



Massachusetts Water Resources Authority

Public Officials Breakfast and Caucus

The Forgotten Infrastructure

**Frederick A. Laskey
Executive Director**

June 10, 2014



ACE¹⁴
ANNUAL CONFERENCE & EXPOSITION

UNITING
THE WORLD of



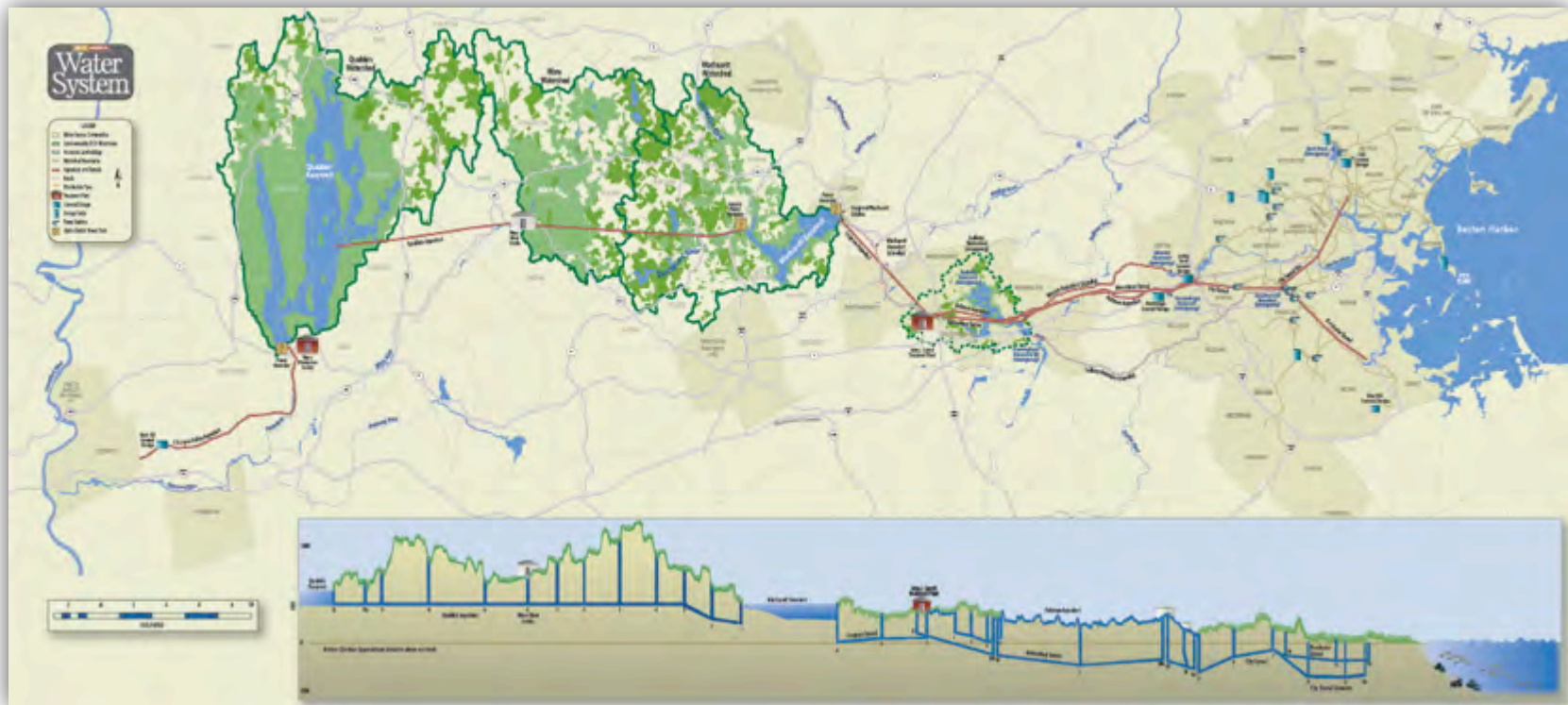


About MWRA



Drinking Water System

- 102 miles of active transmission mains and tunnels (43 miles on standby)
- Two water treatment plants with 430 million gallons per day capacity
- 284 miles of distribution mains with over 4700 valves
- 243 million gallons of covered storage
- 11 pump stations





Make-Up Of MWRA Service Area

- 51 communities that get water service – over 6,000 miles of water pipe
- 43 communities that get sewer service
- Of those, 30 get both water and sewer
 - 39 Towns
 - 20 Cities
 - 1 Fire District

 - 37 Boards of Selectmen
 - 20 Mayors
 - 3 Council Presidents



Governance

The MWRA is governed by an 11-member Board of Directors

Three Gubernatorial Appointees

Secretary of Energy & Environmental Affairs	Co-terminus with Governor
Resident of Connecticut River basin	Co-terminus with Governor
Resident of Merrimack River basin	Co-terminus with Governor

At least one of these members must be a minority.

Three Advisory Board Appointees

Elected by the Advisory Board	3-year term
Elected by the Advisory Board	3-year term
Elected by the Advisory Board	3-year term

Three City of Boston Appointees

Appointed by Mayor of Boston	Co-terminus with Mayor
Appointed by Mayor of Boston	Co-terminus with Mayor
Appointed by Mayor of Boston	Co-terminus with Mayor

Two From Communities That Host Major Facilities

Appointed by Winthrop Council President	4-year term
Appointed by Mayor of Quincy	Co-terminus with Mayor



History of Boston's Water System



1623: The Beginning - Founding Of Boston

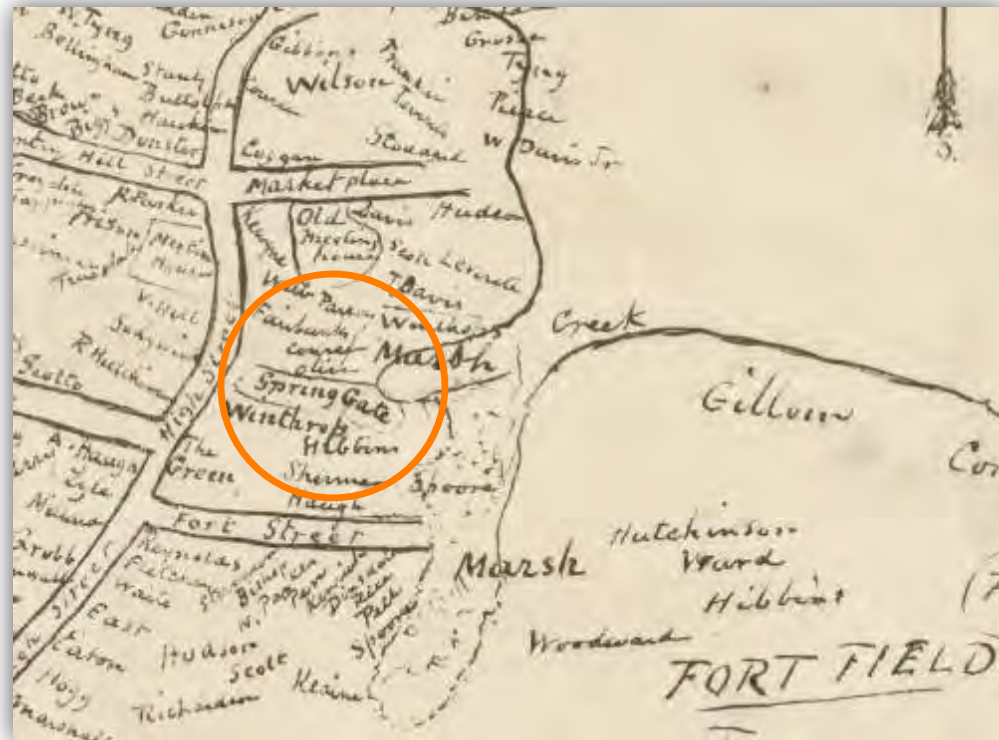
- The first settler to enjoy a drink of water on Shawmut Peninsula – Reverend William Blackstone
- He came to the Plymouth Colony in 1623 and migrated to Shawmut to live a life of solitude in the area that is now Louisburg Square
- Reason why Massachusetts Bay Colony picked the site – Blackstone offered the “**Great Spring**”





The "Great Spring" Was Fenced

- The Great Spring is commemorated by a plaque on Spring Lane



1645 map of Boston with houses and key locations





1652: The “Conduit” –First Water Works In The Colonies

- Several families in the Dock Square area formed the first Corporation in the American Colonies to build and use the “Conduit”
- It was the first use of wooden pipes, house services and a terminal reservoir. It provided water for fire fighting and consumption



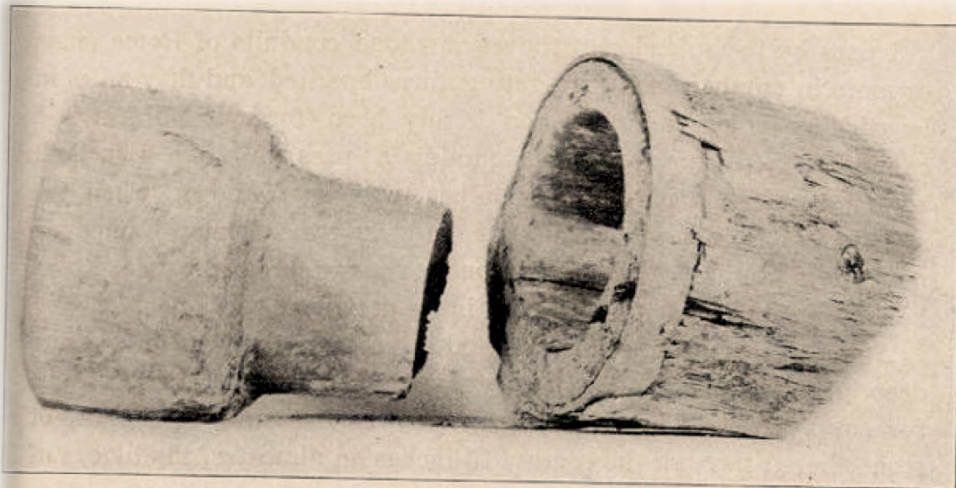


1796: Privatization Fills A Need

- People clamored for better water
- Entrepreneurs filled the need by bringing water from Jamaica Pond using wooden logs
- Laommi Baldwin Sr. served as engineer to the Jamaica Pond Aqueduct Corporation

THREE SHARES FOR SALE,
BOSTON AQUEDUCT.
The value of this property may be ascertained by the following facts:—The quantity of water which can be brought into Boston by the Aqueduct, is sufficient for the use of twenty-four hundred families, which at eight dollars annually, would give a dividend of one hundred and ninety-two dollars per share. Apply to
JOHN MARSTON,

WANTED IMMEDIATELY,
3000' PINE LOGS.
ANY person inclined to contract for the sale and delivery of Three Thousand Yellow Pine, or Hackmatack GREEN LOGS, for the use of the BOSTON AQUEDUCT, will please to apply to
John Marston,
Secretary Aqueduct Corporation.
Boston, July 17, 1799.

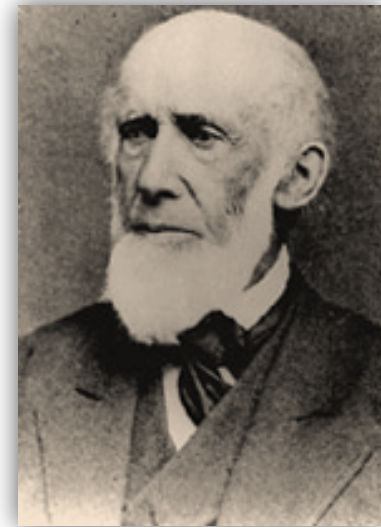


WOODEN PIPE LAID FROM JAMAICA POND.



1820s-1840s: Boston System Expansion

- Controversy rages for 20 years
- Charles River – Middlesex Canal proposed
- John Jervis, the Engineer for New York's Croton supply, was brought in to be the ultimate expert. He had learned his engineering building a portion of the Erie Canal
- He concluded that the choice of Long Pond was the best and political support was successfully rallied to endorse the plan
- Work began in 1845

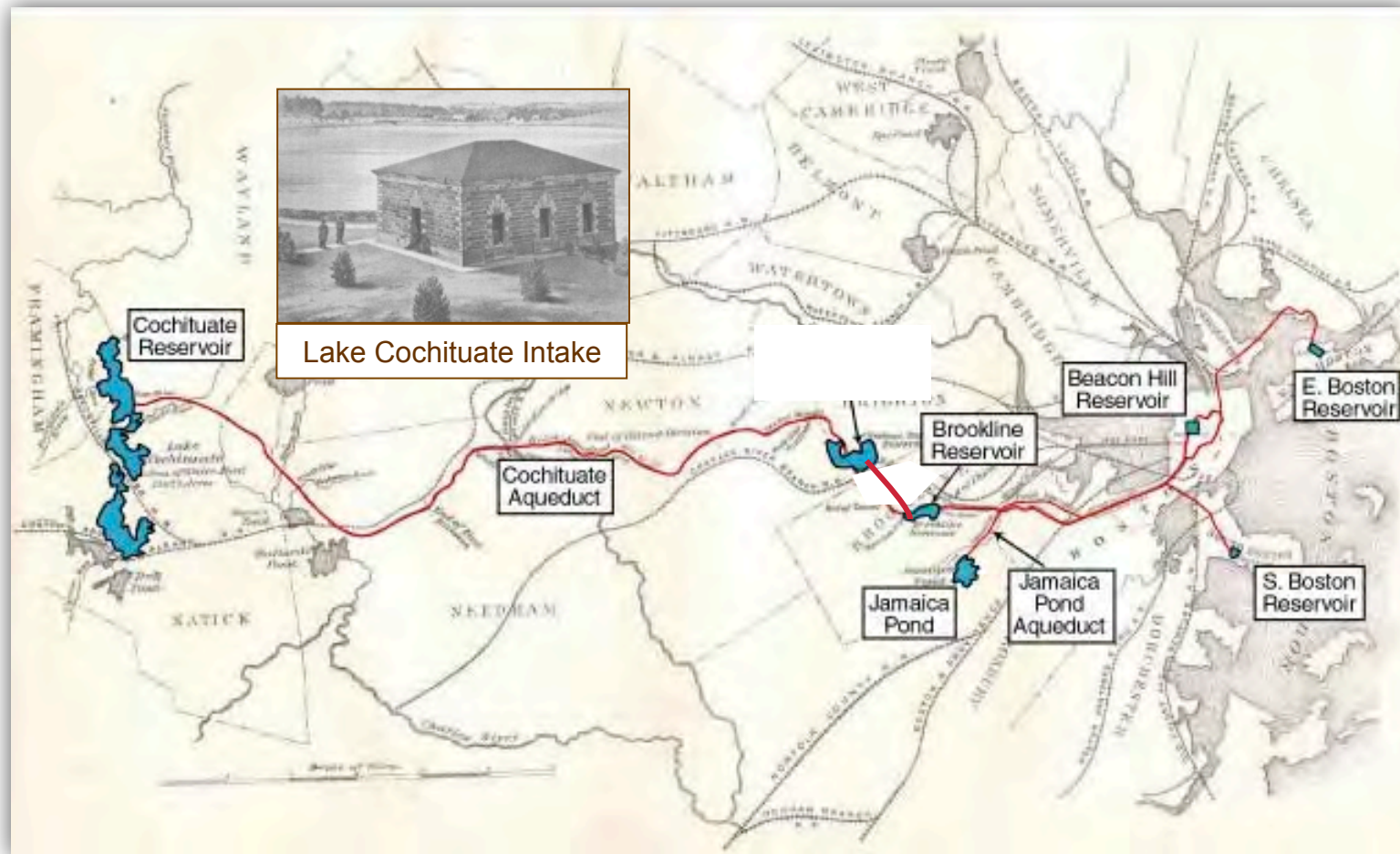


John Jervis



1848: The Result – The Boston Water Works

- Long Pond was renamed Lake Cochituate Reservoir
- The system flowed by gravity through a series of distribution reservoirs





1848: Water Celebration On Boston Common





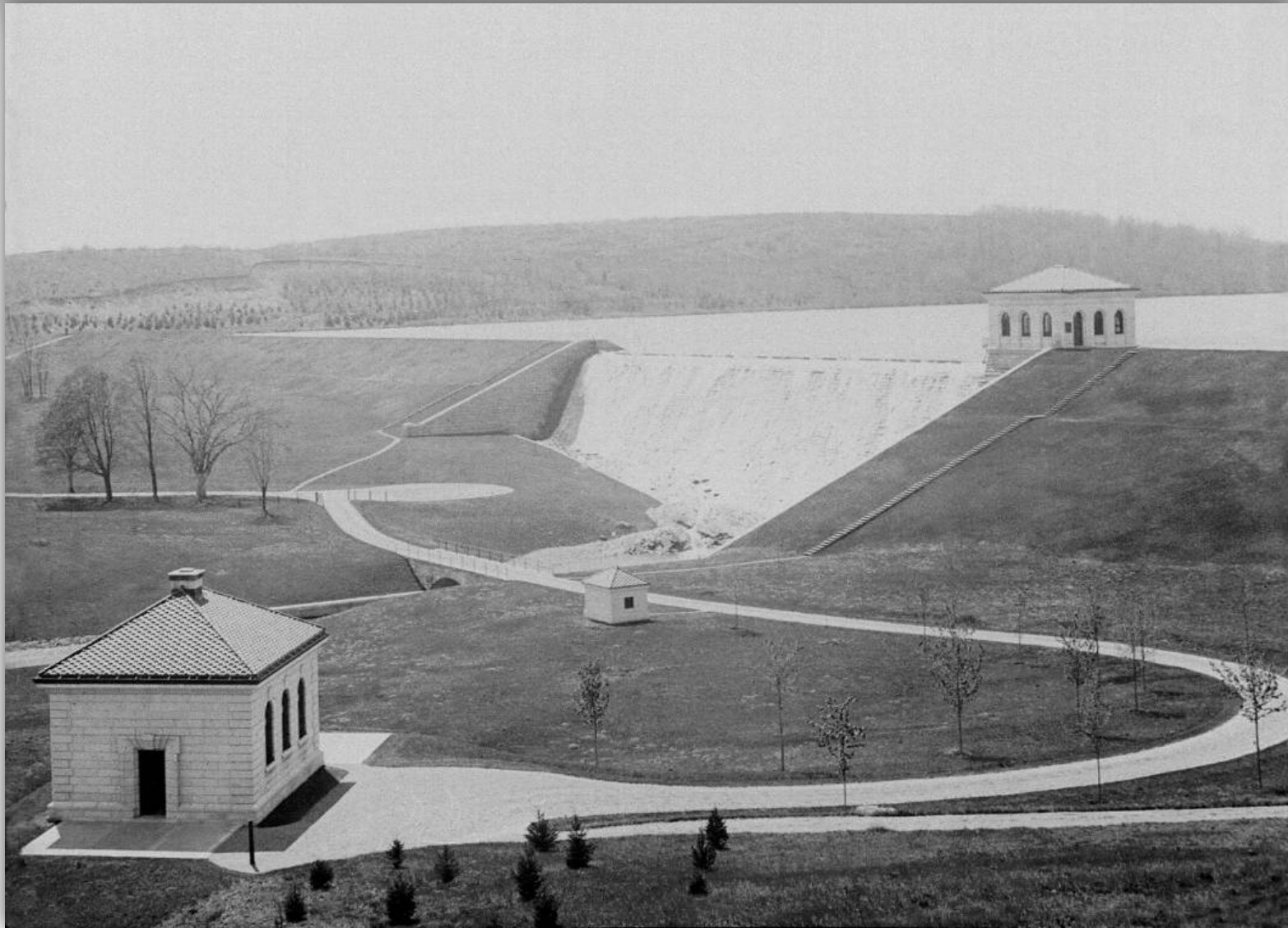
1872: The Great Fire

- Undersized pipes and low pressures hindered the firefighters
- Many distribution improvements followed including another reservoir, larger pipes and more hydrants



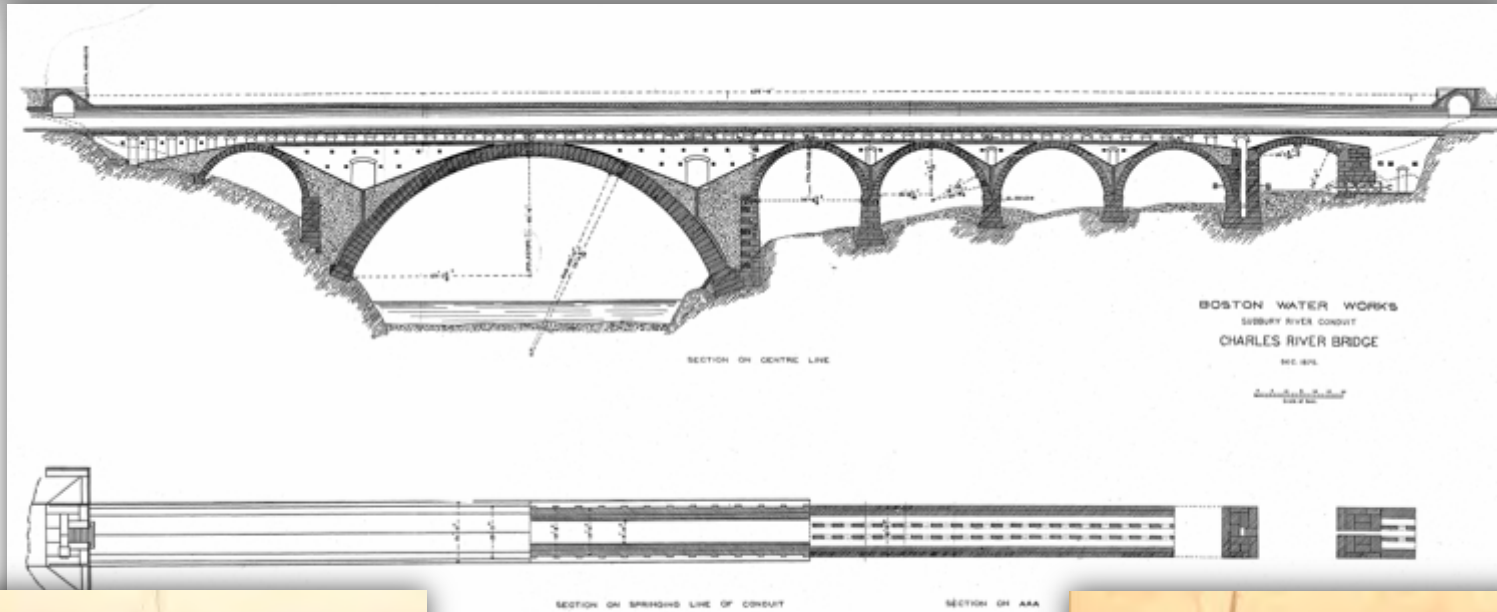


1898: The Fayville Dam And The Sudbury Reservoir Were Completed





Sudbury Aqueduct – Building Echo Bridge Arches





Sudbury Aqueduct

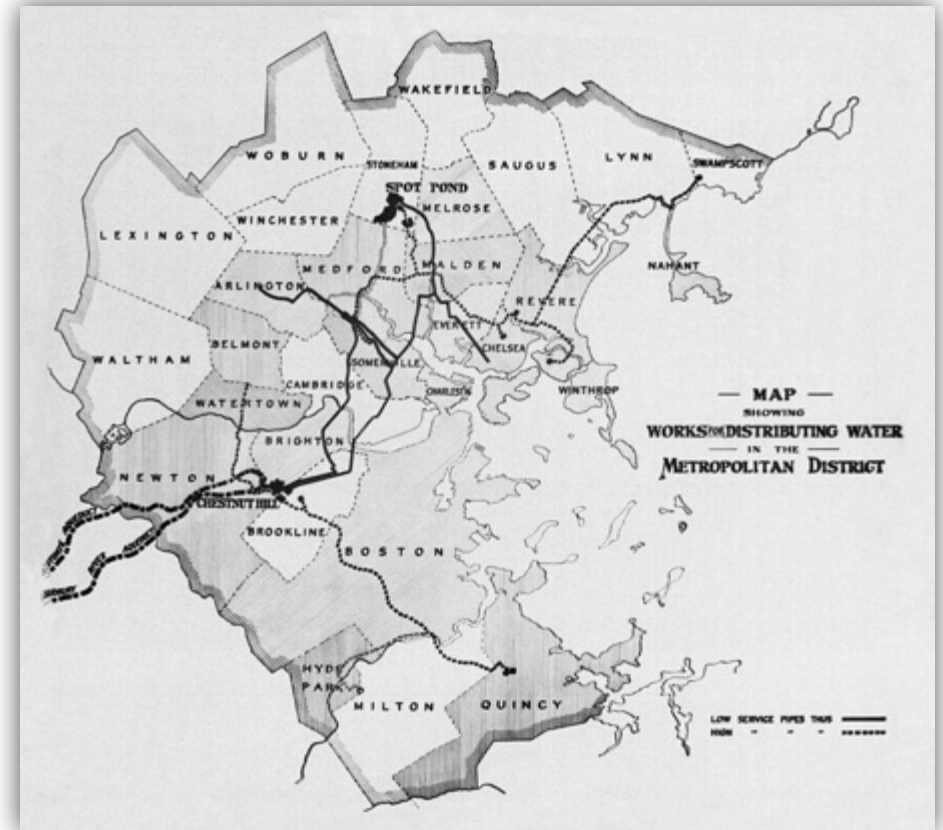


The Farm Pond Gatehouse in Framingham, the aqueduct literally crossed the pond



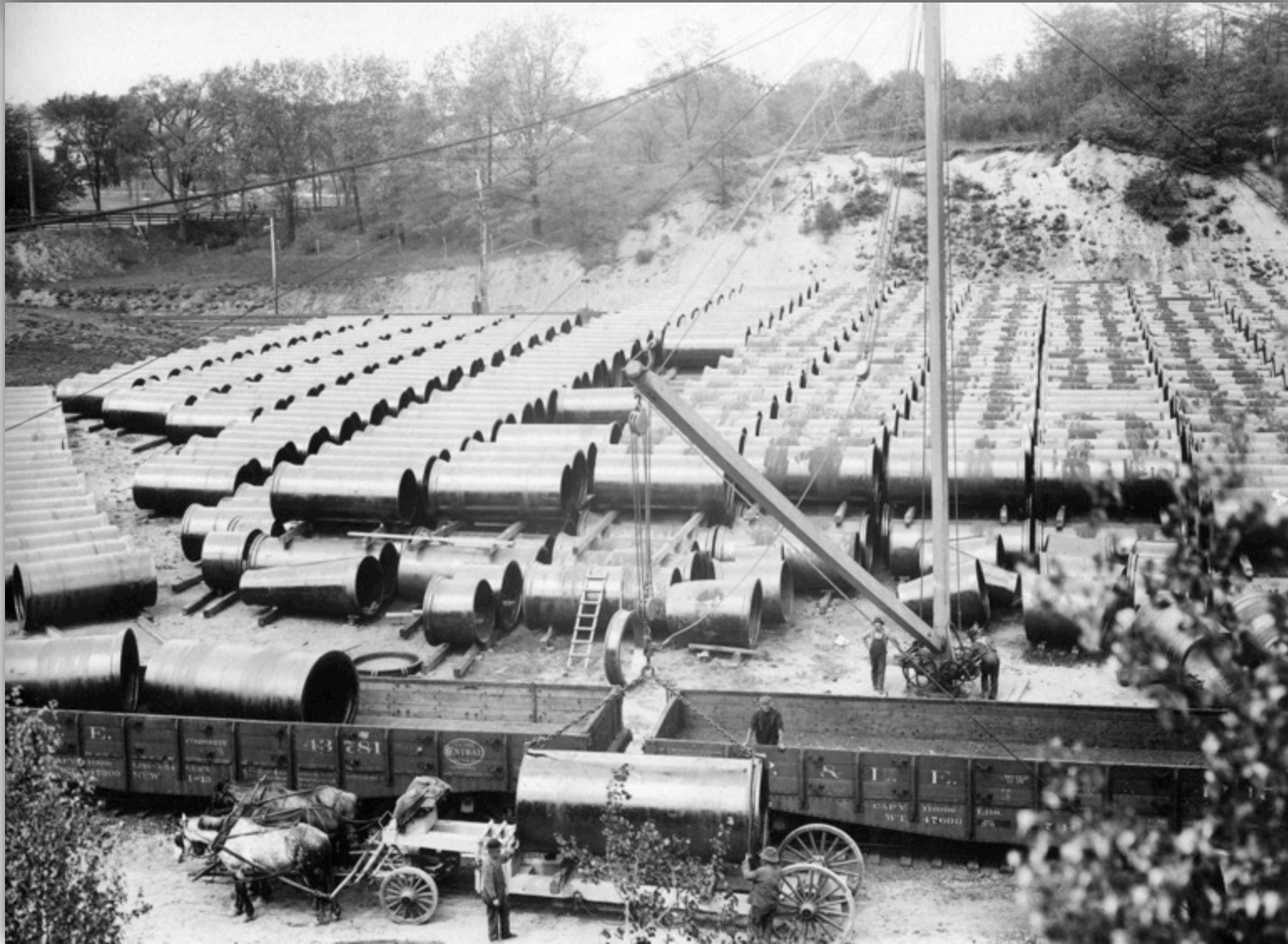
1895: Creation Of The Metropolitan Water District

- By the early 1890s, Boston's water supply was deemed unsafe and inadequate, as were other community supplies surrounding Boston
- After reviewing water supply needs in all metro area communities, a District of 13 far-flung communities is formed
- More communities join in subsequent years





1898: Building The Metropolitan Pipe Network



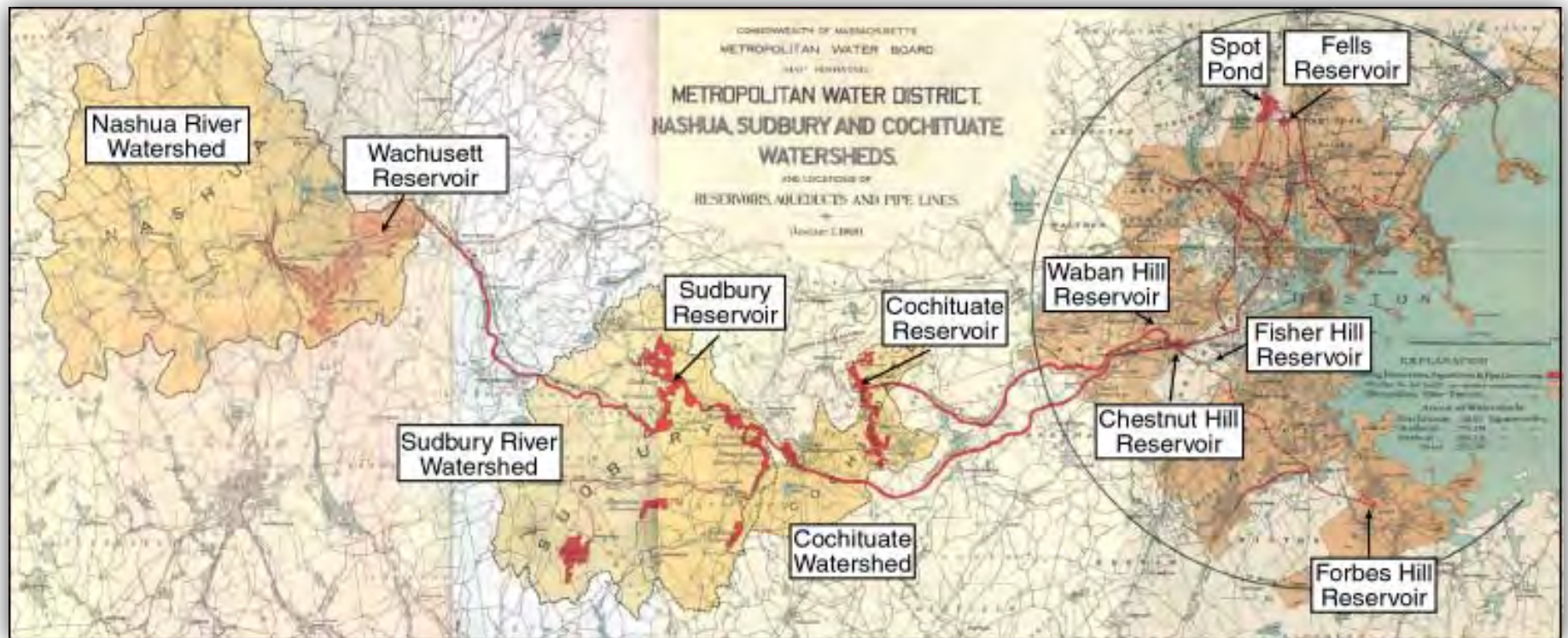


Crossing Rivers





1895: Another Step West





The Wachusett Reservoir

- Chief Engineer Frederick Stearns planned a water source that would be gravity-operated and not require filtration
- In 1897, the site was chosen - the Nashua River was impounded by the Wachusett Dam, 38 miles from Boston
- At the time it was constructed, the Wachusett Reservoir was the largest man-made water supply reservoir in the world
- Its 65 billion gallons supplied 118 million gallons per day





1897: Wachusett Aqueduct





1898: Rosemary Brook Siphon





1899: Chestnut Hill High Service Pump Station





1899: Sudbury Aqueduct Terminal Chamber





1900: Chestnut Hill Low Service Pump Station





Chestnut Hill Also Housed The First Biological Water Laboratory

- In 1889 the Water Board of the City of Boston established a laboratory for systematic study of the biology of the water-supply sources
- The Chestnut Hill laboratory was the first in the country dedicated to biological water analysis





Words To Live By

“...as we progress and find that we can control the quality of the water by our own acts, we realize it is a wicked thing to turn water containing a large amount of organic matter into a city or town for people to drink – children, invalids and people whose constitutions are too weak to overcome the effects of bad water.

I think we should realize the responsibility that rests on us as superintendents and engineers to do all that we can to raise the standard; to insist that a city or town should have good water and that they should judiciously spend enough to make it good.”

*-Desmond Fitzgerald, Boston Water Works
1895 annual meeting of the
New England Water Works Association*





The Quabbin Reservoir

- In 1936, construction of the reservoir began
- The reservoir was filled with water from the Swift River and the Ware River
- Filling began in 1939 and was completed in 1946
- At the time, the 412 billion gallon reservoir was the largest man-made reservoir in the world



Moving a house from Greenwich



On the eve of moving out



The Source Reservoirs

Quabbin Reservoir

Storage: 412 billion gallons

Depth: 150 feet

Length: 17.9 miles

Width: 3 miles



Wachusett Reservoir

Storage: 65 billion gallons

Depth: 129 feet

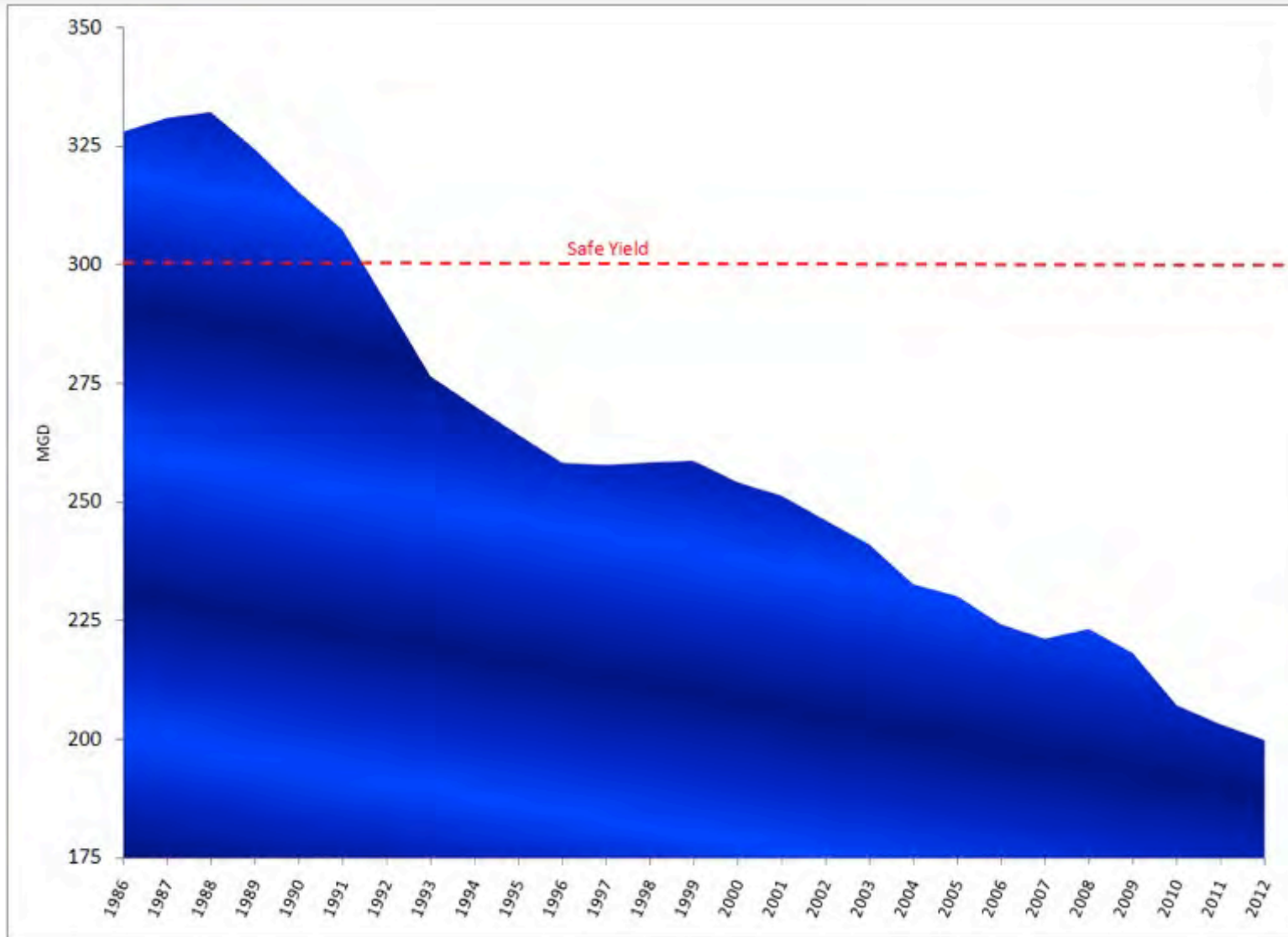
Length: 8.5 miles

Width: 1 mile





MWRA Demand Management Programs

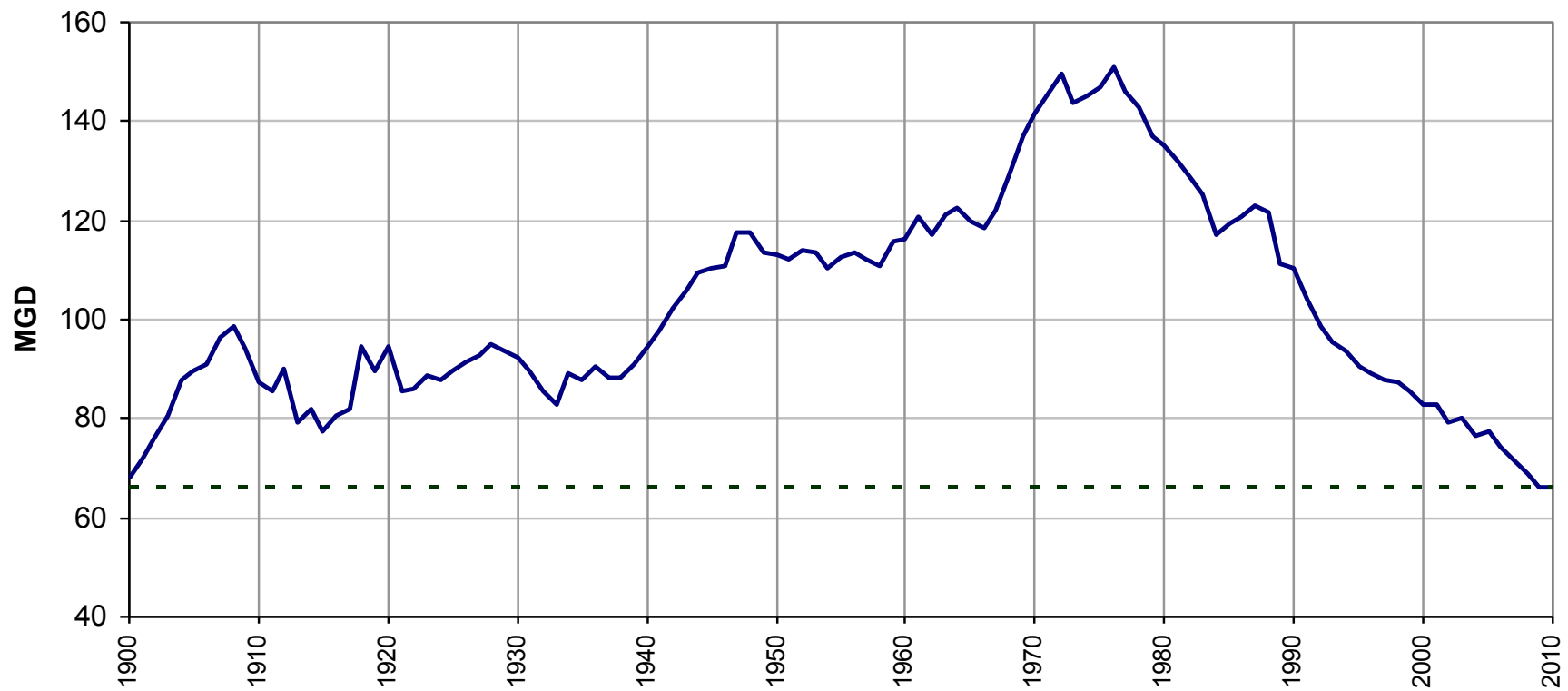


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Boston's Usage Is At A 110-Year Low





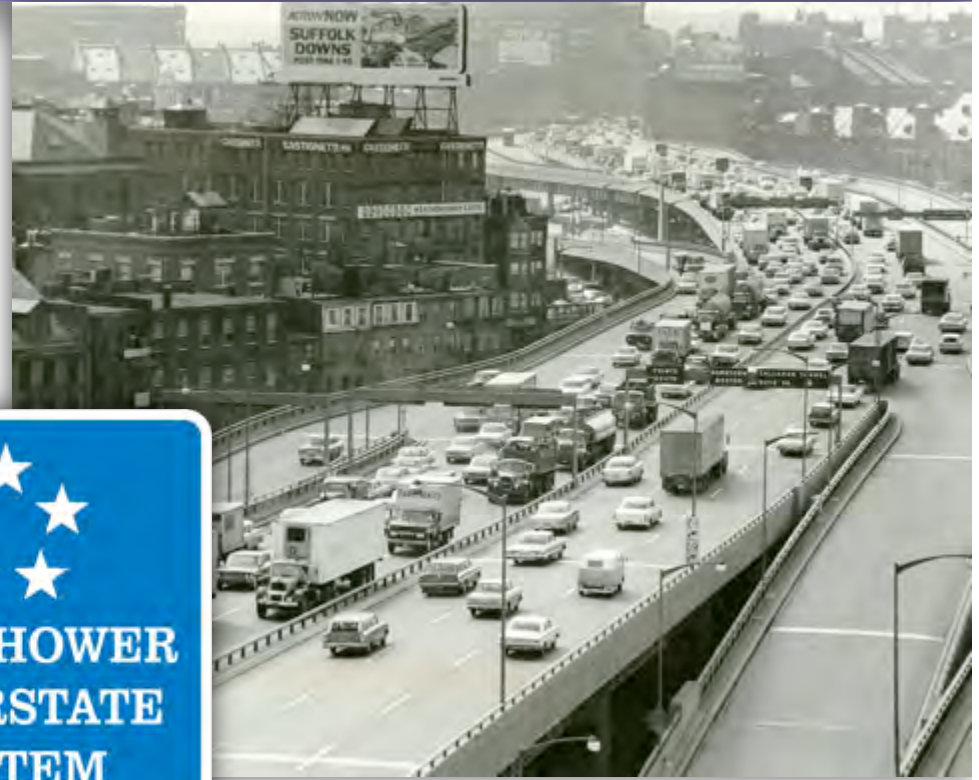
The Pressure Aqueduct System

- In 1936, the Legislature approved the construction of a two high-pressure aqueducts to deliver water to the greater Boston area
- The two aqueducts would carry water from the Wachusett Reservoir to the new Norumbega Reservoir in Weston
- One barrel of the aqueduct system - the Hultman Aqueduct - was completed
- But work on the second barrel did not resume after World War II



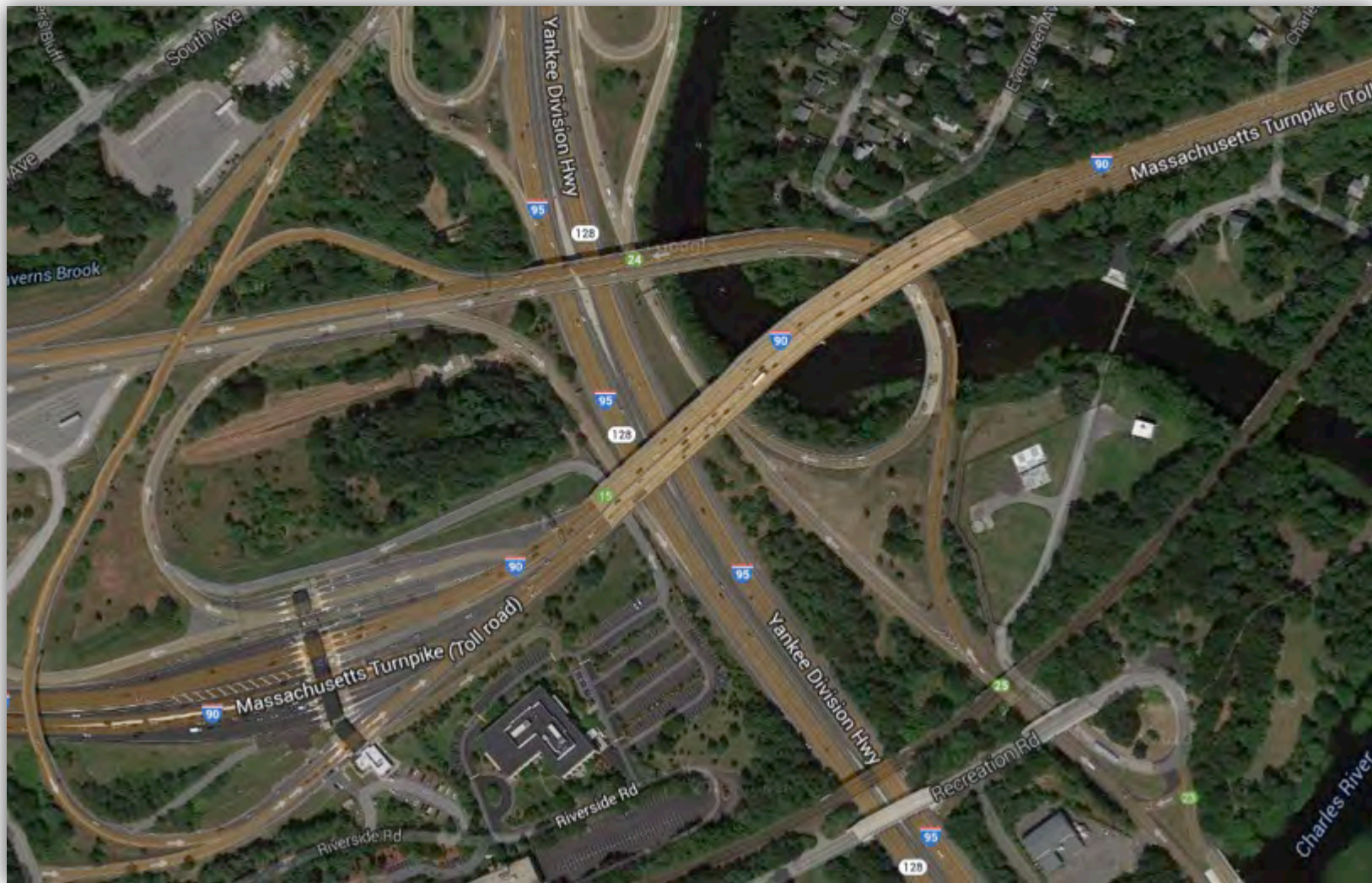


Now Highways Were King, And Water Was All But Forgotten





The Mass Pike Interchange Took The Area For The Second Barrel





85% Of Boston's Water Being Was Delivered Through The Hultman Aqueduct

- Because there was no redundant aqueduct, the Hultman could not be taken out of service for inspection or repair
- And we knew it was leaking





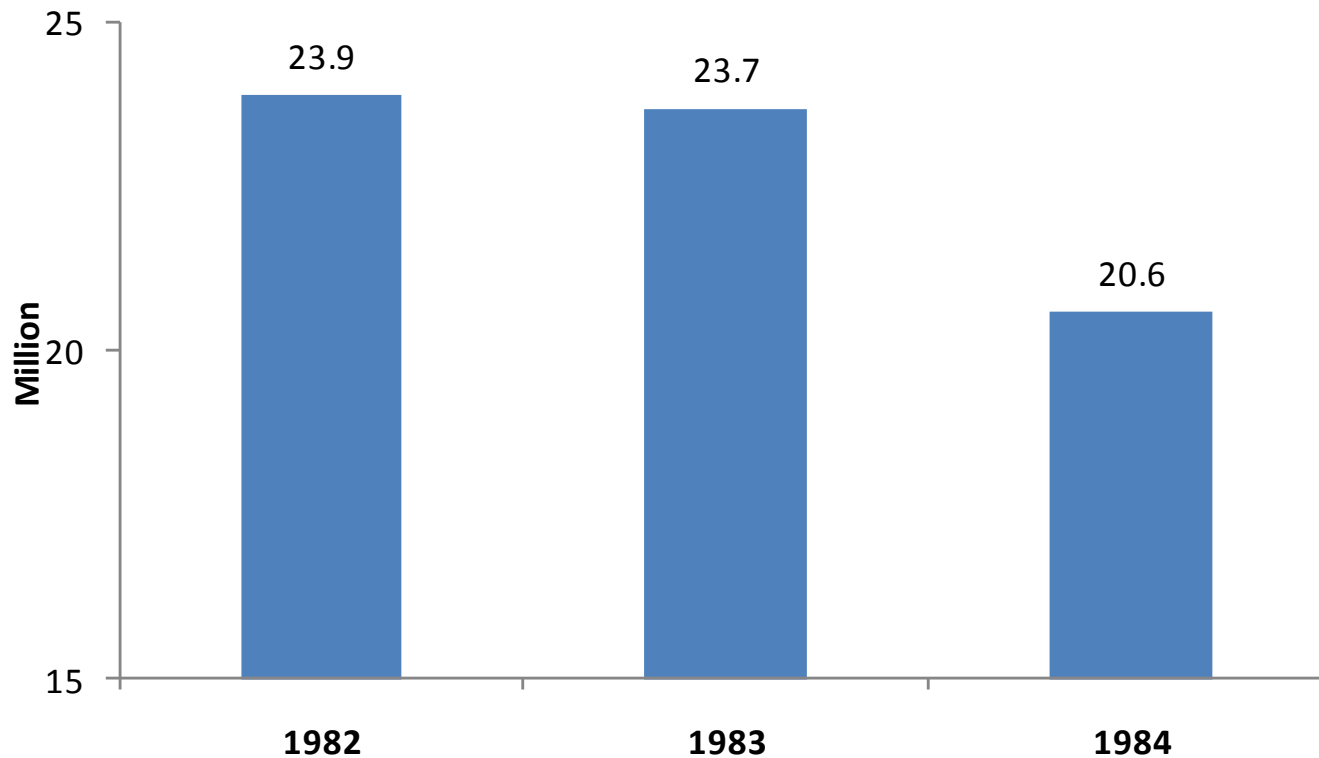
By The 1980s, Things Were Pretty Grim

- Thousands of miles of aging pipelines were leaking millions of gallons of water
- No plans were in place for upgrades to carry the water system into the next century
- And the Northeast Drought of the late 1960s cast doubt on the adequacy of existing sources



Water System Appropriations Were Declining

- Appropriations by the legislature were on the decline, which in turn led to staffing reductions, which in turn led to the deferral of much needed repairs





Looking NW from Bell Rock Street to Medford Street





24" Old Mystic Main, January, 2005





Section 10 Leak, January, 2011





Spot Pond Dam #1 armoring to protect At spillway design flood erosion



Before



After



Tuberculated Pipe





Leaking Valve Assembly





Violation Of The Clean Water Act

- In 1982 and 1983, civil suits were filed against the MDC and other state agencies claiming that the Massachusetts Clean Waters Act had been violated as a result of discharges of untreated and partially treated sewage from Nut and Deer Islands





A New Agency Was Needed

- MDC determined to be unable to fulfill its mission
- Comprehensive legislation was ready for consideration by the legislature in 1984
- But over the summer, progress was slowed as lawmakers, regulators, lawyers, environmentalists and citizens wrangled over the details
- A Federal Judge brought the process to a head by declaring a moratorium on new sewer hookups





And The MWRA Was Created

- In 1985, MWRA assumed responsibility for the water and sewer infrastructure serving greater Boston, and to end the pollution of Boston Harbor from obsolete treatment plants
- MWRA was created as an independent authority charged with raising its revenue from ratepayers, bond sales and grants
- MWRA had to establish wholesale water and sewer rates to cover all costs, including a massive capital program to repair and upgrade the systems
- MWRA was also charged with promotion and enforcement of water conservation and planning for the future
- In compromise with Western and Central Massachusetts, MDC retained watershed management, but MWRA covers costs



Great Progress In One Generation



MWRA Is Best Known For The Boston Harbor Clean-up: A National Environmental Success Story

- The 15-year project cost \$3.8 billion
- About 360 million gallons of wastewater is treated at every day, with a peak capacity of 1.2 billion gallons
- Treated wastewater is discharged 9.5 miles out into the deeper waters of Massachusetts Bay





Combined Sewer Overflow Control Program

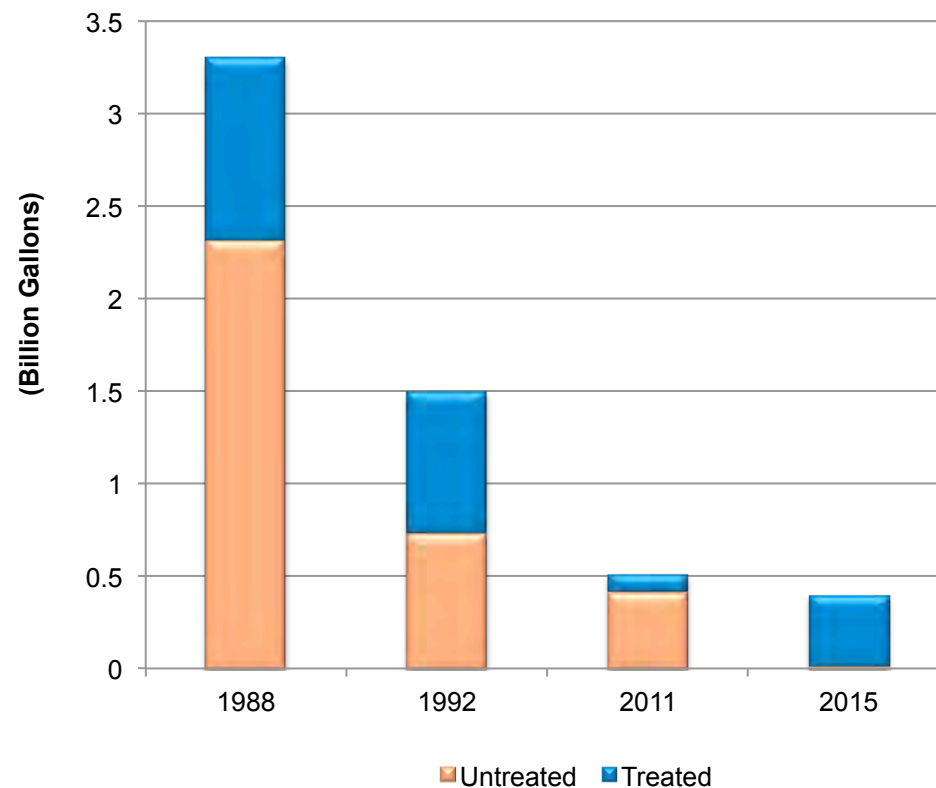
- Five communities - Boston, Brookline, Cambridge, Chelsea and Somerville - have combined sewer systems that connect to MWRA's sewer system
- Since the CSO Control Program began in 1996, 85 miles of new storm drains and sanitary sewers have been installed
- Boston has some of the cleanest urban beaches in the country





Annual CSO Volume Has Been Reduced Dramatically

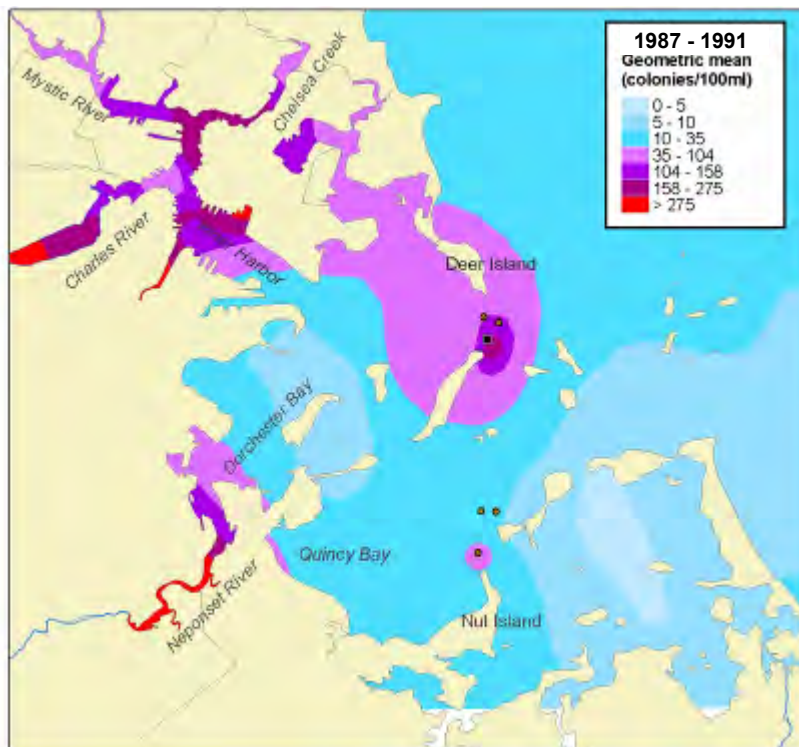
- 32 of 35 projects have been completed to date
- Annual CSO volumes have already been reduced by 2.7 billion gallons
- By 2015, 93% of the remaining CSO flows will be treated



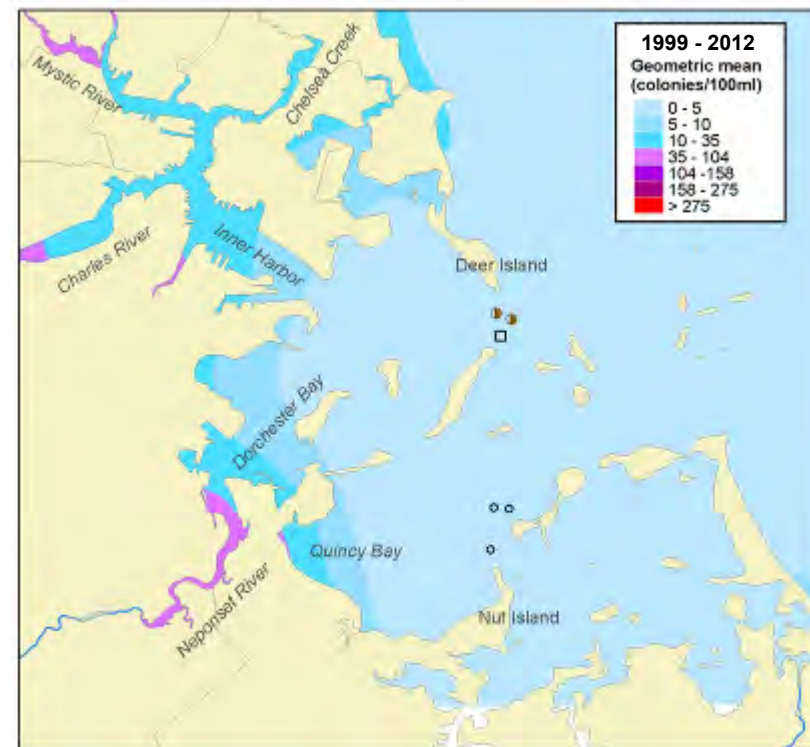


Dramatic Improvements In Water Quality – Even In Wet Weather

1987-1998 (Before Secondary Treatment and South System transfer)



1999 - 2012 (After Secondary Treatment and New Outfall)

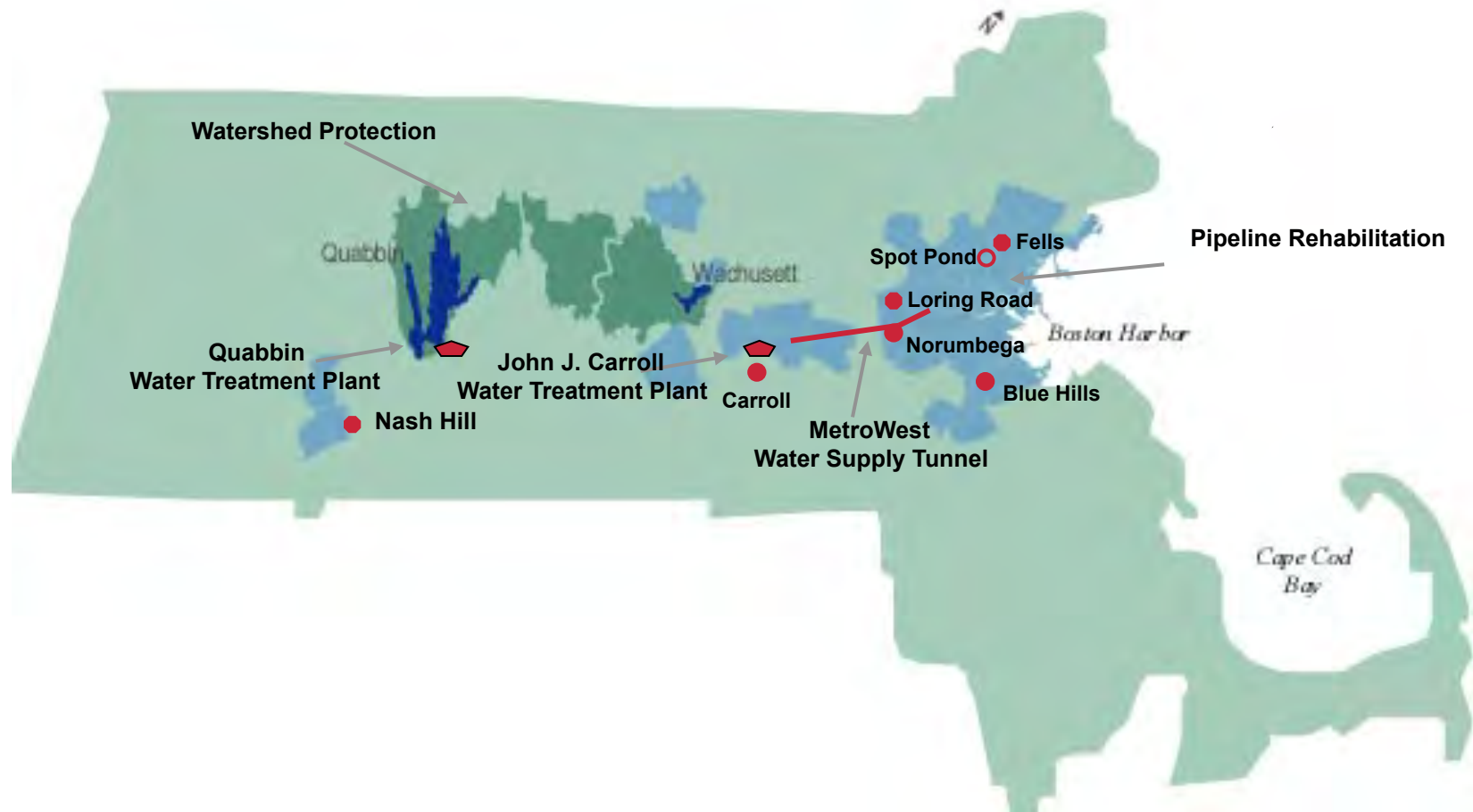


Average *Enterococcus* counts in Boston Harbor in wet weather

The lighter the blue, the better

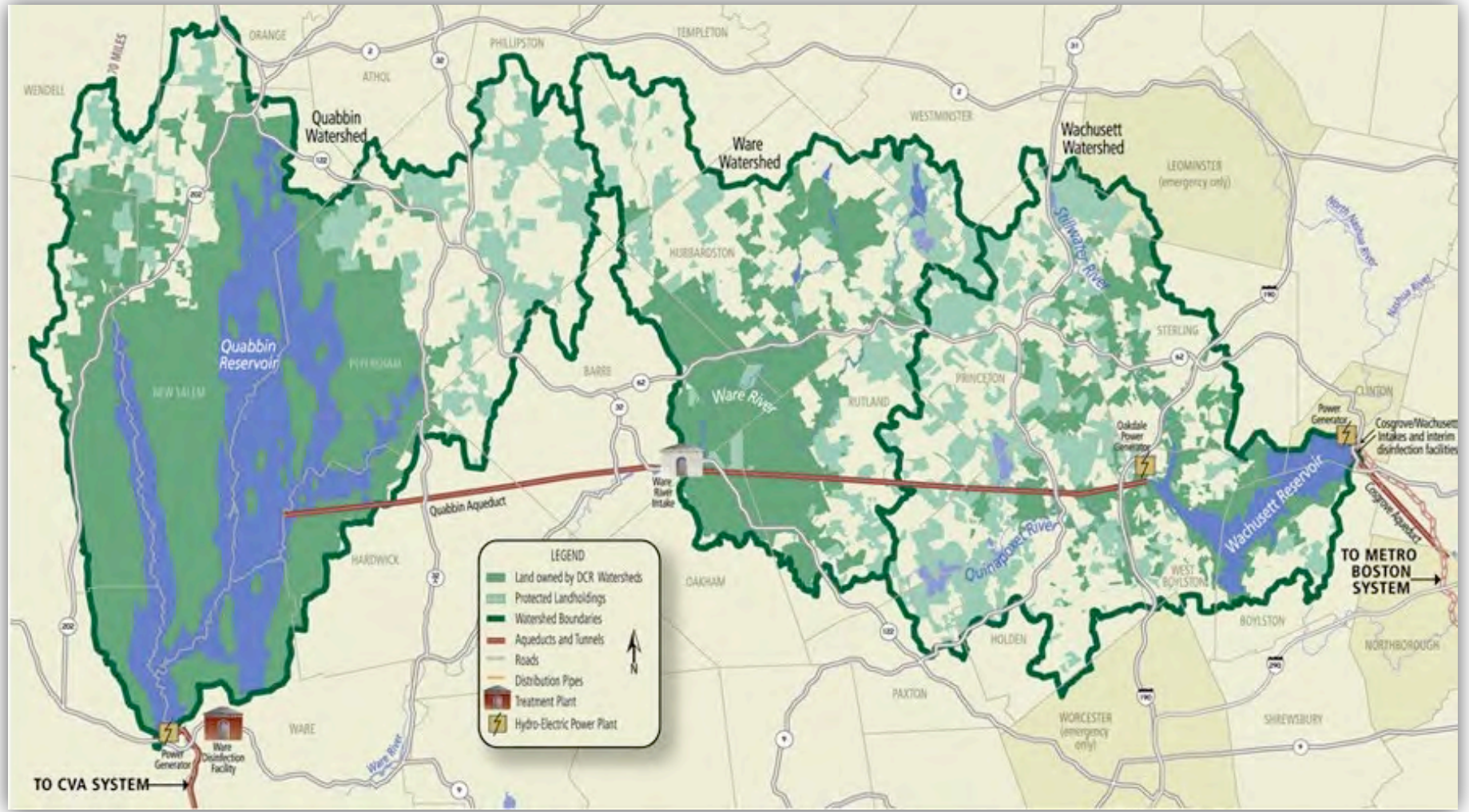


But The Water System Also Needed A Complete Upgrade





400 Square Miles Of Protected Watershed Lands





Land Ownership Over Time

- Since 1985, \$131 million has been invested in land preservation
- So well protected, the Safe Drinking Water Act requires only disinfection

Watershed	% of Watershed
Wachusett Reservoir	56%
Ware River	62%
Quabbin Reservoir	80%



Water Pipeline Rehabbed Or Replaced

- 81 miles of MWRA-owned pipeline
- 474 miles of community-owned pipeline





John J. Carroll Water Treatment Plant

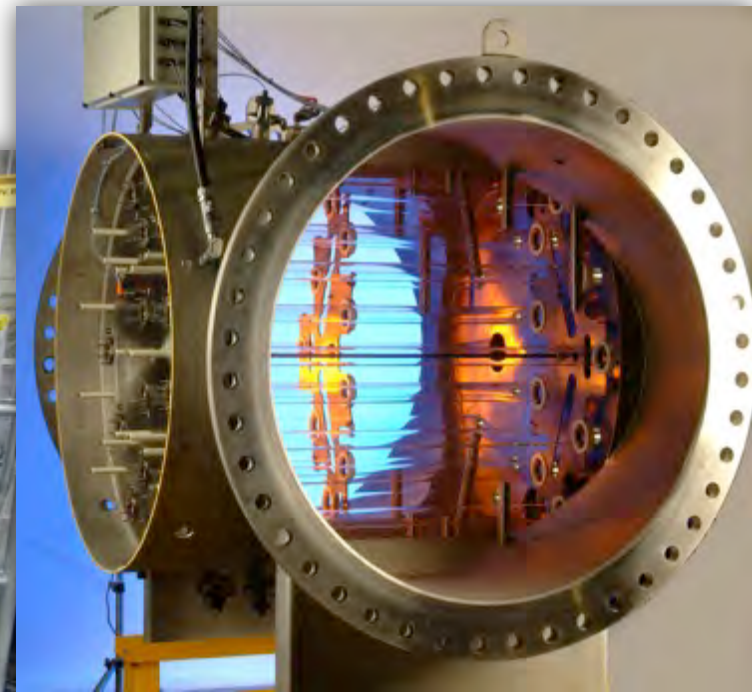
- Completed in July 2005
- Treatment Processes:
 - Ozonation for primary disinfection
 - Corrosion control
 - Chloramination for secondary disinfection
 - Fluoridation





Addition Of Ultraviolet Light Disinfection

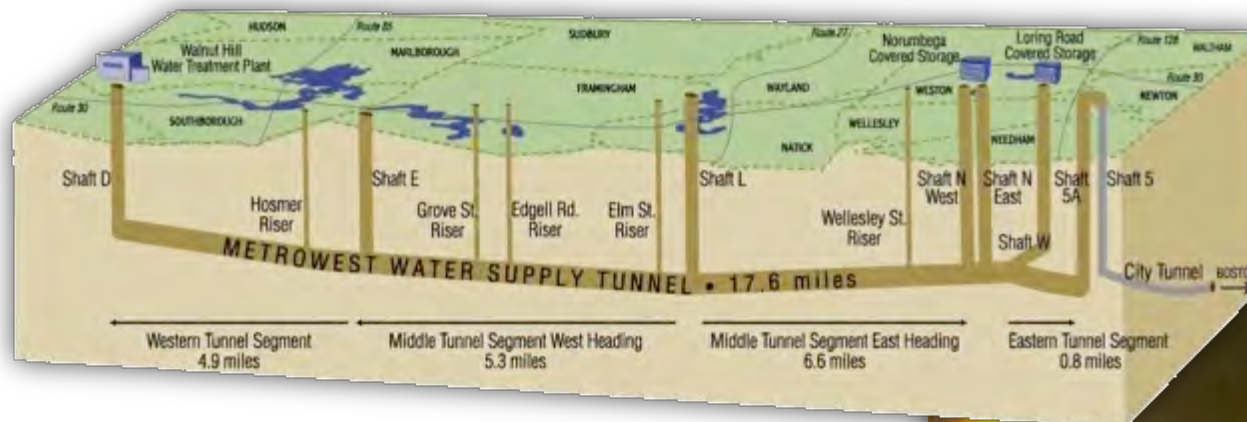
- Unfiltered systems must have two primary disinfectants, one of which must achieve *Cryptosporidium* inactivation
- UV facilities at the Carroll Treatment Plant are on-line as of April 1, 2014





MetroWest Water Supply Tunnel

- The MetroWest Water Supply Tunnel was brought on-line in November 2003
- By March 2004, the Tunnel was being fully utilized allowing the shutdown of the Hultman Aqueduct for repair





Hultman Aqueduct Rehabilitation

- Since 2013, for the first time since originally planned in the 1930s, the Metropolitan Water System has redundancy for the Hultman Aqueduct from Marlborough to Weston





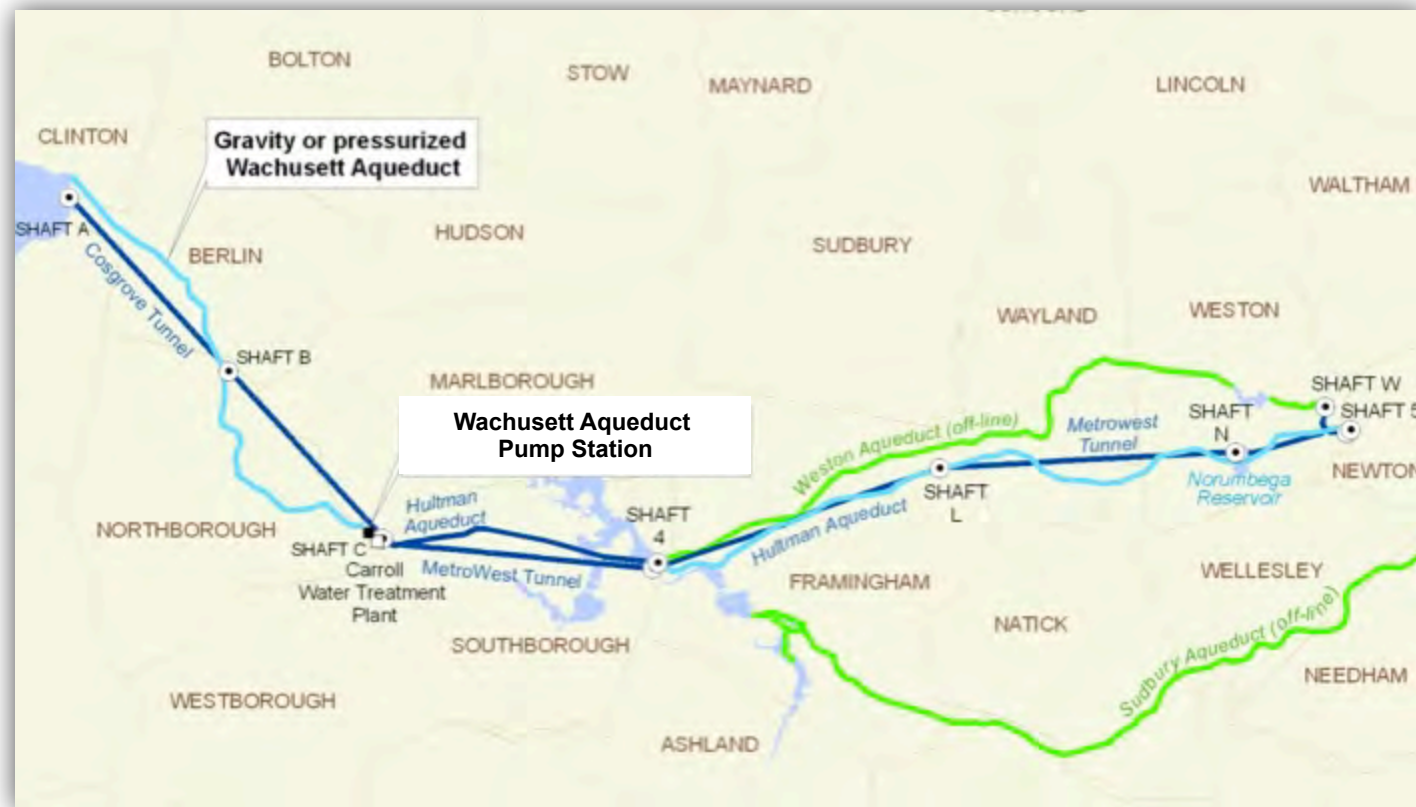
New Wachusett Aqueduct Pump Station In Design





New Wachusett Aqueduct Pump Station In Design

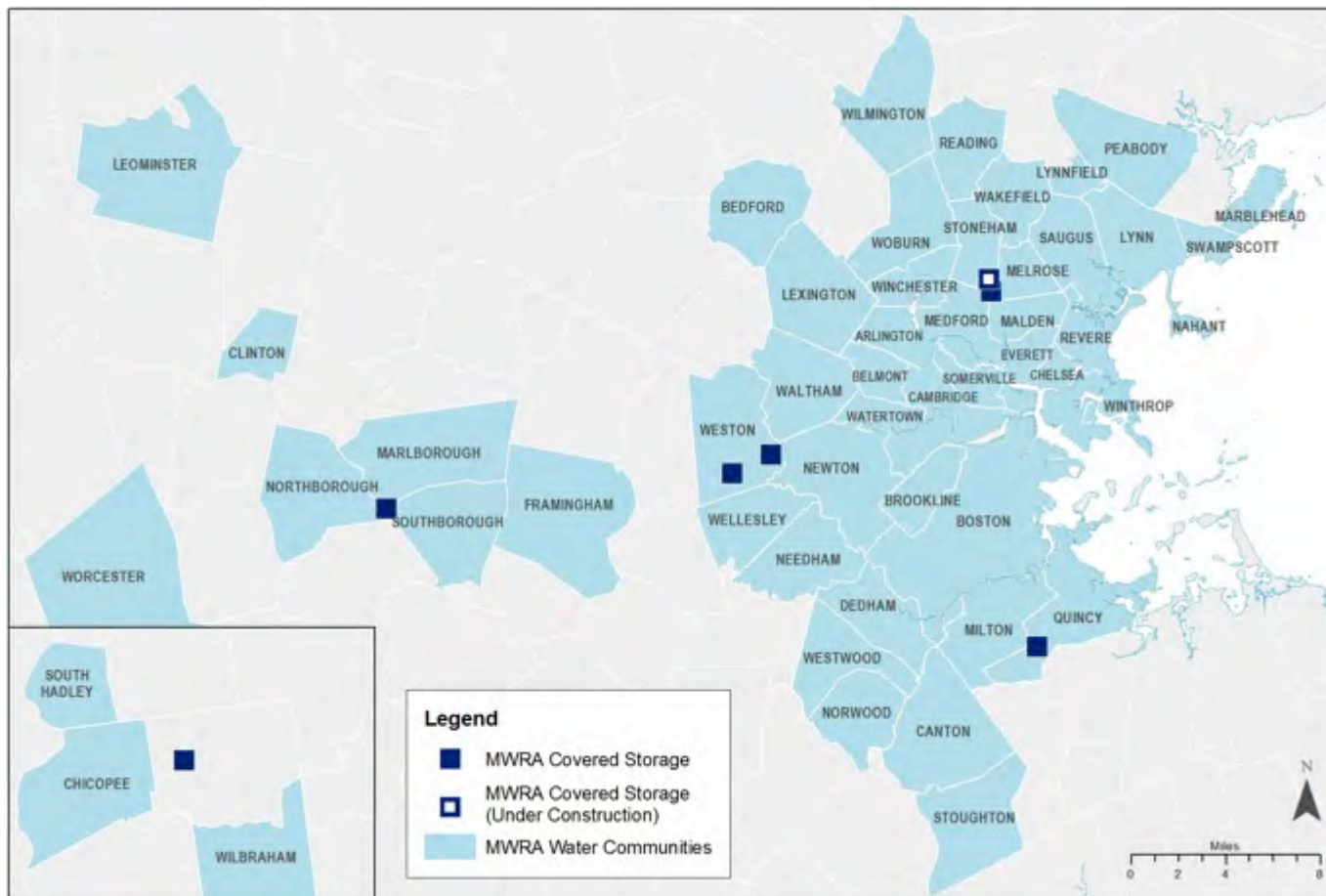
- Will provide redundancy from the Wachusett Reservoir to the Carroll Treatment Plant





Covered Storage Projects

- MWRA has built six new covered storage tanks to replace all open reservoirs
- One more is under construction





Norumbega Covered Storage Facility

- The tank was completed in May 2004
- It provides 115 million gallons of storage for metropolitan Boston





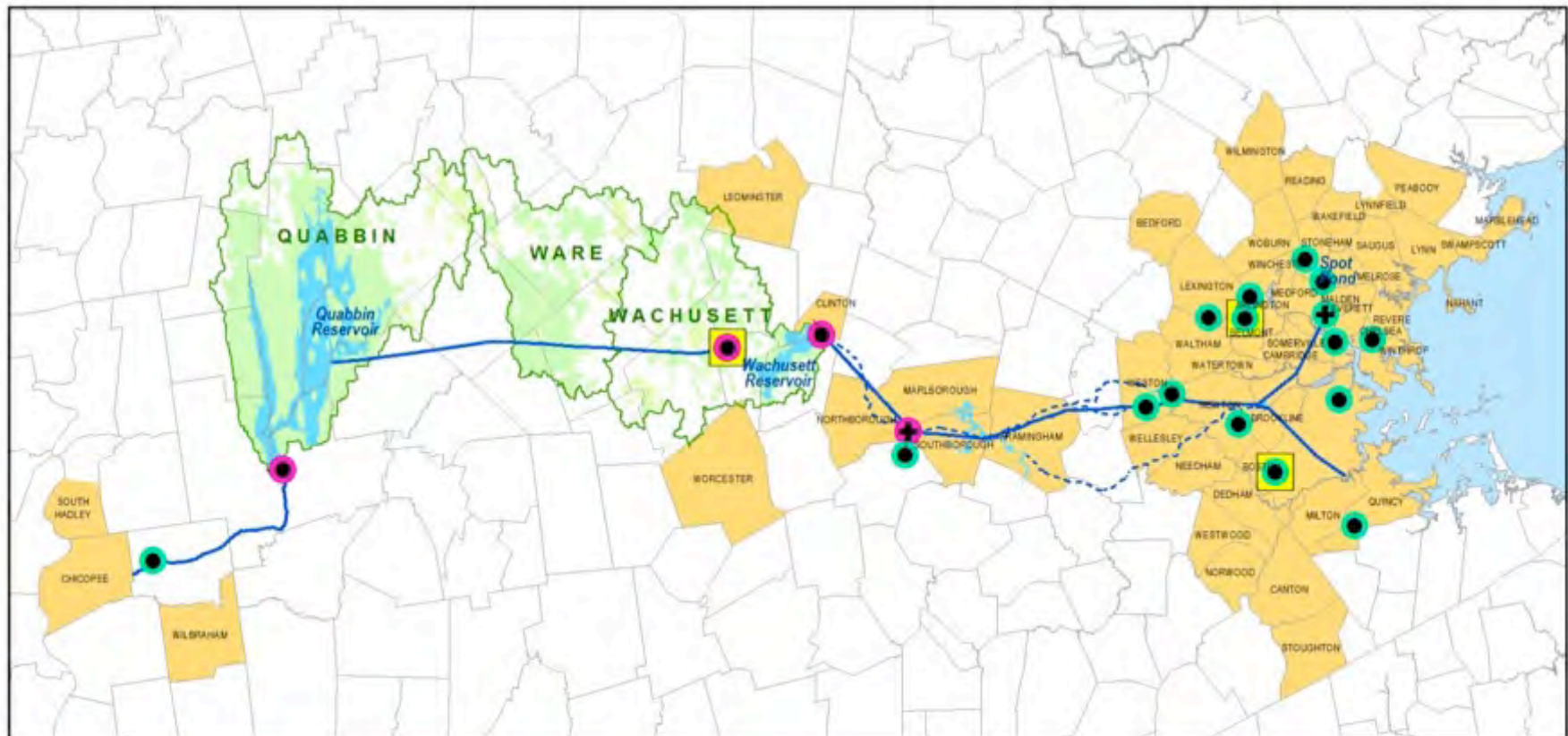
Spot Pond Covered Storage Facility

- 20-million-gallon buried water tank 75% complete
- Buried emergency pump station will provide redundancy for 21 communities





State-Of-The-Art Monitoring System



- Monitoring and Event Detection
- FINISHED
- Under Installation
- MWRA Water Communities
- + Monitoring Only
- RAW



s::can Parameters Monitored

- pH
- Temperature
- Conductivity
- Turbidity
- Dissolved Organic Carbon
- Total Organic Carbon
- Nitrate-N
- UV 254
- Oxidation-Reduction Potential
- Monochloramine
- Free Chlorine
- Total Dissolved Solids

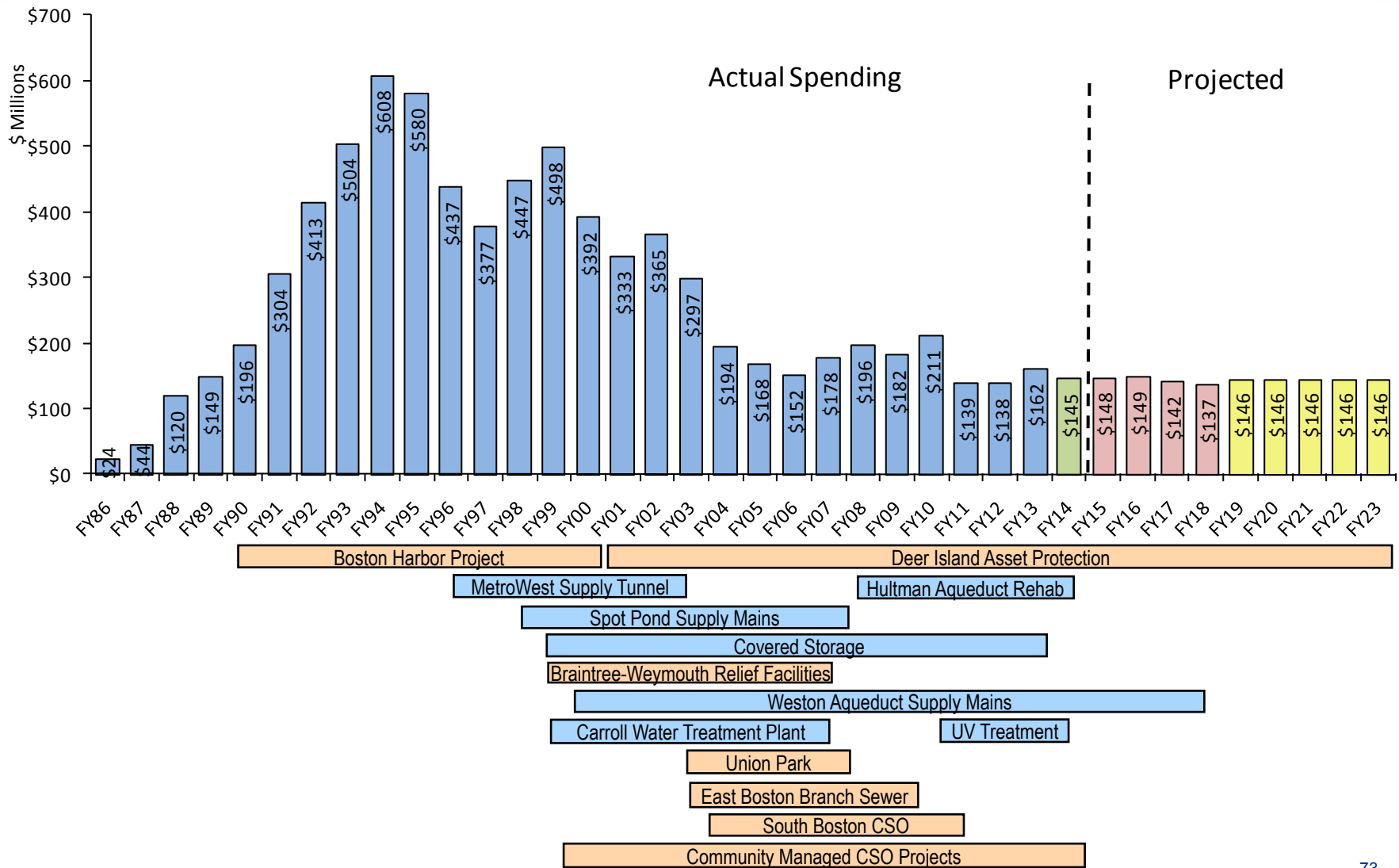




But It Was Very Expensive

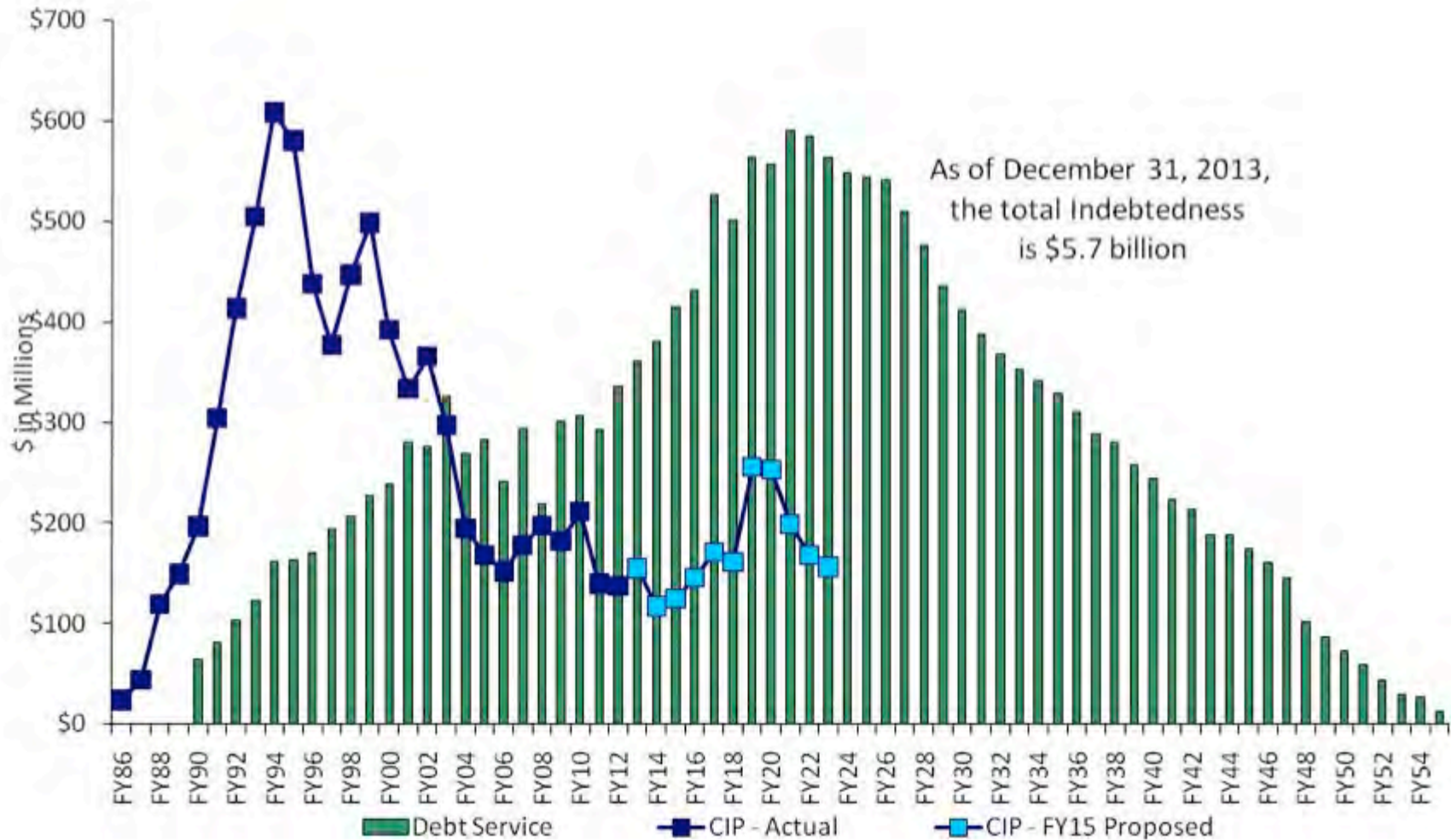


MWRA Has Spent \$7.6 Billion On Water And Sewer System Renewal



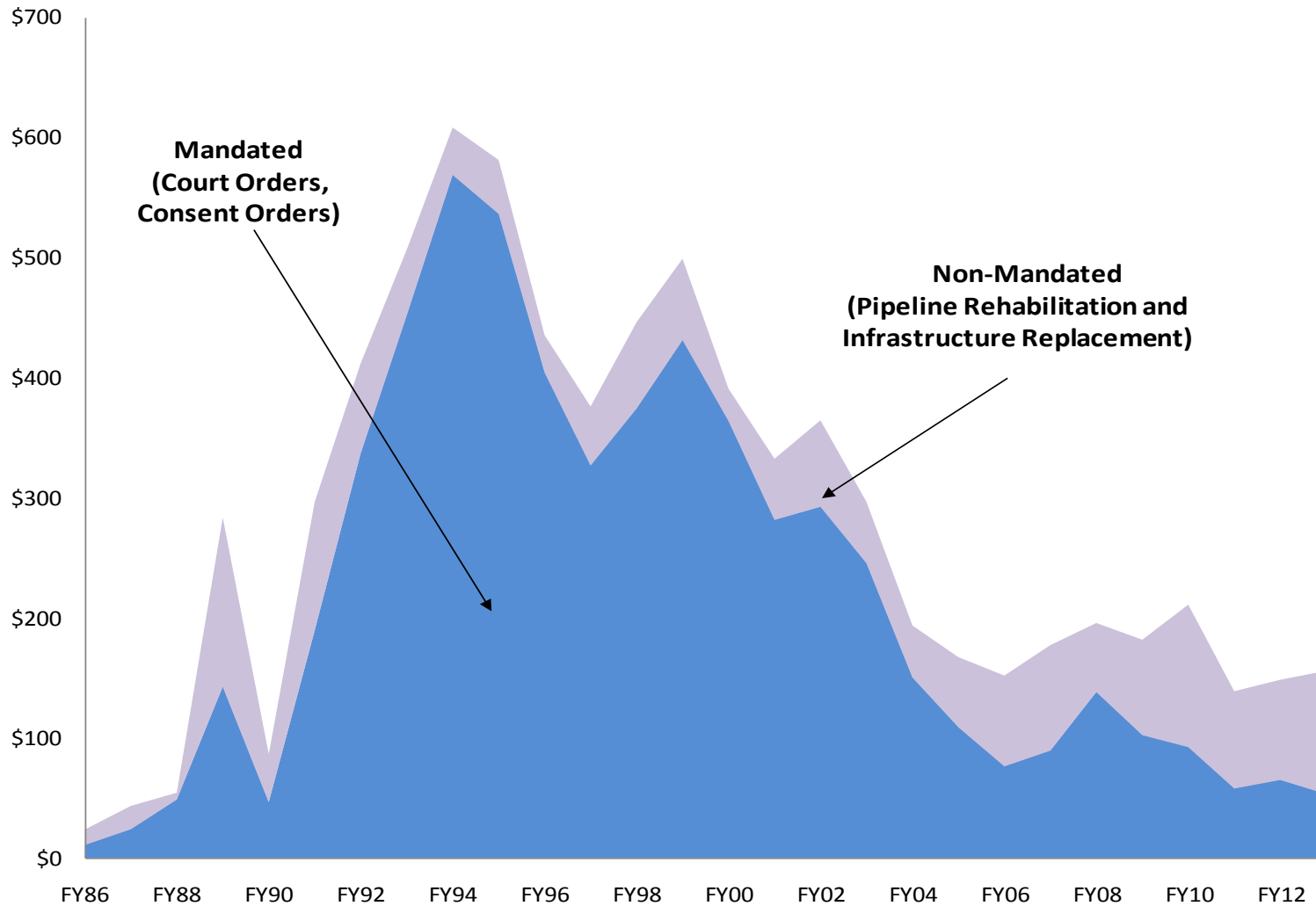


Which Created A Mountain Of Debt



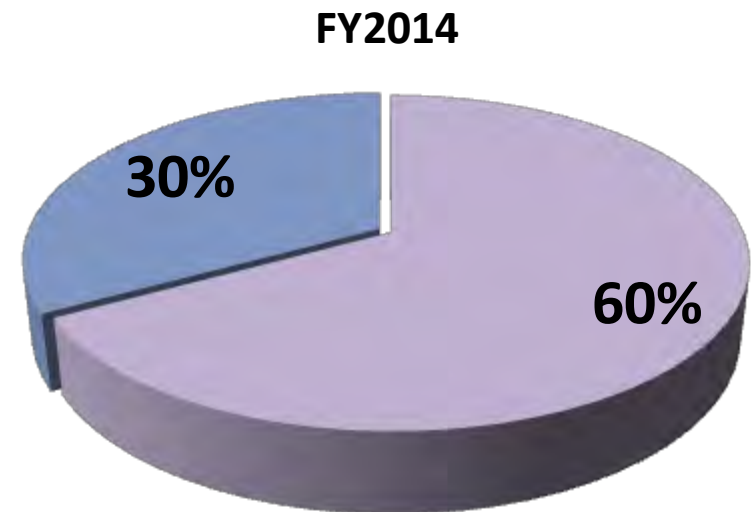
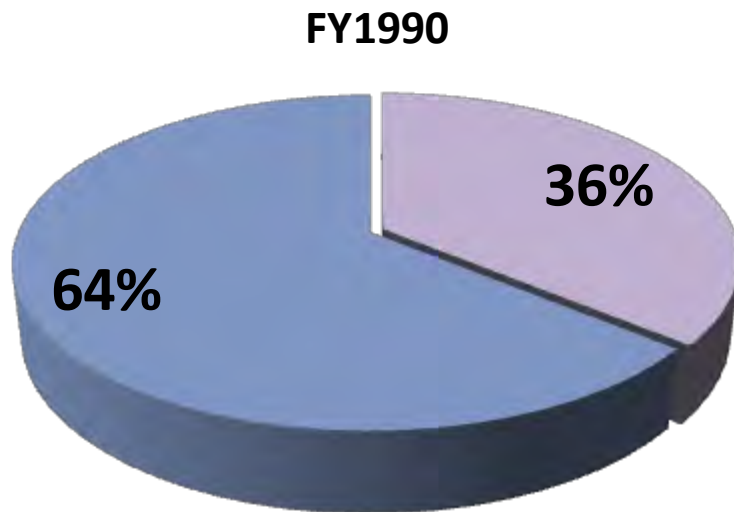


Over 80% Of MWRA's Capital Spending Has Been For Projects Mandated By Federal Or State Regulators





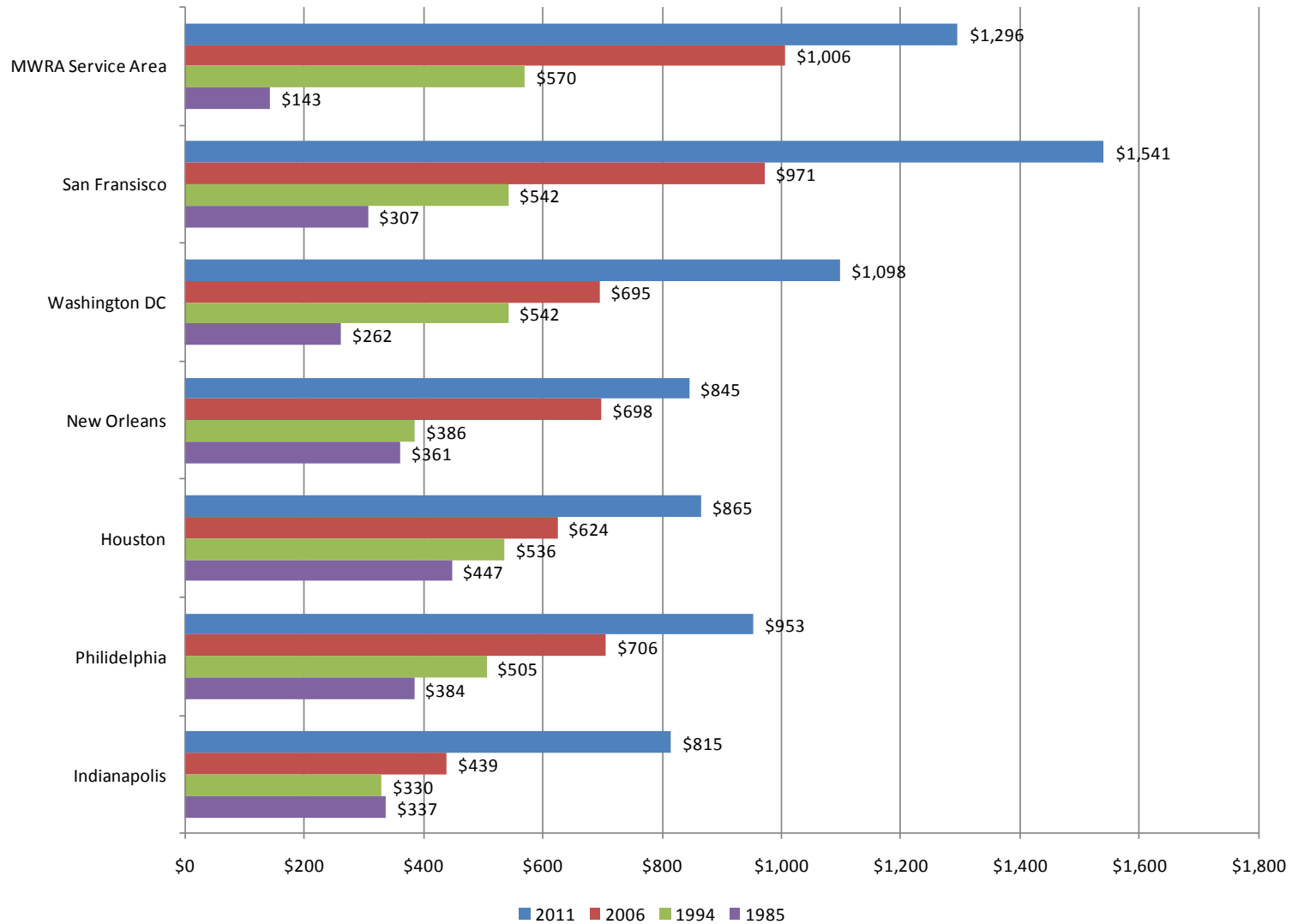
Debt Service Is The Largest Driver Of Rate Increases



Debt Service Direct & Indirect Expenses



Our Rates Quickly Became The Highest In The Country



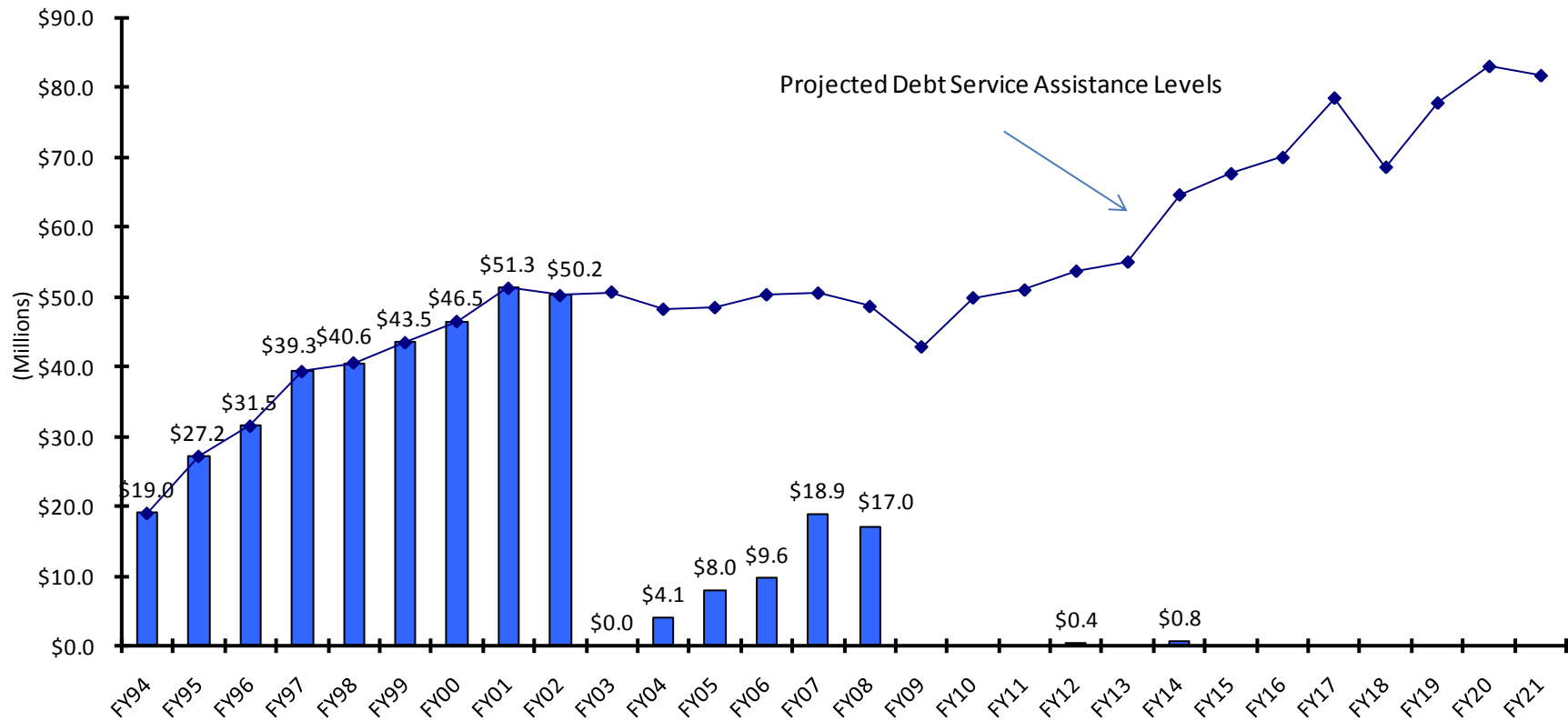


The Ratepayers Have Borne The Burden





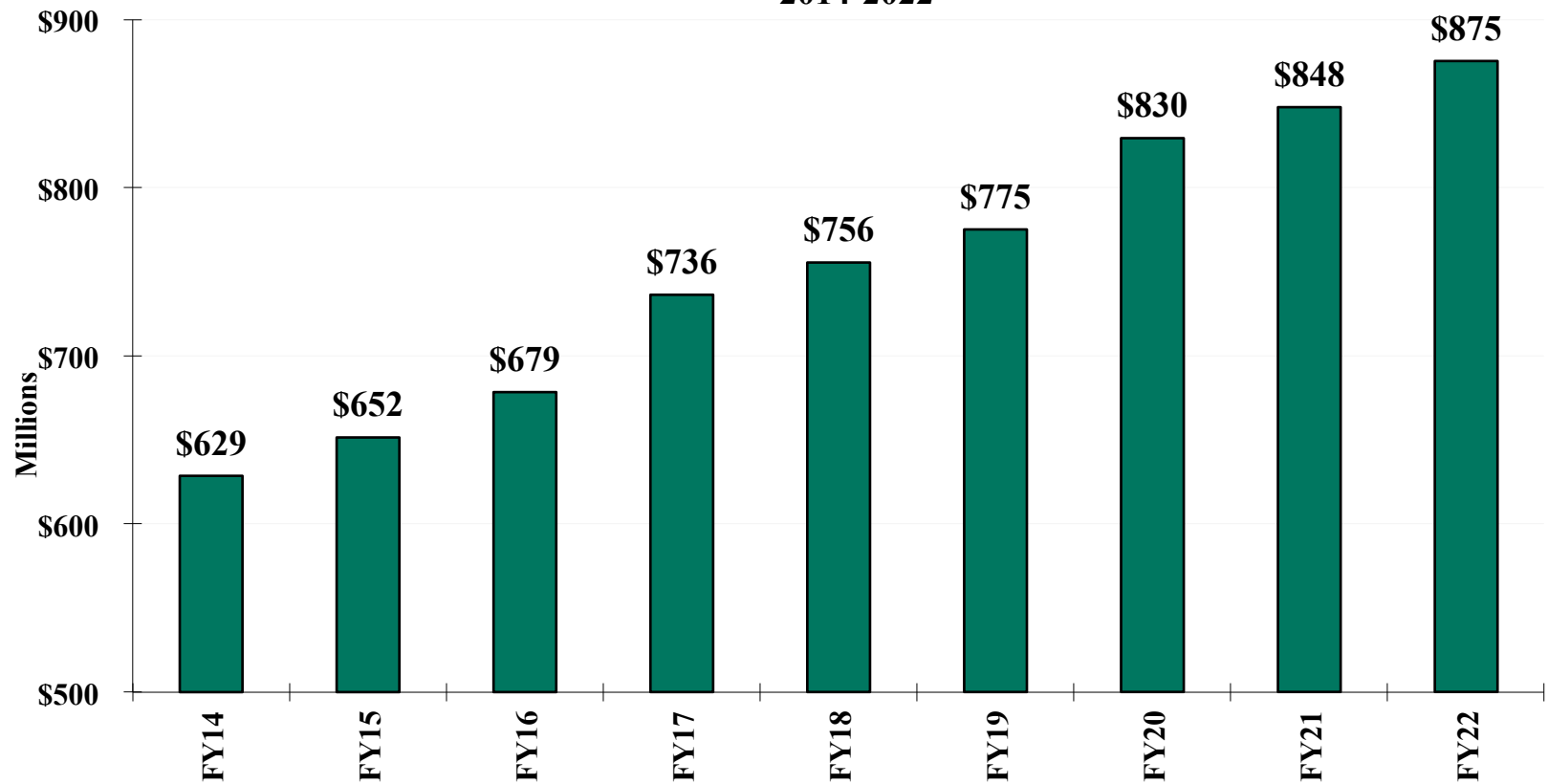
Debt Service Assistance From The State Became A Critical Tool, But When The Economy Took A Downturn, So Did Funding





Heavy Debt Burden for the Foreseeable Future

MWRA Rate Revenue Requirement
2014-2022





What Does The Future Look Like?

- MWRA's Proposed FY15 CEB includes a 3.6% combined water and sewer rate increase
- FY2017 and FY2020 are the most challenging years on the immediate horizon





The Region Has Benefited From MWRA's Projects

A clean Boston Harbor has already generated nearly \$4 billion in waterfront-related construction completed or underway

Save the Harbor/Save the Bay estimated that the completed Project produces \$117 million in annual income from sales, property and income taxes.

A clean, abundant water supply is key to economic growth





Boston's Waterfront Is The Region's Fastest Growing Zip Code





So What's Next?

- Water Infrastructure Alliance estimates a water funding gap of \$10.2 billion statewide
- MWRA's own estimate is \$1.5 billion
- Average age of water pipes is 70 years; some still in service date back to over 1860
- Redundancy





Words To Live By

“...as we progress and find that we can control the quality of the water by our own acts, we realize it is a wicked thing to turn water containing a large amount of organic matter into a city or town for people to drink – children, invalids and people whose constitutions are too weak to overcome the effects of bad water.

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