Jacques Cousteau (JAC) NERR 2019 Nutrient Metadata
January 2019-December 2019
Latest Update: October 17, 2022

I. Data Set and Research Descriptors

1) Principal investigator(s) and contact persons

a) Reserve contact

Thomas M. Grothues
Associate Research Professor
JAC NERR Research Coordinator
Rutgers University Marine Field Station
800 c/o 132 Great Bay Blvd.
Tuckerton, NJ 08087
(609)296-5260 x262
grothues@marine.rutgers.edu

b) Laboratory contact

Ron J. Lauck
Lab Manager / Program Assistant
Department of Ecology, Evolution, and Natural Resources (DEENR), form Inst. Of Marine and Coastal Sciences
Rutgers, The State University of New Jersey
14 College Farm Road
New Brunswick, NJ 08901
office: 848-932-5788

c) Other contacts

Gregg P. Sakowicz
Field Researcher IV, SWMP Technician
Jacques Cousteau National Estuarine Research Reserve
N.J. Agricultural Experiment Station
Rutgers University
130 Great Bay Blvd.
Tuckerton, NJ 08087
(609)296-5260 ext.267
e-mail: sakowicz@marine.rutgers.edu

2) Research objectives

a) Monthly grab

Monthly grab samples for the Jacques Cousteau National Estuarine Research Reserve (JAC NERR) are taken along a well-defined salinity gradient of the Mullica River-Great Bay estuarine system. The sites where the samples are taken along this salinity gradient include Lower Bank and Chestnut Neck in the Mullica River and Buoy 126 and Buoy 139 in Great Bay (see site descriptions below). These four

sampling sites span a distance of more than 30 km. In addition, a monthly grab sample is taken in Little Egg Harbor estuary at Buoy 115 (see site description below). A major objective of this monitoring program is to determine the nutrient concentrations along the aforementioned salinity gradient over a long-term time series. Previous studies have shown that nitrogen standing stocks in the Mullica River-Great Bay Estuary largely consist of nitrate, ammonium, and nitrogen in organic combination. The nitrogen enters at the head of the estuary largely in inorganic form, but in Great Bay it is transformed mainly to organic combination. However, more data are needed to accurately assess the concentrations of the various nitrogen forms along the salinity gradient, and to determine seasonal variations in the concentrations over a protracted period of several years. It is also necessary to obtain continuous monthly measurements of phosphate, which is also a macronutrient of considerable importance to the system.

Monthly grab samples are needed to obtain accurate measurements of nitrate, ammonium, and phosphate because of their overriding importance to primary production in waters of the JAC NERR. These data can then be compared to chlorophyll *a* measurements to assess their relationship to phytoplankton biomass. A major goal of JAC NERR is to characterize biotic communities along the salinity gradient of the Mullica River-Great Bay Estuary, and it is therefore vital to obtain physical-chemical measurements (including nutrient concentrations) along the gradient. A part of this effort is to determine the nutrient concentrations along the salinity gradient, and how these concentrations are influencing biotic processes down-estuary. In addition, a long-term objective of monthly grab sampling is to develop a nutrient (nitrogen) budget for JAC NERR. To develop a budget, data (concentrations) are needed on the various nitrogen species monitored at the SWMP sites as well as data collected on the nitrogen forms associated with atmospheric deposition. An accurate nutrient budget will be useful for analyzing the overall productivity of estuarine waters in the JAC NERR, which will be important to resource managers of the system.

b) **Diel sampling program**

Diel sampling is conducted via an ISCO automated sampler at Buoy 126 in Great Bay to assess nutrient concentrations and changes in concentrations over tidal cycles. In addition, these data augment monthly grab samples taken at Buoy 126 (see above). It is believed that nutrients entering from the watershed estuary are not utilized within the Mullica River because of the lack of light penetration. The depth of the river and the dark color from the tannins flowing down the river from the Pine Barrens hinder the utilization of these nutrients by planktonic organisms. Where the river empties into the bay, light penetration reaches the bottom and allows utilization of the nutrients by phytoplankton, making this region more productive. Diel sampling over the course of a lunar day at Buoy 126 will also be useful in the development of a nutrient budget for the system.

3) **Research methods**

a) **Monthly grab sampling program**

Monthly grab samples were taken at four stations within the Mullica River-Great Bay estuary and at one station in the Little Egg Harbor estuary. Samples were taken at four primary SWMP JAC NEER datasonde stations (Buoy 126, Buoy 139, Chestnut Neck and Lower Bank) and at one station in Little Egg Harbor estuary (Buoy 115), which is considered a secondary SWMP station for nutrient/pigments. Samples were collected at approximately 30-day intervals. Effort was made to obtain grab samples at or before slack low tide conditions (+3 hour before low tide), approximately one month after the previous sampling period. No distinction was made between neap and spring tide conditions. Water-related field parameters were measured in situ with a YSI/Xylem EXO2 datasonde paired with a YSI/Xylem 599150 EXO handheld display unit manually recorded on a field datasheet. Weather-related field parameters

were assessed by observation and estimation. Replicate (N=2) samples were collected by hand with a bucket at an approximate depth of 10 cm. All samples were collected in amber 500 ml Nalgene sample bottles that were previously acid washed (15% H_2SO_4), rinsed (5x) with distilled-deionized water, and rinsed (3x) with ambient water prior to collection of the sample. Samples were immediately placed on ice in a cooler and returned to the laboratory at the Rutgers Marine Field Station. Once in the laboratory, samples were inverted several times to homogenize the sample and processed (e,g, filtered) for nutrient and chlorophyll *a* analysis. Filtered samples were then frozen in a -20°C freezer at RMFS and transported to the Department of Ecology, Evolution, and Natural Resources (DEENR) at Rutgers University as soon as possible thereafter. Once the processed samples were transported to Rutgers University they were stored in a –20°C freezer until analyses were performed.

b) **Diel sampling program**

Monthly diel samples were taken at the principle long-term datasonde station Buoy 126. Samples were collected at approximately 30-day intervals. Sampling occurred during any tidal condition and no distinction was made between spring and neap tide conditions. Twelve samples were collected over a lunar day at 2-hour-and-15-minute intervals using an ISCO auto-sampler. Samples were taken at a fixed depth, approximately 2.0 meters from the bottom. All samples were collected in clear, plastic, 1000 ml ISCO sample bottles that were previously acid washed (15% H_2SO_4), rinsed (5x) with distilled-deionized water. Samples were retrieved as soon as possible after completion of the auto-sampler program. Samples bottles were then transferred from the clear, plastic ISCO bottles to 500 ml amber Nalgene bottles, and were then placed on ice in an opaque cooler at the Rutgers Marine Field Station to shield samples from light. Once in the laboratory, samples were inverted several times to homogenize the sample and processed (e.g. filtered) for nutrient and chlorophyll *a* analysis. Filtered samples were then frozen in a -20°C freezer at RMFS and transported to the Department of Ecology, Evolution, and Natural Resources (DEENR) at Rutgers University as soon as possible thereafter. Once the filtered samples were transported to Rutgers University they were stored in a –20°C freezer until analyses were performed.

4) Site location and character

The Jacques Cousteau National Estuarine Research Reserve (JAC NERR) at Mullica River/Great Bay is located on the northeast coast of the United States on the Atlantic Ocean. The estuary is near Tuckerton, New Jersey about 14 kilometers north of Atlantic City. There were five active sampling stations in 2019. All five locations can be characterized by having little macroalgae (few to no established beds in the immediate locale; only occasional seasonal and structurally-dependent fouling-type macroalgal communities), fast moving tidal currents, and tidal ranges of approximately 1 m (although this can vary significantly depending on moon phase, storm events, and coastal wind conditions (e.g.- "blow out tides" associated with strong offshore winds). All sites are in a relatively undisturbed area with minimal impact from development or pollution.

1) Buoy 115 (B5) - 39º 31' 07.68" N, 74º 17' 13.92" W- This most recent monitoring site is in Little Egg Harbor Bay, bordering the Edwin B. Forsythe Refuge on Holgate (Long Beach Island) about 3 km northeast of the Rutgers University Marine Field Station. Full-time water-quality monitoring of this non-SWMP station was discontinued in 2003 after ice-floes tore the hardware and housings from the structure, however nutrient/pigment data are still collected at this site which is considered a secondary SWMP NUT station. The following site description is from 2002 (the more recent year-long dataset); we do not expect this description to differ significantly from present conditions: The depth of the bay at this site is approximately 3 meters. The bottom consists predominantly of sand with little shell or organic material. Salinity values average about 30.8 psu, with a range of 29.3 to 32.5 psu. Groundwater inputs

from margins of the estuary, as well as surface flow from Mullica River, account for most of the freshwater entering that affects this site. The input of freshwater from local precipitation and marsh surface runoff is of secondary importance. Flocculent material, possibly decaying alga from up-current (during ebb tides) SAV (submerged aquatic vegetation) beds located in the Little Egg Harbor section of Barnegat Bay, was occasionally observed as flotsam and in the water column during the collection of samples at the B5 sampling station, and should be considered a characteristic of this sampling station. This site is not monitored via multiparameter datasonde, so no environmental water quality (WQ) data beyond what it obtained at the time of nutrient grab sample collection are available for 2019.

2) Buoy 126 (B6) - 39° 30' 28.44" N, 74° 20' 18.67" W- located 3 km from Little Egg Inlet on the eastern side of Great Bay and is 100 meters from the nearest land that is a natural marsh island. This is a naturally deep area that has never been dredged, but it is located about 0.5 km from an area in the Intracoastal Waterway that is dredged regularly. The datasonde at this location is attached to Intracoastal Waterway Channel Marker 126 and is the closest monitoring station to Little Egg Inlet. This site can be characterized by having strong tidal currents, 2-3 knots, fine to course sand bottom with an extensive blue mussel bed surrounding the area. Groundwater inputs from margins of the estuary as well as surface flow from Mullica River account for the majority of freshwater coming into the system at this site, followed by input from rainwater from the marsh surface. Monitoring at this station began on 08/06/1996. In 2019, the reported temperature at this station ranged from -0.9°C to 29.0°C, with an average of 16.3°C (NOTE: the datasonde at this station was removed prior to winter icing and was not replaced for a protracted period of time as the station was rebuilt so the average temperature value is biased towards warmer conditions). The reported salinity at this station ranged from 18.5 psu to 31.7 psu, with an average of 28.5 psu. It is important to note that fouling may have occasionally depressed some salinity readings and are "flagged" as such in the dataset, so the aforementioned average and range may not be accurate. The maximum tidal range (including storm surge and drought-level data), as recorded by the datasonde, was 2.00 m. It has been some time since the actual depth at this station has been surveyed (sediment deposition and erosion around the structure has substantial effect on the actual depth of the water column at this station), but in 2008 average depth at the B6 station was assessed at 3.91 m, with a range of 2.72 to 5.09 m.

3) Buoy 139 (B9) – 39° 29' 52.59" N, 74° 22' 52.07" W*- is located 4 kilometers from Buoy 126 on the western side of Great Bay and is located about one to 1-1.5 km from land. The datasonde at this location is attached to Intracoastal Waterway Channel Marker 139. The closest landform is an extensive salt marsh approximately 1.5 kilometers wide, which borders the upland area. This area is dredged by the U.S. Army Corp of Engineers approximately every five to six years to maintain the channel at a depth of approximately 2.5 meters. The surrounding depth of the bay is approximately 1.5 to 2 meters. This site is characterized by having maximum currents of about 1.5 knots with a muddy sand bottom and with little structure or shell. Groundwater inputs from margins of the estuary as well as surface flow from Mullica River account for the majority of freshwater coming into the system at this site, followed by input from rainwater from the marsh surface and above. Monitoring at this station began on 08/02/1996. In 2019, the reported temperature at this station ranged from 0.0°C to 30.0°C, with an average of 17.5°C (NOTE: the datasonde at this station was removed prior to winter icing and was not replaced for a protracted period of time as the station was rebuilt so the average temperature value is biased towards warmer conditions). The reported salinity at this station ranged from 16.3 psu to 31.8 psu, with an average of 27.5 psu. It is important to note that fouling may have occasionally depressed some salinity readings and are "flagged" as such in the dataset, so the aforementioned average and range may not be accurate. The maximum tidal range (including storm surge and drought-level data), as recorded by the datasonde, was 2.22 m. It has been some time since the actual depth at this station has been surveyed (sediment deposition and erosion around the structure has effect on the actual depth of the water column at this station), in 2008 average depth at the B9 station was assessed at 3.18 m, with a range of 2.13 to 4.55 m.

*= these coordinates are a correction to the location reported in past years' metadata reports; the coordinates (39° 29'24.65"N, 74° 22'53.83"W) of the #141 channel marker were attributed to this (#139) channel marker.

4) Chestnut Neck (NE) - 39° 32' 52.37" N, 74° 27' 38.77" W - located 12 kilometers up the Mullica River from the mouth of the river. The river begins at a line drawn between Graveling Point and Oysterbed Point on the northwestern side of Great Bay. The Mullica River at this location is quite wide, about 250 meters. The datasonde is attached to the dock of a small marina along the southern shore of the river adjacent to the main channel. This location has never been dredged. The site is characterized by having tidal currents of less than one knot, during both ebb and flood tide, and has a mixed organic mud/sand bottom. Freshwater input is primarily from groundwater and watershed runoff. Monitoring at this station began on 08/01/1996. In 2019, the reported temperature at this station ranged from -0.8°C to 30.9°C, with an average of 15.5°C. The reported salinity at this station ranged from 1.2 psu to 27.6 psu, with an average of 14.0 psu. It is important to note that fouling may have occasionally depressed some salinity readings and are "flagged" as such in the dataset, so the aforementioned average and range may not be accurate. The maximum tidal range (including storm surge and drought-level data), as recorded by the datasonde, was 2.23 m. It has been some time since the actual depth at this station has been surveyed (sediment deposition and erosion around the structure has effect on the actual depth of the water column at this station), but in 2008 average depth at the NE station was assessed at 2.32 m, with a range of 1.11 to 3.45 m.

5) Lower Bank (BA) - 39° 35' 37.18" N, 74° 33' 05.44" W- located 13 km upriver of the Chestnut Neck location. The Mullica River at this site is about 200 m wide. The datasonde is located at the center of a bridge spanning the Mullica River. The northern bank of the river is sparsely developed with single-family houses and has a steep bank about 5 m high. The southern shore has an extensive marsh and fresh water wetland area about 3 km wide. This site can be characterized by having fast tidal currents, just over one knot, deep water, and fine mixed organic mud and sandy sediment. Freshwater input is primarily from groundwater and watershed runoff. Monitoring at this station began on 10/10/1996. In 2019, the reported temperature at this station ranged from -0.1°C to 32.3°C, with an average of 15.5°C (NOTE: the datasonde at this station was removed prior to winter icing and was not replaced for a protracted period of time as the station was rebuilt so the average temperature value is biased towards warmer conditions). The reported salinity at this station ranged from 0.0 psu to 19.1 psu, with an average of 2.1 psu. It is important to note that fouling may have occasionally depressed some salinity readings and are "flagged" as such in the dataset, so the aforementioned average and range may not be accurate. The maximum tidal range (including storm surge and drought-level data), as recorded by the datasonde, was 2.20 m. It has been some time since the actual depth at this station has been surveyed (sediment deposition and erosion around the structure has effect on the actual depth of the water column at this station), but in 2008 average depth at the BA station was assessed at 2.77 m, with a range of 1.43 to 3.98 m.

Station Code	SWMP Status	Station Name	Location	Active Dates	Reason Decommissioned	Notes
B5	S	jacb5nut	39.51853, -74.28737	Feb 2002-present	NA	Secondary SWMP
B6	P	jacb6nut	39.50790, -74.33850	Feb 2002-present	NA	NA
B9	P	jacb9nut	39.49794, -74.38113	Feb 2002-present	NA	NA
NE	P	jacnenut	39.54790, -74.46080	Feb 2002-present	NA	NA

BA	P	jacbanut	39.59370, -74.55150	Feb 2002-present	NA	NA

5) **Coded variable definitions**

jacb5nut = Jacques Cousteau Reserve Buoy 115 nutrient station
jacb6nut = Jacques Cousteau Reserve Buoy 126 nutrient station
jacb9nut = Jacques Cousteau Reserve Buoy 139 nutrient station
jacnenut = Jacques Cousteau Reserve Chestnut Neck nutrient station
jacbanut = Jacques Cousteau Reserve Lower Bank nutrient station

The monitoring codes are set as:

monthly grab sample program = 1
diel grab sample program = 2

Replicates are also given specific codes. Grab samples in which duplicates sample are taken utilize a "1" for the first sample and a "2" for the second sample. Diel samples are always labeled with a "1" since only one sample is taken at each 2:15 interval.

6) **Data Collection Period**

GRAB SAMPLING

Station Code	Date Collected	Time Replicate 1	Time Replicate 2
jacb5nut	01/03/2019	13:43*	13:44*
jacb5nut	02/27/2019	08:14*	08:15*
jacb5nut	03/19/2019	13:22	13:23
jacb5nut	04/17/2019	10:15*	10:16*
jacb5nut	05/17/2019	12:22	12:23
jacb5nut	06/04/2019	13:42	13:43
jacb5nut	07/15/2019	12:16	12:17
jacb5nut	08/09/2019	09:36	09:37
jacb5nut	09/11/2019	10:40	10:41
jacb5nut	10/25/2019	10:04	10:05
jacb5nut	11/11/2019	11:20	11:21
jacb5nut	12/07/2019	10:54	10:55
jacb6nut	01/03/2019	13:02	13:03
jacb6nut	02/27/2019	07:44*	07:45*
jacb6nut	03/19/2019	12:35	12:36
jacb6nut	04/17/2019	10:05	10:06
jacb6nut	05/17/2019	11:46	11:47
jacb6nut	06/04/2019	12:55	12:56
jacb6nut	07/15/2019	11:44	11:46
jacb6nut	08/09/2019	09:03	09:04
jacb6nut	09/11/2019	10:10	10:11
jacb6nut	10/25/2019	09:36	09:37
jacb6nut	11/11/2019	10:47	10:48

jacb6nut	12/07/2019	09:44	09:46
jacb9nut	01/03/2019	13:29	13:31
jacb9nut	02/27/2019	08:04*	08:05*
jacb9nut	03/19/2019	12:55	12:56
jacb9nut	04/17/2019	10:20	10:21
jacb9nut	05/17/2019	12:03	12:04
jacb9nut	06/04/2019	13:11	13:12
jacb9nut	07/15/2019	11:57	11:58
jacb9nut	08/09/2019	09:16	09:17
jacb9nut	09/11/2019	10:21	10:22
jacb9nut	10/25/2019	09:48	09:49
jacb9nut	11/11/2019	11:01	11:02
jacb9nut	12/07/2019	09:54	09:55
jacnenut	01/03/2019	15:01	15:02
jacnenut	02/27/2019	10:14	10:16
jacnenut	03/19/2019	15:01	15:02
jacnenut	04/16/2019	12:13	12:14
jacnenut	05/17/2019	13:46	13:47
jacnenut	06/03/2019	13:32	13:33
jacnenut	07/15/2019	13:37	13:38
jacnenut	08/09/2019	10:38	10:39
jacnenut	09/09/2019	10:43	10:44
jacnenut	10/25/2019	11:33	11:34
jacnenut	11/11/2019	14:08	14:09
jacnenut	12/07/2019	11:41	11:43
jacbanut	01/03/2019	15:33	15:34
jacbanut	02/27/2019	10:44	10:45
jacbanut	03/19/2019	15:33	15:34
jacbanut	04/16/2019	12:53	12:54
jacbanut	05/17/2019	14:25	14:26
jacbanut	06/03/2019	14:04	14:05
jacbanut	07/15/2019	14:12	14:13
jacbanut	08/09/2019	11:12	11:13
jacbanut	09/09/2019	11:16	11:17
jacbanut	10/25/2019	12:05	12:06
jacbanut	11/11/2019	13:42	13:43
jacbanut	12/07/2019	12:18	12:19

DIEL (ISCO) SAMPLING

Station Code	Month	Start Date	Start Time	End Date	End Time
jacb6nut	January	01/03/2019	13:00	01/04/2019	13:45
jacb6nut	February	02/27/2019	09:15*	02/28/2019	10:00*
jacb6nut	March	03/26/2019	07:00	03/27/2019	07:45
jacb6nut	April	04/24/2019	05:30	04/25/2019	06:15
jacb6nut	May	05/21/2019	04:45	05/22/2019	05:30
jacb6nut	June	06/06/2019	05:00	06/07/2019	05:45

jacb6nut	July	07/23/2019	06:00	07/24/2019	06:45
jacb6nut	August	08/21/2019	05:15	08/22/2019	06:00
jacb6nut	September	09/22/2019	07:15	09/23/2019	08:00
jacb6nut	October	10/23/2019	09:30	10/24/2019	10:15
jacb6nut	November	11/07/2019	10:30	11/08/2019	11:15
jacb6nut	December	12/05/2019	09:00	12/06/2019	09:45

*= Sample not actually collected; these date and timestamps are approximately when the sample in question would have been collected.

7) **Associated researchers and projects**

A few researchers have expressed interest in our 2019 nutrient data but prefer to wait until the review process is complete.

Water Quality (WQ) and Meteorological (MET) data associated with these Nutrient (NUT) data can be obtained via download from the at www.nerrsdata.org . It is recommended that users utilize the new Advanced Query System (www.nerrsdata.org/aqs) to merge the nutrient and water-quality data into one seamless file.

8) **Distribution**

NOAA retains the right to analyze, synthesize and publish summaries of the NERRS System-wide Monitoring Program data. The NERRS retains the right to be fully credited for having collected and processed the data. Following academic courtesy standards, the NERR site where the data were collected should be contacted and fully acknowledged in any subsequent publications in which any part of the data are used. The data set enclosed within this package/transmission is only as good as the quality assurance and quality control procedures outlined by the enclosed metadata reporting statement. The user bears all responsibility for its subsequent use/misuse in any further analyses or comparisons. The Federal government does not assume liability to the Recipient or third persons, nor will the Federal government reimburse or indemnify the Recipient for its liability due to any losses resulting in any way from the use of this data.

Requested citation format:
NOAA National Estuarine Research Reserve System (NERRS). System-wide Monitoring Program. Data accessed from the NOAA NERRS Centralized Data Management Office website: www.nerrsdata.org; *accessed* 12 October 2020.

II. Physical Structure Descriptors

9) **Entry verification**

Monthly nutrient and plant pigment data files, in Excel format, are sent to JC NERR by the Rutgers University, IMCS, Ecosystems Lab. Files consist of sampling station ID, date and time and parameter values expressed in micro moles; these are converted to milligrams per liter (with the exception of Chlorophyll A, which is reported as micrograms per Liter). The Laboratory Supervisor, Ronald Lauck, verifies all parameter values in the excel file through cross comparison with the laboratory data sheets. The data are reviewed for values that appear erroneous or illogical. Any samples found to have questionable results are reanalyzed. JAC NERR staff (Gregg P. Sakowicz, SWMP Technician/Field Researcher) then performs the following:

Nutrient data are entered into a Microsoft Excel worksheet and processed using the NutrientQAQC Excel macro. The NutrientQAQC macro sets up the data worksheet, metadata worksheets, and MDL worksheet; adds chosen parameters and facilitates data entry; allows the user to set the number of significant figures to be reported for each parameter and rounds using banker's rounding rules; allows the user to input MDL values and then automatically flags/codes measured values below MDL and inserts the MDL; calculates parameters chosen by the user and automatically flags/codes for component values below MDL, negative calculated values, and missing data; allows the user to apply QAQC flags and codes to the data; produces summary statistics; graphs selected parameters for review; and exports the resulting data file to the CDMO for tertiary QAQC and assimilation into the CDMO's authoritative online database.

The Analytical Laboratory at Rutgers University calculates and reports results in μM. For purposes of consistency in the NERR System, the Jacques Cousteau NERR calculates the concentrations as mg/ l-1 based on atomic weights of 14.01 and 30.97 for Nitrogen and Phosphorous, respectively. Therefore, Jacques Cousteau NERR staff multiplies the concentrations reported by the Rutgers University Laboratory by 0.01401, 0.03097 to yield concentrations in mg/L as N and P, respectively.

10) **Parameter titles and variable names by data category**

Required NOAA/NERRS System-wide Monitoring Program nutrient parameters are denoted by an asterisk "*".

Data Category	Parameter	Variable Name	Units of Measure
Phosphorus and Nitrogen:			
	Orthophosphate	PO4F	mg/L as P
	Nitrite + Nitrate, Filtered	NO23F	mg/L as N
	Ammonium, Filtered	NH4F	mg/L as N
	Dissolved Inorganic Nitrogen	DIN	mg/L as N
Plant Pigments:			
	Chlorophyll a	CHLA_N	μg/L
Field Parameters:			
	Water Temperature	WTEM_N	°C
	Specific Conductivity	SCON_N	mS/cm^3
	Salinity	SALT_N	ppt
	Dissolved Oxygen	DO_S_N	%Saturation
	Dissolved Oxygen	DO_N	mg/L
	pH	PH_N	pH units
	Turbidity	TURB_N	FNU

Notes:

1. Time is coded based on a 2400 clock and is referenced to Standard Time.

2. Reserves have the option of measuring either NO2 and NO3 or they may substitute NO23 for individual analyses if they can show that NO2 is a minor component relative to NO3. JAC NERR and analytical laboratory staff determined that analysis to isolate individual concentrations for NO2 and NO3 is not necessary. The concentration of NO2 is negligible when compared to the concentration of NO3.

11) **Measured and calculated laboratory parameters**

a) **Variables measured directly**

Nitrogen species:	NO23F, NH4F
Phosphorus species:	PO4F
Other:	CHLA

b) **Computed variables**

DIN:	NO23F+NH4F

12) **Limits of detection**

Method Detection Limits (MDL), the lowest concentration of a parameter that an analytical procedure can reliably detect, have been established by the Rutgers University, IMCS, Ecosystems Laboratory. The MDL is determined as 3 times the standard deviation of a minimum of 7 replicates of a single low concentration sample. Table 1 presents the current MDL's; these values are reviewed and revised periodically. Methods are from Lachat Instruments QuikChem methods.

Table 1. Method Detection Limits (MDL) for measured water quality parameters.

Parameter	Start Date	End Date	MDL	Revisited
NH4F	01/01/2019	12/31/2019	0.0007 (mg/L)	09/20/2017
NO23F	01/01/2019	12/31/2019	0.004 (mg/L)	04/11/2018 (NO2) 09/20/2017 (NO3)
PO4F	01/01/2019	12/31/2019	0.0015 (mg/L)	04/18/2018
CHLA	01/01/2019	12/31/2019	0.31 (µg/L)	2019

13) **Laboratory methods**

i) **Parameter: PO4F**

Rutgers University, IMCS, Ecosystems Lab Laboratory Method
Method Reference: Lachat Instruments, 1993. QuikChem Method 31-115-01-3-A.
Method Descriptor: Samples were filtered with a 0.45 µm membrane filter and subjected to ammonium molybdate and antimony potassium tartate under acidic conditions to form a complex. The complex is reduced with ascorbic acid to form a blue complex that absorbs light at 880 nm.
Preservation Method: Stored in dark at –20°C for up to 30 days.

ii) **Parameter: NO23F**

Rutgers University, IMCS, Ecosystems Lab Laboratory Method
Method Reference: Lachat Instruments, 1992. QuikChem Method 30-107-04-1-A.
Method Descriptor: Samples were filtered with a 0.45 µm membrane filter. Nitrate is reduced to nitrite by passage of sample through a copperized cadmium column. The nitrite (reduced nitrate plus original nitrite) is then determined with sulfanilamide

under acidic conditions to form a diazonium ion. The diazonium ion is coupled with N-(1-naphthyl)ethylenediamine dihydrochloride, which results in a pink dye that absorbs at 520 nm.

Preservation Method: Stored in dark at -20°C for up to 14 days.

iii) **Parameter: NH4F**

Rutgers University, IMCS, Ecosystems Lab Laboratory Method

Method Reference: Lachat Instruments, 1993. QuikChem Method 31-107-06-1-A.

Method Descriptor: Samples were filtered with a 0.45 μm membrane filter. The method used is based on the Berthelot reaction. Samples are subjected to hypochlorite-phenol, which results in indophenol blue. The indophenol blue is measured at 630 nm and is proportional to the ammonium concentration.

Preservation Method: Stored in dark at –20°C for up to 3 days.

iv) **Parameter: CHLA**

Rutgers University, IMCS, Ecosystems Lab Laboratory Method

Method Reference: US.EPA 1997. Method 445.0

Method Descriptor: Samples with a known volume were filtered with a 0.45 μm membrane filter. Samples were dissolved in 5 ml 90% acetone/ 10% $MgCO_3$ solution. Fluorescence determined using a Shimadzu RF-1501 spectrofluorometer.

Preservation Method: Filter is drawn dry, removed, placed in a glass tube with a phenolic screw cap, wrapped in aluminum foil and stored at –20°C for up to 30 days.

14) **Field and Laboratory QA/QC programs**

a) **Precision**

i) **Field variability**

JAC NERR collects two successive grab samples for the monthly grab sample program.

ii) **Laboratory variability**

Rutgers University, IMCS, Ecosystems Lab analyzes a laboratory duplicate once for every nine samples.

iii) **Inter-organizational splits**

None

b) **Accuracy**

i) **Sample spikes**

Rutgers University, IMCS, Ecosystems Lab analyzes a matrix spike once for every ten samples.

ii) **Standard reference material analysis**

None

iii) **Cross calibration exercises**

None

15) QAQC flag definitions – This section details the primary and secondary QAQC flag definitions.

QAQC flags provide documentation of the data and are applied to individual data points by insertion into the parameter's associated flag column (header preceded by an F_). QAQC flags are applied to the nutrient data during secondary QAQC to indicate data that are out of sensor range low (-4), rejected due to QAQC checks (-3), missing (-2), optional and were not collected (-1), suspect (1), and that have been corrected (5). All remaining data are flagged as having passed

initial QAQC checks (0) when the data are uploaded and assimilated into the CDMO ODIS as provisional plus data. The historical data flag (4) is used to indicate data that were submitted to the CDMO prior to the initiation of secondary QAQC flags and codes (and the use of the automated primary QAQC system for WQ and MET data). This flag is only present in historical data that are exported from the CDMO ODIS.

-4 Outside Low Sensor Range
-3 Data Rejected due to QAQC
-2 Missing Data
-1 Optional SWMP Supported Parameter
0 Data Passed Initial QAQC Checks
1 Suspect Data
4 Historical Data: Pre-Auto QAQC
5 Corrected Data

16) QAQC code definitions – This section details the secondary QAQC Code definitions used in combination with the flags above.

QAQC codes are used in conjunction with QAQC flags to provide further documentation of the data and are also applied by insertion into the associated flag column. There are three (3) different code categories, general, sensor, and comment. General errors document general problems with the sample or sample collection, sensor errors document common sensor or parameter specific problems, and comment codes are used to further document conditions or a problem with the data. Only one general or sensor error and one comment code can be applied to a particular data point. However, a record flag column (F_Record) in the nutrient data allows multiple comment codes to be applied to the entire data record.

General errors

GCM	Calculated value could not be determined due to missing data
GCR	Calculated value could not be determined due to rejected data
GDM	Data missing or sample never collected
GQD	Data rejected due to QA/QC checks
GQS	Data suspect due to QA/QC checks
GSM	See metadata

Sensor errors

SBL	Value below minimum limit of method detection
SCB	Calculated value could not be determined due to a below MDL component
SCC	Calculation with this component resulted in a negative value
SNV	Calculated value is negative
SRD	Replicate values differ substantially
SUL	Value above upper limit of method detection

Parameter Comments

CAB	Algal bloom
CDR	Sample diluted and rerun
CHB	Sample held beyond specified holding time
CIP	Ice present in sample vicinity

CIF	Flotsam present in sample vicinity
CLE	Sample collected later/earlier than scheduled
CRE	Significant rain event
CSM	See metadata
CUS	Lab analysis from unpreserved sample

Record comments

CAB	Algal bloom
CHB	Sample held beyond specified holding time
CIP	Ice present in sample vicinity
CIF	Flotsam present in sample vicinity
CLE	Sample collected later/earlier than scheduled
CRE	Significant rain event
CSM	See metadata
CUS	Lab analysis from unpreserved sample

Cloud cover

CCL	clear (0-10%)
CSP	scattered to partly cloudy (10-50%)
CPB	partly to broken (50-90%)
COC	overcast (>90%)
CFY	foggy
CHY	hazy
CCC	cloud (no percentage)

Precipitation

PNP	none
PDR	drizzle
PLR	light rain
PHR	heavy rain
PSQ	squally
PFQ	frozen precipitation (sleet/snow/freezing rain)
PSR	mixed rain and snow

Tide stage

TSE	ebb tide
TSF	flood tide
TSH	high tide
TSL	low tide

Wave height

WH0	0 to <0.1 meters
WH1	0.1 to 0.3 meters
WH2	0.3 to 0.6 meters
WH3	0.6 to > 1.0 meters
WH4	1.0 to 1.3 meters
WH5	1.3 or greater meters

Wind direction

N	from the north
NNE	from the north northeast
NE	from the northeast
ENE	from the east northeast
E	from the east
ESE	from the east southeast
SE	from the southeast
SSE	from the south southeast

S	from the south
SSW	from the south southwest
SW	from the southwest
WSW	from the west southwest
W	from the west
WNW	from the west northwest
NW	from the northwest
NNW	from the north northwest
Wind speed	
WS0	0 to 1 knot
WS1	> 1 to 10 knots
WS2	> 10 to 20 knots
WS3	> 20 to 30 knots
WS4	> 30 to 40 knots
WS5	> 40 knots

17) **Other remarks**

Data may be missing due to problems with sample collection or processing. Laboratories in the NERRS System submit data that are censored at a lower detection rate limit, called the Method Detection Limit or MDL. MDLs for specific parameters are listed in the Laboratory Methods and Detection Limits Section (Section II, Part 12) of this document. Concentrations that are less than this limit are censored with the use of a QAQC flag and code, and the reported value is the method detection limit itself rather than a measured value. For example, if the measured concentration of NO23F was 0.0005 mg/l as N (MDL=0.0008), the reported value would be 0.0008 and would be flagged as out of sensor range low (-4) and coded SBL. In addition, if any of the components used to calculate a variable are below the MDL, the calculated variable is removed and flagged/coded -4 SCB. If a calculated value is negative, it is rejected and all measured components are marked suspect. If additional information on MDL's or missing, suspect, or rejected data is needed, contact the Research Coordinator at the reserve submitting the data.

Note: The way below MDL values are handled in the NERRS SWMP dataset was changed in November of 2011. Previously, below MDL data from 2007-2010 were also flagged/coded, but either reported as the measured value or a blank cell. Any 2007-2011 nutrient/pigment data downloaded from the CDMO prior to November of 2011 will reflect this difference.

NOTE: the Buoy 115 (jacb5nut) in Southern Barnegat Bay is not a required SWMP station, but is collected as additional station as a compliment/comparison to the SWMP samples collected in the Mullica River/Great Bay complex.

NOTE: The B6 station sits within an interface between two bodies of water (Little Egg Harbor and Mullica River) that are often physically and chemically distinct, so some of the discrepancies between some replicates at this station may be accurate and "real" if the replicates were obtained from the two different "plumes" of water; this is something those performing collections attempt to avoid but visual cues may not be distinct enough to discern waters from each source at the time of collection.

No physical ("water quality") parameters are included in this dataset for the diel sample program because these data can be obtained via download from the Buoy 126 station (jacb6wq) at www.nerrsdata.org . It

is recommended that users utilize the Advanced Query System (www.nerrsdata.org/aqs) to merge these nutrient and water-quality data into one seamless file.

While basic and notable weather information was inserted into the F_Record column for all grab samples, it is recommended that users of these data refer to the JAC NERR's meteorological dataset from the Nacote Creek Meteorological station (jacncmet) for weather information. The meteorological dataset can be accessed online at the CDMO home page http://cdmo.baruch.sc.edu/ or www.nerrsdata.org . It is recommended that users utilize the new Advanced Query System (www.nerrsdata.org/aqs) to merge nutrient, weather, and water-quality data into one seamless file

Additionally, regarding inserting comment codes concerning weather, only significant rain events potentially influencing the data were inserted into the diel portion of the dataset. If users seek to correlate the diel samples with weather conditions, it is recommended that they refer to the JAC NERR's meteorological dataset. The meteorological dataset can be accessed online at the CDMO home page http://cdmo.baruch.sc.edu/ or www.nerrsdata.org .

If discrepancies between replicate grab samples are observed they are flagged in the dataset with an "[SRD]" (denoting "Replicate values differ substantially") code in the dataset. It is up to the user to retain or discard these data during analyses.

Nutrient grab samples were not collected at the secondary jacb5nut station on 3 January 2019 due to unsafe conditions (high wind and waves).

Nutrient grab samples were not collected at the jacb5nut, jacb6nut, and jacb9nut station on 27 February 2019 due to unsafe conditions (high wind and waves).

Diel samples were not collected in February due to freezing weather.

Environmental parameters were not measured with the collected grab samples at jacnenut and jacbanut on 27 February 2019 due to instrument malfunction (premature battery drain due to cold weather).

Nutrient grab samples were not collected at the secondary jacb5nut station on 17 April 2019 due to unsafe conditions (high wind and waves).

Turbidity measurements concurrent with the October-December grab samples were not obtained due to the removal of that sensor from the portable Y.S.I. datasonde.

The following sample data were not reported due to instrument malfunction or missing samples (typically due to a damaged collection bottle or sample vial):

Station	Grab or Diel	DateTimeStamp	Parameter(s) Affected
jacb6nut	Diel	06/07/2019 05:45	Chlorophyll
jacb6nut	Grab	07/15/2019 11:45	Chlorophyll

Grab Sample Analysis Dates

Sample hold times for 2019: Samples are held at -20°C. NERRS SOP allows nutrient samples to be held for up to 28 days (CHLA for 30) at -20°C, plus allows for up to 5 days for collecting, processing, and shipping samples. Samples held beyond that time period are flagged suspect and coded CHB. Analysis dates in bold font indicate sample held longer than allowed by NERRS protocols

Station Code	DateTimeStamp	PO4 analysis date	NH4 analysis date	NO23 analysis date	ChlA analysis date
jacb5nut	1/3/2019 13:43	N/A	N/A	N/A	N/A
jacb5nut	1/3/2019 13:44	N/A	N/A	N/A	N/A
jacb6nut	1/3/2019 13:02	**7/2/2019**	**8/20/2019**	**4/29/2019**	1/23/2019
jacb6nut	1/3/2019 13:03	**7/2/2019**	**8/20/2019**	**4/29/2019**	1/23/2019
jacb9nut	1/3/2019 13:29	**7/2/2019**	**8/20/2019**	**4/29/2019**	1/23/2019
jacb9nut	1/3/2019 13:31	**7/2/2019**	**8/20/2019**	**4/29/2019**	1/23/2019
jacnenut	1/3/2019 15:01	**7/2/2019**	**8/20/2019**	**4/29/2019**	1/23/2019
jacnenut	1/3/2019 15:02	**7/2/2019**	**8/20/2019**	**4/29/2019**	1/23/2019
jacbanut	1/3/2019 15:33	**7/2/2019**	**8/20/2019**	**4/29/2019**	1/23/2019
jacbanut	1/3/2019 15:34	**7/2/2019**	**8/20/2019**	**4/29/2019**	1/23/2019
jacb5nut	2/27/2019 8:14	N/A	N/A	N/A	N/A
jacb5nut	2/27/2019 8:15	N/A	N/A	N/A	N/A
jacb6nut	2/27/2019 7:44	N/A	N/A	N/A	N/A
jacb6nut	2/27/2019 7:45	N/A	N/A	N/A	N/A
jacb9nut	2/27/2019 8:04	N/A	N/A	N/A	N/A
jacb9nut	2/27/2019 8:05	N/A	N/A	N/A	N/A
jacnenut	2/27/2019 10:14	**7/2/2019**	**8/20/2019**	**4/29/2019**	3/27/2019
jacnenut	2/27/2019 10:15	**7/2/2019**	**8/20/2019**	**4/29/2019**	3/27/2019
jacbanut	2/27/2019 10:44	**7/2/2019**	**8/20/2019**	**4/29/2019**	3/27/2019
jacbanut	2/27/2019 10:45	**7/2/2019**	**8/20/2019**	**4/29/2019**	3/27/2019
jacb5nut	3/19/2019 13:22	**7/2/2019**	**8/20/2019**	**4/29/2019**	3/27/2019
jacb5nut	3/19/2019 13:23	**7/2/2019**	**8/20/2019**	**4/29/2019**	3/27/2019
jacb6nut	3/19/2019 12:35	**7/2/2019**	**8/20/2019**	**4/29/2019**	3/27/2019
jacb6nut	3/19/2019 12:36	**7/2/2019**	**8/20/2019**	**4/29/2019**	3/27/2019
jacb9nut	3/19/2019 12:55	**7/2/2019**	**8/20/2019**	**4/29/2019**	3/27/2019
jacb9nut	3/19/2019 12:56	**7/2/2019**	**8/20/2019**	**4/29/2019**	3/27/2019
jacnenut	3/19/2019 15:01	**7/2/2019**	**8/20/2019**	**4/29/2019**	3/27/2019
jacnenut	3/19/2019 15:02	**7/2/2019**	**8/20/2019**	**4/29/2019**	3/27/2019
jacbanut	3/19/2019 15:33	**7/2/2019**	**8/20/2019**	**4/29/2019**	3/27/2019
jacbanut	3/19/2019 15:34	**7/2/2019**	**8/20/2019**	**4/29/2019**	3/27/2019
jacb5nut	4/17/2019 10:15	N/A	N/A	N/A	N/A
jacb5nut	4/17/2019 10:16	N/A	N/A	N/A	N/A
jacb6nut	4/17/2019 10:05	**9/30/2019**	**8/20/2019**	**9/30/2019**	5/14/2019
jacb6nut	4/17/2019 10:06	**9/30/2019**	**8/20/2019**	**9/30/2019**	5/14/2019
jacb9nut	4/17/2019 10:20	**9/30/2019**	**8/20/2019**	**9/30/2019**	5/14/2019
jacb9nut	4/17/2019 10:21	**9/30/2019**	**8/20/2019**	**9/30/2019**	5/14/2019
jacnenut	4/16/2019 12:13	**9/30/2019**	**8/20/2019**	**9/30/2019**	5/14/2019
jacnenut	4/16/2019 12:14	**9/30/2019**	**8/20/2019**	**9/30/2019**	5/14/2019
jacbanut	4/16/2019 12:53	**9/30/2019**	**8/20/2019**	**9/30/2019**	5/14/2019
jacbanut	4/16/2019 12:54	**9/30/2019**	**8/20/2019**	**9/30/2019**	5/14/2019
jacb5nut	5/17/2019 12:22	**9/30/2019**	**8/20/2019**	**9/30/2019**	6/11/2019
jacb5nut	5/17/2019 12:23	**9/30/2019**	**8/20/2019**	**9/30/2019**	6/11/2019
jacb6nut	5/17/2019 11:46	**9/30/2019**	**8/20/2019**	**9/30/2019**	6/11/2019
jacb6nut	5/17/2019 11:47	**9/30/2019**	**8/20/2019**	**9/30/2019**	6/11/2019
jacb9nut	5/17/2019 12:03	**9/30/2019**	**8/20/2019**	**9/30/2019**	6/11/2019
jacb9nut	5/17/2019 12:04	**9/30/2019**	**8/20/2019**	**9/30/2019**	6/11/2019
jacnenut	5/17/2019 13:46	**9/30/2019**	**8/20/2019**	**9/30/2019**	6/11/2019

jacnenut	5/17/2019 13:47	**9/30/2019**	**8/20/2019**	**9/30/2019**	6/11/2019
jacbanut	5/17/2019 14:25	**9/30/2019**	**8/20/2019**	**9/30/2019**	6/11/2019
jacbanut	5/17/2019 14:26	**9/30/2019**	**8/20/2019**	**9/30/2019**	6/11/2019
jacb5nut	6/4/2019 13:42	**9/30/2019**	**10/9/2019**	**9/30/2019**	6/18/2019
jacb5nut	6/4/2019 13:43	**9/30/2019**	**10/9/2019**	**9/30/2019**	6/18/2019
jacb6nut	6/4/2019 12:55	**9/30/2019**	**10/9/2019**	**9/30/2019**	6/18/2019
jacb6nut	6/4/2019 12:56	**9/30/2019**	**10/9/2019**	**9/30/2019**	6/18/2019
jacb9nut	6/4/2019 13:11	**9/30/2019**	**10/9/2019**	**9/30/2019**	6/18/2019
jacb9nut	6/4/2019 13:12	**9/30/2019**	**10/9/2019**	**9/30/2019**	6/18/2019
jacnenut	6/3/2019 13:32	**9/30/2019**	**10/9/2019**	**9/30/2019**	6/18/2019
jacnenut	6/3/2019 13:33	**9/30/2019**	**10/9/2019**	**9/30/2019**	6/18/2019
jacbanut	6/3/2019 14:04	**9/30/2019**	**10/9/2019**	**9/30/2019**	6/18/2019
jacbanut	6/3/2019 14:05	**9/30/2019**	**10/9/2019**	**9/30/2019**	6/18/2019
jacb5nut	7/15/2019 12:16	**9/30/2019**	**10/9/2019**	**9/30/2019**	7/31/2019
jacb5nut	7/15/2019 12:17	**9/30/2019**	**10/9/2019**	**9/30/2019**	7/31/2019
jacb6nut	7/15/2019 11:44	**9/30/2019**	**10/9/2019**	**9/30/2019**	7/31/2019
jacb6nut	7/15/2019 11:45	**9/30/2019**	**10/9/2019**	**9/30/2019**	broken vial
jacb9nut	7/15/2019 11:57	**9/30/2019**	**10/9/2019**	**9/30/2019**	7/31/2019
jacb9nut	7/15/2019 11:58	**9/30/2019**	**10/9/2019**	**9/30/2019**	7/31/2019
jacnenut	7/15/2019 13:37	**9/30/2019**	**10/9/2019**	**9/30/2019**	7/31/2019
jacnenut	7/15/2019 13:38	**9/30/2019**	**10/9/2019**	**9/30/2019**	7/31/2019
jacbanut	7/15/2019 14:12	**9/30/2019**	**10/9/2019**	**9/30/2019**	7/31/2019
jacbanut	7/15/2019 14:13	**9/30/2019**	**10/9/2019**	**9/30/2019**	7/31/2019
jacb5nut	8/9/2019 9:36	**9/30/2019**	**10/9/2019**	**9/30/2019**	8/28/2019
jacb5nut	8/9/2019 9:37	**9/30/2019**	**10/9/2019**	**9/30/2019**	8/28/2019
jacb6nut	8/9/2019 9:03	**9/30/2019**	**10/9/2019**	**9/30/2019**	8/28/2019
jacb6nut	8/9/2019 9:04	**9/30/2019**	**10/9/2019**	**9/30/2019**	8/28/2019
jacb9nut	8/9/2019 9:16	**9/30/2019**	**10/9/2019**	**9/30/2019**	8/28/2019
jacb9nut	8/9/2019 9:17	**9/30/2019**	**10/9/2019**	**9/30/2019**	8/28/2019
jacnenut	8/9/2019 10:38	**9/30/2019**	**10/9/2019**	**9/30/2019**	8/28/2019
jacnenut	8/9/2019 10:39	**9/30/2019**	**10/9/2019**	**9/30/2019**	8/28/2019
jacbanut	8/9/2019 11:12	**9/30/2019**	**10/9/2019**	**9/30/2019**	8/28/2019
jacbanut	8/9/2019 11:13	**9/30/2019**	**10/9/2019**	**9/30/2019**	8/28/2019
jacb5nut	9/11/2019 10:40	9/30/2019	10/9/2019	9/30/2019	10/16/2019
jacb5nut	9/11/2019 10:41	9/30/2019	10/9/2019	9/30/2019	10/16/2019
jacb6nut	9/11/2019 10:10	9/30/2019	10/9/2019	9/30/2019	10/16/2019
jacb6nut	9/11/2019 10:11	9/30/2019	10/9/2019	9/30/2019	10/16/2019
jacb9nut	9/11/2019 10:21	9/30/2019	10/9/2019	9/30/2019	10/16/2019
jacb9nut	9/11/2019 10:22	9/30/2019	10/9/2019	9/30/2019	10/16/2019
jacnenut	9/9/2019 10:43	9/30/2019	10/9/2019	9/30/2019	**10/16/2019**
jacnenut	9/9/2019 10:44	9/30/2019	10/9/2019	9/30/2019	**10/16/2019**
jacbanut	9/9/2019 11:16	9/30/2019	10/9/2019	9/30/2019	**10/16/2019**
jacbanut	9/9/2019 11:17	9/30/2019	10/9/2019	9/30/2019	**10/16/2019**
jacb5nut	10/25/2019 10:04	11/20/2019	**12/11/2019**	11/20/2019	11/5/2019
jacb5nut	10/25/2019 10:05	11/20/2019	**12/11/2019**	11/20/2019	11/5/2019
jacb6nut	10/25/2019 9:36	11/20/2019	**12/11/2019**	11/20/2019	11/5/2019
jacb6nut	10/25/2019 9:37	11/20/2019	**12/11/2019**	11/20/2019	11/5/2019
jacb9nut	10/25/2019 9:48	11/20/2019	**12/11/2019**	11/20/2019	11/5/2019
jacb9nut	10/25/2019 9:49	11/20/2019	**12/11/2019**	11/20/2019	11/5/2019
jacnenut	10/25/2019 11:33	11/20/2019	**12/11/2019**	11/20/2019	11/5/2019

jacnenut	10/25/2019 11:34	11/20/2019	**12/11/2019**	11/20/2019	11/5/2019
jacbanut	10/25/2019 12:05	11/20/2019	**12/11/2019**	11/20/2019	11/5/2019
jacbanut	10/25/2019 12:06	11/20/2019	**12/11/2019**	11/20/2019	11/5/2019
jacb5nut	11/11/2019 11:20	11/20/2019	12/11/2019	11/20/2019	12/5/2019
jacb5nut	11/11/2019 11:21	11/20/2019	12/11/2019	11/20/2019	12/5/2019
jacb6nut	11/11/2019 10:47	11/20/2019	12/11/2019	11/20/2019	12/5/2019
jacb6nut	11/11/2019 10:48	11/20/2019	12/11/2019	11/20/2019	12/5/2019
jacb9nut	11/11/2019 11:01	11/20/2019	12/11/2019	11/20/2019	12/5/2019
jacb9nut	11/11/2019 11:02	11/20/2019	12/11/2019	11/20/2019	12/5/2019
jacnenut	11/11/2019 14:08	11/20/2019	12/11/2019	11/20/2019	12/5/2019
jacnenut	11/11/2019 14:09	11/20/2019	12/11/2019	11/20/2019	12/5/2019
jacbanut	11/11/2019 13:42	11/20/2019	12/11/2019	11/20/2019	12/5/2019
jacbanut	11/11/2019 13:43	11/20/2019	12/11/2019	11/20/2019	12/5/2019
jacb5nut	12/7/2019 10:54	**2/26/2020**	12/11/2019	**2/26/2020**	**1/16/2020**
jacb5nut	12/7/2019 10:56	**2/26/2020**	12/11/2019	**2/26/2020**	**1/16/2020**
jacb6nut	12/7/2019 9:44	**2/26/2020**	12/11/2019	**2/26/2020**	**1/16/2020**
jacb6nut	12/7/2019 9:46	**2/26/2020**	12/11/2019	**2/26/2020**	**1/16/2020**
jacb9nut	12/7/2019 9:54	**2/26/2020**	12/11/2019	**2/26/2020**	**1/16/2020**
jacb9nut	12/7/2019 9:56	**2/26/2020**	12/11/2019	**2/26/2020**	**1/16/2020**
jacnenut	12/7/2019 11:41	**2/26/2020**	12/11/2019	**2/26/2020**	**1/16/2020**
jacnenut	12/7/2019 11:43	**2/26/2020**	12/11/2019	**2/26/2020**	**1/16/2020**
jacbanut	12/7/2019 12:18	**2/26/2020**	12/11/2019	**2/26/2020**	**1/16/2020**
jacbanut	12/7/2019 12:20	**2/26/2020**	12/11/2019	**2/26/2020**	**1/16/2020**

Diel Sample Analysis Dates

Station Code	**DateTimeStamp**	**PO4 analysis date**	**NH4 analysis date**	**NO23 analysis date**	**ChlA analysis date**
jacb6nut	1/3/2019 13:00	**7/2/2019**	**8/20/2019**	**4/29/2019**	1/23/2019
jacb6nut	1/3/2019 15:15	**7/2/2019**	**8/20/2019**	**4/29/2019**	1/23/2019
jacb6nut	1/3/2019 17:30	**7/2/2019**	**8/20/2019**	**4/29/2019**	1/23/2019
jacb6nut	1/3/2019 19:45	**7/2/2019**	**8/20/2019**	**4/29/2019**	1/23/2019
jacb6nut	1/3/2019 22:00	**7/2/2019**	**8/20/2019**	**4/29/2019**	1/23/2019
jacb6nut	1/4/2019 0:15	**7/2/2019**	**8/20/2019**	**4/29/2019**	1/23/2019
jacb6nut	1/4/2019 2:30	**7/2/2019**	**8/20/2019**	**4/29/2019**	1/23/2019
jacb6nut	1/4/2019 4:45	**7/2/2019**	**8/20/2019**	**4/29/2019**	1/23/2019
jacb6nut	1/4/2019 7:00	**7/2/2019**	**8/20/2019**	**4/29/2019**	1/23/2019
jacb6nut	1/4/2019 9:15	**7/2/2019**	**8/20/2019**	**4/29/2019**	1/23/2019
jacb6nut	1/4/2019 11:30	**7/2/2019**	**8/20/2019**	**4/29/2019**	1/23/2019
jacb6nut	1/4/2019 13:45	**7/2/2019**	**8/20/2019**	**4/29/2019**	1/23/2019
jacb6nut	2/27/2019 9:15	N/A	N/A	N/A	N/A
jacb6nut	2/27/2019 11:30	N/A	N/A	N/A	N/A
jacb6nut	2/27/2019 13:45	N/A	N/A	N/A	N/A
jacb6nut	2/27/2019 16:00	N/A	N/A	N/A	N/A
jacb6nut	2/27/2019 18:15	N/A	N/A	N/A	N/A
jacb6nut	2/27/2019 20:30	N/A	N/A	N/A	N/A
jacb6nut	2/27/2019 22:45	N/A	N/A	N/A	N/A
jacb6nut	2/28/2019 1:00	N/A	N/A	N/A	N/A
jacb6nut	2/28/2019 3:15	N/A	N/A	N/A	N/A

jacb6nut	2/28/2019 5:30	N/A	N/A	N/A	N/A
jacb6nut	2/28/2019 7:45	N/A	N/A	N/A	N/A
jacb6nut	2/28/2019 10:00	N/A	N/A	N/A	N/A
jacb6nut	3/26/2019 7:00	**9/30/2019**	**8/20/2019**	**9/30/2019**	4/10/2019
jacb6nut	3/26/2019 9:15	**9/30/2019**	**8/20/2019**	**9/30/2019**	4/10/2019
jacb6nut	3/26/2019 11:30	**9/30/2019**	**8/20/2019**	**9/30/2019**	4/10/2019
jacb6nut	3/26/2019 13:45	**9/30/2019**	**8/20/2019**	**9/30/2019**	4/10/2019
jacb6nut	3/26/2019 16:00	**9/30/2019**	**8/20/2019**	**9/30/2019**	4/10/2019
jacb6nut	3/26/2019 18:15	**9/30/2019**	**8/20/2019**	**9/30/2019**	4/10/2019
jacb6nut	3/26/2019 20:30	**9/30/2019**	**8/20/2019**	**9/30/2019**	4/10/2019
jacb6nut	3/26/2019 22:45	**9/30/2019**	**8/20/2019**	**9/30/2019**	4/10/2019
jacb6nut	3/26/2019 1:00	**9/30/2019**	**8/20/2019**	**9/30/2019**	4/10/2019
jacb6nut	3/26/2019 3:15	**9/30/2019**	**8/20/2019**	**9/30/2019**	4/10/2019
jacb6nut	3/26/2019 5:30	**9/30/2019**	**8/20/2019**	**9/30/2019**	4/10/2019
jacb6nut	3/26/2019 7:45	**9/30/2019**	**8/20/2019**	**9/30/2019**	4/10/2019
jacb6nut	4/24/2019 5:30	**9/30/2019**	**8/20/2019**	**9/30/2019**	5/14/2019
jacb6nut	4/24/2019 7:45	**9/30/2019**	**8/20/2019**	**9/30/2019**	5/14/2019
jacb6nut	4/24/2019 10:00	**9/30/2019**	**8/20/2019**	**9/30/2019**	5/14/2019
jacb6nut	4/24/2019 12:15	**9/30/2019**	**8/20/2019**	**9/30/2019**	5/14/2019
jacb6nut	4/24/2019 14:30	**9/30/2019**	**8/20/2019**	**9/30/2019**	5/14/2019
jacb6nut	4/24/2019 16:45	**9/30/2019**	**8/20/2019**	**9/30/2019**	5/14/2019
jacb6nut	4/24/2019 19:00	**9/30/2019**	**8/20/2019**	**9/30/2019**	5/14/2019
jacb6nut	4/24/2019 21:15	**9/30/2019**	**8/20/2019**	**9/30/2019**	5/14/2019
jacb6nut	4/24/2019 23:30	**9/30/2019**	**8/20/2019**	**9/30/2019**	5/14/2019
jacb6nut	4/25/2019 1:45	**9/30/2019**	**8/20/2019**	**9/30/2019**	5/14/2019
jacb6nut	4/25/2019 4:00	**9/30/2019**	**8/20/2019**	**9/30/2019**	5/14/2019
jacb6nut	4/25/2019 6:15	**9/30/2019**	**8/20/2019**	**9/30/2019**	5/14/2019
jacb6nut	5/21/2019 4:45	**9/30/2019**	**8/20/2019**	**9/30/2019**	6/11/2019
jacb6nut	5/21/2019 7:00	**9/30/2019**	**8/20/2019**	**9/30/2019**	6/11/2019
jacb6nut	5/21/2019 9:15	**9/30/2019**	**8/20/2019**	**9/30/2019**	6/11/2019
jacb6nut	5/21/2019 11:30	**9/30/2019**	**8/20/2019**	**9/30/2019**	6/11/2019
jacb6nut	5/21/2019 13:45	**9/30/2019**	**8/20/2019**	**9/30/2019**	6/11/2019
jacb6nut	5/21/2019 16:00	**9/30/2019**	**8/20/2019**	**9/30/2019**	6/11/2019
jacb6nut	5/21/2019 18:15	**9/30/2019**	**8/20/2019**	**9/30/2019**	6/11/2019
jacb6nut	5/21/2019 20:30	**9/30/2019**	**8/20/2019**	**9/30/2019**	6/11/2019
jacb6nut	5/21/2019 22:45	**9/30/2019**	**8/20/2019**	**9/30/2019**	6/11/2019
jacb6nut	5/22/2019 1:00	**9/30/2019**	**8/20/2019**	**9/30/2019**	6/11/2019
jacb6nut	5/22/2019 3:15	**9/30/2019**	**8/20/2019**	**9/30/2019**	6/11/2019
jacb6nut	5/22/2019 5:30	**9/30/2019**	**8/20/2019**	**9/30/2019**	6/11/2019
jacb6nut	6/6/2019 5:00	**9/30/2019**	**10/9/2019**	**9/30/2019**	6/18/2019
jacb6nut	6/6/2019 7:15	**9/30/2019**	**10/9/2019**	**9/30/2019**	6/18/2019
jacb6nut	6/6/2019 9:30	**9/30/2019**	**10/9/2019**	**9/30/2019**	6/18/2019
jacb6nut	6/6/2019 11:45	**9/30/2019**	**10/9/2019**	**9/30/2019**	6/18/2019
jacb6nut	6/6/2019 14:00	**9/30/2019**	**10/9/2019**	**9/30/2019**	6/18/2019
jacb6nut	6/6/2019 16:15	**9/30/2019**	**10/9/2019**	**9/30/2019**	6/18/2019
jacb6nut	6/6/2019 18:30	**9/30/2019**	**10/9/2019**	**9/30/2019**	6/18/2019
jacb6nut	6/6/2019 20:45	**9/30/2019**	**10/9/2019**	**9/30/2019**	6/18/2019
jacb6nut	6/6/2019 23:00	**9/30/2019**	**10/9/2019**	**9/30/2019**	6/18/2019
jacb6nut	6/7/2019 1:15	**9/30/2019**	**10/9/2019**	**9/30/2019**	6/18/2019
jacb6nut	6/7/2019 3:30	**9/30/2019**	**10/9/2019**	**9/30/2019**	6/18/2019

jacb6nut	6/7/2019 5:45	**9/30/2019**	**10/9/2019**	**9/30/2019**	broken vial
jacb6nut	7/23/2019 6:00	**9/30/2019**	**10/9/2019**	**9/30/2019**	7/31/2019
jacb6nut	7/23/2019 8:15	**9/30/2019**	**10/9/2019**	**9/30/2019**	7/31/2019
jacb6nut	7/23/2019 10:30	**9/30/2019**	**10/9/2019**	**9/30/2019**	7/31/2019
jacb6nut	7/23/2019 12:45	**9/30/2019**	**10/9/2019**	**9/30/2019**	7/31/2019
jacb6nut	7/23/2019 15:00	**9/30/2019**	**10/9/2019**	**9/30/2019**	7/31/2019
jacb6nut	7/23/2019 17:15	**9/30/2019**	**10/9/2019**	**9/30/2019**	7/31/2019
jacb6nut	7/23/2019 19:30	**9/30/2019**	**10/9/2019**	**9/30/2019**	7/31/2019
jacb6nut	7/23/2019 21:45	**9/30/2019**	**10/9/2019**	**9/30/2019**	7/31/2019
jacb6nut	7/24/2019 0:00	**9/30/2019**	**10/9/2019**	**9/30/2019**	7/31/2019
jacb6nut	7/24/2019 2:15	**9/30/2019**	**10/9/2019**	**9/30/2019**	7/31/2019
jacb6nut	7/24/2019 4:30	**9/30/2019**	**10/9/2019**	**9/30/2019**	7/31/2019
jacb6nut	7/24/2019 6:45	**9/30/2019**	**10/9/2019**	**9/30/2019**	7/31/2019
jacb6nut	8/21/2019 5:15	**9/30/2019**	**10/9/2019**	**9/30/2019**	8/28/2019
jacb6nut	8/21/2019 7:30	**9/30/2019**	**10/9/2019**	**9/30/2019**	8/28/2019
jacb6nut	8/21/2019 9:45	**9/30/2019**	**10/9/2019**	**9/30/2019**	8/28/2019
jacb6nut	8/21/2019 12:00	**9/30/2019**	**10/9/2019**	**9/30/2019**	8/28/2019
jacb6nut	8/21/2019 14:15	**9/30/2019**	**10/9/2019**	**9/30/2019**	8/28/2019
jacb6nut	8/21/2019 16:30	**9/30/2019**	**10/9/2019**	**9/30/2019**	8/28/2019
jacb6nut	8/21/2019 18:45	**9/30/2019**	**10/9/2019**	**9/30/2019**	8/28/2019
jacb6nut	8/21/2019 21:00	**9/30/2019**	**10/9/2019**	**9/30/2019**	8/28/2019
jacb6nut	8/21/2019 23:15	**9/30/2019**	**10/9/2019**	**9/30/2019**	8/28/2019
jacb6nut	8/22/2019 1:30	**9/30/2019**	**10/9/2019**	**9/30/2019**	8/28/2019
jacb6nut	8/22/2019 3:45	**9/30/2019**	**10/9/2019**	**9/30/2019**	8/28/2019
jacb6nut	8/22/2019 6:00	**9/30/2019**	**10/9/2019**	**9/30/2019**	8/28/2019
jacb6nut	9/22/2019 7:15	9/30/2019	10/9/2019	9/30/2019	10/16/2019
jacb6nut	9/22/2019 9:30	9/30/2019	10/9/2019	9/30/2019	10/16/2019
jacb6nut	9/22/2019 11:45	9/30/2019	10/9/2019	9/30/2019	10/16/2019
jacb6nut	9/22/2019 14:00	9/30/2019	10/9/2019	9/30/2019	10/16/2019
jacb6nut	9/22/2019 16:15	9/30/2019	10/9/2019	9/30/2019	10/16/2019
jacb6nut	9/22/2019 18:30	9/30/2019	10/9/2019	9/30/2019	10/16/2019
jacb6nut	9/22/2019 20:45	9/30/2019	10/9/2019	9/30/2019	10/16/2019
jacb6nut	9/22/2019 23:00	9/30/2019	10/9/2019	9/30/2019	10/16/2019
jacb6nut	9/23/2019 1:15	9/30/2019	10/9/2019	9/30/2019	10/16/2019
jacb6nut	9/23/2019 3:30	9/30/2019	10/9/2019	9/30/2019	10/16/2019
jacb6nut	9/23/2019 5:45	9/30/2019	10/9/2019	9/30/2019	10/16/2019
jacb6nut	9/23/2019 8:00	9/30/2019	10/9/2019	9/30/2019	10/16/2019
jacb6nut	10/23/2019 9:30	11/20/2019	**12/11/2019**	11/20/2019	11/5/2019
jacb6nut	10/23/2019 11:45	11/20/2019	**12/11/2019**	11/20/2019	11/5/2019
jacb6nut	10/23/2019 14:00	11/20/2019	**12/11/2019**	11/20/2019	11/5/2019
jacb6nut	10/23/2019 16:15	11/20/2019	**12/11/2019**	11/20/2019	11/5/2019
jacb6nut	10/23/2019 18:30	11/20/2019	**12/11/2019**	11/20/2019	11/5/2019
jacb6nut	10/23/2019 20:45	11/20/2019	**12/11/2019**	11/20/2019	11/5/2019
jacb6nut	10/23/2019 23:00	11/20/2019	**12/11/2019**	11/20/2019	11/5/2019
jacb6nut	10/24/2019 1:15	11/20/2019	**12/11/2019**	11/20/2019	11/5/2019
jacb6nut	10/24/2019 3:30	11/20/2019	**12/11/2019**	11/20/2019	11/5/2019
jacb6nut	10/24/2019 5:45	11/20/2019	**12/11/2019**	11/20/2019	11/5/2019
jacb6nut	10/24/2019 8:00	11/20/2019	**12/11/2019**	11/20/2019	11/5/2019
jacb6nut	10/24/2019 10:15	11/20/2019	**12/11/2019**	11/20/2019	11/5/2019
jacb6nut	11/7/2019 10:30	11/20/2019	12/11/2019	11/20/2019	12/5/2019

jacb6nut	11/7/2019 12:45	11/20/2019	12/11/2019	11/20/2019	12/5/2019
jacb6nut	11/7/2019 15:00	11/20/2019	12/11/2019	11/20/2019	12/5/2019
jacb6nut	11/7/2019 17:15	11/20/2019	12/11/2019	11/20/2019	12/5/2019
jacb6nut	11/7/2019 19:30	11/20/2019	12/11/2019	11/20/2019	12/5/2019
jacb6nut	11/7/2019 21:45	11/20/2019	12/11/2019	11/20/2019	12/5/2019
jacb6nut	11/8/2019 0:00	11/20/2019	12/11/2019	11/20/2019	12/5/2019
jacb6nut	11/8/2019 2:15	11/20/2019	12/11/2019	11/20/2019	12/5/2019
jacb6nut	11/8/2019 4:30	11/20/2019	12/11/2019	11/20/2019	12/5/2019
jacb6nut	11/8/2019 6:45	11/20/2019	12/11/2019	11/20/2019	12/5/2019
jacb6nut	11/8/2019 9:00	11/20/2019	12/11/2019	11/20/2019	12/5/2019
jacb6nut	11/8/2019 11:15	11/20/2019	12/11/2019	11/20/2019	12/5/2019
jacb6nut	12/5/2019 9:00	**2/26/2020**	12/11/2019	**2/26/2020**	**1/16/2020**
jacb6nut	12/5/2019 11:15	**2/26/2020**	12/11/2019	**2/26/2020**	**1/16/2020**
jacb6nut	12/5/2019 13:30	**2/26/2020**	12/11/2019	**2/26/2020**	**1/16/2020**
jacb6nut	12/5/2019 15:45	**2/26/2020**	12/11/2019	**2/26/2020**	**1/16/2020**
jacb6nut	12/5/2019 18:00	**2/26/2020**	12/11/2019	**2/26/2020**	**1/16/2020**
jacb6nut	12/5/2019 20:15	**2/26/2020**	12/11/2019	**2/26/2020**	**1/16/2020**
jacb6nut	12/5/2019 22:30	**2/26/2020**	12/11/2019	**2/26/2020**	**1/16/2020**
jacb6nut	12/6/2019 0:45	**2/26/2020**	12/11/2019	**2/26/2020**	**1/16/2020**
jacb6nut	12/6/2019 3:00	**2/26/2020**	12/11/2019	**2/26/2020**	**1/16/2020**
jacb6nut	12/6/2019 5:15	**2/26/2020**	12/11/2019	**2/26/2020**	**1/16/2020**
jacb6nut	12/6/2019 7:30	**2/26/2020**	12/11/2019	**2/26/2020**	**1/16/2020**
jacb6nut	12/6/2019 9:45	**2/26/2020**	12/11/2019	**2/26/2020**	**1/16/2020**