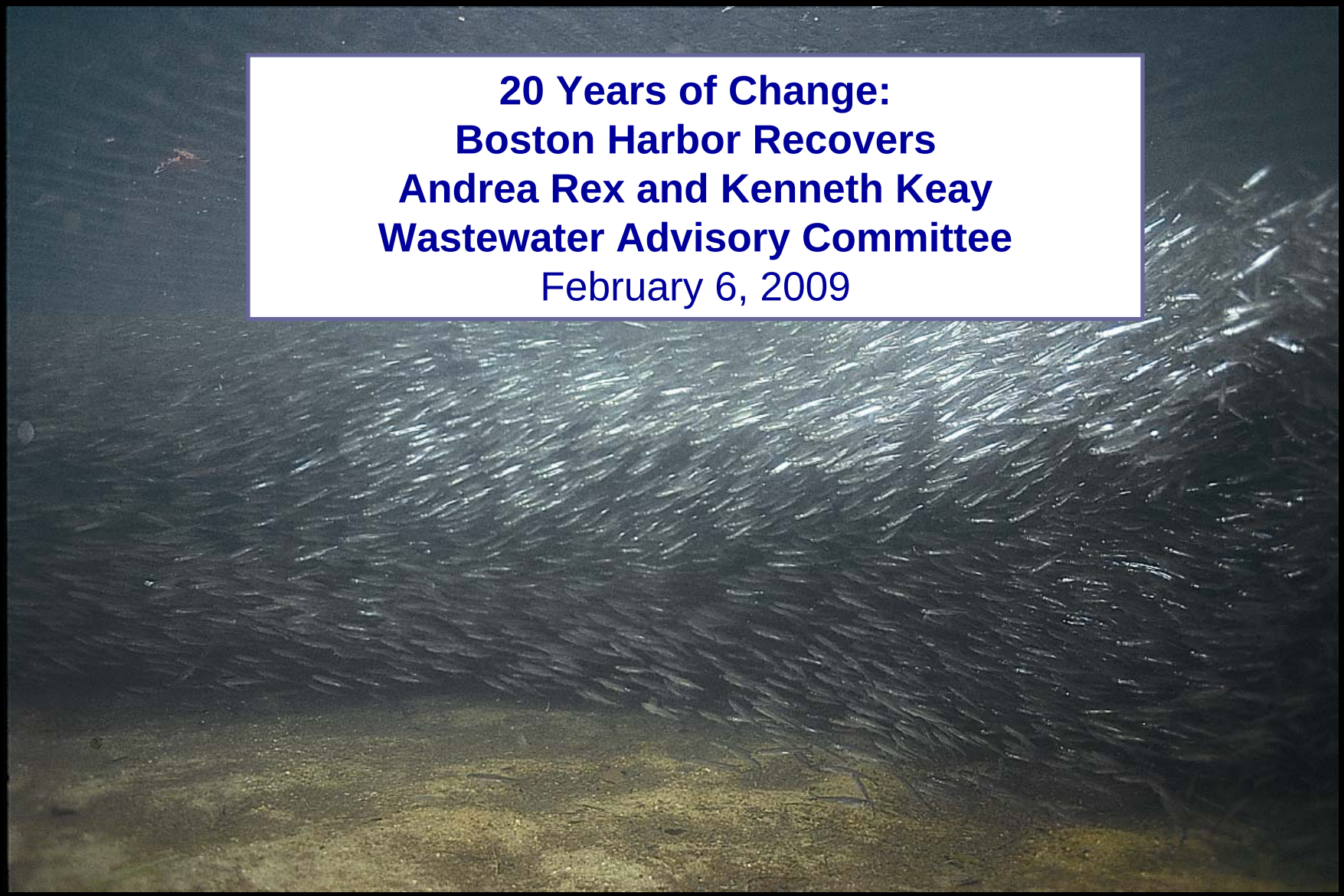
Massachusetts Water Resources Authority



20 Years of Change:
Boston Harbor Recovers

Andrea Rex and Kenneth Keay
Wastewater Advisory Committee

February 6, 2009

Timeline: Starting conditions

1986 Federal judge ordered schedule to construct new Deer Island Treatment Plant and related facilities.

- **Two failing primary treatment plants discharged total 350 million gallons/day to harbor.**
- **Digested sludge discharged in northern harbor.**
- **84 CSOs discharge 3 billion gallons annually during wet weather**

Timeline: Early changes

1988-1991

- **Upgrades old DITP, including improvements to disinfection.**
- **Sewage scum land-filled instead of being discharged into the harbor.**

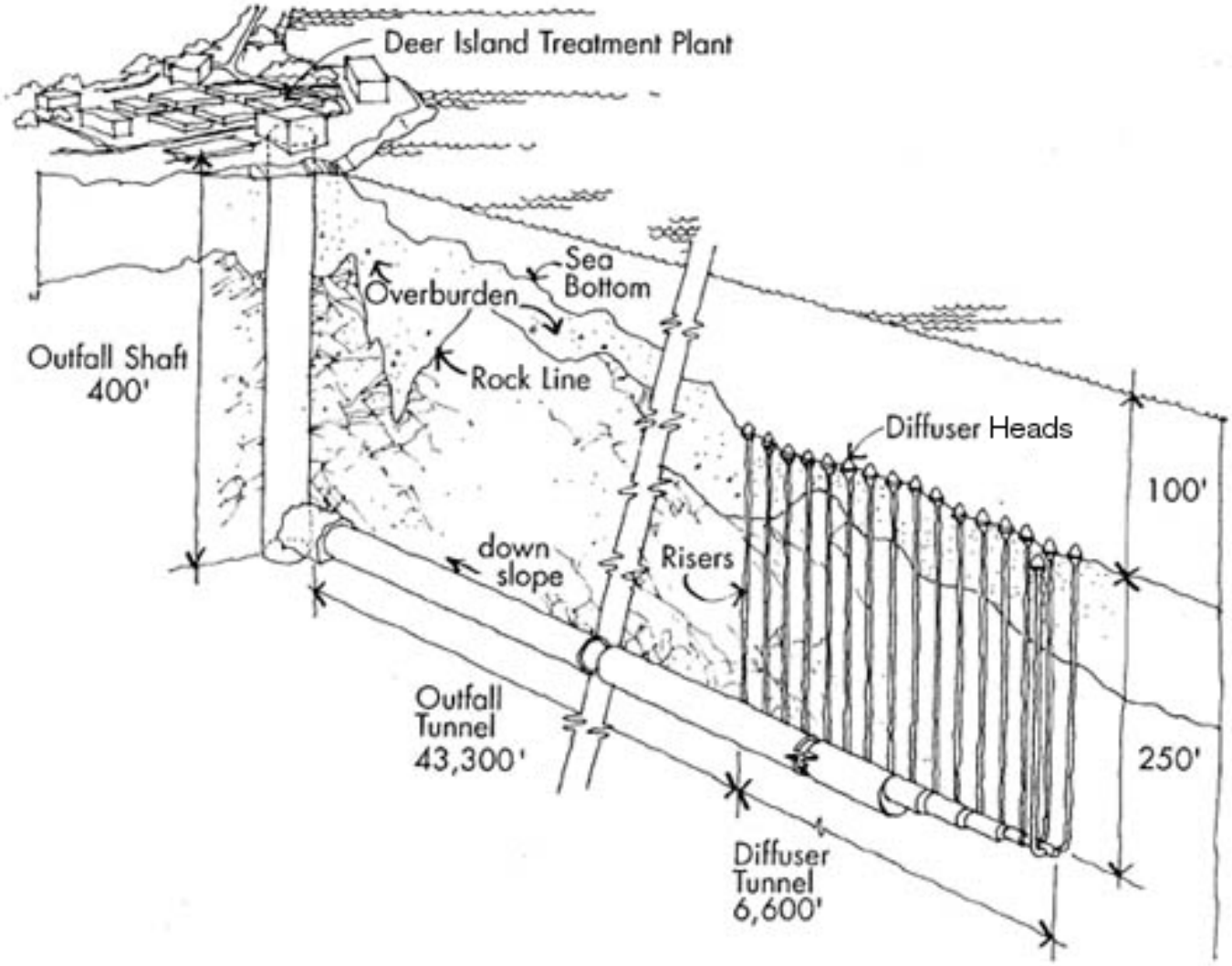
- **1991: End of sludge discharges into the harbor; sludge is made into fertilizer pellets.**
- **CSO discharges cut in half to 1.5 BGY**

Timeline 1992-1998

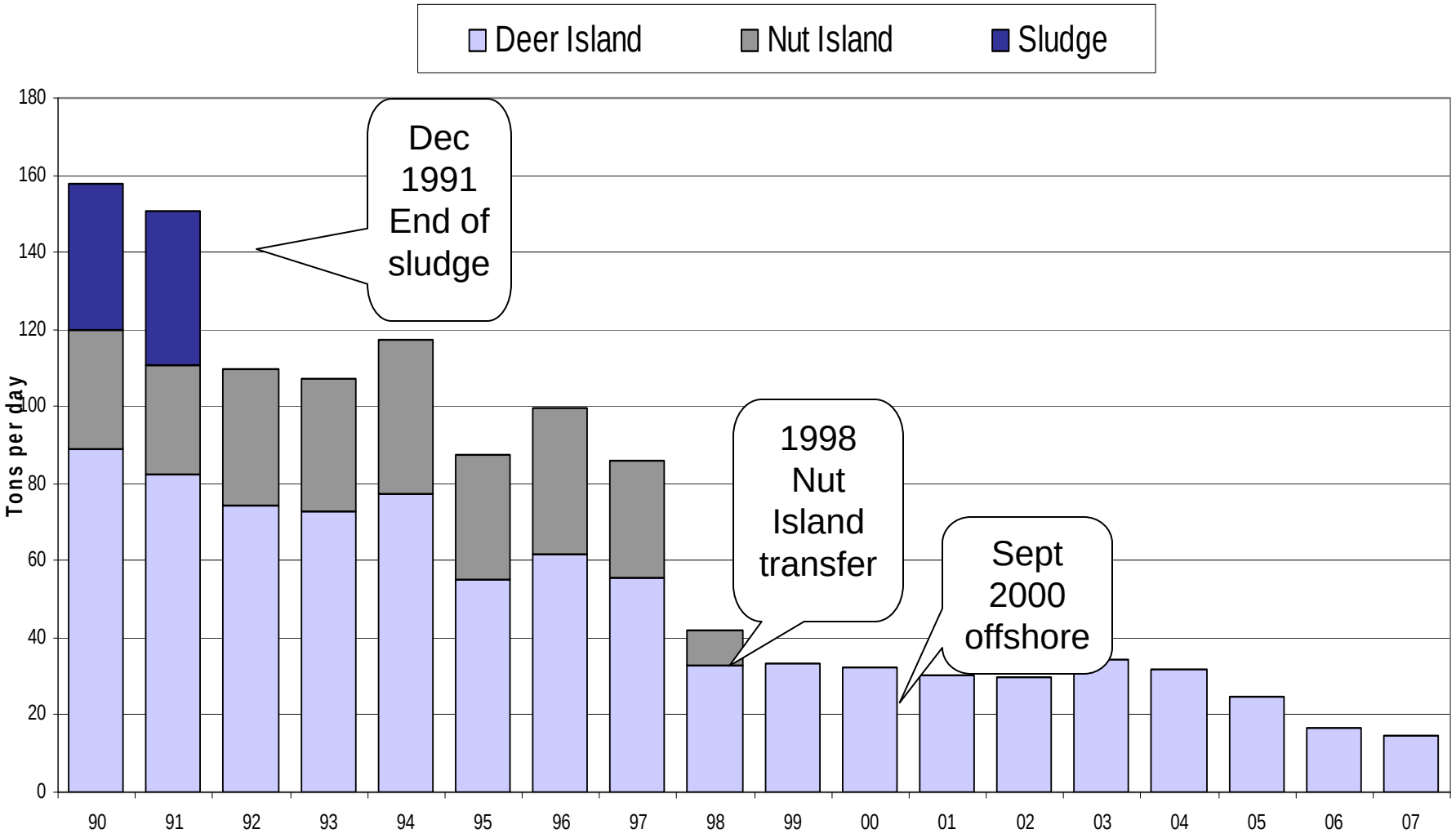
- **Improved pumping capacity at DITP decreases CSO further, most dramatic in Charles River**
- **Start-up of secondary treatment at DITP 1997**
- **Nut Island Treatment Plant flows transferred to DITP.**
- **NITP decommissioned 1998, end of discharges to the southern harbor!**

End of effluent discharges to Boston Harbor: September 2000

Start-up of new 9 mile-long outfall DITP effluent moved from harbor, for discharge to Massachusetts Bay



TSS discharges



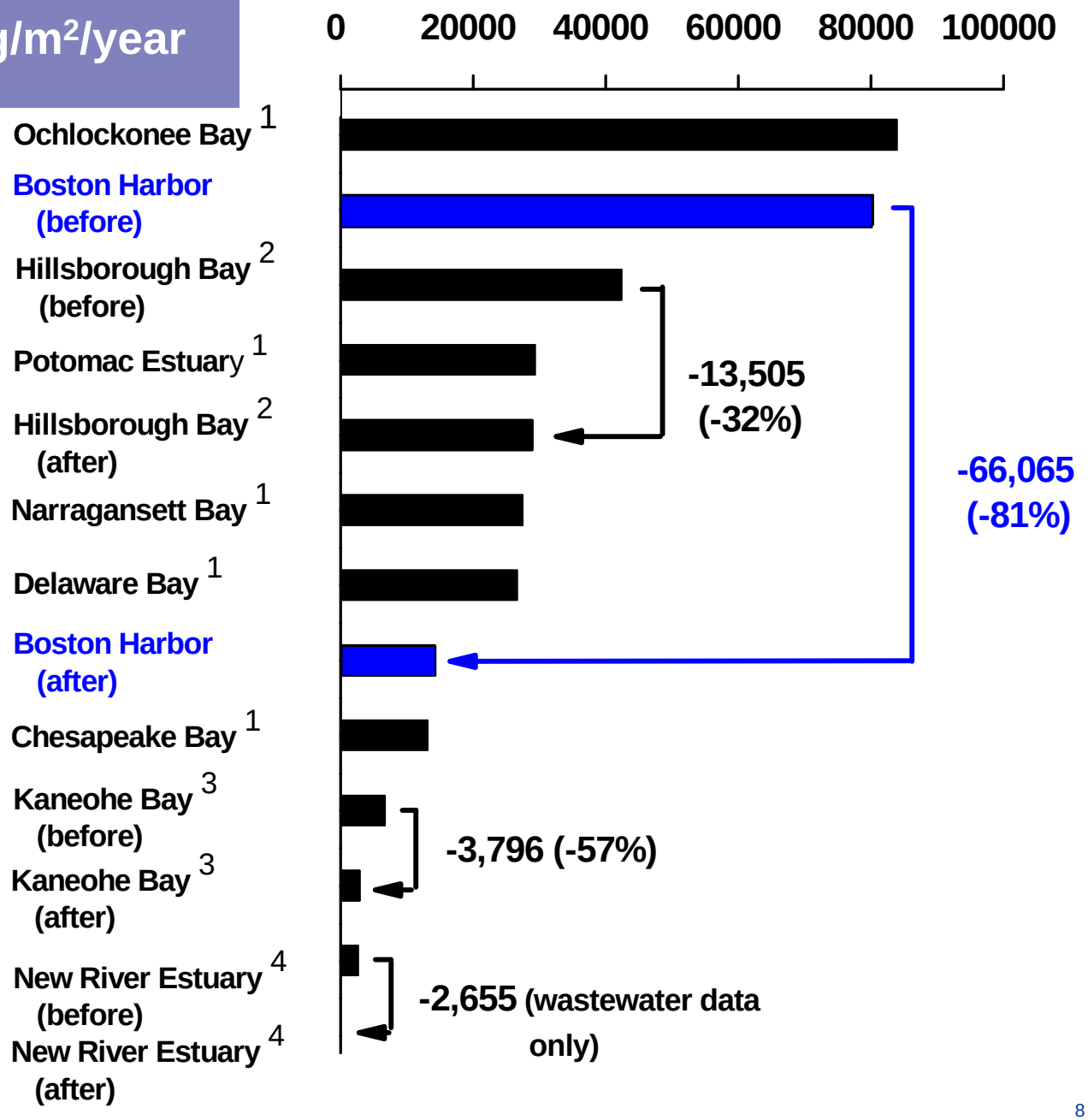
85-90% drop in pollutant loadings to harbor

Fraction	Before diversion (1995 thru Aug 2000)	After diversion (Sept 2000 - 2005)	Difference (%)	% contribution by WWTF loadings
TN	1835 ± 400	354 ± 186	-1481 (-81%)	99%
DIN	1185 ± 242	244 ± 134	-941 (- 78%)	109%
TP	109 ± 25	12 ± 4	-97 (-89%)	100%
DIP	54 ± 15	6 ± 1	-48 (-89%)	100%
TSS	74 ± 15	12 ± 9	-62 (-84%)	94%
POC	5046 ± 1479	496 ± 380	-4450 (-90%)	93%

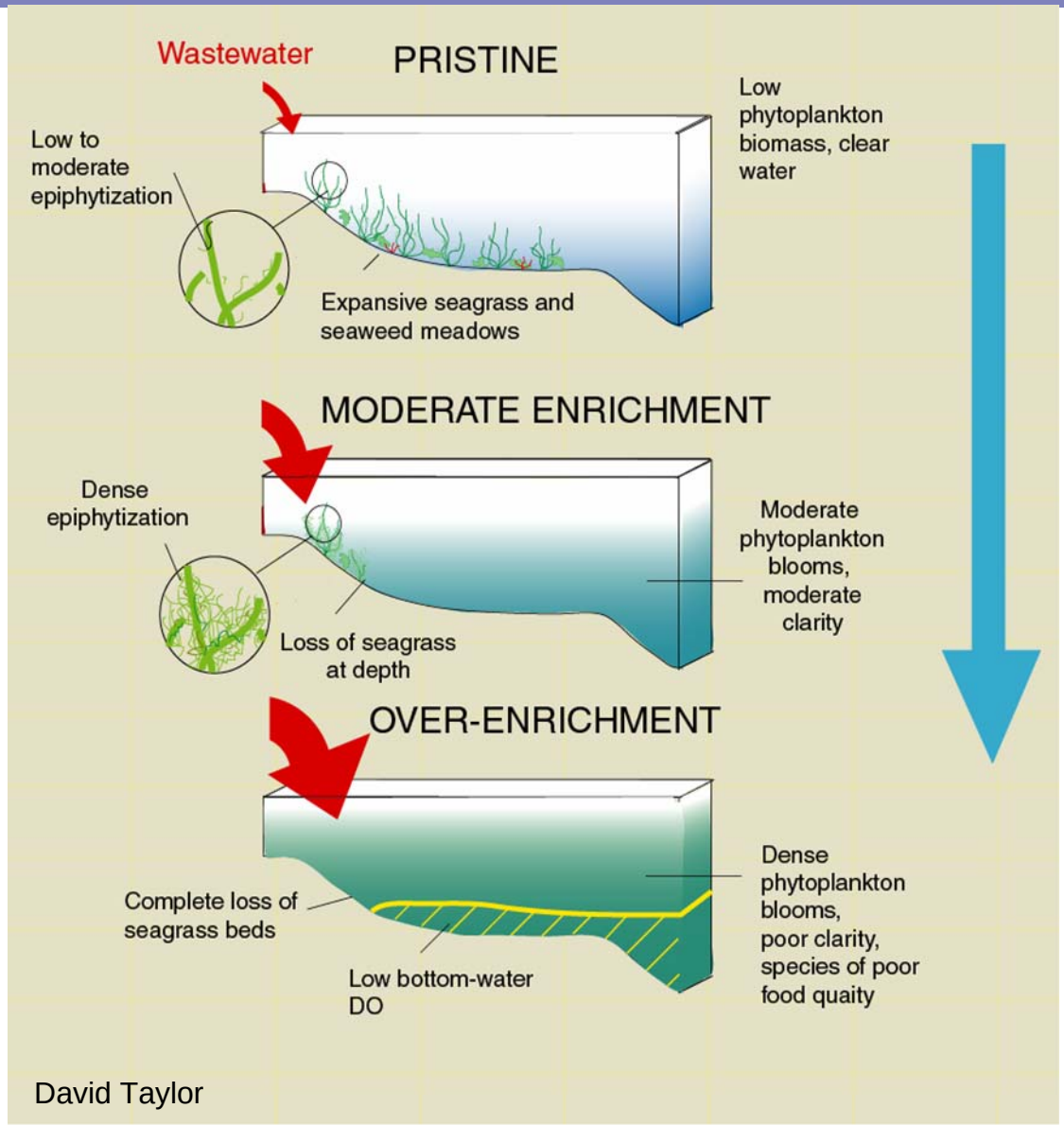
Includes : WWTF + Rivers + Non-point sources (CSO + stormwater + wet atmos + groundwater)

Units : kmol d^{-1} - TN, DIN, TP, DIP and POC ton d^{-1} - TSS

Total N Mg/m²/year

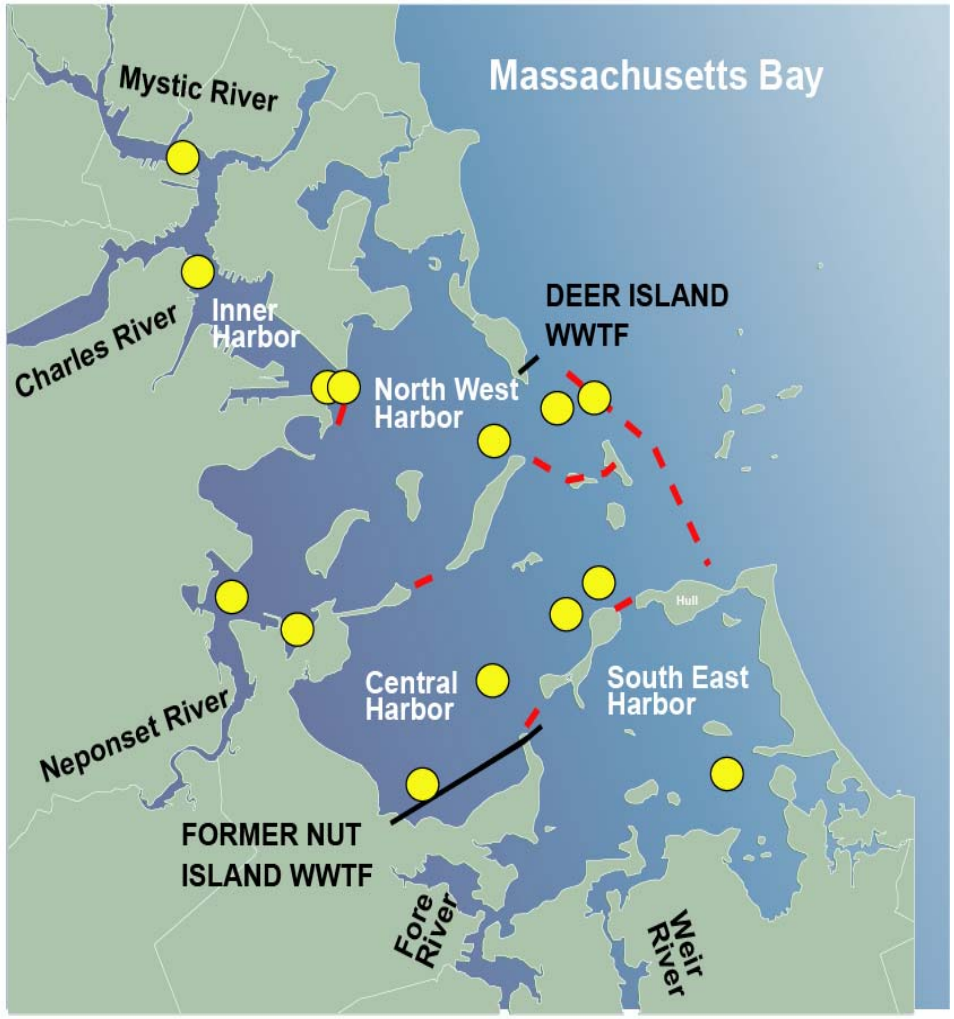


Eutrophication process

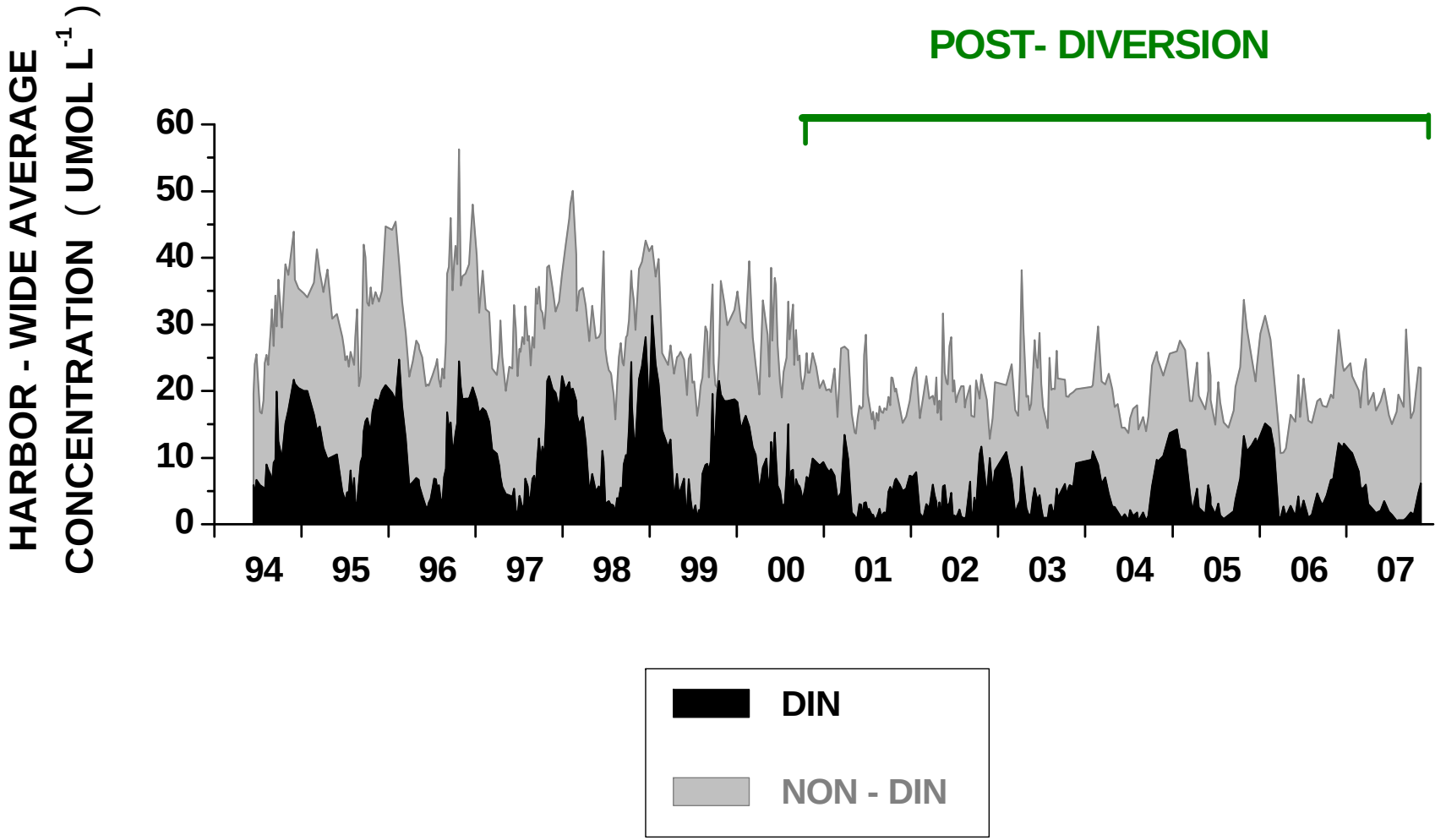


David Taylor

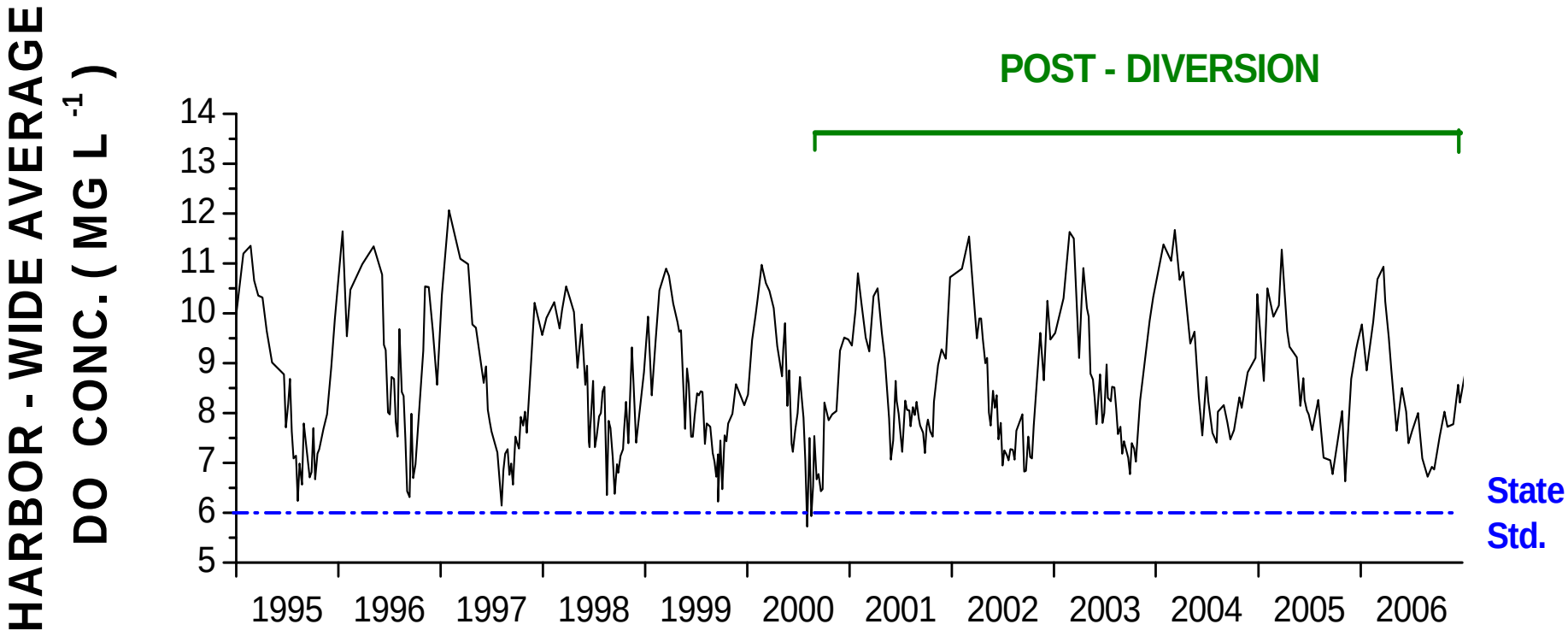
Sampling stations for in-house monitoring



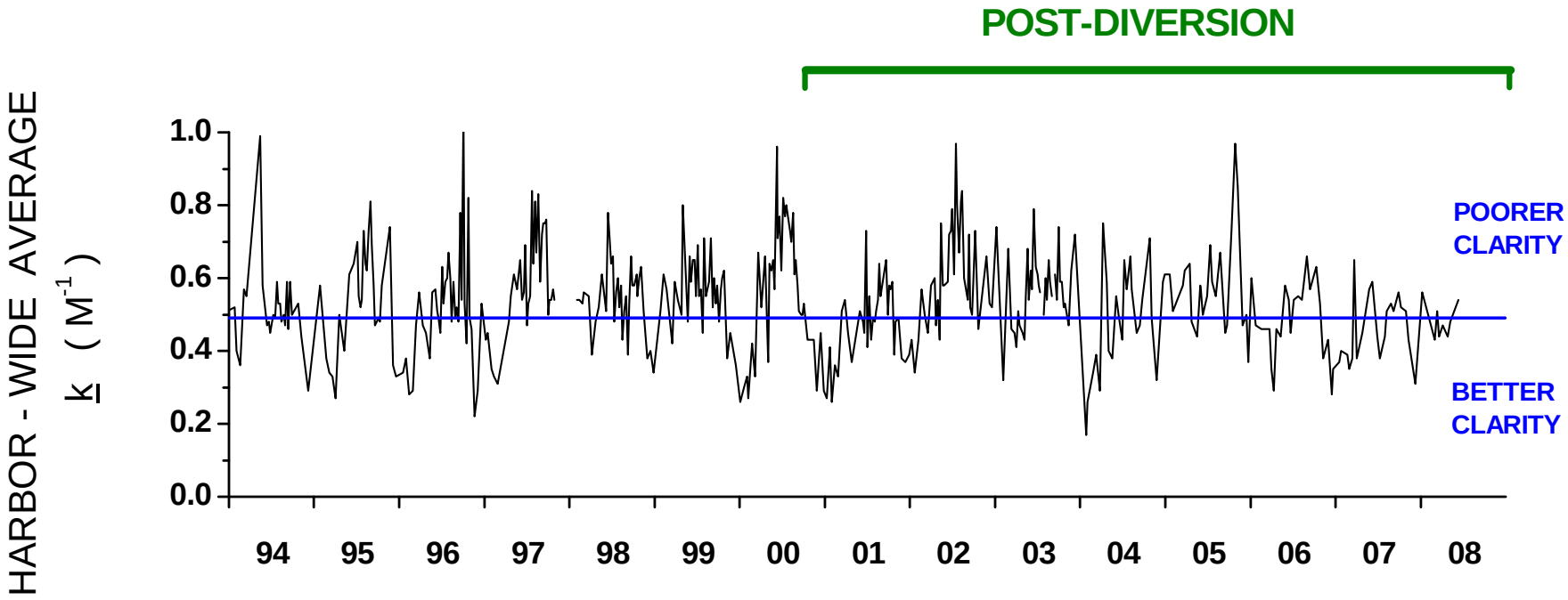
TOTAL NITROGEN



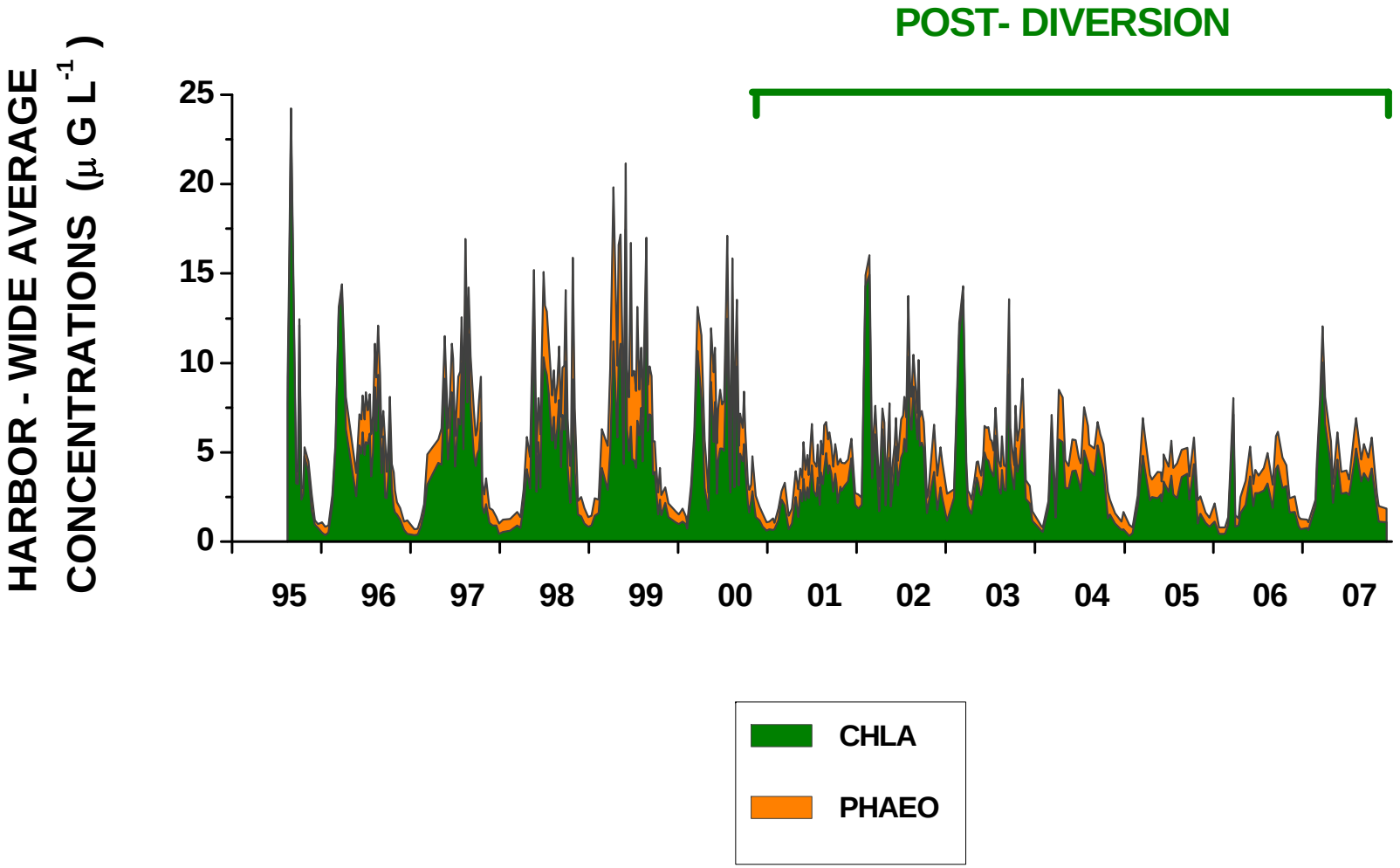
DISSOLVED OXYGEN



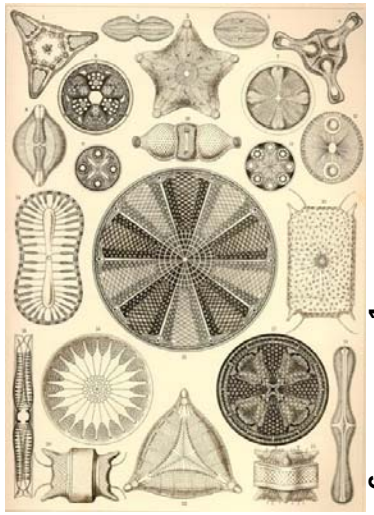
Water clarity is about the same

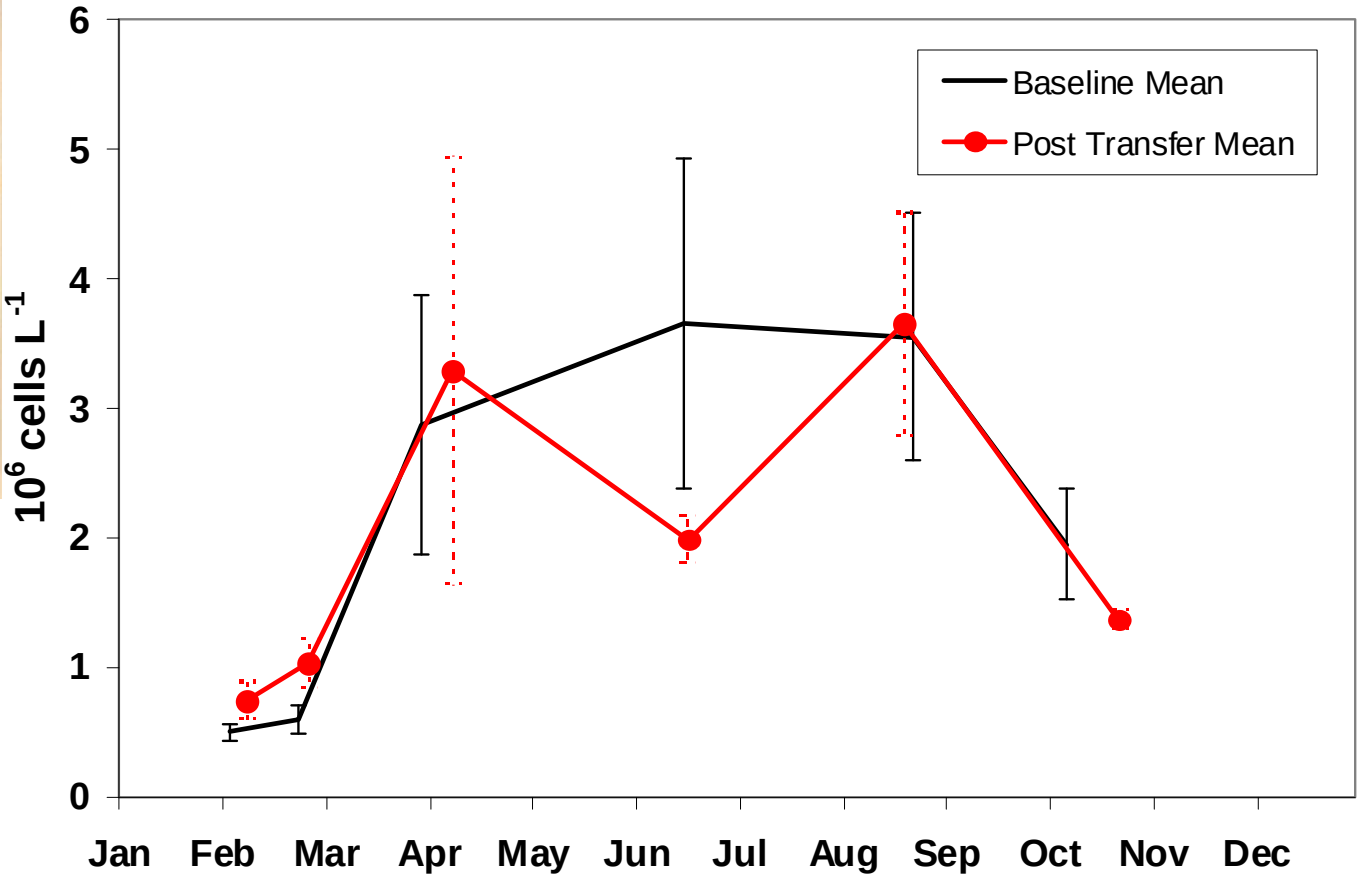


PHYTOPLANKTON BIOMASS



Phytoplankton cycle Boston Harbor: change to bi-modal annual cycle?

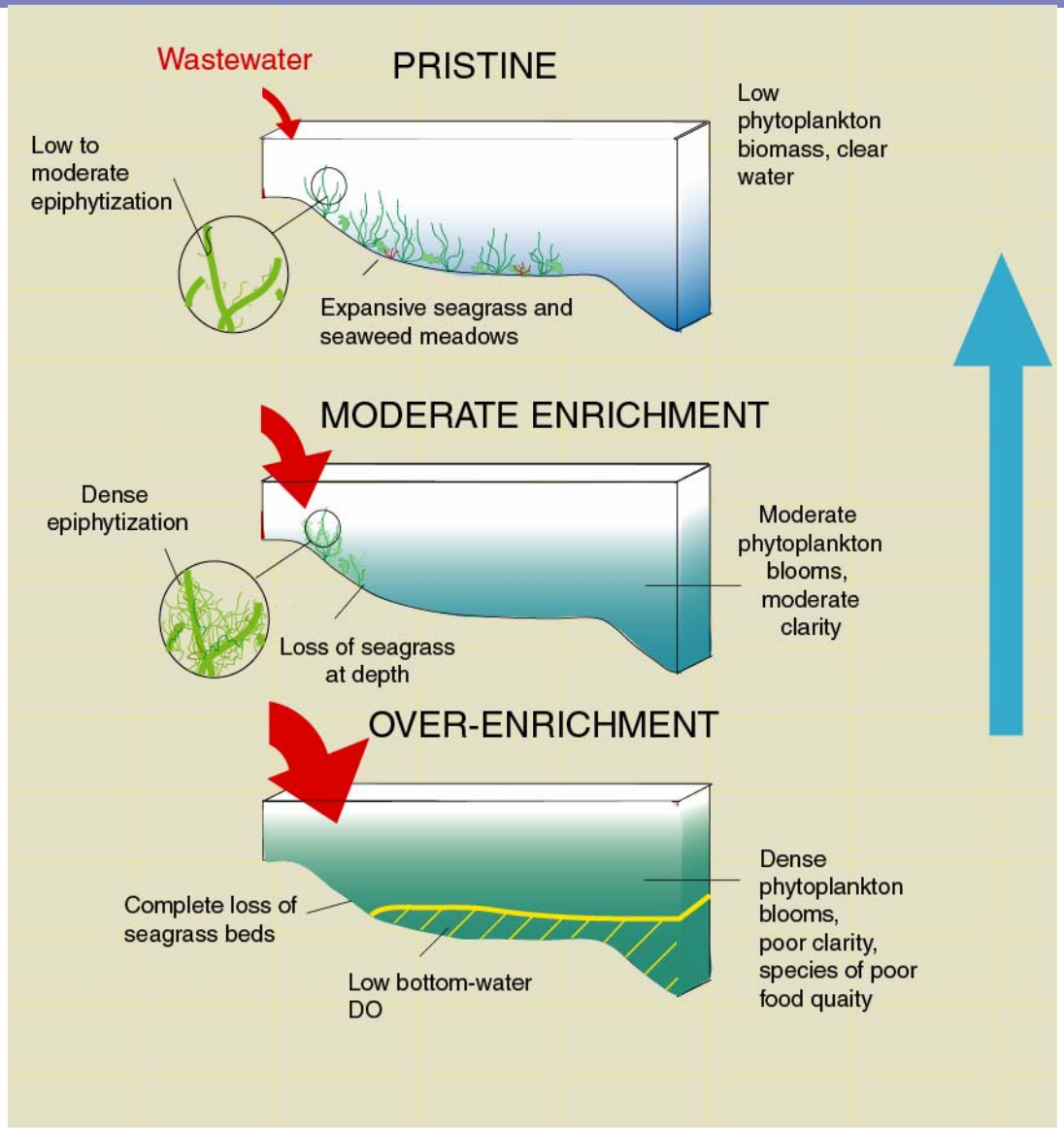




Changes in water quality

	BEFORE (1995 - 2000)	CHANGES (2001 - 2006)		%
TN (µmol l^{-1})	30.9 ± 6.4	20.2 ± 2.9	-10.7	(- 35%) *
TP (µmol l^{-1})	2.1 ± 0.3	1.5 ± 0.3	-0.6	(- 28%) *
Chl-a (µg l^{-1})	4.7 ± 3.1	3.3 ± 2.2	-1.3	(-28%) *
Total phyto (x 10^6 cells l^{-1})	2.08 ± 1.37	1.78 ± 1.18	-0.3	(-14%)
Diatoms (x 10^6 cells l^{-1})	0.84 ± 0.55	0.56 ± 0.37	-0.28	(-33%) *
Primary prodn. (gC $m^{-2} y^{-1}$)	719 ± 498	378 ± 353	-341	(-50%) *
POC (umol l^{-1})	43 ± 16	31 ± 10	-12	(-28%) *
TSS (mg l^{-1})	3.6 ± 1.2	3.8 ± 1.0	+0.2	(+5%)
k (m^{-1})	0.52 ± 0.12	0.53 ± 0.12	+0.1	(+1%)
Bottom DO (mid-summer) (mg l^{-1})	7.0 ± 0.7	7.4 ± 0.6	+0.4	(+5%) *

Reversal of eutrophication



After 2000, WWTPs no longer significant source

CSO projects

2000

- Constitution Beach (Winthrop Bay) CSOs ended.
- Several CSO hydraulic relief projects.
- Cottage Farm CSO facility upgrades.
- Neponset River sewer separation, CSOs closed

2001

- Dorchester Bay CSO facility upgrades
- Prison Point (mouth of Charles) facility upgrade
- Somerville Marginal (mouth of Mystic) upgrade
- Chelsea Relief Sewer projects

CSO Projects

2006

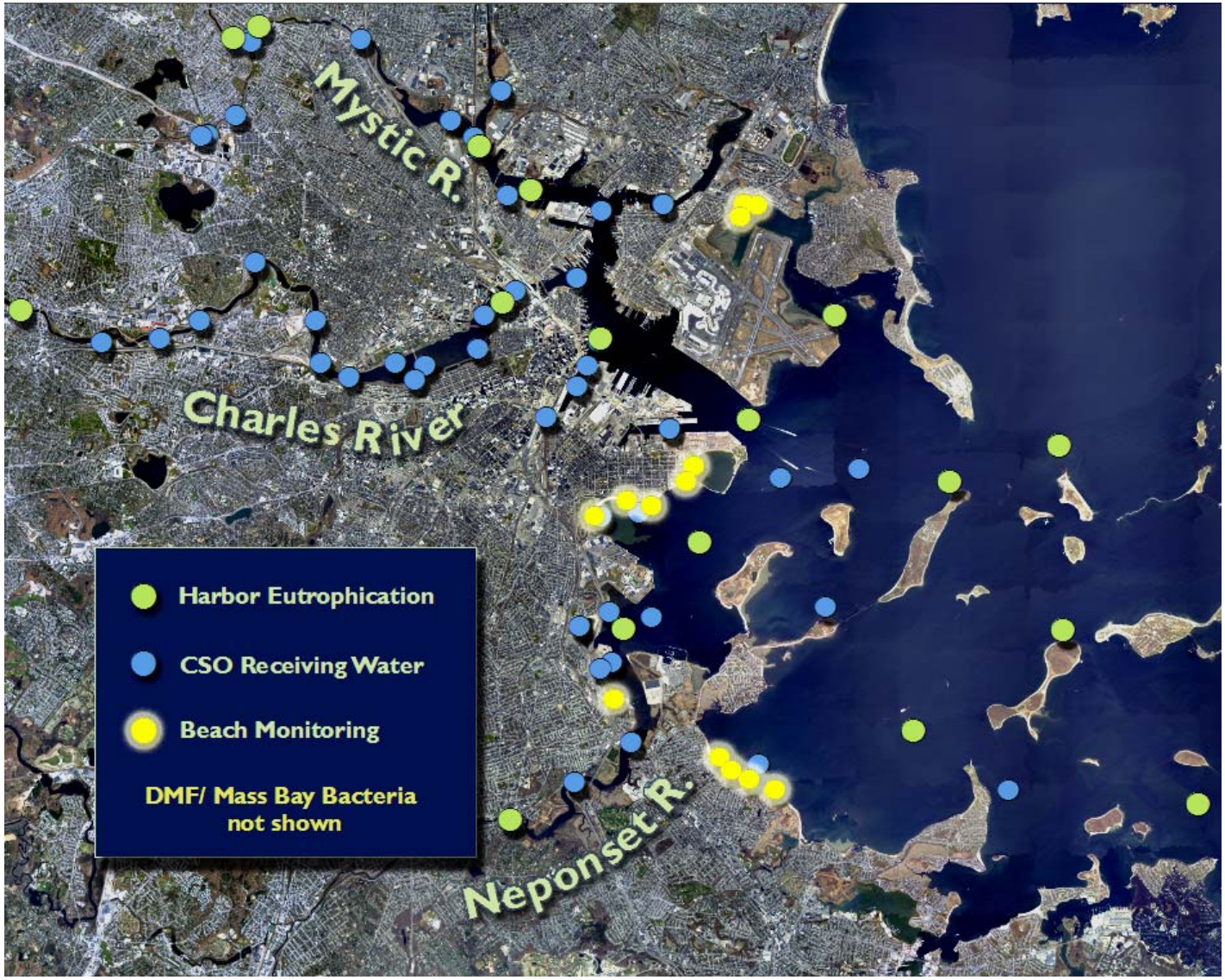
- Stony Brook (large discharge to Charles River) sewer separation
- South Dorchester Bay sewer separation
- Pleasure Bay storm drain improvements

2007

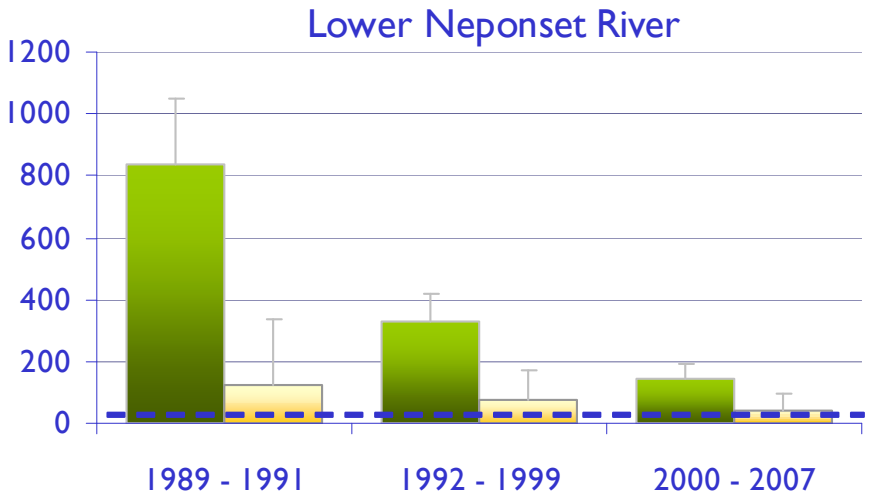
- BOS019 CSO storage facility (Charlestown)
- Union Park Detention and Treatment Facility (Fort Point Channel): Stores 2MG for pump-back, treats remaining overflows
- Fort Point Channel Sewer Separation and Optimization
- Decommissioning of South Dorchester Bay CSO facilities (Fox Point and Commercial Point)

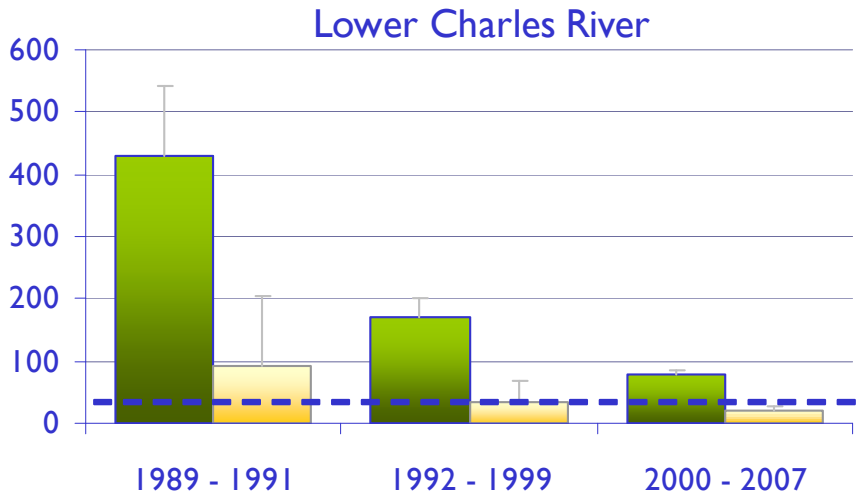
End of CSO discharges to South Dorchester Bay!

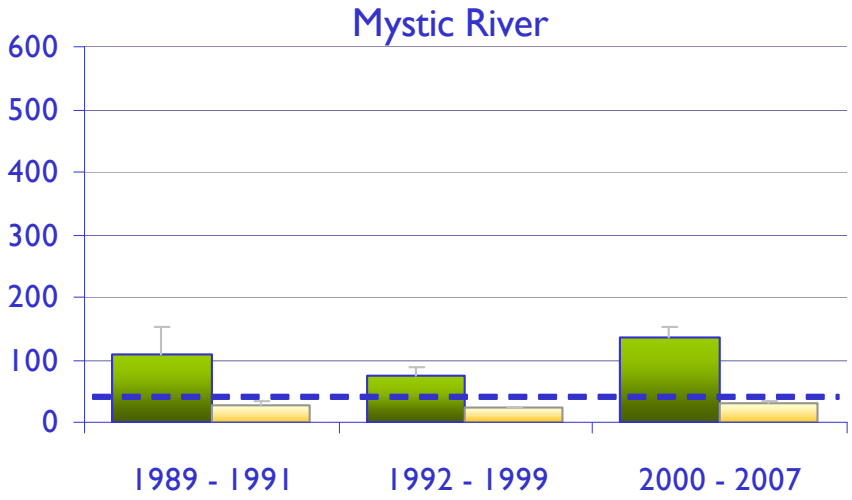
Harbor sampling stations



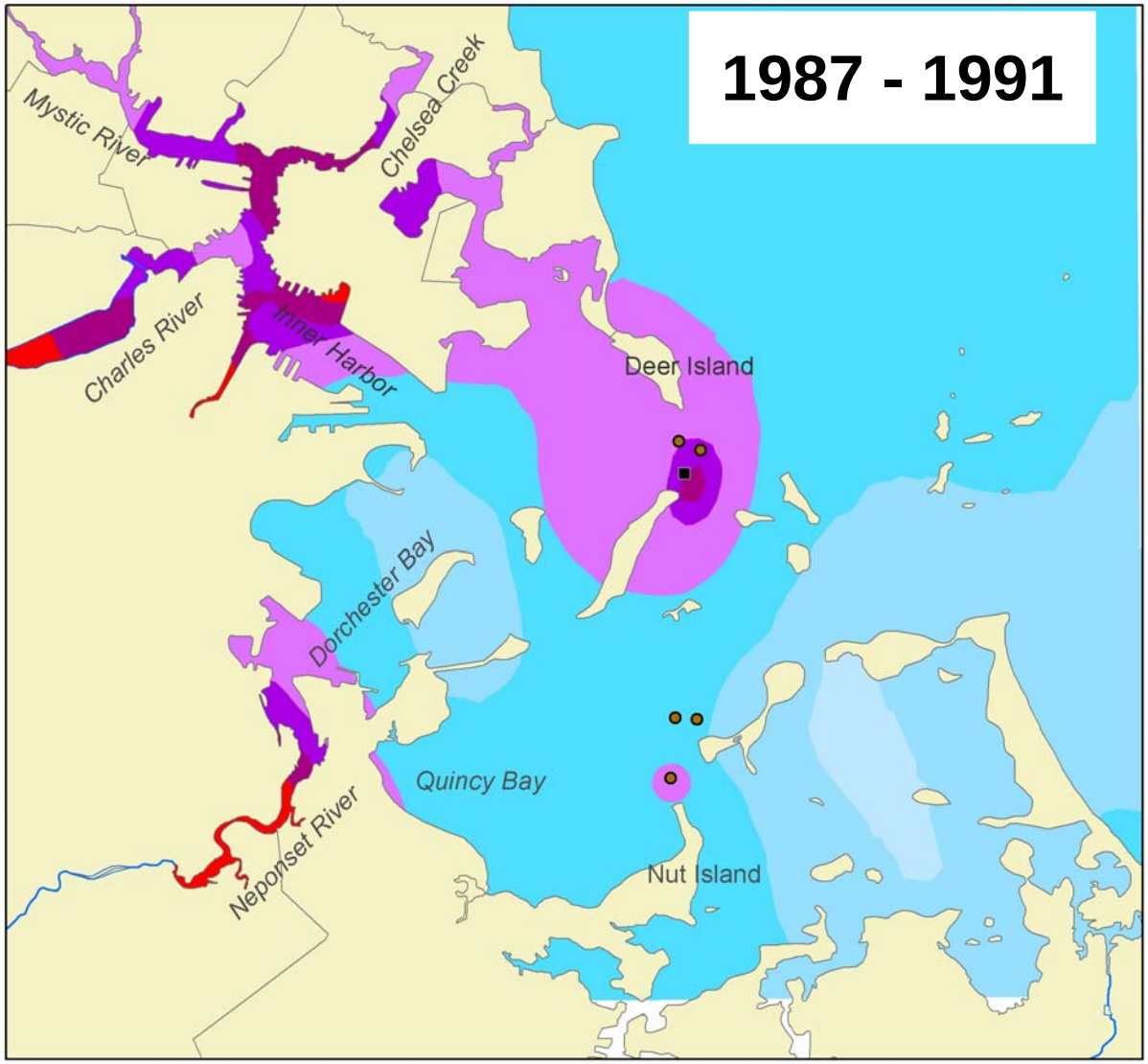
Changes in *Enterococcus* counts: Rivers







Wet weather *Enterococcus*



Geometric mean (colonies/100ml)

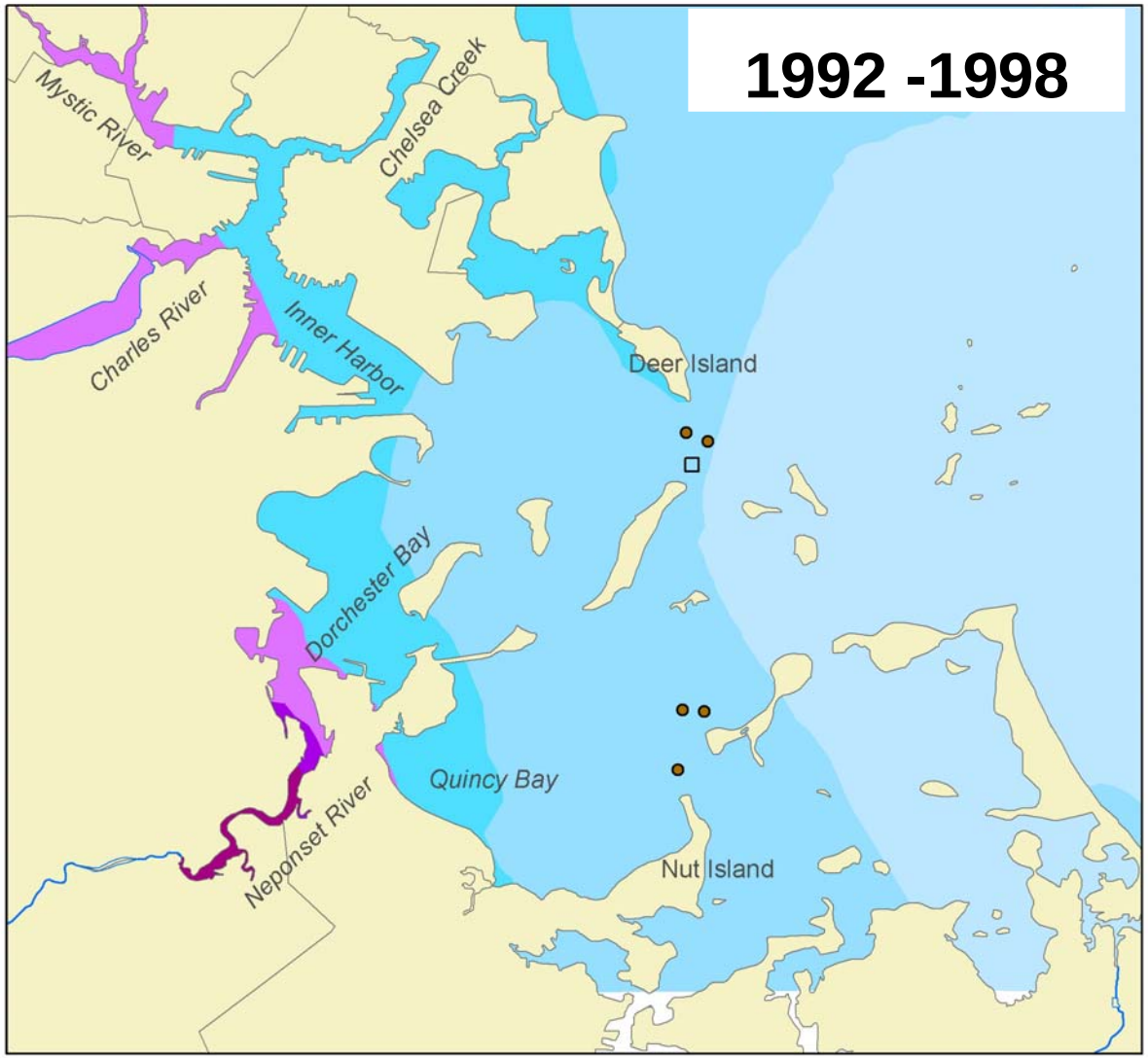
Sampled during rainfall
>= 0.2 inches within 24 hours

Blue contours meet swimming standard, red-purple contours exceed swimming standard.

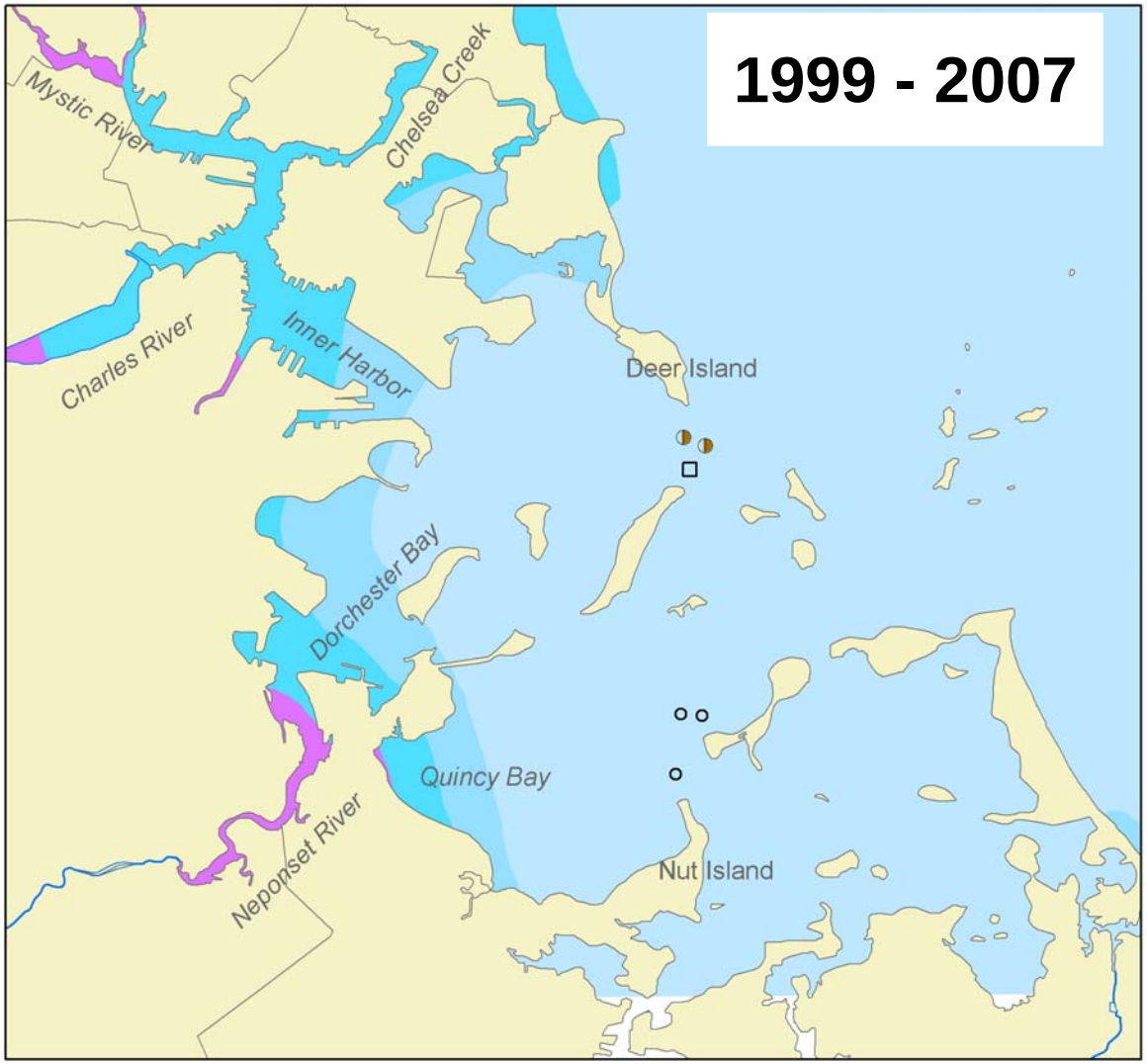
- 0 - 5
- 5 - 10
- 10 - 35
- 35 - 104
- 104 -158
- 158 - 275
- > 275

- active treatment outfall
- active treatment outfall (until 9/5/2000)
- closed treatment outfall
- active NITP sludge outfall
- closed NITP sludge outfall

Wet weather *Enterococcus*



Wet weather *Enterococcus*



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