PROTECTING CRITICAL INFRASTRUCTURE:

RESILIENCY PLANNING & INVESTMENTS IN BOSTON II

A BETTER CITY

BOSTON Green Ribbon COMMISSION

FRIDAY, NOVEMBER 1ST, 2019


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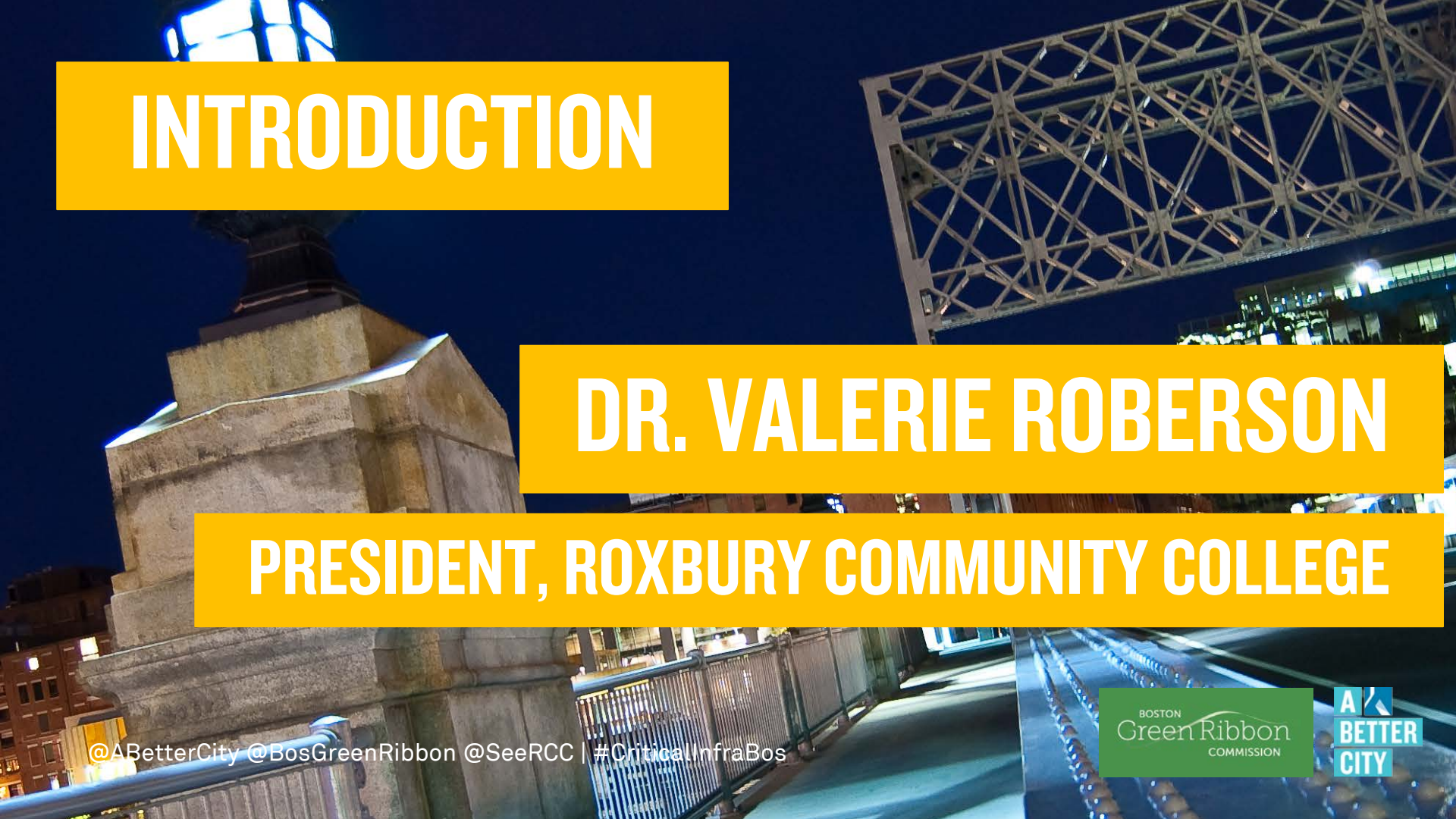

INTRODUCTION

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PRESIDENT, ROXBURY COMMUNITY COLLEGE

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Climate Resiliency at MWRA

Frederick A. Laskey
Executive Director

November 1, 2019

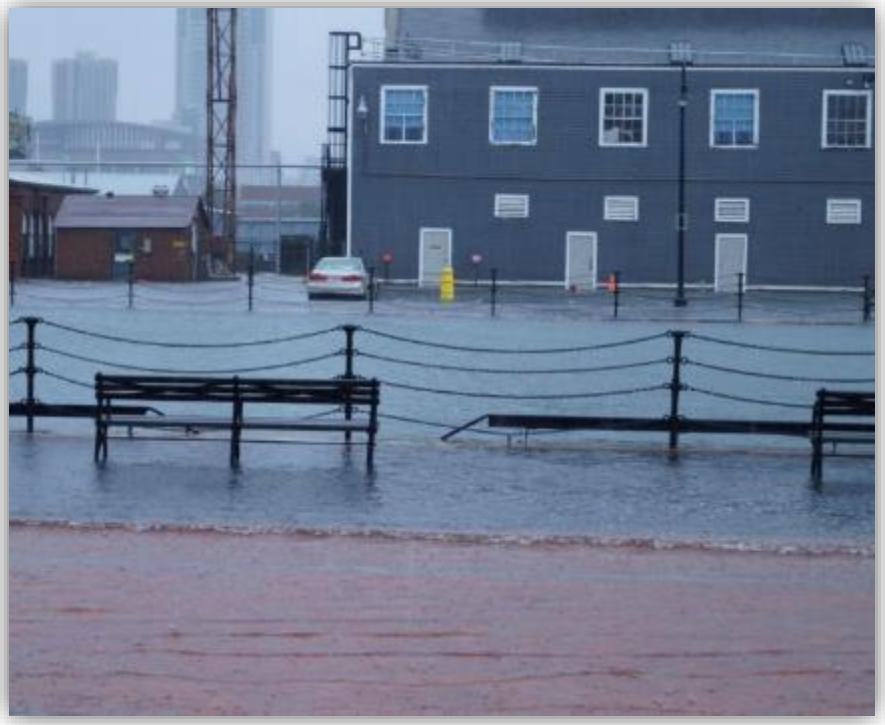
Changing Precipitation Quantity and Patterns

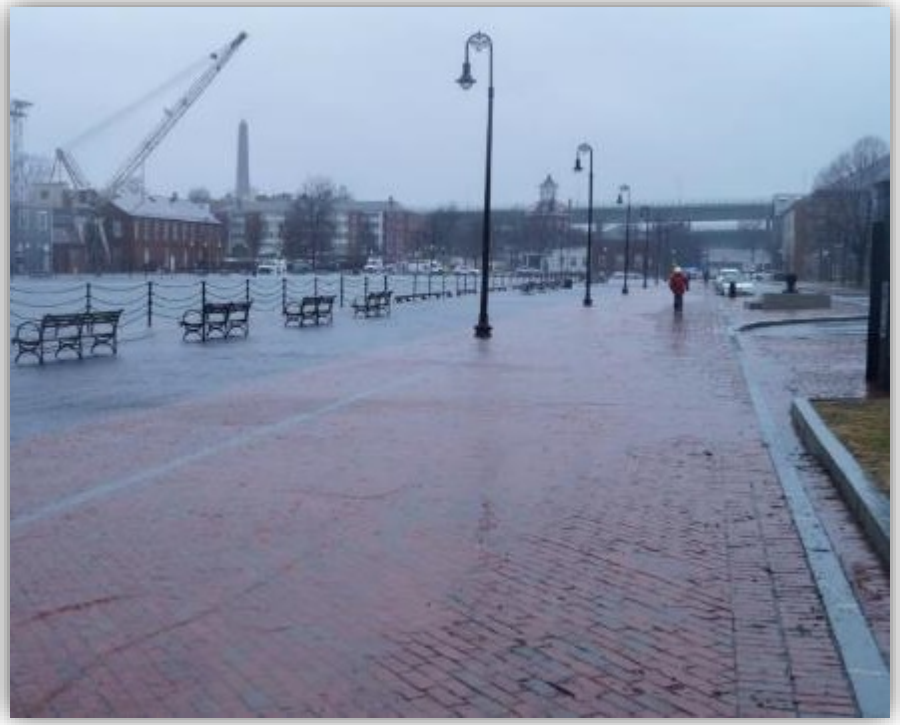
- Currently, we average 104 rain events per year with an average of 44 inches of rainfall
- Models suggest we'll see longer dry spells with shorter, heavier rain
- An overall modest increase in total rainfall
- Flooding during the January and March Nor'easters in 2018 impeded access to several MWRA facilities

No Longer A Theory: State Street, Boston – March 2018

AP/CityLab

Charlestown Navy Yard – March 2018





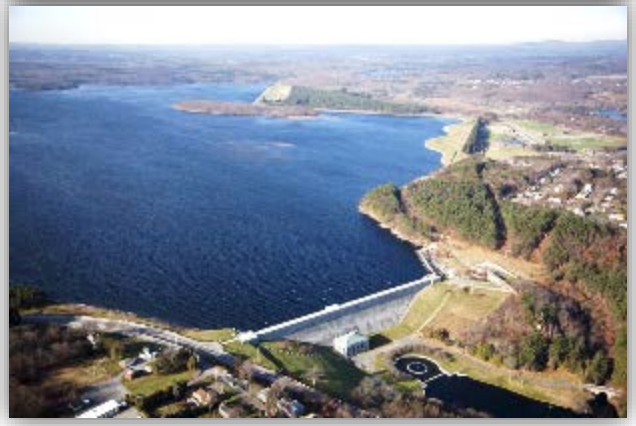
Eastern Avenue, Chelsea – March 2018

Shirley Street, Winthrop – March 2018

Nut Island, Quincy – March 2018

Preparing for Climate Change: Drinking Water System Is In Good Shape

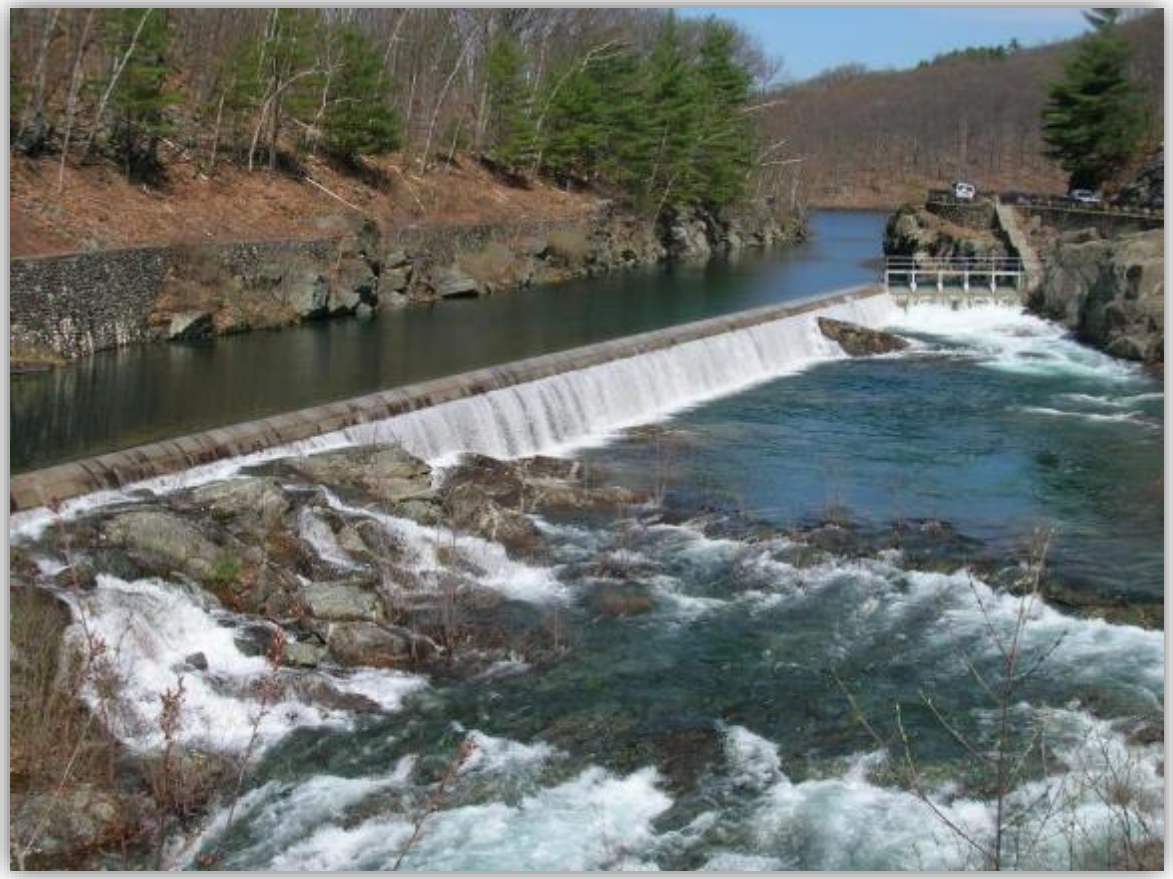
- Quabbin Reservoir, Belchertown
  - 65 miles west of Boston
  - Elevation 528 feet
- Wachusett Reservoir, Clinton
  - 35 miles west of Boston
  - Elevation 395 feet
- Water treatment plant is in Marlborough
- 85% of water delivered by gravity
- Lowest elevation of a water tank is 192 feet above sea level



Significant Investment in Dams

- All MWRA dams, dikes, spillways and appurtenances are inspected routinely by licensed dam safety engineers and are in good condition
- MWRA has spent over $22 million on dam safety projects
- Quabbin and Wachusett spillways have been improved to be able to discharge the probable maximum flood

Quabbin Spillway Rehab



Wachusett Spillway

Wachusett Crest Gate

Adaptation for Sea Level Rise In The Design of Deer Island Treatment Plant

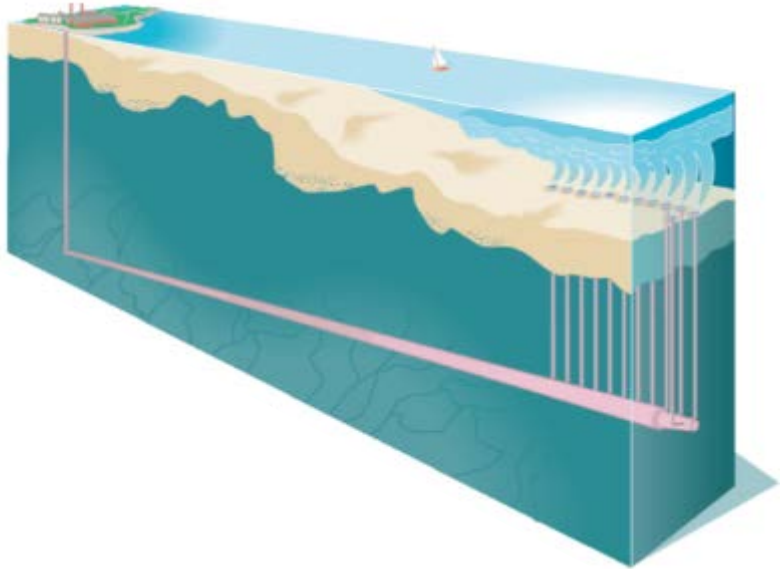
- Deer Island plant fully protected
  - 100-year flood
  - 1.9-foot (0.6 meter) sea level rise
  - Wave run-up of 14 feet (4.3 meters) on east side and 2 feet (0.6 meter) on west side
  - Nut Island headworks in Quincy similarly designed for sea level rise

Deer Island On-Site Power Plant

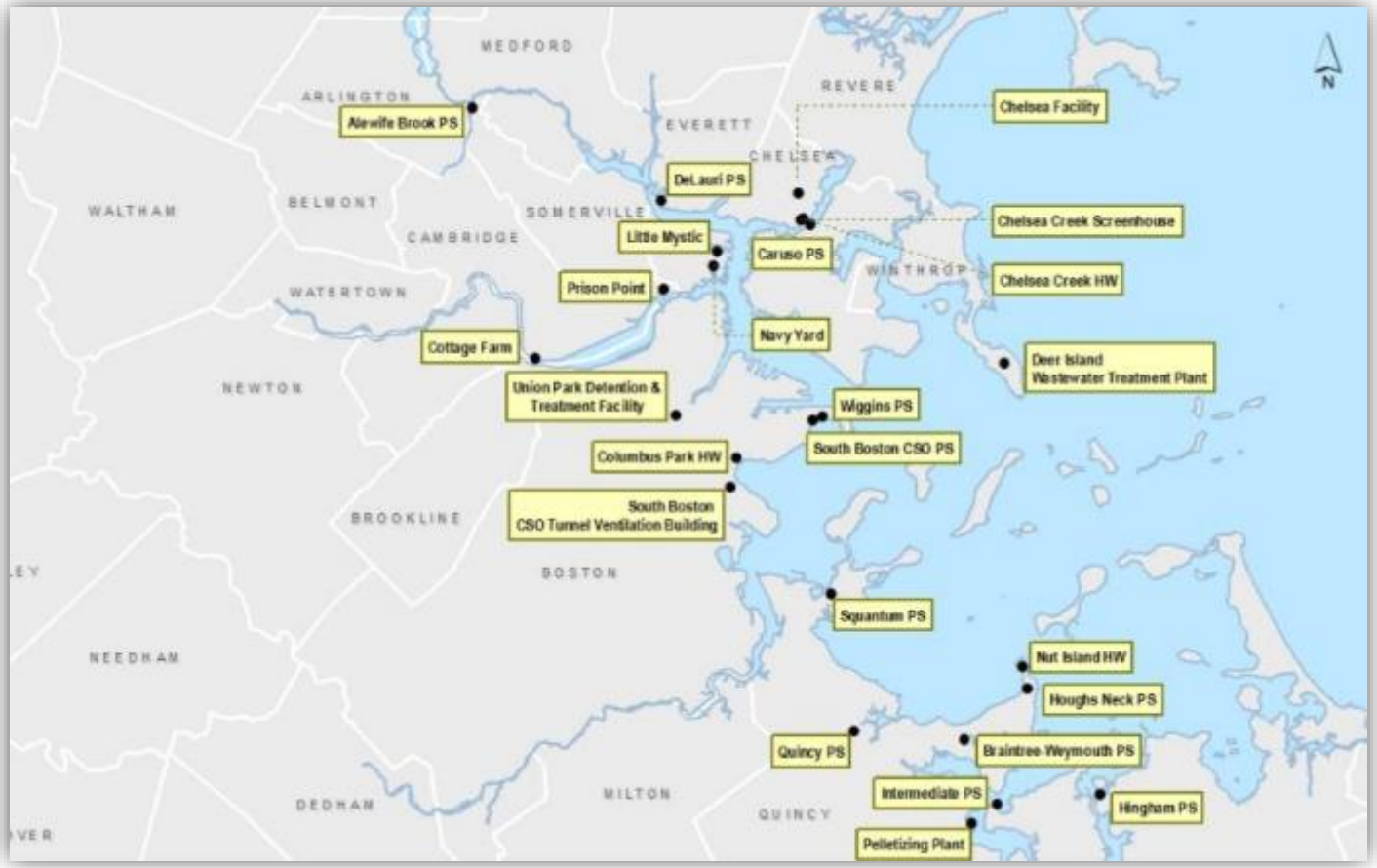
- On-site power plant ensures uninterrupted power supply to keep the plant operating for up to 90 days

A Rising Sea Would Impact the Hydraulics of the Deer Island Outfall Tunnel

- The effluent from the sewage treatment plant is discharged by gravity to the 9.5-mile outfall tunnel
- To maintain hydraulic capacity, plant process tank elevation raised 1.9 feet and tunnel diameter was up-sized from 24 feet to 24.25 feet



MWRA Coastal Facilities



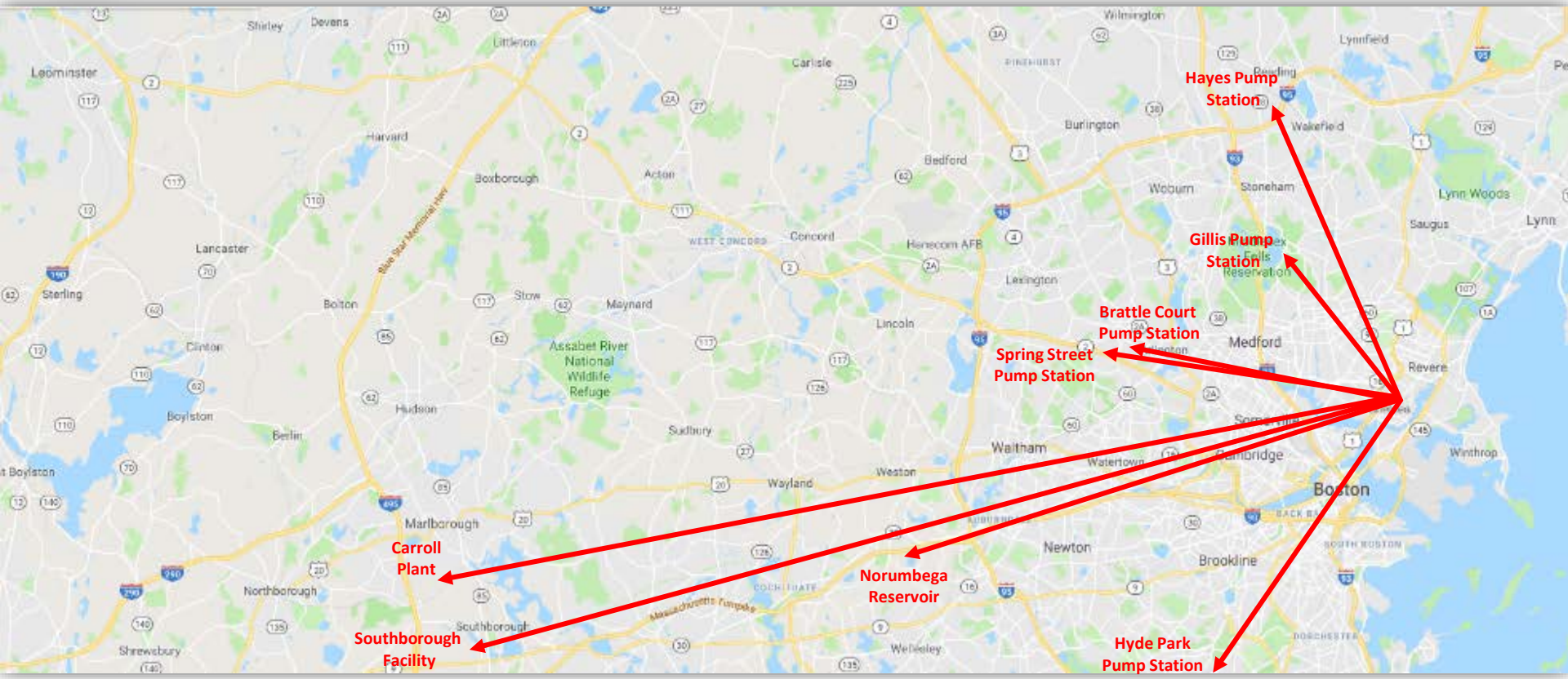
MWRA's Chelsea Facility

- Most of our staff and equipment is at our Chelsea Facility off of Eastern Avenue, across from the Chelsea Creek

Plans in Place to Pre-deploy Staff to Higher Ground

- Back-up water and wastewater operations control center created at Carroll Treatment Plant in Marlborough

Plans to Pre-deploy Staff and Equipment to Higher Ground



Benchmarks For Evaluating Facilities

- 100 year flood as determined by FEMA
- 100 year flood + 2.5 feet (NYC DEP, BHA)
- Hurricane flooding levels as determined by FEMA's SLOSH model (current evacuation planning recommendation) were reviewed
- Wave action (for facilities adjacent to FEMA Hazard Zone VE) was reviewed

MWRA's Approach

- Short-term
  - At-risk buildings are being fitted with temporary flood barriers
  - Expanding fuel storage at wastewater stations

- Long-term
  - Facility rehabilitation on a 20-year cycle
  - Future rehabilitation contracts will include protection measures

- May have to speed things up

Flood Elevations At Chelsea Creek

Southwest Facility View

Backup Generator

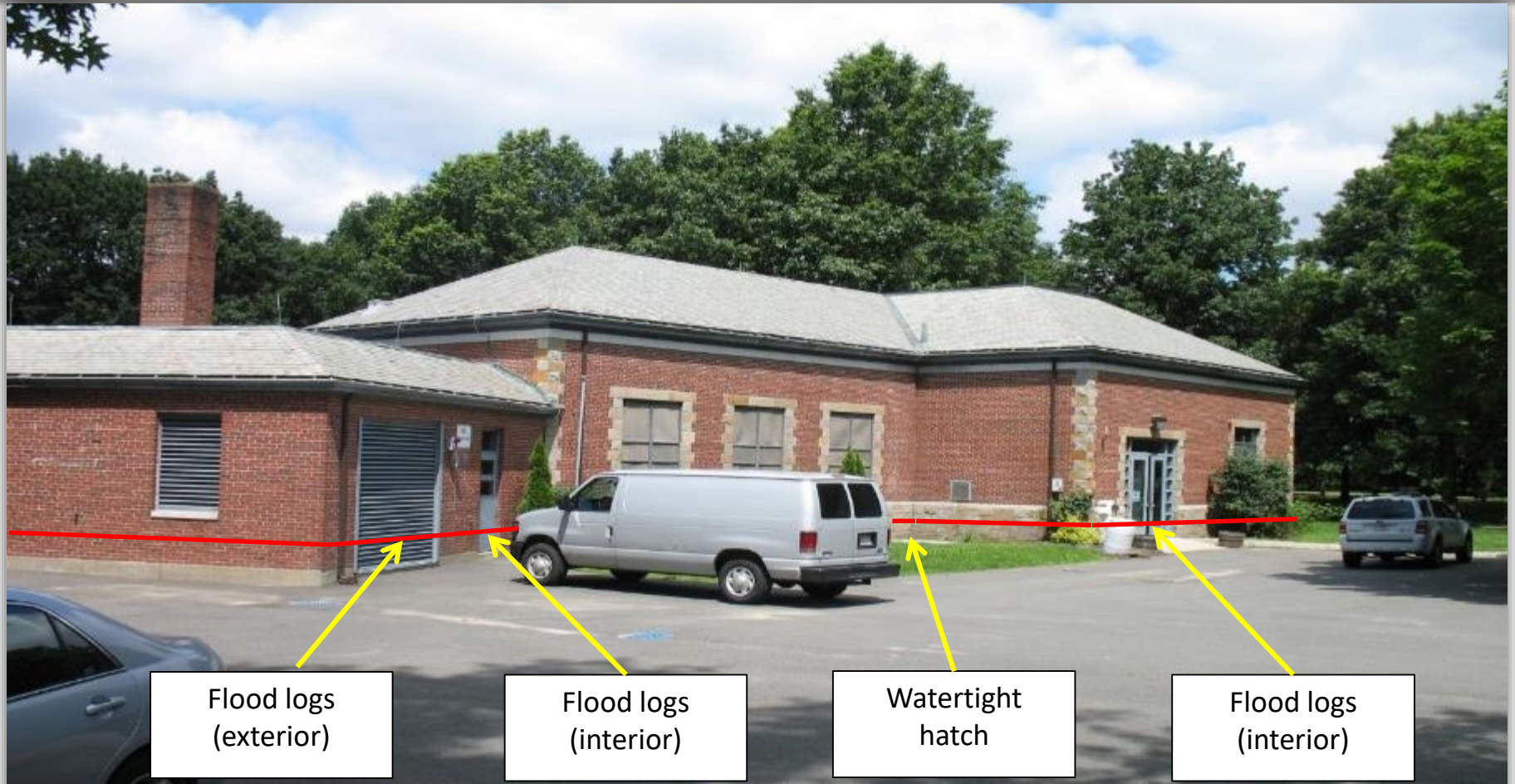
Flood Elevations At Chelsea Creek Headworks

New Flood Control Measures Are Being Added

Chelsea Headworks

Chelsea Headworks

Alewife Brook Pump Station



Alewife Brook Pump Station

Alewife Brook Pump Station

Infiltration and Inflow Funding for Member Communities

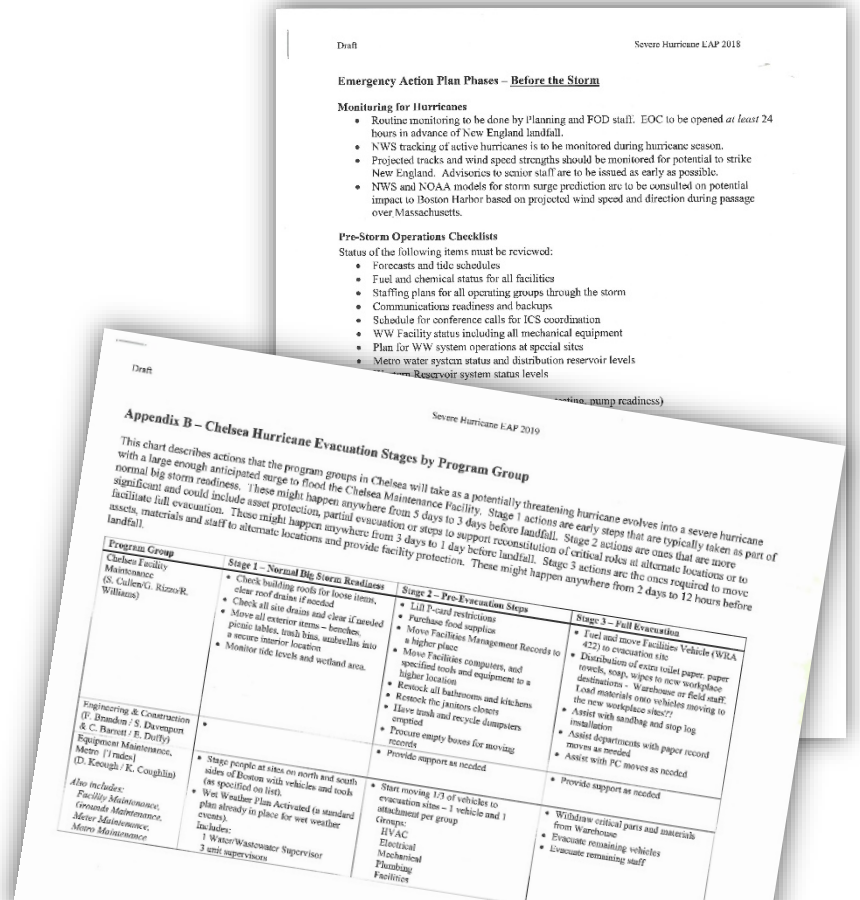
- 191 miles of sewer Cured-In-Place Pipe liner installed
- 160 miles of sewer replaced
- 6,804 manholes rehabilitated/sealed

Coordinating With Other Agencies to Learn and Share

- Metro Mayors Coalition
- EEA Municipal Vulnerability Preparedness Program
- City of Boston
- Mystic River Watershed Association
- Boston Harbor Now

Working With Our Customer Communities

- MWRA works closely with its customer communities, providing training on Emergency Action Plans and guidance assistance with vulnerability assessments



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Severe Hurricane EAP 2018

Emergency Action Plan Phases – Before the Storm

Monitoring for Hurricanes

- Routine monitoring to be done by Planning and FOD staff. EOC to be opened *at least* 24 hours in advance of New England landfall.
- NWS tracking of active hurricanes is to be monitored during hurricane season.
- Projected tracks and wind speed strengths should be monitored for potential to strike New England. Advisories to senior staff are to be issued as early as possible.
- NWS and NOAA models for storm surge prediction are to be consulted on potential impact to Boston Harbor based on projected wind speed and direction during passage over Massachusetts.

Pre-Storm Operations Checklists

Status of the following items must be reviewed:

- Forecasts and tide schedules
- Fuel and chemical status for all facilities
- Staffing plans for all operating groups through the storm
- Communications readiness and backups
- Schedule for conference calls for ICS coordination
- WW Facility status including all mechanical equipment
- Plan for WW system operations at special sites
- Metro water system status and distribution reservoir levels
- Reservoir system status levels

Draft

Severe Hurricane EAP 2019

Appendix B – Chelsea Hurricane Evacuation Stages by Program Group

This chart describes actions that the program groups in Chelsea will take as a potentially threatening hurricane evolves into a severe hurricane with a large enough anticipated surge to flood the Chelsea Maintenance Facility. Stage 1 actions are early steps that are typically taken as part of normal big storm readiness. These might happen anywhere from 5 days to 3 days before landfall. Stage 2 actions are ones that are more significant and could include asset protection, partial evacuation or steps to support reconstitution of critical roles at alternate locations or to facilitate full evacuation. These might happen anywhere from 3 days to 1 day before landfall. Stage 3 actions are the ones required to move assets, materials and staff to alternate locations and provide facility protection. These might happen anywhere from 2 days to 12 hours before landfall).

Program Group	Stage 1 – Normal Big Storm Readiness	Stage 2 – Pre-Evacuation Steps	Stage 3 – Full Evacuation
Chelsea Facility Maintenance (S. Cullen/G. Rizzo/R. Williams)	• Check building roofs for loose items, clear roof drains if needed • Check all site drains and clear if needed • Move all exterior items – benches, picnic tables, trash bins, umbrellas into a secure interior location • Monitor tide levels and wetland area.	• Lift P-card restrictions • Purchase food supplies • Move Facilities Management Records to a higher place • Move Facilities computers, and specified tools and equipment to a higher location • Restock all bathrooms and kitchens • Restock the janitors closets • Have trash and recycle dumpsters emptied • Procure empty boxes for moving records • Provide support as needed	• Fuel and move Facilities Vehicle (WRA 422) to evacuation site • Distribution of extra toilet paper, paper towels, soap, wipes to new workplace destinations – Warehouse or field staff. Load materials onto vehicles moving to the new workplace site(s) • Assist with sandbag and stop log installation • Assist departments with paper record moves as needed • Assist with PC moves as needed • Provide support as needed
Engineering & Construction (F. Brandon / S. Davenport & C. Barrett / E. Duffy) Equipment Maintenance, Metro Trades (D. Keough / K. Coughlin)	• Stage people at sites on north and south sides of Boston with vehicles and tools (as specified on list). • Wet Weather Plan Activated (a standard plan already in place for wet weather events). Includes: 1 Water/Wastewater Supervisor 3 unit supervisors	• Start moving 1/3 of vehicles to evacuation sites – 1 vehicle and 1 attachment per group Groups: HVAC Electrical Mechanical Plumbing Facilities	• Withdraw critical parts and materials from Warehouse • Evacuate remaining vehicles • Evacuate remaining staff
Also includes: *Facility Maintenance,* *Grounds Maintenance,* *Meter Maintenance,* *Metro Maintenance*			


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PROTECTING CRITICAL INFRASTRUCTURE: RESILIENCY PLANNING AND INVESTMENTS IN BOSTON PART II

The Massport Experience

November 1, 2019

Michael Meyran, Acting Port Director
Massachusetts Port Authority

Introduction

- **Massport is an independent authority governed by a board of directors, appointed by the state's governor**
- **Massport owns three lines of business:**

Aviation

- Logan Airport
- Hanscom Field
- Worcester Airport

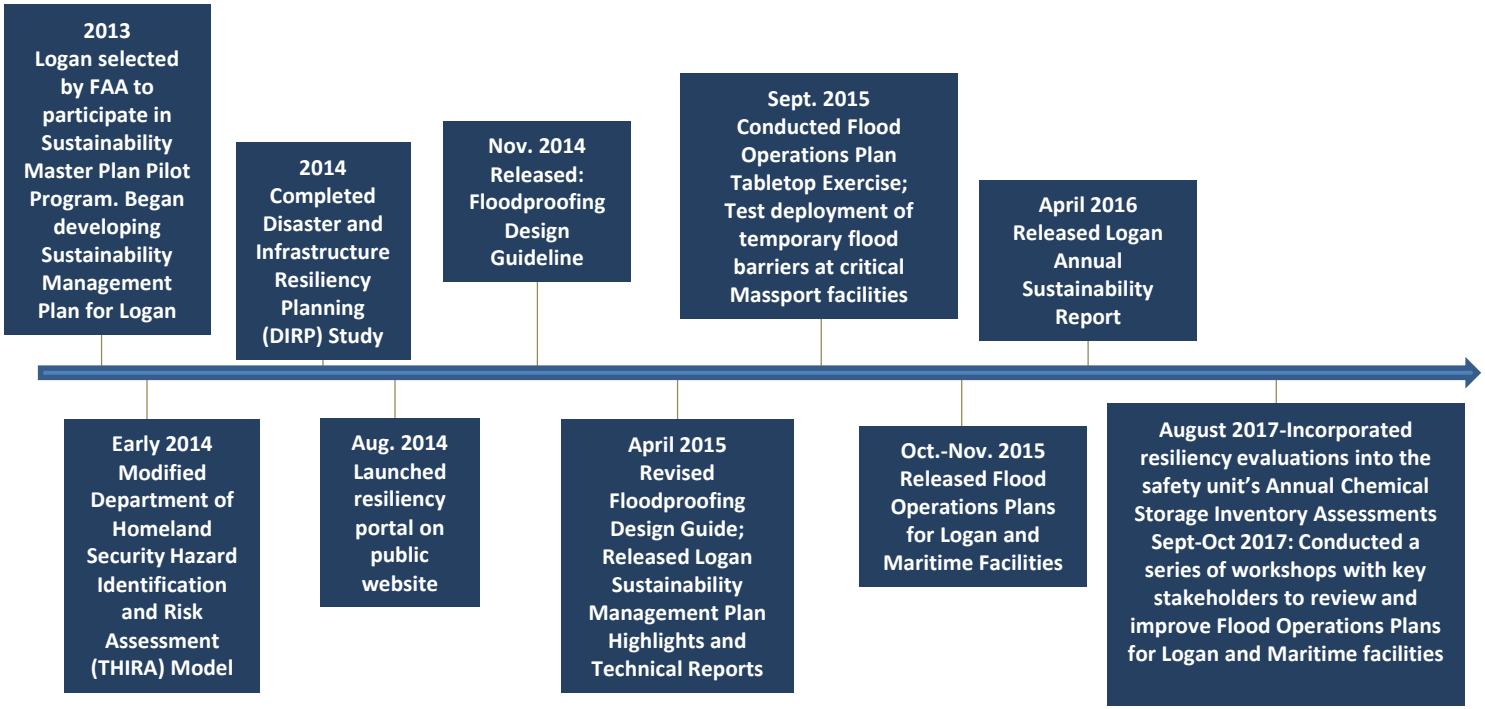
Maritime

- Conley Terminal
- Flynn Cruiseport Boston
- Seafood Landlord
- Boston Autoport

Real Estate

- South Boston
- East Boston
- Charlestown

MASSPORT'S RESILIENCY TIMELINE



2018/2019

Jan 2018: Expanded the Storm water Pollution & Prevention Program (SWPPP) to incorporate resiliency best practices

March 2018: First "real-life" emergency deployment of flood barriers at Maritime properties in preparation for Nor'easter

June 2018: Developed Resiliency Web App

June 2018: Conducted test deployment of temporary flood barriers at one Logan Airport critical asset

Oct 2018: Completed Logan storm water flood risk study.

Aug 2019: First major update to aviation and maritime flood operations plans

DISASTER INFRASTRUCTURE RESILIENCY PLAN

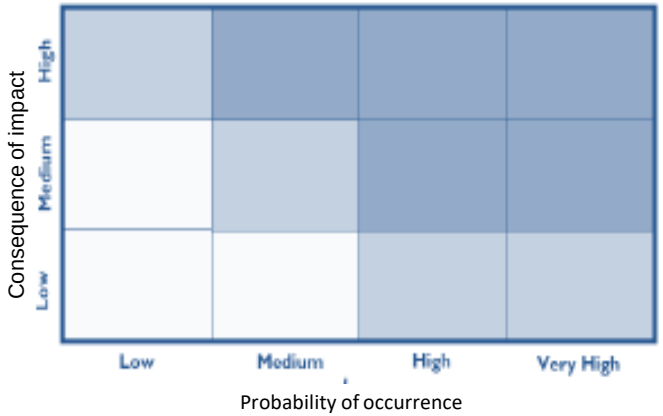
Goals of the project:

- Understand Massport's vulnerability to climate impacts
- Develop short-term and long-term resiliency strategies

Project approach:

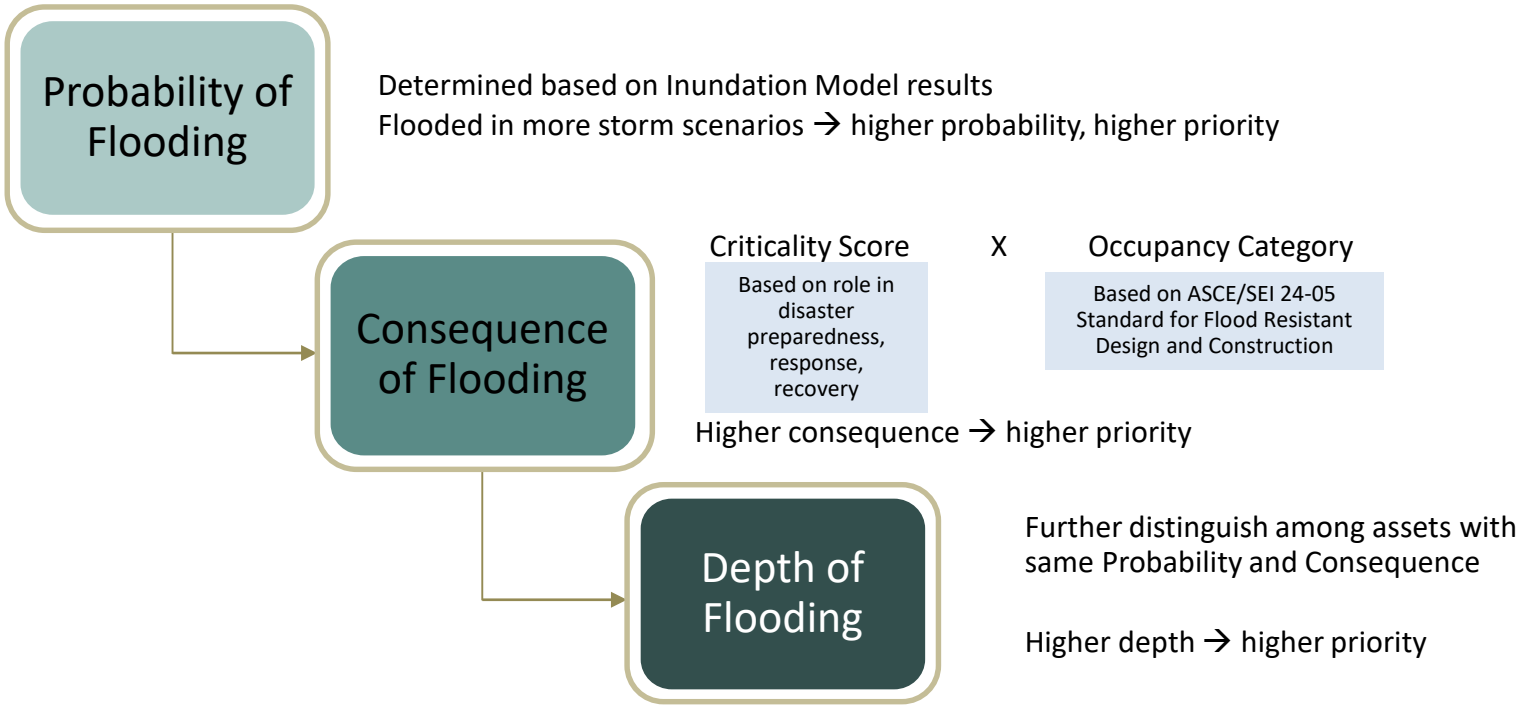
1- Climate projections

2- Vulnerability and risk assessment



3- Adaptation planning & design

RISK-BASED PRIORITIZATION OF ASSETS



FLOOD SCENARIO ELEVATIONS – FISH PIER EAST

FLOOD BARRIERS

ELEVATED PLATFORMS

Generator Combo Unit

Elevated Platform at CTDFC

State Police Generator

ANNUAL TRAINING/TEST TEMPORARY FLOOD BARRIERS

Temporary Flood Barriers deployed May 2019

- Logan Airport – 4 facilities
- Conley Terminal - 2 facilities
- Fish Pier – 3 Facilities

Initially deployed in September 2015

Access Stairs

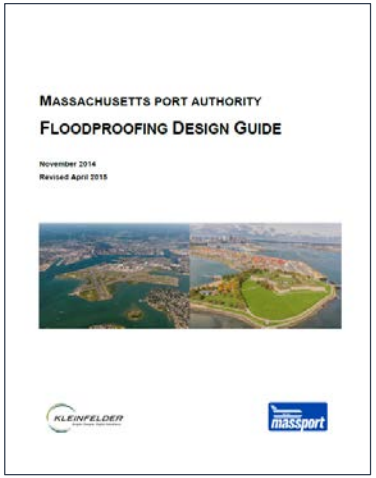
IMPLEMENTED OPERATIONAL PLANS AND GUIDELINES

Flood Operations Plans:

- Specific to Logan and Maritime sites
- Identifies detailed actions, timelines and responsible parties
- Created through collaborative process with MPA stakeholders
- Tabletop exercise to engage functions

Flood-proofing Design Guide:

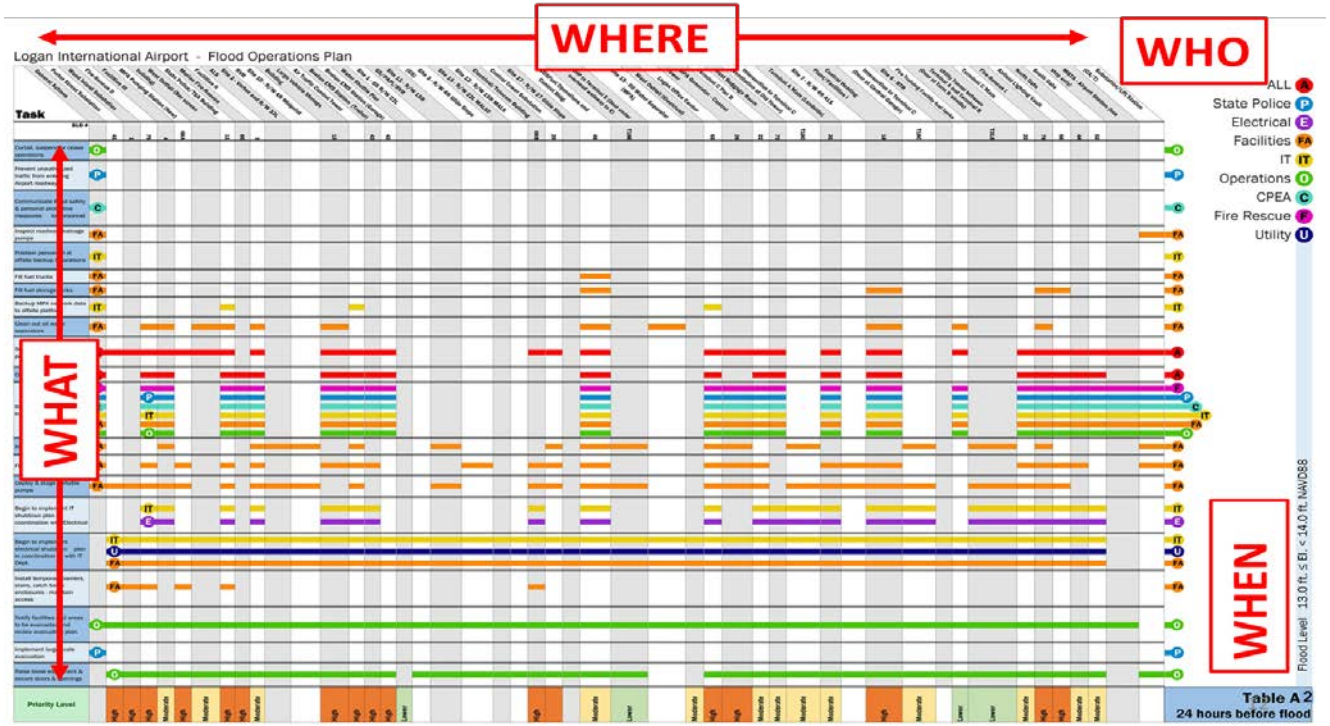
- Design Flood Elevations for construction
  - Different heights for new & existing facilities
- Floodproofing Strategies
  - Wet & dry floodproofing
- Performance standards



Test deployment of temporary flood barriers Electrical Telecom Building at Logan

Conley Terminal test deployment

FLOODING ACTIONS AND TIMELINES



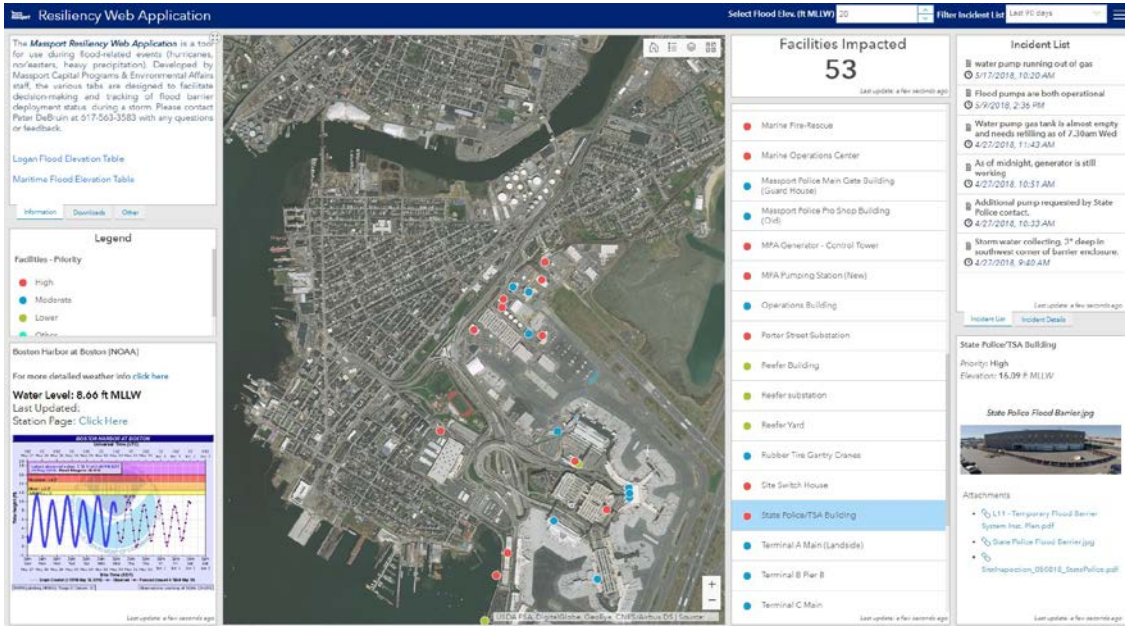
APPLICATION

1.Facilitate management oversight of flooding or heavy precipitation events impacting Massport infrastructure

2.Inform decision-making during a flood event where Massport flood operations plans may or have been activated;

3.Enable real-time field updates via mobile devices of:

i. flood water encroachment
ii. barrier and resource deployments
iii. equipment status or activity milestones
iv. site inspections

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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

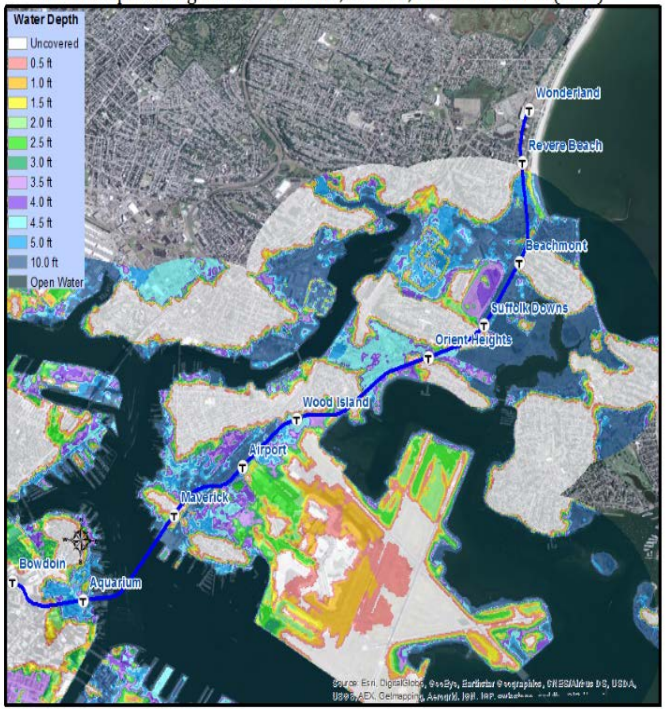
Next Level Down Vulnerability Assessment -- Blue Line

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

Water Depth along MBTA Blue Line, 2070 1,000-Year Storm (Feet)



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.

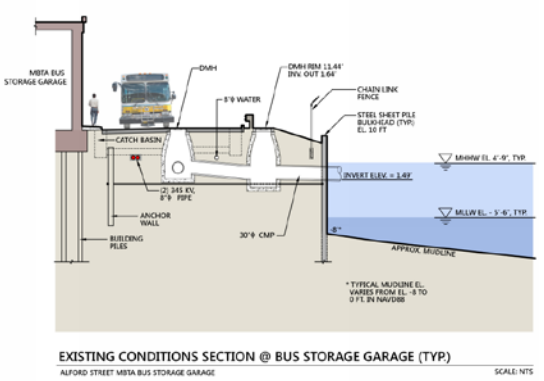
Integrate Resiliency in the Capital Plan

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



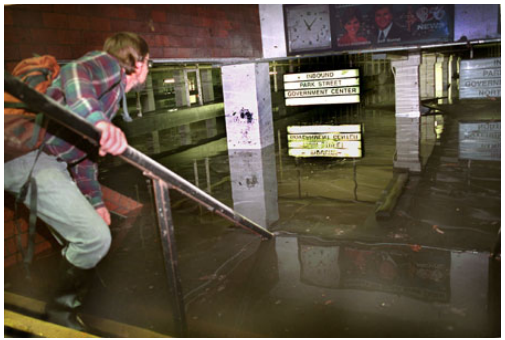
EXISTING CONDITIONS SECTION @ BUS STORAGE GARAGE (TYP.)

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



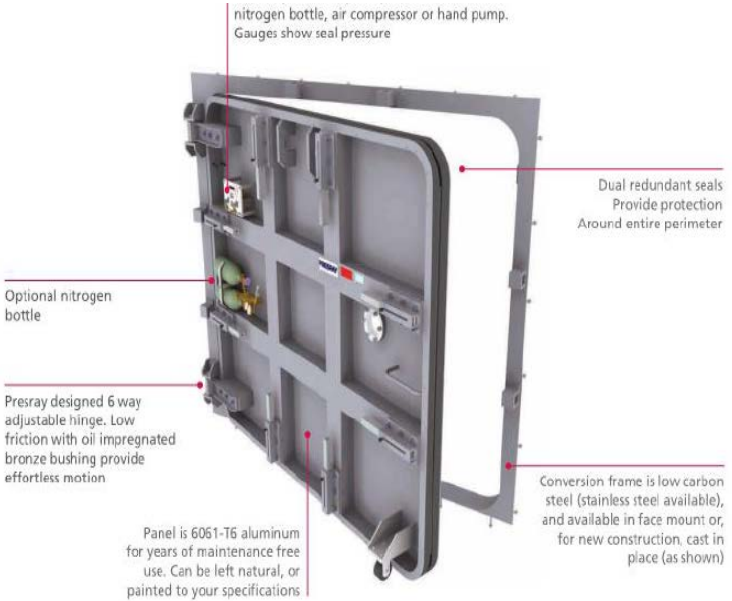
FTA Resiliency Grant: Fenway Portal

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

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Protecting Critical Infrastructure

Resiliency through planning and preparation

November 2019

verizon

Introduction

From our credo:

"We have work because our customers value our high-quality communications services"

"We Run To A Crisis, Not Away"

An enterprise approach for business continuity

Crisis management structure:

- Cross-functional teams
- Emergency operations centers led by senior management
- Local empowerment

Focus on mission critical plans:

- Network systems: Equipment centers, switching, transport
- IT systems: Provisioning, call center routing, self-service tools
- Functional Teams: NMC, tech support, warehouse logistics
- Each plan is updated, exercised and certified each year

Robust annual exercise program:

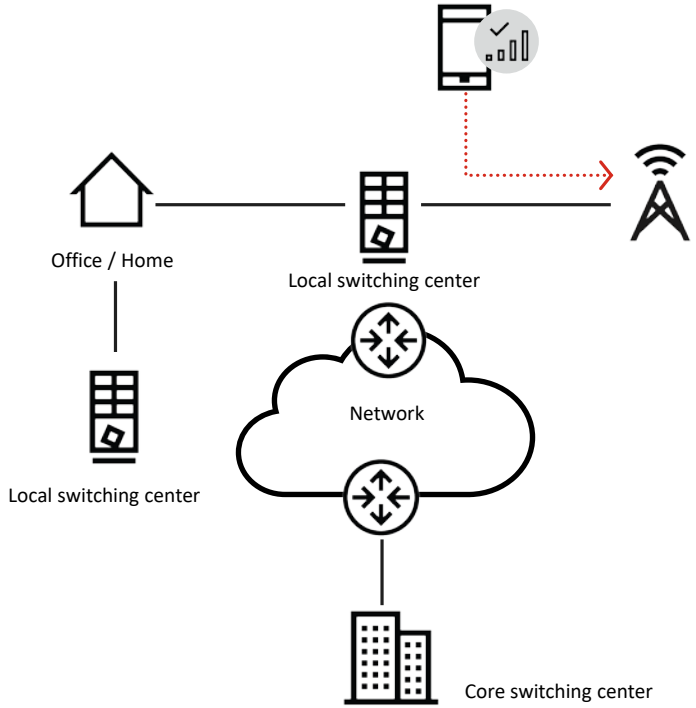
- Internal processes: Storm preparation, cyber attack, building evacuations
- Public and private sector partners: Con Edison, NYS Electric and Gas

Experienced team:

- Global presence and responsibility
- 20-plus years in tech and emergency management
- Industry certifications

Network capabilities: Resilience

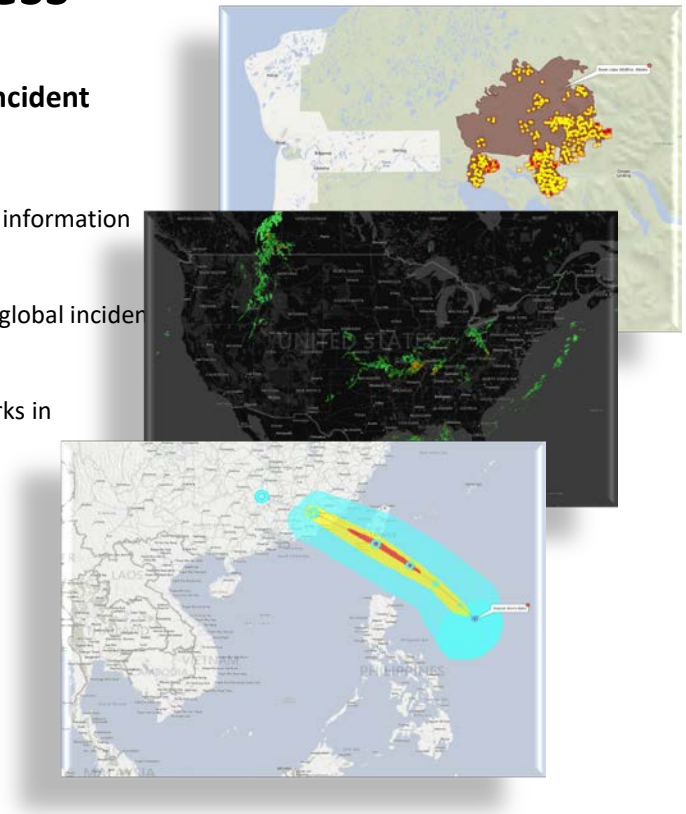
- Rigorous design & engineering standards
- Site selection
- Fire suppression & security systems
- Back-up batteries & generators
- Diverse circuit paths – multiple building entry points
- Expanding mesh networks
- Continued transition to fiber networks
- Disaster recovery plans
- Real-time monitoring and diagnostics
- Portable Assets (COWs, COLTs, generators)



Network capabilities: Situational awareness

The Global Event Management Center is responsible for Global Event Monitoring, Incident Management Support, and Planned Network Maintenance Administration.

- **Global Event Monitoring** – Information Sharing & Analysis Center (ISAC) supporting the monitoring, information gathering, risk analysis, and situational awareness for Verizon operations globally.
- **Incident Management** – Support of Incident Management Coordination when regional, national, or global incident management of an event is required.
- **Change Management** – Administration of planned outages/maintenance of Verizon systems/networks in accordance with pre-defined guidelines and policies.



Network capabilities: Deployable assets

Satellite Backhaul

Satellite Pico-cell on a Trailer (SPOT)

Wireless coverage

Cell on Wheels (COW)

Cell on Light Truck (COLT)

Backup power

Generator on a Trailer (GOATs)

Mobile incident command post

Conference space/workstations

Network capabilities: Specialized training

Major Emergency Response Incident Team (MERIT) –
Verizon's hazardous materials team

- First and Longest Operating HazMat team in Telecom industry, since 1993.
- Team skill sets include technical systems restoration, outside plant, facilities engineering, customer equipment restoration, environmental health and safety, ICS compliance
- Capable of entering and recovering in most hazardous environm

Network capabilities: Our people

The most critical recovery asset

- Thousands of highly-trained and experienced technicians
- Proven ability to respond
- Clear direction and priorities
- Test equipment and tools
- Credentials and company vehicles
- Emergency response training

Exercises and special events

Exercises identify government and private sector capabilities:

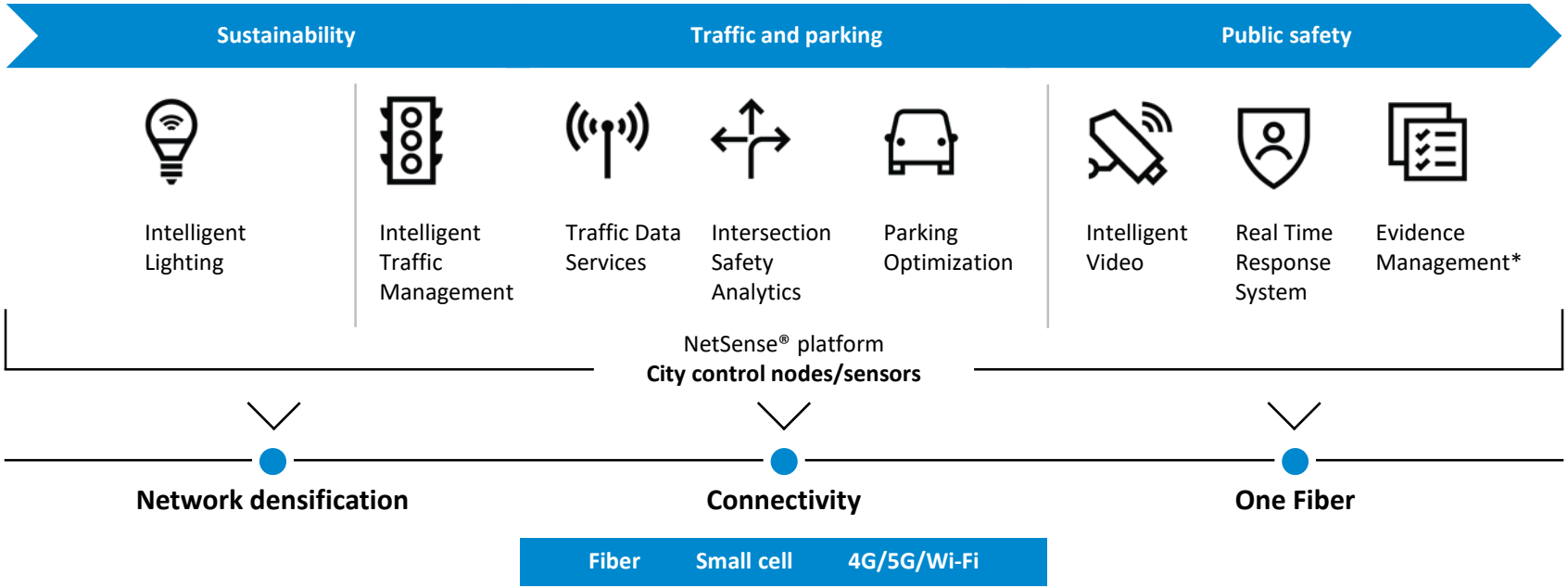
- Establish key contacts
- Understand response timeframes
- Tests capabilities in field

Special events & National Special Security Events (NSSEs):

- Pro-active coordination with government agencies
- Advance preparation: deploy and test assets
- NATO & G8 Summits, Super Bowls, Presidential Inauguration & Conventions

Example Exercises	Location
ESF#2 Exercises	Multiple Cities
FEMA Capstone exercises	Multiple Cities
DHS, FBI, NCTC Joint Counterterrorism Awareness Workshops	Multiple cities
Golden Guardian Functional Exercise Ventura County EOC (CA)	Ventura, CA
VERTEX Exercise (VA)	Northern VA
Tennessee Emergency Management exercise	Nashville, TN
Cascadia Rising – FEMA & multiple states	Pacific NW
Cyberstorm 6	Washington DC

Integrated smart communities solutions



*2H, 2019, Subject to change

Summary

- Verizon is focused on consistently providing high-quality services to our customers
- We invest considerable time and money to prepare for emergency situations, and to test our ability to respond – not only for events that affect us, but also those that affect our customers
- Our response capabilities and our teams have been tested and proven under many difficult, disastrous circumstances

“We don’t wait for the future. We build it.”

Thank You

AMY SMITH

DIRECTOR OF BUSINESS PLANNING & PERFORMANCE, NATIONAL GRID

@ABetterCity @BosGreenRibbon @NationalGridUS | #CriticalInfraBos

BOSTON Green Ribbon COMMISSION

A BETTER CITY

Protecting Critical Infrastructure: Resiliency Planning & Investments

Amy Smith
Director of Business Planning and Performance

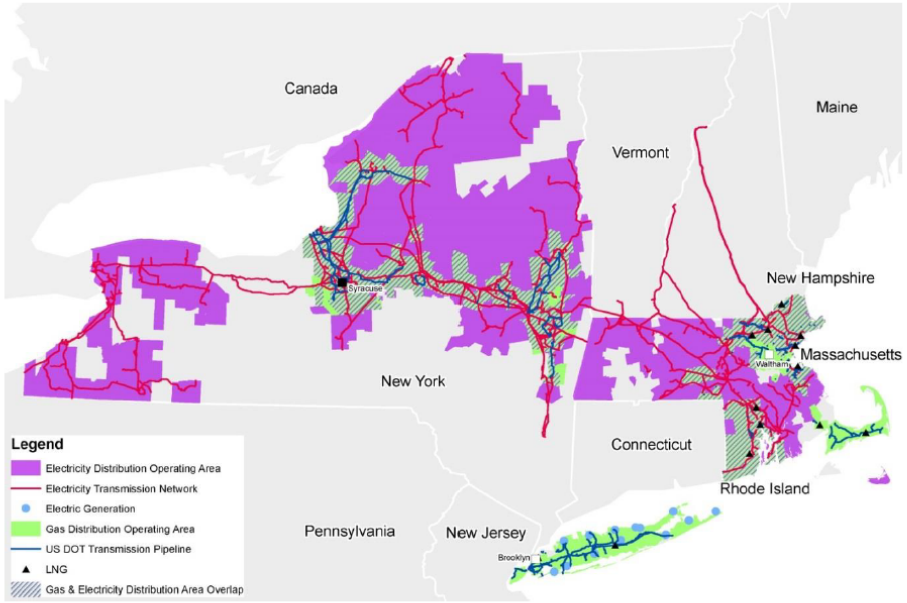
November 1, 2019

nationalgrid

National Grid – Who We Serve

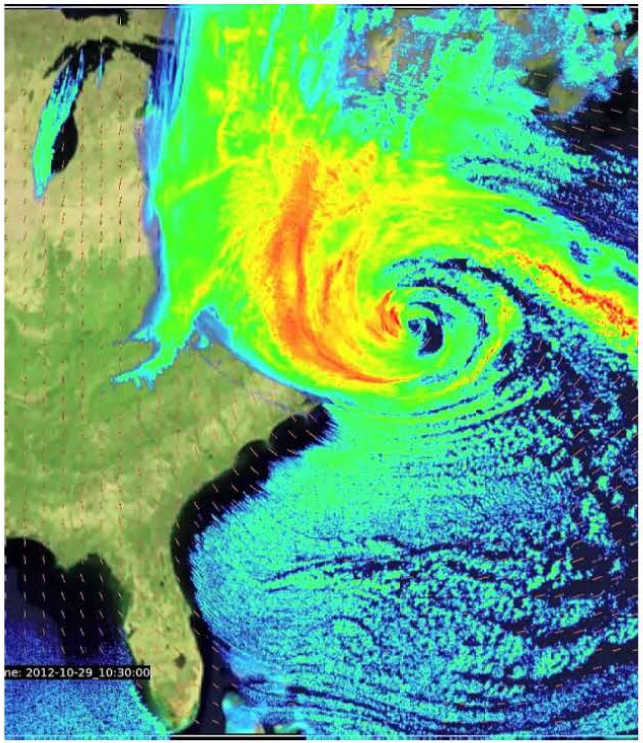
Gas and electric distribution company providing energy to over 7 million customers in NY, MA, and RI

We service 3.6 million gas customers through 35,000 miles of gas pipeline



Challenges Resulting from Climate Change

- Flooding
- Variations in temperature
- More frequent and severe storms



Adaptation and Resilience

National Grid focuses on system hardening and resiliency in the following areas.

- Construction Standards
- System Planning
- Emergency Response Plan

Strategic Asset and System Planning

Single-Feed System Eliminations

Distribution systems supplied by a single district regulator are more vulnerable to customer outages in the event of regulator failure. These projects are designed to improve system reliability/resiliency by connecting these systems to larger distribution systems of the same operating pressure or by upgrading the operating pressure of the existing system and abandoning the district regulator.

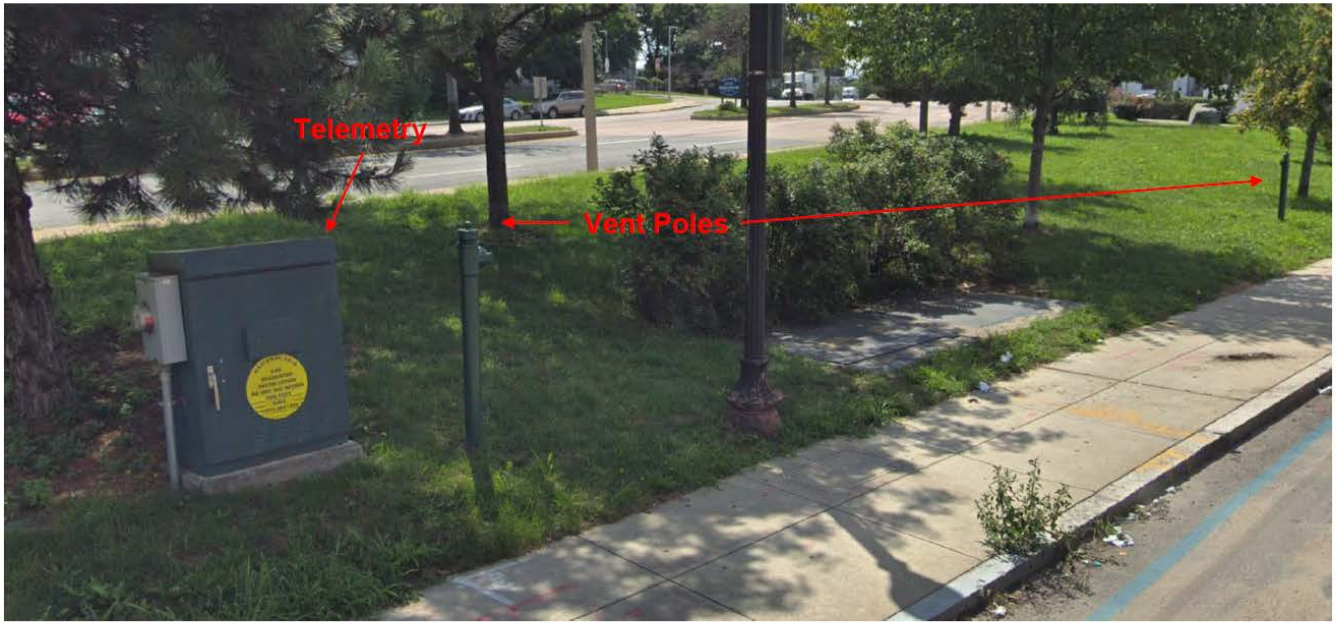
Regulator Station Installation/Replacement

Replaces obsolete regulator station designs with storm hardened prefabricated stations designed to meet or exceed future gas capacity requirements.

Low Pressure to High Pressure Upgrades (LP/HP)

These projects are designed to replace low pressure leak-prone main with high pressure plastic. This prevents ground water infiltration into the gas system that can lead to customer outages as well as reducing leaks (carbon emissions).

Regulator Station Installations



- Prefabricated vaults are designed to withstand extreme weather with redundant regulator runs, Roxtec seals, dry wells, vent poles, & real time telemetry with remote control
- Prefabs can operate when filled with water as pilot regulators are vented above grade
- National Grid has installed 52 prefabs since 2014 in MA

Heater Replacements & System Automation

- Water bath heaters have been installed with redundant burners and updated controls and burner management systems
- AC powered traffic boxes and pole mounted solar boxes have been installed to improve Gas Control's visibility and remote control capabilities
- Backup generators are installed at all take stations and other critical facilities
- These upgrades allow the system to react independently to adverse weather or allow Gas Control to react remotely

Emergency Response Plan

Regardless of hardening and resiliency efforts, National Grid must prepare to respond to extreme weather events.

- Simple, flexible, easily adaptable plan for emergency response
- Annual cycle for revision, training, drills, and exercises

National Grid's Climate Mitigation and Adaptation Plan

National Grid is already seeing the impact of climate change on our system.

We are committed to participating in the solution through the 80x50 pathway. Preparing for and responding to climate change is embedded in the way we plan, construct, and operate our system.

The National Grid Northeast 80x50 Pathway

Our 80x50 Pathway is ambitious and comprehensive, with implications for customers, communities, utilities, automakers, and policymakers.

	40% x 2030	80% x 2050
Power	▪ Ramp up clean electricity generation deployment to achieve 67% zero-carbon electricity supply vs. 45% today	▪ Zero carbon electricity system ▪ Increase large-scale renewables ▪ Inter-seasonal energy storage ▪ New clean electricity options (gas + CCS, modular nuclear)
Transport	▪ Reach more than 10 million light-duty electric vehicles on Northeast roads (50% of all light-duty vehicles) vs. < 75,000 today	▪ More than 20 million light-duty vehicles (100% of the fleet) ▪ Low-carbon heavy duty, rail, and off-road transportation ▪ Reductions in vehicle miles traveled
Heat	▪ Double the rate of EE retrofits ▪ Triple the rate of oil-to-gas heating conversions ▪ Transform the oil-to-electric conversion market (10X scale up)	▪ Sustain thermal efficiency investment ▪ Decarbonize natural gas supply for heating ▪ Hybrid gas/electric heating

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