



**Massachusetts Bay  
Transportation Authority**

---

# **Resiliency Program Review**

***Protecting Critical Infrastructure: Resiliency Planning & Investments in Boston II  
A Better City  
November 1, 2019***



## MBTA Strategic Plan and Resiliency Policy Directive

---

- **2017 MBTA Fiscal and Management Control Board (FMCB) Strategic Plan**
  - › Prioritizes environmental stewardship and climate resiliency
- **Governor Baker's Executive Order 569**
  - › Calls on all state agencies to build on resiliency efforts already in progress





## Developing a Climate Resiliency-Driven Organization

---

- **Expand and codify resiliency programs and policies to formally establish an Authority-wide commitment** to meet the requirements set forth in the FMCB Strategic Plan & EO 569 and build on resiliency efforts already in progress at the MBTA.
  - › Seek to understand vulnerabilities within the MBTA system—and then identify common-sense resiliency measures to reduce such vulnerabilities.
  - › Minimize service disruptions, ensure reliable public transportation to support community needs and the regional economy, and protect taxpayer investments.
  
- **Key Principles**
  - › Integrate cost-effective climate change adaptation planning, implementation, and reporting into all operations, financial planning, and key agency functions.
  - › Embed resiliency into capital programs by incorporating future projections for extreme weather and climate risk into all project development.
  - › Develop and use climate risk vulnerability assessments to identify critical locations in the transit system.



## Authority-Wide Vulnerability Assessment

---

- Completed the *MBTA Vulnerability Assessment Report* in 2017, a high-level assessment looking at the system and its functions as a whole
- Established an approach for developing future vulnerability assessments with a focus on:
  - **Exposure** -- whether an asset will experience any impact from a climate event, based on location and duration of the event
  - **Sensitivity** -- whether that asset, *if exposed to a stressor*, will be impacted in some significant way
  - **Adaptive Capacity** -- the ability of a sensitive asset to react to or recover from exposure or the criticality of the asset to help the system recover
- Overall Findings highlighted the type of climate stressors we can expect and the overall vulnerability of the Blue Line.

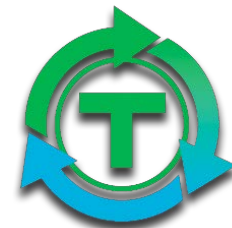


## Transportation Vulnerabilities to Weather and Climate

### Examples of Climate Stressors:

- **Sea level rise, storm surge, & flooding**
  - Inaccessible facilities
  - Structural damage
  - Long-term impacts from exposure to seawater
- **Extreme winter storms**
  - Inaccessible facilities and track
  - Ice damage to equipment
  - Vehicle failure, brittle rail, frost heaves in track bed, broken pavement from ice expansion
- **Extreme heat**
  - Buckled rail
  - Equipment/vehicle overheating
  - Regional brownouts
  - Employee & customer health and safety
- **Extreme wind**
  - Downed trees
  - Downed catenary
  - Damage to roofs or structures



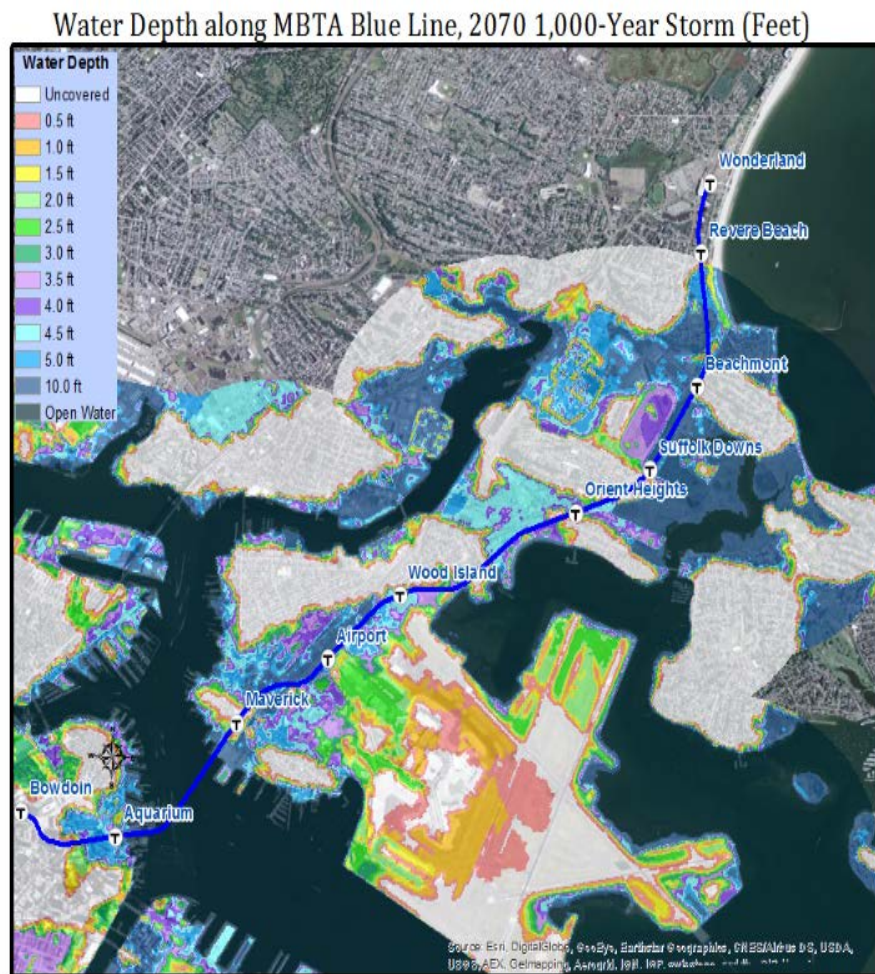


## Next Level Down Vulnerability Assessment -- Blue Line

Most stations on Blue Line could be exposed to flooding by 2070; precipitation-driven or storm surge flooding is plausible at some locations even now.

### Most Consequential Vulnerability:

- Flooding at Aquarium Station
- Flooding at Orient Heights Maintenance Facility from Belle Isle Marsh
- Salt water corrosion to rail, switches, signals, cables





## Further Assessment of Aquarium Station

**Extensive assessment of all of the above- and below-ground points of entrance for water:**

- Headhouse on Atlantic Avenue
- Portal at Maverick
- Ventilation Shafts, Emergency Egress Structures
- Conduits, manholes, utilities, gravel and ballast below headhouse, *etc.*

**Developed a series of possible mitigation approaches:**

- Policy and administrative approaches
- Relocate vulnerable infrastructure from impact zone
- Protect the infrastructure via engineering or operational improvements
- Accommodate the infrastructure while reducing the flooding consequences





## Further Assessment of Orient Heights Maintenance Facility

Facility is vulnerable to flooding by 2030 and worsening as we approach 2070. Some flooding is possible in the near term.

### Critical assets at the facility most likely impacted by storm events:

- Electrical Equipment (substation, generator, power feeds and disconnects, *etc.*)
- Blue Line Fleet in the facility and in the yard
- Signal bungalow and control systems
- Other associated components for security, fire control, maintenance equipment, *etc.*

### Recovery of the facility can be fairly short if we protect the critical components considered most at risk:

- Elevate equipment by an additional 36" to 48"
- Establish operational protocols for moving vehicles as part of emergency preparedness







## Further Assessments to Be Completed

---

### Additional Vulnerabilities Underway

- Systemwide inventory and assessment of all pumping systems
  - » Identify capacity and condition/reliability
  - » Overlay with regional predictive flood mapping to see where pumps need to be upgraded, increased, or replaced

### Additional Vulnerability Assessments to Be Performed

- Red, Orange, and Green Lines
- Bus maintenance facilities
- System-wide power, signals, and communications
- Commuter Rail system with focus on maintenance facilities and layovers



## Major Stakeholders

---

- **Neighborhood of Affordable Housing (NOAH)**
  - ClimateCARE program—Kresge Foundation-funded project in East Boston
  - MBTA actively participating in working group assessing East Boston Vulnerabilities
- **MassDOT**
  - Central Artery Tunnel
  - Expanded coastal study
  - Statewide, interior impacts from heavy precipitation and extreme heat
- **Climate Ready Boston**
  - Ongoing MBTA participation
  - Explore district-scale solutions
- **Metro Boston Climate Preparedness Taskforce**
- **Other Municipalities and NGOs working on Resiliency Issues**



Coordination with these stakeholders allows the MBTA to have access to best available climate data as well as information on other resiliency projects or plans occurring nearby.

---



## Integrate Resiliency into Project Development and Asset Management

Develop risk assessments for infrastructure projects in development in order to build resiliency into “non-resiliency” projects.

- Consider weather and future climate resiliency in all Capital Delivery projects.
- Identify resiliency measures to minimize vulnerability.
  - › Elevated footprint, flood barriers, materials that can withstand increased exposure to high temperatures and flooding, *etc.*

Incorporate weather and climate vulnerabilities into Transit Asset Management system.





## Integrate Resiliency in the Capital Plan

---

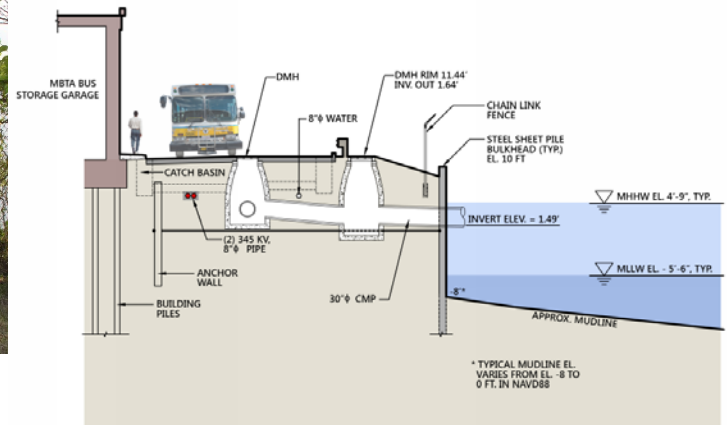
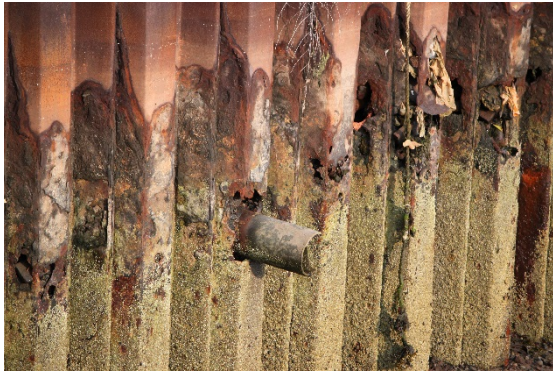
Identify high-need and/or cost-effective resiliency efforts so that they can be prioritized into the CIP.

- Resiliency is currently one of the criteria for new capital projects.
- Work to build a more comprehensive, transparent, and data-driven approach to measuring the climate efficacy of a possible project.
- Recent planning effort through Harvard Kennedy School program:
  - › Developed the foundation of a “calculator” that would allow us to measure the economic, social, and environmental costs and benefits of a resiliency project.
  - › When fully developed, this can be used to compare one type of resiliency project to another.



# FTA Resiliency Grant: Charlestown Bus Garage and Somerville Engineering Rail Yard

## Current Site Conditions



EXISTING CONDITIONS SECTION @ BUS STORAGE GARAGE (TYP)

ALFORD STREET MBTA BUS STORAGE GARAGE

SCALE: NTS



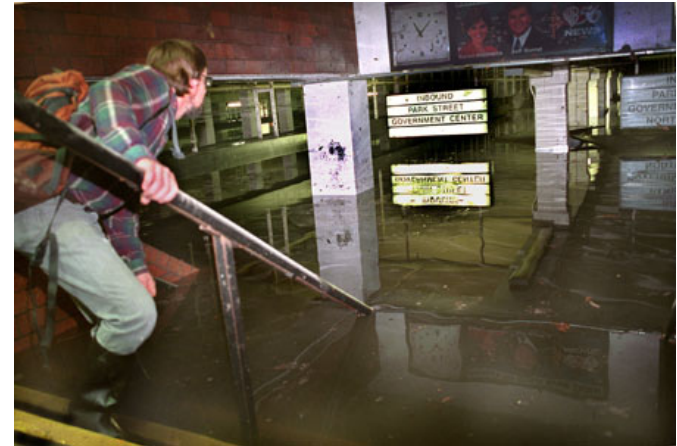
## FTA Resiliency Grant: Charlestown Bus Garage and Somerville Engineering Rail Yard





## FTA Resiliency Grant: Fenway Portal

- Fenway Portal on the D Line flooded in Oct 1996 via Muddy River storm with ~7" of rain over 48 hours.
  - › Resulted in Green Line flooding from Kenmore Station to Arlington Station
- **Existing protection:**
  - › Timber logs and Sandbags
  - › Manual reading of changes in river elevation





## FTA Resiliency Grant: Fenway Portal

MBTA received a \$21 Million FTA competitive grant to improve flood protection.

### Solutions:

- Hinged gate at the top of the slope leading to portal
- Improve pumping and drainage capacity
- Improve communications system

Coordinating with separate DCR/USACE project to restore surface Muddy River flow and help prevent future flooding

