Presentation by ENRG* to MA Environmental Affairs on Meg/SQT MEP Assessment

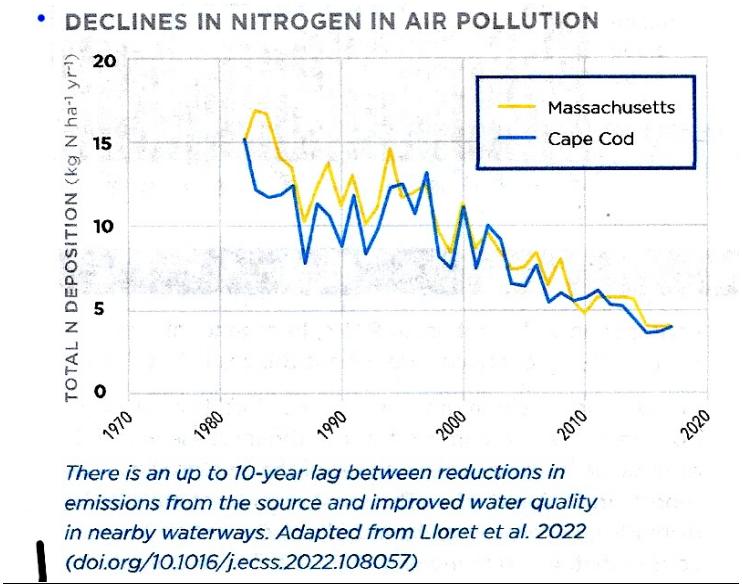
Abstract

An analysis of the Massachusetts Estuary Project's assessment of the effects of nitrate on Megansett and Squeteague Harbors is presented. The degree of impairment, the data and references used in this assessment, the data available but not used and the specific septic load of estuary nitrate that MEP uses is discussed, as well as the post-assessment decrease in nitrate. This investigation finds that septic nitrate is not important in the Megansett/Squeteague system.

* Estuary Nitrate Research Group

1 (a) In 2015, regarding NO3, the MEP Plan stated on pg 9 and frequently throughout: "Slight Impairment". Specifically, "At present" [2015] Meg/SQT is "only slightly beyond its nitrogen threshold". Consequently, a slightly lower NO3 could therefore remove Meg/SQT from the "nitrogen-impaired" to the "De Minimus" status.

For example, since 2015 atmospheric nitrate deposition decreased by 25% (Lloret,2022, fig 2b), visibility has increased by 50% (Seaver, 2025) and "significant reductions in nitrogen" have occurred (BBC, pg 1, 2022. See last page below, "The Bottom Line").



There is an up to 10-year lag between reductions in emissions from the source and improved water quality in nearby waterways. Adapted from Lloret et al. 2022 (doi.org/10.1016/j.ecss.2022.108057)

(b) From the "Meg/SQT Assessment" on page 5 of the MEP:

"Assessment based upon available water quality monitoring data…".
Data also available (but not used) were and are in the following published scientific papers on Buzzards Bay estuary NO3:

i. Bowen, et al., 2007. *Review of Land-Sea Coupling of N into New England Estuaries.* Applied Geochemistry.

ii. Seaver, G. and A Kuzirian, 2007. *NO3 Migration Through Groundwater, Estuaries and Bays*. JCR.

iii. Seaver, G., 2010: *Estuary Response to Abrupt Increase of Groundwater NO3 Input*. Applied Geochemistry.

iv. Seaver, G., 2012: *Long-Term NO3 Transport Through Watersheds to Estuaries on Cape Cod: Climate and Transient Scales*. In Jordan, Ed., Estuaries: Classification, ecology and Human Impacts. Nova Sciences, p. 115-136.

v. Seaver, G. 2019: *Winter's Role in Annual NO3 Regulation in Buzzards Bay Estuaries*. RSMS.

vi. Lloret, J., et al., 2022: *Decade Trajectories of Land-Sea Couplings: Nitrogen Loads*. Estuarine, Coastal and Shelf Sciences.

vii. Seaver, G. and A. Kuzirian, 2024: *Estuary NO3 Sources and Trends in Buzzards Bay*. JCR. (These References are Available online)

(c) The NO3 Data Source for the Meg/SQT MEP:

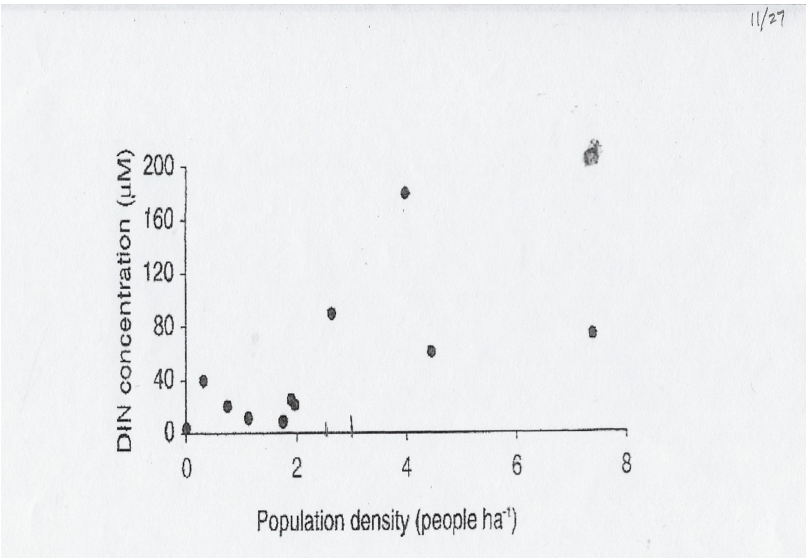
The MEP relies on the Buzzards Bay Coalition data, which is only taken in the summer. As a result, they use their summer Dissolved Organic Nitrogen value for total "N" (pg 9), rather than the total Dissolved Inorganic Nitrogen from the winter data. DON is frequently 10X larger than DIN (see Lloret, figure 7), and is a function of sunlight as well as nitrate. All of the above Seaver references take nitrate data year-round including the winter season, which allows for the calculation of trends, summer-to-winter transfer and winter NO3 export. [BBC 2022 report]

2. The Role of Eelgrass

The MEP on page 9 states that "eelgrass is critical habitat that structures the productivity and resource quality of the entire system". It is hard to believe that a plant confined to part of an estuary's coast would have such a widespread consequence.

3. The Septic Loads to Squeteague.

From the MEP plan, "…nitrogen loads of wastewater represents 59% of watershed load to Squeteague Harbor" (page 5). Both Bowen at al. (2007) and Seaver and Kuzirian (2024) show no penetration of septic NO3 into SQT. Specifically, Bowen shows that DIN is proportional to people density on the watershed above a fixed level, but for a density below 2.5 people/hectare (1/acre) it is not a function of population (see figure 4a of Bowen). The watershed density of Bourne's Buzzards Bay estuaries is 0.5 people/acre, well below the Bowen cut-off and reflects the low density on the JBCC 9000 acres upgradient of these estuaries (see Seaver figure 2).



Concentration of dissolved inorganic N in groundwater from several Cape Cod watersheds versus population density on the watershed. Each data point is an average of many observations. Data from Kroeger (2003) and Bowen, et al., (2007).

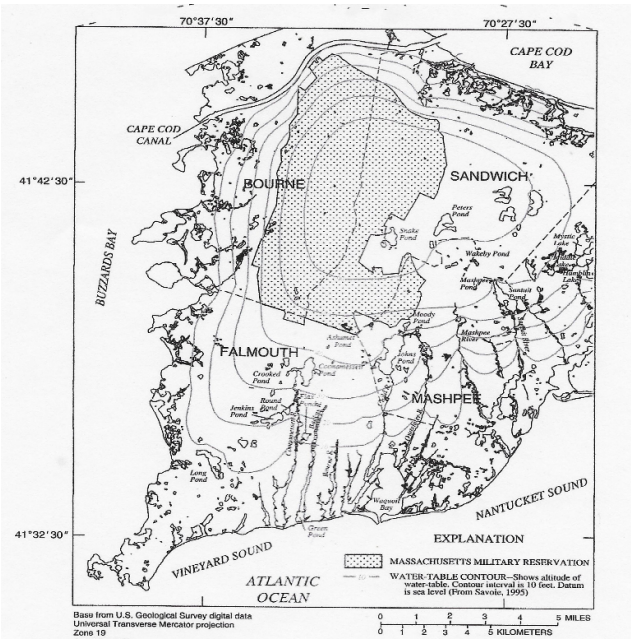
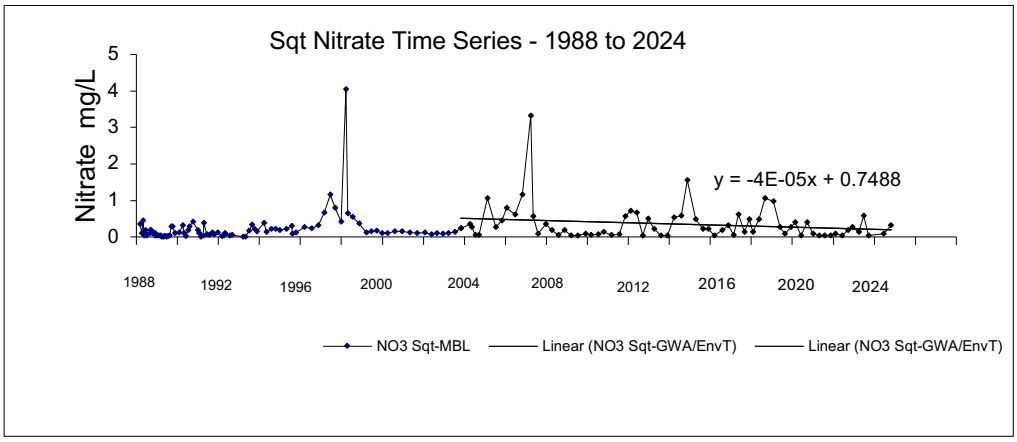


Figure 2

However, if dense, "affordable housing" continues, such as that proposed for the 600 acres on JBCC, Bourne likely would pass the Bowen cut-off and septic NO3 would begin to be a factor in SQT.

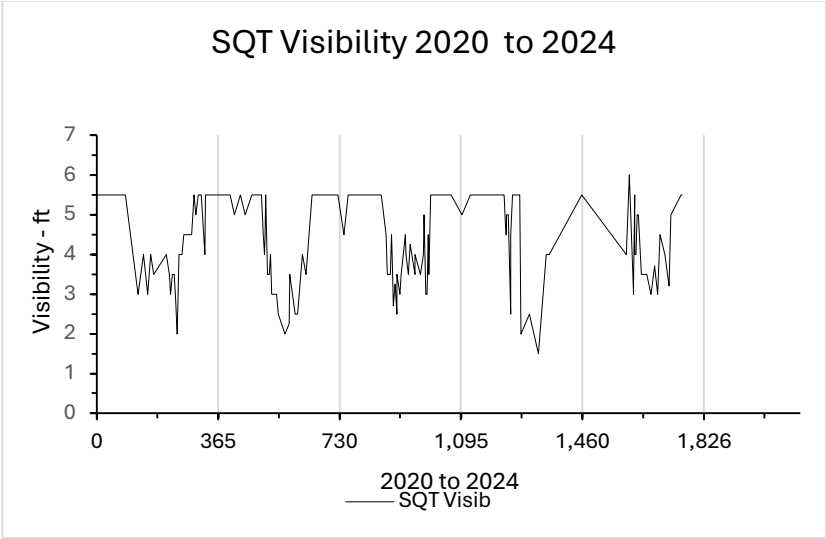
Further, Seaver and Kuzirian in their published Figure 5a below (2024) show Squeteague and SHC NO3 from 1988 to 2024. Over this 35-year period



Bourne's population increased by 48%. If septic NO3 was reaching the estuaries, it would reflect this population increase over these 35 years; however, the baseline NO3 in 1988 is .04 mg/L, as it is in 2024 and at many points in between. The periodic large excursions of NO3 seen are from known sources, which are not detected in summer-only measurements,
where the NO3 is taken up by plankton. We also see since 2004 a declining trend-line in Squeteague NO3 of 63%, the result of declining atmospheric deposition and the decline in spot sources of NO3 from Sqt's watershed.

4. Eelgrass Shading

The MEP Plan cites the loss of eelgrass, caused by cloudy water blocking the sun (and this caused by "slightly higher N"), as the reason for classifying Meg/SQT as "N impaired". However, since 2020 the measured visibility in SQT (Seaver, unpublished figure) has increased by 50%, boat waterline growth has significantly decreased and the BBCoalition has reported "the expansion of eelgrass beds".



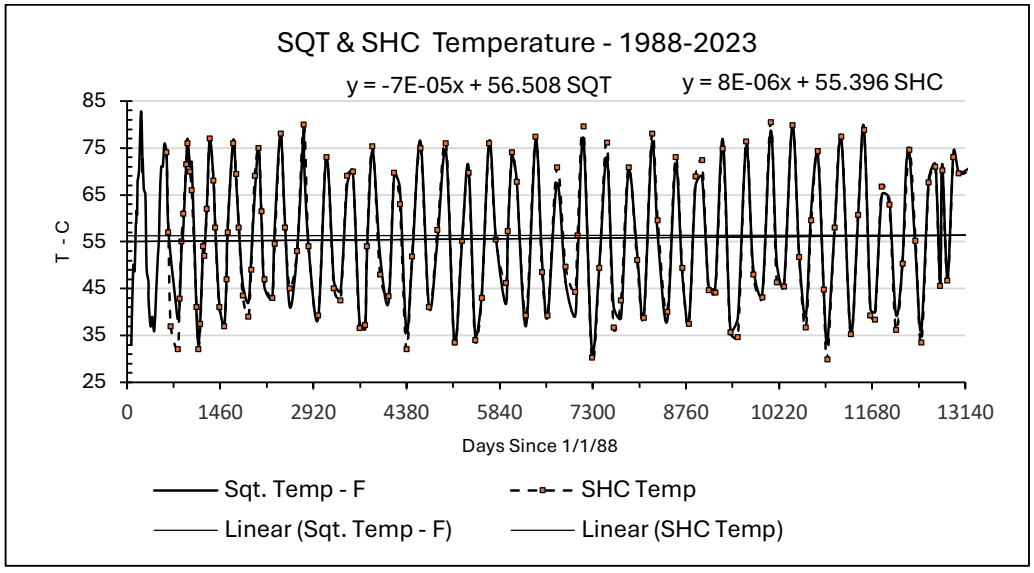
5. Post-2015 Changes - Buzzards Bay Coalition 2022 Report.

The Buzzards Bay Coalition stated in their bi-annual 2022 Report, what the ENRG has stated herein based upon the evidence:

" The bottom line: the improved state of Buzzards Bay score reflects significant reductions in nitrogen. Six years on [since 2015] the data on nitrogen pollution is even better than expected...recovering to levels of 1995...[also] in expansion of eelgrass beds and a Bay scallop harvest not seen in more than a decade (BBC, page 1, 2022. See last page below).

Further, this report, in their "Nitrogen Effect" score, gives Megansett Hbr an 83%, number 7 of 91 bays and an improvement of 11% since 2015. Sqt Hbr is at 58%, an improvement of 1% and both are in their fair to excellent category.

The BBC 2022 report claims on page 1 that "the Bay - up 4 degrees F since the mid 1990s..", (and the CWMP has a section on Climate Change). However, from 1988 to 2024 published Sqt temperature taken 4 times a year (each season) shows a slight trendline decline of -0.507 C. SHC also shows a slightly negative temperature change of -0.290 C (Seaver nd Kuzirian, 2024). Their +4 degrees increase fits in with their statement that "Climate Change [is] the driving factor behind the Bay declines over the past 30 years" (page 1), along with the inclusion of sections in the CWMP on "Climate Change" and "Environmental Justice".



Finally, the BBC attributes the closures of shell fishing from bacteria, in part, to Climate Change temperature increase and sewage (page 4). They do not mention geese feces (or our "Goosebusters" program to combat it), where

there is a direct cause-and-effect to closures from geese that come up on the beach in the morning before the test are taken and the beach is closed to shellfishing that day, and sometimes the camp and swimming as well. Recently, since we have had an energetic Goosebusters program Sqt has not been closed, where other harbors nearby have been.

In conclusion, if the State and Bourne continue on with this plan, the citizens of Bourne will be left with $10's of millions in costs, great disruption of the environment and a permanent maintenance burden and its cost …and little or no effect on estuary nitrate.

George Seaver, Ph.D.
Alan Kuzirian, Ph.D.
ENRG, Cataumet, February 4, 2025

THE BOTTOM LINE

Improved 2022 State of Buzzards Bay score reflects significant reductions in nitrogen and toxic pollution, as well as new challenges facing the Bay due to climate change.

Since the beginning of our State of the Bay reports in 2003, we have documented troubling trends in the health of Buzzards Bay. That year's assessment yielded a score of 48 out of 100. Since then, the score has been stalled at 45 for the last three reports. In all those cases, the story behind that flat line remained the same: slow improvements in things like toxics and bacteria pollution were being eliminated by the impact of expanding nitrogen pollution.

But then in 2015, nitrogen pollution stopped getting worse, and we stopped losing eelgrass beds as well. We hoped that this encouraging pause was signaling that we may have reached the floor on nitrogen pollution getting worse in the Bay.

Pollution Reductions Are Driving Improvements ...

Six years on, the data on nitrogen pollution is even better than expected with the state of pollution in 2018 recovering to levels not seen since 1995 (before declining slightly in the next three years). This is not just great news for improved water clarity and healthy oxygen levels. The conditions created by reduced nitrogen pollution can also be seen in expansion of eelgrass beds throughout the Bay and even a bay scallop harvest in 2018-18 on a scale not seen in more than a decade.

No other form of pollution does more harm to Buzzards Bay and all its harbors and coves than nitrogen, and its 4-point improvement in this State of the Bay should be celebrated. It is the result of years of local efforts to clean up septic systems and old sewer plants as well as state and federal gains in reducing the amount of nitrogen that falls on the Bay from air pollution.

The other pollution reduction to be celebrated is the continued decline of toxics in the Bay. A 3-point improvement in the amount of toxins detected in the Bay's delicate blue mussel populations is a result of the ongoing cleanup of legacy industrial pollution and modern restrictions on the use of toxics in agricultural, industrial and home products.

... but Climate Change is Moving the Goal Post.

Just when it looks like we're beginning to address nitrogen pollution — the driving factor behind Bay declines over the past 30 years — **climate change is moving the goal post and changing the Bay restoration landscape.** Two factors that were not even recognized in the data when we started these assessments in 2003 are taking over as the greatest drivers of Bay decline — warmer water and rising sea levels.

Warmer water in the Bay — up 4 degrees Fahrenheit since the mid 1990s — now allows bacteria to persist longer leading to shellfish bed and beach closures, and extends the season of biological activity in the Bay encouraging algae to bloom on lower levels of nitrogen. In effect, we need to remove more nitrogen in a warmer Bay to see the same water quality improvements.

And rising sea levels are proving to be the Achilles heel of the Bay's vital salt marshes, which are eroding and drowning under higher tides and higher base sea level. This is the most disappointing new challenge identified in these data.

A final point. As a regional assessment, the State of Buzzards Bay scores can mask local variations in the data. Not all corners of the Bay improved and others, like the Westport River, saw exceptional gains.