**STATE OF NEW HAMPSHIRE**

# Response to Public Comment on the Draft 2016 Section 303(d) List of Impaired Waters and the Draft Consolidated Assessment and Listing Methodology

**NOVEMBER 30, 2017**

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

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**STATE OF NEW HAMPSHIRE**

# Response to Public Comment on the Draft 2016 Section 303(d) List of Impaired Waters and the Draft Consolidated Assessment and Listing Methodology

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**NOVEMBER 30, 2017**

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# TABLE OF CONTENTS

## Contents



**Table of Figures**

## INTRODUCTION

On May 8, 2017, the New Hampshire Department of Environmental Services (NHDES) released the Draft 2016 303(d) List of impaired waters and the Draft Consolidated Assessment and Listing Methodology (CALM) for public comments. Downloadable copies of the draft 303(d) list and CALM were made available on the NHDES website for review (http://des.nh.gov/organization/divisions/water/wmb/swqa/index.htm). Public comments were accepted through the close of business on June 23, 2017. In addition to posting at multiple locations on the NHDES website, direct notification by email was sent to nearly 1,500 stakeholders including but not limited to:

Federal agencies
State agencies in New Hampshire and abutting states
Municipal officials
DPW Directors of the MS4 Communities
County Conservation Districts
Regional Planning Commissions
Non-profit interest groups
Volunteer monitoring groups
New England Interstate Water Pollution Control Commission
University of New Hampshire

The following sections contain the comments received, NHDES' responses to comments, and supporting information. The sections are organized as follows:

A. Response to Public Comment (Note: This section contains NHDES' responses to all of the comments received. The responses are organized by reference number. A reference number refers to a specific section of a comment letter in Section B.)

B. Public Comment on the Draft 2016 303(d) List of Impaired Waters (Note: This section contains the full text of all comments received. Each individual comment in the letters has been assigned a reference number. The responses in Section A are organized by reference number.)

C. While the bulk of the comments text is provided in this document the full original comments and attachments received on the May 8, 2017 draft are on the department's FTP site;

1. Go to this address using a web browser: ftp://pubftp.nh.gov/DES/wmb/WaterQuality/SWQA/2016/Draft_CALM_303d_Comments
2. At the login window, click on the box in the lower left hand corner labeled "Login Anonymously."
3. The user name will then be automatically filled in with the word "Anonymous."
4. Type in your email address in the "Email Address" block.
5. Then click on the "Log On" button.

**Table 1**. **Comment letters received by NHDES and the designated comment letter number.**

| **COMMENTER** | **RECEIVED** | **COMMENT #** |
|---|---|---|
| Rick Cantu, OspreyOwl Environmental, LLC | 6/21/2017 | #1 |
| Dean Peschel, Great Bay Municipal Coalition (GBMC) | 6/22/2017 | #2 |
| Dawn Tuomala, Town of Merrimack | 6/23/2017 | #3 |
| Ralph Abele, EPA Region 1 | 6/23/2017 | #4 |
| Michael S. Bezanson, City of Rochester | 6/23/2017 | #5 |
| Tom Irwin, Conservation Law Foundation | 6/23/2017 | #6 |
| John Hall, Great Bay Municipal Coalition (GBMC) | 6/23/2017 | #7 |
| John B Storer, City of Rochester | 7/12/2017 | #8 |

## A. RESPONSE TO PUBLIC COMMENT ON THE MAY 8, 2017 DRAFT

## RESPONSE TO COMMENT #1: Rick Cantu, OspreyOwl Environmental, LLC

***NHDES RESPONSE* to 1- 1**

This section contains opening remarks by Rick Cantu. References to portions of the Draft 2016 303(d) and Draft CALM are discussed in the responses below.

***NHDES RESPONSE* to 1- 2**

NHDES appreciates the catch. The "." has been replaced by a ",".

***NHDES RESPONSE* to 1- 3**

The commenter initially refers to multiple samples and dissolved oxygen in regards to CALM section 3.3.14 Definition of Independent Samples and a concern over possible equipment drift due to a buildup of pollutants. The typical situation involving multiple samples and dissolved oxygen covered under section 3.1.14 is for lake profiling. The data being used in final assessments are from programs that conduct calibrations before every profile and perform full profile replicates on 10% of the profiles conducted. The typical dissolved oxygen profile is completed in 5-10 minutes without leaving the water. Such a process eliminates any concern over the suggested "dust and pollen" contamination on probes. Based on the 10% profile replicates, it is a very rare occasion that results in a sample not meeting the project's quality assurance project plan (QAPP). To qualify for potential impairment, dissolved oxygen profiles with samples not meeting the water quality criteria would have to occur on not one, but multiple days. The commenter also mentioned concerns about possible drift in terms of metals, nutrients, and chlorophyll-a, however those are all lab parameters collected from discrete samples, not field probes.

***NHDES RESPONSE* to 1- 4**

States include threatened segments in Category 5 where appropriate. Inclusion of threatened waters on the 303(d) List is required under 40 CFR 130.7(b)(5)(i). The text, "Waters which are expected to exceed water quality standards by the next listing cycle (every two years)..." comes from EPA's document "Guidance for 2006 Assessment, Listing and Reporting Requirements Pursuant to Sections 303(d), 305(b) and 314 of the Clean Water Act" (July 29, 2005, http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/2006IRG_index.cfm). "Expected to exceed" would only be used in cases where there is sufficient water quality data to calculate a statistically significant degradation trend and the two-year projection of that trend results in predicted water quality worse than the applicable water quality indicator. The CALM does not attempt to describe every possible method of predicting whether a waterbody will or will not meet water quality standard. If the commenter has a particular approach in mind, NHDES welcomes the input. While the "threatened" language exists in the CALM, no such impairments currently exist and, if such a new impairment were proposed, like the rest of the draft 303(d), the impairment would be submitted for public comment prior to final 303(d) submittal.

The commenter wondered what would happen if a waterbody was listed as threatened and in the following two years, water quality standards were not exceeded. This situation has never occurred. As such, we would evaluate such an occurrence on a case-by-case basis.

***__NHDES RESPONSE__ to* 1- 5**

To aid the reviewer of this response we note that the commenter references Section 3.12, which we believe is intended to be either Section 3.1.17 and or Table 3.12.

NHDES has no "Expectations to exceed WQ standards…" as stated by the commenter. Rather, NHDES evaluates the existing data in the context of the water quality standards.

For water quality standards without defined frequency or duration components, the criteria and thresholds should be treated as values not to be exceeded at any point in time or space. In practice, we recognize that such a level of simplicity is not compatible with the variations and nuances of real world data. While some would suggest that one sample exceedance of any magnitude should be treated as an impairment, NHDES does not agree and feels that the "10% rule" with a two-exceedance minimum is a good starting point to determine possible impairments. This is done primarily to eliminate issues with data reliability, equipment malfunction, and unique conditions. The "10% rule" is a heuristic rule of thumb, not strictly accurate or reliable for every situation, but appropriate for the first pass by computer code before humans review the data in the context of covariables.

The commenter goes on to make the same comment, to which NHDES responded, as was made on the Draft 2014 CALM (see comment and response to 5-9 in (NHDES, 2015) ). Between the 2004 and 2006 assessment cycles the department switched from a binomial approach to a straight 10% exceedance approach for the assessment of conventional parameters. This change reduced the number of exceedances needed to consider a parameter as impaired from three to two. While the comment alleges that this is a "...*66% change in criteria*..." it is important to note that this is by no means a change in criteria but a change in the number of samples exceeding the existing water quality criteria needed to consider the waterbody to be not meeting the existing criteria. The commenter concludes the remark on this topic by proposing modifications to CALM table 3-13 that would be more resource conservative (i.e. impairments based of fewer samples) than the existing method used in the CALM. For example, at 25 samples, the current CALM requires 3 exceedances for a waterbody to be considered for impairment while the commenter proposed table modification requires only 2 samples. The commenter's final conclusion point is that, "*There is enough protection within the CALM to stick with the true 10% rule*," further arguing that the existing 10% rule is appropriate.

***__NHDES RESPONSE__ to* 1- 6**

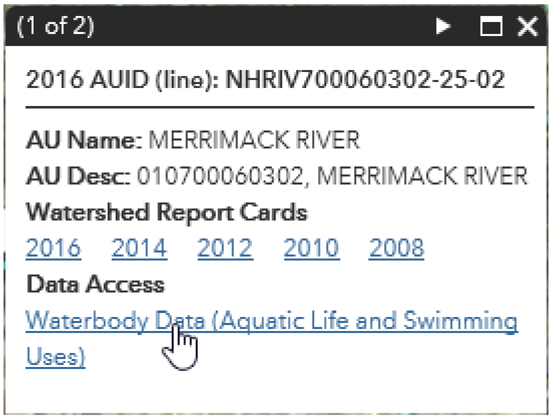
This comment begins with the use of predictive models in the 303(d) assessment process, then references the Merrimack River sampling and modeling by the Army Corps of Engineers (ACOE), and ultimately makes comments on modeled wastewater treatment facility (WWTF) permit limits. This section does not appear to be a CALM comment or a specific 303(d) comment. No response is provided.

***__NHDES RESPONSE__ to* 1- 7**

This section of comments centers around data quality and samples collected by WWTFs. Overall, the commenter seems to be concerned with the use of instream data that is collected by WWTFs and then used in their NPDES permits, which is not a CALM nor specific 303(d) comment. If a WWTF were to submit instream data for the assessment process, NHDES would evaluate the robustness of their QA/QC procedures at that time.

In regards to the assessment process, if the commenter is interested in the data used for a particular assessment we suggest they explore the 2016 Surface Water Quality Assessment Viewer. Through that tool, one can access all of the water quality data reviewed to make assessments including the collecting program (Figure 1).

**Figure 1. Example of what to click on in a pop-up in the 2016 Surface Water Quality Assessment Viewer to access water quality data.**



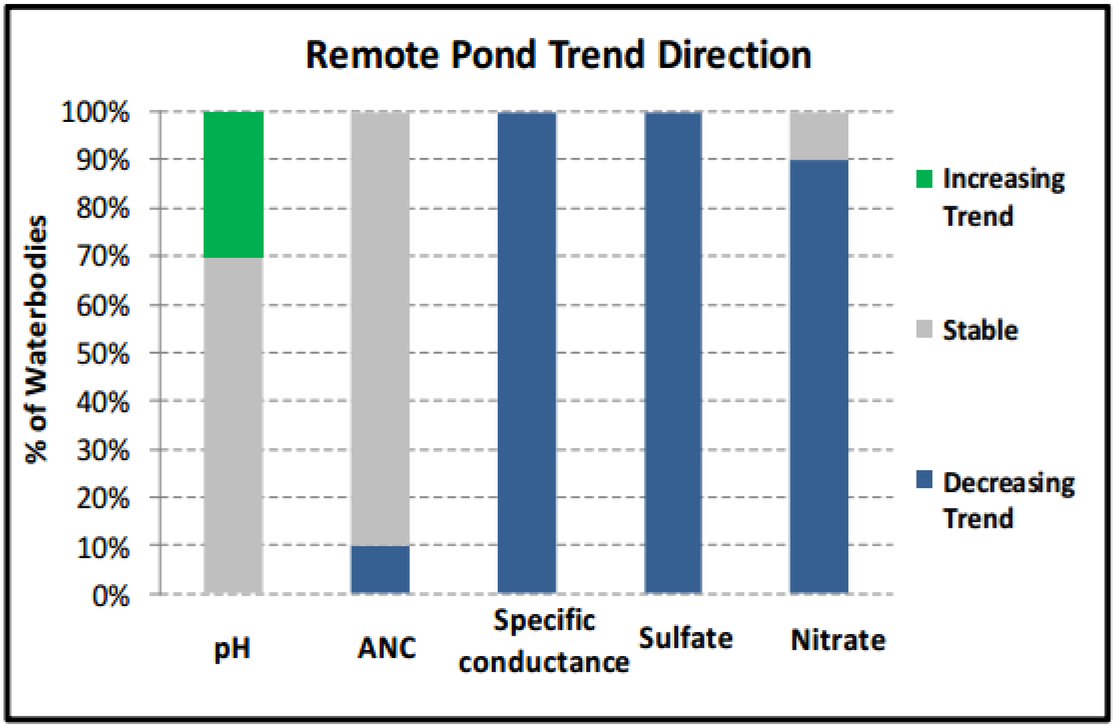

***NHDES RESPONSE*** ***to*** **1- 8**

The commenter dedicated a lengthy section of text to the approach taken by NHDES in the CALM regarding aluminum. The first portion of the comments discusses what the commenter found in the “Sources” field of the assessments and the commenter points out some inconsistencies. NHDES agrees that this field is not particularly useful except in some cases where a source is very clear. The assessment process is not geared toward detailed source assessments so source assessments should be left to those with a more detailed knowledge of the local landscape. The commenter noted several ponds that include “Naturally Occurring Organic Acids” in the source list for aluminum. This stems from the pre-2008 assessment cycles when ponds with a color over 30 cpu had “Naturally Occurring Organic Acids” added to their list of sources. NHDES does not argue that natural processes have a role in aluminum mobilization and is acutely aware that natural conditions are very rare. Chemical weathering in New Hampshire is primarily driven by pH, and that pH has been reduced due to the ongoing impacts of fossil fuel consumption. As such, neither the low pH in parts of the watershed, nor the elevated aluminum caused by increased chemical weathering can be considered completely natural phenomena. Additionally, sources of elevated aluminum, such as auto body corrosion and atmospheric deposition, can result from stormwater runoff from paved areas. Additionally, aluminum is often added to facilitate phosphorus removal from wastewater and from the treatment of drinking water.

There is no single process to determine that a source is solely natural (also see response to **2- 3**). The CALM has been updated to better reflect New Hampshire’s “conditions which exist in the absence of human influences” definition of naturally occurring conditions in Env-Wq 1702.29. In short, a water quality exceedance that is the result of the combined impacts of human and natural sources does not qualify for the natural provision in the water quality standards. While no single process can be used to determine “natural,” there are some guiding concepts that differ by parameter, waterbody type, watershed location, time of year, and the other variables that are considered in the base assessment of a dataset. Many of these processes were summarized by EPA in 2015 when they published the Natural Conditions Framework Interim Document (USEPA, 2015).

The commenter points out that the actions taken since the Clean Air Act have made great strides in reducing acid rain and questions NHDES' acid rain argument for elevated aluminum. In 2015 NHDES published, "Acid Rain Status and Trends: New Hampshire Lakes, Ponds and Rainfall" (NHDES, 2015) and a "2015 Acid Rain Status and Trends" summary (NHDES, 2015). While a portion of the studied lakes have started to improve (increasing pH) even more lakes have not yet responded to the clear reductions in sulfate and nitrate (Figure 2). Due to the geological setting of New Hampshire, it will take many years before this issue is rectified and in kind, the ongoing aluminum issues.

**Figure 2. Trend analysis of acid precipitation related parameters in New Hampshire's remote ponds (NHDES, 2015).**




In 2014, NHDES clarified how we evaluate aluminum samples. Although draft assessments were made in accordance with the clarification, that change was not noted in the draft CALM. The following text has been added to the CALM under "Indicator 11: Water Quality Criteria for Toxic Substances in the Ambient Water."

> On July 1, 2014 NHDES formally clarified to USEPA that the aluminum criteria in the NH surface water quality regulations is acid-soluble aluminum, consistent with USEPA's 1988 ambient water quality criteria document for aluminum. As such, in cases where acid-soluble aluminum was collected, those samples will be used preferentially over any co-sampled dissolved or total fraction samples.

Further, those clarifications were adopted into the updated water quality standards administrative rules on 12/1/2016 (NHDES, 2016).

The commenter provides an interesting study looking at pH, buffering compounds and aluminum in a pair of reservoirs in Massachusetts. In the tables provided, both total and dissolved fractions of aluminum appear to have been sampled, but the commenter identifies these as total recoverable and acid-soluble fractions. The total fraction is determined by acidifying an unfiltered sample to pH <2 with ultra-pure nitric acid (HNO3), heating the sample (i.e. digestion) before analysis. The dissolved fraction is determined by filtering the sample then acidifying the filtrate to pH <2 with nitric acid (HNO3) before analysis. Filtering is typically with a 0.45um membrane of either polycarbonate or cellulose ester. The acid-soluble (aka extractable or acid-extractable) is determined by acidifying an unfiltered sample with ultra-pure nitric acid to a pH = 1.65-1.85, filtering the samples (0.45um) then analyzing the filtrate. Dissolved does not equal acid-soluble. Assuming that this was just a typographical error and dissolved in the table should read acid-soluble aluminum, the dissolved fraction (really acid-soluble) is what would be used by NHDES in assessments. The commenter contends that even though the two reservoirs have different aluminum levels, the biological community is identical and there is no evidence of reduced viability. There are two issues with that analysis. First, based on the available data both Cobble Mountain reservoir (higher pH, higher alkalinity, and low aluminum site) and Borden Brook Reservoir (lower pH, lower alkalinity, and higher aluminum site) would be considered non-impaired based on New Hampshire's water quality standards and the assessment methods described in in the New Hampshire CALM. Second, the commenter presents no robust analysis of the biological community, only a comment from a local forester that the two reservoirs were teeming with fish.

It is worth noting that as of the writing of these responses, EPA has released proposed draft aluminum criteria that take into effect the dissolved organic carbon (DOC), hardness as $CaCO_3$, and pH of a given sample. There is likely to be another chapter written in the coming years as our collective understanding of aluminum chemistry and toxicity evolves.

***NHDES RESPONSE* to 1- 9**

Swimmers in New Hampshire's waters are accustomed to expect, and rely on, clear water so that when they dive in, they know what they are diving into. The commenter brings up some interesting thoughts regarding the swimming designated use chlorophyll-a assessment indicator. An evaluation of the existing chlorophyll-a data available for New Hampshire's freshwaters indicates that 15 ug/L chlorophyll-a is a very rare event (Figure 3), landing at the 98$^{th}$ percentile. Further, when the chlorophyll-a samples are paired with secchi measurements we see that at 15 ug/L chlorophyll-a a median Secchi depth is reduced to ~2.5 m (8 ft) (Figure 4). The commenter draws from a Minnesota lake study that shows a relationship between turbidity and algae to then point out that the relationship does not hold in New Hampshire. As turbidity is a composite optical property of water it does not identify individual substances, rather it indicates that some combination of particles (some absorbing like chlorophyll and some scattering like silt), colored dissolved organic matter (CDOM), and the inherent properties of water, together cloud the water. Due to landscape differences, we would not automatically expect the Minnesota lake relationship to hold in New Hampshire. High chlorophyll-a and elevated turbidity do not necessarily co-occur in a given waterbody. Chlorophyll-a by itself can be a primary optical driver to interfere with recreational activities. Turbidity driven by non-algal properties can also interfere with recreational activities (the upper left corner of Figure 4). In fact, high non-algal turbidity can cause shading conditions that reduce algae's ability to reproduce and suppress chlorophyll-a concentration.

NHDES suspects that in lakes where the best trophic class is eutrophic, the 15 ug/L threshold should be reevaluated. NHDES plans on exploring the datasets to a greater extent in future assessment cycles. No waters were added to the 303(d) list in the 2016 assessment cycle for this parameter.

Also see the response to comment 4-7 in the response to comments on the draft 2014 303(d) (NHDES, 2017).

**Figure 3. Percentile distribution of all valid freshwater samples collected for chlorophyll-a between 1/1/1990-11/21/2016 from the "epilimnion," "composite," "surface," or null depth zones.**

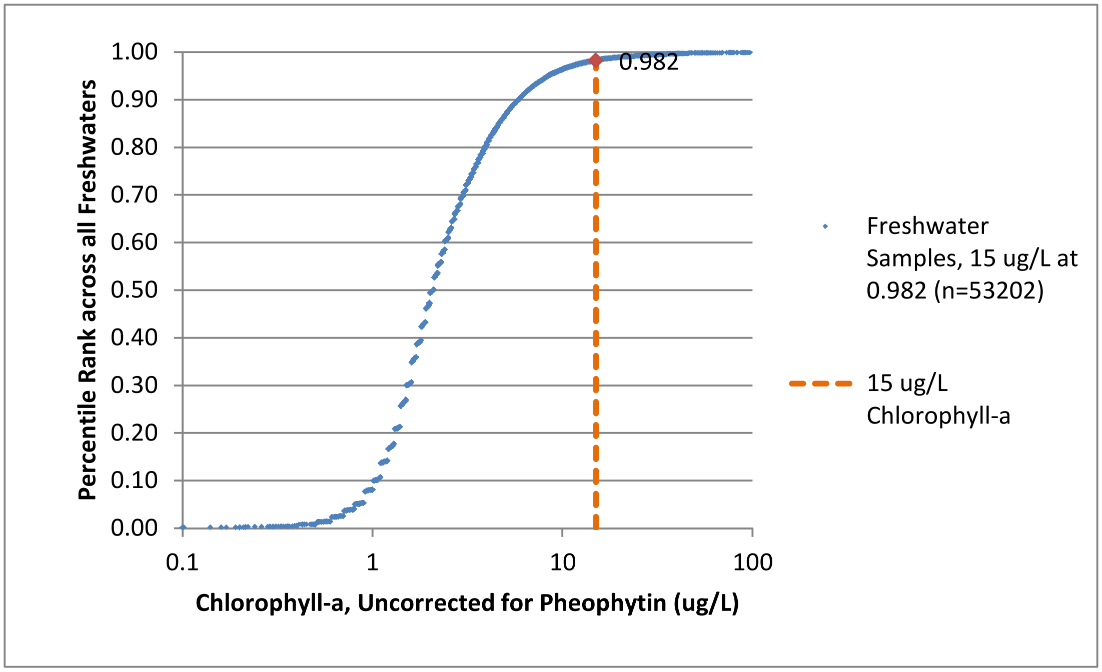
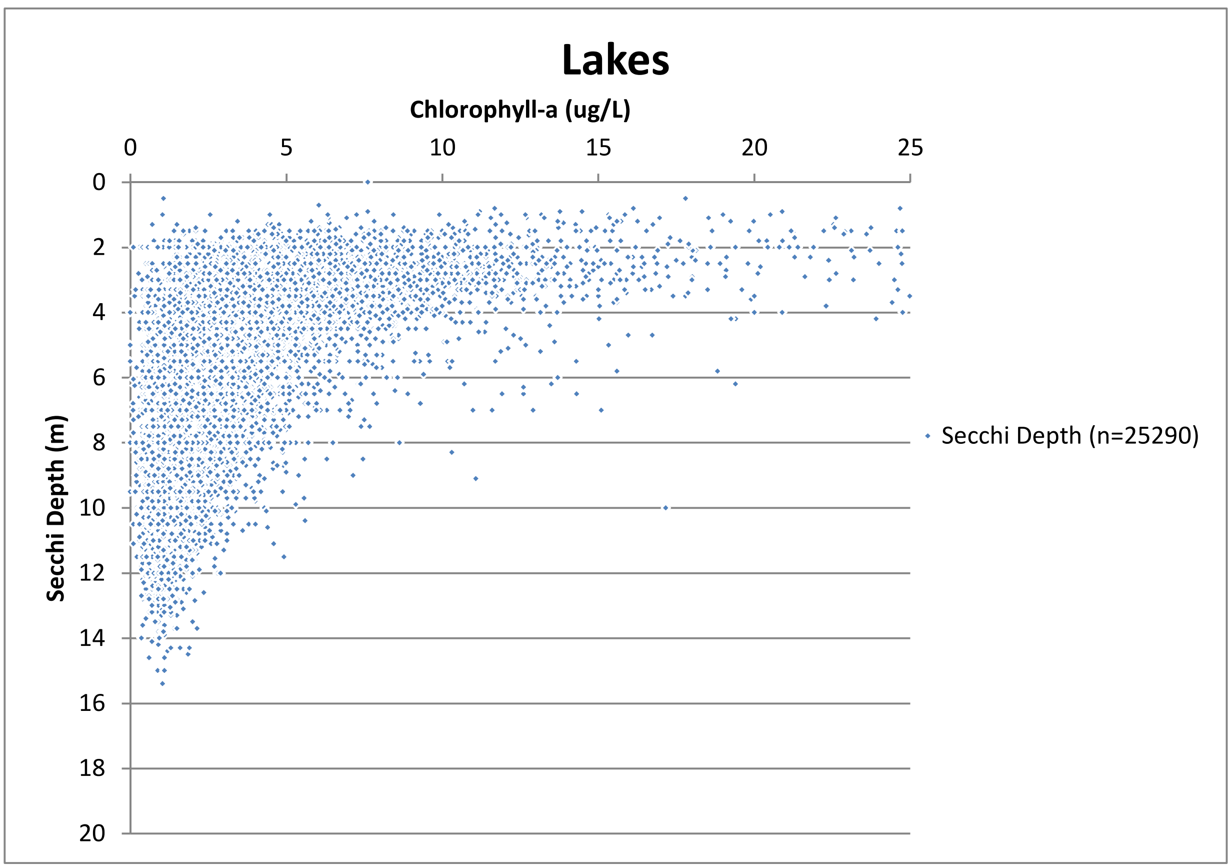



**Figure 4. Secchi depth and chlorophyll-a pairs collected between 1/1/1990-11/21/2016 where the chlorophyll-a is collected from the "epilimnion," "composite," or null depth zones.**



***NHDES RESPONSE* to 1- 10**

Attachments referenced in the comments. No additional responses necessary.

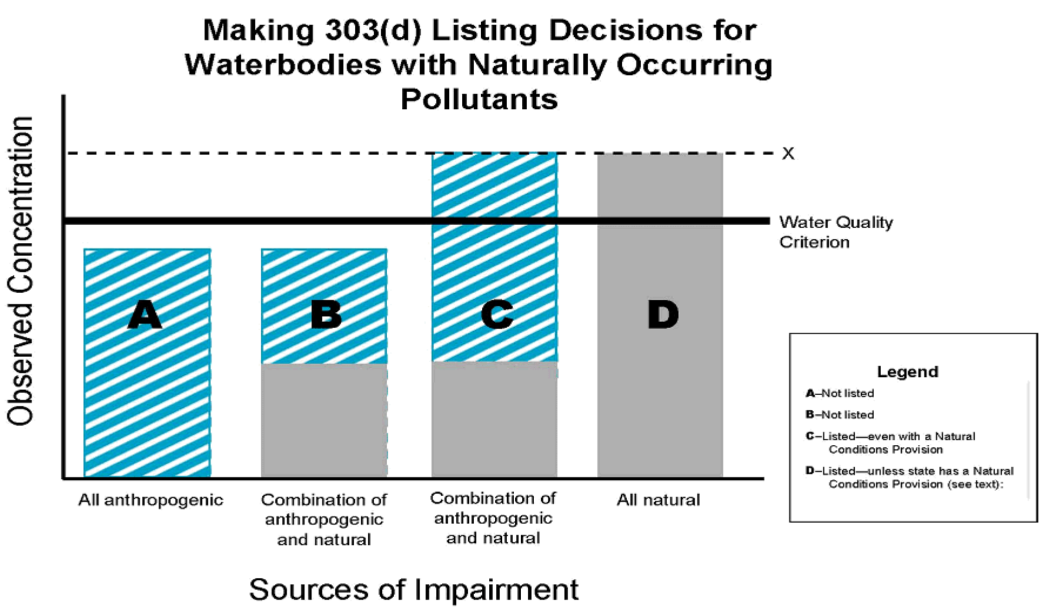
## RESPONSE TO COMMENT #2: Dean Peschel, Great Bay Municipal Coalition (GBMC)

***NHDES RESPONSE*** **to 2- 1**
This section contains opening remarks by Dean Peschel and the Great Bay Municipal Coalition (GBMC). All points in this section are covered in greater detail in the following sections.

***NHDES RESPONSE*** **to 2- 2**
This section provides quotes from the 2016 draft CALM and the 2016 draft Technical Support Document for the Great Bay Estuary. No response is needed.

***NHDES RESPONSE*** **to 2- 3**
This section provides quotes from the 2016 draft CALM wherein the CALM was purported to be inconsistent with New Hampshire's Water Quality Standards and USEPA's assessment guidance. The text quoted by the commenter from the draft 2016 CALM was from EPA's 1997 "Guidelines for the Preparation of the Comprehensive State Water Quality Assessments (305(b) Reports) and Electronic Updates" (USEPA, 1997) and that section of the CALM has not been revised since the 2002 assessment. The example provided by the commenter, "…where no human related sources are present or where impairment would occur even in the absence of human activity" came from the old EPA guidance and does not properly reflect New Hampshire's natural definition. The issue with the statement is the operative word "or" which should have been "and." USEPA's guidance for the 2008 assessment cycle (USEPA, October 12, 2006) provided a useful graphic (Figure 5), which is in keeping with New Hampshire's "conditions which exist in the absence of human influences" definition of naturally occurring conditions in Env-Wq 1702.29.

**Figure 5. Conceptual diagram for making "natural" determinations (not to scale) (USEPA, October 12, 2006).**




**Column A** – The waterbody receives only anthropogenic pollutant loadings. The waterbody does not have to be included on the 303(d) list or placed into Category 5 because the applicable numeric criterion is not exceeded.

**Column B –** The waterbody receives pollutant loadings from both natural background and anthropogenic sources, but because the applicable numeric criterion is not exceeded, the waterbody does not have to be included on the 303(d) list or placed into Category 5.

> **Column C -** The waterbody receives pollutant loadings from both natural background and anthropogenic sources. The applicable numeric criterion is exceeded, and therefore, the waterbody is considered impaired and belongs the 303(d) list or Category 5.
>
> **Column D** - The waterbody receives pollutant loadings from only natural background sources, and the applicable numeric criterion is exceeded. The waterbody is considered impaired and belongs on the 303(d) list or Category 5 unless the State's water quality standards include a natural conditions provision consistent with the standards provision quoted above.

A similar error from the same time period existed in section 3.1.24 "Process for Determining Waters that Belong on the 303(d) List (Category 5)," where the phrase, "If the primary source is not natural proceed to step 4." Which has been corrected to, "If the sole source is not natural, proceed to step 4." to keep the CALM consistent with New Hampshire's Water Quality Standards and USEPA's assessment guidance (USEPA, October 12, 2006) (USEPA, Sep. 3, 2014).

Also see the response to comments on **1- 8** regarding "Naturally Occurring Organic Acids."

***<u>NHDES RESPONSE</u>*** **to 2- 4**

The dissolved oxygen criteria are currently under review through the water quality standards process. Until such time as the criteria in Env-Wq 1700 (NHDES, 2016) are revised, they continue to be the approved state water quality standards. While that review process is under way, NHDES is making any changes to dissolved oxygen assessments with all due caution. It is worth noting that the commenter often references stratified waters. While stratification can and does occur in deeper/less tidally flushed estuaries like the Chesapeake Bay, the only place in the Great Bay estuary with evidence of stratification is just below the head of tide dam on the Lamprey River which is due to salinity stratification within the bathymetric constraints in the upper portion of the tidal river (Pennock, 2004 Lamprey River Dissolved Oxygen Study, 2005).

***<u>NHDES RESPONSE</u>*** **to 2- 5**

This comment section quotes from the draft technical support document. No response necessary.

***<u>NHDES RESPONSE</u>*** **to 2- 6**

The 90$^{th}$ percentile of chlorophyll-a to protect dissolved oxygen comes from the "Numeric Nutrient Criteria for the Great Bay Estuary" (NHDES, 2009). The text in that document pointed out the increase in dissolved oxygen that occurs during phytoplankton blooms and photosynthesis verses the depletion of oxygen during respiration. In fact, the relationship between the 90$^{th}$ percentile of chlorophyll-a indicator and dissolved oxygen is not limited to, as the commenter suggests, a conceptual model wherein the "…short-term deficit caused by phytoplankton respiration." but rather as an indicator of the system productivity. The lowest dissolved oxygen typically occurs once that phytoplankton begins to die, bacteria in the systems respire all of the excess organic matter the phytoplankton created as well as the built up sediment oxygen demand (SOD), and that phytoplankton is no longer photosynthesizing to keep dissolved oxygen elevated. It is for those reasons that the 90$^{th}$ percentile of chlorophyll-a measurements functions as a reasonable indicator of conditions that lead to poor dissolved oxygen.

The commenter cites "C.F.R. §122.44(d) and State law" to say that chlorophyll-a must be documented as a significant factor in the low dissolved oxygen. The manner in which assessments are to be conducted is contained in C.F.R. §130 without mention of C.F.R. §122.44(d), the section that contains the federal code for the National Pollution Discharge Elimination System (NPDES). C.F.R. §122.44 says "Establishing limitations, standards, and other permit conditions" and C.F.R. §122.44(d) is in reference to "Water quality standards and State requirements: any requirements in addition to or more stringent than promulgated effluent limitations guidelines or standards under sections 301, 304, 306, 307, 318 and 405 of CWA necessary…" C.F.R. §122.44 is not relevant to the assessment process as it is a permitting issue and the only reference to the assessment process states that the permit must be consistent with any waste load allocations.

> *C.F.R. §122.44(d), (1)(vii)(B) Effluent limits developed to protect a narrative water quality criterion, a numeric water quality criterion, or both, are consistent with the assumptions and requirements of any available wasteload allocation for the discharge prepared by the State and approved by EPA pursuant to 40 CFR 130.7.*

The commenter also cites “State law” without specificity.

***<u>NHDES RESPONSE</u>*** **to 2- 7**

The commenter states that datalogger data is unreliable based on a comparison of datalogger-based chlorophyll-a values over a highly productive seven-day period to the 90$^{th}$ percentile calculated from 46 grab samples collected over five years. A more apt comparison would explore whether the data distribution of the two datasets (grab based and datalogger based) at station CR7 spanning the data range for which samples were collected via each method. The datalogger data at CR7 spans from Sept 2, 2015 to Nov 25, 2015 (Table 2). Two aspects become evident through data analysis, the first is that the datalogger is better capable of capturing the peak chlorophyll-a conditions and the second is that 90$^{th}$ percentiles calculated from the two datasets are not markedly different. Additionally, when one compares the datalogger based chlorophyll-a with the grab sample based chlorophyll-a for the 5 comparable dates (closest time and depth of collection) we see a strong relationship ($p=0.07$) with a slope close to one (Figure 6).

**Table 2**. **Data distribution statistics for grab samples and datalogger-based samples at Station CR7 in the tidal Cocheco River covering September 9, 2015 to November 9, 2015.**

| **Statistic** | **Grab Samples** | **Datalogger Based Samples** |
|---|---|---|
| Count | 13 | 7,599 |
| Minimum | 0.5 | 1.0 |
| 10$^{th}$ percentile | 0.6 | 2.5 |
| Median (50$^{th}$ percentile) | 7.6 | 4.6 |
| 90$^{th}$ percentile | 28.1 | 26.3 |
| Maximum | 28.9 | 62.6 |

**Figure 6. Depth and time paired samples of chlorophyll-a from datalogger deployment and grab samples at station CR7 in 2015. (On three dates, samples were collected at two depths. The closest depth pairs are plotted here.)**

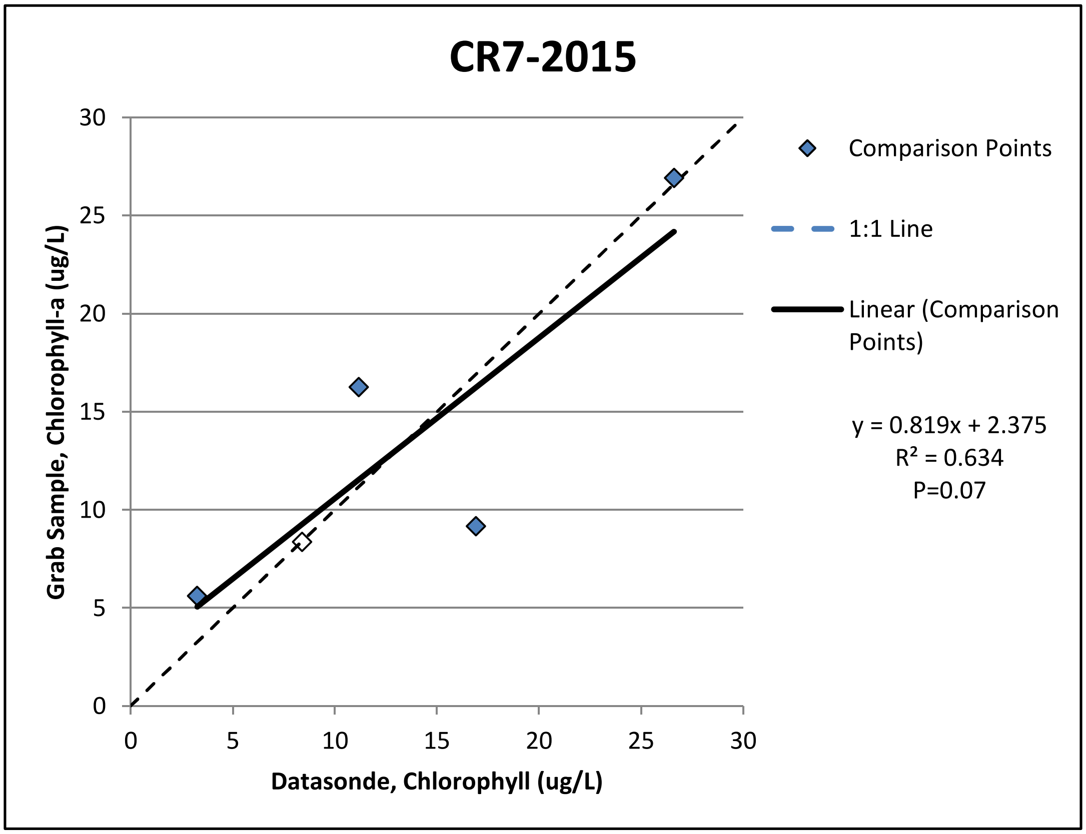



**Table 3. Data points for the depth and time paired samples of chlorophyll-a from datalogger deployment and grab samples at station CR7 in 2015. (data used in Figure 6)**

| **GRAB SAMPLES** | | | **DATALOGGER MEASUREMENTS** | | |
|---|---|---|---|---|---|
| **Grab Sample Date/Time** | **Grab Depth from Surface (m)** | **Grab Sample Chlorophyll-a, Corrected For Pheophytin (ug/L)** | ***Datalogger Sample Date/Time*** | ***Datalogger Depth from Surface (m)*** | ***Datalogger Chlorophyll, (ug/L)*** |
| 9/9/2015 17:13 | 0.5 | 9.1 | *9/9/2015 17:15* | *0.71* | *16.9* |
| 9/12/2015 14:39 | 2.2 | 16.2 | *9/12/2015 14:45* | *2.25* | *11.2* |
| 9/15/2015 15:16 | 2.5 | 5.6 | *9/15/2015 15:15* | *2.59* | *3.3* |
| 9/19/2015 15:42 | 2.1 | 8.3 | *9/19/2015 15:45* | *1.97* | *8.4* |
| 9/23/2015 16:16 | 0.5 | 26.9 | *9/23/2015 16:15* | *0.88* | *26.6* |

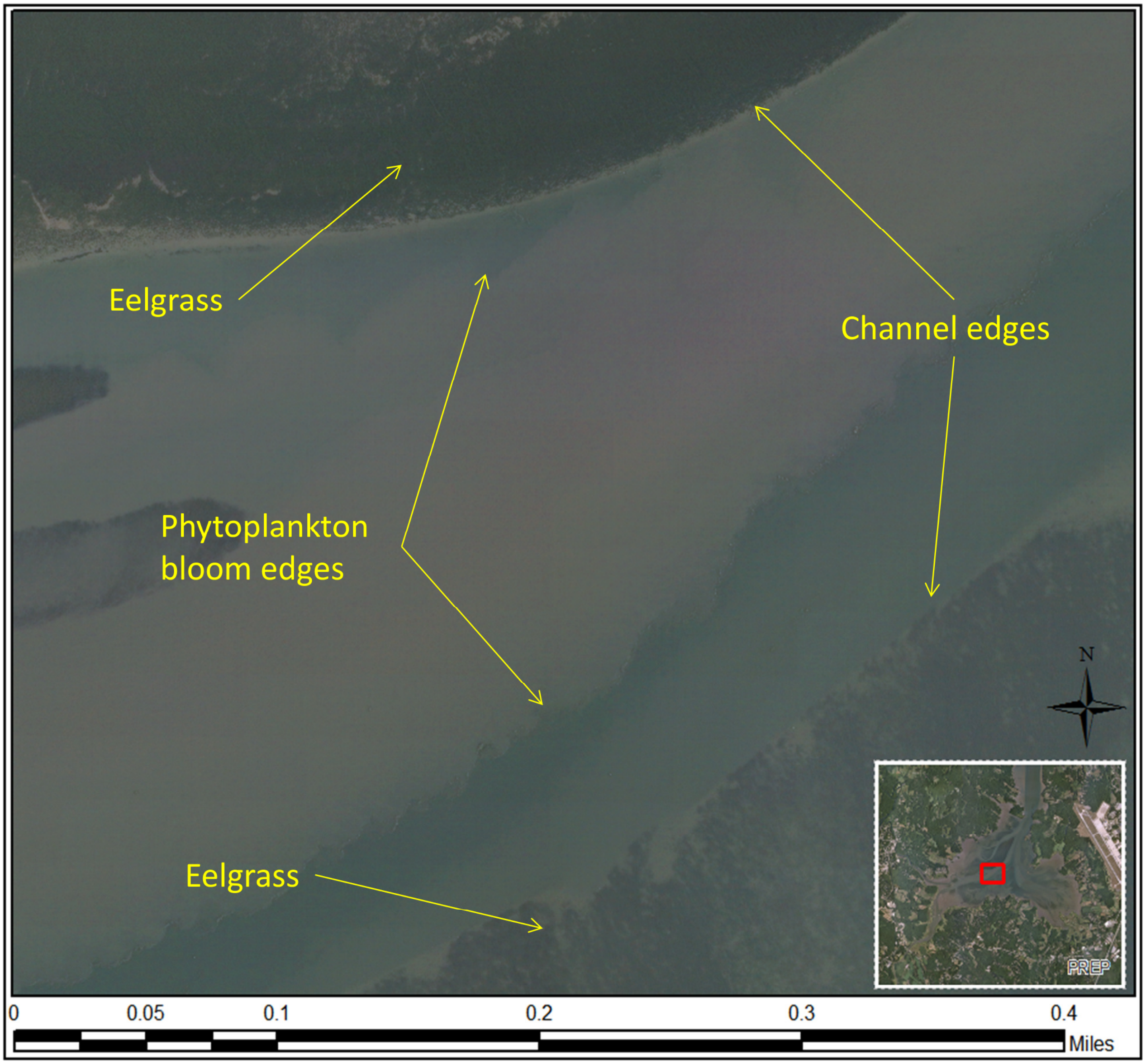
The commenter requests that the data used in the analysis be provided. All of the samples used in the assessment process were provided through the 2016 Surface Water Quality Assessment Viewer (see response to **1- 7**) when the draft assessment was released for public comment. Through that tool, anyone can access all of the water quality data reviewed to make assessments (Figure 1). On May 26, 2017, all of the Great Bay estuary data was placed on the NHDES FTP server (ftp://pubftp.nh.gov/DES/WMB/WaterQuality/SWQA/2016/GBE_Data). On May 26, 2017, notice of that posting was sent to, and acknowledgment of receipt was made by, Richard W. Head on the behalf of the GBMC. Further, all of the data, including the high resolution datalogger data is readily available through the Environmental Monitoring Database (EMD) http://des.nh.gov/organization/divisions/water/wmb/emd/index.htm. For absolute clarity, that data is provided in Table 3 and we note that the grab samples were as high as 28.9 ug/L.

The above relationships between the grab samples and datalogger data, in conjunction with the dissolved oxygen swings, pH swings, grab samples for nitrogen, and information of the tide direction and phase, demonstrate that “the relative biomass is valid and shows large spikes in chlorophyll-a” (NHDES, May 8, 2017) and that those rapid changes can and do occur in this highly dynamic system.

***NHDES RESPONSE*** **to 2- 8**
This comment section quotes from the draft technical support document. No response necessary.

***NHDES RESPONSE*** **to 2- 9**
The commenter appears to misunderstand what NHDES published in regards to chlorophyll-a concentrations in the tidal Cocheco River when they state that NHDES claims rapid phytoplankton growth. To quote the draft TSD, “Low tide brings the highest chlorophyll concentrations down river to the datalogger, and high tide brings low chlorophyll water up river from the Piscataqua River.” This is the basic process of tides in riverine estuaries wherein a large portion of the water at a given high tide is the same water as the last high tide with some level of mixing. The changes recorded by the datalogger at 15 minute intervals do not represent instantaneous growth of phytoplankton, but rather records the concentration in the water, which has had upwards of 12 hours of time to grow, as it flows past the probe at a given moment. A local example of the variation of chlorophyll-a concentrations in Great Bay was incidentally captured on August 5 of 2016 in the imagery that was flown for the eelgrass mapping (Figure 7). In that imagery one can see areas of phytoplankton blooms as well as areas of swirling eddies of bloom moving along large areas of the main channel. A stationary datalogger in those areas would likely record rapid changes in chlorophyll.

**Figure 7. Segment of the Great Bay as seen in the 2016 high resolution imagery flow by Kappa Inc. for the Piscataqua Regional Estuary Project. Note the highly dynamic edge of the phytoplankton bloom.**




NHDES agrees when the commenter notes that the chlorophyll-a concentration is largely a function of tide stage, reflecting the body of water with the highest nutrient concentrations that sloshes back and forth in this riverine estuary. As the nooks and crannies of the estuary release pockets of water over the course of the tide cycle, those individual pockets have a variety of concentrations that help give rise to the high variability in the datalogger record.

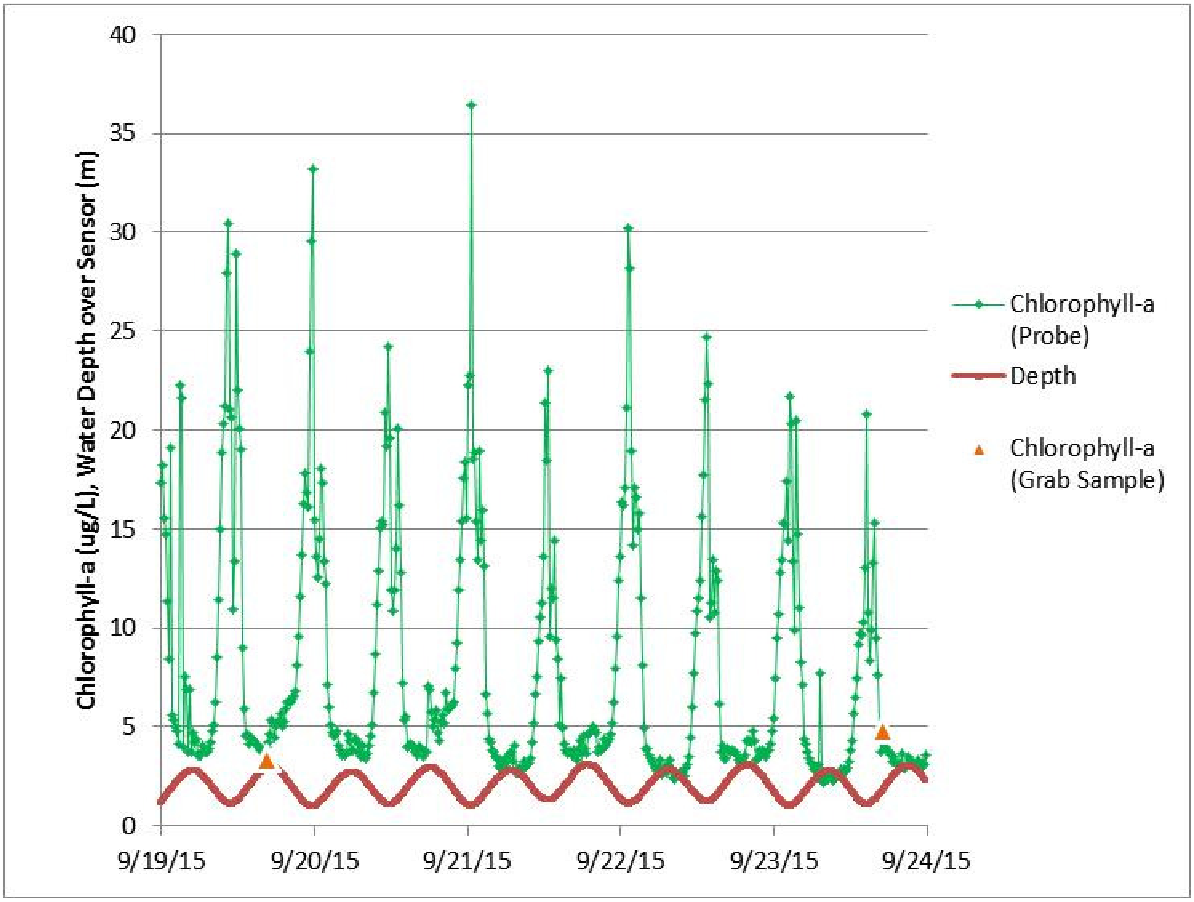
The commenter contends that on September 19, 2015, the chlorophyll-a concentration went from 10 to 30-50 ug/L in successive low tides during the night. This statement is not borne out in the data. The first low tide on September 19 occurred at 11:30 AM with a chlorophyll-a reading of 11-22 ug/L, after which 8 hours of daylight and 4 hours of night passed before the next low tide at September 20 occurred at 00:00 wherein concentrations ranged from 30-50 ug/L. There were sufficient hours of daylight for phytoplankton growth. Further, note that the period in question is nicely bracketed by confirmation samples. On the afternoon of September 19 the calibration check showed the probe measuring 8.4 ug/L (1.97m) and a grab sample measurement of 8.3 ug/L (2.1m) for a relative percent difference (RPD) of 0.8%. Four days later on the afternoon of September 23 the calibration check showed the probe measuring 26.6 ug/L (0.88m) and a grab sample measurement of 26.9 ug/L (0.5m) for a RPD of -1.1% (Table 3).

In spite of the strong relationships in the confirmation monitoring, the commenter suggests that the TSD PERIOD 4 data is in error. The commenter states that the relatively low chlorophyll-a measured in grab samples in the Upper Piscataqua River station UPR4 during PERIOD 4 shows that the Cocheco River data cannot be true. Station UPR4 is 1.8 miles downstream of CR7 and, on an outgoing tide, includes all of the water from the much larger Salmon Falls River. The Upper Piscataqua River station UPR4 had an active datalogger during this time period, the distribution of the data is shown on Table 4. This data begs the question of how the grab samples fit in with the datalogger records. We see that both samples were collected when dilution would be the greatest, that is, exactly when the chlorophyll-a concentration should be the lowest. The first sample was collected at near high tide and the second sample collected just before high tide, and those two samples corroborate the datalogger record (Figure 8).

**Table 4. Chlorophyll-a data distribution statistics for UPR4 in the Upper Piscataqua River covering September 19, 2015 to September 23, 2015.**

| **Statistic** | **Datalogger (Probe) Chlorophyll (ug/L) Readings** |
|---|---:|
| Count | 480 |
| Minimum | 2.2 |
| $10^{th}$ percentile | 3.0 |
| Median ($50^{th}$ percentile) | 4.6 |
| $90^{th}$ percentile | 17.5 |
| Maximum | 36.5 |

**Figure 8. Upper Piscataqua River station UPR4 Chlorophyll and depth from September 19, 2015 to September 23, 2015.**

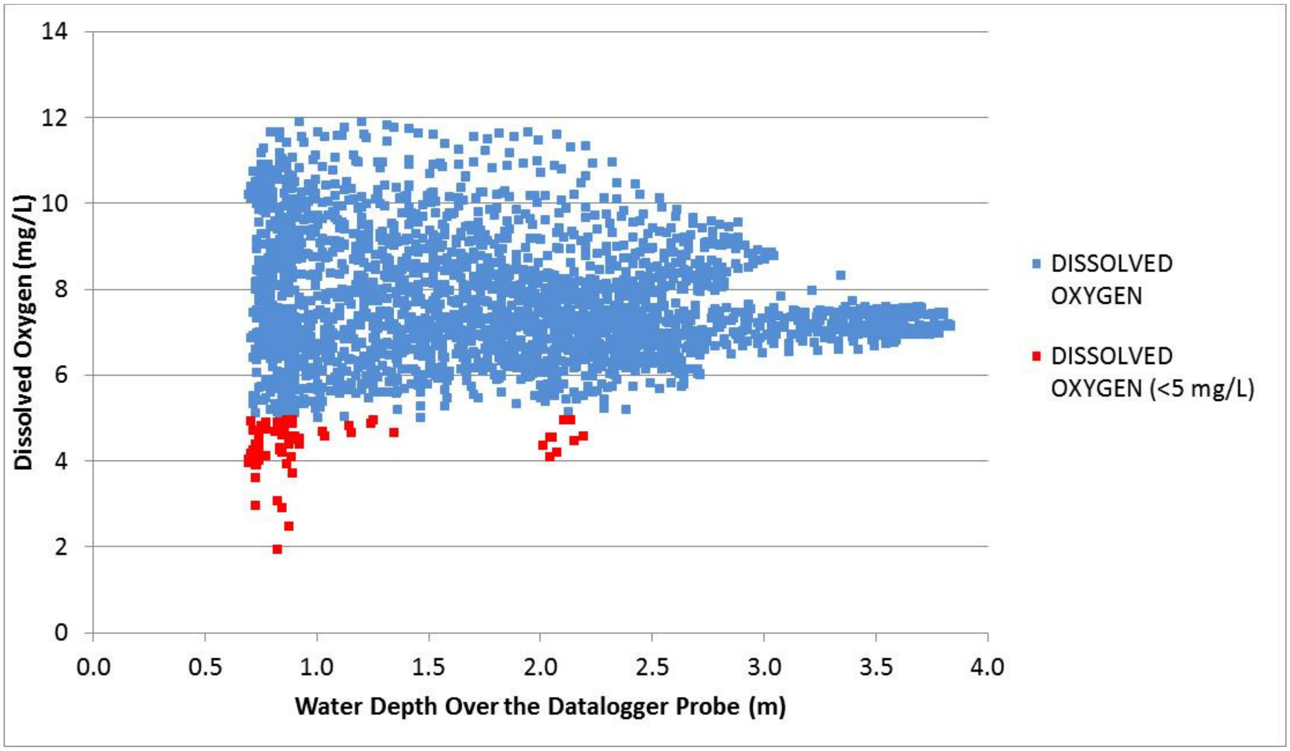



***NHDES RESPONSE*** **to 2- 10**

NHDES agrees that the "10% rule" is a reasonable method to address rare and infrequent low measurements of dissolved oxygen (also see the response to **1- 5**). It is worth noting that although NHDES and this commenter have spent much time and effort considering the 2015 datalogger series, 2015 was not the only year in which low dissolved oxygen was documented. Of the four years (2012-2015) of datalogger records, three of those years demonstrated low dissolved oxygen (2012, 2014, and 2015) with the most dramatic conditions in 2014 and 2015.

The commenter contends that low DO is sporadic and only associated with high or low tidal condition, implying that there is no discernable pattern. However, an evaluation of the data demonstrates that there is a clear discernable pattern to the data. The majority of low dissolved oxygen reading occur near or at low tide when the water has had the longest residency time in the system and a second group occurs at high slack of a neap tide (high tide 2.05-2.20m over datalogger verses median of 2.72m), again, conditions of maximum residency. As the dataloggers used were equipped with probe wipers and the datalogger was cleaned during each of the approximately weekly visits to collect lab samples and field parameters between the datalogger change-outs, biofouling was not a major issue.

**Figure 9. Cocheco River station CR7 dissolved oxygen and depth from September 2, 2015 to October 4, 2015.**




The commenter agrees that the concentration of dissolved oxygen in a parcel of water is in part a function of photosynthesis (oxygen additions) and respiration (oxygen removal). While in a homogenous parcel of water we would expect the resulting dissolved oxygen to show smooth increasing and decreasing transitions, in the tidal Cocheco River a static buoy can see rapid changes as parcels of water move past the buoy. Indeed, the 2015 measurements of TN ranged from 253 to 660 ug/L depending on the tide cycle further driving the variability in chlorophyll-a. A graphic example of the heterogeneous nature of tidal flow paths can be graphically seen in the 2012 steady state injection of a conservative dye at the Portsmouth WWTF. Even many miles up-river, the concentration of dye showed high variability, not a smooth curve (continuous flourometer), and high spatial variability (200 meter buffer measurements) (Aoa, Goblicka, & Calcib) (Figure 10). If that were not a conservative tracer and instead a growth nutrient, the variability in chlorophyll-a with the movement of the tides is understandable.

**Figure 10. Figure 23 in the 2012 "Hydrographic Study of Peirce Island Wastewater Treatment Plant Effluent in the Piscataqua River of Portsmouth, New Hampshire" (Aoa, Goblicka, & Calcib).**

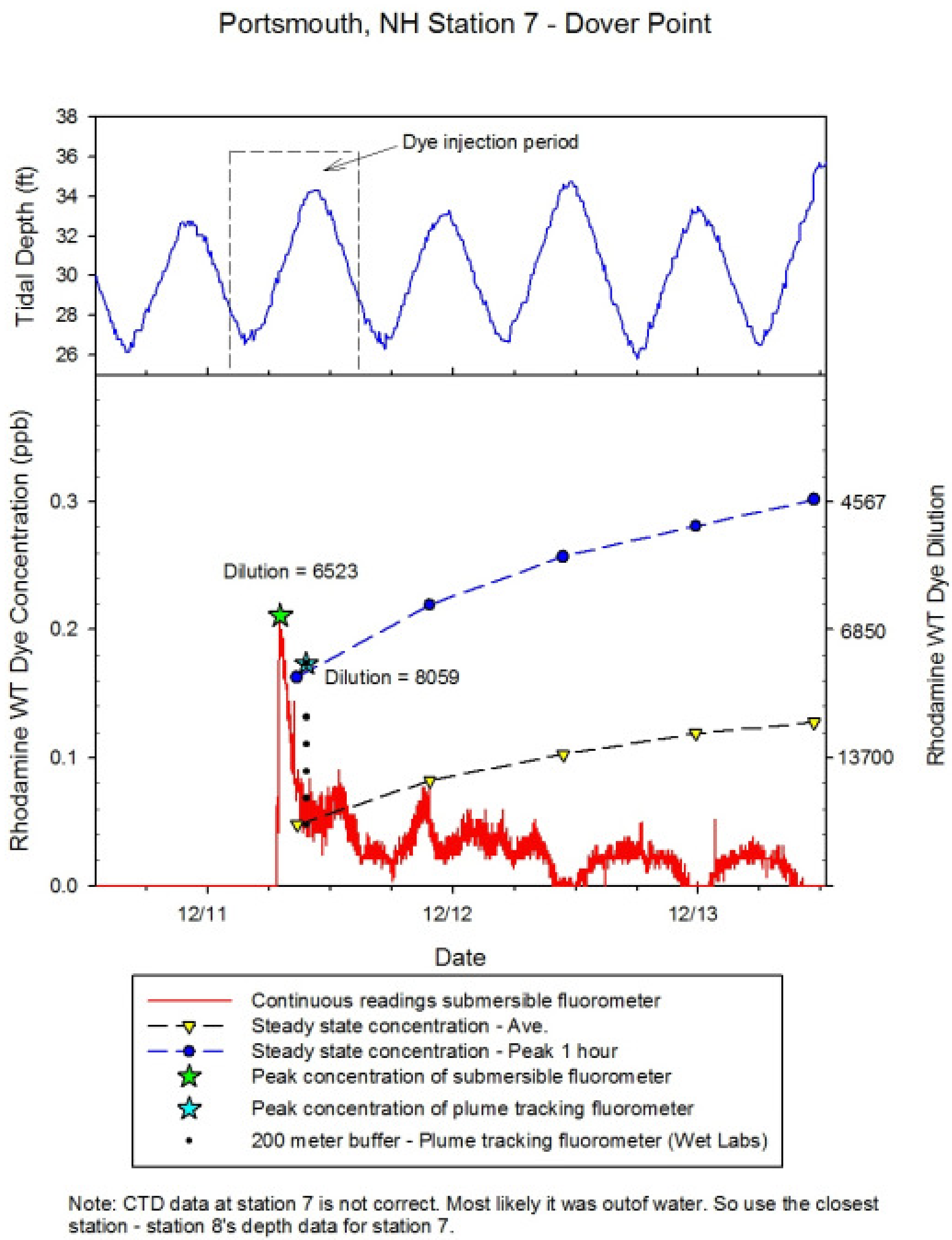



**Fig. 23**

Steady state super-position Rhodamine WT dye concentrations and plume tracking dye concentrations at station 7

Phytoplankton has a direct link to dissolved oxygen concentrations and further, chlorophyll-a as a measure of phytoplankton biomass is an indicator of the in-system productivity, which then becomes part of the water column and sediment oxygen demand (SOD) upon its demise.

The commenter points out that watershed organic loading and SOD contribute to reduced dissolved oxygen in estuarine tidal rivers. NHDES agrees and reiterates that nitrogen is the limiting nutrient which is provided by watershed organic loading and SOD. The commenter then goes on to suggest stratification could be a factor without any evidence in this highly mixed system.

Small, short-term, anomalous low dissolved readings are not the primary trigger of the dissolved oxygen impairment. Rather the primary trigger was the long, sustained low dissolved readings as described in the TSD,

> "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." (NHDES, May 8, 2017)

It is worth noting that, the event wherein the DO fell below 3 mg/L was part of a longer event on 9/14/2015 having DO below 5 mg/L for 3.25 hours. Similarly, the other short excursions below 2 mg/L were part of longer periods below the approved water quality standard.

Also see response to **2- 3** regarding the natural comments.
Also see response to **2- 4** regarding the dissolved oxygen criteria.

***<u>NHDES RESPONSE</u>* to 2- 11**

The commenter suggests that the stressor/responses typical in estuaries that are well documented in the existing scientific literature, do not apply in this estuary. Given that the Cocheco River is an estuarine system, it is appropriate for NHDES to continue to examine the full body of scientific literature regarding nutrient dynamics.

The commenter notes that TN cannot be a problem because the decline in the ambient concentrations of TN from 1,500 ug/L to 488 ug/L has not resulted in an obvious drop in the chlorophyll-a concentration. At 1,500 ug/L, TN was essentially unlimited, therefore, the limits on chlorophyll-a concentration were likely a combined function of system turbidity, self-shading by phytoplankton, and zooplankton grazers. The 2015 measurements of TN ranged from 253 to 660 ug/L depending on the tide cycle which drove the system through a wide range of nutrient variability and limitation. As the TN continues to drop in this system, TN may become a limiting nutrient controlling chlorophyll-a concentration.

Throughout the graphics of the TSD, solid horizontal lines have been used to illustrate numeric water quality criteria. Dashed horizontal lines have been used to illustrate indicator thresholds and other contextual reference values as is the case for the Gulf of Maine TN line. NHDES recognizes that the Gulf of Maine TN reference line was causing confusion and has removed that line. Without that reference line, readers of the TSD should be cognizant that the y-axis range changes with the range seen in a given assessment zone.

Also see response to **2- 3** regarding the natural comments.

***<u>NHDES RESPONSE</u>* to 2- 12**

The first portion of the comment section includes large quotes of the TSD covering the Upper Piscataqua River assessment zone. No response needed.

The impacts of wasting disease on eelgrass is a complicated issue. Wasting disease caused by the slime mold (*Labyrinthula zosterae*) is always present, the question being whether it is present at such a level as to greatly impact eelgrass. The commenter argues that since wasting disease is a natural entity, impacts related to it cannot be considered in impairment determinations. While a natural phenomenon at some level, the degree to which wasting disease impacts eelgrass is intertwined with the multiple other stressors in a system. A system under stress is more susceptible to the infection (Vergeer & den Hartog, 1994) (Rapport, Regeir, & Hutchinson, 1985) and logically, any factors that slow down eelgrass growth give an advantage to wasting disease. Collectively, wasting disease and the suite of other stressors have reduced the overall resiliency of the system (Rapport & Whitford, 1999). The commenter calls out the mass wasting disease in the late 1980s and the weak recovery on the Upper Piscataqua River. This in itself is an indication of the poor resiliency of the system. In contrast, in the late 1980s, Great Bay proper had higher resiliency and was able to recover from that late 1980s event as the whole system did after the 1930's occurrence of wasting disease. Due to the relationship of the multiple stressors and the influence on resiliency, the effects of wasting disease cannot be considered a wholly natural phenomenon. Also see response to **2-3** regarding the natural comments.

One of the critical ecosystem functions provided by eelgrass is the stabilization of the benthic sediments. The loss of eelgrass induces additional sediment resuspension with each tidal cycle. The commenter believes that the current light conditions in the Upper Piscataqua River assessment zone represent the natural condition as they discuss in their Great Bay comments. While Great Bay poor light conditions are addressed in the response to **2- 19** the causes of poor light transmittance will differ in different assessment zones.

Poor light transmittance is only added as an impairment to an assessment zone if the aquatic life it is intended to support is impaired and there is available data indicating that the light transmittance is inadequate to support that aquatic life. Both of those conditions are met in the Upper Piscataqua River. The documentation of poor light transmittance does not imply a cause, only that it limits the success of eelgrass growth in those places where it has at some point existed.

The remaining comments for the Upper Piscataqua River concerning dissolved oxygen and total nitrogen do not relate to impairments.

***<u>NHDES RESPONSE</u>*** **to 2- 13**

The first portion of the comment section includes large quotes of the TSD covering the Lower Piscataqua River – North assessment zone. No response needed.

See the response to **2- 12** for responses related to wasting disease.

The remaining comments for the Lower Piscataqua River-North concerning water clarity, dissolved oxygen, and total nitrogen do not relate to impairments.

***<u>NHDES RESPONSE</u>*** **to 2- 14**

The first portion of the comment section includes large quotes of the TSD covering the Lower Piscataqua River – South assessment zone. No response needed.

Amongst other causes, the commenter points to the 2006 Mother's Day storm as a trigger for eelgrass loss in the Lower Piscataqua River - South. Yet when the data is evaluated, we see that the percent cover following the storm in 2006 (11.6 acres) was the best cover since that recorded in 1962 (21.8 acres).

See the response to **2- 12** for responses related to wasting disease.

The remaining comments for the Lower Piscataqua River-South concerning water clarity, dissolved oxygen, and total nitrogen do not relate to impairments.

***NHDES RESPONSE*** **to 2- 15**

The first portion of the comment section includes large quotes of the TSD covering the Portsmouth Harbor assessment zone. No response needed.

The commenter incorrectly states that the eelgrass cover in Portsmouth harbor remains depressed since the wasting disease event of the late 1980s. Between 1981 (164 acres) and 1999 (136 acres) eelgrass in this area was measured only once (1996) and that 1996 measurement showed 139 acres (85% of the 1981 area). Further, from 2000 to 2003 eelgrass ranged from 155 to 160 acres before declining to the 2014 to 2016 range of 62-87 acres.

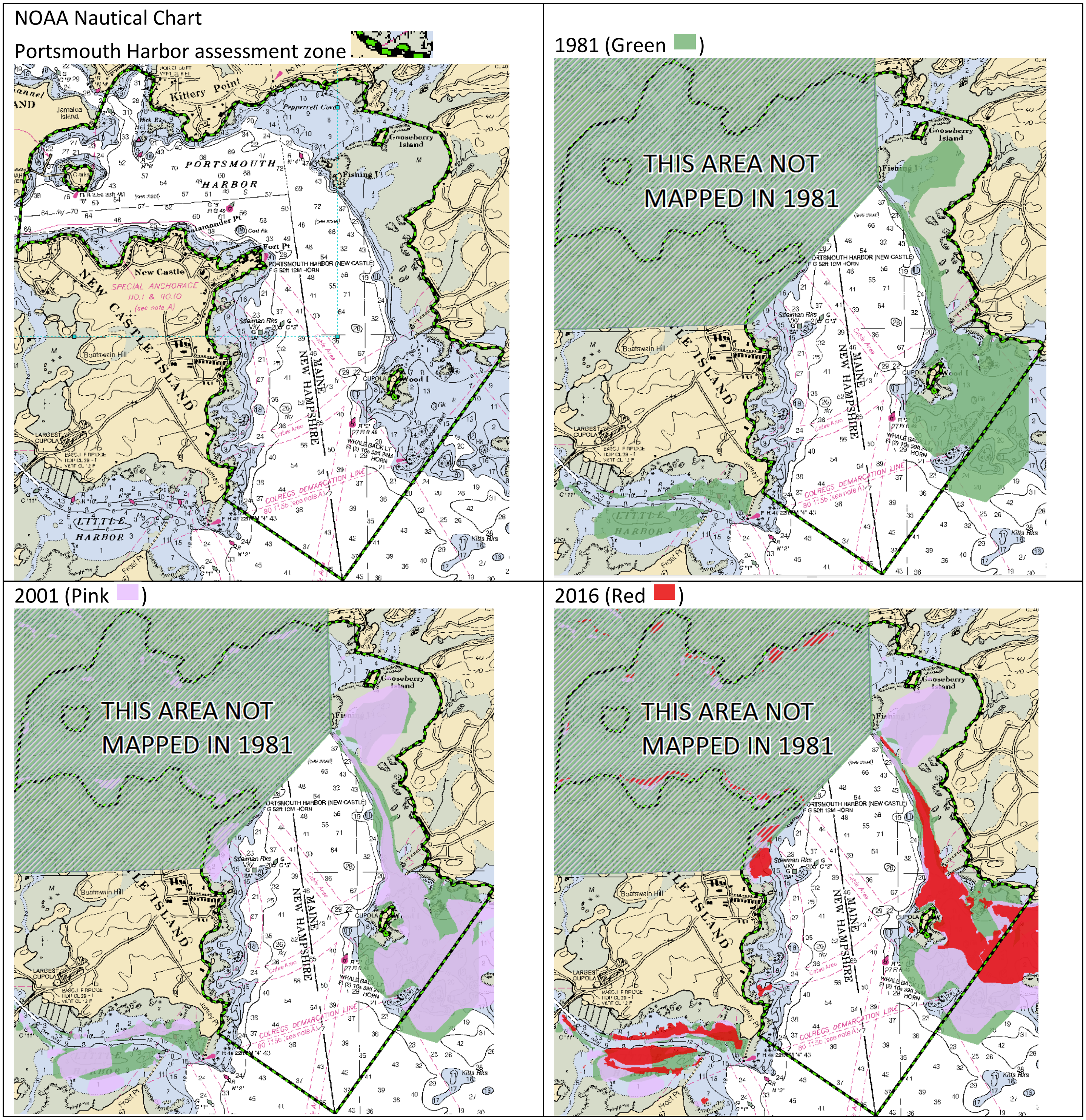
See the response to **2- 12** for responses related to wasting disease.

The commenter states that eelgrass was "decimated" by Canada geese in this assessment zone based on a study by Rivers and Short (Rivers & Short, 2007). While published in 2007, the observed period of Canada geese grazing that had not been seen in the preceding two decades of observations was from January to April of 2003 meaning that the 2002 and 2003 aerial surveys provide the best bracketing to measure whether eelgrass was "decimated." In 2002 the eelgrass covered 157.3 acres and in 2003 the eelgrass covered 159.6 acres. Not only was the eelgrass not "decimated," it showed improvement demonstrating that the assessment zone had resiliency at that time.

The commenter notes an apparent eelgrass cover discrepancy between that reported by NHDES in the TSD and the cover reported by Dr. Short in his 2015 survey report (Short, 2016). Unfortunately, Dr. Short used a non-standard assessment zone for Portsmouth Harbor in that year. All of the acreages reported by NHDES in the TSD use the standard assessment zones.

The commenter questioned whether eelgrass previously grew at the deep edge of the Portsmouth Harbor assessment zone and whether eelgrass has retreated from that deep edge. The image series in Figure 11 illustrates the steps that were taken to reach some of the eelgrass conclusions in the TSD. The loss of eelgrass from the deeper zones over time is clearly evident.

**Figure 11. Portsmouth Harbor assessment zone eelgrass cover over time.**




Regarding Total Suspended Solids (TSS) the commenter provides a partial quote from the NHDES TSD which they truncated and added causality. The full statement was, “Due to the proximity of the Portsmouth WWTF, this assessment zone may be experiencing a large portion of light diminishment from the large TSS load out of the discharge.” Given that from October 2010 to August 2017 the average discharge of TSS out of the WWTF released 2,063 lbs/day while plants similar in size to Portsmouth discharged 115 lbs/day (Rochester, NH), the qualified statement is justified (https://echo.epa.gov/tools/data-downloads/icis-npdes-dmr-and-limit-data-set).

The commenter claims that the light attenuation in Portsmouth Harbor has not met the assessment threshold for "the entire period of record." It must be noted that light was not measured in this zone until 2002. Only one measurement was made in each of 2002 and 2003, those values showed satisfactory light, and indeed eelgrass covered near historic acreage. In 2004, the number of measurements increased and most readings were beyond the impairment threshold while at the same time eelgrass cover began to decrease. Indeed, the threshold for light attenuation has been exceeded for nearly "the entire period of record" and that is reflected in the loss of eelgrass during the corresponding period of eelgrass record.

***<u>NHDES RESPONSE</u>*** **to 2- 16**
The commenter believes that the current light conditions in the Little Harbor/Back Channel assessment zone represent the natural condition as they discuss in their Great Bay comments. Poor light conditions are addressed in the response to **2- 19** and the causes of poor light transmittance will differ in different assessment zones.

***<u>NHDES RESPONSE</u>*** **to 2- 17**
The first portion of the comment section includes large quotes of the TSD covering the Little Bay assessment zone. No response needed.

Eelgrass in Little Bay made several attempts to re-establish but appears to be un-resilient at this time. While the cover in recent years has been much lower than the 409 acres seen in 1980 it has been greater than the 0-7 acres claimed by the commenter from 2007-2016. In fact, in 2011 eelgrass covered 48 acres and in 2012 35 acres, both of which exceed the pre-2006 Mother's Day Flood acreage.

The commenter believes that the current light conditions in the Little Bay assessment zone represent the natural condition as they discuss in their Great Bay comments. Poor light conditions are addressed in the response to **2- 19** and the causes of poor light transmittance will differ in different assessment zones.

The remaining comments for Little Bay concerning chlorophyll-a and total nitrogen do not relate to impairments.

***<u>NHDES RESPONSE</u>*** **to 2- 18**
This section of the comments opens with a series of statements about what the commenter believes the TSD and CALM claim regarding Great Bay. Additional statements are made regarding total nitrogen, chlorophyll-a, and dissolved oxygen, none of which have been determined to be impairments to the aquatic life of Great Bay. No response is needed.

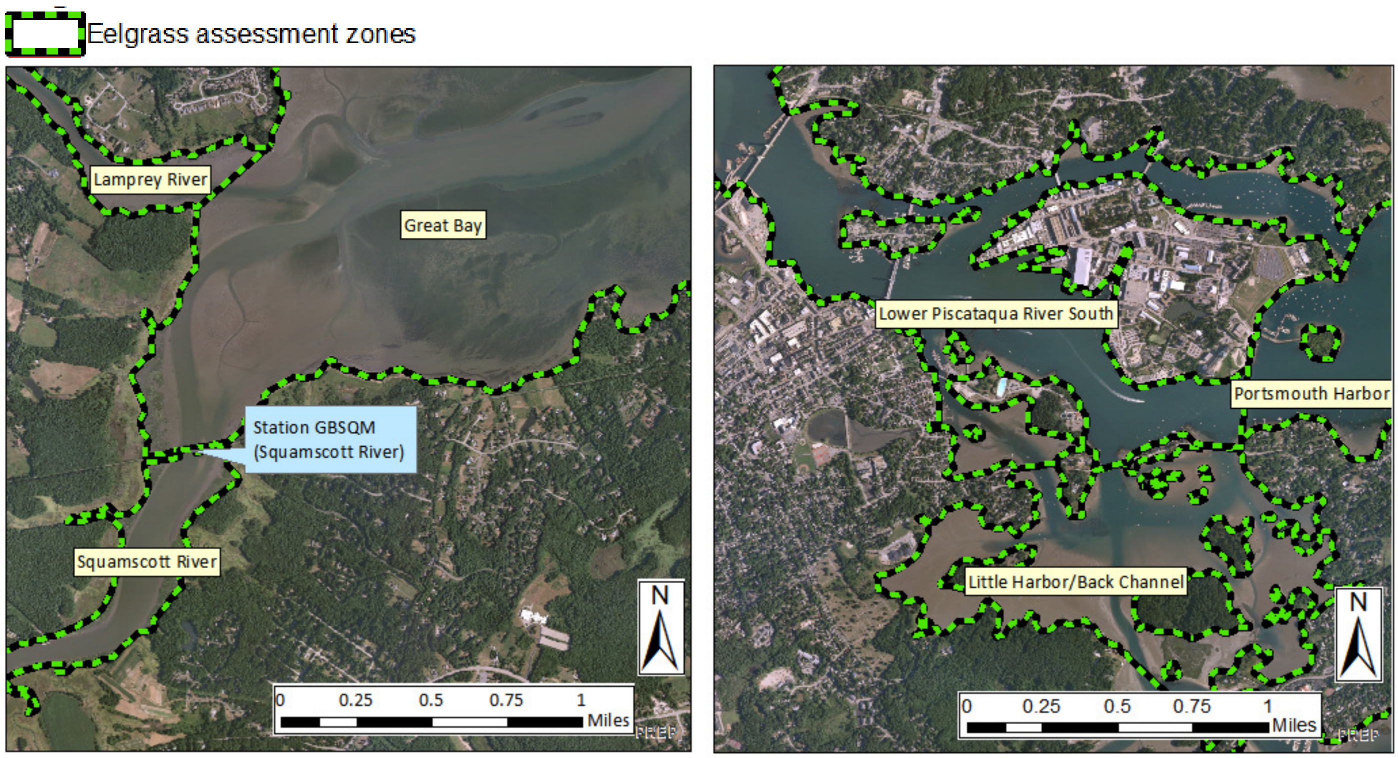
***<u>NHDES RESPONSE</u>*** **to 2- 19**
While some eelgrass may be exposed at low tide, those brief periods cannot provide eelgrass's full daily light needs. This is especially true when low tide occurs at dusk or dawn. The 22% minimum transmittance of light and the framework for the 2m restoration depth is described in the 2009 NHDES criteria document (NHDES, 2009). It is worth noting that the measurements for light attenuation are made in the deeper waters of Great Bay. The shallow waters are extremely vulnerable to the resuspension of particulate matter and that resuspension has a lasting impact as noted by (Morrison, Gregory, Pe'eri, McDowell, & Trowbridge, 2008), wherein they found that the peak turbidity showed a one day lag after wind events. As such, while there may be brief periods of time at dead low tide wherein the eelgrass has full sun exposure, before and after that low tide, the turbidity in the shallow waters is driving available light far below the 22% goal. Many would argue that the 22% incident light is an absolute minimum not a light level for full protection and restoration ( (Dennison, et al., 1993), (Krause-Jensen, Sagert, Schubert, & Boström, 2008), (Ochieng, Short, & Walker, 2010), (Vaudrey, Kremer, Branco, & Short, 2010)). Great Bay has been experiencing elevated nutrient loading for many decades and it is likely that, as has been observed in other systems, the sediment organic content has increased and eelgrass light requirements have increased (Kenworthy, Gallegos, Costello, Field, & di Carlo, 2014).

In the peer review, Dr. Jud Kenworthy wrote,

> "It would also make sense that, in order to have a protective target value, it should be greater than the minimum. Most of the data supporting a 20-22% minimum value are derived from field studies at the deep edge of established eelgrass beds and the correspondence between the percentages of surface light reaching those edges. In many cases, these studies have been conducted in relatively healthy eelgrass beds where the plants are reproducing and clonal integration between plants is supporting growth at the deep edges." (Bierman, Diaz, Kenworthy, & Reckhow, 2014)

The TSD includes light attenuation graphics both with and without the Squamscott River as it lies on the boundary line between the Squamscott and Great Bay assessment zones. The commenter suggests that the Squamscott River data only reflects the Squamscott River conditions. One needs only to look at the 2016 low tide areal imagery (Figure 12 (also see Figure 7)) to see that the impacts of the Squamscott River extend well into Great Bay on the outgoing tide.

**Figure 12. 2016 high resolution imagery flow by Kappa Inc. for the Piscataqua Regional Estuary Project. Left –Great Bay assessment zone (SW area). Right-Lower Piscataqua River-South assessment zone area.**




The commenter claims that "…Kd averaged about 1.1/m in Great Bay prior to 2005, when eelgrass cover exceeded the historical extent identified in the TSD…" This is misleading in that the first consistent light attenuation measurements were made in 2003 (Figure 13 and Figure 14) by which point in time we can now say with hindsight that eelgrass was beginning its downward trajectory (Figure 15 (note x-axis change from Figure 13 and Figure 14)). It is unknown what the light conditions were when eelgrass was healthy and robust while it is clear that at the current light conditions, eelgrass is failing in Great Bay. Further, evidence that eelgrass is failing in the deeper waters, a clear sign of poor light conditions, was presented in the NHDES response to comments on the draft 2014 303(d) (NHDES, 2017). In Long Island Sound, Koch and Beer (Koch & Beer, 1996) found that eelgrass needed light that would allow it to grow 1 meter below the $Z_{min}$(minimum depth based of tidal range) in order for eelgrass to exist. In Great Bay this would translate to a $K_d$ of 0.75/m, a condition which is not currently being met (NHDES, 2017). Additionally, the light attenuation measurements for $K_d$ are only a measure of attenuation in the water column not taking into account attenuation by sediment and epiphytes on the eelgrass leaves, or shading by macroalgae.

**Figure 13. Light attenuation measurements in Great Bay including stations GRBAP and GRBSQ.**

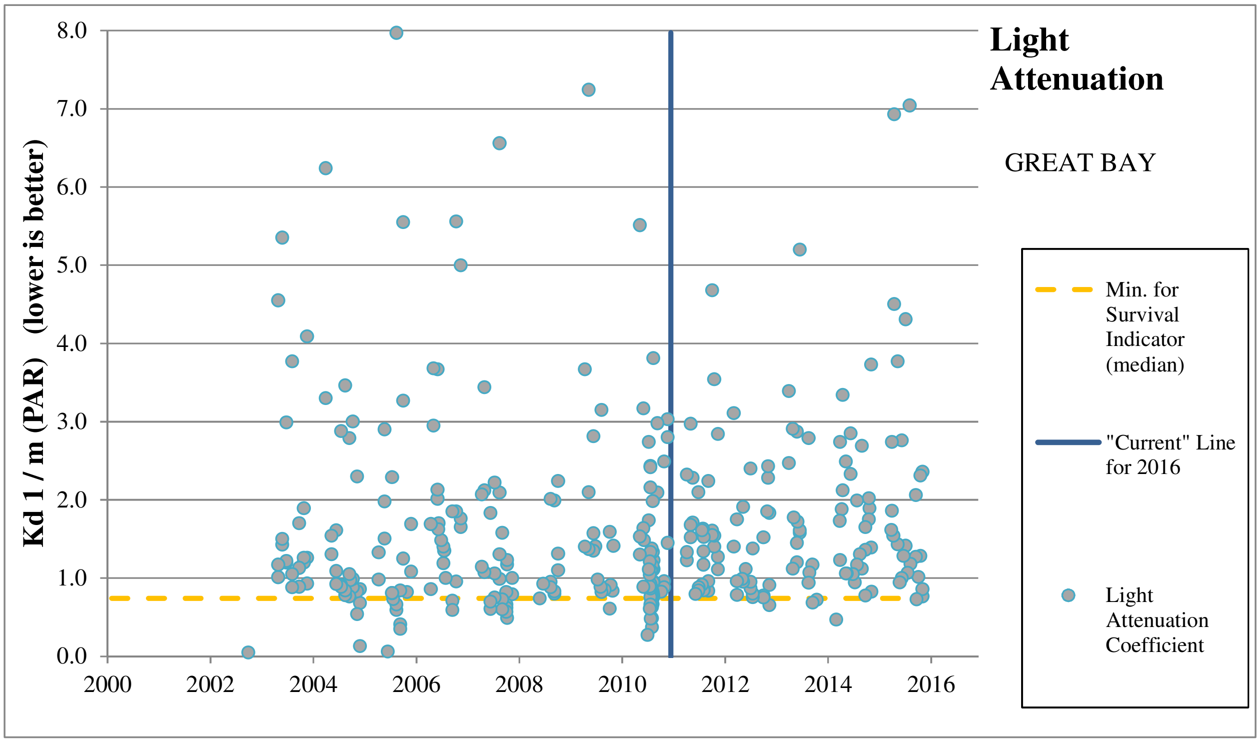



**Figure 14. Light attenuation measurements in Great Bay not including stations GRBAP and GRBSQ.**

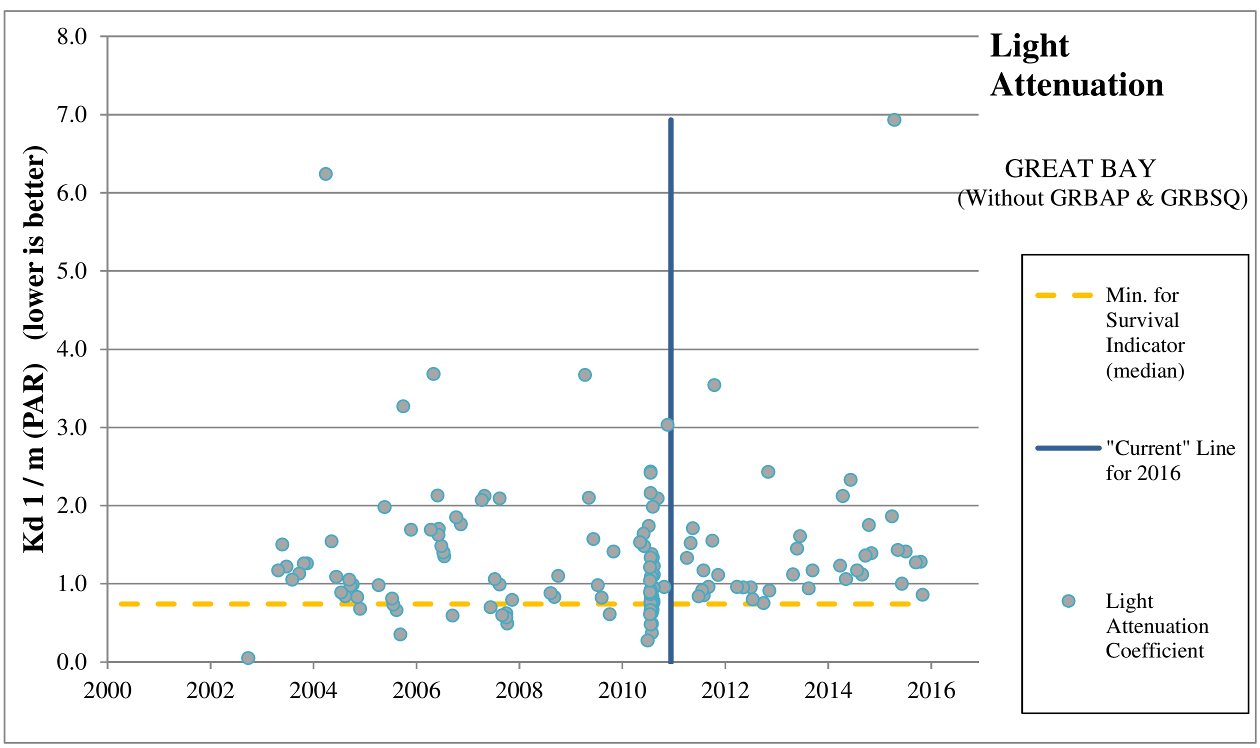
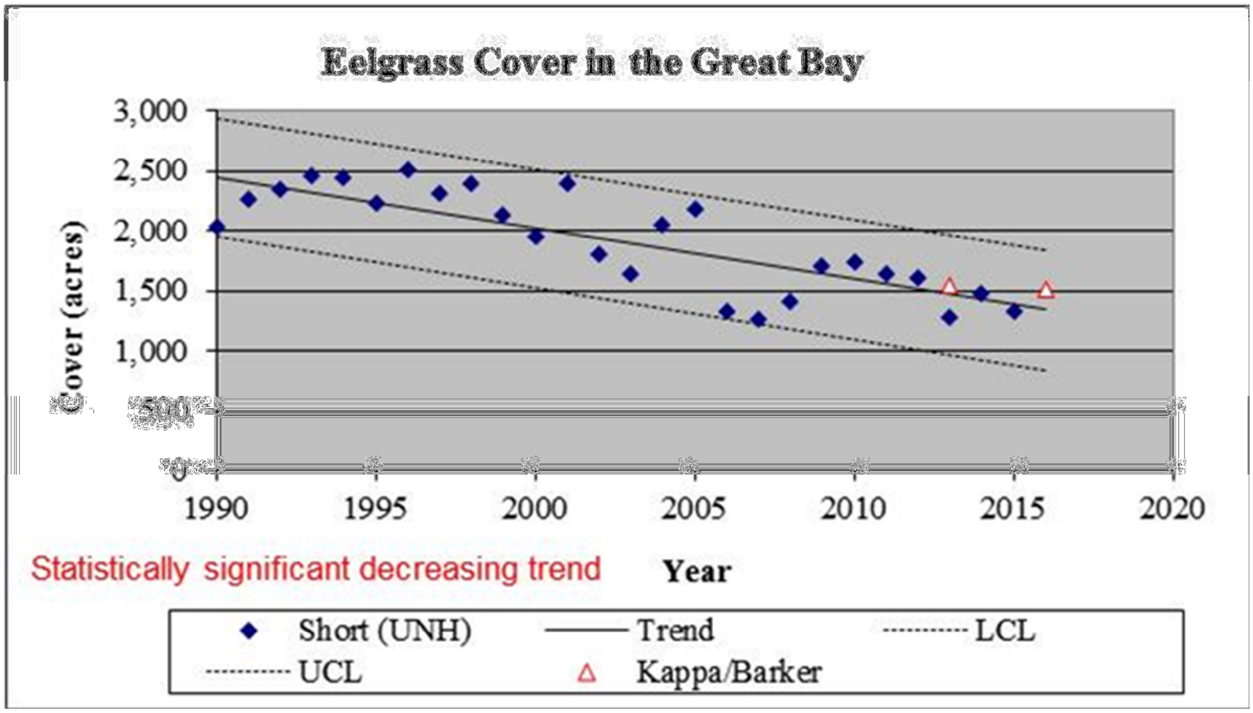


**Figure 15. Great Bay eelgrass cover 1990-2016.**




The commenter simplifies the light attenuation argument to say that only chlorophyll-a is important for impairment determinations. While chlorophyll-a has been shown to attenuate light, there are also non-algal particles (NAP) that are washed in from point and non-point sources in the watershed as well as resuspended in Great Bay by the wind and tidal forces that decrease the light available to eelgrass. NHDES is aware that the NAPs in Great Bay are a likely problem, particularly on the mudflats, and that is one of the reasons that chlorophyll-a is not currently listed as an impairment in Great Bay.

The commenter pointed out an error in the CALM previously discussed in the response to **2- 3**.

A review of the commenter's figure 5 is not warranted on several grounds. That figure contains only 9 of the 13 potential years of paired light attenuation and eelgrass percent cover data, which relates to the issue of dropped eelgrass data (see response to **2- 12**). Utilizing all of the available data creates the opposite relationship, increasing light attenuation as eelgrass cover decreases, though similarly statistically weak. Further, the data for that site is collected in the deepest part of Great Bay, while the losses of eelgrass have occurred elsewhere. Additionally, as annual statistics, a portion of the light attenuation measurements are collected after the eelgrass cover measurements were made within a given year. Finally, all of the data plotted in GBMC's figure 5 covers the period when the eelgrass population is of poor health. The shallow depths of Great Bay further complicate the relationship to light.

***NHDES RESPONSE*** **to 2- 20**
The opening section largely reiterates material from the TSD and the CALM. One item of note is how the eelgrass biomass is considered in the assessment process. The peer reviewers expressly stated that when evaluating the health of the estuary NHDES should consider all confounding factors (Bierman, Diaz, Kenworthy, & Reckhow, 2014) and the Clean Water Act [40 C.F.R § 130.10(d)(6)] states that, "Each state shall assemble and evaluate all readily available water quality-related data and information and each state shall develop the lists required by paragraphs (d)(1), (2), and (3) of this section based upon this data and information." The CALM, in stating how the current biomass data will be evaluated in the context of the water quality assessments, is following these recommendations. At this time, the existing biomass data is not used in and of itself to make full-support or non-support

determinations. Should new biomass data come to light, the integrity and utility of that information will be evaluated.

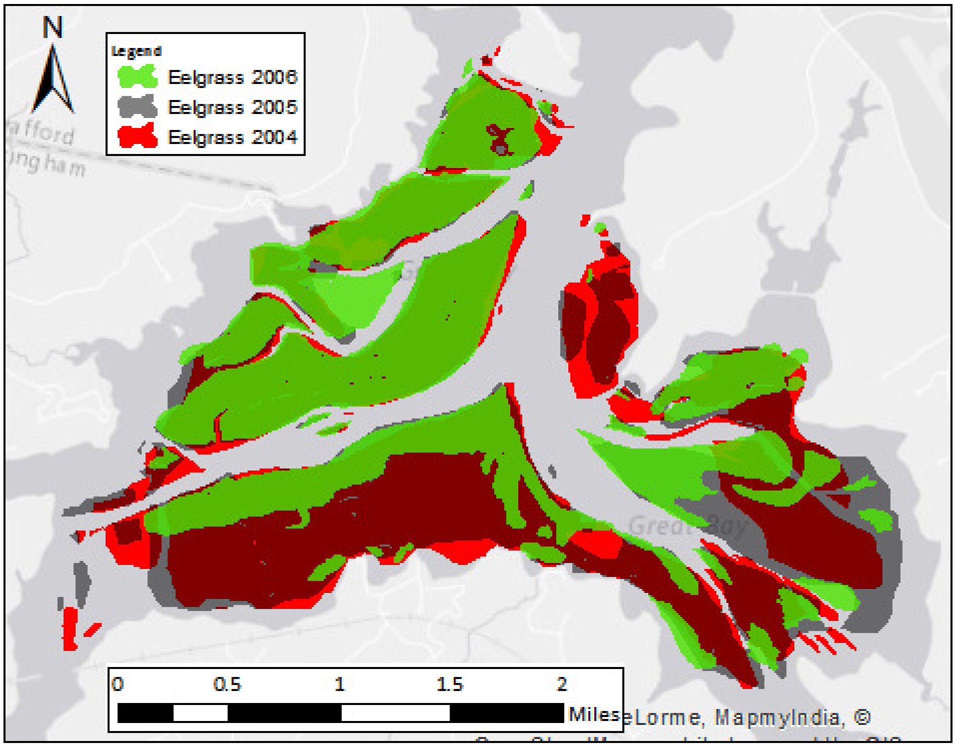
As stated about other assessment zones of the Great Bay estuary, the commenter feels that the loss of eelgrass in Great Bay can be attributed to natural causes. As a starting point, the reader is directed to the response to **2- 3**.

The matter of wasting disease in the system has been discussed in response to **2- 12**. The commenter has chosen to omit all data for which there is any mention of wasting disease. This is problematic because some level of wasting disease is always present and omission of those years ignores a confounding factor that is in all likelihood exacerbated by the other stresses in the estuary.

Severe storms have been called out by the commenter as a trigger for eelgrass loss, particularly the Mother's Day flood of 2006. The commenter has cited (Wang & Linker, 2005) as reporting precipitation and flooding as the "primary driver of seagrass loss and inter-annual variability in Chesapeake Bay and other estuaries" yet the abstract states that, "Model estimates showed that an extreme storm can cause significant damage if it occurs in months of high SAV shoot biomass, but has no significant impact on SAV [submerged aquatic vegetation] if the storm takes place in the winter or in other periods outside of the SAV growing season." Nowhere in that paper are precipitation and flooding identified as the "primary drivers" as suggested by the commenter. Additionally, non-point sources of pollution, which are driven by precipitation, to Great Bay are a larger fraction than the point sources. To the extent that water quality and, in particular, sediment inputs to Great Bay are influenced by non-point sources, NHDES agrees with the commenter that severe short-term reductions in light can have a disproportionate impact of the long-term growth and survival of eelgrass (Backman & Barilotti, 1976) (Moore, Wetzel, & Orth, 1997) and, in the long-term, landscape changes by humans impact water quality in coastal systems (Chen, Cebrian, Lehrter, Stutes, & Goff, 2017).

The commenter provides a graphic showing eelgrass combining 2004 and 2005 verses 2006 (their Figure 6) to say that there was a great loss of eelgrass recorded in 2006 after the Mother's Day flood. Displaying the same data with each year independently we can see how unstable the system has become (Figure 16). There are multiple areas with eelgrass in 2004 that was lost in 2005 while other areas without eelgrass in 2004 had eelgrass in 2005. Although there was a high degree of loss in 2006, even then we see 2006 had 166 acres not present in 2004 or 2005 including some large areas on the northwest side of the bay. Overall, Great Bay appears to be quite susceptible to damage from perturbations (Rapport & Whitford, How Ecosystems Respond to Stress, 1999).

**Figure 16. Great Bay eelgrass cover 2004-2006.**




Regarding the commenter's Figure 7, they state that there are six areas where, "…measureable eelgrass cover never returned to several areas of the Bay that previously continually supported eelgrass cover..." In Figure 17 we have annotated that graphic with letters to ease the discussion. When one looks at the full period of eelgrass record, the general pattern is that the areas missing since 2006 have been on a downward spiral of cycles of growth and death since the stable period in the early 1990s that led up to the decreases in 2006 (Figure 18, Figure 19, Figure 20, Figure 21, Figure 22, Figure 23).

**Figure 17. Annotated version of the commenters Figure 7 adding letters to their red circles.**

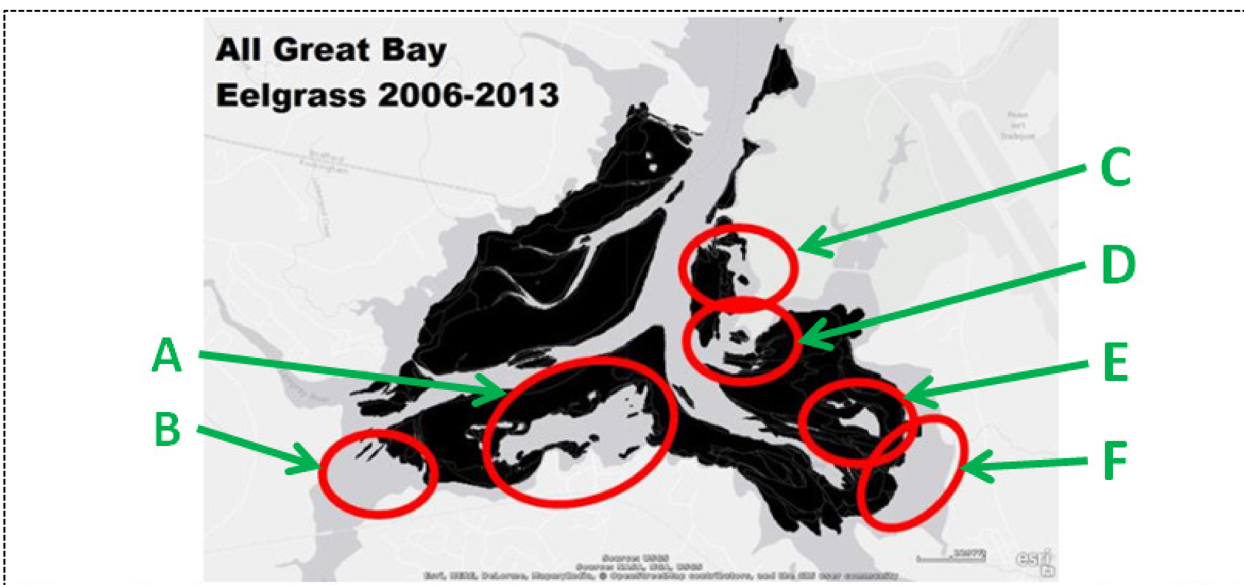



**Figure 7 – Areas in Great Bay that no longer support eelgrass cover since 2006**

A. Figure 18 - From 1990 to 2005 the eelgrass moved in and out of part of the area that was lost in 2006. Much of this area was missing eelgrass in 1990 but self-restored by 1996. Eelgrass in the eastern end of this section was absent in 1999 and reappeared in 2000. This is the area in which a 137 acres of macroalgae was mapped in 2007 (Pe'eri, et al., 2008)(also see Figure 35 in the response to comments on the draft 2014 303d (NHDES, 2017)). It is unknown whether that matt of macroalgae was present in 2006. Macroalgae may have opportunistically moved into that area and it is equally possible that that area was displaced by macroalgae, which has lower light requirements than eelgrass (Fox, 2008) (McGlathery, Sundbäck, & Anderson, 2007).
B. Figure 19 - This area currently has the worst light conditions in Great Bay. Eelgrass has come and gone from this area since the stable period in the early 1990s. Eelgrass exceeded the post 2006 coverage in 1991-1994 and then was absent in 1995, only to regrow in 1996 then fall below the post 2006 cover in 1997. Eelgrass cover reemerged very close to the Squamscott River in 1999 and 2001 and only to be greatly reduced in 2002 and 2003 then minor regrowth in 2004 and 2005. The fact that eelgrass has been gone since 2006 is a continuation of the downward trend.
C. Figure 20 - After a strong eelgrass presence in 1991 and 1993, there appeared to be losses in 1993 which returned and stayed from 1994 to 1996. Eelgrass was largely absent in 1997, rebounded in 1998, only to see large losses in 1999. After strong regrowth in 2000 and 2001 there appears to have been large losses in 2002 with some regrowth in 2003 and large coverage in 2004. There are also areas that grew eelgrass in 2007-2012 that had not grown eelgrass from 1990-2005 (Figure 24)
D. Figure 21 – Overall eelgrass area from 1990 to 1997 was fairly comparable to the post 2006 eelgrass (merged 2007-2013) coverage. There was a loss of coverage from 2000 to 2003 which regrew in 2004 and 2005.
E. Figure 22 – With the exception of 1990, eelgrass covered this area well through the 1990s when compared to the post 2006 eelgrass (merged 2007-2013) coverage. The year 2000 appears to show losses which recovered in 2001. More losses were seen in 2002 and 2003 which recovered in 2005.
F. Figure 23 – Eelgrass was fairly consistent in this area from 1990 to 1998 when compared to the post 2006 eelgrass (merged 2007-2013) coverage. The 1999 and 200 coverages show some apparent loss with partial regrowth in 2001 only to experience larger losses in 2002 and 2003 and a fairly strong regrowth in 2005.

**Figure 18. Variability in eelgrass over time from 1990-2005 in Area A noted by the commenters Figure 7.**

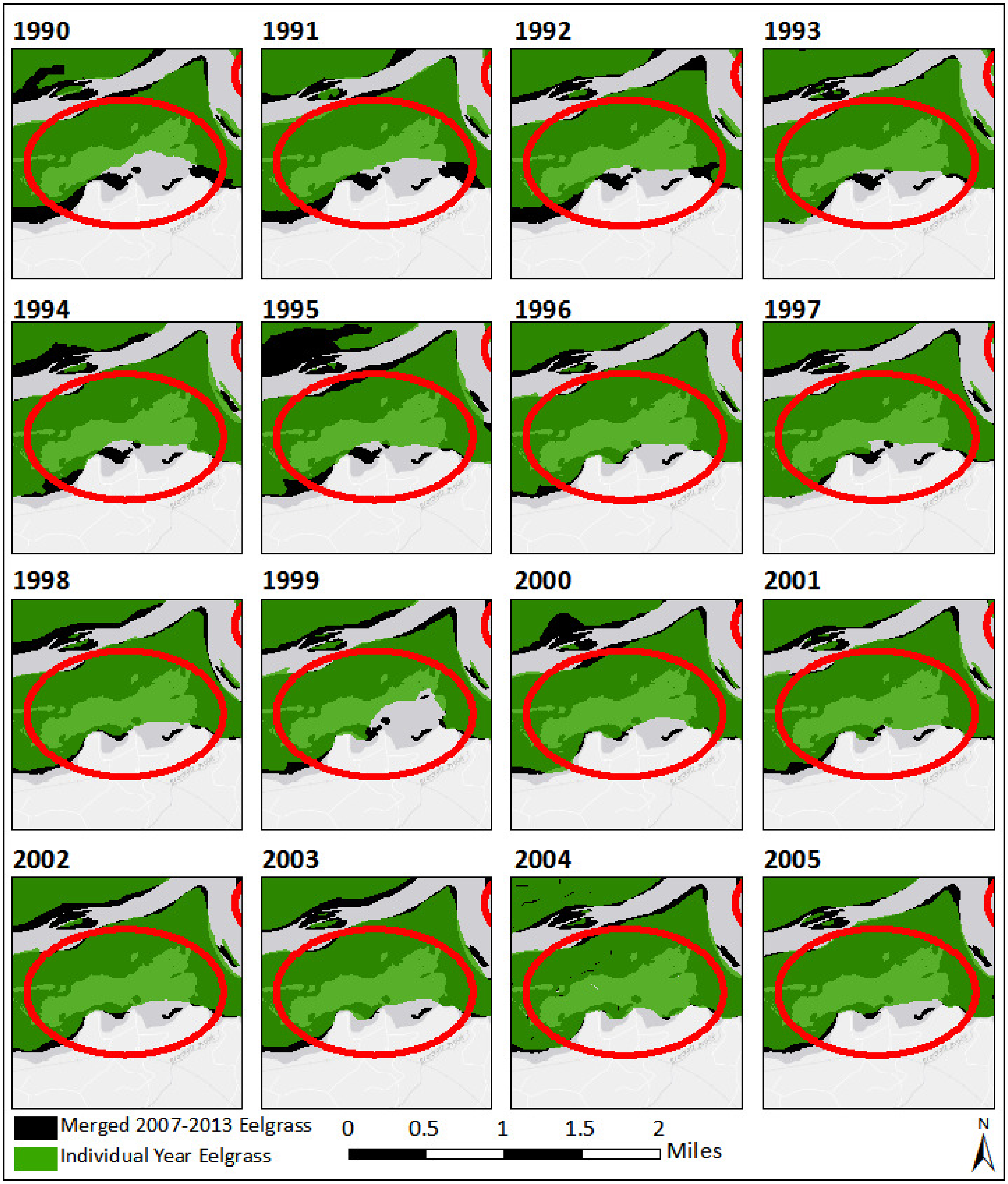


**Figure 19. Variability in eelgrass over time from 1990-2005 in Area B noted by the commenters Figure 7.**

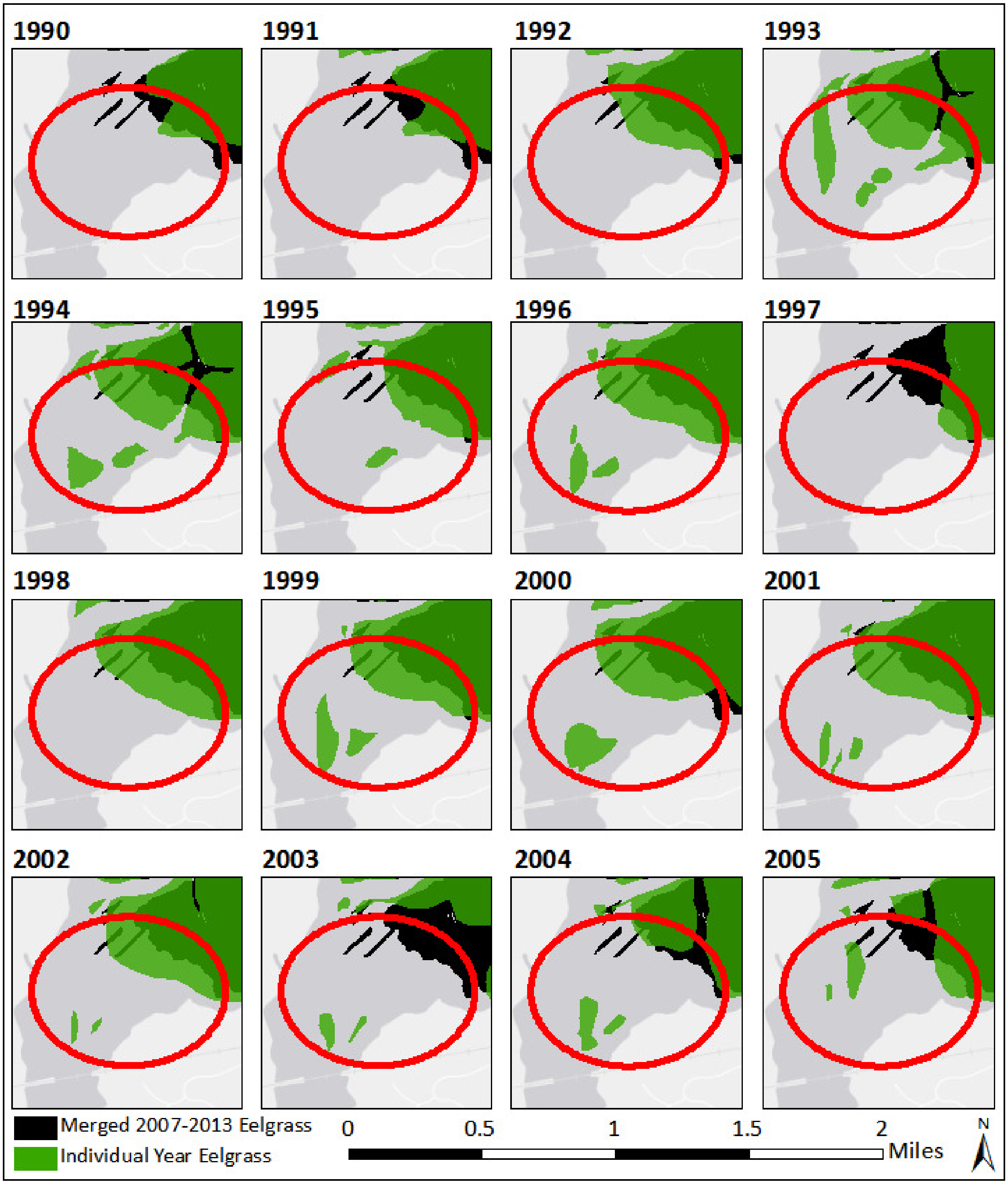


**Figure 20. Variability in eelgrass over time from 1990-2005 in Area C noted by the commenters Figure 7.**

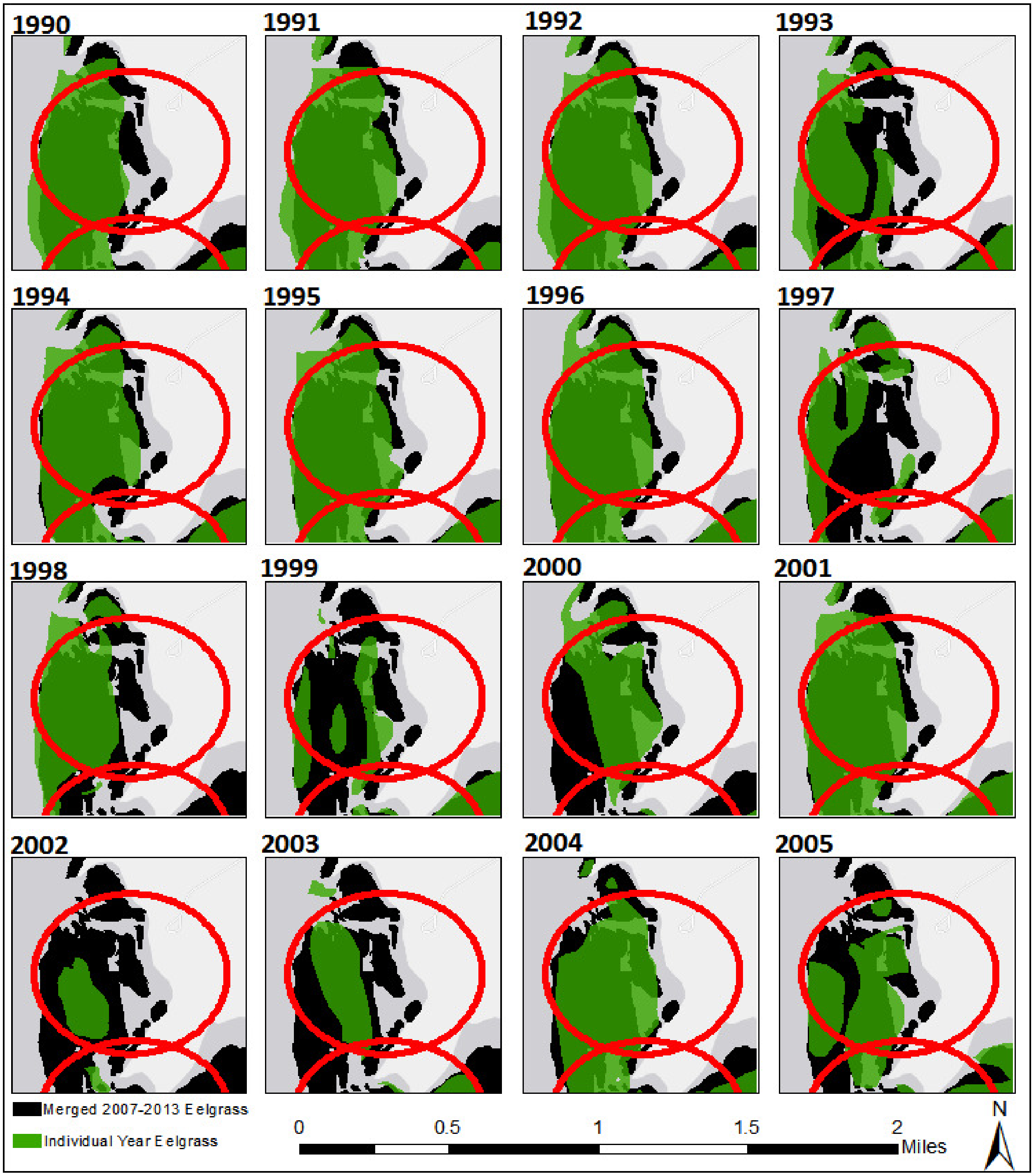


**Figure 21. Variability in eelgrass over time from 1990-2005 in Area D noted by the commenters Figure 7.**

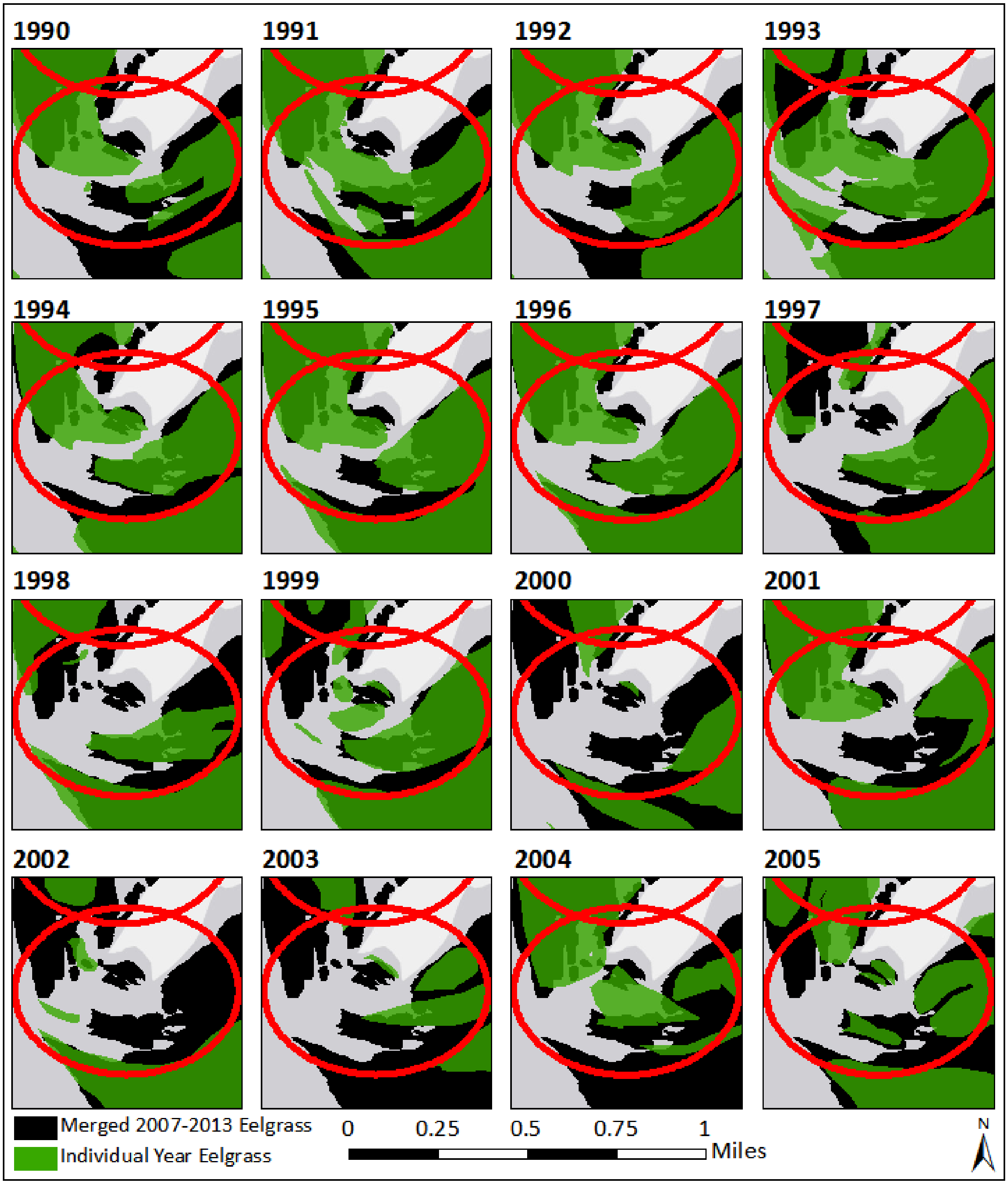


**Figure 22. Variability in eelgrass over time from 1990-2005 in Area E noted by the commenters Figure 7.**

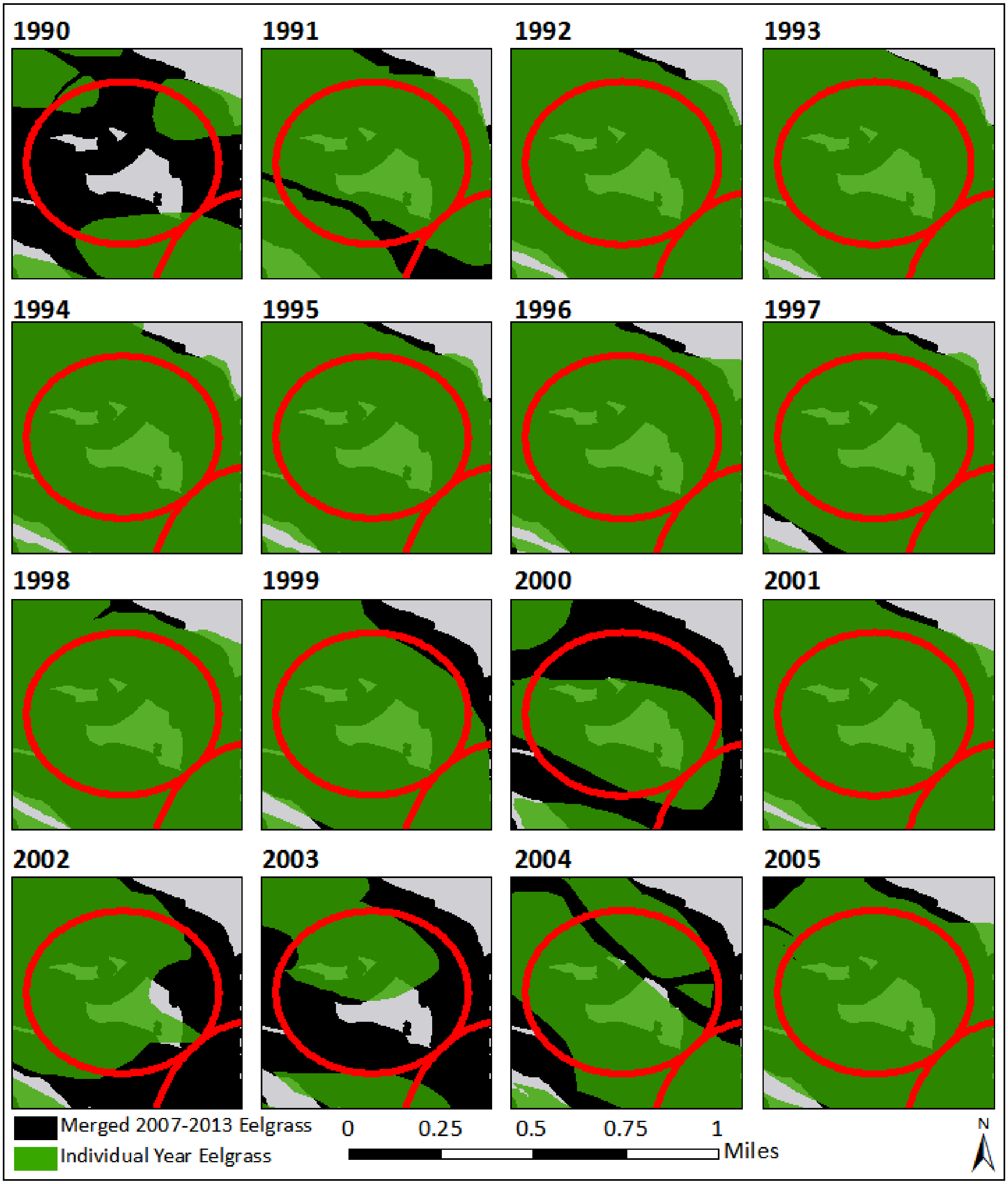
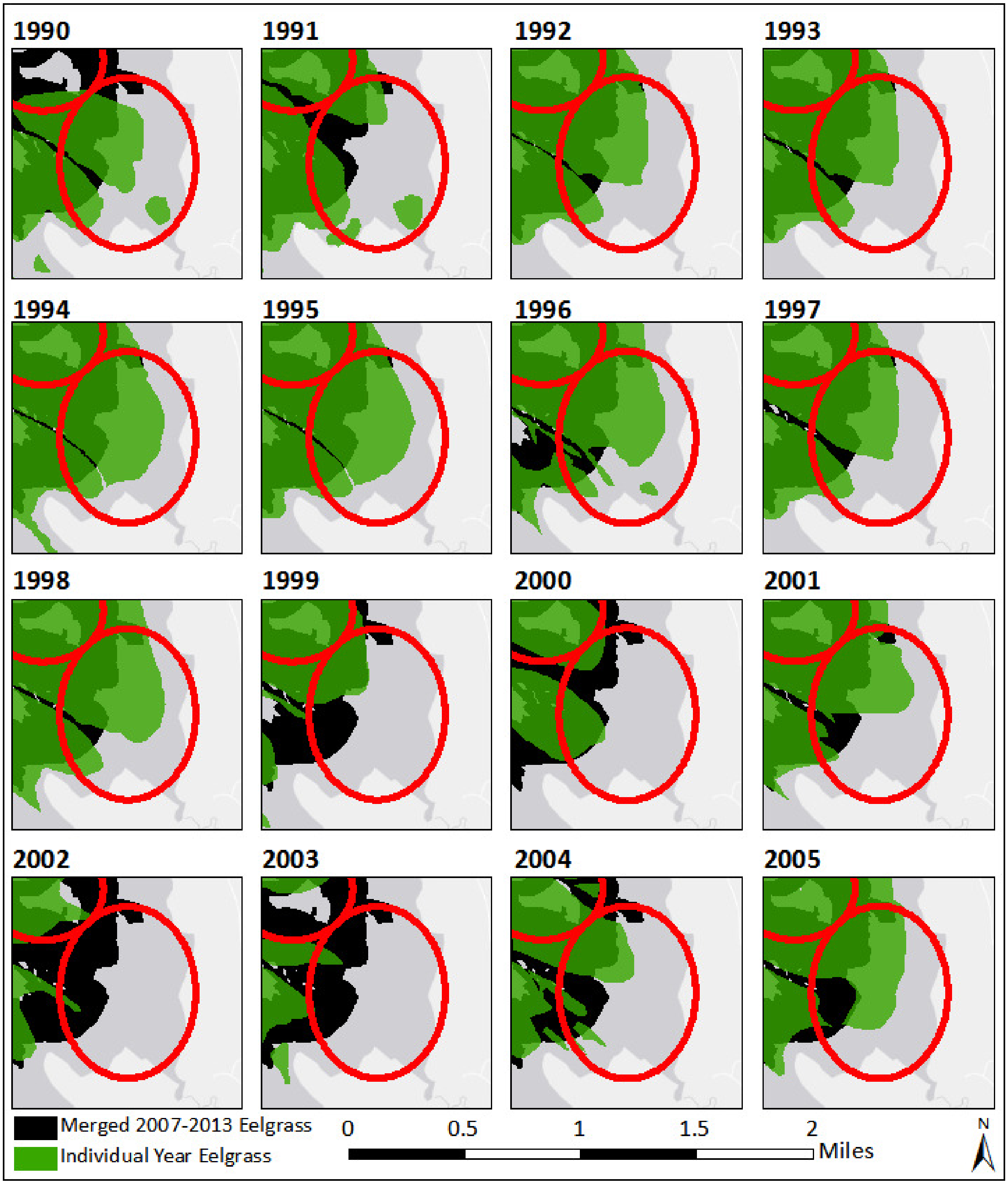


**Figure 23. Variability in eelgrass over time from 1990-2005 in Area F noted by the commenters Figure 7.**



It is also important to note that there are a collection of areas that grew eelgrass after the 2006 storm which did not appear in 2004 or 2005. There were 348 acres mapped between 2006 and 2013 not evident in 2004 or 2005, and 414 acres not mapped between 2006 and 2013 that were seen in 2004 or 2005 (purple verses black in Figure 25). One large area that did not grow eelgrass in any year from 2006 to 2013 is in a median depth habitat (area A noted on the commenters Figure 7 in (Figure 17)) that was largely mapped as macroalgae in 2007 (Morrison, Gregory, Pe'eri, McDowell, & Trowbridge, 2008) (Figure 24, Figure 25).

**Figure 24. Eelgrass 2004/2005 (black) overlaid with eelgrass 2006-2013 (green) like commenters Figure 7 but with the 2006-2013 eelgrass displayed.**

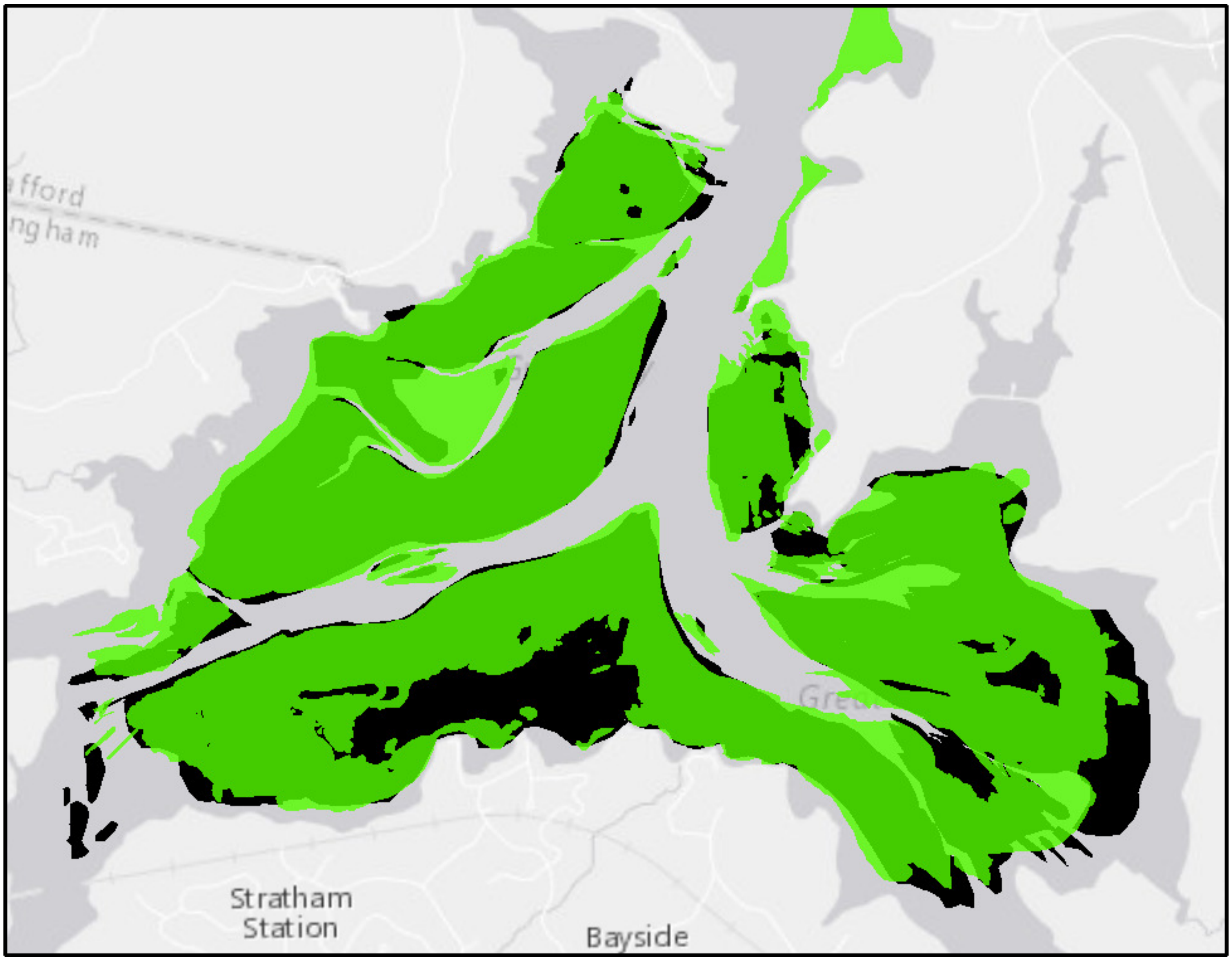
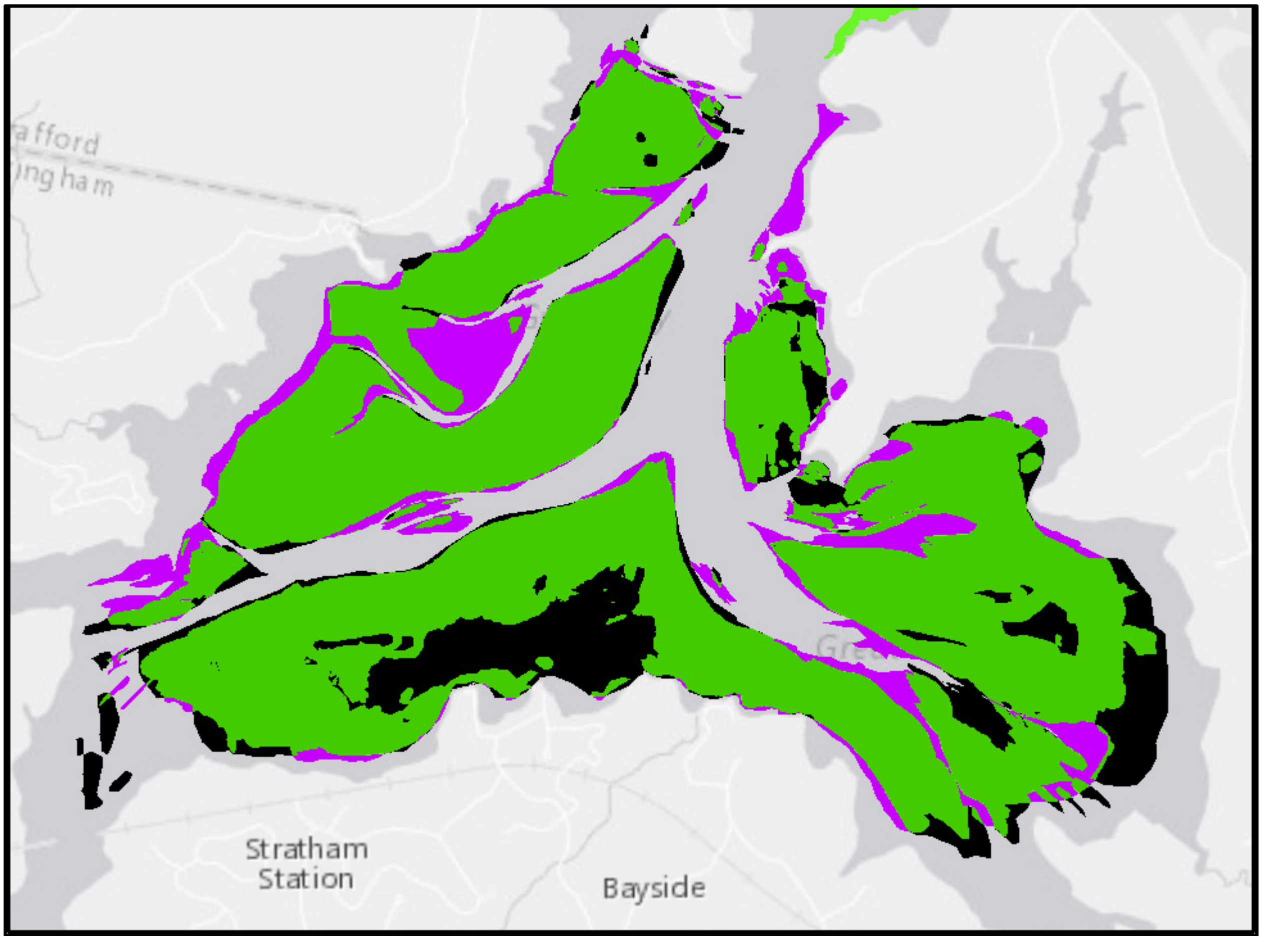


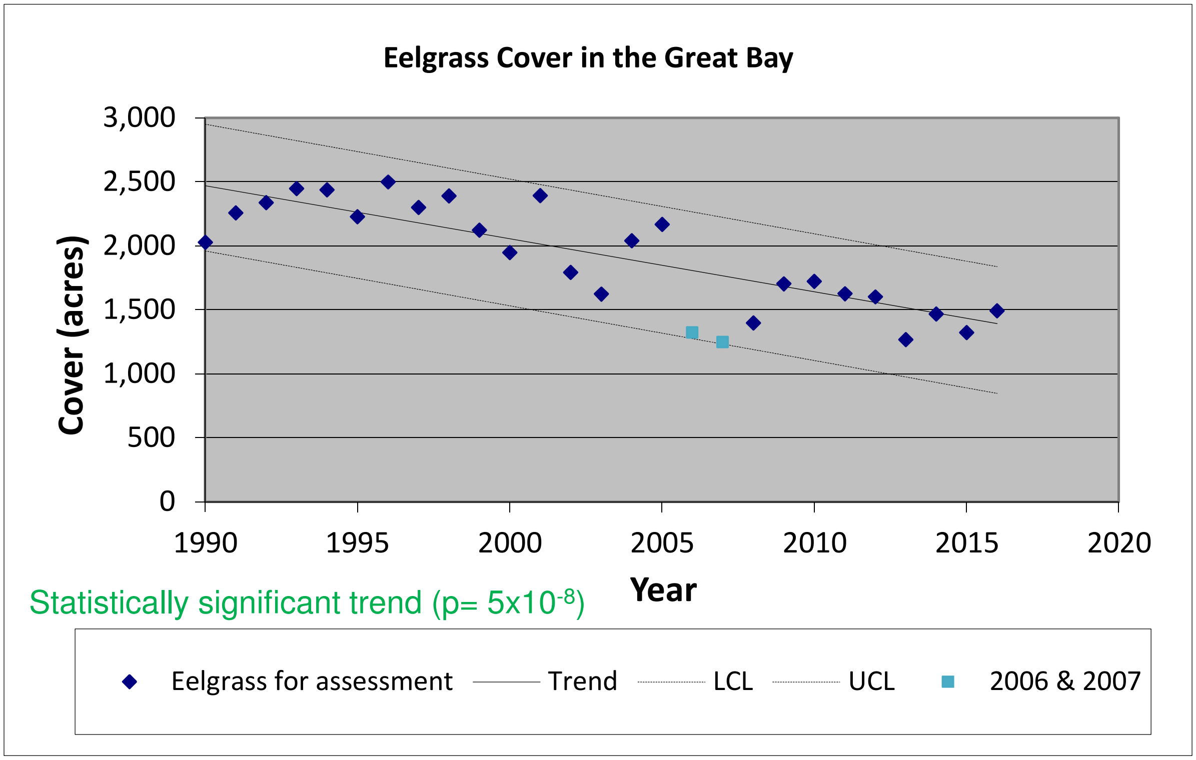
**Figure 25. Eelgrass 2004/2005 (black) overlaid with eelgrass 2006-2013 (green) like commenters Figure 7 but with the 2006-2013 eelgrass displayed and highlighting (purple) areas of eelgrass in 2006-2013 (green) but not in 2004/2005 (black).**




While it is true that the CALM considers habitat degradation as a non-pollutant since one cannot assign a daily load, the CALM does not consider habitat degradation to be a “natural condition” as stated by the commenter.

The peer review stated that data pre-1990 should not be used for modern trends since the system had a full reset in the late 1980s. Using their figure 8 the commenter suggests that the Great Bay is in a secondary stable state as a response to the 2006 flood. Their analysis ignores any year with wasting disease mentioned (see response to **2- 12**) and includes data from before 1990. Another view of the post 1990 data would be to acknowledge the temporary negative impact on eelgrass in 2006-2007 and removed it as temporarily impacted and then partial recovery. In that light, we see a consistent decline in eelgrass cover since the early 1990s (Figure 26).

**Figure 26. Great Bay eelgrass cover trend with 2006 and 2007 removed.**




The commenter provided a modified version of the Great Bay eelgrass depth analysis that was provided in the NHDES response to comments on the draft 2014 303(d) (NHDES, 2017). The commenters' modifications entailed inappropriately dropping 10 years of data between 1981 and 2005 as they have done earlier in their comments citing wasting disease (see response to **2- 12**). With the exception of the severe eelgrass loses in the late 1980s, eelgrass appears to have been stable from the early 1980 to roughly 1990. The current pattern of loss started in the early 1990s. Based on the wasting disease issues in the 1980s, inconsistent mapping, and statements of the peer reviewers, it is inappropriate to begin eelgrass trend analysis prior to 1990. However, the commenter chose to run trend lines through a subset of the data starting in 1981. Between the dropped data and extending the dataset well back into a period that of possible stability they have created the false impression of a single change point at 2006.

All years of eelgrass mapping have included some form of ground-truthing which allows researchers to know which shade of green in the images is eelgrass and which shade of green is macroalgae. The paper referenced by the commenter (Engineers, May 27, 2016) notes that the deep edge of eelgrass may be difficult to detect. Fortunately for Great Bay, at the minus tide flown for the aerial imagery, the deep edge is readily evident (Figure 7).

Details on the historic mapping were provided in (Odell, Eberhardt, Burdick, & Ingraham, 2006) and (NHDES, August 11, 2008), and a refresher is provided here. The 1948 eelgrass dataset (Krochmal, 1949) was collected from boat and shoreline surveys. Given the intimate nature of that survey it is not subject to the difficulties of aerial imagery. That report is available from the UNH library digital collections (https://www.library.unh.edu/find/digital/object/digital%3A00002). It is recognized that there is difficulty in using that data for assessments because most of the places it mapped have subsequently lost 100% of the eelgrass cover. The 1962 Maine Geologic Survey mapped eelgrass mapped the beds on the Maine side of the Piscataqua River as part of the Coastal Maine Geologic Environment survey (MDEP, 1962). The beds were mapped from aerial photography and checked by field visits to some sites. As such, those surveys are not subject to the difficulties of aerial imagery. The 1962 Maine Geologic Survey mapping covered a relatively small portion of the Great Bay estuary. However, the eelgrass beds on the Maine side of the river were not mapped by any other sources until 1996.

Therefore, this historic dataset provides useful information. In 1980-1981, the New Hampshire Fish and Game Department completed an inventory of natural resources in the Great Bay estuary (NHFG, 1981). Eelgrass populations in the Great Bay, Little Bay, and portions of the Piscataqua River were assessed using boat and diver surveys making them not subject to the difficulties of aerial imagery. The surveys did not cover any of the tidal tributaries to Great Bay or Little Bay.

Timing system-wide aerial eelgrass surveys to ideal clear and calm weather conditions is difficult enough. Making that timing align with peak biomass is not within human control. As such, system-wide aerial eelgrass surveys are aligned with a late summer index period. Recognizing the limitations of a given year's survey, NHDES has employed two methods of assessment. The method for trend detection uses many years of data for the analysis and compares the percent cover at the beginning and end of the period. If there is a sufficiently large negative trend, and that trend is statistically significant, an impairment determination may be made. The second method, calculating absolute losses, uses the median of the most recent 3-years of data for a comparison point, again, not relying on a single year survey. It is worth noting that all of the assessment zones that do not meet this absolute loss indicator also do not meet the trend indicator except for cases where 56-100% of the eelgrass has been lost.

## RESPONSE TO COMMENT #3: Dawn Tuomala, Town of Merrimack

***NHDES RESPONSE*** **to 3- 1**
This section contains opening remarks by the Town of Merrimack as well as thoughts on the age of data used in the assessment process.

Merrimack is concerned that data up to 27 years old is used to make assessment decisions. For the 2016 assessment cycle, all available data back to 1990 was pulled into the database, however, it has always been and continues to be the case that the most current data is used in the assessment process as described by section 3.3.11 of the CALM. Why include all of the older data? Extracting the data in this manner allows NHDES to process all data in a consistent manner and the reviewer to examine the current and older data in one step without needing to go into other databases, extract additional data, and then try to merge those datasets together. This greatly streamlines the process when a waterbody was impaired in past cycles and new data indicates support, allowing a data reviewer to quickly answer the questions about data comparability, including, same stations sampled, same time of year, same time of day, similar weather and flow, and other variables that are important for a given waterbody/parameter combination. Given limited resources, NHDES would appreciate any such data that is collected by other organizations to update these old observations with newer data.

NHDES would also like to point out that the age of data used in the assessment process is available in both the watershed report card PDFs and the Excel files created by the data extractions tool of the web-based "Surface Water Quality Assessment Viewer" in the "Last Sample" and "Last Exceed" fields.

Finally, Merrimack suggested that NHDES should identify improvements made in cases where the impairment data is old. This is done in cases where NHDES is aware of projects on the ground or where there are notable trends in a dataset. However, given the scale of the assessment task, this capacity is limited as priority is given to waters moving on or off impaired status.

***NHDES RESPONSE*** **to 3- 2**, **3- 3**, **3- 4**, **3- 5**, & **3- 6**
NHDES applauds the work by the Town of Merrimack to improve water quality and to the extent possible will include notes on the related waterbodies (see response to comment **3- 1**).

***NHDES RESPONSE*** **to 3- 7** (also see response to **1- 8** regarding "natural")
This section is focused on the Souhegan River (NHRIV700060906-18) and there are a series of comments in this section best summed as, "If there is no usable data (3-ND), why is the river given 5-P?" Part of the issue here is that the commenter reviewed the "2016 Draft Status of Each Assessment Unit" Excel file rather than the "Appendix A.2 - 2016, Draft 303(d)" Excel file. With each assessment cycle, NHDES places a file of all assessments for all waterbodies on the assessment website. Filtering that list to just those parameter categories that start with "5" will give you the 303(d) list of impairments while filtering out all of the parameters that have been documented as being; in good condition ("2"), of indeterminate condition ("3"), or non-303(d) impaired ("4"). The rollup of the assessment status by Assessment Unit ID (AUID) is hierarchal and that is reflected in the "2016 Draft Status of Each Assessment Unit" Excel file. That is, every AUID has 6 or 7 designated uses and each designated use may be assessed for zero to 40 parameters. In the rollup, if one parameter is impaired (Categories 4* or 5*), then the designated use is impaired and if one designated use is impaired, then the AUID is impaired. The exception to that process is for the impairments to the fish consumption designated use based on mercury. For freshwaters, we do not roll that up to the AUID level since it would mask everything else going on in the waterbody. The color coded version of the watershed report card for the Souhegan River (NHRIV700060906-18) demonstrates this reasonably well (Figure 27).

**Figure 27. Watershed report card for the Souhegan River (NHRIV700060906-18) from the web-based "Surface Water Quality Assessment Viewer."**

Assessment Unit ID NHRIV700060906-18
Assessment Unit Name SOUHEGAN RIVER
Primary Town MERRIMACK

Size 12.0050 MILES
Beach N
Assessment Unit Category*- 5-P

**2016, 305(b)/303(d) - All Reviewed Parameters by Assessment Unit**
*****DRAFT*****

| Designated Use Description | *Desig. Use Category | Desig. Use Threat | Parameter Name | Parameter Threatened (Y/N) | Last Sample | Last Exceed | Parameter Category* | TMDL Priority | Source Name (Impairments only) |
|---|---|---|---|---|---|---|---|---|---|
| Aquatic Life | 5-P | | ALKALINITY, CARBONATE AS CACO3 | N | 2012 | 2012 | 3-PNS | | |
| | | | AMMONIA (UN-IONIZED) | N | 2006 | N/A | 3-ND | | |
| | | | ARSENIC | N | 1995 | N/A | 3-ND | | |
| | | | Aluminum | N | 2016 | 2016 | 5-M | LOW | Source Unknown |
| | | | Benthic-Macroinvertebrate Bioassessments (Streams) | N | 2012 | NA | 2-M | | |
| | | | CADMIUM | N | 1995 | 1991 | 3-ND | | |
| | | | CHLORIDE | N | 2016 | N/A | 3-PAS | | |
| | | | COPPER | N | 2016 | 2001 | 3-PAS | | |
| | | | DISSOLVED OXYGEN SATURATION | N | 2016 | N/A | 2-G | | |
| | | | IRON | N | 1995 | N/A | 3-ND | | |
| | | | LEAD | N | 2004 | 2001 | 3-ND | | |
| | | | NICKEL | N | 1995 | 1990 | 3-ND | | |
| | | | Oxygen, Dissolved | N | 2016 | 2006 | 5-P | LOW | Source Unknown |
| | | | PHOSPHORUS (TOTAL) | N | 2016 | NLV | 3-PAS | | |
| | | | SELENIUM | N | 1995 | N/A | 3-ND | | |
| | | | TURBIDITY | N | 2016 | N/A | 3-PAS | | |
| | | | ZINC | N | 2004 | 1997 | 3-ND | | |
| | | | pH | N | 2016 | 2016 | 5-M | LOW | Source Unknown |
| Drinking Water After Adequate Treatment | 2-G | | ARSENIC | N | 1995 | 1990 | 3-ND | | |
| | | | COPPER | N | 2016 | N/A | 3-PAS | | |
| | | | ESCHERICHIA COLI | N | 2016 | 2016 | 3-PNS | | |
| | | | FECAL COLIFORM | N | 2004 | 2004 | 3-ND | | |
| | | | IRON | N | 1995 | 1995 | 3-ND | | |
| | | | MANGANESE | N | 1994 | 1994 | 3-ND | | |
| | | | NICKEL | N | 1995 | N/A | 3-ND | | |
| | | | SELENIUM | N | 1995 | N/A | 3-ND | | |
| | | | SULFATES | N | 2016 | N/A | 3-PAS | | |
| Drinking Water After Adequate Treatment | 2-G | | ZINC | N | 2004 | N/A | 3-ND | | |
| | | | | N | 2016 | N/A | 3-PAS | | |
| Fish Consumption | 4A-M | | ARSENIC | N | 1995 | 1990 | 3-ND | | |
| | | | COPPER | N | 2016 | N/A | 3-PAS | | |
| | | | MANGANESE | N | 1994 | N/A | 3-ND | | |
| | | | Mercury | N | | | 4A-M | | Atmospheric Deposition - Toxics |
| | | | NICKEL | N | 1995 | N/A | 3-ND | | |
| | | | SELENIUM | N | 1995 | N/A | 3-ND | | |
| | | | ZINC | N | 2004 | N/A | 3-ND | | |
| Primary Contact Recreation | 4A-P | | CHLOROPHYLL-A | N | 2015 | N/A | 2-G | | |
| | | | Escherichia coli | N | 2016 | 2015 | 4A-P | | Source Unknown |
| Secondary Contact Recreation | 3-PNS | | ESCHERICHIA COLI | N | 2016 | 2015 | 3-PNS | | |
| Wildlife | 3-ND | | | | | | | | |

| Severe | Poor | Likely Bad | No Data | Likely Good | Marginal | Good |
|---|---|---|---|---|---|---|
| Not Supporting, Severe | Not Supporting, Marginal | Insufficient Information – Potentially Full Supporting | No Data | Insufficient Information – Potentially Full Supporting | Full Support, Marginal | Full Support, Good |

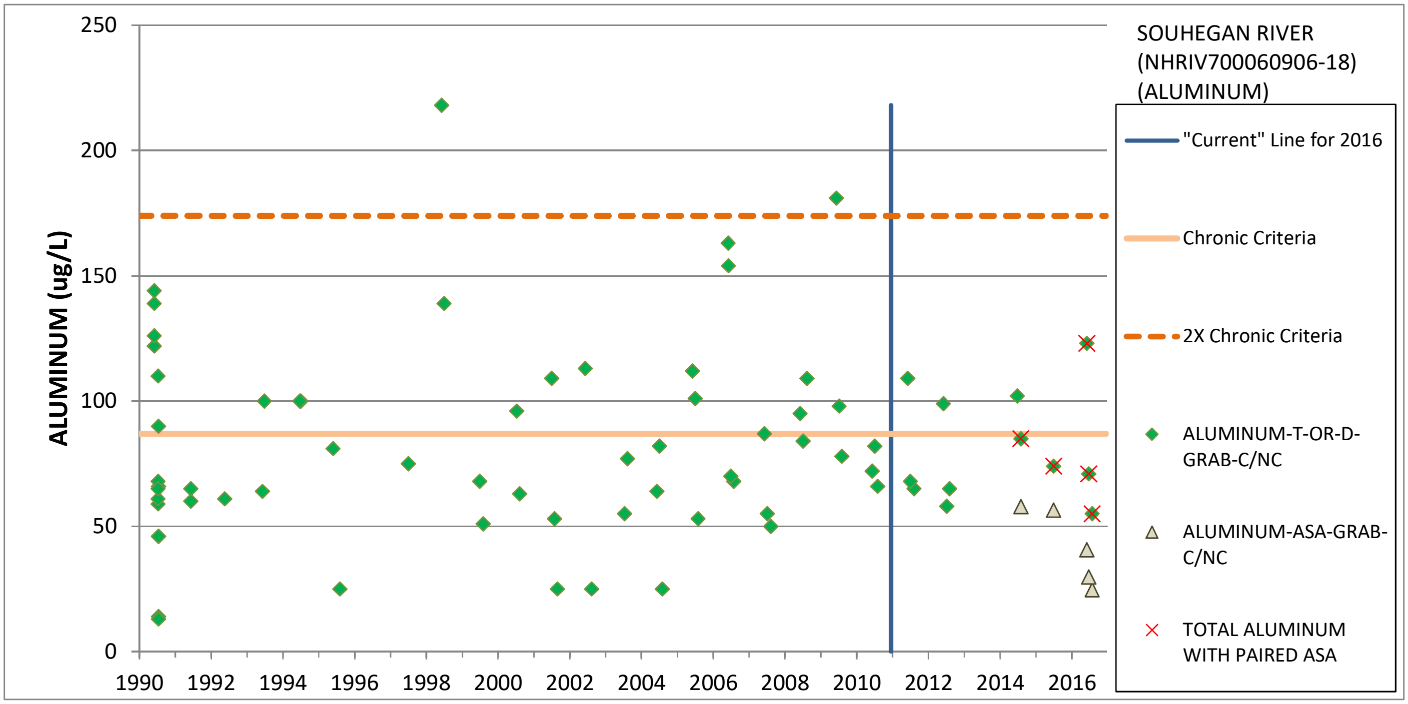
*DES Categories; 2-G - Supports Parameter well above criteria, 2-M - Supports Parameter marginally above criteria, 2-OBS - Exceeds WQ criteria but natural therefore not a WQ exceedence, 3-ND - Insufficient Information/No data, 3-PAS- Insufficient Information/Potentially Attaining Standard, 3-PNS- Insufficient Information/Potentially Not Attaining Standard, (4A-Impaired/TMDL Completed, 4B-Impaired/Other Measure will rectify Impairment, 4C-Impaired/Non-Pollutant, 5-Impaired/TMDL needed) M-Marginal Impairment, P-Severe Impairment, T-Threatened (http://des.nh.gov/organization/divisions/water/wmb/swqa/index.htm)

Page 45 of 71

May 8, 2017

Regarding the aluminum impairment on the Souhegan River (NHRIV700060906-18), Merrimack questioned whether high flows could resuspend sediment high in aluminum. The Souhegan River has been on the list of impairments due to aluminum since the 2010 assessment cycle due to multiple high aluminum samples over time. The more recent data suggests that conditions may be improving (Figure 28) and those possible improvements should be evaluated in the context of flow (Figure 29). Indeed it is quite common to see elevated aluminum as flows increase and as occurs in the Souhegan River (NHRIV700060906-18) (Figure 30). Regarding "natural," see the response to **1- 8**.

**Figure 28. Aluminum samples over time for the Souhegan River (NHRIV700060906-18).**




Notes:

The aluminum indicator threshold shown in the graphic above is to protect the aquatic life designated use.
"Current" Line for 2016 - Per the methodology outlined in the CALM, all data from this referenced data is considered "current" unless. Available older data is provided for context. See the 2016 CALM for addition details.
ALUMINUM-T-OR-D-GRAB-C/NC = Aluminum grab samples collected and analysed as either the total or dissolved fractions.
ALUMINUM-ASA-GRAB-C/NC = Aluminum grab samples collected and analysed as the acid soluble aluminum fraction.
TOTAL ALUMINUM WITH PAIRED ASA = Calling out the samples analysed as the total or dissolved fraction that also were analysed as the acid soluble aluminum fraction.

**Figure 29. River flow on dates for which for the Souhegan River (NHRIV700060906-18) was sampled for aluminum. (Beaver Brook was used due to the completeness of the gage data.)**

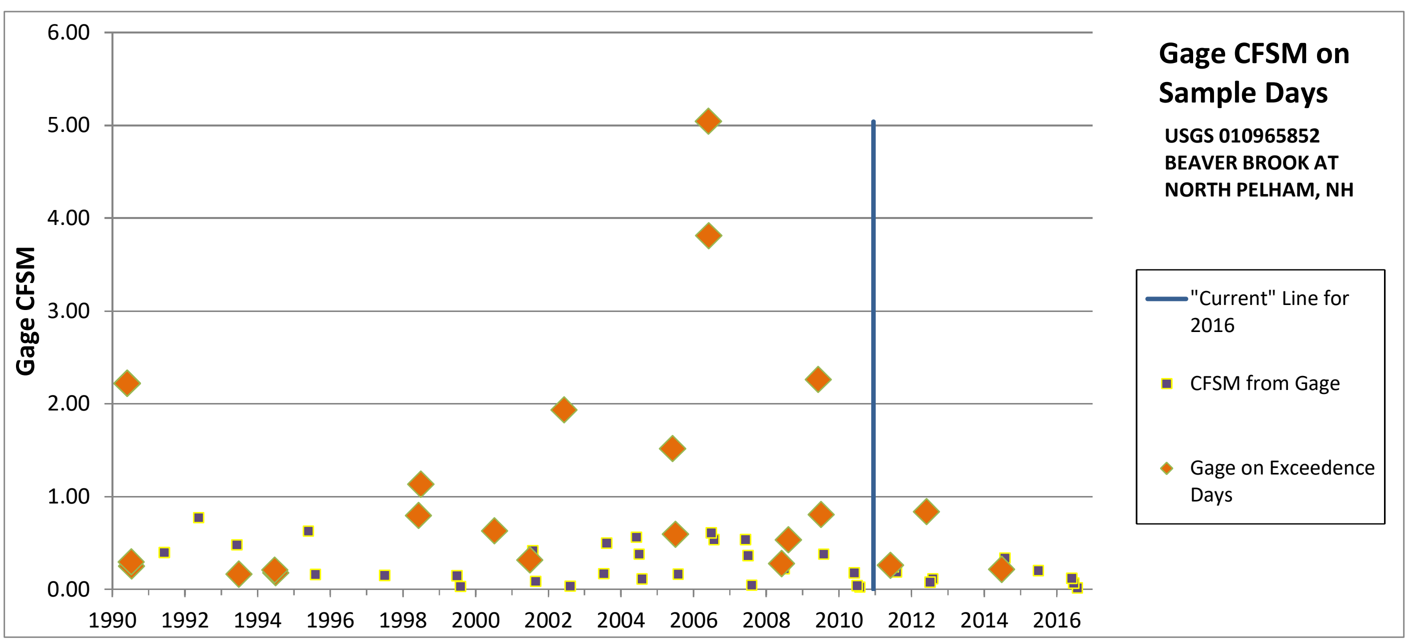
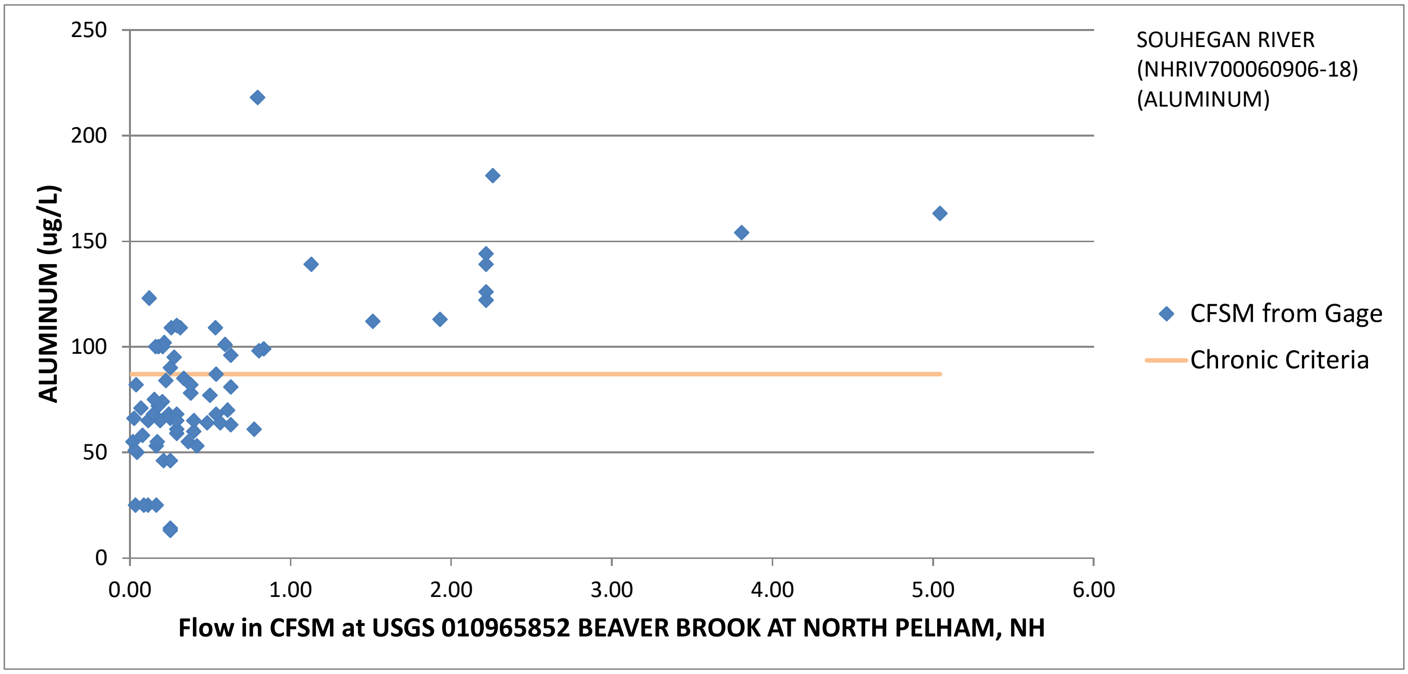


**Figure 30. River flow verses aluminum on dates for which for the Souhegan River (NHRIV700060906-18) was sampled for aluminum. (Beaver Brook was used to the completeness of the gage data).**




***NHDES RESPONSE*** **to 3- 8**
NHDES applauds the work by the Town of Merrimack to protect Baboosic Brook. NHDES will include those notes to the extent possible (see response to comment **3- 1**).

***NHDES RESPONSE*** **to 3- 9** and **3- 10**
The fields noted as highlighted in red (pink) by the commenter are addressed in the response to comment **3- 7**.

The absent fields noted by the yellow highlighting (see **3- 10**) have been addressed in the NHDES database.

Under the “Last Exceed” field in the waterbody report cards one periodically sees an entry “NLV” which stands for “No Logical Value.” That entry exists for parameters that are evaluated based on a calculation from multiple years’ worth of data, therefore no single year is a valid entry to the “Last Exceed” field.

The written comments are addressed by the response to comment **3- 7** regarding impairments.

***NHDES RESPONSE*** **to 3- 11** and **3- 12**

No comments needing responses.

***NHDES RESPONSE*** **to 3- 13**
The main comment on this page is addressed by the response to comment **3- 7** regarding impairments. The line comments require no response.

***NHDES RESPONSE*** **to 3- 14**
The main comment on this page is addressed by the response to comment **3- 7** regarding impairments. The absent fields noted by the yellow highlighting have been addressed in the NHDES database.

***NHDES RESPONSE*** **to 3- 15**
The first two comments in the section are covered by the response to comment **3- 1**.

The impaired benthic macroinvertebrate assessment in Baboosic Brook (NHRIV700060905-19) was first added in the 2006 assessment cycle. At that time, the samples from 2003 were quite "current." It has been suggested in past comments that impairments should be removed when the data is greater than 5 years old. NHDES is sympathetic to this concern. The CALM text applies to what the Clean Water Act requires in instances where older data indicates impairment. Removal of an impairment requires the collection of adequate new data under similar or more limiting conditions indicating support. All data and all knowledge of changes in the stressors to a system are considered when deciding whether a waterbody is kept as impaired or shown as fully supporting a particular indicator. However, resampling is required to remove an impairment.

One way to think about this process is the metaphor of an automobile inspection. If a car fails inspection due to bald tires, that failure (i.e. impairment) remains until it is demonstrated that the car has good tires. This requires both the fix (new tires) and the documentation of that fix (re-inspection). Like Merrimack, NHDES would also like to have information about both the improved conditions and new monitoring data in order to remove impairments based on old data. A more detailed discussion of data and documentation considerations to remove an impairment are provided on the NHDES website (NHDES, 2017).

***NHDES RESPONSE*** **to 3- 16**
The mercury impairment that is assigned to the fish consumption designated use for all waters of the state is described in CALM section 3.2.6 Use: Fish Consumption, Indicator 1 Fish Consumption Advisories Due to Toxics. Fish consumption advisories are issued by the NHDES Environmental Health Program. The advisories are based on risk assessments to determine if any portion of the human population would be at risk eating fish due to pollutant concentrations in fish tissue. A summary of fish consumption advisories in New Hampshire is available on the web at http://des.nh.gov/organization/divisions/air/pehb/ehs/ehp/documents/fish_advisory.pdf. As this is a statistical assessment of all of the available mercury in fish tissue for the state, no data points are assigned to a particular waterbody.

Regarding data age, see the response to comment **3- 15**.

The remaining comments on this page are addressed by the response to comment **3- 7** regarding impairments**.**

***NHDES RESPONSE*** **to 3- 17**
"2,4-D" is a herbicide that may be applied by special permit when treating for variable-leafed milfoil in waterbodies. The full name is 2,4-Dichlorophenoxyacetic acid (CAS Registry Number: 94-75-7) but has a host of synonyms including; Acetic acid, (2,4-dichlorophenoxy)-; (Dichlorophenoxy)acetic acid; Ipaner; Monosan; and many more. In terms of the name shown in the reports, the name that appears in the report comes from an EPA database over which we have no control. NHDES will look at methods to provide a more complete name although the common 2,4-D may be clearer. Further information of 2,4-D permitting may be found on the NHDES Exotic Species Program webpage https://www.des.nh.gov/organization/divisions/water/wmb/exoticspecies/index.htm.

Regarding data age, see the response to comment **3- 15**.

***NHDES RESPONSE*** **to 3- 18**
The commenter asked if it is possible to know the dates of the most recent observation of non-native species in a given waterbody. NHDES will try to incorporate that information into the comments for a waterbody during the next assessment cycle. In the interim, NHDES directs the reader to the "NHDES: Lake Information Mapper" (https://www.des.nh.gov/onestop/gis.htm) through which one can access the recent control activities, the exotics management plan, and the year of discovery for each species for those waterbodies with known infestations.

Regarding the mercury assigned to the fish consumption designated use, see response to comment **3- 16**.

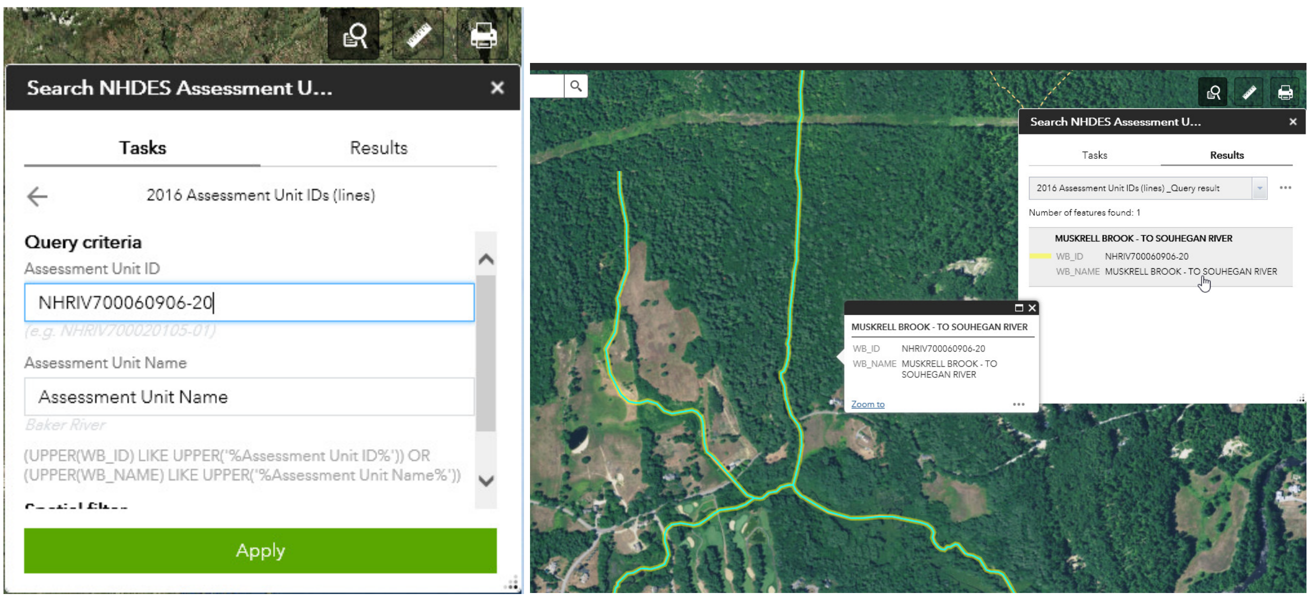
The remaining comments on this page are addressed by the response to comment **3- 7** regarding impairments.

***NHDES RESPONSE*** **to 3- 19** & **3- 20**
No response needed.

***NHDES RESPONSE*** **to 3- 21**
It is unclear why the commenter could not find Muskrell Brook – To Souhegan River (NHRIV700060906-20). In such cases, the search tool on the mapper can be very helpful (Figure 31). It is worth noting that there are periods when the mapper service misbehaves. NHDES is working to make the service more robust.

The remaining comments on this page are addressed by the response to comment **3- 7** regarding impairments.

**Figure 31. Illustration of data mapper search tool and results for Muskrell Brook – To Souhegan River (NHRIV700060906-20).**




***NHDES RESPONSE*** **to 3- 22**
No response needed.

**RESPONSE TO COMMENT #4: Ralph Abele, EPA Region 1**

***<u>NHDES RESPONSE</u>* to 4- 1**
The commenter notes their concerns with the NHDES rationale to not list certain waterbodies and states that those concerns are the same as they had on the draft 2014 303(d). NHDES references our response to comments on the draft 2014 303(d) (NHDES, 2017).

The commenter notes that they will conduct their review of the final 2016 303(d) based on the material already provided and any additional information provided with the final 2016 303(d). No response necessary.

## RESPONSE TO COMMENT #5: Michael S. Bezanson, City of Rochester

***NHDES RESPONSE*** **to 5- 1**

This section contains opening remarks by the City of Rochester principally summarizing their comments, which are provided in detail in the following sections. References to portions of the Draft 2016 303(d) are discussed in the responses below. One point made in the opening remarks and not elsewhere in the comments was the application of the peer review (Bierman, Diaz, Kenworthy, & Reckhow, 2014)**.** Changes were made to the 2014 CALM in response to the comments by the peer review, those changes carried into the 2016 Draft CALM***.***

***NHDES RESPONSE*** **to 5- 2**

To prepare the 303(d) list, the state conducts an inventory of the waters in the state and compiles a list of those waters that fail to meet applicable water quality standards. The 303(d) list is the result of analyzing all available information, including public input; the CALM is not a formula that is applied mechanically to data.

The CALM is not a rule. RSA 541-A:1, XV, defines "rule" as "each regulation, standard, form as defined in paragraph VII-a, or other statement of general applicability adopted by an agency to (a) implement, interpret, or make specific a statute enforced or administered by such agency or (b) prescribe or interpret an agency policy, procedure or practice requirement binding on persons outside the agency, whether members of the general public or personnel in other agencies." The CALM is used to fulfill a federal obligation, not to "implement, interpret, or make specific" a state statute. The CALM creates no "policy, procedure or practice requirement [that is] binding on persons outside the agency." The CALM is used in preparing the 303(d) list, and that list may be used by the federal or state government to make decisions in regulatory programs, but each such decision is made under its own administrative process that includes opportunities for public input and appeal.

***NHDES RESPONSE*** **to 5- 3**

Also see response to comment **2- 4** regarding dissolved oxygen.

2017 SB127 amended three sections of RSA 485.

> *RSA 485-A:6,* ***Rulemaking. –*** *The commissioner shall adopt rules, under RSA 541-A, after public hearing, relative to:*
>
> > *XIV. Dissolved oxygen concentration water quality standards under RSA 485-A:8, II and II-a.*
>
> and
>
> *RSA 485-A:8,* ***Standards for Classification of Surface Waters of the State.***
>
> In RSA 485-A:8 II adding the following text;
>
> > *II. …"The commissioner shall adopt rules, under RSA 541-A, relative to dissolved oxygen water quality standards in a manner consistent with Environmental Protection Agency guidance on dissolved oxygen water criteria published pursuant to section 304(a) of the Clean Water Act, and other relevant scientific information."…*
>
> and adding RSA 485-A:8 IIa.
>
> > *IIa. The commissioner shall adopt rules, under RSA 541-A, relative to dissolved oxygen water quality standards for tidal and saline waters in a manner consistent with Environmental Protection Agency guidance on dissolved oxygen water criteria published pursuant to section 304(a) of the Clean Water Act, and other relevant scientific information.*

The specificity of RSA 485-A:6, XIV to concentration appears to denote exclusivity from saturation. As such, NHDES is not adding any new dissolved oxygen saturation impairments in the 2016 303(d) and notes that all of the waters which were proposed as dissolved oxygen saturation impairments also have dissolved oxygen concentration impairments.

The department appreciates the comments by the City of Rochester as well as their consultant Brown & Caldwell and will take those under advisement as the water quality standard revision process goes forward.

***NHDES RESPONSE*** **to 5- 4**
This section contains points summarized from the Brown & Caldwell comments from which the City of Rochester feels that the CALM is technically deficient. Responses to those comments are provided in detail in the following sections.

***NHDES RESPONSE*** **to 5- 5**
This section contains summarized points regarding what the City of Rochester recommends NHDES does relative to the draft 2016 CALM. Responses to those comments are provided in detail in the following sections.

***NHDES RESPONSE*** **to 5- 6**
As noted in the response to **1- 5**, the "10% rule" is a heuristic rule of thumb, not strictly accurate or reliable for every situation, but appropriate for the first pass by computer code before humans review the data in the context of covariables.

In writing the CALM, NHDES has gone to great length to explain to general processes used to apply the water quality standards to real world datasets. Because of the depth of the document it is both easy to lose track of particular pieces of information and there is created an unfortunate and unrealistic expectation that every possible scenario from the real world of sampling will be fully described. The current dissolved oxygen criteria do not contain a frequency or duration component and as such, some would argue that if the dissolved oxygen of a waterbody goes below the standard at any point in time, the waterbody should be considered impaired. NHDES has taken the approach that dissolved oxygen needs to be documented below the dissolved oxygen standard on multiple sampling events before an impairment is considered. This is done primarily to eliminate issues with data reliability, equipment malfunction, and unique conditions. To move in that direction, the CALM states at page 52 that, "If more than one sample is taken on a given calendar day, the worst case sample will be the independent sample for that day." For dataloggers, the CALM notes on page 53, "Compliance with instantaneous minimum DO concentration (mg/L) criteria shall be based on the minimum of a time series of dissolved oxygen measurements taken at the same location and a maximum of one hour apart for 24 continuous hours except as noted in 5, 6, and 7 below." Regarding the question of using critical season verses non-critical season samples, the draft CALM at page 52 reads, "In cases where there are numerous non-critical season and non-critical time of day samples, the overall sample count will not be used to artificially increase the needed exceedances to exceed the binomial count [10% rule of thumb]." The critical season is defined in the CALM at page 52, "If the surface water is not a cold water natural reproducing fishery, at least 50% of the number of independent samples (i.e. n>5) needed for FS, shall be taken between June 1 and September 30 (i.e., the critical season) and during the critical time of day."

A discussion of the tidal Cocheco River dissolved oxygen sampling is covered in response to comment **2- 10**.

***NHDES RESPONSE*** **to 5- 7**
This section contains points summarized from the Brown & Caldwell comments from which the City of Rochester feels that the assessment is technically deficient. Responses to those comments are provided in detail in the following sections.

***NHDES RESPONSE*** **to 5- 8**
This section principally contains summarized points regarding what the City of Rochester recommends NHDES does relative to the draft 2016 assessment of the tidal Cocheco River. Responses to those comments are provided in detail in the following sections. The comment goes on to recommend that NHDES develop a water

quality management strategy for the Cocheco River. While NHDES agrees and has been working extensively with the communities, such work is well beyond the scope of the 305(b)/303(d) water quality assessment process.

***NHDES RESPONSE*** **to 5- 9**
NHDES notes the support of the City of Rochester for its decision not to impair the Great Bay, Little Bay, and the Upper and Lower Piscataqua Rivers for total nitrogen.

***NHDES RESPONSE*** **to 5- 10**
Closing remarks by the City of Rochester. NHDES appreciates the time taken to review the documents and no further response is needed.

***NHDES RESPONSE*** **to 5- 11**
Opening comments by Caldwell and Brown regarding the focus of their comments. No response needed.

***NHDES RESPONSE*** **to 5- 12**
See the responses to comments **2- 4** and **5- 3** regarding dissolved oxygen. The department appreciates the comments by the City of Rochester's consultant Brown & Caldwell and will take those under advisement as the water quality standard revision process goes forward.

Regarding the magnitude of exceedance (MAGEX) thresholds, see the response to comment **5- 14.**

***NHDES RESPONSE*** **to 5- 13**
See the responses to comments **2- 4** and **5- 3** regarding dissolved oxygen. The department appreciates the comments by the City of Rochester's consultant Brown & Caldwell and will take those under advisement as the water quality standard revision process goes forward.

***NHDES RESPONSE*** **to 5- 14**
The current dissolved oxygen criteria do not contain a frequency or duration component and, as such, some would argue that if the dissolved oxygen of a waterbody dips below the standard at any point in time, the waterbody should be considered impaired. NHDES has taken the approach that a high confidence that a water quality parameter did not meet standards is required to declare that waterbody impaired. The magnitude of exceedance (MAGEX) thresholds are explained in detail in section 3.1.18 of the CALM (NHDES, May 8, 2017). Based on the comment, NHDES went back through the CALM and found that some confusion may have resulted from the mix of terminologies owing back to the original 2002 CALM. The wording throughout the 2016 CALM has been corrected to reflect that the MAGEX are indicator thresholds and not intended as criteria. MAGEX thresholds are typically set beyond the standard water quality criteria or as a function of measurement precision +/- the standard criteria; consequently when MAGEX threshold are exceeded, one has greater confidence that there is an exceedance of the water quality criteria. As a general rule and based on the assessors evaluation of all of the available data, if two or more samples exceeded the MAGEX, waters were assessed as impaired (i.e. not supporting), regardless of the total number of samples taken.

Regarding the nature of any possible future dissolved oxygen criteria the department appreciates the comments by the City of Rochester's consultant Brown & Caldwell and will take those under advisement as the water quality standard revision process goes forward.

***NHDES RESPONSE*** **to 5- 15**
The data and process used to generate the chlorophyll-a to dissolved oxygen relationship and concerns over mixing the different areas of the Great Bay estuary have been previously discussed in the response to comments on the 2012 CALM (NHDES, 4/20/2012).

The peer review comment cited by the commenter is in reference to the total nitrogen thresholds that were established in the 2009 document, not in reference to the chlorophyll-a to dissolved oxygen relationship. The peer reviewers did not directly comment on the relationship between chlorophyll-a to dissolved oxygen but rather kept direct comments to the relationship between total nitrogen and dissolved oxygen as illustrated by the comment from Dr. Bierman (Bierman, Diaz, Kenworthy, & Reckhow, 2014);

> "*With the exception of the nitrification process, nitrogen concentrations are not directly linked to DO, but are only indirectly linked through primary production and the subsequent sequence of physiological processes that utilize the produced organic matter. These include respiration, oxidation of DOC exudates, oxidation of POC, and sediment oxygen demand (SOD).*"

In some places, the peer reviewers answered the question about dissolved oxygen and the concentration of chlorophyll-a in the parts of the Great Bay estuary as illustrated by Dr. Diaz;

> "*The direction taken in the DES 2009 Report relative to low DO appears logical given long-term trends in Great Bay, and what is known about other systems that have develop low DO and hypoxia from excess nutrient driven eutrophication.*"
> "*It is well known that excess algal (phytoplankton and macroalgae) growth can lead to hypoxia,…*", "*…most of the low DO problems seem to be in the tributaries where chlorophyll-a, a measure of phytoplankton standing stock, tends to be higher (See DES 2009 Report figures 14, 18, and 25).*"

Where the short-term variability in the system is heavily confounded by the multitude of physical and biological process time scales, the 5-year 90$^{th}$ percentile chlorophyll-a indicator allows the multitude of physical and biological process time scales in the estuary to reveal the balance of the system (Lawton, 1999) (Li, Lewis, & Harrison, 2010).

It is worth noting that everywhere in the Great Bay estuary that has been demonstrated to not meet the dissolved oxygen criteria, the aquatic life use chlorophyll-a indicator threshold of the 90$^{th}$ percentile of the recent data has exceeded 10 ug/L[1].

***NHDES RESPONSE* to 5- 16**

It should be noted that this comment on the Draft 2016 303d List is nearly identical to the comments made by the City on the 2014 303d List. Our responses below are similarly repeated. The commenter asserts that the chlorophyll-a indicator to protect the swimming designated use is inappropriate. The indicator used (20 ug/L chlorophyll-a) for 305(b)/303(d) assessments has been in place since 2004. The chlorophyll-a (20 ug/L) is an aesthetic indicator, not a health indicator, to identify a threshold at which toxic blooms become likely as the commenter's World Health Organization (WHO) threshold is based upon.

As a maximum value observed over a typical annual cycle, Bricker et. al. (Bricker, Clement, Pirhalla, Orlando, & Farrow, 1999) considered 20 ug/L to be "high" chlorophyll-a. More recently, the National Coastal Condition Assessment of 2010 data (USEPA, National Coastal Condition Assessment 2010, 2015) used 20 ug/L as the break between Fair and Poor (the lowest rating). When NHDES started using the 20 ug/L indicator, one of the points of consideration was the chlorophyll-a concentration that we traditionally observe in New Hampshire's estuaries. NHDES evaluated all of the available coastal data and found that only 1% of the probabilistically collected data and only 3% of all data exceeded 20 ug/L. Indeed, 20 ug/L chlorophyll-a is a rare occurrence (Table 5).

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[1] There is one assessment zone (Lamprey River-South) that has been assessed as impaired for chlorophyll-a since the 2008 assessment cycle. As there are no available chlorophyll-a data for this assessment zone since 2008, the impairment remains. Waters that were impaired in the previous cycle cannot be removed from the 303d list if there are insufficient data to make a new assessment. Also see the 2014 TSD (NHDES, 2015).

**Table 5. New Hampshire estuarine chlorophyll-a data addressed in consideration of an indicator to protect the swimming designated use for the 2004 assessment cycle.**

| Dataset | N | Min | Mean | Median | Max | Percent of samples >20 ug/L |
|---|---|---|---|---|---|---|
| All NH Estuarine Data (1988-2003) | 1,040 | 0.0 | 4.3 | 2.3 | 160.3 | 3% |
| NCA Probabilistic Data (2000-2001) | 76 | 0.7 | 4.5 | 3.2 | 20.1 | 1% |

In evaluating all of the chlorophyll-a data used as "current" data for the 2016 assessment (2011 through 2016), we see a similar distribution (Table 6) except that all metrics have increased. As this is not the probabilistic network and there has been added focus on the high nitrogen sections of the estuary in recent years, this suggests that samples exceeding 20 ug/L are still quite uncommon.

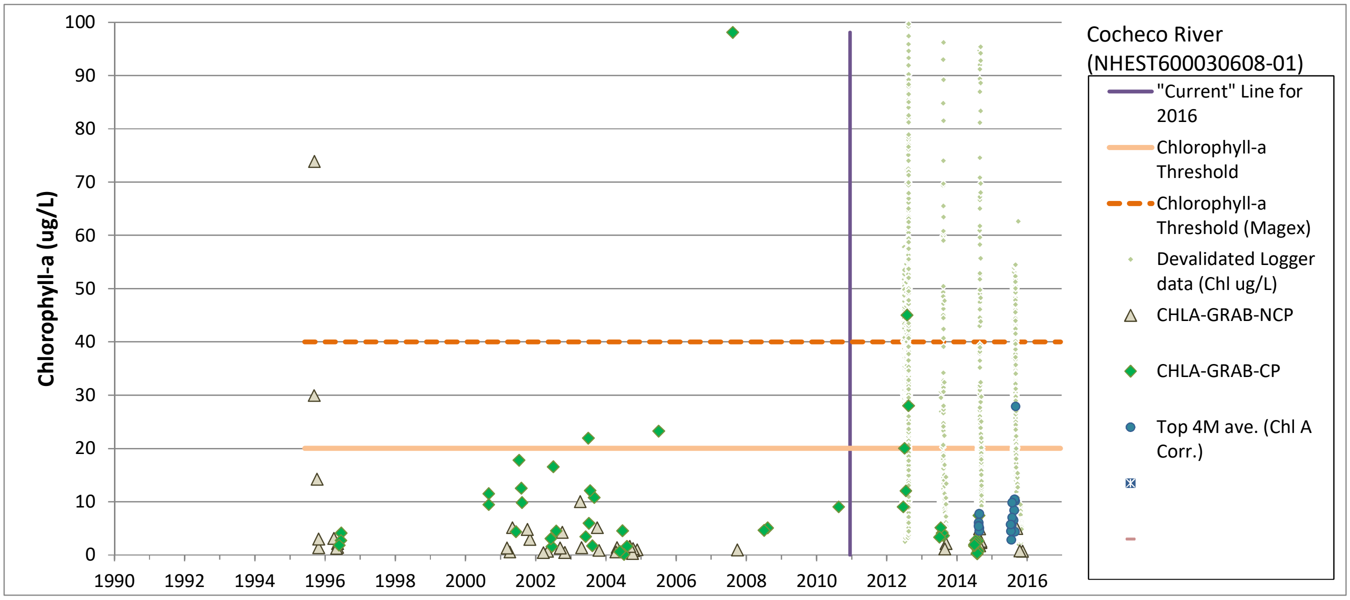
**Table 6. Great Bay estuary estuarine chlorophyll-a data considered "current" for the 2014 assessment cycle.**

| Dataset | N | Min | Mean | Median | Max | Percent of samples >20 ug/L |
|---|---|---|---|---|---|---|
| All Great Bay Estuary Grab sample Data (2008-2013) | 847 | 0.2 | 6.4 | 3.6 | 161.4 | 5% |

The City of Rochester includes references to Stow et. al. (Stow, Roessler, Borsuk, Bowen, & Reckhow, 2003) and VDEQ (VDEQ, 2005) claiming that "…chlorophyll-a in the 20-40 ug/L range are compatible with full use attainment (Stow and others, 2003; VDEQ, 2005)." Two points are germane here. First, both thresholds are in reference to the aquatic life designated use. Second, regarding the Stow et. al. (Stow, Roessler, Borsuk, Bowen, & Reckhow, 2003) study, it is of the Neuse River estuary in North Carolina where 40 ug/L chlorophyll-a is used as a level not to be exceeded per the North Carolina 303(d) listing methodology to protect the aquatic life use support which reads, "Not greater than 40 µg/l for lakes, reservoirs, and other waters subject to growths of macroscopic or microscopic vegetation" (NCDWR, 2015). Regarding VDEQ (VDEQ, 2005), the comment appears to have pulled the highest proposed concentration for the tidal-fresh portions of the James River, while the mesohaline and polyhaline segments of the James River, more hydrologically comparable to the Great Bay estuary, were proposed at 10 ug/L chlorophyll-a (Table 11 in (VDEQ, 2005)).

It may be helpful to define the concentration at which increased chlorophyll-a is considered a bloom, which is what VDEQ (2005) did in order to reduce the likelihood of harmful algae blooms (HABs). To protect against HABs occurring at a chlorophyll-a concentration of 25-30 ug/L in single samples, VDEQ (VDEQ, 2005) proposed an average chlorophyll-a of 10 ug/L (Table 11 in (VDEQ, 2005)). The 2011-2016 average chlorophyll-a of the tidal Cocheco River is 6.7 ug/L (n=46), which includes grab samples up to 45 ug/L chlorophyll-a (Figure 32), and there are likely much higher concentrations if one considers the datalogger records of 2012 through 2015 (also see the figures in the TSD).

**Figure 32. Tidal Cocheco River (NHEST600030608-01) chlorophyll-a data.**




Notes:

The chlorophyll-a indicator threshold shown in the graphic above is to protect the swimming designated us (i.e. primary contact recreation).

"Current" Line for 2016 - Per the methodology outlined in the CALM, all data from this referenced data is considered "current". Available older data is provided for context. See the 2016 CALM for addition details.

CHLA-GRAB-CP = Chlorophyll-a samples collected during the summer critical period.

CHLA-GRAB-NCP = Chlorophyll-a samples collected and outside the summer critical period.

The comments by the City of Rochester make a broad claim without references that the chlorophyll-a targets to protect recreational uses of nine states are seasonal averages and in the range of 15-30 ug/L. Investigation of those nine states' methodologies places the comment into three categories; assessment methodology completely contrary to claim, assessment methodology absent, and assessment methodology claim partially substantiated.

The assessment methodology is completely contrary to the commenters claim regarding Wisconsin, Kansas, and Texas.

Wisconsin - The Wisconsin approach (WDNR, 2015) to the recreational use is similar to the NHDES approach.

> "The protocol was changed to better reflect actual impairments of recreational uses, and to better capture the variability of chlorophyll in lakes. The protocol now uses the percent of days during the sampling season that a lake experiences nuisance algal blooms as its benchmark for assessments. Nuisance algal blooms are defined as exceeding 20 ug/L chlorophyll *a*. This was defined based on user perception surveys conducted in Minnesota. For deep lakes, the impairment threshold is 5% of days of nuisance algal blooms during the sampling season. For shallow lakes, the impairment threshold is 30% of days of nuisance algal blooms during the sampling season."

Kansas – The Kansas approach (KDHE, 2016) is two tiered, using a chlorophyll-a concentration of 12 ug/L average or 12 ug/L in one or more sample in the last two years.

> "For lakes not listed in 2014 for eutrophication, if the lake has a designated use of primary contact recreation but is not an active public water supply and the overall chlorophyll *a* average concentration is greater than 12 ppb [ug/L] or if the chlorophyll *a* concentration is greater than 12 ppb [ug/L] for more than one sample since 2000 and one of the excursions has been obtained during the two most recent sampling dates, list in Category 5."

Texas – The Texas approach (TDEQ, 2015) to chlorophyll-a is similar to the NHDES approach but has a lower threshold. Texas' assessment is not specifically tied to the recreation designated use but rather an overall "general use" and further a binomial count of individual samples greater than 11.6 ug/L chlorophyll-a is applied.

> "A concern for water quality is identified if the screening level is exceeded greater than 20 percent of the time using the binomial method, based on the number of exceedances for a given sample size (see Appendixes A and B)."

Per the methods described in the Texas listing methodology, all of the Great Bay estuary assessment zones would be considered estuarine waters. The estuarine screening level (set at the $85^{th}$ percentile of all data) is 11.6 ug/L (Texas CALM Table 3.10 (TDEQ, 2015) & personal correspondence)

The commenter's claimed assessment methodology is absent in Maryland, Virginia, and Arizona.

Maryland – No such methodology to protect the "water contact sports" (i.e. swimming) designated use. ( (MDE, 2014) & personal correspondence)

Virginia – No such methodology to protect Virginia's "Recreation (swimming) Use" (VDEQ, 2014) Listing Guidance, Table 1 & personal correspondence).

Arizona – This is a state that has a substantially different geological landscape than New Hampshire. While it is somewhat true that Arizona has a chlorophyll-a criteria in law (Arizona Title R18-11-108.03, Effective January 31, 2009), that section was not approved by USEPA R9, nor are those criteria used in 305(b)/303(d) assessments (communication with AZDEQ staff). For "Full Body Contact" (i.e. swimming) the range of chlorophyll-a averages used in the unapproved rules in lakes is from 10 to 30 ug/L, however, based on the total phosphorus values associated to these chlorophyll-a, it is clear that the hydrology and geology of Arizona is nothing like that of New Hampshire and has a target range that starts at nearly twice the concentration of our most eutrophic lakes.

The commenter's claimed assessment methodology is partially substantiated in Oregon, Minnesota, and West Virginia.

Oregon – Partially correct. Oregon uses an average chlorophyll-a concentration in stratified lakes of 10 ug/L, and a 15 ug/L threshold in unstratified lakes, reservoirs, rivers, and estuaries. This pair of thresholds is intended to cover many designated uses; Water Contact Recreation, Aesthetics, Fishing, Water Supply, and Livestock Watering (ODEQ, 2011).

Minnesota – Partially correct. The summer average chlorophyll-a of less than 3 ug/L to less than 30 ug/L is used as a threshold depending upon region, waterbody class, and designated use. It is worth noting that at a chlorophyll-a concentration of 30 ug/L, the assessment target requires a secchi disk depth of only 0.7 meters (MPCA, 2014).

West Virginia – Partially correct. While the assessment methodology in West Virginia's Integrated Report does not specify a designated use, it does require that the average chlorophyll-a in cool water lakes shall be less than 10 ug/L and less than 20 ug/L in warm water lakes. Although unspecific, personal communications with West Virginia Department of Environmental Quality staff reveal that the criteria are "…intended to protect the aquatic life and water contact recreation designated uses..." (WVDEP, 2015)

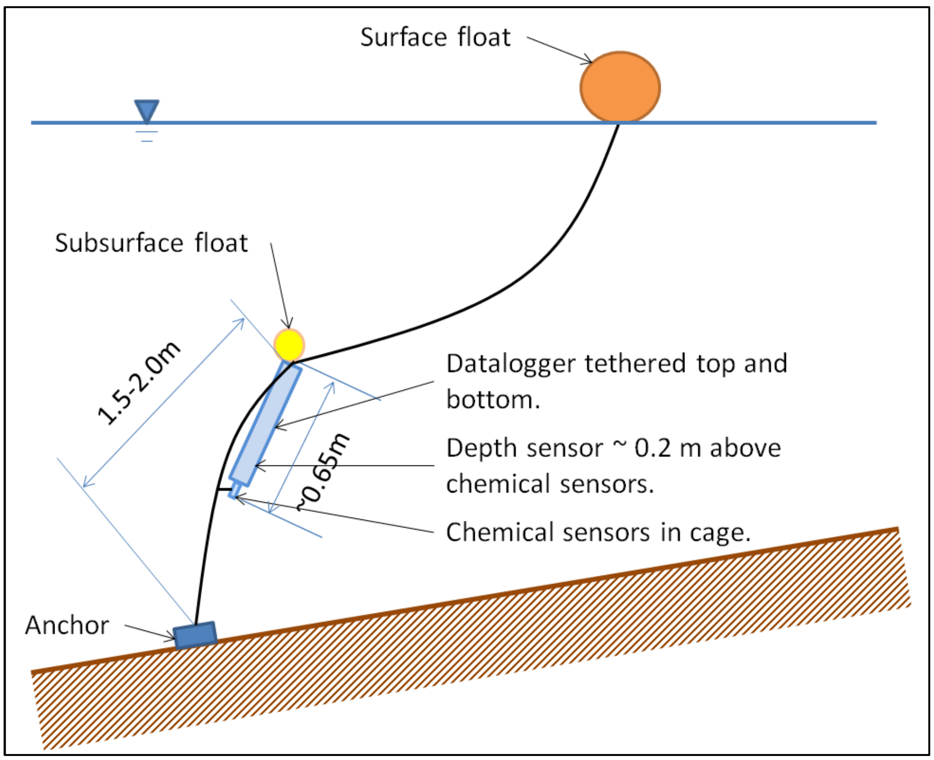
***NHDES RESPONSE*** **to 5- 17**

Based on the comments by the peer review, NHDES revised the nitrogen assessment process for the 2014 CALM. Since that time only technical corrections have been made to that section.

***NHDES RESPONSE*** **to 5- 18**
See the response to comment **2- 4** regarding dissolved oxygen.

In consultation with the researchers that deployed the dataloggers, NHDES produced Figure 33 to help visualize the conditions experienced by the datalogger at station CR7 in the tidal Cocheco River. The rigging includes some important features to maintain quality data and that help explain the data that was displayed in detail in the TSD. Because the datalogger was attached to the line at ~1.5-2.0m and the probes were ~0.65 meters below that attachment point, the probes remained ~0.85-1.35m off of the sediment at all times. The exception would be when the subsurface float was at the water surface such that the remaining tide drop is insufficient to eliminate the ~0.85-1.35m separation between probes and the benthic sediments (this can be observed in the depth profiles on 9/16/2015). In addition, the datalogger is rigged at the top and bottom of the lines so that fast currents cannot cause it to hit the sediment as the angle between the benthic sediment and buoy line was reduced.

**Figure 33. Tidal Cocheco River CR7 deployment schematic.**




NHDES does not “flag” data; we deem it either valid or invalid. Flagging, by adding notes or highlighting, and calling out turbidity data that were 3x the previous measurement is a process the University of New Hampshire (UNH) follows in their preliminary datasets. Based on the comments, it appears that the commenter is reviewing the preliminary files that they received from UNH and not the final versions uploaded to the NHDES Environmental Monitoring Database (EMD), the version that is used in assessments. An initial quality assurance memo from NHDES was issued to Dean Peschel of the GBMC on 4/13/2016 followed by an amended version with initial corrections on 7/28/2016, at which point the data was uploaded to the EMD before the assessment process. Throughout the 2015 deployment at CR7, UNH used a Eureka sensor with wipers on the sensors. The datalogger was cleaned during each of the approximately weekly visits to collect lab samples and field parameters between the datalogger change-outs. The meters passed all pre and post deployment checks. As part of this response to comments on the draft 2016 303(d), NHDES further investigated the closest pairings of the datalogger readings and grab samples collected at CR7 during the period in question. On five dates, grab samples were collected at multiple depths while the datalogger was deployed such that a grab sample was collected within 1 to 7 minutes of the time the datalogger recorded and within 0.15 to 0.29 m of the datalogger depth (also see response to **2- 7**). Based on that evaluation, it became apparent that the turbidity probe became fouled by 9/15/2015 (Figure 34, Table 7). NHDES has begun discussing with the researchers who collected the turbidity data about how those records should be represented in the EMD as well as steps to prevent such occurrences in the future. By comparison, the paired dissolved readings between datalogger and grab samples were very strong particularly given the differences in depth and time (Figure 35, Table 8). The commenter has suggested that the probes received interferences during low tide. If the probes were receiving interference at low tide, those interferences would have been seen at all low tides, regardless of the time of day, not just during the morning low tides.

**Figure 34. Depth and time paired samples of turbidity from datalogger deployment and grab samples at station CR7 in 2015.**

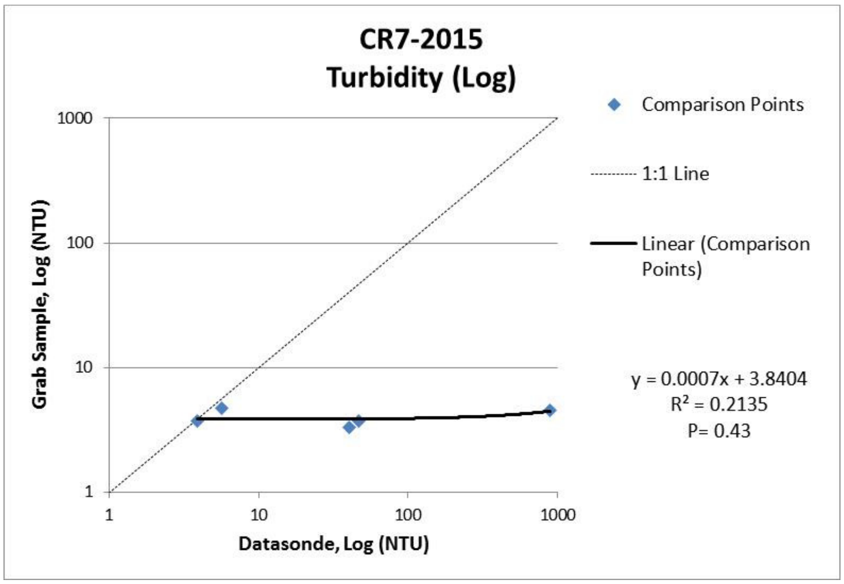



**Table 7. Data points for the depth and time paired samples of turbidity from datalogger deployment and grab samples at station CR7 in 2015. (data used in Figure 34)**

| GRAB SAMPLES | | | DATALOGGER MEASUREMENTS | | |
|---|---|---|---|---|---|
| **Grab Sample Date/Time** | **Grab Depth from Surface (m)** | **Grab Sample Turbidity (NTU)** | ***Datalogger Sample Date/Time*** | ***Datalogger Depth from Surface (m)*** | ***Datalogger Turbidity (NTU)*** |
| 9/9/2015 17:08 | 1.00 | 4.7 | *9/9/2015 17:15* | *0.71* | *5.7* |
| 9/12/2015 14:29 | 2.45 | 3.7 | *9/12/2015 14:30* | *2.33* | *3.9* |
| 9/15/2015 15:16 | 2.75 | 3.3 | *9/15/2015 15:15* | *2.59* | *40.5* |
| 9/19/2015 15:32 | 2.35 | 3.7 | *9/19/2015 15:30* | *2.09* | *46.9* |
| 9/23/2015 16:16 | 1.10 | 4.5 | *9/23/2015 16:15* | *0.88* | *889.4* |

**Figure 35. Depth and time paired samples of dissolved oxygen from datalogger deployment and grab samples at station CR7 in 2015.**

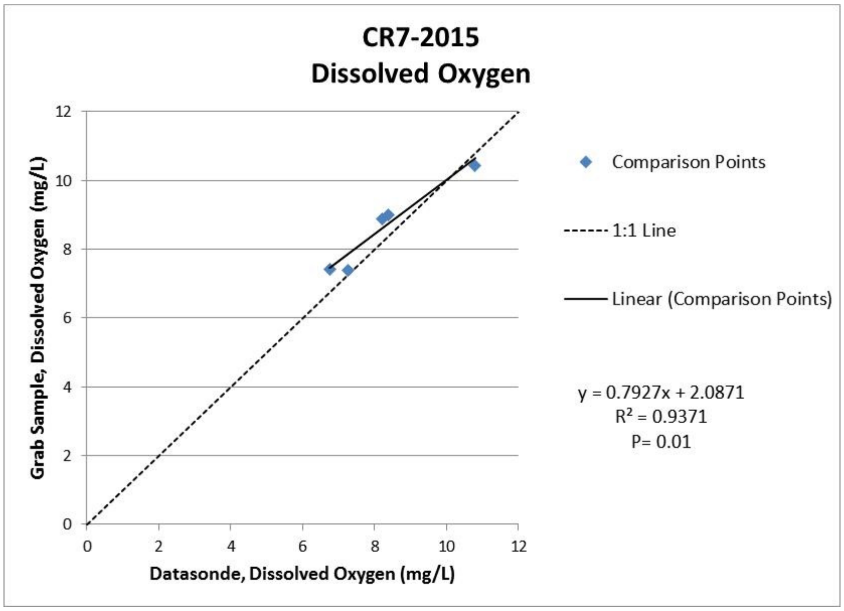


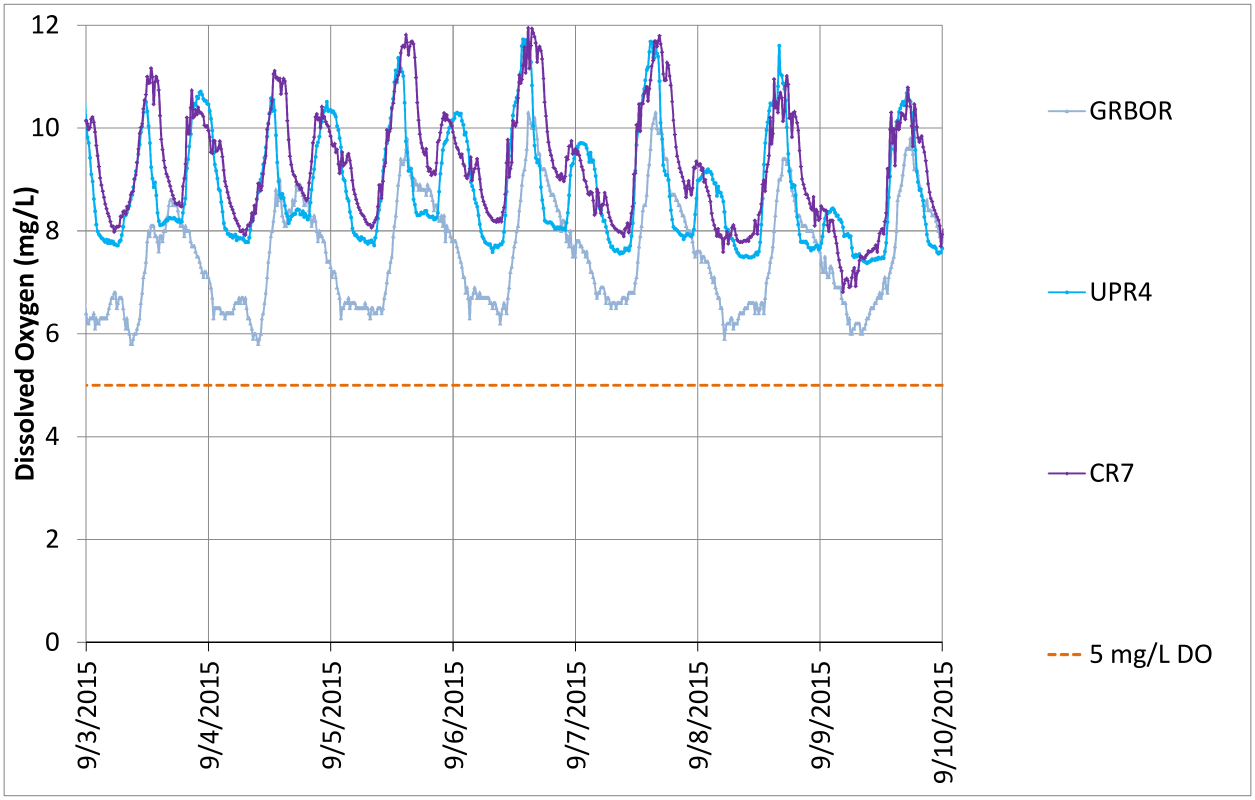

**Table 8. Data points for the depth and time paired samples of dissolved oxygen (mg/L) from datalogger deployment and grab samples at station CR7 in 2015. (data used in Figure 35)**

| GRAB SAMPLES | | | DATALOGGER MEASUREMENTS | | |
|---|---|---|---|---|---|
| **Grab Sample Date/Time** | **Grab Depth from Surface (m)** | **Grab Sample Dissolved Oxygen (mg/L)** | ***Datalogger Sample Date/Time*** | ***Datalogger Depth from Surface (m)*** | ***Datalogger Dissolved Oxygen (mg/L)*** |
| 9/9/2015 17:08 | 1.00 | 10.46 | *9/9/2015 17:15* | *0.71* | *10.79* |
| 9/12/2015 14:29 | 2.45 | 7.42 | *9/12/2015 14:30* | *2.33* | *7.27* |
| 9/15/2015 15:16 | 2.75 | 7.44 | *9/15/2015 15:15* | *2.59* | *6.76* |
| 9/19/2015 15:32 | 2.35 | 8.91 | *9/19/2015 15:30* | *2.09* | *8.22* |
| 9/23/2015 16:16 | 1.10 | 9.03 | *9/23/2015 16:15* | *0.88* | *8.37* |

The commenter suggests the trigger for the low dissolved oxygen is that during the day the organic rich matter on the mudflats is heated up, accelerating decomposition processes on the mud flats and drawing dissolved oxygen down on the flats, then this water flows past the probe at low tide triggering the low dissolved oxygen readings. NHDES agrees that part of the low dissolved oxygen signal at the probe is from the organic rich material on the mudflat that is mixed with primary channel water. We further recognize that a substantial portion of that rich organic material is a build-up from the decades of organic loading from the watershed and WWTF discharges (see response to **2- 3**). It will take time for the estuary to process that legacy enrichment.

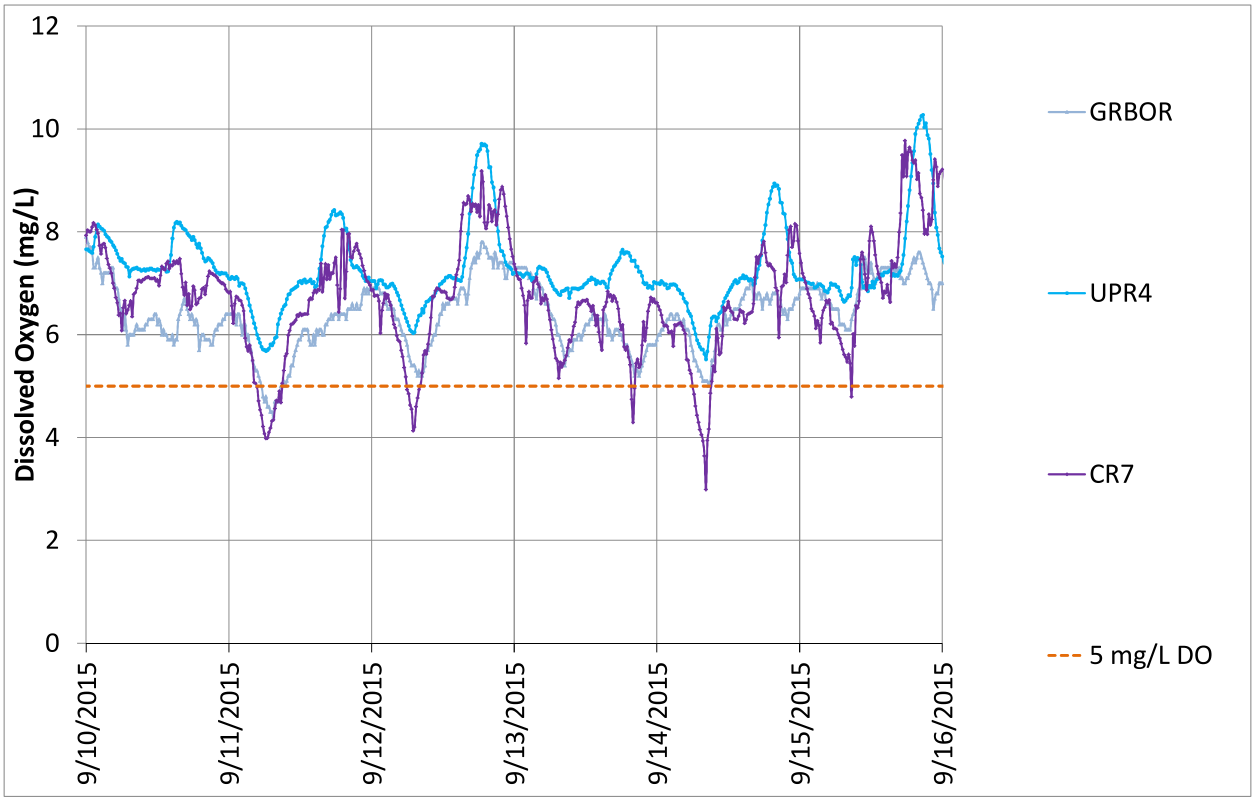
There is another way that we can address the question of whether the CR7 data is valid. CR7 is one of several datalogger probes in the Great Bay estuary, each of which experiences a different level of freshwater inputs, nutrient loads, and tidal flushing. We can start by overlaying several datalogger sites with CR7 that are either near CR7 or have a similar combination of tidal/freshwater flushing and nutrient loading. Here we use the Upper Piscataqua River site UPR4 due to proximity and Oyster River site GRBOR for similar tidal/freshwater flushing and nutrient loading. At the beginning of the 2015 datalogger deployment, when we consider the water temperature, we see that CR7 and UPR4 range from saturated to super-saturated with dissolved oxygen and all three sites experience a 2-4 mg/L DO swing within a day/tide cycle (Figure 36).

**Figure 36. Dissolved oxygen from 9/3/2015 to 9/10/2015 at stations CR7, UPR4, and GRBOR.**



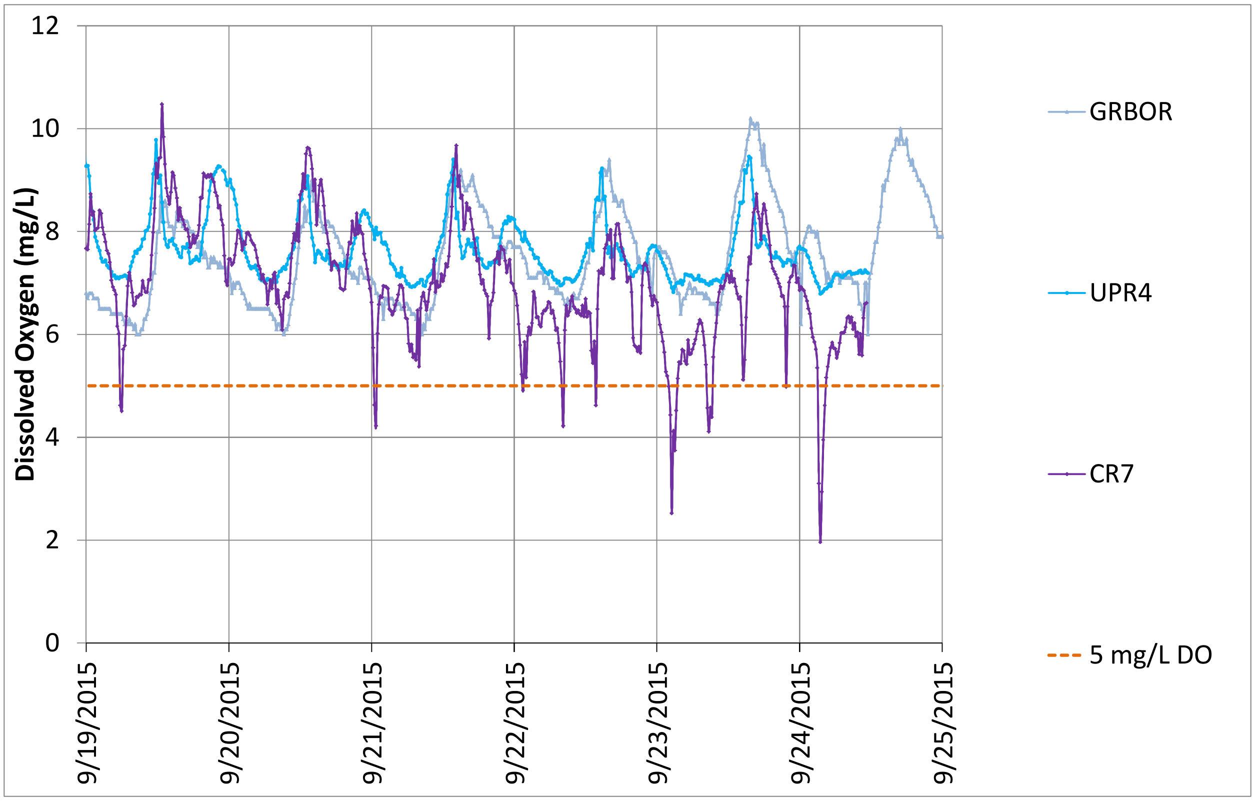
In the first period of 2015 that experienced DO below 5 mg/L we clearly see in the overlay that the timing of the DO drops are largely consistent, however, the swing within a day/tide cycle at CR7 ranges from 2-5 mg/L whereas GRBOR and UPR4 range from 2-3 mg/L. Given its location closer to the mouth of the estuary, UPR4 is better flushed than CR7 and it appears that either GRBOR is better flushed, there is less dead, dying, and decomposing material near GRBOR or most likely, a combination of the two. The end result is that when the chlorophyll biomass maintaining super-saturated conditions dies, CR7 experiences the worst DO condition (Figure 37).

**Figure 37. Dissolved oxygen from 9/10/2015 to 9/16/2015 at stations CR7, UPR4, and GRBOR.**



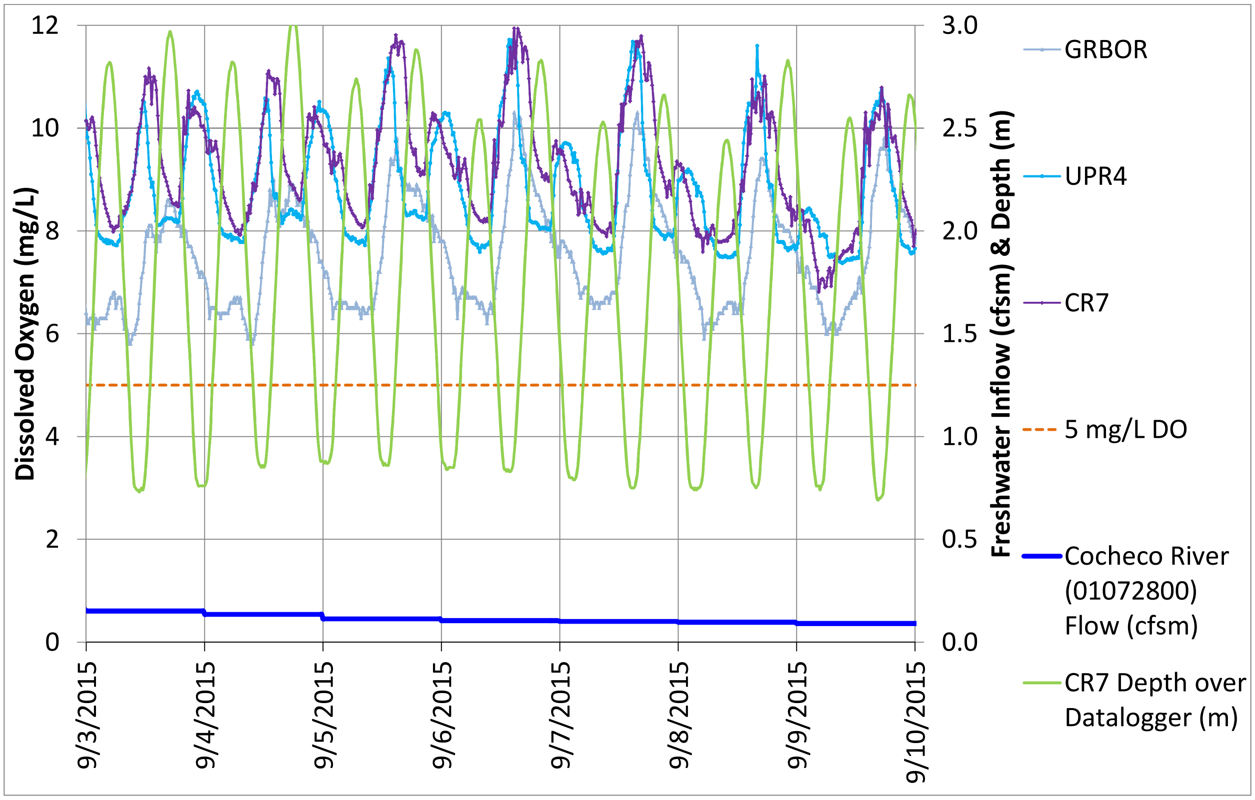
In the second period of 2015 that experienced DO below 5 mg/L, the timing of the DO drops are more-or-less consistent, however, the swings within a day/tide cycle are much different between the three sites. CR7 ranges from 3-6 mg/L whereas GRBOR ranges from 3-4 mg/L and UPR4 ranges from 2-3 mg/L (Figure 38).

**Figure 38. Dissolved oxygen from 9/19/2015 to 9/25/2015 at stations CR7, UPR4, and GRBOR.**



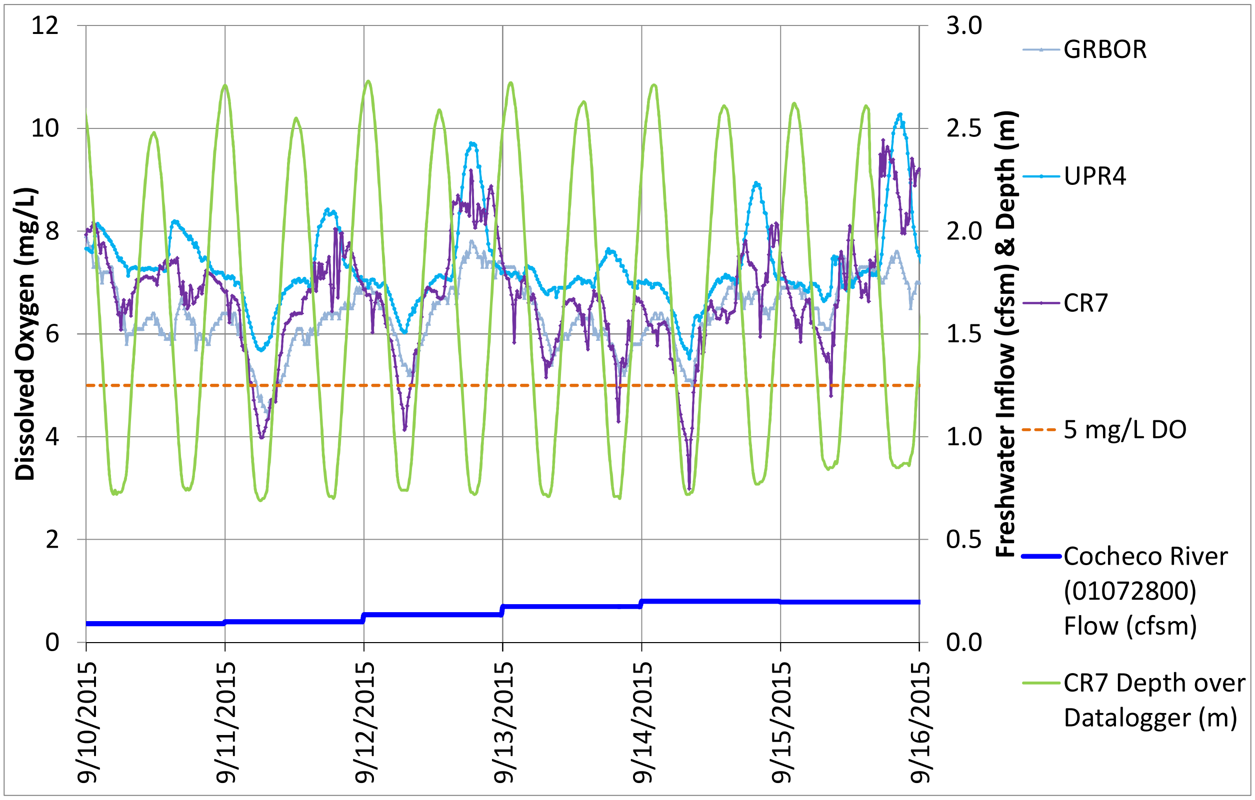
There are a multitude of relevant variables controlling DO but the two that appear to be most highly relevant are the freshwater inflow and the amplitude of the tidal flushing. The freshwater inflow can be described by the USGS Cocheco River stream gage (01072800) and the amplitude of the tidal flushing is easily indicated by the peak depth over the CR7 datalogger. During the first period with its ongoing saturation to super-saturation, we see that freshwater inflow was low and decreasing while the peak depth over the CR7 ranged from 2.4-3.0 m (Figure 39).

**Figure 39. Dissolved oxygen, water depth, and freshwater inflow from 9/3/2015 to 9/10/2015 at stations CR7, UPR4, and GRBOR.**



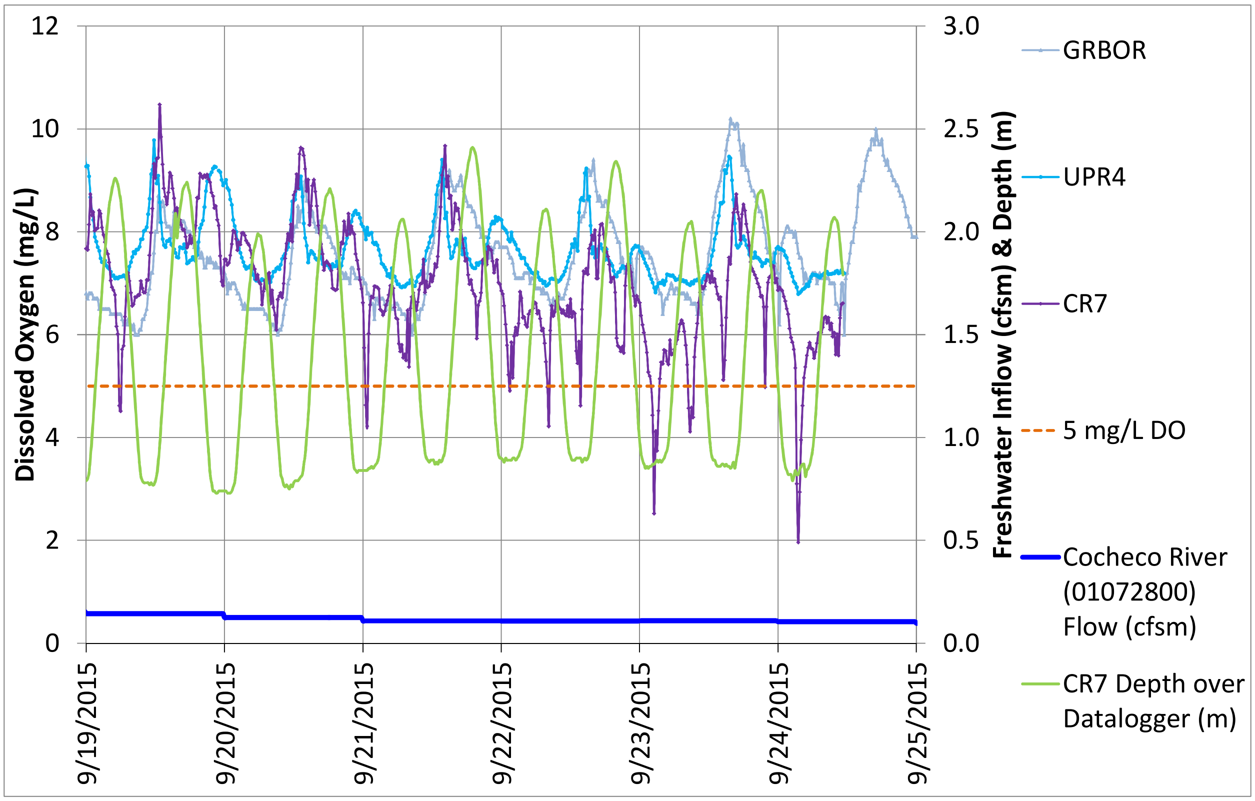
In the first period of 2015 that experienced DO below 5 mg/L, we clearly see in the overlay that freshwater inflow was increasing due to rain in the upstream watershed that helped to flush the freshwater and estuarine system, reduce chlorophyll concentration, and remove the super-saturation conditions. At that time, the maximum depth over the CR7 was lower than during the super-saturated period, ranging from 2.5-2.7 m (Figure 40).

**Figure 40. Dissolved oxygen, water depth, and freshwater inflow from 9/10/2015 to 9/16/2015 at stations CR7, UPR4, and GRBOR.**



In the second period of 2015 that experienced DO below 5 mg/L, freshwater inflow was decreasing and comparable to the super-saturation period. Most notably, the peak depth over the CR7 was greatly reduced ranging only from 2.0-2.4 m (Figure 41). With limited tidal flushing, the duration of time for which the oxygen consuming processes could operate on a given parcel of water was greatly increased, while at the same time, the amount of low oxygen water that was flushed downstream to UPR4 was greatly reduced.

**Figure 41. Dissolved oxygen, water depth, and freshwater inflow from 9/19/2015 to 9/25/2015 at stations CR7, UPR4, and GRBOR.**




By investigating the CR7 dissolved oxygen dynamics in conjunction with the dynamics at other dataloggers in the Great Bay Estuary, as well as, other driving hydrologic variables, we have another line of evidence that confirms the CR7 data integrity.

Also see response to **1- 5** regarding the 10% Rule of Thumb.

***<u>NHDES RESPONSE</u>*** **to 5- 19**

As noted in the response to comment **5- 18** we see additional evidence that the commenter was using the preliminary files they received from UNH and not the final versions uploaded to the NHDES Environmental Monitoring Database (EMD). NHDES appreciates the City of Rochester paying for the collection of the data by UNH and notes that the same methods and equipment were used in the datasets for the 2014 assessment as in the 2016 analysis. The commenter suggests that, "Perhaps *in situ* verification with additional spot sampling…would improve reliability of the data." Between the 9/2/2015 deployment and the 9/25/2015 retrieval the site was visited 6 times wherein the contractor sampled; dissolved oxygen, pH, chlorophyll-a, salinity, turbidity, light attenuation, NO2+NO3, NH4, DON, PN, TP, ortho-P, silica and TSS sampling at one or more depths and recording dates and times.

***NHDES RESPONSE*** **to 5- 20**

See responses to comments **2- 4** and **5- 3** regarding dissolved oxygen criteria.
See response to comment **5- 14** regarding dissolved oxygen criteria and MAGEX assessment indicators.
See responses to comments **2- 10** and **5- 18** regarding the Cocheco River dissolved oxygen data.

***NHDES RESPONSE*** **to 5- 21**

The relationship between the grab samples for chlorophyll-a and chlorophyll as recorded by the continuous datalogger is described in response to **2- 7** and shown graphically in Figure 6. The relationship is more than strong enough to say that the *relative* biomass as represented by the datalogger probe is correct. The explanation for the concentration variability is documented in the response to comment **2- 9** and **2- 10**.

Chlorophyll-a uncorrected for pheophytin as compared to corrected for pheophytin is a better overall measure of total system productivity and a better representation of the algal biomass available for decomposition. With that said, all of the paired grab samples paired with datalogger readings described in response to **2- 7** and shown graphically in Figure 6 were chlorophyll-a corrected for pheophytin.

There was an unfortunate typographical error in the draft TSD in regards to the Cocheco River chlorophyll-a statistics. The correct 90$^{th}$ percentiles should have read;

- chlorophyll-a, corrected for pheophytin = 14.6 ug/L
- chlorophyll-a, uncorrected for pheophytin= 24.8 ug/L
- chlorophyll-a, combined = 17.4 ug/L (this last line repeated 14.6 ug/L in the draft TSD)

All of the percentile statistics calculated for the TSD assume that we do not have a complete census and instead use the Weibull formula (n+1) which is appropriate when describing a sample of all possible conditions. It appears that the commenter's calculation of 12 ug/L is based on the formula for a complete census of data. NHDES does not believe that 23 samples collected over 5 years is a complete census of Cocheco River chlorophyll-a.

The use of a 5-year window is not, as the commenter suggests, to avoid bias of particular environmental conditions, but rather in recognition that there is limited sampling data available in most areas and the ecological health limiting conditions do not occur all of the time. Given that there are were few samples collected compared to the number of days in 5 years and the number of those sampled days that experienced high chlorophyll-a, the potential for Type I errors is decreased.

***NHDES RESPONSE*** **to 5- 22**

See response to comment **2- 7** regarding chlorophyll datalogger data in the Cocheco River.
See response to comment **2- 9** regarding chlorophyll data in the Cocheco River.
See response to comment **5- 15** chlorophyll-a as a dissolved oxygen indicator and **5- 16** regarding chlorophyll-a as a swimming indicator**.**
See response to comment **5- 18** regarding the Cocheco River dissolved oxygen data.

***NHDES RESPONSE*** **to 5- 23**

Many confounding factors have a hand in controlling chlorophyll-a and dissolved oxygen in the Tidal Cocheco River. What is relevant for assessment purposes is whether the human accentuated factors have a hand in that control. Given the concentrations of nitrogen coming from the watershed, the differences in tidal nitrogen concentrations, the high level of chlorophyll-a and associated dissolved oxygen super-saturation, and the die-off phase and subsequent dissolved oxygen depletions, eutrophication effects on designated uses can be attributed to total nitrogen. The commenter has brought up total suspended solids (TSS) which is also caused by human factors such as land use.

Also see time scale discussion in responses to comment **5- 15.**

Also see sampling discussion in responses to comment **5- 19.**

***NHDES RESPONSE* to 5- 24**

This section principally contains summary statements by the commenter previously covered.

Removal of an impairment relies upon sampling data indicating that water quality standards are met, not on our faith that they will be met some time in the near future. This is why we agree with the commenter that monitoring should continue.

The commenter questions whether a TMDL is necessary given the ongoing nutrient loading reductions and whether a TMDL would be of benefit or trigger more burdens on the communities. This is a topic beyond the scope of the data assessment process.

## RESPONSE TO COMMENT #6: Tom Irwin, Conservation Law Foundation

***NHDES RESPONSE*** ***to*** **6- 1**
This section contains opening remarks by the Conservation Law Foundation. References to portions of the Draft 2016 303(d) are discussed in the responses below.

***NHDES RESPONSE*** ***to*** **6- 2**
The commenter notes the trends in water quality conditions that were described in the Piscataqua Regional Estuary Projects 2013 State of Our Estuaries report (PREP, State of Our Estuaries, 2013). While NHDES agrees that those trends are worrisome and have been considered in the assessments, they do not constitute an assessment under sections 305(b) and 303(d). Additionally, there have been additional years of data collected since that time.

***NHDES RESPONSE*** ***to*** **6- 3**
The commenter notes the removal of the chlorophyll-a impairment in the Oyster River and notes that there have been no significant improvements in rest of the Great Bay estuary. While this is not a specific 303(d) comment, NHDES appreciates the recognition by the commenter that due to efforts by the municipalities, there have been substantial reductions in nitrogen loading to multiple sections of the Great Bay estuary and also agree that the non-point source loads are a larger portion of the total nitrogen loading story.

***NHDES RESPONSE*** ***to*** **6- 4**
NHDES appreciates the recognition by the commenter that the text of the peer review (Bierman, Diaz, Kenworthy, & Reckhow, 2014) has at times been misconstrued by certain parties. The peer reviewers agreed that nitrogen plays an important role in estuarine eutrophication and that the 2009 nitrogen document (NHDES, 2009) did not conclusively demonstrate that nitrogen was the primary factor. However, the 2014 delistings, many of which have been maintained through the 2016 draft assessment, are not based on the "primary factor" question but rather on a fresh view of the pre-existing data and the more recent data in the absence of numeric total nitrogen thresholds.

***NHDES RESPONSE*** ***to*** **6- 5**
In a response to increased storm sizes we would anticipate increased non-point source nutrient loads, increased sediment loads, and depending upon the resulting flow paths, increased colored dissolved organic matter (CDOM). Increased nutrient loading could drive up phytoplankton growth, while increased sediment loads would decrease light transmittance and place a layer of control on the phytoplankton growth, and increased CDOM could place an additional control on the phytoplankton growth depending upon the flow path. All of the above are occurring at a range of time scales and with larger storms we would expect the spatial location where one or more of the above factors have its peak impact will also change with storm size and the resulting hydrodynamics. While in principle, according to the vast literature on the subject, reducing nitrogen loading is generally a good idea in all estuaries, when confronted to the ongoing and expected climatic changes, the 305(b) and 303(d) assessment processes cannot impair a waterbody based on the current level of uncertainty in the relationships between factors.

***NHDES RESPONSE*** ***to*** **6- 6**
The commenter supports the NHDES listing of dissolved oxygen and total nitrogen in the tidal Cocheco River.

***NHDES RESPONSE*** ***to*** **6- 7**
The commenter objects to the NHDES decision to not list Great Bay as impaired for total nitrogen pointing to elevated chlorophyll-a, degraded eelgrass beds, poor light transmittance, and adverse impacts of macroalgae and epiphytes. NHDES agrees that eelgrass is degraded but at this time does not have strong enough datasets on

eutrophication indicators to conclusively add total nitrogen as an impairment. As noted in the TSD, most elevated chlorophyll-a is constrained to the areas around the Squamscott River to the best of our knowledge. While poor light transmittance exists, we are aware that a large portion of that poor light transmittance is due to CDOM and TSS. While it appears that drift macroalgae has increased in the Great Bay assessment zone, that data currently covers only the intertidal zone. The literature shows that epiphyte abundance can increase due to increased total nitrogen and have a strong impact on eelgrass, at this time there is no quantification of epiphytes in the Great Bay assessment zone except for pictures and imagery from drift surveys around 2011.

The commenter takes issue with the phrase used in the TSD, "…can be attributed to nitrogen alone." as a justification to not impair the Great Bay assessment zone for total nitrogen. While the commenter refers to wording in the 2016 draft CALM, we must reiterate that the CALM is only a guide to help all parties understand how real world datasets are assessed through the lens of the water quality standards. Also see the response to **5- 6** regarding the 10% rule of thumb**.**

***NHDES RESPONSE* to 6- 8**
The commenter objects to the NHDES decision to not list Little Bay as impaired for total nitrogen.
See the response to **6- 7*.***

***NHDES RESPONSE* to 6- 9**
The commenter objects to the NHDES decision to not list the Upper Piscataqua River as impaired for total nitrogen.
See the response to **6- 3** regarding non-point sources and **6- 7** regarding nitrogen assessments***.***

***NHDES RESPONSE* to 6- 10**
The commenter urges NHDES to list the Winnicut River, Bellamy River, and Upper Sagamore Creek as impaired for total nitrogen.
See the response to and **6- 7** regarding nitrogen assessments***.***

***NHDES RESPONSE* to 6- 11**
Summary remarks by the commenter reflected in the preceding comments. No additional response is necessary.

***NHDES RESPONSE* to 6- 12**
Attachments referenced in the comments. No additional responses necessary.

## RESPONSE TO COMMENT #7: John Hall, Great Bay Municipal Coalition (GBMC)

***NHDES RESPONSE* to 7- 1**
This section contains opening remarks by the Great Bay Municipal Coalition (GBMC) summarizing their comments in the following sections. References to portions of the Draft 2016 Consolidated Assessment and Listing Methodology (CALM) are discussed in the responses below.

***NHDES RESPONSE* to 7- 2**
This section contains opening remarks by the GBMC principally summarizing their comments which are provided in detail in the following sections. References to portions of the Draft 2016 CALM are discussed in the responses below. One point made in the opening remarks and not elsewhere in the comments, was that the GBMC believes that the 2013 Piscataqua Regional Estuary Project (PREP) State of Our Estuaries (SOOE) report was the basis of the NHDES draft 2016 assessment. As noted in response to comment **2- 20**, NHDES is required to assemble and evaluate all readily available data. While the PREP SOOE report does not have the same set of necessary decision rules as the assessment process, it is an instance of local information developed through a very public process that concluded, "Traditional signs of nutrient-problems such as loss of eelgrass habitat, periods of low oxygen in the water of the tidal rivers, and increases of nuisance seaweeds have been observed" (PREP, State of Our Estuaries, 2013).

The commenter references their Attachment 1, "Grand Experiment Report" regarding dissolved oxygen, chlorophyll-a, and total nitrogen in the Upper Piscataqua River. As none of those parameters are considered impaired in the Upper Piscataqua River, no response is necessary.

Eelgrass remains impaired and we caution the commenter that in other systems that have recovered from excessive nitrogen loading, eelgrass recovery took 15 years in Mumford Cove, Connecticut (Vaudrey, Kremer, Branco, & Short, 2010) and decades in Tampa Bay, Florida (Greening, Janicki, & Sherwood, 2016). To expect instantaneous recovery is unrealistic.

***NHDES RESPONSE* to 7- 3**
See response to comment **5- 2** regarding rules**.**

The CALM does not directly determine what would be a violation of water quality standards. That is determined by the Water Quality Standards themselves. Comments about EPA's use and determinations of state water quality standards should be made directly to EPA.

***NHDES RESPONSE* to 7- 4**
All readily available information is used in the assessment (see response to **2- 20**) and all data is available to the public (see response to **2- 7**). No assumptions are made about where and when the public may decide to swim. People could be swimming from shore or off of a boat. The commenter appears to be concerned that samples are being collected in places too shallow to swim. In practice, most if not all samples in the Great Bay estuary are collected by boat and are therefore in deeper water.

The commenter makes the case that other factors impact water clarity. NHDES agrees, see discussion regarding CDOM and NAP in the responses to **2- 19** and **2- 20**.

Regarding natural conditions, see the response to **2- 3**.

***NHDES RESPONSE* to 7- 5**
This section comments on the primary contact recreation (i.e. swimming) designated use portion of the draft 2016 CALM, however most of the comments presented appear to be targeted to somewhat specific assessment

zone outcomes. After an opening remark, the comments are made in three sub-sections, (a, b, and c) each of which addresses different aspects of the aquatic life designated use assessments rather than primary contact recreation. NHDES has responded to the comments in the context of the aquatic life designated use assessment methodologies.

a) The commenter agrees that nutrient inputs can contribute to eutrophication. The comments then turn towards varying sections of the Great Bay estuary. It is important to recall that not every element discussed in the CALM is occurring or even expected to occur in every assessment zone. Different processes are occurring and occurring at different degrees in each assessment zone. NHDES cannot eliminate a whole section of the CALM because something is not known to be occurring in a particular assessment zone.

b) To support their argument that total nitrogen should be removed from the CALM section covering the primary contact recreation (i.e. swimming) designated use the commenter provides a graphic (their figure 1a, a draft slide produced by PREP for review and discussion) showing dissolved inorganic nitrogen (DIN) levels in Great Bay proper. As was noted by NHDES (NHDES, 2017) and the peer review, “total nitrogen is the correct and most robust form of nitrogen to use as an indicator of nitrogen status in an estuary” (Bierman, Diaz, Kenworthy, & Reckhow, 2014) because DIN is rapidly taken up by plants and is also rapidly converted to other forms of nitrogen in the estuarine system. The commenter then goes on to show a draft slide produced by PREP for review and discussion as their figure 1b that aims to estimate total nitrogen loads to the Great Bay estuary as compared with eelgrass cover. This is a comment on total nitrogen and eelgrass for the whole estuary as it relates to the aquatic life designated use. However, the declines in eelgrass started 10 years before the period that the graphic covers. Given that total nitrogen assessments are conducted by discrete zone, Great Bay is not impaired for TN, and total nitrogen appears to be decreasing, no additional response is necessary.

c) The final section discusses macroalgae. While it would be helpful for NHDES to have a quantification method for macroalgae proliferation, there is as of yet no quantification for how much is too much. At this time, macroalgae is used as a secondary supporting piece of information in the total nitrogen assessment process for the aquatic life designated use in accordance with the peer reviewer’s recommendation to include all confounding variables. Full support/non-support determinations are not made for macroalgae. The commenter suggests that if sufficient data existed to show that exotic/invasive macroalgae was impairing aquatic life, NHDES should pursue a category 4C impairment assessment, an impairment for which a TMDL is not required. NHDES does not at this time have enough information about the role of exotic macroalgae in the marine environment to speculate on this issue. However, we continue to be concerned that the nutrient requirements for macroalgae exceed those for eelgrass (Pedersen & Borum, 1996) in part because it can absorb nutrients through every cell and because macroalgae can decouple the sediment to water column nutrient links by intercepting regenerated nutrients released from the sediment (McGlathery K. , 2002) thereby masking the real water column nitrogen concentration. The commenter notes that macroalgae has been predominantly documented in the intertidal areas and it is worth noting that with the exception of the hyperspectral work in 2007 (Pe’eri, et al., 2008), that is the only place macroalgae surveys have been conducted. Macroalgae data in the intertidal is relevant because eelgrass can and has inhabited the intertidal zone. Regrowth of eelgrass has been shown to require minimal populations of drift macroalgae (Valdemarsen, Canal-Vergés, Kristensen, Holmer, & Kristiansen, 2010). Macroalgae beds can shift the microbial community in ways that make recolonization by seagrasses difficult (Gribben, et al., 2017). We know that the recovery and re-expansion of the eelgrass beds will require better light conditions that those needed for basic maintenance( (Dennison, et al., 1993), (Krause-Jensen, Sagert, Schubert, & Boström, 2008), (Ochieng, Short, & Walker, 2010), (Vaudrey, Kremer, Branco, & Short, 2010) and that macroalgae have lower light requirements than seagrasses (McGlathery, Sundbäck, & Anderson, 2007). The commenter suggests that macroalgae is increasing as nitrogen loads are being reduced, however, the few recent years of macroalgae information (2008-2010, 2013-2016) barely starts to cover the time for which nitrogen load information is available (2003-2016). No conclusion about responses to loads or trends are possible with the existing datasets.

Also see response to **2- 6** regarding C.F.R. §122.44(d).

***<u>NHDES RESPONSE</u> to* 7- 6**
As noted by the commenter, the water quality standards state that stratification is to be taken into account when reviewing the dissolved oxygen data in lakes, ponds, and impoundments (NHDES, 2016). The estuary is not such a freshwater, is generally shallow, and is very well mixed. The water quality standards also allow for exceptions to the dissolved oxygen standard, "as naturally occurs" (see response to **2- 3**). At this time, the Lamprey River is the only place known to experience any stratification which is triggered by the bathymetric pinch point at the Upper Narrows and possibly exacerbated by historic dredging/deepening of the basin. Further, the upper assessment zone of the tidal Lamprey River (i.e. Lamprey River – North, NHEST600030709-01-01) directly receives the non-point source loading from the Lamprey River watershed and the discharge from the Newmarket WWTF (the plant upgrade for nutrient removal went active in the summer of 2017). The presence of the point and non-point loading prelude NHDES calling the low dissolved oxygen impairment in that assessment zone a natural occurrence (also see response to **2- 3**), regardless of any stratification effects.

See responses to comments **2- 4** and **5- 3** regarding dissolved oxygen criteria.

***<u>NHDES RESPONSE</u> to* 7- 7**
NHDES used the best available information in the assessments.

See response to **2- 20** regarding Great Bay eelgrass.

***<u>NHDES RESPONSE</u> to* 7- 8**
Percent cover is the driving eelgrass metric that was used in the assessments.

See response to **2- 20** regarding Great Bay eelgrass.

***<u>NHDES RESPONSE</u> to* 7- 9**
Percent cover is the driving eelgrass metric that was used in the assessments.

See response to **2- 20** regarding Great Bay eelgrass and **2- 6** regarding C.F.R. §122.44(d).

***<u>NHDES RESPONSE</u> to* 7- 10**
The commenter states that the end point in the eutrophication process is "mortality." While under extreme circumstances, that may be true for many species of aquatic life, the end point or concern from a water quality standards perspective is defined in Env-Wq 1703;

> Env-Wq 1703.19 <u>Biological and Aquatic Community Integrity.</u>
>
> (a) All 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.

This rule dictates that preventing changes in community structure and function is as much of a goal of the water quality standards as protecting against mortality.

The commenter makes a broad claim that the peer reviewers determined that none of the effects of eutrophication are occurring in the Great Bay estuary. This is a misunderstanding of the peer review findings which identified that eutrophication is a concern in this estuary and that the symptoms we see are likely the result of multiple factors. The CALM is in agreement with the peer reviewers, as Dr. Kenworthy stated in the peer review,

> "First of all, there is compelling scientific evidence that eutrophication of estuaries and coastal embayments and loss of eelgrass can be caused by either the loading or delivery of high concentrations of different forms of inorganic, organic, and total nitrogen (e.g., Taylor et al. 1995, Short et al. 1995, Short and Burdick 1996, Kemp et al. 2004, Burkholder et al. 2007, Krause-Jensen et al. 2008, Vaudry et al. 2010, Latimer and Rego 2010, Benson et al. 2013). Several of these studies also make a direct link between nitrogen concentrations, nitrogen loading and water transparency. Likewise, eliminating point source wastewater discharges and reducing nitrogen loading reversed eelgrass losses in a shallow coastal embayment on Long Island Sound, Ct (Vaudry et al. 2010). Lending credence to the argument that nitrogen management can improve water quality conditions (e.g., water transparency) for the protection and restoration (Dennison et al. 1993, Krause Jensen et al. 2008, Vaudry et al. 2010)." (Bierman, Diaz, Kenworthy, & Reckhow, 2014)

In part as a response to the claims by the GBMC, in 2016 Dr. Bierman of the peer review team stated,

> "Our Peer Review opinion was based on the failure of DES to explicitly consider any of the other important, confounding factors in developing their relationships between nitrogen and eelgrass. The Peer Review did not conclude that nitrogen is not an important factor, but that DES did not present sufficient evidence to support the conclusion that nitrogen was the primary factor that caused eelgrass decline and the in ability of eelgrass to repopulate specific areas." (Bierman V. , 2016)

In keeping with the peer reviewers opinions and the scientific literature, the CALM describes the general process of how NHDES evaluates data, the interplay of confounding factors, and how we may treat the data for those factors. The CALM does not define what data exists and conditions exist in the assessment zones of the estuary, only how that data may be addressed. It should be noted that NHDES has determined impairments only where the data show total nitrogen relates in a "meaningful way" to ecological endpoints and the protection of designated uses.

***NHDES RESPONSE* to 7- 11**

See responses to comments **2- 4** and **5- 3** regarding dissolved oxygen criteria.

In regards to the Great Bay and the Piscataqua River, those areas have not been assessed as impaired for dissolved oxygen. In regards to the Cocheco River the dissolved oxygen condition has been disused in the TSD and in response to **2- 10**.

***NHDES RESPONSE* to 7- 12**

See the responses to **2- 6** regarding chlorophyll and C.F.R. §122.44(d) and **5- 15** regarding chlorophyll.

One of the sources of the high chlorophyll-a on the Squamscott River is the Exeter WWTF Lagoons, as noted by the commenter. Certainly, this exogenous source is important but it is not "naturally occurring" so long as it is a human source. In addition, the levels of total nitrogen in the tidal river are quite high by any estuarine standard which contributes to endogenous phytoplankton growth.

***NHDES RESPONSE* to 7- 13**

There is a great depth of literature regarding the impacts of low light levels of eelgrass survival and that topic has been covered in previous responses (**2- 19**, **6- 7**). The light attenuation (Kd) thresholds were first outlined in a method added to the 2008 draft assessment (NHDES, August 11, 2008) following a well-documented processes (Koch E. W., 2001), not the 2009 Great Bay Nitrogen document (NHDES, 2009), as the commenter claims, and those thresholds are supported by the literature.

Also see the response to **5- 2** regarding rules.

Light on the mud flats is discussed in (**2- 19**). The depth to which eelgrass once survived and thrived, not the mean water depth of Great Bay, is the metric of importance when defining the restoration depth. Light attenuation (Kd) is an independent indicator and NHDES has made no claim that total nitrogen is changing Kd values in Great Bay, in fact, NHDES has not assessed Great Bay as impaired for total nitrogen.

The commenter claims that eelgrass grew robustly in the deepest sections of Great Bay even when the Kd was worse than the indicator threshold. Yet when one evaluates that claim, we see that the eelgrass has not grown robustly since the middle 1990s and no light attenuation measurements were made until 2003.

The commenter is well aware that many factors impact the light attenuation of a given assessment zone yet continues to focus on the relationship between annual nitrogen →chlorophyll-a→ light attenuation in Great Bay proper. As the dynamics of nitrogen, chlorophyll-a, and light attenuation are expected to differ by assessment zone, this must be treated as an assessment decision comment. Great Bay proper is not listed for chlorophyll-a nor for total nitrogen. The Great Bay proper is listed as impaired for light attenuation and the reader is directed to the overall light attenuation discussion in response to **2- 19** and **2- 20**.

Regarding light attenuation and eelgrass acres see the response **2- 19**. As noted before, the shallow depths of Great Bay vastly complicate the relationship to light.

***<u>NHDES RESPONSE</u> to* 7- 14**

Use of the 90$^{th}$ percentile of chlorophyll-a as a rough indicator for when chlorophyll-a is elevated was placed in the CALM as one of the suite of variables that suggest a final decision for nitrogen. While the 2007 work (Morrison, Gregory, Pe'eri, McDowell, & Trowbridge, 2008) looking at the nature of light attenuation suggested 12% of light attenuation over the period was due to chlorophyll-a, we note that 12% is not a trivial amount and that the estimate applies to only one site in one year. It is also worth mentioning that in 2007, during the time period of the moored hyperspectral array, the 90$^{th}$ percentile of directly measure chlorophyll-a at GRBGB was 9.3 ug/L, that is, within the suggested acceptable range and was one of the lowest chlorophyll-a years in the last decade.

The commenter pointed out an error in the CALM previously discussed in the response to **2- 3**.

***<u>NHDES RESPONSE</u> to* 7- 15**

We appreciate the catch on the macrophyte wording in aquatic life use Indicator Part 9e: Macroalgae Indicator. Under Indicator Part 9e: Macroalgae Indicator, references to macrophytes have been changed to macroalgae as the commenter interpreted it to be and as it should have been.

See response **7- 5** regarding non-native species and how much is too much.

The commenter puts forth a series of claims regarding macroalgae in Great Bay proper. At this time NHDES has not made a claim that macroalgae represent an impairment, only that the indications are worrisome as is consistent with a wealth of scientific literature on the topic (see response to **7- 10**). The inclusion of our approach to macroalgae wherever that data may exist is in keeping with the peer reviewer's suggestions to include all confounding variables and to think through the myriad ways that the variables can interact.

See the response to **2- 6** regarding C.F.R. §122.44(d).

Also see the response to **2- 20** for a discussion of macroalgae in Great Bay proper.

***<u>NHDES RESPONSE</u> to* 7- 16**

We appreciate the catch on the wording in aquatic life use Indicator Part 9f: Epiphyte Indicator. It was not NHDES' intent to suggest that epiphytes would displace eelgrass as we are aware that if the eelgrass were gone, there would be few places for the epiphytes to live. That section has been wholly rewritten to reflect the science behind how epiphyte potential support/potential non-support feeds into the overall aquatic life use nitrogen indicator.

At this time NHDES has not made a claim that epiphytes represent an impairment, only that the indications are worrisome, as is consistent with a wealth of scientific literature on the topic. Our approach is to include epiphyte data wherever they exist is in keeping with the peer reviewer's suggestions to document all confounding variable and think through the myriad of ways that the variables can interact.

***<u>NHDES RESPONSE</u> to* 7- 17**

See the response to **2- 12** regarding wasting disease and **2- 20** regarding eelgrass.

***<u>NHDES RESPONSE</u> to* 7- 18**

See the response to **2- 20** regarding eelgrass cover reliability.

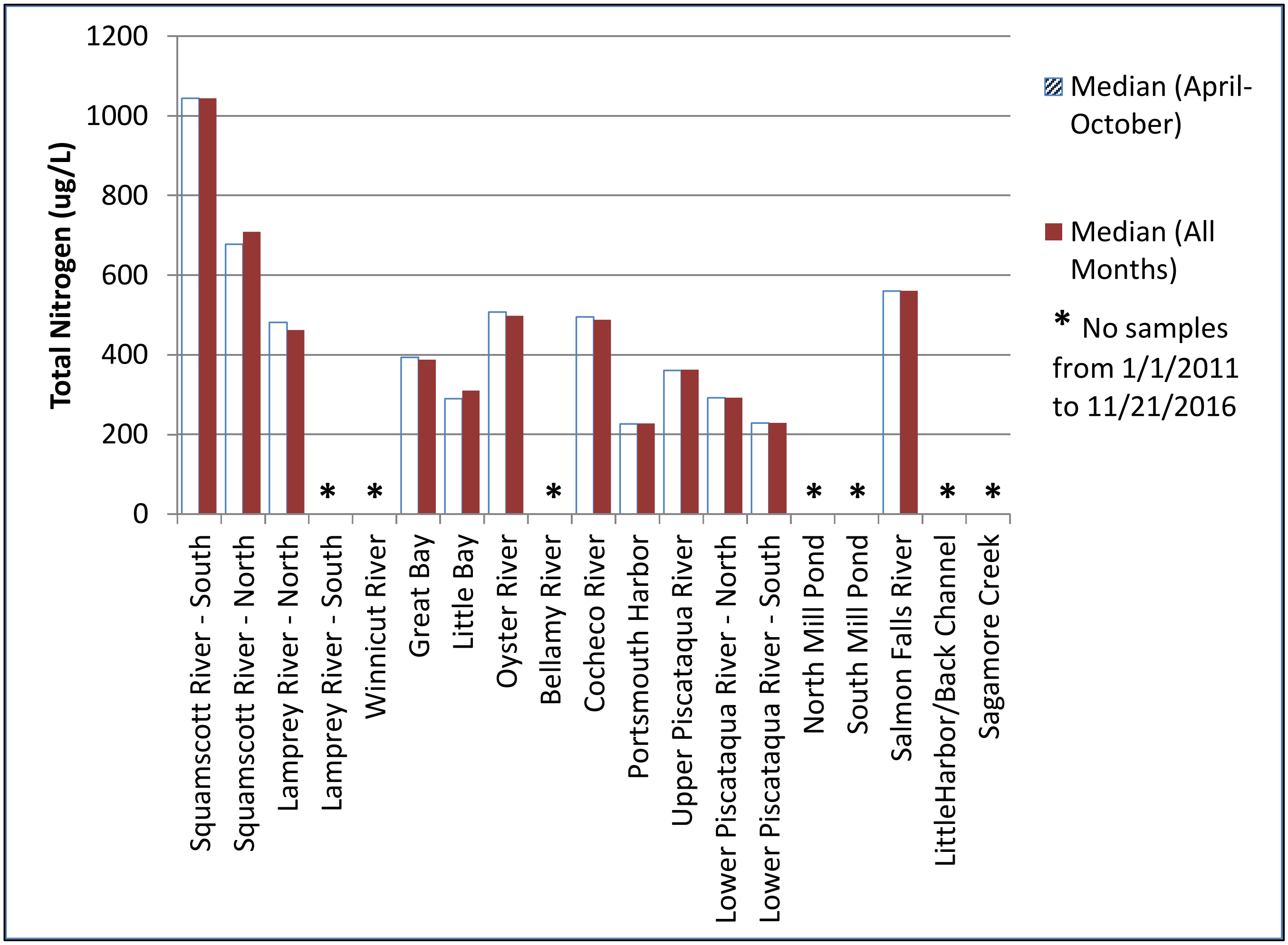
***<u>NHDES RESPONSE</u> to* 7- 19**

See the response to **2- 20** regarding biomass trends.

***<u>NHDES RESPONSE</u> to* 7- 20**

The commenter correctly states that little eelgrass grows during the winter months. However, the annual nutrient concentration statistics reflect the annual loading minus losses. NHDES has investigated the question of "annual" verses "April-October" total nitrogen concentrations (Figure 42). The relative percent differences (RPD) between the two methods of calculation range from -6.5 to 4.2% with 4 of the 12 assessment zones having an RPD of 0%.

**Figure 42. All months and April-October medians for the current data period (1/1/2011 to 11/21-2016) in all assessment zones of the Great Bay estuary.**




The minor differences in the "annual" and "April-October" total nitrogen concentrations is in part due to the fact that few places are visited and sampled for total nitrogen more than 9 months of the year. New Hampshire researchers are tough but there are a few months in the winter where they simply cannot collect samples. Because there is no particular seasonal difference in the calculated total nitrogen, there are no fixed total nitrogen thresholds, and we have been told by researchers that a portion of the formerly ephemeral macroalgae appears to be now overwintering, NHDES will retain the annual total nitrogen calculation at this time.

***NHDES RESPONSE*** ***to*** **7- 21**

This section contains summarized points regarding what the Great Bay Municipal Coalition recommends NHDES does relative to the draft 2016 CALM. Responses to those comments are provided in detail in the preceding sections.

***NHDES RESPONSE*** ***to*** **7- 22**

Attachments, no response necessary.

## RESPONSE TO COMMENT #8: John B Storer, City of Rochester

***<u>NHDES RESPONSE</u>*** **to 8- 1**

See the responses to comments **2- 4** and **5- 3** regarding dissolved oxygen**.**

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## E. PUBLIC COMMENT ON THE DRAFT 2016 SECTION 303 (D) LIST

## COMMENT #1: Rick Cantu, OspreyOwl Environmental, LLC


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June 22, 2017 **1- 1**

Kenneth Edwardson
Water Quality Assessment Coordinator
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Re: Comments on the 2016 Draft CALM

Dear Ken,

Thank you for this opportunity to comment on the documents outlined during this comment period. I have the following comments to offer.

Under waterbody assessments (Table 3-1) there should be a comma rather than a zero after 61 under totals. **1- 2**

Section 3.1.14 the last paragraph states, *"Where there were multiple samples (including samples taken at different depths) taken on the same calendar day and located less than 500 feet horizontally from each other, the worst case value was used as the independent sample for that day and location unless otherwise noted in Section 3.2. For Class B lakes, ponds and large impoundments, it should be noted that only data from the upper layers (i.e., the epilimnion in stratified waterbodies or the top 25% in non-stratified waterbodies) was used for assessment of dissolved oxygen. For all other parameters samples from all depths were considered and the worst case value was used as the independent sample for that day and location."*

When multiple samples are taken there is typically a decay in quality of subsequent samples due to carry over of pollutants, continued aggregation of pollutants on sampling equipment, more environmental contaminant carryover from wind, dust and pollen and a whole host of other conditions. If the higher concentration of samples are beyond the 50% sampling event (say there were 15 samples taken for dissolved oxygen and the results obtained were in the following order, #1-6.7 mg/l, #2-6.9 mg/l, #3-6.7 mg/l, #4-6.4 mg/l, #5-6.6 mg/l, #6- 6.5 mg/l, #7-6.3, #8-6.9, #9-7.3, #10-6.0, #11-5.8, #12-5.2, #13-4.7, #14-5.0, and #15-5.1. The chances are that the meter drift and calibration were compromised over the course of the sampling events. This can be the situation be it metals, nutrients, chlor-a, pH etc. It should be considered that the numeric order and analytical data are matched. If it continually tracks higher than cross-contamination, equipment calibration, or sample handling may be the cause of the discrepancy and not actual in-situ conditions. A footnote should be added to take these phenomena into account when looking at multiple datasets within a 500 foot horizontal area. Also, this would be contrary to the 10% rule outlined on pg. 24 of the CALM as two samples would need to be below 5.0 mg/l. This section of the CALM needs to be clarified. **1- 3**

In Section 3.1.4 the following is noted: "*Threatened:* For any of the use support options noted above, the ADB allows any parameter in an AU to also be flagged as threatened. For this assessment cycle, threatened waters were defined as follow:

- Waters which are expected to exceed water quality standards by the next listing cycle (every two years) and/or,
- Waters that do not have any measured in-stream violations but other data indicate the potential for water quality violations [i.e. see Sections 3.1.20 (predictive models) and 3.1.21 (NPDES permit effluent violations)]." **1- 4**

What is the criteria for "to exceed water quality standards?" Is it 70% of the concentration, 80%, 90%. There are no numerical limitations or narrative standard to support this. If the standard is not violated in two years does this water body come off the threatened list? Again another standard that is vague and non-existent.

The CALM is quite clear on what a WQ violation is. In Section 3.12 the following statement is made, *"In an effort to minimize the Type I error caused by erroneous data while limiting the Type II error caused by discounting data, NHDES employed the "binomial approach" in previous reporting cycles. The binomial approach, however, was criticized by some as being too lenient because the number of exceedances needed for a waterbody to be considered impaired increased with total sample size, and at least 3 exceedances were needed for total sample sizes of 10 or less. The concern was that some waterbodies were not being listed which were actually impaired. In response to these concerns NHDES decided to abandon the binomial approach starting with the 2006 cycle and adopt the slightly more stringent ten percent rule (i.e. 10% rule) for determining use support. In general, the 10% rule simply means that at least 10% of the samples must violate water quality criterion before a waterbody will be listed as impaired."* If water exceeds WQ criteria it is listed. Expectations to exceed WQ standards are arbitrary and in most cases cause unnecessary consternation to a community in which the "expected violation" is listed. **1- 5**

NHDES also states that criticism that the binominal approach was too lenient led the agency to develop the more stringent approach of the 10% rule. This is a complete departure of scientific basis and was done to placate certain groups. Yet the agency will require municipalities to jump through hoops, demonstrate compliance with a significant amount of data and it could actually take years to have an impairment delisted. The NHDES should have examples where the binominal approach that was previously used did actually miss impairments. If not, then the department has to fairly take criticism from both sides of the environmental spectrum to demonstrate there is no arbitrary nature in the decisions being made when they indeed are not based on science.

I also offer these comments that were presented from a previous CALM submittal. This minor criticism should at least give pause to the agency to reasonably adopt the below table**. Items in bold underline are reasonable requests from concerns regarding pushback against the arbitrary change of the binominal rule due to criticism from previous stakeholders.** *"The concern was that some water bodies were not being listed which were actually impaired. In response to these concerns DES decided to abandon the binomial approach starting with the 2006 cycle and adopt **<u>a 66% more</u>** stringent ten percent rule (i.e. 10% rule) for determining use support."*

**Note:** A 66% change in criteria is very stringent, not slightly stringent. An actual percentage change is more accurate than the subjective term which is less. It would also be welcomed to see a footnote where these instances have occurred to show there was truly a need to change from the binominal to the 10% rule approach and not because of a subjective request without any back up evidence of this actually being the case.

In the next section of the 10% rule the following changes are recommended, *"There are a few exceptions to the 10% rule. The first is for situations where 10% of the total number of samples is less than* **ten.** **In cases where the samples were taken in the excellent category, only two samples are used to determine compliance. In cases where the sampling was in the good category only three samples need to be taken. In samples that fall within the fair category, five samples need to be taken to satisfy the minimum sampling criteria. In such cases, the above enumerated minimum sample)** *is used to determine compliance. This is consistent with the previously stated premise that an assessment will not be based on just one sample. The second exception is for relatively large exceedances of the criterion. In such cases, only two exceedances are needed to assess the water as impaired. This is discussed in more detail in section 3.1.18 "Magnitude of Exceedance Criteria". The third exception is that the 10% Rule is not used for probabilistic assessments (see section 3.1.27). Finally, the fourth exception is that this rule only applies to certain parameters. To determine the parameters which were dependent on the 10% Rule for making assessments, see Section 3.2."*

*'The 10% rule is primarily intended to address situations where samples violate criterion but not by large amounts (i.e. values are within the accuracy of sampling* ***and fall within the fair, good or excellent range)*** *and method of analysis). For example, consider a data set containing 20 dissolved oxygen (D.O.) samples where the accuracy of sampling and measurement is +/- 0.5 mg/L. Further, assume only one of the samples (less than 10% of the total samples) violates the instantaneous D.O. criterion of 5 mg/L but by less than 0.5 mg/L (assume the value is 4.6 mg/L). Assuming that all 20 samples were collected under critical conditions, and applying the 10% rule, the AU would be assessed as fully supporting for D.O. and the single 4.6 mg/L value would be interpreted as due to measurement error. If, however, 2 or more of the 20 samples (i.e. greater than or equal to 10% of the samples) had values less than 5.0 mg/L, the AU would be assessed as impaired for D.O.* ***if the sample was considered in the excellent category. It would require three or more samples for the good category and five or more in the fair category****. In other words, the fact that 10% or more of the samples exceeded the criterion,* ***and the sample fell within either the fair, good or excellent criteria*** *is reason enough to conclude that the exceedances are not due to measurement error alone and that violations of the water quality criterion actually exist."*

**Note:** This follows the reasoning previously outlined.

In Table 3-1: Sample Size and Minimum Number of Exceedances (10% Rule) the following suggestion is offered

| Sample Size | Minimum # of exceedances to assess a waterbody as impaired |
|---|---|
| 1-29 | 2 |
| 30-39 | 3 |
| 30-49 | 4 |
| 50-59 | 5 |
| 60-69 | 6 |
| 70-79 | 7 |
| 80-89 | 8 |
| 90-99 | 9 |

**Note:** The 66% reduction from the binominal approach to the 10% rule corrects for minor differences in the error between sample lot rounding. Using the table as proposed in the current CALM actually reduces below the 10% rule in certain sample lot sizes. There is enough protection within the CALM to for these minor adjustments.

The second bullet discusses predictive models outlined in 3.1.20. The criteria is as follows: "A waterbody with potential violations based on predictive modeling, was assessed as threatened instead of impaired (not supporting), to reflect the fact that the violation is predicted and not based on actual measured in-stream violations, provided that the following conditions apply:

- The model is calibrated and verified and is considered to be representative of current conditions.
- The model predicts water quality violations under existing loading conditions, and/or under enforceable pollutant loadings stipulated in a NPDES permit.

Assuming that modeling predicts a violation, and assuming that this is the only violation in the waterbody, such waters were assessed as threatened and assigned an Impairment Category of 4A-T, 4B-T, 4CT, or 5-T depending on the cause of the threat (pollutant or nonpollutant), the source(s) of the threat, if a TMDL was necessary or if other controls would result in attainment of water quality standards. **1- 6**

The Army Corps of Engineers, CDM and Stakeholder Communities have been studying the Merrimack River since 2002. This study has been going on for fifteen years. Recently a presentation on the 'Predictive Modeling' was completed and presented (April 2017, slides in **Attachment 1**). The second slide on page 4 states that the findings from 2002 -2006 show NPS and CSO significant impacts on bacteria. The findings from 2008 – 2014 show NO dissolved oxygen impairments and generally low nutrient levels at the MA/NH border. All field sheets (chain of custody) from these sampling events did not note any algal blooms, fish kills, or other signs of impairments that would illustrate that section 2.2, Designated uses for Class B rivers was being violated. The standard is that the river must be fishable, swimmable, offer other recreational purposes and be suitable for water supply after treatment. The Merrimack River easily meets all these criteria.

The top slide on pg. 14 demonstrates the total phosphorus (TP) baseline concentration discharge from each plant at the time of sampling. The lowest WWTP effluent TP was 1.8 mg/l at the Nashua WWTP with the highest being 7.2 mg/l at the Merrimack County Facilities. The next column demonstrates a modeled result with a dilution calculation, the third column demonstrates model scenario #2 with a 0.75 mg/l TP limit from each WWTP and the fourth column demonstrates a model scenario #3 with a 0.2 mg/l TP discharge from each WWTP.

Going to pg. 17, top slide, you can see from the modeled results that the 0.2 mg/l TP discharge is the only case where the modeled criteria can be met.

Having taken numerous samples from the Merrimack River from 2009 through present day, I am amazed at the clarity and quality of the river. Even during the drought of the summer/fall of 2016 the river remained crystal clear.

Having taken numerous samples from the Merrimack River from 2009 through present day, I am amazed at the clarity and quality of the river. Even during the drought of the summer/fall of 2016 the river remained crystal clear.

The loadings outlined above were analyzed with the river was at low flow conditions, the Merrimack was at its most critical and yet there was no evidence of nutrient enrichment, algal blooms or low turbidity. **Attachment 2** illustrates the percent reduction needed to be made by each WWTP in order to meet the 'Modeled' criteria. The TP reduction ranges from a low of 78% (Nashua) to a high of 94% for (Merrimack County Facilities, Suncook and the Merrimack WWTP). The river by any standard meets and exceeds user's expectations and WQ Class B uses currently. Yet, with the aid of models the Merrimack River, which is already surpassing Class B standards at low flow, critical times, is modeled to be far from meeting standards. An average of an 85% reduction in TP from all WWTPs on the Merrimack River is being dictated by a model. Remember when the rivers were heavily laden with pollutants before WWTPs were built that the goal was to meet 85% removal of BOD and TSS with billions of dollars spent nationwide to achieve these results? Well now the communities of NH discharging into the Merrimack River are being asked to achieve an 85% average nutrient removal when the waters are not displaying any impairment at critical low flows. When you look at the cost to the communities to attain these unneeded discharge concentrations it is clearly regressive environmentalism. Then there are always those who see this as progressive environmentalism regardless of the cost or return on investment.

I have noted in the 303(d) listing that many of the rivers are impaired for several metals. A partial listing is the Lamprey River North, Squamscott, Upper Sagamore Creek, Taylor River Refuge, Rice Dam Pond, and others. The 303(d) listing does refer back to the CALM for determination of how the various waterbody segments were categorized.

The CALM does point out four categories of descriptions for data quality in Table 3-8. The section in the CALM 3.1.10 indicates four levels of data quality information, low, fair, good and excellent. The CALM document states that only data that is considered fair and above is used to make final assessment decisions. The minimum acceptable data is classified as fair (SOPs used in the field or lab, or a QA/QC plan is available and followed and the QA/QC results and metadata are adequate with samplers having some training.

In my wastewater career, which began in 1978, I have worked for 10 municipal wastewater plants spanning the States of NH, ME, MA, CT, NJ and PA. In those 38 years I have never witnessed one plant that had a QA/QC protocol or SOP set up for WET sample testing within their respective waterbodies. Since retiring from wastewater and starting OspreyOwl Environmental, I have worked for nine wastewater plants, one water plant and two industries regarding quality of sampling issues and WET protocols. Again, none of these facilities had a QA/QC plan, let alone a SOP protocol for these sporadic type samples. Yet, I see time and again, in many of the issued draft and final NPDES permits, data that was taken from these very tests that fall within the category of "Low." **1- 7**

The source of data for these metals classifications needs to be reviewed. If there were no SOPs or QA/QC plans associated with the sampling then as per the CALM, these data sets should be used for screening assessment only. These should be categorized within the three (3) category level of, "There is some but insufficient data to assess the parameter per the CALM, however, the data that is available suggests that the parameter is Potentially Attaining Standards (PAS) 3-PAS. The second three (3) category would be, "There is some but insufficient data to assess the parameter per the CALM, however, the data that is available suggests that the parameter is Potentially Not Supporting (PNS) water quality standards (e.g., there is one exceedance), 3-PNS, and finally, the third listing within that category of, "There is no data available for the parameter," 3-ND. This should be the designation upstream from most of the treatment plants, in the event the NHDES or other entity has not taken sufficiently QA/QC or SOP type samples that at least place the data obtained in the fair category or higher.

Another noted area of multiple data concerns are samples that list aluminum along with pH as the impairments. Some of the reasons are listed as unknown and others are listed as atmospheric deposition (acid rain). It appears the areas outside any small urban compact (Four Mile Pond, Dustin Pond, Rock Pond, Three Ponds and Guinea Pond etc.) are listed as two ways, Atmospheric Deposition, Acidity and Naturally Occurring Organic Acids. It is evident the NHDES is leaving the door open for both cases of argument.

In my research, and actually having come upon irrefutable proof in the field, it is becoming evident that the use of "Acid Rain" as a reasoning for high aluminum and low pH no longer holds anywhere near the clout it did in the 1980s through the 1990s. The EPA website states that there has been much progress in the reduction of $SO_2$ (i.e. acid rain component), with an 87% reduction in SO2 from 1980 through 2013. In some of the annual reports it is stated that the land is returning to pre-industrial conditions.

Below are some excerpts from the EPA's Air Quality and acid rain reports. As can be seen great strides have been made in the reduction of $SO_2$ (acidic portion of acid rain).

## Key Points 1- 8

### National $SO_2$ Air Quality

•Based on EPA's air trends data, the national average of SO2 annual mean ambient concentrations decreased from 12.1 ppb to 1.5 ppb (87 percent) between 1980 and 2013.

•The two largest single-year reductions (over 20 percent) occurred in the first year of the ARP, between 1994 and 1995, and recently between 2008 and 2009, just prior to the start of the CAIR SO2program.

### Regional Changes in Air Quality

•Average ambient SO2 concentrations declined in all regions following implementation of the ARP and other emission reduction programs. The most dramatic decline was along the Ohio River Valley and in western Pennsylvania where regional average concentrations declined 86 percent from 1989-1991 to 2011-2013 observation periods.

•Ambient particulate sulfate concentrations have decreased since the ARP was implemented, with average concentrations decreasing by 60 to 65 percent in observed regions from 1989-1991 to2011-2013.

•Average annual ambient total nitrate concentrations declined 47 percent from 1989 -1991 to 2011-2013, with the biggest reductions in the Mid-Atlantic and Northeast.

# Chapter 8: Acid Deposition

Acid deposition, commonly known as "acid rain," is a broad term referring to the mixture of wet and dry deposition from the atmosphere containing higher than normal amounts of sulfuric acids and nitric acids. Some of the most dramatic reductions have occurred in the mid-Appalachian region, including Maryland, New York, West Virginia, Virginia, and most of Pennsylvania. Along with wet sulfate deposition, reductions in precipitation acidity, expressed as hydrogen ion (H+) concentration, have also decreased by similar percentages. Reductions in nitrogen deposition recorded since the early 1990s have been less pronounced than those for sulfur. As noted earlier, emission changes from source categories other than ARP and CAIR sources contribute to changes in air concentrations and deposition of nitrogen. **Monitoring Networks** The Clean Air Status and Trends Network (CASTNET) provides long-term monitoring of regional air quality to determine trends in atmospheric nitrogen, sulfur, ozone concentrations, and deposition fluxes (the rate of particles and gases being deposited to a surface) of sulfur and nitrogen pollutants in order to evaluate the effectiveness of national and regional air pollution control programs. Together, these complementary networks provide long-term data needed to estimate spatial patterns and temporal trends in total deposition.

## Key Points

### Wet Sulfate Map

•The Northeast and Mid-Atlantic have shown the greatest improvement with an overall 64 percent reduction in wet sulfate deposition from 1989-1991 to 2011-2013.•A decrease in both $SO_2$ emissions from sources in the Ohio River Valley and the formation of sulfates which are transported long distances have resulted in reduced sulfate deposition in the Northeast. The reductions in sulfate documented in the region, particularly across New England and portions of New York, were also affected by lowered $SO_2$ emissions in eastern Canada.[10]

### Regional Trends in Deposition

•Between 1989-1991 and 2011-2013, the Northeast and Mid-Atlantic experienced the largest reductions in wet sulfate deposition, 65 percent and 63 percent, respectively.

•The reduction in total sulfur deposition (wet plus dry) has been of similar magnitude as that of wet deposition with an overall average reduction of 68 percent from 1989-1991 to 2011-2013.

•Decreases in dry and total inorganic nitrogen deposition have generally been greater than that of wet deposition with average reductions of 52 percent and 29 percent, respectively. In contrast, wet deposition from inorganic nitrate reduced by an average of 19 percent from 1989-1991 to 2011-2013.

https://www.epa.gov/airmarkets/clean-air-markets-progress

https://www.epa.gov/sites/production/files/2016-10/documents/2013_full_report_0.pdf

Throughout New Hampshire acidity from 'Naturally Occurring Organic Acids' is a component of non-industrialized areas, feeder pond wetlands and is a driving force for lifting aluminum out of the bedrock throughout the State. While doing a study of metal concentration in the Connecticut River and Cook's Brook, in the Springfield, Massachusetts area, I reviewed information that had been gathered by the Water Plant for NPDES permitting purposes for their backwash discharge to Cook's Brook. This information was extensive and covered over two full years from the two large reservoirs that supply water to the entire Springfield area. The Cobble Mountain Reservoir is the biggest with a capacity of 23 billion gallons. The Borden Brook Reservoir is smaller (but still large by any standard) and has a capacity of 2.4 billion gallons.

In looking over the data I could not help but notice the large differences in the total recoverable and acid soluble aluminum levels. Both reservoirs are within the same watershed, both are very close to one another, one rain gage is used to estimate rainfall on both bodies of water (located on the strip of land between the two reservoirs) both are mountain top reservoirs and removed from the population center and all aspects of both watersheds are similar, yet there was a huge discrepancy in aluminum content in both bodies of water. If acid rain was the cause for lowered pH, then both bodies of water should have similar pH values and total/soluble aluminum values. As this is far from the case within both these reservoirs than the indication is something else may indeed be happening.

I did online reviews and found a study that was done in Oslo, Norway (**Attachment 3**) on aluminum and the impact on fish. In talking with the local forester, I was informed that both the Borden and Cobble reservoirs were teaming with fish, had numerous amphibian populations and were both home to hunting Eagles, Osprey and other prey. No fish die-off had ever been evidenced on either of the two reservoirs with both being used as a water source for the West Parish Filters Water Treatment Plant. The forester indicated that for all intent and purposes, both were equal in viability and surrounding flora and fauna.

The data from both the Cobble Mountain and Borden Brook Reservoirs are included below. The yellow highlighted columns are what were studied extensively in the Oslo Study. The associated pH measurement texts are colored red. In this study, it is noted that the fish begin to use sodium to act as a natural protective barrier against the effects of aluminum. It was noted in the report that sodium was a much better predictor of a fish's ability to withstand continual high doses of aluminum and that calcium was only an insignificant secondary supporting cation. In the Region Eight Study done in Colorado by ENSR the findings were that calcium was supportive of keeping fish healthy at higher aluminum concentrations where the hardness of the water was also higher. Sodium was never looked at. As can be seen in the two below tables, pH, Calcium, Sodium, Alkalinity, TRA and ASA are much higher on a continual basis in the Cobble Mountain Reservoir as compared to the Borden Brook Reservoir.

| DATE | COBBLE MOUNTAIN RESERVOIR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | TSS (mg/L) | Temperature (°F) | pH (Standard Units) | Calcium (mg/L) | Sodium (mg/L) | Sulfate (mg/L) | Alkalinity (mg/L) | Total Recoverable Aluminum (ug/L) | Dissolved Aluminum (ug/L) |
| 12/31/12 | 1 | 39.4 | 6.7 | 2.6 | 7.6 | ND | 10 | 49 | --- |
| 1/23/13 | 1 | 38.1 | 6.6 | 3.0 | 9.5 | ND | 10 | 49 | 30 |
| 2/13/13 | <1 | 35.6 | 6.7 | 2.6 | 7.9 | ND | 9 | 56 | 29 |
| 3/13/13 | <1 | 35.0 | 6.5 | 1.4 | 3.3 | ND | 5 | 99 | 83 |
| 4/10/13 | 1 | 38.1 | 6.5 | 2.6 | 8.0 | ND | 8 | 53 | 34 |
| 5/22/13 | 1 | 67.8 | 6.8 | 2.5 | 8.3 | ND | 9 | 42 | 22 |
| 6/12/13 | 2 | 66.1 | 6.9 | 2.4 | 7.7 | ND | 8 | 33 | 11 |
| 7/17/13 | 1 | 84.0 | 6.6 | 2.3 | 7.0 | ND | 5 | 31 | 25 |
| 8/28/13 | 1 | 77.0 | 6.5 | 2.5 | 8.2 | ND | 8 | 22 | 51 |
| 9/18/13 | <1 | 67.8 | 6.5 | 2.4 | 7.1 | ND | 9 | 19 | ND |
| 10/16/13 | 1 | 61.8 | 6.6 | 2.4 | 7.1 | 4.8 | 10 | 21 | 12 |
| 11/6/13 | 1 | 53.5 | 6.6 | 2.4 | 7.0 | ND | 9 | 24 | 18 |
| 12/11/13 | 1 | 40.9 | 6.4 | 2.6 | 7.6 | ND | 8 | 38 | 15 |
| 1/15/14 | 1 | 33.6 | 6.3 | 2.0 | 5.9 | ND | 8 | 69 | 48 |
| 2/12/14 | <1 | 39.7 | 6.5 | 2.6 | 8.3 | 5.0 | 9 | 38 | 18 |
| 3/19/14 | <1 | 32.8 | 6.2 | 2.2 | 6.2 | ND | 6 | 42 | 27 |
| 4/16/14 | 1 | 39.0 | 7.1 | 2.4 | 8.2 | 5.5 | 8 | 64 | 37 |
| 5/14/14 | 1 | 58.5 | 7.4 | 2.5 | 8.4 | ND | 8 | 58 | 35 |
| 6/11/14 | 1 | 67.7 | 7.1 | 2.7 | 9.5 | 5.00 | 8 | 40 | 28 |
| 7/9/14 | 1 | 76.8 | 7.0 | 2.5 | 8.4 | 5.2 | 10 | 28 | 16 |
| 8/13/14 | 1 | 73.0 | 7.0 | 2.6 | 8.8 | ND | 10 | 22 | 15 |
| 9/17/14 | 1 | 69.1 | 6.9 | 2.8 | 9.0 | ND | 9 | 24 | 12 |
| 10/8/14 | <1 | 63.8 | 6.9 | 2.2 | 3.2 | 8.5 | 9 | 100 | 64 |
| 11/12/14 | 1 | 53.0 | 7.2 | 2.7 | 8.5 | 5.5 | 9 | 30 | 19 |
| 12/3/14 | 1 | 45.1 | 7.0 | 2.6 | 9.2 | 6.0 | 9 | 31 | 23 |
| 1/14/15 | 1 | 33.3 | 6.9 | 2.4 | 7.4 | ND | 6 | 51 | 29 |
| 2/4/15 | <1 | 39.2 | 7.1 | 2.6 | 8.4 | 5.4 | 8 | 28 | 26 |
| AVERAGE | | | | 2.46 | 7.62 | | 8.33 | 43.00 | |

| DATE | BORDEN BROOK RESERVOIR TSS (mg/L) | Temperature (°F) | pH (Standard Units) | Calcium (mg/L) | Sodium (mg/L) | Sulfate (mg/L) | Alkalinity (mg/L) | Total Recoverable Aluminum (ug/L) | Dissolved Aluminum (ug/L) |
|---|---|---|---|---|---|---|---|---|---|
| 12/31/12 | 1 | 34.5 | 6.5 | 1.8 | 2.7 | ND | 7 | 150 | --- |
| 1/23/13 | 1 | 33.8 | 6.4 | 1.9 | 2.6 | ND | 5 | 120 | 98 |
| 2/13/13 | 9 | 34.5 | 6.3 | 1.9 | 2.3 | ND | 5 | 120 | 99 |
| 3/13/13 | 1 | 35.1 | 6.2 | 1.8 | 2.9 | ND | 6 | 140 | 97 |
| 4/10/13 | 1 | 39.4 | 6.3 | 1.8 | 3.0 | ND | 4 | 120 | 92 |
| 5/22/13 | 1 | 68.0 | 6.9 | 1.8 | 2.5 | ND | 6 | 91 | 66 |
| 6/12/13 | 1 | 64.4 | 6.4 | 1.6 | 1.8 | ND | 6 | 120 | 80 |
| 7/17/13 | 1 | 87.2 | 6.6 | 1.6 | 2.0 | ND | 7 | 96 | 90 |
| 8/28/13 | 1 | 76.0 | 6.5 | 1.8 | 2.6 | ND | 5 | 77 | 50 |
| 9/18/13 | 1 | 66.0 | 6.4 | 1.7 | 2.2 | ND | 6 | 74 | 49 |
| 10/16/13 | 1 | 59.8 | 6.3 | 1.7 | 2.0 | 4.6 | 7 | 63 | 51 |
| 11/6/13 | 1 | 43.2 | 6.6 | 1.8 | 1.9 | ND | 7 | 86 | 61 |
| 12/11/13 | 1 | 33.2 | 6.4 | 2.1 | 2.4 | ND | 5 | 120 | 78 |
| 1/15/14 | 1 | 32.8 | 5.7 | 1.8 | 2.8 | 5.1 | 4 | 110 | 86 |
| 2/12/14 | 1 | 33.7 | 6.2 | 1.9 | 3.2 | 5.3 | 5 | 120 | 82 |
| 3/19/14 | 1 | 34.0 | 6.1 | 2.0 | 3.0 | 5.1 | 6 | 120 | 91 |
| 4/16/14 | 1 | 41.8 | 6.6 | 1.7 | 2.8 | 5.5 | 5 | 130 | 93 |
| 5/14/14 | 1 | 67.2 | 7.3 | 1.8 | 3.0 | ND | 6 | 120 | 84 |
| 6/11/14 | 2 | 69.4 | 7.2 | 1.9 | 3.2 | 5.2 | 5 | 100 | 77 |
| 7/9/14 | 3 | 77.7 | 6.9 | 1.8 | 2.4 | 5.2 | 6 | 73 | 43 |
| 8/13/14 | 10 | 71.3 | 7.0 | 1.8 | 2.7 | ND | 6 | 87 | 57 |
| 9/17/14 | 2 | 68.0 | 6.9 | 2.0 | 3.0 | 5.1 | 5 | 96 | 64 |
| 10/8/14 | 2 | 63.5 | 6.9 | 2.2 | 3.2 | 8.5 | 6 | 100 | 64 |
| 11/12/14 | 2 | 50.0 | 6.6 | 1.8 | 3.0 | 5.5 | 7 | 120 | 93 |
| 12/3/14 | 2 | 42.0 | 6.9 | 1.8 | 2.6 | 7.3 | 6 | 96 | 130 |
| 1/14/15 | 2 | 33.5 | 6.4 | 1.8 | 2.6 | 5.5 | 5 | 140 | 99 |
| 2/4/15 | 1 | 34.7 | 6.4 | 1.8 | 3.0 | 6.10 | 6 | 120 | 98 |
| | | | | 1.83 | 2.64 | | 5.70 | 107.74 | |

In more discussions with the forester it was learned that the wetland coverage area of the Borden Reservoir was extensive and most of the drainage for supply came from wetland sources. Also notable in the CALM is that wetlands cover 286,700 acres and make up the vast majority of AUs at 52,313. The Cobble Mountain Reservoir was mostly fed by a brook, but also surrounding wetland contribution however, the Cobble Reservoir does not receive near as much wetland contribution as the Borden Reservoir.

This example is a perfect, "Real World" application of the findings within the Oslo, Norway Study and what I have been finding during my 'Clean Sampling' efforts. If acid rain was the main contributing factor to reservoirs, brooks, ponds, or lakes both bodies of water should have relatively the same parameter concentrations and this should only fluctuate with rainfall. There is enough information here and from my field findings to justify that any impairment that couples pH with Aluminum is likely, "Naturally Occurring" and not a result of acid rain. What I have seen in my sampling efforts is that when weather patterns are extremely dry (approaching or in drought conditions with a good example being last summer), the total recoverable aluminum (TRA) and acid soluble aluminum (ASA) are usually very close in concentrations and quite low in metals. This is due to the fact that the rivers are moving so slowly that the particulate aluminum (TRA) tends to settle out and what is remaining in the water column is mostly dissolved (ASA). The pH tends to run higher at these times and almost all Aluminum measurements are <50 ug/l (close to half of the Gold Book standard). This is a direct result of upstream wetlands retaining their low pH waters and higher amounts of TRA and ASA that was lifted out of the bedrock due to the naturally occurring humic and tannic acids. This was an early observation in the 'Manchester, NH Aluminum Study' in the feeder ponds in the White Mountains which all had Aluminum concentrations consistently greater than 200 ug/l.

When the rains come, and the wetlands are flushed, you see a subsequent drop in the pH in the free flowing rivers and streams with an increase in the TRA and ASA. This was evident in the Manchester Aluminum Study, last summer's Springfield, MA study and my ongoing sampling of the Souhegan River for the Greenville WWTP project. In inevitability, when the rains or snow melts come and the feeder wetlands or ponds begin to washout, then the river pH drops and the TRA/ASA rise. This is a naturally occurring condition and the biolife over the millennia have learned to adjust to these changes by using other salts and nutrients to dampen the impact of these swings (as evidenced in the Oslo Study). OspreyOwl Environmental believes there is enough evidence to remove the current speculation of acid rain being the cause of low pH and higher aluminum content and either change the impairment designation to 3-PAS or 3-PN, or to simply state that it is "Naturally Occurring."

This brings us to the most recent practice of taking the river hardness and using this within the NPDES metals calculations to produce a concentration that varies from the Gold Book concentration. The Gold Book does indicate that the toxicity testing that was performed during the study trials was adjusted to 25 mg/l hardness, but subsequent studies have indicated that a harder water is more toxic to aquatic life. In review of some of these studies it was evident that the trials did not take into account the aquatic uptake of calcium, sodium, sulfate and associated alkalinity. It is evident in the Borden Reservoir data that the alkalinity in the lower pH Borden reservoir is on order 30% lower than in the adjacent Cobble reservoir. Yet, the aquatic and amphibian life within and surrounding the lower alkalinity reservoir is identical with no evidence of less viability.

I am certain that there has been no evidence within New Hampshire that demonstrates that a water that is at or slightly above (within the 15% error of instrument concentration measurement) the Gold Book standard for Aluminum has any more detrimental effect on the benthic, aquatic, or amphibian population than a similar water body with half that concentration of Aluminum.

The regulatory community continues to believe that there are problems within water bodies due to Aluminum greater than 87 ug/l when there are actually none because of the natural occurrence. The practice of calling Aluminum above 87 ug/l an impairment continues to put ever mounting financial pressures upon communities and severely limits the options of future nutrient treatment by chemical removal. A great case in point is the findings from the Oslo Study and accompanying data from the Borden and Cobble Reservoirs.

I have been fortunate to sit in on almost every meeting of the Merrimack River Stakeholders held during this study and have provided many comments along the way. I have completed many sampling events outside the study for metals and have spent a good amount of my summers in the Merrimack River doing sampling. I have never seen any algal blooms, submerged aquatic vegetation or dead fish floating anywhere during my sampling days (most intense time has been from 2009 through present).

The most recent meeting of the stakeholders had presented findings within the Merrimack River. Although a few chlorophyll-a values had exceeded 15 ug/l (this 15 ug/l standard was set for recreation purposes and not aquatic protections. " **Indicator 3: Chlorophyll-a (Chl-a***)* *Excessive algal growth (high biomass and high chlorophyll-a values) can impair the public safety and aesthetic enjoyment of surface waters. The General Water Quality Criteria (Env-Wq 1703.03) require that surface waters be free of substances which: produce color or turbidity making the water unsuitable for the designated use, or interfere with recreational activities (Env-Wq 1703.03 (c)(1) c & e). For assessment purposes, chlorophyll-a concentrations in excess of 15 ug/L in fresh water and 20 ug/L in salt water are indicators of excessive algal growth that interferes with recreational activities*.") there was no dissolved oxygen measured impairments and no signs of algal blooms or growth of submerged aquatic vegetation. All at the meeting had agreed that the findings from the sampling events demonstrated that there were no visual impairments within the Merrimack River that demonstrated a need to increase any restrictions upon current pollutant loading. It is worth noting that the Merrimack, NH WWTP, nor the Manchester, NH WWTP had begun their phosphorus treatment processes at the time of the sampling. **1- 9**

Chlorophyll-a is the driving factor within this incredibly costly nutrient reduction objective and the chlorophyll-a value (13.5 ug/l with 10% assimilative capacity reserve and 15 ug/l WQ, Table 3-17 CALM) was based on a "LITERATURE RESEARCH!" This approach cannot be substantiated on a scientific basis here in New Hampshire. I've reviewed a technical evaluation of Chlorophyll-a and Nuisance Thresholds

(**Attachment 4**), and noted many Chlor-a values throughout the country were well above the subjective 15 ug/l criteria set by the NHDES. The explanation by NHDES staff was that a 15 ug/l limit is indicative of the turbidity in the water and is protective of the clarity of water for the purpose of swimmers and other recreational uses. The NHDES has indicated that chlor-a is a predictor of turbidity values (water clarity).

In review of literature research I came across an example where organic algae were measured against inorganic silt and sediment. The findings demonstrated that chlorophyll-a numbers closely matched measured NTUs (**Attachment 5**). It also measured sediment in the mg/l range and what the visual indication portrays is that 1 ug/l of chlor-a equals approximately 1 mg/l of suspended sediment that equals approximately 1 NTU.

In review of the data generated in the Merrimack River Study by CDM (**Attachment 6**) you can see that there is absolutely no correlation between chlor-a and measured turbidity. Looking at the highest in-river turbidity of 3.5 at the down-stream side of the Essex Dam and 3.7 upstream from the Haverhill WWTP you see corresponding chlor-a numbers of 24 ug/l and 25 ug/l respectively. The study demonstrates that chlor-a is a poor predictor of turbidity yet it is probable that all plants will need to meet this expectation in the future (based on modeling efforts). Citizen's user fees will skyrocket, and less money will be available for environmental projects that would certainly be listed above this unneeded expense.

The 15 ug/l value is arbitrary and cannot be supported by literature research, or any scientific basis. Chlor-a should only be used as intended initially as a precursor to nutrient enrichment when TP is high (>0.1 mg/l) and D.O. begins to fall below 5.0 mg/l.

END OF COMMENTS

Respectfully submitted,

Ricardo Cantu
President – OspreyOwl Environmental

ATTACHMENTS PROVIDED ON THE NHDES FTP SITE AS DESCRIBED IN THE INTRODUCTION. **1- 10**

**COMMENT #2: Dean Peschel, Great Bay Municipal Coalition (GBMC)**

GREAT BAY MUNICIPAL COALITION

**VIA EMAIL to 303dcomment@des.state.nh.us**

June 23, 2017

Mr. Ken Edwardson
New Hampshire Department of Environmental Services
Watershed Management Bureau
29 Hazen Drive, P.O. Box 95
Concord, New Hampshire 03302-0095

**RE: <u>2016, 303(d) Comments</u>**

Dear Mr. Edwardson:

In accordance with the Guidance for Submitting Comments on the draft 2016, 303(d) List of Impaired Surface Waters for New Hampshire (https://www.des.nh.gov/organization/divisions/water/wmb/swqa/2016/documents/2016-cmnt-guide-draft-303d.pdf), the Great Bay Municipal Coalition (GBMC) respectfully submits the attached comments on the draft 2016 303(d) List for assessment units within the Great Bay Estuary. **2- 1**

The attached comments identify several significant concerns with the impairment listings. Most of these relate to the data used by the Department as the basis for the listing and the Departments presumption that nitrogen/algal growth is responsible for low DO readings under infrequent low tide conditions. As previously documented, there are significant concerns with the validity of the probe data (chlorophyll-a, dissolved oxygen) used in the assessments. These data are demonstrably unreliable and should not be used for any assessments. We have similar concerns with regard to the data used to characterize eelgrass in the Estuary, but more importantly, a detailed evaluation of all the eelgrass data confirms that reductions in eelgrass cover over time are attributable to natural conditions, not any man-related factor.

Thank you for your consideration of these comments. We look forward to discussing the resolution of these concerns with the Department.

Sincerely,

Dean Peschel

GBMC

Attachment

**Comments on NHDES Draft 2016 Section 303(d) Surface Water Quality List and TSD**

## A. INTRODUCTION

The NHDES Draft 2016 Section 303(d) Surface Water Quality List (May 8, 2017; "Draft 2016 303(d) List") identifies numerous assessment units within the Great Bay Estuary watershed as impaired (DES Categories 5-M and 5-P) for dissolved oxygen (DO), estuarine bioassessments, light attenuation coefficient (Kd), total nitrogen (TN), and chlorophyll-a (chl-a) in accordance with the methodologies presented in the 2016 Section 305(b) and 303(d) Consolidated Assessment and Listing Methodology (May 8, 2017; "CALM") and the Technical Support Document for the Great Bay Estuary Aquatic Life Use Support Assessments, 2016 305(b) Report/ 303(d) List (May 8, 2017; "TSD").

> The complexity of the Great Bay Estuary presents a number of assessment challenges. In addition to the CALM (see section 1.2 above) a Technical Support Document for the Great Bay Estuary Aquatic Life Use Support Assessments, 2016 305(b) Report/303(d) List has been prepared to provide supplemental information regarding New Hampshire's 305(b)/303(d) assessments of the Great Bay Estuary. This document is meant to provide additional information about how the water quality status of each of the 19 assessment zones was determined. Specifically, this document addresses the water quality data used to determine if the estuary meets the Aquatic Life designated use.
>
> (Draft 2016 303(d) List at 2)

2- 2

The CALM presents more detailed background on evaluating eelgrass cover (Indicator 8, CALM at 66) and total nitrogen (Indicator 9; CALM at 68) impairments. The total nitrogen impairment consists of eight sub-indicators, which are described in some detail. The TSD presents detailed evaluations of the eelgrass cover and total nitrogen indicators for the various assessment units in the Great Bay Estuary. The TSD also includes the following general assessment upon which the subsequent evaluations were based.

> *The 2013 State of the Estuaries Report for the estuary (PREP, 2013) showed that the Great Bay Estuary has all the classic signs of eutrophication: increasing nitrogen concentrations, low dissolved oxygen and disappearing eelgrass habitat*. These symptoms of eutrophication have the potential to impair the Aquatic Life 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 document 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.

(TSD at 4 – 5) (Emphasis added.)

## 1. Natural Conditions Are Not Water Quality Impairments

Naturally occurring water quality exceedances are not considered to be violations of the State's water quality standards. (See, CALM at 16)

> In New Hampshire, exceedances of most water quality criteria due to naturally occurring conditions are not considered violations of the water quality standards. According to Env-Wq 1702.29 of the State's surface water quality regulations (NHDES, 2011), naturally occurring conditions means "conditions which exist in the absence of human influences."

Examples of what constitutes naturally occurring conditions are identified in the CALM (at 16), and include the following factors:

**2- 3**

- Low dissolved oxygen (DO) or pH caused by poor aeration or natural organic materials, where no human-related sources are present or where impairment <u>would occur even in the absence of human activity</u>.
- Excessive siltation due to glacial till or turbidity due to glacial flour, where such siltation is not caused by human activity or where impairment would occur <u>even in the absence of human activity</u>.
- Habitat loss or pollutant loads due to <u>catastrophic floods</u> that are excluded from water quality standards or other regulations.

Documentation is provided to support the "natural" determination in comments on the individual assessment units, presented below.

## 2. DO Water Quality Standard Update

The current DO water quality standard for estuarine/marine waters is out of date and, in any event, was not developed to apply under rare stratified conditions as was done in a number of the impairment assessments for the Great Bay Estuary assessment units. To be reasonable, criteria must be applied to reflect the manner in which they were developed (i.e., reflecting underlying scientific studies). The USEPA "Red Book" DO criteria reflected longer term exposures and did not assess aquatic life use protection needs of "bottom" or "stratified" waters. Thus, it is not scientifically defensible to apply this criteria as an "anytime/anyplace" value to protect aquatic life. Moreover a 5.0 mg/L instantaneous minimum WQS interpretation is not scientifically defensible, and there is no scientific basis for the DO saturation standard. Consequently DES's **2- 4** approach to DO standard compliance is arbitrary as applied in the impairment listings for the Great Bay Estuary. The USEPA adopted revised DO criteria for marine waters in 2000, which present the latest science regarding this parameter. This science recognizes that marine waters can become stratified and these waters can routinely fall below 5.0 mg/L DO concentration without resulting in aquatic life use impairment. EPA has approved significantly lower DO criteria for such stratified waters (see, e.g., Chesapeake DO Criteria).

Current legislation, awaiting the Governor's signature, requires the commissioner to adopt rules, under RSA 541-A, relative to dissolved oxygen water quality standards in a manner "consistent" with EPA guidance on DO water quality criteria published pursuant to Section 304(a) of the Clean Water Act, and other relevant scientific information. Such "consistency" would not allow for applying a 5 mg/l DO standard in marine waters under low tide/stratified conditions as necessary to ensure aquatic life protection. Since the most recent criteria recommendation under Section 304(a) of the Clean Water Act is the Ambient Aquatic Life Water Quality Criteria for Dissolved Oxygen (Saltwater): Cape Cod to Cape Hatteras (EPA-822-R-00-012, November 2000), the Department should delay listing any waters as impaired for DO if there are concerns regarding criteria compliance under infrequent, short term or stratified conditions in this system.

## B. COMMENTS ON INDIVIDUAL IMPAIRMENT LISTINGS

### 1. Cocheco River

#### i. Background

The tidal Cocheco River is designated as impaired for chlorophyll-a (5-P), DO (5-M), and TN (5-M). The rationale for this impairment listing is presented in the TSD (at 54 et. seq.). The rationale reads, in part:

> **Chlorophyll-a (5-P)**
>
> The calculated 90th percentile chlorophyll-a in this assessment zone is 14.6 ug/L (n = 46) and a maximum reading of 45 ug/L. The chlorophyll-a indicator threshold to prevent low dissolved oxygen is a 90th percentile below 10 ug/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. 2- 5

**Dissolved Oxygen (5-M)**

Following the 10% method listed in the 2016 CALM, this parameter would be categorized as 5-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 exceedance indicator was layered into the assessment process to address major exceedances and exceedances 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. 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 improve in the coming years.

**Total Nitrogen (5-M)**

The median total nitrogen from 2011 through 2015 was 488 ug/L (n=38). 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 and 2015 of up to 4.25 hours and as low as 2 mg/L. The chlorophyll-a concentration 90th percentile was 14.6 ug/L (n = 46) and a maximum reading of 45 ug/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 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 below.) 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 much 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 is rapidly decreasing 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.

In addition to the rationale presented above, the TSD also includes a detailed assessment of the datalogger results (at 59).

### ii. Chl-a Impairment Comments

- Basis for Impairment Threshold Not Scientifically Defensible

The chl-a impairment discussion in the TSD is based on a presumed effect of chl-a on DO criteria attainment. There is no information provided to support use of 10 µg/L chl-a at the 90th percentile as a basis to presume that the DO criterion will be exceeded. As discussed in the GBMC comments on the CALM (CALM Comments at 13), no data are provided to support this assertion. There is no rational basis to presume this threshold is accurate in consideration of the conceptual model for the effect of chl-a on DO. Use of an elevated concentration, such as the 90th percentile, suggests that the effect is a short-term deficit caused by phytoplankton respiration. Assuming, solely for arguments sake, that the datalogger information presented for PERIOD 1 (TSD at 61) are reasonably accurate, these data show that extremely high concentrations of chl-a (exceeding 50 µg/L) do not cause DO criteria exceedances. Consequently, this chl-a threshold is not supported. 2- 6

DES is required to demonstrate that elevated chl-a concentrations are a significant factor causing eutrophic conditions to determine that this factor needs to be regulated (See, 40 C.F.R. § 122.44(d) and State law). DES would have to show, at a minimum, how the level of chl-a is affecting sediment oxygen demand and diurnal DO conditions (See GBMC CALM comments). DES cannot simply presume a cause and effect relationship under state or federal law or pick a chl-a concentration that is assumed to cause DO impairment. Consequently, this impairment listing should be dropped.

- Probe Data Unreliable

DES is required by state and federal law to base listing decisions only on reliable data. See, 40 CFR Part 130. The chl-a impairment discussion in the TSD notes that the multiple probe based chl-a data were qualified as "estimated" due to poor correlation between the probe data and grab sample data collected concurrent with the dataloggers. The grab sample data are characterized in the listing as having a 90th percentile concentration of 14.6 µg/L based on 46 samples. By comparison, the datalogger results for PERIOD 1 show a minimum chl-a concentration near 14.6 µg/L and numerous measurements exceeding 50 µg/L. A comparison of these values essentially demonstrates that a correlation between the two data sets is non-existent. Moreover, the datalogger readings are inconsistent with decades of physical sample measurements showing far lower algal growth in this system. Consequently, these data should not be presented in a Section 303(d) analysis. In any event, please provide these two data sets and the correlation analysis performed by the Department so that we may further assess the reliability of the datalogger results. 2- 7

Even though the correlation between the grab sample (analytical test) results and the datalogger is described as poor, the TSD claims that "the relative biomass is valid and shows large spikes in chlorophyll-a". Please provide the scientific rationale and evaluation that supports this statement, as a cursory review of the datalogger results suggests that these data are completely unreliable. It is physically impossible for huge spikes in chl-a to occur in this system, as confirmed by prior data and analyses for this assessment area. With regard to the data presented for PERIOD 1 (TSD at 61), the datalogger shows chl-a concentrations spiking at >50 µg/L, dropping below 20 µg/L, and spiking up to 50 µg/L over a period of one hour or less. These saw-tooth observations occur during the day and at night. We are not aware of any scientifically defensible mechanism to explain these observations other than sampler error, which was confirmed by Dr. Steven Jones when similar results occurred from other dataloggers. In response to our data request supporting the claim that the relative biomass is valid, please also provide justification supporting nutrient-stimulated algal growth as the basis for this pattern.

- Data Evaluation Not credible

The chl-a impairment discussion in the TSD notes that the large spikes in chl-a concentration were most pronounced when low tide occurred at midday to late afternoon (maximum photosynthesis duration period) and when freshwater inflow was at a minimum. "Under those conditions, the high nutrient water in the Cocheco River had the optimum conditions to sustain a large phytoplankton biomass." The more detailed description (TSD at 59) makes the following observations:

> In the first period, <u>chlorophyll concentrations are elevated regardless of tide</u> and diel cycles. Photosynthesis by the water column algae drives dissolved oxygen up to 160% saturation (11.8 mg/L at the given temperatures and salinities), so high in fact that even the 3-4 mg/L drawdown during the dark period is often not enough to draw dissolved oxygen down to 100% saturation (7.9 mg/L at the given temperatures and salinities). In the second period, the <u>chlorophyll levels cycle along with the tides</u>. Low tide brings the highest chlorophyll concentrations down river to the datalogger, and high tide brings low chlorophyll water up river from the Piscataqua River. As a result, there is less super-saturation of dissolved oxygen as compared the first period, and when low tide occurs at night or during the early morning, the dissolved oxygen levels dip below 5 mg/L and as low as 3 mg/L due to total system respiration (the death and decomposition of the high level of algae which consume oxygen, continued respiration by the surviving chlorophyll, and other dissolved oxygen consuming sources). In the third period, <u>chlorophyll remains low</u>, and for the most part, dissolved oxygen remains above 5 mg/L. The fourth period demonstrates an accelerated version of the first and second periods combined. It is characterized by an <u>early chlorophyll bloom</u> along with super-saturation then a <u>die-off phase</u> resulting in dissolved oxygen below 5 mg/L and as low as 2 mg/L. After a datalogger data gap, the fifth period, which extended into early October, showed the <u>flushing effect of freshwater river flows</u> which rose to 3.37 cfsm, then the <u>chlorophyll dropped</u>, and dissolved oxygen swings between

**2- 8**

much more normal in the 75 to 95% saturation range (6.8 to 7.5 mg/L at the given temperatures and salinities).

This assessment is not scientifically defensible, as discussed below.

- Data Overview

The graph on page 60 of the TSD presents the entire datalogger record, which spans from 9/2 – 9/24 (21 days) and 9/29 – 10/4 (5 days). Inspection of the graph indicates that the tidal depth at the beginning of the first continuous period of record ranged from 3 meters above the sensor at high tide to 1 meter above the sensor at low tide, for a tidal range of 2 meters. This range decreased at the end of the period, with the tidal range of 1 meter. Consequently, it appears that the start of the monitoring period was leading up to a spring tide and the period ended with a neap tide. Over this period, salinity varied with the tide and generally ranged from 20 psu to 28 psu. Water temperature varied from 25°C to 19°C, generally decreasing over time. The chl-a data show extremely variable and high concentrations over the first six days (PERIOD 1) followed by significantly reduced (and less erratic) concentrations over the next six days (PERIOD 2). This trend to even lower concentrations continues over the next four days (PERIOD 3), but then chl-a concentrations increase dramatically over the last 5 days (PERIOD 4).

The second continuous period of record shows tidal depths ranging from 1 meter to 4 meters above the sensor, with a tidal range of approximately 2.5 meters. The salinity at the beginning of the period was consistent with that seen earlier. However, on 10/1, the low tide salinity began to decrease sharply in response to increasing flows in the Cocheco River. (See, Figure 1). Water temperature decreased from 18°C to 15°C. The chl-a data for this period show very low concentrations following the reduction in salinity observed on 10/1. **2- 9**

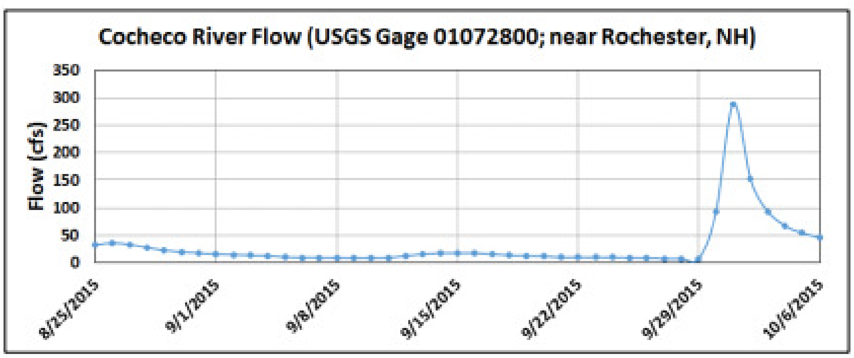


**Figure 1 – USGS Flow Data for the Cocheco River**

Data on total nitrogen concentration are limited for the survey period. The limited data were summarized in discussions of the individual period analyses (TSD at 61 – 65), and are tabulated below.

**Table 1 – Ambient TN Concentration (µg/L)**

| Date | Above Head of Tide Dam | Low Tide (at CR-7) | High Tide (at CR-7) | Piscataqua River (at UPR4) |
|---|---|---|---|---|
| 8/26/2015 | 848 | | | |
| 9/2/2015 | | | 269 | 209 |
| 9/9/2015 | | 447 | | 395 |
| 9/12/2015 | | | 376 | 256 |
| 9/15/2015 | | | 292 | 246 |
| 9/19/2015 | | 355 | | 215 |
| 9/23/2015 | 536 | 660 | | 307 |
| 10/28/2015 | 583 | | | |

- Evaluation of Data

As discussed in the detailed datalogger evaluation, chlorophyll levels cycle with the tides regardless of lighting condition. It is not physically possible for phytoplankton to rapidly grow during every low tide event or for any low tide event as DES's assessment hypothesizes – the data are obviously improper readings. Since no additional data are presented that could explain such a bizarre pattern of chl-a measurements, the entire chl-a assessment based on this information must be discarded.

For example, the PERIOD 1 and PERIOD 4 data show chl-a concentrations tripling over a short period of time, then rapidly decreasing and spiking again. This pattern is repeated day and night and cannot be real. Such a pattern is more consistent with the sonde being fouled as no other physical explanation is rational.

Moreover, the PERIOD 2 and PERIOD 3 data show a pattern with chl-a concentrations increasing at low tide and decreasing at high tide, *regardless of lighting condition*. This pattern is not consistent with "optimum conditions to sustain large phytoplankton biomass" but rather confirms the condition has nothing to do with plant growth stimulation but is solely a function of tidal condition – assuming it is real.

In discussing PERIOD 4, the TSD asserts that the period is characterized by an early chlorophyll bloom followed by a die-off of algae. However, a review of the data presented for the period confirms that this scenario is impossible. Immediately before the "bloom", ambient chl-a concentrations peaked in the afternoon at 10 µg/L at low tide (9/19). The very next low tide, which occurred overnight shows chl-a concentrations ranging from 30 – 50 µg/L. Thus, algal biomass increased by a factor of 3 – 5 in less than 6 hours, overnight. Such "growth" cannot be explained by any scientifically defensible principles of algal growth. This is obviously a data monitoring error.

Once again, this supposed "bloom" persisted for four days (9/20 – 9/23), with peak concentrations of chl-a occurring during each low tide, whether night or day. Monitoring data for the Upper Piscataqua River (Station UPR4) around this time period shows no evidence of any bloom. Samples collected at 4:30 pm on 9/19 (before the onset of the bloom) show chl-a at 3.4

μg/L. Samples collected at 5:00 pm on 9/23 (the tail end of the bloom) show chl-a at 4.9 μg/L. The discrepancy between the datalogger results and the analytical monitoring data, along with the unexplainable growth pattern, confirm that the datalogger results are unreliable and cannot be used in the assessment of use attainment.

As discussed above, these data are not credible and should be disregarded.

### iii. DO Impairment Comments

In assigning the Cocheco River assessment unit as impaired for DO, the TSD claims the available data from the datalogger measurements are sufficient to categorized the river as impaired (5-M) using the 10% method. In discussing this method, the TSD notes that the concept behind the 10% rule was to address random errors within the meter measurement accuracy thereby limiting accidental impairment listings. This approach is reasonable, but it is contingent upon an evaluation of reliable data for the assessment unit at reasonable locations. A review of the data presented in the TSD indicates that the datalogger results are suspect and in any event are not indicative of "impairment" as the low DO is sporadic and only associated with high or low tidal conditions.

- Overview

The TSD attempts to link elevated nutrient concentration with excessive algal growth as a primary effect and low DO as a secondary effect in accordance with the conceptual model for eutrophication, with no credible analysis – just assumption. (See, GBMC Comments on CALM at 13). During the day, algae photosynthesize and should add DO to the receiving water; at night, respiration should deplete DO from the receiving water.

**2- 10**

> when low tide occurs at night or during the early morning, the dissolved oxygen levels dip below 5 mg/L and as low as 3 mg/L due to total system respiration (the death and decomposition of the high level of algae which consume oxygen, continued respiration by the surviving chlorophyll, and other dissolved oxygen consuming sources).
>
> (TSD at 59)

Oxygen depletion is a gradual process whereby DO concentration steadily decreases in response to respiration and decay or steadily increases in response to photosynthesis. Superimposed upon this basic process is tidal fluctuation.

- DO Data Are Not Credible

A review of the datalogger information shows several major anomalies with the measurements. The results for PERIOD 3, for example, show elevated DO corresponding with low tide (see Figure 2). Several of the observations presented in the figure show that the probe is not properly recording the ambient DO when the tide is at its minimum or maximum. (See circled DO concentration values on Figure 2).

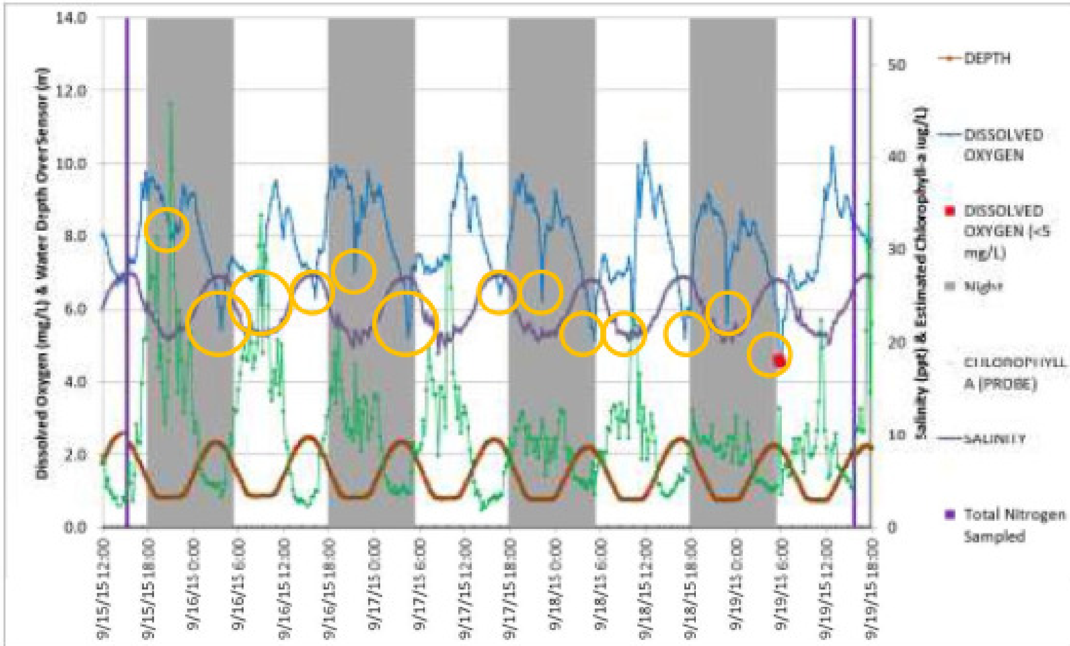


**Figure 2 – Cocheco River PERIOD 3 Datalogger Results**

This pattern is repeated throughout the survey period. Steep declines and increases are also seen to occur around high tide during the day and at night. This pattern suggests that the probe becomes fouled, causing the meter to report unusually low and inaccurate DO concentrations. Since these observations only occur at low tide and at high tide, they may be associated with changes in current velocity. However, regardless of the cause, sudden drops in DO concentration exceeding 1 mg/L are not real in a system of this size, as no source of DO deficit or high DO is identified capable of causing such rapid changes in DO readings.

A majority of the DO exceedances cited in the TSD as the basis for the impairment listing are associated with these anomalies, in particular the observations showing the lowest DO readings. For example, virtually all of the DO impairments identified in PERIOD 4 (TSD at 64) are sudden large drops in concentration followed by rapid increases. These anomalies undercut the reliability of the measurements and, at a minimum, should be removed from the record or the Department must explain the process in the conceptual model by which DO concentration can rapidly drop and then increase over such a short span of time.

- Linkage Between DO Impairment and Nutrient Cause Not Scientifically Defensible

In discussing the DO impairment, the TSD attempts to connect nutrient concentration to algal biomass (i.e., chl-a concentration) and algal biomass to low DO. Low DO, to the extent that any of the data are believable, is affected by multiple factors and the Department has not presented an assessment to show that any of these other factors are not otherwise responsible for the observed conditions. For example, watershed organic loading, sediment oxygen demand (associated with runoff from the watershed), and stratification are natural factors that are well known to contribute to reduced DO in estuarine tidal rivers.

Adjacent tidal areas (marshes, mudflats) are likely to contribute biochemical oxygen demand to the river, and this demand would be maximized at low tide when these areas drain into the river. These factors need to be assessed for significance to determine whether the observed conditions are primarily natural in origin.

- Aquatic Life Uses Not Impaired

As discussed in the GBMC comments on the CALM (at 7-8), the current DO water quality criteria are out of date and need to be amended. Using the most up-to-date information on DO criteria recommendations from USEPA, the extended periods of reduced DO illustrated for PERIOD 2 (TSD at 62) do not reach the level of impairment, whether or not the results are real. Consequently, this assessment zone for the Cocheco River should not be listed as impaired.

### iv. TN Impairment Comments

- Basis for Impairment Listing Not Defensible

The basis for listing the Cocheco River assessment unit as impaired for total nitrogen is presented in the TSD (at 54 – 55). In summary, this listing is based on the following considerations:

- The assessment zone experienced periodic DO concentrations below 5 mg/L.
- The chl-a 90th percentile concentration was 14.6 µg/L.
- The graphic assessment presented in the TSD demonstrates that the growth of algae is causing DO to fall below state standards.
- TN concentrations are high enough to result in these algal blooms. **2- 11**

Although the TSD acknowledges that recent and rapid TN reductions have occurred due to infrastructure investments and improved conditions are expected in the coming years, the assessment zone has been assessed as marginally non-supporting for TN.

As discussed in detail above, the assessments provided concerning algal biomass, DO impairments, and the link between these and TN load has not been demonstrated in a scientifically defensible manner. Moreover, it is not apparent that the observed measures are not due to natural conditions or other watershed sources of oxygen demanding constituents. Given this lack of scientific assessment and the acknowledgment that TN concentrations are at historically low levels, the proposed impairment listing should be withdrawn.

- Data Confirm TN Not Contributing to Impairment

The TSD notes that recent and rapid TN reductions have occurred due to infrastructure investments by the municipalities (Rochester and Dover) that began in 2014 and 2015. Prior to these improvements, the average TN was approximately 1,500 µg/L. (TSD at 59). The data presented above show ambient concentrations that are at least 70% less. Even with these significant reductions, the ambient monitoring data for chl-a, presented in the TSD (at 55), show no change in concentration. Without this connection, TN cannot be causing changes in DO and there is no basis to conclude that TN contributes to use impairments in this assessment zone. Consequently, the impairment listing should be removed for TN.

- Graphical Illustration Misleading

In presenting the available monitoring data for the Cocheco River (TSD at 58), a graph is presented with a dashed red line illustrating the median TN concentration for the Gulf of Maine. In other graphs presenting monitoring data for other constituents (i.e., chl-a, DO concentration, DO percent saturation, light attenuation), similar lines are shown to designate water quality criteria or assumed thresholds of impairment. The median concentration of TN in the Gulf of Maine is not an impairment threshold or any other ecologically relevant target for the Cocheco River. This should be deleted from the figure (and all others where it appears). In addition, any other lines that are not approved State water quality criteria should also be eliminated.

**2. Upper Piscataqua River**

**i. Background**

The Upper Piscataqua River is listed as impaired for eelgrass (5-P) and water clarity (5-P). The Upper Piscataqua River is potentially impaired (3-PNS) for DO concentration and TN.

Regarding the eelgrass impairment, the TSD (at 71) states:

> 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 2014-2016 is 0 acres, which is a decrease of 100%. Since 1990, the trend in eelgrass cover in this assessment zone is a loss of 69.9%. 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.

**2- 12**

Regarding the water clarity impairment, the TSD states:

> Median=1.025 m^-1 (n=81). 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. Therefore, the impaired (5-P) listing from the 2014 303d list has been retained.

Regarding the DO concentration potential impairment, the TSD states:

> 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.

Regarding the TN potential impairment, the TSD states:

> The median total nitrogen from 2011 through 2015 was 363 ug/L (n=94). 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 7.1 ug/L (n = 106) and a maximum reading of 24.5 ug/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=81)) is quite 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 (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.

### ii. Estuarine Bioassessment - Eelgrass Impairment Comments

Eelgrass in the Upper Piscataqua River was completely lost after the wasting disease episode, a natural cause, in the late 1980's and since remained depressed. Eelgrass in the Upper Piscataqua River ranged between 0.4-2.9 acres from 1996-2006 (TSD at 75). After 2006, the Upper Piscataqua River eelgrass was completely lost and surveys measured 0 acres in all annual surveys since then. As discussed in the Great Bay comments below, the losses in the late 1980's and 2006 were due to natural causes. Eelgrass in the Upper Piscataqua River has failed to rebound despite decreasing nutrient levels and consistently low chl-a. This does not render the area 303(d) impaired, as the primary cause of eelgrass loss is due to natural conditions. Therefore, this impairment should be removed.

### iii. Water Clarity Impairment Comments

Reduced water clarity in the estuary has been demonstrated to be naturally occurring and unrelated to eelgrass declines. See, comments for Great Bay Water Clarity Impairment listing. Therefore an impairment listing is inappropriate. Moreover, the TSD and CALM provide a median Kd threshold for eelgrass survival in Upper Piscataqua River based on mean water level (MWL) (TSD at 71; CALM at 70). If this median Kd value is exceeded, the waterbody is designated not supporting uses as it presumes existing eelgrass cannot survive in these waters. This is a regulatory presumption that lacks scientific support and is contrary to the very concept that narrative criteria apply only where specific data confirm aquatic life impairment. Therefore, this water clarity impairment should be removed.

### iv. DO Concentration Potential Impairment Comments

The only DO data below the DO WQS were measured using a data sonde. As discussed in detail earlier, these data are not reliable.

### v. TN Potential Impairment Comments

The TSD acknowledges that "the probe-based chlorophyll-a data…collected from the UPR stations was qualified as 'estimated' per USEPA, due to poor correlation between probe and extracted chlorophyll-a grab sample data" (TSD at 71). As such, these data should not be presented in graphs (TSD at 73).

The TSD states that "the grab sample-based light attenuation (median=1.025/m (n=81)) is quite poor suggesting strong resuspension in the system." (TSD at 71). This speculative statement should be removed as it is unsupported by data or information. Moreover, "resuspension" is not related to TN; it is a physical condition induced by the tidal velocity of the system – a natural condition. Furthermore, the tributaries of Great Bay Estuary have been demonstrated to have naturally poor water clarity. See Great Bay water clarity comments below.

The TSD recognizes that there is no DO issue in the Upper Piscataqua River. Therefore, TN cannot be causing excessive algal productivity resulting in low DO. As discussed in the Great Bay comments, TN is also not contributing to increased algal productivity resulting in reduced water clarity. Therefore, eelgrass declines in the estuary are plainly unrelated to TN-related water clarity changes.

As another potential indicator of TN-driven eutrophication in the Upper Piscataqua River, the TSD reports that changes in macroalgae appear to be occurring in Great Bay Estuary. The only support for this statement is that Dr. Arthur Mathieson, in 2012, was "concerned about the macroalgae and epiphyte condition in Great Bay." (TSD at 71-72). This is not documented reliable "evidence" to suggest that the Upper Piscataqua River may be impaired for TN – it is unsupported hearsay opinion. Furthermore, excessive levels of macroalgae and epiphytes in Great Bay must be attributed to TN from the Upper Piscataqua River before such a TN impairment can be designated. See also, Great Bay comments below.

For these reasons, the Upper Piscataqua River TN 3-PNS designation should be revised to reflect attainment.

### 3. Lower Piscataqua River – North

#### i. Background

The Lower Piscataqua River – North is listed as impaired (5-P) for eelgrass and potentially impaired for water clarity (3-PNS), chl-a (3-PAS), and TN (3-PAS) (TSD at 77).

Regarding the eelgrass impairment, the TSD (at 77) states:

> 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 2014-2016 is 1.4 acres, which is a decrease of 97.7%. Since 1990, the trend in eelgrass cover in this assessment zone is a loss of 54.5%. 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.

Regarding the potential water clarity impairment, the TSD (at 77) states: **2- 13**

> 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 2014 305(b) assessment has been retained.

Regarding the potential chl-a impairment, the TSD (at 77) states:

> The calculated 90th percentile chlorophyll-a in this assessment zone cannot be calculated due to the presence of only five measured values in since 2011 (1.2 to 3.0 ug/L). The chlorophyll-a indicator threshold to prevent low dissolved oxygen is a 90th percentile below 10 ug/L. The limited available data leads to an assessment of Insufficient Information – Potentially Attaining Standards.

Regarding the potential TN impairment, the TSD (at 77) states:

The median total nitrogen from 2011 through 2015 was 292 ug/L (n=2There are no documented dissolved oxygen concentration or saturation criteria exceedances 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)) is poor. 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.

#### ii. Estuarine Bioassessment - Eelgrass Impairment Comments

As discussed in the TSD, the historical extent of eelgrass in this assessment zone was 60.1 acres. Following the extensive outbreak of wasting disease in 1988 – 1989, eelgrass cover was reduced to approximately 20 acres. (See, TSD at 80). This is a 66% reduction from the historical extent, due to natural causes. There was a subsequent outbreak of wasting disease in 1999 – 2000, which further reduced eelgrass cover in this assessment zone to about 10 acres. All eelgrass cover was lost in 2007 and the area remained devoid of eelgrass over a period of 5 years. Since 2012, there has been slight recovery, but eelgrass cover remains below 5 acres.

The primary cause of eelgrass loss in this assessment zone has been due to wasting disease, a natural condition. Subsequent losses have no defined cause, but the historic flooding that occurred in 2006 combined with much higher than average rainfall between 2006 – 2010 are likely contributing factors as discussed in the comments on the CALM (at 19). Because the overwhelming evidence points to natural causes as the basis for the observed eelgrass loss, this impairment listing should be removed.

#### iii. Water Clarity Potential Impairment Comments (3-PNS)

This assessment unit is identified as potentially not supporting for water clarity (insufficient information) because the limited available data show a median light extinction coefficient of 0.756 $m^{-1}$ compared with the target value of 0.75 $m^{-1}$. Notwithstanding the comments presented for the CALM (at 13) that there is no justification for this target value, the impairment designation should be removed because this is a natural condition.

Morrison et al. (2008) studied light extinction in Great Bay Estuary and determined that light extinction is a function of ambient water quality in the Gulf of Maine, colored dissolved organic matter (CDOM), non-algal particulates (NAP), and chl-a. Of these, ambient water quality, CDOM, and NAP account for approximately 88% of the observed light extinction, and these factors are attributed to natural conditions. Moreover, the chl-a data for the assessment zone shows that algae likely contribute even less than 12%. Because the overwhelming evidence points to natural causes as the basis for the observed light extinction coefficient, this impairment listing should be removed.

### iv. Chl-a Potential Impairment (3-PAS) Comments

The assessment unit is classified as Insufficient Information – Potentially Attaining Standards for this parameter. The parameter assessment threshold (90th percentile chl-a ≤ 10 µg/L) is intended to prevent low dissolved oxygen. Notwithstanding comments submitted on the CALM (at 13) concerning the validity of this endpoint, it should be apparent that the assessment zone is fully supporting for chl-a and the listing should be amended accordingly.

The TSD notes that the available data for DO indicate that this assessment zone meets the DO criteria, which are more stringent than necessary to attain aquatic life uses. (See, Comments on CALM at 7). Consequently, chl-a concentration does not threaten compliance with the DO criterion. Moreover, the limited available data (TSD at 78) show that chl-a concentrations have never exceeded the 90th percentile concentration threshold.

### v. TN Potential Impairment (3-PAS) Comments

The assessment unit is classified as Insufficient Information – Potentially Attaining Standards for TN. In reaching this assessment, the TSD notes there are only two data points, DO and chl-a targets are achieved, but eelgrass beds are severely degraded and the light attenuation parameter does not appear to meet its target. As discussed above, issues regarding eelgrass cover and light attenuation are primarily associated with natural conditions. In addition, any adverse effects attributed to TN are mediated through excessive plant growth, such as algal growth. The overwhelming evidence indicates that algal growth is not excessive. Consequently, this assessment zone should be classified as fully attaining for this parameter.

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## 4. Lower Piscataqua River – South

### i. Background

The Lower Piscataqua River – South is listed as impaired (5-P) for eelgrass and potentially impaired for water clarity (3-PAS), chl-a (3-PAS), and TN (3-PAS) (TSD at 82).

Regarding the eelgrass impairment, the TSD (at 82) states:

> 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 2014-2016 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 29.5%. 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. **2- 14**

Regarding the potential water clarity impairment, the TSD states:

> 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 2014 305(b) assessment has been retained.

Regarding the potential chl-a impairment, the TSD states:

> The calculated 90th percentile chlorophyll-a in this assessment zone cannot be calculated due to the presence of only five measured values since 2011 (1.0 to 3.3 ug/L). The chlorophyll-a indicator threshold to prevent low dissolved oxygen is a 90th percentile below 10 ug/L. The limited available data leads to an assessment of Insufficient Information – Potentially Attaining.

Regarding the potential TN impairment, the TSD states:

> The median total nitrogen from 2011 through 2015 was 229 ug/L (n=2). 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.

### ii. Estuarine Bioassessment - Eelgrass Impairment Comments

Eelgrass throughout the estuary died off due to wasting disease in the late 1980's. In many areas, such as the Piscataqua River, the eelgrass failed to rebound to previous levels. In addition, eelgrass cover in the Lower Piscataqua River – South has remained especially depressed since 2007. This appears to be due to the 2006 Mother's Day Storm. Both wasting disease and extreme storms are natural causes. Therefore, no eelgrass impairment should be designated for the Lower Piscataqua River – South because this is a natural condition.

### iii. Water Clarity Potential Impairment Comments (3-PAS)

While not many data are available, the data indicate Kd values well below the 0.75 $m^{-1}$ impairment threshold. As discussed in previous water clarity impairment comments, the poor water clarity in the estuary is due to naturally occurring substances. As such, no impairment or potential impairment for water clarity should be designated for the Lower Piscataqua River – South.

### iv. Chl-a Potential Impairment (3-PAS) Comments

While not many data are available, the data indicate chl-a values well below the 10 ug/L impairment threshold. In fact, including all data presented since 2000, no chl-a measurement exceeded 4 ug/L. As such, no impairment or potential impairment for chl-a should be designated for the Lower Piscataqua River – South.

### v. TN Potential Impairment (3-PAS) Comments

The TSD acknowledges that there are no DO or light attenuation criteria exceedances in the limited data for the Lower Piscataqua River – South. The recent TN data are low, similar to the Gulf of Maine median level. As previously noted, the median concentration of TN in the Gulf of Maine is not an impairment threshold or any other target for the Lower Piscataqua River - South. This should be deleted from the TN figure (TSD at 85). As such, no potential TN impairment should be noted for the Lower Piscataqua River – South.

## 5. Portsmouth Harbor

### i. Background

The draft 303(d) list includes eelgrass (5-P) and water clarity (5-M) impairments for Portsmouth Harbor.

Regarding the eelgrass impairment, the TSD states:

> 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 2014-2016 is 65.4 acres, which is a decrease of 60.1%. Since 1990, the trend in eelgrass cover in this assessment zone is a loss of 40.4%. 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.

Regarding the water clarity impairment, the TSD states:

> 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 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. Due to the proximity of the Portsmouth WWTF, 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 2014 303d list has been retained.

**2- 15**

### ii. Estuarine Bioassessment - Eelgrass Impairment Comments

Eelgrass in Portsmouth Harbor was severely degraded after the wasting disease episode, a natural cause, in the late 1980's and has remained depressed. As shown in the TSD (at 98), following the outbreak of wasting disease, this assessment zone supported approximately 150 acres of eelgrass. Subsequently, a 2007 study identified a population of Canada geese grazing on eelgrass meadows in Portsmouth Harbor, focusing near Fishing Island. [1] These geese decimated eelgrass

[1] Rivers, D. and F.T. Short. 2007. Effect of grazing by Canada geese *Branta Canadensis* on an intertidal eelgrass *Zostera marina* meadow. Marine Ecology Progress Series, 333:271-279.

meadows in this area, and have failed to recover in subsequent surveys. All of these are natural events – with no indication of any man-induced pollution causes. The eelgrass losses in Portsmouth Harbor were due to natural causes (*e.g.*, wasting disease and Canada geese grazing). Furthermore, eelgrass in Portsmouth Harbor has failed to rebound despite decreasing nutrient levels and consistently low chl-a. Therefore, this impairment should be removed.

We also note a discrepancy in the reported eelgrass cover in Portsmouth Harbor. The figure in the TSD (at 98) cites data collected by Dr. Short as the basis for the trend analysis. The reported data do not match the eelgrass cover reported by Dr. Short in his 2015 survey report. [2]

### iii. Water Clarity Impairment Comments

The water clarity assessment for Portsmouth Harbor retains the previous impairment listing because the median light attenuation coefficient ($K_d = 0.593/m$) exceeds the threshold established for a 3 meter restoration depth ($K_d = 0.5/m$). Moreover, the assessment claims that 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. No data are presented to support this assertion. Until such data are presented for public review, this assertion should be deleted from the TSD.

The TSD also includes speculative comments concerning the cause of light attenuation in the assessment zone. The TSD should not speculate that "a large portion of light diminishment [is] from the large TSS load out of the [Portsmouth WWTP] discharge" and that this is causing eelgrass declines in Portsmouth Harbor until scientifically demonstrated. This demonstration has not yet been made and seems like an implausible scenario given significant dilution from Gulf of Maine ambient water as confirmed by the system hydrodynamic model (~500:1 dilution).

The TSD and CALM provide a median Kd threshold for eelgrass survival in Portsmouth Harbor based on mean water level (MWL) (TSD at 95; CALM at 70). If this median Kd value is exceeded, the waterbody is designated not supporting uses as it presumes existing eelgrass cannot survive in these waters. This is a regulatory presumption that lacks scientific support and is contrary to the very concept that narrative criteria apply only where specific data confirm aquatic life impairment. The water clarity threshold specified for the assessment zone is not supported by any scientifically defensible analysis and is explicitly contraindicated by the available data for the area. The light attenuation data presented in the TSD (at 97) shows that the median light attenuation coefficient has routinely exceeded the target for the entire period of record. Over this same time period, eelgrass cover has met the assessment zone target, based on the results reported by Dr. Short in his 2015 survey. Thus, the threshold is not necessary to protect the use upon which it was based. The Department needs to present the data supporting the proposed threshold and seek public comment on its suitability and necessity. In addition, water clarity in the estuary has been demonstrated to be unrelated to eelgrass declines, and in any event is primarily controlled by natural conditions. See, comments for Great Bay Water Clarity Impairment listing.

[2] Short, Frederick T., "Eelgrass Distribution and Biomass in the Great Bay Estuary for 2015" (2016). PREP Publications. Paper 354. http://scholars.unh.edu/prep/354

For all of these reasons, the water clarity impairment listing for Portsmouth Harbor should be removed.

**6. Back Channel at Portsmouth**

**i. Background**

The Back Channel at Portsmouth is listed as impaired for eelgrass (5-P) and water clarity (5-M).

**ii. Light Attenuation Impairment Comments** 2- 16

See Great Bay comments on water clarity. The poor water clarity throughout the estuary is due to natural substances. As such, no water clarity impairment should be designated for the Back Channel because this is a natural condition.

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**7. Little Bay**

**i. Background**

Little Bay is listed as impaired for estuarine bioassessments (eelgrass; 5-P) and water clarity (5-M). Little Bay is potentially impaired (3-PNS) for chl-a and TN.

For the chl-a potential impairment, the TSD (at 41) states:

> The calculated 90th percentile chlorophyll-a in this assessment zone is 11.0 ug/L (n = 59) and a maximum reading of 25.2 ug/L. The chlorophyll-a indicator threshold to prevent low dissolved oxygen is a 90th percentile below 10 ug/L. As chlorophyll-a is now close to the assessment threshold chlorophyll-a has been assessed as Insufficient Information – Potentially Not Supporting.

For the eelgrass impairment, the TSD (at 41) states: 2- 17

> 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 2014-2016 is 0 acres, which is a decrease of 100%. 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.

For the water clarity impairment, the TSD (at 41) states:

> Median=1.075 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 2014 303d list has been retained.

Regarding the 3-PNS designation for TN, the TSD states that, "at this time there are some of the classic indicators of nutrient eutrophication present in this assessment zone and total nitrogen remains elevated." Some of these indicators include the presence of macroalgae, slightly elevated chl-a, poor water clarity, and the loss of historic eelgrass beds. Yet, the TSD recognizes that "there is not a statistically significant trend in total nitrogen over the 2003 to 2015 time period."

#### ii. Chl-a Potential Impairment (3-PNS) Comments

As discussed in the TSD, the impairment indicator for chl-a is based on prevention of DO water quality impairments. The available water quality data for Little Bay show no concerns for attaining the DO water quality standard, with the DO assessment concluding that the available data indicate the assessment zone meets the DO concentration criteria. Moreover, data presented in the TSD for DO (at 42) confirm this to be the case based on hundreds of measurements over decades.

It makes no sense to list these waters as potentially not supporting designated uses for chlorophyll-a, as a surrogate for DO impairment, when the actual DO data confirm that no such impairment is present based on 15 years of record. Therefore, this listing should be revised to fully supporting.

#### iii. Estuarine Bioassessment – Eelgrass Impairment Comments

Eelgrass in Little Bay were almost completely lost after the wasting disease episode, a natural cause, in the late 1980's and have remained depressed since then. Eelgrass in Little Bay ranged between 4-33 acres from 1996-2006.[3] However, after 2006, Little Bay eelgrass was completely lost and surveys measured 0 acres in 7 of the annual surveys from 2007-2016. As discussed in the Great Bay comments below, the losses in 2006 were due to natural causes, and poor water clarity is natural and has been unrelated to eelgrass losses in the estuary. Furthermore, eelgrass in Little Bay have failed to rebound despite decreasing nutrient levels and consistently low chl-a. Therefore, this impairment should be removed.

#### iv. Water Clarity Impairment Comments

See comments for Great Bay Water Clarity Impairment listing.

#### v. TN Potential Impairment (3-PNS) Comments

The TSD recognizes that there is no DO issue in Little Bay. Moreover, as discussed in the Great Bay comments, TN is also not contributing to algal productivity resulting in reduced water clarity. Moreover, eelgrass declines in the estuary are unrelated to water clarity. Because TN is

[3] Short, Frederick T., "Eelgrass Distribution and Biomass in the Great Bay Estuary for 2015" (2016). PREP Publications. Paper 354. http://scholars.unh.edu/prep/354

not causing any of these potential adverse impacts in Little Bay, this 3-PNS designation should be revised to indicate no TN impairment exists in Little Bay.

## 8. Great Bay

### i. Background

As discussed in the TSD, DES has started with an unfounded presumption that the Great Bay Estuary is suffering from the classic signs of eutrophication and the various impairment listings are parameters linked to nutrients. This overall assessment is attributed to the 2013 PREP Estuaries Report (TSD at 4). Both the CALM and the TSD, as well as the 2013 PREP Estuaries Report relied on NHDES' 2009 Numeric Nutrient Criteria for the Great Bay Estuary (June 2009). This document was a draft and was the focus of an independent peer review in 2014. That peer review concluded that the analyses presented in the draft criteria were not scientifically defensible.[4] Based on this assessment, DES revised the assessment status of the Great Bay Estuary in 2014. Consequently, the 2013 PREP assessment and any references to the 2009 draft Numeric Nutrient Criteria must be stricken from the 2016 Integrated Report and its supporting documents.

DES's presumption of eutrophication is premised on an overly simplistic conceptualization of Great Bay. The cited classic signs of eutrophication DES identified in the TSD are increasing nitrogen concentration, low dissolved oxygen, and disappearing eelgrass habitat (TSD at 4). This conceptual model is based on the estuarine eutrophication model used by NOAA, which relates external nutrient inputs to the primary and secondary symptoms of eutrophication (CALM at 44). According to this model, external nutrient inputs stimulate the growth of phytoplankton and macroalgae, which then causes cascading effects. **2- 18**

If external nutrient inputs stimulate the growth of phytoplankton, the excess phytoplankton biomass contributes to an increase in light extinction, which has a negative effect on eelgrass growth due to a reduction in the amount of light that reaches the blades of grass, particularly in deeper areas of the habitat. In addition, the excess biomass contributes to depressed DO concentration, particularly before sunrise, associated with phytoplankton respiration. Finally, the excess biomass will eventually settle and exert an increase in sediment oxygen demand, which will depress the overall DO concentration in the receiving water.

If external nutrient inputs stimulate the growth of macroalgae. Excess macroalgae biomass adversely affects eelgrass by blocking light, habitat competition, and reducing the lower benthic boundary DO concentration. In addition, when the macroalgae die, they contribute to the overall oxygen demand in the receiving water (CALM at 71).

This conceptual model does not appear to be applicable to conditions in the Great Bay Estuary, and in particular for Great Bay. The Bay does not experience low DO concentration, except at boundary areas that reflect riverine conditions at low tide (not associated with the conceptual model), and there are no DO impairment issues elsewhere in the estuary (Little Bay, Lower

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[4] Bierman, V., Diaz, R., Kenworthy, W. and Reckhow, K. February 13, 2014. Joint Report of Peer Review Panel for Numeric Nutrient Criteria for the Great Bay Estuary. New Hampshire Department of Environmental Services. June, 2009.

Piscataqua River, or Portsmouth Harbor). The concentration of phytoplankton chlorophyll-a has remained relatively low and does not show any change in response to varying levels of dissolved inorganic nitrogen (DIN) or TN in the estuary.

Water clarity is naturally relatively poor in the estuary. This is primarily due to the input of colored dissolved organic matter (CDOM) and non-algal particulates (NAP) from the watershed. This natural condition reduces water clarity below the eelgrass restoration depth targets specified in the CALM (at 70).

#### ii. TN Potential Impairment (3-PNS) Comments

The TSD states that Great Bay "has been assessed as Insufficient Information – Potentially Not Supporting (3-PNS) for total nitrogen." (TSD at 34). Total nitrogen concentrations in Great Bay Estuary are conceptually an aquatic life concern for several reasons. Excess TN in estuaries can fuel excess phytoplankton and macroalgal growth which can result in the depletion of DO in the water column. Known as eutrophication, this process can adversely affect aquatic life, potentially resulting in mortality. Another conceptual process through which TN can adversely impact aquatic life is a reduction in water clarity due to high phytoplankton levels such that eelgrass receive inadequate light for photosynthesis. This can result in reduced eelgrass cover and biomass.

The manner in which nutrients affect the primary and secondary responses to external nutrient loads is complex and it is inappropriate to presume that the presence of one or several of these eutrophication responses confirms that external nutrient loads are the cause. DES is required to demonstrate that the external nutrient loads are a significant factor causing eutrophic conditions (See, 40 C.F.R. § 122.44(d) and State law).

Graphs including the Squamscott River station should be removed as it is representative of the conditions in the Squamscott River more so than Great Bay. This is evident when comparing the Great Bay TN graphs including and excluding Stations GRBAP and GRBSQ (TSD at 39) with the Squamscott River TN graph (TSD at 18) (note the changes in scales). The data demonstrate that the Squamscott River conveys high TN levels to Great Bay causing elevated TN concentrations for which more northern Great Bay communities cannot be held responsible.

The TSD graphs of TN over time include a reference line indicating the Gulf of Maine median TN. This line should be removed as, in this context, it implies a target threshold. This is misleading, such a threshold has never been derived and approved by DES or EPA, and compliance with such a threshold is unrealistic.

Moreover, the TSD states that there is no "statistically significant trend in total nitrogen over the 2003 to 2015 time period." (TSD at 33). While perhaps not statistically significant, it is clear that both TN and DIN (Figure 1) concentrations have been decreasing, especially since around 2008. The TSD should recognize this, especially in light of the ongoing nitrogen reductions throughout Great Bay over this timeframe.

Data collected in Great Bay show that TN concentrations have been reduced significantly to levels well below those that occurred in the early 1990's, when eelgrass were considered fully supporting the designated use, and are below the concentrations determined to fully support designated uses elsewhere (*e.g.*, SMAST, Chesapeake Bay). Concurrent with these lower TN levels, eelgrass beds are apparently still degraded in comparison with prior years. Moreover the 2014 Peer Review expressly concluded that the "weight of evidence" does not indicate TN is causing impairment in this system.

Monitoring of the estuary shows that overall phytoplankton chl-a levels have remained constant over an extended period of time, even though external nutrient loads have substantially changed (Figure 3).

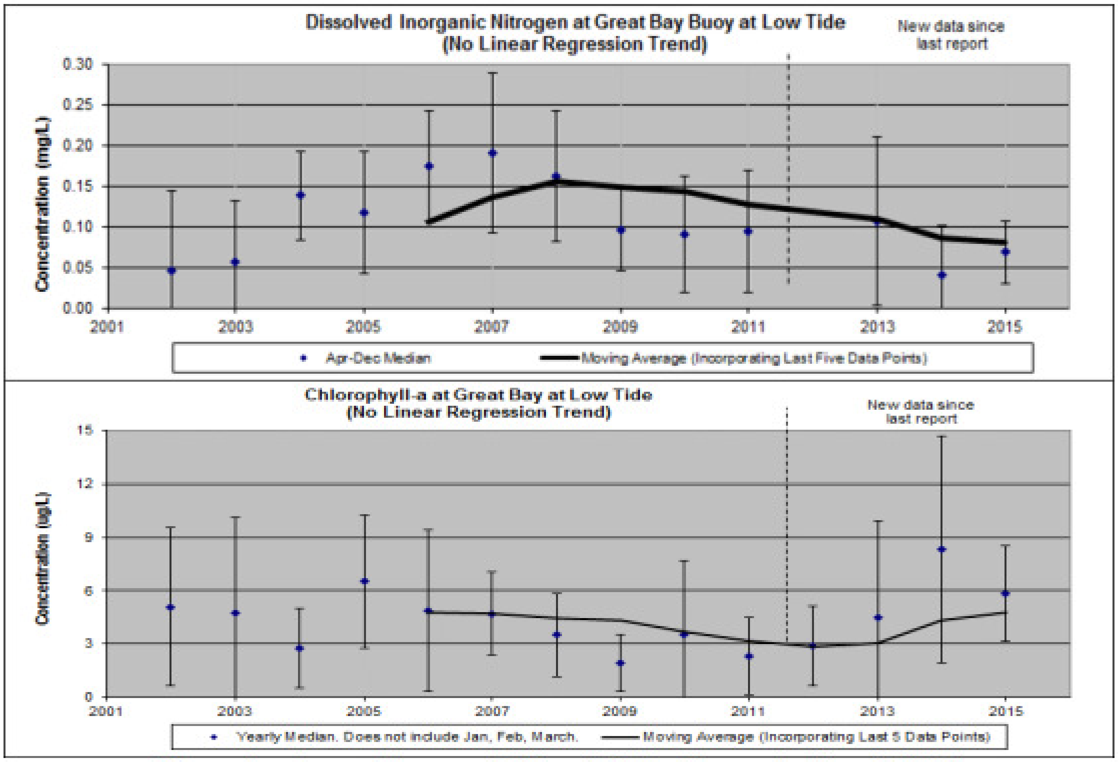



**Figure 3 – Annual Average DIN and Chl-a Concentration (PREP)**

This suggests that external nutrient load is not a significant factor contributing to eutrophic aquatic life impacts. If the primary symptoms of eutrophication do not respond to external nutrient inputs, there can be no relationship between external nutrient inputs and secondary eutrophication symptoms warranting an impairment designation. The available data and information for Great Bay indicates that TN is not causing an aquatic life use impairment and should therefore, the 303(d) listing should be revised to reflect this determination.

### iii. Chl-a Potential Impairment (3-PNS) Comments

The TSD states that the "chlorophyll-a indicator threshold to prevent low dissolved oxygen is a 90$^{th}$ percentile below 10 ug/L. [...] As chlorophyll-a is now close to the assessment threshold chlorophyll-a has been assessed as Insufficient Information – Potentially Not Supporting [3-PNS]." (TSD at 33).

While the TSD excludes Stations GRBAP and GRBSQ from the 90th percentile calculation, these stations' chl-a data are graphed regardless. Graphs including the Squamscott River station should be removed as it is representative of the conditions in the Squamscott River more so than Great Bay. This is evident when comparing the chl-a graphs including and excluding Stations GRBAP and GRBSQ (TSD at 34-35) with the Squamscott River chl-a graph (TSD at 16) (note the change in scales). The data demonstrate that the Squamscott River, along with other tributaries (*e.g.*, Lamprey River – North (TSD at 20)), conveys high algal levels to Great Bay causing the chl-a violations for which more northern Great Bay communities cannot be held responsible. Therefore, Great Bay's supposed chl-a impairment should be removed from 303(d) listing.

Moreover, the source of high chl-a levels in the Squamscott River has been attributed to the lagoon system at Exeter's WWTP. As such, the source on the 303(d) list should be revised from "Unknown" to recognize the identified source at Exeter's WWTP.

**iv. DO Concentration Potential Impairment (3-PNS) Comments**

The TSD states that Great Bay was assessed as Insufficient Information – Potentially Not Supporting (3-PNS) for DO.

The graph including the Squamscott River station DO should be removed as Station "GRBSQ more accurately represents the conditions in the Squamscott River than the entirety of Great Bay proper…" (TSD at 33). This is evident when comparing the chl-a and DO graphs including and excluding Stations GRBAP and GRBSQ (TSD at 34-36) with the Squamscott River chl-a and DO graphs (TSD at 16) (note the change in scales). The data demonstrate that the Squamscott River conveys high algal levels and lower DO to Great Bay causing the DO violations for which more northern Great Bay communities cannot be held responsible. Moreover, the 3-PNS designations are applied to waters with one exceedance (TSD at 13). All current Great Bay DO data (excluding GRBAP and GRBSQ) indicate compliance with the DO WQS. Therefore, Great Bay's DO 3-PNS designation should be revised to an Assessment Database (ADB) Category of 2, representing no impairment.

**v. Water Clarity (Kd) Impairment Comments**

The TSD states that Great Bay is impaired for water clarity (5-M) as the light attenuation coefficient (Kd) threshold (0.75 $m^{-1}$) associated with a 2 m (measured below MWL) eelgrass restoration depth has been violated. Great Bay is shallow with a tidal range of 2 m. At low tides, large portions of Great Bay are exposed as mudflats, rendering the water clarity irrelevant at those times. Moreover, the mean water level for much of Great Bay is only roughly 1 m. Accordingly, a restoration depth of 2 m results in an overly conservative Kd impairment threshold in Great Bay. Therefore, the Kd impairment thresholds and designation for Great Bay must be revised. In any case, before this Kd threshold can be used to assess aquatic life use attainment in Great Bay Estuary, DES must provide the basis and back-up information used to derive and justify this threshold for impairment, and the public must be given the opportunity to review and comment on this justification. **2- 19**

The TSD light attenuation graph including the Squamscott Station should be removed as GRBSQ reflects the conditions in the Squamscott River, not Great Bay (TSD at 37-38). This is evident when comparing the light attenuation graphs including and excluding Stations GRBAP and GRBSQ (TSD at 37-38) with the Squamscott River light attenuation graph (TSD at 17) (note the changes in scales). The data demonstrate that the Squamscott River conveys elevated Kd levels to Great Bay contributing to light attenuation violations for which Great Bay communities cannot be held responsible. Furthermore, the Kd graphs include a "Minimum for Survival Indicator (median)" line, which seems to imply that eelgrass will not survive at Kd values below this value. This is misleading as the Kd routinely exceeds the 0.75 $m^{-1}$ level and yet eelgrass grow widely in Great Bay. Monitoring data reported by PREP show that Kd averaged about 1.1/m in Great Bay prior to 2005, when eelgrass cover exceeded the historical extent identified in the TSD and were not considered impaired. Since there was no narrative criteria violation prior to 2005, when Kd averaged about 1.1/m, it is arbitrary and capricious for the Department to use Kd = 0.75/m as a threshold for eelgrass impairment. Thus, the claimed "minimum required for survival" Kd is obviously misplaced based on the actual eelgrass growth in this system.

The conceptual model relates Kd to external nutrient loads through the growth of phytoplankton (measured as chl-a). As the phytoplankton biomass increases, the cells absorb and/or scatter light resulting in greater light attenuation and less light reaching the eelgrass beds. Consequently, for water clarity to be associated with total nitrogen (*i.e.*, the directly human controlled variable), this link through phytoplankton must be present. It is not. As illustrated in Figure 4, ambient concentration of chl-a shows no statistical trend over a period of 25 years.

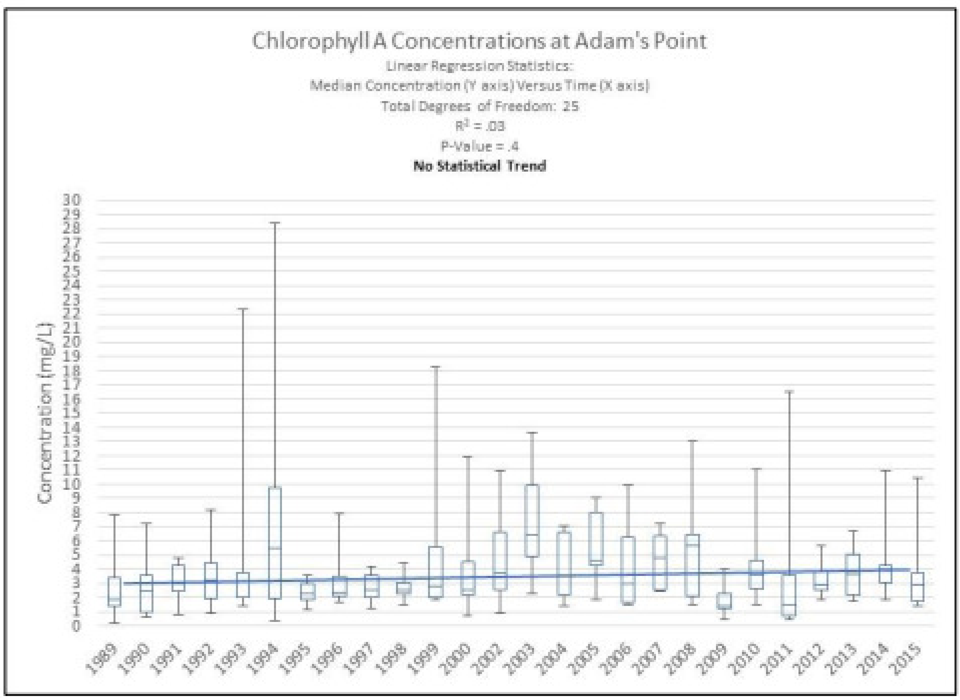



**Figure 4 – Trend in Median Chl-a Concentration (PREP)**

Over this time period, the Kd measured in Great Bay has varied substantially. (See, GBMC Comments on CALM at 13). This would suggest that chl-a is not a significant factor causing changes in water clarity. In fact, the factors contributing to light attenuation in the Great Bay Estuary have been scientifically evaluated. (See, Morrison et al. 2008). Morrison et al. (2008)

determined that CDOM, NAP, and the ambient water were the primary contributors to light attenuation, accounting for 88% of the overall attenuation. The chl-a contribution to water clarity was calculated to be minor in comparison. Step 3 in the CALM's Process for Determining Waters that Belong on the 303(d) List states that:

> exceedance of most water quality criteria due to naturally occurring conditions are allowed and are not considered violations of the water quality standards. Since such waters are not technically in violation of the standards, a TMDL is not necessary for waters impaired or threatened by naturally occurring sources. (CALM at 30).

The CALM also states that if the *primary* source is natural, the waterbody will not be considered impaired (CALM at 30). Given that 1) the primary sources of water column light attenuation are naturally occurring conditions, and 2) chl-a is not a primary or even secondary source of water column light attenuation, Great Bay should not be listed as impaired due to light attenuation.

Furthermore, if the recent measurements of eelgrass cover are compared to the corresponding measurements of median monthly Kd at the Great Bay buoy, the results show that either eelgrass cover increases as water clarity decreases (contrary to the conceptual model) or there is no relationship between the two, even as light transmission increases by 200% (Figure 5).

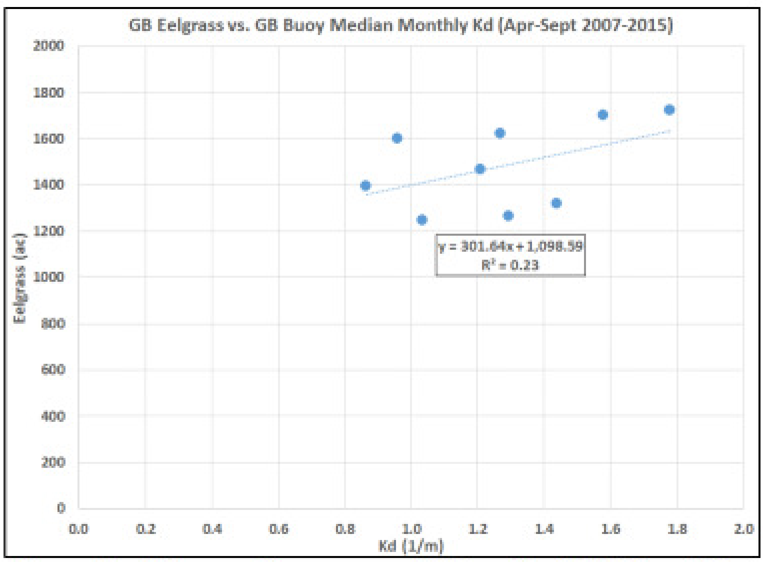



**Figure 5 – Eelgrass Cover versus Water Clarity in Great Bay**

Higher Kd values represent greater light limitation. This indicates that, counter to the conceptual model, Great Bay eelgrass cover tends to increase with increasing light limitation, barring an extreme storm event of similar magnitude to the 2006 Mother's Day Storm. This further confirms that Great Bay eelgrass beds are not declining in response to light limitation and therefore, Great Bay's Kd impairment should be removed from 303(d) listing.

### vi. Estuarine Bioassessment – Eelgrass Impairment Comments

The 303(d) list reports Great bay as impaired (5-P) for estuarine bioassessments (eelgrass) (TSD at 33).

Indicator 8, under Aquatic Life Uses, describes how eelgrass cover in the Great Bay Estuary is assessed to determine whether aquatic life uses are being supported. (CALM at 66 – 68). This indicator provides that uses are not supported if declines in eelgrass cover from historic levels exceed 20% or if an evaluation of recent trends in the eelgrass cover indicator show a 20% loss in the indicator, based on a linear regression of eelgrass cover versus year.

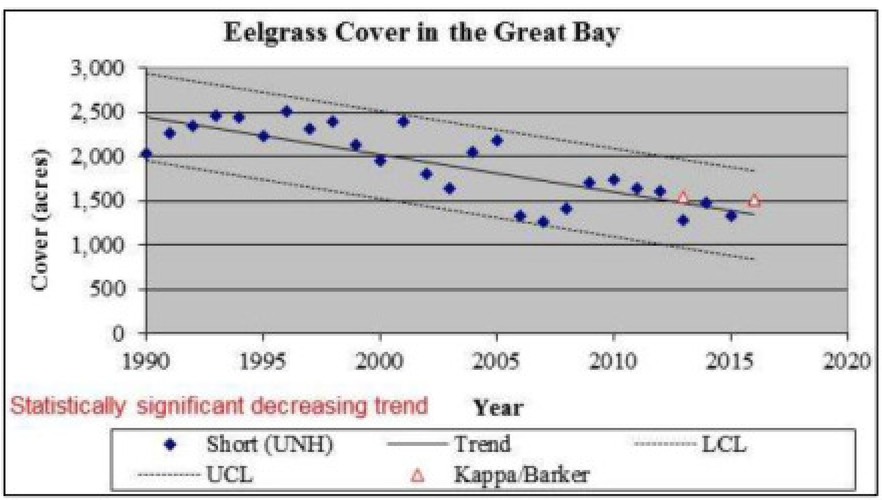
The CALM further provides that NHDES may also consider trends in eelgrass biomass as supplemental information. "Biomass is calculated by multiplying the eelgrass area by the eelgrass density (PREP, 2012)." NHDES may also consider published reports about the proliferation of macroalgae and its impact on eelgrass.

In assessing Great Bay as impaired for estuarine bioassessments (eelgrass), the TSD provides the following support:

> 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 2013-2016 is 1464 acres, which is a 31% decrease. Since 1990, the trend in eelgrass cover in this assessment zone is a loss of 26.4%. 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.

2- 20

(TSD at 33)




(TSD at 38)

The figure in the TSD at 38 is intended to show a decreasing trend in eelgrass cover in Great Bay, and the narrative presented in the TSD indicates that the eelgrass losses are significant and show the Bay is impaired. However, this simple linear regression overlooks several key considerations that, when properly evaluated, demonstrate that losses in eelgrass cover can be attributed to natural conditions. When these natural conditions are factored into the evaluation, eelgrass cover has been stable in Great Bay.

It is well known that eelgrass cover in the estuary has been affected by wasting disease.[5] Specifically, most of the eelgrass in North America and Europe was decimated by an outbreak of wasting disease, caused by the slime mold, *Labyrinthula zostera*, in 1931 – 1932. Based on the historical record, it took decades for eelgrass recovery in the Great Bay Estuary. Wasting disease again decimated the eelgrass population in Great Bay in 1988 – 1989, causing an 85% reduction in eelgrass cover. A small wasting disease outbreak was reported in 1995, and additional outbreaks of wasting disease were reported in 1999 – 2000 and 2002 – 2003. Wasting disease is a natural condition that adversely affects eelgrass cover. The plot evaluating trends in eelgrass cover must remove incidences of wasting disease from the assessment.

Eelgrass cover is also affected by other natural phenomena. One such phenomenon is severe storm events. Significant increases in precipitation and flooding, particularly immediately prior to or during the growing season, has been identified as a primary driver of seagrass loss and inter-annual variability in Chesapeake Bay and other estuaries (Wang and Linker, 2005).[6] One such event occurred in 2006. From May 11-15, 2006, an extreme storm produced 14 in. of precipitation that resulted in regional flooding around Great Bay Estuary. The return frequency of this storm caused exceedances of the 100-year peak stream flow at most streamgages around Great Bay Estuary.[7]

Prior to the 2006 Mother's Day Storm, eelgrass cover throughout Great Bay was extensive. Following the storm, cover measured at the end of the growing season showed significant losses in eelgrass cover, particularly in the areas adjacent to the major tributaries (*i.e.*, Lamprey River, Squamscott River, Winnicut River), which conveyed the excess flow to the Bay. This is clearly illustrated in Figure 6. Figure 6 illustrates eelgrass cover in Great Bay for 2004, 2005, and 2006. Measured eelgrass cover for 2006 is illustrated in green overlying the measured eelgrass cover for 2004 and 2005, illustrated in black. The black areas represent the areas where measurable eelgrass cover was lost in 2006 compared with the previous two years.

Prior to the 2006 Mother's Day Storm, measurable eelgrass cover in Great Bay averaged 2,285 acres, with small inter-annual shifts in location. Following 2006 through 2013, measurable eelgrass cover never returned to several areas of the Bay that previously continually supported eelgrass cover (See, Figure 7; red circles illustrate areas that used to support measurable eelgrass cover prior to 2006), and measurable eelgrass cover has only averaged 1,473 acres during the period from 2006 - 2016. The areas that no longer support measurable eelgrass cover exceed 300 acres. The fact that measurable eelgrass cover has not returned to these areas in eight continuous years of record suggests that these areas no longer provide suitable habitat for eelgrass growth. This should be evident given that eelgrass cover rebounded by 1,700 acres in 1990 (from about 300 acres to 2,000 acres). Eelgrass have a tremendous potential to repopulate areas via seed dispersal, as evidenced in 1990. Since a much greater population of eelgrass (approximately

[5] See, Methodology and Assessment Results related to Eelgrass and Nitrogen I the Great Bay Estuary for Compliance with Water Quality Standards for the New Hampshire 2008 Section 303(d) List. NHDES. August 11, 2008, at 8 – 15 for a detailed history of eelgrass cover and the effects of wasting disease in the Great Bay Estuary.
[6] Wang, P. & Linker, L.C. 2005. Effect of timing of extreme storms on Chesapeake Bay submerged aquatic vegetation. Hurricane Isabel in perspective. CRC Publication 05-160: 177–184.
[7] Olson, S.A., 2007, Flood of May 2006 in New Hampshire: USGS Open-File Report 2007.

1,500 acres) has been unable to re-establish eelgrass cover in these regions, the only plausible explanation is that the habitat no longer supports their growth. The CALM considers habitat degradation to be a non-pollutant cause of impairment and a natural condition.

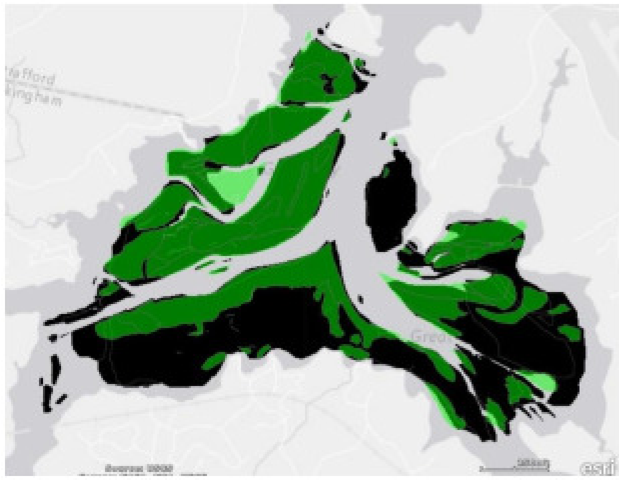


**Figure 6 – Eelgrass cover in Great Bay before and after the 2006 Mother's Day Storm**

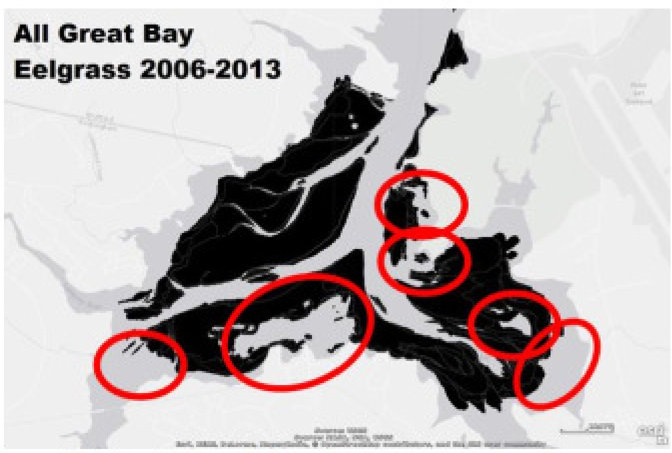



**Figure 7 – Areas in Great Bay that no longer support eelgrass cover since 2006**

If the eelgrass cover data illustrated in the TSD on page 38 are replotted to eliminate years of known wasting disease, and separated into periods prior to the 2006 Mother's Day Storm and after the storm, we find that eelgrass cover was stable prior to the storm and after the storm (Figure 8). However, after the storm the eelgrass cover supported by the Bay was reduced in comparison with the amount of eelgrass cover observed before the storm. This change occurred over the course of one growing season (2006) and has resulted in a stable amount of growth at a level approximately 30% lower than previously observed. During the 2006 growing season, there was a catastrophic flood that affected the entire region. This flood is the cause of the change and is a natural condition.

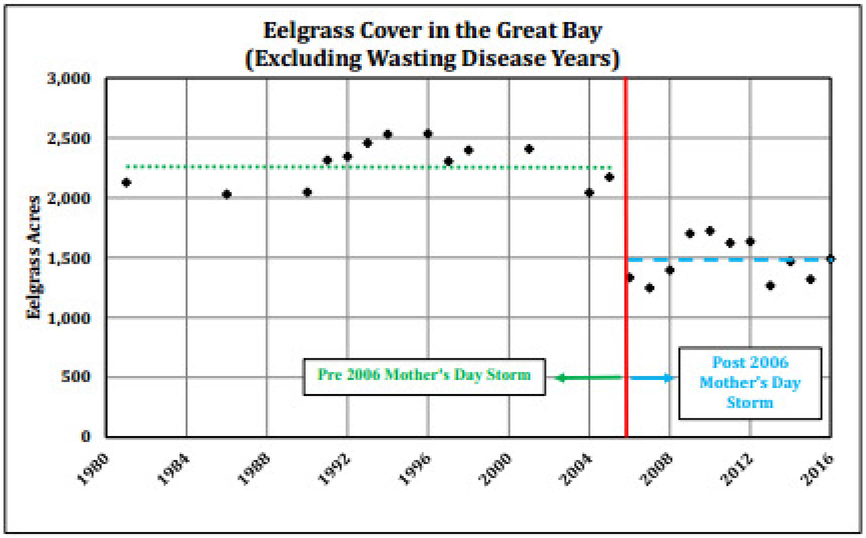



**Figure 8 – Eelgrass Cover in the Great Bay before and after the 2006 Mother's Day Storm**

Eelgrass cover remained stable at all depths of growth prior to and following the 2006 Mother's Day Storm event. The NH DES prepared an evaluation of eelgrass cover sorted by water depth below mean tide level for the period from 1981 through 2014 using the same data presented in the TSD. These data are illustrated in Figure 9a for the period prior to the 2006 Mother's Day Storm (1981 – 2005) and in Figure 9b for the period following the 2006 Mother's Day Storm (2006 – 2014). These data show that the cause for the eelgrass loss was not mediated through transparency, since losses occurred at all depths. Moreover, on either side of the event, eelgrass cover has remained relatively stable for an extended period of time (13 years before 2006 and 11 years since 2006). Over this time period, water clarity has varied substantially. If the decrease in eelgrass cover following 2006 was mediated by water clarity, these long periods of stable growth would not exist.

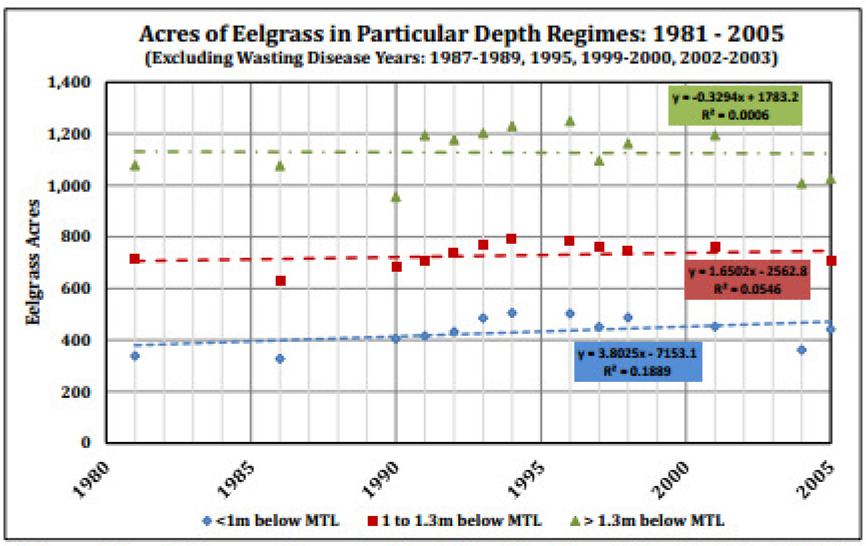



**Figure 9a – Eelgrass Cover by Depth in the Great Bay (1981 – 2005)**

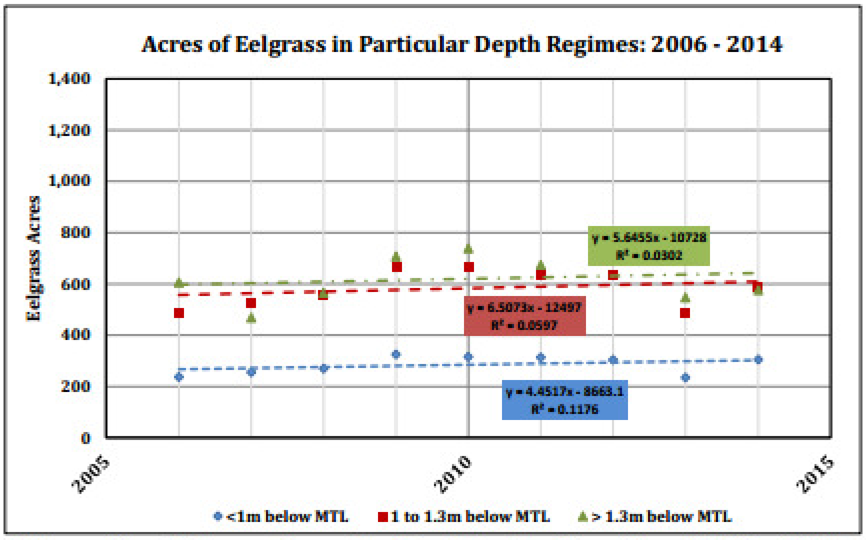



**Figure 9b – Eelgrass Cover by Depth in the Great Bay (2006 – 2014)**

Based on the observations presented above, the instantaneous shift in eelgrass cover in Great Bay beginning in 2006 was caused by natural conditions and do not represent an impairment of the estuarine bioassessment metric. As illustrated in Figure 8, the conditions that occurred in 2006 caused a reduction in total eelgrass cover in Great Bay and those conditions continue to persist.

The CALM states that:

> exceedance of most water quality criteria due to naturally occurring conditions are allowed and are not considered violations of the water quality standards. Since such waters are not technically in violation of the standards, a TMDL is not necessary for waters impaired or threatened by naturally occurring sources. (CALM at 30).

Based on the available information for the system, the primary causes of the eelgrass declines have been "naturally occurring conditions." As such, Great Bay should not be categorized as impaired for eelgrass in accordance with the CALM.

### a) Historical Eelgrass Cover Reliability

Annual eelgrass cover in Great Bay Estuary has been calculated from single day aerial photos typically between late August and early September.[8] Eelgrass beds are delineated and mapped based on the photos. The TSD states that the historical extent of Great Bay eelgrass, to which current levels are compared in impairment determinations, were based on eelgrass measured in 1948, 1962, 1980, and 1981 (TSD at 33). Even with current photographic and computational technologies, the US Army Corps of Engineers notes that "[i]t is not possible to reliably distinguish between eelgrass and macroalgae, or between different species of eelgrass or other seagrasses, using aerial imagery. Aerial photography is also likely to underestimate eelgrass

[8] Short, Frederick T. and Trowbridge, Phil, "UNH Eelgrass (Zostera marina) Monitoring Program for 2010-2014: Quality Assurance Project Plan" (2010). PREP Publications. Paper 350. http://scholars.unh.edu/prep/350

coverage because eelgrass occurring in deeper waters can appear dark and may not be detected."[9] This calls into question the accuracy and reliability of the Great Bay Estuary eelgrass measurements, especially these historical levels. Importantly, the aerial photos from which the eelgrass cover is calculated have never been made publicly available. As a critical component in determining the condition of eelgrass in the estuary and WQS attainment, these photos must be made available for public review to ascertain the accuracy and reliability of the eelgrass measurements. If the 1948 and/or 1962 eelgrass measurements were not based on photography, the basis for these critical eelgrass cover measurements have never been, but must be, presented for public review prior to use as an impairment threshold.

Furthermore, the timing of peak eelgrass cover varies over growing season from year to year. Thus, it is inaccurate to report a single day measurement as definitively the annual peak cover or to make comparisons between years. Dr. Fred Short's SeagrassNet eelgrass measurements confirm this observation.[10] Based on SeagrassNet eelgrass cover data in Great Bay, annual peak cover can occur anytime between July and October. Therefore, a late August to early September snapshot of eelgrass cover should be assessed as neither an annual maximum nor a necessarily accurate representation of eelgrass cover and condition for the year, especially given the potential regulatory implications of eelgrass impairment assessments based solely on these measurements.

#### b) Evaluating Trends in Biomass

As noted earlier, the CALM (at 67 – 68) provides that NHDES may also consider trends in eelgrass biomass, with biomass calculated by multiplying the eelgrass area by the eelgrass density (PREP, 2012). The relationship between eelgrass biomass and eelgrass density, as provided in PREP (2012), was originally provided to PREP by Dr. Fred Short (UNH), but these relationships have never been verified and the data upon which they were based have been lost by Dr. Short. Dr. Short and the UNH Seagrass Ecology Group generated the eelgrass percent cover and biomass were previously presented in Table 1. This relationship indicates an order of magnitude increase in biomass when eelgrass percent cover increases from the 10-30% range to 90-100%. Increasing eelgrass percent cover from the 60-90% range to 90-100% range reportedly results in a corresponding threefold biomass increase.

This relationship provided by Dr. Short varies significantly from relationships published in peer reviewed scientific journals. Carstensen et al. (2016) report that instead of a steep increase in biomass corresponding to percent cover increases, eelgrass biomass levels off as percent cover increases above roughly 25%, largely due to self-shading.[11]

This relationship was developed using real, recorded eelgrass data and a reproducible scientific method as opposed to Dr. Short's cover-biomass relationship which has never been peer-reviewed or assessed for accuracy. The CALM should not use biomass in eelgrass impairment

[9] US Army Corps of Engineers. May 27, 2016. Components of a Complete Eelgrass Delineation and Characterization Report.
http://www.nws.usace.army.mil/Portals/27/docs/regulatory/Forms/Components%20of%20Eelgrass%20Delineation%205-27-16.pdf?ver=2016-05-27-131522-740

[10] SeagrassNet. New Hampshire / Great Bay, USA in Temperate North Atlantic, Percent Cover. http://www.seagrassnet.org/percentcover/NH9.2

[11] Carstensen, J., D. Krause-Jensen, T.J.S. Balsby. 2016. Biomass-Cover Relationship for Eelgrass Meadows. Estuaries and Coasts, 39:440-450.

assessments until, at a minimum, an eelgrass cover-biomass scientifically defensibly relationship is developed and peer-reviewed.

## COMMENT #3: Dawn Tuomala, Town of Merrimack

From: Sarita Croce <scroce@merrimacknh.gov> Sent: Fri 6/23/2017 2:55 PM
To: DES: 303d Comment
Cc: Dawn Tuomala; Kyle Fox; Jim Taylor; Edwardson, Ken
Subject: Town of Merrimack NH 303(d) Comments

Message | Town of Merrimack NH - 303(d )Comments June-23-2017.pdf (11 MB) | Town of Merrimack Response to 303d list June-23-2017.pdf (44 KB)

Dear Mr. Edwardson:

Please find attached for your review the Town of Merrimack's (Town) comments on Sections 303(d) list of impaired waters in the State of New Hampshire. The list was prepared by the New Hampshire Department of Environmental Services (NHDES) in accordance with the Federal Clean Water Act.

As NHDES is already aware, the final MS4 requirements includes Outfall Sampling Program and a detailed Annual Program Evaluation with SWMP revisions customized to achieve verifiable improvements in surface water quality. The Town is rather concerned that the data in the 303(d) list which in some cases is up to 27 years old does not accurately reflect current water quality conditions. As a result, the Town may be required to commit a substantial amount of Town funds for erroneous sampling activities. Therefore, the Town is respectfully requesting NHDES to revisit the comments made on the 303(d) list and include notations for data that is greater than 5 years old. In addition, water bodies whose impairment is based on data which is greater than 10 years old, should identify improvements made which can positively affect the water quality.

The comments were prepared by Dawn Tuomala, DPW Deputy Director, and Sarita Croce, Industrial Pretreatment Manger. Below is our contact information:

Dawn Tuomala
Deputy DPW Director/Town Engineer 3- 1
Town of Merrimack
6 Baboosic Lake Road
Merrimack, NH 03054
(603) 424-5137
dtuomala@merrimacknh.gov

Sarita Croce
Pretreatment Manager
Town of Merrimack Wastewater
36 Mast Road, P.O. Box 235
Merrimack, NH 03054
603-420-1624
scroce@merrimacknh.gov

Please do not hesitate to contact either Dawn or I, if you have any questions. On behalf of the Town, I would like to thank NHDES for giving us the opportunity to comment on the 303(d) list.

**Kind Regards,**
**Sarita Croce**
**Pretreatment Manager**
**Merrimack Wastewater**
**603-883-8196**
scroce@merrimacknh.gov

# TOWN OF MERRIMACK
# INTER-DEPARTMENT COMMUNICATION

**DATE:** June 19, 2017
**AT (OFFICE):** Department of Public Works

**FROM:** Dawn B. Tuomala, PE, LLS, CWS
Deputy Director/Town Engineer

**SUBJECT:** **NHDES 303(d) List Comments/Concerns**
**Town Improvements to Stormwater**

**TO:** Sarita Croce
Pretreatment Manager

Ongoing improvements through various avenues are being made to achieve the Town's desire and goal to have clean water. Various infrastructure, equipment purchases and upgrades have been utilized to help achieve our goal. The GIS system that aids in our mapping of the drainage system and outfalls is being continually updated. Along the way a few Illicit connections had been detected and have been corrected. Street sweeping contacting services have been cleaning all of the streets in Town. All of the streets in the Town are swept at least once during the year, some are swept more, if needed. **3- 2**

The Town of Merrimack has been improving and updating the infrastructure system throughout town. The drainage system has received improvements to improve the quality of the runoff before it reaches the receiving waters. The sewer system has been expanded by installing new sewer lines in areas where individual septic systems are aging.

There are over 5,000 catch basins in the Town of Merrimack. Having so many catch basins to clean the Town has invested in the equipment necessary to clean the catch basins ourselves. The catch basins are all cleaned at least once every three years. There is a particular focus on those basins on the "No Salt" Routes. These are done every year and some of them, are done more than once a year. The catch basin cleaner works, weather permitting, 10 months a year to keep the basins clean. The cleaning slows down or stops pollutants from entering our streams.

- JoEllen Drive and Forsythia Lane had drainage improvements including installing sumps in the catch basins before they discharge into the Naticook Brook.
- Naticook Road and Steep Street have also had drainage improvements to improve the quality of the runoff.

The second phase of the Woodland Drive area is presently being planned and designed now. As monies permit this project will also be put forth to help improve water quality in that area.

Another project that was completed in 2015 involved installing a municipal sewer line with 3 pump stations to take 44 lots off of old, failing individual septic systems. The septic systems were all abutting Naticook Lake. In addition the drainage was improved within the area so that the runoff is now sheet flows instead of becoming concentrated. Catch Basins with sumps were also installed to control the drainage flow and improve stormwater treatment. **3- 3**

Baboosic Brook has been of particular concern to the Town as the brook flows from west to east in the northern part of the town out falling at the Souhegan River just west of the confluence with the Merrimack River. In the past 15 years there have been many storms that have caused flooding along its path. Flooding brings on its own set of concern but can be equally damaging to the water quality. As the flood waters recede they take with it any fertilizers from the lawns and any other particulates that it encounters. By constructing new bridges along its path, widening the narrow constrictions and treating the side slopes so that there won't be any erosion the calculations are showing that the flood elevations will be significantly reduced. To date 4 new bridges have been installed; Bedford Road, Wire Road, Bean Road and most recently completed is the bridge at McGaw Bridge Road. Still to be completed is another bridge on Bedford Road and the final bridge will be at Daniel Webster Highway (US Route 3) in the year 2023. Calculations have shown that once all of these bridges are completed and the waters are allowed to flow the erosion causing velocity will be reduced and the flooding will be significantly reduced. Ultimately, when the waters reach the Souhegan River there should be a significant improvement to the water quality. 3- 4

Presently, the Town is actively pursuing a reduction in the amount of impervious areas. One project being proposed will reduce the width of the pavement on Executive Park Drive and create treatment swales before the runoff gets to Naticook Brook. There have been various other smaller projects, paid for directly out of town budget such as, culvert replacements that improve the runoff before it reaches the small brooks and streams. 3- 5

Other areas of improvement include improving the Town's Storm Water Ordinance and Regulations. Any construction or reconstruction in Town that results in a disturbance greater than 20,000 square feet is now required to have a Storm water Pollution Prevention Plan and a long term maintenance schedule. This far exceeds the EPA requirement of 1 acre.

Merrimack's commitment to our goal of improving the water quality and achieving "Clean Water" is ongoing. Should you have any questions please let me know. 3- 6

Dawn

CC: Kyle Fox; Director
File

| Cycle | Assessment Unit ID | Assessment Unit Name | Primary Town | Water Size | Size Unit | AUID-NHDES Category | Use Description | USE Level - NHDES Category | EPA_ADB- USE Threatened Flag | Supplemental ADB Parameter Name | Supplemental ADB-Parameter Threatened | Parameter Level - NHDES Category | TMDL Priority | Expected To Attain Date | Beach | Pollutant Flag | Comment |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2016 | NHRIV700060906-18 | SOUHEGAN RIVER | MERRIMACK | 12.01 | MILES | 5-P | Drinking Water After Adequate Treatment | 2-G | N | Copper | N | 3-PAS | | | N | | |
| 2016 | NHRIV700060906-18 | SOUHEGAN RIVER | MERRIMACK | 12.01 | MILES | 5-P | Drinking Water After Adequate Treatment | 2-G | N | Manganese | N | 3-ND | | | N | | Based on the information below manganese data appears to have been collected in 1994. In addition, there has been no exceedance, how is the river impaired for manganese? If there is no usable data (3-ND), why is the river given a 5-P? |
| 2016 | NHRIV700060906-18 | SOUHEGAN RIVER | MERRIMACK | 12.01 | MILES | 5-P | Drinking Water After Adequate Treatment | 2-G | N | Fecal Coliform | N | 3-ND | | | N | | |
| 2016 | NHRIV700060906-18 | SOUHEGAN RIVER | MERRIMACK | 12.01 | MILES | 5-P | Secondary Contact Recreation | 3-PNS | N | Escherichia coli | N | 3-PNS | | | N | Y | |
| 2016 | NHRIV700060906-18 | SOUHEGAN RIVER | MERRIMACK | 12.01 | MILES | 5-P | Drinking Water After Adequate Treatment | 2-G | N | Arsenic | N | 3-ND | | | N | | Based on the information below arsenic data appears to have been collected in 1995. In addition, if the last time there was an exceedance for arsenic was 1990, how is the river impaired for arsenic? If there is no usable data (3-ND), why is the river given a 5-P? |
| 2016 | NHRIV700060906-18 | SOUHEGAN RIVER | MERRIMACK | 12.01 | MILES | 5-P | Fish Consumption | 4A-M | N | Manganese | N | 3-ND | | | N | | Based on the information below manganese data appears to have been collected in 1994. In addition, there has been no exceedance, how is the river impaired for manganese? If there is no usable data (3-ND), why is the river given a 5-P? |
| 2016 | NHRIV700060906-18 | SOUHEGAN RIVER | MERRIMACK | 12.01 | MILES | 5-P | Aquatic Life | 5-P | N | Chloride | N | 3-PAS | | | N | Y | |
| 2016 | NHRIV700060906-18 | SOUHEGAN RIVER | MERRIMACK | 12.01 | MILES | 5-P | Aquatic Life | 5-P | N | Zinc | N | 3-ND | | | N | | If there is no usable data (3-ND), why is the river given a 5-P? |
| 2016 | NHRIV700060906-18 | SOUHEGAN RIVER | MERRIMACK | 12.01 | MILES | 5-P | Aquatic Life | 5-P | N | Phosphorus (Total) | N | 3-PAS | | | N | | 3- PAS indicates that there is some but insufficient data to assess per the CALM, however, the data that is available suggests that the parameter is Potentially Attaining Standards (PAS). The chlorophyll-a results (2-G) would support that the river is attaining standards. Why is the river still 5-P? |
| 2016 | NHRIV700060906-18 | SOUHEGAN RIVER | MERRIMACK | 12.01 | MILES | 5-P | Primary Contact Recreation | 4A-P | N | Chlorophyll-a | N | 2-G | | | N | Y | 4 A-P indicates an impairment per CALM. 2G indicates that the water body meet water quality criteria for chlorophyll-a. Why is the river still 4 A-P? |
| 2016 | NHRIV700060906-18 | SOUHEGAN RIVER | MERRIMACK | 12.01 | MILES | 5-P | Aquatic Life | 5-P | N | Ammonia (Un-ionized) | N | 3-ND | | | N | Y | If there is no usable data (3-ND), why is the river given a 5-P? |
| 2016 | NHRIV700060906-18 | SOUHEGAN RIVER | MERRIMACK | 12.01 | MILES | 5-P | Drinking Water After Adequate Treatment | 2-G | N | Iron | N | 3-ND | | | N | | |
| 2016 | NHRIV700060906-18 | SOUHEGAN RIVER | MERRIMACK | 12.01 | MILES | 5-P | Aquatic Life | 5-P | N | Cadmium | N | 3-ND | | | N | | If there is no usable data (3-ND), why is the river given a 5-P? |
| 2016 | NHRIV700060906-18 | SOUHEGAN RIVER | MERRIMACK | 12.01 | MILES | 5-P | Drinking Water After Adequate Treatment | 2-G | N | Sulfates | N | 3-PAS | | | N | Y | |
| 2016 | NHRIV700060906-18 | SOUHEGAN RIVER | MERRIMACK | 12.01 | MILES | 5-P | Fish Consumption | 4A-M | N | Copper | N | 3-PAS | | | N | | |
| 2016 | NHRIV700060906-18 | SOUHEGAN RIVER | MERRIMACK | 12.01 | MILES | 5-P | Aquatic Life | 5-P | N | Iron | N | 3-ND | | | N | | If there is no usable data (3-ND), why is the river given a 5-P? |
| 2016 | NHRIV700060906-18 | SOUHEGAN RIVER | MERRIMACK | 12.01 | MILES | 5-P | Aquatic Life | 5-P | N | Lead | N | 3-ND | | | N | | If there is no usable data (3-ND), why is the river given a 5-P? |
| 2016 | NHRIV700060906-18 | SOUHEGAN RIVER | MERRIMACK | 12.01 | MILES | 5-P | Aquatic Life | 5-P | N | Nickel | N | 3-ND | | | N | | Based on the information below nickel data appears to have been collected in 1995. If there is no usable data (3-ND), why is the river given a 5-P? |
| 2016 | NHRIV700060906-18 | SOUHEGAN RIVER | MERRIMACK | 12.01 | MILES | 5-P | Aquatic Life | 5-P | N | Selenium | N | 3-ND | | | N | | If there is no usable data (3-ND), why is the river given a 5-P? |
| 2016 | NHRIV700060906-18 | SOUHEGAN RIVER | MERRIMACK | 12.01 | MILES | 5-P | Aquatic Life | 5-P | N | Benthic-Macroinvertebrate Bioassessments (Streams) | N | 2-M | | | N | Y | 2-M indicates that the river marginally meets water quality limits. Why is the river still classified as 5-P? |
| 2016 | NHRIV700060906-18 | SOUHEGAN RIVER | MERRIMACK | 12.01 | MILES | 5-P | Aquatic Life | 5-P | N | Alkalinity, Carbonate as CaCO3 | N | 3-PNS | | | N | Y | |
| 2016 | NHRIV700060906-18 | SOUHEGAN RIVER | MERRIMACK | 12.01 | MILES | 5-P | Fish Consumption | 4A-M | N | Nickel | N | 3-ND | | | N | | |
| 2016 | NHRIV700060906-18 | SOUHEGAN RIVER | MERRIMACK | 12.01 | MILES | 5-P | Fish Consumption | 4A-M | N | Selenium | N | 3-ND | | | N | | |
| 2016 | NHRIV700060906-18 | SOUHEGAN RIVER | MERRIMACK | 12.01 | MILES | 5-P | Aquatic Life | 5-P | N | Aluminum | N | 5-M | LOW | | N | Y | We understand that it is not the purpose of the 303(d) process to assess the source of the data. Since aluminum is one of the most abundant elements in the earth's crust and occurs in many rocks and ores, but never as a pure metal, is it possible to notate if the elevated results are associated with precipitation. Heavy rain and wind can churn up sediment from the bottom of the waterway, releasing aluminum and pathogens back into the water. |
| 2016 | NHRIV700060906-18 | SOUHEGAN RIVER | MERRIMACK | 12.01 | MILES | 5-P | Drinking Water After Adequate Treatment | 2-G | N | Nickel | N | 3-ND | | | N | | Based on the information below nickel data appears to have been collected in 1995. If there is no usable data (3-ND), why is the river given a 5-P? |

3- 7

| Assessment Unit ID | NHRIV700060906-18 | Size | 12.0050 MILES |
|---|---|---|---|
| Assessment Unit Name | SOUHEGAN RIVER | Beach | N |
| Primary Town | MERRIMACK | Assessment Unit Category* - 5-P | |

**2016, 305(b)/303(d) - All Reviewed Parameters by Assessment Unit**
*****DRAFT*****

| Designated Use Description | *Desig. Use Category | Desig. Use Threat | Parameter Name | Parameter Threatened (Y/N) | Last Sample | Last Exceed | Parameter Category* | TMDL Priority | Source Name (Impairments only) |
|---|---|---|---|---|---|---|---|---|---|
| Drinking Water After Adequate Treatment | 2-G | | ZINC | N | 2004 | N/A | 3-ND | | |
| | | | | N | 2016 | N/A | 3-PAS | | |
| Fish Consumption | 4A-M | | ARSENIC | N | 1995 | 1990 | 3-ND | | |
| | | | COPPER | N | 2016 | N/A | 3-PAS | | |
| | | | MANGANESE | N | 1994 | N/A | 3-ND | | |
| | | | Mercury | N | | | 4A-M | | Atmospheric Deposition - Toxics |
| | | | NICKEL | N | 1995 | N/A | 3-ND | | |
| | | | SELENIUM | N | 1995 | N/A | 3-ND | | |
| | | | ZINC | N | 2004 | N/A | 3-ND | | |
| Primary Contact Recreation | 4A-P | | CHLOROPHYLL-A | N | 2015 | N/A | 2-G | | |
| | | | Escherichia coli | N | 2016 | 2015 | 4A-P | | Source Unknown |
| Secondary Contact Recreation | 3-PNS | | ESCHERICHIA COLI | N | 2016 | 2015 | 3-PNS | | |
| Wildlife | 3-ND | | | | | | | | |

**General Improvements**

Baboosic Brook has been of particular concern to the Town as the brook flows from west to east in the northern part of the town out falling at the Souhegan River just west of the confluence with the Merrimack River. In the past 15 years there have been many storms that have caused flooding along its path. Flooding brings on its own set of concern but can be equally damaging to the water quality. As the flood waters recede they take with it any fertilizers from the lawns and any other particulates that it encounters. By constructing new bridges along its path, widening the narrow constrictions and treating the side slopes so that there won't be any erosion the calculations are showing that the flood elevations will be significantly reduced. To date 4 new bridges have been installed; Bedford Road, Wire Road, Bean Road and most recently completed is the bridge at McGaw Bridge Road. Still to be completed is another bridge on Bedford Road and the final bridge will be at Daniel Webster Highway (US Route 3) in the year 2023. Calculations have shown that once all of these bridges are completed and the waters are allowed to flow the erosion causing velocity will be reduced and the flooding will be significantly reduced. Ultimately, when the waters reach the Souhegan River there should be a significant improvement to the water quality.

3- 8

| Cycle | Assessment Unit ID | Assessment Unit Name | Primary Town | Water Size | Size Unit | AUID-NHDES Category | Use Description | USE Level - NHDES Category | EPA_ADB- USE Threatened Flag | Supplemental ADB Parameter Name | Supplemental ADB-Parameter Threatened | Parameter Level -NHDES Category | TMDL Priority | Expected To Attain Date | Beach | Pollutant Flag | Comment | Line Item Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2016 | NHRIV700060804-03 | UNNAMED BROOK - TO MERRIMACK RIVER | MERRIMACK | 0.49 | MILES | 3-ND | Fish Consumption | 4A-M | N | Mercury | N | 4A-M | | | N | Y | Per 4AP there is an impairment per the CALM by a pollutant and an EPA-approved TMDL has been completed. In this case the impairment has been determined to be more severe and causes poor water quality conditions. In the highlighted light red row, the 4 AP is associated with 3-ND category which indicates that there is no data, or the data is unusable, for the Paramter, Designated Use, or Assessment Unit. How are these impairments per CALM determined. What is the reason for the discrepancy. In these cases the many of the use level categories are 2-G or 2-M, which indicates that the water body meets the water quality criteria for the parameter.<br>If the use level category indicates compliance with water quality criteria for the parameter, why is the water body still impaired? Line 109 indicates a 4 -AP impairment while both the use level NHDES category and the parameter level category are both 2G (the water quality level is met by a large margin). Line 114, 119, 120, 121, 123, 140, 141, 142,143,144,145,146,17, 148,&149 indicates a 4-AP while both the use level NHDES category is 3 PNS which indicates some insufficient data to assess per the CALM, however, the data that is available suggests that the parameter is Potentially Not Supporting (PNS) water quality standards (e.g., there is one exceedance). The parameter level category indicates 3-ND which indicates that there is no data, or the data is unusable, for the Paramter, Designated Use, or Assessment Unit. Line 139 - columns J & L are missing designations. Highlighted yellow. | |
| 2016 | NHRIV700060804-03 | UNNAMED BROOK - TO MERRIMACK RIVER | MERRIMACK | 0.49 | MILES | 3-ND | Primary Contact Recreation | 3-ND | N | Escherichia coli | N | 3-ND | | | N | | | |
| 2016 | NHRIV700060804-03 | UNNAMED BROOK - TO MERRIMACK RIVER | MERRIMACK | 0.49 | MILES | 3-ND | Secondary Contact Recreation | 3-ND | N | Escherichia coli | N | 3-ND | | | N | | | |
| 2016 | NHRIV700060804-03 | UNNAMED BROOK - TO MERRIMACK RIVER | MERRIMACK | 0.49 | MILES | 3-ND | Aquatic Life | 3-ND | N | Benthic-Macroinvertebrate Bioassessments (Streams) | N | 3-ND | | | N | | | |
| 2016 | NHRIV700060804-03 | UNNAMED BROOK - TO MERRIMACK RIVER | MERRIMACK | 0.49 | MILES | 3-ND | Aquatic Life | 3-ND | N | Dissolved oxygen saturation | N | 3-ND | | | N | | | |
| 2016 | NHRIV700060804-03 | UNNAMED BROOK - TO MERRIMACK RIVER | MERRIMACK | 0.49 | MILES | 3-ND | Aquatic Life | 3-ND | N | Fishes Bioassessments (Streams) | N | 3-ND | | | N | | | |
| 2016 | NHRIV700060804-03 | UNNAMED BROOK - TO MERRIMACK RIVER | MERRIMACK | 0.49 | MILES | 3-ND | Aquatic Life | 3-ND | N | Oxygen, Dissolved | N | 3-ND | | | N | | | |
| 2016 | NHRIV700060804-03 | UNNAMED BROOK - TO MERRIMACK RIVER | MERRIMACK | 0.49 | MILES | 3-ND | Aquatic Life | 3-ND | N | pH | N | 3-ND | | | N | | | |
| 2016 | NHRIV700060804-11 | MERRIMACK RIVER | MERRIMACK | 7.28 | MILES | 4A-P | Primary Contact Recreation | 4A-P | N | Escherichia coli | N | 4A-P | | | N | Y | | |
| 2016 | NHRIV700060804-11 | MERRIMACK RIVER | MERRIMACK | 7.28 | MILES | 4A-P | Fish Consumption | 4A-M | N | Mercury | N | 4A-M | | | N | Y | | |
| 2016 | NHRIV700060804-11 | MERRIMACK RIVER | MERRIMACK | 7.28 | MILES | 4A-P | Aquatic Life | 2-M | N | Oxygen, Dissolved | N | 2-G | LOW | | N | Y | | |
| 2016 | NHRIV700060804-11 | MERRIMACK RIVER | MERRIMACK | 7.28 | MILES | 4A-P | Aquatic Life | 2-M | N | Nickel | N | 3-ND | | | N | | | Nickel data was last collected in 2004 with no exceedances noted in the information below. |
| 2016 | NHRIV700060804-11 | MERRIMACK RIVER | MERRIMACK | 7.28 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | Iron | N | 3-ND | | | N | | | |
| 2016 | NHRIV700060804-11 | MERRIMACK RIVER | MERRIMACK | 7.28 | MILES | 4A-P | Aquatic Life | 2-M | N | Aluminum | N | 3-ND | | | N | | | |
| 2016 | NHRIV700060804-11 | MERRIMACK RIVER | MERRIMACK | 7.28 | MILES | 4A-P | Aquatic Life | 2-M | N | Chloride | N | 3-PAS | | | N | Y | | |
| 2016 | NHRIV700060804-11 | MERRIMACK RIVER | MERRIMACK | 7.28 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | Sulfates | N | 3-ND | | | N | | | |
| 2016 | NHRIV700060804-11 | MERRIMACK RIVER | MERRIMACK | 7.28 | MILES | 4A-P | Secondary Contact Recreation | 2-G | N | Escherichia coli | N | 2-G | | | N | Y | | |
| 2016 | NHRIV700060804-11 | MERRIMACK RIVER | MERRIMACK | 7.28 | MILES | 4A-P | Primary Contact Recreation | 4A-P | N | Chlorophyll-a | N | 3-PAS | | | N | Y | | |
| 2016 | NHRIV700060804-11 | MERRIMACK RIVER | MERRIMACK | 7.28 | MILES | 4A-P | Aquatic Life | 2-M | | Dissolved oxygen saturation | | 2-G | | | N | Y | | |
| 2016 | NHRIV700060804-11 | MERRIMACK RIVER | MERRIMACK | 7.28 | MILES | 4A-P | Aquatic Life | 2-M | N | Turbidity | N | 3-PAS | | | N | Y | | |
| 2016 | NHRIV700060804-11 | MERRIMACK RIVER | MERRIMACK | 7.28 | MILES | 4A-P | Fish Consumption | 4A-M | N | Copper | N | 3-ND | | | N | | | |
| 2016 | NHRIV700060804-11 | MERRIMACK RIVER | MERRIMACK | 7.28 | MILES | 4A-P | Fish Consumption | 4A-M | N | Nickel | N | 3-ND | | | N | | | |
| 2016 | NHRIV700060804-11 | MERRIMACK RIVER | MERRIMACK | 7.28 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | Arsenic | N | 3-ND | | | N | | | |
| 2016 | NHRIV700060804-11 | MERRIMACK RIVER | MERRIMACK | 7.28 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | Escherichia coli | N | 3-PNS | | | N | Y | | |
| 2016 | NHRIV700060804-11 | MERRIMACK RIVER | MERRIMACK | 7.28 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | Manganese | N | 3-ND | | | N | | | |
| 2016 | NHRIV700060804-11 | MERRIMACK RIVER | MERRIMACK | 7.28 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | Zinc | N | 3-ND | | | N | | | |
| 2016 | NHRIV700060804-11 | MERRIMACK RIVER | MERRIMACK | 7.28 | MILES | 4A-P | Aquatic Life | 2-M | N | Lead | N | 3-ND | | | N | | | Lead data was last collected in 2004 with an exceedance in 1991 based on the information below. |
| 2016 | NHRIV700060804-11 | MERRIMACK RIVER | MERRIMACK | 7.28 | MILES | 4A-P | Aquatic Life | 2-M | N | Alkalinity, Carbonate as CaCO3 | N | 3-ND | | | N | | | |
| 2016 | NHRIV700060804-11 | MERRIMACK RIVER | MERRIMACK | 7.28 | MILES | 4A-P | Aquatic Life | 2-M | N | Arsenic | N | 3-ND | | | N | | | |
| 2016 | NHRIV700060804-11 | MERRIMACK RIVER | MERRIMACK | 7.28 | MILES | 4A-P | Aquatic Life | 2-M | N | Iron | N | 3-ND | | | N | | | Iron data was last collected in 1991 with no exceedances noted in the information below. |
| 2016 | NHRIV700060804-11 | MERRIMACK RIVER | MERRIMACK | 7.28 | MILES | 4A-P | Aquatic Life | 2-M | N | Selenium | N | 3-ND | | | N | | | |
| 2016 | NHRIV700060804-11 | MERRIMACK RIVER | MERRIMACK | 7.28 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | Selenium | N | 3-ND | | | N | | | |
| 2016 | NHRIV700060804-11 | MERRIMACK RIVER | MERRIMACK | 7.28 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | Copper | N | 3-ND | | | N | | | |
| 2016 | NHRIV700060804-11 | MERRIMACK RIVER | MERRIMACK | 7.28 | MILES | 4A-P | Aquatic Life | 2-M | N | Cadmium | N | 3-ND | | | N | | | Cadmium data was last collected in 1991 with an exceedance in 1991. |
| 2016 | NHRIV700060804-11 | MERRIMACK RIVER | MERRIMACK | 7.28 | MILES | 4A-P | Aquatic Life | 2-M | N | Copper | N | 3-ND | | | N | | | |
| 2016 | NHRIV700060804-11 | MERRIMACK RIVER | MERRIMACK | 7.28 | MILES | 4A-P | Fish Consumption | 4A-M | N | Selenium | N | 3-ND | | | N | | | |
| 2016 | NHRIV700060804-11 | MERRIMACK RIVER | MERRIMACK | 7.28 | MILES | 4A-P | Fish Consumption | 4A-M | N | Zinc | N | 3-ND | | | N | | | |
| 2016 | NHRIV700060804-11 | MERRIMACK RIVER | MERRIMACK | 7.28 | MILES | 4A-P | Fish Consumption | 4A-M | N | Arsenic | N | 3-ND | | | N | | | |
| 2016 | NHRIV700060804-11 | MERRIMACK RIVER | MERRIMACK | 7.28 | MILES | 4A-P | Aquatic Life | 2-M | | Phosphorus (Total) | | 3-ND | | | N | Y | | |
| 2016 | NHRIV700060804-11 | MERRIMACK RIVER | MERRIMACK | 7.28 | MILES | 4A-P | Aquatic Life | 2-M | N | Zinc | N | 3-ND | | | N | | | |
| 2016 | NHRIV700060804-11 | MERRIMACK RIVER | MERRIMACK | 7.28 | MILES | 4A-P | Aquatic Life | 2-M | N | Nonnative Fish, Shellfish, or Zooplankton | N | 3-PNS | | | N | N | | |
| 2016 | NHRIV700060804-11 | MERRIMACK RIVER | MERRIMACK | 7.28 | MILES | 4A-P | Aquatic Life | 2-M | N | Ammonia (Un-ionized) | N | 3-ND | | | N | | | |
| 2016 | NHRIV700060804-11 | MERRIMACK RIVER | MERRIMACK | 7.28 | MILES | 4A-P | Fish Consumption | 4A-M | N | Manganese | N | 3-ND | | | N | | | |
| 2016 | NHRIV700060804-11 | MERRIMACK RIVER | MERRIMACK | 7.28 | MILES | 4A-P | Aquatic Life | 2-M | | pH | | 2-M | | | N | Y | | |
| 2016 | NHRIV700060804-11 | MERRIMACK RIVER | MERRIMACK | 7.28 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | Nickel | N | 3-ND | | | N | | | |
| 2016 | NHRIV700060804-11 | MERRIMACK RIVER | MERRIMACK | 7.28 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | Fecal Coliform | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Primary Contact Recreation | 4A-P | N | Escherichia coli | N | 4A-P | | | N | Y | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Fish Consumption | 4A-M | N | Mercury | N | 4A-M | | | N | Y | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | 1,1-Dichloroethane | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | Chloroform | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | p-Dichlorobenzene | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Aquatic Life | 3-PNS | N | Naphthalene | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Aquatic Life | 3-PNS | N | Turbidity | N | 3-PAS | | | N | Y | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Aquatic Life | 3-PNS | | pH | | 3-PAS | | | N | Y | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | Naphthalene | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Aquatic Life | 3-PNS | N | Arsenic | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | o-Dichlorobenzene | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | Hexachlorobutadiene | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | Methyl ethyl ketone | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | Selenium | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | Vinyl chloride | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Fish Consumption | 4A-M | N | Cyanide | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Fish Consumption | 4A-M | N | Dichloromethane | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Aquatic Life | 3-PNS | N | Ethylbenzene | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Aquatic Life | 3-PNS | N | 1,1,2,2-Tetrachloroethane | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | Chlorobenzene (mono) | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | Methyl chloride | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | m-Dichlorobenzene | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Aquatic Life | 3-PNS | N | Chloroform | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Aquatic Life | 3-PNS | N | Cyanide | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | Toluene | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | Trichlorofluoromethane (CFC-11) | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Fish Consumption | 4A-M | N | Nickel | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Fish Consumption | 4A-M | N | Trichlorofluoromethane (CFC-11) | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | 1,1,2,2-Tetrachloroethane | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | 1,2,4-Trimethylbenzene | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | Bromoform | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | Dichlorodifluoromethane | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | Dichloromethane | N | 3-ND | | | N | | | |

3- 9

| Cycle | Assessment Unit ID | Assessment Unit Name | Primary Town | Water Size | Size Unit | AUID-NHDES Category | Use Description | USE Level - NHDES Category | EPA_ADB- USE Threatened Flag | Supplemental ADB Parameter Name | Supplemental ADB-Parameter Threatened | Parameter Level -NHDES Category | TMDL Priority | Expected To Attain Date | Beach | Pollutant Flag | Comment | Line Item Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Fish Consumption | 4A-M | N | Bromoform | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Fish Consumption | 4A-M | N | Chlorobenzene (mono) | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Fish Consumption | 4A-M | N | o-Dichlorobenzene | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Fish Consumption | 4A-M | N | 1,1,2,2-Tetrachloroethane | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Fish Consumption | 4A-M | N | Zinc | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Aquatic Life | 3-PNS | N | Alkalinity, Carbonate as CaCO3 | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Fish Consumption | 4A-M | N | m-Dichlorobenzene | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Fish Consumption | 4A-M | N | Methyl bromide | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Fish Consumption | 4A-M | N | Toluene | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Fish Consumption | 4A-M | N | Benzene | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Fish Consumption | 4A-M | N | Vinylidene chloride | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Fish Consumption | 4A-M | N | Vinyl chloride | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | 1,1,1,2-Tetrachloroethane | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | Arsenic | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | Benzene | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | Escherichia coli | N | 3-PNS | | | N | Y | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | Ethelyne dibromide | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Aquatic Life | 3-PNS | N | Lead | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Aquatic Life | 3-PNS | N | Tetrachloroethylene | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Aquatic Life | 3-PNS | N | Toluene | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | Manganese | N | 3-ND | | | N | Y | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | Trichloroethylene | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | Zinc | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Fish Consumption | 4A-M | N | 1,2-Dichloroethane | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Fish Consumption | 4A-M | N | Selenium | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Fish Consumption | 4A-M | N | Tetrachloroethylene | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Fish Consumption | 4A-M | N | Trichloroethylene | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Aquatic Life | 3-PNS | | Dissolved oxygen saturation | | 3-PAS | | | N | Y | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Secondary Contact Recreation | 2-G | N | Escherichia coli | N | 2-G | | | N | Y | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Fish Consumption | 4A-M | N | Arsenic | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Fish Consumption | 4A-M | N | 1,2-Dichloropropane | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Fish Consumption | 4A-M | N | Ethylbenzene | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Fish Consumption | 4A-M | N | Hexachlorobutadiene | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Aquatic Life | 3-PNS | N | Nickel | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | Carbon Disulfide | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | Carbon tetrachloride | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | Methyl bromide | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | Sulfates | N | 3-ND | | | N | | | Sulfates data were last collected in 1991 with no exceedance reported in the table below. |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Aquatic Life | 3-PNS | N | Benzene | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Aquatic Life | 3-PNS | N | 1,2-Dichloroethane | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Aquatic Life | 3-PNS | N | Chloride | N | 3-PAS | | | N | Y | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | Tetrachloroethylene | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Aquatic Life | 3-PNS | N | Zinc | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | Cumene | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | 1,2-Dichloroethane | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | Vinylidene chloride | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | Ethylbenzene | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | Methyl Tertiary-Butyl Ether (MTBE) | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | Fecal Coliform | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Aquatic Life | 3-PNS | N | Oxygen, Dissolved | N | 3-PAS | | | N | Y | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Fish Consumption | 4A-M | N | Chlorodibromomethane | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Fish Consumption | 4A-M | N | p-Dichlorobenzene | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Fish Consumption | 4A-M | N | Manganese | N | 3-ND | | | N | Y | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Primary Contact Recreation | 4A-P | N | Chlorophyll-a | N | 3-PAS | | | N | Y | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | 1,1,1-Trichloroethane | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | 1,2-Dibromo-3-chloropropane | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | trans-1,2-Dichloroethylene | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | tert-Butyl alcohol | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Aquatic Life | 3-PNS | | Phosphorus (Total) | | 3-ND | | | N | Y | | Not sure what "NLV" on the table below refers to. |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Aquatic Life | 3-PNS | N | Aluminum | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Aquatic Life | 3-PNS | N | Cadmium | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Aquatic Life | 3-PNS | N | Carbon tetrachloride | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Aquatic Life | 3-PNS | N | Copper | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Aquatic Life | 3-PNS | N | Hexachlorobutadiene | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Aquatic Life | 3-PNS | N | Iron | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Aquatic Life | 3-PNS | N | Selenium | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Aquatic Life | 3-PNS | N | Trichloroethylene | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Aquatic Life | 3-PNS | N | Ammonia (Un-ionized) | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Aquatic Life | 3-PNS | N | Nonnative Fish, Shellfish, or Zooplankton | N | 3-PNS | | | N | N | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Fish Consumption | 4A-M | N | 1,2,4-Trichlorobenzene | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Fish Consumption | 4A-M | N | Carbon tetrachloride | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Fish Consumption | 4A-M | N | Chloroform | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Fish Consumption | 4A-M | N | Copper | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Fish Consumption | 4A-M | N | Dichlorobromomethane | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Fish Consumption | 4A-M | N | Dichlorodifluoromethane | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Fish Consumption | 4A-M | N | trans-1,2-Dichloroethylene | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | 1,2,4-Trichlorobenzene | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | 1,2-Dichloropropane | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | Chlorodibromomethane | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | Copper | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | Cyanide | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | Dichlorobromomethane | N | 3-ND | | | N | | | |

3- 10

| Cycle | Assessment Unit ID | Assessment Unit Name | Primary Town | Water Size | Size Unit | AUID-NHDES Category | Use Description | USE Level - NHDES Category | EPA_ADB- USE Threatened Flag | Supplemental ADB Parameter Name | Supplemental ADB-Parameter Threatened | Parameter Level -NHDES Category | TMDL Priority | Expected To Attain Date | Beach | Pollutant Flag | Comment | Line Item Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | Iron | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | Methyl isobutyl ketone | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | Nickel | N | 3-ND | | | N | | | |
| 2016 | NHRIV700061002-13 | MERRIMACK RIVER | MERRIMACK | 4.07 | MILES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | Styrene | N | 3-ND | | | N | | | |
| | | | | | | | | | | | N | 3-ND | | | N | | | |

Assessment Unit ID NHIMP700060804-03 Size 0.5000 ACRES
Assessment Unit Name DUMPLING BROOK Beach N
Primary Town MERRIMACK Assessment Unit Category*- 3-ND

2016, 305(b)/303(d) - All Reviewed Parameters by Assessment Unit
***DRAFT***

| Designated Use Description | *Desig. Use Category | Desig. Use Threat | Parameter Name | Parameter Threatened (Y/N) | Last Sample | Last Exceed | Parameter Category* | TMDL Priority | Source Name (Impairments only) |
|---|---|---|---|---|---|---|---|---|---|
| Aquatic Life | 3-ND | | Chlorophyll-a | N | | | 3-ND | | |
| | | | Dissolved oxygen saturation | N | | | 3-ND | | |
| | | | Oxygen, Dissolved | N | | | 3-ND | | |
| | | | pH | N | | | 3-ND | | |
| Drinking Water After Adequate Treatment | 2-G | | | | | | | | |
| Fish Consumption | 4A-M | | Mercury | N | | | 4A-M | | Atmospheric Deposition - Toxics |
| Primary Contact Recreation | 3-ND | | Escherichia coli | N | | | 3-ND | | |
| Secondary Contact Recreation | 3-ND | | Escherichia coli | N | | | 3-ND | | |
| Wildlife | 3-ND | | | | | | | | |

Assessment Unit ID NHRIV700060804-03 Size 0.4930 MILES
Assessment Unit Name UNNAMED BROOK - TO MERRIMACK RIVER Beach N
Primary Town MERRIMACK Assessment Unit Category*- 3-ND

2016, 305(b)/303(d) - All Reviewed Parameters by Assessment Unit
***DRAFT***

| Designated Use Description | *Desig. Use Category | Desig. Use Threat | Parameter Name | Parameter Threatened (Y/N) | Last Sample | Last Exceed | Parameter Category* | TMDL Priority | Source Name (Impairments only) |
|---|---|---|---|---|---|---|---|---|---|
| Aquatic Life | 3-ND | | Benthic-Macroinvertebrate Bioassessments (Streams) | N | | | 3-ND | | |
| | | | Dissolved oxygen saturation | N | | | 3-ND | | |
| | | | Fishes Bioassessments (Streams) | N | | | 3-ND | | |
| | | | Oxygen, Dissolved | N | | | 3-ND | | |
| | | | pH | N | | | 3-ND | | |
| Drinking Water After Adequate Treatment | 2-G | | | | | | | | |
| Fish Consumption | 4A-M | | Mercury | N | | | 4A-M | | Atmospheric Deposition - Toxics |
| Primary Contact Recreation | 3-ND | | Escherichia coli | N | | | 3-ND | | |
| Secondary Contact Recreation | 3-ND | | Escherichia coli | N | | | 3-ND | | |
| Wildlife | 3-ND | | | | | | | | |

3- 11

| Cycle | Assessment Unit ID | Assessment Unit Name | Primary Town | Water Size | Size Unit | AUID-NHDES Category | Use Description | USE Level - NHDES Category | EPA_ADB- USE Threatened Flag | Supplemental ADB Parameter Name | Supplemental ADB-Parameter Threatened | Parameter Level -NHDES Category | TMDL Priority | Expected To Attain Date | Beach | Pollutant Flag | Comment | Line Item Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

Assessment Unit ID NHRIV700060804-11
Assessment Unit Name MERRIMACK RIVER
Primary Town MERRIMACK

Size 7.2830 MILES
Beach N
Assessment Unit Category*- 4A-P

2016, 305(b)/303(d) - All Reviewed Parameters by Assessment Unit ***DRAFT***

| Designated Use Description | *Desig. Use Category | Desig. Use Threat | Parameter Name | Parameter Threatened (Y/N) | Last Sample | Last Exceed | Parameter Category* | TMDL Priority | Source Name (Impairments only) |
|---|---|---|---|---|---|---|---|---|---|
| Aquatic Life | 2-M | | ALKALINITY, CARBONATE AS CACO3 | N | 1991 | 1991 | 3-ND | | |
| | | | ALUMINUM | N | 2004 | N/A | 3-ND | | |
| | | | AMMONIA (UN-IONIZED) | N | 2004 | N/A | 3-ND | | |
| | | | ARSENIC | N | 1991 | N/A | 3-ND | | |
| | | | CADMIUM | N | 1991 | 1991 | 3-ND | | |
| | | | CHLORIDE | N | 2015 | N/A | 3-PAS | | |
| | | | COPPER | N | 2004 | 2004 | 3-ND | | |
| | | | DISSOLVED OXYGEN SATURATION | | 2013 | N/A | 2-G | | |
| | | | IRON | N | 1991 | N/A | 3-ND | | |
| | | | LEAD | N | 2004 | 1991 | 3-ND | | |
| | | | NICKEL | N | 2004 | N/A | 3-ND | | |
| | | | Nonnative Fish, Shellfish, or Zooplankton | N | | | 3-PNS | | |
| | | | OXYGEN, DISSOLVED | N | 2015 | 2005 | 2-G | LOW | |
| | | | PH | | 2013 | 2012 | 2-M | | |
| | | | PHOSPHORUS (TOTAL) | | 2010 | NLV | 3-ND | | |
| | | | SELENIUM | N | 1991 | N/A | 3-ND | | |
| | | | TURBIDITY | N | 2012 | N/A | 3-PAS | | |
| | | | ZINC | N | 2004 | 2004 | 3-ND | | |
| Drinking Water After Adequate Treatment | 2-G | | ARSENIC | N | 1991 | N/A | 3-ND | | |
| | | | COPPER | N | 2004 | N/A | 3-ND | | |
| | | | ESCHERICHIA COLI | N | 2016 | 2016 | 3-PNS | | |
| | | | FECAL COLIFORM | N | 2004 | 2004 | 3-ND | | |
| | | | IRON | N | 1991 | 1991 | 3-ND | | |
| | | | MANGANESE | N | 1991 | N/A | 3-ND | | |
| | | | NICKEL | N | 2004 | N/A | 3-ND | | |
| | | | SELENIUM | N | 1991 | N/A | 3-ND | | |
| | | | SULFATES | N | 1991 | N/A | 3-ND | | |

| Severe | Poor | Likely Bad | No Data | Likely Good | Marginal | Good |
|---|---|---|---|---|---|---|
| Not Supporting, Severe | Not Supporting, Marginal | Insufficient Information – Potentially Full Supporting | No Data | Insufficient Information – Potentially Full Supporting | Full Support, Marginal | Full Support, Good |

*DES Categories: 2-G = Supports Parameter well above criteria, 2-M = Supports Parameter marginally above criteria, 2-OBS = Exceeds WQ criteria but natural therefore not a WQ exceedence, 3-ND = Insufficient Information/No data, 3-PAS= Insufficient Information/Potentially Attaining Standard, 3-PNS= Insufficient Information/Potentially Not Attaining Standard, (4A=Impaired/TMDL Completed, 4B=Impaired/Other Measure will rectify Impairment, 4C=Impaired/Non-Pollutant, 5=Impaired/TMDL needed) M=Marginal Impairment, P=Severe Impairment, T=Threatened (http://des.nh.gov/organization/divisions/water/wmb/swqa/index.htm)

Page 23 of 30

May 8, 2017

Assessment Unit ID NHRIV700060804-11
Assessment Unit Name MERRIMACK RIVER
Primary Town MERRIMACK

Size 7.2830 MILES
Beach N
Assessment Unit Category*- 4A-P

2016, 305(b)/303(d) - All Reviewed Parameters by Assessment Unit ***DRAFT***

| Designated Use Description | *Desig. Use Category | Desig. Use Threat | Parameter Name | Parameter Threatened (Y/N) | Last Sample | Last Exceed | Parameter Category* | TMDL Priority | Source Name (Impairments only) |
|---|---|---|---|---|---|---|---|---|---|
| Drinking Water After Adequate Treatment | 2-G | | ZINC | N | 2004 | N/A | 3-ND | | |
| Fish Consumption | 4A-M | | ARSENIC | N | 1991 | N/A | 3-ND | | |
| | | | COPPER | N | 2004 | N/A | 3-ND | | |
| | | | MANGANESE | N | 1991 | N/A | 3-ND | | |
| | | | Mercury | N | | | 4A-M | | Atmospheric Deposition - Toxics |
| | | | NICKEL | N | 2004 | N/A | 3-ND | | |
| | | | SELENIUM | N | 1991 | N/A | 3-ND | | |
| | | | ZINC | N | 2004 | N/A | 3-ND | | |
| Primary Contact Recreation | 4A-P | | CHLOROPHYLL-A | N | 2012 | N/A | 3-PAS | | |
| | | | Escherichia coli | N | 2016 | 2016 | 4A-P | | Combined Sewer Overflows |
| Secondary Contact Recreation | 2-G | | ESCHERICHIA COLI | N | 2016 | 2003 | 2-G | | |
| Wildlife | 3-ND | | | | | | | | |

3- 12

| Cycle | Assessment Unit ID | Assessment Unit Name | Primary Town | Water Size | Size Unit | AUID-NHDES Category | Use Description | USE Level - NHDES Category | EPA_ADB- USE Threatened Flag | Supplemental ADB Parameter Name | Supplemental ADB-Parameter Threatened | Parameter Level - NHDES Category | TMDL Priority | Expected To Attain Date | Beach | Pollutant Flag | Comment | Line Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2016 | NHLAK700061001-06 | HOLT POND | MERRIMACK | 21.39 | ACRES | 5-P | Aquatic Life | 5-P | N | Oxygen, Dissolved | N | 5-P | LOW | | N | Y | Per the 5-P category, There is an impairment per the CALM by a parameter which is a pollutant that requires a TMDL. The impairment is more severe and causes poor water quality as defined in DES sub-category 4A-P. The highlighted rows have use level categories as 2-G which indicates that the water body meets the water quality criteria for the parameter, and 3ND for the parameter level categories which indicates that there is no data, or the data is unusable, for the Paramter, Designated Use, or Assessment Unit. Why is the water body impaired in these rows? | Dissolved oxygen data was last collected in 2006 with an exceedance in 2006. |
| 2016 | NHLAK700061001-06 | HOLT POND | MERRIMACK | 21.39 | ACRES | 5-P | Aquatic Life | 5-P | N | pH | N | 5-M | LOW | | N | Y | | |
| 2016 | NHLAK700061001-06 | HOLT POND | MERRIMACK | 21.39 | ACRES | 5-P | Aquatic Life | 5-P | N | Dissolved oxygen saturation | N | 5-M | LOW | | N | Y | | |
| 2016 | NHLAK700061001-06 | HOLT POND | MERRIMACK | 21.39 | ACRES | 5-P | Fish Consumption | 4A-M | N | Mercury | N | 4A-M | | | N | Y | | |
| 2016 | NHLAK700061001-06 | HOLT POND | MERRIMACK | 21.39 | ACRES | 5-P | Drinking Water After Adequate Tr | 2-G | N | Escherichia coli | N | 3-PNS | | | N | Y | | E-coli data was last collected in 2006 with an exceedance observed in 2006. 3PNS indicates that insufficient data is available to assess per the CALM, however, the data that is available suggests that the parameter is Potentially Not Supporting (PNS) water quality standards (e.g., there is one exceedance). The 5-P designation is more severe. |
| 2016 | NHLAK700061001-06 | HOLT POND | MERRIMACK | 21.39 | ACRES | 5-P | Primary Contact Recreation | 2-G | N | Escherichia coli | N | 2-G | | | N | Y | | |
| 2016 | NHLAK700061001-06 | HOLT POND | MERRIMACK | 21.39 | ACRES | 5-P | Drinking Water After Adequate Tr | 2-G | N | Iron | N | 3-ND | | | N | | | |
| 2016 | NHLAK700061001-06 | HOLT POND | MERRIMACK | 21.39 | ACRES | 5-P | Secondary Contact Recreation | 2-G | N | Escherichia coli | N | 2-G | | | N | Y | | |
| 2016 | NHLAK700061001-06 | HOLT POND | MERRIMACK | 21.39 | ACRES | 5-P | Aquatic Life | 5-P | N | Ammonia (Un-ionized) | N | 3-PAS | | | N | Y | | Ammonia data was last collected in 2006 with no exceedance reported in the table below. |
| 2016 | NHLAK700061001-06 | HOLT POND | MERRIMACK | 21.39 | ACRES | 5-P | Aquatic Life | 5-P | N | Chloride | N | 3-PNS | | | N | Y | | |
| 2016 | NHLAK700061001-06 | HOLT POND | MERRIMACK | 21.39 | ACRES | 5-P | Drinking Water After Adequate Tr | 2-G | N | Copper | N | 3-ND | | | N | | | |
| 2016 | NHLAK700061001-06 | HOLT POND | MERRIMACK | 21.39 | ACRES | 5-P | Aquatic Life | 5-P | N | Iron | N | 3-ND | | | N | | | |
| 2016 | NHLAK700061001-06 | HOLT POND | MERRIMACK | 21.39 | ACRES | 5-P | Drinking Water After Adequate Tr | 2-G | N | Fecal Coliform | N | 3-ND | | | N | | | |
| 2016 | NHLAK700061001-06 | HOLT POND | MERRIMACK | 21.39 | ACRES | 5-P | Fish Consumption | 4A-M | N | Manganese | N | 3-ND | | | N | | | |
| 2016 | NHLAK700061001-06 | HOLT POND | MERRIMACK | 21.39 | ACRES | 5-P | Aquatic Life | 5-P | N | Turbidity | N | 3-PAS | | | N | Y | | |
| 2016 | NHLAK700061001-06 | HOLT POND | MERRIMACK | 21.39 | ACRES | 5-P | Drinking Water After Adequate Tr | 2-G | N | Manganese | N | 3-ND | | | N | | | |
| 2016 | NHLAK700061001-06 | HOLT POND | MERRIMACK | 21.39 | ACRES | 5-P | Aquatic Life | 5-P | N | Chlorophyll-a | N | 3-ND | | | N | | | |

Assessment Unit ID NHLAK700061001-06
Assessment Unit Name HOLT POND
Primary Town MERRIMACK

Size 21.3850 ACRES
Beach N
Assessment Unit Category*- 5-P

2016, 305(b)/303(d) - All Reviewed Parameters by Assessment Unit ***DRAFT***

| Designated Use Description | *Desig. Use Category | Desig. Use Threat | Parameter Name | Parameter Threatened (Y/N) | Last Sample | Last Exceed | Parameter Category* | TMDL Priority | Source Name (Impairments only) |
|---|---|---|---|---|---|---|---|---|---|
| Aquatic Life | 5-P | | AMMONIA (UN-IONIZED) | N | 2006 | N/A | 3-PAS | | |
| | | | CHLORIDE | N | 2006 | 2006 | 3-PNS | | |
| | | | Chlorophyll-a | N | | | 3-ND | | |
| | | | Dissolved oxygen saturation | N | 2006 | 2006 | 5-M | LOW | Source Unknown |
| | | | IRON | N | 1996 | N/A | 3-ND | | |
| | | | Oxygen, Dissolved | N | 2006 | 2006 | 5-P | LOW | Source Unknown |
| | | | TURBIDITY | N | 2006 | 1999 | 3-PAS | | |
| | | | pH | N | 2006 | 2006 | 5-M | LOW | Atmospheric Deposition - Acidity |
| Drinking Water After Adequate Treatment | 2-G | | COPPER | N | 1996 | N/A | 3-ND | | |
| | | | ESCHERICHIA COLI | N | 2006 | 2006 | 3-PNS | | |
| | | | FECAL COLIFORM | N | 1999 | 1999 | 3-ND | | |
| | | | IRON | N | 1996 | N/A | 3-ND | | |
| | | | MANGANESE | N | 1996 | N/A | 3-ND | | |
| Fish Consumption | 4A-M | | MANGANESE | N | 1996 | N/A | 3-ND | | |
| | | | Mercury | N | | | 4A-M | | Atmospheric Deposition - Toxics |
| Primary Contact Recreation | 2-G | | ESCHERICHIA COLI | N | 2006 | 1996 | 2-G | | |
| Secondary Contact Recreation | 2-G | | ESCHERICHIA COLI | N | 2006 | N/A | 2-G | | |
| Wildlife | 3-ND | | | | | | | | |

3- 13

| Cycle | Assessment Unit ID | Assessment Unit Name | Primary Town | Water Size | Size Unit | AUID-NHDES Category | Use Description | USE Level - NHDES Category | EPA_ADB- USE Threatened Flag | Supplemental ADB Parameter Name | Supplemental ADB-Parameter Threatened | Parameter Level -NHDES Category | TMDL Priority | Expected To Attain Date | Beach | Pollutant Flag | Comment |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2016 | NHRIV700061001-07 | PENNICHUCK BROOK - WITCHES BROOK | MERRIMACK | 3.64 | MILES | 5-P | Primary Contact Recreation | 4A-P | N | Escherichia coli | N | 4A-P | | | N | Y | Per the 5-P category, There is an impairment per the CALM by a parameter which is a pollutant that requires a TMDL. The impairment is more severe and causes poor water quality as defined in DES sub-category 4A-P. The highlighted rows have use level categories as 2-G which indicates that the water body meets the water quality criteria for the parameter, and 3ND for the parameter level categories which indicates that there is no data, or the data is unusable, for the Paramter, Designated Use, or Assessment Unit. Why is the water body impaired in these rows? **In line 13**, both the NHDES use level and the parameter level categories area 2-G which indicates the water body meets the water quality criteria. |
| 2016 | NHRIV700061001-07 | PENNICHUCK BROOK - WITCHES BROOK | MERRIMACK | 3.64 | MILES | 5-P | Aquatic Life | 5-P | N | Dissolved oxygen saturation | N | 5-M | LOW | | N | Y | |
| 2016 | NHRIV700061001-07 | PENNICHUCK BROOK - WITCHES BROOK | MERRIMACK | 3.64 | MILES | 5-P | Aquatic Life | 5-P | N | pH | N | 5-P | LOW | | N | Y | |
| 2016 | NHRIV700061001-07 | PENNICHUCK BROOK - WITCHES BROOK | MERRIMACK | 3.64 | MILES | 5-P | Aquatic Life | 5-P | N | Oxygen, Dissolved | N | 5-P | LOW | | N | Y | |
| 2016 | NHRIV700061001-07 | PENNICHUCK BROOK - WITCHES BROOK | MERRIMACK | 3.64 | MILES | 5-P | Fish Consumption | 4A-M | N | Mercury | N | 4A-M | | | N | Y | |
| 2016 | NHRIV700061001-07 | PENNICHUCK BROOK - WITCHES BROOK | MERRIMACK | 3.64 | MILES | 5-P | Aquatic Life | 5-P | N | Benthic-Macroinvertebrate Bioassessments (Streams) | N | 3-ND | | | N | | |
| 2016 | NHRIV700061001-07 | PENNICHUCK BROOK - WITCHES BROOK | MERRIMACK | 3.64 | MILES | 5-P | Aquatic Life | 5-P | N | Fishes Bioassessments (Streams) | N | 3-ND | | | N | | |
| 2016 | NHRIV700061001-07 | PENNICHUCK BROOK - WITCHES BROOK | MERRIMACK | 3.64 | MILES | 5-P | Drinking Water After Adequate Treatment | 2-G | N | Escherichia coli | N | 3-PNS | | | N | Y | |
| 2016 | NHRIV700061001-07 | PENNICHUCK BROOK - WITCHES BROOK | MERRIMACK | 3.64 | MILES | 5-P | Aquatic Life | 5-P | N | Iron | N | 3-ND | | | N | | |
| 2016 | NHRIV700061001-07 | PENNICHUCK BROOK - WITCHES BROOK | MERRIMACK | 3.64 | MILES | 5-P | Aquatic Life | 5-P | N | Turbidity | N | 3-ND | | | N | Y | |
| 2016 | NHRIV700061001-07 | PENNICHUCK BROOK - WITCHES BROOK | MERRIMACK | 3.64 | MILES | 5-P | Drinking Water After Adequate Treatment | 2-G | N | Manganese | N | 3-ND | | | N | | |
| 2016 | NHRIV700061001-07 | PENNICHUCK BROOK - WITCHES BROOK | MERRIMACK | 3.64 | MILES | 5-P | Secondary Contact Recreation | 2-G | N | Escherichia coli | N | 2-G | | | N | Y | |
| 2016 | NHRIV700061001-07 | PENNICHUCK BROOK - WITCHES BROOK | MERRIMACK | 3.64 | MILES | 5-P | Fish Consumption | 4A-M | N | Manganese | N | 3-ND | | | N | | |
| 2016 | NHRIV700061001-07 | PENNICHUCK BROOK - WITCHES BROOK | MERRIMACK | 3.64 | MILES | 5-P | Drinking Water After Adequate Treatment | 2-G | N | Fecal Coliform | N | 3-ND | | | N | | |
| 2016 | NHRIV700061001-07 | PENNICHUCK BROOK - WITCHES BROOK | MERRIMACK | 3.64 | MILES | 5-P | Aquatic Life | 5-P | N | Alkalinity, Carbonate as CaCO3 | N | 3-ND | | | N | | |
| 2016 | NHRIV700061001-07 | PENNICHUCK BROOK - WITCHES BROOK | MERRIMACK | 3.64 | MILES | 5-P | Aquatic Life | 5-P | N | Ammonia (Un-ionized) | N | 3-ND | | | N | Y | |
| 2016 | NHRIV700061001-07 | PENNICHUCK BROOK - WITCHES BROOK | MERRIMACK | 3.64 | MILES | 5-P | Aquatic Life | 5-P | N | Chloride | N | 3-ND | | | N | Y | |
| 2016 | NHRIV700061001-07 | PENNICHUCK BROOK - WITCHES BROOK | MERRIMACK | 3.64 | MILES | 5-P | Aquatic Life | 5-P | | Phosphorus (Total) | | 3-ND | | | N | Y | Columns J & L are missing designations. Highlighted yellow. |
| 2016 | NHRIV700061001-07 | PENNICHUCK BROOK - WITCHES BROOK | MERRIMACK | 3.64 | MILES | 5-P | Drinking Water After Adequate Treatment | 2-G | N | Copper | N | 3-ND | | | N | | |
| 2016 | NHRIV700061001-07 | PENNICHUCK BROOK - WITCHES BROOK | MERRIMACK | 3.64 | MILES | 5-P | Drinking Water After Adequate Treatment | 2-G | N | Iron | N | 3-ND | | | N | | |
| 2016 | NHRIV700061001-10 | PENNICHUCK BROOK | MERRIMACK | 0.88 | MILES | 3-PAS | Fish Consumption | 4A-M | N | Mercury | N | 4A-M | | | N | Y | |
| 2016 | NHRIV700061001-10 | PENNICHUCK BROOK | MERRIMACK | 0.88 | MILES | 3-PAS | Aquatic Life | 3-PAS | N | Benthic-Macroinvertebrate Bioassessments (Streams) | N | 3-ND | | | N | | |
| 2016 | NHRIV700061001-10 | PENNICHUCK BROOK | MERRIMACK | 0.88 | MILES | 3-PAS | Aquatic Life | 3-PAS | N | pH | N | 3-PAS | | | N | | |
| 2016 | NHRIV700061001-10 | PENNICHUCK BROOK | MERRIMACK | 0.88 | MILES | 3-PAS | Primary Contact Recreation | 3-PAS | N | Escherichia coli | N | 3-PAS | | | N | | |
| 2016 | NHRIV700061001-10 | PENNICHUCK BROOK | MERRIMACK | 0.88 | MILES | 3-PAS | Aquatic Life | 3-PAS | N | Oxygen, Dissolved | N | 3-PAS | | | N | | |
| 2016 | NHRIV700061001-10 | PENNICHUCK BROOK | MERRIMACK | 0.88 | MILES | 3-PAS | Secondary Contact Recreation | 3-PAS | N | Escherichia coli | N | 3-PAS | | | N | | |
| 2016 | NHRIV700061001-10 | PENNICHUCK BROOK | MERRIMACK | 0.88 | MILES | 3-PAS | Aquatic Life | 3-PAS | N | Chloride | N | 3-PAS | | | N | | |
| 2016 | NHRIV700061001-10 | PENNICHUCK BROOK | MERRIMACK | 0.88 | MILES | 3-PAS | Drinking Water After Adequate Treatment | 2-G | N | Escherichia coli | N | 3-PNS | | | N | | |
| 2016 | NHRIV700061001-10 | PENNICHUCK BROOK | MERRIMACK | 0.88 | MILES | 3-PAS | Aquatic Life | 3-PAS | N | Phosphorus (Total) | N | 3-PAS | | | N | | |
| 2016 | NHRIV700061001-10 | PENNICHUCK BROOK | MERRIMACK | 0.88 | MILES | 3-PAS | Aquatic Life | 3-PAS | N | Dissolved oxygen saturation | N | 3-PAS | | | N | | |
| 2016 | NHRIV700061001-10 | PENNICHUCK BROOK | MERRIMACK | 0.88 | MILES | 3-PAS | Aquatic Life | 3-PAS | N | Fishes Bioassessments (Streams) | N | 3-ND | | | N | | |

3- 14

| Cycle | Assessment Unit ID | Assessment Unit Name | Primary Town | Water Size | Size Unit | AUID-NHDES Category | Use Description | USE Level - NHDES Category | EPA_ADB-USE Threatened Flag | Supplemental ADB Parameter Name | Supplemental ADB-Parameter Threatened | Parameter Level - NHDES Category | TMDL Priority | Expected To Attain Date | Beach | Pollutant Flag | Comment |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2016 | NHRIV700060905-16 | BABOOSIC BROOK - UNNAMED BROOK | MERRIMACK | 14.61 | MILES | 3-ND | Fish Consumption | 4A-M | N | Mercury | N | 4A-M | | | N | Y | |
| 2016 | NHRIV700060905-16 | BABOOSIC BROOK - UNNAMED BROOK | MERRIMACK | 14.61 | MILES | 3-ND | Secondary Contact Recreation | 3-ND | N | Escherichia coli | N | 3-ND | | | N | | |
| 2016 | NHRIV700060905-16 | BABOOSIC BROOK - UNNAMED BROOK | MERRIMACK | 14.61 | MILES | 3-ND | Aquatic Life | 3-ND | N | Benthic-Macroinvertebrate Bioassessments (Streams) | N | 3-ND | | | N | | This evaluation indicates that there is insufficent data to assess the impairment. Why does the information on the http://www4.des.state.nh.us/WaterShed_SWQA//SWQA_Map.aspx website differ for benthic macro invertebrates? It appears that the assessment in the 2016 draft assessment list is more accurate. |
| 2016 | NHRIV700060905-16 | BABOOSIC BROOK - UNNAMED BROOK | MERRIMACK | 14.61 | MILES | 3-ND | Aquatic Life | 3-ND | N | Fishes Bioassessments (Streams) | N | 3-ND | | | N | | |
| 2016 | NHRIV700060905-16 | BABOOSIC BROOK - UNNAMED BROOK | MERRIMACK | 14.61 | MILES | 3-ND | Aquatic Life | 3-ND | N | Oxygen, Dissolved | N | 3-ND | | | N | | Refer to the comment above for dissolved oxygen. |
| 2016 | NHRIV700060905-16 | BABOOSIC BROOK - UNNAMED BROOK | MERRIMACK | 14.61 | MILES | 3-ND | Aquatic Life | 3-ND | N | pH | N | 3-ND | | | N | | |
| 2016 | NHRIV700060905-16 | BABOOSIC BROOK - UNNAMED BROOK | MERRIMACK | 14.61 | MILES | 3-ND | Primary Contact Recreation | 3-ND | N | Escherichia coli | N | 3-ND | | | N | | |
| 2016 | NHRIV700060905-16 | BABOOSIC BROOK - UNNAMED BROOK | MERRIMACK | 14.61 | MILES | 3-ND | Aquatic Life | 3-ND | N | Dissolved oxygen saturation | N | 3-ND | | | N | | Based on a review of the information below. This water body should not be classified at 5-P. The data does not suggest that there is an impairment per the CALM by a parameter which is a pollutant that requires a TMDL. There does not appear to be documentation that the impairment is more severe based on data which is 12-17 years old. |
| 2016 | NHRIV700060905-19 | BABOOSIC BROOK - RIDDLE BROOK | MERRIMACK | 10.32 | MILES | 5-P | Aquatic Life | 5-P | N | Oxygen, Dissolved | N | 5-P | LOW | | N | Y | |
| 2016 | NHRIV700060905-19 | BABOOSIC BROOK - RIDDLE BROOK | MERRIMACK | 10.32 | MILES | 5-P | Aquatic Life | 5-P | N | Benthic-Macroinvertebrate Bioassessments (Streams) | N | 5-P | LOW | | N | Y | |
| 2016 | NHRIV700060905-19 | BABOOSIC BROOK - RIDDLE BROOK | MERRIMACK | 10.32 | MILES | 5-P | Fish Consumption | 4A-M | N | Mercury | N | 4A-M | | | N | Y | |
| 2016 | NHRIV700060905-19 | BABOOSIC BROOK - RIDDLE BROOK | MERRIMACK | 10.32 | MILES | 5-P | Aquatic Life | 5-P | N | Dissolved oxygen saturation | N | 3-ND | | | N | | |
| 2016 | NHRIV700060905-19 | BABOOSIC BROOK - RIDDLE BROOK | MERRIMACK | 10.32 | MILES | 5-P | Aquatic Life | 5-P | N | Fishes Bioassessments (Streams) | N | 3-ND | | | N | | |
| 2016 | NHRIV700060905-19 | BABOOSIC BROOK - RIDDLE BROOK | MERRIMACK | 10.32 | MILES | 5-P | Aquatic Life | 5-P | N | Chloride | N | 3-ND | | | N | | |
| 2016 | NHRIV700060905-19 | BABOOSIC BROOK - RIDDLE BROOK | MERRIMACK | 10.32 | MILES | 5-P | Drinking Water After Adequate Treatment | 2-G | N | Escherichia coli | N | 3-ND | | | N | | |
| 2016 | NHRIV700060905-19 | BABOOSIC BROOK - RIDDLE BROOK | MERRIMACK | 10.32 | MILES | 5-P | Aquatic Life | 5-P | N | pH | N | 3-ND | | | N | | |
| 2016 | NHRIV700060905-19 | BABOOSIC BROOK - RIDDLE BROOK | MERRIMACK | 10.32 | MILES | 5-P | Aquatic Life | 5-P | N | Turbidity | N | 3-ND | | | N | | |
| 2016 | NHRIV700060905-19 | BABOOSIC BROOK - RIDDLE BROOK | MERRIMACK | 10.32 | MILES | 5-P | Primary Contact Recreation | 3-ND | N | Escherichia coli | N | 3-ND | | | N | | |
| 2016 | NHRIV700060905-19 | BABOOSIC BROOK - RIDDLE BROOK | MERRIMACK | 10.32 | MILES | 5-P | Aquatic Life | 5-P | | Phosphorus (Total) | | 3-ND | | | N | Y | |
| 2016 | NHRIV700060905-19 | BABOOSIC BROOK - RIDDLE BROOK | MERRIMACK | 10.32 | MILES | 5-P | Secondary Contact Recreation | 3-ND | N | Escherichia coli | N | 3-ND | | | N | | |

Assessment Unit ID NHRIV700060905-19
Assessment Unit Name BABOOSIC BROOK - RIDDLE BROOK
Primary Town MERRIMACK

Size 10.3220 MILES
Beach N
Assessment Unit Category*~ 5-P

**2016, 305(b)/303(d) - All Reviewed Parameters by Assessment Unit**
***DRAFT***

| Designated Use Description | *Desig. Use Category | Desig. Use Threat | Parameter Name | Parameter Threatened (Y/N) | Last Sample | Last Exceed | Parameter Category* | TMDL Priority | Source Name (Impairments only) |
|---|---|---|---|---|---|---|---|---|---|
| Aquatic Life | 5-P | | Benthic-Macroinvertebrate Bioassessments (Streams) | N | 2003 | 2003 | 5-P | LOW | Source Unknown |
| | | | CHLORIDE | N | 2000 | N/A | 3-ND | | |
| | | | Dissolved oxygen saturation | N | | | 3-ND | | |
| | | | Fishes Bioassessments (Streams) | N | | | 3-ND | | |
| | | | Oxygen, Dissolved | N | 2000 | N/A | 5-P | LOW | Source Unknown |
| | | | PH | N | 2000 | N/A | 3-ND | | |
| | | | PHOSPHORUS (TOTAL) | | 2000 | NLV | 3-ND | | |
| | | | TURBIDITY | N | 2000 | N/A | 3-ND | | |
| Drinking Water After Adequate Treatment | 2-G | | ESCHERICHIA COLI | N | 2005 | 2005 | 3-ND | | |
| Fish Consumption | 4A-M | | Mercury | N | | | 4A-M | | Atmospheric Deposition - Toxics |
| Primary Contact Recreation | 3-ND | | ESCHERICHIA COLI | N | 2005 | N/A | 3-ND | | |
| Secondary Contact Recreation | 3-ND | | ESCHERICHIA COLI | N | 2005 | N/A | 3-ND | | |
| Wildlife | 3-ND | | | | | | | | |

**General Comment**

Baboosic Brook has been of particular concern to the Town as the brook flows from west to east in the northern part of the town out falling at the Souhegan River just west of the confluence with the Merrimack River. In the past 15 years there have been many storms that have caused flooding along its path. Flooding brings on its own set of concern but can be equally damaging to the water quality. As the flood waters recede they take with it any fertilizers from the lawns and any other particulates that it encounters. By constructing new bridges along its path, widening the narrow constrictions and treating the side slopes so that there won't be any erosion the calculations are showing that the flood elevations will be significantly reduced. To date 4 new bridges have been installed; Bedford Road, Wire Road, Bean Road and most recently completed is the bridge at McGaw Bridge Road. Still to be completed is another bridge on Bedford Road and the final bridge will be at Daniel Webster Highway (US Route 3) in the year 2023. Calculations have shown that once all of these bridges are completed and the waters are allowed to flow the erosion causing velocity will be reduced and the flooding will be significantly reduced. Ultimately, when the waters reach the Souhegan River there should be a significant improvement to the water quality.

**General Comment**

The data collected to determine impairment is 17 years old. Reeds Ferry drainage improvements have been made before the runoff enters into the Baboosic Brook. It is expected that these improvements will have mitigated impairment issues related to runoff.

3- 15

| Cycle | Assessment Unit ID | Assessment Unit Name | Primary Town | Water Size | Size Unit | AUID-NHDES Category | Use Description | USE Level - NHDES Category | EPA_ADB-USE Threatened Flag | Supplemental ADB Parameter Name | Supplemental ADB-Parameter Threatened | Parameter Level -NHDES Category | TMDL Priority | Expected To Attain Date | Beach | Pollutant Flag | Comment |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2016 | NHLAK700061001-04-02 | BOWERS POND | MERRIMACK | 79.22 | ACRES | 5-M | Aquatic Life | 5-M | N | Iron | N | 5-M | LOW | | N | Y | |
| 2016 | NHLAK700061001-04-02 | BOWERS POND | MERRIMACK | 79.22 | ACRES | 5-M | Fish Consumption | 4A-M | N | Mercury | N | 4A-M | | | N | Y | There is no sample data in the table below for mercury. Not sure what the assessment is based on. |
| 2016 | NHLAK700061001-04-02 | BOWERS POND | MERRIMACK | 79.22 | ACRES | 5-M | Aquatic Life | 5-M | N | Chlorophyll-a | N | 3-ND | | | N | | No data is presented in the table below on Chlorophyll a. Not sure what the assessment is based on. |
| 2016 | NHLAK700061001-04-02 | BOWERS POND | MERRIMACK | 79.22 | ACRES | 5-M | Aquatic Life | 5-M | N | Dissolved oxygen saturation | N | 3-ND | | | N | | No data is presented in the table below on DO. Not sure what the assessment is based on. |
| 2016 | NHLAK700061001-04-02 | BOWERS POND | MERRIMACK | 79.22 | ACRES | 5-M | Drinking Water After Adequate Treatment | 2-G | N | Copper | N | 3-ND | | | N | | |
| 2016 | NHLAK700061001-04-02 | BOWERS POND | MERRIMACK | 79.22 | ACRES | 5-M | Aquatic Life | 5-M | N | Ammonia (Un-ionized) | N | 3-ND | | | N | Y | |
| 2016 | NHLAK700061001-04-02 | BOWERS POND | MERRIMACK | 79.22 | ACRES | 5-M | Aquatic Life | 5-M | N | Chloride | N | 3-ND | | | N | Y | |
| 2016 | NHLAK700061001-04-02 | BOWERS POND | MERRIMACK | 79.22 | ACRES | 5-M | Drinking Water After Adequate Treatment | 2-G | N | Manganese | N | 3-ND | | | N | Y | |
| 2016 | NHLAK700061001-04-02 | BOWERS POND | MERRIMACK | 79.22 | ACRES | 5-M | Drinking Water After Adequate Treatment | 2-G | N | Fecal Coliform | N | 3-ND | | | N | | |
| 2016 | NHLAK700061001-04-02 | BOWERS POND | MERRIMACK | 79.22 | ACRES | 5-M | Aquatic Life | 5-M | N | pH | N | 3-ND | | | N | | |
| 2016 | NHLAK700061001-04-02 | BOWERS POND | MERRIMACK | 79.22 | ACRES | 5-M | Fish Consumption | 4A-M | N | Manganese | N | 3-ND | | | N | Y | |
| 2016 | NHLAK700061001-04-02 | BOWERS POND | MERRIMACK | 79.22 | ACRES | 5-M | Primary Contact Recreation | 3-ND | N | Escherichia coli | N | 3-ND | | | N | | Based on the table below, for primary/secondary recreation there was not exceedance with the last sample collected in 1999. Why is there a 5-M NHDES classification? |
| 2016 | NHLAK700061001-04-02 | BOWERS POND | MERRIMACK | 79.22 | ACRES | 5-M | Drinking Water After Adequate Treatment | 2-G | N | Escherichia coli | N | 3-ND | | | N | | |
| 2016 | NHLAK700061001-04-02 | BOWERS POND | MERRIMACK | 79.22 | ACRES | 5-M | Drinking Water After Adequate Treatment | 2-G | N | Iron | N | 3-ND | | | N | Y | |
| 2016 | NHLAK700061001-04-02 | BOWERS POND | MERRIMACK | 79.22 | ACRES | 5-M | Aquatic Life | 5-M | N | Turbidity | N | 3-ND | | | N | | |
| 2016 | NHLAK700061001-04-02 | BOWERS POND | MERRIMACK | 79.22 | ACRES | 5-M | Secondary Contact Recreation | 3-ND | N | Escherichia coli | N | 3-ND | | | N | | |
| 2016 | NHLAK700061001-04-02 | BOWERS POND | MERRIMACK | 79.22 | ACRES | 5-M | Aquatic Life | 5-M | N | Oxygen, Dissolved | N | 3-ND | | | N | Y | |
| 2016 | NHLAK700061001-04-02 | BOWERS POND | MERRIMACK | 79.22 | ACRES | 5-M | Aquatic Life | 5-M | N | Alkalinity, Carbonate as CaCO3 | N | 3-ND | | | N | Y | |

Assessment Unit ID NHLAK700061001-04-02
Assessment Unit Name BOWERS POND
Primary Town MERRIMACK

Size 79.2210 ACRES
Beach N
Assessment Unit Category*~ 5-M

**2016, 305(b)/303(d) - All Reviewed Parameters by Assessment Unit**
***DRAFT***

| Designated Use Description | *Desig. Use Category | Desig. Use Threat | Parameter Name | Parameter Threatened (Y/N) | Last Sample | Last Exceed | Parameter Category* | TMDL Priority | Source Name (Impairments only) |
|---|---|---|---|---|---|---|---|---|---|
| Aquatic Life | 5-M | | ALKALINITY, CARBONATE AS CACO3 | N | 2005 | 2004 | 3-ND | | |
| | | | AMMONIA (UN-IONIZED) | N | 2005 | N/A | 3-ND | | |
| | | | CHLORIDE | N | 2005 | N/A | 3-ND | | |
| | | | Chlorophyll-a | N | | | 3-ND | | |
| | | | Dissolved oxygen saturation | N | | | 3-ND | | |
| | | | Iron | N | 2005 | 2005 | 5-M | LOW | Source Unknown |
| | | | OXYGEN, DISSOLVED | N | 2004 | 1999 | 3-ND | | |
| | | | PH | N | 1999 | 1999 | 3-ND | | |
| | | | TURBIDITY | N | 2005 | 2005 | 3-ND | | |
| Drinking Water After Adequate Treatment | 2-G | | COPPER | N | 1996 | N/A | 3-ND | | |
| | | | ESCHERICHIA COLI | N | 1999 | 1999 | 3-ND | | |
| | | | FECAL COLIFORM | N | 1999 | 1999 | 3-ND | | |
| | | | IRON | N | 2005 | 2005 | 3-ND | | |
| | | | MANGANESE | N | 2005 | 2005 | 3-ND | | |
| Fish Consumption | 4A-M | | MANGANESE | N | 2005 | 2005 | 3-ND | | |
| | | | Mercury | N | | | 4A-M | | Atmospheric Deposition - Toxics |
| Primary Contact Recreation | 3-ND | | ESCHERICHIA COLI | N | 1999 | N/A | 3-ND | | |
| Secondary Contact Recreation | 3-ND | | ESCHERICHIA COLI | N | 1999 | N/A | 3-ND | | |
| Wildlife | 3-ND | | | | | | | | |

3- 16

| Cycle | Assessment Unit ID | Assessment Unit Name | Primary Town | Water Size | Size Unit | AUID-NHDES Category | Use Description | USE Level - NHDES Category | EPA_ADB-USE Threatened Flag | Supplemental ADB Parameter Name | Supplemental ADB-Parameter Threatened | Parameter Level -NHDES Category | TMDL Priority | Expected To Attain Date | Beach | Pollutant Flag | Comment |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2016 | NHLAK700061002-03 | HORSESHOE POND | MERRIMACK | 43.62 | ACRES | 4A-M | Primary Contact Recreation | 4A-M | N | Cyanobacteria hepatotoxic microcystins | N | 4A-M | | | N | Y | The classification for cyano bacteria is based on recent data. The remaining classifications are based on data that is 20 plus years old. In many cases there was no exceedance identified per the table below. In the case for mercury there is no sampling dates provided in the table. Therefore, it is not clear how the 4AM category was determined. Please provide the full name for "2,4-D." |
| 2016 | NHLAK700061002-03 | HORSESHOE POND | MERRIMACK | 43.62 | ACRES | 4A-M | Primary Contact Recreation | 4A-M | N | Chlorophyll-a | N | 4A-M | | | N | Y | |
| 2016 | NHLAK700061002-03 | HORSESHOE POND | MERRIMACK | 43.62 | ACRES | 4A-M | Aquatic Life | 4A-M | N | pH | N | 4A-M | | | N | Y | |
| 2016 | NHLAK700061002-03 | HORSESHOE POND | MERRIMACK | 43.62 | ACRES | 4A-M | Fish Consumption | 4A-M | N | Mercury | N | 4A-M | | | N | Y | |
| 2016 | NHLAK700061002-03 | HORSESHOE POND | MERRIMACK | 43.62 | ACRES | 4A-M | Primary Contact Recreation | 4A-M | N | Escherichia coli | N | 3-ND | | | N | | |
| 2016 | NHLAK700061002-03 | HORSESHOE POND | MERRIMACK | 43.62 | ACRES | 4A-M | Aquatic Life | 4A-M | N | Chlorophyll-a | N | 3-ND | | | N | | |
| 2016 | NHLAK700061002-03 | HORSESHOE POND | MERRIMACK | 43.62 | ACRES | 4A-M | Drinking Water After Adequate Treatment | 2-G | N | 2,4-D | N | 3-PAS | | | N | Y | |
| 2016 | NHLAK700061002-03 | HORSESHOE POND | MERRIMACK | 43.62 | ACRES | 4A-M | Aquatic Life | 4A-M | N | Alkalinity, Carbonate as CaCO3 | N | 3-ND | | | N | | |
| 2016 | NHLAK700061002-03 | HORSESHOE POND | MERRIMACK | 43.62 | ACRES | 4A-M | Aquatic Life | 4A-M | N | Dissolved oxygen saturation | N | 3-ND | | | N | | |
| 2016 | NHLAK700061002-03 | HORSESHOE POND | MERRIMACK | 43.62 | ACRES | 4A-M | Aquatic Life | 4A-M | N | Chloride | N | 3-ND | | | N | | |
| 2016 | NHLAK700061002-03 | HORSESHOE POND | MERRIMACK | 43.62 | ACRES | 4A-M | Aquatic Life | 4A-M | N | Oxygen, Dissolved | N | 3-ND | | | N | | |
| 2016 | NHLAK700061002-03 | HORSESHOE POND | MERRIMACK | 43.62 | ACRES | 4A-M | Aquatic Life | 4A-M | N | Non-Native Aquatic Plants | N | 4C-M | | | N | N | |
| 2016 | NHLAK700061002-03 | HORSESHOE POND | MERRIMACK | 43.62 | ACRES | 4A-M | Drinking Water After Adequate Treatment | 2-G | N | Sulfates | N | 3-ND | | | N | | |
| 2016 | NHLAK700061002-03 | HORSESHOE POND | MERRIMACK | 43.62 | ACRES | 4A-M | Secondary Contact Recreation | 3-ND | N | Escherichia coli | N | 3-ND | | | N | | |

Assessment Unit ID NHLAK700061002-03
Assessment Unit Name HORSESHOE POND
Primary Town MERRIMACK

Size 43.6220 ACRES
Beach N
Assessment Unit Category*~ 4A-M

**2016, 305(b)/303(d) - All Reviewed Parameters by Assessment Unit**
***DRAFT***

| Designated Use Description | *Desig. Use Category | Desig. Use Threat | Parameter Name | Parameter Threatened (Y/N) | Last Sample | Last Exceed | Parameter Category* | TMDL Priority | Source Name (Impairments only) |
|---|---|---|---|---|---|---|---|---|---|
| Aquatic Life | 4A-M | | ALKALINITY, CARBONATE AS CACO3 | N | 1998 | 1998 | 3-ND | | |
| | | | CHLORIDE | N | 1998 | N/A | 3-ND | | |
| | | | Chlorophyll-a | N | 1999 | NLV | 3-ND | | |
| | | | DISSOLVED OXYGEN SATURATION | N | 1997 | N/A | 3-ND | | |
| | | | Non-Native Aquatic Plants | N | | | 4C-M | | Source Unknown |
| | | | OXYGEN, DISSOLVED | N | 1998 | N/A | 3-ND | | |
| | | | pH | N | 1998 | 1998 | 4A-M | | Atmospheric Deposition - Acidity |
| Drinking Water After Adequate Treatment | 2-G | | 2,4-D | N | 2008 | N/A | 3-PAS | | |
| | | | SULFATES | N | 1998 | N/A | 3-ND | | |
| | | | | N | 1997 | N/A | 3-ND | | |
| Fish Consumption | 4A-M | | Mercury | N | | | 4A-M | | Atmospheric Deposition - Toxics |
| Primary Contact Recreation | 4A-M | | Chlorophyll-a | N | 1999 | 1999 | 4A-M | | Source Unknown |
| | | | Cyanobacteria hepatotoxic microcystins | N | 2013 | 2013 | 4A-M | | Source Unknown |
| | | | Escherichia coli | N | 1997 | NA | 3-ND | | |
| Secondary Contact Recreation | 3-ND | | Escherichia coli | N | 1997 | NA | 3-ND | | |
| Wildlife | 3-ND | | | | | | | | |

3- 17

| Cycle | Assessment Unit ID | Assessment Unit Name | Primary Town | Water Size | Size Unit | AUID-NHDES Category | Use Description | USE Level - NHDES Category | EPA_ADB- USE Threatened Flag | Supplemental ADB Parameter Name | Supplemental ADB-Parameter Threatened | Parameter Level -NHDES Category | TMDL Priority | Expected To Attain Date | Beach | Pollutant Flag | Comment |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2016 | NHLAK700061002-04-01 | NATICOOK L | MERRIMACK | 62.21 | ACRES | 4C-M | Aquatic Life | 4C-M | N | Non-Native Aquatic Plants | N | 4C-M | | | N | N | The date of the observation should be palced in the website. |
| 2016 | NHLAK700061002-04-01 | NATICOOK L | MERRIMACK | 62.21 | ACRES | 4C-M | Fish Consumption | 4A-M | N | Mercury | N | 4A-M | | | N | Y | There are no sampling dates identified for mercury. How was the assessment completed? |
| 2016 | NHLAK700061002-04-01 | NATICOOK L | MERRIMACK | 62.21 | ACRES | 4C-M | Drinking Water After Adequate Treatment | 2-G | N | Sulfates | N | 3-ND | | | N | Y | |
| 2016 | NHLAK700061002-04-01 | NATICOOK L | MERRIMACK | 62.21 | ACRES | 4C-M | Aquatic Life | 4C-M | N | Dissolved oxygen saturation | N | 3-PAS | | | N | Y | |
| 2016 | NHLAK700061002-04-01 | NATICOOK L | MERRIMACK | 62.21 | ACRES | 4C-M | Aquatic Life | 4C-M | N | Turbidity | N | 3-PAS | | | N | | |
| 2016 | NHLAK700061002-04-01 | NATICOOK L | MERRIMACK | 62.21 | ACRES | 4C-M | Primary Contact Recreation | 3-ND | N | Escherichia coli | N | 3-ND | | | N | | |
| 2016 | NHLAK700061002-04-01 | NATICOOK L | MERRIMACK | 62.21 | ACRES | 4C-M | Secondary Contact Recreation | 3-ND | N | Escherichia coli | N | 3-ND | | | N | | |
| 2016 | NHLAK700061002-04-01 | NATICOOK L | MERRIMACK | 62.21 | ACRES | 4C-M | Primary Contact Recreation | 3-ND | N | Chlorophyll-a | N | 2-G | | | N | Y | |
| 2016 | NHLAK700061002-04-01 | NATICOOK L | MERRIMACK | 62.21 | ACRES | 4C-M | Aquatic Life | 4C-M | N | Chloride | N | 3-PAS | | | N | Y | |
| 2016 | NHLAK700061002-04-01 | NATICOOK L | MERRIMACK | 62.21 | ACRES | 4C-M | Aquatic Life | 4C-M | N | Oxygen, Dissolved | N | 3-PAS | | | N | Y | |
| 2016 | NHLAK700061002-04-01 | NATICOOK L | MERRIMACK | 62.21 | ACRES | 4C-M | Aquatic Life | 4C-M | N | pH | N | 3-PAS | | | N | Y | The sampling date was 2015 with the last exceedance observed in 1990. There has been 27 years since the last issue. When will the parameter level impairment be changed to reflect compliance with water quality requirements? |
| 2016 | NHLAK700061002-04-01 | NATICOOK L | MERRIMACK | 62.21 | ACRES | 4C-M | Aquatic Life | 4C-M | N | Chlorophyll-a | N | 2-M | | | N | Y | |
| 2016 | NHLAK700061002-04-01 | NATICOOK L | MERRIMACK | 62.21 | ACRES | 4C-M | Aquatic Life | 4C-M | N | Alkalinity, Carbonate as CaCO3 | N | 3-ND | | | N | Y | |
| 2016 | NHLAK700061002-04-01 | NATICOOK L | MERRIMACK | 62.21 | ACRES | 4C-M | Aquatic Life | 4C-M | N | Phosphorus (Total) | N | 2-M | | | N | Y | |
| 2016 | NHLAK700061002-04-02 | NATICOOK L | MERRIMACK | 0.49 | ACRES | 4A-P | Primary Contact Recreation | 4A-P | N | Escherichia coli | N | 4A-P | | | Y | Y | |
| 2016 | NHLAK700061002-04-02 | NATICOOK L | MERRIMACK | 0.49 | ACRES | 4A-P | Fish Consumption | 4A-M | N | Mercury | N | 4A-M | | | Y | Y | There are no sampling dates identified for mercury. How was the assessment completed? |
| 2016 | NHLAK700061002-04-02 | NATICOOK L | MERRIMACK | 0.49 | ACRES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | Escherichia coli | N | 3-PNS | | | Y | Y | |
| 2016 | NHLAK700061002-04-02 | NATICOOK L | MERRIMACK | 0.49 | ACRES | 4A-P | Aquatic Life | 3-ND | N | pH | N | 3-ND | | | Y | | |
| 2016 | NHLAK700061002-04-02 | NATICOOK L | MERRIMACK | 0.49 | ACRES | 4A-P | Secondary Contact Recreation | 2-G | N | Escherichia coli | N | 2-G | | | Y | Y | |
| 2016 | NHLAK700061002-04-02 | NATICOOK L | MERRIMACK | 0.49 | ACRES | 4A-P | Aquatic Life | 3-ND | N | Dissolved oxygen saturation | N | 3-ND | | | Y | | |
| 2016 | NHLAK700061002-04-02 | NATICOOK L | MERRIMACK | 0.49 | ACRES | 4A-P | Drinking Water After Adequate Treatment | 2-G | N | Fecal Coliform | N | 3-ND | | | Y | | |
| 2016 | NHLAK700061002-04-02 | NATICOOK L | MERRIMACK | 0.49 | ACRES | 4A-P | Aquatic Life | 3-ND | N | Chlorophyll-a | N | 3-ND | | | Y | | |
| 2016 | NHLAK700061002-04-03 | NATICOOK L | MERRIMACK | 1.38 | ACRES | 3-PAS | Fish Consumption | 4A-M | N | Mercury | N | 4A-M | | | Y | Y | There are no sampling dates identified for mercury. How was the assessment completed? |
| 2016 | NHLAK700061002-04-03 | NATICOOK L | MERRIMACK | 1.38 | ACRES | 3-PAS | Aquatic Life | 3-ND | N | Chlorophyll-a | N | 3-ND | | | Y | | |
| 2016 | NHLAK700061002-04-03 | NATICOOK L | MERRIMACK | 1.38 | ACRES | 3-PAS | Aquatic Life | 3-ND | N | Dissolved oxygen saturation | N | 3-ND | | | Y | | The last DO data was collected in 2001 with no identified exceedances. What are the categories (3-PAS) based on? |
| 2016 | NHLAK700061002-04-03 | NATICOOK L | MERRIMACK | 1.38 | ACRES | 3-PAS | Aquatic Life | 3-ND | N | Oxygen, Dissolved | N | 3-ND | | | Y | | |
| 2016 | NHLAK700061002-04-03 | NATICOOK L | MERRIMACK | 1.38 | ACRES | 3-PAS | Primary Contact Recreation | 2-G | N | Escherichia coli | N | 2-G | | | Y | Y | |
| 2016 | NHLAK700061002-04-03 | NATICOOK L | MERRIMACK | 1.38 | ACRES | 3-PAS | Secondary Contact Recreation | 2-G | N | Escherichia coli | N | 2-G | | | Y | Y | |
| 2016 | NHLAK700061002-04-03 | NATICOOK L | MERRIMACK | 1.38 | ACRES | 3-PAS | Drinking Water After Adequate Treatment | 2-G | N | Escherichia coli | N | 3-PNS | | | Y | Y | |
| 2016 | NHLAK700061002-04-03 | NATICOOK L | MERRIMACK | 1.38 | ACRES | 3-PAS | Aquatic Life | 3-ND | N | pH | N | 3-ND | | | Y | | The last sample date for pH was in 2001 with no exceedances identified. When will the parameter level impairment be changed to reflect compliance with water quality requirements? |
| 2016 | NHLAK700061002-04-04 | NATICOOK L | MERRIMACK | 1.38 | ACRES | 3-PAS | Fish Consumption | 4A-M | N | Mercury | N | 4A-M | | | Y | Y | There are no sampling dates identified for mercury. How was the assessment completed? |
| 2016 | NHLAK700061002-04-04 | NATICOOK L | MERRIMACK | 1.38 | ACRES | 3-PAS | Secondary Contact Recreation | 2-G | N | Escherichia coli | N | 2-G | | | Y | Y | |
| 2016 | NHLAK700061002-04-04 | NATICOOK L | MERRIMACK | 1.38 | ACRES | 3-PAS | Aquatic Life | 3-ND | N | Chlorophyll-a | N | 3-ND | | | Y | | |
| 2016 | NHLAK700061002-04-04 | NATICOOK L | MERRIMACK | 1.38 | ACRES | 3-PAS | Aquatic Life | 3-ND | N | Dissolved oxygen saturation | N | 3-ND | | | Y | | |
| 2016 | NHLAK700061002-04-04 | NATICOOK L | MERRIMACK | 1.38 | ACRES | 3-PAS | Aquatic Life | 3-ND | N | Oxygen, Dissolved | N | 3-ND | | | Y | | The last DO sample was collected in 2001 with no exceedance date identified. What was the 3-PAS designation based on? |
| 2016 | NHLAK700061002-04-04 | NATICOOK L | MERRIMACK | 1.38 | ACRES | 3-PAS | Drinking Water After Adequate Treatment | 2-G | N | Fecal Coliform | N | 3-ND | | | Y | | |
| 2016 | NHLAK700061002-04-04 | NATICOOK L | MERRIMACK | 1.38 | ACRES | 3-PAS | Primary Contact Recreation | 2-G | N | Escherichia coli | N | 2-G | | | Y | Y | Samples were last collected in 2016. There was no exceedance identified. When will the impairment classification be changed? |
| 2016 | NHLAK700061002-04-04 | NATICOOK L | MERRIMACK | 1.38 | ACRES | 3-PAS | Drinking Water After Adequate Treatment | 2-G | N | Escherichia coli | N | 3-PNS | | | Y | Y | |
| 2016 | NHLAK700061002-04-04 | NATICOOK L | MERRIMACK | 1.38 | ACRES | 3-PAS | Aquatic Life | 3-ND | N | pH | N | 3-ND | | | Y | | The last sample date for pH was in 2001 with no exceedances identified. When will the parameter level impairment be changed to reflect compliance with water quality requirements? |

3- 18

Assessment Unit ID NHLAK700061002-04-01
Assessment Unit Name NATICOOK LAKE
Primary Town MERRIMACK

Size 62.2130 ACRES
Beach N
Assessment Unit Category*- 4C-M

**2016, 305(b)/303(d) - All Reviewed Parameters by Assessment Unit**
*****DRAFT*****

| Designated Use Description | *Desig. Use Category | Desig. Use Threat | Parameter Name | Parameter Threatened (Y/N) | Last Sample | Last Exceed | Parameter Category* | TMDL Priority | Source Name (Impairments only) |
|---|---|---|---|---|---|---|---|---|---|
| Aquatic Life | 4C-M | | ALKALINITY, CARBONATE AS CACO3 | N | 2001 | 1990 | 3-ND | | |
| | | | CHLORIDE | N | 2015 | N/A | 3-PAS | | |
| | | | CHLOROPHYLL-A | N | 2015 | NLV | 2-M | | |
| | | | DISSOLVED OXYGEN SATURATION | N | 2015 | N/A | 3-PAS | | |
| | | | Non-Native Aquatic Plants | N | | | 4C-M | | Source Unknown |
| | | | OXYGEN, DISSOLVED | N | 2015 | N/A | 3-PAS | | |
| | | | PH | N | 2015 | 1990 | 3-PAS | | |
| | | | PHOSPHORUS (TOTAL) | N | 2015 | NLV | 2-M | | |
| | | | TURBIDITY | N | 2015 | 2006 | 3-PAS | | |
| Drinking Water After Adequate Treatment | 2-G | | SULFATES | N | 2001 | N/A | 3-ND | | |
| | | | | N | 2000 | N/A | 3-ND | | |
| Fish Consumption | 4A-M | | Mercury | N | | | 4A-M | | Atmospheric Deposition - Toxics |
| Primary Contact Recreation | 3-ND | | CHLOROPHYLL-A | N | 2015 | N/A | 2-G | | |
| | | | Escherichia coli | N | 2000 | NA | 3-ND | | |
| Secondary Contact Recreation | 3-ND | | Escherichia coli | N | 2000 | NA | 3-ND | | |
| Wildlife | 3-ND | | | | | | | | |

3- 19

Assessment Unit ID NHLAK700061002-04-02
Assessment Unit Name NATICOOK LAKE - WASSERMAN PARK BEACH
Primary Town MERRIMACK

Size 0.4850 ACRES
Beach Y
Assessment Unit Category*- 4A-P

**2016, 305(b)/303(d) - All Reviewed Parameters by Assessment Unit**
*****DRAFT*****

| Designated Use Description | *Desig. Use Category | Desig. Use Threat | Parameter Name | Parameter Threatened (Y/N) | Last Sample | Last Exceed | Parameter Category* | TMDL Priority | Source Name (Impairments only) |
|---|---|---|---|---|---|---|---|---|---|
| Aquatic Life | 3-ND | | Chlorophyll-a | N | | | 3-ND | | |
| | | | Dissolved oxygen saturation | N | 2000 | NA | 3-ND | | |
| | | | Oxygen, Dissolved | N | 2001 | NA | 3-ND | | |
| | | | pH | N | 2001 | NA | 3-ND | | |
| Drinking Water After Adequate Treatment | 2-G | | ESCHERICHIA COLI | N | 2016 | 2016 | 3-PNS | | |
| | | | FECAL COLIFORM | N | 1991 | 1991 | 3-ND | | |
| Fish Consumption | 4A-M | | Mercury | N | | | 4A-M | | Atmospheric Deposition - Toxics |
| Primary Contact Recreation | 4A-P | | Escherichia coli | N | 2016 | 2011 | 4A-P | | Source Unknown |
| Secondary Contact Recreation | 2-G | | ESCHERICHIA COLI | N | 2016 | N/A | 2-G | | |
| Wildlife | 3-ND | | | | | | | | |

Assessment Unit ID NHLAK700061002-04-03
Assessment Unit Name NATICOOK LAKE - NATICOOK DAY CAMP BEACH
Primary Town MERRIMACK

Size 1.3800 ACRES
Beach Y
Assessment Unit Category*~ 3-PAS

2016, 305(b)/303(d) - All Reviewed Parameters by Assessment Unit
***DRAFT***

| Designated Use Description | *Desig. Use Category | Desig. Use Threat | Parameter Name | Parameter Threatened (Y/N) | Last Sample | Last Exceed | Parameter Category* | TMDL Priority | Source Name (Impairments only) |
|---|---|---|---|---|---|---|---|---|---|
| Aquatic Life | 3-ND | | Chlorophyll-a | N | | | 3-ND | | |
| | | | Dissolved oxygen saturation | N | 2000 | NA | 3-ND | | |
| | | | Oxygen, Dissolved | N | 2001 | NA | 3-ND | | |
| | | | pH | N | 2001 | NA | 3-ND | | |
| Drinking Water After Adequate Treatment | 2-G | | ESCHERICHIA COLI | N | 2008 | 2008 | 3-PNS | | |
| Fish Consumption | 4A-M | | Mercury | N | | | 4A-M | | Atmospheric Deposition - Toxics |
| Primary Contact Recreation | 2-G | | ESCHERICHIA COLI | N | 2008 | N/A | 2-G | | |
| Secondary Contact Recreation | 2-G | | ESCHERICHIA COLI | N | 2008 | N/A | 2-G | | |
| Wil | | | | | | | | | |

3- 20

Assessment Unit ID NHLAK700061002-04-04
Assessment Unit Name NATICOOK LAKE - CAMP SARGENT BEACH
Primary Town MERRIMACK

Size 1.3800 ACRES
Beach Y
Assessment Unit Category*~ 3-PAS

2016, 305(b)/303(d) - All Reviewed Parameters by Assessment Unit
***DRAFT***

| Designated Use Description | *Desig. Use Category | Desig. Use Threat | Parameter Name | Parameter Threatened (Y/N) | Last Sample | Last Exceed | Parameter Category* | TMDL Priority | Source Name (Impairments only) |
|---|---|---|---|---|---|---|---|---|---|
| Aquatic Life | 3-ND | | Chlorophyll-a | N | | | 3-ND | | |
| | | | Dissolved oxygen saturation | N | 2000 | NA | 3-ND | | |
| | | | Oxygen, Dissolved | N | 2001 | NA | 3-ND | | |
| | | | pH | N | 2001 | NA | 3-ND | | |
| Drinking Water After Adequate Treatment | 2-G | | ESCHERICHIA COLI | N | 2016 | 2016 | 3-PNS | | |
| | | | FECAL COLIFORM | N | 1991 | 1991 | 3-ND | | |
| Fish Consumption | 4A-M | | Mercury | N | | | 4A-M | | Atmospheric Deposition - Toxics |
| Primary Contact Recreation | 2-G | | ESCHERICHIA COLI | N | 2016 | N/A | 2-G | | |
| Secondary Contact Recreation | 2-G | | ESCHERICHIA COLI | N | 2016 | N/A | 2-G | | |
| Wildlife | 3-ND | | | | | | | | |

3- 21

| Cycle | Assessment Unit ID | Assessment Unit Name | Primary Town | Water Size | Size Unit | AUID-NHDES Category | Use Description | USE Level - NHDES Category | EPA_ADB-USE Threatened Flag | Supplemental ADB Parameter Name | Supplemental ADB-Parameter Threatene | Parameter Level - NHDES Category | TMDL Priority | Expected To Attain Date | Beach | Pollutant Flag | Comment |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2016 | NHRIV700060906-20 | MUSKRELL BROOK - TO SOUHEGAN RIVER | MERRIMACK | 2.24 | MILES | 5-M | Aquatic Life | 5-M | N | pH | N | 5-M | LOW | | N | Y | Could not find the location on the http://www4.des.state.nh.us/WaterShed_ SWQA//SWQA_Map.aspx website. How does parameter level 3-ND result in a 5-M category. |
| 2016 | NHRIV700060906-20 | MUSKRELL BROOK - TO SOUHEGAN RIVER | MERRIMACK | 2.24 | MILES | 5-M | Aquatic Life | 5-M | N | Dissolved oxygen saturation | N | 5-M | LOW | | N | Y | |
| 2016 | NHRIV700060906-20 | MUSKRELL BROOK - TO SOUHEGAN RIVER | MERRIMACK | 2.24 | MILES | 5-M | Fish Consumption | 4A-M | N | Mercury | N | 4A-M | | | N | Y | |
| 2016 | NHRIV700060906-20 | MUSKRELL BROOK - TO SOUHEGAN RIVER | MERRIMACK | 2.24 | MILES | 5-M | Aquatic Life | 5-M | N | Benthic-Macroinvertebrate Bioassessments (Streams) | N | 3-ND | | | N | | |
| 2016 | NHRIV700060906-20 | MUSKRELL BROOK - TO SOUHEGAN RIVER | MERRIMACK | 2.24 | MILES | 5-M | Drinking Water After Adequate Treatment | 2-G | N | Copper | N | 3-ND | | | N | | |
| 2016 | NHRIV700060906-20 | MUSKRELL BROOK - TO SOUHEGAN RIVER | MERRIMACK | 2.24 | MILES | 5-M | Aquatic Life | 5-M | N | Alkalinity, Carbonate as CaCO3 | N | 3-ND | | | N | | |
| 2016 | NHRIV700060906-20 | MUSKRELL BROOK - TO SOUHEGAN RIVER | MERRIMACK | 2.24 | MILES | 5-M | Aquatic Life | 5-M | N | Cadmium | N | 3-ND | | | N | | |
| 2016 | NHRIV700060906-20 | MUSKRELL BROOK - TO SOUHEGAN RIVER | MERRIMACK | 2.24 | MILES | 5-M | Aquatic Life | 5-M | N | Iron | N | 3-ND | | | N | | |
| 2016 | NHRIV700060906-20 | MUSKRELL BROOK - TO SOUHEGAN RIVER | MERRIMACK | 2.24 | MILES | 5-M | Drinking Water After Adequate Treatment | 2-G | N | Sulfates | N | 3-ND | | | N | | |
| 2016 | NHRIV700060906-20 | MUSKRELL BROOK - TO SOUHEGAN RIVER | MERRIMACK | 2.24 | MILES | 5-M | Primary Contact Recreation | 3-ND | N | Chlorophyll-a | N | 3-ND | | | N | | |
| 2016 | NHRIV700060906-20 | MUSKRELL BROOK - TO SOUHEGAN RIVER | MERRIMACK | 2.24 | MILES | 5-M | Fish Consumption | 4A-M | N | Copper | N | 3-ND | | | N | | |
| 2016 | NHRIV700060906-20 | MUSKRELL BROOK - TO SOUHEGAN RIVER | MERRIMACK | 2.24 | MILES | 5-M | Fish Consumption | 4A-M | N | Selenium | N | 3-ND | | | N | | |
| 2016 | NHRIV700060906-20 | MUSKRELL BROOK - TO SOUHEGAN RIVER | MERRIMACK | 2.24 | MILES | 5-M | Aquatic Life | 5-M | N | Aluminum | N | 3-ND | | | N | | |
| 2016 | NHRIV700060906-20 | MUSKRELL BROOK - TO SOUHEGAN RIVER | MERRIMACK | 2.24 | MILES | 5-M | Aquatic Life | 5-M | N | Ammonia (Un-ionized) | N | 3-ND | | | N | | |
| 2016 | NHRIV700060906-20 | MUSKRELL BROOK - TO SOUHEGAN RIVER | MERRIMACK | 2.24 | MILES | 5-M | Drinking Water After Adequate Treatment | 2-G | N | Escherichia coli | N | 3-ND | | | N | | |
| 2016 | NHRIV700060906-20 | MUSKRELL BROOK - TO SOUHEGAN RIVER | MERRIMACK | 2.24 | MILES | 5-M | Fish Consumption | 4A-M | N | Arsenic | N | 3-ND | | | N | | |
| 2016 | NHRIV700060906-20 | MUSKRELL BROOK - TO SOUHEGAN RIVER | MERRIMACK | 2.24 | MILES | 5-M | Aquatic Life | 5-M | N | Selenium | N | 3-ND | | | N | | |
| 2016 | NHRIV700060906-20 | MUSKRELL BROOK - TO SOUHEGAN RIVER | MERRIMACK | 2.24 | MILES | 5-M | Fish Consumption | 4A-M | N | Zinc | N | 3-ND | | | N | | |
| 2016 | NHRIV700060906-20 | MUSKRELL BROOK - TO SOUHEGAN RIVER | MERRIMACK | 2.24 | MILES | 5-M | Fish Consumption | 4A-M | N | Manganese | N | 3-ND | | | N | | |
| 2016 | NHRIV700060906-20 | MUSKRELL BROOK - TO SOUHEGAN RIVER | MERRIMACK | 2.24 | MILES | 5-M | Fish Consumption | 4A-M | N | Nickel | N | 3-ND | | | N | | |
| 2016 | NHRIV700060906-20 | MUSKRELL BROOK - TO SOUHEGAN RIVER | MERRIMACK | 2.24 | MILES | 5-M | Aquatic Life | 5-M | N | Chloride | N | 3-ND | | | N | | |
| 2016 | NHRIV700060906-20 | MUSKRELL BROOK - TO SOUHEGAN RIVER | MERRIMACK | 2.24 | MILES | 5-M | Drinking Water After Adequate Treatment | 2-G | N | Iron | N | 3-ND | | | N | | |
| 2016 | NHRIV700060906-20 | MUSKRELL BROOK - TO SOUHEGAN RIVER | MERRIMACK | 2.24 | MILES | 5-M | Primary Contact Recreation | 3-ND | N | Escherichia coli | N | 3-ND | | | N | | |
| 2016 | NHRIV700060906-20 | MUSKRELL BROOK - TO SOUHEGAN RIVER | MERRIMACK | 2.24 | MILES | 5-M | Aquatic Life | 5-M | N | Arsenic | N | 3-ND | | | N | | |
| 2016 | NHRIV700060906-20 | MUSKRELL BROOK - TO SOUHEGAN RIVER | MERRIMACK | 2.24 | MILES | 5-M | Aquatic Life | 5-M | N | Oxygen, Dissolved | N | 3-ND | | | N | | |
| 2016 | NHRIV700060906-20 | MUSKRELL BROOK - TO SOUHEGAN RIVER | MERRIMACK | 2.24 | MILES | 5-M | Aquatic Life | 5-M | N | Nickel | N | 3-ND | | | N | | |
| 2016 | NHRIV700060906-20 | MUSKRELL BROOK - TO SOUHEGAN RIVER | MERRIMACK | 2.24 | MILES | 5-M | Drinking Water After Adequate Treatment | 2-G | N | Manganese | N | 3-ND | | | N | | |
| 2016 | NHRIV700060906-20 | MUSKRELL BROOK - TO SOUHEGAN RIVER | MERRIMACK | 2.24 | MILES | 5-M | Drinking Water After Adequate Treatment | 2-G | N | Nickel | N | 3-ND | | | N | | |
| 2016 | NHRIV700060906-20 | MUSKRELL BROOK - TO SOUHEGAN RIVER | MERRIMACK | 2.24 | MILES | 5-M | Drinking Water After Adequate Treatment | 2-G | N | Selenium | N | 3-ND | | | N | | |
| 2016 | NHRIV700060906-20 | MUSKRELL BROOK - TO SOUHEGAN RIVER | MERRIMACK | 2.24 | MILES | 5-M | Aquatic Life | 5-M | | Phosphorus (Total) | | 3-ND | | | N | Y | |
| 2016 | NHRIV700060906-20 | MUSKRELL BROOK - TO SOUHEGAN RIVER | MERRIMACK | 2.24 | MILES | 5-M | Aquatic Life | 5-M | N | Copper | N | 3-ND | | | N | | |
| 2016 | NHRIV700060906-20 | MUSKRELL BROOK - TO SOUHEGAN RIVER | MERRIMACK | 2.24 | MILES | 5-M | Aquatic Life | 5-M | N | Lead | N | 3-ND | | | N | | |
| 2016 | NHRIV700060906-20 | MUSKRELL BROOK - TO SOUHEGAN RIVER | MERRIMACK | 2.24 | MILES | 5-M | Aquatic Life | 5-M | N | Zinc | N | 3-ND | | | N | | |
| 2016 | NHRIV700060906-20 | MUSKRELL BROOK - TO SOUHEGAN RIVER | MERRIMACK | 2.24 | MILES | 5-M | Aquatic Life | 5-M | N | Turbidity | N | 3-ND | | | N | | |
| 2016 | NHRIV700060906-20 | MUSKRELL BROOK - TO SOUHEGAN RIVER | MERRIMACK | 2.24 | MILES | 5-M | Drinking Water After Adequate Treatment | 2-G | N | Arsenic | N | 3-ND | | | N | | |
| 2016 | NHRIV700060906-20 | MUSKRELL BROOK - TO SOUHEGAN RIVER | MERRIMACK | 2.24 | MILES | 5-M | Drinking Water After Adequate Treatment | 2-G | N | Fecal Coliform | N | 3-ND | | | N | | |
| 2016 | NHRIV700060906-20 | MUSKRELL BROOK - TO SOUHEGAN RIVER | MERRIMACK | 2.24 | MILES | 5-M | Drinking Water After Adequate Treatment | 2-G | N | Zinc | N | 3-ND | | | N | | |
| 2016 | NHRIV700060906-20 | MUSKRELL BROOK - TO SOUHEGAN RIVER | MERRIMACK | 2.24 | MILES | 5-M | Secondary Contact Recreation | 3-ND | N | Escherichia coli | N | 3-ND | | | N | | |
| 2016 | NHRIV700060906-20 | MUSKRELL BROOK - TO SOUHEGAN RIVER | MERRIMACK | 2.24 | MILES | 5-M | Aquatic Life | 5-M | N | Fishes Bioassessments (Streams) | N | 3-ND | | | N | | |
| 2016 | NHRIV700060906-21 | UNNAMED BROOK - TO SOUHEGAN RIVER | MERRIMACK | 1.26 | MILES | 3-ND | Fish Consumption | 4A-M | N | Mercury | N | 4A-M | | | N | Y | |
| 2016 | NHRIV700060906-21 | UNNAMED BROOK - TO SOUHEGAN RIVER | MERRIMACK | 1.26 | MILES | 3-ND | Primary Contact Recreation | 3-ND | N | Escherichia coli | N | 3-ND | | | N | | |
| 2016 | NHRIV700060906-21 | UNNAMED BROOK - TO SOUHEGAN RIVER | MERRIMACK | 1.26 | MILES | 3-ND | Secondary Contact Recreation | 3-ND | N | Escherichia coli | N | 3-ND | | | N | | |
| 2016 | NHRIV700060906-21 | UNNAMED BROOK - TO SOUHEGAN RIVER | MERRIMACK | 1.26 | MILES | 3-ND | Aquatic Life | 3-ND | N | Dissolved oxygen saturation | N | 3-ND | | | N | | |
| 2016 | NHRIV700060906-21 | UNNAMED BROOK - TO SOUHEGAN RIVER | MERRIMACK | 1.26 | MILES | 3-ND | Aquatic Life | 3-ND | N | pH | N | 3-ND | | | N | | |
| 2016 | NHRIV700060906-21 | UNNAMED BROOK - TO SOUHEGAN RIVER | MERRIMACK | 1.26 | MILES | 3-ND | Aquatic Life | 3-ND | N | Benthic-Macroinvertebrate Bioassessments (Streams) | N | 3-ND | | | N | | |
| 2016 | NHRIV700060906-21 | UNNAMED BROOK - TO SOUHEGAN RIVER | MERRIMACK | 1.26 | MILES | 3-ND | Aquatic Life | 3-ND | N | Fishes Bioassessments (Streams) | N | 3-ND | | | N | | |
| 2016 | NHRIV700060906-21 | UNNAMED BROOK - TO SOUHEGAN RIVER | MERRIMACK | 1.26 | MILES | 3-ND | Aquatic Life | 3-ND | N | Oxygen, Dissolved | N | 3-ND | | | N | | |

| NH DES Category | General Description (The same categories are used at the AU, Use, and Parameter Level. This table is intended to give a overview of the NH DES Categories. See Table 3-6 in the 2014 CALM for more detail) |
|---|---|
| 2-G | Meets water quality standards by a relatively large margin. |
| 2-M | Meets water quality standards but only marginally. |
| 2-OBS | Parameter exceeds numeric WQC but is a natural exceedance, therefore is not a WQS exceedance and is an observed effect. |
| 3-ND | There is no data, or the data is unusable, for the Paramter, Designated Use, or Assessment Unit. |
| 3-PAS | There is some but insufficient data to assess per the CALM, however, the data that is available suggests that the parameter is Potentially Attaining Standards (PAS) |
| 3-PNS | There is some but insufficient data to assess per the CALM, however, the data that is available suggests that the parameter is Potentially Not Supporting (PNS) water quality standards (e.g., there is one exceedance). |
| 4A-M | There is an impairment per the CALM by a parameter which is a pollutant and an EPA-approved TMDL has been completed. However, the impairment is relatively slight or marginal. |
| 4A-P | There is an impairment per the CALM by a parameter which is a pollutant and an EPA-approved TMDL has been completed. However, the impairment is more severe and causes poor water quality conditions. |
| 4B-M | There is an impairment per the CALM by a parameter which is a pollutant but a TMDL is not necessary since other controls are expected to attain water quality standards within a reasonable time. The impairment is marginal. |
| 4B-P | There is an impairment per the CALM by a parameter which is a pollutant but a TMDL is not necessary since other controls are expected to attain water quality standards within a reasonable time. The impairment is more severe and causes poor water quality. |
| 4B-T | There is a parameter which is considered a pollutant that is threatening impairment as per the CALM but a TMDL is not necessary since other controls are expected to attain water quality standards within a reasonable time. |
| 4C-M | There is a parameter which is not considered a pollutant but is causing impairment per the CALM. The impairment is marginal as defined in DES sub-category 4A-M above. |
| 4C-P | There is a parameter which is not considered a pollutant but is causing impairment per the CALM. The impairment is more severe and causes poor water quality as defined in DES sub-category 4A-P above. |
| 5-M | There is an impairment per the CALM by a parameter which is a pollutant that requires a TMDL. The impairment is marginal as defined in DES sub-category 4A-M above. |
| 5-P | There is an impairment per the CALM by a parameter which is a pollutant that requires a TMDL. The impairment is more severe and causes poor water quality as defined in DES sub-category 4A-P above. |
| 5-T | There is an impairment per the CALM by a parameter which is a pollutant that requires a TMDL. The impairment is threatening as defined in DES sub-category 4B-T above. |

**3- 22**

**COMMENT #4: Ralph Abele, EPA Region 1**

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region I – New England
5 Post Office Square, Suite 100
Boston, MA 02109-3912

June 23, 2017

Ken Edwardson
New Hampshire Department of Environmental Services
Water Division
29 Hazen Drive, Box 95
Concord, NH 03302-0095

Re: New Hampshire's 2016 Draft 303(d) List

Dear Mr. Edwardson:

Thank you for the opportunity to review the State's draft 2016 Clean Water Act section 303(d) list. By this letter, we intend to alert you to questions and concerns we have about whether the administrative record would support the State's decision not to list certain water body segment/impairment combinations in the Great Bay Estuary. These concerns are the same concerns EPA had when we commented on the State's decision to delist certain water body segment/impairment combinations in the Great Bay Estuary on the State's 2014 303(d) list. **4- 1**

We are evaluating the scientific rationale included by NH DES for these decisions, and look forward to receiving any additional information included in the State's final list to support the above-referenced assessment zones. Any such additional information, together with that provided thus far by NH DES, will enable EPA to carry out its obligation to review and to approve or disapprove the decisions the State will make with respect to these and other assessment zones in the Great Bay Estuary and throughout the State. See 40 C.F.R. §130.7.

If you have any questions, please contact me at 617-918-1629, or have someone from your staff contact Toby Stover at 617-918-1604.

Sincerely,

Ralph W. Abele

Ralph W. Abele
Chief, Water Quality Branch

**COMMENT #5: Michael S. Bezanson, City of Rochester**

*City of Rochester, New Hampshire*
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June 23, 2017

VIA EMAIL (303dcomment@des.state.nh.us and wqdata@des.state.nh.us)
and FIRST CLASS MAIL

2016, 303(d) Comments
New Hampshire Department of Environmental Services
Watershed Management Bureau
29 Hazen Drive, P.O. Box 95
Concord, New Hampshire 03302-0095
Attn: Ken Edwardson

RE: Comments on draft 2016 CALM and 303(d) List

Dear Mr. Edwardson: 5- 1

Thank you for providing us with the opportunity to comment on the draft 2016 Consolidated Assessment and Listing Methodology ("CALM") and 303(d) list. The City of Rochester (the "City") has significant concerns about the Department of Environmental Services' ("DES") lack of scientific evidence to place the Cocheco River (Assessment Unit NHEST600030608-01) into Category 5 for chlorophyll-a, dissolved oxygen ("DO") and total nitrogen ("TN"). The City also has concerns about the legal authority to implement the CALM as a guideline rather than through rulemaking. Even if the CALM is legally authorized as a guideline instead of through rulemaking, DES has no legal authority to determine that a waterway is impaired, in whole or in part, based upon chlorophyll-a which has no regulatory limits under the Env-Wq 1700 rules. At a minimum, the CALM as it relates to chlorophyll-a is an invalid promulgation of a water quality standard.

The lack of *any* reference to the 2014 Joint Report of Peer Review Panel or application of the recommendations contained in the peer review panel's report is one of the most glaring deficiencies of the draft 2016 CALM. DES continues to imply potential nitrogen impairments using ambiguous, inappropriate, or unsubstantiated statements while ignoring the 2014 Peer Review Report and other evidence of the lack of nitrogen-related impairments. The CALM should be revised to incorporate the findings of the 2014 Peer Review Report.

There also appears to be inaccurate data that was relied upon by DES to reach its impairment rating for DO. As is described in greater detail in the attached Brown & Caldwell analysis, the data indicates that at low tide the continuous recorder DO measurements in the Cocheco River likely experienced physical interference from the adjacent mud flat as a result of its position on the downward slope of the river channel. This conclusion is supported by the large magnitude drops and rises in DO immediately before and after the recorder came into contact with sediment. Additional evidence that the DO measurements are unreliable due to interference can be found in the continuous recorder turbidity data. A significant portion of the 2015 continuous recorder dataset was flagged for anomalous turbidity measurements by DES. Data were either flagged as being "questionable" or for measured spikes in turbidity more than three times higher than previous measurements. *Eight of the measured DO exceedance days (40 percent) occur during time periods when the turbidity data were flagged. This indicates DES acknowledged the likelihood of unreliable data during the deployment.* Unexplained spikes in turbidity and long periods of questionable turbidity data can be explained by a continuous recorder that is experiencing physical interference that renders the data unreliable for determination of any relationship with nutrients or chlorophyll. DES's acknowledgement of unexplained turbidity conditions supports the conclusion that the sonde positioned on the downward channel slope experienced interference from the adjacent mud flat, specifically at low tide. The coincidental combination of DO exceedances during times of low tide and "questionable" flagged turbidity data is strong evidence the observed DO exceedances are unreliable for assessment purposes and any connection to nutrient impairment.

In addition to the comments in this letter, the City also incorporates in full the analysis by Brown & Caldwell which is attached to this letter, as well as the comments from the Great Bay Municipal Coalition regarding the draft CALM and 303(d) list submitted on or before June 23, 2017.

## I. COMMENTS TO THE 2016 DRAFT CALM

### A. <u>DES Has Not Properly Engaged In Rulemaking to Promulgate the CALM</u>

Under New Hampshire law, a "rule" is defined in relevant part to mean:

> each regulation, standard ... or other statement of general applicability adopted by an agency to (a) implement, interpret, or make specific a statute enforced or administered by such agency or (b) prescribe or interpret an agency policy, procedure or practice requirement binding on persons outside the agency, whether members of the general public or personnel in other agencies.

**5- 2**

New Hampshire Administrative Procedures Act ("APA"), RSA 541-A:1. "Where an agency's efforts 'effect substantive changes binding on persons outside the agency, the agency's policy constitutes a 'rule' that must be promulgated pursuant to the APA.'" *Bel Air Assocs. v. DHHS*, 154 N.H. 228, 233, (2006).

With regard to the impaired waters list, DES generally cites to Section 303(d) of the Clean Water Act which provides for the federal directive to States to submit a list of impaired waters. The federal act, however, cannot be the basis for a state agency to undertake an action. In *Printz v. United States*, 117 S. Ct. 2365, 2380 (1997), the Court wrote that "we adhere to that principle today, and conclude categorically, as we concluded categorically in *New York:* 'The Federal

Government may not compel the States to enact or administer a federal regulatory program.'" *Printz*, 117 S. Ct at 2383. "The Federal Government may neither issue directives requiring the States to address particular problems, nor command the States' officers, or those of their political subdivisions, to administer or enforce a federal regulatory program. It matters not whether policymaking is involved, and no case-by-case weighing of the burdens or benefits is necessary; such commands are fundamentally incompatible with our constitutional system of dual sovereignty." *Printz*, 117 S.Ct. at 2384. In order for DES to act, it must have specific state legislative authority and can only implement those policies as directed by the Legislature. DES has failed to do so and instead is relying on federal statute and rules to promulgate guidelines through the CALM.

While DES has developed rules to establish water quality standards for the State's surface waters under RSA 485-A (Env-Wq 1700 *et seq.*), those rules establish no policy, criteria, procedure or practice by which DES should determine which waterbodies are "impaired." Paragraph 303(d)(1)(A) of the Clean Water Act directs states to "identify those waters within its boundaries for which the effluent limitations required by section 1311(b)(1)(A) and section 1311(b)(1)(B) of this title are not stringent enough to implement any water quality standard applicable to such waters." 33 USC §1313(d)(1)(A). Nothing in the Env-Wq 1700 rules or in RSA 485-A provides the regulated community with any information about how DES would identify those waters for which the effluent limitations are not stringent enough to implement applicable water quality standards. More importantly, by ignoring the rulemaking process, DES has deprived the legislative body any opportunity, either by statute or through the Joint Legislative Committee on Administrative Rules ("JLCAR"), to provide input or feedback on important policy issues that directly and adversely affect New Hampshire municipalities.

In addition, DES's establishment of chlorophyll-a thresholds in the CALM are not supported by the Env-Wq 1700 rules. While there are water quality rules that relate to dissolved oxygen, nitrogen and phosphorous, for example, DES has not established any such water quality rule for chlorophyll-a. Thus, at a minimum, the CALM as it relates to chlorophyll-a is an invalid implementation of a water quality standard without having undergone rulemaking as required by the APA.

Until such time as DES completes the rulemaking process and properly promulgates the CALM, DES should suspend the 2016 303(d) list process. Although the City reserves its argument that the CALM is in its entirety invalid, at a minimum DES should strike all provisions from the CALM that relate to chlorophyll-a and any impairment decisions that relate to the presence or absence of chlorophyll-a.

The CALM also creates a 10% Rule (Section 3.1.17) which is not otherwise found in statute or rule. The CALM states that there was concern "that some waterbodies were not being listed which were actually impaired. In response to these concerns DES decided to abandon the binomial approach ...and adopt the slightly more stringent ten percent rule (i.e. 10% rule) for determining use support. In general, the 10% rule simply means that at least 10% of the samples must violate water quality criterion before a waterbody will be listed as impaired." Section 3.1.17 at p. 25. The CALM, however, provides no analysis to support its conclusion that some waterbodies that were not listed as impaired were actually impaired. Nor does DES attempt to develop any rationale for imposing a 10% rule on its listing decision. This lack of transparency is exactly what the APA rulemaking process is intended to avoid. To the extent DES intends to rely upon the 10% rule, it should promulgate such a rule through the process required by the APA.

### B. The DO Saturation Standard Should Be Removed From the CALM Standards

In addition to the reasons for removing the DO saturation standard discussed in section 1 of Brown & Caldwell's analysis of the draft 2016 CALM which is incorporated herein in full, the New Hampshire Legislature has passed Senate Bill 127 (2017) which removes from RSA 485-A:8, II the current statutory language that Class B waters "shall contain a [DO] content of at least 75 percent of saturation." As of the date of this letter, SB 127 is awaiting the Governor's signature and would become effective sixty days after it is enrolled. Because the CALM is an expression of State policy and the legislative body has expressed its policy decision to remove the DO saturation standard from New Hampshire law, DES should follow the mandate given to it and discontinue reliance on the DO saturation standard and remove any provisions that rely upon it from the CALM. 5- 3

### C. The CALM Has Multiple Additional Technical Deficiencies That Require Modification

The City incorporates Brown & Caldwell's technical analysis of the CALM described on pages 1-6 of its report attached hereto and incorporated herein in full. These areas that the City is asking DES to reconsider include the following:

- The assessment methodology described in the CALM for DO cannot accurately identify when a waterbody does "Not Support" applicable designated uses. 5- 4
- The chlorophyll-a thresholds in the draft 2016 CALM are not scientifically defensible and represent unpromulgated criteria.
- The draft 2016 CALM lacks a viable methodology for diagnosing nitrogen impairments.

### D. Requests and Recommendations

The City respectfully requests the following actions relative to the draft CALM:

1. Suspend its use of the CALM until such time as it has been fully evaluated and considered in a rulemaking process as required by the APA. In the alternative, and at a minimum, all references to standards based upon chlorophyll-a be removed from the CALM. 5- 5

2. In addition to the City's position that the use of chlorophyll-a thresholds to identify impairments in tidal waters is an unpromulgated rule, the use of the chlorophyll-a 90$^{th}$ percentile threshold of 10 µg/l is not a scientifically defensible indicator of DO-related impairments and should not be incorporated into DES's analysis.

3. Similarly, DES should withdraw its use of 20 µg/l of chlorophyll-a as an indicator of algal growth that interferes with recreational activities, as well as the associated MAGEX value of 40 µg/l.

4. Discontinue its use of the DO saturation criteria as an indicator of impairment.

5. Revise its DO daily minimum concentration criterion to a site-specific or recent regional analysis which focuses on ecological response to DO.

6. Remove the MAGEX DO criterion from CALM as it is an irrelevant threshold.

7. DES should retain a weight-of-evidence approach for total nitrogen, but, before implementing it, go beyond the general paradigm described in the CALM and incorporate the specific methods described in the 2014 Joint Report of Peer Review Panel.

## II. Comments Regarding the 2016 Draft Cocheco River 303(d) Listing (AU NHEST600030608-01)

The City's comments pertain to the tidal Cocheco River, specifically to its placement in category 5 of the draft 2016 303(d) list. In brief, the placement of this segment in category 5 is erroneous, and appears to have been driven by a combination of inappropriate thresholds and highly suspect monitoring data. The preponderance of the monitoring data indicate that the tidal Cocheco River is a moderately productive segment that supports all designated uses.

### A. The 10% Rule Was Not Applied In Accordance With the 2016 CALM

As noted in Section I above, DES failed to engage in proper rulemaking when it promulgated its 10% rule described in the CALM. Even if the 10% rule is properly issued as guidance, however, DES has failed to correctly apply it to the data for the Cocheco River. In DES's Technical Support Document for the Great Bay Estuary, the narrative description for DO for the Cocheco River Assessment Zone provides: "Following the 10% method listed in the 2016 CALM, this parameter would be categorized as 5-M. Part of the concept behind the 10% rule was to address random errors within the meter measurement accuracy thereby limiting accidental impairments." It further notes that, "in this assessment zone, there are 163 station/days of data logger DO readings during the critical summer period." 5- 6

Contrary to DES's use of "163 station/days," the CALM provides that "[i]n general, the 10% rule simply means that at least 10% *of the samples* must violate water quality criterion before a waterbody will be listed as impaired." Draft 2016 CALM at p. 25. Under this definition, to apply the 10% rule to data loggers, each sample should be added and the cumulative total should be applied to the denominator when determining the percentage of samples that violate a particular water quality criterion. Nothing in the CALM provides that DES should take a single sample that violates a water quality criterion, throw out the remaining samples, and apply that worst sample point to the entire day. Instead, as described in the CALM, each sample should be considered. For data loggers, each day would contain up to ninety-six samples. When properly applied for the data on the Cocheco River, the samples that exceed water quality standards are a fraction of 10% of the total.

In addition, the CALM does not limit sampling results to the "critical summer period" nor does the CALM define what the critical summer period means. Instead, the CALM describes the "summer months" in its list of "factors considered in the weight of evidence approach." Draft CALM at p. 28. With regard to the Cocheco, DES does not apply a weight of the evidence approach – instead DES threw out data outside the summer period and limited its analysis to a subset of data. No attempt was made to give data outside the summer period any weight.

**B. The 2016 Draft Cocheco River 303(d) Listing Contains a Number of Technical Deficiencies**

As is described in greater detail in the attached Brown & Caldwell analysis which is incorporated herein in full, the draft 303(d) list raises a number of concerns or deficiencies that need to be corrected. Those issues described by Brown & Caldwell include the following:

a. The available DO monitoring data do not support an impairment listing.
   1. The listing is driven by anomalous DO data that are not representative of a nutrient/chlorophyll-a response and likely represent physical condition interference.
   2. There are issues with regard to the quality of the Cocheco River continuous recorder data. **5- 7**
   3. The DO listing relied on an inappropriate DO criteria and MAGEX value.
   4. The preponderance of the DO data indicate favorable conditions.

b. The chlorophyll-a data do not support an impairment listing.

c. There is no technical basis to conclude that the tidal Cocheco River is impaired by nitrogen.

**C. Requests and Recommendations**

The City respectfully requests that DES take the following actions be taken relative to the 303(d) listing for the tidal Cocheco: **5- 8**

1. Revise the draft 2016 303(d) listing for the Cocheco River from category 5 to category 3-PAS for DO and TN and strike its impairment rating for the Cocheco River for Chlorophyll-a or, in the alternative, revise the listing from category 5 to 3-PAS or

lower. This recommendation is based on the fact that evidence of impairment was limited to unreliable DO exceedances that more likely reflect issues with the continuous recorder deployment location and physical interference than an actual ecological response to elevated nutrients in the system. By removing the unreliable DO measurements, the Cocheco River does not meet the requirements for impairment. DO is the only parameter with an actual promulgated water quality standard to assess nutrient health in the Great Bay Estuary that applies to this waterbody, according to DES (NHDES 2017b) and the 2016 CALM (NHDES 2017a). The lack of a verifiable DO impairment indicates there is no reason to place the Cocheco River in assessment category 5.

2. Develop water quality management strategies for the Cocheco River that focus on collaboration between regulatory agencies and affected stakeholders in the watershed. DES has acknowledged the "recent and rapid total nitrogen reductions" in the system as a result of infrastructure investments by Rochester WWTP in 2014 and Dover WWTP in 2015. DES acknowledges significant TN reductions have occurred; between 44 and 66 percent based on the data provided in the DES assessment. Further, DES states that improved conditions are expected in the coming years. Given the TN management strategies already implemented by Rochester and Dover and the significant reductions already observed, the City respectfully disagrees with DES's conclusion that the "response datasets warrant impairment under New Hampshire's narrative standard."

## III. Comments Regarding the 2016 Draft Great Bay Estuary 303(d) Listing[1]

The City is in agreement with DES's decision to not place segments such as the Great Bay, Little Bay, and Upper/Lower Piscataqua River into category 5 for total nitrogen. However, the related narrative of Technical Support Document does not present a balanced technical evaluation of the potential for nutrient-related impairments of the Great Bay. Rather, it largely relies on unsubstantiated assumptions while ignoring the 2014 peer review and other evidence that would point away from nitrogen-related impairments. As stated in the previous comments in this letter and the comments from Brown & Caldwell, the draft 2016 CALM relies on a highly generalized paradigm of nitrogen and coastal eutrophication, without any mechanisms to determine if total nitrogen is a driver of effects. This shortcoming is carried through into the Technical Support Document's discussion of segments such as the Great Bay. The following are some specific criticisms of the discussion of the Great Bay segments: 5- 9

1. *The Technical Support Document narrative relies on problematic thresholds*. The Technical Support Document discussion of potential nutrient-related indicators suffers from the same problems as pointed out in the comments on the draft 2016 CALM and tidal Cocheco segment. These include citation of an unpromulgated $90^{th}$ percentile chlorophyll-a target (10 µ/L) that is a highly unreliable indicator of DO impairments and

[1] The references contained in this Section III are provided with the Brown & Caldwell analysis of the draft CALM and 303(d) list for the Cocheco.

the shortcoming of NH's existing DO concentration and percent-DO saturation criteria, as previously discussed.

2. *The Technical Support Document ignores the 2014 peer review and other evidence that points away from nitrogen impairments*. It is unacceptable that the narrative comments on the Great Bay ignore the 2014 Peer Review Report and its conclusions. DES will recall that the peer review panel was jointly selected by DES and the Great Bay Coalition, and represented top experts in water quality/estuarine science. The 2014 Peer Review Report concluded that no linkage between nitrogen and eelgrass declines had been established. Many of the review panel's findings directly argued against the Technical Support Document's inference of potential nitrogen impairments and claim that macroalgae is a driver:

   - The Great Bay had lower TN concentrations than those that supported eelgrass in other coastal systems.
   - Chlorophyll-a was only a small component of light attenuation, and had no temporal trend over the period of eelgrass decline.
   - Eelgrass declines occurred even where nitrogen concentrations were lowest within the system.
   - There was no strong association between macroalgae and eelgrass in the Great Bay.
   - Nitrogen was not shown to be a causal factor of low DO conditions.

   The Technical Support Document's claim that macroalgae has replaced 5.7 % of the eelgrass area in 2007 was found to be unsupported. As one reviewer stated, "[a]ny relationship between nitrogen impairment, macroalgae growth and eelgrass abundance cannot be supported…The data and arguments provided in the DES 2009 Report to support the weight of evidence for a relationship between nitrogen concentration, macroalgal abundance and eelgrass loss are neither compelling nor scientifically defensible." The Technical Support Document ignores any criticism of the TN macrophyte-eelgrass or TN-DO linkages, and so is highly biased in this regard.

   Other lines of evidence for the lack of nitrogen impairment have been summarized by Lucic (2015), Peschel (2016), Hall and Associates (2015), and Hall and others (2016). Among other lines of evidence, these references demonstrated that periods of eelgrass declines were not accompanied by worsening of water quality parameters, and in fact total nitrogen is currently much lower than pre-2003 period when eelgrass was higher. As expected, recent declines in total nitrogen were not accompanied by major changes in chlorophyll-*a*, water clarity or DO. The available data on eelgrass and macroalgae do not support a systematic or progressive replacement of eelgrass by macroalgae. For example, the loss in eelgrass acreage was much higher than the observed macroalgae acreage in the Great Bay and interannual variability (including increases) of eelgrass acreage has been much higher than the documented macroalgae bed acreage.

3. *There is no basis to claim nuisance macroalgae impairments*. The Technical Support Document quotes Burdick and others (2016): "Monitoring results from 2014 show high levels of cover of nuisance green and red algae…at all sites except near the mouth of the Estuary." This study only evaluated intertidal sites, and simply demonstrated that algae can grow to visible levels on tidal flats which conditions support. This fact is unsurprising and does not constitute an impairment of designated uses. The use of the term "nuisance" is highly value-laden, has no objective basis in the CALM or any other document. Burdick and others (2016) included no demonstration of adverse effects of intertidal macroalgae to eelgrass. Moreover, there is no evidence that macroalgae could be managed though nitrogen. When conditions are favorable, macroalgae can accumulate in Portsmouth Harbor and even open coastal areas where nutrient concentrations are much lower than could be realistically achieved in upper estuary segments.

4. *The Technical Support Document narrative for the Great Bay relies on overly general statements that are biased toward the finding of nitrogen impairments*. Examples include "…classic indicators of nutrient eutrophication are present..." and "there is a clear nutrient "signature" in the data." Such statements are no substitute for demonstrating actual linkages (or the lack thereof) between nitrogen and impairments. Similarly, they do not adequately respond to prior criticisms of such linkages.

The following are recommendations for specific revisions of the parameter comments for the Great Bay segments:

- Add a discussion regarding the lack of evidence of nitrogen impairments, directly citing the 2014 Peer Review Report and more recent references.
- Remove the anecdotal and unsubstantiated statements cited in comment 4 above.
- Remove misleading statements that macroalgae or epiphytic growths have been shown to be a major cause of eelgrass decline; qualify discussion of macroalgae/epiphytes with statements that linkages between nitrogen, eelgrass, and macroalgae have not been established for the Great Bay.
- Remove reference to "nuisance" macroalgal conditions, clarify that Burdick and others (2016) simply demonstrate that algae can accumulate in intertidal zones, and specifically state that this does not necessarily represent an impairment of designated uses.
- Revise the statement "It is less clear… whether the response datasets demonstrate sufficient power to determine that the eutrophication effects on designated uses can be attributed to Total Nitrogen alone" to "It is unclear if total nitrogen is having any adverse impact on designated uses."

## IV. CONCLUSION

The City appreciates the substantial effort undertaken by DES to develop the CALM and 303(d) listings. The draft 2016 CALM and 303(d) list, however, have significant deficiencies that call **5- 10** into question the legal and technical conclusions reached by DES. For the reasons stated in this letter, as well as the attached Brown & Caldwell letter and the comments submitted on behalf of the Great Bay Coalition, all of which are incorporated into this letter in full, the City respectfully requests that DES amend its CALM process and its impairment conclusions in accordance with the requests outlined in this letter and in the referenced documents.

Sincerely,

Michael S. Bezanson, PE
City Engineer

**Attachments**

Brown & Caldwell, *Comments on NHDES draft 2016 CALM and Tidal Cocheco River 303(d) Listing*

**Literature Cited** (not including references cited in the Brown & Caldwell Analysis)

Hall and Associates. 2015. Evaluating the Spatial and Temporal Variability of Eelgrass in Great Bay Estuary, New Hampshire. 18 p.

Hall, W.T., Hall, J.C., Kirby, B.T., Gallagher, T., and Peschel, D. 2016. Impact of Rochester and Dover WWTF Nitrogen Load Reductions on Water Quality of the Upper Piscataqua River. 21. p.

Lucic, R.R. 2015. Great Bay Municipal Coalition Comments on NHDES Draft 2014 303(d) List and CALM. Letter dated Dec. 11, 2015 submitted to Ken Edwardson of NHDES. 91 p.

Peschel, D. 2016. Delisting of Impaired Waters. Letter dated Jul. 20, 2016 submitted to Thomas Burack of NHDES. 2 p.

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# Technical Memorandum

Prepared for: City of Rochester, New Hampshire

**Technical Memorandum [No. 1]**

| | |
|---|---|
| Subject: | Comments on NHDES Draft 2016 CALM and Tidal Cocheco River 303(d) Listing |
| Date: | June 22, 2017 |
| To: | Mr. John Storer; Director of Public Works |
| From: | Clifton Bell, Daniel Hammond, Stacy Villanueva |
| Copy to: | Mr. Richard W. Head; Rath, Young and Pignatelli, P.C. |

5- 11

This technical memorandum presents comments to the New Hampshire Department of Environmental Services (NHDES) regarding the 2016 Draft Consolidated Assessment and Listing Methodology (CALM) document (NHDES, 2017a) and the draft 2016 303(d) List (NHDES, 2017b), with a focus on the tidal Cocheco River (Assessment Unit NHEST600030608-01). These comments were prepared on behalf of the City of Rochester, New Hampshire. We greatly appreciate the opportunity to submit these comments as well as the significant effort involved to develop the CALM and 303(d) listings.

## Comments on the Draft 2016 CALM

Our technical review of the draft 2016 CALM (NHDES, 2017a) focused on the proposed use of several different water quality parameters to diagnose impairments of tidal waters. In general, our review concludes that the CALM lacks defensible methods or thresholds for dissolved oxygen (DO), chlorophyll-a, and total nitrogen (TN) to accurately characterize attainment or impairment of designated uses. The resulting draft 303(d) listings mischaracterize the health of waterbodies, and would result in adverse regulatory and financial consequences for affected stakeholders and the public. The following comments address specific concerns regarding the methods and use of these three water quality parameters in the draft assessments.

1. **<u>The assessment methodology described in the CALM for DO (NHDES 2017a, Section 3.2.4) cannot accurately identify when a waterbody does "Not Support" applicable designated uses</u>.** The following comments highlight the need to derive scientifically defensible DO criteria that accurately identify attainment of designated uses and reflect the specific characteristics of New Hampshire's fresh and estuarine waters.

   a. *<u>NH's existing DO saturation criterion lacks the cause and effect relationship necessary to establish protection of any designated use.</u>* NHDES DO criteria for Class B waters include a daily average saturation requirement of 75 percent. However, NHDES has not provided any evidence or data to support that a daily average of 75 percent saturation is needed to maintain any aquatic life designated use or that a daily average below 75 percent saturation results in harm to any biological community. Additionally, NHDES has not provided any justification of the need for a daily average saturation criterion, along with a daily minimum concentration criterion, and a minimum Magnitude of Exceedance (MAGEX) criterion. In order to be applicable and defensible according to the Clean Water Act (CWA), NHDES needs to provide data and evidence that each of these criteria are needed to protect the aquatic life designated use. Until a scientifically defensible link between the percent saturation criterion and attainment of the aquatic life designated use is established, NHDES should remove the percent saturation criterion from the CALM for assessment purposes. **5- 12**

   b. *<u>NH's existing DO daily minimum concentration criterion lacks a scientifically defensible link to attainment of designated uses for tidal waters and should be revised based on site-specific or recent regional efforts which focus on ecological response to DO</u>*. NHDES DO criterion for Class B waters is a daily minimum of 5.0 mg/L that applies to both fresh and tidal waters (NHDES, 2017a). The application of a single DO concentration criterion for all Class B waters, both tidal and fresh, does not account for the specific chemical, physical, and biological conditions of estuarine waters. DO criteria set as a "one size fits all" for fresh and estuarine waters results in significant opportunity for Type II errors (healthy waterbody being incorrectly assessed as impaired) in estuarine waters.

   Using the specific oxygen requirements of estuarine species to demonstrate attainment of designated uses has been researched by states and the U.S. Environmental Protection Agency (EPA) and incorporated into water quality criteria along the east coast including the Virginian Province (Cape Cod to Cape Hatteras; EPA, 2000) and Chesapeake Bay (EPA, 2003). These efforts include chronic and short-term (acute) DO criteria that protect specific species in estuarine waters, *including the major taxa that inhabit NH's waters*. Other states and regions have concluded that minimum criteria far below 5.0 mg/L are protective of estuarine species (EPA, 2000; EPA, 2003; FDEP, 2013). The NHDES daily minimum criterion of 5.0 mg/L is likely highly overprotective when applied as an instantaneous minimum value outside of the spawning/nursery period. The use of the 5.0 mg/L minimum criterion is out dated and does not reflect the current scientific understanding of the oxygen needs of estuarine species. Further, NHDES has not provided any data or evidence to support the 5.0 mg/L criterion applied as a daily minimum is necessary in NH's estuarine waters to protect aquatic life. **5- 13**

   We acknowledge and support the NHDES ongoing efforts to research and revise the current DO criteria in NH. An approach that distinguishes between fresh and estuarine oxygen requirements and that focuses on specific species in the Great Bay Estuary in a similar fashion as that completed for Chesapeake Bay (EPA, 2003) is warranted. Such an effort could be expedited by building on the Chesapeake Bay efforts using taxa present in both estuaries. The outcome of this process would be expected to result in site or region specific DO criteria, protective of chronic and short-term conditions, that could be applied during and outside of critical spawning/nursery periods.

c. *The MAGEX value has no scientific or ecological basis and should be removed from the CALM for assessment purposes*. NHDES DO criteria include the MAGEX threshold of 4.5 mg/L or 65 percent saturation as a magnitude not to be exceeded more than once regardless of sample size (NHDES, 2017a, Table 3-22). NHDES acknowledges the MAGEX criterion magnitude was based on the reliability of monitoring equipment and not on any threshold that protects against short-term or acute DO impacts on any biological community. Without technical basis linking the 4.5 mg/L magnitude criterion with any ecological meaning, the MAGEX threshold cannot be relied upon to determine if acute DO stress has occurred or if designated uses are being met, as required by the CWA.

Additionally, NHDES has not provided any evidence to suggest a daily minimum criterion and a MAGEX criterion are both necessary to protect designated uses. An appropriately derived daily minimum criterion set at a value to protect designated uses, essentially renders any MAGEX criterion (presumably set below the daily minimum criterion) irrelevant. An exceedance of any MAGEX criterion would also be an exceedance of the daily minimum criterion and would not establish the waterbody as any "more" impaired than an exceedance of the daily minimum criterion by itself. By nature of the frequency and duration components of a daily minimum criterion, this threshold already represents a level below which acute biological stress would be observed. Therefore, an additional MAGEX criterion has no meaning. **5- 14**

We recommend NHDES remove the DO MAGEX criterion from the CALM for assessment purposes as it has no ecological meaning or link to designated uses, nor is it a relevant threshold of impairment. We recommend that revisions to NH's estuarine/marine DO criteria build on established methodologies from other regions, such as Chesapeake Bay (EPA, 2003) and the Virginian Province (EPA, 2000), while focusing on the oxygen requirements of specific species of concern to the Great Bay Estuary (Diaz, 2017).

2. **<u>The chlorophyll-a thresholds in the draft 2016 CALM are not scientifically defensible and represent unpromulgated criteria.</u>** The draft 2016 CALM describes how NHDES would use several different chlorophyll-a thresholds to identify impairments in tidal waters. These seem to represent *de facto* criteria, although NH has never promulgated these values through the triennial review or other process. Moreover, an examination of each threshold reveals that they have little to no technical basis.

   a. *<u>The chlorophyll-a 90th percentile threshold of 10 µg/L is not a defensible indicator of DO-related impairments</u>*. The CALM document describes the methodology of using chlorophyll-a concentrations to protect DO in the Great Bay Estuary (NHDES, 2017a; Section 3.2.4, Indicator 9b). Indicator 9b establishes the 90th percentile chlorophyll-a concentration threshold of 10 µg/L or less to indicate Full Support. This chlorophyll-a threshold is intended to protect DO and, in turn, both are used as response variables to establish that TN concentrations in the Great Bay Estuary support designated uses (NHDES, 2017a). The 90th percentile chlorophyll-a threshold was derived from a regression of instantaneous minimum DO and 90th percentile chlorophyll-a concentrations collected from 17 trend monitoring locations in the Great Bay Estuary over various periods of record for each location from 2000-2008 (NHDES, 2009). While statistically significant, the regression model used is flawed and should not be used for derivation of a causative relationship between chlorophyll-a and DO sufficient to derive a chlorophyll-a threshold. First, NHDES provides no evidence to explain how an instantaneous minimum DO measurement from a multi-year period is in any way related to a 90th percentile chlorophyll-a measurement calculated over a multi-year period. There is no expected causative relationship between these values given that the minimum DO measurement could have come years prior to elevated chlorophyll a that would lead to an increased 90th percentile calculation. The time differences between the two parameter calculations prevent meaningful comparison. **5- 15**

   Second, it is inappropriate to evaluate the relationship between DO and chlorophyll-a by combining multiple locations with differing physical and biological conditions given their position in the estuary. The correlation used to derive the chlorophyll-a threshold (shown in NHDES, 2009; Figure 27) combines tidally influenced stations with full marine and open estuary locations (station locations shown in NHDES, 2009; Figure 2). As indicated by Figure 27 in NHDES 2009, all the stations that depict higher chlorophyll-a and lower DO are tidal and located further up in the estuary. By contrast, all the stations that depict lower chlorophyll-a and higher DO are located in the open estuary. The different physical and biological conditions of these locations prevent adequate comparison for the purposes intended by NHDES. Chlorophyll-DO relations are highly segment-specific and depend on many other factors such as hydraulic characteristics, tidal flushing rates, and natural sources of oxygen demand. The result of this inadequate comparison is the presumption of a cause and effect relationship that, in reality, lacks meaning.

Peer reviewers voiced significant concern over the simplistic methods used to establish relationships between nutrients and nutrient response variables for Great Bay Estuary numeric nutrient criteria development (Bierman et al., 2014). One reviewer stated:

> "*The statistical methods used to derive the numeric thresholds were not based on acceptable scientific methods and the results of those analyses are not reliable for predicting the complexity of responses to changes in nitrogen concentration in the system, including DO, transparency, eelgrass, macroalgae and phytoplankton.*" (Bierman et al., 2014)

Third, the 90th percentile limit is an artificial construct of the given data set and does not have any ecological value. Especially in productive estuarine systems, the NHDES chlorophyll-a threshold does not allow for the typical chlorophyll-a fluctuations that are naturally occurring because of significant tidal flux and other biogeochemical and hydrologic factors typical of these types of systems. NHDES has not provided any evidence for the ecological value or link to designated uses that would justify the 90th percentile chlorophyll-a concentration as a threshold for protection of any biological community or water quality standard.

Finally, the 90th percentile chlorophyll-a threshold has never been promulgated as a water quality criterion, and thus, cannot be used to assess any waterbody for impairment or determine if any designated use is being achieved. Given the flaws in the analysis and lack of promulgation of the threshold, NHDES should not incorporate the 90th percentile chlorophyll-a threshold into the 2016 assessment process. Moreover, it is unclear why NHDES would use chlorophyll as an indicator of DO impairments instead of DO itself.

b. *The CALM lacks defensible chlorophyll-a thresholds to identify recreational impairments*. For salt waters, the 2014 CALM identifies 20 µg/L as an indicator of algal growth that interferes with recreational activities, and this value is applied as a not-to-exceed target (NHDES, 2017a). The associated MAGEX value is 40 µg/L (NHDES, 2017a). The CALM provides no technical reference for 40 µg/L MAGEX value, but cites NHDES (2003) as the basis of the 20 µg/L threshold. A review of NHDES (2003) indicates the primary basis of the 20 µg/L is that EPA has used this threshold as a cut-off to designate "poor quality" of tidal waters in National Coastal Condition reports (e.g., EPA, 2005). A review of the National Condition Coastal Reports, in turn, reveals no scientific basis for the 20 µg/L value. Rather, National Condition Coastal reports such as EPA (2005) simply state that the value was used as a generic indicator for a huge area (East/Gulf West Coast sites). There is no empirical, mechanistic, or literature-based analysis that ties the 20 µg/L to specific harmful effects. It simply appears to be an arbitrary value that would allow the authors to construct an index for data summary purposes. **5- 16**

An examination of more rigorously-derived chlorophyll-a targets reveals that the 20 µg/L is ill-founded as an indicator of primary recreation impairments. One potential mechanism by which algae can impact recreational uses is algal toxins. World Health Organization (WHO) guidelines do not indicate a moderate risk of adverse health effects until chlorophyll-a exceeds 50 µg/L and is coincident with cyanobacterial dominance (e.g., >100,000 cells/mL). For other upper estuarine systems, it has been acknowledged that mean or upper percentile chlorophyll-a concentrations in the 20-40 µg/L range are compatible with full use attainment (Stow et al., 2003; VDEQ, 2005).

Many states have developed chlorophyll-a targets with the primary goal of protecting recreational uses of water bodies. The targets vary in magnitude based on waterbody type and ecoregion. Many of these targets are somewhat similar in magnitude to NH's 20 µg/L target, but expressed as seasonal averages rather than not-to-exceed values. For example, Arizona, Wisconsin, Oregon, Minnesota, Kansas, Texas, Maryland, Virginia, West Virginia, and other states have adopted recreational chlorophyll-a targets in the 15-30 µg/L range for selected water bodies, but all are expressed as seasonal averages.

Chlorophyll-a tends to be lognormally distributed (Thompson and Emery, 2014), such that even healthy systems will experience occasional high values, and seasonal averages are typically much lower than upper-percentile chlorophyll-a values. Accordingly, the use of 20 µg/L as a not-to-exceed value is exceptionally stringent as an indicator of recreational impairment and in reality, is not useful for that purpose. If NHDES desires to promulgate chlorophyll-a criteria to protect against recreational impacts in the Great Bay Estuary, it would be recommended to perform a state- and region-specific analysis that considers the empirical linkages between chlorophyll-a and actual harmful effects, such as algal toxins or harmful algal blooms.

3. **The draft 2016 CALM lacks a viable methodology for diagnosing nitrogen impairments.** The draft 2016 CALM presents total nitrogen as one of the indicators of eutrophication impacts in the Great Bay Estuary (NHDES 2017a; Section 3.2.4, Indicator 9). The CALM is correct to note that there are no numeric values for total nitrogen that define a breakpoint between support and non-support. Unfortunately, the weight-of-evidence approach that NHDES has apparently substituted carries many of the same flaws as the prior (inappropriate) use of a 0.3 mg/L total nitrogen threshold. Because the diagnosis of a nitrogen impairment is highly dependent on the use of flawed thresholds for DO and chlorophyll (as discussed in previous comments), the findings of nitrogen impairments are subject to the same flaws and false positives (Type II errors).

   More fundamentally, the NHDES' weight-of-evidence approach, described in the CALM (NHDES 2017a), relies on an overgeneralization of nitrogen and coastal eutrophication, without establishing any stressor-response mechanisms to attempt to quantify nutrient impacts. The 2014 Joint Report of Peer Review Panel (Bierman et al., 2014) was specifically asked to review the weight of evidence approach established by the NHDES in the development of numeric nutrient criteria for the Great Bay Estuary (NHDES 2009). The reviewers stated that the simplistic NHDES weight of evidence approach did not sufficiently follow EPA guidance, lacked quantitative stressor-response relationships, lacked a detailed reference condition approach, and failed to include a mechanistic modeling approach (Bierman et al., 2014). EPA and the peer review panel conclude that at least three separate types of scientifically defensible approaches should be used concurrently to derive a meaningful weight of evidence for numeric nutrient criteria development (Bierman et al., 2014 and EPA, 2010). The NHDES weight of evidence approach for identifying nutrient impairments does not achieve this standard. **5- 17**

   Unfortunately, prior to the 2016 draft 303(d) list development, NHDES did not revise its methodology based on recommendations from the peer review panel. While we agree that a weight of evidence approach can be useful for development of numeric nutrient criteria and determination of impairments with respect to nutrients, we respectfully request the NHDES remove nutrient impairment designations from the draft 2016 303(d) list until such time as a revised weight of evidence approach can be established and peer reviewed. The revised weight of evidence approach should incorporate the findings of the 2014 Peer Review (Bierman et al., 2014) as well as follow EPA guidance (EPA, 2010).

## Comments on the 2016 Draft Cocheco River 303(d) Listing (AU NHEST600030608-01)

The comments below pertain to the tidal Cocheco River (AU NHEST600030608-01), specifically to its placement in category 5 of the draft 2016 303(d) list. In brief, the placement of this segment in category 5 is erroneous, and appears to have been driven by a combination of inappropriate thresholds and highly suspect monitoring data. The preponderance of the monitoring data indicate that the tidal Cocheco River is a moderately productive segment that supports all designated uses. Specific evidence for these conclusions are provided below.

4. **<u>The available DO monitoring data do not support an impairment listing</u>.** The Cocheco River was listed as impaired based on 20 out of 163 station/days having DO measurements that fell below the daily minimum 5.0 mg/L criterion during the critical summer period (June 1 – September 30) from 2011 – 2015 (NHDES, 2017b). DO was measured using continuous recorders at 1 or 2 locations each summer from 2012 through 2015. Most of the DO exceedances (16 of 20) were observed during the summers of 2014 and 2015. These data do not support placement of the segment into category 5, for the following reasons:

    a. *<u>The listing is driven by anomalous DO data that are not representative of a nutrient/chlorophyll-a response and likely represent physical condition interference</u>.* A review of the continuous recorder data from 2014 and 2015 provided by NHDES indicate anomalous measurements are likely to blame for many (most) of the DO exceedances and those measurements are not likely representative of a nutrient and/or chlorophyll-a response in the Cocheco River. Of the 20 days with DO exceedances, at least 10 days appear to be the result of short duration (less than 1.25 hrs), large magnitude drops in DO that are uncharacteristic of typical DO diel or tidal cycle curves. In fact, six of the exceedances were excursions below the criterion which lasted less than 30 minutes (2 measurements) resulting from a large, instantaneous drop in DO followed immediately by a rebound in DO (15 minutes later) which achieves the criterion. An example of an anomalous change in DO measurements is shown in Figure 1. **5- 18**

    The magnitude of change in DO between successive measurements that lead to the observed exceedances is not typical for the continuous recorder dataset in the Cocheco River. A change of more than 1 mg/L from the prior measurement (15 minutes before) is well outside the average range for a step-change in this dataset (greater than 3 standard deviations from the mean) (Figure 2). Changes of this magnitude only occurred 1.4 percent of the time during the 2014 and 2015 critical time period deployments, indicating changes of this magnitude are anomalous.

    From these observations of DO exceedance, NHDES concluded that chlorophyll-a, representing algal biomass, must be causing low DO at low tide (NHDES, 2017b). However, there is no reason to indicate algal biomass could contribute to such a rapidly developing and short term DO sag with an immediate DO rebound to levels above the DO criterion. This condition simply does not reflect conventional knowledge of algal and oxygen dynamics in estuarine systems. The majority of these exceedances appear to occur at low tide, a fact acknowledged by NHDES (NHDES, 2017b). The apparent concentration of anomalous exceedances at low tide offers another more logical explanation for the observed measurements.

Following a discussion with the personnel responsible for the Cocheco River continuous recorder deployments at the University of New Hampshire (UNH), we have learned that physical conditions of the sonde deployment location likely affect the measurements and render them not representative of nutrient and algal conditions in the system. The continuous recorder is positioned in the water column with probes facing down, suspended in the water column by a subsurface and surface buoy system, and held in place by a mushroom anchor. According to UNH, the sonde is deployed on a downward slope into the dredged channel of the Cocheco River. This positioning is to keep the probes submerged at low tide while keeping the unit out of the navigable channel. UNH reports that the mud flat above the sonde becomes exposed at low tide. As a result, during low tide, water (along with silt, sand, particulates, and organic matter) slough off the mud flat and flow downward past the sonde probes and into the river channel. The shallow water on the mud flat, above the channel heats up during the day, experiences less mixing, and is in close contact with the bacterial decomposition of organic matter in this area. These conditions result in lower DO concentrations in the water on the mud flat compared to the rest of the channel. This physical phenomenon at low tide can easily cause dramatic (and short term) drops in DO measurements as this low oxygen water and organic matter pass by the sonde probes. This scenario is observed throughout the data set, but a majority of the measured DO exceedances occur when low tide occurs in the early morning hours, when DO is expected to be the lowest. This condition was exacerbated by the low freshwater inflow conditions observed in 2014 and 2015 when 80 percent of the DO exceedances were observed.

While these short duration, high magnitude changes in DO may represent real measurements from the continuous recorder, there is no indication that these measurements can reasonably be expected to be the result of elevated chlorophyll-a (algal biomass), as NHDES asserts. The photosynthetic and respiratory effect of phytoplankton on DO typically causes increased DO in the mid to late afternoon and lower DO in the early morning that occurs on a predictable diel pattern with a smooth curve and gradual changes in DO. In contrast, the dramatic drop and rebound in DO occurring over an hour time period or less (as observed in the Cocheco River), would not be indicative of respiration of a planktonic or attached algal community, but should indicate another physical interference in the typical diel pattern of DO. Based on this evaluation, the dramatic decreases in DO observed in the Cocheco River continuous recorder data that result in exceedances of the daily minimum criterion cannot be relied upon to draw a stressor-response relationship between DO, the algal community, and nutrients.

Additional evidence that the DO measurements are unreliable (for assessment purposes) due to the physical effects of the deployment location can be found in the continuous recorder turbidity data. A significant portion of the 2015 continuous recorder dataset was flagged for anomalous turbidity measurements by NHDES. Data were either flagged as being "questionable" or for measured spikes in turbidity more than three times higher than previous measurements. Eight of the measured DO exceedance days (40 percent) occur during time periods when the turbidity data were flagged. This indicates NHDES acknowledged the likelihood of unreliable data during the deployment. Unexplained spikes in turbidity and long periods of questionable turbidity data can be explained by a continuous recorder that is experiencing physical interference that renders the data unreliable for determination of any relationship with nutrients or chlorophyll. The acknowledgement of unexplained turbidity conditions supports the conclusion that the sonde positioned on the downward channel slope is experiencing interference from the adjacent mud flat, specifically at low tide. The coincidental combination of DO exceedances during times of low tide and "questionable," flagged turbidity data is strong evidence the observed DO exceedances are not the result of algal conditions in the Cocheco River, and are therefore unreliable for assessment purposes and any connection to nutrient impairment.

Of the 20 days with DO exceedances, at least 10 of them appear to represent days when the minimum DO measurement reflects potential interference and should be considered unreliable. This is not meant to suggest that only measurements that drop below the 5.0 mg/L threshold are unreliable, it is likely many of the minimum DO measurements at low tide reflect interference even if the measurement didn't drop below the daily minimum threshold. All of these anomalous excursions should be removed from the dataset for the assessment of the Cocheco River. Once removed, the Cocheco River dataset only has, at most, 10 exceedances of the daily minimum DO criterion. Following the "10 percent rule", as applied by NHDES, the Cocheco River (AU NHEST600030608-01) would only have five percent of days exceeding the minimum DO criterion and would not meet the threshold of impairment according to the 2016 CALM (NHDES, 2017a).

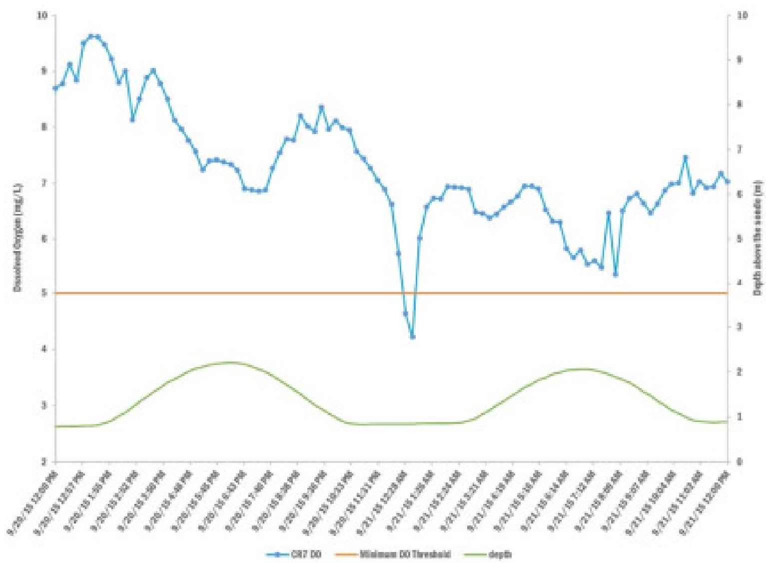


Figure 1. Example of anomalous change in dissolved oxygen measurements resulting in exceedance of the daily minimum criterion, Cocheco River, September 20 - 21, 2015.

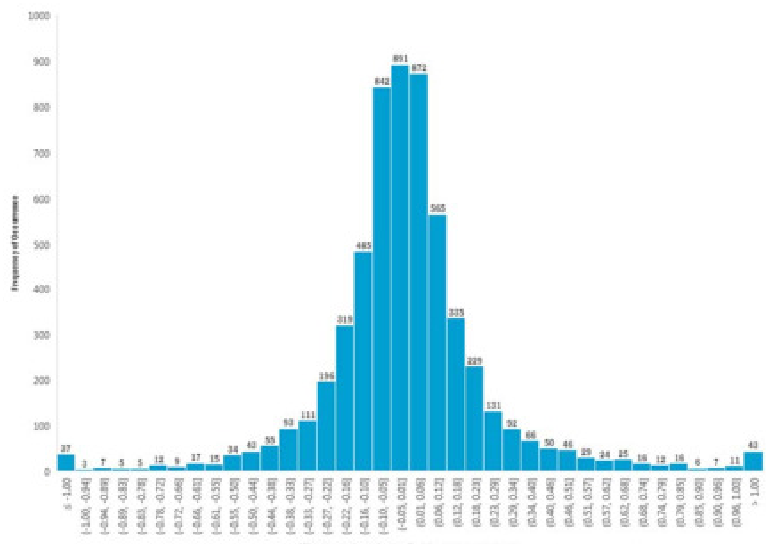


Figure 2. Measured change in successive dissolved oxygen measurements from Cocheco River continuous recorder, 2014 and 2015.

b. *Other general issues with the quality of the Cocheco River continuous recorder data*. Issues with continuous recorder data are to be expected, but the data quality issues observed in the Cocheco River dataset illustrate the need for more rigorous Quality Assurance/Quality Control (QA/QC) procedures to verify the data usability for assessment purposes. During the 2014 deployment, approximately one third of the days recorded at least one DO measurement as "0 mg/L." During the 2015 deployment, numerous data quality issues were noted with the DO and turbidity data that led to several periods of data being qualified and removed from the assessment. In addition to the time periods completely removed from the data in 2015, another four days had at least one DO measurement with a highly suspect "0 mg/L" reading that needed to be flagged and removed from the assessment.

Given the noted data issues and the fact that the continuous recorders are unattended, in an estuarine environment with high tidal flux, and potential for biofouling, the data should be verified more rigorously to be used for assessment purposes. Perhaps periodic *in situ* verification with additional spot sampling and/or more frequent maintenance and calibration/continuing verification would improve reliability of the data. The 2014 NHDES Ambient River Monitoring Program Quality Assurance Project Plan (QAPP) states that "Deployments measuring dissolved oxygen and/or pH are generally no more than two weeks in length in order to maintain the accuracy of the pre-deployment calibrations and avoid potential drift from the calibration settings" (NHDES, 2014). However, this does not appear to have been the case for the 2015 deployment in the Cocheco River, which, according to deployment notes, was only serviced on an approximately monthly schedule. While the Cocheco River continuous recorder is deployed and maintained by UNH, any data submitted to NHDES and used for assessment purposes should be required to follow the NHDES QAPP to ensure data usability and reliability. As a result, the Cocheco River continuous recorder data used in the draft 2016 assessment is suspect and should not be relied upon to make accurate assessment determinations. **5- 19**

The NHDES and affected stakeholders require high quality data from which to make assessment determinations and have confidence the results accurately depict existing conditions. These data will be used to make resource intensive management decisions and accuracy and precision of the data are paramount.

c. *The DO listing relied on an inappropriate DO criteria and MAGEX value*. As discussed in our comments on the draft 2016 CALM, NH's existing DO concentration criterion is not a useful indicator of impairments in estuarine waters and should be revised based on more recent research and EPA-promulgated criteria (EPA, 2000; EPA, 2003; and Diaz, 2017). Similarly, the CALM's DO MAGEX value has no scientific basis and should be removed. The tidal Cocheco River segment was listed as impaired for DO based on an overprotective DO criterion (Diaz, 2017) and anomalous data attributed to unreliable continuous recorder measurements (see comments above). These issues alone and in combination prevent a reliable assessment of the tidal Cocheco River (and all estuarine/marine assessment units). Absent any evidence of actual impairment in the waterbody, the current DO criterion and unreliable data cannot be used to draw any meaningful conclusions regarding the assessment status of the waterbody. **5- 20**

d. *The preponderance of the DO data indicate favorable conditions.* Removing the questionable DO data from the assessment provides the opportunity to make a more representative characterization of DO conditions in the Cocheco River. The available DO data suggest, at most, only five percent of the days exceed the current DO minimum daily concentration criterion. Previous comments regarding the relevance of the percent saturation criterion notwithstanding, only one exceedance of the daily average criterion is observed. These conditions indicate the Cocheco River tidal segment experiences a favorable DO regime and does not trigger impairment according to the CALM (NHDES, 2017a). No evidence has been provided to suggest this segment is experiencing any adverse impacts from the existing DO regime. The current evidence suggests the DO regime in this segment is protective of aquatic life and all designated uses.

5. **The chlorophyll-a data do not support an impairment listing.** The dataset provided by NHDES for the tidal Cocheco River impairment determination is insufficient to draw the cause and effect conclusions that observed chlorophyll-a concentrations represent algal biomass that results in DO impairment. NHDES contends that higher nitrogen freshwater inflows during low tide contribute to increased algal biomass, and through algal die-off and respiration, cause low DO (and therefore criterion exceedances), especially when low tide occurs at night or during early morning (NHDES, 2017b). This is a typical conceptual model of algal and oxygen dynamics in estuarine systems; however, the available water quality data for the Cocheco River lack the rigor to establish that this conceptual model is occurring and causing DO exceedances in the system.

   a. *The conceptual model of impairment is based on the continuous recorder chlorophyll-a measurements that NHDES (correctly) deemed unreliable to use in the assessment of the Cocheco River*. NHDES states "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" (NHDES, 2017b). This assumption is invalid. Given that the continuous recorder data cannot be relied upon, the NHDES has no reason to suggest the relative increasing or decreasing values of the probe readings are any more valid. Without correlation with laboratory measurements of chlorophyll-a, the continuous recorder data should not be used in the assessment to determine if or when chlorophyll-a spikes occurred. The lack of a correlation between probe and grab sample chlorophyll-a measurements as well as the extreme magnitude of variation in the probe measurements (even within the same tide) preclude the use of the probe chlorophyll-a data from any meaningful use in the assessment process. **5- 21**

   b. *Uncorrected chlorophyll-a measurements should not be used*. NHDES calculated a 90$^{th}$ percentile chlorophyll-a concentration during the current period (2011-2015) of 14.6 µg/L (NHDES, 2017b). This calculation used measurements of chlorophyll-a that were both corrected and uncorrected for pheophytin. Chlorophyll-a measurements uncorrected for pheophytin *a* and pheophorbide *a* interfere with the determination of chlorophyll-a because they absorb light in the same spectral region and result in errors in measurement (FDEP, 2011 and

Rice et al., 2012). NHDES cannot combine uncorrected and corrected chlorophyll-a measurements for assessment purposes. We recommend NHDES only use corrected chlorophyll-a measurements for the purposes of assessment.

Using only corrected chlorophyll-a measurements for the Cocheco River during the current period results in 23 available measurements with a 90th percentile of 12.0 µg/L (our previous comments addressing concerns over the validity of the 90th percentile chlorophyll-a threshold notwithstanding, the threshold is discussed here only for comparison of resulting chlorophyll-a concentrations from the inclusion and exclusion of uncorrected measurements). Of the 23 measurements, only four individual measurements exceed the 90th percentile threshold of 10 µg/L set for protection of DO in the Great Bay Estuary (NHDES, 2017a, Section 3.2.4, Indicator 9b). Three of these values were collected over an 11-day period in 2015. These data, concentrated over a short time period do not substantiate an ecological condition worthy of impairment, especially without any meaningful cause and effect relationship between the 10 µg/L threshold and attainment of any designated use (see comment 2.a. above).

The purpose of using an extended time frame (in this case five years) to evaluate chlorophyll-a is to allow for typical fluctuations and to avoid bias in the data from any particular environmental event (such as a single bloom). With only 23 measurements over the five-year period, the three measurements during an 11-day period bias the evaluation of chlorophyll-a and skew the dataset toward impairment. In order to address data bias of this nature, NHDES should include a measure of temporal independence in the CALM (e.g. data collected within seven days of each other at the same location are averaged for assessment purposes) to limit the potential for Type II errors.

c. *The chlorophyll listing of the tidal Cocheco River relied on unpromulgated and technically indefensible thresholds.* As discussed in our comments on the draft 2016 CALM, the CALM lacks defensible chlorophyll-a thresholds to identify impairments. A chlorophyll-a 90th percentile of >10 µg/L is not a meaningful indicator of DO-related impairments. Actual DO conditions in the Cocheco River were favorable, after adjusting for unreliable measurements likely caused by physical interference. Similarly, after removing the uncorrected chlorophyll-a measurements, the Cocheco River does not meet the thresholds for impairment based on the recreational (20 µg/L) or the MAGEX threshold (40 µg/L). Without site-specific, meaningful chlorophyll-a criteria to address tidal areas of the Great Bay Estuary for comparison, the available data suggest existing chlorophyll-a concentrations represent a healthy tidal system, with no indication of designated use impairment. **5- 22**

d. *The preponderance of the chlorophyll-a data indicate that the tidal Cocheco River experiences benign algal levels that would be expected of a productive upper estuary segment.* Given the observed chlorophyll-a conditions in the tidal Cocheco River, there is no reason to suggest this segment experiences anything other than normal fluctuations in primary productivity for its position in the upper estuary. The overall geometric mean chlorophyll-a concentration is 6.1 µg/L, which cannot be expected to contribute to adverse biological conditions or represent eutrophication. The annual geometric mean calculation is used in other states to represent the central tendency of chlorophyll-a levels over time and reducing bias from outliers. The available chlorophyll-a data suggest the tidal Cocheco River is fully supportive of aquatic life.

6. **<u>There is no technical basis to conclude that the tidal Cocheco River is impaired by nitrogen</u>.** As discussed in comments above, the monitoring data do not support placement of the tidal Cocheco River into category 5 on the basis of either DO or chlorophyll-a. It follows directly that there is no basis for a TN listing. Moreover, chlorophyll-a and DO are unlikely to be controlled by nitrogen in this segment; rather, algae are more likely to be limited by hydraulic/flushing factors and light limitations, that in turn are controlled by total suspended solids (TSS) and carbonaceous dissolved organic matter (CDOM). The lack of a nitrogen-chlorophyll linkage is borne out by the available data, which illustrate that the point source nitrogen reductions of 2012-15 were not accompanied by corresponding changes in chlorophyll-a or DO (Hall et al., 2016).

   The lack of paired chlorophyll-a, DO, and TN data in the assessment prevent the establishment of a true cause and effect relationship necessary to verify the conceptual model purposed by NHDES and, therefore, determine impairment. NHDES data used in the assessment include a maximum chlorophyll-a measurement from a station/day (no time was recorded but presumably raw data were collected during high and low tides), a DO minimum daily value from the continuous recorder, and a daily average TN measurement (also presumably from high and low tide raw samples, with no time recorded). These differing calculations and time scales prevent the pairing of data necessary to analyze the relationships between parameters. This is especially important because the NHDES contends low tide and elevated nutrient inputs from freshwater inflows coincide with increased chlorophyll-a which together cause DO criterion exceedances during the night or early morning (NHDES, 2017b). This conceptual model cannot be verified with the data provided by NHDES for the assessment. **5- 23**

## Summary and Recommendations

Based on the evaluation of the data used in the assessment, we recommend NHDES revise the draft 2016 303(d) listing for the Cocheco River from category 5 to category 3-PAS. This recommendation is based on the fact that evidence of impairment was limited to unreliable DO exceedances that more likely reflect issues with the continuous recorder deployment location and physical interference than an actual ecological response to elevated nutrients in the system. By removing the unreliable DO measurements, the Cocheco River does not meet the requirements for impairment. DO is the only parameter with an actual promulgated water quality standard to assess nutrient health in the Great Bay Estuary that applies to this waterbody, according to NHDES (NHDES, 2017b) and the 2016 CALM (NHDES, 2017a). The lack of a verifiable DO impairment indicates there is no reason to place the Cocheco River in assessment category 5.

Developing water quality management strategies for the Cocheco River should focus on collaboration between regulatory agencies and affected stakeholders in the watershed. The NHDES acknowledges the "recent and rapid total nitrogen reductions" in the system as a result of infrastructure investments by Rochester WWTP in 2014 and Dover WWTP in 2015 (NHDES, 2017b). NHDES acknowledges significant TN reductions have occurred; between 44 and 66 percent based on the data provided in the NHDES assessment (NHDES, 2017b; pg. 59). Further, NHDES states that improved conditions are expected in the coming years (NHDES, 2017b; pg. 55). Given the TN management strategies already implemented by Rochester and Dover and the significant reductions already observed, we respectfully disagree with NHDES' conclusion that the "response datasets warrant impairment under New Hampshire's narrative standard" (NHDES, 2017b; pg. 55). **5- 24**

Monitoring should be continued to attempt to quantify changes (if any are measurable) in nutrient response variables to determine if and how much the TN reductions are positively impacting the Cocheco River. This can and should be accomplished without a TMDL which can only serve to require new, more costly, and resource intensive reductions in TN, without establishing that more reductions are necessary or beneficial. Ongoing research in the Upper Piscataqua River is establishing that the TN reductions have had a negligible impact on DO and algal dynamics thus far and other factors are controlling nutrient response variables (Hall et al., 2016). This is evidence that a TMDL requiring additional nutrient reductions would not be the appropriate management strategy even if nutrient impairments were observed in this system.

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**COMMENT #6: Tom Irwin, Conservation Law Foundation**

clf
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June 23, 2017

2016, 303(d) Comments
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Watershed Management Bureau
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Attn: Ken Edwardson

Re: Comments on NHDES DRAFT 2016 Section 305(b) and 303(d) Surface Water Quality Report List of Threatened or Impaired Waters

Conservation Law Foundation (CLF) appreciates the opportunity to comment on the NH Department of Environmental Services' Draft 2016 Section 303(d) and 303(d) Surface Water Quality Report List of Threatened or Impaired Waters, published by the Department on May 8, 2017. CLF is a member-supported environmental advocacy group that works to solve environmental problems facing communities and natural resources in New Hampshire and throughout New England. CLF and its members have a strong interest in restoring and maintaining the health of the Great Bay Estuary and the rivers that feed it. For more than 10 years, CLF has engaged in concerted, ongoing efforts to address and reduce threats to the health of the Great Bay Estuary, which is recognized as an estuary of national significance under Section 320 of the Clean Water Act. **6- 1**

Section 303(d) of the Clean Water Act requires the State of New Hampshire to identify surface waters that are impaired or threatened by a pollutant or pollutant(s) such that they cannot support their designated use. Satisfying the "Aquatic Life" use, one of the designated uses of the numerous water bodies comprising the Great Bay Estuary, requires *inter alia* that:

> (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

*See* Technical Support Document for the Great Bay Estuary Aquatic Life Use Support Assessments, 2016 305(b)/303(d) List at page 5.

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By many measures, the health of the Great Bay Estuary has declined significantly over the past 20 years. According to the Piscataqua Region Estuaries Partnership's most recent State of our Estuaries Report, published in 2013 and provided herewith as Attachment 1, 15 out of 22 indicators of the health of the estuarine system show cautionary or negative trends. Since the previous report in **6- 2**

2010, concentrations of nitrogen and macroalgae had increased, dissolved oxygen in the Estuary's tidal streams was often below levels necessary to support marine life, water clarity in many areas was adversely affected by suspended sediment, and the amount of eelgrass throughout the system had declined. The 2013 report concluded that the Great Bay Estuary shows all the classic signs of eutrophication.

In the two years since DES's last 303(d) report in 2014, only one assessment zone out of the 19 that are described in the Technical Support Document for the Great Bay Estuary Aquatic Life Use Support Assessment, 2016 305(b)/303(d) report – can be delisted for improvement for one water quality indicator. According to the narrative description, the Oyster River has not experienced "large chlorophyll-A blooms for many years," which the Department determined justifies a reclassification of this assessment zone from impaired to marginally fully supporting. The data for six parameters in 18 other assessment zones show either no significant improvement or measurable decline. Clearly, the Great Bay Estuary is a system in distress, with detrimental differences in community structure and function as compared to "naturally occurring conditions." **6- 3**

While municipalities around Great Bay and the Piscataqua River are reducing nitrogen pollution through improved wastewater treatment, wastewater treatment facilities account for 32% of total nitrogen in the estuary as compared to 68% from non-point sources. *See* Great Bay Nitrogen Non-Point Source Study (June 16, 2014) at 3. Accordingly, there remains a significant load of total nitrogen to waters in the estuary.

Certain municipalities, particularly Portsmouth, Dover, and Rochester, have actively engaged in advocacy around nitrogen regulation in the Great Bay estuary. As part of a settlement stemming from a lawsuit brought by the communities against the Department, they secured a commitment for a Peer Review of the Department's 2009 methodology for establishing numeric nutrient criteria in the Great Bay estuary. Certain interests have characterized the resulting Peer Review as establishing that nitrogen is not causally related to the loss of eelgrass in the estuary, a major sign of eutrophication. This is simply not the case. Quite to the contrary, the Peer Review established only that there are multiple factors at work in the estuary that may be contributing to eutrophication, and that in light of those multiple factors the Department's methodology had not definitively established that excess nitrogen is the *primary* factor causing the decline of eelgrass and the inability for eelgrass to repopulate specific areas. Indeed, the Piscataqua Region Estuaries Partnership has interpreted the Peer Review *not* to mean that data contradict the conclusion that nitrogen is a primary cause of eelgrass loss, but rather that there is insufficient data to conclude it is the primary cause of eelgrass loss. *See* PREP Presentation to Technical Advisory Committee (Oct. 28, 2016) (Attachment 2) at 9. Indeed, one of the Peer Review panelists, Vic Bierman, agrees: **6- 4**

> "Our Peer Review opinion was based on the failure of DES to explicitly consider any of the other important, confounding factors in developing their relationships between nitrogen and eelgrass. *The Peer Review did not conclude that nitrogen is not an important factor, but that DES did not present sufficient evidence to support the conclusion that nitrogen was the*

> *primary factor that caused eelgrass decline and the inability of eelgrass to repopulate specific areas."*

*Id.* at 10 (emphasis added). It is also important to note that, as stated above, the Peer Review panel was asked to focus on whether nitrogen is the *primary* factor in eelgrass loss. Whether nitrogen is the *primary* factor is irrelevant for purposes of determining nitrogen impairments and management decisions for the estuary. Indeed, one of the Peer Review panelists, Jud Kenworthy, agrees that Peer Review addressed "the wrong question," stating: "The question could have and should have asked us to deal with the confounding factors instead of just focusing on whether nitrogen was the primary factor." *Id.* It also is noteworthy that the Peer Review itself states:

> [I]*mprovements in water quality/ecological health in Great Bay Estuary* ***can only be obtained by controlling nutrient loads***, not by simply setting numeric nutrient criteria. Such criteria may be beneficial in cases where only narrative criteria exist and progress on nutrient loads is held hostage to endless arguments over how to translate narrative criteria into quantitative criteria. In my opinion, however, numeric criteria are a solution to a regulatory problem, *not a water quality problem*.

Peer Review at 60 (Bierman Response), provided as Attachment 3 (emphases added).

In light of the foregoing, the Peer Review cannot serve as a basis for de-listing nitrogen impairments or for not listing waters as nitrogen-impaired where eelgrass impairments exist.

Listing water bodies as nitrogen-impaired where eutrophic conditions exist – including but not limited to eelgrass loss – also is essential in light of the impacts of climate change. It is well established that climate-related changes such as increased rainfall and warming water temperatures exacerbate the eutrophication impacts of nitrogen. *See, e.g.,* Nancy N. Rabalais *et al.* "Global change and eutrophication of coastal waters," ICES Journal of Marine Science, 66: 1528-1537 (2009), appended as Attachment 4; Brian Moss, *et al.*, "Allied attack: climate change and eutrophication," Inland Waters, pp. 101-105 (2011), appended as Attachment 5.

Changes such as increasing rainfall are added stressors that already are being observed locally. A 2014 graph by the National Climatic Data Center of State-Averaged Total Annual Precipitation for New Hampshire 1895-2013 shows 4 of the 5 wettest years on record occurred since 2005. Appended as Attachment 6. **6- 5**

As impacts of climate change shift the hydrodynamics of the Great Bay Estuary, it is increasingly important to reduce nitrogen loads from both point and non-point sources to combat the conditions that cause eutrophication.

CLF provides the following assessment-unit-specific comments below, incorporating therein by reference all of the comments above:

**Cocheco River**

CLF strongly supports the Department's 2016 relisting of the Cocheco River as Impaired with respect to Dissolved Oxygen and Total Nitrogen. We particularly concur with the rationale for relisting with respect to Total Nitrogen in the narrative description at 55, where elevated Nitrogen is associated with indicators of eutrophication even if it is not proven to be solely responsible:

> "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 much 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."

**6- 6**

This support for relisting is consistent with CLF's 2017 comments on the Department's *Categorization of Unassessed Waters in the Draft 2014 Section 303(d) List of Threatened or Impaired Waters*, appended as Attachment 7, which CLF hereby incorporates into these comments as if fully set forth herein, urging the Department not to delist the Cocheco River for Total Nitrogen.

**Great Bay**

CLF strongly objects to the conclusion cited for Great Bay that, because nitrogen cannot be conclusively identified as the sole cause of impairment, the Department assigns this Estuary Assessment Zone a "3-PNS Potentially Not Supporting" status.

The *Technical Support Document for the Great Bay Estuary Aquatic Life Use Support Assessments, 2016 305(B) Report/303(d) List* acknowledges elevated chlorophyll-a levels, degraded eelgrass beds, poor light attenuation, and adverse impacts of microalgae and epiphytes. It further states:

**6- 7**

> *"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."*

Technical Support Document at page 34. Despite these indicators of impairment, the Report concludes:

*"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."*

As set forth in CLF's February 24, 2017 comments appended as Attachment 7, there is simply no basis in law for requiring that a single pollutant, *on its own*, cause the violation of a water quality standard in order to be listed as a cause of an impairment. The Comprehensive Assessment and Listing Methodology (CALM) makes clear that the term "cause," as an assessment term, is a pollutant "which is causing, or threatening to cause, a water quality violation." CALM at 15. Nowhere does it require a pollutant – such as Total Nitrogen – to be the *sole* cause of impaired conditions.

For the reasons set forth herein, and in CLF's comments provided as Attachment 7, Great Bay must be listed as violating water quality standards ("impaired") for total nitrogen.

**Little Bay**

As stated above with respect to Great Bay, CLF strongly objects to the conclusion that, because nitrogen cannot be conclusively identified as the sole cause of impairment Little Bay, the Department assigns this Estuary Assessment Zone a "3-PNS Potentially Not Supporting" status.

According to the Technical Support Document on page 41, "The historical extent of eelgrass in this assessment zone was 252 acres ... The median current extent of eelgrass in 2014-2016 is 0 acres, which is a decrease of 100%." Additionally, the zone is classified as impaired for water clarity. Several sites within Little Bay show high levels of nuisance green and red algae (*Ulva* and *Gracilaria*), which may be early warning signs of expected changes in phytoplankton (McGlathery, Sundbäck, & Anderson, 2007) (Valiela, et al, 1997). The document states on page 41 that "At this time there are some of the classic indicators of nutrient eutrophication present in this assessment zone and nitrogen remains elevated." Despite these data, DES concludes that Little Bay is classified 3-PNS for nitrogen because "there are insufficient response datasets leading to the determine (sic) that eutrophication by total nitrogen is alone is not know to be strong enough (sic) to warrant impairment under NH's narrative standard." **6- 8**

As stated above for Great Bay, there is no basis in law for requiring that a single pollutant, *on its own*, cause the violation of a water quality standard in order to be listed as a cause of impairment. In light of the foregoing, Little Bay must be included on the Section 303(d) list as impaired for total nitrogen.

**Upper Piscataqua River**

Like Little Bay, the Upper Piscataqua has lost 100% of its eelgrass from historical levels and nearly 70% since 1990, and water clarity is poor. That the nutrient load in this assessment zone is rapidly decreasing due to wastewater treatment upgrades does not mitigate the fact that the Upper Piscataqua shows classic indicators of nutrient eutrophication and total nitrogen remains high. As discussed in the overview portion of CLF's comments, the nutrient load from wastewater treatment facilities contributes 32% of the Nitrogen in the Great Bay Estuary, with the remaining 68% attributable to non-point sources. **6- 9**

Again, there is no basis in law for requiring that a single pollutant, *on its own*, cause the violation of a water quality standard in order to be listed as a cause of impairment. For the above reasons, the Upper Piscataqua River must be listed as impaired for total nitrogen.

**Winnicutt River, Bellamy River, Sagamore Creek**

Each of these assessment zones is severely impaired for eelgrass, with decreases between 74-100% over the historic extent. Because there is little to no data in the Technical Support Document on other indicators in these Assessment Zones, Total Nitrogen is assessed as 3-ND. Given the data about nitrogen loading in the Great Bay Estuary generally, the known relationship of Nitrogen as one of the stressors of eelgrass, the increasing risk of eutrophication due to impacts of climate change, and the established fact that nitrogen need not be identified as the primary cause of eelgrass decline, CLF urges DES to assess these water bodies as Impaired for Total Nitrogen. **6- 10**

For the reasons set forth above, CLF supports the Department's listing of the Cocheco River as impaired for Total Nitrogen and urges the Department to identify Great Bay, Little Bay, the Upper Piscataqua River, Bellamy River, Winnicut River and Sagamore Creek as impaired for this pollutant of such significant concern to the health of these water bodies and the estuary as a whole. Thank you for the opportunity to provide these comments.

Respectfully submitted,

| | |
|---|---|
| Tom Irwin<br>V.P. and CLF New Hampshire Director | Melissa Paly<br>Great Bay – Piscataqua Waterkeeper |

Attachment 1
State of Our Estuaries 2013, Piscataqua Region Estuaries Partnership
http://scholars.unh.edu/cgi/viewcontent.cgi?article=1261&context=prep

Attachment 2
Presentation to Technical Advisory Committee (Oct. 28, 2016) **6- 11**

Attachment 3
Peer Review (Bierman Response)

Attachment 4
Nancy N. Rabalais *et al.* "Global change and eutrophication of coastal waters," ICES Journal of Marine Science, 66: 1528-1537 (2009)

Attachment 5
Brian Moss, *et al.*, "Allied attack: climate change and eutrophication," Inland Waters, pp. 101-105 (2011)

Attachment 6
National Climatic Data Center of State-Averaged Total Annual Precipitation for New Hampshire 1895-2013, 2016

Attachment 7
CLF Comments on "Categorization of Unassessed Waters in the Draft 2014 Section 303(d) List of Threatened or Impaired Waters", February 24, 2017

ATTACHMENTS PROVIDED ON THE NHDES FTP SITE AS DESCRIBED IN THE INTRODUCTION. **6- 12**

## COMMENT #7: John Hall, Great Bay Municipal Coalition (GBMC)

**VIA EMAIL to wqdata@des.state.nh.us**

June 23, 2017

Water Quality Data
New Hampshire Department of Environmental Services
Watershed Management Bureau
29 Hazen Drive, P.O. Box 95
Concord, New Hampshire 03302-0095

**RE: <u>2016, 305(b)/303(d) Comprehensive Assessment and Listing Methodology Comments</u>**

To Whom It May Concern:

In accordance with the Guidance for Submitting Comments on the 2016 305(b)/303(d) Comprehensive Assessment and Listing Methodology (CALM) (https://www.des.nh.gov/organization/divisions/water/wmb/swqa/2016/documents/2016-calm-cmnt-rqst-guide.pdf.), the Great Bay Municipal Coalition (GBMC) respectfully submits the attached comments on the draft 2016 CALM.

The attached comments identify several significant concerns with the methodology used to determine if state waters should be identified as impaired under Section 303(d) of the Clean Water Act. The CALM includes several "impairment" thresholds that are presented without any data to support that they are necessary to protect the linked use or achieve the applicable water quality standard. These include, for example, chlorophyll-a targets to protect primary contact recreation, the dissolved oxygen water quality standard, and water clarity; and, water clarity to protect eelgrass survival. As DES is well-aware, the chosen eelgrass survival "transparency" targets are physically unattainable for this system due to natural conditions. Moreover, the widespread presence of eelgrasses at all habitable depths in Great Bay confirms that the proposed transparency "survival" values are not rational for this system. Because it is well-documented that eelgrasses have been thriving in the deeper bay waters at much lower transparency levels for decades, one cannot reasonably claim a narrative criteria violation due to transparency exists using these values. In any event, if these endpoints are to be used as impairment thresholds to ensure narrative or numeric criteria attainment, they must undergo rulemaking in accordance with state and federal law. **7- 1**

The CALM also uses an outdated dissolved oxygen saturation standard that is not necessary to protect aquatic life uses. This standards needs to be updated in accordance with the best available science on marine DO requirements – as directed by the state legislature and required by Clean Water Act Section 303(c).

In addressing aquatic life use protection for eelgrass, the CALM also establishes an historic eelgrass cover level as the basis for determining impairment. However, the data upon which this acreage threshold was established is suspect and not otherwise available for public review (Dr. Short's aerial photos). Moreover, the threshold is apparently being applied even

where natural causes have reduced eelgrass acreage (i.e., 2006 Mother's Day Storm) – which is contrary to federal and state law, as the CALM itself acknowledges. Consequently, we are requesting that the Department remove the eelgrass impairment designation for this system because the cause of the acreage reduction was a well-documented natural event – the Mother's Day Storm and its aftermath.

Finally, the CALM still includes various presumptions that nutrients (primarily nitrogen) are causing eutrophic conditions, including excessive phytoplankton and macroalgae growth, poor water clarity, low DO, and eelgrass loss. These presumptions have led to improper nutrient impairment listings in the past and continue to lead to misplaced impairment determinations (e.g., proposed Cocheco River TN impairment). We have presented site-specific information for the estuary showing that these variables do not show any response to changes in nutrient load and concentration (which PREP has noted has decreased markedly since 2005/2006). Consequently, the presumed linkage between TN concentration/load and use impairment should be removed from this document, until a credible site-specific scientific basis is presented showing that nutrients are causing adverse ecological effects in this system.

Thank you for your consideration of these comments. We look forward to discussing the resolution of these concerns with the Department.

Sincerely

xx

GBMC

Attachment

**Comments on NHDES Draft 2016 305(b)/303(d) Consolidated Assessment and Listing Methodology (CALM)**

## A. INTRODUCTION

The NHDES Draft 2016 Section 303(d) Surface Water Quality List (May 8, 2017; "Draft 2016 303(d) List") identifies numerous assessment units within the Great Bay Estuary watershed as impaired (DES Categories 5-M and 5-P) for dissolved oxygen (DO), estuarine bioassessments, light attenuation coefficient (Kd), total nitrogen (TN), and chlorophyll-a (chl-a). These impairment designations are based on the methodologies presented in the 2016 Section 305(b) and 303(d) Consolidated Assessment and Listing Methodology (May 8, 2017; "CALM") and the Technical Support Document for the Great Bay Estuary Aquatic Life Use Support Assessments, 2016 305(b) Report/ 303(d) List (May 8, 2017; "TSD").

The CALM presents background on evaluating eelgrass cover (Indicator 8, CALM at 66) and total nitrogen (Indicator 9; CALM at 68) impairments. The total nitrogen impairment consists of eight sub-indicators, which are described in some detail. The TSD states that it presents evaluations of the eelgrass cover and total nitrogen indicators for the various assessment units in the Great Bay Estuary. The TSD also includes the following general assessment upon which the subsequent evaluations were based. **7- 2**

> *The 2013 State of the Estuaries Report for the estuary (PREP, 2013) showed that the Great Bay Estuary has all the classic signs of eutrophication: increasing nitrogen concentrations, low dissolved oxygen and disappearing eelgrass habitat*. These symptoms of eutrophication have the potential to impair the Aquatic Life 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.
>
> (TSD at 4) (Emphasis added)

The mere coincidental occurrence of elevated nitrogen concentration, occasional low DO, and disappearing eelgrass habitat is not sufficient to claim a cause and effect relationship. While the conceptual model shows a potential link between these causal and response variables, it also requires site-specific evaluation to account for the numerous other factors that influence these responses. In the case of the Great Bay Estuary, its shallow depth, low residence time, and watershed characteristics significantly alter its response to nutrient loads in comparison to other estuaries. A detailed evaluation prepared by the Great Bay Municipal Coalition (GBMC) for the Upper Piscataqua River, looking for DO response to significantly lower TN concentrations in 2015, found no linkage to chlorophyll-a concentration, light attenuation, or DO. (Grand Experiment Report, 2016; Attachment 1). The data collected for 2016 again show significantly lower TN concentrations in the estuary without any change in the response variables. Consequently, the presumption in the CALM that response variable indicators can be attributed to external TN loads requires a scientifically defensible demonstration before it can be used as the basis for impairment listings.

As discussed in greater detail below, the CALM presents numerous narrative standard translations (*e.g.*, chlorophyll-a concentration thresholds to protect DO and eelgrass) without providing any supporting evidence that the threshold is necessary or that the causal variable exerts a significant effect on the response variable. These threshold concentrations are surrogate water quality standards and require rulemaking before they can be used in impairment assessments. In addition, all of the aquatic life impairment indicators for the estuary are primarily attributed to natural causes, which have been ignored when the impairment determinations were made.

## B. LEGAL-REGULATORY CONSIDERATION

### 1. State Regulations

The New Hampshire Administrative Procedure Act specifies the following with regard to agency activities that must undergo rulemaking:

> *"each regulation, standard, or other statement of general applicability* adopted by an agency to (a) *implement, interpret* or make specific a statute enforced or administered by such agency or (b) *prescribe or interpret* an agency policy, procedure or practice *requirement binding on persons* outside the agency, whether members of the general public or personnel in other agencies." N.H. Revised Statutes Annotated RSA 541-A:1 (emphasis added).

As interpreted by the court, "[w]here an agency's efforts 'effect substantive changes binding on persons outside the agency, the agency's policy constitutes a 'rule' that must be promulgated pursuant to the [New Hampshire] Administrative Procedures Act.'" *Bel Air Assocs. v. N.H. HHS*, 154 N.H. 228, 233 (N.H. 2006); *see also Asmussen v. Comm'r, N.H. Dep't of Safety*, 145 N.H. 578, 595 (N.H. 2000) (finding "to the extent that the directives bound persons outside the department to substantive changes in 'agency policies, procedures or practice requirements,' RSA 541-A:1, XV, (b), they fell within the definition of 'rule' and were subject to the rulemaking procedures of the [New Hampshire] APA." ). Moreover, "[a]n appellant may challenge the constitutionality of a statute by asserting a facial challenge, an as-applied challenge, or both." *Petition of S. N.H. Med. Ctr.*, 164 N.H. 319, 326 (N.H. 2012); *see also State v. Hollenbeck*, 164 N.H. 154, 158 (N.H. 2012) (noting that "'an as-applied challenge… concedes that the statute may be constitutional in many of its applications, but contends that it is not so under the particular circumstances of the case.'"). "Rules adopted by State boards and agencies may not add to, detract from, or in any way modify statutory law." *Kimball v. N.H. Bd. of Accountancy*, 118 N.H. 567, 568 (N.H. 1978). 7- 3

EPA's latest MS4 permitting action in New Hampshire and the agencies' joint prior attempts to regulate nitrogen due to eelgrass, DO, and light transmission impairment listings in other POTW NPDES permits demonstrates that the Section 303(d) list has significant regulatory impact on NPDES permittees, triggering pollution reduction requirements. Moreover, EPA's permitting actions rely directly on the numeric impairment threshold values that DES places in the CALM to interpret and apply narrative criteria (see, 40 C.F.R. 122.44(d)). Consequently, through the publication of the CALM, the Department has triggered a number of the administrative laws principles established in RSA 541-A:1 that otherwise require formal adoption of the CALM and

Section 303(d) lists. For example, the CALM created (1) specific numeric objectives that govern compliance with narrative criteria (*e.g.*, Kd applicable to marine waters with eelgrass), (2) regulatory presumptions that nutrients are the cause of impairment without the need for an actual cause/effect demonstration that is required by 40 C.F.R. 122.44(d) (*e.g.*, by establishing the criteria that are used to identify when nutrients are causing "excessive plant growth" or "dissolved oxygen" violations) and (3) sought to regulate natural occurrences as pollutant effects, which is beyond statutory authority (areas with eelgrass losses due to major storm events).

These actions constitute changes to state law must undergo formal rulemaking to be adopted. Moreover, to the degree that certain actions are not permissible (*i.e.*, the creation of regulatory presumptions that a specific pollutant is causing a specific criteria violations and regulating natural occurrences such as eelgrass losses due to storms) those provisions and impairment listings created by the presumptions must be removed from the CALM and Section 303(d) list.

**2. Federal Regulations**

The CALM document, which DES uses to identify impaired waters, constitutes, factually and legally, new or revised WQSs. Generally, WQSs, expressed in numerically or in narrative form, define the water quality goals of a particular body of water "by setting forth the uses to be made of the water and the criteria necessary to protect those uses." 40 C.F.R. §§ 130.3, 131.2. In determining when a WQS has been revised, regulatory authorities look to see whether the document in question contained "[p]rovisions that affect attainment decisions made by the State and that define, change, or establish the level of protection to be applied in those attainment decisions, [which] affect existing standards implemented under Section 303(c) of the Act. These provisions constitute new or revised water quality standards." See USEPA Determination on Referral Regarding Florida Administrative Code Chapter 62-303, Identification of Impaired Surface Waters, July 6, 2005, EPA Florida Determination, at 9. Under this definition, revised standards would include provisions that "define, change, or establish the magnitude (concentration), duration, or frequency that the State would use to determine when a waterbody is attaining any applicable water quality standards." The CALM states:

> The primary purpose of this document is to describe the process used to make surface water quality attainment decisions for 305(b) reporting and 303(d) Listing purposes. This document is called the Consolidated Assessment and Listing Methodology (CALM) because it includes the methodology for assessing and listing waters (a term used to describe the process for placing waters on the 303(d) list). (CALM at 1).

Accordingly, the CALM undoubtedly fits the description of revised WQSs.

Policies pertaining to WQSs and their implementation must go through the formal adoption process (*e.g.*, EPA review and approval or disapproval). 40 C.F.R. § 131.13; see also EPA's "Alaska Rule" [1] governing adoption and modification of a state WQS – 40 C.F.R. § 131.21, 65 Fed. Reg. 24641, 24647 (Apr. 27, 2000) (a rule promulgated by EPA requiring EPA to review all

[1] This regulation is commonly referred to as the "Alaska Rule" as it was modified following litigation to clarify EPA's mandatory review obligations and the "applicable standard" before and after the review occurs. *Alaska Clean Water Act Alliance* v. *Clarke*, 1997 U.S. Dist. LEXIS 11144, 27 ELR 21330 (W.D. Wash. 1997).

numeric criteria and narrative implementation procedures as part of the water quality standards approval process); USEPA, Water Quality Standards Handbook, Second Edition, EPA 823-9-94-005a (Aug. 1994), available at https://www.epa.gov/sites/production/files/2016-06/documents/wqs-handbook-1994.pdf, at 3-22 ("To be consistent with the requirements of the Act, the State's procedures to be applied to the narrative criterion *must* be submitted to EPA for review and approval, and will become a part of the State's water quality standards. (emphasis added) (See 40 C.F.R. 131.21 for further discussion). EPA's review and approval of WQSs are critical because regulatory decisions (*e.g.*, § 303(d) listings, NPDES permits, and TMDLs) may only be based on the approved applicable standards. 40 C.F.R. § 131.21.

The required rulemaking and adoption process of the CALM has not occurred. As such, and because the CALM has specific regulatory impacts on communities (*e.g.*, impairment designations affecting permit limit issuance), the CALM violates federal regulations and must complete WQS rulemaking procedures prior to finalization and publication.

In addition, revised WQSs must have scientifically-backed information quantifiably linking causal variables and stressors with ecological adverse impacts to support associated regulatory procedures. 40 C.F.R. § 131.13. As discussed below, several of the CALM indicators lack this supporting scientific information.

## C. PRIMARY CONTACT RECREATION USE

Primary contact recreation use applies to all surface waters and is defined as "waters that are suitable for recreational uses that require or are likely to result in full body contact and/or incidental ingestion of water." (CALM at 40).

### 1. Chlorophyll-a (Indicator 3)

The chlorophyll-a "impairment" indicator for primary contact recreation water quality criteria in tidal waters is chl-a ≤ 20 µg/L while the Magnitude of Exceedance Criteria (MAGEX) is chl-a ≤ 40 µg/L. The basis for applying these values needs to be identified and justified. For example, what is the averaging period (*e.g.*, tidally averaged, low tide reading, instantaneous)? Please provide the basis for these values. The supporting documentation should specify why contact recreation will or cannot occur if these conditions are present.

Since the indicator concentration is based on attainment of the primary contact recreational use, the chl-a indicator should only apply when the primary contact recreational use is reasonably attainable. For example, if the chl-a indicator is only exceeded at low tide (*e.g.*, due to draining water from swamps or tidal rivers), when water depths are insufficient to support primary contact recreation (*e.g.*, one foot water depth), application of the indicator should be suspended. Similarly, with regard to Great Bay, which consists of extensive tidal mud flats, primary contact recreation is not a reasonable use over a significant portion of the tidal cycle. Application of the chl-a indicator should be restricted to only when the primary contact recreational use is reasonably attainable. 7- 4

In addition, the chl-a indicator impairs primary contact recreation due to the reduction in water clarity caused by elevated levels of chl-a. Water clarity in the Great Bay Estuary is significantly reduced by colored dissolved organic matter (CDOM) non-algal particulates (NAP), and the ambient water quality of the Gulf of Maine which are a natural constituent of runoff from the watershed and ocean water (See, Morrison et al., 2008). This factor has a far greater impact on water clarity than algal growth in this system. Moreover, these natural constituents may independently limit primary contact recreation through large areas of the estuary. It would be inappropriate to use the chl-a indicator as a basis for impairment if the use cannot be attained due to these natural conditions.

### 2. Nitrogen in Estuarine Waters (Indicator 4)

The nitrogen indicator for primary contact recreation states:

> "Class B waters shall contain no phosphorus or nitrogen in such concentrations that would impair any existing or designated uses, unless natural occurring." The estuarine eutrophication model used by the National Oceanic and Atmospheric Administration relates external nutrient inputs to primary and secondary symptoms of eutrophication (Bricker, et al., 2007). Elevated chlorophyll-a concentrations and proliferation of macroalgae are primary symptoms of eutrophication.
>
> (CALM at 44)

#### a) Nitrogen Indicator Should Be Removed from CALM

As presented above, the CALM erroneously presumes that nitrogen is the cause of impairment if any of the primary (chl-a, macroalgae) or secondary (low DO) symptoms of eutrophication are present based on the NOAA model. However, while external nutrient inputs can contribute to eutrophic conditions, the model also shows that external factors control whether and how such conditions are expressed. It is not sufficient to say that external loads of nutrients are present and eutrophic conditions exist to conclude that such loads are the cause of eutrophic conditions. In Great Bay, as discussed below, there is no apparent relationship between any form of plant growth and the nutrient levels in the system based on over 30 years of monitoring. Under state law, DES is required to demonstrate that the external nutrient loads are a significant factor *causing* eutrophic conditions (See, 40 C.F.R. § 122.44(d) and State law). Thus, DES is not authorized to create a presumption that nutrients are the cause of a plant growth condition that exists – it must scientifically demonstrate this conclusion with defensible, site-specific information. **7- 5**

#### b) Phytoplankton (Chl-a) Concentrations Do Not Respond to External Nutrient Loads

Monitoring of the estuary shows that overall phytoplankton chl-a levels have remained constant over an extended period of time, even though external nutrient concentrations and loads have substantially changed (Figures 1a and 1b).

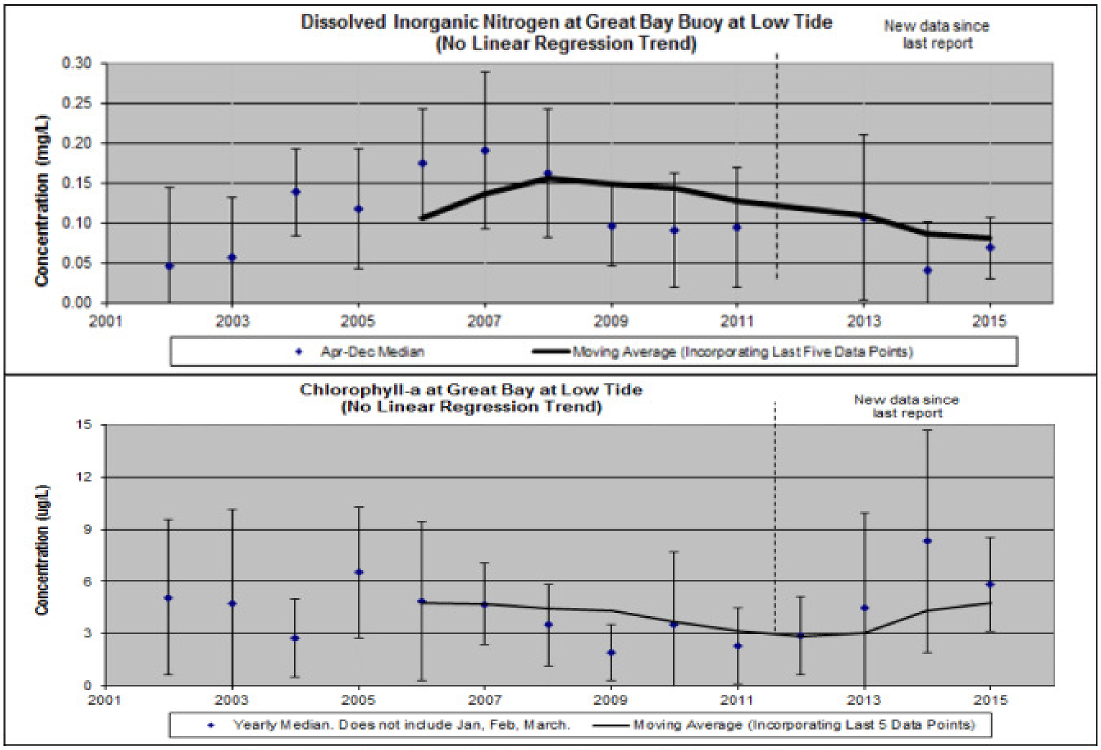


**Figure 1a: Great Bay Buoy DIN and Chl-a at Low Tide**

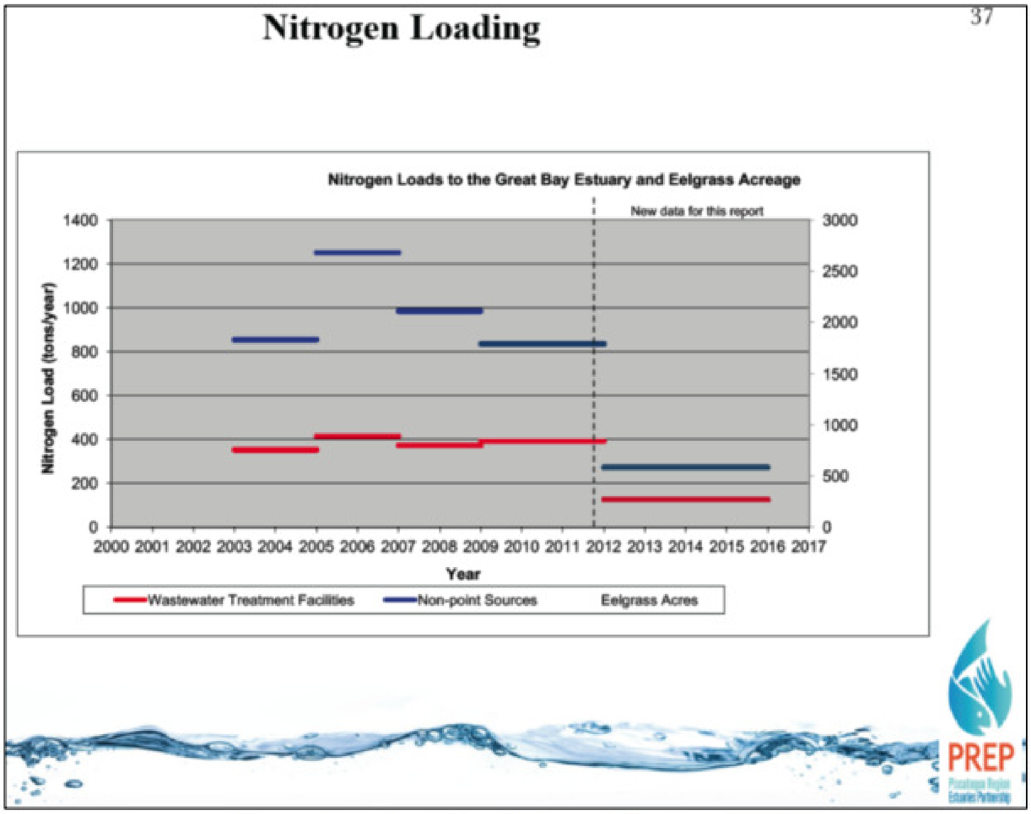


**Figure 1b: Great Bay Estuary Nitrogen Loads**

This dose/response information confirms that external nutrient load is not a significant factor contributing to this indicator. If the primary symptoms of eutrophication do not respond to external nutrient inputs, there is no reasonable basis to presume a relationship between external nutrient inputs and secondary eutrophication symptoms.

**c) Macroalgae**

Macroalgae are present in essentially all estuaries and, based on the data available for this system and others, have relatively low nutrient requirements. Accordingly, the presence and proliferation of macroalgae may occur even at very low TN and TP concentrations. Caution should be used when identifying primary contact recreation impairments based on the identification of macroalgae in estuaries. In addition, the term "proliferation" should be defined and quantified in terms of macroalgae cover or biomass. In particular, DES needs to describe, in detail, precisely how this form of plant growth would interfere with primary contact recreation, as this is not apparent from any of the information presented.

Several prominent species of macroalgae in Great Bay Estuary have been classified as invasive (*e.g.*, *Dasysiphonia japonica* and an invasive *Gracilaria* species) (*Monitoring Macroalgae in the Great Bay Estuary for 2015* (PREP, 2017)). The CALM states that "exotic non-native invasive species" are non-pollutants and "TMDLs are not required for waters impaired by nonpollutants." (CALM at 15). Thus, at a minimum, this indicator must account for invasive macroalgae species, excluding their presence from any such impairment assessments.

Macroalgae in Great Bay have been documented as predominantly present in the inter-tidal area at elevations that do not support eelgrass growth. It is not apparent how macroalgae growth in this area (mud flats) adversely affects primary contact recreation. At a minimum, the CALM should specify that the presence of macroalgae in areas that cannot reasonably support primary contract recreation shall not be identified as an impairment for this use.

Finally, monitoring for macroalgae by Burdick has implied that macroalgae in the estuary are increasing at a time when external nutrient loads have been dramatically reduced. This observation would suggest that external nutrient loads are not a significant factor influencing the occurrence of macroalgae. Finally, if the primary symptoms of eutrophication do not respond to external nutrient inputs, there can be no relationship between external nutrient inputs and secondary eutrophication symptoms.

## D. AQUATIC LIFE USE

The aquatic life use applies to all surface waters and is defined as "waters that provide suitable chemical and physical conditions for supporting a balanced, integrated and adaptive community of aquatic organisms." (CALM at 51).

### 1. Dissolved Oxygen (Indicator 1)

The CALM DO indicator for lakes, ponds, and impoundments states that, when present, stratification should be taken into account when assessing for aquatic life use DO impairments. However, the same consideration is not specifically mentioned for tidal rivers and estuaries despite studies identifying stratification as controlling the occurrence of low DO conditions, for example, in the Lamprey River.[2] The stratification, which has been documented for this system, and which is routinely expected in virtually all estuaries, is a natural condition and, consistent with the approach for fresh waters, the Department should not classify waters as impaired if the impairment is primarily caused by natural conditions (CALM at 16). Consequently, stratification should explicitly be included in the evaluation for this indicator. **7- 6**

Notwithstanding the comment presented above, the current DO water quality standard for estuarine/marine waters is out of date and, in any event, was not developed to apply under rare stratified conditions. To be reasonable, criteria must be applied to reflect the manner in which they were developed (*i.e.*, reflecting underlying scientific studies). The USEPA "Red Book" DO criteria reflected longer term exposures and did not assess aquatic life use protection needs of "bottom" or "stratified" waters. Thus, it is not scientifically defensible to apply this criteria as an "anytime/anyplace" value to protect aquatic life. Moreover a 5.0 mg/L instantaneous minimum WQS interpretation is not scientifically defensible, and there is no scientific basis for the DO saturation standard. Consequently DES's approach to DO standard compliance is arbitrary as applied in the impairment listings for the Great Bay Estuary. The USEPA adopted revised DO criteria for marine waters in 2000, which present the latest science regarding this parameter. This

[2] Pennock, Jonathan, "2004 Lamprey River Dissolved Oxygen Study" (2005). PREP Publications. Paper 183. http://scholars.unh.edu/prep/183

science recognizes that marine waters can become stratified and these waters can routinely fall below 5.0 mg/L DO concentration without resulting in aquatic life use impairment. EPA has approved significantly lower DO criteria for such stratified waters (see, *e.g.*, Chesapeake DO Criteria).

Current legislation, awaiting the Governor's signature, requires the commissioner to adopt rules, under RSA 541-A, relative to DO water quality standards in a manner "consistent" with EPA guidance on DO water quality criteria published pursuant to Section 304(a) of the Clean Water Act and other relevant scientific information. Such "consistency" would not allow for applying a 5 mg/l DO standard in marine waters under low tide/stratified conditions as necessary to ensure aquatic life protection. Since the most recent criteria recommendation under Section 304(a) of the Clean Water Act is the Ambient Aquatic Life Water Quality Criteria for Dissolved Oxygen (Saltwater): Cape Cod to Cape Hatteras (EPA-822-R-00-012, November 2000), the Department should delay listing any waters as impaired for DO if there are concerns regarding criteria compliance under infrequent, short term, or stratified conditions in this system.

### 2. Eelgrass Cover (Indicator 8)

#### a) Background

Indicator 8, under Aquatic Life Uses, describes how eelgrass cover in the Great Bay Estuary is assessed to determine whether aquatic life uses are being supported. (CALM at 66 – 68). This indicator provides that uses are not supported if declines in eelgrass cover from historic levels exceed 20% or if an evaluation of recent trends in the eelgrass cover indicator show a 20% loss in the indicator, based on a linear regression of eelgrass cover versus year.

The CALM further provides that NHDES may also consider trends in eelgrass biomass as supplemental information. "Biomass is calculated by multiplying the eelgrass area by the eelgrass density (PREP, 2012)." NHDES may also consider published reports about the proliferation of macroalgae and its impact on eelgrass.

#### b) Basis for Eelgrass Cover Impairment Listing

In assessing eelgrass cover, the median of the previous three years is compared to the historic value. This historic level has been reported for Great Bay as 2,131 acres from the 1948, 1962, 1980, and 1981 datasets for Great Bay (TSD at 33). The median eelgrass cover for the period 2013 – 2016 is 1,464 acres (a 31% decrease). Since 1990, the trend in eelgrass cover for the Great Bay assessment zone is a loss of 26.4%. Since these assessments exceed the 20% threshold, this assessment zone was assigned an impairment listing of 5-P. **7- 7**

#### c) Basis for Eelgrass Cover Estimates Is Not Scientifically Defensible

The historical extent of eelgrass in all of the Great Bay Estuary assessment zones has been based on aerial photographs of the assessment zone with examination of the photos to determine the acreage of eelgrass cover and the density of the cover.[3, 4] These historical aerial photographs are

[3] Short, Frederick T. and Trowbridge, Phil, "UNH Eelgrass (Zostera marina) Monitoring Program for 2010-2014: Quality Assurance Project Plan" (2010). PREP Publications. Paper 350. http://scholars.unh.edu/prep/350
[4] Barker, Seth, "Eelgrass Distribution in the Great Bay Estuary and Piscataqua River for 2016" (2017). PREP Publications. 367. http://scholars.unh.edu/prep/367

not available for independent assessment and the reliability of the estimates cannot be assessed. If the historical basis for eelgrass extent is not available for independent review and evaluation, it should not be used as the basis for establishing an impairment threshold.

Moreover, this aerial photograph method of measuring eelgrass extent cannot reliably distinguish between eelgrass, other seagrasses, and macroalgae without extensive ground truth confirmation.

> "It is not possible to reliably distinguish between eelgrass and macroalgae, or between different species of other seagrasses, using aerial imagery."
>
> (USACoE, 2016).

The necessary ground truth measurements have not been made for the historical levels of eelgrass. Consequently, it is not possible to establish a reliable historical basis for comparison and these data cannot be used to establish an impairment threshold because the data are not reliable. Moreover, the 20% reduction does not account for other natural disturbances that have been documented to cause far greater than a 20% change in eelgrass acreage (*i.e.*, wasting disease and the 2006 Mother's Day Storm). Under state and federal law, these natural occurrences cannot be a basis for an impairment listing, simply because eelgrass declines exceeded 20%.

### d) Evaluating Trends in Biomass

As noted earlier, the CALM (at 67 – 68) provides that NHDES may also consider trends in eelgrass biomass, with biomass calculated by multiplying the eelgrass area by the eelgrass density (PREP, 2012). The relationship between eelgrass biomass and eelgrass density, as provided in PREP (2012), was originally provided to PREP by Dr. Fred Short (UNH), but these relationships have never been verified and the data upon which they were based have been lost by Dr. Short. (See, email exchange between Philip Trowbridge and Fred Short, September 30, 2008 and November 13, 2008; Attachment 2). NHDES and EPA Region 1 originally intended to use Fred Short's biomass data to evaluate changes in eelgrass biomass with time. However, use of the biomass data was contingent upon an analysis of error associated with the data. This analysis could not be conducted because the data were never provided. Because the required error analysis could not be completed, NHDES concluded: **7- 8**

> Without the missing data, the planned error analysis cannot be completed and DES cannot consider eelgrass biomass as an indicator for 305(b)/303(d) assessments since quality assurance cannot be confirmed.

This situation has not changed, consequently the relationship between eelgrass biomass and eelgrass density, as provided in PREP (2012), cannot be used to consider trends in eelgrass biomass.

Moreover, the relationship provided by Dr. Short varies significantly from relationships published in peer reviewed scientific journals. PREP (2012) used the following unsubstantiated data from the UNH Seagrass Ecology Group (Dr. Short). (See, Table 1)

**Table 1**

| Eelgrass Cover Range (%) | Median Eelgrass Cover (%) | Biomass ($g/m^2$) |
|---|---|---|
| 0 – 10 | 5 | 0 |
| 10 – 30 | 20 | 25 |
| 30 – 60 | 45 | 55 |
| 60 – 90 | 75 | 85 |
| 90 - 100 | 95 | 250 |

These unsubstantiated data suggest a 20% increase from 75% cover to 95% cover results in a 200% increase in biomass. These observations are in stark contrast to published evaluations of the relationship between eelgrass cover and biomass by Carstensen et al. (2016). (See, Figure 2).

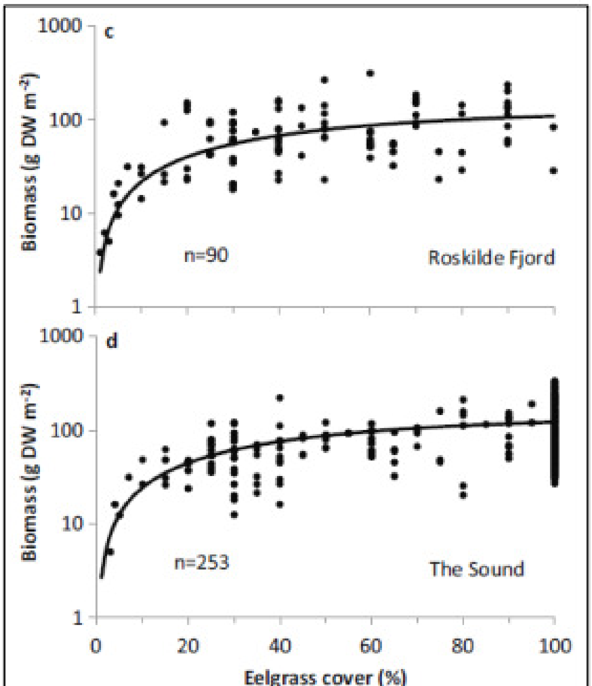


**Fig. 6** Marginal relationships between aboveground eelgrass *biomass* and *cover* of four selected sites. Variations in sampling depth, interannual variations in Secchi depth, and month were accounted for by adjusting observations (*dots*) and the modeled relationships (*solid line*) to a mean sampling depth (Table 1) and an average overall months from March to October using the estimated relationship (Eq. 6) and annual means of Secchi depth. The four selected sites had the most biomass observations and a broad span in Secchi depths and eelgrass depth ranges (Table 1)

**Figure 2: Eelgrass Biomass vs. Percent Cover Relationship (Carstensen et al. 2016)**

These researchers evaluated 791 combined observations of eelgrass cover and biomass from eight different coastal sites to develop their relationship. They found that eelgrass biomass initially increased with cover, but flattened out as cover exceeded 50% due to increases in self-shading. This relationship occurred at all of the individual coastal sites. If a similar cover to biomass relationship is present in Great Bay, the downward trend in eelgrass biomass cited in prior listings would disappear (Figure 3).

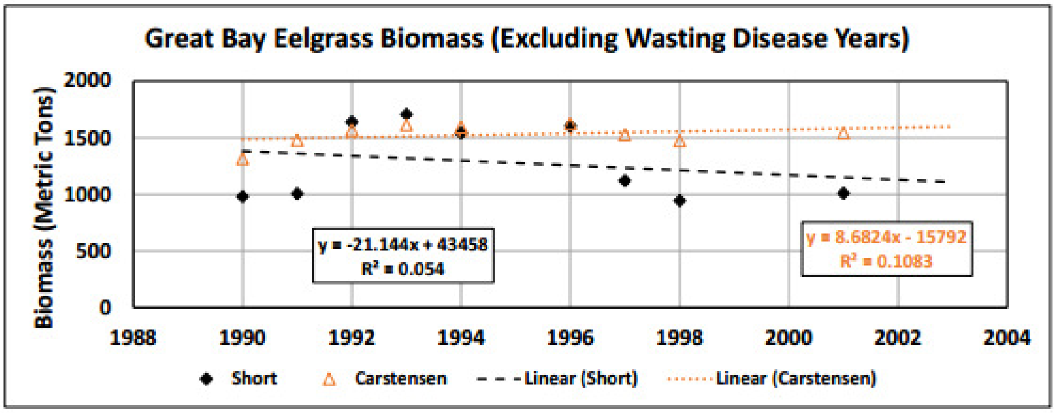


**Figure 3**

Finally, any analysis of biomass trend depends upon accurate measures of eelgrass density. Eelgrass density is currently the subject of research by UNH (See, Fred Short SeagrassNet studies for Great Bay). These studies demonstrate that percent cover (a measure of eelgrass density) varies dramatically through the growing season, with maximum density reported as early as the end of July or as late as mid-October (See, Table 2). In contrast to these observations, the aerial photography used to determine eelgrass cover and density have been collected between August 4 and September 12 in the recent surveys (2002 – 2015). Given the variability in the time of aerial cover acquisition and the variability in time to peak biomass cover, Dr. Short's aerial photographic data cannot be used in any scientifically defensible manner to make assessments regarding trends in eelgrass biomass change from year to year.

**Table 2 – SeagrassNet Results**

| Year | Late July | Mid-October | % Change |
|---|---|---|---|
| 2007 | 35 | 71 | +103 |
| 2008 | 87 | 60 | -31 |
| 2009 | 47 | 34 | -28 |
| 2010 | 57 | 67 | +18 |
| 2011 | 44 | 75 | +70 |
| 2015 | 27 | 41 | +52 |

Since the data upon which the PREP (2012) eelgrass cover – biomass relationship has never been provided for public review, these data yield a relationship contrary to the published literature, and eelgrass density measurements are clearly suspect, they are not "reliable" information and therefore, cannot be used to evaluate trends in eelgrass biomass in the Great Bay Estuary. The CALM should be amended to eliminate this section.

### e) Macroalgae

The CALM states that NHDES may consider published reports about eelgrass impacts due to the proliferation of macroalgae as supplemental information for eelgrass assessments (CALM at 68). Such an approach is not legally defensible. DES is required to demonstrate that macroalgae, if present, are a significant factor causing the loss of eelgrass or some other important adverse impact on aquatic life in the system – not simply that they are present (See, 40 C.F.R. § 122.44(d), 131.13 and State narrative criteria). DES cannot claim that it will use unidentified published reports in the future to claim that macroalgae are impairing estuarine bioassessment. When, and if, DES identifies published reports implicating macroalgae in use impairment, it must issue its findings and request public input before any "new" impairment metric is adopted and applied in state waters. **7- 9**

### 3. Total Nitrogen Concentrations and Associated Impacts in the Great Bay Estuary (Indicator 9)

The CALM indicates that TN concentration in Great Bay Estuary is conceptually an aquatic life concern for several reasons. Excess TN in estuaries can fuel excess phytoplankton and macroalgae growth which can result in the depletion of DO in the water column. Known as eutrophication, this process can adversely affect aquatic life, potentially resulting in mortality.

Another conceptual process through which the CALM indicates that TN can adversely impact aquatic life is via a reduction in water clarity such that eelgrass receive inadequate light for photosynthesis. In some systems, this can result in reduced eelgrass cover and biomass. The CALM also states that the following nutrient-related adverse impacts on aquatic life are to be "assessed independently" but evaluated as "a collection of indicators." If a "preponderance of evidence" demonstrates that TN concentrations are elevated and adverse responses exist in the same assessment unit, DES may declare an aquatic life use impairment due to excess nutrients (CALM at 68-69). **7- 10**

As discussed previously with regard to Primary Contact Recreation Use, the manner in which nutrients affect the primary and secondary responses to external nutrient loads is complex and it is inappropriate to presume that the presence of one or several of these eutrophication responses confirms that external nutrient loads/concentrations are the cause. DES is required to demonstrate that the external nutrient loads are a significant factor causing eutrophic conditions (See, 40 C.F.R. § 122.44(d) and State narrative criteria). Moreover, as previously demonstrated and discussed in the 2014 Peer Review, *none* of these theoretical effects have been documented to be occurring in the Great Bay system due to changes in nutrient levels. Thus, the "preponderance of the evidence" shows that this system is not sensitive, in any ecologically meaningful way, to the TN levels present in the system.

Nevertheless, the CALM provides nine (9) indicators of TN contributing to adverse impacts in Great Bay Estuary. The manner and relevance of these indicators are discussed below.

### a) Indicator 9a – Dissolved Oxygen

As discussed above under Primary Contact Recreation Use, the DO water quality criteria are out of date and need to be updated to reflect the latest EPA guidance on DO water quality criteria published pursuant to Section 304(a) of the Clean Water Act. Moreover, there is no credible **7- 11**

basis to assert that DO in Great Bay, or the Piscataqua/Cocheco system has been significantly, adversely affected by the nutrient levels of those systems.

### b) Indicator 9b – Chlorophyll-a Concentration to Protect DO

The CALM states that 90th percentile chl-a concentrations <= 10 µg/L represent fully supporting uses while chl-a concentrations exceeding this threshold characterize not supporting (CALM at 69). Short term algal levels do not impact sediment oxygen demand, the primary vehicle for algal induced low DO in aquatic systems. Statistically, this 90th percentile threshold is roughly equivalent to a median chl-a concentration of 3-4 µg/L, representing oligotrophic conditions. This is a very stringent and overly conservative threshold that is exceeded in many high quality waters. Please provide the basis and back-up information used to derive and justify this threshold for DO impairment for Great Bay Estuary.

The conceptual model for the effect of chl-a concentration on DO indicates two potential modes of action: respiration causes diurnal fluctuation in ambient DO (with the lowest DO concentration occurring before sunrise) and cell death contributes to oxygen demand in the receiving water (as BOD or SOD) – a very long term process as noted above. In the former case, exceedances of the minimum DO standard must be associated with the diurnal pattern of respiration and photosynthesis. In the latter case, an overall depression in DO concentration throughout the diurnal cycle must be present. Without such a demonstration, use of the chl-a indicator to protect DO cannot be justified. As DES has provided no such information as part of this proposed "evidence" of nutrient induced DO impairment, this indicator must be deleted. **7- 12**

This indicator is irrelevant if the waters are meeting the appropriate DO water quality standard or where the algal growth that it measures is originating from other upstream sources (*e.g.*, Exeter Lagoons). Moreover, even if the DO standard is not achieved, DES cannot presume that elevated levels of chl-a caused DO water quality standard violations without some scientifically defensible demonstration that chl-a is, in fact, the cause or significant contributor to the cause. DO concentration is affected by numerous factors, several of which are naturally occurring (*e.g.*, stratification, temperature, watershed organic loadings). DES is required to demonstrate that elevated chl-a concentrations are a significant factor causing eutrophic conditions to determine that this factor needs to be regulated (See, 40 C.F.R. § 122.44(d) and State law). Without such a demonstration, DES cannot presume a cause and effect relationship under state or federal law.

### c) Indicator 9c – Water Clarity (Kd)

The CALM provides median light attenuation coefficient (Kd) thresholds for *eelgrass survival* for three restoration depth levels based on mean water level (MWL) (CALM at 70). If this median Kd value is exceeded, the waterbody is designated not supporting uses as it presumes existing eelgrass cannot survive in these waters. This is another regulatory presumption that lacks scientific support and is contrary to the very concept that narrative criteria apply only where specific data confirm aquatic life impairment. **7- 13**

First, these restoration depths and Kd thresholds were initially presented in the DES 2009 *Numeric Nutrient Criteria for the Great Bay Estuary* which was found by an expert peer review panel to be scientifically indefensible. Before any of these Kd thresholds can be used to assess aquatic life use attainment in Great Bay Estuary, DES must provide the basis and back-up information, based on eelgrass responses *for this system* used to derive and justify this threshold for impairment. Moreover as these constitute new numeric criteria the public must be given the opportunity to review and comment on this justification and, as noted earlier, these must be adopted into rule.

Second, the CALM claims that the restoration depth for Great Bay Estuary (excluding deeper areas in the lower Piscataqua River and Portsmouth Harbor) is 2 m below MWL. Great Bay is shallow with a tidal range of 2 m. At low tides, large portions of Great Bay are exposed as mudflats, rendering the water clarity irrelevant at those times, as various eelgrass experts have previously noted. Moreover, the mean water level for much of Great Bay is only 1 m. Accordingly, a restoration depth of 2 m results in an overly conservative Kd impairment threshold in Great Bay. Therefore, the Kd impairment thresholds for Great Bay must be revised.

Third, the available data for this system confirmed that eelgrass grew robustly in the deepest sections of Great Bay, even though Kd levels did not meet the claimed requirement for eelgrass survival. Thus, based on the actual locations where eelgrasses are healthy and growing, the Kd levels are plainly unnecessary to protect this form of plant life in this system.

Fourth, the conceptual model relates external nutrient loads to Kd through the growth of phytoplankton (measured as chl-a). As the phytoplankton biomass increases, the cells absorb and/or scatter light resulting in greater light attenuation and less light reaching the eelgrass beds. Consequently, for water clarity to be associated with total nitrogen, this link through phytoplankton must be present. It is not. As illustrated in Figure 4a, ambient concentration of chl-a show no statistical trend over a period of 25 years.

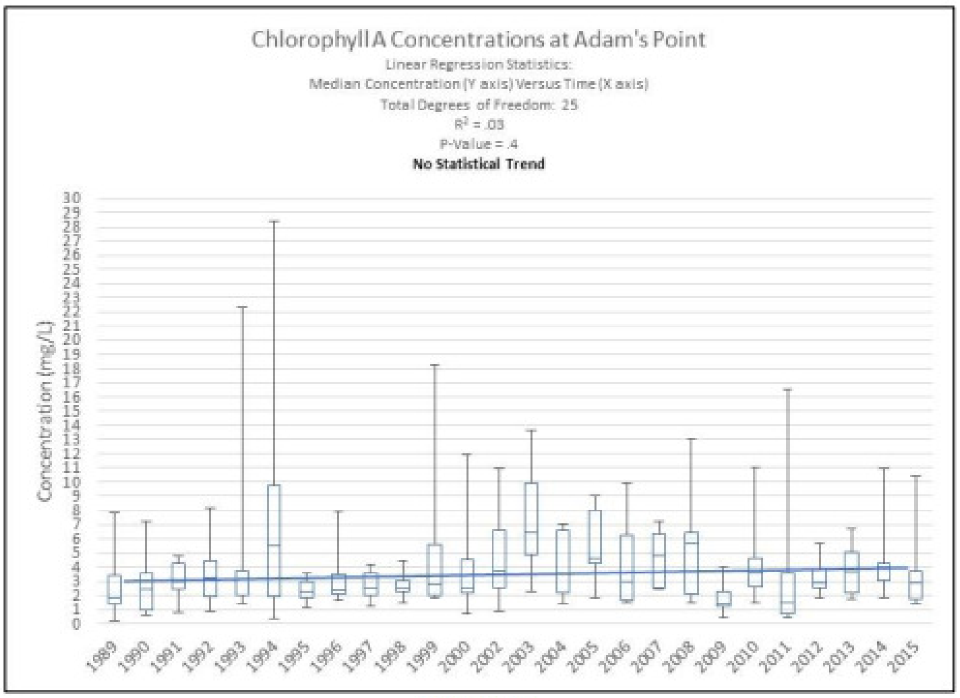


**Figure 4a**

Over this time period, the Kd measured in Great Bay has varied quite substantially (and always failed to meet the proposed Kd target DES proposes) (Figure 4b).

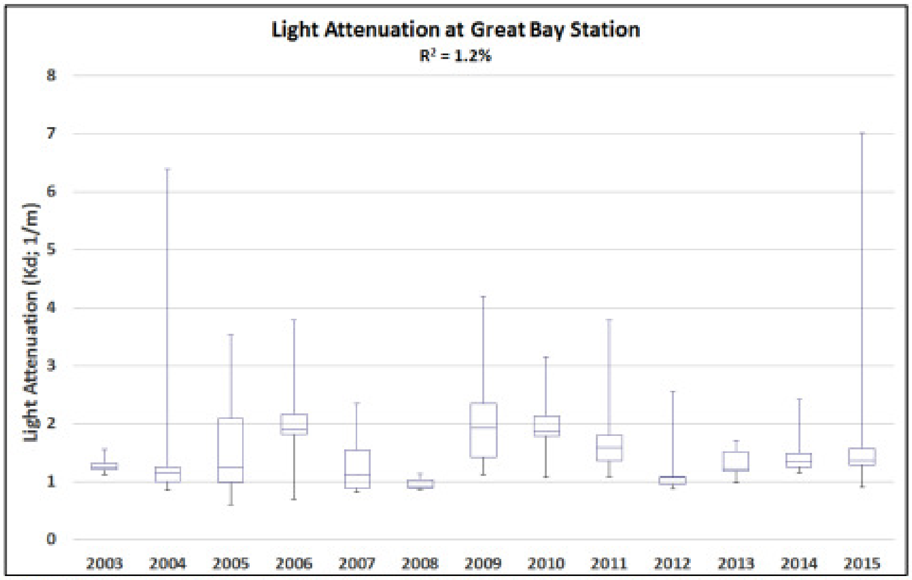


**Figure 4b: Box and whisker plot of monthly light attenuation sampling at low tide from 2003 through 2015, looking only at months April through December. The bottom of the boxes represent first quartile (where 25% of the data occur); the top of the box is the third quartile (where 75% of the data occur). The lower and upper 25% are represented by the "whiskers." The horizontal line in the box is the median and the round dot is the average. Note that 2008 only has data for the months August through October.**

This information confirms that chl-a is not a significant factor causing year to year growing season changes in water clarity. In fact, the factors contributing to light attenuation in the Great Bay Estuary have been scientifically evaluated. (See, Morrison et al. 2008). Morrison et al. (2008) determined that colored dissolved organic matter (CDOM), non-algal particulates (NAP), and the ambient water quality in the Gulf of Maine were the primary contributors to light attenuation, accounting for 88% of the overall attenuation. Moreover, all of these primary factors are natural conditions.

Finally, if the recent measurements of eelgrass cover are compared to the corresponding measurements of median monthly Kd at the Great Bay buoy, the results show that either eelgrass cover increases as water clarity decreases (contrary to the conceptual model) or there is no relationship between the two, even as light transmission increases by 200% (Figure 5).

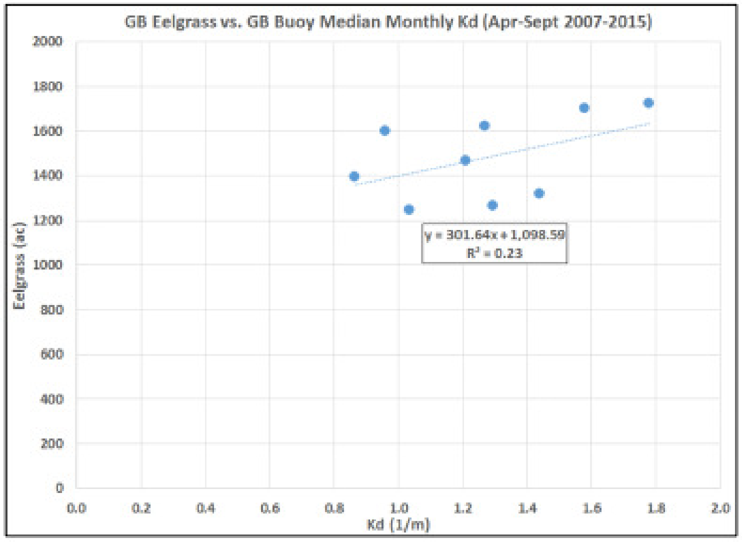


**Figure 5: Great Bay Eelgrass Cover vs. Great Bay Buoy Median Monthly Kd**

Higher Kd values represent greater light limitation. This indicates that, counter to the conceptual model, Great Bay eelgrass cover tends to increase with increasing light limitation, barring an extreme storm event of similar magnitude to the 2006 Mother's Day Storm. This further confirms that Great Bay eelgrass beds are not declining in response to an alleged light limitation in this system and therefore, Kd should be removed from Great Bay Estuary CALM assessments as it has no demonstrated relevance to Great Bay eelgrass cover in the range of 0.9- 1.8/m – well above the proposed 0.75/m indicator recommended in the draft CALM.

**d) Indicator 9d – Chl-a Concentration as Component of Water Clarity**

The CALM states that the impairment threshold for chl-a concentrations as a component of water clarity is "elevated" $90^{th}$ percentile chl-a concentrations (CALM at 71). The description of this indicator refers to Indicator 9b (Chlorophyll-a Concentration to Protect DO) as one calculation method in assessment method. However, the CALM leaves the choice of calculation method open-ended and does not limit it to the method used in Indicator 9b. "Elevated" chl-a is uncertain and subjective language and therefore must be clarified or removed from the CALM.

Studies of Great Bay Estuary have demonstrated that the predominant contributors to water column light attenuation are CDOM, NAP, and water itself – all natural conditions. (See, Morrison et al., 2008). The chl-a contribution to water clarity was calculated to be minor in comparison. Step 3 in the CALM's Process for Determining Waters that Belong on the 303(d) List states that: 7- 14

> exceedance of most water quality criteria due to naturally occurring conditions are allowed and are not considered violations of the water quality standards. Since such waters are not technically in violation of the standards, a TMDL is not necessary for waters impaired or threatened by naturally occurring sources. (CALM at 30).

The CALM also states that if the *primary* source is natural, the waterbody will not be considered impaired (CALM at 30). Given that 1) chl-a is not a primary or even secondary source of water column light attenuation and 2) the primary sources of water column light attenuation are naturally occurring conditions, this indicator should be removed from the CALM.

### e) Indicator 9e – Macroalgae

The CALM states that if macroalgae is documented at "little to no macrophyte growth," this indicates that the waterbody is potentially attaining standards (II-PAS). If "moderate to heavy macrophyte growth is documented," this is indicative of potentially not supporting standards (II-PNS) (CALM at 71).

The term macrophyte includes macroalgae, but not all macrophytes are macroalgae. For example, eelgrasses are classified as macrophytes but eelgrasses are not macroalgae. These terms should not be used interchangeably.

This indicator description acknowledges that "at this time there are no set break points for how much macrophyte growth is acceptable and how much is unacceptable." (CALM at 71). As such, this indicator cannot be used in impairment assessments or the CALM until an acceptable level threshold is identified and defined.

Furthermore, many types of macroalgae in Great Bay Estuary are invasive (*e.g.*, *Dasysiphonia japonica* and an invasive *Gracilaria* species) (*Monitoring Macroalgae in the Great Bay Estuary for 2015* (PREP, 2017)). The CALM states that "exotic non-native invasive species" are nonpollutants and "TMDLs are not required for waters impaired by nonpollutants." (CALM at 15). Thus, inclusion of this macroalgae indicator must account for whether the measured plant growth is an invasive species, excluding their presence from impairment assessments.

Lastly, the CALM implies that because macroalgae occur in areas of the estuary where eelgrass have, at times, been observed, the macroalgae must have displaced and replaced the eelgrass. This has never been demonstrated in Great Bay Estuary – and, in fact, the opposite has been repeatedly demonstrated where eelgrasses have recolonized areas after the Mother's Day Storm and 1988 wasting disease event. Recent studies by researchers at UNH have determined that macroalgae are most common in intertidal areas of Great Bay that do not serve as eelgrass habitat. Depending upon the time of year and location, such growth may be robust. However, such sporadic conditions do not mean eelgrass growth was significantly affected. In addition, based on photographic evidence from deeper waters, eelgrass and macroalgae appear to coexist, with macroalgae and eelgrass occupying the same areas, year after year, in a successional pattern without macroalgae preventing eelgrass from repopulating an area. (See, SeagrassNet studies conducted by Dr. Fred Short). **7- 15**

In conclusion, asserting that "little to no macrophyte growth" may exist to have a healthy estuarine system is not based on any scientifically defensible information (in general or, as required, site-specific). Macroalgae have always existed in this system, subject to changing species and timing at the different locations suiting their growth needs. Consequently, the mere presence of macroalgae, even in areas with eelgrass growth, is not sufficient cause to claim that an area is not achieving designated uses or that the eelgrass habitat is significantly impaired. DES is required to demonstrate that macroalgae, if present, are a significant factor causing the loss of eelgrass (See, 40 C.F.R. § 122.44(d) and State Law) and that their occurrence is not natural or invasive. Consequently, the assumption that the mere existence of some undefined "moderate to heavy" macroalgae growth constitutes system impairment must be deleted.

### 4. Indicator 9f – Epiphytes

The CALM states that if epiphytes are documented at "little to no epiphytic growth," this indicates that the waterbody is potentially attaining standards (II-PAS). If "moderate to heavy epiphytic growth is documented," this is indicative of potentially not supporting standards (II-PNS) (CALM at 71). The CALM claims that excess nutrients can stimulate elevated epiphytic growth which can reduce light available for photosynthesis on eelgrass leaf blades and reduce benthic DO, thereby adversely affecting aquatic organisms. However, the CALM also acknowledges that "[a]t this time there are no set break points for how much macrophyte growth is acceptable and how much is unacceptable" and "some macrophyte growth in the absence of other stressors may be just fine […]." (CALM at 71-72).

Epiphytes, in this context, refer to planktonic accumulations on eelgrass blades. The term macrophytes includes epiphytes, but not all macrophytes are epiphytes; these terms should not be used interchangeably. The claim that "it is clear that exiting [sic] macrophyte growth exist in places where eelgrass once existed," appears to indicate that DES inaccurately intends "macrophyte" to be equivalent to "epiphyte" (CALM at 71). Suggesting that epiphytes replaced eelgrass beds is misplaced – eelgrass are adversely affected by epiphytes primarily by excess accumulations on leaf blades precluding healthy photosynthetic activity in eelgrass (*i.e.*, epiphytes cannot be adversely affecting eelgrass if they are not accumulating on eelgrass). Moreover, this claim that "little to no epiphytic growth," must exist to protect eelgrass health is undocumented, and, for all practical purposes, impossible to achieve in this natural system. Dr. Short recently informed PREP that epiphytes are not a problem in Great Bay (grazers control them), while they occur extensively in the harbor area (where TN is at background levels). Consequently, it is apparent that the presence or absence of epiphytes is not being controlled by nutrients in this system. Consequently, this requirement for "little or no" epiphytic growth should be removed from the CALM. **7- 16**

Finally, the CALM itself acknowledges the absence of a quantified threshold or range for excess epiphytic accumulations on eelgrass. This introduces an unacceptable level of subjectivity in such assessments. Until an excess level is identified, epiphytes should be removed as an excess nutrient indicator.

### 5. Indicator 9g – Eelgrass Cover

This indicator references the eelgrass cover assessment methodology in Indicator 8 (CALM at 72). This indicator provides that uses are not supported if declines in eelgrass cover from historic levels exceed 20% or if an evaluation of recent trends in the eelgrass cover indicator show a 20% loss in the indicator, based on a linear regression of eelgrass cover versus year. The CALM further provides that NHDES may also consider trends in eelgrass biomass as supplemental information. NHDES may also consider published reports about the proliferation of macroalgae and its impact on eelgrass. **7- 17**

### a) Eelgrass Declines Due to Natural Conditions

It is well known that eelgrass cover in the estuary has been affected by wasting disease.[5] Specifically, most of the eelgrass in North America and Europe was decimated by an outbreak of wasting disease, caused by the slime mold, *Labyrinthula zostera*, in 1931 – 1932. Based on the historical record, it took decades for eelgrass recovery in the Great Bay Estuary. Wasting disease again decimated the eelgrass population in Great Bay in 1988 – 1989, causing an 85% reduction in eelgrass cover. A small wasting disease outbreak was reported in 1995, and additional outbreaks of wasting disease were reported in 1999 – 2000 and 2002 – 2003. Wasting disease is a natural condition that adversely affects eelgrass cover. The plot evaluating trends in eelgrass cover must remove incidences of wasting disease from the assessment because natural conditions are not regulated under either state or federal law.

Eelgrass cover is also affected by other natural phenomena. One such phenomenon is severe storm events. Significant increases in precipitation and flooding, particularly immediately prior to or during the growing season, has been identified as a primary driver of seagrass loss and inter-annual variability in Chesapeake Bay and other estuaries (Wang and Linker, 2005).[6] One such event occurred in this system in 2006. From May 11-15, 2006, an extreme storm produced 14 in. of precipitation that resulted in regional flooding around Great Bay Estuary. The return frequency of this storm caused exceedances of the 100-year peak stream flow at most stream gages around Great Bay Estuary.[7]

Prior to the 2006 Mother's Day Storm, eelgrass cover throughout Great Bay was extensive and well above the "impairment" threshold. Following the storm, cover measured at the end of the growing season showed significant losses in eelgrass cover, particularly in the areas adjacent to the major tributaries (*i.e.*, Lamprey River, Squamscott River, Winnicut River), which conveyed the excess flow to the Bay. This is clearly illustrated in Figure 6. Figure 6 illustrates eelgrass cover in Great Bay for 2004, 2005, and 2006. Measured eelgrass cover for 2006 is illustrated in green overlying the measured eelgrass cover for 2004 and 2005, illustrated in black. The black areas represent the areas where measurable eelgrass cover was lost in 2006 compared with the previous two years. This flood is the obvious cause of the change and is a natural condition.

Prior to the 2006 Mother's Day Storm, measurable eelgrass cover in Great Bay averaged 2,285 acres, with small inter-annual shifts in location. Following 2006 through 2013, measurable eelgrass cover never returned to several areas of the bay that previously continually supported eelgrass cover (See, Figure 7; red circles illustrate areas that used to support measurable eelgrass cover prior to 2006), and measurable eelgrass cover has only averaged 1,473 acres during the period from 2006 - 2016. The areas that still lack measurable eelgrass cover exceed 300 acres. The fact that measurable eelgrass cover has not returned to these areas in eight continuous years of record (with much better water clarity from 2011-2016) suggests that these areas no longer provide suitable habitat for eelgrass growth. This should be evident given that eelgrass cover rebounded by 1,700 acres in 1990 (from about 300 acres to 2,000 acres) from the wasting disease

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[5] See, Methodology and Assessment Results related to Eelgrass and Nitrogen I the Great Bay Estuary for Compliance with Water Quality Standards for the New Hampshire 2008 Section 303(d) List. NHDES. August 11, 2008, at 8 – 15 for a detailed history of eelgrass cover and the effects of wasting disease in the Great Bay Estuary.
[6] Wang, P. & Linker, L.C. 2005. Effect of timing of extreme storms on Chesapeake Bay submerged aquatic vegetation. Hurricane Isabel in perspective. CRC Publication 05-160: 177–184.
[7] Olson, S.A., 2007, Flood of May 2006 in New Hampshire: USGS Open-File Report 2007.

event. Eelgrass have a tremendous potential to repopulate areas via seed dispersal, as evidenced in 1990. Since a much greater population of eelgrass (approximately 1,500 acres) has been unable to re-establish eelgrass cover in these regions, the only plausible explanation is that the habitat no longer supports their growth. The CALM considers habitat degradation to be a non-pollutant cause of impairment and a natural condition.

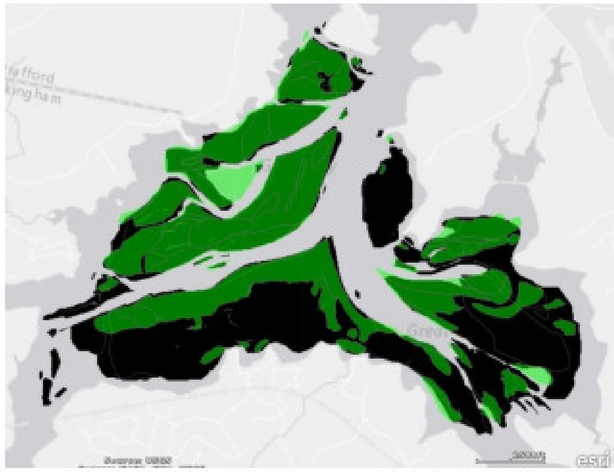

**Figure 6 – Eelgrass cover in Great Bay before and after the 2006 Mother's Day Storm**

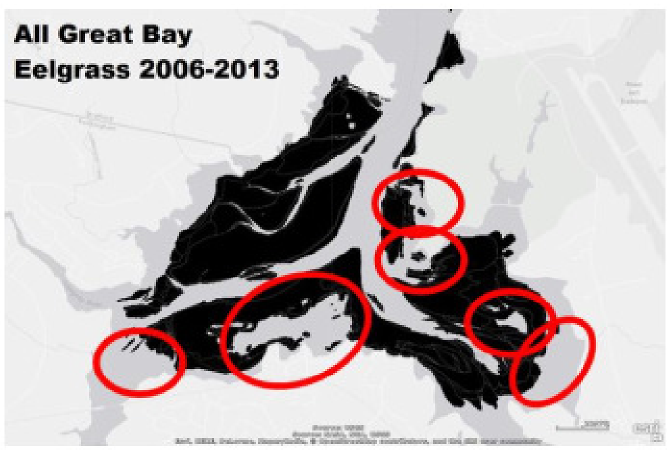


**Figure 7 – Areas in Great Bay that no longer support eelgrass cover since 2006**

If the eelgrass cover data illustrated in the TSD on page 38 are replotted to eliminate years of known wasting disease, and separated into periods prior to the 2006 Mother's Day Storm and after the storm, we find that eelgrass cover was stable prior to the storm and after the storm (Figure 8). However, after the storm the eelgrass cover supported by the bay was reduced in comparison with the amount of eelgrass cover observed before the storm. This change, like the major wasting disease events, occurred over the course of one growing season (2006) and has resulted in a stable amount of growth at a level approximately 30% lower than previously observed.

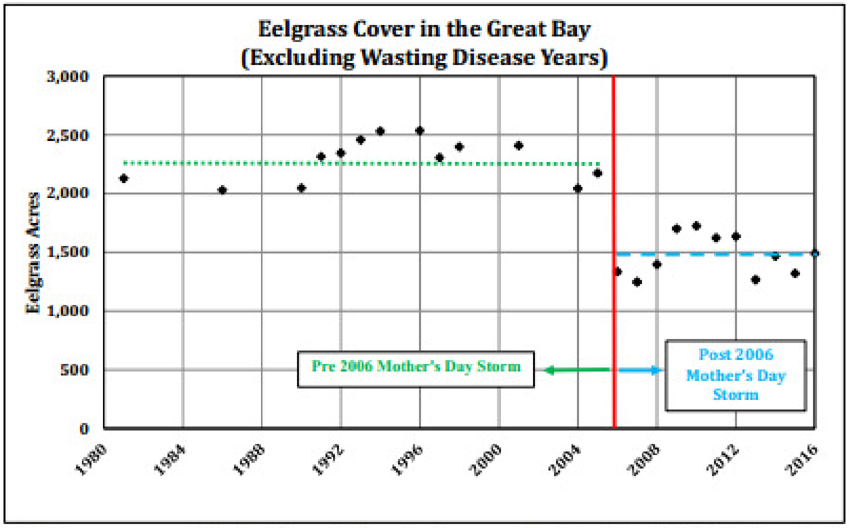


**Figure 8 – Eelgrass cover in the Great Bay before and after the 2006 Mother's Day Storm**

Eelgrass cover remained stable at all depths of growth prior to and following the 2006 Mother's Day Storm event. NHDES prepared an evaluation of eelgrass cover sorted by water depth below mean tide level for the period from 1981 through 2014 using the same data presented in the TSD. These data are illustrated in Figure 9a for the period prior to the 2006 Mother's Day Storm (1981 – 2005) and in Figure 9b for the period following the 2006 Mother's Day Storm (2006 – 2014). These data show that eelgrass loss occurred at all depths. Moreover, on either side of the event, eelgrass cover has remained relatively stable for an extended period of time (13 years before 2006 and 11 years since 2006).

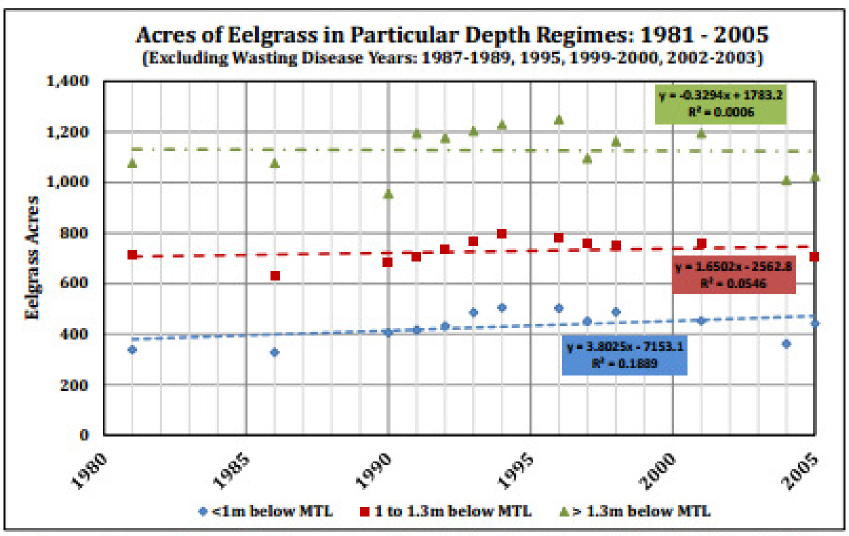


**Figure 9a – Eelgrass Cover by Depth in the Great Bay (1981 – 2005)**

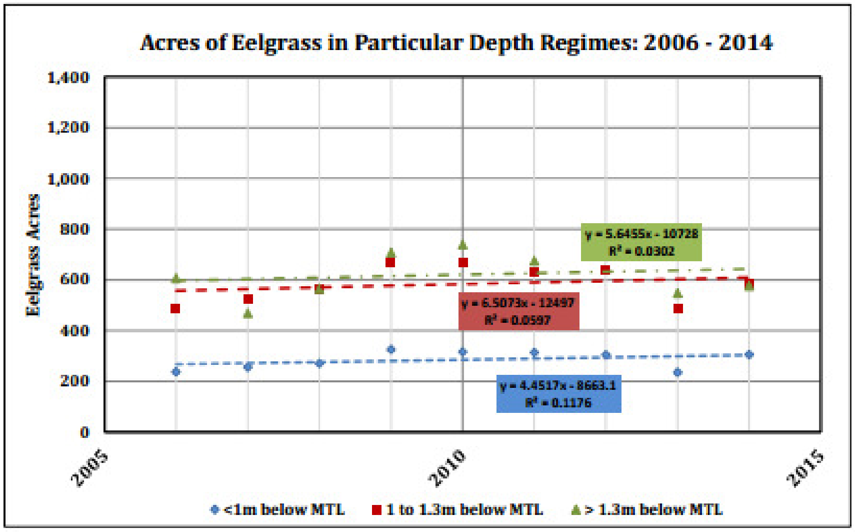


**Figure 9b – Eelgrass Cover by Depth in the Great Bay (2006 – 2014)**

Based on the observations presented above, the instantaneous shift in eelgrass cover in Great Bay beginning in 2006 was caused by natural conditions and do not represent an impairment of the estuarine bioassessment metric. As illustrated in Figure 8, the conditions that occurred in 2006 caused a reduction in total eelgrass cover in Great Bay and those conditions continue to persist today, unrelated to any other change in water quality, and despite major reductions in nitrogen and improved water clarity due to lower rainfall conditions.

The CALM states that:

> exceedance of most water quality criteria due to naturally occurring conditions are allowed and are not considered violations of the water quality standards. Since such waters are not technically in violation of the standards, a TMDL is not necessary for waters impaired or threatened by naturally occurring sources. (CALM at 30).

Based on the available information for the system, the primary causes of the eelgrass declines have been "naturally occurring conditions." As such, Great Bay should not be categorized as impaired for eelgrass in accordance with the CALM.

### b) Eelgrass Cover Reliability

Since 1986, annual eelgrass cover in Great Bay Estuary has been calculated from single day aerial photos taken at 3000 ft at low spring tide between late August and early September.[8] From 1986 to around 2009, the photos were taken using a 35 mm camera while more recent surveys have used digital photography. Eelgrass beds with >10% cover are delineated and mapped based on the photos. Approximately 10-20% of the mapped eelgrass beds are ground-truthed by small

7- 18

[8] Short, Frederick T. and Trowbridge, Phil, "UNH Eelgrass (Zostera marina) Monitoring Program for 2010-2014: Quality Assurance Project Plan" (2010). PREP Publications. Paper 350. http://scholars.unh.edu/prep/350

boat to confirm accuracy and most of the ground-truth evaluations have focused on delineating the deep edge of eelgrass beds adjacent to the central channels in the bay.

The US Army Corps of Engineers notes that "[i]t is not possible to reliably distinguish between eelgrass and macroalgae, or between different species of eelgrass or other seagrasses, using aerial imagery. Aerial photography is also likely to underestimate eelgrass coverage because eelgrass occurring in deeper waters can appear dark and may not be detected."[9] This calls into question the accuracy and reliability of the Great Bay Estuary eelgrass measurements. Moreover, the aerial photos from which the eelgrass cover is calculated have never been made publicly available, despite repeated requests by the Great Bay Municipal Coalition. As a critical component in determining the condition of eelgrass in the estuary and WQS attainment, these photos must be made available for public review to ascertain the accuracy and reliability of the eelgrass measurements if they are to be used in any impairment assessment.

Furthermore, as noted earlier, the timing of peak eelgrass cover varies over growing season from year to year. Thus, it is inaccurate to report a single day measurement as definitively the annual peak cover or to make comparisons between years. Dr. Fred Short's SeagrassNet eelgrass measurements confirm this observation.[10] Based on SeagrassNet eelgrass cover data in Great Bay, annual peak cover can occur anytime between July and October. Therefore, a late August to early September snapshot of eelgrass cover should be assessed as neither an annual maximum nor a necessarily accurate representation of eelgrass cover and condition for the year, especially given the potential regulatory implications of eelgrass impairment assessments based solely on these measurements.

[9] US Army Corps of Engineers. May 27, 2016. Components of a Complete Eelgrass Delineation and Characterization Report. http://www.nws.usace.army.mil/Portals/27/docs/regulatory/Forms/Components%20of%20Eelgrass%20Delineation%205-27-16.pdf?ver=2016-05-27-131522-740

[10] SeagrassNet. New Hampshire / Great Bay, USA in Temperate North Atlantic, Percent Cover. http://www.seagrassnet.org/percentcover/NH9.2

### c) Evaluating Trends in Biomass

As noted earlier, the CALM (at 67 – 68) provides that NHDES may also consider trends in eelgrass biomass, with biomass calculated by multiplying the eelgrass area by the eelgrass density (PREP, 2012). The relationship between eelgrass biomass and eelgrass density, as provided in PREP (2012), was originally provided to PREP by Dr. Fred Short (UNH), but these relationships have never been verified and the data upon which they were based have been lost by Dr. Short. Dr. Short and the UNH Seagrass Ecology Group generated the eelgrass percent cover and biomass were previously presented in Table 1. This relationship indicates an order of magnitude increase in biomass when eelgrass percent cover increases from the 10-30% range to 90-100%. Increasing eelgrass percent cover from the 60-90% range to 90-100% range reportedly results in a corresponding threefold biomass increase.

This relationship provided by Dr. Short varies significantly from relationships published in peer reviewed scientific journals. Carstensen et al. (2016) report that instead of a steep increase in 7- 19

biomass corresponding to percent cover increases, eelgrass biomass levels off as percent cover increases above roughly 25%, largely due to self-shading.[11]

This is relationship was developed using real, recorded eelgrass data and a reproducible scientific method as opposed to Dr. Short's cover-biomass relationship which has never been peer-reviewed or assessed for accuracy. The CALM should not use biomass in eelgrass impairment assessments until, at a minimum, an eelgrass cover-biomass scientifically defensibly relationship is developed and peer-reviewed.

[11] Carstensen, J., D. Krause-Jensen, T.J.S. Balsby. 2016. Biomass-Cover Relationship for Eelgrass Meadows. Estuaries and Coasts, 39:440-450.

### 6. Indicator 9h – Calculation of Total Nitrogen Concentration Indicator

The data requirements for this indicator instruct that median TN concentrations are to be calculated using data from all four seasons. However, TN, in general, is only a potential aquatic life concern when it stimulates excessive plant growth that adversely affects DO concentrations or reduces water clarity for eelgrass photosynthetic activity. In the winter, algal productivity is greatly depressed and eelgrass does not grow. As such, taking into account TN concentrations during this time is irrelevant and scientifically indefensible. This data requirement should be revised to exclude non-growing season time periods (*e.g.*, October to March). **7- 20**

### 7. Indicator 9i – Final Total Nitrogen Concentration Indicator

Based on the information presented above, there is no scientifically defensible basis for asserting that TN causes use impairments in Great Bay Estuary.

## E. REQUESTED ACTIONS

- Delete light extinction coefficient (Kd) as an impairment listing factor
- Delete eelgrass cover and acreage as an impairment listing factor **7- 21**
- Delete presumptions on TN as cause of impairment for eelgrass, light extinction, or DO
- Implement proper application of dissolved oxygen water quality standard (*e.g.*, representative water column sample using appropriate averaging periods)

ATTACHMENTS PROVIDED ON THE NHDES FTP SITE AS DESCRIBED IN THE INTRODUCTION. **7- 22**

**COMMENT #8: John B Storer, City of Rochester**

*City of Rochester, New Hampshire*
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July 12, 2017

VIA EMAIL (kenneth.edwardson@des.nh.gov)
and FIRST CLASS MAIL

Kenneth Edwardson
New Hampshire Department of Environmental Services
Watershed Management Bureau
29 Hazen Drive, P.O. Box 95
Concord, New Hampshire 03302-0095

RE: Supplement to the City of Rochester's
Comments on DES's draft 2016 CALM and 303(d) List

Dear Mr. Edwardson:

I am writing to supplement the City of Rochester's June 23, 2017 comments regarding the Department of Environmental Services' ("DES") draft CALM and 303(d) list. In the City's June 23, 2017 letter, we raised a concern that the draft CALM and 303(d) list failed to incorporate the Legislature's directives as expressed in Senate Bill 127 (2017) ("SB 127"). At the time Rochester submitted its comments, both bodies of the Legislature had passed SB 127, but the Governor had not yet signed it. Subsequent to the closing of the comment period for the CALM and 303(d) list, on July 10, 2017 Governor Sununu signed into law Senate Bill 127. Specifically, SB 127 removes the percent saturation standard from the statute; requires DES to adopt DO water quality standards consistent with EPA guidance and other scientific criteria; prevents DES from calculating nutrient discharge limits based on 7Q10; and specifically requires DES to adopt rules relative to DO for tidal and saline waters consistent with EPA guidance and other scientific criteria. A copy of the new law is attached to this letter. **8- 1**

Now that the bill has been signed by the Governor, and in addition to the comments presented in its June 23, 2017 letter, the City supplements its comments with the updated status of SB 127 and reiterates its request that DES amend the draft CALM and revise the draft 303(d) in a manner that complies with the Legislature's directives described in the law. The new legislation requires that DES's water quality standards be "consistent" with EPA's DO criteria documents and other relevant scientific information. As is described in Brown and Caldwell's analysis attached to the City's June 23rd letter, the current draft CALM and 303(d) list are not consistent with EPA's criteria or other scientific information. Accordingly, they should be revised to reflect the new regulatory directive.

Thank you.

Sincerely,

John B. Storer

John B. Storer, Director of City Services

Enclosure: Senate Bill 127

8- 2

## SB 127 - VERSION ADOPTED BY BOTH BODIES

02/09/2017 0277s
1Jun2017... 1089h
06/08/2017 2348EBA

2017 SESSION

17-0953
08/01

SENATE BILL ***127***

AN ACT relative to dissolved oxygen water quality standards.

SPONSORS: Sen. Gray, Dist 6; Sen. Watters, Dist 4

COMMITTEE: Energy and Natural Resources

---

AMENDED ANALYSIS

This bill defines 7Q10 flows for the purpose of classification of waters.

This bill also authorizes the department of environmental services to make rules regarding dissolved oxygen water quality standards and water quality standards consistent with the Clean Water Act.

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Explanation: Matter added to current law appears in ***bold italics.***
Matter removed from current law appears [~~in brackets and struckthrough.~~]
Matter which is either (a) all new or (b) repealed and reenacted appears in regular type.

**SB 127 - VERSION ADOPTED BY BOTH BODIES**

02/09/2017 0277s
1Jun2017... 1089h
06/08/2017 2348EBA

17-0953
08/01

STATE OF NEW HAMPSHIRE

*In the Year of Our Lord Two Thousand Seventeen*

AN ACT relative to dissolved oxygen water quality standards.

*Be it Enacted by the Senate and House of Representatives in General Court convened:*

1 New Paragraph; Definitions; 7Q10. Amend RSA 485-A:2 by inserting after paragraph XXIII the following new paragraph:

XXIV. "7Q10" means the lowest average flow that occurs for 7 consecutive days on an annual basis with a recurrence interval of once in 10 years on average, expressed in terms of volume per time period.

2 Dissolved Oxygen; Surface Waters of the State. Amend RSA 485-A:8, II to read as follows:

II. Class B waters shall be of the second highest quality and shall have no objectionable physical characteristics[~~, shall contain a dissolved oxygen content of at least 75 percent of saturation,~~] and shall contain not more than either a geometric mean based on at least 3 samples obtained over a 60-day period of 126 Escherichia coli per 100 milliliters, or greater than 406 Escherichia coli per 100 milliliters in any one sample; and for designated beach areas shall contain not more than a geometric mean based on at least 3 samples obtained over a 60-day period of 47 Escherichia coli per 100 milliliters, or 88 Escherichia coli per 100 milliliters in any one sample; unless naturally occurring. There shall be no disposal of sewage or waste into said waters except those which have received adequate treatment to prevent the lowering of the biological, physical, chemical or bacteriological characteristics below those given above, nor shall such disposal of sewage or waste be inimical to aquatic life or to the maintenance of aquatic life in said receiving waters. The pH range for said waters shall be 6.5 to 8.0 except when due to natural causes. ***The commissioner shall adopt rules, under RSA 541-A, relative to dissolved oxygen water quality standards in a manner consistent with Environmental Protection Agency guidance on dissolved oxygen water criteria published pursuant to section 304(a) of the Clean Water Act, and other relevant scientific information.*** Any stream temperature increase associated with the discharge of treated sewage, waste or cooling water, water diversions, or releases shall not be such as to appreciably interfere with the uses assigned to this class. The waters of this classification shall be considered as being acceptable for fishing, swimming and other recreational purposes and, after adequate treatment, for use as water supplies. Where it is demonstrated to the satisfaction of the department that the class B criteria cannot reasonably be met in certain surface waters at all times as a result of combined sewer overflow events, temporary partial use areas shall be established by rules adopted under RSA 485-A:6, XI-c, which meet, as a minimum, the standards specified in paragraph III. ***The commissioner shall not calculate nutrient discharge limits for aquatic life and human health criteria based on 7Q10 flow or such other flow criteria more restrictive than 7Q10.***

***II-a. The commissioner shall adopt rules, under RSA 541-A, relative to dissolved oxygen water quality standards for tidal and saline waters in a manner consistent with Environmental Protection Agency guidance on dissolved oxygen water criteria published pursuant to section 304(a) of the Clean Water Act, and other relevant scientific information.***

3 New Paragraphs; Rulemaking; Dissolved Oxygen Concentration Water Quality Standards. Amend RSA 485-A:6 by inserting after paragraph XIII the following new paragraphs:

XIV. Dissolved oxygen concentration water quality standards under RSA 485-A:8, II and II-a.

XV. Water quality standards consistent with RSA 485-A:8 and as required by the Clean Water Act.

4 Effective Date. This act shall take effect 60 days after its passage.