**JAC NERR Nutrient Metadata**
**January 2023-December 2023**
**Latest Update: 13 June 2024**

Note: This is a provisional metadata document; it has not been authenticated as of its download date. Contents of this document are subject to change throughout the QAQC process and it should not be considered a final record of data documentation until that process is complete. Contact the CDMO (cdmosupport@baruch.sc.edu) or reserve with any additional questions.

## I. Data Set and Research Descriptors

### 1) Principal investigator(s) and contact persons –

#### a) Reserve contact

Thomas M. Grothues
Associate Research Professor
JC NERR Research Coordinator
Rutgers University Marine Field Station
800 c/o 132 Great Bay Blvd.
Tuckerton, NJ 08087
609-249-8802
grothues@marine.rutgers.edu

#### b) Laboratory contact

Carol Jeffery
Laboratory Director
VIMS Analytical Service Center
College of William and Mary
Rt 1208 Greate Road
Gloucester Point, VA 23062
804-684-7213
Email: pollard@vims.edu

#### 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
609-249-8805
e-mail: sakowicz@marine.rutgers.edu

### 2) Research objectives –

a) **Monthly grab**

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. An additional 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 JCNERR. These data can then be compared to chlorophyll *a* measurements to assess their relationship to phytoplankton biomass. A major goal of JNEERR 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 JCNERR. 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 Chestnut Neck in the Mullica River to assess nutrient concentrations and changes in concentrations over tidal cycles. These data augment/are augmented by monthly grab samples taken at Chestnut Neck (see above). This is a change from prior years when the ISCO sampler was located at Channel Marker 126; this change was opted to study and better understand the influence of nutrients (particularly runoff) lower Mullica River, an area of interest for natural shellfish recruitment as well as nearby shellfish farms. This location is co-located with the jacnewq water-monitoring station, as well as being the closest option to the JC NERR's jacncmet meteorological station.

**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 principle JNEERR datasonde stations (Buoy 126, Buoy 139, Chestnut Neck and Lower Bank) and at one station in Little Egg Harbor estuary (Buoy 115). 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. 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 (1x) 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 for nutrient and Chl a analysis. Samples were then frozen in a -20°C freezer and shipped to the Virginia Institute of Marine Sciences (VIMS) Analytical Service Center as soon as possible thereafter. The processed samples were then 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 Chestnut Neck (jacnewq). This constitutes a change from previous years (until 2019) during which diel sampling was conducted at the Buoy 126 (jacb6wq) station. This chance was done to sample waters exchanged by/in the mouth of the Mullica River, targeting areas of natural and commercial shellfish beds. Samples were collected monthly, at approximately 30-day intervals. Initiation of sampling was targeted to commence with the earliest low tide of the day and ran through the low tide of the next day. 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 1 meter 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 immersed in 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 for filtered for nutrient and Chl a analysis. Samples were then frozen in a -20°C freezer and shipped to the Virginia Institute of Marine Sciences (VIMS) Analytical Service Center as soon as possible thereafter. The processed samples were then stored in a –20°C freezer until analyses were performed.

**4) Site location and character –**

| | |
|---|---|
| Site name | Jacb5nut, a.k.a “Buoy 115” |
| Latitude and longitude | 39.51880, 74.28720 |
| Tidal range *(meters)* | 2m (estimated) |
| Salinity range *(psu)* | 21.3-31.9psu (from historical values) |
| Type and amount of freshwater input | Negligible; this site is dominated by tidal exchange |
| Water depth (*meters, MLW*) | 12m |
| Sonde distance from bottom (*meters*) | N/A |
| Bottom habitat or type | Sand, macroalgae |

| | |
|---|---|
| Pollutants in area | None of note; potential runoff-carried products from communities and marinas to north on west side of barrier island |
| Description of watershed | This site was once a secondary water quality (WQ) station but with the damage to (by ice floes) and the replacement (by the U.S. Coast Guard) of the monopod channel marker at this site, affixing of water quality equipment was no longer feasible and this station was abandoned as a secondary SWMP WQ station. It was decided to continue monitoring nutrients as a *secondary* SWMP station at this site due to the relevance of data to numerous SAV, shellfish, and fish research in this portion of the reserve. |

| | |
|---|---|
| Site name | Jacb6nut, a.k.a "Buoy 126" |
| Latitude and longitude | 39.50790, -74.33850 |
| Tidal range *(meters)* | 2.09m |
| Salinity range *(psu)* | 21.3-31.9psu |
| Type and amount of freshwater input | Minimal- dilute from Mullica River, local rain |
| Water depth (*meters, MLW*) | *2.69m (estimated)* |
| Sonde distance from bottom (*meters*) | 0.5-1.0m, contingent on sediment movement and seasonal mussel bed growth |
| Bottom habitat or type | *Soft sediment, seasonal mussel bed* |
| Pollutants in area | None of note; boat traffic may suspend sediment periodically and an aggregation of seals on a nearby island may be a source of bacteria during winter months |
| Description of watershed | 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. NOTE: Despite the name, this station is a tripod United States Coast Guard channel marker, not a "buoy" |

| | |
|---|---|
| Site name | Jacb9nut, a.k.a. "Buoy 139" |
| Latitude and longitude | 39.49794, -74.38113 |
| Tidal range *(meters)* | 1.95m |

| | |
|---|---|
| Salinity range *(psu)* | 19.7-31.9m |
| Type and amount of freshwater input | Minimal- dilute from Mullica River, local rain |
| Water depth (*meters, MLW*) | *2.31m (estimated)* |
| Sonde distance from bottom (*meters*) | *0.5m* |
| Bottom habitat or type | *Muddy sand* |
| Pollutants in area | None of note; boat traffic may suspend sediment periodically |
| Description of watershed | 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 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. NOTE: Despite the name, this station is a tripod United States Coast Guard channel marker, not a "buoy" |

| | |
|---|---|
| Site name | Jacnenut, a.k.a. "Chestnut Neck" |
| Latitude and longitude | 39.54790, -74.46080 |
| Tidal range *(meters)* | 2.05m |
| Salinity range *(psu)* | 2.2-27.3psu |
| Type and amount of freshwater input | Moderate- mid-river station and local rainfall/runoff |
| Water depth (*meters, MLW*) | 2.04m (estimated) |
| Sonde distance from bottom (*meters*) | *0.5m* |
| Bottom habitat or type | mixed organic mud/sand bottom |
| Pollutants in area | None of note; potential runoff from marina lot, organic offal from nearby fish cleaning stations |

| | |
|---|---|
| Description of watershed | 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 then 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. |

| | |
|---|---|
| Site name | Jacnut, a.k.a. "Lower Bank" |
| Latitude and longitude | 39.59370, -74.55150 |
| Tidal range *(meters)* | 2.13m |
| Salinity range *(psu)* | 0.0-19.4psu |
| Type and amount of freshwater input | Maximum among stations; upper-river station, local rainfall and runoff |
| Water depth (*meters, MLW*) | *2.19m (estimated)* |
| Sonde distance from bottom (*meters*) | *0.5m* |
| Bottom habitat or type | fine mixed organic mud and sandy sediment, concrete from bridge footers |
| Pollutants in area | None to note |
| Description of watershed | 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. |

All JAC NERR historical nutrient/pigment monitoring stations:

| Station Code | SWMP Status | Station Name | Location | Active Dates | Reason Decommissioned | Notes |
|---|---|---|---|---|---|---|
| B5 | S | jacb5nut | 39.51880, -74.28720 | Feb 2002-present | NA | Optional/ |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | | 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** –

jacnenut = Jacques Cousteau Nacote Chestnut Neck nutrients

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

**6) Data collection period** –

a) Grab Sampling Program

| Station Code | Date | Time First Sample | Time Second Sample |
|---|---|---|---|
| jacb5nut | 1/17/2023 | 10:14 | 10:16 |
| jacb5nut | 2/1/2023 | 11:50 | 11:52 |
| jacb5nut | 3/1/2023 | 10:43 | 10:45 |
| jacb5nut | 4/10/2023 | 14:36 | 14:38 |
| jacb5nut | 5/3/2023 | 11:01 | 11:03 |
| jacb5nut | 6/5/2023 | 13:12 | 13:14 |
| jacb5nut | 7/12/2023 | 10:32 | 10:34 |
| jacb5nut | 8/8/2023 | 8:41 | 8:43 |
| jacb5nut | 9/11/2023 | 9:19 | 9:21 |
| jacb5nut | 10/2/2023 | 14:03 | 14:05 |
| jacb5nut | 11/2/2023 | 14:51 | 14:53 |
| jacb5nut | 12/5/2023 | 8:33 | 8:35 |
| jacb6nut | 1/17/2023 | 9:45 | 9:47 |
| jacb6nut | 2/1/2023 | 11:21 | 11:23 |
| jacb6nut | 3/1/2023 | 10:11 | 10:13 |
| jacb6nut | 4/10/2023 | 14:23 | 14:25 |
| jacb6nut | 5/3/2023 | 10:49 | 10:51 |
| jacb6nut | 6/5/2023 | 13:02 | 13:04 |
| jacb6nut | 7/12/2023 | 10:21 | 10:23 |
| jacb6nut | 8/8/2023 | 8:27 | 8:29 |
| jacb6nut | 9/11/2023 | 9:08 | 9:10 |
| jacb6nut | 10/2/2023 | 13:52 | 13:34 |
| jacb6nut | 11/2/2023 | 14:38 | 14:40 |
| jacb6nut | 12/5/2023 | 8:20 | 8:22 |
| jacb9nut | 1/17/2023 | 9:58 | 10:00 |

| | | | |
|---|---|---|---|
| jacb9nut | 2/1/2023 | 11:31 | 11:33 |
| jacb9nut | 3/1/2023 | 10:26 | 10:28 |
| jacb9nut | 4/10/2023 | 14:10 | 14:12 |
| jacb9nut | 5/3/2023 | 10:38 | 10:40 |
| jacb9nut | 6/5/2023 | 12:52 | 12:54 |
| jacb9nut | 7/12/2023 | 10:10 | 10:12 |
| jacb9nut | 8/8/2023 | 8:15 | 8:17 |
| jacb9nut | 9/11/2023 | 8:58 | 9:00 |
| jacb9nut | 10/2/2023 | 13:40 | 13:42 |
| jacb9nut | 11/2/2023 | 14:25 | 14:27 |
| jacb9nut | 12/5/2023 | 8:10 | 8:12 |
| jacnenut | 1/17/2023 | 11:24 | 11:26 |
| jacnenut | 2/1/2023 | 13:36 | 13:38 |
| jacnenut | 3/1/2023 | 12:45 | 12:47 |
| jacnenut | 4/10/2023 | 16:04 | 16:06 |
| jacnenut | 5/3/2023 | 12:55 | 12:57 |
| jacnenut | 6/5/2023 | 14:19 | 14:21 |
| jacnenut | 7/12/2023 | 12:37 | 12:39 |
| jacnenut | 8/8/2023 | 10:03 | 10:05 |
| jacnenut | 9/11/2023 | 10:19 | 10:21 |
| jacnenut | 10/2/2023 | 15:08 | 15:10 |
| jacnenut | 11/2/2023 | 16:03 | 16:05 |
| jacnenut | 12/5/2023 | 9:53 | 9:55 |
| jacbanut | 1/17/2023 | 11:54 | 11:56 |
| jacbanut | 2/1/2023 | 14:03 | 14:05 |
| jacbanut | 3/1/2023 | 13:16 | 13:18 |
| jacbanut | 4/10/2023 | 16:37 | 16:39 |
| jacbanut | 5/3/2023 | 13:31 | 13:33 |
| jacbanut | 6/5/2023 | 15:17 | 15:19 |
| jacbanut | 7/12/2023 | 13:11 | 13:12 |
| jacbanut | 8/8/2023 | 10:40 | 10:42 |
| jacbanut | 9/11/2023 | 10:51 | 10:53 |
| jacbanut | 10/2/2023 | 15:44 | 15:46 |
| jacbanut | 11/2/2023 | 16:26 | 16:28 |
| jacbanut | 12/5/2023 | 10:29 | 10:31 |

b) Diel Sampling Program

| Station Code | Date First Sample | Time | Date Last Sample | Time |
|---|---|---|---|---|
| jacnenut | 1/17/2023 | 11:30 | 1/18/2023 | 12:15 |
| jacnenut | 2/5/2023 | 4:00 | 2/7/2023 | 4:45 |
| jacnenut | 3/2/2023 | 12:15 | 3/3/2023 | 13:00 |
| jacnenut | 4/11/2023 | 6:30 | 4/12/2023 | 7:15 |
| jacnenut | 5/3/2023 | 13:00 | 5/4/2023 | 13:45 |
| jacnenut | 6/6/2023 | 4:00 | 6/7/2023 | 4:45 |
| jacnenut | 7/13/2023 | 9:15 | 7/14/2023 | 10:00 |
| jacnenut | 8/9/2023 | 8:15 | 8/10/2023 | 9:00 |
| jacnenut | 9/11/2023 | 11:15 | 9/12/2023 | 12:00 |
| jacnenut | 10/3/2023 | 4:30 | 10/4/2023 | 5:15 |

| | | | | |
|---|---|---|---|---|
| jacnenut | 11/7/2023 | 10:45 | 11/8/2023 | 11:30 |
| jacnenut | 12/5/2023 | 8:00 | 12/6/2023 | 8:45 |

**7) Associated researchers and projects–**

A number of researchers have expressed interest in our 2023 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 2022.

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 the JC NERR by the Virginia Institute of Marine Sciences (VIMS) Analytical Service Center. Files consist of sample ID, sampling date, analysis date, and parameter values expressed in mg/L (ug/L for Chlorophyll). The data are reviewed for values that appear erroneous or illogical. Any samples found to have questionable results are reanalyzed. JC 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.

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

| 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 | ºC |
| | 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.

**11) Measured or calculated laboratory parameters** –

a) **Parameters measured directly**

| | |
|---|---|
| Nitrogen species: | NH4F, NO2F, NO23F |
| Phosphorus species: | PO4F |
| Other: | CHLA_N, PHEA, SiO4F |

b) **Calculated parameters**

| | |
|---|---|
| NO3F | NO23F-NO2F |
| 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 VIMS Nutrient Analytical Laboratory. The MDL is determined as 3 times the standard deviation of a minimum of 7 replicates of a single low concentration sample. These values are reviewed and revised periodically.

| Parameter | Start Date | End Date | MDL | Revisited |
|---|---|---|---|---|
| PO4F | 01/01/23 | 12/31/23 | 0.0016 | 01/06/2023 |
| NH4F | 01/01/23 | 12/31/23 | 0.0062 | 01/06/2023 |
| NO23F | 01/01/23 | 12/31/23 | 0.0055 | 01/06/2023 |
| CHLA_N | 01/01/23 | 12/31/23 | 0.50 | 01/06/2023 |

**13) Laboratory methods** –

i) **Parameter: PO4F**

VIMS Laboratory Method SKALAR Method: O-Phosphate / Total Phosphate, Catnr. 503-365.1, issue 042993/MH/93-Demo1

Method Reference:

- Murphy, J. and J.P. Riley. 1962. A modified single solution method for the determination of phosphate in natural waters. Analytica Chim. Acta 27 : 31-36
- EPA 600/R-97/072 Method 365.5 Determination of Orthophosphate in Estuarine and Coastal Waters by Automated Colorimetric Analysis. IN: Methods for the Determination of Chemical Substances in Marine and Estuarine Environmental Matrices -2nd Edition. National Exposure Research Laboratory, Office of Research and Development. U.S. EPA, Cincinnati, Ohio 45268

Method Descriptor: Ammonium molybdate and antimony potassium tartrate react in a sulfuric acid environment to form an antimony-phospho-molybdo complex, which is reduced to a blue colored complex by ascorbic acid. Reaction is heat catalyzed at 40$^{o}$C. Range is 1 - 50 ppb.

Preservation Method: Preservation Method: 60 ml of sample is filtered through a Whatman® Nuclepore Track-Etched Membrane, 0.4 µm disposable disk filter (47mm), and stored at –20 $^{o}$C until analyzed.

ii) **Parameter: NO23F**

VIMS Laboratory Method: SA461-353.2 - NO2+3

Method Reference:

- U.S. EPA. 1974. Methods for Chemical Analysis of Water and Wastes, pp. 207 -212.
- Wood, E.D., F.A.G. Armstrong, and F.A. Richards. 1967. Determination of nitrate in seawater by cadmium-copper reduction to nitrite. J. Mar. Biol. Assoc. U.K. 47: 23
- Grasshoff, K., M. Ehrhardt and K. Kremling. 1983. Methods of Seawater Analysis. Verlag Chemie, Federal Republic of Germany. 419 pp.
- EPA 600/R-97/072 Method 353.4. Determination of Nitrate and Nitrite in Estuarine and Coastal Waters by Gas Segmented Flow Colorimetric

Analysis. IN: Methods for the Determination of Chemical Substances in Marine and Estuarine Environmental Matrices -2nd Edition. National Exposure Research Laboratory, Office of Research and Development U.S. EPA, Cincinnati, Ohio 45268.

Method Descriptor: Nitrate is reduced quantitatively to nitrite by cadmium metal in the form of an open tubular reactor. The nitrite thus formed plus any originally present in the sample is colorimetrically detected at 540 nm, following its diazotization with sulfanilamide, and subsequent coupling with N-1-naphthylethylenediamine dihydrochloride. The dissolved nitrate concentrations of the samples are calculated as NO3-N.

Preservation Method: 60 ml of sample is filtered through a Whatman® Nuclepore Track-Etched Membrane, 0.4 µm disposable disk filter (47mm), and stored at –20 ºC until analyzed.

iii) **Parameter: NH4F**

VIMS Laboratory Method: SA156-350.1 - NH3

Method Reference:

- U.S. EPA. 1974. Methods for Chemical Analysis of Water and Wastes, pp. 168-174.
- Standard Methods for the Examination of Water and Wastewater, 14th edition. p 410. Method 418A and 418B (1975).
- Annual Book of ASTM Standards, Part 31. "Water", Standard 1426-74, Method A, p 237 (1976).
- EPA 600/R-97/072 Method 349.0. Determination of Ammonia in Estuarine and Coastal Waters by Gas Segmented Continuous Flow Colorimetric Analysis. IN: Methods for the Determination of Chemical Substances in Marine and Estuarine Environmental Matrices -2nd Edition. National Exposure Research Laboratory, Office of Research and Development U.S. EPA, Cincinnati, Ohio 45268.

Method Descriptor: Ammonia reacts with alkaline phenol and hypochlorite to form indophenol blue in an amount that is proportional to the ammonia concentration. The blue color is intensified with sodium nitroprusside. The reaction is catalyzed by heat at 37ºC. The range is 0.01 – 2.0 mg L-1.

Preservation Method: 60 ml of sample is filtered through a Whatman® Nuclepore Track-Etched Membrane, 0.4 µm disposable disk filter (47mm), and stored at –20 ºC until analyzed.

iv) **Parameter: CHLA**

VIMS Analytical Service Center

Method Reference: EPA 445.o

Method Descriptor: Chlorophyll-containing phytoplankton in a measured volume of water are concentrated by vacuum filtration onto a glass fiber filter. The pigments are extracted from the phytoplankton onto a 90% acetone solution with the aid of a mechanical tissue grinder. The samples are steeped in the dark at 4°C for a minimum of

two hours, but not to exceed 24 hours, to ensure complete extraction of the pigments. The filter slurry is centrifuge at 675 grav for a minimum of 15 minutes or longer as necessary to clarify the solution. The supernatant is transferred to a glass cuvette and fluorescent is measured before and after certification with a 1.0 N HCl solution. A standard curve is repaired from known concentrations of chlorophyll a standards the concentration is reported in ug /L.

Preservation Method: Analyzed immediately; stored in dark at -20 °C for "a few" days is permissible.

**14) Field and Laboratory QAQC programs** –

[Instructions/Remove: This section describes field variability, laboratory variability, the use of inter-organizational splits, sample spikes, standards, and cross calibration exercises. Include any information on QAQC checks performed by your lab.]

a) **Precision**
   i. **Field Variability** - For the monthly grab sampling program, JC NERR collects two successive grab samples for the determination of water mass variability.
   ii. **Laboratory Variability** – replicates of all nutrient samples are run
   iii. **Inter-organizational Splits** – none

b) **Accuracy**
   i. **Sample Spikes** – blanks
   ii. **Standard Reference Material Analysis** – none
   iii. **Cross Calibration Exercises** – none

**15) 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** –

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/notes –**

Data may be missing due to problems with sample collection or processing. Laboratories in the NERR 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.

F_record CSM flag explanation(s):

Grab samples: Typically, detailed "Record Comments" concerning weather conditions at the time of sampling are maintained and reported. In 2023 these records were largely lacking and therefore are not reported in the dataset. Meteorological data are collected by the JC NERR's jacncmet SWMP station and available for download at nerrsdata.org It is worth noting that grab samples are consistently collected during the latter half of ebb or low tide during periods not impacted by major storm and/or surge events.

Diel samples: Because these samples are collected autonomously with an ISCO sampler, F_records are typically not reported- unless concurrent with a major storm and/or storm surge events. Meteorological data are collected by the JC NERR's jacncmet SWMP station and available for download at nerrsdata.org

**Sample hold times for 2023:** 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 <1>and coded (CHB). If measured values were below MDL, this resulted in <-4> [SBL] (CHB) flagging/coding.

| Sample Descriptor | NH4F analysis date | No23F analysis date | PO4F analysis date | ChlA Analysis Date |
|---|---|---|---|---|
| 1/17/2023, all grabs | 2/9/2023 | 2/9/2023 | 2/9/2023 | 2/9/2023 |
| 2/1/2023, all grabs | 2/15/2023 | 2/15/2023 | 2/15/2023 | 3/8/2023 |
| 3/1/2023, all grabs | 3/15/2023 | 3/15/2023 | 3/15/2023 | 3/13/2023 |
| 4/10/2023, all grabs | 4/20/2023 | 4/20/2023 | 4/20/2023 | 4/26/2023 |
| 5/3/2023, all grabs | 6/2/2023 | 6/2/2023 | 6/2/2023 | 6/1/2023 |
| 6/5/2023, all grabs | 6/15/2023 | 6/15/2023 | 6/15/2023 | 6/26/2023 |
| 7/12/2023, all grabs | 7/27/2023 | 7/27/2023 | 7/27/2023 | 8/1/2023 |
| 8/8/2023, all grabs | 8/24/2023 | 8/24/2023 | 8/24/2023 | 9/13/2023 |
| 9/11/2023, all grabs | 10/5/2023 | 10/5/2023 | 10/5/2023 | 9/27/2023 |
| 10/2/2023, all grabs | 10/30/2023 | 10/30/2023 | 10/30/2023 | 10/26/2023 |
| 11/2/2023, all grabs | 11/29/2023 | 11/28/2023 | 11/28/2023 | 12/5/2023 |
| 12/5/2023, all grabs | 1/2/2024 | 1/2/2024 | 1/2/2024 | 1/2/2024 |
| 1/17 - 1/18/2023, all diels | 2/9/2023 | 2/9/2023 | 2/9/2023 | 2/9/2023 |
| 2/5 - 2/6/2023, all diels | 2/15/2023 | 2/15/2023 | 2/15/2023 | 3/8/2023 |
| 3/2 - 3/3/2023, all diels | 3/15/2023 | 3/15/2023 | 3/15/2023 | 3/13/2023 |
| 4/11 - 4/12/2023, all diels | 4/20/2023 | 4/20/2023 | 4/20/2023 | 4/26/2023 |
| 5/3 - 5/4/2023, all diels | 6/2/2023 | 6/2/2023 | 6/2/2023 | 6/1/2023 |
| 6/6 - 6/7/2023, all diels | 6/15/2023 | 6/15/2023 | 6/15/2023 | 6/26/2023 |
| 7/13 - 7/14/2023, all diels | 7/27/2023 | 7/27/2023 | 7/27/2023 | 8/1/2023 |
| 8/9 - 8/10/2023, all diels | 8/24/2023 | 8/24/2023 | 8/24/2023 | 9/13/2023 |
| 9/11 - 9/12/2023, all diels | 10/5/2023 | 10/5/2023 | 10/5/2023 | 9/27/2023 |
| 10/3 - 10/4/2023, all diels | 10/30/2023 | 10/30/2023 | 10/30/2023 | 10/26/2023 |
| 11/7 - 11/8/2023, all diels | 11/29/2023 | 11/28/2023 | 11/28/2023 | 12/5/2023 |
| 12/5 - 12/6/2023, all diels | 1/2/2024 | 1/2/2024 | 1/2/2024 | 1/2/2024 |