Massachusetts Water Resources Authority

GO GREEN | Medford

Rivers, Lakes, and Reservoirs: The History of Our Drinking Water in Boston and Medford

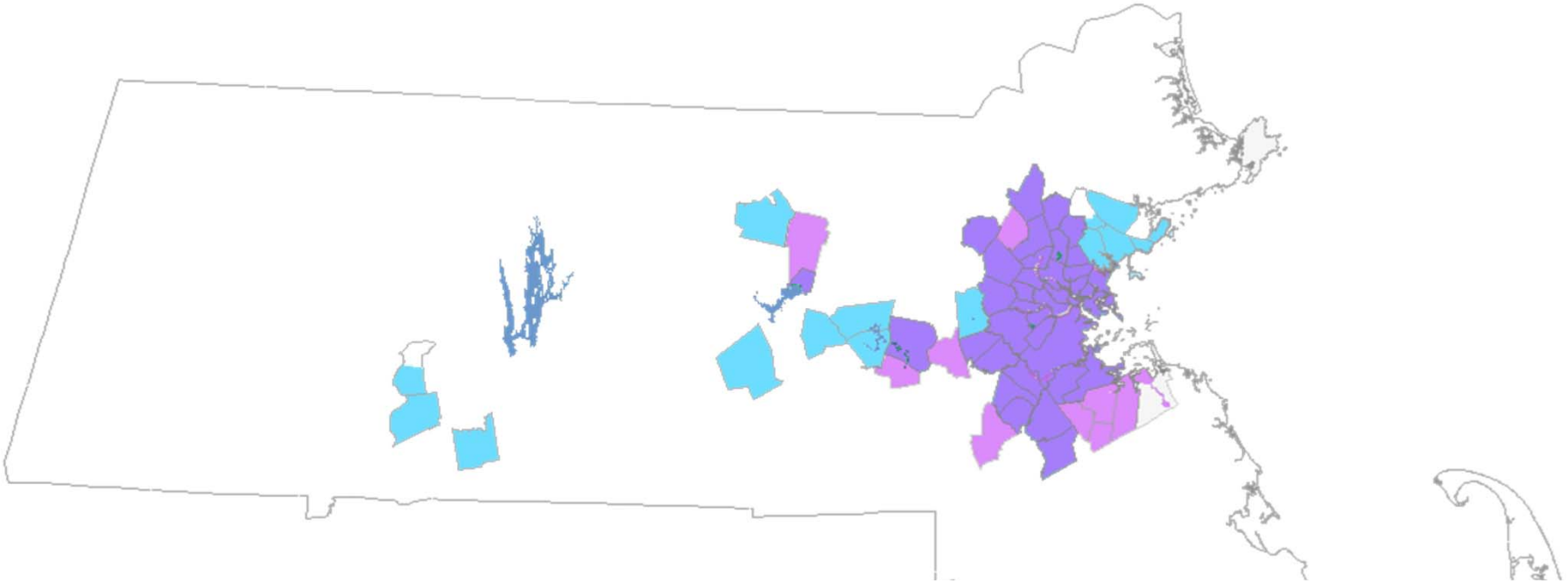
Frederick A. Laskey
Executive Director

April 5, 2018

About MWRA

Who We Serve

- MWRA provides wholesale water and wastewater services to over 2.5 million customers in 61 communities
- On average, MWRA delivers an average of 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



Make-Up Of MWRA Service Area

- 51 communities that get water service – over 6,000 miles of water pipes
- 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

History of the Water System

Early Boston Water System

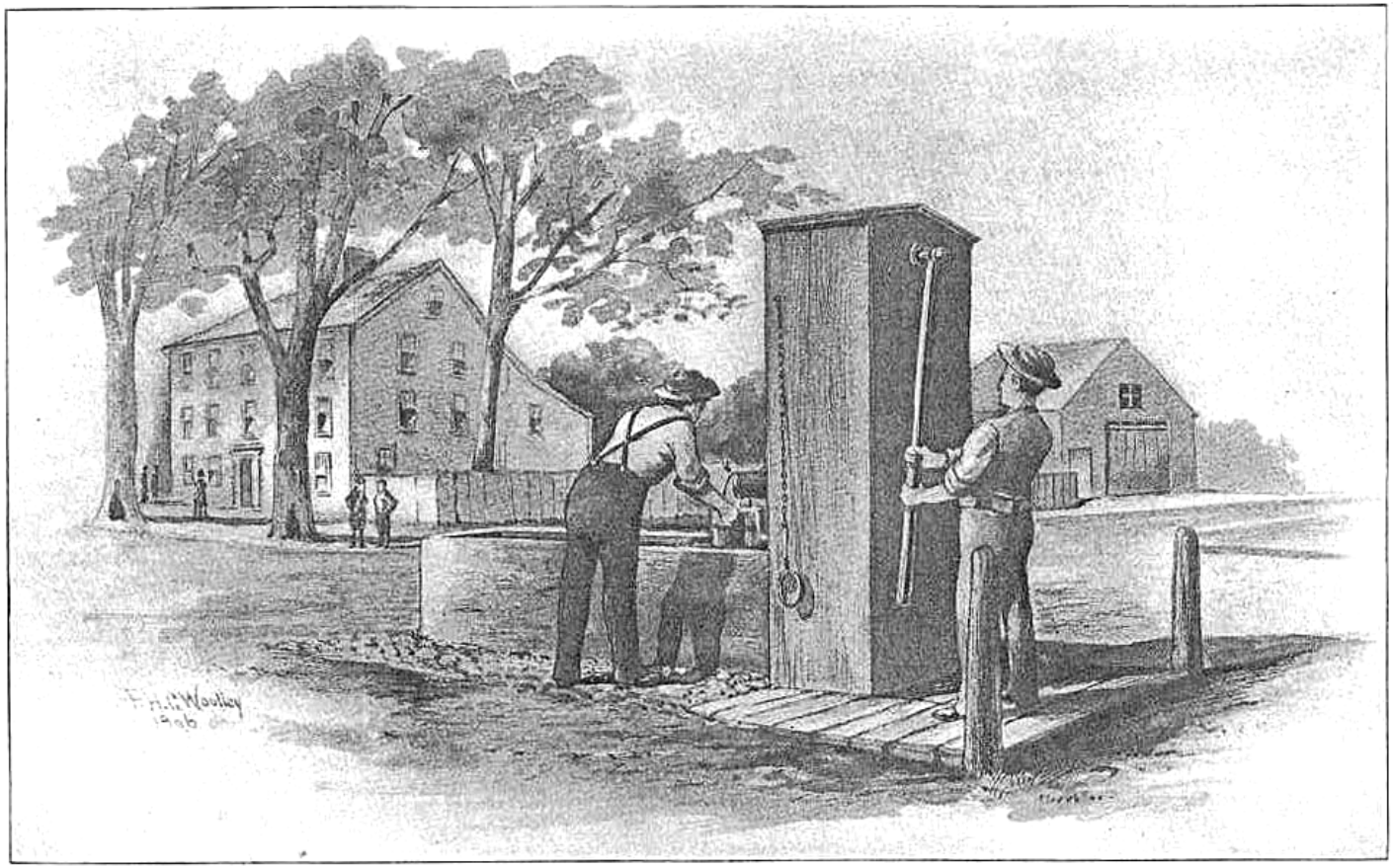
- Early Bostonians relied on local wells, rain barrels and a spring on Boston Common for their water
- In 1795 wooden pipes made from tree trunks delivered water from Jamaica Pond to Boston
- By the 1840s, Jamaica Pond was too small and too polluted to provide water to Boston's 50,000 residents
- A purer and larger source had to be found

Medford's First Water Supply

- Like most towns, Medford's water supply started with a town pump, usually located where the roads crossed (or the "Square")

- Medford's first pump was located at the intersection of Salem, High and Main Streets

The Medford Town Pump



Courtesy of F. C. Wait.

THE MEDFORD TOWN PUMP.

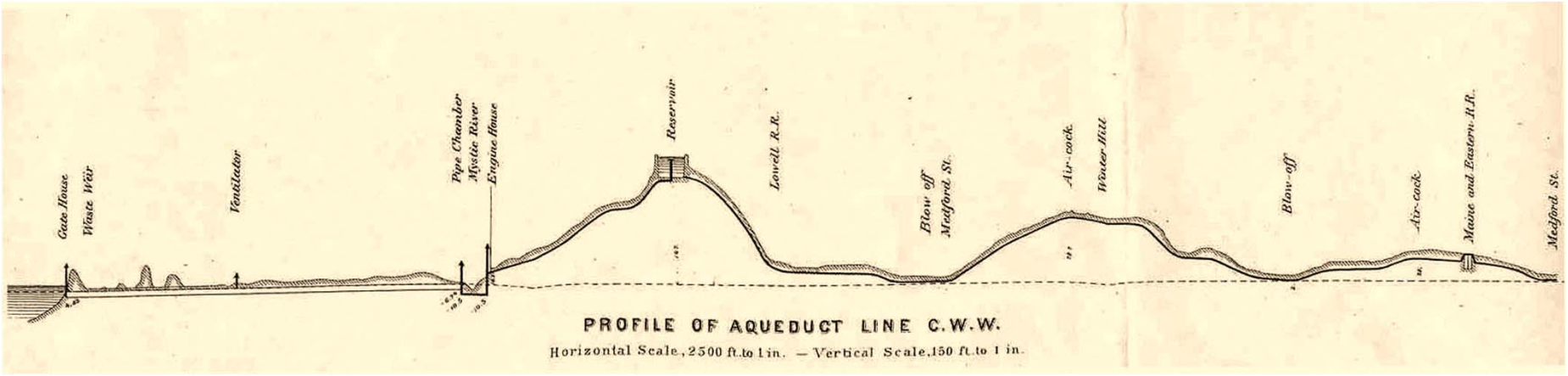
By F. H. C. Woolley.

Growth of Medford's Water Supply System

- Additional pumps were added around the Town, at almshouses and schoolhouses
- Houses near the river could not have wells, since the tide coming in twice a day left groundwater unfit to drink
- In 1802, the first two houses were fitted with "suction" from the town pump
- The pumps continued to provide water for the next few decades
- By the 1840s, reservoirs were added at Washington Street and Ship Avenue

The Mystic Waterworks

- In the meantime, the City of Charlestown had taken Mystic Lake for its water supply
- By 1864, the upper lake was dammed
- Water flowed by gravity to the Mystic Pumping Station and was pumped up to the Tufts Reservoir
- Charlestown now had enough water to meet its own demand and supply other communities



Mystic Lake Dam

Mystic Lake


DISTRIBUTION DEPT. - MEDFORD
UPSTREAM FACE OF DAM, MYSTIC LAKE
JAN. 11, 1898
1458

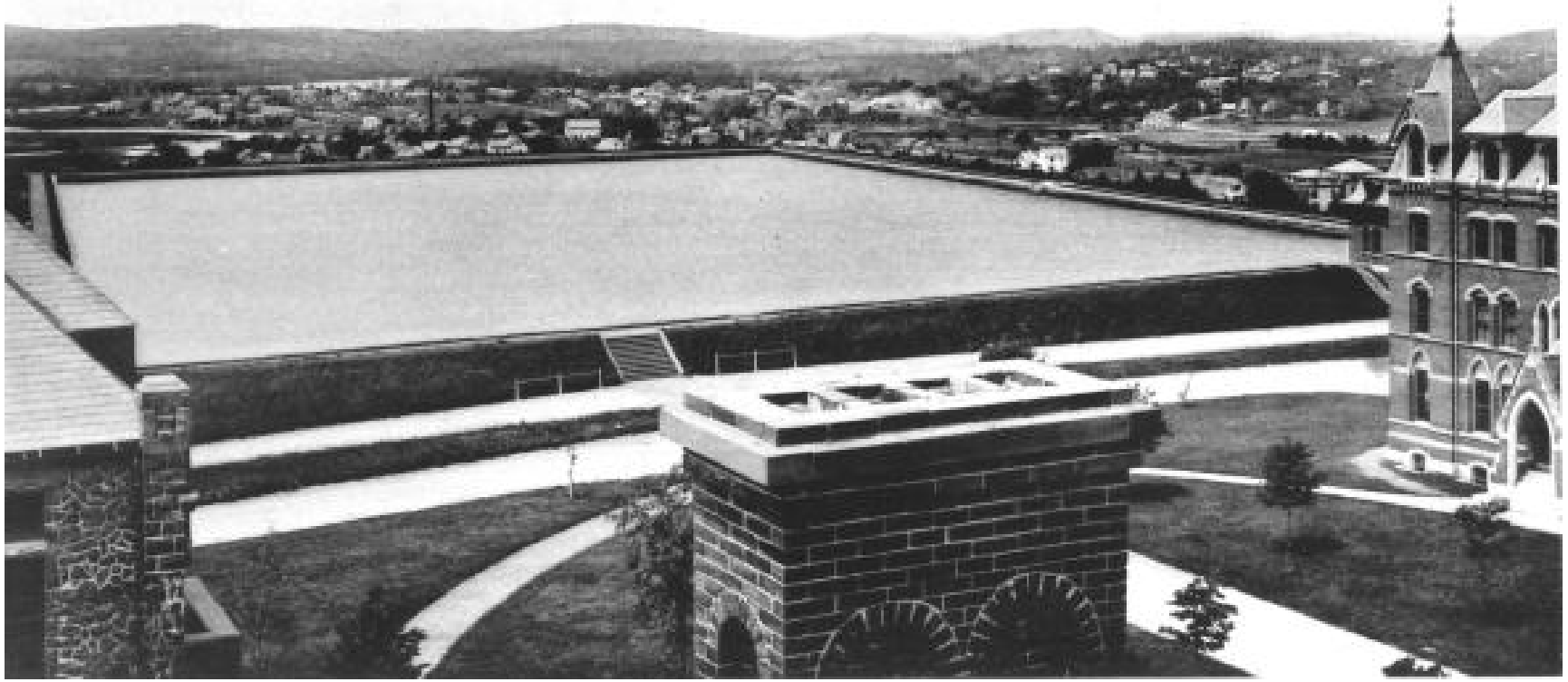
Mystic Lake Engine and Gate House

Mystic Pumping Station

Mystic Reservoir at Tufts College

Mystic Reservoir at Tufts College

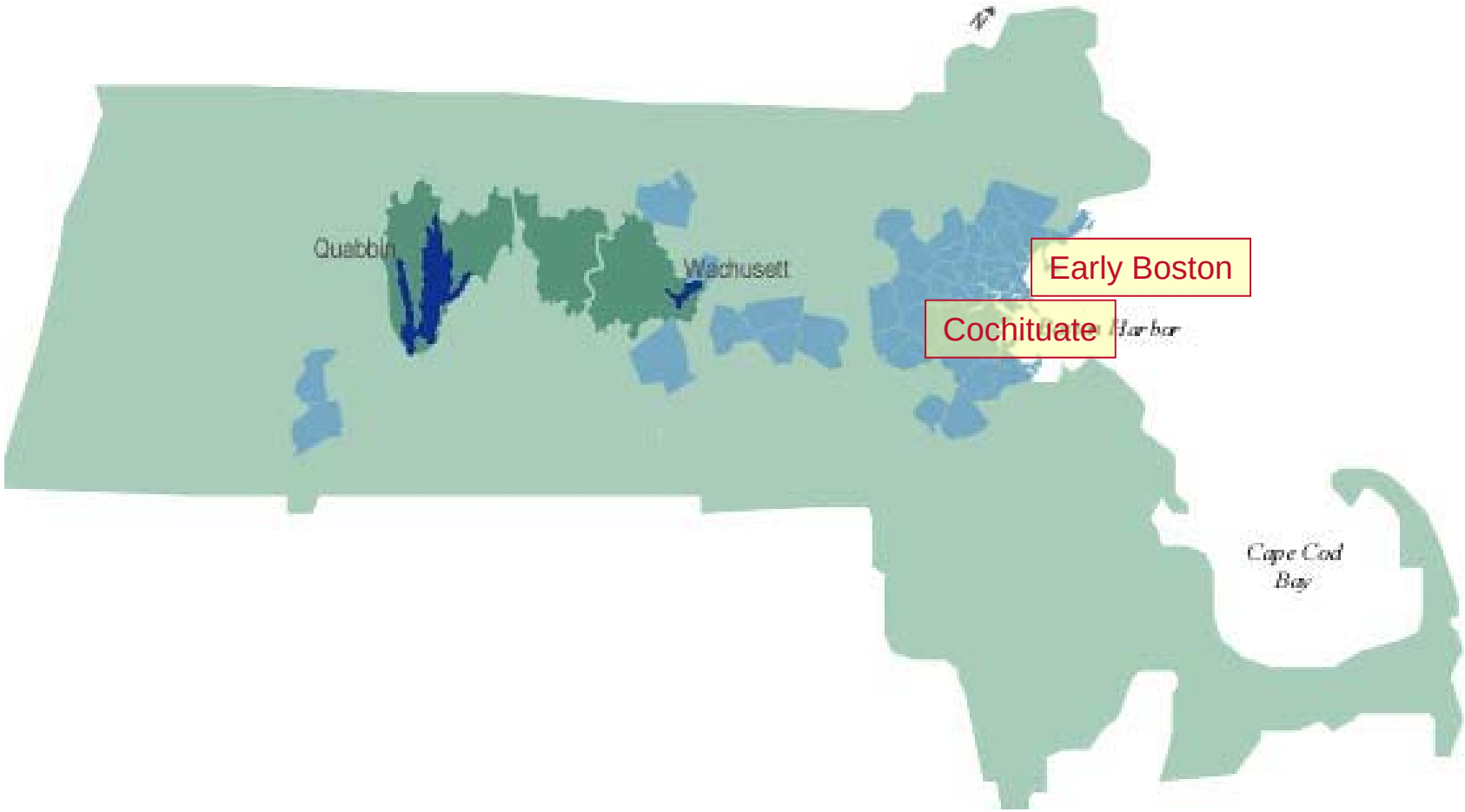
Mystic Reservoir at Tufts College



Mystic Reservoir at Tufts College

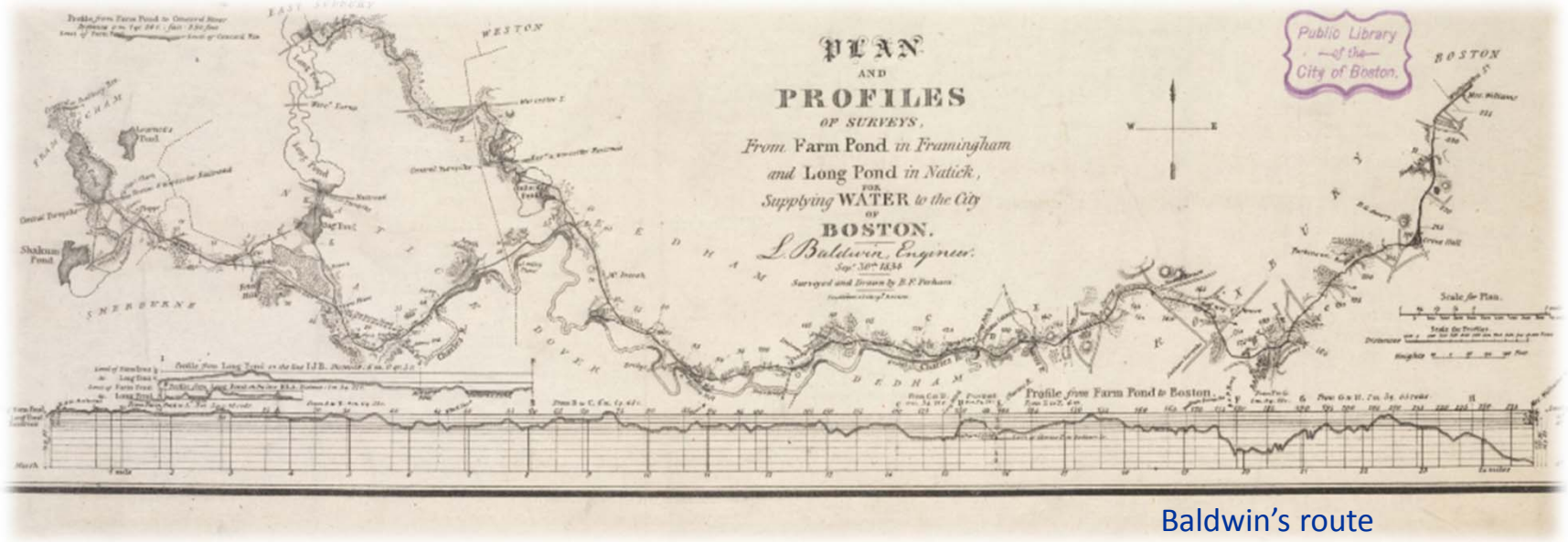
Mystic Reservoir at Tufts College

Water System History - A Journey Westward



Boston Needed More Watet

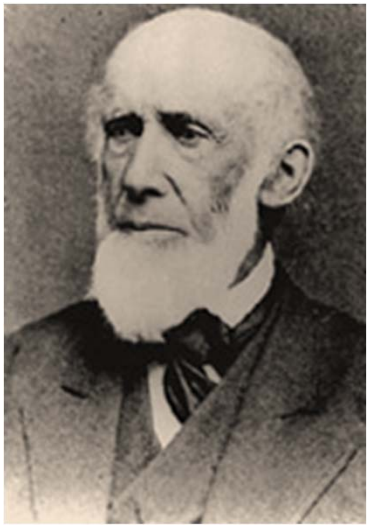
- Inventor Daniel Treadwell was chosen to review choices and recommended pumping from the Charles River at Watertown
- Others pushed the use of Spot Pond and the Mystic Lakes
- Loammi Baldwin Jr. was hired and recommended use of Long Pond in Natick. It was the most costly solution but offered long-term advantages. Water quality was a consideration and this started the trend of finding the upland sources with protected waters



Baldwin's route

1840s: Building Boston's First Municipal System

- Controversy continued into the 1840s
- The owners of the now defunct Middlesex Canal offered to sell it to Boston as a water source, a dubious offer at best
- 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

The Cochituate System

- In 1845 construction began on a new distribution system for Boston
- The Sudbury River was impounded and Lake Cochituate was formed
- The Cochituate Aqueduct transported water to the Brookline Reservoir, which supplied smaller reservoirs all over the City
- Lake Cochituate provided 2 billion gallons of storage and 10 million gallons per day

The Cochituate System

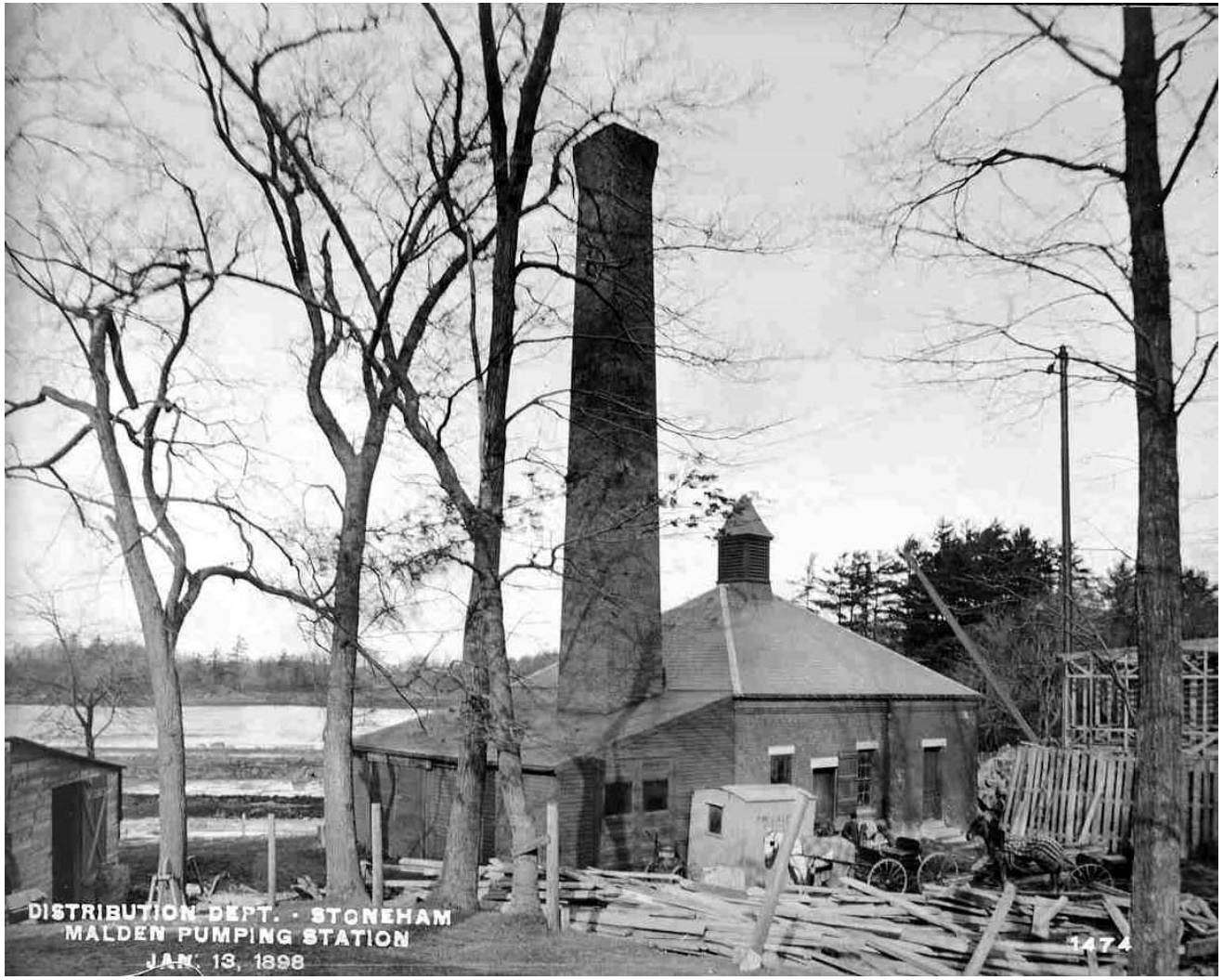
- Water from Lake Cochituate flowed into the Frog Pond on Boston Common in 1848 at a dedication ceremony that drew over 100,000

And Medford Needed More Water, Too

- By the 1860s, Medford needed a new, larger source
- It first looked to Charlestown and it's Mystic Pond supply - but the tide rushed in to the pond twice each day
- Malden and Melrose had already decided to use Spot Pond
- In 1867, the Spot Pond Water Company was incorporated by Medford, Malden and Melrose
- But not without some controversy - Spot Pond was regarded as the region's "Coney Island" with prize fighting, horse racing on the ice and other festivities

Medford Pumping Station at Spot Pond

Malden Pumping Station at Spot Pond



Melrose Pumping Station at Spot Pond

Spot Pond

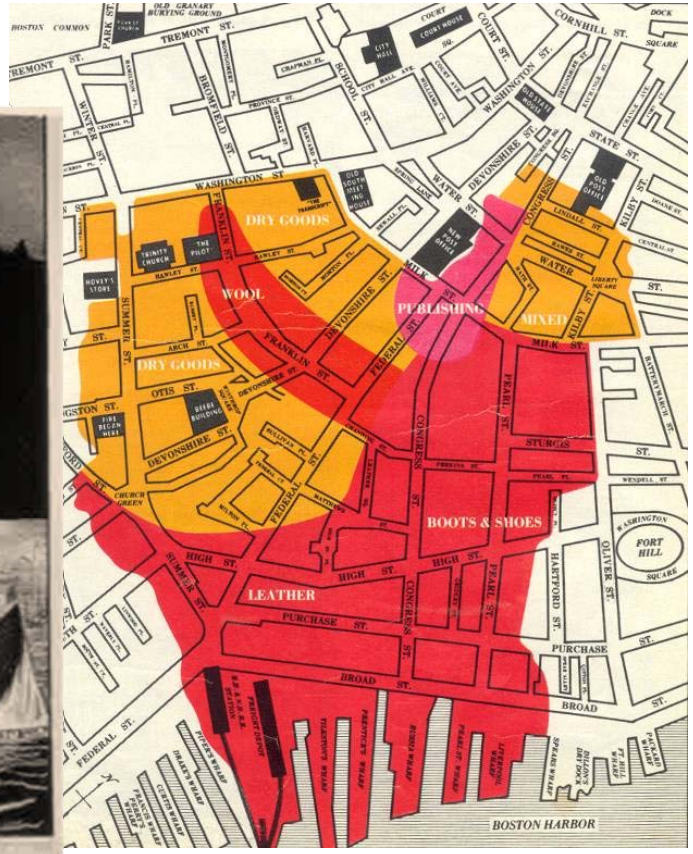
- In 1870, Medford had 845 houses and 5,700 residents
- The first water main from Spot Pond ran down Forest Street to Medford Square
- Service grew rapidly from 45% in the first year to 82% by the 6th year
- In 1896, Wright's Pond - a man-made ice pond - was taken for storage
- The dam was raised and a pump station added to provide service to all elevations

Dam at Wright's Pond

Wright's Pond

1872: The Great Fire

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



Words To Live By

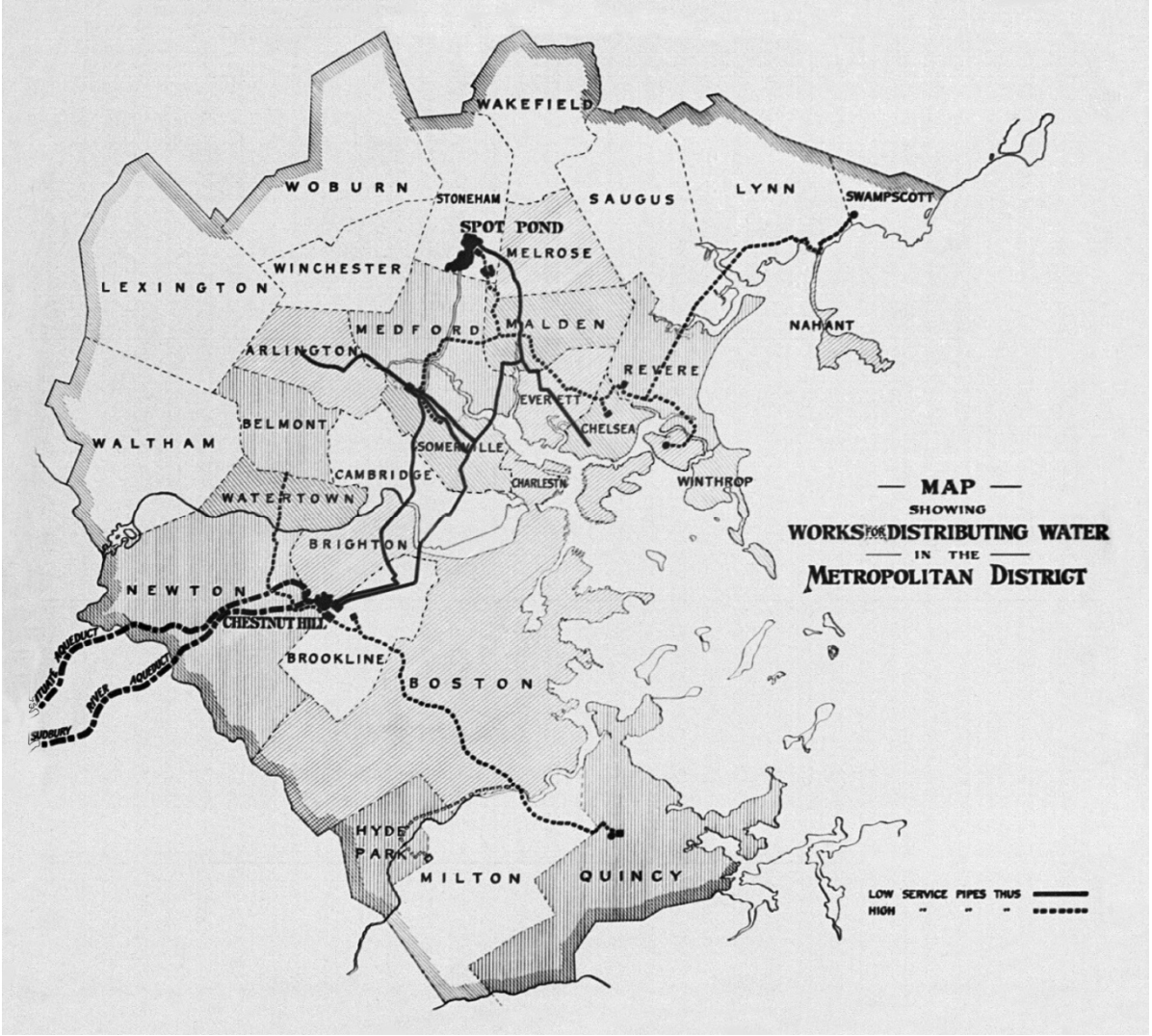
"…as we progress and find that we can control the quality of the water by our own acts, we realize it is a wicked thing to turn water containing a large amount of organic matter into a city or town for people to drink – children, invalids and people whose constitutions are too weak to overcome the effects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

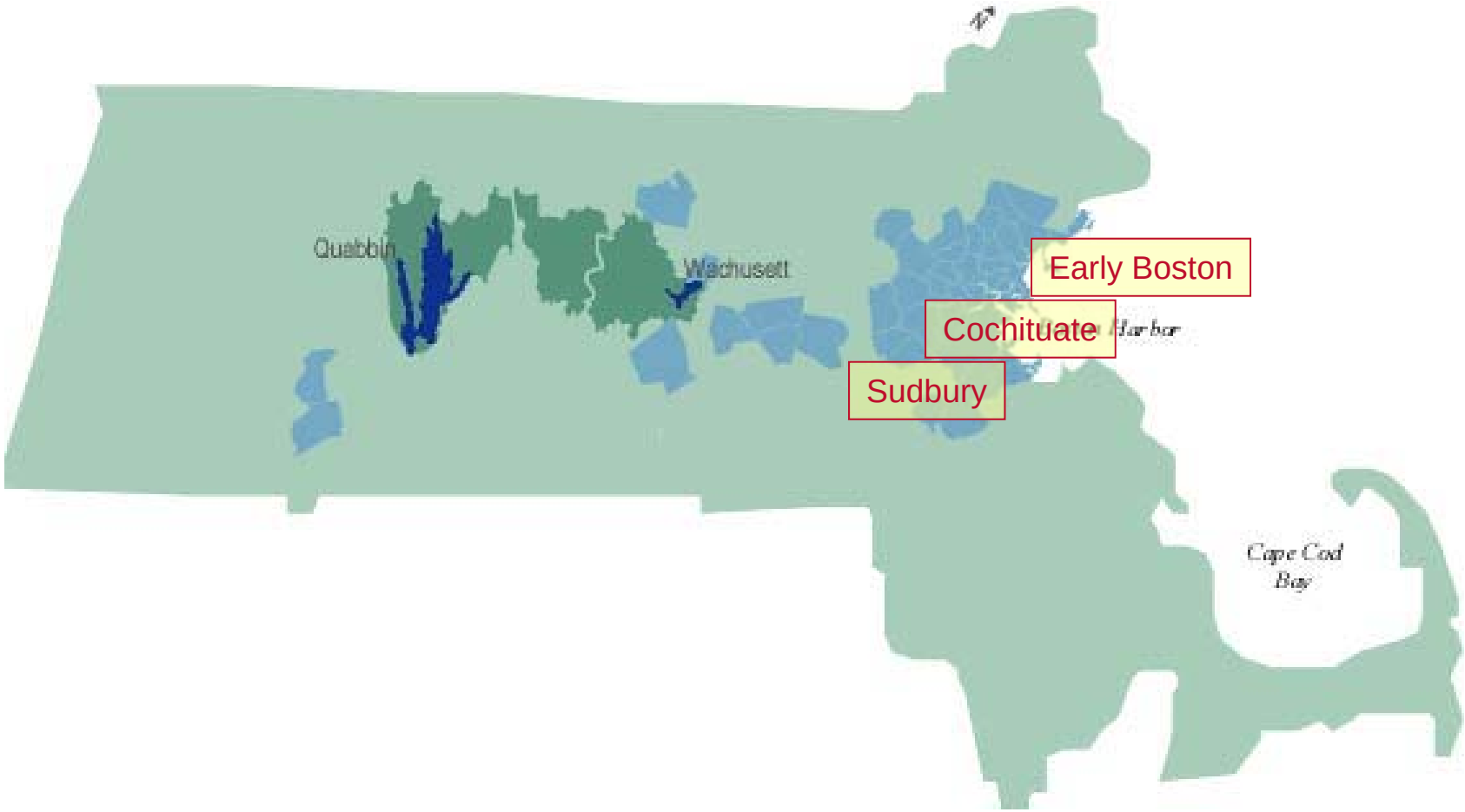
Boston Needed More Water

- By the early 1890s, Boston's water supply was deemed unsafe and inadequate
- Governor Russell proposed a water district including the development of a large water supply for a number of communities
- In 1895, the Metropolitan Water Act called for the taking of water from the south branch of the Nashua River, the Boston Waterworks at Chestnut Hill and Spot Pond
- This system would supply water to the cities and towns within 10 miles of the State House that wanted it

Metropolitan Water District



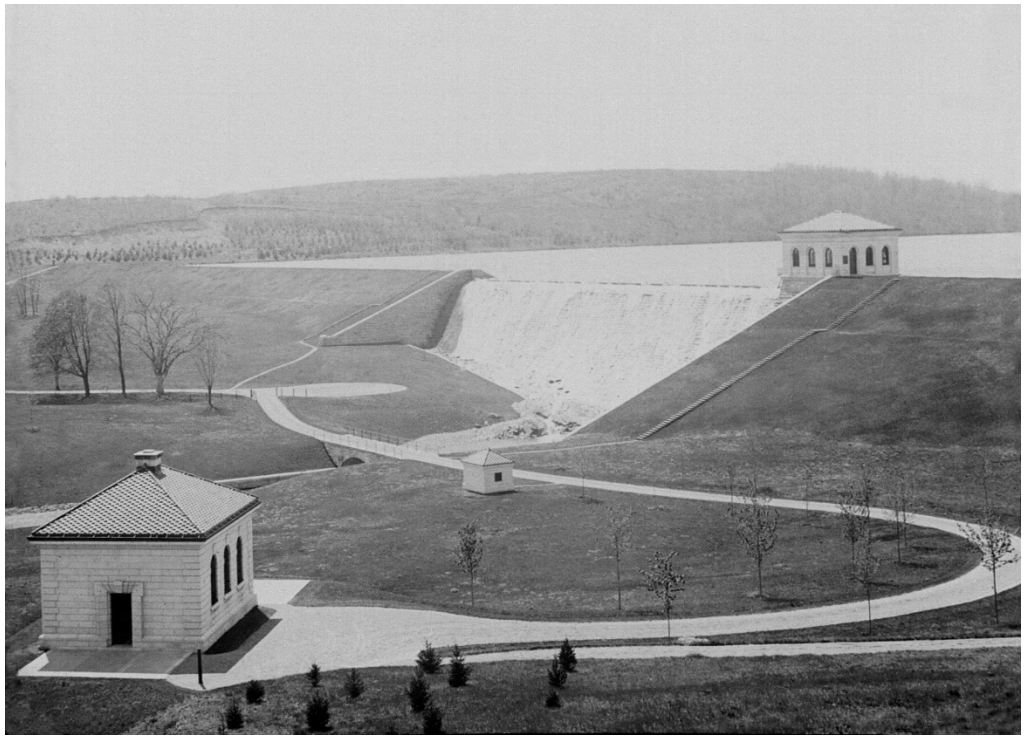
Water System History - A Journey Westward



The Sudbury System

- In 1878, the Sudbury River, 18 miles from Boston, was diverted through the Sudbury Aqueduct to the Chestnut Hill Reservoir

- By 1898, the Fayville Dam and the Sudbury Reservoir were completed



Chestnut Hill Waterworks

- Chestnut Hill became the hub of the waterworks system

- The gravity-operated Cochituate and Sudbury Aqueducts were now interconnected at Chestnut Hill

Chestnut Hill High Service Pumping Station

Chestnut Hill Waterworks

Chestnut Hill Waterworks

Pipe Connections

Spot Pond Expansion

- When the State took Spot Pond in 1898, it offered Medford, Malden and Melrose $250,000 in total
- The communities refused the offer and sued, eventually winning $1.2 million - Medford's share was $470,000
- The Metropolitan Water Board raised the elevation of Spot Pond by 9 feet, bringing the capacity to 1.8 billion gallons

Spot Pond Trench Excavation

Spot Pond Trench Excavation

Spot Pond Inlet Conduit

Spot Pond Excavation

Spot Pond Excavation

“Teaming Bed”


DISTRIBUTION DEPT.
TEAMING BED - PLATE OF 10 MILLION GALLON
ENGINE TO N. H. S. P. STA.
NOV. 10. 1899
WEIGHT OF BED - PLATE COMPLETE, 50,000 LBS.
WEIGHT ON TRUCK, 60,000 LBS.
3043

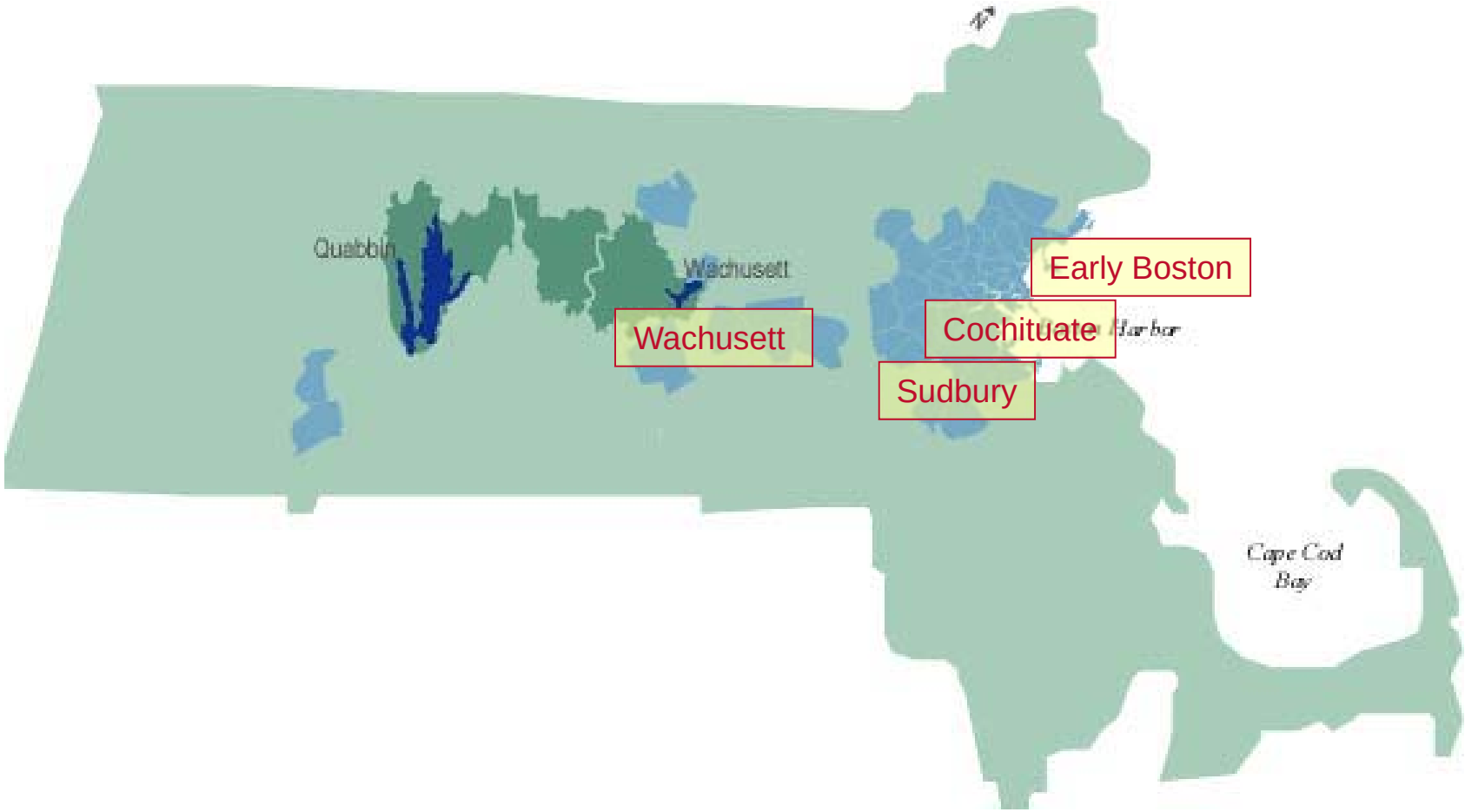
“Teaming Bed”


LAUNDRY
DISTRIBUTION DEPT.
TEAMING BED - PLATE OF 10 MILLION GALLON
ENGINE TO N. H. S. P. STA.
NOV. 10. 1899
3046

Spot Pond Pumping Station

Spot Pond – Moth Damage

Water System History - A Journey Westward



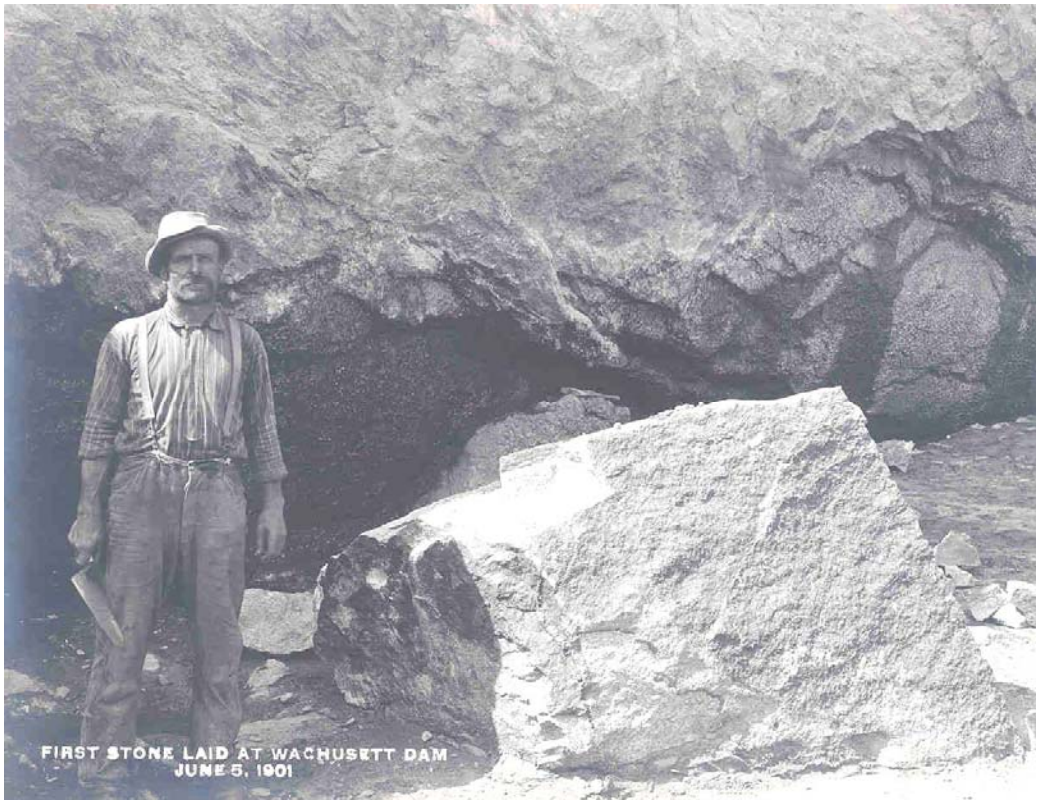
The Wachusett Aqueduct

- 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

The Wachusett Reservoir

- The Nashua River was impounded by the Wachusett Dam, 38 miles from Boston



The Wachusett Reservoir

- 6.5 square miles were flooded in the towns of Boylston, West Boylston, Clinton and Sterling

- Work was completed in 1905 and the reservoir filled in May 1908

- Water was conveyed by the Weston Aqueduct to the Weston Reservoir and then by pipeline to Chestnut Hill and Spot Pond

The Wachusett Reservoir

- At the time it was constructed, the Wachusett Reservoir was the largest man-made water supply reservoir in the world at 65 million gallons

- It supplied 118 million gallons per day

New Water Mains

- The East and West Spot Pond Supply Mains were constructed through Medford, Malden, Melrose, Stoneham, Somerville, Cambridge, and Boston

Governor's Avenue

Governor's Avenue

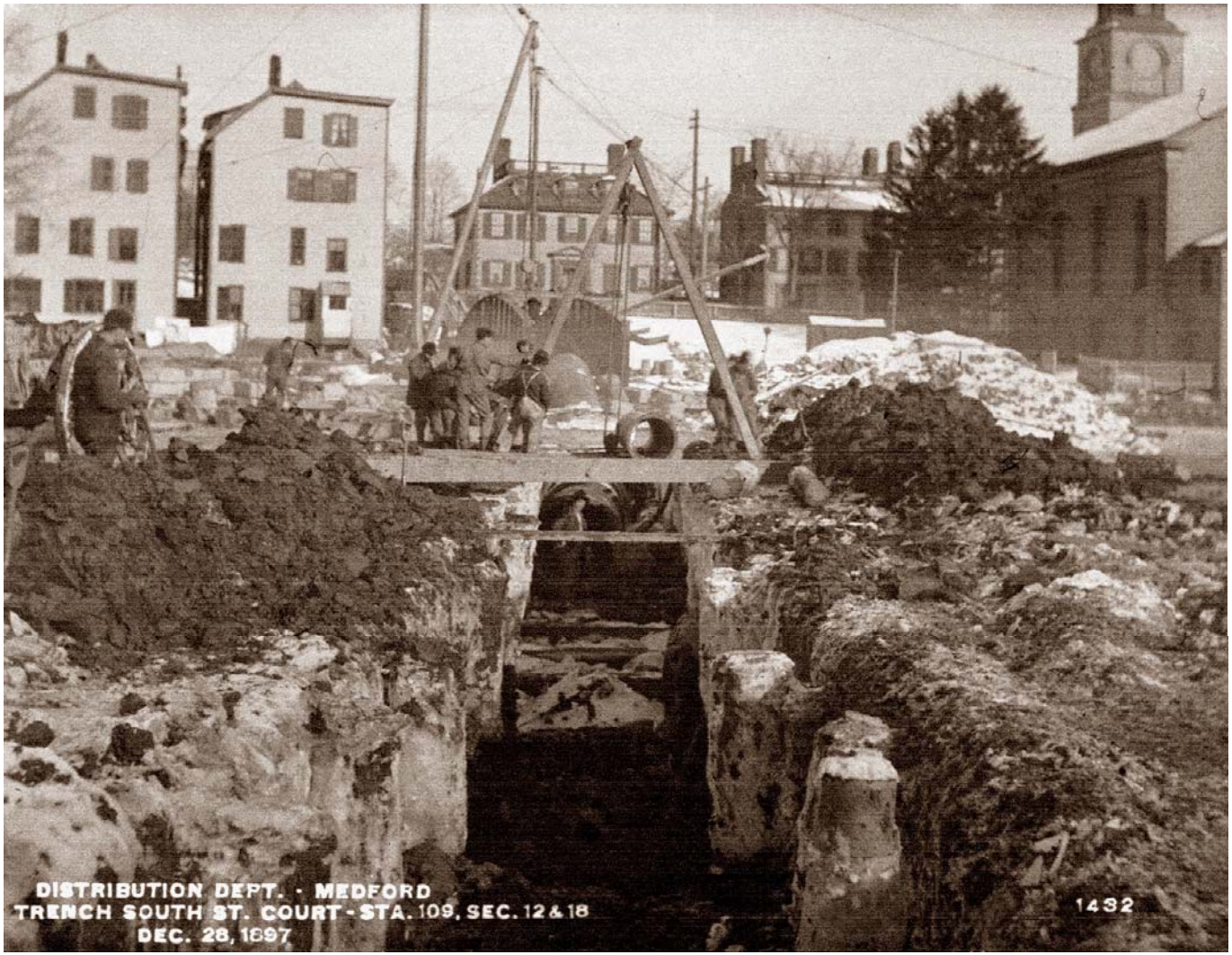
Highland Avenue

Boston Avenue

High and Medford Streets

Mystic River Crossing

South Street Court



Mystic River Pipe Bridge

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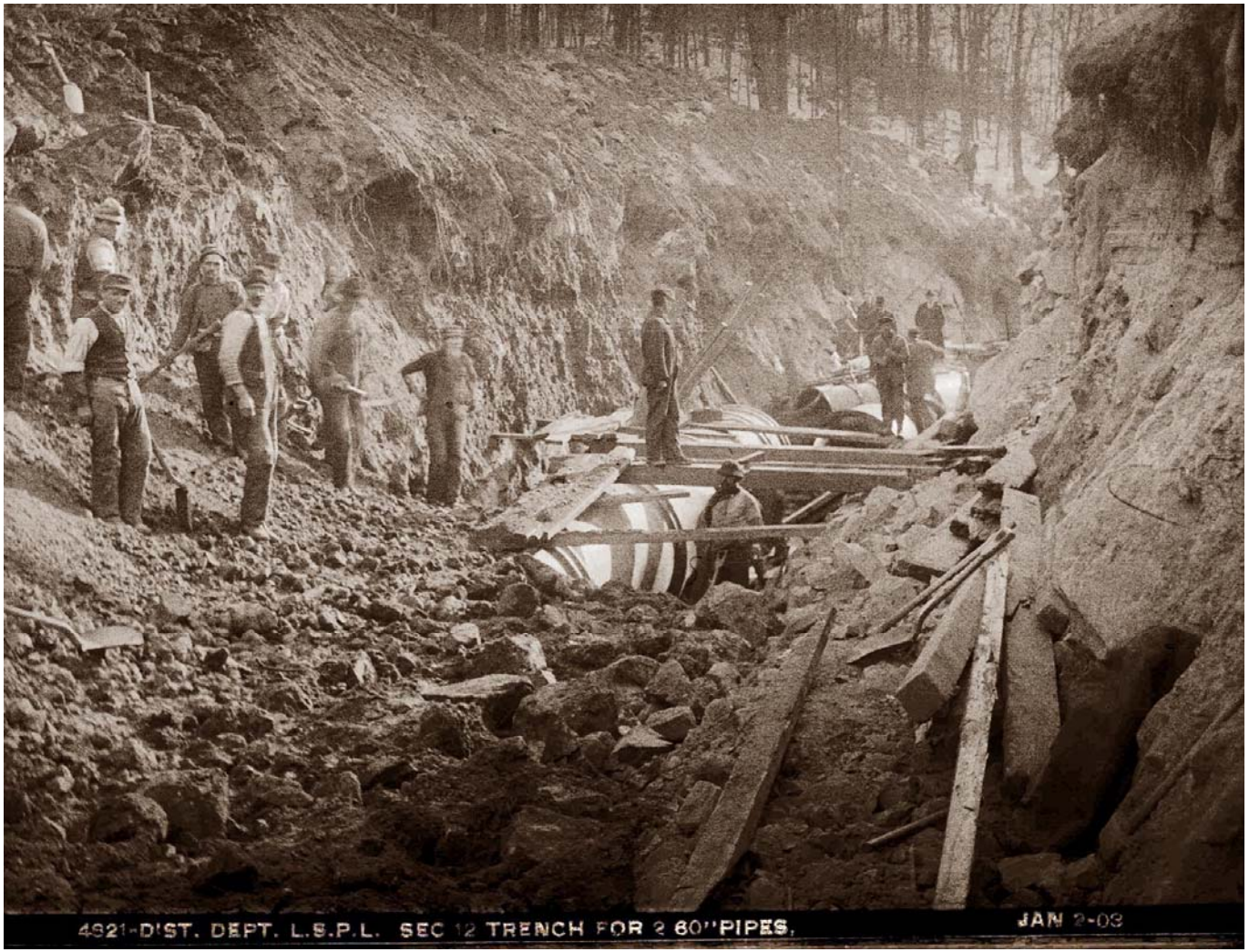
Spot Pond Supply Main



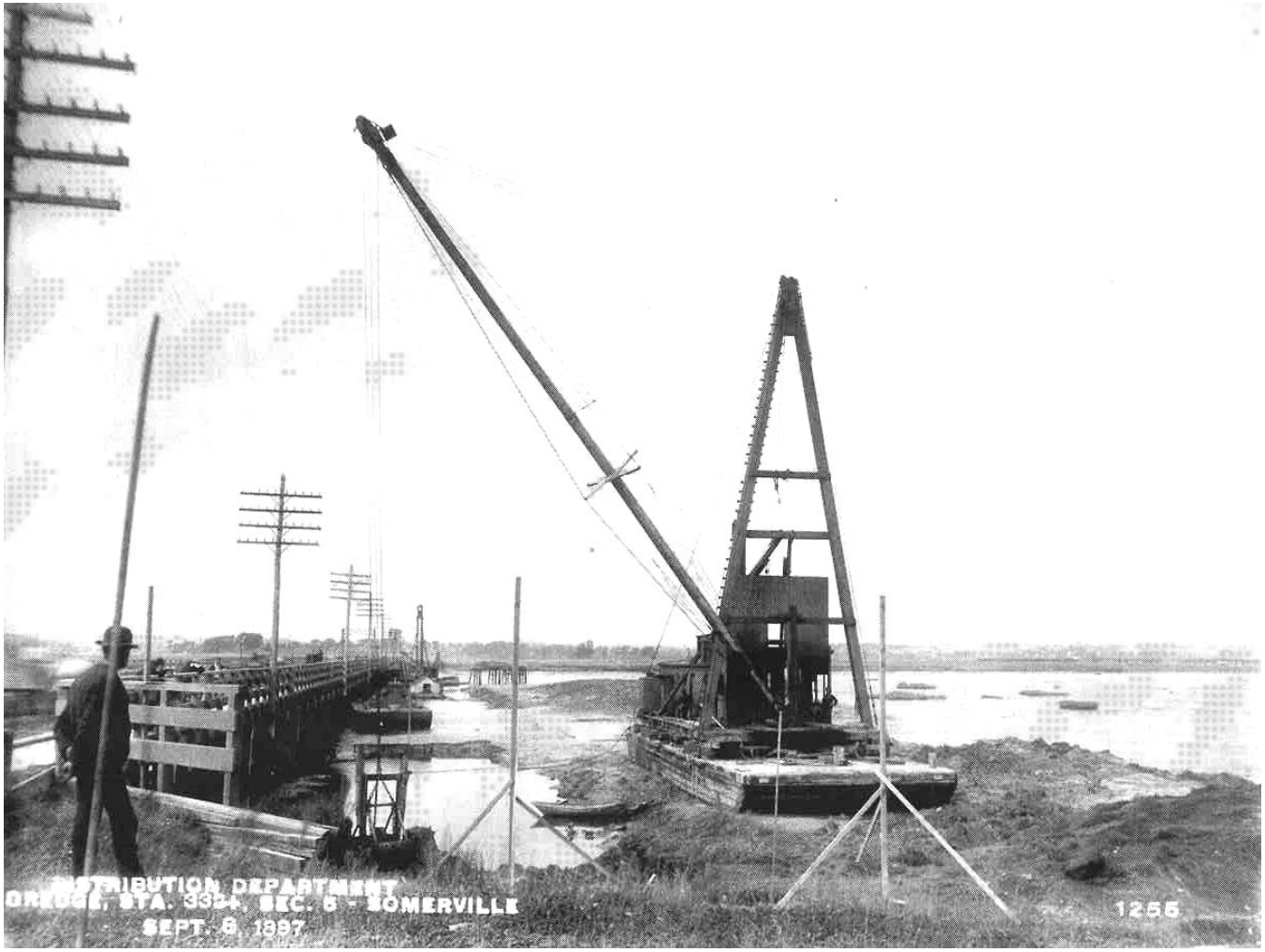
Spot Pond Supply Main

Spot Pond Supply Mains

Malden River

Low Service Pipeline at Wellington

Mystic River



Mystic River

Glenwood Pipe Yard

- Property purchased in 1898 from James W. Tufts for $1 by the Metropolitan Water Board
- Three original buildings, constructed by W. L. Clark & Co., were completed in 1901 at a cost of $21,808.82
- Site had been used since the turn of the century as pipeyard and administrative offices
- MWRA surplused the property last year and the keys were handed over to DCAM two weeks ago

Glenwood Pipe Yard

Somerville Pipe Yard

But Boston Soon Needed More Water

- In 1919, the Metropolitan District Commission was created by an act which consolidated responsibility for water, sewage and parks into one agency
- The MDC and the Department of Public Health were appointed to Joint Board by the legislature to study water supply needs
- The Joint Board made projections for the period 1920 - 1970 and determined current water supply would be inadequate by 1930
- In 1922, the Joint Board recommended the addition of the Ware River and the Quabbin Reservoir to the MDC water supply system

Trivia Question:

- What do these four towns have in common?

  Dana

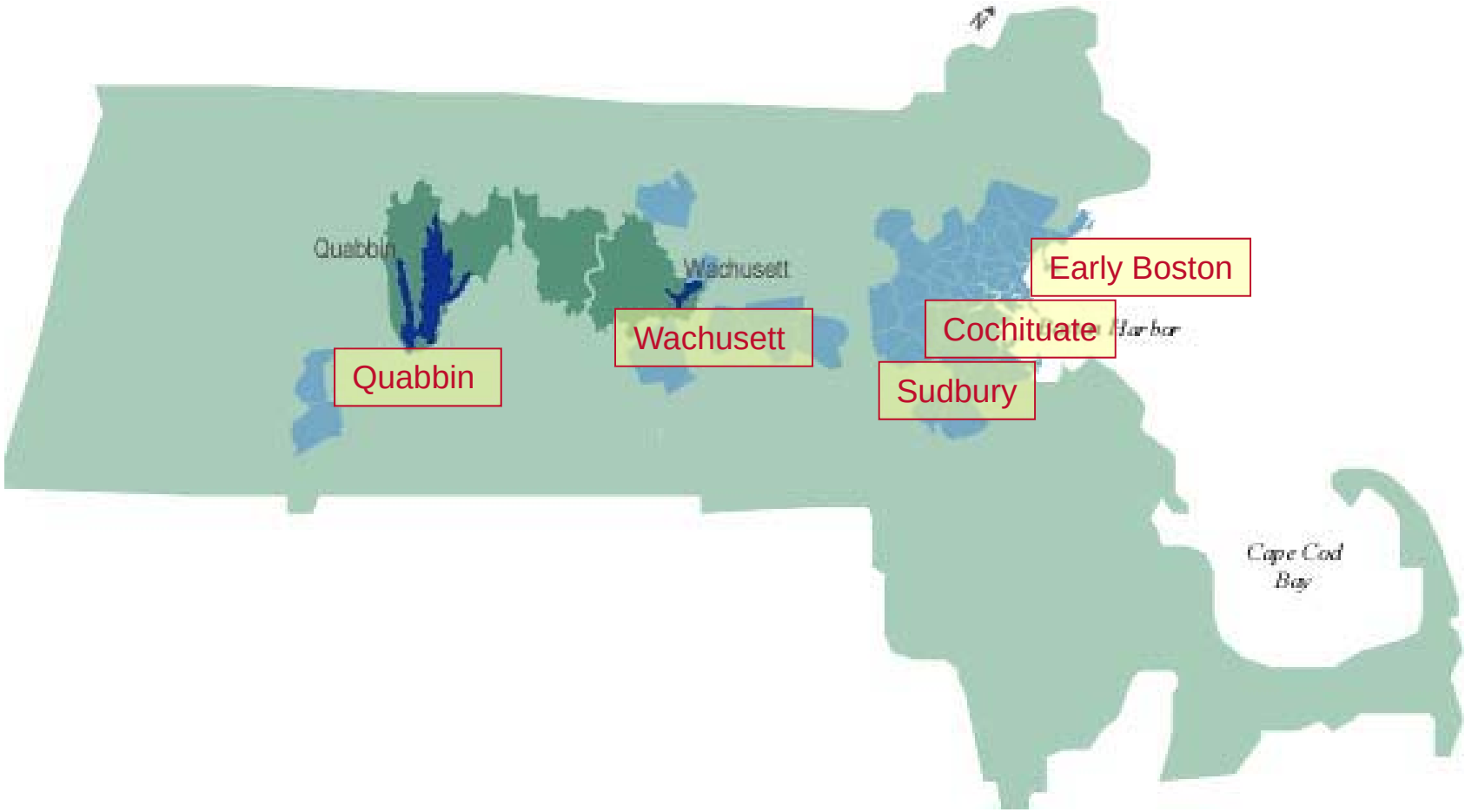
  Enfield

  Greenwich

  Prescott

The Quabbin Reservoir

Water System History - A Journey Westward



The Quabbin Reservoir

- Construction of the Quabbin required the impoundment of the Swift River and the takings of four towns

- The Quabbin Reservoir, 60 miles from Boston, was another source that could be gravity-operated and not require filtration

Enfield

The Quabbin Reservoir

- Construction of the Wachusett-Colebrook Tunnel (now the Quabbin Tunnel) began in 1926, carrying surplus flow from the Ware River to the Wachusett Reservoir

- In the 1930s, the Tunnel was extended to the Swift River

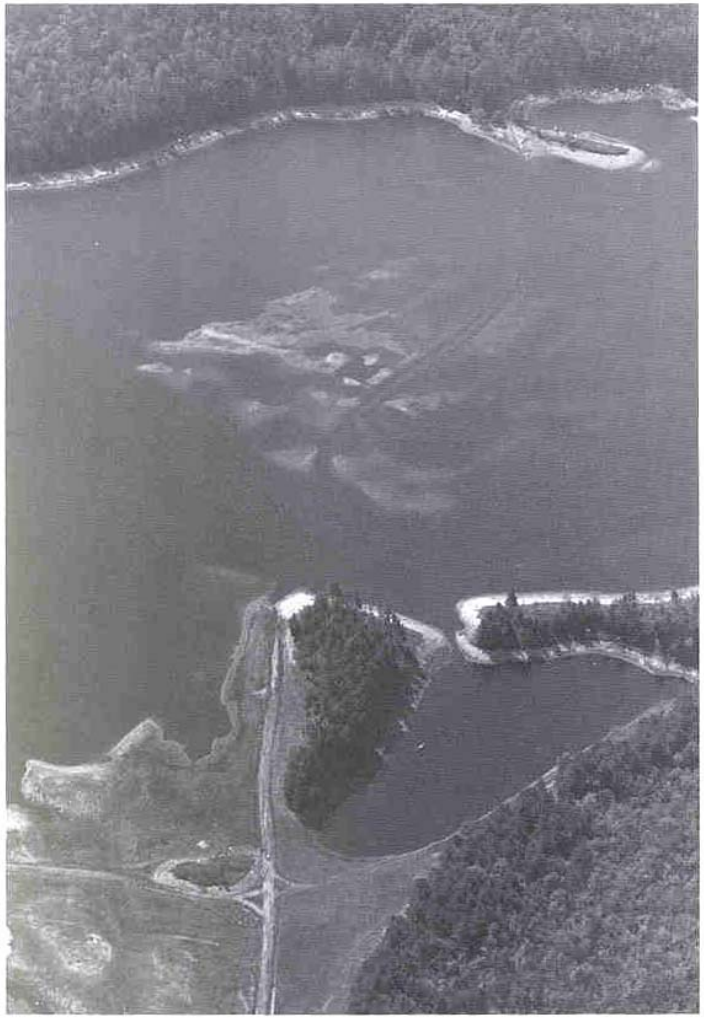
- This two-way tunnel carries flows east and west, depending on time of year

- In 1936, construction of the reservoir began

Moving a house from Greenwich

The Quabbin Reservoir

- 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



Road still visible beneath surface of water

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 - had also been completed
- But work did not resume after World War II
- Until 2013, 85% of Boston's water supply had been provided without redundancy

Meanwhile, at Spot Pond . . .

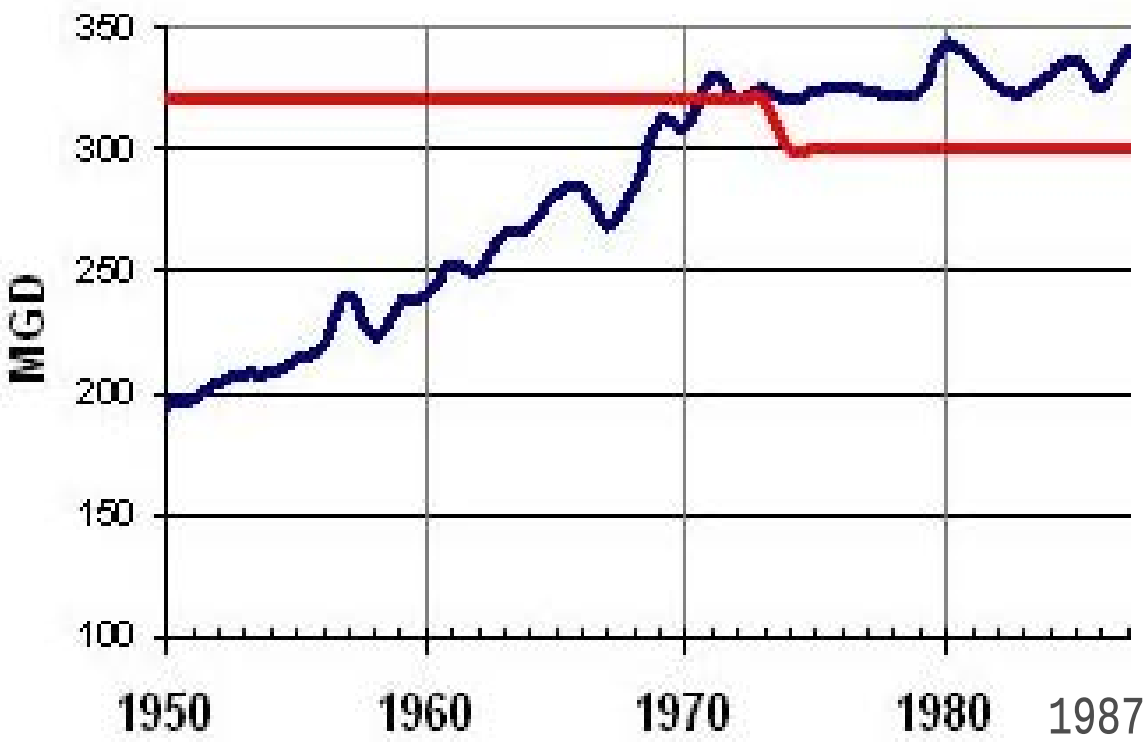
- In the early 1930s, Spot Pond was almost abandoned as a water supply after a germ - Uroglena - contaminated the supply causing a foul taste and odor for several weeks

- The Metropolitan District Commission refused to abandon the Pond and reconstructed a drainage brook in Malden to clear obstructions

- The Board of Health ordered chlorination and construction of a fence around the Pond to protect the water supply

Demand Exceeded Safe Yield

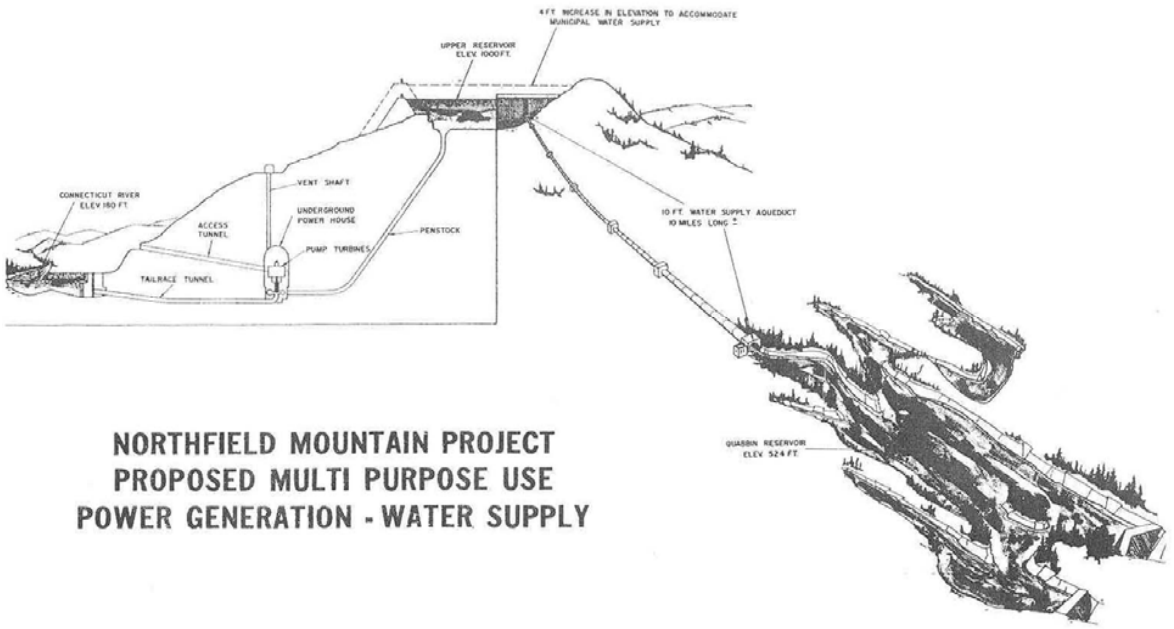
- By the early 1970s, demand exceeded safe yield – and continued to do so for 20 years



Studies For Northfield Mountain Project

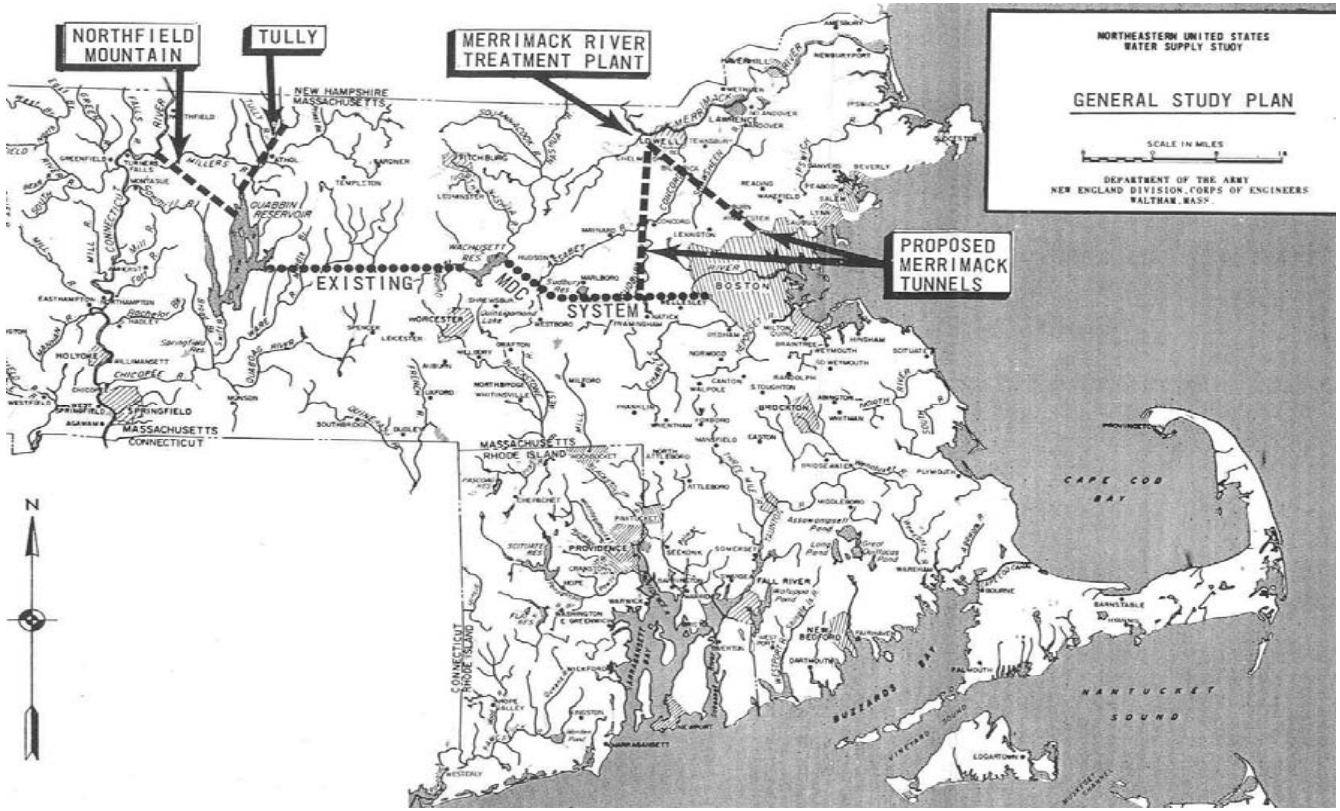
- Studies for the Northfield Mountain Project continued throughout the 1960s

- The project included a pumped-storage facility using water from the Connecticut River

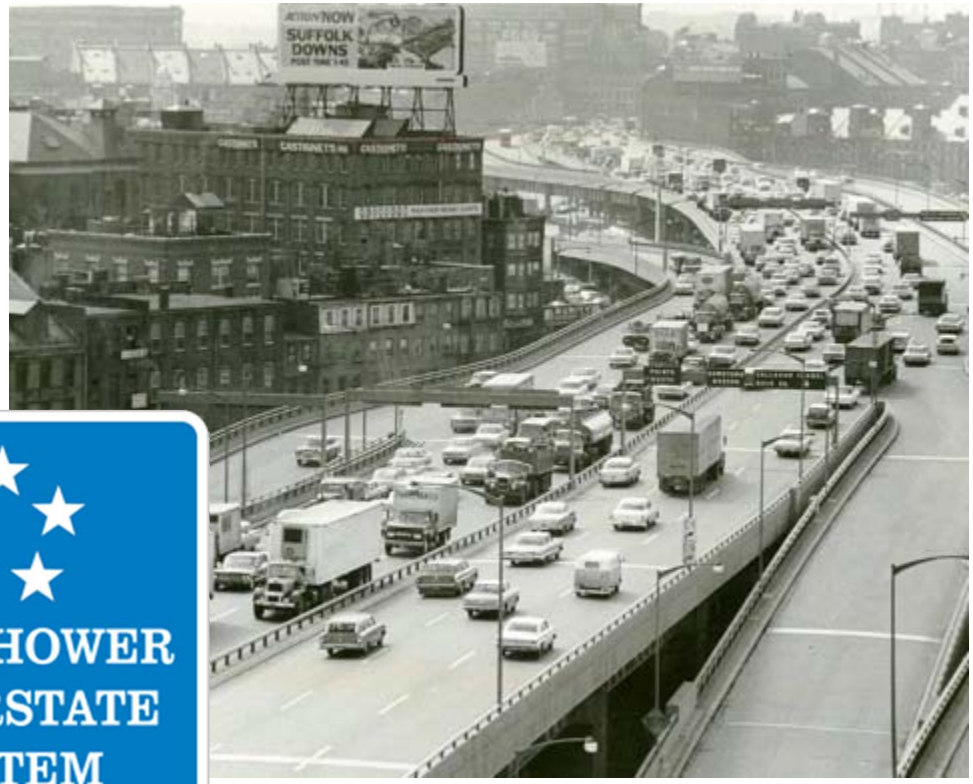


Studies For Northfield Mountain Project

- The Northfield Project was a proposal for skimming Connecticut River spring flood flows and diverting them into the Quabbin Reservoir.
- The measure was authorized by the legislature in both 1967 and 1970



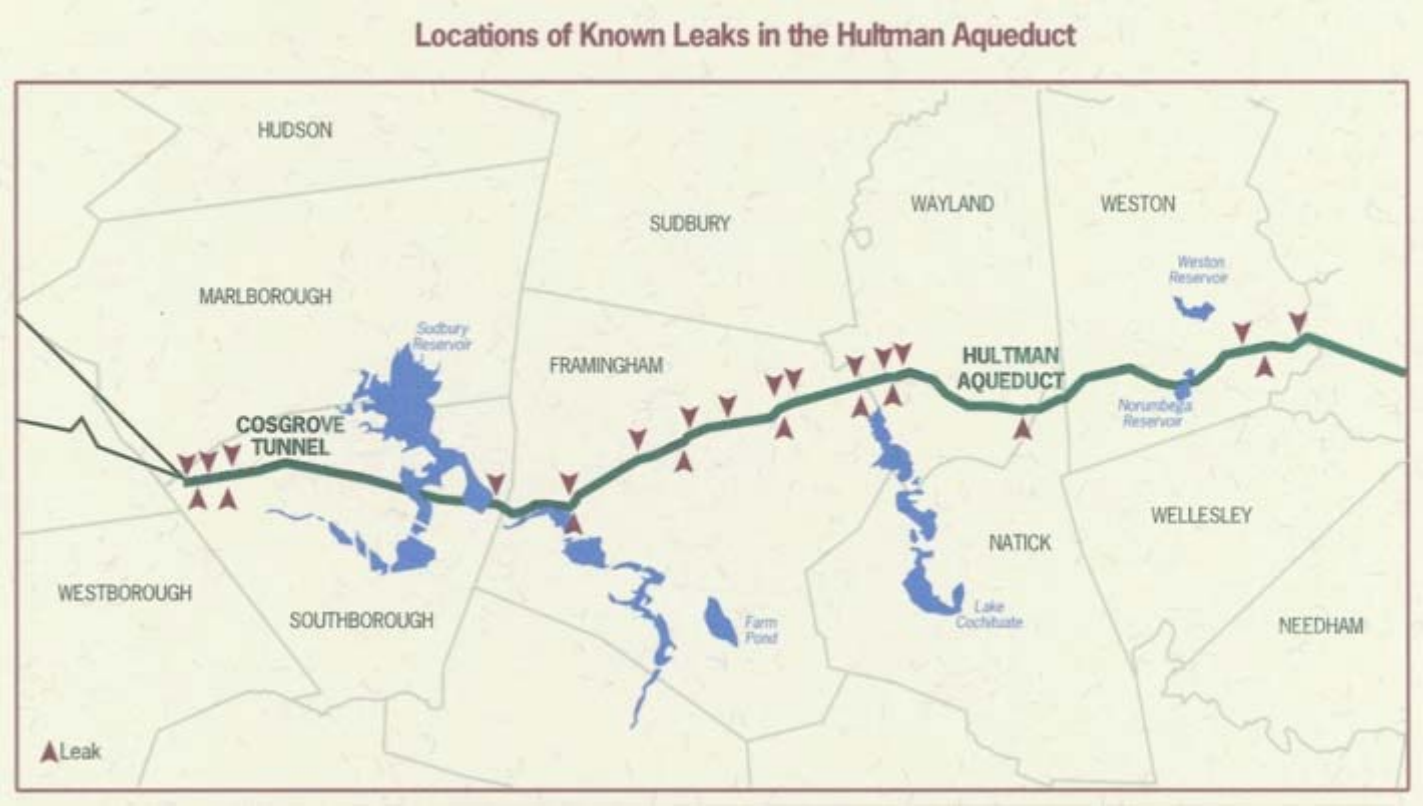
Now Highways Were King, And Water Was All But Forgotten



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

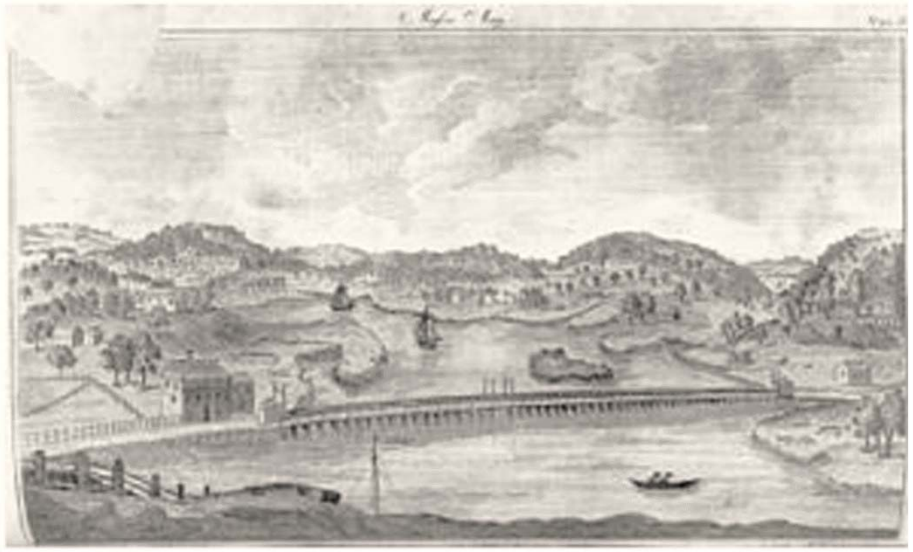


Medford's Sewer History

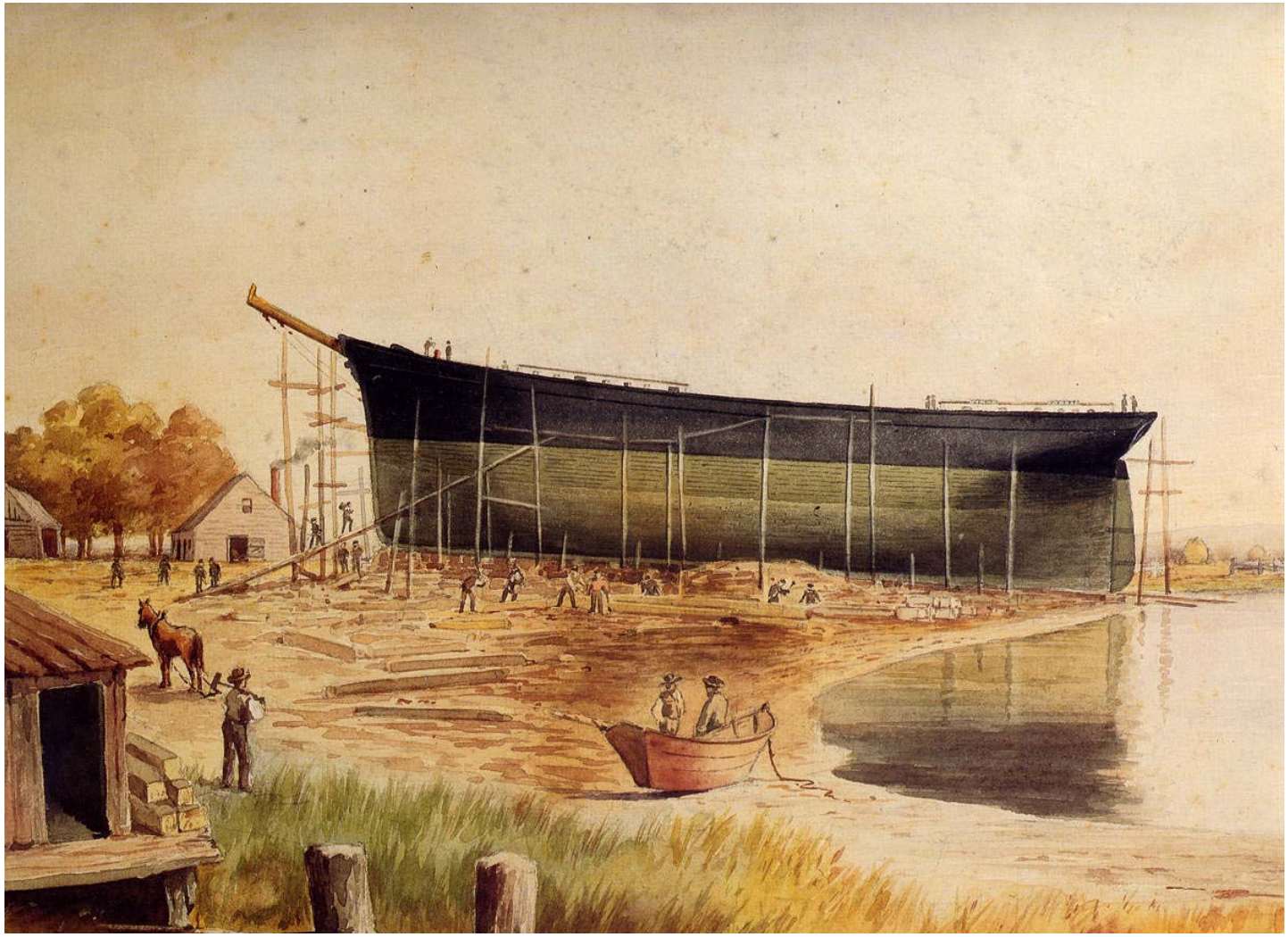
Colonial Settlement

In 1641 Colonial Massachusetts, Edward Johnson described the area as:

"…very full of pleasant springs, and a great variety of very good water."



Shipbuilding in Medford



Shipbuilding in Medford

Mystic Lake Dam

Industrialization and Water Quality

By the 1870s, there were 82 factories in the watershed. On the tributaries of Mystic Pond alone there were:

Tanneries and currying shops	26 (11,325 hides/week)
Glue stock factory	1
Glue factories	2
Wool scouring establishment	1
Gas-Works	1
Shoe factories	14
Inner sole and stiffening works	2
Saw-mills	4
Sash factory	1
Grist, saw-factory, watch-hand and ropewalk (1 each)	4

Industrialization and Water Quality

1881: "The filthy condition of the Alewife Brook…is now little more that an open sewer, the rank odor of which is distinguishable for a long distance from the banks."

"…in the summer of 1903, these 12 physicians had treated in all about 800 cases of malaria in the region tributary to the Alewife Brook, and that the disease was spreading away from the cheaper homes near the marshes and clay pits to the more expensive residential districts on the upland."

Sewers as a Solution

- In 1876 the Boston Water Board decided that constructing a sewer to capture the manufacturing waste was the most effective way to protect the Mystic source
- The sewer was constructed in the towns of Woburn, Winchester and Medford and was put in service in 1878 with the effluent discharging into the Lower Mystic Pond
- In the winter of 1880-81, particularly foul pollution due to the frozen pond (limiting aeration), an unusually high tide pulling salt water into the pond and a vigorous ebb tide made Medford invoke the legislation

1893 Sewer Construction at the Aberjona River

1893 Sewer Construction Winchester and Charlestown

Treatment Was Next

- As a result of Medford's objections, Boston was directed to cease emptying sewage into Mystic Lower Pond and directed to remove the sewer BUT, were given an option to "purify and cleanse" the flow. Medford agreed to this solution

- A treatment plant with a capacity of 324,000 gpd was constructed in Winchester in 1881 to settle out the solids and provide a crude level of chemical treatment prior to discharging flow to the lower pond

Metropolitan and Local Sewers

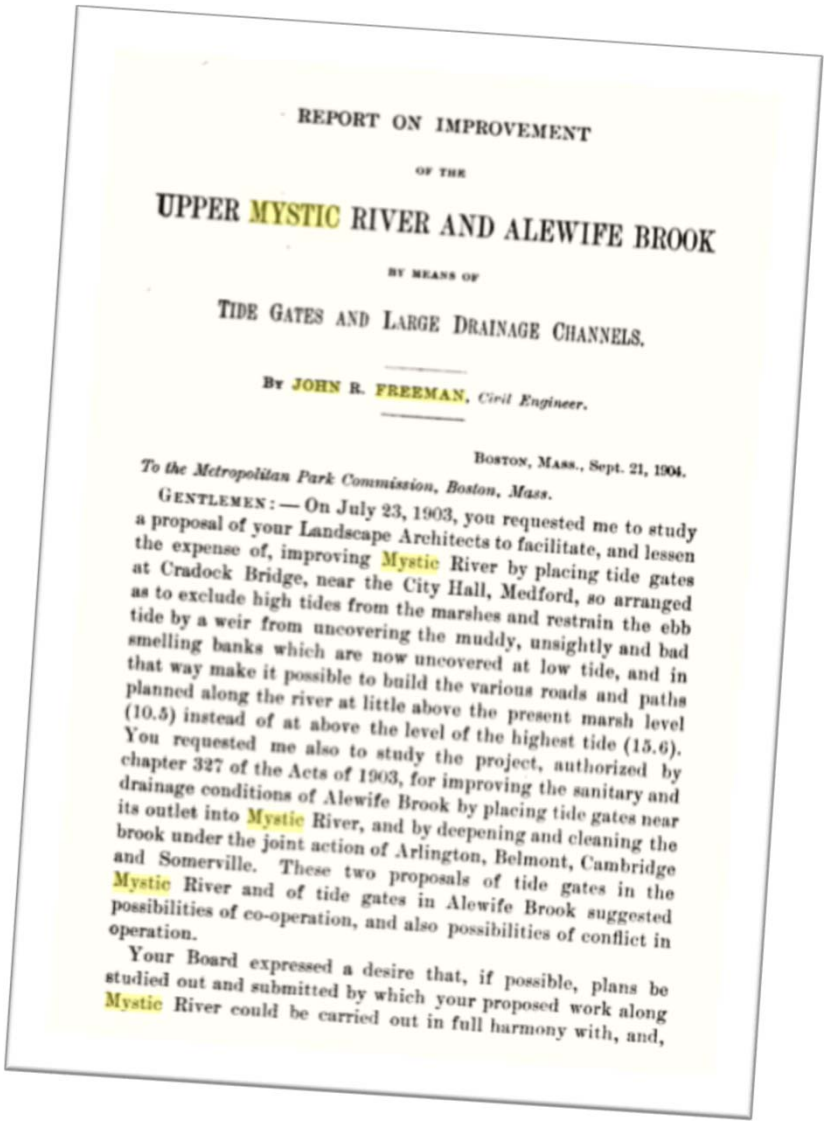
- From the mid 1880s to mid 1890s local communities - including Woburn, Winchester and Stoneham - began construction of local sewers. These systems were then tied into the Metropolitan system as it was developed

Section 21, High Street, Medford. May 14, 1892.

Drainage Improvements

- In 1904, Consulting Engineer John Freeman was tasked with reviewing drainage and tide gate improvements for the Metropolitan Parks in order to address conflicts between plans developed by Olmstead and work proposed by Arlington, Belmont, Cambridge and Somerville to improve sanitation along Alewife Brook

- Freeman's extensive study of flows, topography, channel depth and other features in the Mystic River, Alewife and Wellington Brooks led him to conclude that construction of tide gates and weirs at Craddock Bridge was the preferred solution to improve sanitation



REPORT ON IMPROVEMENT

OF THE

UPPER MYSTIC RIVER AND ALEWIFE BROOK

BY MEANS OF

TIDE GATES AND LARGE DRAINAGE CHANNELS.

By JOHN R. FREEMAN, *Civil Engineer.*

BOSTON, MASS., Sept. 21, 1904.

To the Metropolitan Park Commission, Boston, Mass.

GENTLEMEN: — On July 23, 1903, you requested me to study a proposal of your Landscape Architects to facilitate, and lessen the expense of, improving Mystic River by placing tide gates at Cradock Bridge, near the City Hall, Medford, so arranged as to exclude high tides from the marshes and restrain the ebb tide by a weir from uncovering the muddy, unsightly and bad smelling banks which are now uncovered at low tide, and in that way make it possible to build the various roads and paths planned along the river at little above the present marsh level (10.5) instead of at above the level of the highest tide (15.6). You requested me also to study the project, authorized by chapter 327 of the Acts of 1903, for improving the sanitary and drainage conditions of Alewife Brook by placing tide gates near its outlet into Mystic River, and by deepening and cleaning the brook under the joint action of Arlington, Belmont, Cambridge and Somerville. These two proposals of tide gates in the Mystic River and of tide gates in Alewife Brook suggested possibilities of co-operation, and also possibilities of conflict in operation.

Your Board expressed a desire that, if possible, plans be studied out and submitted by which your proposed work along Mystic River could be carried out in full harmony with, and,

The Craddock Dam (shown in 1964)

Craddock Dam was built in Medford Center in 1909

Malden River Traffic Survey 1922-1930

Year	Tonnage						Value Total Commerce ($)
	Wood, Paper, Lumber	Fuel Oil	Petroleum	Coal	Sand	Total	
1922	1,838	6,880	4,000	43,042	9,520	65,280	817,935
1923	631	5,369	21,250	77,455	22,970	127,675	1,890,261
1924	535	-	37,268	55,624	10,224	103,651	1,403,431
1925	1,517	6,507	31,863	50,704	11,812	102,403	1,843,971
1926	878	7,309	30,309	60,405	8,854	107,755	1,990,413
1927	503	5,561	22,713	47,433	8,422	84,632	1,188,266
1928	5,409	7,231	29,273	45,593	9,632	97,138	1,515,529
1929	1,068	4,500	17,914	39,745	18,356	81,583	1,032,337
1930	203	4,720	-	34,969	4,942	44,834	408,490

The “Basin Elevation Control Project”

- Beginning in the early 1930s, attention turned downstream plan to prepare plans and specifications for the construction of a dam, lock, drawbridge and works across the Mystic River in Somerville and Everett for the purpose of maintaining the water level in the Mystic and Malden Rivers for recreation and other purposes

- Due to delays related to approvals, additional legislation and funding, progress was slow and final selection of the preferred location (downstream of the Malden River confluence) was not confirmed until the late 1940s and construction followed two decades later

Proposed Dam - 1962

Amelia Earhart Dam Under Construction 1966

Metropolitan District Commission
Mystic River Basin Elevation Control Project
Everett-Somerville, Mass. MDC Contract 1360
General view from Everett side.

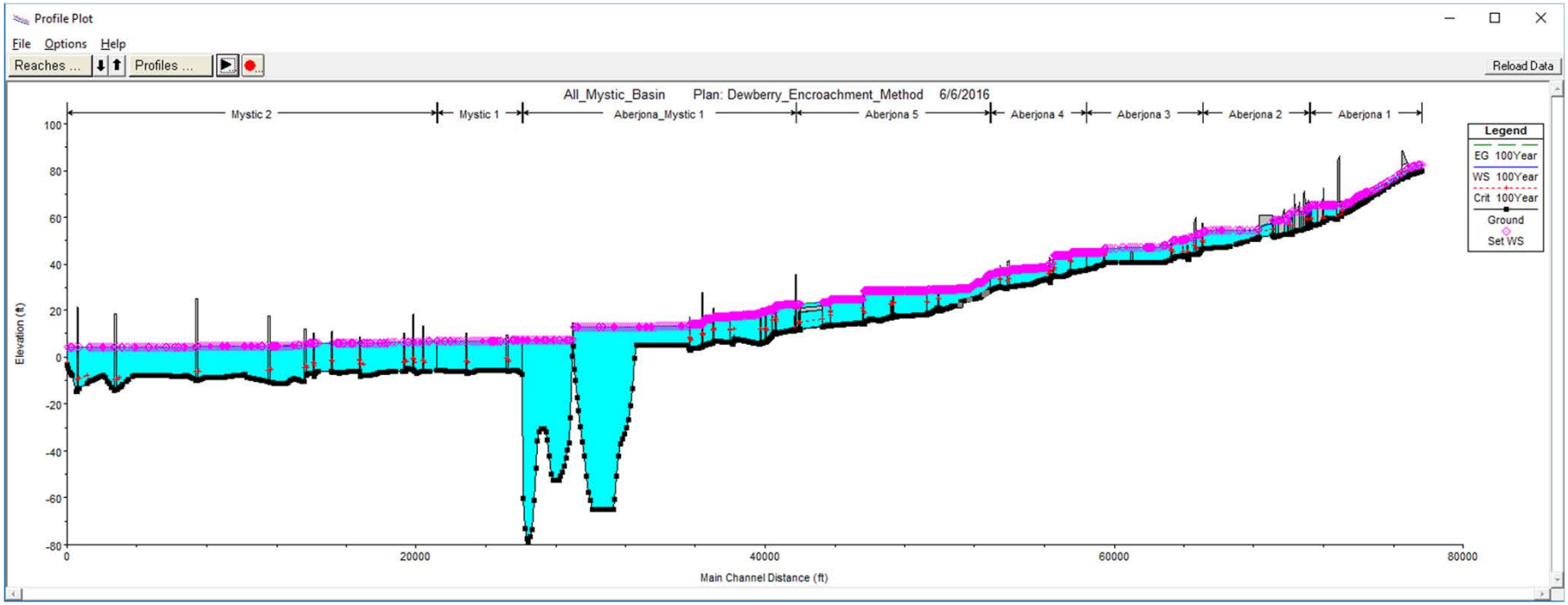
Photo # 128 Date: 6/30/66 By Boston Photo Service, Inc.
Contractor: Perini Corporation & J. Rich Steers, Inc.
Engineer: Charles A. Maguire & Associates

Amelia Earhart Dam Under Construction

Muriel Earhart Morrissey

The Basin

Man-Made ‘Backwater’



The Boston Harbor Clean-up

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 was 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


Telephone (617) 426-3000 ★★★ 25 Cents Tuesday, April 28, 19

Harbor of shame

Hub waterway 'dirtiest in U.S.'

Two Obsolete Wastewater Treatment Plants

Raw Sewage Pouring Into Boston Harbor Daily

Dry Weather CSOs

Great Progress In One Generation

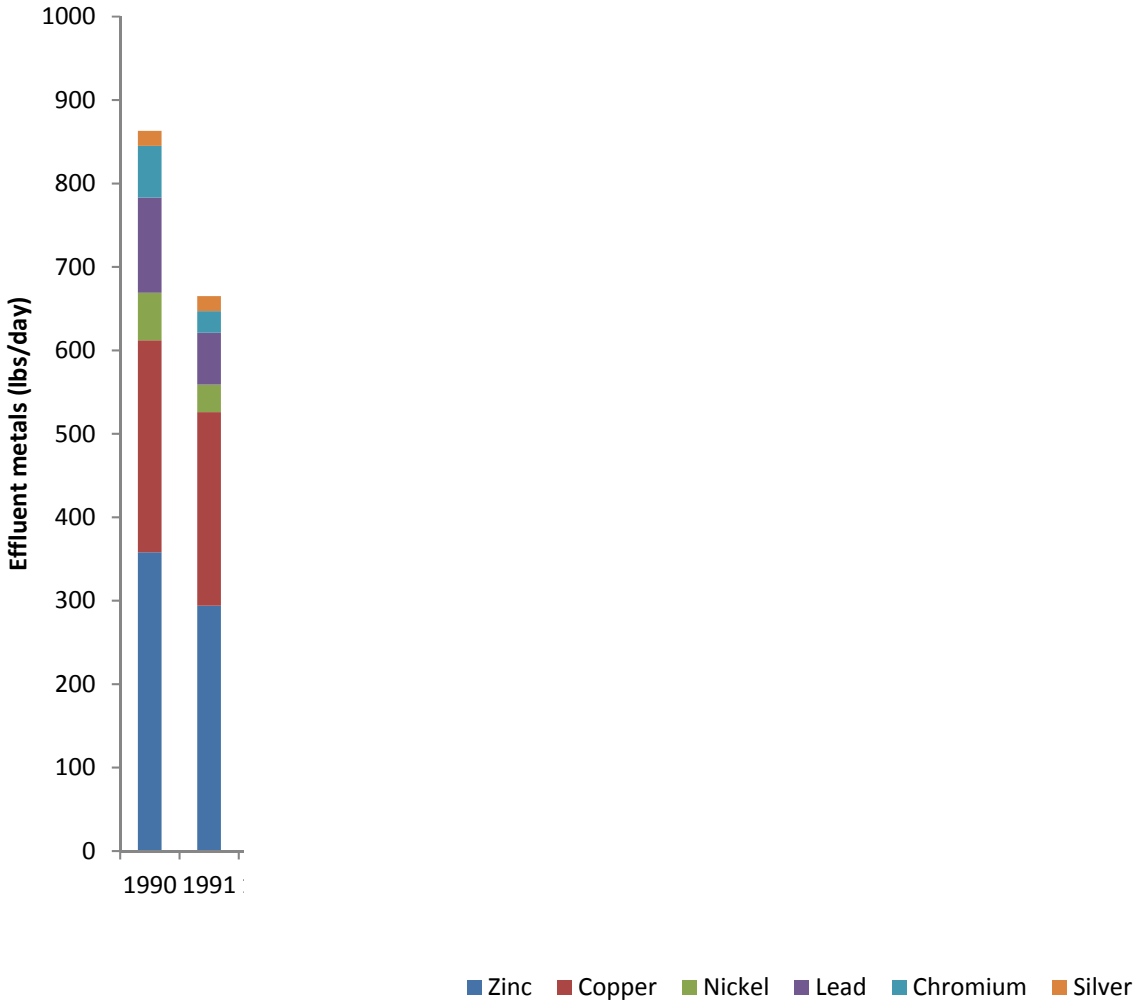
On The Wastewater Side

- The 15-year, $3.8 billion Boston Harbor Project was completed in 2001
- About 380 million gallons of wastewater is treated at the new Deer Island Treatment plant 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

Deer Island Construction

Deer Island Construction

Metals In Deer Island Effluent

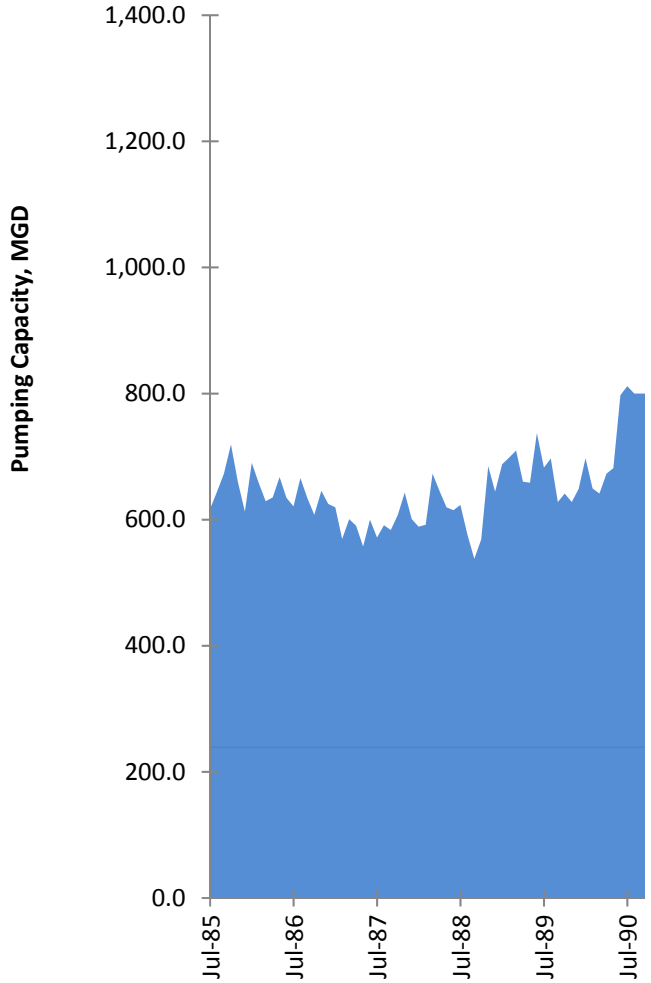


Solids In Deer Island Effluent

The Harbor Continues To Recover

- Water quality in Boston Harbor continues to improve dramatically
  - Sewage solids discharged from Deer Island have been reduced by 85%
  - Toxic pollutants have been reduced by 90%
  - Water is three times as clear

Sewer System Pumping Capacity

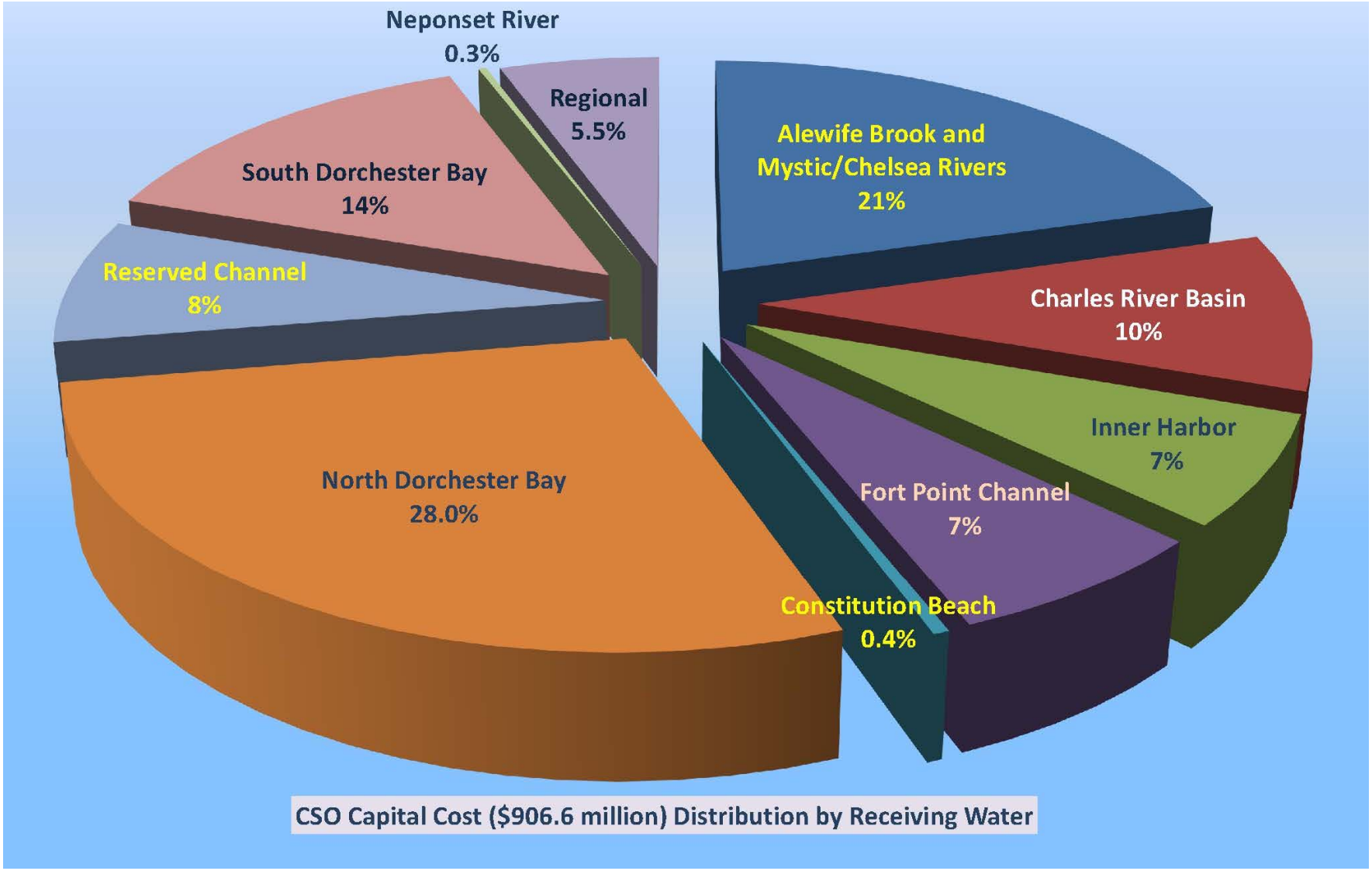


Combined Sewer Overflow Control Program

- Five communities - Boston, Brookline, Cambridge, Chelsea and Somerville - have combined sewer systems that connect to MWRA's sewer system

- Since 1996, over 100 miles of new storm drains and sanitary sewers have been installed

CSO Cost by Receiving Water



CSO Control Efforts and Accomplishments

35 CSO projects designed and constructed in 20 years

125 contracts and agreements

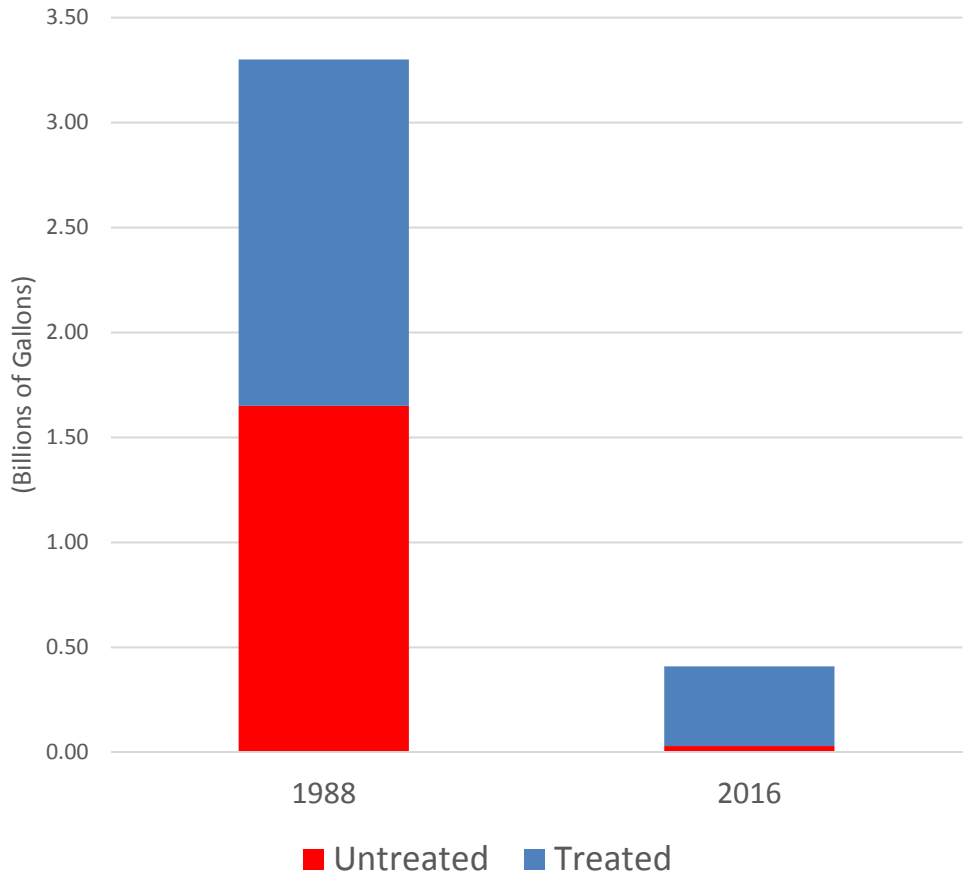
- 82 construction
- 33 engineering
- 10 planning/tech. support

5 MWRA/CSO Community agreements

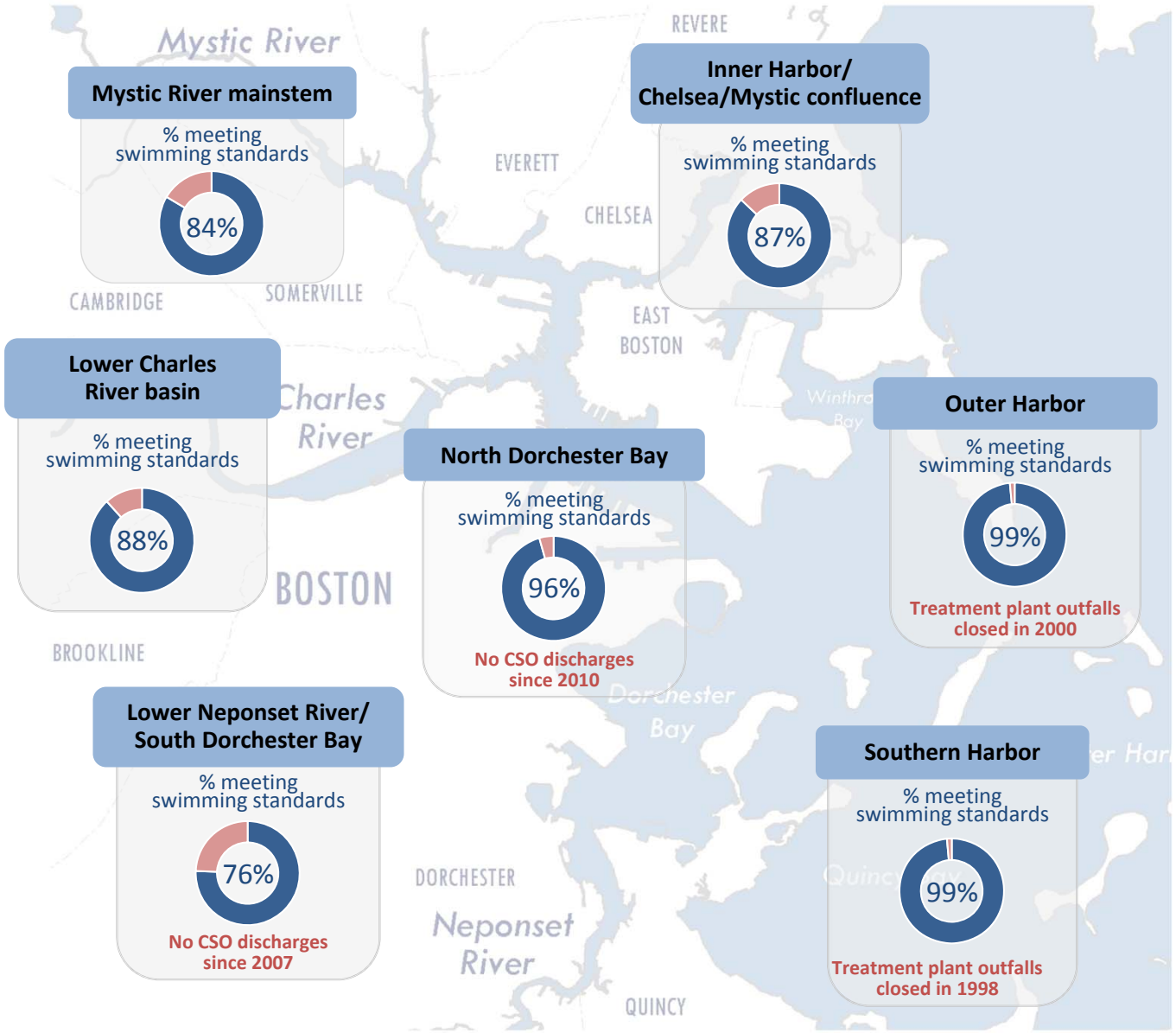
$907 million capital investment by MWRA

Annual CSO Volume Has Been Reduced Dramatically

- The $900 million program included 35 separate construction projects
- Annual CSO volumes have already been reduced by 2.7 billion gallons
- Since 2015, 93% of the remaining CSO flows are treated

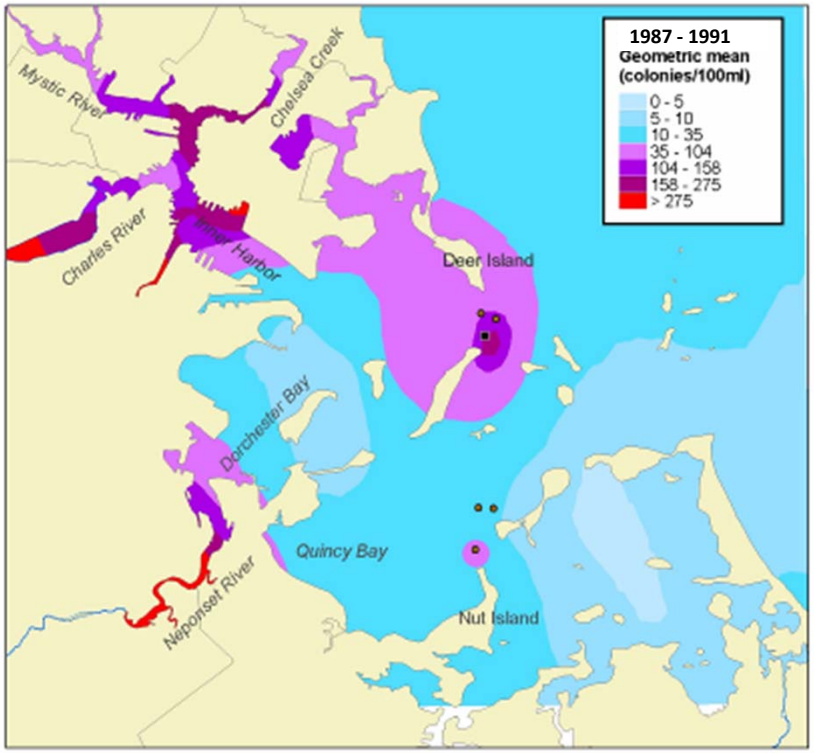


Water Quality In Boston Harbor And Rivers Has Improved

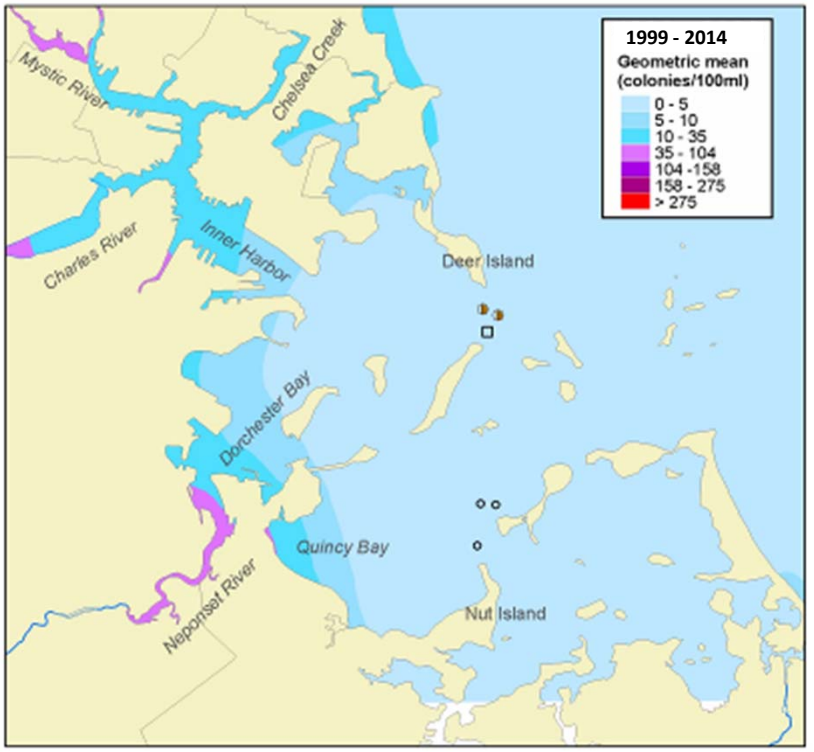


Dramatic Improvements In Water Quality – Even In Wet Weather

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



1999 - 2014 (After Secondary Treatment and New Outfall)



Average *Enterococcus* counts in Boston Harbor in wet weather

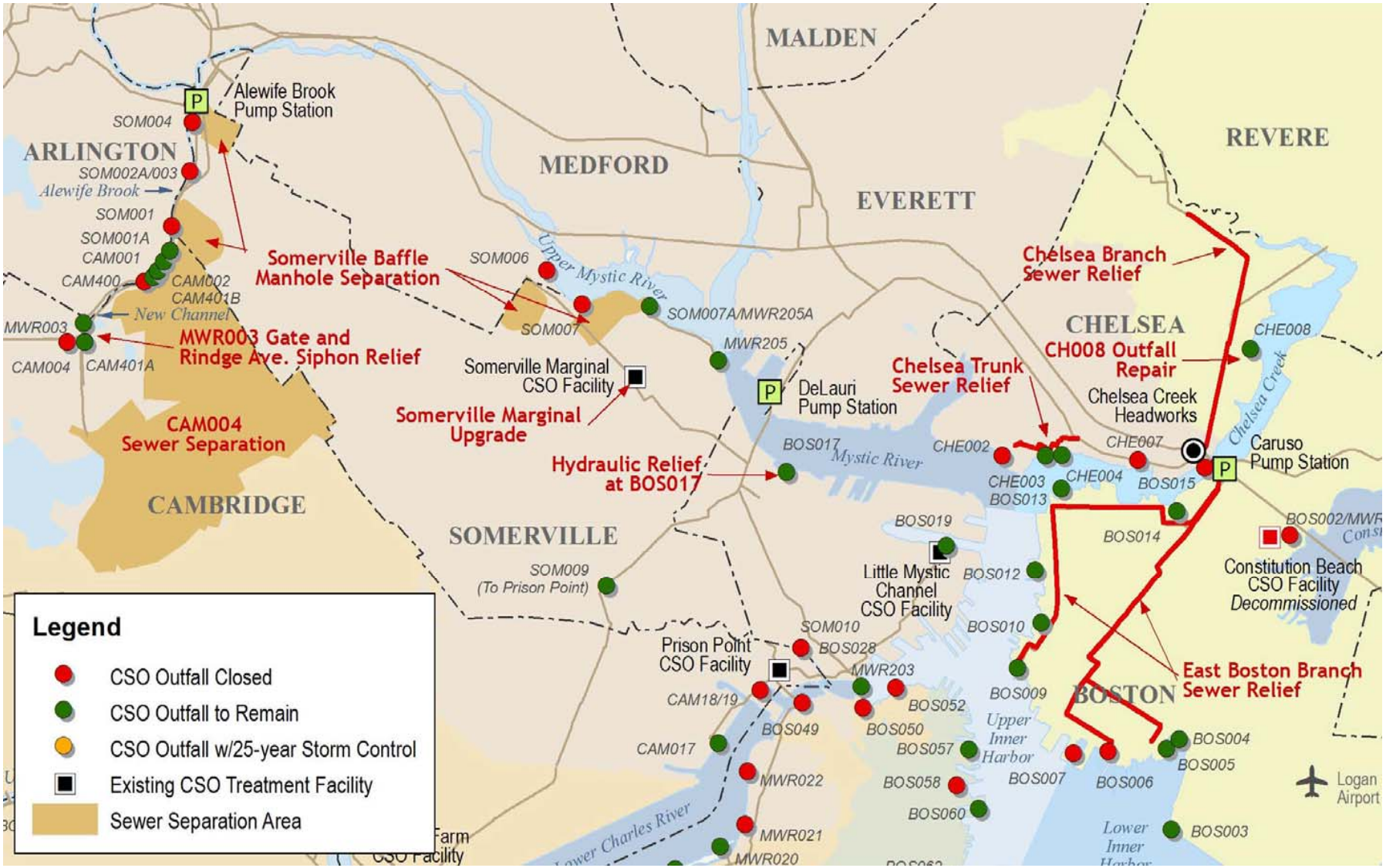
The lighter the blue, the better

The Mystic River Clean-up

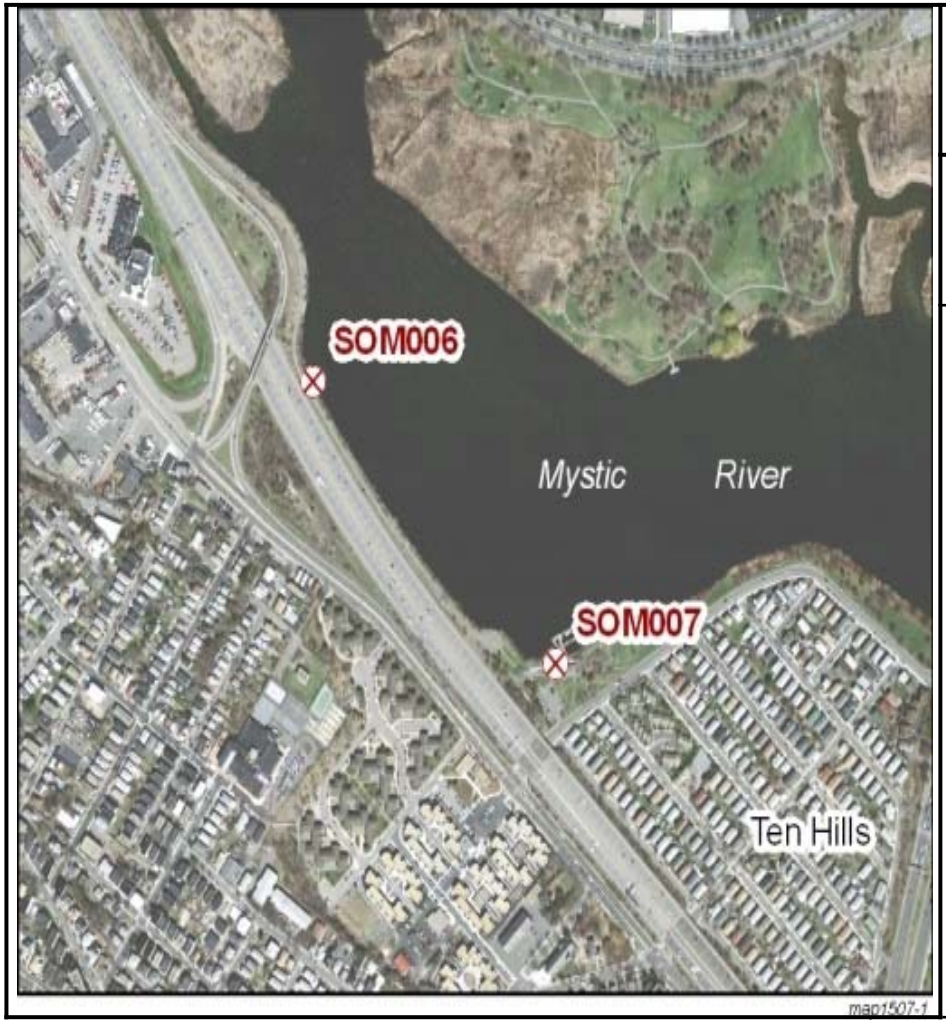
MWRA Investments in the Mystic

CSO Projects	$266 million
Other Wastewater Projects	$115 million
I/I Community Assistance	$76 million
TOTAL	**$453 million**

Alewife Brook and Mystic River CSO Outfalls and Projects



Somerville Baffle Manhole Separation - 1996



Alewife Brook and Upper Mystic River

Capital Cost: $400,000

CSO Outfalls:
SOM001, SOM006, SOM007

Frequency of Discharge (typical year)
Before project: 2
With project: Eliminated

Annual Discharge Volume (typical year)
Before project: 0.04 million gallons
With project: Eliminated

CSO Reduction by Volume: 100%

Somerville Marginal CSO Facility Upgrades

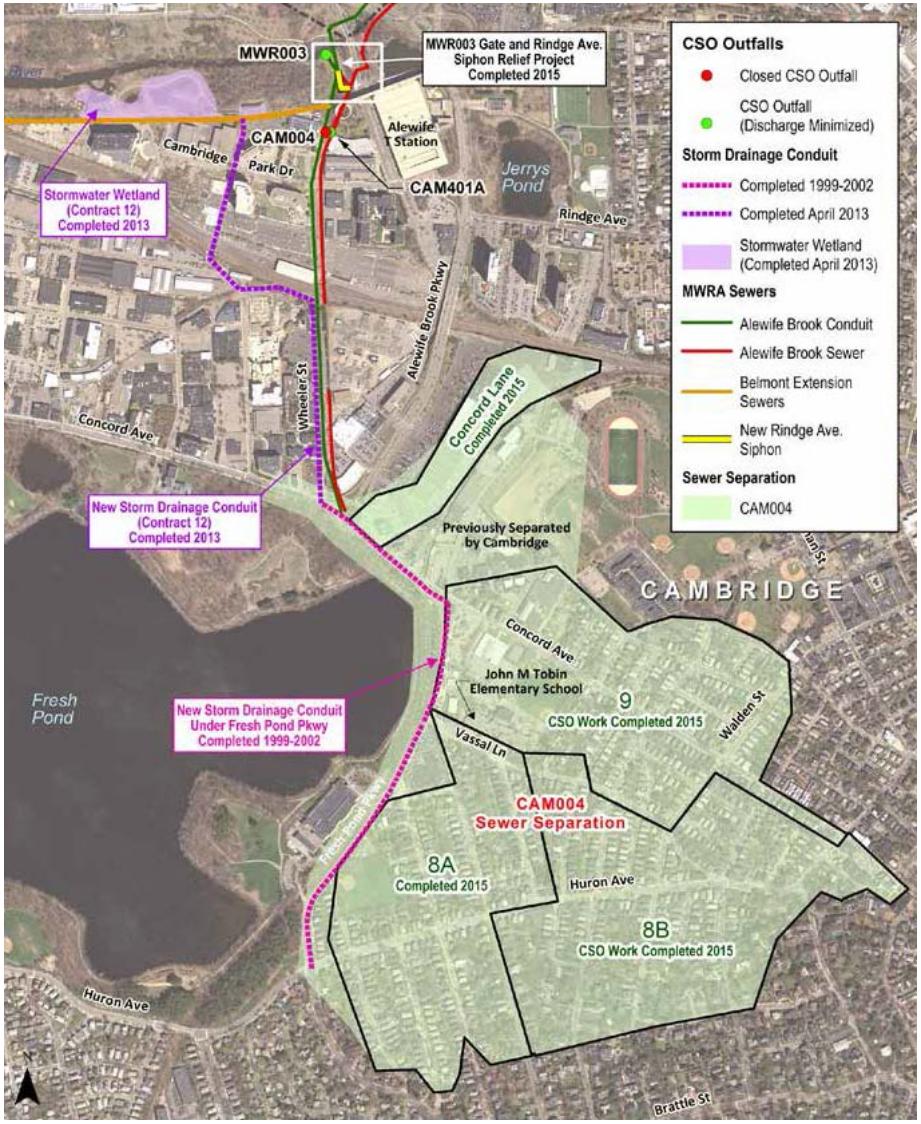
Upgraded chlorination disinfection system, new dechlorination system, and new process control and safety systems

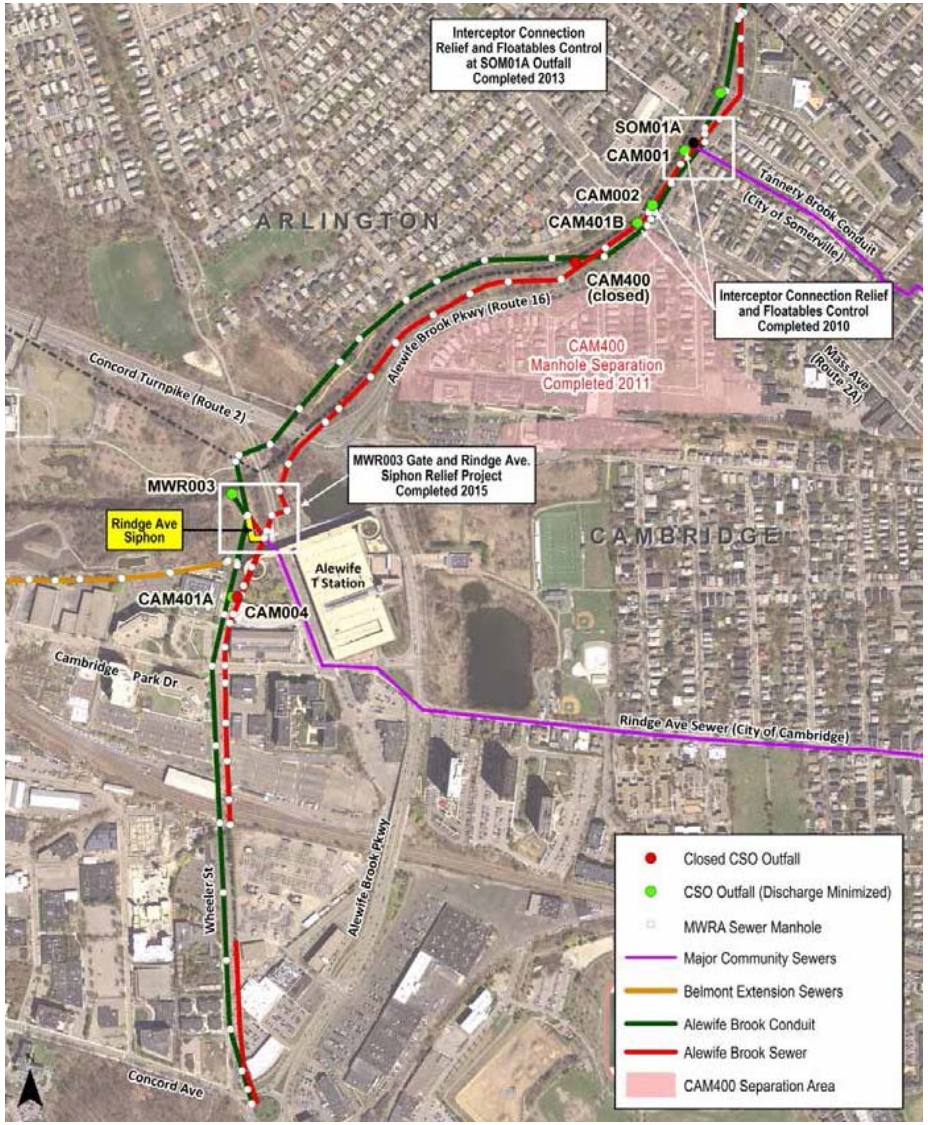
- Completed in 2001
- Capital Cost: $4 million

Influent gate and stop log replacement to ensure water tightness and improve the control of flows into the facility

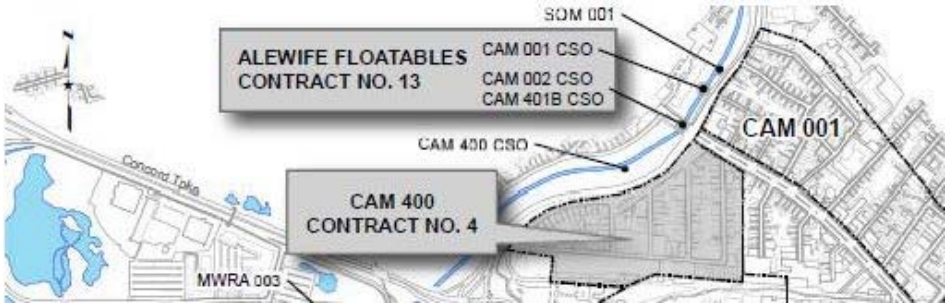
- Completed in 2011
- Capital Cost: $364,000

Alewife Brook CSO Control Plan





Interceptor Connection Relief and Floatables Controls at Outfalls CAM001, 002 and 401B



Alewife Brook

Capital Cost: $2,905,000

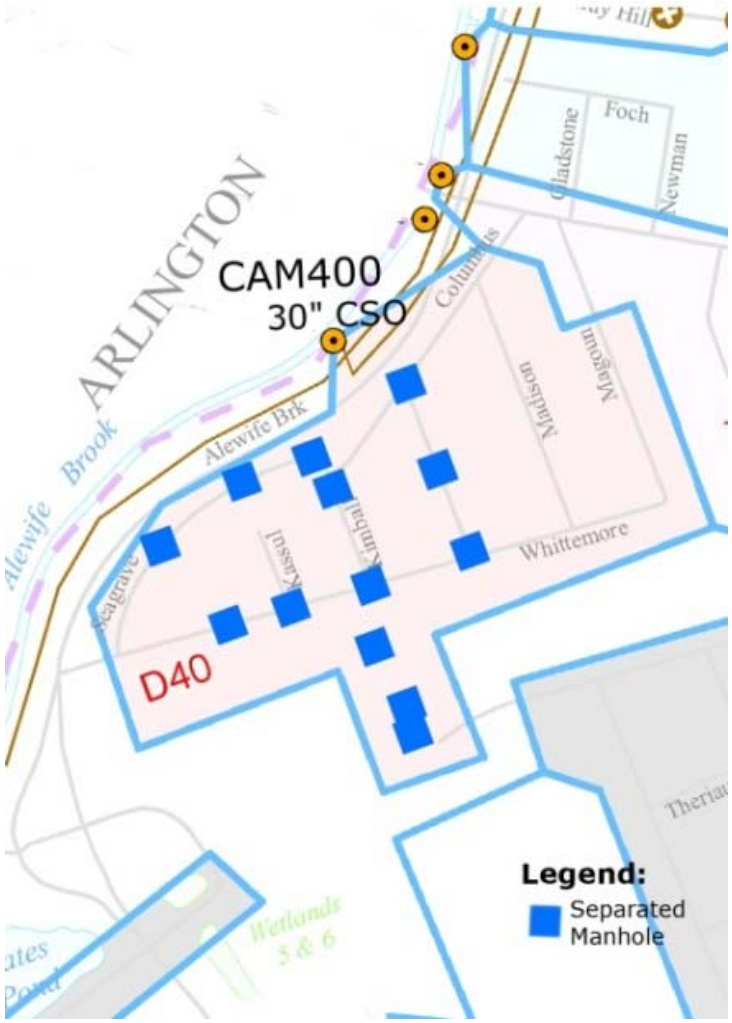
CSO Outfalls:
CAM001, CAM002, CAM401B

Frequency of Discharge (typical year)
Before project: 25
With project: 7

Annual Discharge Volume (typical year)
Before project: 12.1 million gallons
With project: 3.2 million gallons

CSO Reduction by Volume: 74%

CAM400 Combined Manhole Separation



Alewife Brook

Capital Cost: $4,776,000

CSO Outfalls: CAM400

Frequency of Discharge (typical year)
- Before project: 10
- With project: Eliminated

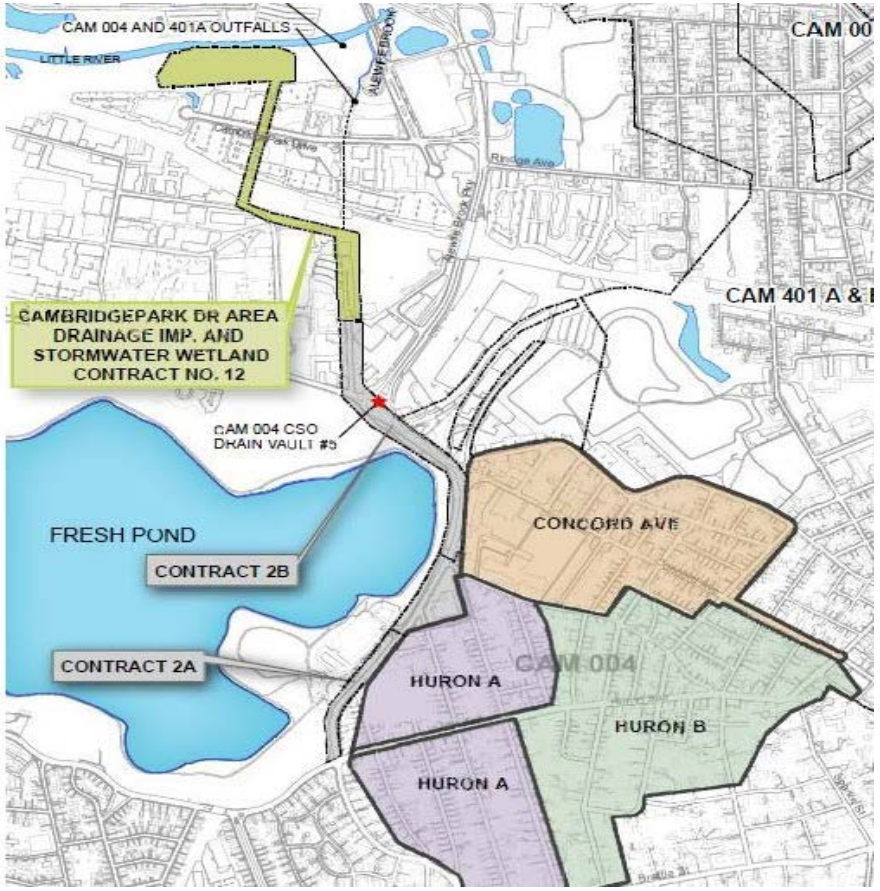
Annual Discharge Volume (typical year)
- Before project: 0.8 million gallons
- With project: Eliminated

CSO Reduction by Volume: 100%

Alewife Wetland and Stormwater Outfall

Alewife Wetland and Stormwater Outfall

Outfall CAM004 Sewer Separation



Alewife Brook

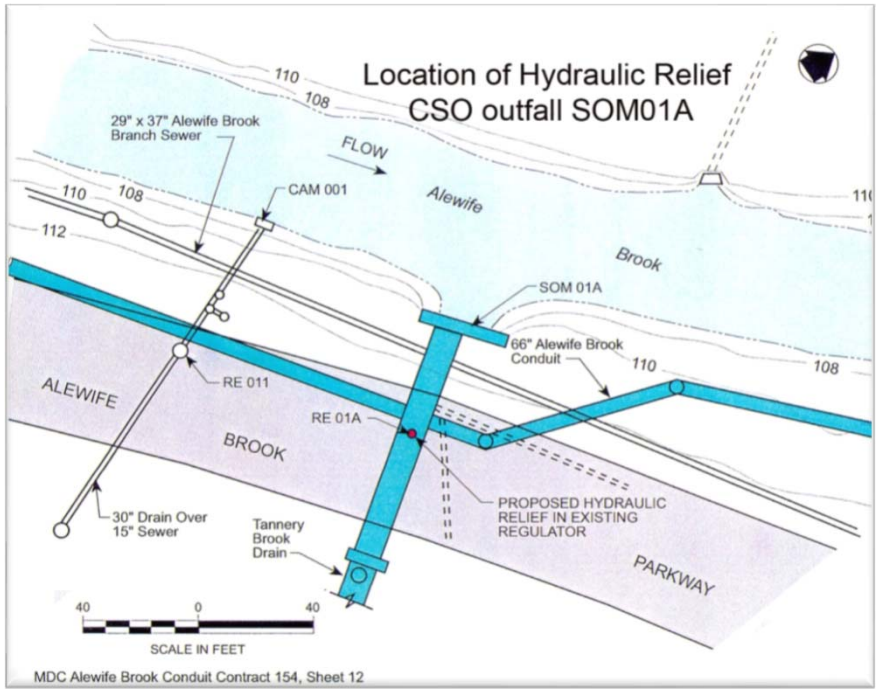
Capital Cost: $100,000,000
$54,000,000 (MWRA Share)

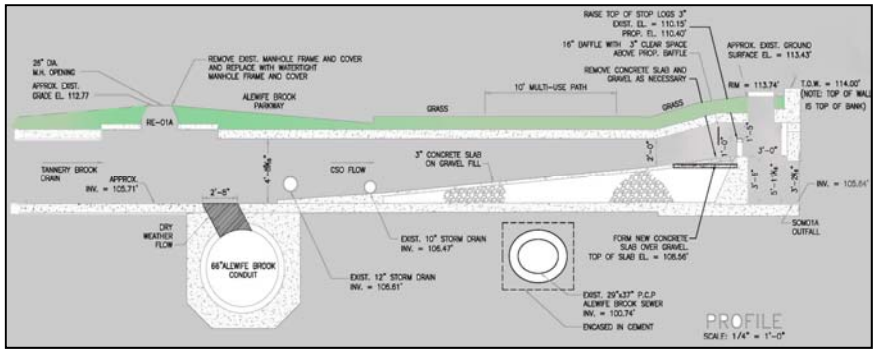
CSO Outfalls:
- Closed CAM004
- Reduced CSO at other Alewife Brook outfalls.

Frequency of Discharge (typical year)
- CAM004 before project: 63
- CAM004 with project: Eliminated

Annual Discharge Volume (typical year)
- CAM004 before project: 24.1 mgal
- CAM004 with project: Eliminated

Outfall SOM01A Interceptor Connection Relief and Floatables Control





Alewife Brook

Capital Cost: $800,000

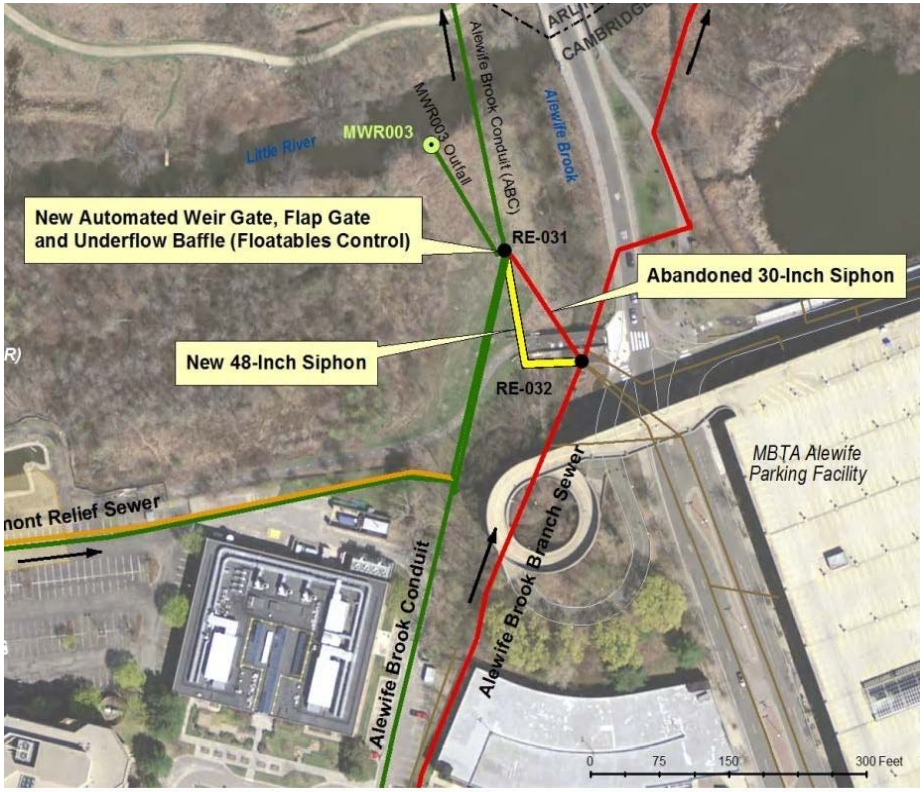
CSO Outfalls: SOM01A

Frequency of Discharge (typical year)
- Before project: 10
- With project: 3

Annual Discharge Volume (typical year)
- Before project: 9.9 million gallons
- With project: 1.3 million gallons

CSO Reduction by Volume: 87%

Outfall MWR003 Gate, Floatables Control and Siphon Relief



Alewife Brook

Capital Cost: $3,763,000

CSO Outfalls: MWR003, CAM004

Frequency of Discharge (typical year)

MWR003 before project: 1
MWR003 with project: 5

CAM004 before project: 63
CAM004 with project: Eliminated

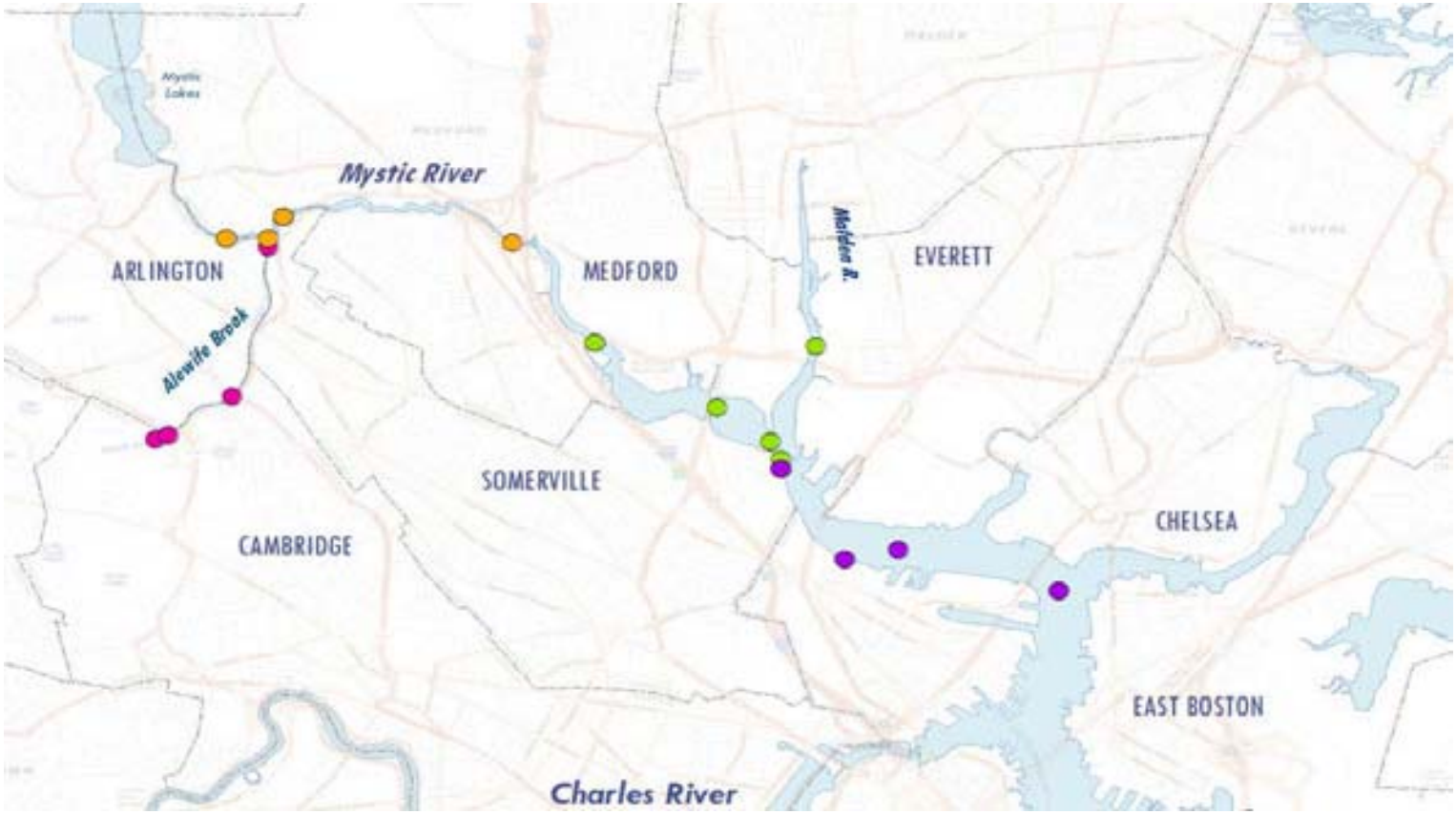
Annual Discharge Volume (typical year)

MWR003 before project: 0.06 mgal
MWR003 with project: 1.0 mgal

CAM004 before project: 24.1 mgal
CAM004 with project: Eliminated

Water Quality Monitoring Locations

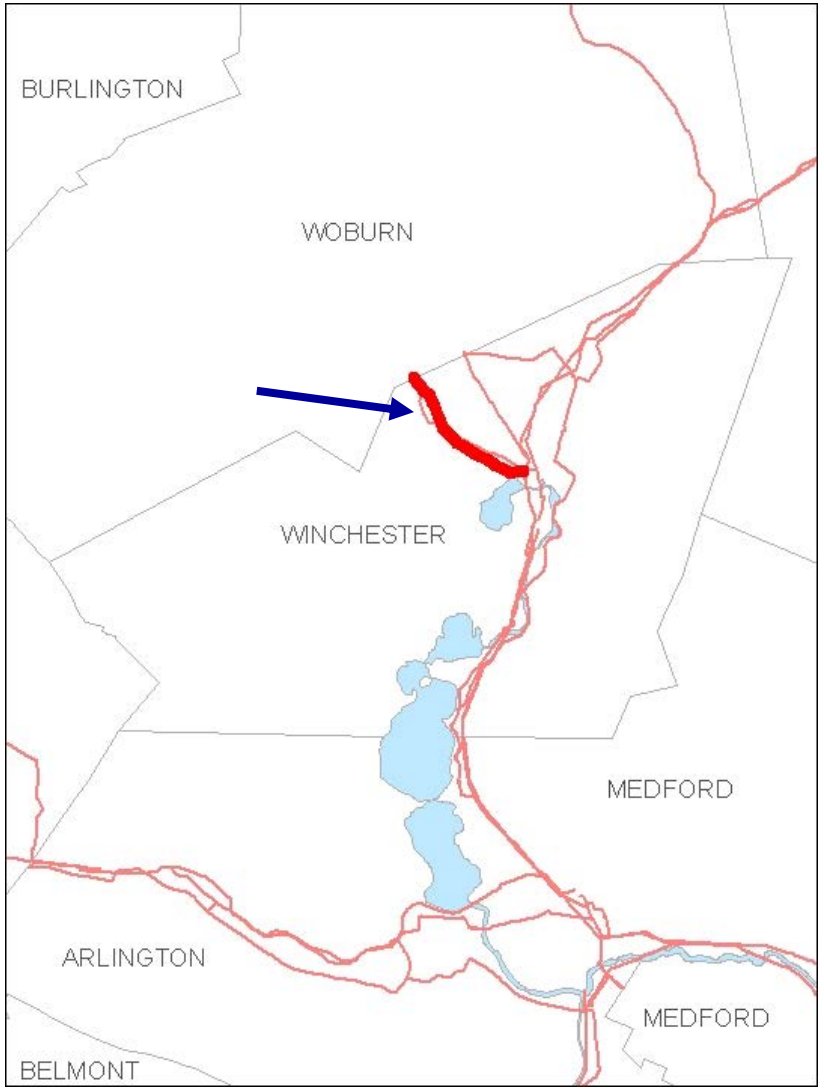
- Sampling at 16 locations in Alewife Brook/Mystic River, from downstream of Mystic Lakes to upstream of the mouth of the Island End River



MWRA Non-CSO Projects Benefitting The Mystic Watershed

Cummingsville Branch Sewer

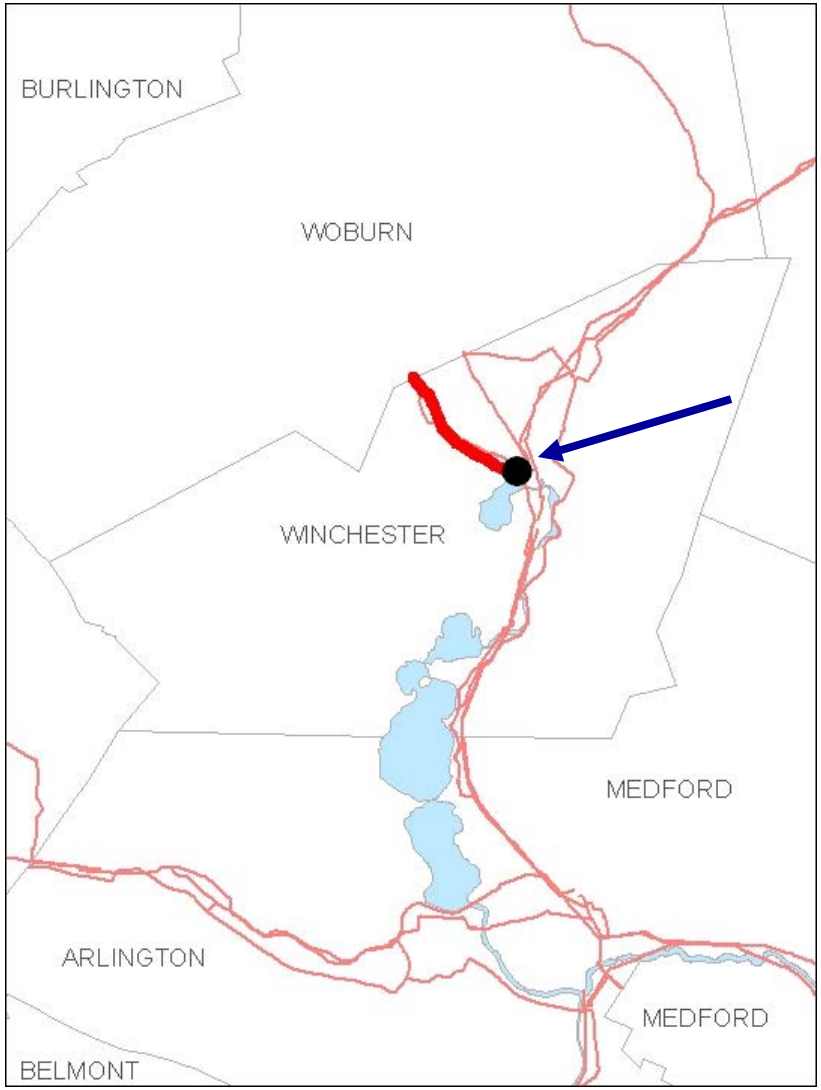
- Construction of a 4,850-foot replacement sewer and rehabilitation of 5,000 feet of sewers in Winchester to provide additional capacity to ensure adequate and reliable wastewater service for upstream communities
  - Completed 2005
  - $4.8 million



Cummingsville Branch Sewer

Wedgemere Siphon

- Construction of new downstream chamber for Section 113 siphon in Winchester to alleviate historic constriction that results in chronic flooding
  - Completed 2007
  - $1.4 million

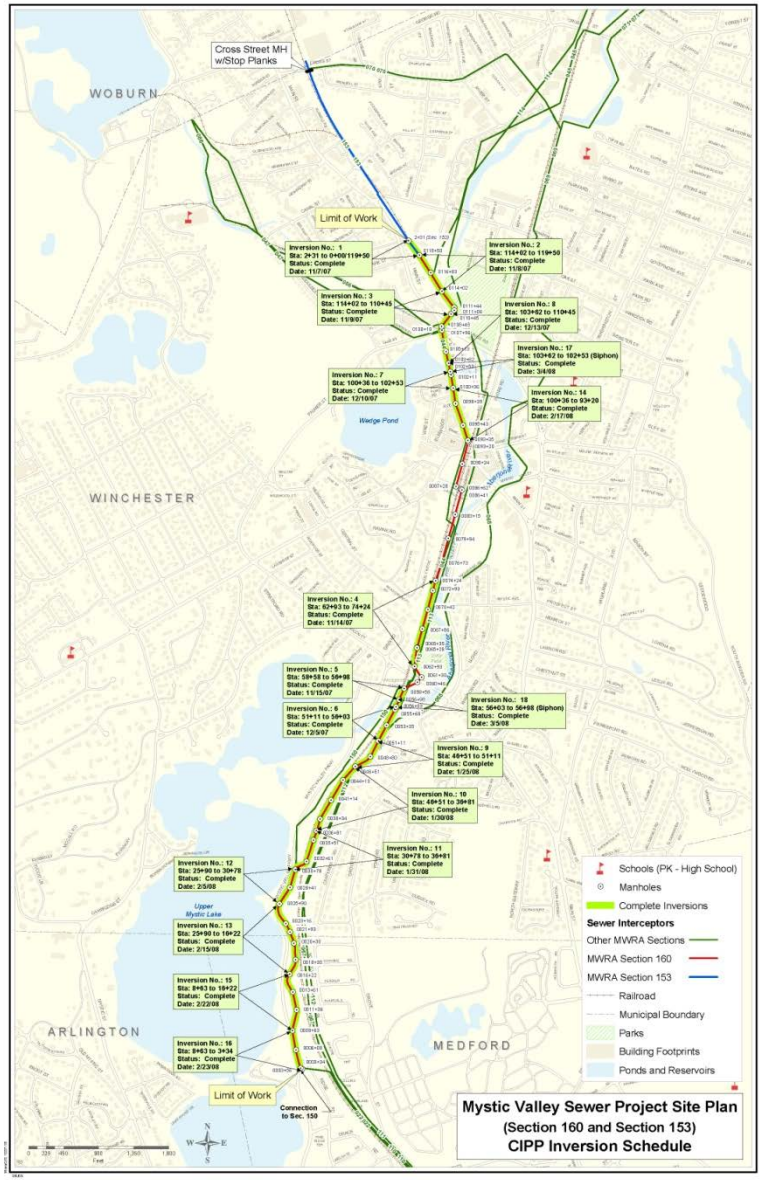


Wedgemere Siphon: Before

Wedgemere Siphon: After

Mystic Valley Sewer Rehabilitation

- Rehabilitation of 11,000 linear feet of Section 160 of the Mystic Valley Sewer in Winchester due to extensive deterioration of the brick and concrete sewer
  - Completed 2008
  - $1.6 million



Rehabilitation of Section 156-Everett, MA

- Rehabilitation of sewer Section 156 and a portion of adjacent Sections 17 and 19, and associated structures/manholes located between Air Force Road and the Malden River in the City of Everett

- The sewer is a 120-year old, 61-inch by 56-inch rounded horseshoe brick sewer, which conveys flows of up to 40 million gallons per day from Wakefield, Stoneham, Woburn, Winchester, and parts of Medford

- Cured-in-Place lining was completed in October 2011. Substantial completion of construction occurred in November 2011. at a cost of $2.6 million

Melrose Sewers

- Design and construct an 18-inch diameter sewer extension of an existing MWRA sewer on Melrose St. to reduce MWRA sewer overflows at the Roosevelt School.

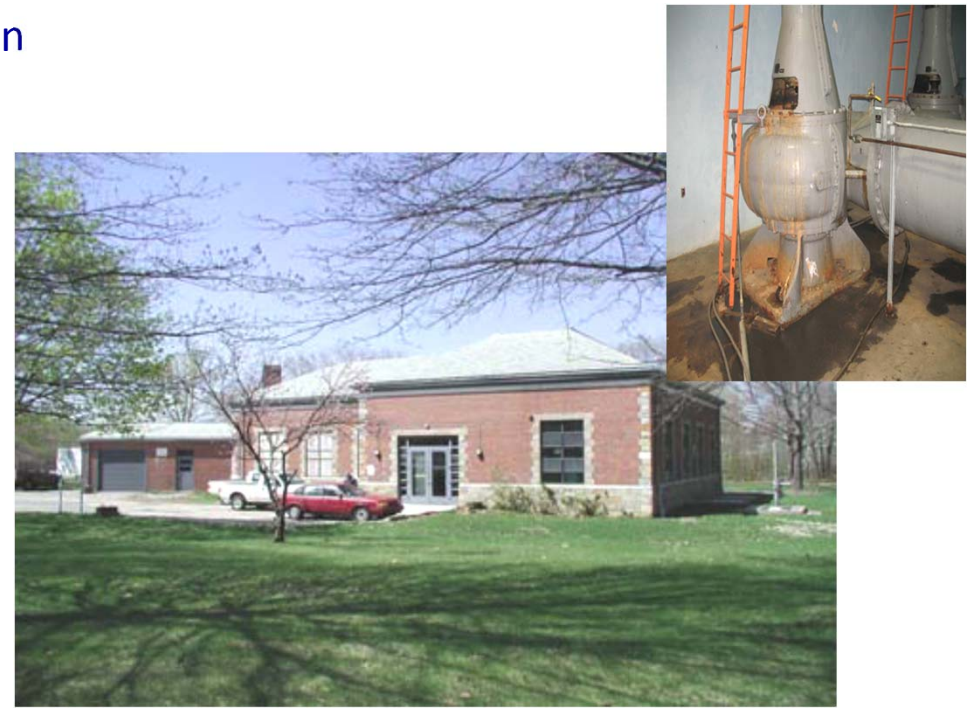
- The construction contract was awarded in January 2010 and completed in September 2010 at a cost of $654,000

Alewife Brook Pump Station Rehabilitation

- The Alewife Brook Pump Station was built in 1951 and serves portions of Arlington, Belmont, Cambridge, Medford and Somerville

- The three original wet weather pumps will be replaced, as will motors, gear drives, bar screens, electrical and HVAC equipment. Roof repairs and major energy efficiency improvements will be made as will modifications for flood protection

- The work is ongoing and will be completed in 2018 at a cost of $12.6 million



If You Clean It, They Will Come

Boston Harbor: Seaport District

Mystic River: Assembly Row

Boston Harbor: Harborwalk

Mystic River: River's Edge

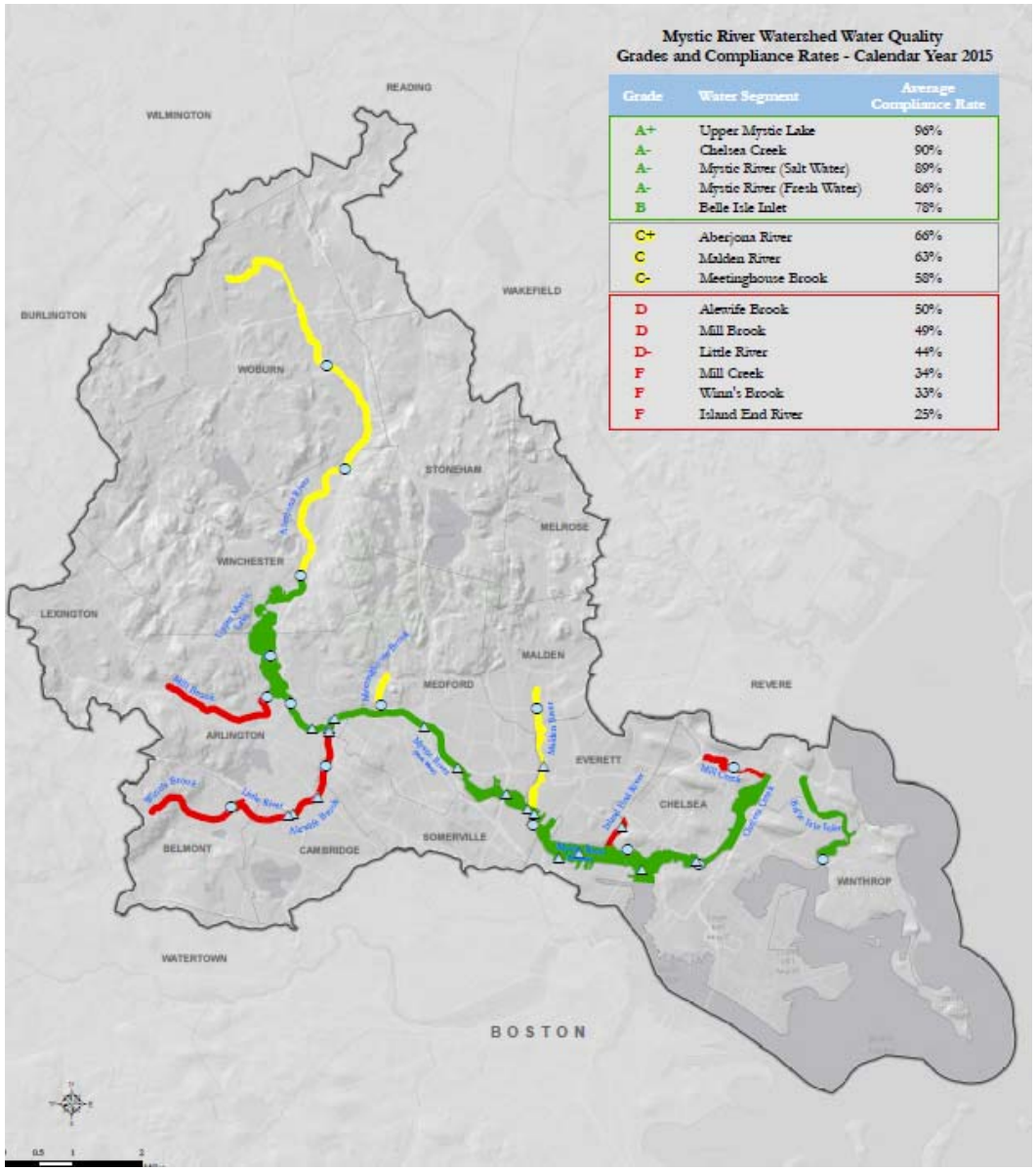
Boston Harbor: Courageous Sailing Center

Mystic River: Tufts Boathouse

Wynn Boston Harbor

Challenges Remain

Mystic River Report Card

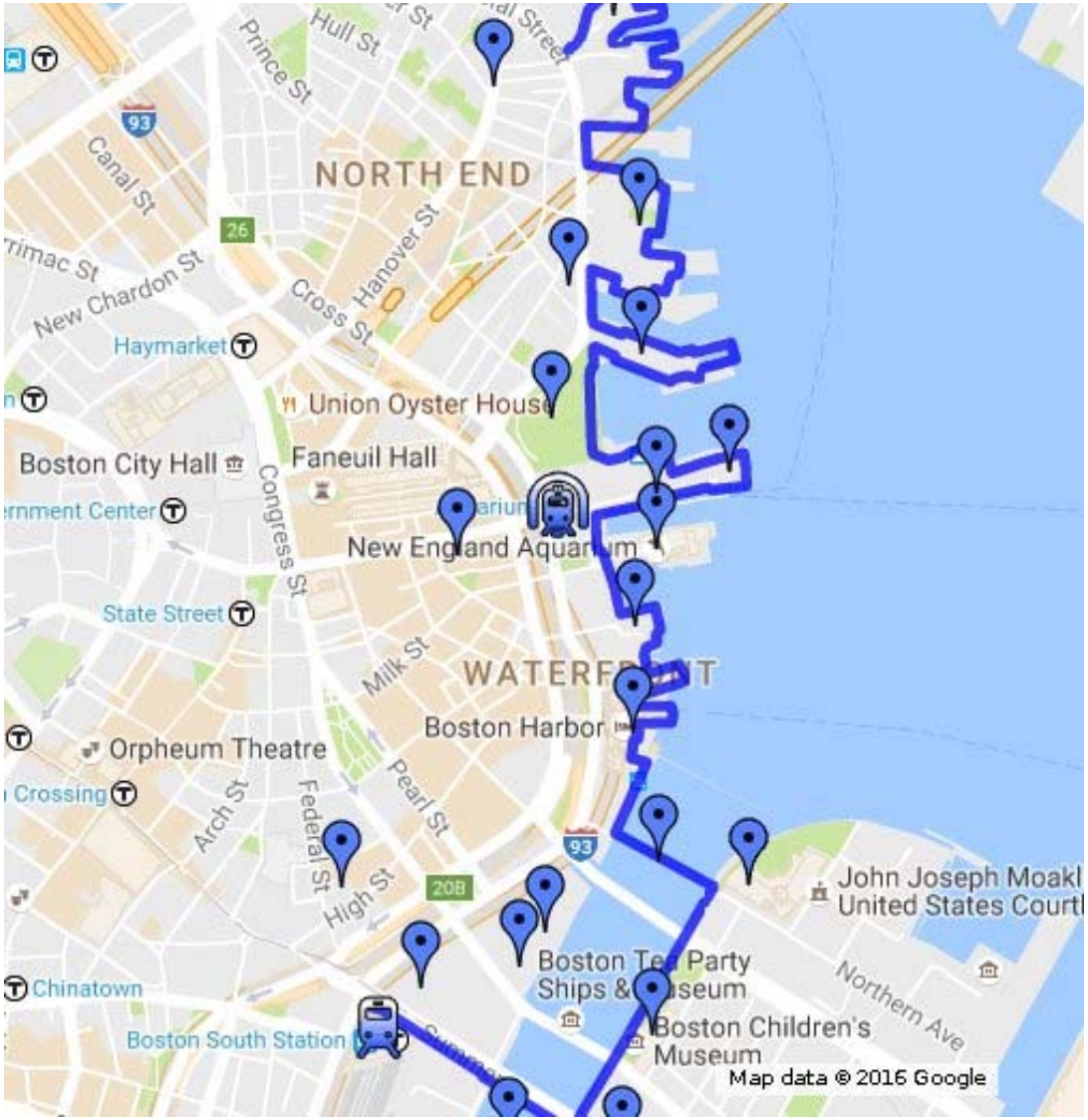


Grade	Water Segment	Average Compliance Rate
A+	Upper Mystic Lake	96%
A-	Chelsea Creek	90%
A-	Mystic River (Salt Water)	89%
A-	Mystic River (Fresh Water)	86%
B	Belle Isle Inlet	78%
C+	Aberjona River	66%
C	Malden River	63%
C-	Meetinghouse Brook	58%
D	Alewife Brook	50%
D	Mill Brook	49%
D-	Little River	44%
F	Mill Creek	34%
F	Winn's Brook	33%
F	Island End River	25%

Invasive Species Control

Climate Change

Boston Harborwalk



Mystic River Urban Trails

Meanwhile, On the Water Side…

By The 1980s, Things Were Pretty Grim On The Water Side

- 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
- Little covered storage
  - Open reservoirs after treatment
  - Crude and inconsistent disinfection

Gaseous Chlorine

And A Lot Of Leaky, Old Pipes

Neglected Dams And Unprotected Watersheds

And A Lot Of Leaky, Old Pipes

Tuberculated Pipe

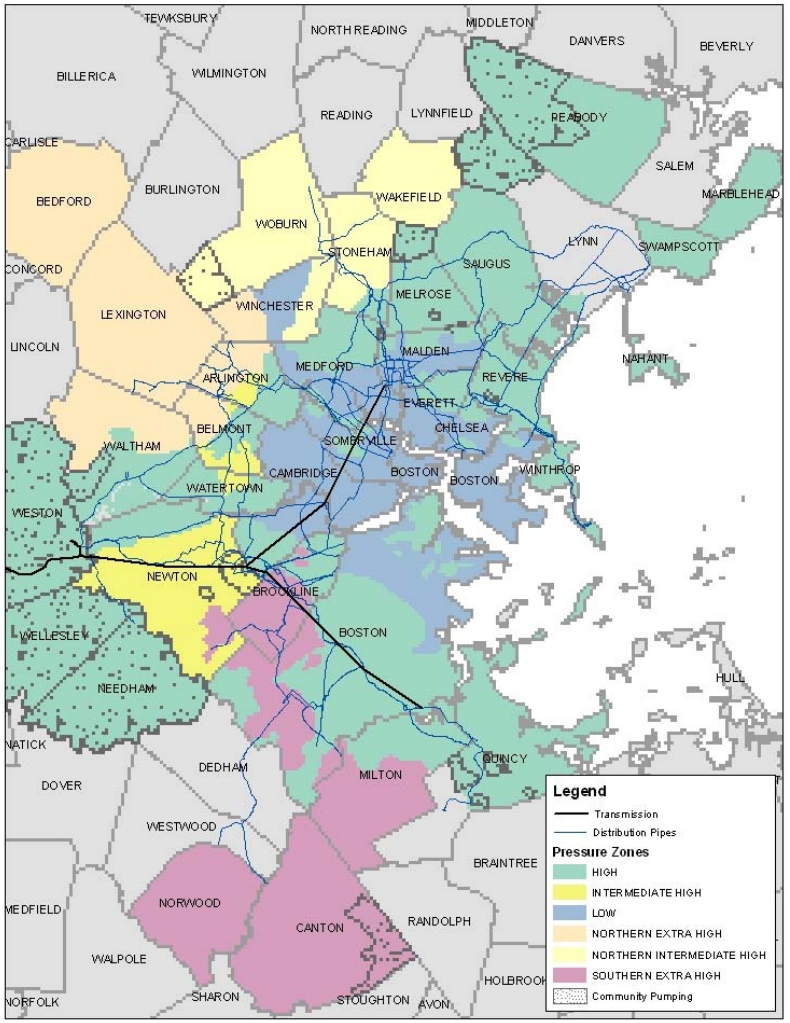
And A Lot Of Leaky, Old Pipes

Leaking Valve Assembly

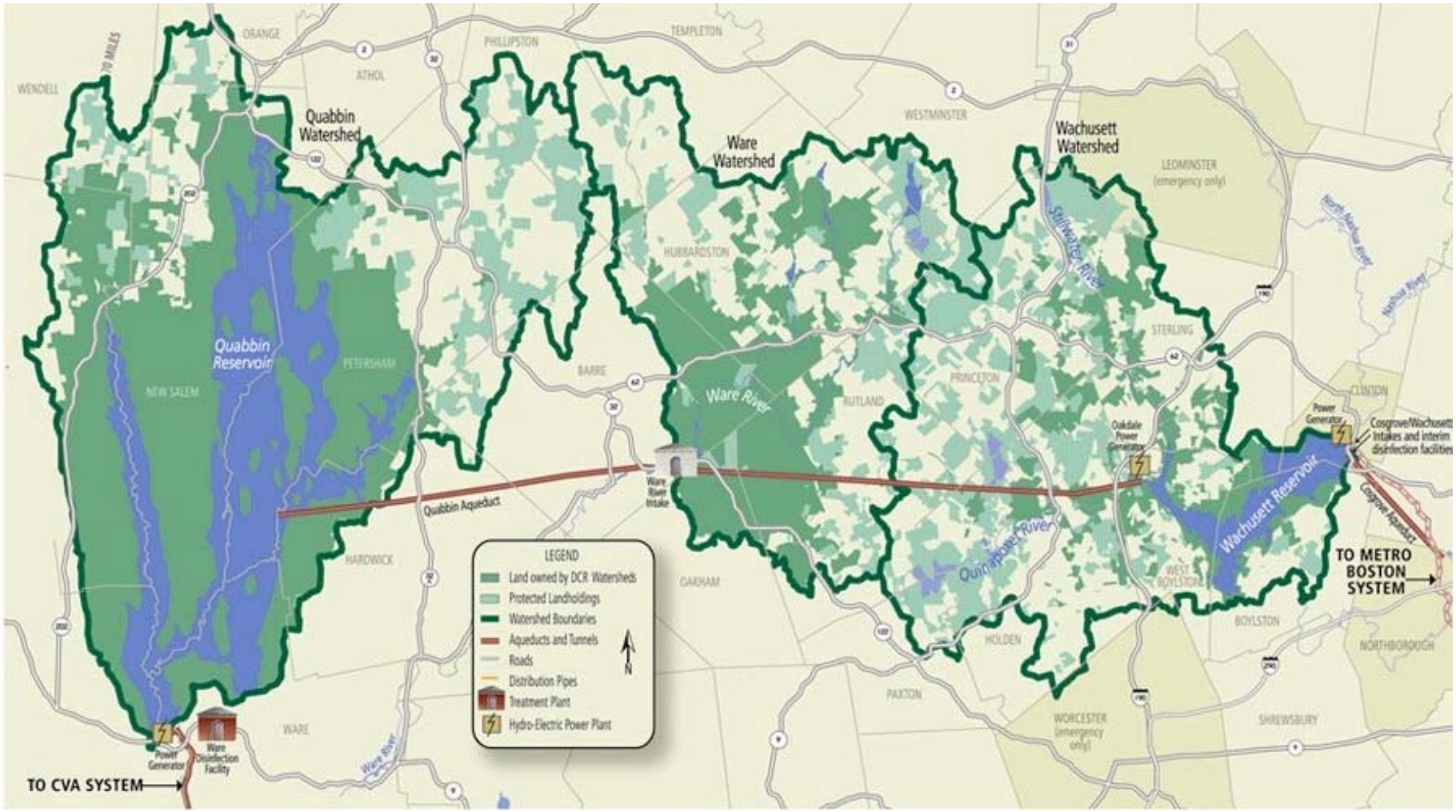
And A Lot Of Leaky, Old Pipes

Today's Water System

- MWRA delivers water to 51 communities in greater Boston
- 3 western communities receive water directly from Quabbin
- On average, MWRA delivers 200 million gallons per day to its water customers, with a peak demand of 350 million gallons



400 Square Miles Of Protected Watershed Lands

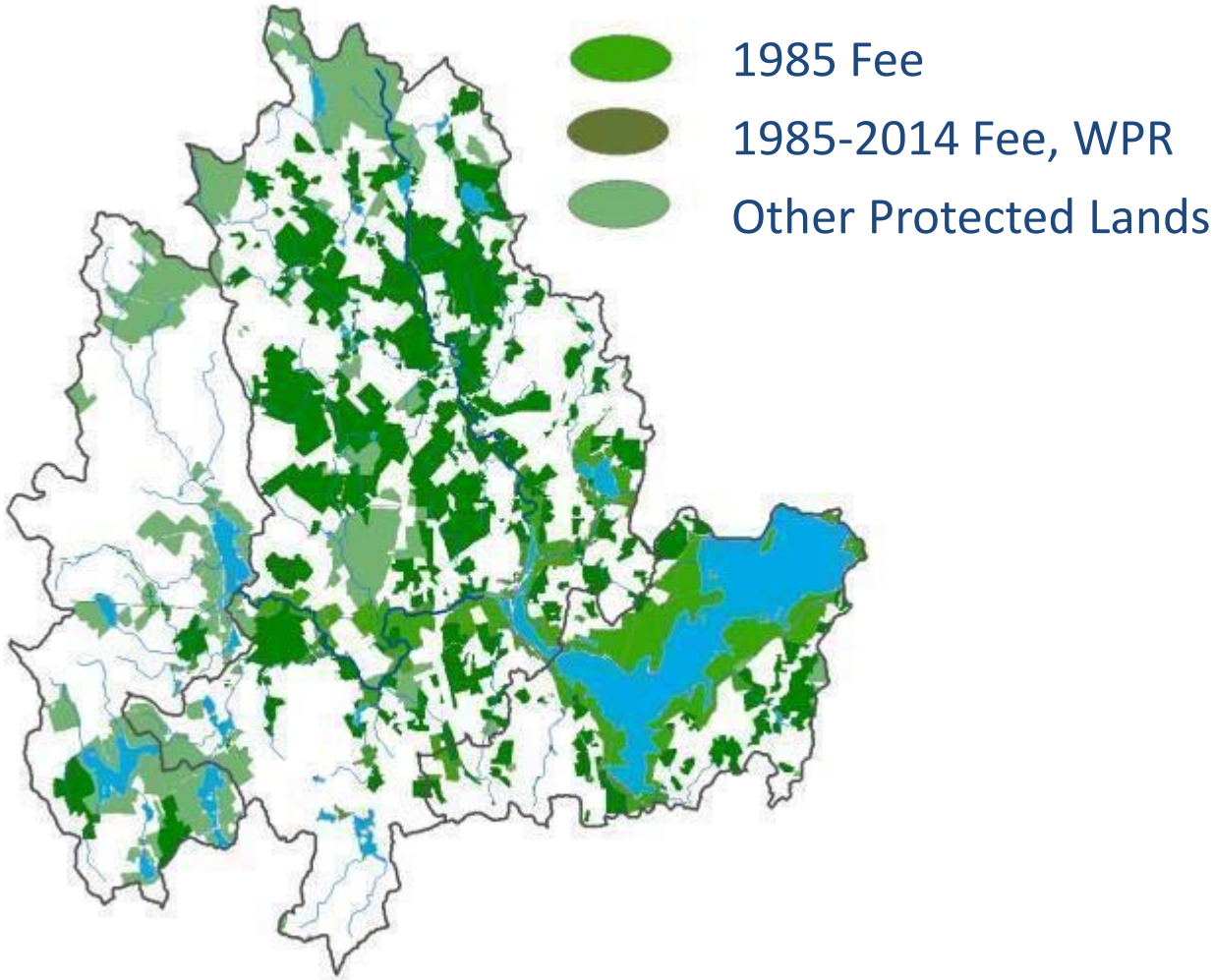


Investments In Watershed Protection

- Since 1985, $133 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%

Wachusett Watershed Protected Land: 1985 - 2014



The Source Reservoirs - Quabbin

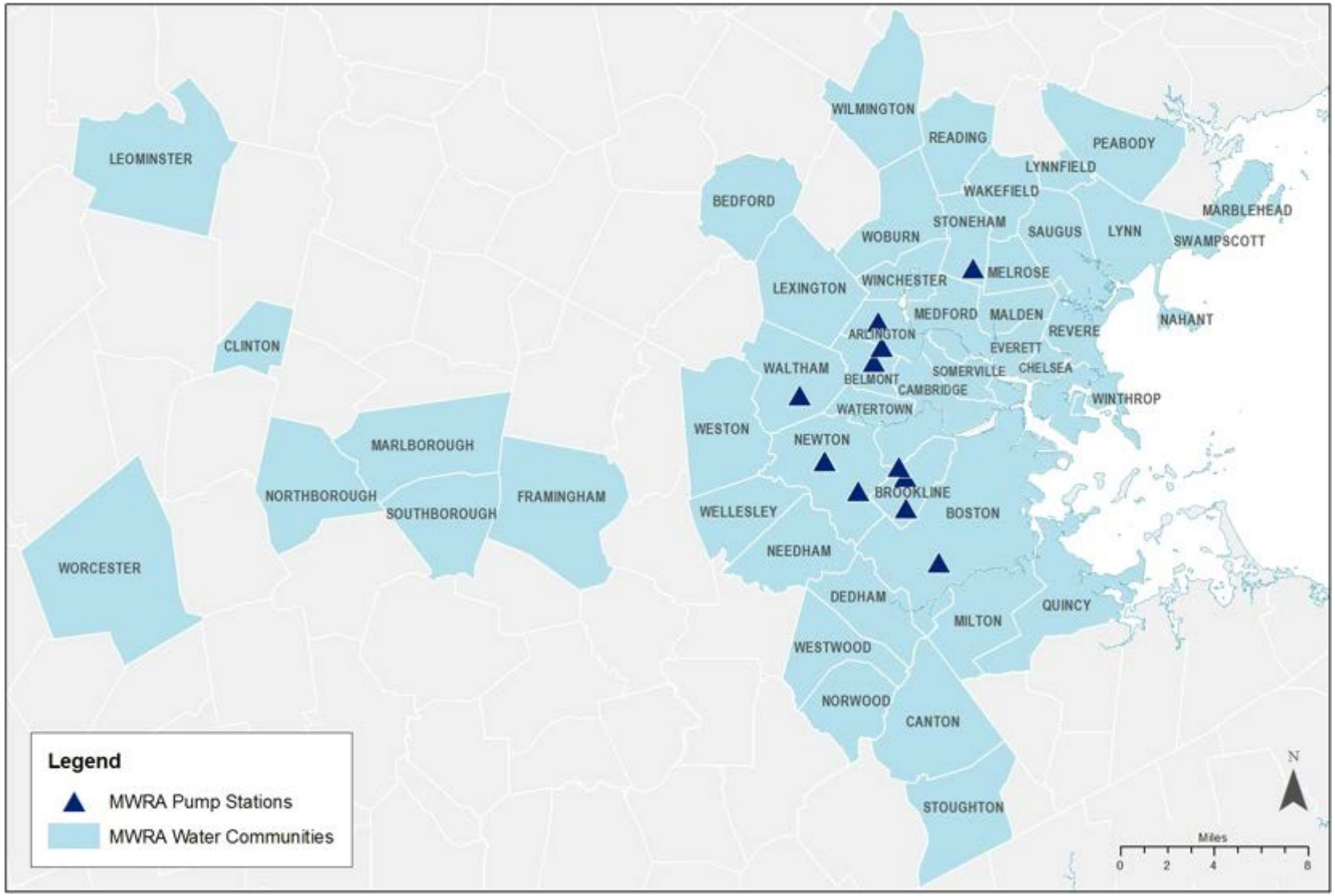
Storage:	412 billion gallons
Depth:	150 feet
Length:	17.9 miles
Width:	3 miles

The Source Reservoirs - Wachusett

Storage:	65 billion gallons
Depth:	129 feet
Length:	8.5 miles
Width:	1 mile

192

11 Water Pump Stations Have Been Rehabilitated



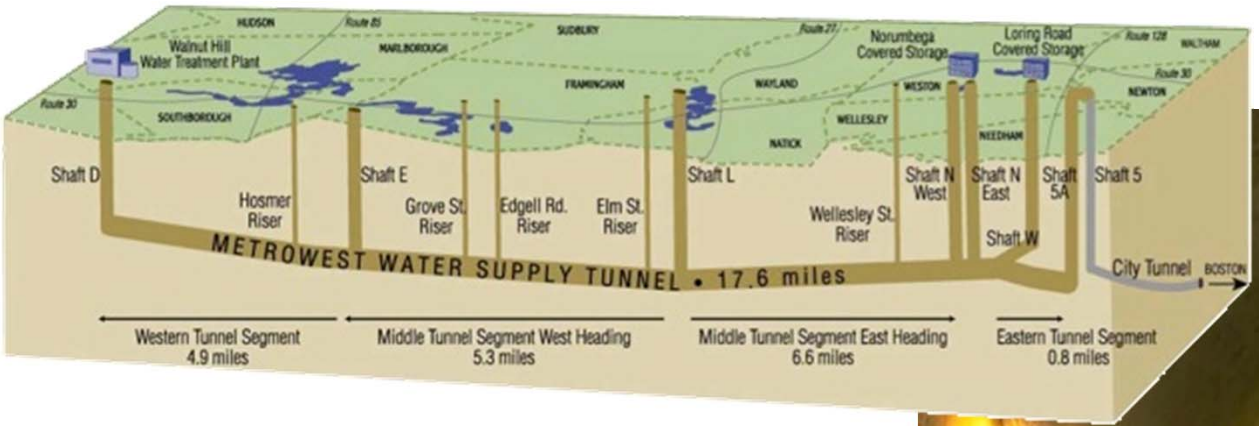
Water Pipeline Rehabbed Or Replaced

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

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

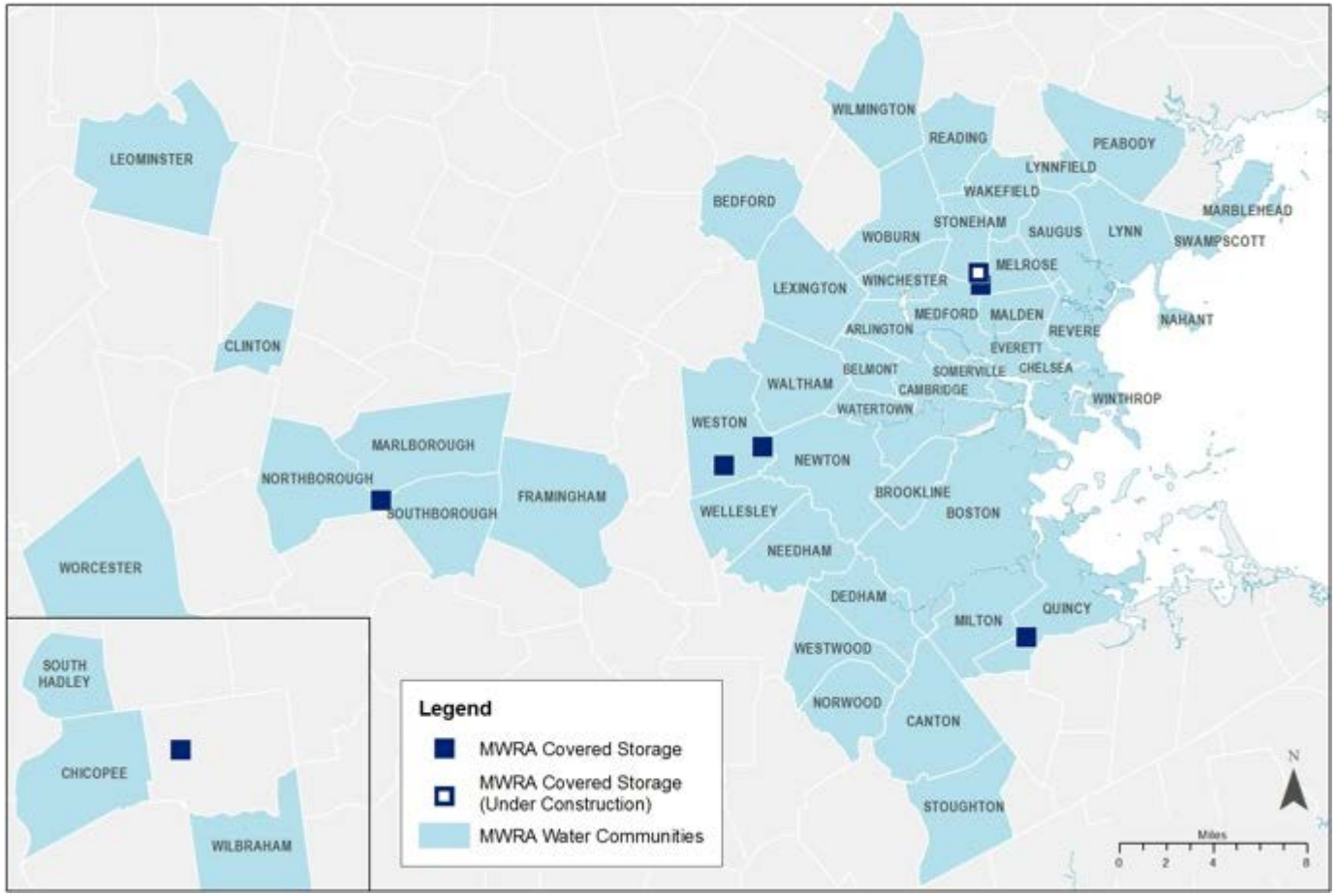


Hultman Aqueduct Rehabilitation

- 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

Covered Storage Projects

- MWRA has built seven new covered storage tanks to replace all open reservoirs



Norumbega Covered Storage Facility, Weston

- Completed in May 2004
- Provides 115 million gallons of storage for metropolitan Boston

Fells Covered Storage

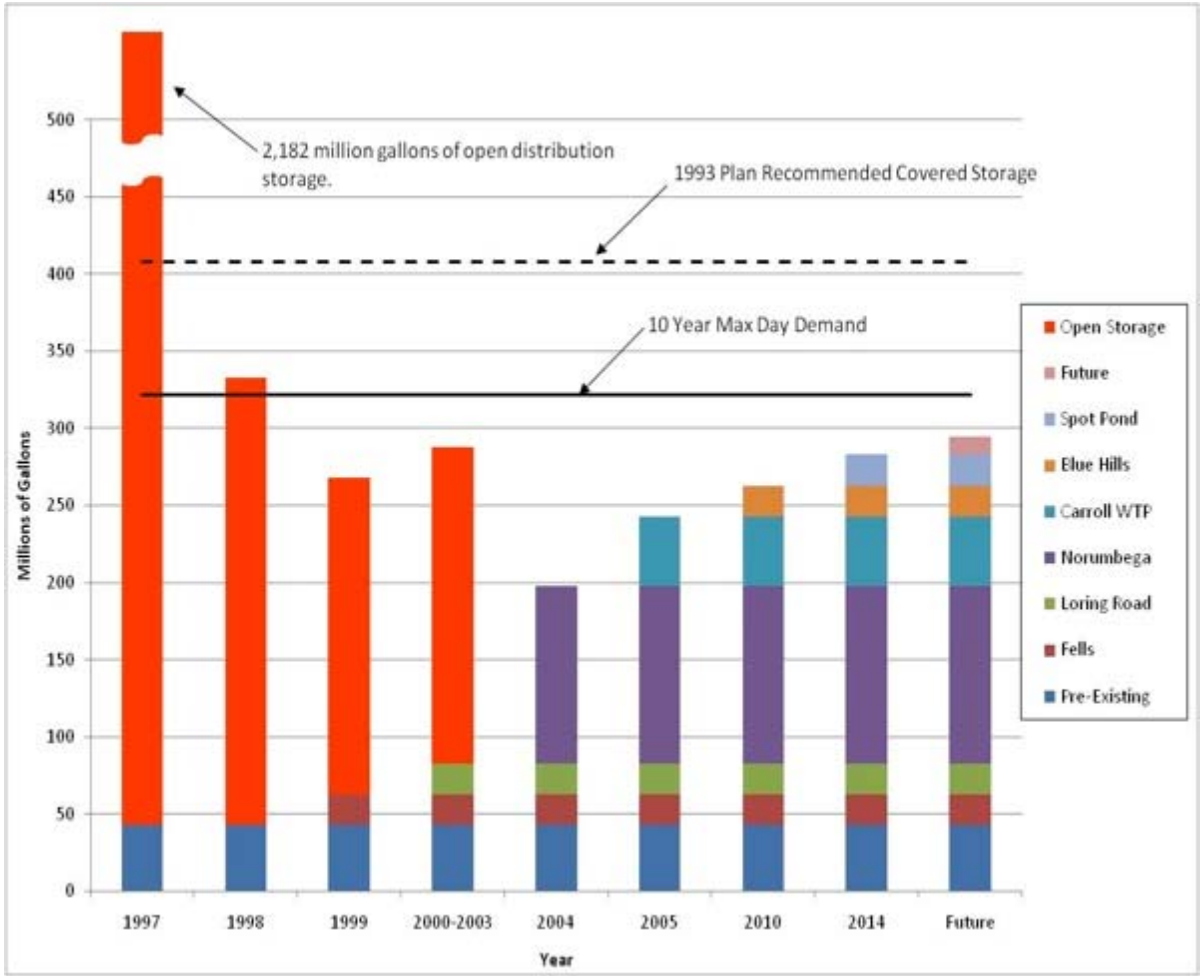
Spot Pond Covered Storage And Pump Station

MWRA Metropolitan Area Storage Capacity Over Time

All open distribution reservoirs taken off-line

Industry practice:

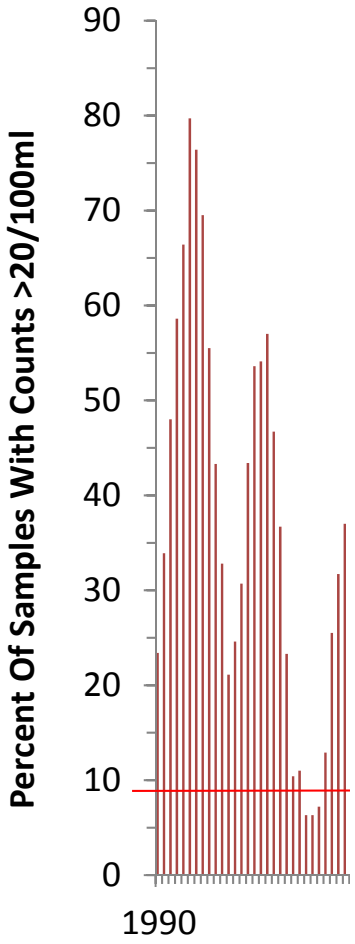
Most similar systems have 1 maximum day or more of storage.



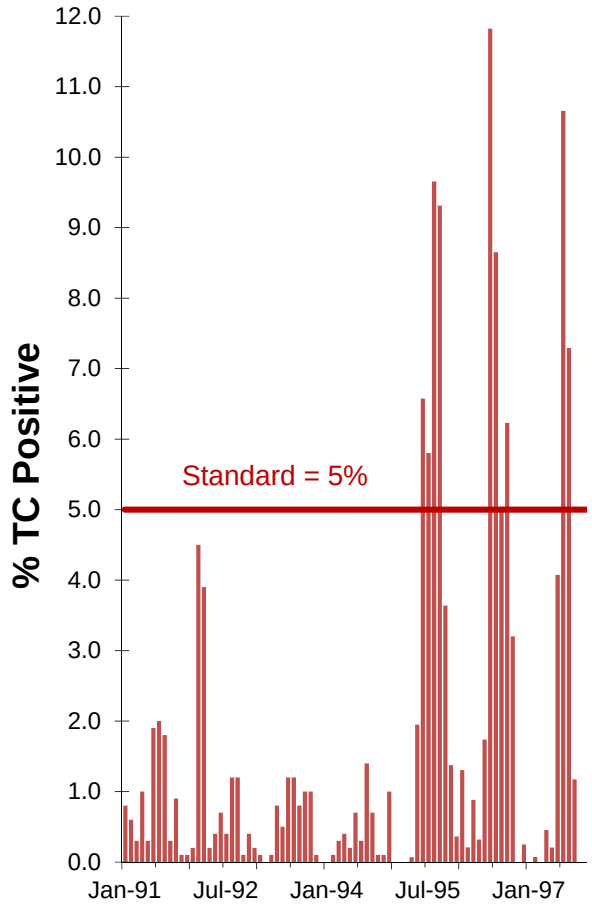
John J. Carroll Water Treatment Plant

- Treatment Processes:
  - Ozone and UV for primary disinfection
  - Corrosion control
  - Chloramination for secondary disinfection
  - Fluoridation

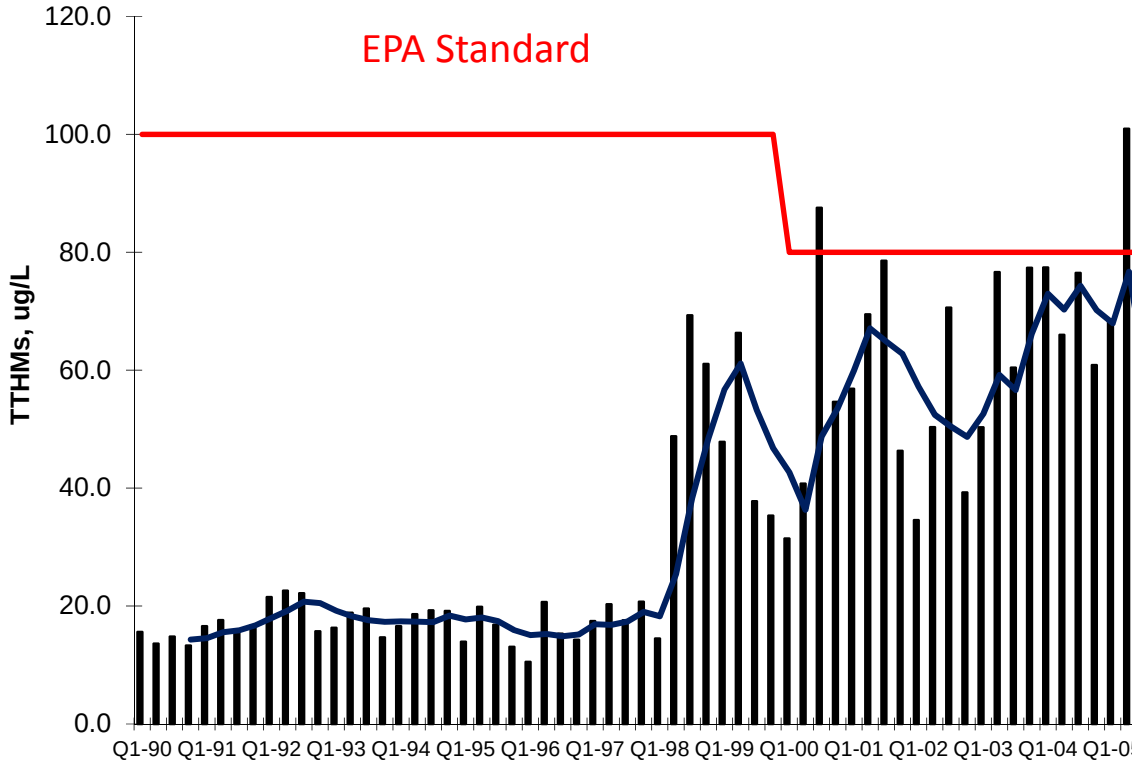
Fecal Coliform Sampling Results At Wachusett Reservoir



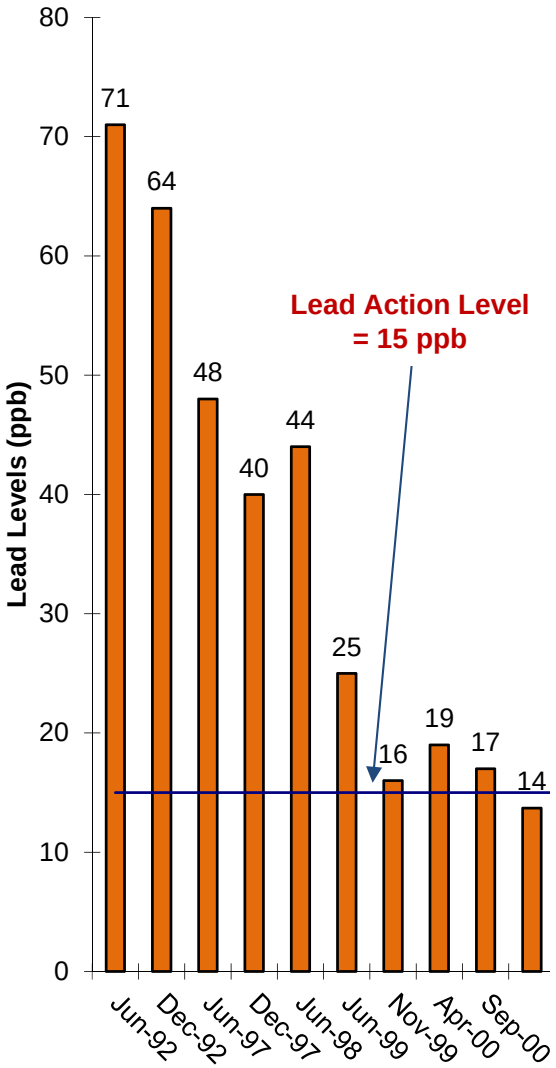
Community Total Coliform Rule Compliance



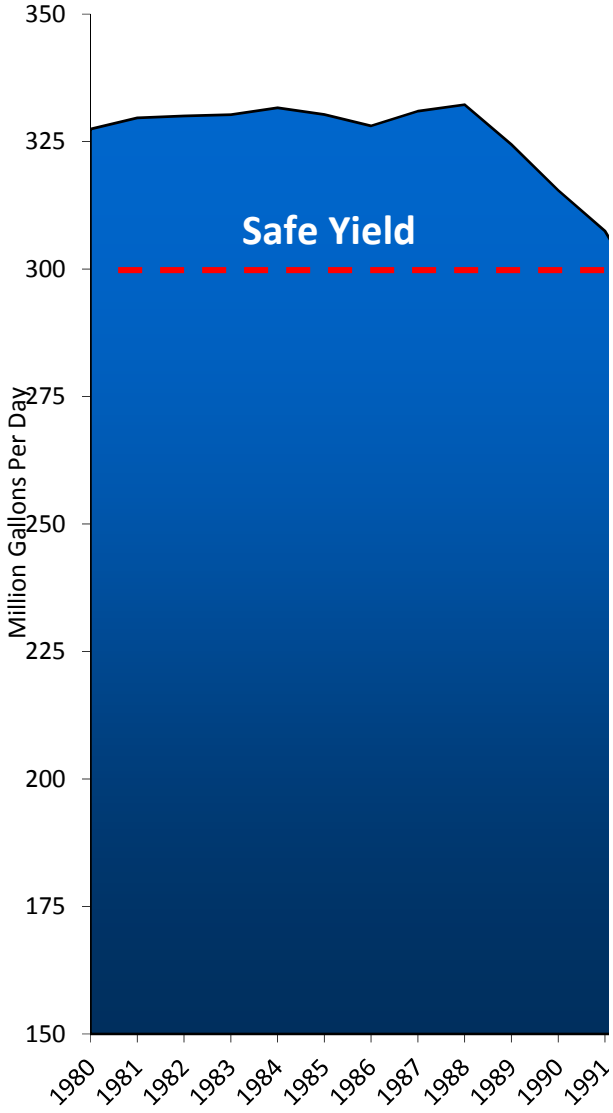
Disinfection By-Products



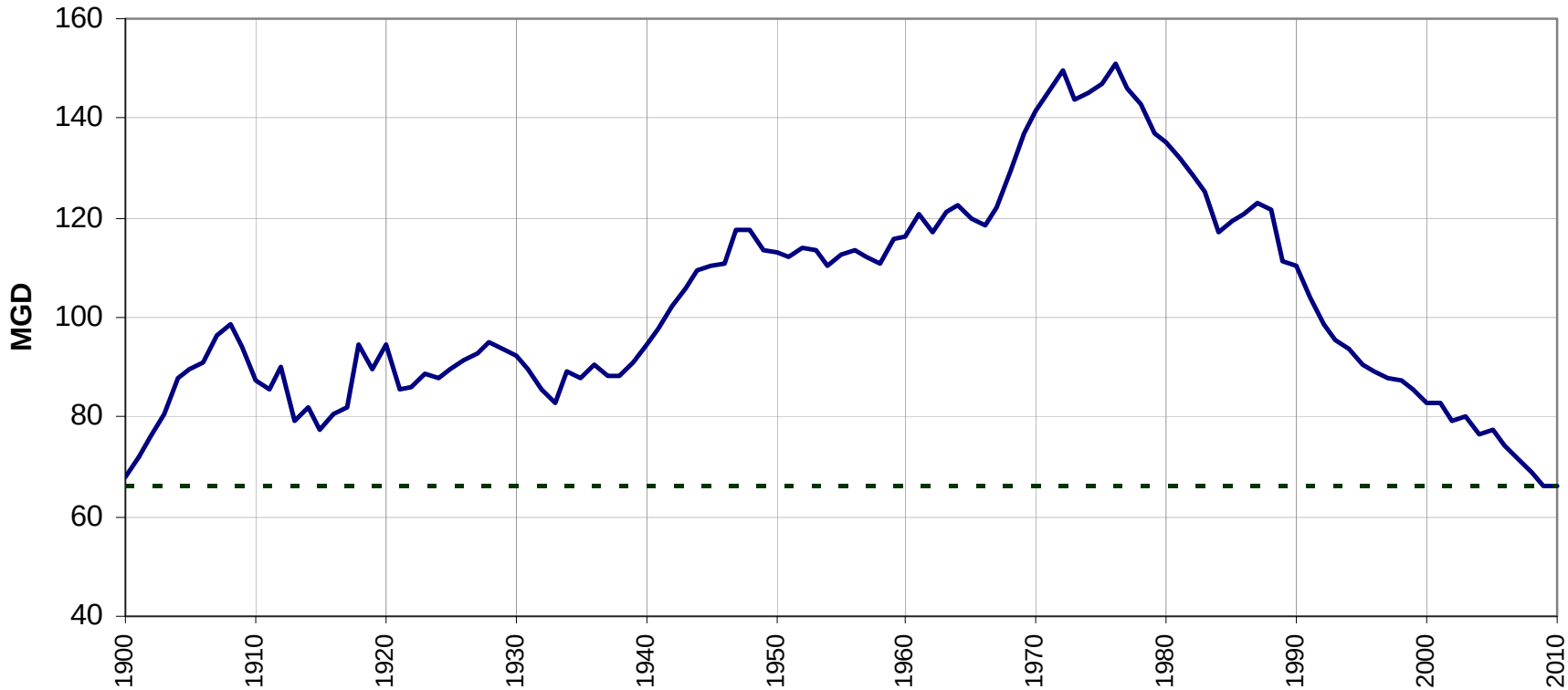
Lead Levels In MWRA Communities



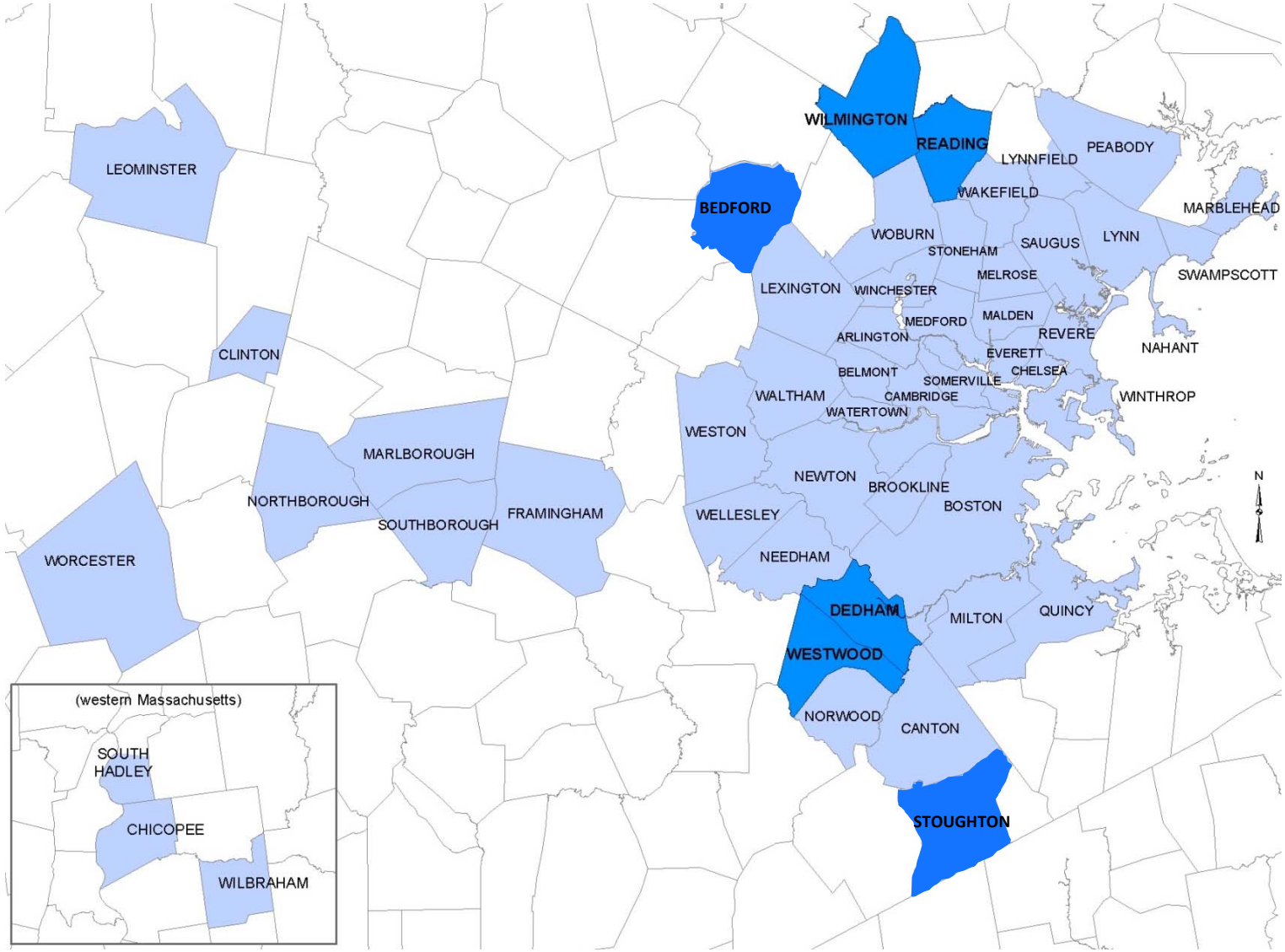
Water Conservation Worked



And Boston's Usage Is At A 110-Year Low



Five Communities Have Joined The MWRA Water System



New Wachusett Aqueduct Pump Station Underway

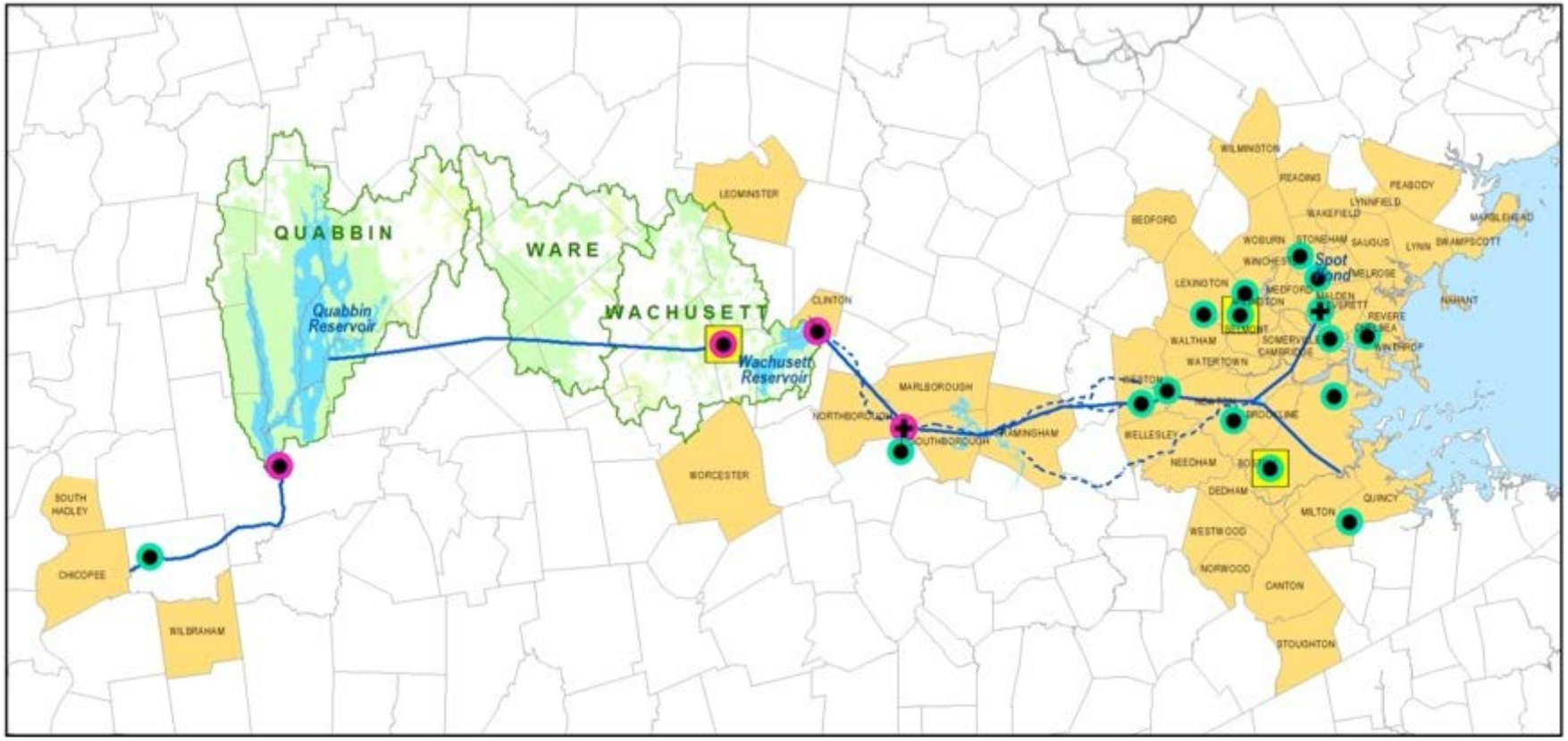
- Will provide redundancy from the Wachusett Reservoir to the Carroll Treatment Plant

Next Major Initiative - Long-Term Water System Redundancy

To provide redundancy for Metropolitan Tunnels which deliver water to 60% of the system

- $1.54 billion
- Project duration 2018 – 2039
- Staff are currently developing the first contract for Preliminary Design/ Geotech/MEPA Review

State-Of-The-Art Monitoring System



s::can Parameters Monitored

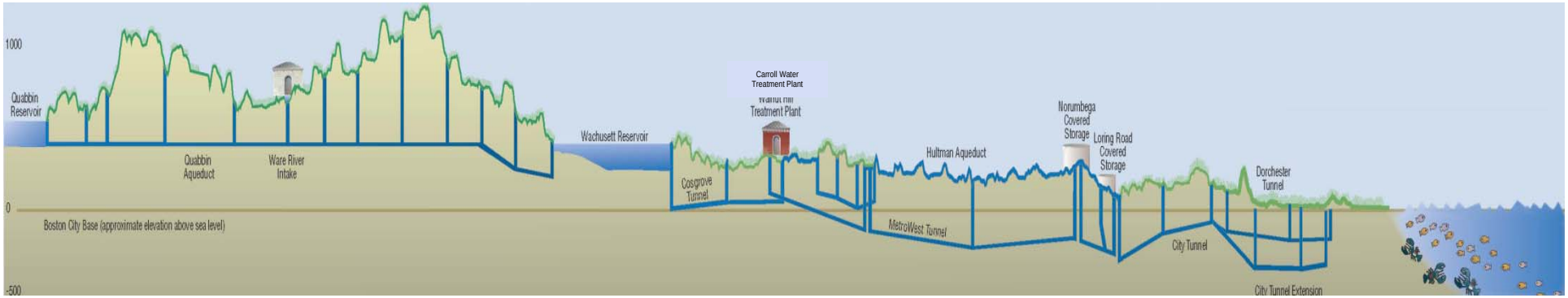
- pH
- Temperature
- Conductivity
- Turbidity
- Dissolved Organic Carbon
- Total Organic Carbon
- Nitrate-N
- UV 254
- Oxidation-Reduction Potential
- Monochloramine
- Free Chlorine
- Total Dissolved Solids

And We Love Being Green!

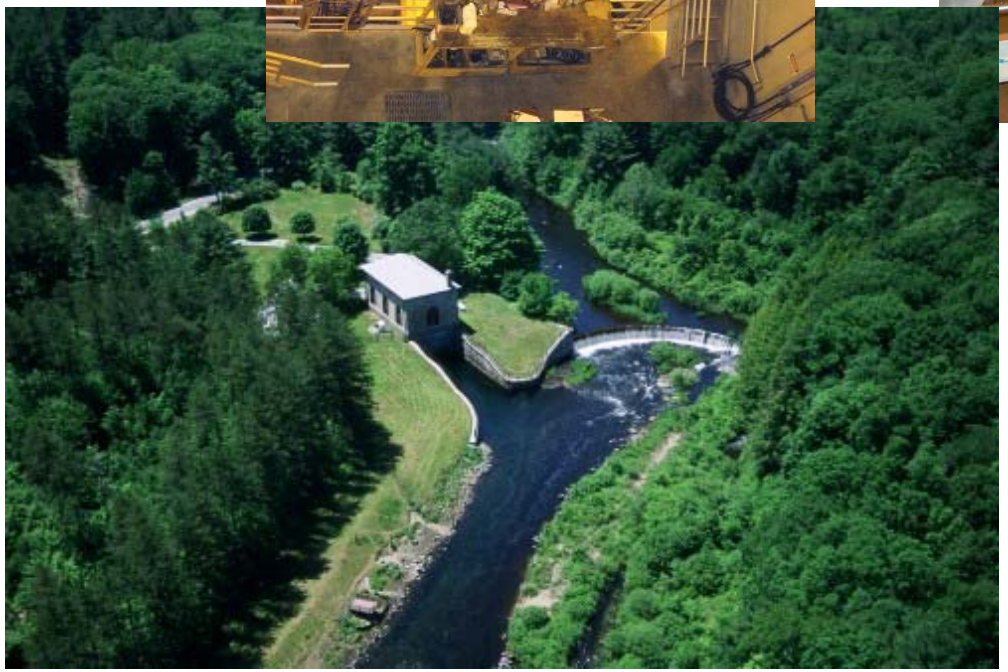
- Of our $40 million annual energy budget, $22 million comes from renewable sources

Water System Profile

- About 85% of the water is delivered by gravity



Hydroelectric Power

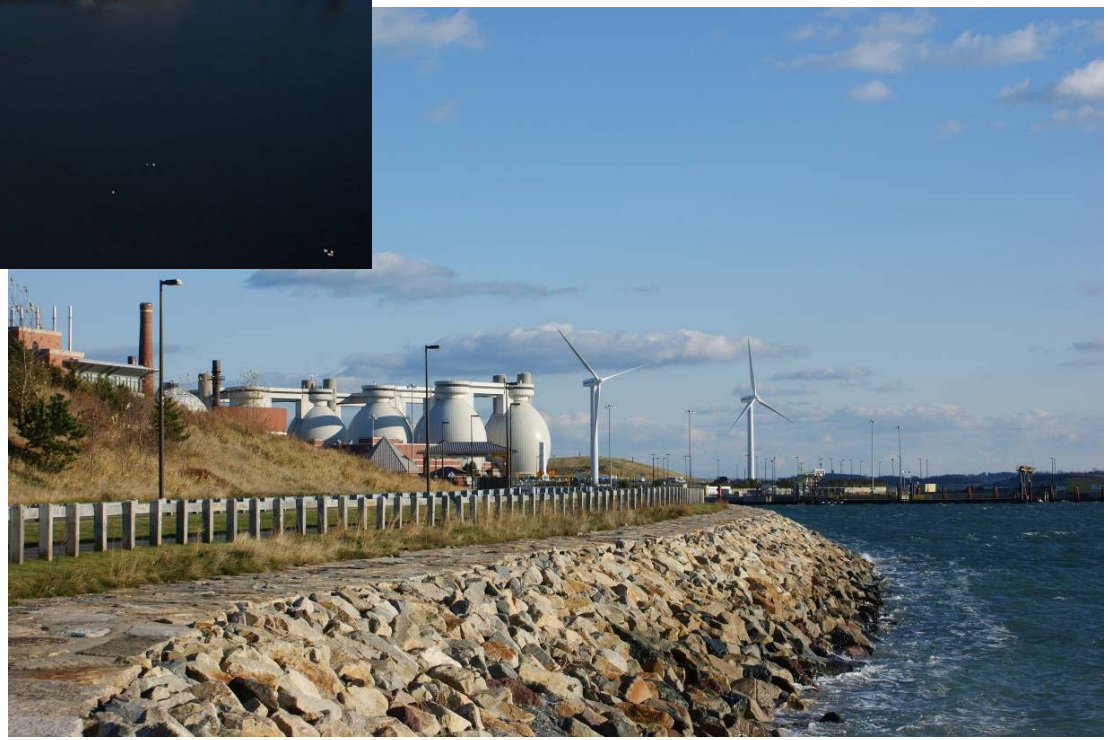


Methane Utilization At Deer Island

- 98% of methane is utilized

Solar Power

Wind Power



Preparing for Climate Change: 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

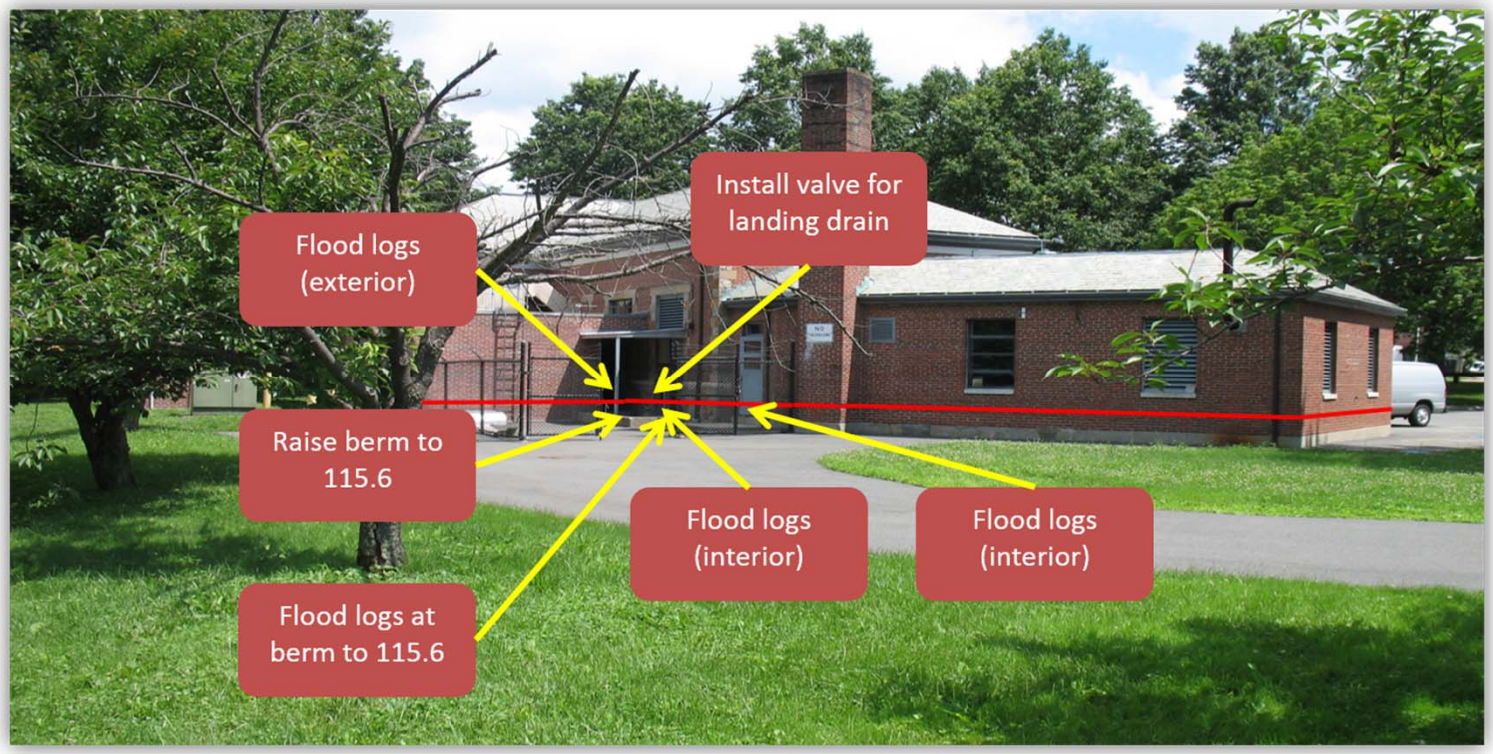
On The Wastewater Side, Sea Level Rise Was Anticipated In The Design of Deer Island Treatment Plant

- Deer Island plant fully protected
  - 100-year flood
  - 1.9-foot sea level rise
  - Wave 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

21 Of MWRA Coastal Sewer Facilities Are Within 15 Feet Of Mean Sea Level

MWRA's Strategy

- 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



Hopefully, We Will Be As Successful In The Coming Years

Deer Island Just Received Another “Platinum Award”

No permit violations for 10 years in a row!

Charles River Gets High Marks

- In its latest annual report card, the EPA has given the Charles River a grade of B+ for water quality

Boston Now Has Some Of The Cleanest Urban Beaches In The Country

The Boston Globe

Michael Levenson - Globe Staff | May 23, 2015

Report gives Boston-area beaches high marks

Says Boston region's waters are cleaner than Waikiki's

Beach-goers at Revere, and in many places elsewhere in the state, enjoy clean water,

88 percent of the time in 2014.

On the national stage, the report found South Boston's beaches had cleaner water than the beaches in Virginia Beach, Va., Coney Island, N.Y., Santa Monica Beach, Calif., and, yes, Waikiki and South Beach. The finding was based on comparable water quality testing data taken between 2012 and 2014 by local officials in those states and then reported to the Environmental Protection Agency.

"These beaches [in the Boston-area], from best to worst, are significantly better than they were 20 years ago, and they're significantly better than most of the urban beaches in the country," said Bruce Berman, director of strategy, communications and programs at Save the Harbor/Save the Bay. "We should be really proud."

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

“Best Drinking Water” In The Country


BOSTON Herald

www.bostonherald.com

WEDNESDAY, JUNE 11, 2014 • $1.00 ($1.50 OUTSIDE OF METRO BOSTON)

Hub’s tap water deemed best in taste test

1 2 3 4 5

(Boston, MA, 06/10/14) Water taste test at the American Water Works Association Annual Conference and Exposition at the Boston Convention and Exhibition Center. Judges for the contest were from left to right: Roy Desrochers from Woburn, MA., Peter Howe from New England Cable News, Matthew Tolcher from Norcross, Georgia and James Naylor from Fort Worth Texas.. Tuesday, June 10, 2014. Staff photo by Ted Fitzgerald