



Changing Climate, Changing Regulations

Institutionalizing Flood Preparedness in Boston



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January 23, 2017

Superstorm Sandy



Rt. 12 Outer Banks



Lower Manhattan



An aerial photograph of a residential neighborhood in Breezy Point, showing significant destruction. The central portion of the image is dominated by a large area of rubble and debris, with many houses completely destroyed or severely damaged. The surrounding areas, particularly on the left and right sides, show rows of intact, multi-story houses with various roof colors (gray, blue, green, red). The houses are densely packed. In the background, there are more houses and some trees. On the right side, there is a parking lot filled with cars and a body of water with some boats. The overall scene depicts a community that has suffered a major disaster, likely a hurricane or storm surge.

Breezy Point

Boston's Waterfront

October 29, 2012



Why Coastal Flooding Happens

- Storm surges
- “Wicked high tides” during full & new moons
- Sea level rise



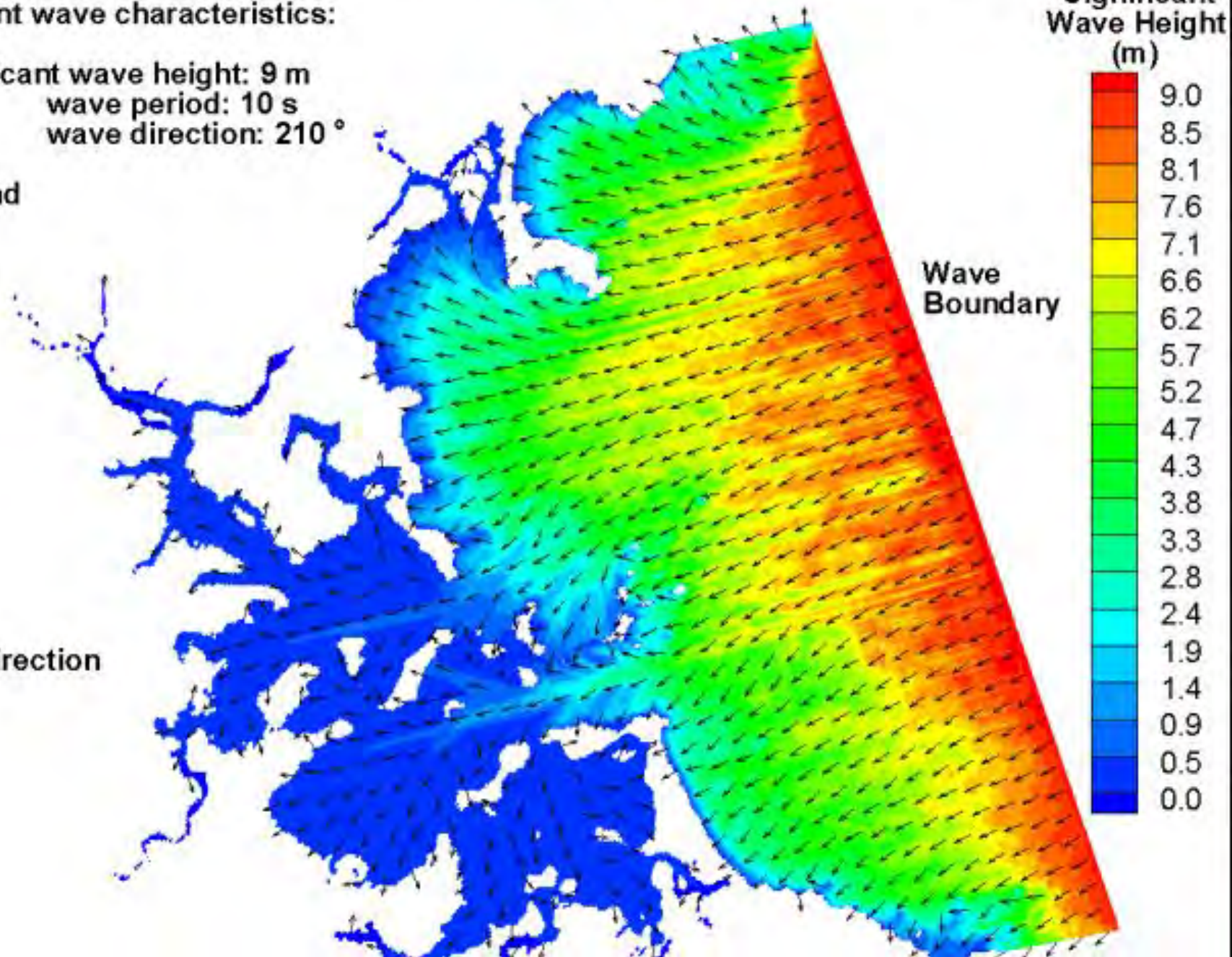
100-Year Wave Condition Applied at Wave Boundary

Incident wave characteristics:

Significant wave height: 9 m
wave period: 10 s
wave direction: 210°

no wind

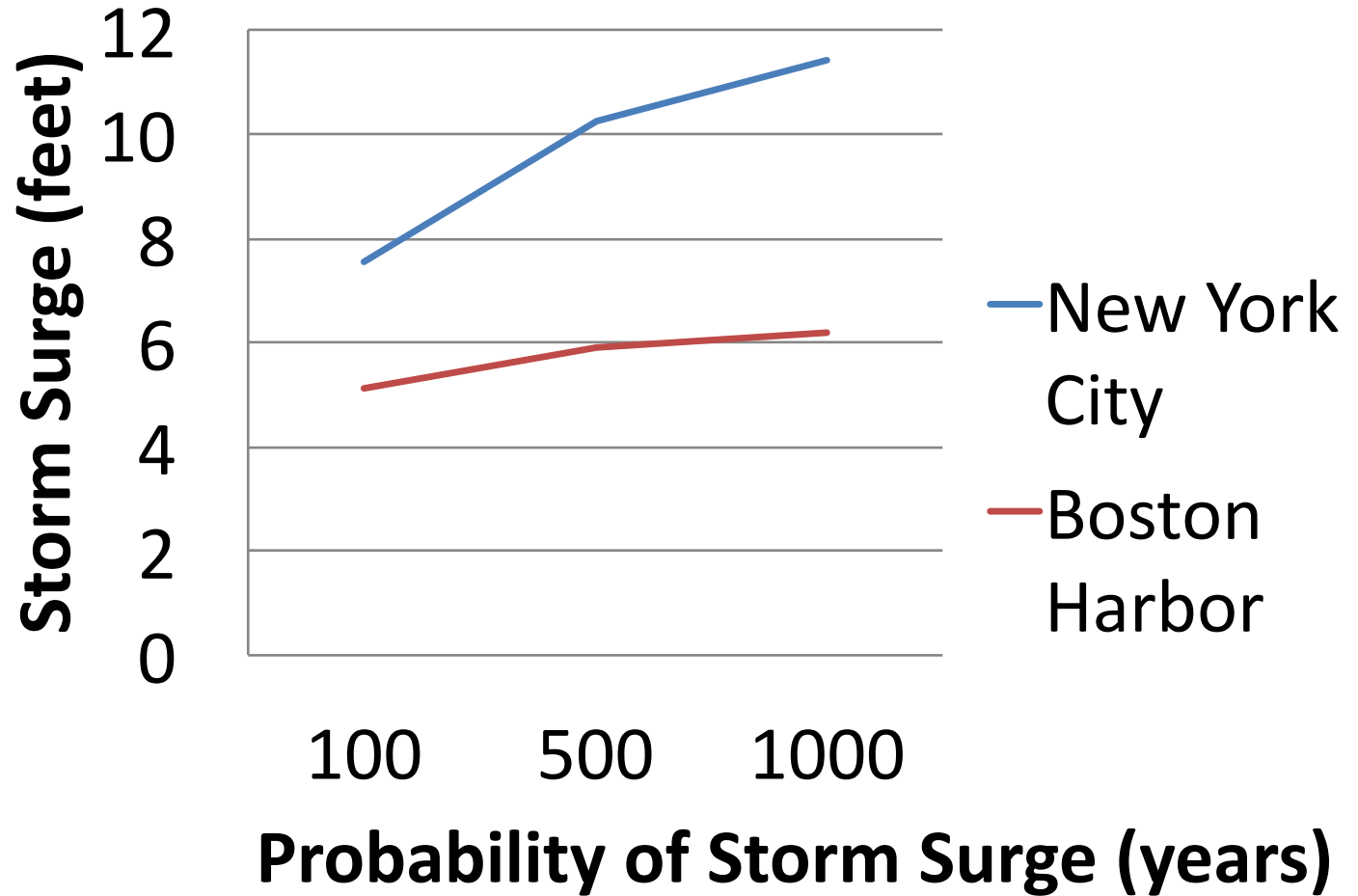
→
Wave direction







100-, 500- and 1,000-year Surges New York City + Boston Harbor



















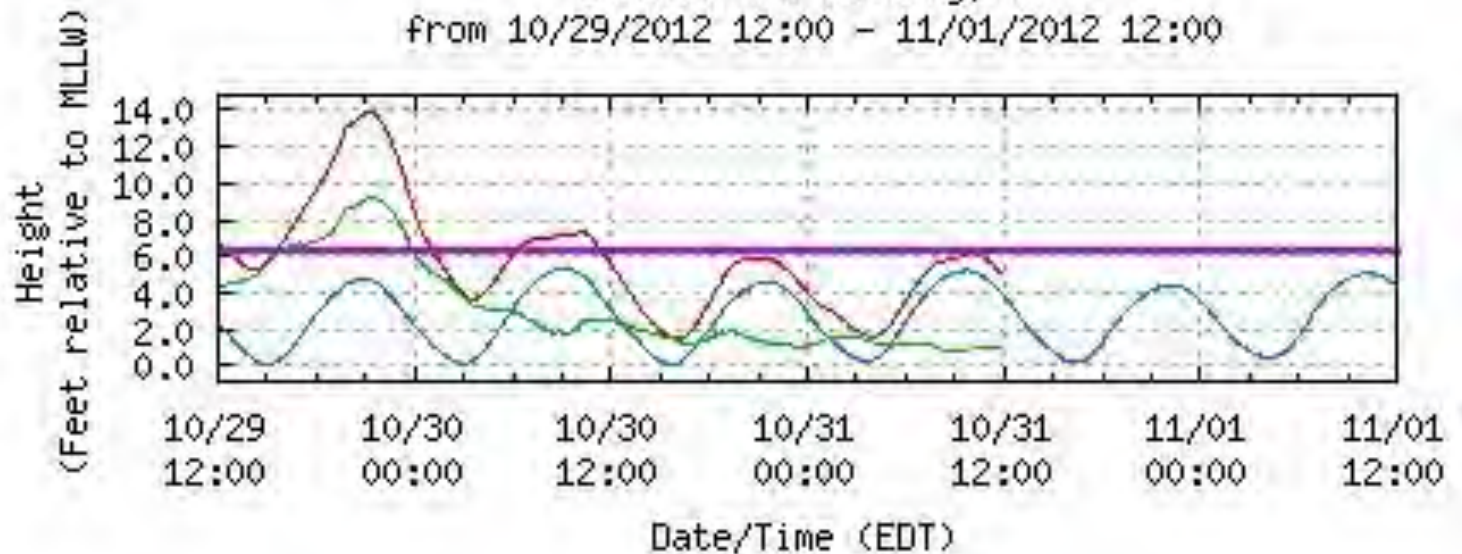
[The Battery, NY](#) - [Return to List](#)

NOAA/NOS/CO-OPS

Preliminary 6 min. Water Level vs. Predicted Plot

8518750 The Battery, NY

from 10/29/2012 12:00 - 11/01/2012 12:00



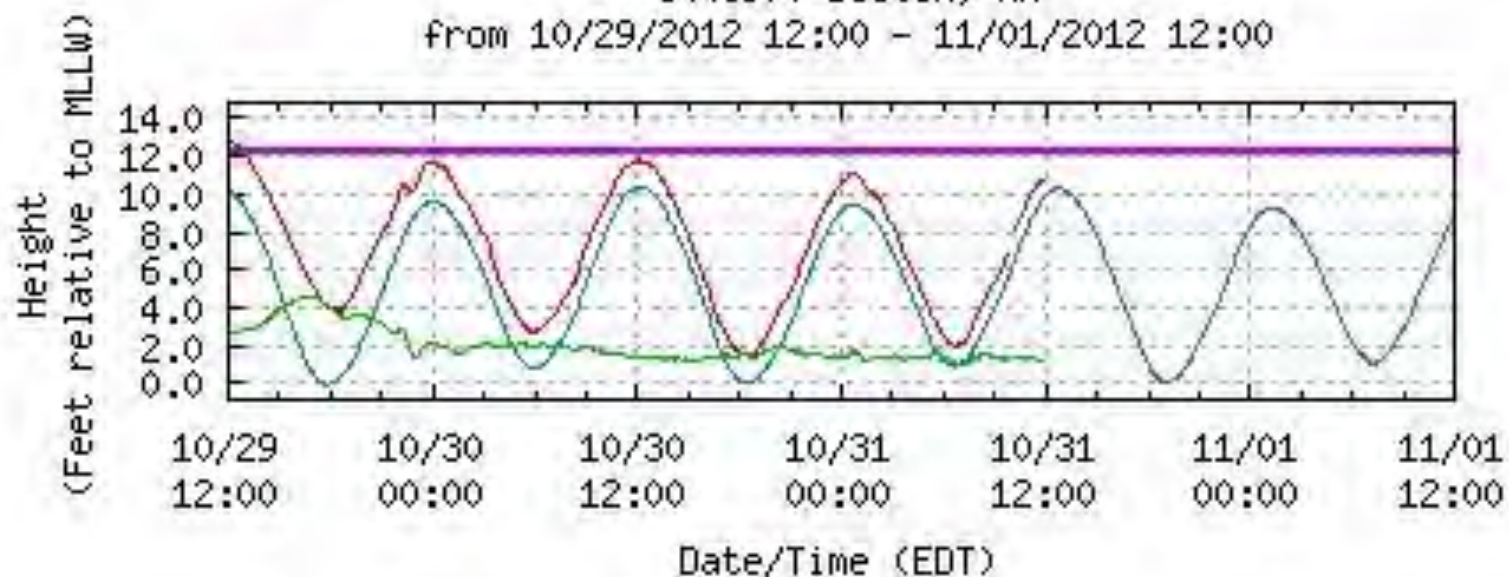
Predicted Tide —
Observed WL —

(Obs-Pred) —
HAT —

Tides

[Boston, MA](#) - [Return to List](#)

NOAA/NOS/CO-OPS
Preliminary 6 min. Water Level vs. Predicted Plot
8443970 Boston, MA
from 10/29/2012 12:00 - 11/01/2012 12:00

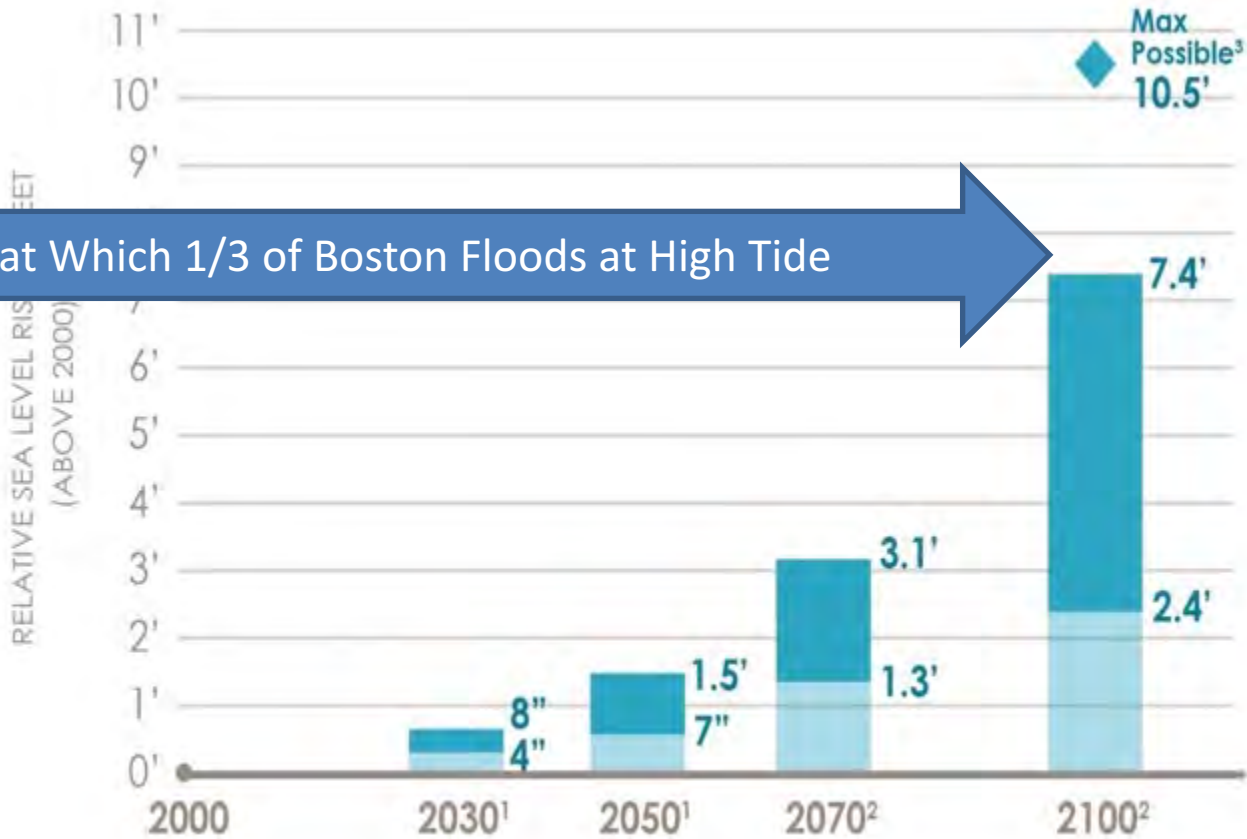


Predicted Tide —
Observed WL —

(Obs-Pred) —
HAT —

Sea Level Rise vs. Carbon Emissions

Height at Which 1/3 of Boston Floods at High Tide

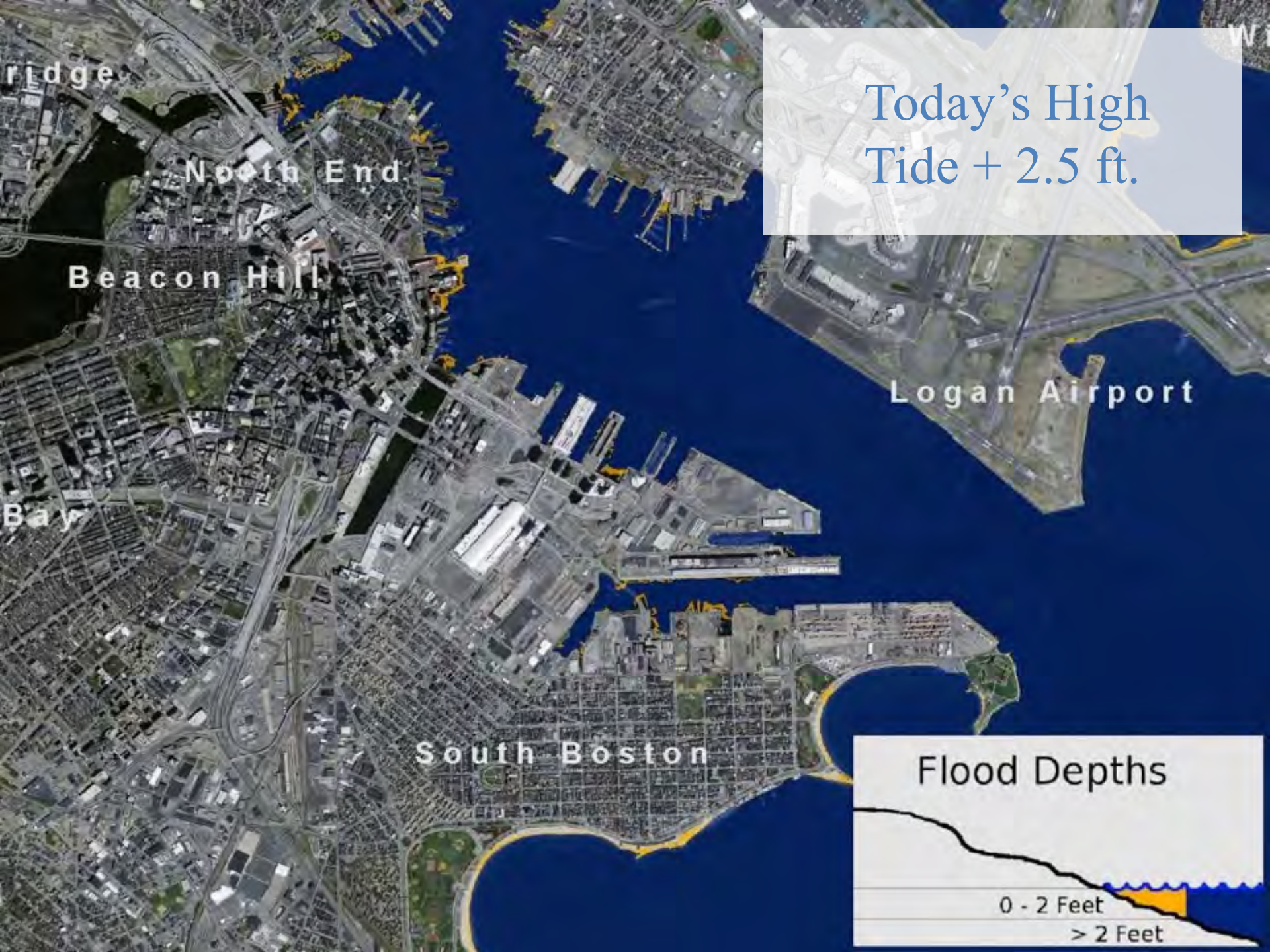


- 1 - Likely under all emission scenarios
- 2 - Likely under moderate to high emission scenarios
- 3 - Low probability under high emission scenario

Data Source: BRAG Report







ridge

North End

Beacon Hill

Bay

South Boston

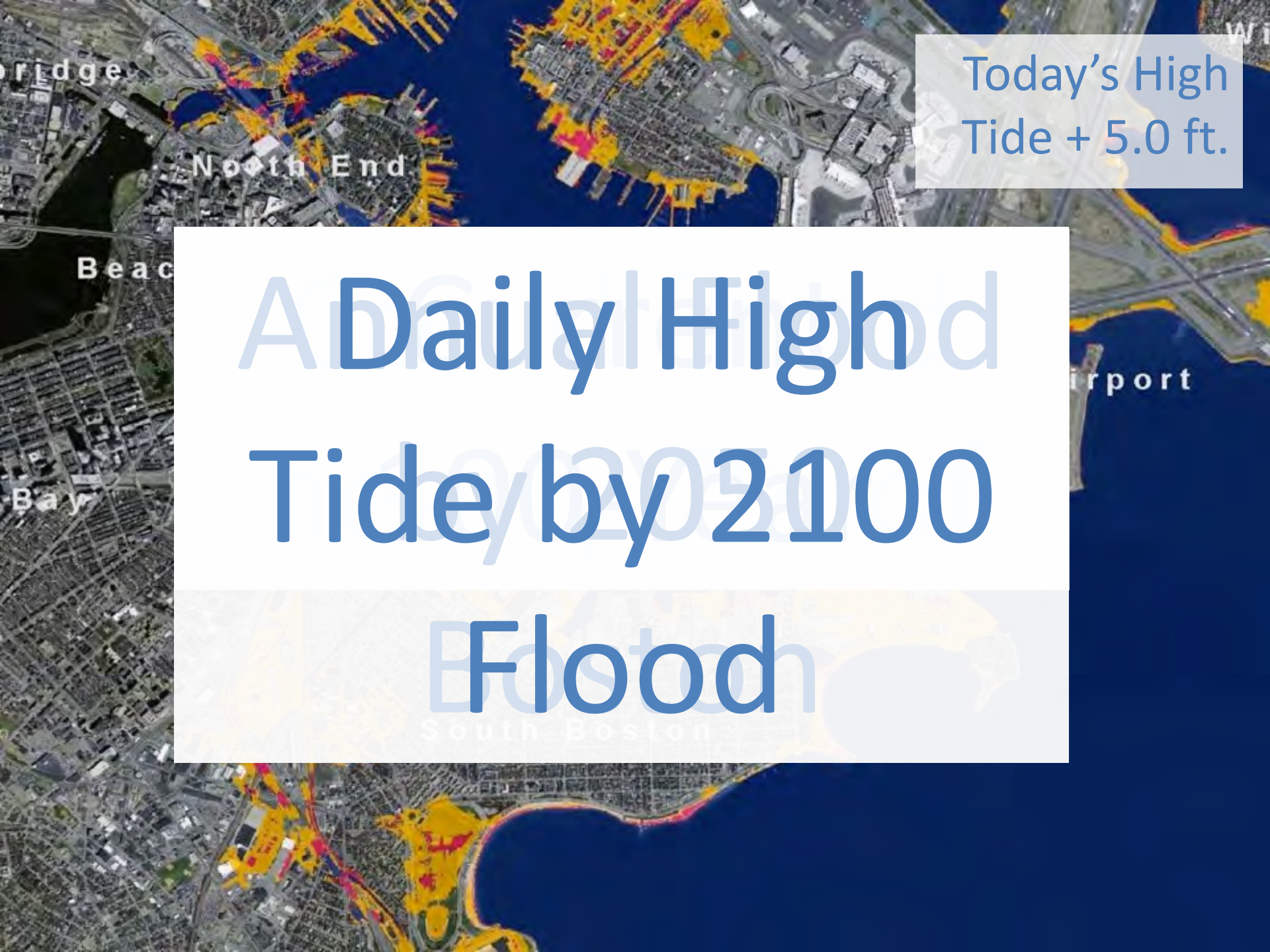
Today's High
Tide + 2.5 ft.

Logan Airport

Flood Depths

0 - 2 Feet

> 2 Feet



Today's High
Tide + 5.0 ft.

A Daily High Tide by 2100 Flood

Boston
South Boston

What Floods at High Tide+5?

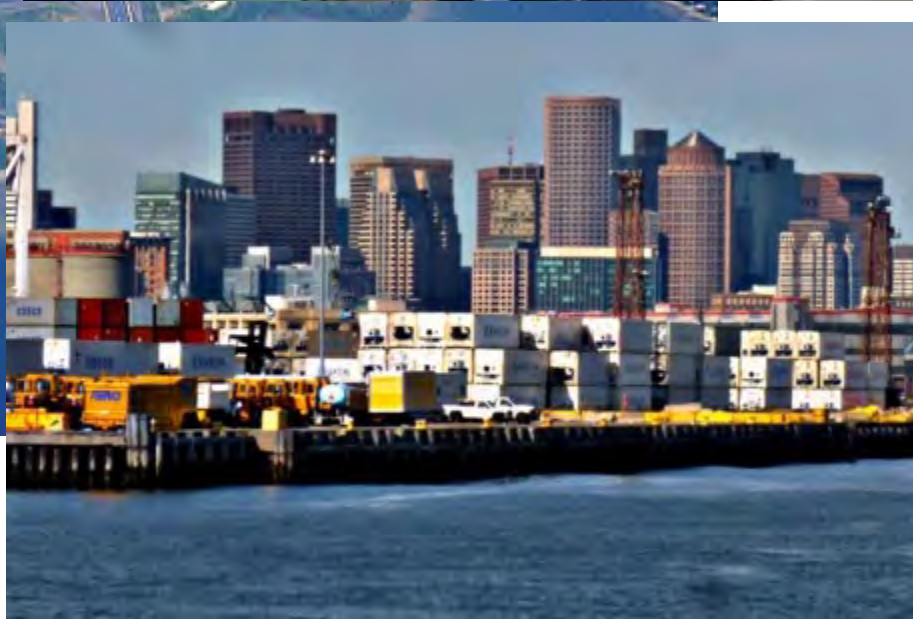


Today's High
Tide + 7.5 ft.

100 Year Flood around 2100 of Boston

South Boston

What Floods at High Tide + 7.5?



How Does This Affect The Built Environment?

- Climate changing during building lifespan
- Regulations assume static conditions
- Regulations need to be indexed to changing conditions



Boston's Flood-Related Regulations

- Article 25, Flood Hazard Districts
- Article 37, Green Buildings (with Article 80 Development Review and Approval)
- The Massachusetts Building Code
- Chapter 91, The Massachusetts Public Waterfront Act
- The Massachusetts Environmental Policy Act
- The Wetlands Protection Act
- FEMA Letters of Map Change

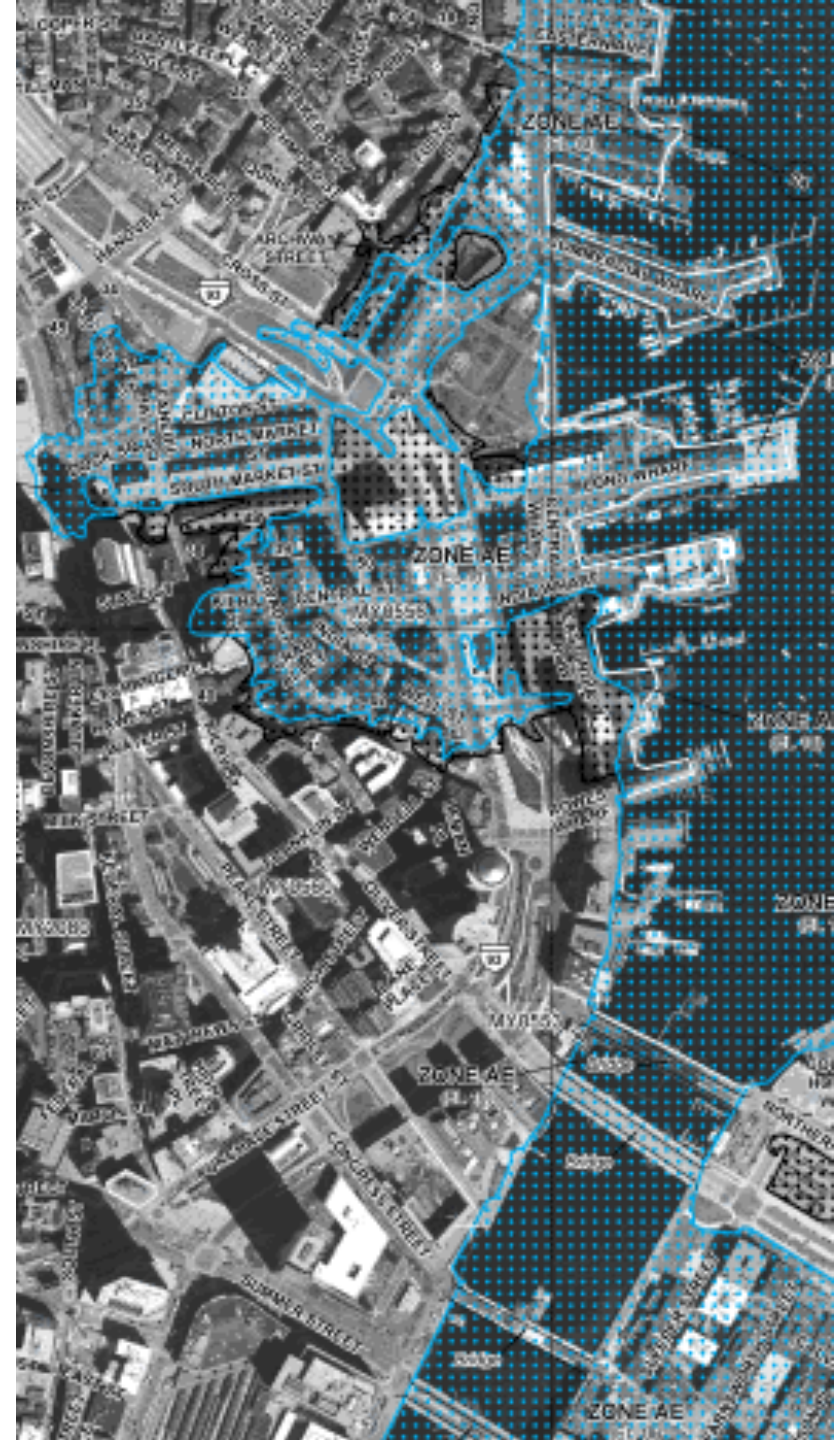
Best Bets

- Today
- Limitations
- Proposed
- In The Meantime...



Article 25: Today

- Based on FEMA Flood Insurance Rate Maps.
- Restricts buildings in areas of flood risk.
- Meets minimum requirements of the National Flood Insurance Program.



Article 25: Limitations

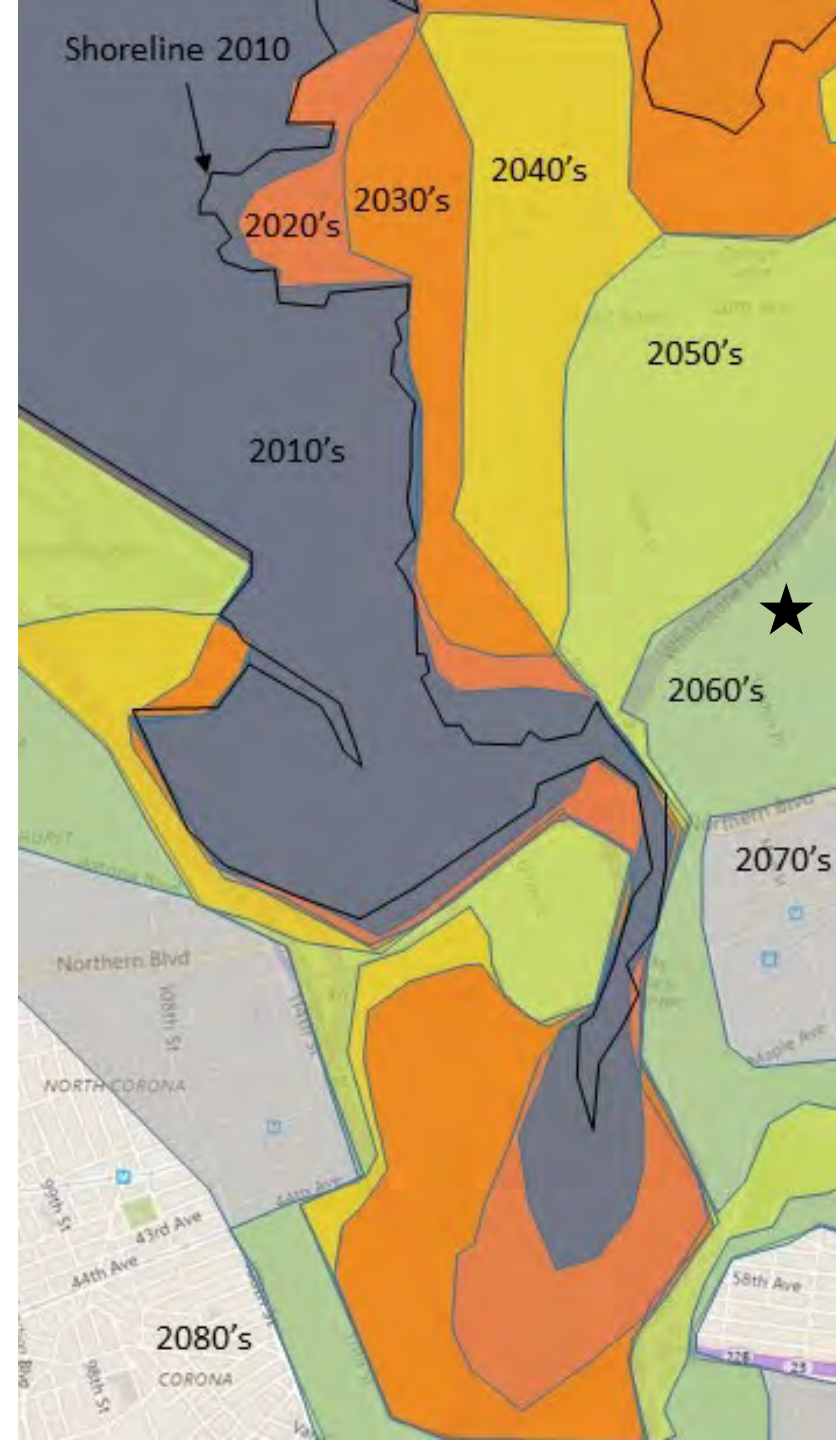
- Maps based on past, not future events.
- Buildings constructed today will last 60+ years.
- By 2070 seas level $\approx +3'$.
- Doesn't apply to existing buildings or to state and federal projects.



Seaport District Fan Pier - Sept 2012

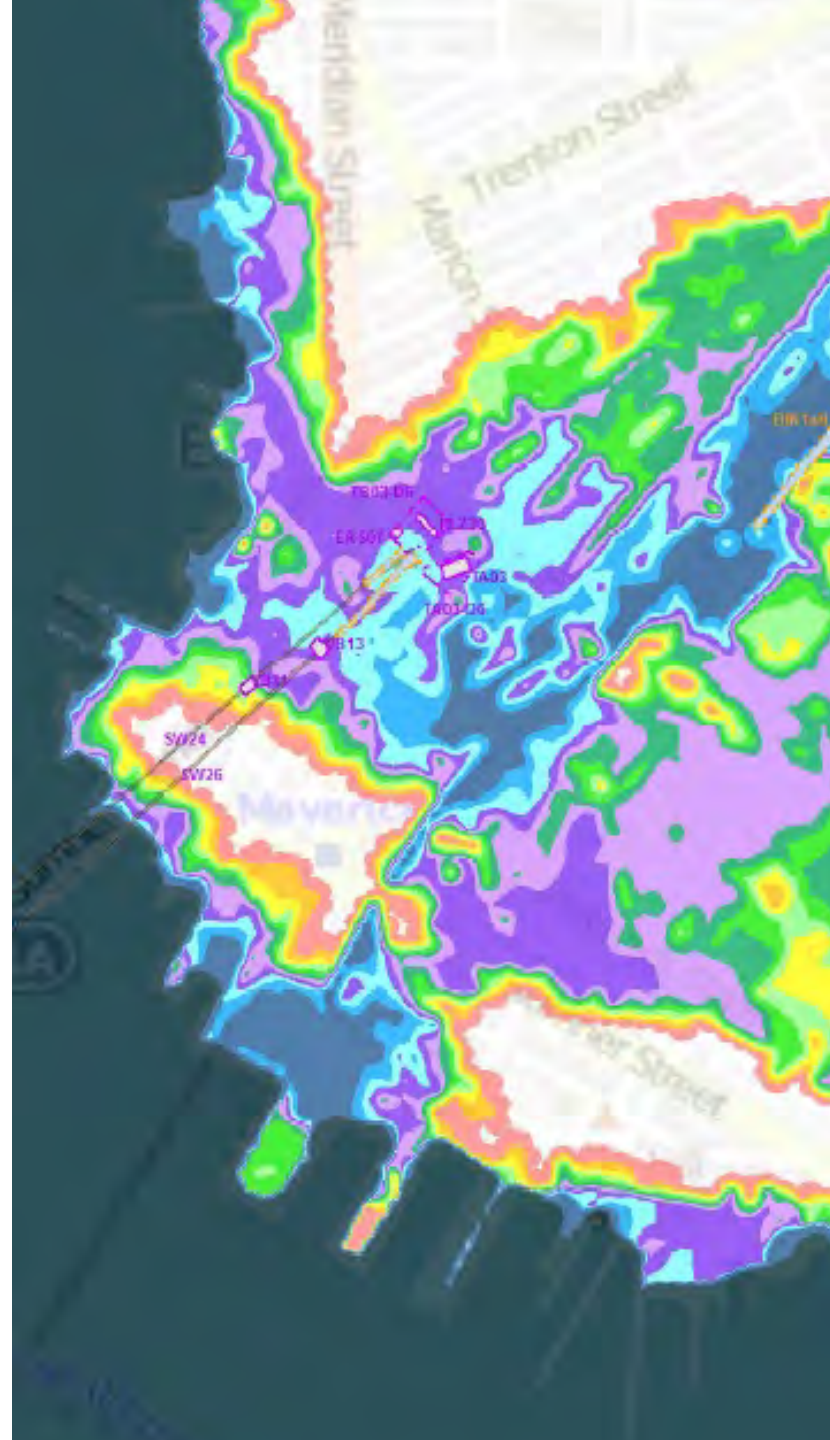
Article 25: Proposed

- Adopt map with future flood zones.
- Require flood resilience for full design life.
- Create a Flood Resilience Overlay District to encourage flood-adaptive design.



Article 25: In the Meantime...

- Consult SLR projections and BH-FRM maps to inform flood risk.
- Build as if the site were in a floodplain TODAY.
- Apply for zoning variances if needed for flood adaptive design.



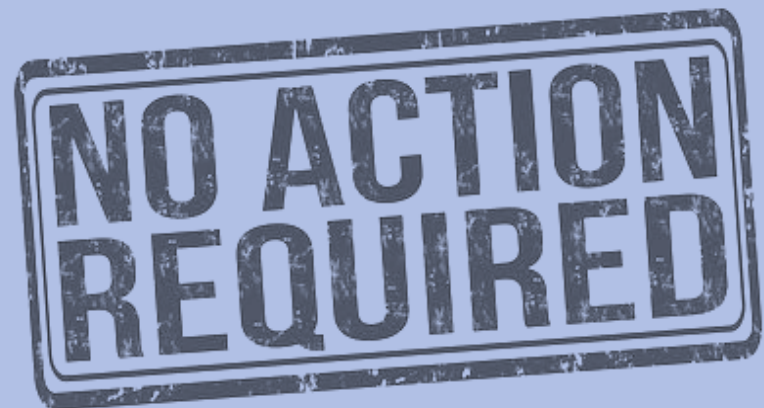
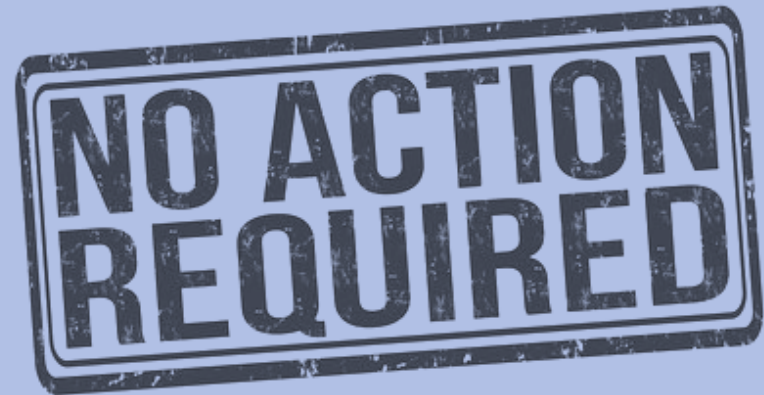
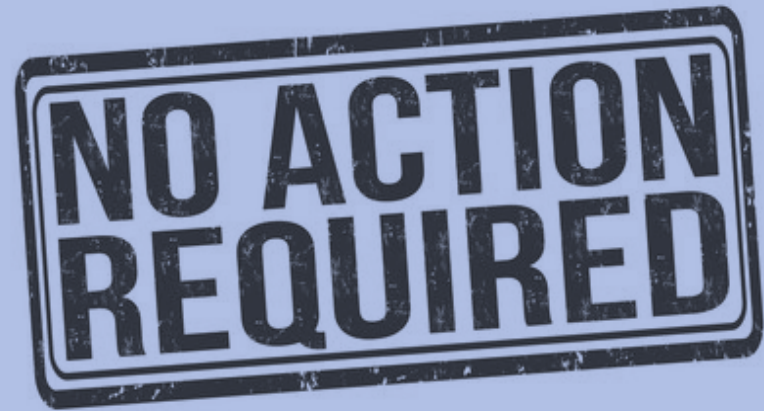
Article 37: Today

- Zoning ordinance administered by IGBC as part of Article 80 project review process.
- Requires completion of Climate Change Preparedness and Resiliency Checklist.



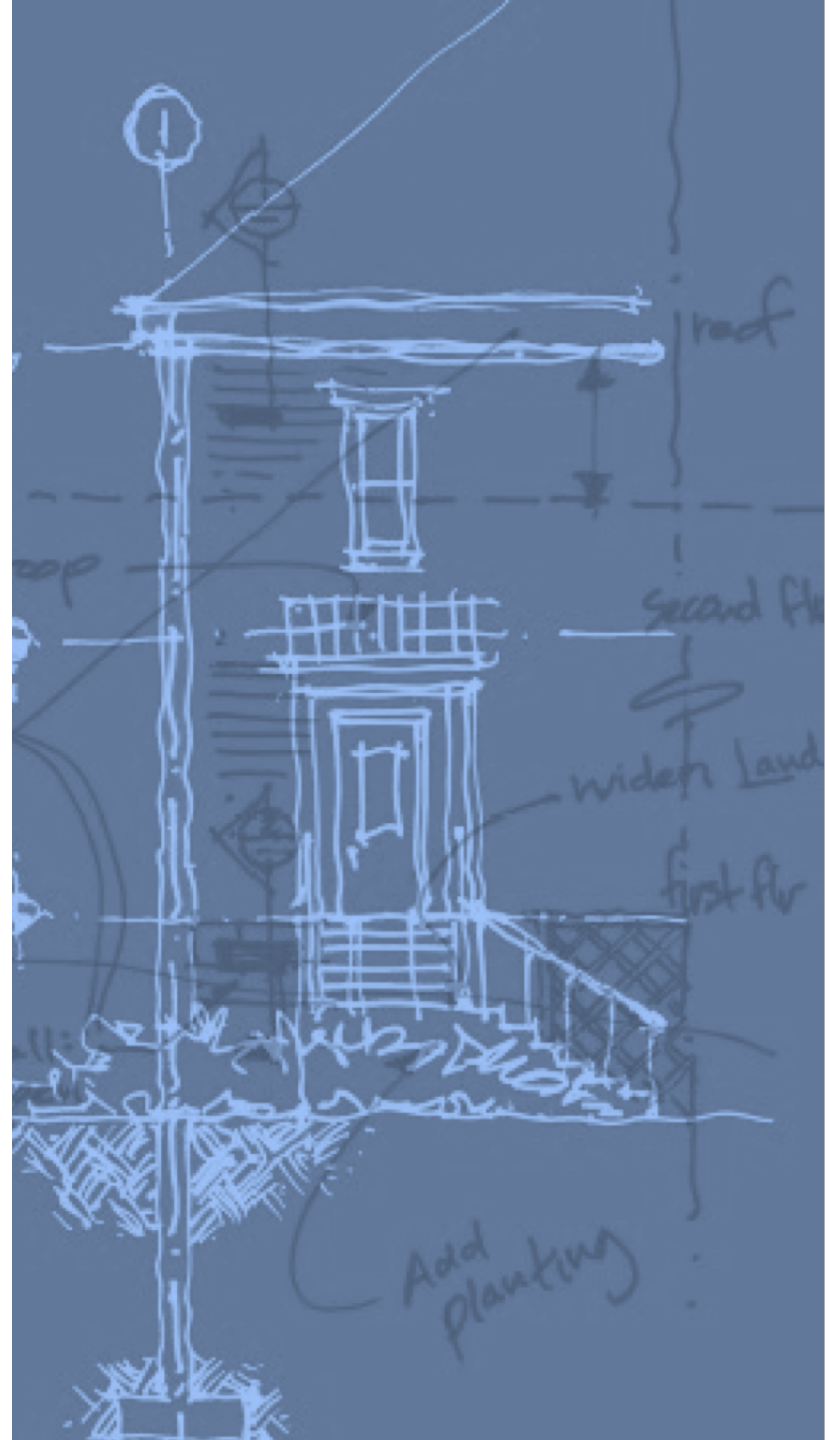
Article 37: Limitations

- Checklist does not require:
 - Consideration of specific conditions; or
 - Taking specific actions to adapt to changing conditions.



Article 37: Proposed

- Incorporate existing guidance into ordinance.
- Develop performance-based design standards for SLR scenarios.



Article 37: In The Meantime...

- Consult Climate Ready Boston SLR projections.
- Follow guidance as if it were required.

**ACTION
REQUIRED**

**ACTION
REQUIRED**

**ACTION
REQUIRED**

MA Building Code: Today

- State Regulation 780 CMR + IBC
- Administered locally
- Provides minimum requirements for flood-resistant design & construction



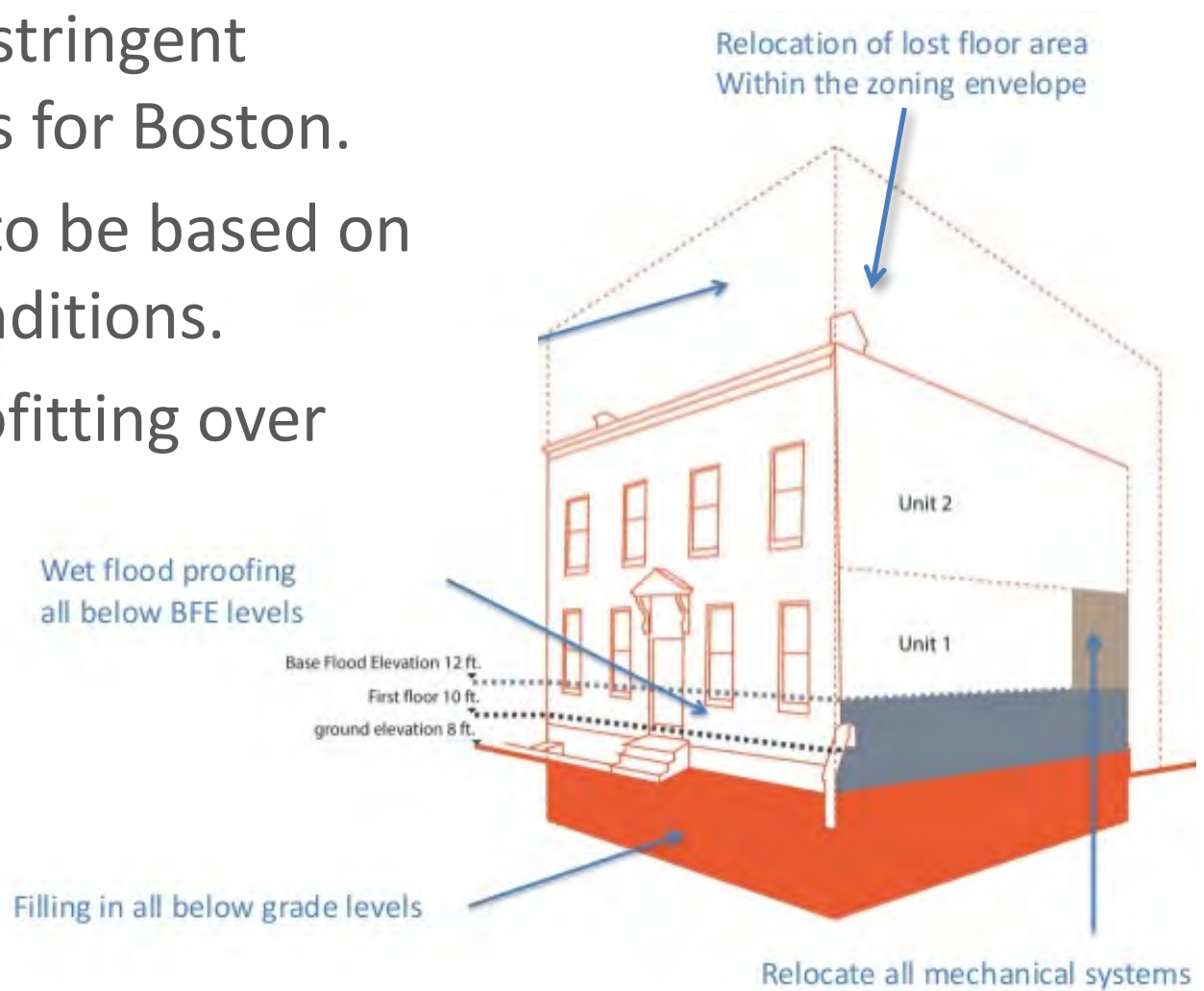
MA Building Code: Limitations

- Does not address resiliency of existing buildings.
- Little incentive to build to higher standards.



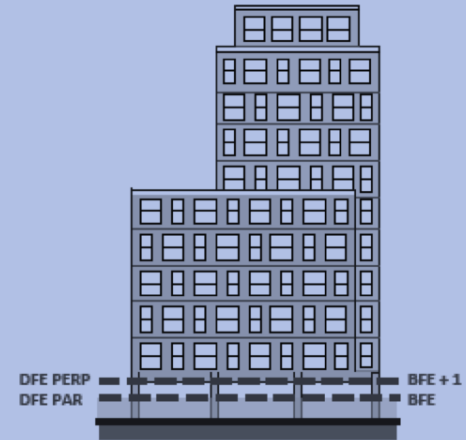
MA Building Code: Proposed

- Adopt more stringent requirements for Boston.
- Require FFE to be based on expected conditions.
- Require retrofitting over time.

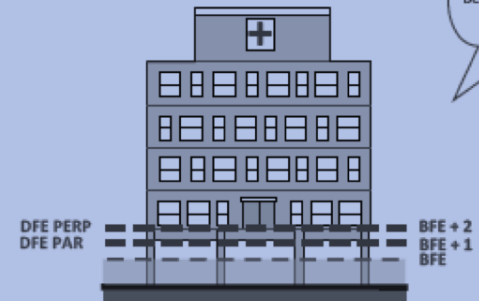


MA Building Code: In The Meantime...

- Voluntarily set FFE/floodproofing at resilient level.
- When renovating, raise mechanicals.



V-Zone: All UTILITIES/ATTENDANT EQUIPMENT required to be placed above DFE + 1. All FLOOD DAMAGE RESISTANT MATERIALS to be used below DFE + 1.



Chapter 91: Today

- Public Waterfront Act administered by MA DEP.
- Guarantees public access to filled and flowed tidelands.
- Requires designing to historical rates of SLR.



Chapter 91: Limitations

- Insufficient to base SLR on historic rates.
- Becomes less relevant as filled tidelands return to flowed tidelands.
- No incentives or mandates to include SLR adaptation.



Chapter 91: Proposed

- Incorporate climate resiliency measures into FPAs.
- Include climate resiliency standards in Chapter 91 revisions.



Chapter 91: In The Meantime...

- Voluntarily adopt resiliency measures.



Summary

- Climate changing during project lifespan
- Regulations assume static conditions
- Regulations need to be indexed to changing conditions
- Best bets for changes are:
 - Article 25- Flood Hazard Districts
 - Article 37- Green Buildings
 - Massachusetts Building Code
 - Chapter 91: Public Waterfront Act
- Don't wait for regulatory changes - act now!

Thank You!

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