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

<table>
<thead>
<tr>
<th>Asset Class</th>
<th>Replacement Asset Value</th>
<th>% of Total</th>
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</thead>
<tbody>
<tr>
<td>Tunnels/Aqueducts</td>
<td>$3,492 million</td>
<td>52%</td>
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<tr>
<td>Dams</td>
<td>$830 million</td>
<td>12%</td>
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<tr>
<td>Treatment</td>
<td>$297 million</td>
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<tr>
<td>Pipelines/Valves</td>
<td>$1,465 million</td>
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<td>Storage Tanks</td>
<td>$347 million</td>
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<td>Pump Stations/Hydropower</td>
<td>$217 million</td>
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<td>Meters</td>
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<td><strong>TOTAL</strong></td>
<td><strong>$6,671 million</strong></td>
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# Wastewater System Infrastructure Replacement Asset Value

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<thead>
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<th>Asset Class</th>
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<th>% of Total</th>
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<tbody>
<tr>
<td>Deer Island Treatment Plant</td>
<td>$2,500 Million</td>
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<td>Deer Island Outfall</td>
<td>$530 Million</td>
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<td>Residuals Pelletizing Plant</td>
<td>$200 Million</td>
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<td>Cross-Harbor Tunnels</td>
<td>$660 Million</td>
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<td>Remote Headworks</td>
<td>$270 Million</td>
<td>4%</td>
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<td>Pump Stations and CSO Facilities</td>
<td>$640 Million</td>
<td>9%</td>
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<td>Sewer Pipelines</td>
<td>$1,900 Million</td>
<td>28%</td>
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<tr>
<td>Clinton Treatment Plant</td>
<td>$60 Million</td>
<td>1%</td>
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**TOTAL**                          | **$6,760 Million**       | **100%**   |
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
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.
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**

<table>
<thead>
<tr>
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<th>FY19-23</th>
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<th>FY29-38</th>
<th>FY39-58</th>
<th>Total</th>
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<td>Water</td>
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<td>$935M</td>
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<td>Wastewater</td>
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<td>$1,139M</td>
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<td>$1,007M</td>
<td>$2,073M</td>
<td>$715M</td>
<td>$310M</td>
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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
• 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
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
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

MWRA Metropolitan Area Storage Capacity Over Time

![Graph showing MWRA Metropolitan Area Storage Capacity Over Time with future localized storage needs identified as Northern Intermediate High, Southern Extra High, and Northern Extra High.](image-url)
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
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
### Existing Projects and New Recommendations*

<table>
<thead>
<tr>
<th></th>
<th>FY19-23 (5 years)</th>
<th>FY24-28 (5 years)</th>
<th>FY29-38 (10 years)</th>
<th>FY39-58 (20 years)</th>
<th>Total (40 years)</th>
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<tr>
<td>Water Projects</td>
<td>$345M</td>
<td>$916M</td>
<td>$915M</td>
<td>$53M</td>
<td>$2,229M</td>
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<td>Projects Recommended in Master Plan</td>
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<td>$19M</td>
<td>$60M</td>
<td>$266M</td>
<td>$352M</td>
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<td>$935M</td>
<td>$975M</td>
<td>$254M</td>
<td>$2,581M</td>
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*Local Water System Assistance Program funds not included in calculations

**Total Water Needs Identified in Master Plan:** $2.58 Billion
16.8% Increase in Renewable Energy Generation
Energy Efficiency at MWRA

19.5% Decrease in Energy Usage

32.1% Decrease in Greenhouse Gas Emissions
Sea Level Rise Adaptation

Alewive Brook Pump Station

- Install valve for landing drain
- Raise berm to 115.6
- Flood logs at berm to 115.6
- Flood logs (interior)
- Flood logs (interior)
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
• 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
• 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 $\text{H}_2\text{S}$ Corrosion
• $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
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

- $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

Key Elements to Minimize Risk of Failure
- Operability of Mechanical Equipment
- Maintenance of Electric/Standby Power
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

- $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

Sewer Rehabilitation Needed to Address Pipeline Defects
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

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<thead>
<tr>
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<td>Wastewater Projects</td>
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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