

Grand Bay (GND) NERR Nutrient Metadata
January - December 2024
Last Updated: June 16, 2025

I. Data Set and Research Descriptors

1) Principal Investigator(s) and Contact Persons:

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2) Research objectives –

a) Monthly grab sampling program

Monthly grab samples were collected to quantify the spatial variability of important nutrients in the water column between sites representing the local salinity gradient.

b) Diel sampling program

Once per month, samples were collected throughout a tidal cycle to quantify the temporal variability of important nutrients and sediment loading in the water column as a function of tidal forcing.

A spreadsheet was used to evenly space sample timing between two low tides, with the low tides being the first and last samples. Sample intervals used each month are noted in section 6 of this document. This is a slight methodology change from the diel sampling conducted through 2016, where samples were collected every 125 minutes unless noted.

3) Research methods –

a) Monthly grab sampling program

Monthly grab samples were taken at six stations within the Grand Bay estuary. Samples were taken at the four Grand Bay data sonde (primary SWMP) stations: Bayou Heron (BH), Point Aux Chenes (PC), Bayou Cumbest (BC), and Bangs Lake (BL). Samples were also taken at two secondary SWMP sites: the surface of Bayou Heron (HS), due to stratification, and at a spill site in Bangs Lake called Bangs Lake North (BN). Attempts were made to collect grab samples within three hours of slack low tide. Rainfall conditions prior to grab sampling were not considered. When possible,

grab samples were obtained in conjunction with diel samples (See 3b). At the Heron Surface and Point Aux Chenes stations, grab samples were collected 0.25 meters below the surface to avoid surface scum. The Point Aux Chenes station is well-mixed and it was determined that sampling at sonde depth was unnecessary. All other grab samples were collected at sonde depth, 0.25 meters from the bottom. Bayou Heron required the use of a Wildco Horizontal Beta Bottle to obtain these grab samples. Samples were collected in 1000 ml Nalgene HDPE (high-density polyethylene) wide-mouthed amber bottles. Prior to sampling, sample bottles were rinsed with 10% HCL and then with distilled water and allowed to air dry in the laboratory. Sample bottles were also rinsed three times with sample water at the sample site prior to sample collection. Samples were immediately placed on ice, stored in a dark cooler, and returned to the laboratory. Once in the laboratory samples were processed for nutrient and Chla analysis.

b) Diel sampling program

Twelve diel samples were collected each month at Bangs Lake using an ISCO 6712 portable auto-sampler 0.25 m from the bottom. The sampler was programmed to take a 950 ml collection at evenly spaced intervals throughout a complete tidal cycle (lunar day). First and last samples were on low tides when possible. No distinction between neap and spring tide was considered. Prior to collection, 1000 ml semi-transparent ISCO sample containers were rinsed with 10% HCL and then with distilled water and allowed to air dry in the laboratory. During collection, samples were stored on ice in these containers within the body of the sampler. The sampler was programmed to flush the collection line prior to collecting each sample. As soon as possible after the final collection time ended, the samples were returned to the laboratory for nutrient, Chla, and TSS analysis.

4) Site location and character –

The Grand Bay Delta was created by sediments from both the Pascagoula and Escatawpa Rivers several thousand to hundreds of years ago. Soon after the delta was created, the Escatawpa became a major tributary to the Pascagoula River when its flow was captured by the larger river system. With the Escatawpa's freshwater inflow shunted to the Pascagoula River, sediment discharge to Grand Bay Delta and the delta's further growth was terminated. The meandering delta channels of the Escatawpa became exclusively tidal water courses a few hundred years ago, after cessation of river flow (Otvos 2007). In 1999, the retrograding delta became home to the 24th National Estuarine Research Reserve, the Grand Bay NERR.

The Grand Bay NERR is part of the Coastal Stream Basin watershed, which consists of three primary sub-watersheds that provide much of the freshwater inputs into the system: Bayou Heron, Bayou Cumbest, and Bangs Lake.

The water quality monitoring sites within the Grand Bay NERR have a tidal range of approximately 0.5 m. Additional site-specific characteristics are as follows:

a) **Bayou Heron (BH)** and **Bayou Heron Surface (HS)**:

From the beginning of the nutrient sampling program in 2005 until early 2016, both surface and bottom samples from Bayou Heron were labeled gndbhnut in the data. Metadata records differentiated between the depths. Because there was not a straightforward way to differentiate between them in the data files themselves, the surface site was re-named Bayou Heron Surface, gndhsnut. It is considered a secondary SWMP station. The bottom site is at sonde depth (0.25 meters above the sediment) and will retain primary SWMP status and the name gndbhnut. Diel samples collected at this site have always been taken at sonde depth. Only surface samples have been affected by the change. Surface samples in older data files have been changed, but ***please read all metadata carefully***. Moving forward, surface samples will be gndhsnut.

The Bayou Heron site, located in the middle reaches of the Bayou Heron sub-watershed, monitors water quality for a semi-pristine area with little development and serves as a reference site for the reserve. Freshwater input is derived from several sources including networks of hydric drains, sheet flow from pine

flatwoods/savannas, and groundwater. Hydric drains import large amounts of surface water from the sub-watershed, including water originating north of Hwy 90 and Interstate 10. Franklin Creek, located northeast of the reserve, flows WNW into the Escatawpa River. Franklin Creek drains a large portion of agricultural land on the Grand Bay plateau and periodically crests into the Bayou Heron sub-watershed during high water events via a small network of hydric drains. These drains eventually deposit water into numerous tidal creeks that enter Bayou Heron. Little is known about the quantity and quality of water flowing through these drains.

*Due to water column stratification and poor mixing, this site can become naturally hypoxic during warmer months (March – October).

Bayou Heron (BH) and Bayou Heron Surface (HS)	
Latitude and longitude	30.4178° N, 88.4054° W
Tidal range (<i>meters</i>)	0.417 m
Salinity range (<i>psu</i>)	0.0 – 27.8 psu
Type and amount of freshwater input	Freshwater input is derived from several sources including networks of hydric drains, sheet flow from pine flatwoods/savannas, and groundwater. Hydric drains import large amounts of surface water from the sub-watershed, including water originating north of Hwy 90 and Interstate 10. Franklin Creek, located northeast of the reserve, flows WNW into the Escatawpa River. Franklin Creek drains a large portion of agricultural land on the Grand Bay plateau and periodically crests into the Bayou Heron sub-watershed during high water events via a small network of hydric drains. These drains eventually deposit water into numerous tidal creeks that enter Bayou Heron. Little is known about the quantity and quality of water flowing through these drains.
Water depth (<i>meters, MLW</i>)	1.72 m
Sonde distance from bottom (<i>meters</i>)	0.25 m
Bottom habitat or type	Soft sediment
Pollutants in area	semi-pristine area with little development
Description of watershed	located in the middle reaches of the Bayou Heron sub-watershed

b) Point Aux Chenes (PC):

This is the most southern water quality site within the boundaries of Grand Bay NERR. It is located in Point Aux Chenes Bay, which is directly influenced by the Mississippi Sound, receiving inputs from waters to the east, including Mobile Bay. This site is also potentially influenced, to an unknown degree, by Bangs Lake and Bayou Cumbest outflows. This station was established in 2005 to replace the Crooked Bayou water quality monitoring station. There are no known direct pollutant sources into Point Aux Chenes Bay, although a large industrial complex is located along the western boundary of the Reserve. This site provides baseline data on the relative influence of marine inputs and tidal influence from the East Mississippi Sound.

Point Aux Chenes (PC)	
Latitude and longitude	30.3486° N, 88.4185° W
Tidal range (<i>meters</i>)	0.417 m
Salinity range (<i>psu</i>), 2023	7.1 – 36.4 psu
Type and amount of freshwater input	Bangs Lake and Bayou Cumbest outflows. Directly influenced by the Mississippi Sound and also receives inputs from waters to the east, including Mobile Bay
Water depth (<i>meters, MLW</i>)	1.32 m
Sonde distance from bottom (<i>meters</i>)	0.25 m
Bottom habitat or type	Soft sediment
Pollutants in area	MS Phosphate Plant superfund site, ~2 miles NW
Description of watershed	Located at the bottom reaches of the Grand Bay watershed

c) **Bayou Cumbest (BC):** [30.3836° N, 88.4364° W].

The Bayou Cumbest site monitors water quality for the Bayou Cumbest sub-watershed, which is a moderately impacted area with some residential housing development and non-point source pollution issues related to failing septic tanks (i.e., elevated levels of fecal coliforms; LaSalle 1997). A substantial canal, called the Nine Mile Canal, was built in the late 1930's and connects the Escatawpa River to Bayou Cumbest upstream from the water quality station.

Bayou Cumbest (BC)	
Latitude and longitude	30.3836° N, 88.4364° W
Tidal range (<i>meters</i>)	0.417 m
Salinity range (<i>psu</i>), 2023	0.1 – 29.8 psu
Type and amount of freshwater input	A substantial canal, called the Nine Mile Canal, was built in the late 1930's and connects the Escatawpa River to Bayou Cumbest upstream from the water quality station.
Water depth (<i>meters, MLW</i>)	0.81 m
Sonde distance from bottom (<i>meters</i>)	0.25 m
Bottom habitat or type	Soft sediment

Pollutants in area	Moderately impacted area with some residential housing development and non-point source pollution issues related to failing septic tanks (i.e., elevated levels of fecal coliforms; LaSalle 1997).
Description of watershed	Bayou Cumbest sub-watershed.

d) **Bangs Lake (BL):** [30.3571° N, 88.4629° W].

The Bangs Lake site is located towards the southern end of the Bangs Lake sub-watershed, an area with minimal residential development. Adjacent parcels include Chevron USA oil and gas refinery and the Mississippi Phosphates industrial facility. Both sites are surrounded by containment levees constructed to direct any contaminant spills towards Bayou Casotte, a heavily industrialized and impacted area to the west of these facilities. However, a spill from a gypsum pile at the phosphate facility was discharged into Bangs Lake in 2005 and had substantial negative impacts. A man-made drainage ditch runs into the north part of Bangs Lake and is believed to drain a residential area, which may have failing septic tanks (LaSalle 1997). The ditch is also adjacent to the former Jackson County Industrial Water Plant. Bangs Lake has been impacted by high fecal coliform counts and a fecal coliform TMDL was developed for the Bayou Cumbest and Bangs Lake watersheds in 2000 (MSU-CREC 2000).

Bangs Lake (BL)	
Latitude and longitude	30.3571° N, 88.4629° W
Tidal range (<i>meters</i>)	0.417 m
Salinity range (<i>psu</i>), 2023	5.9 – 29.8 psu
Type and amount of freshwater input	Hydric drains import large amounts of surface water from the sub-watershed, including Bayou Cumbest and 9- mile canal
Water depth (<i>meters</i> , <i>MLW</i>)	0.76 m
Sonde distance from bottom (<i>meters</i>)	0.25 m
Bottom habitat or type	Soft sediment
Pollutants in area	Adjacent parcels include Chevron USA oil and gas refinery and the Mississippi Phosphates industrial facility.
Description of watershed	Southern end of the Bangs Lake sub-watershed

e) **Bangs Lake North (BN):** [30.36695° N, 88.47100° W].

The Bangs Lake North site monitors the water quality of the north end of Bangs Lake. This site was added in order to monitor the effects of millions of gallons of highly acidic runoff that breached a nearby fertilizer manufacturer's containment system and entered the lake during an extremely heavy rain event in April 2005. This site is very similar to Bangs Lake (BL) in water depth, salinity range and bottom habitat.

All Grand Bay NERR historical nutrient/pigment monitoring stations (P=primary station, S=Secondary station):

Station Code	SWMP Status	Station Name	Location	Active Dates	Reason Decommissioned	Notes
gndblnut	P	Bangs Lake	30° 21' 25.5594" -88° 27' 46.44"	02/01/2005 - current	NA	NA
gndbnnut	S	Bangs Lake North	30° 22' 0.84" -88° 28' 15.96"	02/01/2005 - current	NA	NA
gndbcnut	P	Bayou Cumbest	30° 23' 0.96" -88° 26' 11.04"	02/01/2005 - current	NA	NA
gndbhnut	P	Bayou Heron	30° 25' 4.0794" -88° 24' 19.44"	02/01/2005 - current	NA	NA
gndhsnut	S	Bayou Heron Surface	30° 25' 4.0794" -88° 24' 19.44"	02/01/2005 - current	NA	NA
gndpcnut	P	Point Aux Chenes	30° 20' 54.96" -88° 25' 6.5994"	02/01/2005 - current	NA	NA

Sources cited within this section:

LaSalle, M.W. (1997). Water Quality Monitoring of Shellfish Growing Waters and Residential Rock-Reed Wastewater Treatment Systems at Bayou Cumbest, Mississippi. Final Report to the Gulf of Mexico Program. 58 pp.

Mississippi State University Coastal Research and Extension Center (MSU-CREC). (2000). Fecal Coliform TMDL for Bayou Cumbest/Bangs Lake Watershed, Coastal Streams Basin, Jackson County, MS. Prepared for the Mississippi Department of Environmental Quality. Approved Final Version May 5, 2000.

Otvos, E.G. (2007). Geological Framework and Evolution History. Pages 22-46 in Grand Bay National Estuarine Research Reserve: An Ecological Characterization (Peterson, M.S., G.L. Waggy and M.S. Woodrey, editors). Grand Bay National Estuarine Research Reserve, Moss Point, Mississippi.

5) Coded variable definitions –

Station codes (column 'A' of nutrient data report):

gndbhnut = Grand Bay NERR, site Bayou Heron (sonde depth) nutrient data
gndhsnut = Grand Bay NERR, site Bayou Heron Surface nutrient data
gndpcnut = Grand Bay NERR, site Point Aux Chenes nutrient data
gndbcnut = Grand Bay NERR, site Bayou Cumbest nutrient data
gndblnut = Grand Bay NERR, site Bangs Lake nutrient data
gndbnnut = Grand Bay NERR, site Bangs Lake North nutrient data

Monitoring program (column "C" of nutrient data report):

1 = Monthly grab sample
2 = Diel grab sample

Nutrient parameter comment code columns (denoted with a 'F_' and found in columns immediately following reported data variable. Refer to section 10 for parameter titles and variable names by data category.)

6) Data collection period –

The first nutrient samples were collected at all sites in March 2005. Individual collection dates and times for both the monthly grab program and diel program are reported in column B of the nutrient database.

Monthly Grab Samples

SITE	DATE	REP 1	REP2
gndhsnut	1/30/2024	10:02	10:04
	2/21/2024	9:30	9:32
	3/21/2024	11:45	11:47
	4/23/2024	10:00	10:02
	5/20/2024	8:29	8:31
	6/25/2024	9:12	9:14
	7/15/2024	9:40	9:42
	8/14/2024	8:29	8:31
	9/23/2024	10:41	10:43
	10/21/2024	11:52	11:54
	11/21/2024	12:56	12:58
	12/16/2024	9:28	9:30

SITE	DATE	REP 1	REP2
gndbhnut	1/30/2024	10:06	10:08
	2/21/2024	9:34	9:36
	3/21/2024	11:49	11:51
	4/23/2024	10:04	10:06
	5/20/2024	8:33	8:35
	6/25/2024	9:16	9:18
	7/15/2024	9:44	9:46
	8/14/2024	8:33	8:35
	9/23/2024	10:45	10:47
	10/21/2024	11:56	11:58
	11/21/2024	13:00	13:02
	12/16/2024	9:32	9:34

SITE	DATE	REP 1	REP2
gndpcnut	1/30/2024	11:20	11:22
	2/21/2024	10:34	10:36
	3/21/2024	10:15	10:17
	4/23/2024	11:27	11:29
	5/20/2024	12:07	12:10
	6/25/2024	11:15	11:17
	7/15/2024	10:32	10:34
	8/13/2024	13:38	13:40
	9/23/2024	10:13	10:15
	10/21/2024	11:04	11:06
	11/21/2024	12:15	12:17
	12/16/2024	13:02	13:04

SITE	DATE	REP 1	REP2
gnbdbcnut	1/30/2024	14:00	14:02
	2/21/2024	10:23	10:25
	3/21/2024	12:55	12:57
	4/23/2024	12:38	12:40
	5/20/2024	13:28	13:30
	6/25/2024	9:20	9:22
	7/15/2024	12:09	12:10
	8/13/2024	11:50	11:52
	9/23/2024	9:31	9:33
	10/21/2024	11:24	11:26
	11/21/2024	11:29	11:32
	12/16/2024	11:40	11:43
SITE	DATE	REP 1	REP2
gnbdblnut	1/30/2024	11:52	11:54
	2/21/2024	11:40	11:42
	3/21/2024	9:05	9:07
	4/23/2024	10:40	10:42
	5/20/2024	14:02	14:04
	6/25/2024	10:51	10:53
	7/15/2024	11:25	11:27
	8/13/2024	13:20	13:22
	9/23/2024	9:57	9:59
	10/21/2024	10:24	10:26
	11/21/2024	11:25	11:27
	12/16/2024	12:10	12:13
SITE	DATE	REP 1	REP2
gnbdbnnut	1/30/2024	12:13	12:15
	2/21/2024	11:22	11:24
	3/21/2024	9:29	9:31
	4/23/2024	10:57	11:00
	5/20/2024	14:51	14:53
	6/25/2024	10:16	10:18
	7/15/2024	10:54	10:56
	8/13/2024	12:53	12:55
	9/23/2024	9:45	9:47
	10/21/2024	10:42	10:44
	11/21/2024	11:40	11:42
	12/16/2024	12:30	12:32

* no sample taken - Tide too low to reach site, waters too rough and/or thunderstorm formed;
Time given is approximate time sample would have been taken. **Bold** indicates grab samples were
not taken within 3 hours of low tide

Monthly Diel Samples

Station	Start	End	Sample Interval
gnbdblnut	1/29/2024 8:44	1/30/2024 8:12	2:08

gndblnt	2/20/2024 5:19	2/21/2024 6:04	2:15
gndblnt	3/20/2024 4:41	3/21/2024 5:15	2:14
*gndblnt	*4/23/2024 11:24	*4/23/2024 11:35	2:11
gndblnt	5/20/2024 18:38	5/21/2024 19:12	2:14
*gndblnt	*6/24/2024 10:00	*6/25/2024 10:01	2:11
^gndblnt	^7/15/2024 12:33	^7/16/2024 12:34	2:11
gndblnt	8/13/2024 13:58	8/14/2024 14:43	2:15
gndblnt	9/23/2024 12:31	9/24/2024 13:38	2:17
gndblnt	10/21/2024 10:50	10/22/2024 11:57	2:17
gndblnt	11/21/2024 12:34	11/22/2024 12:51	2:14
gndblnt	12/17/2024 9:14	12/18/2024 9:59	2:14

*samples taken from high-tide to high-tide

^24 hr sampling period. Close to, but not low to low tide

7) Associated researchers and projects–

Several research and monitoring projects, in addition to educational workshops and outreach events, are currently using nutrient data from the Grand Bay NERR.

- **Site Selection for Natural Resource Damage Assessment (NRDA) funded subtidal and intertidal reefs in the Grand Bay NERR** –Mississippi Department of Environmental Quality (MDEQ) and Mississippi Department of Marine Resources (MDMR)
- **Long-term monitoring of artificial reef fish communities in the Grand Bay NERR.** – Dr. Jonathan Pitchford, Michael Archer, Michael Brochard (Grand Bay NERR)
- **GNDNERR Sentinel Site Initiative: A program to better understand SLR and its effects on coastal environments** – Dr. Jonathan Pitchford, Will Underwood, Jay McIlwain, Michael Archer, Michael Brochard (Grand Bay NERR)
- **Erosion Monitoring - 11 Shorelines are monitored to Estimate the Rate of Erosion at Sites Representing Varying Degrees of Wave Exposure and Geological Substrates** - Jay McIlwain, Michael Archer, Michael Brochard, Dr. Jonathan Pitchford, Will Underwood (Grand Bay NERR)
- **Fish Communities of Nearshore Habitats within the Grand Bay NERR/NWR** –Michael Brochard, Kim Cressman, Dr. Jonathan Pitchford, Dr. Ayesha Gray (Grand Bay NERR)
- **Distribution and Abundance of Winter Marsh Birds Across Coastal Mississippi Tidal Marshes** – Dr. Mark Woodrey (Grand Bay NERR/Mississippi State University), Dr. Ray Iglay (Mississippi State University), Dr. Kristine Evans (Mississippi State University), Dr. Scott Rush (Mississippi State University), Jared Feura (Mississippi State University), Spencer Weitzel (Mississippi State University)
- **Distribution and Abundance of Breeding Marsh Birds Across Coastal Mississippi Tidal Marshes** – Dr. Mark Woodrey (Grand Bay NERR/Mississippi State University), Dr. Ray Iglay (Mississippi State University), Dr. Kristine Evans (Mississippi State University), Dr. Scott Rush (Mississippi State University), Jared Feura (Mississippi State University), Spencer Weitzel (Mississippi State University)
- **Fire Effects in Gulf of Mexico Marshes: Historical Perspectives, Management, and Monitoring of Mottled Ducks and Black and Yellow Rails** - Dr. Auriel Fournier (Illinois Natural History Survey), Dr. Mark Woodrey (Mississippi State University), and Dr. Kristine Evans (Mississippi State University)
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- **Refining techniques for high-frequency monitoring of chlorophyll *a* in the NERRS** – Dr. Nikki Dix (GTM NERR), Dr. Erik Smith (NIWB NERR), Silas Tanner (GTM NERR), Shannon Dunnigan (GTM

NERR), Dr. Scott Phipps (Weeks Bay NERR), Thomas Gregory (Great Bay NERR), Jeremy Miller (Wells NERR), Kim Cressman (Grand Bay NERR), Sebastian Mejia (OWC NERR), Dr. Sylvia Yang (Padilla Bay NERR), Nicole Burnett (Padilla Bay NERR), Dr. Ed Buskey (MAR NERR), Cammie Hyatt (MAR NERR), Hannah Ramage (Lake Superior NERR), Dr. Rachel Guy (Sapelo NERR), Dr. Rikke Jeppesen (Elkhorn Slough NERR), and Dr. Shimi Rii (He'eia NERR)

As part of the SWMP long-term monitoring program, GND NERR also monitors 15-minute meteorological and water quality data which may be correlated with this nutrient/pigment dataset. These data are available at www.nerrsdata.org.

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 –

Samples were collected and analysis performed in accordance with Grand Bay National Estuarine Research Reserve's Standard Operating Procedures for Water Chemistry. Analysis data was recorded in both a laboratory logbook and electronically in spreadsheet form. This data was then transferred in general formatting into the comprehensive Excel form employed by the NERR system for yearly reporting purposes. Data was checked twice for transfer accuracy. Cassy Porter, Jeneil Patel, and Elizabeth Moore were responsible for these tasks.

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 –

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

<u>Data Category</u>	<u>Parameter</u>	<u>Variable</u>	<u>Unit</u>
Phosphorus and Nitrogen:	*Orthophosphate, filtered	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
Other Lab Parameters:	Total Suspended Solids	TSS	mg/L

Notes:

1. Time is coded based on a 2400 clock and is referenced to Central 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. NO₂ has been shown to be a minor component in the Grand Bay NERR system by data from 2005-2011. Through July 2012, NO₂ was measured when NO₂₃ was above the detection limit. The majority of NO₂ samples measured during this time period were below detection. In August 2012, Grand Bay NERR completely stopped measuring NO₂ as a separate parameter and began measuring NO₂₃ exclusively.

11) Measured or calculated laboratory parameters –

a) Parameters measured directly

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

b) Calculated parameters

Nitrogen species: DIN = NO23F + NH4F
Other: TSS

12) Limits of detection –

Method Detection Limit (MDL), the lowest concentration of a parameter that an analytical procedure can reliably detect, has been established by the Grand Bay laboratory technicians for each parameter. 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
PO4F	01/01/24	08/31/24	0.002
PO4F	09/01/24	12/31/24	0.003
NH4F	01/01/24	08/31/24	0.005
NH4F	09/01/24	12/31/24	0.003
NO23F	01/01/24	08/31/24	0.006
NO23F	09/01/24	12/31/24	0.006
CHLA_N	07/06/23	01/09/24	0.0

CHLA_N	01/10/24	12/31/24	0.02
TSS	01/01/24	12/31/24	1.41

13) Laboratory methods –

a) Parameter: **Chlorophyll *a***

Method References:

Grand Bay National Estuarine Research Reserve - SOP
 Standard Methods for the Examination of Water and Wastewater, 20th edition. p 10-18. 10200 H.
 Chlorophyll - Fluorometric Determination of Chlorophyll.
 EPA Method 445.0 *In Vitro* Determination of Chlorophyll *a* by Fluorescence revision 1.2 pp. 22.

Method Descriptor:

Instrumentation: Fluorometer (Turner Designs Trilogy)
 The method used requires filtering a known quantity of water through a glass fiber filter (4.7 cm GF/F). This filter is stored dry in a freezer at -20°C until extraction. In preparation for extraction, the filter is placed in a 15 ml centrifuge tube with 10 ml of 90% aqueous acetone. The tube is then placed in a dark refrigerator for 18-24 hours. After extraction is complete, the tube is removed from the freezer and stored in a dark room for 30 minutes to allow for temperature equilibration. Three milliliters of the sample are then removed from the tube and placed in a 1.0 cm glass (or methacrylate) fluorometer cell. Fluorescence is read at excitation = 485 nm and emission = 685 nm (note: emission filter must be accurate to within 10 nm). Chlorophyll *a* concentration of the sample is determined by comparison with a standard curve of known chlorophyll *a* concentrations. The Turner Designs Trilogy performs this determination automatically against a standard curve with known concentrations that has been programmed into its memory.

Preservation Method:

A known quantity of water is filtered through a glass fiber filter (4.7 cm GF/F). This filter is stored dry in a freezer at -20°C until extraction.

b) Parameter: **Ammonia (NH4F)**

Method References:

Grand Bay National Estuarine Research Reserve - SOP
 Standard Methods for the Examination of Water and Wastewater, 20th edition. p 4-108. 4500-NH₃
 F. Phenate Method.

Method Descriptor:

Instrumentation: Spectrophotometer (Shimadzu UV-2550).
 An intensely blue compound, indophenol, is formed by the reaction of ammonia, hypochlorite, and phenol catalyzed by sodium nitroprusside. The indophenol blue is proportional to the ammonia concentration. The color develops at room temperature (22 to 27°C) in subdued light after 1 hour and is stable for 24 hours. Absorbance is measured with a spectrophotometer at 640 nm.

Preservation Method:

Sample is filtered as soon as possible after collection. Ammonia analysis begins as soon after filtering as possible. If necessary, samples can be stored in a freezer at -20°C for 28 days.

d) Parameter: **Nitrite + Nitrate (NO23F)**

NOTE: NO₂ is a minor component of NO₂₃ in the Grand Bay NERR system, as evidenced by data from 2005-2011. Through July 2012, NO₂ was measured when NO₂₃ was above the detection limit and was otherwise assumed to be below detection. The majority of NO₂ samples measured

during this time period were below detection. In August 2012, Grand Bay NERR completely stopped measuring NO₂ as a separate parameter and began measuring NO₃ exclusively.

Method References:

Grand Bay National Estuarine Research Reserve - SOP

Standard Methods for the Examination of Water and Wastewater, 20th edition. p 4-117. 4500-NO₃-E. Cadmium Reduction Method.

Method Descriptor:

Instrumentation: Spectrophotometer (Shimadzu UV-2550).

Nitrate is reduced almost quantitatively to nitrite in the presence of cadmium (Cd). This method uses commercially available Cd granules treated with copper sulfate and packed in a glass column. The nitrite produced thus is determined by diazotizing with sulfanilamide and coupling with N-(1-naphthyl)-ethylenediamine dihydrochloride to form a highly colored azo dye that is measured colorimetrically.

Preservation Method:

Sample is filtered as soon as possible after collection. Analysis begins as soon after filtering as possible. If necessary, samples can be stored in a freezer at -20°C for 28 days.

e) Parameter: **Dissolved Reactive Phosphorus (PO₄F)**

Method References:

Grand Bay National Estuarine Research Reserve - SOP

Standard Methods for the Examination of Water and Wastewater, 20th edition. p 4-146. 4500-P E. Ascorbic Acid Method.

Method Descriptor:

Instrumentation: Spectrophotometer (Shimadzu UV-2550).

Ammonium molybdate and potassium antimonyl tartrate react in acid medium with orthophosphate to form a heteropoly acid – phosphomolybdic acid – that is reduced to intensely colored molybdenum blue by ascorbic acid. Measure absorbance of each sample at 880 nm.

Preservation Method:

Sample is filtered as soon as possible after collection. Analysis begins as soon after filtering as possible. If necessary, samples can be stored in a freezer at -20°C for 28 days.

f) Parameter: **Total Suspended Solids (TSS)**

Method References:

Grand Bay National Estuarine Research Reserve - SOP

Standard Methods for the Examination of Water and Wastewater, 20th edition. p 2-57. 2540 D.

Method Descriptor:

A known amount of sample water is passed through a pre-dried and pre-weighed glass fiber filter (1.5 micron Whatman GF/F). The filter is placed in an aluminum dish and dried in a drying oven at 104°C until it reaches a constant weight. It is then weighed again and the difference in pre- and post-weights is the TSS value.

Preservation Method

Sample is filtered as soon as possible after collection. Analysis begins as soon after filtering as possible. If necessary, samples can be held in a refrigerator at 4°C for up to 7 days until analysis.

14) Field and Laboratory QAQC programs –

- a) Precision:
 - i) Field Variability – True field replicates are taken at each site during grab sampling. The one replicate is a successive grab. Sample XXXXXX-G1 is taken and then sampler emptied. The grab sampler is deployed once again to acquire XXXXXX-G2.
 - ii) Laboratory variability – Duplicates and spikes are analyzed with each monthly batch of samples.
 - iii) Inter-organizational splits – Grand Bay participated in the NERRS Interlaboratory Comparison in 2024.
- b) Accuracy:
 - i) Sample spikes – Spikes are performed monthly. 0.5 mL of 1 mg/L standard is added to a replicate sample, which should increase the concentration of the analyte by ~0.02 mg/L.
 - ii) Standard reference material analysis – QC standards are ordered from North Central Labs for NO₃, NH₄, and PO₄ annually.
 - iii) Cross calibration exercises – GND NERR did not participate in cross calibration exercises in 2024.

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 NO_{23F} 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.

Sample hold times for 2024: 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. Back-up samples are held at -80°C beginning 08/13/2024.

Sample Descriptor	Data of analysis				
	PO4F	NH4F	NO23F	CHLA	TSS
1/30/2024, all grabs	2/8/2024	2/6/2024	2/23/2024	2/2/2024	2/1/2024
1/29-30/2024, all diels	2/8/2024	2/6/2024	2/23/2024	2/2/2024	2/1/2024
2/21/2024, all grabs	3/4/2024	3/5/2024	3/8/2024	3/2/2024	2/26/2024
2/20-21/2024, all diels	3/4/2024	3/5/2024	3/8/2024	3/2/2024	2/26/2024
3/21/2024, all grabs	3/25/2024	4/9/2024	3/26/2024	4/1/2024	3/21/2024
3/20-21/2024, all diels	3/25/2024	4/9/2024	3/26/2024	4/1/2024	3/21/2024
4/23/2024, grabs 1-4, 7-12	4/25/2024	5/2/2024	5/3/2024	4/29/2024	4/29/2024
4/24/2024, grabs 5-6	4/25/2024	5/2/2024	5/3/2024	4/29/2024	4/29/2024
4/23-24/2024, all diels	4/25/2024	5/2/2024	5/3/2024	4/29/2024	4/29/2024
5/20/2024, all grabs	5/30/2024	5/29/2024	*+8/16/2024	5/27/2024	5/23/2024
5/20-21/2024, all diels	5/30/2024	5/29/2024	*+8/16/2024	5/27/2024	5/23/2024
6/24/2024, grabs 5-12	6/27/2024	7/2/2024	7/18/2024	7/1/2024	6/27/2024
6/25/2024, grabs 1-4	6/27/2024	7/2/2024	7/18/2024	7/1/2024	6/27/2024
6/24-25/2024, all diels	6/27/2024	7/2/2024	7/18/2024	7/1/2024	6/27/2024
7/15/2024, all grabs	7/26/2024	8/2/2024	8/7/2024	7/23/2024	7/17/2024
7/15-26/2024, all diels	7/26/2024	8/2/2024	8/7/2024	7/23/2024	7/17/2024
8/13/2024, all grabs	8/18/2024	8/21/2024	8/27/2024	9/4/2024	8/16/2024
8/12-13/2024, all diels	8/18/2024	8/21/2024	8/27/2024	9/4/2024	8/20/2024
9/23/2024, all grabs	10/2/2024	10/3/2024	10/1/2024	9/29/2024	9/27/2024
9/23-24/2024, all diels	10/2/2024	10/3/2024	10/1/2024	9/29/2024	9/27/2024
10/21/2024, all grabs	10/28/2024	11/15/2024	10/30/2024	11/4/2024	10/22/2024
10/21-22/2024, all diels	10/28/2024	11/15/2024	10/30/2024	11/4/2024	10/23/2024
11/21/2024, all grabs	11/26/2024	12/5/2024	12/3/2024	11/24/2024	11/26/2024
11/21-22/2024, all diels	11/26/2024	12/5/2024	12/3/2024	11/24/2024	11/26/2024
12/16/2024, all grabs	12/27/2024	1/9/2025	1/3/2025	12/20/2024	12/19/2024
12/17-18/2024, all diels	12/27/2024	1/9/2025	1/3/2025	12/20/2024	12/19/2024

*samples held longer than allowed by NERRS protocols. flagged either <-4> [SBL] (CHB) if below detection – or <1> (CHB) if above MDL.

+back-up samples stored at -80°C.

General note on laboratory analyses

{TSL} Tide was too low for ISCO sampler to reach water column and no sample was collected

Diel samples only:

gndblnut Monitoring program 2

1/29/2024 8:44

1/29/2024 10:52

1/29/2024 13:00

1/29/2024 15:08
1/29/2024 17:16
2/20/2024 5:19
2/20/2024 7:34
2/20/2024 9:49
2/20/2024 12:04
8/14/2024 14:43

{CLE} {CSM} samples collected earlier/later than expected and not within 3 hours of low tide:

1/30/2024 gndbcnut grab samples
6/24-25/2024 diel and grab samples, all sites
7/15-16/2024 diel and grab samples, all sites

{CSM} 3/20-21/2024 and 4/23-24/2024:

<-2> [GCM] Missing NOX analysis due to bad standard. Back-up samples were not available.

gndhsnut 1/30/2024 <-3>[SBL](CSM). Reps 1 and 2 did not have at least 2.5mg of dried residue on filter and is therefore rejected.

gndhsnut 5/20/2024 <-3>(CSM). Reps 1 and 2 did not have at least 2.5mg of dried residue on filter and is therefore rejected.