



# Master Plan Workshop #3:

## Open Space & Rec., Natural Resources, Resilience & Sustainability

The background of the slide is a blue-tinted photograph of a city street. On the right side, there is a prominent church tower with a dome and arched windows. The street is lined with buildings, and a few people can be seen walking on the sidewalks. The overall atmosphere is urban and historical.

# AGENDA

**01** Purpose

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**02** Natural Resources

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**03** Open Space & Recreation

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**03** Resilience & Sustainability

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**04** Hearing From You

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**05** Upcoming Engagement

A blue-tinted photograph of a city street. On the left is a multi-story brick building. On the right is a historic building with a prominent clock tower. In the background, a church with a cross on its roof is visible. The street has crosswalks and a few trees. The text "01 PURPOSE" is overlaid in the center in a bold, yellow font.

# 01 PURPOSE

# WHAT IS A MASTER PLAN ?

- A **blueprint** to guide local government in achieving the community's vision.
- Provides a **basis for decision-making** about long-term physical development.



# 02 NATURAL RESOURCES

# Overview of Natural Resources

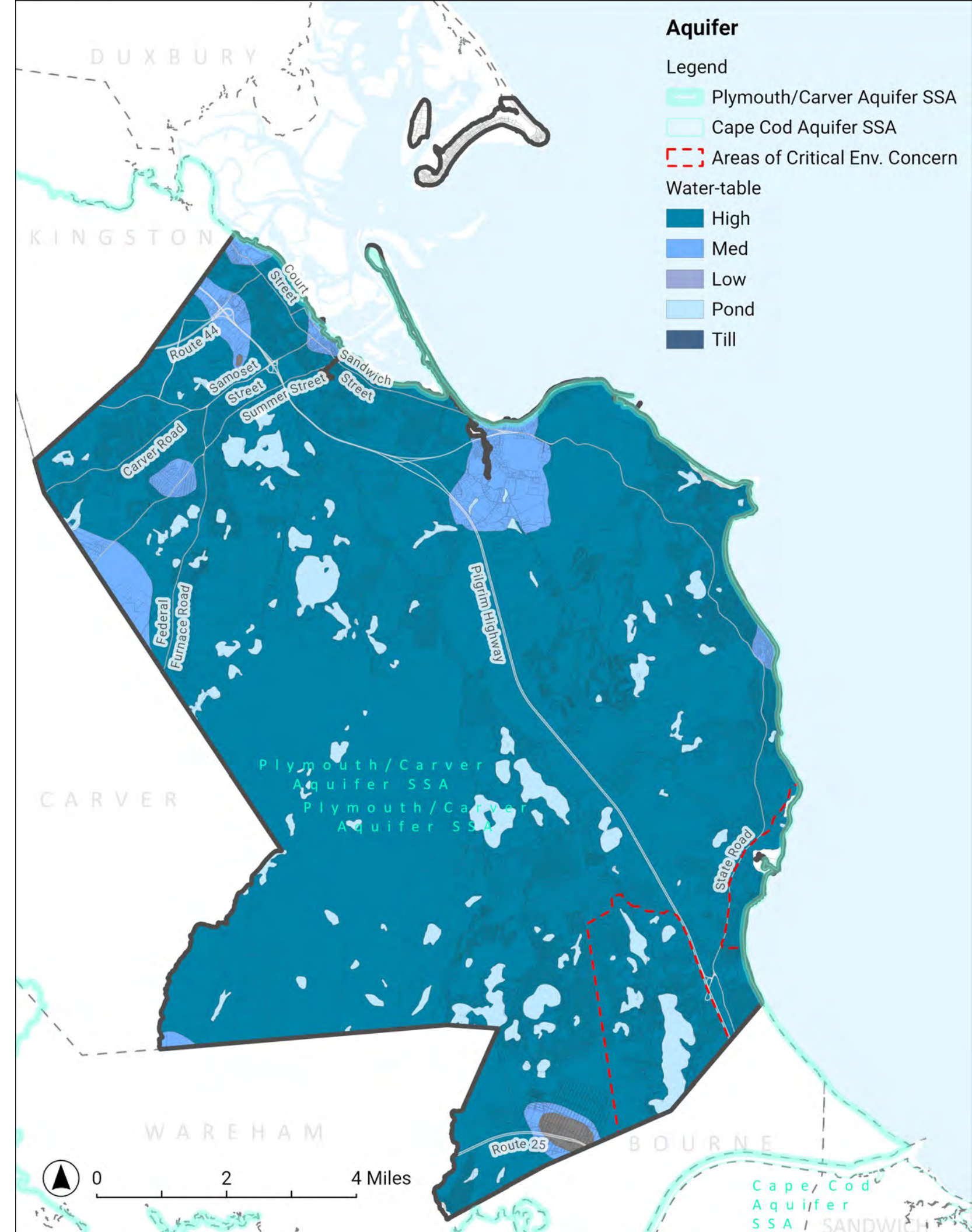
- Second largest sole-source aquifer in state
- Over 365 inland ponds, including 32 rare coastal plain ponds
- 36 miles of coastline
- Third largest area of globally rare pine barren in the eastern U.S
- Third highest per square mile occurrence of rare, threatened and endangered species in state



# Plymouth-Carver Aquifer supports Plymouth and others

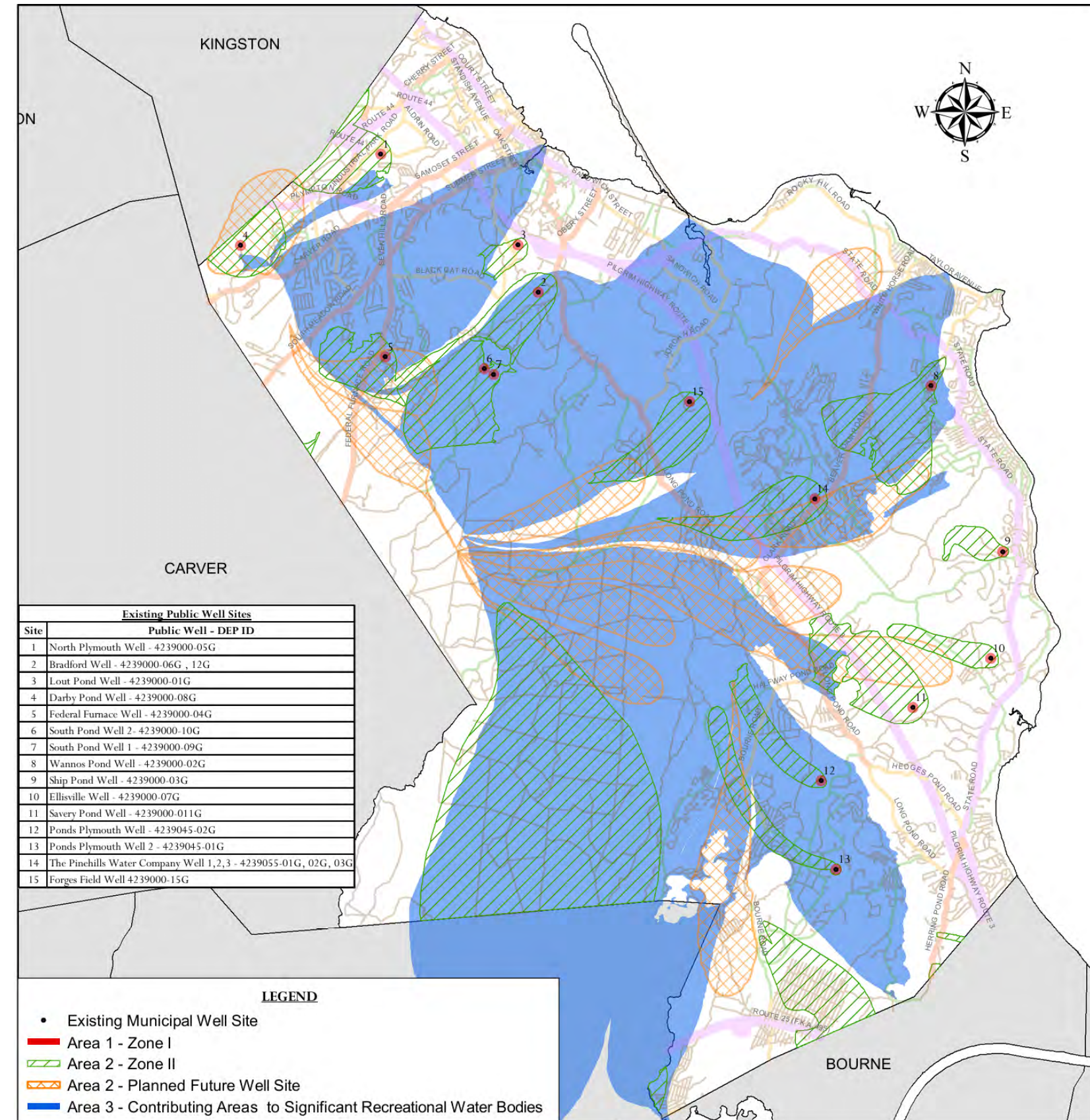
- Spans ~199 square miles beneath Plymouth and Carver
- Contains ~500 billion gallons of potable water
- Sole drinking water source for ~200,000 residents across Bourne, Carver, Kingston, Plymouth, Plympton, Middleborough & Wareham
- Feeds Plymouth's freshwater streams, rivers, and ponds

Source: MassGIS



# Aquifer protections exist, but face mounting pressures

- ~80% of Plymouth's total land area is located within its Aquifer Protection Zoning District (APZD) due to high water table and recharge areas
  - APZD limits development through strict density, use, and wastewater discharge requirements
- Threatened by increasing population growth and impacts of climate change including drought, pollution, saltwater intrusion and increasing water demands

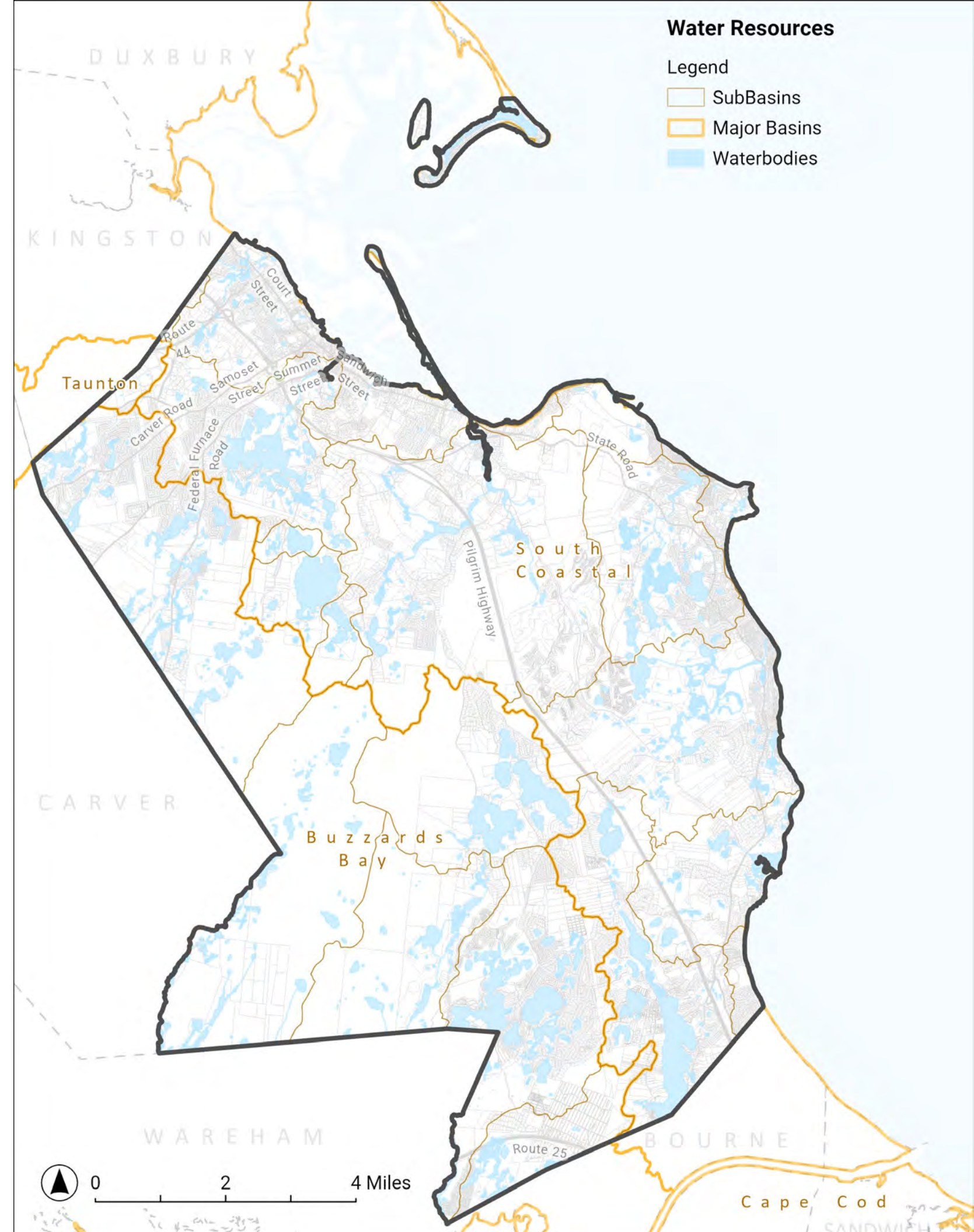


# Plymouth's inland ponds support important natural communities, but are at risk of impairment from pollution

- 365 inland ponds, including 32 rare coastal plain ponds
- Several impaired ponds require TDML for remediation: Boot Pond, Cooks Pond, Ezekiel Pond, Great Herring Pond, Great South Pond, Billington Sea, Island Pond, Russell Millpond, Savery Pond
- Encroaching development in pond areas creates additional risk

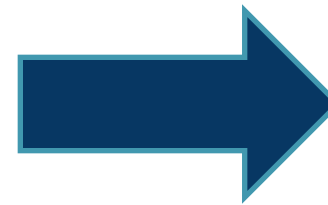
Impairment is primarily due to non-point sources such as septic systems, stormwater runoff, fertilizer runoff, and sedimentation.

Source: MA DEP TDML; MassGIS



# Concerns about water quality are increasing as development and changing land use patterns impact water recharge and runoff

- Building on undeveloped land reduces pervious surfaces, increases stormwater runoff, and expands use of septic systems
- Aging private septic systems result in more frequent failures and leaching of wastewater into water table
- Conversion of Chapter 61 agricultural lands into residential use reduces infiltration



Leads to nitrification and eutrophication of waterbodies, harming aquatic organisms, and putting groundwater and surface water resources at risk of contamination

Reduces land's capacity to absorb stormwater runoff and facilitate infiltration, impacting recharge

Source: 2004 Plymouth Master Plan; Plymouth OSRP; Stakeholder interviews

# Plymouth's natural features provide important habitats for rare species

- Plymouth's pine barren ecosystem, located in Myles Standish State Forest, is one of largest remaining
- 34 rare species listed by MA Natural Heritage and Endangered Species Program (NHESP)
- Pine barrens, wetland areas, plain ponds, streams, vernal pools, Plymouth Harbor, and coastal beaches provide critical habitats

Source: MassGIS



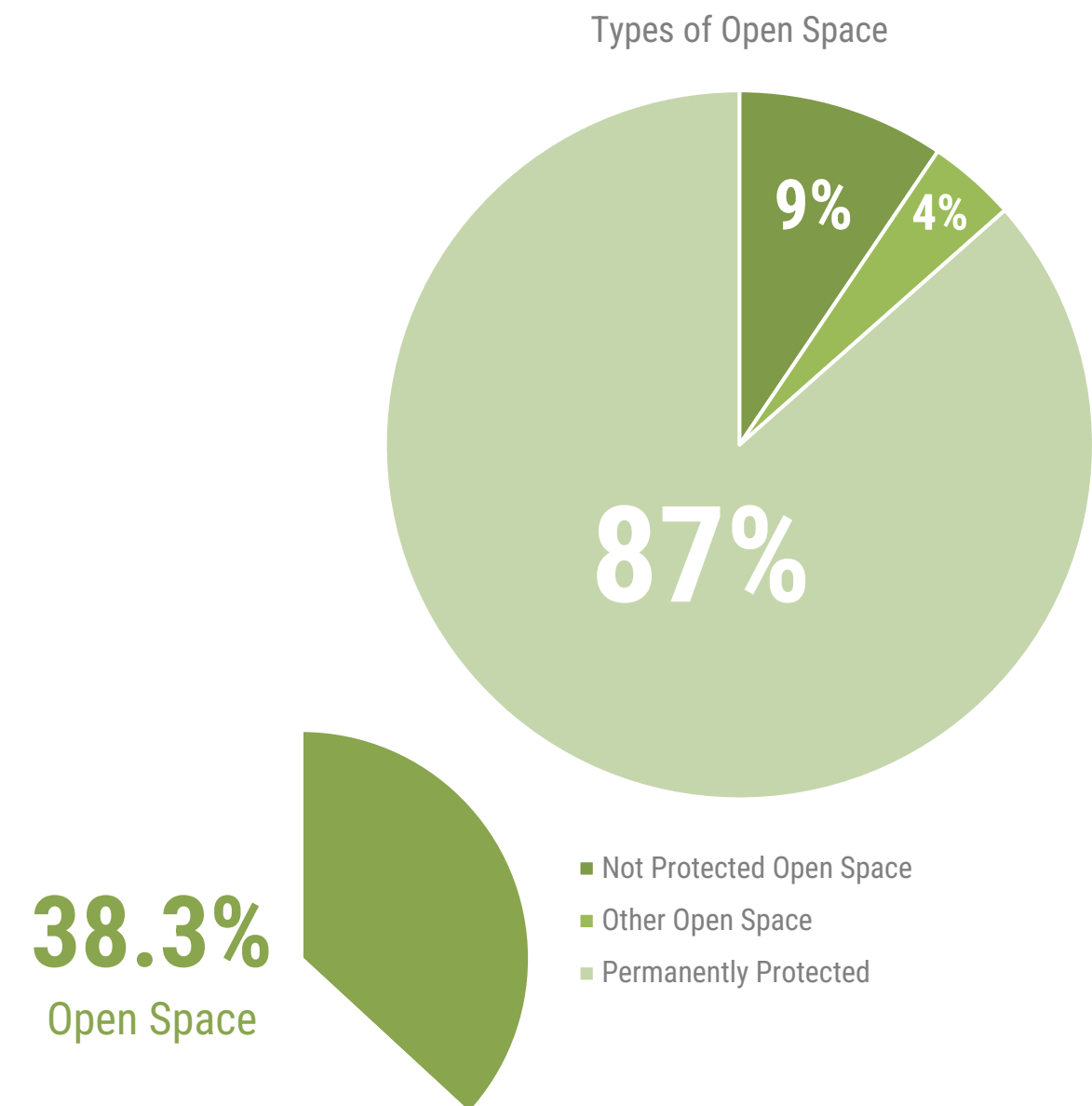
# Things to think about

- What natural resources do you most care about?
- How do you interact with Plymouth's natural environment?
- How should Plymouth balance natural resource protection with growth and development?

# 03 OPEN SPACE & RECREATION

## More than one-third of Plymouth's total land area is designated as open space or for recreation use

- 25,217 acres of open and recreational space
- ~90% of which is permanently protected, making more than a quarter of Plymouth's land designated as protected open space



Source: MassGIS

# Half of open space is owned by the State and used for shared recreation and conservation use

- Myles Standish State Forest represents ~50% of the publicly owned open space
- 5,677 acres of open space owned by Town of Plymouth
- 50% of open space and recreation resources are for shared recreation and conservation use
- One-third is primarily for conservation purposes
- 14% is for active recreation

Open Space and Recreational Facilities by

## OWNERSHIP

| Ownership                        | Area [Acre] | Percentage Total |
|----------------------------------|-------------|------------------|
| State                            | 13,387      | 53%              |
| Municipal                        | 5,677       | 23%              |
| Private for Profit               | 2,830       | 11%              |
| Land Trust                       | 2,135       | 8%               |
| Private NonProfit                | 842         | 3%               |
| Federal                          | 209         | 0.8%             |
| County Conservation Organization | 92          | 0.4%             |
|                                  | 44          | 0.2%             |

Open Space and Recreational Facilities by

## TYPE

| Primary Purpose             | Area [Acre] | Percentage Total |
|-----------------------------|-------------|------------------|
| Recreation and Conservation | 12,721      | 50%              |
| Conservation*               | 8,479       | 34%              |
| Recreation**                | 3,456       | 14%              |
| Water Supply Protection     | 197         | 0.8%             |
| Historical/Cultural         | 194         | 0.8%             |
| Agriculture                 | 147         | 0.6%             |
| Other                       | 23          | 0.1%             |

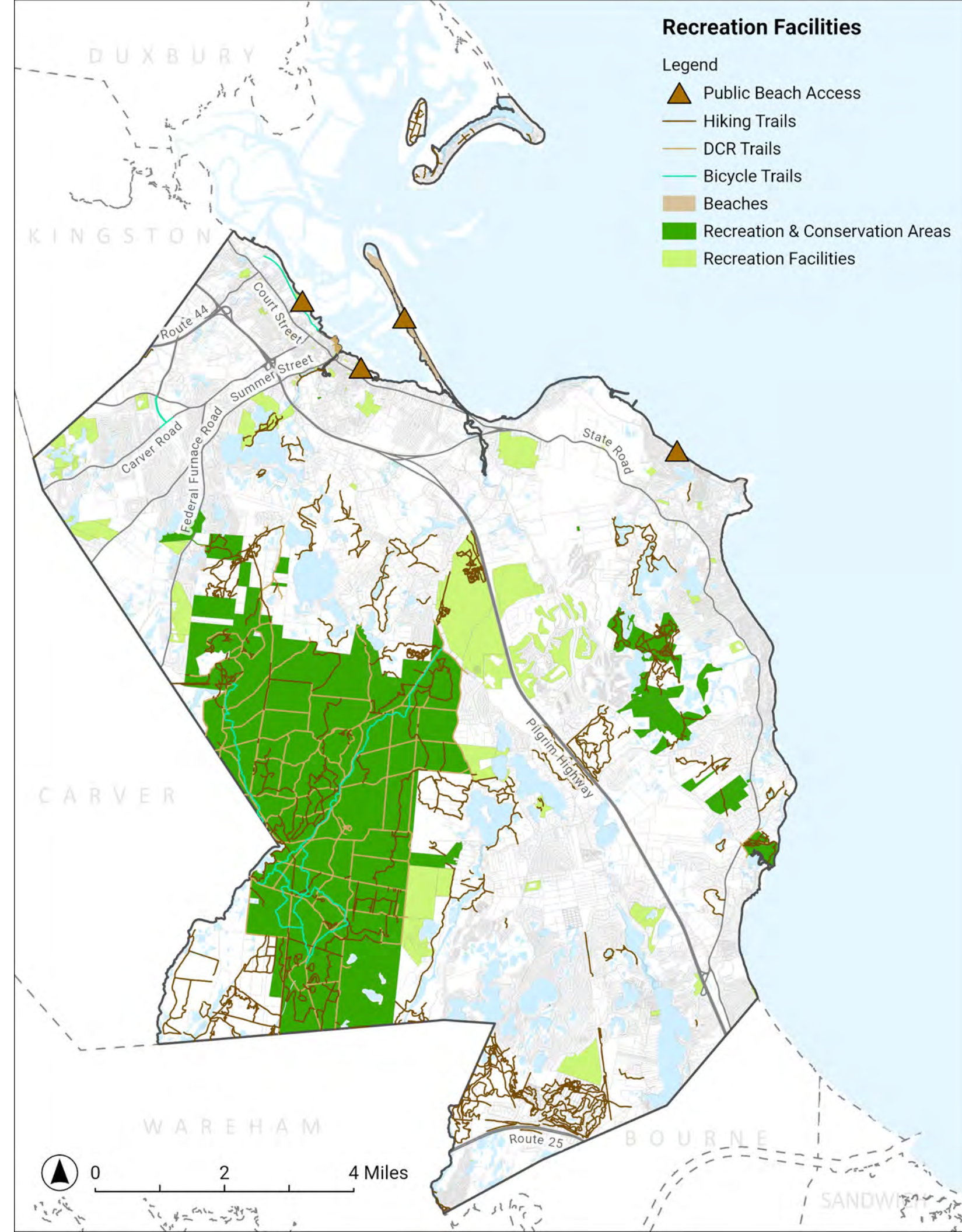
\* Activities are non-facility based

\*\* Activities are facility based

# Significant active parkland complement Plymouth's conservation lands

- Includes historic monuments, large town parks, small village parks and playgrounds, school facilities, and beaches
- 35 park and playground facilities
- 3 indoor recreation facilities - Manomet Youth Center, Memorial Hall, Boys & Girls Club
- School playing fields offer additional active recreation resources

Source: Plymouth OSRP; MassGIS



# Plymouth's acquisition of open space largely supported through CPA

- Town has acquired and preserved over 1,600 acres of open space through Community Preservation Act (CPA)
  - 1.5% surcharge on residential property taxes to support open space acquisition
- ~\$21 million dollars generated, along with State matching funds of over \$10 million

Source: Plymouth OSRP; MassGIS



North Plymouth Rail Trail



Pickball Courts at Forges Field



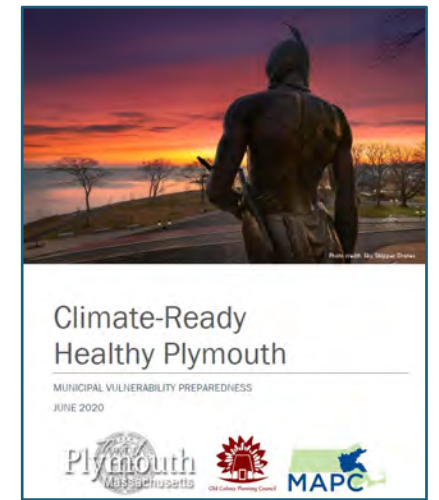
Town Brook

# Things to think about

- What open space and recreational resources and facilities do you use the most?
- How could Plymouth's existing open space and recreational resources and facilities be improved?
- Where could new open space, recreational spaces, and programming be accommodated and what opportunities should they provide?
- What's missing?

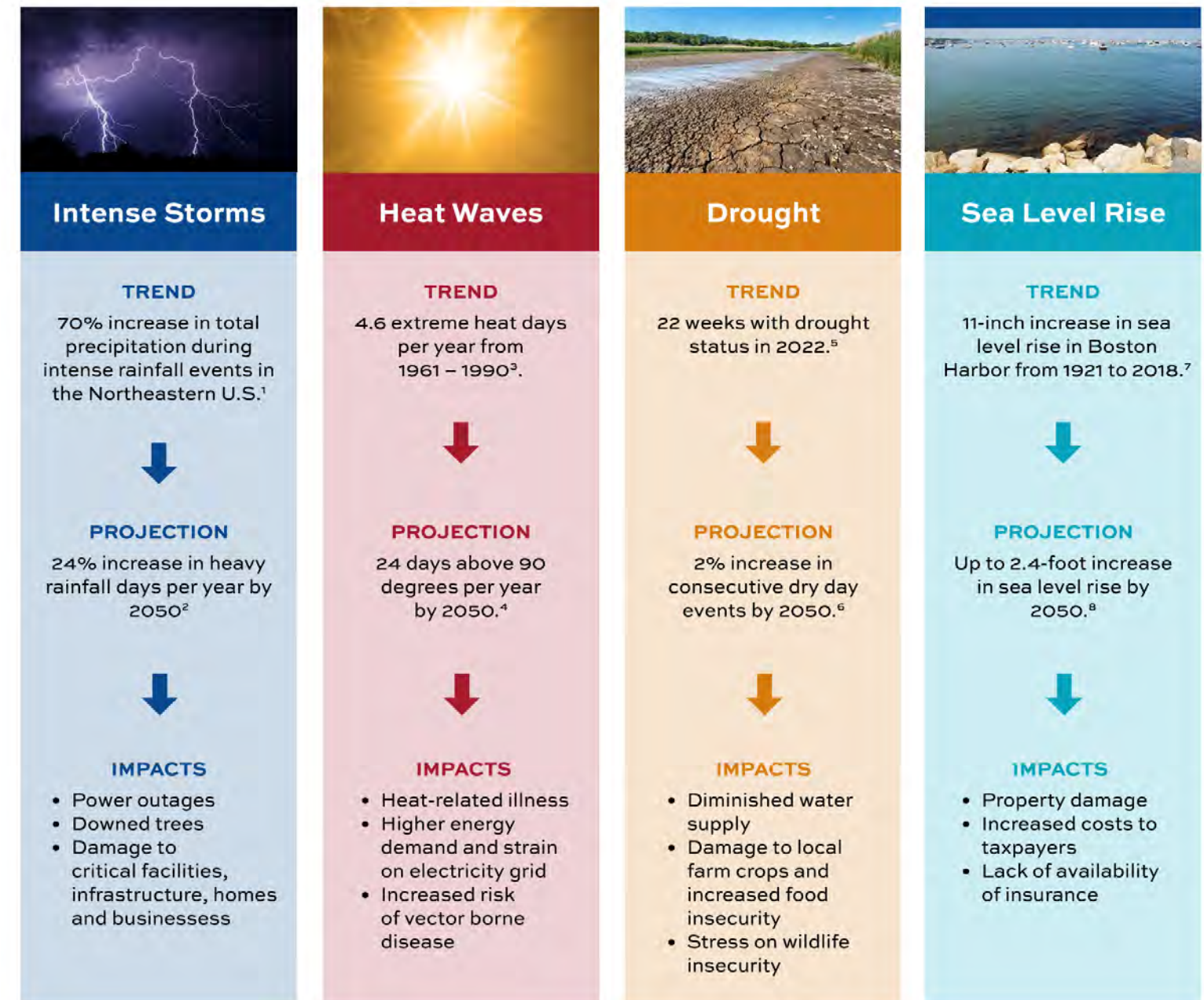
# 04 CLIMATE RESILIENCE & SUSTAINABILITY

# Recent climate resilience & sustainability planning initiatives



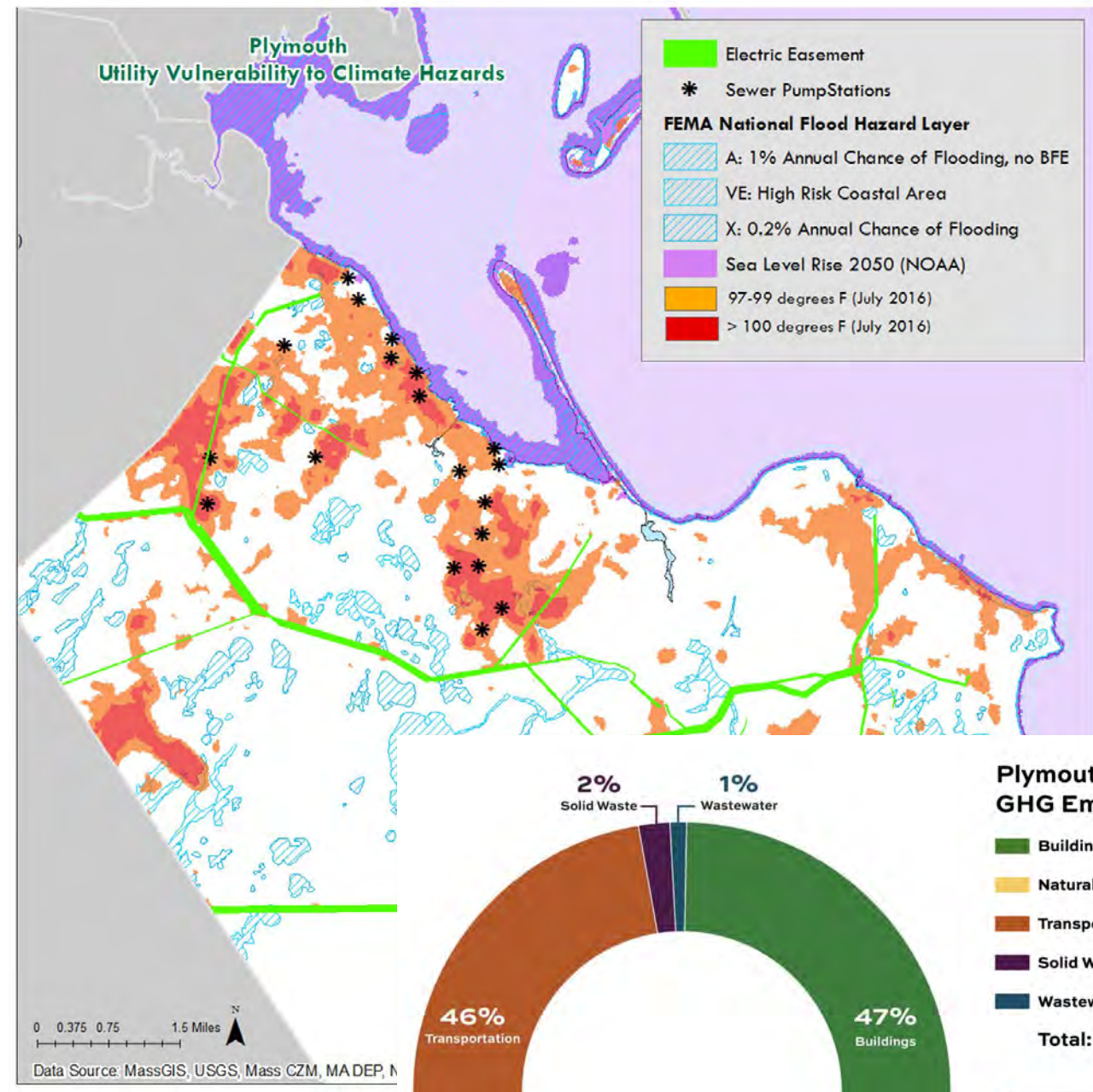
- **2020: *Climate-Ready Healthy Plymouth: Municipal Vulnerability Preparedness Plan (MVP)***
  - Identifies climate risks and Plymouth's most vulnerable assets
- **2024: *Priority Plymouth: Climate Action & Adaptation Plan***
  - Focuses on GHG emissions reduction and climate adaptation

## Climate change in Plymouth

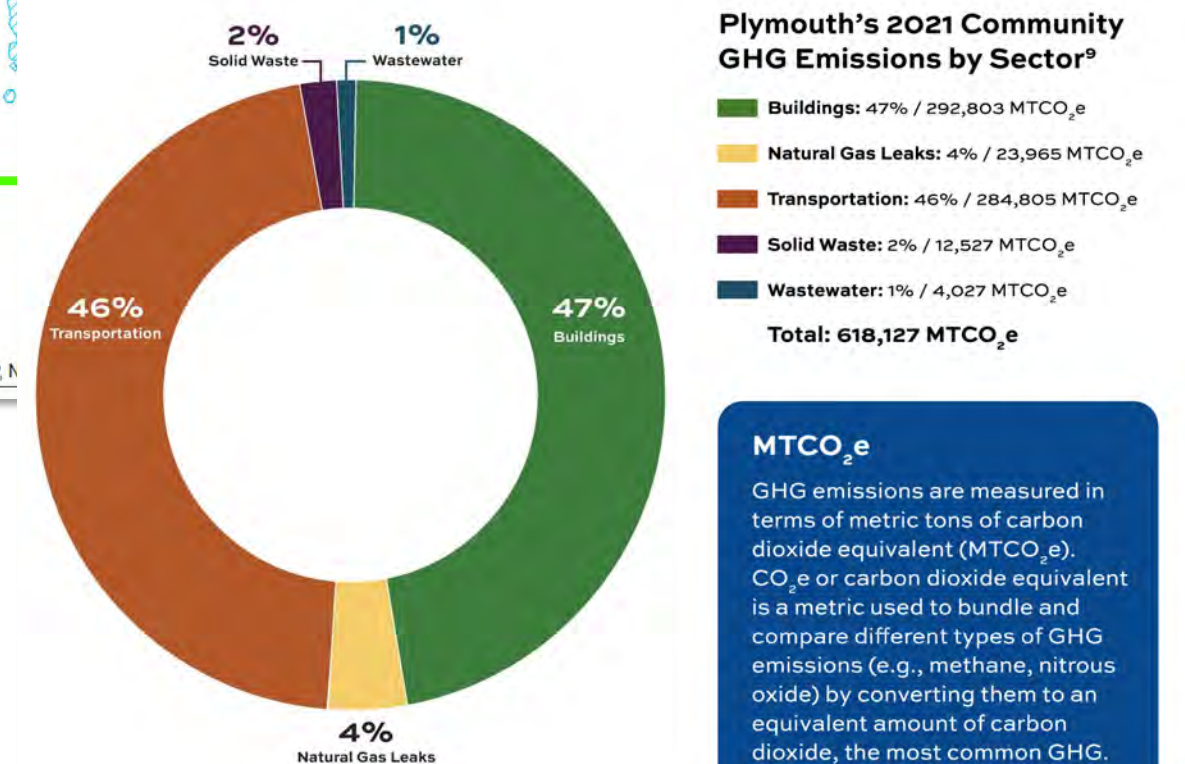


# Common climate resilience & sustainability themes

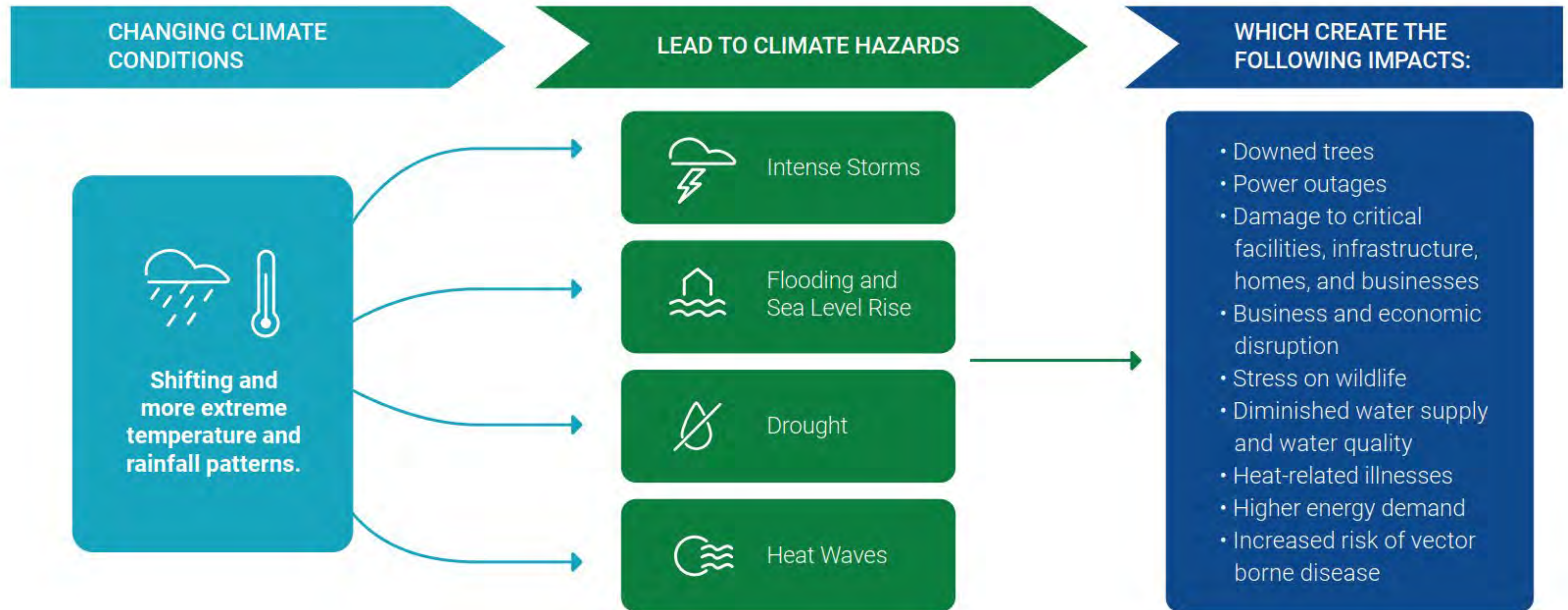
- Buildings and transportation are largest contributors to Plymouth's GHG emissions
- Increasing precipitation, intensifying storms, and sea level rise are most pressing climate impacts
- Importance of identifying vulnerable facilities and areas
- Emphasis on protection of coastal open space



*From Plymouth's  
MPV and Climate  
Action Plan*



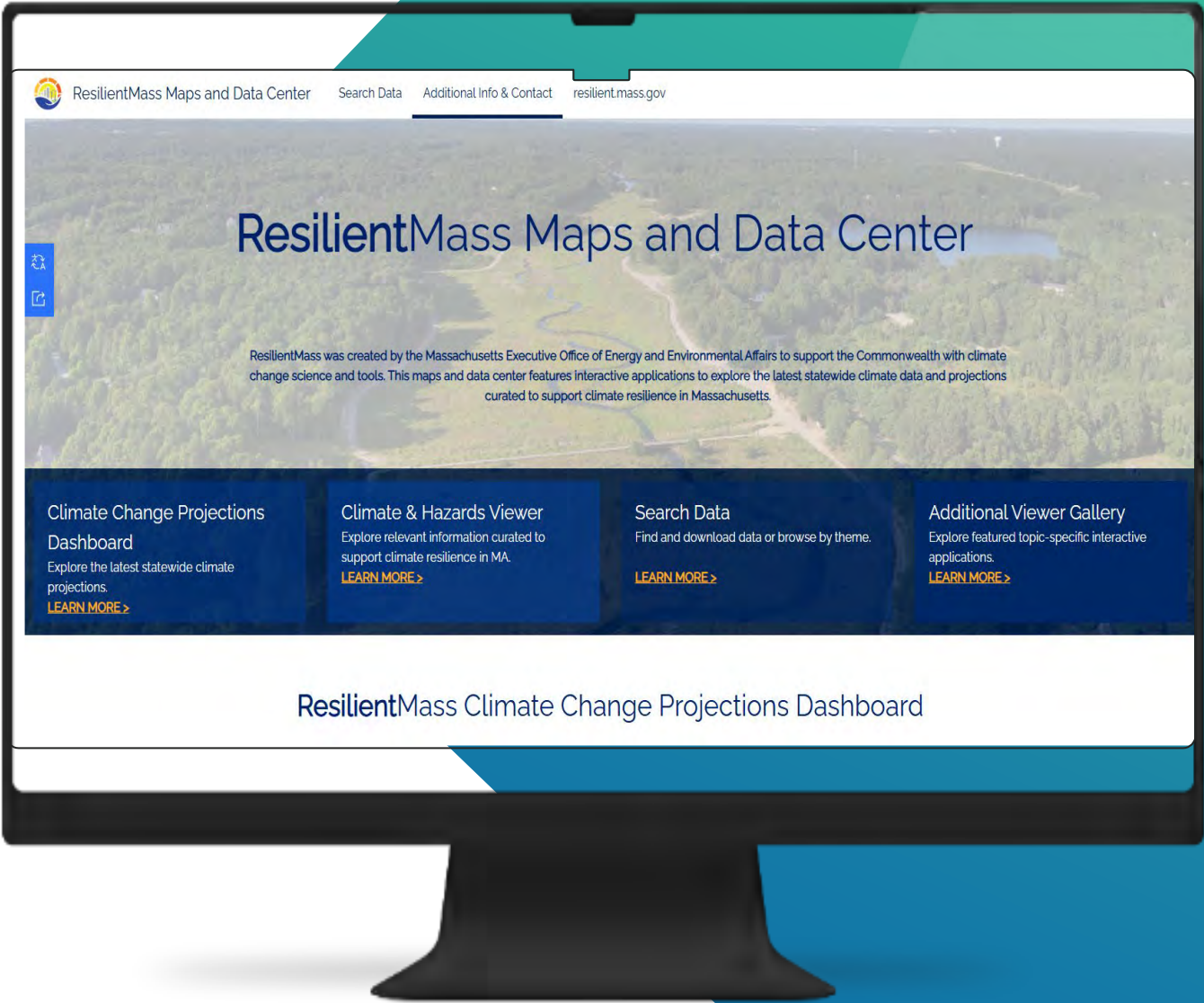
# How climate change may affect Plymouth



# ResilientMass provides projections for many climate related hazards

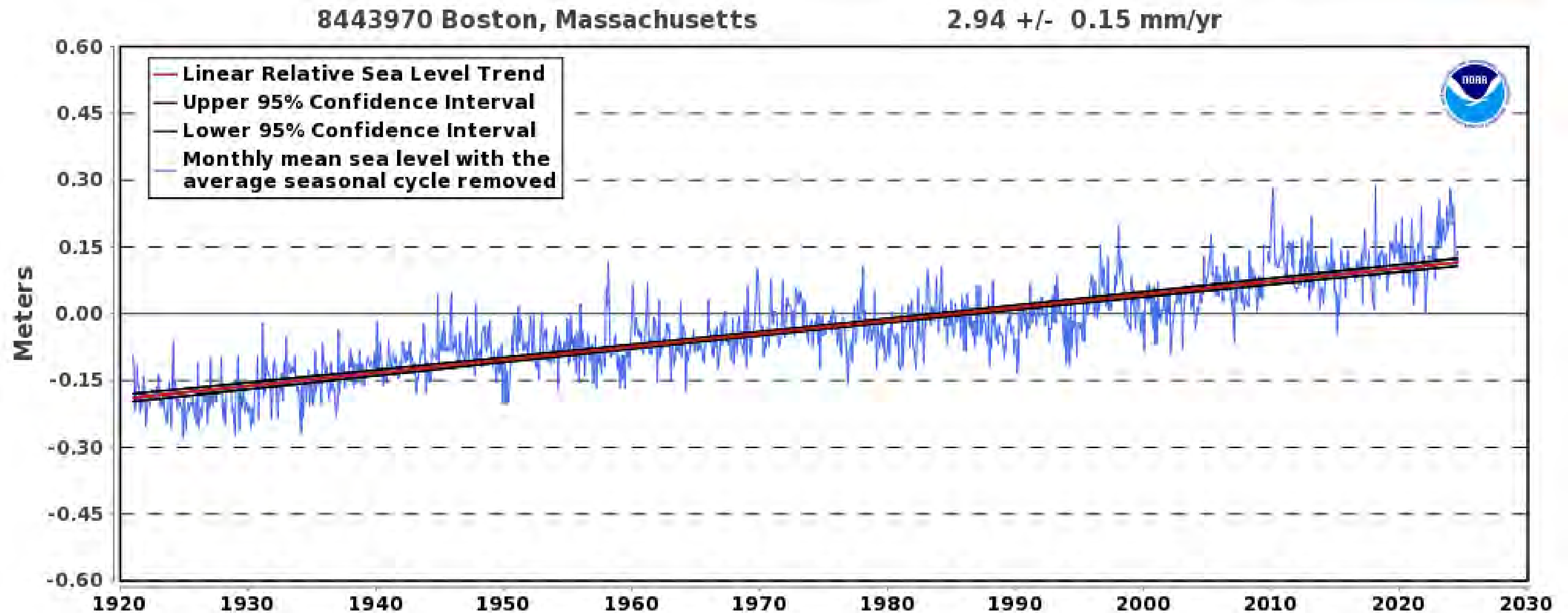
<https://resilient.mass.gov/home.html>

|                            | 2030                                   | 2050                                   | 2070                                   |
|----------------------------|----------------------------------------|----------------------------------------|----------------------------------------|
| Days <32F                  | <b>-28</b><br>(-14 to -35)<br>106      | <b>-40</b><br>(-28 to -51)<br>106      | <b>-51</b><br>(-40 to -64)<br>106      |
| Days >90F                  | <b>+4</b><br>(1 to 6)<br>1             | <b>+9</b><br>(4 to 16)<br>1            | <b>+16</b><br>(9 to 33)<br>1           |
| Total Annual Precipitation | <b>+5.9%</b><br>(-5.9 to 18.3)<br>42.8 | <b>+7.7%</b><br>(-5.5 to 21.1)<br>42.8 | <b>+9.5%</b><br>(-5.6 to 24.8)<br>42.8 |
| 99th %-ile rainfall        | <b>+6.2%</b><br>(2.7 to 8.2)<br>1.1    | <b>+9.5%</b><br>(6.2 to 12.5)<br>1.1   | <b>+12.5%</b><br>(9.5 to 17)<br>1.1    |

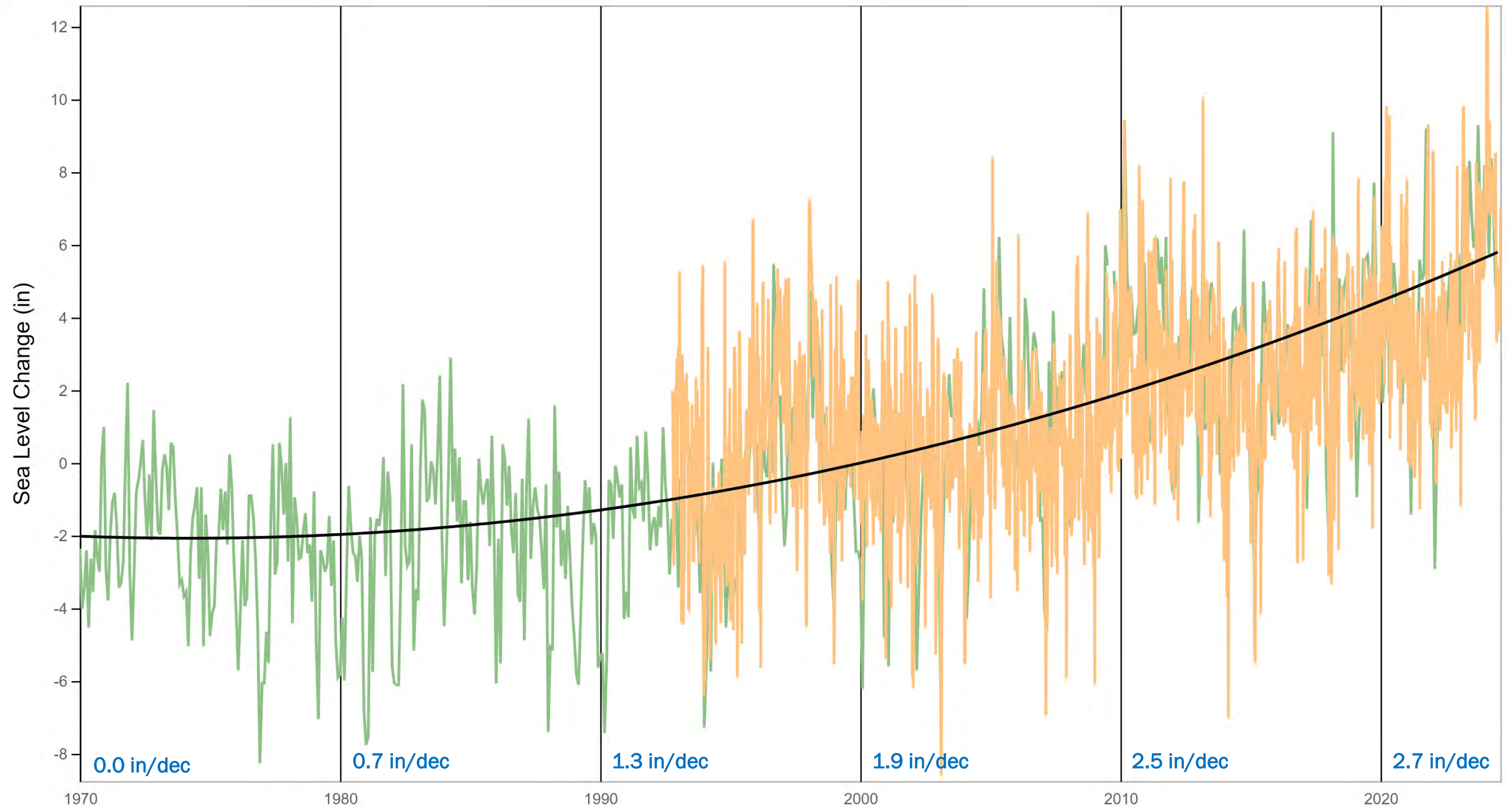


ResilientMass Climate Change Projections Dashboard  
Town of Plymouth

# In the Boston region, sea level rose ~12 inches in 100 years

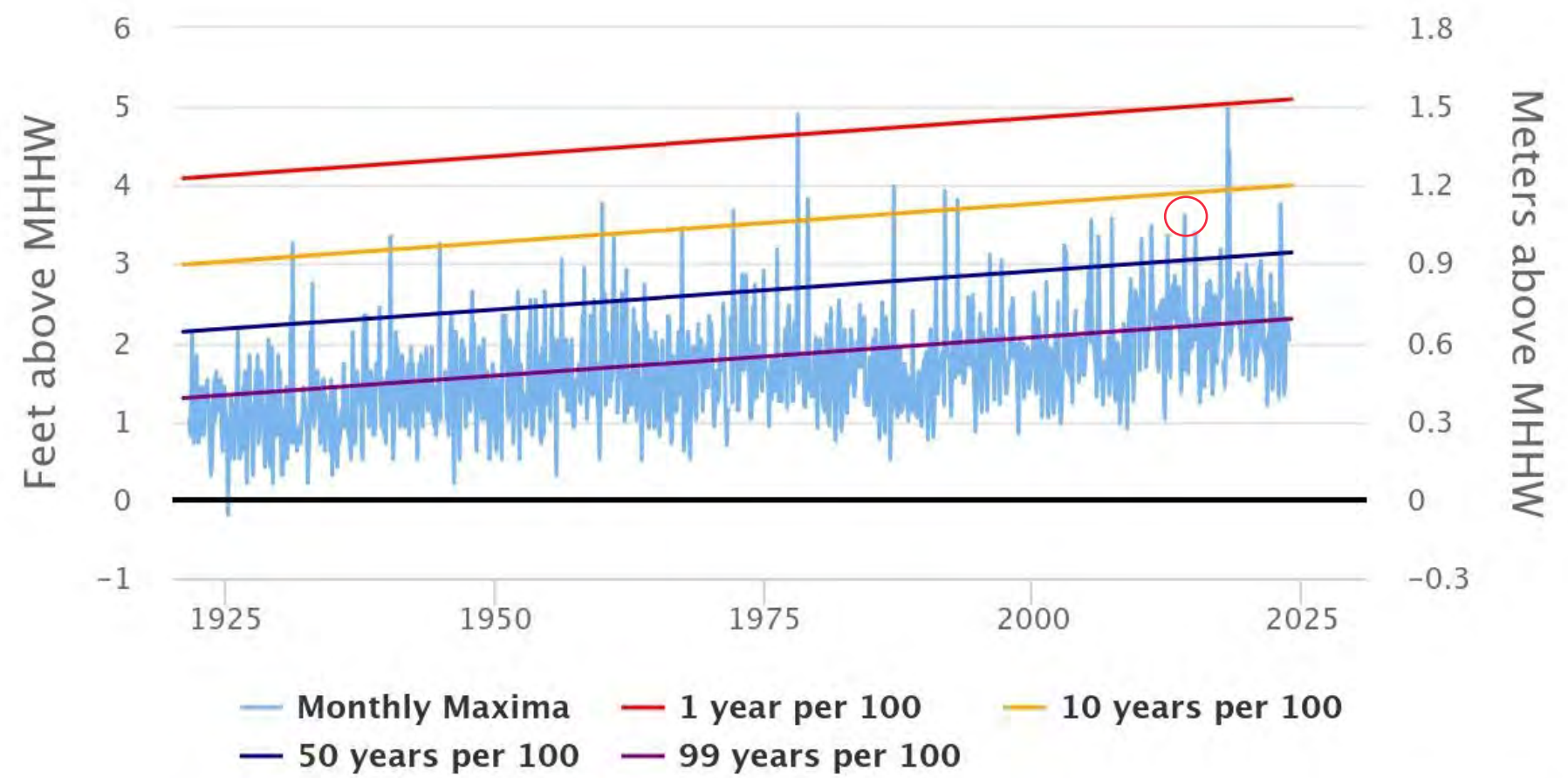


# In the Boston region, sea level rose ~8" in the last 50 yrs



<https://sealevel.globalchange.gov/national-sea-level-explorer/>

# Recorded Extreme Water Levels in Boston region



NOAA/NOS/Center for Operational Oceanographic Projects and Services

○ January 2014 +3.6 FT. MHHW



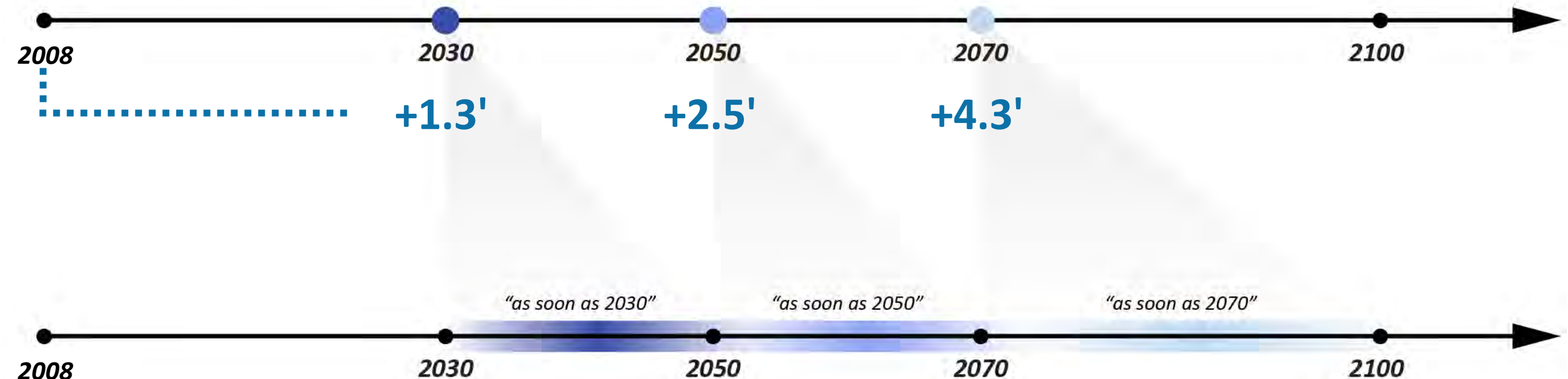
Coastal flooding and wave attack at Bert's Landing (Plymouth Long Beach)  
NBC News, 1/3/2014

# Sea Level Rise Projections for Plymouth, MA

MA EEA recommends using the “High” SLR scenario for conservative planning

## MA STATE (EEA) SEA LEVEL RISE TIME HORIZONS

*EEA's projections (based on DeConto & Kopp, 2017) incorporated in MC-FRM were designed to minimize the risk of underpredicting SLR.*



## CURRENT INTERPRETATION

*Considering recent SLR projections and EEA's probabilistic scenarios.*

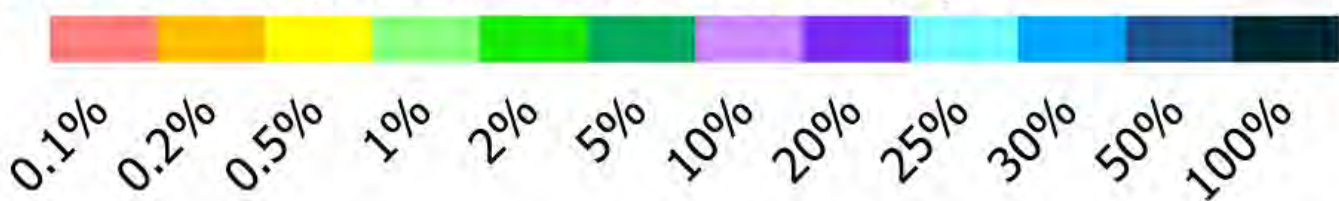
# MC-FRM Background

MC-FRM is a probabilistic hydrodynamic model that considers a variety of factors influencing coastal storm surge flooding along the entire MA coastline

The primary model output is:

- › **Storm Surge Flooding:** Represents flooding caused by storm events, with probabilities described using Annual Exceedance Probabilities (AEPs). AEPs indicate the chance of a storm occurring in any given year, and the likelihood of occurrence increases over longer time periods.

MC-FRM Annual Exceedance Probability



| Annual Exceedance Probability |         | Cumulative Probability Period |         |         |
|-------------------------------|---------|-------------------------------|---------|---------|
|                               |         | 10-Year                       | 25-Year | 50-Year |
| 1%                            | 1/100   | 9.6%                          | 22.6%   | 39.5%   |
| 10%                           | 1/10    | 65.1%                         | 91.7%   | 99.5%   |
| 100%                          | 100/100 | 100%                          | 100%    | 100%    |



# Flood Risk in Downtown Plymouth Area 2030



2050



MC-FRM Annual Exceedance Probability



2070



# 2030 Flood Risk in White Horse Beach



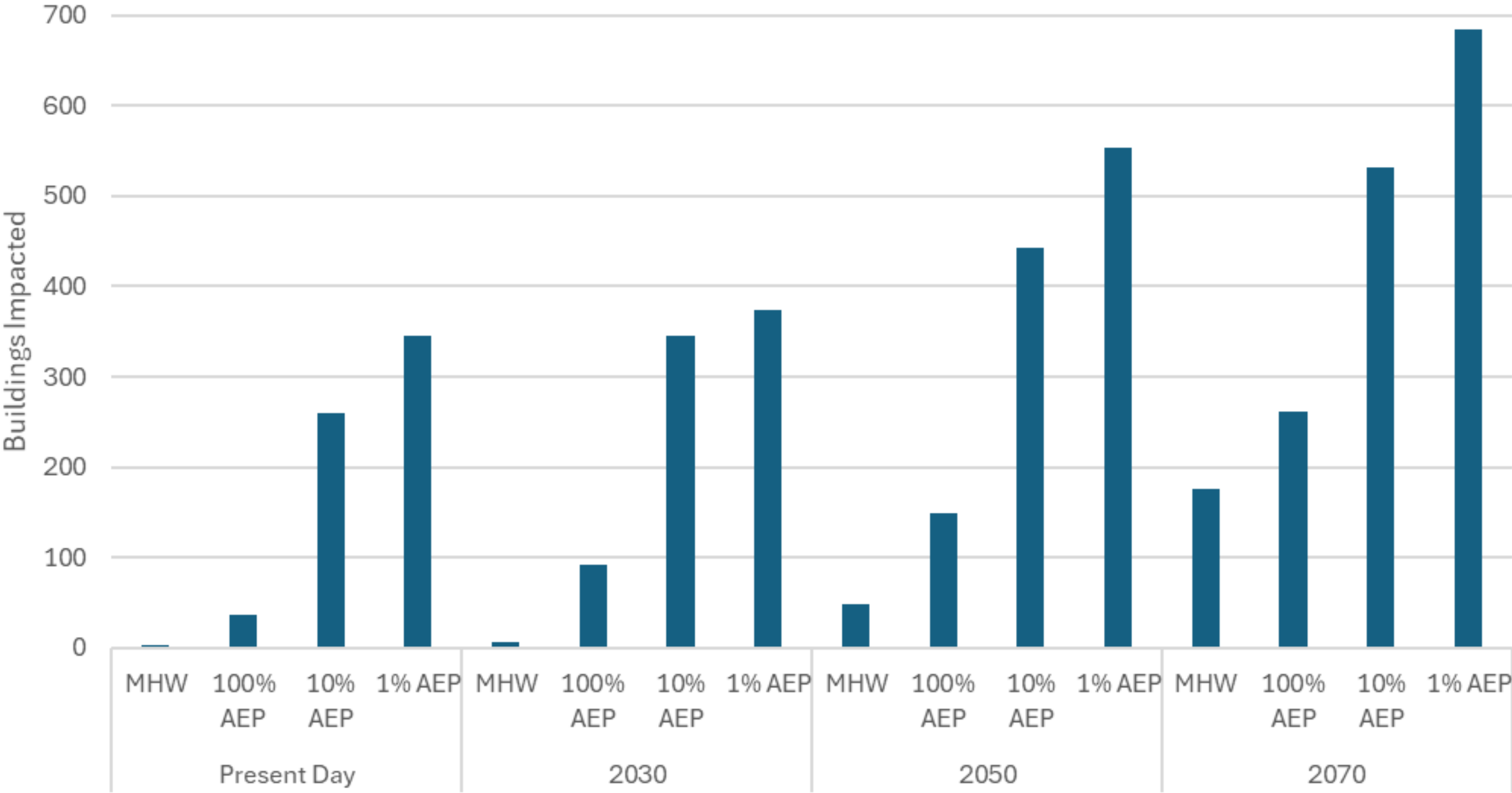
# 2050

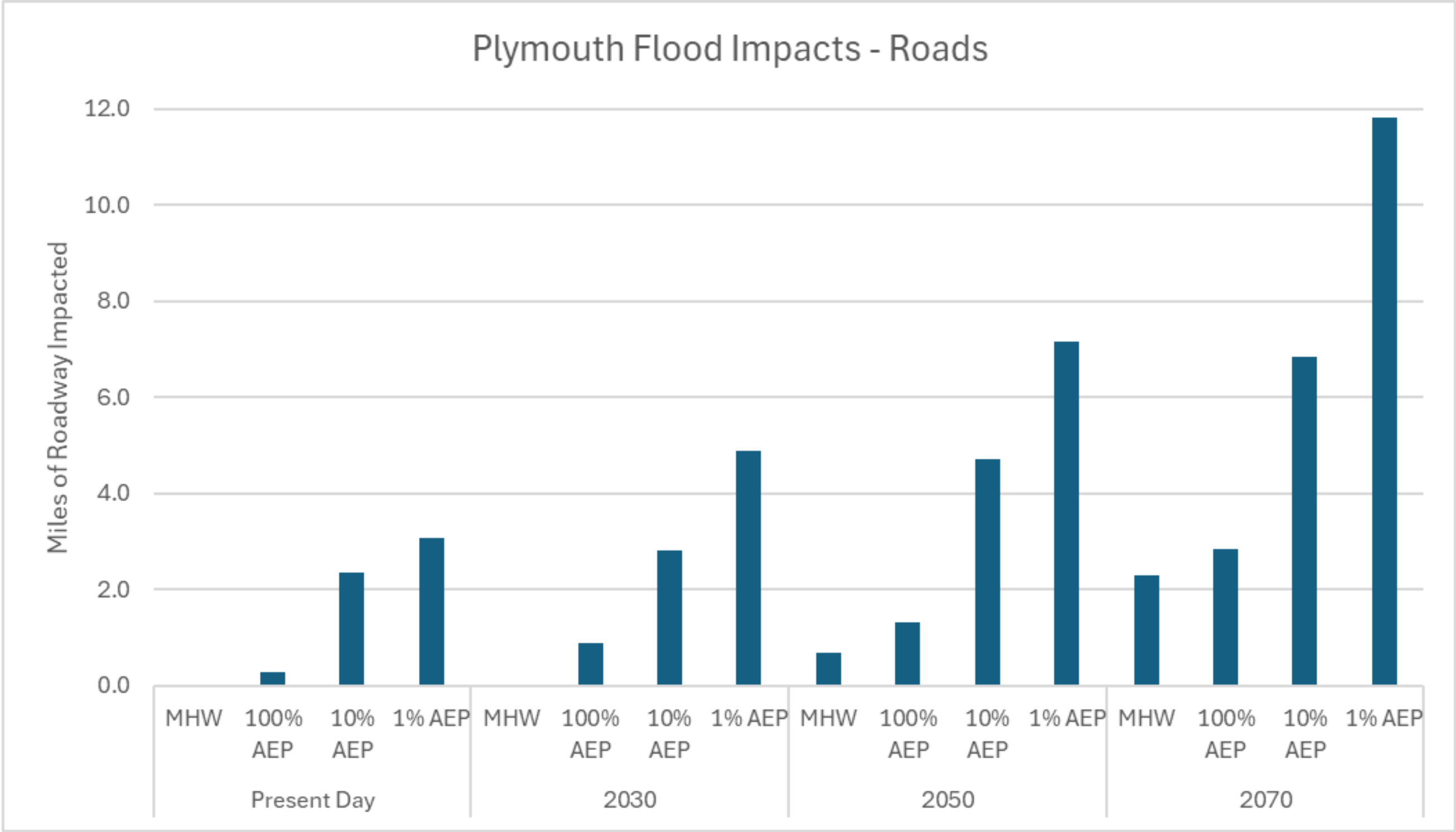


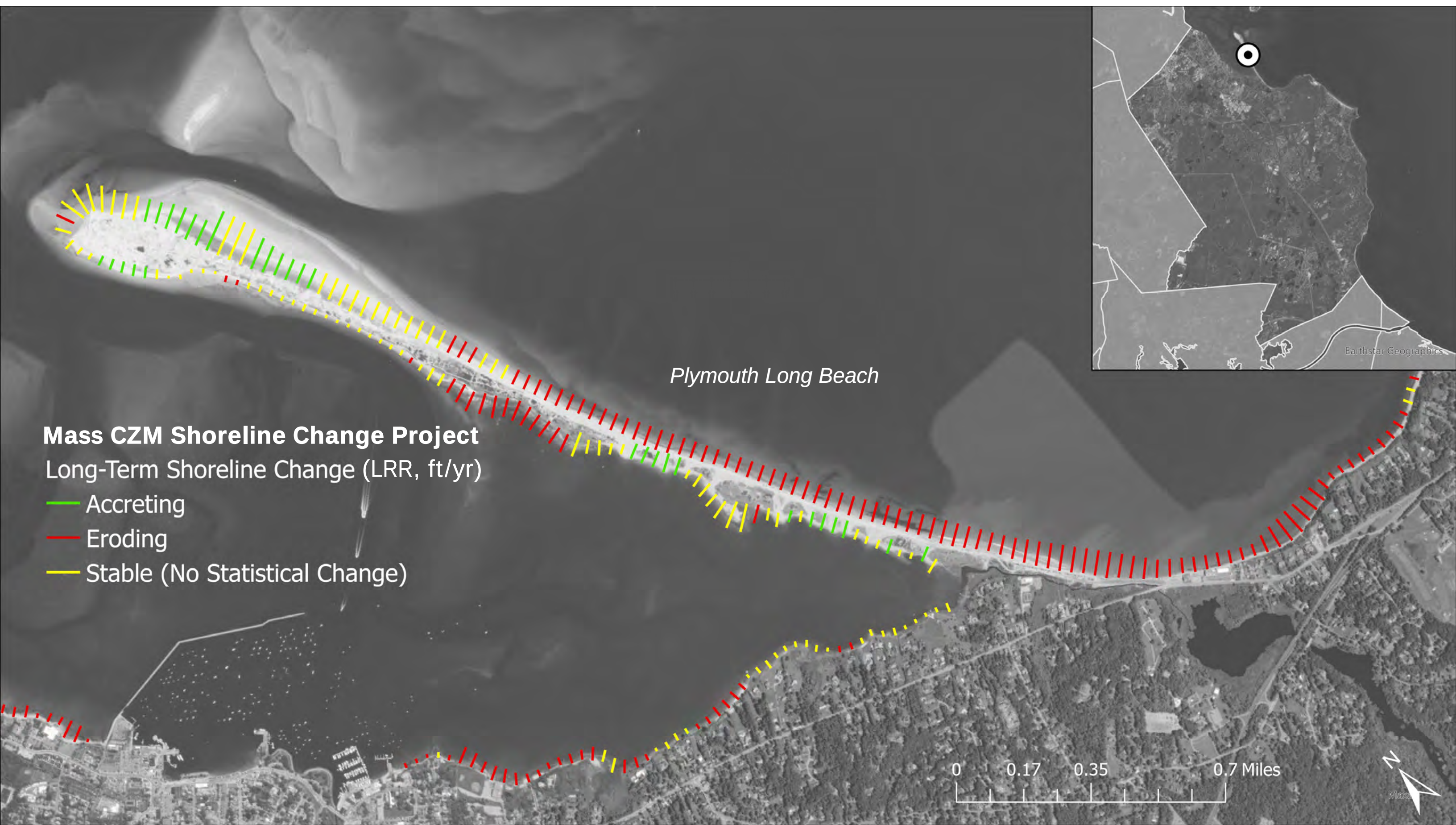
# 2070



Plymouth Flood Impacts - Buildings



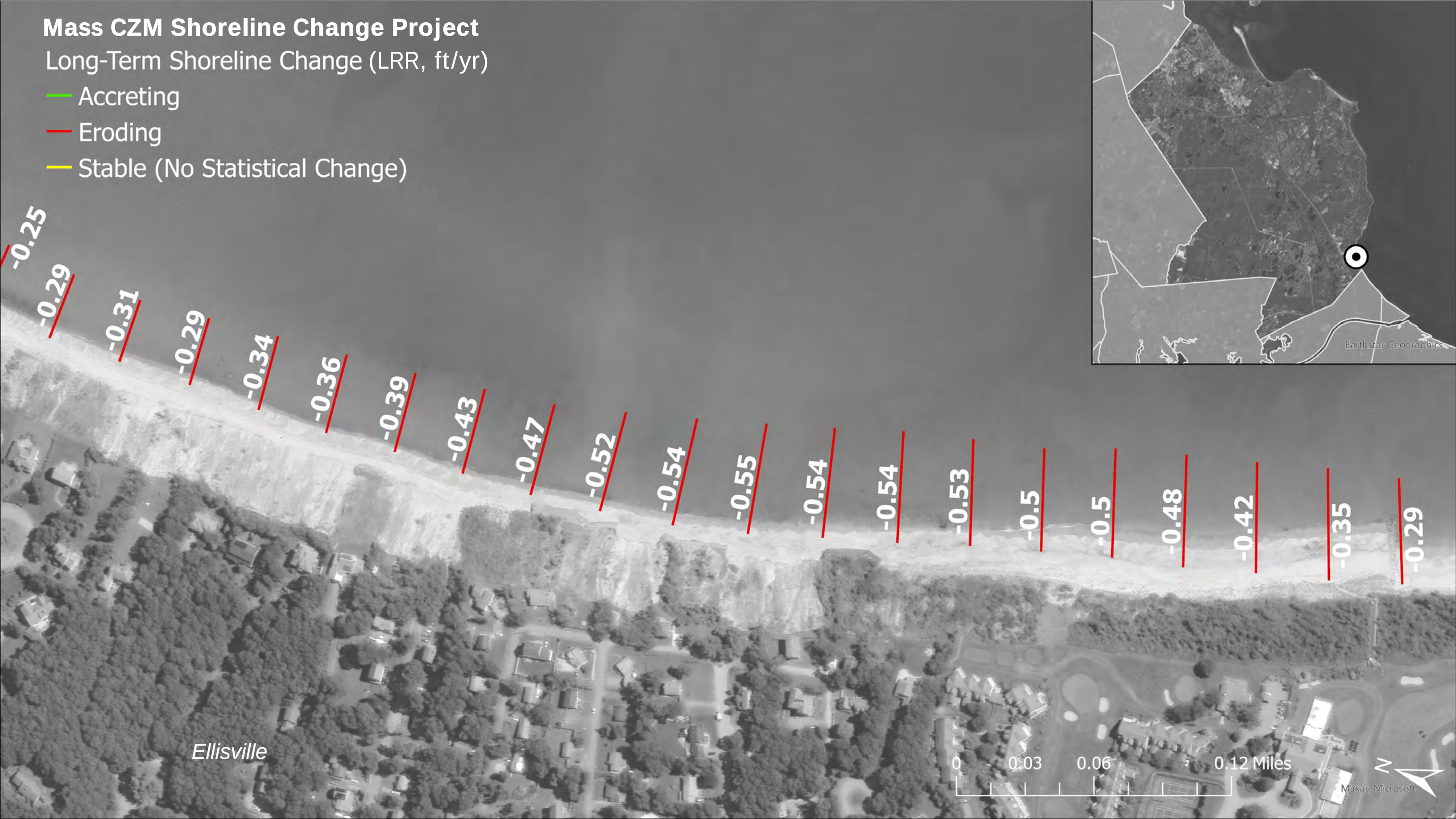


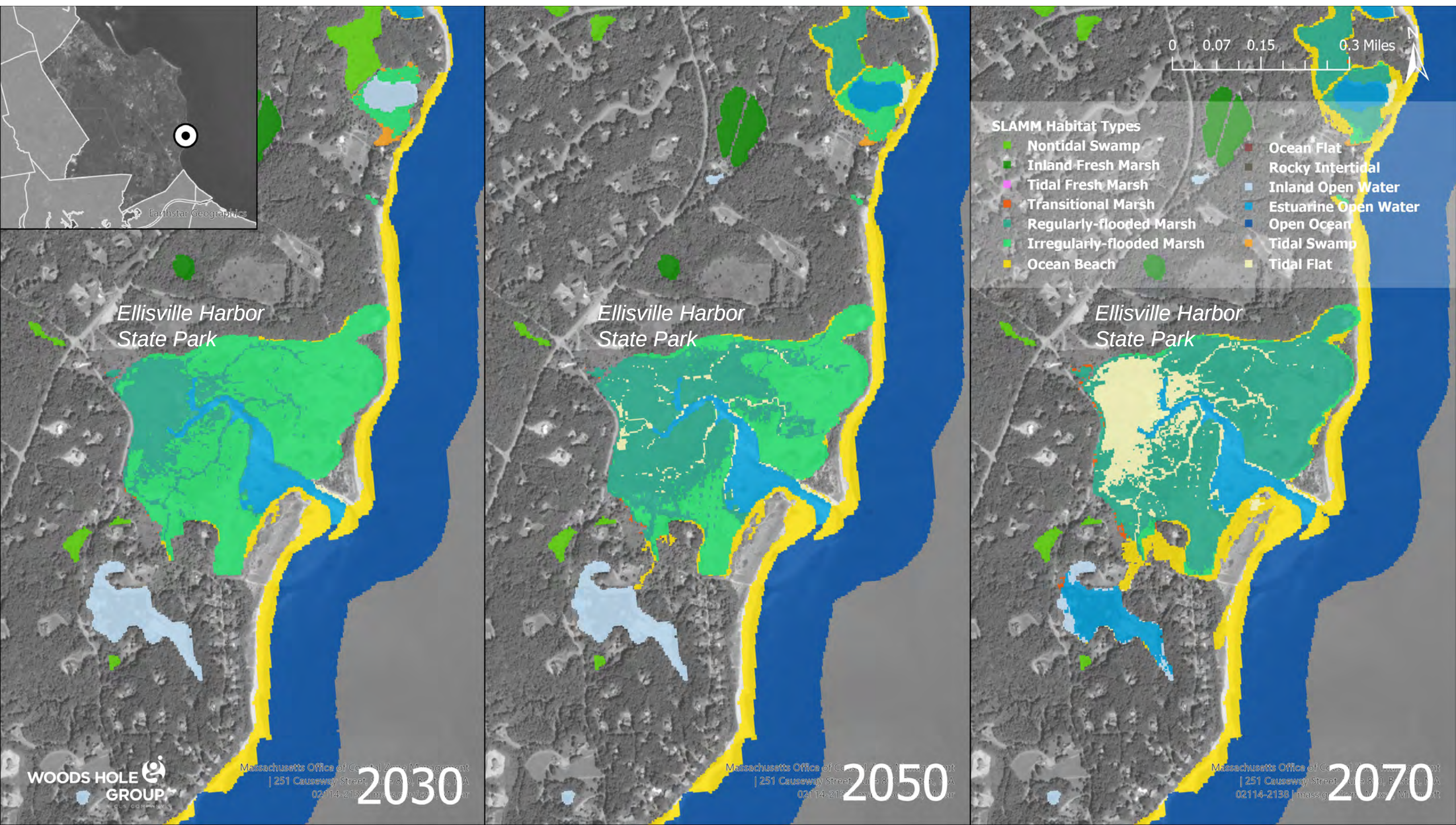


Mass CZM Shoreline Change Project

Long-Term Shoreline Change (LRR, ft/yr)

- Accreting
- Eroding
- Stable (No Statistical Change)





# Adaptation Strategies – a Summary of Approaches (NCCCAREF, 2019)



## Avoid

Identify future 'no-build areas' and use planning tools to prevent new development in areas at risk now or in future



## Accommodate

Continue to use the land but accommodate changes by building on piles, converting agriculture to fish farming or growing flood- or salt-tolerant crops



## Retreat

Withdraw, relocate or abandon assets that are at risk; ecosystems are allowed to retreat landward as sea levels rise



## Protect

Use hard structures (eg sea walls) or soft solutions (eg dunes and vegetation) to protect land from the sea. May be prohibitively expensive, especially in the long term



Key Considerations:

### Cost of response



Low – high  
Potential cost to government and regulators

### Length of protection



Short- to long-term protection

# Adaptation Strategies –Landscape Scale

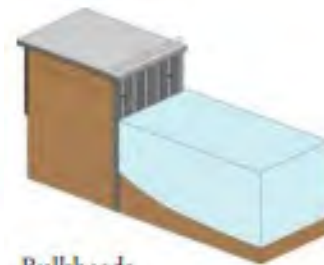
## Protect (hardened infrastructure)



Elevation of Land and Streets



Floodwalls



Bulkheads



Revetments



Seawalls



Levees (or Dikes)



Breakwaters

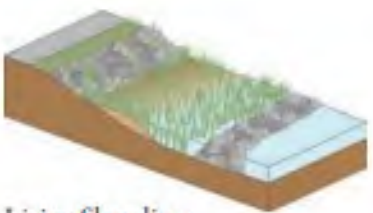


Surge Barriers

## Protect (natural or nature-based infrastructure)



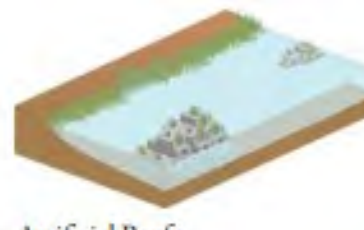
Beaches and Dunes



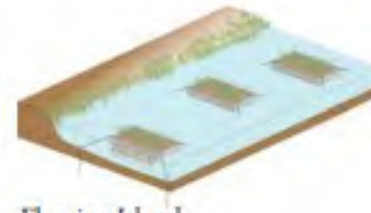
Living Shorelines



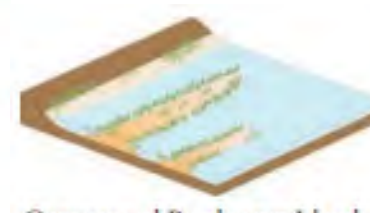
Constructed Wetlands



Artificial Reefs



Floating Islands



Constructed Breakwater Islands

## Protect (hybrid infrastructure)



Waterfront Parks



Multi-purpose Levees

## Relocate/Retreat



Strategic Retreat

(Credit: Modified from NYCPlanning, Coastal Climate Resilience Urban Waterfront Adaptive Strategies)

# Key Climate Change Takeaways for Plymouth

## Anticipated trends for climate related impacts:

- **Milder winters** with less frequent freezing
- **Hotter summers** with more frequent extreme heat
- On average **more precipitation**, but increasingly characterized by prolonged dry periods and more concentrated bursts of extreme precipitation
- **Accelerating sea level rise** causing more frequent and more widespread high-tide (sunny day) flooding, resulting in potential loss of access and shifts in coastal wetlands
- **More frequent and more intense coastal storms** compounded by rising seas, resulting in increased frequency and severity of damage from coastal flooding and erosion

## Key considerations for planning:

- Resilience is the ability to **prepare for, respond to, and recover from** the effects of climate change while minimizing damage to the environment, economy, and society
- With long-term uncertainty for future conditions, it is important to adopt adaptation strategies that are **flexible and can be phased over time** in response to evolving conditions
- Adaptations that incorporate **nature-based solutions** also provide community and ecosystem co-benefits

# Things to think about

- How have you observed or experienced climate related impacts over the last ten years?
- What do you see as the largest climate and resilience issues facing Plymouth today? What about in the future?
- What climate adaptation strategies should be prioritized? What and where?
- How can/should Plymouth's Master Plan support these strategies?

A blue-tinted photograph of a town street. On the left is a multi-story brick building. On the right is a historic building with a prominent clock tower. In the background, a church with a steeple is visible through trees. The street has crosswalks and a bench. The text "05 YOUR TURN!" is overlaid in the center in a bold, yellow font.

# 05 YOUR TURN!

# Tonight's discussion

**We need your input** to inform community goals and priorities for natural resource conservation, open space and recreation planning, and sustainability and resilience in Plymouth.

- 45 minutes of small group discussions followed by report-backs
- There will be an online survey for those who could not attend tonight



# Natural Resources

- What natural resources do you most care about?
- How do you interact with Plymouth's natural environment?
- How should Plymouth balance natural resource protection with growth and development?

# Open Space & Recreation

- What open space and recreational resources and facilities do you use the most?
- How could Plymouth's existing open space and recreational resources and facilities be improved?
- Where could new open space, recreational spaces, and programming be accommodated and what opportunities should they provide?
- What's missing

# Climate Resilience & Sustainability

- How have you observed or experienced climate related impacts over the last ten years?
- What do you see as the largest climate and resilience issues facing Plymouth today? What about in the future?
- What climate adaptation strategies should be prioritized? What and where?
- How can/should Plymouth's Master Plan support these strategies?

# Please leave all written materials on the tables

What we hear will be used to develop topic specific **draft goals and priorities** for the future of Plymouth

- Ideas on the individual worksheets and table maps will be summarized.
- Input from the online survey will be added to tonight's.



# 06 UPCOMING ENGAGEMENT OPPORTUNITIES

# ALL SURVEYS REMAIN OPEN

Online surveys from all past public meetings and workshops are available on the project website

Tell your friends and neighbors!

Take a survey!



## Land Use, Housing, & Transportation Survey

Similar to the second topic workshop on November 20.

[Take The Survey](#)



## Economic Development & Infrastructure/Services

Similar to the first topic workshop on October 24.

[Take The Survey](#)

# PUBLIC LISTENING SESSIONS

Sessions are taking place across  
Plymouth

**5 remaining** and **one virtual** option  
available



## *"Charting Our Future Together"* **Plymouth Master Plan** **Public Listening Sessions**

**We want to hear from you!** Listening sessions are being held at various village locations to meet people where they are and gather perspectives from different areas of Plymouth. Hosted by the Plymouth Master Planning Committee, these public sessions will include a brief presentation followed by an opportunity to discuss planning priorities and provide feedback on key questions.

**All listening sessions will be held from 6:00 - 7:30pm**

Session 01  
**Wednesday,  
October 30**

The Pinehills  
The Stonebridge Club  
(55 Stonebridge Rd)

Session 02  
**Monday,  
November 18**

North Plymouth  
Cold Spring Elementary  
(25 Alden St)

Session 03  
**Monday,  
December 9**

Plymouth Center  
Town Hall & **Hybrid via ZOOM**  
(26 Court St)

Session 04  
**Monday,  
December 16**

West Plymouth  
West Elementary  
(170 Plympton Rd)

Session 05  
**Monday,  
January 6**

Cedarville  
Cedarville Fire Station  
(2209 State Rd)

Session 06  
**Thursday,  
January 16**

Manomet  
Manomet Elementary  
(70 Manomet Pt Rd)

Session 07  
**Wednesday,  
January 29**

Redbrook  
Great Room at Redbrook  
(1 Greenside Way N)

Unable to attend in-person? Share your feedback via the online survey:

[tinyurl.com/PlymouthMasterPlan](https://tinyurl.com/PlymouthMasterPlan)

*If you require language interpretation services for any of these events, please notify the project team at least two weeks in advance of the meeting date at [PlymouthMasterPlan@gmail.com](mailto:PlymouthMasterPlan@gmail.com).*

# VISIT OUR WEBSITE TO PARTICIPATE ONLINE AND STAY INFORMED

Participate when it's convenient for you.

- Interactive map and surveys
- Latest project news and upcoming meetings/events
- Past presentations and project documents



Project website link:

<https://tinyurl.com/PlymouthMasterPlan>



A blue-tinted photograph of a town street scene. On the left, there are shops with signs for 'LONG HOUSE CRAFT BEER', 'WINE BAR', and 'AXE THROWING'. A person is walking away from the camera on the sidewalk. In the center, there are large trees and outdoor seating areas with tables and chairs under umbrellas. On the right, there is a multi-story building with many windows. The overall atmosphere is peaceful and scenic.

# THANK YOU!