STATE OF NEW HAMPSHIRE

Technical Support Document for the Great Bay Estuary Aquatic Life Integrity Use Support Assessments, 2018 305(b) Report/303(d) List

January 3, 2020

Technical Support Document for the Great Bay Estuary Aquatic Life Integrity Use Support Assessments, 2018 305(b) Report/303(d) List

STATE OF NEW HAMPSHIRE
DEPARTMENT OF ENVIRONMENTAL SERVICES
29 HAZEN DRIVE
CONCORD, N.H. 03301

ROBERT R. SCOTT
Commissioner

CLARK B. FREISE
Assistant Commissioner

THOMAS E. O'DONOVAN, P.E., P.M.P.
Water Division Director

Prepared by:
Ken Edwardson

January 3, 2020

New Hampshire Department of Environmental Services
PO Box 95, Concord, NH 03302-0095
www.des.nh.gov | (603) 271-3503

Table of Contents

Introduction

The Federal Water Pollution Control Act [PL92-500, commonly called the Clean Water Act (CWA)], as last reauthorized by the Water Quality Act of 1987, requires each state to submit two surface water quality documents to the U.S. Environmental Protection Agency (USEPA) every two years. Section 305(b) of the CWA requires submittal of a report (commonly called the "305(b) Report") that describes the quality of its surface waters and an analysis of the extent to which all such waters provide for the protection and propagation of a balanced population of shellfish, fish, and wildlife, and allow recreational activities in and on the water. The second document, typically called the "303(d) List," which is required by Section 303(d) of the CWA, includes surface waters that are:

1. Impaired or threatened by a pollutant or pollutant(s).
2. Not expected to meet water quality standards within a reasonable time even after application of best available technology standards for point sources or best management practices for nonpoint sources.
3. Require the development and implementation of a comprehensive water quality study (i.e., called a Total Maximum Daily Load or TMDL study) that is designed to meet water quality standards.

In accordance with these requirements, the New Hampshire Department of Environmental Services (NHDES) assesses all available data for freshwaters and marine waters every two years to determine compliance with the Surface Water Quality Regulations, Env-Wq 1700 *et sq*. The assessments determine whether or not water quality supports specific designated uses. Designated uses are the desirable uses that surface waters should support such as swimming (i.e., Primary Contact Recreation) and Aquatic Life use. The full list of designated uses considered by NHDES is:

- Aquatic Life Integrity: Waters that support aquatic life, including a balanced, integrated, and adaptive community of organisms having a species composition, diversity and functional organization comparable to that of similar natural habitats of the region.
- Fish Consumption: Waters that support a population of fish free from toxicants and pathogens that could pose a human health risk to consumers.
- Shellfish Consumption: Waters that support a population of shellfish free from toxicants and pathogens that could pose a human health risk to consumers.
- Potential Drinking Water Supply: Waters that could be suitable for human intake and meet state and federal drinking water requirements after adequate treatment.
- Swimming and Other Recreation In and On the Water: Waters that are suitable for swimming, wading, boating of all types, fishing, surfing, and similar activities.
    - Primary Contact Recreation (i.e. swimming): Waters suitable for recreational uses that require or are likely to result in full body contact and/or incidental ingestion of water.
    - Secondary Contact Recreation (i.e. boating): Waters that support recreational uses that involve minor contact with the water.
- Wildlife: Waters that provide habitat capable of supporting any life stage or activity of undomesticated fauna on a regular or periodic basis.

The Great Bay estuary constitutes approximately 86% (by area) of all New Hampshire estuaries. The Great Bay estuary is a valuable resource to the state and nation, and, as such, has been designated by USEPA as an "estuary of national significance" under Section 320 of the CWA. The 2013 State of the Estuaries Report (SOOE) for the estuary (PREP, State of Our Estuaries, 2013) showed that the Great Bay estuary has all the classic signs of eutrophication: increasing nitrogen concentrations, low dissolved

oxygen and disappearing eelgrass habitat. The 2018 report (PREP, 2018) that followed found that the estuaries are declining due to stress from human activities as well as natural processes influenced by human activities. These symptoms of eutrophication have the potential to impair the Aquatic Life Integrity designated use, which would be a violation of the state water quality standards for nutrients (Env-Wq 1703.14) and biological and aquatic community integrity (Env-Wq 1703.19):

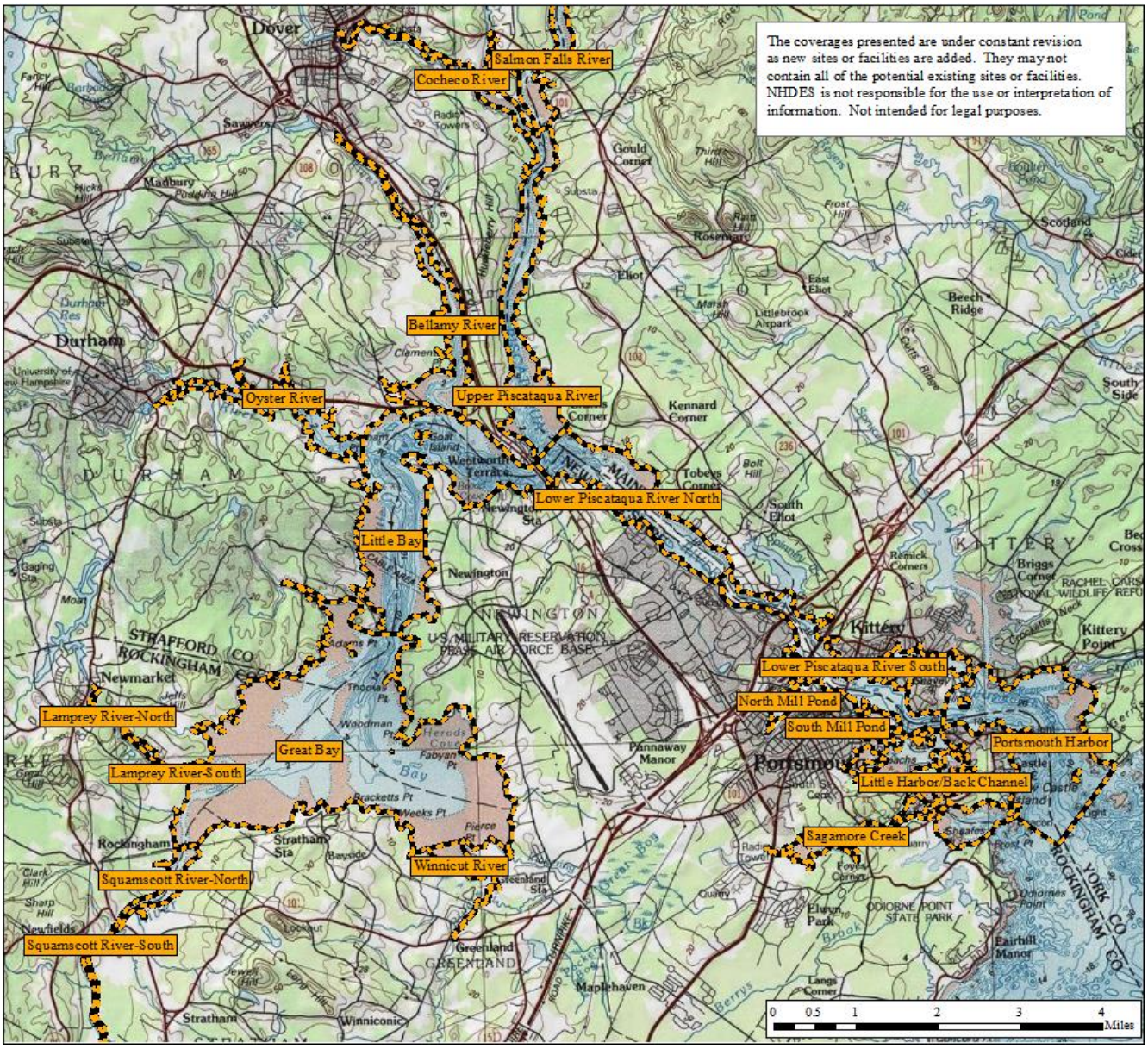
> Env-Wq 1703.14
> (b) Class B waters shall contain no phosphorus or nitrogen in such concentrations that would impair any existing or designated uses, unless naturally occurring.
>
> Env-Wq 1703.19
> (a) The surface waters shall support and maintain a balanced, integrated, and adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of similar natural habitats of a region.
> (b) Differences from naturally occurring conditions shall be limited to non-detrimental differences in community structure and function.

Given the complexity of the Great Bay estuary and the inherent challenges in assessing it, this technical support document (TSD) is meant to provide additional information about how the water quality status of each of the 19 assessment zone was determined. Specifically, this document addresses the water quality data used to determine if the estuary meets the Aquatic Life designated use.

Estuary Assessment Zones

For 305(b)/303(d) assessments, NHDES uses 43 assessment units to cover the Great Bay estuary that are coincident with the shellfish growing areas established by the NHDES Shellfish Program. Great Bay itself consists of seven different assessment units. Nitrogen and eutrophication parameters are logically evaluated utilizing data from larger aggregates of assessment units covering contiguous areas. Eutrophication effects are less localized than the bacteria pollution sources that affect shellfish harvesting. Therefore, NHDES aggregated the 43 assessment units in the Great Bay estuary into 19 assessment zones. The boundaries of each of the aggregated assessment zones are shown in Figure 1. For the purposes of 305(b)/303(d) reporting, the categories assigned to these larger assessment zones will be assigned to each of the assessment units comprising the assessment zone. For the Salmon Falls/Piscataqua River, the assessment zones cover both the New Hampshire and Maine sides of the main stem of the river in order to select data from both sides of the river. The river is well-mixed and data from both sides of the state line are needed to provide a comprehensive dataset for assessments. However, the impairment determinations made by NHDES only apply to the New Hampshire side of the river. The Maine Department of Environmental Protection makes its own impairment determinations for the Maine side of the Salmon Falls/Piscataqua River. No changes have been made to the composition or locations of assessment zones between the 2016 and 2018 reporting cycles reported in this document.

Figure 1. Great Bay estuary assessment zones for the 2018 305(b)/303(d) aquatic life integrity designated use assessments.



Eelgrass Mapping

In 2013, eelgrass was mapped in the Great Bay estuary using two different sets of aerial imagery. As has been done since 1996, UNH (Dr. Fred Short) mapped eelgrass using low-altitude, oblique aerial photographs, while in 2013, 2016, and 2017, Seth Barker used high resolution vertical aerial imagery collected by Cornerstone Energy Services (formerly Kappa Mapping Inc). Eelgrass extent was independently mapped using both sets of imagery in 2013. These concurrent datasets were obtained as a way to evaluate each of the methodologies. For assessment purposes, NHDES took an average of the eelgrass mapped by UNH and Cornerstone/Barker in the years where both mappers produced datasets.

Water Quality Data

The NHDES Environmental Monitoring Database (EMD) is a publically accessible database containing field observations, measurements and laboratory samples for various public, private and volunteer programs. It was developed in March 2003 and became available on the web in June 2004. Data sets are continuously being added and updated. Datasets from the EMD are the foundation of the water quality assessments. The procedures below describe the processes that were undertaken to compile and synthesis the comprehensive dataset from the EMD for the Aquatic Life designated use assessment of the Great Bay estuary described in this document.

1. The base dataset that is considered "current" data for the 2018 assessments are the measurements collected on or after January 1, 2012, that were incorporated in the NHDES Environmental Monitoring Database (EMD) by August 7, 2018. For nutrients and most estuarine samples this generally meant data collected through 2016. To enhance the ability to look across cycles and into more historic data the Supplemental Assessment Database (SADB) minimum date age was set to January 1, 1990.
2. The data were pulled from the EMD into the SADB by an automated query. Some of the conditions on the query were:
   a. Results marked as invalid were excluded.
   b. Results marked as Below Detection Limits (BDL) were assigned a value of one-half the Method Detection Limit (MDL). There are two limited cases of high detection limits where this was not followed as to not introduce bias; 1) where ammonia samples were BDL and the MDL was greater than or equal to 200 µg/L, and 2) where total Kjeldahl nitrogen samples were BDL and the MDL was greater than or equal to 500 µg/L. [Also note: Regarding BDLs, in the nutrient criteria report, NHDES used the MDL for BDLs. In the bulk query, the adjusted value is reported as 1/2 the MDL. PREP has used 1/2 MDL for BDLs for trends in "modern" datasets. Therefore, for the 2018 assessments, NHDES will apply the 1/2 MDL approach for consistency across datasets.]
   c. Quality assurance samples were excluded. This condition removed field duplicate samples. [Note: QA samples: In the nutrient criteria report, NHDES averaged field duplicate results. In the bulk data pull for the 305(b)/303(d) assessment, field duplicates were excluded. PREP has included replicates in the past but recently the TAC decided to not include QA samples to be consistent across datasets. Therefore, since the 2016 assessments, NHDES has excluded QA replicate samples for consistency.]

Aquatic Life Integrity Designated Use Assessment Summary Table

Comparison of the Final 2016 and Final 2018 assessment of eutrophication parameters for the Aquatic Life designated use in the Great Bay assessment zones. Assessment category definitions are provided in sections 3.1.3 and 3.1.5 of the 2018 CALM.

De-impairment | New Impairment

Assessment Zone	Cycle	Chlorophyll-a	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Sat)	Estuarine Bioassessments (eelgrass)	Water Clarity (Light Attenuation Coefficient)	Total Nitrogen
Squamscott River South	2016	5-P	5-P	5-M	No Std	No Std	5-P
	2018	5-P	5-P	5-M	No Std	No Std	5-P
Squamscott River North	2016	5-P	5-P	5-M	5-P	5-P	5-P
	2018	5-P	5-P	5-M	5-P	5-P	5-P
Lamprey River North	2016	5-M	5-P	5-P	No Std	No Std	5-M
	2018	5-M	5-P	5-P	No Std	No Std	5-M
Lamprey River South	2016	5-M	2-G	3-ND	5-P	5-P	5-M
	2018	5-M	3-PNS	3-PNS	5-P	5-P	5-M
Winnicut River	2016	3-ND	3-ND	3-ND	5-P	3-ND	3-ND
	2018	3-ND	3-ND	3-ND	5-P	3-ND	3-ND
Great Bay	2016	3-PNS	3-PNS	2-M	5-P	5-M	3-PNS
	2018	3-PNS	3-PNS	3-PAS	5-P	5-M	3-PNS
Little Bay	2016	3-PNS	2-G	2-G	5-P	5-M	3-PNS
	2018	3-PNS	2-G	3-PAS	5-P	5-M	3-PNS
Oyster River	2016	2-M	5-P	5-P	5-P	5-P	5-P
	2018	2-M	5-P	5-P	5-P	5-P	5-M
Bellamy River	2016	3-ND	3-ND	3-ND	5-P	3-ND	3-ND
	2018	3-PNS	3-PNS	3-PAS	5-P	3-PNS	3-PNS
Cocheco River	2016	5-P	5-M	2-M	No Std	No Std	5-M
	2018	5-P	5-M	3-PAS	No Std	No Std	5-M
Salmon Falls River	2016	5-P	5-P	5-M	No Std	No Std	5-M
	2018	5-P	5-P	5-M	No Std	No Std	5-M
Upper Piscataqua River	2016	2-M	3-PNS	2-G	5-P	5-P	3-PNS
	2018	2-M	3-PNS	3-PAS	5-P	5-M	3-PNS
Lower Piscataqua River - North	2016	3-PAS	2-G	2-G	5-P	3-PNS	3-PAS
	2018	2-G	2-G	3-PAS	5-P	3-PNS	3-PAS
Lower Piscataqua River - South	2016	3-PAS	2-G	2-G	5-P	3-PAS	3-PAS
	2018	2-G	2-G	3-PAS	5-P	3-PAS	3-PAS
North Mill Pond	2016	3-ND	3-ND	3-ND	3-ND	3-ND	3-ND
	2018	3-ND	3-ND	3-ND	3-ND	3-ND	3-ND
South Mill Pond	2016	3-ND	3-ND	3-ND	3-PAS	3-ND	3-ND
	2018	3-ND	3-ND	3-ND	3-PAS	3-ND	3-ND
Portsmouth Harbor	2016	2-G	2-G	2-G	5-P	5-M	2-M
	2018	2-G	2-G	3-PAS	5-P	5-M	2-M
Little Harbor/Back Channel	2016	3-ND	3-ND	3-ND	5-P	5-M	3-ND
	2018	3-ND	3-ND	3-ND	5-P	5-M	3-ND
Sagamore Creek	2016	3-ND	2-M	3-ND	5-P	3-ND	3-ND
	2018	3-ND	5-M	3-PNS	5-P	3-ND	3-PNS

Assessment Zone Data Summaries

Plot Legend and Summary Table Abbreviations

In the assessment zone summaries that follow, all available data from January 1, 2000, to August 7, 2018, are displayed in the data plots for context (except eelgrass cover which is platted back to 1990). Summary statistics in the data tables cover the period from January 1, 2012, to August 7, 2018. For nutrients and most estuarine samples this generally meant data collected through 2016. The legend for a given attribute only contains indicator text for those indicators that have data available since the year 2000. The full comparison codes for the samples are predominantly those from the SADB and were used within the legend of the graphs and tables for brevity. The descriptions for those codes are provided below.

- Chlorophyll-a
    - CHLOROPHYLL A, CORRECTED FOR PHEOPHYTIN - The majority of the chlorophyll-a in the marine environment has been processed with the correction for pheophytin.
    - CHLOROPHYLL A, UNCORRECTED FOR PHEOPHYTIN – In a few cases samples the chlorophyll-a in the marine environment has been processed without the correction for pheophytin.
    - CHLOROPHYLL A, combined – In those cases where both corrected and uncorrected chlorophyll-a have been collected, the statistics for the combined measurements are provided.
    - Annual 90th Percentile (n>=5) – Plots only.
- Dissolved Oxygen Concentration
    - DO-PPM-24HR-MIN-CP = 24-hour minimum dissolved oxygen concentration from a datalogger deployed during the summer critical period.
    - DO-PPM-24HR-MIN-NCP = 24-hour minimum dissolved oxygen concentration from a datalogger not deployed during the summer critical period.
    - DO-PPM-GRAB-CP = Grab samples of dissolved oxygen concentration during the summer critical period.
    - DO-PPM-GRAB-NCP = Grab samples of dissolved oxygen concentration during the summer critical period.
- Dissolved Oxygen Percent Saturation
    - DO-PERC-24H-MEAN-CP = 24-hour average dissolved oxygen percent saturation from a datalogger deployed during the summer critical period.
    - DO-PERC-24H-MEAN-NCP = 24-hour average dissolved oxygen percent saturation from a datalogger not deployed during the summer critical period.
    - DO-PERC-2TIDE-GRAB-CP = The average to two grab samples for dissolved oxygen percent saturation, one at high tide and one at low tide of a single day, during the summer critical period.
    - DO-PERC-2TIDE-GRAB-NCP = The average to two grab samples for dissolved oxygen percent saturation, one at high tide and one at low tide of a single day, not during the summer critical period.

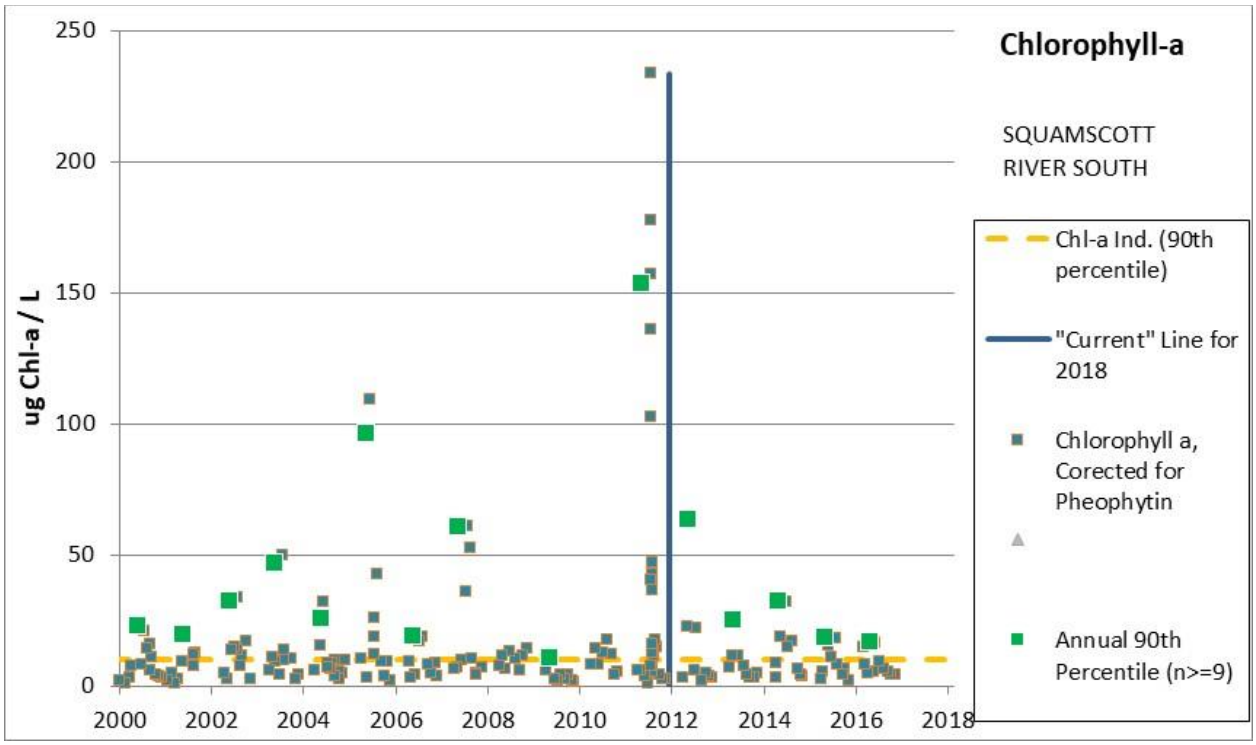
    - DO-PERC-GRAB (% sat) = Dissolved oxygen percent saturation grab samples not used in a high tide-low tide average.
- Total Suspended Solids (TSS)
    - TSS – Total Suspended Solids
    - Annual Median (n>=5) – Plots only
- Light Attenuation Coefficient (Water Clarity)
    - Light Attenuation Coefficient – A measurement of the light attenuation coefficient, Kd.
    - Annual Median (n>=5) – Plots only
- Eelgrass and Light Attenuation Coefficient (Water Clarity)
    - Eelgrass cover acres – Plots only
    - Light Attenuation Coefficient – A measurement of the light attenuation coefficient, Kd.
    - Annual Median Light Attenuation Coefficient (n>=5) – Plots only
- Nitrogen – Graphics within this document plot the primary indicator of total productivity within the system, total nitrogen (TN), while the tables provide the statistics for TN and individual fractions of nitrogen. In most cases, there was one sample collected at a given station per day. Where multiple samples were collected at a particular station on a single day, those samples for multiple times and/or depths were processed as described in the sections above.
    - Day Ave of TN – Total Nitrogen
    - Annual Median (n>=5) – Plots only
    - Annual Median (n<5) – Plots only
    - Day Ave of TDN – Total Dissolved Nitrogen.
    - Day Ave of DIN (NH3 + NO2/3) – Dissolved Inorganic Nitrogen
    - Day Ave of NH3 - Ammonia
    - Day Ave of PON – Particulate Organic Nitrogen
    - Day Ave of NO2/3 – Nitrite/Nitrate
- Turbidity (data tables only) – While both grab samples and datalogger records exist for turbidity, daily statistics make up 98% of the record. As such, the table provides summary statistics on the two data types (grab samples and daily medians) as a single group.
- Colored Dissolved Organic Matter (CDOM) (data tables only) – Summary statistics are provided based on the currently available CDOM data.
- Salinity (data tables only)
    - Grab Samples
    - Datalogger Daily Median
- Plot Reference Lines
    - “Current” Line for 2018 - Per the methodology outlined in the CALM, all data to the right of this referenced data are considered “current.” Available older data are provided for context and are needed for that historic context if newer data indicates improved conditions. See the 2018 CALM for addition details.
    - Chl-a Ind. (90^{th} percentile) – This is the reference line for the chlorophyll-a indicator. The 90^{th} percentile (10 µg/L) of the assessment zone dataset is compared to this chlorophyll-a indicator described in the CALM.

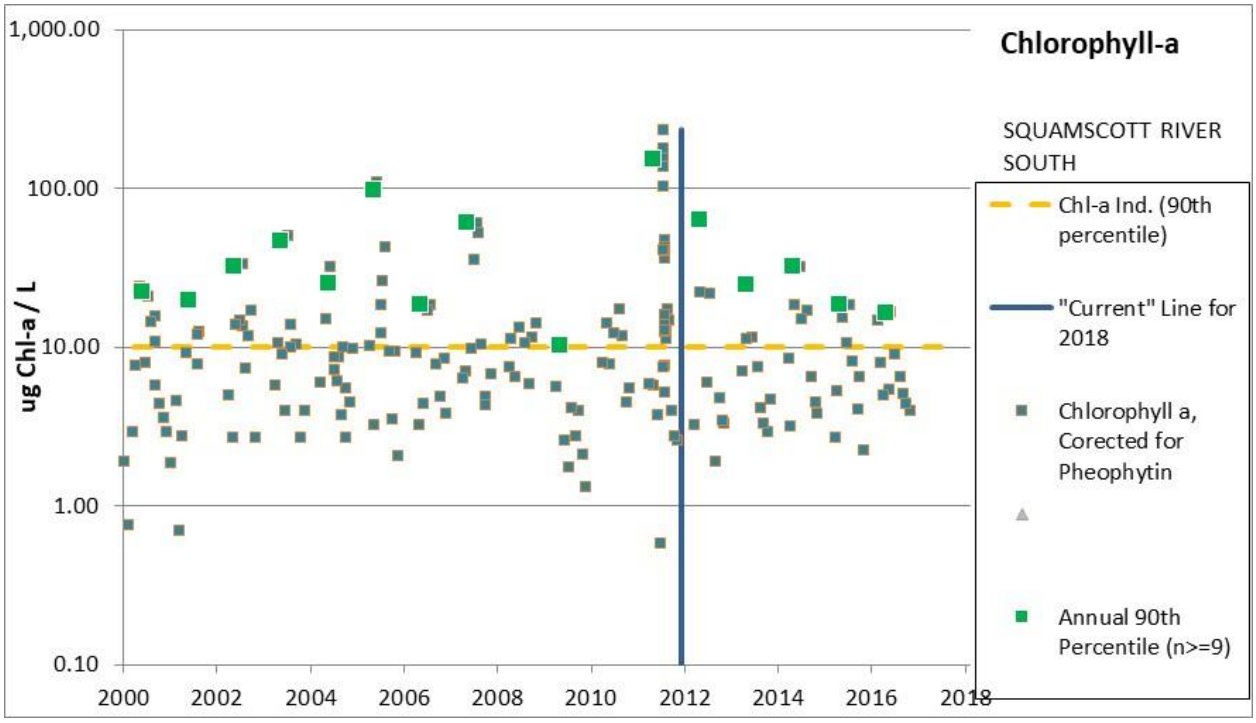
- DO mg/L Std. – This is the 5 mg/L reference line for the dissolved oxygen standard.
- DO mg/L Ind MAGEX – This is the 4.5 mg/L reference line for the dissolved oxygen magnitude of exceedence indicator described in the CALM.
- DO % Sat Ind. – This is the 24-hour average 75 percent reference line for the dissolved oxygen percent saturation indicator.
- DO % Sat Ind. MAGEX – This is the 24-hour average 65% reference line for the dissolved oxygen percent saturation magnitude of exceedence indicator described in the CALM.
- Survival Min. Ind. (median) – This is light attenuation coefficient indicator that corresponds to the minimum light needed for eelgrass to survive at the restoration depth set for a given assessment zone. The median of the assessment zone dataset is compared to this light attenuation coefficient indicator as described in the CALM.

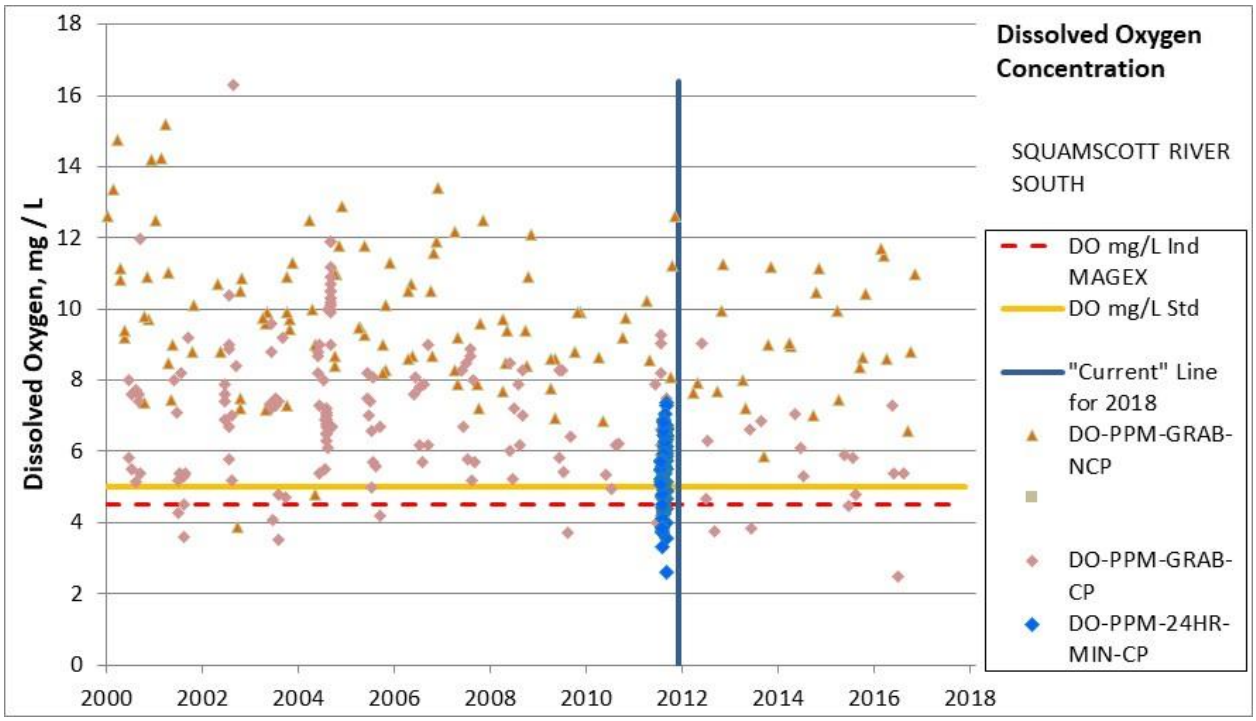
Assessment Zone = SQUAMSCOTT RIVER SOUTH

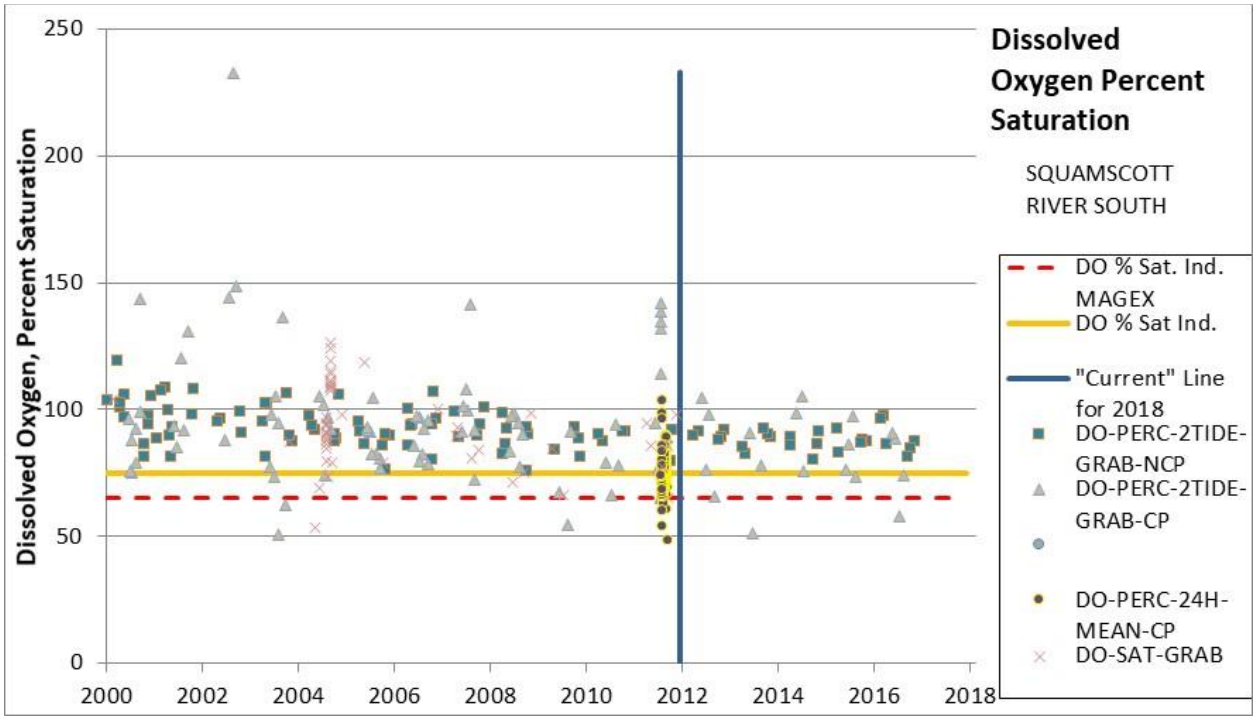
(NHEST600030806-01-01)

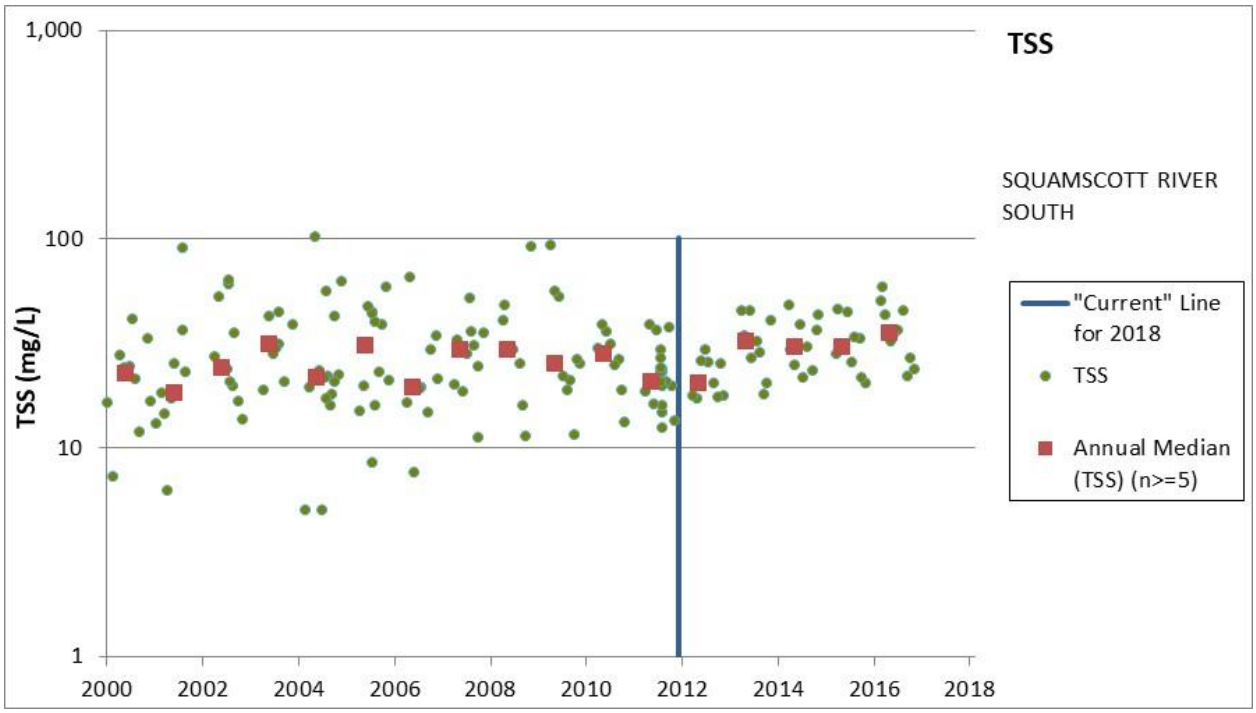
Indicator	Aquatic Life Use Category 2016 / 2018	2018 Comment
Chlorophyll-a	5-P / 5-P	All of the chlorophyll-a data reported for the Squamscott River South since 2012 has been collected at Chapmans Landing, the downstream boundary of the assessment zones. The 90th percentile for chlorophyll-a is 22 µg/L (n=46). The chlorophyll-a indicator threshold to prevent low dissolved oxygen is a 90th percentile below 10 µg/L. As noted in the March 20, 2012 HydroQual report, "…such elevated algal levels probably contribute to increased SOD which will contribute to lower DO when algal levels are low…" (HydroQual, March 20, 2012). Additionally, there are still frequent dissolved oxygen concentration criteria exceedences.
Dissolved Oxygen (mg/L)	5-P / 5-P	All of the dissolved oxygen (DO) concentration data reported for the Squamscott River South since 2012 has been grab samples collected at Chapmans Landing, the downstream boundary of the assessment zones. Five of the 18 summer readings were below 5 mg/L and went as low as 2.5 mg/L. The most recent datalogger record was collected in the Squamscott River South assessment zone was in 2011 and reported in March 2012 by HydroQual, consultants for the Great Bay Municipal Coalition (HydroQual, March 20, 2012). That data showed numerous violations of the dissolved oxygen concentration standard and the daily average (24 hour) percent saturation indicator in this assessment zone. The report documents water quality sampling, including datasonde deployments, conducted by UNH in the Squamscott River in August and September 2011.The 2011 datalogger also demonstrated that grab samples underrepresent the frequency of low dissolved oxygen conditions.
Dissolved Oxygen (% Saturation)	5-M / 5-M	Since the datalogger deployments in 2011 only grab samples have been collected. Those grab samples are collected at consecutive paired high and low tides and the average concentration is compared to the assessment indicator. The GRBCL site shows a significant decrease over time for both the summer (critical) and non-summer (non-critical) periods. The newer grab samples suggest that the low saturation seen in the datalogger deployments has continued.
Estuarine Bioassessments (eelgrass)	No Std / No Std	Not applicable. Eelgrass habitat has not historically existed in this assessment zone. This assessment zone was created for the 2012 cycle by splitting the Squamscott River assessment zone (assessment unit ID = NHEST600030806-01) into two pieces. The parent assessment zone was listed as impaired (5-P) for eelgrass loss on the 2010 303d list. For the 2012 list, the impairment was associated with the other child assessment zone (Squamscott River North; NHEST600030806-01-02) because eelgrass has not historically existed in this assessment zone.
Water Clarity (Light Attenuation Coefficient)	No Std / No Std	Not applicable. This assessment unit was created for the 2012 cycle by splitting the Squamscott River assessment zone (assessment unit ID = NHEST600030806-01) into two pieces. The parent assessment zone was listed as impaired (5-P) for water clarity to protect eelgrass habitat on the 2010 303d list. The impairment was contingent upon the Estuarine Bioassessments (eelgrass) impairment and therefore not retained on this assessment zone in 2012 because eelgrass has not historically existed in this assessment zone.
Total Nitrogen	5-P / 5-P	The median total nitrogen from 2012 through 2016 was 753 µg/L (n=45). While lower than the 2016 assessment cycle median, all of the total nitrogen (TN) data reported for the Squamscott River South since 2012 have been collected at Chapmans Landing, the downstream boundary of the assessment zones while the older data was a better representation of the TN in the assessment zone. This assessment zone experiences frequent dissolved oxygen concentrations well below 5 mg/L. It is of note that pre-2012 some periods demonstrated super saturation including multiple days in 2011 experiencing dissolved oxygen saturation over 125 percent and up to 169 percent in grab samples. The 90th percentile for chlorophyll-a concentration was 22 (n=46) from 2012 through 2018 including one sample measured at 63 µg/L. This assessment zone has not seen TN reductions as of yet, however wastewater treatment upgrades are under construction. Many of the classic indicators of nutrient eutrophication are present in this assessment zone. As such, the impairment for nitrogen has been retained.

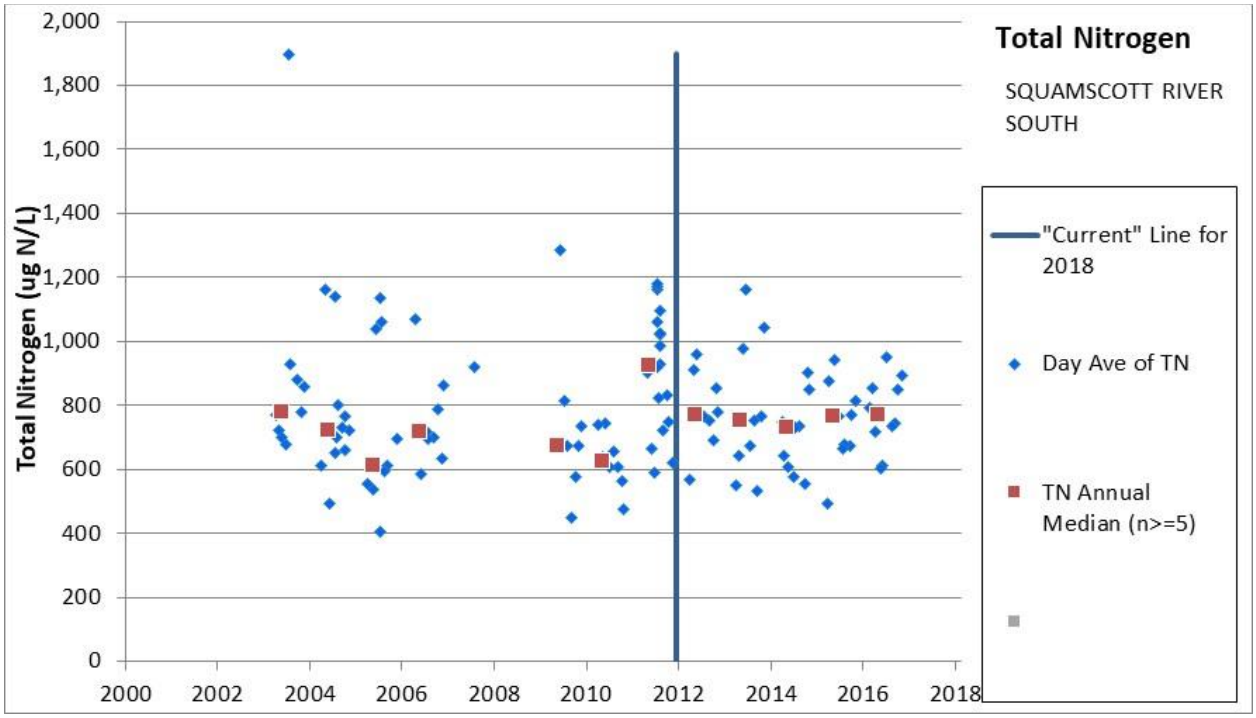

Chlorophyll-a
SQUAMSCOTT RIVER SOUTH
ug Chl-a / L
250
200
150
100
50
0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Chl-a Ind. (90th percentile)
"Current" Line for 2018
Chlorophyll a, Corected for Pheophytin
Annual 90th Percentile (n>=9)


Chlorophyll-a
SQUAMSCOTT RIVER SOUTH
ug Chl-a / L
1,000.00
100.00
10.00
1.00
0.10
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Chl-a Ind. (90th percentile)
"Current" Line for 2018
Chlorophyll a, Corected for Pheophytin
Annual 90th Percentile (n>=9)


Dissolved Oxygen Concentration
SQUAMSCOTT RIVER SOUTH
Dissolved Oxygen, mg / L
DO mg/L Ind MAGEX
DO mg/L Std
"Current" Line for 2018
DO-PPM-GRAB-NCP
DO-PPM-GRAB-CP
DO-PPM-24HR-MIN-CP


Dissolved Oxygen Percent Saturation
SQUAMSCOTT RIVER SOUTH
Dissolved Oxygen, Percent Saturation
DO % Sat. Ind. MAGEX
DO % Sat Ind.
"Current" Line for 2018
DO-PERC-2TIDE-GRAB-NCP
DO-PERC-2TIDE-GRAB-CP
DO-PERC-24H-MEAN-CP
DO-SAT-GRAB


TSS
SQUAMSCOTT RIVER SOUTH
TSS (mg/L)
1,000
100
10
1
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
"Current" Line for 2018
TSS
Annual Median (TSS) (n>=5)

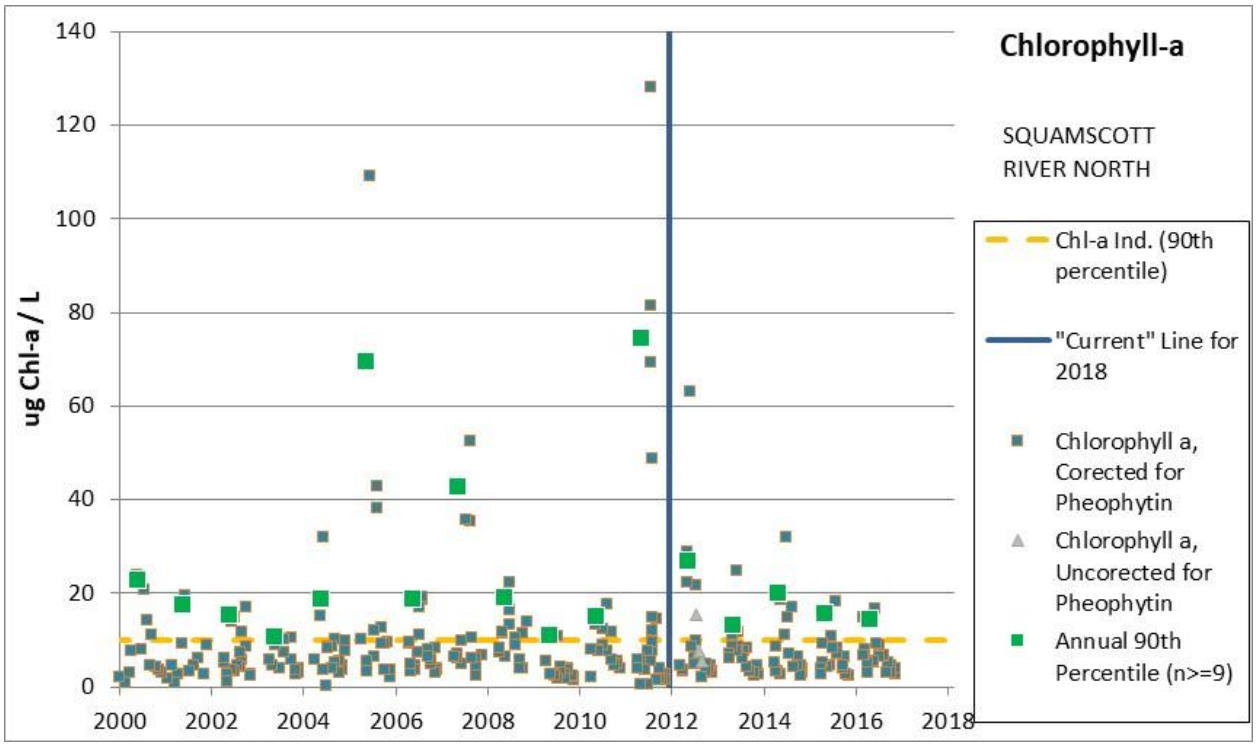

Total Nitrogen
SQUAMSCOTT RIVER SOUTH
Total Nitrogen (ug N/L)
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
"Current" Line for 2018
Day Ave of TN
TN Annual Median (n>=5)

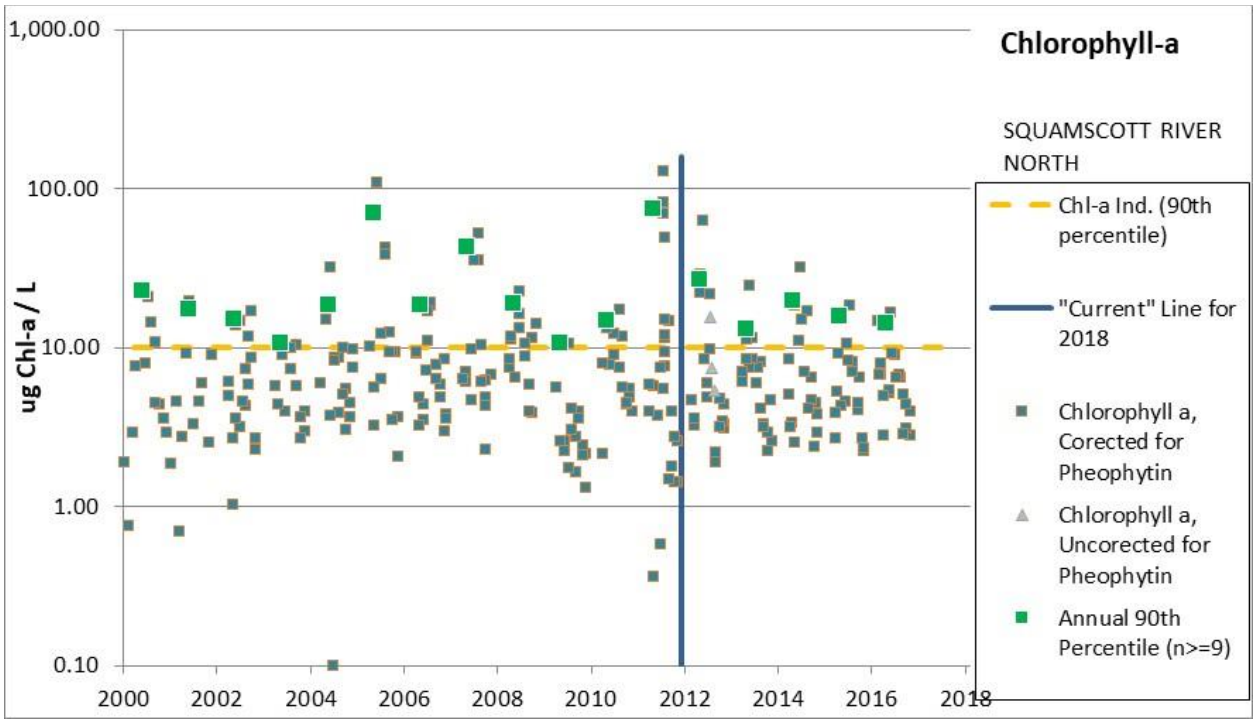
Squamscott River - South Assessment Zone (1/1/2012-5/25/2018)	**Count**	**Minimum**	**Median**	**90th Percentile**	**Maximum**
CHLOROPHYLL A, CORRECTED FOR PHEOPHYTIN (µg/L)	46	1.9	6.5	21.9	63.1
CHLOROPHYLL A, UNCORRECTED FOR PHEOPHYTIN (µg/L)	0	-	-	-	-
CHLOROPHYLL A, Combined (µg/L)	46	1.9	6.5	21.9	63.1
LIGHT ATTENUATION COEFFICIENT (1/m)	42	1.300	2.693	4.270	4.855
TURBIDITY (NTU)	0	-	-	-	-
COLORED DISSOLVED ORGANIC MATTER (CDOM) (1/m)	0	-	-	-	-
TSS (mg/L)	46	17.2	29.5	45.6	59.1
DO-PPM-24HR-MIN-CP (mg/L)	0	-	-	-	-
DO-PPM-24HR-MIN-NCP (mg/L)	0	-	-	-	-
DO-PPM-GRAB-CP (mg/L)	18	2.5	5.6	7.5	9.1
DO-PPM-GRAB-NCP (mg/L)	26	5.9	8.9	11.3	11.7
DO-PERC-24H-MEAN-CP (% sat)	0	-	-	-	-
DO-PERC-24H-MEAN-NCP (% sat)	0	-	-	-	-
DO-PERC-2TIDE-GRAB-CP (% sat)	18	51.5	82.2	104.9	105.3
DO-PERC-2TIDE-GRAB-NCP (% sat)	26	80.0	87.9	93.6	97.5
DO-PERC-GRAB (% sat)	0	-	-	-	-
Day Ave of TN (µg N/L)	45	494	753	955	1,163
Day Ave of TDN (µg N/L)	46	333	553	738	948
Day Ave of DIN (NH3 + NO2/3) (µg N/L)	46	77	348	577	613
Day Ave of NH3 (µg N/L)	46	34	174	350	411
Day Ave of PON (µg N/L)	0	-	-	-	-
Day Ave of NO2/3 (µg N/L)	46	35	168	257	301
SALINITY-Grabs (pss)	44	1	13	24	26
SALINITY-Datalogger Daily Median (pss)	0	-	-	-	-

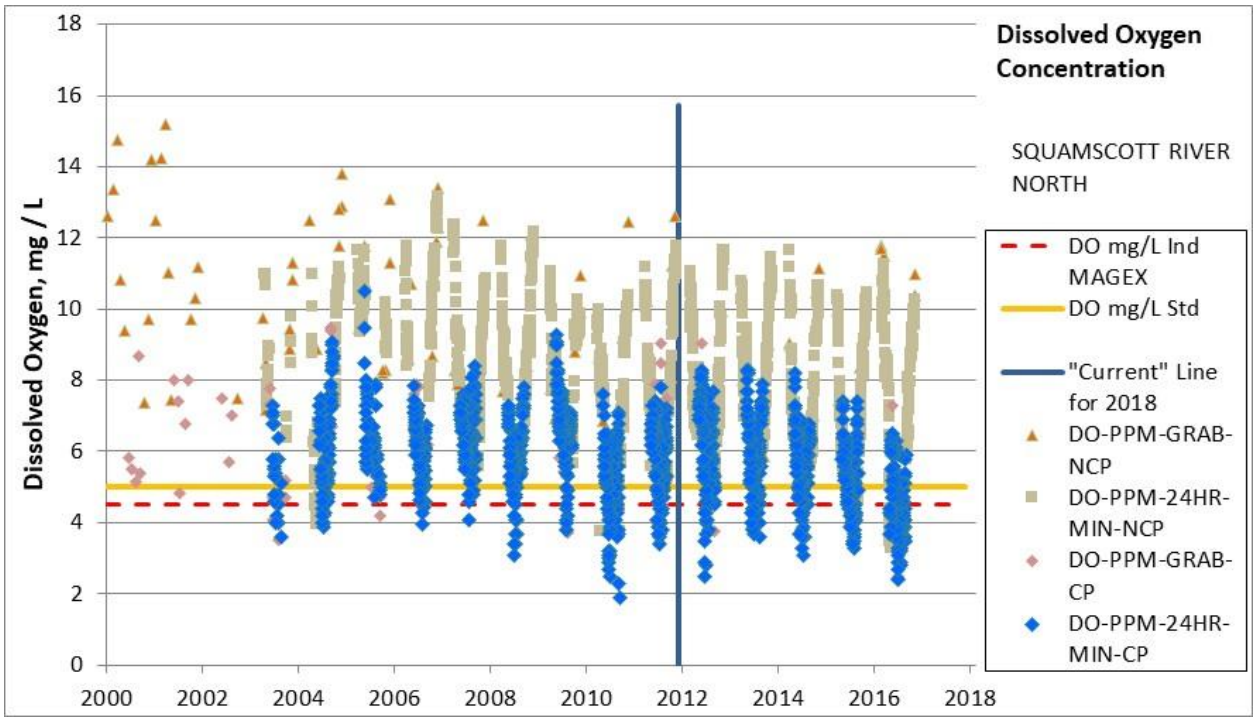
Assessment Zone = SQUAMSCOTT RIVER NORTH

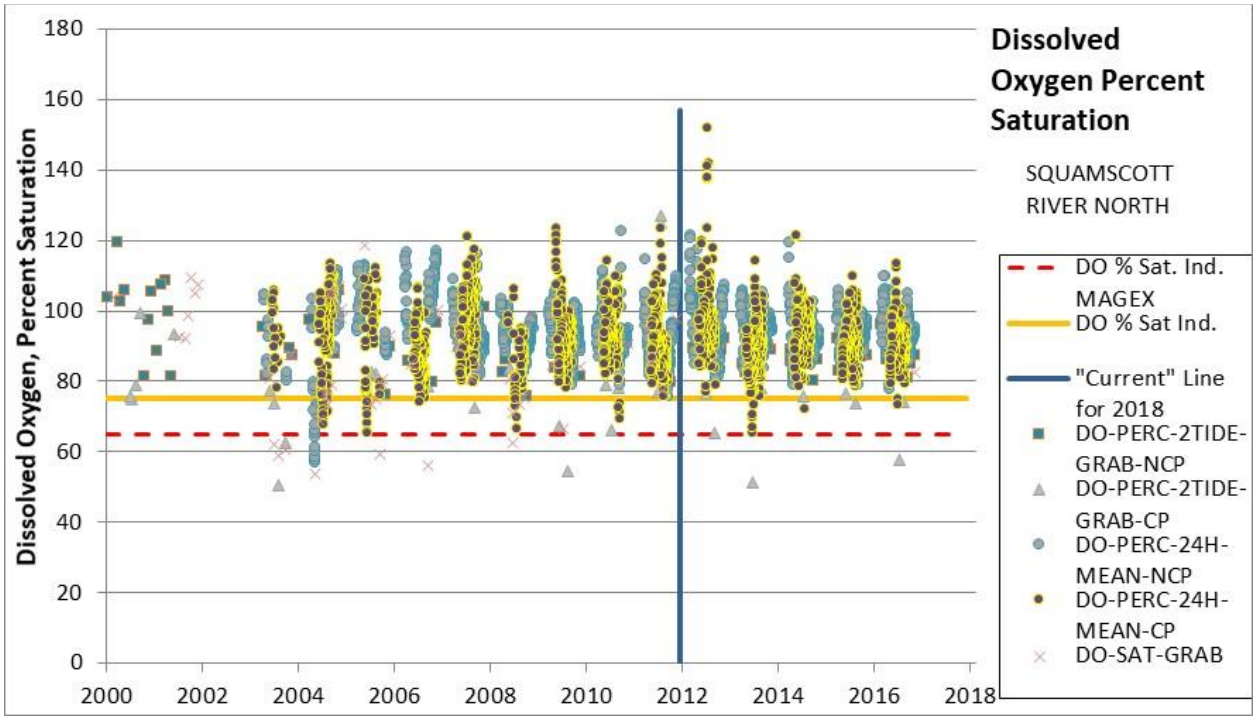
(NHEST600030806-01-02)

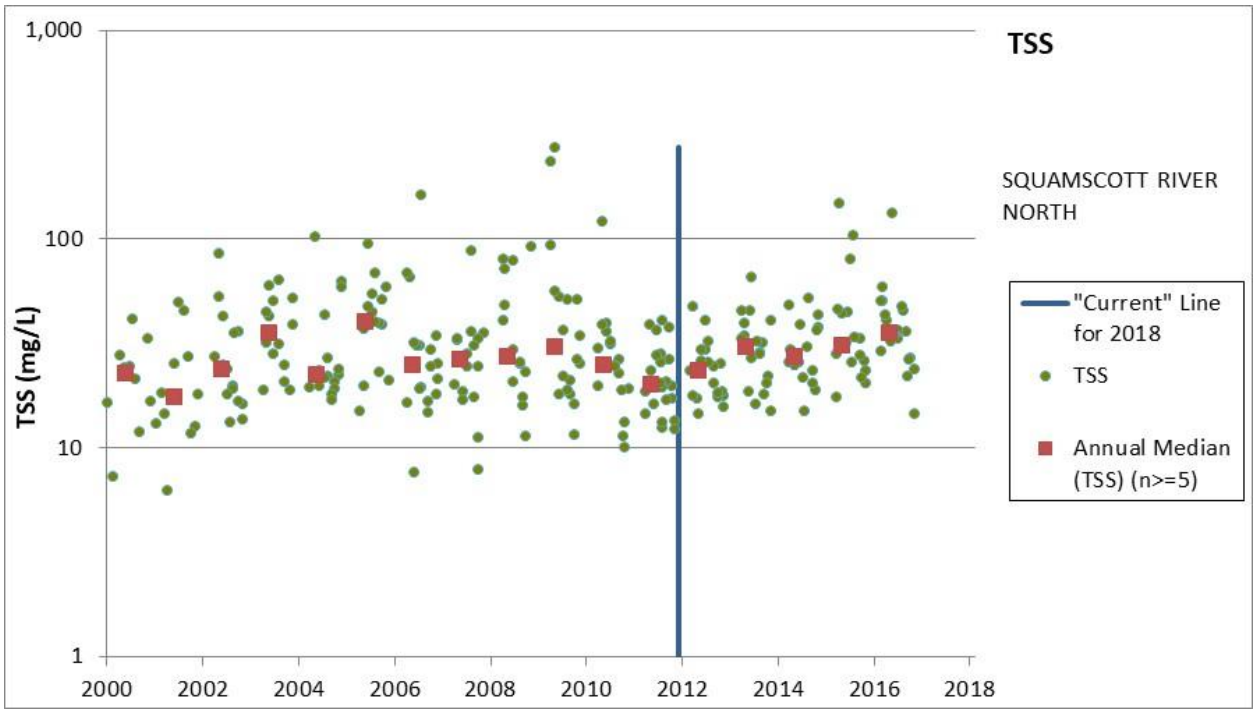
Indicator	Aquatic Life Use Category 2016 / 2018	2018 Comment
Chlorophyll-a	5-P / 5-P	The 90th percentile for chlorophyll-a, is 16.7 µg/L (n=96). The chlorophyll-a indicator threshold to prevent low dissolved oxygen is a 90th percentile below 10 µg/L. As noted in the March 20, 2012 HydroQual report, "…such elevated algal levels probably contribute to increased SOD which will contribute to lower DO when algal levels are low…" (HydroQual, March 20, 2012). Additionally, there are still frequent dissolved oxygen concentration criteria exceedences.
Dissolved Oxygen (mg/L)	5-P / 5-P	Dissolved oxygen concentration measurements in this assessment zone fall below the 5 mg/L criteria every year. Because a portion of those measurements fall below 4 mg/L each year, and in some years below 3 mg/L, this impairment is considered severe.
Dissolved Oxygen (% Saturation)	5-M / 5-M	Following the 10% method listed in the 2018 CALM this parameter would be categorized as 2-M. Part of the concept behind the 10% rule was to address random errors within the meter measurement accuracy, thereby limiting accidental impairments. The magnitude of exceedence indicator was layered into the assessment process to address major exceedences and exceedences beyond all normal measurement errors. In the case of this assessment zone there are 477 station/days of DO readings during the critical summer period. Three of the last five years of data show criteria exceedences sometimes on multiple days, which demonstrates that this phenomenon is not limited to a single summer. Looking back through the dataset, we see that this is a regularly occurring condition, further demonstrating that this phenomenon is not limited to a single summer. It is clear that it is common in this assessment zone to have 24-hour average dissolved oxygen below 75 percent. While no 24-hour average dissolved oxygen readings fell below the magnitude of exceedence indicator of 65 percent, there were several close values (e.g. 65.4 percent average on July 10, 2013).
Estuarine Bioassessments (eelgrass)	5-P / 5-P	In the 2012 assessment cycle, this assessment zone was listed as impaired for "Estuarine Bioassessments" (i.e. a lack of eelgrass) based on the 1948 survey that indicated that roughly 42 acres of eelgrass were present and despite intensive mapping efforts since 1981, eelgrass has never again been documented in this zone. While the 1948 map is rough enough that we cannot say that precisely 42 acres of eelgrass were present, its presence was clearly documented. Combined with the application of the Eelgrass Site Selection Model (Short, Davis, Kopp, Short, & Burdick, 2002) and a rudimentary suitability evaluation of temperature and salinity leads one to conclude that eelgrass should be present. Taken in totality, there is insufficient evidence to remove the 2016 "Estuarine Bioassessment" impairment. As such, the impairment for "Estuarine Bioassessments" and "Water Clarity (Light Attenuation Coefficient)" has been retained on the 2018 final 303(d).
Water Clarity (Light Attenuation Coefficient)	5-P / 5-P	Median water clarity is 2.75 m^-1 (n=83). For an eelgrass restoration depth of 2 m, the light attenuation coefficient threshold is 0.75 m^-1. Therefore, the impaired (5-P) listing from the 2016 303d list has been retained.
Total Nitrogen	5-P / 5-P	The median total nitrogen from 2012 through 2016 was 745 µg/L (n=91). This assessment zone continues to experience frequently dissolved oxygen concentrations well below 5 mg/L. During some periods this assessment zone also demonstrates severe super saturation including multiple days in 2012 experiencing 24-hour average dissolved oxygen saturation in excess of 125 percent and as high as 152 percent. The chlorophyll-a concentration 90th percentile was 16.7 (n=96) from 2012 through 2016. As noted in the March 20, 2012 HydroQual report, "The substantial reduction in the concentration of algal cells that settle to the river bottom and contribute to river SOD as a consequence of a reduction in the Exeter WWTP effluent nitrogen will increase Squamscott River minimum DO levels and possibly attain the DO standard." (HydroQual, March 20, 2012). This assessment zone has not seen TN reductions as of yet, however wastewater treatment upgrades are under construction. Many of the classic indicators of nutrient eutrophication are present in this assessment zone. As such, the impairment for nitrogen has been retained.

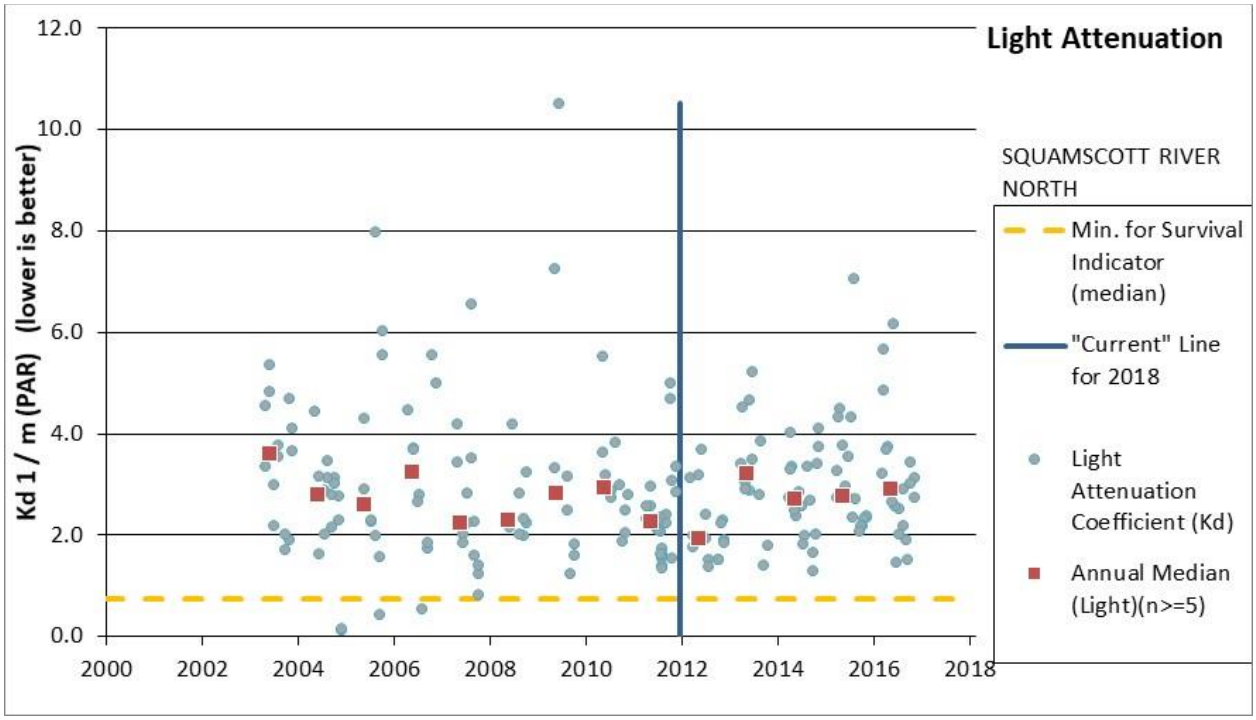

Chlorophyll-a
SQUAMSCOTT RIVER NORTH
ug Chl-a / L
140
120
100
80
60
40
20
0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Chl-a Ind. (90th percentile)
"Current" Line for 2018
Chlorophyll a, Corected for Pheophytin
Chlorophyll a, Uncorected for Pheophytin
Annual 90th Percentile (n>=9)

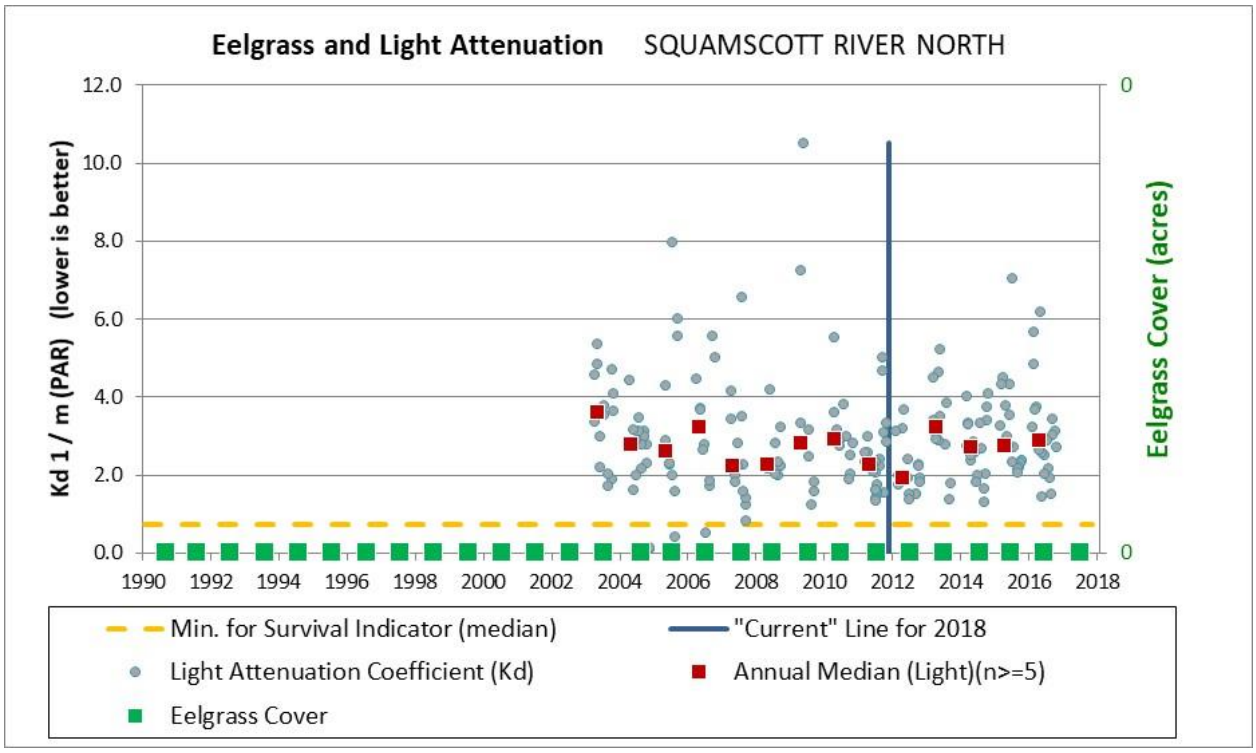

Chlorophyll-a
SQUAMSCOTT RIVER NORTH
ug Chl-a / L
1,000.00
100.00
10.00
1.00
0.10
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Chl-a Ind. (90th percentile)
"Current" Line for 2018
Chlorophyll a, Corected for Pheophytin
Chlorophyll a, Uncorected for Pheophytin
Annual 90th Percentile (n>=9)

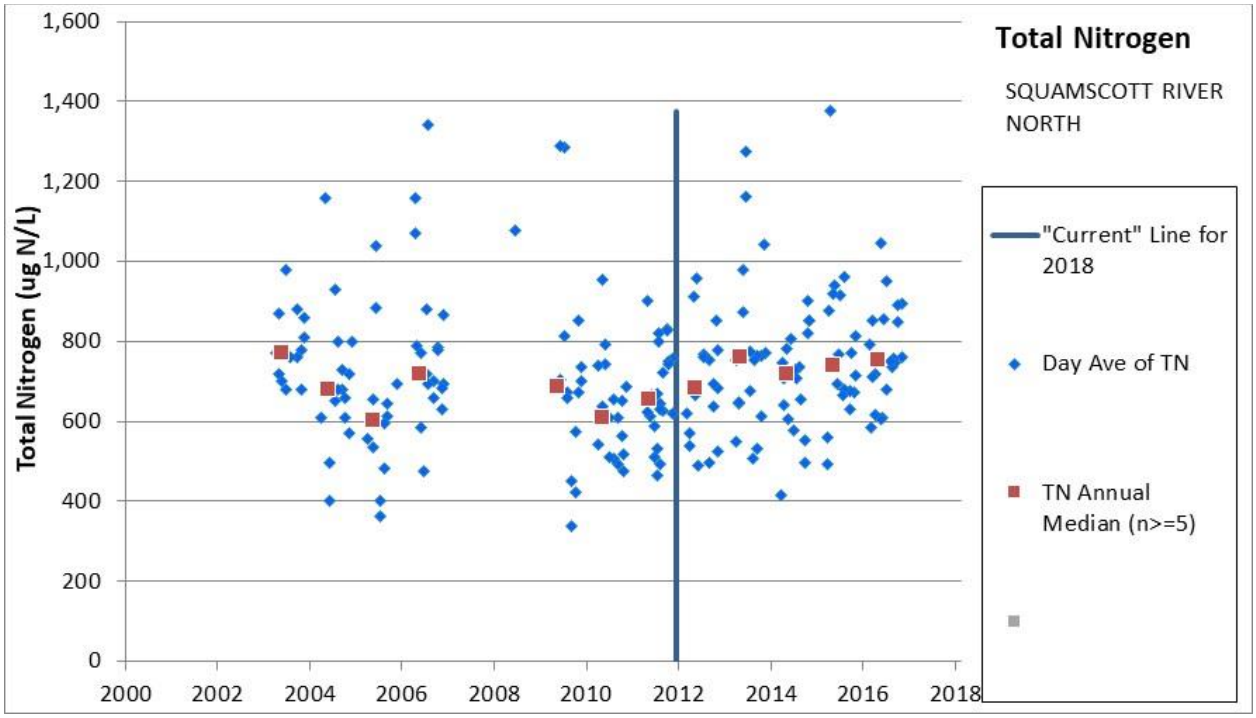

Dissolved Oxygen Concentration
SQUAMSCOTT RIVER NORTH
Dissolved Oxygen, mg / L
DO mg/L Ind MAGEX
DO mg/L Std
"Current" Line for 2018
DO-PPM-GRAB-NCP
DO-PPM-24HR-MIN-NCP
DO-PPM-GRAB-CP
DO-PPM-24HR-MIN-CP


Dissolved Oxygen Percent Saturation
SQUAMSCOTT RIVER NORTH
Dissolved Oxygen, Percent Saturation
DO % Sat. Ind. MAGEX
DO % Sat Ind.
"Current" Line for 2018
DO-PERC-2TIDE-GRAB-NCP
DO-PERC-2TIDE-GRAB-CP
DO-PERC-24H-MEAN-NCP
DO-PERC-24H-MEAN-CP
DO-SAT-GRAB


TSS
SQUAMSCOTT RIVER NORTH
TSS (mg/L)
1,000
100
10
1
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
"Current" Line for 2018
TSS
Annual Median (TSS) (n>=5)


Light Attenuation
SQUAMSCOTT RIVER NORTH
Kd 1 / m (PAR) (lower is better)
12.0
10.0
8.0
6.0
4.0
2.0
0.0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Min. for Survival Indicator (median)
"Current" Line for 2018
Light Attenuation Coefficient (Kd)
Annual Median (Light)(n>=5)


Eelgrass and Light Attenuation
SQUAMSCOTT RIVER NORTH
Kd 1 / m (PAR) (lower is better)
Eelgrass Cover (acres)
12.0
10.0
8.0
6.0
4.0
2.0
0.0
0
0
1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016 2018
Min. for Survival Indicator (median)
"Current" Line for 2018
Light Attenuation Coefficient (Kd)
Annual Median (Light)(n>=5)
Eelgrass Cover

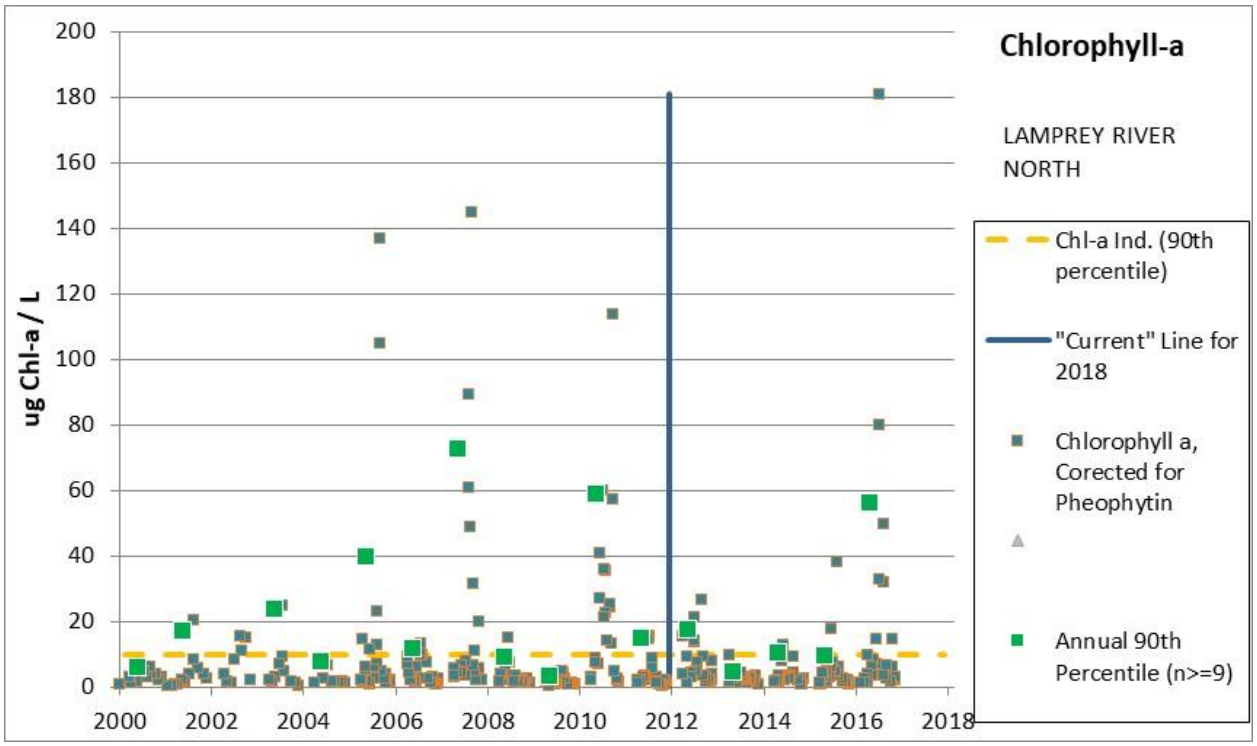

Total Nitrogen
SQUAMSCOTT RIVER NORTH
Total Nitrogen (ug N/L)
1,600
1,400
1,200
1,000
800
600
400
200
0
2000 2002 2004 2006 2008 2010 2012 2014 2016 2018
"Current" Line for 2018
Day Ave of TN
TN Annual Median (n>=5)

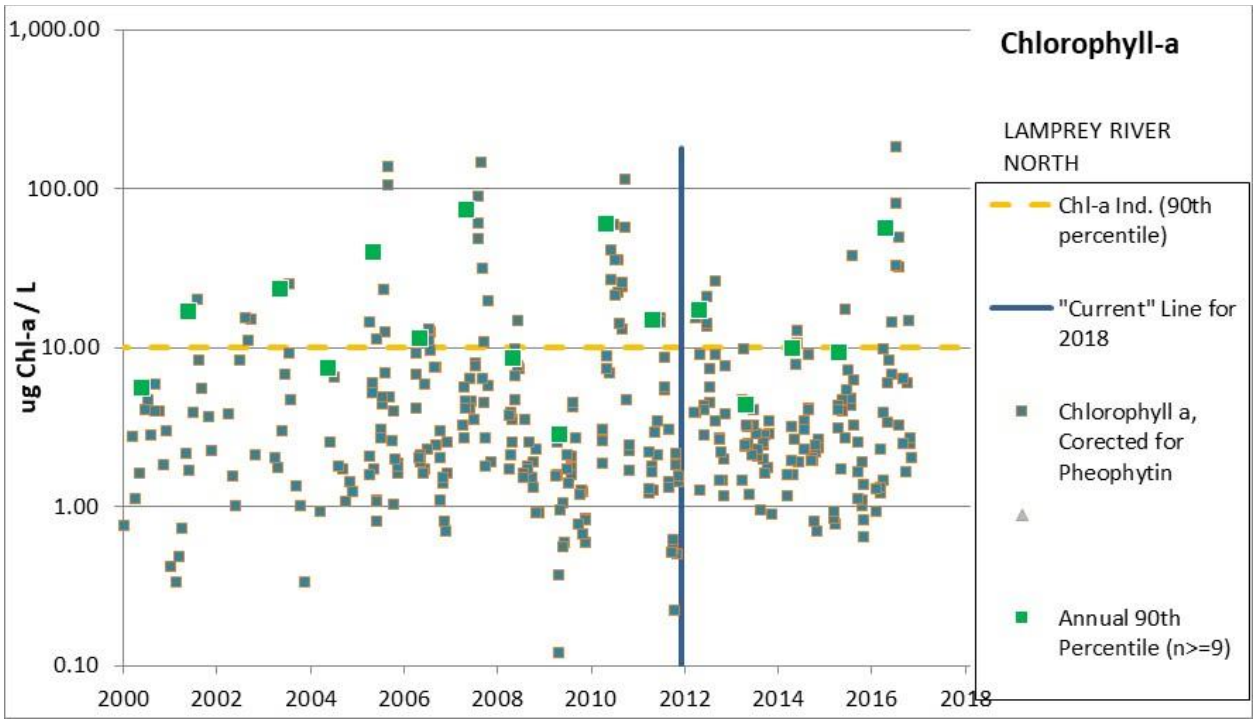
Squamscott River - North Assessment Zone (1/1/2012-5/25/2018)	**Count**	**Minimum**	**Median**	**90th Percentile**	**Maximum**
CHLOROPHYLL A, CORRECTED FOR PHEOPHYTIN (µg/L)	93	1.9	5.1	16.8	63.1
CHLOROPHYLL A, UNCORRECTED FOR PHEOPHYTIN (µg/L)	3	5.4	7.5	-	15.6
CHLOROPHYLL A, Combined (µg/L)	96	1.9	5.3	16.7	63.1
LIGHT ATTENUATION COEFFICIENT (1/m)	83	1.300	2.750	4.442	7.050
TURBIDITY (NTU)	1,143	2.0	14.0	33.0	506.0
COLORED DISSOLVED ORGANIC MATTER (CDOM) (1/m)	0	-	-	-	-
TSS (mg/L)	93	14.6	28.9	49.4	148.6
DO-PPM-24HR-MIN-CP (mg/L)	595	2.4	5.4	7.1	8.3
DO-PPM-24HR-MIN-NCP (mg/L)	595	3.3	8.4	10.6	11.7
DO-PPM-GRAB-CP (mg/L)	18	2.5	5.6	7.5	9.1
DO-PPM-GRAB-NCP (mg/L)	28	5.9	9.0	11.5	11.8
DO-PERC-24H-MEAN-CP (% sat)	590	65.4	91.8	103.2	152.0
DO-PERC-24H-MEAN-NCP (% sat)	583	77.9	94.0	103.5	121.7
DO-PERC-2TIDE-GRAB-CP (% sat)	18	51.5	82.2	104.9	105.3
DO-PERC-2TIDE-GRAB-NCP (% sat)	26	80.0	87.9	93.6	97.5
DO-PERC-GRAB (% sat)	2	83.0	90.0	-	98.0
Day Ave of TN (µg N/L)	91	416	745	950	1,376
Day Ave of TDN (µg N/L)	93	228	550	710	948
Day Ave of DIN (NH3 + NO2/3) (µg N/L)	93	66	347	563	616
Day Ave of NH3 (µg N/L)	93	34	186	326	411
Day Ave of PON (µg N/L)	0	-	-	-	-
Day Ave of NO2/3 (µg N/L)	93	30	154	248	469
SALINITY-Grabs (pss)	90	1	13	24	27
SALINITY-Datalogger Daily Median (pss)	1,190	7	23	29	32

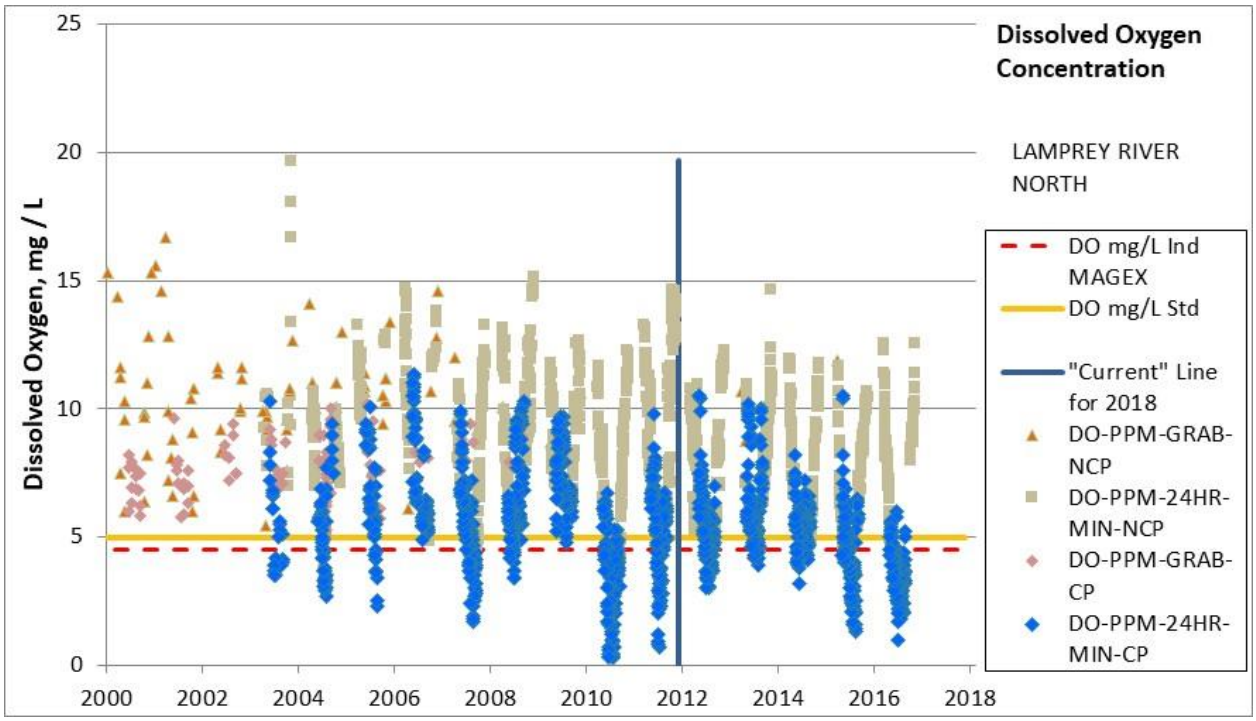
Assessment Zone = LAMPREY RIVER NORTH

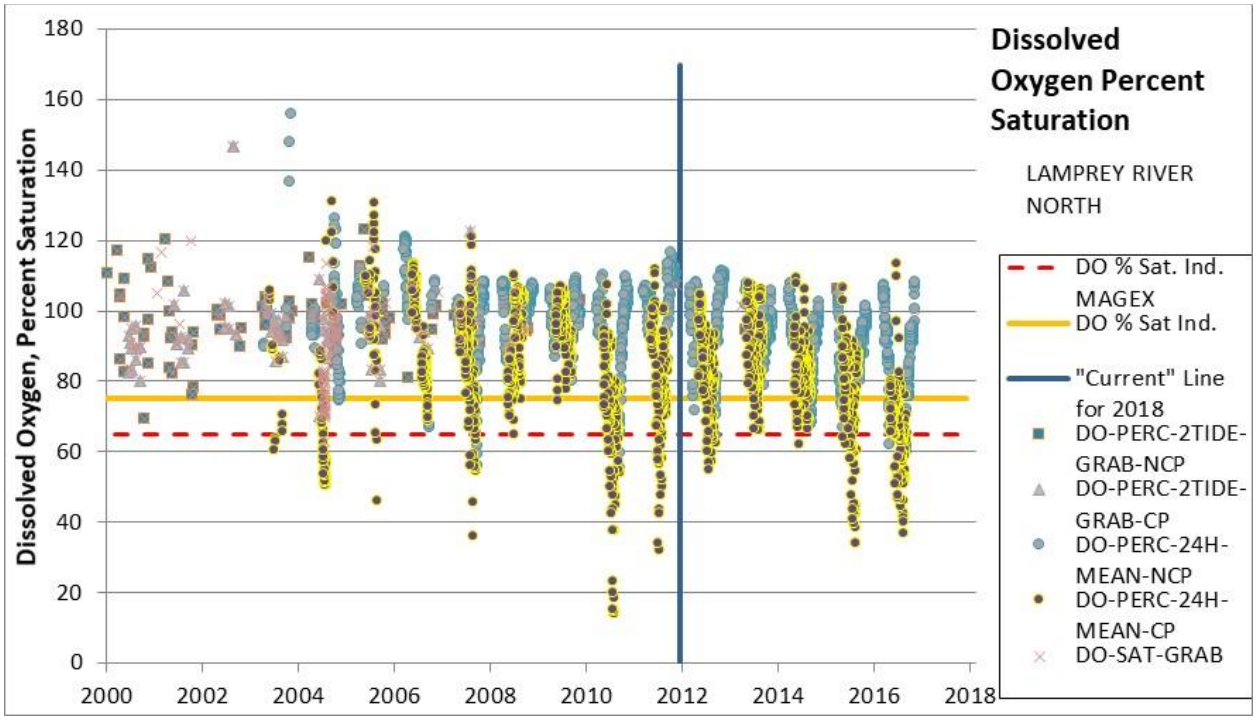
(NHEST600030709-01-01)

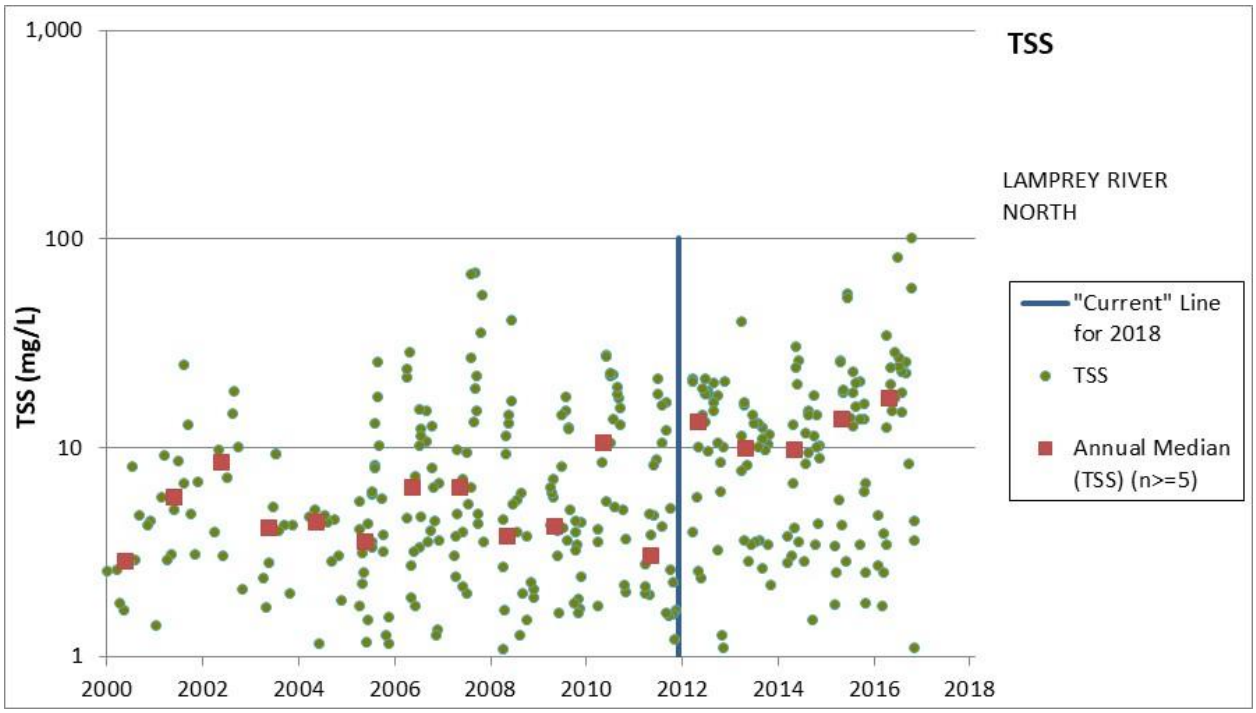
Indicator	Aquatic Life Use Category 2016 / 2018	2018 Comment
Chlorophyll-a	5-M / 5-M	The calculated 90th percentile chlorophyll-a in this assessment zone is 14 µg/L (n = 131) and the zone had a multiple readings over 50 µg/L. The chlorophyll-a indicator threshold to prevent low dissolved oxygen is a 90th percentile below 10 µg/L. Additionally, there are still frequent dissolved oxygen concentration criteria and percent saturation indicator exceedences. Large nutrient load reductions began when the new waste water treatment facility came online in 2017, however the monitoring covering the period after the upgrade is not yet available. The chlorophyll-a impairment has been retained.
Dissolved Oxygen (mg/L)	5-P / 5-P	Dissolved oxygen concentration measurements in this assessment zone fall below the 5 mg/L criteria every year. Because a portion of those measurements fall below 4 mg/L each year, and in some years down to 1 mg/L, this impairment is considered severe.
Dissolved Oxygen (% Saturation)	5-P / 5-P	Dissolved oxygen 24-hour average percent saturation measurements in this assessment zone fall below the 75% indicator every year. Because a portion of those measurements fall below 65% each year, and in some years below 40%, the indicator suggests that the aquatic life use is impaired, as such, dissolved oxygen 24-hour average percent saturation has been assessed as not supporting.
Estuarine Bioassessments (eelgrass)	No Std / No Std	Not applicable. Eelgrass habitat has not historically existed in this assessment zone.
Water Clarity (Light Attenuation Coefficient)	No Std / No Std	Not applicable. The water clarity has not been assessed because eelgrass has not historically existed in this assessment zone.
Total Nitrogen	5-M / 5-M	The median total nitrogen from 2012 through 2016 was 482 µg/L (n=49). It is important to note that the available data ends before the large nutrient load reductions from the new waste water treatment facility came online in 2017. This assessment zone experiences frequent dissolved oxygen concentrations well below the 5 mg/L criteria and daily average saturation below the 75 percent indicator. During some periods this assessment zone also demonstrates super saturation including multiple days in 2012 and a few dates in 2011 experiencing dissolved oxygen saturation over 125%. The chlorophyll-a concentration 90th percentile was 14 µg/L (n=131) from 2012 through 2016 and several measurements were over 50 µg/L. Many of the classic indicators of nutrient eutrophication are present in this assessment zone. As such, the impairment for nitrogen has been retained.

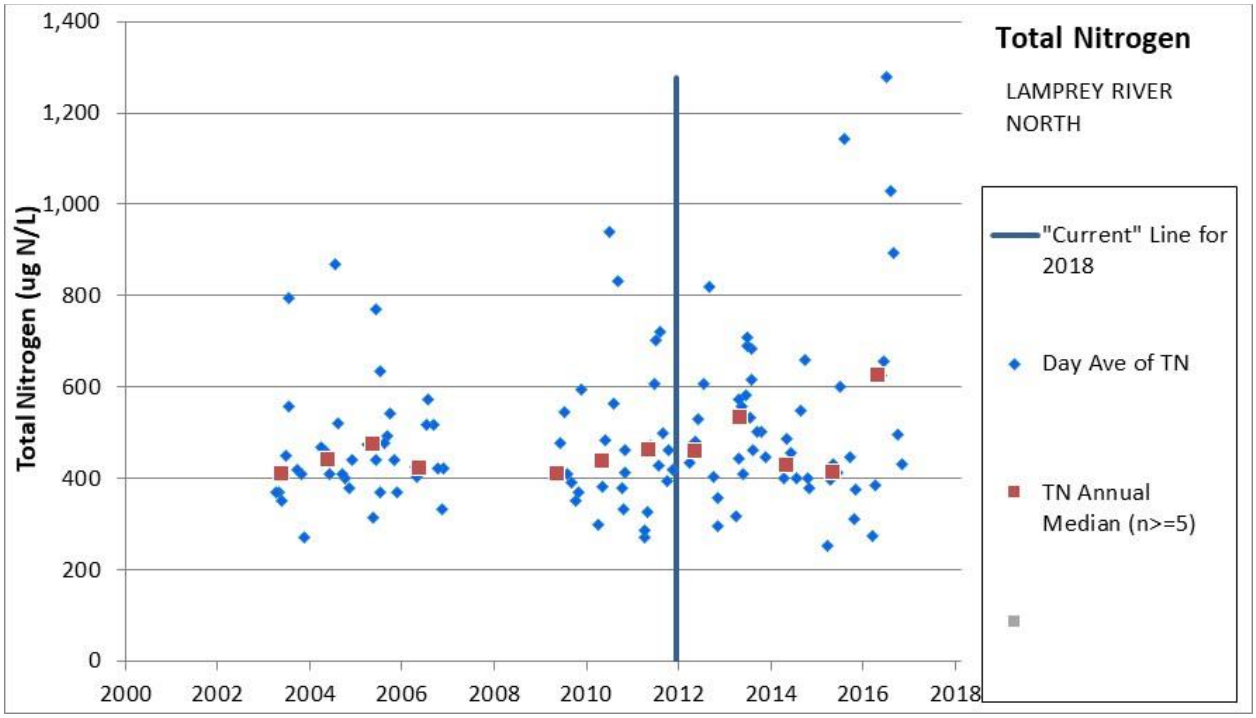

Chlorophyll-a
LAMPREY RIVER NORTH
ug Chl-a / L
200
180
160
140
120
100
80
60
40
20
0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Chl-a Ind. (90th percentile)
"Current" Line for 2018
Chlorophyll a, Corected for Pheophytin
Annual 90th Percentile (n>=9)


Chlorophyll-a
LAMPREY RIVER NORTH
ug Chl-a / L
1,000.00
100.00
10.00
1.00
0.10
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Chl-a Ind. (90th percentile)
"Current" Line for 2018
Chlorophyll a, Corected for Pheophytin
Annual 90th Percentile (n>=9)


Dissolved Oxygen Concentration
LAMPREY RIVER NORTH
Dissolved Oxygen, mg / L
25
20
15
10
5
0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
DO mg/L Ind MAGEX
DO mg/L Std
"Current" Line for 2018
DO-PPM-GRAB-NCP
DO-PPM-24HR-MIN-NCP
DO-PPM-GRAB-CP
DO-PPM-24HR-MIN-CP


Dissolved Oxygen Percent Saturation
LAMPREY RIVER NORTH
Dissolved Oxygen, Percent Saturation
180
160
140
120
100
80
60
40
20
0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
DO % Sat. Ind. MAGEX
DO % Sat Ind.
"Current" Line for 2018
DO-PERC-2TIDE-GRAB-NCP
DO-PERC-2TIDE-GRAB-CP
DO-PERC-24H-MEAN-NCP
DO-PERC-24H-MEAN-CP
DO-SAT-GRAB


TSS
LAMPREY RIVER NORTH
TSS (mg/L)
1,000
100
10
1
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
"Current" Line for 2018
TSS
Annual Median (TSS) (n>=5)


Total Nitrogen
LAMPREY RIVER NORTH
Total Nitrogen (ug N/L)
1,400
1,200
1,000
800
600
400
200
0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
"Current" Line for 2018
Day Ave of TN
TN Annual Median (n>=5)

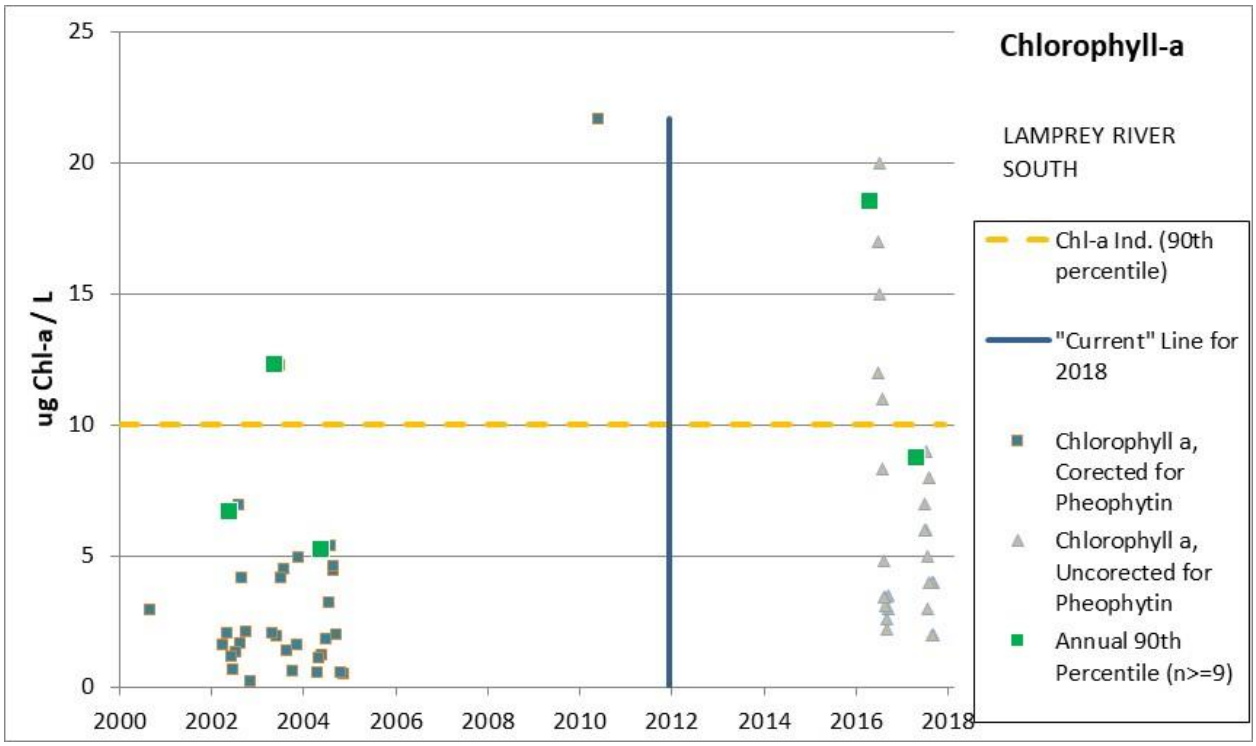
Lamprey River - North Assessment Zone (1/1/2012-5/25/2018)	**Count**	**Minimum**	**Median**	**90th Percentile**	**Maximum**
CHLOROPHYLL A, CORRECTED FOR PHEOPHYTIN (µg/L)	131	0.6	2.8	14.0	181.0
CHLOROPHYLL A, UNCORRECTED FOR PHEOPHYTIN (µg/L)	0	-	-	-	-
CHLOROPHYLL A, Combined (µg/L)	131	0.6	2.8	14.0	181.0
LIGHT ATTENUATION COEFFICIENT (1/m)	39	1.070	1.560	2.130	2.580
TURBIDITY (NTU)	1,103	0.0	5.0	12.0	173.0
COLORED DISSOLVED ORGANIC MATTER (CDOM) (1/m)	0	-	-	-	-
TSS (mg/L)	132	1.1	11.4	25.8	100.9
DO-PPM-24HR-MIN-CP (mg/L)	586	1.0	5.0	7.0	10.5
DO-PPM-24HR-MIN-NCP (mg/L)	501	4.4	8.7	11.1	14.7
DO-PPM-GRAB-CP (mg/L)	0	-	-	-	-
DO-PPM-GRAB-NCP (mg/L)	3	8.8	10.7	-	11.9
DO-PERC-24H-MEAN-CP (% sat)	599	34.0	79.5	97.3	113.4
DO-PERC-24H-MEAN-NCP (% sat)	537	60.2	94.6	105.6	111.4
DO-PERC-2TIDE-GRAB-CP (% sat)	0	-	-	-	-
DO-PERC-2TIDE-GRAB-NCP (% sat)	2	94.5	100.4	-	106.4
DO-PERC-GRAB (% sat)	1	101.4	101.4	-	101.4
Day Ave of TN (µg N/L)	49	254	482	820	1,279
Day Ave of TDN (µg N/L)	132	211	500	698	1,027
Day Ave of DIN (NH3 + NO2/3) (µg N/L)	132	76	327	554	828
Day Ave of NH3 (µg N/L)	132	6	146	356	633
Day Ave of PON (µg N/L)	0	-	-	-	-
Day Ave of NO2/3 (µg N/L)	132	43	152	248	453
SALINITY-Grabs (pss)	43	0	2	24	26
SALINITY-Datalogger Daily Median (pss)	1,119	0	19	26	30

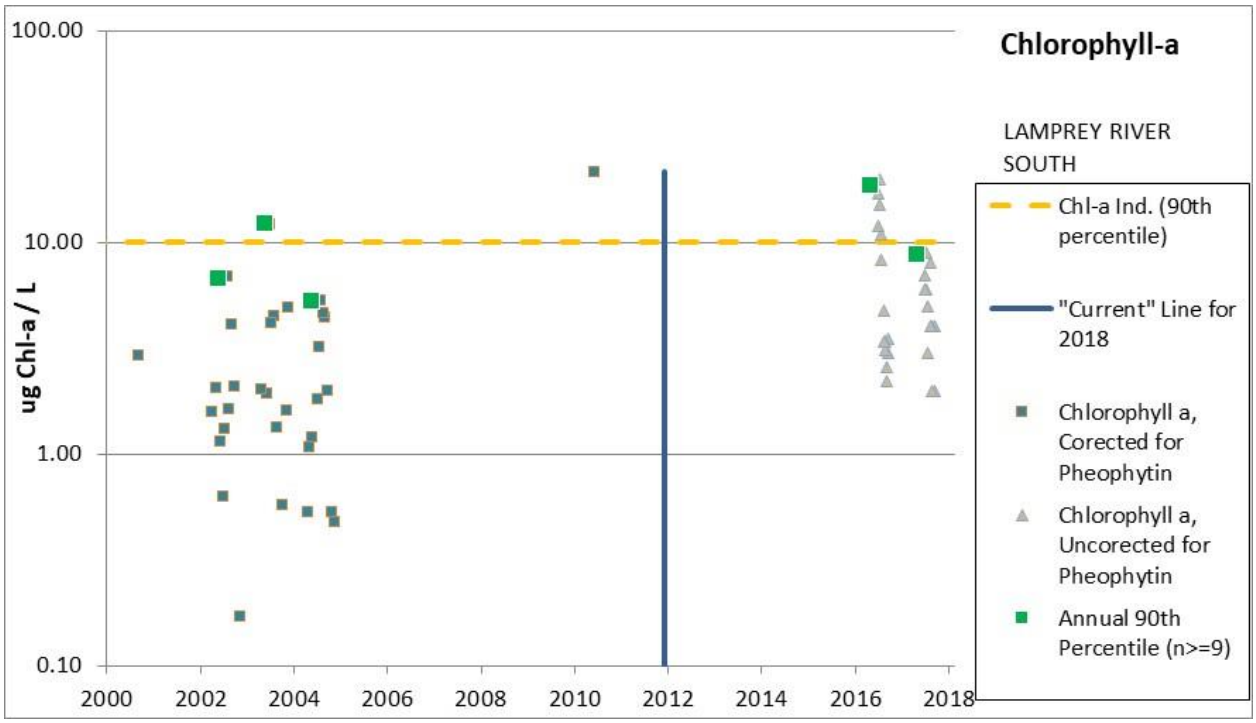
Assessment Zone = LAMPREY RIVER SOUTH

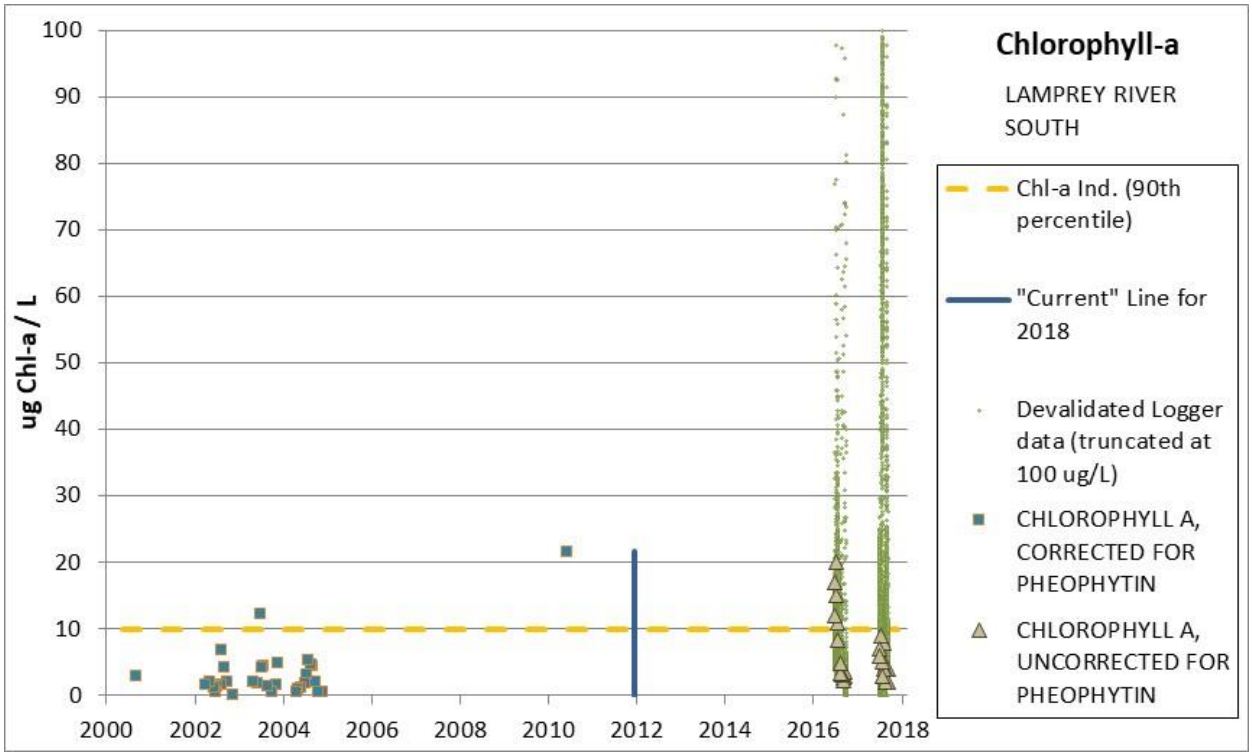
(NHEST600030709-01-02)

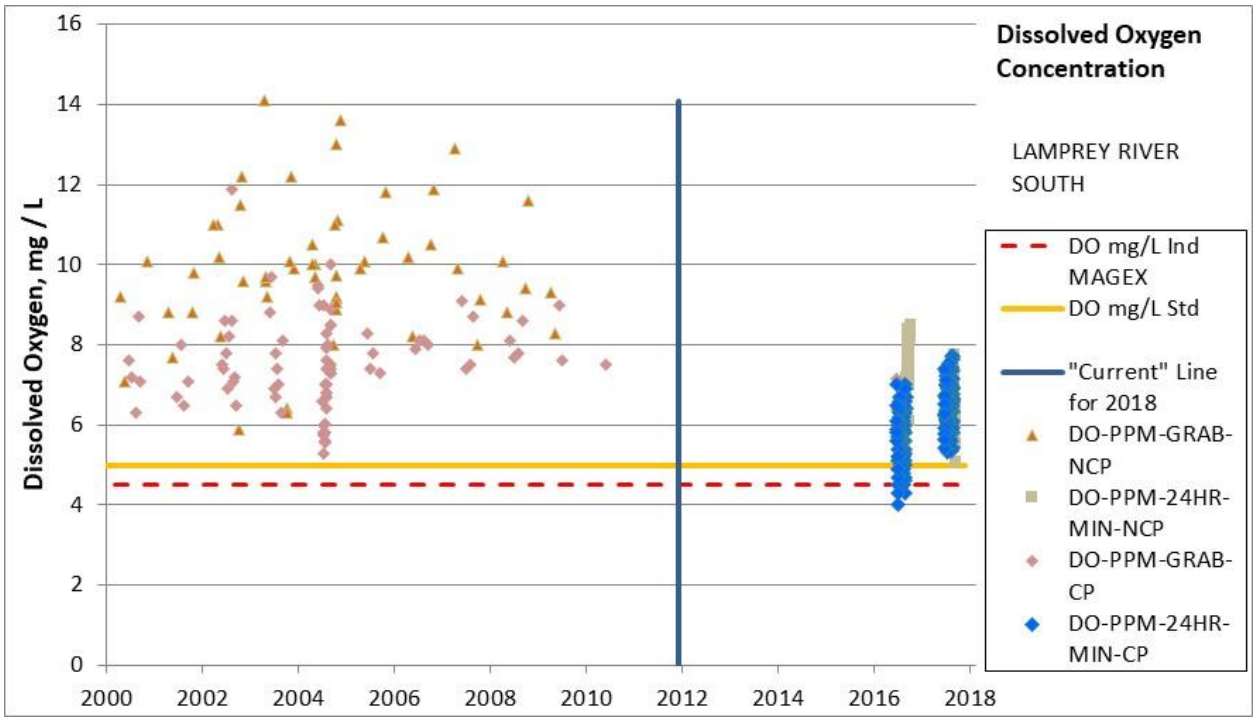
Indicator	Aquatic Life Use Category 2016 / 2018	2018 Comment
Chlorophyll-a	5-M / 5-M	The calculated 90th percentile chlorophyll-a in this assessment zone is 15.6 µg/L (n = 26). The chlorophyll-a indicator threshold to prevent low dissolved oxygen is a 90th percentile below 10 µg/L. Although the probe based chlorophyll-a data (not used in the median above) collected in the assessment zone at two sites in both 2016 and 2017 was qualified as "estimated," due to poor correlation between probe and extracted chlorophyll-a grab sample data, the relative biomass is valid and shows large spikes in chlorophyll-a. Additionally, there were measured apparent dissolved oxygen concentration criteria exceedences and minor percent saturation indicator exceedences. Large nutrient load reductions began when the new waste water treatment facility came online in 2017 and the differences in the 2016 verses 2017 datasets suggest that those reductions are having the desired impact. The chlorophyll-a impairment has been retained until additional data demonstrates continued chlorophyll-a reductions.
Dissolved Oxygen (mg/L)	2-G / 3-PNS	This assessment zone received its first datalogger deployments in 2016 and 2017, straddling the period when the new waste water treatment facility came online. Dissolved oxygen concentration measurements in 2016 in this assessment zone routinely fell below the 5 mg/L and at times below 4 mg/L. Further, 2016 was a low freshwater inflow year leading to stressful conditions. In contrast all 2017 measurements remained above 5 mg/L and 2017 was a much more normal summer inflow year. While no dataloggers were deployed in 2018, it is anticipated that the summer of 2019 will see a renewed effort to deploy dataloggers in this assessment zone. Given the change in loading and differences in concentration between 2016 and 2017 dissolved oxygen concentration has been assessed as potentially not supporting.
Dissolved Oxygen (% Saturation)	3-ND / 3-PNS	Full-support or non-support determinations are no longer made for dissolved oxygen percent saturation due to SB127 in 2017 amending three sections of RSA 485. This assessment zone received its first datalogger deployments in 2016 and 2017, straddling the period when the new waste water treatment facility came online. Dissolved oxygen 24-hour average percent saturation measurements in this assessment zone periodically fell below the 75 percent in both 2016 and 2017. Because a portion of those measurements fall below 75 percent, the indicator suggests that the aquatic life use is impaired, as such, dissolved oxygen 24-hour average percent saturation has been assessed as potentially not supporting.
Estuarine Bioassessments (eelgrass)	5-P / 5-P	The historical extent of eelgrass in this assessment zone was 53.4 acres from the 1948 dataset. Patches of eelgrass were found in 2003 (2.2 acres) and 2011 (0.5 acres). The median current extent of eelgrass in 2015-2017 is 0 acres, which is a 100% decrease. Since 1990, the trend in eelgrass cover in this assessment zone could not be determined because the eelgrass cover has been zero for most years since 1981. The thresholds for impairment are either loss of more than 20% of the historic extent of eelgrass or a recent trend of greater than 20% loss.
Water Clarity (Light Attenuation Coefficient)	5-P / 5-P	The median light attenuation could not be calculated for the 2012 through 2016 period (n=0) within this assessment zone. For an eelgrass restoration depth of 2 m, the light attenuation coefficient indicator threshold is 0.75 m^-1. This assessment zone historically had eelgrass growing in both the shallows and deeper habitat making the 2m restoration depth a valid target. This assessment unit (zone) was created for the 2012 cycle by splitting the Lamprey River assessment unit (NHEST600030709-01) into two pieces. The parent assessment zone was listed as impaired (5-P) for water clarity based on data from station GRBLR to protect eelgrass habitat on the 2010 303d list. The GRBLR station is roughly 0.5 miles upstream (north) of the Lamprey River North/South split and has a median light attenuation coefficient of 1.56 m^-1 (n=39) for the 2012 through 2016 period. The downstream boundary to the Lamprey River South assessment zone is Great Bay, which had a Median=1.46 m^-1 (n=124) for the 2012 through 2016 period. Assessment zones that were impaired in the previous cycle cannot be removed from the 303d list if there are insufficient data to make a new assessment. Given the lack of new site specific data and the measurements upstream and

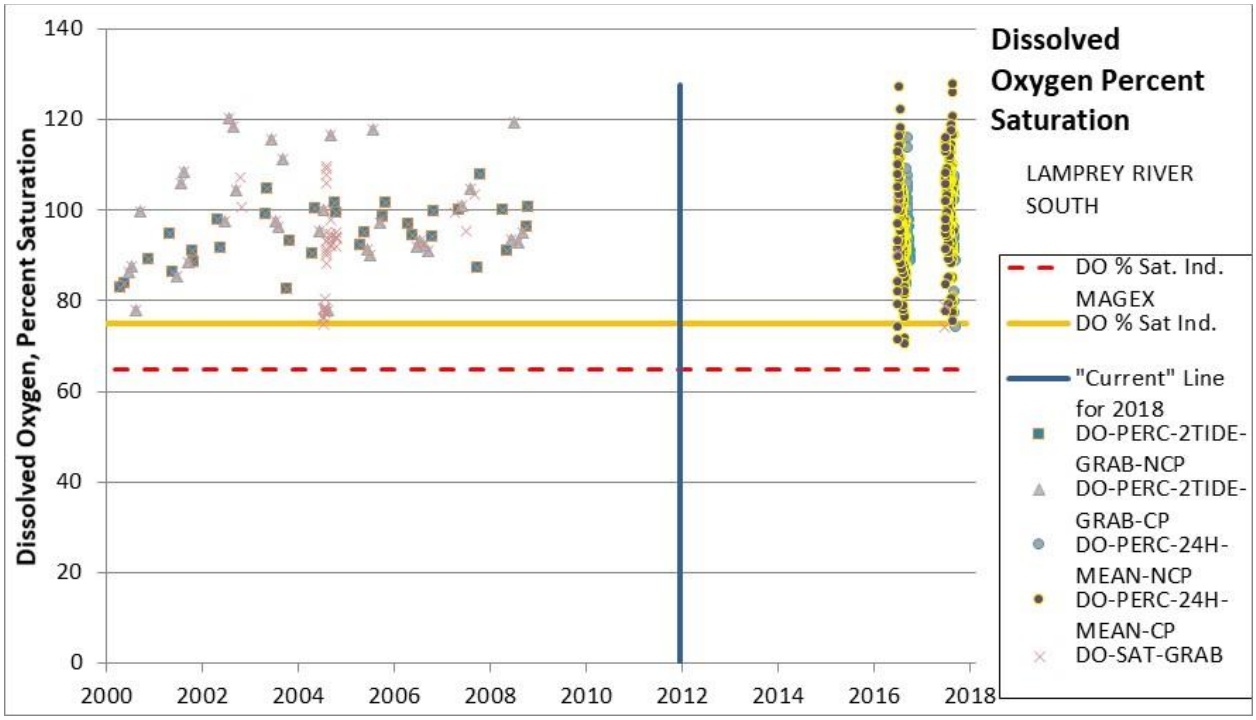
		downstream of this assessment zone the impaired (5-P) listing from the 2016 303d list has been retained.
Total Nitrogen	5-M / 5-M	The median total nitrogen from 2012 through 2017 was 395 µg/L (n=26). It is important to note that the available data straddles the period when the new waste water treatment facility came online and the reduction in total nitrogen is apparent in the dataset. The calculated 90th percentile chlorophyll-a in this assessment zone is 15.6 µg/L (n = 26). The eelgrass beds have been eliminated. The median light attenuation coefficient was not calculated due to no samples collected in the 2012 through 2018 period in this assessment zone, however, both the upstream assessment light attenuation coefficient is poor (median = 1.56 m^-1, n=39) and the downstream assessment zone is impaired due to the poor light attenuation coefficient (median = 1.46 m^-1, n=124). This assessment zone experienced dissolved oxygen concentrations well below the 5 mg/L criteria in 2016 but none in 2017 and daily average saturation below the 75% indicator fell below 75% in both 2016 and 2017. This assessment zone is generally characterized by limited and sometimes mixed eutrophication indicator data. While local data is limited and sometimes mixed its neighboring assessment zones have more detailed datasets. The upstream Lamprey River North assessment zone has extensive datasets demonstration impairments due to elevated chlorophyll-a and severely depleted dissolved oxygen. The downstream Great Bay assessment zone has elevated chlorophyll-a and marginal dissolved oxygen due to the severely poor condition coming out of the Squamscott River assessment zone as well as degraded eelgrass, poor light transmittance, and evidence of macroalgae. Taken in totality, there is insufficient evidence to remove the 2016 total nitrogen impairment. As such, the impairment for nitrogen has been retained and we look forward to the data that will be collected in 2019.

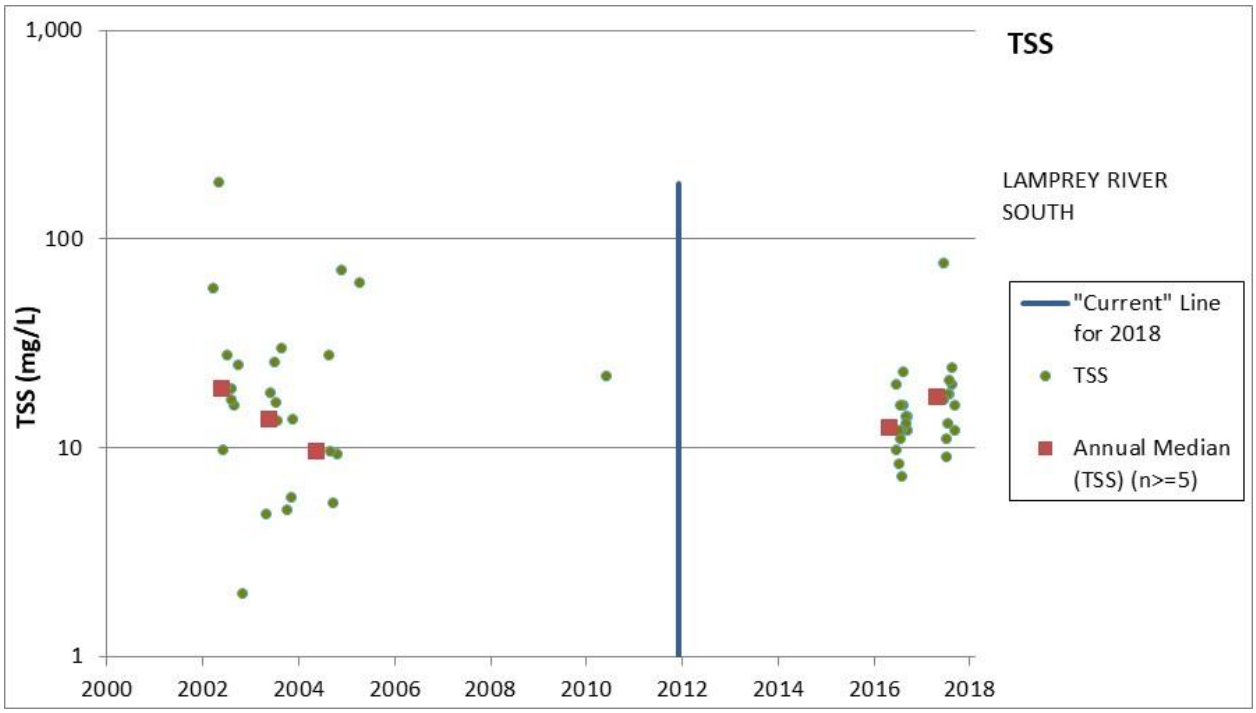


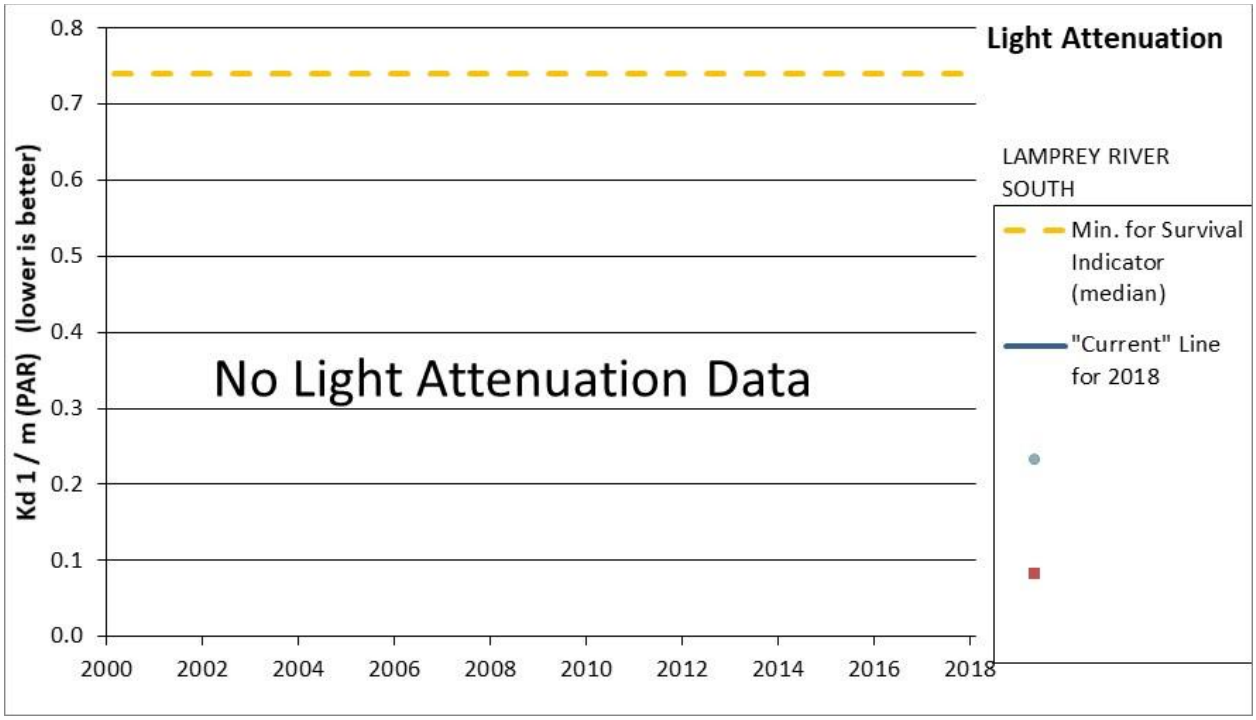

Chlorophyll-a
LAMPREY RIVER SOUTH
ug Chl-a / L
100.00
10.00
1.00
0.10
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Chl-a Ind. (90th percentile)
"Current" Line for 2018
Chlorophyll a, Corected for Pheophytin
Chlorophyll a, Uncorected for Pheophytin
Annual 90th Percentile (n>=9)

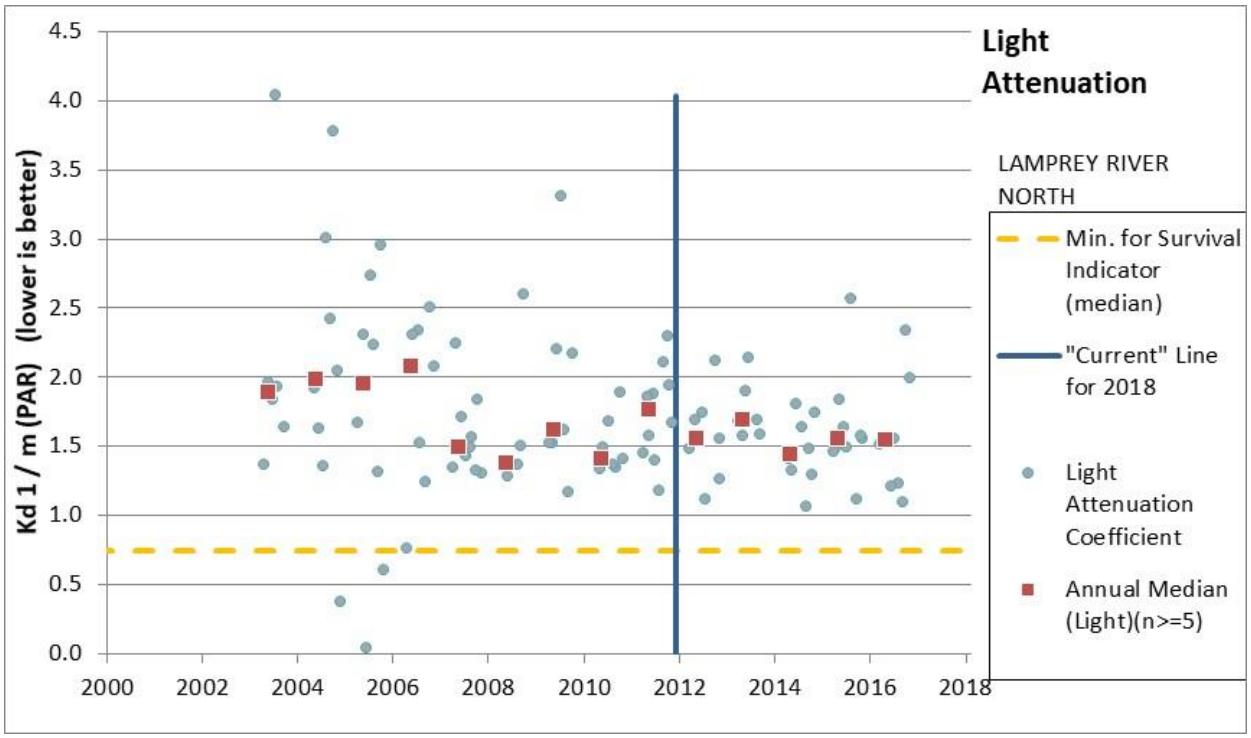

Chlorophyll-a
LAMPREY RIVER SOUTH
ug Chl-a / L
100
90
80
70
60
50
40
30
20
10
0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Chl-a Ind. (90th percentile)
"Current" Line for 2018
Devalidated Logger data (truncated at 100 ug/L)
CHLOROPHYLL A, CORRECTED FOR PHEOPHYTIN
CHLOROPHYLL A, UNCORRECTED FOR PHEOPHYTIN

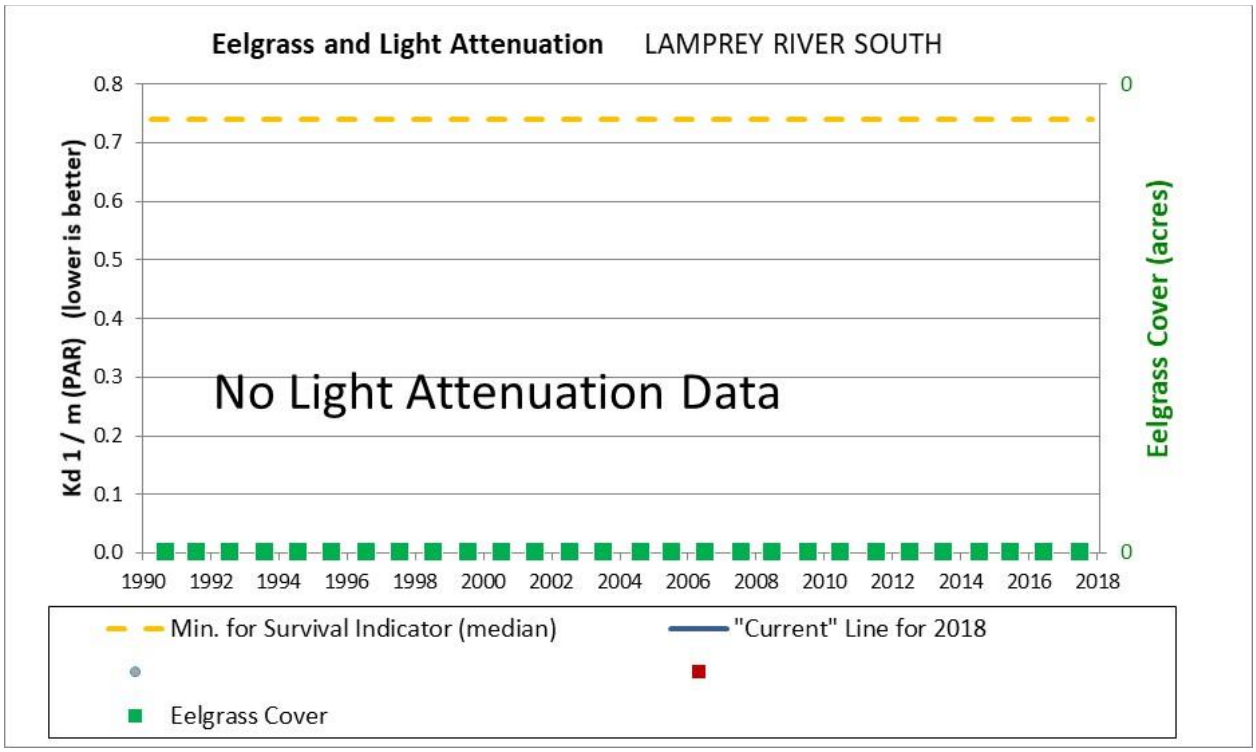

Dissolved Oxygen Concentration
LAMPREY RIVER SOUTH
Dissolved Oxygen, mg / L
16
14
12
10
8
6
4
2
0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
DO mg/L Ind MAGEX
DO mg/L Std
"Current" Line for 2018
DO-PPM-GRAB-NCP
DO-PPM-24HR-MIN-NCP
DO-PPM-GRAB-CP
DO-PPM-24HR-MIN-CP

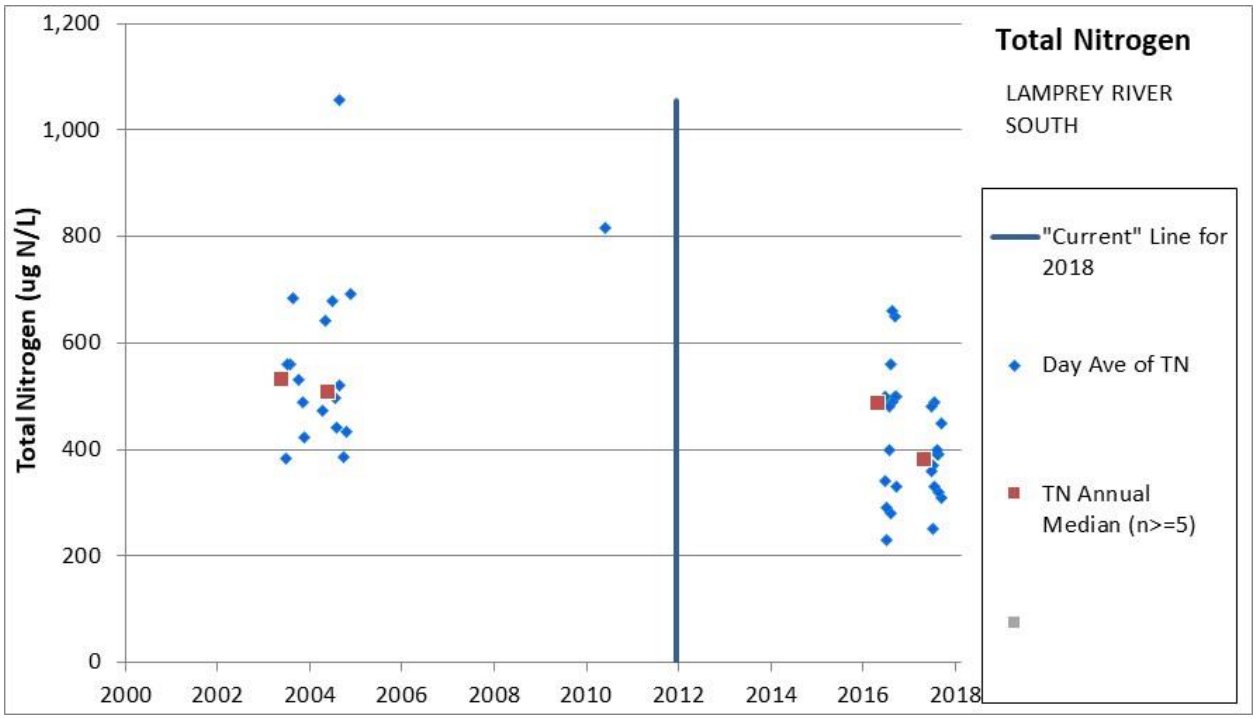

Dissolved Oxygen Percent Saturation
LAMPREY RIVER SOUTH
Dissolved Oxygen, Percent Saturation
140
120
100
80
60
40
20
0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
DO % Sat. Ind. MAGEX
DO % Sat Ind.
"Current" Line for 2018
DO-PERC-2TIDE-GRAB-NCP
DO-PERC-2TIDE-GRAB-CP
DO-PERC-24H-MEAN-NCP
DO-PERC-24H-MEAN-CP
DO-SAT-GRAB


TSS
LAMPREY RIVER SOUTH
"Current" Line for 2018
TSS
Annual Median (TSS) (n>=5)
TSS (mg/L)
1,000
100
10
1
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018


Light Attenuation
LAMPREY RIVER SOUTH
Min. for Survival Indicator (median)
"Current" Line for 2018
No Light Attenuation Data
Kd 1 / m (PAR) (lower is better)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018


Light Attenuation
LAMPREY RIVER NORTH
Kd 1 / m (PAR) (lower is better)
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Min. for Survival Indicator (median)
"Current" Line for 2018
Light Attenuation Coefficient
Annual Median (Light)(n>=5)


Eelgrass and Light Attenuation
LAMPREY RIVER SOUTH
Kd 1 / m (PAR) (lower is better)
Eelgrass Cover (acres)
No Light Attenuation Data
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
0
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Min. for Survival Indicator (median)
"Current" Line for 2018
Eelgrass Cover

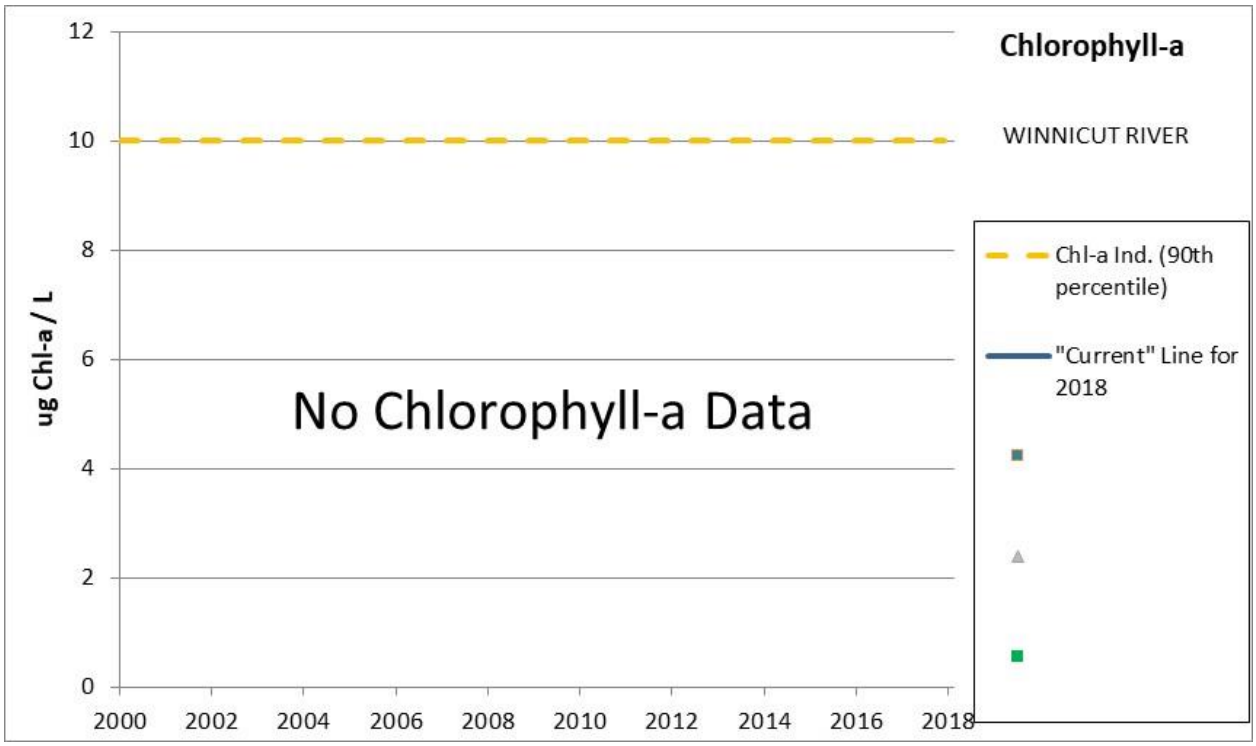


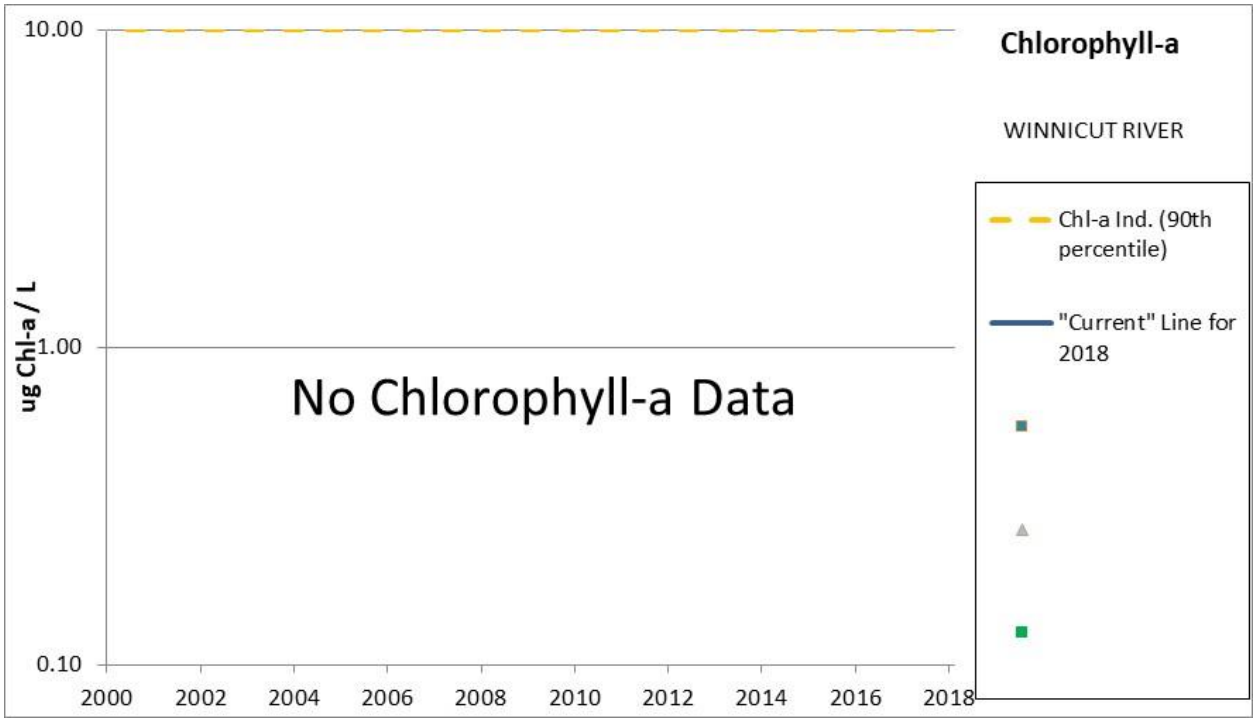
Lamprey River - South Assessment Zone (1/1/2012-5/25/2018)	**Count**	**Minimum**	**Median**	**90th Percentile**	**Maximum**
CHLOROPHYLL A, CORRECTED FOR PHEOPHYTIN (µg/L)	0	-	-	-	-
CHLOROPHYLL A, UNCORRECTED FOR PHEOPHYTIN (µg/L)	26	2.0	4.4	15.6	20.0
CHLOROPHYLL A, Combined (µg/L)	26	2.0	4.4	15.6	20.0
LIGHT ATTENUATION COEFFICIENT (1/m)	0	-	-	-	-
TURBIDITY (NTU)	0	-	-	-	-
COLORED DISSOLVED ORGANIC MATTER (CDOM) (1/m)	0	-	-	-	-
TSS (mg/L)	26	7.3	14.0	23.3	76.0
DO-PPM-24HR-MIN-CP (mg/L)	242	4.0	6.2	7.2	7.7
DO-PPM-24HR-MIN-NCP (mg/L)	69	5.1	7.2	8.3	8.5
DO-PPM-GRAB-CP (mg/L)	4	6.0	6.3	-	7.2
DO-PPM-GRAB-NCP (mg/L)	1	5.9	5.9	-	5.9
DO-PERC-24H-MEAN-CP (% sat)	268	70.5	98.0	112.1	127.7
DO-PERC-24H-MEAN-NCP (% sat)	66	74.2	93.8	106.2	115.8
DO-PERC-2TIDE-GRAB-CP (% sat)	0	-	-	-	-
DO-PERC-2TIDE-GRAB-NCP (% sat)	0	-	-	-	-
DO-PERC-GRAB (% sat)	7	74.2	79.0	-	102.0
Day Ave of TN (µg N/L)	26	230	395	587	660
Day Ave of TDN (µg N/L)	0	-	-	-	-
Day Ave of DIN (NH3 + NO2/3) (µg N/L)	21	37	180	464	508
Day Ave of NH3 (µg N/L)	25	11	130	351	368
Day Ave of PON (µg N/L)	0	-	-	-	-
Day Ave of NO2/3 (µg N/L)	23	23	54	116	140
SALINITY-Grabs (pss)	26	15	26	29	31
SALINITY-Datalogger Daily Median (pss)	325	12	27	31	31

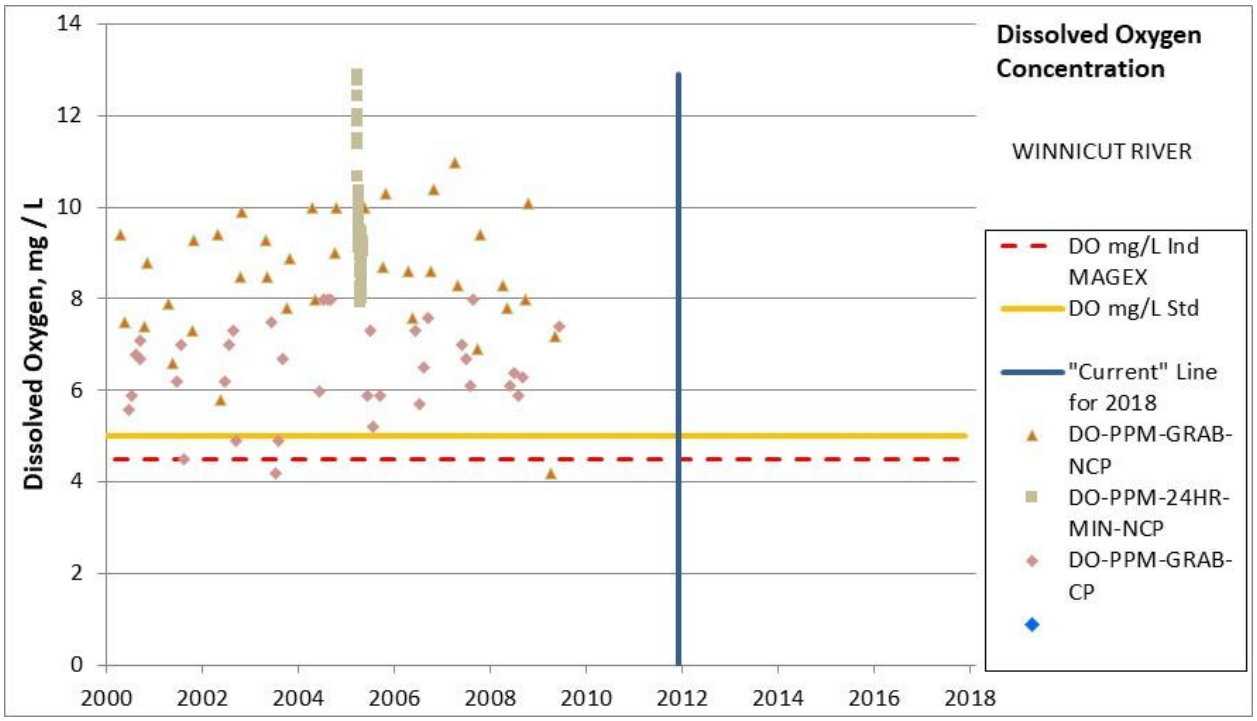
Assessment Zone = WINNICUT RIVER

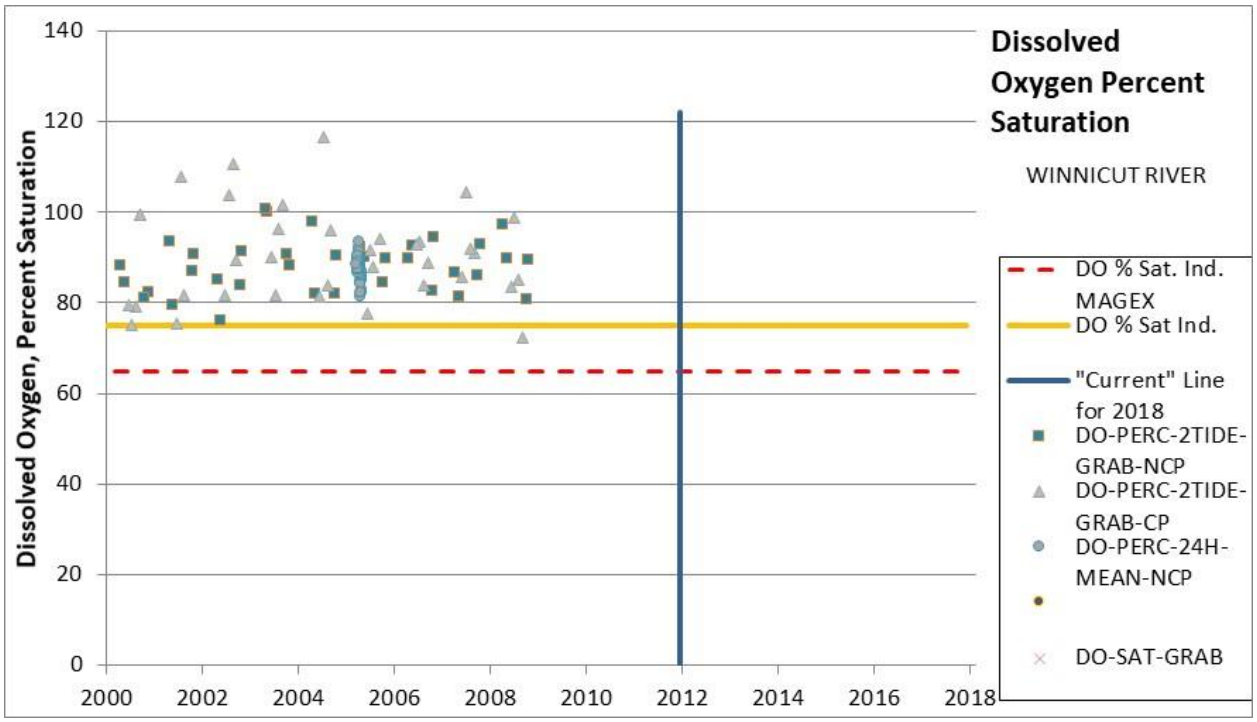
(NHEST600030904-01)

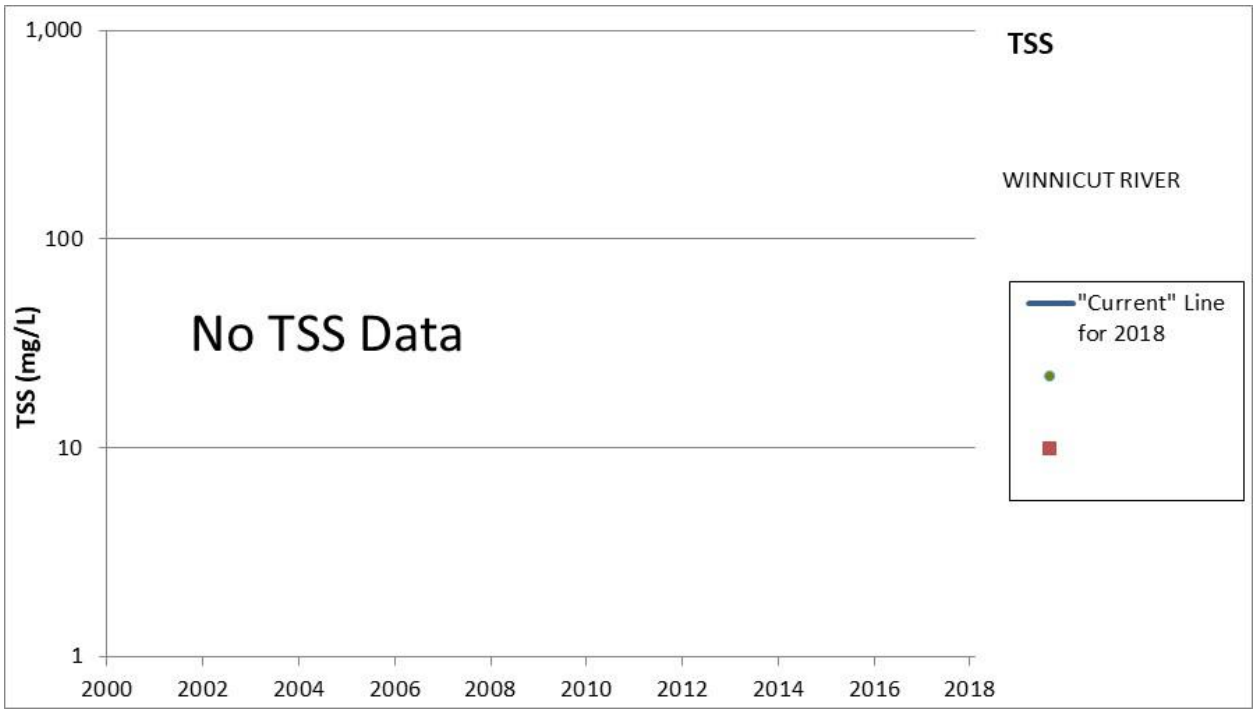
Indicator	Aquatic Life Use Category 2016 / 2018	2018 Comment
Chlorophyll-a	3-ND / 3-ND	The chlorophyll-a indicator threshold to prevent low dissolved oxygen is a 90th percentile below 10 µg/L. However, no chlorophyll-a data was collected in the current period for this assessment zone.
Dissolved Oxygen (mg/L)	3-ND / 3-ND	This assessment zone has no measurements for dissolved oxygen concentration since 2009. As such, this assessment zone has been assessed as 3-ND (No Data) dissolved oxygen concentration.
Dissolved Oxygen (% Saturation)	3-ND / 3-ND	Full-support or non-support determinations are no longer made for dissolved oxygen percent saturation due to SB127 in 2017 amending three sections of RSA 485. This assessment zone has no measurements for dissolved oxygen percent saturation since 2008. As such, this assessment zone has been assessed as 3-ND (No Data) for dissolved oxygen percent saturation.
Estuarine Bioassessments (eelgrass)	5-P / 5-P	The historical extent of eelgrass in this assessment zone was not available from the 1948, 1962, 1980, and 1981 datasets. Eelgrass was present from 1990 through 2006. The median current extent of eelgrass in 2015-2017 is 0 acres. Since 1990, the trend in eelgrass cover in this assessment zone is a loss of 79.0%. The thresholds for impairment are either loss of more than 20% of the historic extent of eelgrass or a recent trend of greater than 20% loss.
Water Clarity (Light Attenuation Coefficient)	3-ND / 3-ND	No light attenuation coefficient data has been collected in the current period for this assessment zone.
Total Nitrogen	3-ND / 3-ND	There are no “current” total nitrogen data from which to calculate a median total nitrogen from 2012 through 2018. As such, this assessment zone has been assessed as 3-ND (No Data) for total nitrogen.

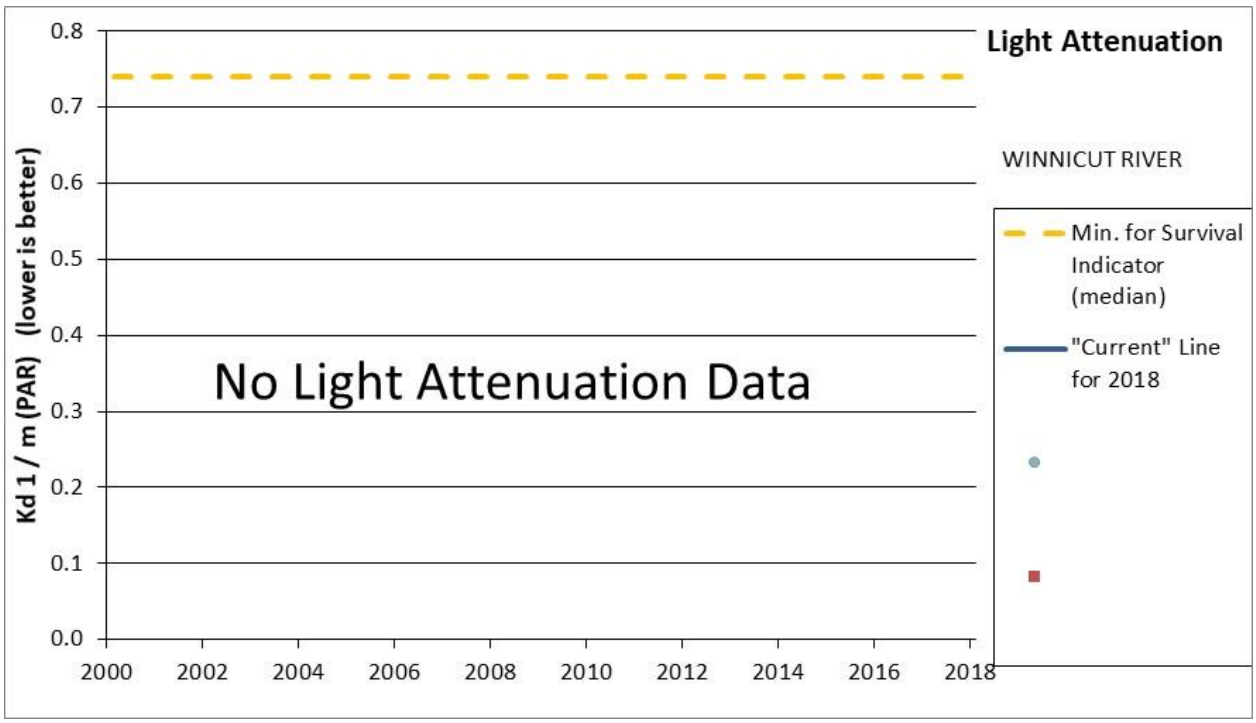

Chlorophyll-a
WINNICUT RIVER
ug Chl-a / L
No Chlorophyll-a Data
Chl-a Ind. (90th percentile)
"Current" Line for 2018
12
10
8
6
4
2
0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018

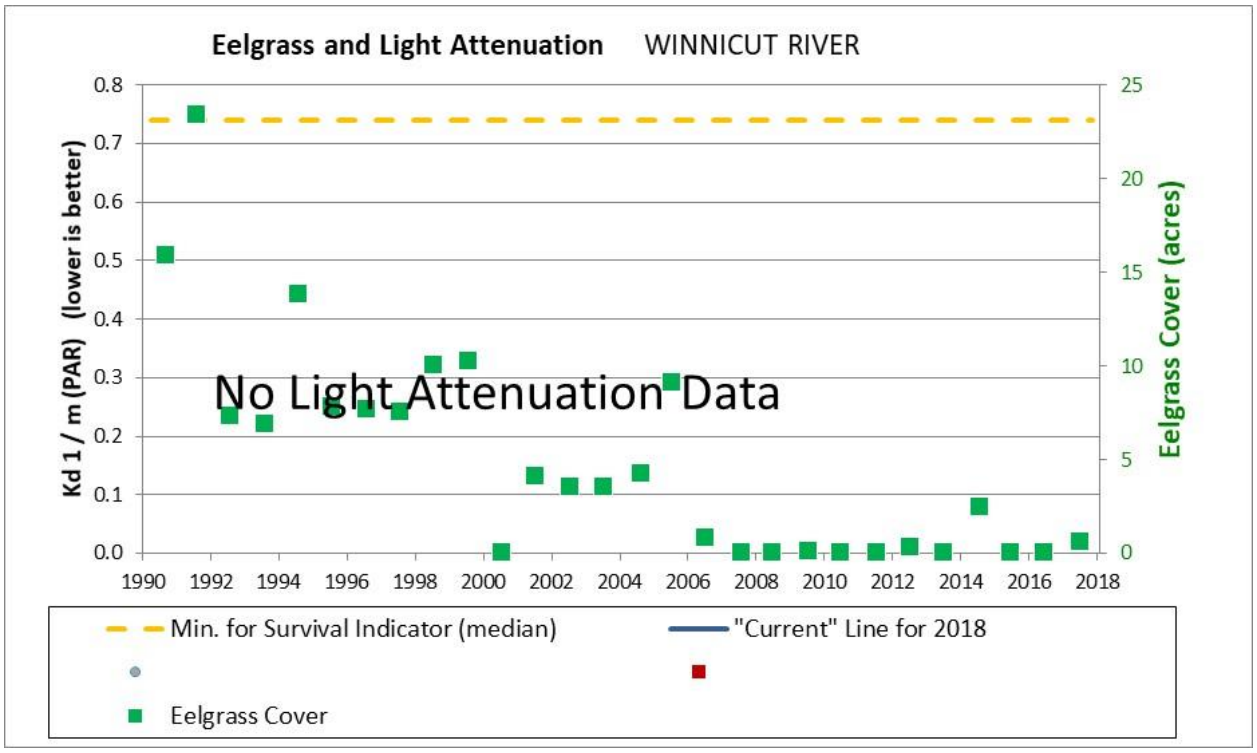

Chlorophyll-a
WINNICUT RIVER
ug Chl-a / L
No Chlorophyll-a Data
Chl-a Ind. (90th percentile)
"Current" Line for 2018
10.00
1.00
0.10
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018

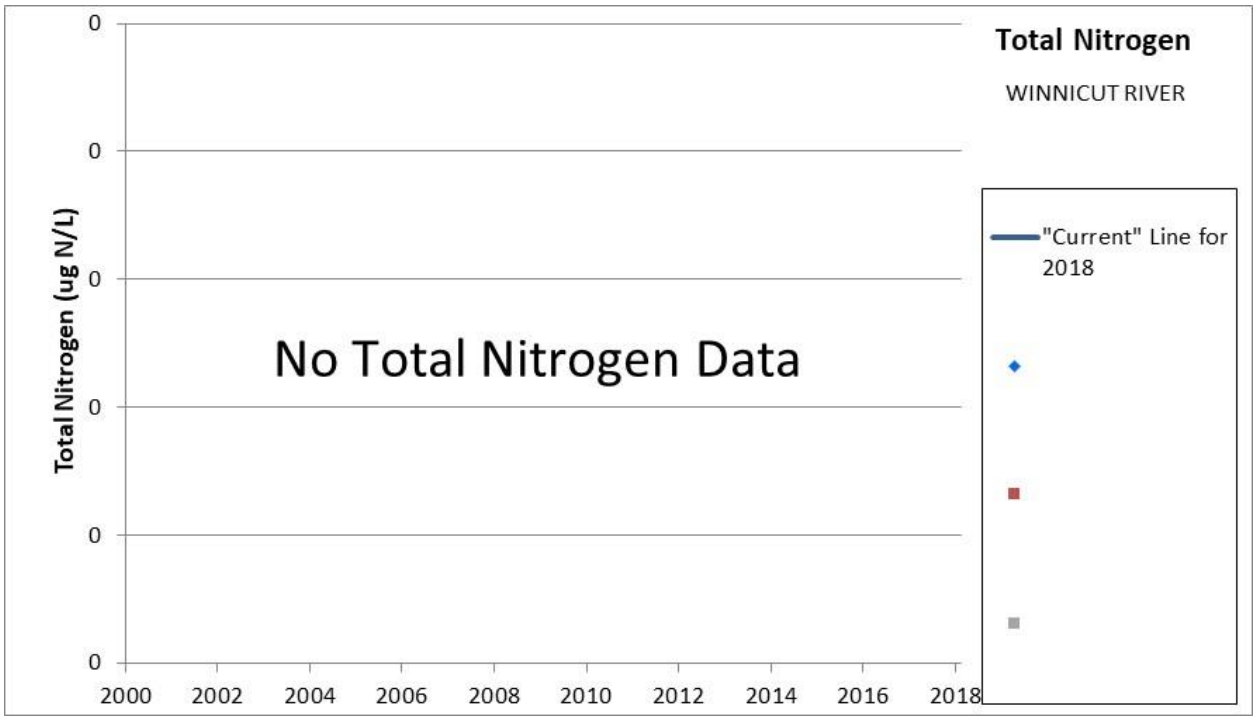

Dissolved Oxygen Concentration
WINNICUT RIVER
Dissolved Oxygen, mg / L
14
12
10
8
6
4
2
0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
DO mg/L Ind MAGEX
DO mg/L Std
"Current" Line for 2018
DO-PPM-GRAB-NCP
DO-PPM-24HR-MIN-NCP
DO-PPM-GRAB-CP


Dissolved Oxygen Percent Saturation
WINNICUT RIVER
Dissolved Oxygen, Percent Saturation
140
120
100
80
60
40
20
0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
DO % Sat. Ind. MAGEX
DO % Sat Ind.
"Current" Line for 2018
DO-PERC-2TIDE-GRAB-NCP
DO-PERC-2TIDE-GRAB-CP
DO-PERC-24H-MEAN-NCP
DO-SAT-GRAB


TSS
WINNICUT RIVER
No TSS Data
TSS (mg/L)
1,000
100
10
1
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
"Current" Line for 2018


Light Attenuation
WINNICUT RIVER
No Light Attenuation Data
Kd 1 / m (PAR) (lower is better)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Min. for Survival Indicator (median)
"Current" Line for 2018


Eelgrass and Light Attenuation
WINNICUT RIVER
Kd 1 / m (PAR) (lower is better)
Eelgrass Cover (acres)
No Light Attenuation Data
Min. for Survival Indicator (median)
"Current" Line for 2018
Eelgrass Cover


Total Nitrogen
WINNICUT RIVER
Total Nitrogen (ug N/L)
No Total Nitrogen Data
"Current" Line for 2018

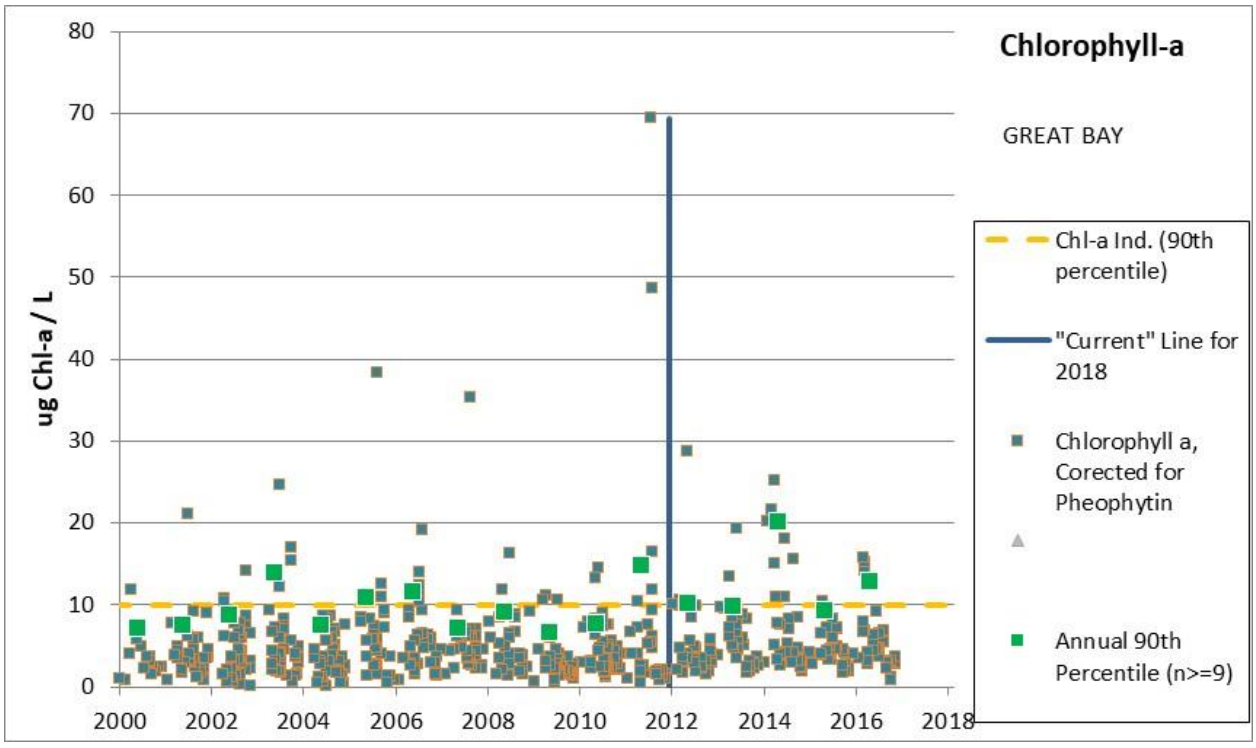
Winnicut River Assessment Zone (1/1/2012-5/25/2018)	**Count**	**Minimum**	**Median**	**90th Percentile**	**Maximum**
CHLOROPHYLL A, CORRECTED FOR PHEOPHYTIN (µg/L)	0	-	-	-	-
CHLOROPHYLL A, UNCORRECTED FOR PHEOPHYTIN (µg/L)	0	-	-	-	-
CHLOROPHYLL A, Combined (µg/L)	0	-	-	-	-
LIGHT ATTENUATION COEFFICIENT (1/m)	0	-	-	-	-
TURBIDITY (NTU)	0	-	-	-	-
COLORED DISSOLVED ORGANIC MATTER (CDOM) (1/m)	0	-	-	-	-
TSS (mg/L)	0	-	-	-	-
DO-PPM-24HR-MIN-CP (mg/L)	0	-	-	-	-
DO-PPM-24HR-MIN-NCP (mg/L)	0	-	-	-	-
DO-PPM-GRAB-CP (mg/L)	0	-	-	-	-
DO-PPM-GRAB-NCP (mg/L)	0	-	-	-	-
DO-PERC-24H-MEAN-CP (% sat)	0	-	-	-	-
DO-PERC-24H-MEAN-NCP (% sat)	0	-	-	-	-
DO-PERC-2TIDE-GRAB-CP (% sat)	0	-	-	-	-
DO-PERC-2TIDE-GRAB-NCP (% sat)	0	-	-	-	-
DO-PERC-GRAB (% sat)	0	-	-	-	-
Day Ave of TN (µg N/L)	0	-	-	-	-
Day Ave of TDN (µg N/L)	0	-	-	-	-
Day Ave of DIN (NH3 + NO2/3) (µg N/L)	0	-	-	-	-
Day Ave of NH3 (µg N/L)	0	-	-	-	-
Day Ave of PON (µg N/L)	0	-	-	-	-
Day Ave of NO2/3 (µg N/L)	0	-	-	-	-
SALINITY-Grabs (pss)	36	7	22	28	30
SALINITY-Datalogger Daily Median (pss)	0	-	-	-	-

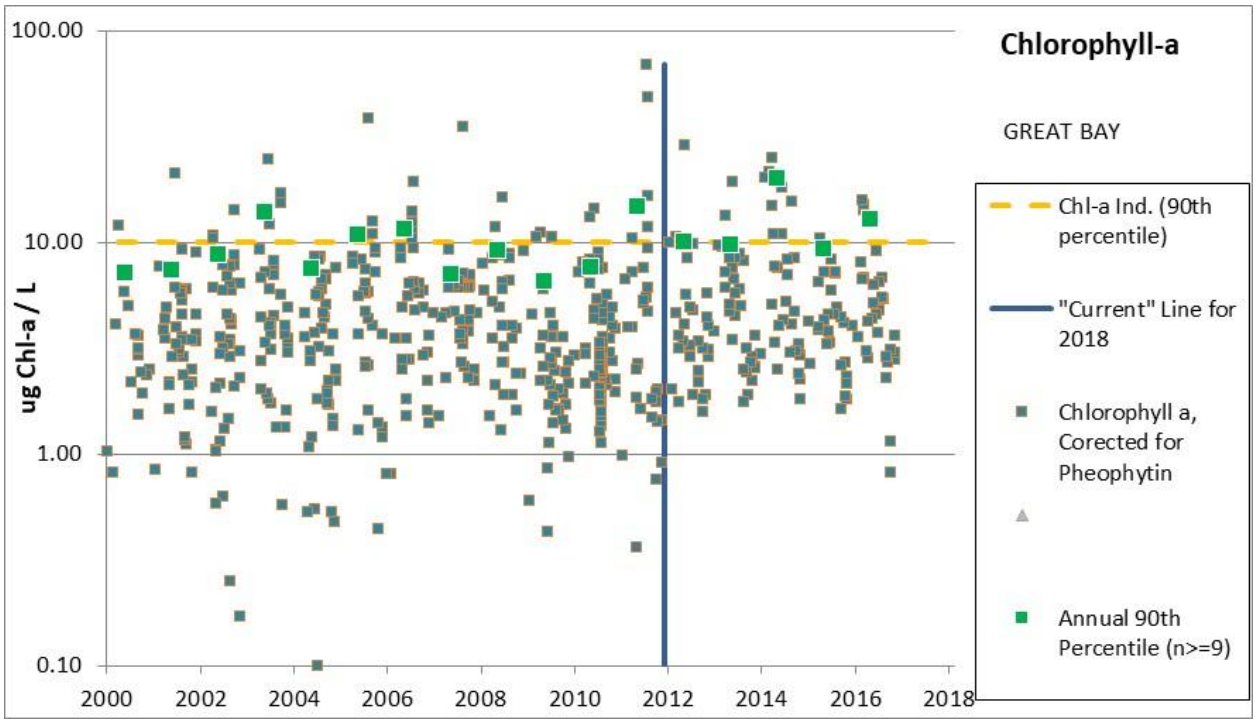
Assessment Zone = GREAT BAY

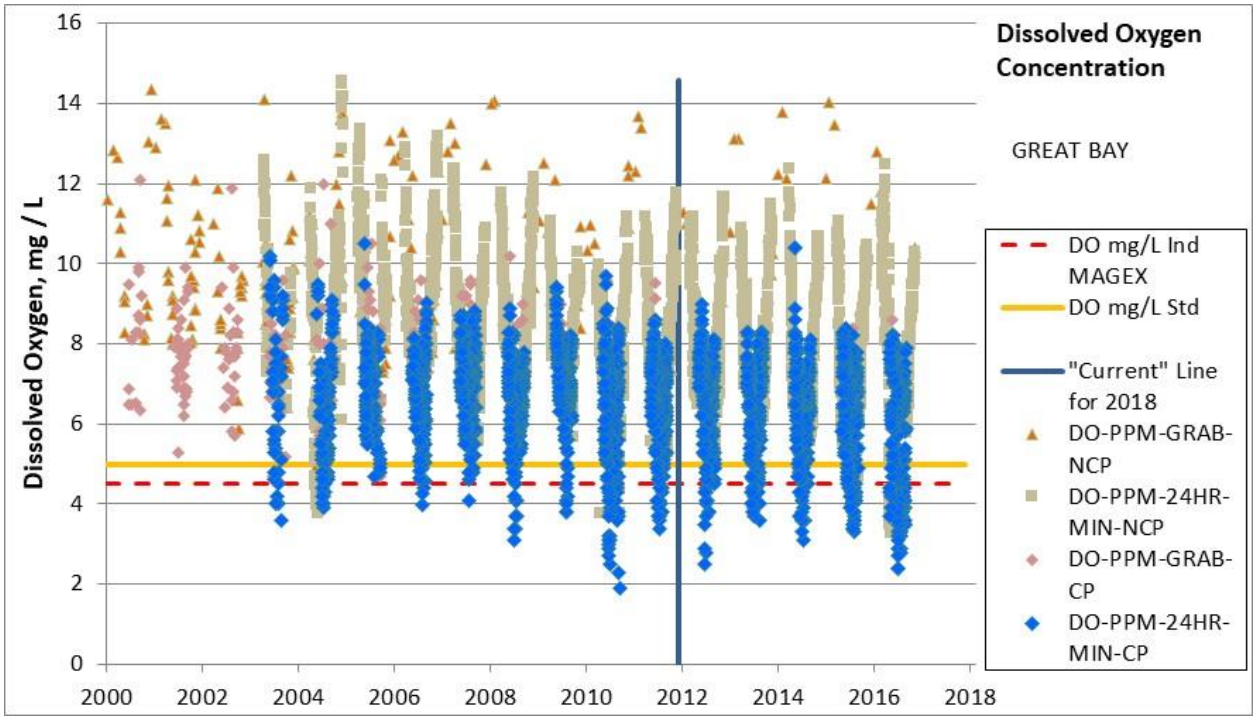
(NHEST600030904-02, NHEST600030904-03, NHEST600030904-04-02, NHEST600030904-04-03, NHEST600030904-04-04, NHEST600030904-04-05, NHEST600030904-04-06)

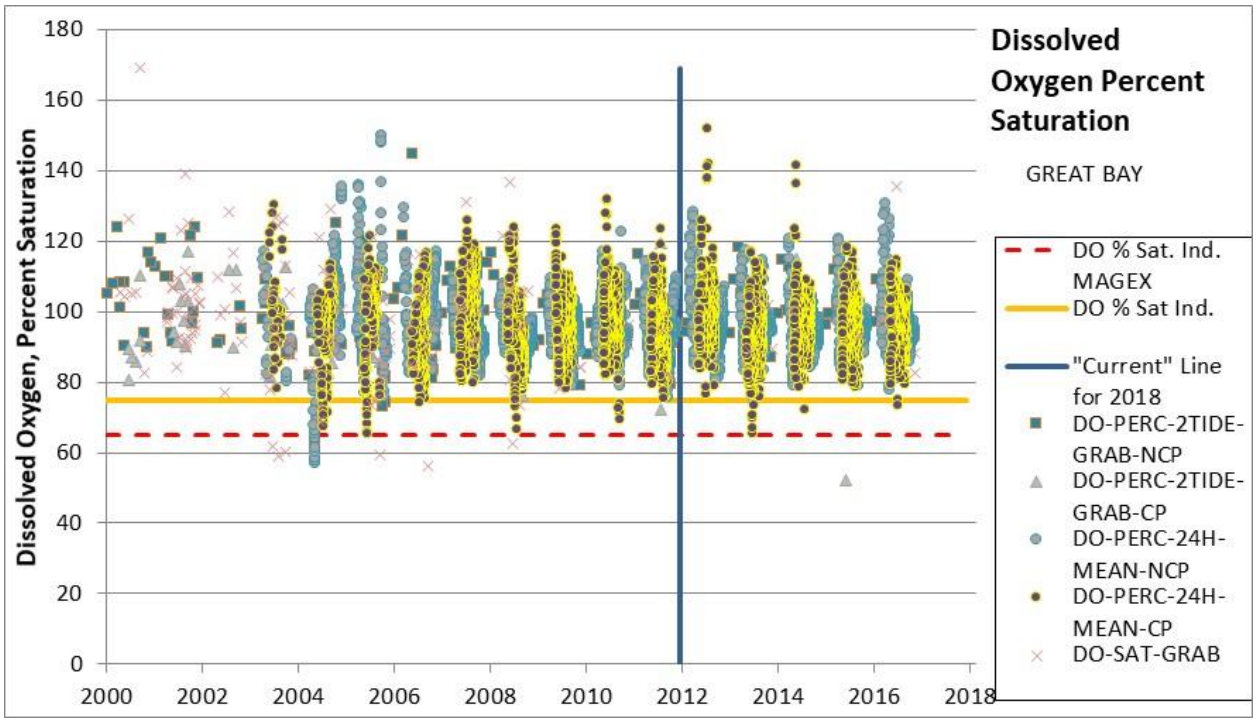
Indicator	Aquatic Life Use Category 2016 / 2018	2018 Comment
Chlorophyll-a	3-PNS / 3-PNS	The calculated 90th percentile for chlorophyll-a in this assessment zone is 10.6 µg/L (n = 150) [15.1 µg/L (n=47) without GRBAP and GRBSQ]. The chlorophyll-a indicator threshold to prevent low dissolved oxygen is a 90th percentile below 10 µg/L. It would be very valuable to deploy a continuous chlorophyll probe to determine if the grab samples are representative of the full chlorophyll data distribution. As chlorophyll-a is at the assessment threshold and dissolved oxygen is marginally acceptable in much of Great Bay, chlorophyll-a has been assessed as Insufficient Information – Potentially Not Supporting.
Dissolved Oxygen (mg/L)	3-PNS / 3-PNS	This assessment zone has 24 hour datalogger and grab measurements for dissolved oxygen concentration. One of the assigned stations (GRBSQ - Squamscott River datasonde at RR bridge) is at the mouth of the Squamscott River, precisely at the divide between the Squamscott River and Great Bay assessment zones. The very low readings from GRBSQ are a cause for concern. While GRBSQ more accurately represents the conditions in the Squamscott River than the entirety of Great Bay proper, it indicates that low DO issues are likely to extend into portions of Great Bay. The primary sampled station (GRBGB) inside of the Great Bay assessment zone also shows marginal dissolved oxygen samples 0.5 meters off the bottom including concentrations in 2011 and 2012 and 2016 dipping below 5.5 mg/L. Considering all the data across the assessment zone, conditions warrant retention of the dissolved oxygen concentration assessment as Insufficient Information – Potentially Not Supporting.
Dissolved Oxygen (% Saturation)	2-M / 3-PAS	Full-support or non-support determinations are no longer made for dissolved oxygen percent saturation due to SB127 in 2017 amending three sections of RSA 485. This assessment zone has 24 hour datalogger and grab measurements for dissolved oxygen percent saturation. One of the assigned stations (GRBSQ - Squamscott River datasonde at RR bridge) is at the mouth of the Squamscott River, precisely at the divide between the Squamscott River and Great Bay assessment zones. While GRBSQ more accurately represents the conditions in the Squamscott River than the entirety of Great Bay proper, it does indicate low DO issues are likely to extend into portions of Great Bay. The primary sampled station (GRBGB) inside of the Great Bay assessment zone also shows acceptable dissolved oxygen saturation 0.5 meters off the bottom. These marginally low readings from GRBSQ are not severe enough at this time to warrant calling the assessment zone potentially not-supporting for dissolved oxygen percent saturation.
Estuarine Bioassessments (eelgrass)	5-P / 5-P	The historical extent of eelgrass in this assessment zone was 2,130.7 acres from the 1948, 1962, 1980, and 1981 datasets. The median current extent of eelgrass in 2015-2017 is 1,362 acres, which is a 36% decrease. Since 1990, the trend in eelgrass cover in this assessment zone is a loss of 28%. The thresholds for impairment are either loss of more than 20% of the historic extent of eelgrass or a recent trend of greater than 20% loss.
Water Clarity (Light Attenuation Coefficient)	5-M / 5-M	Median=1.46 m^-1 (n=124) [1.28 µg/L (n=38) without GRBAP and GRBSQ]. For an eelgrass restoration depth of 2 m, the light attenuation coefficient threshold is 0.75 m^-1. This assessment zone historically had eelgrass growing in both the shallows and deeper habitat making the 2m restoration depth a valid target. Therefore, the impaired (5-M) listing from the 2016 303d list has been retained.
Total Nitrogen	3-PNS / 3-PNS	The median total nitrogen from 2012 through 2016 was 329 µg/L (n=46) when considering only the stations in the middle of Great Bay; and 358 µg/L (n=150) when including the boundary stations GRBSQ and GRBAP. This assessment zone has no demonstrated dissolved oxygen exceedences at station GRBGB in the middle of Great Bay. However, when considering all sampling stations of Great Bay there are areas in the southwest that likely exhibit poor dissolved

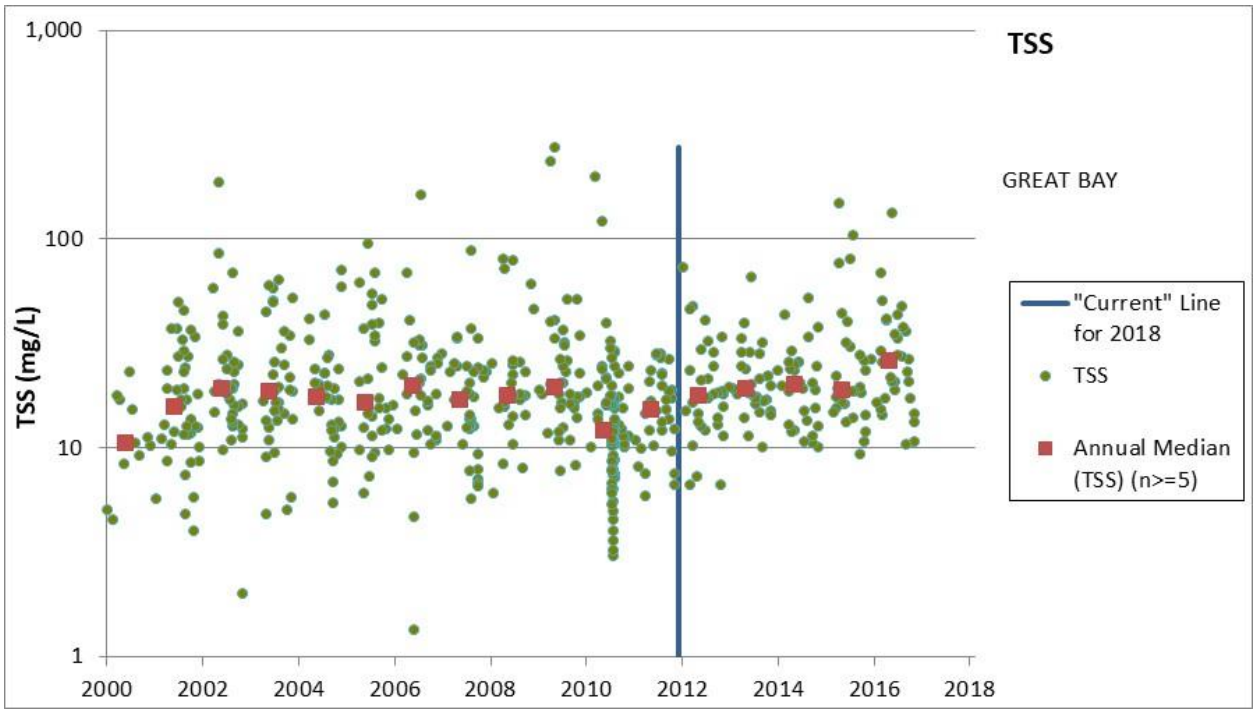
		oxygen. Likewise, the calculated 90th percentile chlorophyll-a in this assessment zone is 10.6 µg/L (n = 150), which is just above the threshold described in the CALM but dissolved oxygen problems are not evident in the main part of the Great Bay. The eelgrass beds are degraded and the available light attenuation (median=1.46 m^-1 (n=124)) is poor. For shallow systems, it is expected that changes in macroalgae will precede changes in phytoplankton (McGlathery, Sundbäck, & Anderson, 2007) (Valiela, et al., 1997), as appears to be occurring in the Great Bay assessment zone. There is evidence that macroalgae is impacting eelgrass and changing the species composition and diversity in Great Bay to some extent. Using data from Great Bay (Pe'eri, Morrison, Short, Mathieson, Brook, & Trowbridge, 2008), NHDES determined that macroalgae mats had replaced nearly 5.7% of the area formerly occupied by eelgrass in Great Bay in 2007 (NHDES, 2009) and that replaced area has not been recolonized by eelgrass. Some of the loss of eelgrass in the intertidal zone is consistent with smothering by macroalgae. The foremost authority on macroalgae for this estuary, Dr. Arthur C. Mathieson, commented on the draft 2012 303(d) that he remains concerned about the macroalgae and epiphyte conditions in Great Bay Bay (NHDES, 2013). Burdick et al. (2016) note that, "Monitoring results from 2014 show high levels of cover of nuisance green and red algae (*Ulva* and *Gracilaria*, respectively) at all sites except near the mouth of the Estuary." The Burdick et al. (Burdick, Mathieson, Peter, & Sydney, 2016) study included several sites within Great Bay. Some of the classic indicators of nutrient eutrophication are present in this assessment zone and total nitrogen remains elevated in portions of the assessment zone. As the discussion above illustrates, there is a clear nutrient "signature" in the data. It is less clear, at this time, whether the response datasets demonstrate sufficient power to determine that the eutrophication effects on designated uses can be attributed to total nitrogen alone. Given that uncertainty, impairment is not warranted under New Hampshire's narrative standard. As such, this assessment zone has been assessed as Insufficient Information – Potentially Not Supporting (3-PNS) for total nitrogen.

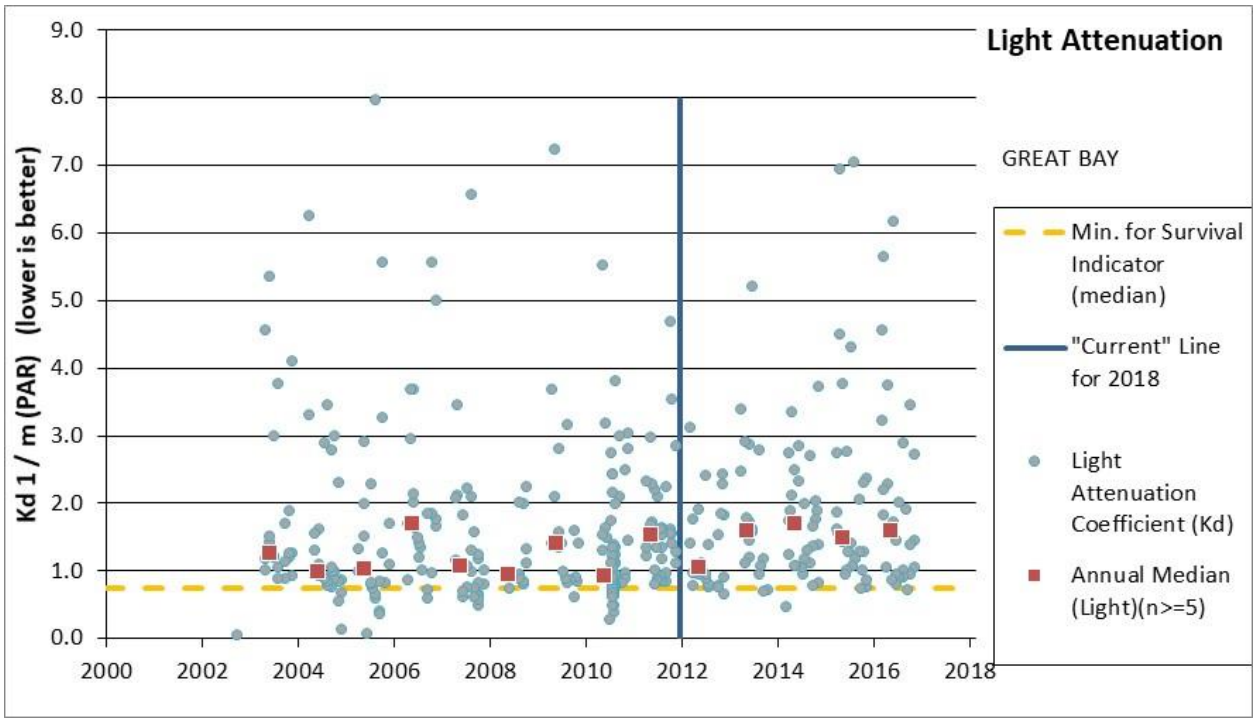


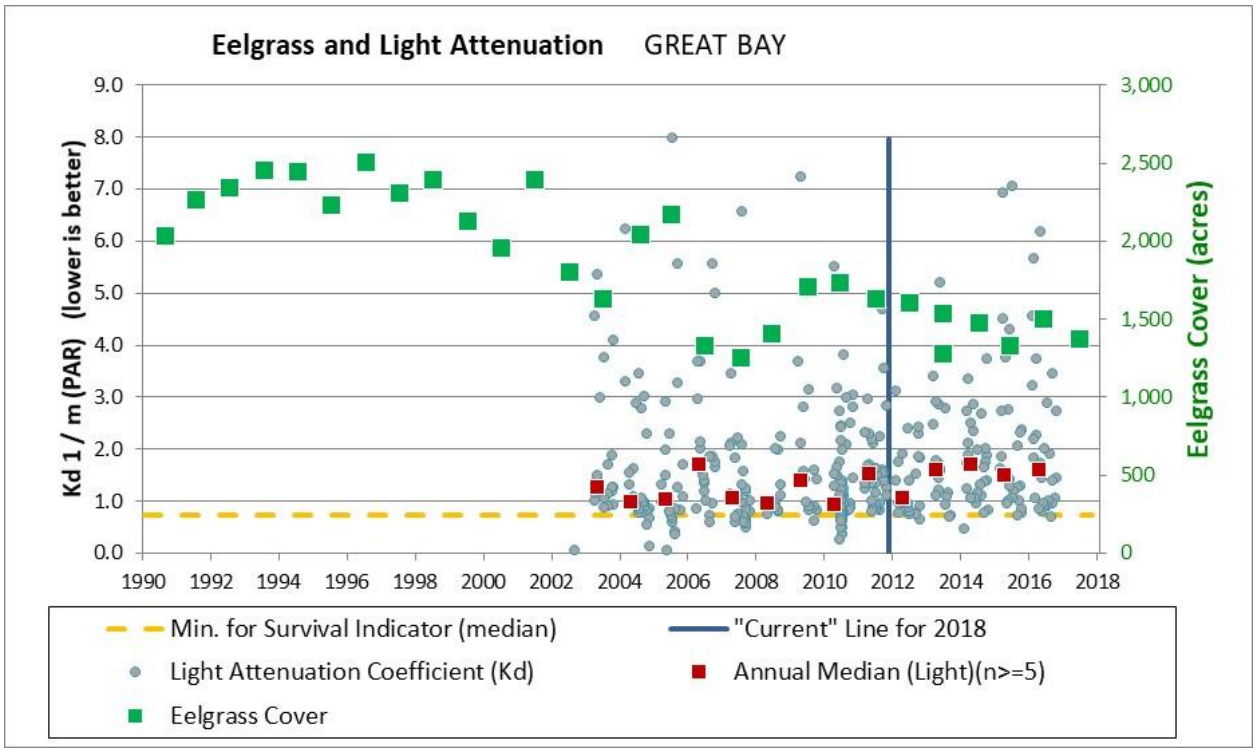

Chlorophyll-a
GREAT BAY
ug Chl-a / L
100.00
10.00
1.00
0.10
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Chl-a Ind. (90th percentile)
"Current" Line for 2018
Chlorophyll a, Corected for Pheophytin
Annual 90th Percentile (n>=9)

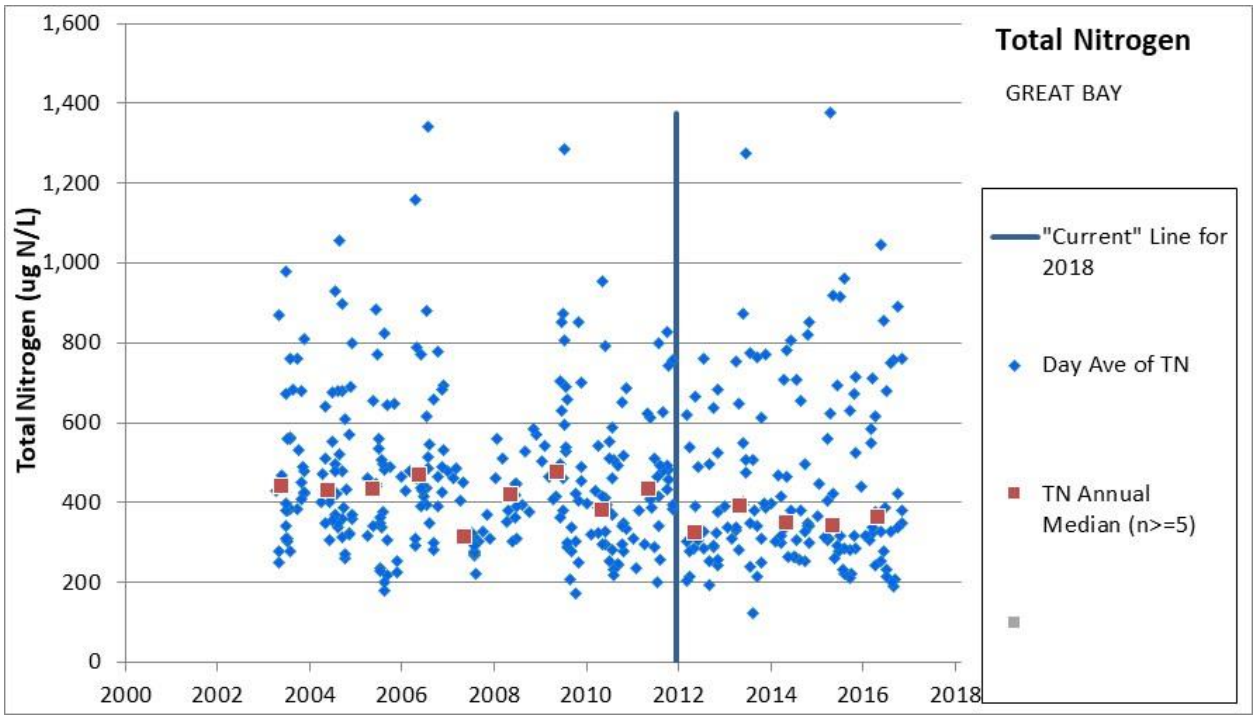

Dissolved Oxygen Concentration
GREAT BAY
Dissolved Oxygen, mg / L
16
14
12
10
8
6
4
2
0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
DO mg/L Ind MAGEX
DO mg/L Std
"Current" Line for 2018
DO-PPM-GRAB-NCP
DO-PPM-24HR-MIN-NCP
DO-PPM-GRAB-CP
DO-PPM-24HR-MIN-CP

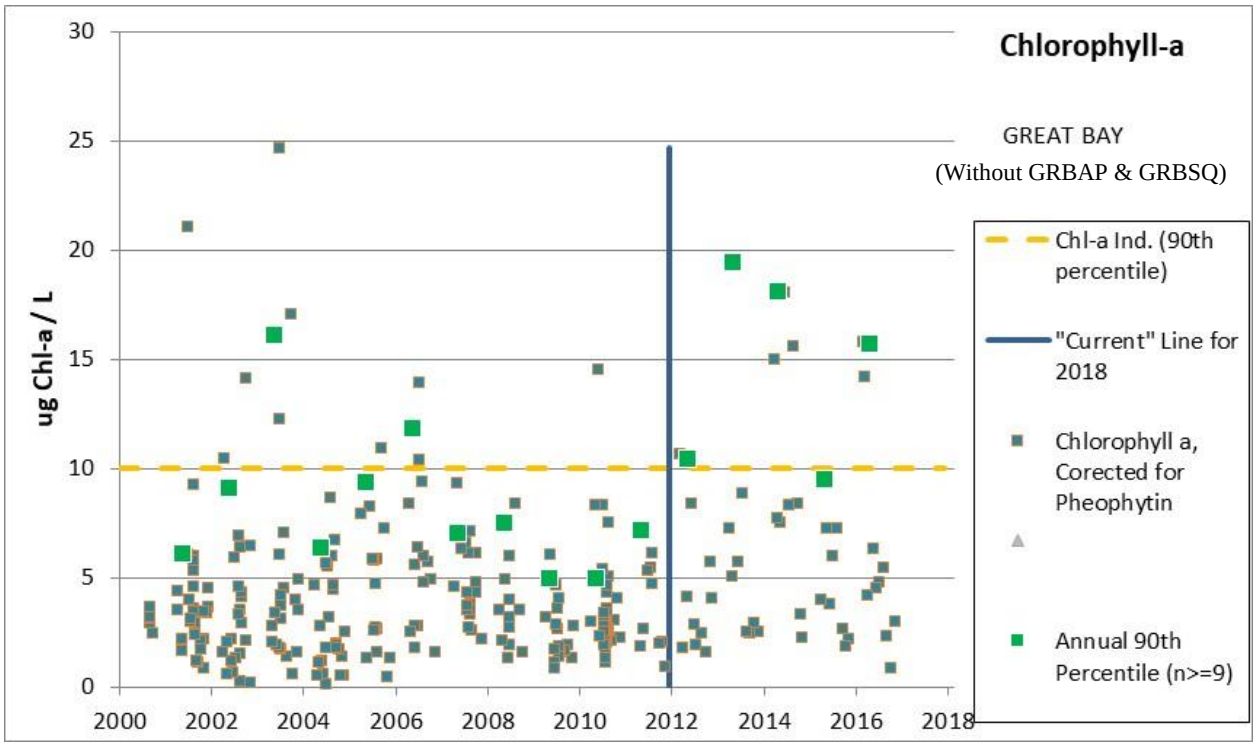

Dissolved Oxygen Percent Saturation
GREAT BAY
Dissolved Oxygen, Percent Saturation
180
160
140
120
100
80
60
40
20
0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
DO % Sat. Ind. MAGEX
DO % Sat Ind.
"Current" Line for 2018
DO-PERC-2TIDE-GRAB-NCP
DO-PERC-2TIDE-GRAB-CP
DO-PERC-24H-MEAN-NCP
DO-PERC-24H-MEAN-CP
DO-SAT-GRAB

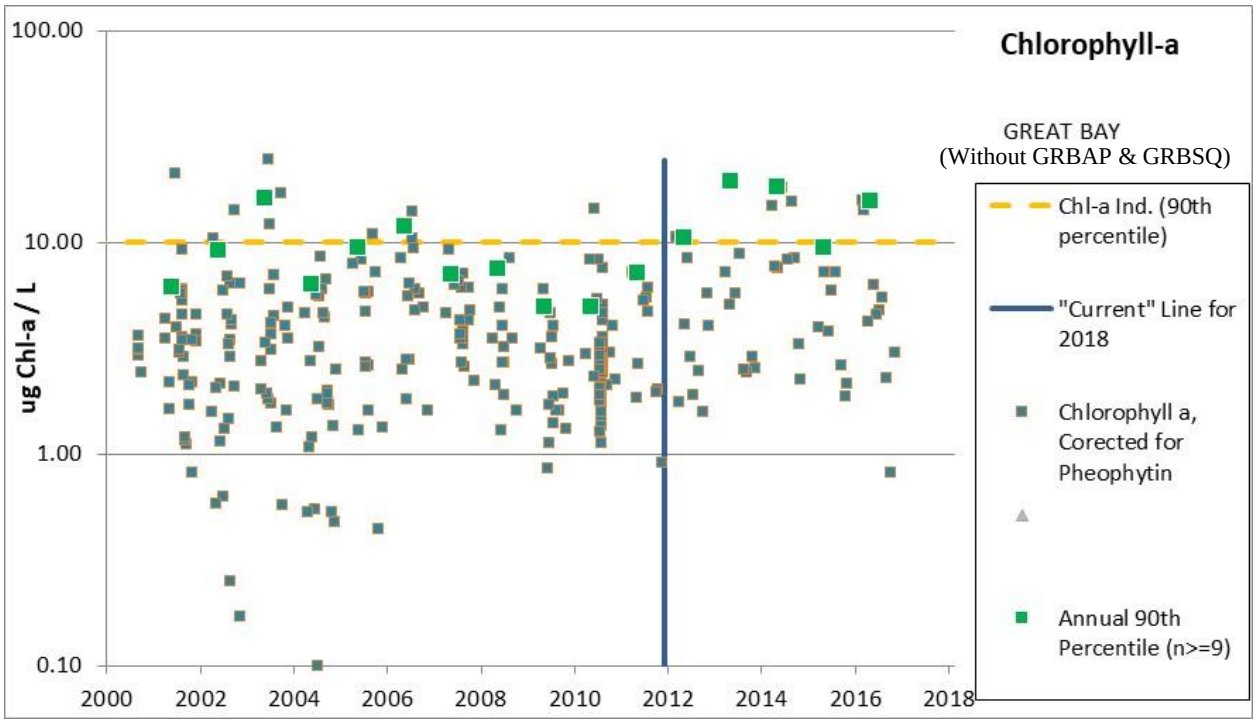

TSS
GREAT BAY
TSS (mg/L)
1,000
100
10
1
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
"Current" Line for 2018
TSS
Annual Median (TSS) (n>=5)

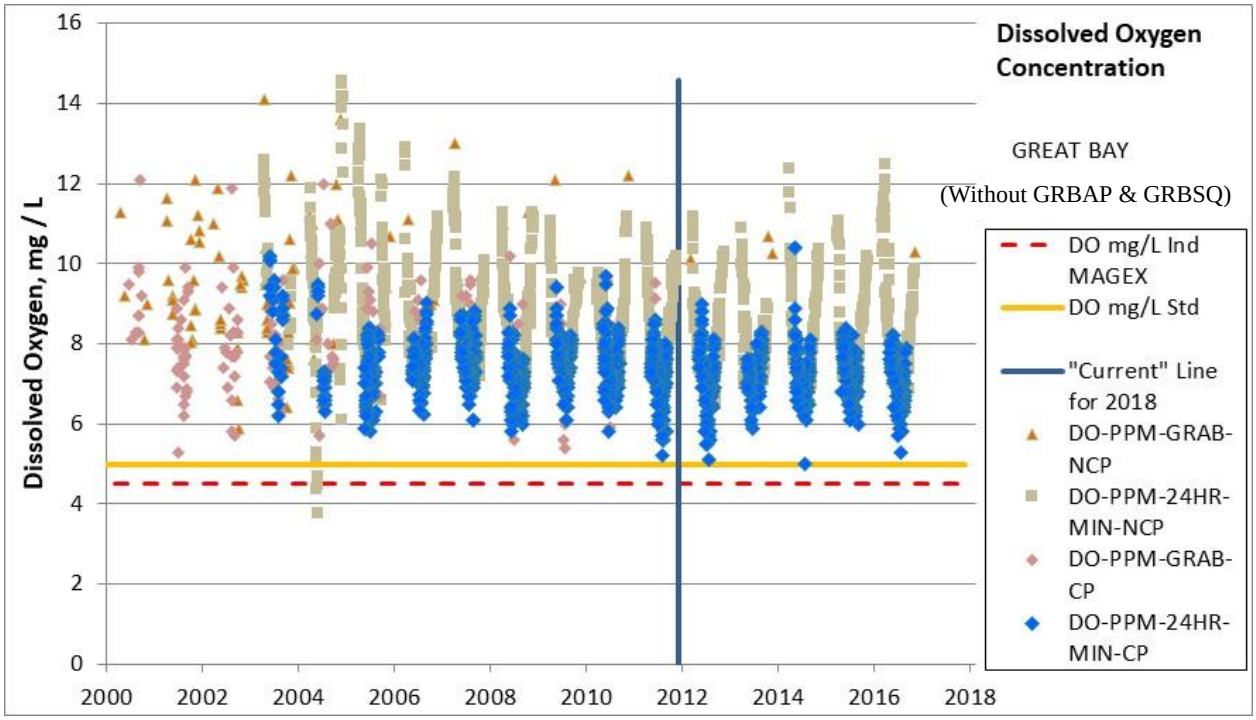

Light Attenuation
GREAT BAY
Kd 1 / m (PAR) (lower is better)
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Min. for Survival Indicator (median)
"Current" Line for 2018
Light Attenuation Coefficient (Kd)
Annual Median (Light)(n>=5)

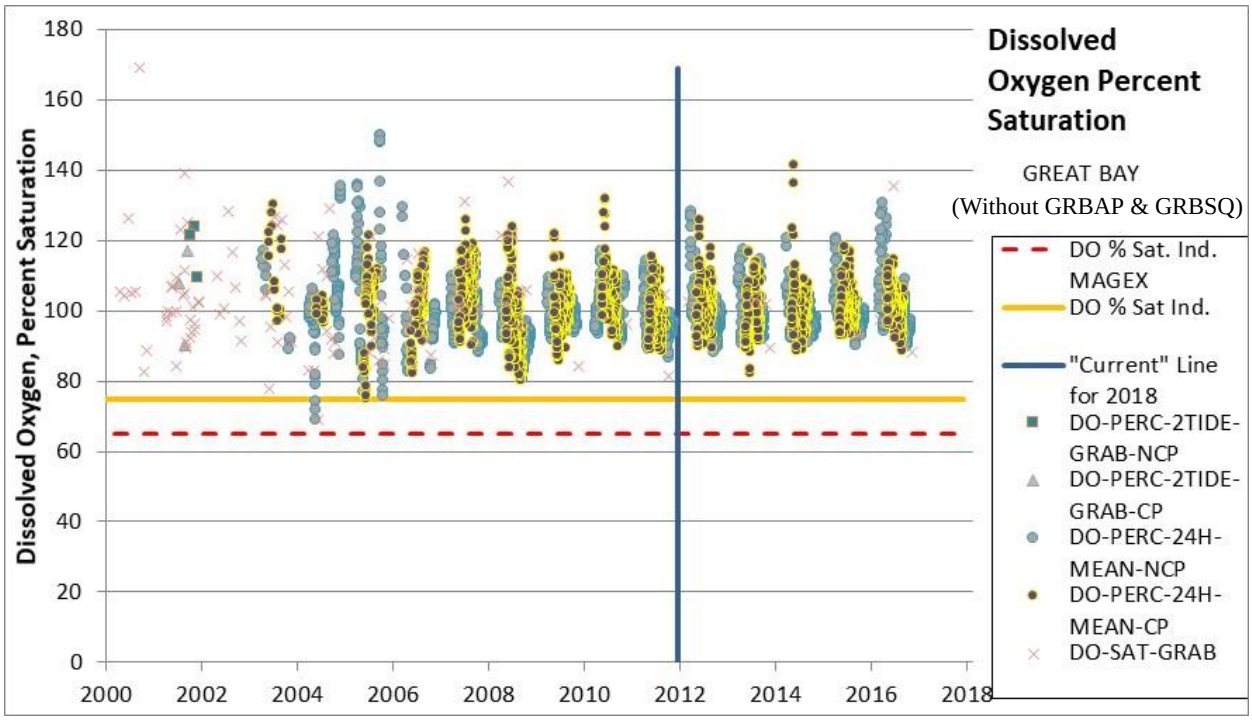

Eelgrass and Light Attenuation
GREAT BAY
Kd 1 / m (PAR) (lower is better)
Eelgrass Cover (acres)
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
3,000
2,500
2,000
1,500
1,000
500
0
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Min. for Survival Indicator (median)
"Current" Line for 2018
Light Attenuation Coefficient (Kd)
Annual Median (Light)(n>=5)
Eelgrass Cover

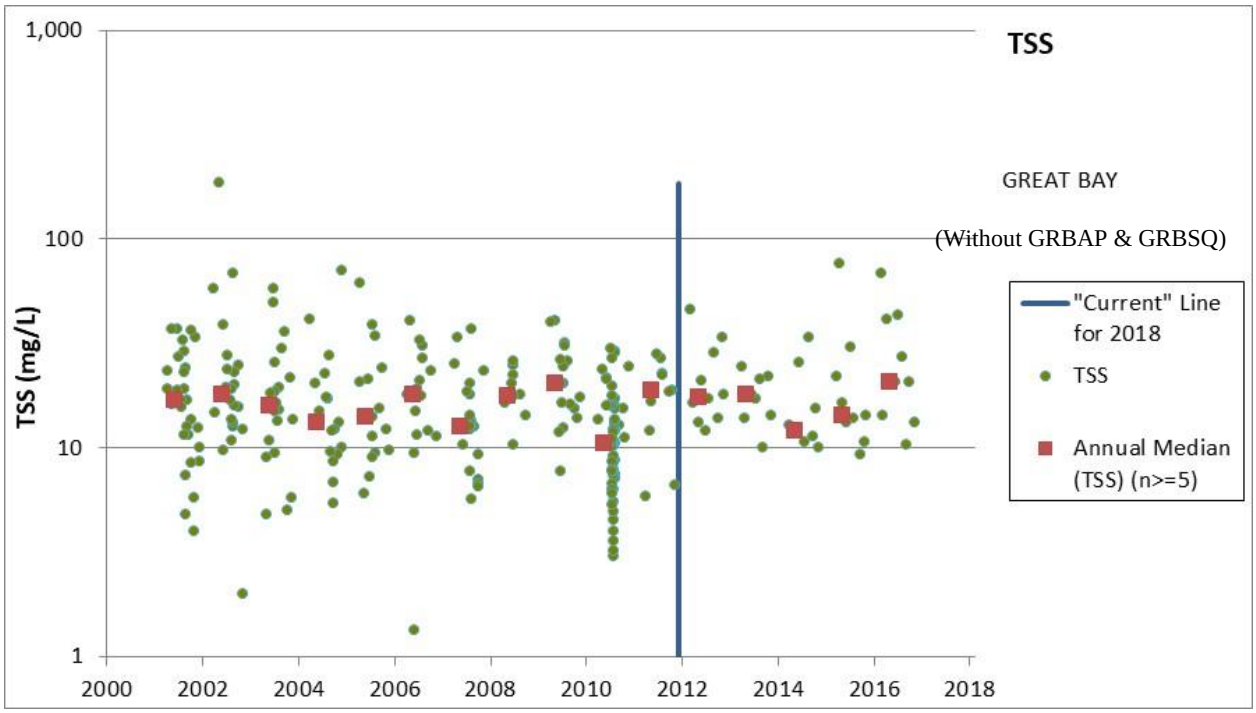

Total Nitrogen
GREAT BAY
Total Nitrogen (ug N/L)
1,600
1,400
1,200
1,000
800
600
400
200
0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
"Current" Line for 2018
Day Ave of TN
TN Annual Median (n>=5)

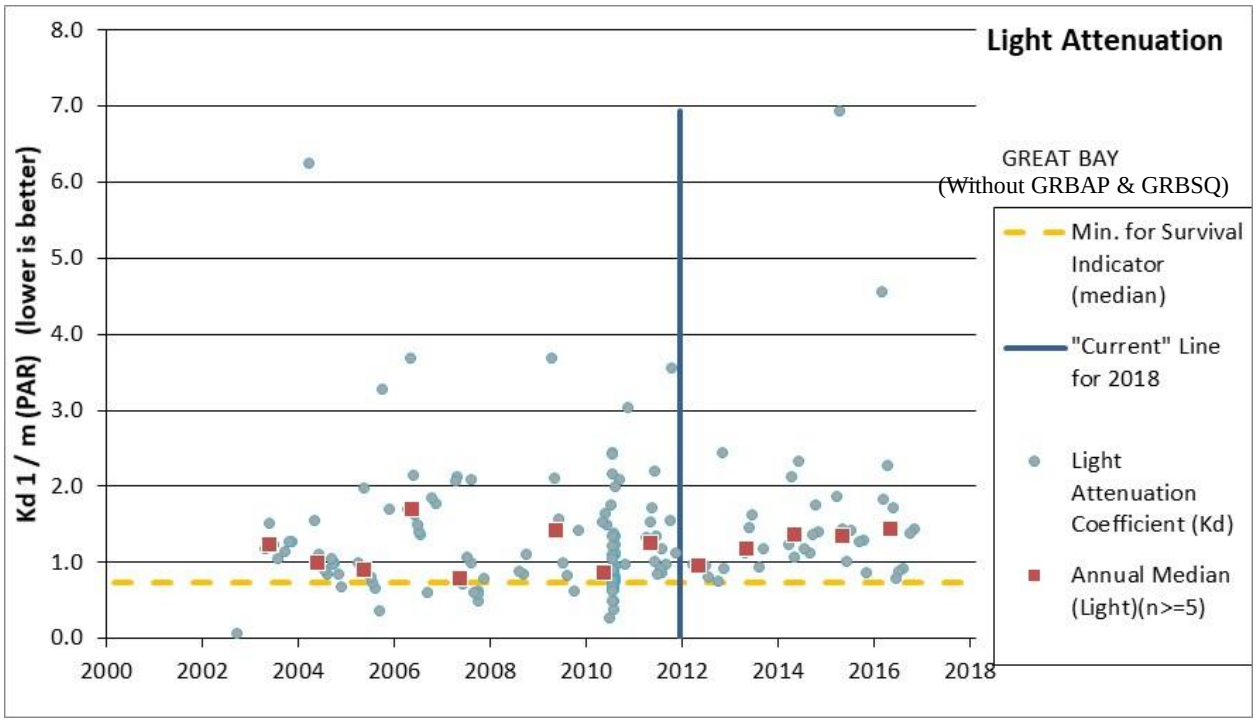

Chlorophyll-a
GREAT BAY
(Without GRBAP & GRBSQ)
ug Chl-a / L
30
25
20
15
10
5
0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Chl-a Ind. (90th percentile)
"Current" Line for 2018
Chlorophyll a, Corected for Pheophytin
Annual 90th Percentile (n>=9)

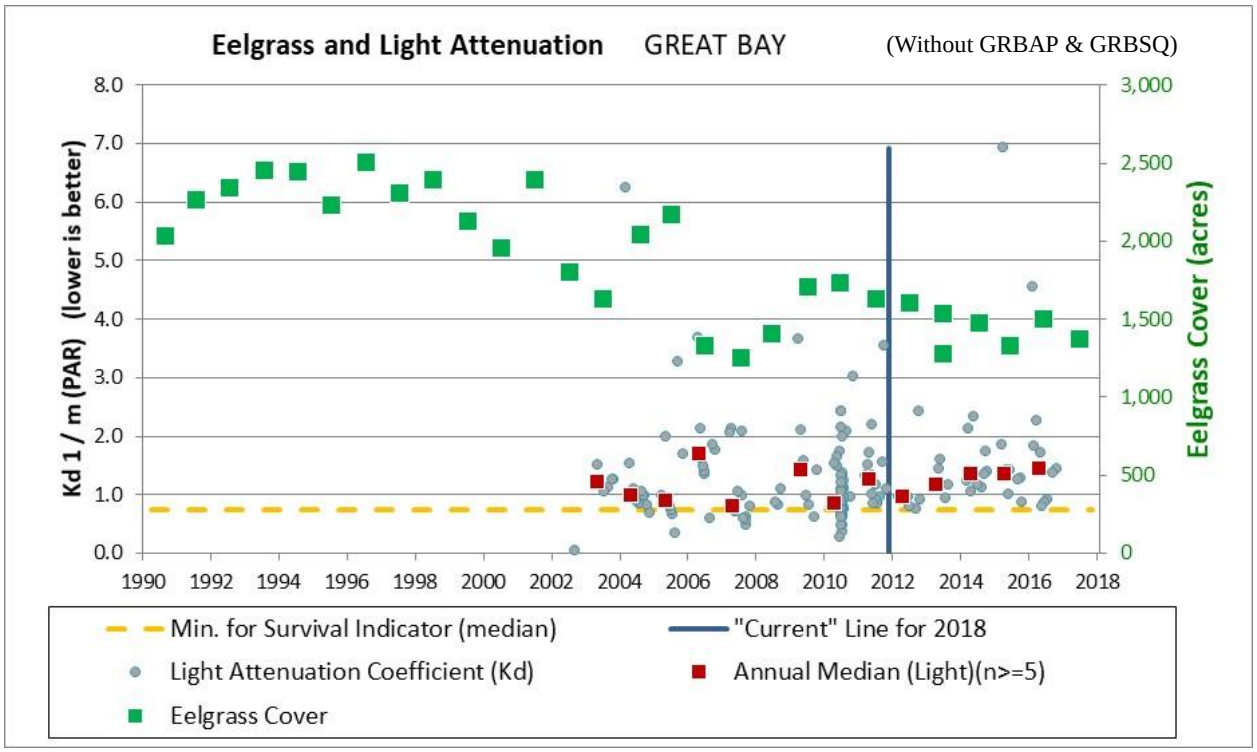

Chlorophyll-a
GREAT BAY
(Without GRBAP & GRBSQ)
ug Chl-a / L
100.00
10.00
1.00
0.10
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Chl-a Ind. (90th percentile)
"Current" Line for 2018
Chlorophyll a, Corected for Pheophytin
Annual 90th Percentile (n>=9)

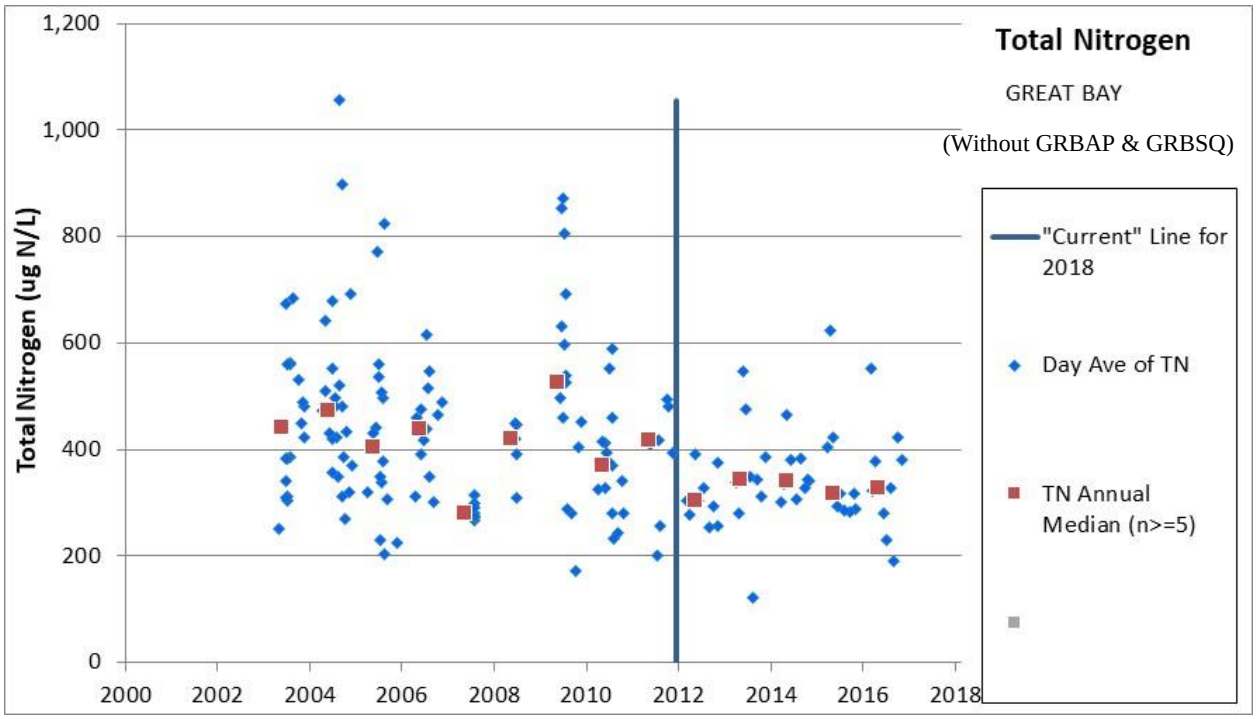

Dissolved Oxygen Concentration
GREAT BAY
(Without GRBAP & GRBSQ)
Dissolved Oxygen, mg / L
16
14
12
10
8
6
4
2
0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
DO mg/L Ind MAGEX
DO mg/L Std
"Current" Line for 2018
DO-PPM-GRAB-NCP
DO-PPM-24HR-MIN-NCP
DO-PPM-GRAB-CP
DO-PPM-24HR-MIN-CP


Dissolved Oxygen Percent Saturation
GREAT BAY
(Without GRBAP & GRBSQ)
Dissolved Oxygen, Percent Saturation
180
160
140
120
100
80
60
40
20
0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
DO % Sat. Ind. MAGEX
DO % Sat Ind.
"Current" Line for 2018
DO-PERC-2TIDE-GRAB-NCP
DO-PERC-2TIDE-GRAB-CP
DO-PERC-24H-MEAN-NCP
DO-PERC-24H-MEAN-CP
DO-SAT-GRAB


TSS
GREAT BAY
(Without GRBAP & GRBSQ)
TSS (mg/L)
1,000
100
10
1
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
"Current" Line for 2018
TSS
Annual Median (TSS) (n>=5)


Light Attenuation
GREAT BAY
(Without GRBAP & GRBSQ)
Kd 1 / m (PAR) (lower is better)
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Min. for Survival Indicator (median)
"Current" Line for 2018
Light Attenuation Coefficient (Kd)
Annual Median (Light)(n>=5)


Eelgrass and Light Attenuation
GREAT BAY
(Without GRBAP & GRBSQ)
Kd 1 / m (PAR) (lower is better)
Eelgrass Cover (acres)
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
3,000
2,500
2,000
1,500
1,000
500
0
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Min. for Survival Indicator (median)
"Current" Line for 2018
Light Attenuation Coefficient (Kd)
Annual Median (Light)(n>=5)
Eelgrass Cover



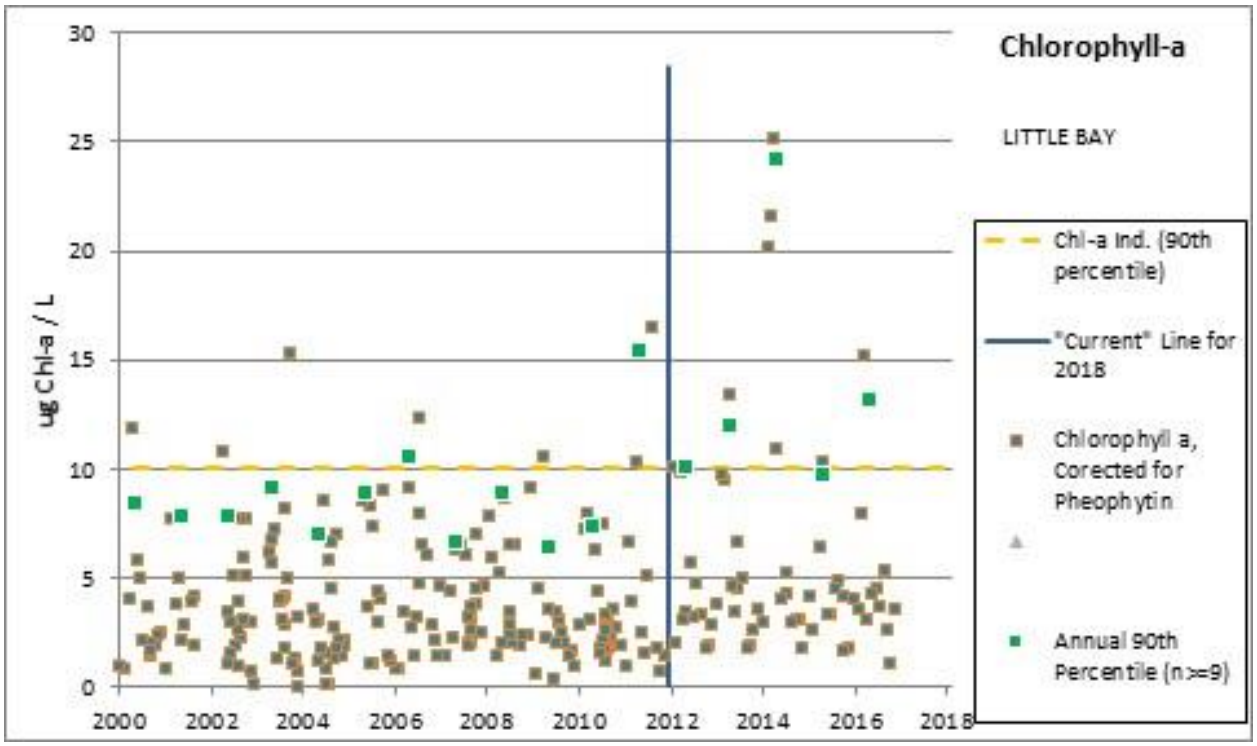
Great Bay Assessment Zone (1/1/2012-5/25/2018)	Count	Minimum	Median	90th Percentile	Maximum
CHLOROPHYLL A, CORRECTED FOR PHEOPHYTIN (µg/L)	154	0.8	4.3	10.5	28.7
CHLOROPHYLL A, UNCORRECTED FOR PHEOPHYTIN (µg/L)	0	-	-	-	-
CHLOROPHYLL A, Combined (µg/L)	154	0.8	4.3	10.5	28.7
LIGHT ATTENUATION COEFFICIENT (1/m)	124	0.480	1.460	3.425	7.050
TURBIDITY (NTU)	2,176	0.0	8.0	26.0	1,126.5
COLORED DISSOLVED ORGANIC MATTER (CDOM) (1/m)	0	-	-	-	-
TSS (mg/L)	153	6.6	19.3	43.1	148.6
DO-PPM-24HR-MIN-CP (mg/L)	1,126	2.4	6.5	7.8	10.4
DO-PPM-24HR-MIN-NCP (mg/L)	1,109	3.3	8.6	10.5	12.5
DO-PPM-GRAB-CP (mg/L)	19	5.7	7.3	8.6	8.9
DO-PPM-GRAB-NCP (mg/L)	47	7.5	10.3	13.1	14.0
DO-PERC-24H-MEAN-CP (% sat)	1,106	65.4	97.1	107.9	152.0
DO-PERC-24H-MEAN-NCP (% sat)	1,080	77.9	96.1	106.8	130.7
DO-PERC-2TIDE-GRAB-CP (% sat)	18	52.2	96.6	113.6	115.2
DO-PERC-2TID-GRAB-NCP (% sat)	39	87.1	97.0	114.3	118.9
DO-PERC-GRAB (% sat)	12	82.5	97.8	125.9	135.6
Day Ave of TN (µg N/L)	150	122	358	770	1,376
Day Ave of TDN (µg N/L)	155	50	252	604	896
Day Ave of DIN (NH3 + NO2/3) (µg N/L)	155	5	122	392	616
Day Ave of NH3 (µg N/L)	155	3	35	221	408
Day Ave of PON (µg N/L)	0	-	-	-	-
Day Ave of NO2/3 (µg N/L)	155	3	83	194	469
SALINITY-Grabs (pss)	583	0	23	28	31
SALINITY-Datalogger Daily Median (pss)	2,244	6	25	30	32

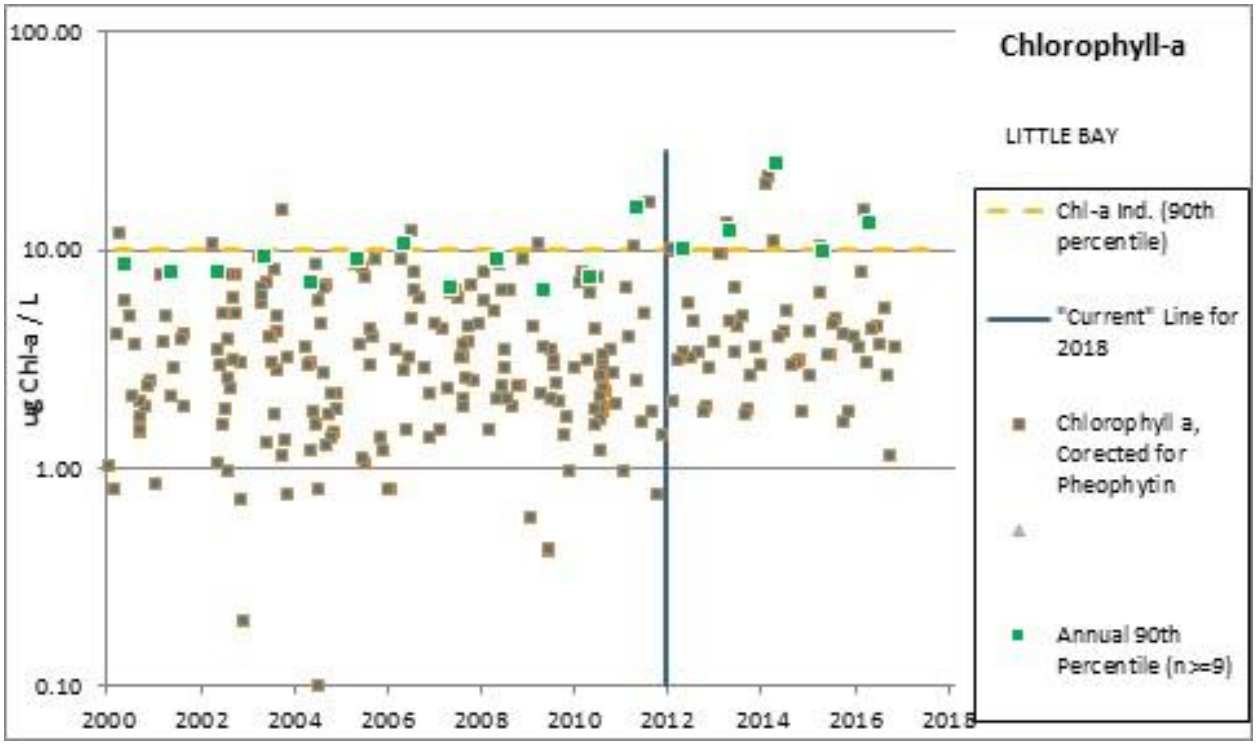
Great Bay Assessment Zone (Without GRBAP & GRBSQ) (1/1/2012-5/25/2018)	**Count**	**Minimum**	**Median**	**90th Percentile**	**Maximum**
CHLOROPHYLL A, CORRECTED FOR PHEOPHYTIN (µg/L)	47	0.8	4.8	15.1	19.4
CHLOROPHYLL A, UNCORRECTED FOR PHEOPHYTIN (µg/L)	0	-	-	-	-
CHLOROPHYLL A, Combined (µg/L)	47	0.8	4.8	15.1	19.4
LIGHT ATTENUATION COEFFICIENT (1/m)	38	0.760	1.285	2.350	6.940
TURBIDITY (NTU)	1,033	0.0	5.0	10.0	1,126.5
COLORED DISSOLVED ORGANIC MATTER (CDOM) (1/m)	0	-	-	-	-
TSS (mg/L)	47	9.3	17.1	41.7	76.4
DO-PPM-24HR-MIN-CP (mg/L)	531	5.0	7.2	8.0	10.4
DO-PPM-24HR-MIN-NCP (mg/L)	514	6.5	8.8	10.4	12.5
DO-PPM-GRAB-CP (mg/L)	0	-	-	-	-
DO-PPM-GRAB-NCP (mg/L)	5	10.1	10.3	-	11.2
DO-PERC-24H-MEAN-CP (% sat)	516	82.2	101.3	110.4	141.7
DO-PERC-24H-MEAN-NCP (% sat)	497	88.2	98.4	112.3	130.7
DO-PERC-2TIDE-GRAB-CP (% sat)	0	-	-	-	-
DO-PERC-2TIDE-GRAB-NCP (% sat)	0	-	-	-	-
DO-PERC-GRAB (% sat)	8	88.2	99.7	-	135.6
Day Ave of TN (µg N/L)	46	122	329	467	624
Day Ave of TDN (µg N/L)	47	50	205	333	373
Day Ave of DIN (NH3 + NO2/3) (µg N/L)	47	5	59	172	275
Day Ave of NH3 (µg N/L)	47	3	16	58	73
Day Ave of PON (µg N/L)	0	-	-	-	-
Day Ave of NO2/3 (µg N/L)	47	3	29	120	246
SALINITY-Grabs (pss)	446	0.3	23.2	28.2	31
SALINITY-Datalogger Daily Median (pss)	1054	6.1	26.9	30.7	32.2

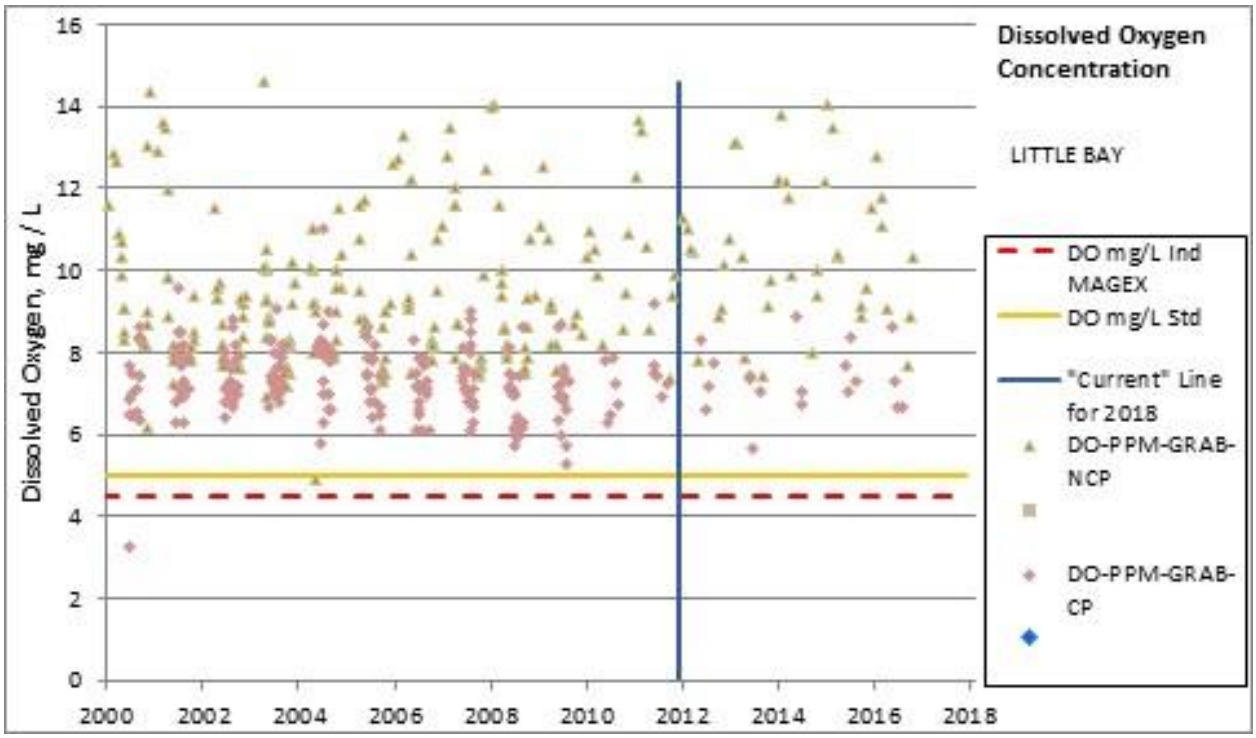
Assessment Zone = LITTLE BAY

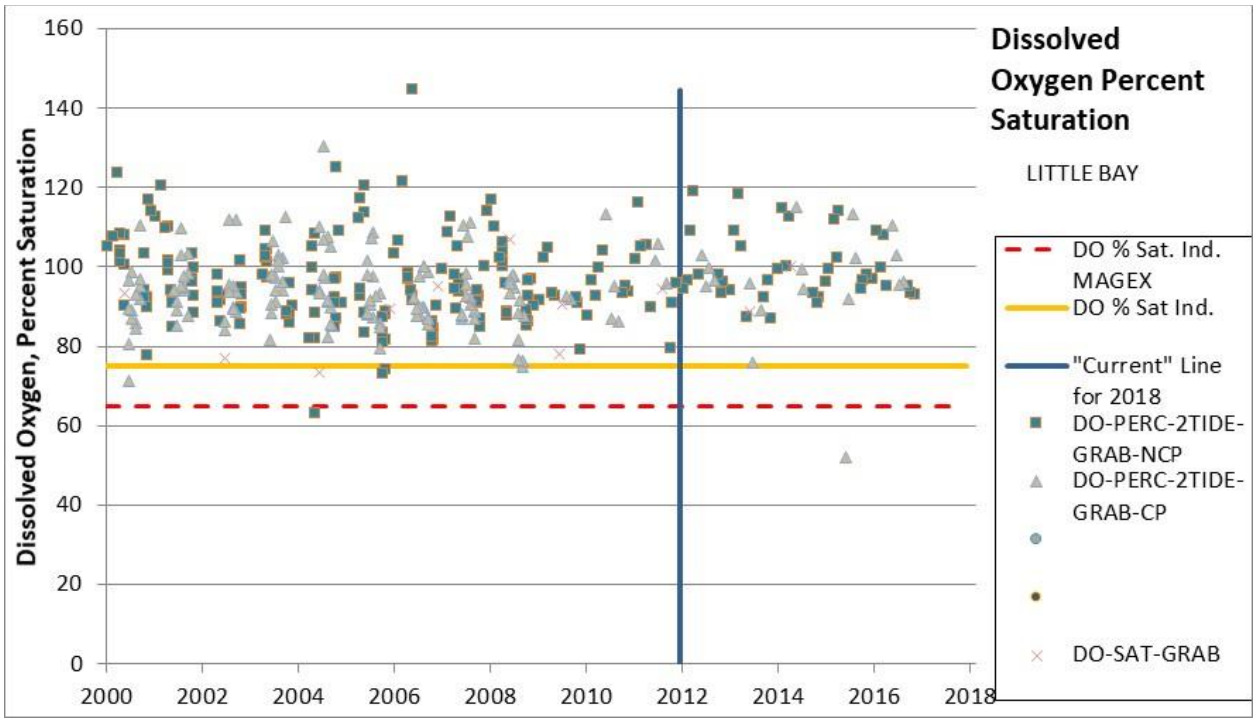
(NHEST600030904-06-10, NHEST600030904-06-11, NHEST600030904-06-12, NHEST600030904-06-14, NHEST600030904-06-15, NHEST600030904-06-18, NHEST600030904-06-19)

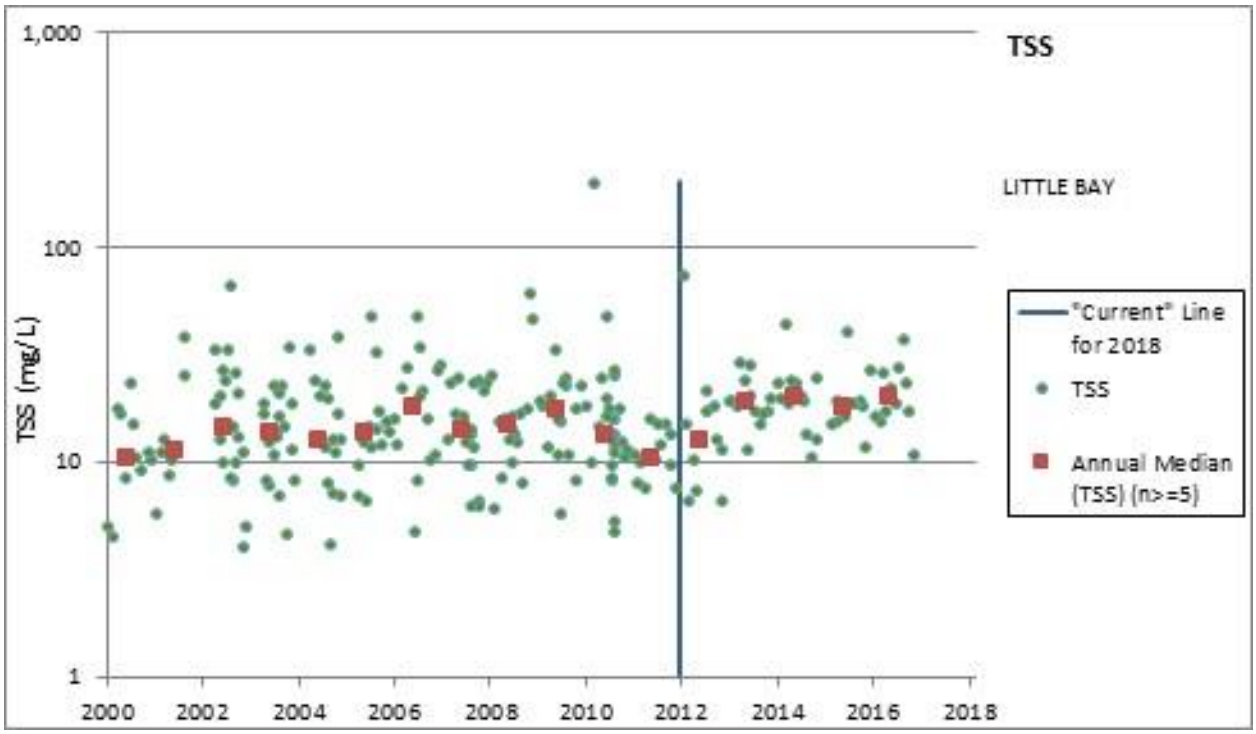
Indicator	Aquatic Life Use Category 2016 / 2018	2018 Comment
Chlorophyll-a	3-PNS / 3-PNS	The calculated 90th percentile chlorophyll-a in this assessment zone is 10.9 µg/L (n = 60) and a maximum reading of 25.2 µg/L. The chlorophyll-a indicator threshold to prevent low dissolved oxygen is a 90th percentile below 10 µg/L. As chlorophyll-a is now close to the assessment threshold and dissolved oxygen is acceptable in Little Bay, chlorophyll-a has been assessed as Insufficient Information – Potentially Not Supporting.
Dissolved Oxygen (mg/L)	2-G / 2-G	This assessment zone does not have a datalogger, only surface (0.5m below surface) grab sample measurements (GRBAP) for dissolved oxygen concentration and those measurements have been collected from 2012 through 2016. The available data indicates that this assessment zone meets the dissolved oxygen concentration criteria.
Dissolved Oxygen (% Saturation)	2-G / 3-PAS	Full-support or non-support determinations are no longer made for dissolved oxygen percent saturation due to SB127 in 2017 amending three sections of RSA 485. This assessment zone does not have a datalogger, so only high-tide/low-tide paired surface (0.5m below surface) grab sample measurements (GRBAP) can be used to evaluate against the dissolved oxygen 24-hour average percent saturation indicator. Those measurements have been collected from 2012 through 2016 yielding rare grab samples at or below 75%. The weight of the available data indicates that this assessment zone meets the dissolved oxygen percent saturation indicator.
Estuarine Bioassessments (eelgrass)	5-P / 5-P	The historical extent of eelgrass in this assessment zone was 252 acres from the 1948, 1962, 1980, and 1981 datasets. The median current extent of eelgrass in 2015-2017 is 1.7 acres, which is a decrease of 99.3%. There is no significant trend in eelgrass cover in this assessment zone since 1990. The thresholds for impairment are either loss of more than 20% of the historic extent of eelgrass or a recent trend of greater than 20% loss.
Water Clarity (Light Attenuation Coefficient)	5-M / 5-M	Median=1.055 m^-1 (n=45). For an eelgrass restoration depth of 2 m, the light attenuation coefficient threshold is 0.75 m^-1. This assessment zone historically had eelgrass growing in both the shallows and deeper habitat making the 2m restoration depth a valid target. Therefore, the impaired (5-M) listing from the 2016 303d list has been retained.
Total Nitrogen	3-PNS / 3-PNS	The median total nitrogen from 2012 through 2016 was 307 µg/L (n=58). Based exclusively on grab samples, the measurements in this assessment zone do not demonstrate dissolved oxygen concentration exceedences and there were only occasional grab samples at or below 75% saturation. The calculated 90th percentile chlorophyll-a in this assessment zone is 10.9 µg/L (n = 60) and a maximum reading of 25.2 µg/L. Chlorophyll-a is just above the threshold described in the CALM but dissolved oxygen problems are not evident in the Little Bay dissolved oxygen data. The eelgrass beds are severely degraded (99% reduction from historic) and the available light attenuation (median=1.055 m^-1 (n=45)) is poor. For shallow systems, it is expected that changes in macroalgae will precede changes in phytoplankton (McGlathery, Sundbäck, & Anderson, 2007) (Valiela, et al., 1997), as appears to be occurring in the Great Bay Estuary. Burdick et al. (Burdick, Mathieson, Peter, & Sydney, 2016) note that, "Monitoring results from 2014 show high levels of cover of nuisance green and red algae (*Ulva* and *Gracilaria*, respectively) at all sites except near the mouth of the Estuary." That study included several sites within Little Bay. At this time there are some of the classic indicators of nutrient eutrophication present in this assessment zone. However, there are insufficient response datasets leading to the determine that eutrophication by total nitrogen is alone is not known to be strong enough to warrant impairment under New Hampshire's narrative standard. As such, this assessment zone has been assessed as Insufficient Information – Potentially Not Supporting (3-PNS) for total nitrogen.

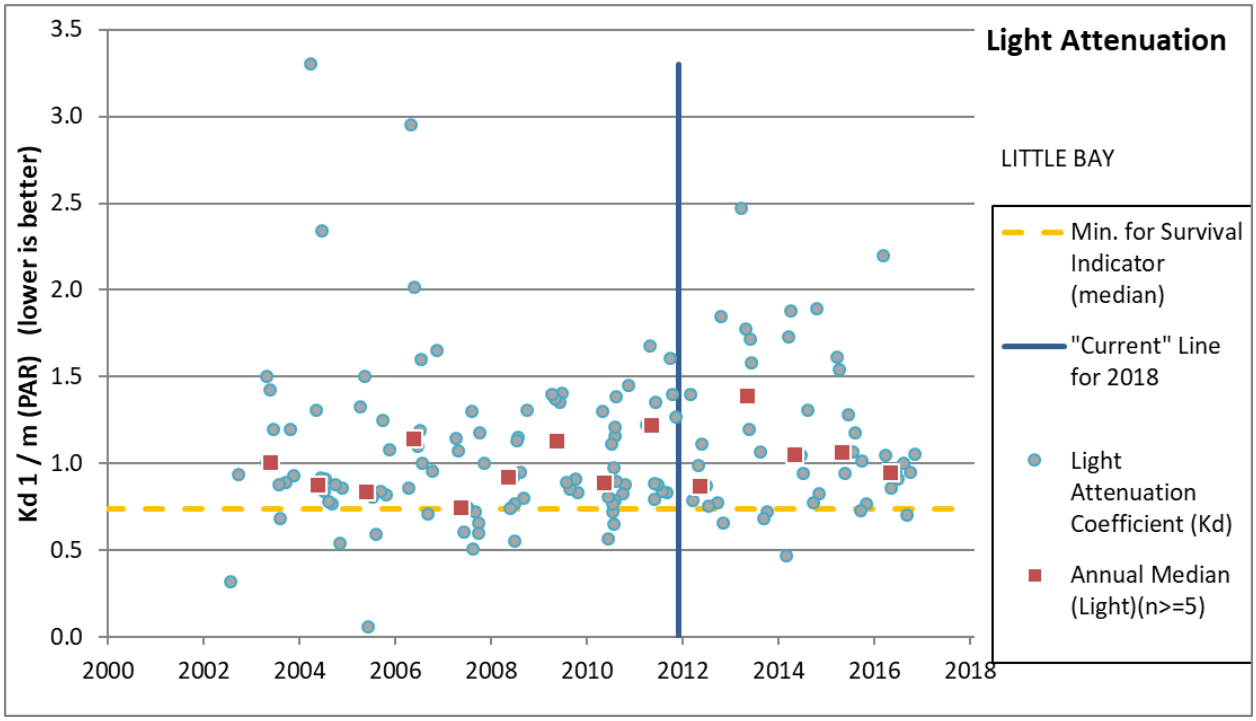

Chlorophyll-a
LITTLE BAY
ug Chl-a / L
30
25
20
15
10
5
0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Chl-a Ind. (90th percentile)
"Current" Line for 2018
Chlorophyll a, Corected for Pheophytin
Annual 90th Percentile (n>=9)

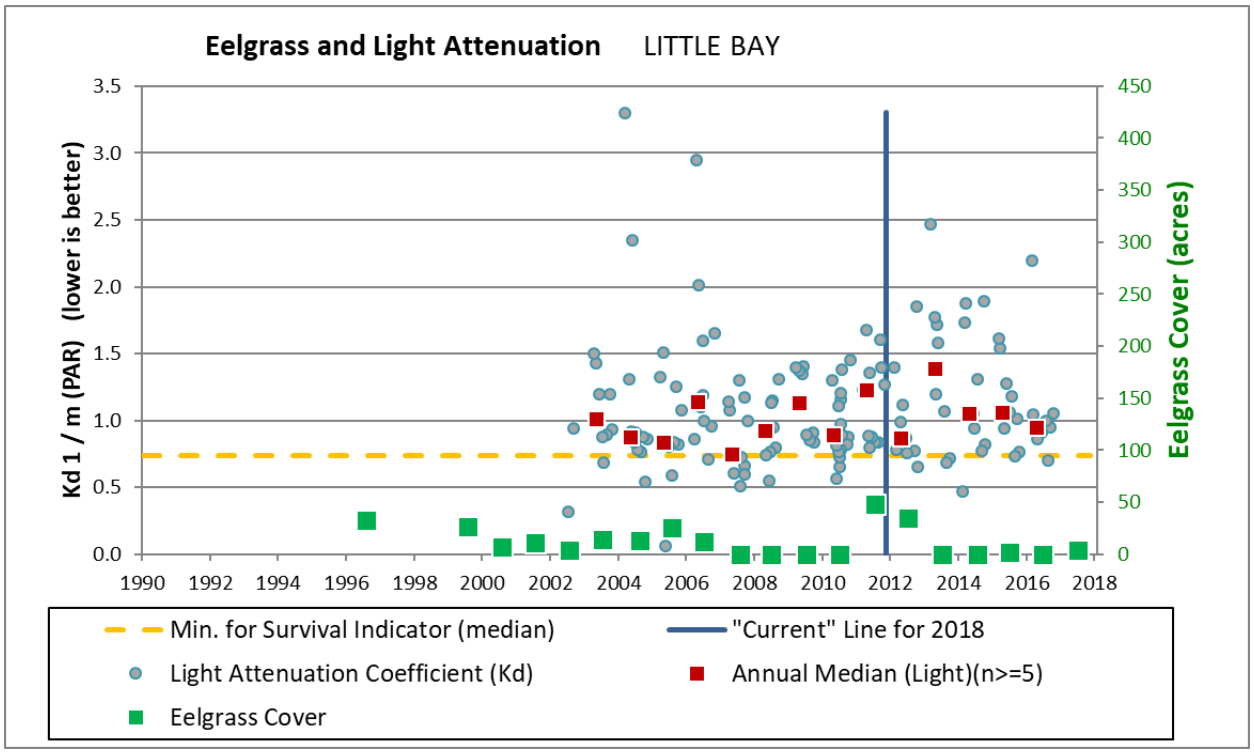

Chlorophyll-a
LITTLE BAY
ug Chl-a / L
100.00
10.00
1.00
0.10
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Chl-a Ind. (90th percentile)
"Current" Line for 2018
Chlorophyll a, Corected for Pheophytin
Annual 90th Percentile (n>=9)

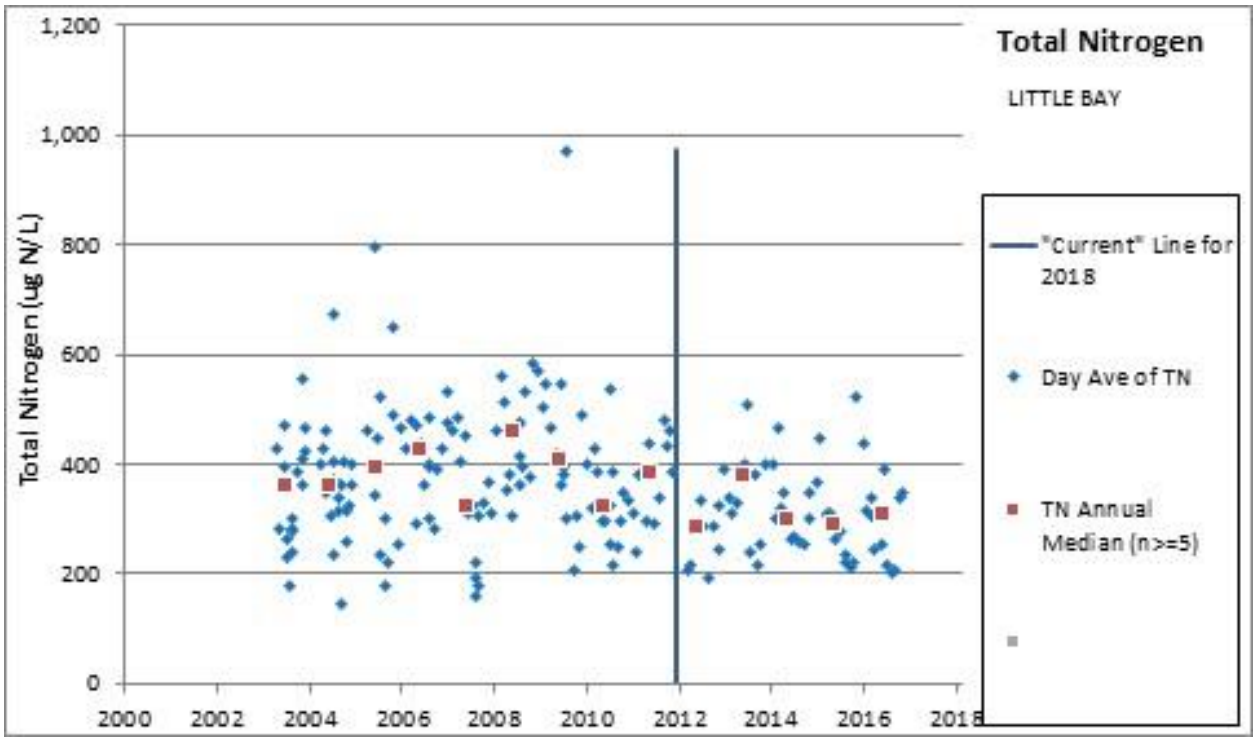

Dissolved Oxygen Concentration
LITTLE BAY
Dissolved Oxygen, mg / L
DO mg/L Ind MAGEX
DO mg/L Std
"Current" Line for 2018
DO-PPM-GRAB-NCP
DO-PPM-GRAB-CP


Dissolved Oxygen Percent Saturation
LITTLE BAY
Dissolved Oxygen, Percent Saturation
DO % Sat. Ind. MAGEX
DO % Sat Ind.
"Current" Line for 2018
DO-PERC-2TIDE-GRAB-NCP
DO-PERC-2TIDE-GRAB-CP
DO-SAT-GRAB


TSS
LITTLE BAY
TSS (mg/L)
1,000
100
10
1
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
"Current" Line for 2018
TSS
Annual Median (TSS) (n>=5)


Light Attenuation
LITTLE BAY
Kd 1 / m (PAR) (lower is better)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Min. for Survival Indicator (median)
"Current" Line for 2018
Light Attenuation Coefficient (Kd)
Annual Median (Light)(n>=5)


Eelgrass and Light Attenuation
LITTLE BAY
Kd 1 / m (PAR) (lower is better)
Eelgrass Cover (acres)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
450
400
350
300
250
200
150
100
50
0
1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016 2018
Min. for Survival Indicator (median)
"Current" Line for 2018
Light Attenuation Coefficient (Kd)
Annual Median (Light)(n>=5)
Eelgrass Cover

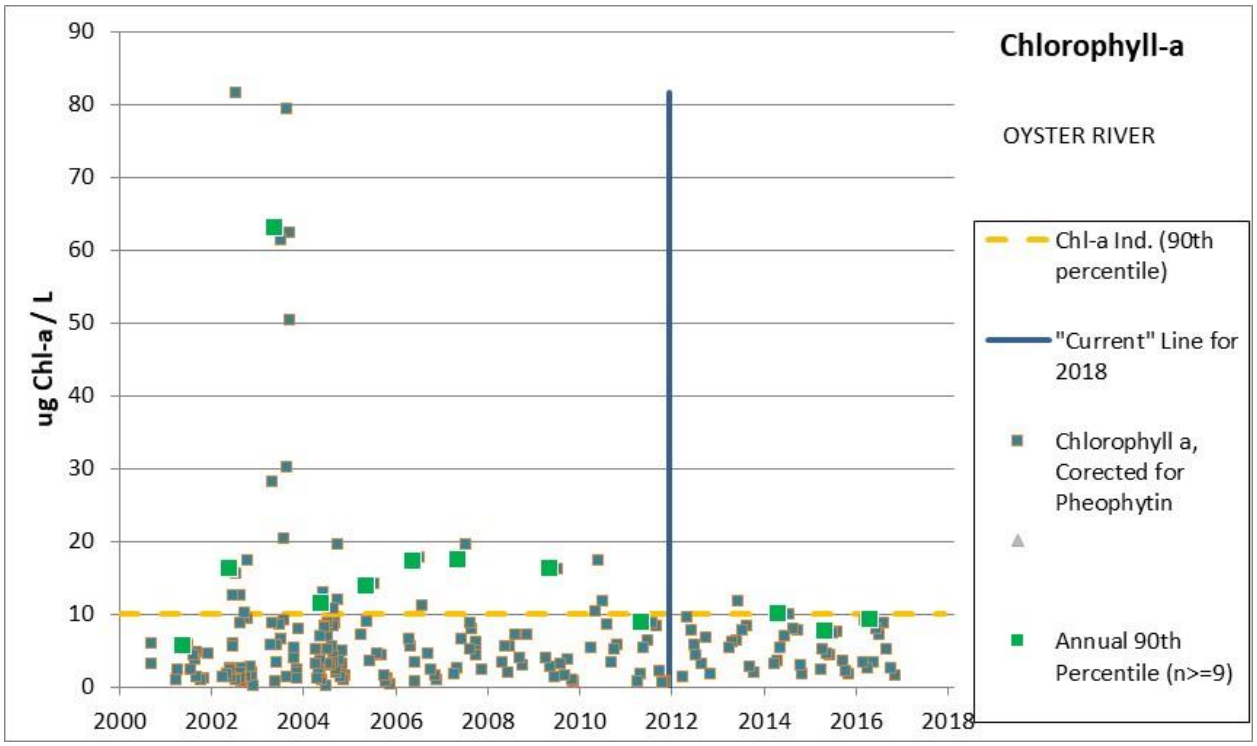

Total Nitrogen
LITTLE BAY
Total Nitrogen (ug N/L)
1,200
1,000
800
600
400
200
0
2000 2002 2004 2006 2008 2010 2012 2014 2016 2018
"Current" Line for 2018
Day Ave of TN
TN Annual Median (n>=5)

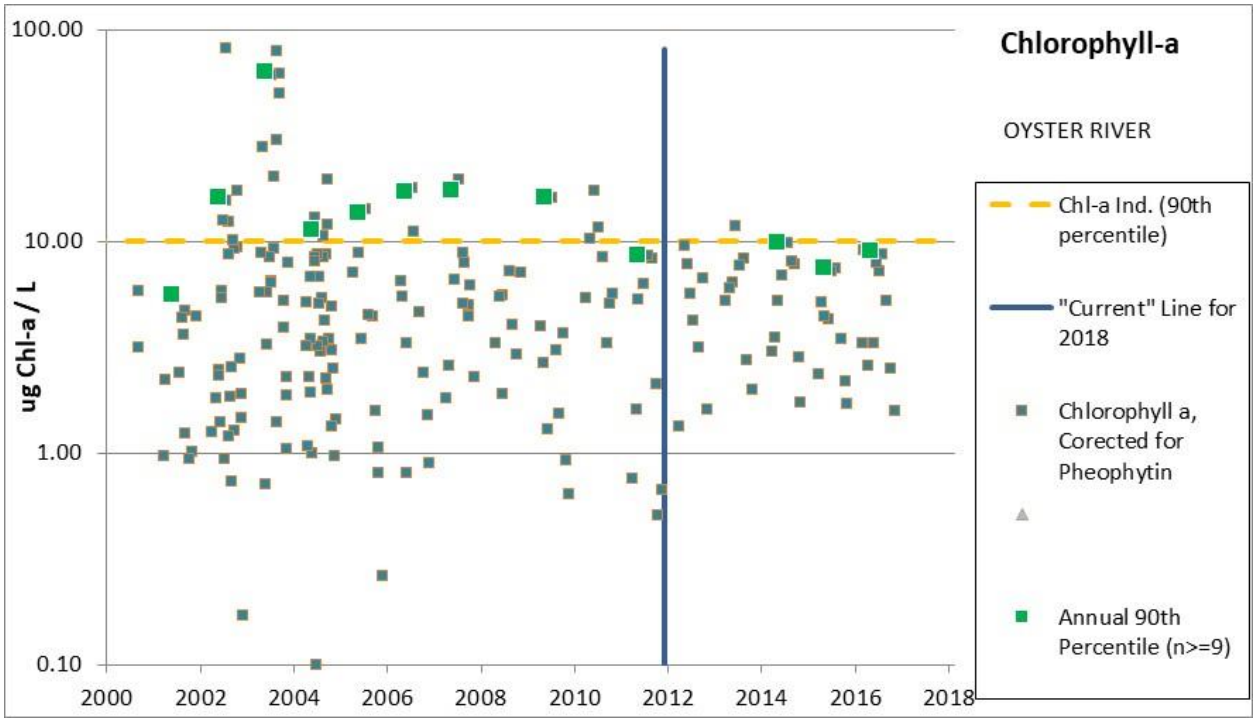
Little Bay Assessment Zone (1/1/2012-5/25/2018)	**Count**	**Minimum**	**Median**	**90th Percentile**	**Maximum**
CHLOROPHYLL A, CORRECTED FOR PHEOPHYTIN (µg/L)	60	1.2	3.9	10.9	25.2
CHLOROPHYLL A, UNCORRECTED FOR PHEOPHYTIN (µg/L)	0	-	-	-	-
CHLOROPHYLL A, Combined (µg/L)	60	1.2	3.9	10.9	25.2
LIGHT ATTENUATION COEFFICIENT (1/m)	45	0.480	1.055	1.872	2.480
TURBIDITY (NTU)	0	-	-	-	-
COLORED DISSOLVED ORGANIC MATTER (CDOM) (1/m)	0	-	-	-	-
TSS (mg/L)	59	6.6	18.6	28.6	73.1
DO-PPM-24HR-MIN-CP (mg/L)	0	-	-	-	-
DO-PPM-24HR-MIN-NCP (mg/L)	0	-	-	-	-
DO-PPM-GRAB-CP (mg/L)	19	5.7	7.3	8.6	8.9
DO-PPM-GRAB-NCP (mg/L)	40	7.5	10.3	13.1	14.0
DO-PERC-24H-MEAN-CP (% sat)	0	-	-	-	-
DO-PERC-24H-MEAN-NCP (% sat)	0	-	-	-	-
DO-PERC-2TIDE-GRAB-CP (% sat)	18	52.2	96.6	113.6	115.2
DO-PERC-2TIDE-GRAB-NCP (% sat)	39	87.1	97.0	114.3	118.9
DO-PERC-GRAB (% sat)	2	89	95	-	100
Day Ave of TN (µg N/L)	58	194	307	404	524
Day Ave of TDN (µg N/L)	61	128	196	324	479
Day Ave of DIN (NH3 + NO2/3) (µg N/L)	61	8	86	220	274
Day Ave of NH3 (µg N/L)	61	3	26	58	85
Day Ave of PON (µg N/L)	0	-	-	-	-
Day Ave of NO2/3 (µg N/L)	61	3	58	171	217
SALINITY-Grabs (pss)	531	7	25	29	32
SALINITY-Datalogger Daily Median (pss)	481	0	24	27	29

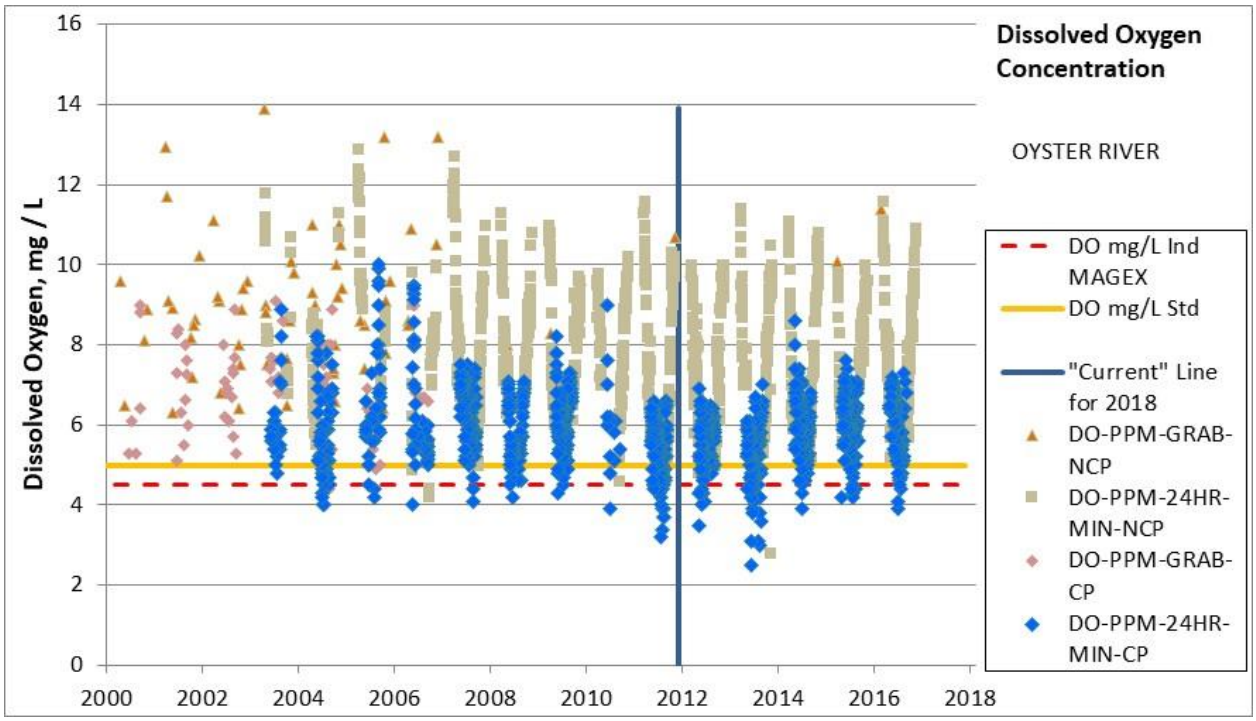
Assessment Zone = OYSTER RIVER

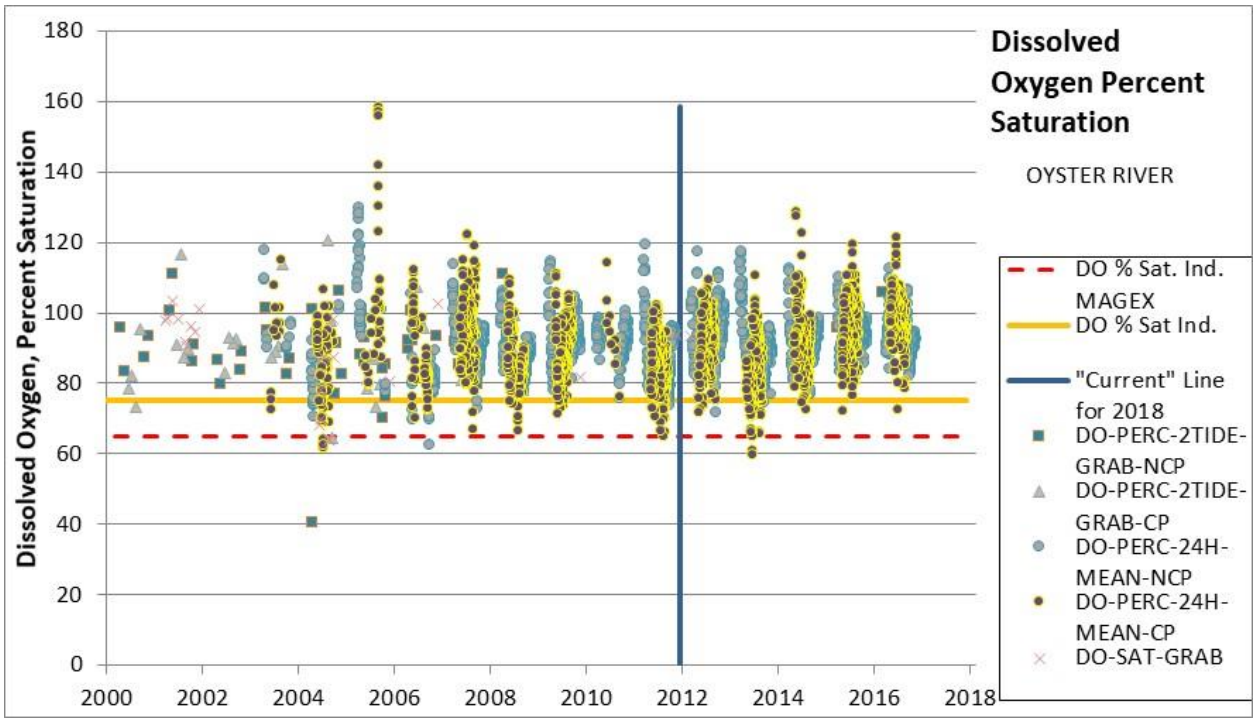
(NHEST600030902-01-03, NHEST600030904-06-17)

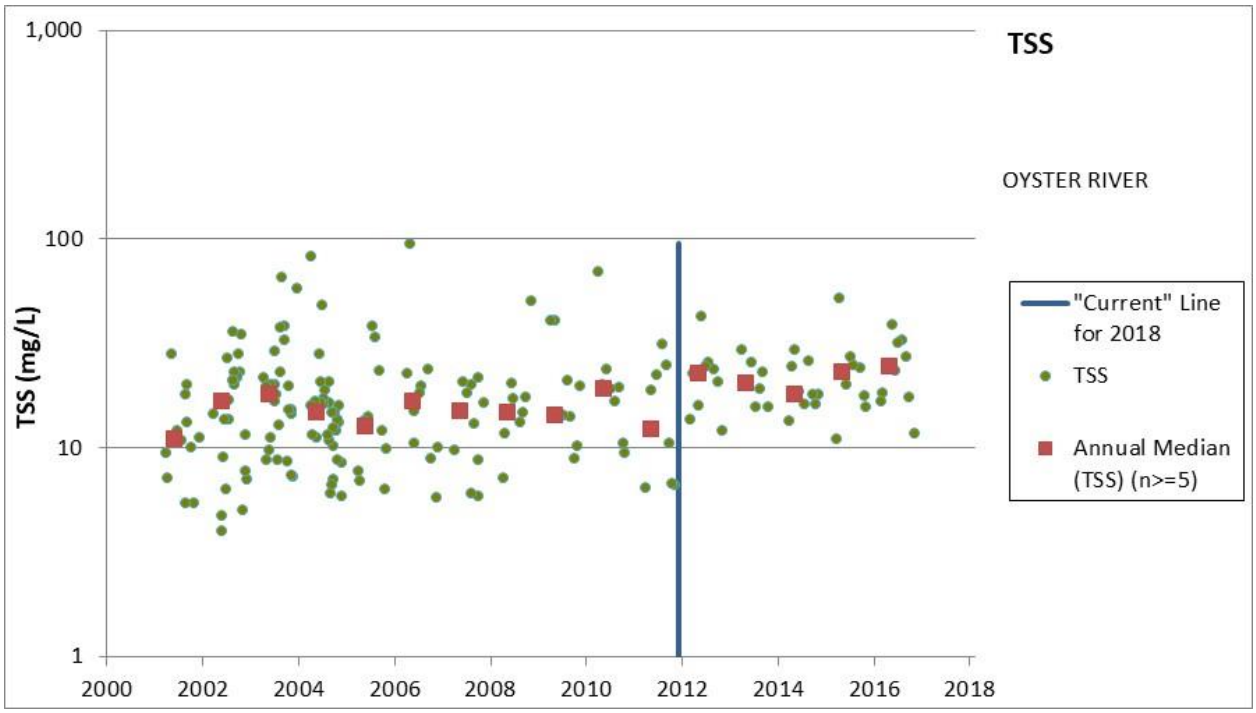
Indicator	Aquatic Life Use Category 2016 / 2018	2018 Comment
Chlorophyll-a	2-M / 2-M	The calculated 90th percentile chlorophyll-a in this assessment zone is 8.8 µg/L (n = 44) and a maximum reading of 11.8 µg/L. The chlorophyll-a indicator threshold to prevent low dissolved oxygen is a 90th percentile below 10 µg/L. Large Chlorophyll-a blooms have not occurred in the assessment unit for many years. Therefore, the assessment for chlorophyll a remains marginally fully supporting (2-M) for the 2018 assessment.
Dissolved Oxygen (mg/L)	5-P / 5-P	While the minimum dissolved oxygen concentration appears to be improving, dissolved oxygen concentration measurements in this assessment zone fall below the 5 mg/L criteria every year. In most years a portion of those measurements fall below 4 mg/L and in some years below 3 mg/L, therefore this impairment is considered severe.
Dissolved Oxygen (% Saturation)	5-P / 5-P	While the minimum dissolved oxygen saturation appears to be improving and while less than 10% of daily averages fall below 75% saturation (30 of 1,125 days), dissolved oxygen 24-hour average percent saturation measurements in this assessment zone do fall below the 75% indicator nearly every year. In one recent year (2013) a portion of those measurements fell below 65%, therefore this assessment zone has been assessed as potentially not supporting aquatic life based on the dissolved oxygen saturation indicator.
Estuarine Bioassessments (eelgrass)	5-P / 5-P	The historical extent of eelgrass in this assessment zone was 182.5 acres from the 1948 dataset. Some of eelgrass was found in 1996 (14 acres) and 2015 (2.4 acres). The median current extent of eelgrass in 2015-2017 is 0 acres, which is a decrease of 100%. Since 1990, the trend in eelgrass cover in this assessment zone could not be determined because the eelgrass cover has been zero for most years since 1981. The thresholds for impairment are either loss of more than 20% of the historic extent of eelgrass or a recent trend of greater than 20% loss.
Water Clarity (Light Attenuation Coefficient)	5-P / 5-P	Median=1.400 m^-1 (n=35). For an eelgrass restoration depth of 2 m, the light attenuation coefficient threshold is 0.75 m^-1. The recent mapping (2015 showed 2.4 acres, the first observed eelgrass since the 1996 mapping effort) showed eelgrass principally in the shallow areas. Older datasets had eelgrass growing in both the shallow and deeper habitat. The potential for the deeper habitat and the improved restoration potential provided by improved water clarity make the 2m restoration depth a valid target. Therefore, the impaired (5-P) listing from the 2016 303d list has been retained.
Total Nitrogen	5-P / 5-M	The median total nitrogen from 2012 through 2016 was 459 µg/L (n=43). This assessment zone experiences frequent dissolved oxygen concentrations well below 5 mg/L and, at times, below 3 mg/L. The daily average dissolved oxygen percent saturation falls below 75% nearly every year and in one recent year below 65%. During multiple years this assessment zone has also demonstrated super saturation over 125% including peak saturations of 167% (2016), 163% (2015), 191% (2014), 145% (2013), and 151% (2012). The chlorophyll-a concentration 90th percentile was 8.8 (n=44) from 2012 through 2016. The eelgrass beds are severely degraded and the available light attenuation (median=1.400 m^-1 (n=35)) is poor. The nearest POTW discharge is actively ratcheting down their nitrogen discharge but at this time many of the classic indicators of nutrient eutrophication are present in this assessment zone. As such, the impairment for nitrogen has been retained.

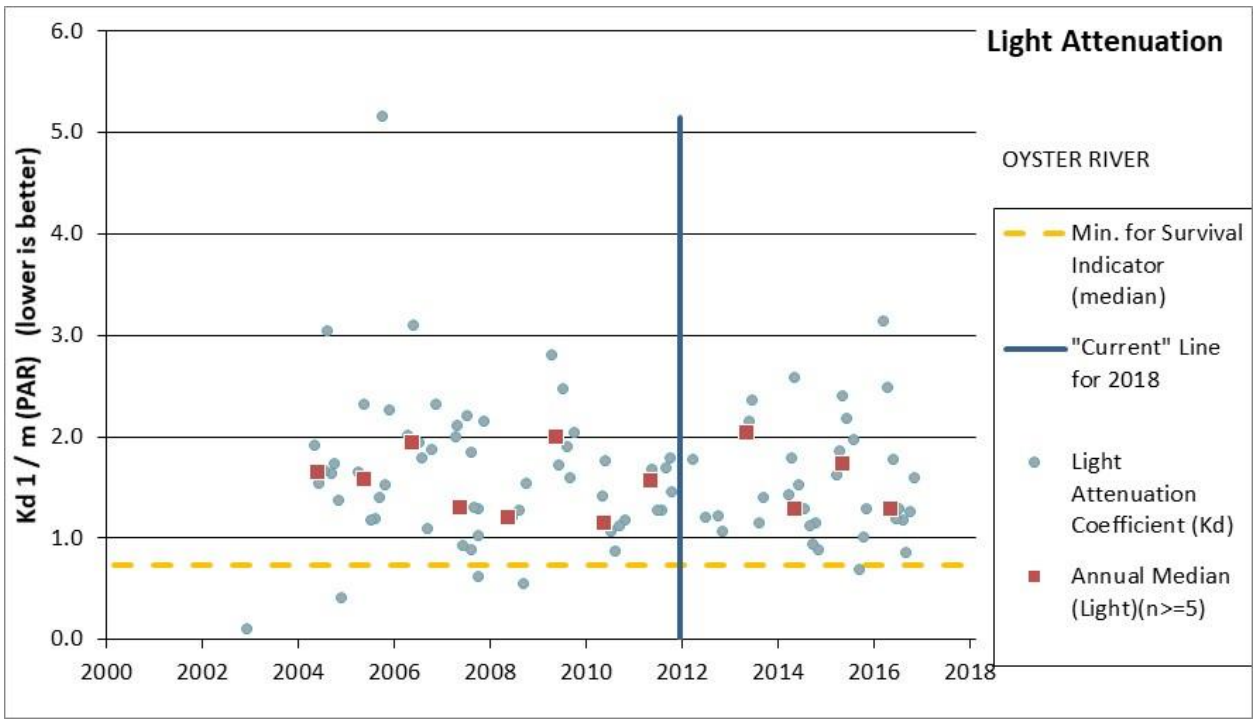

Chlorophyll-a
OYSTER RIVER
ug Chl-a / L
90
80
70
60
50
40
30
20
10
0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Chl-a Ind. (90th percentile)
"Current" Line for 2018
Chlorophyll a, Corected for Pheophytin
Annual 90th Percentile (n>=9)

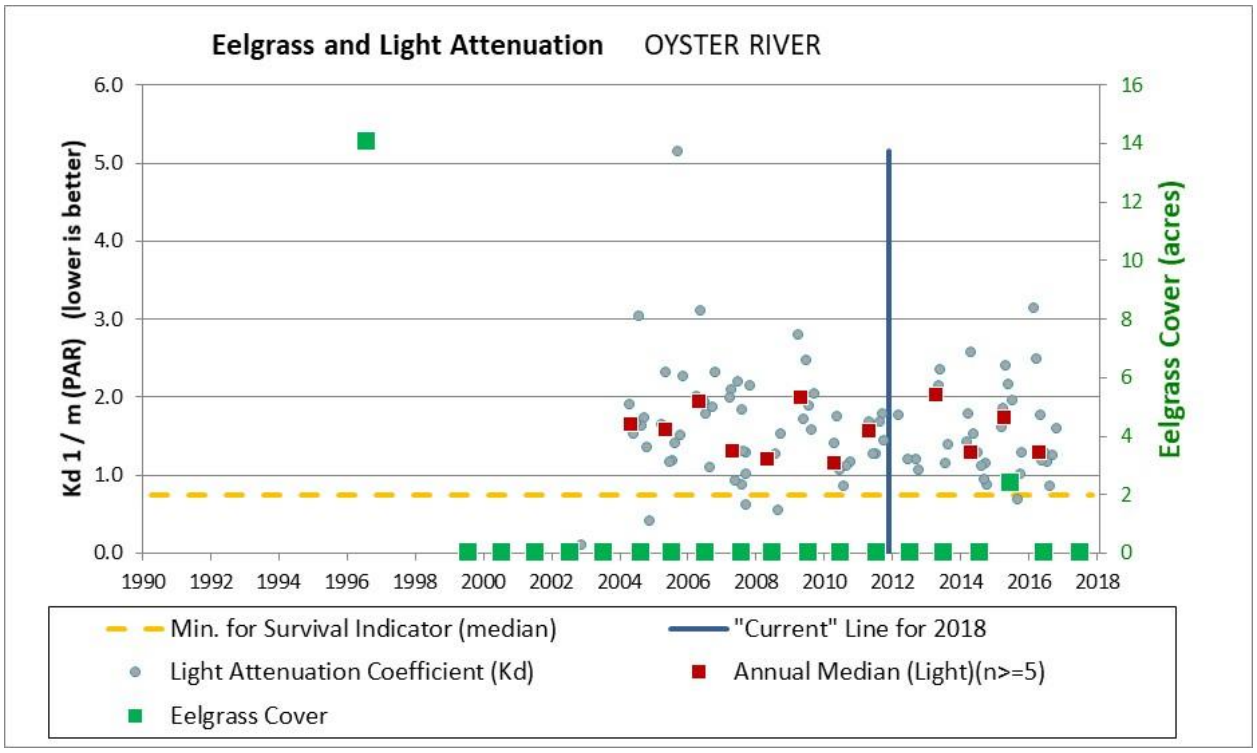

Chlorophyll-a
OYSTER RIVER
ug Chl-a / L
100.00
10.00
1.00
0.10
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Chl-a Ind. (90th percentile)
"Current" Line for 2018
Chlorophyll a, Corected for Pheophytin
Annual 90th Percentile (n>=9)

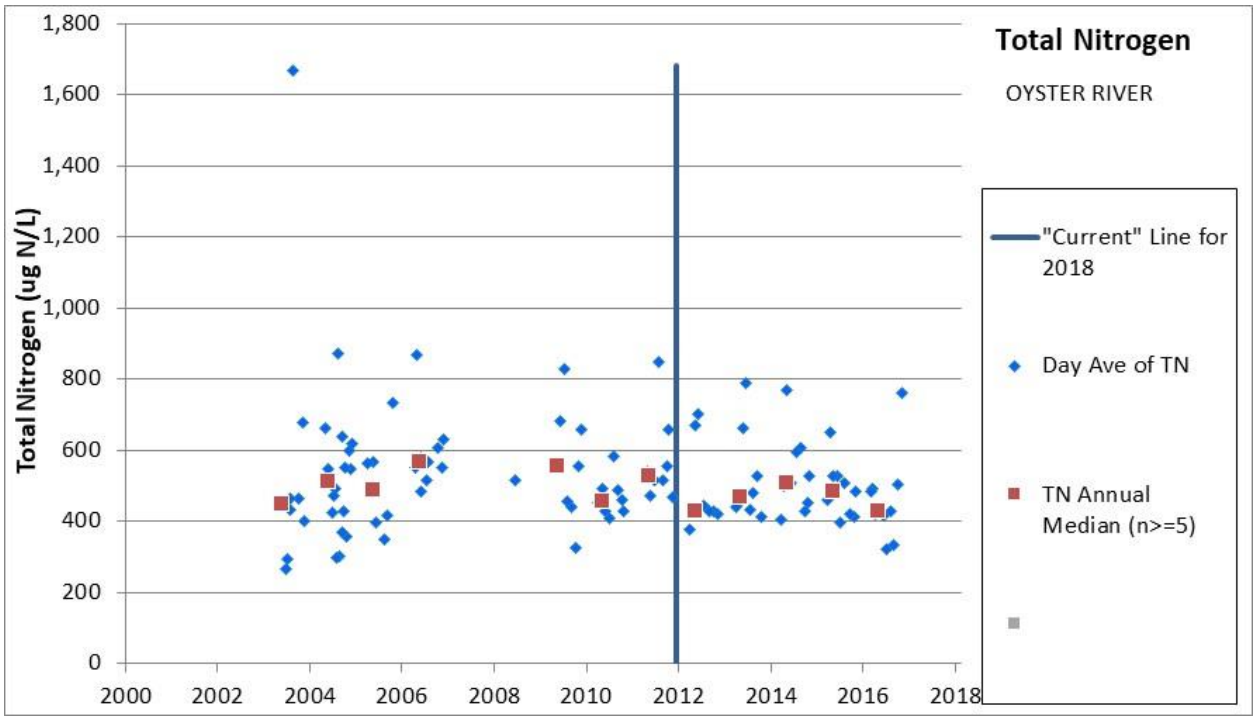

Dissolved Oxygen Concentration
OYSTER RIVER
Dissolved Oxygen, mg / L
16
14
12
10
8
6
4
2
0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
DO mg/L Ind MAGEX
DO mg/L Std
"Current" Line for 2018
DO-PPM-GRAB-NCP
DO-PPM-24HR-MIN-NCP
DO-PPM-GRAB-CP
DO-PPM-24HR-MIN-CP


Dissolved Oxygen Percent Saturation
OYSTER RIVER
Dissolved Oxygen, Percent Saturation
180
160
140
120
100
80
60
40
20
0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
DO % Sat. Ind. MAGEX
DO % Sat Ind.
"Current" Line for 2018
DO-PERC-2TIDE-GRAB-NCP
DO-PERC-2TIDE-GRAB-CP
DO-PERC-24H-MEAN-NCP
DO-PERC-24H-MEAN-CP
DO-SAT-GRAB


TSS
OYSTER RIVER
TSS (mg/L)
1,000
100
10
1
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
"Current" Line for 2018
TSS
Annual Median (TSS) (n>=5)


Light Attenuation
OYSTER RIVER
Kd 1 / m (PAR) (lower is better)
6.0
5.0
4.0
3.0
2.0
1.0
0.0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Min. for Survival Indicator (median)
"Current" Line for 2018
Light Attenuation Coefficient (Kd)
Annual Median (Light)(n>=5)


Eelgrass and Light Attenuation
OYSTER RIVER
Kd 1 / m (PAR) (lower is better)
Eelgrass Cover (acres)
6.0
5.0
4.0
3.0
2.0
1.0
0.0
16
14
12
10
8
6
4
2
0
1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016 2018
Min. for Survival Indicator (median)
"Current" Line for 2018
Light Attenuation Coefficient (Kd)
Annual Median (Light)(n>=5)
Eelgrass Cover


Total Nitrogen
OYSTER RIVER
Total Nitrogen (ug N/L)
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
2000 2002 2004 2006 2008 2010 2012 2014 2016 2018
"Current" Line for 2018
Day Ave of TN
TN Annual Median (n>=5)

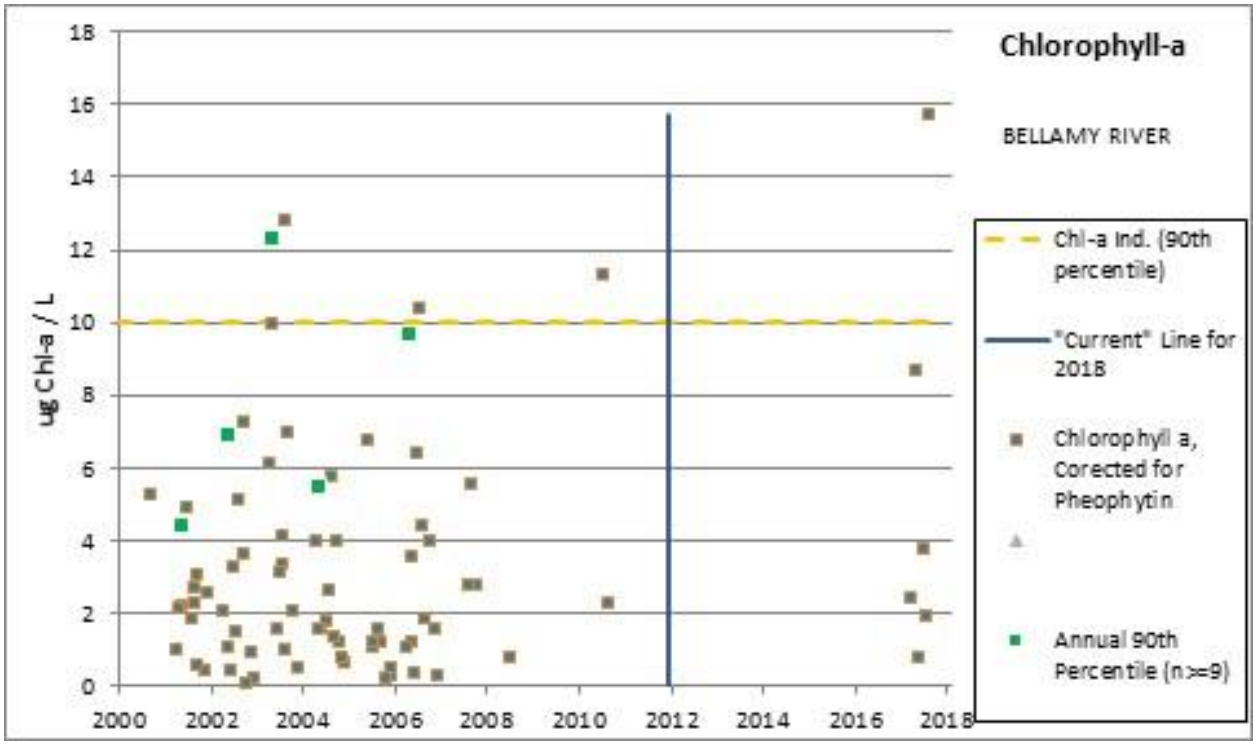
Oyster River Assessment Zone (1/1/2012-5/25/2018)	**Count**	**Minimum**	**Median**	**90th Percentile**	**Maximum**
CHLOROPHYLL A, CORRECTED FOR PHEOPHYTIN (µg/L)	44	1.3	5.2	8.8	11.8
CHLOROPHYLL A, UNCORRECTED FOR PHEOPHYTIN (µg/L)	0	-	-	-	-
CHLOROPHYLL A, Combined (µg/L)	44	1.3	5.2	8.8	11.8
LIGHT ATTENUATION COEFFICIENT (1/m)	35	0.690	1.400	2.442	3.150
TURBIDITY (NTU)	1,144	0.0	7.0	23.0	223.0
COLORED DISSOLVED ORGANIC MATTER (CDOM) (1/m)	0	-	-	-	-
TSS (mg/L)	45	11.1	20.9	32.4	52.4
DO-PPM-24HR-MIN-CP (mg/L)	570	2.5	5.8	6.7	8.6
DO-PPM-24HR-MIN-NCP (mg/L)	554	2.8	8.1	10.0	11.6
DO-PPM-GRAB-CP (mg/L)	0	-	-	-	-
DO-PPM-GRAB-NCP (mg/L)	3	9.8	10.1	-	11.4
DO-PERC-24H-MEAN-CP (% sat)	590	59.7	92.8	105.6	128.7
DO-PERC-24H-MEAN-NCP (% sat)	533	71.7	92.5	103.6	117.6
DO-PERC-2TIDE-GRAB-CP (% sat)	0	-	-	-	-
DO-PERC-2TIDE-GRAB-NCP (% sat)	2	95.7	100.8	-	105.9
DO-PERC-GRAB (% sat)	1	93.5	93.5	-	93.5
Day Ave of TN (µg N/L)	43	321	459	690	791
Day Ave of TDN (µg N/L)	45	179	347	481	677
Day Ave of DIN (NH3 + NO2/3) (µg N/L)	45	29	190	327	574
Day Ave of NH3 (µg N/L)	45	19	66	142	202
Day Ave of PON (µg N/L)	0	-	-	-	-
Day Ave of NO2/3 (µg N/L)	45	4	97	224	530
SALINITY-Grabs (pss)	127	0	22	28	31
SALINITY-Datalogger Daily Median (pss)	1,131	10	25	29	31

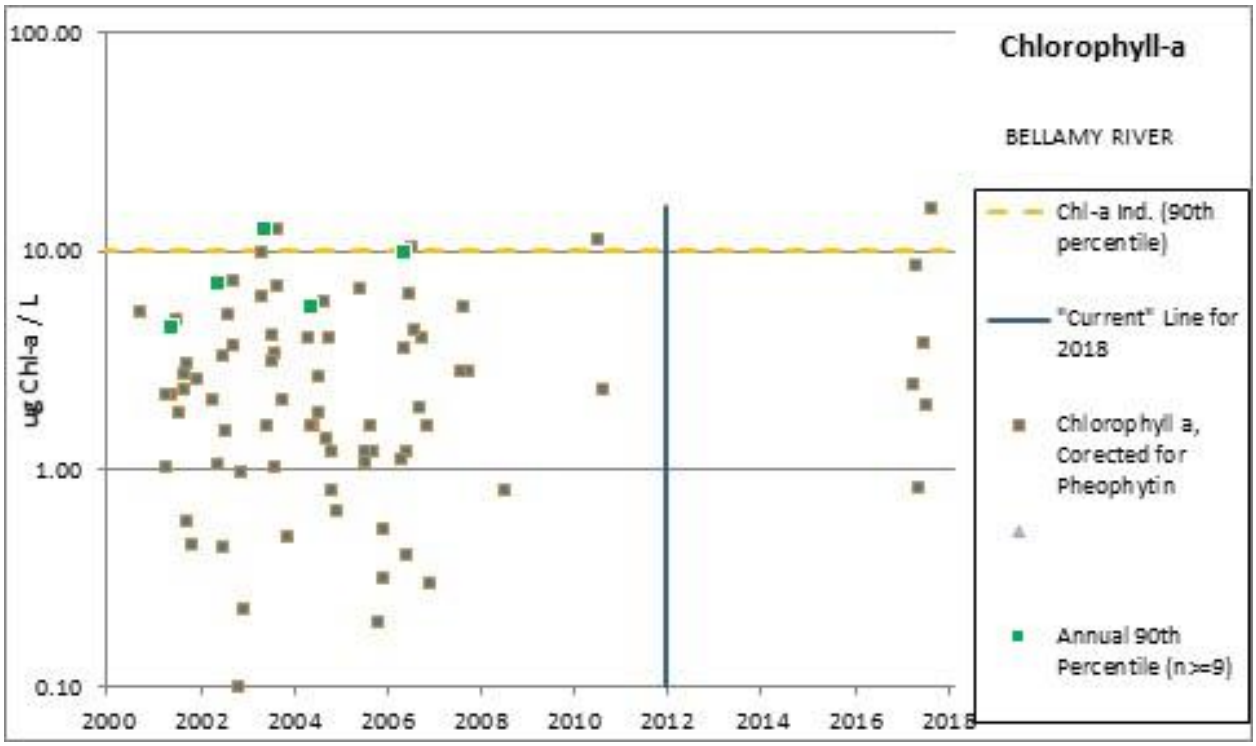
Assessment Zone = BELLAMY RIVER

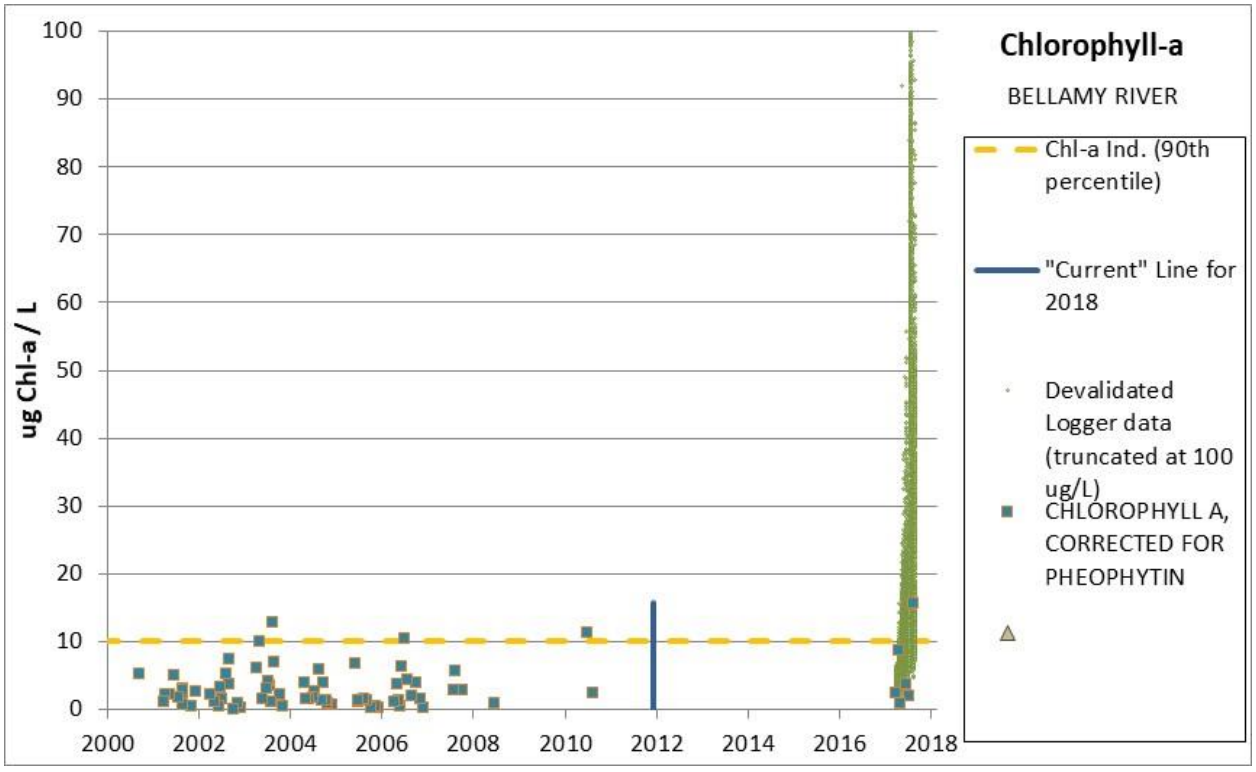
(NHEST600030903-01-01, NHEST600030903-01-03, NHEST600030903-01-04)

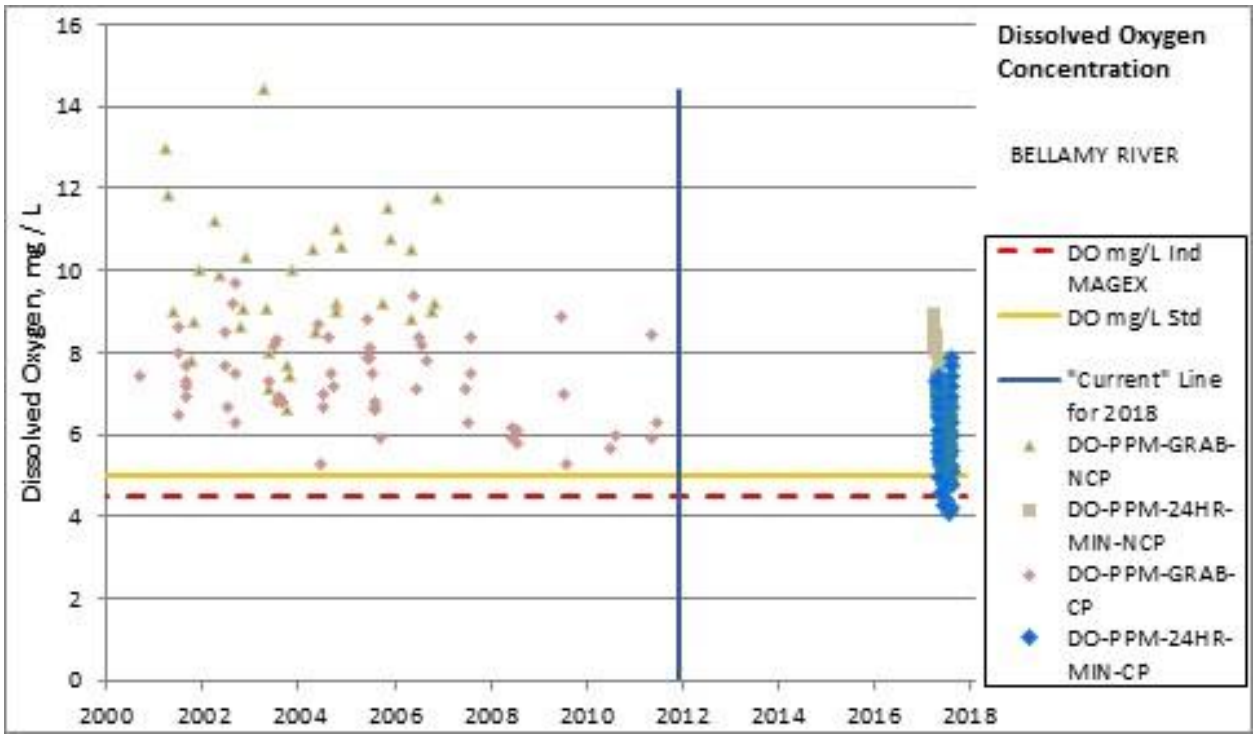
Indicator	Aquatic Life Use Category 2016 / 2018	2018 Comment
Chlorophyll-a	3-ND / 3-PNS	The calculated 90th percentile chlorophyll-a in this assessment zone cannot be calculated due to the limited dataset (n=6) that ranges from 0.8 to 15.7 µg/L. The chlorophyll-a indicator threshold to prevent low dissolved oxygen is a 90th percentile below 10 µg/L. Although the probe based chlorophyll-a data (not used in the median above) collected in the assessment zone in 2017 was qualified as "estimated," due to poor correlation between probe and extracted chlorophyll-a grab sample data, the relative biomass is valid and shows large spikes in chlorophyll-a. The available dissolved oxygen data discussed below was collected in 2017 and suggests there is a moderate level of stress in the system. Therefore, this assessment zone has been assessed as potentially not supporting aquatic life based on chlorophyll-a.
Dissolved Oxygen (mg/L)	3-ND / 3-PNS	This assessment zone had its first datalogger deployment in 2017. 12 of 118 days (10%) of summer datalogger records experienced DO below 5 mg/L however no days fell below 4 mg/L none of the 36 non-summer days of DO records fell below 5 mg/L. All of the low DO values were at, or leading up to, low tide, most were between 05:00-10:45 while one occurred at 19:45. From the overall dataset we see that from that in 2017 there were 13 days on which DO fell below 5 mg/L for 0.25 to 3.5 hours; there were 5 days on which DO fell below 4.5 mg/L for 0.25 to 2.5 hours; and there were no days on which DO fell below 4 mg/L. The frequency, duration, and magnitude of those dips have not risen to the severity that warrants an impairment. Additional data was collected in 2018 that has not yet been QA/QC'd. Final assessment is deferred until that additional data can be evaluated. In the interim, this assessment zone has been assessed as potentially not supporting aquatic life due to low dissolved oxygen.
Dissolved Oxygen (% Saturation)	3-ND / 3-PAS	Full-support or non-support determinations are no longer made for dissolved oxygen percent saturation due to SB127 in 2017 amending three sections of RSA 485. This assessment zone had its first datalogger deployment in 2017. 1 of 117 days (1%) of summer datalogger records experienced DO saturation below the 24-hour average 75% indicator and none of the 34 days of non-summer 24-hour average DO saturation records fell below the 75% indicator. This assessment zone has been assessed as potentially supporting aquatic life based on dissolved oxygen percent saturation.
Estuarine Bioassessments (eelgrass)	5-P / 5-P	The historical extent of eelgrass in this assessment zone was 66.9 acres from the 1948, 1962, 1980, and 1981 datasets. Some eelgrass was found in 2004 (0.8 acres). The median current extent of eelgrass in 2015-2017 is 0 acres, which is a decrease of 100%. Since 1990, the trend in eelgrass cover in this assessment zone could not be determined because the eelgrass cover has been zero for most years since 1981. The thresholds for impairment are either loss of more than 20% of the historic extent of eelgrass or a recent trend of greater than 20% loss.
Water Clarity (Light Attenuation Coefficient)	3-ND / 3-PNS	Median=1.360 m^-1 (n=3). For an eelgrass restoration depth of 2 m, the light attenuation coefficient threshold is 0.75 m^-1. All of the light attenuation coefficient measurements far exceeded the restoration depth based threshold as have 9 of the 11 sampled ever collected in this assessment zone. Although the CALM does recognize that it is an interpretation of the narrative water quality criteria and NHDES has the latitude to stray from the documented approach outlined in the CALM, and use best professional judgement, it is the feeling of NHDES that calling the Bellamy River impaired based on the three "current" data points would be significant departure from the CALM. Given the eelgrass condition and the available light data, this assessment zone has been assessed as potentially not supporting aquatic life integrity due to light attenuation.
Total Nitrogen	3-ND / 3-PNS	In 2017, this assessment had its first total nitrogen samples collected since 2010. The median of the recent data was 509 µg/L (n=5) which is consistent with the 2003-2010 data. The dissolved oxygen concentration data collected in 2017 suggested potential non-support as did the available

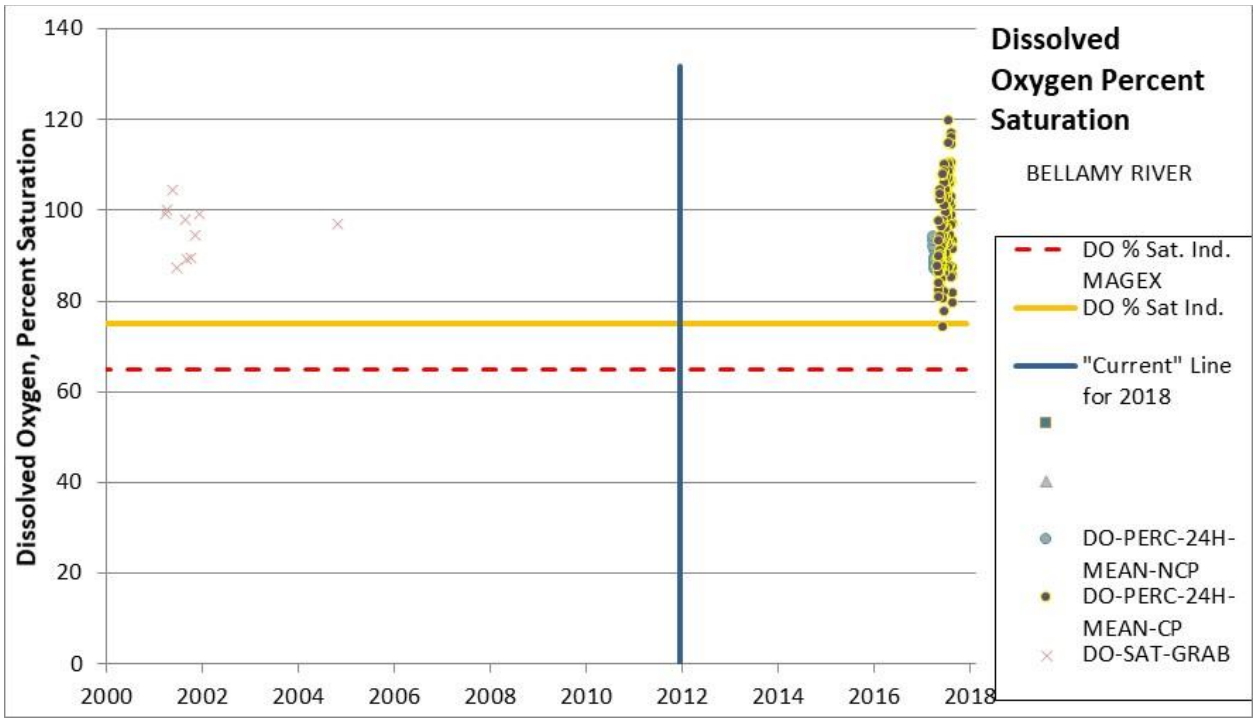
		chlorophyll-a samples. Dissolved oxygen percent saturation data typically met the indicator threshold. The newly available light attenuation data is consistent with older data and far worse than the indicator threshold. Eelgrass has been absent from this assessment zone since 1981 with only a small reoccurrence in 2004 (0.8 acres). No sampling efforts have taken place to evaluate the extent of epiphytes and macrophytes. Additional data was collected in 2018 that has not yet been QA/QC'd and more sampling is planned for 2019. There are not sufficient datasets to determine that eutrophication by total nitrogen is alone is not known to be strong enough to warrant impairment under New Hampshire's narrative standard. As such, this assessment zone has been assessed as potentially not supporting aquatic life based on total nitrogen.

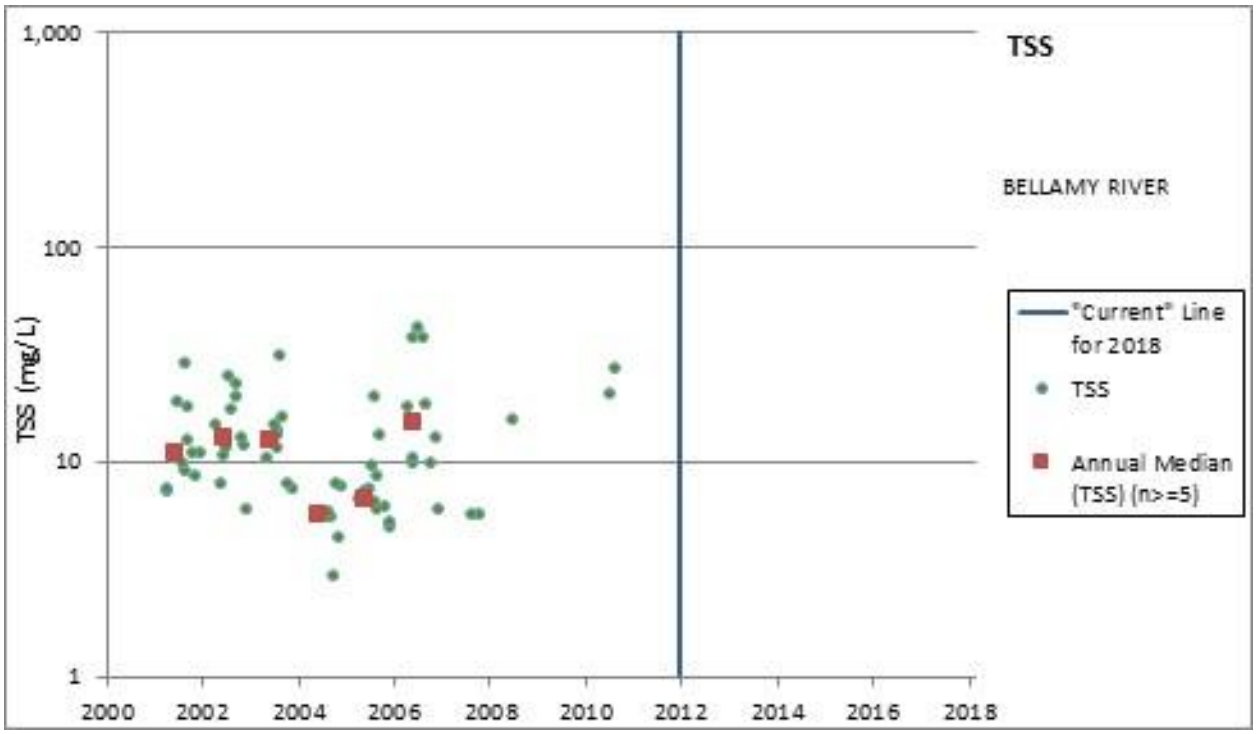


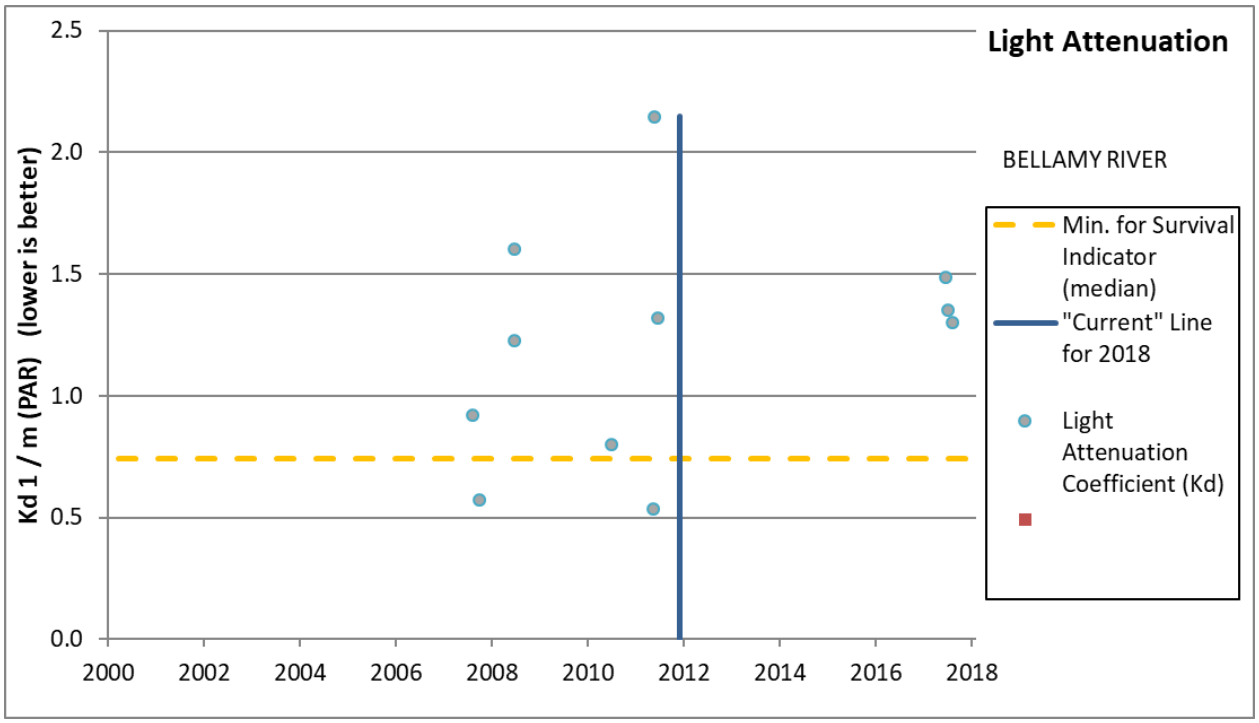

Chlorophyll-a
BELLAMY RIVER
ug Chl-a / L
100.00
10.00
1.00
0.10
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Chl-a Ind. (90th percentile)
"Current" Line for 2018
Chlorophyll a, Corected for Pheophytin
Annual 90th Percentile (n>=9)

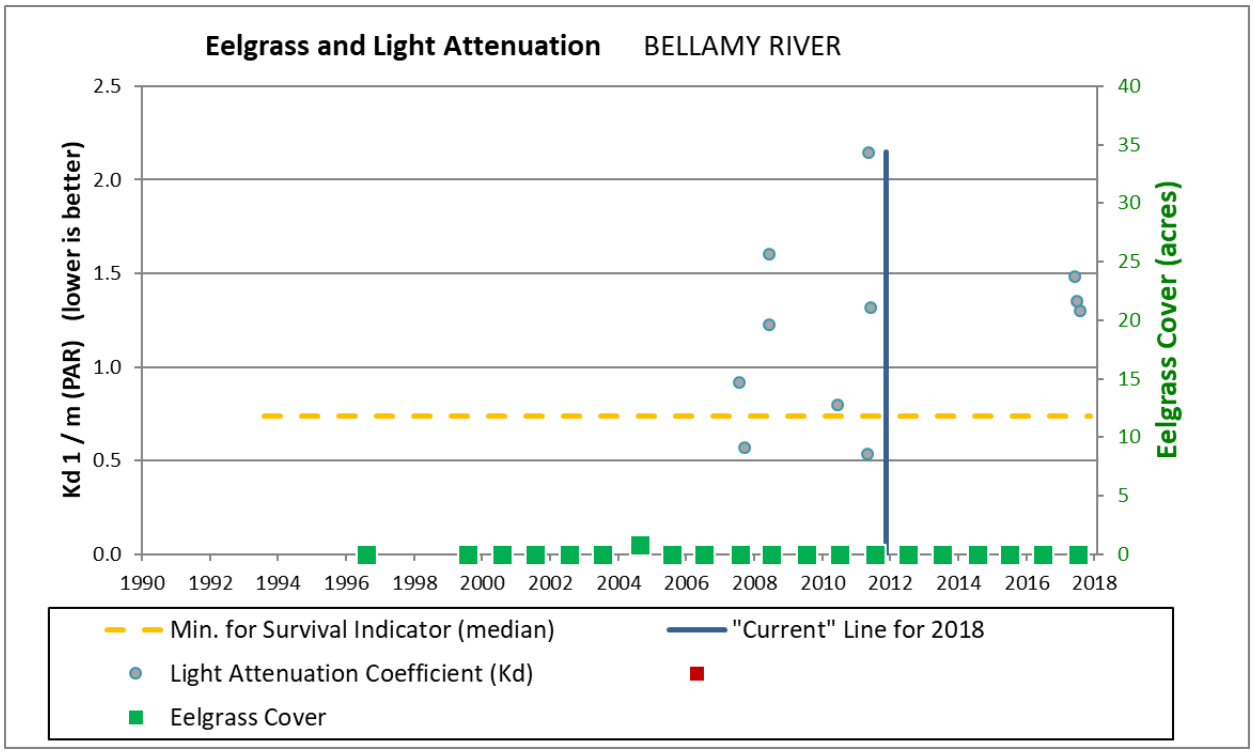

Chlorophyll-a
BELLAMY RIVER
ug Chl-a / L
100
90
80
70
60
50
40
30
20
10
0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Chl-a Ind. (90th percentile)
"Current" Line for 2018
Devalidated Logger data (truncated at 100 ug/L)
CHLOROPHYLL A, CORRECTED FOR PHEOPHYTIN

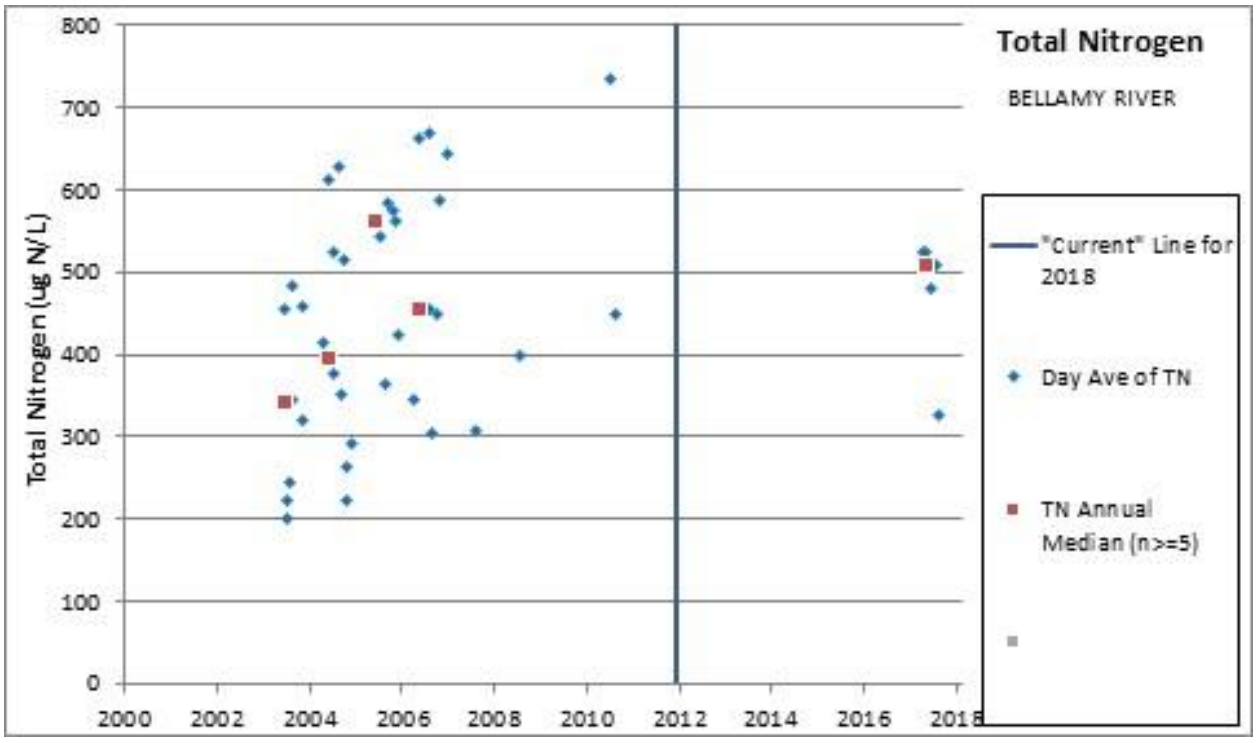

Dissolved Oxygen Concentration
BELLAMY RIVER
Dissolved Oxygen, mg / L
DO mg/L Ind MAGEX
DO mg/L Std
"Current" Line for 2018
DO-PPM-GRAB-NCP
DO-PPM-24HR-MIN-NCP
DO-PPM-GRAB-CP
DO-PPM-24HR-MIN-CP


Dissolved Oxygen Percent Saturation
BELLAMY RIVER
Dissolved Oxygen, Percent Saturation
DO % Sat. Ind. MAGEX
DO % Sat Ind.
"Current" Line for 2018
DO-PERC-24H-MEAN-NCP
DO-PERC-24H-MEAN-CP
DO-SAT-GRAB


TSS
BELLAMY RIVER
TSS (mg/L)
1,000
100
10
1
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
"Current" Line for 2018
TSS
Annual Median (TSS) (n>=5)


Light Attenuation
BELLAMY RIVER
Kd 1 / m (PAR) (lower is better)
2.5
2.0
1.5
1.0
0.5
0.0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Min. for Survival Indicator (median)
"Current" Line for 2018
Light Attenuation Coefficient (Kd)





Bellamy River Assessment Zone (1/1/2012-5/25/2018)	Count	Minimum	Median	90th Percentile	Maximum
CHLOROPHYLL A, CORRECTED FOR PHEOPHYTIN (µg/L)	6	0.8	3.1	-	15.7
CHLOROPHYLL A, UNCORRECTED FOR PHEOPHYTIN (µg/L)	0	-	-	-	-
CHLOROPHYLL A, Combined (µg/L)	6	0.8	3.1	-	15.7
LIGHT ATTENUATION COEFFICIENT (1/m)	3	1.310	1.360	-	1.495
TURBIDITY (NTU)	133	4.0	8.0	11.6	47.0
COLORED DISSOLVED ORGANIC MATTER (CDOM) (1/m)	0	-	-	-	-

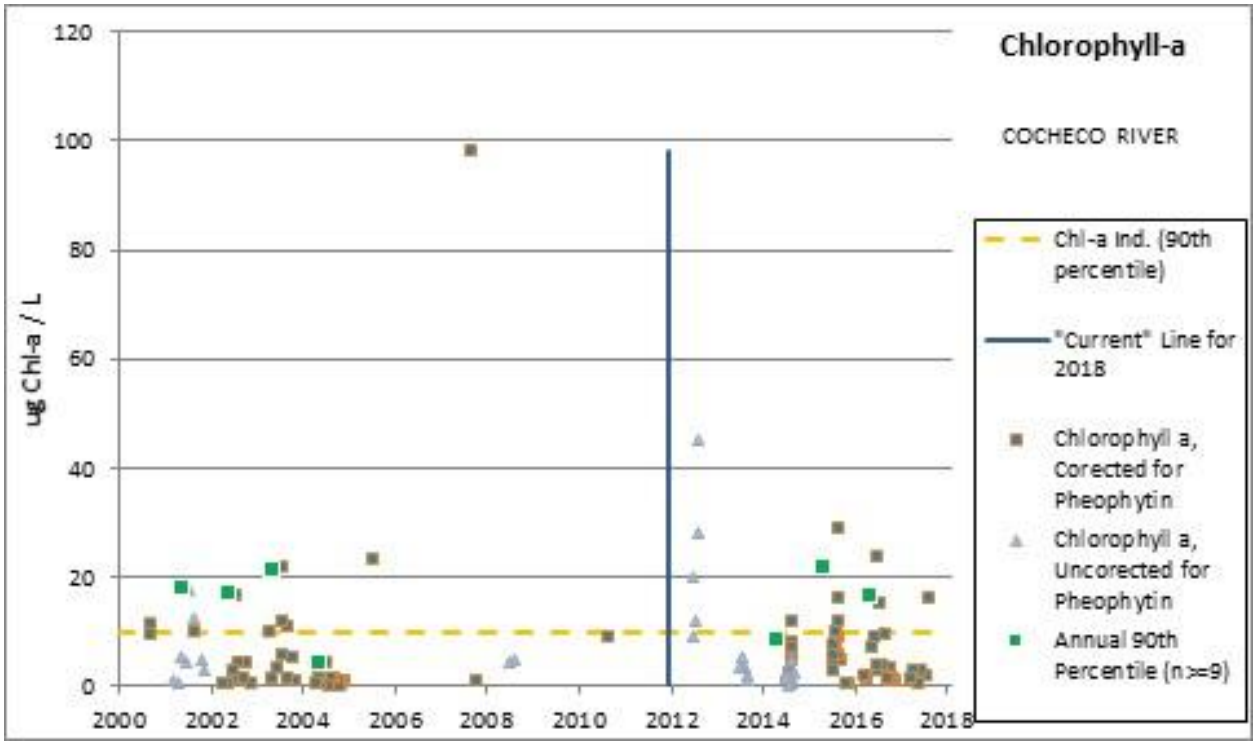
TSS (mg/L)	0	-	-	-	-
DO-PPM-24HR-MIN-CP (mg/L)	117	4.1	5.9	7.1	7.9
DO-PPM-24HR-MIN-NCP (mg/L)	35	6.9	8.3	8.5	9.0
DO-PPM-GRAB-CP (mg/L)	0	-	-	-	-
DO-PPM-GRAB-NCP (mg/L)	0	-	-	-	-
DO-PERC-24H-MEAN-CP (% sat)	116	74.2	96.1	109.0	119.8
DO-PERC-24H-MEAN-NCP (% sat)	34	86.3	89.2	92.0	94.2
DO-PERC-2TIDE-GRAB-CP (% sat)	0	-	-	-	-
DO-PERC-2TIDE-GRAB-NCP (% sat)	0	-	-	-	-
DO-PERC-GRAB (% sat)	0	-	-	-	-
Day Ave of TN (µg N/L)	5	326	509	-	525
Day Ave of TDN (µg N/L)	6	216	313	-	407
Day Ave of DIN (NH3 + NO2/3) (µg N/L)	6	59	145	-	184
Day Ave of NH3 (µg N/L)	6	3	27	-	88
Day Ave of PON (µg N/L)	0	-	-	-	-
Day Ave of NO2/3 (µg N/L)	6	56	99	-	155
SALINITY-Grabs (pss)	219	0	23	29	31
SALINITY-Datalogger Daily Median (pss)	152	9	23	28	29

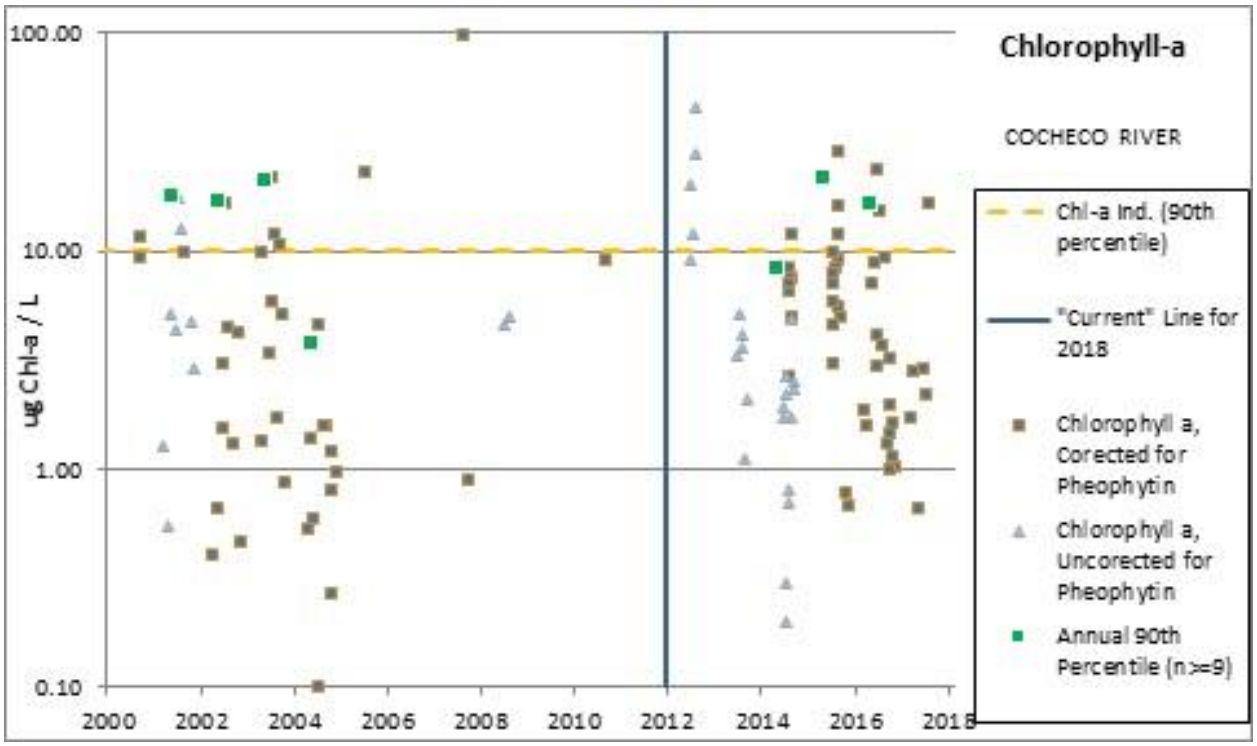
Assessment Zone = COCHECO RIVER

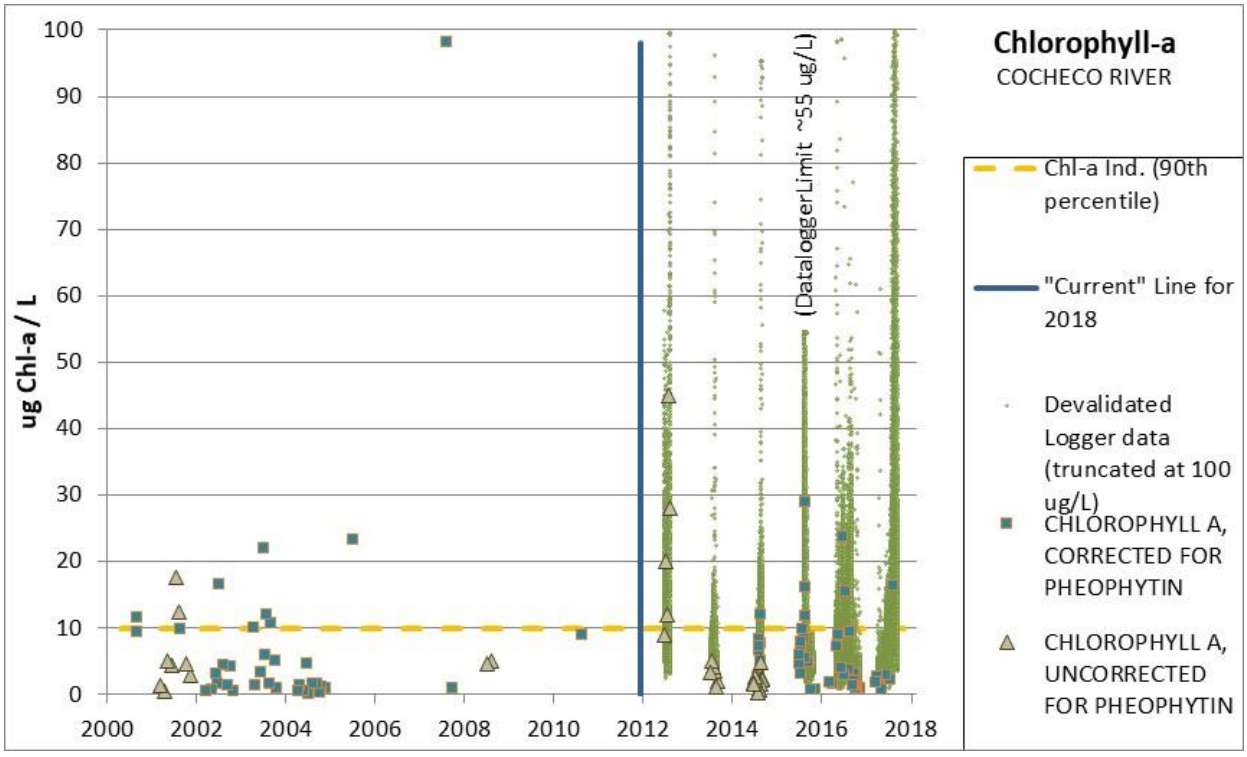
(NHEST600030608-01)

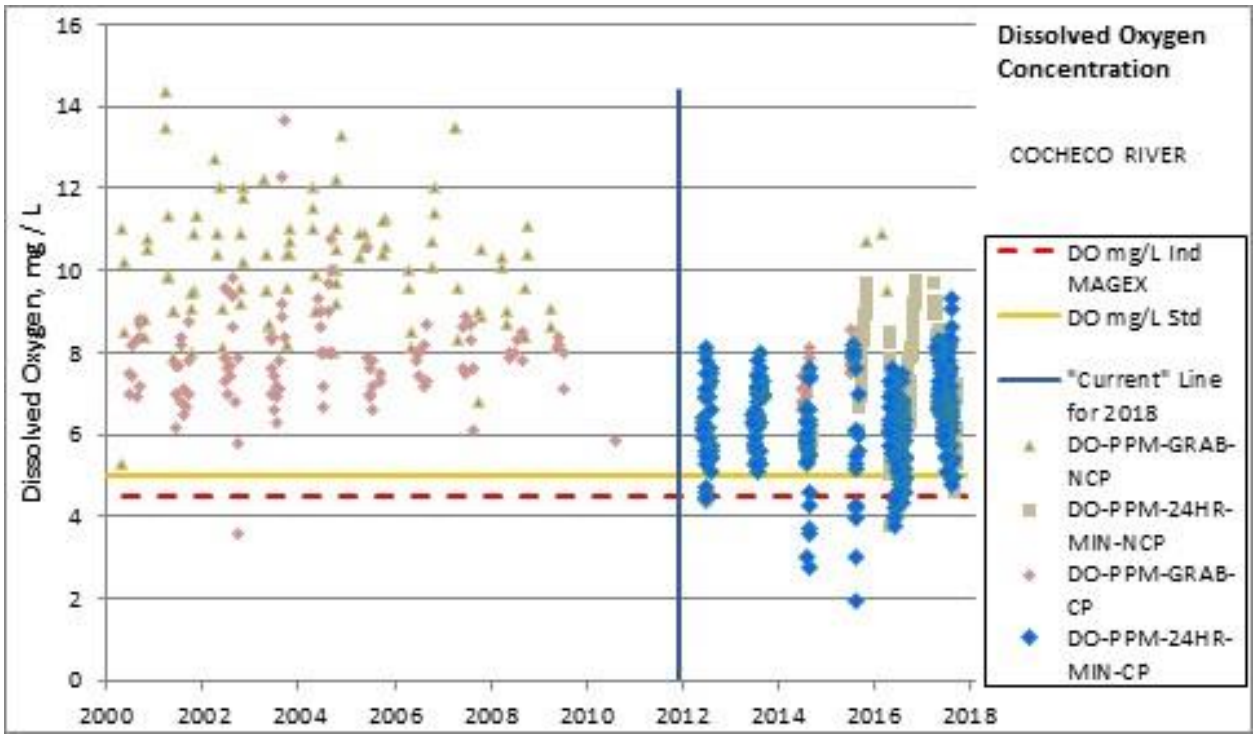
Indicator	Aquatic Life Use Category 2016 / 2018	2018 Comment
Chlorophyll-a	5-P / 5-P	The calculated 90th percentile chlorophyll-a in this assessment zone is 16.2 µg/L (n = 70) and a maximum reading of 45 µg/L. The chlorophyll-a indicator threshold to prevent low dissolved oxygen is a 90th percentile below 10 µg/L. Although the multiple probe based chlorophyll-a data (not used in the median above) collected in the assessment zone was qualified as "estimated," due to poor correlation between probe and extracted chlorophyll-a grab sample data, the relative biomass is valid and shows large spikes in chlorophyll-a. Those spikes were most pronounced when low tide (maximum freshwater signal and maximum water temperature) occurred at midday to late afternoon (maximum photosynthesis duration period) and when freshwater inflow was at a minimum (0.23 – 0.10 cfsm) (minimum dilution of upstream loading). Under those conditions, the high nutrient water in the Cocheco River had the optimum conditions to sustain a large phytoplankton biomass. The 2016 assessment has been retained.
Dissolved Oxygen (mg/L)	5-M / 5-M	Following the 10% method listed in the 2018 CALM, this parameter would be categorized as 5-M (40 of 388 days of summer dataloggers few below 5 mg/L). Part of the concept behind the 10% rule was to address random errors within the meter measurement accuracy thereby limiting accidental impairments. The magnitude of exceedence indicator was layered into the assessment process to address major exceedences and exceedences beyond all normal measurement errors. In this assessment zone, there are 163 station/days of datalogger DO readings during the critical summer period. Of the overall dataset, there were 20 days on which DO fell below 5 mg/L for 0.25 to 4.25 hours; there were 8 days on which DO fell below 4 mg/L for 0.25 to 1.25 hours; there were 4 days on which DO fell below 3 mg/L for 0.25 to 0.5 hours; and there was 1 day on which DO fell below 2 mg/L for 0.25 hour. Most of those low DO reading occurred in 2015 at station CR7. The frequency, duration, and magnitude of those DO excursions warrant impairment. While the 2017 datalogger records looked better than prior years, the higher summer flows (and hence flushing) in 2017 when compared to 2015 and 2016 must be weighted into the assessment decision. Given the concerted effort by the municipalities to reduce nutrient loading through infrastructure investments, nonpoint source controls and stormwater ordinances, NHDES anticipates that the condition will continue to improve in the coming years.
Dissolved Oxygen (% Saturation)	2-M / 3-PAS	Full-support or non-support determinations are no longer made for dissolved oxygen percent saturation due to SB127 in 2017 amending three sections of RSA 485. Dissolved oxygen percent saturation has been assessed using dataloggers from 2012 through 2017. On only one occasion prior to 2016 did the 24-hour average percent saturation fall below 75%. Following the 10% method listed in the 2018 CALM, this parameter would be categorized as 3-PAS (5 of 369 days of summer dataloggers few below the 75 percent daily average percent saturation indicator).
Estuarine Bioassessments (eelgrass)	No Std/ No Std	Not applicable. Eelgrass habitat has not historically existed in this assessment zone.
Water Clarity (Light Attenuation Coefficient)	No Std/ No Std	Not applicable. The water clarity has not been assessed because eelgrass has not historically existed in this assessment zone.
Total Nitrogen	5-M / 5-M	The median total nitrogen from 2012 through 2017 was 484 µg/L (n=53). It must be noted that recent and rapid total nitrogen reductions have occurred due to infrastructure investments by the municipalities (Rochester WWTP reductions in 2014 and Dover WWTP began reductions in 2015). This assessment zone experienced periodic dissolved oxygen concentrations below 5 mg/L in 2014 through 2017 of up to 4.25 hours and as low as 2 mg/L. The chlorophyll-a concentration

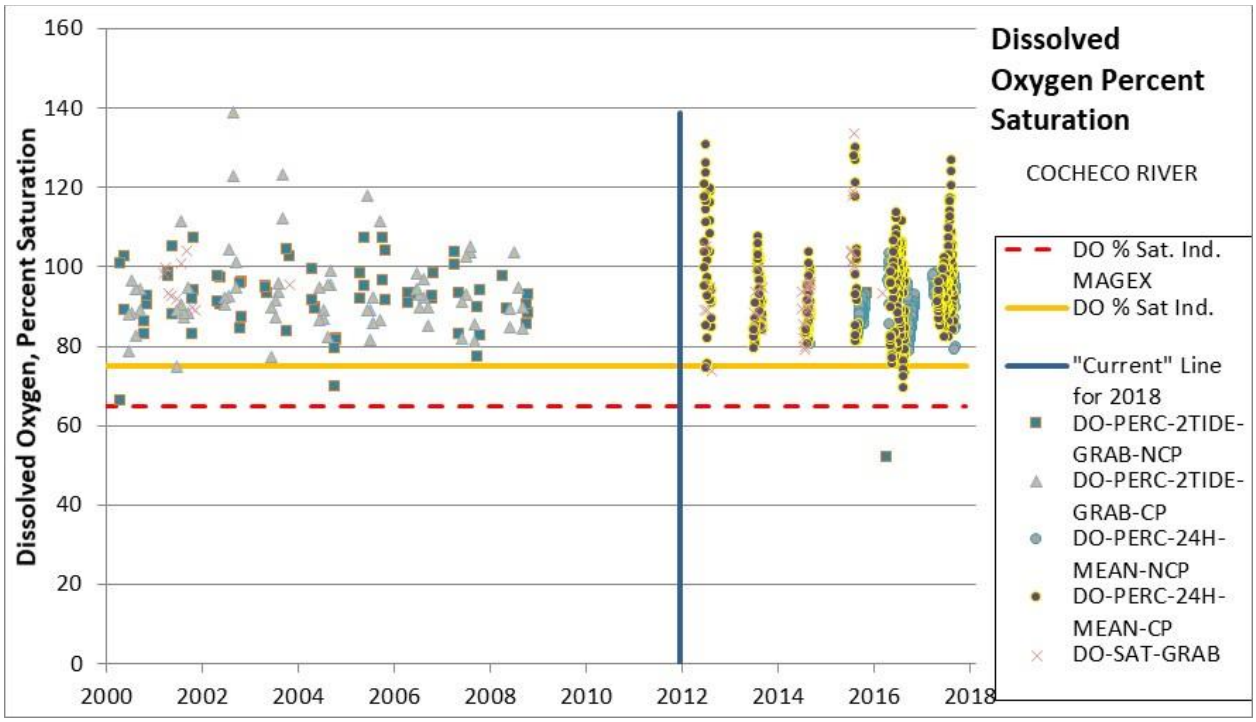
		90th percentile was 16.2 µg/L (n = 70) and a maximum reading of 45 µg/L. Although the probe based chlorophyll-a data (not used in the median above) was qualified as "estimated" due to poor correlation between probe and extracted chlorophyll-a grab sample data, the relative biomass is valid and demonstrates that chlorophyll-a biomass can be quite high depending upon the timing of the tide cycle. The Cocheco River appears to be a system in flux. The 2016 TSD (NHDES, May 8, 2017) provided graphics and accompanying narrative below demonstrate that the growth of algae is causing dissolved oxygen to fall below state standards. The concentrations of total nitrogen are high enough, especially at low tide and lower river flow conditions, to result in these algal blooms (see the Detailed Cocheco River 2015 Datalogger Evaluation section in the 2016 TSD (NHDES, May 8, 2017).) It is not clear at this time whether the measured high chlorophyll and low DO is solely the result of current loads of nitrogen or if the historically higher loads are still flushing through the ecosystem. Some of the classic indicators of nutrient eutrophication are present in this assessment zone and total nitrogen remains elevated. The newer datasets provide a more robust set of indicators of eutrophication than were available for the 2014 assessment and those response datasets demonstrate sufficient power to determine that the eutrophication effects on designated uses can be attributed to total nitrogen. While there has been a rapid decrease in nutrient loading and improved conditions expected in the coming years, the response datasets warrant impairment under New Hampshire's narrative standard. As such, this assessment zone has been assessed as marginally non-supporting (5-M) for total nitrogen.

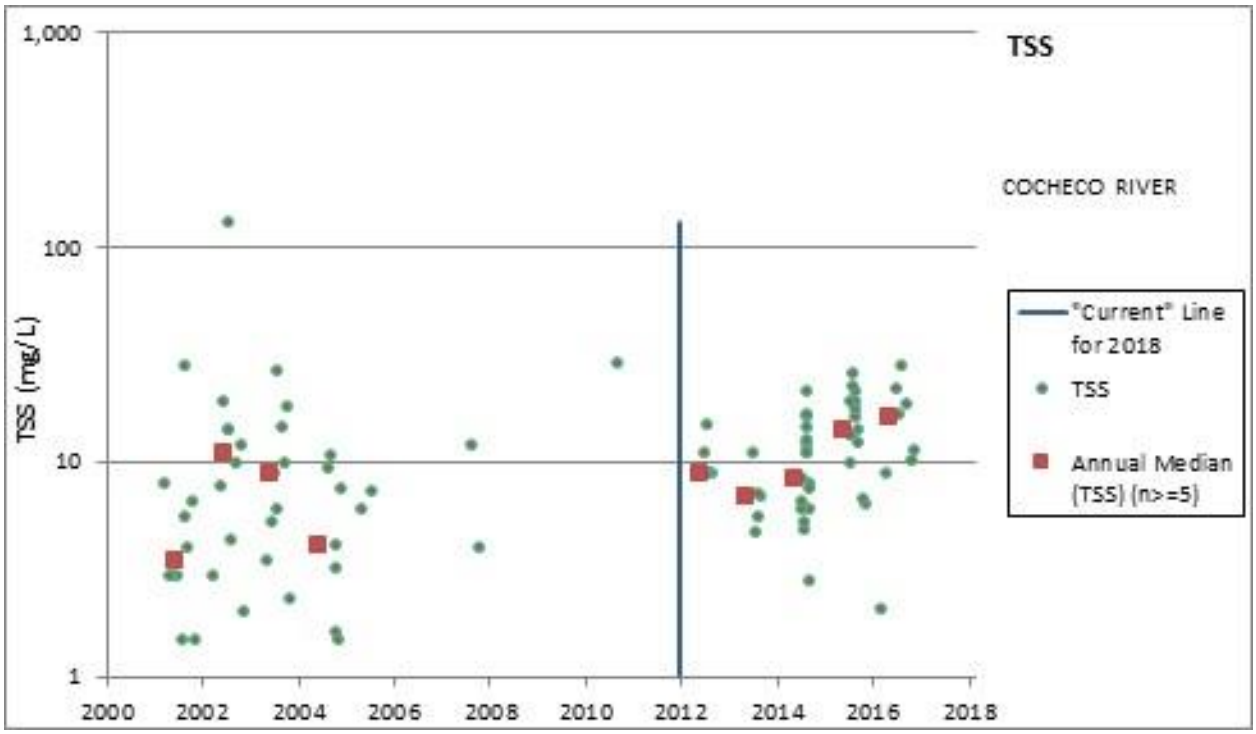


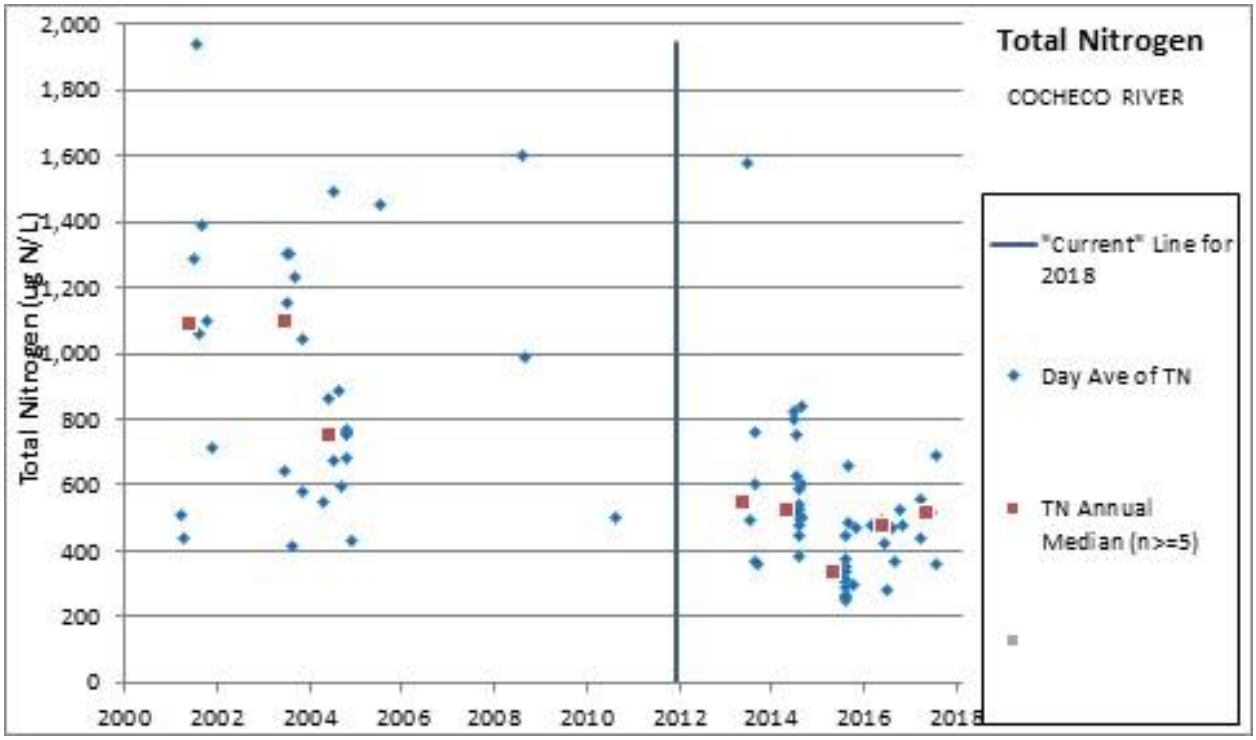

Chlorophyll-a
COCHECO RIVER
ug Chl-a / L
100.00
10.00
1.00
0.10
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Chl-a Ind. (90th percentile)
"Current" Line for 2018
Chlorophyll a, Corected for Pheophytin
Chlorophyll a, Uncorected for Pheophytin
Annual 90th Percentile (n>=9)


Chlorophyll-a
COCHECO RIVER
ug Chl-a / L
100
90
80
70
60
50
40
30
20
10
0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
(DataloggerLimit ~55 ug/L)
Chl-a Ind. (90th percentile)
"Current" Line for 2018
Devalidated Logger data (truncated at 100 ug/L)
CHLOROPHYLL A, CORRECTED FOR PHEOPHYTIN
CHLOROPHYLL A, UNCORRECTED FOR PHEOPHYTIN


Dissolved Oxygen Concentration
COCHECO RIVER
Dissolved Oxygen, mg / L
DO mg/L Ind MAGEX
DO mg/L Std
"Current" Line for 2018
DO-PPM-GRAB-NCP
DO-PPM-24HR-MIN-NCP
DO-PPM-GRAB-CP
DO-PPM-24HR-MIN-CP


Dissolved Oxygen Percent Saturation
COCHECO RIVER
Dissolved Oxygen, Percent Saturation
DO % Sat. Ind. MAGEX
DO % Sat Ind.
"Current" Line for 2018
DO-PERC-2TIDE-GRAB-NCP
DO-PERC-2TIDE-GRAB-CP
DO-PERC-24H-MEAN-NCP
DO-PERC-24H-MEAN-CP
DO-SAT-GRAB


TSS
COCHECO RIVER
TSS (mg/L)
1,000
100
10
1
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
"Current" Line for 2018
TSS
Annual Median (TSS) (n>=5)

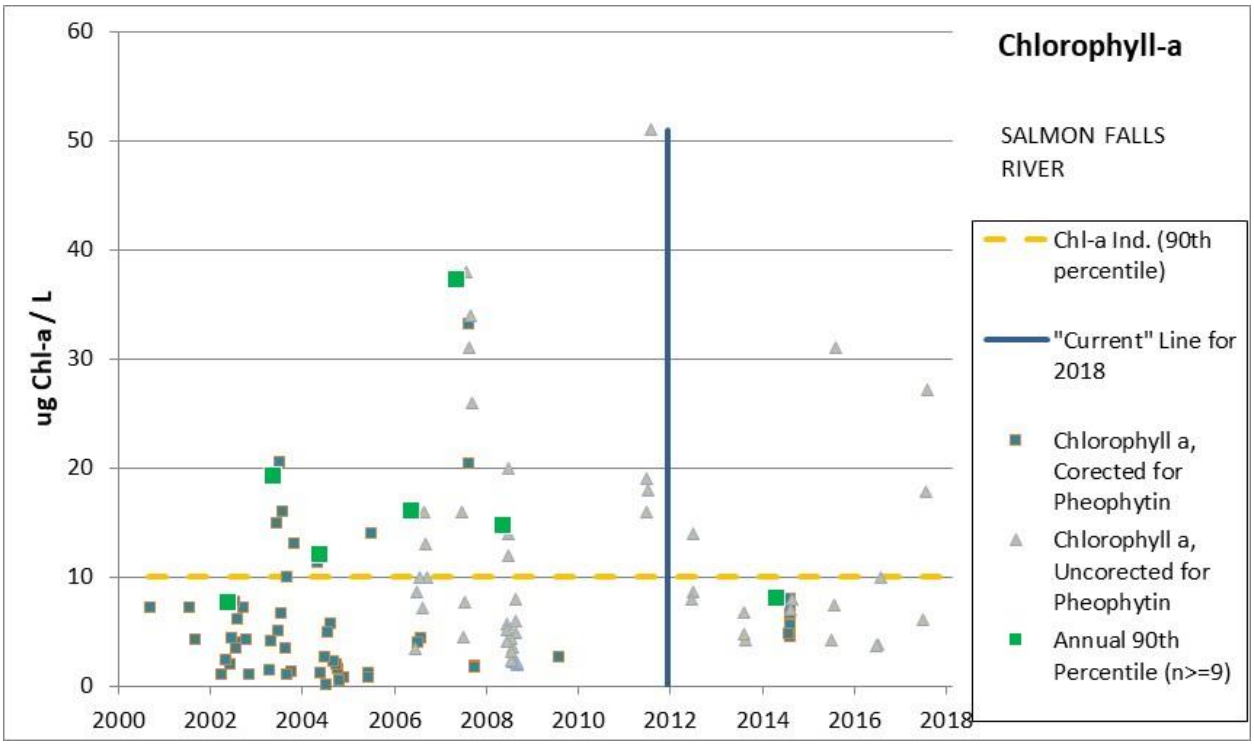

Total Nitrogen
COCHECO RIVER
Total Nitrogen (ug N/L)
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
"Current" Line for 2018
Day Ave of TN
TN Annual Median (n>=5)

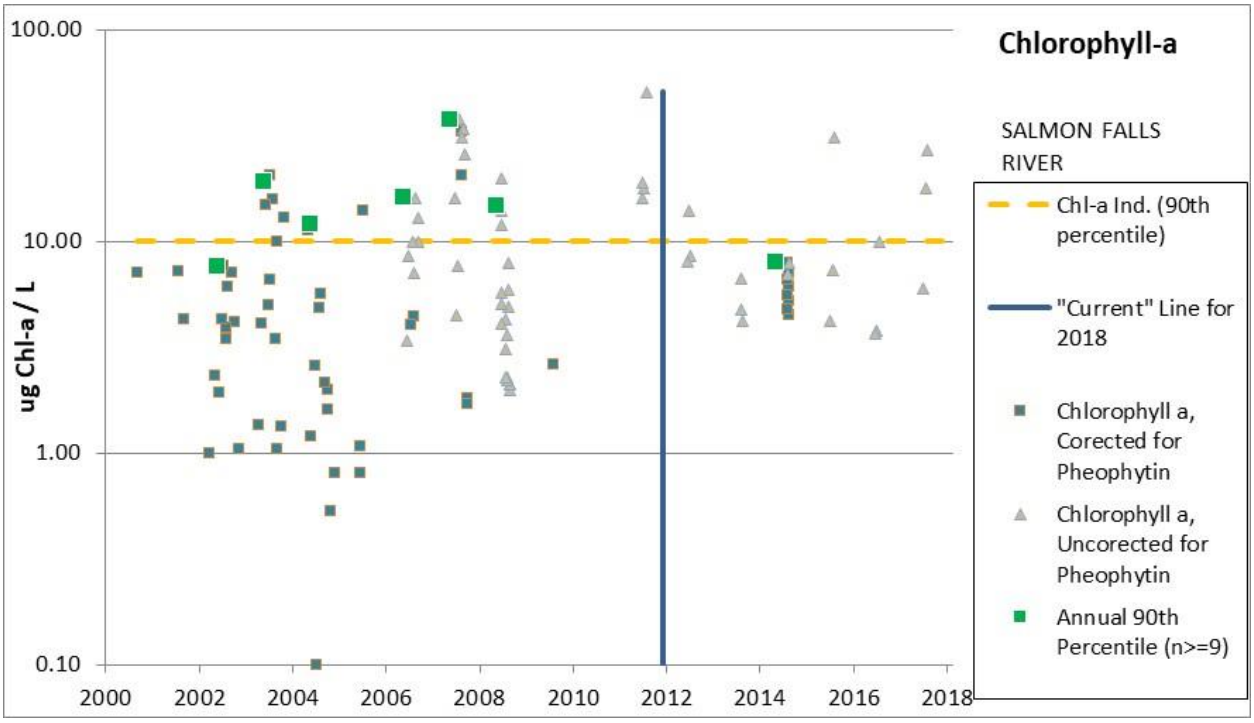
Cocheco River Assessment Zone (1/1/2012-5/25/2018)	**Count**	**Minimum**	**Median**	**90th Percentile**	**Maximum**
CHLOROPHYLL A, CORRECTED FOR PHEOPHYTIN (µg/L)	47	0.7	5.0	15.6	28.9
CHLOROPHYLL A, UNCORRECTED FOR PHEOPHYTIN (µg/L)	23	0.2	2.5	24.8	45.0
CHLOROPHYLL A, Combined (µg/L)	70	0.2	3.7	16.2	45.0
LIGHT ATTENUATION COEFFICIENT (1/m)	31	0.760	1.220	1.768	2.200
TURBIDITY (NTU)	475	0.2	5.9	15.1	1,222.0
COLORED DISSOLVED ORGANIC MATTER (CDOM) (1/m)	0	-	-	-	-
TSS (mg/L)	52	2.1	11.0	21.2	28.4
DO-PPM-24HR-MIN-CP (mg/L)	388	2.0	6.4	7.6	9.3
DO-PPM-24HR-MIN-NCP (mg/L)	176	3.8	8.3	9.3	9.8
DO-PPM-GRAB-CP (mg/L)	29	5.9	7.3	8.1	8.6
DO-PPM-GRAB-NCP (mg/L)	3	9.5	10.7	-	10.9
DO-PERC-24H-MEAN-CP (% sat)	369	69.6	94.4	108.8	130.8
DO-PERC-24H-MEAN-NCP (% sat)	174	78.8	89.5	96.9	103.5
DO-PERC-2TIDE-GRAB-CP (% sat)	0	-	-	-	-
DO-PERC-2TIDE-GRAB-NCP (% sat)	2	52.0	72.7	-	93.5
DO-PERC-GRAB (% sat)	36	74.0	94.1	108.9	133.7
Day Ave of TN (µg N/L)	53	253	484	756	1,580
Day Ave of TDN (µg N/L)	30	167	266	434	455
Day Ave of DIN (NH3 + NO2/3) (µg N/L)	54	6	151	284	889
Day Ave of NH3 (µg N/L)	55	3	30	70	500
Day Ave of PON (µg N/L)	12	35	111	446	488
Day Ave of NO2/3 (µg N/L)	54	2	115	233	816
SALINITY-Grabs (pss)	66	3	19	26	27
SALINITY-Datalogger Daily Median (pss)	592	0	21	26	29

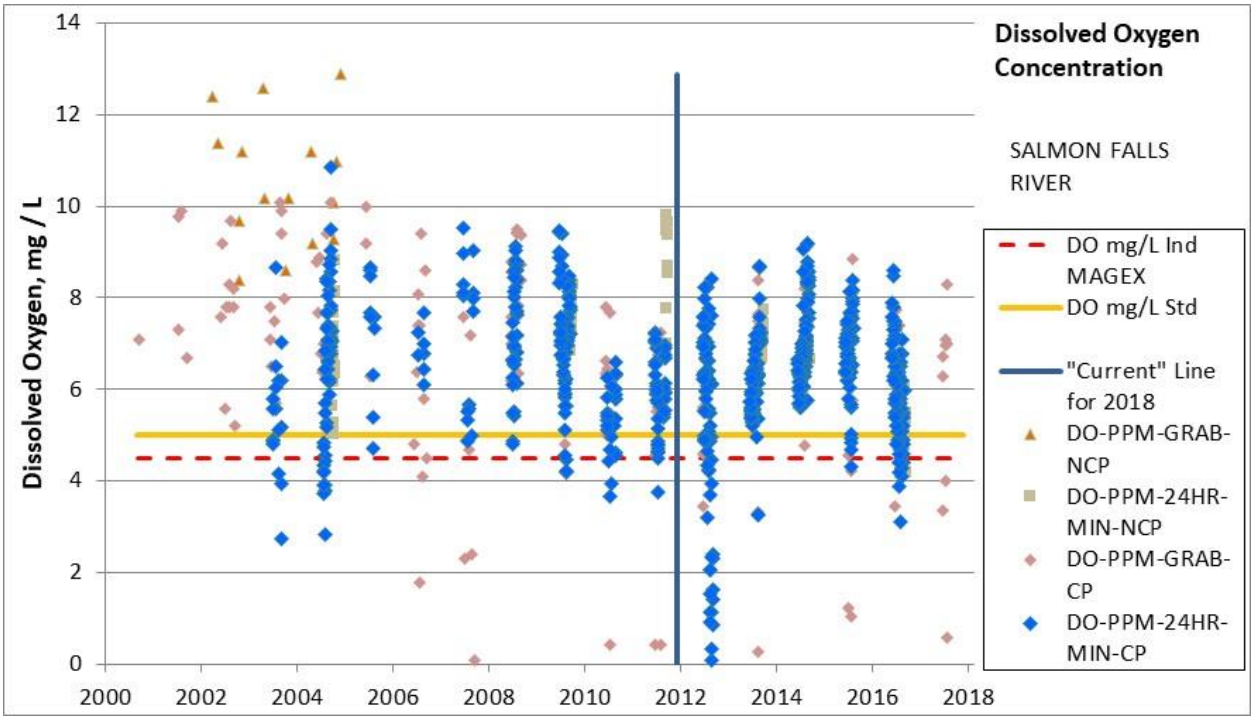
Assessment Zone = SALMON FALLS RIVER

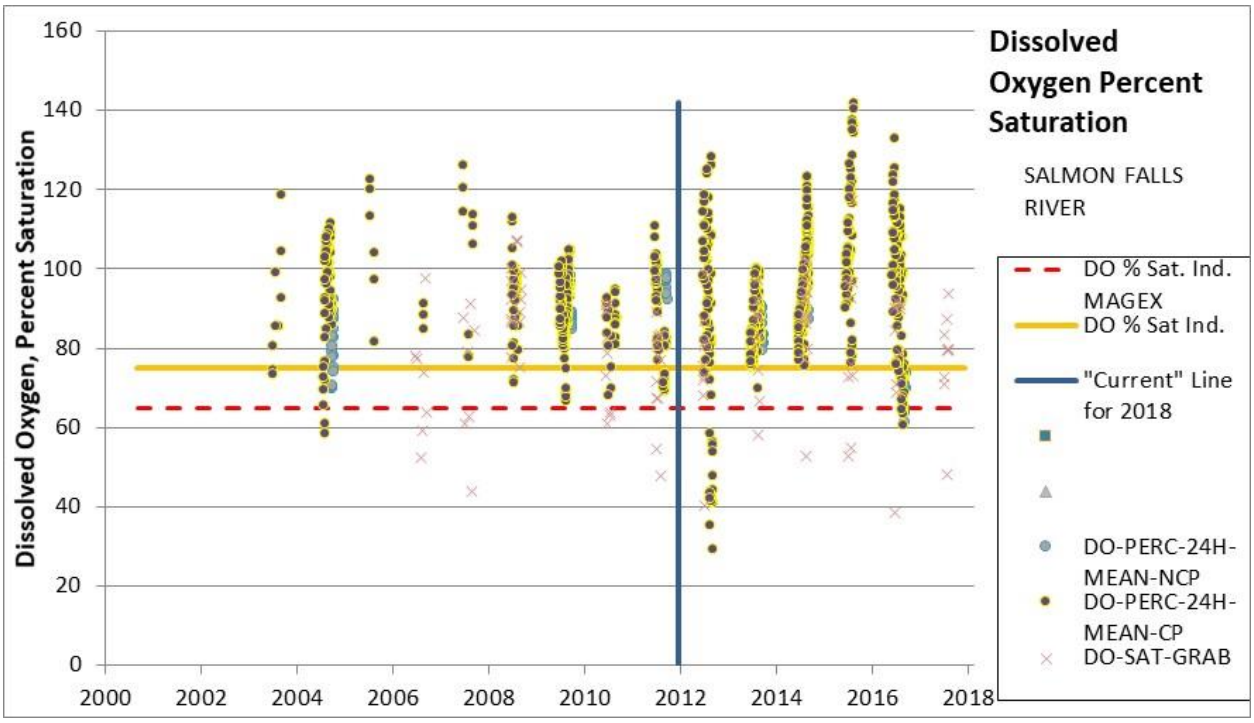
(NHEST600030406-01)

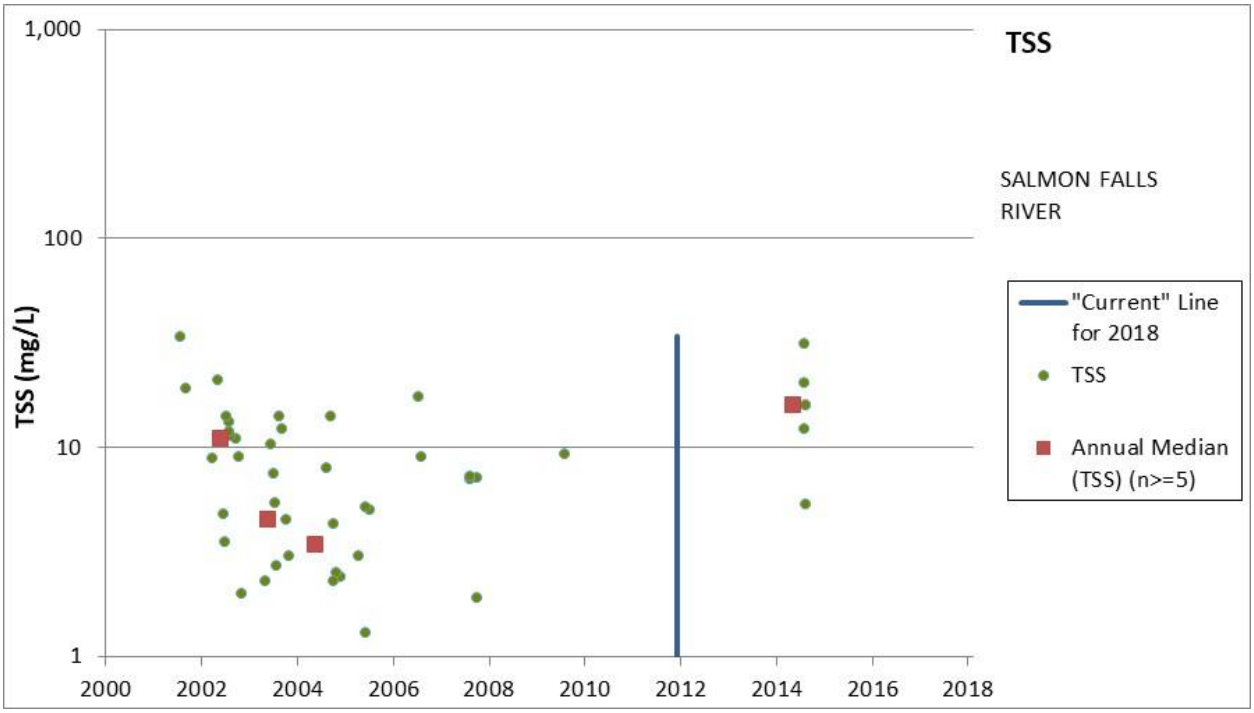
Indicator	Aquatic Life Use Category 2016 / 2018	2018 Comment
Chlorophyll-a	5-P / 5-P	The calculated 90th percentile chlorophyll-a in this assessment zone is 21.5 µg/L (n = 25) and a maximum reading of 31 µg/L. The chlorophyll-a indicator threshold to prevent low dissolved oxygen is a 90th percentile below 10 µg/L. Additionally, there are still frequent dissolved oxygen concentration criteria and percent saturation indicator exceedences.
Dissolved Oxygen (mg/L)	5-P / 5-P	Dissolved oxygen concentration measurements in this assessment zone fall below the 5 mg/L criteria every year. In most years a portion of those measurements fall below 4 mg/L and in 2012 there were many measurements below 1 mg/L, as such, this impairment is considered severe.
Dissolved Oxygen (% Saturation)	5-M / 5-M	Dissolved oxygen 24-hour average percent saturation measurements in this assessment zone fall below the 75% indicator every year. In 2012 many of the datalogger based 24-hour averages were below 50%. The indicator suggests that the aquatic life use is impaired, as such, dissolved oxygen 24-hour average percent saturation has been assessed as not supporting.
Estuarine Bioassessments (eelgrass)	No Std / No Std	Not applicable. Eelgrass habitat has not historically existed in this assessment zone.
Water Clarity (Light Attenuation Coefficient)	No Std / No Std	Not applicable. The water clarity has not been assessed because eelgrass has not historically existed in this assessment zone.
Total Nitrogen	5-M / 5-M	The median total nitrogen from 2012 through 2017 was 620 µg/L (n=60). This assessment zone experiences frequent dissolved oxygen concentrations well below 5 mg/L and daily average saturation below 75%. During multiple years this assessment zone also demonstrated super saturation well over 125% The chlorophyll-a concentration 90th percentile was 21.5 µg/L (n = 25) and a maximum reading of 31 µg/L. Many of the classic indicators of nutrient eutrophication are present in this assessment zone. As such, the impairment for nitrogen has been retained.

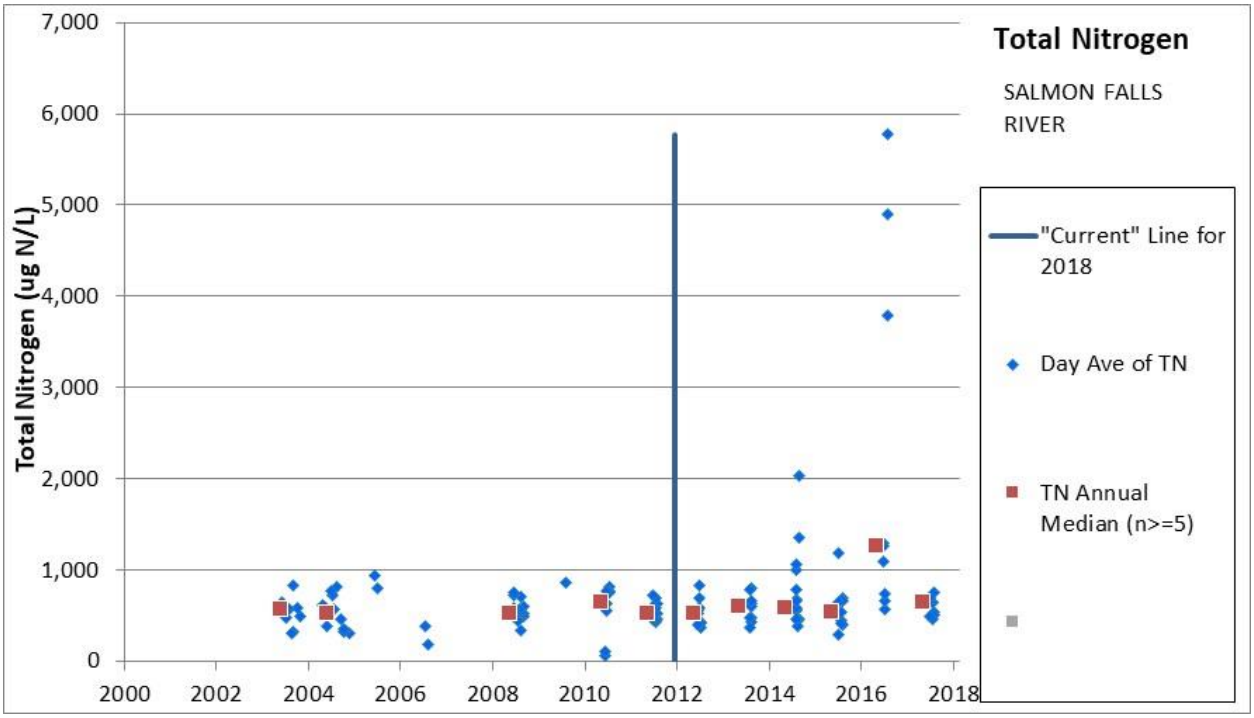

Chlorophyll-a
SALMON FALLS RIVER
ug Chl-a / L
60
50
40
30
20
10
0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Chl-a Ind. (90th percentile)
"Current" Line for 2018
Chlorophyll a, Corected for Pheophytin
Chlorophyll a, Uncorected for Pheophytin
Annual 90th Percentile (n>=9)


Chlorophyll-a
SALMON FALLS RIVER
ug Chl-a / L
100.00
10.00
1.00
0.10
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Chl-a Ind. (90th percentile)
"Current" Line for 2018
Chlorophyll a, Corected for Pheophytin
Chlorophyll a, Uncorected for Pheophytin
Annual 90th Percentile (n>=9)


Dissolved Oxygen Concentration
SALMON FALLS RIVER
Dissolved Oxygen, mg / L
DO mg/L Ind MAGEX
DO mg/L Std
"Current" Line for 2018
DO-PPM-GRAB-NCP
DO-PPM-24HR-MIN-NCP
DO-PPM-GRAB-CP
DO-PPM-24HR-MIN-CP


Dissolved Oxygen Percent Saturation
SALMON FALLS RIVER
Dissolved Oxygen, Percent Saturation
DO % Sat. Ind. MAGEX
DO % Sat Ind.
"Current" Line for 2018
DO-PERC-24H-MEAN-NCP
DO-PERC-24H-MEAN-CP
DO-SAT-GRAB


TSS
SALMON FALLS RIVER
TSS (mg/L)
1,000
100
10
1
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
"Current" Line for 2018
TSS
Annual Median (TSS) (n>=5)


Total Nitrogen
SALMON FALLS RIVER
Total Nitrogen (ug N/L)
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
"Current" Line for 2018
Day Ave of TN
TN Annual Median (n>=5)

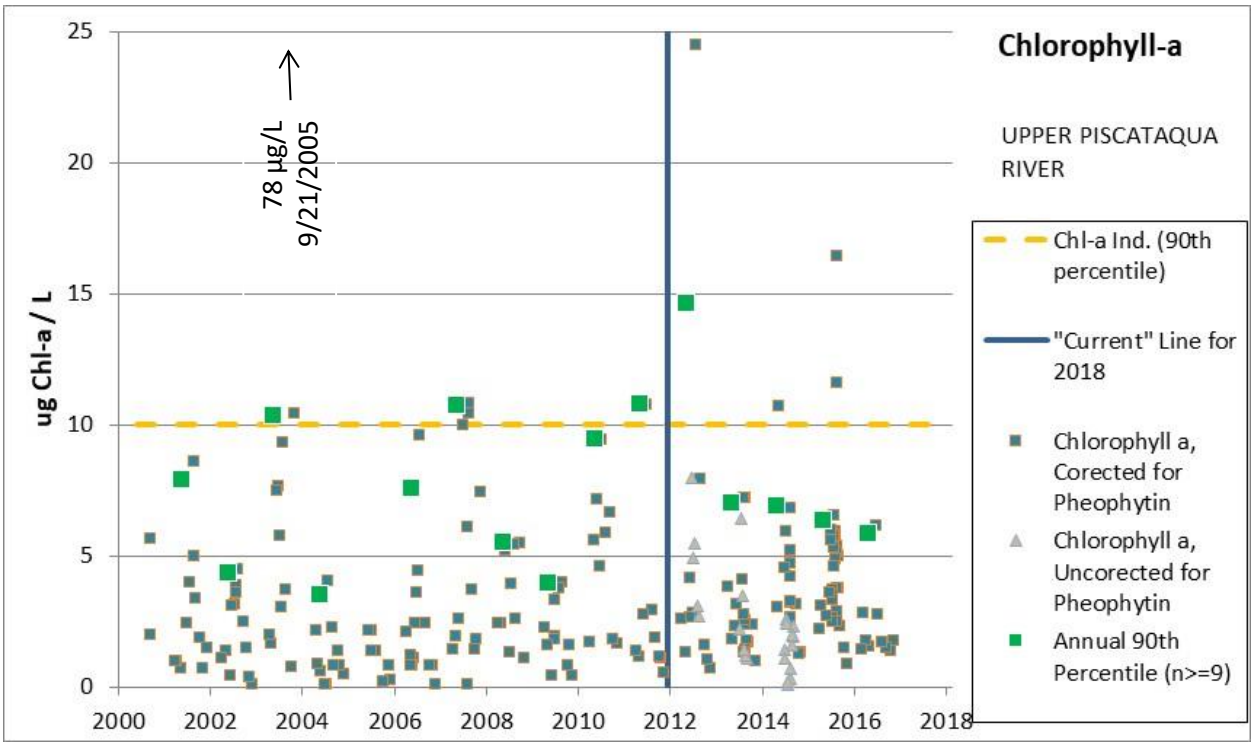
Salmon Falls River Assessment Zone (1/1/2012-5/25/2018)	**Count**	**Minimum**	**Median**	**90th Percentile**	**Maximum**
CHLOROPHYLL A, CORRECTED FOR PHEOPHYTIN (µg/L)	8	4.5	5.8	-	7.9
CHLOROPHYLL A, UNCORRECTED FOR PHEOPHYTIN (µg/L)	17	3.7	7.4	27.9	31.0
CHLOROPHYLL A, Combined (µg/L)	25	3.7	6.7	21.5	31.0
LIGHT ATTENUATION COEFFICIENT (1/m)	6	1.108	1.279	-	1.580
TURBIDITY (NTU)	454	0.0	2.8	7.9	332.2
COLORED DISSOLVED ORGANIC MATTER (CDOM) (1/m)	0	-	-	-	-
TSS (mg/L)	6	5.4	15.9	-	31.5
DO-PPM-24HR-MIN-CP (mg/L)	427	0.1	6.4	7.9	9.2
DO-PPM-24HR-MIN-NCP (mg/L)	28	4.2	7.0	7.5	7.8
DO-PPM-GRAB-CP (mg/L)	58	0.3	6.7	8.2	9.1
DO-PPM-GRAB-NCP (mg/L)	0	-	-	-	-
DO-PERC-24H-MEAN-CP (% sat)	416	29.4	94.7	115.5	141.9
DO-PERC-24H-MEAN-NCP (% sat)	24	61.4	81.8	90.2	90.8
DO-PERC-2TIDE-GRAB-CP (% sat)	0	-	-	-	-
DO-PERC-2TIDE-GRAB-NCP (% sat)	0	-	-	-	-
DO-PERC-GRAB (% sat)	58	38.7	82.5	97.5	117.2
Day Ave of TN (µg N/L)	60	300	620	1,287	5,775
Day Ave of TDN (µg N/L)	0	-	-	-	-
Day Ave of DIN (NH3 + NO2/3) (µg N/L)	56	60	223	408	689
Day Ave of NH3 (µg N/L)	58	5	100	191	251
Day Ave of PON (µg N/L)	0	-	-	-	-
Day Ave of NO2/3 (µg N/L)	57	25	130	274	491
SALINITY-Grabs (pss)	48	0	11	20	23
SALINITY-Datalogger Daily Median (pss)	409	0	18	22	27

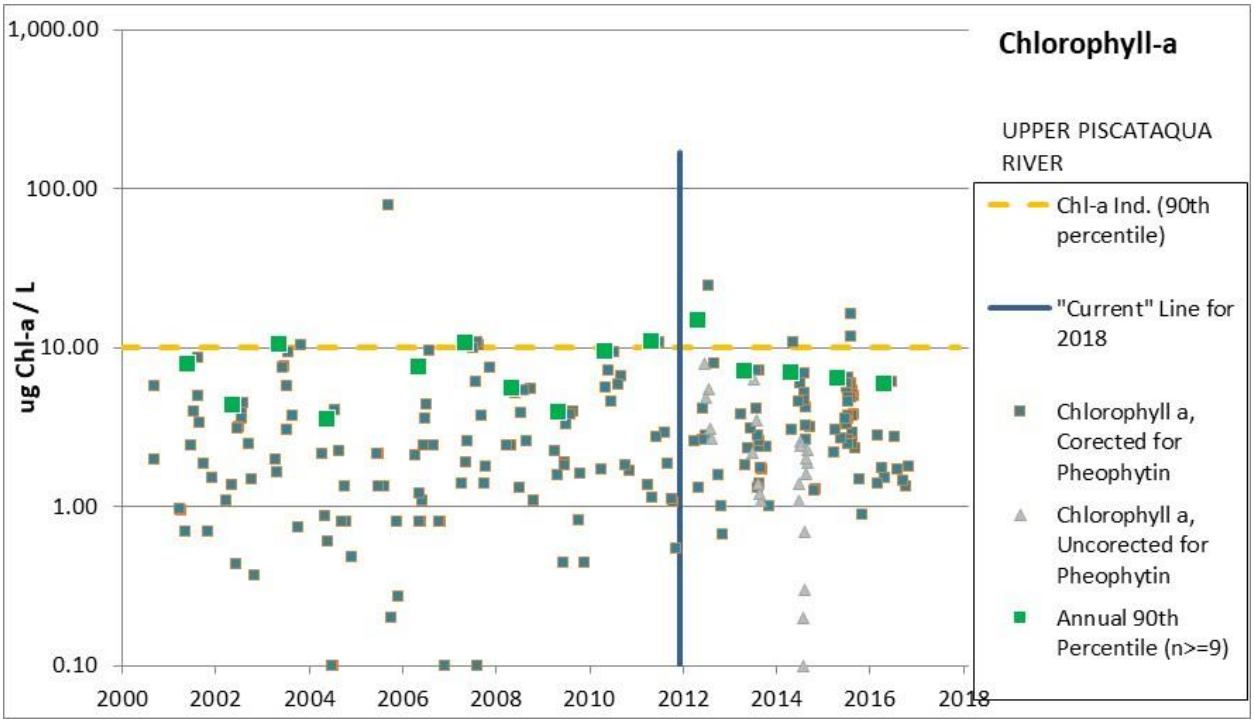
Assessment Zone = UPPER PISCATAQUA RIVER

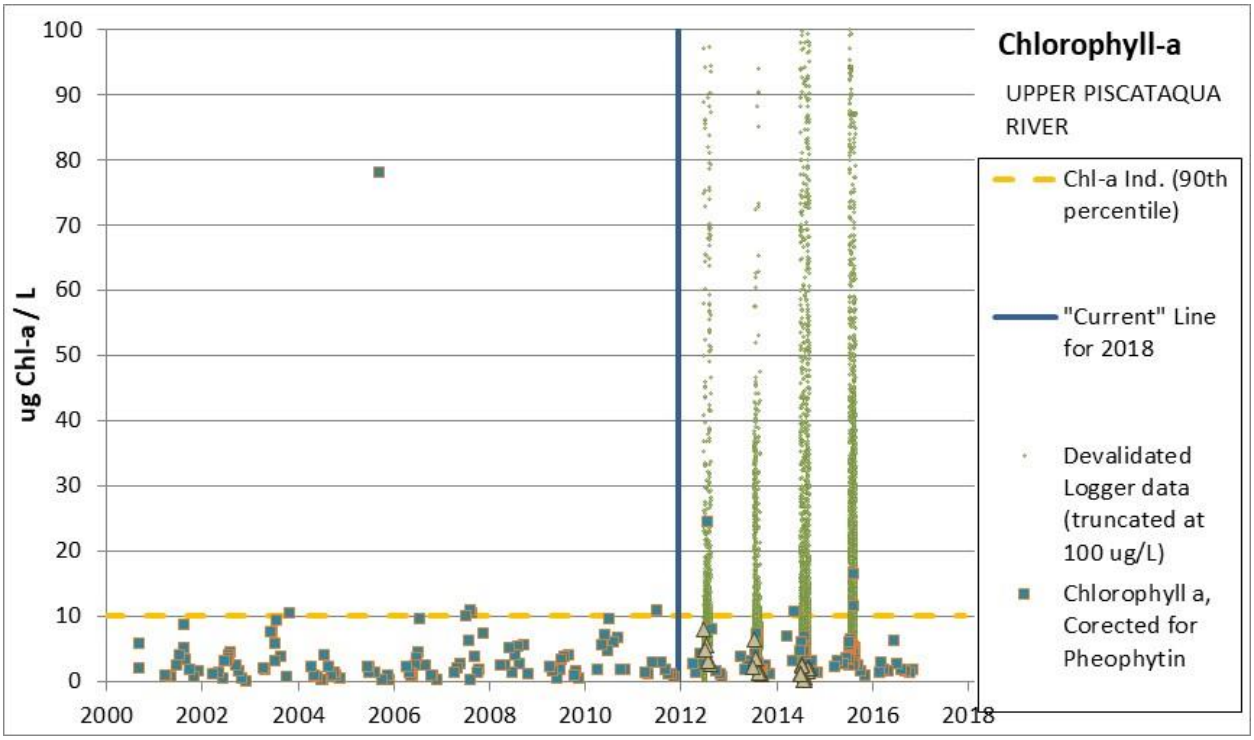
(NHEST600031001-01-01, NHEST600031001-01-02, NHEST600031001-01-03)

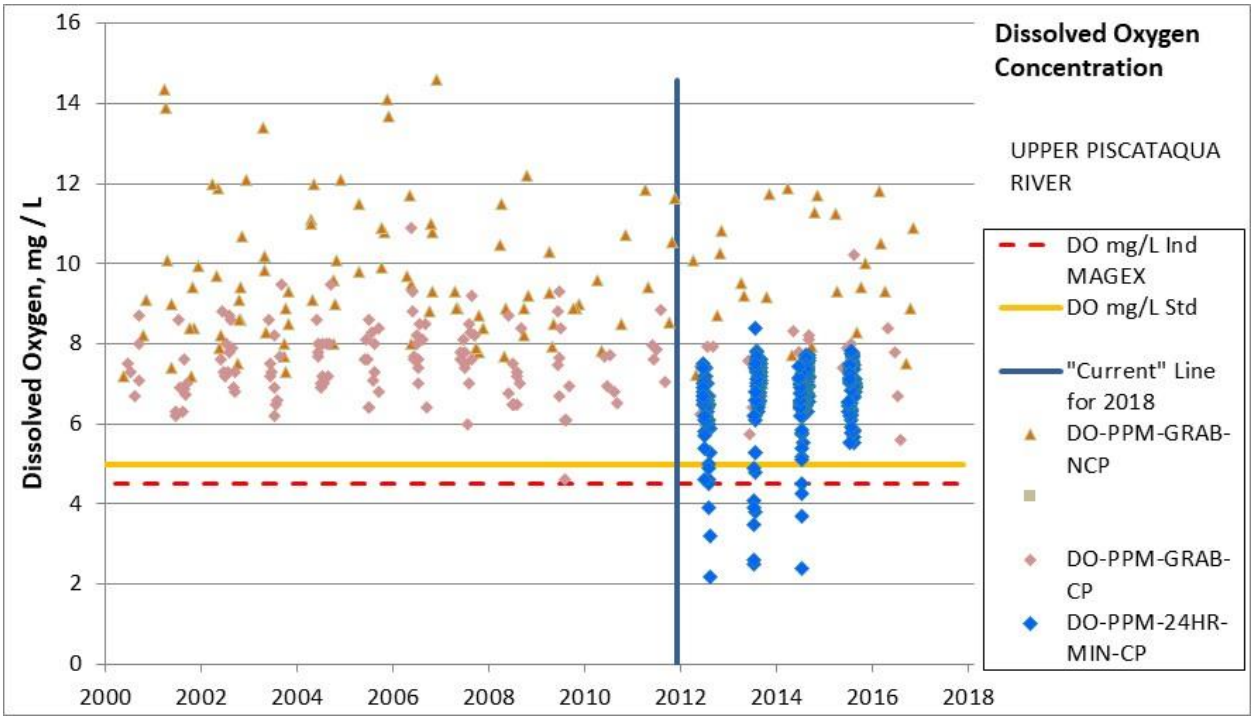
Indicator	Aquatic Life Use Category 2016 / 2018	2018 Comment
Chlorophyll-a	2-M / 2-M	The calculated 90th percentile chlorophyll-a in this assessment zone is 6.6 µg/L (n = 107) and a maximum reading of 24.5 µg/L. Although the probe based chlorophyll-a data (not used in the median above) collected from the UPR stations was qualified as "estimated" due to poor correlation between probe and extracted chlorophyll-a grab sample data, the relative biomass is valid and shows severe spikes in chlorophyll-a. The chlorophyll-a indicator threshold to prevent low dissolved oxygen is a 90th percentile below 10 µg/L.
Dissolved Oxygen (mg/L)	3-PNS / 3-PNS	Before 2012, only grab samples of dissolved oxygen had been collected in the Upper Piscataqua River assessment zone. In the case of this assessment zone there are 383 station/days of datalogger DO readings during the critical summer period. From that overall dataset we see that from 2012 to 2014 there were 19 days on which DO fell below 5 mg/L for 0.25 to 2.75 hours; there were 10 days on which DO fell below 4 mg/L for 0.25 to 2.25 hours; and there were four days on which DO fell below 3 mg/L for 0.25 to 0.5 hours. While similar to the Cocheco River, these low DO events are both less frequent and of lower magnitude than was seen in the Cocheco River. The frequency, duration, and magnitude of those dips have not risen to the severity that warrants and impairment. Further, the 52-day 2015 dataset demonstrated that dissolved oxygen always stayed above 5.5 mg/L, in contrast to the same months (August and September) in 2012 through 2014, and under slightly warmer conditions that the earlier time period. Acknowledging the existing data, this assessment zone is being assessed as potentially not supporting the dissolved oxygen indicator.
Dissolved Oxygen (% Saturation)	2-G / 3-PAS	Full-support or non-support determinations are no longer made for dissolved oxygen percent saturation due to SB127 in 2017 amending three sections of RSA 485. This assessment zone has only grab sample measurements for dissolved oxygen 24-hour average percent saturation up until 2011. In 2012 through 2015 dataloggers were deployed and no 24-hour averages fell below 75%. The available data indicates that this assessment zone meets the dissolved oxygen saturation criteria.
Estuarine Bioassessments (eelgrass)	5-P / 5-P	The historical extent of eelgrass in this assessment zone was 79.7 acres from the 1948, 1962, 1980, and 1981 datasets. The median current extent of eelgrass in 2015-2017 is 0 acres, which is a decrease of 100%. Since 1990, the trend in eelgrass cover in this assessment zone is a loss of 67.6%. The thresholds for impairment are either loss of more than 20% of the historic extent of eelgrass or a recent trend of greater than 20% loss.
Water Clarity (Light Attenuation Coefficient)	5-P / 5-M	Median=1.025 m^-1 (n=83). For an eelgrass restoration depth of 2 m, the light attenuation coefficient threshold is 0.75 m^-1. This assessment zone historically had eelgrass growing in both the shallows and some in deeper habitat making the 2m restoration depth a valid target. Given how close the light attenuation coefficient is to the indicator and to be consistent with other parts of the estuary, the impaired status has been shifted to marginal (5-M).
Total Nitrogen	3-PNS / 3-PNS	The median total nitrogen from 2012 through 2016 was 355 µg/L (n=96). While the dissolved oxygen data shows that this assessment zone experiences short duration concentrations below the 5 mg/L criteria, they do not support an impairment determination for DO. The 24-hour average dissolved oxygen percent saturation did not fall below 75% in the available dataset. The calculated 90th percentile chlorophyll-a in this assessment zone is 6.6 µg/L (n = 107) and a maximum reading of 24.5 µg/L. Although the probe-based chlorophyll-a data (not used in the median above) collected from the UPR stations was qualified as "estimated" per USEPA, due to

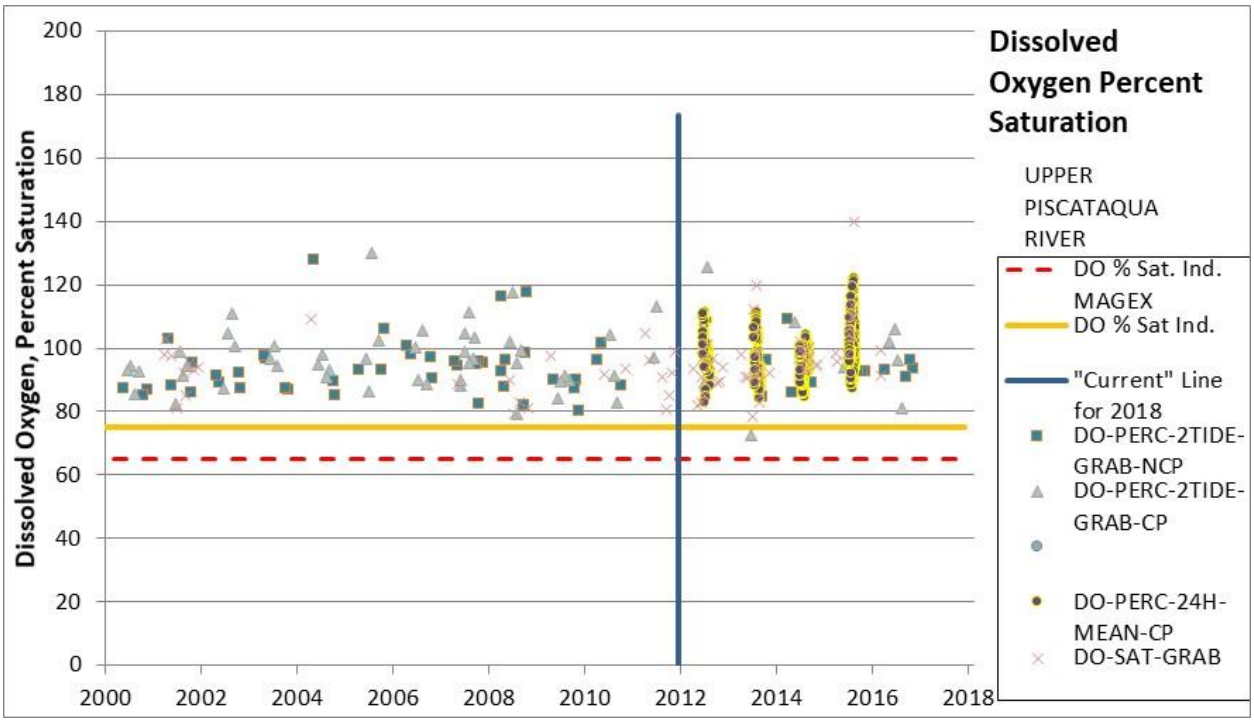
		poor correlation between probe and extracted chlorophyll-a grab sample data, the relative biomass is valid and shows large spikes in chlorophyll-a under certain conditions. The grab sample-based light attenuation (median=1.025 m^-1, n=83) is poor suggesting strong resuspension in the system. For shallow systems, it is expected that changes in macroalgae will precede changes in phytoplankton (McGlathery, Sundbäck, & Anderson, 2007) (Valiela, et al., 1997), as appears to be occurring in the Great Bay Estuary. The foremost authority on macroalgae for this estuary, Dr. Arthur C. Mathieson, commented on the draft 2012 303(d) that he remains concerned about the macroalgae and epiphyte conditions in Great Bay estuary (NHDES, 2013). At this time there are some of the classic indicators of nutrient eutrophication present in this assessment zone and total nitrogen remains high. However, there are insufficient response datasets to determine that the eutrophication by total nitrogen alone is not known to be strong enough to warrant impairment under New Hampshire's narrative standard. Additionally, the nutrient load to this assessment zone is rapidly decreasing due to ongoing work by the municipalities (Rochester reductions in 2014 and Dover began reductions in 2015). As such, this assessment zone has been assessed as Insufficient Information – Potentially Not Supporting (3-PNS) for total nitrogen.

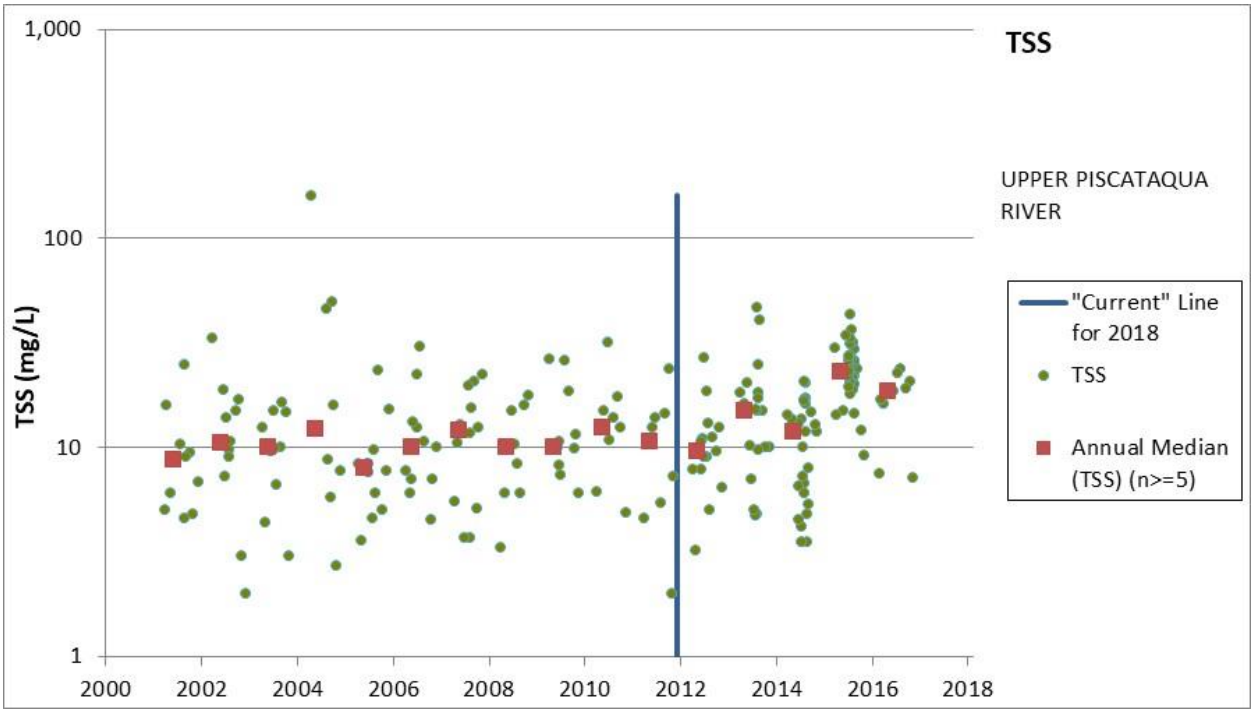


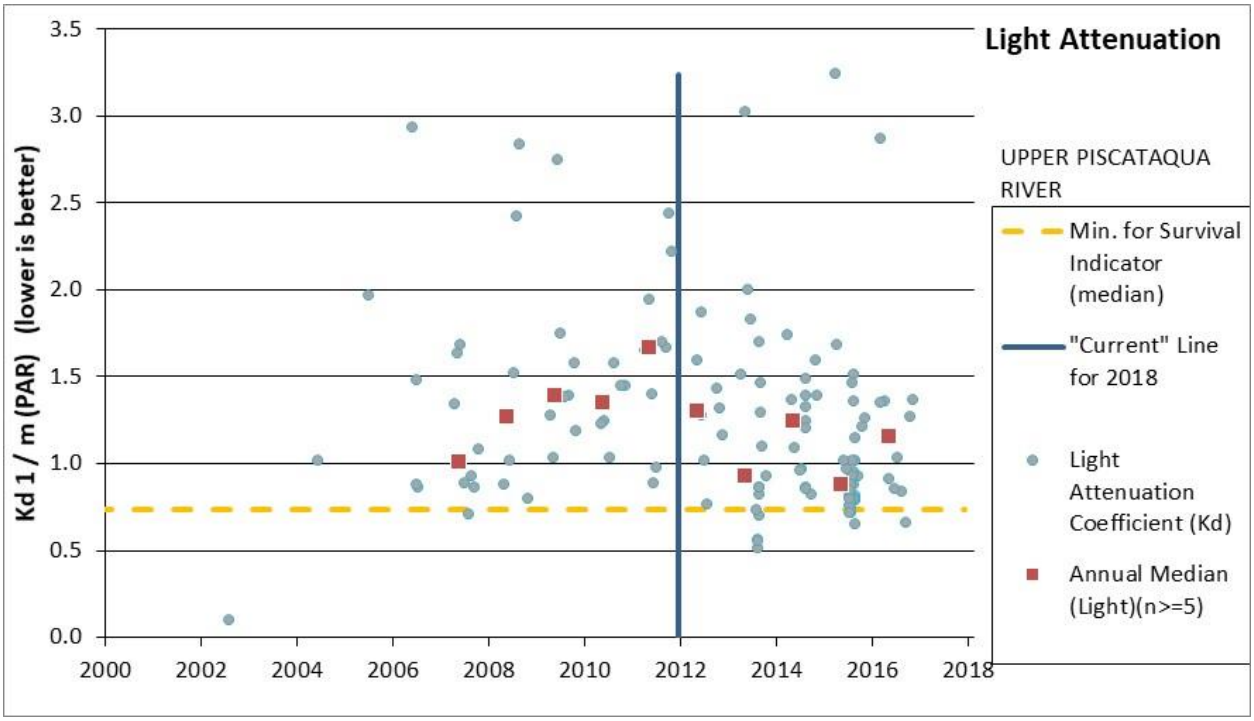

Chlorophyll-a
UPPER PISCATAQUA RIVER
ug Chl-a / L
1,000.00
100.00
10.00
1.00
0.10
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Chl-a Ind. (90th percentile)
"Current" Line for 2018
Chlorophyll a, Corected for Pheophytin
Chlorophyll a, Uncorected for Pheophytin
Annual 90th Percentile (n>=9)

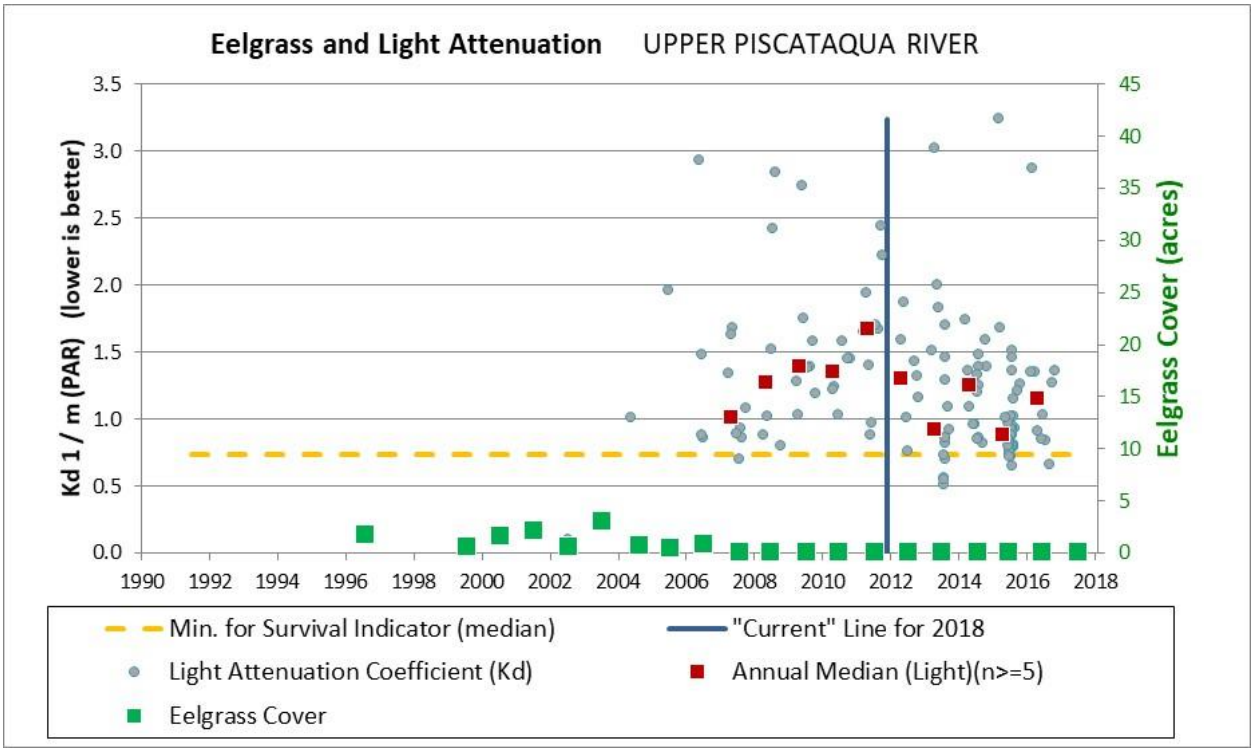

Chlorophyll-a
UPPER PISCATAQUA RIVER
ug Chl-a / L
100
90
80
70
60
50
40
30
20
10
0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Chl-a Ind. (90th percentile)
"Current" Line for 2018
Devalidated Logger data (truncated at 100 ug/L)
Chlorophyll a, Corected for Pheophytin

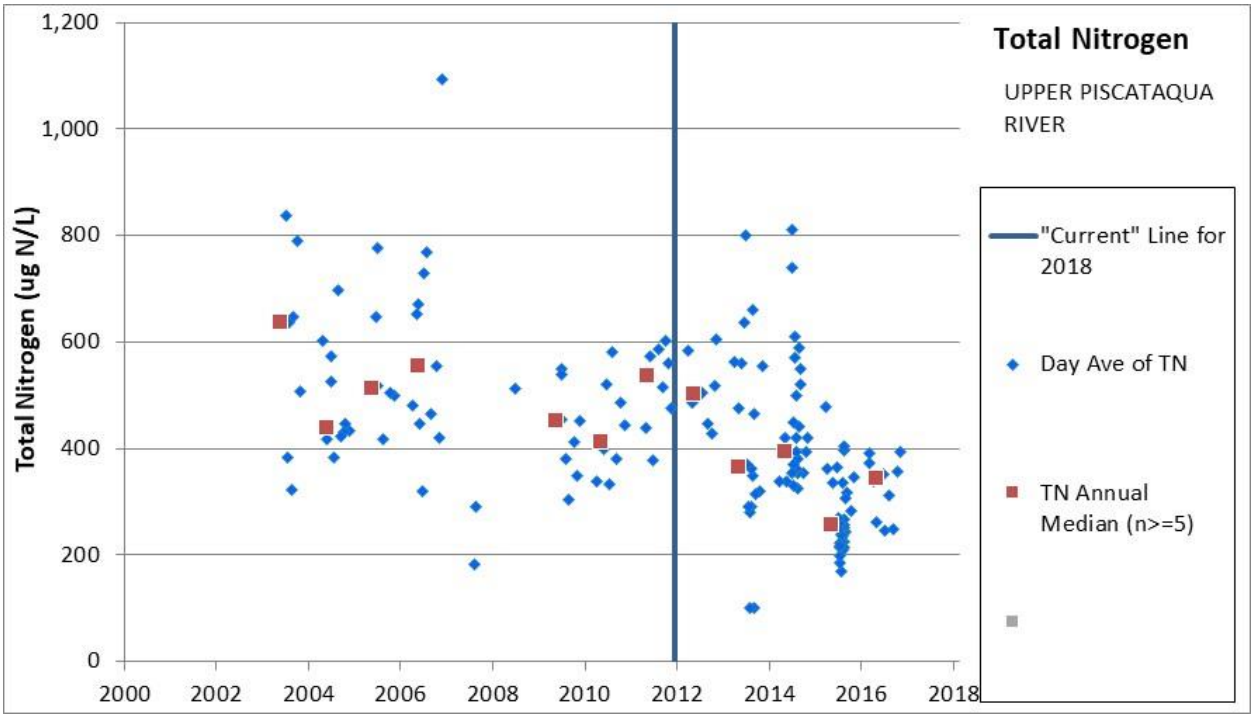

Dissolved Oxygen Concentration
UPPER PISCATAQUA RIVER
Dissolved Oxygen, mg / L
DO mg/L Ind MAGEX
DO mg/L Std
"Current" Line for 2018
DO-PPM-GRAB-NCP
DO-PPM-GRAB-CP
DO-PPM-24HR-MIN-CP


Dissolved Oxygen Percent Saturation
UPPER PISCATAQUA RIVER
Dissolved Oxygen, Percent Saturation
DO % Sat. Ind. MAGEX
DO % Sat Ind.
"Current" Line for 2018
DO-PERC-2TIDE-GRAB-NCP
DO-PERC-2TIDE-GRAB-CP
DO-PERC-24H-MEAN-CP
DO-SAT-GRAB


TSS
UPPER PISCATAQUA RIVER
TSS (mg/L)
1,000
100
10
1
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
"Current" Line for 2018
TSS
Annual Median (TSS) (n>=5)


Light Attenuation
UPPER PISCATAQUA RIVER
Kd 1 / m (PAR) (lower is better)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Min. for Survival Indicator (median)
"Current" Line for 2018
Light Attenuation Coefficient (Kd)
Annual Median (Light)(n>=5)


Eelgrass and Light Attenuation
UPPER PISCATAQUA RIVER
Kd 1 / m (PAR) (lower is better)
Eelgrass Cover (acres)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
45
40
35
30
25
20
15
10
5
0
1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016 2018
Min. for Survival Indicator (median)
"Current" Line for 2018
Light Attenuation Coefficient (Kd)
Annual Median (Light)(n>=5)
Eelgrass Cover

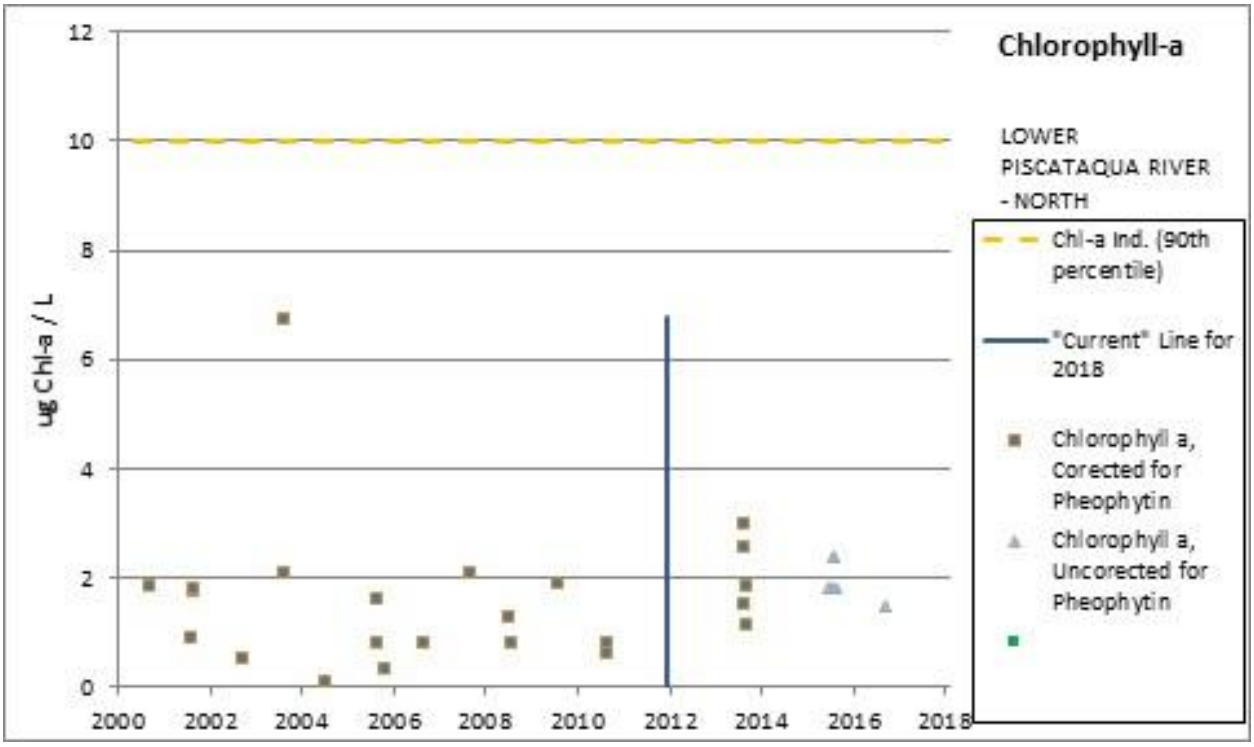

Total Nitrogen
UPPER PISCATAQUA RIVER
Total Nitrogen (ug N/L)
1,200
1,000
800
600
400
200
0
2000 2002 2004 2006 2008 2010 2012 2014 2016 2018
"Current" Line for 2018
Day Ave of TN
TN Annual Median (n>=5)

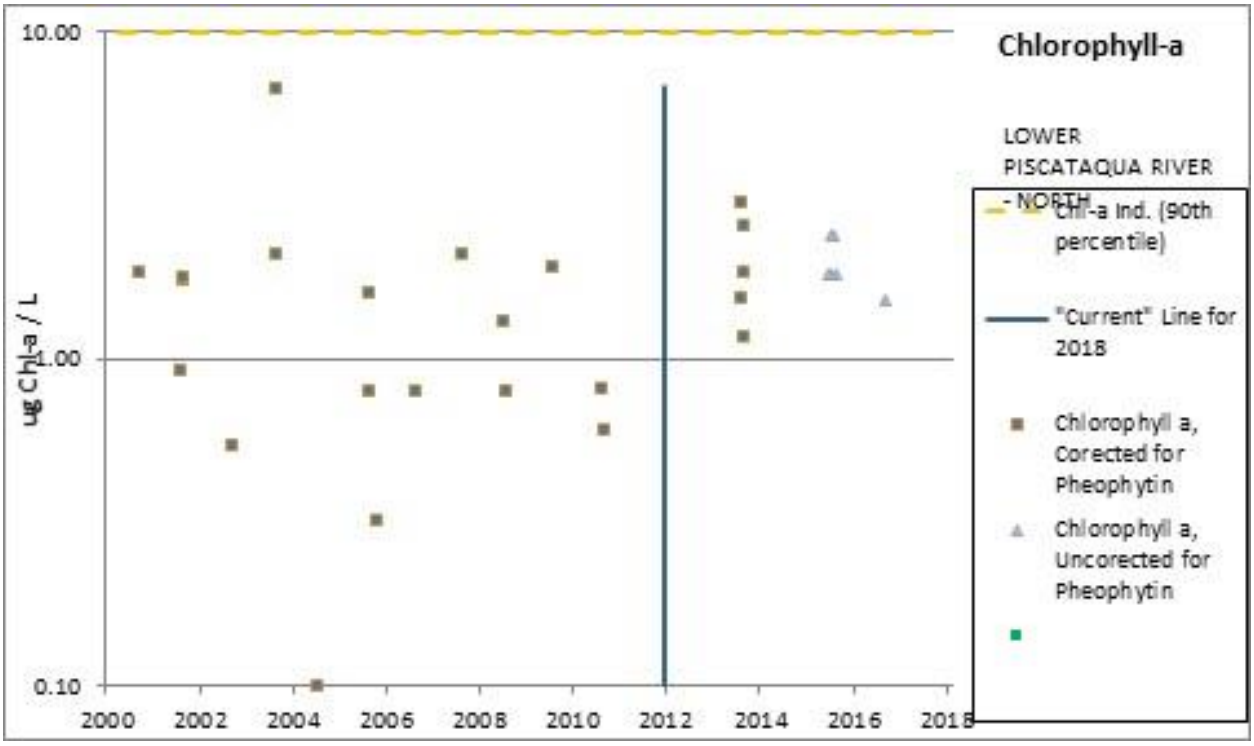
Upper Piscataqua River Assessment Zone (1/1/2012-5/25/2018)	**Count**	**Minimum**	**Median**	**90th Percentile**	**Maximum**
CHLOROPHYLL A, CORRECTED FOR PHEOPHYTIN (µg/L)	84	0.7	3.1	6.9	24.5
CHLOROPHYLL A, UNCORRECTED FOR PHEOPHYTIN (µg/L)	23	0.1	2.0	6.0	8.0
CHLOROPHYLL A, Combined (µg/L)	107	0.1	2.8	6.6	24.5
LIGHT ATTENUATION COEFFICIENT (1/m)	83	0.520	1.025	1.702	3.250
TURBIDITY (NTU)	128	1.1	4.0	7.0	15.5
COLORED DISSOLVED ORGANIC MATTER (CDOM) (1/m)	0	-	-	-	-
TSS (mg/L)	104	3.2	15.6	28.7	46.9
DO-PPM-24HR-MIN-CP (mg/L)	353	2.2	6.8	7.5	8.4
DO-PPM-24HR-MIN-NCP (mg/L)	0	-	-	-	-
DO-PPM-GRAB-CP (mg/L)	34	5.6	7.3	8.4	10.2
DO-PPM-GRAB-NCP (mg/L)	26	7.0	9.5	11.8	11.9
DO-PERC-24H-MEAN-CP (% sat)	353	83.0	95.8	108.5	122.0
DO-PERC-24H-MEAN-NCP (% sat)	0	-	-	-	-
DO-PERC-2TIDE-GRAB-CP (% sat)	12	72.5	96.7	122.3	125.5
DO-PERC-2TIDE-GRAB-NCP (% sat)	12	84.6	92.7	105.3	109.2
DO-PERC-GRAB (% sat)	51	78.5	96.2	110.1	139.7
Day Ave of TN (µg N/L)	96	100	355	574	810
Day Ave of TDN (µg N/L)	73	121	252	434	551
Day Ave of DIN (NH3 + NO2/3) (µg N/L)	97	5	107	250	425
Day Ave of NH3 (µg N/L)	99	3	30	65	500
Day Ave of PON (µg N/L)	26	37	76	221	284
Day Ave of NO2/3 (µg N/L)	97	2	70	204	386
SALINITY-Grabs (pss)	170	1	24	30	31
SALINITY-Datalogger Daily Median (pss)	383	10	27	30	31

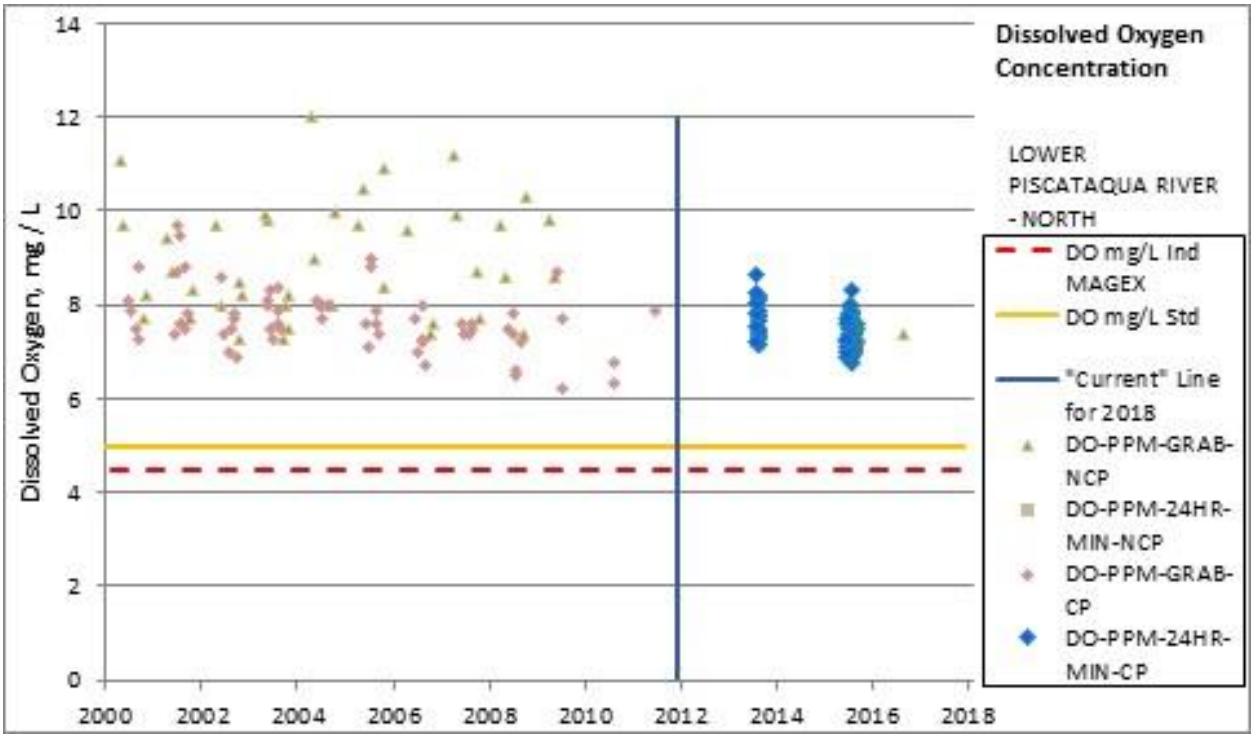
Assessment Zone = LOWER PISCATAQUA RIVER - NORTH

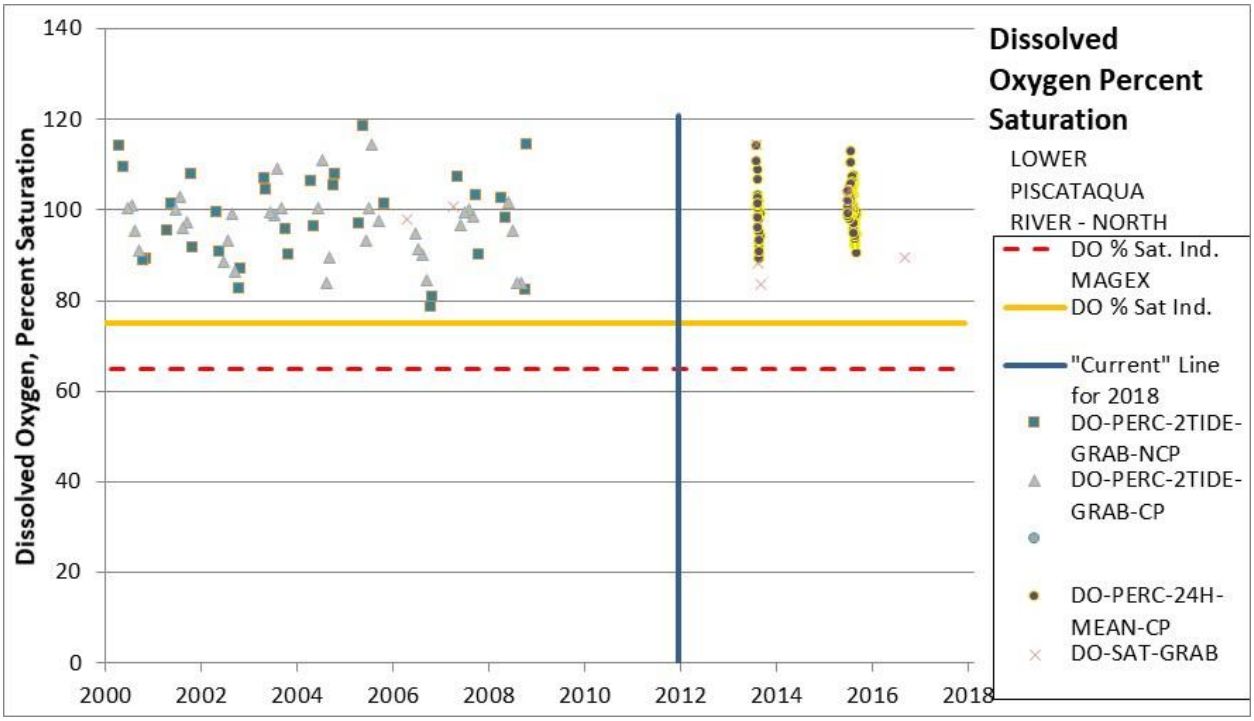
(NHEST600031001-02-01)

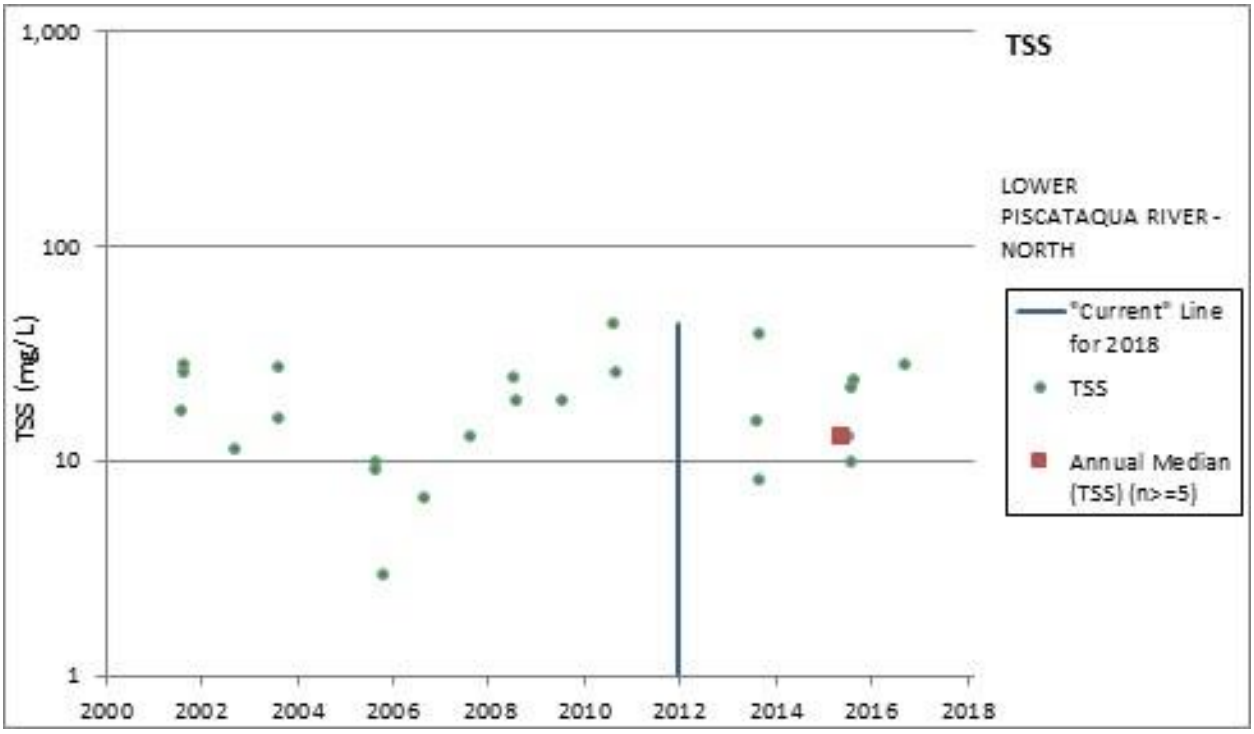
Indicator	Aquatic Life Use Category 2016 / 2018	2018 Comment
Chlorophyll-a	3-PAS / 2-G	The calculated 90th percentile chlorophyll-a in this assessment zone is 2.9 µg/L (n = 11) and a maximum reading of 3 µg/L. The chlorophyll-a indicator threshold to prevent low dissolved oxygen is a 90th percentile below 10 µg/L. The available data leads to an assessment of Full Support.
Dissolved Oxygen (mg/L)	2-G / 2-G	This assessment zone had a datalogger deployment in 2013 and 2015. During those periods no dissolved oxygen concentration measurements fell below 5 mg/L. The available data indicates that this assessment zone meets the dissolved oxygen concentration criteria.
Dissolved Oxygen (% Saturation)	2-G / 3-PAS	Full-support or non-support determinations are no longer made for dissolved oxygen percent saturation due to SB127 in 2017 amending three sections of RSA 485. This assessment zone had datalogger deployments in 2013 and 2015. During those periods no 24 hour averages fell below 75%. The available data indicates that this assessment zone meets the dissolved oxygen saturation indicator.
Estuarine Bioassessments (eelgrass)	5-P / 5-P	The historical extent of eelgrass in this assessment zone was 60.1 acres from the 1948, 1962, 1980, and 1981 datasets. The median current extent of eelgrass in 2015-2017 is 0 acres, which is a decrease of 100%. Since 1990, the trend in eelgrass cover in this assessment zone is a loss of 67.6%. The thresholds for impairment are either loss of more than 20% of the historic extent of eelgrass or a recent trend of greater than 20% loss.
Water Clarity (Light Attenuation Coefficient)	3-PNS/ 3-PNS	Median=0.765 m^-1 (n=4). For an eelgrass restoration depth of 2 m, the light attenuation coefficient threshold is 0.75 m^-1. This assessment zone historically had eelgrass growing in both the shallows and deeper habitat making the 2m restoration depth a valid target. Therefore, the insufficient information – potentially not supporting (3-PNS) assessment from the 2016 305(b) assessment has been retained due to the scarcity of data.
Total Nitrogen	3-PAS / 3-PAS	The median total nitrogen from 2012 through 2015 was 268 µg/L (n=4). There are no documented dissolved oxygen concentration or saturation criteria exceedences in the available data. The limited chlorophyll-a data suggests that this assessment zone would meet chlorophyll-a indicator to protect dissolved oxygen. The eelgrass beds are severely degraded and the limited available light attenuation (median=0.765 m^-1, n=4) just over the indicator threshold. There are insufficient data to indicate that the eutrophication is strong enough to warrant a total nitrogen impairment. As such, the assessment zone has been assessed as insufficient information-potential attaining standards for nitrogen.

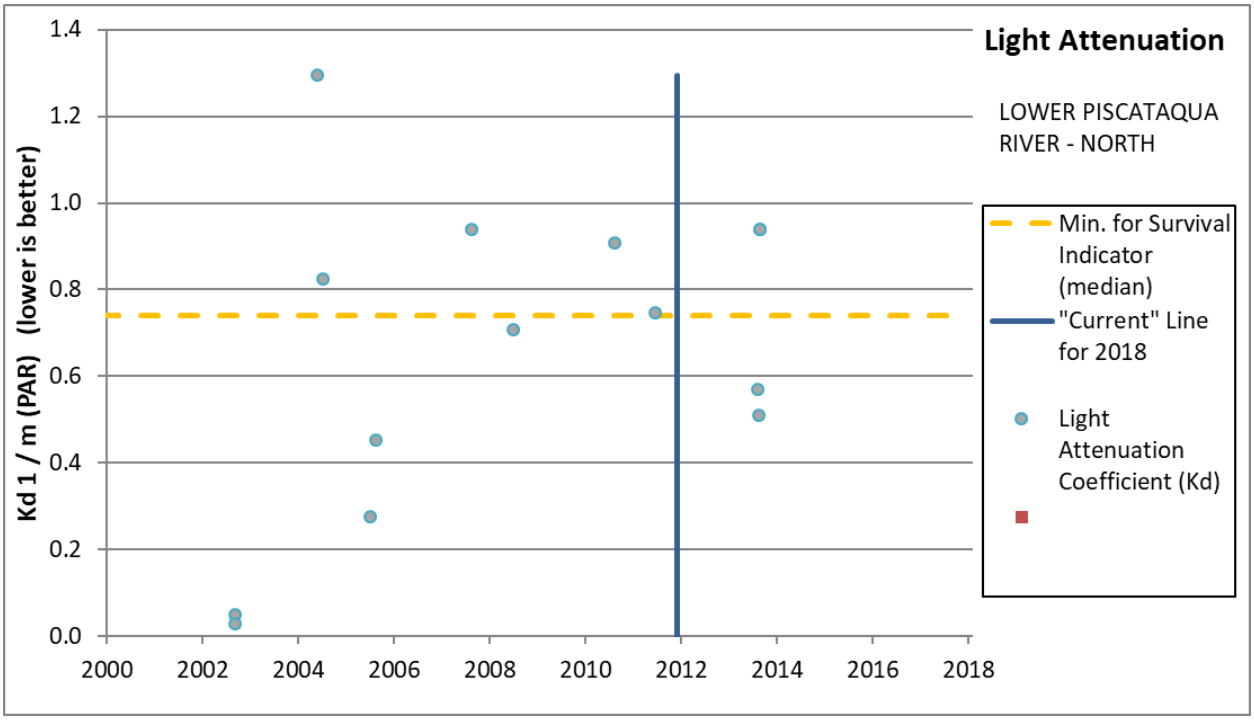

Chlorophyll-a
LOWER PISCATAQUA RIVER - NORTH
ug Chl-a / L
12
10
8
6
4
2
0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Chl-a Ind. (90th percentile)
"Current" Line for 2018
Chlorophyll a, Corected for Pheophytin
Chlorophyll a, Uncorected for Pheophytin

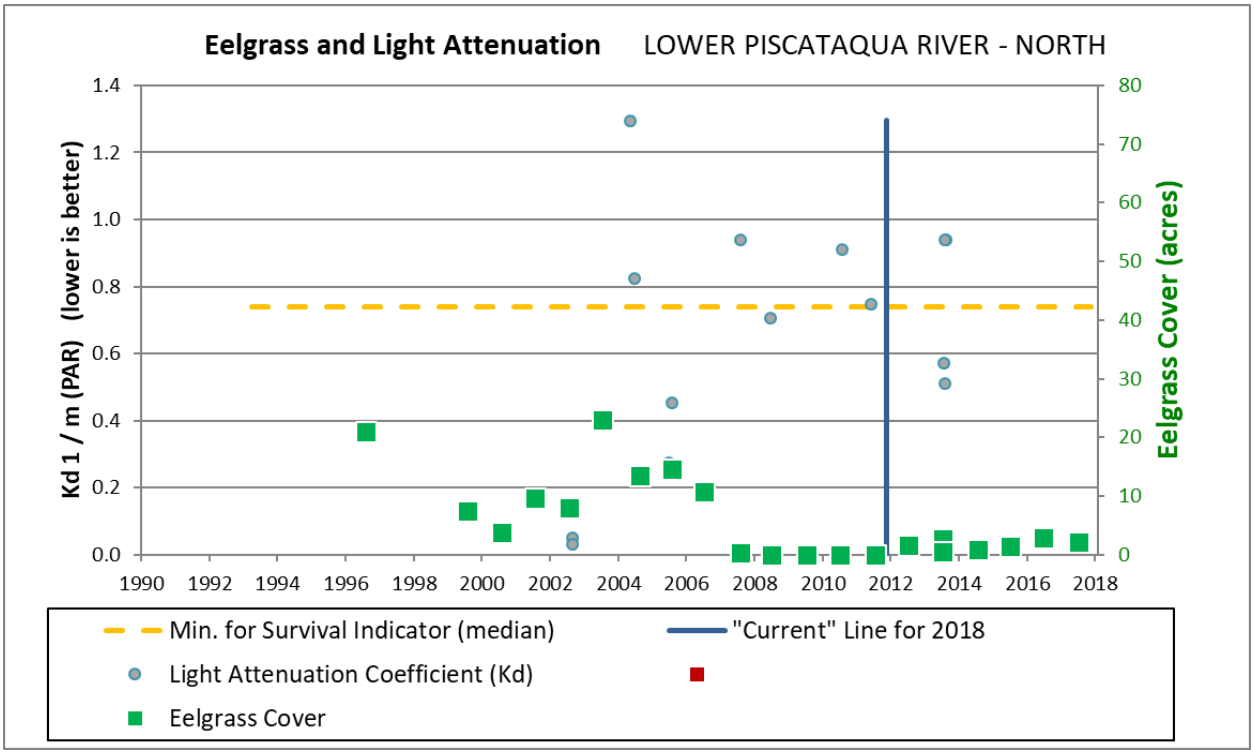

Chlorophyll-a
LOWER PISCATAQUA RIVER - NORTH
ug Chl-a / L
10.00
1.00
0.10
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Chl-a Ind. (90th percentile)
"Current" Line for 2018
Chlorophyll a, Corected for Pheophytin
Chlorophyll a, Uncorected for Pheophytin

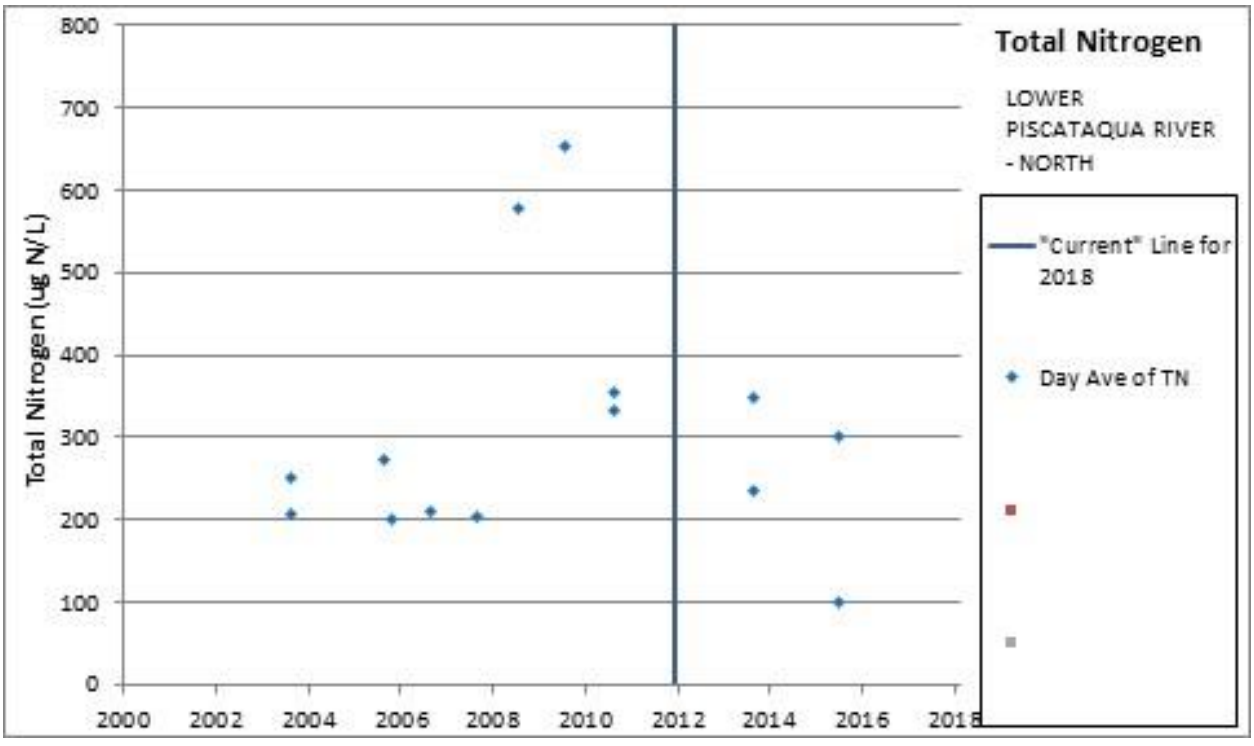

Dissolved Oxygen Concentration
Dissolved Oxygen, mg / L
0
2
4
6
8
10
12
14
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
LOWER PISCATAQUA RIVER - NORTH
DO mg/L Ind MAGEX
DO mg/L Std
"Current" Line for 2018
DO-PPM-GRAB-NCP
DO-PPM-24HR-MIN-NCP
DO-PPM-GRAB-CP
DO-PPM-24HR-MIN-CP


Dissolved Oxygen Percent Saturation
Dissolved Oxygen, Percent Saturation
0
20
40
60
80
100
120
140
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
LOWER PISCATAQUA RIVER - NORTH
DO % Sat. Ind. MAGEX
DO % Sat Ind.
"Current" Line for 2018
DO-PERC-2TIDE-GRAB-NCP
DO-PERC-2TIDE-GRAB-CP
DO-PERC-24H-MEAN-CP
DO-SAT-GRAB


TSS
LOWER PISCATAQUA RIVER - NORTH
"Current" Line for 2018
TSS
Annual Median (TSS) (n>=5)
TSS (mg/L)
1,000
100
10
1
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018


Light Attenuation
LOWER PISCATAQUA RIVER - NORTH
Min. for Survival Indicator (median)
"Current" Line for 2018
Light Attenuation Coefficient (Kd)
Kd 1 / m (PAR) (lower is better)
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018


Eelgrass and Light Attenuation
LOWER PISCATAQUA RIVER - NORTH
Kd 1 / m (PAR) (lower is better)
Eelgrass Cover (acres)
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
80
70
60
50
40
30
20
10
0
1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016 2018
Min. for Survival Indicator (median)
"Current" Line for 2018
Light Attenuation Coefficient (Kd)
Eelgrass Cover

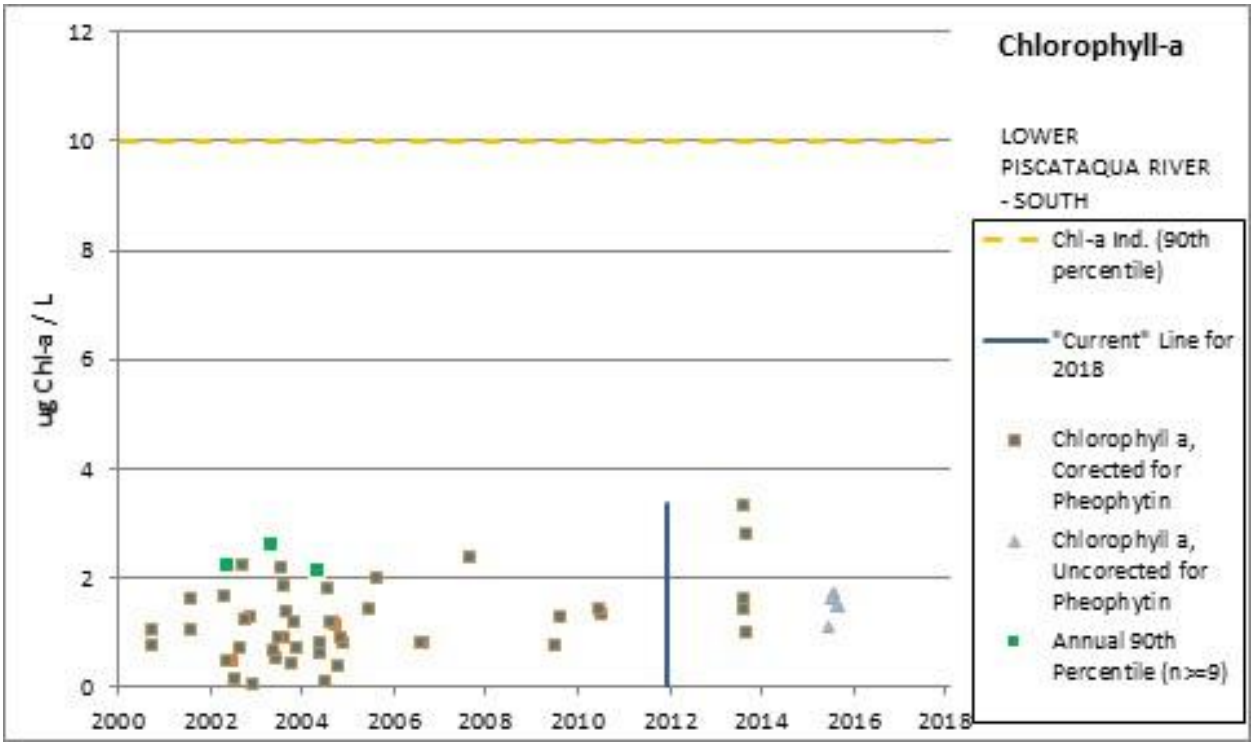

Total Nitrogen
LOWER PISCATAQUA RIVER - NORTH
Total Nitrogen (ug N/L)
800
700
600
500
400
300
200
100
0
2000 2002 2004 2006 2008 2010 2012 2014 2016 2018
"Current" Line for 2018
Day Ave of TN

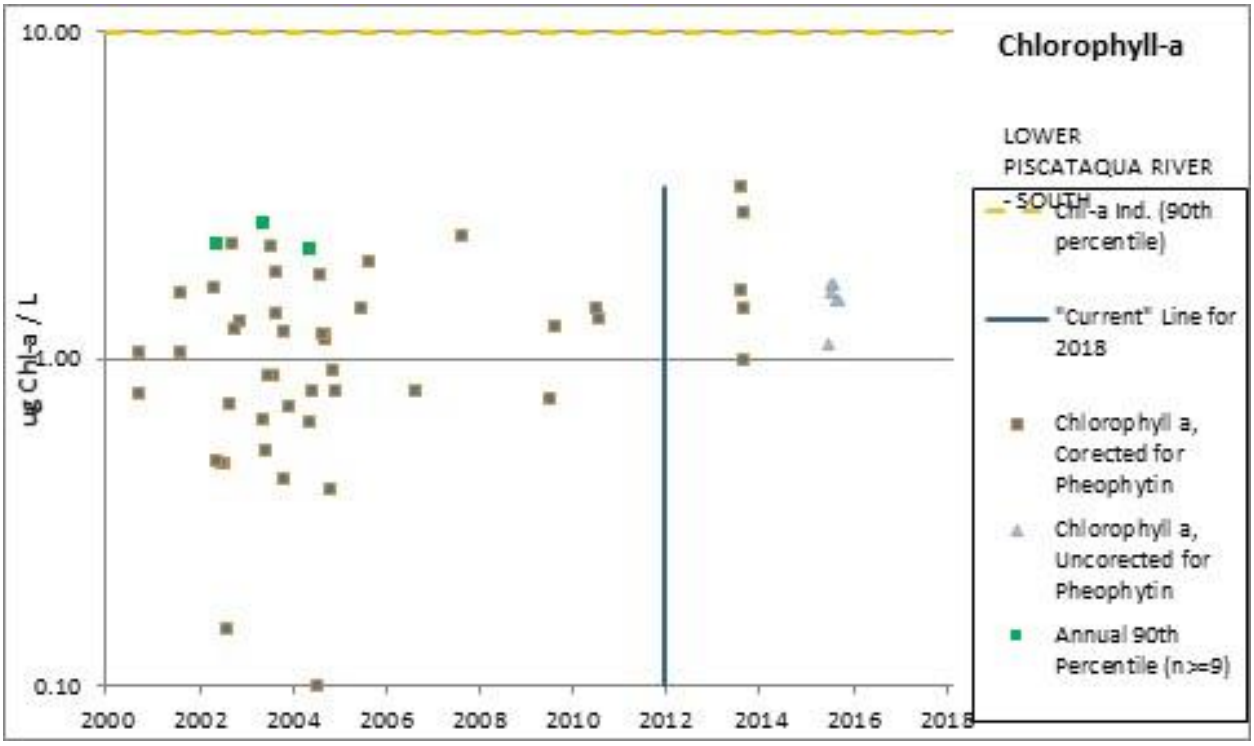
Lower Piscataqua River - North Assessment Zone (1/1/2012-5/25/2018)	**Count**	**Minimum**	**Median**	**90th Percentile**	**Maximum**
CHLOROPHYLL A, CORRECTED FOR PHEOPHYTIN (µg/L)	5	1.2	1.9	-	3.0
CHLOROPHYLL A, UNCORRECTED FOR PHEOPHYTIN (µg/L)	6	1.5	1.8	-	2.4
CHLOROPHYLL A, Combined (µg/L)	11	1.2	1.8	2.9	3.0
LIGHT ATTENUATION COEFFICIENT (1/m)	4	0.520	0.765	-	0.950
TURBIDITY (NTU)	29	1.5	3.5	5.1	6.4
COLORED DISSOLVED ORGANIC MATTER (CDOM) (1/m)	0	-	-	-	-
TSS (mg/L)	9	8.2	15.4	39.6	39.6
DO-PPM-24HR-MIN-CP (mg/L)	90	6.8	7.5	8.0	8.6
DO-PPM-24HR-MIN-NCP (mg/L)	1	7.1	7.1	-	7.1
DO-PPM-GRAB-CP (mg/L)	1	7.8	7.8	-	7.8
DO-PPM-GRAB-NCP (mg/L)	1	7.4	7.4	-	7.4
DO-PERC-24H-MEAN-CP (% sat)	88	89.2	99.8	106.8	114.1
DO-PERC-24H-MEAN-NCP (% sat)	0	-	-	-	-
DO-PERC-2TIDE-GRAB-CP (% sat)	0	-	-	-	-
DO-PERC-2TIDE-GRAB-NCP (% sat)	0	-	-	-	-
DO-PERC-GRAB (% sat)	7	83.5	100.4	-	114.5
Day Ave of TN (µg N/L)	4	100	268	-	348
Day Ave of TDN (µg N/L)	2	164	200	-	235
Day Ave of DIN (NH3 + NO2/3) (µg N/L)	4	8	53	-	97
Day Ave of NH3 (µg N/L)	8	3	33	-	57
Day Ave of PON (µg N/L)	2	72	93	-	113
Day Ave of NO2/3 (µg N/L)	4	5	10	-	63
SALINITY-Grabs (pss)	63	20	28	31	32
SALINITY-Datalogger Daily Median (pss)	96	26	31	31	32

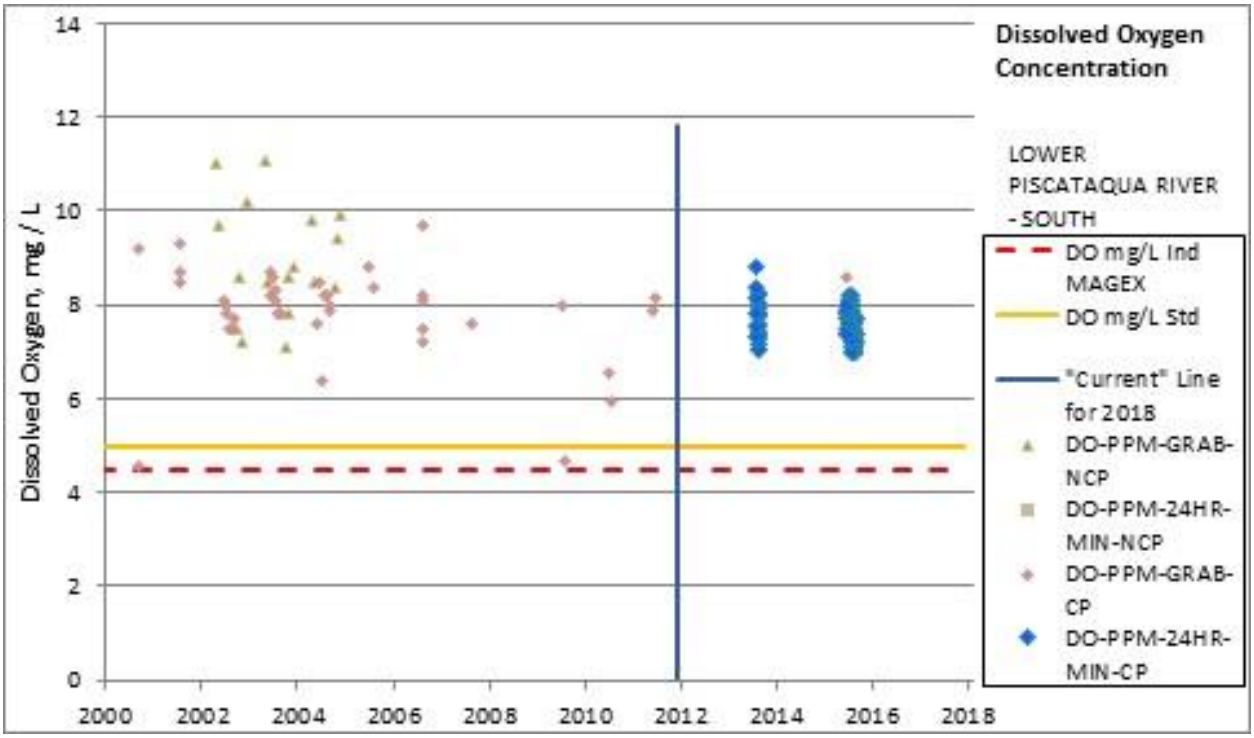
Assessment Zone = LOWER PISCATAQUA RIVER - SOUTH

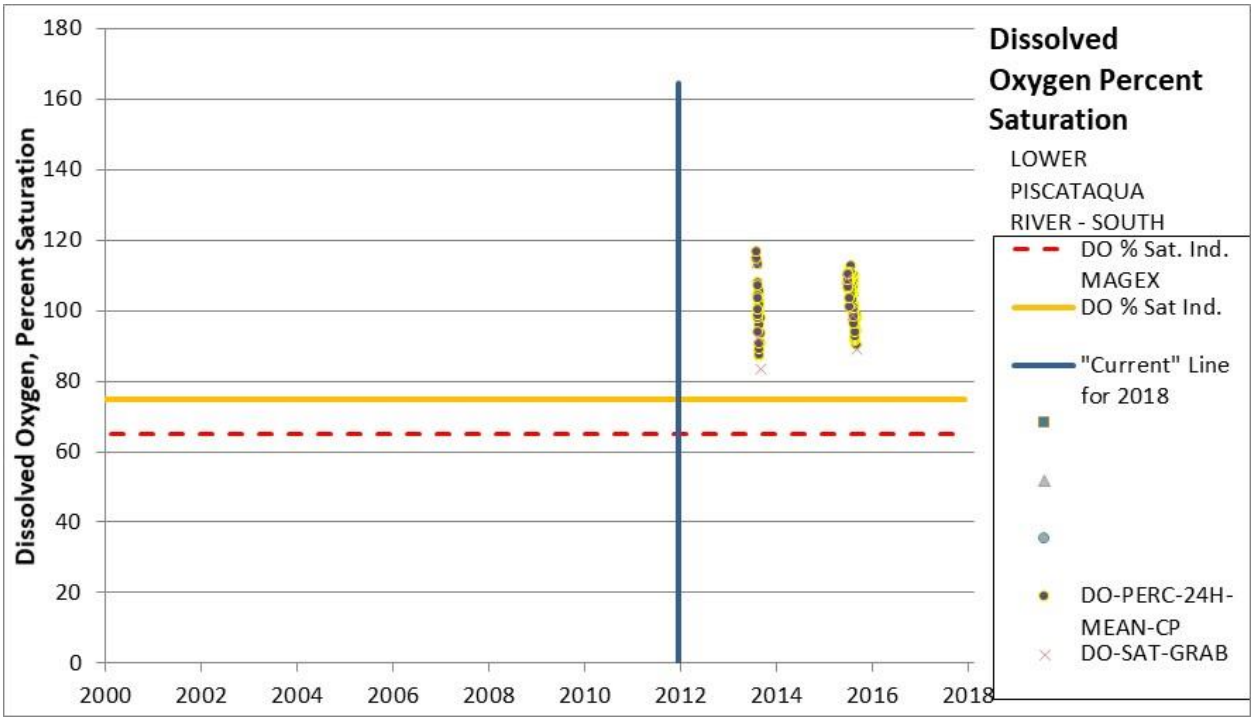
(NHEST600031001-02-02)

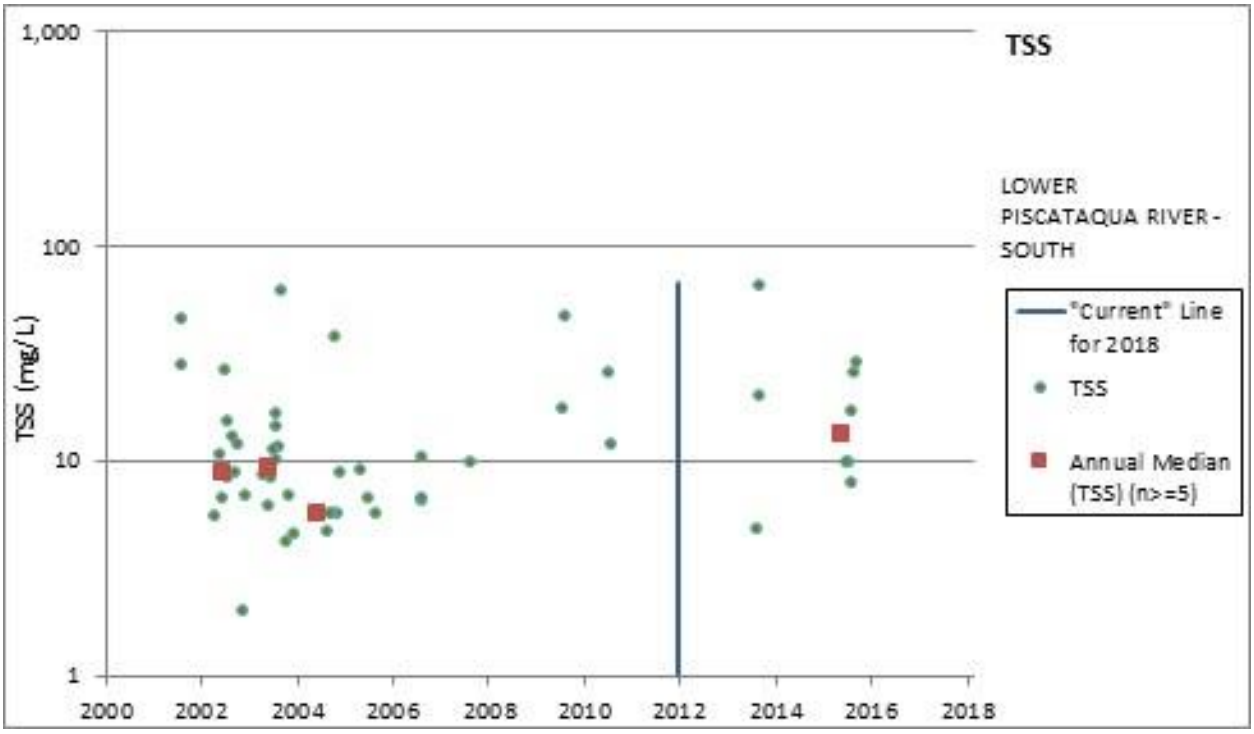
Indicator	Aquatic Life Use Category 2016 / 2018	2018 Comment
Chlorophyll-a	3-PAS / 2-G	The calculated 90th percentile chlorophyll-a in this assessment zone is 3.2 µg/L (n = 11) and a maximum reading of 3.3 µg/L. The chlorophyll-a indicator threshold to prevent low dissolved oxygen is a 90th percentile below 10 µg/L. The available data leads to an assessment of Full Support.
Dissolved Oxygen (mg/L)	2-G / 2-G	This assessment zone had datalogger deployments in 2013 and 2015. During those periods no dissolved oxygen concentration measurements fell below 5 mg/L. The available data indicates that this assessment zone meets the dissolved oxygen concentration criteria.
Dissolved Oxygen (% Saturation)	2-G / 3-PAS	Full-support or non-support determinations are no longer made for dissolved oxygen percent saturation due to SB127 in 2017 amending three sections of RSA 485. This assessment zone had datalogger deployments in 2013 and 2015 to compare to the dissolved oxygen percent saturation criteria. During that period no dissolved oxygen 24-hour average percent saturation measurement fell below 75%. The available data indicates that this assessment zone meets the dissolved oxygen percent saturation indicator.
Estuarine Bioassessments (eelgrass)	5-P / 5-P	The historical extent of eelgrass in this assessment zone was 32.5 acres from the 1948, 1962, 1980, and 1981 datasets. The median current extent of eelgrass in 2015-2017 is 3.6 acres, which is a decrease of 88.9%. Since 1990, the trend in eelgrass cover in this assessment zone is a loss of 33.8%. The thresholds for impairment are either loss of more than 20% of the historic extent of eelgrass or a recent trend of greater than 20% loss.
Water Clarity (Light Attenuation Coefficient)	3-PAS / 3-PAS	Median=0.565 m^-1 (n=4). For an eelgrass restoration depth of 2 m, the light attenuation coefficient threshold is 0.75 m^-1. This assessment zone historically had eelgrass growing in both the shallows and deeper habitat making the 2m restoration depth a valid target. Therefore, the insufficient information – potentially attaining standards (3-PAS) assessment from the 2016 305(b) assessment has been retained.
Total Nitrogen	3-PAS / 3-PAS	The median total nitrogen from 2011 through 2015 was 210 µg/L (n=4). There are no documented dissolved oxygen concentration or saturation criteria exceedences in the available data. The limited chlorophyll-a data suggests that this assessment zone would meet chlorophyll-a indicator to protect dissolved oxygen. The eelgrass beds are severely degraded however the limited available light attenuation (median=0.565 m^-1, n=4) appears sufficient for the 2 m restoration depth. There data to indicate that the eutrophication signal is low in this assessment zone but there is little total nitrogen data. As such, the assessment zone has been assessed as insufficient information-potential attaining standards for total nitrogen.

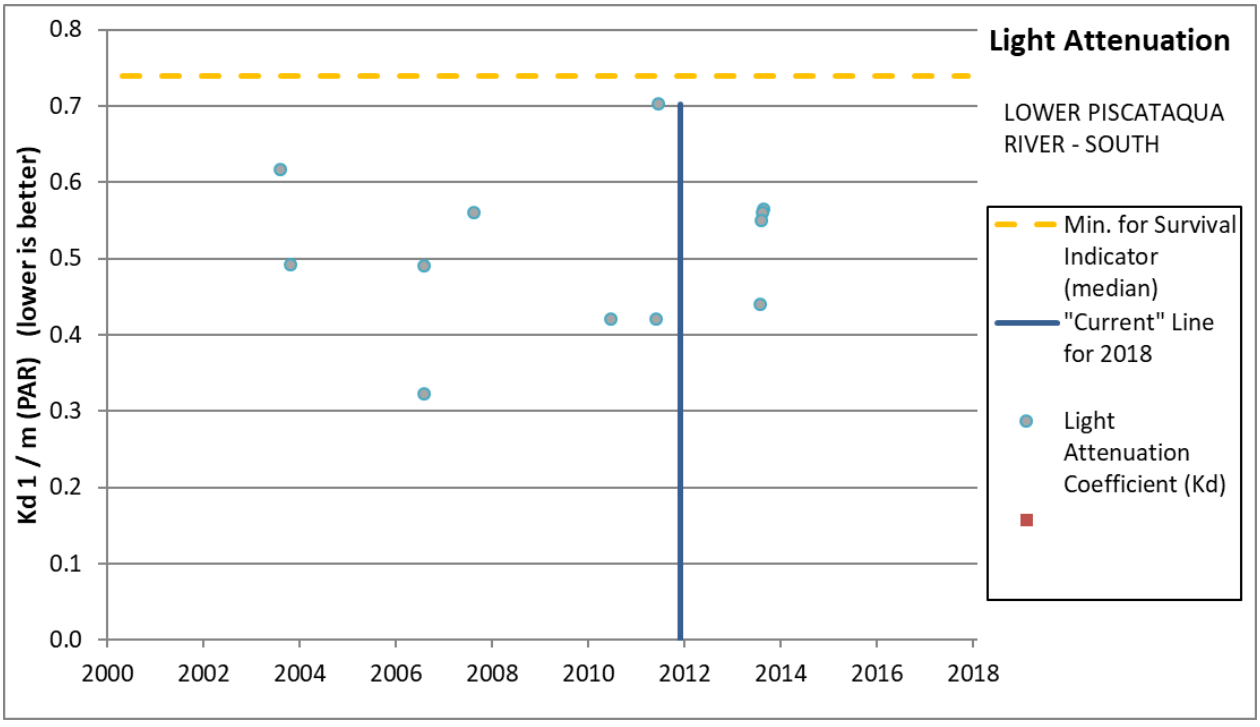

Chlorophyll-a
LOWER PISCATAQUA RIVER - SOUTH
ug Chl-a / L
12
10
8
6
4
2
0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Chl-a Ind. (90th percentile)
"Current" Line for 2018
Chlorophyll a, Corected for Pheophytin
Chlorophyll a, Uncorected for Pheophytin
Annual 90th Percentile (n>=9)

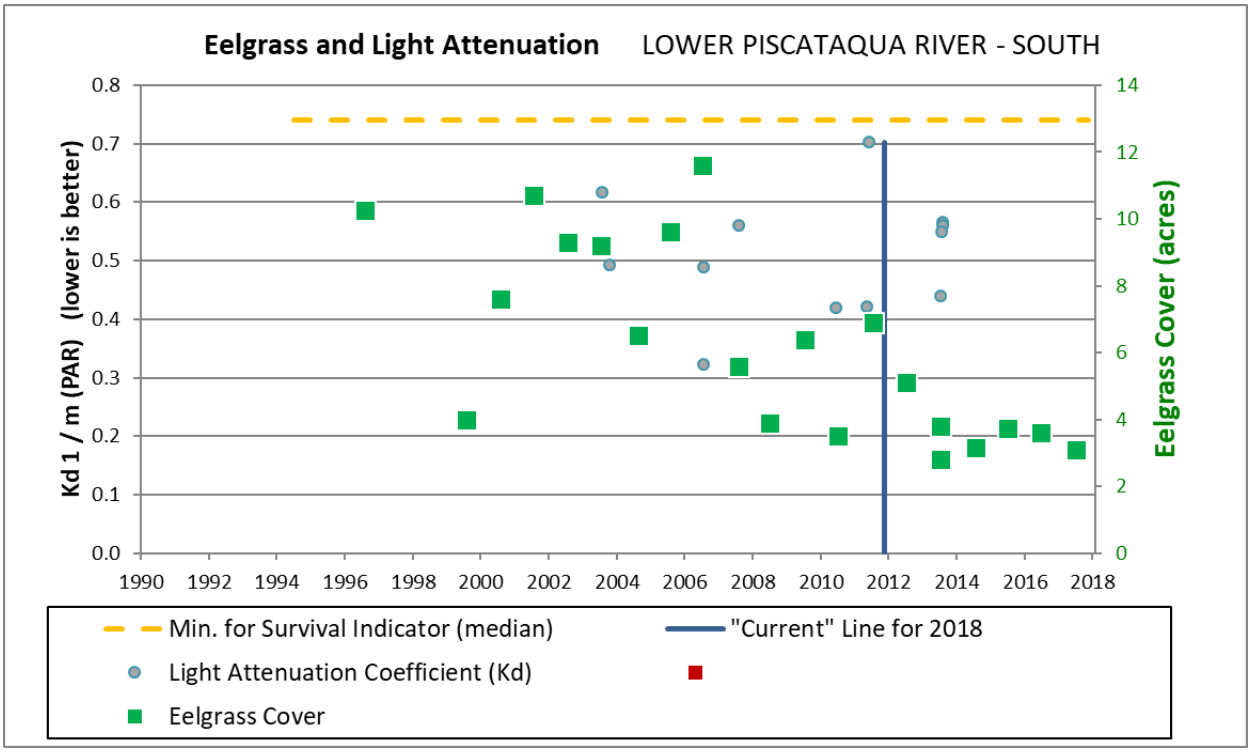

Chlorophyll-a
LOWER PISCATAQUA RIVER - SOUTH
ug Chl-a / L
10.00
1.00
0.10
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Chl-a Ind. (90th percentile)
"Current" Line for 2018
Chlorophyll a, Corected for Pheophytin
Chlorophyll a, Uncorected for Pheophytin
Annual 90th Percentile (n>=9)

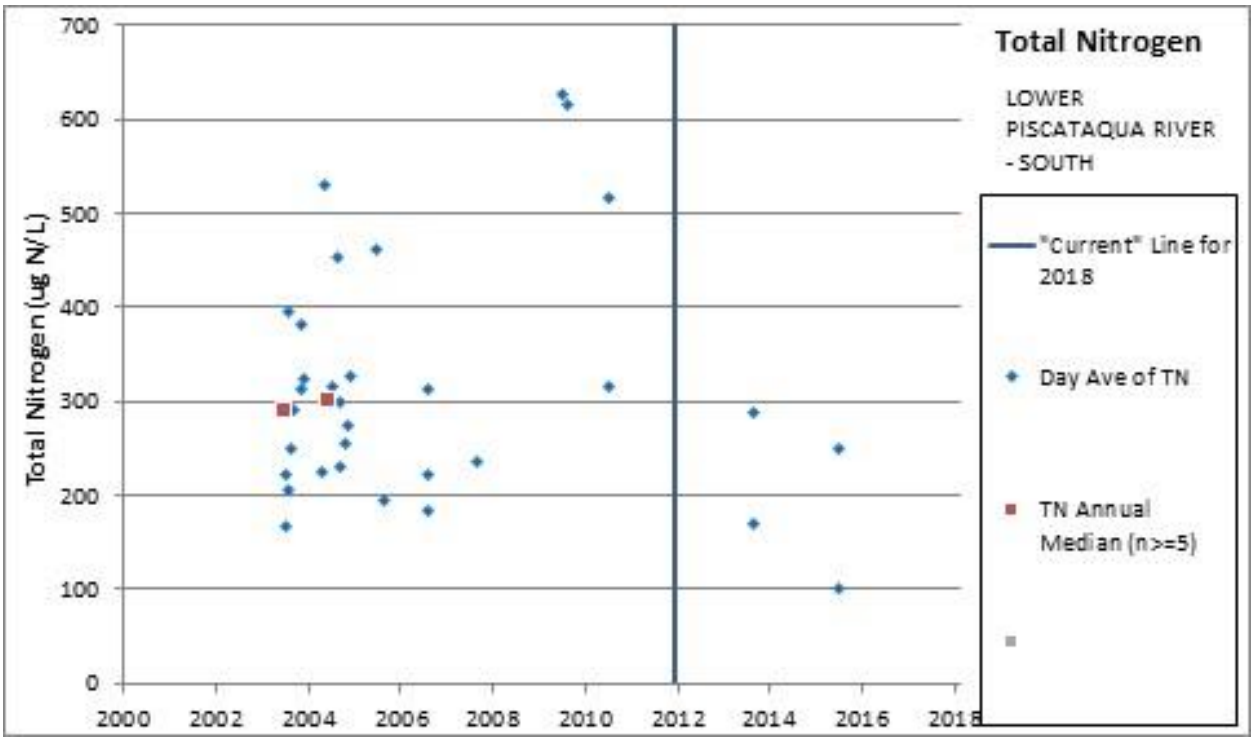

Dissolved Oxygen Concentration
Dissolved Oxygen, mg / L
LOWER PISCATAQUA RIVER - SOUTH
DO mg/L Ind MAGEX
DO mg/L Std
"Current" Line for 2018
DO-PPM-GRAB-NCP
DO-PPM-24HR-MIN-NCP
DO-PPM-GRAB-CP
DO-PPM-24HR-MIN-CP


Dissolved Oxygen Percent Saturation
Dissolved Oxygen, Percent Saturation
LOWER PISCATAQUA RIVER - SOUTH
DO % Sat. Ind. MAGEX
DO % Sat Ind.
"Current" Line for 2018
DO-PERC-24H-MEAN-CP
DO-SAT-GRAB


TSS
LOWER PISCATAQUA RIVER - SOUTH
"Current" Line for 2018
TSS
Annual Median (TSS) (n>=5)
TSS (mg/L)
1,000
100
10
1
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018


Light Attenuation
LOWER PISCATAQUA RIVER - SOUTH
Min. for Survival Indicator (median)
"Current" Line for 2018
Light Attenuation Coefficient (Kd)
Kd 1 / m (PAR) (lower is better)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018


Eelgrass and Light Attenuation
LOWER PISCATAQUA RIVER - SOUTH
Kd 1 / m (PAR) (lower is better)
Eelgrass Cover (acres)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0
2
4
6
8
10
12
14
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Min. for Survival Indicator (median)
"Current" Line for 2018
Light Attenuation Coefficient (Kd)
Eelgrass Cover

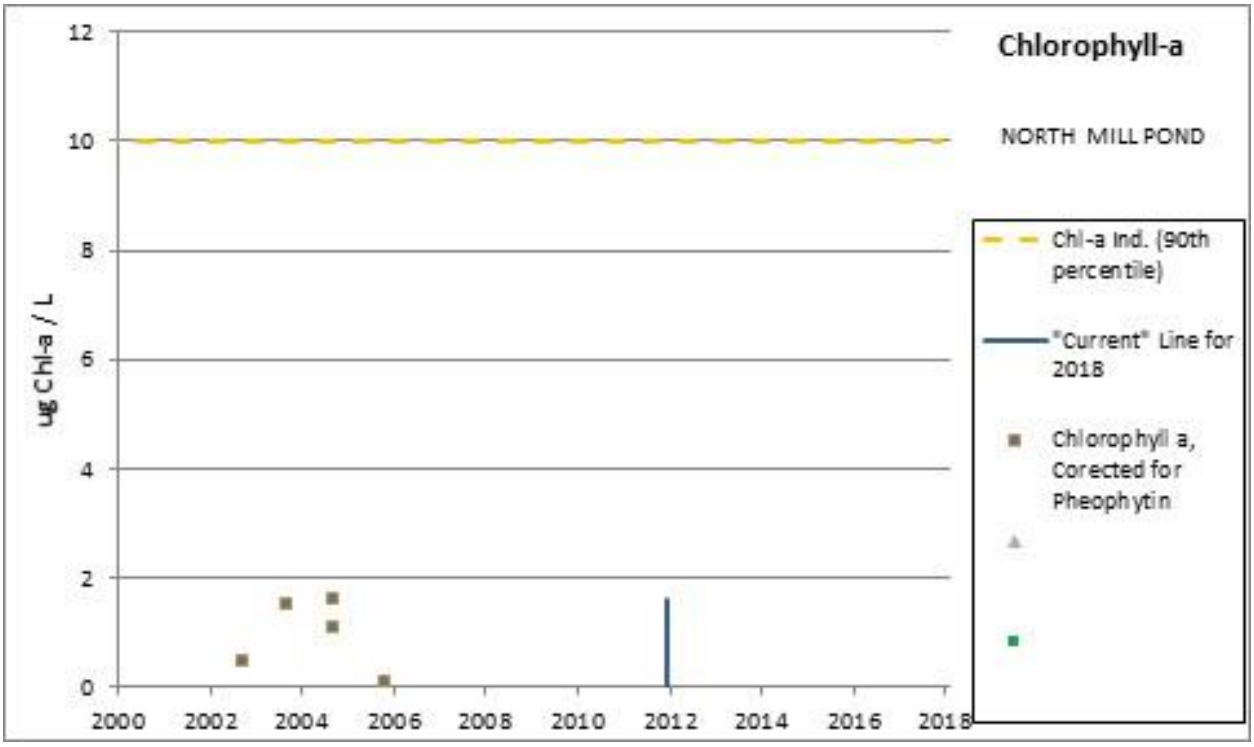

Total Nitrogen
LOWER PISCATAQUA RIVER - SOUTH
Total Nitrogen (ug N/L)
0
100
200
300
400
500
600
700
2000
2002
2004
2006
2008
2010
2012
2014
2016
"Current" Line for 2018
Day Ave of TN
TN Annual Median (n>=5)

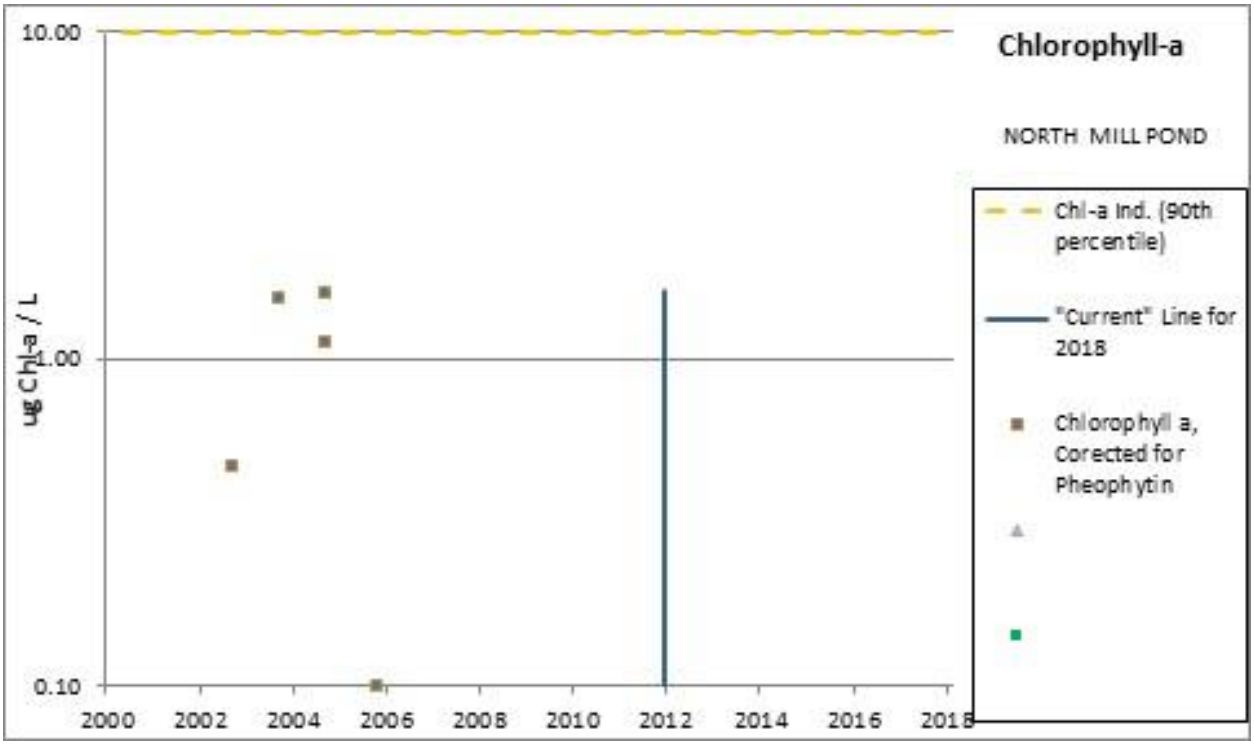
Lower Piscataqua River - South Assessment Zone (1/1/2012-5/25/2018)	**Count**	**Minimum**	**Median**	**90th Percentile**	**Maximum**
CHLOROPHYLL A, CORRECTED FOR PHEOPHYTIN (µg/L)	5	1.0	1.6	-	3.3
CHLOROPHYLL A, UNCORRECTED FOR PHEOPHYTIN (µg/L)	6	1.1	1.6	-	1.7
CHLOROPHYLL A, Combined (µg/L)	11	1.0	1.6	3.2	3.3
LIGHT ATTENUATION COEFFICIENT (1/m)	4	0.450	0.565	-	0.575
TURBIDITY (NTU)	29	0.9	1.4	2.4	5.7
COLORED DISSOLVED ORGANIC MATTER (CDOM) (1/m)	0	-	-	-	-
TSS (mg/L)	9	4.9	17.0	66.8	66.8
DO-PPM-24HR-MIN-CP (mg/L)	96	7.0	7.6	8.1	8.8
DO-PPM-24HR-MIN-NCP (mg/L)	1	7.1	7.1	-	7.1
DO-PPM-GRAB-CP (mg/L)	2	7.6	8.1	-	8.6
DO-PPM-GRAB-NCP (mg/L)	1	7.9	7.9	-	7.9
DO-PERC-24H-MEAN-CP (% sat)	95	87.1	103.8	110.2	116.9
DO-PERC-24H-MEAN-NCP (% sat)	0	-	-	-	-
DO-PERC-2TIDE-GRAB-CP (% sat)	0	-	-	-	-
DO-PERC-2TIDE-GRAB-NCP (% sat)	0	-	-	-	-
DO-PERC-GRAB (% sat)	6	83.7	95.4	-	113.3
Day Ave of TN (µg N/L)	4	100	210	-	288
Day Ave of TDN (µg N/L)	2	140	168	-	196
Day Ave of DIN (NH3 + NO2/3) (µg N/L)	4	10	42	-	86
Day Ave of NH3 (µg N/L)	8	8	26	-	36
Day Ave of PON (µg N/L)	2	30	61	-	92
Day Ave of NO2/3 (µg N/L)	4	2	10	-	59
SALINITY-Grabs (pss)	18	29	31	33	33
SALINITY-Datalogger Daily Median (pss)	102	29	31	32	32

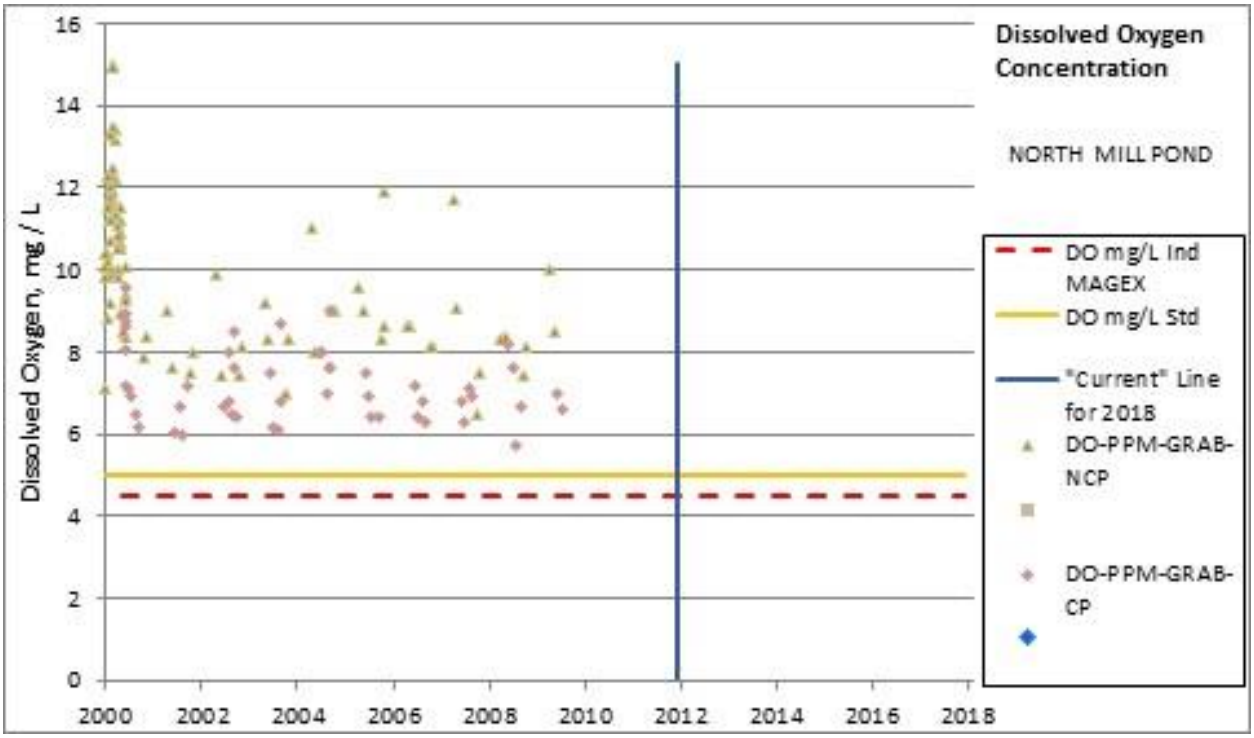
Assessment Zone = NORTH MILL POND

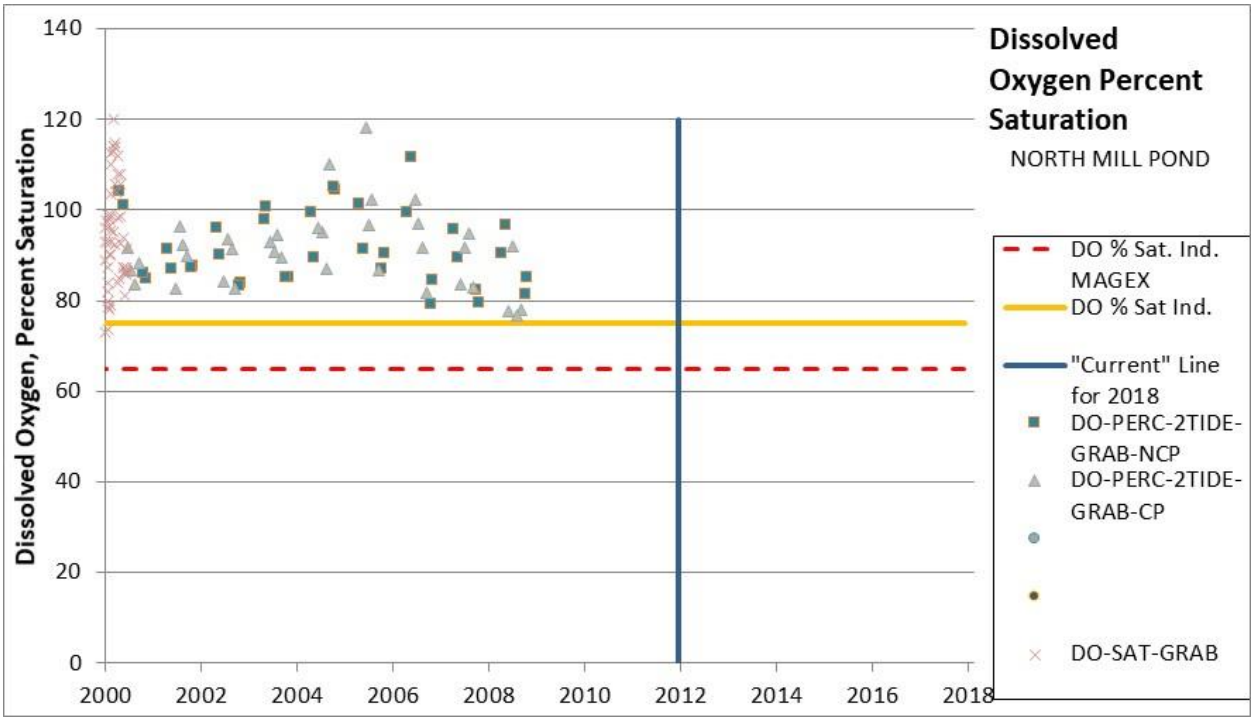
(NHEST600031001-10)

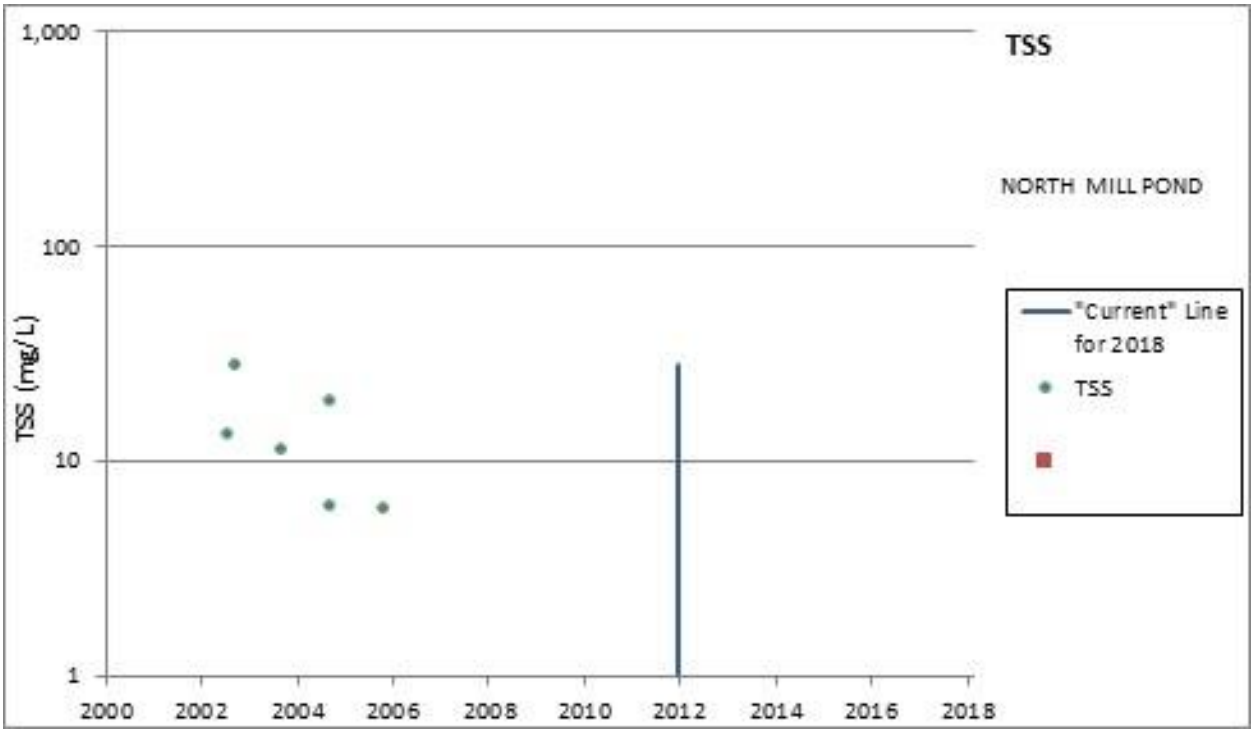
Indicator	Aquatic Life Use Category 2016 / 2018	2018 Comment
Chlorophyll-a	3-ND / 3-ND	The chlorophyll-a indicator threshold to prevent low dissolved oxygen is a 90th percentile below 10 µg/L. This assessment zone has no measurements for chlorophyll-a since 2005.
Dissolved Oxygen (mg/L)	3-ND / 3-ND	This assessment zone has only grab sample measurements for dissolved oxygen concentration and those measurements were only collected up through 2009. As such, this assessment zone has been assessed as 3-ND (No Data) for the dissolved oxygen concentration criteria.
Dissolved Oxygen (% Saturation)	3-ND / 3-ND	Full-support or non-support determinations are no longer made for dissolved oxygen percent saturation due to SB127 in 2017 amending three sections of RSA 485. This assessment zone has only grab sample measurements for dissolved oxygen 24-hour average percent saturation and those measurements were only collected up through 2008. As such, this assessment zone has been assessed as 3-ND (No Data) for the dissolved oxygen percent saturation indicator.
Estuarine Bioassessments (eelgrass)	3-ND / 3-ND	No data has been collected in the current period.
Water Clarity (Light Attenuation Coefficient)	3-ND / 3-ND	No data has been collected in the current period.
Total Nitrogen	3-ND / 3-ND	No data has been collected in the current period.

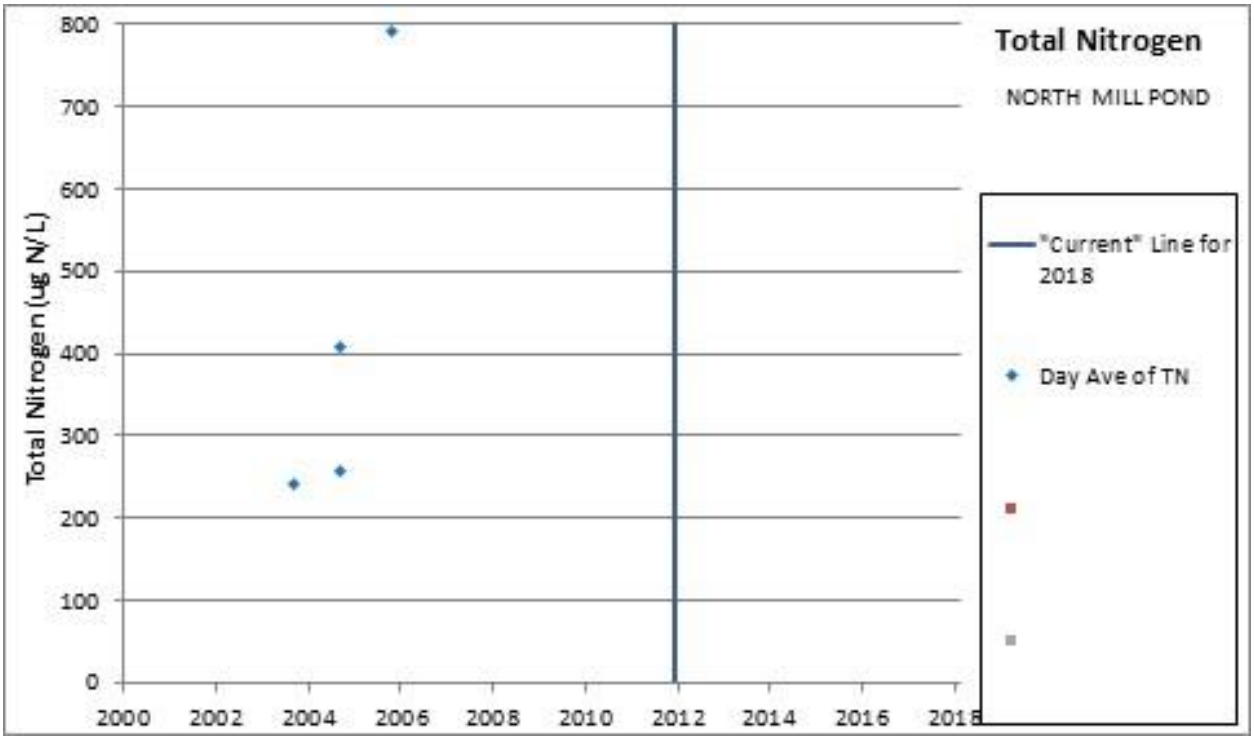

Chlorophyll-a
NORTH MILL POND
ug Chl-a / L
12
10
8
6
4
2
0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Chl-a Ind. (90th percentile)
"Current" Line for 2018
Chlorophyll a, Corected for Pheophytin


Chlorophyll-a
NORTH MILL POND
ug Chl-a / L
10.00
1.00
0.10
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Chl-a Ind. (90th percentile)
"Current" Line for 2018
Chlorophyll a, Corected for Pheophytin


Dissolved Oxygen Concentration
NORTH MILL POND
Dissolved Oxygen, mg / L
DO mg/L Ind MAGEX
DO mg/L Std
"Current" Line for 2018
DO-PPM-GRAB-NCP
DO-PPM-GRAB-CP


Dissolved Oxygen Percent Saturation
NORTH MILL POND
Dissolved Oxygen, Percent Saturation
DO % Sat. Ind. MAGEX
DO % Sat Ind.
"Current" Line for 2018
DO-PERC-2TIDE-GRAB-NCP
DO-PERC-2TIDE-GRAB-CP
DO-SAT-GRAB


TSS
NORTH MILL POND
TSS (mg/L)
1,000
100
10
1
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
"Current" Line for 2018
TSS

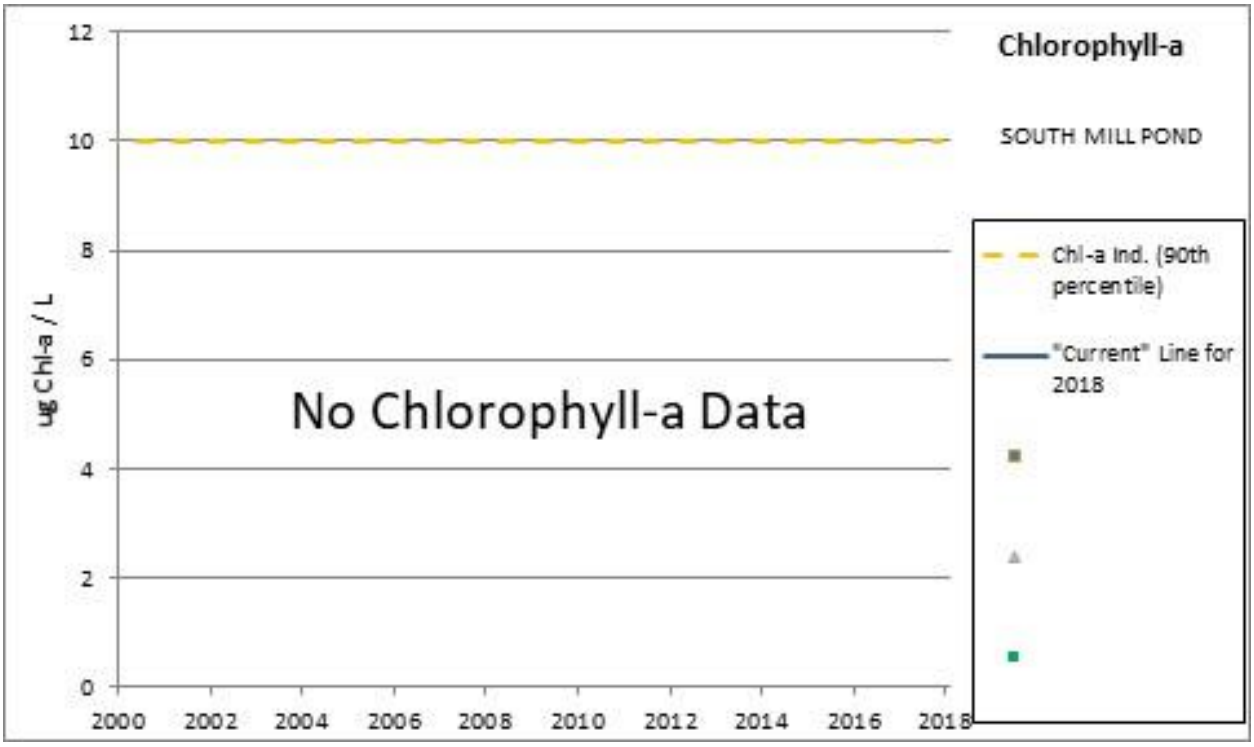

Total Nitrogen
NORTH MILL POND
Total Nitrogen (ug N/L)
800
700
600
500
400
300
200
100
0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
"Current" Line for 2018
Day Ave of TN

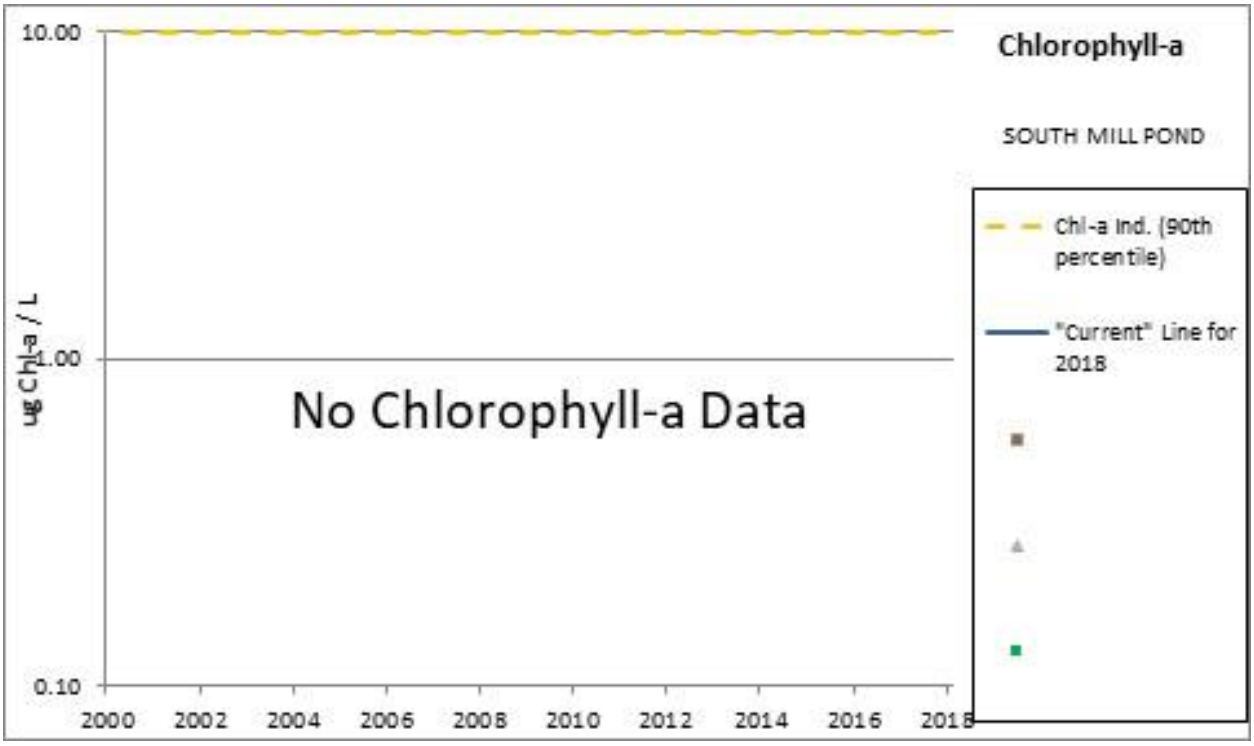
North Mill Pond Assessment Zone (1/1/2012-5/25/2018)	**Count**	**Minimum**	**Median**	**90th Percentile**	**Maximum**
CHLOROPHYLL A, CORRECTED FOR PHEOPHYTIN (µg/L)	0	-	-	-	-
CHLOROPHYLL A, UNCORRECTED FOR PHEOPHYTIN (µg/L)	0	-	-	-	-
CHLOROPHYLL A, Combined (µg/L)	0	-	-	-	-
LIGHT ATTENUATION COEFFICIENT (1/m)	0	-	-	-	-
TURBIDITY (NTU)	0	-	-	-	-
COLORED DISSOLVED ORGANIC MATTER (CDOM) (1/m)	0	-	-	-	-
TSS (mg/L)	0	-	-	-	-
DO-PPM-24HR-MIN-CP (mg/L)	0	-	-	-	-
DO-PPM-24HR-MIN-NCP (mg/L)	0	-	-	-	-
DO-PPM-GRAB-CP (mg/L)	0	-	-	-	-
DO-PPM-GRAB-NCP (mg/L)	0	-	-	-	-
DO-PERC-24H-MEAN-CP (% sat)	0	-	-	-	-
DO-PERC-24H-MEAN-NCP (% sat)	0	-	-	-	-
DO-PERC-2TIDE-GRAB-CP (% sat)	0	-	-	-	-
DO-PERC-2TIDE-GRAB-NCP (% sat)	0	-	-	-	-
DO-PERC-GRAB (% sat)	0	-	-	-	-
Day Ave of TN (µg N/L)	0	-	-	-	-
Day Ave of TDN (µg N/L)	0	-	-	-	-
Day Ave of DIN (NH3 + NO2/3) (µg N/L)	0	-	-	-	-
Day Ave of NH3 (µg N/L)	0	-	-	-	-
Day Ave of PON (µg N/L)	0	-	-	-	-
Day Ave of NO2/3 (µg N/L)	0	-	-	-	-
SALINITY-Grabs (pss)	0	-	-	-	-
SALINITY-Datalogger Daily Median (pss)	0	-	-	-	-

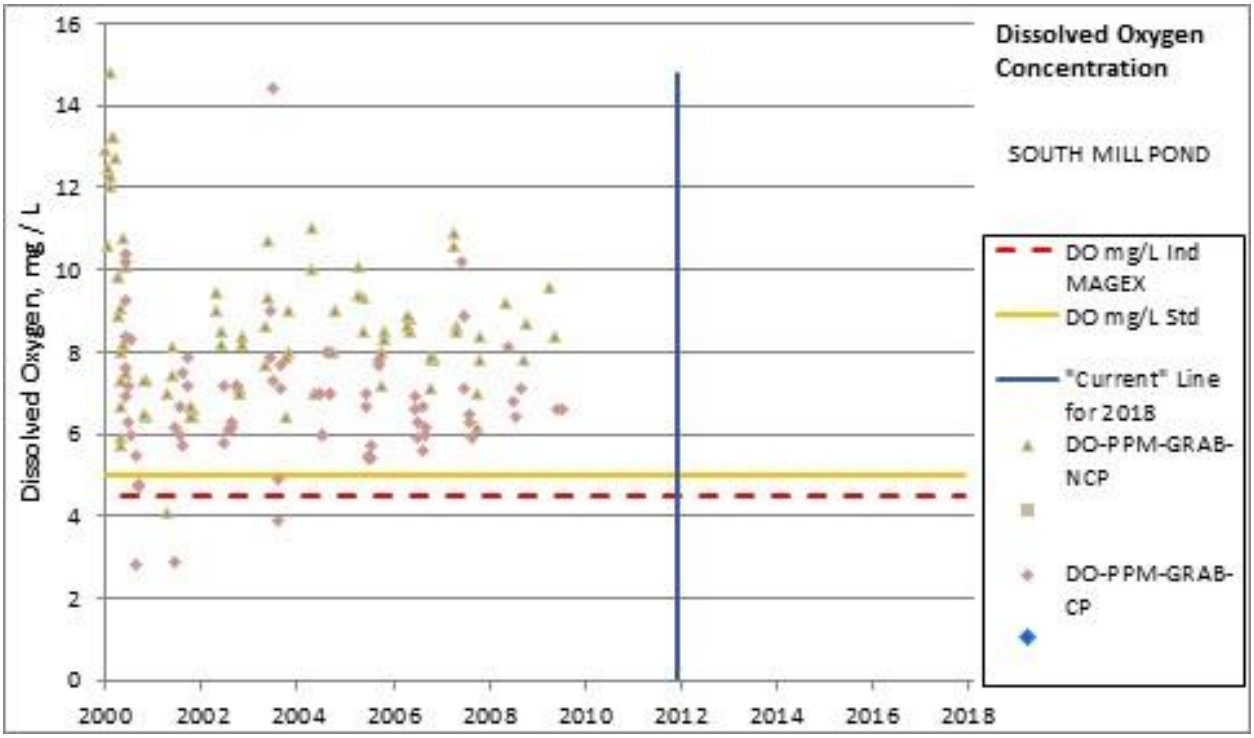
Assessment Zone = SOUTH MILL POND

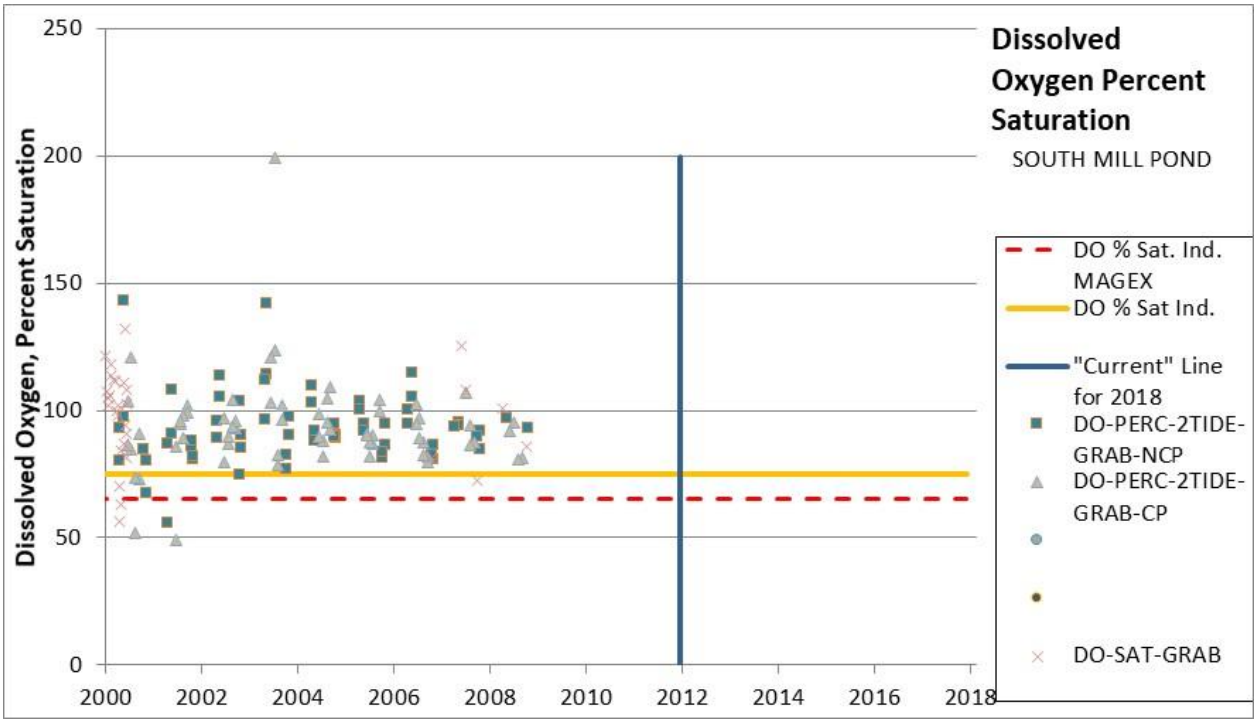
(NHEST600031001-09)

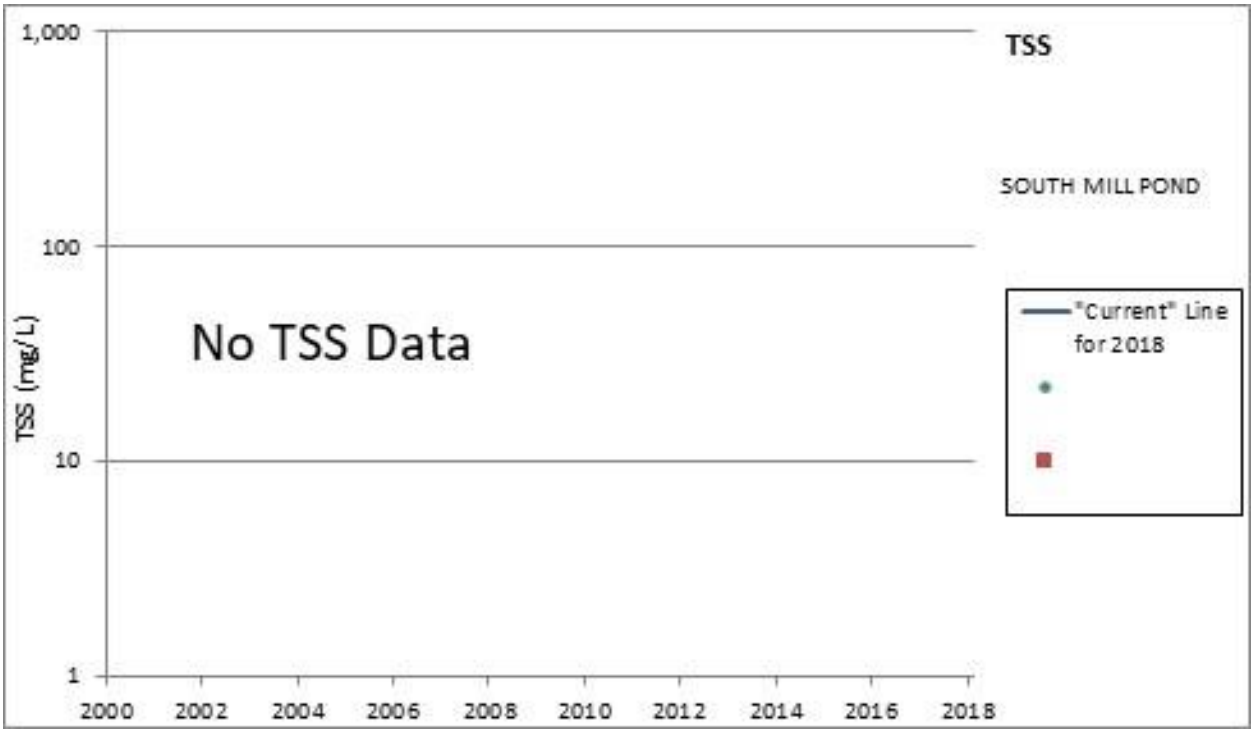
Indicator	Aquatic Life Use Category 2016 / 2018	2018 Comment
Chlorophyll-a	3-ND / 3-ND	The chlorophyll-a indicator threshold to prevent low dissolved oxygen is a 90th percentile below 10 µg/L. However, there is no chlorophyll-a data for this assessment zone.
Dissolved Oxygen (mg/L)	3-ND / 3-ND	This assessment zone has only grab sample measurements for dissolved oxygen concentration and those measurements were only collected up through 2009. As such, this assessment zone has been assessed as 3-ND (No Data) for the dissolved oxygen concentration criteria.
Dissolved Oxygen (% Saturation)	3-ND / 3-ND	Full-support or non-support determinations are no longer made for dissolved oxygen percent saturation due to SB127 in 2017 amending three sections of RSA 485. This assessment zone has only grab sample measurements for dissolved oxygen 24-hour average percent saturation and those measurements were only collected up through 2008. As such, this assessment zone has been assessed as 3-ND (No Data) for the dissolved oxygen percent saturation indicator.
Estuarine Bioassessments (eelgrass)	3-PAS / 3-PAS	In 2016, a 0.012 acres (520 sq feet) patch of eelgrass was seen in South Mill Pond for the first time. While the patch was below the minimum mapping unit and not field verified, the mapper was confident that based on morphology and growth pattern the plant seen was indeed *Zostera marina*. As there is no known baseline for comparison and the mapping effort only represents a single year of presence, and not seen again in 2017, estuarine bioassessments (eelgrass) has been assessed as Insufficient Information – Potentially Attaining Standards.
Water Clarity (Light Attenuation Coefficient)	3-ND / 3-ND	No data has been collected in the current period.
Total Nitrogen	3-ND / 3-ND	No data has been collected in the current period.

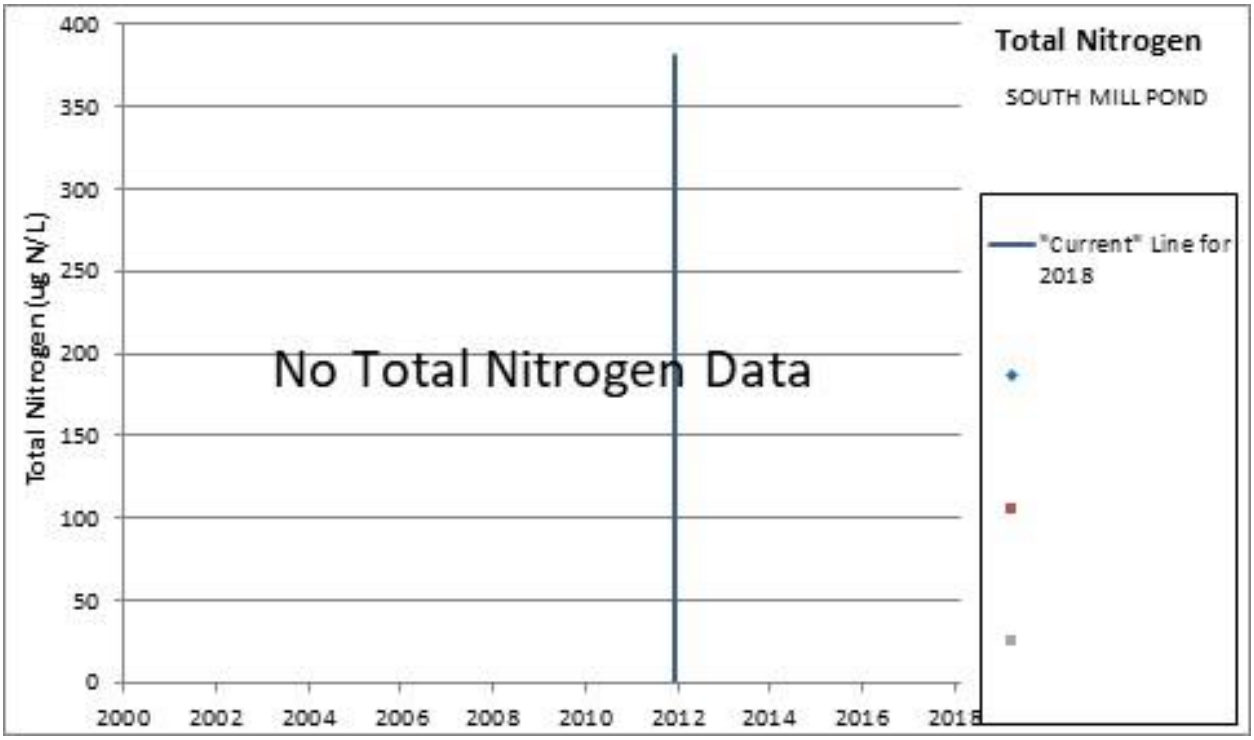

Chlorophyll-a
SOUTH MILL POND
ug Chl-a / L
12
10
8
6
4
2
0
No Chlorophyll-a Data
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Chl-a Ind. (90th percentile)
"Current" Line for 2018


Chlorophyll-a
SOUTH MILL POND
ug Chl-a / L
10.00
1.00
0.10
No Chlorophyll-a Data
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Chl-a Ind. (90th percentile)
"Current" Line for 2018


Dissolved Oxygen Concentration
SOUTH MILL POND
Dissolved Oxygen, mg / L
DO mg/L Ind MAGEX
DO mg/L Std
"Current" Line for 2018
DO-PPM-GRAB-NCP
DO-PPM-GRAB-CP


Dissolved Oxygen Percent Saturation
SOUTH MILL POND
Dissolved Oxygen, Percent Saturation
DO % Sat. Ind. MAGEX
DO % Sat Ind.
"Current" Line for 2018
DO-PERC-2TIDE-GRAB-NCP
DO-PERC-2TIDE-GRAB-CP
DO-SAT-GRAB


TSS
SOUTH MILL POND
No TSS Data
TSS (mg/L)
1,000
100
10
1
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
"Current" Line for 2018


Total Nitrogen
SOUTH MILL POND
No Total Nitrogen Data
Total Nitrogen (ug N/L)
400
350
300
250
200
150
100
50
0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
"Current" Line for 2018

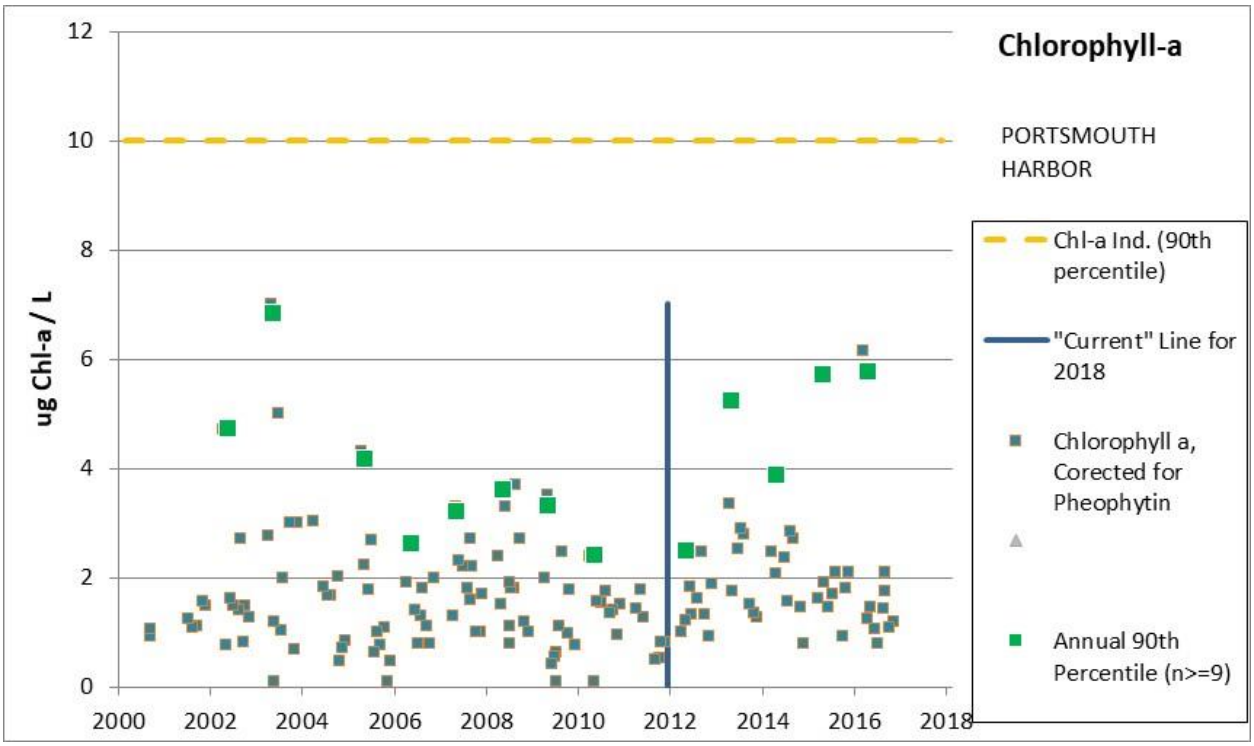
South Mill Pond Assessment Zone (1/1/2012-5/25/2018)	**Count**	**Minimum**	**Median**	**90th Percentile**	**Maximum**
CHLOROPHYLL A, CORRECTED FOR PHEOPHYTIN (µg/L)	0	-	-	-	-
CHLOROPHYLL A, UNCORRECTED FOR PHEOPHYTIN (µg/L)	0	-	-	-	-
CHLOROPHYLL A, Combined (µg/L)	0	-	-	-	-
LIGHT ATTENUATION COEFFICIENT (1/m)	0	-	-	-	-
TURBIDITY (NTU)	0	-	-	-	-
COLORED DISSOLVED ORGANIC MATTER (CDOM) (1/m)	0	-	-	-	-
TSS (mg/L)	0	-	-	-	-
DO-PPM-24HR-MIN-CP (mg/L)	0	-	-	-	-
DO-PPM-24HR-MIN-NCP (mg/L)	0	-	-	-	-
DO-PPM-GRAB-CP (mg/L)	0	-	-	-	-
DO-PPM-GRAB-NCP (mg/L)	0	-	-	-	-
DO-PERC-24H-MEAN-CP (% sat)	0	-	-	-	-
DO-PERC-24H-MEAN-NCP (% sat)	0	-	-	-	-
DO-PERC-2TIDE-GRAB-CP (% sat)	0	-	-	-	-
DO-PERC-2TIDE-GRAB-NCP (% sat)	0	-	-	-	-
DO-PERC-GRAB (% sat)	0	-	-	-	-
Day Ave of TN (µg N/L)	0	-	-	-	-
Day Ave of TDN (µg N/L)	0	-	-	-	-
Day Ave of DIN (NH3 + NO2/3) (µg N/L)	0	-	-	-	-
Day Ave of NH3 (µg N/L)	0	-	-	-	-
Day Ave of PON (µg N/L)	0	-	-	-	-
Day Ave of NO2/3 (µg N/L)	0	-	-	-	-
SALINITY-Grabs (pss)	0	-	-	-	-
SALINITY-Datalogger Daily Median (pss)	0	-	-	-	-

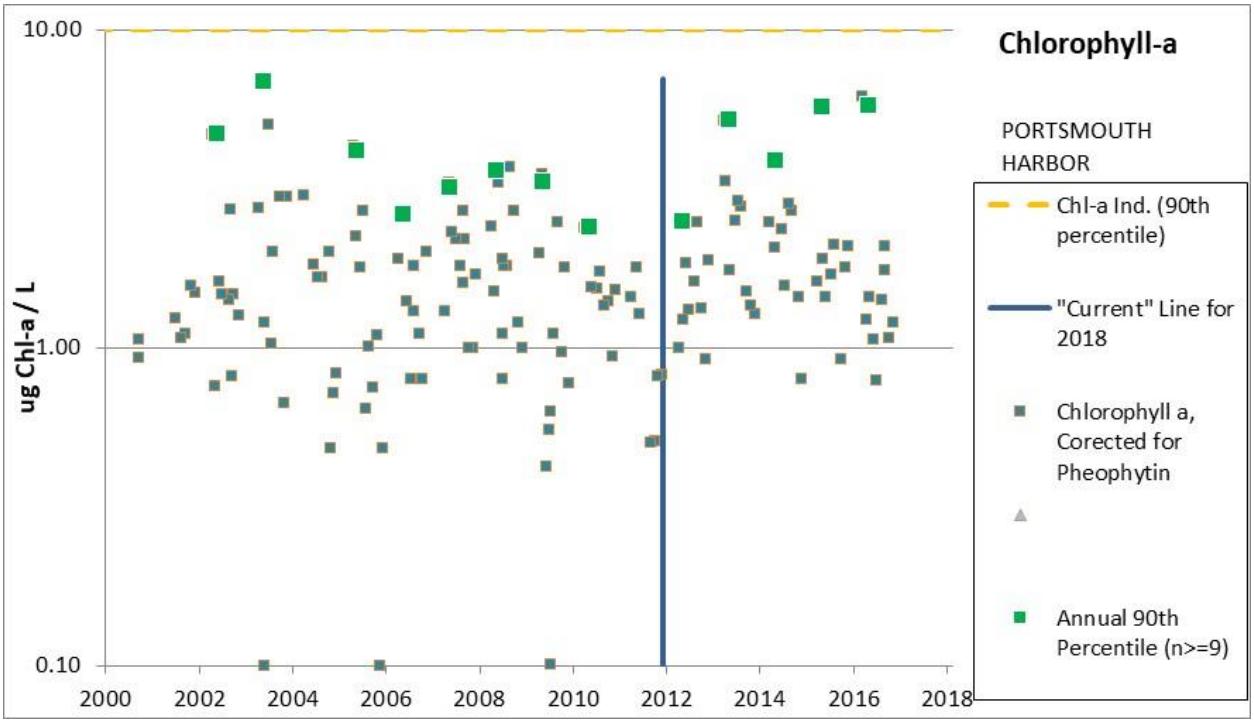
Assessment Zone = PORTSMOUTH HARBOR

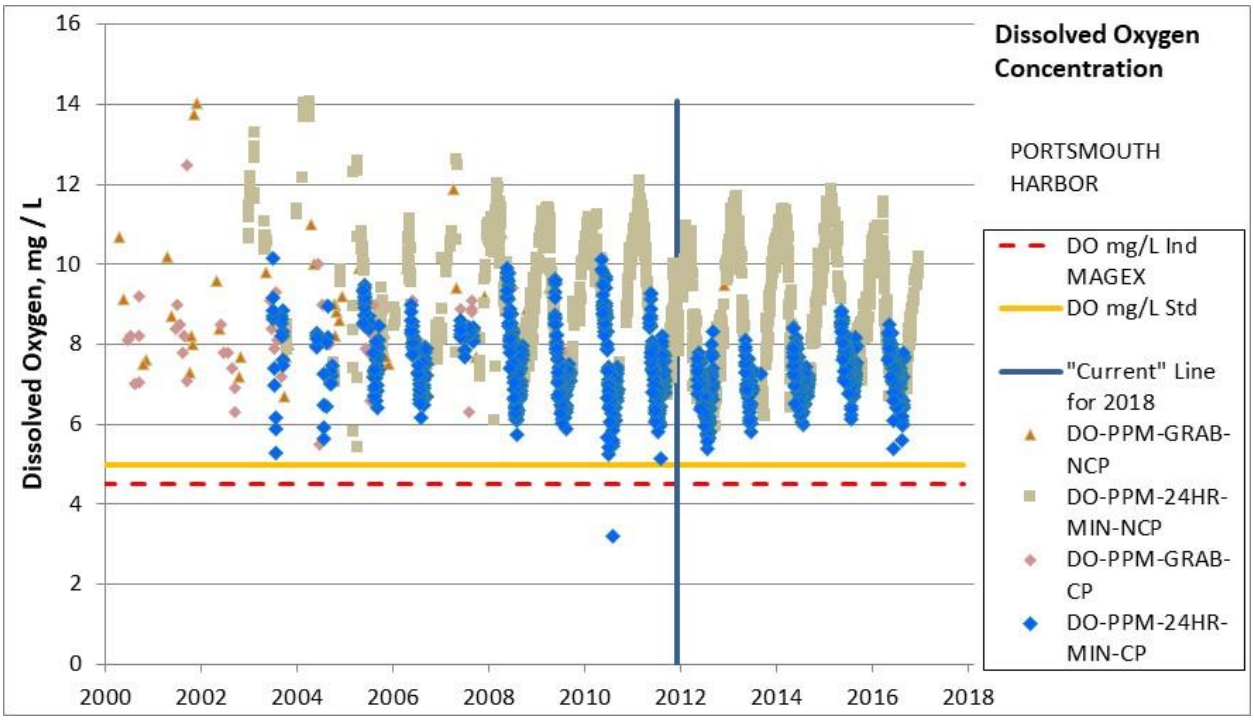
(NHEST600031001-11)

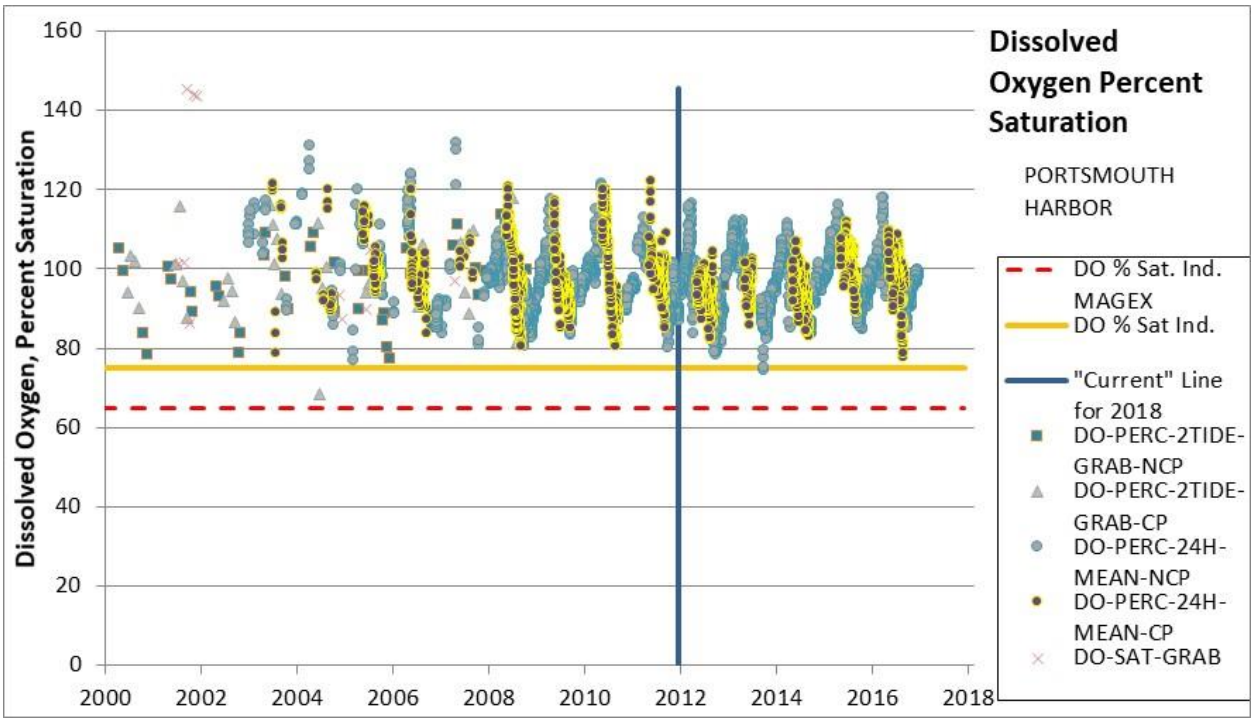
Indicator	Aquatic Life Use Category 2016 / 2018	2018 Comment
Chlorophyll-a	2-G / 2-G	The calculated 90th percentile chlorophyll-a in this assessment zone is 3.5 µg/L (n = 46) and a maximum reading of 6.2 µg/L. The chlorophyll-a indicator threshold to prevent low dissolved oxygen is a 90th percentile below 10 µg/L. The available data leads to an assessment of Full Support.
Dissolved Oxygen (mg/L)	2-G / 2-G	This assessment zone has datalogger and grab measurements for dissolved oxygen concentration covering 2012 through 2016. No samples fell below 5 mg/L. The available data indicates that this assessment zone meets the dissolved oxygen concentration criteria.
Dissolved Oxygen (% Saturation)	2-G / 3-PAS	Full-support or non-support determinations are no longer made for dissolved oxygen percent saturation due to SB127 in 2017 amending three sections of RSA 485. This assessment zone has 24-hour average datalogger and grab measurements for dissolved oxygen percent saturation covering 2012 through 2016. Only one 24-hour average appears to fall below 75%saturation. The available data indicates that this assessment zone meets the dissolved oxygen percent saturation indicator.
Estuarine Bioassessments (eelgrass)	5-P / 5-P	The historical extent of eelgrass in this assessment zone was 227.7 acres from the 1948, 1962, 1980, and 1981 datasets. The median current extent of eelgrass in 2015-2017 is 81.4 acres, which is a decrease of 50.4%. Since 1990, the trend in eelgrass cover in this assessment zone is a loss of 39.4%. The thresholds for impairment are either loss of more than 20% of the historic extent of eelgrass or a recent trend of greater than 20% loss.
Water Clarity (Light Attenuation Coefficient)	5-M / 5-M	Median=0.593 m^-1 (n=40). For an eelgrass restoration depth of 3 m, the light attenuation coefficient threshold is 0.5 m^-1. This assessment zone historically had eelgrass growing in both the shallows and deeper habitat making the 3 m restoration depth a valid target. Further, a review of the location of the deep edge of the eelgrass suggests that the maximum depth of eelgrass survival is not as deep as it was in the past. Due to the proximity of the Portsmouth WWTF (which is in a state of upgrade), this assessment zone may be experiencing a large portion of light diminishment from the large TSS load out of the discharge. Therefore, the impaired (5-M) listing from the 2016 303d list has been retained.
Total Nitrogen	2-M / 2-M	The median total nitrogen from 2012 through 2016 was 228 µg/L (n=45). In the continuous data (2012-2016) the dissolved oxygen concentration was always met and there was a single day where the percent saturation indicator was not met. The chlorophyll-a data indicates that this assessment zone meets the chlorophyll-a indicator to protect dissolved oxygen. The eelgrass beds are severely degraded. The available light attenuation data (median=0.593 m^-1, n=40) appears inadequate for the 3 m restoration depth but may be reflective the Total Suspended Solids (TSS) load from the Portsmouth WWTF (which is in a state of upgrade). For shallow systems, it is expected that changes in macroalgae will precede changes in phytoplankton (McGlathery, Sundbäck, & Anderson, 2007) (Valiela, et al., 1997). No direct sampling efforts have taken place to evaluate the extent of epiphytes and macrophytes however regarding macroalgae, Burdick et al. (Burdick, Mathieson, Peter, & Sydney, 2016)stated, “Monitoring results from 2014 show high levels of cover of nuisance green and red algae (*Ulva* and *Gracilaria*, respectively) at all sites except near the mouth of the Estuary.” The “mouth of the estuary site” is Four Tree Island, approximately 1 mile upstream from the Portsmouth Harbor assessment zone. While the five-year median total nitrogen is remains slightly above the estimated offshore total nitrogen concentration of 200 µg/L, the data suggest that Portsmouth Harbor total nitrogen is decreasing

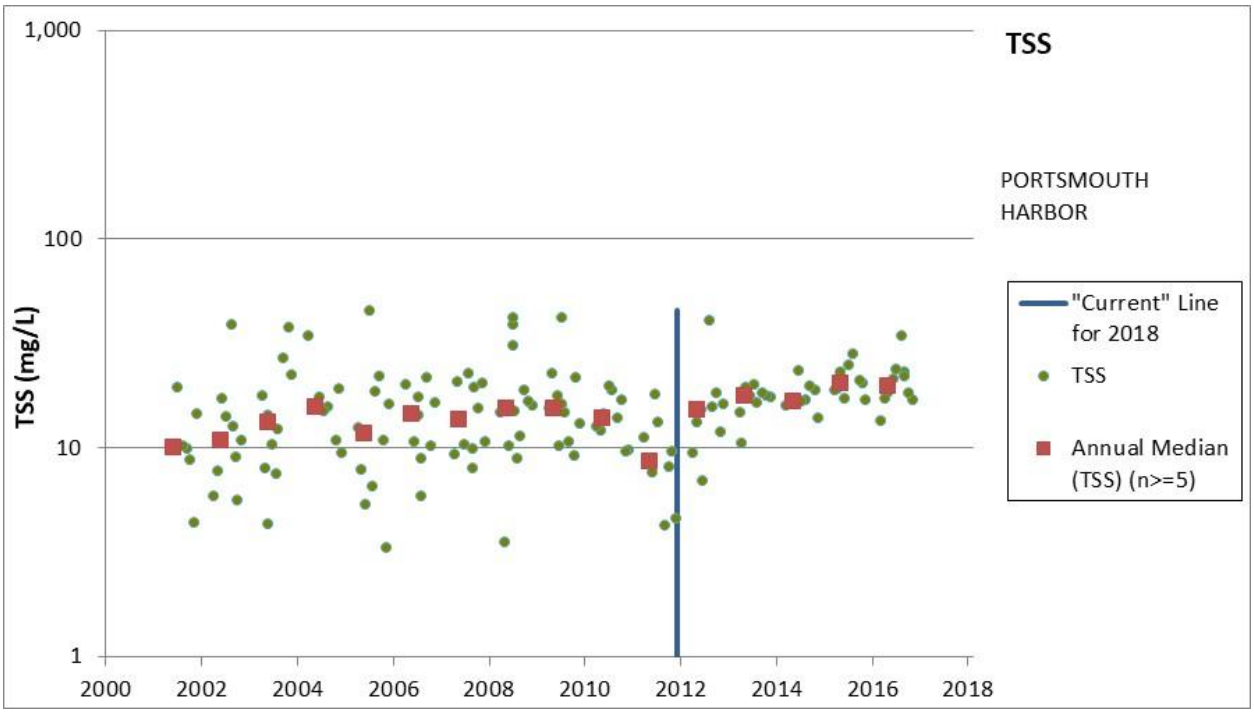
		with essentially offshore -like conditions in 2015 and 2016. At this time there are few of the classic indicators of nutrient eutrophication present in this assessment zone. There is insufficient power in the response datasets to determine that eutrophication by total nitrogen is alone is not known to be strong enough to warrant impairment under New Hampshire's narrative standard. As such, this assessment zone has been assessed as marginally fully supporting (2-M) for total nitrogen.

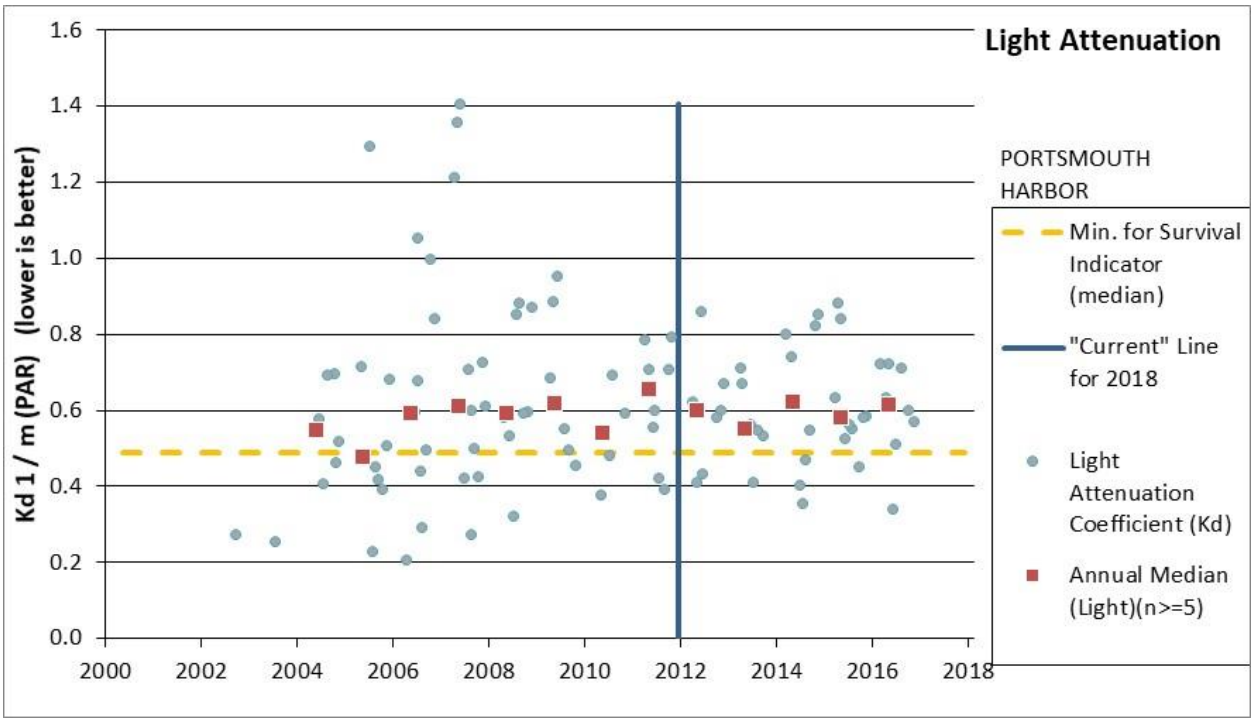


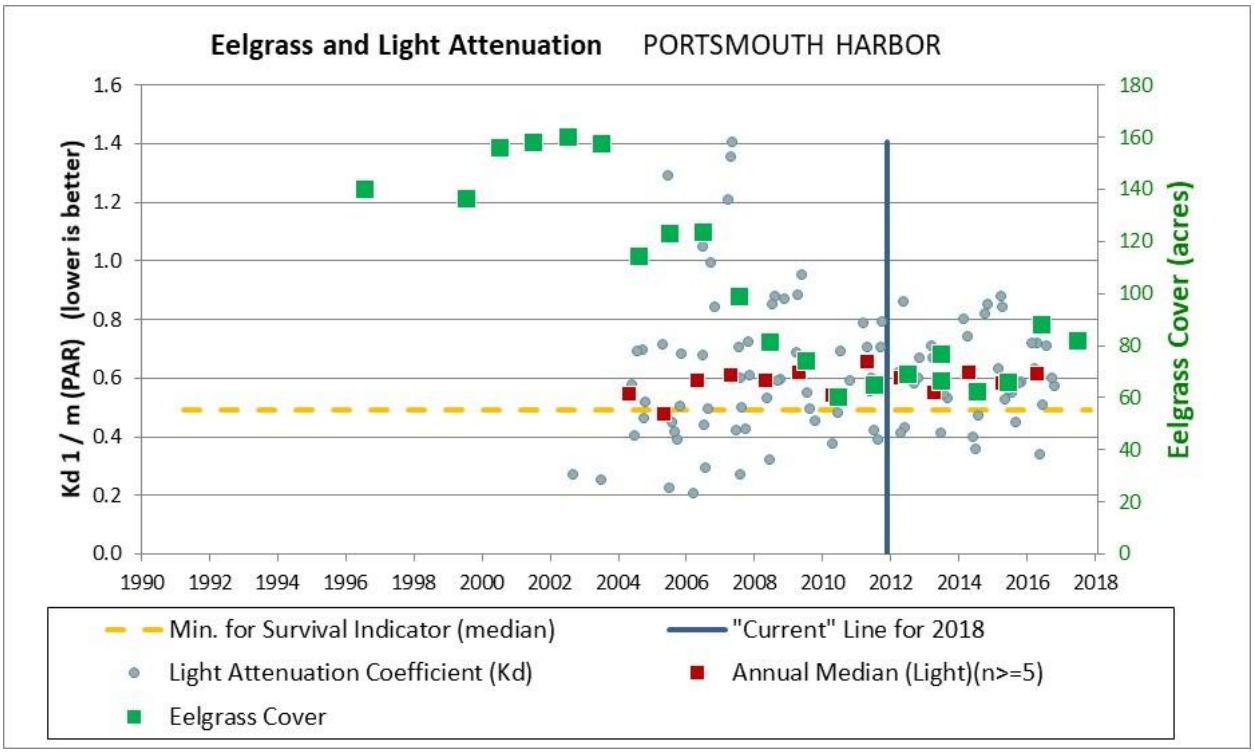

Chlorophyll-a
PORTSMOUTH HARBOR
ug Chl-a / L
10.00
1.00
0.10
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Chl-a Ind. (90th percentile)
"Current" Line for 2018
Chlorophyll a, Corected for Pheophytin
Annual 90th Percentile (n>=9)

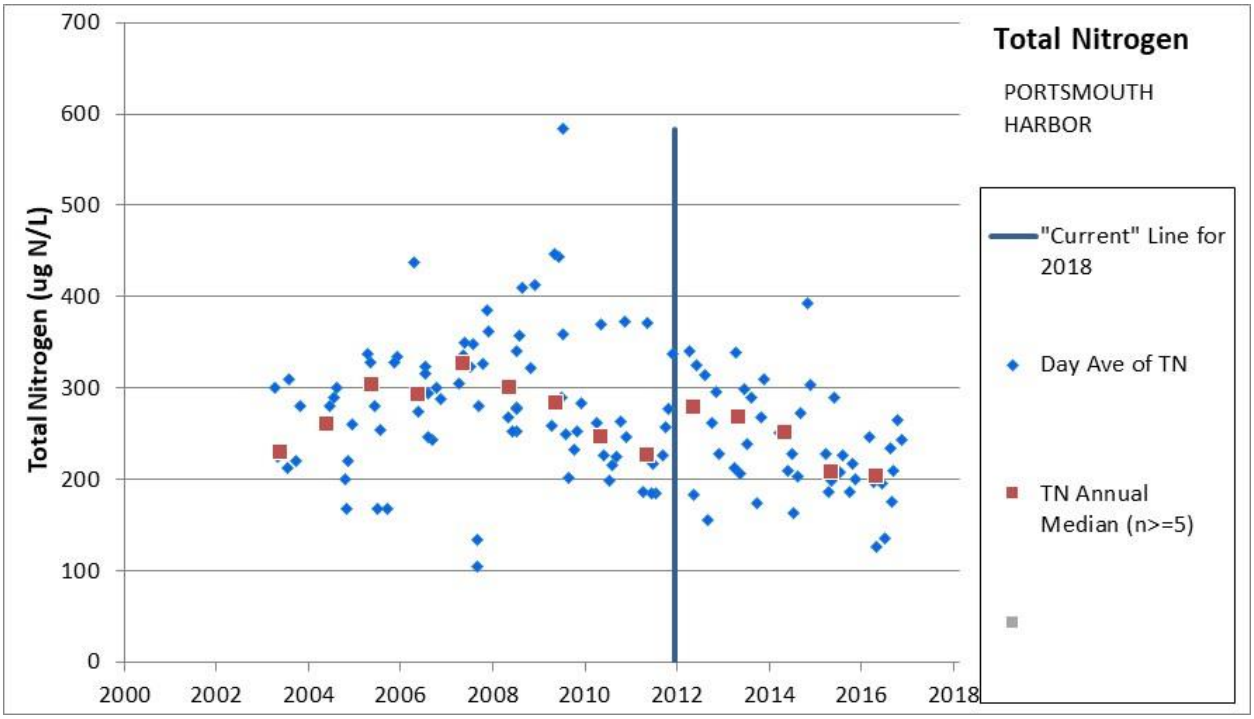

Dissolved Oxygen Concentration
PORTSMOUTH HARBOR
Dissolved Oxygen, mg / L
16
14
12
10
8
6
4
2
0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
DO mg/L Ind MAGEX
DO mg/L Std
"Current" Line for 2018
DO-PPM-GRAB-NCP
DO-PPM-24HR-MIN-NCP
DO-PPM-GRAB-CP
DO-PPM-24HR-MIN-CP


Dissolved Oxygen Percent Saturation
PORTSMOUTH HARBOR
Dissolved Oxygen, Percent Saturation
160
140
120
100
80
60
40
20
0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
DO % Sat. Ind. MAGEX
DO % Sat Ind.
"Current" Line for 2018
DO-PERC-2TIDE-GRAB-NCP
DO-PERC-2TIDE-GRAB-CP
DO-PERC-24H-MEAN-NCP
DO-PERC-24H-MEAN-CP
DO-SAT-GRAB


TSS
PORTSMOUTH HARBOR
TSS (mg/L)
1,000
100
10
1
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
"Current" Line for 2018
TSS
Annual Median (TSS) (n>=5)


Light Attenuation
PORTSMOUTH HARBOR
Kd 1 / m (PAR) (lower is better)
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Min. for Survival Indicator (median)
"Current" Line for 2018
Light Attenuation Coefficient (Kd)
Annual Median (Light)(n>=5)


Eelgrass and Light Attenuation
PORTSMOUTH HARBOR
Kd 1 / m (PAR) (lower is better)
Eelgrass Cover (acres)
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
180
160
140
120
100
80
60
40
20
0
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Min. for Survival Indicator (median)
"Current" Line for 2018
Light Attenuation Coefficient (Kd)
Annual Median (Light)(n>=5)
Eelgrass Cover

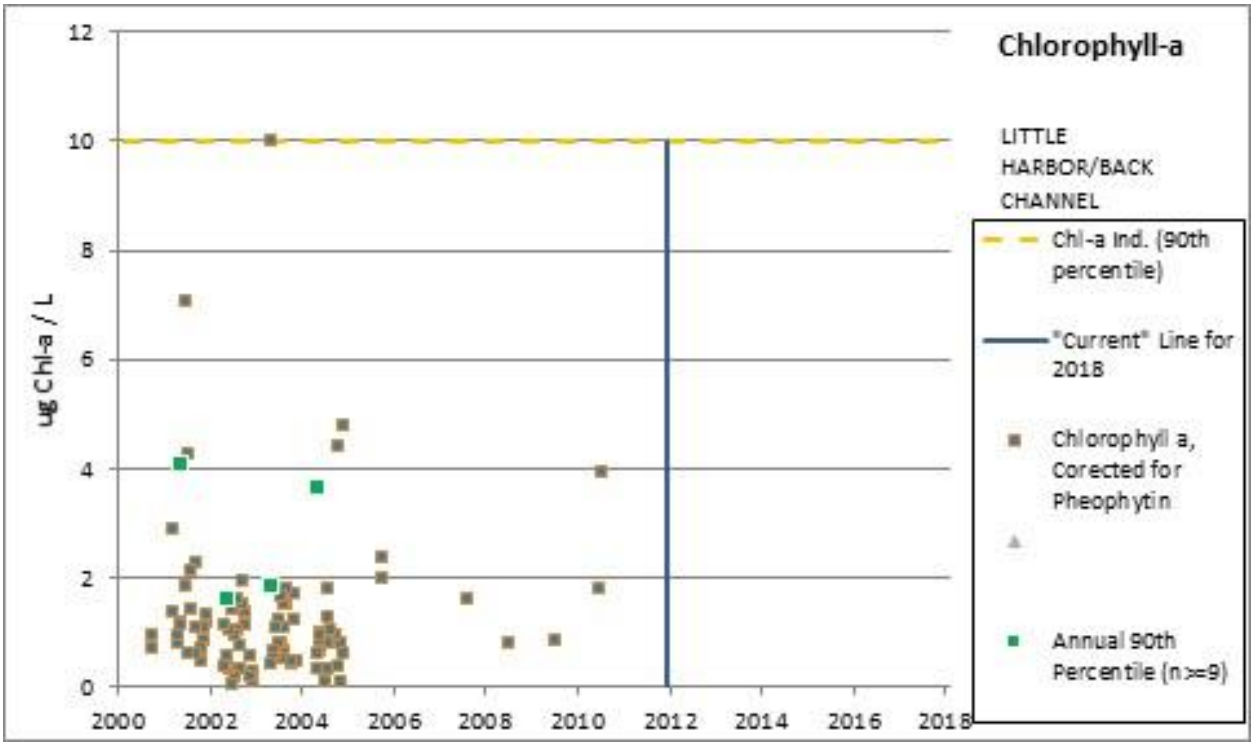

Total Nitrogen
PORTSMOUTH HARBOR
Total Nitrogen (ug N/L)
700
600
500
400
300
200
100
0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
"Current" Line for 2018
Day Ave of TN
TN Annual Median (n>=5)

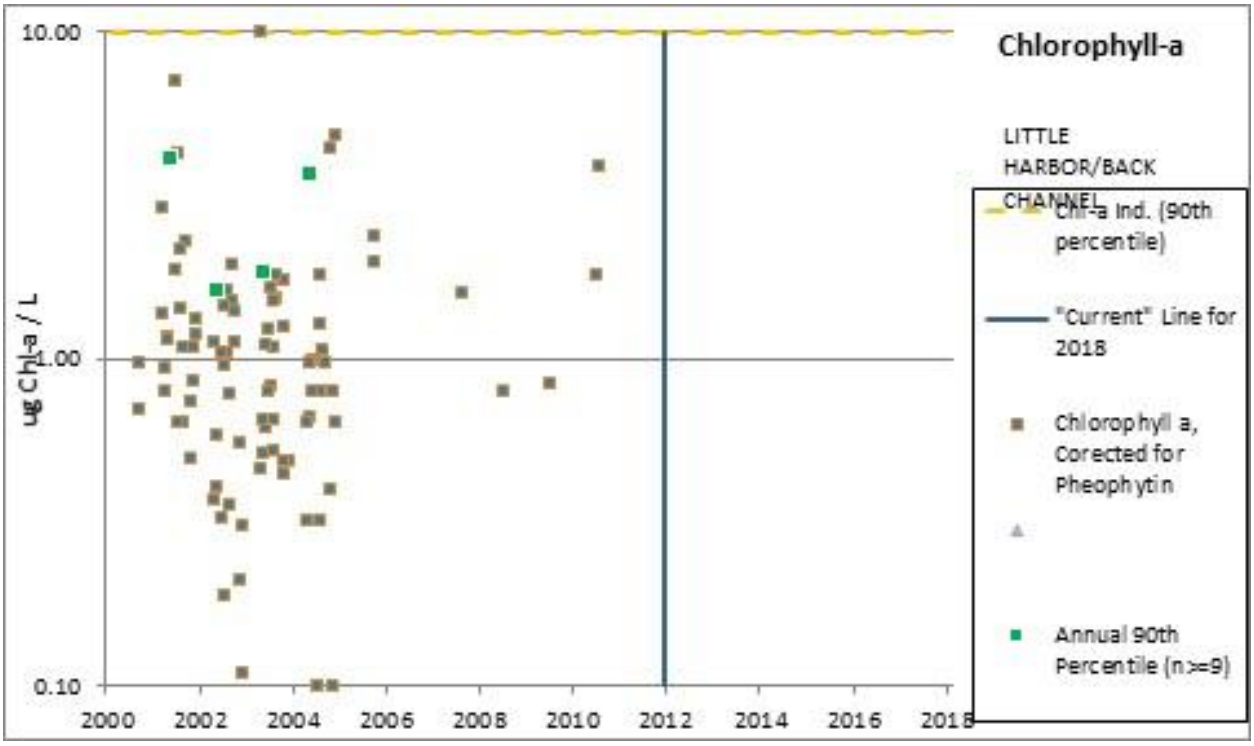
Portsmouth Harbor Assessment Zone (1/1/2012-5/25/2018)	**Count**	**Minimum**	**Median**	**90th Percentile**	**Maximum**
CHLOROPHYLL A, CORRECTED FOR PHEOPHYTIN (µg/L)	46	0.8	1.7	3.5	6.2
CHLOROPHYLL A, UNCORRECTED FOR PHEOPHYTIN (µg/L)	0	-	-	-	-
CHLOROPHYLL A, Combined (µg/L)	46	0.8	1.7	3.5	6.2
LIGHT ATTENUATION COEFFICIENT (1/m)	40	0.350	0.593	0.848	0.890
TURBIDITY (NTU)	1,702	0.0	1.0	3.8	372.5
COLORED DISSOLVED ORGANIC MATTER (CDOM) (1/m)	0	-	-	-	-
TSS (mg/L)	46	7.0	17.9	24.1	40.4
DO-PPM-24HR-MIN-CP (mg/L)	516	5.4	7.2	8.0	8.8
DO-PPM-24HR-MIN-NCP (mg/L)	1,175	6.0	9.7	11.2	11.9
DO-PPM-GRAB-CP (mg/L)	0	-	-	-	-
DO-PPM-GRAB-NCP (mg/L)	1	9.5	9.5	-	9.5
DO-PERC-24H-MEAN-CP (% sat)	524	77.7	97.4	105.4	112.0
DO-PERC-24H-MEAN-NCP (% sat)	1,176	74.5	98.0	107.2	117.9
DO-PERC-2TIDE-GRAB-CP (% sat)	0	-	-	-	-
DO-PERC-2TIDE-GRAB-NCP (% sat)	1	95.8	95.8	-	95.8
DO-PERC-GRAB (% sat)	0	-	-	-	-
Day Ave of TN (µg N/L)	45	127	228	318	393
Day Ave of TDN (µg N/L)	46	81	161	261	292
Day Ave of DIN (NH3 + NO2/3) (µg N/L)	46	10	74	189	228
Day Ave of NH3 (µg N/L)	46	3	27	89	144
Day Ave of PON (µg N/L)	0	-	-	-	-
Day Ave of NO2/3 (µg N/L)	46	3	38	127	186
SALINITY-Grabs (pss)	100	23	29	32	32
SALINITY-Datalogger Daily Median (pss)	1,700	20	31	32	33

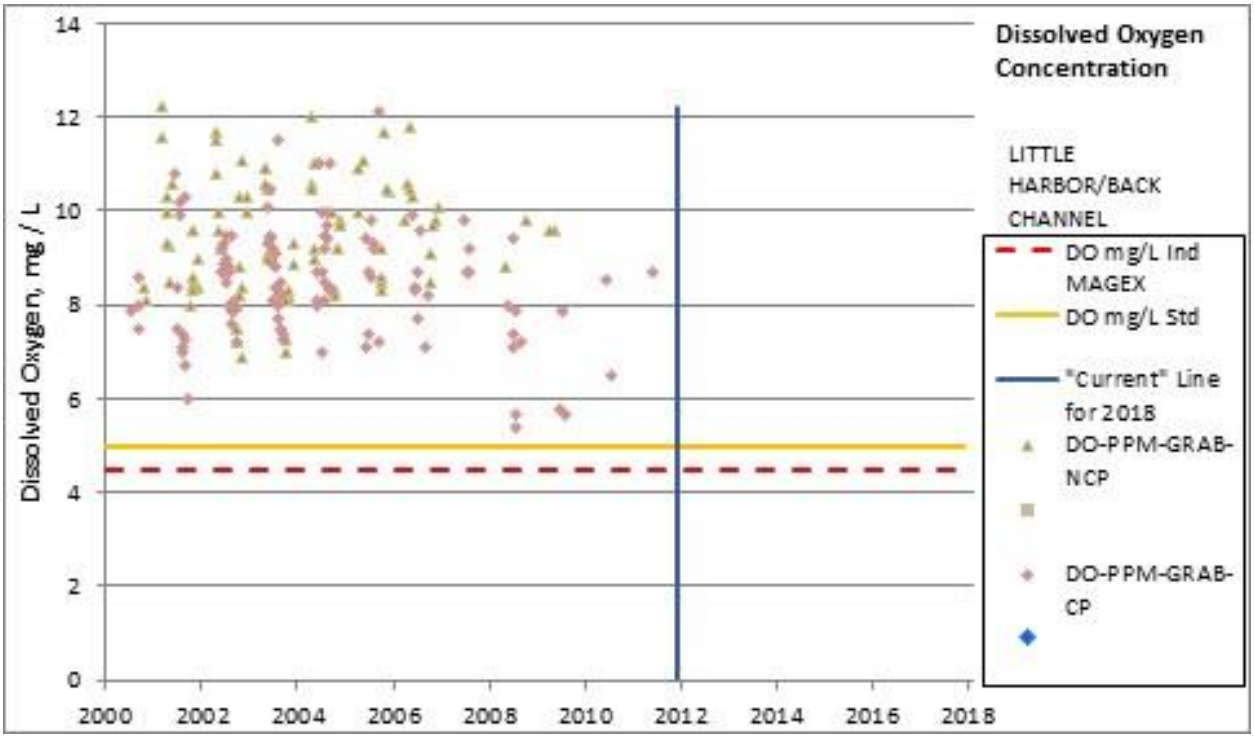
Assessment Zone = LITTLE HARBOR/BACK CHANNEL

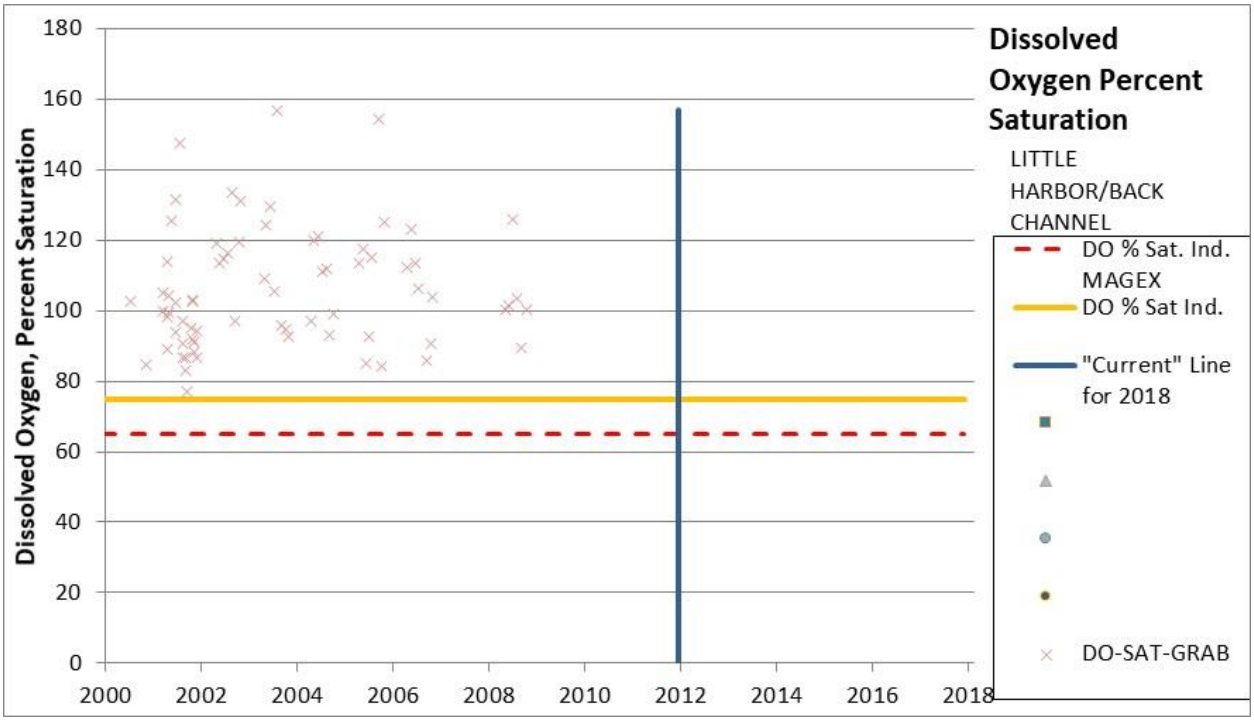
(NHEST600031001-05, NHEST600031001-08, NHEST600031002-02)

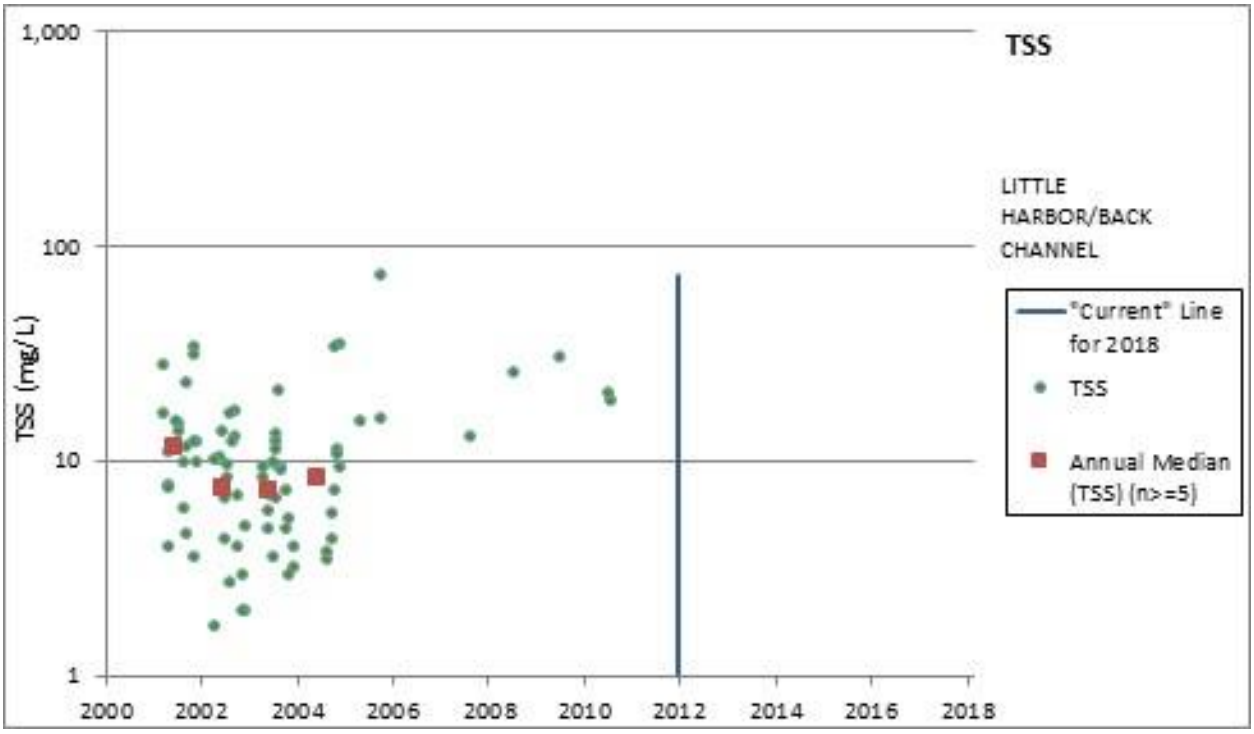
Indicator	Aquatic Life Use Category 2016 / 2018	2018 Comment
Chlorophyll-a	3-ND / 3-ND	The chlorophyll-a indicator threshold to prevent low dissolved oxygen is a 90th percentile below 10 µg/L. This assessment zone has no measurements for chlorophyll-a since 2010.
Dissolved Oxygen (mg/L)	3-ND / 3-ND	This assessment zone has no measurements for dissolved oxygen concentration since 2010. As such, this assessment zone has been assessed as 3-ND (No Data) dissolved oxygen concentration.
Dissolved Oxygen (% Saturation)	3-ND / 3-ND	Full-support or non-support determinations are no longer made for dissolved oxygen percent saturation due to SB127 in 2017 amending three sections of RSA 485. No data has been collected in the current period.
Estuarine Bioassessments (eelgrass)	5-P / 5-P	The historical extent of eelgrass in this assessment zone was 68.8 acres from the 1948, 1962, 1980, and 1981 datasets. The median current extent of eelgrass in 2015-2017 is 36.9 acres, which is a decrease of 46.3%. Since 1990, the trend in eelgrass cover in this assessment zone is a loss of 36.5%. The thresholds for impairment are either loss of more than 20% of the historic extent of eelgrass or a recent trend of greater than 20% loss.
Water Clarity (Light Attenuation Coefficient)	5-M / 5-M	There have been no light measurements collected since 2010. For an eelgrass restoration depth of 3 m, the light attenuation coefficient threshold is 0.5 m^-1. This assessment zone historically had eelgrass growing in both the shallows and deeper habitat making the 3 m restoration depth a valid target. This assessment zone was listed as impaired (5-M) for water clarity to protect eelgrass habitat on the 2010 303d list. At that time the Light Attenuation Coefficient median was 0.58 m^-1 (n=25). Assessment zones that were impaired in the previous cycle cannot be removed from the 303d list if there are insufficient data to make a new assessment. Therefore, the impaired (5-M) listing from the 2010 through 2016 303d lists has been retained.
Total Nitrogen	3-ND/ 3-ND	There have been no total nitrogen samples collected since 2010 and therefore there is no data from which to calculate a median total nitrogen from 2012 through 2016. There are no data to evaluate dissolved oxygen concentration or percent saturation, or chlorophyll-a. The eelgrass beds are less than half their historic extent. There have been no light measurements collected since 2010 to compare to the 3 m restoration depth. No direct sampling efforts have taken place to evaluate the extent of epiphytes and macrophytes however regarding macroalgae, Burdick et al. (Burdick, Mathieson, Peter, & Sydney, 2016) stated, “Monitoring results from 2014 show high levels of cover of nuisance green and red algae (*Ulva* and *Gracilaria*, respectively) at all sites except near the mouth of the Estuary.” The “mouth of the estuary site” is Four Tree Island, approximately 0.5 mile upstream from the Portsmouth Harbor assessment zone. This assessment zone is generally characterized by its lack eutrophication indicator data. Overall, there is insufficient power in the response datasets to determine that eutrophication by total nitrogen is alone is not known to be strong enough to warrant impairment under New Hampshire’s narrative standard. As such, this assessment zone has been assessed as 3-ND (No Data) total nitrogen.

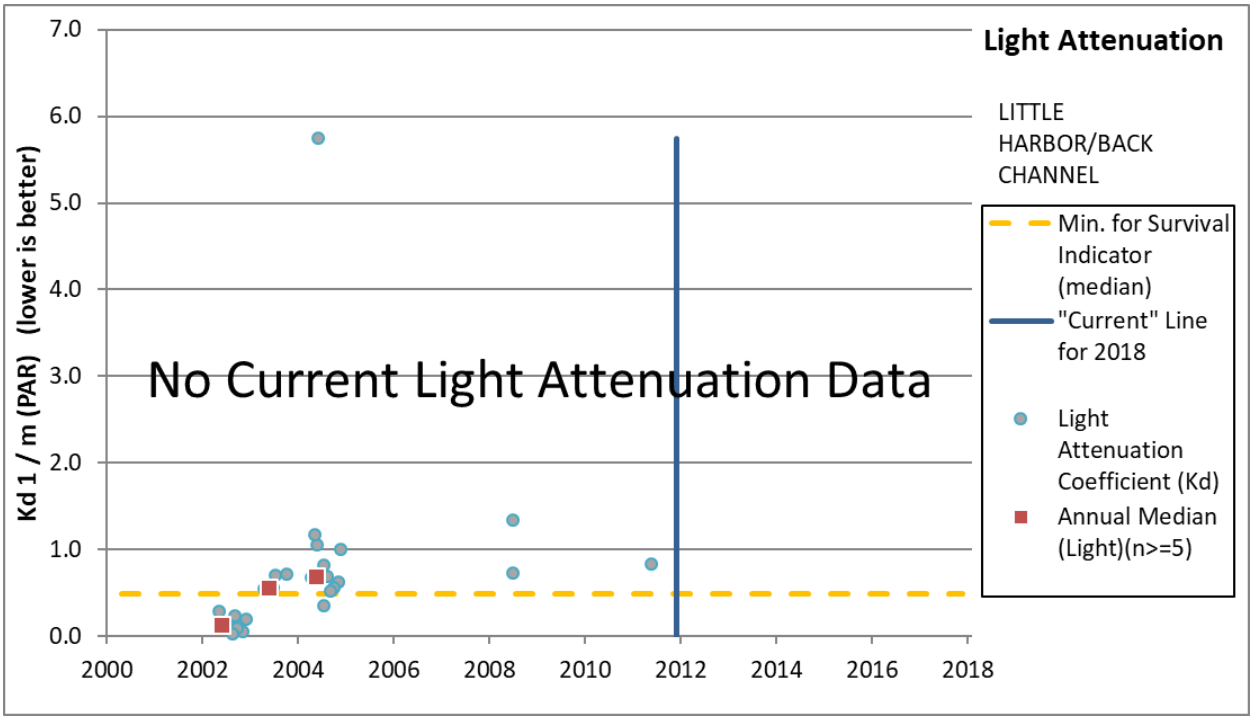

Chlorophyll-a
LITTLE HARBOR/BACK CHANNEL
Chl-a Ind. (90th percentile)
"Current" Line for 2018
Chlorophyll a, Corected for Pheophytin
Annual 90th Percentile (n>=9)
ug Chl-a / L
12
10
8
6
4
2
0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018

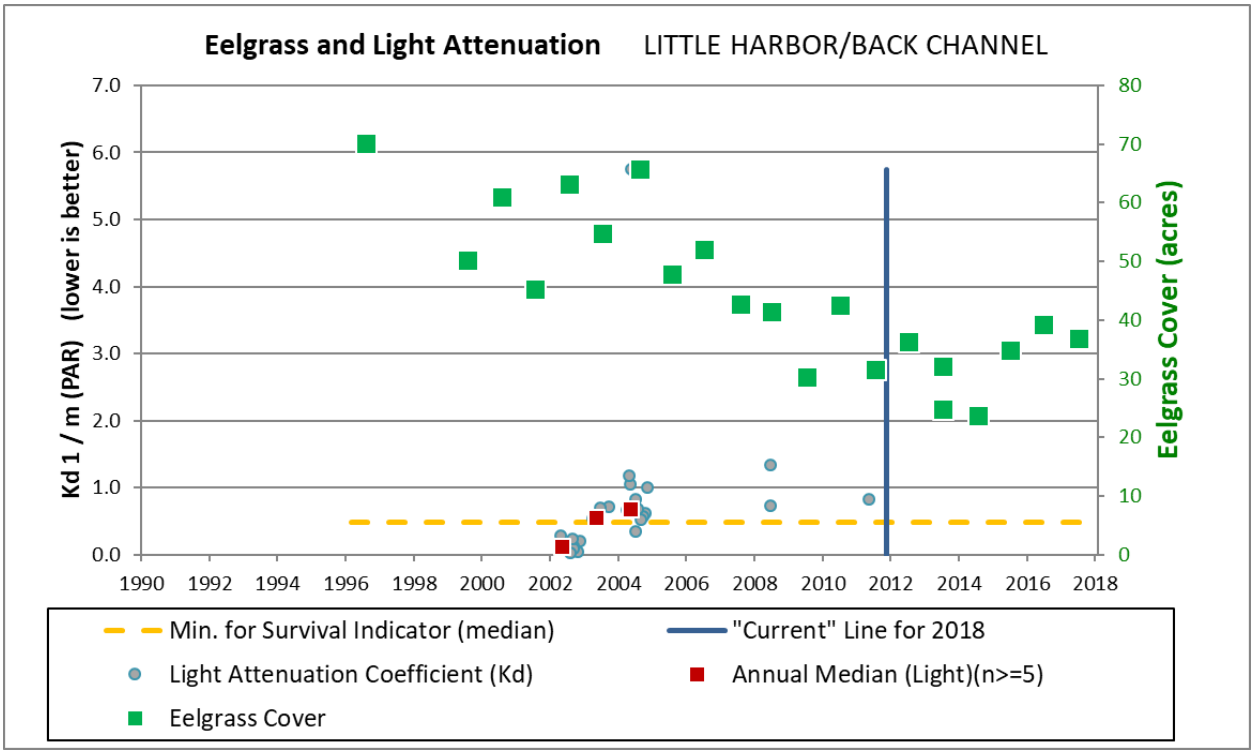

Chlorophyll-a
LITTLE HARBOR/BACK CHANNEL
Chl-a Ind. (90th percentile)
"Current" Line for 2018
Chlorophyll a, Corected for Pheophytin
Annual 90th Percentile (n>=9)
ug Chl-a / L
10.00
1.00
0.10
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018

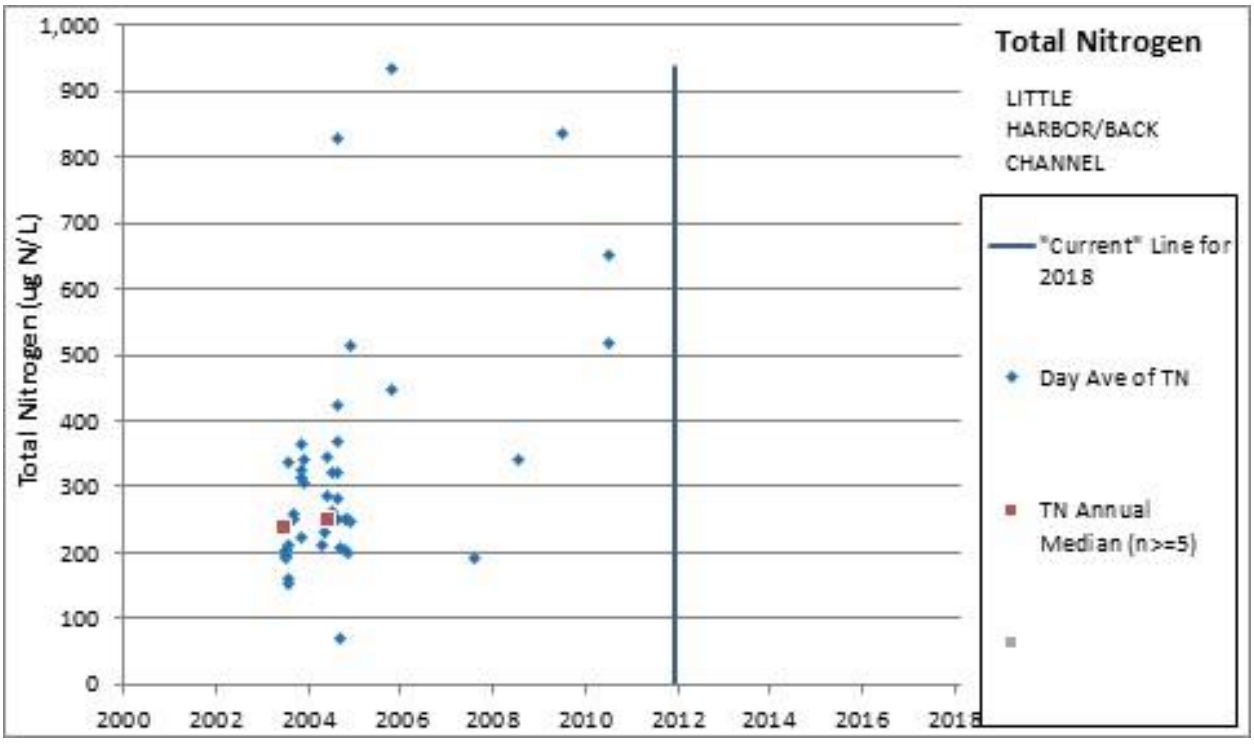

Dissolved Oxygen Concentration
Dissolved Oxygen, mg / L
14
12
10
8
6
4
2
0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
LITTLE HARBOR/BACK CHANNEL
DO mg/L Ind MAGEX
DO mg/L Std
"Current" Line for 2018
DO-PPM-GRAB-NCP
DO-PPM-GRAB-CP


Dissolved Oxygen Percent Saturation
Dissolved Oxygen, Percent Saturation
180
160
140
120
100
80
60
40
20
0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
LITTLE HARBOR/BACK CHANNEL
DO % Sat. Ind. MAGEX
DO % Sat Ind.
"Current" Line for 2018
DO-SAT-GRAB


TSS
LITTLE HARBOR/BACK CHANNEL
"Current" Line for 2018
TSS
Annual Median (TSS) (n>=5)
TSS (mg/L)
1,000
100
10
1
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018


Light Attenuation
LITTLE HARBOR/BACK CHANNEL
Min. for Survival Indicator (median)
"Current" Line for 2018
Light Attenuation Coefficient (Kd)
Annual Median (Light)(n>=5)
No Current Light Attenuation Data
Kd 1 / m (PAR) (lower is better)
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018


Eelgrass and Light Attenuation
LITTLE HARBOR/BACK CHANNEL
Kd 1 / m (PAR) (lower is better)
Eelgrass Cover (acres)
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
80
70
60
50
40
30
20
10
0
1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016 2018
Min. for Survival Indicator (median)
"Current" Line for 2018
Light Attenuation Coefficient (Kd)
Annual Median (Light)(n>=5)
Eelgrass Cover

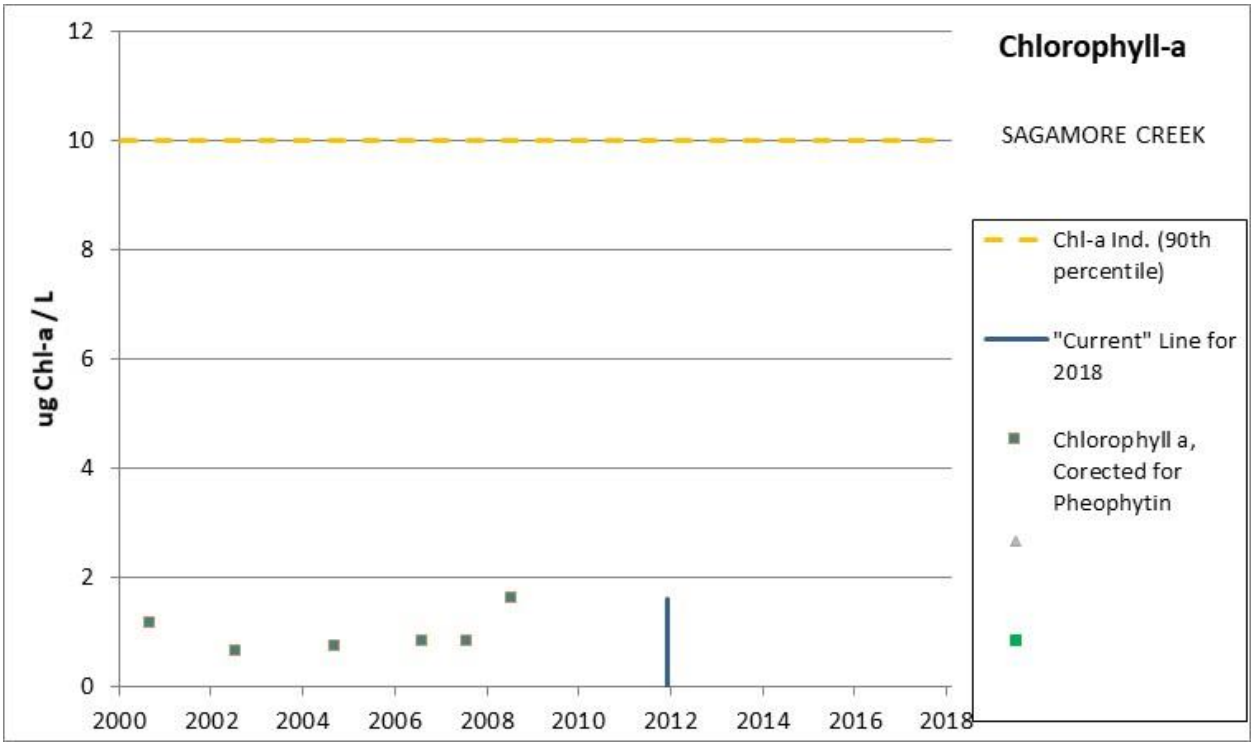

Total Nitrogen
LITTLE HARBOR/BACK CHANNEL
Total Nitrogen (ug N/L)
1,000
900
800
700
600
500
400
300
200
100
0
2000 2002 2004 2006 2008 2010 2012 2014 2016 2018
"Current" Line for 2018
Day Ave of TN
TN Annual Median (n>=5)

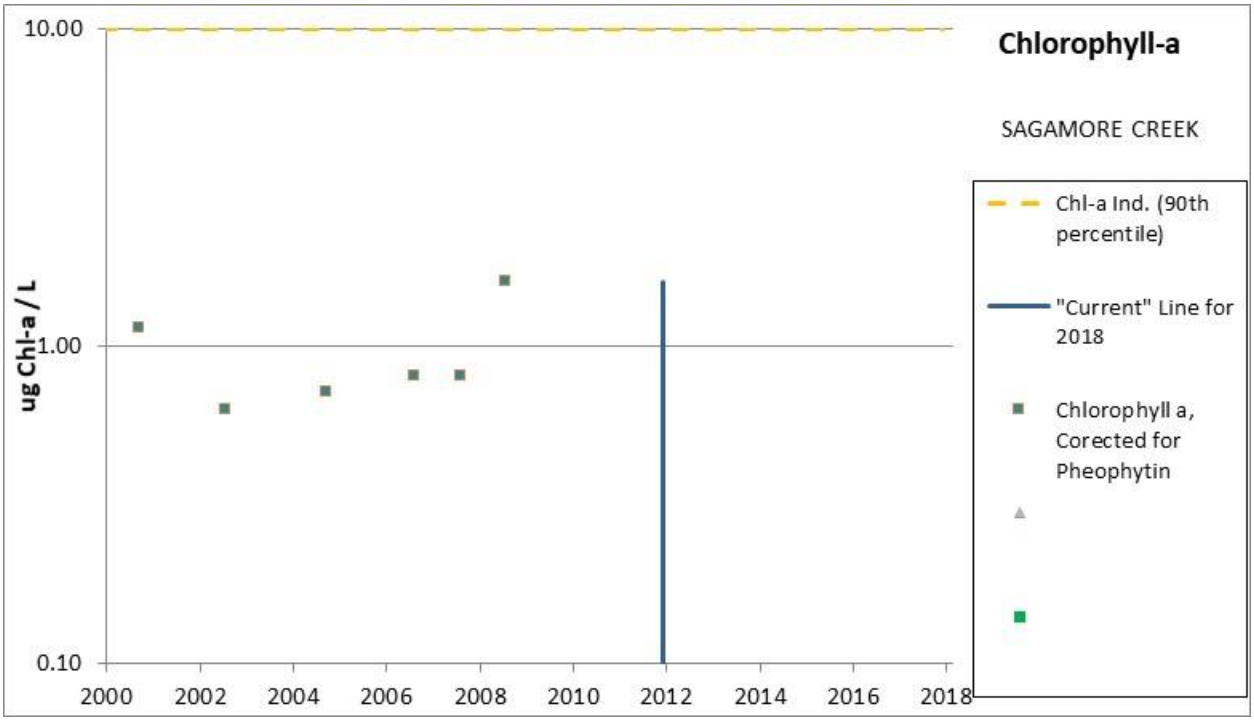
Little Harbor / Back Channel Assessment Zone (1/1/2012-5/25/2018)	**Count**	**Minimum**	**Median**	**90th Percentile**	**Maximum**
CHLOROPHYLL A, CORRECTED FOR PHEOPHYTIN (µg/L)	0	-	-	-	-
CHLOROPHYLL A, UNCORRECTED FOR PHEOPHYTIN (µg/L)	0	-	-	-	-
CHLOROPHYLL A, Combined (µg/L)	0	-	-	-	-
LIGHT ATTENUATION COEFFICIENT (1/m)	0	-	-	-	-
TURBIDITY (NTU)	0	-	-	-	-
COLORED DISSOLVED ORGANIC MATTER (CDOM) (1/m)	0	-	-	-	-
TSS (mg/L)	0	-	-	-	-
DO-PPM-24HR-MIN-CP (mg/L)	0	-	-	-	-
DO-PPM-24HR-MIN-NCP (mg/L)	0	-	-	-	-
DO-PPM-GRAB-CP (mg/L)	0	-	-	-	-
DO-PPM-GRAB-NCP (mg/L)	0	-	-	-	-
DO-PERC-24H-MEAN-CP (% sat)	0	-	-	-	-
DO-PERC-24H-MEAN-NCP (% sat)	0	-	-	-	-
DO-PERC-2TIDE-GRAB-CP (% sat)	0	-	-	-	-
DO-PERC-2TIDE-GRAB-NCP (% sat)	0	-	-	-	-
DO-PERC-GRAB (% sat)	0	-	-	-	-
Day Ave of TN (µg N/L)	0	-	-	-	-
Day Ave of TDN (µg N/L)	0	-	-	-	-
Day Ave of DIN (NH3 + NO2/3) (µg N/L)	0	-	-	-	-
Day Ave of NH3 (µg N/L)	0	-	-	-	-
Day Ave of PON (µg N/L)	0	-	-	-	-
Day Ave of NO2/3 (µg N/L)	0	-	-	-	-
SALINITY-Grabs (pss)	252	1	30	32	33
SALINITY-Datalogger Daily Median (pss)	0	-	-	-	-

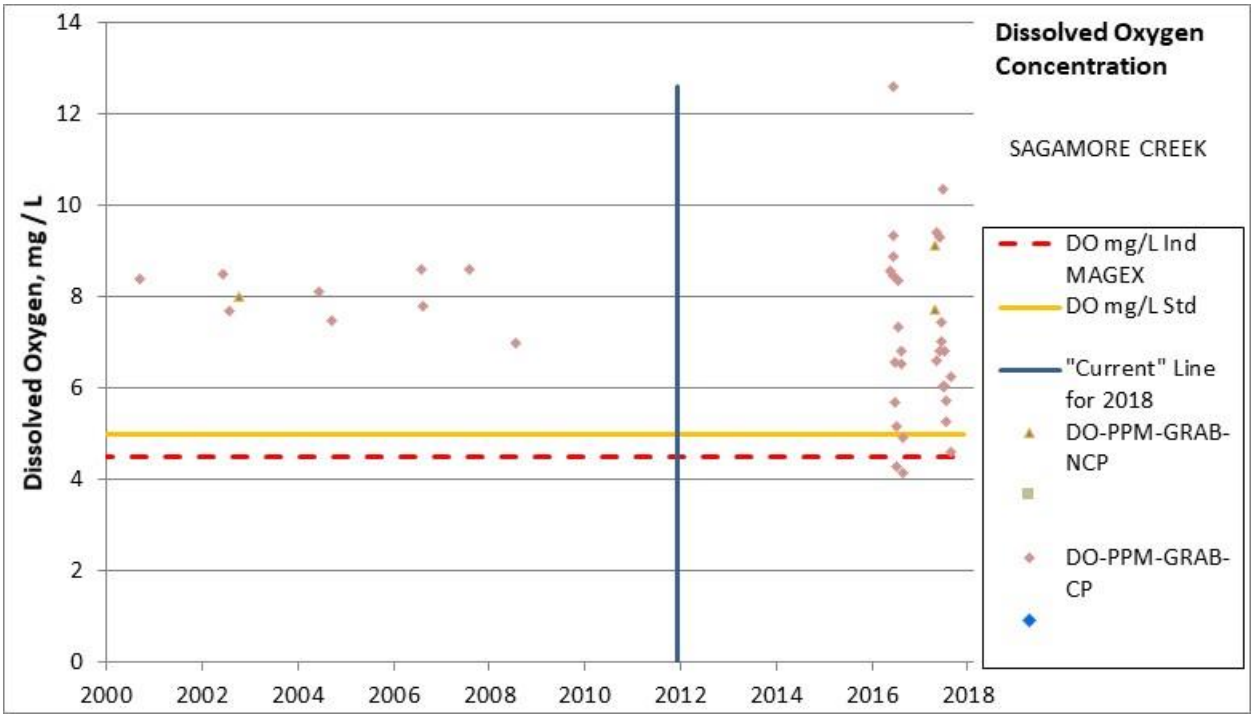
Assessment Zone = SAGAMORE CREEK

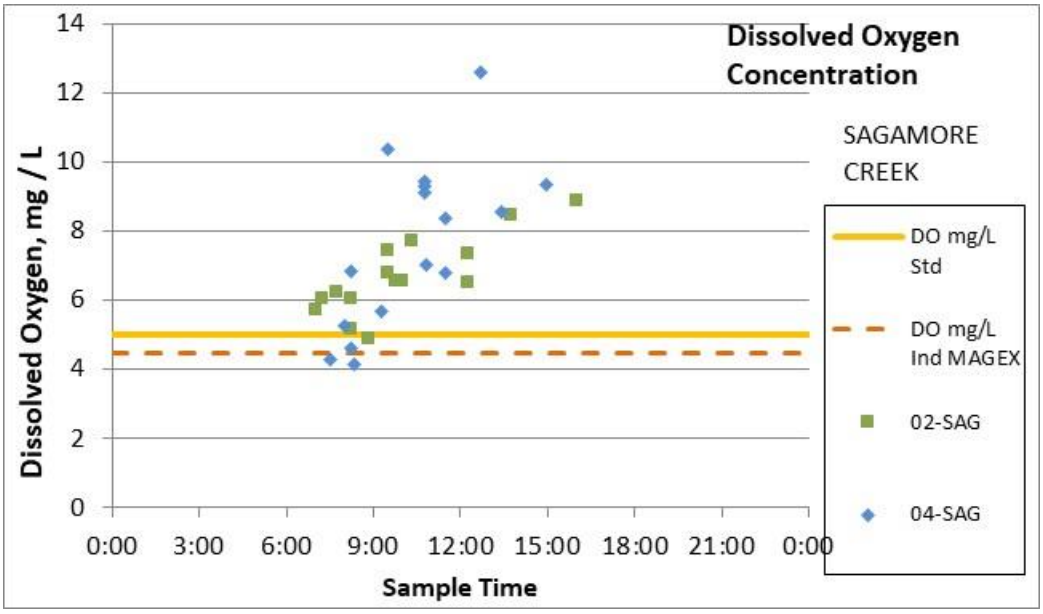
(NHEST600031001-03, NHEST600031001-04)

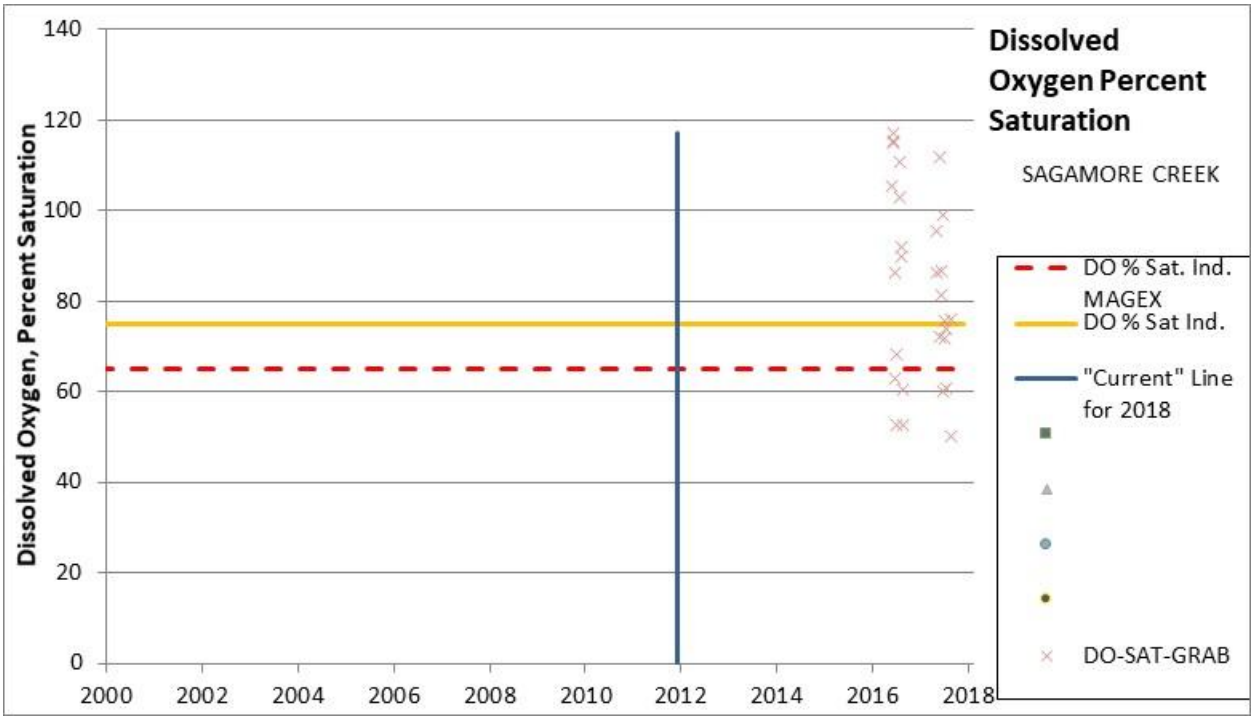
Indicator	Aquatic Life Use Category 2016 / 2018	2018 Comment
Chlorophyll-a	3-ND / 3-ND	The calculated 90th percentile chlorophyll-a in this assessment zone cannot be calculated due to the presence of only one measured value since 2008 (1.6 µg/L). The chlorophyll-a indicator threshold to prevent low dissolved oxygen is a 90th percentile below 10 µg/L.
Dissolved Oxygen (mg/L)	2-M / 5-M	Four of the 31 (13%) grab samples collected were below 5 mg/L and 2 of those measurements were below 4.5 mg/L. Low values were consistently early in the day. Three of the 4 low readings were at 04-SAG, which is the Route 1B bridge site. The fourth low reading was at 02-SAG (the Route 1A bridge) on the same date as one of the 04-SAG low readings but not as low. Typically, we find that grab samples under-estimate the frequency and magnitude of degraded water quality. Given that on one of the sample dates we see that the below 5 mg/L readings extended through the upstream mile of the a 2-mile-long estuary, the timing of the low DO values, the percent of low DO samples, that the low values were reported in both of the sampled years, and that grab samples under-estimate the frequency and magnitude of degraded water quality assessment zone has been added to the 303(d) list due to low dissolved oxygen concentration.
Dissolved Oxygen (% Saturation)	3-ND / 3-PNS	Full-support or non-support determinations are no longer made for dissolved oxygen percent saturation due to SB127 in 2017 amending three sections of RSA 485. Eleven of the 28 (39%) grab samples collected were below 75% saturation and on three dates approached 50% saturation. Typically, we find that grab samples under-estimate the frequency and magnitude of degraded water quality. Low values were consistently early in the day. Low readings occurred at both sampled sites and in both the 2016 and 2017 datasets. The indicator suggests that the aquatic life use is impaired, as such, dissolved oxygen 24-hour average percent saturation has been assessed as potentially not supporting.
Estuarine Bioassessments (eelgrass)	5-P / 5-P	The historical extent of eelgrass in this assessment zone was 4.1 acres from the 1948, 1962, 1980, and 1981 datasets. The median current extent of eelgrass in 2015-2017 is 1.7 acres, which is a decrease of 58.3%. Since 1990, the trend in eelgrass cover in this assessment zone was not significant. The threshold for impairment are either loss of more than 20% of the historic extent of eelgrass or a recent trend of greater than 20% loss.
Water Clarity (Light Attenuation Coefficient)	3-ND / 3-ND	There have been no light measurements collected since 2005.This assessment zone historically had eelgrass growing in both the shallows and deeper habitat making the 3m restoration depth a valid target. Further, a review of the location of the deep edge of the eelgrass suggests that the maximum depth of eelgrass survival is not as deep as it was in the past. As there is no measured light attenuation, this zone remains assessed as “no data.”
Total Nitrogen	3-ND / 3-PNS	There is one “current” total nitrogen measurement in the available dataset, a measurement of 1,230 µg/L. The available dissolved oxygen data shows that water quality concentration standard is not met and the dissolved oxygen percent saturation indicator is not met. There is no light attenuation data in the current period. There is no current chlorophyll-a data. The eelgrass beds are severely degraded. There are insufficient data to indicate that the eutrophication is strong enough to warrant impairment. Given the concentration of the one total nitrogen sample and the concentration of the three old samples, this assessment zone has been assessed as Insufficient Information – Potentially Not Supporting (3-PNS) for total nitrogen.

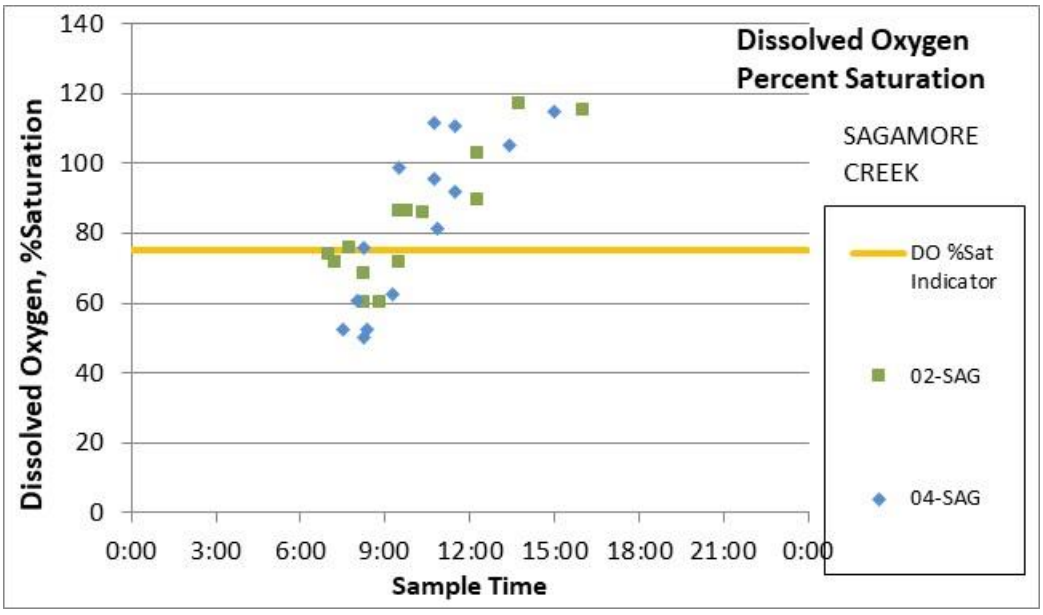

Chlorophyll-a
SAGAMORE CREEK
ug Chl-a / L
12
10
8
6
4
2
0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Chl-a Ind. (90th percentile)
"Current" Line for 2018
Chlorophyll a, Corected for Pheophytin

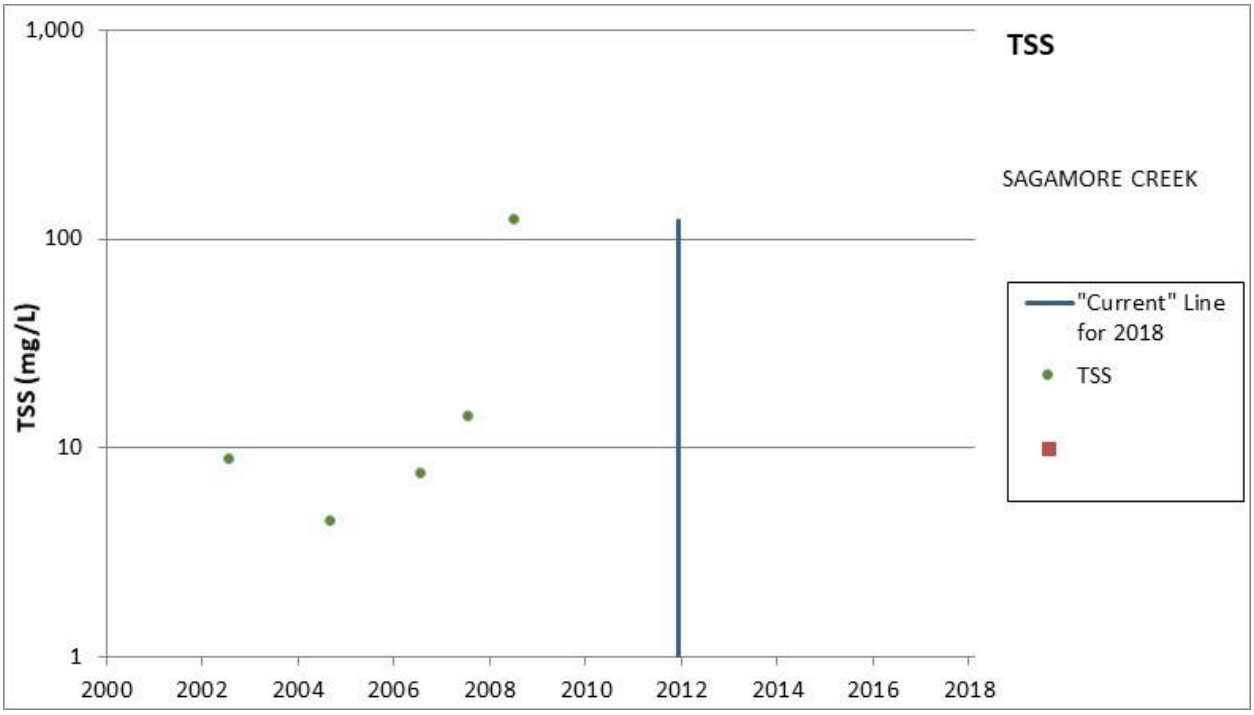

Chlorophyll-a
SAGAMORE CREEK
ug Chl-a / L
10.00
1.00
0.10
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Chl-a Ind. (90th percentile)
"Current" Line for 2018
Chlorophyll a, Corected for Pheophytin

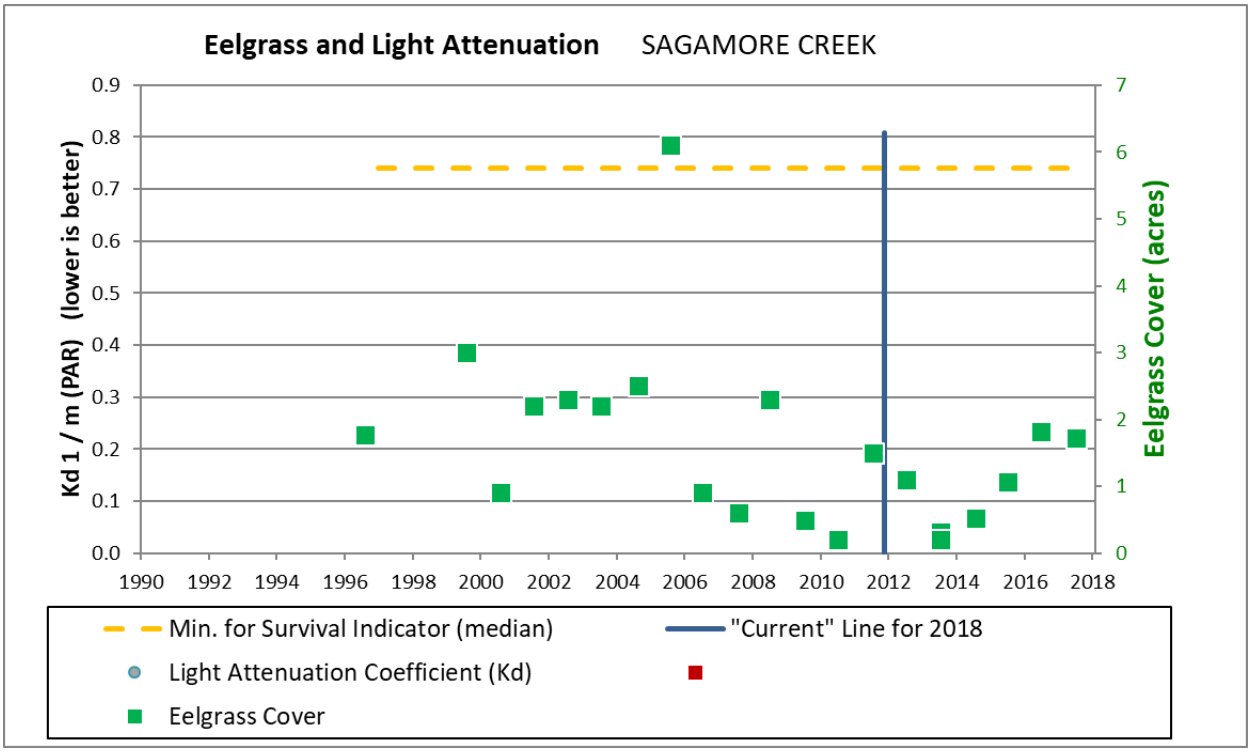

Dissolved Oxygen Concentration
SAGAMORE CREEK
Dissolved Oxygen, mg / L
14
12
10
8
6
4
2
0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
DO mg/L Ind MAGEX
DO mg/L Std
"Current" Line for 2018
DO-PPM-GRAB-NCP
DO-PPM-GRAB-CP

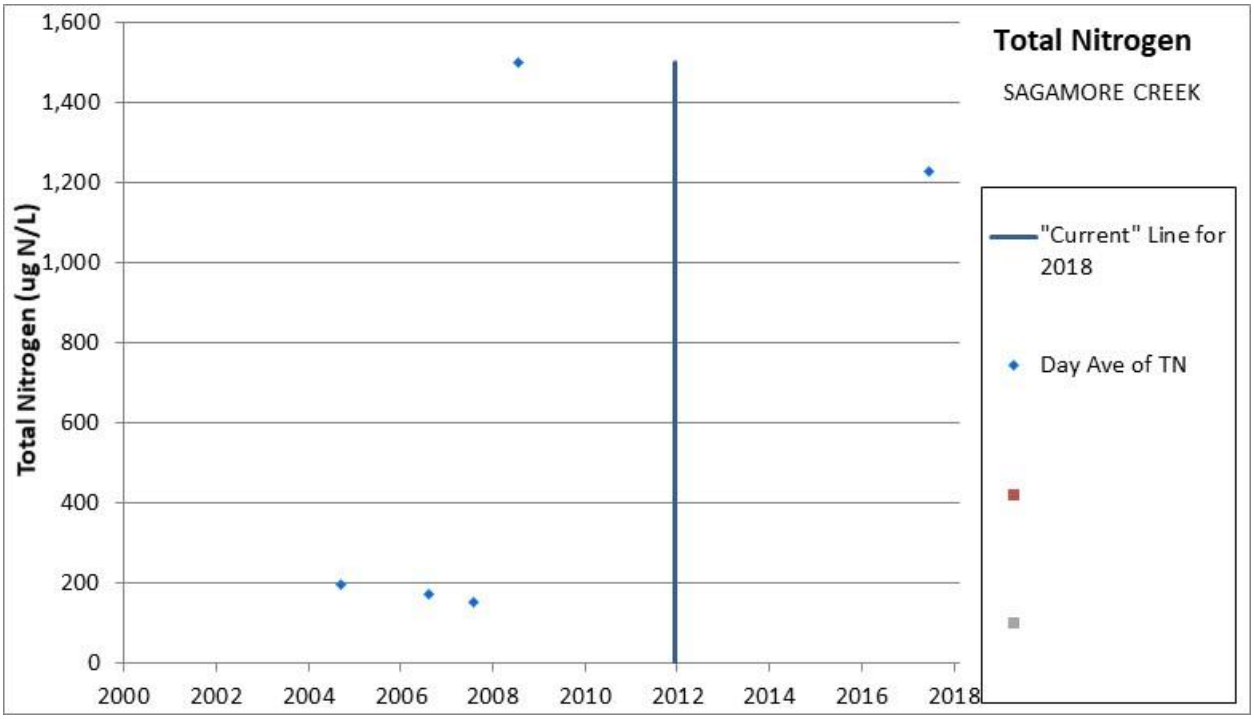

Dissolved Oxygen Concentration
SAGAMORE CREEK
Dissolved Oxygen, mg / L
14
12
10
8
6
4
2
0
0:00
3:00
6:00
9:00
12:00
15:00
18:00
21:00
0:00
Sample Time
DO mg/L Std
DO mg/L Ind MAGEX
02-SAG
04-SAG


Dissolved Oxygen Percent Saturation
SAGAMORE CREEK
Dissolved Oxygen, Percent Saturation
140
120
100
80
60
40
20
0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
DO % Sat. Ind. MAGEX
DO % Sat Ind.
"Current" Line for 2018
DO-SAT-GRAB


Dissolved Oxygen Percent Saturation
SAGAMORE CREEK
Dissolved Oxygen, %Saturation
140
120
100
80
60
40
20
0
0:00
3:00
6:00
9:00
12:00
15:00
18:00
21:00
0:00
Sample Time
DO %Sat Indicator
02-SAG
04-SAG


TSS
SAGAMORE CREEK
TSS (mg/L)
1,000
100
10
1
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
"Current" Line for 2018
TSS


Eelgrass and Light Attenuation
SAGAMORE CREEK
Kd 1 / m (PAR) (lower is better)
Eelgrass Cover (acres)
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
7
6
5
4
3
2
1
0
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Min. for Survival Indicator (median)
"Current" Line for 2018
Light Attenuation Coefficient (Kd)
Eelgrass Cover



Sagamore Creek Assessment Zone (1/1/2012-5/25/2018)	**Count**	**Minimum**	**Median**	**90th Percentile**	**Maximum**
CHLOROPHYLL A, CORRECTED FOR PHEOPHYTIN (µg/L)	0	-	-	-	-
CHLOROPHYLL A, UNCORRECTED FOR PHEOPHYTIN (µg/L)	0	-	-	-	-
CHLOROPHYLL A, Combined (µg/L)	0	-	-	-	-
LIGHT ATTENUATION COEFFICIENT (1/m)	0	-	-	-	-
TURBIDITY (NTU)	28	1.7	4.7	9.5	14.0
COLORED DISSOLVED ORGANIC MATTER (CDOM) (1/m)	0	-	-	-	-
TSS (mg/L)	0	-	-	-	-
DO-PPM-24HR-MIN-CP (mg/L)	0	-	-	-	-
DO-PPM-24HR-MIN-NCP (mg/L)	0	-	-	-	-
DO-PPM-GRAB-CP (mg/L)	29	4.2	6.8	9.4	12.6
DO-PPM-GRAB-NCP (mg/L)	2	7.7	8.4	-	9.1
DO-PERC-24H-MEAN-CP (% sat)	0	-	-	-	-
DO-PERC-24H-MEAN-NCP (% sat)	0	-	-	-	-
DO-PERC-2TIDE-GRAB-CP (% sat)	0	-	-	-	-
DO-PERC-2TIDE-GRAB-NCP (% sat)	0	-	-	-	-
DO-PERC-GRAB (% sat)	31	50.0	86.3	116.6	178.0
Day Ave of TN (µg N/L)	1	1,230	1,230	-	1,230
Day Ave of TDN (µg N/L)	0	-	-	-	-
Day Ave of DIN (NH3 + NO2/3) (µg N/L)	0	-	-	-	-
Day Ave of NH3 (µg N/L)	0	-	-	-	-
Day Ave of PON (µg N/L)	0	-	-	-	-
Day Ave of NO2/3 (µg N/L)	6	150	205	-	300
SALINITY-Grabs (pss)	101	16.0	29.6	32.0	32.4
SALINITY-Datalogger Daily Median (pss)	0	-	-	-	-

References

Burdick, D., Mathieson, A., Peter, C., & Sydney, N. (2016). *Monitoring Macroalgae in the Great Bay Estuary for 2014.* Piscataqua Region Estuaries Partnership.

HydroQual. (March 20, 2012). *Squamscott River August-September 2011 Field Studies.* HydroQual.

McGlathery, K., Sundbäck, K., & Anderson, I. (2007, October 25). Eutrophication in shallow coastal bays and lagoons: the role of plants in the coastal filter. *Marine Ecology Progress Series, Vol. 348*, pp. 1-18. doi:10.3354/meps07132

NHDES. (2013). *Response to Public Comment and Summary of Substative Differences Between the Draft and Final 2012 Section 303(d) Surface Water Quality Report, July 19,2013.* NHDES. Retrieved from http://www.des.nh.gov/organization/divisions/water/wmb/swqa/2012/documents/a33-303d-cmnt-response.pdf

NHDES. (May 8, 2017). *Technical Support Document for the Great Bay Estuary Aquatic Life Use Support Assessments, 2016 305(b) Report/303(d) List (R-WD-17-12).* Concord: NHDES.

PREP. (2013). *State of Our Estuaries.* Durham, NH: Piscataqua Region Estuaries Partnership. Retrieved from www.stateofourestuaries.org

PREP. (2018). *State of our Estuaries 2018.* Durham, NH: Piscataqua Region Estuaries Partnership. Retrieved from www.StateofOurEstuaries.org

Short, F., Davis, R. C., Kopp, B. S., Short, C. A., & Burdick, D. M. (2002). Site-selection model for optimal transplantation of eelgrass Zostera marina in the northeastern US. *227*, 253-267.

Valiela, I., Collins, G., Kremer, J., Lajtha, K., Geist, M., Seely, B., . . . Sham, C. H. (1997). Nitrogen Loading from Coastal Watersheds to Receiving Estuaries: New Method and Application. *Ecological Applications, 7*(2), pp. 358-380.