Charles River Watershed Association

Emerald Necklace Conservancy

MUDDY RIVER EXISTING CONDITIONS

APR 9, 2024 | 7 PM

LAND & WATER ACKNOWLEDGEMENT

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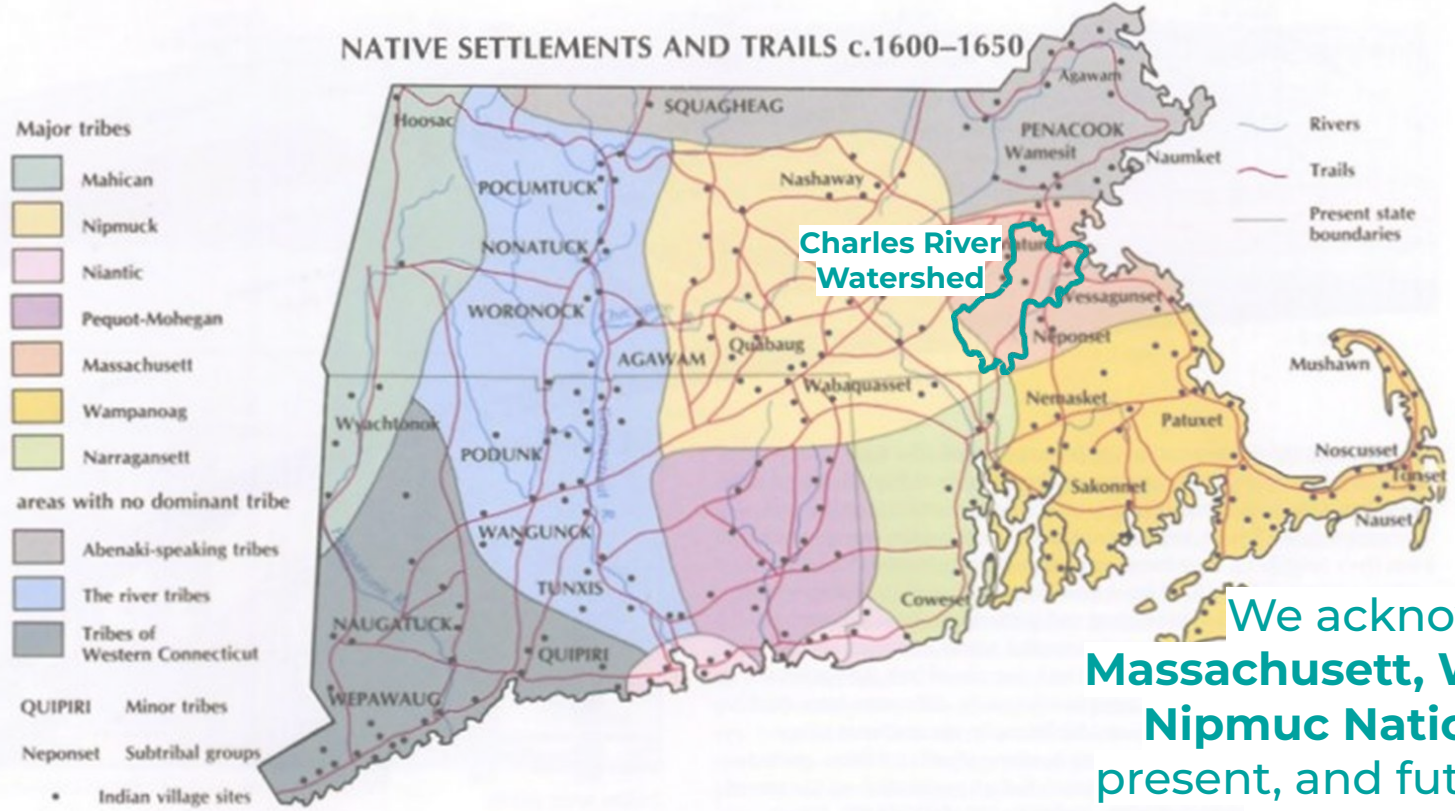

We acknowledge the **Massachusett, Wampanoag, and Nipmuc Nations** as the past, present, and future caretakers of this land and water.

AGENDA

Emerald Necklace CONSERVANCY

Charles River Watershed Association

- VISION PLAN OBJECTIVES
- COMMUNITY CHARACTERISTICS
- WATERSHED CONDITIONS
- FUTURE CONSIDERATIONS
- NEXT STEPS

VISION PLAN OBJECTIVES

- Paris is making the Seine swimmable for 2024 Olympics
- 1972 Clean Water Act promised “fishable, swimmable” rivers by 1983
- 1995 Clean Charles Initiative promised “swimmable” Charles by 2005
- No swimmable Charles without a cleaner Muddy!

WHY WE ARE HERE

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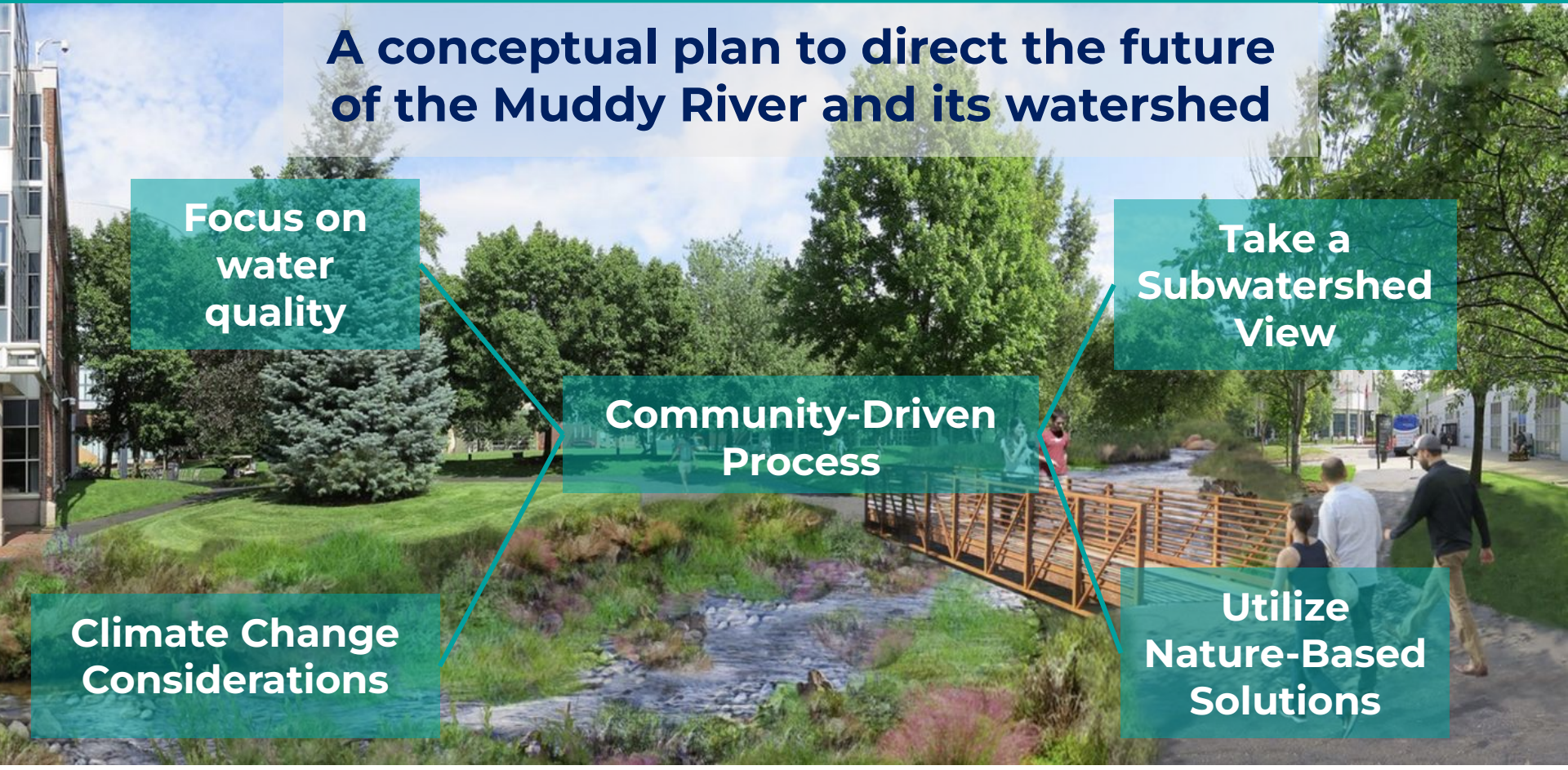

VISION PLAN NEXT STEPS

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COMMUNITY PROCESS

TECHNICAL REVIEW

PROJECT TEAM

Charles River Watershed Association

Personnel:

Lisa Kumpf, Max Rome, Emily Norton

Role: technical analyses, community engagement

Emerald Necklace Conservancy

Personnel:

Karen Mauney-Brodek, Jack Schleifer

Role: public partnerships, land stewardship, community engagement

CBI Catalyzing Collaboration

Personnel:

Patrick Field, Elizabeth Cooper, Aarati Halbe

Role: facilitators, community engagement

KEY PARTNERS

Emerald Necklace Conservancy

Charles River Watershed Association

CITY of BOSTON

Boston Water and Sewer Commission

dcr Massachusetts

Muddy Water Initiative

Maintenance and Management Oversight Committee MMOC Muddy River Restoration Project

Charlesgate Alliance

YOU!

Local groups

Local places of worship

Universities

Hospitals

This list is growing and we would love your participation!

CHARLES RIVER WATERSHED

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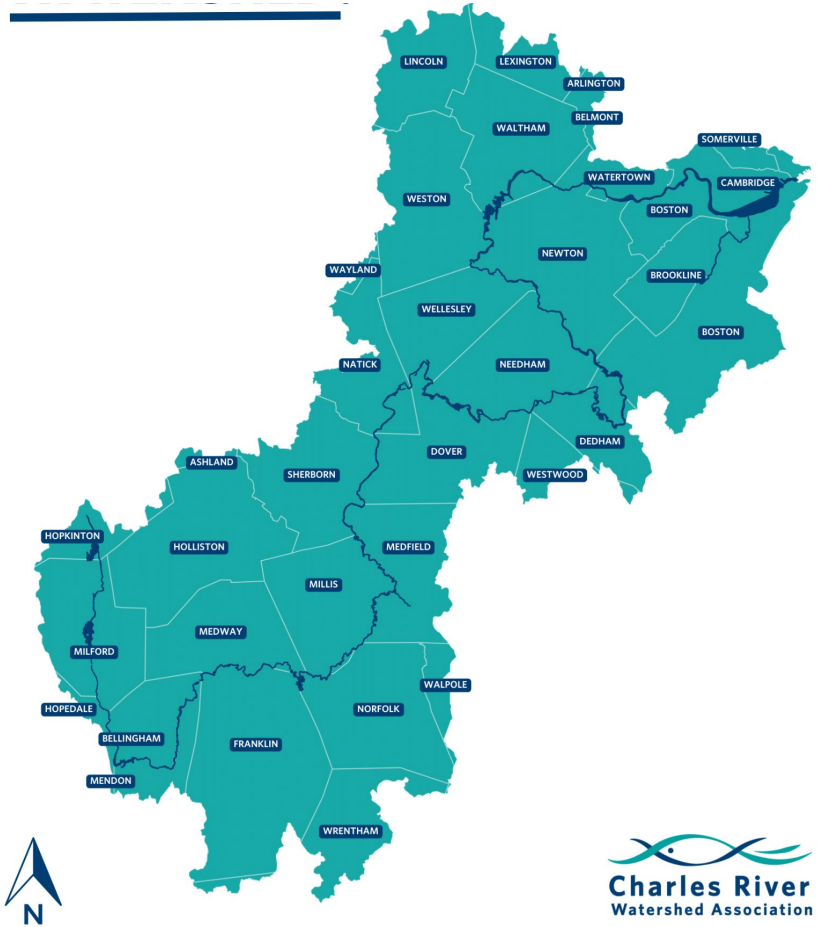
- 80 miles long
- 19 dams
- 308 sq miles
- 35 cities + towns
  - Begins in Hopkinton
  - Runs through 23 towns
- Flows north
- 1M+ residents



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MUDDY RIVER [SUB] WATERSHED

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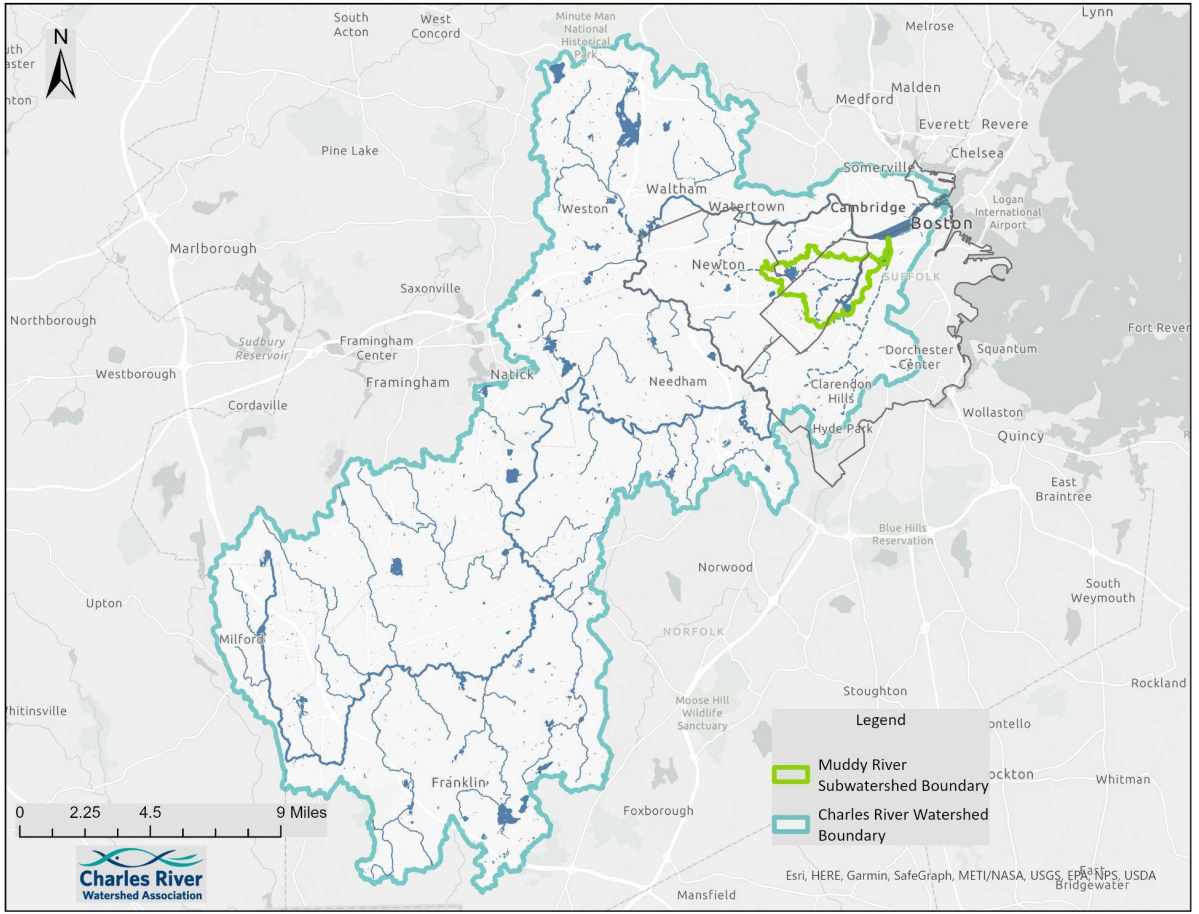
- **2%** of Charles River watershed
- **6 mi²** - spans Brookline, Newton, and Boston neighborhoods of Brighton, Jamaica Plain, Mission Hill, Longwood, and Fenway



HISTORICAL CONTEXT

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Historically a Tidal Channel → **City Parkland under Olmsted** → **Modern Urbanization and Restoration**


COMMUNITY
CHARACTERISTICS

DEMOGRAPHICS

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81,000 Residents*

- 62.6% White
- 18.5% Asian
- 8.5 % Hispanic/Latino
- 5.4% Black

Selection: over 25% area within watershed AND area within watershed ≥ the smallest block fully within the watershed

-Numbers vary modestly depending on which census tracts you include.

Other Factors:

- ~13% in College Student Housing
- 10% of families are low-income
- 17% > 65 yo
- ~13% < 18 yo

ENVIRONMENTAL JUSTICE

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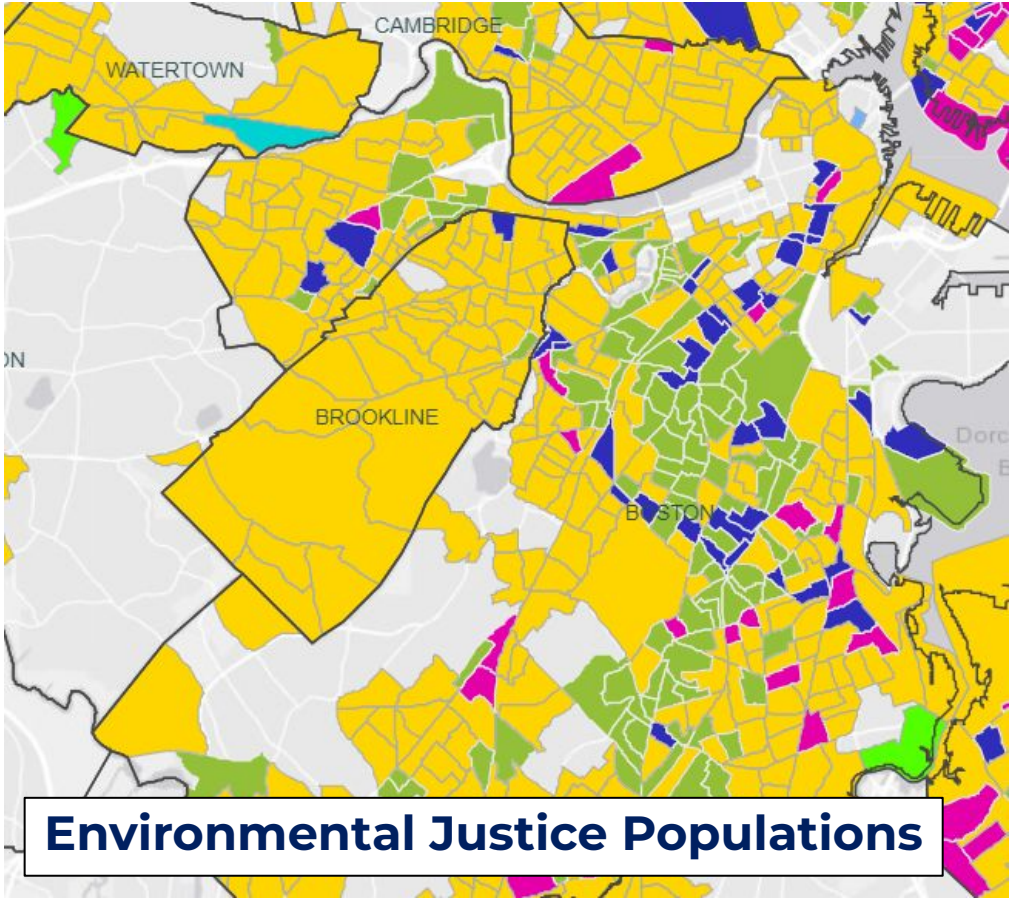

Environmental Justice Populations

- Minority: the block group minority population is >= 40%, or the block group minority population is >= 25% and the median household income of the municipality the block group is in is < 150% of the Massachusetts median household income
- Income: at least 25% of households have a median household income 65% or less than the state median household income
- Language isolation: 25% or more of households do not include anyone older than 14 who speaks English very well
- Minority and Income
- Minority and English isolation
- Income and English isolation
- Minority, Income and English isolation

- Mainly minority populations
- Some low income populations

COMMON COMMUNITY THEMES

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Stakeholders have **many perspectives** on the Muddy

a. Historic Preservation (Olmsted's vision)
b. Restoration (of natural functions and Olmsted's vision both)
c. Water quality (in the Muddy itself in part driven by visible manifestations of poor quality)
d. Water quantity (too little or sometimes too much)
e. Recreation, solace, and retreat
f. Natural habitat and wildlife

From our Kick-Off November Meeting and Subsequent seven interviews with key stakeholders and conversations with municipalities

COMMON COMMUNITY THEMES

- Most stakeholders tend to think of **part, but not all**, of the Muddy Watershed
  - There is a limited constituency for “upstream” portions of the Muddy due to heavy urbanization, highly developed land, and lack of physical visibility (a lot of pipes!)
- Contributions to **poor water quality** are often not understood in their totality
- The communities around and near the Muddy **care deeply** about this precious resource.
  - However, many long-term, long-involved stakeholders are experiencing some *fatigue*
  - Thus, community engagement around the Muddy *needs expansion* - cast a wider net and bring in more partners to support and advocate for the vision

COMMUNITY CHARACTERISTICS

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YOUR FEEDBACK

What did we miss about characterizing the community within the Muddy River watershed?

Please raise your hand or write a word or short phrase in the chat.


WATERSHED
CONDITIONS

MUDDY RIVER WATERSHED

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Key Stats:

- 5.9 square miles
- 44% impervious
- 4 jurisdictions
- 60% in Brookline
- 53% of Brookline
- >50 drainage pipes

Focus:

- Village Brook
- Tannery Brook
- Daisy Field
- Longwood Ave

TAKE-AWAY MESSAGE #1

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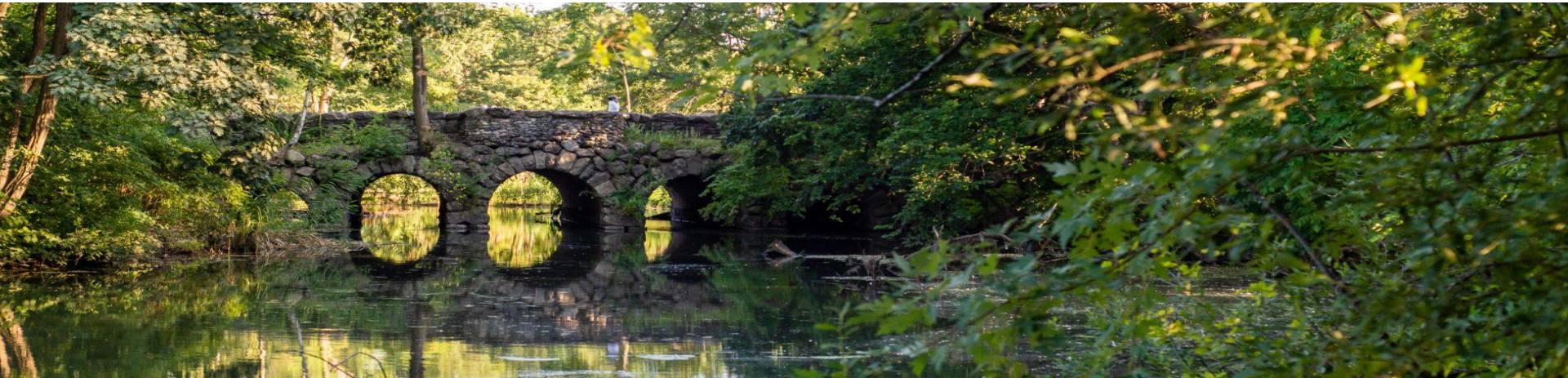
RIVERS ARE WATERSHEDS

The Muddy River is not just a river - it is an entire, interconnected **watershed**.

It spans across Boston, Brookline, and Newton. **Brookline** is a very important part of the watershed.



WATER LEVEL

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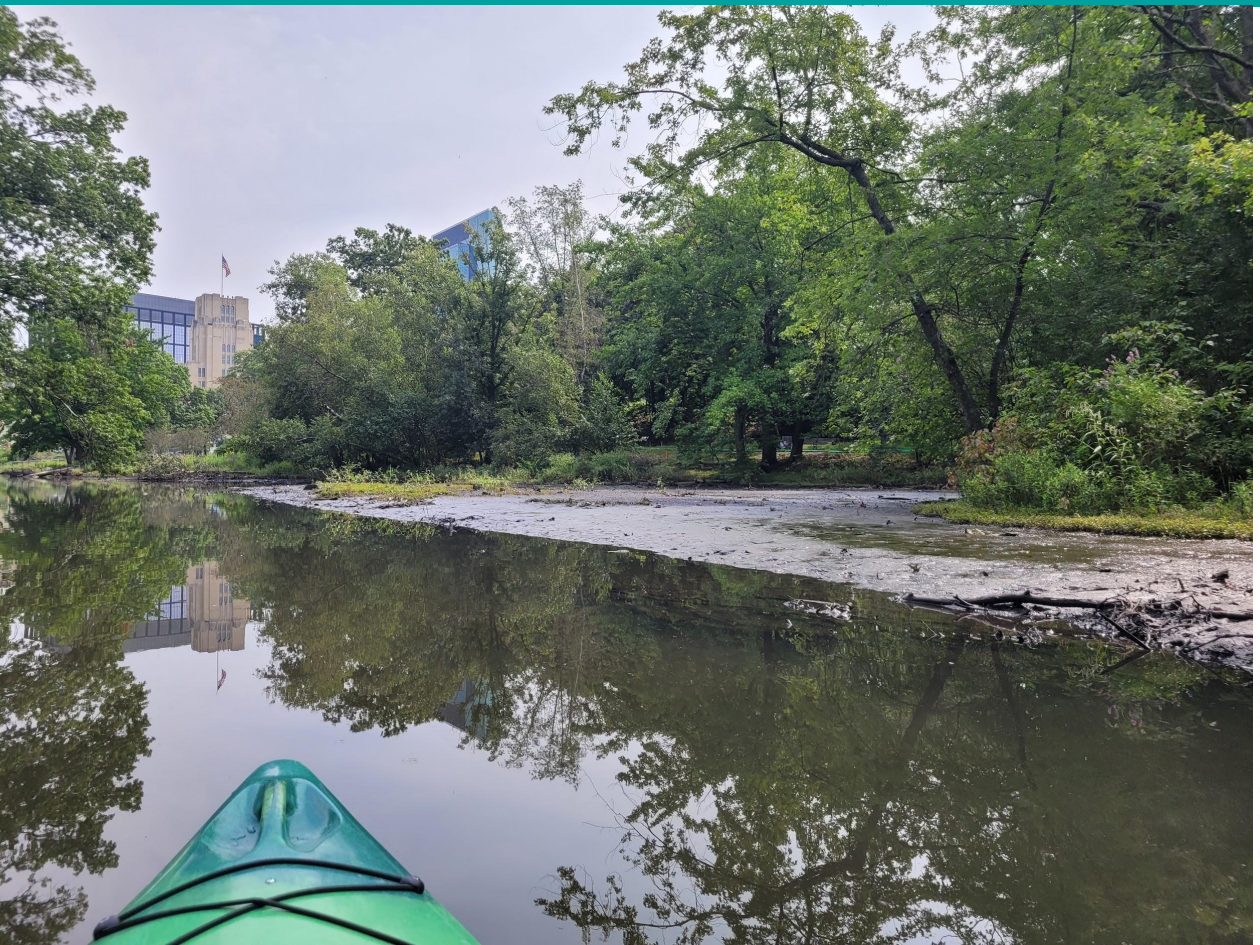
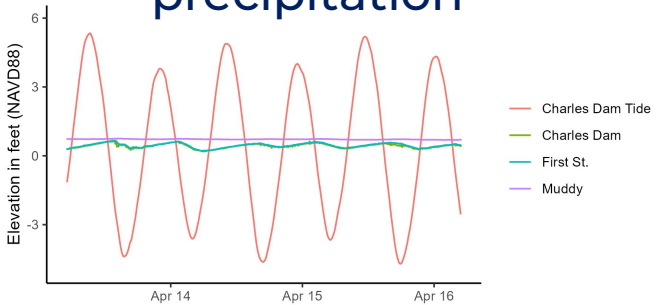


- In dry weather: Muddy water level is determined by the Charles
- In wet weather: Muddy level is determined by precipitation



WATER QUANTITY

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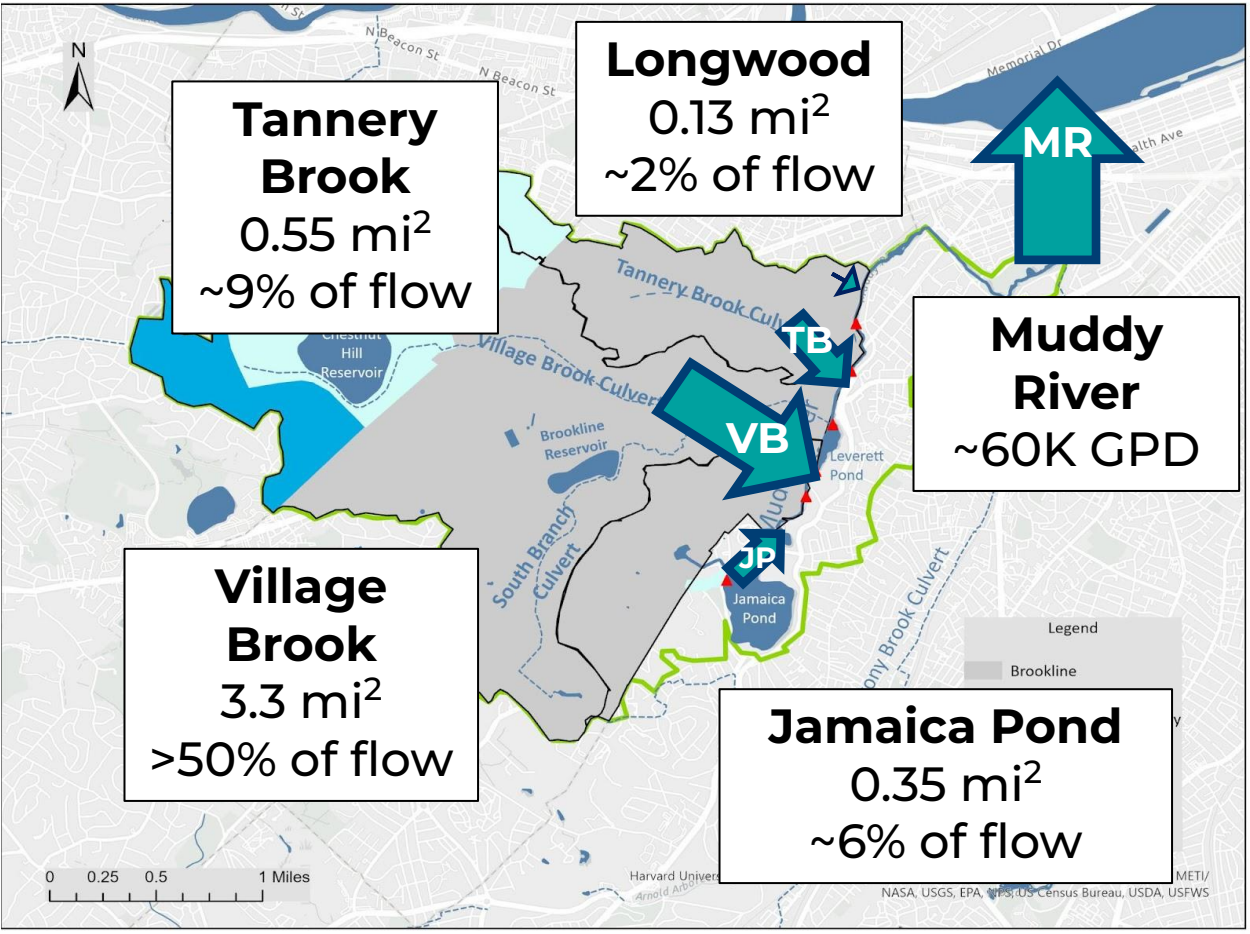

Source	Year	Area (mi²)	Flow (CFS)	Units	Flow (GPD)
BWSC	2012, 2023	7.2	16	Mean	184,813
Stream Stats		6.6	6.55	Median	75,658
USACE	2016	5.93	6	"Normal"	69,305
USGS*	2002	6.3	4.51	Mean	52,094
*Assumed highest quality Study					

"Measuring streamflow along this river is complicated due its physical location, which is in the backwater of the much larger Charles River basin, as well as the numerous hydraulic restrictions…"

- USACE 2016

TAKE-AWAY MESSAGE #2

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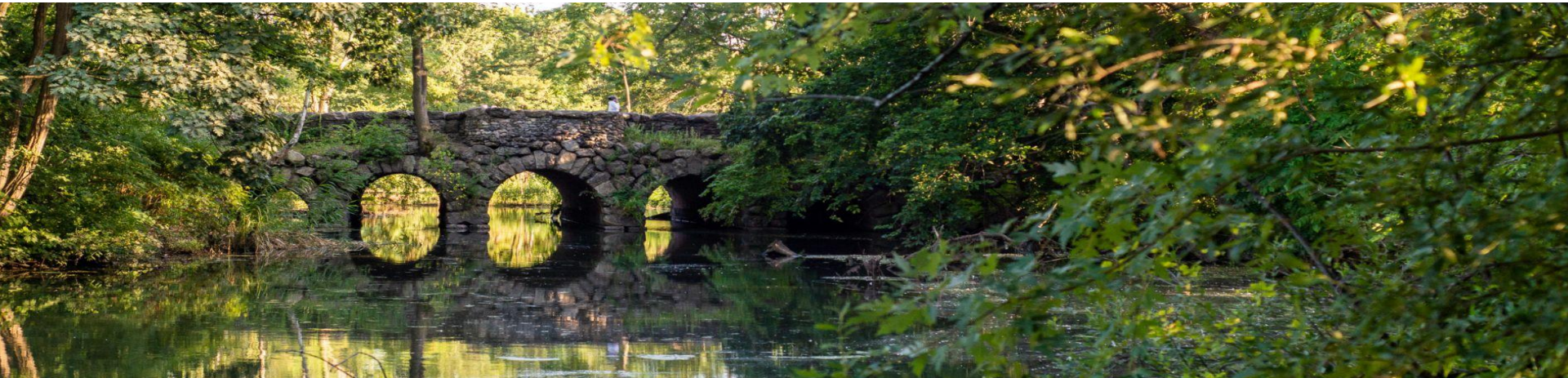
WATER QUALITY & QUANTITY ARE CONNECTED

Water quantity is difficult to measure, but is critical for understanding **where** pollution comes from and **how much** pollution there is.



URBAN STREAM SYNDROME

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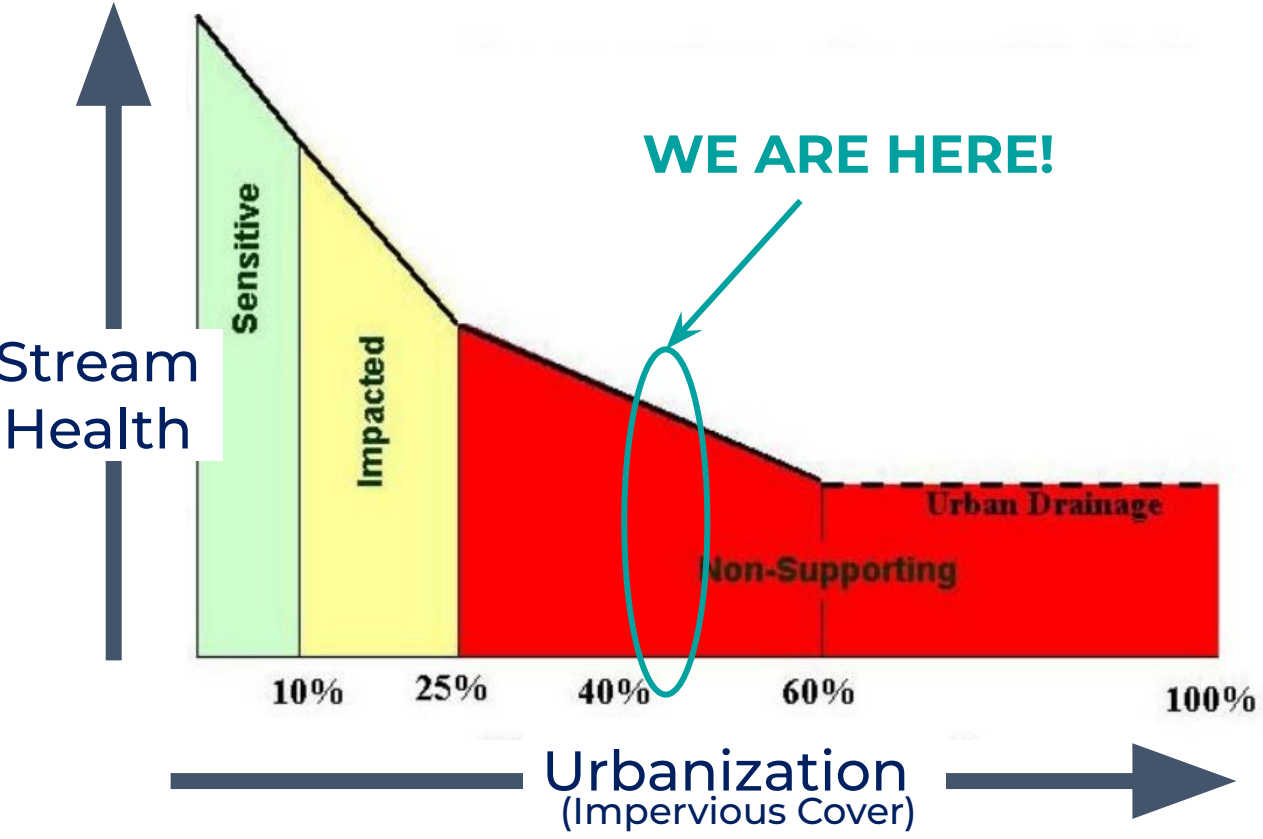

- ↑ High Flows
- ↑ Erosion
- ↑ Nutrient Loading
- ↑ Bacterial Contamination
- ↑ Temperature
- ↓ Habitat Space & Complexity
- ↓ Biodiversity
- ↓ Water Quality

Center for Watershed Protection - Impervious Cover Model

PATHWAYS OF POLLUTION

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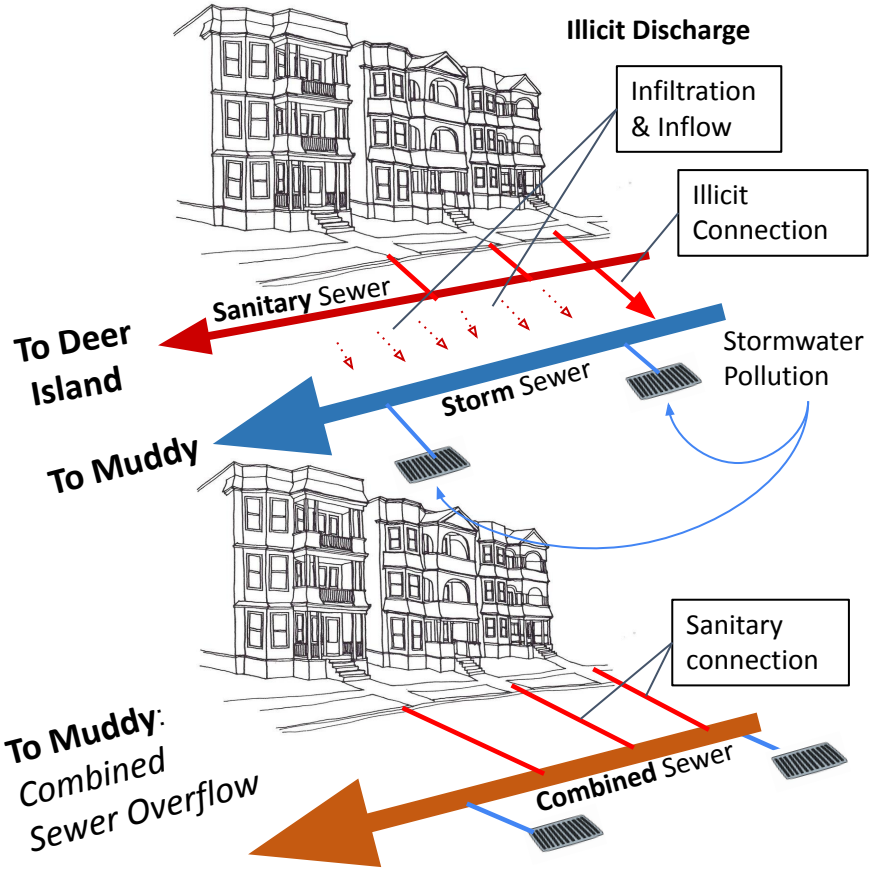

TAKE-AWAY MESSAGE #3

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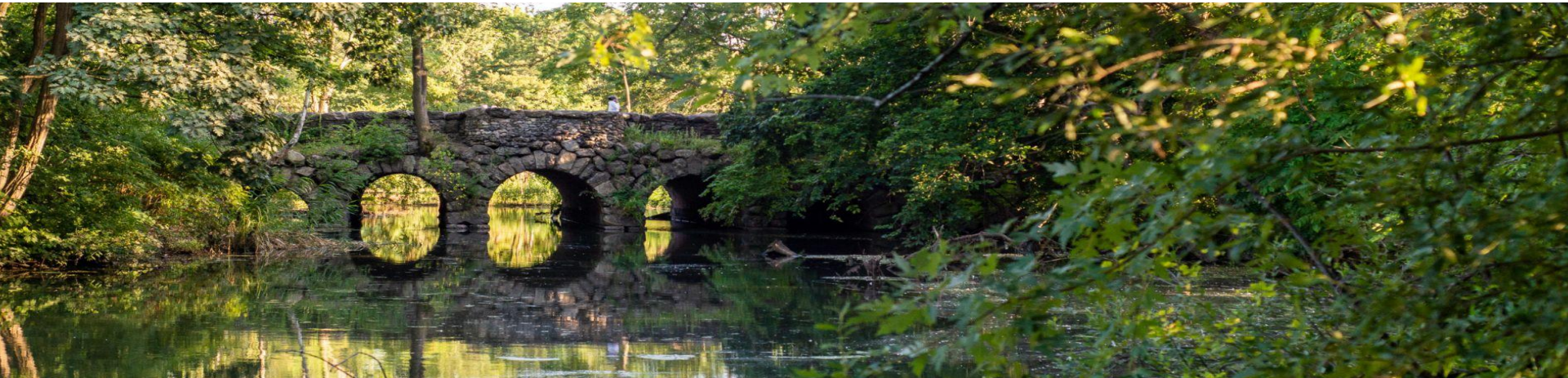
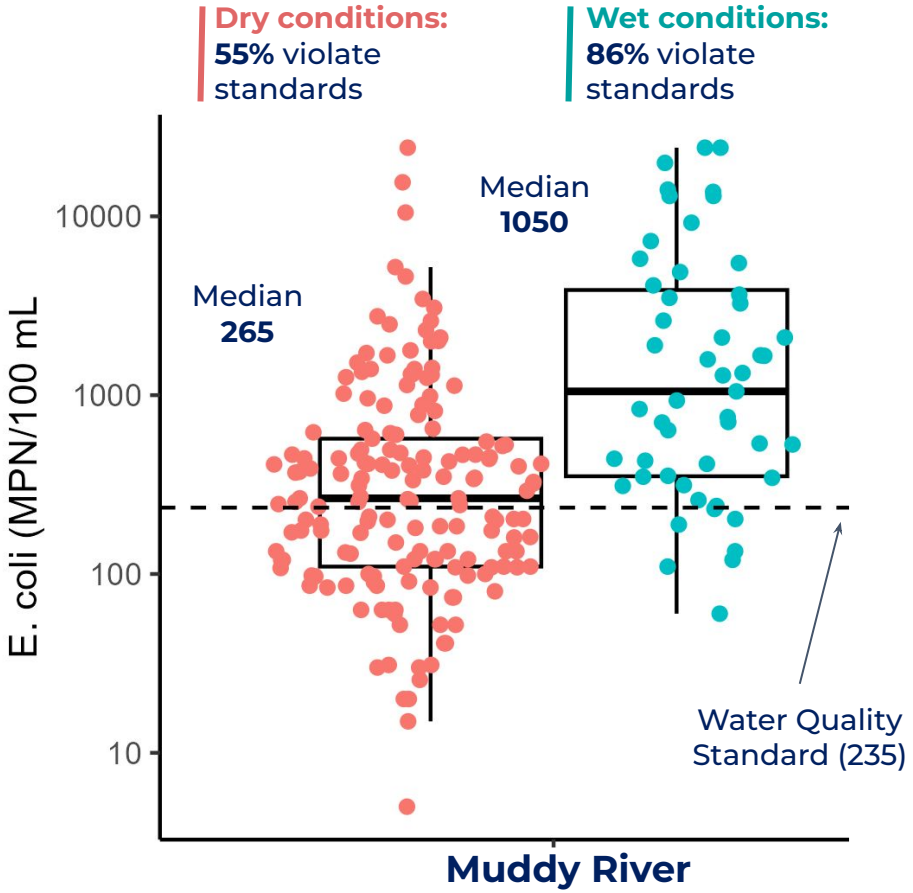
WE NEED TO ADDRESS URBAN DRAINAGE CHALLENGES

Restoring the Muddy River requires us to address these root challenges of urban drainage, including **illicit discharge**, **CSOs**, and **stormwater runoff**.



BACTERIAL CONTAMINATION



SOURCES OF CONTAMINATION

- Contamination in **dry** conditions = **illicit** source
- Contamination in **wet** conditions = **stormwater/CSO** source

BACTERIAL CONTAMINATION

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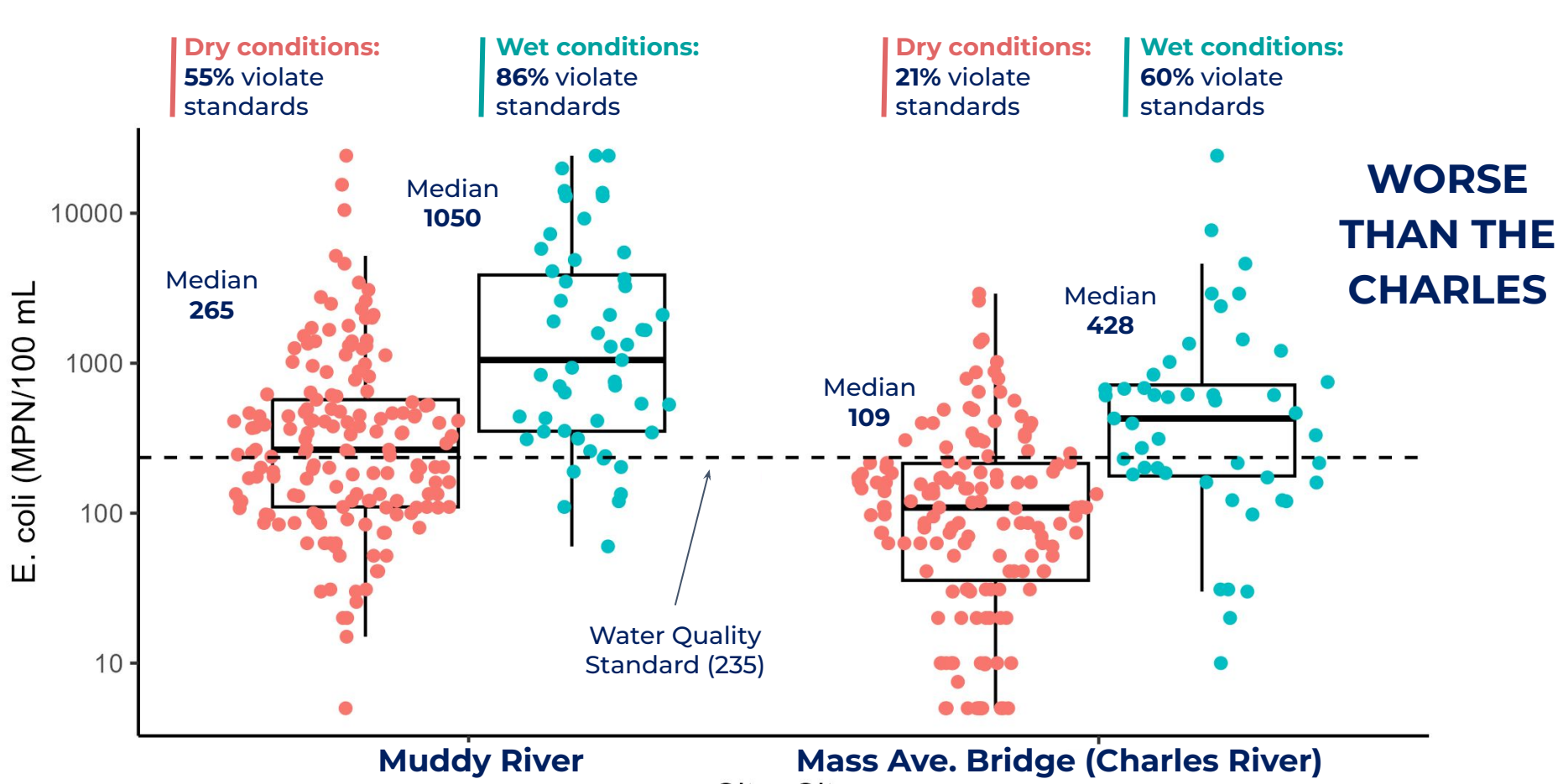

BACTERIAL CONTAMINATION

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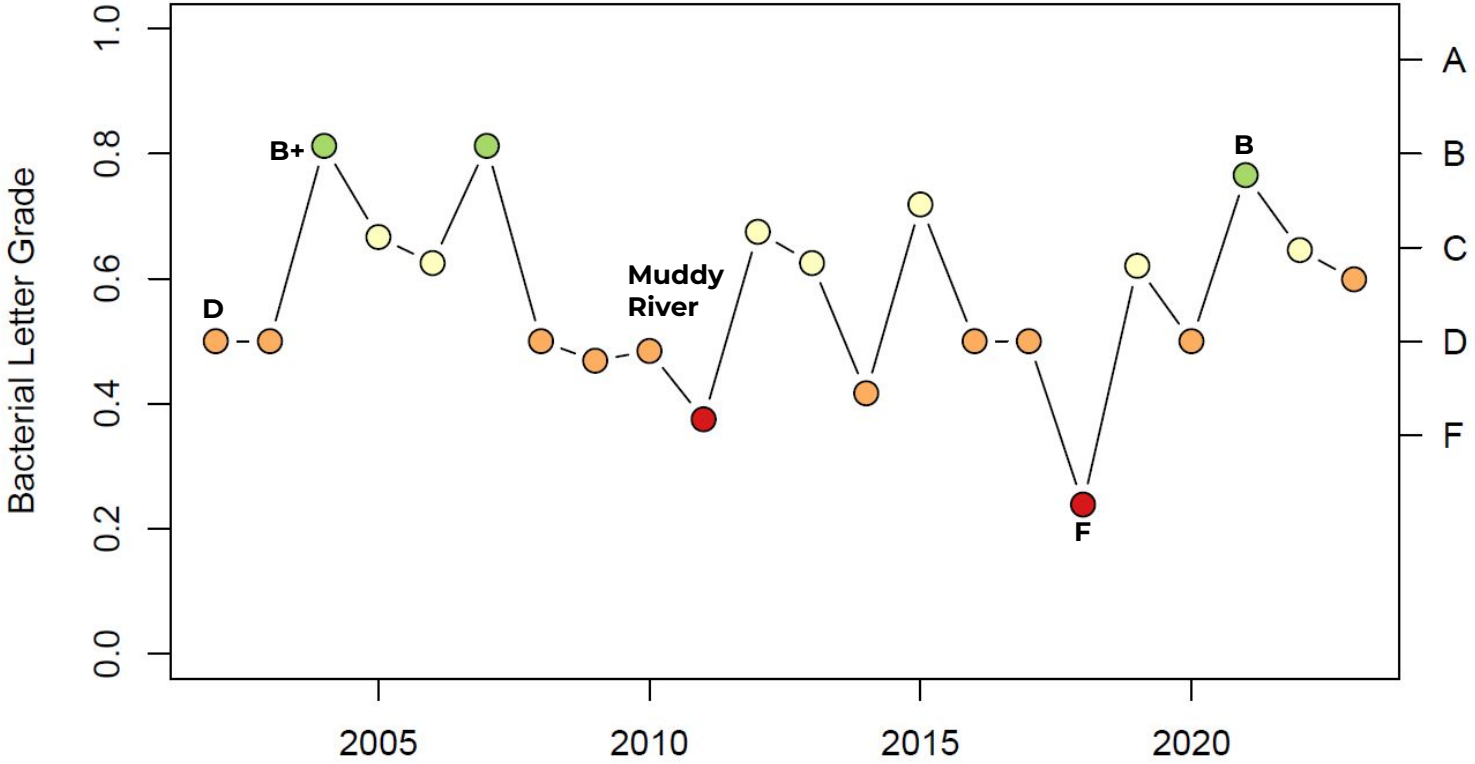
NO IMPROVING TREND FROM 2002 - 2023



Muddy River: Grades range from **F to B+**

BACTERIAL CONTAMINATION

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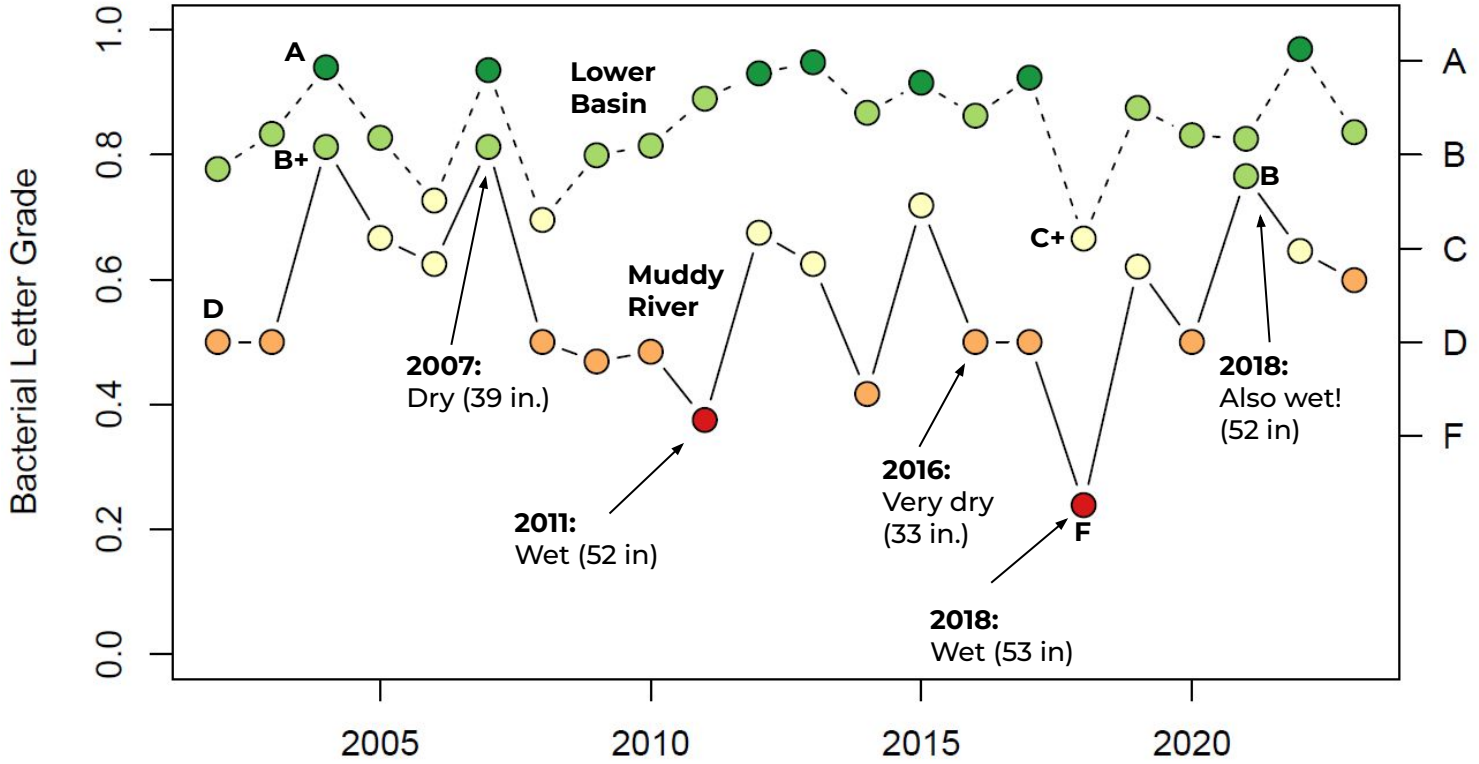
MUDDY WORSE THAN CHARLES RIVER



Charles River: Grades range from **C+ to A**

Poor correlation with Charles River

Only partially explained by precipitation

TAKE-AWAY MESSAGE #4

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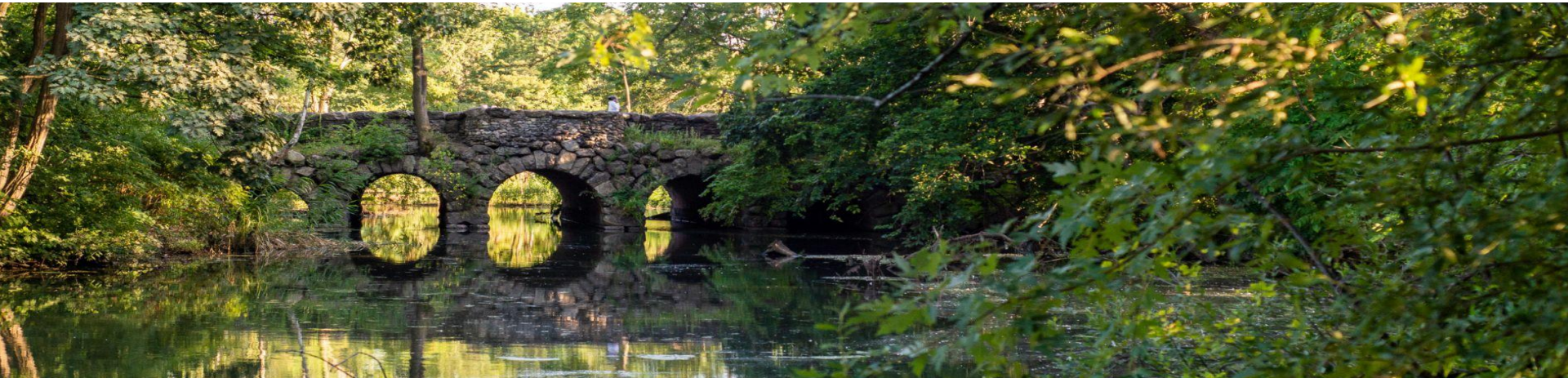
BACTERIAL CONTAMINATION IS THE MOST PRESSING TYPE OF POLLUTION TO THE MUDDY

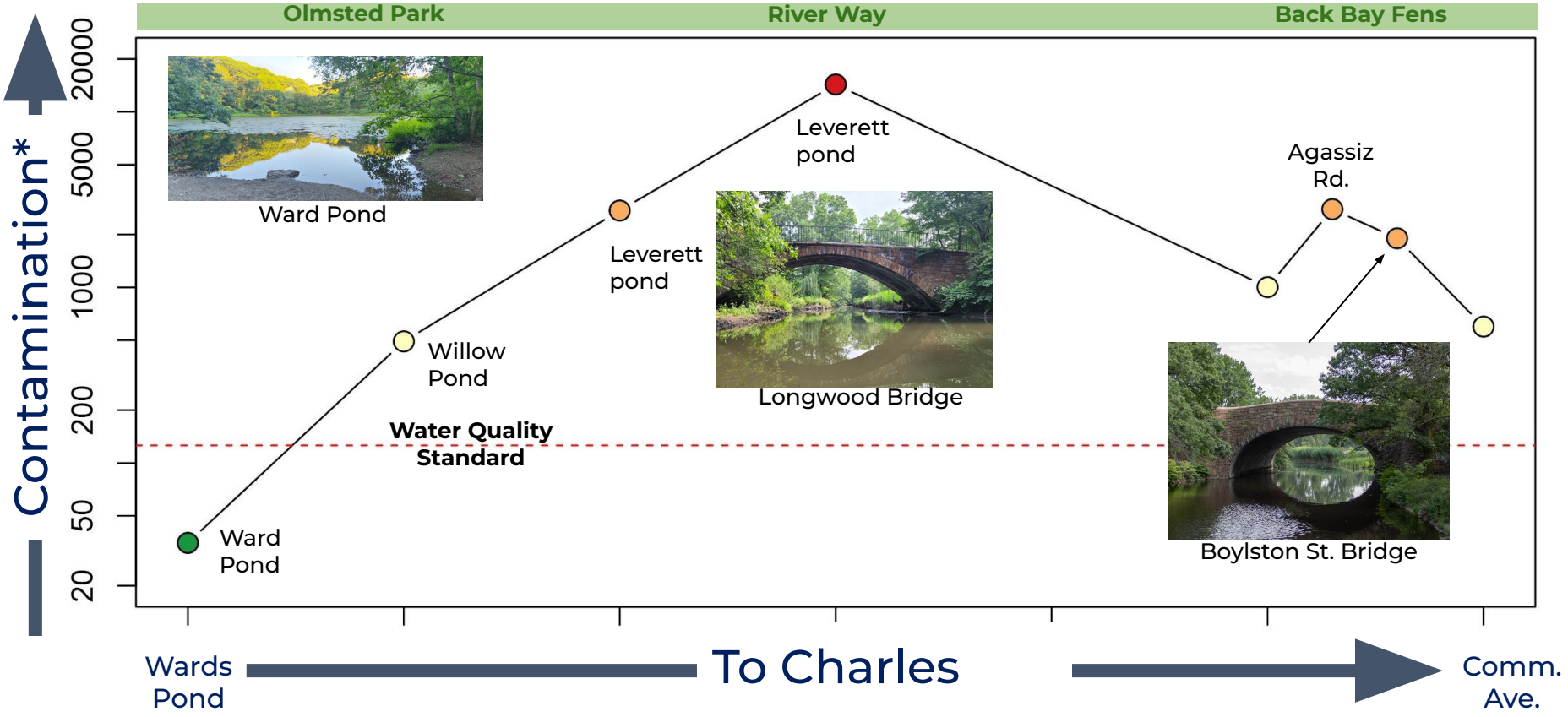
Bacteria levels are **consistently higher** in the Muddy than in the Charles, they **exceed water quality standards**, and are elevated even in dry weather.



BACTERIAL CONTAMINATION

Emerald Necklace CONSERVANCY

Charles River Watershed Association



*E. Coli geometric mean (MPN/100 ML); Data from CRWA 2016, BWSC (2018-2023), Brookline (2018-2023)

BACTERIAL CONTAMINATION

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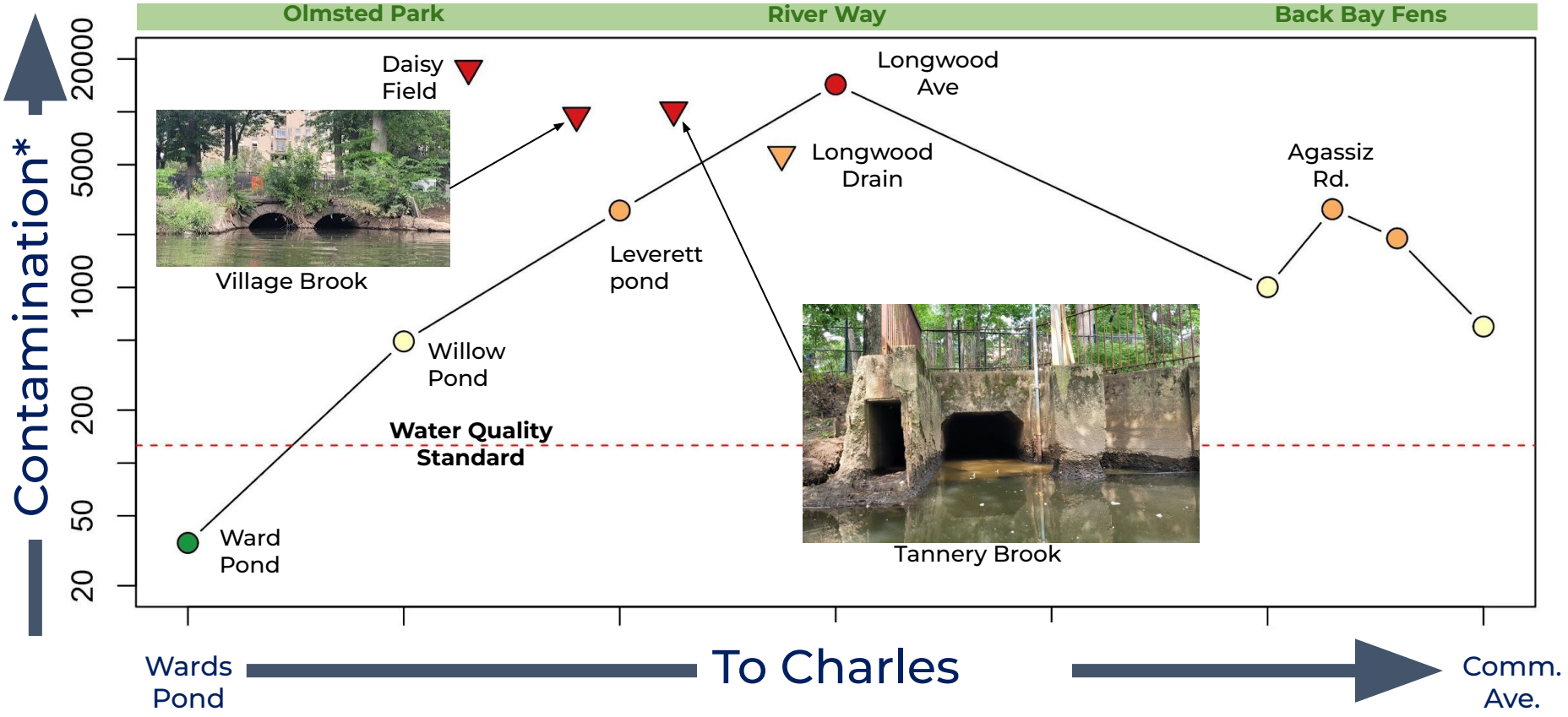

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TAKE-AWAY MESSAGE #5

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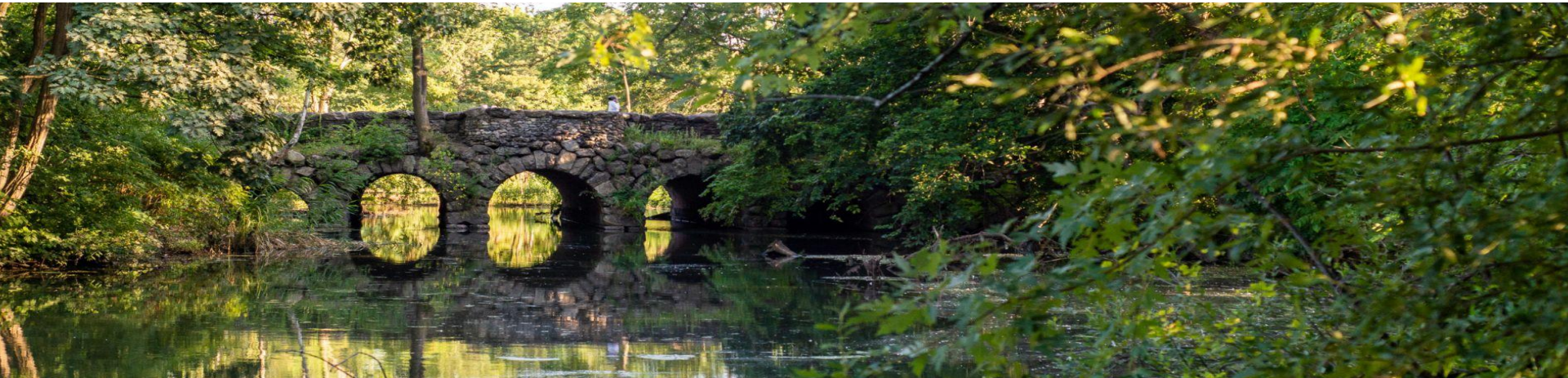
WE NEED TO FOCUS ON THE SOURCES OF BACTERIAL CONTAMINATION

The Muddy has some capacity for **self-purification**.

Contaminated flows **into Leverett Pond** and **upstream of the Longwood Ave bridge** overwhelm that capacity.



WATERSHED CONDITIONS

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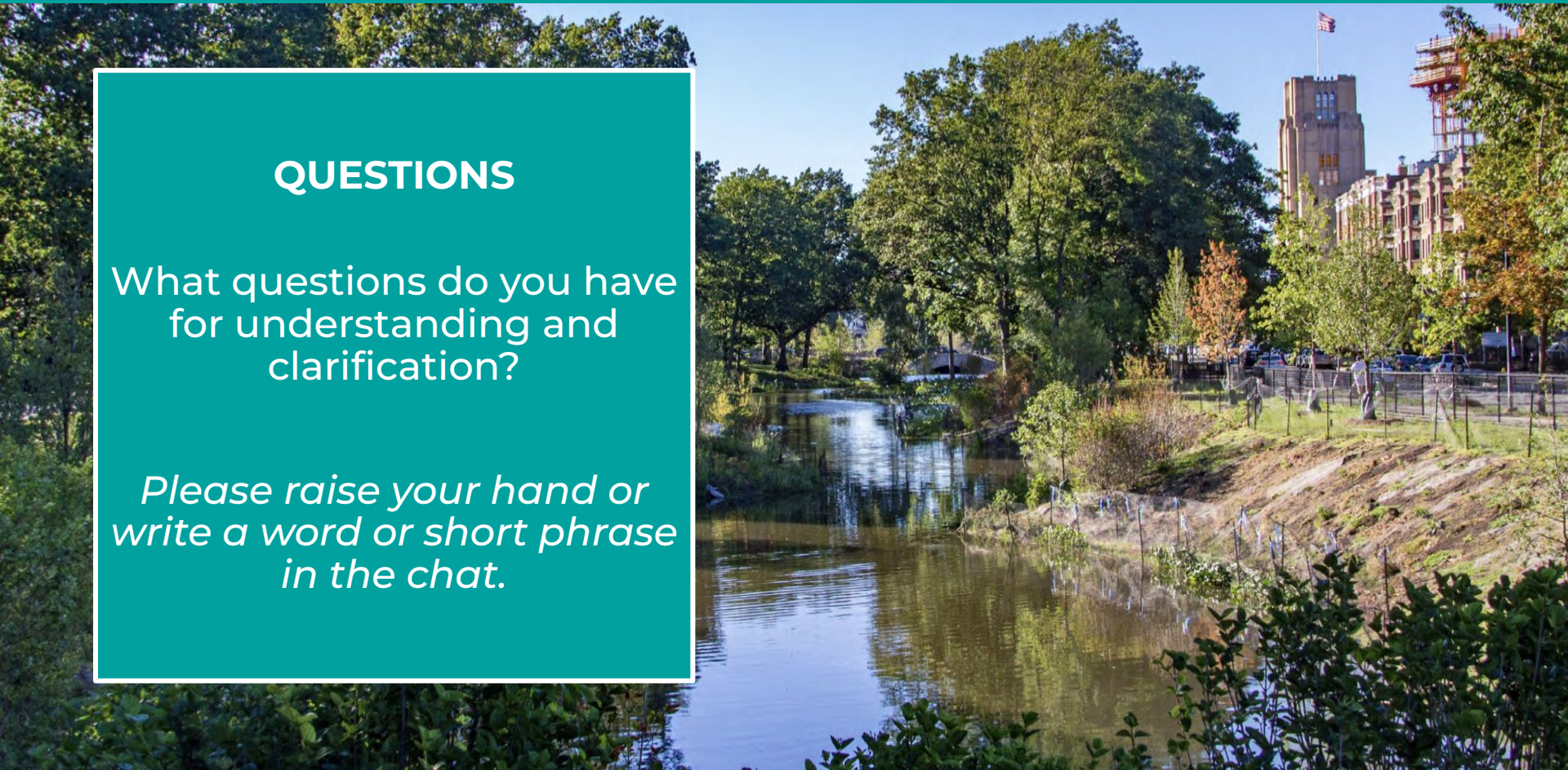

QUESTIONS

What questions do you have for understanding and clarification?

Please raise your hand or write a word or short phrase in the chat.

ILLICIT DISCHARGES

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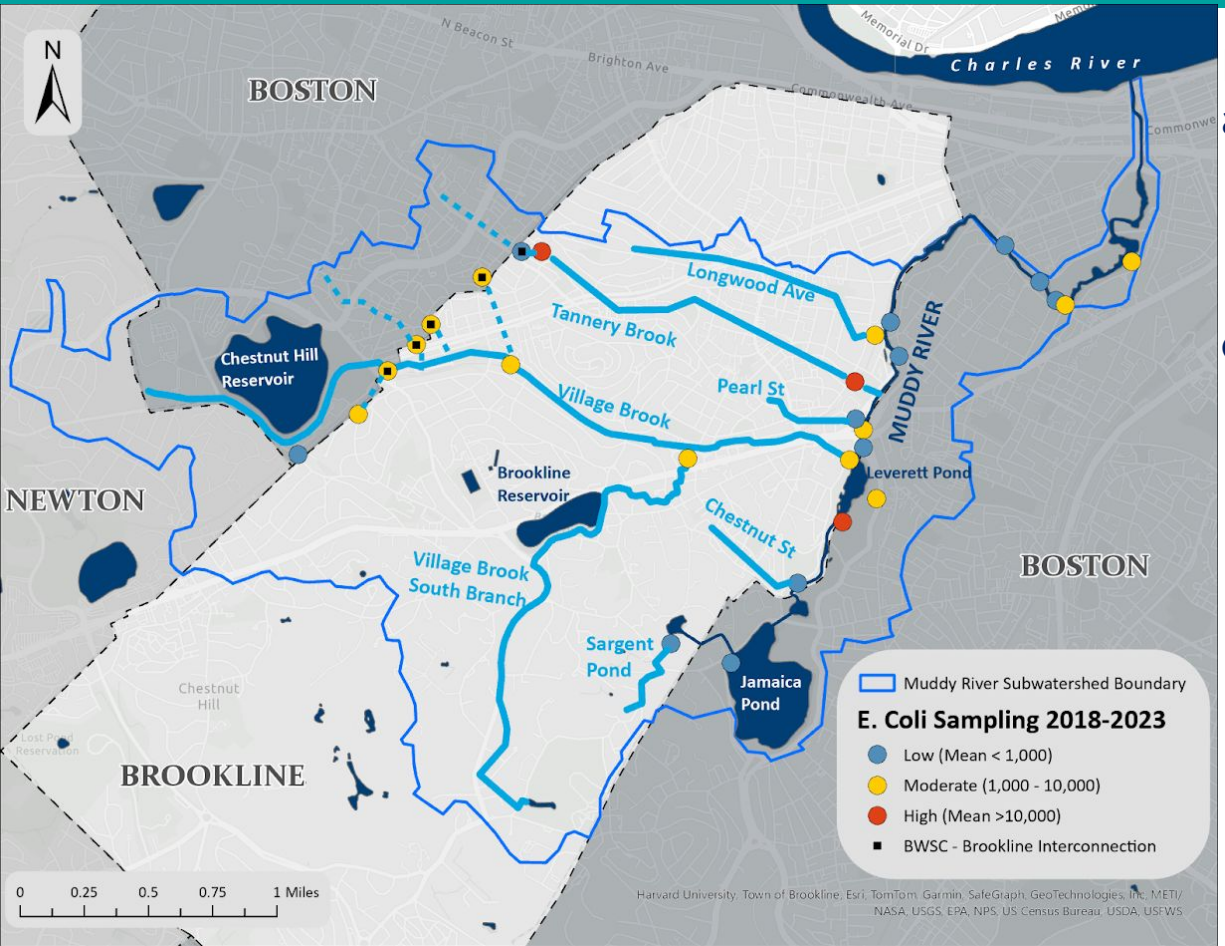

Illicit Discharge Detection and Elimination

- BWSC and Brookline conduct annual sampling and outfall screening to identify potential sources of contamination

Ongoing projects:

- Addressing ID in **Daisy Field Drainage**
- Relining sanitary sewers within **Village Brook drainage**

ILLICIT DISCHARGES

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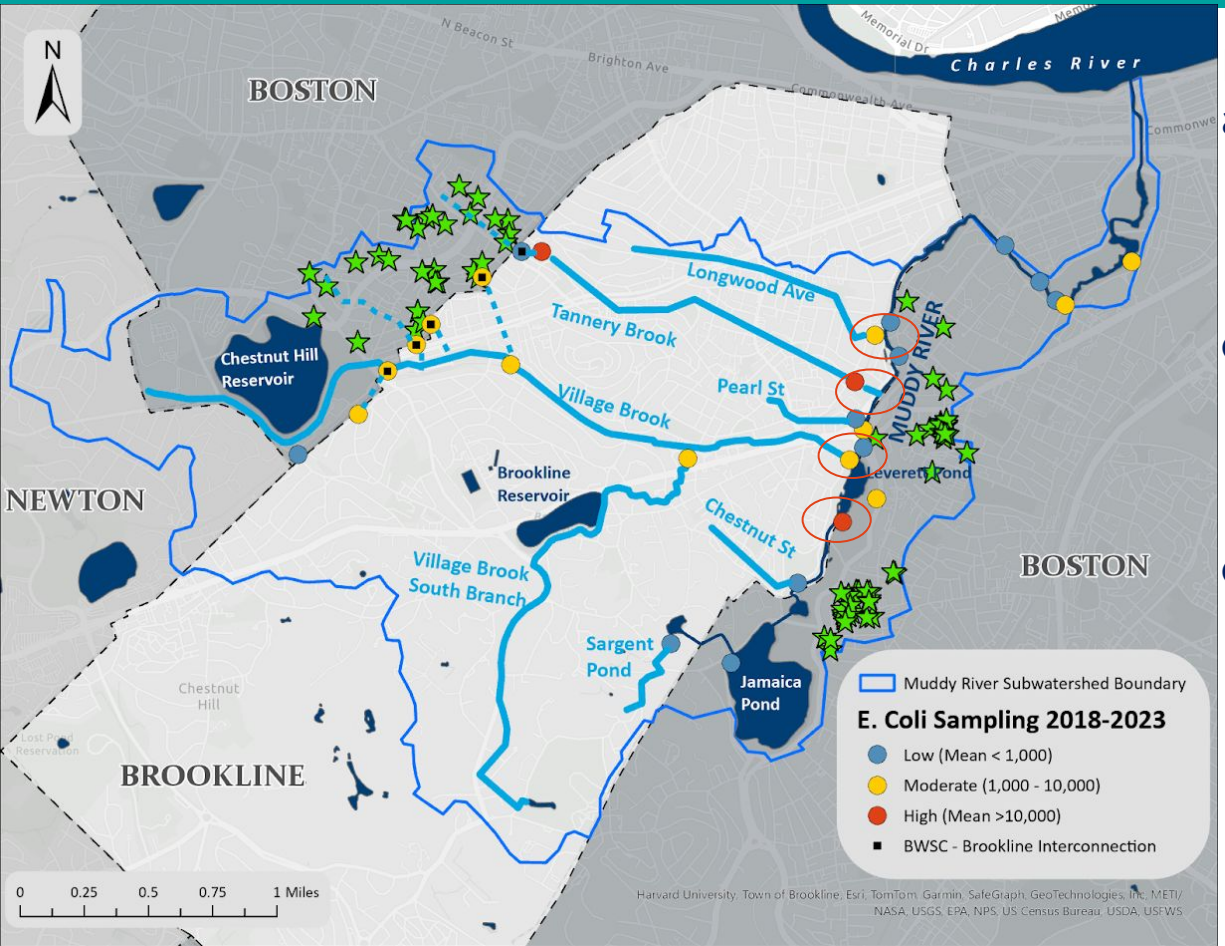
Charles River Watershed Association



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- BWSC and Brookline conduct annual sampling and outfall screening to identify potential sources of contamination

Ongoing projects:

- Addressing ID in **Daisy Field Drainage**
- Relining sanitary sewers within **Village Brook drainage**

Complete Projects

- BWSC: **72** ID, >90,000 GDP
- ★ from the Muddy Watershed since 1986
- Brookline: **54** ID, >19,000 GPD (town-wide), since 2005

ILLICIT DISCHARGES

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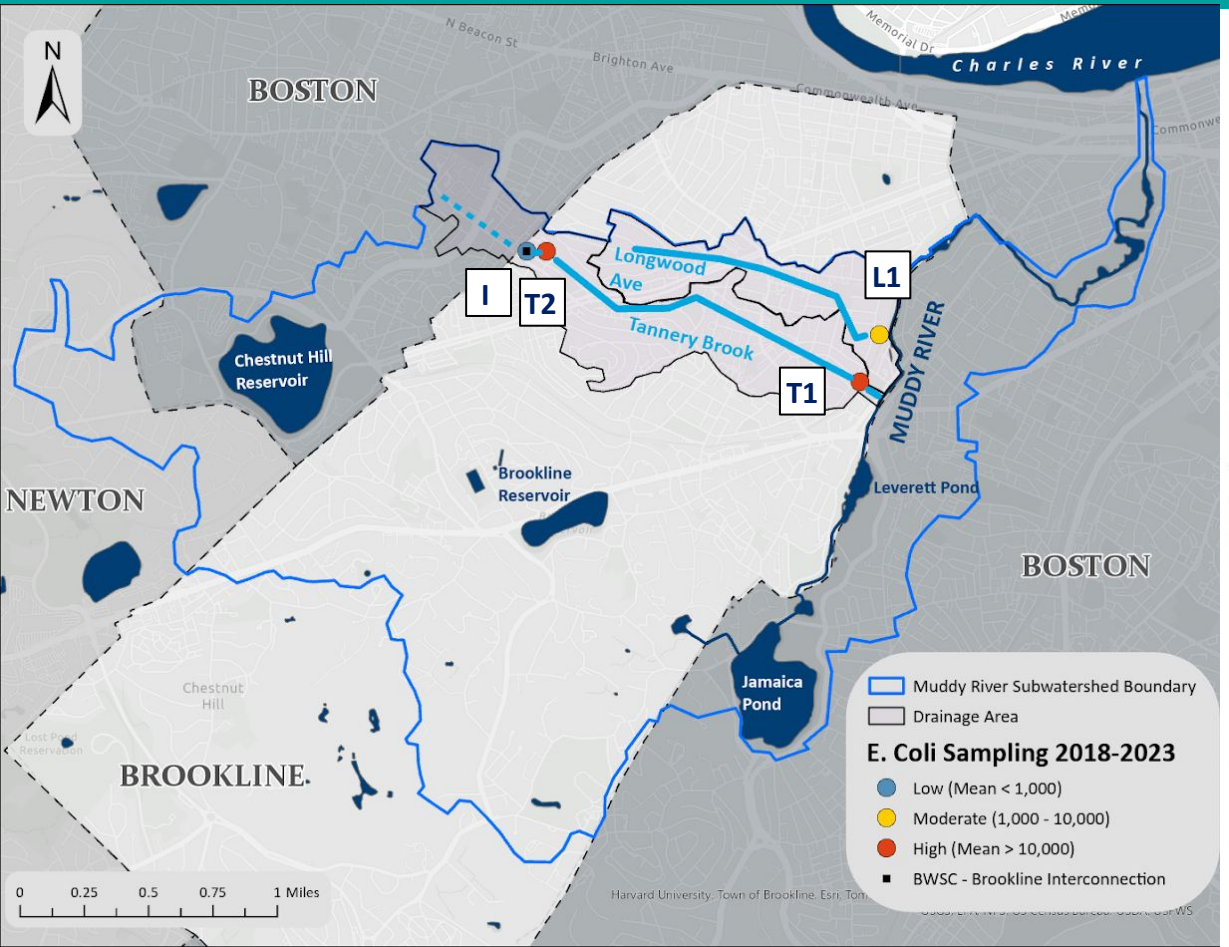

LONGWOOD AVE & TANNERY BROOK

	2018	2019	2020	2020*	2021	2022	2023
Longwood							
L1	30,000	3,000	1,900	11,146	4,900		11,000
Tannery Brook							
T1	5,400	80,000	9,000	24,014	6,900	2,400	8,500
T2	4,500	6,900	80,000		15,000	80,000	19,000
I	3,100	16,000	30		2,900	380	

ILLICIT DISCHARGES

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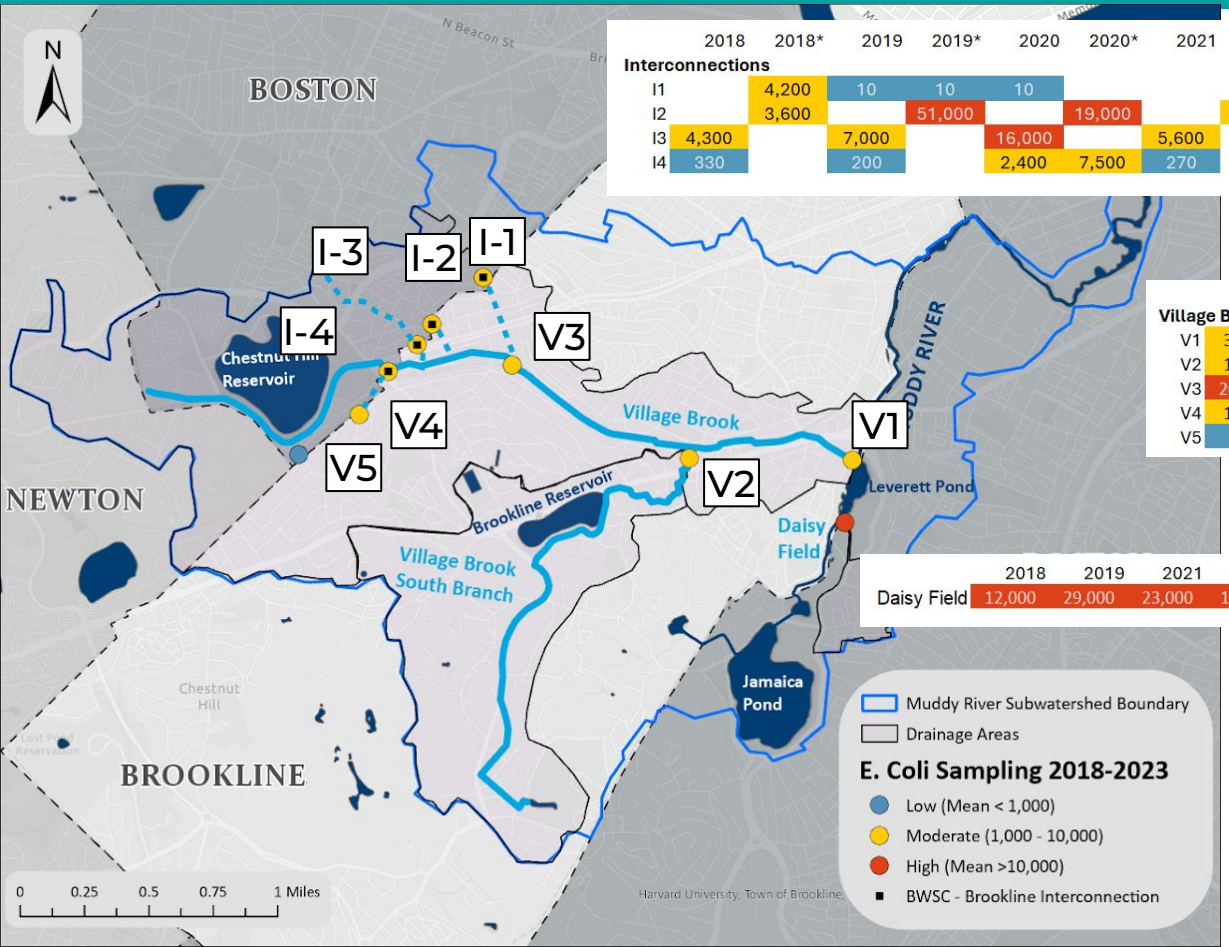

Interconnections	2018	2018*	2019	2019*	2020	2020*	2021	2021*	2022	2022*	2023
I1		4,200	10	10	10					1,900	2,500
I2		3,600		51,000		19,000		7,000		13,000	
I3	4,300		7,000		16,000		5,600		500		6,500
I4	330		200		2,400	7,500	270		2,000		1,900

Village Brook	2018	2019	2020	2020*	2021	2022	2023
V1	3,300	5,800	3,600	38,698	43,000		6,500
V2	1,900	1,000	820		2,500		4,800
V3	20,000	600	560		1,100	14,000	2,700
V4	1,800	11,000	36,000		33,000	5,200	4,100
V5	220	730	160		120		80

	2018	2019	2021	2022	2023
Daisy Field	12,000	29,000	23,000	12,000	13,000

VILLAGE BROOK & DAISY FIELD

TAKE-AWAY MESSAGE #6

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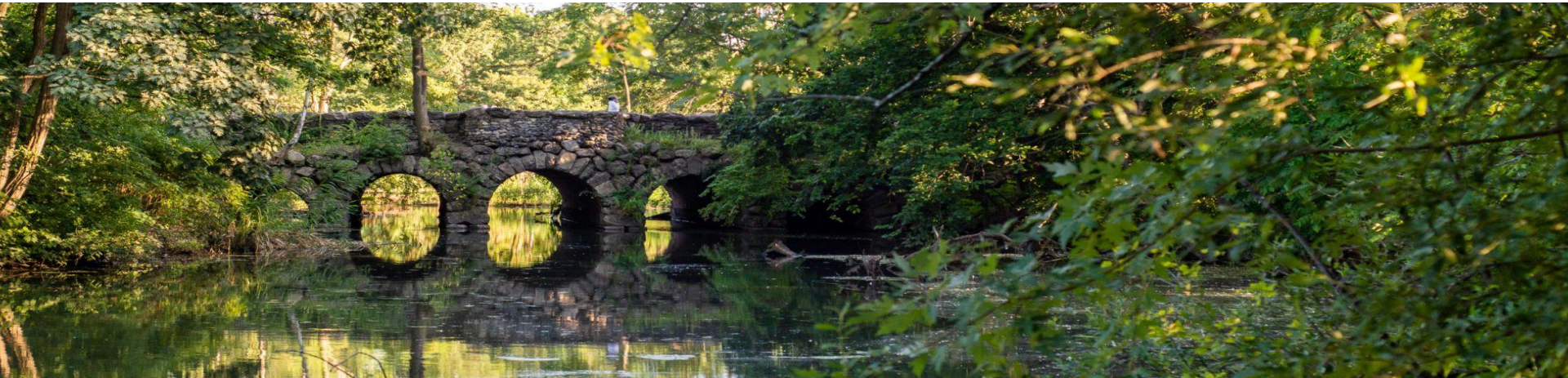
MORE NEEDS TO BE DONE TO FULLY ELIMINATE ILLICIT CONNECTIONS

Illicit connections are the primary source of bacterial contamination, especially evident at **major outfalls** to the Muddy. Though municipalities have made a **substantial effort**, there is more to do.



WATERSHED CONDITIONS

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QUESTIONS

What questions do you have for understanding and clarification?

Please raise your hand or write a word or short phrase in the chat.

RIVERBANK CONDITIONS

- Over 400 acres of riparian habitat along the Muddy River
- Invasive species observed including
  - Phragmites
  - Japanese knotweed
  - Purple loosestrife
  - Mugwort

Phragmites
(*Phragmites australis*)

Japanese knotweed
(*Reynoutria japonica)*

Purple loosestrife
(*Lythrum salicaria*)

RIVERBANK CONDITIONS

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Phase II restoration area: Some purple loosestrife but mainly good diversity and healthy established plantings. Many dragonflies and turtles.

RIVERBANK CONDITIONS

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Undercut banks and low water levels

Fences are accumulating sediment and debris, and in places collapsing

TAKE-AWAY MESSAGE #7

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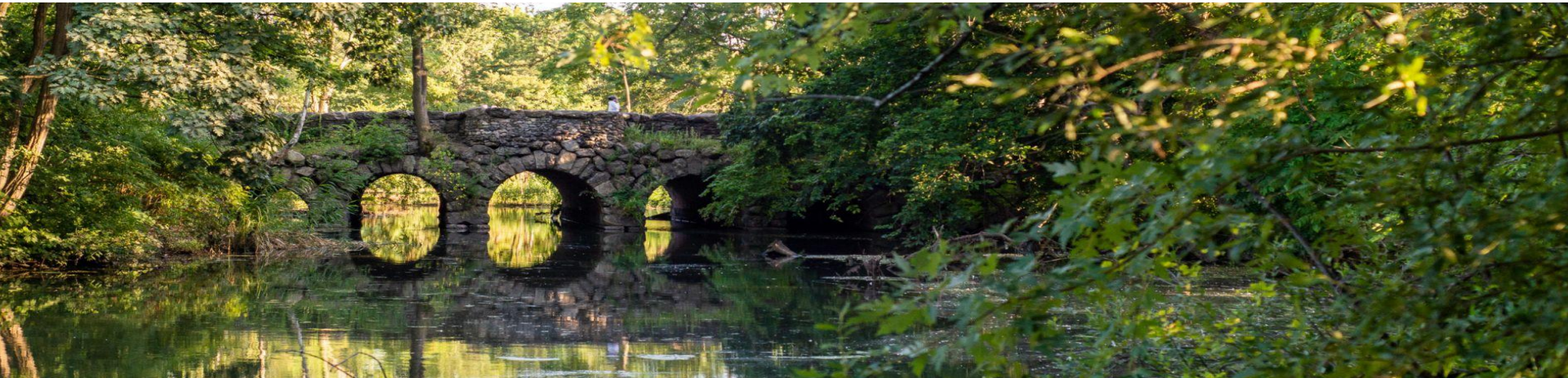
RECENT INVESTMENTS HAVE BEEN MADE INTO THE RIVERBANKS, BUT MAINTENANCE AND INVASIVE MANAGEMENT ARE NEEDED

These **riparian areas** have tremendous capacity to **improve water quality** in the Muddy River.



WATERSHED CONDITIONS

Emerald Necklace CONSERVANCY

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YOUR FEEDBACK

What questions do you have for understanding and clarification?

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FUTURE
CONSIDERATIONS

CLIMATE IMPACTS

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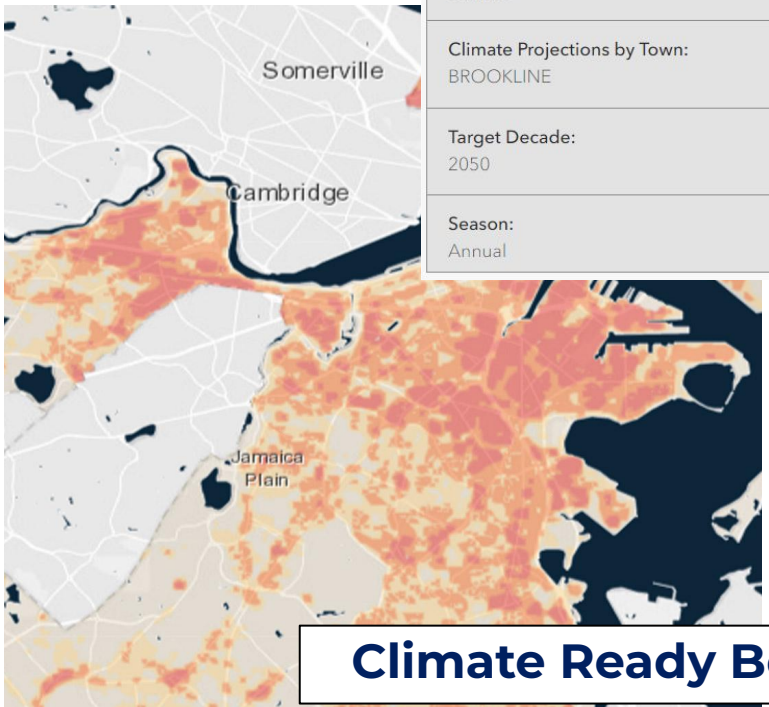
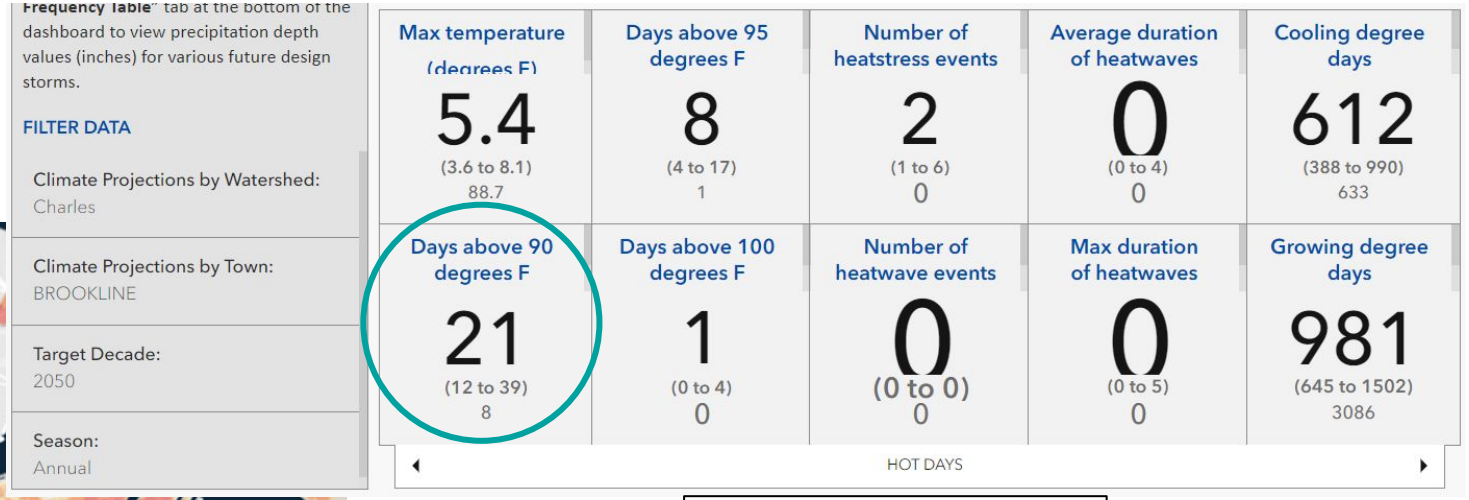


Climate Ready Boston



Resilient MA

- Brookline Flooding Model being developed

PLANNED PROJECTS

- Willow Pond dredging
- Daisy Field Green Infrastructure
- DCR Outfall Rehabilitation
- MassDOT Storrow Drive realignment at Charlesgate
- Charlesgate Revitalization

Landing Studio

REGULATORY FRAMEWORK

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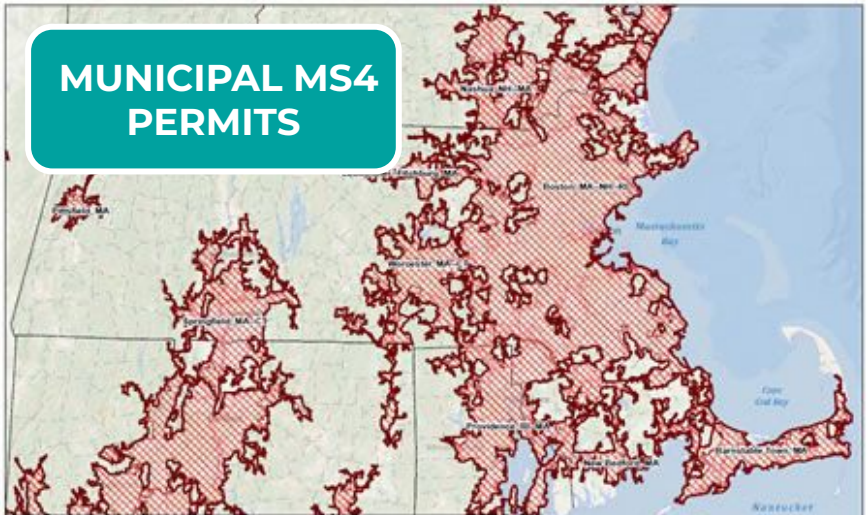
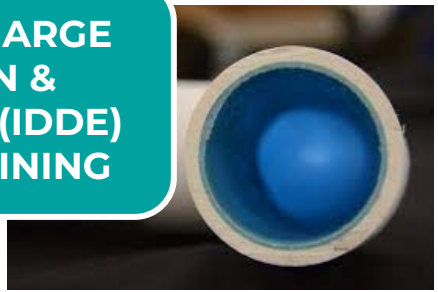
Charles River Watershed Association

MUNICIPAL MS4 PERMITS



ILLICIT DISCHARGE DETECTION & ELIMINATION (IDDE) and PIPE RELINING



- Brookline IDDE
- BWSC 2018 Consent Decree

Large impervious properties will be required to reduce pollution.

BIG BOX STORES, UNIVERSITIES, STRIP MALLS, & INDUSTRIAL LANDS WILL BE REGULATED JUST LIKE CITIES & TOWNS.

Thanks to the Clean Water Act, large polluters will now be held responsible for the disproportionate impact they have on our waterways.

LARGE IMPERVIOUS PROPERTIES MAKE UP:

OF THE WATERSHED

OF THE POLLUTION

LARGE PARCEL PERMITS (RDA)

TOOLBOX

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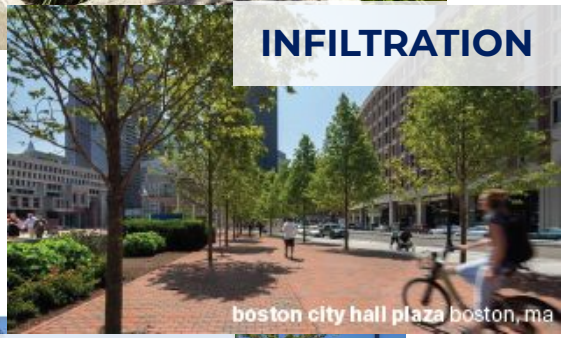
BIORETENTION

INFILTRATION



PERMEABLE PAVEMENT

	Improved Quality of Life	Reduced Heat Island	Improved Air Quality	Community Involvement	Job Creation	Reduced Energy Costs	Carbon Sequestration	Habitat Improvement	Increased Property Value
Bioretention (Infiltration)	●	●	●	●	●	◐	●	●	●
Biofiltration	●	●	●	●	●	◐	●	●	●
Bioretention Planters	●	●	●	●	●	◐	●	●	●
Tree Filter	●	●	●	●	●	◐	●	●	●
Sub-Surface Infiltration	○	○	○	○	◐	○	○	○	○
Infiltration Trench	○	◐	◐	○	◐	○	◐	◐	○
Surface Infiltration Basin	●	●	●	●	●	◐	●	●	●
Porous Asphalt	○	○	○	○	●	○	○	○	○
Permeable Pavers	◐	○	○	○	●	○	○	○	◐
Green Roofs	●	●	●	●	●	●	●	●	●
Blue Roofs	○	◐	○	○	◐	◐	○	○	○
Cisterns	◐	○	○	○	●	○	○	○	◐

○ Little to No Benefit ◐ Moderate Benefit ● High Benefit

OTHER

- Depaving
- Dredging
- In-stream treatment

Central and/or **Distributed**

Source: BWSC GI Handbook

PRECEDENT PROJECTS

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ALEWIFE RESERVATION CONSTRUCTED WETLAND

- **3.5 acre** wetland habitat
- Treats stormwater flows from **400 acres**
- **Equilizes flow** from 10-year storm
- Treated water flows to Alewife Brook and Mystic River (Cambridge, MA)

PRECEDENT PROJECTS

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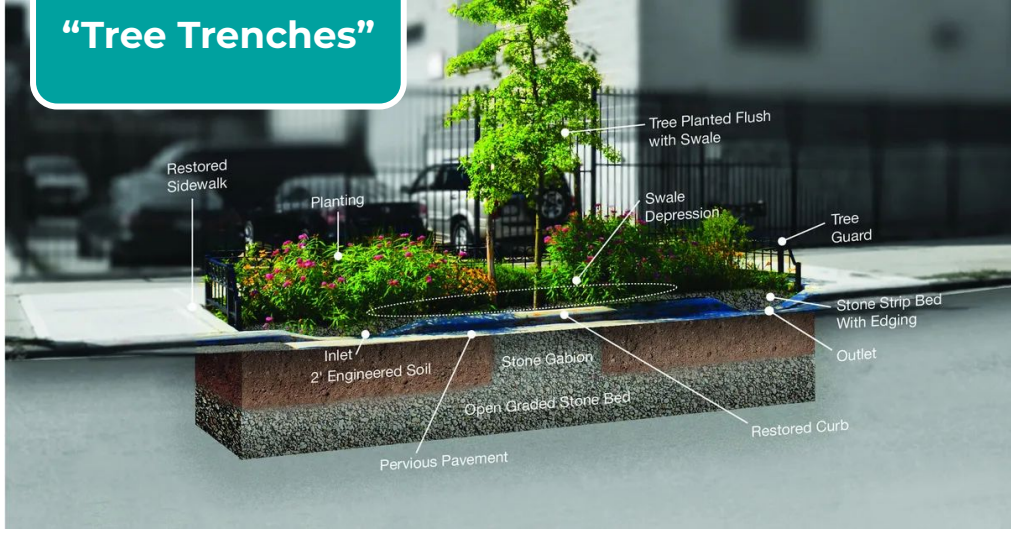
LA STORMWATER TREATMENT FACILITY

- Treat and divert stormwater from 5,000 acres
- Capacity of 2-4 MGD
- Advanced treatment, constructed wetlands, water reuse

PRECEDENT PROJECTS

- Integrated Green Stormwater Infrastructure
  - Philadelphia, New York, Portland Oregon

“Tree Trenches”



Keep the water out of the pipes!

FUTURE CONSIDERATIONS

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Charles River Watershed Association

YOUR FEEDBACK

What concepts presented tonight are you especially excited about?

How do you want to be involved in this process?

Please raise your hand or write a word or short phrase in the chat.

VISION PLAN NEXT STEPS

Emerald Necklace CONSERVANCY

Charles River Watershed Association

COMMUNITY PROCESS

TECHNICAL REVIEW

THANK YOU

Emerald Necklace CONSERVANCY

Charles River Watershed Association

THANK YOU FOR ATTENDING

PLEASE STAY INVOLVED

REACH OUT ANY TIME TO:

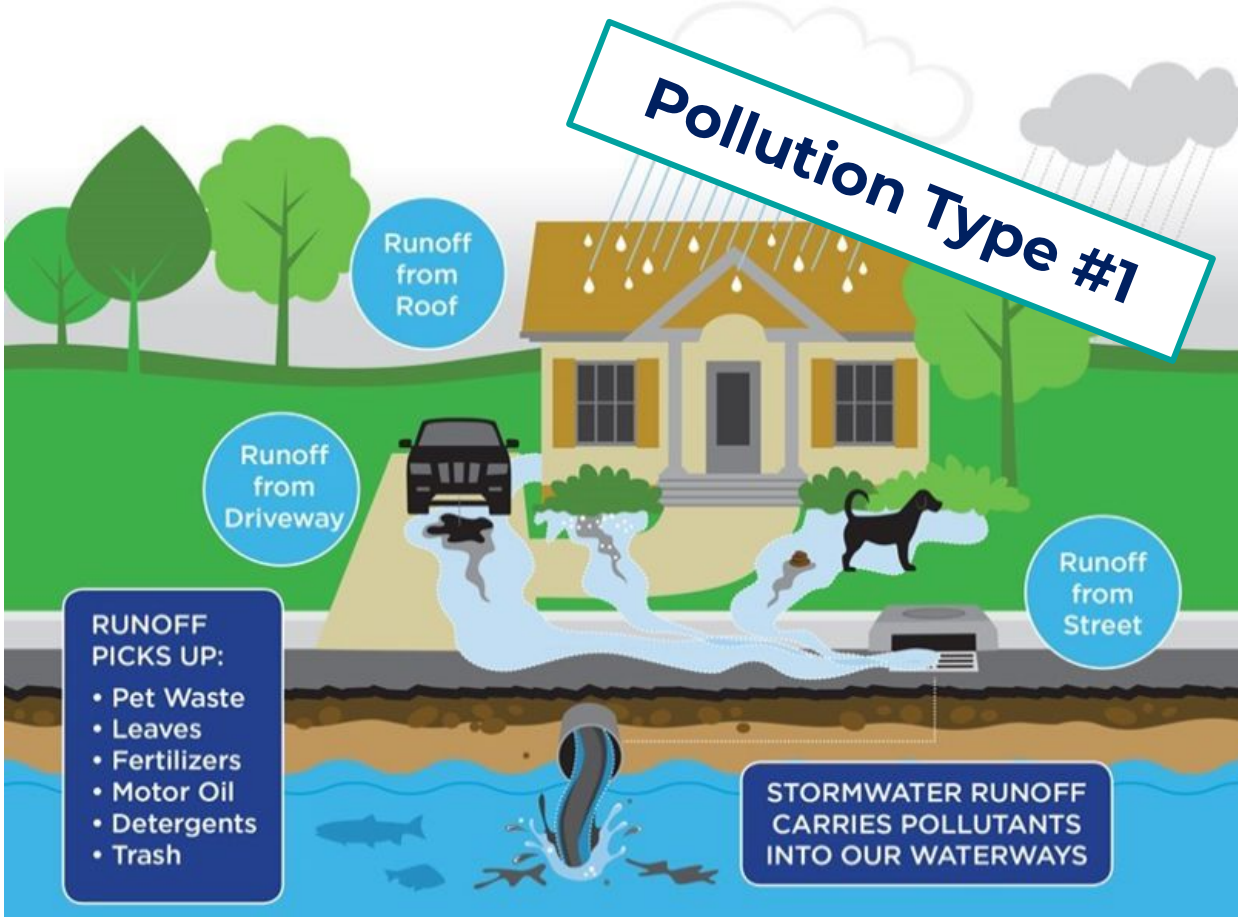
Lisa Kumpf, CRWA

Senior River Restoration Program Manager

Lkumpf@crwa.org

STORMWATER

- Non-point source pollution
- Stormwater runoff carries pollution from streets into river
- Worsened by aging sewer & stormwater infrastructure
- Main pollutant is phosphorus - excess nutrients from leaves, fertilizers, detergents, etc



COMBINED SEWER OVERFLOWS

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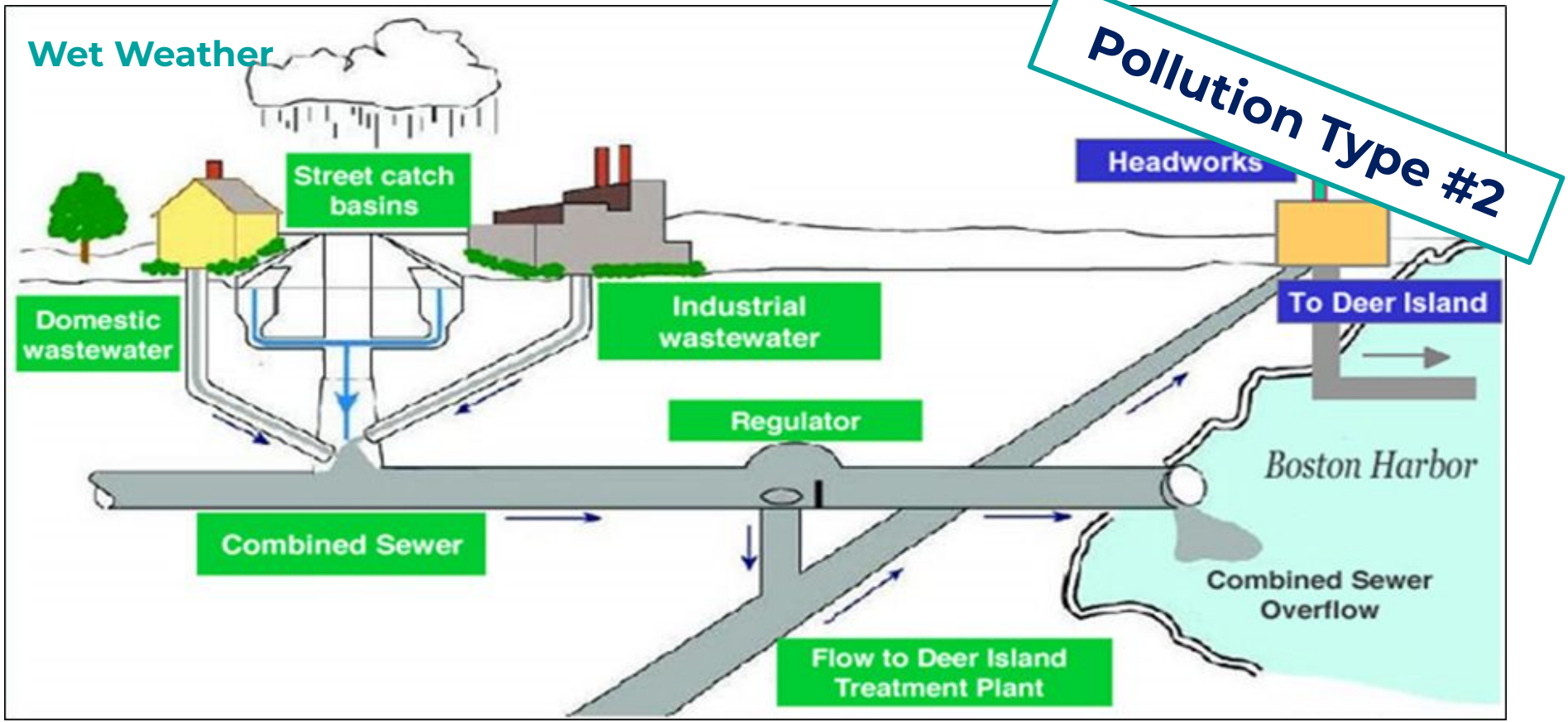
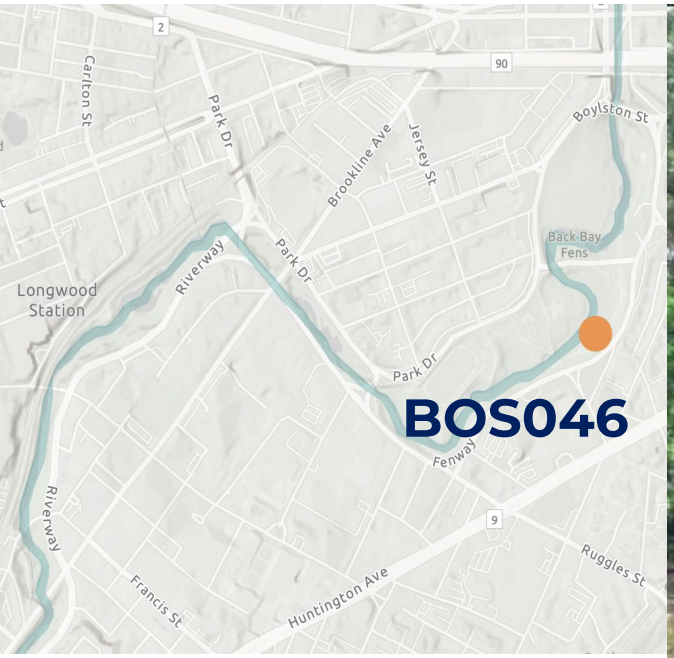


COMBINED SEWER OVERFLOW

Emerald Necklace CONSERVANCY

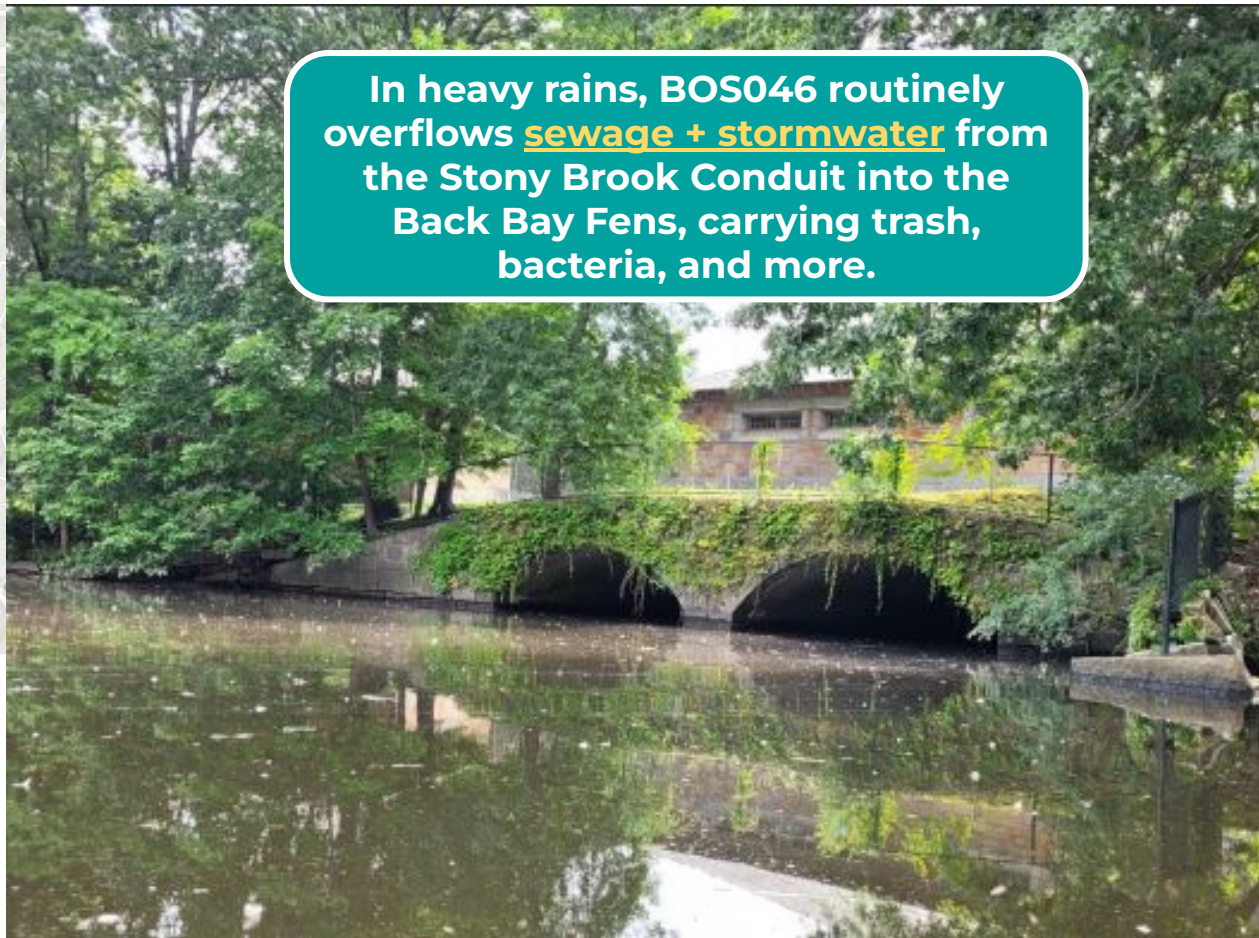
Charles River Watershed Association



IN 2023:

4 activations

4.3 million gallons



In heavy rains, BOS046 routinely overflows sewage + stormwater from the Stony Brook Conduit into the Back Bay Fens, carrying trash, bacteria, and more.

ILLICIT DISCHARGES

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Charles River Watershed Association

Table 2: Land Uses, Generating Sites and Activities That Produce Indirect Discharges

Land Use	Generating Site	Activity that Produces Discharge
Residential	• Apartments • Multi-family • Single Family Detached	• Car Washing • Driveway Cleaning • Dumping/Spills (e.g., leaf litter and RV/boat holding tank effluent) • Equipment Washdowns • Lawn/Landscape Watering • Septic System Maintenance • Swimming Pool Discharges
Commercial	• Campgrounds/RV parks • Car Dealers/Rental Car Companies • Car Washes • Commercial Laundry/Dry Cleaning • Gas Stations/Auto Repair Shops • Marinas • Nurseries and Garden Centers • Oil Change Shops • Restaurants • Swimming Pools	• Building Maintenance (powe • Dumping/Spills • Landscaping/Grounds Care • Outdoor Fluid Storage • Parking Lot Maintenance (p • Vehicle Fueling • Vehicle Maintenance/Repai • Vehicle Washing • Washdown of greasy equipr traps
Industrial	• Auto recyclers • Beverages and brewing • Construction vehicle washouts • Distribution centers • Food processing • Garbage truck washouts • Marinas, boat building and repair • Metal plating operations • Paper and wood products • Petroleum storage and refining • Printing	• All commercial activities • Industrial process water or r • Loading and un-loading are • Outdoor material storage (fl
Institutional	• Cemeteries • Churches • Corporate Campuses • Hospitals • Schools and Universities	• Building Maintenance (e.g., power w • Dumping/Spills • Landscaping/Grounds Care (irrigation) • Parking Lot Maintenance (power washing) • Vehicle Washing
Municipal	• Airports • Landfills • Maintenance Depots • Municipal Fleet Storage Areas • Ports • Public Works Yards • Streets and Highways	• Building Maintenance (power washing) • Dumping/Spills • Landscaping/Grounds Care (irrigation) • Outdoor Fluid Storage • Parking Lot Maintenance (power washing) • Road Maintenance • Spill Prevention/Response • Vehicle Fueling • Vehicle Maintenance/Repair • Vehicle Washing

Pollution Type #3

WATER QUANTITY

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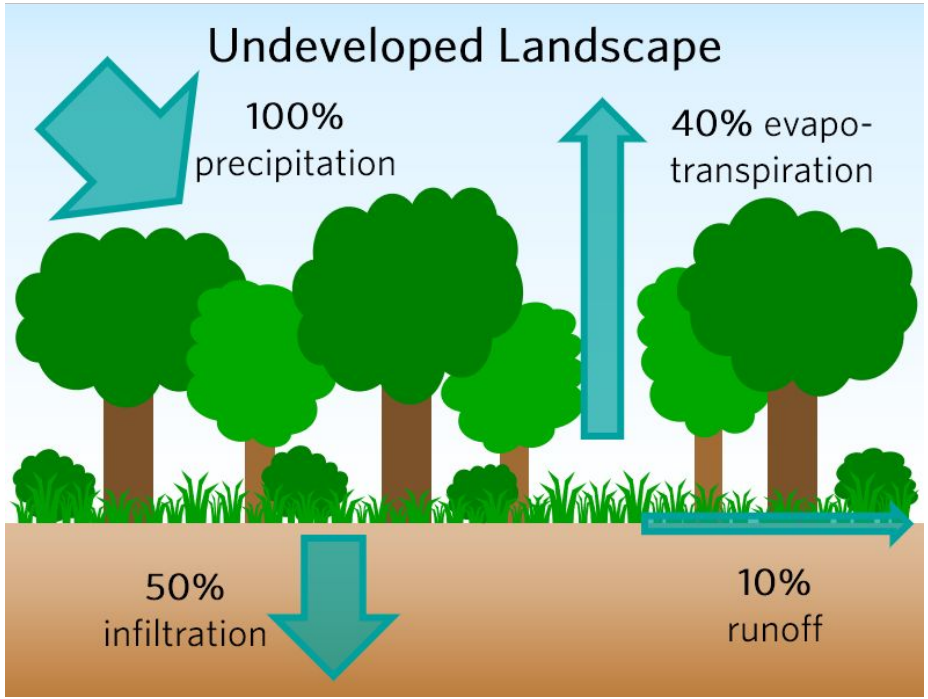
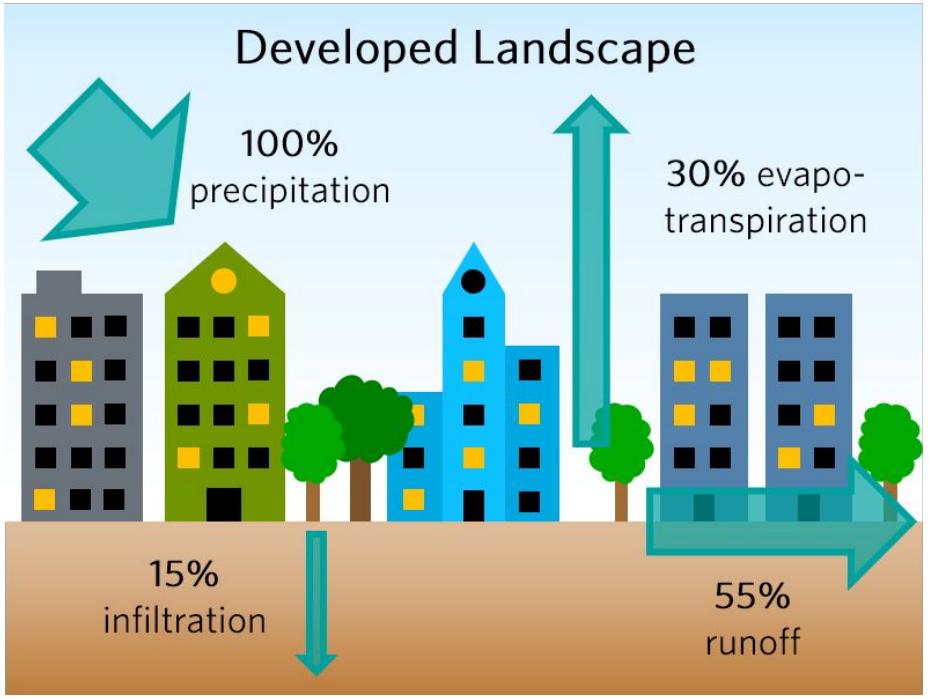
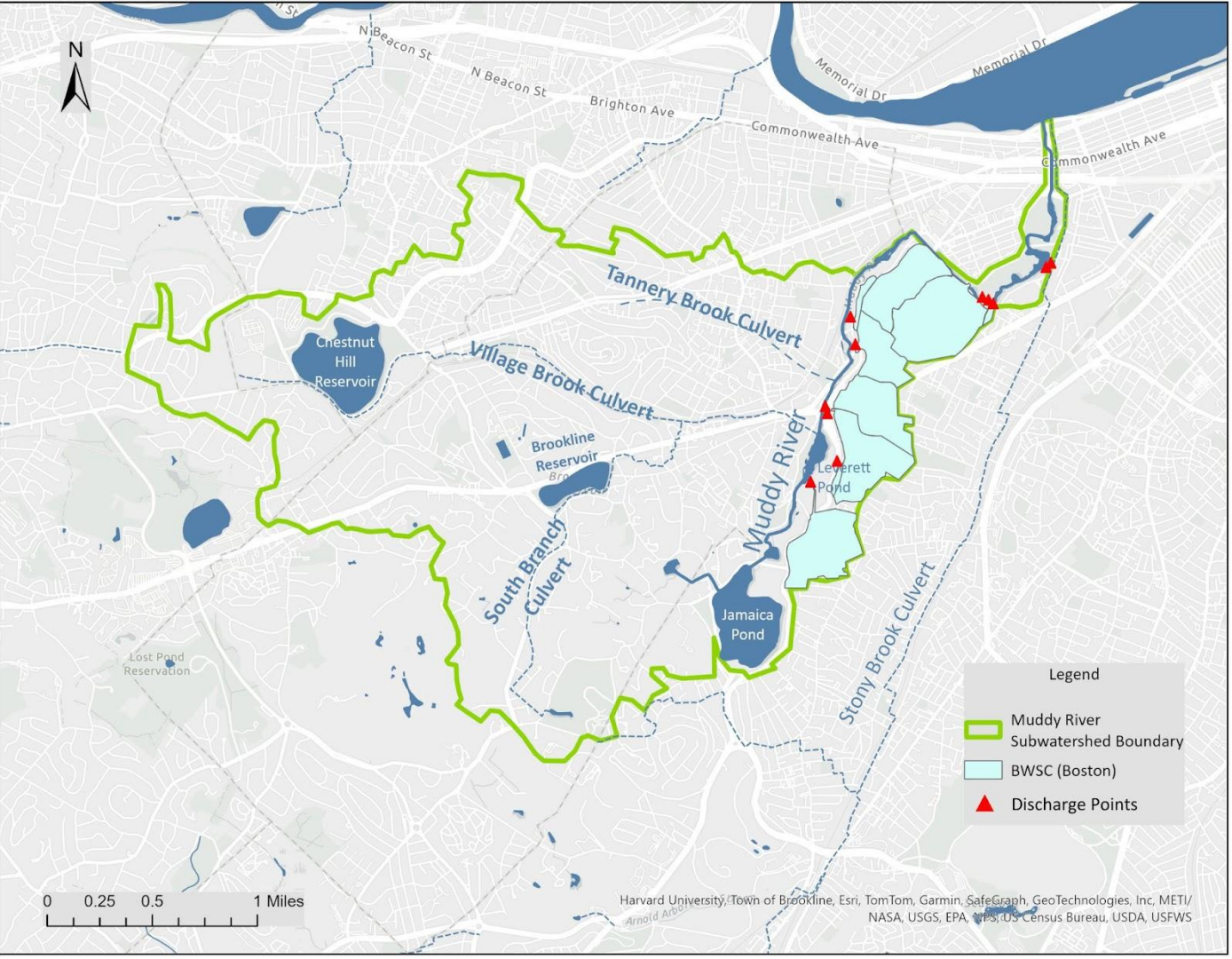




Land use alters natural hydrology



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Charles River Watershed Association

Muddy in Boston

-1.3 Square Miles

-22% of watershed

- 60% impervious
  - 30% of P load
  - (780 lbs-P)

Focus:

Daisy Field and Longwood Drain

NUTRIENT POLLUTION

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Study	Watershed Area (ac)	P Load (lbs)	Comments
TMDL 2007	4,005 (6.3)	3,408	Based on 2005 Land Use Land Cover Map
BWSC 2012 / 2023	4,633 (7.2)	4,123/ 3,709	Based on BWSC hydrologic and hydraulic model with water quality component added.
CRWA LULC analysis	3,806 (5.9)	3,311	Based on 2021 LULC map from UVM and 2020 NRCS Soil Survey

- Phosphorus loading is ~3,300 lbs per year
- 3.9% of total nutrient pollution to the Charles
- 13% of Lower Basin loading
- TMDL target is 1,298 lbs

TMDL

BACTERIA POLLUTION

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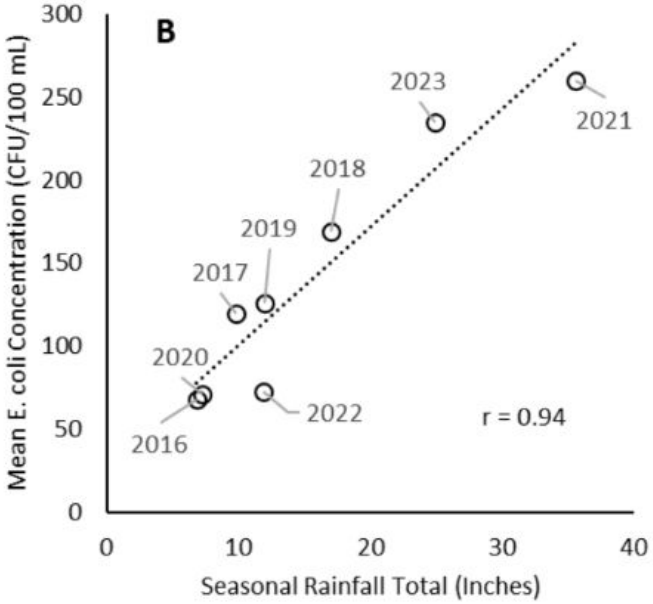
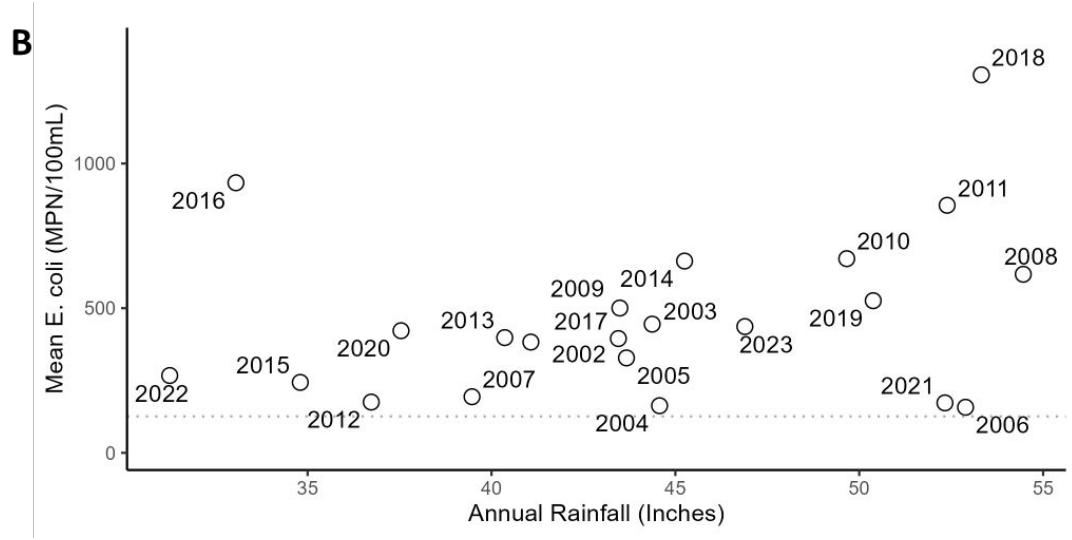
Charles River Lower Basin



Muddy River



- Weak correlation with rainfall = **dry weather** contamination source

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QUESTIONS

1. What did we miss?

2. What do you want know more about?

Please raise your hand or enter a short answer in chat

Water Levels - I

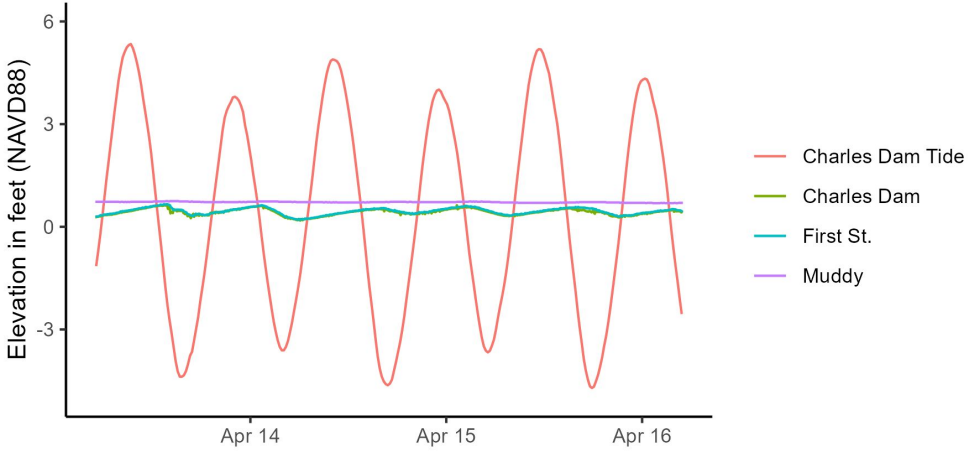
Charles River Watershed Association

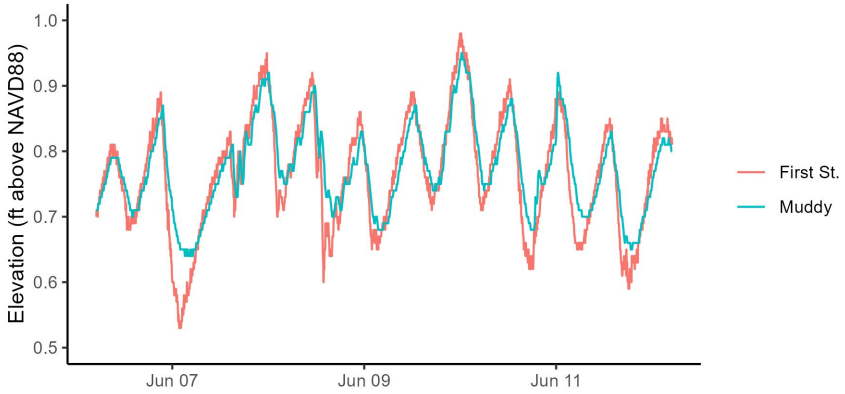
Muddy River water level and flow rates are influenced by changing water levels on the Charles River. Water level is monitored by USGS gages at 3 locations using alternate vertical datum:

Location	Datum	To NAVD 88*
New Charles Dam	MCD	*X-106.64*
First Street (Broad Canal)	MCD	*X-106.68*
Muddy River (Netherland Rd)	NAVD 88	*X-6.62*

**Per "USACE EB - Muddy Ph2 MWPA_Water_Level_03.16.23.pdf"*

- Boston Harbor has a daily tidal range of ~10'
- Within the Charles this is modulated to <1'
- Charles High level is limited to 1.8' by pumping
- Muddy "backwaters" during rising tide when flow is low.





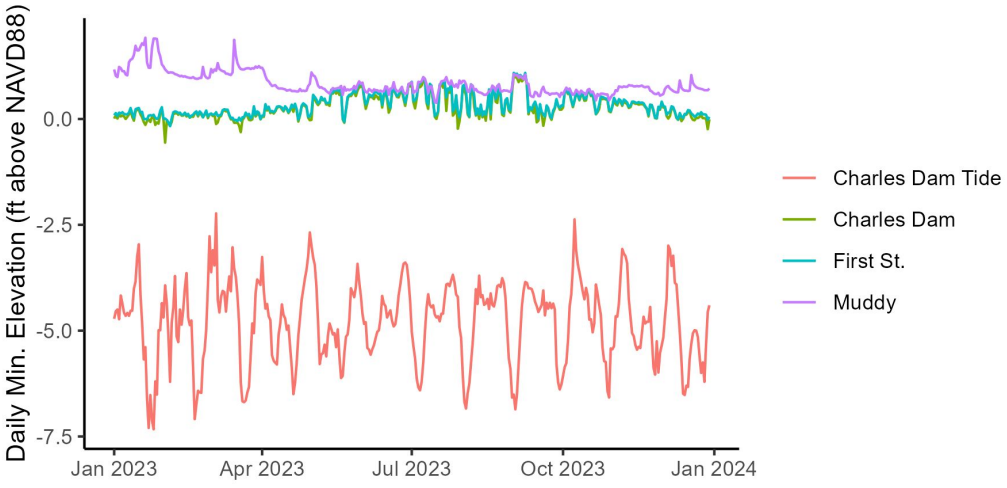
Water Levels - II

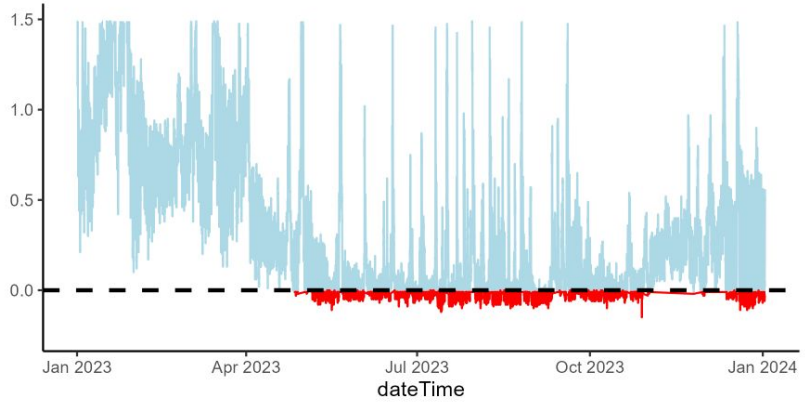
Charles River Watershed Association

2023 Water Level Summary

Site	Low	Median	High	Annual Range	Daily Range
Charles Dam Tide	-7.3	0.3	7.8	15.2	10.0
Charles Dam	-0.6	0.6	1.8	2.3	0.7
First St.	-0.2	0.6	1.8	2.0	0.6
Muddy	0.4	0.9	5.1	4.8	0.4

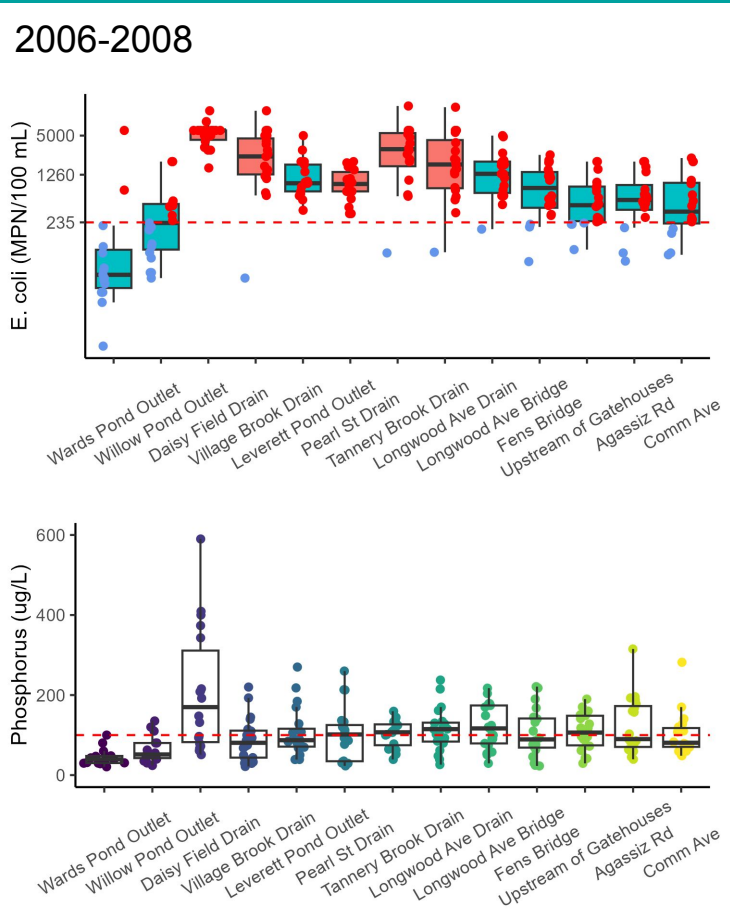
- Charles Low regulated to prepare for heavy flow.
- Charles Lowest levels occur during winter spring and fall when Muddy levels are highest.
- Charles River sees 2.3' of range in a typical year
- When flows are high Muddy Elevation is set by precipitation
- When flows are low Muddy elevation set by Charles Elevation

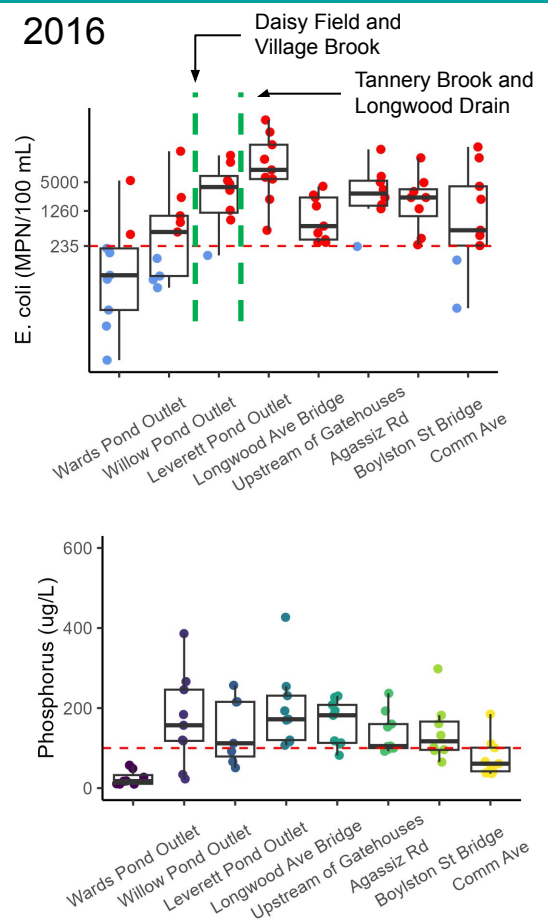


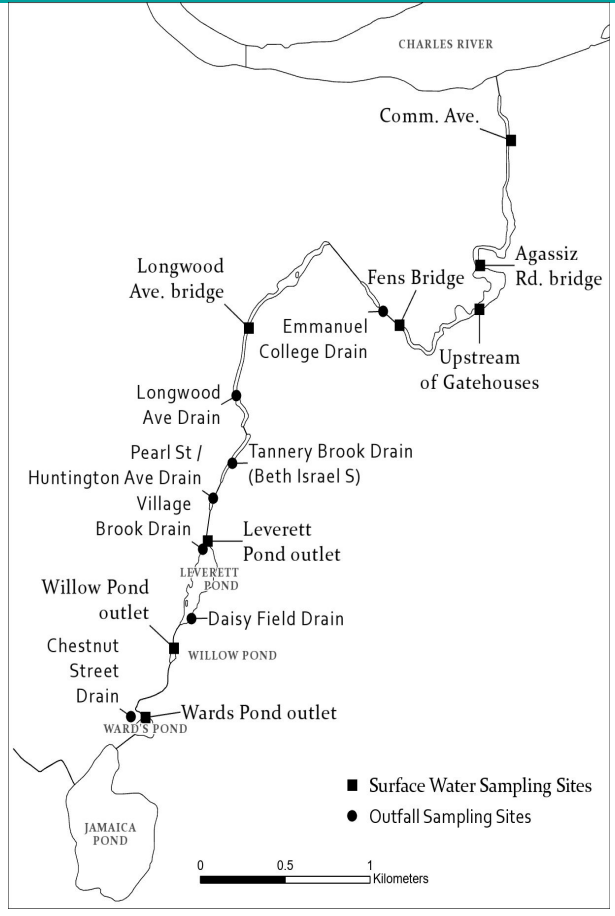


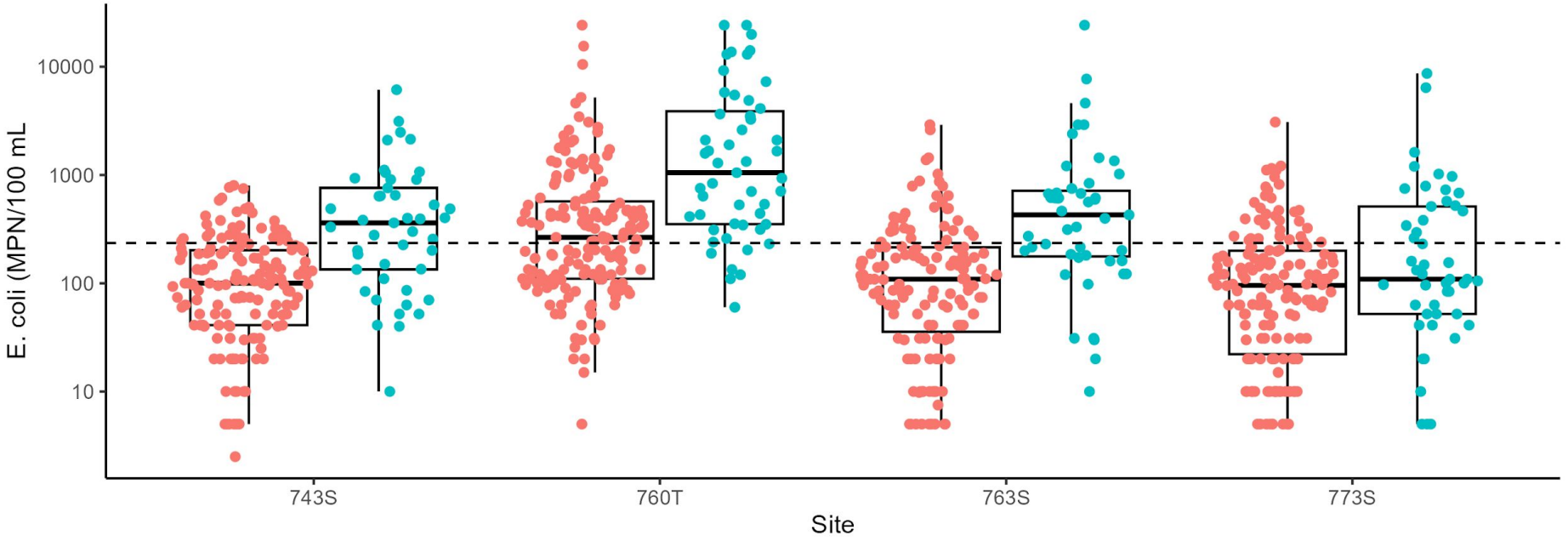
Spatial Trends - alternate

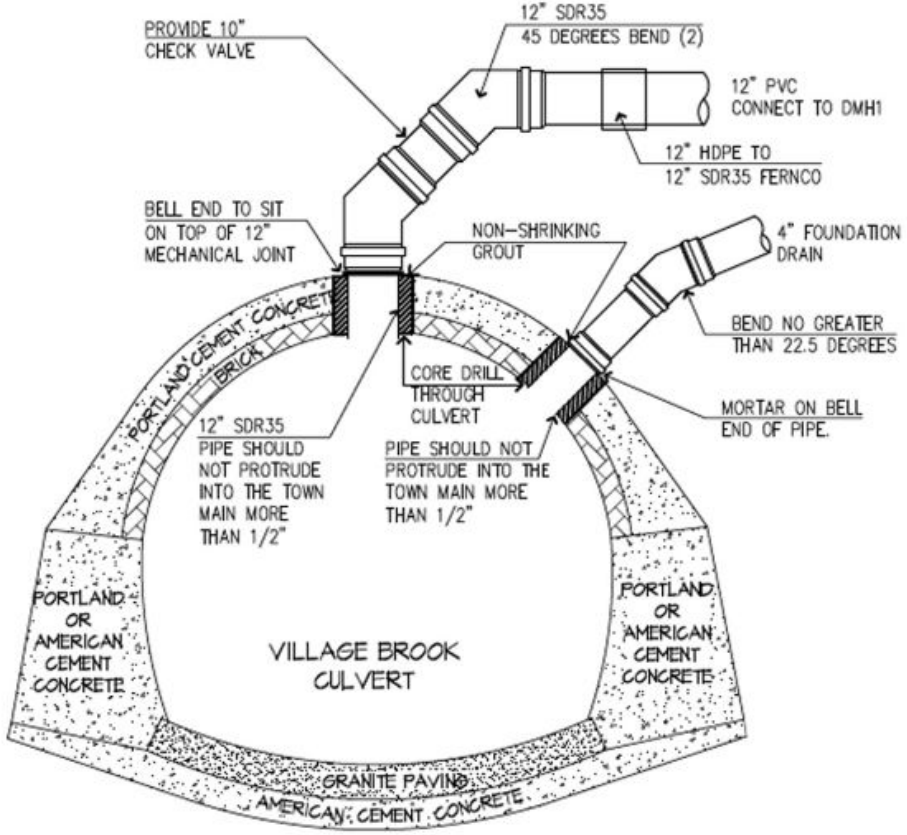
Charles River Watershed Association








E. coli (MPN/100 mL
10000
1000
100
10
743S
760T
763S
773S
Site

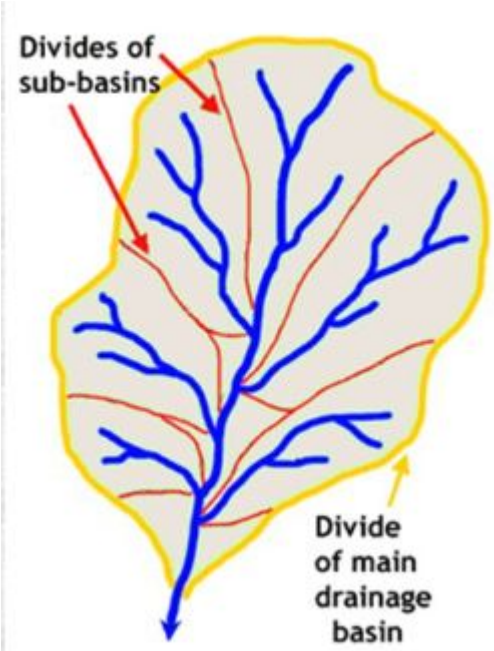

PROVIDE 10" CHECK VALVE
12" SDR35 45 DEGREES BEND (2)
12" PVC CONNECT TO DMH1
12" HDPE TO 12" SDR35 FERNCO
BELL END TO SIT ON TOP OF 12" MECHANICAL JOINT
NON-SHRINKING GROUT
4" FOUNDATION DRAIN
BEND NO GREATER THAN 22.5 DEGREES
CORE DRILL THROUGH CULVERT
MORTAR ON BELL END OF PIPE.
12" SDR35 PIPE SHOULD NOT PROTRUDE INTO THE TOWN MAIN MORE THAN 1/2"
PIPE SHOULD NOT PROTRUDE INTO THE TOWN MAIN MORE THAN 1/2"
PORTLAND CEMENT CONCRETE
BRICK
PORTLAND OR AMERICAN CEMENT CONCRETE
PORTLAND OR AMERICAN CEMENT CONCRETE
VILLAGE BROOK CULVERT
GRANITE PAVING
AMERICAN CEMENT CONCRETE

WATER QUANTITY

Source	Year	Area (mi^2)	Flow (CFS)	Units	Flow (GPD)
BWSC	2012, 2023	7.2	16	Mean	184,813
Stream Stats		6.6	6.55	Median	75,658
USACE	2016	5.93	6	"Normal"	69,305
USGS*	2002	6.3	4.51	Mean	52,094
*Assumed highest quality Study					

Drainage-Area Ratio Method

The method equates the ratio of streamflow at two stream locations to the ratio of the respective drainage areas. - USGS



"Measuring streamflow along this river is complicated due its physical location, which is in the backwater of the much larger Charles River basin, as well as the numerous hydraulic restrictions…" - USACE 2016