**Estero Bay Aquatic Preserve (EBAP) Water Quality Metadata**

**January 1, 2020-June 30, 2020**

**Latest Update:** July 16, 2020

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 Aquatic Preserve office ([Stephanie.Erickson@floridadep.gov](mailto:Stephanie.Erickson@floridadep.gov)) with any additional questions.

**I. Data Set and Research Descriptors**

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**2) Entry verification –**

Deployment data are uploaded from the YSI data sonde to a Personal Computer (IBM compatible). Files are exported from EcoWatch in a comma separated file (CSV) or KOR Software in an Excel File (.XLS). Prior to October 2018, data were organized into files by site, year, and month. All pre- and post-deployment data are removed from the files at this time. Monthly files are then prepared, processed, and reviewed following the procedures in the Centralized Data Management Office’s (CDMO) National Estuarine Research Reserves (NERR) System-wide Monitoring Program (SWMP) Data Management Manual Version 6.6 (February 2015). The monthly files are opened in Microsoft Excel, formatted to match the CDMO template, and processed using the NERRQAQC macro. Since October 2018, data files from each deployment have been uploaded to the NERRS Centralized Data Management Office (CDMO) Non-SWMP Data Upload Service where data undergo automated primary QAQC. All pre- and post-deployment data are removed from the file prior to upload. During primary QAQC, data are flagged if they are missing or out of sensor range. The edited file is then returned to the Aquatic Preserve office for secondary QAQC where it is opened in Microsoft Excel and processed using the CDMO’s NERRQAQC Excel macro. The macro inserts station codes, creates metadata worksheets for flagged data and summary statistics, and graphs the data for review. It allows the user to apply QAQC flags and codes to the data, remove any overlapping deployment data, append files, and export the resulting data file for upload to the Aquatic Preserve database. Upload after secondary QAQC results in ingestion into the Aquatic Preserve database as provisional plus data, and finally tertiary QAQC by the Office of Resilience and Coastal Protection’s (RCP) Data Coordinator and assimilation into the Aquatic Preserve database as authenticated data. Where deployment overlap occurs between files, the data produced by the newly calibrated sonde is generally accepted as being the most accurate. For more information on QAQC flags and codes, see Sections 11 and 12. Data management at Estero Bay Aquatic Preserve is currently performed by Rebecca Cray and tertiary review by RCP is conducted by Kathryn Petrinec.

**3) Research objectives –**

In 2004, the Florida Department of Environmental Protection’s (FDEP) Office of Coastal and Aquatic Managed Areas (CAMA), now RCP, began a pilot program using extended deployed water quality monitoring devices, or datasondes, across several of its field offices. After the Estero Bay Aquatic Preserve (EBAP) office was selected, three datasonde monitoring sites were set up within the bay. There were several factors considered when selecting the monitoring sites including salinity gradients, water depth, freshwater inputs, tidal circulation patterns and the location of navigational markers. Additionally, to correlate existing data collection efforts and refrain from duplicating data, locations of other water quality studies were also taken into consideration.

The datasondes, located in a long, shallow estuary, are affected by saltwater inclusion from several Gulf of Mexico inlets and freshwater input from five tributaries. The passes are, from north to south: Hurricane Pass, Matanzas Pass, Big Carlos Pass, New Pass, Big Hickory Pass, and Wiggins Pass in Collier County. The tributaries are, from north to south: Hendry Creek, Mullock Creek, Estero River, Spring Creek, and the Imperial River. The watershed for Estero Bay spans 359.6 square miles and encompasses both the Southern Coastal Plain and Southern Florida Coastal Plain ecoregions, which comprise areas that are typical of low, flat, southern Florida lands dominated by wetlands and characterized by slow, sheet-flow drainage patterns. Natural communities include mangrove-dominated islands along the coast with salt marsh habitats occurring landward of the mangrove zone, pine flatwoods, cypress swamps, and cabbage palm hammocks. The communities within the bay include seagrass beds, mangrove islands, salt marshes, tidal flats, and oyster bars. In the past, the naturally dispersed water patterns distributed nutrients over broad areas of wetland vegetation and seasonal fluctuations in flow from rainfall created the necessary salinity regime in Estero Bay for good estuarine productivity. However, increased development in the area since the 1960’s has led to changes in the natural river systems around Estero Bay, altering freshwater inflow patterns. The watershed activities that potentially impact the bay include point-source wastewater discharge and non-point source runoff or leaching of pollution from roads, agriculture lands, urban areas, and un-vegetated lands which contain fertilizers, pesticides, herbicides, metals, sediments, petroleum compounds, and bacteria.

The datasonde data provides information on the overall health of Estero Bay on a continuous basis. Specifically, the data from these stations provide a baseline of water quality measurements for identifying, monitoring, and comparing differences in the parameters over time. The data also aid in the interpretation of changes observed in indicator organisms, bay communities, and for making comparisons to other geographical areas. The data may also assist with the understanding of effects from anthropogenic changes within the bay. The principle goal of the program is to attain baseline data on the overall water quality of Estero Bay for the purpose of preventing further degradation.

**4) Research methods –**

Beginning July 14, 2004 two water quality stations, EB01 (Tom Winter) in the north end of Estero Bay and EB02 (Spring Creek) in the central portion of the bay, were designated as permanent Continuous Water Quality Monitoring Program sites for Estero Bay Aquatic Preserve. A third water quality station, EB03 (Fish Trap Bay), was added on November 23, 2004 at the southern end of the preserve. The dataset from these three monitoring stations has been essentially uninterrupted since the first day of deployment.

Until July 2017, all sondes deployed had been YSI 6600 Extended Deployment System (EDS) with three that are the V2-2 model. Beginning on July 5, 2017, YSI EXO2 sondes were deployed at EB01. Beginning on March 29, 2018, YSI EXO3 sondes were deployed at EB02. YSI 6600 EDS sondes continue to be used at EB03. Prior to deployment, the sondes are calibrated for pH, specific conductivity, turbidity, dissolved oxygen, and depth following the procedures outlined in the YSI Operating and Service Manual. Prior to the December 2011 deployment, the depth was calibrated using a barometric pressure value of 760 mmHg for each calibration, actual atmospheric pressure was not calculated. For the December 6, 2011 deployment a NIST certified barometer was used to obtain the actual atmospheric pressure and determine the depth offset value. Prior to the June 29, 2010 deployment, rapid pulse dissolved oxygen sensors were used; from that deployment onward, all YSI 6600 sondes were equipped with optical dissolved oxygen sensors with mechanical cleaning.

A two-point calibration is used for pH (YSI buffers 7 & 10) and turbidity (0 NTU deionized water & 126 NTU YSI, Inc.). A 50 mS/cm solution (YSI conductivity calibrator) is used to calibrate specific conductivity. Beginning March 24, 2020, initial calibration verifications were conducted for each of the following parameters: specific conductivity, pH, and turbidity. For specific conductivity, calibration is verified using a 10 mS/cm solution. For pH, calibration is verified in pH 10 buffer. For turbidity, calibration is verified in the 124 FNU standard. Dissolved oxygen (DO) is calibrated in oxygen saturated water, using a bucket and an aerator. Prior to June 29, 2010, rapid pulse dissolved oxygen sensors were calibrated using water saturated air, using a small amount of water in a vented calibration cup. The percent saturation value is determined by using the current barometric pressure to convert to the adjusted value and entered into EcoWatch. ROX optical DO probes are deployed at all three sites. The depth is also calibrated by using the current barometric pressure to determine the depth offset value and entered into EcoWatch.

All sondes are deployed within 4-inch diameter PVC pipes, which are attached to either a private residential dock (EB01) or “aid-to-navigation” pilings (EB02 and EB03). The pipes are oriented vertically and attached with stainless steel rods molded to wrap around the piling and bolted to galvanized hangers. Up to three hangers are used depending on the height of the pipe. A stainless steel bolt is also installed at the end of the pipes to keep the sonde from falling through. The submerged end of the PVC has two rows of rectangular holes whose short ends are rounded (pill/stadium shaped). There are 4 holes per row measuring vertically approximately 8 inches tall and horizontally 2 inches wide. Sondes are secured by rope to an eyebolt in the top of the PVC caps. An additional hole is drilled through the top of the pipes and caps in order to insert a bolt and lock for security. The bottoms of the pipes are open and positioned such that the sensors are 0.5 meters above the bottom.

The sondes are further protected from crabs and other live organisms by attempting to restrict the openings on the sonde guard with plastic mesh screening. The plastic mesh (with 1/8 inch diamond-shaped holes) is attached to the outside of the sondes guard’s circumference using low- profile zip ties. In 2015, increased antifouling efforts were applied to guards in the form of copper tape on the exterior of the plastic guards plus copper alloy woven mesh (McNichols Co., 4 mesh, 0.047’’ woven square weave, 66% open area). This same copper mesh is applied to the exterior of the copper antifouling sonde guards on EXO sondes as well.

Sondes are deployed, generally, for two weeks to one month at a time. The sampling period is set for 15-minute intervals (readings are made every 15 minutes). The following physical water quality parameters are recorded: temperature (degrees Celsius), specific conductivity (mS/cm), salinity (parts per thousand), dissolved oxygen (mg/L and % saturation), depth (m), pH and turbidity (NTU). To test how well the sondes hold calibration, field measurements are performed using a handheld YSI instrument (YSI 85 2004-Feb. 2008, YSI556 Feb. 2008-July 2015, YSI ProDSS July 2015-present) which serves as a “spot check” at the time of deployment and retrieval. The parameters recorded are temperature, specific conductivity, conductivity, salinity, dissolved oxygen (mg/L and % saturation), and depth. Additionally, a post-deployment calibration verification is conducted in the lab. The parameters include temperature, pH (7.0 and 10.0), turbidity (0 NTU and beginning with the 4/16/2019 deployment 124 NTU for EXOs and 126 NTU for 6600s), specific conductivity (50 mS/cm), DO%, depth, and battery volts.

**5) Site location and character –**

**EB01 (Tom Winter):**

Lat/Long (Decimal Degrees): 26.434944 -81.911389

The EB01 datasonde is located on the bay side of Estero Island in Matanzas Pass, across from Julies Island, and is the most northern of the three site locations. The Tom Winter labeling is to clarify the sonde location which is affixed to a residential dock (parcel 28-46-24- W3-0020B.0390) approximately 300 meters across the channel from Julie’s Island. The monitoring site is approximately 5.0 km (linear dimension) from Matanzas Pass Bridge to the northwest and 4.4 km from Big Carlos Pass to the southeast. The closest tributary is the Y- junction of the mouths of Hendry Creek and Mullock Creek, approximately 5.1 km northeast of the sonde location. Matanzas Pass is roughly 8.9 km long and has a mid-channel depth of approximately 1.0 to 3.6 meters at MHW. At the sampling site, the depth is 2.05 meters at MHW and the width of the water body is 335 meters. Tides at EB01 are mixed semidiurnal and range from 0.85 m to 1.39 m according to the NOAA Tides and Currents website; Estero Island, Estero Bay, FL Datum, Station ID 8725351, 1983-2001 Epoch. Salinities range from 2.2 ppt to 34.4 ppt and fluctuate daily with tides, wind, rainfall, and freshwater discharge (USGS Scientific Investigations Report 2007-5217, Estero Bay near Horseshoe Keys data, 10/1/2004 – 09/30/2005). The channel substrate is predominantly fine sand and there is no bottom vegetation. Generally, Estero Island’s shoreline, on the bay side, is sea walled and will not have any vegetation. The closest vegetation are red and black mangrove islands across the channel. The land to the north of the site contains a significant amount of protected state-owned preserve area known as Estero Bay Preserve State Park.

# EB02 (Spring Creek):

Lat/Long (Decimal Degrees): 26.385917 -81.846333

The EB02 site is located northwest of the mouth of Spring Creek and south of Coconut Point. The sonde is affixed to navigational marker 9A within the Spring Creek access channel. The average depth at this site is approximately 1.70 meters at MHW. Tides at EB02 are mixed semidiurnal and range from 0.74 m to 1.27 m according to the NOAA Tides and Currents website; Coconut Point, Estero Bay, FL Datum, Station ID 8725319, 1983-2001 Epoch. Salinities range from 8.2 ppt to 35.9 ppt and fluctuate daily with tides, wind, rainfall, and freshwater discharge (USGS Scientific Investigations Report 2007-5217, Big Carlos Pass data, 10/5/2004 – 09/30/2005). The substrate within the channel is a mixture of sand and silt with no bottom vegetation. However, there is seagrass found in the vicinity. Mature red and black mangrove forests dominate the nearby banks of the bay and several mangrove islands are nearby. The mouth of Spring Creek is approximately 4.4 km downstream from where a six-lane highway (SR 41) crosses over the tributary.

# EB03 (Fish Trap Bay):

Lat/Long (Decimal Degrees): 26.354972 -81.844528

The EB03 site is located east of Broadway Channel and north of Intrepid Waters at the southern end of EBAP. The sonde is affixed to a piling (manatee caution sign) in the center of Big Hickory Bay. The mouth of the Imperial River is approximately 2.1 km to the south of the sonde’s location and is the closest tributary. The average depth at MHW is approximately 1.40 meters. Tides are mixed semidiurnal and range from 0.62m to 0.81m (NOAA Tides and Currents website; Fish trap Bay, Estero Bay, FL Datum, Station ID 8725272, 1983-2001 Epoch). Salinities range from 1.6 ppt to 33.6 ppt and fluctuate daily with tides, wind, rainfall, and freshwater discharge (USGS Scientific Investigations Report 2007-5217, Fishtrap Bay data, 10/1/2004 – 09/30/2005). The substrate within the channel is a mixture of sand and silt with no bottom vegetation. Mature red and black mangrove forests dominate the nearby banks of the preserve. The dominant natural vegetation of the watershed is hydric pine, scrubby flatwoods, and cypress. The mouth of Imperial River is approximately 2.1 km downstream from a six-lane highway (SR 41) and approximately 7.6 km from I-75, both of which cross over the tributary.

**Aquatic Preserve Station Timeline:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Station Code** | **Station Name** | **Location** | **Active Dates** | **Reason Decommissioned** | **Notes** |
| EB01 | Tom Winter | 26.434944, -81.911389 | 07/14/2004-current | NA | NA |
| EB02 | Spring Creek | 26.385917, -81.846333 | 07/14/2004-current | NA | NA |
| EB03 | Fish Trap | 26.354972, -81.844528 | 11/30/2004-current | NA | NA |

**6) Data collection period –**

**EB01:**

|  |  |  |  |
| --- | --- | --- | --- |
| **#** | **Deployment** | **First Reading** | **Last Reading** |
| 1 | 01121919 | 12/19/2019 12:15 | 1/16/2020 11:30 |
| 2 | 01011620 | 1/16/2020 12:00 | 2/4/2020 10:00 |
| 3 | 01020420 | 2/4/2020 10:45 | 3/4/2020 13:15 |
| 4 | 01030420 | 3/4/2020 13:45 | 3/25/2020 8:30 |
| 5 | 01032520 | 3/25/2020 9:00 | 4/22/2020 8:45 |
| 6 | 01042220 | 4/22/2020 9:15 | 5/19/2020 8:15 |
| 7 | 01051920 | 5/19/2020 8:45 | 6/17/2020 11:45 |
| 8 | 01061720 | 6/17/2020 12:15 | 7/9/2020 10:45 |
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**EB02**

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| --- | --- | --- | --- |
| **#** | **Deployment** | **First Reading** | **Last Reading** |
| 1 | 02121919 | 12/19/2019 11:14 | 1/16/2020 10:30 |
|  |  | Extended Deployment |  |
| 2 | 02011620 | 1/16/2020 11:15 | 3/4/2020 11:45 |
|  |  | Extended Deployment |  |
| 3 | 02030420 | 3/4/2020 12:30 | 4/22/2020 10:00 |
| 4 | 02042220 | 4/22/2020 10:30 | 5/19/2020 10:15 |
| 5 | 02051920 | 5/19/2020 10:45 | 6/17/2020 8:30 |
| 6 | 02061720 | 6/17/2020 9:00 | 7/9/2020 9:15 |
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**EB03**

|  |  |  |  |
| --- | --- | --- | --- |
| **#** | **Deployment** | **First Reading** | **Last Reading** |
| 1 | 03121919 | 12/19/19 10:15 | 1/16/2020 10:00 |
| 2 | 03011620 | 1/16/2020 10:15 | 2/4/2020 11:00 |
| 3 | 03020420 | 2/4/2020 11:45 | 3/4/2020 11:00 |
| 4 | 03030420 | 3/4/2020 11:45 | 3/25/2020 9:45 |
| 5 | 03032520 | 3/25/2020 10:00 | 4/22/2020 11:15 |
| 6 | 03042220 | 4/22/2020 11:45 | 5/19/2020 9:30 |
| 7 | 03051920 | 5/19/2020 10:00 | 6/17/2020 9:15 |
| 8 | 03061720 | 6/17/2020 9:45 | 7/9/2020 8:30 |
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**7) Distribution –**

Considerable effort has been made to ensure the accuracy of the information provided and meet quality assurance guidelines used by the Florida’s Department of Environmental Protection Estero Bay Aquatic Preserve program. Please note that the included data are estimates of actual conditions subject to improvements in accuracy and precision of field methods over time as well as infrequencies in sampling duration, rendering data in some instances, to be unsuitable for temporal or spatial comparisons. As a result, the user is responsible for interpretations based on supplied data.

Neither the State of Florida nor the Florida Department of Environmental Protection makes any warranty, expressed or implied, including the warranties of merchantability and fitness for a particular purpose arising out of the use or inability to use the data, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights.

The Principle Investigators (PI) retains the right to be fully credited for having collected and process the data.  Following academic courtesy standards, the Aquatic Preserve 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.

Aquatic Preserve water quality data and metadata can be obtained from the Principal Investigators and Contact Persons (see section 1) and online at the Aquatic Preserves data portal home page [www.floridaapdata.org](http://www.floridaapdata.org). Data are available in comma delimited format.

**8) Associated researchers and projects** (link to other products or programs) **–**

In addition to this water quality dataset, Estero Bay Aquatic Preserve conducts epibenthic monitoring of five seagrass sites. Starting in 2002, five fixed stations located throughout the aquatic preserve are monitored twice a year, once in the dormant season and once in the growing season, using Braun-Blanquet techniques. Beginning in 2016, macroalgae has been collected at each of these transects during seagrass surveys. These samples are analyzed to determine species present and biomass of each species. Abundance scores are also applied to algae as part of the seagrass monitoring. Two of these seagrass sites are located within close proximity of the EB02 and EB03 sonde locations.

Since 1998, volunteers with the Charlotte Harbor Estuaries Volunteer Water Quality Monitoring Network (CHEVWQMN) have collected water quality data once a month at up to 7 sites within Estero Bay (or 46 sites within the greater Charlotte Harbor region). This program is currently coordinated through the Charlotte Harbor Aquatic Preserves office in Punta Gorda, FL.

In 2008, EBAP began monitoring the nesting effort of wading and diving birds which use mangrove islands within the bay as rookeries.

In 2018, EBAP established a protocol for annual mapping and assessment of eight oyster bars around Estero Bay to establish a baseline for oyster health within the bay and track its trends through time. In addition, during the Fall of 2018, sampling to collect death assemblage specimens from three oyster bars was completed to examine the age and changes in historical body size.

Beginning in February 2012, red tide samples for Florida Fish and Wildlife Conservation Commission’s (FWC) Fish and Wildlife Research Institute (FWRI) have been collected by Estero Bay Aquatic Preserve staff during datasonde retrieval, by the CHEVWQMN volunteers, and/or more often as requested by FWRI.

Lee County and FDEP’s Division of Environmental Assessment and Restoration collect water quality samples within Estero Bay and the watershed.

**II. Physical Structure Descriptors**

**9) Sensor specifications –**

EBAP deploys YSI 6600 EDS and YSI 6600 – V2 (2) EDS as well as YSI EXO2 and YSI EXO3 datasondes. YSI EXO2 sondes were deployed at EB01 throughout 2018. YSI 6600 series sondes were deployed at EB02 until March 29, 2018 after which YSI EXO3 datasondes were used. YSI 6600 series sondes were deployed at EB03 throughout 2018.

Sensor specifications for YSI 6600 datasondes are as follows:

Parameter: Temperature

Units: Celsius (C)

Sensor Type: Thermistor

Model#: 6560

Range: -5 to 50 C

Accuracy: +/- 0.15

Resolution: 0.01 C

Parameter: Conductivity

Units: milli-Siemens per cm (mS/cm)

Sensor Type: 4-electrode cell with autoranging

Model#: 6560

Range: 0 to 100 mS/cm

Accuracy: +/- 0.5% of reading + 0.001 mS/cm

Resolution: 0.001 mS/cm to 0.1 mS/cm (range dependant)

Parameter: Salinity

Units: parts per thousand (ppt)

Sensor Type: Calculated from conductivity and temperature

Range: 0 to 70 ppt

Accuracy: +/- 1.0% of reading pr 0.1 ppt, whichever is greater

Resolution: 0.01 ppt

Sensor Type: Optical probe w/ mechanical cleaning

Model#: 6150 ROX

Range: 0 to 500% air saturation

Accuracy: 0-200% air saturation: +/- 1% of the reading or 1% air saturation, whichever is greater 200-500% air saturation: +/- 15% or reading

Resolution: 0.1% air saturation

Parameter: Dissolved Oxygen mg/L (Calculated from % air saturation, temperature, and salinity)

Units: milligrams/Liter (mg/L)

Sensor Type: Optical probe w/ mechanical cleaning

Model#: 6150 ROX

Range: 0 to 50 mg/L

Accuracy: 0-20 mg/L: +/-0.1 mg/l or 1% of the reading, whichever is greater

20 to 50 mg/L: +/- 15% of the reading

Resolution: 0.01 mg/L

Parameter: Non-vented Level - Shallow (Depth)

Units: feet or meters (ft or m)

Sensor Type: Stainless steel strain gauge

Range: 0 to 30 ft (9.1 m)

Accuracy: +/- 0.06 ft (0.018 m)

Resolution: 0.001 ft (0.001 m)

Parameter: pH – bulb probe or EDS flat glass probe

Units: pH units

Sensor Type: Glass combination electrode

Model#: 6561 or 6561FG

Range: 0 to 14 units

Accuracy: +/- 0.2 units

Resolution: 0.01 units

Parameter: Turbidity

Units: nephelometric turbidity units (NTU)

Sensor Type: Optical, 90 degree scatter, with mechanical cleaning

Model#: 6136

Range: 0 to 1000 NTU

Accuracy: +/- 2% of reading or 0.3 NTU (whichever is greater)

Resolution: 0.1 NTU

Sensor specifications for EXO2 and EXO3 datasondes are as follows:

Parameter: Temperature

Units: Celsius (C)

Sensor Type: Wiped probe; Thermistor

Model#: 599827

Range: -5 to 50 C

Accuracy: ±0.2 C

Resolution: 0.001 C

Parameter: Conductivity

Units: milli-Siemens per cm (mS/cm)

Sensor Type: Wiped probe; 4-electrode cell with autoranging

Model#: 599827

Range: 0 to 100 mS/cm

Accuracy: ±1% of the reading or 0.002 mS/cm, whichever is greater

Resolution: 0.0001 to 0.01 mS/cm (range dependent)

Parameter: Salinity

Units: practical salinity units (psu)/parts per thousand (ppt)

Model#: 599827

Sensor Type: Wiped probe; Calculated from conductivity and temperature

Range: 0 to 70 ppt

Accuracy: ±2% of the reading or 0.2 ppt, whichever is greater

Resolution: 0.01 psu

Parameter: Dissolved Oxygen % saturation

Sensor Type: Optical probe w/ mechanical cleaning

Model#: 599100-01

Range: 0 to 500% air saturation

Accuracy: 0-200% air saturation: +/- 1% of the reading or 1% air saturation, whichever is greater 200-500% air saturation: +/- 5% or reading

Resolution: 0.1% air saturation

Parameter: Dissolved Oxygen mg/L (Calculated from % air saturation, temperature, and salinity)

Units: milligrams/Liter (mg/L)

Sensor Type: Optical probe w/ mechanical cleaning

Model#: 599100-01

Range: 0 to 50 mg/L

Accuracy: 0-20 mg/L: +/-0.1 mg/l or 1% of the reading, whichever is greater

20 to 50 mg/L: +/- 5% of the reading

Resolution: 0.01 mg/L

Parameter: Non-vented Level - Shallow (Depth)

Units: feet or meters (ft or m)

Sensor Type: Stainless steel strain gauge

Range: 0 to 33 ft (10 m)

Accuracy: +/- 0.013 ft (0.004 m)

Resolution: 0.001 ft (0.001 m)

Parameter: pH

Units: pH units

Sensor Type: Glass combination electrode

Model#: 599701(guarded) or 599702(wiped)

Range: 0 to 14 units

Accuracy: +/- 0.1 units within +/- 10° of calibration temperature, +/- 0.2 units for entire temperature range

Resolution: 0.01 units

Parameter: Turbidity

Units: formazin nephelometric units (FNU)

Sensor Type: Optical, 90 degree scatter

Model#: 599101-01

Range: 0 to 4000 FNU

Accuracy: 0 to 999 FNU: 0.3 FNU or +/-2% of reading (whichever is greater); 1000 to 4000 FNU +/-5% of reading

Resolution: 0 to 999 FNU: 0.01 FNU, 1000 to 4000 FNU: 0.1 FNU

**Dissolved Oxygen Qualifier (Rapid Pulse / Clark type sensor):**

The reliability of dissolved oxygen (DO) data collected with the rapid pulse / Clark type sensor after 96 hours post-deployment for non-EDS (Extended Deployment System) data sondes may be problematic due to fouling which forms on the DO probe membrane during some deployments (Wenner et al. 2001). Some Reserves utilize the YSI 6600 EDS data sondes, which increase DO accuracy and longevity by reducing the environmental effects of fouling. Optical DO probes have further improved data reliability. The user is therefore advised to consult the metadata for sensor type information and to exercise caution when utilizing rapid pulse / Clark type sensor DO data beyond the initial 96-hour time period. Potential drift is not always problematic for some uses of the data, i.e. periodicity analysis. It should also be noted that the amount of fouling is very site specific and that not all data are affected. If there are concerns about fouling impacts on DO data beyond any information documented in the metadata and/or QAQC flags/codes, please contact the Research Coordinator at the specific NERR site regarding site and seasonal variation in fouling of the DO sensor. EBAP transitioned all dissolved oxygen sensors from rapid pulse to optical type sensors during the June 30, 2010 deployment.

**Depth Qualifier:**

YSI data sondes can be equipped with either vented or non-vented depth/level sensors.  Readings for both vented and non-vented sensors are automatically compensated for water density change due to variations in temperature and salinity; but for all non-vented depth measurements, changes in atmospheric pressure between calibrations appear as changes in water depth.  The error is equal to approximately 1.02 cm for every 1 millibar change in atmospheric pressure and is eliminated for vented sensors because they are vented to the atmosphere throughout the deployment time interval.

Standard calibration protocol calls for all non-vented depth sensors to read 0 meters at a (local) barometric pressure of 1013.25 mb (760 mm/hg).  To achieve this, each site calibrates their depth sensor with a depth offset number, which is calculated using the actual atmospheric pressure at the time of calibration and the equation provided in the Aquatic Preserve calibration sheet or digital calibration log.  This offset procedure standardizes each depth calibration. If accurate atmospheric pressure data are available, non-vented sensor depth measurements can be corrected. The Principal Investigator should be contacted in order to obtain information regarding atmospheric pressure data availability. EBAP began calibrating depth with an offset with the December 6, 2011 deployment.

**Salinity Units Qualifier:**

The 6600 series sondes report salinity in parts per thousand (ppt) units, the EXO sondes report practical salinity units (psu). These units are essentially the same and for Aquatic Preserve purposes are understood to be equivalent, however psu is considered the more appropriate designation. Moving forward the Aquatic Preserve program will assign psu salinity units for all data regardless of sonde type.

**Turbidity Qualifier:**

The 6600 series sondes report turbidity in nephelometric turbidity units (NTU), the EXO sondes use formazin nephelometric units (FNU). These units are essentially the same but indicate a difference in sensor methodology, for Aquatic Preserve purposes they will be considered equivalent. Moving forward, the Aquatic Preserve program will use FNU/NTU as the designated units for all turbidity data regardless of sonde type. If turbidity units and sensor methodology are of concern, please see the Sensor Specifications portion of the metadata.

**10) Coded variable definitions –**

|  |  |  |
| --- | --- | --- |
| Sampling Station: | Sampling Site Code: | Station Code: |
| Tom Winter | EB01 | EB01 |
| Spring Creek | EB02 | EB02 |
| Fish Trap Bay | EB03 | EB03 |

**11) 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\_). During primary automated QAQC (performed by the CDMO), -5, -4, and -2 flags are applied automatically to indicate data that is missing and above or below sensor range. All remaining data are then flagged 0, passing initial QAQC checks. During secondary and tertiary QAQC 1, -3, and 5 flags may be used to note data as suspect, rejected due to QAQC, or corrected.

-5 Outside High Sensor Range

-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

2 *Open - reserved for later flag*

3 Calculated data: non-vented depth/level sensor correction for changes in barometric pressure

4 Historical Data: Pre-Auto QAQC

5 Corrected Data

**12) 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 deployment or YSI datasonde, sensor errors are sensor specific, 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, but some comment codes (marked with an \* below) can be applied to the entire record in the F\_Record column.

General Errors

GIC No instrument deployed due to ice

GIM Instrument malfunction

GIT Instrument recording error; recovered telemetry data

GMC No instrument deployed due to maintenance/calibration

GNF Deployment tube clogged / no flow

GOW Out of water event

GPF Power failure / low battery

GQR Data rejected due to QA/QC checks

GSM See metadata

Corrected Depth/Level Data Codes

GCC Calculated with data that were corrected during QA/QC

GCM Calculated value could not be determined due to missing data

GCR Calculated value could not be determined due to rejected data

GCS Calculated value suspect due to questionable data

GCU Calculated value could not be determined due to unavailable data

Sensor Errors

SBO Blocked optic

SCF Conductivity sensor failure

SCS Chlorophyll spike

SDF Depth port frozen

SDG Suspect due to sensor diagnostics

SDO DO suspect

SDP DO membrane puncture

SIC Incorrect calibration / contaminated standard

SNV Negative value

SOW Sensor out of water

SPC Post calibration out of range

SQR Data rejected due to QAQC checks

SSD Sensor drift

SSM Sensor malfunction

SSR Sensor removed / not deployed

STF Catastrophic temperature sensor failure

STS Turbidity spike

SWM Wiper malfunction / loss

Comments

CAB\* Algal bloom

CAF Acceptable calibration/accuracy error of sensor

CAP Depth sensor in water, affected by atmospheric pressure

CBF Biofouling

CCU Cause unknown

CDA\* DO hypoxia (<3 mg/L)

CDB\* Disturbed bottom

CDF Data appear to fit conditions

CFK\* Fish kill

CIP \* Surface ice present at sample station

CLT\* Low tide

CMC\* In field maintenance/cleaning

CMD\* Mud in probe guard

CND New deployment begins

CRE\* Significant rain event

CSM\* See metadata

CTS Turbidity spike

CVT\* Possible vandalism/tampering

CWD\* Data collected at wrong depth

CWE\* Significant weather event

**13) Post deployment information** –

**EB01**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Deployment** | **SpCond** | **pH 7** | **pH 10** | **mV slope** | **Turb (0)** | **Turb (124)** | **Depth (cal val)** | **DO% (cal val)** |
| 01121919 | 50.0195 | 7.15 | 10.17 | 177.3 | 0.31 | 124.08 | 0.058 (0.027) | 100.0 (100.3) |
| 01011620 | 49.7475 | 7.14 | 10.13 | 178.5 | -0.08 | 113.73 | -0.009 (-0.027) | 100.3 (99.7) |
| 01020420 | 49.9291 | 7.09 | 10.09 | 179.0 | 0.06 | 124.41 | -0.067 (-0.136) | 99.2 (98.7) |
| 01030420 | 50.2973 | 7.09 | 10.10 | 180.2 | 0.75 | 125.33 | -0.140 (-0.177) | 98.5 (98.3) |
| 01032520 | 50.0994 | 7.13 | 10.04 | 180.9 | 0.42 | 124.30 | -0.178 (0.000) | 98.6 (100.0) |
| 01042220 | 50.0174 | 7.10 | 10.09 | 180.2 | 0.44 | 121.80 | -0.059 (-0.041) | 98.8 (99.6) |
| 01051920 | 50.2414 | 7.07 | 10.06 | 179.9 | 0.15 | 122.56 | 0.026 (0.014) | 99.6 (100.2) |
| 01061720 | 50.2317 | 7.11 | 10.10 | 180.0 | 1.28 | 127.19 | -0.010 (-0.027) | 99.9 (99.8) |

**EB02**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Deployment** | **SpCond** | **pH 7** | **pH 10** | **mV slope** | **Turb (0)** | **Turb (124)** | **Depth (cal val)** | **DO% (cal val)** |
| 02121919 | 50.2504 | 7.15 | 10.11 | 177.20 | 0.14 | 124.49 | 0.031 (0.027) | 100.9 (100.3) |
|  |  |  |  |  |  |  |  |  |
| 02011620 | 49.7681 | 7.02 | 10.02 | 178.80 | 0.82 | 126.90 | -0.034 (-0.136) | 99.5 (98.7) |
|  |  |  |  |  |  |  |  |  |
| 02030420 | 50.1857 | 7.22 | 10.2 | 178.6 | 0.34 | 124.08 | -0.137 (0.000) | 99.3 (100.0) |
| 02042220 | 50.1237 | 6.99 | 9.99 | 175.90 | 0.42 | 123.75 | -0.027 (-0.054) | 99.3 (99.5) |
| 02051920 | 50.0207 | 7.19 | 10.15 | 176.00 | 0.19 | 123.67 | 0.013 (0.014) | 100.1 (100.2) |
| 02061720 | 50.1778 | 7.31 | 10.31 | 177.90 | 0.67 | 123.99 | -0.029 (-0.027) | 99.7 (99.8) |

**EB03**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Deployment** | **SpCond** | **pH 7** | **pH 10** | **mV slope** | **Turb (0)** | **Turb (124)** | **Depth (cal val)** | **DO% (cal val)** |
| 03121919 | 50.19 | 7.06 | 10.04 | 172.00 | 0.80 | 126.30 | 0.029 (0.027) | 100.1 (100.3) |
| 03011620 | 49.89 | 6.93 | 9.95 | 169.90 | 0.30 | 126.20 | -0.022 (-0.027) | 100.7 (99.7) |
| 03020420 | 49.20 | 7.06 | 10.04 | 171.90 | -1.90 | 126.60 | -0.090 (-0.136) | 99.5 (98.7) |
| 03030420 | 49.88 | 7.03 | 10.01 | 169.50 | 1.60 | 129.00 | -0.129 (-0.177) | 98.3 (98.3) |
| 03032520 | 50.36 | 7.02 | 10.01 | 172.10 | 0.10 | 126.30 | -0.194 (0.000) | 99.4 (100.0) |
| 03042220 | 49.86 | 7.01 | 9.99 | 169.50 | -0.70 | 125.40 | -0.053 (-0.054) | 98.5 (99.5) |
| 03051920 | 50.31 | 7.01 | 9.95 | 169.00 | 2.20 | 125.60 | 0.025 (0.014) | 99.6 (100.2) |
| 03061720 | 50.05 | 7.04 | 10.00 | 167.00 | 1.30 | 126.40 | -0.026 (-0.027) | 98.6 (99.8) |

**14) Other remarks/notes –**

Data are missing due to equipment or associated specific probes not being deployed, equipment failure, time of maintenance or calibration of equipment, or repair/replacement of a sampling station platform. Any NANs in the dataset stand for “not a number” and are the result of low power, disconnected wires, or out of range readings. If additional information on missing data is needed, contact the Aquatic Preserve office.

All data files are QAQC’d using the 2012 CDMO Excel macro. This macro automatically flags negative turbidity values between 0 and -2 NTU as Suspect <1> with the comment Acceptable Calibration/Accuracy Error of Sensor (CAF). In addition, the macro automatically flags DO values less than 3 mg/L as Passed Initial QAQC Checks <0> with the comment DO Hypoxia (<3 mg/L) (CDA). The DO flag is based on Federal standards. During the primary QAQC session, any reading that falls outside a sensor’s range (see section II. Physical Structure descriptors) is rejected (-3). For example, all turbidity readings over 1000 NTU are rejected (-3, SBO). Small negative depth readings where all other data is in line are marked suspect (1, SNV, CAP) per the CDMO manual since this is within the accuracy of the sensor. The shallow depth sensor is a non-vented probe that is susceptible to changes in barometric pressure when deployed in shallow estuaries, please refer to the depth qualifier under Section II. Additionally, negative turbidity readings between 0 and -2 have been flagged as suspect data (1, SNV, CAF) since the value is within the accuracy of the probe per the CDMO operations manual. Data from all out of water events (distinguished by both low SpCond values and low/negative depths) has all been rejected (-3, GOW, CLT)

Additionally, for Estero Bay, anomalous turbidity readings >126 NTU (the high calibration value), not within a well-defined turbidity peak (e.g., neighboring readings are not close), are marked as a suspect turbidity spike (1, STS). These readings may either be caused by optical interference by animals or fouling, or an unknown local disturbance. A description of all other flag/code combinations that appear in the dataset are noted below.

**EB01**

|  |  |  |
| --- | --- | --- |
| **Deployment** | **Other Notes** | |
| 01121919 | Tube worm growing in depth port. pH readings high on post-cal but match previous deployment-not flagged. |
| 01011620 | pH sensor mV in 7 standard on post-cal were -46.7 and readings were a bit high; therefore all pH data rejected. Turbidity did not pass post-calibration verification so all turbidity data also rejected. |
| 01020420 | No flags applied. |
| 01030420 | No flags applied. |
| 01032520 | pH and depth do not appear to pass post-deployment verification; however, the readings match very well with the previous deployment. |
| 01042220 | Depth sensor covered in colonial tunicate and sensor did not pass post-deployment verification, therefore all readings flagged suspect. All turbidity readings >1000 NTU rejected and all >126 NTU flagged suspect. |
| 01051920 | tunicates on depth sensor, but did not seem to impact depth readings during post-cal. Turbidity readings >1000 NTU flagged rejected and >126 NTU flagged suspect. Lots of crabs were in the guard when retrieved and may have been responsible for spike in turbidity. Tropical Storm Cristobal brought heavy wind and rains ~June 5-8 even though it made landfall in Louisiana. |
| 01061720 | pH a little outside of range (sensor getting old), check surrounding deployments; Turbidity readings >126 NTU flagged suspect, >1000 NTU flagged rejected. |

**EB02**

|  |  |
| --- | --- |
| **Deployment** | **Other Notes** |
| 02121919 | pH readings high but mVs great and matches up well with previous deployment so not flagged. Turbidity values >1000 NTU flagged as rejected; values >126 NTU flagged suspect. |
|  | Sonde left in water for extra long deployment because other EXO3 sonde was still at YSI for maintenance |
| 02011620 | Depth readings all considered suspect. All turbidity readings >1000 NTU rejected; all turbidity readings >126 NTU except those on 2/21 and 2/22 that are part of defined turbidity peaks flagged suspect. |
|  | Sonde left in water for extra long deployment because other EXO3 sonde was still at YSI for maintenance |
| 02030420 | All pH readings flagged suspect. The sensor did not pass post-deployment verification; however the readings align nicely with the previous deployment. The sensor likely drifted due to age and the extended deployment length. All negative depth readings flagged suspect; none seem to indicate out of water events. Turbidity readings >1000 NTU flagged as rejected. All >126 NTU, except the one on 3/7/2020, flagged suspect. That one appears to exist in a defined turbidity peak. |
| 02042220 | No additional notes. |
| 02051920 | Tunicates around depth sensor but did not seem to interfere with readings during post-cal. Tropical Storm Cristobal brought heavy wind and rains ~June 5-8 even though it made landfall in Louisiana. All turbidity readings >1000 NTU flagged rejected and >126 NTU flagged suspect. Lots of crabs in guard may have caused turbidity spikes. pH not flagged (passed DEP standards for post-cal but not YSI); sensor likely needs replacement but all readings appear within range and match well with deployments before and after.. |
| 02061720 | pH sensor readings too high and mV far out of range (-51.0 mV in 7 buffer), all pH readings for deployment rejected. Turbidity readings >126 NTU flagged suspect, >1000 NTU flagged rejected. |

**EB03**

|  |  |
| --- | --- |
| **Deployment** | **Other Notes** |
| 03121919 | Several out of water events, some flagged rejected when parameters other than SpC and Sal affected, others flagged suspect when SpC and Sal drop low because it could be a freshwater lens or water below sensor. All negative depth values flagged suspect. All turbidity >1000 NTU rejected. Turbidity values of 144 on 01/13 and 149 on 01/14 suspect since outside distinct peak but already suspect due to possible out of water. |
| 03011620 | Several out of water events, some flagged rejected when parameters other than SpC and Sal affected, others flagged suspect when SpC and Sal drop low because it could be a freshwater lens or water below sensor. All negative depth values flagged suspect. |
| 03020420 | All negative turbidity readings occurred during out of water events and calibration verification passed in 126 so remaining readings not flagged. Several out of water events flagged rejected and suspect. Rejected if multiple parameters clearly affected and suspect when salinity very low and slight change in one or more other parameters but not enough to be sure it isn't caused by a freshwater lens as tide ebbs. All negative depth values flagged suspect if not part of out of water event. |
| 03030420 | Turbidity reading 11.2 before cleaning fouling off wiper; may be some drift due to biofouling. Not flagged (yet)--will look at next deployment's data to evaluate. Some windy days toward end of deployment may explain higher turbidity readings. Several out of water events rejected, correlate with low tides. Some readings surrounding those are flagged suspect since it is possible that a freshwater wedge passed the sensors. All negative depth readings flagged suspect. |
| 03032520 | Turbidity read 1627.3 in zero standard before I cleaned the sensor face and removed the wiper. There was tunicate growing on the sensor face and a bryozoan on the wiper. The wiper was also parked at ~90 degrees so the bryozoan was over the sensor window. Drift due to biofouling should be flagged at end of deployment. Since sensor passed after cleaning, keep readings from beginning of deployment. All turbidity readings starting on 4/12/2020 were flagged as rejected. Depth readings all flagged as suspect since post-deployment verification out of range. |
| 03042220 | bungee cord on piling (not ours)-no evidence anyone messed with the instrument. Several out of water events occurring around low tides flagged as either rejected or suspect. All turbidity readings >1000 NTU rejected; all greater than 126 NTU flagged suspect. All negative depth readings flagged suspect--none seemed to correspond with out of water events. |
| 03051920 | Tunicates and bryozoans on wipers. Turbidity post-cal value with wiper still on was 432.6 NTU in zero standard. Once removed wiper, verifications were within range. Therefore end of deployment flagged starting 06/04/2020rejected due to drift from biofouling. 5/24/2020 21:15-22:30 suspected out of water event (may have just been freshwater wedge or that half the conductivity sensor was above water--hole not totally filled). Tropical Storm Cristobal brought heavy wind and rains ~June 5-8 even though it made landfall in Louisiana. All negative depths flagged suspect. All turbidity values >1000 NTU flagged rejected and >126 NTU flagged suspect. |
| 03061720 | Turbidity read 11.4 NTU in zero standard before algae was cleaned off sensor, after that it passed post-deployment calibration checks. Marked end of deployment (starting 7/1/2020 00:00) rejected due to drift from biofouling. All negative depths flagged suspect. |

**15) Acknowledgement:**

The data included with this document were collected by the staff of the Florida Department of Environmental Protection at the Estero Bay Aquatic Preserve. Any products derived from these data should clearly acknowledge this source (please use the attached logo). This recognition is important for ensuring that this long-term monitoring program continues to receive the necessary political and financial support.

