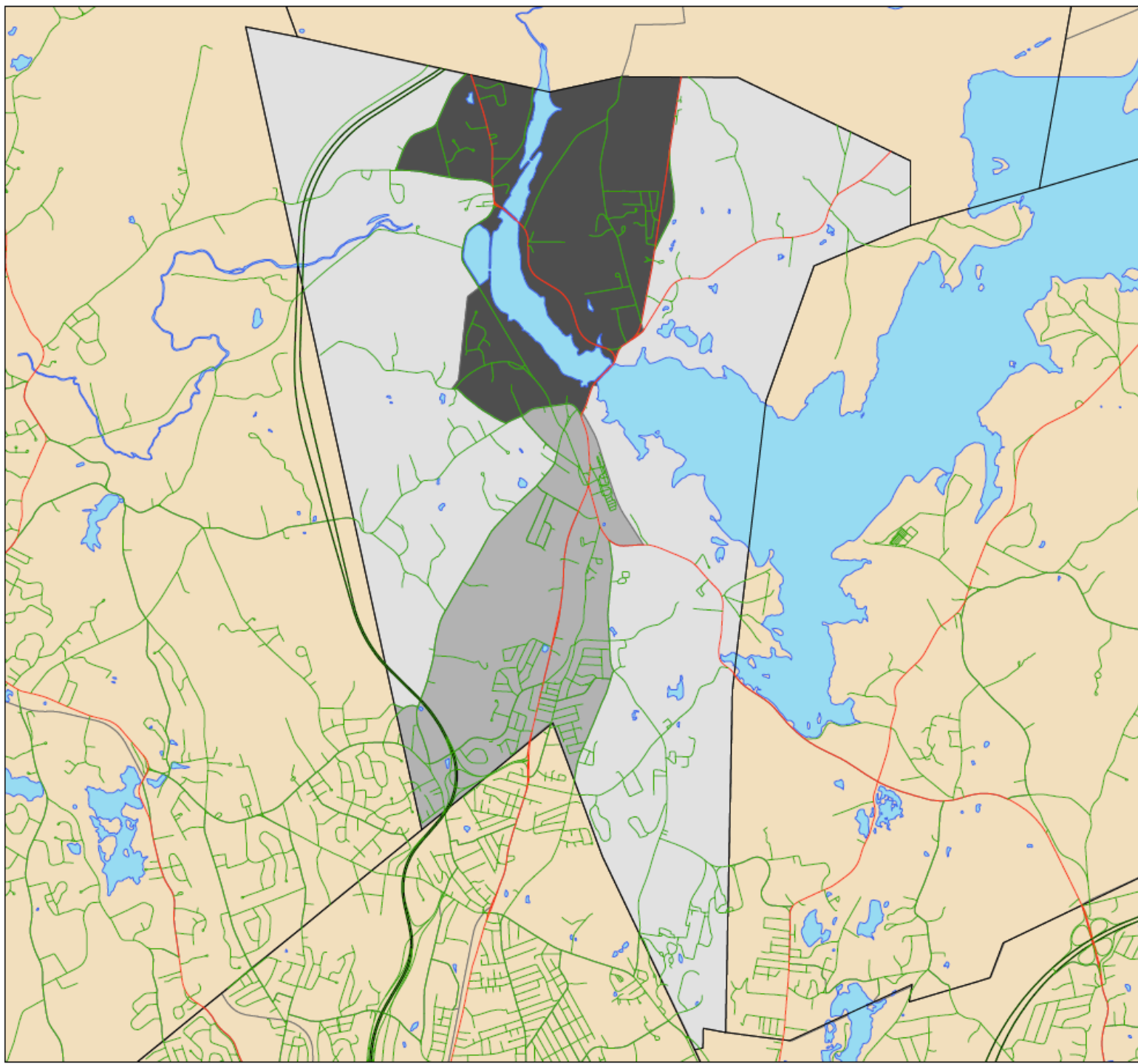
0 0.3 0.6 1.2 Miles

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RC/Pre-Disaster Mitigation/MVP

Date: 5/8/2016



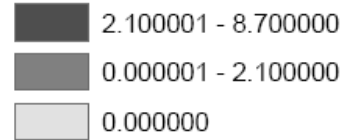
Vulnerable Populations: Limited English Proficiency

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Preparedness (MVP)
Workshop: West Boylston

Limited English Proficiency

Legend

Percent Limited English



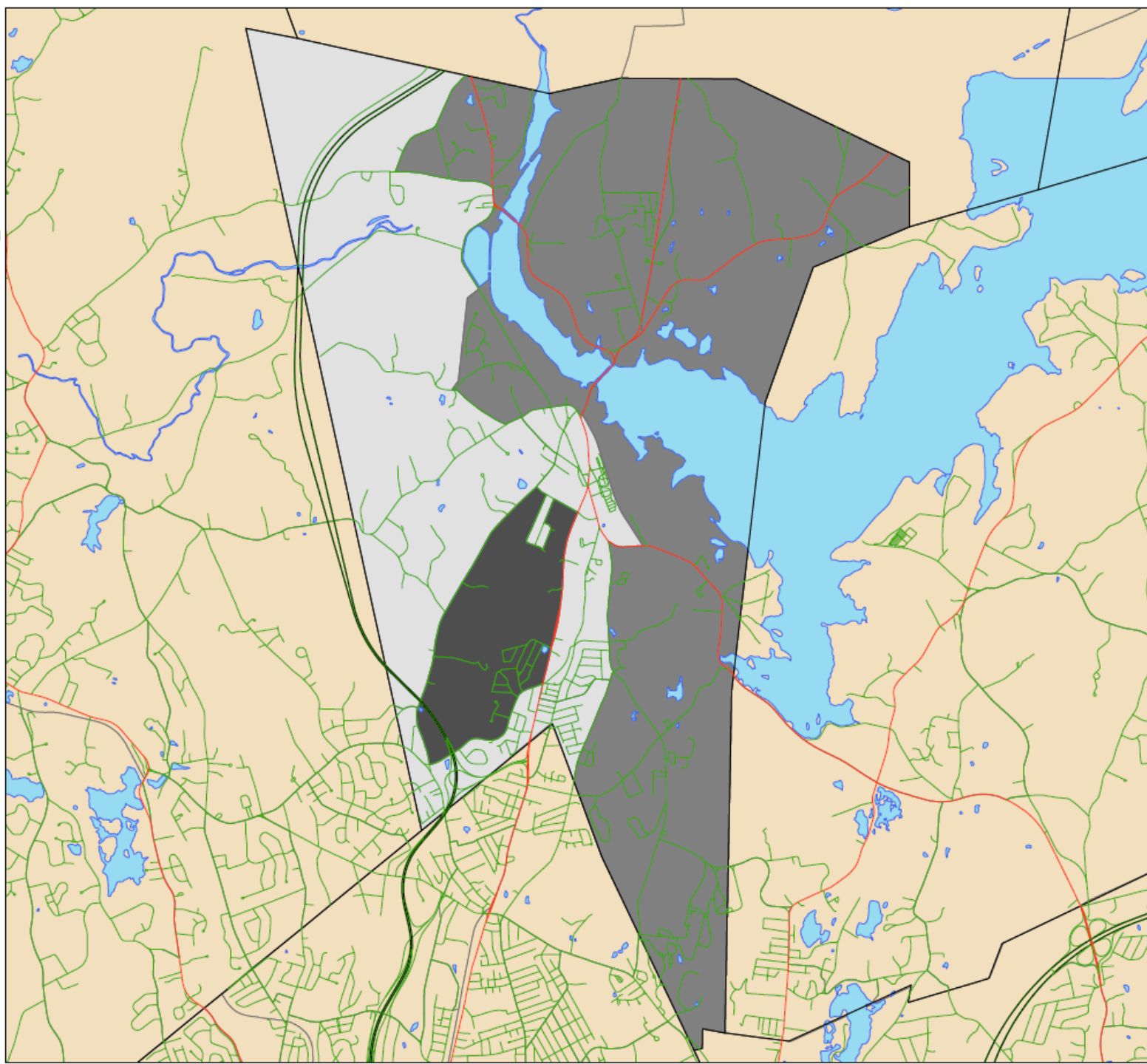
0 0.3 0.6 1.2 Miles

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R:\Pre-Disaster Mitigation\MVP

Date: 5/8/2016



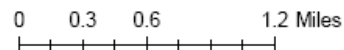
Vulnerable Populations: Median Income

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Preparedness (MVP)
Workshop: West Boylston

Household Income

Legend

Median HH Income

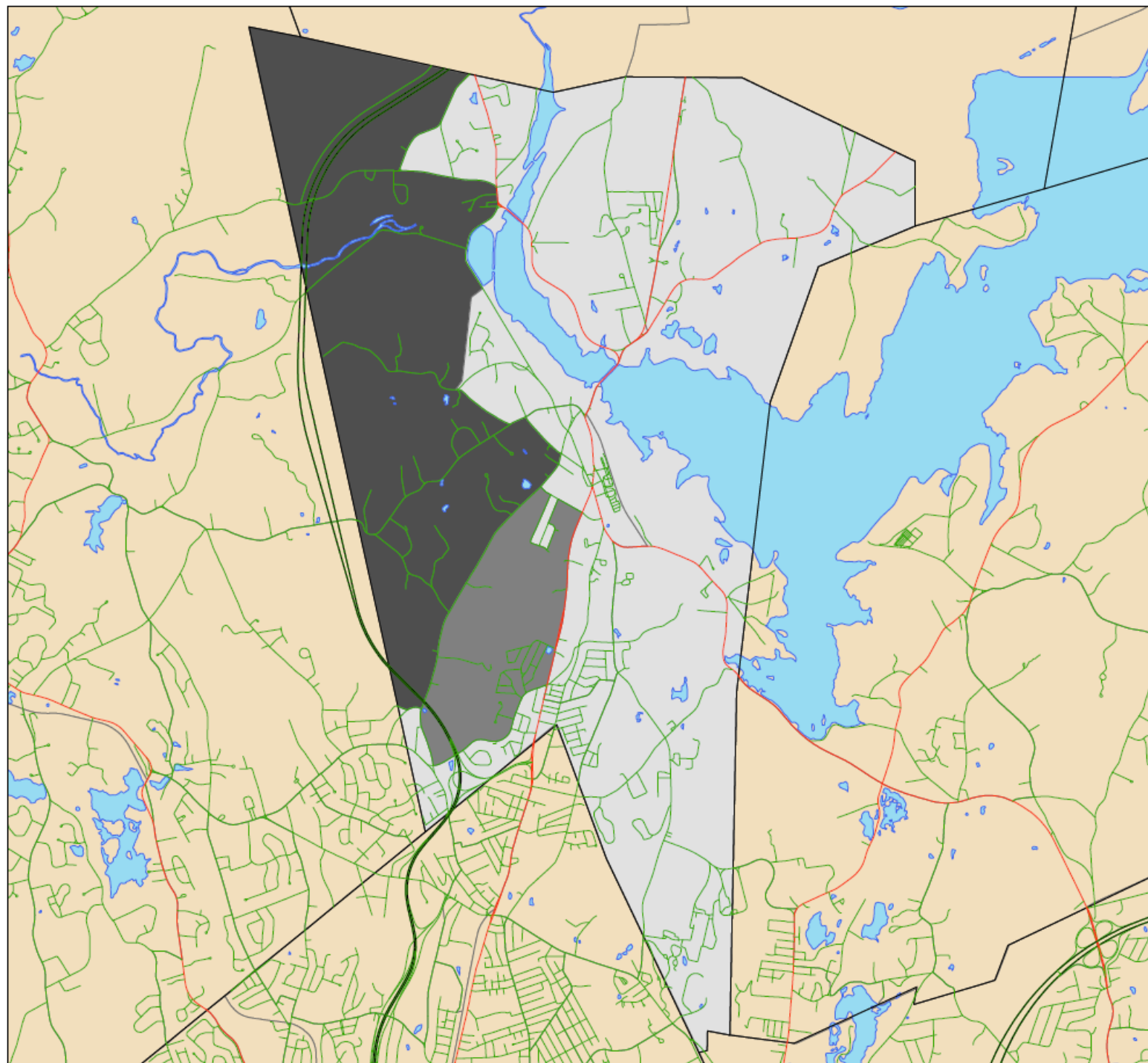


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Date: 5/9/2016



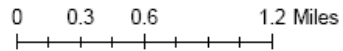
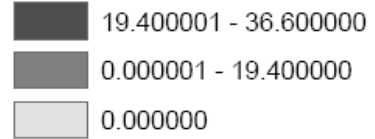
Vulnerable Populations: Renter-Occupied Housing

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Renter Occupancy

Legend

Percent Renter Occupied

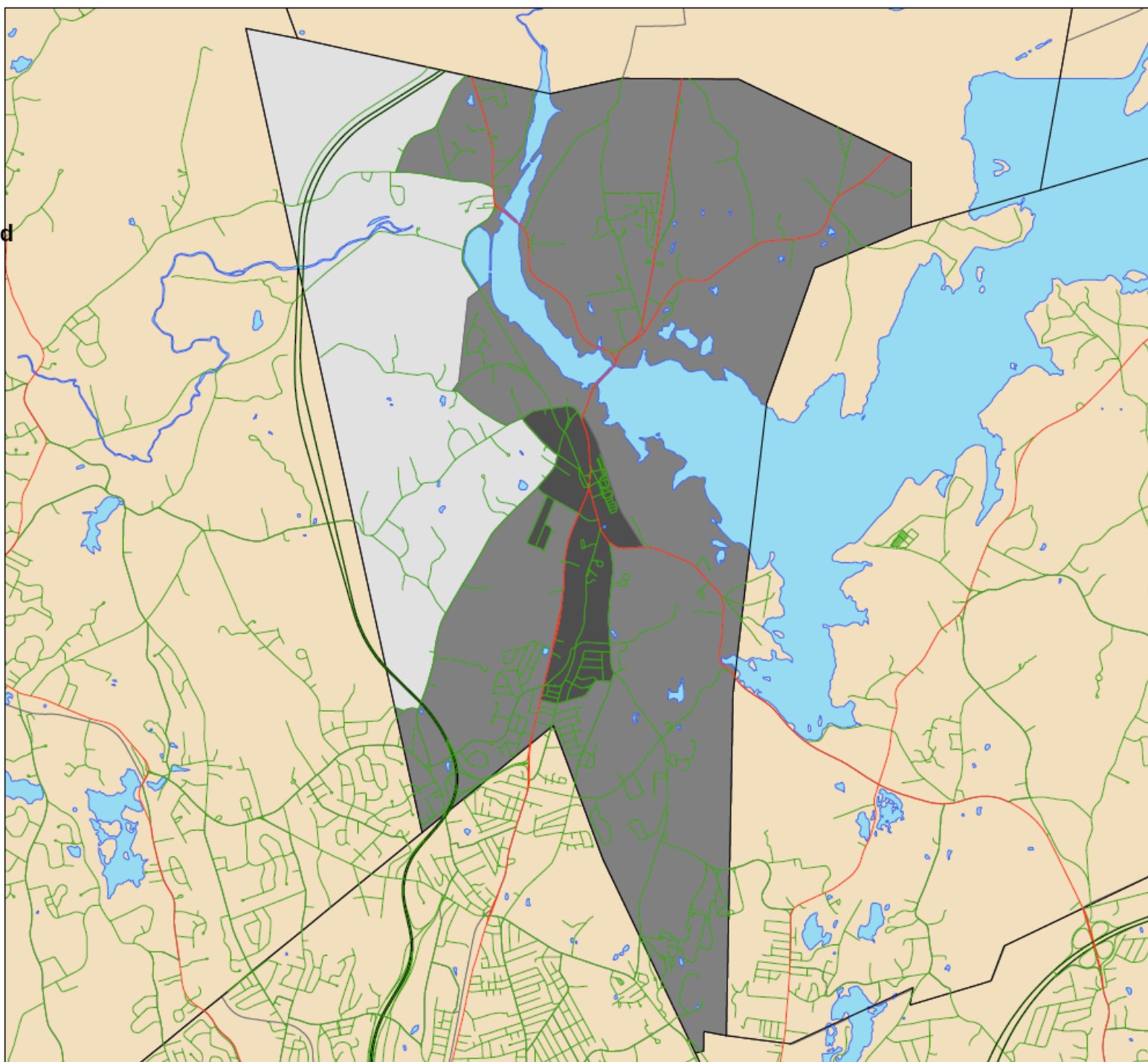


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Date: 5/9/2018



Questions?

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Municipal Vulnerability Preparedness Workshop

Town of West Boylston



May 14, 2019
8:30 AM – 4:30 PM
West Boylston Town Hall
140 Worcester Street, West Boylston, MA 01583



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