



MWRA's Climate Change Strategy

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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



The Good News



Large Reservoirs With Large Storage Capacity + 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





Dams Not Threatened

- 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 \$22 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)



Quabbin Spillway Rehab





Wachusett Crest Gate





Wachusett Crest Gate





Wachusett Spillway





Weston Reservoir Parapet Wall





Armored the Earthen Dam at Spot Pond

- MWRA controls 28 dams and dikes – large and small

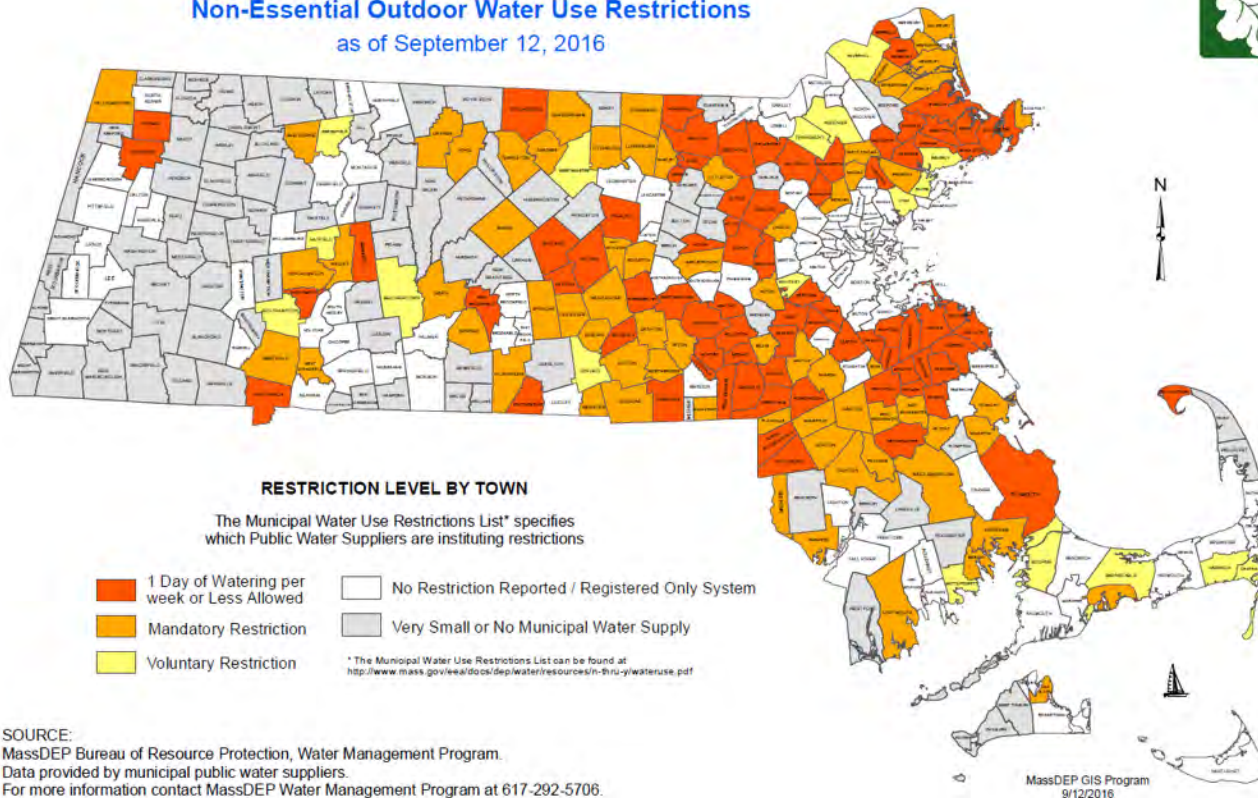




2016 Drought



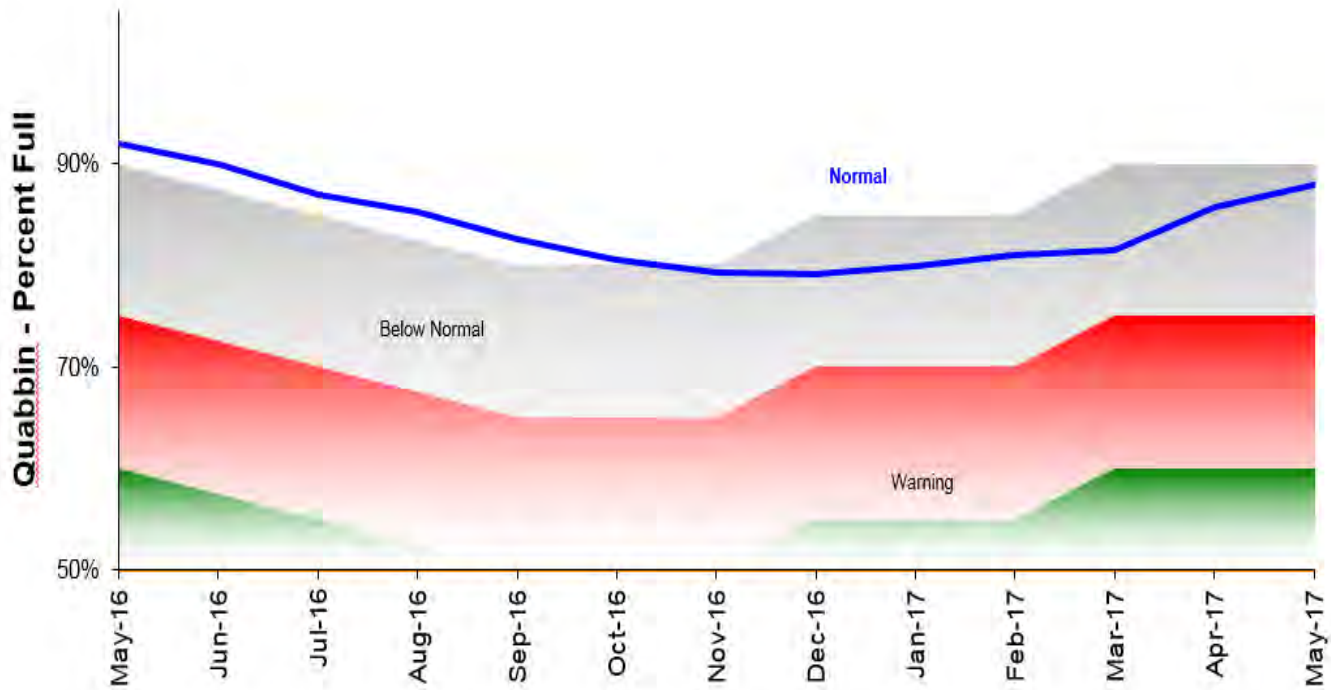
Non-Essential Outdoor Water Use Restrictions as of September 12, 2016



SOURCE:
MassDEP Bureau of Resource Protection, Water Management Program.
Data provided by municipal public water suppliers.
For more information contact MassDEP Water Management Program at 617-292-5706.

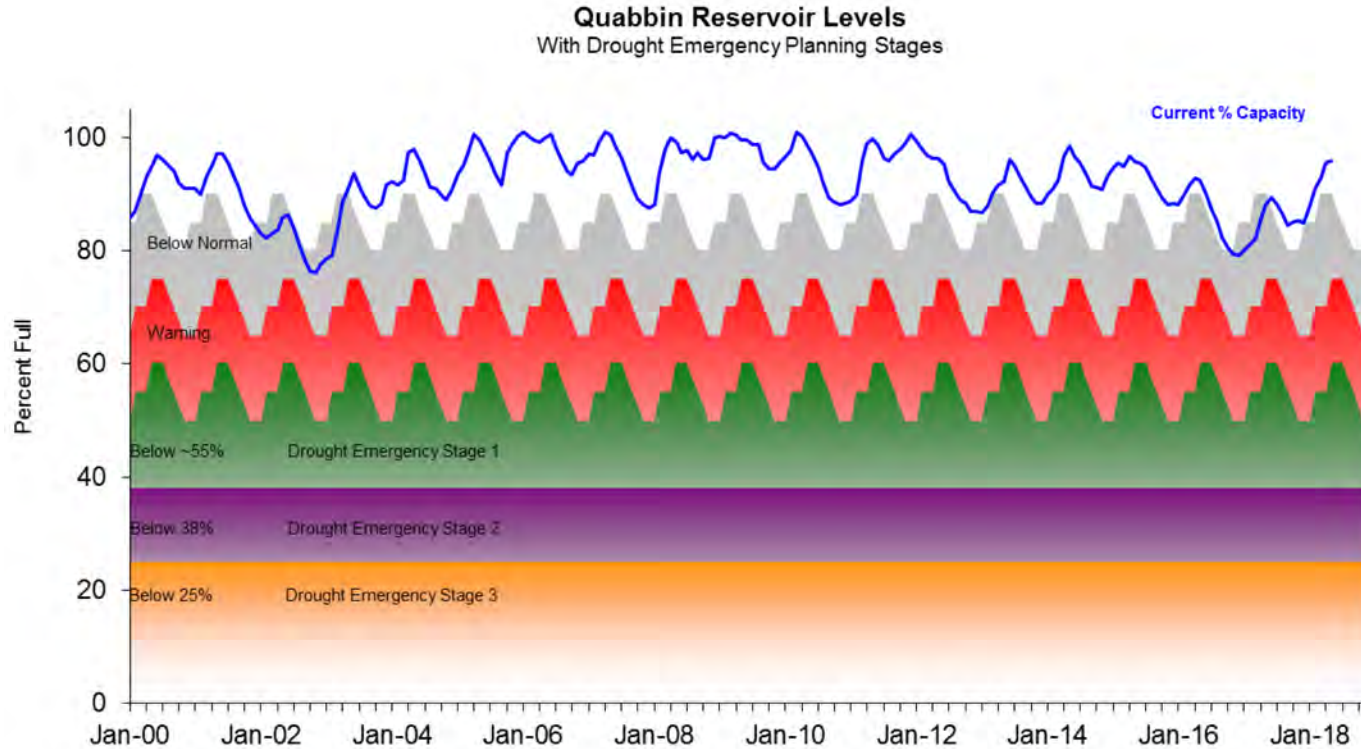


Quabbin Reacted Very Slowly





Even at Below Normal Levels, Quabbin Had Plenty of Water





MWRA Was Able to Provide Water to Outside Communities

Community	Amount Supplied (Million Gallons)
Worcester	847.3
Cambridge	515.2
Burlington	7.9
Ashland	3.2

- MWRA also supplied an extra 11.25 mgd to its partially supplied communities



Stressed Basins Adjacent To MWRA Service





Sea Level Rise Was Anticipated In The Design of Deer Island Treatment Plant

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





On-site Power Plant

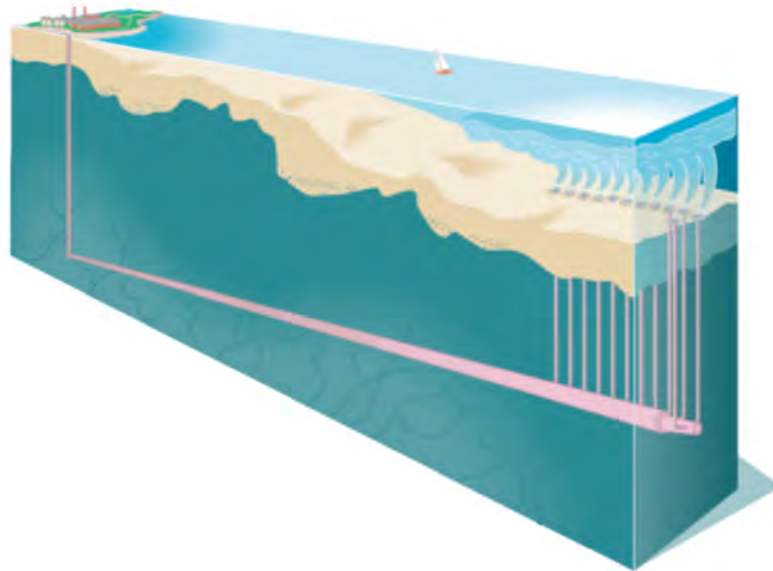
- On-site power plant ensures uninterrupted power supply to keep the plant operating for up to 90 days





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
- 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





Continuity of Operations



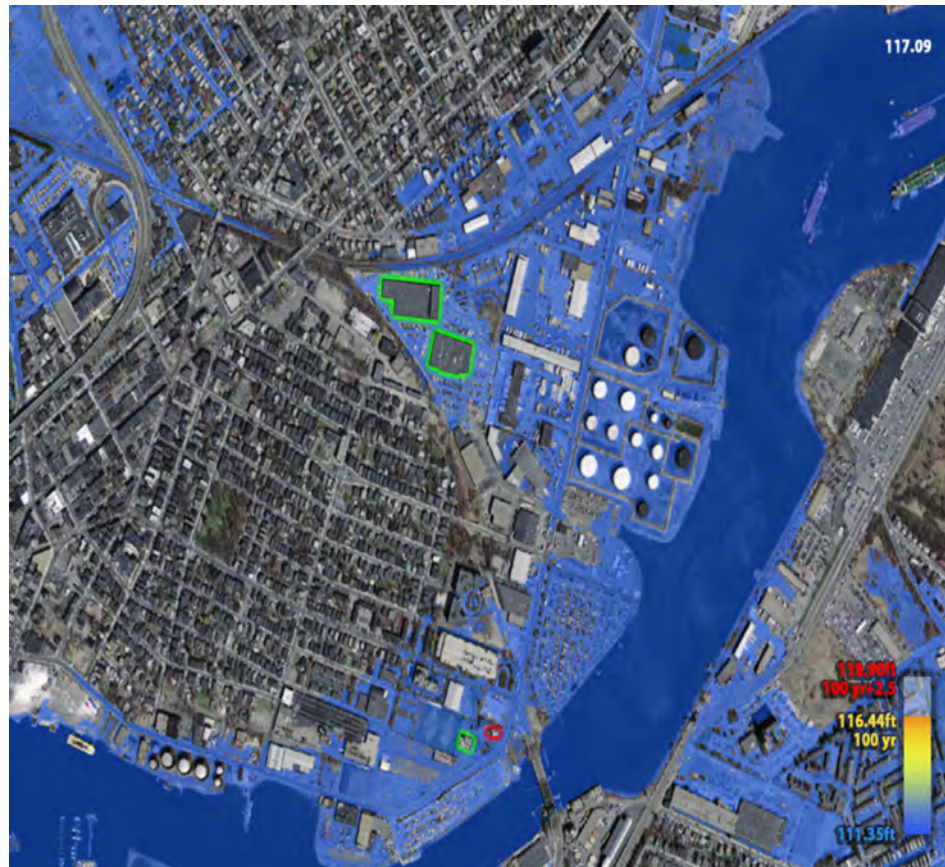
MWRA's Chelsea Facility

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



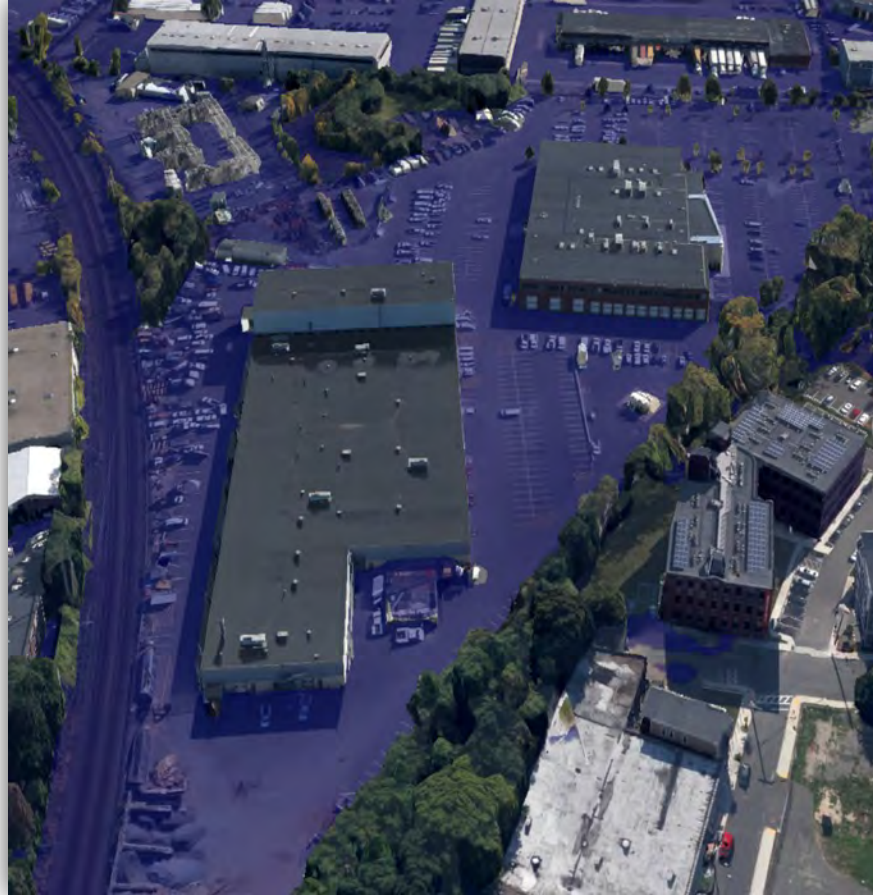


Chelsea Facility Flood Inundation





Chelsea Facility Flood Inundation





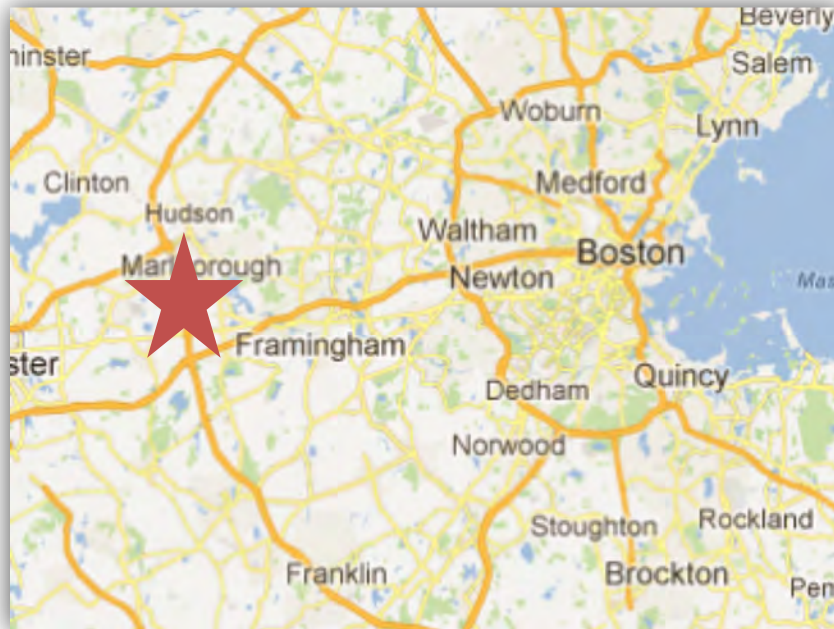
Plans In Place to Move Vehicles and Equipment to Higher Ground





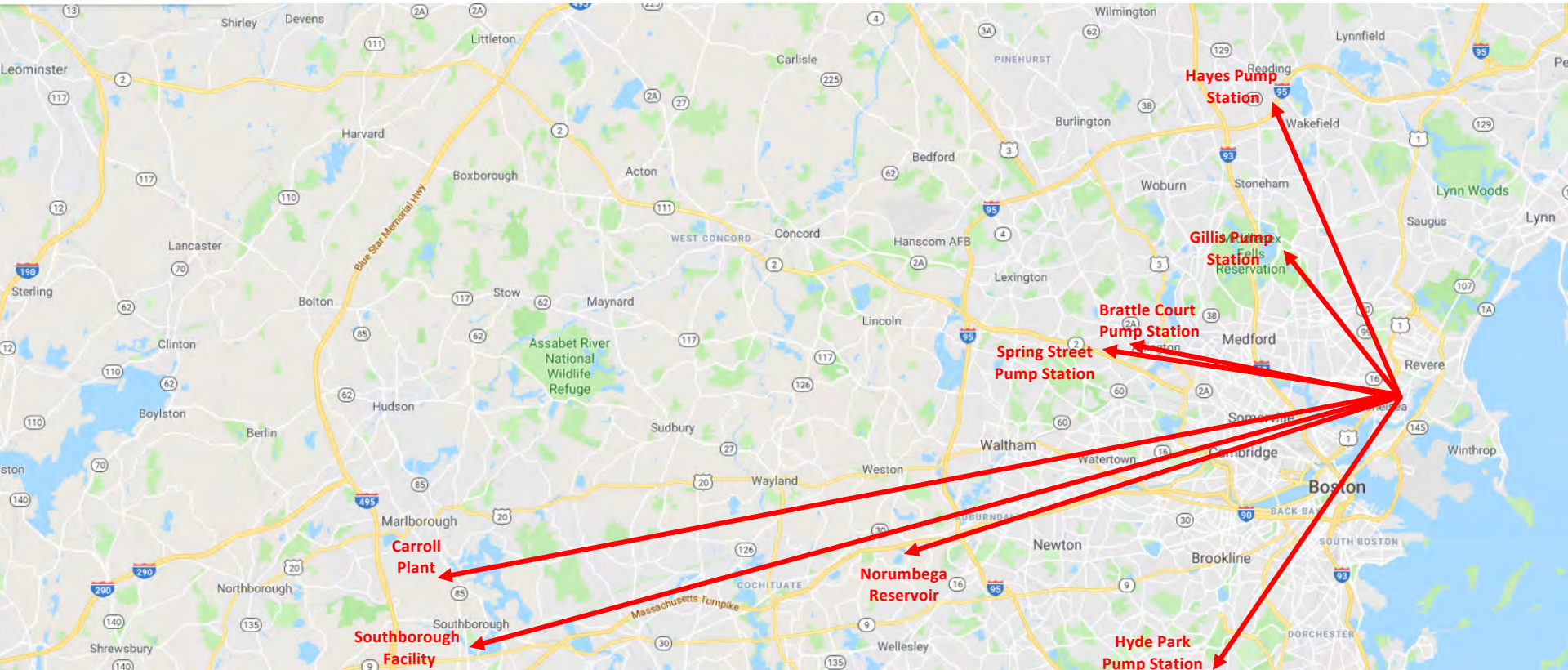
Plans in Place To Pre-deploy Staff To Higher Ground

- 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





Coastal Facilities



Localized Flooding

- Flooding during the January and March Nor'easters this year impeded access to several MWRA facilities



Charlestown Navy Yard





Eastern Avenue, Chelsea





Shirley Street, Winthrop





Nut Island, Quincy





MWRA Coastal Facilities





Benchmarks For Evaluating Facilities

- 100 year flood as determined by FEMA (current regulatory requirement)
- 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



Flood Elevations At Chelsea Creek Headworks





How Do Facilities Measure Up?

	Rank	Facility Name	Mitigation Actions Comments
Likely Affected By 100 Yr Storm	1	PELLETIZING PLANT	Barrier around backup generator and transformers erected. (*)
	2	HOUGHS NECK PUMP STATION	Stop plank barriers installed in entryways. (*)
	3	SQUANTUM PUMP STATION	Stop plank barriers installed in entryways. (*)
	4	ALFORD ST FACILITY	Sand bags will be used for flood protection. Future work under review.
	5	QUINCY PUMP STATION	Stop plank barriers installed in entryways. (*)
	6	CHELSEA CREEK SCREENHOUSE	Installed retaining wall to protect generator and main power panel; stop log barriers at all doors and roll-up doors; sump pumps inside building; two isolation gates to protect facility; raised ventilation louver above required elevation; led panels to protect all windows to required elevation; all new electrical installed above required elevation where feasible
	7	BRAINTREE-WEYMOUTH PUMP STATION	Stop plank barriers installed in entryways. (*)
	8	SOUTH BOSTON CSO TUNNEL VENTILATION BLDG	Flood protection plan drafted, flood protection specs designed, requisition for materials purchase submitted.
Likely Affected By Storm Within 1 ft below a 100 Yr Storm	9	SOUTH BOSTON CSO PUMP STATION	Flood protection design specs from vendor being reviewed in-house.
	10	CHARLESTOWN NAVY YARD FACILITY	MIS equipment and staff moved to upper floors.
	11	ALEWIFE BROOK PUMP STATION	Contractor installing flood protection system. Moving most critical equipment above flood level.
	12	CHELSEA CREEK HEADWORKS	Construction contract in progress to add stop log barriers at all doors including overhead coiling doors. Openings in façade being filled and moved above EL 119. Escape hatches, loading hatch and shaft opening being protected to EL 119. Valves being added to ductwork on mezzanine to isolate shafts upstream of influent gates.
	13	UNION PARK DETENTION & TREATMENT FACILITY	Operating Contractor designing specs which call for using sand bags at entry ways and isolating facility if required.
Likely Affected By a 100yr-2.5ft	14	MYSTIC RIVER GATEHOUSE	No adverse impact if flooded.
	15	CHELSEA ADMINISTRATION FACILITY	Flood protection plan drafted, flood protection specs designed, material specs out on street for quote Flood protection design specs from Vendor being reviewed in-house and modified due to requirement changes.
	16	CHELSEA MAINTENANCE FACILITY	Flood protection plan drafted, flood protection specs designed, material specs out on street for quote Flood protection design specs from Vendor being reviewed in-house and modified due to requirement changes.
Likely Affected By a	17	DEER ISLAND TREATMENT FACILITY	Plant processes designed to withstand a Category 3 Hurricane to allow uninterrupted facility operation. Some support facilities and access may be impacted.
	18	WIGGINS PUMP STATION	Will include flood plain protection in upcoming capital replacement project.
	19	COTTAGE FARM CSO FACILITY	
Very Unlikely To be Affected	20	DELAURI PUMP STATION	
	21	CARUSO PUMP STATION	
	22	PRISON POINT CSO FACILITY	
	23	SOMERVILLE MARGINAL CSO FACILITY	
	24	COLUMBUS PARK HEADWORKS	
	25	SOMERVILLE SAMPLING BUILDING	
	26	WARD STREET HEADWORKS	
	27	INTERMEDIATE PUMP STATION	
	28	LITTLE MYSTIC CHANNEL CSO FACILITY	
	29	HINGHAM PUMP STATION	
	30	NUT ISLAND HEADWORKS	

Projects have been prioritized from the top of the chart (most immediate risk) down through the rankings.

* In some cases specifications are being revised due to more recent updates to the FEMA flood maps. Future modifications to protection measures will be made as necessary.



Facilities Impact Summary



- 8 Sewer Facilities Likely Affected by a 100 Year Event
- 4 Sewer and 1 Administration Facility Within One foot of a 100 Year Event
- 3 Sewer Facilities Affected by 100 plus 2.5 ft Event
- 3 Sewer Facilities Likely Affected by Hurricane Flooding
- 11 Sewer Facilities Unlikely Affected

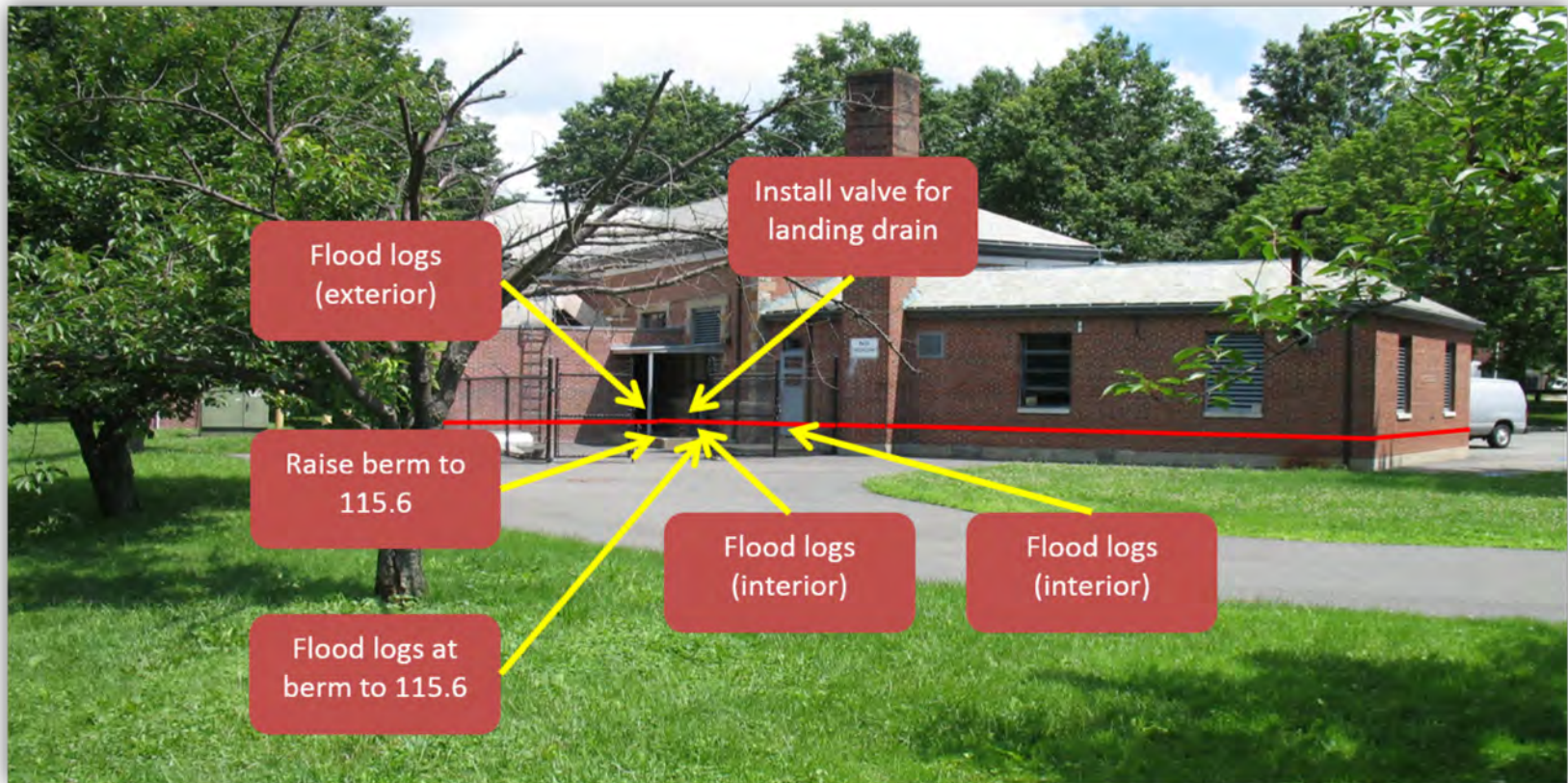


MWRA's Pragmatic Approach

- Short-term
 - At-risk buildings are being fitted with temporary flood barriers
- Long-term
 - Facility rehabilitation on a 20-year cycle
 - Future rehabilitation contracts will include protection measures
- May have to speed things up



Alewife Brook Pump Station





Alewife Brook Pump Station





Chelsea Screenhouse





Chelsea Headworks





Blocking and Tackling

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





New Flood Control Measures Are Being Added



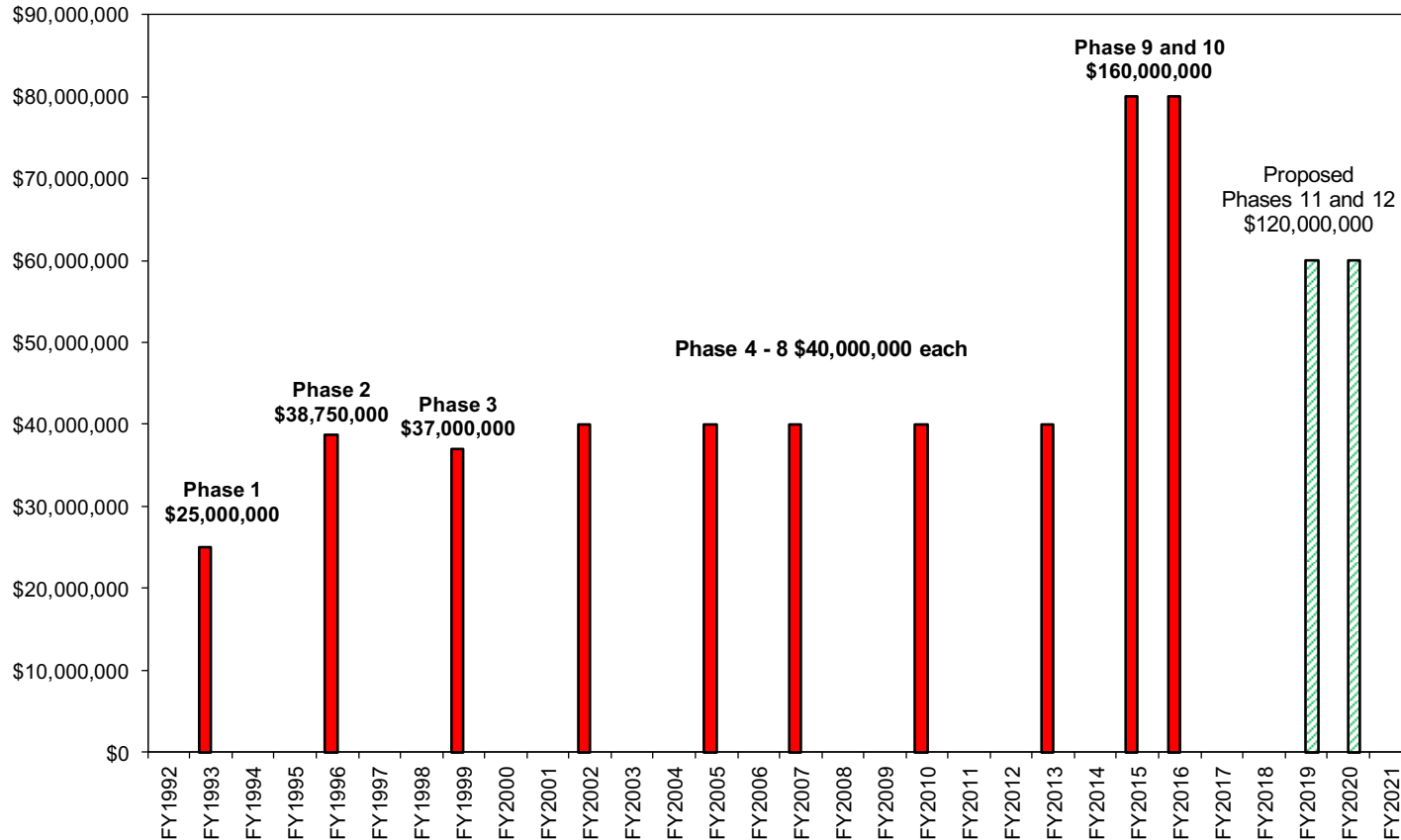


New Flood Control Measures Are Being Added





MWRA's Long-Term Commitment to Fund Community I/I Reduction





I/I Funding Results

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



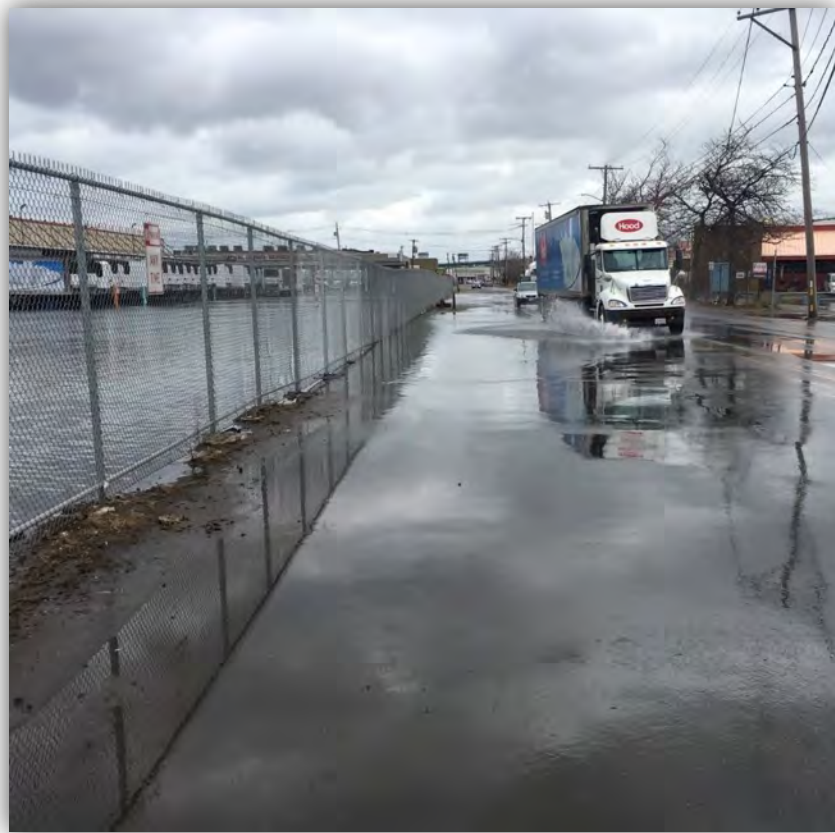


Overflows Will Increase





Chelsea Produce Center





It's Already Here



East Boston





State Street, Boston



AP/CityLab



Damage at Deer Island





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