**Tampa Bay Aquatic Preserves (TBAP)
Water Quality Metadata Report**

January - March 2009
Latest Update: 01/08/2019

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 (randy.runnels@dep.state.fl.us) with any additional questions.

**I. Data Set and Research Descriptors**

1. **Principal investigator & contact persons:**

Principal Investigator:

Randy Runnels, Aquatic Preserve Manager

130 77th Street East

Terra Ceia, FL 34250

(239) 530-1011

randy.runnels@dep.state.fl.us

1. **Entry verification:**

YSI data are downloaded directly from the YSI 6600 EDS (extended deployment system) into the EcoWatch software, plotted, and initially analyzed for major anomalies and missing data. YSI raw data files are then downloaded as a comma delimited file (.cdf) and imported into Microsoft Excel as a comma-space delimited file (.csv). These raw data files are then organized into standardized monthly data sets. The monthly files are carefully edited by staff for data anomalies that are identified in the dataset and Section 14 of this document. Data are deleted or rejected when the sonde malfunctioned, probes malfunctioned, data are out of range for a particular site, or the sonde is out of the water.

Data are pre-processed in Excel using the macros to correct any time stamp errors, convert data into proper units, and make sure parameters are in the correct order. Anomalous data found during the initial QA/QC process are flagged and/or deleted in Excel.

Beginning in July 2018, data underwent a two-step (primary and secondary) Quality Assurance/Quality Control (QA/QC) procedure as outlined in the NERRS CDMO Data Management Manual Version 6.6 (<http://cdmo.baruch.sc.edu/request-manuals/>).

The primary QA/QC process was performed by the CDMO and involved inserting flag columns into the data files for each water quality parameter, creating a flag record column, and creating an automated process that applied standardized flags to data if the values were outside sensor specifications as determined by YSI, the instrument manufacturer. Yearly data files that completed the primary QA/QC process were returned to FCO staff for secondary QA/QC. Data were evaluated, and standardized flags and codes were applied to individual data points by insertion into the flag columns using the CDMO’s NERRQAQC Excel macro to provide further documentation of the data. Data files were then returned to the CDMO for ingestion into the Florida Aquatic Preserves database as provisional data. For more information on QA/QC flags and codes, see Sections 11 and 12.

1. **Research objectives:**

Water quality has long been of interest to the Tampa Bay environmental community as both an indicator and driver of ecosystem health. A big-picture perspective has resulted in substantial reductions in nutrients and other pollutants that had seriously impaired Tampa Bay several decades ago. Past pollutant sources of concern specific to Terra Ceia have included sewage and septic effluent into Terra Ceia Bay and phosphate process water discharges into Bishop Harbor. While there is a trend toward a decrease in these impacts, new threats to water quality at Terra Ceia are increasing in the form of a domestic housing development boom in the local watershed. Additionally, increased cargo traffic resulting from the expansion of Port Manatee and additional industrialization of the port area may raise new water quality issues.

As Terra Ceia moves into a crossroads where water quality may continue to improve or may become degraded by regional growth, strategically-placed permanent monitoring stations will give valuable insights into the status and trends of such parameters as water level, salinity, dissolved oxygen, pH, temperature and turbidity. For several years, the TCAP program has been experimenting with technology and partnerships aimed at developing cost effective, reliable continual monitoring stations at key locations in the preserve. A permanent station in the low salinity region of Frog Creek had been fitted with cell phone telemetry, and data from this station was available, in nearly real-time, to TCAP staff and the public. This strategy proved to be prohibitively expensive beyond the pilot project. Present emphasis has shifted to the development of low-cost radio telemetry in partnership with University of South Florida. Similar technology is planned for other stations within the program. Additional stations in other Tampa Bay preserves will be considered, but considerable expansion outside Terra Ceia is not planned at this time. TCAP is working with the appropriate entities ultimately to incorporate these stations into the Gulf Coast Ocean Observing System and to distribute information on constructing the stations through the Alliance for Coastal Technologies.

Contingent upon the success of the fixed monitoring and data telemetry stations, TCAP also may proceed to develop a buoy-based station that can be temporarily located near dredging projects and other events. By supplying nearly real-time information to TCAP staff, this station might help prevent some of the ongoing degradation.

1. **Research Methods:**

Research methods are currently unavailable.

1. **Site location and character:**

The Tampa Bay Aquatic Preserves were established in 1969 and include four aquatic preserves in Pinellas, Hillsborough and Manatee County. These four protected areas range from some of Florida’s most densely developed areas (Pinellas County and Boca Ciega Bay) to relatively undeveloped areas (Terra Ceia and Cockroach Bay) and protect 380,000 acres of lands and waters.

The Terra Ceia Aquatic Preserve is located entirely within northwestern Manatee County. The preserve encompasses several inlets of southeastern Tampa Bay, as well as much of the southeastern Tampa Bay shoreline. Situated on either side of the Sunshine Skyway, the aquatic preserve is central to the Bradenton/St. Petersburg/Tampa area. The aquatic preserve's northern boundary begins just south of the mouth of Little Redfish Creek at Port Manatee. The southern boundary lies between the mouths of Terra Ceia Bay and the Manatee River at Emerson Point on Snead Island. The boundary extends northwesterly from these points out to the Manatee-Hillsborough county line and the Intracoastal Waterway, respectively, which then crosses and forms the outermost corner of the preserve.

With the exception of the city of Palmetto and the Palmetto Point subdivision, most of the adjacent uplands are within the Terra Ceia Florida Forever project. Bishop Harbor, Clambar Bay, Williams Bayou and the Terra Ceia River are bordered by state-owned uplands. Palmetto is the only incorporated city bordering the aquatic preserve.

The aquatic preserve is composed of state-owned submerged lands totaling 24,900 acres of predominately pristine submerged and wetland areas within Tampa Bay, Terra Ceia Bay, Miguel Bay, Joe Bay, Bishop Harbor and tidal waters of all tributaries including Frog Creek/Terra Ceia River and McMullen Creek. Terra Ceia Aquatic Preserve has open water, several inlet bays, and tidally influenced creeks and rivers and contains a diverse variety of natural communities, including seagrass, mangroves, salt marsh, tidal flats, hardbottom, oyster bars and clam beds.

By virtue of its location along southeast Tampa Bay, Terra Ceia represents much of the remaining undeveloped shoreline of one of Florida's most densely populated watersheds. With increasing urbanization, it is becoming more important that residents and visitors be able to drive a short distance down I-75 or I-275 and experience Tampa Bay in its natural state. For many, visiting the Terra Ceia area is like stepping back in time to experience the natural beauty that attracted early settlers to the Tampa Bay area. Such experiences create a public appreciation for the natural functions of ecosystems that do so much to provide clean water, clean air and abundant seafood for people.

The aquatic preserve contains a considerable amount of Tampa Bay's seagrass and much of the bay's hardbottom acreage. As a temperate/subtropical climatic transition zone, the area provides a natural workshop for the study of effects of climate change and urbanization that is yielding science-derived information of gulf-wide significance. This site provides a unique opportunity to study the effects of climate change regarding genetic adaptation, diversity, interaction, dominance shifts due to parasite/disease interaction, and changes in reproduction trends.

Terra Ceia Aquatic Preserve was designated as an Outstanding Florida Water on May 22, 1986.

Download a copy of the [Terra Ceia Aquatic Preserve Management Plan](http://publicfiles.dep.state.fl.us/cama/plans/aquatic/Terra_Ceia_Aquatic_Preserve_Management_Plan_2009.pdf), approved by the Acquisition and Restoration Council on June 11, 2009. The plan was approved by the Governor and Cabinet on Aug. 11, 2009.

**Station Timeline:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Station Code** | **Station Name** | **Location** | **Active Dates** | **Reason Decommissioned** | **Notes** |
| BH | Bishop Harbor | 27.608 N 82.571 W |  | Office Closure | N/A |
| FC | Frog Creek | 27.591 N 82.552 W |  | Office Closure | N/A |

1. **Data collection period:**

Data collection period and deployment information are currently unavailable

1. **Distribution:**

The Principle Investigator (PI) retains the right to be fully credited for having collected and processed the data. Following academic courtesy standards, the PI and Aquatic Preserve (AP) site where the data were collected will be contacted and fully acknowledged in any subsequent publications in which any part of the data are used. 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. Water quality data and metadata can be obtained from the PI (see section 1).

1. **Associated researchers and projects:**

Additional research information is currently unavailable.

**II. Physical Structure Descriptors**

1. **Sensor specifications**:

### Table 2. YSI 6600 EDS data sonde

Parameter: Temperature

Units: Celsius (C)

Sensor Type: Thermistor

Model #: 6560

Range: -5 to 45 °C

Accuracy: +/-0.15 °C

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 dependent)

Parameter: Salinity

Units: parts per thousand (ppt)

Sensor Type: Calculated from conductivity and temperature

Range: 0 to 70 ppt

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

Resolution: 0.01 ppt

Parameter: Dissolved Oxygen % saturation

Units: percent air saturation (%)

Sensor Type: Rapid Pulse – Clark type, polarographic

Model #: 6562

Range: 0 to 500 % air saturation

Accuracy: 0-200 % air saturation, +/- 2 % of the reading or 2 % air saturation, whichever is greater; 200-500 % air saturation, +/- 6 % of the reading

Resolution: 0.1 % air saturation

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

Units: milligrams per Liter (mg/L)

Sensor Type: Rapid Pulse – Clark type, polarographic

Model #: 6562

Range: 0 to 50 mg/L

Accuracy: 0 to 20 mg/L, +/- 2 % of the reading or 0.2 mg/L, whichever is greater; 20 to 50 mg/L, +/- 6 % 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 (specify whether EDS probe or not)

Units: units

Sensor Type: Glass combination electrode

Model #: 6561

Range: 0 to 14 units

Accuracy: +/- 0.2 units

Resolution: 0.01 units

Parameter: Turbidity

Units: nephelometric turbidity units (NTU)

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

Model #: 6136

Range: 0 to 1000 NTU

Accuracy: +/- 5 % reading or 2 NTU (whichever is greater)

Resolution: 0.1 NTU

Dissolved Oxygen Qualifier: The reliability of the dissolved oxygen (DO) data 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). Many Aquatic Preserves have upgraded to YSI 6600 EDS data sondes, which increase DO accuracy and longevity by reducing the environmental effects of fouling. The user is therefore advised to consult the metadata and to exercise caution when utilizing the DO data beyond the initial 96-hour time period. However, this potential drift is not always problematic for some uses of the data (e.g., periodicity analysis). It should be noted that the amount of fouling is site specific and that not all data are affected. The Principal Investigator at should be contacted concerning the reliability of the DO data because of the site and seasonal variation in the fouling of the DO sensor.

Depth Qualifier: The water quality monitoring program utilizes YSI data sondes that can be equipped with either depth or water level sensors. Both sensors measure water depth, but by convention, level sensors refer to atmospherically vented measurements and depth refers to non-vented measurements. Standard calibration protocols for the non-vented sensor use the atmosphere pressure at the time of calibration. Therefore, changes in atmospheric pressure between calibrations appear as changes in water depth. The error is equal to approximately 1.03 cm for every 1millibar change in atmospheric pressure. This error is eliminated for level sensors because they are vented to the atmosphere throughout the deployment time interval. If proper atmospheric pressure data is available, non-vented sensor depth measurements can be corrected for deployments between calibrations. Readings for both vented and non-vented sensors are automatically compensated for water density changes due to variations in temperature and salinity. The Principal Investigator should be contacted in order to obtain information regarding atmospheric pressure data availability. All data sondes used at all 6600 sites in 2006 were non-vented models.

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

Turbidity Qualifier: 6600 series sondes report turbidity in nephelometric turbidity units (NTU) and the EXO sondes use formazin nephelometric units (FNU). These units are essentially the same but indicate a difference in sensor methodology, for AP water quality program purposes they will be considered equivalent. Moving forward, the AP 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.

1. **Coded variable definitions:**

**Site definitions:**

|  |  |  |
| --- | --- | --- |
| **Sampling Station:** | **Sampling Site Code:** | **Station Code:** |
| Bishop Harbor | BH | TCBH |
| Frog Creek | FC | TCFC |

1. **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

1. **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

1. **Post deployment information:**

Post deployment information is currently unavailable.

1. **Other remarks/notes:**

**Missing Data**

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 Principal Investigator.

**Rejected Data:**

 Obvious outliers, data associated with probe malfunction, and/or calibration (both pre and post) problems are rejected as specified below. For more details about rejected data, contact the Principal Investigator.

 **See Metadata “CSM” “GSM” Notes/Comments from Data Files**

**Anomalous/Suspect data:**

**Note #1:** Slight shifts in data are sometimes correlated with sonde exchanges. These shifts are most noticeable in pH, specific conductivity, salinity, DO% and DO conc, and may be related to sensor drift (e.g., due to fouling) and/or calibration/performance differences between sondes.

**Note #2:** Turbidity “outliers” (i.e., values that are negative or greater than 1000 NTU for 6600 series sondes and 4000 NTU for EXO series sondes) were not deleted from the monthly records. Readings greater than 1000 NTU for 6600 series sondes and 4000 NTU for EXO series sondes are considered out of range and are rejected. They have been left in the database to provide users with a complete dataset and to allow true visual representation of the data in graphs. Negative turbidity values occur throughout the year at all four sites. Some of these negative values are within the accuracy range of the sensor (+/- 2.0 %) and, therefore, were not removed from the dataset. They were marked suspect with the CAF code.

**Note #3**: Turbidity data is subject to single and clusters of spikes that occur in the beginning and middle of deployments. Turbidity values that fall between 500 and 1000 are not specifically indicated as suspect data, but possibly could be interpreted as suspect. Turbidity spikes may be associated with wiper malfunction but mostly the reason is unknown. Data users should exercise caution when interpreting turbidity data that fall within this range.