

# CLIMATE CHANGE ADAPTATION IN MASSACHUSETTS



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*Executive Office of Energy and Environmental Affairs*



# MA Global Warming Solutions Act of 2008

## Mitigation

- Reduce greenhouse gas emissions below 1990 levels by 10-25% by 2020 and 80% reduction by 2050
- “Clean Energy and Climate Plan for 2020” (the 2020 Plan)

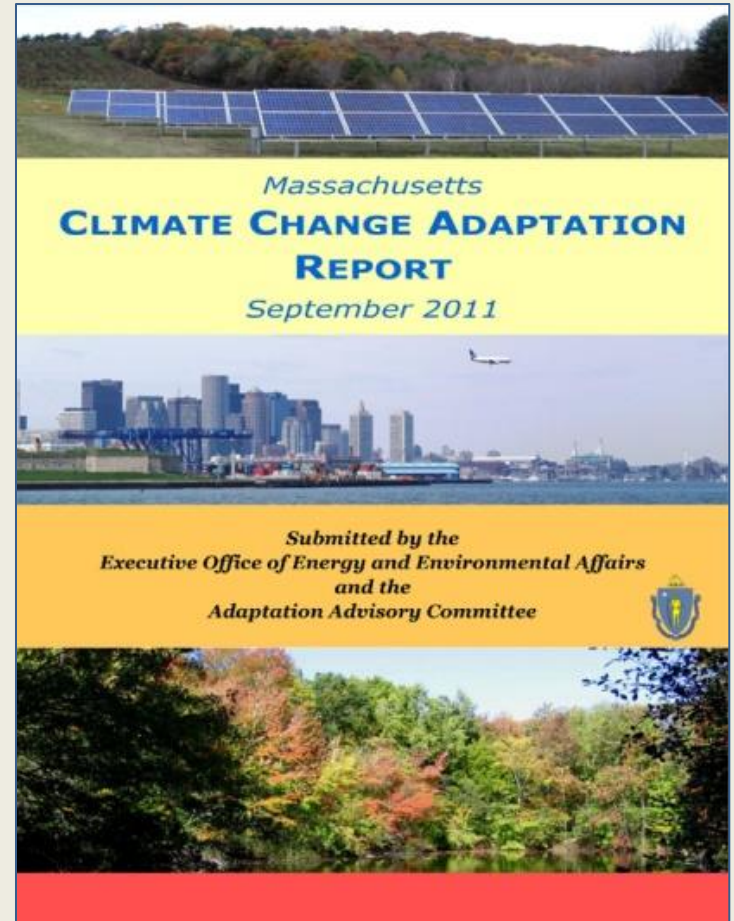
## Adaptation

- Convene a committee and prepare a report to Legislature to: “analyze strategies for adapting to the predicted impacts of climate change in the Commonwealth”
- MA Climate Change Adaptation Report issued in 2011



# MA Climate Change Adaptation Report, 2011

- Climate Change Impacts
- Natural Resources and Habitat
- Key Infrastructure
- Human Health and Welfare
- Local Economy and Government
- Coastal Zone and Oceans
- Cross-Cutting Strategies



<http://www.mass.gov/environment/cca>



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# Potential Impacts and Vulnerabilities

- **Sea Level Rise and Flooding**
  - Coastal inundation and storm surges
  - Property damage and loss of natural habitats
  - Interruption of key services
- **Extreme Weather**
  - High winds, hurricanes, storm surges, waves, ice storms, flooding
  - Reduced emergency response capacity
- **Precipitation**
  - Decreased summer, increased winter precipitation
  - Less spring snow melt and earlier peak streamflow
  - Current 100-year flood every 2-3 years by 2100
  - Extended low-flow periods, decreased summer water supply
- **Temperature**
  - Higher temps, more extreme heat

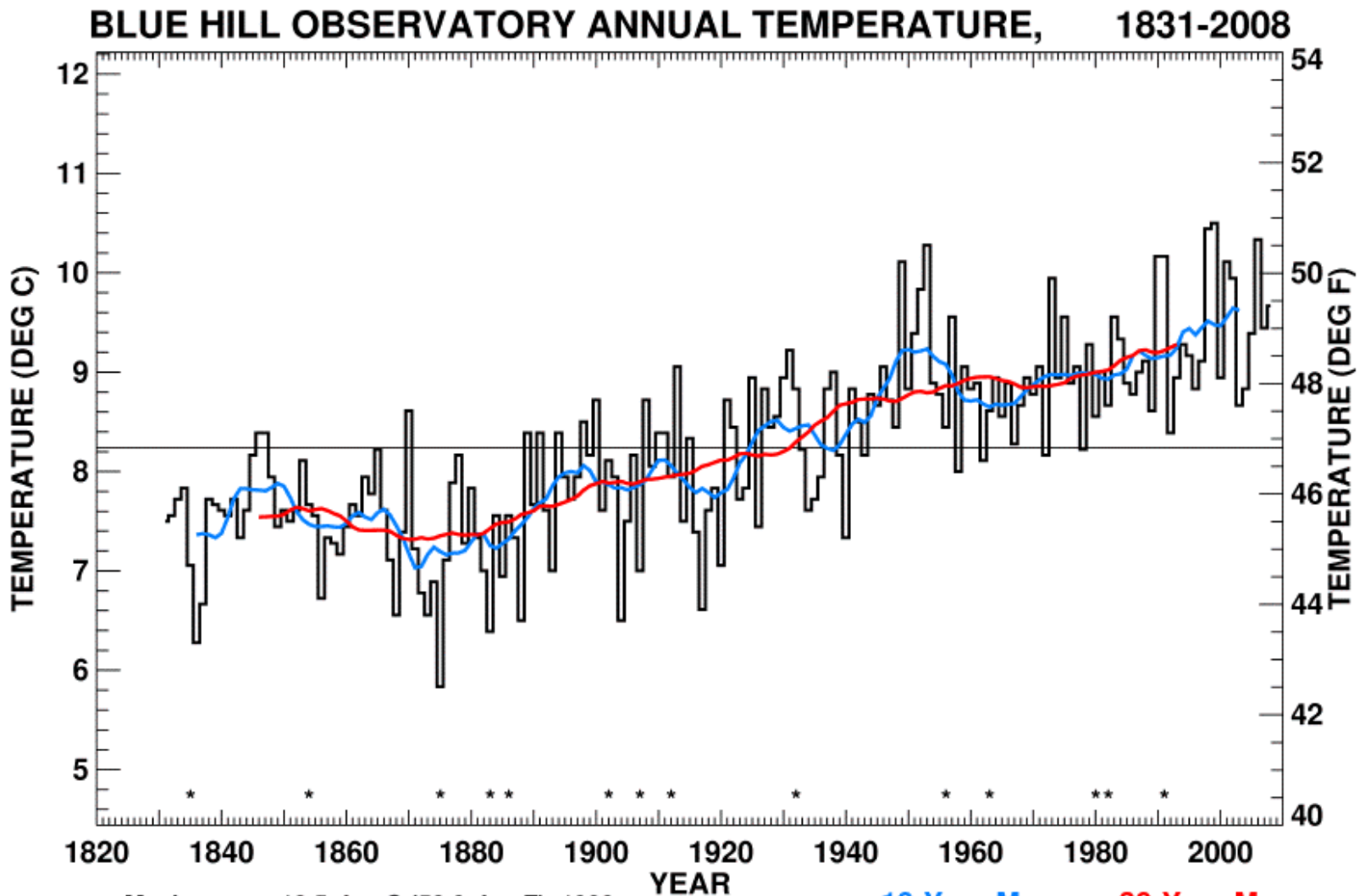


# Predicted Northeast Climate Change Impacts

<b>PARAMETER</b>	<b>CURRENT (1961-1990)</b>	<b>PREDICTED RANGE by 2100</b>
Annual Temperature (° F)	46	50 to 55
Annual Precipitation (inches)	41	43 to 46
Sea Level Rise (inches)	3.1	11 to 79
Streamflow-spring peak flow (days from January 1)	85	74 to 75
Short Droughts (#/30 yr)	13	16 to 23
Snow Days/Month (days)	5	3 to 1
Length of growing season (days)	184	213 to 227



# Observed Annual Average Temperature in MA



Maximum: 10.5 deg C (50.9 deg F), 1999  
Minimum: 5.8 deg C (42.5 deg F), 1875  
Record Mean: 8.2 deg C (46.8 deg F)

\* Indicates dates of largest global volcanic eruptions.

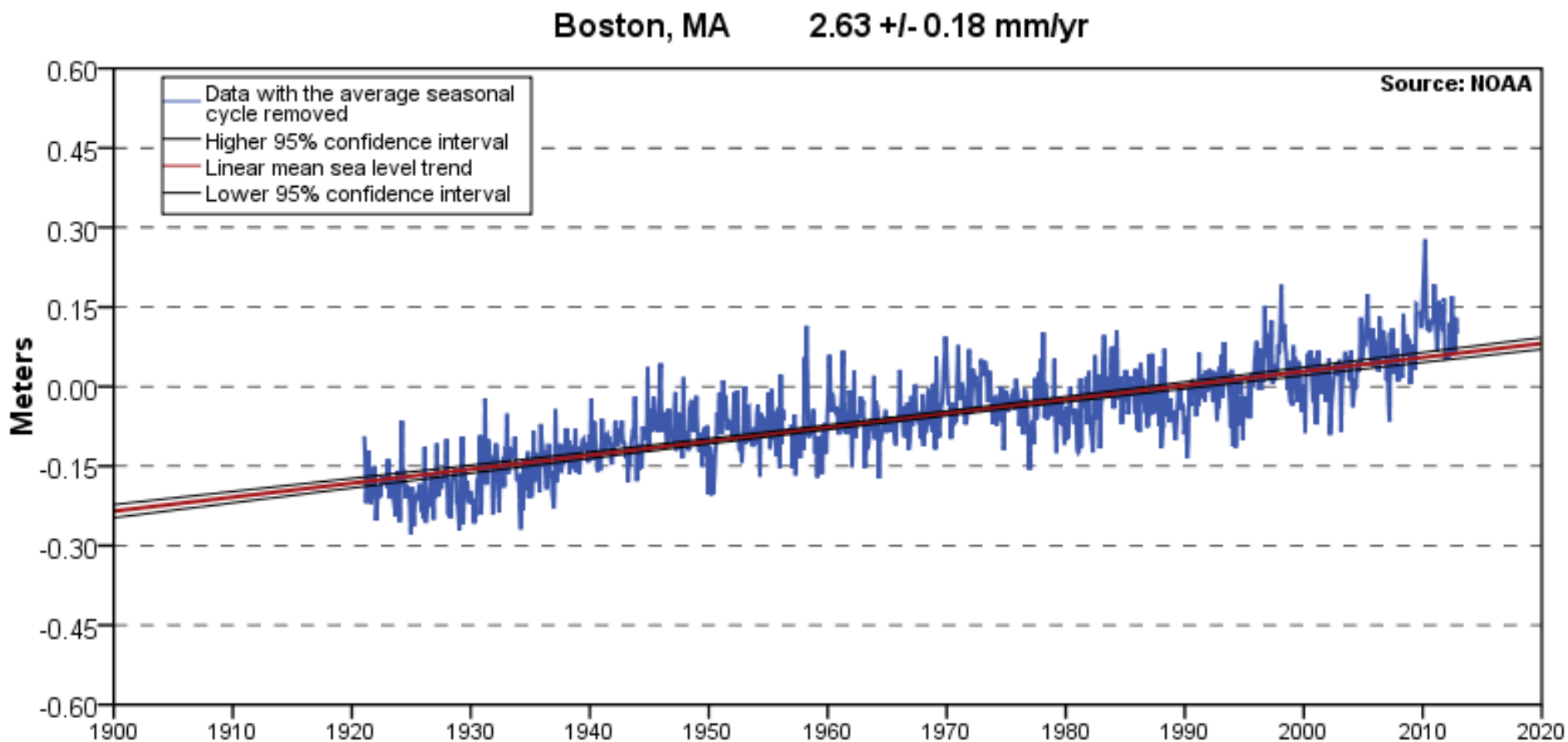
Note: Plot includes temperature data for 1831-1884 from Milton and Canton that were adjusted to the Blue Hill summit location.

Michael J. Iacono, Atmospheric and Environmental Research, Inc. / Blue Hill Observatory



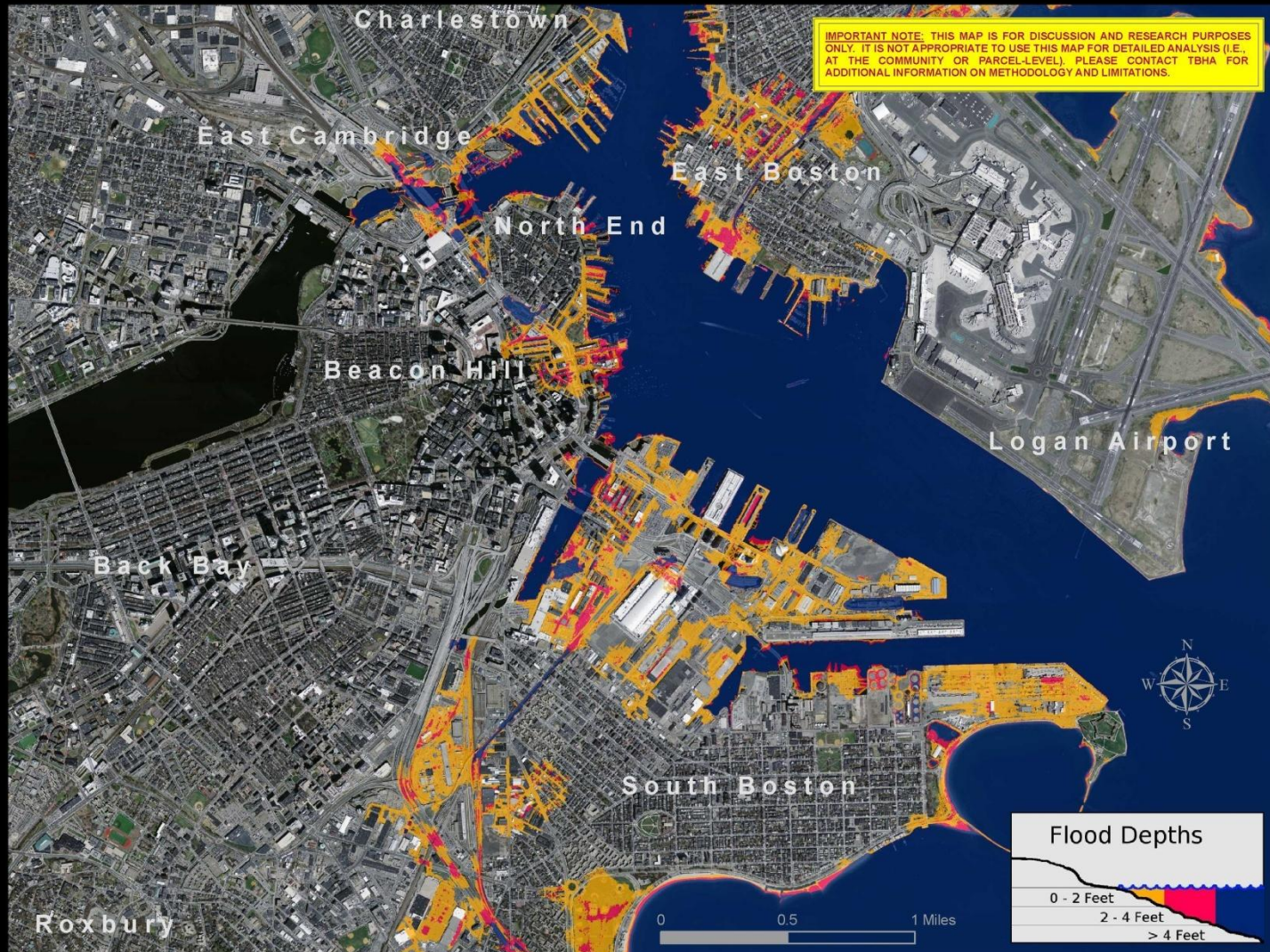
# Sea Level Rise in Boston, MA

## 8" over past 80 years



# Boston – 5 feet of Sea Level Rise or Surge

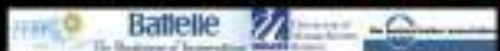
Source: The Boston Harbor Association, 2013





# Boston – 7.5 feet of Sea Level Rise or Surge

Source: The Boston Harbor Association, 2013



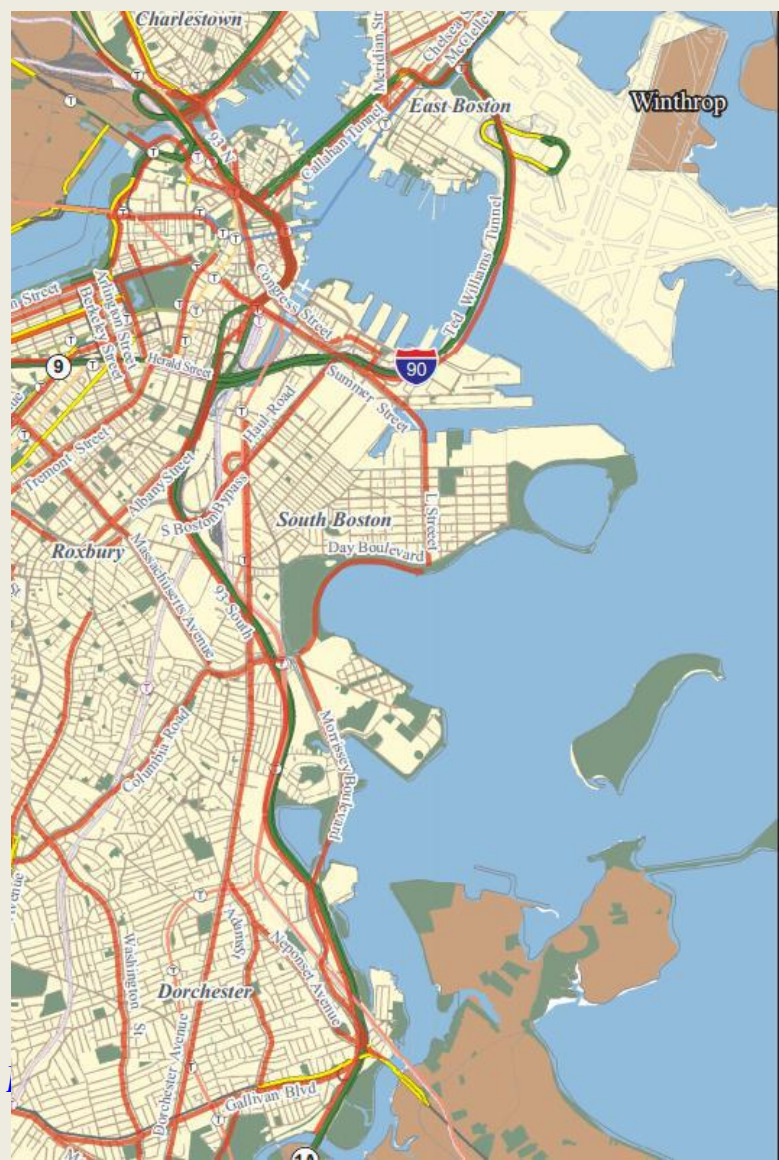
Boston Inner Harbor  
Mean Higher High Water Plus 7.5 Feet  
Sources: MassGIS, NOAA, USGS

Map Developer:  
Dora Golden, Ellen Douglas - UNH, Boston  
Paul Roberts - Battelle  
The Boston Harbor Association



# Comparison: 5 feet of Sea Level Rise and Evacuation Routes

sources: City of Boston and TBHA



# Potential Losses to Boston with Sea Level Rise (2050)

- 0.65 m (~2 ft) sea level rise = \$463 billion in losses
- Only 23 of 184 insurance companies surveyed have comprehensive climate change strategies

*(Photo: [www.economicsofplace.com](http://www.economicsofplace.com))*



# MA Water Resources Authority (MWRA)

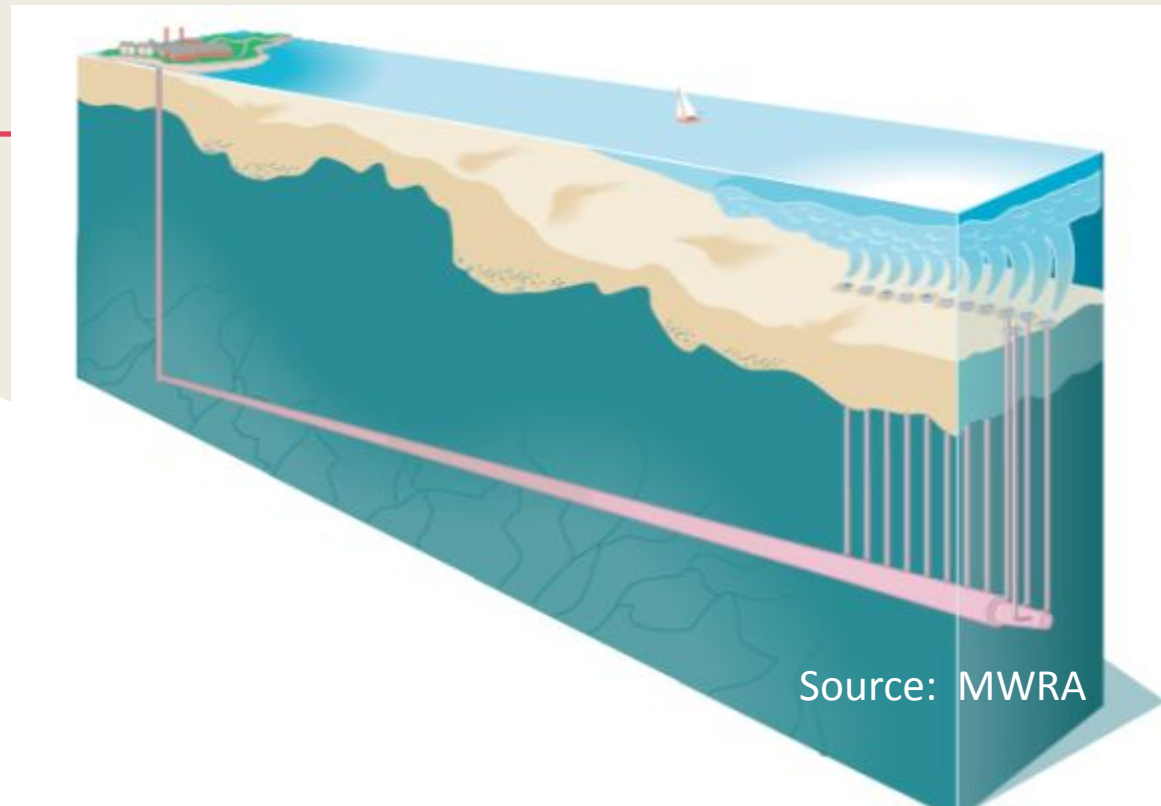
## Deer Island WWTP

- Over 2.5 million customers (~1/3 of MA Population)
- 200 million gallons/day to water customers
- 350 million gallons of wastewater/day collected and treated, peak capacity of 1.2 billion gallons/day
- Deer Island plant protected against Sea Level Rise and power outages
  - Designed in 1989
  - Protected against 100-year flood
  - Protected against 1.9-foot sea level rise
  - On-site plant for uninterrupted power



# Hydraulics of Outfall Design Considers Sea Level Rise

- Sewage treatment plant effluent is discharged through a gravity fed downhill pipe
- Tunnel diameter design was increased from 24 to 24.25 feet



# MWRA's Coastal Sewer Facilities

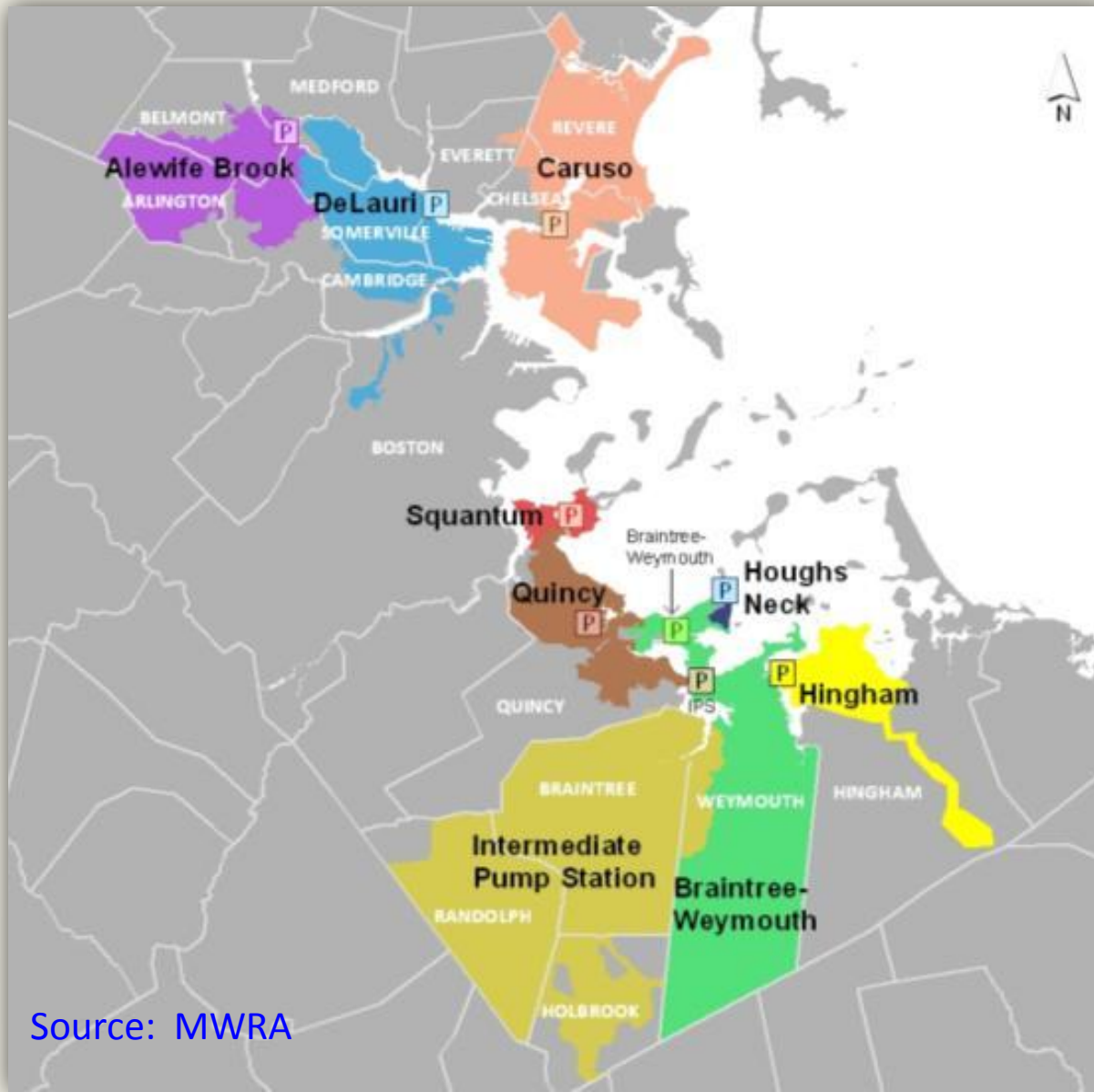
## 21 within 15 ft of Mean Sea Level



Source: MWRA

# MWRA's Coastal Pump Stations

## Areas Potentially Affected

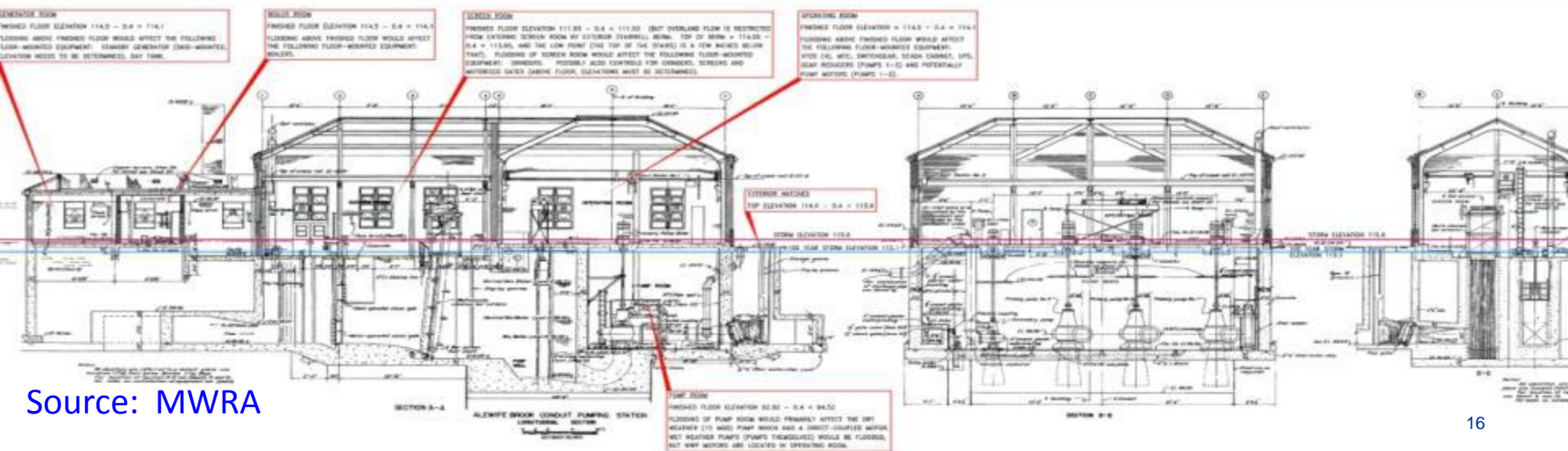


Source: MWRA



# Going Forward at MWRA 's Deer Island WWTP

- Short-term
  - Low-lying facilities protected with sandbags and pumps
  - Mobile generators deployed in advance of storms
  - Increased staffing
- Long-term
  - Future rehabilitation contracts will take sea level rise into account
  - Consider moving important equipment to higher elevations



Source: MWRA



# Spaulding Rehabilitation Hospital - Charlestown

- Opened April 27, 2013
- 8 stories, 132 beds
- Designed for 2 ft of sea level rise as new 100-year flood elevation; first floor is 1.35 ft higher than that
- Patient rooms have key-operable windows and are not on ground or lower floors
- Mechanical and electrical systems on the roof



# Implementation of Adaptation Strategies by State Government

## Executive Office of Energy and Environmental Affairs

- convening committee to develop climate scenarios
- updating MA Environmental Policy Act public review process to consider effects of climate such as sea level rise
- developing priority infrastructure and preparedness projects

## Department of Environmental Protection

- updating tidelands & waterways (Chap 91) regulations to address sea level rise
- updated precipitation for wetlands and stream crossings
- desktop tool predicts flooding at water/wastewater treatment plants

## Department of Fish and Game

- using BioMap2 and Wildlife Action Plans for conservation and to manage vulnerable habitats



# Implementation of Adaptation Strategies by State Government

## Coastal Zone Management

- Storm Smart Coasts Program for municipalities
- developing visualizations tools and workshops

## Department of Transportation

- effects of sea level rise on Central Artery (\$500,000+ budget)
- enhancing The Boston Harbor Assn's SLR model

## MassPort

- disaster and infrastructure resiliency planning at Logan Airport and sea ports (\$500,000 budget)

## Department of Public Health

- assessing emergency preparedness of all 351 municipalities (heat waves)



# Implementation of Adaptation Strategies by Municipalities

## City of Cambridge

- vulnerability analysis
- enhance MA DOT model (works off of TBHA model)

## Boston Redevelopment Authority

- inventory of buildings

## Boston Conservation Commission

- sea level rise/wetlands ordinance

## Metropolitan Area Planning Council (regional planning)

- vulnerability analysis of region (101 communities)



# Thank you



## MA Adaptation Report

<http://www.mass.gov/environment/cca>

## Global Warming Solutions Act

<http://www.malegislature.gov/Laws/SessionLaws/Acts/2008/Chapter298>

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