**STATE OF NEW HAMPSHIRE** 

# Technical Support Document for the Great Bay Estuary Aquatic Life Integrity Designated Use Assessments, 2020/2022 305(b) Report/303(d) List

February 18, 2022



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### **Table of Contents**

Introduction	4
Estuary Assessment Zones	5
Eelgrass Mapping	6
Water Quality Data	7
Assessment Zone Data Summaries	8
Aquatic Life Integrity Designated Use Assessment Summary Table	
Assessment Zone = SQUAMSCOTT RIVER SOUTH	13
Assessment Zone = SQUAMSCOTT RIVER NORTH	
Assessment Zone = LAMPREY RIVER NORTH	26
Assessment Zone = LAMPREY RIVER SOUTH	31
Assessment Zone = WINNICUT RIVER	
Assessment Zone = GREAT BAY	44
Assessment Zone = OYSTER RIVER	58
Assessment Zone = BELLAMY RIVER	65
Assessment Zone = LITTLE BAY	72
Assessment Zone = COCHECO RIVER	79
Assessment Zone = SALMON FALLS RIVER	86
Assessment Zone = UPPER PISCATAQUA RIVER	91
Assessment Zone = LOWER PISCATAQUA RIVER - NORTH	98
Assessment Zone = LOWER PISCATAQUA RIVER - SOUTH	
Assessment Zone = NORTH MILL POND	
Assessment Zone = SOUTH MILL POND	
Assessment Zone = PORTSMOUTH HARBOR	
Assessment Zone = SAGAMORE CREEK	
Assessment Zone = LITTLE HARBOR/BACK CHANNEL	
References	

#### Introduction

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

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

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

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

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

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

#### Env-Wq 1703.14

(b) Class B waters shall contain no phosphorus or nitrogen in such concentrations that would impair any existing or designated uses, unless naturally occurring.

#### Env-Wq 1703.19

(a) The surface waters shall support and maintain a balanced, integrated, and adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of similar natural habitats of a region.

(b) Differences from naturally occurring conditions shall be limited to non-detrimental differences in community structure and function.

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

On January 17, 2020 NHDES withdrew from further consideration the following assessment zones, and their respective parameters, from the 2018 303(d) list: Little Bay, Bellamy River, Upper Piscataqua River, Portsmouth Harbor, Little Harbor/Back Channel and Great Bay assessment zones (NHDES, January 17, 2020). As such, for those assessment zones, the 2020/2022 assessment represents and update to the 2016 surface water quality assessments.

#### **Estuary Assessment Zones**

For 305(b)/303(d) assessments, NHDES uses 43 assessment units to cover the Great Bay estuary that are coincident with the shellfish growing areas established by the NHDES Shellfish Program. Great Bay itself consists of seven different assessment units. Nitrogen and eutrophication parameters are logically evaluated utilizing data from larger aggregates of assessment units covering contiguous areas. Eutrophication effects are less localized than the bacteria pollution sources that affect shellfish harvesting. Therefore, NHDES aggregated the 43 assessment units in the Great Bay estuary into 19 assessment zones. The boundaries of each of the aggregated assessment zones are shown in Figure 1. For the purposes of 305(b)/303(d) reporting, the categories assigned to these larger assessment zones will be assigned to each of the assessment units comprising the assessment zone. For the Salmon Falls/Piscataqua River, the assessment zones cover both the New Hampshire and Maine sides of the main stem of the river in order to select data from both sides of the river. The river is well-mixed and data from both sides of the State-line are needed to provide a comprehensive dataset for assessments.

However, the impairment determinations made by NHDES only apply to the New Hampshire side of the river. The Maine Department of Environmental Protection makes its own assessment determinations for the Maine side of the Salmon Falls/Piscataqua River. No changes have been made to the composition or locations of assessment zones between the 2016-2018 and 2020/2022 reporting cycles.

Figure 1. Great Bay estuary assessment zones for the 2020/2022 305(b)/303(d) aquatic life integrity designated use assessments.



#### **Eelgrass Mapping**

In 2013, eelgrass was mapped in the Great Bay estuary using two different sets of aerial imagery. As has been done since 1996, UNH (Dr. Fred Short) mapped eelgrass using low-altitude, oblique aerial

photographs, while in 2013, 2016, 2017, and 2019, Seth Barker used high resolution vertical aerial imagery collected by Cornerstone Energy Services (formerly Kappa Mapping Inc.). Eelgrass extent was independently mapped using both sets of imagery in 2013. These concurrent datasets were obtained as a way to evaluate each of the methodologies. For assessment purposes, NHDES took an average of the eelgrass mapped by UNH and Cornerstone/Barker in the years where both mappers produced datasets. Eelgrass was not mapped in 2018. As such, 2016, 2017 and 2019 were used to calculate recent the 3-year median for historic acreage comparisons.

#### Water Quality Data

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

- The base dataset that is considered "current" data for the 2020/2022 assessments are the measurements collected on or after January 1, 2014, that were incorporated in the NHDES Environmental Monitoring Database (EMD) by January 10, 2020. For nutrients and most estuarine samples this generally meant data collected through the end of 2018. To enhance the ability to look across cycles and into more historic data the Supplemental Assessment Database (SADB) minimum date age was set to January 1, 1990.
- 2. The data were pulled from the EMD into the SADB by an automated query. Some of the conditions on the query were:
  - a. Results marked as invalid were carried forward but marked as not to be used in the final summaries.
  - b. Results marked as Below Detection Limits (BDL) were assigned a value of one-half the Method Detection Limit (MDL). There are two limited cases of high detection limits where this was not followed as to not introduce bias; 1) where ammonia samples were BDL and the MDL was greater than or equal to 200 µg/L, and 2) where total Kjeldahl nitrogen samples were BDL and the MDL was greater than or equal to 500 µg/L. [Also note: Regarding BDLs, in the nutrient criteria report, NHDES used the MDL for BDLs. In the bulk query, the adjusted value is reported as 1/2 the MDL. PREP has used 1/2 MDL for BDLs for trends in "modern" datasets. Therefore, for the 2020/2022 assessments, NHDES will apply the 1/2 MDL approach for consistency across datasets.]
  - c. Quality assurance samples were excluded. This condition removed field duplicate samples. [Note: QA samples: In the nutrient criteria report, NHDES averaged field duplicate results. In the bulk data pull for the 305(b)/303(d) assessment, field duplicates were excluded to have consistency between eutrophication assessment methods and other DES assessments methods. PREP had included replicates in the past but as of 2014 the TAC decided to not include QA samples to be

consistent across datasets. Therefore, since the 2012 assessments, NHDES has excluded QA replicate samples for consistency.]

#### Assessment Zone Data Summaries

Plot Legend and Summary Table Abbreviations

In the assessment zone summaries that follow, all available data from January 1, 2000, to January 10, 2020, are displayed in the data plots for context (except eelgrass cover which is plotted back to 1990 along with all available light attenuation data). Summary statistics in the data tables cover the period from January 1, 2014, to January 10, 2020. For nutrients and most estuarine samples this generally meant data collected through 2018. The legend for a given attribute only contains text for those parameters that have data available since the year 2000. The full comparison codes for the samples are predominantly those from the SADB and were used within the legend of the graphs and tables for brevity. The descriptions for those codes are provided below. For total nitrogen, total suspended solids and light attenuation coefficient, in cases where multiple samples were collected on a single day from a given station, those samples were averaged for the day for use in the plots and data tables. For chlorophyll-a the highest concentration for a day is used.

- Chlorophyll-a
  - CHLOROPHYLL A, CORRECTED FOR PHEOPHYTIN The majority of the chlorophyll-a in the marine environment has been processed with the correction for pheophytin.
  - CHLOROPHYLL A, UNCORRECTED FOR PHEOPHYTIN In a few cases samples the chlorophyll-a in the marine environment has been processed without the correction for pheophytin.
  - CHLOROPHYLL A, combined In those cases where both corrected and uncorrected chlorophyll-a have been collected, the statistics for the combined measurements are provided.
  - Annual 90<sup>th</sup> Percentile ( $n \ge 5$ ) Plots only.
  - Daily 10th/90th Percentile Devalidated Logger data Plots only.
- Dissolved Oxygen Concentration
  - DO-PPM-24HR-MIN-CP = 24-hour minimum dissolved oxygen concentration from a datalogger deployed during the summer critical period.
  - DO-PPM-24HR-MIN-NCP = 24-hour minimum dissolved oxygen concentration from a datalogger not deployed during the summer critical period.
  - DO-PPM-GRAB-CP = Grab samples of dissolved oxygen concentration during the summer critical period.
  - DO-PPM-GRAB-NCP = Grab samples of dissolved oxygen concentration during the summer critical period.
- Dissolved Oxygen Percent Saturation
  - DO-PERC-24H-MEAN-CP = 24-hour average dissolved oxygen percent saturation from a datalogger deployed during the summer critical period.

- DO-PERC-24H-MEAN-NCP = 24-hour average dissolved oxygen percent saturation from a datalogger not deployed during the summer critical period.
- DO-PERC-2TIDE-GRAB-CP = The average to two grab samples for dissolved oxygen percent saturation, one at high tide and one at low tide of a single day, during the summer critical period.
- DO-PERC-2TIDE-GRAB-NCP = The average to two grab samples for dissolved oxygen percent saturation, one at high tide and one at low tide of a single day, not during the summer critical period.
- DO-PERC-GRAB (% sat) = Dissolved oxygen percent saturation grab samples not used in a high tide-low tide average.
- Total Suspended Solids (TSS)
  - TSS Total Suspended Solids
  - Annual Median (n>=5) Plots only
- Light Attenuation Coefficient (Water Clarity)
  - Light Attenuation Coefficient A measurement of the light attenuation coefficient, Kd.
  - Annual Median (n>=5) Plots only
- Eelgrass and Light Attenuation Coefficient (Water Clarity)
  - Eelgrass cover acres Plots only
  - Light Attenuation Coefficient A measurement of the light attenuation coefficient, Kd.
  - Annual Median Light Attenuation Coefficient (n>=5) Plots only
- Nitrogen Graphics within this document plot the primary measure of total productivity within the system, total nitrogen (TN), while the tables provide the statistics for TN and individual fractions of nitrogen. In most cases, there was one sample collected at a given station per day. Where multiple samples were collected at a particular station on a single day, those samples for multiple times and/or depths were averaged and then processed as described in the sections above.
  - Day Ave of TN Total Nitrogen

If multiple values of TN are available for the same date / time / station, the hierarchy is 1 over 2 over 3.

- 1. If total dissolved nitrogen and particulate nitrogen were measured, sum these two values.
- 2. If TN was measured directly, use that value.
- 3. If total Kjeldahl nitrogen and nitrate+nitrite were measured, sum these two values.
- Annual Median (n>=5) Plots only
- Annual Median (n<5) Plots only
- Day Ave of TDN Total Dissolved Nitrogen
- Day Ave of DIN (NH3 + NO2/3) Dissolved Inorganic Nitrogen
- Day Ave of NH3 Ammonia
- Day Ave of PON Particulate Organic Nitrogen
- Day Ave of NO2/3 Nitrite/Nitrate

- Turbidity (data tables only) While both grab samples and datalogger records exist for turbidity, daily statistics make up 98% of the record. As such, the table provides summary statistics on the two data types (grab samples and daily medians) as a single group.
- Colored Dissolved Organic Matter (CDOM) (data tables only) Summary statistics are provided based on the currently available CDOM data.
- Salinity (data tables only)
  - o Grab Samples
  - Datalogger Daily Median
- Plot Reference Lines
  - "Current" Line for 2020/2022 Per the methodology outlined in the CALM, all data to the right of this referenced data are considered "current." Available older data are provided for context and are needed for that historic context if newer data indicates improved conditions. See the 2020/2022 CALM for addition details.
  - $\circ$  Chl-a Ind. (90<sup>th</sup> percentile) This is the reference line for the chlorophyll-a indicator. The 90<sup>th</sup> percentile (10 µg/L) of the assessment zone dataset is compared to this chlorophyll-a threshold indicator described in the CALM.
  - DO mg/L Std. This is the 5 mg/L reference line for the dissolved oxygen criteria.
  - DO mg/L Ind MAGEX This is the 4.5 mg/L reference line for the dissolved oxygen magnitude of exceedance indicator described in the CALM.
  - DO % Sat Std. This is the 24-hour average 75 percent reference line for the dissolved oxygen percent saturation criteria.
  - DO % Sat Ind. MAGEX This is the 24-hour average 65% reference line for the dissolved oxygen percent saturation magnitude of exceedance indicator described in the CALM.
  - Survival Min. Ind. (median) This is the light attenuation coefficient threshold that corresponds to the minimum light needed for eelgrass to survive at the restoration depth set for a given assessment zone. The median of the assessment zone dataset is compared to this light attenuation coefficient threshold indicator as described in the CALM.

#### Aquatic Life Integrity Designated Use Assessment Summary Table

Comparison of the Final 2016 and Final 2018 (based on assessment zone) to the 2020/2022 assessment of eutrophication parameters for the Aquatic Life designated use in the Great Bay Estuary assessment zones. Assessment category definitions are provided in sections 3.1.3 and 3.1.5 of the 2020/2022 CALM.

De-Impairment		Ne	New Impairment				
Assessment Zone	Cycle	Chlorophyll-a	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Sat)	Estuarine Bioassessments (eelgrass)	Water Clarity (Light Attenuation Coefficient, Kd)	Total Nitrogen
Squamscott River	2018	5-P	5-P	5-M	No Std	No Std	5-P
South	2020/2022	5-P	5-P	5-P	No Std	No Std	5-P
Squamscott River	2018	5-P	5-P	5-M	5-P	5-P	5-P
North	2020/2022	5-P	5-P	5-M	5-P	5-P	5-P
Lamprey River	2018	5-M	5-P	5-P	No Std	No Std	5-M
North	2020/2022	5-M	5-P	5-P	No Std	No Std	5-M
Lamprey River	2018	5-M	2-G	3-ND	5-P	5-P	5-M
South	2020/2022	5-M	3-PNS	3-PNS	5-P	5-P	5-M
	2018	3-ND	3-ND	3-ND	5-P	3-ND	3-ND
Winnicut River	2020/2022	3-ND	3-ND	3-ND	5-P	3-ND	3-ND
	2016	3-PNS	3-PNS	2-M	5-P	5-M	3-PNS
Great Bay	2020/2022	5-M	3-PNS	2-M	5-P	5-M	5-M
	2018	2-M	5-P	5-P	5-P	5-P	5-P
Oyster River	2020/2022	5-M	5-P	5-P	5-P	5-P	5-M
	2016	3-ND	3-ND	3-ND	5-P	3-ND	3-ND
Bellamy River	2020/2022	5-M	5-P	2-M	5-P	5-P	5-P
Little Bay	2016	3-PNS	2-G	2-G	5-P	5-M	3-PNS
	2020/2022	3-PNS	2-G	2-G	5-P	5-M	3-PNS
Cocheco River	2018	5-P	5-M	2-M	No Std	No Std	5-M
	2020/2022	5-P	5-M	3-PAS	No Std	No Std	5-M
Salmon Falls River	2018	5-P	5-P	5-M	No Std	No Std	5-M
	2020/2022	5-P	5-P	5-M	No Std	No Std	5-M
Upper Piscataqua	2016	2-M	3-PNS	2-G	5-P	5-P	3-PNS
River	2020/2022	2-M	2-M	2-M	5-P	5-M	3-PNS
Lower Piscataqua	2018	2-G	2-G	3-PAS	5-P	3-PNS	3-PAS
River - North	2020/2022	3-PAS	2-G	2-G	5-P	3-ND	3-PAS
Lower Piscataqua	2018	2-G	2-G	3-PAS	5-P	3-PAS	3-PAS
River - South	2020/2022	3-PAS	2-G	2-G	5-P	3-ND	3-PAS
North Mill Dond	2018	3-ND	3-ND	3-ND	3-ND	3-ND	3-ND
	2020/2022	3-ND	3-ND	3-ND	3-ND	3-ND	3-ND
South Mill Dond	2018	3-ND	3-ND	3-ND	3-PAS	3-ND	3-ND
	2020/2022	3-ND	3-ND	3-ND	3-PAS	3-ND	3-ND
Portsmouth	2016	2-G	2-G	3-PAS	5-P	5-M	2-M
Harbor	2020/2022	2-G	2-G	2-G	5-P	5-M	2-M
Sagamore Creek	2018	3-ND	5-M	3-PNS	5-P	3-ND	3-ND
Sagamore Creek	2020/2022	5-P	5-P	2-M	5-P	3-ND	5-M

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Assessment Zone	Cycle	Chlorophyll-a	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Sat)	Estuarine Bioassessments (eelgrass)	Water Clarity (Light Attenuation Coefficient, Kd)	Total Nitrogen
Little Harbor/Back	2016	3-ND	2-M	3-ND	5-P	5-M	3-ND
Channel	2020/2022	3-PAS	3-PAS	3-ND	5-M	5-M	3-ND

#### Assessment Zone = SQUAMSCOTT RIVER SOUTH

(NHEST600030806-01-01)

As of the date of data retrieval (January 10, 2020) water quality data for this assessment zone through 2019 had been uploaded to the Environmental Monitoring Database for this assessment zone. For this assessment zone, that means there are three additional years (2017, 2018, 2019) of data compared to the 2018 assessment.

Indicator	Aquatic Life Use Category 2018 / 2020/2022	2020/2022 Comment
Chlorophyll-a	5-P / 5-P	All of the chlorophyll-a data reported for the Squamscott River South from 2012 through 2017 has been collected at Chapmans Landing (GRBCL), the downstream boundary of the assessment zones. In 2018 and 2019, the GRBCL data was supplemented with two years of data collected at three sites further upstream in proximity to the WWTF discharges. Consequentially, the 90 <sup>th</sup> percentile for chlorophyll-a for the 2020/2022 assessment is now up to 38 $\mu$ g/L (n=88). The chlorophyll-a indicator threshold to prevent low dissolved oxygen is a 90 <sup>th</sup> percentile below 10 $\mu$ g/L. As noted in the March 20, 2012 HydroQual report, "…such elevated algal levels probably contribute to increased SOD which will contribute to lower DO when algal levels are low…" (HydroQual, March 20, 2012). The chlorophyll-a impairment has been retained.
Dissolved Oxygen (mg/L)	5-P / 5-P	All of the dissolved oxygen (DO) concentration data reported for the Squamscott River South from 2012 through 2017 has been collected at Chapmans Landing (GRBCL), the downstream boundary of the assessment zones. In 2018 and 2019, the GRBCL grab sample data was supplemented with two years of datalogger deployments collected at three sites further upstream in proximity to the WWTF discharges. Excursions below 5 mg/L in the 2018/2019 datasets were frequent, of extended durations and far below 5 mg/L. The new deployments, as well as the 2011 datalogger deployment, demonstrated that grab samples underrepresent the frequency of low dissolved oxygen conditions.
Dissolved Oxygen (% Saturation)	5-M / 5-P	All of the dissolved oxygen (DO) percent saturation data reported for the Squamscott River South from 2012 through 2017 has been collected at Chapmans Landing (GRBCL), the downstream boundary of the assessment zones. In 2018 and 2019, the GRBCL grab sample data was supplemented with two years of datalogger deployments collected at three sites further upstream in proximity to the WWTF discharges. Excursions below 75 percent daily average saturation in the 2018/2019 datasets were frequent and on multiple occasions falling below a daily average of 50%. The new deployments, as well as the 2011 datalogger deployment, demonstrated that paired high-tide/low-tide grab sample percent saturation averages underrepresent the frequency of low dissolved oxygen saturation conditions.
Estuarine Bioassessments (eelgrass)	No Std / No Std	Not applicable. Eelgrass habitat has not historically existed in this assessment zone. This assessment zone was created for the 2012 cycle by splitting the Squamscott River assessment zone (assessment unit ID = NHEST600030806-01) into two pieces. The parent assessment zone was listed as impaired (5-P) for eelgrass loss on the 2010 303d list. For the 2012 list, the impairment was associated with the other child assessment zone (Squamscott River North; NHEST600030806-01-02) because eelgrass has not historically existed in this assessment zone.
Water Clarity (Light Attenuation Coefficient)	No Std / No Std	Not applicable. This assessment unit was created for the 2012 cycle by splitting the Squamscott River assessment zone (assessment unit ID = NHEST600030806-01) into two pieces. The parent assessment zone was listed as impaired (5-P) for water clarity to protect eelgrass habitat on the 2010 303d list. The impairment was contingent upon the Estuarine Bioassessments (eelgrass) impairment and therefore not retained on this assessment zone in 2012 because eelgrass has not historically existed in this assessment zone.
Total Nitrogen	5-P / 5-P	The median total nitrogen from 2014 through 2019 was 752 µg/L (n=88), just 1 ug/L lower than the 2018 assessment cycle median. All of the total nitrogen (TN) data used in the 2018 assessment was collected at Chapmans Landing, the downstream boundary of the assessment

zone. The 2020/2022 assessment includes data collected in 2018 and 2019 at three sites further
upstream in proximity to the WWTF discharges. This extension of sampling is reflected in the
apparently higher TN in 2018 and in part makes the 2019 TN not look substantially lower even
though Exeter's new nitrogen removal process went on-line on June 10, 2019 and after a few
weeks of initial operation was switched to the designed Bardenpho configuration (Town of
Exeter, January 31, 2020). This assessment zone experiences frequent dissolved oxygen
concentrations far below 5 mg/L and far below daily average percent saturation of 75%. It is of
note that some periods pre-2012 demonstrated super saturation including multiple days in the
2011 as well as 2018/2019 experiencing dissolved oxygen saturation well over 125 percent. The
90 <sup>th</sup> percentile for chlorophyll-a concentration was 38 (n=88) from 2014 through 2019 including
one sample measured at 84 $\mu$ g/L. Total nitrogen reductions began in the summer of 2019 within
this assessment zone. The status of the indicators of nutrients and nutrient-related impacts has
not changed, and continue to present a preponderance of evidence that eutrophication effects
are lingering. As such, the impairment has been retained.





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CP

DO-PPM-24HR-MIN-CP





Squamscott River - South Assessment Zone	Date			90th	
(1/1/2014-1/10/2020)	Count	Minimum	Median	Percentile	Maximum
CHLOROPHYLL A, CORRECTED FOR PHEOPHYTIN (ug/L)	88	0.5	8.5	38.0	84.0
CHLOROPHYLL A, UNCORRECTED FOR PHEOPHYTIN (ug/L)	0	-	-	-	-
CHLOROPHYLL A, Combined (ug/L)	88	0.0	8.5	38.0	84.0
LIGHT ATTENUATION COEFFICIENT (1/m)	43	1.30	3.03	4.85	8.73
TURBIDITY (NTU)	0	-	-	-	-
TURBIDITY (datalogger daily median) (NTU)	0	-	-	-	-
TSS (mg/L)	83	2.5	31.0	53.3	100.7
COLORED DISSOLVED ORGANIC MATTER (CDOM) (1/m)	0	-	-	-	-
DISSOLVED ORGANIC CARBON	46	2.8	5.2	9.4	12.3
DO-PPM-24HR-MIN-CP (mg/L)	338	0.5	4.5	6.6	9.7
DO-PPM-24HR-MIN-NCP (mg/L)	1	5.4	5.4	-	5.4
DO-PPM-GRAB-CP (mg/L)	42	2.5	6.0	9.2	10.6
DO-PPM-GRAB-NCP (mg/L)	28	5.3	9.0	11.9	13.7
DO-PERC-24H-MEAN-CP (% sat)	310	37.7	74.0	107.4	137.4
DO-PERC-24H-MEAN-NCP (% sat)	0	-	-	-	-
DO-PERC-2TIDE-GRAB-CP (% sat)	18	58.0	83.0	104.9	105.3
DO-PERC-2TIDE-GRAB-NCP (% sat)	26	70.8	87.2	97.2	98.4
DO-PERC-GRAB (% sat)	26	41.2	79.8	112.6	121.9
Day Ave of TN (ug N/L)	88	460	752	1,200	1,900
Day Ave of TDN (ug N/L)	46	333	586	800	1,309
Day Ave of DIN (NH3 + NO2/3) (ug N/L)	78	77	330	575	880
Day Ave of NH3 (ug N/L)	78	3	163	330	500
Day Ave of PON (ug N/L)	0	-	-	-	-
Day Ave of NO2/3 (ug N/L)	88	35	160	273	561
SALINITY-Grabs (pss)	86	0.1	6.6	19.7	26.5
SALINITY-Datalogger Daily Median (pss)	324	0.1	5.8	15.5	23.8
pH-grab	7	6.9	7.1	-	7.7
pH-24HR (min)	339	6.5	7.0	6.8*	7.5
pH-24HR (max)	339	6.7	7.7	8.5	9.1
Temperature	86	1.7	21.6	25.5	28.3
Temperature-Daily Median	339	15.2	24.1	26.5	29.3

\*As a statistic on the pH minimum, this is the 10<sup>th</sup> rather that an 90<sup>th</sup> percentile.

#### Assessment Zone = SQUAMSCOTT RIVER NORTH (NHEST600030806-01-02)

As of the date of data retrieval (January 10, 2020) water quality data through 2018 had been uploaded to the Environmental Monitoring Database for this assessment zone. For this assessment zone, that means there are two additional years of data (2017, 2018) compared to the 2018 assessment but the 2019 data is not included.

Indicator	Aquatic Life Use Category 2018 / 2020/2022	2020/2022 Comment
Chlorophyll-a	5-P / 5-P	The 90 <sup>th</sup> percentile for chlorophyll-a, is 16.4 $\mu$ g/L (n=92). The chlorophyll-a indicator threshold to prevent low dissolved oxygen and preserve light for eelgrass is a 90 <sup>th</sup> percentile below 10 $\mu$ g/L. As noted in the March 20, 2012 HydroQual report, "such elevated algal levels probably contribute to increased SOD which will contribute to lower DO when algal levels are low" (HydroQual, March 20, 2012). Although the probe based chlorophyll-a data (not used in the median above) collected in the assessment zone at in both 2017 and 2018 was qualified as "estimated," due to poor correlation between probe and extracted chlorophyll-a grab sample data, the relative biomass is valid and the data distribution is similar to that of the grab samples of chlorophyll-a. The chlorophyll-a impairment has been retained.
Dissolved Oxygen (mg/L)	5-P / 5-P	Dissolved oxygen concentration measurements in this assessment zone fall below the 5 mg/L criteria every year. Because a portion of those measurements fall below 4 mg/L each year, and in some years below 3 mg/L, this impairment is considered severe.
Dissolved Oxygen (% Saturation)	5-M / 5-M	Following the 10% method listed in the 2020/2022 CALM this parameter would be categorized as 2-M. Part of the concept behind the 10% rule was to address random errors within the meter measurement accuracy, thereby limiting accidental impairments. The magnitude of exceedance indicator threshold was layered into the assessment process to address major exceedances and exceedances beyond all normal measurement errors. In the case of this assessment zone there are 595 station/days of DO readings during the critical summer period. Four of the last five years of data show criteria exceedances sometimes on multiple days, which demonstrates that this phenomenon is not limited to a single summer. Looking back through the dataset, we see that this is a regularly occurring condition, further demonstrating that this phenomenon is not limited to a single summer. It is clear that it is common in this assessment zone to have 24-hour average dissolved oxygen below 75 percent. While no 24-hour average dissolved oxygen readings fell below the magnitude of exceedance indicator threshold of 65 percent, there were several close values (e.g. 68 percent average in 2018).
Estuarine Bioassessments (eelgrass)	5-P / 5-P	In the 2012 assessment cycle, this assessment zone was listed as impaired for "Estuarine Bioassessments" (i.e. a lack of eelgrass) based on the 1948 survey that indicated that roughly 42 acres of eelgrass were present and despite intensive mapping efforts since 1981, eelgrass has never again been documented in this zone. While the 1948 map is rough enough that we cannot say that precisely 42 acres of eelgrass were present, its presence was clearly documented. Combined with the application of the Eelgrass Site Selection Model (Short, Davis, Kopp, Short, & Burdick, 2002) and a rudimentary suitability evaluation of temperature and salinity leads one to conclude that eelgrass should be present. Taken in totality, there is insufficient evidence to remove the 2018 "Estuarine Bioassessment" impairment. As such, the impairment for "Estuarine Bioassessments" and "Water Clarity (Light Attenuation Coefficient)" has been retained on the 2020/2022 final 303(d).
Water Clarity (Light Attenuation Coefficient)	5-P / 5-P	Median water clarity is 3.00 m^-1 (n=84). For an eelgrass restoration depth of 2 m, the light attenuation coefficient threshold is 0.75 m^-1. Therefore, the impaired (5-P) listing from the 2016 303d list has been retained.
Total Nitrogen	5-P / 5-P	The median total nitrogen from 2014 through 2018 was 769 µg/L (n=92). This assessment zone continues to experience frequently dissolved oxygen concentrations well below 5 mg/L and periodically below a 24-hour average dissolved oxygen saturation of 75%. The chlorophyll-a

concentration 90 <sup>th</sup> percentile was 16.4 (n=92) from 2014 through 2018. This data used in this
assessment does not include the period after Exeter WWTF's new nitrogen removal process went
on-line on June 10, 2019 and then after a few weeks of initial operation was switched to the
designed Bardenpho configuration (Town of Exeter, January 31, 2020). The status of the indicators of
nutrients and nutrient-related impacts has not changed, and continue to present a preponderance of
evidence that eutrophication effects are ongoing. As such, the impairment for nitrogen has been
retained

















Squamscott River - North Assessment Zone	Date			90th	
(1/1/2014-1/10/2020)	Count	Minimum	Median	Percentile	Maximum
CHLOROPHYLL A, CORRECTED FOR PHEOPHYTIN (ug/L)	92	0.5	5.1	16.4	32.0
CHLOROPHYLL A, UNCORRECTED FOR PHEOPHYTIN (ug/L)	0	-	-	-	-
CHLOROPHYLL A, Combined (ug/L)	92	0.0	5.1	16.4	32.0
LIGHT ATTENUATION COEFFICIENT (1/m)	84	1.30	3.00	5.47	10.92
TURBIDITY (NTU)	0	-	-	-	-
TURBIDITY (datalogger daily median) (NTU)	1,136	3.0	13.0	24.0	229.0
TSS (mg/L)	81	5.7	32.2	76.7	201.8
COLORED DISSOLVED ORGANIC MATTER (CDOM) (1/m)	0	-	-	-	-
DISSOLVED ORGANIC CARBON	92	1.4	5.3	9.6	12.3
DO-PPM-24HR-MIN-CP (mg/L)	594	2.4	5.1	6.6	8.2
DO-PPM-24HR-MIN-NCP (mg/L)	544	3.3	8.4	10.5	12.2
DO-PPM-GRAB-CP (mg/L)	18	2.5	5.9	7.8	8.9
DO-PPM-GRAB-NCP (mg/L)	31	5.3	9.4	11.8	13.7
DO-PERC-24H-MEAN-CP (% sat)	595	67.9	90.9	100.9	121.5
DO-PERC-24H-MEAN-NCP (% sat)	531	75.5	91.5	99.2	119.4
DO-PERC-2TIDE-GRAB-CP (% sat)		58.0	83.0	104.9	105.3
DO-PERC-2TIDE-GRAB-NCP (% sat)		70.8	87.4	97.3	98.4
DO-PERC-GRAB (% sat)	4	82.5	88.5	-	98.0
Day Ave of TN (ug N/L)	92	416	769	1,240	1,851
Day Ave of TDN (ug N/L)	92	228	591	781	1,309
Day Ave of DIN (NH3 + NO2/3) (ug N/L)	92	77	374	571	918
Day Ave of NH3 (ug N/L)	92	3	188	327	549
Day Ave of PON (ug N/L)	0	-	-	-	-
Day Ave of NO2/3 (ug N/L)	92	35	165	283	561
SALINITY-Grabs (pss)	89	0.1	11.5	23.6	26.9
SALINITY-Datalogger Daily Median (pss)	1,137	0.7	22.9	29.3	31.5
pH-grab	0	-	-	-	-
pH-24HR (min)	1,125	6.4	7.2	7*	7.9
pH-24HR (max)	1,125	7.4	8.0	8.1	8.4
Temperature	90	1.7	16.0	24.7	26.9
Temperature-Daily Median	1,143	0.1	18.0	24.3	26.8

\*As a statistic on the pH minimum, this is the 10<sup>th</sup> rather that an 90<sup>th</sup> percentile.

#### Assessment Zone = LAMPREY RIVER NORTH (NHEST600030709-01-01)

As of the date of data retrieval (January 10, 2020) water quality data through 2018 had been uploaded to the Environmental Monitoring Database for this assessment zone. For this assessment zone, that means there are two additional years of data (2017, 2018) compared to the 2018 assessment but the 2019 data is not included.

Indicator	Aquatic Life Use Category 2018 / 2020/2022	2020/2022 Comment
Chlorophyll-a	5-M / 5-M	The calculated 90 <sup>th</sup> percentile chlorophyll-a in this assessment zone is 11.7 $\mu$ g/L (n = 133) and there have been no readings over 50 $\mu$ g/L since 2016. The chlorophyll-a indicator threshold to prevent low dissolved oxygen is a 90 <sup>th</sup> percentile below 10 $\mu$ g/L. Large nutrient load reductions began when the new waste water treatment facility came online in 2017, which may be reflected on the lack of very high readings in 2017 and 2018. The chlorophyll-a impairment has been retained.
Dissolved Oxygen (mg/L)	5-P / 5-P	Dissolved oxygen concentration measurements in this assessment zone fall below the 5 mg/L criteria every year. Because a portion of those measurements fall below 4 mg/L each year, and in some years within the "current period" down to 1 mg/L, this impairment is considered severe.
Dissolved Oxygen (% Saturation)	5-Р / 5-Р	Dissolved oxygen 24-hour average percent saturation measurements in this assessment zone fall below the 75% every year. Because a portion of those measurements fall below 65% each year, and in some years below 40% within the "current period", this criteria indicator suggests that the aquatic life use is impaired, as such, dissolved oxygen 24-hour average percent saturation has been assessed as not supporting.
Estuarine Bioassessments (eelgrass)	No Std / No Std	Not applicable. Eelgrass habitat has not historically existed in this assessment zone.
Water Clarity (Light Attenuation Coefficient)	No Std / No Std	Not applicable. The water clarity has not been assessed because eelgrass has not historically existed in this assessment zone.
Total Nitrogen	5-M / 5-M	The median total nitrogen from 2014 through 2018 was 438 $\mu$ g/L (n=45). It is important to note that some of the 2017 and all of the 2018 data represents the period after the large nutrient load reductions from the new waste water treatment facility came online in 2017. Indeed, the 2017 and 2018 datasets do not show the spikes over 700 ug/L that have been present for years. In the available dataset, this assessment zone still experiences frequent dissolved oxygen concentrations well below the 5 mg/L criteria and daily average saturation below 75 percent. The chlorophyll-a concentration 90 <sup>th</sup> percentile was 11.7 $\mu$ g/L (n=133) from 2014 through 2018 and several measurements were over 50 $\mu$ g/L. The status of the indicators of nutrients and nutrient- related impacts has not changed, and continue to present a preponderance of evidence that eutrophication effects are ongoing. As such, the impairment for nitrogen has been retained.











Lamprey River - North Assessment Zone	Date			90th	
(1/1/2014-1/10/2020)	Count	Minimum	Median	Percentile	Maximum
CHLOROPHYLL A, CORRECTED FOR PHEOPHYTIN (ug/L)	132	0.1	2.7	11.9	181.0
CHLOROPHYLL A, UNCORRECTED FOR PHEOPHYTIN (ug/L)	1	3.0	3.0	-	3.0
CHLOROPHYLL A, Combined (ug/L)	133	0.1	2.7	11.7	181.0
LIGHT ATTENUATION COEFFICIENT (1/m)	41	0.95	1.56	2.45	2.75
TURBIDITY (NTU)	0	-	-	-	-
TURBIDITY (datalogger daily median) (NTU)	1,142	0.0	5.0	10.0	19.0
TSS (mg/L)	132	0.5	10.9	42.6	151.1
COLORED DISSOLVED ORGANIC MATTER (CDOM) (1/m)	0	-	-	-	-
DISSOLVED ORGANIC CARBON	132	2.5	4.6	7.8	11.3
DO-PPM-24HR-MIN-CP (mg/L)	590	1.0	4.9	6.6	10.9
DO-PPM-24HR-MIN-NCP (mg/L)	509	3.8	8.9	12.3	15.4
DO-PPM-GRAB-CP (mg/L)	1	6.5	6.5	-	6.5
DO-PPM-GRAB-NCP (mg/L)	4	10.8	12.7	-	14.1
DO-PERC-24H-MEAN-CP (% sat)	601	34.0	77.3	96.1	113.4
DO-PERC-24H-MEAN-NCP (% sat)	543	59.5	95.6	105.9	108.6
DO-PERC-2TIDE-GRAB-CP (% sat)		-	-	-	-
DO-PERC-2TIDE-GRAB-NCP (% sat)	3	106.4	107.4	-	107.5
DO-PERC-GRAB (% sat)	3	98.1	98.4	-	104.9
Day Ave of TN (ug N/L)	45	254	438	763	1,279
Day Ave of TDN (ug N/L)	132	211	434	646	1,027
Day Ave of DIN (NH3 + NO2/3) (ug N/L)	133	57	238	481	828
Day Ave of NH3 (ug N/L)	133	3	60	302	633
Day Ave of PON (ug N/L)	0	-	-	-	-
Day Ave of NO2/3 (ug N/L)	133	42	142	221	453
SALINITY-Grabs (pss)	44	0.0	1.5	20.9	24.9
SALINITY-Datalogger Daily Median (pss)	1,124	0.0	17.6	26.2	30.1
pH-grab	1	6.8	6.8	-	6.8
pH-24HR (min)	1,160	6.0	7.2	6.8*	7.8
pH-24HR (max)	1,160	6.2	7.6	7.9	8.2
Temperature	44	1.9	16.7	24.7	26.7
Temperature-Daily Median	1,158	0.1	18.4	24.7	27.3

\*As a statistic on the pH minimum, this is the 10th rather that an 90th percentile.

#### Assessment Zone = LAMPREY RIVER SOUTH (NHEST600030709-01-02)

As of the date of data retrieval (January 10, 2020) water quality data through 2017 had been uploaded to the Environmental Monitoring Database for this assessment zone. While no grab samples or dataloggers were deployed in 2018, UNH collected data for Newmarket in 2019 and will in 2020 and 2021 which will be made public at some point. For this assessment zone, that means there are no additional years of data compared to the 2018 assessment.

Indicator	Aquatic Life Use Category 2018 / 2020/2022	2020/2022 Comment
Chlorophyll-a	5-M / 5-M	The calculated 90 <sup>th</sup> percentile chlorophyll-a (uncorrected for pheophytin) in this assessment zone is 15.6 $\mu$ g/L (n = 26). The chlorophyll-a indicator threshold to prevent low dissolved oxygen and preserve light for eelgrass is a 90 <sup>th</sup> percentile below 10 $\mu$ g/L. Although the probe based chlorophyll-a data (not used in the median above) collected in the assessment zone at two sites in both 2016 and 2017 was qualified as "estimated," due to poor correlation between probe and extracted chlorophyll-a grab sample data, the relative biomass is valid and shows large spikes in chlorophyll-a. Large nutrient load reductions began when the new waste water treatment facility came online in 2017 and the differences in the 2016 verses 2017 datasets suggest that those reductions are having the desired impact. The chlorophyll-a impairment has been retained until additional data demonstrates continued chlorophyll-a reductions.
Dissolved Oxygen (mg/L)	3-PNS / 3- PNS	This assessment zone received its first datalogger deployments in 2016 and 2017, straddling the period when the new waste water treatment facility came online. Dissolved oxygen concentration measurements in 2016 in this assessment zone routinely fell below the 5 mg/L and at times below 4 mg/L. Given the change in loading and differences in concentration between 2016 and 2017 there is not yet enough DO data to justify changing the assessment status, therefore, dissolved oxygen concentration has been retained as being assessed as potentially not supporting.
Dissolved Oxygen (% Saturation)	3-PNS / 3- PNS	This assessment zone received its first datalogger deployments in 2016 and 2017, straddling the period when the new waste water treatment facility came online. Dissolved oxygen 24-hour average percent saturation measurements in this assessment zone periodically fell below the 75 percent in both 2016 and 2017. Because a portion of those measurements fall below 75 percent, the data suggests that the aquatic life use is impaired, as such, dissolved oxygen 24-hour average percent saturation has been retained as being assessed as potentially not supporting.
Estuarine Bioassessments (eelgrass)	5-P / 5-P	The historical extent of eelgrass in this assessment zone was 53.4 acres from the 1948 dataset. Patches of eelgrass were found in 2003 (2.2 acres) and 2011 (0.5 acres). The median current extent of eelgrass in 2016-2019 is 0 acres, which is a 100% decrease. Since 1990, the trend in eelgrass cover in this assessment zone could not be determined because the eelgrass cover has been zero for most years since 1981. The thresholds for impairment are either a loss of more than 20% of the historic extent of eelgrass or a recent trend of greater than 20% loss.
Water Clarity (Light Attenuation Coefficient)	5-Р / 5-Р	The median light attenuation could not be calculated for the for the current period (n=0) within this assessment zone. For an eelgrass restoration depth of 2 m, the light attenuation coefficient indicator threshold is 0.75 m^-1. This assessment zone historically had eelgrass growing in both the shallows and deeper habitat making the 2m restoration depth a valid target. This assessment unit (zone) was created for the 2012 cycle by splitting the Lamprey River assessment unit (NHEST600030709-01) into two pieces. The parent assessment zone was listed as impaired (5-P) for water clarity based on data from station GRBLR to protect eelgrass habitat on the 2010 303d list. The GRBLR station is roughly 0.5 miles upstream (north) of the Lamprey River North/South split and has a median light attenuation coefficient of 1.56 m^-1 (n=41) for the 2014 through 2017 period. The downstream boundary to the Lamprey River South assessment zone is Great Bay, which had a median=1.63 m^-1 (n=131) for the 2014 through 2018 period. Assessment zones that were impaired in the previous cycle cannot be removed from the 303d list if there are insufficient data to make a new assessment.

		Given the lack of new site specific data and the measurements upstream and downstream of this assessment zone the impaired (5-P) listing from the 2016 303d list has been retained.
Total Nitrogen	5-M / 5-M	The median total nitrogen from 2014 through 2017 was 395 µg/L (n=26). It is important to note that the available data straddles the period when the new waste water treatment facility came online and the reduction in total nitrogen is apparent in the dataset. The calculated 90 <sup>th</sup> percentile chlorophyll-a in this assessment zone is 15.6 µg/L (n = 26). The eelgrass beds have been eliminated. The median light attenuation coefficient was not calculated due to no samples collected in the 2014 through 2017 period in this assessment zone, however, both the upstream assessment light attenuation coefficient is poor (median = 1.56 m^-1, n=41) and the downstream assessment zone is impaired due to the poor light attenuation coefficient (median = 1.63 m^-1, n=131). This assessment zone experienced dissolved oxygen concentrations well below the 5 mg/L criteria in 2016 but none in 2017 and daily average saturation fell below 75% in both 2016 and 2017. This assessment zone is generally characterized by limited and sometimes mixed eutrophication indicator data. While local data is currently limited and sometimes mixed its neighboring assessment zones have more detailed datasets. The upstream Lamprey River North assessment zone has extensive datasets demonstration impairments due to elevated chlorophyll-a and severely depleted dissolved oxygen. The downstream Great Bay assessment zone has elevated chlorophyll-a and marginal dissolved oxygen due to the severely poor condition coming out of the Squamscott River assessment zone as well as degraded eelgrass, poor light transmittance, and evidence of macroalgae. The status of the indicators of nutrients and nutrient-related impacts has not changed, and continue to present a preponderance of evidence that eutrophication effects are lingering. As such, the impairment for nitrogen has been retained and we look forward to the exploring complete post WWTF upgrade data.
















Lamprey River - South Assessment Zone	Date			90th	
(1/1/2014-1/10/2020)	Count	Minimum	Median	Percentile	Maximum
CHLOROPHYLL A, CORRECTED FOR PHEOPHYTIN (ug/L)	0	-	-	-	-
CHLOROPHYLL A, UNCORRECTED FOR PHEOPHYTIN (ug/L)	26	2.0	4.4	15.6	20.0
CHLOROPHYLL A, Combined (ug/L)	26	0.0	4.4	15.6	20.0
LIGHT ATTENUATION COEFFICIENT (1/m)	0	-	-	-	-
TURBIDITY (NTU)	0	-	-	-	-
TURBIDITY (datalogger daily median) (NTU)	0	-	-	-	-
TSS (mg/L)	26	7.3	14.0	23.3	76.0
COLORED DISSOLVED ORGANIC MATTER (CDOM) (1/m)	0	-	-	-	-
DISSOLVED ORGANIC CARBON	0	-	-	-	-
DO-PPM-24HR-MIN-CP (mg/L)	242	4.0	6.2	7.2	7.7
DO-PPM-24HR-MIN-NCP (mg/L)	70	5.1	7.2	8.3	8.5
DO-PPM-GRAB-CP (mg/L)	4	6.0	6.3	-	7.2
DO-PPM-GRAB-NCP (mg/L)	0	-	-	-	-
DO-PERC-24H-MEAN-CP (% sat)	268	70.5	98.0	112.1	127.7
DO-PERC-24H-MEAN-NCP (% sat)		74.2	93.8	106.2	115.8
DO-PERC-2TIDE-GRAB-CP (% sat)		-	-	-	-
DO-PERC-2TIDE-GRAB-NCP (% sat)		-	-	-	-
DO-PERC-GRAB (% sat)	4	74.2	85.0	-	102.0
Day Ave of TN (ug N/L)		230	395	587	660
Day Ave of TDN (ug N/L)	0	-	-	-	-
Day Ave of DIN (NH3 + NO2/3) (ug N/L)	26	37	158	461	508
Day Ave of NH3 (ug N/L)	27	11	124	348	368
Day Ave of PON (ug N/L)	0	-	-	-	-
Day Ave of NO2/3 (ug N/L)	26	10	48	113	140
SALINITY-Grabs (pss)	26	15.0	25.9	29.2	30.9
SALINITY-Datalogger Daily Median (pss)	325	12.0	27.3	30.6	31.3
pH-grab	0	-	-	-	-
pH-24HR (min)	356	7.2	7.7	7.5*	8.1
pH-24HR (max)	356	7.6	8.0	8.2	8.6
Temperature	26	14.4	21.0	25.6	26.0
Temperature-Daily Median	341	8.9	21.1	25.3	27.2

# Assessment Zone = WINNICUT RIVER (NHEST600030904-01)

As of the date of data retrieval (January 10, 2020) water quality data through 2016 had been uploaded to the Environmental Monitoring Database for this assessment zone. For this assessment zone, that means there are no additional years of data compared to the 2018 assessment.

Indicator	Aquatic Life Use Category 2018 / 2020/2022	2020/2022 Comment
Chlorophyll-a	3-ND / 3-ND	The chlorophyll-a indicator threshold to prevent low dissolved oxygen and preserve light for eelgrass is a 90 <sup>th</sup> percentile below 10 $\mu$ g/L. However, no chlorophyll-a data was collected in the current period for this assessment zone.
Dissolved Oxygen (mg/L)	3-ND / 3-ND	This assessment zone has no measurements for dissolved oxygen concentration since 2009. As such, this assessment zone has been assessed as 3-ND (No Data) dissolved oxygen concentration.
Dissolved Oxygen (% Saturation)	3-ND / 3-ND	This assessment zone has no measurements for dissolved oxygen percent saturation since 2008. As such, this assessment zone has been assessed as 3-ND (No Data) for dissolved oxygen percent saturation.
Estuarine Bioassessments (eelgrass)	5-P / 5-P	The historical extent of eelgrass in this assessment zone was not available from the 1948, 1962, 1980, and 1981 datasets. Eelgrass was present from 1990 through 2006. The median current extent of eelgrass in 2016-2019 is 0.6 acres. Since 1990, the trend in eelgrass cover in this assessment zone is a loss of 80.6%. The thresholds for impairment are either a loss of more than 20% of the historic extent of eelgrass or a recent trend of greater than 20% loss.
Water Clarity (Light Attenuation Coefficient)	3-ND / 3-ND	No light attenuation coefficient data has been collected in the current period for this assessment zone.
Total Nitrogen	3-ND / 3-ND	There are no "current" total nitrogen data from which to calculate a median total nitrogen from 2012 through 2018. As such, this assessment zone cannot be assessed for total nitrogen.















Winnicut River Assessment Zone	Date			90th	
(1/1/2014-1/10/2020)	Count	Minimum	Median	Percentile	Maximum
CHLOROPHYLL A, CORRECTED FOR PHEOPHYTIN (ug/L)	0	-	-	-	-
CHLOROPHYLL A, UNCORRECTED FOR PHEOPHYTIN (ug/L)	0	-	-	-	-
CHLOROPHYLL A, Combined (ug/L)	0	-	-	-	-
LIGHT ATTENUATION COEFFICIENT (1/m)	0	-	-	-	-
TURBIDITY (NTU)	0	-	-	-	-
TURBIDITY (datalogger daily median) (NTU)	0	-	-	-	-
TSS (mg/L)	0	-	-	-	-
COLORED DISSOLVED ORGANIC MATTER (CDOM) (1/m)	0	-	-	-	-
DISSOLVED ORGANIC CARBON	0	-	-	-	-
DO-PPM-24HR-MIN-CP (mg/L)	0	-	-	-	-
DO-PPM-24HR-MIN-NCP (mg/L)	0	-	-	-	-
DO-PPM-GRAB-CP (mg/L)	0	-	-	-	-
DO-PPM-GRAB-NCP (mg/L)	0	-	-	-	-
DO-PERC-24H-MEAN-CP (% sat)	0	-	-	-	-
DO-PERC-24H-MEAN-NCP (% sat)		-	-	-	-
DO-PERC-2TIDE-GRAB-CP (% sat)		-	-	-	-
DO-PERC-2TIDE-GRAB-NCP (% sat)		-	-	-	-
DO-PERC-GRAB (% sat)	0	-	-	-	-
Day Ave of TN (ug N/L)		-	-	-	-
Day Ave of TDN (ug N/L)	0	-	-	-	-
Day Ave of DIN (NH3 + NO2/3) (ug N/L)	0	-	-	-	-
Day Ave of NH3 (ug N/L)	0	-	-	-	-
Day Ave of PON (ug N/L)	0	-	-	-	-
Day Ave of NO2/3 (ug N/L)	0	-	-	-	-
SALINITY-Grabs (pss)	10	7.0	24.2	29.3	29.7
SALINITY-Datalogger Daily Median (pss)	0	-	-	-	-
pH-grab	0	-	-	-	-
pH-24HR (min)	0	-	-	-	-
pH-24HR (max)	0	-	-	-	-
Temperature	10	4.5	16.0	23.3	23.3
Temperature-Daily Median	0	-	-	-	-

## Assessment Zone = GREAT BAY

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

As of the date of data retrieval (January 10, 2020) water quality data through 2018 had been uploaded to the Environmental Monitoring Database for this assessment zone. For this assessment zone, that means there are three additional years of data (2016, 2017, 2018) compared to the 2016 assessment but the 2019 data is not included. There were two new stations to the Great Bay assessment zone. In 2017 (Jun-Dec) Great Bay West had a datalogger deployed and in 2018 (Apr-Nov) Great Bay East had a datalogger deployed and grab samples for chemistry and chlorophyll-a.

Indicator	Aquatic Life Use Category 2016 / 2020/2022	2020/2022 Comment
Chlorophyll-a	3-PNS / 5-M	The calculated 90 <sup>th</sup> percentile for chlorophyll-a in this assessment zone is 14.9 µg/L (n = 160) [21.3 µg/L (n=58) without GRBAP and GRBSQ]. The chlorophyll-a indicator threshold to prevent low dissolved oxygen and preserve light for eelgrass is a 90 <sup>th</sup> percentile below 10 µg/L. Elevated chlorophyll-a levels were particularly common in 2017 and 2018 in the non-boundary stations, GRBGB and the new GRBGBE exceeding 40 ug/L on 4 of the 36 different grab sample dates, the highest reading being 60.9 ug/L at GRBGB. Although the probe based chlorophyll-a data (not used in the median above) collected in the assessment zone at GRBGB (2017 and 2018) and GRBGBW (2018) was qualified as "estimated," due to poor correlation between probe and extracted chlorophyll-a grab sample data, the relative biomass is valid and shows a similar distribution to the grab samples. It is worth noting that while grab samples are surface collected (0.5m), the dataloggers are at depth, affixed off the bottom, confounding any paired grab/probe analysis. As chlorophyll-a is very high at the Squamscott River boundary and generally high and at times very high at two additional stations within Great Bay, one of the response variables is marginal (dissolved oxygen), and the other is very poor (light), chlorophyll-a has been assessed as Not Supporting.
Dissolved Oxygen (mg/L)	3-PNS / 3-PNS	This assessment zone has 24 hour datalogger and grab measurements for dissolved oxygen concentration. One of the assigned stations (GRBSQ - Squamscott River datalogger at RR bridge) is at the mouth of the Squamscott River, precisely at the divide between the Squamscott River and Great Bay assessment zones. The very low readings from GRBSQ are a cause for concern. While GRBSQ more accurately represents the conditions in the Squamscott River than the entirety of Great Bay proper, it indicates that low DO issues are likely to extend into portions of Great Bay. As it has for years, the GRBGB station had no readings below 5 mg/L (2014-2018). In 2017 a new rotational site was established on the west side of Great Bay (GRBGBW) and had a minimum DO of 5.7 mg/L. Were the low DO issues from GRBSQ to extend into Great Bay, GRBGBW is the datalogger where we would expect to see those low DO concentrations. Then, in 2018 an additional new rotational site was established on the east side of Great Bay (GRBGBE) which recorded a minimum DO below 5 mg/L on 4-dates (9/5 to 9/8). Even by themselves, the 4 summer critical period (n=122) values are insufficient to trigger impairment based on the 10% rule. Considering all the data across the assessment zone, conditions warrant retention of the dissolved oxygen concentration assessment as Insufficient Information – Potentially Not Supporting.
Dissolved Oxygen (% Saturation)	3-PAS / 2-M	This assessment zone has 24 hour datalogger and grab measurements for dissolved oxygen percent saturation. One of the assigned stations (GRBSQ - Squamscott River datalogger at RR bridge) is at the mouth of the Squamscott River, precisely at the divide between the Squamscott River and Great Bay assessment zones. While GRBSQ more accurately represents the conditions in the Squamscott River than the entirety of Great Bay proper, it does indicate low DO issues are likely to extend into portions of Great Bay. The primary sampled station (GRBGB) as well as the

		new GRBBGW and GRBGBE stations inside of the Great Bay assessment zone all have recorded acceptable dissolved oxygen saturation 0.5 meters off the bottom.
Estuarine Bioassessments (eelgrass)	5-P / 5-P	The historical extent of eelgrass in this assessment zone was 2,130.7 acres from the 1948, 1962, 1980, and 1981 datasets. The median current extent of eelgrass in 2016-2019 is 1,450 acres, which is a 31.9% decrease. Since 1990, the trend in eelgrass cover in this assessment zone is a loss of 30.4%. The thresholds for impairment are either a loss of more than 20% of the historic extent of eelgrass or a recent trend of greater than 20% loss.
Water Clarity (Light Attenuation Coefficient)	5-M / 5-M	Median=1.63 m^-1 (n=131) [1.42 $\mu$ g/L (n=46) without GRBAP and GRBSQ]. For an eelgrass restoration depth of 2 m, the light attenuation coefficient threshold is 0.75 m^-1. This assessment zone historically had eelgrass growing in both the shallows and deeper habitat making the 2m restoration depth a valid target. Therefore, the impaired (5-M) listing from the 2018 303d list has been retained.
Total Nitrogen	3-PNS / 5-M	The median total nitrogen from 2014 through 2019 was 378 µg/L (n=58) when considering only the stations in the middle of Great Bay; and 401 µg/L (n=161) when including the boundary stations GRBSQ and GRBAP. The long-term Great Bay site (GRBGB) recorded 6-measurments over 500 µg/L in 2018 (6/19=518 µg/L, 8/14=542 µg/L, 9/25=501 µg/L, 10/15=864 µg/L, 11/12=569 µg/L, 8 12/3=643 µg/L, The new GRBGBE site documented 3-measurments over 500 µg/L in 2018 (8/17=908 µg/L, 9/24= 502 µg/L, 10/16=1,610 µg/L, 11/19=501 µg/L). Dr. Howes indicated (Howes, 2019) a growing season (May-Sept) average of 320-350 µg/L "should be protective of that resource [eelgrass in the Great Bay system] based on [his] experience with nearby Massachusetts estuarine waters." As indicated here, the median total nitrogen from 2014 through 2019 was 378 µg/L (n=58) when considering only the stations in the middle of Great Bay. The average of the same 58 samples is 429 µg/L over the full calendar year and 409 µg/L (n=33) in the growing season. The calculated 90 <sup>th</sup> percentile for chlorophyll-a in this assessment zone is 14.9 µg/L (n = 160) [21.3 µg/L (n=58) without GRBAP and GRBSQ]. For shallow systems, it is expected that changes in macroalgae will precede changes in phytoplankton (McGlathery, Sundbäck, & Anderson, 2007) (Valiela, et al., 1997), which in part appears to be the case in the Great Bay assessment zone. Both intertidal green and red seaweeds (macroalgae decreased (weakly significantly) since 2014 at Adams Point (Burdick, et al., 2020). However, the appreciable cover at Lubberland Creek and Sunset Hill Farm did not show statistical decreases although those two sites have only been sampled 3-times from 2013-2019 making trend detection more difficult (Burdick, et al., 2020). Beginning in 2018, subtidal sampling was first added to the macroalgae monitoring at the four sites around Great Bay. The 2019 annual macroalgae report notes that, "sites with the highest percent cover and biomass of red and green seaweed had the lowest abundance of e
		main stations GRBGB, GRBGBW (2017) and GRBGBE (2018). However, when considering all

sampling stations of Great Bay there are areas in the southwest that may exhibit poor daily average dissolved oxygen percent saturation.
Per the CALM, in order to assess compliance with the narrative nutrient criteria for the Great Bay estuary, the indicators of nutrients and nutrient-related impacts are collectively evaluated . The methodology describes that the assessment decision is based on a preponderance of evidence and the status of those indicators. In this assessment zone, not only has eelgrass been lost and light attenuation is unsuitable for its growth, but the chlorophyll-a indicator is elevated above the 90 <sup>th</sup> percentile for the protection of eelgrass and is elevated as compared to previous assessment periods. The levels of TN in the assessment zone are higher than what would be considered protective levels (Howes, 2019) and are quite high (over 500 ug/L) on many occasions (13 of 58 samples or 22% of the time). Given the number of eutrophication indicators that are above the levels identified in CALM as needed to support aquatic life use, and the preponderance of evidence indicating the impacts of eutrophication, this assessment zone has been moved to non-supporting for total nitrogen.





































Great Bay Assessment Zone	Date			90th	
(1/1/2014-1/10/2020)	Count	Minimum	Median	Percentile	Maximum
CHLOROPHYLL A, CORRECTED FOR PHEOPHYTIN (ug/L)	157	0.8	4.4	15.0	60.9
CHLOROPHYLL A, UNCORRECTED FOR PHEOPHYTIN (ug/L)	3	4.8	5.5	-	9.6
CHLOROPHYLL A, Combined (ug/L)	160	0.8	4.5	14.9	60.9
LIGHT ATTENUATION COEFFICIENT (1/m)	131	0.48	1.63	4.48	10.92
TURBIDITY (NTU)	0	-	-	-	-
TURBIDITY (datalogger daily median) (NTU)	2,627	1.0	7.0	20.0	366.0
TSS (mg/L)	138	9.3	21.6	52.4	201.8
COLORED DISSOLVED ORGANIC MATTER (CDOM) (1/m)	0	-	-	-	-
DISSOLVED ORGANIC CARBON	158	1.4	3.3	6.3	12.2
DO-PPM-24HR-MIN-CP (mg/L)	1,415	2.4	6.5	7.8	10.4
DO-PPM-24HR-MIN-NCP (mg/L)	1,241	3.3	8.7	10.5	12.5
DO-PPM-GRAB-CP (mg/L)	22	6.0	7.6	9.4	9.7
DO-PPM-GRAB-NCP (mg/L)	49	7.5	11.2	12.8	14.0
DO-PERC-24H-MEAN-CP (% sat)	1,400	67.9	98.5	110.8	141.7
DO-PERC-24H-MEAN-NCP (% sat)		75.5	93.7	103.8	130.7
DO-PERC-2TIDE-GRAB-CP (% sat)		52.2	102.3	115.9	118.8
DO-PERC-2TIDE-GRAB-NCP (% sat)	40	83.8	97.1	111.8	114.9
DO-PERC-GRAB (% sat)	9	82.5	94.4	119.3	119.3
Day Ave of TN (ug N/L)	161	190	401	908	1,851
Day Ave of TDN (ug N/L)	158	128	276	658	1,017
Day Ave of DIN (NH3 + NO2/3) (ug N/L)	161	5	148	404	918
Day Ave of NH3 (ug N/L)	161	3	35	223	549
Day Ave of PON (ug N/L)	0	-	-	-	-
Day Ave of NO2/3 (ug N/L)	161	2	94	204	506
SALINITY-Grabs (pss)	287	0.1	22.4	27.0	30.4
SALINITY-Datalogger Daily Median (pss)	2,637	0.7	24.9	30.0	32.2
pH-grab	3	7.8	8.1	-	8.2
pH-24HR (min)	2,499	6.4	7.6	7.1*	8.3
pH-24HR (max)	2,499	7.4	8.0	8.2	8.6
Temperature	288	-1.5	13.3	23.0	25.9
Temperature-Daily Median	2,664	0.1	17.6	23.5	26.8

Great Bay Assessment Zone (Without GRBAP & GRBSQ)	Date			90th	
(1/1/2014-1/10/2020)	Count	Minimum	Median	Percentile	Maximum
CHLOROPHYLL A, CORRECTED FOR PHEOPHYTIN (ug/L)	55	0.8	5.8	23.7	60.9
CHLOROPHYLL A, UNCORRECTED FOR PHEOPHYTIN (ug/L)	3	4.8	5.5	-	9.6
CHLOROPHYLL A, Combined (ug/L)	58	0.8	5.6	21.3	60.9
LIGHT ATTENUATION COEFFICIENT (1/m)	46	0.80	1.42	2.57	6.94
TURBIDITY (NTU)	0	-	-	-	-
TURBIDITY (datalogger daily median) (NTU)	1,491	1.0	5.0	10.0	366.0
TSS (mg/L)	49	9.3	19.6	50.4	175.4
COLORED DISSOLVED ORGANIC MATTER (CDOM) (1/m)	0	-	-	-	-
DISSOLVED ORGANIC CARBON	55	1.6	3.1	5.8	8.3
DO-PPM-24HR-MIN-CP (mg/L)	821	2.8	7.1	8.0	10.4
DO-PPM-24HR-MIN-NCP (mg/L)	697	5.4	8.8	10.5	12.5
DO-PPM-GRAB-CP (mg/L)		7.0	9.2	-	9.5
DO-PPM-GRAB-NCP (mg/L)	7	10.3	11.9	-	12.3
DO-PERC-24H-MEAN-CP (% sat)	805	80.8	102.9	113.3	141.7
DO-PERC-24H-MEAN-NCP (% sat)		82.9	95.7	106.8	130.7
DO-PERC-2TIDE-GRAB-CP (% sat)		-	-	-	-
DO-PERC-2TIDE-GRAB-NCP (% sat)		95.5	98.0	-	109.2
DO-PERC-GRAB (% sat)	4	88.2	96.0	-	119.3
Day Ave of TN (ug N/L)		190	378	575	1,610
Day Ave of TDN (ug N/L)	55	129	234	377	432
Day Ave of DIN (NH3 + NO2/3) (ug N/L)	58	5	74	192	275
Day Ave of NH3 (ug N/L)	58	3	19	68	106
Day Ave of PON (ug N/L)	0	-	-	-	-
Day Ave of NO2/3 (ug N/L)	58	2	58	156	245
SALINITY-Grabs (pss)	177	0.3	23.4	27.2	30.4
SALINITY-Datalogger Daily Median (pss)	1,500	7.6	26.5	30.3	32.2
pH-grab	3	7.8	8.1	-	8.2
pH-24HR (min)	1,374	7.2	7.8	7.6*	8.3
pH-24HR (max)	1,374	7.4	8.0	8.2	8.6
Temperature	177	-0.1	13.3	22.8	25.7
Temperature-Daily Median	1,521	3.1	17.5	22.8	25.9

## Assessment Zone = OYSTER RIVER

(NHEST600030902-01-03, NHEST600030902-01-04, NHEST600030904-06-17)

As of the date of data retrieval (January 10, 2020) water quality data through 2018 had been uploaded to the Environmental Monitoring Database for this assessment zone. For this assessment zone, that means there are two additional years of data (2017, 2018) compared to the 2018 assessment but the 2019 data is not included.

Indicator	Aquatic Life Use Category 2018 / 2020/2022	2020/2022 Comment
Chlorophyll-a	2-M / 5-M	The calculated 90 <sup>th</sup> percentile chlorophyll-a in this assessment zone is 13.0 $\mu$ g/L (n = 46) and a maximum reading of 66.9 $\mu$ g/L in 2017. The chlorophyll-a indicator threshold to prevent low dissolved oxygen and preserve light for eelgrass is a 90 <sup>th</sup> percentile below 10 $\mu$ g/L. Although there was probe based chlorophyll-a data (not used in the median above) collected in the assessment zone in 2017, that data did not cover enough of a summer season (4/27-6/17) to be considered here. The assessment for chlorophyll a remains not supporting.
Dissolved Oxygen (mg/L)	5-P / 5-P	Up until 2016 the minimum dissolved oxygen concentration appeared to be improving, however, 2017 and 2018 saw the worst recorded dissolved oxygen in the 16-years of datalogger deployment. Dissolved oxygen concentration measurements in this assessment zone fall below the 5 mg/L criteria every year and in 2017 and 2018 below 3 mg/L and on rare occasions even below 2 mg/L, therefore this impairment is considered severe.
Dissolved Oxygen (% Saturation)	5-P / 5-P	Up until 2016 the minimum dissolved oxygen percent saturation appeared to be improving, however, 2017 and 2018 saw some of the most extreme recorded dissolved oxygen saturation in the 16-years of datalogger deployment with many days below a 24-hour average of 75%. Further, in 2017 and 2018 there were 24-hour averages frequently in excess of 120% and occasionally over 140% in 2018. In 2013 and again in 2018 a portion of those 24-hour averages fell below 65%, therefore this assessment zone has been assessed as potentially not supporting aquatic life based on the dissolved oxygen saturation.
Estuarine Bioassessments (eelgrass)	5-P / 5-P	The historical extent of eelgrass in this assessment zone was 182.5 acres from the 1948 dataset. Some of eelgrass was found in 1996 (14 acres) and 2015 (2.4 acres). The median current extent of eelgrass in 2016-2019 is 0 acres, which is a decrease of 100%. Since 1990, the trend in eelgrass cover in this assessment zone could not be determined because the eelgrass cover has been zero for most years since 1981. The thresholds for impairment are either a loss of more than 20% of the historic extent of eelgrass or a recent trend of greater than 20% loss.
Water Clarity (Light Attenuation Coefficient)	5-P / 5-P	Median=1.41 m^-1 (n=32). For an eelgrass restoration depth of 2 m, the light attenuation coefficient threshold is 0.75 m^-1. The recent mapping (2015 showed 2.4 acres, the first observed eelgrass since the 1996 mapping effort) showed eelgrass principally in the shallow areas. Older datasets had eelgrass growing in both the shallow and deeper habitat. The potential for the deeper habitat and the improved restoration potential provided by improved water clarity make the 2m restoration depth a valid target. Therefore, the impaired (5-P) listing from the 2018 303d list has been retained.
Total Nitrogen	5-Р / 5-Р	The median total nitrogen from 2014 through 2018 was 505 µg/L (n=46). This assessment zone experiences frequent dissolved oxygen concentrations well below 5 mg/L and, at times, below 2 mg/L. The daily average dissolved oxygen percent saturation falls below 75% nearly every year and in one recent year below 65%. During multiple years this assessment zone has also demonstrated super saturation over 125% including 24-hour averages unto 145% (2018). The chlorophyll-a concentration 90 <sup>th</sup> percentile was 13.0 (n=46) from 2014 through 2018. The eelgrass beds are severely degraded and the available light attenuation (median=1.41 m^-1 (n=32)) is poor. In the 2019 macroalgae annual report, the appreciable cover at Wagon Hill Farm did not show statistical decreases although that site has only been sampled 3-times (2013, 2015, 2018) making trend detection more difficult (Burdick, et al., 2020). The status of the indicators of

	nutrients and nutrient-related impacts has not changed, and continue to present a
	preponderance of evidence that eutrophication effects are ongoing. As such, the impairment for
	nitrogen has been retained.

















Oyster River Assessment Zone	Date			90th	
(1/1/2014-1/10/2020)	Count	Minimum	Median	Percentile	Maximum
CHLOROPHYLL A, CORRECTED FOR PHEOPHYTIN (ug/L)	46	0.4	4.9	13.0	66.9
CHLOROPHYLL A, UNCORRECTED FOR PHEOPHYTIN (ug/L)	0	-	-	-	-
CHLOROPHYLL A, Combined (ug/L)	46	0.0	4.9	13.0	66.9
LIGHT ATTENUATION COEFFICIENT (1/m)	32	0.69	1.41	2	3.15
TURBIDITY (NTU)	0	-	-	-	-
TURBIDITY (datalogger daily median) (NTU)	1,133	2.0	8.0	15.0	197.0
TSS (mg/L)	46	3.9	19.6	39.7	61.1
COLORED DISSOLVED ORGANIC MATTER (CDOM) (1/m)	0	-	-	-	-
DISSOLVED ORGANIC CARBON	46	2.0	3.8	6.0	8.6
DO-PPM-24HR-MIN-CP (mg/L)	571	1.2	5.9	6.9	8.6
DO-PPM-24HR-MIN-NCP (mg/L)	528	4.2	7.9	10.1	11.6
DO-PPM-GRAB-CP (mg/L)	0	-	-	-	-
DO-PPM-GRAB-NCP (mg/L)	5	10.1	11.4	-	12.8
DO-PERC-24H-MEAN-CP (% sat)	597	55.1	95.7	112.8	145.1
DO-PERC-24H-MEAN-NCP (% sat)		72.1	90.8	98.2	115.3
DO-PERC-2TIDE-GRAB-CP (% sat)		-	-	-	-
DO-PERC-2TIDE-GRAB-NCP (% sat)		95.7	103.2	-	108.4
DO-PERC-GRAB (% sat)	0	-	-	-	-
Day Ave of TN (ug N/L)		321	505	751	864
Day Ave of TDN (ug N/L)	46	179	365	518	677
Day Ave of DIN (NH3 + NO2/3) (ug N/L)	46	39	202	330	574
Day Ave of NH3 (ug N/L)	46	3	64	167	208
Day Ave of PON (ug N/L)	0	-	-	-	-
Day Ave of NO2/3 (ug N/L)	46	20	104	220	530
SALINITY-Grabs (pss)	104	0.0	19.0	26.8	30.6
SALINITY-Datalogger Daily Median (pss)	1,108	0.7	24.6	29.3	31.1
pH-grab	0	-	-	-	-
pH-24HR (min)	1,123	6.3	7.6	7.3*	8.0
pH-24HR (max)	1,123	7.4	7.9	8.1	8.8
Temperature	104	0.9	12.9	22.6	28.1
Temperature-Daily Median	1,840	1.8	17.9	23.5	27.6

## Assessment Zone = BELLAMY RIVER

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

As of the date of data retrieval (January 10, 2020) water quality data through 2018 had been uploaded to the Environmental Monitoring Database for this assessment zone. For this assessment zone, that means there is two additional year of data (2017, 2018) compared to the 2016 assessment but the 2019 data is not included.

	Aquatic Life Use Category 2016 /	
Indicator	2020/2022	2020/2022 Comment
Chlorophyll-a	3-PNS / 5-P	The calculated 90 <sup>th</sup> percentile chlorophyll-a in this assessment zone is 28.4 $\mu$ g/L (n = 21) and a maximum reading of 86.2 $\mu$ g/L. The chlorophyll-a indicator threshold to prevent low dissolved oxygen and preserve light for eelgrass is a 90 <sup>th</sup> percentile below 10 $\mu$ g/L. Although the probe based chlorophyll-a data (not used in the median above) collected in the assessment zone in 2017 and 2018 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 with the regular tidal cycles. Therefore, this assessment zone has been assessed as not supporting aquatic life based on chlorophyll-a.
Dissolved Oxygen (mg/L)	3-PNS / 5-P	This assessment zone had its first datalogger deployments in 2017 and 2018. 36 of 241 days (15%) of summer datalogger records experienced DO below 5 mg/L and 78 distinct events in the full record where DO fell below 5 mg/L. Additionally, 5 of the events saw DO fall below 3 mg/L. Many of the low DO events occurred in the night to early morning hours that coincided with low tide and these events lasted up to 5-hours around low-tide. In both 2017 and 2018 the DO below 5 mg/L started in mid-July. The added warmth of August and September of 2018 may have contributed in The available dissolved oxygen data discussed below was collected in 2017 and 2018 indicates there is a consistent moderate level of stress in the system and multiple occasions of severe stress when the DO goes below 3 mg/L. The frequency, duration, and magnitude of the low DO warrants an impairment. This assessment zone has been assessed as not supporting aquatic life due to low dissolved oxygen concentration.
Dissolved Oxygen (% Saturation)	3-PAS / 2-M	Based on the datalogger data-set, in 2017 there was one day that DO percent saturation 24-hour average fell to 74% and in 2018 there were 9 days including one day when the average fell to 62% (insufficient to trigger the magnitude of exceedance indicator). In 2018 there was a 4-consecutive day period wherein the 24-hour averages were below 75%. The earliest percent saturation below 75% was in mid-July. Counting just the summer critical period, there were 8 days (3%) in 2017 and 2018 (n=242 days of datalogger record) during which the 24-hour averages were below 75%. Similarly, counting all days of datalogger record, there were 10 days (2%) in 2017 and 2018 (n=436 days of datalogger record) during which the 24-hour averages were below 75%. Regardless of the time period, this indictor does not reach the 10% exceedance limit to suggest impairment. This assessment zone has been assessed as supporting aquatic life based on dissolved oxygen percent saturation.
Estuarine Bioassessments (eelgrass)	5-P / 5-P	The historical extent of eelgrass in this assessment zone was 66.9 acres from the 1948, 1962, 1980, and 1981 datasets. Some eelgrass was found in 2004 (0.8 acres). The median current extent of eelgrass in 2016-2019 is 0 acres, which is a decrease of 100%. Since 1990, the trend in eelgrass cover in this assessment zone could not be determined because the eelgrass cover has been zero for most years since 1981. The thresholds for impairment are either a loss of more than 20% of the historic extent of eelgrass or a recent trend of greater than 20% loss.
Water Clarity (Light Attenuation Coefficient)	3-PNS / 5-P	Median water clarity is 1.88 m <sup>-1</sup> (n=15). For an eelgrass restoration depth of 2 m, the light attenuation coefficient threshold is 0.75 m <sup>-1</sup> . Given the eelgrass condition and the available light data, this assessment zone has been assessed as not supporting aquatic life integrity due to light attenuation.



















Bellamy River Assessment Zone				90th	
(1/1/2014-1/10/2020)	Count	Minimum	Median	Percentile	Maximum
CHLOROPHYLL A, CORRECTED FOR PHEOPHYTIN (ug/L)		0.6	3.9	35.8	86.2
CHLOROPHYLL A, UNCORRECTED FOR PHEOPHYTIN (ug/L)		2.0	5.3	-	6.0
CHLOROPHYLL A, Combined (ug/L)		0.6	4.1	28.4	86.2
LIGHT ATTENUATION COEFFICIENT (1/m)		1.12	1.88	2.51	2.87
TURBIDITY (NTU)		-	-	-	-
TURBIDITY (datalogger daily median) (NTU)		3.0	7.0	11.0	47.0
TSS (mg/L)		9.3	21.3	49.9	57.4
COLORED DISSOLVED ORGANIC MATTER (CDOM) (1/m)		-	-	-	-
DISSOLVED ORGANIC CARBON		2.8	4.8	7.3	8.4
DO-PPM-24HR-MIN-CP (mg/L)		1.9	5.9	6.7	8.3
DO-PPM-24HR-MIN-NCP (mg/L)		4.4	8.1	9.9	11.1
DO-PPM-GRAB-CP (mg/L)		5.9	6.3	-	8.5
DO-PPM-GRAB-NCP (mg/L)	2	11.2	11.7	-	12.2
DO-PERC-24H-MEAN-CP (% sat)	242	61.7	94.5	110.9	139.0
DO-PERC-24H-MEAN-NCP (% sat)	194	71.1	89.5	96.4	106.6
DO-PERC-2TIDE-GRAB-CP (% sat)	0	-	-	-	-
DO-PERC-2TIDE-GRAB-NCP (% sat)	2	96.2	102.6	-	109.0
DO-PERC-GRAB (% sat)		93.7	94.1	-	94.4
Day Ave of TN (ug N/L)		326	471	661	1,140
Day Ave of TDN (ug N/L)		216	313	416	501
Day Ave of DIN (NH3 + NO2/3) (ug N/L)		38	129	208	243
Day Ave of NH3 (ug N/L)		3	35	94	154
Day Ave of PON (ug N/L)		240	315	-	390
Day Ave of NO2/3 (ug N/L)		23	89	155	176
SALINITY-Grabs (pss)		0.1	22.5	27.8	30.7
SALINITY-Datalogger Daily Median (pss)		1.6	21.9	27.8	28.9
pH-grab	3	7.2	7.7	-	7.9
pH-24HR (min)	417	6.8	7.5	7.2*	7.9
pH-24HR (max)	417	7.5	8.0	8.1	8.5
Temperature		1.0	13.9	21.5	25.6
Temperature-Daily Median		3.7	18.6	24.5	27.8

## Assessment Zone = LITTLE BAY

(NHEST600030904-06-10, NHEST600030904-06-11, NHEST600030904-06-14, NHEST600030904-06-15, NHEST600030904-06-18, NHEST600030904-06-19, NHEST600030904-06-20)

As of the date of data retrieval (January 10, 2020) water quality data through 2018 had been uploaded to the Environmental Monitoring Database for this assessment zone. For this assessment zone, that means there are three additional years of data (2016, 2017, 2018) compared to the 2016 assessment but the 2019 data is not included. There were two new stations to the Little Bay assessment zone. In 2017 (Jun-Dec) a datalogger was deployed in at GRBLB and in 2018 (May-Nov) grab samples for chemistry and chlorophyll-a were collected and a datalogger deployed at GRBULB.

Indicator	Aquatic Life Use Category 2016 / 2020/2022	2020/2022 Comment
Chlorophyll-a	3-PNS / 3-PNS	The calculated 90 <sup>th</sup> percentile chlorophyll-a in this assessment zone is 11.4 $\mu$ g/L (n = 67) and a maximum reading of 25.2 $\mu$ g/L. The dataset includes the new GRBULB (2018) sampling site. The chlorophyll-a indicator threshold to prevent low dissolved oxygen and preserve light for eelgrass is a 90 <sup>th</sup> percentile below 10 $\mu$ g/L. Although the multiple probe based chlorophyll-a data (2017 and 2018) (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 did not show large spikes in chlorophyll-a. As chlorophyll-a is marginally above the assessment threshold, one of the response variables is fine, and the other is marginal bad, chlorophyll-a has been assessed as Insufficient Information – Potentially Not Supporting.
Dissolved Oxygen (mg/L)	2-G / 2-G	This assessment zone did not have a datalogger until 2017, only surface (0.5m below surface) grab sample measurements (GRBAP) for dissolved oxygen concentration. A datalogger was deployed in 2017 at GRBLB from June-December and in 2018 at GRBULB from May-November. The available data indicates that this assessment zone meets the dissolved oxygen concentration criteria.
Dissolved Oxygen (% Saturation)	2-G / 2-G	This assessment zone did not have a datalogger until 2017, only surface (0.5m below surface) grab sample measurements (GRBAP) to evaluate against the dissolved oxygen 24-hour average percent saturation. A datalogger was deployed in 2017 at GRBLB from June-December and in 2018 at GRBULB from May-November. The available data indicates that this assessment zone's dissolved oxygen percent saturation is good.
Estuarine Bioassessments (eelgrass)	5-Р / 5-Р	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 2016-2019 is 3.6 acres. While 2019 had the most eelgrass since 2012 there is an overall a decrease of 98.6%. There is no significant trend in eelgrass cover in this assessment zone since 1990. The thresholds for impairment are either a loss of more than 20% of the historic extent of eelgrass or a recent trend of greater than 20% loss.
Water Clarity (Light Attenuation Coefficient)	5-M / 5-M	The dataset includes the new GRBULB (2018) sampling site in addition the annual data at GRBAP. Median=1.19 m^-1 (n=53). 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 2018 303d list has been retained.
Total Nitrogen	3-PNS / 3-PNS	The dataset includes the new GRBULB (2018) sampling site in addition the annual data at GRBAP. The median total nitrogen from 2014 through 2018 was 314 $\mu$ g/L (n=68). Dr. Howes indicated (Howes, 2019) a growing season (May-Sept) average of 320-350 ug/L "should be protective of that resource [Great Bay system] based on [his] experience with nearby Massachusetts estuarine waters." As indicated here, the median total nitrogen from 2014 through 2019 was 314 $\mu$ g/L
	(n=68). The average of the same 68 samples is 328 ug/L over the full calendar year and 308 ug/L	
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	(n=32) in the growing season.	
	Based on grab samples from 2014-2016 and a mix of grab samples and dataloggers from 2017-	
	2018, the measurements in this assessment zone do not demonstrate dissolved oxygen	
	concentration exceedances and there were only occasional grab samples at or below 75%	
	saturation. The calculated 90 <sup>th</sup> percentile chlorophyll-a in this assessment zone is 11.4 $\mu$ g/L (n =	
	67) and a maximum reading of 25.2 $\mu$ g/L. Chlorophyll-a is just above the threshold described in	
	the CALM but dissolved oxygen problems are not evident in the Little Bay grab or datalogger	
	data. The eelgrass beds are severely degraded (98.6% reduction from historic) and the available	
	light attenuation (median=1.19 m^-1 (n=53)) is poor. For shallow systems, it is expected that	
	changes in macroalgae will precede changes in phytoplankton (McGlathery, Sundbäck, &	
	Anderson, 2007) (Valiela, et al., 1997), as appears to be occurring in the Great Bay Estuary.	
	Burdick et al. (Burdick, Mathieson, Peter, & Sydney, 2016) note that, "Monitoring results from	
	2014 show high levels of cover of nuisance green and red algae (Ulva and Gracilaria,	
	respectively) at all sites except near the mouth of the Estuary." That study included several sites	
	within Little Bay. In the 2019 macroalgae annual report, the appreciable cover at Cedar Point	
	(near the mouth of the Bellamy) appears to have a visually downwards trend in green macroalgae	
	but did not show statistical decreases although that site has only been sampled 3-times (2013,	
	2015, 2018) making trend detection more difficult (Burdick, et al., 2020). The status of the	
	indicators of nutrients and nutrient-related impacts do not present a preponderance of evidence	
	that eutrophication effects are occurring in this zone. While eelgrass has been lost and light	
	attenuation is often not sufficient, DO levels are better than the levels of concern, chlorophyll-a is	
	close to the assessment indicator threshold and TN levels are within protective levels (Howes,	
	2019) with few high measurements above 500 ug/L (only 2 of 68 samples). This assessment zone	
	has been assessed as insufficient information – potentially not supporting (3-PNS) for total	
	nitrogen.	





(n>=9)











Little Bay Assessment Zone				90th	
(1/1/2014-1/10/2020)	Count	Minimum	Median	Percentile	Maximum
CHLOROPHYLL A, CORRECTED FOR PHEOPHYTIN (ug/L)	65	0.6	4.0	11.8	25.2
CHLOROPHYLL A, UNCORRECTED FOR PHEOPHYTIN (ug/L)	2	2.9	4.6	-	6.3
CHLOROPHYLL A, Combined (ug/L)	67	0.6	4.0	11.4	25.2
LIGHT ATTENUATION COEFFICIENT (1/m)	53	0.48	1.19	1.85	2.22
TURBIDITY (NTU)	0	-	-	-	-
TURBIDITY (datalogger daily median) (NTU)	391	2.0	4.0	6.0	12.0
TSS (mg/L)	58	10.0	19.1	28.1	43.2
COLORED DISSOLVED ORGANIC MATTER (CDOM) (1/m)	0	-	-	-	-
DISSOLVED ORGANIC CARBON	66	1.5	2.7	4.0	7.0
DO-PPM-24HR-MIN-CP (mg/L)	240	5.9	7.5	8.3	9.5
DO-PPM-24HR-MIN-NCP (mg/L)	151	6.9	8.3	9.5	11.2
DO-PPM-GRAB-CP (mg/L)	21	6.0	7.7	9.2	9.7
DO-PPM-GRAB-NCP (mg/L)	39	7.5	11.1	12.8	14.0
DO-PERC-24H-MEAN-CP (% sat)	235	84.1	101.6	109.5	122.1
DO-PERC-24H-MEAN-NCP (% sat)	147	83.2	92.5	99.6	119.9
DO-PERC-2TIDE-GRAB-CP (% sat)	19	52.2	102.3	115.9	118.8
DO-PERC-2TIDE-GRAB-NCP (% sat)	38	83.8	97.6	112.0	114.9
DO-PERC-GRAB (% sat)	1	100.3	100.3	-	100.3
Day Ave of TN (ug N/L)	68	202	314	447	524
Day Ave of TDN (ug N/L)	66	128	207	339	479
Day Ave of DIN (NH3 + NO2/3) (ug N/L)	68	8	92	221	265
Day Ave of NH3 (ug N/L)	68	3	27	60	129
Day Ave of PON (ug N/L)	0	-	-	-	-
Day Ave of NO2/3 (ug N/L)	68	3	61	169	226
SALINITY-Grabs (pss)	242	0.1	25.4	28.9	31.0
SALINITY-Datalogger Daily Median (pss)	872	0.0	25.0	29.3	30.6
pH-grab	2	7.9	8.0	-	8.1
pH-24HR (min)	391	7.4	7.9	7.7*	8.1
pH-24HR (max)	391	7.6	8.0	8.1	8.4
Temperature	243	-1.5	14.6	21.8	28.6
Temperature-Daily Median	5,581	2.2	17.6	21.1	24.6

# Assessment Zone = COCHECO RIVER

(NHEST600030608-01)

As of the date of data retrieval (January 10, 2020) water quality data through 2018 had been uploaded to the Environmental Monitoring Database for this assessment zone. For this assessment zone, that means there is one additional year of data (2018) compared to the 2018 assessment but the 2019 data is not included.

	Aquatic Life Use Category 2018 /	
Indicator	2020/2022	2020/2022 Comment
Chlorophyll-a	5-P / 5-P	The calculated 90 <sup>th</sup> percentile chlorophyll-a in this assessment zone is 16.1 $\mu$ g/L (n = 71) and a maximum reading of 79 $\mu$ g/L. The chlorophyll-a indicator threshold to prevent low dissolved oxygen is a 90 <sup>th</sup> percentile below 10 $\mu$ g/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.
Dissolved Oxygen (mg/L)	5-M / 5-M	Following the 10% method described in the 2020/2022 CALM, this parameter would be categorized as impaired (42 of 406 days of summer dataloggers few below 5 mg/L, or 10.3% of the days). 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 threshold (< 4.5 mg/L) was layered into the assessment process to address major exceedances and exceedances beyond all normal measurement errors. Of the overall "current" dataset, there were 42 days on which DO fell below 5 mg/L; there were 9 days on which DO fell below 4 mg/L; there were 3 days on which DO fell below 3 mg/; and there was 1 day on which DO fell below 2 mg/L. While the most severe DO depletion occurred in 2014 and 2015, the DO depletion is ongoing as of the 2018 dataset. Given the concerted effort by the municipalities to reduce nutrient loading through infrastructure investments, nonpoint source controls and stormwater ordinances, NHDES anticipates that the condition will continue to improve in the coming years.
Dissolved Oxygen (% Saturation)	2-M / 2-M	Dissolved oxygen percent saturation has been assessed using dataloggers from 2012 through 2018. On only 7-occasions did the critical summer period 24-hour average percent saturation fall below 75% (1.5% of measure days) with a 24-hour minimum of 70% saturation.
Estuarine Bioassessments (eelgrass)	No Std/ No Std	Not applicable. Eelgrass habitat has not historically existed in this assessment zone.
Water Clarity (Light Attenuation Coefficient)	No Std/ No Std	Not applicable. The water clarity has not been assessed because eelgrass has not historically existed in this assessment zone.
Total Nitrogen	5-M / 5-M	The median total nitrogen from 2014 through 2019 was 493 µg/L (n=59). It must be noted that recent total nitrogen reductions have occurred due to infrastructure investments by the municipalities (Rochester WWTP reductions in 2014 and Dover WWTP began reductions in 2015). This assessment zone experienced periodic dissolved oxygen concentrations below 5 mg/L in 2014 through 2018 and as low as 2 mg/L and periodic daily average dissolved saturation below 75%. The chlorophyll-a concentration 90th percentile was 16.1 µg/L (n = 71) and a maximum

reading of 79 µg/L. Although the probe based chlorophyll-a data (not used in the median above) was qualified as "estimated" due to poor correlation between probe and extracted chlorophyll-a grab sample data, the relative biomass is valid and demonstrates that chlorophyll-a biomass can be quite high depending upon the timing on the tide cycle. The Cocheco River appears to be a system in flux. The 2016 TSD (NHDES, May 8, 2017) provided graphics and accompanying narrative to demonstrate that the growth of algae is causing dissolved oxygen to fall below State standards. The concentration of total nitrogen is high enough, especially at low tide and lower river flow conditions, to result in these algal blooms (see the Detailed Cocheco River 2015 Datalogger Evaluation section in the 2016 TSD (NHDES, May 8, 2017) ) It is not clear at this time.
loads of nitrogen or if the historically higher loads are still flushing through the ecosystem. The status of the indicators of nutrients and nutrient-related impacts has not changed, and continue to present a preponderance of evidence that eutrophication effects are ongoing. While there has been a rapid decrease in nutrient loading and improved conditions expected in the coming years, the response datasets still warrant nitrogen impairment under New Hampshire's narrative standard.















Cocheco River Assessment Zone				90th	
(1/1/2014-1/10/2020)	Count	Minimum	Median	Percentile	Maximum
CHLOROPHYLL A, CORRECTED FOR PHEOPHYTIN (ug/L)	59	0.4	3.7	16.4	79.0
CHLOROPHYLL A, UNCORRECTED FOR PHEOPHYTIN (ug/L)	12	0.2	1.8	4.2	4.9
CHLOROPHYLL A, Combined (ug/L)	71	0.2	2.9	16.1	79.0
LIGHT ATTENUATION COEFFICIENT (1/m)	43	0.76	1.32	2.00	4.99
TURBIDITY (NTU)	19	1.3	3.9	5.1	8.5
TURBIDITY (datalogger daily median) (NTU)	754	0.2	6.0	11.0	1,222.0
TSS (mg/L)	54	2.1	11.7	21.8	28.4
COLORED DISSOLVED ORGANIC MATTER (CDOM) (1/m)	0	-	-	-	-
DISSOLVED ORGANIC CARBON	42	2.0	3.8	6.7	13.4
DO-PPM-24HR-MIN-CP (mg/L)	406	2.0	6.2	7.5	9.3
DO-PPM-24HR-MIN-NCP (mg/L)	340	3.8	8.4	10.3	13.0
DO-PPM-GRAB-CP (mg/L)	23	6.1	7.3	8.2	8.6
DO-PPM-GRAB-NCP (mg/L)	3	9.5	10.7	-	10.9
DO-PERC-24H-MEAN-CP (% sat)	403	69.6	93.1	107.1	129.9
DO-PERC-24H-MEAN-NCP (% sat)	340	78.1	90.1	99.2	105.5
DO-PERC-2TIDE-GRAB-CP (% sat)	0	-	-	-	-
DO-PERC-2TIDE-GRAB-NCP (% sat)	3	52.0	93.5	-	106.9
DO-PERC-GRAB (% sat)	25	79.3	95.2	118.5	133.7
Day Ave of TN (ug N/L)	59	253	493	746	840
Day Ave of TDN (ug N/L)	42	167	360	459	536
Day Ave of DIN (NH3 + NO2/3) (ug N/L)	60	6	170	289	408
Day Ave of NH3 (ug N/L)	60	3	29	61	109
Day Ave of PON (ug N/L)	19	5	115	350	488
Day Ave of NO2/3 (ug N/L)	60	2	131	254	357
SALINITY-Grabs (pss)	54	0.2	18.0	26.0	26.8
SALINITY-Datalogger Daily Median (pss)	769	0.1	21.1	25.6	28.8
pH-grab	23	7.2	7.7	8.0	10.8
pH-24HR (min)	751	6.2	7.5	7.11*	8.1
pH-24HR (max)	751	7.1	7.9	8.1	8.5
Temperature	55	2.3	20.8	24.9	25.9
Temperature-Daily Median	788	1.4	18.0	23.7	25.9

### Assessment Zone = SALMON FALLS RIVER (NHEST600030406-01)

As of the date of data retrieval (January 10, 2020) water quality data through 2018 had been uploaded to the Environmental Monitoring Database for this assessment zone. For this assessment zone, that means there is one year of additional datalogger data (2017) and one year of additional grab sample data (2018) compared to the 2018 assessment but the 2019 data is not included.

	Aquatic Life Use Category 2018 /	
Indicator	2020/2022	2020/2022 Comment
Chlorophyll-a	5-P / 5-P	The calculated 90 <sup>th</sup> percentile chlorophyll-a in this assessment zone is 24.3 $\mu$ g/L (n = 22) and a maximum reading of 31 $\mu$ g/L. The chlorophyll-a indicator threshold to prevent low dissolved oxygen is a 90 <sup>th</sup> percentile below 10 $\mu$ g/L. The chlorophyll-a impairment has been retained.
Dissolved Oxygen (mg/L)	5-P / 5-P	Dissolved oxygen concentration measurements in this assessment zone fall below the 5 mg/L criteria every year. In most years a portion of those measurements fall below 4 mg/L, down to 3.1 mg/L in 2017 and in 2012 there were many measurements below 1 mg/L, as such, this impairment is considered severe.
Dissolved Oxygen (% Saturation)	5-M / 5-M	Dissolved oxygen 24-hour average percent saturation measurements in this assessment zone fall below the 75% indicator criteria every year. In 2012 many of the datalogger based 24-hour averages were below 50%. The data suggests that the aquatic life use is impaired, as such, dissolved oxygen 24-hour average percent saturation has been assessed as not supporting.
Estuarine Bioassessments (eelgrass)	No Std / No Std	Not applicable. Eelgrass habitat has not historically existed in this assessment zone.
Water Clarity (Light Attenuation Coefficient)	No Std / No Std	Not applicable. The water clarity has not been assessed because eelgrass has not historically existed in this assessment zone.
Total Nitrogen	5-M / 5-P	The median total nitrogen from 2014 through 2019 was 672 $\mu$ g/L (n=51). This assessment zone experiences frequent dissolved oxygen concentrations well below 5 mg/L and daily average saturation below 75%. During multiple years this assessment zone also demonstrated super saturation well over 125% The chlorophyll-a concentration 90 <sup>th</sup> percentile was 24.3 $\mu$ g/L (n = 22) and a maximum reading of 31 $\mu$ g/L. The status of the indicators of nutrients and nutrient-related impacts has not changed, and continue to present a preponderance of evidence that eutrophication effects are ongoing. As such, the impairment for nitrogen has been retained.













Salmon Falls River Assessment Zone	Date			90th	
(1/1/2014-1/10/2020)	Count	Minimum	Median	Percentile	Maximum
CHLOROPHYLL A, CORRECTED FOR PHEOPHYTIN (ug/L)	8	4.5	5.8	-	7.9
CHLOROPHYLL A, UNCORRECTED FOR PHEOPHYTIN (ug/L)	14	3.7	7.2	29.1	31.0
CHLOROPHYLL A, Combined (ug/L)	22	3.7	6.7	24.3	31.0
LIGHT ATTENUATION COEFFICIENT (1/m)	6	1.11	1.28	-	1.58
TURBIDITY (NTU)	6	2.2	2.7	-	3.3
TURBIDITY (datalogger daily median) (NTU)	310	0.0	3.0	9.8	332.2
TSS (mg/L)	6	5.4	15.9	-	31.5
COLORED DISSOLVED ORGANIC MATTER (CDOM) (1/m)	0	-	-	-	-
DISSOLVED ORGANIC CARBON	0	-	-	-	-
DO-PPM-24HR-MIN-CP (mg/L)	287	3.1	6.7	8.1	9.2
DO-PPM-24HR-MIN-NCP (mg/L)	32	4.0	6.2	7.2	8.0
DO-PPM-GRAB-CP (mg/L)	49	0.6	7.0	8.2	9.1
DO-PPM-GRAB-NCP (mg/L)	0	-	-	-	-
DO-PERC-24H-MEAN-CP (% sat)	280	60.5	98.3	117.7	141.9
DO-PERC-24H-MEAN-NCP (% sat)	28	61.4	82.8	94.7	96.8
DO-PERC-2TIDE-GRAB-CP (% sat)	0	-	-	-	-
DO-PERC-2TIDE-GRAB-NCP (% sat)	0	-	-	-	-
DO-PERC-GRAB (% sat)	49	38.7	84.3	96.6	117.2
Day Ave of TN (ug N/L)	51	300	672	1,346	5,775
Day Ave of TDN (ug N/L)	0	-	-	-	-
Day Ave of DIN (NH3 + NO2/3) (ug N/L)	51	28	219	405	689
Day Ave of NH3 (ug N/L)	51	12	77	187	251
Day Ave of PON (ug N/L)	0	-	-	-	-
Day Ave of NO2/3 (ug N/L)	51	17	131	274	491
SALINITY-Grabs (pss)	48	0.0	7.3	19.1	23.2
SALINITY-Datalogger Daily Median (pss)	273	0.1	18.6	23.4	26.5
pH-grab	49	6.4	7.1	7.7	8.0
pH-24HR (min)	260	6.2	7.5	7.1*	8.2
pH-24HR (max)	260	6.4	7.9	8.1	8.5
Temperature	51	18.0	23.0	25.4	26.0
Temperature-Daily Median	321	14.7	23.1	25.7	33.6

#### Assessment Zone = UPPER PISCATAQUA RIVER

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

As of the date of data retrieval (January 10, 2020) water quality data through 2018 had been uploaded to the Environmental Monitoring Database for this assessment zone. For this assessment zone, that means there are three additional years of data (2016, 2017, 2018) compared to the 2016 assessment but the 2019 data is not included.

	Aquatic Life Use Category	
Indicator	2016 / 2020/2022	2020/2022 Comment
Chlorophyll-a	2-M / 2-M	The calculated 90 <sup>th</sup> percentile chlorophyll-a in this assessment zone is 6.5 $\mu$ g/L (n = 89) and a maximum reading of 21.6 $\mu$ g/L. Although the probe based chlorophyll-a data (not used in the median above) collected from the UPR stations was qualified as "estimated" due to poor correlation between probe and extracted chlorophyll-a grab sample data, the relative biomass is valid and shows large spikes in chlorophyll-a. The chlorophyll-a indicator threshold to prevent low dissolved oxygen and preserve light for eelgrass is a 90 <sup>th</sup> percentile below 10 $\mu$ g/L.
Dissolved Oxygen (mg/L)	3-PNS / 2-M	Before 2012, only grab samples of dissolved oxygen had been collected in the Upper Piscataqua River assessment zone. The datalogger deployments from 2012-2014 indicated that there were infrequent but at time severe reductions in DO. 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). The data logger deployments fin 2015, 2017 and 2018 demonstrate no DO in the summer months below 5.6 mg/L. Acknowledging the existing data and changes in nutrient loading, this assessment zone is being assessed as supporting the dissolved oxygen criteria indicator.
Dissolved Oxygen (% Saturation)	3-PAS / 2-M	This assessment zone has only grab sample measurements for dissolved oxygen 24-hour average percent saturation up until 2011. In 2012-2015, 2017, and 2018 dataloggers were deployed and no 24-hour averages fell below 75%. The available data indicates that this assessment zone has good dissolved oxygen saturation.
Estuarine Bioassessments (eelgrass)	5-Р / 5-Р	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 2016-2019 is 0 acres, which is a decrease of 100%. In 2019 2.2 acres of eelgrass were mapped, the first eelgrass measured since the last bits of eelgrass that had been hanging on were lost after 2006. Since 1990, the trend in eelgrass cover in this assessment zone is a loss of 100%. The thresholds for impairment are either a loss of more than 20% of the historic extent of eelgrass or a recent trend of greater than 20% loss.
Water Clarity (Light Attenuation Coefficient)	5-M / 5-M	Median=1.03 m^-1 (n=72). For an eelgrass restoration depth of 2 m, the light attenuation coefficient threshold is 0.75 m^-1. This assessment zone historically had eelgrass growing in both the shallows and some in deeper habitat making the 2m restoration depth a valid target. Given how close the light attenuation coefficient is to the indicator threshold and to be consistent with other parts of the estuary, the impaired status has been retained as marginal (5-M).
Total Nitrogen	3-PNS / 3-PNS	The median total nitrogen from 2014 through 2019 was 355 $\mu$ g/L (n=89). The TN was lowest in 2015 (drought year) and has risen since but not as high as it was pre-2015. While the dissolved oxygen data showed that this assessment zone experienced short duration concentrations below the 5 mg/L criteria before 2015, the assessment zone has had no DO issues since that time. The 24-hour average dissolved oxygen percent saturation did not fall below 75% in any of the 4-years of datalogger records in the current period. The calculated 90 <sup>th</sup> percentile chlorophyll-a in this assessment zone is 6.5 $\mu$ g/L (n = 89) and a maximum reading of 21.6 $\mu$ g/L. Although the probe based chlorophyll-a data (not used in the median above) collected from the UPR stations was qualified as "estimated" due to poor correlation between probe and extracted chlorophyll-a grab

sample data, the relative biomass is valid and shows moderate spikes in chlorophyll-a. The grab sample-based light attenuation (median=1.03 m^-1, n=72) is poor suggesting strong resuspension in the system. For shallow systems, it is expected that changes in macroalgae will precede changes in phytoplankton (McGlathery, Sundbäck, & Anderson, 2007) (Valiela, et al., 1997), as appears to be occurring in the Great Bay Estuary. The foremost authority on macroalgae for this estuary, Dr. Arthur C. Mathieson, commented on the draft 2012 303(d) that he remained concerned about the macroalgae and epiphyte conditions in Great Bay estuary (NHDES, 2013). In the 2019 macroalgae annual report, the appreciable cover at Hilton Point appears to have a visually downwards trend in green macroalgae but did not show statistical decreases in any macroalgae, although that site has only been sampled 3-times (2013, 2015, 2018) making trend detection more difficult (Burdick, et al., 2020). The status of the indicators of nutrients and nutrient-related impacts do not present a preponderance of evidence that eutrophication effects are occurring in this zone. While eelgrass has been lost and light attenuation is typically not sufficient, DO and chlorophyll a levels in this zone are good and the TN levels are elevated but typically within the restoration range. Additionally, the point-source nutrient load to this assessment zone is rapidly decreasing due to ongoing work at WWTFs by the nearby municipalities (Rochester reductions in 2014 and Dover began reductions in 2015, Portsmouth to be online in 2020). As such, this assessment zone has been assessed as insufficient information –
be online in 2020). As such, this assessment zone has been assessed as insufficient information – potentially not supporting (3-PNS) for total nitrogen.





10

5

0

2000

2002

2004

2006

2008

2010

2012

2014

2016

2018

2020

Corrected for Pheophytin

Chlorophyll a,

(n>=9)

Uncorrected for Pheophytin

Annual 90th Percentile (All Chlorophyll a)

Δ













Upper Piscataqua River Assessment Zone	Date			90th	
(1/1/2014-1/10/2020)	Count	Minimum	Median	Percentile	Maximum
CHLOROPHYLL A, CORRECTED FOR PHEOPHYTIN (ug/L)	76	0.5	3.3	6.9	21.6
CHLOROPHYLL A, UNCORRECTED FOR PHEOPHYTIN (ug/L)	13	0.1	1.6	2.5	2.6
CHLOROPHYLL A, Combined (ug/L)	89	0.1	2.9	6.5	21.6
LIGHT ATTENUATION COEFFICIENT (1/m)	72	0.66	1.03	1.79	3.56
TURBIDITY (NTU)	32	1.4	2.6	3.5	4.1
TURBIDITY (datalogger daily median) (NTU)	517	1.1	5.0	12.0	432.0
TSS (mg/L)	82	3.5	16.2	29.1	43.4
COLORED DISSOLVED ORGANIC MATTER (CDOM) (1/m)	0	-	-	-	-
DISSOLVED ORGANIC CARBON	70	1.6	2.9	5.2	11.3
DO-PPM-24HR-MIN-CP (mg/L)	437	2.4	7.0	7.6	9.5
DO-PPM-24HR-MIN-NCP (mg/L)	186	4.5	8.2	10.0	11.1
DO-PPM-GRAB-CP (mg/L)	22	5.6	7.6	8.4	10.2
DO-PPM-GRAB-NCP (mg/L)	20	7.5	10.0	12.1	13.6
DO-PERC-24H-MEAN-CP (% sat)	451	79.9	97.8	108.8	126.6
DO-PERC-24H-MEAN-NCP (% sat)	180	83.7	92.8	97.6	107.8
DO-PERC-2TIDE-GRAB-CP (% sat)	9	81.2	97.0	115.1	115.1
DO-PERC-2TIDE-GRAB-NCP (% sat)	13	86.1	92.8	107.4	109.2
DO-PERC-GRAB (% sat)	19	91.4	97.1	102.0	139.7
Day Ave of TN (ug N/L)	89	169	355	550	810
Day Ave of TDN (ug N/L)	70	121	240	375	570
Day Ave of DIN (NH3 + NO2/3) (ug N/L)	89	6	106	200	259
Day Ave of NH3 (ug N/L)	89	3	28	60	79
Day Ave of PON (ug N/L)	24	37	75	223	284
Day Ave of NO2/3 (ug N/L)	89	3	75	151	232
SALINITY-Grabs (pss)	101	0.7	24.1	29.9	30.9
SALINITY-Datalogger Daily Median (pss)	666	5.8	26.3	29.1	31.2
pH-grab	7	7.2	7.7	-	7.9
pH-24HR (min)	666	6.6	7.7	7.3*	8.1
pH-24HR (max)	666	7.7	8.0	8.2	8.5
Temperature	102	1.1	19.3	23.7	26.2
Temperature-Daily Median	666	3.1	18.9	22.3	24.5

## Assessment Zone = LOWER PISCATAQUA RIVER - NORTH (NHEST600031001-02-01)

As of the date of data retrieval (January 10, 2020) water quality data through 2018 had been uploaded to the Environmental Monitoring Database for this assessment zone. For this assessment zone, that means there is one additional year of datalogger data (2017) compared to the 2018 assessment but the 2019 data is not included.

	Aquatic Life Use Category 2018 /	
Indicator	2020/2022	2020/2022 Comment
Chlorophyll-a	3-PAS / 3-PAS	The calculated 90 <sup>th</sup> percentile chlorophyll-a in this assessment zone cannot be calculated due to the presence of only 7 measured values in the current period. Of that dataset the minimum and maximum are 1.8 and 3.1 ug/L. The chlorophyll-a indicator threshold to prevent low dissolved oxygen and preserve light for eelgrass is a 90 <sup>th</sup> percentile below 10 $\mu$ g/L.
Dissolved Oxygen (mg/L)	2-G / 2-G	This assessment zone had a datalogger deployment in 2013, 2015 and 2017. During those periods no dissolved oxygen concentration measurements fell below 6.7 mg/L. The available data indicates that this assessment zone meets the dissolved oxygen concentration criteria.
Dissolved Oxygen (% Saturation)	2-G / 2-G	This assessment zone had datalogger deployments in 2013, 2015 and 2017. During those periods no 24 hour averages fell below 82%. The available data indicates that this assessment zone has good dissolved oxygen saturation .
Estuarine Bioassessments (eelgrass)	5-Р / 5-Р	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 2016-2019 is 3 acres, which is a decrease of 95.1%. Since 1990, the trend in eelgrass cover in this assessment zone is a loss of 49.7%. The thresholds for impairment are either a loss of more than 20% of the historic extent of eelgrass or a recent trend of greater than 20% loss.
Water Clarity (Light Attenuation Coefficient)	3-PNS/ 3-ND	There have been no light measurements collected since 2013. Measurements from 2002 to 2013 ranged from 0.05 to 1.3 m^-1. 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. As there is no measured light attenuation, this zone remains assessed as "no data."
Total Nitrogen	3-PAS / 3-PAS	The median total nitrogen from 2014 through 2019 was 300 µg/L (n=3). Dissolved oxygen concentration remains above 5 mg/L and saturation remains above 75% daily average in the available data. The limited chlorophyll-a data suggests that this assessment zone would meet the chlorophyll-a indicator threshold. The eelgrass beds are severely degraded. There is no longer any current light attenuation data. The limited response dataset does not provide enough evidence to make a full assessment, however the limited indicators of nutrients and nutrient-related impacts do not present a preponderance of evidence that eutrophication effects are occurring in this zone. As such, the assessment zone has been assessed as insufficient information-potential attaining standards for total nitrogen.

















Lower Piscataqua River - North Assessment Zone	Date			90th	
(1/1/2014-1/10/2020)	Count	Minimum	Median	Percentile	Maximum
CHLOROPHYLL A, CORRECTED FOR PHEOPHYTIN (ug/L)	0	-	-	-	-
CHLOROPHYLL A, UNCORRECTED FOR PHEOPHYTIN (ug/L)	7	1.5	1.8	-	3.1
CHLOROPHYLL A, Combined (ug/L)	7	0.0	1.8	-	3.1
LIGHT ATTENUATION COEFFICIENT (1/m)	0	-	-	-	-
TURBIDITY (NTU)	0	-	-	-	-
TURBIDITY (datalogger daily median) (NTU)	150	1.0	2.0	3.0	7.0
TSS (mg/L)	6	10.0	17.5	-	28.0
COLORED DISSOLVED ORGANIC MATTER (CDOM) (1/m)	0	-	-	-	-
DISSOLVED ORGANIC CARBON	0	-	-	-	-
DO-PPM-24HR-MIN-CP (mg/L)	148	6.8	7.6	8.3	9.6
DO-PPM-24HR-MIN-NCP (mg/L)	69	6.7	7.9	9.0	9.4
DO-PPM-GRAB-CP (mg/L)	2	7.8	7.9	-	7.9
DO-PPM-GRAB-NCP (mg/L)	1	7.4	7.4	-	7.4
DO-PERC-24H-MEAN-CP (% sat)	143	90.6	101.7	110.9	125.5
DO-PERC-24H-MEAN-NCP (% sat)	65	81.8	89.5	95.2	100.1
DO-PERC-2TIDE-GRAB-CP (% sat)	0	-	-	-	-
DO-PERC-2TIDE-GRAB-NCP (% sat)	0	-	-	-	-
DO-PERC-GRAB (% sat)	2	89.6	95.0	-	100.4
Day Ave of TN (ug N/L)	3	100	300	-	343
Day Ave of TDN (ug N/L)	0	-	-	-	-
Day Ave of DIN (NH3 + NO2/3) (ug N/L)	3	52	53	-	73
Day Ave of NH3 (ug N/L)	7	10	38	-	57
Day Ave of PON (ug N/L)	0	-	-	-	-
Day Ave of NO2/3 (ug N/L)	3	10	10	-	35
SALINITY-Grabs (pss)	19	19.8	29.5	30.8	31.1
SALINITY-Datalogger Daily Median (pss)	217	24.9	30.5	31.2	31.6
pH-grab	2	7.7	7.9	-	8.0
pH-24HR (min)	141	7.7	7.9	7.8*	8.1
pH-24HR (max)	141	7.8	8.0	8.2	8.3
Temperature	19	1.6	16.6	19.1	19.4
Temperature-Daily Median	217	6.2	16.5	19.4	20.9

## Assessment Zone = LOWER PISCATAQUA RIVER - SOUTH (NHEST600031001-02-02)

As of the date of data retrieval (January 10, 2020) water quality data through 2018 had been uploaded to the Environmental Monitoring Database for this assessment zone. For this assessment zone, that means there are no additional years of data compared to the 2018 assessment.

Indicator	Aquatic Life Use Category 2018 / 2020/2022	2020/2022 Comment
Chlorophyll-a	3-PAS / 3-PAS	The calculated 90 <sup>th</sup> percentile chlorophyll-a in this assessment zone cannot be calculated due to the presence of only 8 measured values in the current period. Of that dataset the minimum and maximum are 1.7 and 13.1 ug/L. The chlorophyll-a indicator threshold to prevent low dissolved oxygen and preserve light for eelgrass is a 90 <sup>th</sup> percentile below 10 $\mu$ g/L.
Dissolved Oxygen (mg/L)	2-G / 2-G	This assessment zone had a datalogger deployment in 2015 and 2017. During those periods no dissolved oxygen concentration measurements fell below 7.1 mg/L. The available data indicates that this assessment zone meets the dissolved oxygen concentration criteria.
Dissolved Oxygen (% Saturation)	2-G / 2-G	This assessment zone had datalogger deployments in 2015 and 2017. During those periods no 24 hour averages fell below 90%. The available data indicates that this assessment zone has good dissolved oxygen saturation.
Estuarine Bioassessments (eelgrass)	5-P / 5-P	The historical extent of eelgrass in this assessment zone was 32.5 acres from the 1948, 1962, 1980, and 1981 datasets. The median current extent of eelgrass in 2016-2019 is 3.6 acres, which is a decrease of 89.1%. Since 1990, the trend in eelgrass cover in this assessment zone is a loss of 38.7%. The thresholds for impairment are either a loss of more than 20% of the historic extent of eelgrass or a recent trend of greater than 20% loss.
Water Clarity (Light Attenuation Coefficient)	3-PAS / 3-ND	There have been no light measurements collected since 2013. Measurements from 2002 to 2013 ranged from 0.3 to 0.7 m^-1. 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. As there is no measured light attenuation, this zone remains assessed as "no data."
Total Nitrogen	3-PAS / 3-PAS	The median total nitrogen from 2014 through 2019 was 272 µg/L (n=4). Dissolved oxygen concentration remains above 5 mg/L and saturation remains above 75% daily average in the available data. The limited chlorophyll-a data suggests that this assessment zone would meet chlorophyll-a indicator threshold. The eelgrass beds are severely degraded and there are no current light measurements to compare to the 2 m restoration depth. The limited response dataset does not provide enough evidence to make a full assessment, however the limited indicators of nutrients and nutrient-related impacts do not present a preponderance of evidence that eutrophication effects are occurring in this zone. As such, the assessment zone has been assessed as insufficient information-potential attaining standards for total nitrogen.


















Lower Piscataqua River - South Assessment Zone	Date			90th	
(1/1/2014-1/10/2020)	Count	Minimum	Median	Percentile	Maximum
CHLOROPHYLL A, CORRECTED FOR PHEOPHYTIN (ug/L)	0	-	-	-	-
CHLOROPHYLL A, UNCORRECTED FOR PHEOPHYTIN (ug/L)	8	1.1	1.7	-	13.1
CHLOROPHYLL A, Combined (ug/L)	8	0.0	1.7	-	13.1
LIGHT ATTENUATION COEFFICIENT (1/m)	0	-	-	-	-
TURBIDITY (NTU)	0	-	-	-	-
TURBIDITY (datalogger daily median) (NTU)	0	-	-	-	-
TSS (mg/L)	6	8.0	13.5	-	29.0
COLORED DISSOLVED ORGANIC MATTER (CDOM) (1/m)	0	-	-	-	-
DISSOLVED ORGANIC CARBON	0	-	-	-	-
DO-PPM-24HR-MIN-CP (mg/L)	72	7.0	7.6	8.1	8.2
DO-PPM-24HR-MIN-NCP (mg/L)	1	7.1	7.1	-	7.1
DO-PPM-GRAB-CP (mg/L)	4	7.6	8.0	-	8.6
DO-PPM-GRAB-NCP (mg/L)	1	7.9	7.9	-	7.9
DO-PERC-24H-MEAN-CP (% sat)	69	90.2	105.2	110.2	112.7
DO-PERC-24H-MEAN-NCP (% sat)	0	-	-	-	-
DO-PERC-2TIDE-GRAB-CP (% sat)	0	-	-	-	-
DO-PERC-2TIDE-GRAB-NCP (% sat)	0	-	-	-	-
DO-PERC-GRAB (% sat)	3	89.1	98.8	-	108.9
Day Ave of TN (ug N/L)	4	100	272	-	315
Day Ave of TDN (ug N/L)	0	-	-	-	-
Day Ave of DIN (NH3 + NO2/3) (ug N/L)	4	38	50	-	75
Day Ave of NH3 (ug N/L)	8	22	31	-	36
Day Ave of PON (ug N/L)	0	-	-	-	-
Day Ave of NO2/3 (ug N/L)	4	10	14	-	41
SALINITY-Grabs (pss)	8	28.3	30.3	-	32.3
SALINITY-Datalogger Daily Median (pss)	73	30.5	31.3	31.6	31.7
pH-grab	2	8.0	8.0	-	8.1
pH-24HR (min)	73	7.9	8.0	7.9*	8.0
pH-24HR (max)	73	7.9	8.1	8.1	8.1
Temperature	8	14.4	17.9	-	19.3
Temperature-Daily Median	73	13.7	17.4	19.1	19.7

### Assessment Zone = NORTH MILL POND (NHEST600031001-10)

As of the date of data retrieval (January 10, 2020) water quality data through 2018 had been uploaded to the Environmental Monitoring Database for this assessment zone. For this assessment zone, that means there are no additional years of data compared to the 2018 assessment.

Indicator	Aquatic Life Use Category 2018 / 2020/2022	2020/2022 Comment
Chlorophyll-a	3-ND / 3-ND	The chlorophyll-a indicator threshold to prevent low dissolved oxygen is a 90 <sup>th</sup> percentile below 10 µg/L. This assessment zone has no measurements for chlorophyll-a since 2005.
Dissolved Oxygen (mg/L)	3-ND / 3-ND	This assessment zone has only grab sample measurements for dissolved oxygen concentration and those measurements were only collected up through 2009. As such, this assessment zone has been assessed as 3-ND (No Data) for the dissolved oxygen concentration criteria.
Dissolved Oxygen (% Saturation)	3-ND / 3-ND	This assessment zone has only grab sample measurements for dissolved oxygen 24-hour average percent saturation and those measurements were only collected up through 2008. As such, this assessment zone has been assessed as 3-ND (No Data) for dissolved oxygen percent saturation .
Estuarine Bioassessments (eelgrass)	3-ND / 3-ND	No data has been collected in the current period.
Water Clarity (Light Attenuation Coefficient)	3-ND / 3-ND	No data has been collected in the current period.
Total Nitrogen	3-ND / 3-ND	There are no "current" total nitrogen data from which to calculate a median total nitrogen from 2012 through 2018. As such, this assessment zone cannot be assessed for total nitrogen.













North Mill Pond Assessment Zone	Date			90th	
(1/1/2014-1/10/2020)	Count	Minimum	Median	Percentile	Maximum
CHLOROPHYLL A, CORRECTED FOR PHEOPHYTIN (ug/L)	0	-	-	-	-
CHLOROPHYLL A, UNCORRECTED FOR PHEOPHYTIN (ug/L)	0	-	-	-	-
CHLOROPHYLL A, Combined (ug/L)	0	-	-	-	-
LIGHT ATTENUATION COEFFICIENT (1/m)	0	-	-	-	-
TURBIDITY (NTU)	0	-	-	-	-
TURBIDITY (datalogger daily median) (NTU)	0	-	-	-	-
TSS (mg/L)	0	-	-	-	-
COLORED DISSOLVED ORGANIC MATTER (CDOM) (1/m)	0	-	-	-	-
DISSOLVED ORGANIC CARBON	0	-	-	-	-
DO-PPM-24HR-MIN-CP (mg/L)	0	-	-	-	-
DO-PPM-24HR-MIN-NCP (mg/L)	0	-	-	-	-
DO-PPM-GRAB-CP (mg/L)	0	-	-	-	-
DO-PPM-GRAB-NCP (mg/L)	0	-	-	-	-
DO-PERC-24H-MEAN-CP (% sat)	0	-	-	-	-
DO-PERC-24H-MEAN-NCP (% sat)	0	-	-	-	-
DO-PERC-2TIDE-GRAB-CP (% sat)	0	-	-	-	-
DO-PERC-2TIDE-GRAB-NCP (% sat)	0	-	-	-	-
DO-PERC-GRAB (% sat)	0	-	-	-	-
Day Ave of TN (ug N/L)	0	-	-	-	-
Day Ave of TDN (ug N/L)	0	-	-	-	-
Day Ave of DIN (NH3 + NO2/3) (ug N/L)	0	-	-	-	-
Day Ave of NH3 (ug N/L)	0	-	-	-	-
Day Ave of PON (ug N/L)	0	-	-	-	-
Day Ave of NO2/3 (ug N/L)	0	-	-	-	-
SALINITY-Grabs (pss)	0	-	-	-	-
SALINITY-Datalogger Daily Median (pss)	0	-	-	-	-
pH-grab	0	-	-	-	-
pH-24HR (min)	0	-	-	-	-
pH-24HR (max)	0	-	-	-	-
Temperature	0	-	-	-	-
Temperature-Daily Median	0	-	-	-	-

# Assessment Zone = SOUTH MILL POND

(NHEST600031001-09)

As of the date of data retrieval (January 10, 2020) water quality data through 2018 had been uploaded to the Environmental Monitoring Database for this assessment zone. For this assessment zone, that means there are no additional years of data compared to the 2018 assessment.

Indicator	Aquatic Life Use Category 2018 / 2020/2022	2020/2022 Comment
Chlorophyll-a	3-ND / 3-ND	The chlorophyll-a indicator threshold to prevent low dissolved oxygen is a $90^{th}$ percentile below 10 µg/L. However, there is no chlorophyll-a data for this assessment zone.
Dissolved Oxygen (mg/L)	3-ND / 3-ND	This assessment zone has only grab sample measurements for dissolved oxygen concentration and those measurements were only collected up through 2009. As such, this assessment zone has been assessed as 3-ND (No Data) for the dissolved oxygen concentration criteria.
Dissolved Oxygen (% Saturation)	3-ND / 3-ND	This assessment zone has only grab sample measurements for dissolved oxygen 24-hour average percent saturation and those measurements were only collected up through 2008. As such, this assessment zone has been assessed as 3-ND (No Data) for dissolved oxygen percent saturation .
Estuarine Bioassessments (eelgrass)	3-PAS / 3-PAS	In 2016, a 0.012 acres (520 sq feet) patch of eelgrass was seen in South Mill Pond for the first time. While the patch was below the minimum mapping unit and not field verified, the mapper was confident that based on morphology and growth pattern the plant seen was indeed <i>Zostera marina</i> . As there is no known baseline for comparison and the mapping effort only represents a single year of presence, and not seen again in 2017, estuarine bioassessments (eelgrass) has been assessed as Insufficient Information – Potentially Attaining Standards.
Water Clarity (Light Attenuation Coefficient)	3-ND / 3-ND	No data has been collected in the current period.
Total Nitrogen	3-ND / 3-ND	There are no "current" total nitrogen data from which to calculate a median total nitrogen from 2012 through 2018. As such, this assessment zone cannot be assessed for total nitrogen.







0 2000

2002

2004

2006

2008

2010

2012

2014

2016

2018

2020

GRAB-NCP DO-PERC-2TIDE-

GRAB-CP

DO-SAT-GRAB

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South Mill Pond Assessment Zone	Date			90th	
(1/1/2014-1/10/2020)	Count	Minimum	Median	Percentile	Maximum
CHLOROPHYLL A, CORRECTED FOR PHEOPHYTIN (ug/L)	0	-	-	-	-
CHLOROPHYLL A, UNCORRECTED FOR PHEOPHYTIN (ug/L)	0	-	-	-	-
CHLOROPHYLL A, Combined (ug/L)	0	-	-	-	-
LIGHT ATTENUATION COEFFICIENT (1/m)	0	-	-	-	-
TURBIDITY (NTU)	0	-	-	-	-
TURBIDITY (datalogger daily median) (NTU)	0	-	-	-	-
TSS (mg/L)	0	-	-	-	-
COLORED DISSOLVED ORGANIC MATTER (CDOM) (1/m)	0	-	-	-	-
DISSOLVED ORGANIC CARBON	0	-	-	-	-
DO-PPM-24HR-MIN-CP (mg/L)	0	-	-	-	-
DO-PPM-24HR-MIN-NCP (mg/L)	0	-	-	-	-
DO-PPM-GRAB-CP (mg/L)	0	-	-	-	-
DO-PPM-GRAB-NCP (mg/L)	0	-	-	-	-
DO-PERC-24H-MEAN-CP (% sat)	0	-	-	-	-
DO-PERC-24H-MEAN-NCP (% sat)	0	-	-	-	-
DO-PERC-2TIDE-GRAB-CP (% sat)	0	-	-	-	-
DO-PERC-2TIDE-GRAB-NCP (% sat)	0	-	-	-	-
DO-PERC-GRAB (% sat)	0	-	-	-	-
Day Ave of TN (ug N/L)	0	-	-	-	-
Day Ave of TDN (ug N/L)	0	-	-	-	-
Day Ave of DIN (NH3 + NO2/3) (ug N/L)	0	-	-	-	-
Day Ave of NH3 (ug N/L)	0	-	-	-	-
Day Ave of PON (ug N/L)	0	-	-	-	-
Day Ave of NO2/3 (ug N/L)	0	-	-	-	-
SALINITY-Grabs (pss)	0	-	-	-	-
SALINITY-Datalogger Daily Median (pss)	0	-	-	-	-
pH-grab	0	-	-	-	-
pH-24HR (min)	0	-	-	-	-
pH-24HR (max)	0	-	-	-	-
Temperature	0	-	-	-	-
Temperature-Daily Median	0	-	-	-	-

# Assessment Zone = PORTSMOUTH HARBOR (NHEST600031001-11)

As of the date of data retrieval (January 10, 2020), data datalogger data through February 2018 and grab sample data through 2017 had been uploaded to the Environmental Monitoring Database for this assessment zone. For this assessment zone, that means there are three more years (2016, 2017, 2018) of datalogger data and two more years (2016, 2017) of grab samples compared to the 2016 assessment and the 2019 data is not included.

	Aquatic Life Use Category 2016 /	
Indicator Chlorophyll-a	2020/2022 2-G / 2-G	<b>2020/2022 Comment</b> The calculated 90 <sup>th</sup> percentile chlorophyll-a in this assessment zone is 5.8 $\mu$ g/L (n = 37) and a maximum reading of 14.6 $\mu$ g/L. The chlorophyll-a indicator threshold to prevent low dissolved oxygen and preserve light for eelgrass is a 90 <sup>th</sup> percentile below 10 $\mu$ g/L. The available data indicates that this assessment zone meets the chlorophyll-a indicator threshold.
Dissolved Oxygen (mg/L)	2-G / 2-G	This assessment zone has datalogger and grab measurements for dissolved oxygen concentration covering 2012 through 2018. No samples fell below 5 mg/L. The available data indicates that this assessment zone meets the dissolved oxygen concentration criteria.
Dissolved Oxygen (% Saturation)	2-G / 2-G	This assessment zone has 24-hour average datalogger and grab measurements for dissolved oxygen percent saturation covering 2012 through 2018. All 24-hour averages are above 75% saturation in the current period. The available data indicates that this assessment zone has good dissolved oxygen percent saturation.
Estuarine Bioassessments (eelgrass)	5-P / 5-P	The historical extent of eelgrass in this assessment zone was 227.7 acres from the 1948, 1962, 1980, and 1981 datasets. The median current extent of eelgrass in 2016-2019 is 87.1 acres, which is a decrease of 46.9%. Since 1990, the trend in eelgrass cover in this assessment zone is a loss of 38.9%. The thresholds for impairment are either a loss of more than 20% of the historic extent of eelgrass or a recent trend of greater than 20% loss.
Water Clarity (Light Attenuation Coefficient)	5-M / 5-M	Median=0.59 m <sup>-1</sup> (n=32). For an eelgrass restoration depth of 3 m, the light attenuation coefficient threshold is 0.5 m <sup>-1</sup> . This assessment zone historically had eelgrass growing in both the shallows and deeper habitat making the 3 m restoration depth a valid target. Further, a review of the location of the deep edge of the eelgrass suggests that the maximum depth of eelgrass survival is not as deep as it was in the past. Due to the proximity of the Portsmouth WWTF, the data through 2018 reflects the pre-upgrade period when there was still a large TSS load out of the discharge. The impaired (5-M) listing from the 2018 303d list has been retained.
Total Nitrogen	2-M / 2-M	The median total nitrogen from 2014 through 2019 was 228 µg/L (n=37). In the continuous data (2014-2018) the dissolved oxygen concentration always remains above 5 mg/L and saturation always remains above 75% daily average. The chlorophyll-a data indicates that this assessment zone meets the chlorophyll-a indicator threshold. The eelgrass beds are severely degraded. The available light attenuation data (median=0.59 m^-1, n=32) appears inadequate for the 3 m restoration depth but may be reflective the Total Suspended Solids (TSS) load from the pre-upgrade Portsmouth WWTF (upgrade nearing completion). For shallow systems, it is expected that changes in macroalgae will precede changes in phytoplankton (McGlathery, Sundbäck, & Anderson, 2007) (Valiela, et al., 1997). No direct sampling efforts have taken place to evaluate the extent of epiphytes and macrophytes however regarding macroalgae, Burdick et al. (Burdick, Mathieson, Peter, & Sydney, 2016) stated, "Monitoring results from 2014 show high levels of cover of nuisance green and red algae ( <i>Ulva</i> and <i>Gracilaria</i> , respectively) at all sites except near the mouth of the Estuary." The "mouth of the estuary site" is Four Tree Island, approximately 1 mile upstream from the Portsmouth Harbor assessment zone. In the 2019 macroalgae annual report, the appreciable cover at Four Tree Island is dominated by fucoids (brown) and intermittent nuisance seaweeds (reds and greens) but did not show a statistical trend, although that site has only been sampled 3-times (2014, 2016, 2019) making trend detection more difficult

(Burdick, et al., 2020). While the five-year median total nitrogen is remains slightly above the
estimated offshore total nitrogen concentration of 200 $\mu$ g/L, the data suggest that Portsmouth
Harbor total nitrogen has been decreasing over time with essentially offshore-like conditions in
2015 and 2016. The status of the indicators of nutrients and nutrient-related impacts do not
present a preponderance of evidence that eutrophication effects are occurring in this zone. While
eelgrass has been lost and light attenuation is often not sufficient, DO and chlorophyll a levels in
this zone are sufficient and the TN levels are only slightly elevated from the off-shore
concentration but well within the restoration range. As such, this assessment zone has been
assessed as marginally fully supporting (2-M) for total nitrogen.

















Portsmouth Harbor Assessment Zone	Date			90th	
(1/1/2014-1/10/2020)	Count	Minimum	Median	Percentile	Maximum
CHLOROPHYLL A, CORRECTED FOR PHEOPHYTIN (ug/L)	37	0.5	1.7	5.8	14.6
CHLOROPHYLL A, UNCORRECTED FOR PHEOPHYTIN (ug/L)	0	-	-	-	-
CHLOROPHYLL A, Combined (ug/L)	37	0.0	1.7	5.8	14.6
LIGHT ATTENUATION COEFFICIENT (1/m)	32	0.35	0.59	0.84	0.89
TURBIDITY (NTU)	0	-	-	-	-
TURBIDITY (datalogger daily median) (NTU)	1,383	0.0	1.0	2.7	96.7
TSS (mg/L)	33	13.4	18.8	24.5	34.4
COLORED DISSOLVED ORGANIC MATTER (CDOM) (1/m)	0	-	-	-	-
DISSOLVED ORGANIC CARBON	37	1.1	1.5	2.2	2.6
DO-PPM-24HR-MIN-CP (mg/L)	453	5.4	7.3	8.2	9.9
DO-PPM-24HR-MIN-NCP (mg/L)	905	6.1	9.6	11.1	11.9
DO-PPM-GRAB-CP (mg/L)	0	-	-	-	-
DO-PPM-GRAB-NCP (mg/L)	1	11.2	11.2	-	11.2
DO-PERC-24H-MEAN-CP (% sat)	462	77.7	98.7	106.7	127.3
DO-PERC-24H-MEAN-NCP (% sat)	908	78.0	97.7	105.9	117.9
DO-PERC-2TIDE-GRAB-CP (% sat)	0	-	-	-	-
DO-PERC-2TIDE-GRAB-NCP (% sat)	1	107.4	107.4	-	107.4
DO-PERC-GRAB (% sat)	0	-	-	-	-
Day Ave of TN (ug N/L)	37	127	228	312	393
Day Ave of TDN (ug N/L)	37	81	165	249	344
Day Ave of DIN (NH3 + NO2/3) (ug N/L)	37	18	86	174	288
Day Ave of NH3 (ug N/L)	37	3	25	54	100
Day Ave of PON (ug N/L)	0	-	-	-	-
Day Ave of NO2/3 (ug N/L)	37	11	52	148	285
SALINITY-Grabs (pss)	51	22.8	28.6	30.8	32.1
SALINITY-Datalogger Daily Median (pss)	1,317	20.0	30.8	31.9	32.9
pH-grab	0	-	-	-	-
pH-24HR (min)	1,127	7.2	7.9	7.6*	8.1
pH-24HR (max)	1,127	7.3	7.9	8.1	8.8
Temperature	51	1.0	11.6	16.9	18.9
Temperature-Daily Median	1,389	-1.1	9.4	16.3	19.8

### Assessment Zone = SAGAMORE CREEK (NHEST600031001-03, NHEST600031001-04)

As of the date of data retrieval (January 10, 2020) water quality data through 2018 had been uploaded to the Environmental Monitoring Database for this assessment zone. For this assessment zone, that means there is one additional year (2018) of datalogger and grab samples for limited parameters compared to the 2018 assessment but no 2019 data is not included.

Indicator	Aquatic Life Use Category 2018 / 2020/2022	2020/2022 Comment
Chlorophyll-a	3-ND / 5-P	The calculated 90 <sup>th</sup> percentile chlorophyll-a (corrected for pheophytin) in this assessment zone is 22.7 $\mu$ g/L (n = 27). The chlorophyll-a indicator threshold to prevent low dissolved oxygen and preserve light for eelgrass is a 90 <sup>th</sup> percentile below 10 $\mu$ g/L.
Dissolved Oxygen (mg/L)	5-M / 5-P	In 2016-2018 this zone had grab samples for DO collected at three sites 02-SAG, 04-SAG and LHB19. Seven of the 38 (18%) grab samples collected were below 5 mg/L and 4 of those measurements were below 4.5 mg/L. Low values were consistently early in the day. Typically, we find that grab samples under-estimate the frequency and magnitude of degraded water quality. Since the 2018 assessment, 2018 datalogger data has been uploaded for sites 02-SAG and 04-SAG. In the summer critical period, 44% of daily records (n=59) were below 5 mg/L, on 9-dates DO fell below 4 mg/L and on 3 dates below 3 mg/L. The available data indicates that this assessment zone does not meet the dissolved oxygen concentration criteria.
Dissolved Oxygen (% Saturation)	3-PNS / 2-M	In 2016-2018 this zone had grab samples for DO collected at three sites 02-SAG, 04-SAG and LHB19. Grab samples were recorded on 47 dates. Typically, we find that grab samples underestimate the frequency and magnitude of degraded water quality. Since the 2018 assessment, 2018 datalogger data has been uploaded for sites 02-SAG and 04-SAG. In the summer critical period, 8% of daily records (n=53) were below 75% saturation and the lowest 24-hour average was 69%. The available data indicates that this assessment zone has marginally good dissolved oxygen saturation.
Estuarine Bioassessments (eelgrass)	5-P / 5-P	The historical extent of eelgrass in this assessment zone was 4.1 acres from the 1948, 1962, 1980, and 1981 datasets. The median current extent of eelgrass in 2016-2019 is 1.7 acres, which is a decrease of 58.3%. Since 1990, the trend in eelgrass cover in this assessment zone was not significant. The threshold for impairment are either a loss of more than 20% of the historic extent of eelgrass or a recent trend of greater than 20% loss.
Water Clarity (Light Attenuation Coefficient)	3-ND / 3-ND	There have been no light measurements collected since 2005. This assessment zone historically had eelgrass growing in both the shallows and deeper habitat making the 3m restoration depth a valid target. Further, a review of the location of the deep edge of the eelgrass suggests that the maximum depth of eelgrass survival is not as deep as it was in the past. As there is no measured light attenuation, this zone remains assessed as "no data."
Total Nitrogen	3-ND / 5-M	The median total nitrogen from 2014 through 2019 was 567 $\mu$ g/L (n=10) having a range of 309- 1,230 ug/L. While short of the desired 15 samples for the median, if an optimistic 5-samples were added into the dataset based on the Portsmouth Harbor median (228 ug/L), the median would still be 397 ug/L. The available dissolved oxygen data shows that water quality concentration frequently falls well below 5 mg/L however the daily average dissolved oxygen percent saturation remains marginally over 75%. There is no light attenuation data in the current period. Chlorophyll-a is high at 22.7 $\mu$ g/L (n = 27). The eelgrass beds are severely degraded. The status of the indicators of nutrients and nutrient-related impacts have not changed, and continue to present a preponderance of evidence that eutrophication effects are ongoing. While, the high median total nitrogen would suggest a severe-not supporting assessment, the assessment zone has been placed at marginally-not supporting due to having only 10-total nitrogen samples.























Sagamore Creek Assessment Zone	Date			90th	
(1/1/2014-1/10/2020)	Count	Minimum	Median	Percentile	Maximum
CHLOROPHYLL A, CORRECTED FOR PHEOPHYTIN (ug/L)	27	0.9	1.8	22.7	83.8
CHLOROPHYLL A, UNCORRECTED FOR PHEOPHYTIN (ug/L)	0	-	-	-	-
CHLOROPHYLL A, Combined (ug/L)	27	0.0	1.8	22.7	83.8
LIGHT ATTENUATION COEFFICIENT (1/m)	0	-	-	-	-
TURBIDITY (NTU)	26	1.7	4.7	10.3	14.0
TURBIDITY (datalogger daily median) (NTU)	96	0.0	5.5	18.9	38.7
TSS (mg/L)	0	-	-	-	-
COLORED DISSOLVED ORGANIC MATTER (CDOM) (1/m)	0	-	-	-	-
DISSOLVED ORGANIC CARBON	27	0.7	2.4	5.1	5.8
DO-PPM-24HR-MIN-CP (mg/L)	59	2.8	5.1	6.2	8.2
DO-PPM-24HR-MIN-NCP (mg/L)	32	5.1	6.1	6.8	7.4
DO-PPM-GRAB-CP (mg/L)	38	2.9	6.7	9.4	12.6
DO-PPM-GRAB-NCP (mg/L)	9	5.6	6.6	7.9	7.9
DO-PERC-24H-MEAN-CP (% sat)	53	69.1	84.4	106.2	115.6
DO-PERC-24H-MEAN-NCP (% sat)	28	77.1	87.7	94.6	95.8
DO-PERC-2TIDE-GRAB-CP (% sat)	0	-	-	-	-
DO-PERC-2TIDE-GRAB-NCP (% sat)	0	-	-	-	-
DO-PERC-GRAB (% sat)	47	47.7	72.0	112.0	117.0
Day Ave of TN (ug N/L)	10	309	567	1,197	1,230
Day Ave of TDN (ug N/L)	27	112	211	499	591
Day Ave of DIN (NH3 + NO2/3) (ug N/L)	0	-	-	-	-
Day Ave of NH3 (ug N/L)	0	-	-	-	-
Day Ave of PON (ug N/L)	0	-	-	-	-
Day Ave of NO2/3 (ug N/L)	33	11	51	215	300
SALINITY-Grabs (pss)	52	11.2	29.6	31.8	32.5
SALINITY-Datalogger Daily Median (pss)	0	-	-	-	-
pH-grab	48	6.7	7.7	9.0	9.2
pH-24HR (min)	115	6.8	7.5	7*	8.0
pH-24HR (max)	115	7.7	8.1	8.2	8.2
Temperature	68	1.9	17.8	23.3	27.3
Temperature-Daily Median	115	12.3	19.1	22.9	24.8

## Assessment Zone = LITTLE HARBOR/BACK CHANNEL (NHEST600031001-05, NHEST600031001-08, NHEST600031002-02)

As of the date of data retrieval (January 10, 2020) water quality data through 2018 had been uploaded to the Environmental Monitoring Database for this assessment zone. For this assessment zone, that means there are no additional years of data compared to the 2016 assessment.

Indicator	Aquatic Life Use Category 2016 / 2020/2022	2020/2022 Comment
Chlorophyll-a	3-ND / 3-PAS	The calculated 90 <sup>th</sup> percentile chlorophyll-a in this assessment zone cannot be calculated due to the presence of only a single measurement in the current period. That single measurement was 0.7 ug/L in 2015. The chlorophyll-a indicator threshold to prevent low dissolved oxygen and preserve light for eelgrass is a 90 <sup>th</sup> percentile below 10 $\mu$ g/L. As such, this assessment zone has been assessed as insufficient information – potentially attaining standards (3-PAS) based on the chlorophyll-a indicator threshold.
Dissolved Oxygen (mg/L)	3-ND / 3-PAS	This assessment zone has a single grab sample measurement collected in 2015 (8.7 mg/L). Routine measurements for dissolved oxygen concentration ended in 2010. As such, this assessment zone has been assessed as insufficient information – potentially attaining standards (3-PAS) for dissolved oxygen concentration.
Dissolved Oxygen (% Saturation)	3-ND / 3-ND	No data has been collected in the current period.
Estuarine Bioassessments (eelgrass)	5-P / 5-M	The historical extent of eelgrass in this assessment zone was 68.8 acres from the 1948, 1962, 1980, and 1981 datasets. The median current extent of eelgrass in 2016-2019 is 39.2 acres, which is a decrease of 43.1%. Since 1990, the trend in eelgrass cover in this assessment zone is a loss of 38.9%. The thresholds for impairment are either a loss of more than 20% of the historic extent of eelgrass or a recent trend of greater than 20% loss.
Water Clarity (Light Attenuation Coefficient)	5-M / 5-M	There have been no light measurements collected since 2010. For an eelgrass restoration depth of 3 m, the light attenuation coefficient threshold is 0.5 m <sup>-1</sup> . This assessment zone historically had eelgrass growing in both the shallows and deeper habitat making the 3 m restoration depth a valid target. This assessment zone was listed as impaired (5-M) for water clarity to protect eelgrass habitat on the 2010 303d list. At that time the Light Attenuation Coefficient median was 0.58 m <sup>-1</sup> (n=25). Assessment zones that were impaired in the previous cycle cannot be removed from the 303d list if there are insufficient data to make a new assessment. Therefore, the impaired (5-M) listing from the 2010 through 2016 303d lists has been retained.
Total Nitrogen	3-ND/ 3-PAS	There was one total nitrogen sample collected in 2015 of 225 ug/L and therefore there is insufficient data from which to calculate a median total nitrogen from 2014 through 2019. There is a single grab sample to evaluate dissolved oxygen concentration and chlorophyll-a, and no samples to evaluate percent saturation. The eelgrass beds are just over half their historic extent. There have been no light measurements collected since 2010 to compare to the 3 m restoration depth. No direct sampling efforts have taken place to evaluate the extent of epiphytes and macrophytes however regarding macroalgae, Burdick et al. (Burdick, Mathieson, Peter, & Sydney, 2016) stated, "Monitoring results from 2014 show high levels of cover of nuisance green and red algae ( <i>Ulva</i> and <i>Gracilaria</i> , respectively) at all sites except near the mouth of the Estuary." The "mouth of the estuary site" is Four Tree Island, approximately 0.5 mile upstream from the Portsmouth Harbor assessment zone. In the 2019 macroalgae annual report, the appreciable cover at Four Tree Island is dominated by fucoids (brown) and intermittent nuisance seaweeds (reds and greens) but did not show statistical decreases although that site has only been sampled

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Little Harbor / Back Channel Assessment Zone	Date			90th	
(1/1/2014-1/10/2020)	Count	Minimum	Median	Percentile	Maximum
CHLOROPHYLL A, CORRECTED FOR PHEOPHYTIN (ug/L)	0	-	-	-	-
CHLOROPHYLL A, UNCORRECTED FOR PHEOPHYTIN (ug/L)	1	0.7	0.7	-	0.7
CHLOROPHYLL A, Combined (ug/L)	1	0.0	0.7	-	0.7
LIGHT ATTENUATION COEFFICIENT (1/m)	0	-	-	-	-
TURBIDITY (NTU)	0	-	-	-	-
TURBIDITY (datalogger daily median) (NTU)	0	-	-	-	-
TSS (mg/L)	0	-	-	-	-
COLORED DISSOLVED ORGANIC MATTER (CDOM) (1/m)	0	-	-	-	-
DISSOLVED ORGANIC CARBON	0	-	-	-	-
DO-PPM-24HR-MIN-CP (mg/L)	0	-	-	-	-
DO-PPM-24HR-MIN-NCP (mg/L)	0	-	-	-	-
DO-PPM-GRAB-CP (mg/L)	1	8.7	8.7	-	8.7
DO-PPM-GRAB-NCP (mg/L)	0	-	-	-	-
DO-PERC-24H-MEAN-CP (% sat)	0	-	-	-	-
DO-PERC-24H-MEAN-NCP (% sat)	0	-	-	-	-
DO-PERC-2TIDE-GRAB-CP (% sat)	0	-	-	-	-
DO-PERC-2TIDE-GRAB-NCP (% sat)	0	-	-	-	-
DO-PERC-GRAB (% sat)	0	-	-	-	-
Day Ave of TN (ug N/L)	1	225	225	-	225
Day Ave of TDN (ug N/L)	0	-	-	-	-
Day Ave of DIN (NH3 + NO2/3) (ug N/L)	1	60	60	-	60
Day Ave of NH3 (ug N/L)	1	38	38	-	38
Day Ave of PON (ug N/L)	0	-	-	-	-
Day Ave of NO2/3 (ug N/L)	1	22	22	-	22
SALINITY-Grabs (pss)	77	15.8	29.8	31.6	32.1
SALINITY-Datalogger Daily Median (pss)	0	-	-	-	-
pH-grab	1	8.0	8.0	-	8.0
pH-24HR (min)	0	-	-	-	-
pH-24HR (max)	0	-	-	-	-
Temperature	77	1.5	9.4	16.7	18.9
Temperature-Daily Median	0	-	-	-	-

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