



Massachusetts Water Resources Authority

*Update on 2018  
Water and Wastewater Master Plan*

February 12, 2019



## Background – 33 Years of MWRA Capital Investment

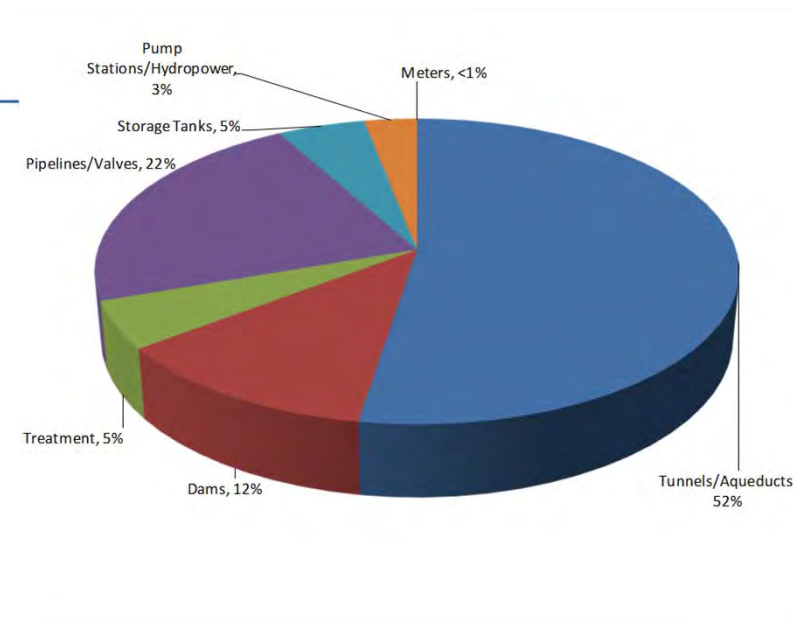
### **FY86-18 \$8.3 Billion Capital Spending**

- 70% on Wastewater - \$5.8 Billion
- 28% on Waterworks - \$2.3 Billion
- 2% on Business and Operations Support - \$200 Million



## Water System Infrastructure Replacement Asset Value

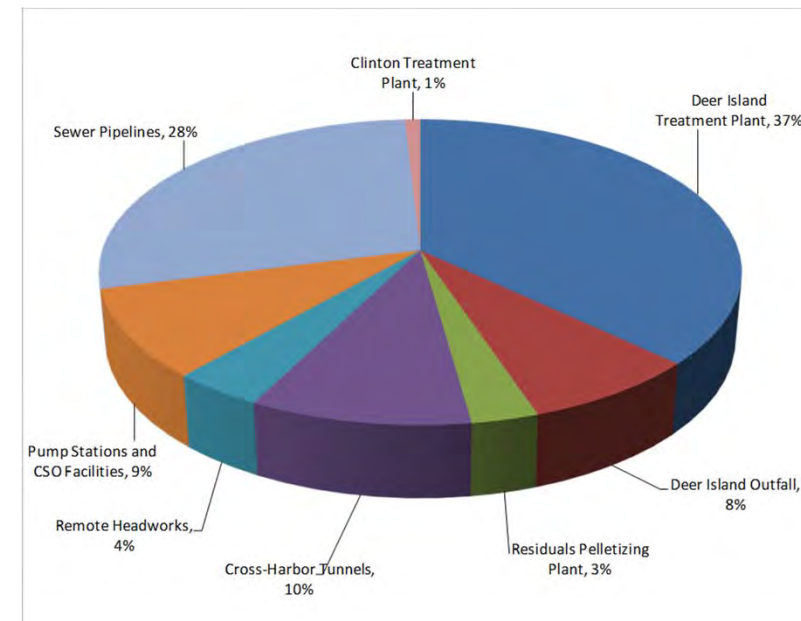
<u>Asset Class</u>	<u>Replacement Asset Value</u>	<u>% of Total</u>
Tunnels/Aqueducts	\$3,492 million	52%
Dams	\$830 million	12%
Treatment	\$297 million	5%
Pipelines/Valves	\$1,465 million	22%
Storage Tanks	\$347 million	5%
Pump Stations/Hydropower	\$217 million	3%
Meters	\$25 million	<1%
<b>TOTAL</b>	<b>\$6,671 million</b>	<b>100%</b>





## Wastewater System Infrastructure Replacement Asset Value

Asset Class	Replacement Asset Value	% of Total
Deer Island Treatment Plant	\$2,500 Million	37%
Deer Island Outfall	\$530 Million	8%
Residuals Pelletizing Plant	\$200 Million	3%
Cross-Harbor Tunnels	\$660 Million	10%
Remote Headworks	\$270 Million	4%
Pump Stations and CSO Facilities	\$640 Million	9%
Sewer Pipelines	\$1,900 Million	28%
Clinton Treatment Plant	\$60 Million	1%
<b>TOTAL</b>	<b>\$6,760 Million</b>	<b>100%</b>





## Overview of MWRA Master Planning

- 40-Year Master Plan Updates Planned Every 5 Years
  - 2006 (FY07-48) and 2013 (FY14-53)
- 2018 Master Plan Includes All Projects **PROGRAMMED** in FY19 CIP
- Master Plan Also Includes Additional Projects **RECOMMENDED** (System Needs) in 40-Year Planning Period (FY19 through FY58)
- Focus on Next Two CIP Cap Periods – FY19-23 and FY24-28
- Draft Master Plan Used to Help Guide FY19-23 CIP Cap Discussions



## Master Plan vs Business Plan

### Master Plan

- Detailed listing, explanation and prioritization of all short and long-term projects that impact capital needs over a 40-year period
- Used by Staff and Advisory Board to develop capital investment priorities during development of annual CIP and to help project long-term rates

### Business Plan

- Concise listing of MWRA goals over a short (5-year) period
- Used to engage Board of Directors and outside agencies in discussion of MWRA's goals and plan to meet them



## Water System Goals

Goal 1: Provide reliable water delivery

Goal 2: Deliver high quality water

Goal 3: Assure an adequate supply of water

Goal 4: Manage the system efficiently and effectively.



## Wastewater System Goals

- Goal 1: Provide reliable and safe sewer service
  
- Goal 2: Provide environmentally sound wastewater collection and treatment, pretreatment, residual disposal, and combined sewer overflow control
  
- Goal 3: Assure appropriate future wastewater collection and treatment capacity
  
- Goal 4: Manage regional sewer service efficiently and cost-effectively





## What the 2018 Master Plan Includes

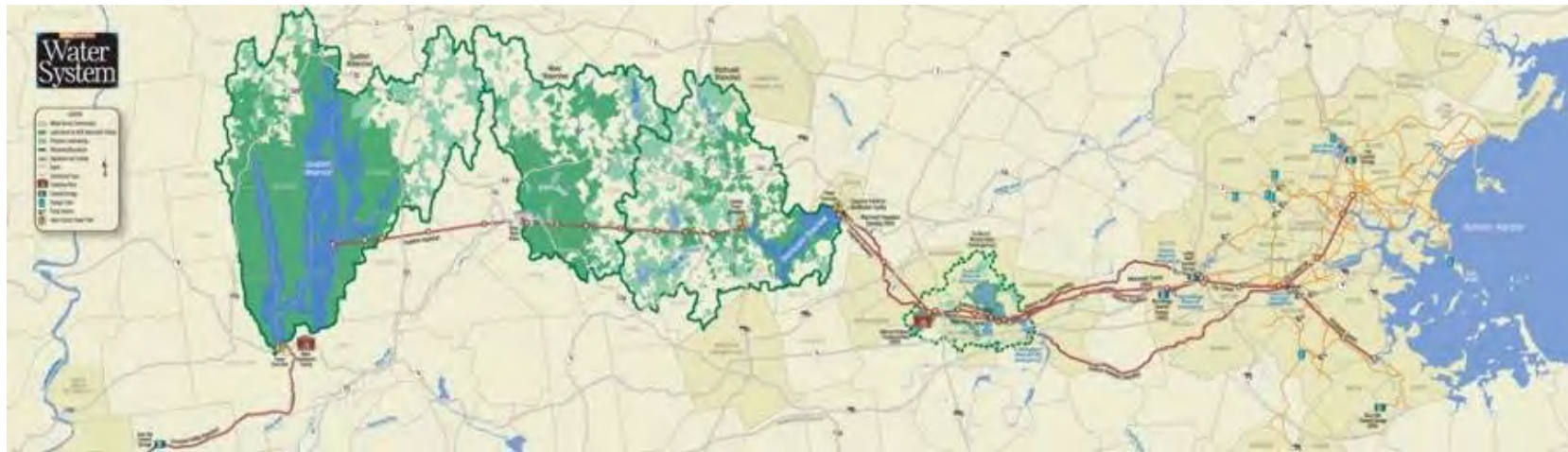
- FY 19-23 CIP (5 year) Cap is \$984.8M
- FY19 Approved (one year) CIP Spending is \$122.9M  
(Excluding Community Grant/Loan Programs)
- **System Needs Identified in 2018 Master Plan = \$5.7 Billion**

	<b>FY19-23</b>	<b>FY24-28</b>	<b>FY29-38</b>	<b>FY39-58</b>	<b>Total</b>
	5 years	5 years	10 years	20 years	40 years
Water	\$353M	\$935M	\$975M	\$319M	\$2.6B
Wastewater	\$654M	\$1,139M	\$456M	\$921M	\$3.2B
Total	\$1,007M	\$2,073M	\$1,431M	\$1,240M	\$5.7B
5 Year Average	\$1,007M	\$2,073M	\$715M	\$310M	\$719M



## MWRA Water System Overview

- 102 miles of active transmission mains and tunnels
- 43 miles of standby transmission facilities
- Water treatment capacity 405 MGD
- 284 miles of distribution mains
- 5,597 valves
- 287 MG of covered storage
- 13 pump stations (includes Wachusett Aqueduct Pumping Station)





## Water System Master Plan Themes

### 2006

- Redundancy
  - Initiate Planning Efforts
  - Continue Work on NIH/SEH and Lynnfield Projects
  - Complete Blue Hills
- Continue Pipeline Rehabilitation
- Identify Asset Protection Needs

### 2013

- Redundancy
  - Implementation Underway
  - Transmission System
  - Distribution System
  - Storage
- Continue Pipeline Rehabilitation
- Increase Asset Protection Funding



## Water System Master Plan Themes

### 2013

- Redundancy
  - Implementation Underway
  - Transmission System
  - Distribution System Storage
- Continue Pipeline Rehabilitation
- Increase Asset Protection Funding

### 2018

- Redundancy
  - Implementation Underway
  - WAPS Nearing Completion
  - Metropolitan Tunnels
  - Spot Pond Storage/PS
  - Distribution Storage in Future
- Continue Pipeline Rehabilitation
- Continue Asset Protection Funding



## 2018 Master Plan Assumptions - WATER

- Safe Yield Sufficient for Future Needs
- No New Regulations Anticipated in Future
- Climate Change Impacts on Yield Insignificant



## Major 2018 Master Plan Recommendations - WATER

- Redundancy and Storage Projects approximately \$1.72 billion in FY19-58
- Existing and Recommended Projects include:
  - Wachusett Aqueduct Pump Station
  - Metropolitan Tunnels Redundancy Program
  - Interim Improvements Program
  - Southern Extra High
  - Northern Intermediate High
  - Section 75 Extension
  - NEH Looping/Additional Storage
  - Parallel Line to Meters 55/68



## Major 2018 Master Plan Recommendations - WATER

- Quabbin Tunnel Inspection Included in CIP
- Inspection of Cosgrove Tunnel and Metropolitan Tunnel System Recommended in Master Plan
- \$65 Million Recommended for Design/Rehabilitation of Metropolitan Tunnels



## Transmission Redundancy Updates Since 2013 Master Plan

- Construction of the Wachusett Aqueduct Pump Station Nearing Completion
- Will Provide Redundancy for Cosgrove Tunnel







## Metropolitan Tunnels Redundancy



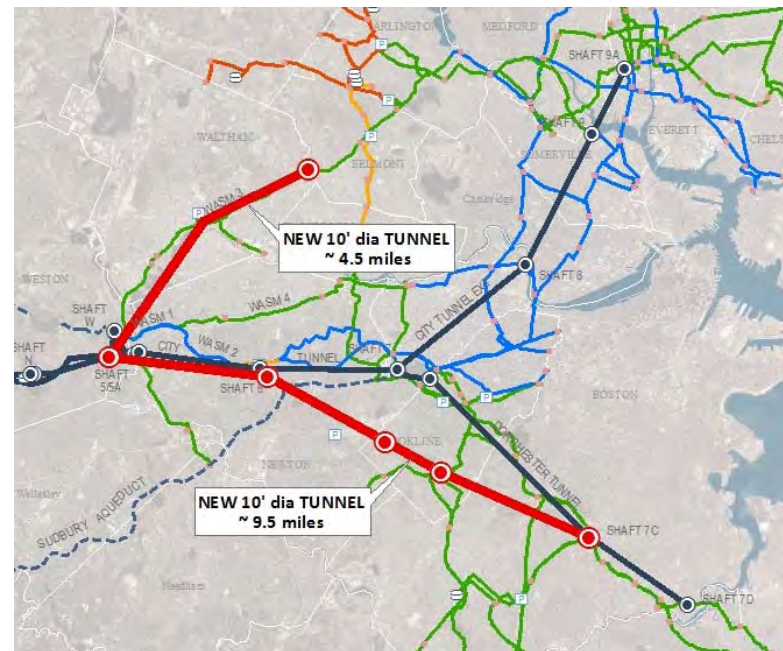
### Redundancy Issue:

- Failure of Deep Rock Tunnels Unlikely
- Failure of Surface Connection Valves and Piping Possible
- Failure of Surface Connection at Shaft Can Require Isolation of Large Portion of Tunnel System
- Old Isolation Valves at 3 Key Shafts Must Be Taken Out of Service for Maintenance.



## Transmission Redundancy Updates Since 2013 Master Plan

- Metropolitan Tunnel Redundancy Program Starting Up
  - New Tunnel Redundancy Department Formed
  - Procurement Underway for Program Support Services Contract
  - Future Contract for Preliminary Design/MEPA Review Planned for FY20





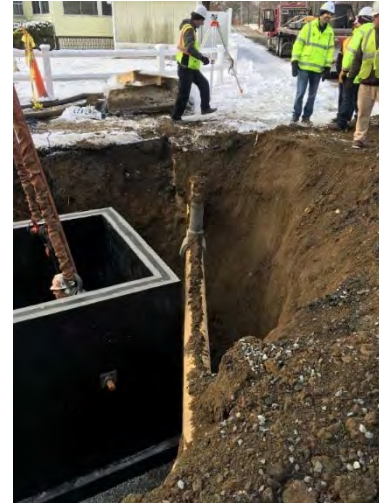
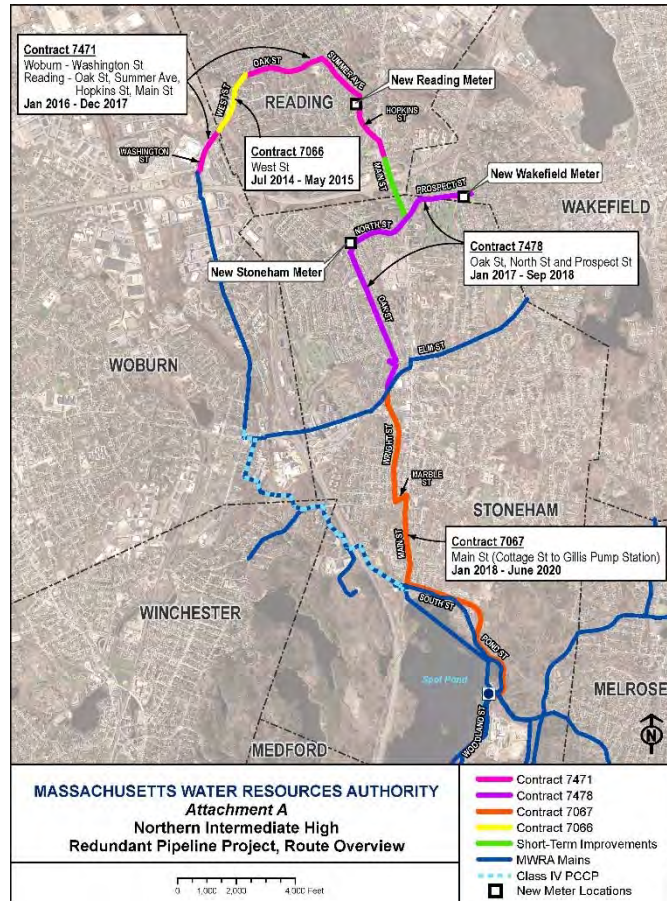
## Transmission Redundancy Updates Since 2013 Master Plan

- Interim Improvements Program Implemented to Mitigate Risks During Planning and Construction of Proposed Redundant Tunnel
  - Tops of Shafts Improvements - Design Underway  
(structural reinforcing to extend useful life)
  - Chestnut Hill Emergency Pump Station Improvements – Designer Being Procured  
(new pump controls and isolation valves for more reliability)
  - WASM 3 Rehabilitation - Design Underway
  - Low Service PRV Improvements – Design Underway  
(increase capacity of Low Service system to enhance emergency response)
  - Commonwealth Ave Pump Station Improvements – Construction Contract Being Awarded  
(redundant connection to Low Service system)





# NIH Redundancy Underway

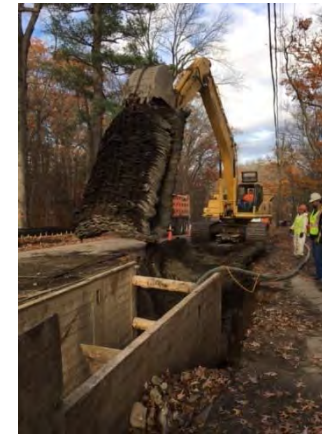


Total Construction Cost  
\$55,700,000





# Southern Extra High Redundancy Underway



Total Anticipated Construction Cost: \$50 million





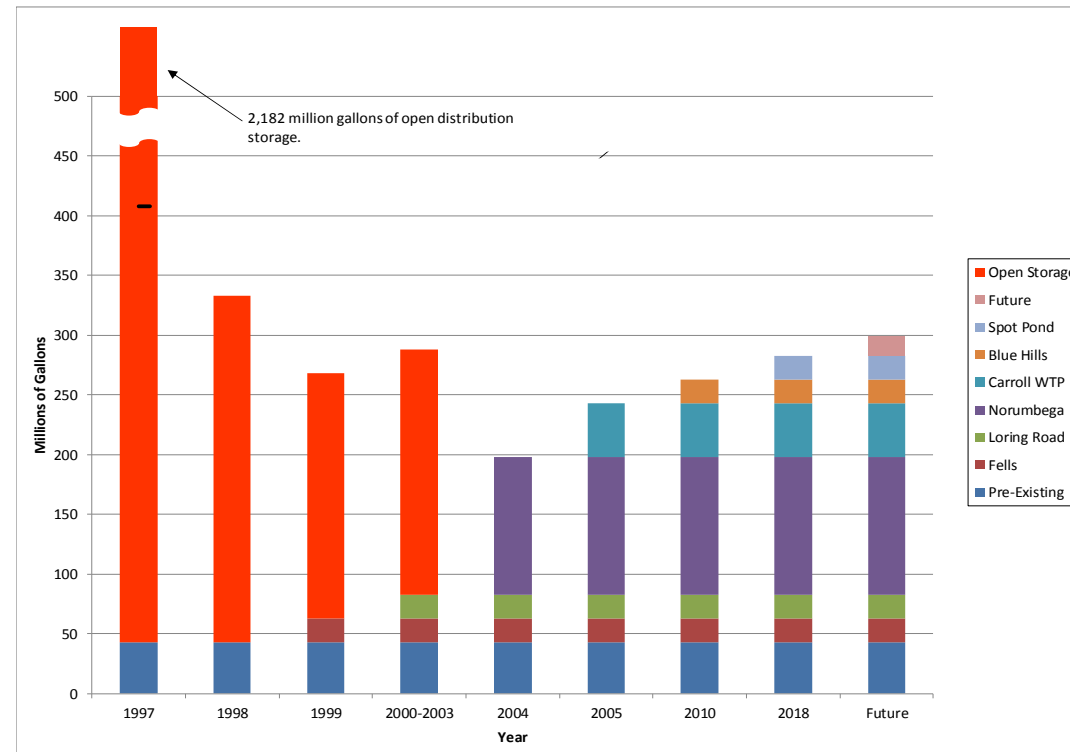
## MWRA Metropolitan Area Storage Capacity Over Time

### System-Wide Evaluation Completed in 1993

- DEP Guidelines and Ten State Standards require at least 1 day of storage
- Industry Practice: Most similar systems have 1 maximum day or more of storage

### Future Localized Storage Needs

- Northern Intermediate High
- Southern Extra High
- Northern Extra High





## Spot Pond Covered Storage Facility and Pump Station







## Metropolitan Pipeline Rehabilitation

Existing and Recommended Metropolitan System Pipeline Expenditures Total \$321M (excludes WASM3 work) in FY19-58

- Lining of Older Unlined Cast-Iron Mains to Preserve Water Quality
- Expanded Metropolitan Area Cathodic Protection Program (\$56M in FY19)
- Replacement/Rehabilitation of Steel Pipes
- Pipeline Study Recommended in FY25 to Assess Need for Further Rehabilitation







## Asset Protection - Pump Stations, Valves, Storage, Dams, Buildings and Support Systems

Existing and Recommended Asset Protection Projects total \$361 million in FY19-58 for:

- Equipment
- Valves
- Pump Stations
- Storage Facilities
- Treatment Facilities
- Transmission Buildings
- Dams
- Ancillary Support Systems





## Asset Protection - Water Treatment

### Age and Condition:

- Carroll Water Treatment Plant Electrical and Mechanical Systems Likely to Require Replacement/Upgrades

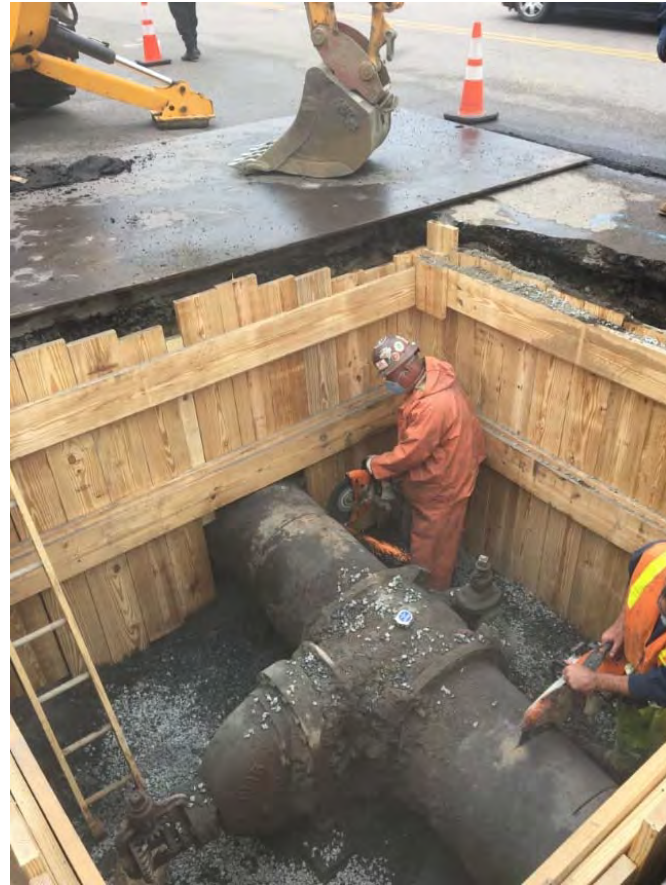
### Asset Protection Projects:

- Existing Carroll Plant Projects Total \$41M in FY19 CIP
- Additional \$30M Recommended in FY29-58





## Section 65, Medford, Valve Replacement





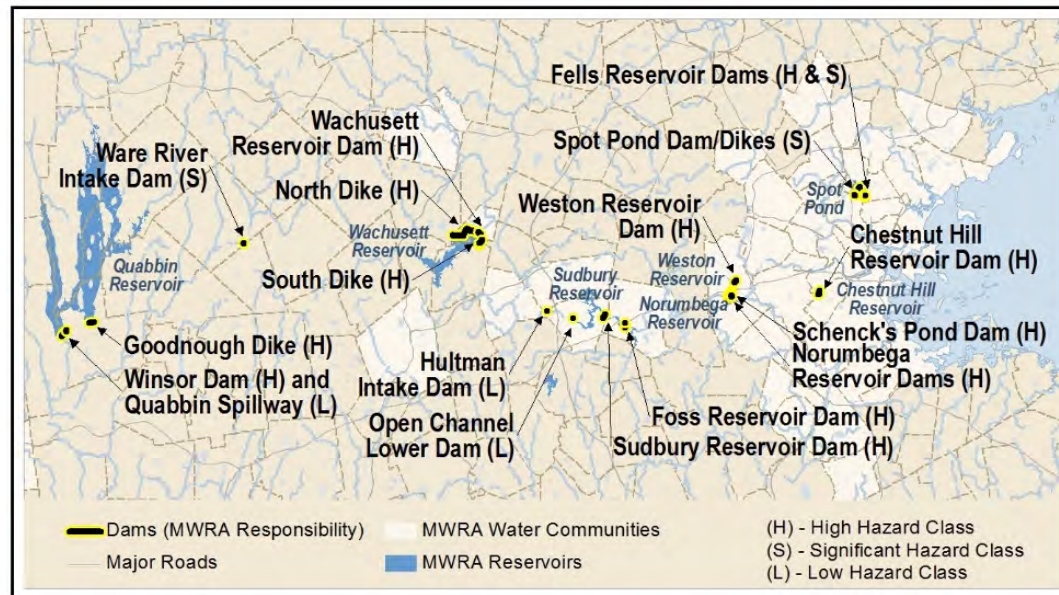


# Cathodic Protection Work, Section 57, Revere Beach Parkway





# Water System Dams Asset Protection



- Significant Improvements Achieved
- \$10M Recommended in FY19-58





## Community Financial Assistance - Water Loans

- Over 6,612 Miles of Community-Owned Water Pipe
- Approximately 1,800 miles (27%) Remain Unlined
- \$400M Distributed Since July 2000
- Two Additional Phases of Funds Recommended in FY29-48



## Water System Master Plan - Summary

### Existing Projects and New Recommendations\*

	<b>FY19-23</b> 5 years	<b>FY24-28</b> 5 years	<b>FY29-38</b> 10 years	<b>FY39-58</b> 20 years	<b>Total</b> 40 years
Water Projects Programmed in FY19 CIP	\$345M	\$916M	\$915M	\$53M	\$2,229M
Projects Recommended in Master Plan	\$8M	\$19M	\$60M	\$266M	\$352M
<b>Total</b>	<b>\$353M</b>	<b>\$935M</b>	<b>\$975M</b>	<b>\$254M</b>	<b>\$2,581M</b>

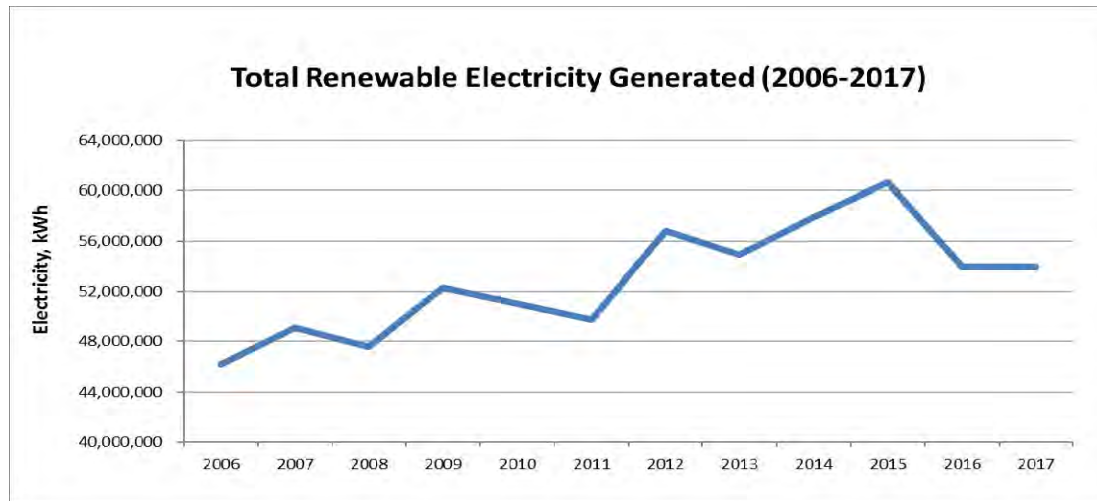
**Total Water Needs Identified in Master Plan: \$2.58 Billion**

\*Local Water System Assistance Program funds not included in calculations





## Renewable Energy Generation at MWRA



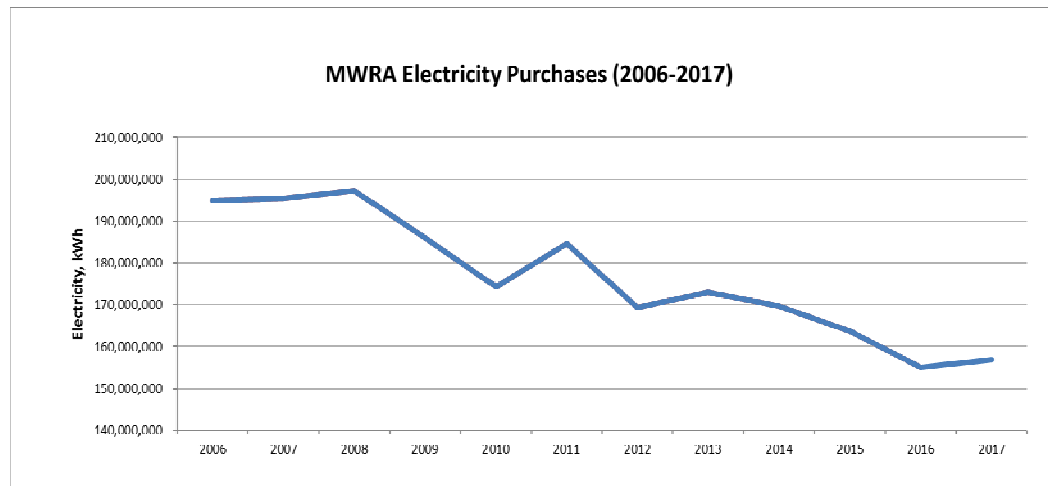
16.8% Increase in Renewable Energy Generation







## Energy Efficiency at MWRA

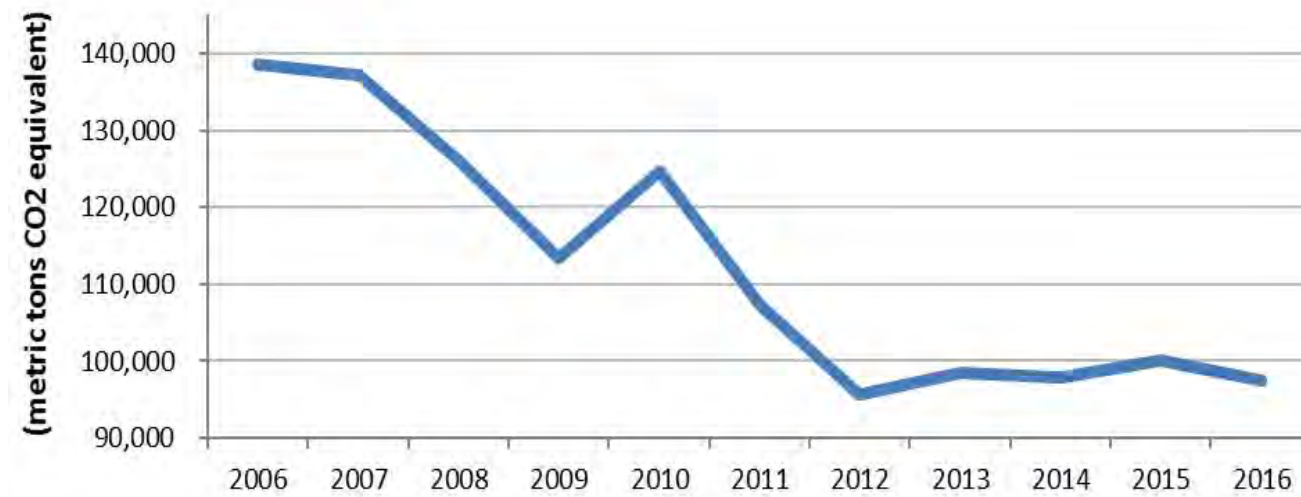


19.5% Decrease in Energy Usage





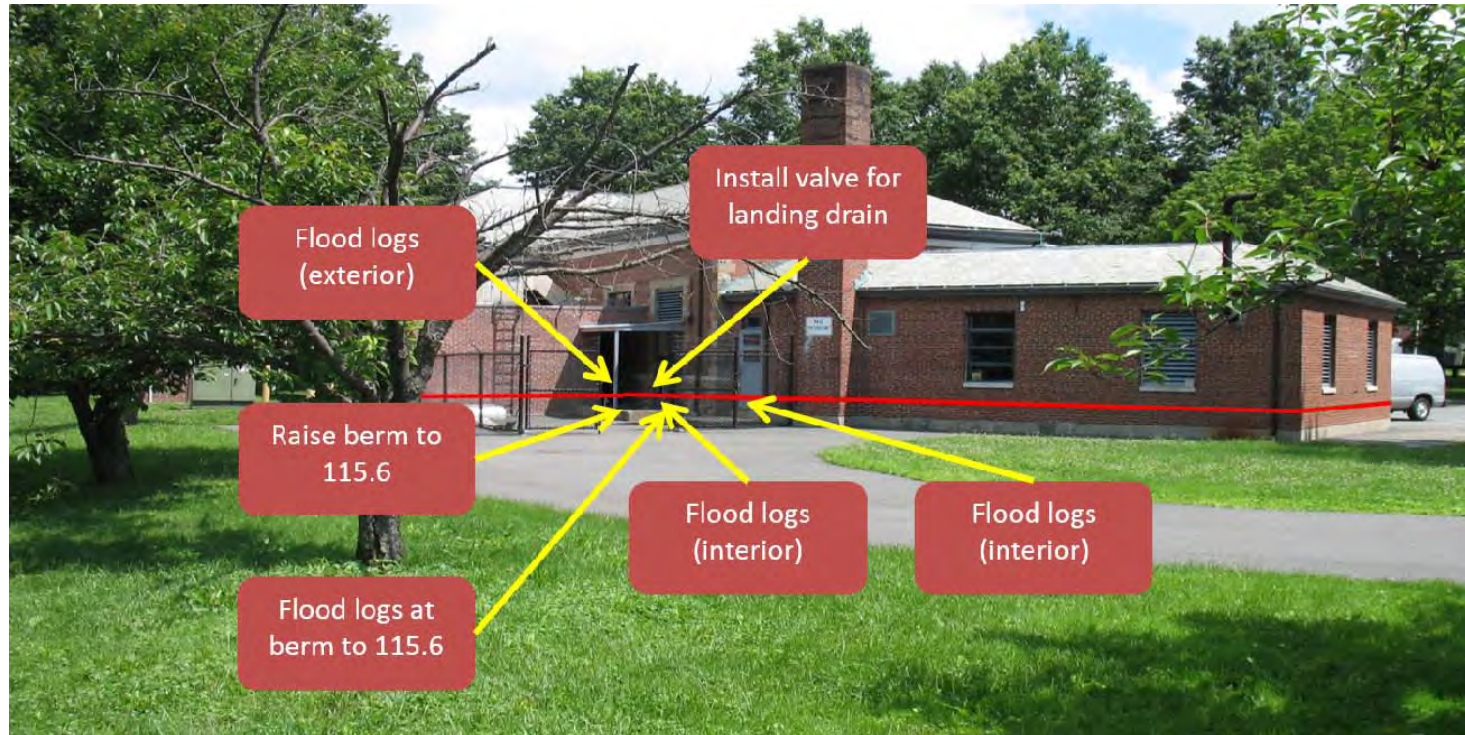
## Greenhouse Gas Emissions Reductions 2006-2016



32.1% Decrease in Greenhouse Gas Emissions



## Sea Level Rise Adaptation



Alewife Brook Pump Station



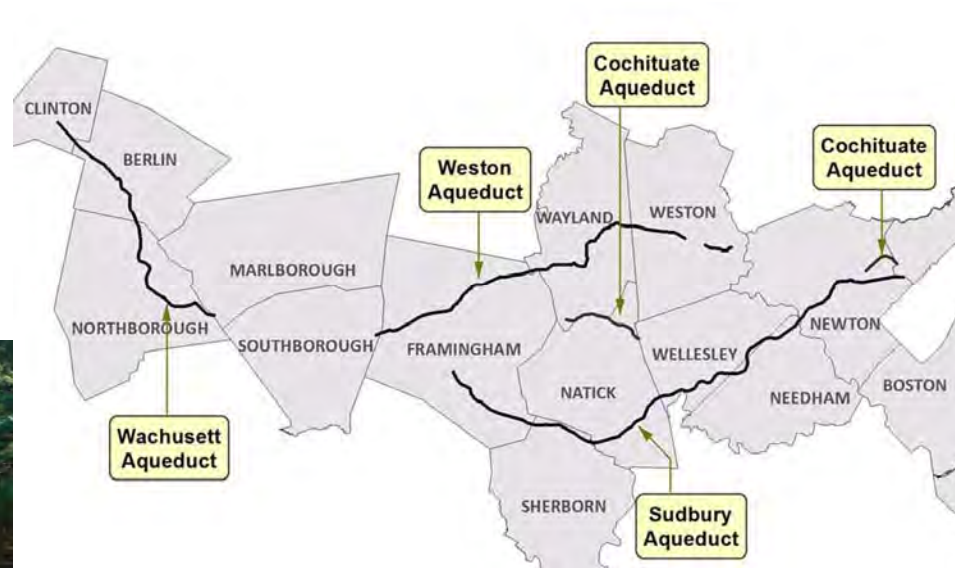
## Public Access







# Aqueduct Trails





## Alewife Stormwater Wetland





## MWRA Wastewater System Overview

- Deer Island Treatment Plant
  - 360 Million Gal/Day Average
  - 1,270 Million Gal/Day Peak
  - 9.4 Mile Outfall Tunnel
- Clinton Treatment Plant
- Residuals Plant - Beneficial Reuse
- 19 miles of Cross-Harbor Tunnels
- 4 Remote Headworks
- 20 Pump Stations and CSO Facilities
- 226 miles of Gravity Sewers
- 29 miles of Force Mains, Siphons, and CSO/Emergency Outfalls





## Wastewater System Master Plan Themes

### 2006

- Deer Island Asset Protection
  - Identify Increasing Needs as Plant Ages
- Residuals Facilities
  - Develop Long-Term Facilities Plan
- Remote Headworks
  - Develop Rehabilitation Plan for Older Headworks
- Interceptor Renewal Asset Protection
  - Develop Methodology to Identify Needs
- CSO Control Plan
  - Major Expenditures Required
- Long-Term Regulatory Changes
  - No Significant Spending Planned

### 2013

- Deer Island Asset Protection
  - Continued Long-Term Investments
- Residuals Facilities
  - Determine Timing of Replacement Needs
- Remote Headworks
  - Determine Timing of Design/Construction Projects
- Interceptor Renewal Asset Protection
  - Reassessment and Timing of Rehabilitation Projects
- CSO Control Plan
  - Ramping Down Expenditures (\$49M Remaining in CIP)
  - Planning for 3 Year Performance Assessment
- Long-Term Regulatory Changes
  - No Significant Spending Planned





## Wastewater System Master Plan Themes

### 2013

- Deer Island Asset Protection
  - Continued Long-Term Investments
- Residuals Facilities
  - Determine Timing of Replacement Needs
- Remote Headworks
  - Determine Timing of Design/Construction Projects
- Interceptor Renewal Asset Protection
  - Reassessment and Timing of Rehabilitation Projects
- CSO Control Plan
  - Ramping Down Expenditures (\$49M Remaining in CIP)
  - Planning for 3 Year Performance Assessment
- Long-Term Regulatory Changes
  - No Significant Spending Planned

### 2018

- Deer Island Asset Protection
  - Continued Long-Term Investments
  - Complete Marine Cable Project (CEB Impact)
- Residuals Facilities
  - Major Upgrades Planned FY24-32
- Remote Headworks
  - Phase 1 Upgrades (Chelsea Creek HW) in Construction
  - Phase 2 Upgrades (Ward St & Columbus Pk HW) Planned FY24-28
- Interceptor Renewal Asset Protection
  - First Few Projects Ongoing through FY24
  - Planning for Additional Reinvestments FY24-38
- CSO Control Plan
  - Ongoing 3 Year Performance Assessment Will Complete \$900M Program
- Long-Term Regulatory Changes
  - Continue to monitor Emerging Contaminants
  - No Significant Spending Planned



## 2018 Master Plan Assumptions - Wastewater

- Over 90% of Wastewater CIP Expenditures for Rehabilitation/Replacement
- No New Member Communities Anticipated
- Population Growth Expected to be Modest – No Impact to Flows/Loads
- No Significant Funds for Regulatory Changes
- Flood Mitigation for Storm Surge/Sea Level Rise To Be Addressed During Facility Upgrades Where Needed



## Deer Island Wastewater Treatment Plant

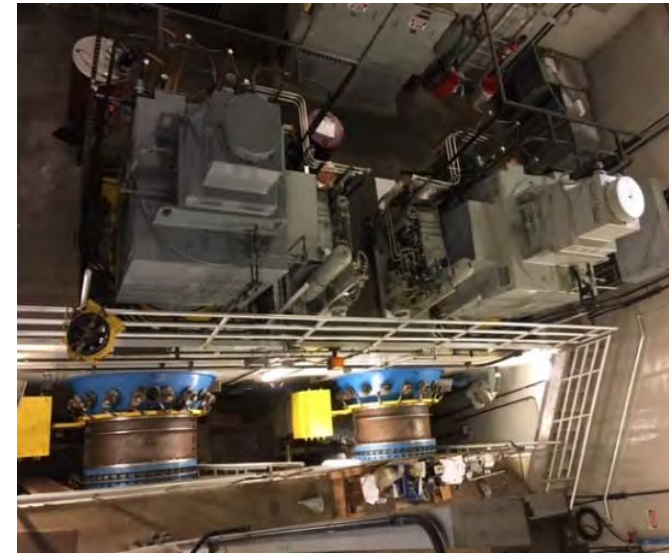
- \$2.5 Billion Replacement Asset Value
- \$530M Additional Replacement Asset Value for 9.5-mile Outfall Tunnel
- Treatment Capacity
  - Maximum
    - 1.27 Billion Gal/Day
  - Average Daily Flow
    - 360 Million Gal/Day
- 70,000 Pieces of Equipment
- Significant Asset Protection Needs for Maintenance, Repair, and Replacement of Aging Plant
  - \$660M Programmed in CIP and \$40M Recommended FY19-28
  - \$44M Programmed in CIP and \$639M Recommended FY29-58





## Deer Island Energy Improvements

- Combined Heat and Power (CHP) Project to Optimize Use of Methane Gas and Overall Efficiency Programmed in FY19 CIP at \$90M in FY19-29
- Hydroturbine Generator (HTG) Replacement Programmed in FY19 CIP at \$11M in FY20-26





## Deer Island Energy Improvements

- 62% of Total Power Needs Met with Green Sources
- Once Combined Heat and Power Improvements Implemented, up to 90% of Total Power Needs will be Met with Green Sources







## Residuals Processing Facility

- \$200M Replacement Asset Value
- Contract Operation – NEFCo through 2020
- Full responsibility for O&M (\$15M annually)
- Beneficial Reuse of Pellets is Expected to Continue
- Residuals facility will need large-scale equipment replacement in next 10 to 15 years.
  - \$103M Programmed in CIP FY19-32
  - \$81M Recommended in CIP FY39-58





## Cross-Harbor Tunnels



- \$660M Replacement Asset Value
- 19 miles – 11.5 & 10 foot diameter
- 100-120 foot deep shafts
- 2 Older Tunnels – 1953
  - Midway through 100+ year useful life
  - \$5M Inspection Programmed in CIP FY24-28
  - \$10M Shaft Repairs Programmed in CIP FY19-27
- Inter-Island Tunnel – 1998
  - Inspect with other tunnels to provide baseline
- \$50M Recommended for Future Inspection/Cleaning/Repair of Tunnels in FY46-50



## Cross-Harbor Tunnels

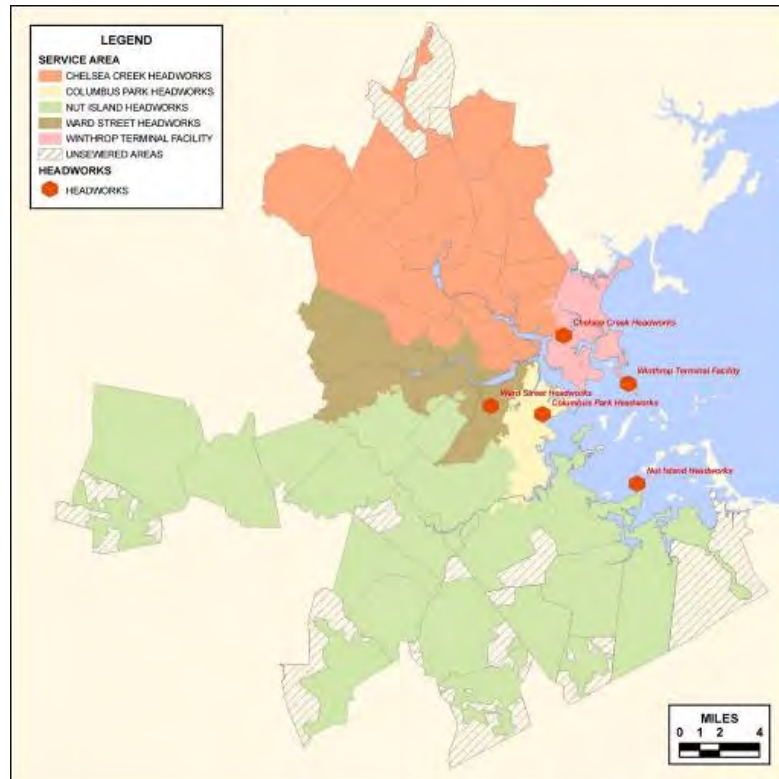


Tunnel Shaft Repairs Needed due to H<sub>2</sub>S Corrosion





## Remote Headworks



- \$270M Replacement Asset Value
  - Chelsea Creek 1967
  - Columbus Park 1967
  - Ward Street 1967
  - Nut Island 1998
- Headworks Require Significant Reinvestment
- Chelsea Creek HW Upgrade \$54M Programmed in CIP FY19-22
- Columbus Park/Ward Street HW Upgrades \$126M Programmed in CIP FY20-28
- Nut Island Headworks Odor Control and HVAC Improvements \$42M Programmed in CIP FY19-22
- Nut Island Headworks Mechanical and Electrical Upgrades \$25M Programmed in CIP FY24-29





## Chelsea Creek Headworks Upgrade







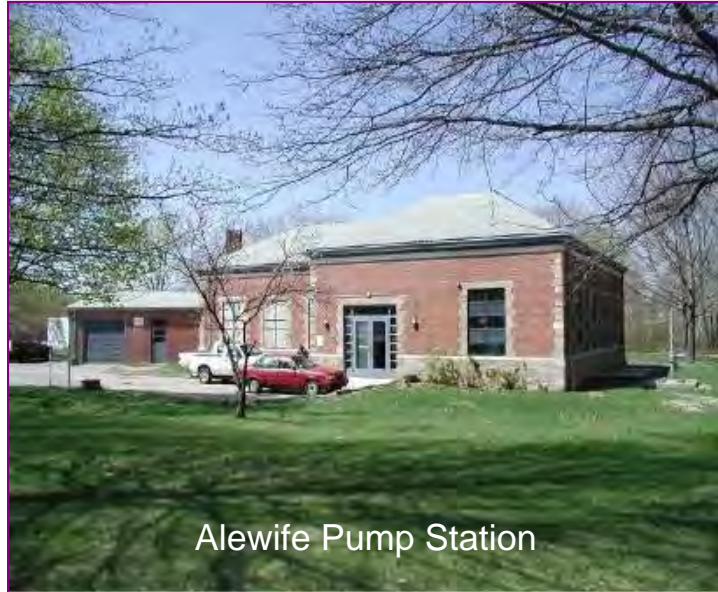
## 20 Pump Stations and CSO Facilities



- \$640M Replacement Asset Value
- Average Age 27 years - Good to Excellent Condition
- 15 of 20 Facilities Built by MWRA, 1987-2011
- 5 of 20 Facilities Pre-MWRA, 1951-1980



## 20 Pump Stations and CSO Facilities



Alewife Pump Station

### Key Elements to Minimize Risk of Failure

- Operability of Mechanical Equipment
- Maintenance of Electric/Standby Power

- \$73M Programmed in CIP FY19-28 for Pump Station/CSO Facility Rehabilitations
  - Alewife PS (in construction)
  - Castle Island PS
  - Cottage Farm CSO
  - Prison Point CSO
  - Preliminary Design for Next 5 Older Facilities
- \$90M Recommended for FY24-28 for Rehabilitation of Next 5 Older Facilities
- \$100M Recommended for Future Pump Station and CSO Facilities Upgrades FY29-58



## Alewife Brook Pump Station Rehabilitation







# CSO Control Program



- \$900M Total Program Cost
- \$2.5M Programmed in CIP for 3-Year CSO Control Performance Assessment
- No Additional CSO Control Program funds recommended
- Future CSO Facility costs are integrated with future pump station upgrades

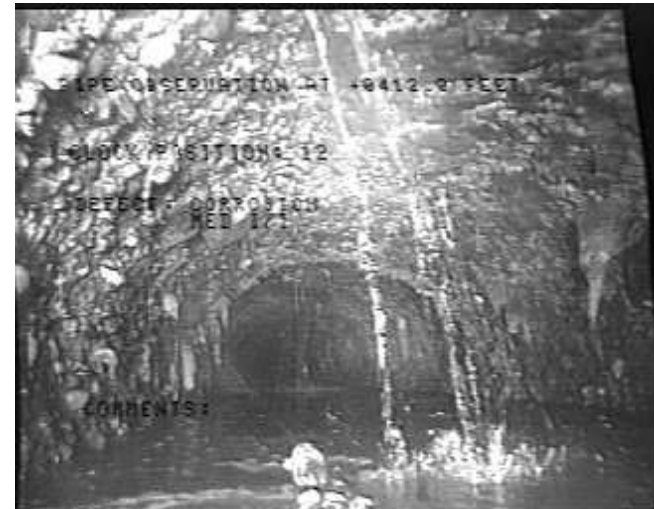


## Collection System Sewers



Sewer Rehabilitation Needed to Address Pipeline Defects

- \$1.9 Billion Replacement Asset Value
- 226 Miles of Gravity Sewers
- 29 Miles of Force Mains, Siphons and CSO/Emergency Outfalls
- 4,000 Manholes and Structures







## Interceptor Renewal

- \$120M Programmed in CIP in FY19-38 for First 6 of 12 Interceptor Renewal Projects
- \$5M Programmed in CIP in FY19-23 to begin Siphon Structure Rehabilitation
- \$295M Recommended for Remaining 6 of 12 Interceptor Renewal Projects FY24-58

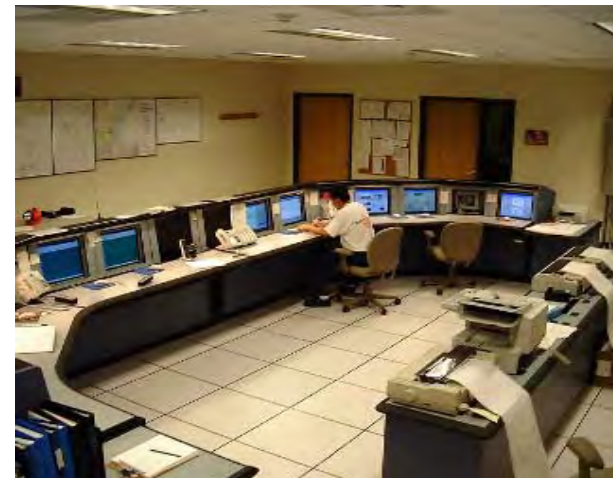
Typical Sewer Rehabilitation  
Using Cured-In-Place-Pipe Liner





## Wastewater Metering and SCADA

- Wastewater Metering and Supervisory Control and Data Acquisition (SCADA) for Monitoring and Controlling Facilities
  - \$23M for Metering System Upgrades Programmed in CIP in FY19-31 and \$20M Recommended in FY39-58
  - For SCADA Equipment, \$7.7M Programmed in CIP in FY19-28 and \$10M Recommended in FY39-58





## Community I/I Financial Assistance

- Over 5,300 Miles of Community-Owned Sewer Pipes
- 43 Communities – 556 Local Projects Funded
- \$370M Distributed through December 2018 in grants and loans
- \$200M Programmed in CIP in FY19-40
- Two Additional \$100M Funding Rounds Recommended for FY24-40





## What the Wastewater System Master Plan Includes

### Existing Projects and New Recommendations

	<b>FY19-23</b> 5 years	<b>FY24-28</b> 5 years	<b>FY29-38</b> 10 years	<b>FY39-58</b> 20 years	<b>Total</b> 40 years
Wastewater Projects Programmed in FY19 CIP	\$644M	\$841M	\$63M	\$(13)M	\$1,535M
Projects Recommended in Master Plan	\$10M	\$298M	\$393M	\$934M	\$1,635M
<b>Total</b>	<b>\$654M</b>	<b>\$1,139M</b>	<b>\$456M</b>	<b>\$921M</b>	<b>\$3,170M</b>

**Total Wastewater Needs Identified in Master Plan: \$3.17 Billion**



## Future Challenges

- Preserving Institutional Knowledge
- Regulatory Decisions and/or Changes
- Monitoring Climate Change and Adaptation Strategies
- Energy Pricing