**Elkhorn Slough (ELK) NERR Water Quality Metadata**

**January 2013 to December 2013**

**Latest Update:** March 13, 2014

**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 (IBM compatible). Files are exported from EcoWatch in a comma-delimited format (.CDF) and uploaded to the CDMO where the data undergo automated primary QAQC and become part of the CDMO’s online provisional database. All pre- and post-deployment data are removed from the .CDF file prior to upload. During primary QAQC, data are flagged if they are missing or out of sensor range. The edited file is returned to the ELK Reserve 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 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 (compiled as a quarterly, and consequently as an annual file) for upload to the CDMO. Upload after secondary QAQC results in ingestion into the database as provisional plus data, 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. Persons responsible for sonde calibration and deployment were John Haskins, Miguel Rodriguez, Brady Latham, Laura Mercado and Rikke Preisler. Persons responsible for data management and QA/QC were John Haskins, Miguel Rodriguez, and Rikke Preisler.

**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 as the control site while monitoring the two impacted sites (Azevedo Pond and North Marsh) for possible future 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 three to four week period at the four sites in Elkhorn Slough. One site, South Marsh (SM), is in a relatively un-impacted side channel of the slough and the second site, Azevedo Pond (AP), is in a pond that receives fertilizer and pesticide run-off from an adjoining strawberry field. The third site, North Marsh (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, Vierra Mouth, 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 in the pipe maintains the YSI exactly one foot (30cm) above the bottom. This 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 maintains the YSI exactly one foot (30cm) above the pond bottom. 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, depth, turbidity, and pH are recorded. At South Marsh, additionally chlorophyll is recorded.

At the end of each approximate 30-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 126 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 2 hours to equilibrate at 0% saturation. Tap water saturated with an airstone 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, Miguel Rodriguez, and Rikke Preisler 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 and Rikke Preisler has started using 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 in 2011.

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/).

**5) Site location and character**

Elkhorn Slough is located on the West Coast of the United States in Central California. It connects with the Pacific Ocean in central Monterey Bay near Moss Landing, California. There are four sampling sites.

AP (Azevedo Pond)(36°50’44.64”N, 121°45’13.24”W) is in a pond that receives fertilizer and pesticide runoff from a strawberry field in year-round production. The YSI is located about 10m from a tidal control structure in front of a culvert connecting the pond to the slough. The tide ranged from 1.07 to 2.48 meters and salinity ranged from 23.4 ppt during heavy run-off to 42.1 ppt during strong evaporation. The sonde is located approximately 30 cm off the bottom, which is composed of silty mud.

NM (North Marsh)(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. The tide ranged from approximately 0.63 to 1.12 meters. Salinity ranged between 29.0 and 44.2 ppt and is affected by freshwater run-off from agriculture and upland run-off. The sonde is approximately 30 cm off the bottom, which is composed of silty mud.

SM (South Marsh)(36°49’05.00”N, 121°44’21.83”W) is located approximately 3 km south of NM and is surrounded by mostly reserve land. This site receives run-off mostly from uplands with some run-off coming from cattle ranches. This site receives the least amount of pollution. The tidal range was from -0.46 to 2.38 meters and the salinity range was from 27.8 to 34.9 ppt. The sonde is approximately 30 cm off the bottom, which is composed of slightly compacted silty mud.

The fourth site, VM (Vierra Mouth)(36°48’39.95”N, 121°44’45.40”W), is located at the mouth of the slough and is used to identify oceanic influence. The tidal range was from -0.45 to 2.30 meters and salinity ranged from 29.7 to 34.9 ppt. The sonde 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 since it is at the mouth of the slough. There are several auto-wreck yards located approximately 2 km east of this site.

**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

12/10/2012 12:15 01/07/2013 12:15

01/07/2013 12:00 02/04/2013 10:45\*

02/04/2013 11:00 03/04/2013 12:00

03/04/2013 12:00 04/01/2013 13:15

04/01/2013 13:30 04/30/2013 11:45

04/30/2013 11:30 05/13/2013 11:00\*\*

05/13/2013 13:45\*\* 05/30/2013 08:45

05/30/2013 08:30 06/24/2013 11:15

06/24/2013 11:00 07/22/2013 11:00

07/22/2013 10:45 08/19/2013 11:15

08/19/2013 11:15 09/16/2013 13:00

09/16/2013 13:15 10/14/2013 13:00

10/14/2013 12:45 11/11/2013 11:45\*\*\*

11/11/2013 11:30 12/09/2013 11:15

12/09/2013 11:00 01/06/2014 11:15

\*sonde stopped working 3 days into deployment due to water in battery compartment, data after 01/10/2014 02:15:00 from this time window was from EXO sonde

\*\*data missing from 5/13/2013 11:00:00 to 5/13/2013 13:45:00 due to instrument maintenance

\*\*\*sonde ran out of battery on 11/02/2013 00:45:00

**North Marsh**

Start Date Start Time End Date End Time

12/18/2012 12:30 01/15/2013 12:30

01/15/2013 12:15 02/15/2013 15:00

02/15/2013 14:45 03/11/2013 11:00

03/11/2013 10:45 04/08/2013 11:00

04/08/2013 10:45 05/06/2013 10:30

05/06/2013 10:15 06/03/2013 11:00

06/03/2013 10:45 07/01/2013 11:00

07/01/2013 10:00 07/29/2013 11:00

07/29/2013 10:45 08/27/2013 09:30

08/27/2013 09:15 09/23/2013 15:30

09/23/2013 13:30 10/21/2013 11:15

10/21/2013 11:00 11/18/2013 11:30

11/18/2013 11:15 12/16/2013 13:00

12/16/2013 12:45 01/13/2014 11:30

**South Marsh**

Start Date Start Time End Date End Time

12/04/2012 10:00 01/02/2013 12:15

01/02/2013 12:00 01/28/2013 13:15

01/28/2013 13:00 02/25/2013 12:30

02/25/2013 12:30 03/25/2013 11:00

03/25/2013 10:45 04/22/2013 10:45

04/22/2013 10:30 05/21/2013 11:15

05/21/2013 11:00 06/17/2013 11:00

06/17/2013 10:45 07/15/2013 10:30

07/15/2013 10:15 08/12/2013 10:30

08/12/2013 10:15 09/10/2013 12:45

09/10/2013 12:15 10/08/2013 09:00

10/08/2013 08:45 11/04/2013 11:30

11/04/2013 11:15 12/02/2013 11:15

12/02/2013 11:00 01/02/2014 11:45

**Vierra Mouth**

Start Date Start time End Date End Time

12/24/2012 15:00 01/24/2013 11:15

01/24/2013 11:00 02/18/2013 12:30

02/18/2013 12:15 03/18/2013 11:45

03/18/2013 11:30 04/15/2013 11:00

04/15/2013 10:45 05/14/2013 07:45

05/14/2013 08:00 06/10/2013 11:15

06/10/2013 11:00 07/08/2013 10:30

07/08/2013 10:15 08/05/2013 11:00

08/05/2013 11:15 09/05/2013 12:00

09/05/2013 11:45 09/30/2013 11:00

09/30/2013 11:30 10/28/2013 10:30

10/28/2013 10:15 11/25/2013 11:30

11/25/2013 11:15 12/23/2013 11:45

12/23/2013 11:30 01/21/2014 11:45

**7) Distribution**.

NOAA/ERD retains the right to analyze, synthesize and publish summaries of the NERRS System-wide Monitoring Program data. The PI retains the right to be fully credited for having collected and processed the data. Following academic courtesy standards, the PI and NERR site where the data were collected will be contacted and fully acknowledged in any subsequent publications in which any part of the data are used. Manuscripts resulting from this NOAA/OCRM supported research that are produced for publication in open literature, including refereed scientific journals, will acknowledge that the research was conducted under an award from the Estuarine Reserves Division, Office of Ocean and Coastal Resource Management, National Ocean Service, National Oceanic and Atmospheric Administration. 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.

NERR water quality data and metadata can be obtained from the Research Coordinator, Kerstin Wasson: [kerstin.wasson@gmail.com](mailto:kerstin.wasson@gmail.com) at the ELK NERR site (please see Principal Investigators and Contact Persons above too), 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 [http://cdmo.baruch.sc.edu/](http://cfcdmo.baruch.sc.edu/). Data are available in text tab-delimited format.

**8) Associated researchers and projects** (link to other products or programs) **–** Describe briefly other research (data collection) that correlates or enhances the data collected by data loggers. At a minimum, mention the SWMP MET and NUT data sets.

Elkhorn Slough NERR encourages research from many areas, the following are current projects related to or near the water quality stations.

### The following researchers are working directly with us here at the Elkhorn Slough NERR

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

Rikke Preisler 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 permant transects. The surveys include varies clam and shrimp species, in addition to fat innkeeper worms.

Charlie Endris works on remote-sensing using GIS to analyze habitat change and NERR biomonitoring 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, Miguel Rodriguez, and Rikke Preisler conduct water quality research currently focusing on eutrophication in the slough and are managing the SWMP weather monitoring and the SWMP nutrient programs that 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 Minhoto restoration by collecting sediment cores using a Vibrocore.

Anderson, Brian; UC Davis, seine for topsmelt - study pesticide levels in indicator fish.

Baguley, Jeff: collects mud cores to characterize meifauna esp. harpacticoid copepods

Carlisle, Aron; Dale, Jonathan, Chapple, Taylor: catch small leopard sharks in the Parsons complex, using a gill net, in order to examine physiological response in sharks to different habitat conditions.

Espinosa, Sara, Staedler, Michelle, et al. observe otters from land-based sites in orde to track sea otter movement and survival (radio-tagged animals) and patterns of distribution, abundance, and behavior (entire Slough population)

Fabian, Rachael, UC Santa Cruz: collects Batillaria snails to assess effects of ocean acidification on Batillaria. Batillaria is used as proxy for other snails.

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

Fresquez, Carla; UC Santa Cruz, assess high marsh, collect soil cores, clear small areas of bare ground - investigate invasions of upland weeds into the high marsh.

Gibble, Corinne; Kudela, Raphe, UC Santa Cruz: collect small numbers of invertebrates to determine whether toxic algal blooms are posing a threat to common sea otter prey

Hammerstrom, Kamille; Moss Landing Marine Laboratories, deploy eelgrass seeds and transplants by diving; coffee-can cores and sieving of mud; from shore and boat (for subtidal)- eelgrass restoration science project

Hughes, Brent; UC Santa Cruz, conducts surveys and experiments with algal biomass and seagrass populations and additionally quantifies eutrophication indicators.

Johnson, Andrew; Monterey Bay Aquarium: tracks sea otter movements; assesses rehabilitated animals; studies otters

Kvitek, Rikk; Spear, Brian; California State University Monterey Bay, use small boat in Parson's complex - map Slough bathymetry to monitor changes resulting from tidal scour

Launer, Andrea; Moss Landing Marine Laboratories: uses gillnet and seine for leopard sharks in Parsons complex; downloads data from transmitter near Parsons RR bridge in order to better understand habitat use of the estuary by leopard sharks

Lidgard, Scott collects bryozoans at Whislestop lagoon to understand gene expression and development in Bugula.

Quackenbush, Ashley; Kyle Olejniczak; Patrick Mulcahy take photo quadrats in the intertidal in order to survey abundance of snails, sponges, and algae.

Tomoleoni, Joseph collects 10-15 invertebrates (jack knife clams, mussels) to compare ease of opening of different types of sea otter prey.

Weitzman, Ben; Staedler, Michelle; Espinosa, Sarah; et al. capture sea otters and implant radiotags; track tagged sea otters to determine how sea otters are using the estuary: which habitats are being used and how, by which otters.

Zabin, Chela; Chang, Andy; Deck, Anna, check recruitment plates and maintain temperature loggers in order to characterize oyster recruitment and physical conditions in comparative study with SF Bay

**Frequent docent researchers**: Shirley Murphy (various bird monitoring programs). ; Ron Eby (marsh, bird, otter monitoring)

**Frequent personel:** Miguel Rodriguez (water quality intern), Ken Pollak, Celeste Stanik, Margie Kay (volunteer water quality research assistants), Brady Latham, Laura Mercado (water quality interns).

**II. Physical Structure Descriptors**

**9) Sensor specifications –** Include the parameter description, units, sensor type, model #, range of measurement, accuracy and resolution for each sensor for all measuring devices (6000, 6600, 6600 EDS, 6600 EDS V2, or 6600 V2). ***Specify if all of your sondes are the same model and have the same configuration. If not, detail how many of each model you have, what different sensor configurations you use, and where the different models/configurations are deployed.*** See the following example and include the disclaimers below.

### YSI 6600EDS datalogger

ELK NERR deployed 6600EDS data sondes at NM, AP, VM in 2012

YSI 6600EDS data sonde:

Parameter: Temperature

Units: Celsius (C)

Sensor Type: Thermistor

Model#: 6560

Range: -5 to 50 C

Accuracy: +/- 0.15

Resolution: 0.01 C

Parameter: Conductivity

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

Sensor Type: 4-electrode cell with autoranging

Model#: 6560

Range: 0 to 100 mS/cm

Accuracy: +/- 0.5% of reading + 0.001 mS/cm

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

Parameter: Salinity

Units: parts per thousand (ppt)

Sensor Type: Calculated from conductivity and temperature

Range: 0 to 70 ppt

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

Resolution: 0.01 ppt

Parameter: Dissolved Oxygen % saturation

Sensor Type: Optical probe w/ mechanical cleaning

Model#: 6150 ROX

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: +/- 15% 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#: 6150 ROX

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: +/- 15% of the reading

Resolution: 0.01 mg/L

Parameter: Non-vented Level - Shallow (Depth)

Units: feet or meters (ft or m)

Sensor Type: Stainless steel strain gauge

Range: 0 to 30 ft (9.1 m)

Accuracy: +/- 0.06 ft (0.018 m)

Resolution: 0.001 ft (0.001 m)

Parameter: pH – bulb probe

Units: pH units

Sensor Type: Glass combination electrode

Model#: 6561

Range: 0 to 14 units

Accuracy: +/- 0.2 units

Resolution: 0.01 units

Parameter: Turbidity

Units: nephelometric turbidity units (NTU)

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

Model#: 6136

Range: 0 to 1000 NTU

Accuracy: +/- 2% of reading or 0.3 NTU (whichever is greater)

Resolution: 0.1 NTU

### YSI 6600EDS V2 datalogger

ELK NERR deployed 6600EDS V2 data sondes at SM in 2012

Parameter: Temperature

Units: Celsius (C)

Sensor Type: Thermistor

Model#: 6560

Range: -5 to 50 C

Accuracy: +/- 0.15

Resolution: 0.01 C

Parameter: Conductivity

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

Sensor Type: 4-electrode cell with autoranging

Model#: 6560

Range: 0 to 100 mS/cm

Accuracy: +/- 0.5% of reading + 0.001 mS/cm

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

Parameter: Salinity

Units: parts per thousand (ppt)

Sensor Type: Calculated from conductivity and temperature

Range: 0 to 70 ppt

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

Resolution: 0.01 ppt

Parameter: Dissolved Oxygen % saturation

Sensor Type: Optical probe w/ mechanical cleaning

Model#: 6150 ROX

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: +/- 15% 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#: 6150 ROX

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: +/- 15% of the reading

Resolution: 0.01 mg/L

Parameter: Non-vented Level - Shallow (Depth)

Units: feet or meters (ft or m)

Sensor Type: Stainless steel strain gauge

Range: 0 to 30 ft (9.1 m)

Accuracy: +/- 0.06 ft (0.018 m)

Resolution: 0.001 ft (0.001 m)

Parameter: pH – bulb probe

Units: pH units

Sensor Type: Glass combination electrode

Model#: 6561

Range: 0 to 14 units

Accuracy: +/- 0.2 units

Resolution: 0.01 units

Parameter: Turbidity

Units: nephelometric turbidity units (NTU)

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

Model#: 6136

Range: 0 to 1000 NTU

Accuracy: +/- 2% of reading or 0.3 NTU (whichever is greater)

Resolution: 0.1 NTU

Parameter: Chlorophyll Fluorescence

Units: micrograms/Liter

Sensor Type: Optical probe w/ mechanical cleaning

Model#: 6025

Range: 0 to 400 ug/Liter

Accuracy: Dependent on methodology

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

**Dissolved Oxygen Qualifier:**

The reliability of the dissolved oxygen (DO) data after 96 hours post-deployment for non-EDS (Extended Deployment System) data sondes may be problematic due to fouling which forms on the DO probe membrane during some deployments (Wenner et al. 2001). Many reserves have upgraded to the YSI 6600 EDS data sondes, which increases DO accuracy and longevity by reducing the environmental effects of fouling. The user is therefore advised to consult the metadata and to exercise caution when utilizing the DO data beyond the initial 96-hour time period. However, this potential drift is not always problematic for some uses of the data, i.e. periodicity analysis. It should also be noted that the amount of fouling is very site specific and that not all data are affected. The Research Coordinator at the specific NERR site should be contacted concerning the reliability of the DO data because of the site and seasonal variation in the fouling of the DO sensor.

**Depth Qualifier:**

The 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 1.03 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.

**10) Coded variable definitions –** List the sampling station, sampling site code, and station code used in the data.

**Sampling station: Sampling site code: Station code: Data Type:**

South Marsh SM elksmwq water quality data

Azevedo Pond AP elkapwq water quality data

North Marsh NM elknmwq water quality data

Vierra Mouth VM elkvmwq water quality data

**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

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** – Use this section for documentation of post calibration information for instruments deployed at each site. ***At a minimum, include: Date (specify if this is the deployment begin date or date of post calibration), SpCond, DO%, pH (7), and Turb (0 NTU).*** Depth and additional pH and Turb post cal information are also beneficial. If using the post calibration log macro, make sure to specify the standards used and edit your table as necessary.

All dates are the dates the sondes were retrieved and post-calibrated.

**Azevedo Pond**

Retrieval DO% DO% pH pH Depth Turb Turb Cond Batt

Date (0) (100) (7.0) (10.0) (0.0m) (0.0 NTU) (100/126 NTU) (53 ms/cm) (V)

01/07/2013 -0.7 103.0 7.01 10.10 0.993 0.4 126.4 52.26 12.1

02/04/2013 0.0 102.0 7.20 10.11 0.919 1.1 92.7 52.89 out

03/04/2013 0.1 101.0 7.02 10.18 0.929 -0.3 127.9 52.11 10.2

04/01/2013 0.6 101.3 63.92 9.76 0.940 0.2 129.5 54.12 11.5

04/30/2013 0.6 100.7 7.18 9.87 0.908 0.1 126.6 54.30 9.0

05/13/2013 0.1 98.8 7.04 10.08 -1.408 -0.2 122.3 51.52 10.8

05/30/2013 0.2 101.1 7.08 10.14 1.042 0.0 125.8 52.61 10.3

06/24/2013 0.0 100.8 7.09 10.00 0.983 1.8 127.8 51.99 10.0

07/22/2013 -0.2 101.0 7.21 10.40 1.023 -0.1 122.1 24.17 6.0

08/19/2013 0.1 97.9 7.10 9.77 1.031 0.2 125.6 53.03 9.7

09/16/2013 0.5 101.0 7.05 10.02 1.003 -0.3 123.0 53.64 10.3

10/14/2013 0.5 99.8 7.12 10.13 1.052 -0.1 127.7 54.02 10.0

11/11/2013 -2.5 87.9 7.20 10.26 1.114 0.7 127.5 51.82 Dead

12/09/2013 -0.5 105.8 -9.99 -9.99 1.181 78.0 214.0 54.06 9.6

01/06/2014 0.1 101.9 6.95 9.82 1.152 0.2 125.9 51.76 10.8

**North Marsh**

Retrieval DO% DO% pH pH Depth Turb Turb Cond Batt

Date (0) (100) (7.0) (10.0) (0.0m) (0.0 NTU) (100/126 NTU) (53 ms/cm) (V)

01/15/2013 0.7 102.5 7.01 9.96 0.171 -1.3 124.7 52.31 11.1

02/15/2013 0.4 100.0 7.08 9.97 0.659 0.1 118.5 50.76 11.9

03/11/2013 0.4 102.9 7.01 10.24 0.671 0.1 125.7 54.57 10.7

04/08/2013 0.1 102.1 7.10 9.95 0.527 0.4 126.2 51.82 11.2

05/06/2013 -0.4 99.7 7.08 10.21 0.539 0.3 130.5 52.82 10.9

06/03/2013 0.1 99.4 7.14 9.77 0.581 -0.2 132.2 52.55 10.5

07/01/2013 0.6 96.4 7.22 9.81 1.203 0.3 125.4 52.17 11.3

07/29/2013 -0.9 101.2 6.91 9.77 0.643 -0.2 126.6 53.07 11.0

08/27/2013 0.2 100.4 7.17 10.02 0.595 0.1 128.2 51.87 10.9

09/24/2013 1.0 95.8 7.05 9.95 0.580 1.1 129.2 52.42 10.8

10/21/2013 0.3 99.9 7.03 10.13 0.610 1.3 113.1 54.45 11.2

11/18/2013 0.4 99.3 7.17 10.00 0.679 0.1 131.0 51.66 11.1

12/16/2013 -2.3 91.5 7.07 10.24 1.082 -0.9 123.8 52.05 11.7

01/13/2014 0.6 102.4 7.64 10.54 0.736 0.3 127.9 51.90 11.0

**South Marsh**

Retrieval DO% DO% pH pH Depth Turb Turb Cond Batt

Date (0) (100) (7.0) (10.0) (0.0m) (0.0 NTU) (100/126 NTU) (53 ms/cm) (V)

01/02/2013 0.0 100.5 7.09 10.21 -0.608 0.0 127.6 52.46 12.0

01/28/2013 0.3 100.1 7.04 9.87 -4.24 0.7 130.8 52.40 10.0

02/25/2012 0.0 101.0 7.07 9.76 0.020 0.1 127.5 52.91 12.4

03/25/2013 -0.2 100.6 7.00 9.96 -0.415 0.6 113.7 52.91 12.5

04/22/2013 -0.1 102.8 6.98 10.09 -0.686 0.3 127.7 53.82 12.3

05/21/2013 -0.1 100.3 6.92 10.07 -0.643 0.2 124.8 52.89 11.7

06/17/2013 -0.2 101.0 6.99 9.90 -0.595 3.8 116.9 53.55 12.1

07/15/2013 0.6 100.7 6.92 9.63 -0.662 0.0 125.2 27.02\* 11.3

08/12/2013 0.0 100.5 7.16 10.22 -0.633 0.5 123.9 53.38 out

09/10/2013 0.5 101.1 6.94 9.80 -0.686 0.4 128.9 52.14 11.1

10/08/2013 0.5 99.0 7.19 9.85 -0.709 0.2 257.1 53.23 11.5

11/04/2013 -0.6 103.1 6.93 9.88 -0.652 -0.4 125.8 53.15 12.1

12/02/2013 0.0 101.2 7.07 10.11 -0.616 0.0 127.2 53.02 11.1

01/02/2014 0.1 100.5 6.99 10.18 0.027 0.4 116.7 53.41 11.8

\*This value was not correctly recorded. We don’t know what the true value was.

**Vierra Mouth**

Retrieval DO% DO% pH pH Depth Turb Turb Cond Batt

Date (0) (100) (7.0) (10.0) (0.0m) (0.0 NTU) (100/126 NTU) (53 ms/cm) (V)

01/24/2013 -0.2 102.2 6.88 10.23 -1.848 0.4 72.2 53.53 11.3

02/18/2013 0.1 99.5 7.02 10.05 -1.907 0.0 161.4 52.49 11.1

03/18/2013 -0.1 101.0 6.95 9.65 -1.773 0.0 122.4 55.96 11.8

04/15/2013 0.2 100.3 7.01 9.92 -1.860 0.8 125.5 53.08 11.0

05/14/2013 0.5 103.5 6.97 10.07 -1.789 0.1 125.0 52.77 11.7

06/10/2013 0.2 101.7 7.16 10.11 -1.827 0.9 127.9 53.36 13.0

07/08/2013 0.5 99.6 7.12 9.98 -1.831 0.6 126.2 52.69 10.5

08/05/2013 -0.3 101.2 7.28 9.65 -1.854 0.3 124.0 53.56 11.3

09/05/2013 0.8 101.4 6.94 9.93 -1.635 0.3 108.6 51.12 11.0

09/30/2013 0.1 98.3 7.21 9.97 -1.572 0.1 127.6 53.88 10.8

10/28/2013 0.6 103.5 7.16 10.14 -1.675 0.1 132.3 53.03 11.2

11/25/2013 0.2 100.9 7.00 9.92 -1.500 0.6 128.5 52.85 12.5

12/23/2013 0.4 102.4 7.24 10.03 -4.700 -0.2 122.4 51.66 12.3

01/21/2014 -0.5 97.8 7.03 10.13 -1.618 0.4 124.2 52.22 12.0

**14) Other remarks/notes –** Use this section for further documentation of the research data set. Include any additional notes regarding the data set in general, circumstances not covered by the flags and comment codes, or specific data that were coded with the CSM “See Metadata” comment code. You may include the metadata worksheets here if so desired. You may also include information on major storms or precipitation events that could have affected the data recorded at the sample sites. Include the following excerpt:

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 elkapwq:

**01/10/2013 02:15:00**

Sonde battery compartment flooded and sonde stopped collecting data for this deployment. No data are available from 01/10/2013 02:15:00 to 01/16/2013 16:30:00. The CVS file named elkapwq010713 submitted to CDMO thus contains data from sonde 00L1167AD Billy from 01/07/2013 12:00:00 to 01/10/2013 02:15:00, and data from sonde 12M1167AD DoubleXO from 01/16/2013 16:30:00 to 02/04/2013 10:45:00.

**01/16/2013 16:30:00 to 02/04/2013 10:45:00**

Data in this time period is from the EXO sonde, which was deployed right next to the regular 6600 sonde that ran out of battery. No .dat file was submitted containing the data from 01/16/2013 16:30:00 to 02/04/2013 10:45:00 because the EXO sonde does not have .dat files.

**04/30/2013 11:30:00 to 05/13/2013 11:00:00**

Depth was incorrectly calibrated and thus 2.388 m was added to all depth data in order to obtain the true level of the sonde during this deployment. Hence if depth appeared as -1.408m in the data, the true level was -1.408m + 2.388m = 0.980m.

**05/13/2013 11:00:00 to 05/13/2013 13:45:00**

No data collected due to removal of instrument. Instrument appeared non-working, and was transported back to lab for re-calibration. consequently, intrument seemed to work again

**06/27/2013 00:15:00 to 07/12/2013 23:15:00**

Data label suspect because when pH probe was cleaned on 07/17/2013 at 08:15:00 pH data was drastically different than right before cleaning.

**07/12/2013 23:30:00 to 07/17/2013 00:08:00**

Data rejected because when pH probe was cleaned on 07/17/2013 at 08:15:00 pH data was drastically different than right before cleaning.

**10/21/2013 06:30:00 to 11/02/2013 00:30:00**

Post-calibration of DO probe at 0% saturation was not 0% but -2.5%. Hence, poor calibration caused the small negative values in the data.

**11/02/2013 00:30:00 to 11/11/2013 11:15:00**

No data because sonde ran out of battery

Additional metadata for elknmwq:

**05/19/2013 09:00:00 to 05/22/2013 11:00:00**

Salinity and conductivity data suspect, because sonde was cleaned on 05/22/2103 at 11:15 to 11:30 after which time salinity and conductivity changed substantially, relative to right before cleaning.

**06/03/2013 10:45:00 to 07/29/2013 10:30:00**

Depth was incorrectly calibrated and thus 0.6152 was added to all depth data in order to obtain the true level of the sonde during these deployments.

Additional metadata for elksmwq:

**01/28/2013 13:15:00 to 02/25/2013 12:15:00**

Sonde was improperly seated in white PVC pipe and depth is off set for this entire deployment. There is no reason to suspect that all other parameters are invalid.

Additional metadata for elkvmwq:

**02/05/2013 09:00:00**

Turbidity sensor was most likely blocked by an octopus.

**03/15/2013 01:00:00 to 03/16/2013 23:45:00**

Turbidity sensor was most likely blocked by an octopus.

**06/26/2013 08:00:00 to 07/08/2013 10:15:00**

When sonde was cleaned, it was reinserted into the white PVC pipe in a slightly wrong spot. Data were corrected in this time period.

**07/24/2013 07:15:00 to 08/05/2013 11:00:00**

Level at VM was adjusted and re-measured. A new stop inside the long white PVC was installed, as the old one had disappeared over time. All level values recorded after 07/24/2013 07:15:00 are adjusted to the new level.