Smast University of Massachusetts Dartmouth
The School for Marine Science and Technology

Technical Memorandum

FINAL

Water Quality Monitoring and Assessment of the Martha's Vineyard Island-Wide Estuaries and Salt Ponds Summary 2018 (year 3 of 3)

To:

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The present Technical Memorandum on the results of the summer 2018 Martha's Vineyard Island-wide Water Quality Monitoring Program is organized as follows and mirrors the format of the 2016 and 2017 water quality summary memo to ease the cross comparability of data from one year to the next:

1. Overview

- Background
- Need for a Monitoring Program

2. Summary of Sampling Approach for each of the estuaries and salt ponds of Martha's Vineyard. The following systems represent all the estuaries that will eventually be sampled under the unified monitoring program, however, a few were not sampled initially in year 1 (2016) of the program and some estuaries were added in year 2 (2017) of the program and all 2017 estuaries were also monitored in year 3 (2018) (sampled = X, not sampled = 0 in list below):

2016 /2017 /2018

X	X	X	1) Lake Tashmoo (**Yes** - MEP Threshold
X	X	X	2) Lagoon Pond (Yes - MEP Threshold)
X	X	X	3) Oak Bluffs Harbor (Yes - MEP Threshold)
X	X	X	4) Farm Pond (Yes - MEP Threshold
X	X	X	5) Sengekontacket Pond (Yes - MEP Threshold
X	X	X	6) Cape Pogue / Pochet Pond (To Be Developed - MEP Threshold)
X	X	X	7) Katama Bay/Edgartown Harbor (To Be Developed - MEP Threshold)
0	0	0	8) Oyster Pond (To Be Developed - MEP Threshold)
X	X	X	9) Edgartown Great Pond (Yes - MEP Threshold)
0	X	X	10) Tisbury Great / Black Point Pond (Yes - MEP Threshold)
X	X	X	11) Chilmark Pond (Yes - MEP Threshold
0	X	X	12) Menemsha / Squibnocket Ponds (Yes - MEP Threshold)
0	X	X	13) James Pond (No - MEP Threshold)

3. Results of Sampling: Summary of Water Quality Results

   - Review of and comparison to historical data used in the MEP Reports

4. Trophic State: Water Quality/Eutrophication Status

5. Recommendations for Future Monitoring

Overview

Background: Coastal salt ponds and estuaries are among the most productive components of the coastal ocean. These circulation-restricted embayments support extensive and diverse plant and animal communities providing the foundation for many important commercial and recreational fisheries. The aesthetic value of these systems, as well as the freshwater ponds within their watersheds are important resources to both residents and the tourist industry alike. Maintaining high levels of water quality and ecological health in these aquatic systems (fresh and marine) is fundamental to the enjoyment and utilization of these valuable resources and the tax base and economy of all coastal communities.

Nutrient over-enrichment is the major ecological threat to water quality in the salt ponds and embayments across all the Towns of Martha's Vineyard, primarily via ecological degradation which results when nutrient loading exceeds the critical nutrient threshold i.e. the assimilative capacity (the highest level of loading without causing habitat impairments). Each aquatic system has its own specific threshold, based upon its configuration, mixing and flushing rate. Of the various forms of pollution that threaten coastal waters (nutrients, pathogens and toxics), nutrient inputs are the most ubiquitous, insidious and difficult to control. This is especially true for nutrients originating from non-point sources, such as nitrogen and phosphorous transported in the groundwater from on-site septic treatment systems, agriculture or even residential lawn fertilization.

On-site septic treatment systems are the primary mechanism for waste disposal within the watersheds of nearly all the estuaries of Martha's Vineyard with the exception of Edgartown Great Pond. Edgartown Great Pond is in a somewhat different situation as the watershed receives treated wastewater effluent from the Town's wastewater treatment facility. Nevertheless, the nutrient characteristics and ecological health of that system must be monitored given its nitrogen over-enrichment partially related to the "old" WWTF prior to the construction of the new facility. At present the improved treated effluent discharges to Edgartown Great Pond via groundwater and the pond only has tidal flushing during its periodic openings to the Atlantic Ocean thru managed breaching of the barrier beach. Given the reduced nitrogen loading and improved tidal flushing due to improved opening protocols, Edgartown Great Pond habitat quality appears to be improving with some expansion of eelgrass habitat, a very sensitive indicator of nutrient enrichment and associated water clarity.

Since the primary nutrients, nitrogen and phosphorous, are natural components of estuarine and fresh pond systems, it is important that management allow for the natural capacity of these systems to absorb watershed nutrient inputs. Through the coupling of monitoring data to the Massachusetts Estuaries Project (MEP) watershed loading analysis developed in collaboration with the Coastal Systems Program (CSP), the most cost-effective management strategies can be found to protect these valuable aquatic environments of Martha's Vineyard. Moreover, as nutrient load reduction strategies become implemented across the Island and in specific estuarine watersheds, maintaining the regular monitoring of nutrient related water quality is critical for assessing the extent to which a particular implementation approach is having its planned effect toward restoration and how much additional effort may be required to meet restoration goals.

Need for a Monitoring Program: Conserving and/or restoring the environmental health of coastal embayments and freshwater ponds is achievable, but only through proper management of the waters and watersheds of each. Managing environmental health requires a quantitative understanding of the biological and physical processes which control nutrient related water quality within a specific basin and the role of watershed inputs in the nutrient balance of the receiving waters. An essential step in managing these fresh and saltwater systems is to monitor water quality. The results of a long- term monitoring effort are needed to determine the status and trend of each system's ecological health to assess the need for management actions and their success when implemented. Nutrient impaired systems can be restored but require that long-term water quality data be coupled with higher-end ecological data to support the development of quantitative site-specific management plans.

As in 2016 and 2017, the 2018 water quality monitoring of the fresh and saltwater systems of Martha's Vineyard was focused on summer-time conditions, as the warmer months typically have the lowest water quality conditions, which are the target of resource management. The Martha's Vineyard Commission as well as the Towns of Martha's Vineyard have a long history of monitoring of the Island's aquatic systems to support the protection and management of the natural resources of the Island. Generally, water quality monitoring has been undertaken by the MVC Water Resources Planner, Town Shellfish or Natural Resources Departments. These past efforts have also supported nutrient related estuarine analyses by the Massachusetts Estuaries Project for restoration/protection of all the coastal systems of southeastern Massachusetts and specifically on the island of Martha's Vineyard. Over the past 8-10 years, the MEP has established the estuarine specific nitrogen thresholds for nearly all of the estuaries of Martha's Vineyard with the exception of James Pond, Oyster Pond, Katama Bay, Cape Pogue Bay and Pocha Pond. Field data collection has been completed under the umbrella of the MEP for future analysis of these remaining systems. Modeling and nitrogen threshold development is forth coming assuming funds can be garnered from the Town.

Water quality monitoring programs, like the unified Island-wide program initiated in the summer of 2016 across all the coastal systems of Martha's Vineyard, are the most efficient way to maximize the value of the results. The efficiency is achieved by structuring the sampling and analysis program such that results can be cross compared to historic water quality monitoring data and that collected throughout the region. For example, a similar unified monitoring program was initiated in 2010 covering all of the estuaries on Nantucket Island. Both the Vineyard and Nantucket programs utilize exactly the same sampling and analytical protocols ensuring seamless cross comparability. In this manner, inter-ecosystem comparisons can be made to better assess system health/impairment and function and formulate appropriate nutrient management strategies. This allows individual Martha's Vineyard Towns to directly benefit from lessons learned across the Island as well as throughout the wider region, be it Cape Cod or the Island of Nantucket.

Summary of Sampling Approach

Monitoring Project Team: To address the present nutrient related ecological health issues of the salt ponds and embayments across the Island of Martha's Vineyard and to provide necessary information with which to develop policies to protect and/or remediate these systems with regard to nutrient overloading, a long-term, unified monitoring effort was established for the summer 2016, which was continued and expanded in the summers of 2017 and 2018. The overall monitoring program is coordinated through the Martha's Vineyard Commission (MVC) and the Coastal Systems Program (CSP) at the University of Massachusetts-Dartmouth (UMD), School for Marine Science and Technology (SMAST). This unified monitoring program builds on the multiple and diverse historic water quality monitoring efforts. These prior monitoring efforts were undertaken beginning as early as 2000 and continued through around 2007 to support the baseline water quality monitoring needs of the Massachusetts Estuaries Project (MEP). In 2016 the MVC determined that the need for consistent water quality monitoring Island-wide required establishment of a Martha’s Vineyard Water Quality Monitoring Program. This program would build on the prior monitoring effort with technical support through the Coastal Systems Program (CSP) at the University of Massachusetts-Dartmouth, School for Marine Science and Technology (SMAST). The CSP had been responsible for the analysis of the prior water sampling results completed in the estuaries of Martha's Vineyard as part of the MEP nutrient thresholds development. The sampling under the new Monitoring Program was streamlined based upon the prior results to yield the necessary information for management and be sustainable over the long-term. The field and laboratory procedures and assays used in the new program were similar to those of previous years to ensure comparability. Water quality monitoring in 2016, 2017 and 2018 was completed as a collaboration between the Martha's Vineyard Commission (MVC) and the Coastal Systems Program.

The Martha's Vineyard Commission is serving as Project Leader and lead field organization and the Coastal Systems Program is providing laboratory services through the Coastal Systems Analytical Facility at SMAST. Coordination and oversight of the program is by the MVC Water Resources Planner (Ms. Sheri Caseau) with CSP-SMAST providing the technical oversight, analytical support and data interpretation.

While the Martha's Vineyard Commission and its Water Resources Planner have extensive experience in water sample collection and have an inventory of necessary sampling equipment, prior to sampling volunteers & staff were equipped and trained as warranted to ensure that sampling protocols are understood and properly implemented (primary focus is on any new staff and new sampling locations). Training takes place in the early summer in advance of the July sampling events in 2016, with refreshers in 2017 and 2018. The Coastal Systems Program has also been responsible for the development and coordination of the majority of the estuarine and pond water quality monitoring across southeastern Massachusetts, Cape Cod and the Island of Nantucket as well as the analysis of all the samples collected and synthesis of the resulting water quality data. As such, the CSP is able to leverage this comprehensive water quality database on an as needed basis to further evaluate results obtained from the Martha's Vineyard Island-wide Monitoring Program. It should also be noted that The Coastal Systems Analytical Facility, in addition to conducting research quality assays of environmental samples, has been cleared for regulatory nutrient related water quality assays in Massachusetts estuaries. This required review of all laboratory protocols, inter-calibration studies and blind performance and evaluation (P&E) samples was most recently completed in 2018. In addition, laboratory procedures and QA/QC protocols have been reviewed and various agencies have reviewed MEP water quality data results. This makes the Coastal Systems Analytical Facility uniquely qualified for the conduct of low level (i.e. low concentration) environmental nutrient assays in a regulatory setting (TMDL’s) and this level of analytical rigor is the basis for the Martha's Vineyard Island-wide Water Quality Monitoring Program.

CSP scientists focused primarily on the analysis of samples collected from the Island- wide effort, data analysis and program coordination while the Martha's Vineyard Commission focused primarily on field sampling and data collection on physical parameters. Both groups participated in the compilation of field and laboratory data to provide an ecological overview of water quality conditions within each of the systems for the benefit and use by all the Towns of Martha's Vineyard. The goals of the monitoring program are to:

(1) determine the present ecological health of each of the major salt ponds and estuaries across the Island of Martha's Vineyard,

(2) gauge (as historical data allows) the decline or recovery of various salt ponds and embayments over the long-term (also part of TMDL compliance), and

(3) provide the foundation (and context) for detailed quantitative measures for proper

nutrient and resource management, if needed, and to assess the success of implemented restoration alternatives,

(4) compliance monitoring to meet requirements of TMDLs as they are developed and as towns across the island move into implementation of restoration approaches,

(5) provide a mechanism to easily compare present water quality data to MEP established nutrientthresholds.

The latter points (3 & 4) are critical for restoration planning should an estuarine system be found to be impaired or trending toward impairment.

Water Quality Program Description: As was the case during historical sampling to develop the baseline water quality data sets in each estuary for the MEP as well as the sampling that took place in 2016-2018, sampling took place during the warmer summer months (July, August), the critical period for environmental management. Samples were collected in year 3 of the unified Island-wide Monitoring Program from 13 of 14 estuarine systems (Oyster Pond not sampled) and 1 freshwater pond (Sheriffs Pond in 2018, Looks Pond in 2017, Wiggies/aka. Fresh Pond in 2016) as depicted in Figures 2-15 on dates ("events") as summarized in Table 1a and Table 1b. Sampling followed the general schedule presented in Table 1c.

The Martha's Vineyard Commission oversaw the sampling and all samplers who were involved were given refresher "training" to meet QA requirements. The physical parameters measured in the estuaries included: total depth, Secchi depth (light penetration), temperature, specific conductivity/salinity (YSI meter), general weather, wind speed and direction, dissolved oxygen levels and observations of moorings, birds, shellfishing and unusual events (fish kills, algal blooms, etc). Laboratory analyses for estuaries included: salinity (ppt), nitrate + nitrite (NO_x), ammonium (NH_4), dissolved organic nitrogen (DON), particulate organic carbon and nitrogen (POC/N), chlorophyll-*a* (CHLA) and pheophytin-*a* (PHEO) and orthophosphate (PO_4). The estuarine sampling in 2018 was generally based on completion of four (4) sampling events over July and August (see Table 1a, 1b, 1c for summary). In some instances additional sampling events extended into September or October and in the case of Tisbury Great Pond a sampling event was also undertaken in June. The precise dates were selected based upon early morning mid-tides for tidal estuaries and simply in the early morning for salt ponds without tidal exchange (no inlet). The systems sampled in 2016 were expanded in 2017 to include Looks Pond (freshwater), Tisbury Great Pond, James Pond and Menemsha/Squibnocket Ponds. Fresh Pond was not sampled in 2017. Sampling in 2018 included Sheriffs Pond rather than Looks Pond and also the estuaries sampled in 2017. In 2018, water samples were collected at 68 locations (1 station in Sheriffs Pond, 67 estuarine stations) including sentinel stations established as part of the MEP nutrient threshold assessments. Sampling these stations generated a maximum of 81 samples per event (including multiple depths at deep stations, but not including QA samples). It should be noted that some systems had additional events (>4). QA samples were collected at ~5% of the stations for a given event. Data were compiled and reviewed by the Coastal Systems Program Analytical Facility staff and QA Officer for accuracy and evaluated to discern any possible artifacts caused by improper sampling, holding or storage procedures.

Table 1a. Sampling Schedule for 2018 Martha's Vineyard Island-Wide Water Quality Monitoring Program

(2018) Month	Cape Pogue Bay	PochaPond	Katama Bay	Edgartown Great Pond	Chilmark Pond	Sheriffs Pond	Farm Pond
Jan							
Feb							
Mar							
April							
May							
June							
July	Jul. 19, 31	Jul. 19, 31	Jul. 19, 31	Jul. 11	Jul. 16	Jul. 5, 16, 25	Jul. 17, 31
August	Aug. 15, 29	Aug. 15, 29	Aug. 15, 29	Aug. 13	Aug. 9, 28	Aug. 9, 28	Aug. 14
September				Sept. 5, 19	Sept. 23	Sept. 10	Sept. 15
October							
November							
December							
Total Events	**4**	**4**	**4**	**4**	**4**	**6**	**4**

Table 1b. Sampling Schedule for 2018 Martha's Vineyard Island-Wide Water Quality Monitoring Program

(2018) Month	Oak Bluffs Harbor	Lake Tashmoo	Lagoon Pond	Sengekontacket Pond	Tisbury Great Pond	Menemsha Pond	Squibnocket Pond	James Pond
Jan								
Feb								
Mar								
April								
May								
June					June 21			
July	Jul. 5, 17	July 2, 16, 30	Jul. 5, 18	Jul. 17	Jul. 24	Jul. 10, 25	Jul. 9, 23	Jul. 10, 30
August	Aug. 1, 13	Aug. 14	Aug. 2,16	Aug. 14	Aug. 23	Aug. 7, 21	Aug. 6, 20	Aug. 8, 21
September				Sept. 4, 17	Sept. 6			
October					Oct. 3			
November								
December								
Total Events	**4**	**4**	**4**	**4**	**5**	**4**	**4**	**4**

Table 1c – Summary of sampling by station for each estuary / salt pond system. Number of samples per event are ideal. Systems in red were not included in year 1 (2016) of the monitoring program, but James Pond, Menemsha/Squibnocket Pond and Tisbury Great Pond (and Fresh Pond {2016, aka. Wigges Pond}, Looks Pond {2017}) were added into the sampling program in year 2 (2017). Fresh and Wiggies Ponds not sampled in 2018, however, Sheriffs Pond was sampled in year 3 (2018). Oyster Pond was not sampled in 2016, 2017 or 2018.

Town	Embayment	Number of Stations	Sample Depths	Total Samples per Event	Total Samples per Summer
Edgartown Oak Bluffs	Sengekontacket Pond	SKT-2,3,4,5,6,7,,9	6 mid, 1 surf,btm	8	32
Edgartown	Cape Pogue Bay	POG-2,3,4,5	4 mid	4	16
Edgartown	Pocha Pond	PCA-1,3	2 mid	2	8
Edgartown	Katama Bay	KAT-1,2,3,4,5,7	6 mid	6	24
Edgartown	Oyster Pond	OYS-1,2,3,4	4 mid	4	16
Edgartown	Edgartown Great Pond	EGP-2,3,4,5,6,7,9,10,11	9 mid	9	36
Oak Bluffs	Wiggies Pond (aka Fresh Pond)	FRS-1,2,3	3 surf,3 btm	6	24
Oak Bluffs	Farm Pond	FRM-1,2,3	3 mid	3	12
Oak Bluffs	Oak Bluffs Harbor	MV-15,16,14	2 mid, 1 surf,btm	4	16
Oak Bluffs Tisbury	Lagoon Pond	LGP-2,4,8,9,11	3 surf, 2 surf,btm	7	24
Tisbury	Lake Tashmoo	MV-21,2,3,4, sentinel	4 mid, 1 surf,btm	6	24
West Tisbury	James Pond	JMS-1,3,4	3 mid	3	12
West Tisbury	Looks Pond	LOOKS-4	1 mid	1	4
Chilmark Aquinnah	Menemsha Pond	MEN-2,3,5,6,7	5 surf,btm	10	40
Chilmark Aquinnah	Squibnocket Pond	SQB-1,3	2 surf,btm	4	16
Chilmark	Chilmark Pond	CHP-1,2,4,5,6,Upper	6 mid	6	24
Chilmark West Tisbury	Tisbury Great Pond	TGP-1,3A,4,5,6,7,8	6 surf, 1 surf,btm	8	32
Sub-Total				81	324
QA Samples @ 5%				3	
Grand Total					**336**

Figure 1 - Estuaries of Martha's Vineyard that have already undergone a minimum of 3 years water quality monitoring by the MVC with support from the Coastal Systems Program. Most estuaries already have regulatory nitrogen thresholds developed by the Massachusetts Estuaries Project (MEP). The Island-wide water quality monitoring program builds on this historical baseline data. Year 1 (2016) of the Island-wide water quality monitoring program covered all the estuaries except: Oyster Pond, Tisbury Great Pond, James Pond and Menemsha/Squibnocket Ponds, all of which (with the exception of Oyster Pond) were added in year 2 (2017) and continued in year 3 (2018) of the program.

STATION LOCATION MAPS FOR ESTUARIES OF MARTHA'S VINEYARD

Figure 2 – Historic Sampling Points (yellow symbols) in Lake Tashmoo including MEP established sentinel station (new station between MV4 and MV5). Stations re-visited for 2016, 2017 and 2018 sampling seasons. Stations denoted by a red X are historic stations that are no longer being sampled under the unified Island-wide Monitoring Program.

Figure 3 – Historic Sampling Points (yellow symbols) in Lagoon Pond including MEP established sentinel station LGP-2. Stations re-visited for 2016, 2017 and 2018 sampling seasons. Stations denoted by a red X are historic stations that are no longer being sampled under the unified Island-wide Monitoring Program.

Figure 4 – Historic Sampling Points (white labels) in Oak Bluffs Harbor including MEP established sentinel station (MV-14) in Sunset Lake. Stations re-visited for 2016, 2017 and 2018 sampling seasons. Stations denoted by a red X are historic stations that are no longer being sampled under the unified Island-wide Monitoring Program.

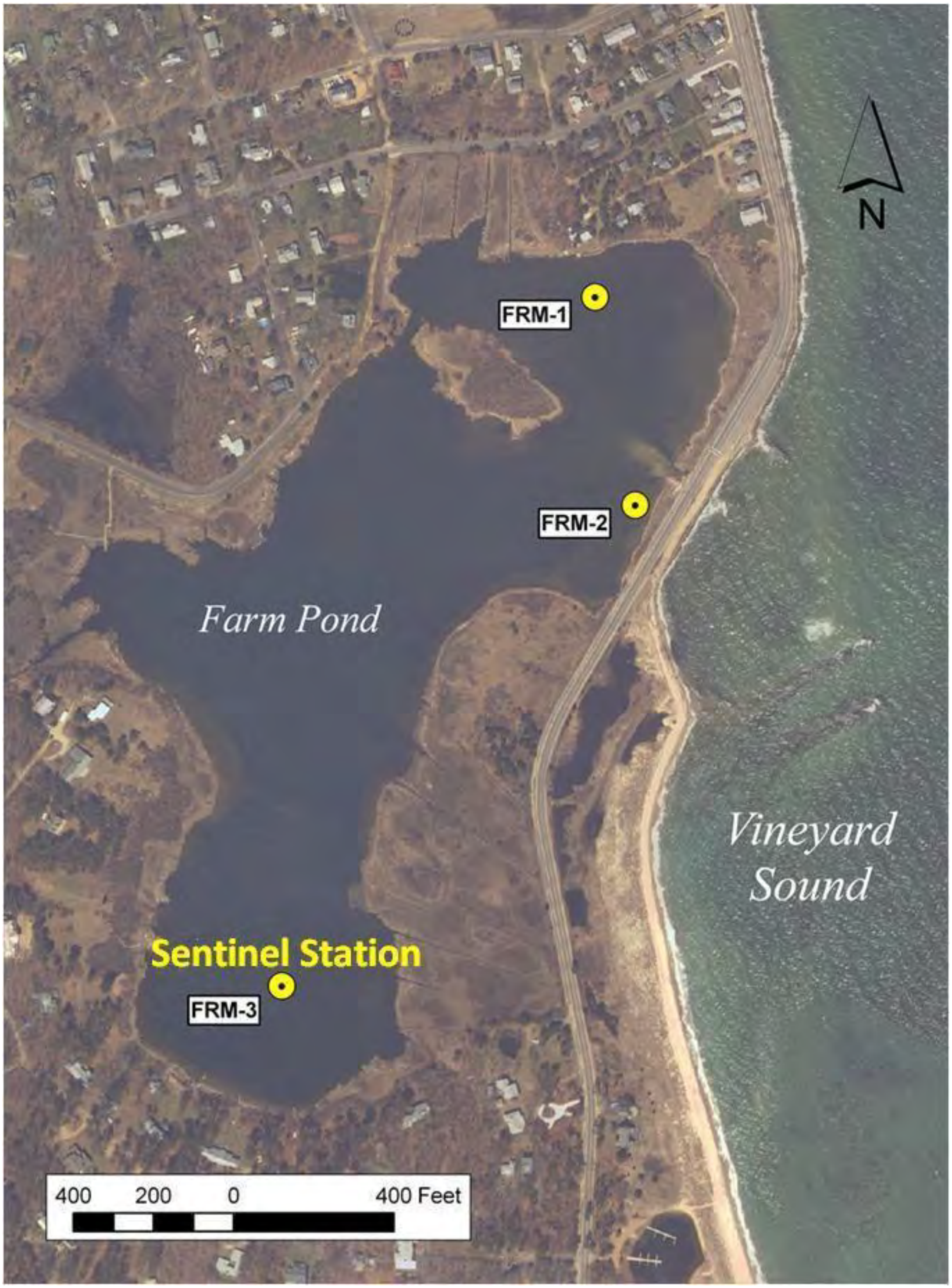


Figure 5 – Historic Sampling Points (yellow symbols) in Farm Pond including MEP established sentinel station FRM-3. Stations re-visited for 2016, 2017 and 2018 sampling seasons.

Figure 6a – Historic Sampling Points (yellow symbols) in Sengekontacket Pond including MEP established sentinel stations SKT-4 and SKT-9. Stations re-visited for 2016, 2017 and 2018 sampling seasons. Stations denoted by a red X are historic stations that are no longer being sampled under the unified Island-wide Monitoring Program.

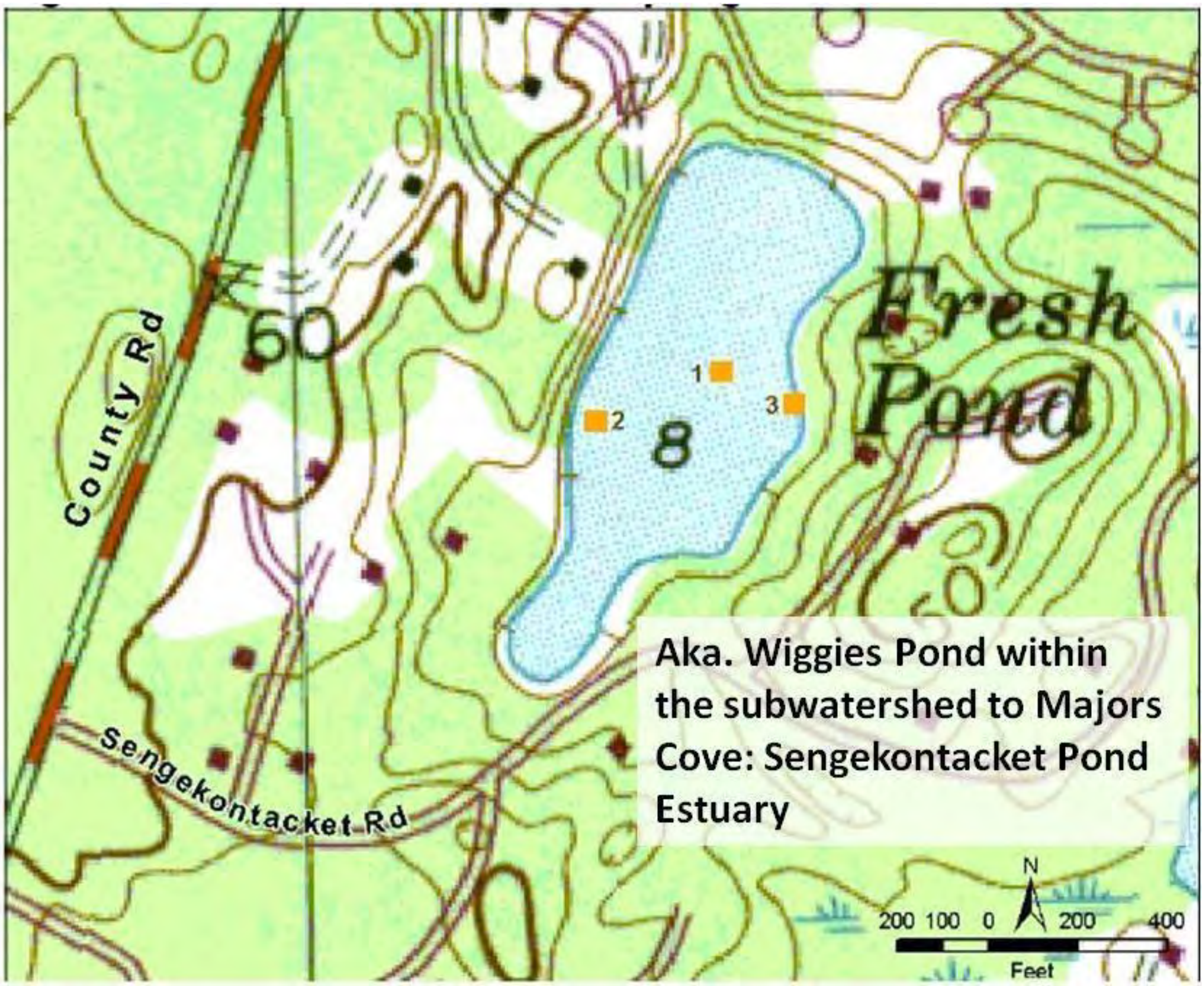


Figure 6b – Historic Sampling Points (yellow symbols) in Fresh Pond (aka. Wiggies Pond) within the subwatershed to Majors Cove located in the Sengekontacket Pond Estuary. Due to historic documented stratification, stations were sampled in 2016 at 2 depths each (surface and bottom). In the future, Stations 2 and 3 maybe re-oriented to run length wise across the pond for better spatial distribution. Fresh Pond was sampled in 2016, but not in 2017 or 2018.

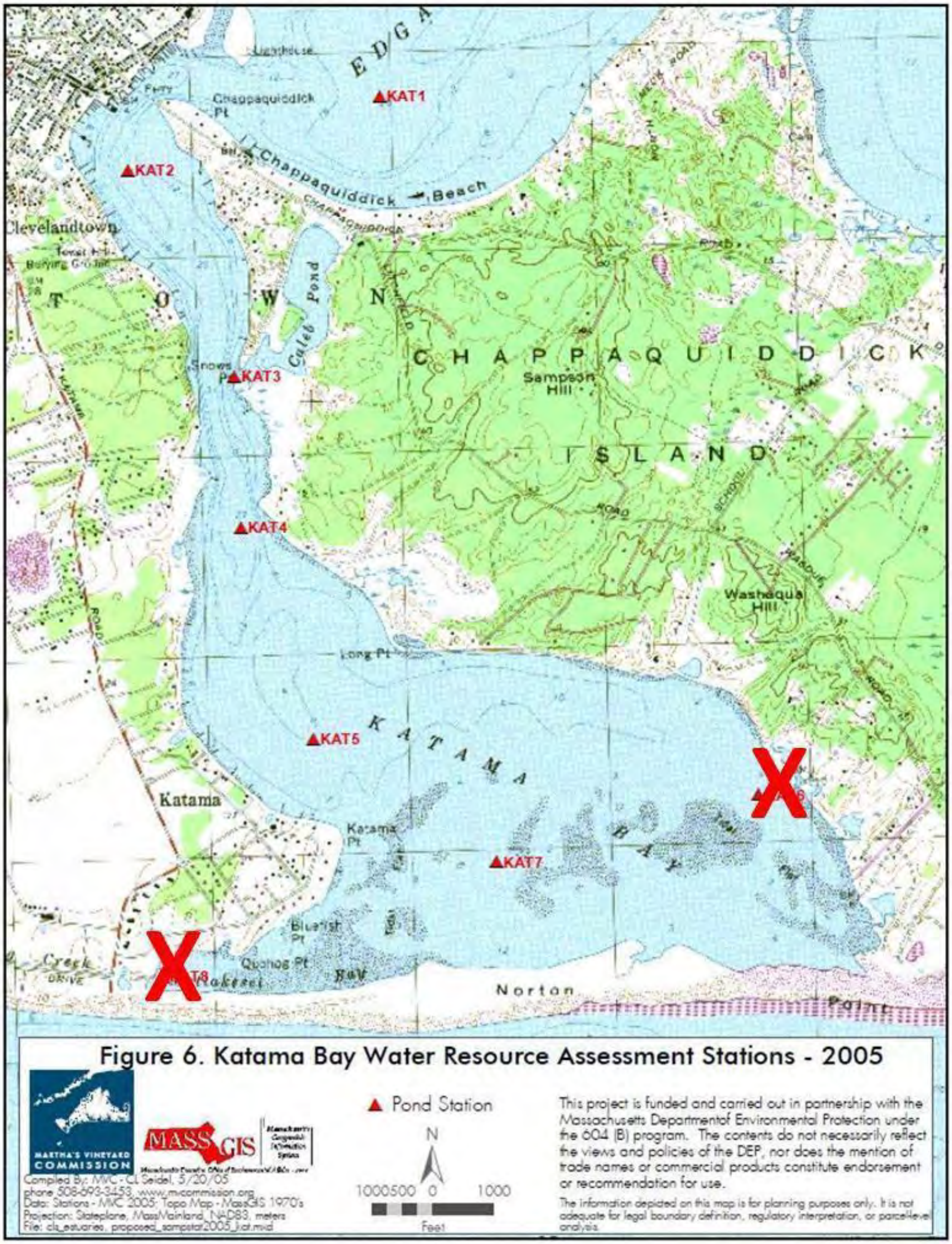


Figure 7 – Historic Sampling Points (red symbols) in Katama Bay. Stations re-visited for 2016, 2017 and 2018 sampling seasons. Stations denoted by a red X are historic stations that are no longer being sampled under the unified Island-wide Monitoring Program.

Figure 8 – Historic Sampling Points (red symbols) in Cape Pogue Bay. Stations re-visited for 2016, 2017 and 2018 sampling seasons. Stations denoted by a red X are historic stations that are no longer being sampled under the unified Island-wide Monitoring Program.

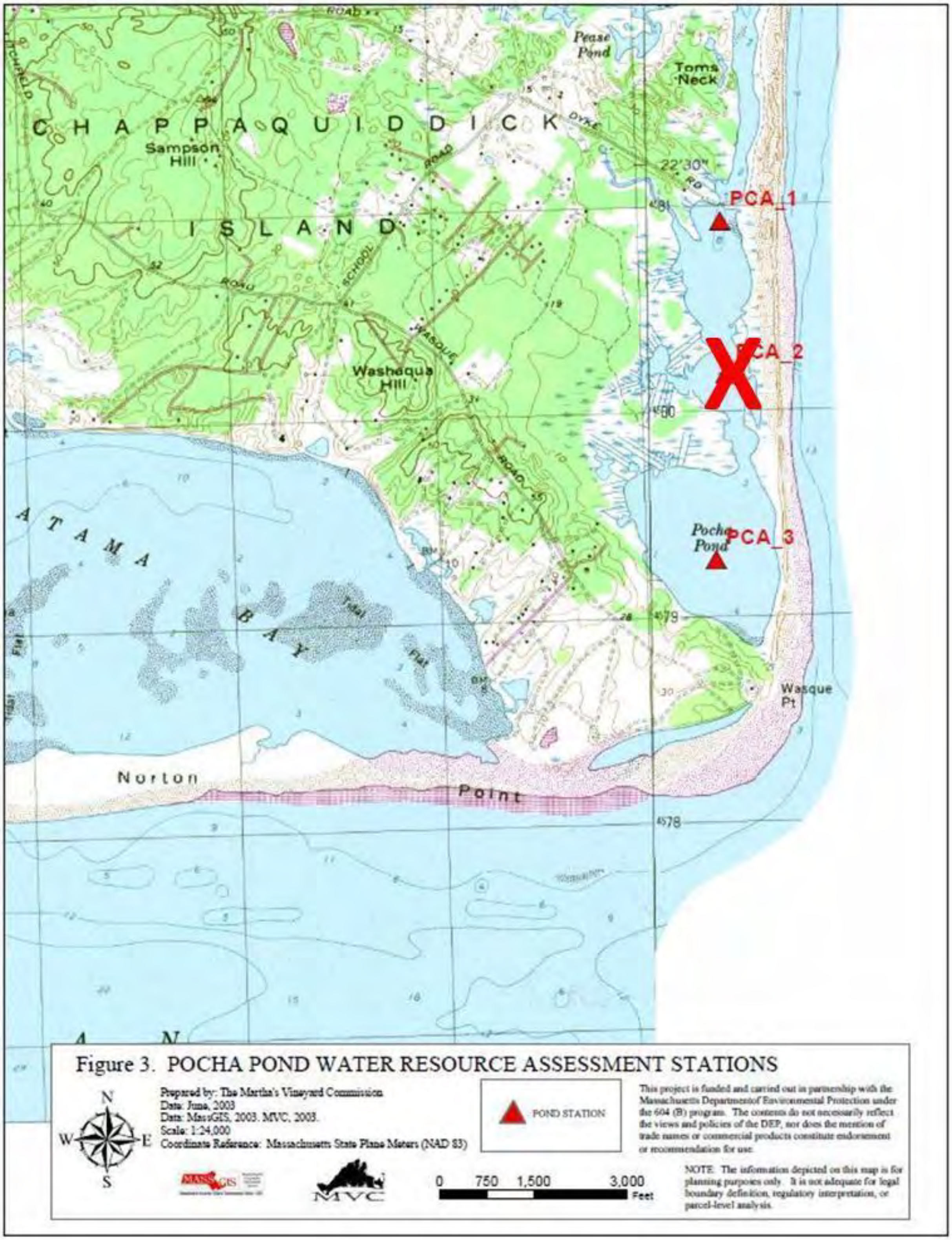


Figure 9 – Historic Sampling Points (red symbols) in Pocha Pond. Stations re-visited for 2016, 2017 and 2018 sampling seasons. Stations denoted by a red X are historic stations that are no longer being sampled under the unified Island-wide Monitoring Program.

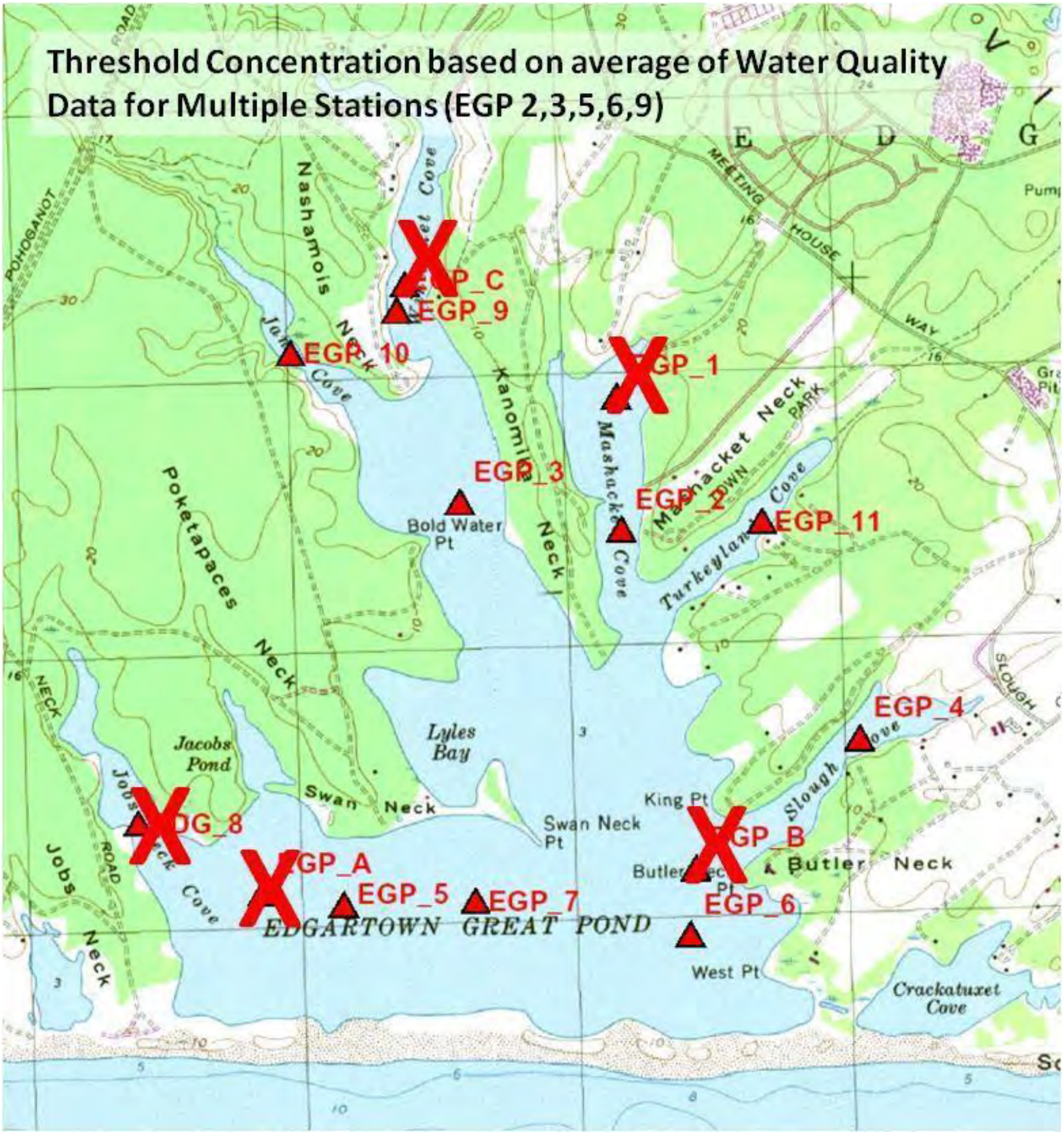


Figure 10 – Historic Sampling Points (red symbols) in Edgartown Great Pond including MEP established "sentinel station" (average of EGP 2,3,5,6,9). Stations re-visited for 2016, 2017 and 2018 sampling seasons. Stations denoted by a red X are historic stations that are no longer being sampled under the unified Island-wide Monitoring Program.

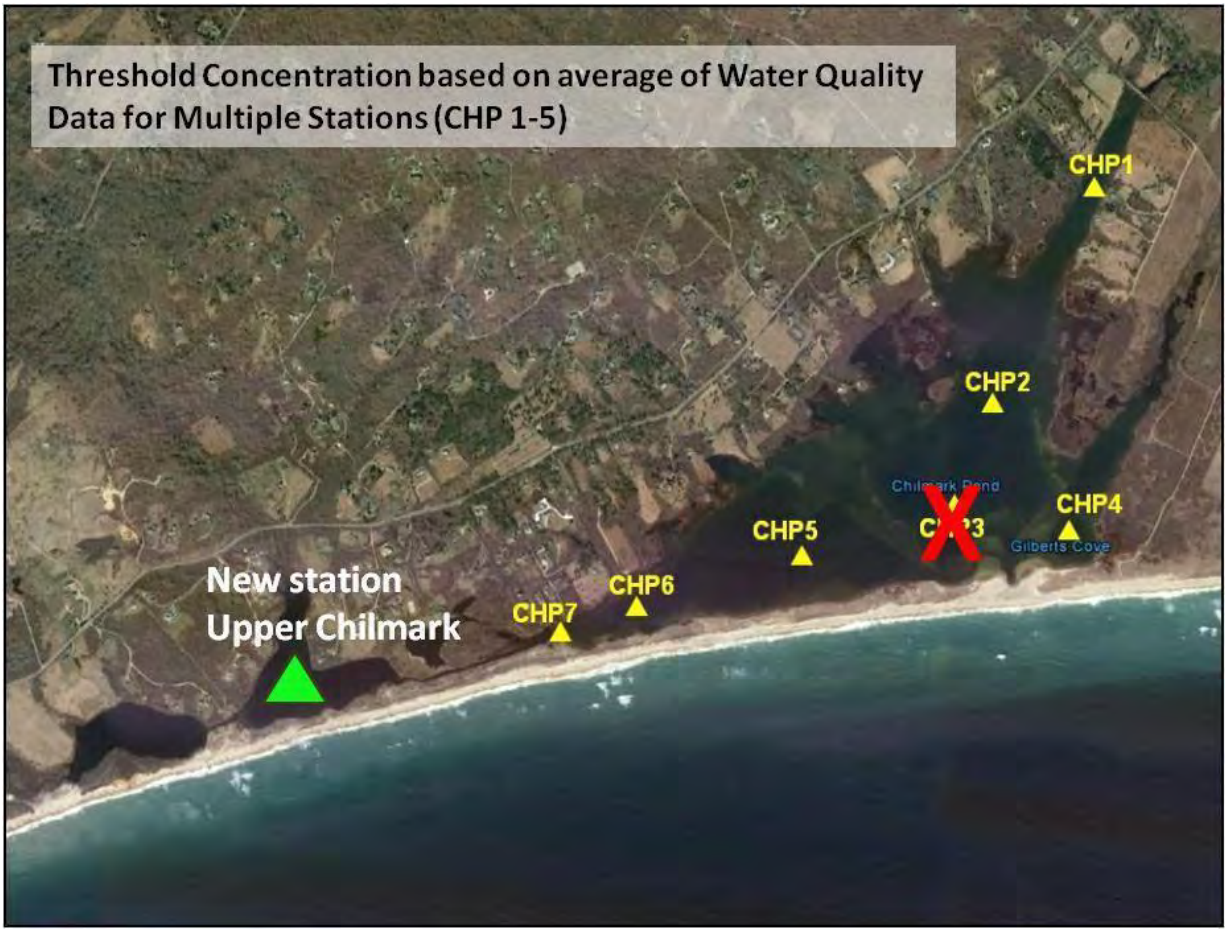


Figure 11 – Historic Sampling Points (yellow symbols) in Chilmark Pond including MEP established "sentinel station" (average of CHP 1-5). Stations re-visited for 2016, 2017 and 2018 sampling seasons. Stations denoted by a red X are historic stations that are not being sampled under the unified Island-wide Monitoring Program.

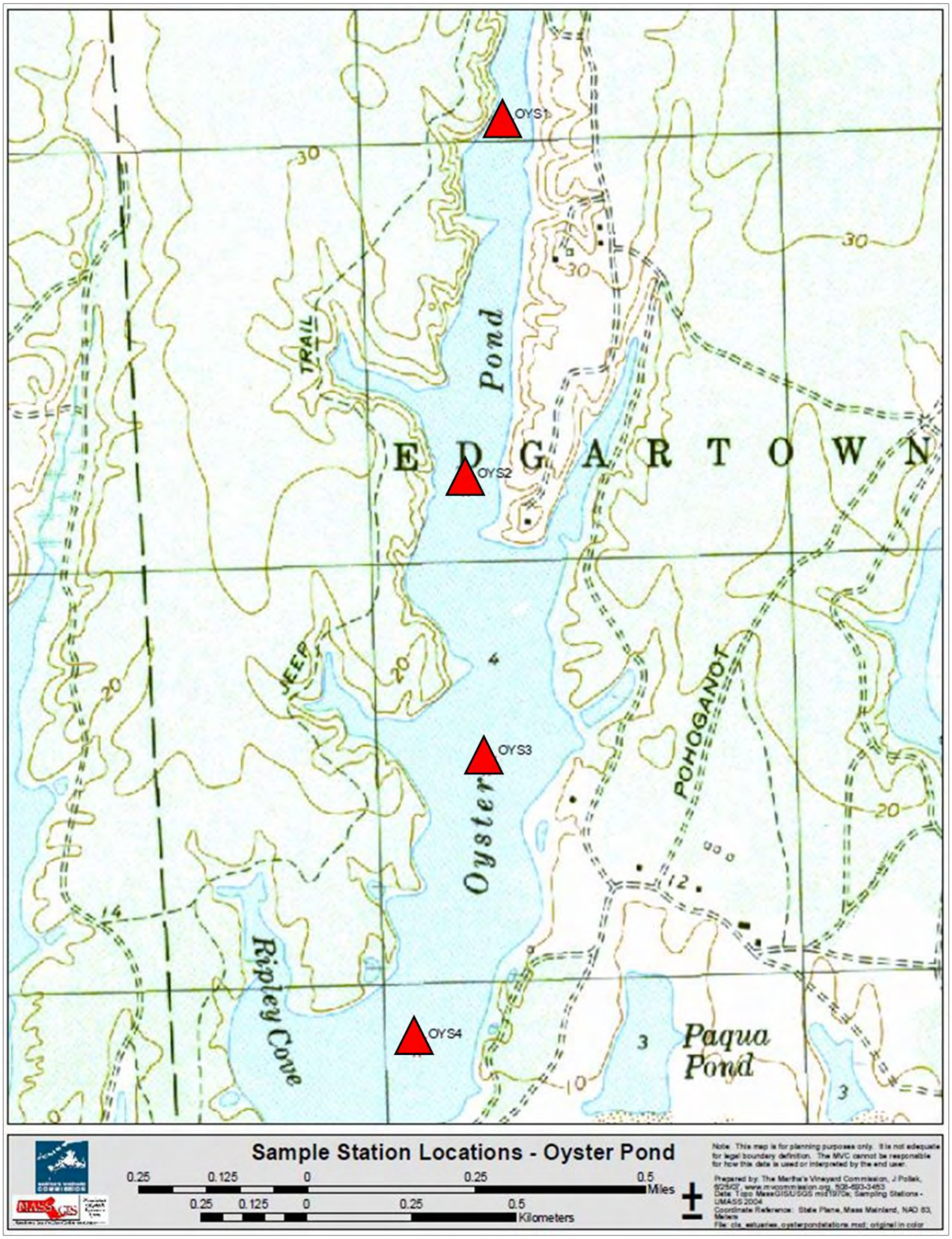


Figure 12 – Historic Sampling Points (red symbols) in Oyster Pond. Oyster Pond was not sampled in 2016, 2017 or 2018 but will be included in the island-wide program as funding becomes available.

Figure 13 – Historic Sampling Points (red symbols) in Tisbury Great Pond including MEP established "sentinel station" (average of TGP 4,5,6) and TGP7. Stations denoted by a red X are historic stations that are not being sampled under the unified Island-wide Monitoring Program. Tisbury Great Pond was not sampled in 2016 but was included in the island-wide program in 2017 and 2018.

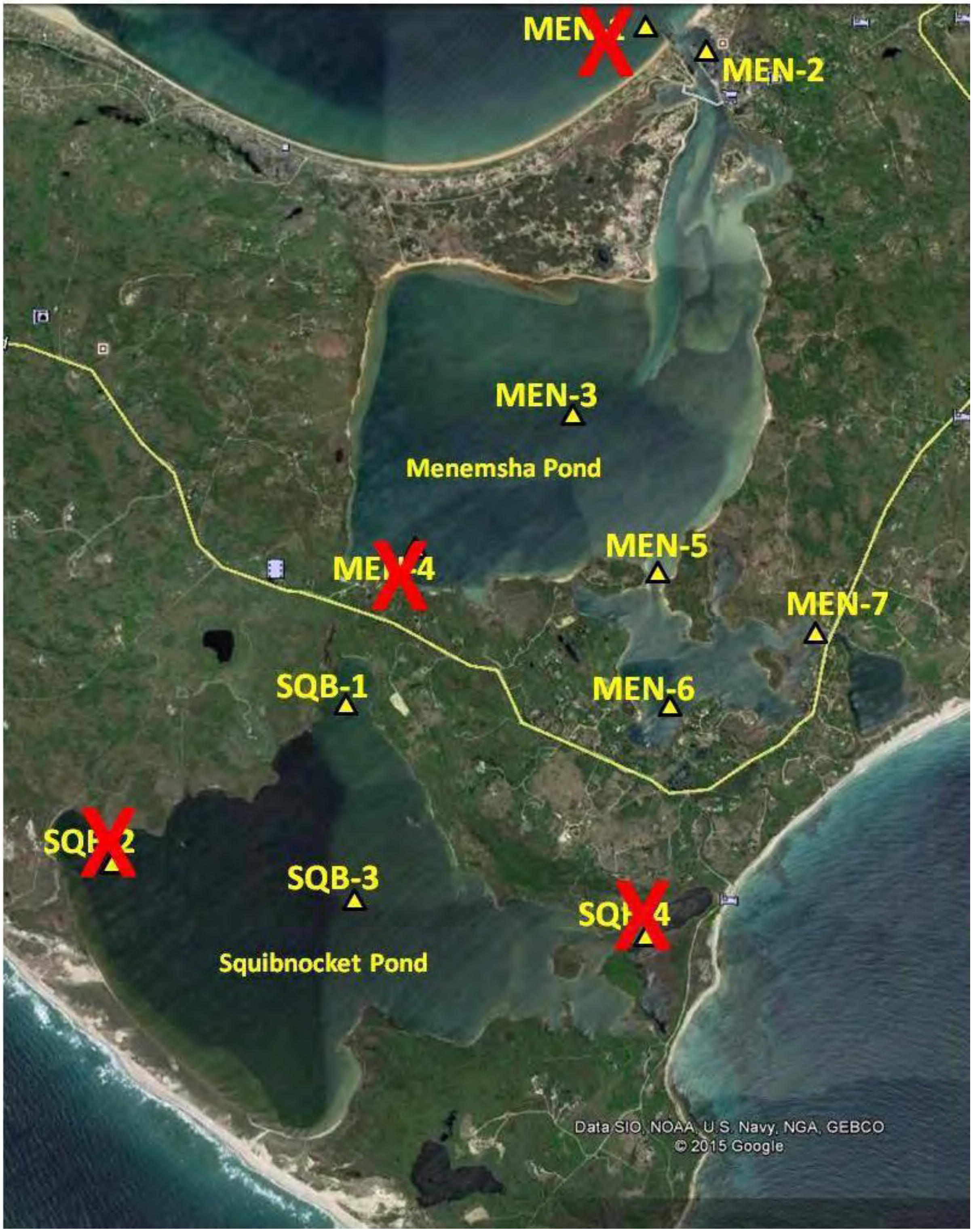


Figure 14 – Historic Sampling Points (yellow symbols) in Menemsha Pond and Squibnocket Pond including MEP established sentinel station. Stations denoted by a red X are historic stations that are not being sampled under the unified Island-wide Monitoring Program. Menemsha / Squibnocket Ponds were not sampled in 2016 but was included in the island-wide program in 2017 and 2018.

Figure 15 – Historic Sampling Points (red symbols) in James Pond. Stations denoted by a red X are historic stations that are no longer being sampled under the unified Island-wide Monitoring Program. James Pond was not sampled in 2016 but was included in the island-wide program in 2017 and 2018.

Summary of 2018 Water Quality Results for Martha's Vineyard Island-wide Sampling

Water samples collected in July through September in the estuarine systems of Martha's Vineyard indicate that organic nitrogen (dissolved + particulate) dominates the Total Nitrogen pool (2018: 93%-99%, 2017: 88%-99%, 2016: 94%-98%) with the majority of the TN pool (2018: 40%-72%, 2017: 46%-90%, 2016: 57%-78%) comprised of dissolved organic nitrogen (DON) and the remainder as particulate organic nitrogen (PON) (2018: 23%-58%, 2017: 20%-53%, 2016: 20%-40%). Meanwhile, bio-available nutrients in the form of nitrite and nitrate (NOx) and ammonium (NH_4) account for only 1%-7% in 2018 (2017: 1%-12%, 2016: 1%-8%) of the water-column Total Nitrogen pool (Table 2, Figure 17, Appendix A). This contrasts with the fact that virtually all of the nitrogen entering from the watershed is in bio-available forms, primarily as nitrate. This breakdown of nitrogen constituents appears relatively consistent over the three year period (2016-2018) during which monitoring has taken place across the estuaries of Martha's Vineyard. These results are typical for estuarine systems throughout New England, where nitrogen is the nutrient responsible for eutrophication and therefore the nutrient critical for management.

As previously observed and consistent with biological/ecological theory, the predominance of organic nitrogen in the Total Nitrogen (TN) pool in these systems indicates that phytoplankton are effectively converting the bio-available inorganic forms of nitrogen into organic forms (e.g. biomass). Where tidal flushing is effective, much of this particulate matter along with dissolved nitrogen forms is washed out of the system resulting in good water clarity as seen in the greater secchi depth readings and lower chlorophyll levels in the basins nearest the tidal inlets, such as in Lagoon Pond (LGP-9, average secchi depth 2.32m {2017: 3.52m}) and the Edgartown Harbor / channel into Katama Bay (KAT-2, average Secchi depth 2.49m {2017: 2.48m}). Summary data is presented in Table 2 and Total Pigment concentrations are plotted in Figures 16a-16m. By comparison, in Tisbury Great Pond, which is only periodically opened to flushing with the Atlantic Ocean, average secchi depths were low across all the stations ranging from 0.66m to 1.19m and DON (40%) and PON (58%) accounted for almost all (98%) of the TN pool. The high proportion of TN as particulate and dissolved forms is consistent with the growth of phytoplankton, hence high average Total Pigment concentrations (Chlorophyll-a + Pheophytin-a = 18.41 ug/L (range: 13.73 - 25.77 ug/L) averaged across all stations, 10 ug/L being indicative of impairment). Similarly, in Chilmark Pond which is also only seasonally opened to the Atlantic Ocean, average Secchi depths were also low across all the stations ranging from 0.47m to 1.91m and DON (70%) and PON (29%) accounted for almost all (99%) of the TN pool. The high proportion of TN as PON and DON is consistent with the high phytoplankton biomass as indicated by the Total Pigment concentrations (Chlorophyll-a + Pheophytin-a = 15.61 ug/L {range: 3.93-60.98 ug/L} average of all stations).

As part of the data analysis, the role of nitrogen as the nutrient to be targeted for management was confirmed by evaluating the molar ratio of bioavailable nitrogen and phosphorus. This ratio, also called the Redfield Ratio, gives a general assessment of nitrogen versus phosphorus as the critical nutrient of eutrophication (nutrient impairment). Values much less than 16 (<10) indicate nitrogen additions will stimulate plant growth and much greater than 16 (>22), that phosphorus may be the concern.

For almost all of the estuarine stations sampled in Martha's Vineyard estuaries in 2018, N/P values averaged 2 and were generally less than 6 and virtually always less than 8, indicating nitrogen is the nutrient to be managed. Only the periodically opened Edgartown Great Pond showed periodically higher N/P ratios (Edgartown 2018 avg. of 8.22, range 2.75-14.99) consistent with its more brackish waters (17-22 ppt, 2018-2016). This likely relates to the periodic openings to salt water exchange which has resulted in a freshening of the salt pond. While these ponds still provide marine habitats, maintaining their marine condition through tidal exchanges obviates the need for additional phosphorus control (in addition to nitrogen). If N/P ratios rise it may become useful to conduct a more definitive analysis on N versus P stimulation of phytoplankton.

As a general rule, within each estuary, those basins that have more tidal flushing have higher water clarity, lower phytoplankton biomass and lower TN levels. This can be most clearly seen in 2018 in Menemsha-Squibnocket Ponds, where the main basin of Menemsha Pond supports total chlorophyll-a and TN levels of ~7 ug/L and 0.28 mg/L and the tidally restricted tributary basin of Squibnocket Pond ~10 ug/L and 0.65 mg/L, respectively. The longer residence time of water in a basin allows for a greater buildup of nitrogen and for phytoplankton growth as seen in the high pigment levels. It is this lower flushing, higher residence time scenario that increases the sensitivity of these basins to nitrogen inputs compared to the adjacent higher flushed basins under similar nitrogen loading rates. This effect is seen in Total Pigment levels being lowest (5.0 - 10.0 ug/L) in well flushed systems across the Island, such as lower Lagoon Pond, Katama Bay, Cape Pogue Bay and Oak Bluffs Harbor (Table 2). These chlorophyll-*a* levels are indicative of generally high water quality conditions and can be supportive of both eelgrass and benthic animal habitat. Where tidal flushing is more restricted as in Chilmark Pond, water clarity is relatively poor as shown by generally shallower Secchi Depth recordings and high total pigment concentrations, (2018: 3.93 - 60.98 ug/L, 2017: 8.6 - 23.4 ug/L, 2016: 4.27 - 24.16 ug/L, and also in Tisbury Great Pond (2018: 13.73 - 25.77 ug/L, 2017: 15.2 – 36.6 ug/L, Table 2). These chlorophyll-*a* levels are indicative of nutrient enrichment and are generally associated with impairments to eelgrass and benthic animal communities, as was found by the MEP assessments. This is even more evident in salt ponds that are only periodically opened, such as Tisbury Great Pond and Edgartown Great Pond, where watershed N loading from year to year is relatively constant and water quality is controlled mainly by the frequency and duration of their managed openings to tidal exchange.

The general pattern of highest water quality in basins with high rates of tidal flushing and low water residence times is consistent with summer time results from across the estuaries of Martha's Vineyard in 2016, 2017 and 2018 as well as from other estuaries across Cape Cod and Nantucket. This effect can be seen within individual estuaries or in comparing whole systems with differing tidal exchanges. However, inter-annual differences in water quality generally result from differences in meteorological events or variations in tidal flushing due to the success of openings in closed ponds or the occlusion of tidal inlets by sedimentation. It should be noted that in general, total pigment levels in 2018 across most of the estuaries of Martha's Vineyard seemed higher compared to 2017 and 2016 levels. These inter-annual differences need to be monitored to be able to establish clear trends as towns across the island move into nutrient management to meet the MEP established nitrogen thresholds for restoration.

The need for long-term monitoring is reinforced by the fact that in almost all estuaries sampled in 2016, 2017 and 2018, 2017-2018 typically showed significantly higher total chlorophyll-*a* levels. While this may be the result of different meteorological and environmental conditions (since it was seen across multiple estuaries) determining the “typical” estuarine conditions requires multiple years of monitoring data collected in a uniform manner. At present the potential general increase in chlorophyll from 2016 to 2017 to 2018 will need to be verified in the coming year to determine if it is merely inter-annual variation or a trend.

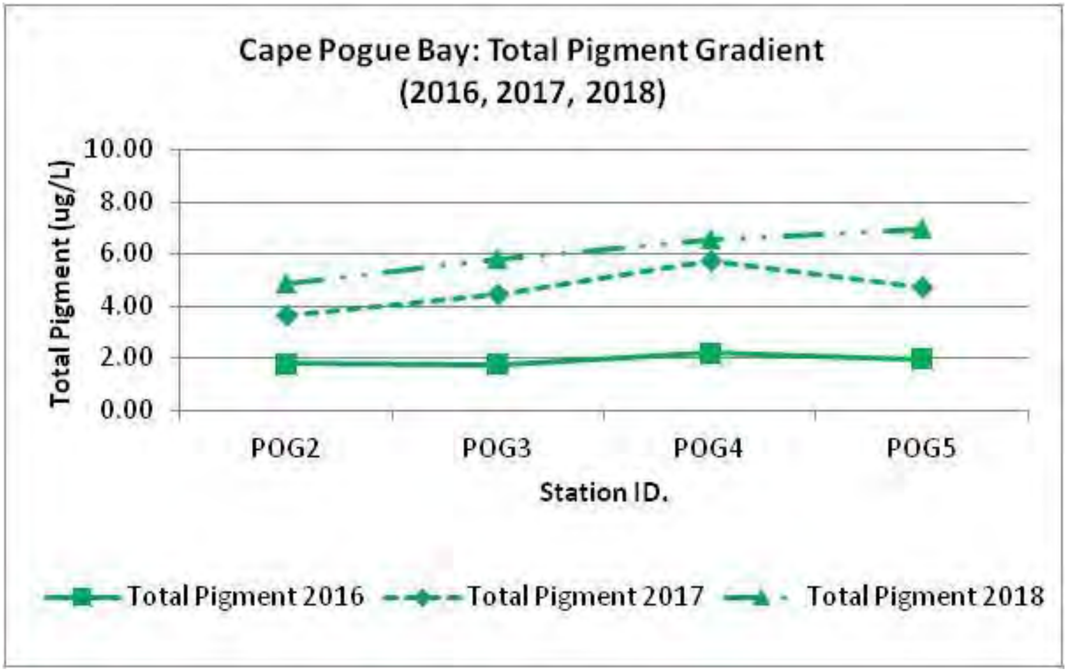


Figure 16a. Station averages of total pigment (chlorophyll a + pheophytin *a*) in Cape Pogue Bay (Summer 2016, 2017 and 2018 sampling season). Levels greater than 10 ug/L typically indicate impaired habitat.

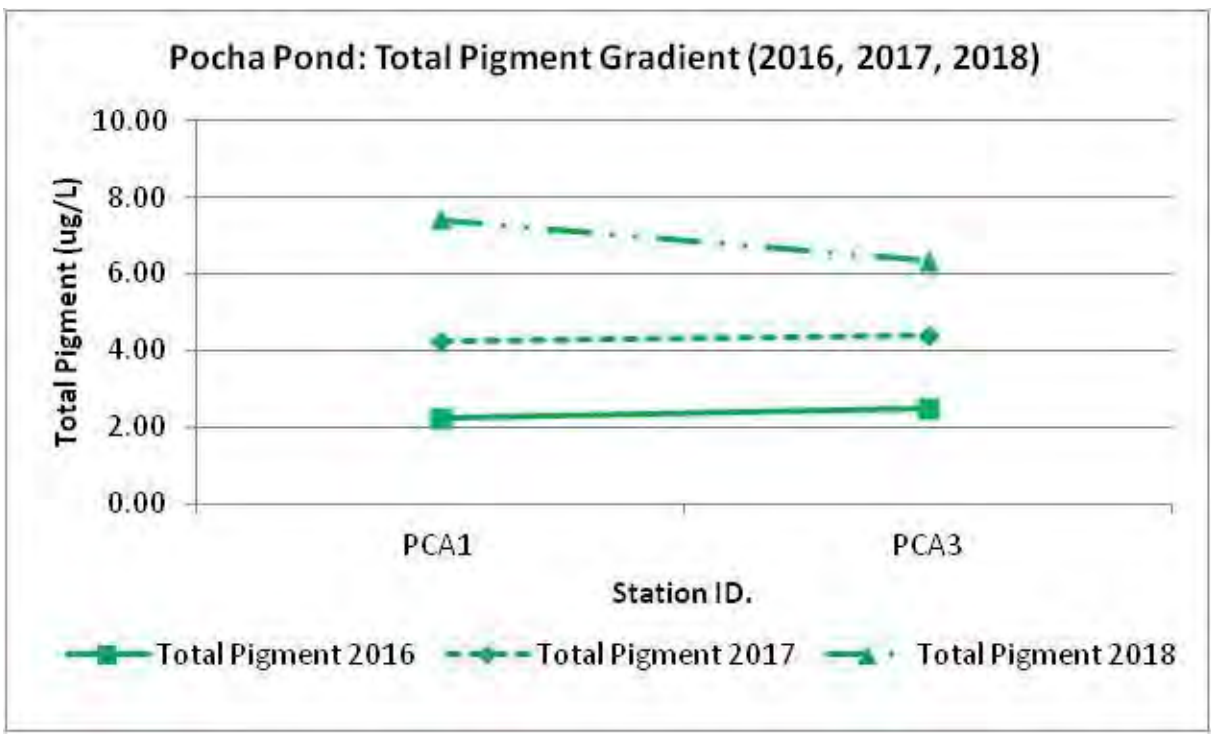


Figure 16b. Station averages of total pigment (chlorophyll a + pheophytin *a*) in Pocha Pond (Summer 2016, 2017 and 2018 sampling season). Levels greater than 10 ug/L typically indicate impaired habitat.

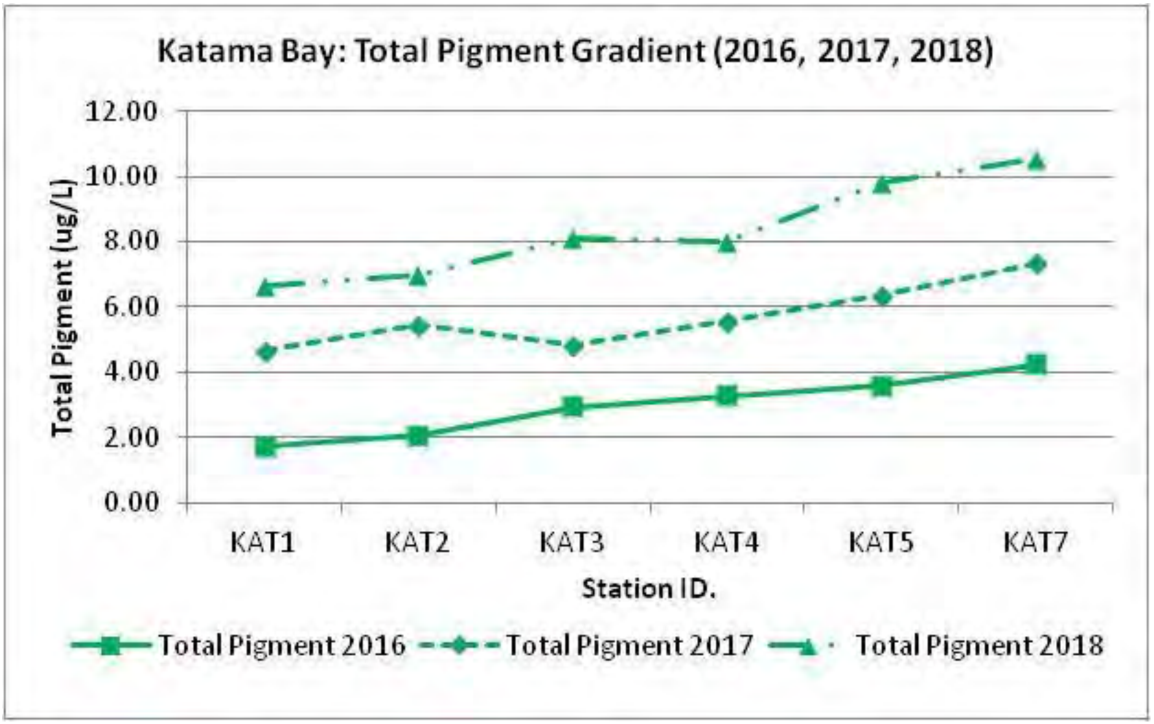


Figure 16c. Station averages of total pigment (chlorophyll a + pheophytin *a*) in Katama Bay (Summer 2016, 2017 and 2018 sampling season). Levels greater than 10 ug/L typically indicate impaired habitat.

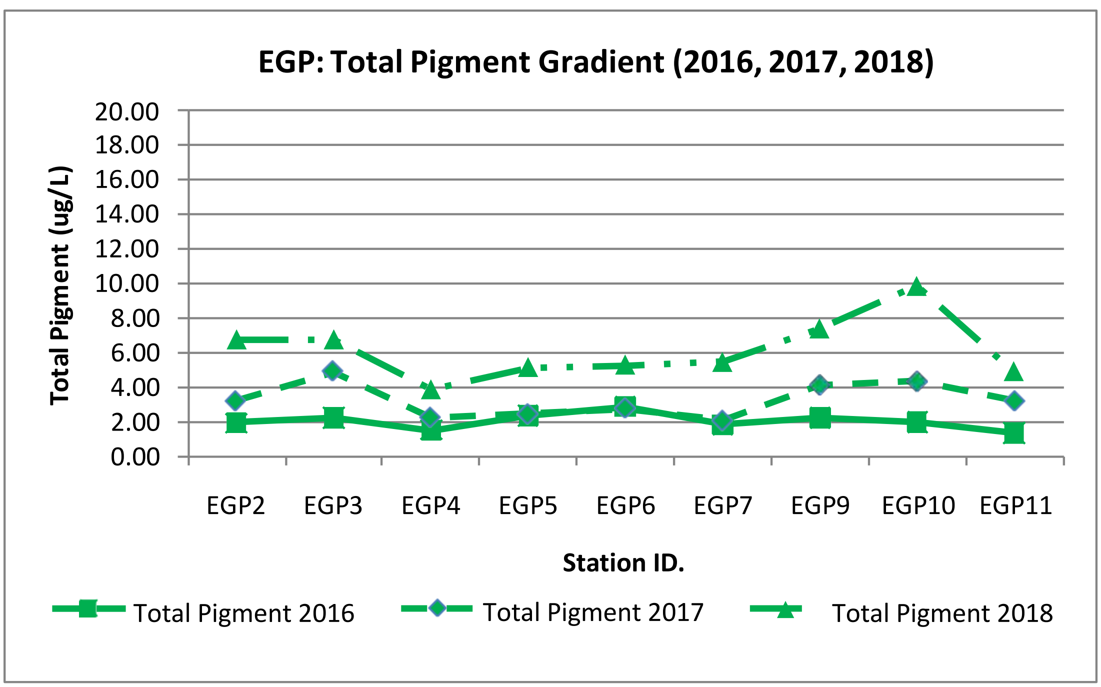


Figure 16d. Station averages of total pigment (chlorophyll a + pheophytin *a*) in Edgartown Great Pond (Summer 2016, 2017 and 2018 sampling season). Levels greater than 10 ug/L typically indicate impaired habitat.

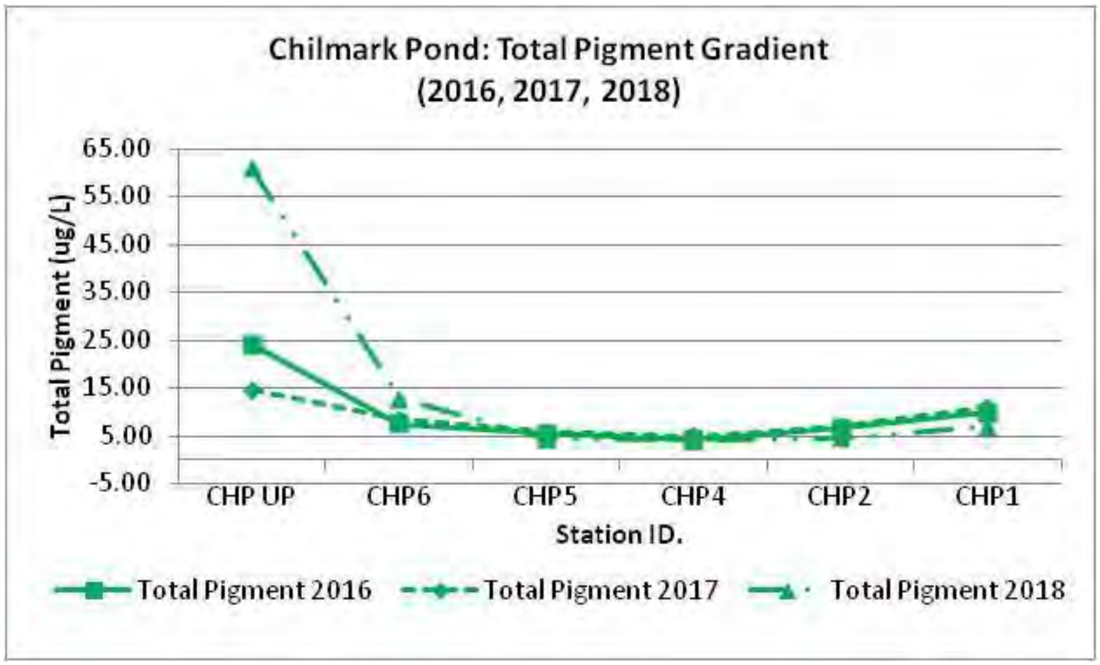


Figure 16e. Station averages of total pigment (chlorophyll a + pheophytin *a*) in Chilmark Pond (Summer 2016, 2017 and 2018 sampling season). Levels greater than 10 ug/L typically indicate impaired habitat.

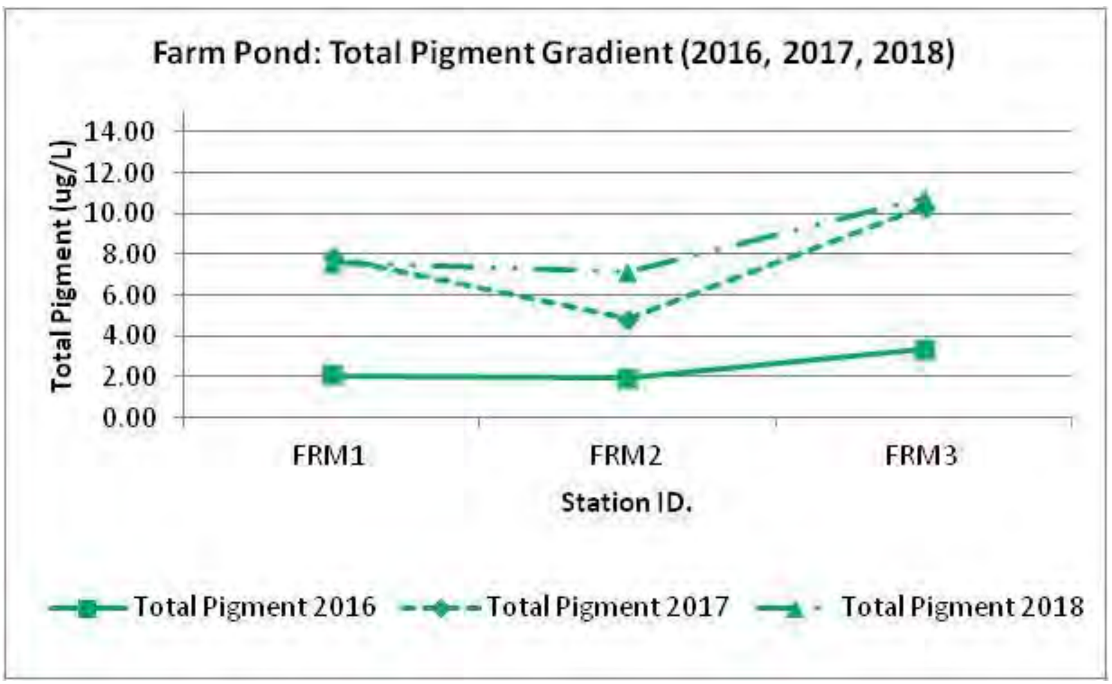


Figure 16f. Station averages of total pigment (chlorophyll a + pheophytin *a*) in Farm Pond (Summer 2016, 2017 and 2018 sampling season). Levels greater than 10 ug/L typically indicate impaired habitat.

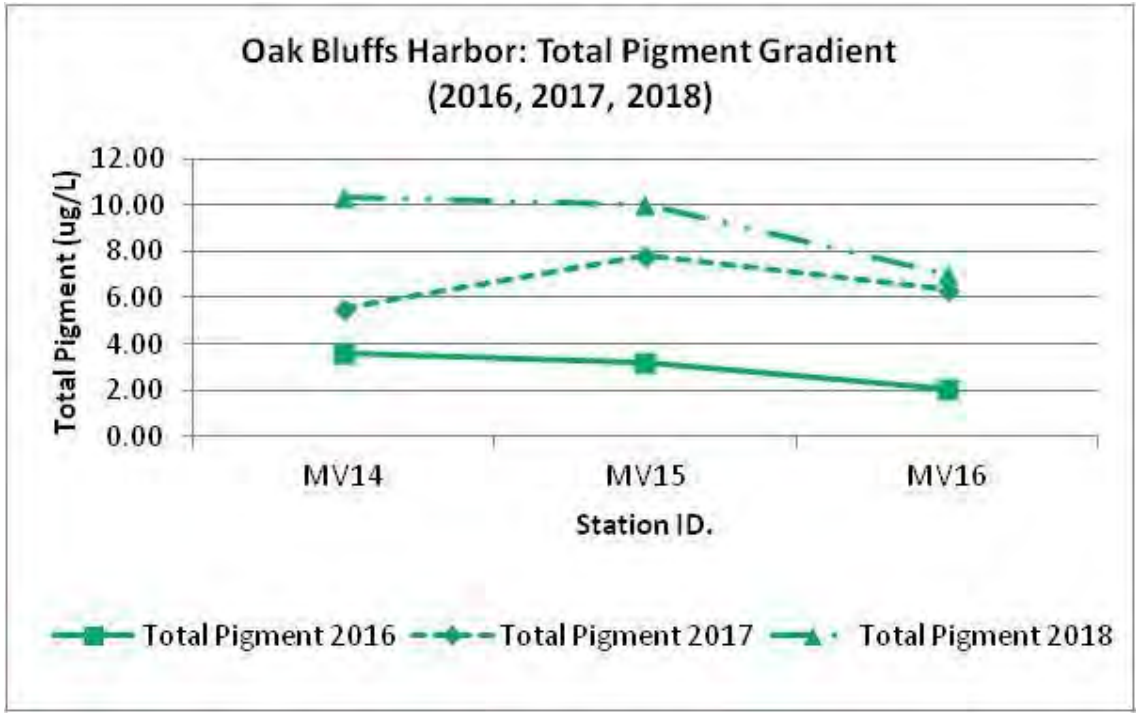


Figure 16g. Station averages of total pigment (chlorophyll a + pheophytin *a*) in Oak Bluffs Harbor (Summer 2016, 2017 and 2018 sampling season). Levels greater than 10 ug/L typically indicate impaired habitat.

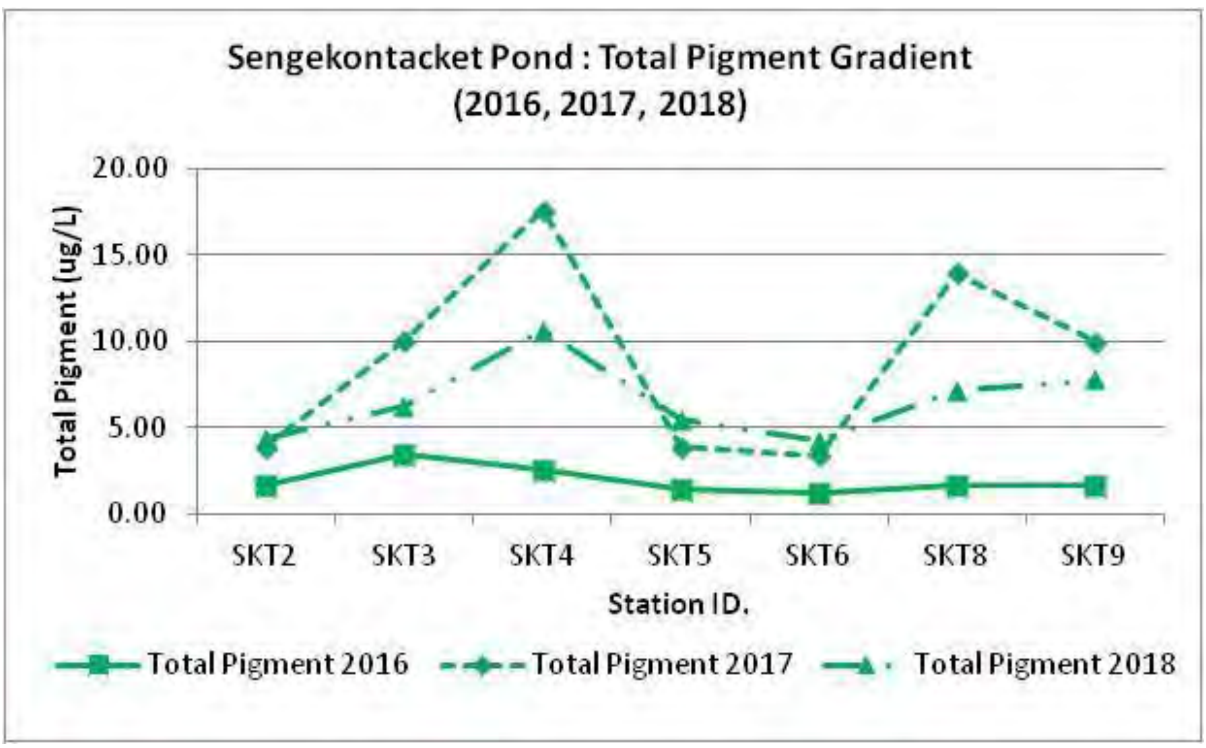


Figure 16h. Station averages of total pigment (chlorophyll a + pheophytin *a*) in Sengekontacket Pond (Summer 2016, 2017 and 2018 sampling season). Levels greater than 10 ug/L typically indicate impaired habitat.

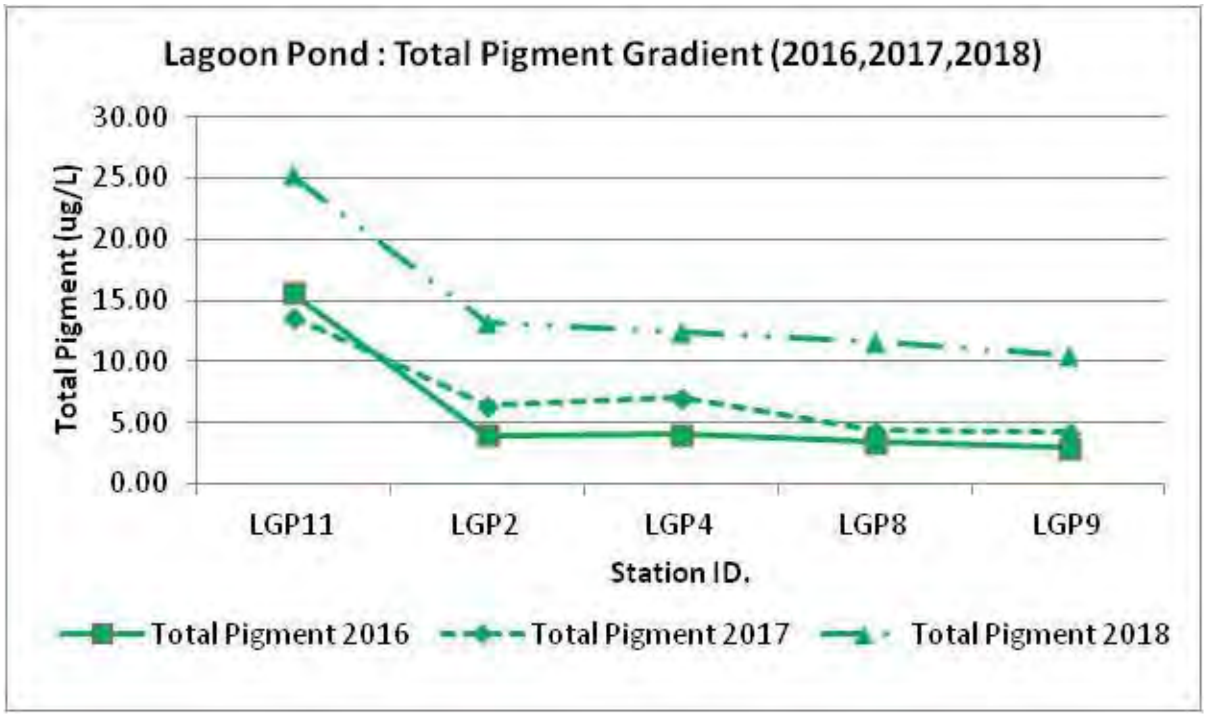


Figure 16i. Station averages of total pigment (chlorophyll a + pheophytin *a*) in Lagoon Pond (Summer 2016, 2017 and 2018 sampling season). Levels greater than 10 ug/L typically indicate impaired habitat.

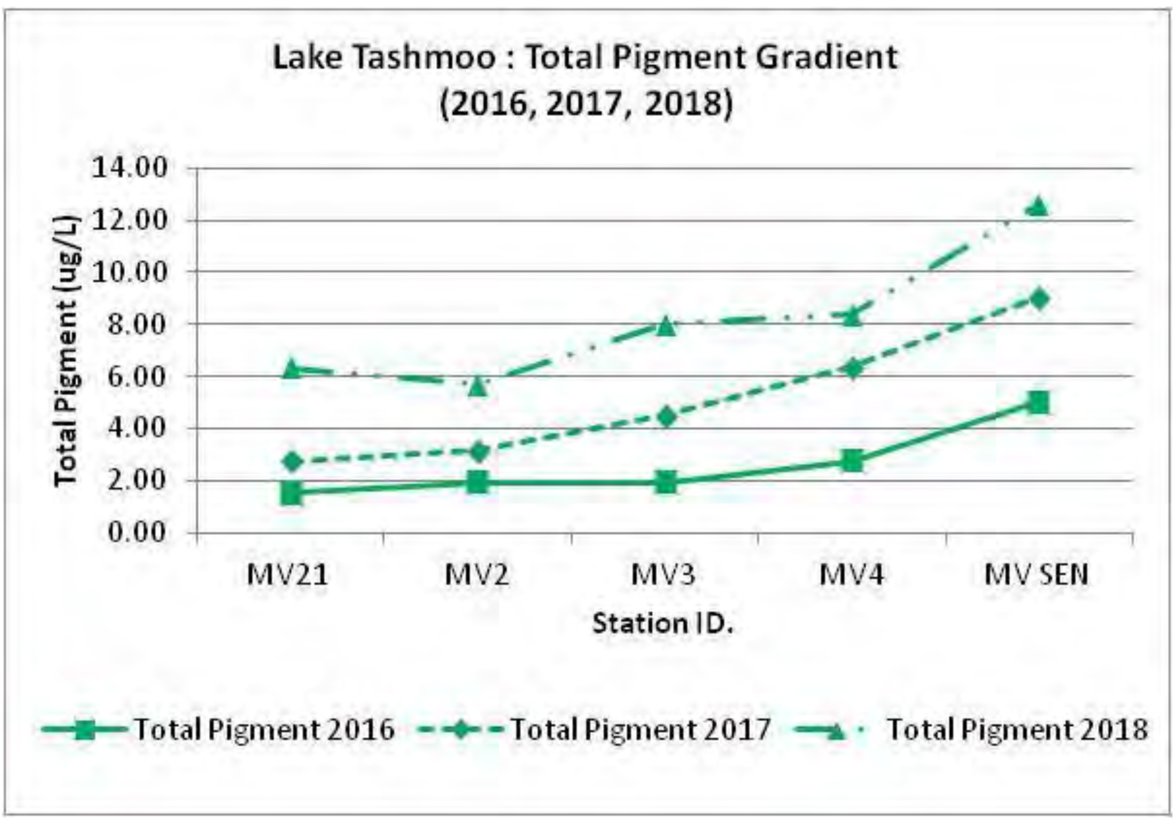


Figure 16j. Station averages of total pigment (chlorophyll a + pheophytin *a* in Lake Tashmoo (Summer 2016, 2017 and 2018 sampling season). Levels greater than 10 ug/L typically indicate impaired habitat.

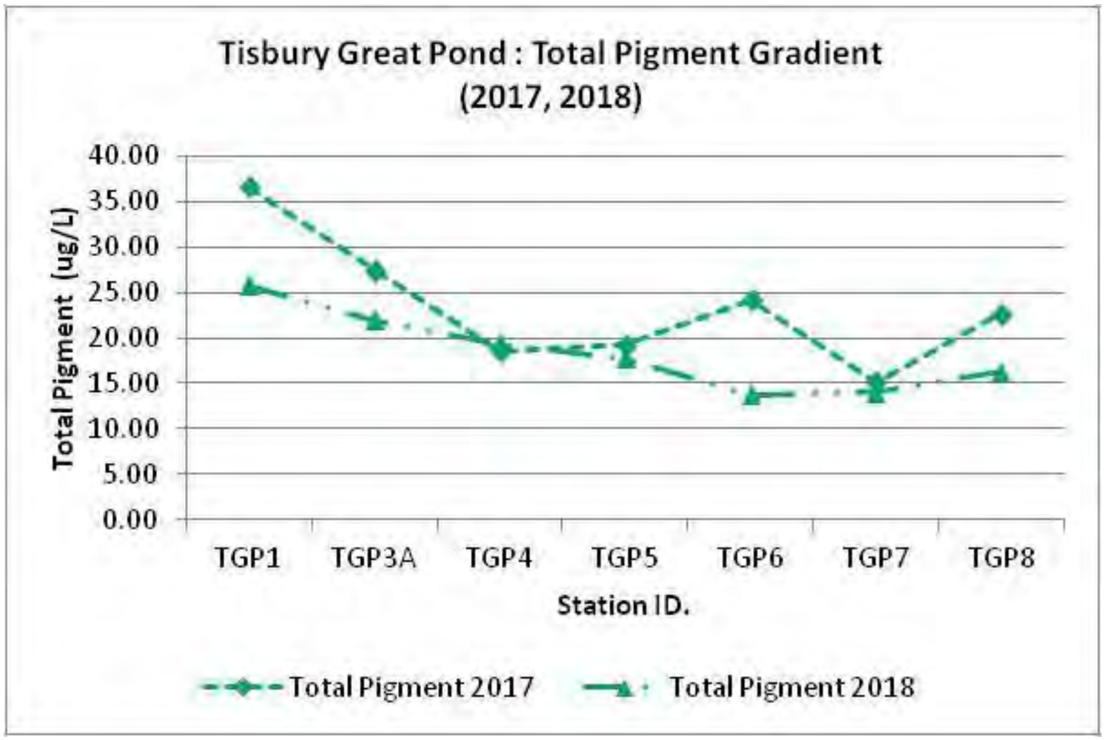


Figure 16k. Station averages of total pigment (chlorophyll a + pheophytin *a* in Tisbury Great Pond (sampling started in summer 2017, continued in 2018). Levels greater than 10 ug/L typically indicate impaired habitat.

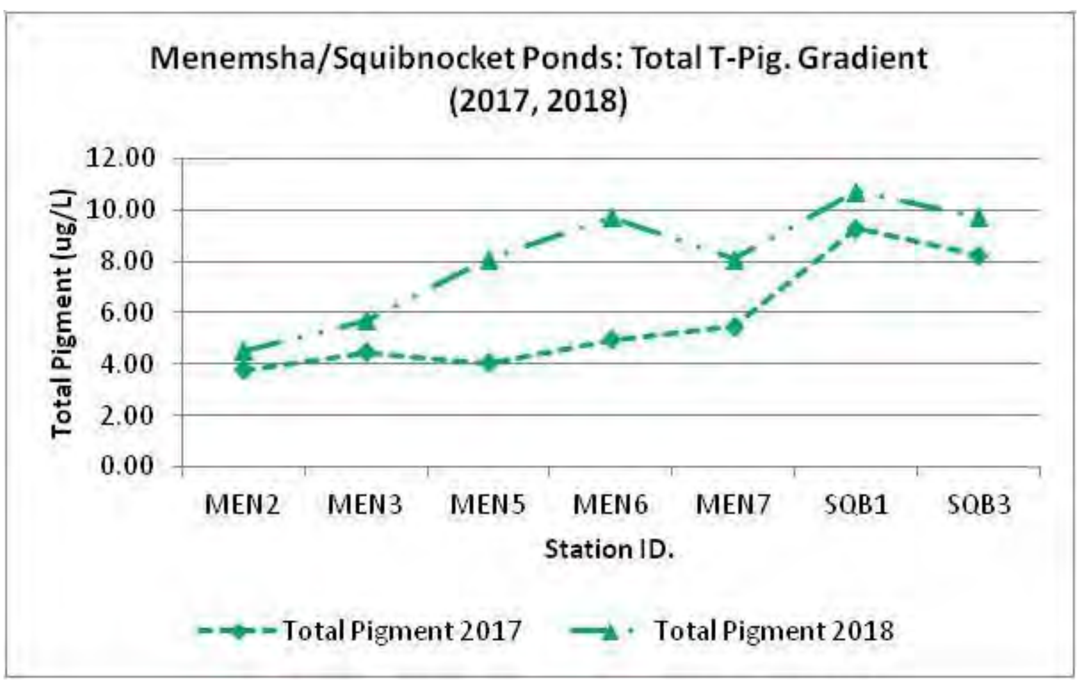


Figure 16L. Station averages of total pigment (chlorophyll a + pheophytin *a* in the Menemsha-Squibnocket Pond system (sampling started in summer 2017, continued in 2018). Levels greater than 10 ug/L typically indicate impaired habitat.

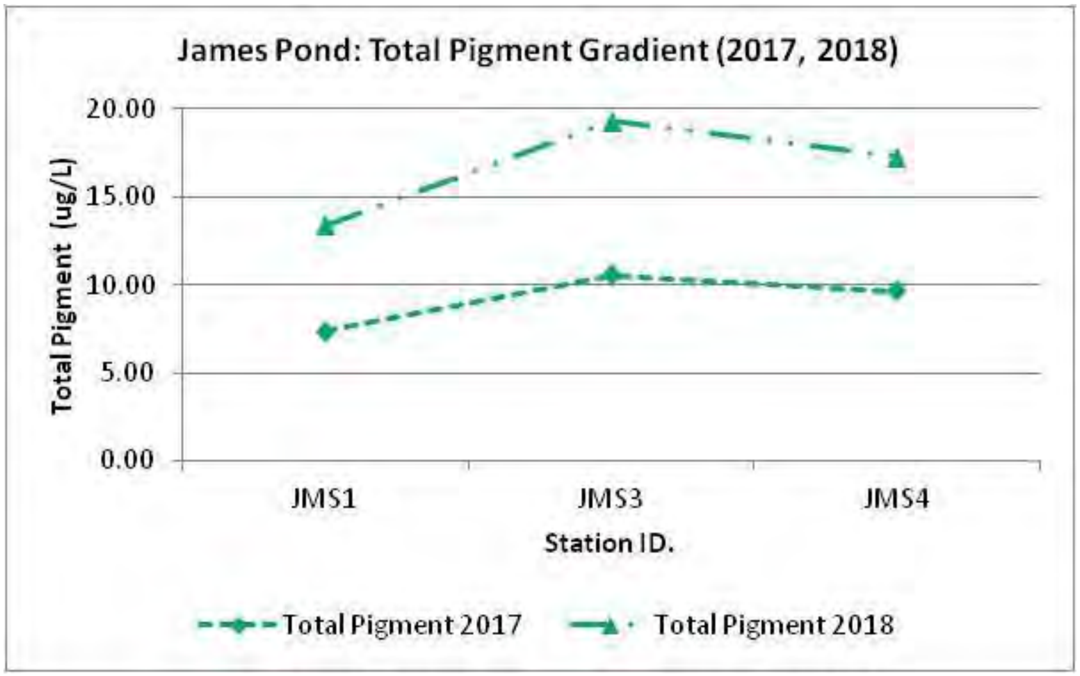


Figure 16M. Station averages of total pigment (chlorophyll a + pheophytin *a* in the James Pond system (sampling started in summer 2017, continued in 2018). Levels greater than 10 ug/L typically indicate impaired habitat.

A general view of the status of each estuary can be derived from the average Total Nitrogen (TN) values in a given system. But averaging over entire estuaries, while useful for comparing systems, obscures the nutrient gradients that occur within each system. Martha's Vineyard estuaries assessed in 2018 (2017 and 2016 values in [ ] respectively) had significantly lower TN levels in systems that exchange tidal waters year round via a fixed inlet compared to levels in tidally restricted or periodically opened basins, emphasizing the need to maintain maximum tidal flushing of the Island's estuaries This is clearly apparent when the open basins of Lake Tashmoo 0.335 mg/L [0.311 mg/L, 0.359 mg/L], Lagoon Pond 0.290 mg/L [0.332 mg/L, 0.396 mg/L], Oak Bluffs Harbor 0.349 mg/L [0.393 mg/L, 0.397 mg/L], Katama Bay 0.308 mg/L [0.363 mg/L, 0.404 mg/L], Sengekontacket Pond 0.335 mg/L [0.393 mg/L, 0.430 mg/L], Pocha Pond 0.399 mg/L [0.412 mg/L, 0.449 mg/L], and Cape Pogue Bay 0.326 mg/L [0.361 mg/L, 0.458 mg/L], are compared to the restricted/closed basins of Farm Pond 0.413 mg/L [0.512 mg/L, 0.478 mg/L], Edgartown Great Pond 0.419 mg/L [0.419 mg/L, 0.522 mg/L], and James Pond 0.718 mg/L [0.618 mg/L, not sampled in 2016]. As mentioned above, this "flushing effect" is very clear seen in comparing the main basin of Menemsha Pond 0.276 mg/L [2017: 0.348 mg/L, not sampled in 2016] to the associated tidally restricted basin of Squibnocket Pond, 0.652 mg/L [2017: 0.768 mg/L, not sampled in 2016], which has very low watershed loading but more than twice the TN concentration in the water column.

By comparison, the average TN concentration in Chilmark Pond, which is only periodically open to flushing with Atlantic Ocean water when the barrier beach is breached, was 0.536 mg/L [0.574 mg/L, 0.927 mg/L]. In Tisbury Great Pond, also only periodically open to low nutrient ocean water, the TN level in 2018 was 0.642 mg/L [2017: 0.780 mg/L, not sampled in 2016]. The significantly higher concentration of total nitrogen in Chilmark Pond and Tisbury Great pond compared to systems that exchange water with the ocean or sound suggests that the frequency and efficacy of the annual openings in these closed systems plays a major role in maintaining the ecological health of these great salt ponds. Moreover, the lower TN levels in Chilmark Pond (2018 vs. 2017) suggests that the efficacy of the opening in a given year is critical to subsequent summer water quality conditions. As such, monitoring the water quality in these closed systems as well as in tidally restricted systems such as Squibnocket Pond, Farm Pond and James Pond (small occluded culvert, TN level 0.718 mg/L) is critical for properly managing the nitrogen concentration at the MEP established sentinel stations. Additionally, as stated in 2017 and 2016, the importance of effective openings for managing closed salt ponds such as Chilmark Pond and Tisbury Great Pond would warrant consideration of monitoring openings in a specific manner in order to develop pond specific criteria to guide the timing of the openings and the most favorable conditions for maximizing effectiveness (e.g. wind strength and direction, tidal conditions, pond water levels). To the extent that pond openings can be made more effective and nitrogen levels decline, other nitrogen management alternatives become less necessary. The general rule is that the higher the tidal flushing of a basin the more nitrogen loading it can tolerate without impairment, hence its sensitivity to nitrogen inputs. Since the physical structure and flushing rate of each estuary is different, the tolerable amount of nitrogen input load is different for each estuary and salt pond on Martha’s Vineyard (refer to MEP Threshold Reports specifically). While the site specific N threshold for most of the Island's estuaries has been performed by the MEP, consistent monitoring by the Martha's Vineyard Commission continues as the best approach to refine these N thresholds and to discern trends in nutrient related water quality due to management or changes in tidal flushing.

Watershed N loading to the Island’s estuaries is clearly reflected in the average TN levels in each estuary being significantly higher than historical average TN values in the “offshore” (aka. boundary stations) such as MV6 located offshore from Lake Tashmoo (0.270), station offshore Pleasant Bay (0.232 mg/L) and station NTKS located in Nantucket Sound (0.290-0.294 mg/L). The higher observed levels within the estuaries compared to the offshore waters which enter on a flood tide results from the addition of nitrogen entering the estuarine basins from the surrounding watersheds. The magnitude of the TN increase depends largely on the rate of tidal exchange and the amount of watershed loading. All TN values and plots are summarized and presented in Table 2a [2018], Table 2b [2017], Table 2c [2016] and Figure17.

In reviewing the 2018, 2017 and 2016 dissolved oxygen data, it does not appear that there is sufficient temporal sampling in the three years, with four summer sampling events per year, to capture the critical minimum oxygen levels. Therefore, while assessment of the oxygen levels in each estuary was performed (20% low DO, Table 2a), it will be necessary to conduct a multi-year composite analysis once sufficient data has been collected. It is also possible to strengthen the dissolved oxygen data base in specific estuarine basins, building on the monitoring results. We have made some recommendations which we have noted at the end of the discussion section.

Comparison of the 2018 data with historical MEP baseline: At all sites, historical TN levels were compared to 2018, 2017 and 2016 TN concentrations. The length of the historical water quality data record that was used as the baseline for the Massachusetts

Estuaries Project (MEP) varied from 3-7 years depending on the estuary and available data. Historical data presented here are from the MEP Nitrogen Threshold Reports for: 1) Edgartown Great Pond, 2) Chilmark Pond, 3) Lake Tashmoo, 4) Lagoon Pond, 5) Oak Bluffs Harbor, 6) Farm Pond, 7) Sengekontacket Pond, 8) Tisbury Great Pond and 9) Menemsha Pond - Squibnocket Pond. It should be noted that Sheriffs Pond (sampled only in 2018), Fresh or Wiggies Pond (sampled in 2016) and Looks Pond (sampled in 2017) are truly freshwater, salinity $\leq$0.23 PSU. Neither James Pond (estuarine) nor the freshwater ponds received specific analysis under the MEP.

Not all sites sampled historically were sampled in 2018 as the Island-wide water quality monitoring was designed specifically to meet the needs of compliance monitoring rather than establishing a water quality baseline for modeling as completed by the MEP. However, all of the estuarine stations sampled in 2016 were re-sampled in 2017 and 2018, with additional estuaries being sampled each year as funding allowed. Those stations that were sampled in 2018 and 2017 are compared to both the 2016 data as well as the historical data provided in Tables 3 through 11. While Tisbury Great Pond was assessed under the MEP, water quality monitoring was not undertaken in 2016 due to limited funds, however, it was sampled in 2017 and 2018. The Menemsha Pond and Squibnocket Pond system, evaluated in the summer of 2016 under the MEP for nitrogen threshold development was integrated into the Island-wide monitoring program for the summer of 2017 and sampling continued in 2018. Cape Pogue Bay, Pocha Pond and Katama Bay are potentially to be evaluated in the future consistent with the MEP approach and the 2018, 2017 and 2016 water quality data will be utilized in that assessment. James Pond is not presently slated for an MEP style analysis, however, it was integrated into the Island-wide water quality monitoring program for summers 2017 and 2018. Water quality data collected in James Pond will serve to extend the limited existing baseline data, to support an MEP level assessment of the pond should the Town of West Tisbury request the Coastal Systems Program to do so in the future.

Edgartown Great Pond: The 2018, 2017 and 2016 Edgartown Great Pond TN data generally compares well with historical data from the same sampling stations sampled by the MVC as part of the Island-wide Water Quality Monitoring Program (Figure 18, Table 3). Not all of the historical sites were sampled in 2018, 2017 or 2016, specifically EGP-1,8,A,B,C. In general, TN levels at all the stations sampled in 2018 were lower than in 2017 and 2016, 2018 being a high rainfall year and 2016 being a low groundwater inflow year. In closed ponds, freshwater inflows provide some “flushing” when the pond is closed, which can affect TN levels. Most significant is that the TN levels across the pond were significantly lower than at the time of the MEP assessment (2003-2006) and in 2016 were at the threshold TN level set for this salt pond and met the regulatory threshold for TN in 2017 and 2018 (Figure 17 and Appendix A). This likely stems from the lower watershed loading now compared to during the MEP, primarily due to the depuration of the former WWTF plume and the improved openings of the pond in recent years.

The observed lowering of TN levels has been anticipated as the historic high nitrogen groundwater plume resulting from discharge at the previous WWTF has been flushing out, lowering the load to the pond. In addition, the Town of Edgartown has modified the pond opening protocol over the past decade to increase the volumetric exchange that occurs with each opening, resulting in lower post-breach nitrogen levels in pond waters. The 2018 TN concentrations ranged from 0.370 mg/L - 0.450 mg/L.

2017 TN concentrations ranged from 0.390 mg/L - 0.502 mg/L. In 2016 TN concentrations ranged from 0.469 mg/L - 0.552 mg/L whereas the historical TN data at the same stations ranged from 0.582 mg/L - 0.711 mg/L. The MEP TN threshold was set at 0.50 mg/L as an average of stations EGP- 2,3,5,6,9. The historical average TN concentration at the time the MEP analysis was completed for those 5 stations was 0.597 mg/L. Based on the 2018, 2017 and 2016 data, the average TN concentration for those same stations was 0.419 mg/L, 0.447 mg/L and 0.523 mg/L respectively, slightly lower than the threshold in 2018 and 2017 and slightly above the 0.50 mg/L MEP threshold in 2016 but lower than it was historically. The lowering of TN is consistent with observations of water clarity, eelgrass coverage and shellfish production in this Great Pond. Given the inter-annual variability, monitoring should continue to confirm that levels are consistently remaining below the MEP threshold. If TN levels in 2019 and 2020 remain below the MEP threshold, that is a good indication that the opening schedule and the improved WWTP effluent are resulting in a stable TN concentration and that the improved management is having a sustained positive ecological response. It may also be worthwhile to compare the duration of the openings in both 2018, 2017 and 2016 as that may indicate another reason for the lower levels in 2018 and 2017 and underscore the importance of maintaining effective pond openings. The addition of the 2018 monitoring results indicates that if sustained, Edgartown Great Pond may have achieved compliance with the USEPA/MassDEP TMDL issued under the Clean Water Act. Confirmation will need reassessment of eelgrass and infauna habitats in 2020/2021.

Chilmark Pond: The 2018 Chilmark Pond TN levels were generally lower than in 2017 and 2016, which were higher than the values determined by the MVC as part of establishing the water quality baseline for the Massachusetts Estuaries Project. The MEP baseline was based on data from 2004 (Figure 19, Table 4). TN levels were variable in the 2016-2018 interval, due to variable openings, with 2018 being lowest and 2016 levels at all the stations higher than the nitrogen threshold developed by the MEP. The 2018 TN concentrations ranged from 0.430 mg/L - 0.560 mg/L. 2017 TN concentrations ranged from 0.533 mg/L - 0.642 mg/L. The 2016 TN concentrations ranged from 0.797 mg/L - 1.096 mg/L, higher than the 0.704-0.808 mg/L range found in the historic data. Both the 2016 and 2017 data sets are significantly higher than the MEP TN threshold of 0.50 mg/L as an average of stations CHP-1,2,4,5, needed for restoration of pond habitats, however, the 2018 TN levels appear to have been below the MEP TN threshold. This can be seen more clearly in the average TN concentration for those same stations historically (0.744 mg/L, 2004), in 2016 (0.877 mg/L), in 2017 (0.588 mg/L) and in 2018 (0.470 mg/L). The high levels of TN in Chilmark Pond above the MEP threshold in 2016 and 2017 are consistent with the elevated levels of total pigment observed during the summer 2016 and 2017 water quality monitoring. The linkage between TN and phytoplankton is further supported by the lower total pigment levels in 2017, particularly at station CHP-UP (2016, 2017) being associated with lower TN levels. Interestingly, TN levels in 2018 at freshwater station CHP-UP were significantly higher than in 2017 (0.770 mg/L vs. 0.556 mg/L respectively) with a commensurate increase in total pigments (2018: 60.98 ug/L, 2017: 14.47 ug/L) . While it is not possible to definitively confirm a trend with only the 2016, 2017 and 2018 data, TN levels do appear to be have declined in Chilmark Pond, possibly due to improved openings two years in a row. Chilmark Pond nutrient water quality appears to depend heavily on the frequency and duration of periodic openings, as seen in the last 3 years of monitoring. As with other closed salt ponds on Martha's Vineyard, it would be useful to compare the difference in the timing and duration of openings undertaken in each year 2016, 2017 and 2018 to ascertain the degree to which that may be driving the lower TN levels observed in 2018.

Lake Tashmoo: As in 2017, the 2018 Lake Tashmoo TN data generally compares well (albeit generally slightly lower) with historical data and the 2017 and 2016 data from the same sampling stations sampled by the MVC as part of the Island-wide Water Quality Monitoring Program (Figure 20, Table 5). As in 2016 and 2017, not all of the historical sites were sampled in 2018, specifically MV-1 and MV-5. In general, TN levels in 2018, 2017 and 2016 at all the stations sampled were nearly the same (+/-) than the station averages from 2001 to 2007. The TN concentrations in 2018 ranged from 0.270 mg/L - 0.480 mg/L. The TN concentrations in 2017 ranged from 0.258 mg/L - 0.362 mg/L. In 2016 the TN concentrations ranged from 0.273 mg/L - 0.355 mg/L whereas the historical TN data at the same stations ranged from 0.314 mg/L - 0.360 mg/L. The lowest TN concentration observed in 2018 (0.270 mg/L) was at MV-2 which had a very similar TN level to the nearby station MV-21 (0.280 mg/L). TN levels in 2017 (0.258 mg/L) and 2016 (0.273 mg/L) at station MV-21 closest to the inlet of the system were nearly identical to the 2018 data, all of which were slightly lower than the historical average at that station (0.314 mg/L) as determined by the MEP. It is not possible based on three year to definitively determine if this represents a “real” change, but it is clear that there has not been a substantive shift in the habitat health of the basin (0.280, 0.258, 0.273 and 0.314 mg/L all indicate high quality waters at MV-21). The MEP TN threshold was set at 0.36 mg/L at a sentinel station (MV- SEN) to be located between MV-4 and MV-5. As this is a new station sampled for the first time in 2016 there is no historical data at this location. Based on the 2018, 2017 and 2016 data, the average TN concentration for the MEP established sentinel location is 0.340 mg/L, 0.362 mg/L and 0.482 mg/L respectively, 2018 level being only slightly lower and 2017 level only slightly above the 0.360 mg/L MEP threshold. It is clear that Lake Tashmoo is only slightly over its N threshold, which suggests that only small N reductions may be needed and that monitoring needs to focus on small changes in this system in coming years. The TN concentrations observed at MV-SEN in 2018, 2017 and 2016 are consistent with the higher total pigment concentrations measured at that location compared to lower levels at stations closer to the inlet. The stations that had lower TN concentrations also had commensurately lower total pigment levels. Interestingly, while TN levels across all stations were generally similar over 2016-2018, total pigment levels were slightly higher in 2018, possibly due to meteorological differences from one summer to the next.

Lagoon Pond: The 2018, 2017 and 2016 Lagoon Pond TN data generally compares well with historical data from the same sampling stations (Figure 21, Table 6), however, the 2018 and 2017 observations do appear lower than both the 2016 TN levels as well as the average of the historical data (2002-2007). Not all of the historical sites were sampled in 2018, 2017 (LGP-6,10 excluded) or 2016, specifically LGP-10. In general, TN levels in 2018 were all slightly lower than in 2017 and in 2016 at all the stations sampled and TN levels in 2016 were nearly the same (+/-) as station averages from 2002 to 2007. In 2016, TN concentrations at 3 out of 5 stations sampled (LGP-2,4,8) were slightly higher than the historical averages and slightly lower at 2 of 5 stations (LGP-6,9). The 2018 TN data ranged from 0.260 mg/L - 0.320 mg/L, the 2017 TN data ranged from 0.295 mg/L - 0.360 mg/L whereas the 2016 TN concentrations ranged from 0.317 mg/L - 0.460 mg/L and the historical TN data at the same stations ranged from 0.333 mg/L - 0.418 mg/L. As in previous years, the lowest TN concentration observed in 2018 (0.260 mg/L), 2017 (0.295 mg/L) and 2016 (0.317 mg/L) was at station LGP-9 closest to the inlet of the system and was slightly lower than the historical average at that station (0.333 mg/L) as determined by the MEP.

The MEP TN threshold was set at 0.35 mg/L at the sentinel station (LGP-2). Based on the 2018, 2017 and 2016 data, the average TN concentration for the MEP established sentinel location was 0.320 mg/L, 0.346 mg/L and 0.432 mg/L respectively, above the 0.35 mg/L MEP threshold in 2016 but the same as the threshold in 2017 and slightly below the threshold in 2018. The MEP determined historical average for station LGP-2 was 0.360 mg/L indicating that TN concentrations maybe trending downward but still need to be carefully monitored and managed in this system. The 2018 and 2017 TN levels are very close to the historical long term average and the MEP threshold value. As such inter-annual variability may result in TN levels being above/below the threshold and the historical average in a given year, but the recent 3 year average is not statistically different from the long-term average. It would take sustained 2018 TN levels to meet this goal.

Even though TN levels were slightly lower in 2018 and 2017 compared to 2016, Total pigment levels in 2018 where higher than in 2017 and in 2017 were nearly the same as in 2016. Unlike in 2016 and 2017, in the lower tidal reaches (LGP-8,9) total pigment was generally high (11.6 ug/L and 10.5 ug/L respectively) and high levels were also observed at more up-gradient stations with the highest observed total pigment levels at LGP-11 (2018: 25.2 ug/L, 2017: 13.6 ug/L, 2016: 15.6 ug/L), well over 10 ug/L which is a typical threshold for sign of impairment. LGP-12 was not sampled in 2018 and 2017. In 2018, Total Pigment levels seem more uniformly elevated compared to 2017 and 2016 supporting the contention of a “region-wide” bloom event occurring over an extended period of time in the summer of 2018. These elevated pigment levels were also observed in other systems across the Island indicating that meteorological conditions may have been well suited to higher primary production. Uppermost stations continue to show the effects of nitrogen enrichment.

Oak Bluffs Harbor: Oak Bluffs Harbor TN levels were slightly lower in 2018 than in 2016 and 2017 and 2018 compared well with the historical data from the same sampling stations sampled by the MVC as part of the baseline MEP monitoring effort (Figure 22, Table 7). Not all of the historical sampling sites were sampled in 2016, 2017 or 2018, specifically MV-17. The slightly higher TN levels at all stations in 2017 and at 2 of 3 stations (MV-14,15) in 2016 compared to MEP historical data but did not continue into 2018. In 2018, TN levels reflected the historical TN levels, underscoring the need for multiple years of data for determining change. The 2018 TN concentrations ranged from 0.290 mg/L - 0.390 mg/L and the historical TN data (at the same stations) ranged from 0.325 mg/L - 0.392 mg/L similar but lower than the TN levels in 2017 which ranged from 0.342 mg/L - 0.431 mg/L and in 2016 which ranged from 0.306 mg/L - 0.463 mg/L. The lowest TN concentration observed in 2018 (0.290 mg/L), 2017 (0.342 mg/L) and 2016 (0.306 mg/L) was at station MV-16 closest to the tidal inlet, slightly higher in 2017 but not significantly different from the historical average at that station. These data suggest that the level of variability in the data will require several years (3-5) monitoring to detect these small differences.

The MEP TN threshold was set at <0.45 mg/L at the sentinel station (MV-14, outflow from Sunset Lake). Based on the 2018 data, the summer time average TN level at MV-14 was 0.390 mg/L (2017: 0.431 mg/L), with 2016 data showing an average TN concentration of 0.463 mg/L, slightly greater than the MEP threshold established for the sentinel location. Recent TN concentrations are fluctuating around the historical levels and around the threshold level. Given how close current TN levels are compared to the MEP threshold concentration, more intense sampling may be desired to support a robust trend analysis to determine if the system remains over the regulatory threshold or is declining. As of 2018, it is not clear if the 2016-2018 decrease, is “real”, or there has been a change in tidal flushing through the tidal channel between Sunset Lake and the Harbor, which would explain the change.

Farm Pond: The 2018, 2017 and 2016 Farm Pond TN data shows limited year-to-year variability and also compares well with historical data from the same sampling stations sampled by the MVC as part of the MEP baseline (Figure 23, Table 8). All of the same stations were sampled in each dataset. In general, TN levels in 2018 at all stations were slightly lower than 2016 levels and historical levels (2002-2008) with intermediate TN levels in 2017. The pond does not appear to be well horizontally mixed throughout, as station FRM-3 has higher TN and total pigment levels compared to the other stations in each year. In 2017, TN concentrations were slightly lower than the historical average at 2 out of 3 stations sampled (FRM-1,2) and slightly higher at 1 station (FRM-3, MEP sentinel station). The 2018 TN concentrations ranged from 0.390 mg/L - 0.450 mg/L. The 2017 TN concentrations ranged from 0.430 mg/L - 0.610 mg/L and in 2016 TN concentrations ranged from 0.427 mg/L - 0.544 mg/L whereas the historical TN data at the same stations was generally higher at stations FRM-1 and 2, ranging from 0.505 mg/L - 0.530 mg/L. The lowest TN concentration observed in 2018 (0.390 mg/L) was at station FRM-1 close to but not nearest to the occluded inlet which has not yet been improved despite years of consideration. In 2017, the lowest level (0.430 mg/L) was at station FRM-2 (nearest to inlet) whereas in 2016 (0.427 mg/L) it was at station FRM-1 located at the end of the pond and also close to the inlet of the system. These levels were slightly lower than the historical average at station FRM-1 (0.516 mg/L) and FRM-2 (0.505 mg/L) as determined by the MEP.

The MEP TN threshold for Farm Pond was set at 0.45 mg/L at the sentinel station (FRM- 3). Based on the 2018, 2017 and 2016 data, the TN level remains above the threshold ranging from 0.452-0.610 (it takes multiple years below threshold to be in regulatory compliance). It does not appear that recent TN levels have declined from historical levels at station FRM-3 (0.530 mg/L). As such, it appears that nitrogen management through enhanced tidal flushing remains to be fully implemented. The higher TN concentration observed at FRM-3 in 2017 is consistent with the slightly higher total pigment concentrations measured across the pond in 2017, however, the pigment levels in 2018 which were slightly higher or the same as in 2017 is not consistent with the uniformly lower TN levels observed in 2018. It should be noted that as in 2017 and 2016, total pigment in 2018 was generally low. However, in 2018 and 2017 at FRM-3, T-pigment levels reached/approached the 10 ug/L threshold indicative of impaired water quality. At present there is no clear temporal trend in nutrient related water quality in Farm Pond.

Sengekontacket Pond: As in 2016 and 2017, the 2018 Sengekontacket Pond TN data generally compares well with historical data from the same sampling stations sampled by the MVC as part of developing the MEP water quality baseline (Figure 24, Table 9). Most of the historical sites were sampled in 2018, 2017 and 2016 with the exception of SKT-1 and SKT-7. In general, TN levels in 2018 were generally lower than in 2016, with 2017 having the poorest nutrient related water quality of the past 3 years. TN levels in 2018 were slightly lower than 2016 and 2017 except at the central basin stations and overall the average of the 2016-2018 results are nearly identical to the MEP baseline, except for the outflow from Trapps Pond and lower Majors Cove which were higher.

However, there was also year to year variation with 2016 TN levels at all stations generally higher than station averages from 2003 to 2009. In 2016, TN concentrations were higher than the historical average at 6 out of 7 stations (SKT-2,3,4,5,8,9), while in 2017 5 of 7 stations (exceptions SKT-4 and SKT-9) were the same as 2016. In 2018 TN levels across 2 stations were significantly lower than the historical average. The 2018 TN concentrations ranged from 0.270 mg/L - 0.430 mg/L. The 2017 TN concentrations ranged from 0.256 mg/L - 0.518 mg/L whereas in 2016 TN concentrations ranged from 0.427 mg/L - 0.544 mg/L and the historical TN data at the same stations ranged from 0.299 mg/L - 0.545 mg/L. The lowest TN concentration observed in 2018, 2017 and 2016 was at station SKT-6 located closest to the inlet of the system and was lower or the same as the historical average at that station (0.270 mg/L, 0.256 mg/L and 0.299 mg/L respectively vs. 0.302 mg/L) as determined by the MEP. The highest TN levels were associated with Trapps Pond and Majors Cove.

The MEP TN threshold was set at 0.35 mg/L at the sentinel stations (SKT-4 and SKT-9) to restore eelgrass coverage. Based on the 2018, 2017 and 2016 data, the average TN concentration at the MEP established sentinel locations was 0.434 mg/L and 0.489 mg/L, respectively. However, in 2018 TN levels were close to threshold at SKT-4 for the first time, but well above threshold at SKT-9. The MEP determined historical average TN concentrations for stations SKT- 4 and SKT-9 were 0.406 mg/L and 0.445 mg/L respectively. Given the annual variability and measured TN levels it is clear that this estuary remains above its nitrogen threshold and continues to support impaired tributary basins, although the main lagoon basin has higher water quality given its flushing and proximity to the tidal inlets.

The higher TN concentration observed at SKT-4 in 2016, 2017 and 2018 is consistent with the slightly higher total pigment concentrations measured at SKT-4 and SKT-3 (both associated with Majors Cove), however, it should be noted that total pigment was generally low and consistent with the moderate TN concentrations measured in 2016. In 2017, total pigment levels were significantly higher, potentially due to higher TN levels in 2017 and meteorological conditions, and exceeded the standard 10 ug/L threshold indicating continuing impairment. In 2018, total pigment levels followed the same distribution among all the stations as was observed in 2017, however, levels were generally lower than in 2017, in line with the lower TN levels observed in 2018 across 6 out of 7 stations compared to 2017. As such it is critical to continue monitoring nutrient related water quality in this estuary. The apparent increasing TN levels in Trapps Pond with high total pigment levels underscores the need to assess the tidal inlet to Trapps Pond relative to increasing the presently restricted tidal flushing.

Tisbury Great Pond: In both 2017 and 2018 Tisbury Great Pond data collected by the MVC Island-wide Water Quality Monitoring Program showed higher TN levels than the historical averages from the same sampling stations used by the MEP (Figure 25, Table 10). However, the 2018 TN levels were lower than observed in 2017. Not all of the historical sites were sampled in 2018 or 2017, specifically TGP-2,3,and 9. Tisbury Great Pond was not sampled in 2016 so comparisons can only be made to the historical averages established by the MEP (1995-2007 and 2011). The 2018 TN concentrations ranged from 0.540 mg/L - 0.760 mg/L, while in 2017 TN ranged from 0.706 mg/L - 0.950 mg/L, higher than the historical TN at the same stations which ranged from 0.422 mg/L - 0.785 mg/L. The lowest TN concentrations observed in 2018 (0.540 mg/L and 0.590 mg/L) were at station TGP-5 located within Tiah Cove and TGP-7 closest to the periodically opened inlet of the system. The lowest TN concentrations observed in 2017 was also at TGP-7 (0.712 mg/L), with a similar level (0.706 mg/L) at station TGP-4 located just south of the confluence between Town Cove and Pear Tree Cove, but were ~0.1 mg/L higher than in 2018. It is not possible based on two years to determine if this represents a “real” change in the system or more likely reflects interannual differences in opening success. However, it does indicate that high TN levels can periodically occur in the Pond (very likely due to the duration of the periodic opening to the Atlantic Ocean).

The MEP TN threshold was set at 0.46 mg/L at a "sentinel" station represented by the average of TGP-4,5,6 and 0.48 mg/L at a secondary station TGP-7. Based on the 2018 data [2017 data], the average TN concentration for the MEP established "sentinel" location (average of TGP-4,5,6) is 0.587 mg/L [0.752 mg/L], well above the 0.46 mg/L MEP threshold. Average 2018 [2017] TN concentrations at station TGP-7 was 0.590 mg/L [0.712 mg/L], also above the 0.48 mg/L threshold at this secondary sentinel station. All of these results are consistent and clearly indicate the need for a combination of nitrogen management and more effective openings for habitat restoration.

The high TN concentrations observed at all stations supported the high total pigment concentrations measured at each monitoring location. As might be expected the lower TN levels in 2018 compared to 2017 were associated with lower average total pigment levels as well. The role of nitrogen in stimulating phytoplankton biomass is also seen each year in the observation from stations that had lower TN concentrations (TGP-4,5,7) also having commensurately lower total pigment levels. Given the high variability in TN and phytoplankton levels between 2017 and 2018, it appears that opening frequency and duration likely is a major driver (after watershed N inputs) in determining the nutrient related water quality of Tisbury Great Pond.

Menemsha Pond and Squibnocket Pond: The 2018 and 2017 Menemsha Pond and Squibnocket Pond TN data from the MVC Island-wide Water Quality Monitoring Program is directly comparable to the historical data set from the same stations used in the MEP (Figure 26, Table 11). Not all of the historical sites were sampled in 2018 or 2017, specifically MEN-1,4,7,8,9,10 and SQB-2,4. Unfortunately, Menemsha / Squibnocket Ponds were not sampled in 2016 so only the 2018 and 2017 data can be compared to the historical averages established by the MEP (2000 - 2012). Nonetheless, while the 2017 TN concentrations and distribution in the main basin of Menemsha Pond were not significantly different from the historical data (2017 = 0.288-0.434 mg TN/L; historic = 0.287-0.399 mg TN/L), 2018 levels (0.23-0.32 mg/L) at all stations appeared slightly lower than both 2017 and historical levels. Squibnocket Pond also showed little change from 2017 and historic TN levels (2018 = 0.65 mg/L, 2017 = 0.754-0.783 mg TN/L; historic = 0.763-0.769 mg TN/L).

In the tributary basin of Nashaquitsa Pond to Menemsha Pond the 2018 TN levels were significantly lower (MEN-5 = 0.27 mg/L and MEN-6=0.28 mg/L) than in 2017 (0.405

mg/L) and more similar to the historic baseline (0.341 mg/L). It should be noted that the MEP had identified this tributary basin as having declining water quality. It may be that the variation in TN in 2017 and 2018 from historic levels related to the dredging of the main channel into Menemsha Pond, which was completed after the 2017 field season in Fall 2017. While a quantitative analysis of the flushing of Menemsha Pond with low nutrient water from Vineyard Sound is not yet available, increased flushing with low nutrient water from Vineyard Sound would serve to lower TN levels across all the stations in Menemsha Pond inclusive of the stations in Nashaquitsa Pond. As in [2017], the lowest TN concentrations observed in 2018 (0.23 mg/L and 0.23 mg/L, [0.288 mg/L and 0.301 mg/L]) were at station MEN-2 located just inside the inlet to Menemsha Harbor and MEN-3 located just inside the main basin of Menemsha Pond where Menemsha Channel enters the main basin funneling low nutrient water from Vineyard Sound into the overall system. TN levels in 2018 at both of these stations were ~0.08 - 0.15 mg/L lower than the long term historical average at the same stations (0.341 mg/L and 0.385 mg/L respectively) as determined by the MEP. However, this difference is at the limit of detection and is only based on 2 years of MVC monitoring so additional data will be needed to determine if it is a new condition (e.g. increased tidal exchange possibly) or merely natural inter-annual variation. A review of the dredging results on tidal exchange should be undertaken to both guide future efforts in Menemsha and other coastal ponds on Martha's Vineyard.

In Menemsha Pond, the MEP TN threshold was set at 0.35 mg/L for eelgrass restoration at an integrated sentinel station (average of MEN-4,5,8,9,10) and in Squibnocket Pond the threshold was set at 0.50 mg/L for restoration of benthic animal habitat (average of SQB-1,2,3,4). A direct comparison of the 2018 and 2017 data to the MEP threshold for Menemsha Pond and Squibnocket Pond is not possible because specific stations that comprise the averages were not all sampled. Sampling of all stations included in the TMDL threshold in Menemsha Pond for eelgrass should be considered for 2019 as resources allow. This would allow a determination relative to the TMDL after the completion of the channel dredging in Fall 2017 and the lower TN levels observed in 2018. It does appear that sampling of only 2 stations in Squibnocket Pond instead of the 4 sentinel stations (SQB 1-4) is appropriate, as TN levels remain well above the TMDL threshold. As found throughout the MVC Island-Wide Monitoring effort, phytoplankton levels in many estuaries tend to vary directly with TN levels. In the Menemsha-Squibnocket Estuary total pigment levels were slightly higher in 2018 compared to 2017 levels despite slightly lower TN values, however, in both years the higher TN levels in Squibnocket Pond were associated with higher total chlorophyll-*a* pigments when compared to Menemsha Pond basins. TN levels in Menemsha Pond supported the low total pigment observations (4.54 ug/l - 9.72 ug/L, [2017: 3.76 ug/L - 5.45 ug/L]) and in Squibnocket Pond, the higher TN levels are in line with the higher observed total pigment levels (9.73 ug/L - 10.73 ug/L, [2017: 8.23 ug/L - 9.28 ug/L]). The elevated TN and total pigment levels in Squibnocket Pond are clear indication of the need for a combination of nitrogen management and more effective flushing through the culvert connecting Squibnocket Pond to Menemsha Pond (or through other means). Total pigment levels or chlorophyll-*a* levels that exceed the standard 10 ug/L threshold generally indicates impairment of water quality.

Based upon the large dredging project in Menemsha Channel and the improvement in nutrient related water quality in 2018, continued monitoring of nutrient related water quality in this estuary is important in order to determine if the TMDL threshold compliance for Menemsha Pond has been reached and if not, how much less nitrogen management may now be needed to achieve the threshold compared to the prior MEP assessment.

James Pond: As of this date, MEP assessment, modeling and nutrient threshold analysis to sustain or restore key estuarine habitats within James Pond has not been conducted. As such, there is limited information available as a point of comparison for the water quality monitoring data collected during the summer 2018 and 2017 field season. As historical monitoring data becomes available, those data can be integrated into future water quality summary reports generated annually as part of the Island-wide Water Quality Monitoring Program.

The 2018 and 2017 samplings represent the available comprehensive nutrient related water quality monitoring results for James Pond. Although data from only 2 years is available at this time, the results clearly show impaired water quality in this salt pond. In 2018 and [2017] James Pond supported very high TN levels, 0.63-0.78 mg/L and [0.556 mg/L - 0.729 mg/L], were levels typically associated with nitrogen impairment to eelgrass and infauna habitats in other Martha's Vineyard estuaries. This determination is supported by observed low bottom water oxygen levels of 4.1 – 4.3 mg/L and high phytoplankton biomass measured in 2018 and [2017] as total chlorophyll-*a* pigment averaging from 13.4 ug/L and [7.37 ug/L] near the inlet and 19.3 ug/L and [10.55 ug/L] in the main basin. Average total pigment levels or chlorophyll-*a* levels that exceed the standard 10 ug/L threshold generally indicates impairment of water quality. Given the limited available data and the apparent nitrogen related impairment of James Pond it is important to continue monitoring nutrient related water quality in this estuary to verify these initial results and to build a sufficient baseline should higher level analysis, such as conducted by the MEP, be needed/requested. Such a full assessment would be needed to determine the specific nitrogen threshold needed to restore this salt pond, and whether lowering nitrogen inputs or increasing tidal flush (and by how much) is feasible for restoration.

Trophic State of the Estuaries of Martha's Vineyard (2018)

The Trophic State of an estuary is a quantitative indicator of its nutrient related ecological health and is based on concentrations of Nitrogen (DIN, TON), Secchi Depth, lowest measured concentrations of Dissolved Oxygen (average of lowest 20% of measurements), and Chlorophyll-*a* pigments (surrogate for phytoplankton biomass). Trophic health scales generally range from Oligotrophic (healthy-low nutrient) to Mesotrophic (showing signs of deterioration of health due to nutrient enrichment) to Eutrophic (unhealthy, deteriorated condition, high nutrient, large phytoplankton blooms, oxygen depletion). The Trophic Health Index Score used here is a basic numerical scale based on criteria for open water embayments which integrates the above measured parameters into a single Index value for comparison to a habitat quality scale (Howes et al. 1999, http://www.savebuzzardsbay.org). For the estuaries of Martha's Vineyard, a trophic index score was calculated for each sampling location for each sampling year, (2018, Table 12a; 2017, Table 12b; 2016, Table 13). It is important to understand that the Index is useful as a guide and provides a simple way to integrate the multiple parameters related to nutrient related habitat health, but the scale has relatively broad rankings and the index it is not comprehensive. For example in estuaries, such as those on Martha's Vineyard, there are only periodic depletions of bottom water dissolved oxygen, generally related to nutrient enrichment coupled with periodic watercolumn stratification (i.e. lack of vertical mixing). While these short-term depletions have important ecological consequences, they are difficult to capture in programs that sample 4 or 5 dates per summer. It should be noted that the issue primarily relates to the key habitat metric of dissolved oxygen, as the other water quality parameters do not change as rapidly as dissolved oxygen, which can vary 10 mg/L in a single day. As a result, the MVC monitoring program should be accurately capturing estuarine nutrient and phytoplankton levels. There is always some uncertainty in the Index until several years of data are available. However, in the almost 100 estuaries where this Index has been used, it has been found to be generally useful for determining general nutrient related health and has been very useful in prioritizing systems or specific basins for more detailed analysis (e.g. continuous DO recorders, benthic animal surveys, etc).

It should be noted that as more oxygen data from the monitoring program becomes available, the Index becomes more robust, as has been found in MEP analyses of Cape Cod estuaries. That said, it is presently possible, to conduct a preliminary assessment of the nutrient related health of the basins within each of the 14 estuarine systems included in the Martha's Vineyard Island-wide Water Quality Monitoring Program based on the 2-3 years of monitoring (2016-2018) completed to date.

The Health Status of each estuarine basin was based on the Health Index Score, which is determined from the numeric data collected during the sampling events (Tables 1c and 2a). The ranges of Index scores that fall within a particular Health Status determination are given at the bottom of Table 12a. Figures 27-38 show the distribution of Health Status throughout each estuary based on the 2016-2018 monitoring program results. The colors of each triangle in the figures represent the Bay Health Index status of the associated basin in the noted monitoring summer (upper triangle is based on 2016, middle triangle on 2017, and lower triangle on 2018) and follow the designation scheme below:

Color	Health Status
Blue	High Quality
Blue/Yellow	High-Moderate
Yellow	Moderate
Yellow/Red	Moderate/Fair
Red	Fair/Poor

Edgartown Great Pond: During summers of 2016, 2017 and 2018 Edgartown Great Pond supported relatively high water quality (High/Moderate) throughout all of its basins, with slightly lower (Moderate) water quality seen at 3 upper basin stations in 1 year or 11% of assessments (Figure 25). At present there appears to be random variation between years, with 5 stations in 2018 showing high quality waters and only 2 showing moderate quality. Most of the high water quality was found in the more open water portions of the estuary with moderate water quality in 2 of the main upper tributary basins. In general, the water quality in Edgartown Great Pond is currently suggesting only a moderate to low level of potential habitat impairment and the Pond is maintaining some high quality estuarine habitat.

Throughout this salt pond, the Index was lowered primarily by chlorophyll (phytoplankton) and organic nitrogen levels and to some extent the degree of oxygen depletion. All of these indicators are consistent with nitrogen inputs resulting in phytoplankton growth and decay. The relative uniformity of the status indicators across the pond is frequently seen in large salt ponds which only have periodic connection to offshore waters (e.g. no regular tidal exchange). In these settings the salt pond operates hydrodynamically like fresh ponds with mixing and circulation mainly through wind driven water movements rather than tidal currents. The result is that water quality indicators become relatively uniform throughout the basin except if there are narrow enclosed tributary basins where groundwater and surface water carrying watershed derived nutrients enter the system. This contrasts with tidal estuaries where watershed inputs are typically entering mainly in the inland most reaches with twice a day entry of high quality marine waters through the tidal inlet. This structure sets up water quality gradients within the estuary, typically with poor water quality in the inner tidal reaches grading to high water quality near the tidal inlet.

At present, it appears from the Health Index results that the periodic tidal breaching of the barrier beach to create periodic tidal exchange is sustaining high-moderate water quality throughout Edgartown Great Pond. It is likely that this also is the result of the decline in the historic nitrogen load from the now decommissioned WWTF. The current level of water quality is improved over that observed during the MEP assessment which was at TN levels >0.1 mg TN/L higher. If monitoring over the next few years continues to find these results, it may be appropriate to conduct a more detailed habitat evaluation relative to the Clean Water Act TMDL.

Chilmark Pond: The MVC Island-Wide Water Quality Monitoring Program supported a status assessment of Chilmark Pond based on the three years of monitoring, 2016 – 2018. Chilmark Pond does not have a fixed tidal inlet to support regular tidal exchange.

Instead, it is periodically breached and remains open for variable periods of time. Openings prior to the 2018 field season was relatively prolonged. The integrated Health Index indicates that nutrient related water quality throughout the upper and western portions of Chilmark Pond is impaired based on its moderate to poor summertime water quality (Figure 26). Key parameters (water clarity, organic nitrogen levels and phytoplankton biomass) are all consistent with a nutrient enriched basin, with poor clarity and high organic nitrogen due to high phytoplankton biomass. However, in summer 2018 the main basin (CHP-2,4,5), closest to the area of opening, showed significantly improved nutrient related water quality, achieving a high quality rating. The 2018 samplings showed that in the main basin nitrogen and phytoplankton levels were significantly lower than in 2016 and 2017. It is likely that the variation in TN levels relates to the success of the pond openings in 2016 and 2017 compared to 2018, however, this hypothesis needs further investigation as the salinity levels were lower in 2018 (not higher as might be expected). An analysis of the opening of Chilmark Pond is warranted as the 2018 monitoring of the main basin indicated high quality waters and TN levels <0.5 mg/L, supportive of unimpaired infauna animal habitat, a key metric in the TMDL for this system. It now appears that periodic tidal flushing is able, in some circumstances, to support high to moderately impaired water quality in Chilmark Pond, however, given the apparent variability in opening “success” it appears that nitrogen management remains part of the restoration strategy for this salt pond. However, since 2018 supported the highest water quality on record, it is likely that continued efforts to improve the quality of the openings can result in a refined and focused opening protocol and lessen the need for watershed nitrogen management if successful.

Lake Tashmoo: Lake Tashmoo is a classic simple estuary with a single tidal inlet, a linear basin to inland headwaters. As such it has highest quality waters near the tidal inlet with a slight decline in quality towards the head water station (MVSEN, Figure 27). Lake Tashmoo was found to be moderately impaired by nitrogen in the MEP analysis, based mainly on declines in eelgrass coverage and benthic animal communities, with some periodic DO depletions. The present analysis of water quality parameters is consistent with the MEP water quality assessment, with the slightly lower water quality in 2016-2018 at the upper station being due to phytoplankton and nitrogen levels with some oxygen depletion. However, throughout most of its estuarine reach, there is generally high water clarity, low total nitrogen and low phytoplankton biomass compared to other estuaries (e.g. tributary to Cape Cod Bay and Buzzards Bay). The high quality waters in Lake Tashmoo is supporting the infaunal habitat and eelgrass beds that remain in the system. Eelgrass is typically associated with the highest quality waters and estuarine habitat, but as the coverage is declining and showing signs of stress (e.g. significant epiphytic growth), it appears that nitrogen is just above its threshold level, as was confirmed in the 2016 - 2018 TN measurements, particularly at the upper sentinel station (MV-SEN).

TN levels in the upper basin were approaching the system’s TN threshold, although still exceeded it. Multiple years of high water quality need to be observed before it is clear if the system has restored its water quality and at present the slightly higher than threshold values fall in the range of natural variation for this system. However, Heath Status of the basins of Lake Tashmoo will be tracked closely as the MVC Water Quality Monitoring Program continues. It should be noted that given the only moderate nitrogen impairment seen in Lake Tashmoo, only modest nitrogen management is needed for restoration and it is important to maintain healthy exchange of water via the tidal inlet.

Lagoon Pond: Lagoon Pond, like Lake Tashmoo, is a classic simple estuary with a single tidal inlet, a relatively linear basin to inland headwaters. Lagoon Pond has a single headwater "stream" and pond with a direct discharge to the uppermost estuarine reach. As such its highest quality waters are near the tidal inlet, with a gradual decline in water quality from the high quality waters in the lower basins to the moderate water quality at the head water station (LGP-6 Figure 30). In contrast, the innermost shallow region of South End Basin is highly nitrogen enriched (LGP-11 and LGP-12) with low oxygen and phytoplankton blooms, in a restricted area with limited flushing. The deeper waters in the upper pond, nitrogen loading and flushing differences result in the entire upper pond showing slight nutrient related impairment (i.e. High-Moderate water quality) mainly seen as oxygen depletion in the deep basins. Similarly, Lagoon Pond was found to be impaired by nitrogen in the MEP analysis, based mainly on declines in eelgrass coverage and benthic animal communities, with some periodic DO depletions. The present analysis of water quality parameters is consistent with the MEP water quality assessment. Except for the innermost region of South End Basin which has poor water quality with high nitrogen, low oxygen and high chlorophyll-*a* levels, the basins comprising the main stem of Lagoon Pond currently support high (lower basins) to moderately impaired water quality (upper basins), consistent with its remaining eelgrass areas and benthic animal communities. The water quality impairment of the upper basins is primarily due to modest nitrogen enrichment and periodic oxygen declines in deeper waters, but generally good water clarity and low phytoplankton biomass exists in the system compared to other estuaries (e.g. Cape Cod and Buzzards Bay). These latter parameters are supporting the eelgrass beds that remain in the system. Eelgrass is typically associated with the highest quality waters and estuarine habitat, but as the coverage is declining, it appears that nitrogen levels remain above the threshold level for high quality estuarine habitat (2016-2018). As such, only a modest amount of nitrogen management is needed for restoration of the main basins. The South End Basin appears to be impaired, in part, by its circulation and sub-watershed nitrogen loading as it does not appear to be well integrated with the water quality in the main basins. The observed inter-annual variation at stations LGP-2,4,6 underscores the need for multi-year monitoring to assess "real" changes in water and habitat quality (e.g. is there a real trend toward declining quality from 2016-2018?).

Oak Bluffs Harbor: Oak Bluffs Harbor is a heavily altered coastal salt pond that has an engineered tidal inlet that supports twice daily tidal exchange with the high quality waters of Vineyard Sound. The system consists of a main basin with a smaller basin (Sunset Lake) connected through a culvert. Given its small size and tidal exchange the main basin supports relatively high water quality, while the enclosed tributary basin of Sunset Lake and possibly the western station (marina area) is showing some nutrient related impairment (Figure 31). The Sunset Lake moderate water quality (impairment) results from its elevated nitrogen levels, reduced water clarity and periodic oxygen depletion. Oak Bluffs Harbor was also found to be impaired by nitrogen in the MEP analysis, based mainly on declines in eelgrass coverage and benthic animal communities, with some periodic DO depletions. The present analysis (2016-2018) of water quality parameters is consistent with the MEP water quality assessment. Sunset Lake is likely being impacted both by its local sub-watershed and it hydrodynamics, but a specific analysis needs to confirm if altering the tidal flows would be sufficient for its restoration. However, the moderate impairment appearing in the main basin is likely related to its function as a harbor and its structure. The main basin is currently supporting high water quality with some benthic animal impairment possibly due mainly to its structure (depositional basin) and use. In comparing water quality during the MEP (2001-2007) to the present monitoring results (2016-2018), it appears that TN levels may have increased and that overall water quality is slightly lower at present than observed historically (2001-2017). An analysis of changes in N loading and tidal flushing should be considered if the present TN, chlorophyll-*a* and oxygen depletion levels continue. In any case, Oak Bluffs Harbor and Sunset Lake continue to support generally moderately impaired water quality, due in part from the depositional nature of the main basin.

Farm Pond: Farm Pond is a heavily altered coastal salt pond with a tidal inlet (culvert) that is currently restricted and has not been improved to enhance flushing of the system (as recommended based on the MEP threshold analysis, 2010). Coastal processes have damaged the culvert and it has been targeted for a new inlet for about a decade. The MEP determined that properly restoring tidal exchange with a new culvert/channel structure would be sufficient to restore Farm Pond water and habitat quality, without additional actions. The 2016 – 2018 water quality results are similar to that assessed by the MEP. Due to the reduced tidal exchange, Farm Pond water quality parameters (Figure 32) are relatively uniformly distributed, with no high quality waters and generally moderate quality waters within the main basin. The lack of strong horizontal gradients results from the low level of flushing with mixing mainly from wind (i.e. it is operating like Chilmark Pond or Edgartown Great Pond). The present moderate impairment is due to the system's sensitivity to nitrogen inputs because of the restricted tidal flows. Under these conditions moderate phytoplankton levels and associated deposition result in moderate levels of oxygen depletion in bottom waters and reduced clarity. The renewed monitoring in 2016 - 2018 will provide an excellent baseline for assessing restoration success related to the future installation of the new tidal inlet. The 2016 - 2018 monitoring results demonstrate that Farm Pond has not improved since the MEP assessment and underscore the need for restoration of tidal exchange to this system, as it remains significantly above its nitrogen threshold level and can be remedied with improved tidal exchange.

Sengekontacket Pond: Sengekontacket Pond is a coastal lagoon formed behind a barrier beach with two engineered tidal inlets that are periodically dredged to maintain tidal exchange with Nantucket Sound. Water quality within the Sengekontacket Pond System is heterogeneous, with high quality waters throughout the main basin (lagoon) and lower quality waters in its tributary basins (Trapps Pond, Majors Cove). The main tributary basin of Majors Cove is less well flushed than the main basin, with resulting slightly lower water quality due to nitrogen enrichment, lower water clarity and periodic oxygen depletion. The other major tributary basin, Trapps Pond, shows a greater reduction in water quality, being tidally restricted, more nitrogen enriched, with lower clarity and greater oxygen depletion than Majors Cove (Figure 33, {SKT-9}). The Trapps Pond monitoring station is located at the tidal culvert between the main basin and Trapps Pond and is only monitored on the ebbing tide so that Trapps Pond waters are being evaluated. However, it is likely that water from the uppermost tidal reach in this tributary basin is of even lower quality than the measured outflowing water. It appears that the impaired water and habitat quality within Trapps Pond is due to its restricted tidal exchange, which is inadequate to maintain low TN levels with its present watershed nitrogen loading. While most of the Sengekontacket Pond estuary is supporting high water quality, the tributaries of Major's Cove and Trapps Pond continue to show moderate nitrogen related impairments. Data from the 2016 – 2018 sampling period show interannual variations outside of the main basin and only slight changes in TN levels. TN levels appeared to be higher after the 2016 and 2017 monitoring when comparing to historical levels in both basins, but this pattern was not verified by the 2018 results. Only continued monitoring will determine whether nitrogen conditions are truly increasing, however, when coupled to the possible decline in the health index at some stations (SKT-3,4,8), and that the system is just over its nitrogen threshold, the data collected over the past three summer sampling seasons supports the need to track this system's water quality closely given its valuable estuarine resources.

Katama Bay: Katama Bay is functionally a large enclosed basin with a single tidal inlet. However, it is periodically altered by coastal processes that open an additional tidal inlet to the Atlantic Ocean through the southern barrier beach, such as happened within the last decade. As such the pond's tidal flushing can vary significantly between a 1 and 2 inlet system. During the 2016 monitoring effort, Katama Bay supported generally high quality waters throughout, with only the innermost region near the barrier beach showing only slightly lower quality waters (Figure 34). However, in 2017 all of the stations within the main basin were showing slightly higher TN levels and lower water quality than 2016, and slight water quality impairment. This pattern continued in 2018 with the slight impairment due to lower clarity associated with elevated phytoplankton biomass and nitrogen and some oxygen depletion. The change in levels is most likely associated with circulation, as the impaired stations are furthest from the entry of high quality water through the Edgartown Harbor inlet coupled to nitrogen inputs from the western shore of the basin. Water quality in this main basin is uniformly high in the 2 inlet configuration due to the enhanced tidal exchange with Atlantic Ocean water entering from the south.

Cape Pogue Bay-Pocha Pond: One of the largest estuaries in the region is the Cape Pogue Bay-Pocha Pond System. This estuary has a single natural tidal inlet and tributary basins. The watershed to the entire system contributes a low nitrogen load relative to present tidal flushing and is relatively undeveloped. The main basin nearest the tidal inlet is Cape Pogue Bay. This basin has a small tributary basin to the east (Shear Pen Pond), which is a tidally connected salt pond and a large tributary basin to the south (Pocha Pond) which is a large basin connected through a long tidal channel. It appears that the basin was formed by coastal processes building a large barrier beach system enclosing the basin thus creating a lagoonal estuary. Water quality within this large estuary appears to be primarily based on the physical structure and tidal exchange, primarily related to distance from the tidal inlet. Watershed nitrogen loading plays only a background role in this system. Overall there are high quality waters throughout the main basin (Cape Pogue Bay) and only slightly lower quality waters in the tributary basins (Figure 35-36). The main basin generally has low nitrogen and phytoplankton levels with high clarity and only modest oxygen depletions, as is also the case for its tributary, Shear Pen Pond. To date the inlet to Shear Pen Pond has not been evaluated for any restrictions or occlusion, which might be useful should the conditions of 2016 be repeated. The major tributary basin of Pocha Pond is generally showing consistent high/moderate water quality (2016-2018) with the slight impairment due primarily to the occurrence of moderate phytoplankton levels (seen as total chlorophyll-*a*) with localized periodic small oxygen depletions in its lower tidal reaches. The Pocha Pond tributary with its long narrow basin and shallow waters appears to support moderate phytoplankton growth each summer as it has a longer flushing time than Cape Pogue Bay. However, due to the low level of nitrogen loading to this tributary basin, like Cape Poque Bay Pocha Pond generally supports high nutrient related water quality. Unless there is an increase in nitrogen loading or a change in tidal exchange, it may be possible to conduct less monitoring in this system in the future.

Menemsha Pond – Squibnocket Pond: The Menemsha-Squibnocket Pond Embayment System is a complex coastal open water embayment comprised of a large northern basin (Menemsha Pond) that is connected to a smaller basin on the southeastern side (Nashaquitsa Pond) which in turn is connected via a shallow channel to a terminal basin (Stonewall Pond). Menemsha Pond exchanges water directly with Vineyard Sound / Menemsha Bight via Menemsha Channel (which was dredged prior to the summer of 2018). Squibnocket Pond is a large basin hydraulically connected to Menemsha Pond via a herring creek that passes under State Road and its circulation is mainly through wind driven mixing rather than the limited tidal exchange throught the culvert. The tributary basin of Squibnocket Pond is maintained as an estuary by the periodic overwash of the barrier beach as well as limited tidal exchange with estuarine waters of Menemsha Pond via the herring creek. Additionally, both Menemsha Pond and Squibnocket Pond receive fresh groundwater from the surrounding watershed as well as to a more limited extent from three small surfacewater discharges (Black Brook into Squibnocket Pond, and two creek discharges into Menemsha Pond, one at Pease Point and the other into Menemsha Inner Basin). At present the extent of tidal exchange between Squibnocket Pond and Menemsha Pond plays a fundamental role in the maintenance of nutrient related water quality and habitat health throughout this portion of the estuary.

MEP assessment found the Menemsha Pond, Nashaquitsa Pond and Stonewall Pond to be just beyond their ability to assimilate nitrogen without impairment and showing a low level of nitrogen enrichment, with moderate water quality and habitat impairments in Menemsha Pond and Nashquitsa Pond and significant impairment of Stonewall Pond (due to recent complete loss of eelgrass coverage). Impaired water quality was found in Squibnocket Pond as indicated by high nitrogen and phytoplankton levels and periodic low oxygen, associated with impaired benthic animal habitat.

The MVC Island-Wide Water Quality Monitoring Program (2017 and 2018) observed water quality similar to the MEP in Squibnocket Pond and Menemsha Pond tributaries in 2017, but it appears that the newly dredged channel into Menemsha Pond (prior to 2018) may have improved nitrogen related water quality in this basin (Figure 37). In 2018 TN levels met the TMDL, but it is the only post-dredge sampling year currently available. The improvement in lower TN levels and other metrics and the overall index was seen in Nashaquitsa Pond and Stonewall Pond, as well. However, a single year is not a trend and it will take more temporal sampling to verify if the 2018 improvement is sustained.

In contrast, Squibnocket Pond remained similar to the MEP levels of impaired water quality in both 2017 and 2018, although 2018 did have slightly improved water quality and slightly lower nitrogen levels. This basin is moderately impaired by nitrogen with elevated phytoplankton levels and moderate oxygen depletions. The slight change from 2017 to 2018 appears to be further evidence of the low level of exchange with the high quality waters of Menemsha Pond through the herring creek. Since there are only 2 years of sampling and only 1 year after a possible major change (dredging the main channel into Menemsha Pond), it is recommended that sampling continue throughout this system for the next few years. It would be a major finding, if indeed the improved water quality in Menemsha Pond continues and it would suggest a possible management plan for this system.

Tisbury Great Pond : Tisbury Great Pond is a complex estuary with the main basin formed by a barrier beach enclosing a lagoon with multiple tributary drowned river valley estuaries eroded into the outwash plain. Only 2 years of data have been collected by the MVC Island-Wide Water Quality Monitoring Program (2017 and 2018). Water quality was relatively stable from 2017 to 2018 with only a single station showing a major change (Figure 38). The spatial pattern is similar to similarly configured ponds (e.g. Edgartown Great Pond) with slightly lower water quality in the upper tributary basins compared to the lower lagoon. However, since this estuary does not have a fixed tidal inlet and needs to be "opened" periodically to exchange its high nutrient brackish waters with low nutrient saline offshore waters, it does not generally show large internal gradients. As such, this system operates more like a large freshwater pond/lake where horizontal mixing is through wind and not tidal currents. This is consistent with the generally moderately impaired water quality throughout, with lower water quality in the tributary receiving the most watershed inflow and nitrogen load.

Both monitoring years found Tisbury Great Pond to be well above its threshold nitrogen level set in its TMDL under the Clean Water Act. However, conditions in 2017 were associated with more impaired water quality than in 2018. In 2017 higher nitrogen levels, high chlorophyll-*a* levels and moderate to high oxygen depletion was observed. While 2018 was somewhat improved with lower nitrogen (still higher than the nitrogen threshold) and less oxygen depletion, chlorophyll levels were typically high in all basins (averaging 14 ug/L-25 ug/L) indicating impairment through nitrogen enrichment. As other ponds with managed openings, Tisbury Great Pond water quality is dependent on the frequency and duration of each opening. At present, it does not seem that improved openings alone will be sufficient to alleviate the nitrogen impaired water quality in this system without some level of nitrogen management. However, as more data on the specific links between openings and water quality becomes available, openings may be able to improve.

James Pond: James Pond is a shallow salt pond with a single basin and restricted tidal inlet. There has yet to be an MEP assessment and nitrogen threshold analysis for this salt pond, but there are 2 years of data collected by the MVC Island-Wide Water Quality Monitoring Program (2017 and 2018). Based upon its water quality metrics alone, James Pond appears to be significantly impaired by nitrogen enrichment, in part likely due to its restricted tidal inlet. Nitrogen levels were moderate to high (0.55 – 0.75 mg/L) and phytoplankton levels were high, averaging >10 ug/L in the main basin, with higher levels of TN and phytoplankton and greater oxygen depletion in 2018 than 2017. Overall the water quality index was moderate to poor in 2018 and only slightly better in 2017 and it is likely that infauna analysis will show significant impairment of this resource. If continued monitoring is consistent with the data to date, it is clear that James Pond should receive MEP analysis to determine the most effective approach for restoration.

Recommendations for Future Monitoring (2018)

Due to the critical importance of dissolved oxygen to the ecological health of an estuarine basin, specific locations may need additional data in coming years to support more quantitative analysis for restoration. The few stations selected should collect high frequency data using automated sensors. This is only needed when the low frequency sampling of the monitoring program suggests that a problem may exist in a specific basin OR where conditions appear to have significantly improved. At this point, the assessment of Lagoon Pond upper, Lake Tashmoo sentinel basin, Oak Bluffs Main Basin and Majors Cove has raised concerns over potential decline, while other basins like Menemsha Pond and Edgartown Great Pond appear to have improved. The high frequency data is to decrease uncertainty in the present status of these basins. However, procedural steps should also be implemented to strengthen the oxygen data base from the on-going monitoring program. Specifically, continue doing Winkler Titrations on water samples where meter readings of D.O. are < 5mg/L. Winkler titration is a more accurate and precise method for quantifying dissolved oxygen concentrations. This prevents future decisions from being misled by oxygen meter data that was erroneously low due to a problem during field collection.

The MVC Island-Wide Water Quality Monitoring Program results indicate that a few systems may benefit from higher level analysis to document that they are approaching unimpaired conditions and have met their TMDL targets for habitat quality. Water Quality data from 2016-2018 suggest that Edgartown Great Pond, Menemsha Pond need additional confirmation that they are meeting their restoration targets. Similarly, it may be possible to reduce the sampling of Cape Pogue Bay and Pocha Pond after the initial 3 years of monitoring, especially if time-series monitoring of dissolved oxygen and chlorophyll a is conducted to confirm the monitoring designation of this system as containing high quality waters.

While more data is needed for developing many restoration alternatives for implementation and ascertaining trends of water quality conditions as estuaries are managed, the 2016-2018 Monitoring Program data sets have brought forward a positive action that can serve as a solid base for future adaptive management strategies. As mentioned in 2016 and supported by the 2017 and 2018 data, for the salt ponds that are only periodically breached to allow temporary tidal exchange it appears that an analysis of present opening protocols coupled to estuarine response may provide a means to achieve partial improvement of water quality in the short term. While opening analysis was performed for salt ponds during the Massachusetts Estuaries Project, it was not possible to determine the effectiveness through follow on changes in water quality. Of particular note are Edgartown Great Pond where there appears to be a long-term trend to greatly improved water quality and Chilmark Pond which has highly variable water quality from year to year apparently due to opening success. More recent data from Tisbury Great Pond (2017-2018) indicates a system that continues to be impaired by elevated nitrogen levels throughout much of its estuarine reaches. A recommendation to leverage the monitoring results is to track the opening efforts of the various groups conducting the openings and as possible collect a few samples at strategic times that capture the "opening success". Over time this will allow a data based evolution of the opening protocols to maximize their positive impacts on the ponds. CSP should be consulted in advance of collecting samples around openings and closings of beach breaches to insure the validity of the sampling.

Two other tidally restricted salt ponds, Farm Pond and James Pond, are showing significantly impaired water and habitat quality. A new inlet has been proposed for Farm Pond, which the MEP determined would restore this system, but is has not been completed. It is suggested that outreach to MassDEP and MassDER be undertaken as to the current issues. James Pond has highly impaired water quality, which could possibly be remediated by restored tidal flows. However, hydrodynamic analysis would need to be undertaken to evaluate such an alternative if the monitoring continues to show impairment.

In addition, for specific systems such as Menemsha Pond / Squibnocket Pond and Tisbury Great Pond whose MEP nitrogen thresholds are based on an average of water quality data from multiple stations, it is critical that the Island-wide water quality monitoring program collect samples from each station comprising the average. Otherwise, it will not be possible to correctly determine if the MEP threshold is being attained. However, the additional stations should be undertaken in basins that are currently approaching their threshold nitrogen values. For example in Menemsha Pond additional stations should be considered for 2019 as 2018 post-dredging data indicated that the main basin TN levels had declined to their restoration targets. The current 2 stations in Squibnocket Pond are sufficient as this basin continues to be well above its target TN value.

Similarly, if continued water quality monitoring shows that some basins are currently supporting high water quality, at or near their TDML levels, it would be prudent to begin planning for targeted data collection on benthic habitat and complete a review of eelgrass distributions. The concept would be to have these systems removed from the impaired waters listing or better define what is needed to reach their TMDLs.

Embayment	Sample ID	Secchi average (meters)	Secchi Depth % of WC	20% Low DO (mg/L)	20% Low DO (% Sat.)	Salinity (ppt)	Avg. PO4 (mg/L)	Avg. NH4 (mg/L)	Avg. Nox (mg/L)	Avg. DIN (mg/L)	Avg. DON (mg/L)	Avg. TDN (mg/L)	Avg. POC (mg/L)	Avg. PON (mg/L)	Avg. TON (mg/L)	Avg. TN (mg/L)	Avg. Chla (ug/L)	Avg. Phaeo (ug/L)	Chla/Phaeo Ratio	Avg. Total Pig (ug/L)
CAPE POGUE	POG2	3.05	76%	5.52	80%	31.23	0.0069	0.0026	0.0014	0.0040	0.17	0.17	0.46	0.08	0.24	0.25	3.71	1.15	0.75	4.87
CAPE POGUE	POG3	2.18	80%	4.86	71%	31.30	0.0070	0.0061	0.0020	0.0080	0.22	0.23	0.55	0.10	0.32	0.33	3.84	1.95	0.69	5.79
CAPE POGUE	POG4	2.06	56%	4.83	70%	31.33	0.0071	0.0025	0.0013	0.0038	0.23	0.24	0.62	0.10	0.34	0.34	4.29	2.25	0.67	6.54
CAPE POGUE	POG5	2.17	98%	4.55	66%	31.20	0.0104	0.0078	0.0021	0.0099	0.26	0.27	0.66	0.11	0.38	0.39	4.62	2.33	0.69	6.95
POCHA	PCA1	1.46	89%	4.59	67%	31.20	0.0237	0.0044	0.0016	0.0060	0.28	0.28	0.79	0.13	0.41	0.41	5.18	2.24	0.74	7.43
POCHA	PCA3	1.57	100%	4.87	72%	31.28	0.0103	0.0053	0.0014	0.0067	0.27	0.27	0.66	0.11	0.38	0.39	4.67	1.67	0.74	6.34
KATAMA BAY	KAT1	2.78	34%	5.27	75%	31.13	0.0138	0.0089	0.0037	0.0126	0.20	0.21	0.42	0.07	0.27	0.28	4.97	1.68	0.75	6.65
KATAMA BAY	KAT2	2.49	57%	5.06	73%	31.08	0.0132	0.0090	0.0028	0.0118	0.17	0.19	0.48	0.08	0.26	0.27	5.45	1.52	0.77	6.97
KATAMA BAY	KAT3	1.24	97%	5.52	80%	30.95	0.0161	0.0114	0.0016	0.0130	0.20	0.22	0.50	0.09	0.29	0.30	6.14	1.98	0.73	8.12
KATAMA BAY	KAT4	1.83	19%	4.89	71%	31.00	0.0185	0.0144	0.0036	0.0181	0.18	0.20	0.55	0.10	0.27	0.29	6.12	1.86	0.74	7.98
KATAMA BAY	KAT5	1.75	75%	4.77	69%	30.95	0.0213	0.0149	0.0028	0.0177	0.18	0.20	0.56	0.10	0.29	0.30	6.21	3.60	0.69	9.81
KATAMA BAY	KAT7	1.24	94%	5.08	73%	30.88	0.0214	0.0052	0.0016	0.0068	0.27	0.28	0.68	0.12	0.40	0.40	7.66	2.86	0.76	10.53
EDGARTOWN GREAT	EGP2	2.70	100%	5.77	75%	17.25	0.0015	0.0122	0.0005	0.0127	0.29	0.30	0.49	0.09	0.37	0.39	5.55	1.15	0.85	6.71
EDGARTOWN GREAT	EGP3	2.38	86%	4.76	64%	17.10	0.0016	0.0169	0.0006	0.0175	0.28	0.30	0.50	0.09	0.37	0.39	5.68	1.03	0.85	6.71
EDGARTOWN GREAT	EGP4	1.67	100%	5.24	68%	17.25	0.0036	0.0206	0.0050	0.0256	0.34	0.36	0.46	0.08	0.42	0.44	3.23	0.58	0.86	3.81
EDGARTOWN GREAT	EGP5	2.10	100%	5.46	71%	18.53	0.0048	0.0199	0.0004	0.0202	0.31	0.33	0.45	0.08	0.39	0.41	4.69	0.42	0.91	5.10
EDGARTOWN GREAT	EGP6	1.90	100%	6.18	83%	18.18	0.0038	0.0097	0.0006	0.0103	0.31	0.32	0.80	0.13	0.44	0.45	4.47	2.55	0.90	5.24
EDGARTOWN GREAT	EGP7	2.23	100%	5.09	68%	19.03	0.0020	0.0136	0.0006	0.0142	0.32	0.33	0.43	0.07	0.39	0.40	4.32	1.08	0.83	5.40
EDGARTOWN GREAT	EGP9	1.89	94%	5.94	81%	15.00	0.0020	0.0212	0.0090	0.0302	0.32	0.35	0.59	0.11	0.42	0.45	6.12	1.22	0.80	7.34
EDGARTOWN GREAT	EGP10	1.73	100%	4.72	61%	17.23	0.0015	0.0178	0.0004	0.0181	0.26	0.28	0.85	0.15	0.41	0.43	6.79	3.03	0.72	9.81
EDGARTOWN GREAT	EGP11	1.93	100%	5.61	73%	17.53	0.0036	0.0225	0.0029	0.0254	0.27	0.29	0.42	0.07	0.34	0.37	4.03	0.83	0.84	4.86
CHILMARK POND	CHP UP	1.09	72%	9.26	115%	0.13	0.0077	0.0039	0.0019	0.0057	0.29	0.29	2.75	0.48	0.77	0.77	46.36	14.62	0.69	60.98
CHILMARK POND	CHP6	0.47	100%	ND	ND	6.30	0.0015	0.0083	0.0005	0.0088	0.38	0.39	1.02	0.17	0.55	0.56	10.55	2.35	0.72	12.90
CHILMARK POND	CHP5	1.71	100%	6.55	82%	8.60	0.0030	0.0036	0.0004	0.0040	0.38	0.39	0.57	0.09	0.48	0.48	3.52	0.78	0.72	4.30
CHILMARK POND	CHP4	1.30	100%	7.18	90%	8.80	0.0028	0.0033	0.0004	0.0037	0.35	0.36	0.43	0.07	0.43	0.43	2.80	1.13	0.70	3.93
CHILMARK POND	CHP2	1.91	99%	6.51	87%	8.68	0.0038	0.0035	0.0004	0.0038	0.37	0.37	0.53	0.09	0.45	0.46	3.44	1.13	0.71	4.57
CHILMARK POND	CHP1	1.04	100%	5.89	73%	7.98	0.0025	0.0051	0.0004	0.0054	0.38	0.38	0.80	0.13	0.50	0.51	4.96	2.03	0.66	6.98
OAK BLUFFS HARBOR/SUNSET LAKE	MV14	0.70	100%	ND	ND	28.10	0.0106	0.0106	0.0177	0.0282	0.22	0.25	0.87	0.15	0.37	0.39	6.06	4.26	0.57	10.32
OAK BLUFFS HARBOR/SUNSET LAKE	MV15	1.33	100%	3.95	56%	29.19	0.0105	0.0306	0.0107	0.0413	0.18	0.22	0.79	0.15	0.32	0.37	5.98	4.01	0.58	9.99
OAK BLUFFS HARBOR/SUNSET LAKE	MV16	2.74	75%	5.17	73%	29.49	0.0103	0.0075	0.0016	0.0091	0.18	0.19	0.54	0.09	0.28	0.29	4.80	2.18	0.69	6.98
FARM POND	FRM1	0.93	100%	3.99	61%	30.68	0.0077	0.0073	0.0019	0.0091	0.27	0.28	0.64	0.11	0.38	0.39	5.01	2.55	0.69	7.56
FARM POND	FRM2	0.68	100%	3.88	56%	30.70	0.0060	0.0056	0.0029	0.0086	0.27	0.27	0.70	0.12	0.39	0.40	4.40	2.75	0.66	7.15
FARM POND	FRM3	1.23	100%	2.14	31%	30.00	0.0081	0.0052	0.0020	0.0072	0.30	0.30	0.82	0.15	0.44	0.45	7.01	3.79	0.61	10.80
SENGEKONTACKET	SKT2	1.60	100%	4.81	68%	30.93	0.0157	0.0221	0.0028	0.0249	0.21	0.24	0.46	0.08	0.29	0.31	3.04	1.31	0.70	4.35
SENGEKONTACKET	SKT3	2.43	90%	4.32	62%	30.50	0.0170	0.0173	0.0032	0.0205	0.28	0.30	0.56	0.10	0.38	0.40	4.09	2.10	0.66	6.19
SENGEKONTACKET	SKT4	1.58	105%	3.19	46%	30.38	0.0175	0.0134	0.0026	0.0160	0.19	0.21	0.75	0.14	0.33	0.35	5.65	5.01	0.54	10.65
SENGEKONTACKET	SKT5	1.37	100%	5.17	74%	31.20	0.0180	0.0096	0.0019	0.0115	0.18	0.19	0.51	0.08	0.26	0.27	3.47	1.97	0.64	5.44
SENGEKONTACKET	SKT6	1.93	100%	4.90	69%	31.15	0.0172	0.0156	0.0020	0.0176	0.19	0.21	0.37	0.06	0.25	0.27	3.04	1.19	0.72	4.23
SENGEKONTACKET	SKT8	1.78	100%	4.15	59%	31.00	0.0101	0.0201	0.0017	0.0217	0.18	0.20	0.66	0.12	0.30	0.32	4.74	2.40	0.67	7.14
SENGEKONTACKET	SKT9	0.52	100%	ND	ND	30.08	0.0107	0.0314	0.0048	0.0362	0.29	0.33	0.62	0.11	0.40	0.43	4.07	3.69	0.53	7.76
LAGOON POND	LGP11	1.12	93%	3.25	44%	23.78	0.0065	0.0349	0.2581	0.2930	0.18	0.47	1.24	0.23	0.41	0.70	19.54	5.66	0.72	25.21
LAGOON POND	LGP2	2.29	27%	1.43	20%	29.34	0.0181	0.0413	0.0005	0.0417	0.14	0.19	0.75	0.14	0.28	0.32	8.12	5.00	0.68	13.13
LAGOON POND	LGP4	2.22	44%	1.38	29%	29.34	0.0173	0.0084	0.0004	0.0088	0.14	0.15	0.83	0.15	0.29	0.30	8.27	4.10	0.67	12.36
LAGOON POND	LGP6	2.26	60%	4.37	62%	28.63	0.0163	0.0057	0.0046	0.0104	0.14	0.15	0.79	0.15	0.29	0.30	7.72	2.32	0.80	10.03
LAGOON POND	LGP8	2.06	36%	5.66	80%	29.29	0.0097	0.0049	0.0004	0.0053	0.16	0.17	0.83	0.14	0.30	0.31	8.90	2.71	0.77	11.61
LAGOON POND	LGP9	2.32	43%	5.59	79%	28.10	0.0075	0.0054	0.0015	0.0070	0.12	0.13	0.77	0.13	0.25	0.26	8.02	2.43	0.79	10.45
LAKE TASHMOO	MV21	0.86	100%	6.09	84%	30.40	0.0084	0.0063	0.0018	0.0081	0.18	0.19	0.52	0.09	0.28	0.28	4.74	1.59	0.78	6.32
LAKE TASHMOO	MV2	2.81	100%	5.54	78%	31.28	0.0091	0.0034	0.0029	0.0063	0.16	0.17	0.52	0.10	0.26	0.27	3.69	2.00	0.69	5.69
LAKE TASHMOO	MV3	2.61	89%	6.21	88%	31.28	0.0106	0.0056	0.0012	0.0068	0.18	0.18	0.66	0.12	0.30	0.30	6.25	1.74	0.78	7.99
LAKE TASHMOO	MV4	2.48	67%	6.04	86%	31.33	0.0085	0.0029	0.0027	0.0057	0.16	0.17	1.71	0.31	0.47	0.48	5.97	2.42	0.73	8.39
LAKE TASHMOO	MV SEN	2.15	58%	5.55	78%	29.89	0.0123	0.0074	0.0169	0.0240	0.18	0.19	0.92	0.17	0.32	0.34	9.30	3.34	0.73	12.64
TASHMOO SPRINGS (FW POND)	MV7	0.25	100%	6.49	71%	0.80	0.0089	0.1094	0.1058	0.2152	0.14	0.36	4.35	0.71	0.85	1.07	39.75	9.26	0.81	49.01

Table 2a. Summary of Water Quality Parameters, 2018 Martha's Vineyard Island-wide Water Quality Monitoring Program. Values are Station Averages of all sampling events, July-Sept. for estuarine and salt pond sites. Looks Pond received 1 sampling event in June, July August and September.

Embayment	Sample ID	Secchi average (meters)	Secchi Depth % of WC	20% Low DO (mg/L)	20% Low DO (% Sat.)	Salinity (ppt)	Avg. PO4 (mg/L)	Avg. NH4 (mg/L)	Avg. Nox (mg/L)	Avg. DIN (mg/L)	Avg. DON (mg/L)	Avg. TDN (mg/L)	Avg. POC (mg/L)	Avg. PON (mg/L)	Avg. TON (mg/L)	Avg. TN (mg/L)	Avg. Chla (ug/L)	Avg. Phaeo (ug/L)	Chla/Phaeo Ratio	Avg. Total Pig (ug/L)
TISBURY GREAT POND	TGP1	0.66	86%	6.83	79%	11.08	0.0319	0.0115	0.0663	0.0778	0.22	0.30	2.00	0.36	0.58	0.66	14.09	11.68	0.60	25.77
TISBURY GREAT POND	TGP3A	0.67	66%	6.15	79%	10.37	0.0259	0.0046	0.0004	0.0049	0.28	0.29	2.54	0.43	0.72	0.72	12.61	9.36	0.66	21.97
TISBURY GREAT POND	TGP4	1.09	51%	5.02	67%	15.59	0.0229	0.0056	0.0014	0.0070	0.24	0.25	2.13	0.37	0.61	0.62	10.17	9.14	0.61	19.32
TISBURY GREAT POND	TGP5	1.19	59%	6.62	85%	11.25	0.0119	0.0061	0.0004	0.0065	0.20	0.21	1.93	0.33	0.53	0.54	10.32	7.45	0.69	17.77
TISBURY GREAT POND	TGP6	1.18	46%	6.78	88%	13.28	0.0025	0.0068	0.0012	0.0080	0.27	0.27	1.90	0.33	0.59	0.60	10.19	3.54	0.79	13.73
TISBURY GREAT POND	TGP7	1.03	48%	6.54	86%	18.15	0.0109	0.0041	0.0006	0.0047	0.25	0.25	1.94	0.34	0.59	0.59	7.60	6.48	0.74	14.08
TISBURY GREAT POND	TGP8	0.98	47%	3.78	49%	14.83	0.0197	0.0044	0.0004	0.0047	0.33	0.34	2.34	0.42	0.76	0.76	10.32	5.90	0.74	16.21
MENEMSHA POND	MEN2	3.49	96%	5.34	73%	31.39	0.0308	0.0029	0.0039	0.0068	0.16	0.17	0.38	0.06	0.22	0.23	2.82	1.72	0.64	4.54
MENEMSHA POND	MEN3	2.74	41%	5.72	78%	31.41	0.0152	0.0004	0.0015	0.0018	0.14	0.14	0.53	0.09	0.23	0.23	3.68	2.02	0.70	5.70
MENEMSHA POND	MEN5	1.86	83%	5.38	76%	31.28	0.0180	0.0011	0.0017	0.0028	0.17	0.17	0.62	0.10	0.26	0.27	5.18	2.90	0.70	8.09
MENEMSHA POND	MEN6	1.35	93%	5.45	76%	31.33	0.0197	0.0026	0.0015	0.0042	0.16	0.16	0.73	0.12	0.28	0.28	5.68	4.03	0.63	9.72
MENEMSHA POND	MEN7	1.03	100%	5.07	76%	30.95	0.0383	0.0070	0.0059	0.0129	0.21	0.22	0.59	0.10	0.31	0.32	3.75	4.34	0.54	8.08
SQUIBNOCKET	SQB1	1.74	54%	6.00	78%	10.84	0.0138	0.0059	0.0018	0.0076	0.42	0.43	1.24	0.22	0.65	0.65	7.49	3.25	0.70	10.73
SQUIBNOCKET	SQB3	1.46	44%	6.63	85%	10.78	0.0112	0.0051	0.0013	0.0065	0.42	0.43	1.31	0.22	0.64	0.65	6.99	2.74	0.73	9.73
JAMES POND	JMS1	0.25	100%	ND	ND	21.87	0.0826	0.0368	0.0007	0.0375	0.37	0.40	1.23	0.23	0.59	0.63	5.42	7.97	0.46	13.40
JAMES POND	JMS3	1.09	77%	4.15	56%	23.09	0.0717	0.0026	0.0004	0.0030	0.44	0.45	1.81	0.33	0.78	0.78	10.18	9.12	0.53	19.31
JAMES POND	JMS4	0.82	94%	4.34	62%	22.75	0.0858	0.0098	0.0004	0.0102	0.39	0.40	1.97	0.34	0.73	0.74	7.02	10.25	0.43	17.27
SHERIFFS POND	SRF1	0.35	98%	0.11	1%	0.23	0.0033	0.0177	0.0149	0.0325	0.72	0.75	3.81	0.61	1.33	1.37	20.60	7.11	0.75	27.71
SHERIFFS POND	SRF2	0.62	75%	6.23	74%	0.22	0.0031	0.0153	0.0055	0.0209	0.87	0.89	3.64	0.65	1.52	1.54	19.01	5.04	0.85	24.05
SHERIFFS POND	SRF3	0.36	76%	0.60	7%	0.22	0.0027	0.0176	0.0023	0.0199	0.87	0.89	3.51	0.62	1.49	1.51	20.93	5.24	0.81	26.17
MINK MEADOWS	MME	0.20	100%	6.63	78%	4.30	0.0021	0.0113	0.0017	0.0130	0.89	0.90	3.17	0.49	1.38	1.39	19.54	0.95	0.95	20.50
MINK MEADOWS	MMW	0.20	100%	7.54	87%	3.50	0.0070	0.0202	0.0004	0.0206	0.85	0.87	3.17	0.42	1.27	1.29	16.31	0.03	1.00	16.34

Table 2a cont'd. Summary of Water Quality Parameters, 2018 Martha's Vineyard Island-wide Water Quality Monitoring Program. Values are Station Averages of all sampling events, July-Sept. for estuarine and salt pond sites.

Embayment	Sample ID	Secchi average (meters)	Secchi Depth % of WC	20% Low DO (mg/L)	20% Low DO (% Sat.)	Salinity (ppt)	Avg. PO4 (mg/L)	Avg. NH4 (mg/L)	Avg. Nox (mg/L)	Avg. DIN (mg/L)	Avg. DON (mg/L)	Avg. TDN (mg/L)	Avg. POC (mg/L)	Avg. PON (mg/L)	Avg. TON (mg/L)	Avg. TN (mg/L)	Avg. Chla (ug/L)	Avg. Phaeo (ug/L)	Chla/Phaeo Ratio	Avg. Total Pig (ug/L)
CAPE POGUE BAY	POG2	3.20	61%	5.40	76%	30.9	0.013	0.011	0.004	0.014	0.242	0.256	0.336	0.060	0.301	0.315	2.65	1.01	0.71	3.66
CAPE POGUE BAY	POG3	2.31	78%	5.23	68%	30.9	0.015	0.021	0.004	0.026	0.302	0.327	0.387	0.069	0.371	0.397	3.01	1.42	0.66	4.43
CAPE POGUE BAY	POG4	2.52	75%	4.93	70%	30.9	0.012	0.013	0.004	0.017	0.298	0.315	0.464	0.084	0.382	0.399	3.68	2.09	0.64	5.76
CAPE POGUE BAY	POG5	1.91	91%	4.62	66%	30.6	0.012	0.026	0.006	0.032	0.221	0.253	0.443	0.081	0.302	0.335	2.84	1.87	0.60	4.71
POCHA POND	PCA1	1.59	80%	4.56	65%	30.4	0.013	0.030	0.006	0.036	0.300	0.336	0.487	0.085	0.385	0.422	2.81	1.42	0.63	4.22
POCHA POND	PCA3	1.57	96%	4.78	62%	30.2	0.009	0.025	0.005	0.029	0.293	0.323	0.447	0.081	0.374	0.403	3.06	1.31	0.67	4.37
KATAMA BAY	KAT1	2.69	33%	5.37	72%	30.9	0.016	0.021	0.005	0.026	0.218	0.244	0.347	0.060	0.278	0.304	3.09	1.57	0.67	4.66
KATAMA BAY	KAT2	2.48	53%	5.23	68%	30.6	0.021	0.025	0.007	0.032	0.261	0.293	0.415	0.076	0.337	0.369	3.87	1.59	0.68	5.47
KATAMA BAY	KAT3	2.25	33%	5.17	70%	30.4	0.021	0.025	0.007	0.031	0.264	0.296	0.387	0.071	0.335	0.367	3.21	1.62	0.65	4.84
KATAMA BAY	KAT4	2.54	28%	5.27	68%	30.3	0.025	0.026	0.009	0.034	0.250	0.284	0.442	0.084	0.334	0.368	4.00	1.55	0.70	5.55
KATAMA BAY	KAT5	1.91	86%	5.29	74%	30.4	0.029	0.026	0.006	0.032	0.249	0.280	0.461	0.089	0.338	0.370	4.67	1.68	0.72	6.35
KATAMA BAY	KAT7	1.18	97%	5.14	68%	30.1	0.022	0.022	0.005	0.026	0.258	0.284	0.572	0.114	0.372	0.398	5.61	1.73	0.72	7.35
EDGARTOWN GREAT POND	EGP2	2.59	92%	5.40	70%	19.0	0.003	0.024	0.007	0.031	0.323	0.354	0.480	0.087	0.410	0.441	2.63	0.52	0.79	3.15
EDGARTOWN GREAT POND	EGP3	2.50	72%	5.74	75%	19.5	0.002	0.022	0.006	0.028	0.330	0.359	0.644	0.119	0.449	0.477	4.31	0.57	0.89	4.88
EDGARTOWN GREAT POND	EGP4	2.11	100%	4.94	68%	18.7	0.002	0.023	0.018	0.040	0.277	0.318	0.416	0.073	0.350	0.390	1.65	0.55	0.74	2.20
EDGARTOWN GREAT POND	EGP5	2.26	95%	5.31	68%	19.2	0.002	0.034	0.008	0.041	0.377	0.418	0.454	0.084	0.461	0.502	1.90	0.49	0.77	2.39
EDGARTOWN GREAT POND	EGP6	2.24	96%	5.76	74%	19.3	0.002	0.017	0.007	0.024	0.278	0.302	0.500	0.092	0.370	0.394	2.18	0.54	0.78	2.72
EDGARTOWN GREAT POND	EGP7	2.61	96%	5.08	69%	19.4	0.002	0.025	0.007	0.032	0.263	0.295	0.430	0.072	0.336	0.368	1.58	0.43	0.78	2.01
EDGARTOWN GREAT POND	EGP9	1.99	95%	4.55	63%	17.4	0.002	0.044	0.008	0.031	0.268	0.299	0.614	0.117	0.390	0.421	3.23	0.84	0.81	4.07
EDGARTOWN GREAT POND	EGP10	1.79	93%	4.89	68%	18.9	0.002	0.025	0.008	0.033	0.262	0.295	0.663	0.127	0.389	0.422	3.50	0.77	0.81	4.27
EDGARTOWN GREAT POND	EGP11	1.26	100%	5.42	68%	18.7	0.002	0.029	0.009	0.038	0.236	0.274	0.456	0.083	0.318	0.356	2.49	0.65	0.79	3.14
CHILMARK POND	CHP UP	1.23	79%	7.21	85%	0.4	0.020	0.013	0.007	0.020	0.377	0.396	1.008	0.160	0.537	0.556	5.54	8.93	0.47	14.47
CHILMARK POND	CHP6	0.68	100%	5.04	57%	9.5	0.005	0.047	0.018	0.065	0.330	0.394	0.883	0.140	0.469	0.534	5.56	2.74	0.64	8.30
CHILMARK POND	CHP5	1.70	86%	5.63	69%	12.4	0.002	0.071	0.026	0.097	0.369	0.466	0.734	0.112	0.481	0.578	2.78	2.97	0.51	5.75
CHILMARK POND	CHP4	1.45	93%	5.44	68%	12.7	0.002	0.049	0.021	0.070	0.376	0.446	0.535	0.086	0.462	0.533	2.96	2.01	0.58	4.97
CHILMARK POND	CHP2	1.56	63%	5.94	74%	12.5	0.004	0.074	0.032	0.106	0.366	0.471	0.827	0.127	0.493	0.598	4.18	2.91	0.59	7.09
CHILMARK POND	CHP1	1.14	74%	5.02	63%	12.1	0.002	0.041	0.022	0.063	0.345	0.408	1.360	0.234	0.579	0.642	9.19	1.84	0.77	11.04
OAK BLUFFS HARBOR/SUNSET LAKE	MV14	0.72	100%	4.63	63%	29.3	0.010	0.024	0.043	0.067	0.260	0.328	0.605	0.103	0.364	0.431	3.75	1.81	0.67	5.56
OAK BLUFFS HARBOR/SUNSET LAKE	MV15	1.57	100%	5.10	71%	30.6	0.012	0.017	0.011	0.028	0.260	0.288	0.625	0.120	0.380	0.408	5.86	1.95	0.73	7.81
OAK BLUFFS HARBOR/SUNSET LAKE	MV16	2.91	81%	5.16	71%	30.8	0.011	0.017	0.005	0.022	0.232	0.254	0.505	0.088	0.320	0.342	4.83	1.54	0.71	6.37
FARM POND	FRM1	0.85	100%	4.31	60%	29.7	0.008	0.014	0.008	0.021	0.355	0.377	0.686	0.120	0.475	0.496	6.12	1.78	0.68	7.90
FARM POND	FRM2	0.87	100%	4.05	58%	29.8	0.008	0.020	0.004	0.024	0.301	0.325	0.626	0.104	0.405	0.430	3.78	1.09	0.69	4.87
FARM POND	FRM3	1.11	100%	3.30	47%	29.5	0.013	0.022	0.002	0.024	0.383	0.407	1.126	0.202	0.585	0.610	8.69	1.64	0.80	10.32
SENGEKONTACKET POND	SKT2	1.69	100%	4.96	69%	30.7	0.012	0.006	0.003	0.010	0.221	0.231	0.474	0.082	0.303	0.313	2.85	0.99	0.74	3.84
SENGEKONTACKET POND	SKT3	2.09	76%	4.64	64%	30.2	0.012	0.003	0.003	0.006	0.266	0.272	0.981	0.164	0.430	0.437	8.22	1.84	0.87	10.06
SENGEKONTACKET POND	SKT4	1.22	97%	5.19	73%	29.9	0.013	0.004	0.002	0.006	0.265	0.271	1.450	0.247	0.512	0.518	16.21	1.40	0.89	17.62
SENGEKONTACKET POND	SKT5	2.38	94%	5.44	75%	30.9	0.012	0.011	0.002	0.013	0.217	0.230	0.365	0.061	0.278	0.291	3.01	0.88	0.73	3.88
SENGEKONTACKET POND	SKT6	2.28	100%	4.84	67%	30.9	0.012	0.005	0.003	0.008	0.173	0.181	0.410	0.075	0.248	0.256	2.63	0.73	0.75	3.36
SENGEKONTACKET POND	SKT8	1.76	99%	4.59	65%	30.5	0.007	0.008	0.004	0.012	0.222	0.234	1.123	0.179	0.400	0.412	13.46	0.46	0.91	13.92
SENGEKONTACKET POND	SKT9	0.86	100%	4.28	61%	29.1	0.009	0.006	0.002	0.008	0.367	0.375	0.977	0.146	0.513	0.521	9.04	0.88	0.80	9.93
LOOKS POND	LOOK4	0.50	100%	10.22	112%	0.2	0.040	0.003	0.013	0.016	0.305	0.321	0.808	0.078	0.328	0.338	2.29	3.84	0.36	6.13
LAGOON POND	LGP11	1.42	100%	4.50	62%	23.7	0.007	0.034	0.443	0.477	0.304	0.781	1.338	0.249	0.553	1.030	11.16	2.47	0.76	13.63
LAGOON POND	LGP2	2.94	35%	3.24	43%	30.2	0.011	0.004	0.004	0.009	0.226	0.235	0.657	0.111	0.337	0.346	5.00	1.48	0.79	6.48
LAGOON POND	LGP4	2.78	55%	2.57	35%	29.3	0.015	0.010	0.006	0.016	0.225	0.241	0.707	0.119	0.344	0.360	5.29	1.74	0.76	7.03
LAGOON POND	LGP8	2.86	49%	5.27	69%	30.1	0.007	0.007	0.003	0.010	0.227	0.237	0.518	0.092	0.319	0.329	3.56	0.79	0.82	4.34
LAGOON POND	LGP9	3.52	63%	5.39	71%	30.9	0.006	0.010	0.004	0.013	0.200	0.214	0.466	0.081	0.281	0.295	3.40	0.81	0.81	4.21
LAKE TASHMOO	MV21	0.96	100%	5.56	76%	30.8	0.012	0.002	0.003	0.005	0.190	0.195	0.358	0.063	0.253	0.258	2.09	0.67	0.72	2.75
LAKE TASHMOO	MV2	3.01	94%	4.82	65%	30.8	0.011	0.002	0.005	0.007	0.187	0.194	0.401	0.070	0.257	0.264	2.45	0.72	0.69	3.16
LAKE TASHMOO	MV3	2.56	84%	4.80	66%	30.8	0.013	0.001	0.005	0.005	0.197	0.203	0.637	0.119	0.316	0.321	3.34	1.17	0.63	4.51
LAKE TASHMOO	MV4	2.36	81%	4.85	67%	30.7	0.013	0.000	0.004	0.004	0.203	0.207	0.793	0.141	0.345	0.349	5.29	1.09	0.67	6.38
LAKE TASHMOO	MV SEN	2.20	60%	4.27	59%	30.6	0.018	0.002	0.003	0.005	0.223	0.228	0.761	0.133	0.357	0.362	7.50	1.56	0.64	9.05

Table 2b. Summary of Water Quality Parameters, 2017 Martha's Vineyard Island-wide Water Quality Monitoring Program. Values are Station Averages of all sampling events, July-Sept. for estuarine and salt pond sites. Looks Pond received 1 sampling event in June, July August and September.

Embayment	Sample ID	Secchi average (meters)	Secchi Depth % of WC	20% Low DO (mg/L)	20% Low DO (% Sat.)	Salinity (ppt)	Avg. PO4 (mg/L)	Avg. NH4 (mg/L)	Avg. Nox (mg/L)	Avg. DIN (mg/L)	Avg. DON (mg/L)	Avg. TDN (mg/L)	Avg. POC (mg/L)	Avg. PON (mg/L)	Avg. TON (mg/L)	Avg. TN (mg/L)	Avg. Chla (ug/L)	Avg. Phaeo (ug/L)	Chla/Phaeo Ratio	Avg. Total Pig (ug/L)
TISBURY GREAT POND	TGP1	0.71	85%	4.22	59%	15.8	0.102	0.005	0.020	0.026	0.453	0.478	2.817	0.472	0.924	0.950	33.16	3.48	0.83	36.64
TISBURY GREAT POND	TGP3A	0.63	100%	4.85	61%	18.4	0.130	0.010	0.003	0.013	0.380	0.393	2.742	0.419	0.799	0.812	25.35	2.09	0.83	27.44
TISBURY GREAT POND	TGP4	1.31	54%	4.70	60%	20.5	0.141	0.005	0.003	0.008	0.303	0.311	2.409	0.395	0.698	0.706	16.00	2.52	0.80	18.52
TISBURY GREAT POND	TGP5	0.96	43%	6.08	82%	13.7	0.098	0.004	0.006	0.010	0.343	0.352	2.441	0.382	0.725	0.735	18.91	0.34	0.97	19.24
TISBURY GREAT POND	TGP6	0.98	37%	3.22	44%	18.5	0.118	0.006	0.003	0.009	0.351	0.360	2.881	0.456	0.807	0.816	22.88	1.33	0.89	24.22
TISBURY GREAT POND	TGP7	1.31	68%	5.80	75%	19.8	0.131	0.005	0.001	0.006	0.321	0.327	2.589	0.385	0.705	0.712	12.99	2.19	0.77	15.19
TISBURY GREAT POND	TGP8	0.96	82%	5.76	77%	18.4	0.138	0.007	0.004	0.011	0.362	0.374	2.151	0.357	0.719	0.730	21.10	1.52	0.79	22.63
MENEMSHA POND	MEN2	3.61	88%	6.05	79%	31.0	0.011	0.013	0.003	0.016	0.189	0.205	0.513	0.082	0.272	0.288	2.77	0.98	0.76	3.76
MENEMSHA POND	MEN3	3.49	63%	5.42	72%	30.9	0.008	0.006	0.003	0.008	0.197	0.206	0.549	0.095	0.292	0.301	3.19	1.27	0.74	4.46
MENEMSHA POND	MEN5	2.24	93%	4.90	81%	30.9	0.010	0.006	0.005	0.011	0.207	0.218	0.517	0.092	0.300	0.311	3.17	0.86	0.78	4.02
MENEMSHA POND	MEN6	1.86	86%	5.40	73%	30.7	0.011	0.008	0.004	0.012	0.283	0.294	0.617	0.111	0.393	0.405	4.18	0.76	0.80	4.93
MENEMSHA POND	MEN7	1.59	100%	4.58	63%	30.4	0.020	0.020	0.004	0.024	0.281	0.305	0.751	0.129	0.410	0.434	4.66	0.79	0.82	5.45
SQUIBNOCKET POND	SQB1	2.79	79%	5.82	76%	12.2	0.008	0.005	0.004	0.009	0.525	0.534	1.394	0.249	0.774	0.783	6.79	2.49	0.72	9.28
SQUIBNOCKET POND	SQB3	2.00	51%	6.85	89%	12.1	0.007	0.009	0.006	0.015	0.516	0.531	1.233	0.222	0.738	0.754	7.01	1.22	0.81	8.23
JAMES POND	JMS1	0.25	100%	4.52	64%	27.3	0.033	0.047	0.004	0.052	0.476	0.527	1.165	0.202	0.678	0.729	5.14	2.23	0.69	7.37
JAMES POND	JMS3	1.28	95%	5.54	80%	26.8	0.023	0.017	0.008	0.025	0.356	0.381	1.170	0.203	0.546	0.570	7.23	3.32	0.74	10.55
JAMES POND	JMS4	0.90	100%	4.51	65%	27.2	0.030	0.003	0.005	0.008	0.340	0.347	1.219	0.208	0.548	0.556	7.26	2.37	0.72	9.63

Table 2b cont'd. Summary of Water Quality Parameters, 2017 Martha's Vineyard Island-wide Water Quality Monitoring Program. Values are Station Averages of all sampling events, July-Sept. for estuarine and salt pond sites.

Embayment	Sample ID	Secchi average (meters)	Secchi Depth % of WC	20% Low DO (mg/L)	20% Low DO (% Sat.)	Salinity (ppt)	Avg. PO4 (mg/L)	Avg. NH4 (mg/L)	Avg. Nox (mg/L)	Avg. DIN (mg/L)	Avg. DON (mg/L)	Avg. TDN (mg/L)	Avg. POC (mg/L)	Avg. PON (mg/L)	Avg. TON (mg/L)	Avg. TN (mg/L)	Avg. Chla (ug/L)	Avg. Phaeo (ug/L)	Chla/Phaeo Ratio	Avg. Total Pig (ug/L)
CAPE POGUE BAY	POG2	2.68	49%	5.04	72%	32.48	0.0108	0.0106	0.0012	0.0119	0.2433	0.2552	0.5023	0.0814	0.3247	0.3366	1.35	0.42	0.75	1.77
	POG3	2.25	45%	4.17	60%	32.63	0.0130	0.0220	0.0027	0.0247	0.4733	0.4980	0.5358	0.0929	0.5662	0.5908	1.00	0.74	0.56	1.74
	POG4	2.44	66%	4.66	68%	32.73	0.0119	0.0158	0.0015	0.0173	0.2834	0.3007	0.6006	0.1044	0.3879	0.4051	1.42	0.76	0.63	2.18
	POG5	1.82	93%	4.25	62%	32.65	0.0110	0.0160	0.0030	0.0190	0.3723	0.3913	0.6062	0.1078	0.4801	0.4991	1.05	0.91	0.53	1.96
POCHA POND	PCA1	1.07	100%	4.25	63%	32.58	0.0113	0.0200	0.0040	0.0239	0.3099	0.3338	0.6890	0.1170	0.4269	0.4509	1.30	0.94	0.58	2.24
	PCA2	1.80	72%	4.97	72%	33.50	0.0111	0.0040	0.0020	0.0059	0.2338	0.2397	0.9450	0.1444	0.3782	0.3841	2.15	0.76	0.74	2.91
	PCA3	1.48	87%	4.09	61%	32.58	0.0100	0.0205	0.0040	0.0245	0.3462	0.3707	0.8561	0.1405	0.4868	0.5112	1.56	0.94	0.61	2.50
KATAMA BAY	KAT1	3.03	35%	4.86	69%	32.43	0.0165	0.0132	0.0033	0.0164	0.2520	0.2684	0.4454	0.0828	0.3348	0.3513	1.23	0.49	0.73	1.72
	KAT2	2.81	60%	4.78	68%	32.43	0.0184	0.0145	0.0029	0.0174	0.2849	0.3023	0.4782	0.0834	0.3682	0.3857	1.33	0.74	0.64	2.07
	KAT3	1.16	100%	4.57	66%	32.08	0.0210	0.0127	0.0024	0.0151	0.2363	0.2514	0.6866	0.1247	0.3610	0.3761	2.16	0.76	0.72	2.93
	KAT4	2.00	18%	4.79	69%	32.33	0.0228	0.0195	0.0045	0.0240	0.2914	0.3155	0.6498	0.1165	0.4079	0.4319	2.07	1.20	0.63	3.28
	KAT5	1.80	63%	4.71	68%	32.15	0.0288	0.0150	0.0031	0.0181	0.2629	0.2809	0.7049	0.1402	0.4031	0.4211	2.38	1.20	0.66	3.57
	KAT7	1.28	94%	4.56	65%	32.08	0.0263	0.0118	0.0017	0.0135	0.2903	0.3038	0.8422	0.1553	0.4456	0.4591	3.03	1.20	0.71	4.23
EDGARTOWN GREAT POND	EGP2	2.38	92%	3.63	68%	21.63	0.0012	0.0338	0.0024	0.0362	0.3938	0.4300	0.6454	0.1223	0.5160	0.5522	1.64	0.27	0.83	1.91
	EGP3	2.63	78%	4.75	66%	21.50	0.0009	0.0222	0.0019	0.0242	0.3791	0.4033	0.6010	0.1118	0.4909	0.5151	2.03	0.17	0.91	2.19
	EGP4	1.75	100%	4.59	65%	21.50	0.0011	0.0390	0.0062	0.0453	0.3479	0.3931	0.6677	0.1028	0.4506	0.4959	1.23	0.24	0.80	1.47
	EGP5	2.23	100%	4.83	68%	22.85	0.0005	0.0274	0.0022	0.0295	0.3897	0.4192	0.7599	0.1249	0.5146	0.5441	2.09	0.24	0.84	2.33
	EGP6	2.28	100%	4.65	65%	22.43	0.0005	0.0206	0.0014	0.0220	0.3816	0.4036	0.7398	0.1311	0.5128	0.5347	2.66	0.19	0.87	2.85
	EGP7	2.66	100%	4.56	64%	22.78	0.0009	0.0329	0.0016	0.0345	0.3934	0.4279	0.6456	0.1126	0.5061	0.5406	1.60	0.19	0.86	1.80
	EGP9	1.88	100%	4.60	65%	20.78	0.0009	0.0203	0.0027	0.0230	0.3090	0.3319	0.8229	0.1366	0.4456	0.4686	1.85	0.34	0.84	2.19
	EGP10	1.80	100%	4.33	62%	21.08	0.0013	0.0231	0.0021	0.0253	0.3580	0.3833	0.7030	0.1152	0.4732	0.4984	1.73	0.22	0.87	1.95
	EGP11	1.60	100%	4.16	59%	21.40	0.0009	0.0494	0.0029	0.0523	0.3969	0.4492	0.5736	0.0994	0.4963	0.5486	1.10	0.23	0.82	1.33
CHILMARK POND	CHP UP	0.78	56%	6.46	79%	0.13	0.0326	0.0030	0.0024	0.0055	0.4145	0.4200	3.7003	0.6761	1.0907	1.0961	23.19	0.96	0.97	24.16
	CHP7	0.72	100%	2.78	36%	5.77	0.0174	0.0207	0.0042	0.0249	0.5248	0.5497	2.3354	0.4127	0.9375	0.9624	13.16	1.64	0.80	14.80
	CHP6	0.85	89%	4.98	65%	9.20	0.0168	0.0190	0.0032	0.0222	0.5525	0.5747	1.9863	0.3488	0.9013	0.9235	6.81	0.72	0.88	7.53
	CHP5	1.18	61%	5.28	69%	9.50	0.0064	0.0061	0.0019	0.0081	0.5672	0.5753	1.7618	0.2570	0.8223	0.8320	4.98	0.43	0.88	5.41
	CHP4	1.09	80%	5.50	71%	9.75	0.0108	0.0041	0.0020	0.0061	0.5918	0.5979	1.1489	0.1995	0.7913	0.7974	3.59	0.69	0.84	4.27
	CHP2	1.16	54%	5.13	67%	9.88	0.0215	0.0034	0.0023	0.0056	0.5609	0.5665	1.7785	0.2893	0.8502	0.8558	6.04	0.62	0.87	6.66
	CHP1	0.90	61%	4.91	64%	9.58	0.0059	0.0038	0.0024	0.0062	0.6427	0.6489	2.6034	0.3750	1.0178	1.0240	9.32	0.48	0.92	9.80
OAK BLUFFS HARBOR	MV14	0.90	100%	3.73	52%	30.50	0.0142	0.0096	0.0262	0.0358	0.2533	0.2891	0.9596	0.1742	0.4275	0.4633	2.48	1.14	0.69	3.62
	MV15	1.79	100%	4.56	63%	31.60	0.0176	0.0095	0.0126	0.0221	0.2713	0.2934	0.8708	0.1273	0.3987	0.4207	2.43	0.77	0.74	3.20
	MV16	2.81	78%	4.80	67%	31.81	0.0129	0.0132	0.0035	0.0167	0.2082	0.2249	0.5120	0.0810	0.2892	0.3059	1.45	0.62	0.69	2.08
FARM POND	FRM1	0.79	100%	4.30	62%	31.58	0.0153	0.0106	0.0060	0.0165	0.3033	0.3199	0.6457	0.1074	0.4108	0.4273	1.48	0.59	0.71	2.07
	FRM2	0.97	100%	3.42	48%	31.55	0.0149	0.0073	0.0038	0.0110	0.3407	0.3517	0.6054	0.1111	0.4518	0.4628	1.20	0.73	0.64	1.93
	FRM3	1.20	100%	2.84	42%	30.65	0.0613	0.0070	0.0036	0.0106	0.3615	0.3721	0.9738	0.1720	0.5334	0.5440	2.38	0.97	0.74	3.35
SENGEKONTACKET POND	SKT2	1.88	100%	4.25	61%	31.88	0.0135	0.0143	0.0022	0.0165	0.3474	0.3639	0.6014	0.0951	0.4425	0.4590	1.15	0.48	0.70	1.62
	SKT3	2.37	89%	3.93	57%	31.50	0.0115	0.0141	0.0027	0.0167	0.3804	0.3971	0.7691	0.1481	0.5285	0.5452	2.72	0.67	0.74	3.39
	SKT4	1.41	98%	3.82	55%	30.85	0.0151	0.0142	0.0041	0.0184	0.2883	0.3066	0.7281	0.1305	0.4188	0.4372	1.50	1.06	0.58	2.56
	SKT5	1.23	100%	4.59	65%	31.95	0.0112	0.0101	0.0016	0.0117	0.2286	0.2403	0.4614	0.0753	0.3039	0.3156	0.88	0.54	0.59	1.41
	SKT6	2.27	100%	4.44	63%	31.95	0.0135	0.0134	0.0022	0.0157	0.2150	0.2306	0.3810	0.0679	0.2828	0.2985	0.82	0.36	0.69	1.18
	SKT8	1.93	100%	4.28	62%	31.48	0.0040	0.0121	0.0017	0.0138	0.3192	0.3330	0.5876	0.1124	0.4316	0.4454	1.31	0.35	0.77	1.66
	SKT9	0.30	100%	3.48	51%	30.45	0.0085	0.0250	0.0045	0.0295	0.3899	0.4195	0.5468	0.0890	0.4789	0.5085	0.93	0.74	0.57	1.67
FRESH POND	FRS1	1.93	59%	5.44	68%	0.05	0.0016	0.0020	0.0041	0.0061	0.4076	0.4137	0.8022	0.1103	0.5179	0.5240	1.50	0.71	0.64	2.22
	FRS2	1.78	88%	5.48	69%	0.03	0.0026	0.0030	0.0033	0.0063	0.4127	0.4190	0.7497	0.1201	0.5328	0.5391	1.15	0.67	0.63	1.82
	FRS3	1.98	89%	5.50	69%	0.03	0.0049	0.0072	0.0049	0.0121	0.3999	0.4120	0.6857	0.0906	0.4905	0.5026	1.17	0.70	0.62	1.87
LAGOON POND	LGP11	0.93	78%	2.75	35%	26.48	0.0088	0.0280	0.3447	0.3727	0.4802	0.8528	5.6625	0.9640	1.4553	1.8279	8.16	7.46	0.64	15.61
	LGP12	0.23	89%	2.96	39%	23.58	0.0190	0.0344	0.2872	0.3216	0.5719	0.8935	5.8302	1.0202	1.5921	1.9136	11.00	5.96	0.66	16.97
	LGP2	2.73	31%	1.94	27%	31.75	0.0213	0.0119	0.0021	0.0141	0.2654	0.2795	0.9164	0.1526	0.4180	0.4320	3.28	0.72	0.79	4.00
	LGP4	2.69	36%	0.49	7%	31.48	0.0268	0.0111	0.0020	0.0131	0.2568	0.2698	1.2330	0.1904	0.4471	0.4602	3.07	0.98	0.73	4.05
	LGP6	2.19	42%	2.94	42%	31.20	0.0332	0.0196	0.0042	0.0238	0.3892	0.4130	0.5614	0.1060	0.3587	0.3858	1.27	0.49	0.72	1.75
	LGP8	2.88	48%	4.31	60%	31.38	0.0151	0.0117	0.0017	0.0134	0.2376	0.2510	0.9078	0.1360	0.3736	0.3870	3.02	0.45	0.81	3.47
	LGP9	3.20	59%	3.99	57%	31.65	0.0143	0.0097	0.0021	0.0119	0.2050	0.2169	0.6397	0.1005	0.3055	0.3174	2.29	0.70	0.70	2.99
LAKE TASHMOO	MV21	0.81	100%	5.13	71%	31.63	0.0126	0.0114	0.0028	0.0142	0.1910	0.2052	0.4163	0.0676	0.2586	0.2728	1.07	0.44	0.72	1.51
	MV2	2.80	93%	4.82	66%	31.60	0.0320	0.0125	0.0018	0.0142	0.2374	0.2516	0.4819	0.0844	0.3217	0.3360	1.47	0.46	0.77	1.94
	MV3	2.46	88%	4.66	65%	31.53	0.0153	0.0097	0.0021	0.0118	0.2308	0.2425	0.6889	0.1088	0.3396	0.3514	1.33	0.58	0.72	1.91
	MV4	2.60	84%	4.70	65%	31.68	0.0146	0.0125	0.0016	0.0140	0.2268	0.2408	0.7036	0.1138	0.3406	0.3546	1.97	0.79	0.71	2.75
	MVSEN	2.00	70%	4.38	62%	30.89	0.0173	0.0138	0.0046	0.0184	0.2386	0.2570	1.4494	0.2249	0.4636	0.4820	4.10	0.92	0.80	5.02

Table 2c. Summary of Water Quality Parameters, 2016 Martha's Vineyard Island-wide Water Quality Monitoring Program. Values are Station Averages of all sampling events, July-Aug for estuarine and salt pond sites. Farm Pond and Oak Bluffs Harbor received 1 sampling event in August and 1 in September. All other systems were sampled twice in both July and August.

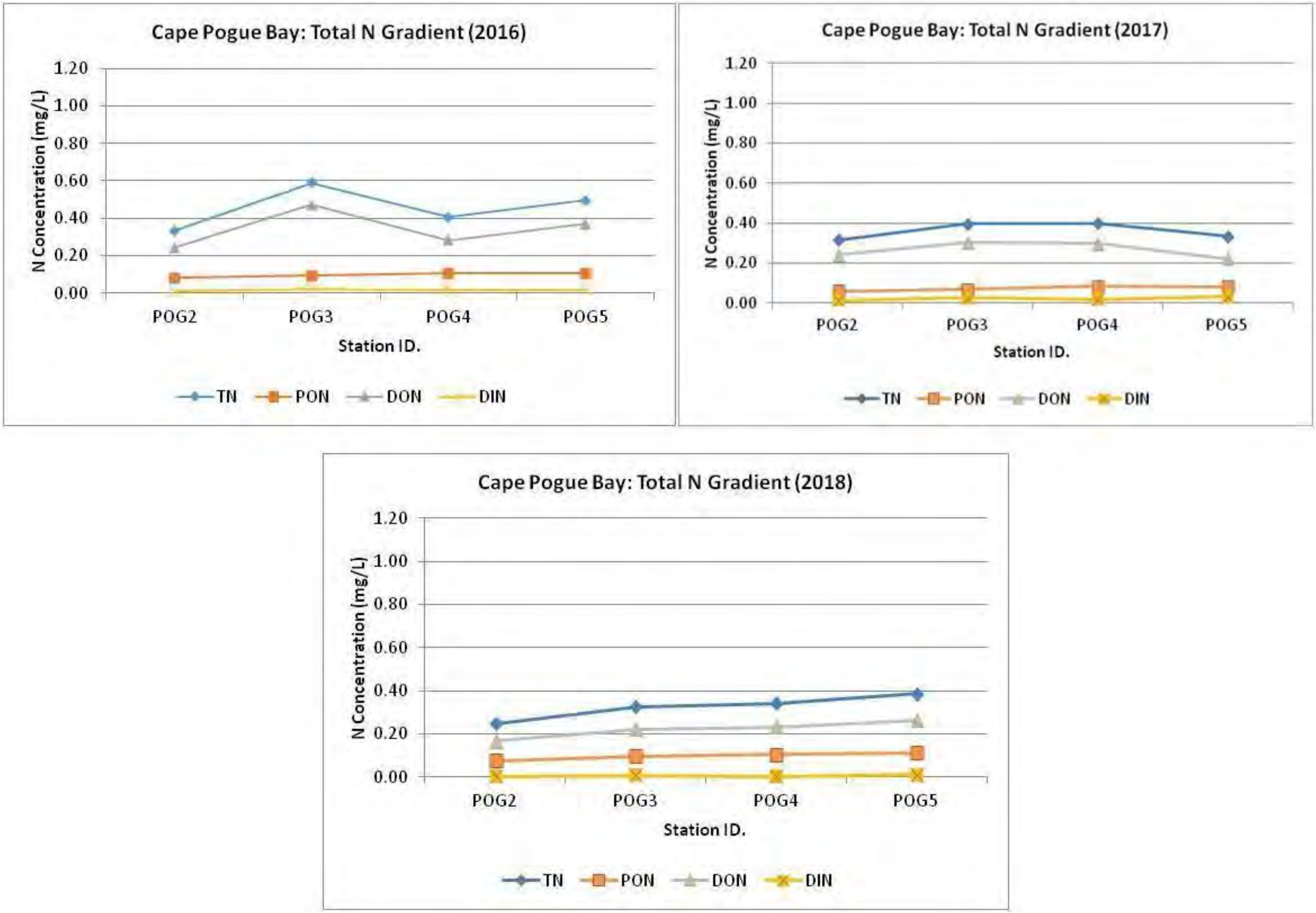


Figure 17. Comparison of nitrogen species in the Martha's Vineyard estuaries and salt ponds (Summer 2016, 2017 and 2018 sampling season). Presently, no MEP Threshold set for Cape Pogue Bay.

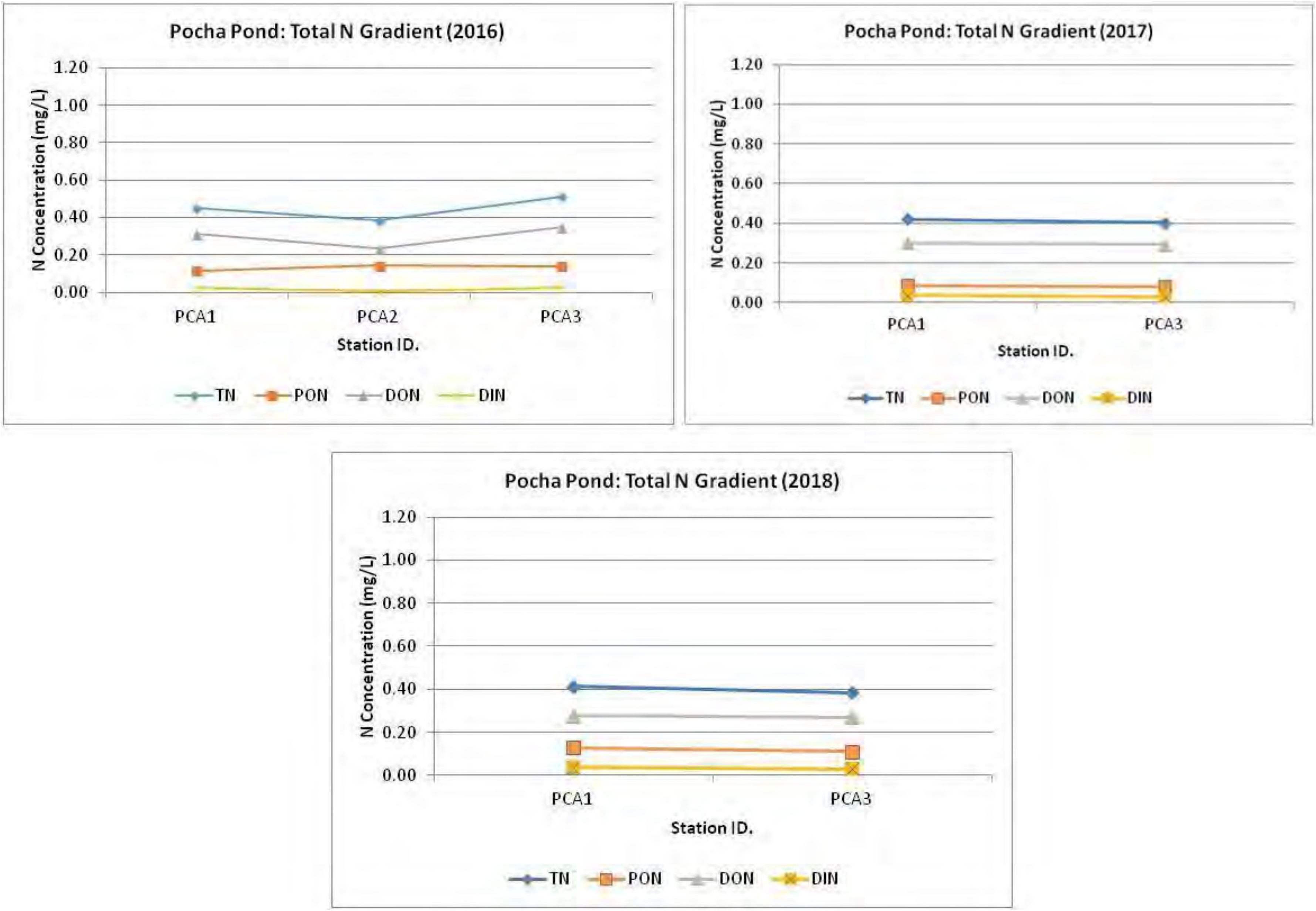
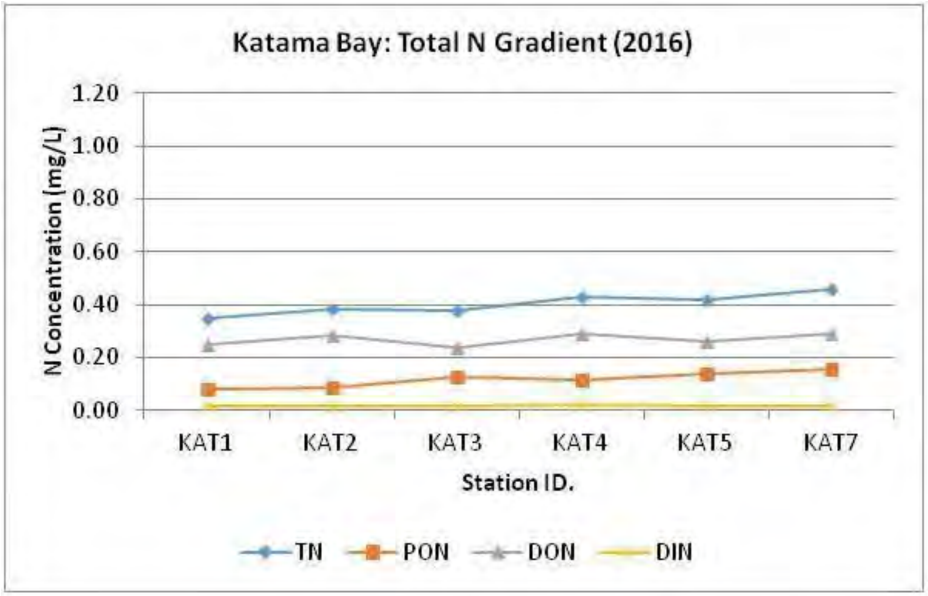
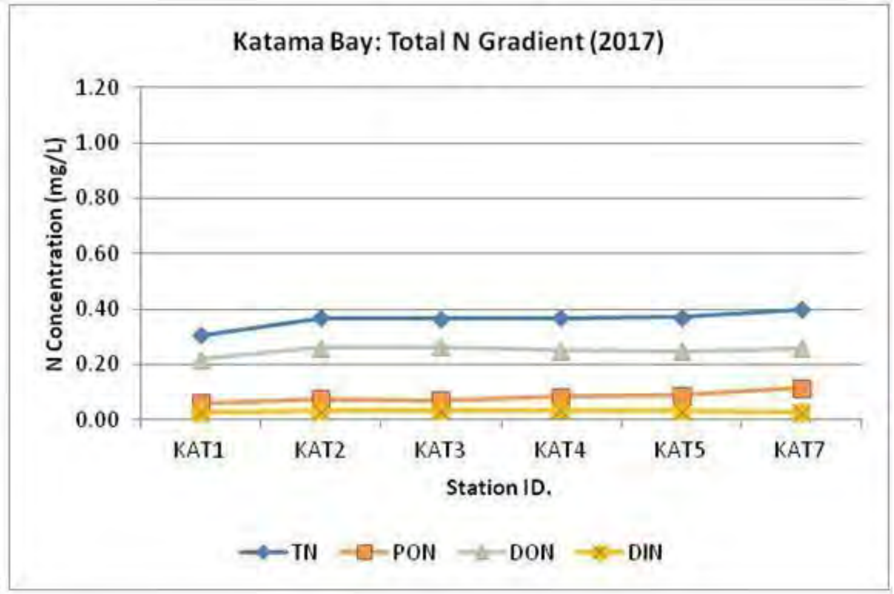


Figure 17 cont'd. Comparison of nitrogen species in the Martha's Vineyard estuaries and salt ponds (Summer 2016, 2017 and 2018 sampling season). Presently, no MEP Threshold set for Pocha Pond.





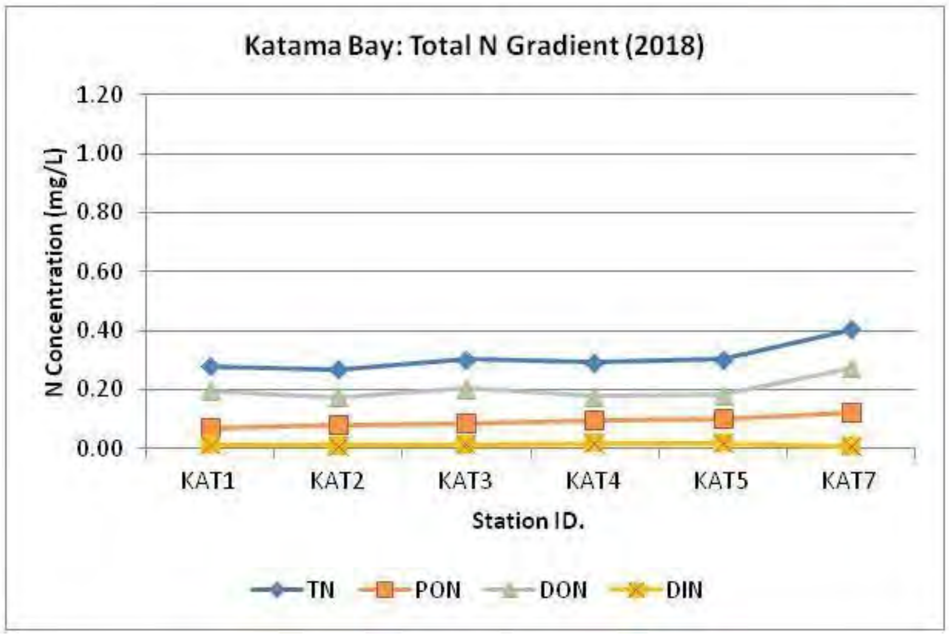


Figure 17 cont'd. Comparison of nitrogen species in the Martha's Vineyard estuaries and salt ponds (Summer 2016, 2017 and 2018 sampling season). Presently, no MEP Threshold set for Katama Bay.

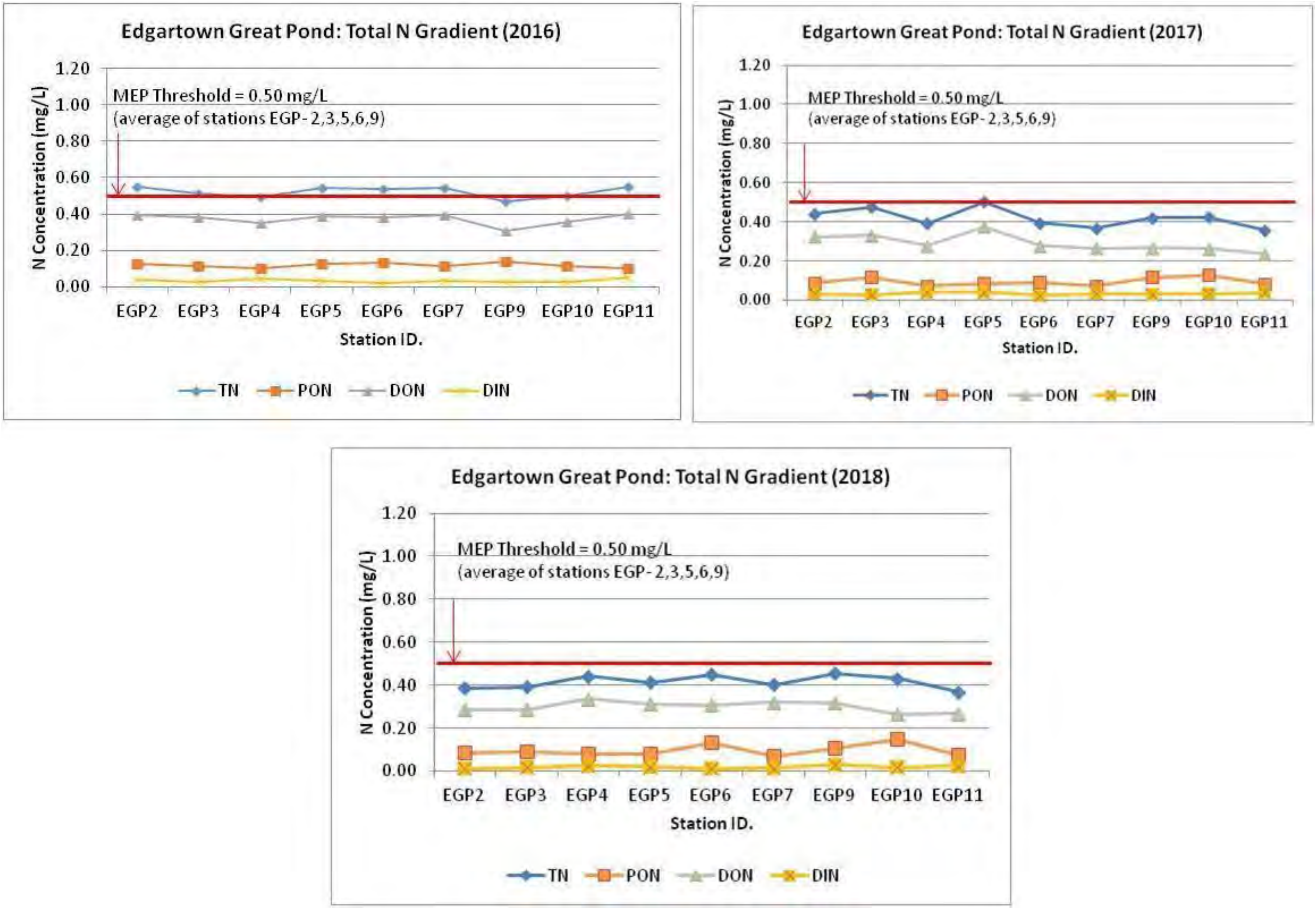


Figure 17 cont'd. Comparison of nitrogen species in the Edgartown Great Pond system (Summer 2016, 2017 and 2018 sampling season).

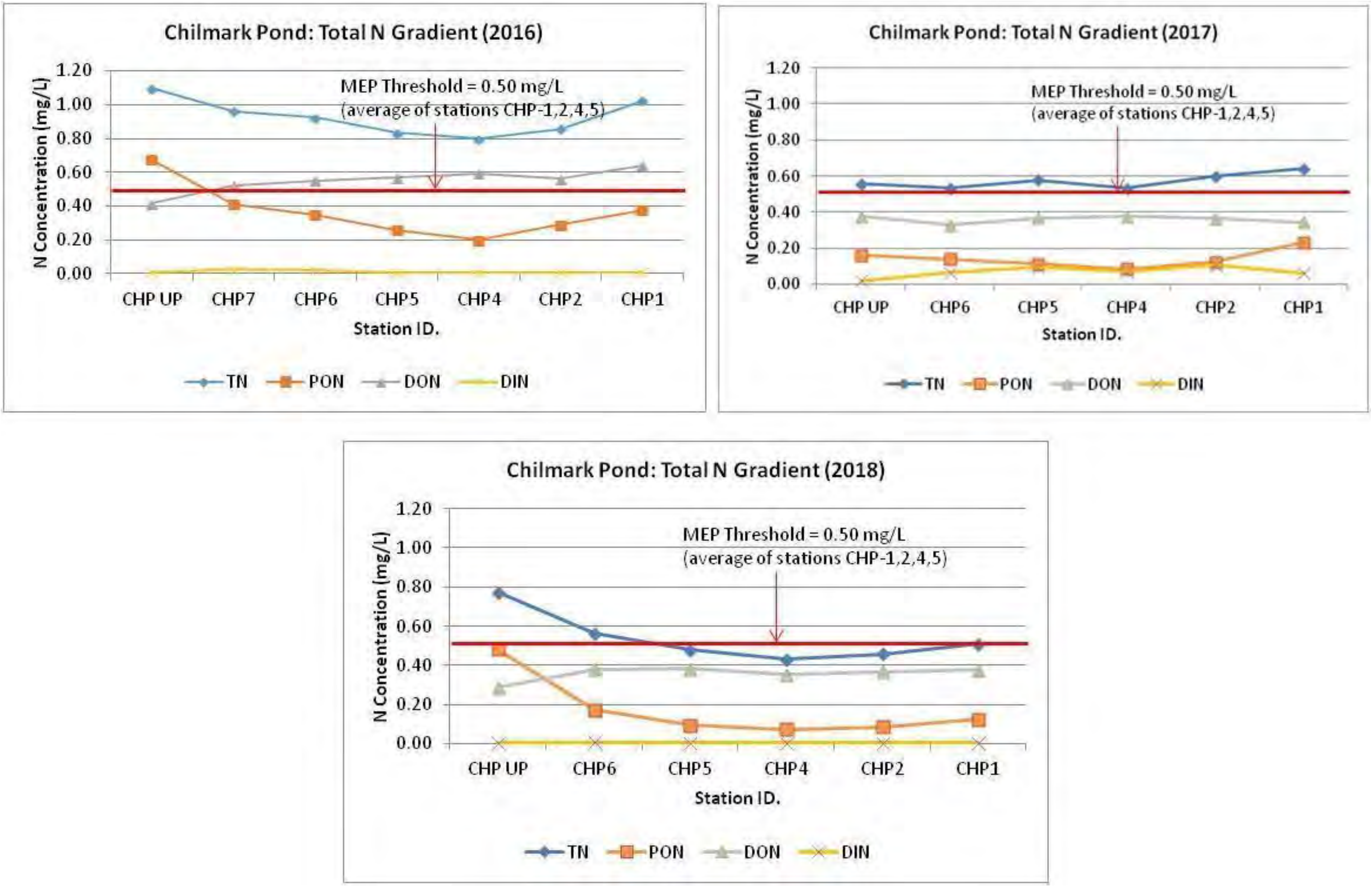


Figure 17 cont'd. Comparison of nitrogen species in the Chilmark Pond system (Summer 2016, 2017 and 2018 sampling season).

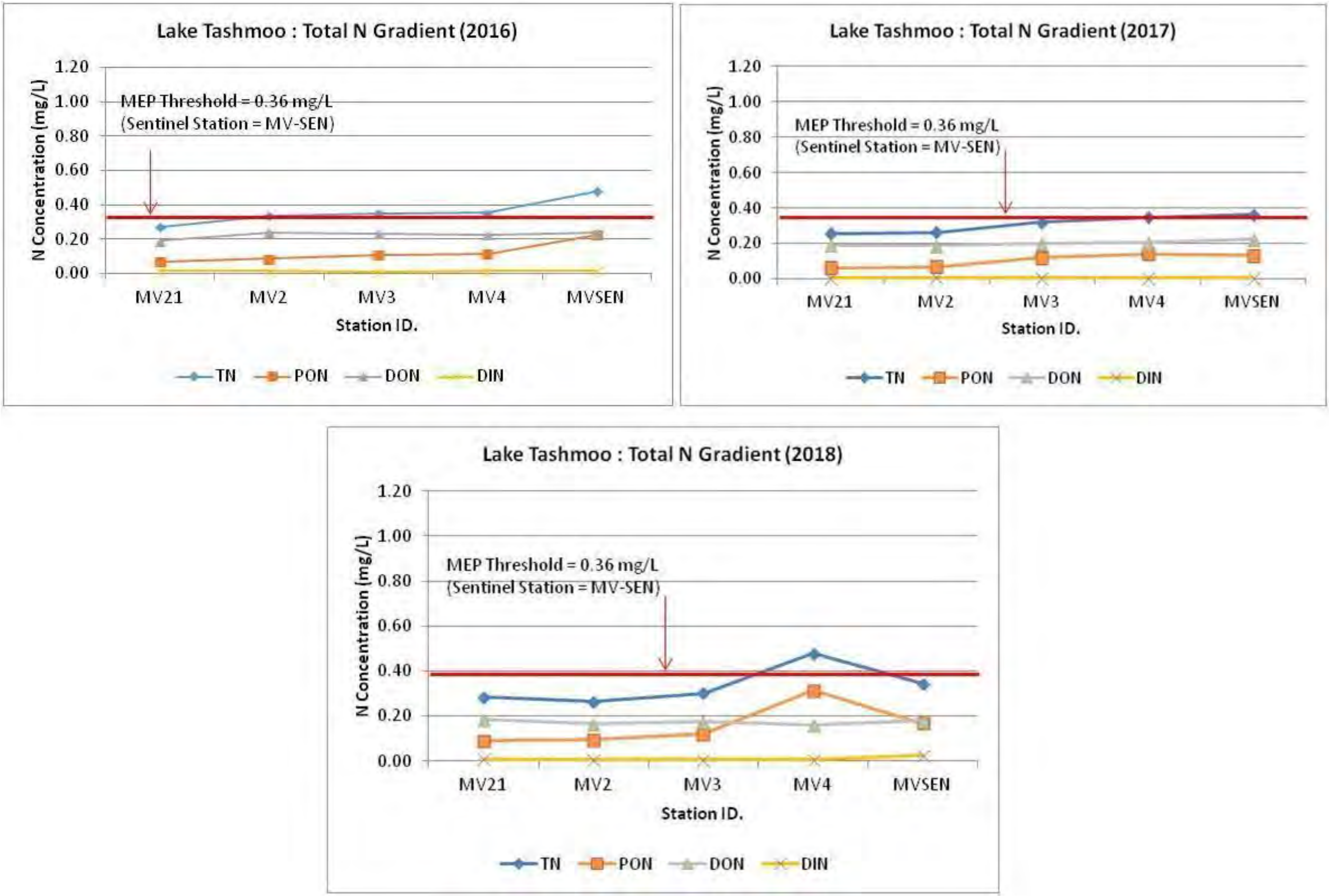


Figure 17 cont'd. Comparison of nitrogen species in the Lake Tashmoo system (Summer 2016, 2017 and 2018 sampling season).

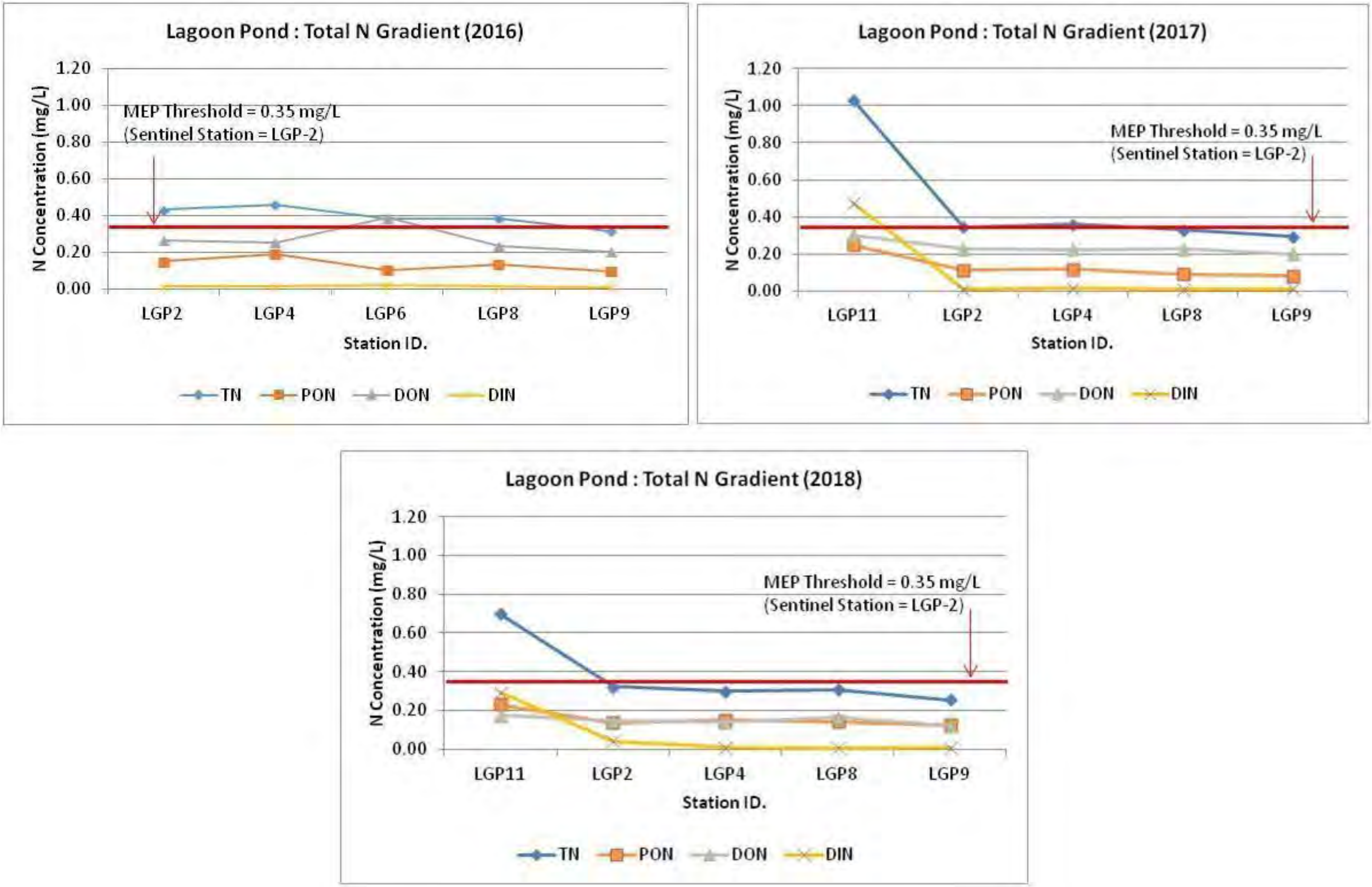


Figure 17 cont'd. Comparison of nitrogen species in the Lagoon Pond system (Summer 2016, 2017 and 2018 sampling season).

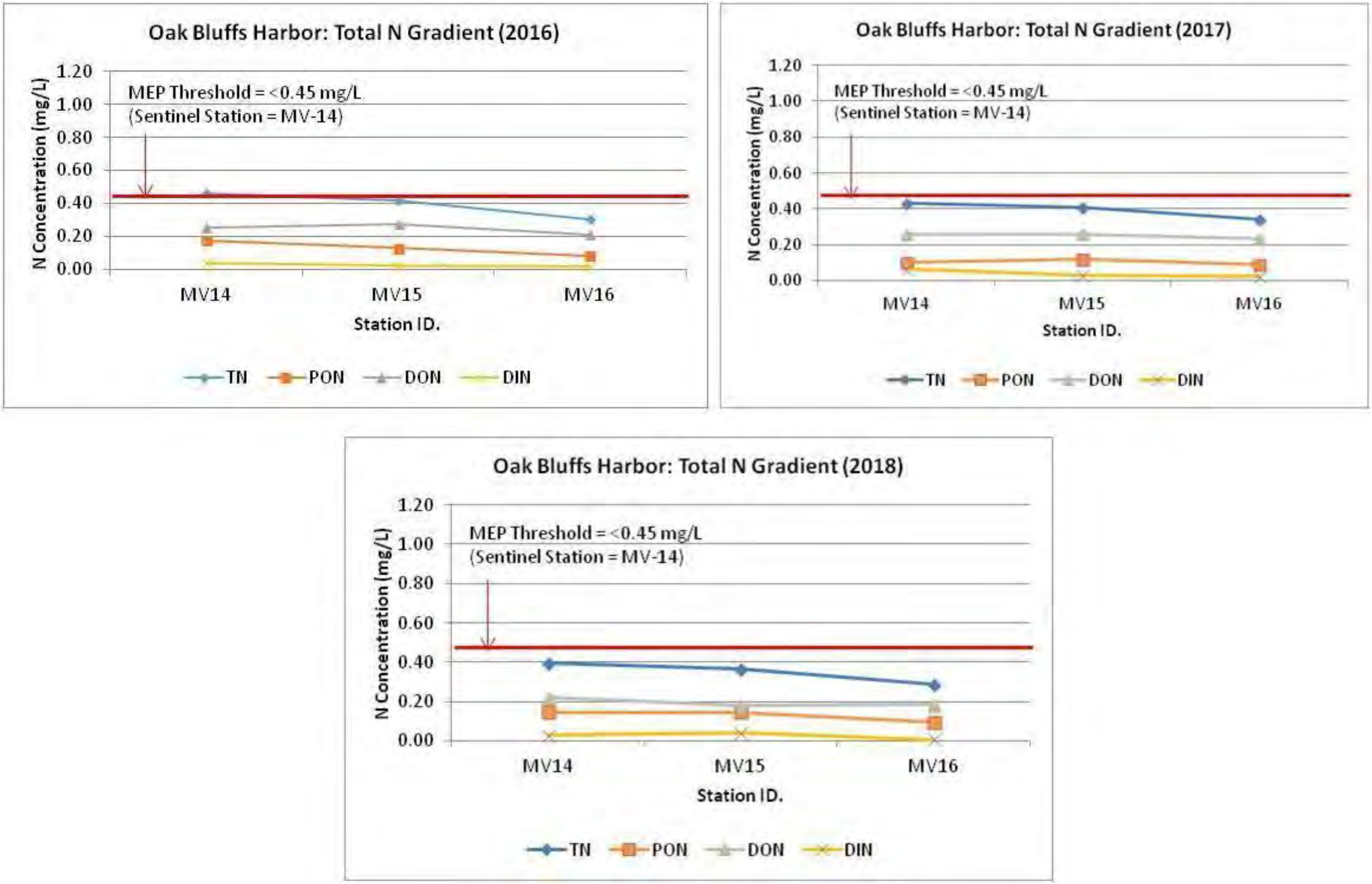


Figure 17 cont'd. Comparison of nitrogen species in the Oak Bluffs Harbor system (Summer 2016, 2017 and 2018 sampling season).

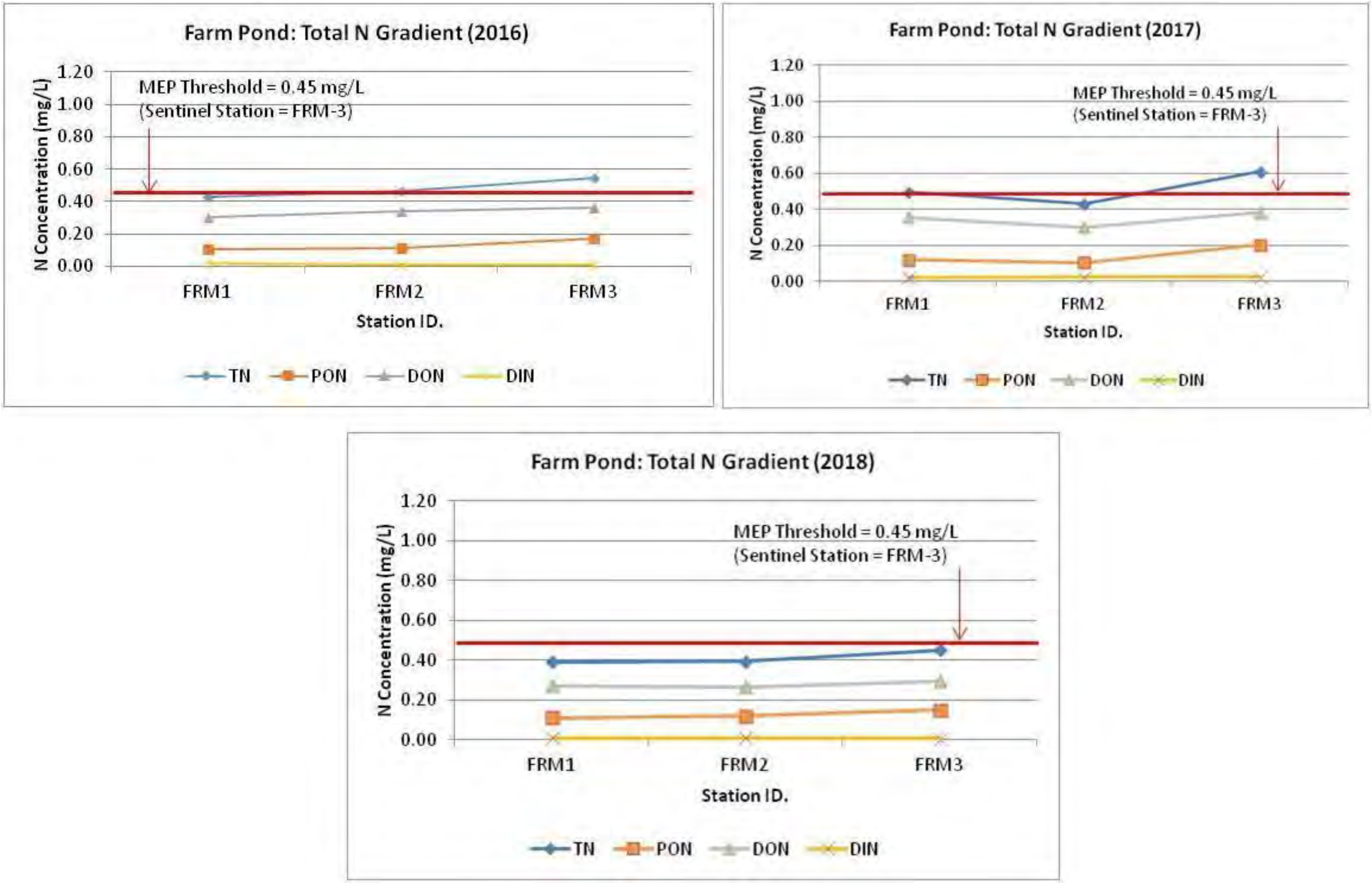


Figure 17 cont'd. Comparison of nitrogen species in the Farm Pond system (Summer 2016, 2017 and 2018 sampling season).

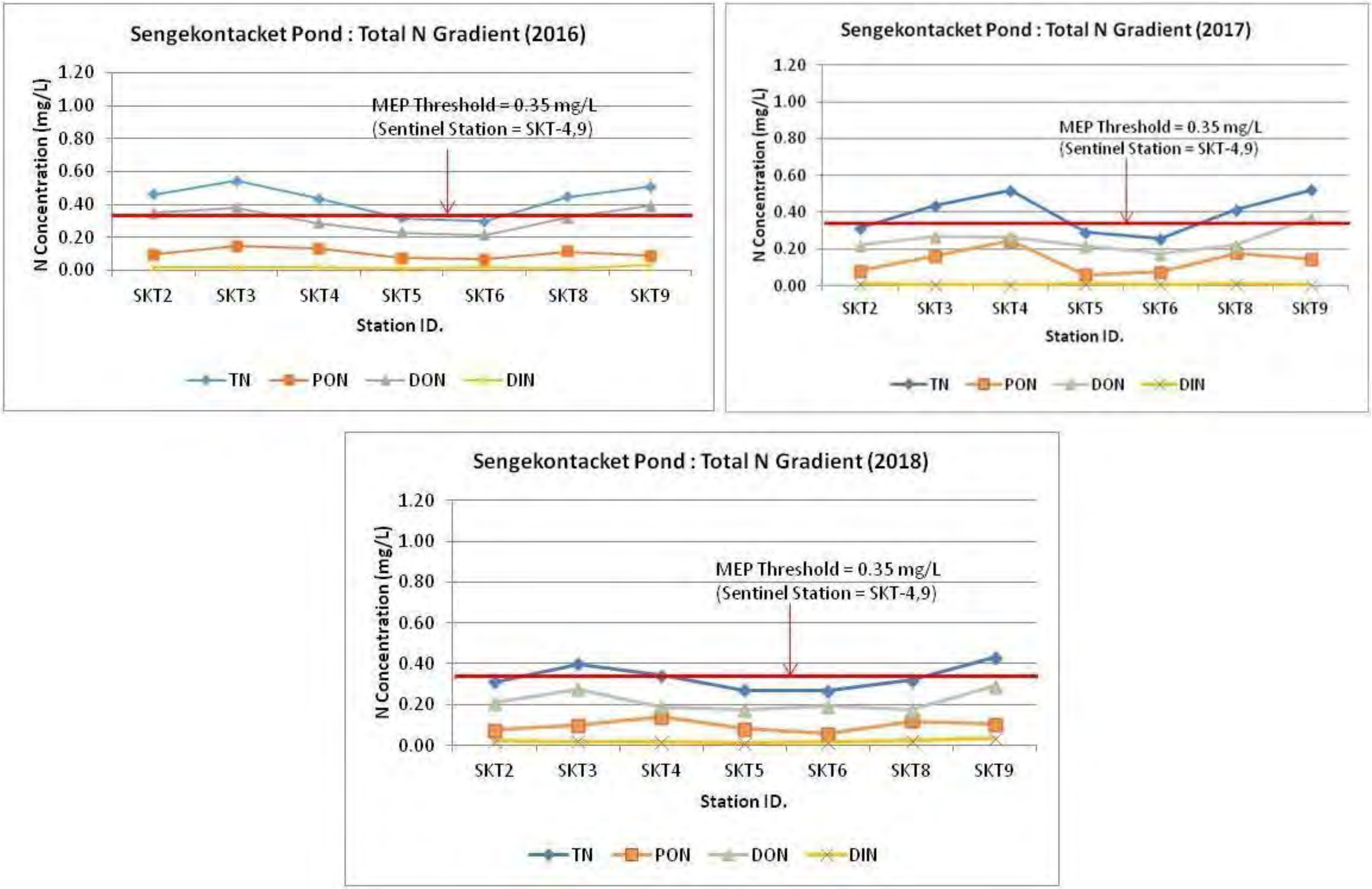


Figure 17 cont'd. Comparison of nitrogen species in the Sengekontacket Pond system (Summer 2016, 2017 and 2018 sampling season).

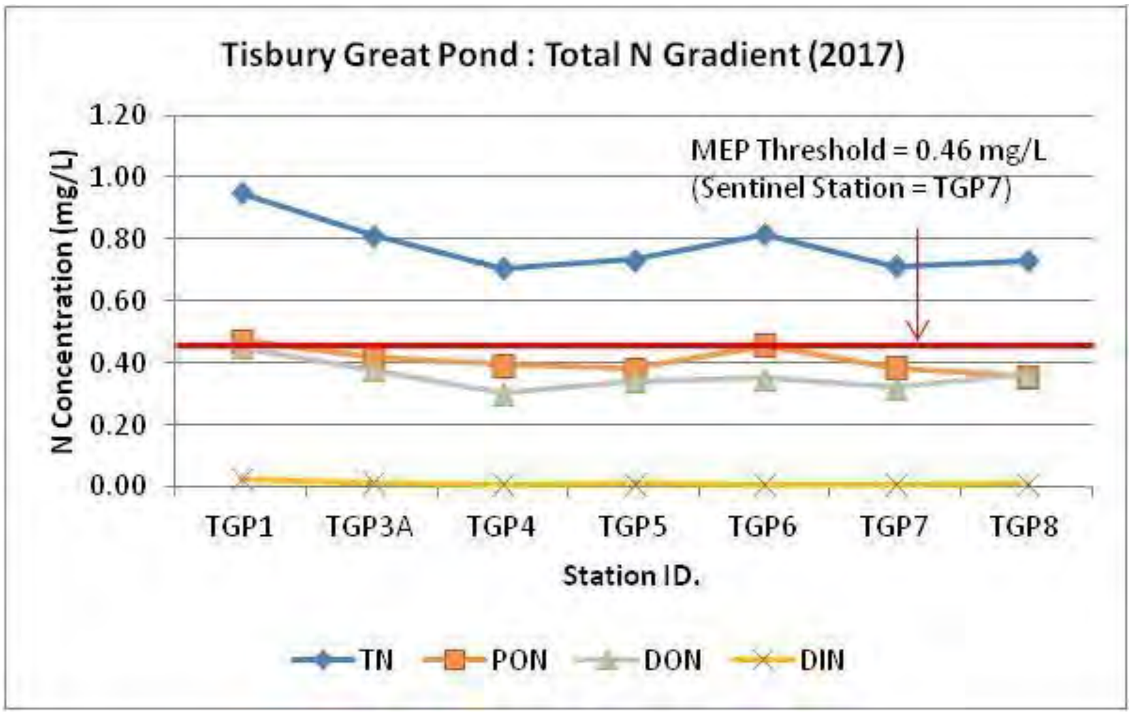


Figure 17 cont'd. Comparison of nitrogen species in the Tisbury Great Pond system (Summer 2017 sampling season, no sampling in 2016).

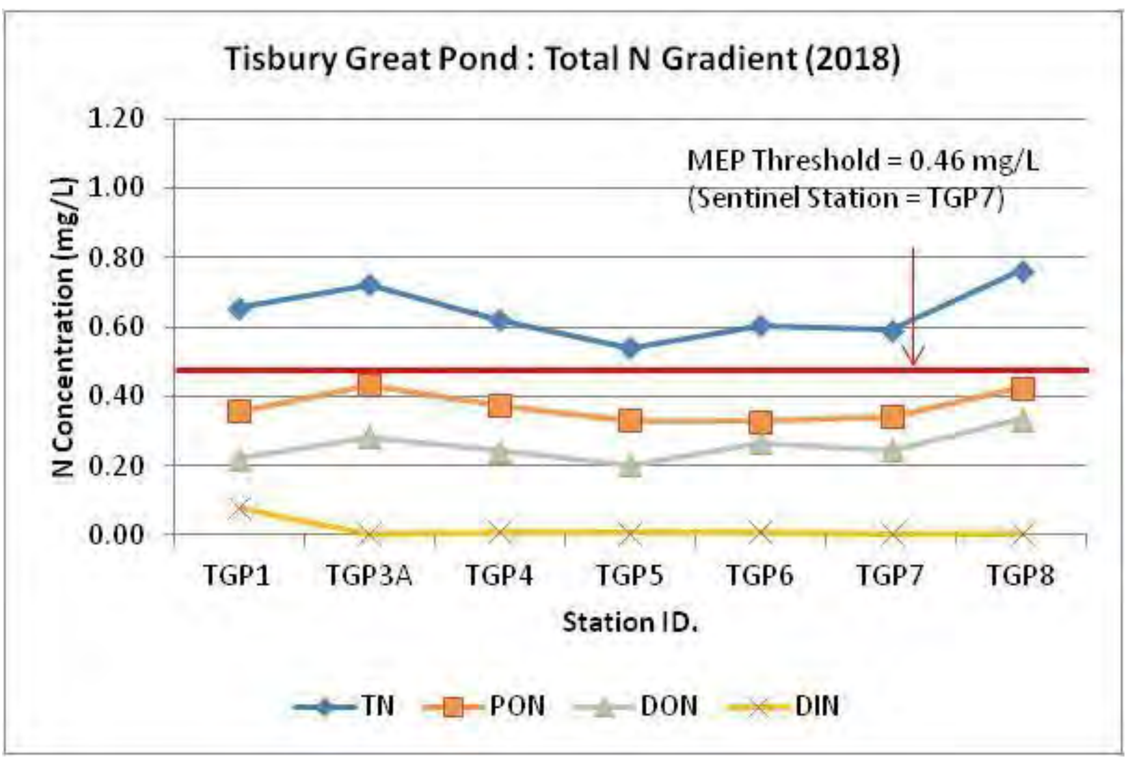


Figure 17 cont'd. Comparison of nitrogen species in the Tisbury Great Pond system (Summer 2018 sampling season, no sampling in 2016).

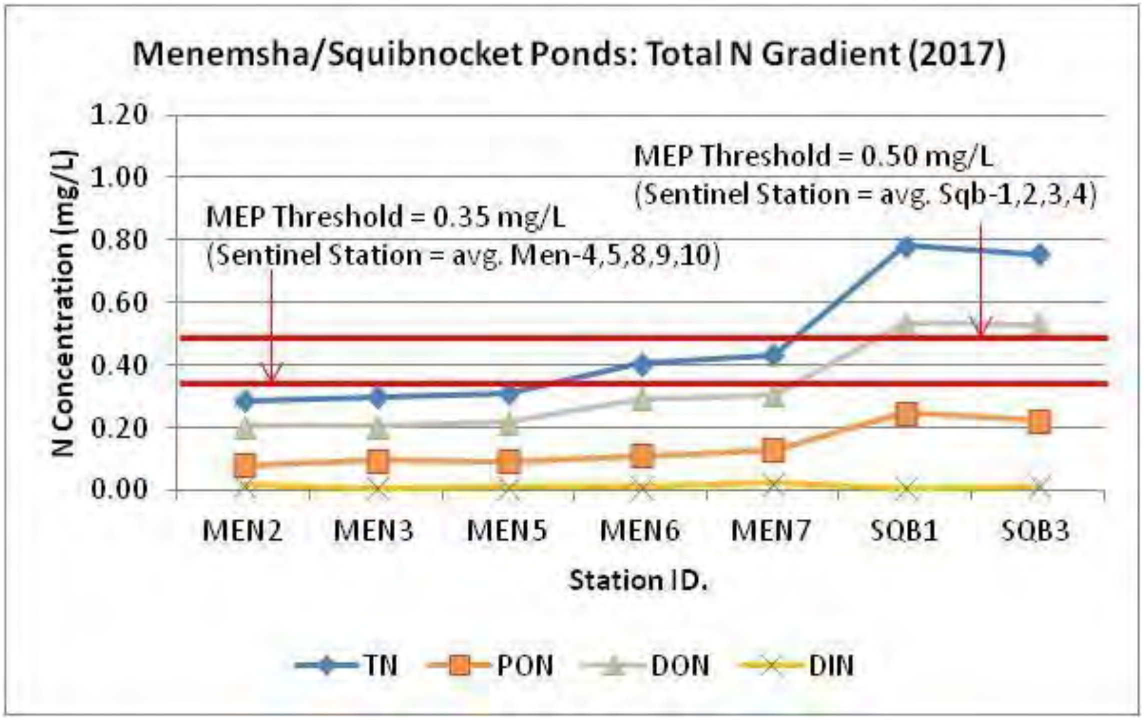


Figure 17 cont'd. Comparison of nitrogen species in the Menemsha Pond and Squibnocket Pond system (Summer 2017 sampling season, no sampling in 2016).

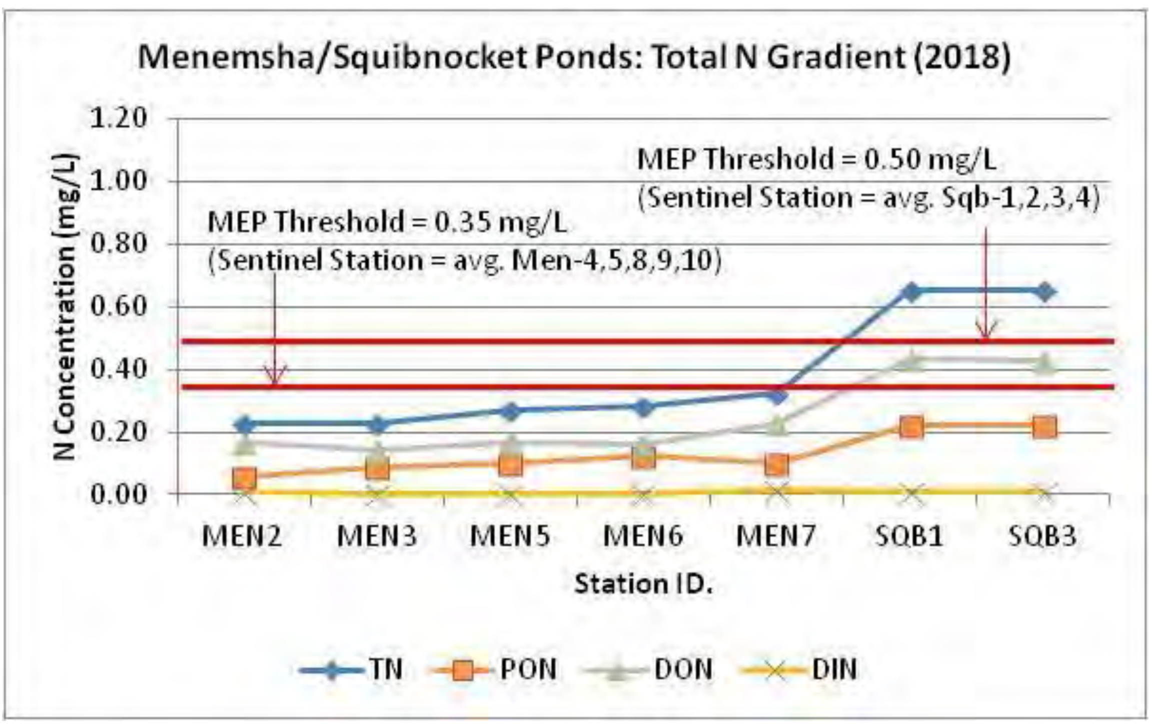


Figure 17 cont'd. Comparison of nitrogen species in the Menemsha Pond and Squibnocket Pond system (Summer 2018 sampling season, no sampling in 2016).

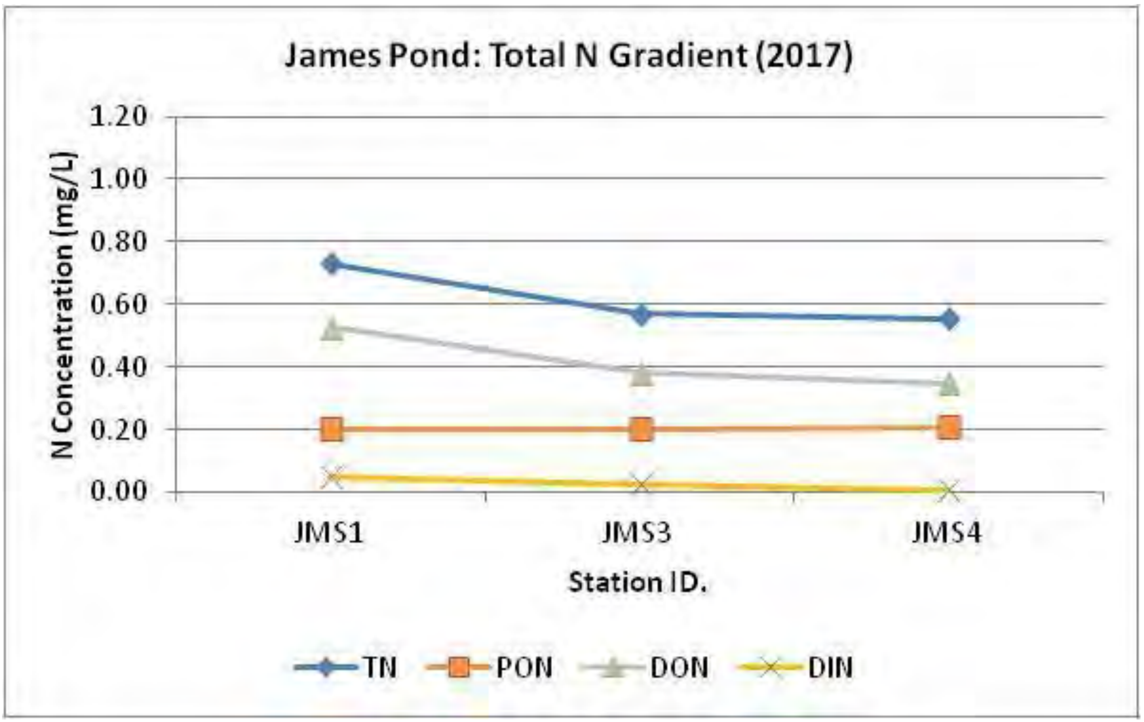


Figure 17 cont'd. Comparison of nitrogen species in the James Pond system (Summer 2017 sampling season, no sampling in 2016).

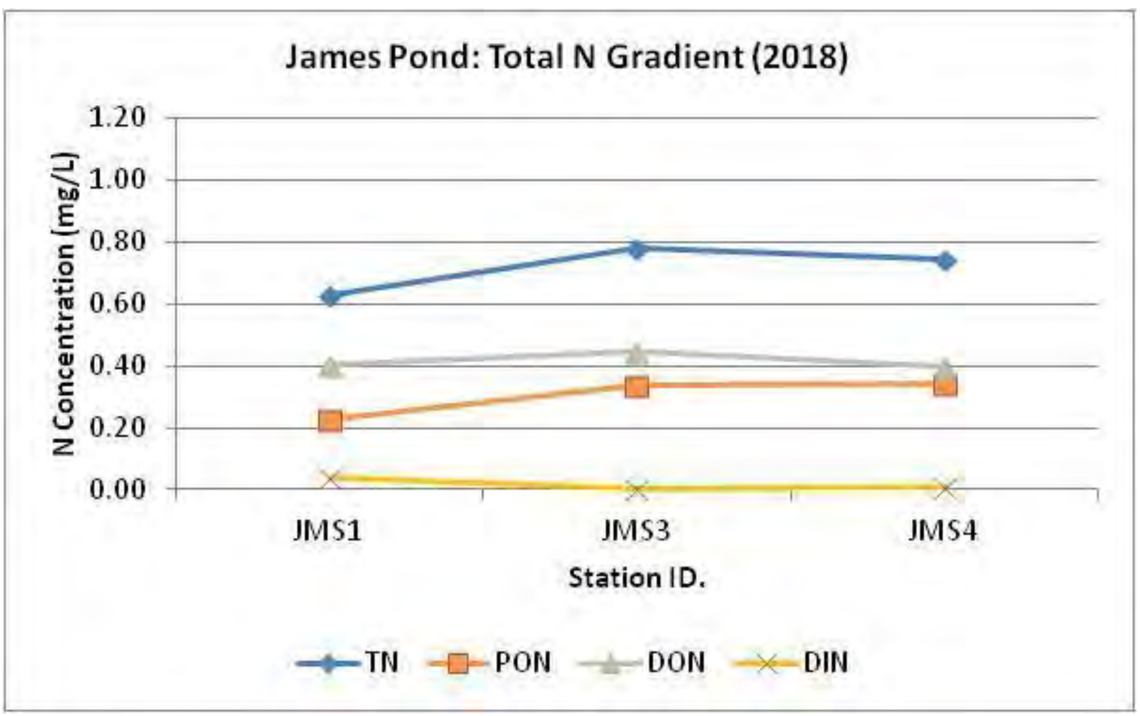


Figure 17 cont'd. Comparison of nitrogen species in the James Pond system (Summer 2018 sampling season, no sampling in 2016).

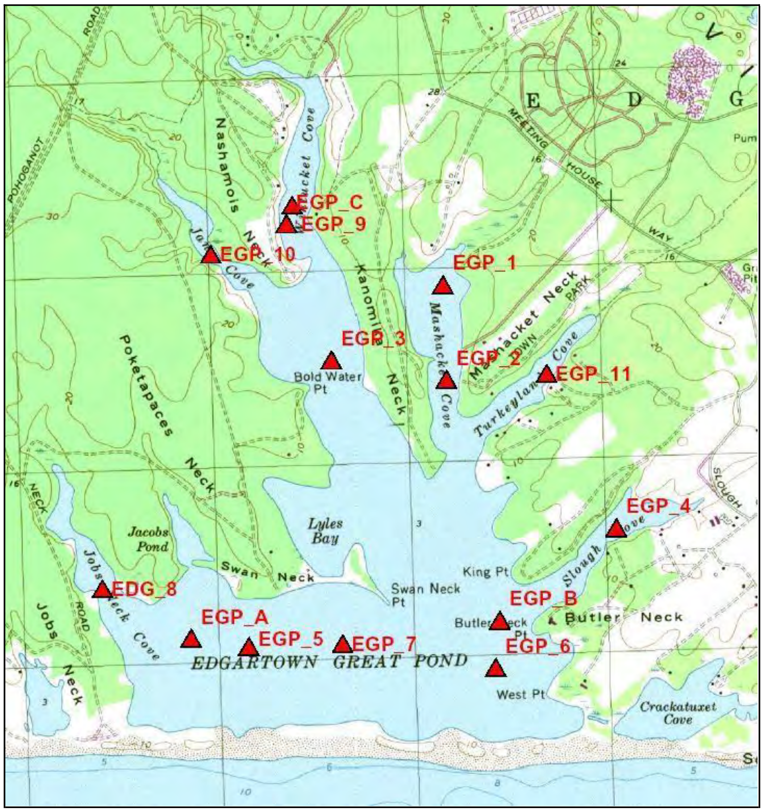


Figure 18. Estuarine water quality monitoring station locations in the Edgartown Great Pond estuary system. Station labels correspond to those provided in Table 3 below. Red diamonds indicate locations of MEP monitoring stations. Not all stations were included in the summer 2016 sampling effort. MEP "Sentinel station" (average of EGP 2,3,5,6,9). MEP TN threshold = 0.50 mg/L.

Station Location	MEP TN (mg/L)	MEP Salinity (ppt)	2016 TN (mg/L)	2017 TN (mg/L)	2018 TN (mg/L)
Jobs Neck Cove – EGP8	0.583	17.9			
Jane's Cove – EGP10	0.582	16.5	**0.498**	**0.422**	**0.430**
Wintucket Cove – EGP9	0.597	18	**0.469**	**0.421**	**0.450**
Upper Mash Cove – EGP1	0.65	18.9			
Lower Mash Cove – EGP2	0.613	18.2	**0.552**	**0.441**	**0.390**
Turkeyland Cove – EGP11	0.639	19.8	**0.549**	**0.356**	**0.370**
Upper Slough Cove – EGP4	0.711	16.2	**0.496**	**0.39**	**0.440**
Upper EGP Basin – EGP3	0.587	18.4	**0.515**	**0.477**	**0.390**
Lower EGP West – EGP5	0.595	20.9	**0.544**	**0.502**	**0.410**
Lower EGP East – EGP6	0.591	22.1	**0.535**	**0.394**	**0.450**
Lower EGP Mid - EGP7	--	--	**--**	**0.368**	**0.400**
Atlantic Ocean	0.232	32.3	**--**	**--**	**--**

Table 3. MEP mean values of TN and salinity used in the development of the nutrient threshold for Edgartown Great Pond. Measured nitrogen concentrations and salinities for Edgartown Great Pond. MEP values are calculated as the average of the separate yearly means. TN data represented in this table were collected in 2003 through 2006 in Great Pond and 2002 through 2004 for salinity. The offshore Atlantic Ocean data (offshore Pleasant Bay Inlet) are from the summer of 2005.

Figure 19. MEP monitoring station location in Chilmark Pond that was used in the water quality analysis for the Massachusetts Estuaries Project. MEP established "sentinel station" (average of CHP 1-5). MEP TN Threshold = 0.50 mg/L or less.

Station Location	MEP TN (mg/L)	MEP N	2016 TN (mg/L)	2017 TN (mg/L)	2018 TN (mg/L)
Wades Cove Upper (CHP-1)	**0.757**	20	**1.024**	**0.642**	**0.510**
Chilmark Pond (CHP-2)	**0.733**	20	**0.856**	**0.598**	**0.460**
Gilberts Cove (CHP-4)	**0.769**	9	**0.797**	**0.533**	**0.430**
Chilmark Pond (CHP-5)	**0.753**	15	**0.832**	**0.578**	**0.480**
Chilmark Pond (CHP-6)	**0.704**	12	**0.924**	**0.534**	**0.560**
Chilmark Pond (CHP-7)	**0.808**	7	**0.962**		
Chilmark Pond Upper (CHP-up)	--	--	**1.096**	**0.556**	**0.770**
Atlantic Ocean	**0.232**	17	--	**--**	**--**

Table 4. Comparison of MEP mean values of TN with summer 2016 and 2017 sampling effort (all values are mg/L) from Chilmark Pond. Measured nitrogen concentrations for Chilmark Pond. TN data represented in this table were collected from 2004 in Chilmark Pond. The offshore Atlantic Ocean data (offshore Pleasant Bay Inlet) are from the summer of 2005. MEP N represents sample size.

Figure 20. MEP monitoring station location in Lake Tashmoo that was used in the water quality analysis for the Massachusetts Estuaries Project. MEP established "sentinel station" between MV4 and MV5 (MV SEN, newly established station in 2016). MEP TN Threshold = 0.36 mg/L.

Sub-Embayment	Monitoring station	MEP Mean TN (mg/L)	MEP N	MEP Model average	2016 Mean TN (mg/L)	2017 Mean TN (mg/L)	2018 Mean TN (mg/L)
Lower Basin	MV21	**0.314**	29	0.300	**0.273**	**0.258**	**0.280**
Lower Basin	MV1	**0.306**	28	0.311		--	--
Lower Basin	MV2	**0.301**	28	0.329	**0.336**	**0.264**	**0.270**
Mid-Upper Basin	MV3	**0.343**	38	0.369	**0.351**	**0.321**	**0.300**
Mid-Upper Basin	MV4	**0.36**	37	0.385	**0.355**	**0.349**	**0.480**
Upper Basin	MV5	**0.447**	37	0.423		--	--
MEP Sentinel Station	MV-SEN				**0.482**	**0.362**	**0.340**
Offshore	MV6	**0.27**	60	-		--	--

Table 5. MEP Measured data and modeled nitrogen concentrations for the Lake Tashmoo estuarine system. All concentrations are given in mg/L N. "MEP Mean TN" values are calculated as the average of all measurements. MEP Data represented in this table were collected in the summers of 2001 through 2007. MEP N represents sample size.

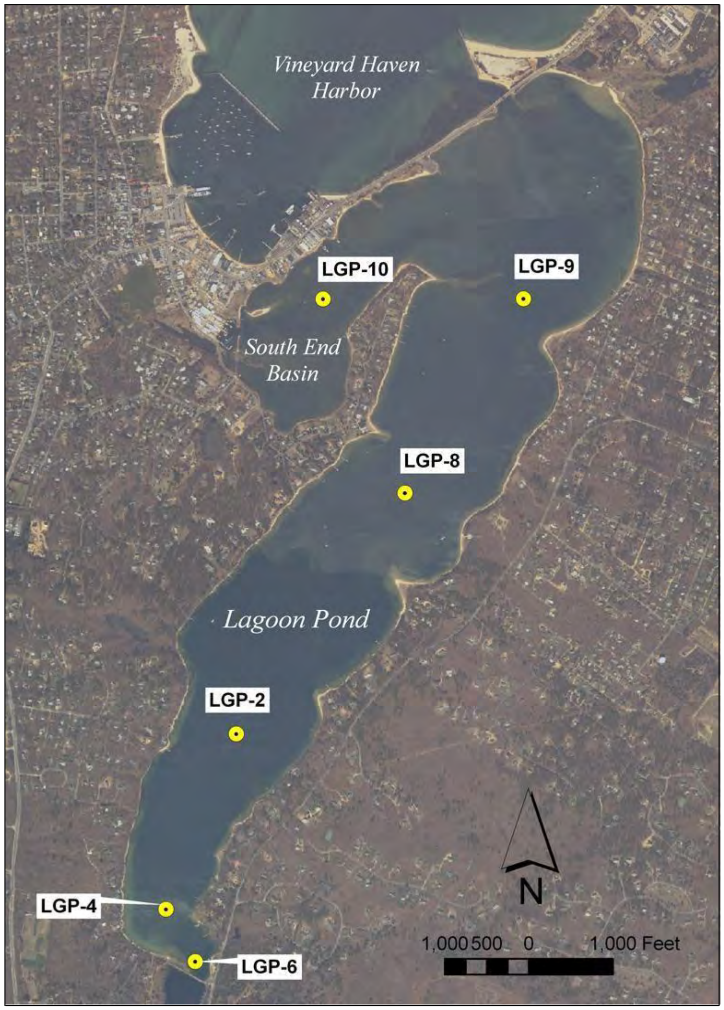


Figure 21. MEP monitoring station location in Lagoon Pond that was used in the water quality analysis for the Massachusetts Estuaries Project. MEP established "sentinel station" (LGP2). MEP TN Threshold = 0.35 mg/L.

Sub-Embayment	Monitoring station	MEP Mean TN (mg/L)	N	MEP Model average	2016 Mean TN (mg/L)	2017 Mean TN (mg/L)	2018 Mean TN (mg/L)
Lagoon Pond head at dike	LGP-6	**0.418**	23	0.413	**0.386**	--	--
Lagoon Pond Head	LGP-4	**0.384**	100	0.385	**0.460**	**0.360**	**0.300**
Lagoon Pond upper Basin	LGP-2	**0.36**	135	0.371	**0.432**	**0.346**	**0.320**
Lagoon Pond mid Basin	LGP-8	**0.359**	66	0.338	**0.387**	**0.329**	**0.310**
Lagoon Pond lower Basin	LGP-9	**0.333**	60	0.328	**0.317**	**0.295**	**0.260**
West Arm (South End Basin)	LGP-10	**0.386**	35	0.378	--	--	--
Nantucket Sound	NTKS	**0.290**	48	--	--	--	--

Table 6. Measured data and modeled Nitrogen concentrations for the Lagoon Pond estuarine system used in the MEP modeling and threshold development. All concentrations are given in mg/L N. “MEP Mean TN” values are calculated as the average of the separate yearly means. MEP Data represented in this table were collected in the summers of 2002 through 2007.

Figure 22. Estuarine water quality monitoring station locations in the Oak Bluffs Harbor and Sunset Lake System used to establish the MEP water quality baseline. MEP TN threshold is <0.45 mg/L in Sunset Lake.

Monitoring station	2001 Mean (mg/L)	2002 Mean (mg/L)	2003 Mean (mg/L)	2004 Mean (mg/L)	2005 Mean (mg/L)	2006 Mean (mg/L)	2007 Mean (mg/L)	01-07 mean (mg/L)	N	MEP Model average	2016 Mean TN (mg/L)	2017 Mean TN (mg/L)	2018 Mean TN (mg/L)
MV-14	0.382	--	0.39	0.411	0.386	0.413	0.35	**0.392**	35	0.392	**0.463**	**0.431**	**0.39**
MV-15	0.333	0.363	0.351	0.321	0.296	0.327	0.318	**0.329**	41	0.32	**0.421**	**0.408**	**0.37**
MV-16	0.338	0.363	0.32	0.389	0.273	0.324	0.302	**0.325**	63	0.313	**0.306**	**0.342**	**0.29**
MV-17	--	0.355	0.385	0.373	0.305	0.375	0.328	**0.351**	34	0.335	--	--	--

Table 7. Comparison of MEP mean values of TN with summer 2016 and 2017 data (all values are mg/L) from Oak Bluffs Harbor. Town of Oak Bluffs water quality monitoring data, and MEP modeled Nitrogen concentrations for the Oak Bluffs Harbor System. “01-07 mean” values are calculated as the average of the separate yearly means.

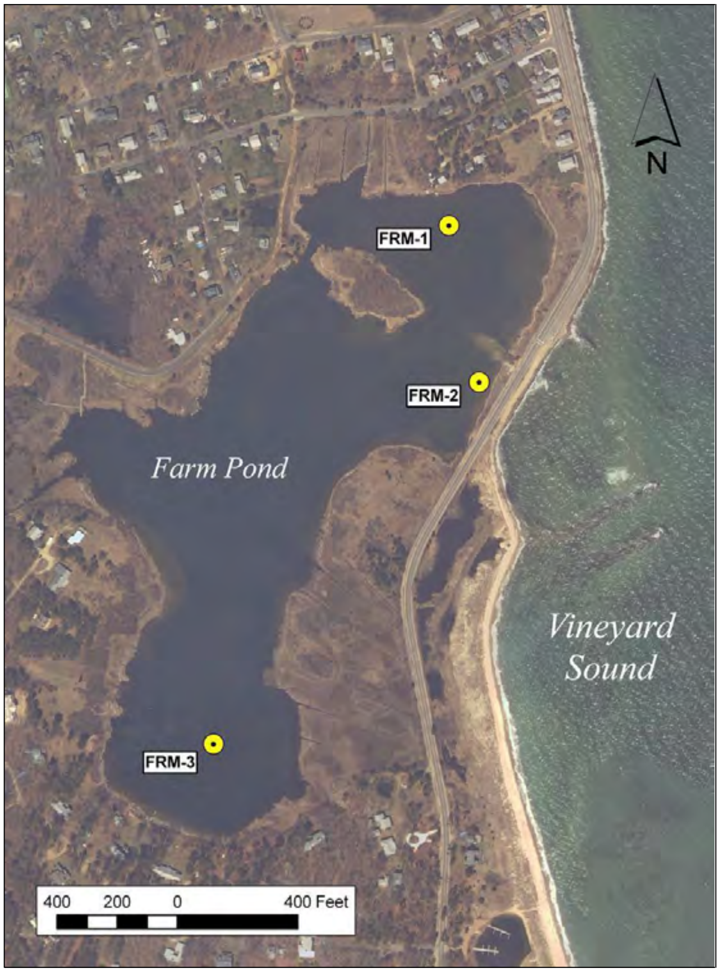


Figure 23. Estuarine water quality monitoring station locations in the Farm Pond System used to establish the MEP water quality baseline. MEP TN threshold is 0.45 mg/L at MEP "sentinel" station (FAM-3).

Sub-Embayment	Monitoring station	MEP Mean TN (mg/L)	N	MEP Model average	2016 Mean TN (mg/L)	2017 Mean TN (mg/L)	2018 Mean TN (mg/L)
North Basin	FRM-1	**0.516**	18	0.496	**0.427**	**0.496**	**0.390**
Mid Pond	FRM-2	**0.505**	16	0.480	**0.463**	**0.430**	**0.400**
South Basin	FRM-3	**0.530**	17	0.508	**0.544**	**0.610**	**0.450**
Nantucket Sound	NTKS	**0.294**	4	--	--	--	--

Table 8. Comparison of MEP mean values of TN with summer 2016 and 2017 data (all values are mg/L) from Farm Pond. Measured data and modeled Nitrogen concentrations for the Farm Pond estuarine system used in the model calibration. All concentrations are given in mg/L N. “MEP Mean TN” values are calculated as the average of the separate yearly means. MEP Mean Data represented in this table were collected in the summers of 2002 through 2008.

Figure 24. Estuarine water quality monitoring station locations in the Sengekontacket Pond System used to establish the MEP water quality baseline. MEP TN threshold is 0.35 mg/L at water quality monitoring stations SKT-4 and SKT-9, to restore eelgrass habitat within Majors Cove/Sengekontacket Pond and to improve eelgrass habitat within Trapps Pond. The approximate locations of the sentinel threshold stations for Sengekontacket Pond (SKT-4 and SKT-9) are shown. There is no baseline water quality station within Trapps Pond.

Sub-Embayment	Farm Neck Inlet	Farm Neck Basin	Majors Cove	Majors Cove	Main Inlet	Ocean Heights	Ocean Heights	Ocean Heights	Trapps Pond
Monitoring station	**Skt-1**	**Skt-2**	**Skt-3**	**Skt-4**	**Skt-5**	**Skt-6**	**Skt-7**	**Skt-8**	**Skt-9**
2003 mean	0.457	0.451	0.554	0.611	0.306	0.365	0.42	0.604	0.607
2004 mean	0.35	0.369	0.416	0.366	0.288	0.315	0.299	0.417	0.413
2005 mean	0.268	0.285	0.351	0.356	0.205	0.268	0.217	0.311	0.396
2006 mean	0.351	0.373	0.421	0.437	0.355	0.319	0.312	0.412	0.516
2007 mean	0.348	0.336	--	0.392	0.257	0.259	0.279	0.38	--
2008 mean	0.402	0.365	0.347	0.373	0.336	0.27	0.429	0.381	0.38
2009 mean	0.295	0.294	0.342	0.347	0.248	0.264	0.263	0.378	0.422
mean	**0.351**	**0.347**	**0.414**	**0.406**	**0.29**	**0.302**	**0.314**	**0.392**	**0.445**
N	24	24	25	25	25	25	27	24	20
model average	0.308	0.32	0.351	0.375	0.299	0.308	0.306	0.331	0.382
2016 mean		**0.459**	**0.545**	**0.437**	**0.316**	**0.299**		**0.445**	**0.509**
2017 mean		**0.313**	**0.437**	**0.518**	**0.291**	**0.256**		**0.412**	**0.521**
2018 mean		**0.310**	**0.400**	**0.350**	**0.270**	**0.270**		**0.320**	**0.430**

Table 9. Comparison of MEP mean values of TN with summer 2016 data (all values are mg/L) from Sengekontacket Pond. Measured data and modeled Nitrogen concentrations for the Sengekontacket Pond estuarine system used in the model calibration. All concentrations are given in mg/L N. "Data mean" values are calculated as the average of the separate yearly means. Data represented in this table were collected in the summers of 2003 through 2009.

Figure 25. Estuarine water quality monitoring station locations in the Tisbury Great Pond System used to establish the MEP water quality baseline. MEP TN threshold is 0.46 mg/L at MEP "sentinel" station (average TGP-4,5,6) and 0.48 mg/L at TGP-7.

Station Location	Station ID	TN MEP mean (mg/L)	Salinity MEP mean (ppt)	2017 TN mean (mg/L)	2018 TN mean (mg/L)
Town Cove upper	TGP-1	0.643	9.9	**0.950**	**0.660**
Tiasquam River	TGP-2	0.563	10.5	--	--
Pear Tree Cove	TGP3	0.485	12.6	--	--
Muddy Cove	TGP-3A	0.785	14.7	**0.812**	**0.720**
Town Cove Mid	TGP-4	0.528	14.7	**0.706**	**0.620**
Tiah Cove	TGP-5	0.422	12.0	**0.735**	**0.540**
Deep Bottom Cove	TGP-6	0.536	14.3	**0.816**	**0.600**
Tisbury Great Pond low	TGP-7	0.509	17.0	**0.712**	**0.590**
Crab Creek	TGP-8	0.43	13.1	**0.730**	**0.760**
Tisbury Great Pond mid	TGP-9	0.413	13.2	--	--
Atlantic Ocean		0.232	32.3	--	--
NOTE: TN MEP mean data represented in this table were collected from 1995 through 2007 and 2011 in Tisbury Great Pond. The offshore Atlantic Ocean data (offshore Pleasant Bay Inlet) are from the summer of 2005. MEP established "sentinel station" (average of TGP 4,5,6 and TGP7).					

Table 10. Comparison of MEP mean values of TN with summer 2017 data from Tisbury Great Pond. TGP was not sampled in 2016. All values are mg/L for TN, ppt for salinity. “Data mean” values are calculated as the average of the separate yearly means. TN data represented in this table were collected from 1995 through 2007 and 2011 in Great Pond. The offshore Atlantic Ocean data (offshore Pleasant Bay Inlet) are from the summer of 2005.

Figure 26. Estuarine water quality monitoring station locations in the Menemsha and Squibnocket Ponds System used to establish the MEP water quality baseline. MEP TN threshold in Menemsha Pond is 0.35 mg/L at MEP "sentinel" station (avgerage of MEN-4,5,8,9,10) and the MEP TN threshold in Squibnocket Pond is 0.50 mg/L at MEP "sentinel" station (average of SQB-1,2,3,4).

Station Location	Station ID	TN MEP mean (mg/L)	N	MEP Model TN mean (mg/L)	2017 TN mean (mg/L)	2018 TN mean (mg/L)
Menemsha Creek Low	MEN 1	0.287	23	0.296	--	--
Menemsha Creek Low	MEN 2	0.341	24	0.304	**0.288**	**0.23**
Menemsha Main Basin	MEN 3	0.385	29	0.311	**0.301**	**0.23**
Menemsha Main Basin	MEN 4	0.399	25	0.404	--	--
Nashaquitsa Mouth	MEN 5	0.338	26	0.335	**0.311**	**0.27**
Nashaquitsa Basin	MEN 6	0.341	23	0.347	**0.405**	**0.28**
Stonewall Pond Basin	MEN 7	--	--	--	**0.434**	**0.32**
Menemsha Main Basin	MEN 8	0.379	23	0.368	--	--
Menemsha Main Basin	MEN 9	0.386	23	0.358	--	--
Menemsha Creek	MEN 10	0.351	22	0.308	--	--
Squibnocket Basin	SQ 1	0.763	20	0.761	**0.783**	**0.65**
Squibnocket Basin	SQ 2	0.798	22	0.793	--	--
Squibnocket Basin	SQ 3	0.769	18	0.786	**0.754**	**0.65**
Squibnocket Basin	SQ 4	0.853	15	0.817	--	--

NOTE: TN MEP mean data and modeled nitrogen concentrations for the Menemsha and Squibnocket Ponds system are given in mg/L N. “Data mean” values are calculated as the average of all measurements. Data represented in this table were collected in the summers of 2000 through 2012. MEP TN threshold in Menemsha Pond is 0.35 mg/L at MEP "sentinel" station (avgerage of MEN-4,5,8,9,10) and the MEP TN threshold in Squibnocket Pond is 0.50 mg/L at MEP "sentinel" station (average of SQB-1,2,3,4).

Table 11. Comparison of MEP mean values of TN with summer 2017 data from Menemsha Pond and Squibnocket Pond. These ponds were not sampled in 2016. “Data mean” values are calculated as the average of the separate yearly means. TN data represented in this table were collected from the summers of 2000 through 2012.

Table 12a. 2018 Trophic Health Index Scores and status for water quality monitoring stations in Vineyard estuaries based upon open water embayment (not salt marsh) habitat quality scales. calculated ***with*** Dissolved Oxygen data (described in Howes et. al., 1999 at www.savebuzzardsbay.org).

2018 EMBAYMENT	YR	Secchi SCORE	Low20% Oxsat SCORE	DIN SCORE	TON SCORE	T-Pig SCORE	EUTRO Index	2018 EUTROPHICATION RANKING
CAPE POGUE BAY								
POG2	2018	100.0	86.1	100.0	100.0	59.8	89.2	High
POG3	2018	80.0	70.5	100.0	82.8	45.4	75.7	High
POG4	2018	76.7	69.6	100.0	75.4	35.3	71.4	High
POG5	2018	79.8	62.6	100.0	61.0	30.2	66.7	High
POCHA POND								
PCA1	2018	55.4	64.2	100.0	50.9	24.7	59.0	Moderate
PCA1	2018	ND	ND	ND	ND	ND	ND	ND
PCA3	2018	59.8	72.1	100.0	60.4	37.8	66.0	High-Mod
KATAMA BAY								
KAT1	2018	95.2	77.6	100.0	100.0	33.9	81.3	High
KAT2	2018	88.3	74.3	100.0	100.0	30.0	78.5	High
KAT3	2018	45.0	85.4	100.0	95.3	17.3	68.6	High
KAT4	2018	69.1	71.3	88.9	100.0	18.8	69.6	High
KAT5	2018	66.5	67.7	89.8	97.3	1.6	64.6	High-Mod
KAT7	2018	45.2	74.7	100.0	53.9	0.0	54.8	Moderate
EDGARTOWN GREAT POND								
EGP2	2018	93.5	77.9	100.0	61.9	33.2	73.3	High
EGP3	2018	85.5	58.0	90.4	61.7	33.1	65.7	High-Mod
EGP4	2018	63.5	66.2	73.8	48.2	80.2	66.4	High-Mod
EGP5	2018	77.8	70.4	84.0	56.0	55.9	68.8	High
EGP6	2018	71.6	90.7	100.0	41.0	53.6	71.4	High
EGP7	2018	81.4	66.2	99.4	57.2	51.2	71.1	High
EGP9	2018	71.2	86.8	66.5	45.9	25.6	59.2	Moderate
EGP10	2018	65.6	52.7	88.8	49.0	1.6	51.5	Moderate
EGP11	2018	72.4	73.7	74.1	73.6	59.9	70.8	High
CHILMARK POND								
CHP UP	2018	37.1	100.0	100.0	0.0	0.0	47.4	Moderate
CHP6	2018	ND	ND	100.0	10.5	0.0	36.8	Moderate
CHP5	2018	65.2	88.8	100.0	29.9	70.1	70.8	High
CHP4	2018	48.0	100.0	100.0	44.5	77.5	74.0	High
CHP2	2018	72.0	96.2	100.0	36.5	65.1	74.0	High
CHP1	2018	34.2	74.9	100.0	22.7	29.8	52.3	Moderate
OAK BLUFFS HARBOR								
MV14	2018	ND	ND	69.5	64.6	0.0	44.7	Moderate
MV15	2018	49.2	42.0	53.0	80.5	0.1	45.0	Moderate
MV16	2018	94.4	74.1	100.0	100.0	29.9	79.7	High
FARM POND								
FRM1	2018	27.1	52.5	100.0	59.0	23.3	52.4	Moderate
FRM2	2018	7.8	40.7	100.0	57.6	27.9	46.8	Moderate
FRM3	2018	44.6	0.0	100.0	39.4	0.0	36.8	Moderate

Table 12a. cont'd. 2018 Trophic Health Index Scores and status for water quality monitoring stations in Martha's Vineyard estuaries based upon open water embayment (not salt marsh) habitat quality scales. Index calculated ***with*** Dissolved Oxygen data (described in Howes et. al., 1999 at www.savebuzzardsbay.org).

2018 EMBAYMENT	YR	Secchi SCORE	Low20% Oxsat SCORE	DIN SCORE	TON SCORE	T-Pig SCORE	EUTRO Index	2018 EUTROPHICATION RANKING
SENGEKONTACKET POND								
SKT2	2018	60.9	65.0	75.0	96.6	69.2	73.3	High
SKT3	2018	86.8	53.5	83.5	60.5	39.8	64.8	High-Mod
SKT4	2018	60.0	16.3	94.3	78.7	0.0	49.9	Moderate
SKT5	2018	51.4	75.5	100.0	100.0	50.5	75.5	High
SKT6	2018	72.4	67.5	90.0	100.0	71.4	80.3	High
SKT8	2018	67.6	47.3	80.9	92.4	28.0	63.2	High-Mod
SKT9	2018	ND	ND	58.8	54.5	21.0	44.8	Moderate
LAGOON POND								
LGP11	2018	38.8	12.9	0.0	51.0	0.0	20.5	Fair-Poor
LGP2	2018	83.3	0.0	52.5	99.6	0.0	47.1	Moderate
LGP4	2018	81.2	0.0	100.0	95.2	0.0	55.3	Moderate
LGP6	2018	82.4	54.8	100.0	97.7	0.0	67.0	High-Mod
LGP8	2018	76.7	86.0	100.0	89.6	0.0	70.5	High
LGP9	2018	84.0	83.7	100.0	100.0	0.0	73.5	High
LAKE TASHMOO								
MV21	2018	22.4	92.2	100.0	100.0	38.1	70.5	High
MV2	2018	96.0	81.9	100.0	100.0	46.9	85.0	High
MV3	2018	91.4	97.4	100.0	93.1	18.6	80.1	High
MV4	2018	88.1	94.0	100.0	31.1	14.6	65.6	High-Mod
MV SEN	2018	79.2	82.0	76.6	82.4	0.0	64.0	High-Mod
MV7	2018	ND	70.5	0.0	0.0	0.0	17.6	Fair-Poor
TISBURY GREAT POND								
TGP1	2018	6.2	84.7	25.5	5.0	0.0	24.3	Fair-Poor
TGP3A	2018	7.2	83.5	100.0	0.0	0.0	38.1	Mod-Fair
TGP4	2018	37.2	63.3	100.0	0.0	0.0	40.1	Moderate
TGP5	2018	42.7	93.0	100.0	15.9	0.0	50.3	Moderate
TGP6	2018	41.8	96.9	100.0	1.2	0.0	48.0	Moderate
TGP7	2018	33.8	94.7	100.0	3.1	0.0	46.3	Moderate
TGP8	2018	30.7	25.6	100.0	0.0	0.0	31.3	Mod-Fair
MENEMSHA POND								
MEN2	2018	100.0	74.8	100.0	100.0	65.6	88.1	High
MEN3	2018	94.3	81.9	100.0	100.0	46.7	84.6	High
MEN5	2018	70.4	78.7	100.0	100.0	17.6	73.3	High
MEN6	2018	50.2	78.6	100.0	100.0	2.4	66.2	High-Mod
MEN7	2018	33.4	78.9	100.0	86.4	17.7	63.3	High-Mod
SQUIBNOCKET POND								
SQB1	2018	66.1	82.9	100.0	0.0	0.0	49.8	Moderate
SQB3	2018	55.3	92.6	100.0	0.0	2.3	50.0	Moderate
JAMES POND								
JMS1	2018	ND	ND	57.2	1.6	0.0	19.6	Fair-Poor
JMS3	2018	36.8	41.8	100.0	0.0	0.0	35.7	Mod-Fair
JMS4	2018	19.6	53.7	100.0	0.0	0.0	34.7	Mod-Fair
SHERIFFS POND								
SRF1	2018	0.0	0.0	63.4	0.0	0.0	12.7	Fair-Poor
SRF2	2018	1.5	75.7	82.7	0.0	0.0	32.0	Mod-Fair
SRF3	2018	0.0	0.0	84.7	0.0	0.0	16.9	Fair-Poor
MINK MEADOWS POND								
MME	2018	0.0	82.0	100.0	0.0	0.0	36.4	Mod-Fair
MMW	2018	0.0	95.5	83.3	0.0	0.0	35.7	Mod-Fair

Table 12b. 2017 Trophic Health Index Scores and status for water quality monitoring stations in Martha's Vineyard estuaries based upon open water embayment (not salt marsh) habitat quality scales. Index calculated ***with*** Dissolved Oxygen data (described in Howes et. al., 1999 at www.savebuzzardsbay.org).

EMBAYMENT STATION	YEAR	Secchi SCORE	Low20% Oxsat SCORE	DIN SCORE	TON SCORE	T-Pig SCORE	EUTRO Index	2017 EUTROPHICATION RANKING
CAPE POGUE BAY								
POG2	2017	100.0	79.2	98.9	90.5	83.6	90.4	High
POG3	2017	83.8	65.3	73.5	63.2	67.6	70.7	High
POG4	2017	89.1	69.7	91.2	59.4	45.8	71.0	High
POG5	2017	71.9	62.4	63.9	89.9	62.5	70.1	High
POCHA POND								
PCA1	2017	60.5	60.8	58.7	58.1	71.6	61.9	High-Mod
PCA2	2017	ND	ND	ND	ND	ND	ND	ND
PCA3	2017	59.7	53.4	67.7	62.1	68.7	62.3	High-Mod
KATAMA BAY								
KAT1	2017	93.2	72.8	73.0	100.0	63.4	80.5	High
KAT2	2017	88.2	64.9	64.3	75.8	50.2	68.7	High
KAT3	2017	82.2	68.3	64.9	76.3	60.3	70.4	High
KAT4	2017	89.6	65.5	61.0	76.9	48.9	68.4	High-Mod
KAT5	2017	71.8	76.5	64.4	75.4	37.7	65.2	High-Mod
KAT7	2017	41.9	65.7	72.6	62.7	25.6	53.7	Moderate
EDGARTOWN GREAT POND								
EGP2	2017	90.9	69.8	65.1	50.0	96.0	74.3	High
EGP3	2017	88.7	77.0	69.3	38.1	59.6	66.5	High-Mod
EGP4	2017	78.2	65.3	54.0	70.7	100.0	73.7	High
EGP5	2017	82.4	66.3	53.0	34.6	100.0	67.2	High-Mod
EGP6	2017	82.0	76.1	76.3	63.4	100.0	79.6	High
EGP7	2017	91.4	66.8	64.5	76.1	100.0	79.8	High
EGP9	2017	74.6	56.8	65.5	56.4	74.7	65.6	High-Mod
EGP10	2017	67.8	65.1	63.0	56.7	70.7	64.7	High-Mod
EGP11	2017	46.0	65.1	56.6	83.2	96.2	69.4	High
CHILMARK POND								
CHP UP	2017	44.5	92.5	85.3	14.6	0.0	47.4	Moderate
CHP7	2017	ND	ND	ND	ND	ND	ND	Moderate
CHP6	2017	7.3	44.0	33.6	32.2	15.5	26.5	Fair-Poor
CHP5	2017	64.6	66.9	15.8	29.1	46.0	44.5	Moderate
CHP4	2017	54.7	65.8	29.9	34.2	58.1	48.5	Moderate
CHP2	2017	59.4	75.3	12.2	25.9	28.6	40.3	Moderate
CHP1	2017	40.1	55.7	34.6	4.6	0.0	27.0	Fair-Poor
OAK BLUFFS HARBOR								
MV14	2017	10.9	55.9	31.9	65.7	48.7	42.6	Moderate
MV15	2017	59.8	70.7	70.2	59.9	20.5	56.2	Moderate
MV16	2017	98.0	70.9	80.1	82.6	37.5	73.8	High
FARM POND								
FRM1	2017	21.3	50.1	81.8	30.6	19.5	40.7	Moderate
FRM2	2017	23.3	45.1	75.7	51.5	59.7	51.1	Moderate
FRM3	2017	38.1	19.0	76.2	3.2	0.0	27.3	Fair-Poor

Table 12b cont'd. 2017 Trophic Health Index Scores and status for water quality monitoring stations in Martha's Vineyard estuaries based upon open water embayment (not salt marsh) habitat quality scales. Index calculated ***with*** Dissolved Oxygen data (described in Howes et. al., 1999 at www.savebuzzardsbay.org).

EMBAYMENT STATION	YEAR	Secchi SCORE	Low20% Oxsat SCORE	DIN SCORE	TON SCORE	T-Pig SCORE	EUTRO Index	2017 EUTROPHICATION RANKING
SENGEKONTACKET POND								
SKT2	2017	64.3	66.8	100.0	89.6	79.6	80.1	High
SKT3	2017	77.5	58.0	100.0	43.6	0.0	55.8	Moderate
SKT4	2017	44.0	74.6	100.0	20.7	0.0	47.9	Moderate
SKT5	2017	85.5	77.4	100.0	100.0	78.6	88.3	High
SKT6	2017	82.9	62.9	100.0	100.0	90.6	87.3	High
SKT8	2017	66.7	59.4	100.0	53.1	0.0	55.9	Moderate
SKT9	2017	22.5	51.9	100.0	20.5	0.6	39.1	Moderate
FRESH POND								
FRS1	2017	ND	ND	ND	ND	ND	ND	ND
FRS2	2017	ND	ND	ND	ND	ND	ND	ND
FRS3	2017	ND	ND	ND	ND	ND	ND	ND
LOOKS POND								
LOOK4	2017	0.0	100.0	93.2	79.3	40.6	62.6	High-Mod
LAGOON POND								
LGP11	2017	53.3	54.6	0.0	10.7	0.0	23.7	Fair-Poor
LGP12	2017	ND	ND	ND	ND	ND	ND	ND
LGP2	2017	98.7	8.9	100.0	75.6	36.1	63.9	High-Mod
LGP4	2017	95.3	0.0	95.2	73.0	29.3	58.6	Moderate
LGP6	2017	ND	ND	ND	ND	ND	40.0	Moderate
LGP8	2017	97.1	67.9	100.0	82.8	69.3	83.4	High
LGP9	2017	100.0	71.4	100.0	99.4	71.9	88.5	High
LAKE TASHMOO								
MV21	2017	29.4	78.4	100.0	100.0	100.0	81.6	High
MV2	2017	100.0	60.8	100.0	100.0	95.7	91.3	High
MV3	2017	90.1	61.9	100.0	84.1	66.1	80.4	High
MV4	2017	85.0	63.6	100.0	72.7	37.3	71.7	High
MVSEN	2017	80.7	47.0	100.0	68.3	8.3	60.8	High-Mod
TISBURY GREAT POND								
TGP1	2017	10.3	47.2	73.8	0.0	0.0	26.3	Fair-Poor
TGP3A	2017	3.4	51.8	100.0	0.0	0.0	31.0	Mod-Fair
TGP4	2017	48.6	50.8	100.0	0.0	0.0	39.9	Moderate
TGP5	2017	29.1	88.2	100.0	0.0	0.0	43.5	Moderate
TGP6	2017	30.2	13.0	100.0	0.0	0.0	28.6	Fair-Poor
TGP7	2017	48.5	78.0	100.0	0.0	0.0	45.3	Moderate
TGP8	2017	29.1	80.5	100.0	0.0	0.0	41.9	Moderate
MENEMSHA POND								
MEN2	2017	100.0	84.0	94.2	100.0	81.3	91.9	High
MEN3	2017	100.0	71.8	100.0	94.4	67.0	86.6	High
MEN5	2017	82.0	86.3	100.0	91.1	75.6	87.0	High
MEN6	2017	70.2	74.3	100.0	55.4	58.7	71.7	High
MEN7	2017	60.5	56.4	76.4	49.9	50.5	58.7	Moderate
SQUIBNOCKET POND								
SQB1	2017	95.4	78.8	100.0	0.0	6.2	56.1	Moderate
SQB3	2017	74.8	99.0	96.0	0.0	16.2	57.2	Moderate
JAMES POND								
JMS1	2017	0.0	57.6	43.4	0.0	25.3	25.3	Fair-Poor
JMS3	2017	47.2	85.7	74.8	12.3	0.0	44.0	Moderate
JMS4	2017	25.2	59.9	100.0	11.9	3.1	40.0	Moderate

	YEAR	Secchi SCORE	Low20% Oxsat SCORE	DIN SCORE	TON SCORE	T-Pig SCORE	EUTRO Index	2016 EUTROPHICATION RATING
POG2	2016	93.0	72.6	100.0	80.6	100.0	89.2	High
POG3	2016	82.1	50.9	75.4	7.6	100.0	63.2	High-Moderate
POG4	2016	87.1	66.3	90.9	57.2	100.0	80.3	High
POG5	2016	68.8	53.3	86.8	29.2	100.0	67.6	High-Moderate
PCA1	2016	35.9	56.0	76.7	44.7	100.0	62.7	High-Moderate
PCA2	2016	68.3	72.4	100.0	60.5	100.0	80.2	High
PCA3	2016	55.9	52.2	75.8	27.4	100.0	62.3	High-Moderate
KAT1	2016	100.0	67.7	93.0	76.5	100.0	87.4	High
KAT2	2016	95.9	65.7	90.5	64.1	100.0	83.2	High
KAT3	2016	41.1	60.9	96.7	66.7	100.0	73.1	High
KAT4	2016	74.8	66.5	76.5	50.6	92.7	72.2	High
KAT5	2016	68.3	64.9	89.0	52.2	85.5	72.0	High
KAT7	2016	47.2	59.6	100.0	39.0	71.4	63.5	High-Moderate
EGP2	2016	85.6	64.5	58.7	19.8	100.0	65.7	High-Moderate
EGP3	2016	91.7	62.1	76.3	26.3	100.0	71.3	High
EGP4	2016	66.5	59.0	49.0	37.6	100.0	62.4	High-Moderate
EGP5	2016	81.4	65.4	67.6	20.2	100.0	66.9	High-Moderate
EGP6	2016	82.8	60.5	80.5	20.6	100.0	68.9	High-Moderate
EGP7	2016	92.6	58.0	60.8	22.3	100.0	66.8	High-Moderate
EGP9	2016	70.8	60.6	78.5	39.0	100.0	69.8	High
EGP10	2016	68.3	54.0	74.4	31.2	100.0	65.6	High-Moderate
EGP11	2016	60.9	47.6	42.8	24.9	100.0	55.2	Moderate
CHP UP	2016	15.9	83.6	100.0	0.0	0.0	39.9	Moderate
CHP7	2016	11.0	0.0	75.0	0.0	0.0	17.2	Fair/Poor
CHP6	2016	21.6	59.8	80.0	0.0	23.5	37.0	Mod-Fair
CHP5	2016	41.8	67.1	100.0	0.0	51.1	52.0	Moderate
CHP4	2016	37.0	71.2	100.0	0.0	70.6	55.7	Moderate
CHP2	2016	41.0	64.0	100.0	0.0	33.8	47.7	Moderate
CHP1	2016	25.2	58.1	100.0	0.0	1.7	37.0	Moderate-Fair
MV14	2016	24.9	31.7	59.2	44.5	84.3	48.9	Moderate
MV15	2016	67.8	56.4	80.3	53.6	94.6	70.5	High
MV16	2016	96.0	62.7	92.3	95.8	100.0	89.3	High
FRM1	2016	17.1	54.2	92.8	49.7	100.0	62.8	High-Moderate
FRM2	2016	29.7	23.6	100.0	37.2	100.0	58.1	Moderate
FRM3	2016	42.9	6.4	100.0	15.4	90.7	51.1	Moderate

Table 13. 2016 Trophic Health Index Scores and status for water quality monitoring stations in Martha's Vineyard estuaries based upon open water embayment (not salt marsh) habitat quality scales. Index calculated *with* Dissolved Oxygen data (described in Howes et. al., 1999 at www.savebuzzardsbay.org).

EMBAYMENT STATION	YEAR	Secchi SCORE	Low20% Oxsat SCORE	DIN SCORE	TON SCORE	T-Pig SCORE	EUTRO Index	2016 EUTROPHICATION RATING
SKT2	2016	70.8	51.4	92.9	39.9	100.0	71.0	High
SKT3	2016	85.3	42.8	92.3	16.7	89.7	65.4	High-Moderate
SKT4	2016	53.2	39.9	88.2	47.2	100.0	65.7	High-Moderate
SKT5	2016	44.8	60.4	100.0	89.2	100.0	78.9	High
SKT6	2016	82.6	55.7	95.1	98.7	100.0	86.4	High
SKT8	2016	72.7	54.2	100.0	43.2	100.0	74.0	High
SKT9	2016	0.0	29.3	67.6	29.6	100.0	45.3	Moderate
FRS1	2016	72.6	65.3	100.0	19.3	100.0	71.4	High
FRS2	2016	67.6	66.8	100.0	15.6	100.0	70.0	High
FRS3	2016	74.0	66.8	100.0	26.5	100.0	73.5	High
LGP11	2016	26.9	0.0	0.0	0.0	0.0	5.4	Fair/Poor
LGP12	2016	0.0	0.0	0.0	0.0	0.0	0.0	Fair/Poor
LGP2	2016	94.0	0.0	99.8	47.4	76.2	63.5	High-Moderate
LGP4	2016	93.2	0.0	100.0	38.6	75.0	61.4	High-Moderate
LGP6	2016	80.5	6.0	76.9	67.5	100.0	66.2	High-Moderate
LGP8	2016	97.5	50.8	100.0	62.2	88.0	79.7	High
LGP9	2016	100.0	43.5	100.0	88.6	100.0	86.4	High
MV21	2016	18.8	70.0	99.3	100.0	100.0	77.6	High
MV2	2016	95.7	62.6	99.3	81.8	100.0	87.9	High
MV3	2016	87.7	59.5	100.0	74.7	100.0	84.4	High
MV4	2016	91.1	60.4	99.9	74.3	100.0	85.2	High
MVSEN	2016	74.8	53.1	88.1	33.8	57.3	61.4	High-Moderate

Table 13 cont'd. 2016 Trophic Health Index Scores and status for water quality monitoring stations in Martha's Vineyard estuaries based upon open water embayment (not salt marsh) habitat quality scales. Index calculated *with* Dissolved Oxygen data (described in Howes et. al., 1999 at www.savebuzzardsbay.org).

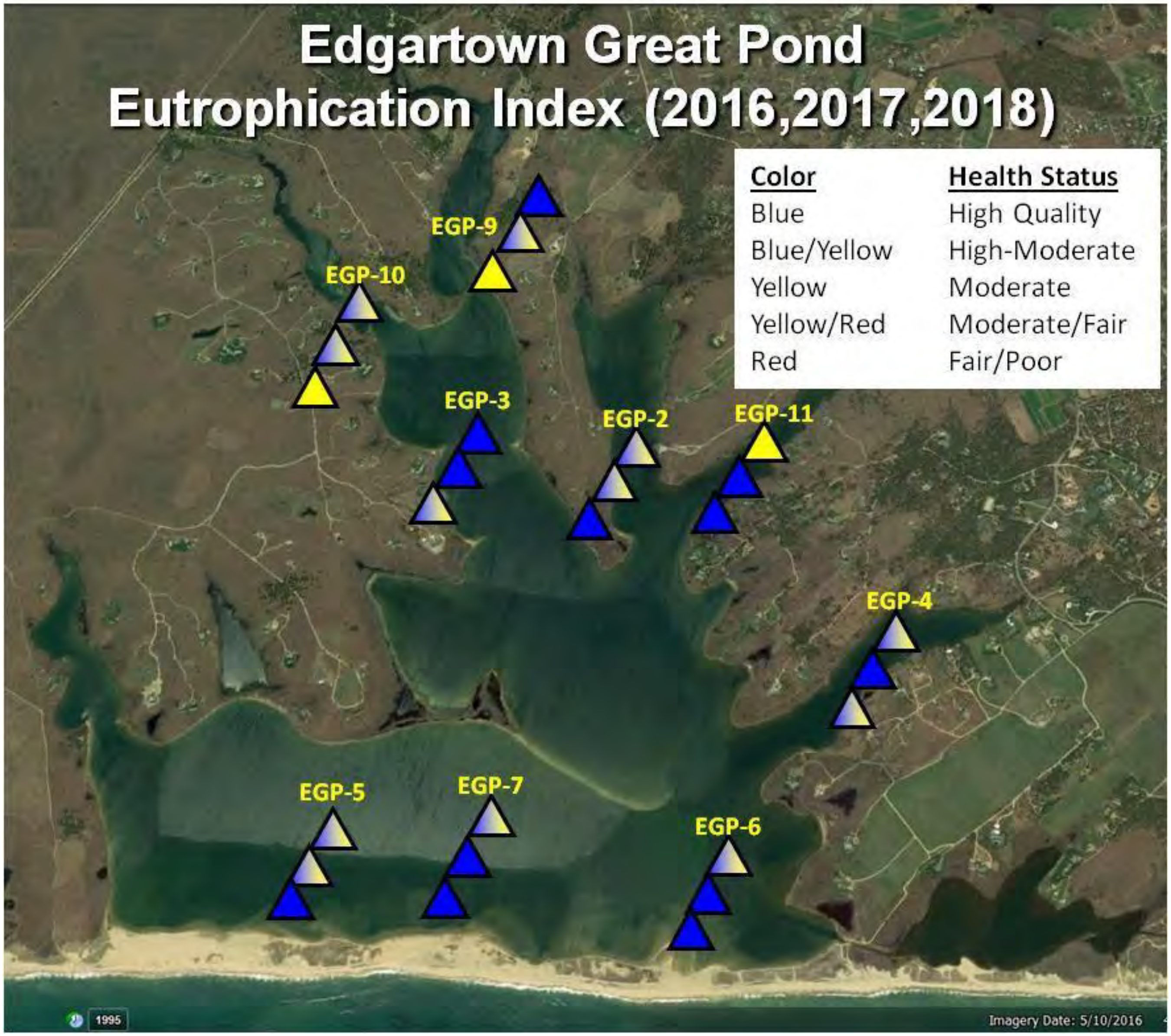


Figure 27. Edgartown Great Pond Eutrophication Index 2016 (upper triangle), 2017 (middle triangle) and 2018 (lower triangle). Colors indicate High (Blue), Moderate (Yellow), Fair/Poor (Red) nutrient related water quality.

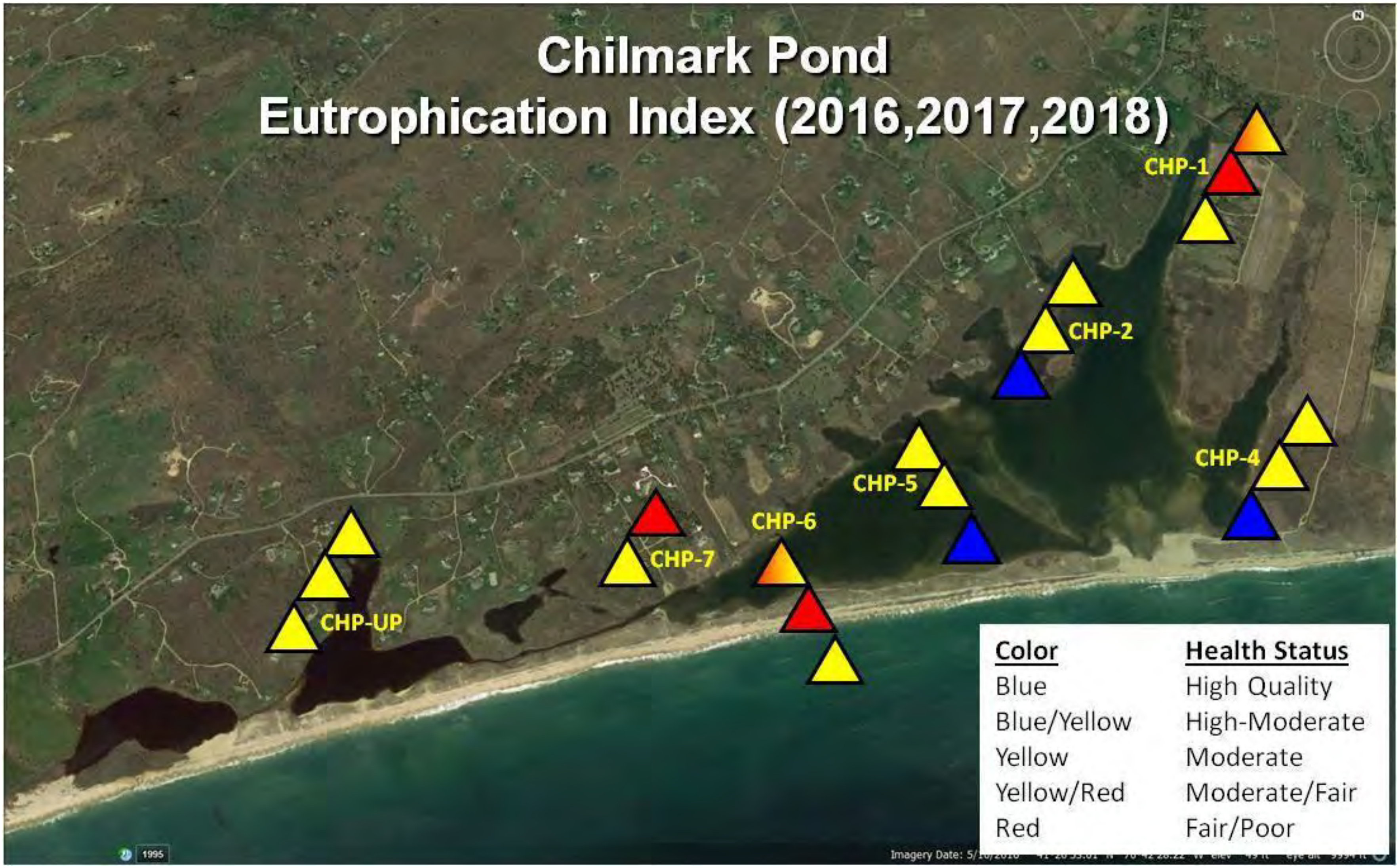


Figure 28. Chilmark Pond Eutrophication Index 2016 (upper triangle), 2017 (middle triangle) and 2018 (lower triangle). Colors indicate High (Blue), Moderate (Yellow), Fair/Poor (Red) nutrient related water quality.

CHP-7 only sampled in 2016 and 2017.

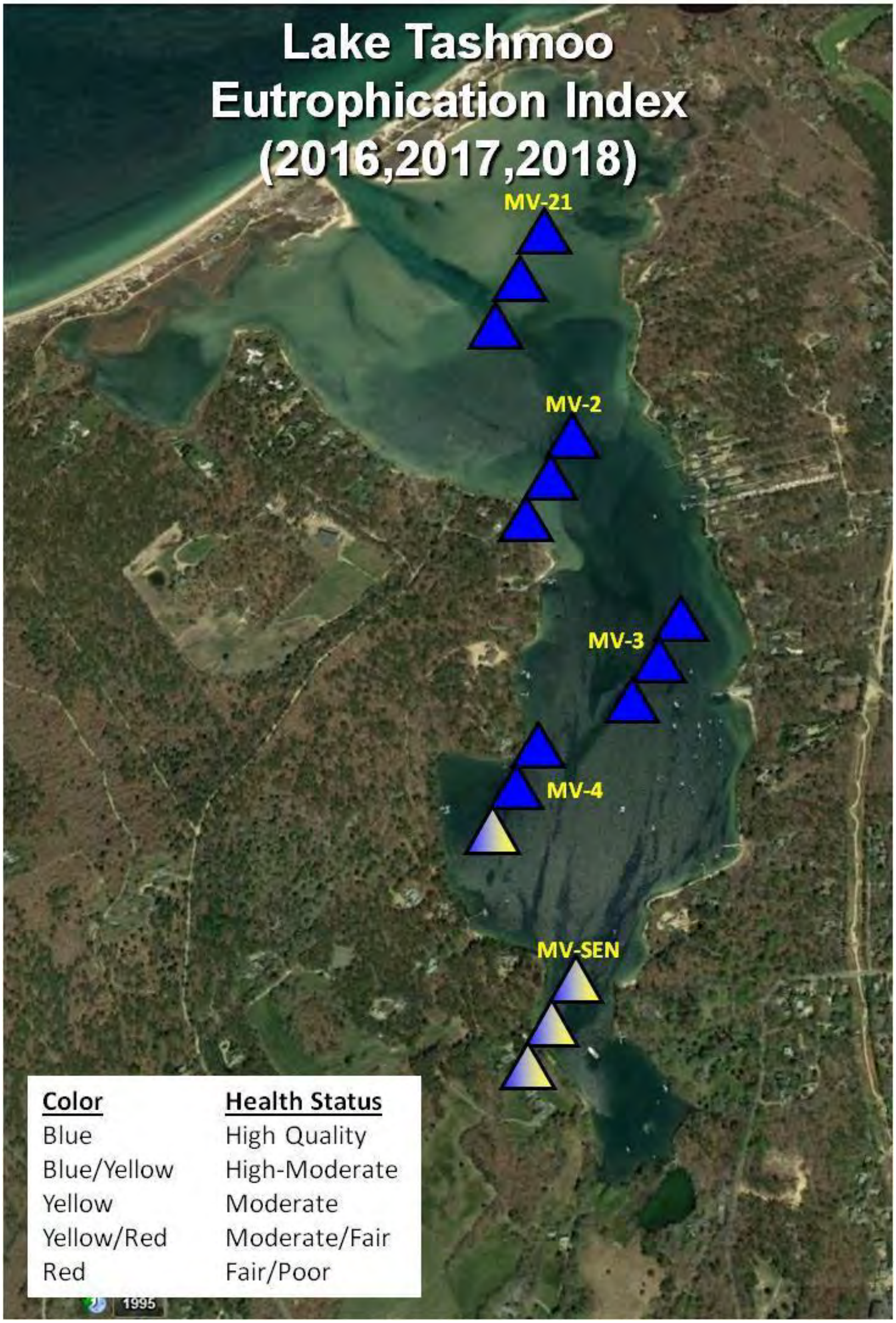


Figure 29. Lake Tashmoo Eutrophication Index 2016 (upper triangle), 2017 (middle triangle) and 2018 (lower triangle). Colors indicate High (Blue), Moderate (Yellow), Fair/Poor (Red) nutrient related water quality

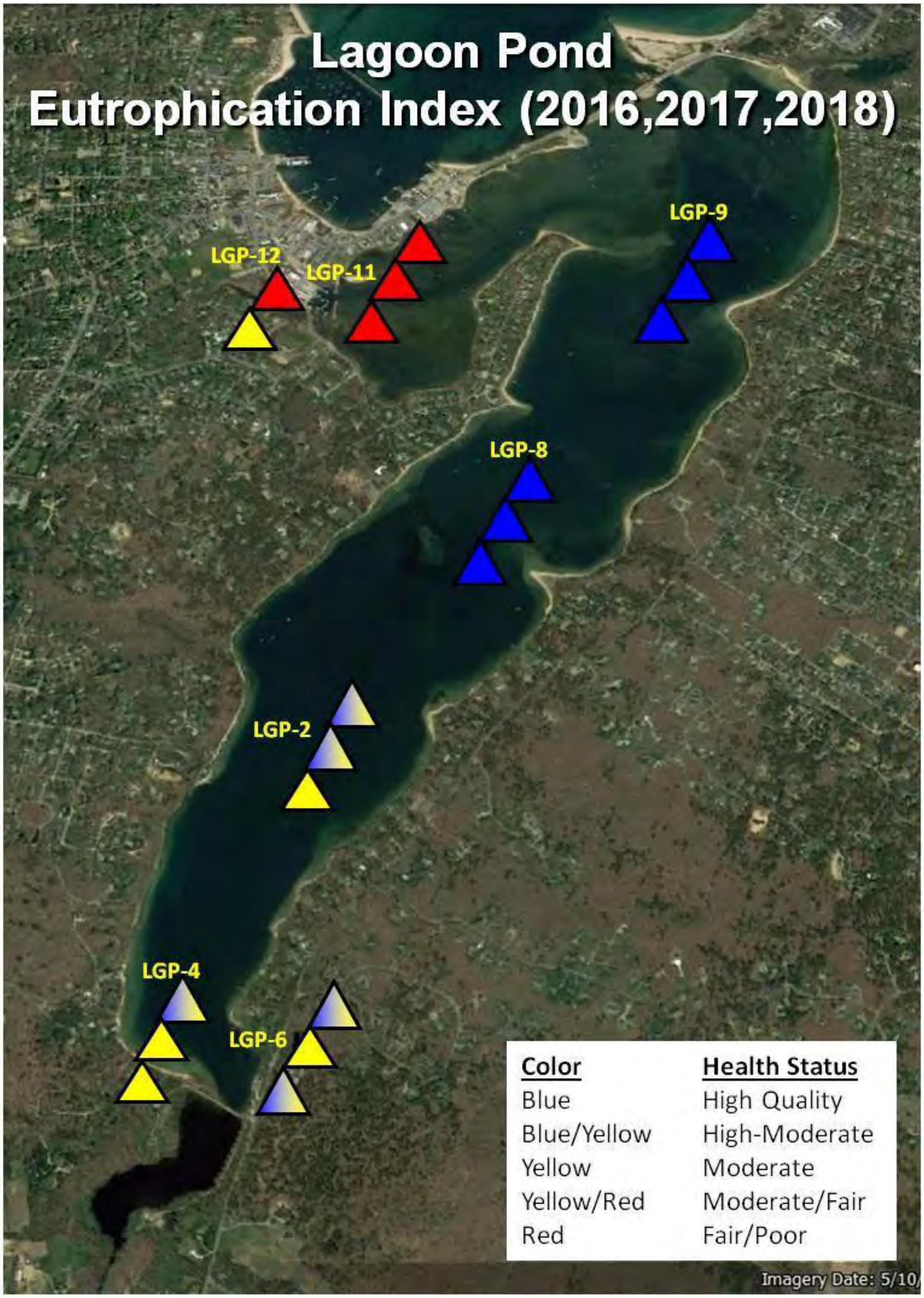


Figure 30. Lagoon Pond Eutrophication Index 2016 (upper triangle), 2017 (middle triangle) and 2018 (lower triangle). Colors indicate High (Blue), Moderate (Yellow), Fair/Poor (Red) nutrient related water quality. LGP-12 only sampled in 2016 and 2017.

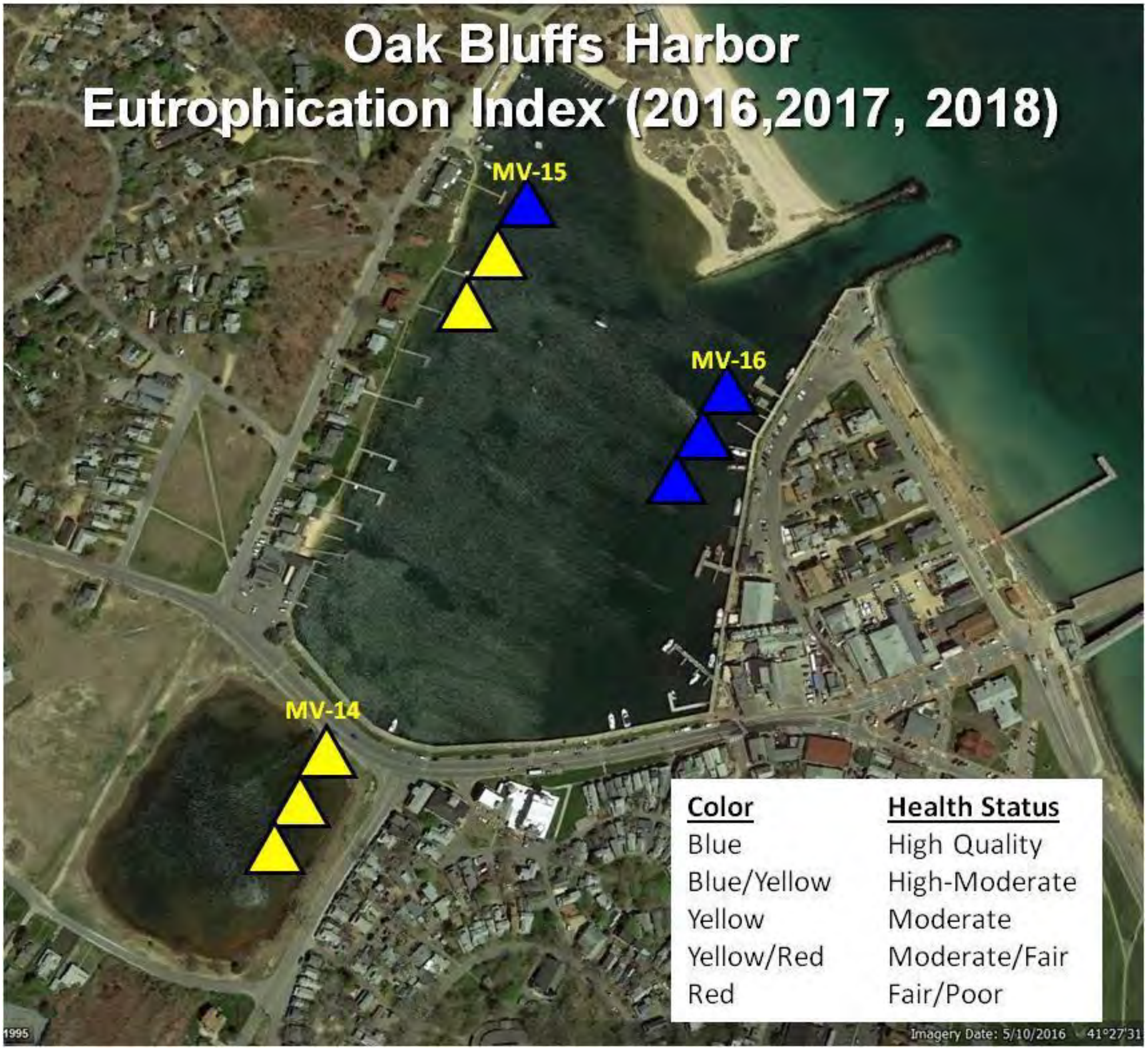


Figure 31. Oak Bluffs Harbor Eutrophication Index 2016 (upper triangle), 2017 (middle triangle) and 2018 (lower triangle). Colors indicate High (Blue), Moderate (Yellow), Fair/Poor (Red) nutrient related water quality.

Figure 32. Farm Pond Eutrophication Index 2016 (upper triangle), 2017 (middle triangle) and 2018 (lower triangle). Colors indicate High (Blue), Moderate (Yellow), Fair/Poor (Red) nutrient related water quality.

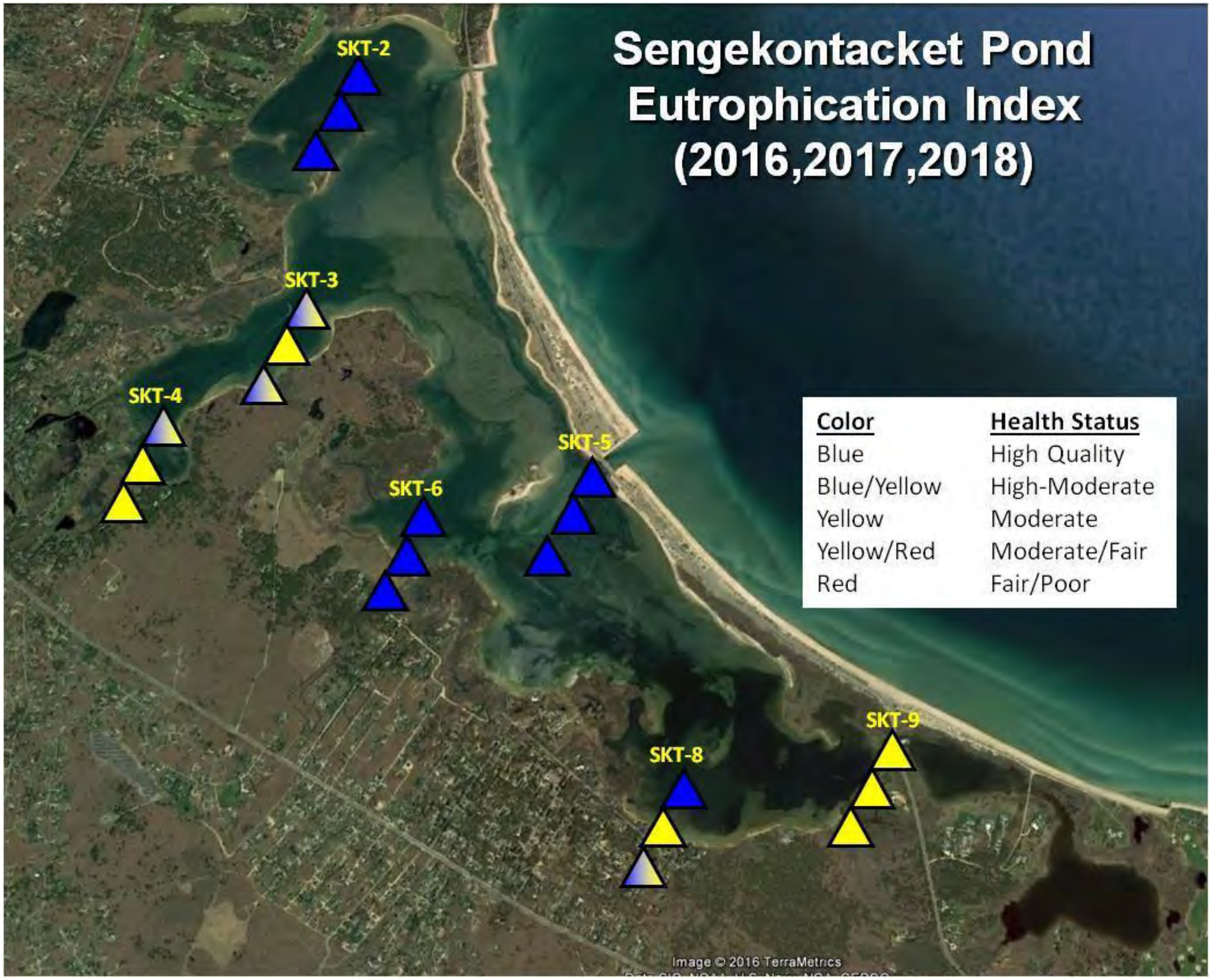


Figure 33. Sengekontacket Pond Eutrophication Index 2016 (upper triangle), 2017 (middle triangle) and 2018 (lower triangle). Colors indicate High (Blue), Moderate (Yellow), Fair/Poor (Red) nutrient related water quality.

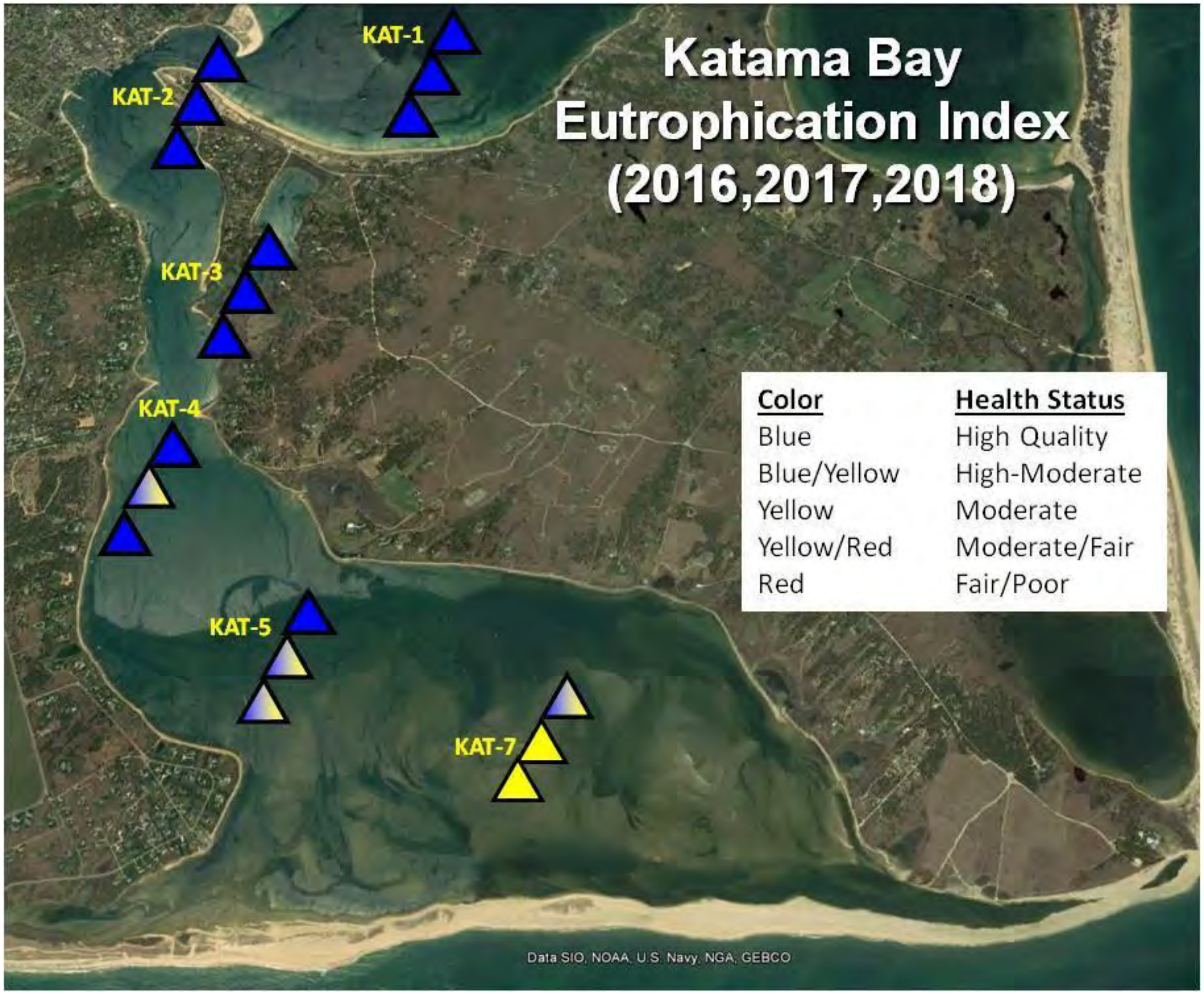


Figure 34. Katama Bay Eutrophication Index2016 (upper triangle), 2017 (middle triangle) and 2018 (lower triangle). Colors indicate High (Blue), Moderate (Yellow), Fair/Poor (Red) nutrient related water quality.

quality.

Figure 35. Cape Pogue Bay Eutrophication Index 2016 (upper triangle), 2017 (middle triangle) and 2018 (lower triangle). Colors indicate High (Blue), Moderate (Yellow), Fair/Poor (Red) nutrient related water quality.

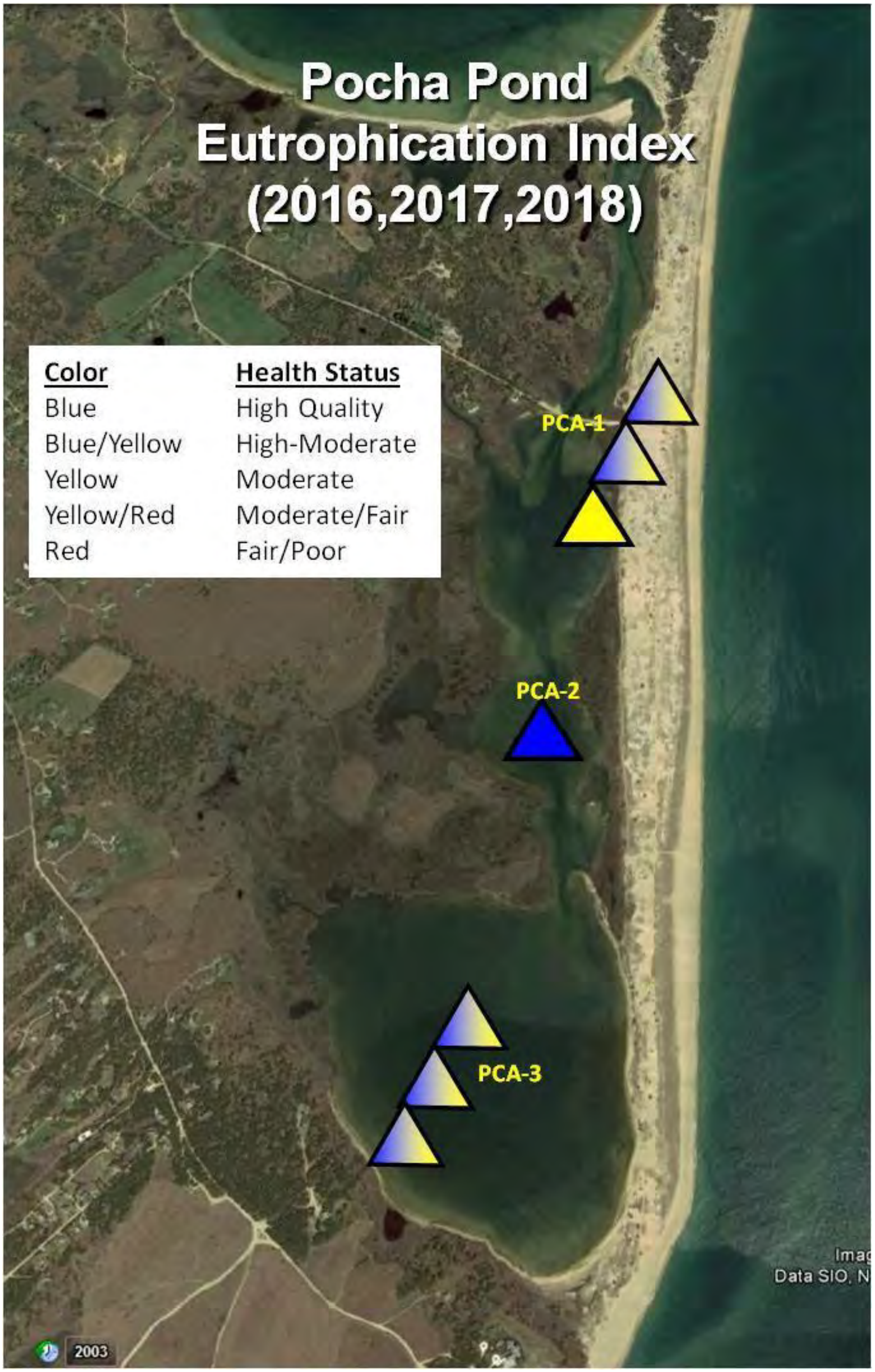


Figure 36. Pocha Pond Eutrophication Index 2016 (upper triangle), 2017 (middle triangle) and 2018 (lower triangle). Colors indicate High (Blue), Moderate (Yellow), Fair/Poor (Red) nutrient related water quality. PCA-2 only sampled in 2016.

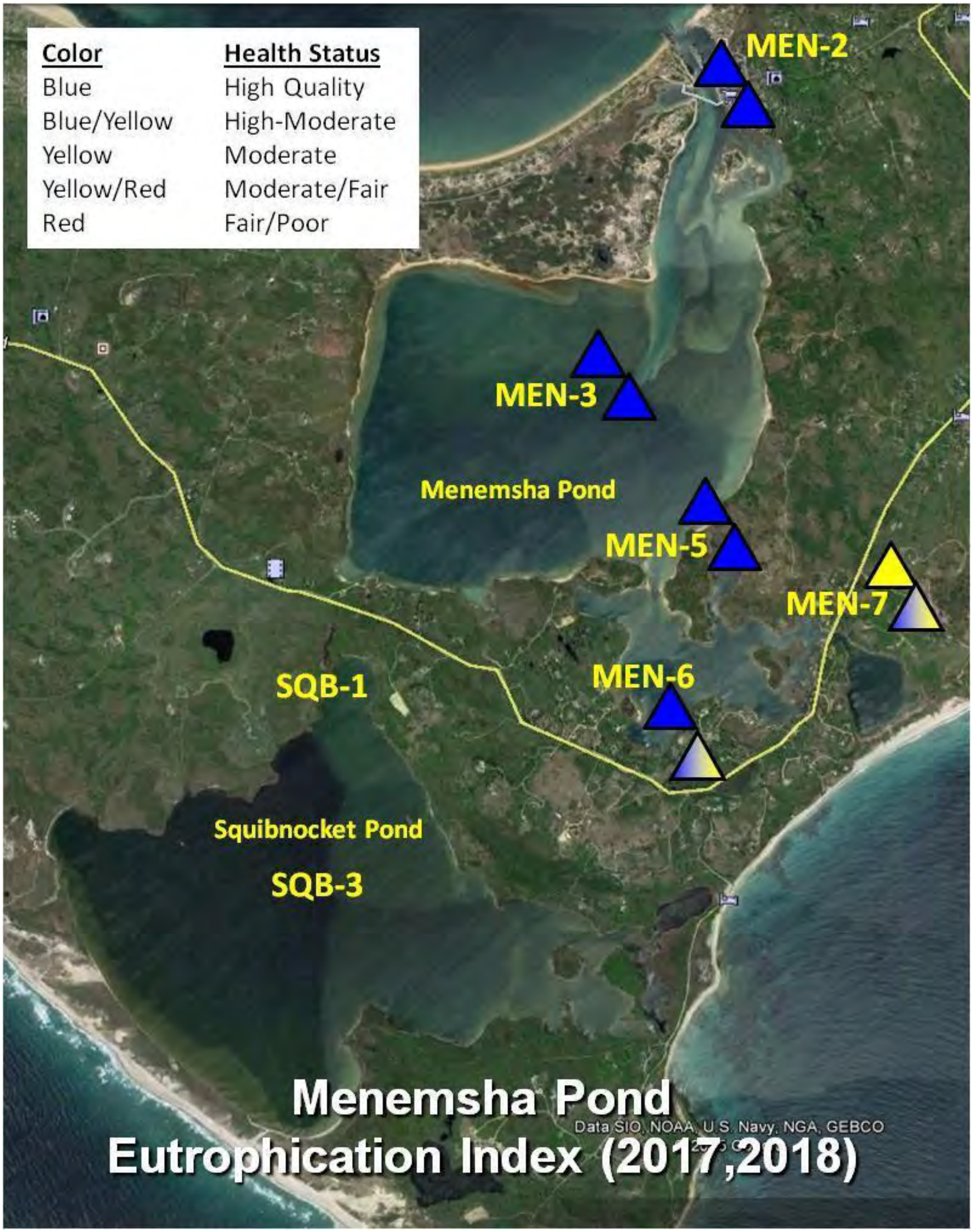


Figure 37a. Menemsha Pond Eutrophication Index 2017 (upper triangle) and 2018 (lower triangle). Colors indicate High (Blue), Moderate (Yellow), Fair/Poor (Red) nutrient related water quality. MEN-7 only sampled in 2017, 2018.

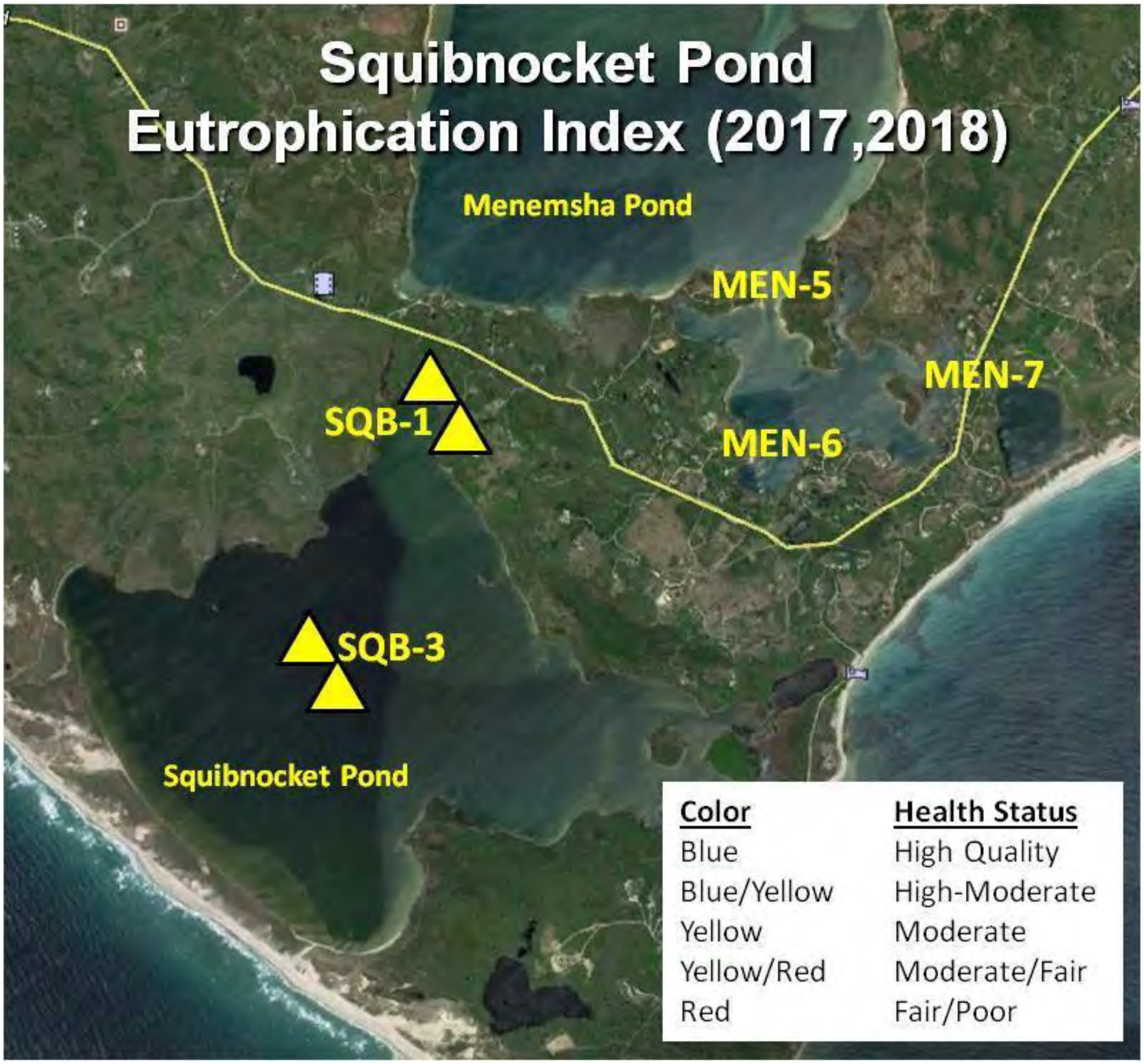


Figure 37b. Squibnocket Pond Eutrophication Index 2017 (upper) and 2018 (lower). Colors indicate High (Blue), Moderate (Yellow), Fair/Poor (Red) nutrient related water quality.

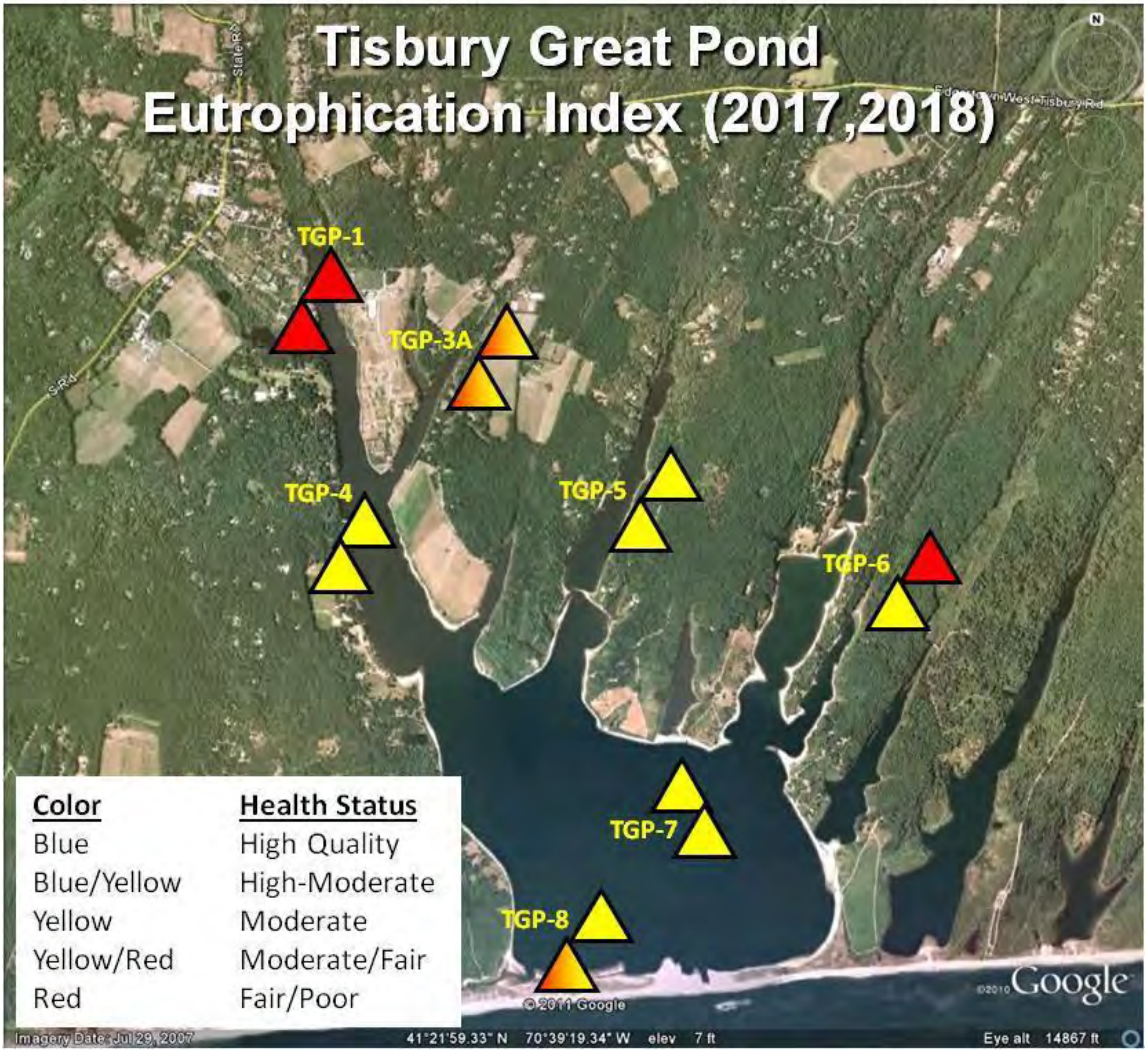


Figure 38. Tisbury Great Pond Eutrophication Index 2017 (upper triangle) and 2018 (lower triangle). Colors indicate High (Blue), Moderate (Yellow), Fair/Poor (Red) nutrient related water quality.

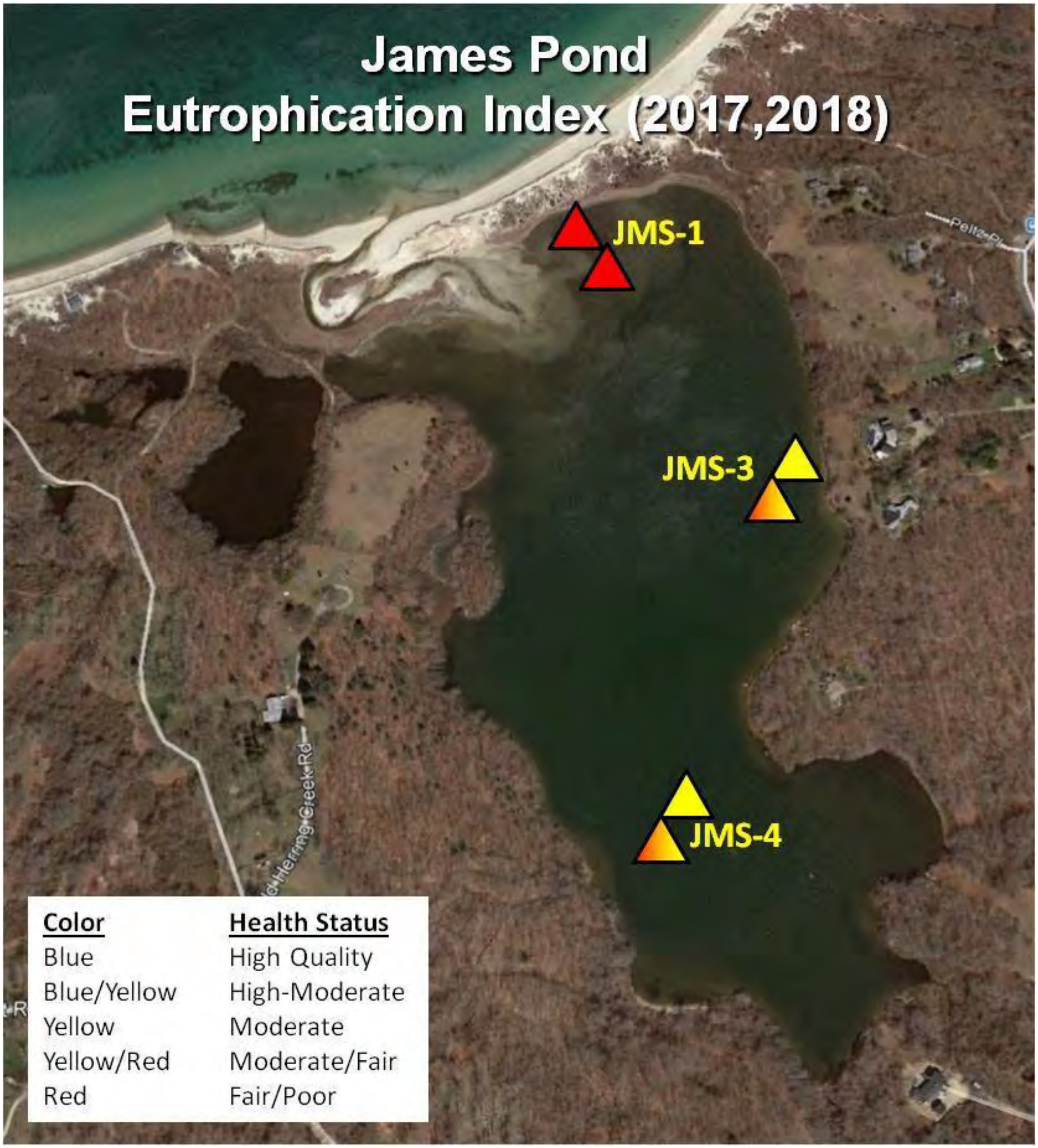


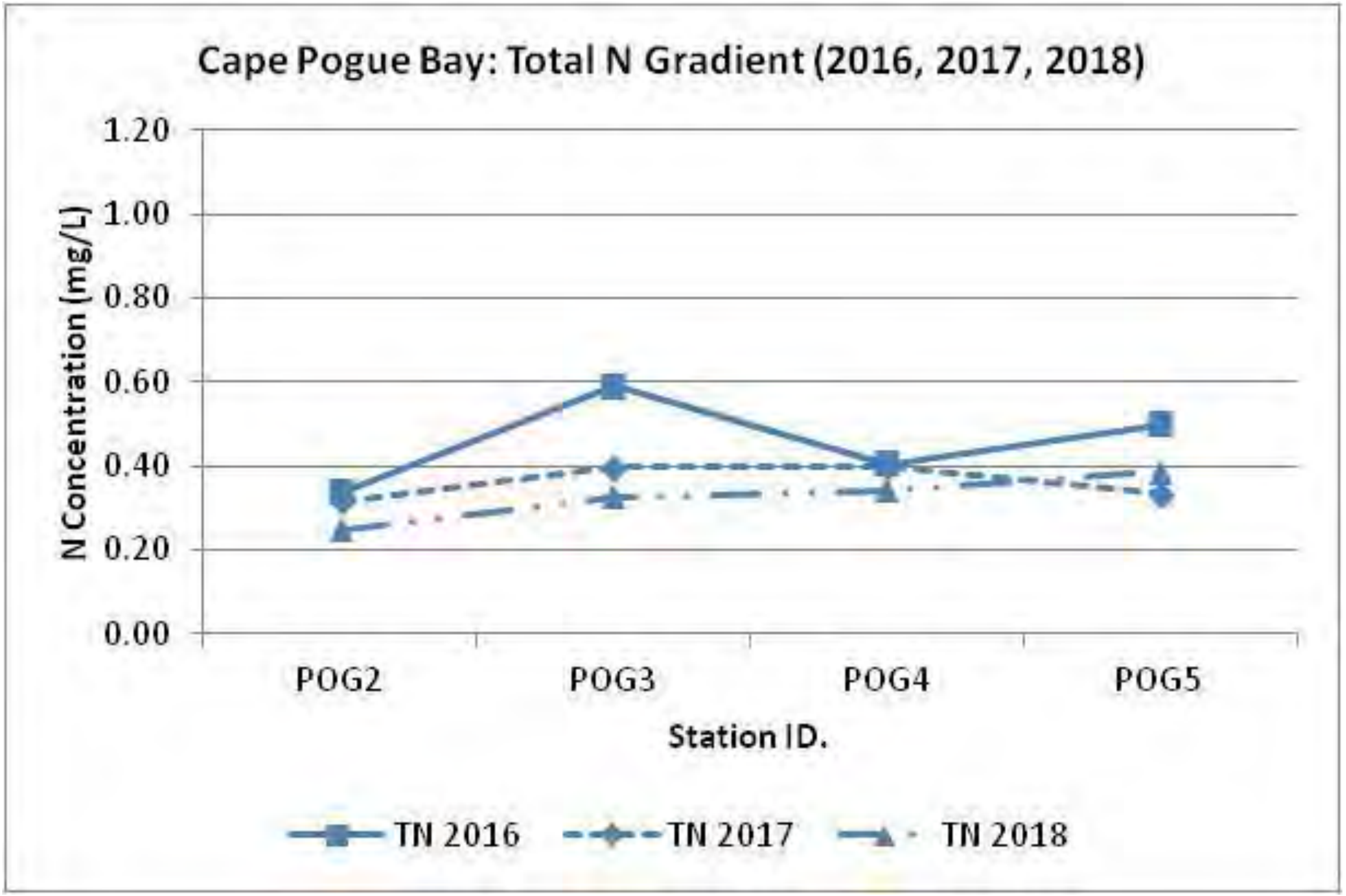
Figure 39. James Pond Eutrophication Index 2017 (upper triangle) and 2018 (lower triangle). Colors indicate High (Blue), Moderate (Yellow), Fair/Poor (Red) nutrient related water quality.

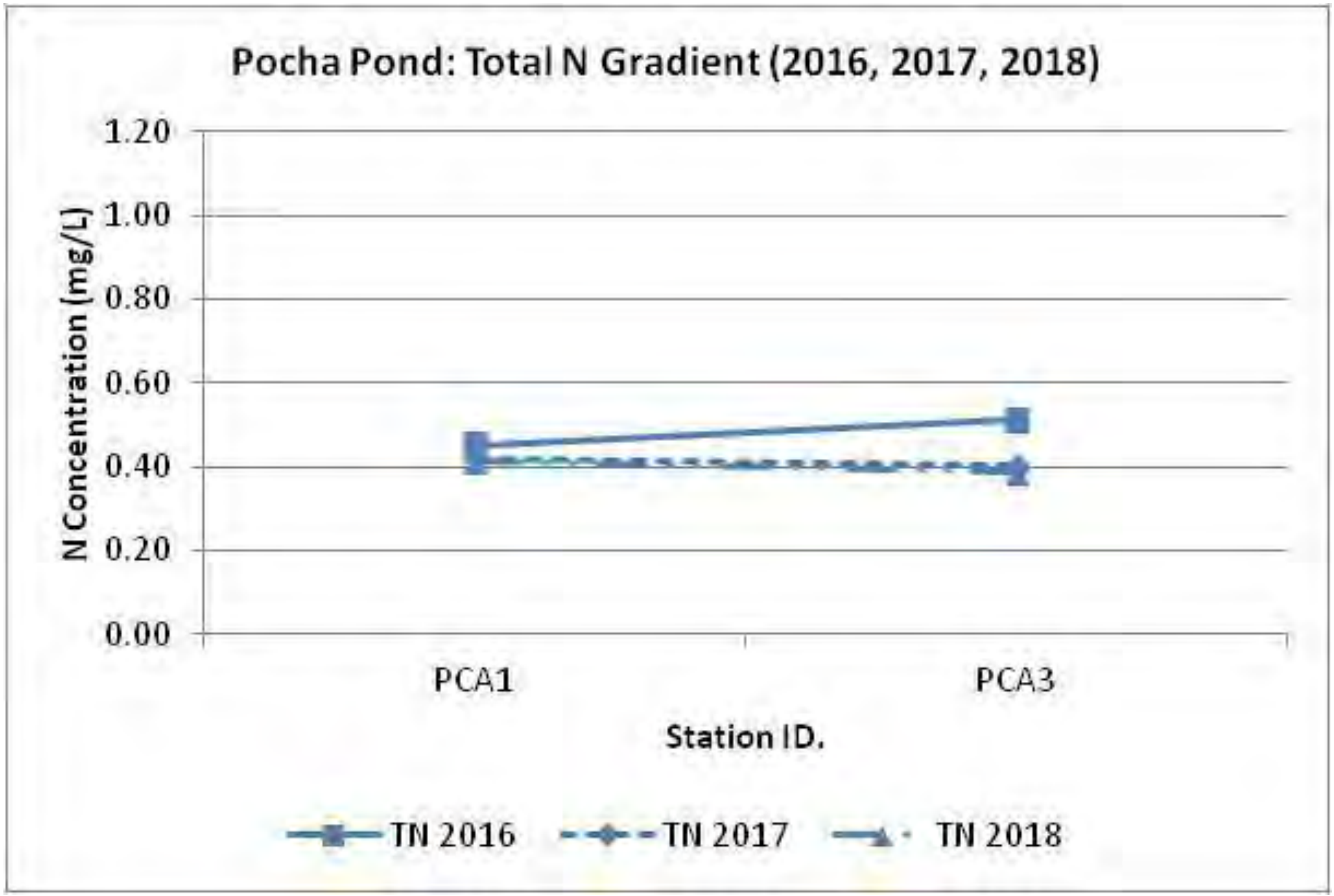
APPENDIX A

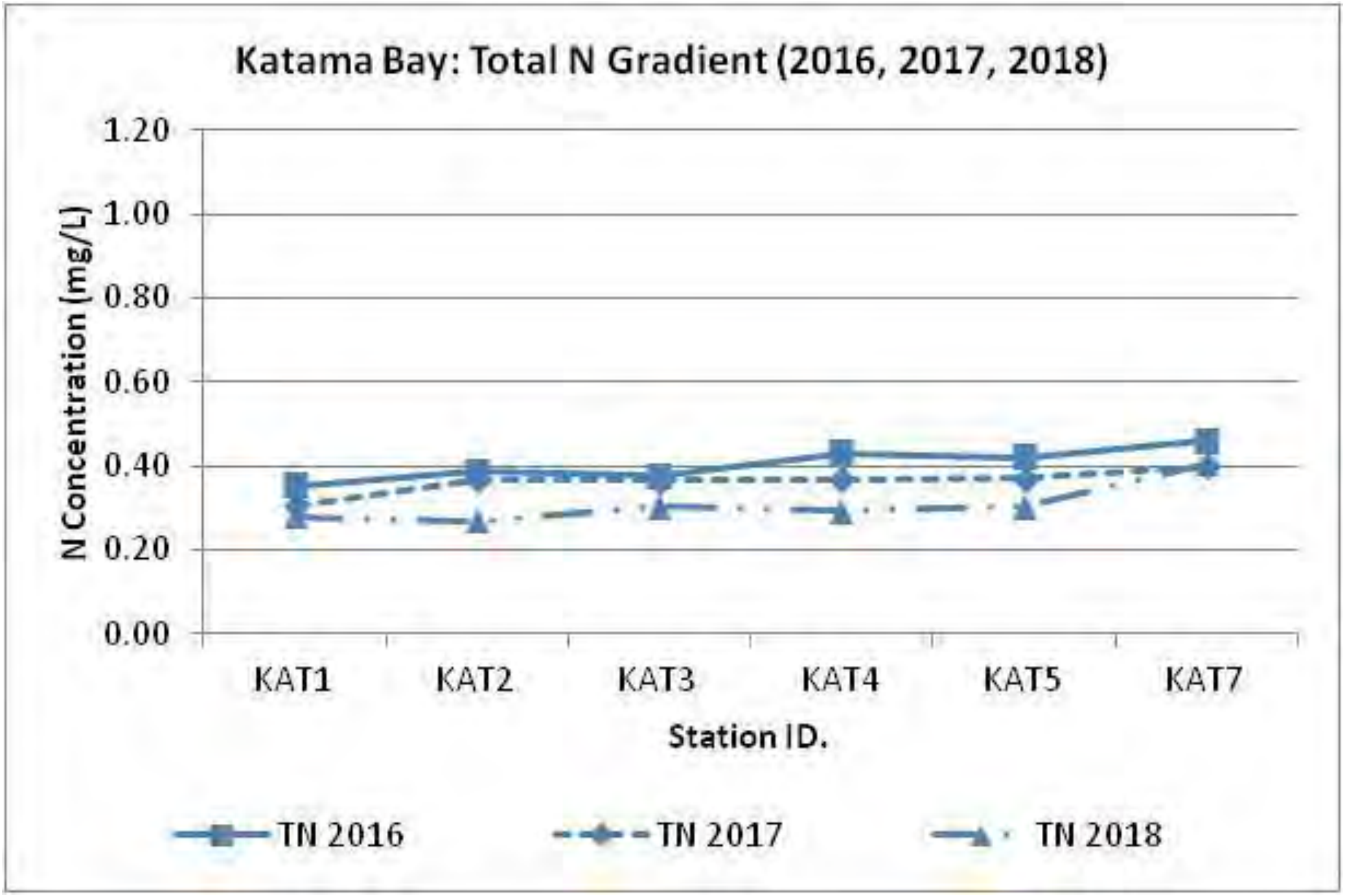
TN PLOTS (2016, 2017, 2018)

No MEP Thresholds Developed for:

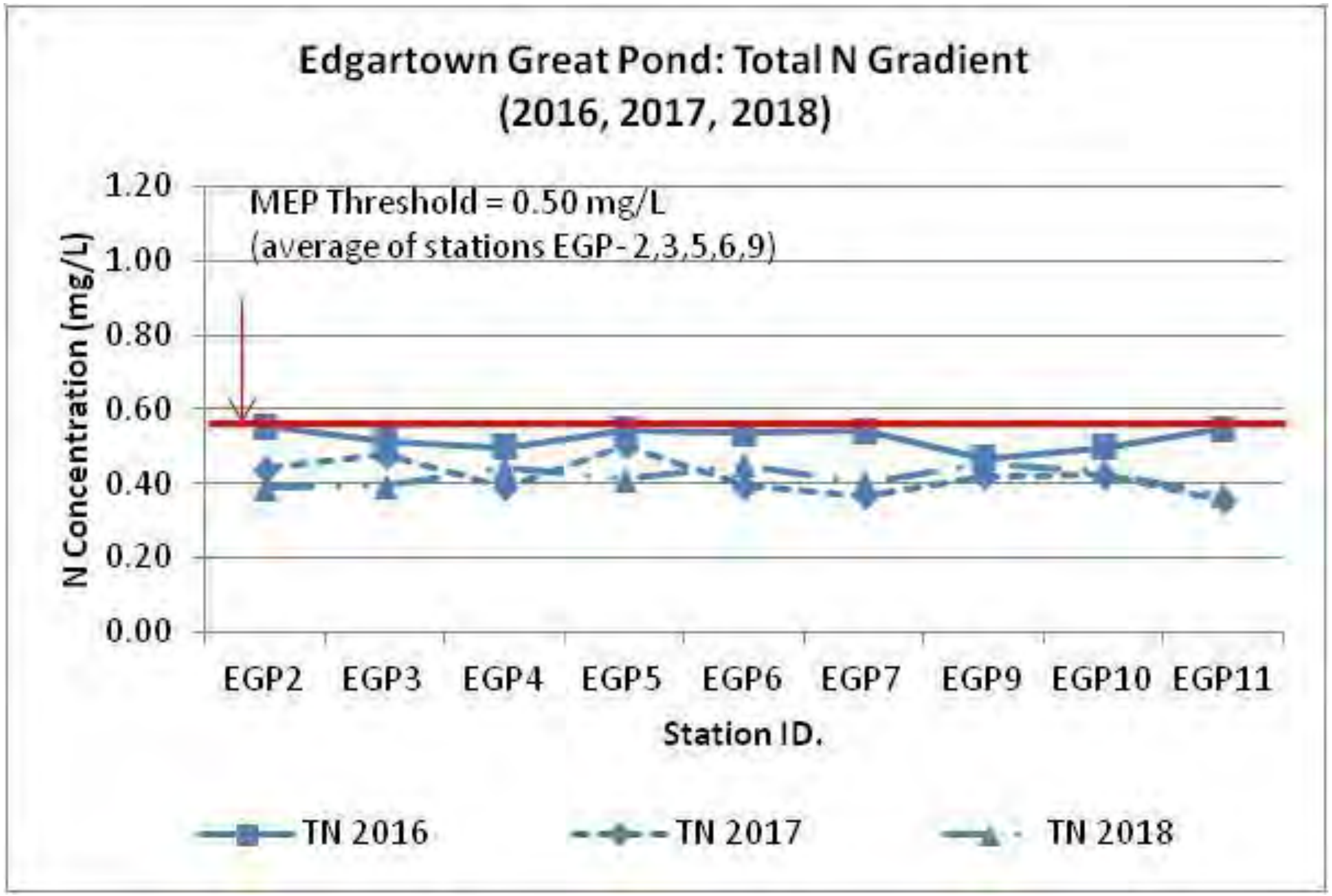
Katama Bay
Cape Pogue Bay
Pocha Pond
James Pond

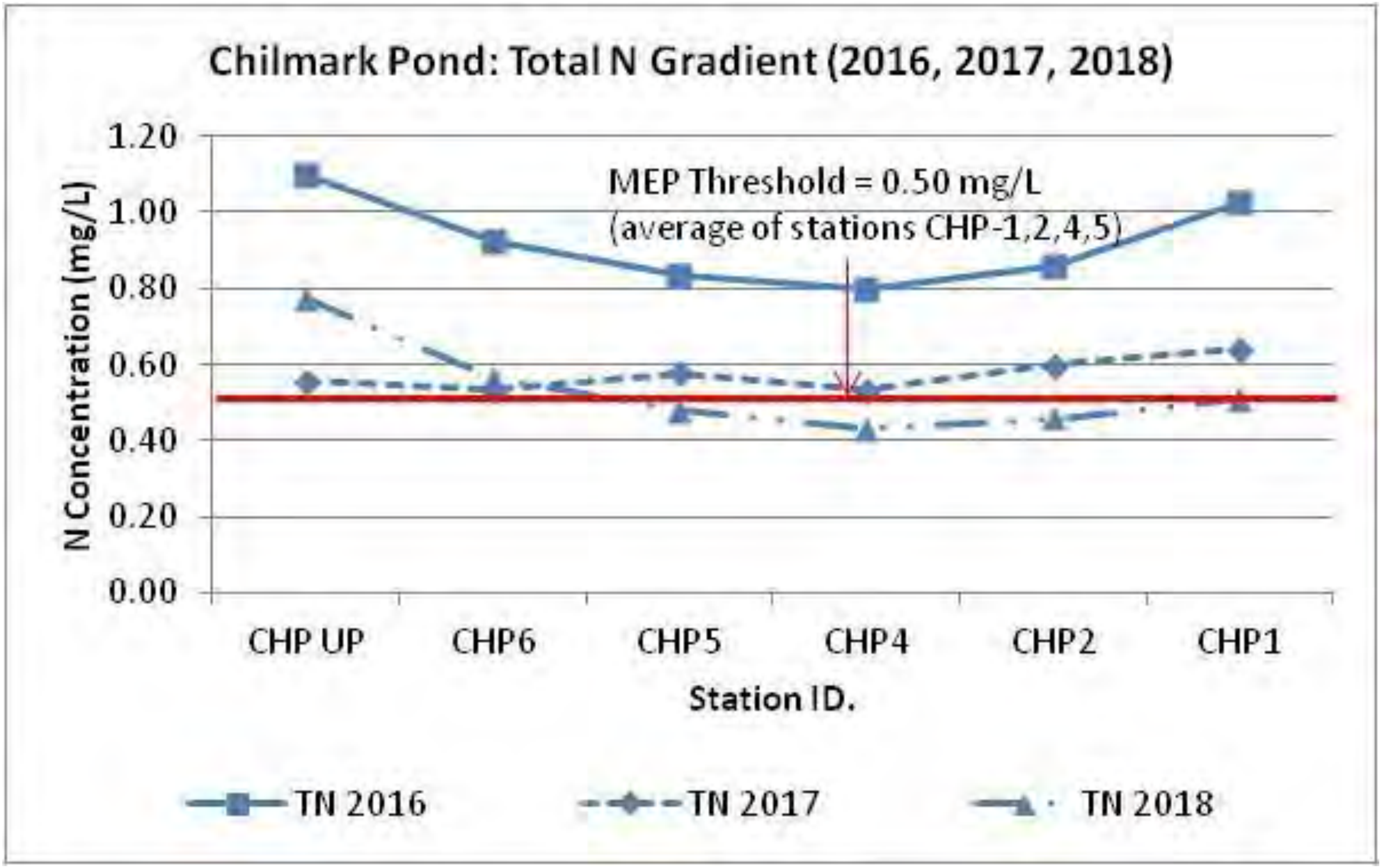

Cape Pogue Bay: Total N Gradient (2016, 2017, 2018)
N Concentration (mg/L)
1.20
1.00
0.80
0.60
0.40
0.20
0.00
POG2
POG3
POG4
POG5
Station ID.
TN 2016
TN 2017
TN 2018


Pocha Pond: Total N Gradient (2016, 2017, 2018)
N Concentration (mg/L)
1.20
1.00
0.80
0.60
0.40
0.20
0.00
PCA1
PCA3
Station ID.
TN 2016
TN 2017
TN 2018

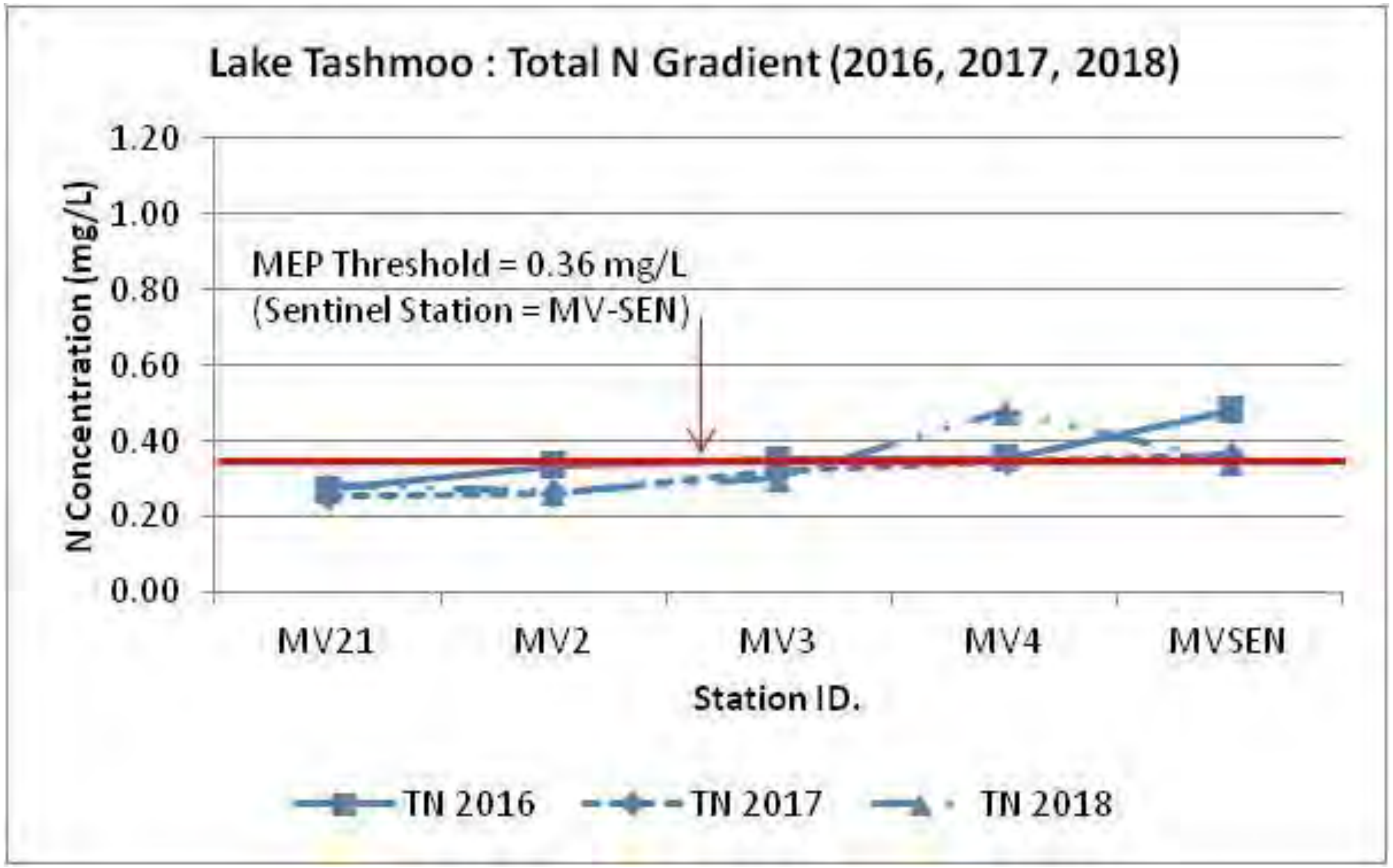


Katama Bay: Total N Gradient (2016, 2017, 2018)
N Concentration (mg/L)
1.20
1.00
0.80
0.60
0.40
0.20
0.00
KAT1
KAT2
KAT3
KAT4
KAT5
KAT7
Station ID.
TN 2016
TN 2017
TN 2018

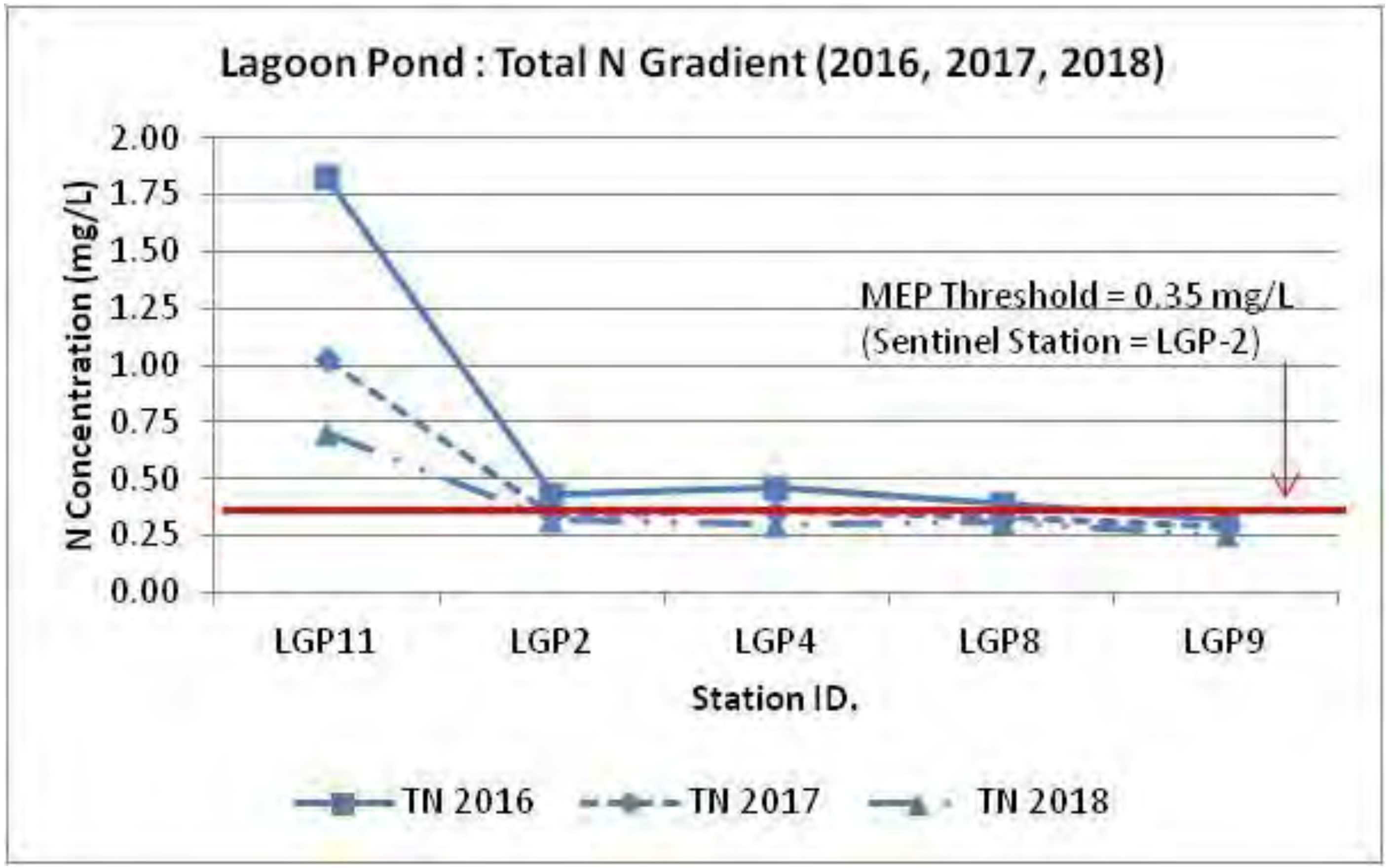

Edgartown Great Pond: Total N Gradient
(2016, 2017, 2018)
MEP Threshold = 0.50 mg/L
(average of stations EGP-2,3,5,6,9)
N Concentration (mg/L)
1.20
1.00
0.80
0.60
0.40
0.20
0.00
EGP2
EGP3
EGP4
EGP5
EGP6
EGP7
EGP9
EGP10
EGP11
Station ID.
TN 2016
TN 2017
TN 2018

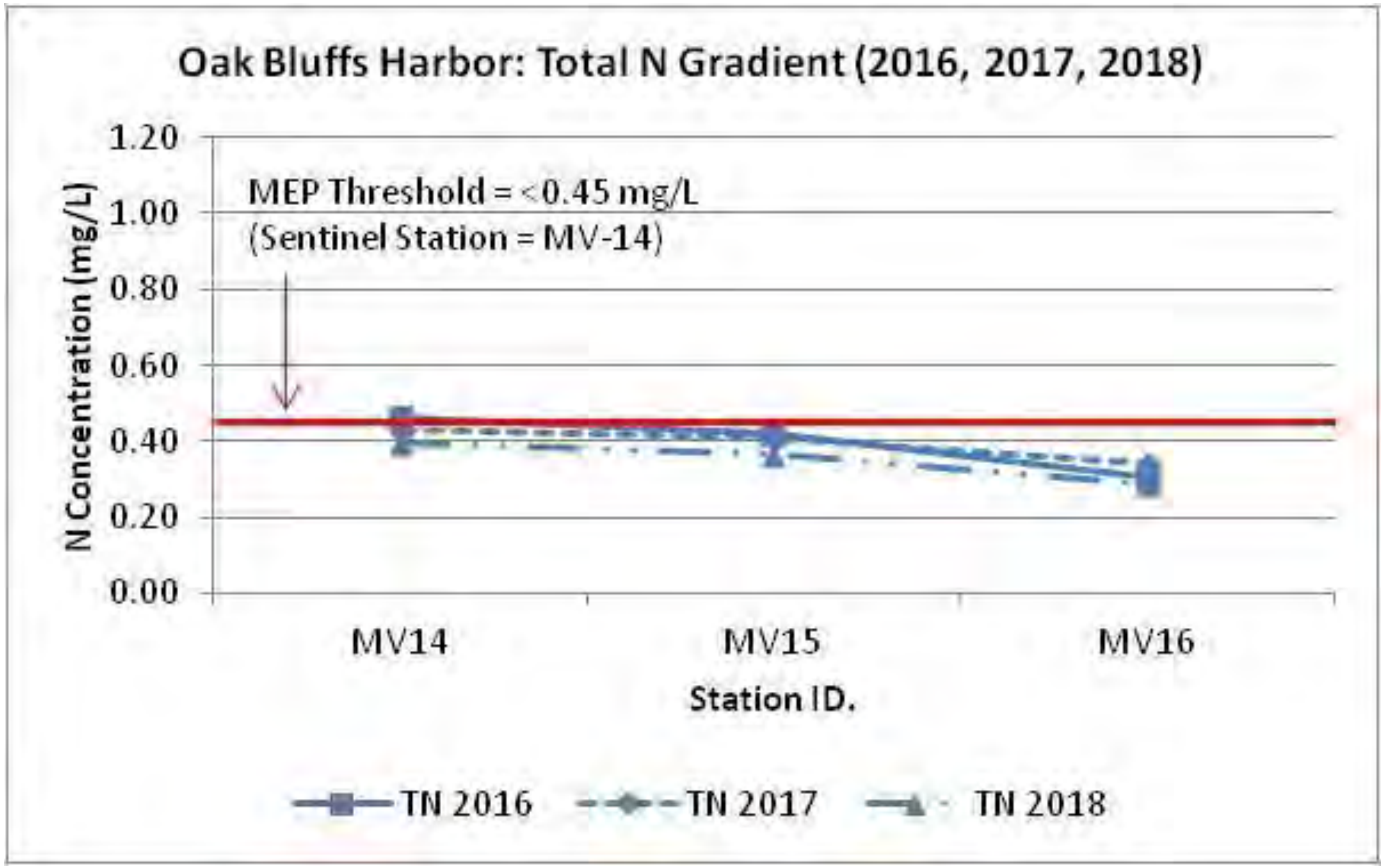


Chilmark Pond: Total N Gradient (2016, 2017, 2018)
1.20
1.00
0.80
0.60
0.40
0.20
0.00
N Concentration (mg/L)
MEP Threshold = 0.50 mg/L
(average of stations CHP-1,2,4,5)
CHP UP
CHP6
CHP5
CHP4
CHP2
CHP1
Station ID.
TN 2016
TN 2017
TN 2018

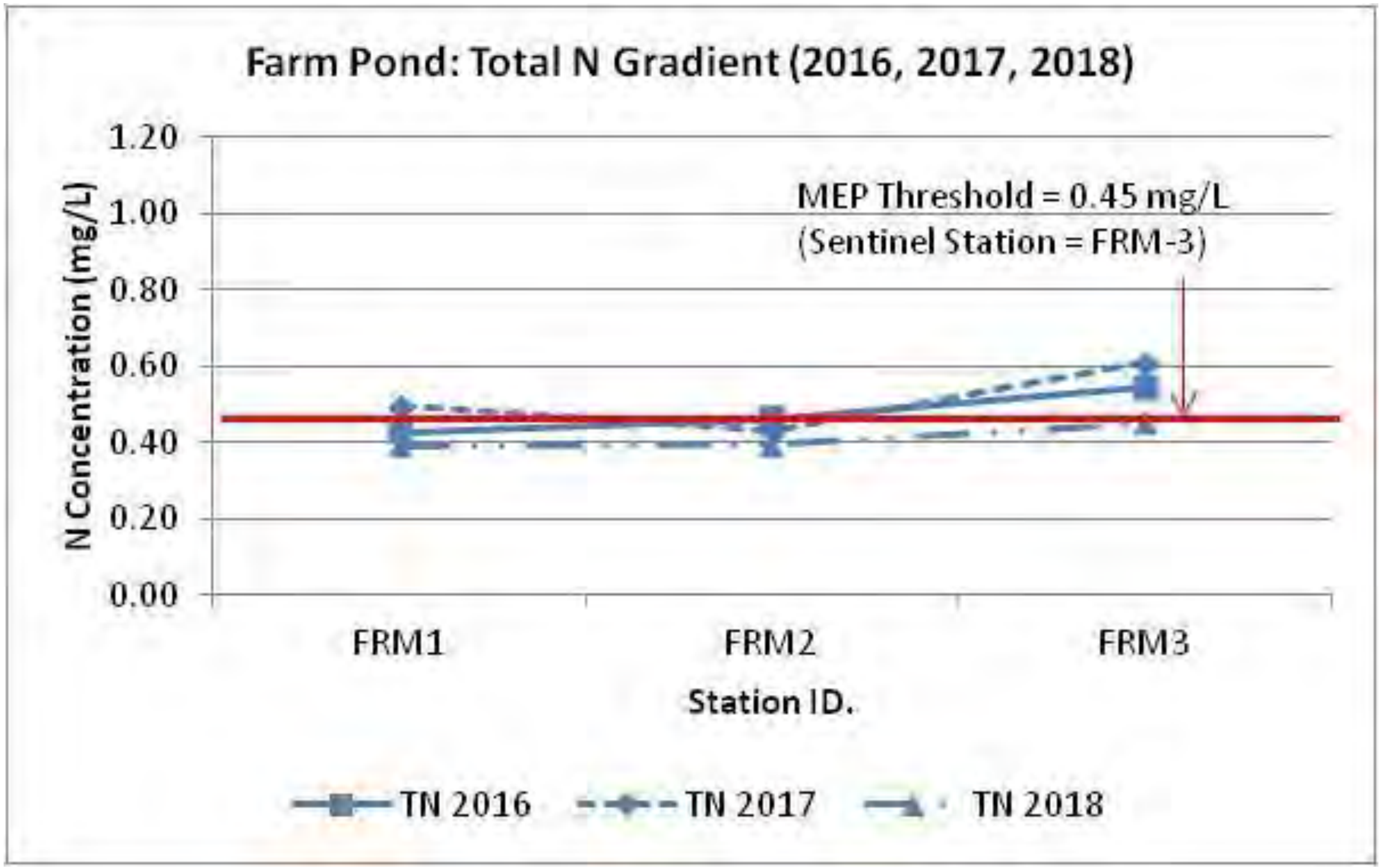


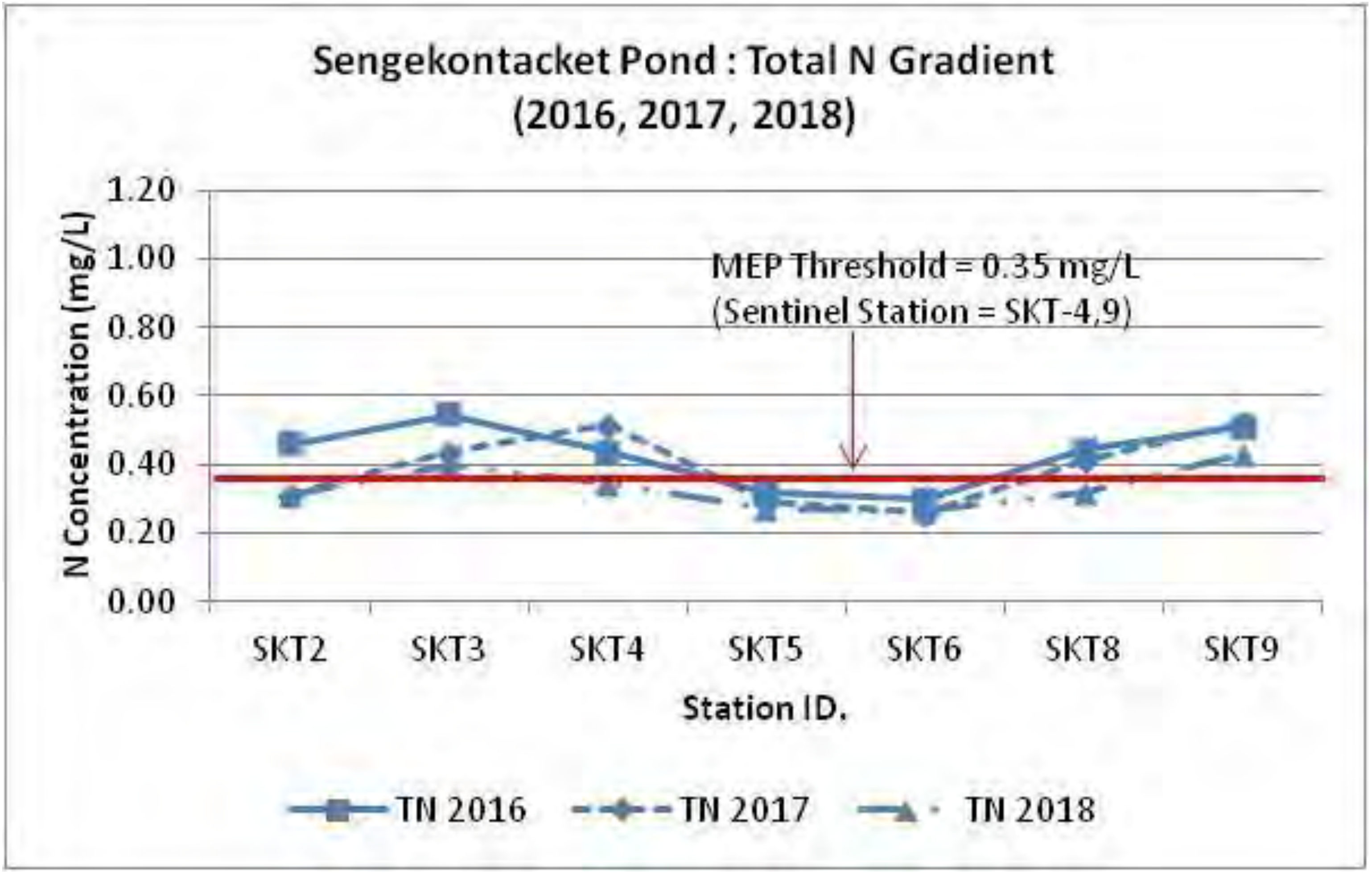
Lake Tashmoo : Total N Gradient (2016, 2017, 2018)
N Concentration (mg/L)
1.20
1.00
0.80
0.60
0.40
0.20
0.00
MEP Threshold = 0.36 mg/L
(Sentinel Station = MV-SEN)
MV21
MV2
MV3
MV4
MVSEN
Station ID.
TN 2016
TN 2017
TN 2018

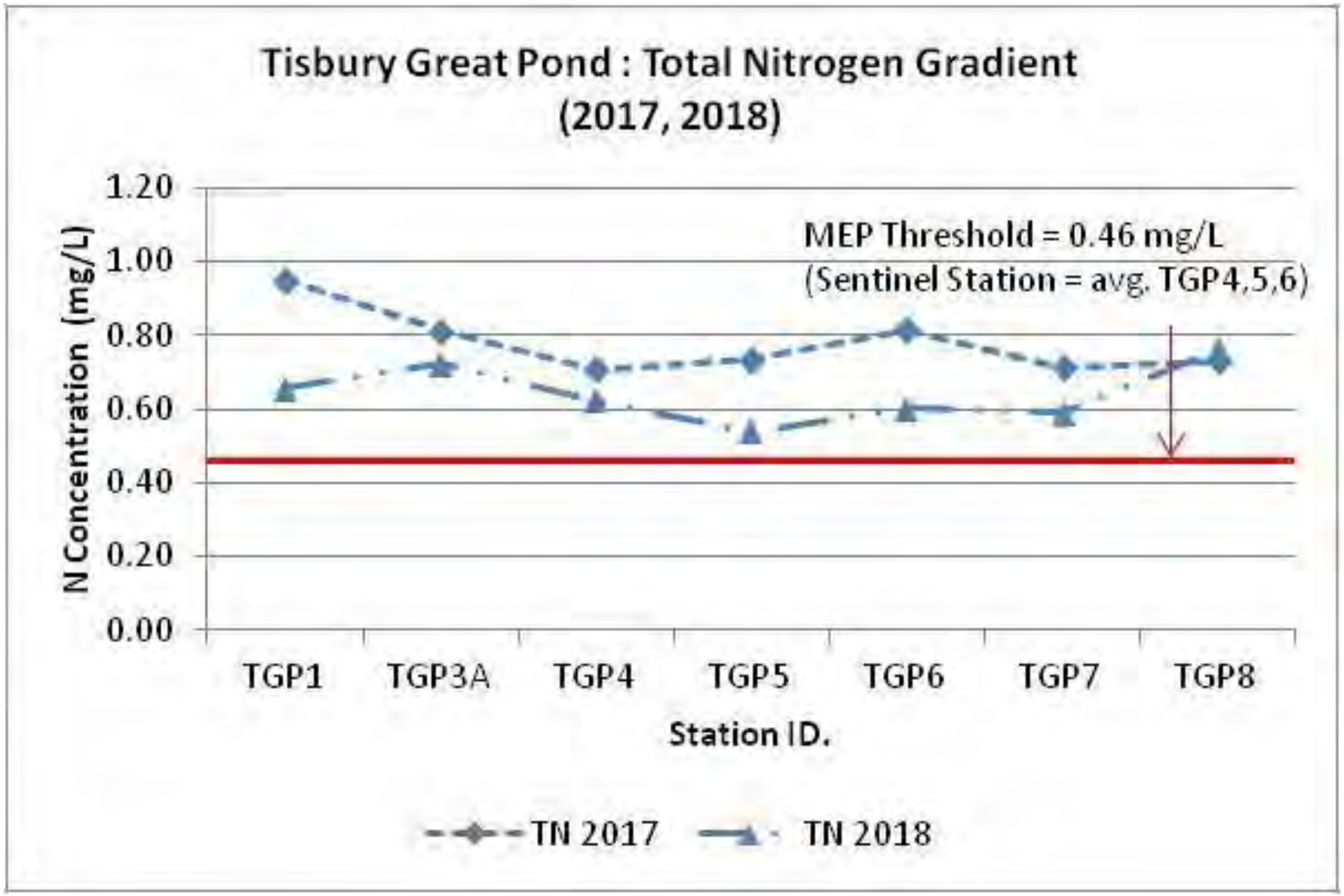

Lagoon Pond : Total N Gradient (2016, 2017, 2018)
N Concentration (mg/L)
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
MEP Threshold = 0.35 mg/L
(Sentinel Station = LGP-2)
LGP11
LGP2
LGP4
LGP8
LGP9
Station ID.
TN 2016
TN 2017
TN 2018



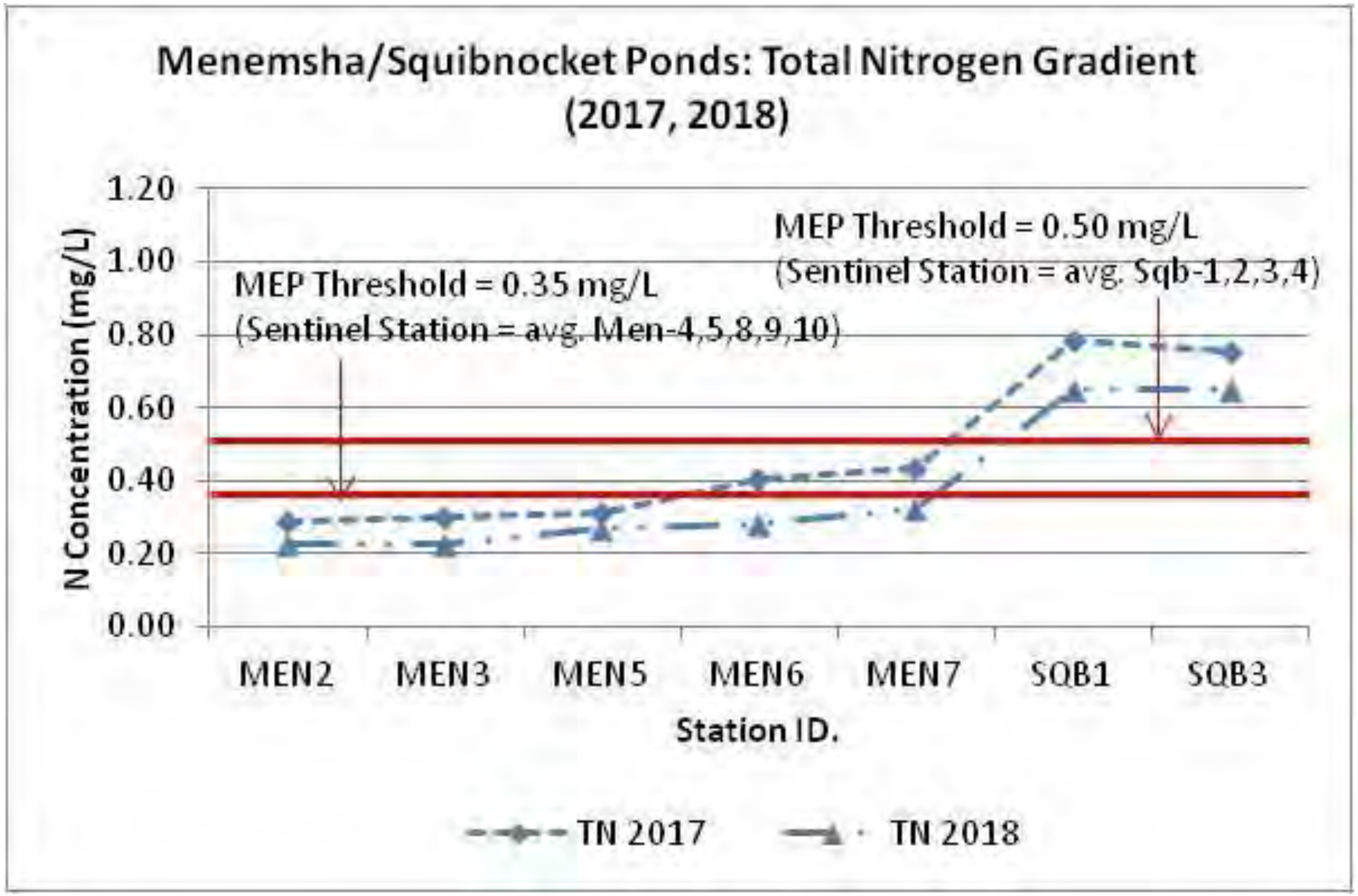
Oak Bluffs Harbor: Total N Gradient (2016, 2017, 2018)
MEP Threshold = <0.45 mg/L
(Sentinel Station = MV-14)
N Concentration (mg/L)
1.20
1.00
0.80
0.60
0.40
0.20
0.00
MV14
MV15
MV16
Station ID.
TN 2016
TN 2017
TN 2018


Farm Pond: Total N Gradient (2016, 2017, 2018)
N Concentration (mg/L)
1.20
1.00
0.80
0.60
0.40
0.20
0.00
MEP Threshold = 0.45 mg/L
(Sentinel Station = FRM-3)
FRM1
FRM2
FRM3
Station ID.
TN 2016
TN 2017
TN 2018

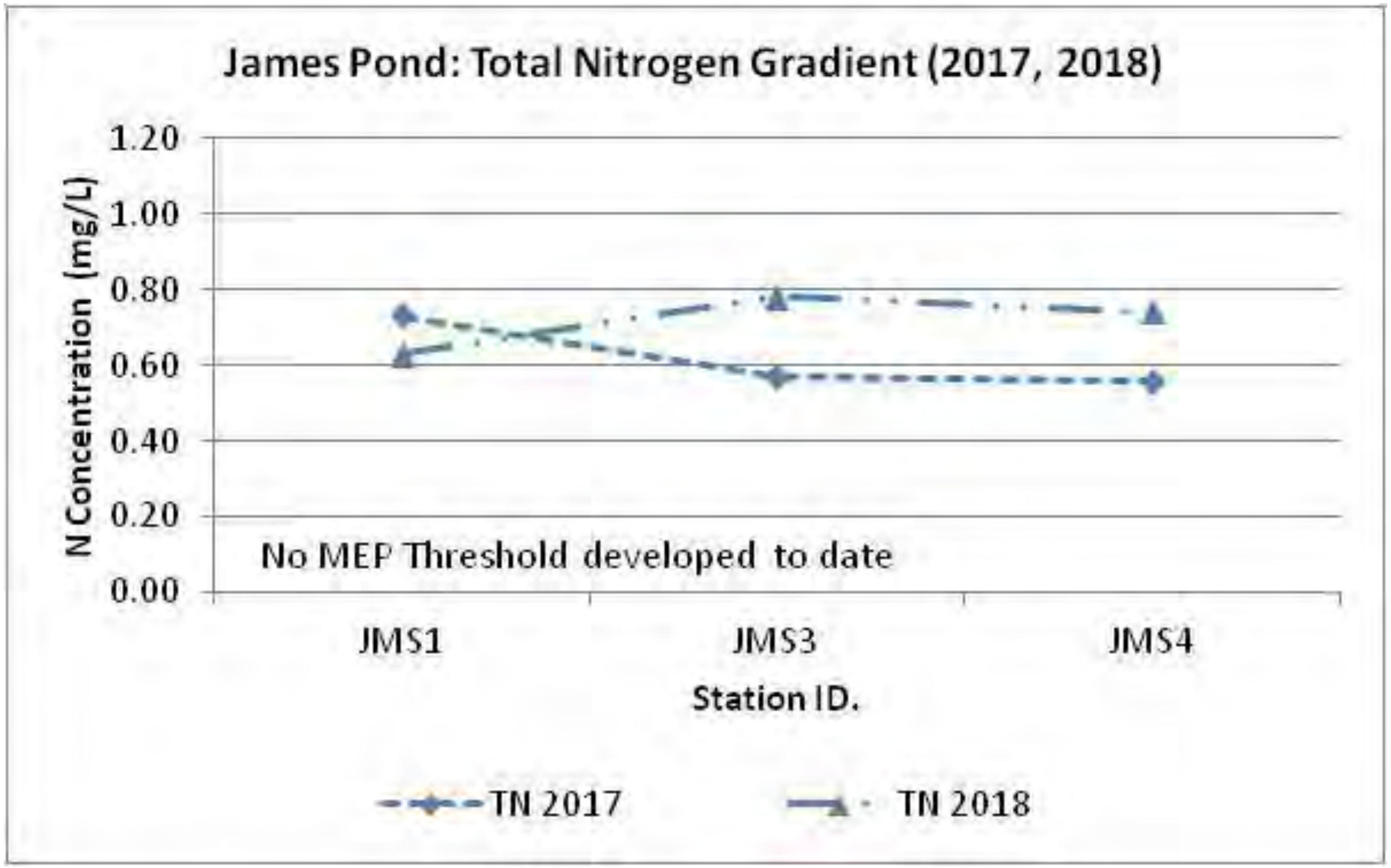

Sengekontacket Pond : Total N Gradient
(2016, 2017, 2018)
N Concentration (mg/L)
1.20
1.00
0.80
0.60
0.40
0.20
0.00
MEP Threshold = 0.35 mg/L
(Sentinel Station = SKT-4,9)
SKT2
SKT3
SKT4
SKT5
SKT6
SKT8
SKT9
Station ID.
TN 2016
TN 2017
TN 2018



Tisbury Great Pond : Total Nitrogen Gradient
(2017, 2018)
MEP Threshold = 0.46 mg/L
(Sentinel Station = avg. TGP4,5,6)
N Concentration (mg/L)
1.20
1.00
0.80
0.60
0.40
0.20
0.00
TGP1
TGP3A
TGP4
TGP5
TGP6
TGP7
TGP8
Station ID.
TN 2017
TN 2018



Menemsha/Squibnocket Ponds: Total Nitrogen Gradient
(2017, 2018)
N Concentration (mg/L)
1.20
1.00
0.80
0.60
0.40
0.20
0.00
MEP Threshold = 0.50 mg/L
(Sentinel Station = avg. Sqb-1,2,3,4)
MEP Threshold = 0.35 mg/L
(Sentinel Station = avg. Men-4,5,8,9,10)
MEN2
MEN3
MEN5
MEN6
MEN7
SQB1
SQB3
Station ID.
TN 2017
TN 2018



James Pond: Total Nitrogen Gradient (2017, 2018)
N Concentration (mg/L)
1.20
1.00
0.80
0.60
0.40
0.20
0.00
No MEP Threshold developed to date
JMS1
JMS3
JMS4
Station ID.
TN 2017
TN 2018