

**STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL PROTECTION**

Project Title:	Real-Time Water Quality Monitoring for the Florida Keys National Marine Sanctuary (FKNMS)
Grantee Name:	Florida International University
Grantee's Grant Manager:	James Fourqurean
Reporting Period:	Final Report (June 15, 2023)
Contact:	Benjamin Binder (bbinder@fiu.edu)

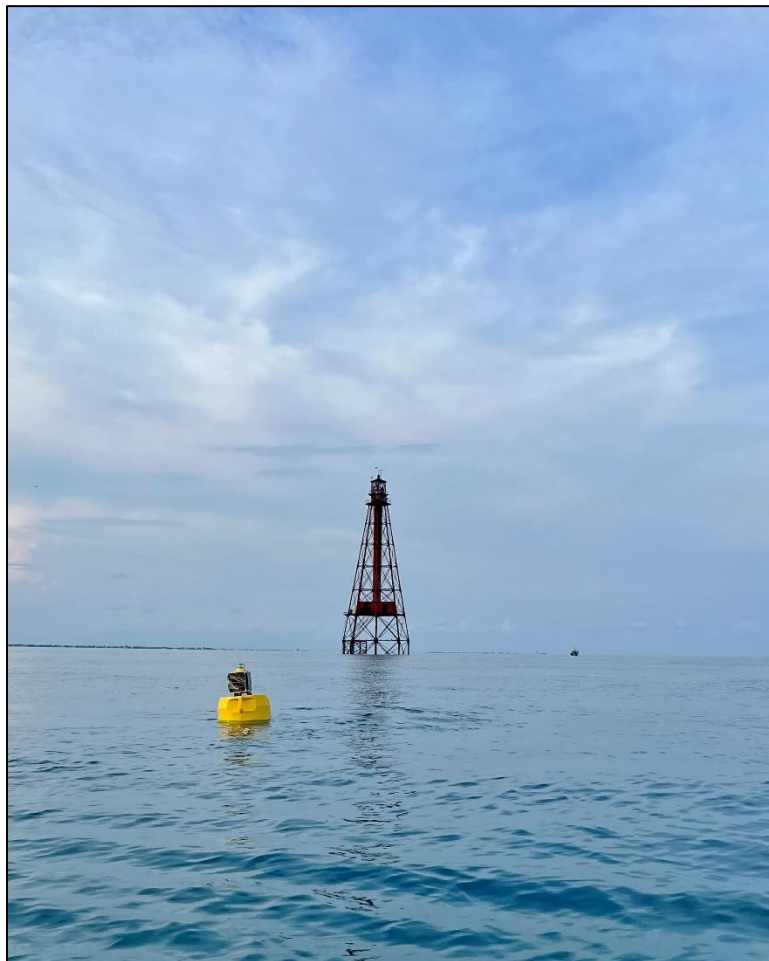


Figure 1 - DB600 buoy at Sombbrero Lighthouse offshore of Marathon, Florida.

Project Summary:

Four long-term water quality monitoring buoys were deployed between Fowey Rocks and Sand Key, along the Florida Reef Tract in May/June 2023 (Figure 2). Note that the northern most buoy was deployed at North Patch Reef in the Florida Keys National Marine Sanctuary (FKNMS) temporarily, while awaiting National Park Service approval for deployment at Fowey Rocks. The

four buoys were placed on existing mooring tackle provided by the FKNMS, replacing recreational mooring buoys near the peripheries of the recreational mooring fields (Table 1).

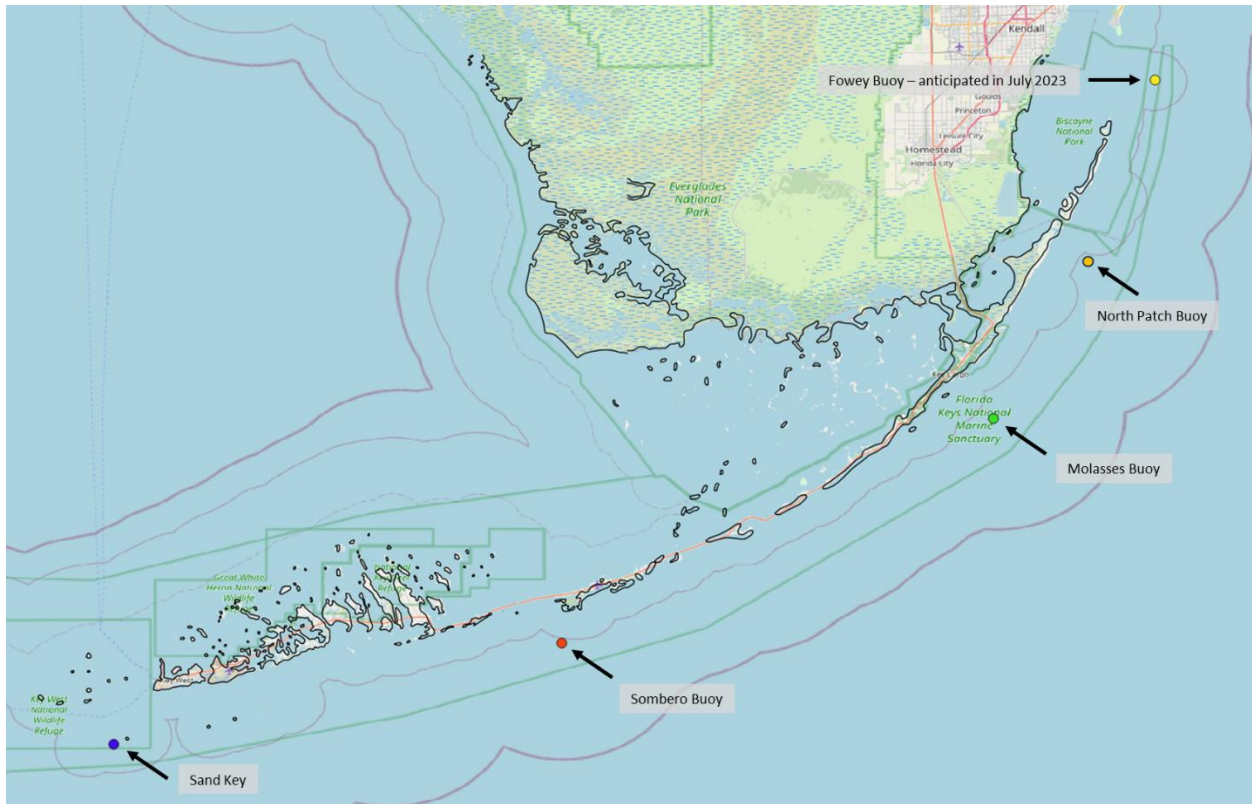


Figure 2 - Buoy Locations.

Table 1 - Water quality buoy locations.

Location	Lat	Lon	Latitude	Longitude	Pin/Manta Number
Sand Key Light	24.4523	-81.8806	24 27.138	-81 52.836	S24-Pin
Sombrero Light	24.6257	-81.1125	24 37.542	-81 06.750	SO18-Manta
Molasses Reef	25.0105	-80.3724	24 00.630	-80 22.344	M29-Pin
North Patch*	25.3137	-80.1989	25 18.820	-80 11.931	N2-Pin

* North Patch buoy will be relocated to Fowey Rocks upon National Park Service permit approval.

The data buoys were custom designed by Xylem engineers to meet the needs of the FIU research team, and consisted of a DB600 buoy fit with a Xylem Ai1 data logger, freely rotating inductive swivel, high-tensile strength wire rope, a subsurface buoy, and in-line sonde mounting system for rapid replacement and maintenance (Figure 3). This design replaced the proposed buoy design due to its anticipated superior performance in offshore conditions. Data sondes (YSI EXO2's) were configured with an array of sensors; including turbidity, pH, temperature, dissolved oxygen, conductivity, and depth. Surface (air) temperature is also recorded by the onboard computer at the surface. Data are telemetered via cellular connection to Hydrosphere (Xylem) every 15 minutes. Total algae sensors are being installed during the first round of calibrations, which will provide algae concentration for general taxonomic groups. Sites were revisited after

one week post deployment to ensure tether integrity, are being visited after one month of deployment, and will be revisited every three months (~90 days) for calibration and maintenance.

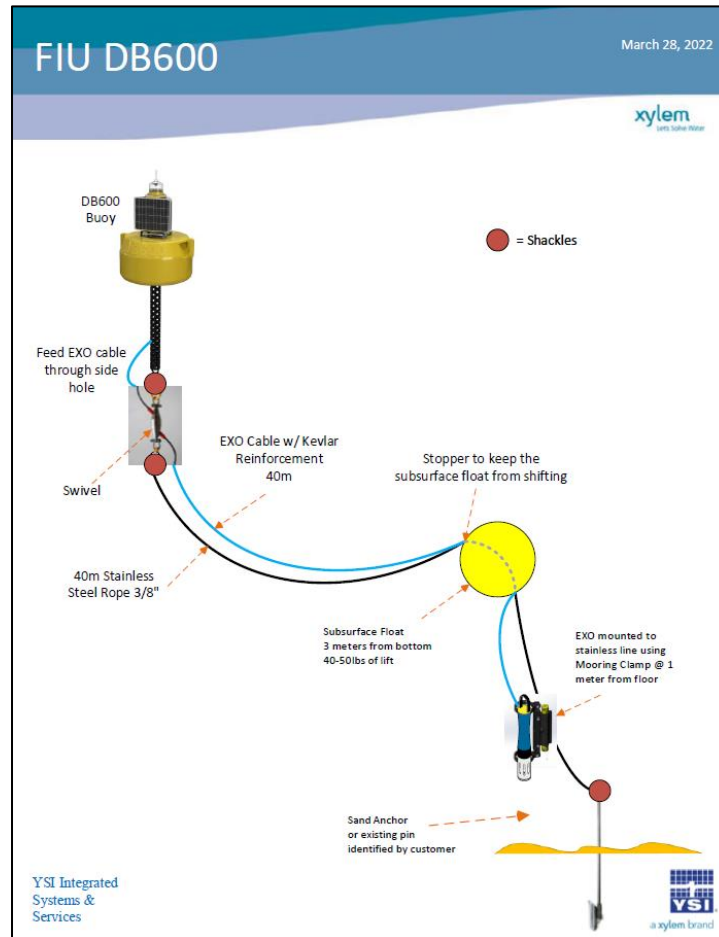


Figure 3 - Water quality data buoy configuration.

Near real-time data are made publically available through Hydrosphere ([HydroSphere \(xylem.com\)](https://www.xylem.com)) with a 15 minute delay. The provided link allows users to view, generate custom datagrams, and export custom figures for a range of uses. Complete data records are being distributed to project partners and backed up to an archive storage space on a weekly basis. Certified data (QA/QC'd) will be provided via the FIU web portal (in development) after a ~90-day delay, following calibration corrections and infield system maintenance.

For more information on design, deployment, and data collection standards, please contact Benjamin Binder (bbinder@fiu.edu). For all project materials, including photos, documents, permits, and receipts, please visit the shared Onedrive: [FDEP WQ Buoys - FINAL REPORT PACKAGE](#).

Task Completion:

Task 1: Purchase electronics, sensors and installation supplies

- a) FIU will provide a report on equipment orders, a full receipt of payment for the order, and complete the first billing within 3 months of start of project or by June 30 2022, whichever is first.*
- b) FIU will provide follow-up receipts when equipment is received.*

Purchasing of equipment was initiated in Fall 2021, but due to production delays, the full order was not delivered until January 2023. All items were accounted for, and buoys were assembled in March 2023 following the hire of a new staff member dedicated to ongoing remote sensing projects. Receipts for equipment have been uploaded to a shared Onedrive folder: [Receipts \(Payments to Xylem\)](#).

Task 2: Install physical infrastructure

- a) FIU will provide a final report on site selection and station identification with details of the construction plan and schedule.*
- b) Upon installation, FIU will provide a final report of the installation sites with photographs of the installed stations, information on where the depth sensors are installed, and precise coordinates.*

Sites were identified by the FKNMS buoy management team and FIU researchers. No construction of moorings was required, as the buoy team allowed FIU to remove existing mooring balls and install the water quality buoys on existing bottom tackle as identified in Table 1 (see Figure 4 for example). The mooring balls were recovered by the FIU team and delivered to the FKNMS office for reuse. Depth information for the sonde is provided in near real-time via Hydrosphere, but each sonde was deployed between 1-2m above the sea bottom. Total water column depth is approximately 20-22' for all four locations. Precise coordinates are also identified in Table 1. Supplementary photos of the buoys and installation can be found on Onedrive: [Imagery \(Photo and Video\)](#).

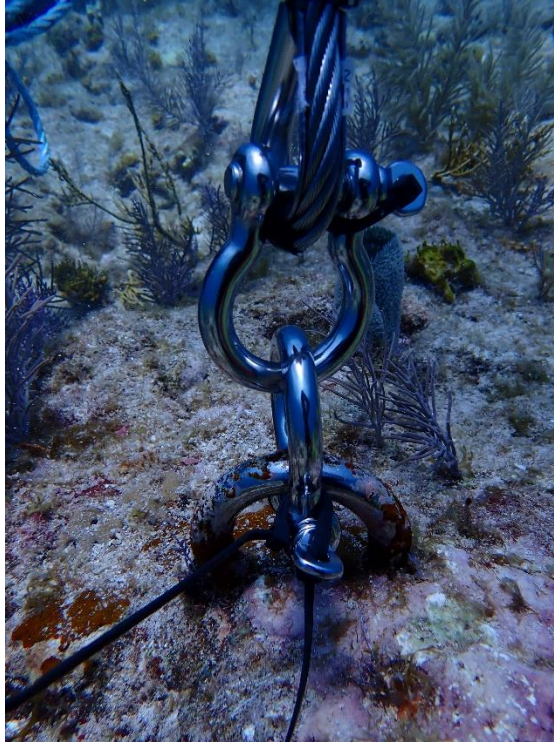


Figure 4 - Stainless steel bolt used to secure buoy tethers provided by Florida Keys National Marine Sanctuary.

Task 3: Initiate data management processes

- a) FIU will provide a final report on the completion of initial data delivery and establishment of continued live data deliveries including instructions on how to access the data.*
- b) FIU will provide quality-checked data to both DEP and NOAA on a regular basis corresponding with sonde swaps.*

Near real-time data are made publically available through Hydrosphere ([HydroSphere \(xylem.com\)](http://HydroSphere(xylem.com))) with a 15 minute delay. The provided link allows users to view, generate custom datagrams, and export custom figures for a range of uses. For comprehensive data access instructions via Hydrosphere, please see Figures 5-7. Complete tabular data records from sondes are scheduled for weekly delivery to Nicholas Parr, James Fourqurean, and Benjamin Binder for review. Additional recipients can be added, and the delivery schedule can be modified by contacting the Hydrosphere data administrator (Benjamin Binder). Data are also being archived to a secure physical storage system and are slated for inclusion in the FIU water quality web portal that is currently under development. Certified data will be provided via the web portal with a 90-day delay, which will allow for calibration corrections that account for sensor drift over the deployment period. Instructions can also be found in a supplementary PDF format on Onedrive: [Hydrosphere Data Instructions.pdf](#)

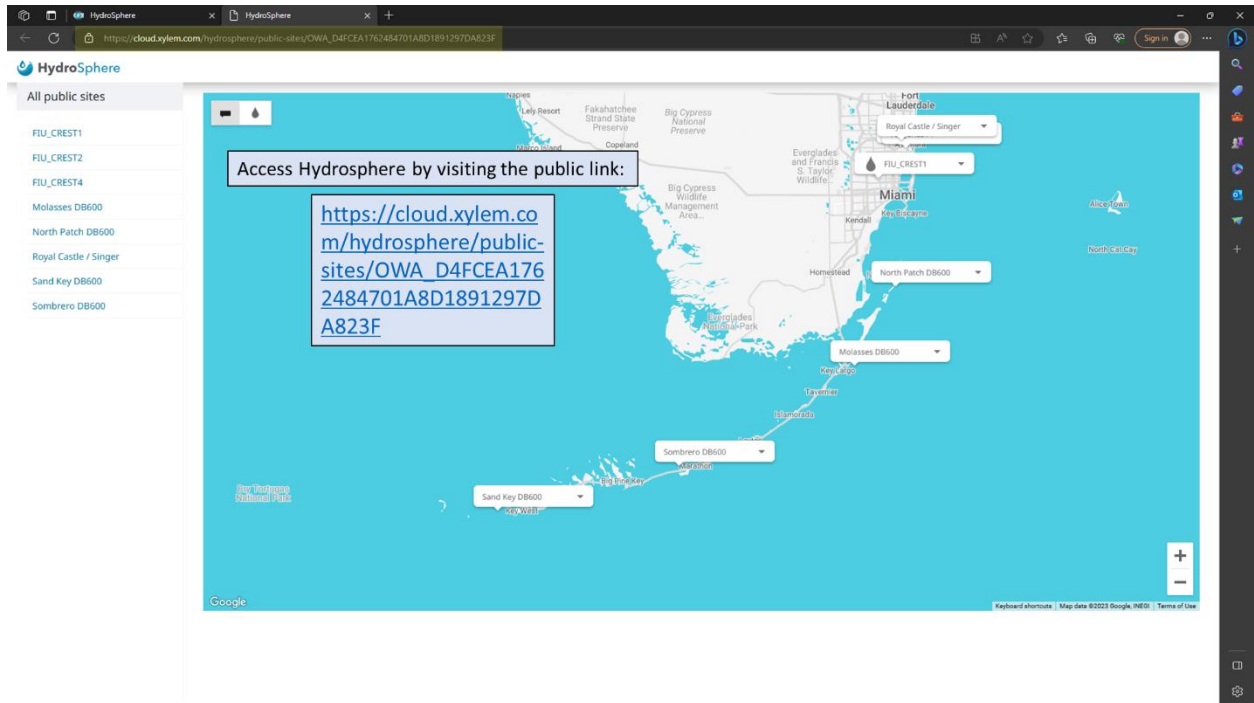


Figure 5 - Hydrosphere landing page and public web address.

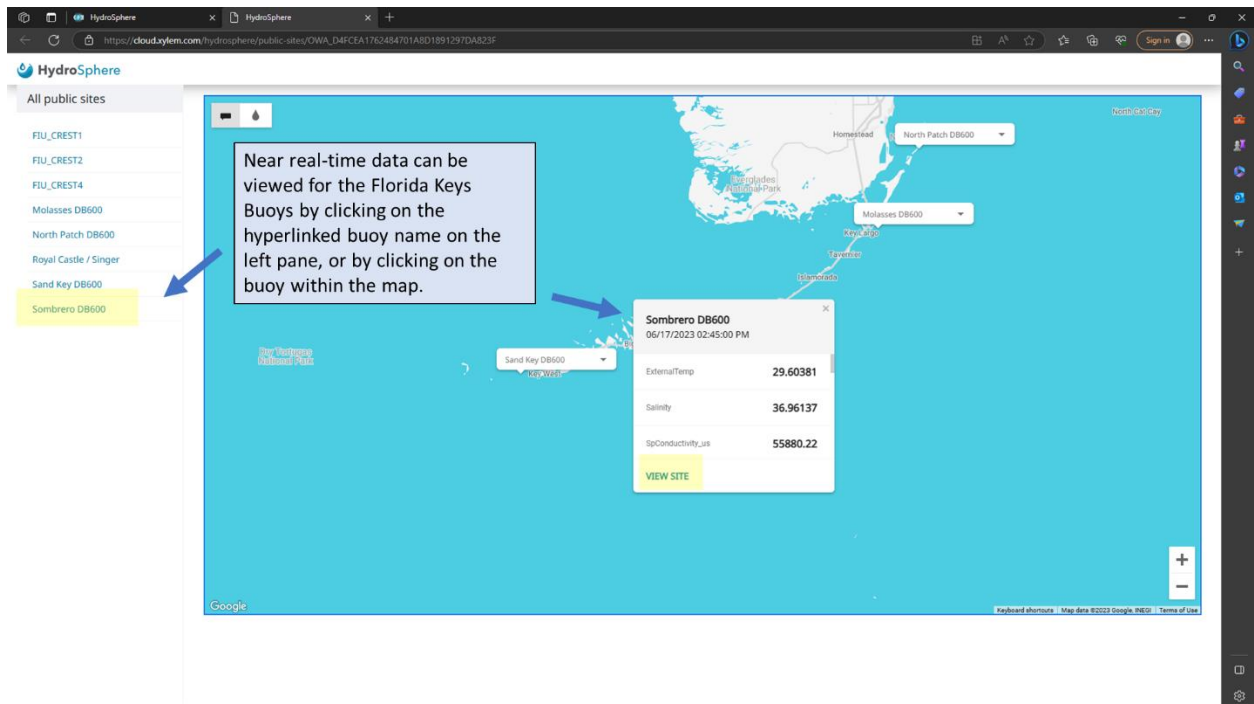
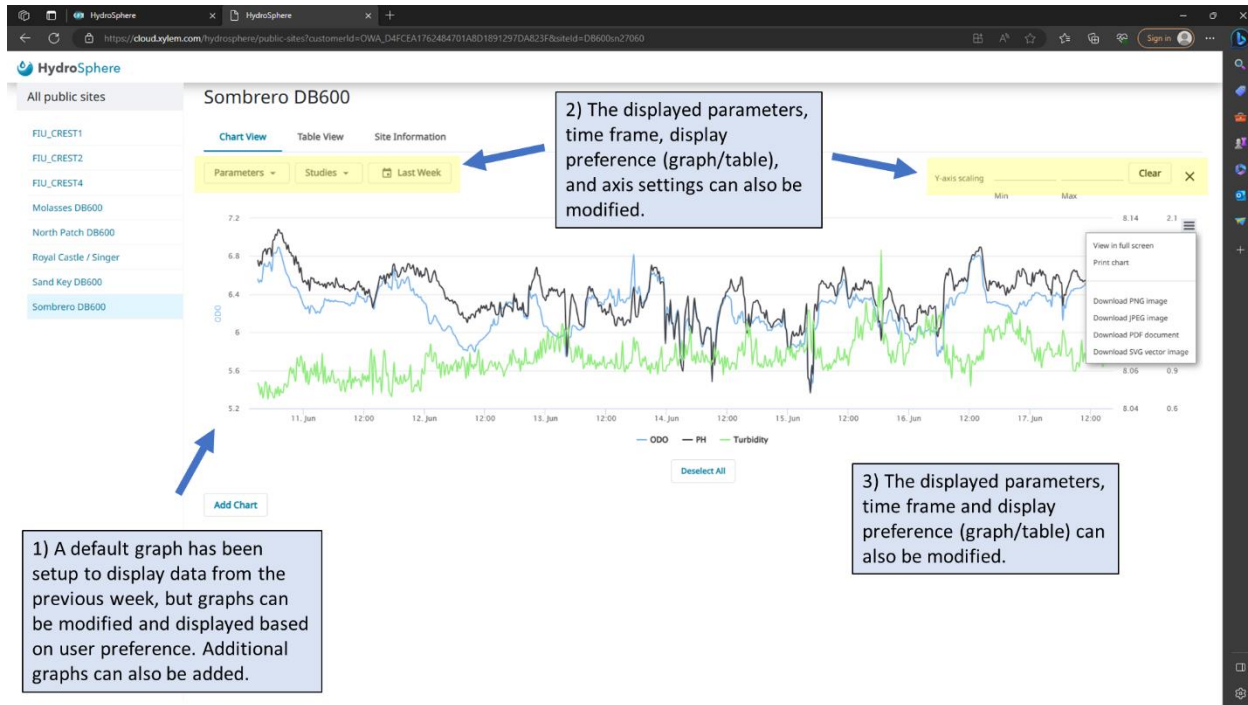


Figure 6 - Accessing site specific data on Hydrosphere.



1) A default graph has been setup to display data from the previous week, but graphs can be modified and displayed based on user preference. Additional graphs can also be added.

2) The displayed parameters, time frame, display preference (graph/table), and axis settings can also be modified.

3) The displayed parameters, time frame and display preference (graph/table) can also be modified.

Figure 7 - Site specific data visualization and user defined graph modifications.