**Tomoka Marsh Aquatic Preserve (TMAP)**

**Water Quality Metadata**

January – March 2021

Latest Update: April 27, 2021

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 Ashley.Hurley@FloridaDEP.gov with any additional questions.

**I. Data Set and Research Descriptors**

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

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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-delimited format (.CDF), EcoWatch Lite in a comma separated file (CSV) or KOR Software in an Excel File (.XLS) and 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 FCO Data Coordinator and/or 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 Florida Coastal Office’s 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.

**3) Research objectives –**

The objective of this effort is to establish baseline data by quantifying the spatial/temporal variability and trends, both seasonally and as a function of tidal force, of selected abiotic parameters within the Aquatic Preserves; and to record changes in water quality due to major storm events such as hurricanes. The datasonde data provides information on the overall health of the Halifax river within Tomoka Marsh on a continuous basis. More specifically, the data from these stations provide water quality measurements for identifying, monitoring, and comparing differences in the parameters over time. The data may also assist with the understanding of effects from anthropogenic changes within the Aquatic Preserve for the purpose of preventing further degradation.

**4) Research methods –**

Beginning January 8, 2021 Tomoka Marsh Aquatic Preserve deployed its first ever EXO2, continuous water quality station TMGB (Tomoka March Gamble Rogers). The dataset from this station has been uninterrupted since the first day of deployment.

Prior to deployment, the sonde is calibrated for pH, specific conductivity, turbidity, dissolved oxygen, and depth following the procedures outlined in the YSI Operating and Service Manual and the National Estuarine Research Reserve System (NERRS) - System Wide Monitoring Program (SWMP) YSI/Xylem EXO Multi-Parameter Water Quality Standard Operating Procedures.

DO is calibrated using a 5-gallon bucket of water that is aerated to 100% air saturated water and temperature of the water bath is monitored using a NIST certified and traceable thermometer that gets recertified annually. DO is calibrated in conjunction with water bath temperature and the barometric pressure reading from a YSI ProPlus handheld meter. ODO gain must be within 0.87 – 1.25. pH is calibrated using a 3-point calibration (7, 10, 4) using buffer reagents from Fisher Scientific. Pre calibration readings, post calibration readings, and pHmV are recorded. pHmV and pH slope must be within the specified ranges. Conductivity calibration is a one-point calibration that is conducted using 50,000 mS/cm SpCond standard from RICCA. Cell constant must be verified and within the acceptable range. Turbidity is a two-point calibration using 0.0 and 124 FNU. The 0.0 FNU standard is Deionized (DI) water and the 124 FNU standard 6073G turbidity standard from YSI. Temperature accuracy is verified during the water bath and DO calibration with a NIST certified and traceable thermometer as well as checked against other EXO2 sondes in the same water bath.

The EXO2 sonde is deployed within a 4-inch diameter PVC pipe that is attached to an FWC owned and maintained manatee sign east of the ICW. The PVC is oriented vertically and attached with galvanized steel hangers that wrap around the piling and are bolted together. A stainless-steel bolt is also installed at the end of the PVC to keep the sonde from falling through. Holes are drilled circumferentially around submerged portion of the PVC housing to ensure adequate water flow around the probes. The sonde is secured by rope to an eyebolt in the top of the PVC cap. The PVC cap is steel and is locked with a combination lock for security. The bottom of the PVC is open and positioned 0.5 meters above the bottom.

The sonde sensors are further protected with a copper anti-fouling guard that is again wrapped in copper mesh wiring and zip tied to the cooper guard. Sensors and the sonde body are all heat shrink wrapped with a YSI specific protective material to aid in the cleaning and protection of the sensors.

Currently TMGR is being deployed 3 weeks at a time in concurrence with two other EXO2 sondes in the NE region due to limited staff and to lower expenses on calibration standards. The sampling interval is set for 15-minute readings on the quarter hour, Eastern Standard Time. 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 sonde holds calibration, field measurements are performed using a handheld YSI instrument (YSI ProPlus) which serves as a “spot check” at the time of deployment and retrieval. The YSI ProPlus parameters recorded are temperature, specific conductivity, conductivity, salinity, dissolved oxygen (mg/L and % saturation), and depth.

**5) Site location and character –**

Tomoka Marsh Aquatic Preserve (TMAP) is an estuarine system comprised of approximately 3,000 acres including more than 4.5 miles of the NE flowing Tomoka River, 10 miles of the Halifax River (ICW), 8 miles of Bulow Creek, Smith Creek (ICW), the 376-acre Tomoka basin, saltwater marshes and spoil islands. The mixing of saltwater from the Atlantic Ocean is introduced through the Matanzas inlet 28 miles to the north and the Ponce DeLeon Inlet 24 miles to the south, with freshwater from the Tomoka River, Bulow Creek and the upper Halifax River drainage basin, that which creates the estuary and sustains the saltwater marshes. TMAP’s wetlands were severely altered in the 50’s and 60’s by dragline mosquito ditching that greatly reduced the wetland area, altered the hydrology and lessened the ecosystem. Some of these wetlands have been restored as part of ongoing restoration efforts. TMAP has never had a continuous water quality station, the first EXO2 datasonde site TMGR was established and deployed 01/08/2021. The goals of this program are to establish baseline water quality; evaluate daily, seasonal and long-term trends.

 **TMGB – Tomoka Marsh Gamble Rogers**

 **Lat/Long (Decimal Degrees): 29.43636, -81.11181**

Station TMGR is located near the northern boundary of the TMAP within the southern portion of Smith Creek (ICW) just before it converges with the Halifax River (ICW). TMGR is mounted to Manatee slow zone piling visible from the Gamble Rogers boat ramp and kayak launch area and can be accessed by kayak or small boat. This area exhibits estuarine characteristics with freshwater inputs from the Halifax river drainage basin emptying through the marsh and into the tidal influenced Smith Creek. This area provides an important nursery area for fish, shrimp, and crab caught commercially and recreationally. The average depth at this site 0.9m at mid tide. The tides at TMGB are mixed semidiurnal and range from 0.356m (1.17ft) to -0.104m (-0.34ft) according to NOAA Tides and Current website; nearest station: 8720833, Smith Creek, Flagler Beach, FL.

Salinity in this area range from 18 ppt to 32 ppt and fluctuate seasonally and daily with tides, wind, rainfall, and runoff. Freshwater influences are pushed up the Halifax river north from the Tomoka river, Tomoka basin and Bulow creek by tides and winds. Northern freshwater inputs come from storm water runoff from the town of Palm Coast into Smith Creek/Halifax river watershed drainage basin and from Graham swamp in Palm Coast, FL, which is also the headwaters of Bulow Creek. Substrate in this portion of the ICW are sand, silt, and muck with some patchy oyster clumps. The east side of the ICW has some saltmarsh buffer and the west side of the ICW is mainly mangrove lined. This is a high boat traffic area and a narrow portion of the ICW. There are ongoing marsh restoration efforts in this area, as well as living shoreline stabilization projects underway.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Station Code | Station Name | Location | Active Dates | Reason Decommissioned | Notes |
| TMGR | TMGR | 29.43636 N -81.11181 W | 01/08/2021 - present | NA | NA |

**6) Data collection period –**

TMGR is the first datasonde to be deployed in TMAP, it has been continuously operating since January of 2021 in Smith creek/Halifax river.

The deployment and retrieval date/times for TMGR for the 2021 sampling season are listed below:

|  |  |
| --- | --- |
| Deployment date/time | Retrieval date/time |
| 01/08/2021, 11:45 | 01/29/2021, 10:30 |
| 01/29/2021, 10:30 | 02/19/2021, 11:00 |
| 02/19/2021, 11:00 | 03/12/2021, 09:15 |
| 03/12/2021, 09:15 | 04/07/2021, 09:15 |

**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 PI retains the right to be fully credited for having collected and processed the data. Following academic courtesy standards, the PI and Estero Bay Aquatic Preserve, 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.

Tomoka Marsh Aquatic Preserve water quality data and metadata can be obtained from the Manager at the individual Aquatic Preserve office (please see Principal Investigators and Contact Persons) 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 –**

* SJRWMD has restored approximately 100 acres of saltmarsh dragline ditches within TMAP marshes [Restoring our coastal wetlands – SJRWMD](https://www.sjrwmd.com/education/wetlands/coastal-wetlands-restoration/)
* SJRWMD has conducted water sampling, oyster monitoring, fkye net sampling and bird surveys pre and post restoration of Flagler restoration site.
* Volusia county conducts its own water quality sampling along the Halifax river.
* North Peninsular State park is doing a marsh restoration project along the Halifax river [Salt Marsh Restoration | Florida State Parks](https://www.floridastateparks.org/learn/salt-marsh-restoration)
* FWC, UF, Tomoka State park, and Gamble Rogers state park have completed and are monitoring multiple living shoreline projects.

**II. Physical Structure Descriptors**

**9) Sensor specifications –**

YSI EXO Sonde:

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

**10) Coded variable definitions –**

|  |  |  |
| --- | --- | --- |
| Sampling Station | Sampling Site Code | Station Code |
| Tomoka Marsh Gamble Rogers | TMGR | TMGRWQ |

**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** –

[Instructions/Remove: This section details the secondary QAQC Code definitions used in combination with the flags above. Include the following excerpt:]

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** –

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Deployment Date | Temp (°C) | SpCond (mS/cm) | DO % | pH | Turbidity (NTU) | Depth (m) |
| Std. | N/A | 50.00 | 100 | 7.00 | 0.00 | N/A |
| 01/08/2021 | 17.29 | 50.190 | 102.1 | 7.07 | 0.39 | 0.151 |
| 01/29/2021 | 20.91 | 46.410 | 100.4 | 7.02 | 0.17 | 0.043 |
| 02/19/2021 | 19.05 | 50.006 | 101.4 | 6.95 | 0.13 | 0.153 |
| 03/12/2021 | 19.71 | 49.566 | 101.2 | 7.06 | 0.04 | 0.062 |

**14) 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) were flagged from the monthly records. Readings greater than 1000 NTU for 6600 series sondes are considered out of range and are rejected. They have been left in the monthly tab database to provide users with a complete dataset and to allow true visual representation of the data in graphs.

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 or with organisms such as crabs blocking the sensor. Data users should exercise caution when interpreting turbidity data that fall within this range.

Acknowledgement: The data included with this document were collected by the staff of the Florida Department of Environmental Protection. Any products derived from these data should clearly acknowledge this source (please use the attached logos below). This recognition is important for ensuring that these long-term monitoring programs continue to receive the necessary political and financial support.

