**ELK** **NERR Water Quality Metadata**

**January to December 2019**

**Latest Update:** June 22, 2021

**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 logger to a personal computer with Windows 7 or newer operating system. 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 CDMO where they undergo automated primary QAQC; automated depth/level corrections for changes in barometric pressure (cDepth or cLevel parameters); and become part of the CDMO’s online provisional database. 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 reserve 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 CDMO. Upload after secondary QAQC results in ingestion into the database as provisional plus data, recalculation of cDepth or cLevel parameters, and finally tertiary QAQC by the CDMO and assimilation into the CDMO’s authoritative online database. 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. John Haskins and Rikke Jeppesen are responsible for data QC at ELK NERR.

**3) Research objectives**

The goal of the research and monitoring of water quality at Elkhorn Slough NERR is to establish baselines for water quality parameters for Elkhorn Slough by using South Marsh (SM) as a control site while monitoring two impacted sites, Azevedo Pond (AP), and North Marsh (NM) for possible problems. Additionally, in order to identify oceanic influence on the water quality parameters at Elkhorn Slough, we monitor a fourth site, Vierra Mouth (VM). Water quality measurements are recorded every 15 minutes over a four week period at the four sites in Elkhorn Slough. One site (SM) is in a relatively un-impacted side channel of the slough and the second site (AP), is in a pond that receives fertilizer and pesticide run-off from an adjoining strawberry field. The third site (NM) was added in April 1999 and is located in an area where there is both agricultural and non-agricultural run-off. The fourth site (VM) is located at the mouth of the slough and is used to identify oceanic influence. This site was added March 14, 2001.

**4) Research methods**

The Elkhorn Slough water quality monitoring program began in July 1995. All four sites described above are monitored simultaneously. Prior to YSI deployment at SM, a 20-foot length of 4-inch diameter PVC pipe was placed in the slough to house the YSI. Holes were drilled in the pipe to remove 10% of the pipe's surface area and to allow water flow across the YSI. The pipe was positioned vertically in the slough with one end pushed into the soft bottom sediments and the other end secured to a permanent dock. A bolt inside and across the diameter of the pipe maintains the YSI about one foot (30cm) above the bottom. The setup is exactly the same at North Marsh except that the PVC pipe is secured to shore. Prior to YSI deployment at AP, a supportive framework of rope and PVC was placed at the site to house the YSI. The structure maintained the YSI exactly one foot (30cm) above the pond bottom. In 2012, a 40 ft board walk and a 5 ft black ABS pipe were installed to replace the original sonde support structure. A larger diameter ABS pipe slides up and down the 2-inch ABS pipe, which is protruding vertically from the substrate. Perpendicularly mounted on the sliding ABS is a 4-inch diameter white PVC pipe, 3-ft long, which functions as the housing for the YSI. The white PVC housing has been drilled with 1-inch diameter holes, in order to ensure water circulation at the YSI. At Vierra Mouth, the installed PVC pipe housing the YSI sonde is the same as at South Marsh. Every 15 minutes over a 30-day period, measurements of specific conductivity, salinity, dissolved oxygen, temperature, level, turbidity, and pH are recorded. At South Marsh, additionally chlorophyll is recorded.

At the end of each approximate 28-day period, the YSI datalogger is brought back to the lab to download the data, and to clean and recalibrate the sonde. Data are downloaded onto a PC and then all data are transferred to a server at the reserve ([\\SBSERVER](file:///\\SBSERVER)). Sonde body and probes are cleaned. Calibration is performed as outlined in the YSI manual. Buffer solutions of pH 7 and pH 10 are purchased from a scientific supply store and used for two-point calibration of the pH probe. Since the beginning of July 1999 a conductivity standard of 53 mS/cm was used to calibrate the conductivity probe. The turbidity probe is calibrated using a two-point calibration with DI water (0 NTU) and 124 NTU standard. Deionized water is used to calibrate the chlorophyll probe on the sonde at SM. The DO probe was calibrated using a 2-point calibration. A mixture of 2 g sodium sulfite dissolved in 1 L tap water was left for 1 hour to equilibrate at 0% saturation. Tap water saturated with an air-stone for at least 15 minutes prior to calibration was used for the 100% saturation. Before retrieving a sonde from a site a new sonde is calibrated in the lab before retrieving the currently deployed one, in order to replace the one in the field. This eliminates the loss of data due to cleaning and calibration. QA/QC was done according to the CDMO manual by John Haskins and/or Rikke Jeppesen using the macros provided by the CDMO. Data are then looked over more rigorously to identify and document anomalies and missing data. Additionally, John Haskins uses Matlab, in order to better identify anomalies in the monthly data, by overlaying the current month’s data onto all data at a site, since 1995. This method allows to more easily identify probe drift and malfunction, in addition to natural variation in the data. This method has only been used for all four sites since 2011.

A Sutron Sat-Link2 transmitter was installed at the Azevedo Pond station on 04/22/2014 and transmits data to the NOAA GOES satellite, NESDIS ID #3B053520. 3B053520 is the GOES ID for that particular station. The transmissions are scheduled hourly and contain four (4) data sets reflecting fifteen minute data sampling intervals. Upon receipt by the CDMO, the data undergoes the same automated primary QAQC process detailed in Section 2 above. The “real-time” telemetry data become part of the provisional dataset until undergoing secondary and tertiary QAQC and assimilation in the CDMO’s authoritative online database. Provisional and authoritative data are available at [http://cdmo.baruch.sc.edu](http://cdmo.baruch.sc.edu/).

In December 2019, a Storm3 unit was installed at this site.

A Sutron Sat-Link2 transmitter was installed at the South Marsh station on 09/28/2006 and transmits data to the NOAA GOES satellite, NESDIS ID #3B026768. 3B026768 is the GOES ID for that particular station. The transmissions are scheduled hourly and contain four (4) data sets reflecting fifteen minute data sampling intervals. Upon receipt by the CDMO, the data undergoes the same automated primary QAQC process detailed in Section 2 above. The “real-time” telemetry data become part of the provisional dataset until undergoing secondary and tertiary QAQC and assimilation in the CDMO’s authoritative online database. Provisional and authoritative data are available at [http://cdmo.baruch.sc.edu](http://cdmo.baruch.sc.edu/).

A Sutron Sat-Link2 transmitter was installed at the North Marsh station on 07/17/2017 and transmits data to the NOAA GOES satellite, NESDIS ID #3B0543B0 is the GOES ID for that particular station. The transmissions are scheduled hourly and contain four (4) data sets reflecting fifteen minute data sampling intervals. Upon receipt by the CDMO, the data undergoes the same automated primary QAQC process detailed in Section 2 above. The “real-time” telemetry data become part of the provisional dataset until undergoing secondary and tertiary QAQC and assimilation in the CDMO’s authoritative online database. Provisional and authoritative data are available at [http://cdmo.baruch.sc.edu](http://cdmo.baruch.sc.edu/).

A Sutron Sat-Link2 transmitter was installed at the Vierra Mouth station on 6/27/2012 and transmits data to the NOAA GOES satellite, NESDIS ID #3B04D428. 3B04D428 is the GOES ID for that particular station. The transmissions are scheduled hourly and contain four (4) data sets reflecting fifteen minute data sampling intervals. Upon receipt by the CDMO, the data undergoes the same automated primary QAQC process detailed in Section 2 above. The “real-time” telemetry data become part of the provisional dataset until undergoing secondary and tertiary QAQC and assimilation in the CDMO’s authoritative online database. Provisional and authoritative data are available at [http://cdmo.baruch.sc.edu](http://cdmo.baruch.sc.edu/).

All four sites at ELK report level. Additional information on methods used follow:

|  |  |
| --- | --- |
| Site Name | Azevedo Pond |
| Site infrastructure description | Sonde resting in a 4-inch diameter PVC tube w/holes for flow. PVC is mounted perpendicularly on a pole driven roughly 4 feet into mud. Roughly 4 by 10 ft elevated dock to access sonde. |
| Surveying equipment | *Sprinter 250M* |
| Survey monument used | GU3197 Laser leveled to ELKS1 |
| Survey occupation date | Sept 27, 2016 |
| Survey occupation duration | 2 x 3 hr 59 min |
| Ellipsoid height | 3.109 |
| “Quick Check” marker for deployment tube | Methods still in development. Measure distance from top of dock surface to top of tube surface. This check, should be done at the beginning of each deployment. Distance = x.xx m on MM/DD/YYYY |
| “Quick Check” for sonde being deployed at the same location | Visual verification that sonde rests on bottom of deployment tube. This check, should be done at the beginning of each deployment. |
| Annual resurveying | No dates for 2019, since this is a new table/method. |

|  |  |
| --- | --- |
| Site Name | North Marsh |
| Site infrastructure description | Sonde is resting inside a 20 foot long, 4-inch diameter PVC tube, with a PVC rod, perpendicularly intersecting the tube to serve as a stop. Upper end of tube is affixed to rip-rap on land. Lower end is pounded 1-2 feet into the mud. |
| Surveying equipment | *Sprinter 250M* |
| Survey monument used | GU3197 laser leveled ELKS2 |
| Survey occupation date | Sept 27, 2016 |
| Survey occupation duration | 2 x 3 hr 59 min |
| Ellipsoid height | 1.939 |
| “Quick Check” marker for deployment tube | Methods still in development. Measure distance from top of PVC to top of marked rip-rap rock. This check, should be done at the beginning of each deployment. Distance = x.xx m on MM/DD/YYYY |
| “Quick Check” for sonde being deployed at the same location | Visual verification that sonde rests on bottom of deployment tube. This check, should be done at the beginning of each deployment. |
| Annual resurveying | No dates for 2019, since this is a new table/method. |

|  |  |
| --- | --- |
| Site Name | South Marsh |
| Site infrastructure description | Sonde resting inside a 4-inch diameter PVC tube w/holes for flow. PVC is mounted parallel to/on a pole driven roughly 4 feet into mud. The pole is supported by superstrut, as of 2018. Roughly 4 by 8 ft floating dock to access sonde. |
| Surveying equipment | *Trimble R8* |
| Survey monument used | BPSM |
| Survey occupation date | Aug 18, 2020 |
| Survey occupation duration | 4 hrs 11 min |
| Ellipsoid height | 2.949 |
| “Quick Check” marker for deployment tube | Methods still in development. Measure distance from top of PVC to top of round pole supported by superstrut. This check, should be done at the beginning of each deployment. Distance = x.xx m on MM/DD/YYYY |
| “Quick Check” for sonde being deployed at the same location | Visual verification that sonde rests on bottom of deployment tube. This check, should be done at the beginning of each deployment. |
| Annual resurveying | *Aug 18, 2020* |

|  |  |
| --- | --- |
| Site Name | Vierra Mouth |
| Site infrastructure description | Sonde resting inside a 4-inch diameter PVC tube w/holes for flow. PVC is mounted parallel to a narrow concrete pier. PVC pole driven roughly 4 feet into mud. At the bottom of the PVC is a smaller PVC perpendicular to the 4-inch tube, serving as a stop. |
| Surveying equipment | *Trimble 5800* |
| Survey monument used | VCB1 |
| Survey occupation date | Sept 11, 2018 |
| Survey occupation duration | 2 hrs 44 min |
| Ellipsoid height | 3.474 |
| “Quick Check” marker for deployment tube | Methods still in development. Measure distance from top of PVC to top of concrete pier surface. This check, should be done at the beginning of each deployment. Distance = x.xx m on MM/DD/YYYY |
| “Quick Check” for sonde being deployed at the same location | Methods still in development. Measure distance from top of 4 inch PVC to bottom of sonde cage, while sonde is lodged inside the tube. Duct tape a meter tape to the sonde cage. This check, should be done at the beginning of each deployment. Distance = 5.135 m on 02/01/2021 |
| Annual resurveying | *Sept 11, 2018* |

**5) Site location and character**

Azevedo Pond (AP)(36°50’44.64”N, 121°45’13.24”W) is in a pond that receives fertilizer and pesticide run-off from a strawberry field in year-round production. The sample station is located about 10m from a tidal control structure in front of a culvert connecting the pond to the slough. In 2019, the tide ranged from 1.19 m to 2.36 meters at this site and salinity ranged from 12.4 ppt during heavy run-off to 38.9 ppt during strong evaporation. The YSI sonde associated with this site (collecting readings for the water quality dataset) is located approximately 30 cm off the bottom, which is composed of silty mud. An EXO2 sonde is deployed at this site.

North Marsh (NM)(36°50’04.75”N, 121°44’18. 33”W) is located in-between South Marsh and Azevedo Pond. This site is impacted by both agricultural and urban run-off. In 2019, the tide ranged from approximately 0.61 m to 1.20 meters at this site. Salinity ranged between 15.3 and 41.2 ppt and is affected by freshwater run-off from agriculture and upland run-off. The YSI sonde associated with this site (WQ dataset) is approximately 30 cm off the bottom, which is composed of silty mud. An EXO2 sonde is deployed at this site.

South Marsh (SM)(36°49’05.00”N, 121°44’21.83”W) which is located approximately 3 km south of NM and is surrounded by mostly reserve land, is in a side channel of the slough and is relatively free from impact by anthropogenic influence. This site receives run-off mostly from uplands with some run-off coming from cattle ranches. This site receives the least amount of pollution. In 2019, the tidal range was from x.xx to y.yy meters at this site and the salinity range was from 28.3 to 36.2 ppt. The YSI sonde associated with this site (collecting readings for the water quality dataset) is approximately 30 cm off the bottom, which is composed of compacted silty mud.

An EXO2 sonde is deployed at this site.

The fourth site Vierra Mouth (VM) (36°48’39.95”N, 121°46’45.22”W) is located at the mouth of the slough and is used to identify oceanic influence. In 2019, the tidal range was from -0.39 m to 2.21 meters at this site and salinity ranged from 23.5 to 33.8 ppt. The YSI sonde associated with this site (collecting readings for the water quality dataset) is located approximately 30 cm off the bottom which is composed of compacted mud and sand due to strong tidal currents. This site receives drainage from the entire watershed due to its location at the mouth. There are several auto wrecking yards located approximately 2 km east of this site. An EXO2 sonde is deployed at this site.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Station Code | SWMP Status | Station Name | Location | Active Dates | Reason Decommissioned | Notes |
| AP | P | Azevedo Pond | 36°50’44.64”N, 121°45’13.24”W | June 1995-current | NA | NA |
| NM | P | North Marsh | 36°50’04.75”N, 121°44’18. 33”W | April 1999 - curernt | NA | NA |
| SM | P | South Marsh | 36°49’05.00”N, 121°44’21.83”W | June 1995-current | NA | NA |
| VM | P | Vierra Mouth | 36°48’39.95”N, 121°46’45.22”W | March 2001 - current | NA | NA |

**6) Data collection period**

Sampling at Azevedo Pond and South Marsh began simultaneously at the end of June 1995 and data collection is ongoing. North Marsh began sampling on April 15, 1999. Vierra Mouth began sampling on March 14, 2001 at 13:00.

**Deployment recovery times and dates**

**Azevedo Pond**

Start Date Start Time End Date End Time

12/03/2018 11:30 01/02/2019 12:15

01/02/2019 12:30 01/28/2019 10:45

01/28/2019 11:00 02/25/2019 13:00

02/25/2019 13:15 03/27/2019 09:15

03/27/2019 09:30 04/25/2019 08:45

04/25/2019 09:00 05/20/2019 10:15

05/20/2019 10:30 06/17/2019 09:45

06/17/2019 10:00 07/15/2019 09:45

07/15/2019 10:00 08/12/2019 13:30

08/12/2019 13:45 09/09/2019 10:45

09/09/2019 11:00 10/07/2019 10:00

10/07/2019 10:15 11/04/2019 11:00

11/04/2019 11:15 12/02/2019 12:00

12/02/2019 12:15 12/27/2019 12:45

12/27/2019 13:00 01/27/2020 11:30

**North Marsh**

Start Date Start Time End Date End Time

12/10/2018 10:30 01/07/2019 12:30

01/07/2019 12:45 02/04/2019 10:30

02/04/2019 10:45 03/04/2019 11:00

03/04/2019 11:15 04/01/2019 10:15

04/01/2019 10:30 04/29/2019 11:00

04/29/2019 11:15 05/28/2019 12:45

05/28/2019 13:00 06/24/2019 10:00

06/24/2019 10:15 07/22/2019 12:30

07/22/2019 12:45 08/19/2019 10:45

08/19/2019 11:00 09/16/2019 13:00

09/16/2019 13:15 10/14/2019 12:45

10/14/2019 13:00 11/11/2019 11:00

11/11/2019 11:15 12/09/2019 12:15

12/09/2019 12:30 01/06/2020 12:30

**South Marsh**

Start Date Start Time End Date End Time

12/19/2018 11:15 01/23/2019 11:45

01/23/2019 12:00 02/18/2019 11:45

02/18/2019 12:00 03/20/2019 14:15

03/20/2019 14:30 04/17/2019 08:45

04/17/2019 09:00 05/13/2019 10:30

05/13/2019 10:45 06/10/2019 10:45

06/10/2019 11:30 07/08/2019 09:45

07/08/2019 10:00 08/05/2019 11:45

08/05/2019 12:00 09/03/2019 10:45

09/03/2019 11:00 09/30/2019 11:15

09/30/2019 11:30 10/29/2019 10:15

10/29/2019 10:30 11/25/2019 12:00

11/25/2019 12:15 12/23/2019 11:30

12/23/2019 11:45 01/20/2020 10:45

**Vierra Mouth**

Start Date Start time End Date End Time

12/17/2018 11:00 01/14/2019 12:15

01/14/2019 12:30 02/11/2019 12:30

02/11/2019 12:45 03/08/2019 11:30

03/08/2019 11:45 04/08/2019 11:30

04/08/2019 11:45 05/06/2019 10:45

05/06/2019 11:00 06/03/2019 11:30

06/03/2019 12:00 06/26/2019 13:00

06/26/2019 13:45 07/29/2019 11:15

07/29/2019 11:30 08/26/2019 10:45

08/26/2019 11:15 09/23/2019 11:00

09/23/2019 11:30 10/21/2019 11:15

10/21/2019 11:30 11/19/2019 11:45

11/19/2019 12:00 12/16/2019 11:45

12/16/2019 12:00 01/13/2020 11:15

**7) Distribution**

NOAA retains the right to analyze, synthesize and publish summaries of the NERRS System-wide Monitoring Program data.  The NERRS retains the right to be fully credited for having collected and process the data.  Following academic courtesy standards, the NERR site where the data were collected should be contacted and fully acknowledged in any subsequent publications in which any part of the data are used.  The data set enclosed within this package/transmission is only as good as the quality assurance and quality control procedures outlined by the enclosed metadata reporting statement.  The user bears all responsibility for its subsequent use/misuse in any further analyses or comparisons.  The Federal government does not assume liability to the Recipient or third persons, nor will the Federal government reimburse or indemnify the Recipient for its liability due to any losses resulting in any way from the use of this data.

Requested citation format:

NOAA National Estuarine Research Reserve System (NERRS). System-wide Monitoring Program. Data accessed from the NOAA NERRS Centralized Data Management Office website: <http://www.nerrsdata.org/>; *accessed* 12 October 2020.

Also include the following excerpt in the metadata which will address how and where the data can be obtained.

NERR water quality data and metadata can be obtained from the Research Coordinator at the individual NERR site (please see Principal Investigators and Contact Persons), from the Data Manager at the Centralized Data Management Office (please see personnel directory under the general information link on the CDMO home page) and online at the CDMO home page [www.nerrsdata.org](http://www.nerrsdata.org).  Data are available in comma delimited format.

**8) Associated researchers and projects**

As part of the SWMP long-term monitoring program, ELK NERR also monitors 15-minute meteorological along with monthly grab samples and diel sampling for nutrient data which may be correlated with this water quality dataset. These data are available at [www.nerrsdata.org](http://www.nerrsdata.org)

In addition to our reserve staff, multiple researchers from multiple institutions conduct research that makes use of our long-term monitoring data. The researchers are listed below.

**Research conducted by reserve staff**

Susie Fork conducts field survey monitoring of shorebirds; egret and heron rookery, bird nest boxes, raptors, and invertebrate populations.

Rikke Jeppesen and Susie Fork conduct annual crab trapping in order to track crab populations, particularly invasions by non-native European crabs. Additionally, Susie Fork conducts annual invertebrate surveys on mudflats, in permanent transects. The surveys include various clam and shrimp species, in addition to fat innkeeper worms.

Charlie Endris works on remote-sensing using GIS to analyze habitat change and NERR bio-monitoring pilot studies for Tier 1, emergent vegetation.

Kerstin Wasson monitors oyster recruitment and conducts experiments to determine the status and trajectory of native oyster populations.

John Haskins and Rikke Jeppesen conduct water quality research currently focusing on eutrophication in the slough and are managing the SWMP weather monitoring and the SWMP water quality programs, from which the data are used in conjunction with eutrophication research.

**The following researchers are affiliated with other institutions.**

Aiello, Ivano, Moss Landing Marine Laboratories: examines sediment characteristics relevant to Hester Marsh restoration by collecting sediment cores using a Vibrocore

Apodaca, Alec, University of California Berkeley, uses instruments to assess topography, canoe surveys to examine banks, auger holes to examine sediment, in order to understand indigenous interactions with estuarine resources

Behesti, Kat; University of California, Santa Cruz: monitors marsh, crabs, and otters with fencing experiments to examine the effects of otters and crabs on salt marsh health.

Francis, Chris, Stanford University: collects water samples and sediment cores to study the diversity and activity of (de)-nitrifying microbial communities

Gaskins, Leo, Duke University: collects native crabs, *Pachygrapsus crassipes*, tether and video observe them to investigate predation on crabs by raccoons and Southern sea otters

Hammerstrom, Kamille; Oliver, John; Moss Landing Marine Laboratories: assess effects of Parsons sill on benthic infauna, coffee-can cores and sieving of mud; from shore and boat

Jue, Nathaniel, California State University Monterey Bay: collects soil and water samples at South Marsh and Whistlestop to examine microbial processes remediating pesticides

Parkin, Jennifer; ESNERR volunteer; monitors salt marsh restoration effects on water birds, and observes the tern colony

Searcy, Chris, University of Miami: installs drift fences and checks pitfall traps to assess salamander metamorph success at Upper Cattail Pond.

Siegler, Katie, University of California, Davis: seines for topsmelt to study the levels of pesticide in indicator species

Tanner, Karen, Martin Genova; University of California Santa Cruz; transplants and monitors plants to explore the role of mycorrhizae in supporting marsh plants

**Frequent docent researchers**: Shirley Murphy (various bird monitoring programs). Ron Eby (marsh, bird, otter monitoring). Celeste Stanik, Margie Kay, Ken Pollak, Jennifer Parkin (NUT monitoring field and lab work).

**Frequent interns:** Kathleen Hicks (water quality interns).

**II. Physical Structure Descriptors**

**9) Sensor specifications –**

ELK NERR deployed EXO2 data loggers at all four sites in 2019. All sondes are the same model with the same probe configuration at each site except that SM has a chlorophyll probe, while the other three sites do not.

YSI EXO Sonde:

Parameter: Temperature

Units: Celsius (C)

Sensor Type: CT2 Probe, Thermistor

Model#: 599870

Range: -5 to 50 C

Accuracy: -5 to 35: +/- 0.01, 35 to 50: +/- .005

Resolution: 0.01 C

Parameter: Conductivity

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

Sensor Type: CT2 Probe, 4-electrode cell with autoranging

Model#: 599870

Range: 0 to 200 mS/cm

Accuracy: 0 to 100: +/- 0.5% of reading or 0.001 mS/cm; 100 to 200: +/- 1% of reading

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

Parameter: Salinity

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

Sensor Type: CT2 probe, Calculated from conductivity and temperature

Range: 0 to 70 psu

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

Resolution: 0.01 psu

OR

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

Parameter: Chlorophyll

Units: micrograms/Liter

Sensor Type: Optical probe

Model#: 599102-01

Range: 0 to 400 ug/Liter

Accuracy: Dependent on methodology

Resolution: 0.1 ug/L chl a, 0.1% FS

**Depth Qualifier:**

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

Beginning in 2006, NERR SWMP standard calibration protocol calls for all non-vented depth sensors to read 0 meters at a (local) barometric pressure of 1013.25 mb (760 mm/hg).  To achieve this, each site calibrates their depth sensor with a depth offset number, which is calculated using the actual atmospheric pressure at the time of calibration and the equation provided in the SWMP calibration sheet or digital calibration log.  This offset procedure standardizes each depth calibration for the entire NERR System.  If accurate atmospheric pressure data are available, non-vented sensor depth measurements at any NERR can be corrected.

In 2010, the CDMO began automatically correcting depth/level data for changes in barometric pressure as measured by the reserve’s associated meteorological station during data ingestion. These corrected depth/level data are reported as cDepth and cLevel, and are assigned QAQC flags and codes based on QAQC protocols. Please see sections 11 and 12 for QAQC flag and code definitions.

**NOTE: older depth data cannot be corrected without verifying that the depth offset was in place and whether a vented or non-vented depth sensor was in use. No SWMP data prior to 2006 can be corrected using this method.** The following equation is used for corrected depth/level data provided by the CDMO beginning in 2010:

((1013-BP)\*0.0102)+Depth/Level = cDepth/cLevel.

**Salinity Units Qualifier:**

In 2013, EXO sondes were approved for SWMP use and began to be utilized by reserves. While the 6600 series sondes report salinity in parts per thousand (ppt) units, the EXO sondes report practical salinity units (psu). These units are essentially the same and for SWMP purposes are understood to be equivalent, however psu is considered the more appropriate designation. Moving forward the NERR System will assign psu salinity units for all data regardless of sonde type.

**Turbidity Qualifier:**

In 2013, EXO sondes were approved for SWMP use and began to be utilized by reserves. While the 6600 series sondes report turbidity in nephelometric turbidity units (NTU), the EXO sondes use formazin nephelometric units (FNU). These units are essentially the same but indicate a difference in sensor methodology, for SWMP purposes they will be considered equivalent. Moving forward, the NERR System 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.

**Chlorophyll Fluorescence Disclaimer:**

YSI chlorophyll sensors (6025 or 599102-01) are designed to serve as a proxy for chlorophyll concentrations in the field for monitoring applications and complement traditional lab extraction methods; therefore, there are accuracy limitations associated with the data that are detailed in the YSI manual including interference from other fluorescent species, differences in calibration method, and effects of cell structure, particle size, organism type, temperature, and light on sensor measurements.

**10) Coded variable definitions**

Sampling station: Sampling site code: Station code:

Azevedo Pond AP elkapwq

North Marsh NM elknmwq

South Marsh SM elksmwq

Vierra Mouth VM elkvmwq

**11) QAQC flag definitions**

QAQC flags provide documentation of the data and are applied to individual data points by insertion into the parameter’s associated flag column (header preceded by an F\_). During primary automated QAQC (performed by the CDMO), -5, -4, and -2 flags are applied automatically to indicate data that is missing and above or below sensor range. All remaining data are then flagged 0, passing initial QAQC checks. During secondary and tertiary QAQC 1, -3, and 5 flags may be used to note data as suspect, rejected due to QAQC, or corrected.

-5 Outside High Sensor Range

-4 Outside Low Sensor Range

-3 Data Rejected due to QAQC

-2 Missing Data

-1 Optional SWMP Supported Parameter

0 Data Passed Initial QAQC Checks

1 Suspect Data

2 *Open - reserved for later flag*

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

4 Historical Data: Pre-Auto QAQC

5 Corrected Data

**12) QAQC code definitions**

QAQC codes are used in conjunction with QAQC flags to provide further documentation of the data and are also applied by insertion into the associated flag column. There are three (3) different code categories, general, sensor, and comment. General errors document general problems with the deployment or YSI datasonde, sensor errors are sensor specific, and comment codes are used to further document conditions or a problem with the data. Only one general or sensor error and one comment code can be applied to a particular data point, but some comment codes (marked with an \* below) can be applied to the entire record in the F\_Record column.

General Errors

GIC No instrument deployed due to ice

GIM Instrument malfunction

GIT Instrument recording error; recovered telemetry data

GMC No instrument deployed due to maintenance/calibration

GNF Deployment tube clogged / no flow

GOW Out of water event

GPF Power failure / low battery

GQR Data rejected due to QA/QC checks

GSM See metadata

Corrected Depth/Level Data Codes

GCC Calculated with data that were corrected during QA/QC

GCM Calculated value could not be determined due to missing data

GCR Calculated value could not be determined due to rejected data

GCS Calculated value suspect due to questionable data

GCU Calculated value could not be determined due to unavailable data

Sensor Errors

SBO Blocked optic

SCF Conductivity sensor failure

SCS Chlorophyll spike

SDF Depth port frozen

SDG Suspect due to sensor diagnostics

SDO DO suspect

SDP DO membrane puncture

SIC Incorrect calibration / contaminated standard

SNV Negative value

SOW Sensor out of water

SPC Post calibration out of range

SQR Data rejected due to QAQC checks

SSD Sensor drift

SSM Sensor malfunction

SSR Sensor removed / not deployed

STF Catastrophic temperature sensor failure

STS Turbidity spike

SWM Wiper malfunction / loss

Comments

CAB\* Algal bloom

CAF Acceptable calibration/accuracy error of sensor

CAP Depth sensor in water, affected by atmospheric pressure

CBF Biofouling

CCU Cause unknown

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

CDB\* Disturbed bottom

CDF Data appear to fit conditions

CFK\* Fish kill

CIP \* Surface ice present at sample station

CLT\* Low tide

CMC\* In field maintenance/cleaning

CMD\* Mud in probe guard

CND New deployment begins

CRE\* Significant rain event

CSM\* See metadata

CTS Turbidity spike

CVT\* Possible vandalism/tampering

CWD\* Data collected at wrong depth

CWE\* Significant weather event

**13) Post deployment information**

**Azevedo Pond**

Retrieval DO% DO% pH pH Level Turb Turb Cond Batt

Date of post-cal (0) (100) (7.0) (10.0) (0.0m) (0.0 NTU) (124.0 NTU) (53 ms/cm) (V)

01/02/2019 0.1 101.9 7.13 10.08 0.617 0.01 123.90 54.01 6.0

01/28/2019 -0.1 101.7 7.15 10.05 ND -0.02 125.19 53.90 5.7

02/25/2019 ND 103.3 7.09 9.96 1.062 0.08 121.70 52.87 5.8

03/27/2019 -0.5 100.1 7.15 10.07 1.053 0.23 122.60 53.15 5.6

04/25/2019 -0.6 100.7 7.03 9.98 1.070 0.11 129.75 52.70 5.3

05/20/2019 -0.7 102.3 7.11 9.94 1.069 -0.01 126.98 52.85 5.8

06/17/2019 -0.4 101.7 7.08 9.91 1.022 0.05 123.12 53.20 6.0

07/15/2019 -0.2 101.8 7.10 10.07 1.072 -0.03 124.38 51.13 5.5

08/12/2019 0.7 99.6 7.31 10.31 1.045 0.10 124.38 53.39 5.9

09/09/2019 -0.2 102.4 7.09 10.08 1.048 0.09 123.94 34.69 5.1

10/07/2019 0.1 100.20 7.17 10.09 1.032 -0.01 122.64 52.70 5.4

11/04/2019 ND 103.5 7.15 10.14 1.039 0.08 124.96 51.89 5.3

12/02/2019 0.6 105.2 7.27 10.15 1.057 0.10 126.39 52.92 5.3

12/27/2019 0.0 100.4 7.24 9.95 ND 0.03 120.7 45.2 5.9

01/27/2020 0.2 104.5 7.09 10.12 1.229 0.84 121.36 53.25 5.5

**North Marsh**

Retrieval DO% DO% pH pH Level Turb Turb Cond Batt

Date of post-cal (0) (100) (7.0) (10.0) (0.0m) (0.0 NTU) (124.0 NTU) (53 ms/cm) (V)

01/07/2019 0.1 101.4 6.94 9.87 0.597 0.07 123.51 52.63 5.4

02/04/2019 0.9 104.1 7.12 10.06 ND 0.10 120.25 52.75 5.9

03/04/2019 0.9 100.1 7.05 9.94 0.590 -0.05 124.30 52.83 5.4

04/01/2019 0.4 100.1 7.28 10.20 0.546 1.52 115.10 53.32 5.7

04/29/2019 -0.3 99.7 7.25 10.12 0.503 0.09 128.95 54.36 5.6

05/28/2019 ND 100.5 7.03 10.05 0.553 0.04 125.54 52.01 6.1

06/24/2019 0.3 98.4 7.23 10.11 0.531 1.37 111.75 51.74 5.3

07/22/2019 0.4 102.2 7.10 10.02 0.542 -0.19 124.03 52.77 5.8

08/19/2019 0.2 104.5 7.26 10.27 0.563 0.15 122.82 52.98 6.1

09/16/2019 0.8 98.9 7.09 9.98 ND 0.03 124.3 51.93 5.8

10/14/2019 0.7 104.5 7.20 10.20 0.530 0.01 124.10 52.90 5.7

11/11/2019 -0.2 101.8 7.38 10.19 0.557 0.00 124.74 54.07 5.4

12/09/2019 -0.1 102.2 6.95 9.89 0.592 -0.03 123.52 52.07 5.4

01/06/2020 0.5 104.5 7.16 10.06 0.697 0.36 117.79 53.68 5.8

**South Marsh**

Retrieval DO% DO% pH pH Level Turb Turb Cond Batt

Date of post-cal (0) (100) (7.0) (10.0) (0.0m) (0.0 NTU) (124.0 NTU) (53 ms/cm) (V)

01/23/2019 0.9 105.8 6.95 9.89 -0.866 0.06 125.18 53.11 5.9

02/18/2019 -0.1 101.2 7.17 10.07 -1.524 5.20 109.23 53.34 5.7

03/20/2019 0.3 101.0 6.98 9.92 -1.117 0.02 125.30 53.17 5.4

04/17/2019 0.6 104.1 7.28 9.99 -1.042 0.01 128.63 53.51 5.9

05/13/2019 -0.2 102.0 6.98 9.89 -1.099 -1.93 122.47 53.54 6.0

06/10/2019 1.3 100.0 7.09 9.90 -1.133 -0.71 124.04 49.03 5.6

07/08/2019 0.2 99.7 7.06 10.01 -0.983 0.48 124.46 51.44 5.6

08/05/2019 0.01 101.0 7.04 9.91 ND 0.51 126.65 53.48 6.0

09/03/2019 0.3 101.9 7.29 10.31 -1.013 0.06 123.30 53.03 5.5

09/30/2019 0.7 104.7 7.13 10.05 -1.016 0.04 126.14 51.53 5.1

10/29/2019 -0.2 103.1 6.86 9.76 -1.038 2.77 123.30 53.33 5.4

11/25/2019 0.8 104.1 7.15 10.08 -1.020 0.03 126.02 53.45 5.9

12/23/2019 0.3 100.5 7.35 10.17 -1.061 -0.05 120.74 52.85 5.2

01/20/2020 0.6 104.1 7.22 10.09 -0.973 0.16 123.08 53.03 5.2

**Vierra Mouth**

Retrieval DO% DO% pH pH Level Turb Turb Cond Batt

Date of post-cal (0) (100) (7.0) (10.0) (0.0m) (0.0 NTU) (124.0 NTU) (53 ms/cm) (V)

01/14/2019 -0.2 98.60 7.06 10.09 -1.929 0.06 124.75 53.58 5.9

02/11/2019 0.6 98.80 7.01 9.96 -1.705 -0.02 123.56 52.65 5.3

03/08/2019 -0.4 104.1 7.13 10.06 -1.748 0.00 122.70 52.52 5.6

04/08/2019 0.4 103.2 7.15 10.04 -1.708 0.14 130.66 53.09 4.9

05/06/2019 0.2 102.5 7.03 9.96 -1.797 0.09 123.83 53.10 5.6

06/03/2019 0.2 100.6 7.06 10.03 -1.801 0.7 123.77 53.17 out

06/26/2019 0.3 102.3 7.21 10.11 -1.791 0.03 123.06 53.11 5.3

07/29/2019 -0.5 102.2 7.07 9.94 -0.997 -0.02 123.82 53.04 5.4

08/26/2019 -0.2 101.9 7.20 10.08 -1.820 -0.08 124.14 51.91 5.3

09/23/2019 -0.4 99.5 6.92 9.85 -1.825 -0.05 124.940 52.07 4.6

10/21/2019 ND 103.5 6.18 6.17 -1.762 0.06 123.53 52.95 5.4

11/19/2019 ND 99.1 7.05 9.77 ND 11.86 118.80 54.07 0

12/16/2019 No post-cal data. No communication with sonde

01/13/2020 -0.2 101.4 7.13 10.05 -1.677 0.09 123.53 52.80 4.8

\*Note: pH post-deployment readings are temperature dependent and minor variations are expected as a result.

ND = no data

**14) Other remarks/notes**

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

Additional metadata for elkapwq2019:

01/01/2019 00:00:00 to 01/15/2019 10:30:00

Depth was calibrated incorrectly. 0.628m was subtracted from all depth readings.

03/03/2019 11:30:00 to 03/27/2019 08:30:00

Batillaria snail got wedged in between wiper and cond/temp probe, causing the wiper to malfunction for the remainder of this deployment

06/17/2019 10:00:00 to 06/17/2019 12:00:00

A survey of a nearby experiment influenced turbidity and other parameters during this time.

Additional metadata for elknmwq2019:

05/28/2019 13:00:00 to 06/24/2019 10:00:00

Upon sonde retrieval wiper had fallen off. Towards end of deployment, turbidity sensor had biofouling on the sensor tip. Probably affected readings after 06/17/2019.

Additional metadata for elksmwq2019:

12/19/2018 10:45:00 to 01/23/2019 11:45:00

Depth correction was -1.015m and it should have been -1.138m. Therefore 0.123m was subtracted from all depths for this deployment.

01/23/2019 12:00:00 to 02/18/2019 11:45:00

Depth correction was -1.623m and it should have been -1.138m. Therefore 0.485m was added to all depths for this deployment.

Additional metadata for elkvmwq2019:

06/26/2020 13:15:00 to 07/29/2020 11:15:00

Depth calibration offset was mistakenly set to -1.015m while it should have been -1.791m. Therefore, 1.791 – 1.015 = 0.776m was subtracted from all depth readings, to obtain the correct level in the QA’d data.