MWRA’s Pragmatic Approach to Climate Change Adaptation

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Wastewater Advisory Committee
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Two Pronged Approach to a Long Term Concern

• **Adaptation:**
  – Understand the Potential Impacts
  – Mitigate Impacts
  – Create Resiliency

• **Mitigation:**
  – Reduce Greenhouse Gases
  – Contribute to the Common Good
  – Reduce Costs
  – Improve Environmental Footprint
  – Improve Public Perception
MWRA Service Area

- MWRA provides wholesale water and wastewater services to over 2.5 million customers in 61 communities.
- On average, MWRA delivers about 200 million gallons per day to its water customers.
- MWRA collects and treats an average of 350 million gallons of wastewater per day, with a peak capacity of 1.2 billion gallons.
Our Mission in Short

• Adequate, Reliable Supply of High Quality Drinking Water
• Environmentally Responsible Collection, Treatment and Disposal of Wastewater

• Drink with Confidence
• Flush with Pride

• All Accomplished Affordably

• Under All Circumstances
Adaptation For Sea Level Rise In The Design of Deer Island WWTP
Adaptation For Sea Level Rise In The Design of Deer Island

- Deer Island plant fully protected
  - 100-year flood
  - 1.9-foot sea level rise
  - Wave runup of 14 feet on east side and 2 feet on west side

- On-site power plant ensures uninterrupted power supply

- Nut Island Headworks in Quincy similarly designed for sea level rise
A Rising Sea Impacts The Hydraulics Of The Outfall Tunnel

- The effluent from the sewage treatment plant is discharged by gravity to the 9.5 mile
- To maintain hydraulic capacity,
  - Plant raised 1.9 feet in elevation
  - tunnel diameter was up-sized from 24 feet to 24.25 feet
Over time, more models and finer resolution – make use of the additional detail.

GCM computational cells color coded by predicted precipitation: Source: NCAR
Large Reservoir to Yield + More Precipitation = Plenty of High Quality Water
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
• All MWRA dams, dikes, spillways and appurtenances are inspected routinely by licensed dam safety engineers and are in good condition.

• Since 2006, MWRA has spent over $21 million on dam safety projects.

• Quabbin and Wachusett spillways have been improved to be able to discharge the probable maximum flood (1 in 1000 years).

• All drinking water pump stations and storage tanks above flooding elevation.
Installation of a crest gate greatly enhances discharge operations.
Sea-Level Rise Is Already With Us
Trend For Boston Inner Harbor, NOAA Tidal Gage #8443970 (1921 – 2013)

Data source:
http://tidesandcurrents.noaa.gov/data_menu.shtml?bdate=19210101&edate=20130511&wl_sensor_hist=W5&relative=&datum=6&unit=1&shift=g&stn=8443970+Boston%2C+MA&type=Historic+Tide+Data&format=View+Data
Sandy Not Like Previous Storms
Sandy Track

Hurricane Sandy Storm Track (2012)

- Tropical
- Depression
- Storm
- Cat 1
- Cat 2
- Cat 3
- Cat 4
- Cat 5

11 PM Mon Oct 29

11 AM Mon Oct 22

Tropical Depression 2012 11:39 PM EDT
How Did Sandy Measure Up?

**BOSTON**

**NEW YORK**

NOAA/NOS/CO-OPS
Preliminary Water Level (A1:1) vs. Predicted Plot
844379 Boston, MA
From 2012/10/29 -2012/10/30

11’ above MSL
9’ higher than normal high tide.

4.6ft
How Did Sandy Compare to Historical Storms?

- **Boston**
  - 100 Year + 2.5 ft
  - Blizzard of 78

- **New York**
  - Max Sandy
  - 100 Year + 2.5 ft
  - 100 Yr Storm
21 of MWRA Coastal Sewer Facilities Are Within 15 Feet Of Mean Sea Level
Areas Potentially Affected By Loss Of Coastal Pump Stations
Impact of Global Warming: 100 Year Storm and Sea Level Rise In Year 2100.

Data sources: Flooded area IPCC, ground elevations determined by LIDAR.
Hurricane Sandy Impacts On NY/NJ Water Utilities

- Many water utilities lost power due to lack of generators

- NYC water was safe to drink, but surrounding counties in NY and NJ had do not use advisories, or boil water notices

- Passaic Valley was forced to release billions of gallons of raw or partially treated sewage into New York Bay over several weeks
Benchmarks For Evaluating Facilities

- 100 year flood as determined by FEMA (current regulatory requirement).
- 100 year flood + 2.5ft (NYC DEP, BHA).

Additionally
- 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.
How Do Facilities Measure Up?

- Low – Facilities that only have flooding potential in one of the Hurricane Scenarios (Categories 1, 2, 3, and 4 as determined by the SLOSH model)
- Minimal – Facilities that have a very low likelihood of flooding
- Maximum – Facilities that flood in a 100 year event
- High – Facilities that are within 1 foot of flooding in a 100 year event or essential facility that floods in a 100 year plus 2.5 ft event
- Moderate – Facilities that flood or are within 1 foot of flooding in a 100 year plus 2.5 ft event
- Likely Very Unlikely to be Affected
- Likely Affected by a 100 year event
- Likely Affected by a 100 year + 2.5 ft event

<table>
<thead>
<tr>
<th>Ranking</th>
<th>Facility Name</th>
<th>Town</th>
<th>Risk</th>
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<tbody>
<tr>
<td>1</td>
<td>Chelsea Creek Screenhouse</td>
<td>Chelsea</td>
<td>Maximum</td>
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<tr>
<td>2</td>
<td>Braintree-Weymouth Pump Station</td>
<td>Quincy</td>
<td>High</td>
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<td>3</td>
<td>South Boston CSO Tunnel Ventilation Building</td>
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<td>4</td>
<td>Squamut Pond Station</td>
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<td>5</td>
<td>Pelletizing Plant</td>
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<td>6</td>
<td>Chelsea Creek Headworks</td>
<td>Chelsea</td>
<td>High</td>
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<tr>
<td>7</td>
<td>Somerville Marginal CSO Facility</td>
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<td>8</td>
<td>Alford St Facility</td>
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<tr>
<td>9</td>
<td>Mystic River Gatehouse</td>
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<td>10</td>
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<td>16</td>
<td>Quinny Pump Station</td>
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<td>Union Park Detention &amp; Treatment Facility</td>
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<td>Intermediate Pump Station</td>
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<td>Deer Island</td>
<td>Winthrop</td>
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<tr>
<td>30</td>
<td>Nut Island Headworks</td>
<td>Quincy</td>
<td>Minimal</td>
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Facilities Impact Summary

- 6 Sewer Facilities Likely Affected by a 100 Year Event.
- 9 Sewer and 3 Administration Facilities Likely Affected by a 100 Year + 2.5 feet Event.
- 7 Sewer Facilities Likely Affected by Hurricane Only.
- 5 Sewer Facilities Very Unlikely to be Affected.
- No Water Facility At Risk of Service Disruption.
Chelsea Screenhouse - Vulnerabilities

Southwest Facility View

Backup Generator
Braintree-Weymouth Replacement Pump Station

Exterior South Side View
First Floor

Interior South Side View
First Floor Switch Gear Room
Braintree-Weymouth Replacement Pump Station
High Tide
Chelsea Administration & Maintenance Facilities
Flood Inundation

FEMA 100 Year Flood Elevation +2.5ft
Chelsea Administration & Maintenance Facilities

FEMA 100 Year Flood Elevation

FEMA 100 Year Flood Elevation + 2.5ft
Past Practice

- Low-lying facilities are protected with sandbags and pumps.
- Mobile generators are deployed in advance of storms.
- Increased staffing
Going Forward

• Short-term
  – At-risk buildings may be fitted with temporary flood barriers.

• Long-term
  – Future rehabilitation contracts will take sea level rise into account.
  – Consider moving important equipment to higher elevations.
Evaluated Several Flood Barrier Options
Alewife Pumping Station
Proposed Modifications
Planning to Avoid Inundation
Created SOPs To Redeploy Staff And Equipment To Higher Ground

- Staff and equipment redeployed to pre-determined locations in advance of storms.
- Back-up water and wastewater operations control center created at Carroll Treatment Plant in Marlborough.
Climate Change and The Planning Process

- MWRA Master Plan update process puts issues on the table for senior management and the Board of Directors to grapple with.
- Climate change is treated as an extra dimension in the assessment of infrastructure reinvestment.
- Climate change is also an input for the vulnerability analysis for extreme events (such as hurricane preparedness exercises) which identifies infrastructure fixes to provide extra resiliency.
- Think about all aspects whenever a facility is being evaluated or upgraded: use the investment cycle
MWRA Drivers for Energy Efficiency Focus

• Environmental agency
  – MWRA has been successfully meeting the goals established in Governor Patrick’s Executive Order 484 (April 2007)
    – Goals include:
      - Overall Reduction of Energy Consumption
      - Increase Renewable On-site Energy Production
      - Purchase of Renewable Energy

• Cost Savings

• Operations
  – Equipment replacement

• Recognition and Reputation
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Questions or Comments?

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