How Cities Change Rivers:

Views from the Mystic River

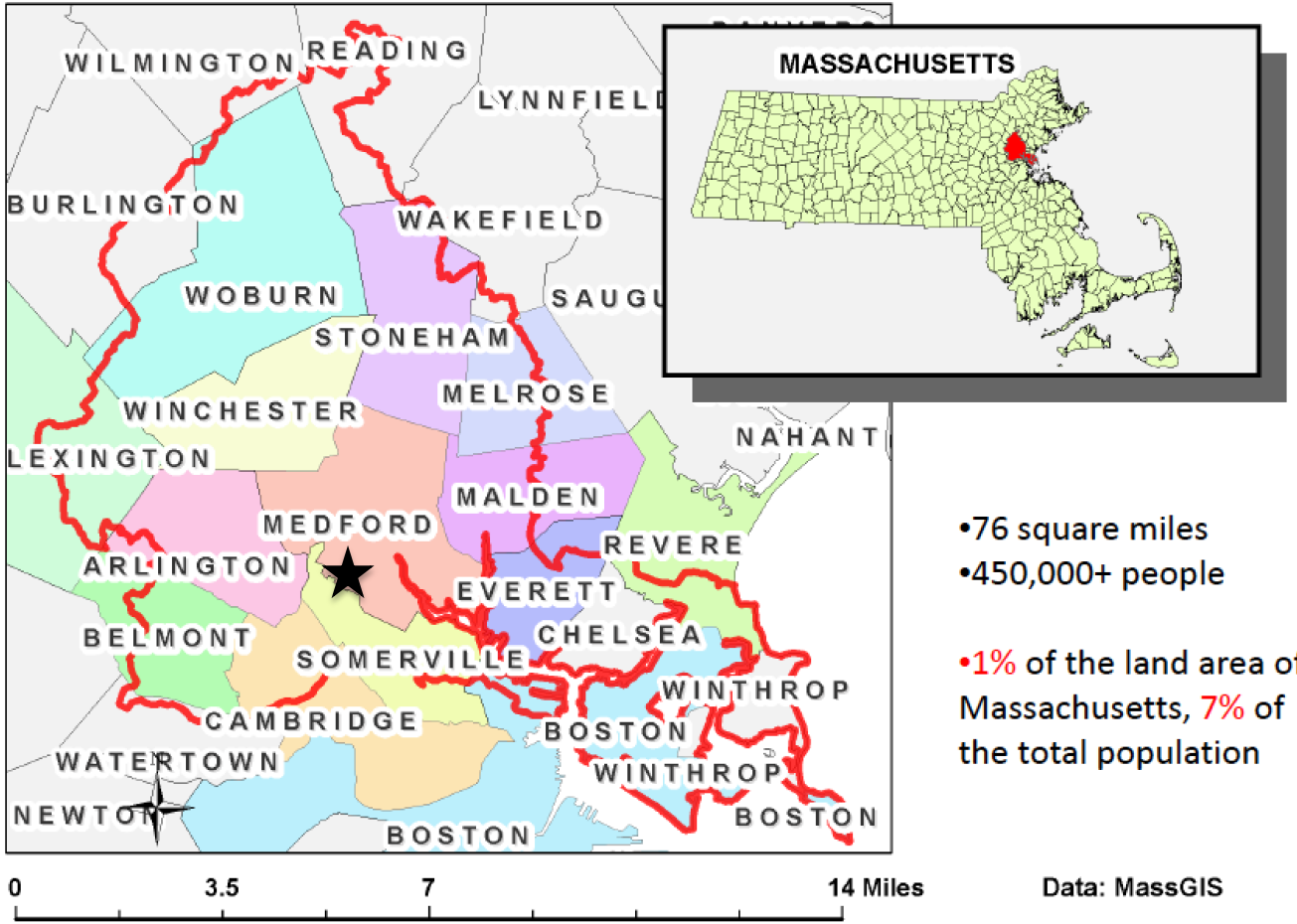
Andrew Hrycyna
Mystic River Watershed Association
April 2024

Mystic River
WATERSHED ASSOCIATION

Cities change rivers

Urban rivers are living systems

Mystic River Watershed



- 76 square miles
- 450,000+ people

- 1% of the land area of Massachusetts, 7% of the total population

Data: MassGIS

Mystic River
WATERSHED ASSOCIATION

- Volunteer/membership organization
- Founded 1972, the year of the CWA
- Professional staff of 19 today, including climate, greenways, outreach and education, 100’s of volunteers
- Methods: using data to influence policy and practice
- Partnership with EPA, DEP, cities and towns, many others


SANTARPIO'S PIZZA
PRE-FLIGHT
AIRPORT PARKING


OCEAN LORD

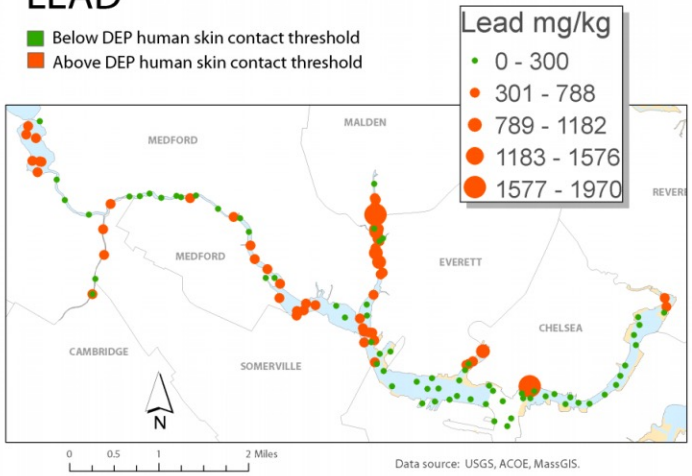

SCF

How Cities Change Rivers:

Pollution

LEAD

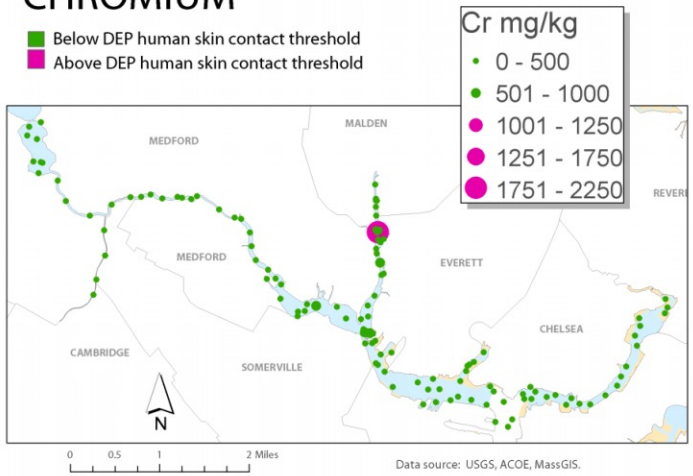
Below DEP human skin contact threshold
Above DEP human skin contact threshold



Data source: USGS, ACOE, MassGIS.

CHROMIUM

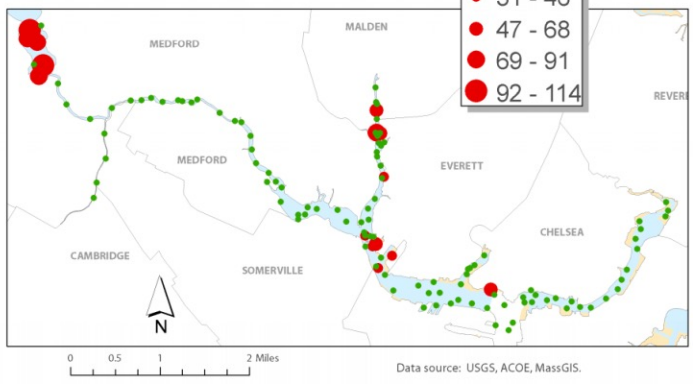
Below DEP human skin contact threshold
Above DEP human skin contact threshold



Data source: USGS, ACOE, MassGIS.

ARSENIC

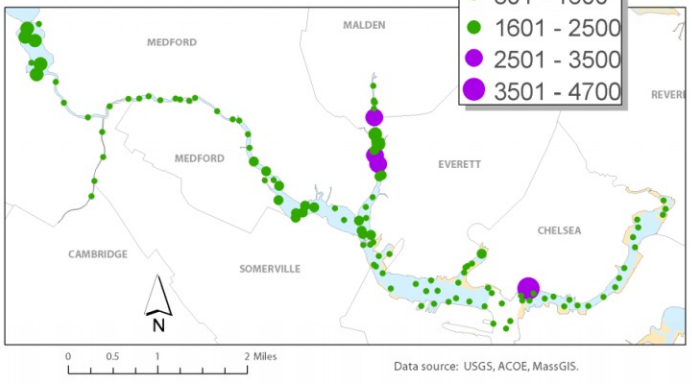
Below DEP human skin contact threshold
Above DEP human skin contact threshold



Data source: USGS, ACOE, MassGIS.

ZINC

Below DEP human skin contact threshold
Above DEP human skin contact threshold



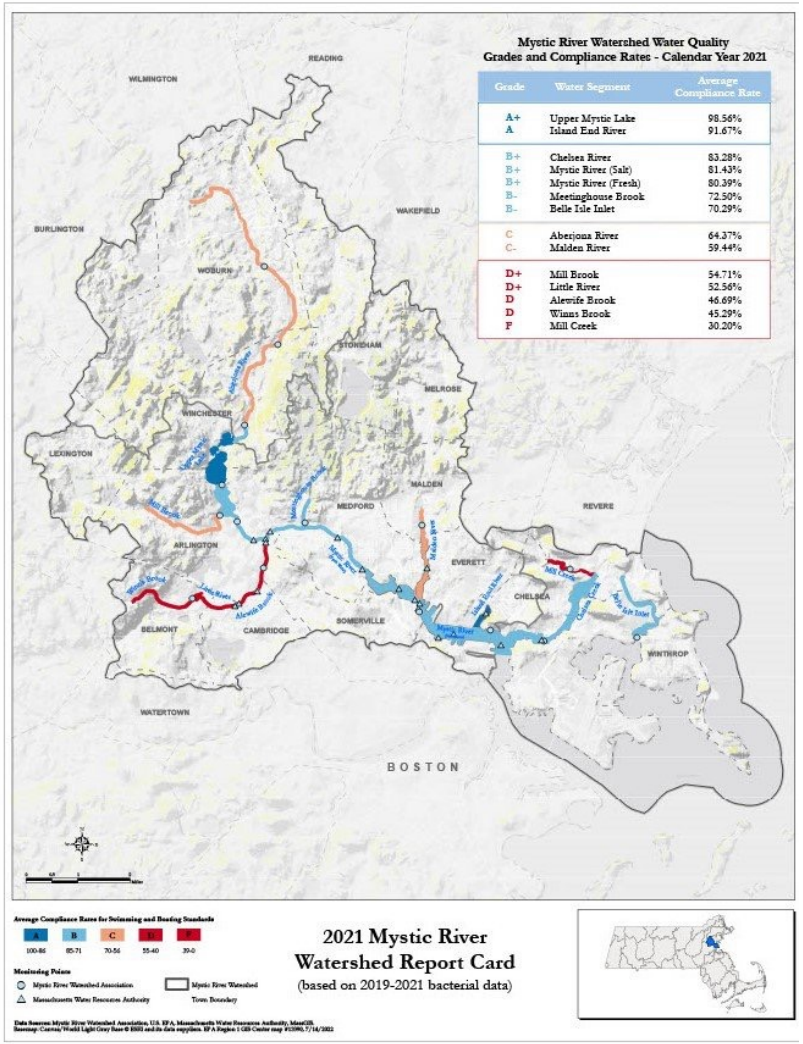
Data source: USGS, ACOE, MassGIS.

Four Pollutants We Track

- Wastewater (measured by bacteria)
- Trash
- Phosphorus (nutrients)
- Road Salt

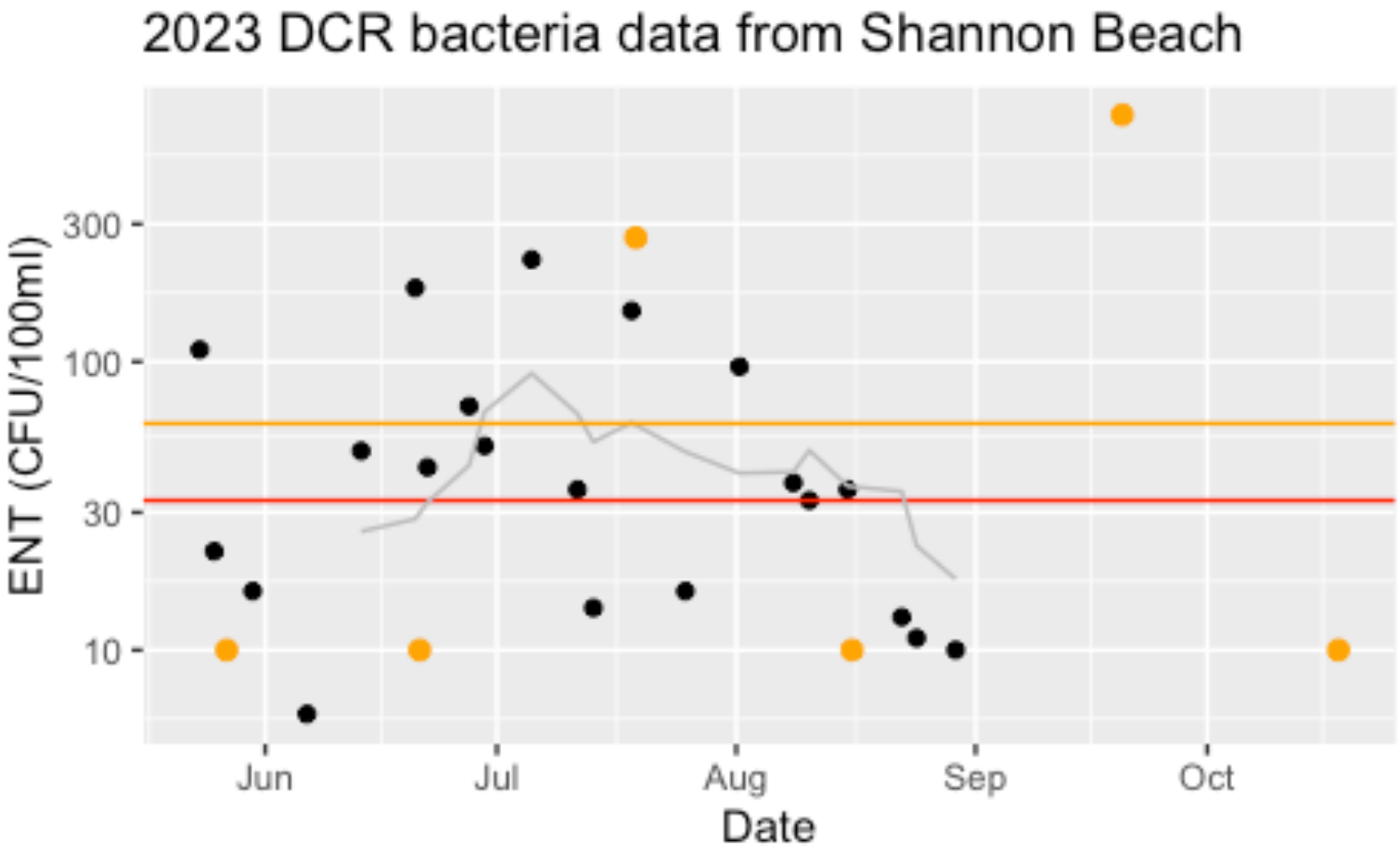
Clean Water Act

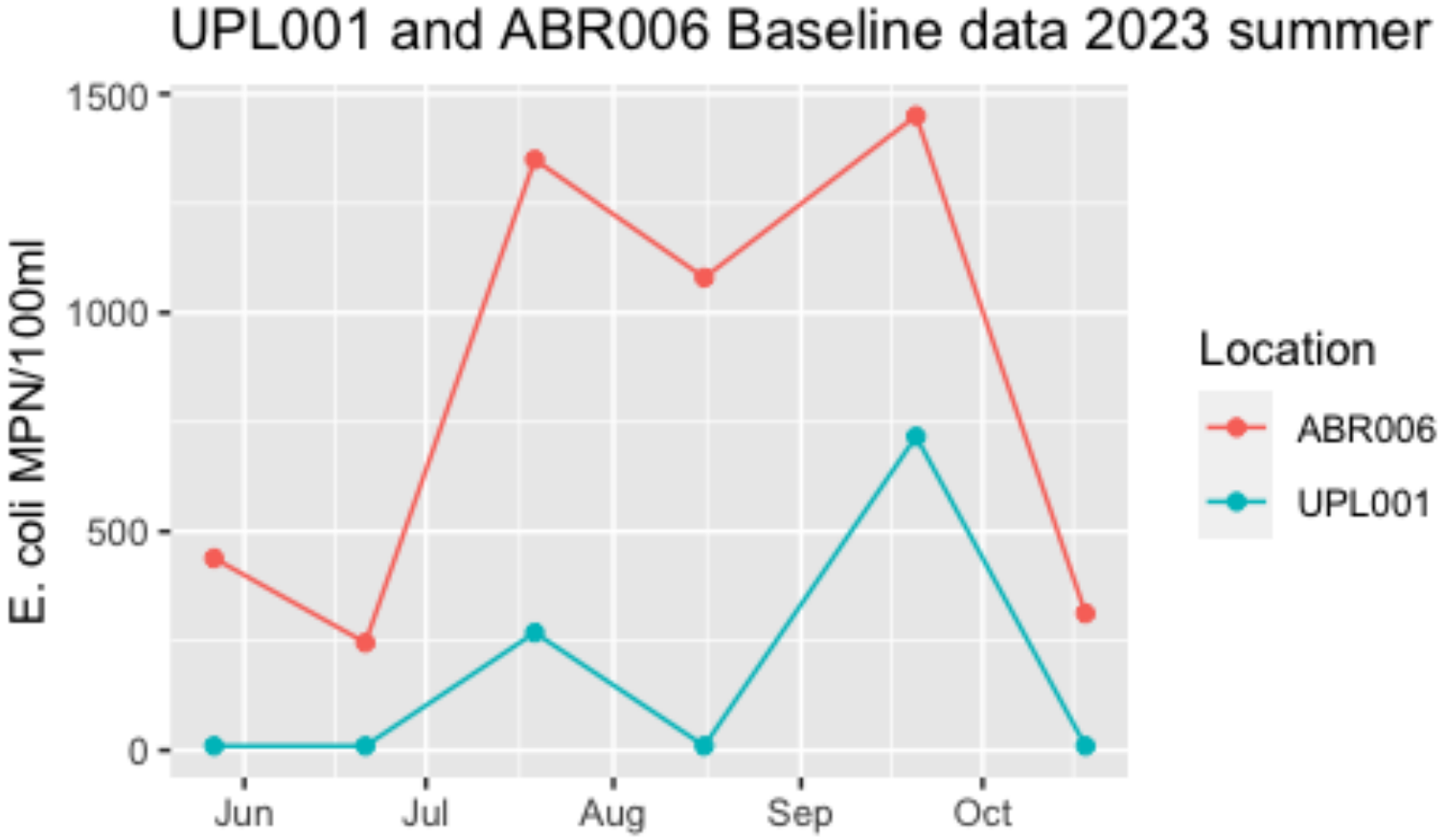
- Point source pollution
- Wastewater treatment
- Wetlands
- Scope is surface waters of the US
- Often health-based standards for water quality
- Huge environmental success story, like the CAA
- Problems remain

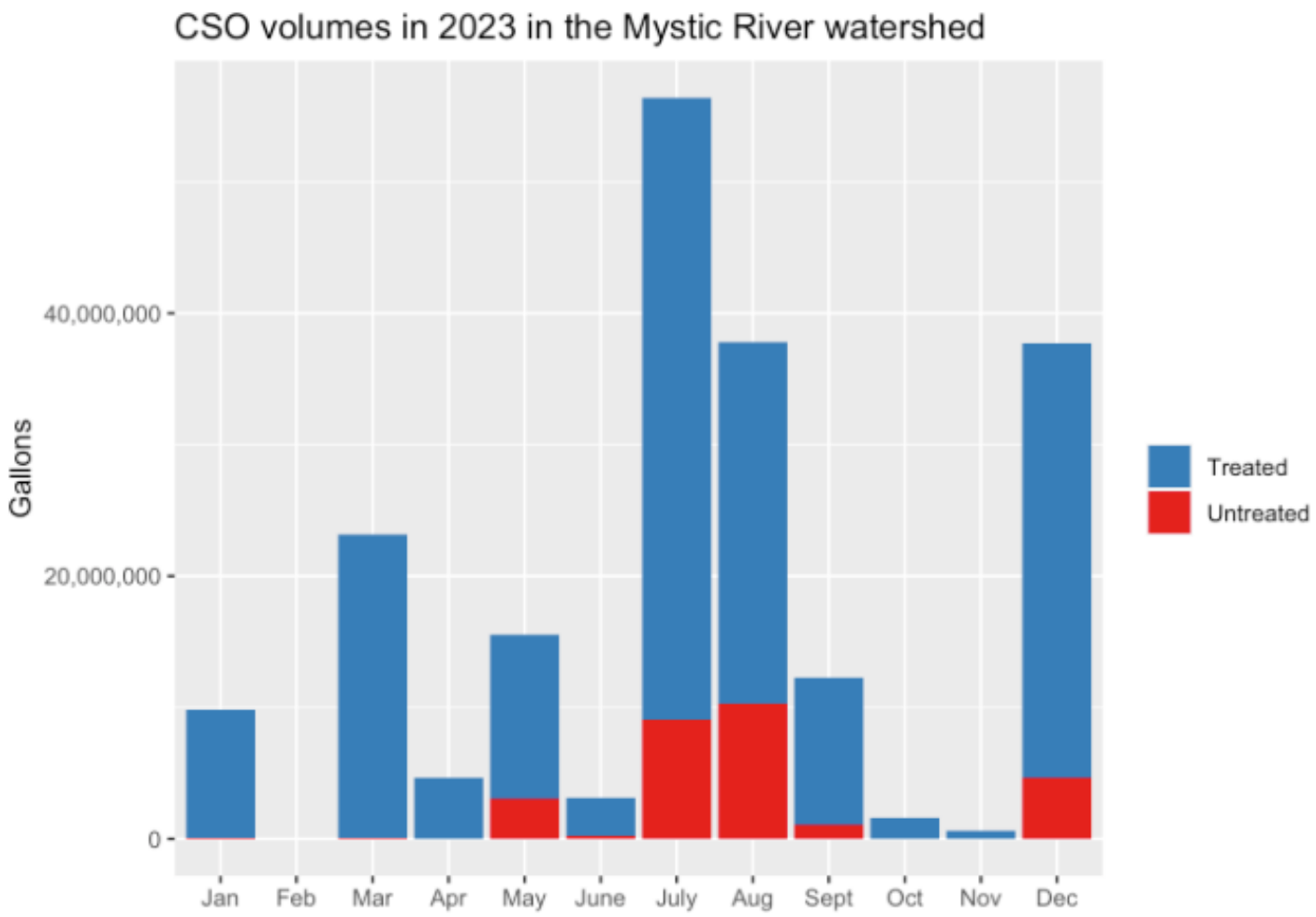


EPA water quality report card: Bacteria

- Mystic River: B+
- Alewife Brook: D
- These grades based on bacteria
- Public health concern

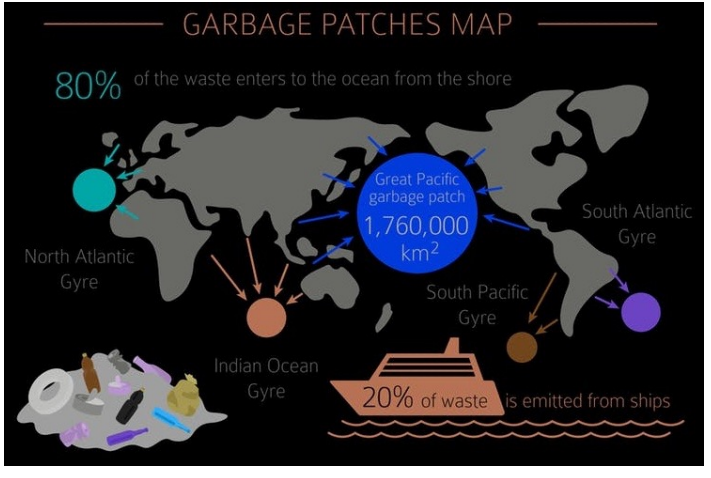

2023 DCR bacteria data from Shannon Beach
ENT (CFU/100ml)
300
100
30
10
Jun
Jul
Aug
Sep
Oct
Date


UPL001 and ABR006 Baseline data 2023 summer
E. coli MPN/100ml
1500
1000
500
0
Jun
Jul
Aug
Sep
Oct
Location
ABR006
UPL001


CSO volumes in 2023 in the Mystic River watershed
Gallons
40,000,000
20,000,000
0
Jan
Feb
Mar
Apr
May
June
July
Aug
Sept
Oct
Nov
Dec
Treated
Untreated

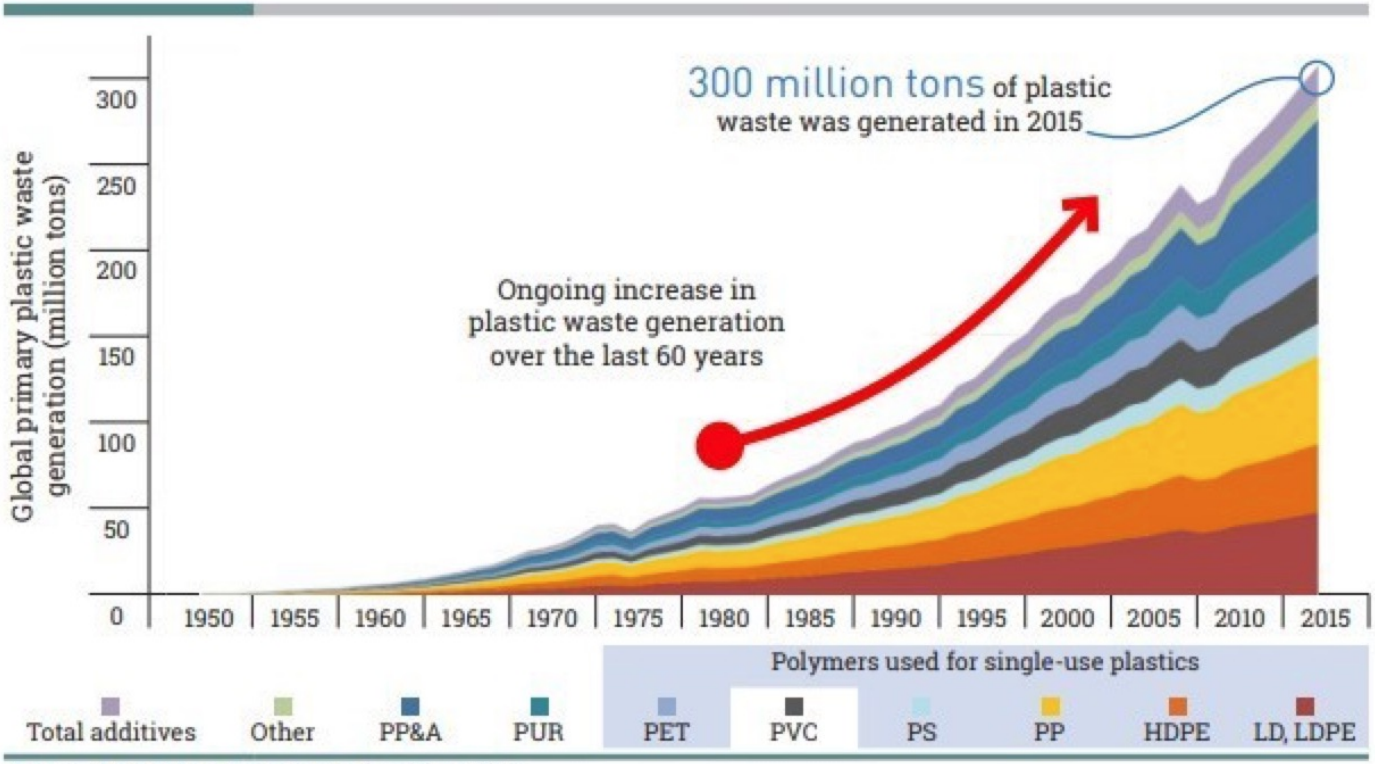
Stormwater pipes carry trash to rivers

Plastic in the oceans



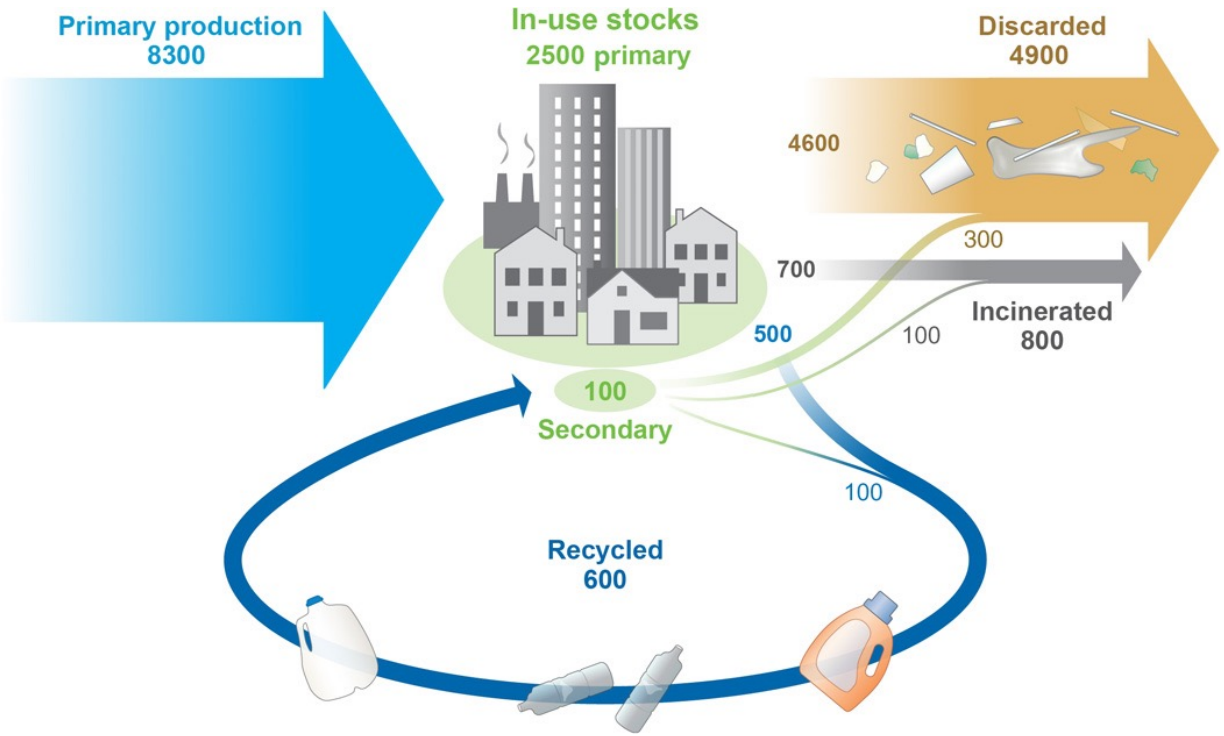
Plastic waste generation, 1950-2015

Figure 1.4. Global primary plastics waste generation, 1950 - 2015[16]



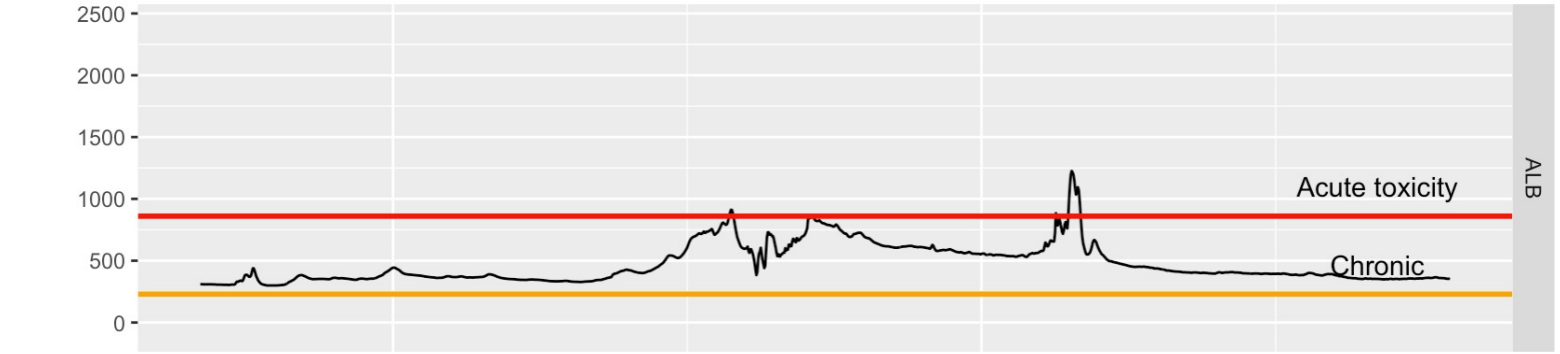
Source: *Adapted from Geyer, Jambeck, and Law, 2017*

Production and fate of all plastic ever made

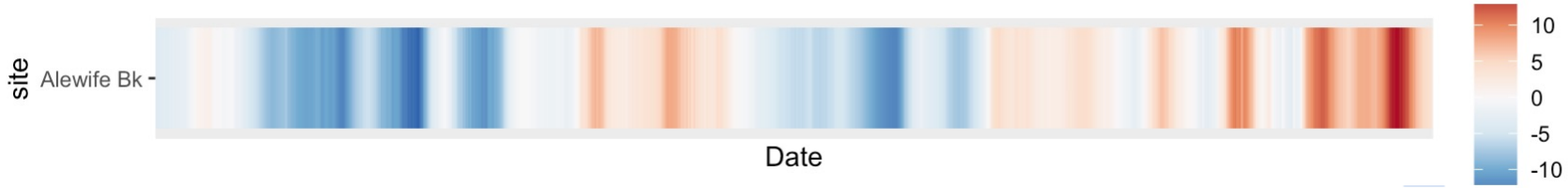


Production, use, and fate of all plastics ever made. **Geyer, et al, *Science Advances* (2017)**

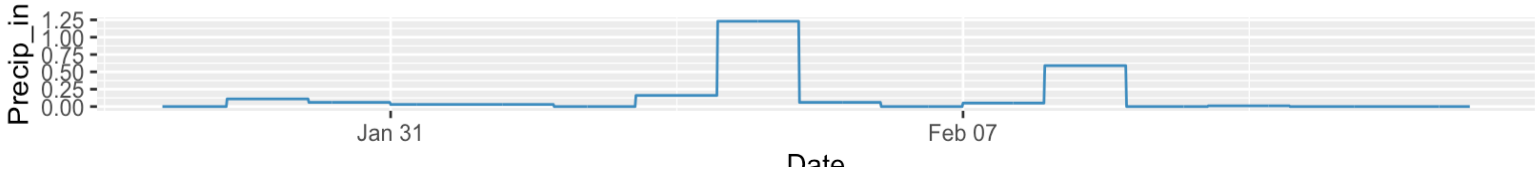
Effects of Road Salt: Chloride concentrations, Alewife Brook, Jan 2022



Air temperature

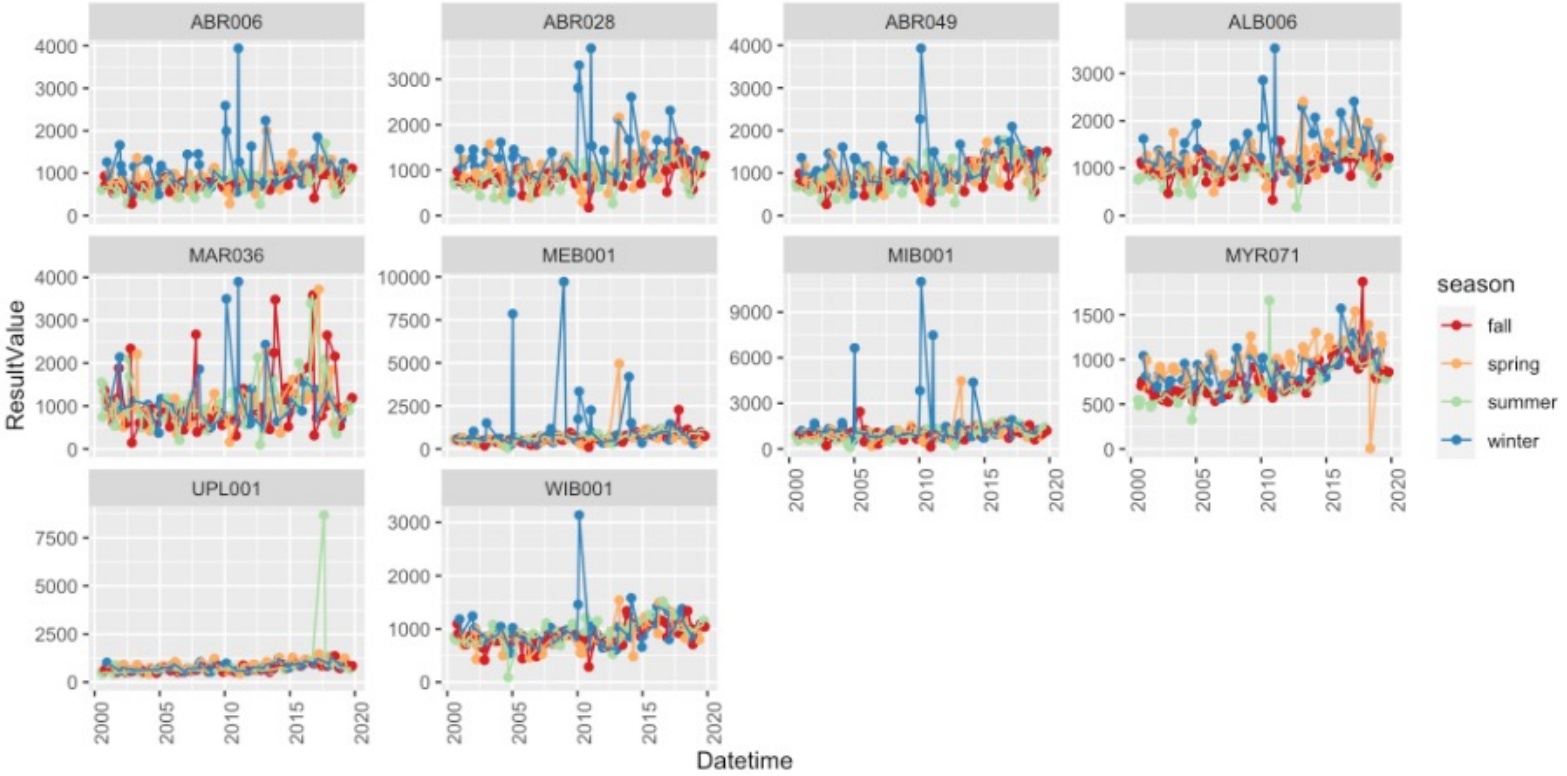


Total Daily Precip



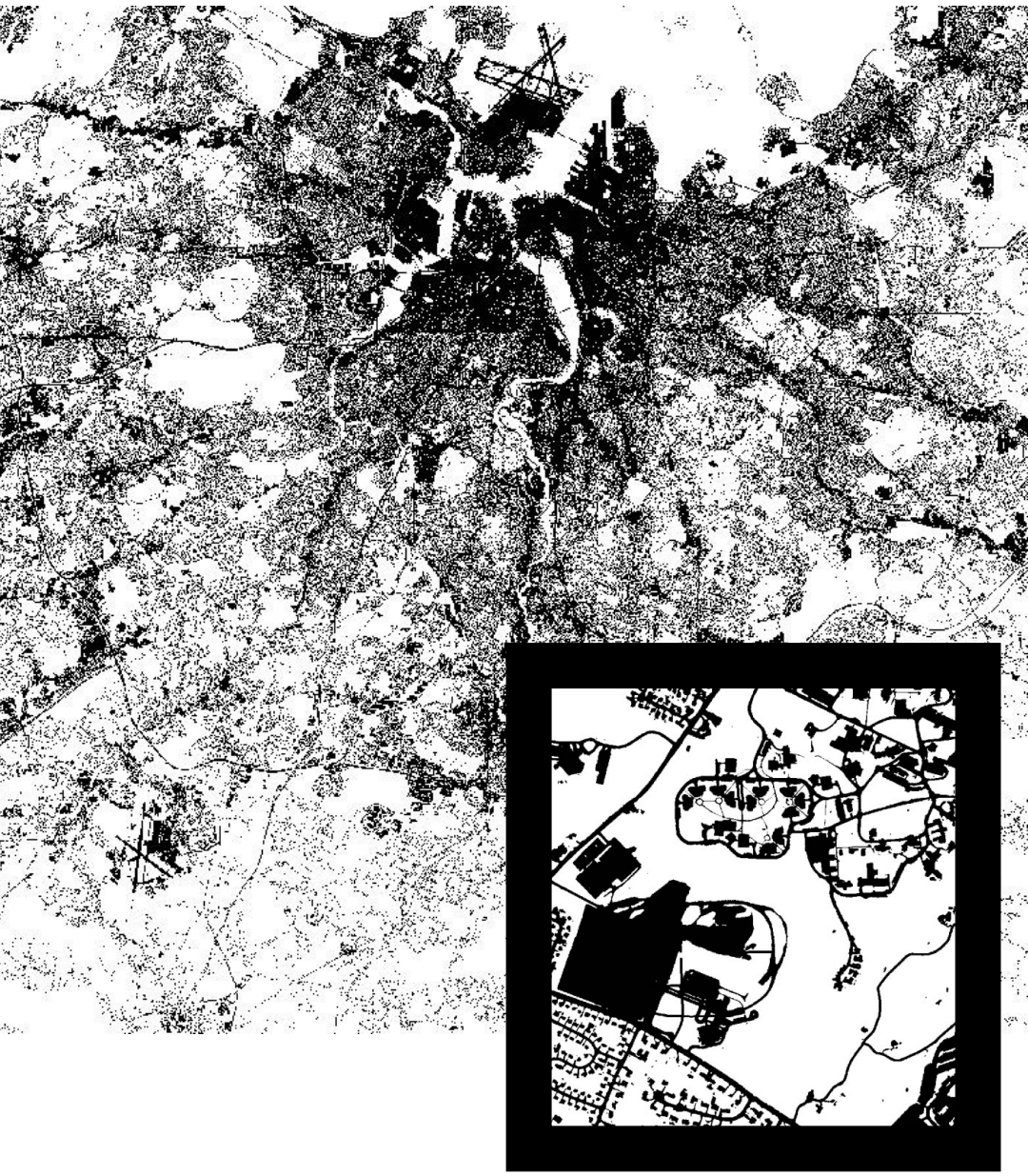
Historical baseline data

Every month MyRWA has sampled at 10 sites around the watershed for 20 years in our baseline monitoring program. Specific conductance data over time at each site is depicted in this figure. Trends at all sites seem to be positive, in all seasons, suggesting increasing chloride concentrations in freshwater lakes, streams, and even groundwater over time.

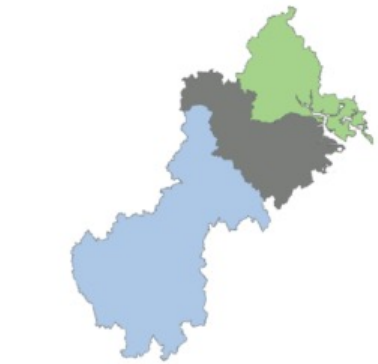


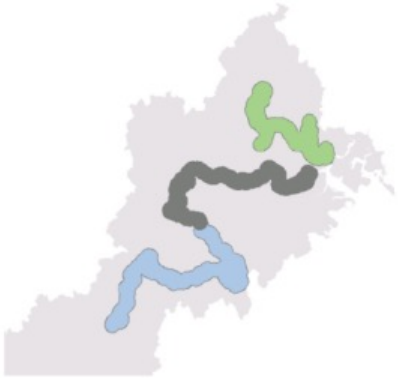
How Cities Change Rivers:

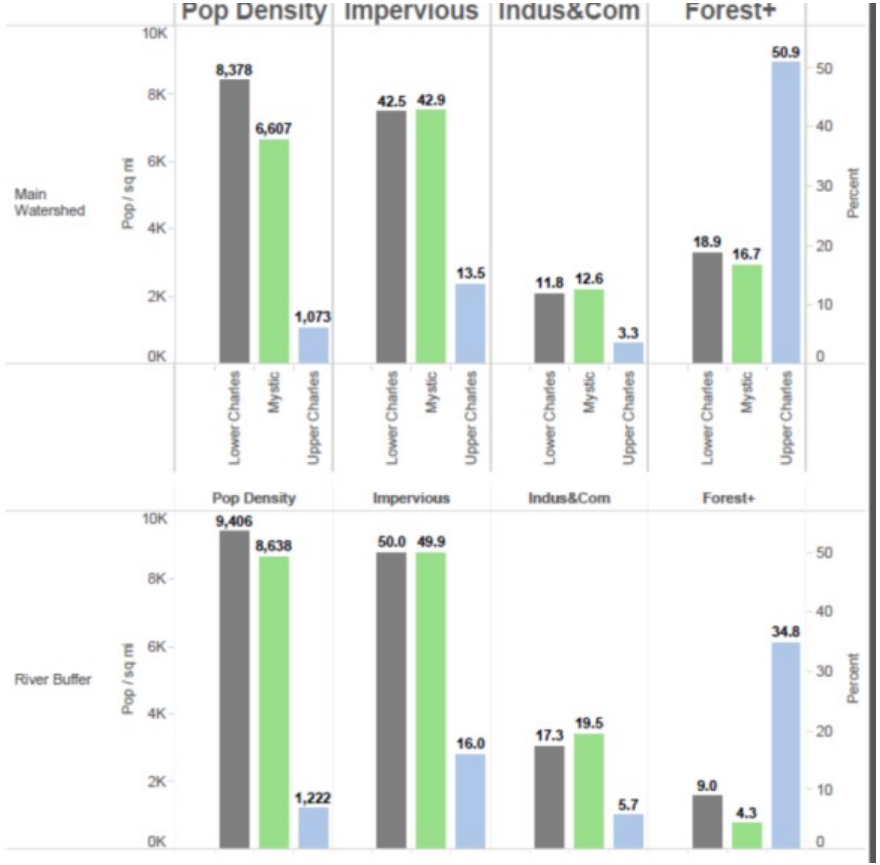
Impervious surface



Urbanization in Charles and Mystic watersheds







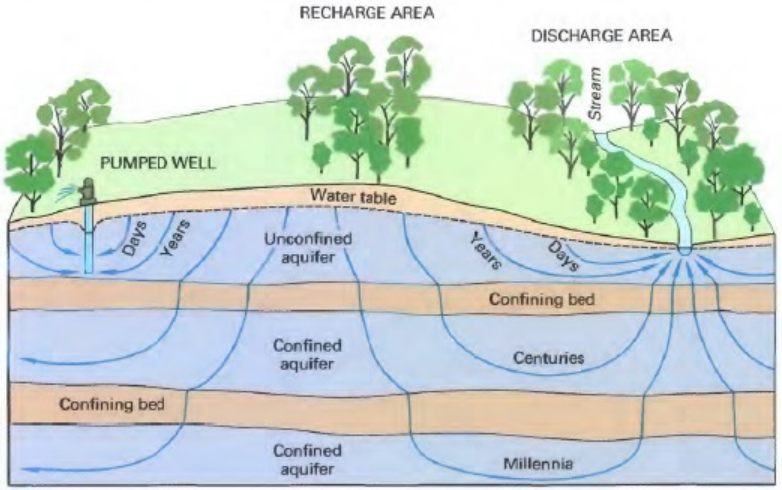


Figure 3. *Ground-water flow paths vary greatly in length, depth, and traveltime from points of recharge to points of discharge in the ground-water system.*

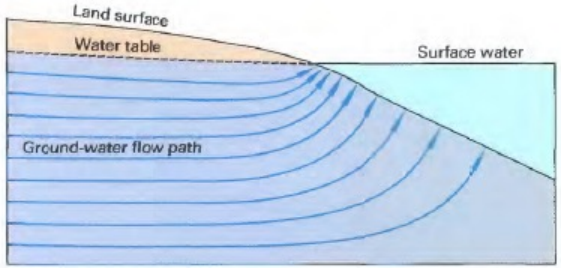


Figure 4. *Ground-water seepage into surface water usually is greatest near shore. In flow diagrams such as that shown here, the quantity of discharge is equal between any two flow lines; therefore, the closer flow lines indicate greater discharge per unit of bottom area.*

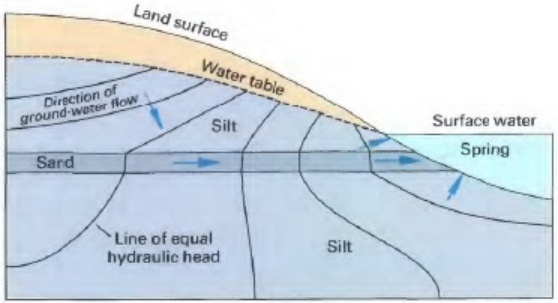


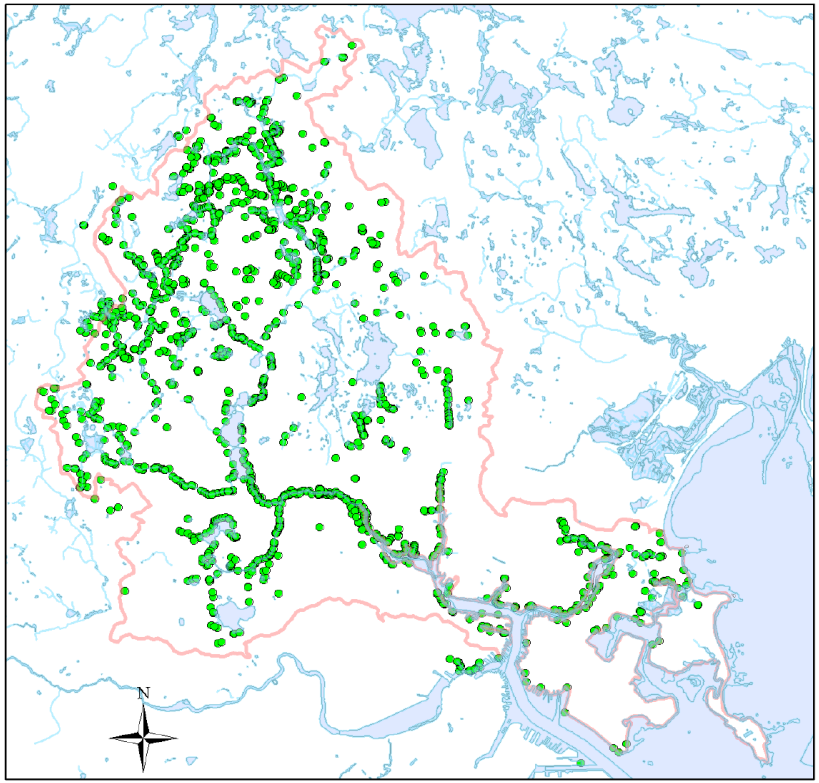
Figure 5. *Subaqueous springs can result from preferred paths of ground-water flow through highly permeable sediments.*

Source: USGS, *Ground water and surface water; a single resource*


ALEWIFE
DRCS


Alewife Brook
Alewife Brook Pkwy
Claredon Hill Towers
Broadway

Outfalls: Where stormwater comes out



Legend

- Storm water outfall
- Mystic_River_Watershed

Data: MyRWA, Municipal GISs
MassGIS

Flow in urban vs. rural streams

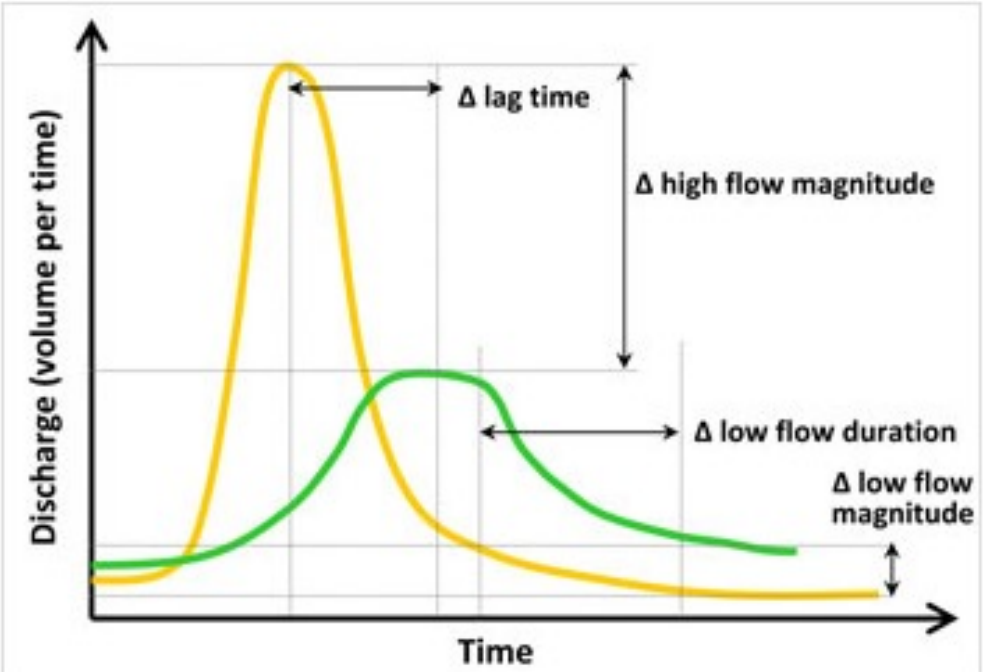
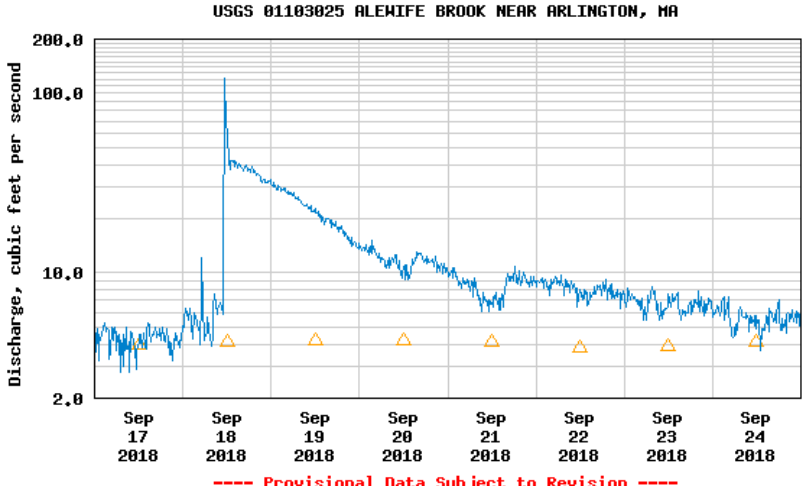
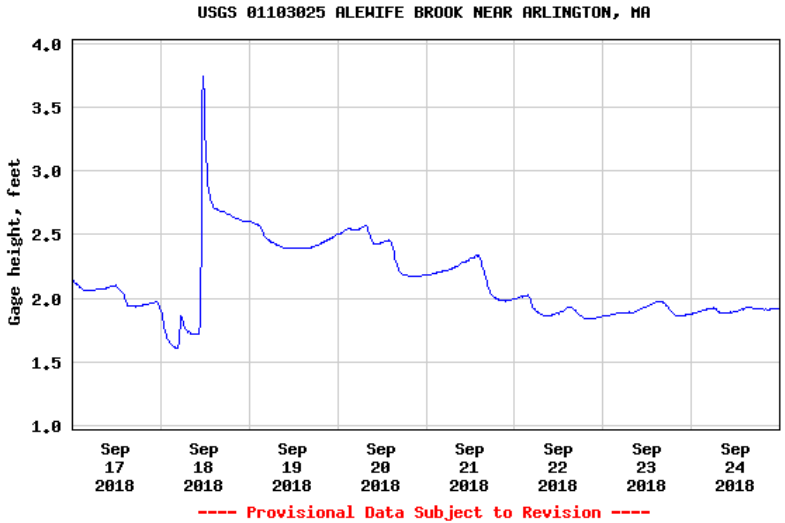


Figure 34. Hypothetical hydrographs for an urban stream (yellow) and a rural stream (green) after a storm, illustrating some common changes in stormflow and baseflow that occur with urban development. Other changes are listed at left.

Alewife Brook, Sept 17-24, 2018, 1.5” rain



Flow



Height

Negative ecosystem effects of impervious surface

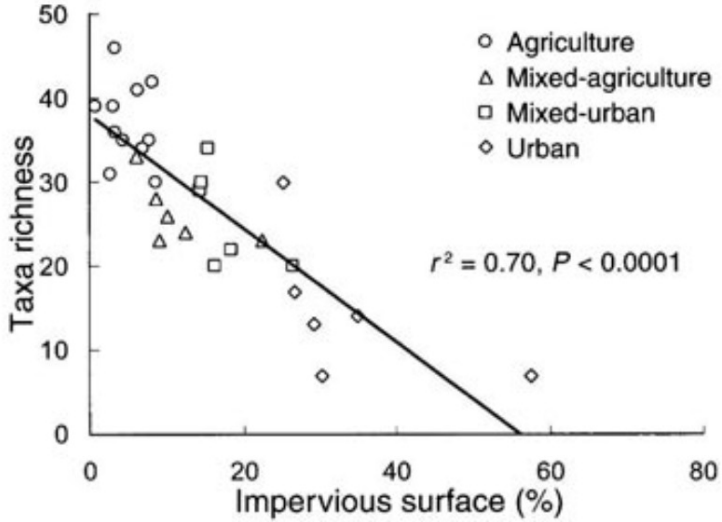
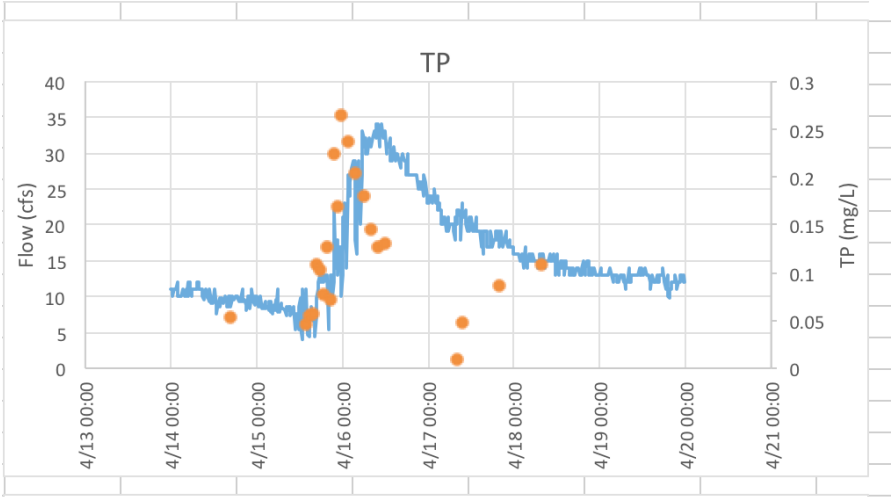
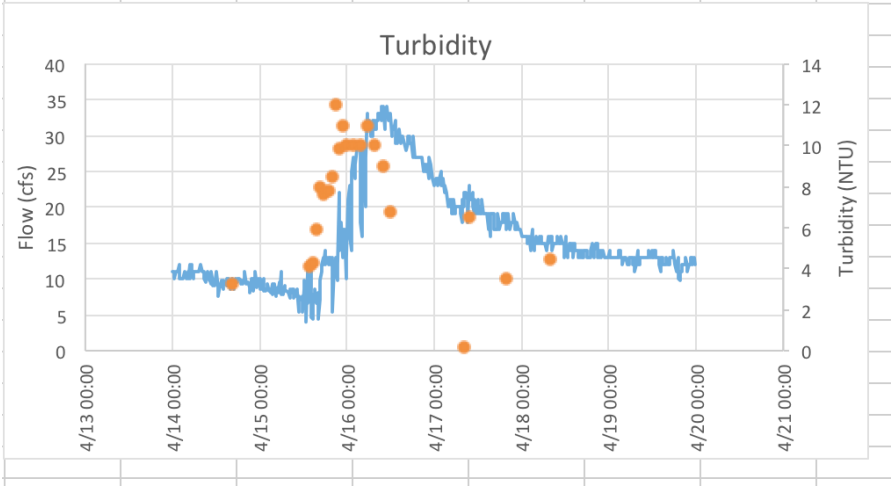


Figure 20. Relationship between total macroinvertebrate richness and % impervious surface cover in 29 headwater Maryland streams sampled in 2001. Taxa richness declined linearly with increasing impervious cover.
From *Moore AA & Palmer MA. 2005. Invertebrate biodiversity in agricultural and urban headwater streams: implications for conservation and management. Ecological Applications 15(4):1169-1177.* Reprinted with permission.

Nutrients as pollutants

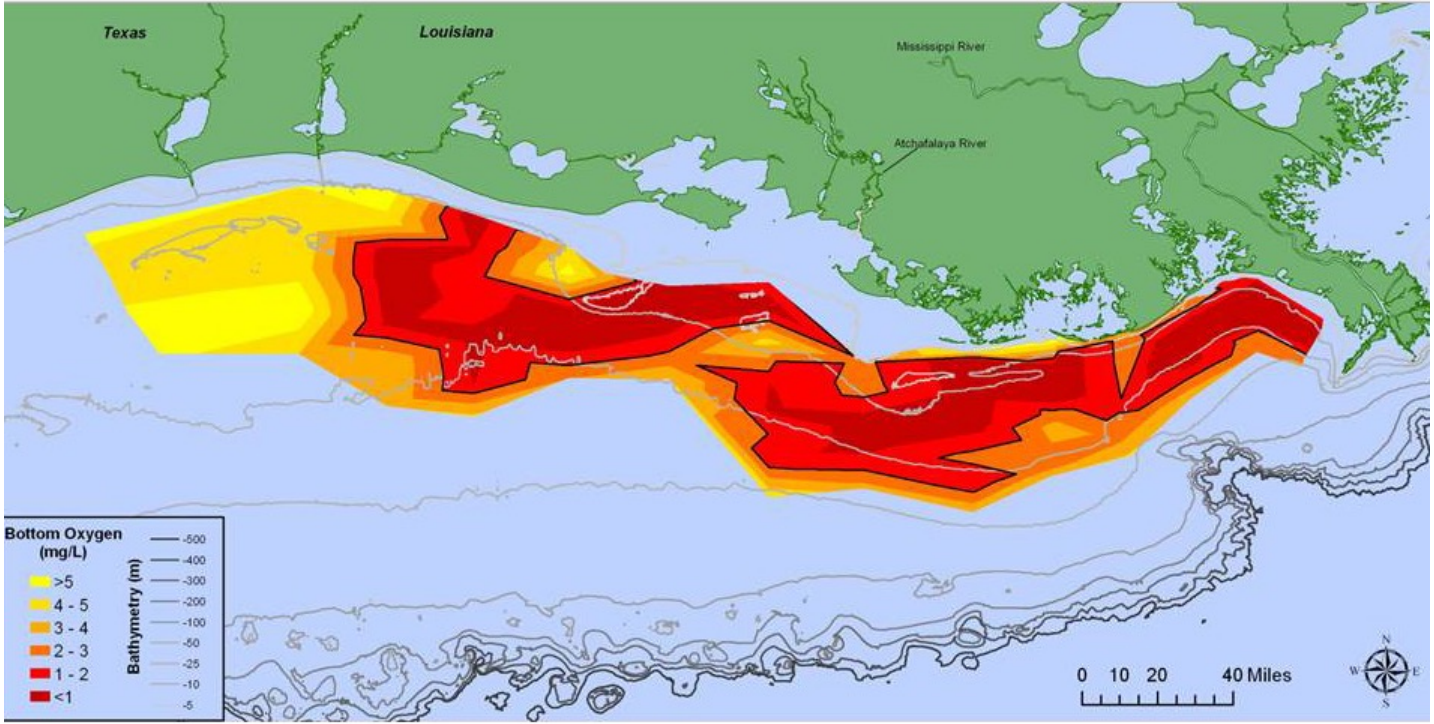
- Phosphorus is limiting nutrient in freshwater
- **High in urban areas, largely off impervious surface**
- Fosters algal blooms and invasive plants
- Leads to eutrophication: low oxygen, etc.
- Public health implications: cyanobacteria





Phosphorus in a storm

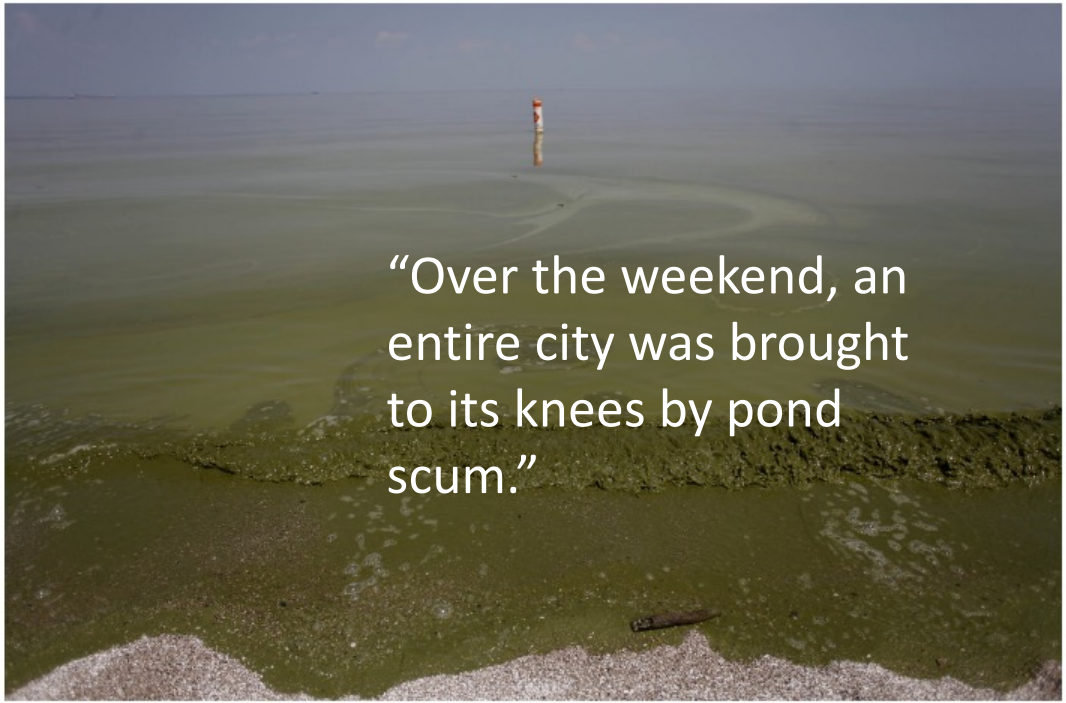
Alewife Brook
4/16/14



Map showing distribution of bottom-water dissolved oxygen from July 28 to August 3, west of the Mississippi River delta. Black lined areas — areas in red to deep red — have very little dissolved oxygen. (Data: Nancy Rabalais, LUMCON; R Eugene Turner, LSU. Credit: NOAA)

Cyanobacteria Are Far From Just Toledo's Problem

Carl Zimmer
MATTER AUG. 7, 2014



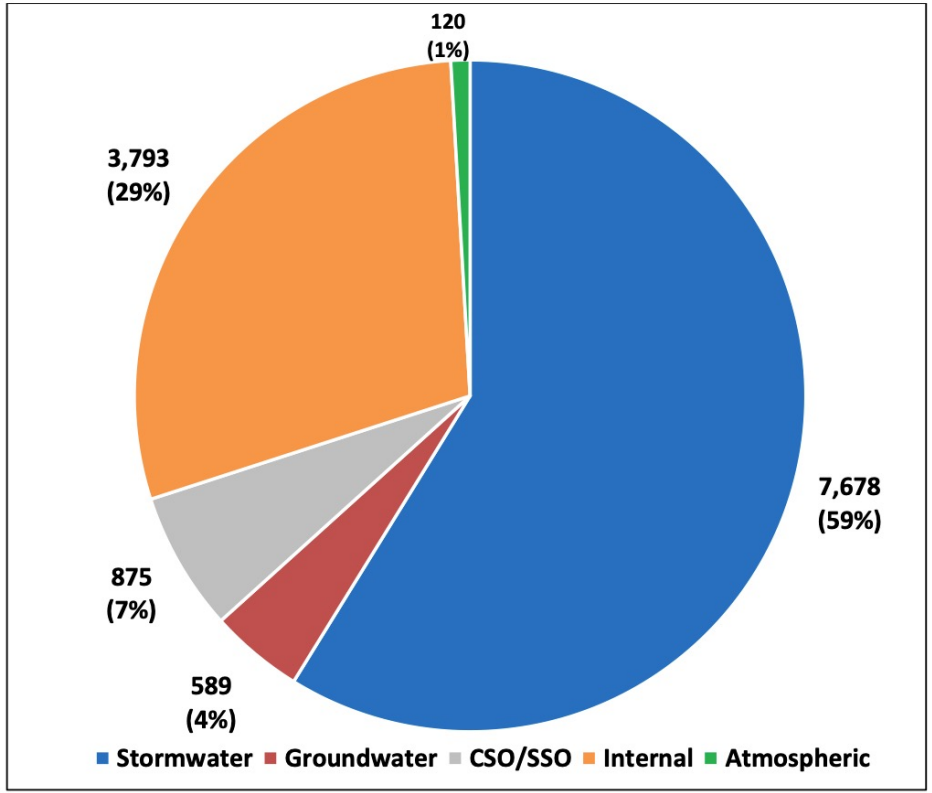
The algae-clogged waters of Lake Erie as seen from Maumee Bay State Park near Toledo, Ohio.
Joshua Lott for The New York Times


Mystic River
Cyanobacteria Bloom
Summer 2017


Evidence of impairment:
Invasive plants

Mystic River Alternative TMDL

1



Loads are in lb./yr. External load = stormwater + groundwater +_CSO/SSO load

Figure VII-IX. Calibration 2015 - Total Phosphorus Loads for Mystic River

2 "The stormwater load reductions required to meet water quality targets under future conditions … were between **59 and 62 percent."**

https://www.epa.gov/sites/default/files/2020-05/documents/mystic-phosphorus-tmdl-development.pdf


Stormwater constructed wetland:
a phosphorus filter
Alewife Reservation, Cambridge

Small-solutions in the Mystic

Bio-basin in Arlington, MA

Infiltration trench in Arlington, MA

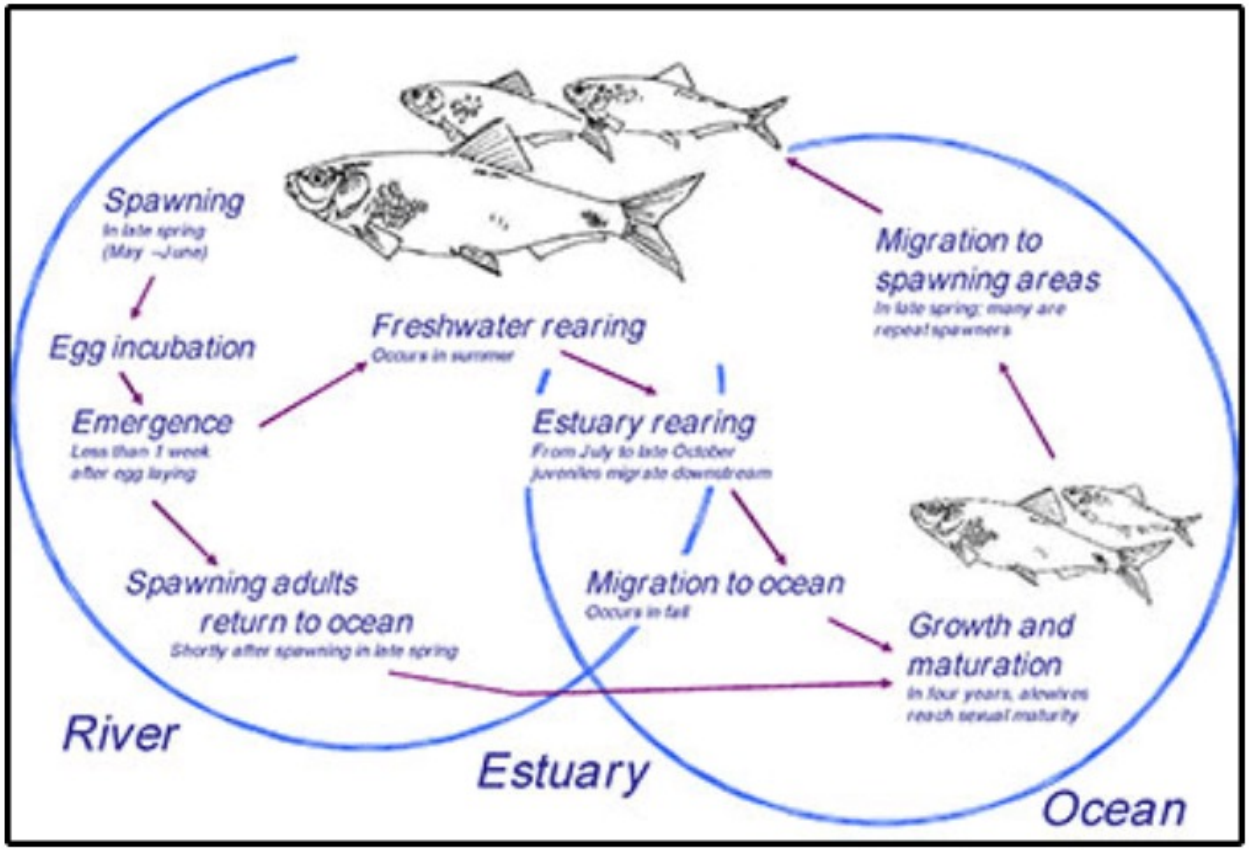
”restoring natural hydrology”

Mystic River
WATERSHED ASSOCIATION

Urban rivers as living systems:

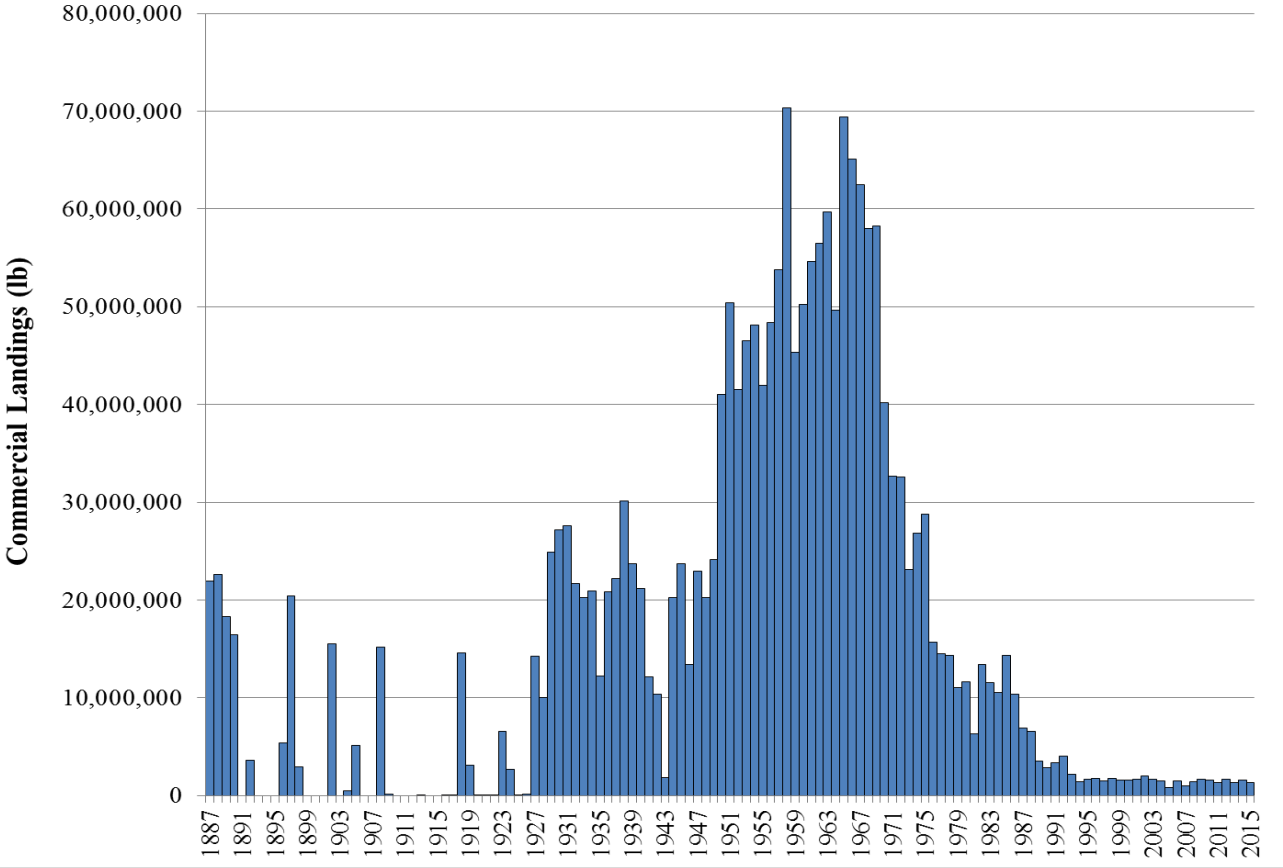
River Herring

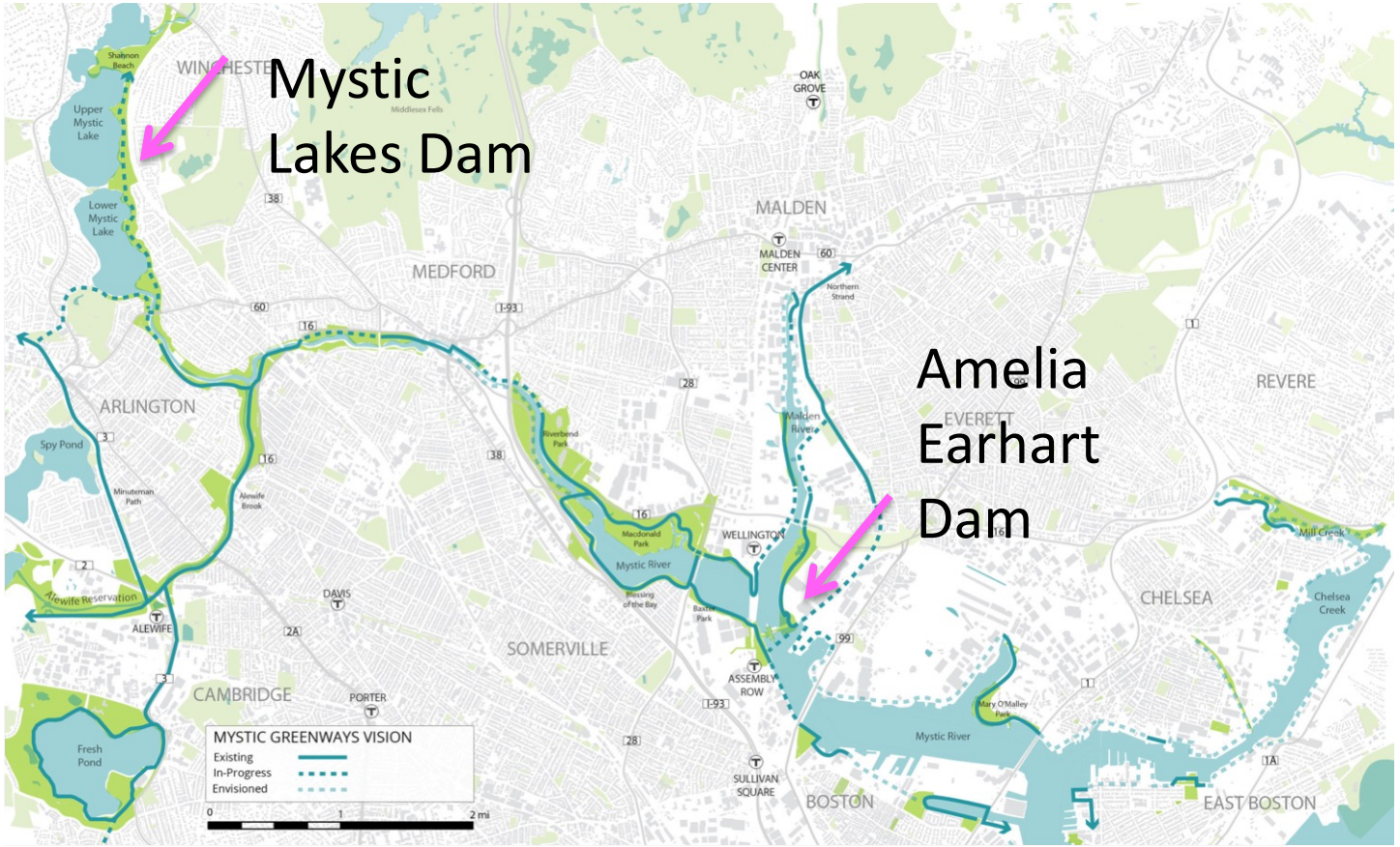
The "River Herring" Life Cycle



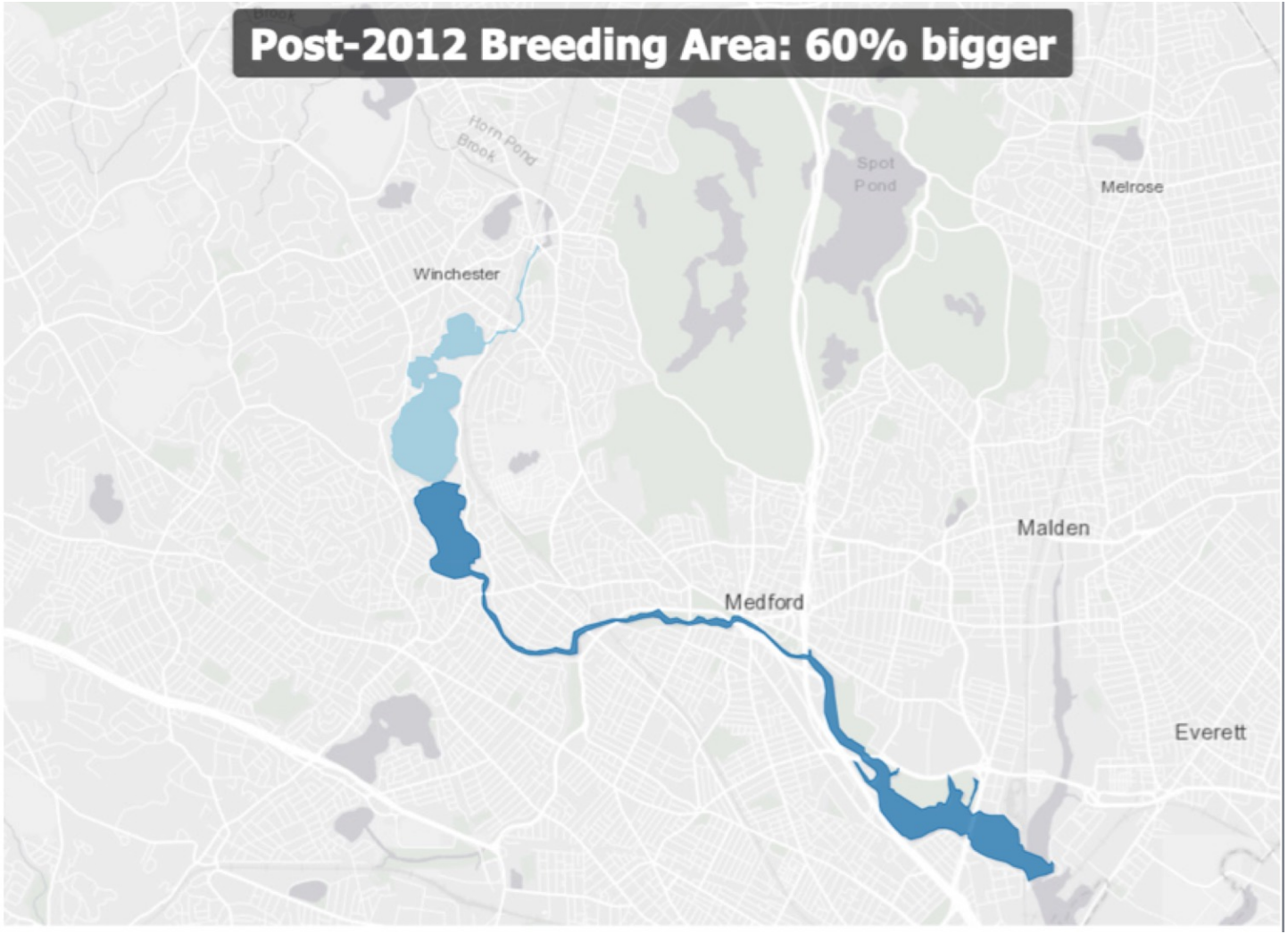
https://www.fws.gov/fisheries/fishmigration/alewife.html

Conservation background: huge decline



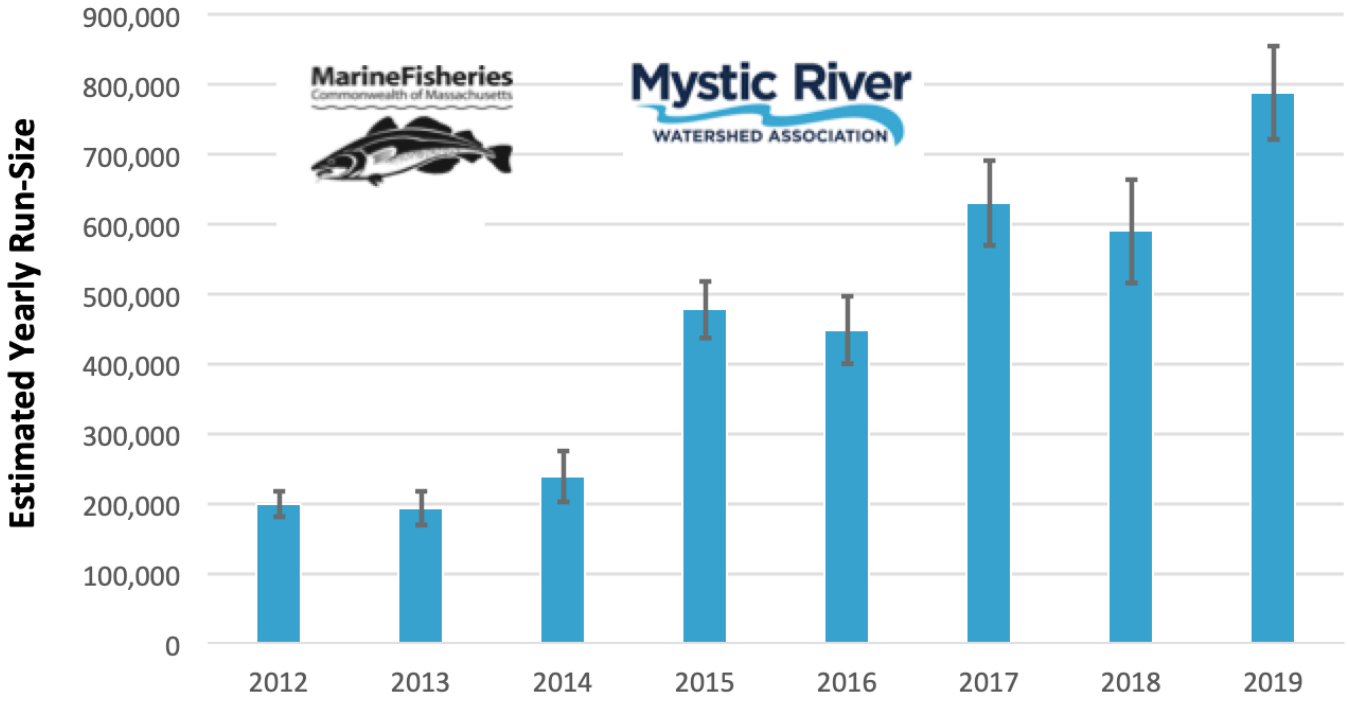

Mystic
Lakes Dam
Amelia
Earhart
Dam
Shannon Beach
Upper Mystic Lake
Lower Mystic Lake
WINCHESTER
Middlesex Fells
MEDFORD
MALDEN
OAK GROVE
MALDEN CENTER
Northern Strand
ARLINGTON
Spy Pond
Minuteman Path
Alewife Brook
Alewife Reservation
ALEWIFE
DAVIS
PORTER
CAMBRIDGE
Fresh Pond
SOMERVILLE
Riverbend Park
Mystic River
Blessing of the Bay
Macdonald Park
Baxter Park
WELLINGTON
Malden River
EVERETT
REVERE
Mill Creek
CHELSEA
Chelsea Creek
ASSEMBLY ROW
SULLIVAN SQUARE
BOSTON
Mary O'Malley Park
EAST BOSTON
MYSTIC GREENWAYS VISION
Existing
In-Progress
Envisioned
0
1
2 mi


Pre-2012 Breeding Area
Brook
Horn Pond Brook
Spot Pond
Melrose
Winchester
Malden
Medford
Everett

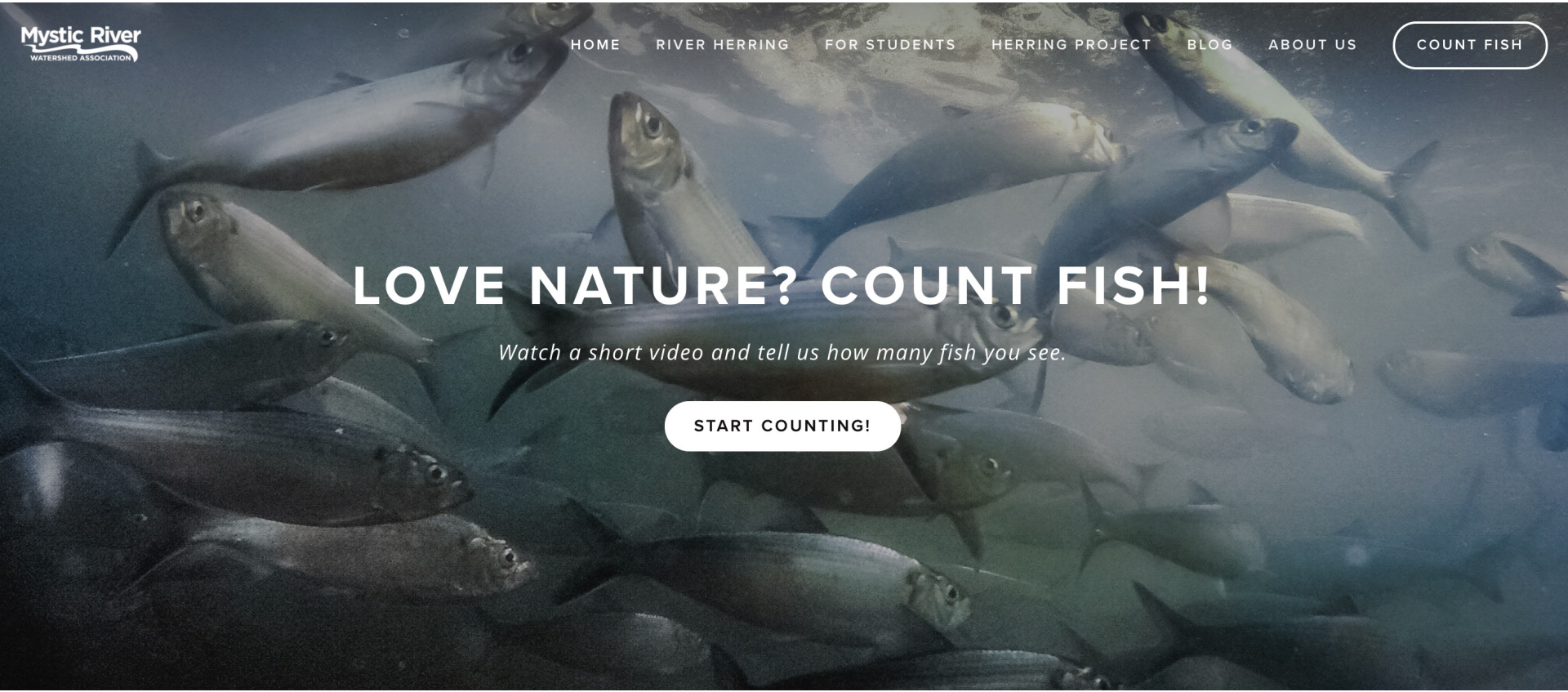

Post-2012 Breeding Area: 60% bigger
Horn Pond Brook
Spot Pond
Melrose
Winchester
Malden
Medford
Everett

Estimated Mystic Herring Run, 2012-19

Mystic Lakes, Medford, MA



Mystic Herring video website



http://www.mysticherring.org/

Link to video of herring migrating

Questions?

Feel free to email with any questions.

andy@mysticriver.org