

Quality Manual
for
State of Florida Department of Environmental Protection (DEP)
Office of Resilience and Coastal Protection
Aquatic Preserve Continuous Water Quality Monitoring Program

3900 Commonwealth Boulevard

Tallahassee, Florida 32399

Prepared by

Samantha Howe
Kathryn Petrinec
Cheryl P. Clark

April 1, 2021

Effective: April 2021



Alex Reed, Director

April 6, 2021



Michael Shirley, Deputy Director

April 6, 2021

Table of Contents

1.	Scope of Work	4
2.	Statement of Policy.....	4
3.	Ethics Statement.....	5
4.	Organization and Responsibilities	5
	Responsibilities of Key Personnel.....	6
	Approved Signatories.....	8
	Employee Training	8
5.	Documentation.....	9
	Generation, Retention and Storage of Records	9
	Documentation Control and Maintenance	10
	Documentation/Reports Generated.....	10
	Supporting Documentation/Reports	11
6.	Data Identification and Data Integrity	11
	Nomenclature	11
	Data integrity	12
7.	Confidentiality	12
8.	Capabilities.....	12
	Sampling capabilities	12
	Sampling procedures	12
	Collection frequency.....	12
9.	Equipment and Instruments.....	12
	Data Collection Equipment and Software.....	13
	Calibration and Standards.....	13
	Equipment Maintenance and Documentation.....	14
10.	Review and Assessment.....	15
	Quality Control Measures	15
	Field Quality Control	15
	Lab Quality Control	15
	Quality Control Criteria	15
11.	Data Review.....	18
	Primary QAQC	18
	Raw Data Entry	18

Raw Data Validation	18
Limited Data Entry	18
Limited Data Validation.....	18
Secondary QAQC	19
QC Flags.....	19
QC Codes.....	20
Database Management.....	22
Tertiary QAQC	22
Corrective Actions.....	22
Database Management.....	23
12. Consumer Relations	23
13. Appendix	24
Manuals	24
Datasonde Maintenance.....	24
Data Management.....	24
Continuous Water Quality Training Tutorials and Materials	24
AP Continuous Water Quality Technician Training Workshop (TTW)	24
SWMP Technician Training Workshop (TTW)	24
Associated documentation	24
14. Summary of Quality Plan Revisions	25

List of Figures

Figure 1: Organizational Chart	8
--------------------------------------	---

List of Tables

Table 1: Aquatic Preserve Active Stations	5
Table 2: Calibration Verification Standards	16
Table 3: Sensor Specifications for YSI Datasondes.....	17

1. Scope of Work

The Office of Resilience and Coastal Protection's (RCP) Continuous Water Quality Monitoring Program began in 1995 and was expanded to the Aquatic Preserve (AP) sites in late 2003. Water quality stations were established to answer specific questions within the managed areas. Calibration and post-deployment readings were performed in accordance with methods outlined by either YSI's Operating and Service Manual, the NERR SWMP YSI EXO or 6-Series Multi-Parameter Water Quality Monitoring Procedure SOP, and/or the Florida Department of Environmental Protection's (FDEP) Division of Environmental Assessment and Restoration (DEAR) Specific Field-Testing Procedures FT 1100 through FT 3000. In 2018, under the Project of Special Merit (PSM), RCP coordinated with the Centralized Data Management Office (CDMO) and the AP offices to assess the historical and current AP water quality monitoring data in order to evaluate the quality of data, identify needs, and provide insight and recommendations about potential causes of data loss and how to improve data collections. All previously collected AP data files were reformatted to align with SWMP in order to provide a statewide standard for data comparison. By adopting the National Estuarine Research Reserves (NERR) System-Wide Monitoring Program's (SWMP) monitoring protocols and database management techniques, the existing near-continuous (15-minute) AP water quality data seamlessly combines with the NERR water quality data and enables the AP continuous WQ monitoring program to integrate their data into important national and regional initiatives as well as Office of Resilience and Coastal Protection (RCP) data repositories including the Florida [Aquatic Preserve Data Portal](#) and the Statewide Ecosystem Assessment of Coastal and Aquatic Resources (SEACAR) [Data Discovery Interface](#).

The current AP continuous water quality monitoring program is conducted in accordance with the nationally-coordinated and standardized NERR SWMP. YSI/EXO 6-series sondes and EXO sondes are approved instruments for collecting data. Data are collected in 15-minute intervals for eight parameters (water temperature, specific conductivity, salinity, dissolved oxygen percent, dissolved oxygen mg/L, depth, pH and turbidity). NERR SWMP EXO or 6-Series SOPs are the minimum SOP requirement and are used in conjunction with YSI's (instrument manufacturer's) user manuals. The APs perform calibration verifications and bracketing procedures as outlined by the field-testing protocols established by the FDEP.

2. Statement of Policy

This Quality Manual for the Aquatic Preserve Continuous Water Quality Monitoring Program states the procedures used by FDEP and the Florida APs to ensure that the data generated by the DEP are verifiable, and that the procedures used to generate data are designed to produce data that are reproducible, comparable, and defensible within known limits of precision and accuracy. The department's quality assurance requirements for analytical laboratories and field activities are codified in Chapter 62-160, Florida Administrative Code (F.A.C.), Quality Assurance (QA Rules).

Data collected using the procedures established by the National Oceanic and Atmospheric Administration (NOAA) NERR SWMP follow quality assurance requirements that have been developed in accordance with known federal guidelines and/or standards for environmental data collection activities and oceanographic datasets (NOAA Administrative Order 216-101). For more information regarding the NOAA Office for Coastal Management Data Policy for the NERRs National Monitoring Program, please visit: <http://cdmo.baruch.sc.edu/data/policy.cfm>.

Project funding provided by a grant agreement from the Florida Department of Environmental Protection, Florida Coastal Management Program, and by a Grant provided by the Office of Ocean and

Coastal Resource Management under the Coastal Zone Management Act of 1972, as amended, National Oceanic and Atmospheric Administration Award No. NA17NOS4190167.

3. Ethics Statement

All employees and contract employees of the DEP RCP are held to high professional ethical standards in the performance of their duties. All employees are required to read, understand and sign an 'Ethics Statement' attesting to their commitment to honesty and integrity in performance of their duties. In addition, all employees are required to attend an annual ethics training class. Improper, unethical or illegal actions will be dealt with according to the published Administrative Directives of the DEP.

4. Organization and Responsibilities

The RCP continuous water quality monitoring program began in 1995 with the NERRs and was expanded to the Aquatic Preserves in late 2003. Today, RCP's Aquatic Preserve Program maintains continuous water quality monitoring stations in aquatic preserves across the state (Table 1) and the three NERRs.

Table 1: Aquatic Preserve Active Stations

Aquatic Preserve Office	Station Names	Aquatic Preserve
Big Bend Seagrasses APs	Steinhatchee (BBSST) Chassahowitzka (BBSCH)	Big Bend Seagrasses St. Martins Marsh
Biscayne Bay APs	Little River (LR03) Tuttle Basin (BB14) Tuttle Basin (JT71) Miami River (MR03) Miami River (MR07)	Biscayne Bay Biscayne Bay Biscayne Bay Biscayne Bay Biscayne Bay
Central Panhandle APs	Alligator Harbor 2 (CPAH2) FSU Marine Lab (CPFS) Windmark (WD)	Alligator Harbor Alligator Harbor Central Panhandle
Charlotte Harbor APs	Matlacha Pass 1A (MP1A) Matlacha Pass 2B (MP2B) Matlacha Pass 3C (MP3C) Charlotte Harbor West Wall 1 (CHWW1)	Matlacha Pass Matlacha Pass Matlacha Pass Charlotte Harbor
Estero Bay AP	Tom Winter (EB01) Spring Creek (EB02) Fish Trap Bay (EB03) Hendry & Mullock Creeks (EB04)	Estero Bay Estero Bay Estero Bay Estero Bay
Northeast Florida AP	Edwards Creek (NEECF)	Nassau River-St. Johns River Marshes
Northwest Florida AP	Yellow River Marsh AP Station 1 (YRMAP1)	Yellow River Marsh
Tomoka Marsh AP	Gamble Rogers (TMGR)	Tomoka Marsh

Responsibilities of Key Personnel

Trained personnel are responsible for coordinating data submissions with the AP offices, addressing Quality Assurance/Quality Control (QAQC) activities, and managing the data portal (FloridaAPdata.org) to ensure that data produced and received adhere to DEP protocols.

Alex Reed, Office of Resilience and Coastal Protection Director

The Office of Resilience and Coastal Protection is led by the Director, who oversees the administrative direction of the office.

Michael Shirley, Ph.D., Deputy Director

The Deputy Director is responsible for both the technical and administrative direction of the office.

Cheryl Clark, Coastal Projects Manager

Project Manager (PMP®) for the SEACAR Program, oversees projects and contracts included within SEACAR, the Florida Coastal Water Quality Assessment and Integration Project, and Habitat and Water Quality Improvements including the Florida Aquatic Preserve Data Portal and Water Quality Technician Training.

Samantha Howe, Aquatic Preserve Data Manager, RCP Quality Assurance Officer, Government Operations Consultant II

The AP Data Manager is responsible for coordinating data submittals with the aquatic preserves and handling the data that is submitted, which includes running QAQC checks and managing the data portal. The AP Data Manager provides support to the QA Office in helping to update manuals and ensuring that proper sampling methods are being used.

The Quality Assurance (QA) Officer serves as the lead QA Officer for RCP. The QA Officer is responsible for the production and revisions of the Quality Manual, providing quality assurance oversight, and ensuring that personnel adhere to proper sampling collection and analysis methods.

Tim Jones, Big Bend Seagrasses APs Manager, Environmental Specialist III

Oversees the resource management and several ecosystem monitoring programs, including water quality monitoring for the Big Bend Seagrasses Aquatic Preserves.

Trisha Green, Big Bend Seagrasses APs, Environmental Specialist II

Implements resource management and ecosystem monitoring programs, and performs the role of water quality technician, responsible for data management and datasonde calibration, deployment, retrieval, and maintenance.

Laura Eldredge, Biscayne Bay APs Manager, Environmental Specialist III

Oversees resource management and several ecosystem monitoring programs, including water quality monitoring for the Biscayne Bay Aquatic Preserves.

Aliza Karim, Biscayne Bay APs, Environmental Specialist II

Implements resource management and ecosystem monitoring programs, and performs the role of water quality technician, responsible for data management and datasonde calibration, deployment, retrieval, and maintenance.

Jon Brucker, Central Panhandle APs Manager, Environmental Specialist III

Oversees resource management and several ecosystem monitoring programs, including water quality monitoring for the Central Panhandle Aquatic Preserves.

Mindy Brown, Charlotte Harbor APs Manager, Environmental Specialist III

Oversees resource management and several ecosystem monitoring programs, including water quality monitoring for the Charlotte Harbor Aquatic Preserves.

Mary McMurray, Charlotte Harbor APs, Environmental Specialist I

Implements resource management and ecosystem monitoring programs, and performs the role of water quality technician, responsible for data management and datasonde calibration, deployment, retrieval, and maintenance.

Stephanie Erickson, Estero Bay AP Manager, Environmental Specialist III

Oversees resource management and several ecosystem monitoring programs, including water quality monitoring for the Estero Bay Aquatic Preserve.

Rebecca Cray, Estero Bay AP, Environmental Specialist I

Implements resource management and ecosystem monitoring programs, and performs the role of water quality technician, responsible for data management and datasonde calibration, deployment, retrieval, and maintenance.

Jimmy Tomazinis, Northeast Florida APs Manager, Environmental Specialist II

Oversees resource management and several ecosystem monitoring programs, including water quality monitoring for the Northeast Aquatic Preserves.

Chris Kurtz, Northeast Florida APs, Environmental Specialist I

Implements resource management and ecosystem monitoring programs, and performs the role of water quality technician, responsible for data management and datasonde calibration, deployment, retrieval, and maintenance.

Beth Fugate, Northwest Florida APs Manager, Environmental Specialist III

Oversees resource management and several ecosystem monitoring programs, including water quality monitoring for the Northwest Florida Aquatic Preserves.

Zach Schang, Northwest Florida APs, Environmental Specialist I

Implements resource management and ecosystem monitoring programs, and performs the role of water quality technician, responsible for data management and datasonde calibration, deployment, retrieval, and maintenance.

Ashley Hurley, Tomoka Marsh AP Manager, Environmental Specialist III

Oversees resource management and several ecosystem monitoring programs, including water quality monitoring for the Tomoka Marsh Aquatic Preserve.

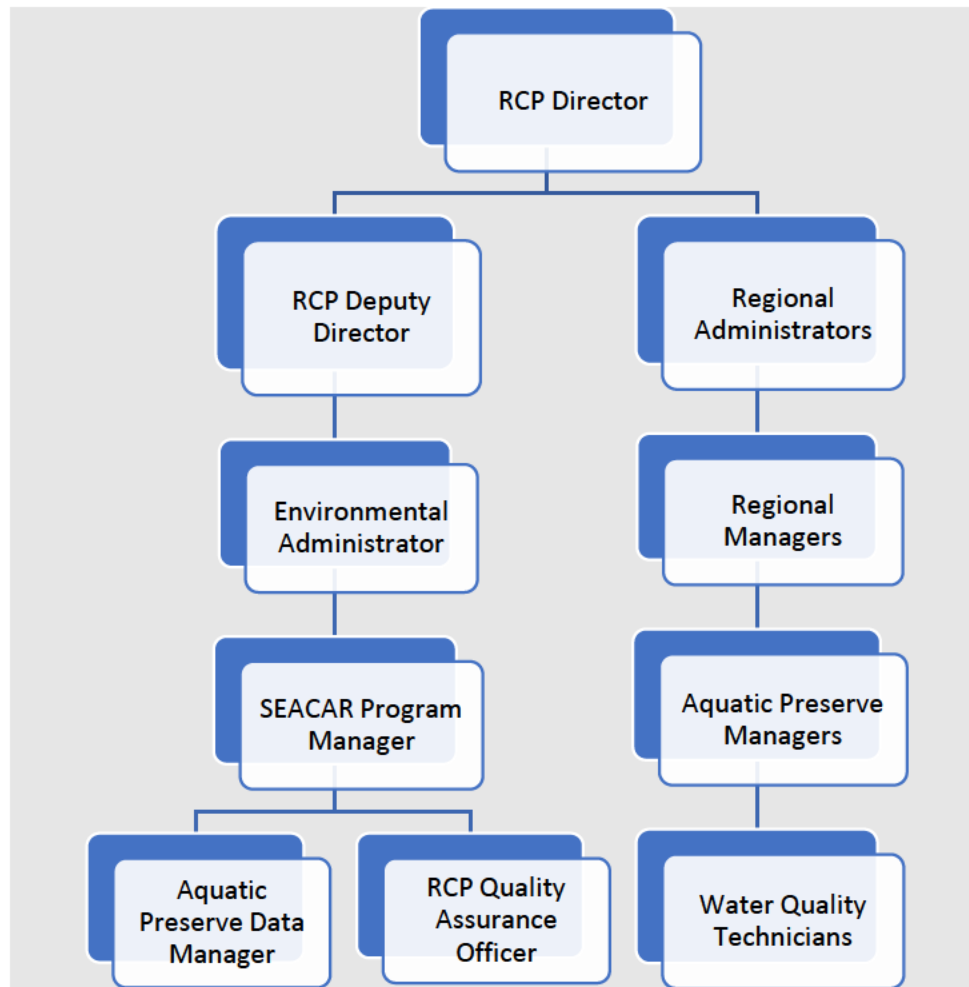


Figure 1: Organizational Chart

Approved Signatories

Approved signatories within the DEP are stated as:

- 1) Alex Reed, RCP Director
- 2) Michael Shirley, RCP Deputy Director

Employee Training

DEP staff who are responsible for AP sample collection are required to attend the AP's Continuous Water Quality Technician Training Workshop and the DEP FT1000 – FT1500 Field Testing Standard Operating Procedures (SOP) and basic data review trainings annually. Staff are also encouraged to virtually attend the NERRS SWMP Technician Training Workshop hosted by the Centralized Data Management Office (CDMO) annually. All employees are required to review training resources annually. Training resources for the Continuous Water Quality Technician Training Workshop and the NERRS SWMP Technician Training Workshop are available on the AP Data Portal training resources webpage: https://www.floridaapdata.org/training_online.php and DEP SOP training materials are located on the QA training webpage: <https://floridadep.gov/dear/quality-assurance/content/training-presentations>.

5. Documentation

Generation, Retention and Storage of Records

AP staff are required to use a calibration log to document that the datasonde was maintained, calibrated correctly and passed post deployment verifications. There is not a standardized calibration log used, and each AP office can use their own log, although the [AP Water Quality Calibration Log](#) is provided and used by some of the APs. Calibration logs should include: station information, deployment file name, datasonde and probe identification numbers, datasonde maintenance, technician name, datasonde calibration pre/post deployment data, sensor diagnostics, programming information and comments. Once complete, the hard-copy versions of the calibration log are scanned and saved in the Datasonde Program Managers shared network file location ([\\Fldep1\fco\CAMA\Fieldstuff\Datasonde Program](#)) and/or entered into an Excel version of the deployment log and saved in the Datasonde Program Managers shared network file location for long-term storage. Digital calibration logs produced by KOR software during datasonde calibrations should be archived in the shared network file location quarterly.

Documentation from sampling events are recorded on the calibration logs or on field logs. Field sampling documentation should include datasonde deployment and retrieval information, including date, time, technician, infield maintenance and field data (at minimum water temperature, specific conductance, salinity, and dissolved oxygen). Hard-copy versions of the field logs are scanned and saved in the Datasonde Program Managers shared network file location ([\\Fldep1\fco\CAMA\Fieldstuff\Datasonde Program](#)) and/or entered into an Excel version of the field log and saved in the Datasonde Program Managers shared network file location for long-term storage.

Raw data files must be submitted to the Datasonde Program Managers shared file location within two weeks of data retrieval from the instrument for automated primary Quality Assurance/Quality Control (QAQC). Automated primary QAQC may be performed by the AP Data Manager or the water quality technicians. Quarterly secondary QAQC reviewed data files and metadata documents must be submitted to RCP based on the following schedule:

Quarter 1: May 1st
Quarter 2: August 1st
Quarter 3: November 1st
Quarter 4: February 1st
Annual: April 15th

Quarterly metadata reports should include cumulative data for the year through the quarter being submitted, for example:

Quarter 1: January 1 – March 31
Quarter 2: January 1 – June 30
Quarter 3: January 1 – September 30
Quarter 4: January 1 – December 31

APs will append their quarterly data submissions into yearly data files, perform a second and more intensive round of secondary QAQC, and submit these files to replace the quarterly files and be posted as provisional plus data. After the DEP performs the final tertiary QAQC, the data will be posted as authenticated.

All data files and metadata reports are stored in the Datasonde Program Managers shared network file location ([\\Fldep1\fco\CAMA\Fieldstuff\Datasonde Program](#)) for long-term storage.

Staff are also required to record datasonde and probe maintenance information and maintain a sensor inventory. These documents are stored in the Datasonde Program Managers shared network file location.

Documentation Control and Maintenance

DEP generated SOP documents contain the SOP name, version number, effective date, review/revision date, and author. The draft watermark is removed from final SOP documents and can only be edited by the program manager or QA Officer.

For more information about the Florida DEP Standard Operating Procedures for Field Testing (FT1100, FT1200, FT1500), please visit <https://floridadep.gov/dear/florida-dep-laboratory/content/dep-laboratory-quality-assurance-manual-and-sops>.

For more information on CDMO Water Quality Management Procedures please visit https://www.floridaapdata.org/docs_training/CDMO_Data_Management_Manual_V6.6.pdf.

Data and Metadata documents are available for download on the AP Data Portal <https://www.floridaapdata.org/>.

Documentation/Reports Generated

1) *Aquatic Preserve Protocols*

- SOP for BBAP Datasonde Calibration (EXO) (2021)
- SOP for BBAP Datasonde Continuous Monitoring (2021)

2) *Quality Assurance Plans/Manuals*

- Biscayne Bay Aquatic Preserves QA Project Plan

3) *Reports*

- Florida Coastal Water Quality Assessment and Integration Report
- Leary 2012. Robust and Powerful Trend Analyses for Continuous Water Quality Monitoring within Estero Bay Aquatic Preserve (2004-2011)

4) *Metadata Reports*

- Annual and Quarterly Metadata Reports

Supporting Documentation/Reports

1) *Sampling Documents*

- Field collection data sheets
- Digital calibration log produced by KorEXO software
- Calibration logs
- Equipment maintenance tracking
- Sensor inventory tracking spreadsheet

2) *Data Management and Analysis SOPs*

- NOAA CDMO NERR SWMP Data Management Manual
- NOAA NERRS SWMP YSI/Xylem EXO Multi-Parameter Water Quality Monitoring Standard Operating Procedure Version 2.0
- YSI 6-Series Multi-Parameter Water Quality Monitoring Standard Operating Procedure Version 4.6
- Quick Reference 6-Series Calibration Checklist
- Quick Reference 6-Series Post-Deployment Checklist
- Quick Reference EXO Calibration Checklist
- Quick Reference EXO Post-Deployment Checklist
- Quick Reference EXO KOR V2 Calibration Checklist
- Quick Reference EXO KOR V2 Post-Deployment Checklist

3) *Manuals*

- EXO User Manual
- NOAA CDMO NERR SWMP Data Management Manual

6. Data Identification and Data Integrity

Nomenclature

Raw and limited data files should follow the proper naming convention. Data files need to include the AP code, station code, and the date of deployment (mmddyy), for example, EB02_010120.

Quarterly and annual secondary QAQC data files appended by the AP Data Manager or submitted by the approved Aquatic Preserves should include the Aquatic Preserve and station code as well as the year and cumulative quarters being submitted, for example, EB02_2020_Q1_Q2_Q3.

Tertiary review files should be named with the Aquatic Preserve, station code, year, and TQC indicating that tertiary QAQC has been performed, for example, EB02_2020_TQC.

Metadata reports must follow the outlined naming convention. Quarterly and annual metadata reports should include the Aquatic Preserve, date range for data included in the document, two-digit year, and m.prov, for example, bbsap01-03.20m.prov for Q1 and bbsap01-12.20m.prov for Q4 and annual.

Data integrity

Appropriate supporting metadata files are required before a data file, data set, data layer, or database can be accepted by or made available via the AP water quality data portal. Data and metadata are available and can be downloaded from the [AP Water Quality Portal](#). Additional records can be provided upon request. Please contact samantha.howe@floridadep.gov.

7. Confidentiality

All records and documents generated by DEP RCP are public records and may be subject to disclosure according to guidelines and exceptions published in Chapter 119 of Florida Statutes.

8. Capabilities

Sampling capabilities

Trained AP staff are capable of planning, scheduling, and collecting high-quality data and managing all aspects of data review and reporting. The aquatic preserves are responsible for following SWMP continuous monitoring protocols in regard to datasonde calibration, deployment, post-deployment, and QAQC with the assistance from AP Data Manager. Determination of station set up and configuration is dictated by the individual Aquatic Preserves. Suggested methods include a perforated PVC (or other plastic) tube attached to a piling or bridge abutment or a steel cage resting on the bottom. Probes must be between 0.25 to 0.50 meters above the substrate. YSI-recommended tube design is available in the [APWQ Documents folder](#) along with other AP configurations.

Sampling procedures

Standardized instrument handling, maintenance, calibration, deployment, and post-deployment procedures are outlined in the NOAA [NERRS SWMP YSI/Xylem EXO Multi-Parameter Water Quality Monitoring SOP v2.0](#) regarding the collection of data using YSI/Xylem EXO Multi-Parameter Water Quality datasondes and are outlined in the [YSI 6-Series Multi-Parameter Water Quality Monitoring Standard Operating Procedure Ver4.6](#) for the YSI 6-Series datasondes. Both SOPs should be used in conjunction with the Xylem/YSI datasonde user manuals.

Initial calibration verification and continuing calibrations for the following analytes: specific conductance ([FT 1200](#)) and pH ([FT 1100](#)) are conducted following DEP SOPs. Dissolved oxygen (mg/L) calibration is verified using the Solubility of Oxygen in Water at Atmospheric Pressure Table ([Table FT 1500-1](#)).

Collection frequency

Near-continuous water quality data are collected year-round at 15-minute intervals from stations within or adjacent to Aquatic Preserves. Maximum deployment time for both EXO and 6-series datasondes is 30 days before they must be replaced with calibrated and verified datasondes.

9. Equipment and Instruments

Equipment used is standardized and programs can only use Xylem/YSI 6-series or EXO datasondes. Sampling equipment are consistent with the SOPs below:

Introduction for EXO datasondes

NERRS SWMP YSI/Xylem EXO Multi-Parameter Water Quality Monitoring SOP v1.2

NERRS SWMP YSI/Xylem EXO Multi-Parameter Water Quality Monitoring SOP v2.0

Introduction for 6-series datasondes

YSI 6-Series Multi-Parameter Water Quality Monitoring SOP v4.6

Data Collection Equipment and Software

YSI 6-series datasonde

- Temperature/conductivity Sensor (#006560)
- pH probe (#606579)
- Dissolved oxygen probe (rapid pulse #006562 or optical #606150)
- Turbidity probe (#606136)

Xylem/YSI EXO Multi-Parameter Water Quality datasondes

- Conductivity and Temperature sensor (wiped) (#599827)
- Conductivity and Temperature Digital Smart Sensor (nonwiped) (#599870)
- Dissolved Oxygen Probe (#599100-01)
- Wiped pH Probe (#599702)
- Smart (Wiped) pH sensor with field replaceable tip (#599702)
- pH Digital Smart Sensor unguarded (#577602)
- Turbidity Probe (#599101-01)
- Total Algae (Chlorophyll) Probe (#599102-01)
- Smart Total Algae Sensor (Chlorophyll & BGA PE) (#599103-01)
- Smart FDOM (CDOM) Sensor (#599104-01)
- Central wiper (#599090-01)

Barometric Pressure Sensor

YSI Handheld instrument (Professional (Pro) Series) and probes

NIST-Traceable digital thermometer

NERRQAQC and NutrientQAQC macros

EXO KORS software (EXO sondes)

EcoWatch (or EcoWatch Lite) (6600 sondes)

Additional supplies: Wet white towel, cooler, cleaning materials, camera, tools and lock

Calibration and Standards

Datasonde sensors are calibrated by the AP water quality technicians or managers in the AP field office before each deployment. The temperature thermistor is confirmed using a NIST certified temperature probe prior to calibration. A one-point calibration is used for specific conductivity (50.00 mS/cm standard solution) and a two-point calibration for pH (7.00, 10.00 and/or 4.00 buffer solution), and a two-point calibration for turbidity (0 FNU DI water & YSI 124 FNU standard).

Dissolved oxygen (DO) is calibrated in air-saturated water, using a bucket and an aerator. The percent saturation value is determined by using the current barometric pressure to convert to the

adjusted value and entered into KorEXO software. Depth is also calibrated by using the current barometric pressure to determine the depth offset value and is entered into KorEXO (See [NERR SWMP EXO SOP](#), Appendix B). Sensors are verified by ensuring that the sensor diagnostics are within range immediately after calibration and an initial calibration verification (ICV) is performed on the specific conductivity, pH, dissolved oxygen, and turbidity sensors following DEP SOPs.

Information pertaining to lot numbers and manufacturer name and date of standards of buffers used in calibration procedures are documented in the KorEXO software and saved in a digital calibration sheet for each probe. Expiration dates of standards and buffers can be logged in the notes section for each sensor. Digital Calibration sheets are required to be submitted to the [Calibration Logs folder](#). They can be retrieved locally at the following location:

- Original Lab view KOR: This PC\Windows(C:)\Program Files (X86)\KOR-EXO\Data Files
- KOR 2.3.10.0 (latest version): This PC\Windows(C:)\Users\User name\Documents\YSI\EXO Exports\Archive

Approximately every month, the deployed datasondes are removed from the water and returned to the lab for post-deployment continuing calibration verification (CCV), data retrieval, cleaning, and for conducting any necessary maintenance or repairs. Newly calibrated datasondes are deployed at the time of retrieval during a 15-minute interval to maintain near-continuous readings.

For step-by-step SWMP calibration methods consult the [NERRS SWMP YSI/Xylem EXO Multi-Parameter Water Quality Monitoring SOP v1.2](#), [NERRS SWMP YSI/Xylem EXO Multi-Parameter Water Quality Monitoring SOP v2.0](#), [YSI 6-Series Multi-Parameter Water Quality Monitoring SOP v4.6](#) and DEP SOPS ([FT 1100](#), [FT 1200](#), [Table FT 1500-1](#)).

Please consult the Quick Reference Guides for additional information:

- [Quick Reference 6-Series Calibration Checklist](#)
- [Quick Reference 6-Series Post-Deployment Checklist](#)
- [Quick Reference EXO Calibration Checklist](#)
- [Quick Reference EXO Post-Deployment Checklist](#)
- [Quick Reference EXO KOR V2 Calibration Checklist](#)
- [Quick Reference EXO KOR V2 Post-Deployment Checklist](#)

Equipment Maintenance and Documentation

Datasonde cleaning and maintenance takes place in accordance with the methods outlined in the [NOAA NERRS SWMP YSI/Xylem EXO Multi-Parameter Water Quality Monitoring SOP](#), the [YSI 6-Series Multi-Parameter Water Quality Monitoring SOP](#), or the [EXO User Manual](#) after each deployment.

Instrument and probe maintenance occur once the sensors have been properly cleaned and is based on manufacturer recommendations, technician observations, sensor QC score, and data review.

Please consult the following documents for additional maintenance information:

- [10 Tips to Prevent Biofouling on Water Quality Instruments](#)
- [Preventative Maintenance \(Maintaining EXO Sonde & Sensor Wetmate Connector\)](#)
- [Calibration Tips for 6-Series Sondes & Sensors](#)

10. Review and Assessment

Quality Control Measures

AP staff use several quality control measures to ensure that high-quality data are being collected. Quality control samples assess the accuracy and precision of sampling and analytical techniques.

Field Quality Control

Sampling personnel are required to take discrete sample measurements in the field during instrument deployments. Calibrated and verified YSI 6600, EXO2, EXO3, or YSI Handheld instruments (Professional (Pro) Series) may be used to collect discrete samples. Data collected during discrete sampling is then compared to the datasonde readings after deployment to verify the datasondes are properly calibrated and collecting accurate data.

At the end of each sampling period, datasondes are retrieved from the field, wrapped in a wet, white towel and placed in a cooler for transport. Once returned to the AP office it is recommended that post-deployment procedures do not begin until there are at least 2-hours of post-deployment data collected after retrieval. The retrieval data can be used to help verify that the datasonde was collecting accurate data.

Lab Quality Control

Expiration dates of standards and buffers used for calibrating datasondes are recorded on the front of each standard/buffer container. Lot numbers are entered into KorEXO software and expiration dates can be added to the notes section for each sensor in KorEXO, which will be automatically recorded on each calibration log generated in KOR. Expired standards/buffers are not used.

Quality Control Criteria

The AP data undergo a three-step (primary, secondary, and tertiary) QAQC process as outlined in the [NERRS CDMO Data Management Manual Version 6.6](#) and discussed in section 11, Data Review. This section details the specific quality control criteria pertinent to the data collection and review process.

Datasonde Probe Verification Acceptance Criteria

The EXO datasondes have a built-in smart sensor technology called SmartQC, a mechanism to normalize different sensors and to assess the current state of individual sensor performance relative to factory-defined performance parameters. Every EXO sensor has an embedded microprocessor which, along with calibration metadata, enables the EXO to warn users of calibration errors or when a sensor is unable to be calibrated due to age, fouling, or damage. For any sensor, a QC Score is presented as red, yellow, or green. A green SmartQC score means the sensor is calibrated properly and all parameters used to assess its performance state are within factory-defined limits. A yellow SmartQC score means that the sensor will still perform within factory-defined limits, but that during calibration, enough of an adjustment was required to suggest that the sensor is drifting from those limits or may soon require some adjustments. Technicians may use a sensor that has a green or yellow SmartQC score. However, it is not recommended to use a sensor with a yellow SmartQC score for long-term deployment. A red Smart QC score means that the sensor is not performing within factory-specified limits and must

be addressed or replaced prior to deployment. For more information regarding the SmartQC technology please see the [Smart QC Handbook](#) and the [EXO User Manual](#), page 83.

Calibration Verification Acceptance Criteria

It is required to calibrate the datasonde sensors prior to each deployment. Immediately following calibration, an initial calibration verification (ICV) is performed to ensure that the sensor is reading accurately in a known standard. If the sensor reading falls outside of the acceptance criteria found in Table 3, then staff can try to recalibrate the sensor. If the sensor falls outside of the acceptance criteria after recalibrating, it is required to replace the sensor or begin the calibration process again. In addition to the ICV, a quantitative bracket is performed to verify that the samples are reading accurately in two known standards. The standards used for the quantitative bracket can be higher or lower than the standard used at calibration but should cover the range of measurements that you would expect to see when the datasonde is deployed in the field.

AP staff are required to perform post-deployment sensor verifications or continuing calibration verification (CCV) within 24 hours of retrieving the datasonde. These verifications draw attention to mechanical drift of the sensors during deployment or the effects of biofouling. This process is critical not only for data QA/QC, but also for data users to know if the data were affected by biofouling, wear and tear, or other issues. It is also recommended that staff take pictures of the datasonde, datasonde guard, and probes at retrieval to help with identifying any issues related to biofouling or sensor malfunctions.

Sensors are to be verified by placing the sensor in a known standard and taking readings while the datasonde is in discrete mode. Sensors are to be verified post-deployment using the standards listed in Table 2.

If the sensor does not meet the acceptance criteria listed in Table 3 during post-deployment verifications, the data are flagged and coded as suspect or are rejected. If the sensor does not meet the acceptance criteria because of a sensor malfunction the data may be flagged during the automated primary QA/QC process. All data are reviewed by trained staff and the flags and codes are applied to the data and/or addressed during the secondary QA/QC process.

Table 2: Calibration Verification Standards

Parameter	Pre-Deployment Calibration (SWMP)	Initial Calibration Verification (DEP)	Post-Deployment Verification or CCV (SWMP)
Turbidity	2-Point Calibration: 0.0 in DI water 124 FNU standard	124 FNU Standard	2-Point Check: 0.0 in DI water 124 FNU standard
pH	2-Point Calibration: 7 standard 10 standard	10 or 4 standard*	2-Point Check: 7 standard 10 standard
Specific Conductance	1-Point Calibration: 50 mS/cm standard	20 mS/cm standard*	1-Point Check: 50 mS/cm standard

**Recommended (other standards can be used that ensure proper bracketing of samples)*

Table 3: Sensor Specifications for YSI Datasondes

Parameter	6-Series Datasonde Sensor Specifications	EXO Datasonde Sensor Specifications
pH	± 0.2 unit	± 0.1 units within ± 10°C of calibration temperature ± 0.2 units for entire temperature range
Specific Conductance	± 0.5% of reading + 0.001 mS/cm	0 to 100: ± 0.5% of reading or 0.001 mS/cm 100 to 200: ± 1% of reading Wiped Sensor: ±1% of the reading or 0.002 mS/cm (whichever is greater)
Temperature	± 0.15°C	-5 to 35°C: ± 0.01, 35 to 50°C: ± .005 Wiped Sensor: ± 0.2°C
Dissolved Oxygen	Optical sensor % Saturation: ± 15% or reading 0-20 mg/L: ± 2% of the reading or 0.2 mg/L (whichever is greater) 20 to 50 mg/L: ± 6% of the reading	% Saturation: ± 5% or reading 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
Turbidity	± 2% of reading or 0.3 NTU (whichever is greater)	0 to 999 FNU: 0.3 FNU or ± 2% of reading (whichever is greater) 1000 to 4000 FNU: ± 5% of reading

11. Data Review

A summary of the data review process and AP responsibilities can be found in [The Florida Coastal Water Quality Assessment and Integration Project Water Quality Data Management Responsibilities](#).

Primary QAQC

Raw Data Entry

Discrete sampling values collected in the field are recorded in a field notebook or on the calibration or field log. After each deployment data are uploaded from the datasonde using a DEP-issued computer to the datasonde software program. Files are then exported in a .DAT, .CSV, or .BIN file format. Values recorded during post-deployment verifications are written in the “Post-Deployment” and “Sensor Diagnostics” sections of the calibration log.

Calibration logs and field information are required for every instrument deployment. They are combined into one deployment log, which should contain all the calibration and field information for a particular sonde through its deployment in the field. Deployment logs are completed and submitted to the DEP’s [Datasonde Program shared folder](#). To gain access to this folder please contact the AP Data Manager. The Aquatic Preserves must also submit raw, completely unchanged, .DAT or .BIN files to the [Raw Data](#) folder after each deployment.

Raw Data Validation

Raw data are reviewed by AP staff and the AP Data Manager. AP staff may use the datasonde software to view and visually check the data file and ensure that data were collected for each parameter while the instrument was deployed in the field. Staff also use the datasonde software to note any obvious errors or problems that occurred during the deployment. Staff can also create graphs for each deployment to help identify errors, problems and/or anomalies. Any notes pertaining to the graphs are useful during data reviews and metadata document creation.

Limited Data Entry

The AP Data Manager (or approved AP staff) copies the raw data file into the [limited.csv](#) folder and then removes pre- and post- deployment readings, saving the file in this location. The AP Data Manager (or approved AP staff) then uploads the limited data file to the Centralized Data Management Office’s (CDMO) [Non-SWMP Data Upload Service](#) for primary QAQC.

The primary QAQC process performed by the CDMO’s Non-SWMP Data Upload Service involves inserting flag columns into the data files for each water quality parameter, creating a flag record column, and creating an automated process that applies standardized flags to data if the values are outside sensor specifications as determined by YSI, the instrument manufacturer. The resulting Primary QAQC file is emailed to the chosen recipients.

Limited Data Validation

The AP Data Manager reviews the Primary QAQC files and notifies the AP staff if any errors are detected. The AP Data Manager saves the finalized file to the [primary QAQC](#) folder. This file is referred to as a provisional data file. The AP Data Manager may modify the column order in the provisional data file, so the files match the established format; however, data are not removed.

The AP staff inspects deployment or monthly files for malfunctions, suspect and/or anomalous data and makes notes. The Data Manager or AP staff use the primary QAQC data files to create monthly files, which are merged to create quarterly files. Quarterly files are saved in the [quarterly data](#) folder. AP staff then create a quarterly metadata report using the AP metadata template in the Datasonde Program shared network file folder and places it in the [metadata folder](#).

Secondary QAQC

AP staff analyze the primary QAQC data files for malfunctions, suspect, and/or anomalous data and make notes. All calibration logs, field logs, field condition notes, sampling collection errors or problems, data, and graphs are created by AP staff and are used to verify the data.

Quarterly, AP staff evaluate data for validity based on weather data, field observations, QC checks, graphs and instrument diagnostics. Data are rejected if the anomalies are attributed to sensor malfunction and/or excessive fouling. In addition to observations of any physical damage (e.g., compromised DO probe membrane), sensor malfunctions are detected if the reading of the probe is outside the range established for the sensor or if the post-deployment readings were out of range. Additionally, AP staff create a metadata report. The information collected during the quarterly review is detailed on the quarterly metadata report and saved in the metadata folder.

The AP Data Manager reviews the quarterly data files and applies standardized QAQC flags and codes using the AP notes and/or metadata report for all Aquatic Preserves except for Biscayne Bay APs, Estero Bay AP, Northeast APs, and Tomoka Marsh AP. Staff from these approved APs are responsible for reviewing and applying the standardized QAQC flags and codes to their data. Data are evaluated, and standardized flags and codes are applied to individual data points by insertion into the flag columns using tools provided by the CDMO ([Microsoft Excel macro](#)) to provide further documentation on the reliability of the data.

QC Flags

QC flags applied during the primary QAQC process are replaced with either rejected flags, if anomalies are attributed to sensor malfunctions or if data checks failed post-deployment; or with suspect flags for all other anomalous data. All rejected, suspect, and missing data are retained within the dataset and flagged appropriately. Each parameter in the data portal exported data file contains a flag column. Below is a list of available QC flags and their descriptions.

- -5 Outside high sensor range
- -4 Outside low sensor range
- -3 Data rejected due to QAQC
- -2 Missing data
- -1 Optional parameter not collected
- 0 Passed initial QAQC checks
- 1 Suspect data
- 2 Reserved for future use

- 3 Calculated data: non-vented depth/level sensor correction for changes in barometric pressure
- 4 Historical: Pre-auto QAQC
- 5 Corrected data

QC Codes

QC codes are used in conjunction with the QC flags to provide additional documentation of the data. General error codes are used to document general problems with the deployment or datasonde; sensor error codes are used to document sensor errors; comment codes are used to further document conditions or problems with the data; and select comment codes are applied to the entire record using the flag record column. Only one flag and general or sensor error and one comment code are applied to a data point when applicable. Data that passed initial QAQC checks are then flagged as good data and are not required to contain codes. Below is a list of available QC codes and their descriptions.

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 QAQC checks
- GSM See metadata

Corrected Depth/Level Data Codes

- GCC Calculated with data that were corrected during QAQC
- 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

*Indicates comments that can be applied to an entire record in the F_Record column.

For more information about the flags and codes process, please see the links below:

[NOAA CDMO NERR SWMP Data Management Manual](#)
https://www.floridaapdata.org/about_data_qaqc.php

Yearly, the quarterly data files are merged into annual files by the AP Data Manager and placed in the [annual data](#) folder. The AP staff are notified that the annual files are ready for review. AP staff review the annual file for malfunctions, suspect, and/or anomalous data and make additional notes in the metadata report (if necessary). AP staff save the final yearly metadata report and data files in the shared Datasonde Program folder.

The AP Data Manager reviews the annual data files, metadata report, calibration logs, and post-deployment verifications and updates the dataset and/or metadata report (if necessary).

Database Management

After the flags and codes have been appropriately applied, the AP Data Manager ensures that the column order matches the following: m_date, F_Record, temp, f_temp, spcond, f_spcond, sal, f_sal, do_pct, f_do_pct, do_mgl, f_do_mgl, depth, f_depth, ph, f_ph, turb, f_turb, Historical, ProvisionalPlus. Next, the AP Data Manager populates the Historical and ProvisionalPlus columns as follows:

Historical: 0 = indicates that the data have not been through tertiary review, 1 = data have been authenticated and completed the tertiary review

ProvisionalPlus: 0 = provisional data (completed primary QAQC), 1 = data have been through secondary QAQC by AP (provisional plus QAQC)

Quarterly data files and metadata reports then get uploaded as provisional plus data in the AP Data Portal (www.FloridaAPdata.org).

Annual data files and metadata reports then get uploaded as provisional plus data in the AP Data Portal (www.FloridaAPdata.org) and overwrite the quarterly data files and metadata reports.

The AP Data Manager updates AP Data Portal quarterly, annually, and upon request if AP makes any changes to data files or metadata reports.

Tertiary QAQC

A third and final step of QAQC, tertiary QAQC, is conducted by the AP Data Manager.

The AP Data Manager reviews annual data file, metadata report, calibration logs, and post-deployment checks. The AP Data Manager creates a Data Review Questions and Comments document with suggested edits and notes if all required accompanying documents have been submitted. The AP Data Manager emails the document to AP staff and saves correspondence and files in the [tertiary QAQC](#) folder.

The AP Data Manager conducts a tertiary review meeting with AP staff and makes corrections to the data and/or metadata, if needed. AP Data Manager finalizes data and metadata. After tertiary review is complete and metadata is finalized, AP Data Manager uploads data to the AP Data Portal as authenticated data overwriting previous versions. The authenticated metadata document is also created by removing the provisional statement at the top of the report as well as removing “.prov” from the file name.

Corrective Actions

- [Results of Audits](#)
Internal audits are not required for staff. Individual team leads or AP staff may elect to perform audits as needed.
- [Feedback from Data Users](#)
Users and AP staff are encouraged to review the data on the AP Data Portal and submit any feedback to the program.

Database Management

The University of South Carolina's CDMO maintains the FloridaAPdata.org database and data portal under contract with the Department. Data files (.CSV) are imported into the database by the AP Data Manager using an automated web service. Metadata files are manually uploaded by CDMO at the request of the AP Data Manager. The database is occasionally query optimized (mainly useful after several large record imports by using the VACUUM ANALYZE and REINDEX commands) and backup is performed periodically.

12. Consumer Relations

All data and metadata are available on the AP Data Portal (www.FloridaAPdata.org). Users should contact Cheryl.P.Clark@floridadep.gov or Samantha.Howe@floridadep.gov if they have questions regarding the data or the QAQC process.

13. Appendix

Manuals

- i. [*Introduction for EXO datasondes*](#)
- ii. [*NERRS SWMP YSI/Xylem EXO Multi-Parameter Water Quality Monitoring SOP v1.2*](#)
- iii. [*NERRS SWMP YSI/Xylem EXO Multi-Parameter Water Quality Monitoring SOP v2.0*](#)
- iv. [*Introduction for 6-series datasondes*](#)
- v. [*YSI 6-Series Multi-Parameter Water Quality Monitoring SOP v4.6*](#)

Datasonde Maintenance

- i. [*EXO User Manual*](#)
- ii. [*10 Tips to Prevent Biofouling on Water Quality Instruments*](#)
- iii. [*Preventative Maintenance \(Maintaining EXO Sonde & Sensor Wetmate Connector\)*](#)
- iv. [*Calibration Tips for 6-Series Sondes & Sensors*](#)

Data Management

- i. [*NERRS SWMP Water Quality Calibration Log*](#)
- ii. [*Continuous WQ Field Log*](#)
- iii. [*Sensor inventory tracking spreadsheet*](#)

Continuous Water Quality Training Tutorials and Materials

AP Continuous Water Quality Technician Training Workshop (TTW)

- i. [*TTW 2020 training and presentation recordings*](#)

SWMP Technician Training Workshop (TTW)

- i. [*TTW 2016 training and presentation recordings*](#)
 - 1) [*Mike Lizotte WQ service and maintenance of EXO and 6-series sondes*](#)
 - 2) [*Mike Lizotte WQ 6-series calibrations*](#)
- ii. [*TTW 2019 training and presentation recordings*](#)
 - 1) [*Mike Mensinger, WQ Data Collection Basics*](#)
 - 2) [*Curt Butler, YSI WQ Training Part 1*](#)
 - 3) [*Curt Butler, YSI WQ Training Part 2*](#)
 - 4) [*Mike Mensinger and Curt Butler, WQ Problem Data*](#)
 - 5) [*Chris Peter – New Technology for Old Problems*](#)
 - 6) [*Benjamin Ganon – EXO and ISCO Pairing to Sample Remotely*](#)
 - 7) [*Melissa Ide, SWMP Data Management Updates*](#)
- iii. [*TTW 2020 training and presentation recordings*](#)
 - 1) [*Day 1 \(12/02/2020\)*](#)
 - 2) [*Day 2 \(12/04/2020\)*](#)

Associated documentation

- i. [*2019 TTW WQ SWMP Data Collection Basics Outline v1.0*](#)
- ii. [*2019 TTW WQ Problem Data Session Outline v1.0*](#)
- iii. [*2019 TTW WQ Beginner Data Management Training for WQ Outline v1.0*](#)

14. Summary of Quality Plan Revisions