Rookery Bay National Estuarine Research Reserve (RKBNERR)
NERR Nutrient Metadata
January – December 2023
Latest update: November 19, 2024

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

I. Data Set and Research Descriptors

1) Principal investigator(s) and contact persons:

a) Principal Investigator:

Jay Black, Research Coordinator
300 Tower Road
Naples, FL 34113
(239) 530-5964
Jay.J.Black@FloridaDEP.gov

b) System-Wide Monitoring Program (SWMP) Contacts:

Julie Brader Drevenkar, SWMP Program Manager
Rookery Bay National Estuarine Research Reserve
300 Tower Road
Naples, FL 34113
Tel: (239) 530-5965
Fax: (239) 530-5983
Julie.Drevenkar@dep.state.fl.us

Sarah Norris, SWMP Technician (Through 02/15/2023)
Rookery Bay National Estuarine Research Reserve
300 Tower Road
Naples, FL 34113

Jenna Flickinger, SWMP Technician (Starting 06/26/2023)
Rookery Bay National Estuarine Research Reserve
300 Tower Road
Naples, FL 34113

c) Laboratory Contacts:

Colin Wright, Ph.D., Chemistry Program Administrator
Florida Department of Environmental Protection
Bureau of Laboratories
2600 Blair Stone Road M.S. 6512
Tallahassee, Florida 32399-2400
Phone: (850) 245-8102
Colin.Wright@dep.state.fl.us

Cheryl Swanson, Biology Program Administrator
Florida Department of Environmental Protection

Bureau of Laboratories
2600 Blair Stone Road M.S. 6512
Tallahassee, Florida 32399-2400
Phone: (850) 245-8171
Cheryl.Swanson@dep.state.fl.us

2) Research objectives

The System-wide Monitoring Program water quality initiative began at the RKBNERR in 1996. Currently, there are four primary SWMP stations and one secondary SWMP station that are in estuaries affected by watersheds demonstrating different patterns of land use. Their placement addresses priority resource management issues that are identified in the Reserve's management plan. Specifically, the data from these stations provide valuable information concerning the effects of land-use activities on the quantity, quality, and timing of freshwater inflow into the reserve. Each bay studied exhibits a pattern of altered freshwater inflow.

a) **Monthly Grab Sampling Program:** The principal objective of the monthly grab sampling is to determine spatial and temporal differences in water quality between sites representing different land-use patterns.

b) **Diel Sampling Program:** The principal objective of the diel sampling is to quantify temporal variability over a lunar tidal cycle and to determine the impact of tidal water exchange within Henderson Creek (a source of freshwater into the Rookery Bay proper waterbody).

3) Research methods

a) Monthly Grab Sampling Program

Monthly grab samples were collected at all four primary SWMP water quality stations: Henderson Creek, Middle Blackwater River, Faka Union Bay, and Fakahatchee Bay. Beginning in October 2012, grab samples were also collected at Pumpkin Bay which was designated a Secondary SWMP Station by the CDMO in October of 2016. Duplicate grab samples were taken every month at each of the water quality stations following the National Estuarine Research Reserve System Nutrient and Chlorophyll Monitoring Program and Database Design SOP v1.8. Slack low tide was generally not considered for the grab sampling events due to the travel time between sites and the time constraints with the contracted laboratory. Rainfall conditions prior to grab sampling were generally not considered due to constraints with the contracted laboratory.

Sample bottles were pre-cleaned by the contracted laboratory following their Quality Assurance Management Plan (available on request). The bottle kits for each station were labeled with a unique sample identification number and chain of custody sheets were completed for tracking the samples during laboratory analysis and in the laboratory database. Tubing for the water sampling device (peristaltic pump), carboys (for deionized water), and filter holders were pre-cleaned using a Florida Department of Environmental Protection (FLDEP) decontamination procedure (FLDEP SOP FC1000/DEP-QAA-01/001) which involved: cleaning with phosphate-free soap, rinsing three times with tap water, soaking from 4 - 24 hours in a 10% hydrochloric acid bath, rinsing three times with deionized water, and drying for 24 hours. One to two days prior to field sampling, the filter holders were assembled with in-line filters (0.7 µm glass microfiber filters and 0.45 µm membrane filters).

At each water quality station, grab samples for dissolved nutrients were collected 0.5 meter below the surface (near surface grab) using a peristaltic pump. A filter holder attached to the peristaltic pump tubing was used to filter for dissolved nutrients in the field. Nitrile gloves were worn through the entire process of sample collection and filtering. Unfiltered parameters included chlorophyll *a*, phaeophytin *a*, total phosphorous (TP), total Kjeldahl nitrogen (TKN), and total suspended solids (TSS). Filtered parameters included ammonium (NH4), nitrite + nitrate (NO23), nitrite (NO2), and orthophosphate (PO4).

Chlorophyll *a*/ phaeophytin *a* and TSS sample bottles were rinsed three times with the sample water then filled to the shoulder, capped, and immediately stored in a cooler with ice. The nitrite/ orthophosphate bottle was rinsed three times with filtered water and then filled with the filtrate, capped, and immediately stored in a cooler with ice. The sample bottles for ammonia, nitrite + nitrate, total Kjeldhal nitrogen, and total phosphorus contained sulfuric acid for preservation and therefore were not rinsed before adding the sample. All sample bottles were made of translucent high-density polyethylene (HDPE) except for the chlorophyll *a*/ phaeophytin *a* bottle which was an opaque amber HDPE bottle. To avoid cross contamination, the peristaltic pump tubing was rinsed thoroughly with deionized water after each sampling and then rinsed thoroughly with sample water before sampling at each new station. New gloves and filters were used at each site. Additionally, an equipment blank using deionized water was performed at the end of each sampling event following all the same procedures. Samples were shipped overnight to the FLDEP lab in Tallahassee, FL.

Starting in January 2018, additional Chlorophyll *a* grab samples were collected at each site, using the same collection methods, in a different opaque amber HDPE bottles to compare the fluorometric and spectrophotometer method of analysis. The FLDEP lab reported the results for comparison purposes and the fluorometric data are available by request. The method comparisons were concluded July 2020 and the original spectrophotometer method was continued.

At each site physical/chemical water quality parameters were measured at the same depth as the nutrient samples were collected. A YSI EXO1 datasonde with handheld display was used to record the measurements. Recorded parameters included salinity (ppt), specific conductivity (mS/cm), temperature (°C), dissolved oxygen (% and mg/L), pH, and turbidity (NTU). Equipment calibration was done according to NERRS SWMP EXO SOP v2.2 and FLDEP SOP 001/01.

b) Diel Sampling Program

Monthly diel samples were collected at the depth of the water quality datasonde (0.25 meters above the bottom) every 2.5 hours over a lunar day (24hr:48 min) using an ISCO refrigerated auto-sampler (model 6712FR). The sampler was stationed approximately 100 meters from the Lower Henderson water quality site, on the RKBNERR Shell Island Road dock. Prior to sampling, the polyethylene bottles used in the auto-sampler were washed following the same FLDEP decontamination procedure as described above in the grab sampling methods. A day before the sampling was to begin, the ISCO auto-sampler was set up and programmed. The siphon hose was rinsed with 900 ml ambient water prior to programming the auto-sampler. Sample bottles for the laboratory analysis were pre-cleaned by the contracted laboratory following their Quality Assurance Management Plan (available by request). Bottle kits for each sample interval (11) were labeled with a unique sample identification number and chain of custody sheets were completed for tracking the samples during laboratory analysis and in the laboratory database.

Sample filtration: Nitrile gloves were worn during sample processing. At Rookery Bay's laboratory, each polyethylene bottle containing 1000 ml of sample water was shaken to homogenize the sample. A peristaltic pump with a filter holder attached to the sampling tube was used to filter for dissolved nutrients. For dissolved phosphorus and nitrite, HDPE sample bottles were filled with the filtrate, capped, and immediately stored in a cooler with ice. For ammonium and nitrite + nitrate, the HDPE sample bottles contained sulfuric acid for preservation and therefore were not rinsed before adding the filtrate, capped, and immediately stored in a cooler with ice. New filters were used for each sample. For the chlorophyll *a* samples, HDPE amber sample bottles were filled with at least 500 ml of unfiltered sample, capped, and immediately stored in a cooler with ice. Samples were shipped overnight to the FLDEP lab in Tallahassee, FL.

c) All Samples

Samples are placed on ice immediately after collection and kept on ice while shipped overnight to the to the FLDEP lab in Tallahassee, FL. Once at the lab, they are inventoried and placed in the appropriate refrigerator/freezer. Refrigerators range from 0 to 6.0˚C and freezers from -30.0 to -5.0˚C.

4) Site location and character

The RKBNERR spans approximately 110,000 acres (445.2 km^2) of public lands on Florida's Gulf coast south of Naples. Approximately 5 percent (6,000 acres) are uplands and 95 percent (104,000 acres) are submerged lands. Within the submerged lands, 68,000 acres are open water, and 36,000 acres are mangroves. The Reserve covers approximately 40 percent of the Collier County coastline, from Gordon Pass in Naples southward to the northwestern boundary of Everglades National Park. Major habitats of the Reserve include extensive pristine subtropical mangrove-forested wetlands, undeveloped barrier islands, and some of the last remaining intact tropical hardwood hammocks and coastal scrub habitats in southwest Florida. The coastal ecosystem within the Reserve has national and international significance as the western edge of the Everglades ecosystem, yet it is located adjacent to one of the fastest developing coastal areas in the United States. DEP has designated all tidally connected waters within the boundaries of the Reserve as Class II and Outstanding Florida Waters (OFW).

Natural drainage patterns within Collier County have been significantly altered by the construction of canal systems designed to lower annual peak water levels during the wet season to prevent flooding. Such canals include the Henderson Creek Canal, Lely Canal, Faka Union Canal, and borrow canals used for constructing U.S. 41 (Tamiami Trail), State Road 951 (Collier Boulevard), and County Road 92. A combination of fixed weirs and gates control canal flow, preventing excessive freshwater drainage and saltwater encroachment. The primary basins that feed the Rookery Bay Reserve watershed are Lely (SFWMD No. 6), Henderson Creek, and Picayune Strand. These basins are sub-units of SFWMD.

The climate for southwest Florida is classified as Tropical Monsoon climatic group of Köppen–Geiger climate classification (1961). The average annual rainfall is 50-55 inches (127-140 cm) per year (Thomas 1974), with the wet season extending from the end of May through the beginning of October. The average annual air temperature in the Reserve as recorded by the RKBNERR SWMP weather station was 24.3 °C (75.7°F) for 2023, however the summer was the hottest on record with max temperatures of 37.3 °C (99.1°F). Seasonal variation in temperature within the Reserve follows that of rainfall with a summer period of high temperatures between May and October and a cooler period extending from December through March. Southwestern Florida lies in the seasonal tropical weather belt that channels hurricanes toward or along the coast. One of the most common extreme weather impacts to the Reserve area is from tropical cyclones such as tropical depressions, tropical storms, and hurricanes. On average, Naples is affected once every 2.67 years by tropical cyclones, every 6.68 years by hurricanes, and every 10.5 years by major hurricanes. The last major hurricane that affected this area was Hurricane Irma on September 10, 2017, which made landfall on Marco Island with sustained winds of 115 mph.

Station Descriptions:

<u>Lower Henderson Creek (rkblhwq):</u>

The Lower Henderson Creek station is affixed to a piling with a manatee caution sign located approximately 100 meters across the Reserve's Shell Island Road boat dock. The dominant marsh vegetation near the sampling site is red mangrove and the dominant natural vegetation of the watershed is hydric pine and cypress.

Site name	**Lower Henderson Creek (rkblhwq)**

Latitude and longitude	26.02749 N, -81.73361 W
Tidal range	0.50 m to 2.24 m (average 1.37 m)
Salinity range	18.2 to 37.9 psu during 2023
Type and amount of freshwater input	Lower Henderson Creek station receives most of its freshwater from a canal system that drains a watershed area with approximately 65% developed versus natural landscape. Land-use in the developed area is divided between residential, commercial, and agricultural activities. Residential areas include developments with septic systems. A weir controls most of the freshwater flowing into Henderson Creek. The amount of water released from this weir can sometimes mask natural tidal salinity patterns.
Water depth	Estimated 1.25 m at MLW
Sonde distance from bottom	0.25 m
Bottom habitat or type	Predominantly fine sand and oyster shells. There is no bottom vegetation.
Pollutants in area	Typical non-point source pollutant runoff from an urban canal system that runs along the SR 951 including residential and commercial properties that drain into the creek.
Description of watershed	The monitoring site is approximately 5 km downstream of a four-lane highway (SR 951) that crosses over Henderson Creek. The creek is 5.8 km long (mainstream linear dimension), has an average mid-channel depth of approximately 2 meters at MHW, and an average width of 239 meters. The historic Henderson Creek watershed was approximately 50% under State ownership and much of this protected area had intact cypress sloughs and other wetland vegetation. Canals and water use for agriculture and human consumption have altered the hydroperiod of this watershed.

Middle Blackwater River (rkbmbwq):

The Middle Blackwater River station is affixed to navigational marker 17 within the river channel. Salinities fluctuate with the tides and watershed rainfall. Mature red mangrove forests dominate the banks of the river with patches of oyster bars.

Site name	**Middle Blackwater River (rkbmbwq)**
Latitude and longitude	25.9343 N, -81.5946 W
Tidal range	0.16 and 2.14 m (average 1.10 m)
Salinity range	18.8 to 39.6 psu during 2023
Type and amount of freshwater input	The salinity fluctuations of this site suggest that seasonal fluctuations in salinity are more closely correlated to watershed rainfall patterns. Based on modeling of historic flow-way patterns, the watershed draining into Blackwater River has been significantly reduced possibly resulting in higher than historical salinity values. Recently, in 2023,

	during the Picayune Strand Restoration Project, a 7-mile canal was built along an agricultural property, called the Western Protection Feature that will drain into the Collier Seminole State Park to the north of the site.
Water depth	Estimated 1.0 m at MLW
Sonde distance from bottom	0.25 m
Bottom habitat or type	The substrate within the channel is a mixture of sand and silt with oyster shell with some organic matter mixed in. There is no bottom vegetation.
Pollutants in area	Non-point source pollutant runoff from an urban canal system that runs along the US 41 including agricultural operations, residential and commercial properties that drain into the river.
Description of watershed	The Middle Blackwater River station has a watershed that is 65% natural landscape. Agriculture dominates the land-use activities within the developed area of the watershed, but residential and commercial development of the watershed has been increasing. In addition, canals and roads built during the 1960's (Picayune Strand, formerly Southern Golden Gate Estates) to the east, may have caused significant disruptions to sheet-flow reducing the amounts of freshwater flowing to this estuary. Upstream influences consist of the Collier-Seminole State Park boat basin and upstream agricultural fields adjacent to Blackwater River's main feeder canal (US 41 canal).

Faka Union Bay (rkbfuwq):

The Faka Union Bay station is located at the mouth of the Faka Union Canal on a manatee speed zone sign next to the main channel. Mature red mangrove forests and spoil islands dominate the banks of the canal.

Site name	**Faka Union Bay (rkbfuwq)**
Latitude and longitude	25.9005 N, -81.5159 W
Tidal range	0.06 and 1.89 m (average 0.75 m)
Salinity range	2.1 to 38.9 psu during 2023
Type and amount of freshwater input	Salinities fluctuate daily with tides, seasonal rainfall, and management of upstream water control structures.
Water depth	Estimated 1.0 m at MLW
Sonde distance from bottom	0.25 m
Bottom habitat or type	The substrate within the channel is a mixture of sand and silt with some organic matter.
Pollutants in area	Non-point source pollutant runoff from an urban canal system that runs along the US 41 including agricultural operations, residential and commercial properties that drain into the river.
Description of watershed	The Faka Union Bay station is located immediately downstream of Port of the Isles community and the failed housing development and current Picayune Strand Restoration Project

	(PSRP). Four canals constructed for the original project converge into one canal (Faka Union Canal) which drains into Faka Union Bay. Consequently, this station represents the most extreme state of altered freshwater inflow of the four monitoring sites in the Ten Thousand Islands. Faka Union Bay experiences lower than historical salinity values and extreme fluctuations in salinity during the wet season.

Fakahatchee Bay (rkbfbwq):

The Fakahatchee Bay station is located at the mouth of two rivers, Fakahatchee River and East River, secured to a 6-inch PVC pipe hydro-jetted into the substrate. Mature red mangrove forests dominate the banks of the rivers with an oyster bar adjacent to the site.

Site name	**Fakahatchee Bay (rkbfbwq)**
Latitude and longitude	25.8922 N, -81.4770 W
Tidal range	0.00 and 2.02 m (average 0.79 m)
Salinity range	8.30 to 39.6 psu during 2023
Type and amount of freshwater input	Salinities fluctuate daily with the tides and seasonal rainfall.
Water depth	Estimated 1.0 m at MLW
Sonde distance from bottom	0.25 m
Bottom habitat or type	The substrate within the channel is a mixture of sand, silt and some organic matter.
Pollutants in area	Upstream there are minimal influences from the Picayune Strand State Forest with non-point source pollutants possible from the culverts under I-75 and US 41.
Description of watershed	The Fakahatchee Bay station is the least disturbed system relative to the other sites in the Ten Thousand Islands. The Fakahatchee Bay watershed is primarily under preserve status and has been relatively undisturbed by the hydrologic alteration of the Southern Golden Gate Estates canal system. Fakahatchee Strand State Preserve and Big Cypress National Park manage the headwaters of Fakahatchee Bay. Because Fakahatchee Bay's watershed is considered the least altered, the water quality data collected from this station serves as a reference for assessing the effectiveness of the PSRP.

Pumpkin Bay (rkbpbwq):

The Pumpkin Bay station is located at the mouth of the Pumpkin River secured to a 6-inch PVC pipe hydro-jetted into the substrate. Mature red mangrove forests dominate the Pumpkin River and the bay.

Site name	**Pumpkin Bay (rkbpbwq)**
Latitude and longitude	25.9141 N, -81.5404 W

Tidal range	0.00 and 1.82 m (average 0.70 m)
Salinity range	16.9 to 40.0 psu during 2023
Type and amount of freshwater input	Salinities fluctuate daily with the tides and seasonal rainfall.
Water depth	Estimated 1.0 m at MLW
Sonde distance from bottom	0.25 m
Bottom habitat or type	The bottom habitat is predominantly fine sand and silt. There is no bottom vegetation.
Pollutants in area	Upland land use is minimal with the main influences being US 41 and the Picayune Strand canal system, which has diverted freshwater to Faka Union Bay.
Description of watershed	The watershed is mostly undeveloped with the main influences being US 41 and the Picayune Strand canal system, which has diverted freshwater to Faka Union Bay. Like Blackwater River, the modeling of historic flow-way patterns show the watershed draining into Pumpkin Bay has been significantly reduced resulting in higher than historical salinity values.

All Rookery Bay NERR historical nutrient/pigment monitoring stations:

Station Code	SWMP Status	Station Name	Location	Active Dates	Reason Decommissioned	Notes
rkblhwq	Primary (P)	Lower Henderson Creek	26.02749 -81.73361	01/01/2002 00:00 - current	NA	NA
rkbmbwq	Primary (P)	Middle Blackwater River	25.93469 -81.59485	01/01/2002 00:00 – current	NA	NA
rkbfuwq	Primary (P)	Faka Union Bay	25.90048 -81.51590	01/01/2001 00:00 – current	NA	NA
rkbfbwq	Primary (P)	Fakahatchee Bay	25.88955 -81.47656	01/01/2000 00:00 – current	NA	NA
rkbpbwq	Secondary (S)	Pumpkin Bay	25.91417 -81.54034	07/06/2016 00:00 – current	NA	NA

5) Coded variable definitions

Station Codes:
rkblhnut = Rookery Bay Lower Henderson nutrients (monthly grabs and diel sampling)
rkbmbnut = Rookery Bay Middle Blackwater nutrients (monthly grabs)
rkbfunut = Rookery Bay Faka Union nutrients (monthly grabs)
rkbfbnut = Rookery Bay Fakahatchee Bay nutrients (monthly grabs)
rkbpbnut = Rookery Bay Pumpkin Bay nutrients (monthly grabs, Secondary SWMP station)

Monitoring Codes:
monthly grab sample program = 1

monthly diel sample program = 2

Replicate grab samples were denoted as 1 for the first sample and 2 for the second sample at each station in the "*Rep*" column. Since 1 diel sample was collected every 2.5 hrs., the replicate number was always denoted as 1 in the "*Rep*" column.

6) Data collection period

The RKBNERR monthly grab sampling began in January 2002 at all the primary SWMP sampling stations. Grab sampling began in October 2012 at the Secondary SWMP station, rkbpbnut. Diel sampling began at the Lower Henderson Creek site in February 2002. Start times and end times have been modified to report in Eastern Standard Time (EST).

Monthly Grab Sampling Collection Period: January – December 2023

Station Code	Date Time Stamp (rep 1)	Date Time Stamp (rep 2)
rkblhnut	01/18/2023 08:04	01/18/2023 08:09
rkblhnut	02/14/2023 08:02	02/14/2023 08:07
rkblhnut	03/08/2023 08:19	03/08/2023 08:27
rkblhnut	04/13/2023 07:00	04/13/2023 07:07
rkblhnut	05/09/2023 12:18	05/09/2023 12:25
rkblhnut	06/20/2023 11:19	06/20/2023 11:25
rkblhnut	07/11/2023 05:46	07/11/2023 05:52
rkblhnut	08/08/2023 10:16	08/08/2023 10:22
rkblhnut	09/19/2023 10:22	09/19/2023 10:27
rkblhnut	10/17/2023 12:15	10/17/2023 12:22
rkblhnut	11/08/2023 08:06	11/08/2023 08:13
rkblhnut	12/06/2023 13:00	12/06/2023 13:06
rkbmbnut	01/18/2023 13:00	01/18/2023 13:04
rkbmbnut	02/14/2023 11:51	02/14/2023 11:56
rkbmbnut	03/08/2023 10:26	03/08/2023 10:33
rkbmbnut	04/13/2023 08:57	04/13/2023 09:03
rkbmbnut	05/09/2023 07:36	05/09/2023 07:39
rkbmbnut	06/20/2023 09:17	06/20/2023 09:22
rkbmbnut	07/11/2023 10:04	07/11/2023 10:11
rkbmbnut	08/08/2023 08:41	08/08/2023 08:46
rkbmbnut	09/19/2023 06:34	09/19/2023 06:42
rkbmbnut	10/17/2023 10:13	10/17/2023 10:19
rkbmbnut	11/08/2023 10:20	11/08/2023 10:26
rkbmbnut	12/06/2023 08:44	12/06/2023 08:49
rkbfunut	01/18/2023 11:40	01/18/2023 11:46
rkbfunut	02/14/2023 10:36	02/14/2023 10:40
rkbfunut	03/08/2023 11:22	03/08/2023 11:29
rkbfunut	04/13/2023 10:26	04/13/2023 10:32

rkbfunut	05/09/2023 09:00	05/09/2023 09:07
rkbfunut	06/20/2023 08:15	06/20/2023 08:21
rkbfunut	07/11/2023 08:41	07/11/2023 08:46
rkbfunut	08/08/2023 07:31	08/08/2023 07:38
rkbfunut	09/19/2023 07:46	09/19/2023 07:51
rkbfunut	10/17/2023 09:13	10/17/2023 09:18
rkbfunut	11/08/2023 11:36	11/08/2023 11:42
rkbfunut	12/06/2023 10:05	12/06/2023 10:11
rkbfbnut	01/18/2023 11:04	01/18/2023 11:09
rkbfbnut	02/14/2023 10:09	02/14/2023 10:12
rkbfbnut	03/08/2023 12:03	03/08/2023 12:10
rkbfbnut	04/13/2023 11:00	04/13/2023 11:06
rkbfbnut	05/09/2023 09:41	05/09/2023 09:49
rkbfbnut	06/20/2023 07:44	06/20/2023 07:52
rkbfbnut	07/11/2023 08:07	07/11/2023 08:14
rkbfbnut	08/08/2023 06:56	08/08/2023 07:02
rkbfbnut	09/19/2023 08:13	09/19/2023 08:18
rkbfbnut	10/17/2023 08:42	10/17/2023 08:49
rkbfbnut	11/08/2023 12:04	11/08/2023 12:09
rkbfbnut	12/06/2023 10:39	12/06/2023 10:44
rkbpbnut	01/18/2023 12:12	01/18/2023 12:16
rkbpbnut	02/14/2023 11:06	02/14/2023 11:12
rkbpbnut	03/08/2023 12:47	03/08/2023 12:52
rkbpbnut	04/13/2023 09:52	04/13/2023 10:00
rkbpbnut	05/09/2023 08:22	05/09/2023 08:28
rkbpbnut	06/20/2023 07:10	06/20/2023 07:15
rkbpbnut	07/11/2023 09:17	07/11/2023 09:23
rkbpbnut	08/08/2023 08:00	08/08/2023 08:05
rkbpbnut	09/19/2023 07:19	09/19/2023 07:27
rkbpbnut	10/17/2023 07:23	10/17/2023 07:28
rkbpbnut	11/08/2023 11:05	11/08/2023 11:10
rkbpbnut	12/06/2023 09:32	12/06/2023 09:37

Monthly Diel Sampling Collection Period: January – December 2023

The November and December diel sampling events were not collected due to re-construction of the dock that the ISCO was located. Compliance logs were submitted and approved by the Oversite Committee.

Station Code	Date Time stamp (begin)	Date Time stamp (end)
rkblhnut	01/10/2023 09:30	01/11/2023 10:30
rkblhnut	02/07/2023 08:30	02/08/2023 09:30
rkblhnut	03/21/2023 08:00	03/22/2023 09:00
rkblhnut	04/18/2023 06:30	04/19/2023 07:30

rkblhnut	05/16/2023 05:30	05/17/2023 06:30
rkblhnut	06/13/2023 04:00	06/14/2023 05:00
rkblhnut	07/18/2023 08:00	07/19/2023 09:00
rkblhnut	08/15/2023 07:00	08/16/2023 08:00
rkblhnut	09/12/2023 06:00	09/13/2023 07:00
rkblhnut	10/10/2023 05:00	10/11/2023 06:00

7) Associated researchers and projects

Both water quality and nutrient data generated by RKBNERR have been used by the USACOE, USFWS, SFWMD and Florida DEP to analyze restoration targets established for the PSRP, which is a portion of the CERP.

In 2021, Florida DEP started using water quality and nutrient data to create an internal departmental data analysis dashboard to analyze the duration of hypoxia, trends and comparisons relating to dissolved oxygen (DO) and other analytes available for the continuous monitoring stations, change and patterns at those stations, including how the stations may relate to external factors. Florida DEP is also using SWMP data for the Statewide Ecosystem Assessment of Coastal and Aquatic Resources (SEACAR) project. The project will provide status and trends reporting through web-based access to data and assessments and a tiered reporting format for a variety of audiences.

Other significant water quality research and monitoring initiatives within the RKBNERR include regular monitoring by Florida Department of Environmental Protection's Division of Environmental Assessment and Restoration (https://floridadep.gov/DEAR) water quality assessment program, oyster reef/benthic crab survey (1999 – 2008), long-term fisheries survey (July 1998 - June 2013 and October 2015 - present), shark demographics survey (May 2000 - present) and shorebird mortality MST water quality study (July 2021 – present). The fisheries data are obtained through monthly trawls in the bays corresponding with the SWMP water quality sites to document the population dynamics in a variety of fish species, as well as commercially important invertebrates such as stone crabs, blue crabs and pink shrimp. Shark demographic data are also collected monthly from the reference bays downstream of the PSRP through long-line and gillnet 'tag, measure and release' surveys. Benthic crabs were collected from oyster reefs using Hester-Dendy collection substrates at the four SWMP water quality stations. In October 2021, NOAA submitted the paper "Canals reroute freshwater to the Ten Thousand Islands, Florida USA: Too much freshwater vs not enough and how much does it matter to estuarine fish?", to *Estuaries and Coasts*.

The water quality and nutrient data are also used by visiting investigators/ researchers to support the research conducted within the Reserve.

As part of the SWMP long-term monitoring program, RKBNERR 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

The analytical results (electronic files) were provided monthly from the contracted laboratory to Julie Drevenkar, SWMP Manager. Upon receiving the results, the SWMP Manager reviewed the data for errors. The SWMP Manager was responsible for compilation and QA/QC of the final data set according to chapter 10 of the Centralized Data Management Office (CDMO) NERR SWMP Data Management Manual v 6.8. The data reported from the lab were in the required units making it unnecessary to convert the data prior to entering it into Microsoft Excel.

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 "*".

Data Category	Parameter	Variable Name	Units of Measure
Phosphorus			
	Orthophosphate, Filtered*	PO4F	mg/L as P
	Total Phosphorus	TP	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
	Total Kjeldahl Nitrogen	TKN	mg/L as N
	Total Organic Nitrogen	TON	mg/L as N
Plant Pigments			
	Chlorophyll *a* *	CHLA_N	µg/L

	Phaeophytin	PHEA	µg/L
Other Lab Parameters			
	Total Suspended Solids	TSS	mg/L
Field Parameters			
	Water Temperature	WTEM_N	degrees Celsius
	Specific Conductance	SCON_N	mS/cm
	Salinity	SALT_N	ppt
	Dissolved Oxygen	DO_N	mg/L
	Dissolved Oxygen Saturation	DO_S_N	percent
	pH	PH_N	standard units
	Turbidity	TURB_N	NTU/FNU

Notes:

1. Time is coded based on a 2400 clock and is referenced to Standard Time.
2. Reserves have the option of measuring either NO2 and NO3 or they may substitute NO23 for individual analyses if they can show that NO2 is a minor component relative to NO3.

11) Measured or calculated laboratory parameters

a) Parameters measured directly

Phosphorus species:	PO4F, TP
Nitrogen species:	NH4F, NO2F, NO23F, TKN
Plant Pigments:	CHLA_N, PHEA
Other:	TSS

b) Calculated parameters

NO3	(NO23F*Df) – (NO2F*Df)
	Df = Dilution factor
DIN	NO23F + NH4F
TON	TKN – NH4F
TN	TKN + NO23F

12) Limits of detection

Method Detection Limits (MDL), the lowest concentration of a parameter that an analytical procedure can reliably detect, were established by the Florida Department of Environmental Protection (FLDEP) Laboratory. MDLs were determined using the U.S. Environmental Protection Agency MDL procedure found in Title 40 Code of Federal Regulations Part 136 (40 CFR 136, Appendix B, revision 2.0). Once the MDL was established using this method, verification was done prior to use. Verification included analyzing a known standard at 2-3 times the calculated MDL. Additionally, various checks and balances were used to ensure suitability of the MDL. Every quarter the labs employed verification checks on all MDLs. If the verification checks met the lab's acceptance criteria, then the MDL remained unchanged. The MDL for all parameters were determined by the FLDEP Laboratory.

FLDEP laboratory MDL determination:

The FLDEP Laboratory defines the MDL as the minimum measured concentration of a substance that can be reported with 99% confidence that the measured concentration is distinguishable from the method blank result. MDLs are determined using the method specified in the Federal Register, 40 CFR Part136 Appendix B Revision 2, using LCSs prepared near the estimated detection limit as surrogates to estimate methodological noise for actual method blanks to directly measure methodological noise. If none of the method blanks give numerical results for an individual analyte, method blanks are not required for the determination of the MDL. Where the possibility exists for significant systematic bias from sample preparation and handling or from the analytical determinative step (typically inorganic analyses), bias is taken into account when calculating detection limits. Published MDLs may be set higher than experimentally determined MDLs to (1) avoid observed positive interferences from matrix effects or common reagent contaminants or (2) for reporting convenience (i.e., to group common compounds with similar but slightly different experimentally determined MDLs). MDLs are determined in a suitable analyte-free matrix when possible. For certain analytes and matrices, no suitable, analyte-free matrix may be available. In those cases, MDLs are determined in the absence of any matrix, but in the presence of all preparatory reagents carried through the full preparatory and determinative steps. LOD verification procedures may be found in SOP LB-031, *Limit of Detection Verification*. (From page 42 of FLDEP Laboratory Quality Manual 2023 located at: Florida DEP Laboratory Quality Manual (state.fl.us))

2023 MDLs

Monthly MDL Changes: Due to the need for sample dilution by the lab for the sample to be analyzed, chlorophyll *a*, pheaphytin *a*, nitrite+nitrate, and TSS MDLs may be elevated. Some values are flagged as below sensor limits <-4> [SBL] while the value reported is higher than the normal MDL. A table of these instances are below.

Parameter	Start Date	End Date	Nominal (Base) MDL	MDL Range	Date Revisited	SOP Name
PO4F	08/11/2022	08/17/2023	0.004	0.004	08/04/2022	NU-070-1.22
PO4F	08/18/2023	12/31/2023	0.004	0.004	08/18/2023	NU-070-1.23
TP	12/27/2021	08/06/2023	0.002	0.002	12/27/2021	NU-082-1.16
TP	08/07/2023	12/31/2023	0.002	0.002	08/01/2023	NU-082-1.17
NH4F	10/10/2022	10/10/2023	0.002	0.002 – 0.008	08/31/2022	NU-104-1.3
NH4F	10/11/2023	12/31/2023	0.002	0.002 – 0.008	10/10/2023	NU-104-1.4
NO23F	12/27/2021	07/20/2023	0.004	0.004 - 0.020	12/20/2021	NU-066-1.24
NO23F	07/21/2023	12/31/2023	0.004	0.004 - 0.020	07/21/2023	NU-066-1.25
TKN	02/01/2022	07/09/2023	0.080	0.080 - 4.0	01/27/2022	NU-092-1.12
TKN	07/10/2023	12/31/2023	0.080	0.080 - 4.0	06/27/2023	NU-092-1.13
CHLA_N	02/16/2022	02/05/2023	0.82	0.82 – 4.60	02/16/2022	BB-029-2.9
CHLA_N	02/06/2023	03/20/2023	0.82	0.82 – 4.60	02/03/2023	BB-029-2.10
CHLA_N	03/21/2023	12/31/2023	0.82	0.82 – 4.60	03/21/2023	BB-029-2.11
PHEA	02/16/2022	02/05/2023	0.90	0.90 – 5.00	02/16/2022	BB-029-2.9
PHEA	02/06/2023	03/20/2023	0.90	0.90 – 5.00	02/03/2023	BB-029-2.10
PHEA	03/21/2023	12/31/2023	0.90	0.90 – 5.00	03/21/2023	BB-029-2.11
TSS	10/03/2022	10/03/2023	2.0 or 3.0*	2.0 - 3.0	10/03/2022	NU-051-3.26
TSS	10/04/2023	12/31/2023	2.0 or 3.0*	2.0 - 3.0	10/03/2023	NU-051-3.27

*MDL for Total Suspended Solids is 3.0 mg/L when conductivity is > 15,000 µmhos/cm.

FLDEP MDLs for the chlorophyll suite of components may change by station and month based on the need to dilute samples during processing. The base MDL listed in the FLDEP SOP is based on the maximum filtration volume and minimum extract volume and will therefore be the lowest MDL. This MDL was last verified by the FLDEP laboratory 03/21/2023 (as presented in version BB-029-2.11 of the FLDEP SOP for *Spectrophotometric Determination of Corrected and Uncorrected Chlorophyll a and Phaeophytin*, available here: https://fldeploc.dep.state.fl.us/sop/sop3.asp?sect=BIOLOGY&cat=CHLOROPHYLL-BOD-SEDIMENT+GRAIN+SIZE&A1=Submit).

The sample MDL is calculated based on the number of times a sample must be diluted. For example, if a CHL_A sample must be diluted to twice its volume, the base MDL of 0.55 ug/L is multiplied by a dilution factor of two (0.55 ug/L x 2) thus resulting in an MDL of 1.10 ug/L. For samples that fall below the MDL and their MDL is greater than the base MDL, individual sample MDLs are listed in the table below. These data have been flagged and coded as -4 SBL in the dataset.

13) Laboratory methods

Chemical and biological analysis was performed by the Florida Department of Environmental Protection Laboratory. FLDEP SOP hold times are as follows:

NH4F, Ammonia	Cool, ≤6 °C, H2SO4 to pH<2	28 days
NO2F, Nitrite	Cool, ≤6 °C	48 hours
NO23F, Nitrate-Nitrite	Cool, ≤6 °C, H2SO4 to pH<2	28 days
TP, Total Phosphorous	Cool, ≤6 °C, H2SO4 to pH<2	28 days
TKN, Total Kjeldahl Nitrogen	Cool, ≤6 °C, H2SO4 to pH<2	28 days
TON, Total Organic Nitrogen	Cool, ≤6 °C, H2SO4 to pH<2	28 days
PO4F, Orthophosphate	Cool, to ≤6 °C	Filter w/in 15 minutes; Analyze w/in 48 hours
TSS, Total Suspended Solids	Cool, to ≤6 °C	7 days

*Note that FDEP lab hold times INCLUDE time spent in transport and held at the laboratory.

a) Parameter: PO4F

FDEP SOP: PO4_NU_070-1.21, PO4_NU-070-1.22
Reference Method: EPA 365.1 Revision 2.0
Method Reference: U.S. Environmental Protection Agency (EPA), 1993. Determination of Phosphorus by Semi-Automated Colorimetry, EPA Method 365.1 Revision 2.0. Cincinnati, OH and Bran+Lubbe method G-146-95 Rev. 3.
Method Description: Ammonium molybdate and antimony potassium tartrate react in an acid medium with dilute solutions of phosphorus to form an antimony-phosphomolybdate complex. This complex is reduced to an intensely blue-colored complex by ascorbic acid. The color is proportional to the phosphorus concentration and is measured with a rapid flow autoanalyzer.
Preservation Method: Samples are filtered through 0.7 µm glass microfiber filters and 0.45 µm membrane filters in the field, stored in ice and shipped. Samples stored in the laboratory at 4 ºC and are analyzed within 28 days of collection.

b) Parameter: TP

FDEP SOP: TP_NU-082-1.15, TP_NU-082-1.16
Reference Method: EPA 365.1 Revision 2.0

Method Reference U.S. Environmental Protection Agency (EPA), 1993. Determination of Phosphorus by Semi-Automated Colorimetry, EPA Method 365.1 Revision 2.0. Cincinnati, OH.
Method Description: Ammonium molybdate and antimony potassium tartrate react in an acidmedium with dilute solutions of phosphorus to form an antimony-phosphomolybdate complex. All the phosphorus present in the sample regardless of forms is measured by the persulfate digestion procedure.
Preservation Method: Samples were preserved with H_2SO_4 to a pH ≤ 2, stored on ice and shipped. Samples stored in the laboratory at 4 ºC and are analyzed within 28 days of collection.

c) Parameter: NH4F

There was a change in instrumentation used to analyze ammonia. Prior to 02/15/2021 an OI Analytical Gas Diffusion Segmented Flow Analyzer was used. That instrument was phased out and the newer Seal Bran+Luebbe AA3 Gas Diffusion Segmented Flow Analyzer is now being used. The method remains unchanged.

FDEP SOP: NH4_NU-104-1.2, NH4_NU-104-1.3
Reference Method: EPA 350.1 Revision. 2.0 (no distillation)
Method Reference: U.S. Environmental Protection Agency (EPA), 1993, Determination of Ammonia Nitrogen by Semi-Automated Colorimetry, EPA Method 350.1 Revision 2.0. Cincinnati, OH and OI Analytical Method 327152 utilizing gas diffusion.
Method Description: Alkaline phenol and hypochlorite react with ammonia to form indophenol blue that is proportional to the ammonia concentration. The blue color formed is intensified with sodium nitroprusside. The color's absorbance is directly proportional to analyte concentration and is measured with a rapid flow autoanalyzer.
Preservation Method: Samples are filtered through 0.7 µm glass microfiber filters and 0.45 µm membrane filters in the field and preserved with H2SO4 to a pH ≤ 2, stored in ice and shipped. Samples are analyzed within 28 days of collection.

NOTE: This method measures total ammonia, NH3 is considered negligible.

d) Parameter: NO2F

FDEP SOP: Nitrite NO2_NU-087-1.14
Reference Method: EPA 353.2 Revision 2.0
Method Reference: This method is based upon EPA method 353.2, Rev. 2.0 (1993) and Seal Analytical AQ2 method EPA-137-A Rev.1.
Method Description: The diazonium compound, formed by diazotation of sulfanilamide by nitrite in water under acid conditions, is coupled with N-(1-naphthyl)-ethylenediamine dihydrochloride (NED) to produce a reddish-purple azo dye, which is measured colorimetrically at a wavelength of 520 nm.
Preservation Method: Samples are filtered through 0.7 µm glass microfiber filters and 0.45 µm membrane filters in the field and preserved with H2SO4 to a pH ≤ 2, stored in ice, shipped, and analyzed within 48 hours.

e) Parameter: NO23F

FDEP SOP: Nitrate_Nitrite_NU-066-1.24
Reference Method: EPA 353.2 Revision 2.0
Method Reference: U.S. Environmental Protection Agency (EPA), 1993. Nitrogen, Nitrate-Nitrite (Colorimetric, Automated, Cadmium Reduction), EPA Method 353.2 Revision 2.0. Cincinnati, OH and Seal Analytical AQ2 method EPA-137-A Rev. 1.
Method Description: A filtered sample is passed through a column containing granulated copper-cadmium to reduce nitrate to nitrite. The nitrite (that was originally present plus reduced nitrate) is determined by diazotizing with sulfanilamide and coupling with N-(1-naphthyl)-ethylenediamine

dihydrochloride to form a highly colored azo dye, which is measured colorimetrically with a rapid flow autoanalyzer.
Preservation Method: Samples are filtered through 0.7 μm glass microfiber filters and 0.45 μm membrane filters in the field and preserved with H2SO4 to a pH ≤ 2, stored in ice and shipped. Samples are analyzed within 28 days of collection.

f) Parameter: TKN

FDEP SOP: TKN_NU-092-1.12
Reference Method: EPA 351.2 Revision 2.0
Method Reference: U.S. Environmental Protection Agency (EPA), 1993. Determination of Total Kjeldahl nitrogen by Semi-Automated Colorimetry, EPA Method 351.2 Revision 2.0. Cincinnati, OH and AQ2 method No: EPA-111-A Rev.4.
Method Description: The sample is heated in the presence of sulfuric acid, H2SO4 for two- and one-half hours. The residue is cooled, diluted to 25 mL and analyzed for ammonia. This digested sample may also be used for phosphorus determination. Total Kjeldahl nitrogen is the sum of free-ammonia and organic nitrogen compounds which are converted to ammonium sulfate (NH4)2SO4, under the conditions of digestion described. Organic Kjeldahl nitrogen is the difference obtained by subtracting the free ammonia value from the total Kjeldahl nitrogen value. Reduced volume versions of this method that use the same reagents and molar ratios are acceptable provided they meet the quality control and performance requirements stated in the method.
Preservation Method: Samples were preserved with H_2SO_4 and stored at 4 ºC until analysis.

g) Parameter: TSS

FDEP SOP: TSS_NU-051-3.24, TSS_NU-051-3.25, TSS_NU-051-3.26
Reference Method: Standard Methods 2540 D-97
Method Description: A well-mixed sample is filtered through a pre-weighed glass fiber filter. The filter and any residue are then dried to a constant weight at 103-105 ºC. The filter is cooled in a desiccator, weighed and the result used to compute the TSS of the sample.
Preservation Method: Samples are collected as whole water samples, stored in ice and shipped. Samples are stored at 4°C in the laboratory and filtration is performed within 48 hours of collection.

h) Parameter: CHLA and PHEA

FDEP SOP: Spectrophotometric CHLA and PHEA BB-029-2.8, Spectrophotometric CHLA and PHEA BB-029-2.9
Reference Method: SM 10200 H and EPA 446.0 Revision 1.2
Method Reference APHA (American Public Health Association), 2001. Standard Methods for the Examination of Water and Wastewater, (SM 10200H). 20th Edition, Baltimore, Maryland: United Book Press, Inc. and U.S. Environmental Protection Agency (EPA), 1993. In Vitro Determination of Chlorophylls a, b, c1+c2 and Pheopigments in Marine and Freshwater Algae by Visible Spectrophotometry, EPA Method 446.0 Revision 1.2. Cincinnati, OH.
Method Description: An extractive spectrophotometric technique was used to determine chlorophyll *a* concentration. Samples were filtered immediately at the laboratory. Filters were placed in a tissue grinder with 2-3 ml of 90% aqueous acetone. Extracts steeped for at least 2 hours at 4 °C in the dark. Extracts were analyzed using a UV/VIS Spectrophotometer.
Preservation Method: Samples are collected as whole water samples in a dark sampling bottle and stored at 4 ºC and filtered at the lab upon arrival.

14) Field and Laboratory QAQC programs

The FDEP laboratory has an established quality control program for monitoring the performance of test methods. The laboratory QA/QC procedures for the State of Florida Department of Environmental

Protection Bureau of Laboratories FDOH Certification Number E31780 are as prescribed in the Quality Manual (https://floridadep.gov/dear/florida-dep-laboratory/content/dep-laboratory-quality-assurance-manual-and-sops) and test SOPs.

a) Precision

i. **Field variability** - In the field each month, two successive grab samples are collected at each site. Replicate (N=2) samples are collected using a pole sampler lowered to the approximate depth of the data sonde probes in closed position and then opened to draw water from the specified depth. One field blank is included in each monthly collection.

ii. **Laboratory variability** - Method blanks and duplicate samples are run with every sample batch. A batch of samples consists of 20 or fewer samples (with the exception of microbiology) that are prepared and/or analyzed in a single run. Microbiology samples are batched by day, so that all samples received and processed on a given day are in the same prep and analysis batch. Saline matrices are batched separately where the test is impacted by high conductivity samples.

Replicate analyses are used to evaluate precision (with the exception of microbiology). Precision is expressed by the relative percent difference (RPD) to compare duplicate samples/spikes A and B and is based on the formula:

$$RPD\ (\%) = |A-B|/(A+B) \times 200$$

Precision may be determined from duplicate authentic samples, from duplicate Laboratory Control Samples (LCS), or from matrix spike duplicates. Where RPDs are calculated based on matrix spike duplicates, A and B represent the raw results of the spiked sample (spike plus the background). Microbiology precision is evaluated according to Standard Methods 9020, in which the precision criteria (calculated by multiplying the mean range of the last fifteen points by 3.27) is compared to the log value range between duplicates.

iii. **Inter-organizational splits** – None

b) Accuracy

i. **Sample spikes** – Sample spikes are performed with each sample batch. The acceptance limits for sample or spike duplicates is a RPD of less than 20% if both results are above the PQL. Laboratory fortified blanks are run with each sample batch, acceptance limits for recovery are 85-115%.

ii. **Standard Reference Material Analysis** – Check standards are included in each batch and at the beginning and end of each run. Check standard acceptance limits for recovery are 85-115%.

iii. **Cross Calibration Exercises** – FDEP laboratory Chemistry and Microbiology sections participated in two rounds of performance testing (PT) in 2022. The first round was in the spring and the second in the fall. The studies are performed by many labs around the nation to and are required to maintain the lab's TNI certification. Additionally, the laboratory participated in two voluntary PT studies administered by United States Geological Survey (USGS) for Trace Metals and Nutrients in the spring and fall.

15) QAQC flag definitions

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

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

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

16) QAQC code definitions

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

General errors

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

Sensor errors

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

Parameter Comments

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

Record comments

CAB	Algal bloom

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

Cloud cover

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

Precipitation

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

Tide stage

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

Wave height

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

Wind direction

N from the north
NNE from the north northeast
NE from the northeast
ENE from the east northeast
E from the east
ESE from the east southeast
SE from the southeast
SSE from the south southeast
S from the south
SSW from the south southwest
SW from the southwest
WSW from the west southwest
W from the west
WNW from the west northwest
NW from the northwest
NNW from the north northwest

Wind speed

WS0 0 to 1 knot

WS1 > 1 to 10 knots
WS2 > 10 to 20 knots
WS3 > 20 to 30 knots
WS4 > 30 to 40 knots
WS5 > 40 knots

17) Other remarks/notes

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

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

Sample hold times for 2023: Samples are held at 4°C by the FDEP Laboratory. NERRS SOP allows nutrient samples to be held for up to 24 hours at 4°C or 28 days at 4°C with acidification, plus up to 5 days for collecting, processing, and shipping samples. Samples held beyond that time period are flagged suspect and coded CHB. The dates recorded in the table below are the longest hold date that the FLDEP Laboratory analyzed each parameter.

Sample Date	Program Type	Date Analyzed				
		PO4F	NH4	NO2	NO23	CHLA_N
01/10/2023 - 01/11/2023	Diel	01/12/2023	01/12/2023	01/12/2023	01/24/2023	01/19/2023
01/18/2023	Grab	01/19/2023	01/19/2023	01/19/2023	01/31/2023	01/23/2023
02/07/2023 - 02/08/2023	Diel	02/09/2023	02/09/2023	02/09/2023	02/17/2023	02/14/2023
02/14/2023	Grab	02/15/2023	02/15/2023	02/15/2023	02/22/2023	02/17/2023
03/08/2023	Grab	03/09/2023	03/09/2023	03/09/2023	03/16/2023	03/13/2023
03/21/2023 - 03/22/2023	Diel	03/23/2023	03/23/2023	03/23/2023	03/31/2023	03/29/2023
04/13/2023	Grab	04/14/2023	04/14/2023	04/14/2023	04/21/2023	04/25/2023
04/18/2023 - 04/19/2023	Diel	04/20/2023	04/20/2023	04/20/2023	05/02/2023	05/01/2023
05/09/2023	Grab	05/10/2023	05/10/2023	05/10/2023	05/22/2023	05/22/2023
05/16/2023 - 05/17/2023	Diel	05/18/2023	05/18/2023	05/18/2023	05/24/2023	05/31/2023
06/13/2023 - 06/14/2023	Diel	06/15/2023	06/15/2023	06/15/2023	06/26/2023	06/20/2023
06/20/2023	Grab	06/21/2023	06/21/2023	06/21/2023	06/28/2023	06/27/2023
07/11/2023	Grab	07/12/2023	07/12/2023	07/12/2023	07/17/2023	07/14/2023
07/18/2023 - 07/19/2023	Diel	07/20/2023	07/20/2023	07/20/2023	07/25/2023	07/26/2023
08/08/2023	Grab	08/09/2023	08/09/2023	08/09/2023	08/25/2023	08/10/2023
08/15/2023 - 08/16/2023	Diel	08/17/2023	08/17/2023	08/17/2023	08/29/2023	08/21/2023
09/12/2023 - 09/13/2023	Diel	09/14/2023	09/14/2023	09/14/2023	10/02/2023	09/18/2023
09/19/2023	Grab	09/20/2023	09/20/2023	09/20/2023	10/02/2023	09/26/2023
10/10/2023 - 10/11/2023	Diel	10/12/2023	10/12/2023	10/12/2023	10/23/2023	10/25/2023
10/17/2023	Grab	10/18/2023	10/18/2023	10/18/2023	10/23/2023	10/27/2023
11/08/2023	Grab	11/09/2023	11/09/2023	11/09/2023	11/27/2023	11/20/2023
12/06/2023	Grab	12/07/2023	12/07/2023	12/07/2023	12/11/2023	12/13/2023

Monthly QAQC Code explanations:

The November and December diel sampling events were not collected due to re-construction of the dock that the ISCO was located. Compliance logs were submitted and approved by the Oversite Committee.

January
All Ammonia grab samples were flagged suspect due to an elevated reading for the equipment blank sample.

The Chlorophyll *a* (CHLA) and Phaeophytin (PHEA) diel sample for rkblhnut taken at 01/10/2023 17:00 were J- qualified, "Estimated value and/or the analysis did not meet established quality control criteria."

February
All Ammonia grab samples were flagged suspect due to an elevated reading for the equipment blank sample.

The Total Suspended Solids (TSS) grab sample for rkblhnut taken on 02/14/2023 08:07 was A-qualified, "Value reported is the mean of two or more determinations."

March
All Ammonia grab samples were flagged suspect due to an elevated reading for the equipment blank sample.

The Chlorophyll *a* (CHLA) grab sample for rkbpbnut taken at 03/08/2023 12:52 was A-qualified, "Value reported is the mean of two or more determinations."

Diel samples on 03/22/2023 06:30 and 09:00 the chemistry analysis was not performed due to an equipment failure with the ISCO sampler producing a low sample volume.

Diel samples on 03/22/2023 09:00 the Chlorophyll *a* (CHLA) and Phaeophytin (PHEA) analysis were not performed due to an equipment failure with the ISCO sampler producing a low sample volume.

April
All Ammonia grab samples were flagged suspect due to an elevated reading for the equipment blank sample.

For the diel sample on 04/19/2023 02:30 the NH4 and NO23 analysis was not performed due to an equipment failure with the ISCO sampler producing a low sample volume.

May
All Ammonia grab samples were flagged suspect due to an elevated reading for the equipment blank sample.

For the diel sample on 05/17/2023 06:30 the chemistry analysis was not performed due to an equipment failure with the ISCO sampler producing a low sample volume.

June
Diel samples from 06/13/2023 09:00 to 06/14/2023 05:00 the Ammonia (NH4) MDL was elevated because of sample matrix interference.

The Chlorophyll *a* (CHLA) diel sample for rkblhnut taken at 06/13/2023 04:00 was A-qualified, "Value reported is the mean of two or more determinations."

The Chlorophyll *a* (CHLA) and Pheophytin diel samples for rkblhnut taken on 6/13/2023 at 06:30, 09:00 and 11:30 were J- qualified, "Estimated value and/or the analysis did not meet established quality control criteria."

The Total Suspended Solids (TSS) grab sample for rkblhnut taken on 06/20/2023 09:22 was A-qualified, "Value reported is the mean of two or more determinations."

July
All Ammonia grab samples were flagged suspect due to an elevated reading for the equipment blank sample.

The Chlorophyll *a* (CHLA) diel sample for rkblhnut taken at 07/18/2023 08:00 was A-qualified, "Value reported is the mean of two or more determinations."

August
All Ammonia grab samples were flagged suspect due to an elevated reading for the equipment blank sample.

September
All Ammonia grab samples were flagged suspect due to an elevated reading for the equipment blank sample.

For the 09/12/2023 13:30 diel sample, the PO4 sample was Q-qualified, "sample held beyond normal holding time" by the lab due to the "sample expired upon receipt", but the sample was within the CDMO's hold time criteria.

For the diel sample collection from 09/12/2023 16:00 through 07:00 samples were not collected due to an equipment malfunction.

October
All Ammonia grab samples were flagged suspect due to an elevated reading for the equipment blank sample.

The sample for rkbfbnut 10/17/2023 08:42 the results for Chlorophyll *a* (CHLA) and Phaeophytin (PHEA) were elevated due to a very turbid sample and only 0.5 mL was filtered (instead of 200-500 mL), leading to the very high MDL. Data was rejected.

The Nitrite (NO2) diel sample for rkbfunut taken at 10/17/2023 09:13 and rkbmbwq 10/17/2023 10:13 were J- qualified, "Estimated value and/or the analysis did not meet established quality control criteria."

The Chlorophyll *a* (CHLA) diel sample for rkblhnut taken at 10/17/2023 12:22 was A-qualified, "Value reported is the mean of two or more determinations."

November
All Ammonia grab samples were flagged suspect due to an elevated reading for the equipment blank sample.

The Total Suspended Solids (TSS) grab sample for rkblhnut taken on 11/08/2023 08:06 was A-qualified, "Value reported is the mean of two or more determinations."

December
All Ammonia grab samples were flagged suspect due to an elevated reading for the equipment blank sample.

The 12/06/2023 10:44 grab sample for rkbfbnut was O-qualified for Chlorophyll *a* (CHLA) and Phaeophytin (PHEA), "Sampled, but analysis lost or not performed.", by the lab due to the "During sample extraction the tissue grinder tube broke and sample was lost prior to analysis."

2022 - 2023 weather conditions based on SFWMD Big Cypress Basin (BCB) Hydrologic Reports:

December 2022: The month of December for the Big Cypress Basin continued with warm and dry conditions apart from the last week which ushered in a strong cold front. The cold front was the result of an arctic blast which brought in near freezing conditions to the Basin which triggered the unusual weather warning of "falling iguanas." Even with a rainfall deficit for December, the 2022 cumulative rainfall for the Basin was above average at 63.9 inches which is 113% above average. The basin-wide

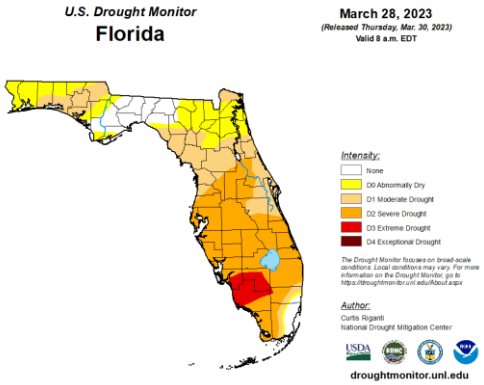
December monthly average was 1.7 inches which is 94% of normal, which is below the average 1.8 inches typically collected.

January and February: A pattern of drier-than-normal weather persisted over the Basin during the months of January and February. A rare three yearlong La Nina event, which has been partially responsible for the drier climatological conditions for the past 3 winters, ended in early March and neutral conditions are expected to remain in place through early summer. Long range precipitation outlooks have transitioned from drier than normal to equal chances of above, normal, or below normal rainfall. Long range temperature outlooks remain consistently above average for Florida.
A majority of Collier County is now designated with severe drought conditions.

January: The basin-wide January monthly average was 0.5 inches (25% of normal), which is below the average 2.1 inches typically collected.

February: The basin-wide February monthly average was 0.09 inches (5% of normal), which is below the average 1.68 inches typically collected.

March: In March, the Basin experienced unusually dry weather conditions with below-average precipitation levels. The total rainfall for the month was only 26% of the historical average, measuring 0.45 inches. Additionally, certain regions within the Basin have gone without significant rainfall for over three months, further exacerbating the drier conditions. According to the current Florida drought maps the Basin is in a severe drought, with some areas of the basin experiencing an extreme drought (below). The Florida Forest Service also reports an extremely elevated KBDI for Collier County indicating extremely dry conditions at the surface.



April: April's rainfall in the Basin was significant, totaling 3.8 inches or 160% of the normal amount for that month. However, this precipitation was not enough to overcome the drier climatological conditions which were partially contributed by a rare three yearlong La Nina event. Based on the National Weather Service's (NWS) Climate Prediction Center, conditions in the equatorial Pacific Ocean began a shift to average sea-surface temperatures signaling the end of a La Nina pattern. NWS is also forecasting a 90% chance of an El Nino event towards the end of 2023 which typically result in a less active hurricane season and a wetter-than-normal winter.

May: In May the Big Cypress Basin (Basin) received 4.2 inches of rain slightly surpassing the normal monthly average of 4.1 inches. Despite the above average rainfall for the month, canal levels in the upper and middle reaches of the Basin remained in water conservation mode. District meteorologists declared the official onset of the wet season on May 14th, which is approximately two weeks earlier than usual.

June: With only 66% of the average rainfall, June marked an unusually dry month, ranking as the 7th driest based on the Basin's period of record from 1990. Hurricane season officially commenced on June 1st and two named storms, Bret and Cindy, developed early in the season. Although they had no impact

on the District, the development of storms this early in the season was attributed, in part, to the record high sea surface temperatures. The warmer sea surface temperatures in the Atlantic are more typical of conditions seen in August. Given the record-breaking warm temperatures in the Atlantic, experts have revised their forecast for the 2023 hurricane season and are now anticipating an above-average season. Drought conditions in May improved from moderate drought to predominantly normal or non-drought conditions. However, with the lack of significant rainfall in June conditions along the coastal areas regressed from non-drought conditions to abnormally dry according to the National Integrated Drought Information System (NIDIS).

July: July continued the drier than average rainfall for trend for the Basin. As a result of the mostly southwest steering winds and Saharan dust, July's rainfall is the lowest recorded since at least 1990 when the Basin's period of record began. The Basin's annual rainfall deficit has now increased to almost 12 inches, which is approximately one month of wet season rainfall. The Basin receives 80% of its annual rainfall from wet season and if the below average rainfall trend continues until the end of wet season, surface water levels would continue to be well below desired levels as dry season begins. On July 26th, the North Atlantic reached a record breaking 76.8 degrees Fahrenheit and is expected to continue with the record-breaking trend into August. There is a concern with the increase in sea surface temperatures that there will be a higher potential for more high-category hurricanes. July also witnessed the formation of Hurricane Don in the Atlantic, the first hurricane of the 2023 season, but did not pose a threat to the Basin. Hurricane season is most active from mid-August through mid-October. The Colorado State University Hurricane forecast was updated July 4th to an above average season with 18 named storms and 9 hurricanes. Forecasts were previously for a near normal season due to influence of El Nino but the record-breaking ocean temperatures have influenced the updated forecast. Based on the National Weather Service's 30-day forecast, there is an equal chance of normal precipitation. The temperature outlook for the next 30 days indicates a 50-60% likelihood of above average temperatures. The 3-month projection for the Basin predicts an equal chance of normal precipitation and a 50-60% likelihood of above-average temperatures. Long term dry season outlooks indicate above average rainfall chances for Florida from November through April 2024.

July rainfall was the lowest on record for the Basin. The basin-wide monthly average was 4.33 inches (48% of normal), which is well below the average 8.90 inches typically collected. Based on collected gauge and radar data, the rainfall distribution across the Basin was fairly uniform except for an isolated area in the Fakahatchee basin which had local rainfall of around 13 inches. The Fakahatchee basin received the highest rainfall with a 9.98 inch areal average across the watershed and the lowest was the Coastal basin with about 3.99 inches. The Basin's total areal weighted average rainfall was 6.7 inches.

August: August received 6.4 inches of rainfall, which marks it as the third lowest on record since 1990, when the Basin 's period of record began. With the end of wet season approaching, the Basin is approximately at a 14.2-inch rainfall deficit based on the annual average. As of mid- September, 2023 is trending below 2007, the driest year on record for the Basin. The Basin receives almost 80% of its annual rainfall during wet season and any significant deficit could have negative impacts to canal levels heading into dry season. With a month and a half remaining of wet season, and hurricane season reaching its peak in the Atlantic, there's still opportunity for significant rainfall events replenishing the rainfall deficit heading into dry season. As a result of the below -normal rainfall for August, coastal areas of the Basin have been placed in moderate drought to abnormally dry conditions, according to the U.S. Drought Monitor. Based on the most recent drought map, 11% of the Basin is under moderate drought conditions and 17% are abnormally dry conditions.

On Tuesday August 29th, Hurricane Idalia passed offshore of the Basin approximately 150 miles and made landfall August 30th as a category 3 hurricane at Florida's Big Bend area. Although Idalia tracked North and did not directly hit the Basin, the area still felt the effects of storm surge and tropical storm force winds. A King tide was also in effect, which further exacerbated storm surge conditions as Hurricane Idalia passed by the Basin. During peak high tide, tailwater levels at coastal structure COCO1 measured 4.8 feet (NGVD), which is approximately 2 feet higher than normal. Coastal areas downstream

of our coastal structures experienced some localized flooding in yards and roadways due to the elevated tidal conditions. The average 3-day rainfall from Hurricane Idalia was recorded at the Basin's rain gauges, totaling 1.2 inches and did not have any significant impact on canal levels. Long term dry season outlooks indicate above average rainfall chances for Florida from November through April 2024.

August rainfall was the 3rd lowest on record for the Basin. The basin-wide monthly average was **6.4 inches (67% of normal)**, which is well below the average **9.6 inches** typically collected. The Basin's total areal weighted average rainfall was **8.05 inches**.

September: September continued the trend with drier -than-normal conditions for the Big Cypress Basin (Basin). The last half of September brought much needed rainfall to the Basin, however, it was not enough to overcome the Basin's annual rainfall deficit. This year continues to follow a similar pattern to 2007, which holds the record as the driest year in the Basin's period of record (1990). As of October, the Basin is 16- inches below the typical annual average for rainfall. Drought conditions for the Basin were mostly unchanged from the previous month. Based on the latest report from the U.S. Drought Monitor, abnormally dry conditions increased slightly from last month and moderate drought conditions decreased for areas along the Basin's coast. The basin-wide monthly average was 7.5 inches (81% of normal), which is well below the average 9.3 inches typically collected. Based on collected gauge and radar data, the rainfall distribution across the Basin was not very uniform and ranged from almost 3 inches to an extreme of almost 13 inches. The Basin's total areal weighted average rainfall was 8.12 inches.

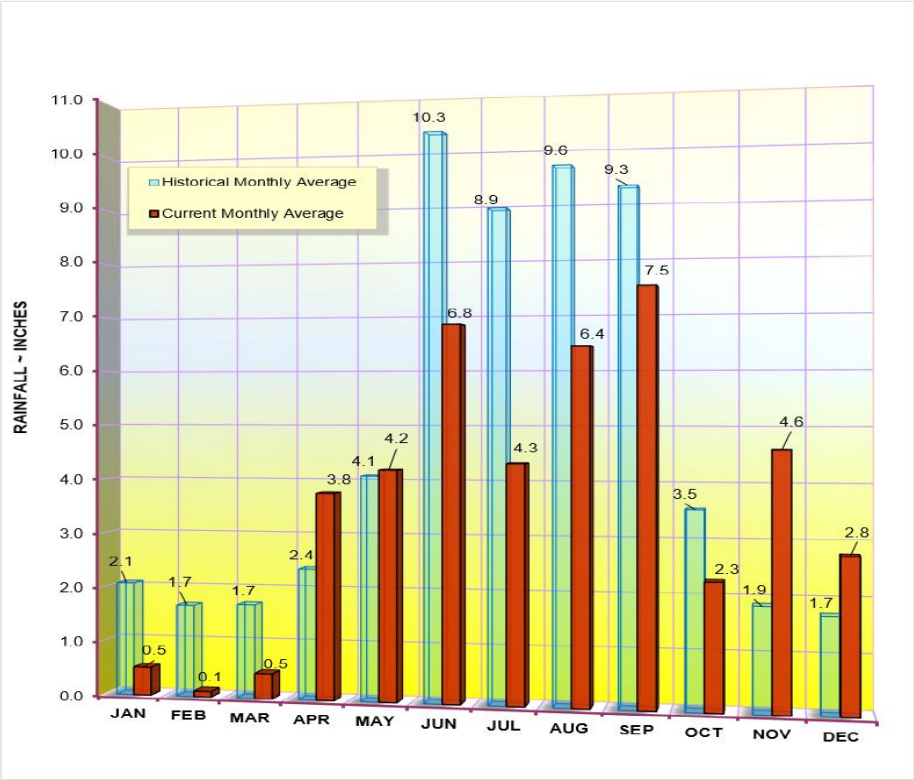
October: October continued the multi-month trend of drier-than-normal conditions for the Big Cypress Basin (Basin). All portions of the Basin had below average rainfall for the month, with several places recording less than 1.5 inches of rain for the month. The annual rainfall so far in 2023 is now lower than the driest year in the BCB period of record. If the below average rainfall trend continues, 2023 may become driest in BCB records. As measured by twenty-four (24) reporting stations, the basin-wide monthly average was 2.3 inches (64% of normal), which is well below the average 3.6 inches typically collected.

November: The first half of November continued the trend of drier than normal conditions. Water levels in the Basin were declining roughly two months earlier than normal and trending with the driest year on record. However, on November 13th, the Basin experienced a significant rainfall event, with amounts ranging from 4.5 to 5 inches (equivalent to a 5-year 12-hour storm event) and local maxima reaching 7.5 inches. This 12-hour November rainfall event marked the second-highest daily rainfall during November in the recorded history of the Basin, and the monthly total was 242% above normal. Despite the near record-breaking amount of rainfall for November, the Basin was still 14 inches below the typical annual average for rainfall. The much-needed rainfall, however, led to a notable increase in water levels bringing the system to much above normal. As measured by twenty-four (24) reporting stations, the basin-wide monthly average was 4.6 inches (242% of normal), which is well above the average 1.9 inches typically collected.

November 30th marked the end to the 2023 Hurricane season, during which we experienced a total of 20 named storms. Among them, 7 developed into hurricanes, with 3 intensifying into major hurricanes. This year ranks 4th for the most named storms since 1950, exceeding the annual average of 14. Fortunately, only one storm, Idalia, came close to posing a threat to the Basin.

December: The first half of December continued the trend of a typical winter dry season, followed in the second half by the effects of an El Niño winter with 65% more rainfall on average than the previous December. By definition, during El Niño, trade winds weaken, causing warm water to push back east thus the Pacific jet stream moves south of its neutral position. With this shift, areas in the northern U.S. and Canada are dryer and warmer than usual. But in the U.S. Gulf Coast and Southeast, these periods are wetter than usual. Yet, despite 43.3" of rainfall, 2023 is one of the lowest annual totals in the period of records, leaving the Basin 14 inches below the typical annual average of 57.2". The basin-wide monthly

average was **2.78 inches (161% of normal)**, well above the long-term monthly average **1.73 inches** typically collected.



Acknowledgement: The data included with this document were collected by the staff of the Florida Department of Environmental Protection at the Rookery Bay National Estuarine Research Reserve with funding through NOAA's Estuarine Research Division. Any products derived from these data should clearly acknowledge this source (please use the attached logos). This recognition is important for ensuring that this long-term monitoring program continues to receive the necessary political and financial support.