WQB NERR Water Quality Metadata
Data Collected: January 2016 – December 2016
Latest Update: January 9, 2018

I. Data Set and Research Descriptors

1) Principal investigator(s) and contact persons

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2) Entry verification

The data are uploaded in three file formats (each to separate files identified with the same file name but with unique extensions: .CSV, .DAT, .INI) from the YSI 6600 data loggers to a PC with the YSI 6600 EcoWatch software. Two of these (PC6000 and ASCII text formats) are kept on file in the WBNERR archive. Initially, file contents visually examined for anomalies (e.g., sensor malfunction, battery failure, spurious values, etc.) by the technician, Jordan Mora, after downloading data after deployment and post calibration analysis.

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 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. All QAQC data reviews are conducted by Jordan Mora, Research Associate (see contact information above). For more information on QAQC flags and codes, see Sections 11 and 12.

Copies of all files are retained at the Reserve which includes the formatted PC6000 data files (.dat), as well as the raw text files (.csv) and final exported text files (.txt) archived at the CDMO site.

3) Research objectives

For the NERR System-Wide Monitoring Program (SWMP), the YSI 6600 data loggers are programmed to record water quality parameters every 15 minutes. A total of four SWMP sites were located in the Waquoit Bay estuarine system during 2015. These four are: 1) Metoxit Point (MP), in operation since 1998, is located in the middle of Waquoit Bay's main basin; 2) Menauhant (MH), in operation since March 2001, is located adjacent to Eel Pond Inlet on Vineyard Sound – one of the two tidal inlets into the Waquoit Bay estuary; 3) Child's River (CR), in operation since May 2002, located near the head of the tidal section of Child's River— one of the two main surface fresh water sources to Waquoit Bay; and 4) Sage Lot (SL), in operation since May 2002, located in Sage Lot Pond—a relatively pristine tidal pond surrounded by salt marsh and barrier beach, possessing one of the bay's few remaining eelgrass stands.

The main purpose of the SWMP water quality monitoring program is to aid Waquoit Bay NERR in one of its priority missions - to perform as a natural laboratory and platform for coastal and estuarine research. The long term, continuous detailed monitoring of the estuary's basic hydro-physical parameters is an essential tool and context for any research activities located here. Besides this overarching mission, there are also several specific research interests. One primary issue for the Waquoit Bay ecosystem is the influence of anthropogenic induced alterations by nitrogen enrichment. Waquoit Bay receives nitrogen from several sources, including but not limited to septic systems (their leachate percolates into groundwater which then enters the bay), run off from roads, run off containing domestic and agricultural fertilizer and animal waste, and atmospheric sources. This elevated nitrogen loading to the bay has resulted in enhanced eutrophication that has contributed to the alteration of the bay's habitats. For example, thick mats of seaweeds (macroalgae) now cover the bottom where eelgrass meadows thrived in the 1970's. Unfortunately, there are few definitive records of the bay's water quality conditions during that period, which makes it difficult to evaluate the rates of change. To facilitate future evaluation, long-term records from SWMP can be used to track water column conditions. Of particular interest, in this regard are measurements of dissolved oxygen (DO) and turbidity, as well as dissolved nitrogen and chlorophyll concentration (this data is available by contacting the reserve). Such records will facilitate evaluation of changes which may come about from a continuation of watershed alteration that result from current development patterns (i.e., non-sewered residential areas served by private septic systems typically consisting of septic tanks and leach fields) as well as non-industrial commercial development, such as golf courses, cranberry bogs, and retail shopping outlets. The records will be useful for evaluating the efficacy of remediation efforts intended to reduce the nitrogen loading from these sources to Waquoit Bay.

Another focus of long-term research interest is the detection of climate change and the determination of its effects on the estuarine environment. Characterizing the variability of the various water column parameters, such as their scale, magnitude and frequency, is likely to be an important aspect of the estuarine ecosystem that may be sensitive to climate change. Related to this focus is an interest in the impact of storms (hurricanes and northeasters) and other extreme meteorological events on the estuary. For example, what temperature and wind field thresholds exist that might bring about or trigger certain conditions within the bay? The observations recorded by the SWMP will allow for these types of studies. .

4) **Research methods**

Multi-parameter YSI 6600-series or EXO2 data loggers, hereafter referred to as sondes, are deployed at each permanent water quality monitoring station at the Waquoit Bay Reserve. Since in-situ instrumentation can only record conditions at a specific location, permanent monitoring stations for SWMP are chosen to be in some way representative of the overall estuary. This is difficult in practice since estuaries by their very definition are coastal regions where large physical, chemical and biological variations tend to occur in space and time, so that often no particular location within the system is "typical" of the overall system. Establishing a number of stations can overcome this problem somewhat, and as of 2002 four permanent stations were established in the Waquoit Bay estuaries. Our current SWMP stations are situated to represent, as much as possible, the diversity of the estuary and its inputs/outputs. Additional details concerning the station characteristics are discussed in the next section.

The YSI sondes measure and record ambient water temperature, specific conductivity (and calculate salinity), dissolved oxygen (mg/L and % saturated), turbidity (NTU), Chlorophyll-a (ug/L) water level (m), and pH at 15 minute intervals during deployment periods extending for approximately three weeks (three weeks during the summer months, four weeks during winter months). Note that the pressure sensors currently in use are non-vented and so variations in atmospheric pressure are recorded as changes in water depth (atmospheric data are available from our SWMP meteorological station (as of January 2002) and other nearby meteorological observatories), so it is possible to make this correction to the depth data (approximately +1 cm of depth is equal to +1 mb of air pressure), for increased accuracy. Also, at our Metoxit Point site (from 12/2000 to present), Child's River site (from 3/2003 to present), Menauhant site (from 7/2006 to present), and our Sage Lot site (from 6/2006 to present) we have been using an optic chlorophyll fluorescence sensor.

Multi-parameter YSI sondes are deployed and retrieved every two to three weeks. The "old" sonde is retrieved and a "new" replacement Sonde is deployed immediately so that ideally no record gap occurs. The 2-3 week deployment duration is constrained by a combination of battery life (shorter life in colder waters) and fouling of the DO sensor (and other sensors to a lesser degree) during the warm summer months. Prior to deployment (usually within 24 hrs), each instrument is checked and its sensors re-calibrated using standard YSI (Operating Manual) protocols. Similarly, after a deployment, each sonde is brought back to the laboratory for a post-deployment check, data downloading, instrument and sensor cleaning. The conductivity sensors are calibrated with 50.00 mS/cm YSI standard. The pH sensors are calibrated with 7.0 and 10.0 pH standard solutions (2-point calibrations). The turbidity standard used is 126.0 NTU/124FNU, and distilled water (DI) for 0 NTU/FNU. Temperature sensors are checked periodically against a calibrated mercury thermometer. The chlorophyll probe is calibrated on a 2-point calibration with distilled water (DI) and a Fluorescent Red Dye (Rhodamine WT) at a 0.5 mg/ L concentration. See Chlorophyll Qualifier in Sensor Specifications section below regarding chlorophyll fluorescence accuracy. Oxygen sensor membranes are inspected before and after each deployment. Oxygen sensor membranes are replaced 24 hours prior to each deployment when the sensor drifts substantially from 100% saturation at calibration. Final DO calibration was not done until the membrane had been in place for at least 8 hours. As another check on instrument performance, in-situ measurements of water temperature, DO, salinity, specific conductance, and pH are made using a handheld YSI device (pre-December 2016: YSI 650; post-December 2016: YSI EXO2) at deployment/retrieval times.

Starting in July 2016, EXO2 sondes were deployed at Metoxit Point. Prior to July 2016, 6600series sondes were deployed at Metoxit Point. The 6600-series sondes are deployed at all other stations as of November 2016.

Two types of silos housed the YSI sondes during their deployment. One type for dock side stations (Menauhant and Childs River) and the other for open water stations away from shore structures (Metoxit and Sage Lot). The Menauhant site, located at a yacht club dock, is adjacent to a tidal inlet, and the Child's River site, located at commercial marina and boat yard, is adjacent to the upper reaches of a tidal river. For open water, a two part structure has been designed consisting of a submerged fixed tower and a separate removable silo apparatus that sleeves over the fixed tower. The Metoxit Point and Sage Lot silos are set so that the sonde's sensor package is 0.5 m off the bottom. The removable silo apparatus can be lifted on and off the tower for inspection, cleaning or other maintenance. The sondes are deployed into the removable silos consisting of open-ended vertically mounted 4" PVC pipe (each silo is perforated in its lower portion around the business end of the sonde). The fixed tower structure consists of a vertical reinforced concrete filled 3" PVC pipe about 1.3 meters in height extending upward from a 300 lb cast reinforced concrete base (30" in diameter and 6" thickness) anchored into the bottom by a reinforced concrete filled 4" PVC pipe about 1 m in length. The whole structure is somewhat reminiscent of large "child's toy top". For dock-side locations and the silo apparatuses are a more typical type – a single PVC section (4" ID) mounted vertically onto a pier piling or bulkhead. The base of these silos is also ventilated with large holes (1.0" diameter) and their sensor packages (bottom of the sonde) are both mounted about 0.5 m off the bottom. All mooring silos are painted with antifouling paint at the beginning of the spring season, and periodically checked and scrubbed during the summer season.

In July of 2006, a Sutron Sat-Link2 transmitter was installed at the Menauhant Yacht Club station and transmits data to the NOAA GOES satellite, NESDIS ID #3B030074 (where 3B030074 is the GOES ID for that particular station.) The transmissions are scheduled hourly and contain four (4) datasets 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.

5) **Site location and character**

General description of Waquoit Bay estuarine system:

The Waquoit Bay National Estuarine Research Reserve (WBNERR) is located in the northeastern United States on the southern coast of Cape Cod, Massachusetts. About 8,000 people maintain permanent residency in Waquoit Bay's drainage area, which covers parts of the towns of Falmouth, Mashpee, and Sandwich. During summer months, the population swells 2-3 times with the greatest housing concentrations immediate to the coastline (water views and frontage). In addition, the upper portions of the watershed include a military base, Otis Air Force Base and the Massachusetts Military Reservation, portions of which have been designated by the EPA as Superfund sites due to past practices of dumping jet fuel and other volatile groundwater contaminants.

WBNERR's estuaries are representative of shallow tidal lagoons that occur from Cape Cod to Sandy Hook, New Jersey. WBNERR is within the northern edge of the Virginian biogeographic province, on the transitional border (Cape Cod) with the Acadian biogeographic province to the north and east. Like many embayment's located on glacial outwash plains, Waquoit Bay is shallow (< 5 m), fronted by prominent barrier beaches (i.e., those of South Cape Beach State Park and Washburn Island), and is backed by salt marshes and upland coastal forests of scrub pine and oak. Two narrow, navigable inlets, reinforced with granite jetties, pass through two barrier beaches to connect Waquoit Bay with Vineyard Sound to the south. A third shallow and generally un-navigable inlet opened through the Washburn Island barrier beach during Hurricane Bob in August 1991, and closed up in February 2002.

Bottom sediments in the bay are organic rich (C organic conc. ~ 3-4%) silts and medium sands. Sediment cores taken in summer of 2002 indicate that the depth of these estuarine sediments is up to 9 m thick in places. Dating work on these sediment cores suggests that the Waquoit Bay basin has been inundated by the sea for about 5000 years, and sediment accumulation rates were estimated to be between 2-10 mm/yr, with higher rates in the upper 1 m of sediments (Maio et al. 2016).. Thick (up to 0.3 m) macroalgae (seaweed) mats overlie much of the bottom of the bay, and largely consist of species *Cladophora vagabunda*, *Gracilaria tikvahiae*, and *Enteromorpha* spp. The dominant marsh vegetation in Waquoit Bay is *Spartina alterniflora* and *Spartina patens*. Dominant upland vegetation includes mixed forests of red oak, white oak, and pitch pine, and other shrubs and plants common to coastal New England. Land-use in the bay's watershed is about 60% natural vegetation, but the remaining land is largely residential housing, with some commercial (retail malls), and minor amounts of agriculture (~3%; e.g., cranberry bogs).

Dense housing developments cover the two peninsulas that form the western shore of the Waquoit Bay estuarine system. Although the developments themselves are outside of the Reserve boundaries, dissolved nitrogen in discharges from their septic systems (via groundwater) and in fertilizer run-off from their lawns has significant effects on the functioning of the Waquoit Bay ecosystem. These impacts have been a primary subject of study at the Reserve since its designation (1988). One outcome of this research has been the delineation of sub-watersheds within the overall drainage area for Waquoit Bay, of which WBNERR is a small part. This knowledge allows for the design of experiments based on the spatial variation of nutrient loading and other land-use related impacts.

At the northern end of the bay, an area comprising a separate sub-watershed, coastal bluffs of glacial till rise 30 feet above sea level. The northern basin of the bay, just below these bluffs, is its deepest area (approximately 3 m MLW), while much of the remainder of the bay is about 1.5 m. Bourne, Bog, and Caleb Ponds are freshwater kettle hole ponds on the northern-most shore of the bay. As components of the same sub-watershed, they have a common albeit minor freshwater outflow into the bay's northern basin via a narrow channel through a brackish marsh. To the east and south, other sub-watersheds surround several tidal and freshwater ponds, including Hamblin and Jehu Ponds, brackish salt ponds that are connected to the main bay by the tidal waters of Little and Great Rivers, respectively. The shorelines of the ponds are developed with residences that are occupied both seasonally and year round. Hamblin Pond and Little River are components of one sub-watershed, and Jehu Pond and Great River are elements of a separate sub-watershed. Further south lays Sage Lot Pond. It is in the least developed sub-watershed and also contains a barrier beach and salt marsh ecosystem of the reserve's South Cape Beach State Park. To the east of Sage Lot Pond and within the same sub-watershed, lies the highly brackish Flat Pond. It receives minimal tidal flows of salt water from Sage Lot Pond through a narrow, excavated and culverted channel. In the spring of 2008 two (2) channel culverts were replaced, one with a bridge and the second with a wider, less restrictive culvert to aid in tidal flushing of the pond. The preponderance of the input to Flat Pond is groundwater and run off, both of which are likely affected (e.g., nutrients, pesticides, bacteria) by an adjacent golf course and near-by upper-scale residential development.

The largest source of surface freshwater to Waquoit Bay is the Quashnet / Moonakis River. Although named "river", this and Child's River are more appropriately described as "streams" because of their small channels and discharge ~1.0 CFS. A component of yet another sub-watershed, the Quashnet River originates in Johns Pond situated north of the bay and traverses forests, cranberry bogs, residential areas, and the Quashnet Valley Golf Course before entering the bay near the southern "boundary" of the northern basin. ("Quashnet" applies to that portion of the river within the town of Mashpee, and "Moonakis" refers to the brackish estuary at the river's mouth, lying in the town of Falmouth. Quashnet will be used hereafter to refer to the entire river.) The Quashnet River's tidal portion has sufficient numbers of coliform bacteria to cause it to be closed to shell fishing most of the time. The source(s) of these bacteria (human or avian) is unknown at this time.

The Childs River is the second largest input of surface freshwater to the bay. A component of another sub-watershed, it runs through densely developed residential areas. The Childs River sub-watershed receives the highest nitrogen loading and is the largest nitrogen contributor to the Waquoit Bay system of all the sub-watersheds. In the upper tidal portions of the river the highest nutrient and chlorophyll levels and the lowest dissolved oxygen readings of any region in the bay have been recorded and so this location represents an end-member for looking at anthropogenic inputs and impacts on the system. Another, albeit smaller, source of freshwater to Waquoit Bay is the discharge of Red Brook through brackish marshlands into Hamblin Pond. Additional freshwater enters the bay elsewhere through groundwater seepage (perhaps up to 50% of all freshwater input into the bay), precipitation and the flows of smaller brooks. There is relatively little surface water runoff entering directly into the bay due to the high percolation rates of Cape Cod's coarse, sandy soils.

Knowledge of the homo/heterogeneity of the water masses in Waquoit Bay was originally derived from measurements made by reserve staff and from data obtained by the reserve's volunteer water quality monitoring group, the Waquoit BayWatchers who have collected depth profiles of Waquoit Bay water quality since 1993. Subsequent research by reserve staff has revealed that lateral mixing has considerable influence because tidal currents follow a general course through the bay. This results in an overall structure to horizontal patterns of water quality characteristics. The pattern it produces is a gyre in the central portion of the main bay whereby currents follow a generally counter-clockwise flow around a central area that exhibits reduced exchange with the remainder of the bay. The flushing rate within the gyre is diminished when compared with other more peripheral areas of the bay. The location of the gyre meanders slightly, apparently under the influence of tides and wind. Due to the shallow conditions, restricted tidal inlets, and low amplitude tidal forcing of Vineyard Sound here (tides are semi-diurnal with a range about 0.5 m) water levels in the bay are also strongly influenced by wind forcing. Southerly winds increase tidal heights and advance the phase of the flood and retard the phase of ebb (northerly winds have the opposite effect).

<u>Metoxit Point (MP)</u>

The Metoxit Point station (41° 34' 8.04"N 70° 31' 17.76" W, 2.2 m deep) initiated in 1998, is located in the main basin of Waquoit Bay and was selected to be within or near the outer regions of the gyre (described above) and more or less represents "typical" water mass conditions and residence times for the bay. Sonde sensors are located 0.5m above the bottom sediments. The location is at least a half mile from shore, well flushed and mixed by tides, and is in an area that is minimally disturbed by routine activities on the bay (e.g. boat traffic, shell fishing, etc.). Bottom sediments at the site are organic rich mud often overlain by thick algal (*Cladophora*) mats. Because of this site's fairly open exposure to the south (greatest fetch over the bay), it has been observed that when sustained southerly winds are greater than about 20 kts, the Metoxit Point site experiences increased turbidity (sediment suspension events).

The tidal range (maximum-minimum water level; including only the data which pass quality control standards) for Metoxit Point has been calculated using water level data, corrected for barometric pressure, for 2014-2016. The average value obtained from these three years is 0.90 m. Metoxit Point's average relative water level is 1.23 m, and has been calculated based on data available through 2016 (including only the data which pass quality control standards). The 2014 data was used to calculate salinities (ppt) for this site: the maximum value was 32.13, the minimum value was 13.69 and the average was 30.21.

<u>Menauhant Yacht Club (MH)</u>

The Menauhant station (41° 33' 9.36" N 70° 32' 54.60" W, 1.2 m deep), initiated in March 2001, is located within the Eel Pond Inlet at the Menauhant Yacht Club dock. Eel Pond Inlet is the westernmost of the two main tidal inlets into the Waquoit Bay system. The site was chosen because it occupies one of the strategic locations for gauging the system's water mass characteristics. Entering waters represent the marine end-member while outflows represent the final product of estuarine water mass modification and export to shelf waters. The site also has easy walk-in access to a secure private pier that extends into the throat of the inlet.

Due to the turbulent tidal flow within the inlet, conditions are vertically well mixed, and the site can be maintained year round even through ice-over conditions in the rest of the bay during severely cold winters. Bottom sediments at this site are clean sands and gravels with almost no attached bottom vegetation. Since inception, we have noted that strong south to southeast (onshore) winds tend to produce turbidity events at this site from the wave induced suspension of fine sediments and organic material in the upstream near-shore zone. While we have found that these types of turbidity events are localized to windward near-shore areas in the bay, the transport of these sediments at inlet mouths during such times is perhaps a dominant sedimentation process within the estuarine system. In other words, while the choice of our location may be producing a localized signal in turbidity, the turbidity signal may reflect key processes in the system at large.

The water level range (maximum-minimum water level, including only the data which pass quality control standards) for Menauhant has been calculated using water level data, corrected for barometric pressure, for the time period 2014-2016. The average value obtained from these three years is 1.55 m. Menauhant's average water level is 0.71 m. It has been calculated based on data available through the end of 2016 (including only the data which pass quality control standards). The 2014 data was used to calculate salinities (ppt) for this site: the maximum value was 32.13, the minimum value was 0.27 and the average was 31.34.

<u>Child's River (CR)</u>

The Child's River station (41° 34 ' 47.28" N 70° 31' 51.24" W, 1.2 m deep), initiated in May 2002, is located on a dock piling at Bosun's Marina (changed from Edward's Boat Yard in 2012), a commercial marina near the upper tidal reaches of Child's River— one of the two main surface fresh water sources to Waquoit Bay (see general description of Waquoit Bay watershed above). This location is very strongly stratified, characterized by a salt wedge with fresher river water overlying saline ocean water. Vertical salinity ranges can run from 0-10 ppm at the surface to more than 30 ppm just 1 m below. The sonde sensors are usually well within the salt wedge portion of the water column (sonde sensors located ~25cm above the sediment), nonetheless this location is also our freshest SWMP site, and is at the opposite end of Child's River from the seaward Menauhant station. Bottom sediments are fine organic rich muds.

This location represents the most terrigenously and anthropogenically-impacted SWMP site. Monthly water quality, collected near this location for the past decade, shows very high chlorophyll concentrations during the warmer months and more recent dissolved nutrient records show very high nutrient-loads. Boat traffic at the marina likely leads to increased turbidity during the boating season as well. As this site is dockside at a private marina, general security is high and access is easily available. During the winter, the marina installs bubblers (deicers) at the end of each pier to prevent damage from ice. During these months (generally mid-December through March), we do not deploy a sonde. The disturbance from the bubbler changes the water quality characteristics of the river such that any data collected is artificial.

The water level range (maximum-minimum water level, including only the data which pass quality control standards) for the Child's River site has been calculated using water level data, corrected for barometric pressure, for the time period 2014-2016. The average value obtained from these three years is 1.30 m. The Child's River's average water level is 0.8322 m. The average water level has been calculated based on data available through the end of 2016 (including only the data which pass quality control standards). The 2014 data was used to calculate salinities (ppt) for this site: the maximum value was 30.58, the minimum value was 14.76 and the average was 27.83.

Sage Lot (SL)

The Sage Lot station (41° 33'15.12" N 70° 30'30.20" W, 1.2 m deep), initiated in May 2002, is located in a deeper portion of Sage Lot Pond – a small sub-estuary of Waquoit Bay (20 ha) surrounded by salt marsh and barrier beach. Its small watershed is the least developed of all of Waquoit Bay's sub-watersheds and Sage Lot Pond is considered to be its least impacted and most pristine sub-estuary. Bottom sediments are organic rich muds. Sage Lot Pond possesses one of the few remaining eelgrass beds in the Waquoit Bay system.

The Child's River and Sage Lot Pond sites are considered to represent opposite end-members of nutrient-loading and human-induced influence. Researchers often locate their experiments in these two locations to take advantage of this difference. However, Sage Lot Pond is hydrologically connected to an upstream brackish source -- Flat Pond – via a series of tidal creeks, drainage ditches and culverts. Flat Pond borders a country club and golf course and some concern exists for its impact on the water quality of Sage Lot Pond. Currently, Sage Lot Pond is closed to shellfishing in summer months because of high fecal coliform concentrations, though these are thought to be of avian source.

The water level range (maximum-minimum water level, including only the data which pass quality control standards) for the Sage Lot Pond site has been calculated using water level data, corrected for barometric pressure, for the time period 2014-2016. The average value obtained from these three years is 0.99 m. Sage Lot Pond's average water level is 0.60 m. The average water level has been calculated based on data available through the end of 2016 (including only the data which pass quality control standards). The 2014 data was used to calculate salinities (ppt) for this site: the maximum value was 32.28, the minimum value was 24.22 and the average was 30.26.

Station Code	SWMP Status	Station Name	Location	Active Dates	Reason Decommissioned	Notes
wqbcrwq	P	Child's River	41° 34' 47.28 N, 70° 31' 51.24 W	05/01/2002 00:00 -	NA	NA
wqbslwq	P	Sage Lot	41° 33' 15.12 N, 70° 30' 30.20 W	05/01/2002 00:00 -	NA	NA

wqbmhwq	P	Menauhant	41° 33' 9.36 N, 70° 32' 54.60 W	03/01/2001 00:00 -	NA	NA
wqbmpwq	P	Metoxit Point	41° 34' 8.04 N, 70° 31' 17.76 W	11/01/1998 00:00 -	NA	NA
wqbcbwq	P	Central Basin	41° 33' 55.80 N, 70° 31' 15.96 W	10/01/1995 00:00 - 12/01/1998 00:00	MP was considered more representative of the average water quality dynamics in Waquoit Bay. The MP site is located outside an anti-clockwise gyre, where water exchange is reduced.	
wqbctwq	P	Adjacent to Central Basin	41° 33' 55.80 N, 70° 31' 15.96 W	09/01/1998 00:00 - 10/01/1998 00:00	Considered a “rover” site. Never designed to be long-term	
wqbnbwq	P	North Basin	41° 34' 43.68 N, 70° 31' 25.32 W	10/01/1995 00:00 - 12/01/1997 00:00	Considered a “rover” site. Never designed to be long-term	
wqbnswq	P	North Basin Surface	41° 34' 43.68 N, 70° 31' 25.32 W	07/01/1997 00:00 - 12/01/1997 00:00	Considered a “rover” site. Never designed to be long-term	

6) **Data collection period**

SWMP water quality monitoring in Waquoit Bay was initiated in 1995. Several different pilot sites (i.e., North Basin and Central Basin) were occupied for varying durations before settling on our first permanent long term site at Metoxit Point in summer 1998. The Menauhant site was our second permanent station and began operation in March 2001. Sage Lot and Childs River sites began operation in May 2002.

In 2016, year-round data was only possible at the Menauhant station. Due to interference from a bubbler system at the marina on Childs River, that station was not occupied from December 2015 to April 2016. Due to icy conditions during the winter season and timing of boat launch, the Metoxit Point and Sage Lot stations were not occupied between December 2015 and April 2016. In preparation for the winter (before the boats are pulled), the Metoxit Point and Sage Lot stations were removed on 12/07/2015 and 12/09/2015, respectively. Childs River station was removed on 12/08/2015 once the bubblers were observed at the marina. The deployment dates and times for 2016 are indicated below:

Menauhant

START	END
12/31/15 10:30	01/26/16 10:45
01/26/16 11:00	02/23/16 15:45
02/23/16 16:15	03/25/16 08:45
03/25/16 09:00	03/30/16 13:15
03/30/16 13:30	04/27/16 10:45
04/27/16 11:15	05/19/16 14:00
05/19/16 14:15	06/14/16 09:00
06/14/16 09:15	07/07/16 12:00
07/07/16 12:15	07/28/16 09:15
07/28/16 09:30	08/12/16 08:30
08/12/16 08:45	09/02/16 07:15
09/02/16 07:30	09/23/16 10:00
09/23/16 10:30	10/18/16 09:30
10/18/16 10:00	11/04/16 10:00
11/04/16 10:15	11/30/16 09:45
11/30/16 10:15	12/20/16 13:30
12/20/16 13:45	01/17/17 12:00

Metoxit Point

START	END
05/04/16 10:15	05/19/16 10:15
05/19/16 10:30	06/14/16 10:15
06/14/16 10:45	07/06/16 10:45
07/06/16 11:00	07/25/16 10:00
07/25/16 10:30	08/18/16 09:00
08/18/16 09:15	09/07/16 07:45
09/07/16 08:00	09/27/16 15:15
09/27/16 15:30	10/20/16 09:45
10/20/16 10:00	11/10/16 13:15
11/10/16 13:30	12/02/16 12:00
12/02/16 12:15	12/13/16 13:30

Child’s River

START	END
04/27/16 11:00	05/24/16 09:00
05/24/16 09:15	06/21/16 09:00
06/21/16 09:15	07/07/16 12:15
07/07/16 12:45	07/28/16 09:30
07/28/16 09:45	08/12/16 09:00
08/12/16 09:15	09/02/16 07:45
09/02/16 08:00	09/23/16 10:30

09/23/16 10:45	10/18/16 09:45
10/18/16 10:00	11/04/16 10:30
11/04/16 10:45	11/30/16 10:00
11/30/16 10:15	12/20/16 14:30

Sage Lot

START	END
05/04/16 12:00	05/23/16 11:45
05/23/16 12:15	06/16/16 12:30
06/16/16 12:45	07/06/16 09:30
07/03/16 09:45	07/28/16 14:30
07/28/16 14:45	08/19/16 09:30
08/19/16 09:45	09/09/16 10:30
09/09/16 10:45	09/27/16 14:00
09/27/16 14:15	10/20/16 08:30
10/20/16 08:45	11/08/16 11:45
11/08/16 12:15	11/30/16 13:45
11/30/16 14:00	12/14/16 12:00

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 2016.

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. Data are available in comma delimited format.

8) Associated researchers and projects

BayWatchers:

The Reserve has carried out a citizen-based water quality monitoring program since 1993 called *BayWatchers*. Water quality measurements are carried out at 9 sites within Waquoit Bay estuary for the purposes of 1) constructing a long time series of water quality information to determine trends, as well as 2) providing a sentinel role to detect unusual changes and events. Monthly (October-May) and Bi-weekly (June-September) measurements are made year-round on a set schedule. Chl-*a* samples are processed and analyzed using Turner 10AU fluorometer at WBNERR. Dissolved inorganic nutrient samples are currently analyzed by the Provincetown Center for Coastal Studies (pre-2015 data was analyzed at the Woods Hole Oceanographic Institute). All data is processed and archived at WBNERR and is publicly available upon request.

A new field procedure was initiated in July 2007 and a ninth site was added at the south basin of Waquoit Bay at the first inlet buoy in the main channel. A change at this time was made from previous wet chemical measurements to utilizing hand-held YSI 85 meters to measure water temperature, salinity, and dissolved oxygen (% and mg/L). Each meter is calibrated each sampling period for dissolved oxygen. Measurements are taken at the surface (0.25m) and the bottom at each site. The bottom depth is recorded. Additionally, due to shallow depths at most sites, water clarity measurements with Secchi discs have been discarded for turbidity measurements.

Two bottles of water are now collected at each site for nutrients analysis, at approximately 0.25m below the surface, by locking the bottles into a hand-held apparatus. This new sampling procedure has helped in standardizing the depth sampled for all sites in our chemical analysis. The bottles are mounted to a pole and capped with rubber stoppers attached to a rope. When the bottles are lowered to a marked level (0.25m) on the apparatus, the rope is pulled and water enters the bottle. The cap is placed on the bottles and returned back to the lab for turbidity, chlorophyll, and nutrient analysis. Physical characterization of the site and sampling period are recorded each sampling date (time of sampling, weather conditions-sun/clouds/rain/fog, name of team members, etc) and any other observations are recorded.

II. Physical Structure Descriptors

9) Sensor specifications –

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
Units: percent air saturation (%)
Sensor Type: Rapid Pulse - Clark type, polargraphic
Model#: 6562
Range: 0 to 500% air saturation
Accuracy: 0-200% air saturation: +/- 2% of the reading or 2% air saturation, whichever is greater; 200 to 500% air saturation: +/- 6% of the reading
Resolution: 0.1% air saturation

or

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: Rapid Pulse - Clark type, polargraphic
Model#: 6562
Range: 0 to 50 mg/L
Accuracy: 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
Resolution: 0.01 mg/L

or

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 or EDS flat glass probe
Units: pH units
Sensor Type: Glass combination electrode
Model#: 6561 or 6561FG
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

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: +/- 0.01 units within +/- 10° of calibration temperature, +/- 0.02 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

Dissolved Oxygen Qualifier (Rapid Pulse / Clark type sensor):
The reliability of dissolved oxygen (DO) data collected with the rapid pulse / Clark type sensor 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). Some Reserves utilize the YSI 6600 EDS data sondes, which increase DO accuracy and longevity by reducing the environmental effects of fouling. Optical DO probes have further improved data reliability. The user is therefore advised to consult the metadata for sensor type information and to exercise caution when utilizing rapid pulse / Clark type sensor DO data beyond the initial 96-hour time period. 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. If there are concerns about fouling impacts on DO data beyond any information documented in the metadata and/or QAQC flags/codes, please contact the Research Coordinator at the specific NERR site regarding site and seasonal variation in 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 1.02 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 – All NERRS sites are required to use the following file naming convention.

Station Codes:

Sampling Station	Sampling Site Code	Station Code
Metoxit Point	MP	wqbmpwq
Menauhant	MH	wqbmhwq
Child's River	CR	wqbcrwq
Sage Lot	SL	wqbslwq

File definitions: NERR Reserve/YSI deployment site/data type code/year
Example: wqbmpwq2008 (designates 2008 water quality data for the Metoxit Point site)

11) QAQC flag definitions – This section details the automated and secondary QAQC flag definitions. Include the following excerpt**:**

> 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 – This section details the secondary QAQC Code definitions used in combination with the flags above. Include the following excerpt:

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

General Errors
GIC No instrument deployed due to ice
GIM Instrument malfunction
GIT Instrument recording error; recovered telemetry data
GMC No instrument deployed due to maintenance/calibration
GNF Deployment tube clogged / no flow
GOW Out of water event
GPF Power failure / low battery
GQR Data rejected due to QA/QC checks
GSM See metadata
Corrected Depth/Level Data Codes
GCC Calculated with data that were corrected during QA/QC
GCM Calculated value could not be determined due to missing data
GCR Calculated value could not be determined due to rejected data
GCS Calculated value suspect due to questionable data
GCU Calculated value could not be determined due to unavailable data

Sensor Errors
SBO Blocked optic
SCF Conductivity sensor failure
SCS Chlorophyll spike
SDF Depth port frozen
SDG Suspect due to sensor diagnostics
SDO DO suspect
SDP DO membrane puncture
SIC Incorrect calibration / contaminated standard

SNV	Negative value
SOW	Sensor out of water
SPC	Post calibration out of range
SQR	Data rejected due to QAQC checks
SSD	Sensor drift
SSM	Sensor malfunction
SSR	Sensor removed / not deployed
STF	Catastrophic temperature sensor failure
STS	Turbidity spike
SWM	Wiper malfunction / loss

Comments

CAB*	Algal bloom
CAF	Acceptable calibration/accuracy error of sensor
CAP	Depth sensor in water, affected by atmospheric pressure
CBF	Biofouling
CCU	Cause unknown
CDA*	DO hypoxia (<3 mg/L)
CDB*	Disturbed bottom
CDF	Data appear to fit conditions
CFK*	Fish kill
CIP*	Surface ice present at sample station
CLT*	Low tide
CMC*	In field maintenance/cleaning
CMD*	Mud in probe guard
CND	New deployment begins
CRE*	Significant rain event
CSM*	See metadata
CTS	Turbidity spike
CVT*	Possible vandalism/tampering
CWD*	Data collected at wrong depth
CWE*	Significant weather event

13) Post deployment information – Included in annual metadata document.

Sage Lot

Date Retrieved	DO	Baro.	Depth	Depth	SpCond	pH 7	pH 10	Turbidity	Turbidity	Chl 0	Chl	Rhodamine
	100%	Pres.		Offset	50.00	7.00	10.00	DI	126.0	DI	Rhodamine	Std value
	%	mmHg	m	m	mS/cm			NTU	NTU	μg/L	μg/L	μg/L
05/23/16	98.2	757.8	-0.039	-0.03	50.11	7.07	10.01	-0.2	125.6	-0.2	119.4	119.6
06/16/16	95.4	754.1	-0.082	-0.081	49.51	6.93	9.91	426.1*	127.4*	-0.1	119.0	112.9
07/06/16	98.1	756.0	-0.050	-0.055	50.05	7.06	10.04	-0.8	112.9	0.5	107.5	112.9
07/28/16	99.1	756.4	-0.039	-0.049	50.78	7.05	10.01	0.3	126.2	0.4	110.4	108.7
08/19/16	99.2	757.9	-0.03	-0.029	50.01	7.01	10.05	-0.7	126.2	1.2	106.4	110.2
09/09/16	99.2	756.0	-0.054	-0.055	47.68	7.06	10.08	-0.2	127.7	0.5	113.0	113.8
09/27/16	99.8	763.8	0.057	0.052	50.35	7.03	10.08	0.3	126.7	-0.5	112.9	114.0
10/20/16	100.3	764.9	0.074	0.067	50.20	7.12	10.11	-0.1	126.3	-0.5	111.5	116.4
11/08/16	33.0**	760.1**	NA	0.001	20.62**	7.02**	9.44**	0.0**	180.2**	0.1**	111.2**	115.6**
11/30/16	98.9	748.0	-0.182	-0.164	50.11	6.95	9.94	0.1	125.8	-0.5	116.9	117.2
12/14/16	100.7	751.9	-0.114	0.111	49.99	6.94	10.01	0.3	126.4	-0.4	120.5	119.6

pH out of calibration. *Turbidity probe failed post-calibration. Readings during deployment have been marked as suspect.

** Thermistor failed in field. Air temperature was reading 87°C at post-calibration. All post-calibration values reflect failed C/T probe.

Childs River

Date Retrieved	DO	Baro.	Depth	Depth	SpCond	pH 7	pH 10	Turbidity	Turbidity	Chl 0	Chl	Rhodamine
	100%	Pres.		Offset	50.00	7.00	10.00	DI	126.0	DI	Rhodamine	Std value
	%	mmHg	m	m	mS/cm			NTU	NTU	µg/L	µg/L	µg/L
05/24/16	98.9	756.7	-0.040	-0.045	49.45	6.81	9.81	0.2	126.3	0.4	117.8	119.2
06/21/16	97.9	754.0	-0.08	-0.082	50.26	7.00	9.99	0.5	125.3	0.1	116.2	113.6
07/07/16	98.2	754.5	-0.079	-0.075	54.09*	7.05	10.01	0.2	124.4	-1.0	107.4	110.6
07/28/16	94.8	757.2	-0.034	-0.039	49.84	7.11	10.13	3.0	126.3	-0.4	111.8	109.5
08/12/16	98.7	757.0	-0.034	-0.041	49.64	7.08	10.11	-0.3	124.3	0.4	108.6	110.0
09/02/16	96.8	759.8	-0.001	-0.003	49.87	6.90	9.95	-0.5	127.2	0.3	112.6	111.9
09/23/16	NA	758.9	-0.020	-0.015	50.27	6.97	9.95	0.0	126.4	0.8	110.5	111.9
10/18/16	100.7	758.4	-0.040	-0.022	50.96	7.03	10.0	-0.2	127.2	0.2	115.8	115.6
11/04/16	99.4	761.0	0.018	0.014	49.70	7.05	10.01	0.3	126.9	-0.5	114.9	114.2
11/30/16	99.2	758.1	-0.025	-0.026	50.65	7.05	9.9?	-0.2	124.1	-0.1	112.9	117.2
12/20/16	102.0	768.0	0.098	0.109	50.05	7.02	9.99	0.4	129.4	0.1	116.8	118.2

*SpCond high for post-calibration.
pH out of calibration.

Metoxit Point *(Starting 07/06/16, switched from 6600-series to EXO2)*

Date Retrieved	DO	Baro.	Depth	Depth	SpCond	pH 7	pH 10	Turbidity	Turbidity	Chl 0	Chl	Rhodamine
	100%	Pres.		Offset	50.00	7.00	10.00	DI	126.0/124.0	DI	Rhodamine	Std value
	%	mmHg	m	m	mS/cm			NTU/FNU	NTU/FNU	µg/L	µg/L	µg/L
05/19/16	100.1	762.0	0.037	0.027	50.96	7.05	10.04	0.3	125.8	-0.5	123.0	121.5
06/14/16	99.7	755.3	-0.069	-0.064	49.52	6.74	9.76	1.1	115.5	**NA	**NA	**NA
07/06/16	98.5	756.0	-0.050	-0.055	49.64	7.13	10.11	-0.6	124.5	**NA	**NA	**NA
07/25/16	100.1	757.5	-0.025	-0.034	49.90	7.05	10.06	-2.1	127.6	0.05	63.2	64.5
08/18/16	101.9	759.5	0.000	-0.007	51.06	7.04	10.09	0.19	134.8	-0.13	65.2	64.7
09/07/16	98.8	760.0	-0.002	0	50.03	7.07	10.07	0.22	125.5	-0.02	61.22	65.3
09/27/16	101.2	763.9	0.051	0.053	49.94	7.14	10.20	0.17	128.7	-0.07	68.1	67.8
10/20/16	100.4	764.7	0.071	0.064	50.05	7.05	10.07	0.13	126.5	0.1	65.4	67.8
11/10/16	100.6	756.0	-0.052	-0.055	49.83	7.06	10.00	0.04	122.1	-0.01	65.6	67.3
12/02/16	99.9	753.8	-0.089	-0.085	50.13	7.09	10.04	0.06	121.7	0.04	68.3	68.4
12/13/16	101.1	758.1	-0.023	-0.026	50.17	6.99	9.99	0.09	122.3	-0.02	70.42	69.6

pH out of calibration.
** No chlorophyll probe.

Menauhant

Date Retrieved	DO	Baro.	Depth	Depth	SpCond	pH 7	pH 10	Turb	Turb	Chl 0	Chl	Rhodamine
	100%	Pres.		Offset	50.00	7.00	10.00	DI	126.0	DI	Rhodamine	Std value
	%	mmHg	m	m	mS/cm			NTU	NTU	µg/L	µg/L	µg/L
01/26/2016	99.9	760.8	0.004	0.011	50.64	7.41	10.42	2.4	124.4	0.2	118.6	124.2
02/23/2016	100.9	761.9	0.015	0.026	49.18	6.86	10.01	3.7	132.1	0.3	115.6	121.3
3/25/2016	97.1	750.0	-0.081	-0.136	49.5	7.14	10.13	-0.1	125.5	0.1	124.6	121.7
3/30/2016	100.5	767.8	0.095	0.106	51.48	7.14	10.16	0.7	126.8	-0.1	120.5	118.2
04/27/2016	100.4	757.0	-0.055	-0.041	50.49	7.02	10.03	0.1	125.7	-0.1	123.4	112.5
05/19/16	100.8	764.1	0.070	0.056	50.60	7.04	10.08	-2.3	126.6	0.1	119.9	126.2
06/14/16	99.4	756.0	-0.053	-0.055	48.04*	7.01	9.99	-0.2	125.8	0.4	123.7	116.6
07/07/16	104.1	754.3	-0.070	-0.078	49.92	7.01	10.06	0.1	124.8	1.7	108.7	111.2
07/28/16	99.4	757.5	-0.030	-0.034	49.91	7.08	10.07	0.6	126.0	-0.2	111.6	109.5
08/12/16	98.5	757.0	-0.040	-0.041	50.05	7.04	10.03	0.0	126.7	0.3	108.9	109.7
09/02/16	97.5	759.6	-0.006	-0.006	51.1	7.04	9.98	0.1	126.9	0.0	112.0	113.8
09/23/16	98.4	759.0	-0.010	-0.014	49.86	7.15	10.13	-0.2	126.3	0.4	111.3	113.3
10/18/16	98.5	758.6	-0.030	-0.020	48.5	7.13	10.14	-0.2	127.8	-0.1	117.1	116.8
11/04/16	98.6	761.0	0.014	0.014	49.4	7.03	10.01	2.1	126.7	0.4	116.0	114.8
11/30/16	102.2	748.0	-0.164	50.62	50.62	7.13	10.17	0.0	121.4	0.1	113.5	118.2
12/20/16	101.0	768.5	0.120	0.116	49.54	7.06	10.01	0.1	126.7	0.3	117.3	118.6
01/17/17	100.9	763.5	0.049	0.048	49.91	7.01	10.08	0.3	125.4	0.2	125.5	117.8

* SpCond low for post-calibration.
pH out of calibration.

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.

NOTE 1: SMALL NEGATIVE TURBIDITY ANOMALIES: Slight negative turbidity values sometimes occur as a result of small calibration offsets. Often these turbidity minimum values are between 0 and -2 NTU. All of these small negative turbidity values (the minimum for a given deployment) should be considered to be within 2 NTU of the true datum for correction purposes. This data has been given a Flag Code of <1> and retained.

NOTE 2: BIOLOGICAL-RELATED TURBIDITY ANOMALIES: This type anomaly includes turbidity readings that are either outside of the normal range or spikes way above background and unrelated to increased sediment suspension or decreased water column clarity. We believe these records are real (and not sensor malfunction), though not reflective of actual water column turbidity. These extreme values are likely due to biological factors (such as small fish, crabs, or other marine organisms). Our criteria for flagging these data are single spikes (above rather constant background) over 50NTU that are more than 10 times surrounding values. These readings were rejected <-3>.

NOTE 3: SUSPENSION EVENT RELATED TURBIDITY ANOMALIES: This type of anomaly includes turbidity readings that were either outside the normal range, or spikes way above background that are related to elevated turbidity levels indicative of wind wave-induced suspension (at the Menauhant site typically where vegetation often re-circulates due to wind and tidal currents or gets caught on the sonde guard) or prop wash-related suspension events (at the Childs River site typically). We believe these are real (and not sensor malfunction), though not reflective of actual water column turbidity. These extreme values are likely due to large floating particles (i.e., seaweeds, detritus, etc.) suspended in the water column during storm events usually from strong southerly winds in the Waquoit Bay area. (see end of section 5 for more detail on these events at this site). Our criteria for flagging these data are values over 100NTU that are more than 5 times the magnitude of surrounding values, and linked to high winds. These readings were rejected <-3>.

NOTE 4: SMALL NEGATIVE DEPTH ANOMALIES: This type of anomaly occurs due to barometric pressure differences between time of calibration and the reading and ice conditions. In all such cases, barometric pressure differences are checked as well as comparison with other parameters for indications of aerial exposure to verify that all data are valid submerged readings.

NOTE 5: MISSING DATA: Data are missing due to equipment or associated specific probes not being deployed, equipment failure, time of maintenance or calibration of equipment, or repair/replacement of a sampling station platform. Any NANs in the dataset stand for "not a number" and are the result of low power, disconnected wires, or out of range readings. If additional information on missing data is needed, contact the Research Coordinator at the reserve submitting the data.

NOTE 6: ELEVATED CHLOROPHYLL FLUORESCENCE ANOMALIES
Due to interference from biofouling or floating detritus, the chlorophyll fluorescence optic sensors will record values which are above the normal environmental range. Values over three times the magnitude of surrounding values are flagged as suspect <1> and given the code [SCS] indicating a chlorophyll spike. Additionally, sustained values > 100µg/L are considered suspect unless the conditions at the site can be verified (e.g., discrete chlorophyll samples processed in the lab). Spikes that exceed 400 µg/L are flagged as rejected <-3> with the code [SCS].

FIELD and "CSM" NOTES: All times reported in Eastern Standard Time (EST)

Menauhant (MH)

General (MH)

- 04/27/16 to 05/19/16 {CSM} – Sondes are deployed with a plastic fine mesh cover over the guard to reduce the number of crabs sitting on the optical sensors. Due to the high velocity of the water moving through the Menauhant channel, floating algae gets caught in the mesh causing interference with the optical sensors. The algae biofouling mainly affects the turbidity and chlorophyll readings causing reoccurring spikes in the data. Most of turbidity and chlorophyll data has been rejected or marked as suspect during this time period due to the biofouling interference.

- 06/05/16 to 06/09/16 {CSM} – Sondes are deployed with a plastic fine mesh cover over the guard to reduce the number of crabs sitting on the optical sensors. Due to the high velocity of the water moving through the Menauhant channel, floating algae gets caught in the mesh causing interference with the optical sensors. The algae biofouling mainly affects the turbidity and chlorophyll readings causing reoccurring spikes in the data. Most of turbidity and chlorophyll data has been rejected or marked as suspect during this time period due to the biofouling interference. When we removed the sonde for infield maintenance, the algae was removed and the turbidity and chlorophyll sensors returned to baseline = 0.

- 06/09/2016 8:16 to 9:00 <-3>[GOW](CMC) - Sonde was removed while PVC silo was being replaced. All data rejected during out of water event.

- 06/14/16 to 07/07/16 {CSM} - Sondes are deployed with a plastic fine mesh cover over the guard to reduce the number of crabs sitting on the optical sensors. Due to the high velocity of the water moving through the Menauhant channel, floating algae sometimes gets caught in the mesh causing interference with the optical sensors. The algae biofouling mainly affects the turbidity and chlorophyll readings causing reoccurring spikes in the data. Most of turbidity and/or chlorophyll data has been rejected or marked as suspect during this time period due to the biofouling interference.
    - The sonde was checked on 07/01/16 and the mesh was removed. The turbidity levels resumed to a normal zero baseline. However, a crab or algae must have covered the chlorophyll probe following the removal of the mesh because the chlorophyll numbers greatly deteriorated after the infield maintenance on 07/01/16.

- 10/23/2016 00:00 to 00:15, <1>{CSM}(CDF) – Data appear to fit conditions but are marked suspect. A strong rain storm combined with the turn of a lower than usual tide caused dramatic drops in temperature, specific conductivity, and salinity while also causing a jump in dissolved oxygen, turbidity, and chlorophyll fluorescence.

- 11/04/2016 10:15 to 11/30/2016 9:45, <-3> [STF](CSM) – The conductivity and temperature probe was replaced before deployment due to a failing conductivity sensor (SN: 02J0212). However, the probe was replaced with a faulty thermistor (SN: 07D100222). During this deployment temperature, specific conductivity, salinity, pH, dissolved oxygen (% and mg/L), depth, turbidity, and chlorophyll fluorescence measurements are rejected due to the bad thermistor.

- 12/26/2016 10:30, <-3> {CSM}(CMC) – Changed field cable for the telemetry station. The sonde was removed at 10:30 EST to disconnect old field cable and connect replacement. Due to this required maintenance, all data are rejected during this out of water event.

Temperature (MH)

- 01/19/2016 to 01/26/2016 <-3> [SSD](CSM) – On 01/19/2016, the tide was so low that the depth sensor was near the surface or out of the water for several hours (11:45 to 14:15). Following the near surface/out of water event, the temperature, specific conductivity, and salinity appear off until the sondes is exchanged on 01/26/2016. Water or debris may have frozen inside and around the temperature and specific conductivity sensors. The post-calibration appeared normal.

Specific Conductivity and Salinity (MH)

- 01/19/2016 to 01/26/2016 <-3> [SSD](CSM) – On 01/19/2016, the air temperature dropped precipitously and tide was so low that the depth sensor was near the surface or out of the water for several hours (11:45 to 14:15). Following the near surface/out of water event, the temperature, specific conductivity, and salinity appear off until the sondes is exchanged on 01/26/2016. Water or debris may have frozen inside and around the temperature and specific conductivity sensors.

- 05/20/16 to 07/07/16 <-3>[SSD](CSM) – Only one day after deployment, the specific conductivity/salinity sensors were affected by biofouling. There was a sudden, precipitous drop in the readings which is best explained by a small animal taking up residence inside the ports. The sonde was covered in star tunicates when retrieved three weeks later. It's likely a tunicate was growing inside the sensor cavity. Additionally, the post-calibration showed no signs of sensor malfunction, further strengthening the biofouling theory.

- 10/02/16 to end of deployment (10/18/16), <-3>[SPC](CSM) – All data are rejected during this period because the post-calibration values for specific conductivity were very low (50.0 mS/cm solution showed 48.5 mS/cm). There was a heavy rainstorm on October 1st which could have dropped the salinity concentration, but the salinity continued to decline sharply rather than rebounding to normal levels. Algae was found on the probe at retrieval and may have disrupted readings as well.

Dissolved Oxygen, % and mg/L (MH)

- 01/19/2016 to 01/26/2016 <-3>[SQR](CSM) – Because temperature and conductivity are rejected during this period as a result of freezing ports during an out of water event, dissolved oxygen readings are also rejected.

pH (MH)

- 12/30/2015 to 1/26/2016, <-3>[SPC](CSM) – pH values are rejected; the probe showed no indication of trouble during pre-calibration, but post-calibration indicates inaccurate readings (see post-calibration data in Section 13).

- 1/26/2016 to 2/23/2016, <-3>[SIC](CSM) – pH values are suspiciously high. All of this deployment is rejected. The poor post-calibration indicates that the pH probe requires reconditioning – it may have been slow to react during pre-calibration.

- 3/25/2016 to 3/30/2016, <-3> [SIC](CSM) - pH values are suspiciously low relative to the previous deployment. All of this deployment is rejected. The pH probe may require reconditioning – it may have been slow to react during calibration.

- 07/07/2016 to 07/28/2016 <CAF> - Marked as within acceptable calibration/accuracy error of sensor because pre and post-calibration values look really good – not sure why these didn’t line up well in the field.

Turbidity (MH)

- 12/31/2015 to 1/6/2016, <1>[SSD](CSM) – Turbidity values are suspect due to sensor drift. Optic sensors were wiped clean on 1/6/2016 with a kimwipe and values return to zero for baseline. May have been copper resin or biofouling on the optical sensor.

- 6/14/2016 to 07/01/2016, <-3>[SSD](CSM) – Turbidity values were elevated until the sonde was removed from the wiper on 07/01/2016 and the optic sensor was cleaned with a kimwipe. One crab was found inside the guard, but no additional biofouling was noted on the sensor. The mesh around the guard, which was covered in algae, was also removed. Turbidity values resume normal baseline after the infield cleaning. Intermittent elevated turbidity values following the cleaning were likely crabs walking over the sensor.

- 10/26/2016 02:30 to 11/04/2016, <-3>[SSD](CBF) – Pieces of macroalgae were observed caught in the guard upon retrieval. This is the likely explanation for the high turbidity values for the latter half of this deployment. Because the measurements resume steady readings near zero upon sonde exchange, the data within the previous deployment are rejected.

- 11/13/2016 10:15 to 11/30/2016, <1>[SSD](CBF) – Turbidity values are marked as suspect during this period since it is unclear whether biofouling from algal communities or a high concentration of suspended sediments, due to extreme low tides, caused the elevated readings.

Chlorophyll Fluorescence (MH)

- <1> [SBO] (CSM) –

  The normal range for chlorophyll-a concentration at Menauhant is 0-50 µg/L, so sustained data that is much higher than this is marked as suspect. When chlorophyll fluorescence data is flagged using the above code it is because the data are temporarily elevated (>50µg/L) for more than one or two readings (i.e., over thirty minutes of data collection), but post-calibration is normal. The elevated readings do not stay high for the remainder of the deployment and resume a normal baseline (<5 µg/L) indicating that the optic sensor was blocked temporarily. These elevated readings can last a few hours or a few days. The reasons for the elevated data are most likely from: 1) macroalgae caught in between the probes or on the sonde guard near the sensor, or 2) crabs (primarily the invasive Asian shore crab) sitting over the optic. Post-calibration of the sensor is normal.

- <-3> [SBO](CSM) –

  The normal range for chlorophyll-a concentration at Menauhant is 0-50 µg/L. When chlorophyll fluorescence data are rejected using the code above, the data are >150µg/L for more than two readings (i.e., over thirty minutes of data collection), but post-calibration is normal. Additionally, the elevated readings do not stay high for the rest of the deployment and resume a normal baseline (<5 µg/L) indicating that the optic sensor was blocked temporarily. These elevated readings can last a few hours or a few days. The reasons for the elevated data are most likely from: 1) macroalgae caught in between the probes or on the sonde guard near the sensor, or 2) crabs (primarily the invasive Asian shore crab) sitting over the optic.

Childs River (CR)

General (CR)

- 06/09/2016, <-3>[GOW](CMC) – Sonde was removed while PVC silo was being replaced. All data rejected during out of water event.

- 08/31/2016 5:15 to 09/02/2016 7:45, <-3>{CSM}[SSD](CBF) – Dense tunicate growth on sonde caused drift in the following data parameters: Temperature, Specific Conductivity, Salinity, Dissolved Oxygen (% and mg/L) and pH.

- 01:15 11/27/2016 to 10:00 11/30/2016, <-2> [GPF](CSM) – Data is unavailable during this time period because the battery failed on 11/27/2016. Data resumes on 11/30/2016 when the new deployment starts.

- 12/15/2016 to 12/16/2016, {CSM} – There was an extremely low tide event (<0.2m) for these two days, which flushed suspended particles along with colder, fresher water from upstream to the sonde location affecting temperature, specific conductivity, salinity, pH, turbidity, and chlorophyll-a fluorescence. Bosun marina staff noted that it was the lowest tide on their records.

Specific Conductivity and Salinity (CR)

- 06/20/2016 5:45 to 19:15, <1>(CSM) – Odd salinity and specific conductivity readings. May have been a shrimp inside the sensor or a response to the rapidly dropping barometric pressure prior to evening thunderstorm.

pH (CR)

- 05/24/2016 to 05/26/2016, <1>(CSM) – Conductivity and salinity values appear abnormally high until a rain event on May 27 and 28th, 2016. Because of the high conductivity values, DO is also marked suspect as a dependent parameter.

- 11/04/16 to 11/27/2016, <1> [SIC](CSM) – pH values seem elevated in relation to previous and following deployments. Although pre- and post-calibration values appear normal, the measurements are marked suspect.

Turbidity (CR)

- 17:15 12/15/2016 to 14:30 12/20/2016, <1> [SSD](CSM) – Turbidity values are marked as suspect during this time period because there is a baseline shift of approximately 2 NTU. The shift started during an extreme low tide event when suspended sediment or algae particles might have clung to the optic sensor. Post-calibration at 126 NTU appeared high (129.4 NTU) further suggesting the sensor may have been covered by a light film or debris.

Metoxit Point (MP)

General (MP)

- On 07/25/2016, 6600-series YSI sondes were no longer deployed at Metoxit Point. They were replaced with EXO2 sondes.

Specific Conductivity & Salinity (MP)

- 07/25/16 to 08/18/16, <-3>[SIC](CSM) – The specific conductivity and salinity values are too high during this entire deployment. The pre- and post-calibration values were high even though the sensor calibrated successfully before deployment. This was the first deployment for a non-wiped conductivity probe. Later deployments using this same probe appear within acceptable ranges.

Chlorophyll fluorescence (MP)

- <-2> (CSM) - No chlorophyll fluorescence data due to a shortage in probes for the following deployments:

Start	End
05/19/16 10:30	06/14/16 10:15
06/14/16 10:45	07/06/16 10:45

Sage Lot (SL)

General (SL)

- 14:45 10/26/16 to 11:45 11/08/16, <-3> [STF](CSM) – The thermistor on the temperature and conductivity probe failed on 10/26/16 affecting temperature, specific conductivity, salinity, dissolved oxygen, depth, pH, turbidity, and chlorophyll fluorescence readings. All of these parameters have been rejected during the time of the failed thermistor.

Turbidity (SL)

- 06/01/16 to 06/16/16, <-3>[SPC](CSM) – The turbidity probe was out of normal range for both low and high post-calibration solutions. The readings were very irregular. The probe seems to have started irregular readings on 06/01/16.

YSI 650 or EXO1 In-Situ Comparison Data

A hand-held YSI 650 was used for field calibration and data were recorded at YSI deployment depths. Sonde deployment and retrieval (or last / first) comparisons for each site in addition to the hand-held measurements are shown below in Tables 1-4. They represent another form of post-check on retrieved sonde data as it is assumed that the recently calibrated deployed sonde is highly accurate on its initial measurement. If the assumption holds true, we should expect last / first readings to be quite similar within the usual 15 minute time difference between readings if the retrieved instrument was still reading accurately. Large differences indicate potential problems.

Table 1: Metoxit Point (MP) Deployment/Retrieval YSI 650/EXO1 Data Data

	Date	Time	Temp	SpCond	Salinity	DO %	DO Conc.	pH	Depth
MP	M/D/Y	hh:mm	C	mS/cm	ppt	%	mg/L		m
Deploy	05/04/16	10:13	12.02	46.13	29.86	82.9	7.4	7.68	0.733
Retrieve	05/19/16	10:21	15.04	46.81	30.46	91.0	7.61	7.79	1.162
Deploy	05/19/16	10:21	15.04	46.81	30.46	91.0	7.61	7.79	1.162
Retrieve	06/14/16	10:31	18.89	46.81	30.48	106.3	8.24	7.93	0.445
Deploy	06/14/16	10:31	18.89	46.81	30.48	106.3	8.24	7.93	0.445
Retrieve	07/06/16	10:46	24.8	46.10	29.93	101.6	7.08	7.82	1.040
Deploy	07/06/16	10:46	24.8	46.10	29.93	101.6	7.08	7.82	1.040
Retrieve	07/25/16	9:00	26.61	46.19	29.92	115.8	7.84	7.80	1.146
Deploy	07/25/16	9:00	26.61	46.19	29.92	115.8	7.84	7.80	1.146
Retrieve	08/18/16	9:10	26.29	48.2	31.3	41.9	2.81	7.40	1.502
Deploy	08/18/16	9:10	26.29	48.2	31.3	41.9	2.81	7.40	1.502
Retrieve	09/07/16	7:45	22.11	47.02	30.62	94.0	6.95	7.49	0.743
Deploy	09/07/16	7:45	22.11	47.02	30.62	94.0	6.95	7.49	0.743
Retrieve	09/27/16	15:13	19.63	47.33	30.86	107.9	8.25	NA	0.748
Deploy	09/27/16	15:13	19.63	47.33	30.86	107.9	8.25	NA	0.748
Retrieve	10/20/16	9:50	18.01	46.82	30.48	100.9	7.96	NA	0.850
Deploy	10/20/16	9:50	18.01	46.82	30.48	100.9	7.96	NA	0.850
Retrieve	11/10/16	13:20	11.28	47.40	30.76	117.2	10.53	NA	0.511
Deploy	11/10/16	13:20	11.28	47.40	30.76	117.2	10.53	NA	0.511
Retrieve	12/02/16	12:14	8:19	46.67	30.02	116.0	11.23	8.04	1.05
Deploy	12/02/16	12:14	8:19	46.67	30.02	116.0	11.23	8.04	1.05
Retrieve	12/13/16	13:38	3.81	47.63	30.43	100.1	10.74	8.01	0.660

*The pH is suspect because it's much lower than average. New EXO1 handheld was obtained in December 2016, so pH values resume reliability.

Table 2: Menauhant (MH) Deployment/Retrieval YSI 650/EXO1 Data

	Date	Time	Temp	SpCond	Salinity	DO %	DO Conc.	pH	Depth
	M/D/Y	hh:mm	C	mS/cm	ppt	%	mg/L		m
Deploy	12/30/15	10:23	7.2	47.77	30.71	96.3	9.51	7.63	0.625
Retrieve	1/26/16	10:40	1.23	48.75	30.56	116.7	13.32	NA	1.025
Deploy	1/26/16	10:40	1.23	48.75	30.56	116.7	13.32	NA	1.025
Retrieve	2/23/16	15:55	3.22	47.52	30.05	108.6	11.84	7.32	1.229
Deploy	2/23/16	15:55	3.22	47.52	30.05	108.6	11.84	7.32	1.229
Retrieve	3/25/16	8:56	8.03	47.39	30.54	100.0	9.7	7.63	0.908
Deploy	3/25/16	8:56	8.03	47.39	30.54	100.0	9.7	7.63	0.908
Retrieve	3/30/16	13:20	8.15	46.9	30.24	110.5	10.72	7.65	0.883
Deploy	3/30/16	13:20	8.15	46.9	30.24	110.5	10.72	7.65	0.883
Retrieve	04/27/16	11:02	11.87	47.46	30.85	101.9	9.09	7.91	0.812
Deploy	04/27/16	11:02	11.87	47.46	30.85	101.9	9.09	7.91	0.812
Retrieve	05/19/16	14:03	15.88	47.18	30.72	114.2	9.37	7.71	0.740
Deploy	05/19/16	14:03	15.88	47.18	30.72	114.2	9.37	7.71	0.740
Retrieve	06/14/16	9:06	18.89	46.81	30.48	106.3	8.24	7.93	0.445
Deploy	06/14/16	9:06	18.89	46.81	30.48	106.3	8.24	7.93	0.445
Retrieve	07/07/16	12:06	25.18	48.04	31.31	112.0	7.72	7.84	0.713
Deploy	07/07/16	12:06	25.18	48.04	31.31	112.0	7.72	7.84	0.713
Retrieve	07/28/16	9:16	25.9	48.36	31.51	97.6	6.64	7.56	0.712
Deploy	07/28/16	9:16	25.9	48.36	31.51	97.6	6.64	7.56	0.712
Retrieve	08/12/16	8:34	24.86	48.85	31.90	93.4	6.43	7.37	0.901
Deploy	08/12/16	8:34	24.86	48.85	31.90	93.4	6.43	7.37	0.901
Retrieve	09/02/16	7:44	23.33	48.82	31.91	91.8	6.51	7.60	0.956
Deploy	09/02/16	7:44	23.33	48.82	31.91	91.8	6.51	7.60	0.956
Retrieve	09/23/16	10:15	23.06	48.20	31.46	105.0	7.51	NA	0.853
Deploy	09/23/16	10:15	23.06	48.20	31.46	105.0	7.51	NA	0.853
Retrieve	10/18/16	9:37	17.36	48.80	31.93	104.1	8.24	NA	0.976
Deploy	10/18/16	9:37	17.36	48.80	31.93	104.1	8.24	NA	0.976
Retrieve	11/04/16	10:12	12.97	48.4	31.54	99.7	8.64	NA	1.164
Deploy	11/04/16	10:12	12.97	48.4	31.54	99.7	8.64	NA	1.164
Retrieve	11/30/16	9:51	7.86	48.83	31.52	88.6	8.57	NA	0.943

Menauhant Continued									
	Date	Time	Temp	SpCond	Salinity	DO %	DO Conc.	pH	Depth
	M/D/Y	hh:mm	C	mS/cm	ppt	%	mg/L		m
Deploy	11/30/16	9:51	7.86	48.83	31.52	88.6	8.57	NA	0.943
Retrieve	12/20/16	13:41	3.48	49.91	31.76	102.3	10.97	8.02	0.936
Deploy	12/20/16	13:41	3.48	49.91	31.76	102.3	10.97	8.02	0.936
Retrieve	01/17/17	12:12	2.97	49.47	31.56	103.3	11.22	7.94	1.04

*The pH is suspect because it's much lower than average. New EXO1 handheld was obtained in December 2016, so pH values resume reliability.

Table 3: Child's River Deployment/Retrieval YSI 650/EXO1 Data

	Date	Time	Temp	SpCond	Salinity	DO %	DO Conc.	pH	Depth
	M/D/YY	hh:mm	C	mS/cm	ppt	%	mg/L		m
Deploy	04/27/16	10:46	13.18	31.09	19.37	89.5	8.33	7.96	0.399
Retrieve	05/24/16	9:13	18.13	44.90	29.10	77.6	6.16	7.46	0.645
Deploy	05/24/16	9:13	18.13	44.90	29.10	77.6	6.16	7.46	0.645
Retrieve	06/21/16	9:02	24.05	43.80	28.25	24.0	1.7	7.19	0.911
Deploy	06/21/16	9:02	24.05	43.80	28.25	24.0	1.7	7.19	0.911
Retrieve	07/07/16	12:27	25.98	42.20	27.07	87.8	6.1	7.66	0.759
Deploy	07/07/16	12:27	25.98	42.20	27.07	87.8	6.1	7.66	0.759
Retrieve	07/28/16	9:40	27.18	33.19	20.99	60.3	4.24	7.41	0.432
Deploy	07/28/16	9:40	27.18	33.19	20.99	60.3	4.24	7.41	0.432
Retrieve	08/12/16	8:56	26.26	39.78	25.35	10.8	0.76	7.03	0.624
Deploy	08/12/16	8:56	26.26	39.78	25.35	10.8	0.76	7.03	0.624
Retrieve	09/02/16	7:44	24.77	46.63	30.28	34.4	2.39	7.53	0.980
Deploy	09/02/16	7:44	24.77	46.63	30.28	34.4	2.39	7.53	0.980
Retrieve	09/23/16	10:39	24.29	44.73	28.91	84.7	6.02	NA	0.793
Deploy	09/23/16	10:39	24.29	44.73	28.91	84.7	6.02	NA	0.793
Retrieve	10/18/16	9:50	17.41	45.56	29.58	106.6	8.55	NA	1.149
Deploy	10/18/16	9:50	17.41	45.56	29.58	106.6	8.55	NA	1.149
Retrieve	11/04/16	10:36	13.61	45.68	29.59	112.1	9.71	NA	0.844
Deploy	11/04/16	10:36	13.61	45.68	29.59	112.1	9.71	NA	0.844
Retrieve	11/30/16	10:08	8.09	45.67	29.3	86.5	8.44	NA	1.071
Deploy	11/30/16	10:08	8.09	45.67	29.3	86.5	8.44	NA	1.071
Retrieve	12/20/16	14:40	3.80	46.84	29.67	121.5	13.15	7.14	1.094

*The pH is suspect because it's much lower than average. New EXO1 handheld was obtained in December 2016, so pH values resume reliability.

Table 4: Sage Lot Deployment/Retrieval YSI 650/EXO1 Data

	Date	Time	Temp	SpCond	Salinity	DO %	DO Conc.	pH	Depth
	M/D/Y	hh:mm	C	mS/cm	ppt	%	mg/L		m
Deploy	05/04/16	11:59	11.84	45.47	29.38	102.1	9.18	7.81	0.214
Retrieve	05/23/16	11:56	18.04	45.81	29.75	110.2	8.72	7.62	0.701
Deploy	05/23/16	11:56	18.04	45.81	29.75	110.2	8.72	7.62	0.701
Retrieve	06/16/16	12:41	22.74	45.93	29.91	101.3	7.43	7.75	0.370
Deploy	06/16/16	12:41	22.74	45.93	29.91	101.3	7.43	7.75	0.370
Retrieve	07/06/16	9:31	24.73	45.9	29.74	100.6	7.07	7.62	0.416
Deploy	07/06/16	9:31	24.73	45.9	29.74	100.6	7.07	7.62	0.416
Retrieve	07/28/16	14:38	29.29	48.1	31.23	138.7	8.95	7.54	0.561
Deploy	07/28/16	14:38	29.29	48.1	31.23	138.7	8.95	7.54	0.561
Retrieve	08/19/16	9:28	25.76	48.85	31.87	91.0	6.19	7.20	0.801
Deploy	08/19/16	9:28	25.76	48.85	31.87	91.0	6.19	7.20	0.801
Retrieve	09/09/16	10:28	23.45	48.28	31.45	87.6	6.22	NA	0.420
Deploy	09/09/16	10:28	23.45	48.28	31.45	87.6	6.22	NA	0.420
Retrieve	09/27/16	13:58	18.83	47.43	30.93	91.7	7.09	NA	0.487
Deploy	09/27/16	13:58	18.83	47.43	30.93	91.7	7.09	NA	0.487
Retrieve	10/20/16	8:32	17.87	47.67	31.11	90.6	7.14	NA	0.862
Deploy	10/20/16	8:32	17.87	47.67	31.11	90.6	7.14	NA	0.862
Retrieve	11/08/16	12:01	9.51	45.34	29.16	109.7	10.36	NA	0.659
Deploy	11/08/16	12:01	9.51	45.34	29.16	109.7	10.36	NA	0.659
Retrieve	11/30/16	13:53	8.29	47.16	30.37	106.2	10.26	NA	1.007
Deploy	11/30/16	13:53	8.29	47.16	30.37	106.2	10.26	NA	1.007
Retrieve	12/14/16	12:14	4.4	47.96	30.53	103.8	10.98	8.00	0.492

*The pH is suspect because it's much lower than average. New EXO1 handheld was obtained in December 2016, so pH values resume reliability.

Literature Cited:

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