



# *User-Friendly Ways to Communicate MWRA's Environmental Data*

**Sally Rege Carroll**

Senior Analyst, Environmental Quality

# Who am I?

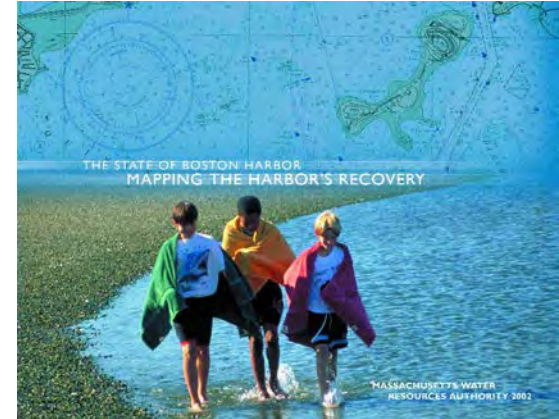
**Sally Carroll, Sr. Analyst**

**MWRA Environmental Quality Department**

- >24 years at MWRA
- Editing and reporting on science > 30 years
- Special interest in Science Communications
- Sally.carroll@mwra.com

# How Data Depiction Developed

- Creation of MWRA and Boston Harbor Project 1984
- Award-winning State of Boston Harbor 90-02
- NPDES Permit – web reporting Data posted online 2000
- **Public notification:** must make data understandable
- **More information moved to the website**



## 2017 Outfall Monitoring Overview

Massachusetts Water Resources Authority  
Environmental Quality  
Department Report 2018-07

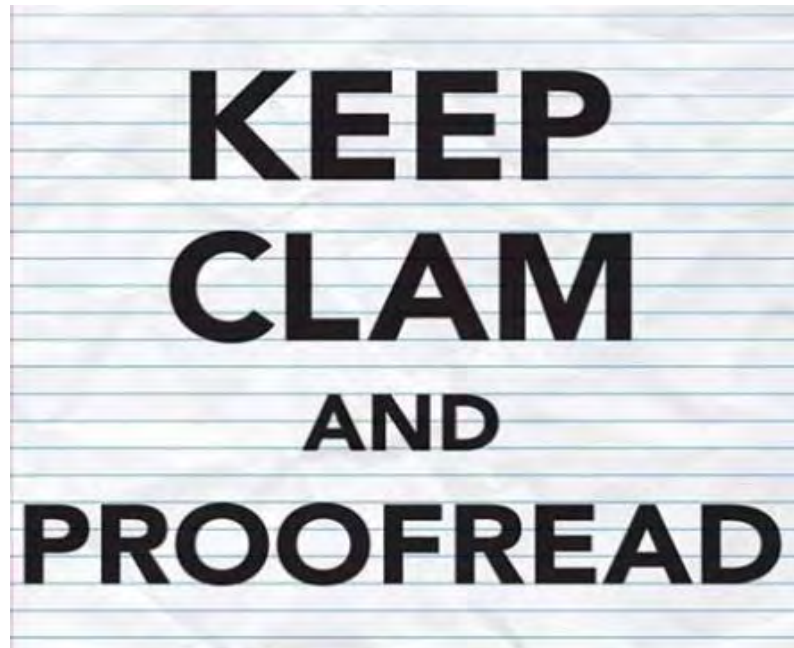


# PARIS IN THE THE SPRING

Design for the skimmer

Headers tell what's happening quickly

Data images should strive to do the same



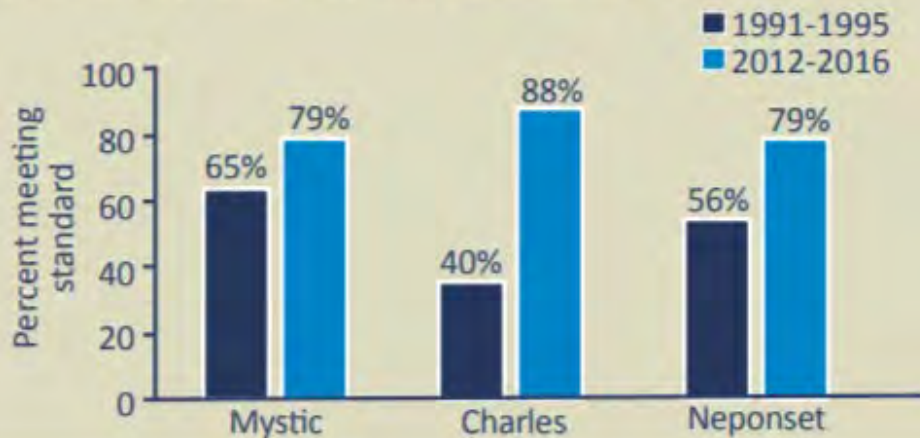
# MAKE IT SKIMMABLE

- Keep some empty space
- Eye-catching side-bars
- Clear and Concise
- User-friendly graphs
- Relevant images



## Cleaner Rivers After Improvements

Percent of samples meeting freshwater swimming standard for *Enterococcus* bacteria in tributary rivers:



## CHARLES RIVER

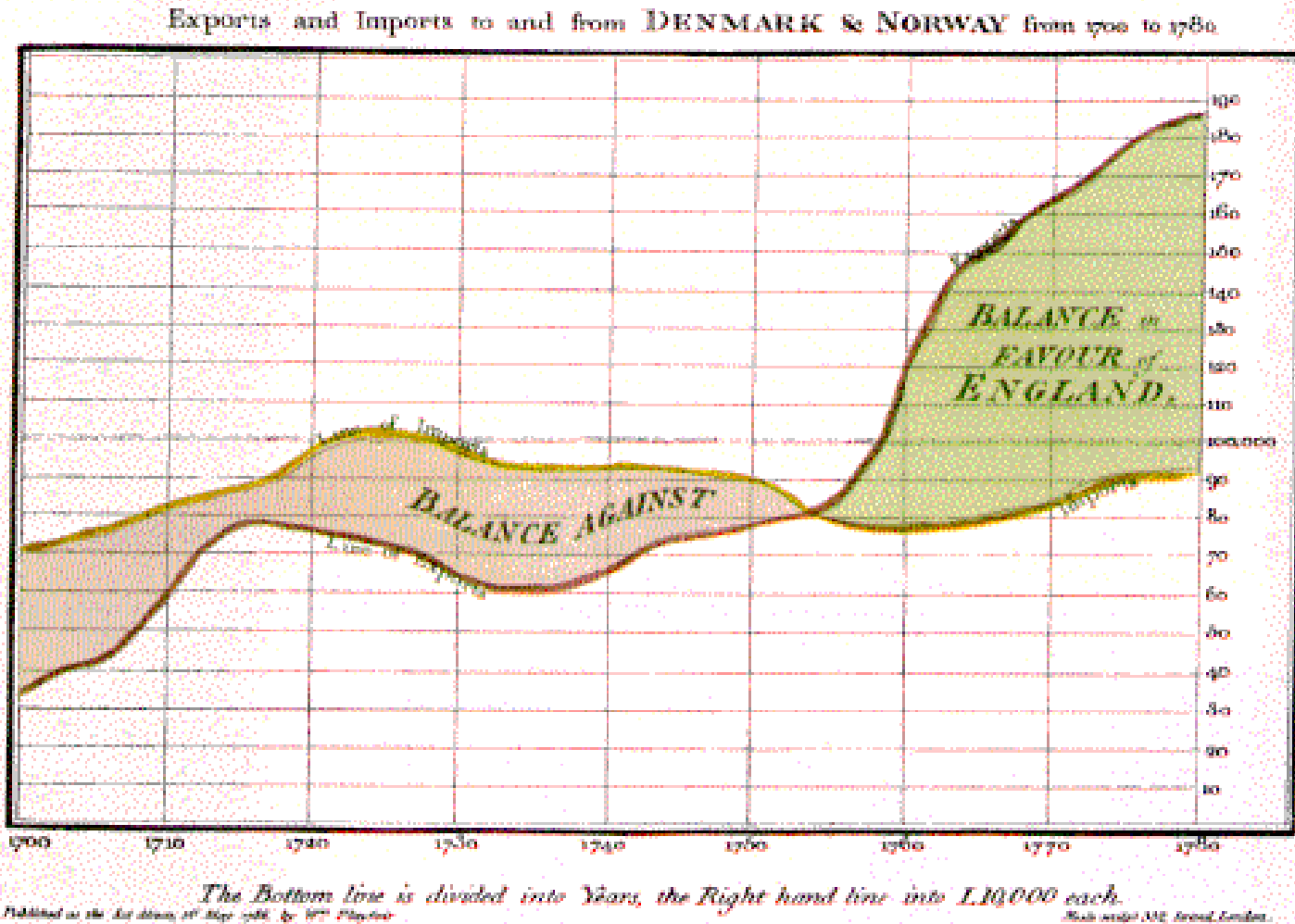
The Charles meanders nearly 80 miles from Echo Lake in Hopkinton to Boston Harbor. The river's mouth, originally a tidal estuarine saltmarsh, has been dammed since the early 1900s. The dam controls river flow and flooding, and fills the Charles River basin, a popular urban recreational area. However, the river's ecosystem is degraded by the dam, as it prevents tidal flushing, trapping pollutants in the basin.

**Charles River water quality**

**“More of our neurons are dedicated to vision than the other four senses combined.”**

*Imagethink.net*

# Imports vs. exports between England and Denmark/Norway, 1786. One of the first data depictions.



In 1786, William Playfair, a Scottish economist, published *The Commercial and Political Atlas* ([visionlearning.com](http://www.visionlearning.com))

# USING IMAGES

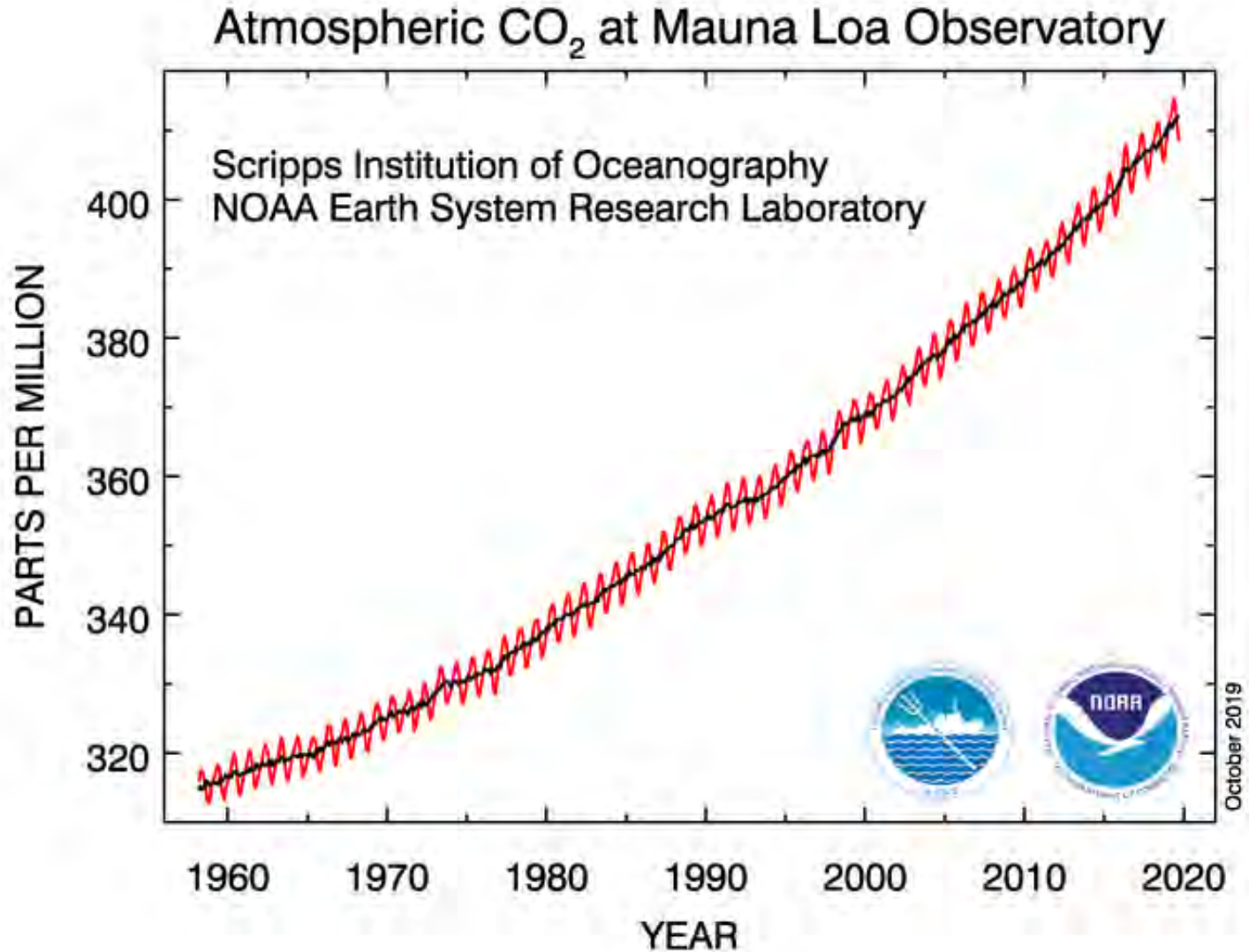
A list of numbers won't quickly show a trend

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Ave
-99.99	-99.99	315.7	317.45	317.5	317.26	315.86	314.93	313.2	312.44	313.33	314.67	-99.99
315.62	316.38	316.71	317.72	318.29	318.16	316.54	314.8	313.84	313.26	314.8	315.58	315.99
316.43	316.97	317.58	319.02	320.03	319.59	318.18	315.91	314.16	313.84	315	316.19	316.9
316.93	317.7	318.54	319.48	320.58	319.77	318.57	316.79	314.8	315.38	316.1	317.01	317.6
317.94	318.56	319.68	320.63	321.01	320.55	319.58	317.4	316.25	315.42	316.69	317.7	318.4
318.74	319.08	319.86	321.39	322.24	321.47	319.74	317.77	316.21	315.99	317.12	318.31	318.9
319.57	-99.99	-99.99	-99.99	322.24	321.89	320.44	318.7	316.79	316.79	317.79	318.71	-99.99
319.44	320.44	320.89	322.13	322.16	321.87	321.39	318.8	317.81	317.3	318.87	319.42	320.0
320.62	321.59	322.39	323.87	324.01	323.75	322.39	320.37	318.64	318.1	319.79	321.08	321.3
322.06	322.5	323.04	324.42	325	324.09	322.55	320.92	319.31	319.31	320.72	321.96	322.1
322.57	323.15	323.89	325.02	325.57	325.36	324.14	322.03	320.41	320.25	321.31	322.84	323.0
324	324.42	325.64	326.66	327.34	326.76	325.88	323.67	322.38	321.78	322.85	324.12	324.6
325.03	325.99	326.87	328.14	328.07	327.66	326.35	324.69	323.1	323.16	323.98	325.13	325.6
326.17	326.68	327.18	327.78	328.92	328.57	327.34	325.46	323.36	323.57	324.8	326.01	326.3
326.77	327.63	327.75	329.72	330.07	329.09	328.05	326.32	324.93	325.06	326.5	327.55	327.4
326.55	329.56	330.3	331.5	332.48	332.07	330.87	329.31	327.51	327.18	328.16	328.64	329.6
329.35	330.71	331.48	332.65	333.09	332.25	331.18	329.4	327.43	327.37	328.46	329.57	330.2
330.4	331.41	332.04	333.31	333.96	333.6	331.91	330.06	328.56	328.34	329.49	330.76	331.1
331.75	332.56	333.5	334.58	334.87	334.34	333.05	330.94	329.3	328.94	330.31	331.68	332.1
332.93	333.42	334.7	336.07	336.74	336.27	334.93	332.75	331.59	331.16	332.4	333.85	333.1
334.97	335.39	336.64	337.76	338.01	337.89	336.54	334.68	332.76	332.55	333.92	334.95	335.5
336.23	336.76	337.96	338.89	339.47	339.29	337.73	336.09	333.91	333.86	335.29	336.73	336.8
338.01	338.36	340.08	340.77	341.46	341.17	339.56	337.6	335.88	336.02	337.1	338.21	338.8
339.23	340.47	341.38	342.51	342.91	342.25	340.49	338.43	336.69	336.86	338.36	339.61	339.9
340.75	341.61	342.7	343.57	344.13	343.35	342.06	339.81	337.98	337.86	339.26	340.49	341.1
341.37	342.52	343.1	344.94	345.75	345.32	343.98	342.39	339.86	339.99	341.15	342.99	342.7
343.7	344.5	345.28	347.08	347.43	346.79	345.4	343.28	341.07	341.35	342.98	344.22	344.4
344.97	346	347.43	348.35	348.93	348.25	346.56	344.68	343.09	342.8	344.24	345.55	345.1
346.3	346.96	347.86	349.55	350.21	349.54	347.94	345.9	344.85	344.17	345.66	346.9	347.1
348.02	348.47	349.42	350.99	351.84	351.25	349.52	348.1	346.45	346.36	347.81	348.96	348.9
350.43	351.73	352.22	353.59	354.22	353.79	352.38	350.43	348.72	348.88	350.07	351.34	351.4
352.76	353.07	353.68	355.42	355.67	355.13	353.9	351.67	349.8	349.99	351.29	352.52	352.9
353.66	354.7	355.39	356.2	357.16	356.23	354.82	352.91	350.96	351.18	352.83	354.21	354.1
354.72	355.75	357.16	358.6	359.33	358.24	356.17	354.02	352.15	352.21	353.75	354.98	355.5
355.98	356.72	357.81	359.15	359.66	359.25	357.02	355	353.01	353.31	354.16	355.4	356.3
356.7	357.16	358.38	359.46	360.28	359.6	357.57	355.52	353.69	353.99	355.34	356.8	357.0
358.37	358.91	359.97	361.26	361.68	360.95	359.55	357.48	355.84	355.99	357.58	359.04	358.8
359.97	361	361.64	363.45	363.79	363.26	361.9	359.46	358.05	357.76	359.56	360.7	360.8
362.05	363.25	364.02	364.72	365.41	364.97	363.65	361.48	359.45	359.6	360.76	362.33	362.6
363.18	364	364.56	366.35	366.79	365.62	364.47	362.51	360.19	360.77	362.43	364.28	363.7
365.33	366.15	367.31	368.61	369.3	368.87	367.64	365.77	363.9	364.23	365.46	366.97	366.6
368.15	368.87	369.59	371.14	371	370.35	369.27	366.93	364.63	365.13	366.67	368.01	368.3
369.14	369.46	370.52	371.66	371.82	371.7	370.12	368.12	366.62	366.73	368.29	369.53	369.4
370.28	371.5	372.12	372.87	374.02	373.3	371.62	369.55	367.96	368.09	369.68	371.24	371.0
372.43	373.09	373.52	374.86	375.55	375.41	374.02	371.49	370.7	370.25	372.08	373.78	373.1
374.68	375.63	376.11	377.65	378.35	378.13	376.62	374.5	372.99	373.01	374.35	375.7	375.6
376.79	377.37	378.41	380.52	380.63	379.57	377.79	375.86	374.07	374.24	375.86	377.47	377.3
378.37	379.69	380.41	382.1	382.28	382.13	380.66	378.71	376.42	376.88	378.32	380.04	379.6
381.38	382.03	382.64	384.62	384.95	384.06	382.29	380.47	378.67	379.06	380.14	381.74	381.8
382.45	383.68	384.23	386.26	386.39	385.87	384.39	381.78	380.73	380.81	382.33	383.69	383.5
385.07	385.72	385.85	386.71	386.45	387.64	386.1	383.95	382.91	382.73	383.96	385.02	385.3



# USING IMAGES

Graph shows trend faster than the table

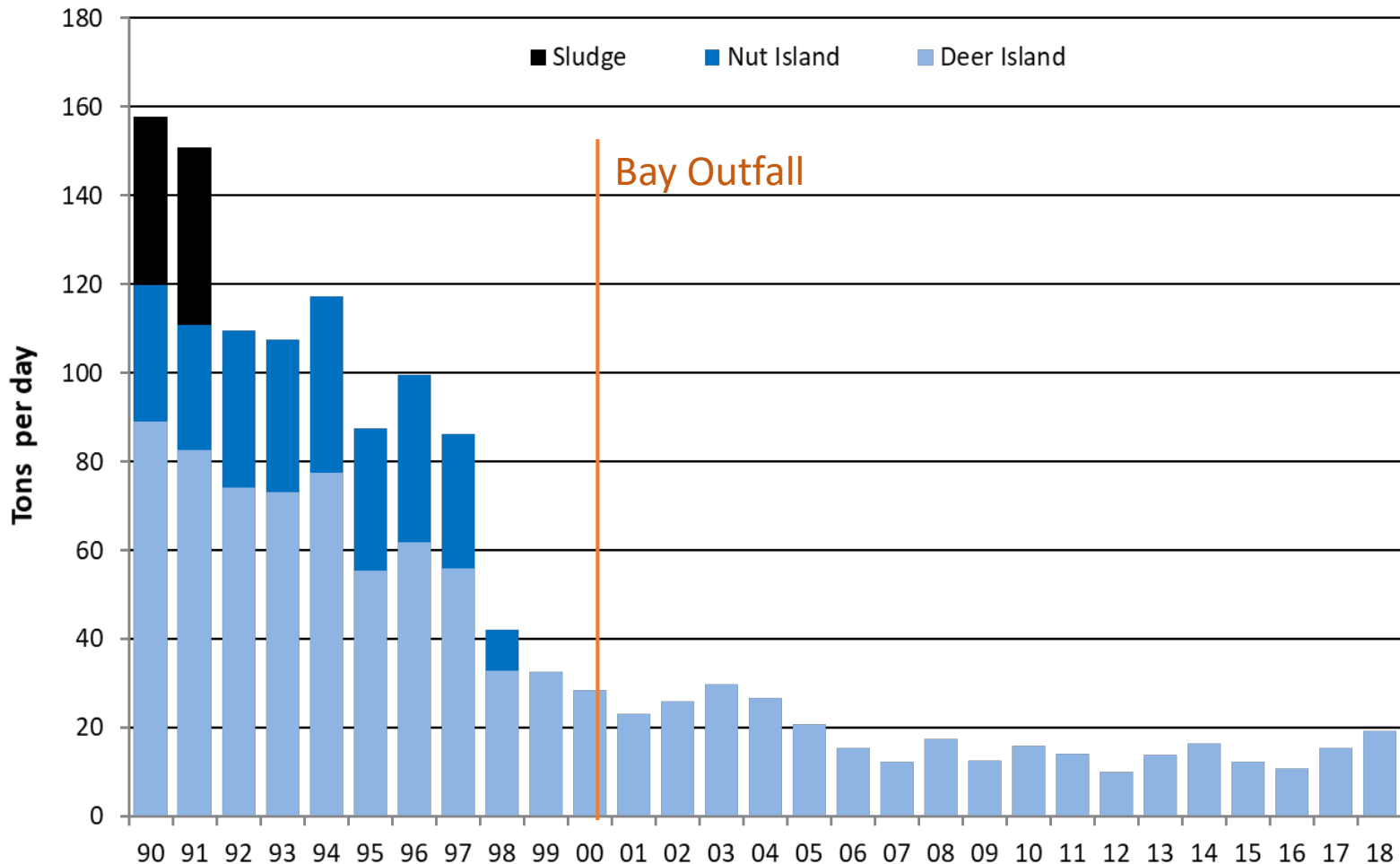


# **CHALLENGES IN DATA PRESENTATION**

- **In simplifying we lose information**
- **Good news is a harder sell**

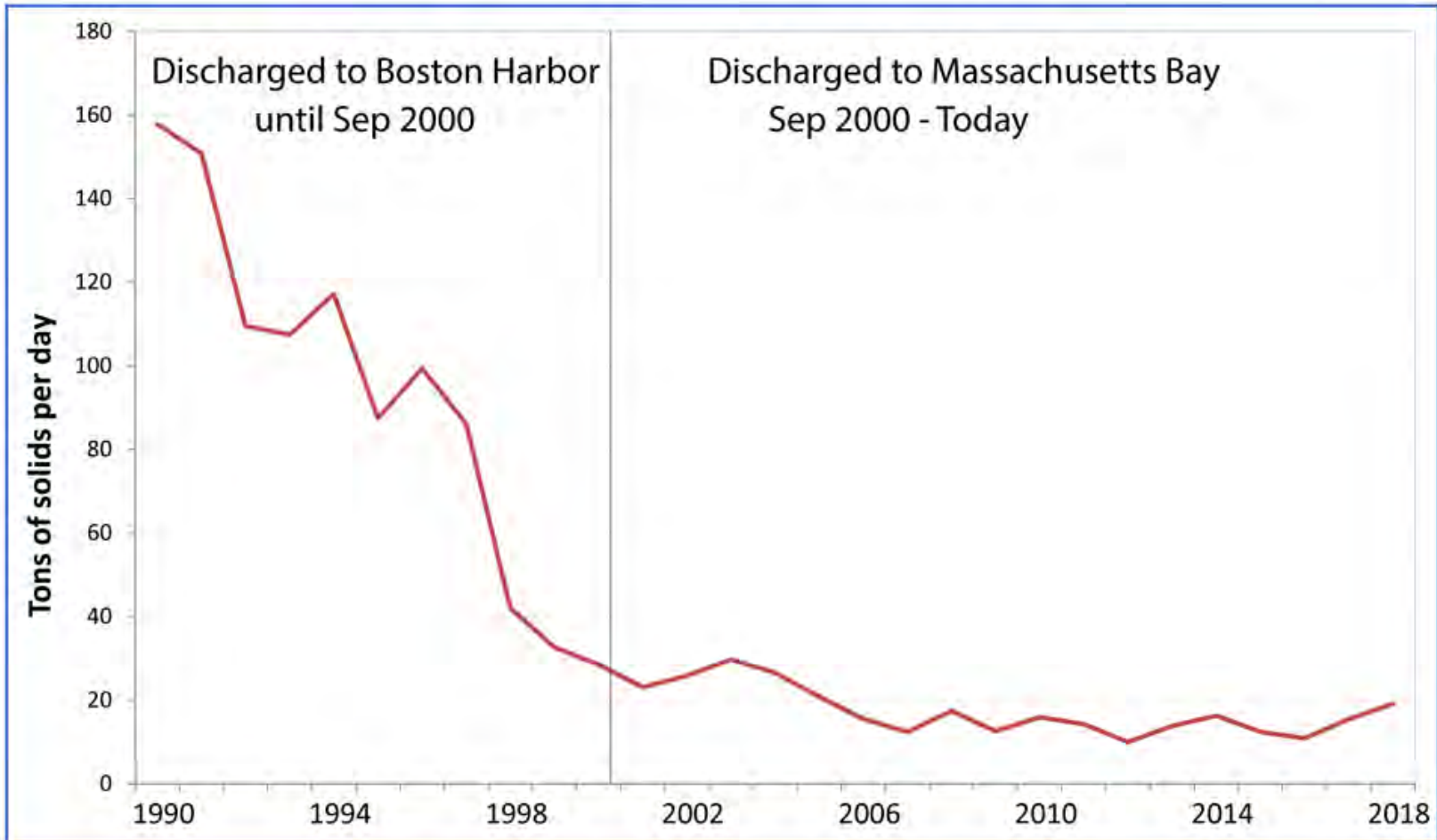
# CHALLENGE: What if we just showed the last 20 years?

## Solids discharge from Deer Island Treatment Plant.

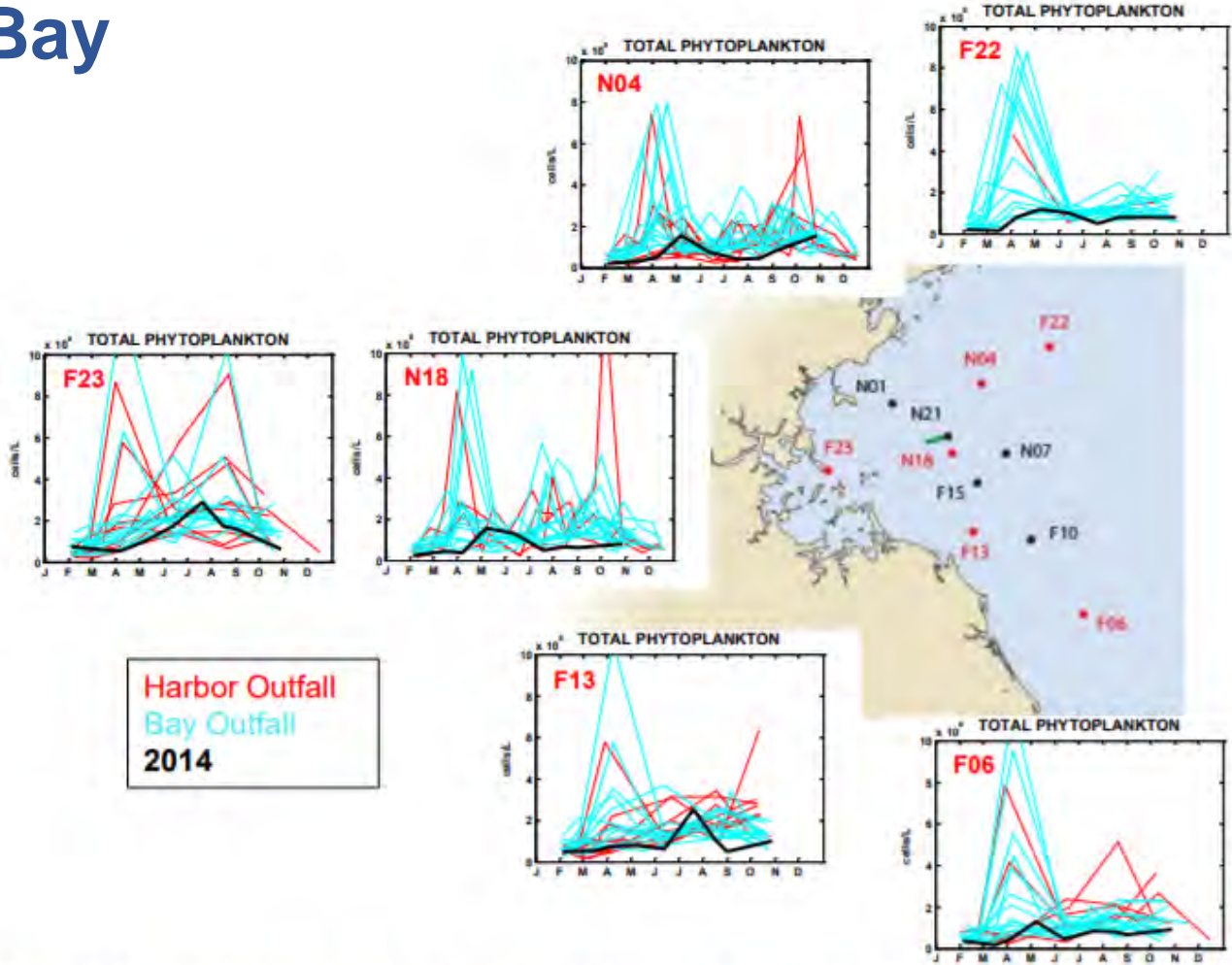


# SIMPLIFIED: Graph emphasizes message Solids discharge line with no sources or sludge

## Solids in MWRA Effluent Remain Low



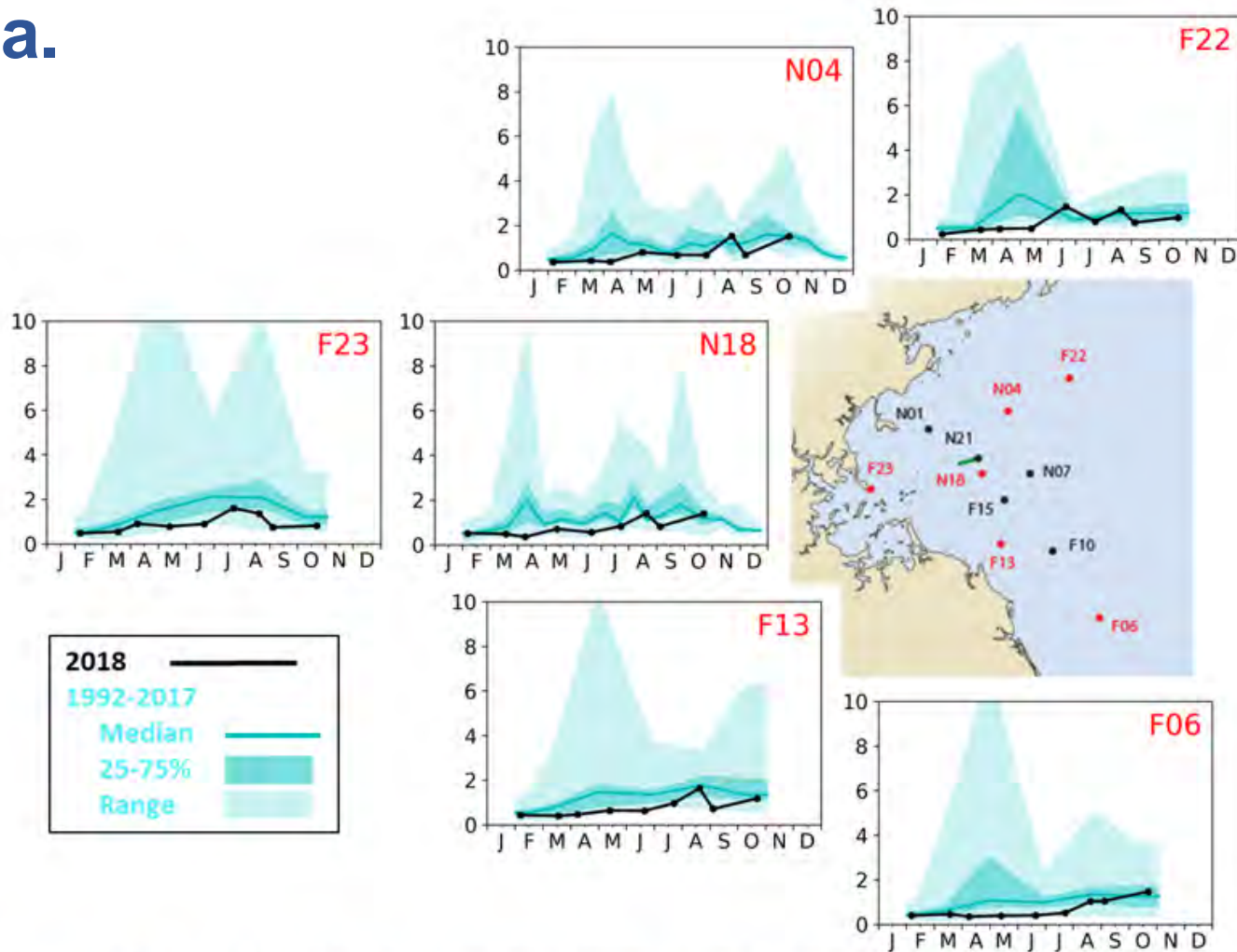
# 2014 Chlorophyll graph uses individual lines and color to depict previous years' data in the Harbor and Bay



Harbor Outfall  
 Bay Outfall  
 2014

Figure 3-12. Total phytoplankton abundance at selected stations in 2014 compared to baseline (Harbor Outfall) and post-discharge (Bay Outfall) monitoring years.

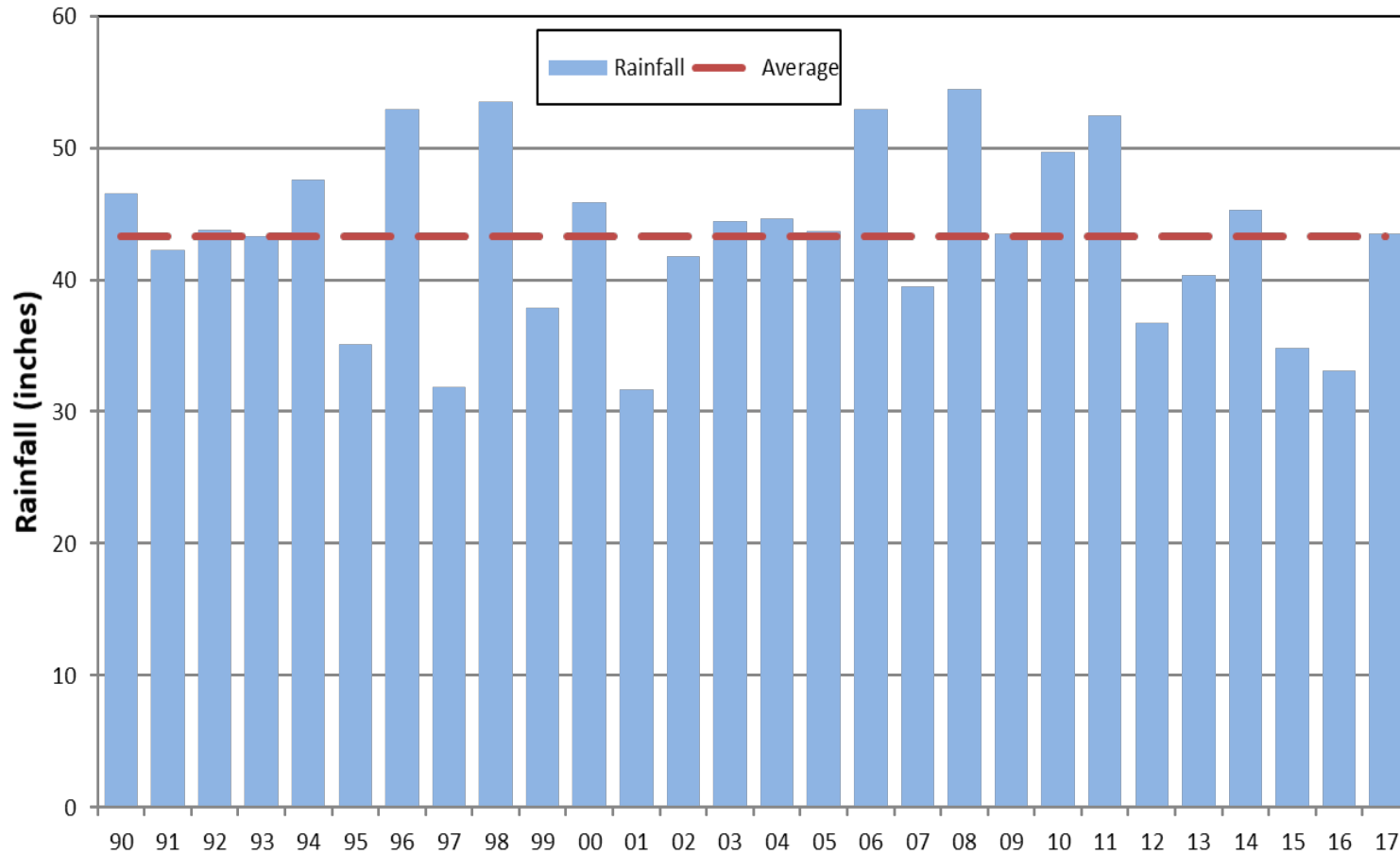
Similar chlorophyll graph in 2018 uses shading to replace the lines showing previous years' data.



**Figure 3-10. Total phytoplankton abundance (million cells per liter) at selected stations in 2018 compared to prior years.** (For some stations, historic data extend later in the year than the current survey schedule.)

# CONTEXT: Compared to What?

## Annual Rainfall in Boston, 1990-2017



**Red line (average rainfall) helps reader distinguish drought or wet years.**

# CONTEXT: Before and After Using Color

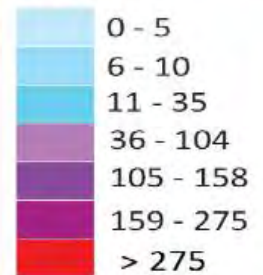
## Bacteria in Boston Harbor Before and After Improvements: “The Lighter the Blue, the Better”

Before Improved treatment and Infrastructure



Blue meets swim standard

Geometric mean col/100 mL



- active outfall
- closed outfall
- Sludge outfall
- closed sludge outfall

Most Boston Harbor projects completed

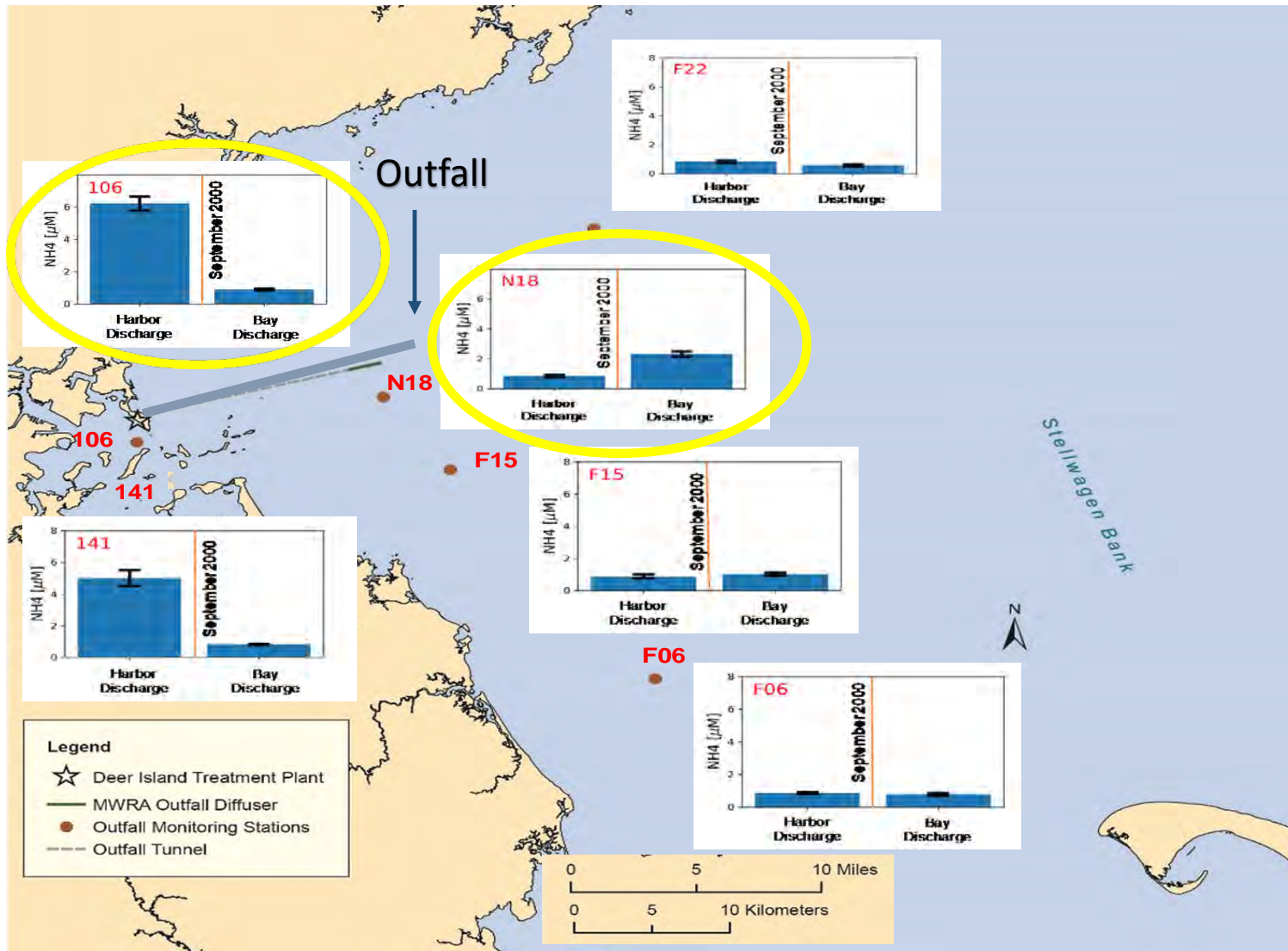


Average *Enterococcus* counts in Boston Harbor in wet weather

*The lighter the blue, the better*



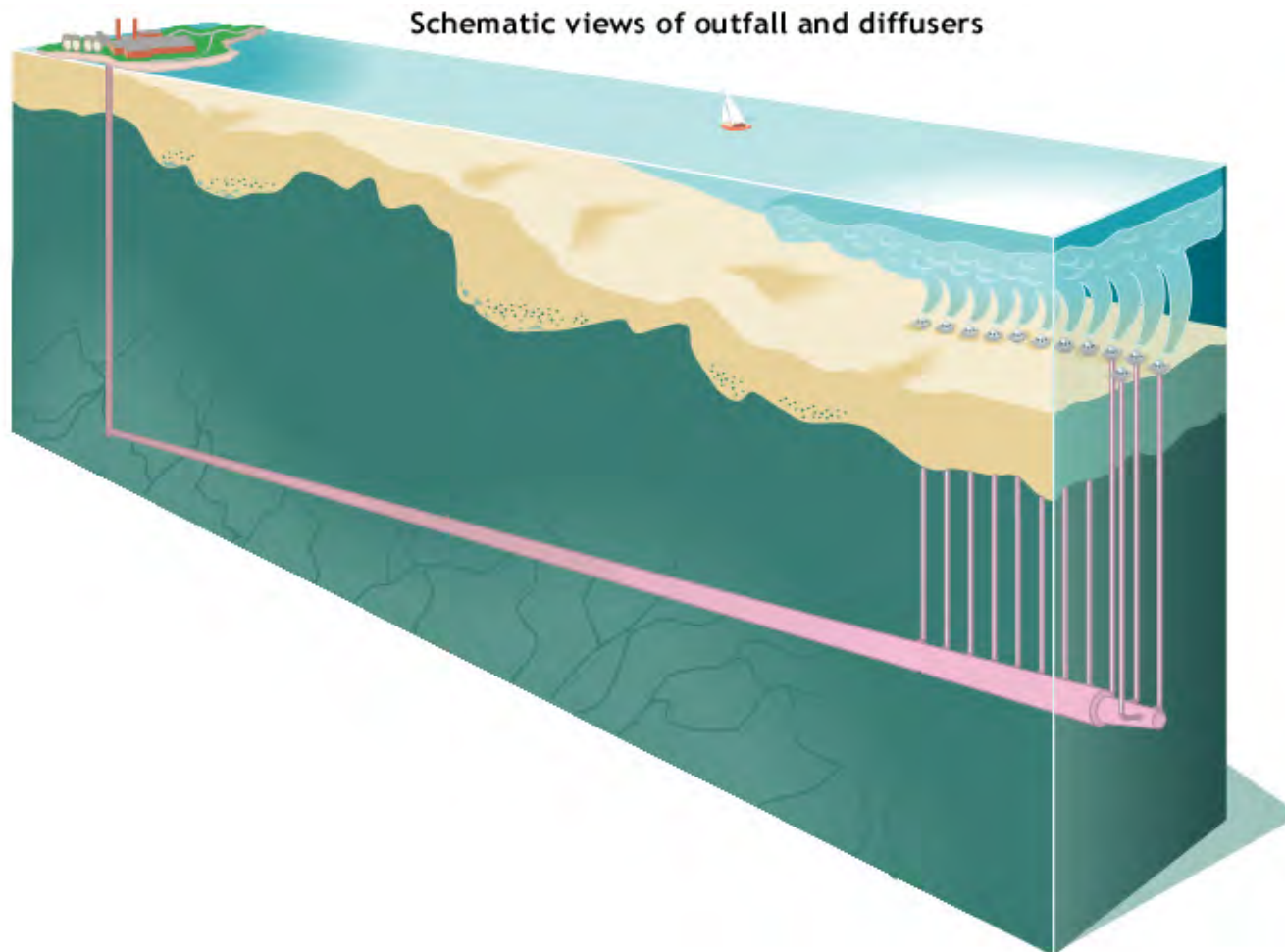
# LOCATION MAP of Nitrogen shows sharp decrease in Harbor and slight Bay increase only near outfall



# CONTEXT: Beware Assumed Knowledge

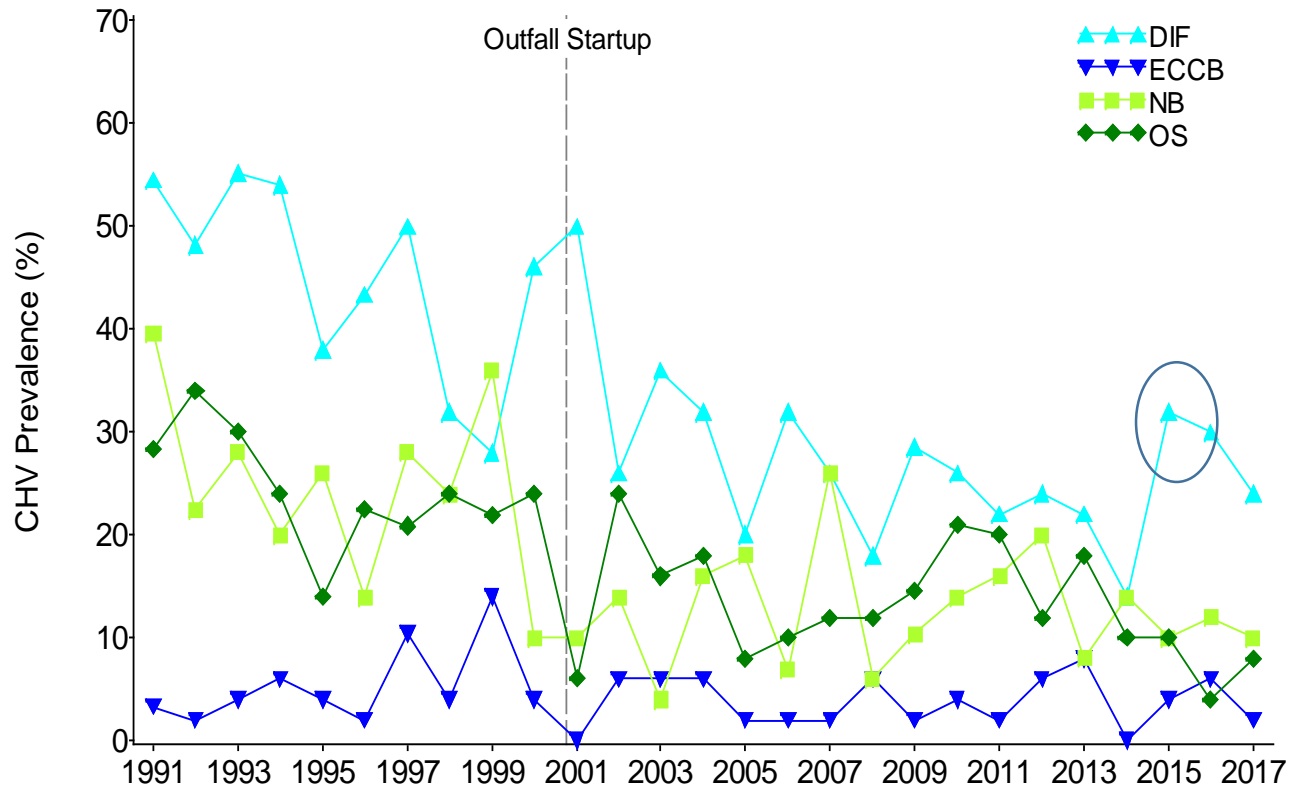
Does everyone know what the outfall looks like?

Where Deer Island is?



# VISUAL AID: Variable data can make it difficult to see a trend, reader needs guidance

## Pre-cancerous lesions (CHV) in flounder, 1991–2017

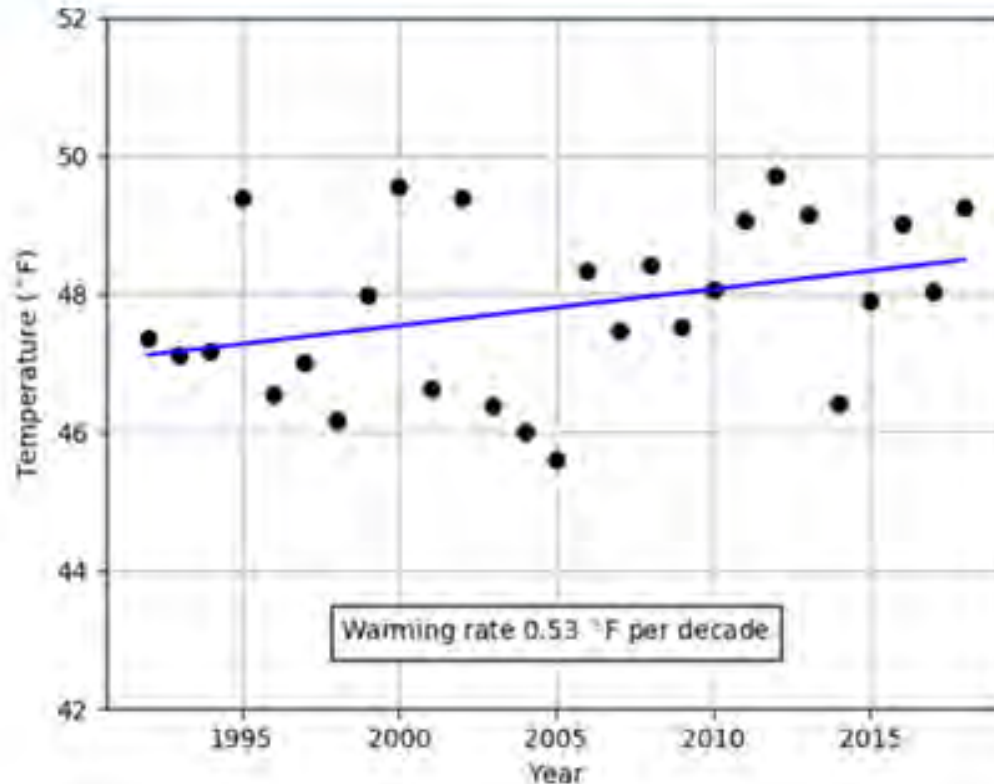


DIF = Deer Island Flats, ECCB = Eastern Cape Cod Bay, NB = Nantasket Beach, OS = Outfall Site

# VISUAL AID

## Blue line shows a trend in Mass. Bay temperature

Mass. Bay Temperature Increased by Over 1° F in 20 Years

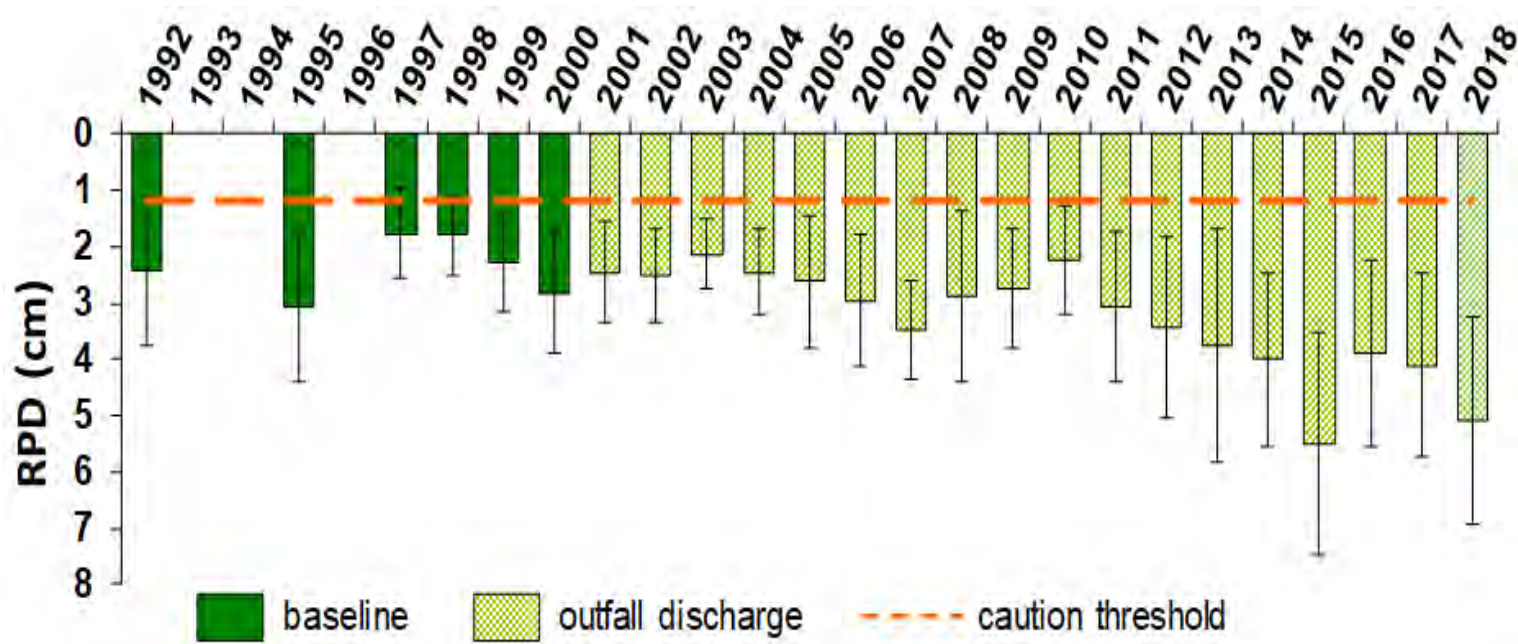


MWRA's long-term monitoring helps to identify trends in the environment. Our data shows that the temperature in Mass. Bay has increased by more than 1 degree Fahrenheit since 1991.

# VISUAL AID

Depth of aerated sediments near the outfall:  
shown by downward bars

Depth of Bay sediment oxygenated layer, 1992-2018



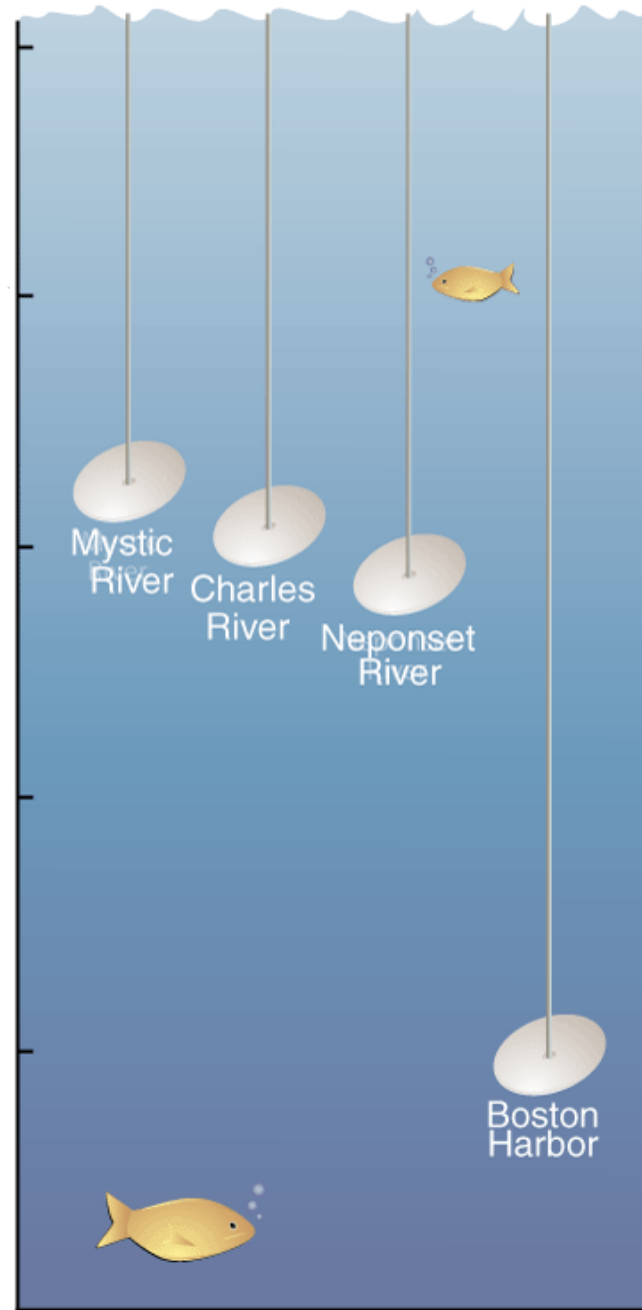
# VISUAL AID to Depth of aerated sediments graph:

Harbor sediments cross-section image:  
Lighter sediments are oxygenated



**VISUAL AID increases understanding of water clarity data in Harbor and Rivers:**

**Water clarity depth is measured by visibility of a white “secchi” disk.**



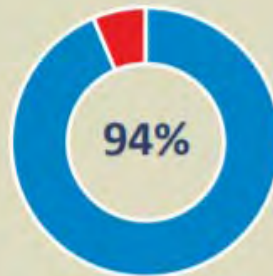
# VISUAL AID

“Doughnuts” show percent of samples passing swim standard at beaches

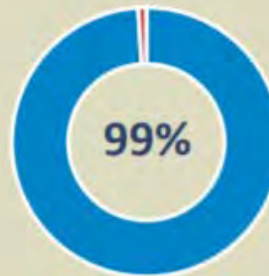


MWRA's efforts to eliminate wet-weather discharges of sewage and stormwater have resulted in the cleanest urban beaches in the country.

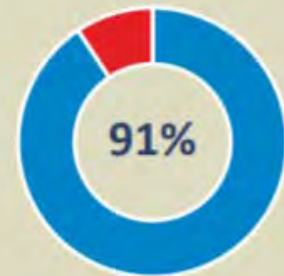
Percent of samples meeting the saltwater swimming standard for *Enterococcus* at Harbor Beaches 2012-2016:



Constitution Beach



South Boston Beaches



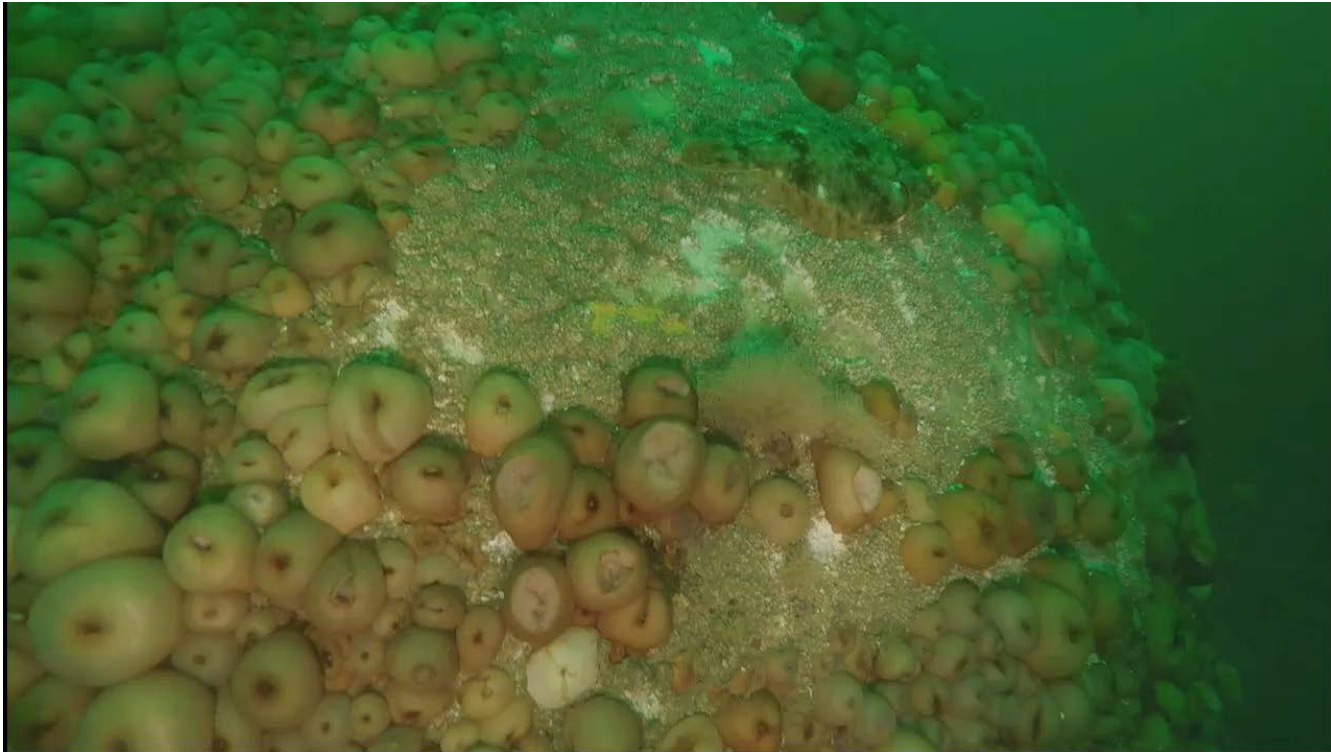
Malibu Beach

South Boston beaches have met swimming standards 99% of the time in the last 5 years. Today, any high bacteria counts are mainly from stormwater runoff, which often contains animal waste and other sources of bacteria.



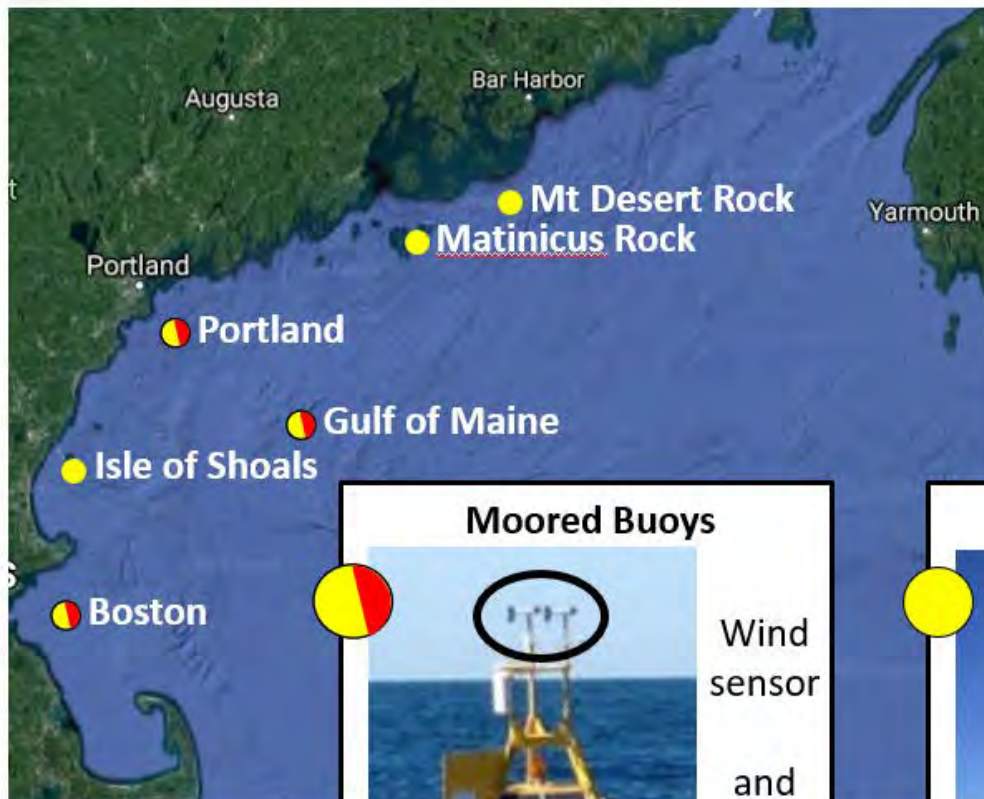
# RELEVANT PHOTOS AND VIDEO

Video showing teeming life on an outfall diffuser supports abundance and diversity data





## Long time series hourly observations



- NOAA's National Data Buoy Center
- 1985-2018 (34 yrs)
- Coastal/offshore
- 3 Moored buoys
- 3 Island-based

Moored Buoys



Wind  
sensor  
and  
Wave  
sensor

CMAN Stations



Wind  
sensor

**Relevant photos and map show where wind and wave measurements are taken. (Dan Codiga)**

# KEEP TEXT READABLE:

## Avoid Acronyms!

“Based on the results of **RLA** and **RRISSC**, the Trail Creek Watershed advanced to the third and most detailed phase of **WARSSS**, the Prediction Level Assessment (**PLA**).” [Advisory Committee on Water Information website]

- ❖ **Introduce the acronym up front and use it *only* when the full name won't work**
- ❖ **Avoid acronyms of more than 4 letters, especially if they don't spell a word**

# KEEP TEXT READABLE:

## Avoid Bureaucratese and the Passive Voice

- A MAJORITY OF = **MOST**
- NEARFIELD = **NEAR THE OUTFALL**
- IT WAS OBSERVED = **WE FOUND**
- AT THE PRESENT TIME = **NOW**
- SAMPLES WERE TAKEN = **MWRA SAMPLED**
- IN GREATER ABUNDANCE = **MORE ABUNDANT**

# Questions or Comments?



Visit us online at

<http://www.mwra.state.ma.us/harbor/html/whatsnew.htm>