Chesapeake Bay Maryland (CBM) NERR Nutrient Metadata
January - December 2005
Latest Update: May 15, 2025

I. Data Set & Research Descriptors

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

a) **Reserve Contacts**

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2) **Research objectives** –

The principal objectives of this effort are to provide baseline nutrient concentration data at fixed sites throughout the Chesapeake Bay National Estuarine Research Reserve in

Maryland's (CBM NERR) tidal waters. This information supports the National Estuarine Research Reserve's (NERR) System Wide Monitoring Program (SWMP) and supplements water quality information taken at the same fixed sites. Specific goals of this effort include: 1) tracking and recording nutrient conditions to better understand and explain current conditions with the aid of additional data (water quality and meteorological) collected concurrently 2) creating a database capable of detecting long-term changes in nutrient conditions of these systems 3) recording and identifying temporal and spatial differences in nutrient conditions to include changes on a diel time frame and to collect ancillary data in support of other research efforts.

At CBM NERR, water quality and nutrient data were collected at four sites during 2005. Three sites are at the Jug Bay Component of the Reserve and one site is at the Otter Point Creek Component. The three sites at Jug Bay were selected in an effort to examine water quality and nutrient information across different spatial scales and at sites demonstrating different levels of anthropogenic activities. The site at Otter Point Creek was selected to provide baseline information for the Otter Point Creek site and to use for comparison to one or more of the Jug Bay sites.

a) Monthly Grab Sampling Program

The goals of the monthly grab samples are to create a long-term database of nutrient information at each site for the purpose of detecting temporal and spatial changes. This nutrient information supplements water chemistry data to provide a complete picture of water quality at the NERR sites.

b) Diel Sampling Program

The goal of the diel sampling is to catalog short-term variability in nutrient concentrations across different tidal cycles at the Jug Bay Railroad site. This temporal nutrient data provides a comprehensive look at the variation in water quality over a 24-hour period.

3) **Research methods**

a) Monthly Grab Sampling Program

Monthly nutrient grab samples were taken at the four principal water quality monitoring stations: Mataponi Creek, Railroad Bridge, Iron Pot Landing, and Otter Point Creek. NERR protocol calls for duplicate monthly nutrient grab samples taken at all four sites on the same day within 3 hours of slack tide. Due to the location of the Jug Bay sites being 2 to 3 hours away from the Otter Point Creek site and because they are completely different systems, Otter Point Creek was not sampled on the same day as the other three sites. Instead all three Jug Bay sites were sampled on the same day, while the Otter Point Creek was sampled the following week. In accordance to NERR protocol, duplicate samples were taken once monthly at each of the four sites and analyzed for chlorophyll a concentrations, nitrate, nitrite, ammonium, and ortho-phosphate. Additional parameters to include total suspended solids, total volatile solids and total nitrogen and total phosphorus were also sampled at the same time. CBM NERR, in collaboration with the Maryland Department of Natural Resources Continuous Monitoring Program were interested in a larger suite of nutrient data collected bi-weekly from April 1-October 31, 2005. As such, an additional round of sampling (not in duplicate) was conducted each month at the same four sites for a larger number of parameters than required by the

NERR System. These additional parameters are not reported here but can be obtained by contacting Julie Bortz (see contacts).

Duplicate whole water samples were collected using a horizontal Alpha Bottle lowered to the depth of the YSI instrument. A sample was captured in the Alpha Bottle at the same time the YSI 6600EDS logged a water quality reading. This sample was decanted from the Alpha Bottle to a one liter Nalgene bottle for filtering. After decanting the first sample the Alpha Bottle was lowered a second time to capture the duplicate sample. Nalgene bottles are only washed with Liquinox laboratory soap, rinsed three to five times with tap water and then rinsed three to five time with DI water. Acid washing is not used due to Chlorophyll sampling from the same bottle, to reduce the licing of cells from residual acid. The filter units are acid washed, barring the chlorophyll filter frit, with liquinox soap, rinsed three times with tap water, rinsed three times with 10% HCl solution, rinsed three times with tap again, and finally a rinse of DI water three times. Samples are placed on ice and stored in a freezer at the office until courier transports the samples to analytical labs.

b) Diel Sampling Program

In addition to discrete grab samples taken at each of the four sites, additional diel data was collected once monthly beginning on February 23, 2005 at the Railroad Bridge station located at the Jug Bay Component. Using an ISCO automated sampler field teams conducted diel sampling as per NERR protocol. These unattended samplers, set at a depth of approximately 0.3 meters off the bottom, were programmed to sample every two and one half hours, over a twenty-four hour lunar period, starting at a scheduled YSI 6600EDS data collection interval. Using 1000mL plastic ISCO bottles, the bottles were only washed with Liquinox laboratory soap, rinsed three to five times with tap water and then rinsed three to five time with DI water. Acid washing is not used due to Chlorophyll sampling from the same bottle, to reduce the licing of cells from residual acid. The filter units are acid washed, barring the chlorophyll filter frit, with liquinox soap, rinsed three times with tap water, rinsed three times with 10% HCl solution, rinsed three times with tap again, and finally a rinse of DI water three times. Samples are placed on ice and stored in a freezer at the office until courier transports them on ice to the lab. A two-liter bottle of frozen water was placed in the sample compartment of these samplers to preserve collected samples over the 24hr deployment period. During each 24hr deployment, 11 whole water samples were collected and stored in the automated sampler until retrieved and taken back to the lab for processing.

All whole water samples (weekly, duplicate, and monthly diel) were collected in the field and either filtered at the site or preserved on ice and taken back to the lab for filtering and sample preparation later that same day. See Section 16 for the filtration Standard Operating Procedure.

4) **Site location and character –**

The Chesapeake Bay National Estuarine Research Reserve in Maryland consists of three components: Otter Point Creek on the Bush River along the upper western shore of the Chesapeake Bay, Jug Bay along the Patuxent River in the middle Bay and Monie Bay on the

lower eastern shore of the Chesapeake Bay. At CBM NERR, water quality and nutrient data are collected at four sites. Three sites are at the Jug Bay Component of the Reserve and one site is at the Otter Point Creek Component. The Jug Bay Component of the Reserve is located in the tidal headwaters of the Patuxent River. The watershed for this portion of the river includes portions of the DC Metropolitan area but has dense, tracks of protected riparian areas surrounding this portion of the river. Jug Bay itself, is a 722-acre tidal estuary providing a narrow transition zone between brackish marshes and upland freshwater wetlands. The broad, shallow waters of Jug Bay support a profusion of freshwater plants and animals. Vegetation crowds the river channel and forms an interlaced pattern of tidal and non-tidal marshes, swamps and forested wetlands surrounded by upland woods and fields. The Otter Point Creek Component of the Reserve is located along the tidal headwaters of the Bush River, which drains much of Harford County, including the rapidly growing town of Bel Air, Maryland. Otter Point Creek is a tributary of the Bush River in the upper Chesapeake Bay and consists of 672 acres of open water, tidal marshes, forested wetlands and upland hardwood forests, surrounded by major highways, large residential communities, and heavy commercial and industrial development.

The following is a list of sites with a detailed description of site characteristics and other relevant information.

Mataponi Creek (MC) 38° 44.599'N, 76° 42.446'W (NAD83) or 38.74331667, -76.70743333 (GIS format)

Site MC is located at the Jug Bay Component of the Reserve, in a small tributary (Mataponi Creek) off the upper tidal headwaters of the Patuxent River, Maryland. MC is 2.4 km upstream from the mouth and located in the midchannel of the creek, which is approximately 7m wide at that point. The southern bank is steep and covered mainly with hardwood trees while the Northern bank is tidal marsh. The YSI water quality sonde was deployed vertically in a perforated PVC pipe. Average depth at this site is roughly 0.7 meters with a mean tidal fluctuation of approximately 0.6 m. The YSI is deployed 0.25 m off of the creek bottom. Salinities at this site rarely exceed 0.1 ppt. The bottom habitat is soft sediment, and submerged macrophytes are abundant and dense during the summer months. Because this site is located along the main channel of the Mataponi Creek, water quality is reflective of the general quality of water flowing along the main portion of the creek. The submerged macrophyte community at this site is seasonally very dense and thus water quality is thought to be strongly influenced by the presence of SAV during the summer months. Because of the dense submerged macrophyte community and limited degree of anthropogenic activities occurring within the watershed of this site, MC is thought to be a "reference" water quality site for the Reserve. Historic sampling at this site began in 2003.

Railroad Bridge (RR) 38° 46.877'N, 76° 42.822'W (NAD 83) or 38.78128333, -76.7137 (GIS format)

Site RR is located in the mainstem of the upper tidal headwaters of the Patuxent River, Maryland. The site is slightly upstream (roughly 0.3km) from Jackson's Landing at the Patuxent River Park (previous PR site). This section of the Patuxent River is approximately 70m wide and average depth at the site is 1.4m. The YSI sonde is deployed 0.25 m off of the

river bottom. Salinities at this site rarely exceed 0.3 ppt. Bottom habitat is soft sediment, and submerged macrophytes are evident in the shallow areas (<0.5m MLW) during summer months. Mean tidal fluctuation is approximately 0.6 m. The site location (RR) is at the end of the old railroad bed and is deployed vertically in a perforated PVC pipe near midchannel of the Patuxent River. Because this site is located along the main channel of the Patuxent River, water quality is reflective of the general quality of water flowing along the main portion of the river. The site is roughly 1km downstream of the confluence of the Western Branch tributary and the Patuxent River Mainstem. Thus water quality is influenced by Western Branch tributary which receives tertiary treated effluent from a large wastewater treatment plant (averaging 10-20 mgd) which discharges directly into the Western Branch tributary of the Patuxent River just upstream of site IP. Because of the location of this site along the main portion of the Patuxent River, this site is thought to be characteristic of this portion of the Patuxent River and thus similar to the historic (1995-2002) site (Jug Bay) located at 38° 46' 50.6" N, 76° 42' 29.1" W.

Iron Pot Landing (IP) 38° 47.760'N, 76° 43.248' W (NAD 83)
or 38.796, -76.7208 (GIS Format)

Site IP is located 2.09km from the mouth of Western Branch. The YSI sonde at IP is deployed vertically in a perforated PVC pipe and attached to a small pier near midchannel of the river and has an average depth of 1.6m. The YSI is deployed 0.25 m off of the river bottom. The site is roughly 1km downstream of a large (10-20 mgd) wastewater treatment plant effluent discharge site. The river is approximately 15m wide and flows through extensive riparian buffers. Both banks of the river are flanked by hardwood flora. Tides are semi-diurnal and mean tidal fluctuation is approximately 0.6 m. Salinity at this site is generally 0.1 ppt. Bottom habitat is soft sediment, and narrow submerged macrophyte grassbeds are occasionally evident in the shallow areas downstream during the summer months. Because of the proximity of this site to the discharge location for a large WWTP, this site is considered an “impacted” site for the reserve. Historic sampling at this site began in 2003.

Otter Point Creek (OC) 39° 27.047'N, 76° 16.474'W (NAD 83)
or 39.45078333, -76.27456667 (GIS Format)

Site OC is located within the Otter Point Creek Component of the Reserve, in the tidal headwaters of the Bush River. The Otter Point Creek component is a large but shallow tidally flooded marsh with average depths less then 1m on low tide. The site is approximately 0.3km from the Anita C. Leight Estuary Center. Site OC is deployed vertically in a perforated PVC pipe and has an average depth of 0.7m. The YSI is deployed 0.25 m off of the creek bottom. Bottom habitat is extremely soft sediment, and submerged macrophyte communities inundate the site during summer months, creating a dense and almost impenetrable ground cover. Salinity at this station rarely rises above 0.1 ppt. Tides in Otter Point Creek are semi-diurnal and have a mean range of about 0.3 m. The average water levels are generally lower in the winter due to north and northwest winds that increase the egress from Chesapeake Bay. The sonde was periodically exposed to air at some low tides, and sediments at the site are extremely fine and flocculent. Because of the shallowness of the tidal marsh, coupled with the dramatic daily changes in the depth, deployments at the site

presented many problems. These problems included periodic exposure of the sonde, very high turbidity and sedimentation rates associated with tidal infiltration and wind and wave generated resuspension, which caused severe fouling of the probes. Water quality at the site represented extreme shallow water habitats. Thus it is not uncommon to see very large fluctuations in temperature and dissolved oxygen at this site ranging from complete anoxia to full saturation, due in part to the shallow nature of the site, presence of dense macrophyte communities, and the effects of marsh processes on water quality. This site is thought to be representative of water quality within the Otter Point Creek component throughout most of the year, with the exception of the summer months when dense submerged macrophyte communities greatly influence the site. There are no known pollutants at this site and historic sampling began in 2003.

5) **Code variable definitions –**

Site definitions:

cbmrrnut = Chesapeake Bay Maryland Reserve nutrient data for Railroad Bridge
cbmmcnut = Chesapeake Bay Maryland Reserve nutrient data for Mataponi Creek
cbmipnut = Chesapeake Bay Maryland Reserve nutrient data for Iron Pot Landing
cbmocnut = Chesapeake Bay Maryland Reserve nutrient data for Otter Point Creek

Monitoring Program Codes:

1 = Monthly (weekly) grab sample
2 = Diel sampling

Rep Codes:

1 = Routine sampling
2 = Duplicate sampling
S = Routine monthly duplicate when there is a conflict with the Diel sample in the database.

6) **Data collection period –**

Nutrient samples were collected using an Alpha Bottle or ISCO Sampler. At Railroad Bridge (Jug Bay Wetlands Sanctuary)(RR) sampling began on January 4, 2005 and continued through December 20, 2005; Mataponi Creek (MTI) began January 4, 2005 and continued through December 20, 2005; Iron Pot Landing (IP) began January 4, 2005 and continued through December 6,2005; and Otter Point Creek (OC) began January 4, 2005 and continued through December 6, 2005.

(RR) Railroad Monthly Grab Sampling

Date	Time
1/4/2005	9:30
1/20/2005	11:45
2/24/2005	11:15
3/10/2005	9:30
3/30/2005	9:30

4/12/2005	10:00
4/26/2005	9:30
5/10/2005	8:30
5/24/2005	11:00
6/7/2005	11:00
6/21/2005	8:15
7/6/2005	8:45
7/19/2005	9:15
8/2/2005	9:15
8/16/2005	10:30
8/30/2005	7:15
9/13/2005	13:15
9/27/2005	13:15
10/11/2005	13:00
10/25/2005	13:15
11/9/2005	12:30
11/22/2005	13:00
12/6/2005	10:30
12/20/2005	10:45

(RR) Railroad Diel Grab Sampling

Date	Time			
2/23/2005	0:30	-	2/24/2005	1:30
3/30/2005	10:00	-	3/31/2005	11:00
4/26/2005	10:00	-	4/27/2005	11:00
5/23/2005	8:00	-	5/24/2005	9:00
6/30/2005	0:30	-	7/1/2005	10:30
7/26/2005	8:00	-	7/27/2005	9:00
8/31/2005	8:00	-	9/1/2005	9:00
9/29/2005	5:00	-	9/30/2005	6:00
10/25/2005	13:15	-	10/26/2005	14:15
11/23/2005	13:00	-	11/24/2005	14:00
1/5/2006	13:00	-	1/6/2006	14:00

(MC) Mataponi Creek

Date	Time
1/4/2005	11:45
1/20/2005	14:00
2/24/2005	9:45
3/10/2005	12:15
3/30/2005	13:00
4/12/2005	13:15
4/26/2005	12:30
5/10/2005	11:00
5/24/2005	8:15

6/7/2005	7:45
6/21/2005	11:15
7/6/2005	11:45
7/19/2005	6:45
8/2/2005	7:00
8/16/2005	8:00
8/30/2005	10:30
9/13/2005	11:15
9/27/2005	16:15
10/11/2005	10:15
10/25/2005	10:45
11/9/2005	16:00
11/22/2005	10:30
12/6/2005	12:45
12/20/2005	13:00

(IP) Iron Pot Landing

Date	Time
1/4/2005	10:45
1/20/2005	15:00
3/10/2005	11:00
3/30/2005	11:15
4/12/2005	12:15
4/26/2005	11:15
5/10/2005	10:00
5/24/2005	9:30
6/7/2005	9:30
6/21/2005	10:00
7/6/2005	10:30
7/19/2005	8:00
8/2/2005	8:00
8/16/2005	9:15
8/30/2005	9:15
9/13/2005	12:15
9/27/2005	15:00
10/11/2005	11:45
10/25/2005	12:00
11/9/2005	15:00
11/22/2005	11:45
12/6/2005	11:30

(OC) Otter Point Creek

Date	Time
1/4/2005	10:00
1/19/2005	10:30
2/24/2005	10:30
3/8/2005	10:00

3/24/2005	8:00
4/5/2005	11:30
4/19/2005	9:30
5/3/2005	9:15
5/17/2005	9:45
5/31/2005	6:45
6/14/2005	7:30
6/28/2005	7:45
07/12/2005	12:45
07/26/2005	07:00
08/09/2005	12:30
08/23/2005	14:00
09/06/2005	11:45
09/20/2005	13:15
10/04/2005	12:30
10/18/2005	12:45
11/02/2005	10:15
12/01/2005	13:15
12/06/2005	11:00

7) **Associated researchers and projects**

The Jug Bay Wetlands Sanctuary staff has been collecting weekly to monthly temperature, salinity, dissolved oxygen, and nutrient samples at various tidal and non-tidal sites throughout the Jug Bay marsh since 1989. One of their historic sites includes the current (RR) site as well as the historic (1995-2002) (JB) site. Sampling for their sites is done monthly throughout the year (when ice is not present) and includes parameters such as nitrate/nitrite, ammonium and chlorophyll a. Additionally, the staff samples at other sites throughout the Jug Bay marsh, which provide additional similar data at a larger spatial scale.

Staff at the Anita C. Leight Estuary Center at Otter Point Creek, in conjunction with CBNERR/MD staff, have also been collecting bi-weekly to monthly temperature, salinity, dissolved oxygen, total suspended solids, chlorophyll a, and nutrient samples (to include nitrate/nitrite, ammonium, ortho-phosphate, total nitrogen and total phosphorus) at the same location as datalogger OC and 5 other sites in the OPC marsh since 2002. For more information on either the Jud Bay Wetlands Sanctuary or Otter Point Creek monitoring, contact Julie Bortz, the Reserve's Research Coordinator.

Additional discrete nutrient data and semi-continuous water quality data is also available through the Department of Natural Resources Continuous Monitoring Program (see www.eyesonthebay.net) that provides increased spatial coverage of many of the same parameters around both RR and OC sites for 2005. This monitoring program included as many as 36 additional continuous monitoring sites (similar to the CBM NERR effort) throughout Maryland tidal waters sampled semi-continuously (every 15 minutes) from April-October 2005. In addition to the high temporal resolution of water quality at these sites, Maryland Department of Natural Resources also conducts water quality cruises between and amongst many of these same sites which are used to create interpolated water quality maps,

providing a high degree of spatial resolution around their permanent continuous monitoring (YSI sonde) sites. Interpolated water quality maps are available for both the Jug Bay and Otter Point Creek sites through the Maryland Department of Natural Resources or CBM NERR. The Maryland Department of Natural Resources Continuous Monitoring Program began in 1999 with the number of sites monitored increasing yearly to 2005. For more information on this program and the water quality monitoring cruises see www.eyesonthebay.net.

8) **Distribution –**
NOAA/ERD retains the right to analyze, synthesize and publish summaries of the NERRS System-wide Monitoring Program data. The PI retains the right to be fully credited for having collected and processed the data. Following academic courtesy standards, the PI and NERR site where the data were collected will be contacted and fully acknowledged in any subsequent publications in which any part of the data are used. Manuscripts resulting from this NOAA/OCRM supported research that are produced for publication in open literature, including refereed scientific journals, will acknowledge that the research was conducted under an award from the Estuarine Reserves Division, Office of Ocean and Coastal Resource Management, National Ocean Service, National Oceanic and Atmospheric Administration. 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.

NERR water quality data and metadata can be obtained from the Research Coordinator at the individual NERR site (please see Section 1. 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 http://cdmo.baruch.sc.edu/. Data are available in text tab-delimited format, Microsoft Excel spreadsheet format and comma-delimited format.

II. Physical Structure Descriptors

9) **Entry verification** – Nutrient samples are sent to Nutrient Analytical Services Laboratory (NASL) at the University of Maryland's Chesapeake Biological Laboratory. The samples are analyzed and problems in sample quality are indicated with an Analytical Problem Code (APC). Additionally, quality assurance/quality control (QA/QC) samples are analyzed and reviewed by NASL to ensure their instrumentation and analytical procedures are not producing erroneous results. Chlorophyll samples are sent to the Maryland Department of Health and Mental Hygiene (DHMH) for analysis. Data from DHMH is handled and QA/QC'd following similar protocols to those in place by NASL. The APC codes in use have been regionally accepted by all partners participating in water quality monitoring of the Chesapeake Bay under guidance of the Environmental

Protection Agency's Chesapeake Bay Program Office (CBP). The nutrient data is sent from NASL to the Maryland Department of Natural Resources' Tidewater Ecosystem Assessment division where it is entered into our main water quality database and is merged with the time and date matched field and chlorophyll data. Any APC codes associated with nutrient or chlorophyll data that indicate the data should be rejected are hidden and made unavailable. Data values that fall below CBP accepted Minimum Detection Limits (MDL) are hidden and a new value is set at the MDL and is flagged to indicate the value has been set to MDL. Once the data has been entered into the data management system, a series of reports and plots are generated for review by an analyst (Chris Heyer). Automatic range checks flag and report any data values that exceed the ranges. The analyst reviews the data and the range check reports to determine if the data are acceptable based on conditions at adjacent stations, weather at the time of sampling, and historic data. Data that are rejected during this QA/QC process are hidden. Once the data has undergone with QA/QC check by the analyst it is made final and available to the scientific community for use. This data is then sent to the DNR field office where a CBM NERR technician (John Zimmerelli) conforms this data into the correct NERR format and variable comment codes. This data is run through a final QA/QC check verifying missing data and calculated values, and an explanation for these data points is provided.

10) **Parameter Titles and Variable Names by Data Category**

Required NOAA/NERRS System-wide Monitoring Program water quality parameters are denoted by an asterisks "*".

Data Category	Parameter	Variable Name	Units of Measure
Phosphorus:	*Orthophosphate, Filtered	PO4F	mg/L as P
Nitrogen:	*Nitrite + Nitrate, Filtered	NO23F	mg/L as N
	*Nitrite, Filtered	NO2F	mg/L as N
	*Nitrate, Filtered	NO3F	mg/L as N
	*Ammonium, Filtered	NH4F	mg/L as N
Plant Pigments:			
	*Chlorophyll a	CHLA_N	µg/L

Notes:
1. Time is coded based on a 2400 hour clock and is referenced to Standard Time.
2. Reserves have the option of measuring either NO23 or NO2 or NO3.

11) **Measured and Calculated Laboratory Parameters** –

a) **Variables Measured Directly**

Nitrogen species: NO2F, NO23F, NH4F

Phosphorus species: PO4F
Other: CHLA_N

b) **Computed Variables**
NO3F: NO23F-NO2F

12) **Limits of Detection and Laboratory Methods** – Dates in use for 2004.

Methods References, and Holding Times and Conditions.

Parameter (Units)	Detection Limit (or Range)	Method Reference	Holding Time and Condition
Orthophosphate (mg/L as P)	0.0006 mg/L	EPA method 365.1 (EPA 1979)	Freezing-28 d
Nitrite (mg/L as N)	0.0002 mg/L	EPA method 353.2 (EPA 1979)	Freezing-28 d
Nitrite + Nitrate (mg/L as N)	0.0007 mg/L	EPA method 353.2 (EPA 1979)	Freezing-28 d
Ammonium (mg/L as N)	0.003 mg/L	EPA method 350.1 (EPA 1979)	Freezing-28 d
Chlorophyll *a* (µg/L)	0.1 µg/L	APHA (1981)	Freezing-28 d

The MDL is determined as 3 times the standard deviation of a minimum of 7 replicates of a single low concentration sample.

13) **Lab Methods**
Parameter: PO4

i) Method Summary: Ammonium molybdate and antimony potassium tartrate react in an acid medium with dilute solutions of phosphorus to form an antimony-phospho-molybdate complex which is reduced to an intensely blue-colored complex by ascorbic acid. Color is proportional to phosphorus concentration.

ii) Method References: Technicon Industrial Method No. 155-71W/Tentative. 1973. Technicon Industrial Systems. Tarrytown, New York, 10591.

USEPA. 1979. Method No. 365.1 *in* Methods for chemical analysis of water and wastes. United States Environmental Protection Agency, Office of Research and Development. Cincinnati, Ohio. Report No. EPA-600/4-79-020 March 1979. 460pp.

Froelich, P.N. and M.E.Q. Pilson. 1978. Systematic absorbance error with Technicon AutoAnalyzer II colorimeter. Water Res. 12:599-603.

iii) Preservation Method: Samples are immediately filtered through 47mm glass fiber filter pads, decanted into an Auto Analyzer vial, and placed on ice. Upon returning to the lab Auto Analyzer vial is placed in freezer at –20ºC until analysis. Maximum holing time is 28 days.

Parameter: NH4

i) Method Summary: Determination of ammonium is by the Berthelot Reaction in which a blue-colored compound similar to indophenol forms when a solution of ammonium salt is added to sodium phenoxide, followed by the addition of sodium hypochlorite. The addition of a potassium sodium tartrate and sodium citrate solution prevents precipitation of hydroxides of calcium and magnesium.

ii) Method References: Technicon Industrial Method No. 804-86T. August 1986. Technicon Industrial Systems. Tarrytown, New York, 10591.

Kerouel, R. and A. Aminot. 1987. Procédure optimisée hors-contaminations pour l'analyze des éléments nutritifs dissous dans l'eau de mer. Mar. Environ. Res. 22:19-32.

iii) Preservation Method: Samples are immediately filtered through 47mm glass fiber filter pads, decanted into an Auto Analyzer vial, and placed on ice. Upon returning to the lab Auto Analyzer vial is placed in freezer at –20ºC until analysis. Maximum holing time is 28 days.

Parameter: NO2

i) Method Summary: Nitrite reacts under acidic conditions with sulfanilamide to form a diazo compound that couples with N-1-naphthylethylenediamine dihydrochloride to form a reddish-purple azo dye measured at 520 nm..

ii) Method References: Technicon Industrial Method No. 818-87T. February 1987. Technicon Industrial Systems. Tarrytown, New York, 10591.

iii) Preservation Method: Samples are immediately filtered through 47mm glass fiber filter pads, decanted into an Auto Analyzer vial, and placed on ice. Upon returning to the lab Auto Analyzer vial is placed in freezer at –20ºC until analysis. Maximum holing time is 28 days.

Parameter: NO23

i) Method Summary: Filtered samples are passed through a granulated copper-cadmium column to reduce nitrate to nitrite. The nitrite (originally present plus reduced nitrate) then is determined by diazotizing with

sulfanilamide and coupling with N-1- naphthylethylenediamine dihydrochloride to from a colored azo dye. Nitrate concentration is obtained by subtracting the corresponding nitrite value from the nitrite + nitrate concentration.

ii) Method References: Technicon Industrial Method No. 158-71 W/A† Tentative. 1977. Technical Industrial Systems. Tarrytown, New York, 10591.

USEPA. 1979. Method No. 365.2 *in* Methods for chemical analysis of water and wastes. United States Environmental Protection Agency, Office of Research and Development. Cincinnati, Ohio. Report No. EPA-600/4-79-020 March 1979. 460pp.

iii) Preservation Method: Samples are immediately filtered through 47mm glass fiber filter pads, decanted into an Auto Analyzer vial, and placed on ice. Upon returning to the lab Auto Analyzer vial is placed in freezer at –20ºC until analysis. Maximum holing time is 28 days.

Parameter: Chlorophyll

i) **Method Summary:** The chlorophyll and related compounds are extracted from the filtered algae with aqueous buffered 90% acetone solution. The concentration of the pigments is determined by measuring the light absorption of the extract.

The chlorophyll *a* content in every sample are calculated as follows:

Calculating Chlorophyll

AMT_FILT = SAMVOL_L in database.

Divide the following by 1000:

OD630B
OD645B
OD647B
OD663B
OD664B
OD665A
OD750A
OD750B

Divide the Amount Filtered (AMT_FILT) by 100

PHEO = 26.7*((1.7*(OD665A - OD750A)) - (OD664B - OD750B))) * (EXVOL_ML / (AMT_FILT * LIPAT_CM))

CHAA = 26.7*((OD664B - OD750B) - (OD665A - OD750A))) *
(EXVOL_ML / (AMT_FILT * LIPAT_CM))

If:
ABS(OD664B - OD750B) < 0.00001 or
ABS(OD665A - OD750A) < 0.00001 or
(OD664B - OD750B) < (OD665A - OD750A) or
(OD664B - OD750B) > 2 * (OD665A - OD750A) or
(LIPAT_CM * AMT)FILT) < 0.00001
Then: Set PHEO = Null and Set CHAA = Null

If CHAA < 0.0 and is not Null, then set CHAA = 0.0

ii) Method References: 1002 G. Chlorophyll "1.Spectrophotometric Determination of Chlorophyll a, b, and c (Trichromatic method)" Standard Methods for the Examination of Water and Waste Water, 14th Ed., American Public Health Association, 1976, 1029-1031.

10200 H. Chlorophyll "2. Spectrophotometric Determination of Standard Methods for the Examination of Water and Waste Water, 17th Ed., American Public Health Association, 1989, 10-31 - 10-34.

Chlorophyll- Spectrophotometric U.S. Environment Protection Agency, Environmental Monitoring Systems Laboratory, Cincinnati, OH, Revised 3/91.

Standard Practices for Measurement of Chlorophyll Content of Algae in Surface Waters ASTM, D 3731 - 87, 15 - 18.

iii) Preservation Method: Samples are immediately filtered through a 47mm glass fiber filter pad, placed in a foil square, and then placed on ice. Upon returning the foil square is placed in freezer at –20°C until analysis. Maximum holing time is not to exceed 30 days.

14) Reporting of Missing Data and Data with Concentrations Lower than Method Detection Limits –

Nutrient/Chla comment codes and definitions are provided in the following table. Missing data are denoted by a blank cell " " and commented coded with an "M". Laboratories in the NERRS System submit data that are censored at a lower detection rate limit, called the Method Detection Limit or MDL. MDL's for specific parameters are listed in the Laboratory Methods and Detection Limits Section (Section II, Part 14) of this document. Measured concentrations that are less than this limit are replaced with the minimum detection limit value and comment coded with a "B" in the variable code comment column. For example, the measured concentration of NO23F was 0.0005 mg/L as N (MDL=0.0008), the reported value would be 0.0008 with a "B" placed in the NO23F comment code

column. Calculated parameters are comment coded with a "C" and if any of the components used in the calculation are below the MDL, the calculated value is removed and also comment coded with a "B". If a calculated value is negative, the value is removed and comment coded with an "N".

Note: The way below MDL values are handled in the NERRS SWMP dataset was changed in November of 2011. Previously, below MDL data from 2002-2006 were also coded with a B, but replaced with -9999 place holders. Any 2002-2006 nutrient/pigment data downloaded from the CDMO prior to December November of 2011 will contain -9999s representing below MDL concentrations.

Comment Code	Definition
A	Value above upper limit of method detection
B	Value below method detection limit
C	Calculated value
D	Data deleted or calculated value could not be determined due to deleted data, see metadata for details
H	Sample held beyond specified holding time
K	Check metadata for further details
M	Data missing, sample never collected or calculated value could not be determined due to missing data
P	Significant precipitation (reserve defined, see metadata for further details)
U	Lab analysis from unpreserved sample
S	Data suspect, see metadata for further details

Missing Data

January Diel samples missing due to ice.

December 2005 Diel taken in the beginning of January 2006 due to staffing and holiday issues. A second diel sample was taken in late Jan. 2006 for the 2006 sampling season.

Chlorophyll data missing due to Lab rejection of sample results.

Station Code	Date	Time	Monitoring Program	Rep
cbmrrnut	7/19/2005	9:15	1	2
cbmrrnut	12/20/2005	10:45	1	1
cbmrrnut	12/20/2005	10:45	1	2
cbmocnut	3/24/2005	8:00	1	1
cbmocnut	4/5/2005	11:30	1	1
cbmmcnut	3/30/2005	13:00	1	2
cbmmcnut	3/30/2005	13:00	1	1
cbmmcnut	10/25/2005	10:45	1	2

cbmipnut	3/30/2005	11:15	1	1
cbmipnut	3/30/2005	11:15	1	2
cbmipnut	6/21/2005	10:00	1	1

Chlorophyll data missing for unknown reason.

Station Code	Date	Time	Monitoring Program	Rep
cbmrrnut	1/20/2005	11:45	1	2
cbmrrnut	1/20/2005	11:45	1	1
cbmocnut	1/19/2005	10:30	1	1
cbmocnut	1/19/2005	10:30	1	2
cbmmcnut	1/20/2005	14:00	1	1
cbmipnut	1/20/2005	15:00	1	2
cbmipnut	1/20/2005	15:00	1	1

The following PO4, NH4, NO2, and NO23 data missing for unknown reason. Samples were taken no data reported from lab and no data code given. NO3 missing because it is a calculated variable and is missing either NO2 or NO23 for the calculation.

PO4

Station Code	Date	Time	Monitoring Program	Rep
cbmrrnut	1/4/2005	9:30	1	1
cbmrrnut	1/20/2005	11:45	1	2
cbmrrnut	1/20/2005	11:45	1	1
cbmocnut	1/4/2005	10:00	1	1
cbmocnut	1/19/2005	10:30	1	1
cbmocnut	1/19/2005	10:30	1	2
cbmmcnut	1/4/2005	11:45	1	1
cbmmcnut	1/20/2005	14:00	1	1
cbmipnut	1/4/2005	10:45	1	1
cbmipnut	1/20/2005	15:00	1	2
cbmipnut	1/20/2005	15:00	1	1

NH4

Station Code	Date	Time	Monitoring Program	Rep
cbmmcnut	1/20/2005	14:00	1	1

NO2

Station Code	Date	Time	Monitoring Program	Rep
cbmmcnut	1/20/2005	14:00	1	1

NO23, NO3

Station Code	Date	Time	Monitoring Program	Rep
cbmrrnut	2/24/2005	11:15	1	2
cbmrrnut	2/24/2005	11:15	1	1
cbmocnut	2/24/2005	10:30	1	2
cbmocnut	2/24/2005	10:30	1	1
cbmmcnut	1/20/2005	14:00	1	1
cbmmcnut	2/24/2005	9:45	1	1
cbmmcnut	2/24/2005	9:45	1	2

Deleted Data

NH4 data deleted due to below detection limit, NO2 Data deleted due to an inconsistent relationship between variables, NO3 data deleted because it's a calculated value based upon NO2.

Station Code	Date	Time	Monitoring Program	Rep	NH4F	NO2F	NO3F
cbmrrnut	9/29/2005	15:00	2	1	-0.003	0.0010	0.000
cbmrrnut	9/29/2005	17:30	2	1	0.000	0.0140	0.317

NH4 data on 9/30/2005 deleted because value below Detection limit. All NO2 data deleted because values below detection limit, all NO3 values deleted because it is calculated based on NO2.

Station Code	Date	Time	Monitoring Program	Rep	NH4F	NO2F	NO3F
cbmrrnut	9/30/2005	6:00	2	1	0.002	0.0010	0.006
cbmocnut	8/23/2005	14:00	1	2		0.0005	0.004
cbmocnut	9/20/2005	13:15	1	2		0.0004	0.010
cbmmcnut	9/13/2005	11:15	1	1		0.0006	0.021

PO4 data deleted because value considered suspect (value exceeds theoretical equivalent).

Station Code	Date	Time	Monitoring Program	Rep	PO4F
cbmipnut	9/13/2005	12:15	1	1	0.649

15) **QA/QC Programs –**

a) **Precision**

i) **Field Variability** – The Maryland Department of Natural Resources (MDNR) maintains CBM NERR sites in conjunction with their Continuous Monitoring Program, which maintains over 30 sites where water quality and nutrient data are collected. As such, field variability is checked with 10% of all samples being taken as duplicates. These duplicate samples are field duplicates taken as a replicate, or additional sample, taken concurrently at the time of sampling.

ii) **Laboratory Variability** – The Chesapeake Biological Laboratory (CBL) is responsible for analyzing CBM NERR nutrient samples as well as other nutrient samples taken through MDNR's Continuous Monitoring Program. CBL verifies the quality of their analytical process by running 10% of all samples through an additional test to duplicate procedures and check the accuracy of their reporting.

iii) **Inter-organizational splits** - All nutrient parameters for CBM NERR were analyzed by CBL with the exception of Chlorophyll A which is sent to the Department of Health and Mental Hygiene (DHMH) where samples are analyzed using the same procedures as CBL but at no cost to CBM NERR and MDNR. DHMH is an EPA certified laboratory.

b) **Accuracy**

i) **Sample Spikes** – Sample outliers range from 85 to 115 percent. CBL typically gets 90 to 110 percent recovery.

ii) **Standard Reference Material Analysis –** none

iii) **Cross Calibration Exercises** - Nutrient Analytical Services has participated in many cross calibration exercises. Participation in such programs is an excellent means of determining accuracy of results. Examples of such cross calibration exercises include the Chesapeake Bay Program Quarterly Split Samples, Chesapeake Bay Program Blind Audits, USGS Standard Reference Sample Project, US EPA Method Validation Studies and International Council for the Exploration of the Sea Inter-comparison Exercise for Nutrients in Sea Water.

16) **Other Remarks**

On 5/15/2025 this dataset was updated to include embedded QAQC flags and codes for anomalous/suspect, rejected, missing, and below detection limit data. System-wide monitoring data beginning in 2007 were processed to allow for QAQC flags and codes to be embedded in the data files rather than using the original single letter codes used for the nutrient and pigment dataset along with the detailed sections in the metadata document for suspect, missing, and rejected data. Please note that prior to 2007, rejected data were deleted from the dataset so they are unavailable to be used at all. Suspect, missing, rejected and below minimum detection flags and appropriate three

letter codes were embedded retroactively for dataset consistency. The QAQC flag/codes corresponding to the original letter codes are detailed below.

Flag/code	*If also C*	Historic Letter Code	Historic Code Definition
<1> [SUL]		A	Value above upper limit of method detection
<-4> [SBL]	<-4> [SCB]	B	Value below method detection limit
no need to flag/code unless combined		C	Calculated value
<-3> [GQD]	<3> [GCR]	D	Data deleted or calculated value could not be determined due to deleted data, see metadata for details
<1> (CHB)		H	Sample held beyond specified holding time
<0> (CSM) unless other flag		K	Check metadata for further details
<-2> [GDM]	<-2> [GCM]	M	Data missing, sample never collected or calculated value could not be determined due to missing data
<-3> [SNV] and <1> [SCC] for components		N	Negative calculated value
(CRE) or F_Record {CRE}		P	Significant precipitation (reserve defined, see metadata for further details)
<0> (CUS)		U	Lab analysis from unpreserved sample
<1> (CSM)		S	Data suspect, see metadata for further details

a) The 2005 sampling year was a relatively typical year for the Chesapeake Bay region regarding temperature and precipitation. For more information regarding rainfall and storms which may have impacted water quality and nutrient concentrations at the above four sites, meteorological information is available at both sites and can be obtained by contacting Julie Bortz, the Reserve's Research Coordinator.

b) Filtration Standard Operating Procedure:

A. <u>Particulate sample filtration, processing and storage</u>

1. Chlorophyll

Chlorophyll samples are filtered in the same manner for all programs.

a) For every depth sampled, clean a 47mm bell with deionized (DI) water. Set up unit for filtering. Be sure that there is a trap in line between the manifold and the vacuum source.

b) Place a Whatman 47mm GF/F glass fiber filter pad (pore size = 0.7 µm) on the filter frit. Always use clean forceps when handling the filter pads.

c) Mix sample thoroughly by agitating and shaking the sample bottle vigorously, then rinse graduated cylinder three times with sample.

d) Agitate the sample again before measuring in the graduated cylinder. Fill graduated cylinder with sample and filter desired volume through filtration unit. Be sure to use a graduate that is close to the volume being filtered (ex: if you are only filtering 80 ml of sample use a 100 ml graduate). **Keep the vacuum pressure below 10 inches of Hg** (around 8" Hg is good).

e) Filter sufficient volume of sample (50 - 1500 ml) to solidly color the filter pad.

f) Record the total volume filtered on the foil square.

g) Agitate the squirt bottle of $MgCO_3$, as it settles rapidly. Add approximately 1 ml of $MgCO_3$ suspension (1.0 g $MgCO_3$ in 100 ml of DI water) to the last 25 ml of sample in the filtration bell.

<u>NOTE: Samples for dissolved parameters are not to be collected from this filtrate.</u>

h) Using forceps (1 or 2 pair), fold filter in half with sample inside and remove filter pad.

i) Place pad in pre-marked foil square, and carefully fold foil square in thirds, horizontally. Then fold the ends in to seal the filter inside. Be sure forceps do not touch sample residue on the filter pads, because the sample will adhere to the forceps. When filtering chlorophyll for core samples, after you fold the filter in half, fold in half again to make it ¼ size so it will fit in the small zip-lock bag neatly.

j) Be sure that foil square is marked with date, station, depth of sample, volume of sample filtered, and sample number. For core samples, be sure the baggie is labeled with the station number, date and volume filtered.

k) Place foil packet into zip-lock plastic bag or pad container. When sampling on the small boats or a land run place the foils in a bag or pad container in the ice chest and place them in the appropriately labeled bag in the Field Office freezer when you return to the office. The bags for the chlorophyll samples go in the bin marked DHMH in the freezer.

l) Record sample station number, date, volume filtered (L), depth (m), layer, start time, end time and field scientist sign-off on the chlorophyll volume sheet. Record the study code, submitter code, data category code and replicate number, if not already pre-filled in, on chlorophyll volume sheet. This sheet is submitted to the laboratory with the samples. When you return the samples to the Field Office freezer, place the volume sheet in the rack on the side of the freezer marked "Chlorophyll, DHMH".

NOTE: The filter pads for chlorophyll samples should be exposed to as little direct sunlight as possible. Store as soon as possible.

2. **Particulate Carbon/ Particulate Nitrogen (PC/PN)**

PC/PN samples are filtered in the same manner for all programs.

a) Follow steps A.1.a. through A.1.d. above setting up two 25 mm filter bells using two pre-combusted 25 mm GF/F filters (pore size = 0.7 μm). The PC/PN pads come from CBL.

b) Filter 10-200 ml through each filter. Filter enough sample to leave noticeable color on the filter pad.

c) Make sure filter is sucked dry and the **same volume is filtered for both pads**.

d) Record the volume filtered (total volume through one pad - do not add the volumes for the 2 pads together) on the foil square.

NOTE: Samples for dissolved parameters are not to be collected from this filtrate.

e) Using forceps, fold each filter in half.
f) Place both filters in a foil square labeled with date, CBL sample number, station, sample layer, PC/PN, and volume filtered. Be sure that the pads are not overlapping in the foil square to keep them from freezing together.
g) Fold the foil square as described in step A.1.i. above and then place folded foil in zip-lock bag or pad container, and put in the freezer (large boats) or in a cooler on ice (small boats & land).
h) Upon return to the Field Office, place the foils in their appropriate zip-lock bag in the sample freezer and place the bag in the CBL bin. Put the completed CBL volume sheet in the rack on the side of the freezer marked "CBL".

3. **Particulate Phosphorus/ Particulate Inorganic Phosphorus (PP/PIP)**
   a) Follow steps A.1.a. through A.1.d. above setting up and rinsing two 47 mm filter bells and flasks. The filters used are two Whatman 47 mm GF/F filters (same pads we use for chlorophyll).
   b) Filter 50 ml of sample through each filter pad.
   c) Use the filtrate as an equipment rinse and discard.
   d) Then filter enough additional (another 50 - 450 ml) to leave a noticeable color on the filter pad.
   e) Record the **total** volume filtered through each pad being sure to add the 50 ml rinse water (total volume through one pad – do not add the volumes for the 2 pads together) on the foil square.
   f) **Use this filtrate to fill up the tubes for the dissolved parameter analysis. See section C (Filtered dissolved nutrient sample collection) below.**
   g) After collecting filtrate, make sure filter is sucked dry.
   h) Rinse the filter pad using at least three - 10 ml rinses of DI water, sucking the pad dry after each rinse.
   i) Using forceps, fold each filter in half.
   j) Place both filters in a foil square labeled with date, PP/PIP, CBL sample number, station, sample layer, and volume filtered (this is the total volume of sample through each pad, including the initial 50 ml rinse). Be sure that the pads are not overlapping in the foil square to keep them from freezing together.
   k) Fold the foil square as described in step A.1.i. above. Place foil square in zip-lock bag or pad container, and put in the cooler on ice until you return to the field office.
   l) Upon return to the Field Office, place the foils in their appropriate zip-lock bag in the sample freezer and place the bag in the CBL bin. Put the completed CBL volume sheet in the rack on the side of the freezer marked "CBL".

4. **Total Suspended Solids/ Volatile Suspended Solids (TSS/VSS)**

The instructions below apply to samples processed for TSS/VSS for Dataflow and Continuous Monitoring programs.

a) Follow steps A.1.a. through A.1.d. above, setting up and rinsing one 47 mm filter bell and flask. The filter used is a pre-combusted and pre-weighed 47 mm GF/F filters (pore size = 0.7 µm). The VSS pads come in individually numbered petri dishes from CBL. Remove one pad from its individual petri dish and place on the filter screen. Record the pad number from the petri dish on the TSS/VSS foil label in the space marked "Pad #".

b) Filter 50 - 500 ml and filter through the filter pad leaving a noticeable color on the pad.

c) Make sure filter is sucked dry and rinse the filter pad using at least three - 10 ml rinses of DI water, sucking the pad dry after each rinse. If the sample is very salty (e.g. Lower Chesapeake, Coastal Bays) you should rinse an extra 1-2 times.

NOTE: Samples for dissolved parameters are not to be collected from this filtrate.

d) Using forceps, fold the filter in half. Place the filter in a foil square labeled with date, TSS/VSS, CBL sample number, station, sample layer, and volume filtered, and VSS pad number.

e) Fold the foil square as described in step A.1.i. above. Place foil square in zip-lock bag or pad container, and put in the cooler on ice until you return to the field office.

f) Upon return to the Field Office, place the foils in their appropriate zip-lock bag in the sample freezer and place the bag in the CBL bin. Put the completed CBL volume sheet in the rack on the side of the freezer marked "CBL".

B. Dissolved nutrient sample filtration & collection

NOTE: The filtrate collected for this sample must come from either the TSS/PP or PP/PIP filtration set-up. If you cannot get enough water through these pads to fill all tubes, then use plain GF/F filters to get enough filtrate. The filtrate may not come from pads that are pre-combusted (PC/PN & VSS) or units that are in contact with $MGCO_3$ (CHLA).

1. The following steps are to be completed for collection of all filtrate for the samples below:

a) Run 50 ml of sample water through the filter.

b) Use this 50 ml of filtrate to rinse the flask and then discard.

c) Run more sample water through the filter and collect in the flask.

2. Total Dissolved Nitrogen & Phosphorus (TDN/TDP)

a) Rinse the TDN/P tube (30 ml borosilicate glass – tall skinny tube!) and cap three times with filtrate.

b) Flick all remaining water droplets out of the test tube and cap.

c) Rinse the 10 ml graduated cylinder three times with filtrate.

d) Fill the graduated cylinder with 10 ml of filtrate.
e) Carefully, pour the 10 ml of filtrate into the test tube and cap tightly.
f) Store the test tube in the freezer.
g) If on a land run or small boat, store the tubes on ice in a cooler and place in the Field Office freezer when you return from the field.

3. **Nitrate, Nitrite, Ammonia, Orthophosphate & Silicate**
   a) Rinse the 4 like-numbered AA vials (4 ml polystyrene cups) and 4 caps three times with filtrate.
   b) Fill the AA vials with filtrate up to ridge where the caps are seated.
   c) Snap the caps on the vials. You should hear them snap twice to be fully seated.
   d) Store 3 AA vials in the freezer. Store 1 AA vial in the refrigerator.
   e) If on a land run or small boat, store the tubes on ice in a cooler and place in the Field Office freezer and refrigerator when you return from the field.
4. **Dissolved Organic Carbon (DOC)**
   a) Rinse the DOC tube (30 ml Teflon – short, fat tube!) and cap three times with filtrate.
   b) Fill the tube 2/3- 3/4 full with filtrate and cap tightly.
   c) Store the test tube in the freezer.
   d) If on a land run or small boat, store the tubes on ice in a cooler and place in the Field Office freezer when you return from the field.