

Jacques Cousteau (JAC) NERR 2016 Nutrient Metadata
January 2016-December 2016
Latest Update: November 16, 2018

I. Data Set and Research Descriptors

1) Principal investigator(s) and contact persons

a) Reserve contact

Michael J. Kennish
Department of Marine and Coastal Sciences
Rutgers University
New Brunswick, New Jersey 08901
Phone: 848-932-3386 ext.23386
e-mail: kennish@marine.rutgers.edu

b) Laboratory contact

Ron J. Lauck
Lab Manager / Program Assistant
Department of Environmental Science
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 sampling program

Monthly grab samples for the Jacques Cousteau National Estuarine Research Reserve (JCNERR) 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 JC NERR. These data can then be compared to chlorophyll *a* measurements to assess their relationship to phytoplankton biomass. A major goal of JC 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 JC 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 JC 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 the four primary SWMP JC NERR 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 sonde 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 shaken and processed (e.g. filtered) for nutrient and Chl a analysis. Samples were then frozen in a -20 °C freezer at RMFS and transported to Rutgers University, IMCS as soon as possible thereafter. Once the processed samples were then transported to Rutgers University, IMCS 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 bottle were placed on ice in an opaque cooler at the Rutgers Marine Field Station to shield samples from light. Once in the laboratory, samples were shaken and processed (e.g. filtered) for filtered for nutrient and Chl a analysis. Samples were then frozen in a -20°C freezer at RMFS and transported to Rutgers University, IMCS as soon as possible thereafter. Once the filtered samples were then transported to Rutgers University, IMCS they were stored in a -20 °C freezer until analyses were performed.

4) Site location and character

All Jacques Cousteau NERR historical nutrient/pigment monitoring stations:

Station Code	SWMP Status	Station Name	Location	Active Dates	Reason Decommissioned	Notes
jacb5nut	S	Buoy 115	39° 31' 7.68 N, 74° 17' 13.92 W	02/01/2002 - current	NA	NA
Jacb6nut	P	Buoy 126	39° 30' 28.44 N, 74° 20' 18.67 W	02/01/2002 - current	NA	NA
jacb9nut	P	Buoy 139	39° 29' 52.59 N, 74° 22' 52.07 W	02/01/2002 current	NA	NA
jacbanut	P	Lower Bank	39° 35' 37.18 N, 74° 33' 5.44 W	02/01/2002 - current	NA	NA
jacnenut	P	Chestnut Neck	39° 32' 52.37 N, 74° 27' 38.77 W	02/01/2002 - current	NA	NA

The Jacques Cousteau National Estuarine Research Reserve (JCNERR) 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 four active sampling stations in 2009. All four 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 1m (although this can vary significantly depending on moon state, 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) - 39° 31' 07.68"N, 74° 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 ppt, with a range of 29.3 to 32.5 ppt. 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 jacb5nut and should be considered a characteristic of this sampling station.

2) Buoy 126 (B6) - 39deg 30'28.44"N, 74 deg 20'18.67"W- located three kilometers 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 kilometers from an area in the Intracoastal Waterway that is dredged regularly. The datasonde at this location is attached to Intracoastal Waterway Buoy 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 coarse 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 2016, the reported temperature at this station ranged from -1.6°C to 29.1°C, with an average of 14.0°C. The reported salinity at this station ranged from 20.7psu to 33.0psu, with an average of 29.6psu. 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 2.73m. 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 3.91m, with a range of 2.72 to 5.09m. The results of a sonar depth-survey of reserve waters by the USGS are anticipated, and we (the JCNERR) plan to independently survey the area in 2017 as well.

3) Buoy 139 (B9) – 39deg 29'52.59"N, 74deg 22'52.07"W*- is located 4 kilometers from Buoy 126 on the western side of Great Bay and is located about one to one and one-half kilometers from land. The datasonde at this location is attached to Intracoastal Waterway Buoy 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 2016, the reported temperature at this station ranged from -1.6°C to 30.5°C, with an average of 14.5°C. The reported salinity at this station ranged from 20.4psu to 32.9psu, with an average of 28.6psu. 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 2.48m. 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 3.18m, with a range of 2.13 to 4.55m. The results of a sonar depth-survey of

reserve waters by the USGS are anticipated, and we (the JCNERR) plan to independently survey the area in 2017 as well.

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

4) Chestnut Neck (NE) - 39deg 32'52.37"N, 74deg 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 2016, the reported temperature at this station ranged from -1.2°C to 30.8°C, with an average of 15.1°C. The reported salinity at this station ranged from 3.5psu to 29.0psu, with an average of 17.5psu. 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 2.36m. 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 2.32m, with a range of 1.11 to 3.45m. The results of a sonar depth-survey of reserve waters by the USGS are anticipated, and we (the JCNERR) plan to independently survey the area in 2017 as well.

5) Lower Bank (BA) - 39deg 35'37.18"N, 74 deg 33'05.44"W- located 13 kilometers upriver of the Chestnut Neck location. The Mullica River at this site is about two hundred meters 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 five meters high. The southern shore has an extensive marsh and fresh water wetland area about three kilometers 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 2016, the reported temperature at this station ranged from -0.2°C to 35.0°C, with an average of 15.5°C. The reported salinity at this station ranged from 0.0psu to 19.0psu, with an average of 4.7psu. 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 2.45m. 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 2.77m, with a range of 1.43 to 3.98m. The results of a sonar depth-survey of reserve waters by the

USGS are anticipated, and we (the JCNERR) plan to independently survey the area in 2017 as well.

5) Code variable definitions

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

The monitoring codes are set as “1” to indicate grab samples and “2” to indicate diel samples. 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	04/18/16	10:44	10:46
jacb5nut	05/18/16	9:22	9:24
jacb5nut	06/02/16	9:42	9:44
jacb5nut	07/06/16	12:25	12:27
jacb5nut	08/15/16	9:40	9:42
jacb5nut	09/12/16	10:11	10:13
jacb5nut	10/17/16	13:17	13:19
jacb5nut	11/02/16	13:44	13:46
jacb5nut	12/05/16	15:27	15:29
jacb6nut	01/07/16	11:05	11:07
jacb6nut	04/18/16	10:35	10:37
jacb6nut	05/18/16	8:53	8:55
jacb6nut	06/02/16	9:33	9:35
jacb6nut	07/06/16	12:14	12:16
jacb6nut	08/15/16	9:32	9:34
jacb6nut	09/12/16	9:44	9:46
jacb6nut	10/17/16	12:53	12:55
jacb6nut	11/02/16	13:35	13:37
jacb6nut	12/05/16	15:03	15:05

jacb9nut	01/07/16	11:16	11:18
jacb9nut	04/18/16	10:25	10:27
jacb9nut	05/18/16	9:03	9:05
jacb9nut	06/02/16	9:21	9:23
jacb9nut	07/06/16	12:07	12:09
jacb9nut	08/15/16	9:25	9:27
jacb9nut	09/12/16	9:53	9:55
jacb9nut	10/17/16	13:04	13:06
jacb9nut	11/01/16	13:07	13:09
jacb9nut	12/05/16	15:12	15:14

jacnenut	01/07/16	13:04	13:06
jacnenut	04/19/16	12:04	12:06
jacnenut	05/18/16	10:16	10:18
jacnenut	06/02/16	13:20	13:22
jacnenut	07/06/16	13:40	13:42
jacnenut	08/15/16	10:56	10:58
jacnenut	09/12/16	11:12	11:14
jacnenut	10/17/16	14:53	14:55
jacnenut	11/02/16	15:27	15:29
jacnenut	12/05/16	16:25	16:27

jacbanut	01/07/16	13:34	13:36
jacbanut	04/19/16	12:36	12:38
jacbanut	05/18/16	10:44	10:46
jacbanut	06/02/16	14:16	14:18
jacbanut	07/06/16	14:11	14:13
jacbanut	08/15/16	11:25	11:27
jacbanut	09/12/16	11:44	11:46
jacbanut	10/17/16	15:23	15:25
jacbanut	11/02/16	16:02	16:04
jacbanut	12/05/16	16:53	16:55

DIEL (ISCO) SAMPLING

Station Code	Month	Start Date	Start Time	End Date	End Time
jacb6nut	January	01/07/16	12:15	01/08/16	13:00
jacb6nut	April	04/26/16	5:00	04/27/16	5:45
jacb6nut	May	05/17/16	11:00	05/18/16	11:45
jacb6nut	June	06/08/16	4:30	06/09/16	5:15
jacb6nut	July	07/12/16	8:15	07/13/16	9:00
jacb6nut	August	08/23/16	5:30	08/24/16	6:15
jacb6nut	September	09/21/16	5:30	09/22/16	6:15
jacb6nut	October	10/11/16	10:00	10/12/16	10:45
jacb6nut	November	11/12/16	12:00	11/13/16	12:45

7) Associated researchers and projects

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 process 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 2016.

NERR nutrient data and metadata can be obtained from the Research Coordinator at the individual NERR site (please see Principal investigators and contact persons), from the Data Manager at the Centralized Data Management Office (please see personnel directory under the general information link on the CDMO home page) and online at the CDMO home page www.nerrsdata.org. Data are available in comma separated version format.

II. Physical Structure Descriptors

9) Entry verification

Monthly nutrient and plant pigment data files, in excel format, are sent to JNEERR 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. JNEERR 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 based on atomic weights of 14.01, 30.97, and 12.01 for Nitrogen, Phosphorous, and Carbon, respectively. Therefore, Jacques Cousteau NERR staff multiplies the concentrations reported by the Rutgers University Laboratory by 0.01401, 0.03097, and 0.01201 to yield concentrations in mg/L as N, P, and C respectively.

10) Parameter titles and variable names by data category

Required NOAA/NERRS System-wide Monitoring Program nutrient parameters are denoted by an asterisks “*”.

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	$\mu\text{g/L}$
Field Parameters:			
	Water Temperature	WTEM_N	$^{\circ}\text{C}$
	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

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.

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
NH ₄ F	01/07	12/31/2016	0.001 (mg/L)	2012*
NO ₂₃ F	01/07	12/31/2016	0.001 (mg/L)	2012*

PO4F	01/07	12/31/2016	0.003 (mg/L)	2012*
CHLA	01/03	12/31/2016	0.01 (ug/L)	2012*

*= MDL's were last formally verified in 2012. The analytical laboratory has assured us the consistency and quality of DI and filter blanks confirms the quality of the results.

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% MgCO₃ 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

JCNERR 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
<i>Wind speed</i>	
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 NO₃F 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 (primary) SWMP station, but is considered a secondary SWMP station. Data are collected 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.

Nutrient grab samples were not collected at the aforementioned jacob5nut station in January 2016 due to the timing of tidal restrictions affecting re-entry of the RUMFS boat basin.

Nutrient samples were not collected for either program in February and March of 2016 due to winter conditions and ice.

While the December 2016 grab samples were collected under zero-precipitation conditions, substantial rainfall occurred in the days prior to sampling.

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 (jacob6wq) at www.nerrsdata.org . It is recommended that users utilize the new 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 JCNERR’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 affecting 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 JCNERR’s meteorological dataset. The meteorological dataset can be accessed online at the CDMO home page <http://cdmo.baruch.sc.edu/> or www.nerrsdata.org .

A few discrepancies between replicate grab samples were observed and 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.

The following ChlA grab sample datum was not reported due to a broken vial at the analytical laboratory:

Station	DateTimeStamp
jacob6nut	8/15/2016 09:34

A malfunctioning probe resulted in the omission of dissolved oxygen spot-sampled “field data” associated with the September 2016 grab samples.

Flocculent material, possibly decaying alga from up-current SAV (submerged aquatic vegetation) beds located up-current (during ebb tides) 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 jacob5nut.

The following concentrations (in mg/L) were reported by the laboratory for the DI and filter blanks. Values should be near-zero and/or below the Minimal Detection Limit (MDL) for each parameter. Values below the MDL of each parameter are denoted by “SBL”. Higher values suggest instrument drift or contamination may have affected the accuracy of the measured values of the samples.

Grab sampling program

Month	Blank type	NO ₃ F (MDL=0.001)	NH ₄ F (MDL=0.001)	PO ₄ F (MDL=0.003)
January	DI	SBL	SBL	SBL
January	Filter	SBL	SBL	SBL
April	DI	SBL	SBL	SBL
April	Filter	0.001	SBL	SBL
May	DI	SBL	SBL	SBL
May	Filter	SBL	SBL	SBL
June	DI	SBL	SBL	SBL
June	Filter	SBL	SBL	SBL
July	DI	SBL	SBL	SBL
July	Filter	SBL	SBL	SBL
August	DI	SBL	SBL	SBL
August	Filter	0.001	SBL	SBL
September	DI	SBL	SBL	SBL
September	Filter	SBL	SBL	SBL
October	DI	SBL	SBL	SBL
October	Filter	SBL	SBL	SBL
November	DI	0.001	SBL	SBL
November	Filter	SBL	SBL	SBL
December	DI	SBL	SBL	SBL
December	Filter	SBL	SBL	SBL

Diel sampling program

Month	Blank Type	NO ₃ F (MDL=0.001)	NH ₄ F (MDL=0.001)	PO ₄ F (MDL=0.003)
-------	------------	----------------------------------	----------------------------------	----------------------------------

January	DI	SBL	SBL	SBL
January	Filter	SBL	SBL	SBL
April	DI	SBL	SBL	SBL
April	Filter	SBL	SBL	SBL
May	DI	SBL	SBL	SBL
May	Filter	SBL	SBL	SBL
June	DI	SBL	SBL	SBL
June	Filter	SBL	SBL	SBL
July	DI	SBL	SBL	SBL
July	Filter	SBL	SBL	SBL
August	DI	SBL	SBL	SBL
August	Filter	SBL	SBL	SBL
September	DI	SBL	SBL	SBL
September	Filter	SBL	SBL	SBL
October	DI	SBL	SBL	SBL
October	Filter	SBL	SBL	SBL
November	DI	SBL	SBL	SBL
November	Filter	0.001	SBL	SBL
December	DI	SBL	SBL	SBL
December	Filter	SBL	SBL	0.003

Sample hold times for 2016: Samples are held at -20°C. NERRS SOP allows nutrient samples to be held for up to 28 days (CHLA for 30), 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. Samples held too long prior to analysis are indicated with an asterisk below.

GRAB SAMPLES

SMWP Station	Date Collected	Parameter and Date Analyzed			
		PO4F	NH4F	NO23F	CHLA_N
jacb5nut	04/18/16	12/07/2016*	08/02/2016*	08/02/2016*	10/26/2016*
jacb5nut	05/18/16	12/07/2016*	08/02/2016*	08/02/2016*	10/26/2016*
jacb5nut	06/02/16	12/07/2016*	08/02/2016*	08/02/2016*	11/21/2016*
jacb5nut	07/06/16	12/07/2016*	08/02/2016	08/02/2016	08/02/2016
jacb5nut	08/15/16	03/22/2017*	02/08/2017*	02/08/2017*	03/02/2017*
jacb5nut	09/12/16	03/22/2017*	02/08/2017*	02/08/2017*	11/29/2017*
jacb5nut	10/17/16	03/22/2017*	02/08/2017*	02/08/2017*	11/09/2017
jacb5nut	11/02/16	03/22/2017*	02/08/2017*	02/08/2017*	01/18/2017*
jacb5nut	12/05/16	03/22/2017*	02/08/2017*	02/08/2017*	03/08/2017*
jacb6nut	01/07/16	12/07/2016*	08/02/2016*	08/02/2016*	09/28/2016*
jacb6nut	04/18/16	12/07/2016*	08/02/2016*	08/02/2016*	10/26/2016*
jacb6nut	05/18/16	12/07/2016*	08/02/2016*	08/02/2016*	10/26/2016*
jacb6nut	06/02/16	12/07/2016*	08/02/2016*	08/02/2016*	11/21/2016*

jacb6nut	07/06/16	12/07/2016*	08/02/2016	08/02/2016	08/02/2016
jacb6nut	08/15/16	03/22/2017*	02/08/2017*	02/08/2017*	03/02/2017*
jacb6nut	09/12/16	03/22/2017*	02/08/2017*	02/08/2017*	11/29/2017*
jacb6nut	10/17/16	03/22/2017*	02/08/2017*	02/08/2017*	11/09/2017
jacb6nut	11/02/16	03/22/2017*	02/08/2017*	02/08/2017*	01/18/2017*
jacb6nut	12/05/16	03/22/2017*	02/08/2017*	02/08/2017*	03/08/2017*
jacb9nut	01/07/16	12/07/2016*	08/02/2016*	08/02/2016*	09/28/2016*
jacb9nut	04/18/16	12/07/2016*	08/02/2016*	08/02/2016*	10/26/2016*
jacb9nut	05/18/16	12/07/2016*	08/02/2016*	08/02/2016*	10/26/2016*
jacb9nut	06/02/16	12/07/2016*	08/02/2016*	08/02/2016*	11/21/2016*
jacb9nut	07/06/16	12/07/2016*	08/02/2016	08/02/2016	08/02/2016
jacb9nut	08/15/16	03/22/2017*	02/08/2017*	02/08/2017*	03/02/2017*
jacb9nut	09/12/16	03/22/2017*	02/08/2017*	02/08/2017*	11/29/2017*
jacb9nut	10/17/16	03/22/2017*	02/08/2017*	02/08/2017*	11/09/2017
jacb9nut	11/01/16	03/22/2017*	02/08/2017*	02/08/2017*	01/18/2017*
jacb9nut	12/05/16	03/22/2017*	02/08/2017*	02/08/2017*	03/08/2017*
jacnenut	01/07/16	12/07/2016*	08/02/2016*	08/02/2016*	09/28/2016*
jacnenut	04/19/16	12/07/2016*	08/02/2016*	08/02/2016*	10/26/2016*
jacnenut	05/18/16	12/07/2016*	08/02/2016*	08/02/2016*	10/26/2016*
jacnenut	06/02/16	12/07/2016*	08/02/2016*	08/02/2016*	11/21/2016*
jacnenut	07/06/16	12/07/2016*	08/02/2016	08/02/2016	08/02/2016
jacnenut	08/15/16	03/22/2017*	02/08/2017*	02/08/2017*	03/02/2017*
jacnenut	09/12/16	03/22/2017*	02/08/2017*	02/08/2017*	11/29/2017*
jacnenut	10/17/16	03/22/2017*	02/08/2017*	02/08/2017*	11/09/2017
jacnenut	11/02/16	03/22/2017*	02/08/2017*	02/08/2017*	01/18/2017*
jacnenut	12/05/16	03/22/2017*	02/08/2017*	02/08/2017*	03/08/2017*
jacbanut	01/07/16	12/07/2016*	08/02/2016*	08/02/2016*	09/28/2016*
jacbanut	04/19/16	12/07/2016*	08/02/2016*	08/02/2016*	10/26/2016*
jacbanut	05/18/16	12/07/2016*	08/02/2016*	08/02/2016*	10/26/2016*
jacbanut	06/02/16	12/07/2016*	08/02/2016*	08/02/2016*	11/21/2016*
jacbanut	07/06/16	12/07/2016*	08/02/2016	08/02/2016	08/02/2016
jacbanut	08/15/16	03/22/2017*	02/08/2017*	02/08/2017*	03/02/2017*
jacbanut	09/12/16	03/22/2017*	02/08/2017*	02/08/2017*	11/29/2017*
jacbanut	10/17/16	03/22/2017*	02/08/2017*	02/08/2017*	11/09/2017
jacbanut	11/02/16	03/22/2017*	02/08/2017*	02/08/2017*	01/18/2017*
jacbanut	12/05/16	03/22/2017*	02/08/2017*	02/08/2017*	03/08/2017*

DIEL (ISCO) SAMPLES

SMWP Station	Date Collected	Parameter and Date Analyzed			
		PO4F	NH4F	NO23F	CHLA_N
jacb6nut	01/07-08/16	12/07/2016*	08/02/2016*	08/02/2016*	09/28/2016*

jacb6nut	04/26-27/16	12/07/2016*	08/02/2016*	08/02/2016*	10/26/2016*
jacb6nut	05/17-18/16	12/07/2016*	08/02/2016*	08/02/2016*	10/26/2016*
jacb6nut	06/08-09/16	12/07/2016*	08/02/2016*	08/02/2016*	11/21/2016*
jacb6nut	07/12-13/16	12/07/2016*	08/02/2016	08/02/2016	08/02/2016
jacb6nut	08/23-24/16	05/16/2017*	02/08/2017*	02/08/2017*	03/01/2017*
jacb6nut	09/21-22/16	05/16/2017*	02/08/2017*	02/08/2017*	11/29/2017*
jacb6nut	10/11-12/16	05/16/2017*	02/08/2017*	02/08/2017*	11/09/2017
jacb6nut	11/12-13/16	05/16/2017*	02/08/2017*	02/08/2017*	01/18/2017*
jacb6nut	12/13-14/16	05/16/2017*	02/08/2017*	02/08/2017*	03/08/2017*