WELLS (WEL) National Estuarine Research Reserve
Provisional Water Quality Metadata
January-September 2014
Latest Update: May 16, 2016

I. Data Set & Research Descriptors

1). Principal investigator & 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 they undergo automated primary QAQC; automated depth/level corrections for changes in barometric pressure (cDepth or cLevel parameters); and become part of the CDMO's online provisional database. All pre- and post-deployment data are removed from the file prior to upload. During primary QAQC, data are flagged if they are missing or out of sensor range. The edited file is then returned to the Reserve for secondary QAQC where it is opened in Microsoft Excel and processed using the CDMO's NERRQAQC Excel macro. The macro inserts station codes, creates metadata worksheets for flagged data and summary statistics, and graphs the data for review. It allows the user to apply QAQC flags and codes to the data, remove any overlapping deployment data, append files, and export the resulting data file for upload to the CDMO. Upload after secondary QAQC results in ingestion into the database as provisional plus data, recalculation of cDepth or cLevel parameters, and finally tertiary QAQC by the CDMO and assimilation into the CDMO's authoritative online database. Where deployment overlap occurs between files, the data produced by the newly calibrated sonde is generally accepted as being the most accurate. For more information on QAQC flags and codes, see Sections 11 and 12. Jeremy Miller is responsible for all data management.

3). Research objectives:

The Webhannet River estuary is located in proximity to heavily used beaches in Wells, Maine. It has

a shoreline that is highly developed with residential and commercial structures. The estuary receives water from a 14 sq. mi. watershed that is well forested. We are measuring variations in hydrologic variables in the Webhannet River estuary at the Head of Tide and at the Inlet. Data from Head of Tide will integrate surface and ground water inputs (from both point and non-point sources) from the freshwater watershed into the estuary. Data from the Inlet will integrate surface and ground water inputs from the freshwater watershed and the estuarine watershed. Differences in data between the Head of Tide and the Inlet will indicate inputs from the estuarine portion of the watershed (on the ebb tide), and inputs from the Gulf of Maine on the flood tide. The instruments will track runoff events via salinity, and will measure pollutant-carrying sediment particles via turbidity. Our working hypothesis is that the freshwater watershed is the primary source of sediment and therefore potential NPS pollutants in the estuary. These two variables will indicate the potential for non-point source pollutants to enter the estuary, and whether they are of upland, estuarine, or Gulf of Maine origin. Other variables measured by the data loggers (DO, temperature, pH, specific conductivity, and water level) will provide important baseline data to track changes in the estuary's physicochemical parameters over the long term. These variables can be affected by changes in human water use, and by natural or human induced changes in Inlet and river channel morphology, climate, and organic loadings. The Inlet site is heavily impacted at the Wells Harbor dock and is our long-term monitoring site. The Head of Tide site is relatively un-impacted, located just east of the US Route One Bridge, and is our roving site. We also collect data at the Skinner Mill site (SM) which acts as the head of tide site for the Little River/Merriland river estuary and at the mouth of the Little River (LM) to have comparative data for a less developed estuary.

4). Research Methods

The Wells NERR YSI monitoring program began in April 1995 at one site (Head of Tide site-HT) and May 1995 at a second site (Inlet site-IN) in the Webhannet River estuary. Two additional sites were added in 2002, Mile Road (ML) site began in March in the Webhannet River estuary and Little River Mouth (LM) in April in the Merriland/Branch/Little River Estuary. For 2004, the Mile Road (ML) site was eliminated and a new site at Skinner Mill (SM) in the Merriland/Branch/Little River Estuary was added. All data loggers have 1/4 inch black vexar mesh wrapped on the outside of the probe protective housing (using rubber bands) of the sonde guard to prevent fouling and unwanted animals. All deployment structures (PVC tubes) described below, are labeled with the Wells NERR information.

*IMPORTANT CHANGE TO ALL SITES: In 2004, the YSI Extended Deployment System was used for all deployments. This system consists of a small brush that sweeps all the probes (except for depth) prior to each reading, greatly reducing the problem of biofouling. The Extended Deployment System is reflected in the "EDS" in the sonde model number.

* IMPORTANT CHANGE TO THE SKINNER (SM) SITE:
On 5/30/2006 the location of the Skinner Mill (SM) was changed to better reflect a head of tide and head of estuary scenario. The site was moved approximately 100 meters downstream from the original site described in 2004-5 metadata. In addition, a Sutron Sat-Link2 transmitter was installed at this station, and transmits data to the NOAA GOES satellite, NESDIS ID #3B035008. The transmissions are scheduled hourly and contain four (4) datasets reflecting fifteen minute data sampling intervals. The telemetry data is "Provisional" data and not the "Authentic" dataset used for long term monitoring and study. This data can be viewed by going to http://cdmo.baruch.sc.edu."

* IMPORTANT INFORMATION PERTAINNING TO THE INLET (IN) SITE:
The Inlet site (IN) deployment methods are different than the other sites (SM, HT, LM). A 23 foot, 4 inch diameter high grade PVC tube was installed against a dock piling. Four steel flat bars with bolts were used to attach this 23 foot PVC tube against the dock piling. A 3 by 1.5 inch PVC transducer was glued on the inside bottom of the PVC tube to allow the sonde to sit exactly 1.0 meter (3.28 ft) off the bottom. Several

vertical holes, representative of the sonde guard, were cut out the circumference near the bottom of the PVC pipe to allow water flow to the probes. An "L" shaped steel bar with two end-holes is placed through two created slits about a half of foot from the top of the PVC tube. A stainless steel wire (1/16") is attached to the sonde bail using two stainless steel clips; and to one end of the "L" shaped steel bar for sonde deployment and retrieval. A marine lock is attached through the other end of the "L" shaped steel bar to hold the bar, wire, and sonde in place and for security. A PVC threaded cap screws in to the threaded top of the PVC tube, also for security. A hole was created in the PVC cap to allow the sonde to hook up with the telemetry unit using the 50 foot vented cable. The telemetry unit was removed in 2004 and is no longer in service at this site.

All other sites, Head of Tide (HT), Little River Mouth (LM), and Skinner Mill (SM) are deployed similarly to each other as of 5/30/2006. These sites use a 5 foot, 4 inch diameter high grade PVC tube. The PVC tube is attached to a 12 foot, heavy steel sign post using a stainless steel bolt at the bottom of the tube, a stainless steel cable wrap at the top, and several thick electrical cable ties in between. The steel sign post was pounded in about 6 feet into the river bottom, such that the bottom of the PVC tube was flat on the river bottom. The PVC tube has one 3 by 1.5 inch PVC transducer glued on the inside bottom of the PVC tube to allow the sonde to sit exactly at a certain height off the bottom (see below). Several vertical holes, representative of the sonde guard, were cut out the circumference near the bottom of the PVC pipe to allow water flow to the probes. An "L" shaped steel bar with two end-holes is placed through two created slits about a half of foot from the top of the PVC tube. A stainless steel wire (1/16") is attached to the sonde bail using two stainless steel clips; and to one end of the "L" shaped steel bar for sonde deployment and retrieval. A marine lock is attached through the other end of the "L" shaped steel bar to hold the bar, wire, and sonde in place and for security. A flotation buoy is tied to the PVC tubes incase the deployment structure ever gets dislodged. The deployment depth for these sites is such that the probe-end of the data logger is secured 0.15 meters (6 inches) off the bottom.

Deployment and Data Intervals:
Three to four week variable sampling periods were chosen for all data sondes due to limitations created by the life of the dissolved oxygen membrane, probe fouling, limited battery power, and to minimize risk of lost data in the event of a malfunction. Measurements of temperature, specific conductivity, salinity, percent saturation, dissolved oxygen, depth, pH, and turbidity are recorded at 15 minute intervals throughout the deployment period.

Calibration and Standards Used:
After the deployment period, the data logger is brought back into the Wells NERR Laboratory for downloading, cleaning, and calibration. These procedures are carried out to the methods described in the YSI Operating Manual. Calibration standards are used for specific conductivity (10 mS/cm), pH (buffer solutions of pH 4, 7, and 10), and turbidity (126 NTU). The pH standards are purchased from VWR. Conductivity and turbidity standards are purchased from YSI, Inc. The dissolved oxygen membranes are replaced and sit 6-24 hours before each deployment. During periods when we have an idle YSI logger, the deployments are continuous (retrieved logger is immediately swapped with a newly deployed logger). If no idle logger is available (for example, it is away for repair), after approximately 6-24 hours of down time for cleaning, maintenance and recalibration, the YSI Data logger is redeployed for another sampling period.

QA/QC of Instruments:
At each deployment and retrieval, a YSI Model 85 handheld unit collects temperature, DO mg/L, DO %, and salinity. These parameters are recorded on the calibration/deployment/retrieval data sheets and compared to the sonde data. In addition, at the end of each deployment, the data is immediately downloaded and a graph viewed of the data to look for periods of missing or anomalous data. “Post-calibration” data (using calibration standards) are also recorded, to verify that the probes are still measuring accurately after retrieval. The use of the newest version of the National Estuarine Research Reserve (NERR) System-Wide

Monitoring Program (SWMP) YSI 6-Series Multi-Parameter Water Quality Monitor Standard Operating Procedures began in 2005 when they became available.

5). Site location and character

The Wells National Estuarine Research Reserve is located in York County, within the Town of Wells, on the coast of southern Maine and faces the Atlantic Ocean. The Wells NERR is approximately 31 km (20 miles) south of Portland, Maine and 110 km (70 miles) north of Boston, Massachusetts. The Reserve encompasses 1,690 acres along the Gulf of Maine coastline of tidally-flushed wetlands, riparian and transitional upland fields and forests within the Little River Estuary and the larger Webhannet River Estuary. Both estuaries arise in the sandy glacial outwash plain about eight miles inland. Both rivers empty into Wells Bay, a sandy basin stretching for approximately ten miles along the Atlantic coast. Bordering each river's Inlet are double spit barrier beaches attached to the mainland. The backbarrier system in the Webhannet River Estuary is approximately 5 sq. km and is composed of large intertidal marshes (predominantly S. patens and S. alterniflora), intertidal sand and mud flats, and tidal channels. The watershed for the Webhannet River estuary covers an area of 35 sq. km and has a total of 6 streams, brooks or creeks, which enter the estuary. These tributaries flow across sand and gravel deposits near the headwaters and the impermeable sandy muds of the Presumpscot Formation in the lower reaches. The watershed for the Little River estuary covers an area of 84 sq. km and has a total of 2 tributaries. The backbarrier system in the Little River Estuary is approximately 2.51 sq. km and is composed of large intertidal marshes (predominantly S. patens and S. alterniflora), intertidal sand and mud flats, and tidal channels. The Webhannet River is connected to the ocean via Wells Inlet, which has a spring tidal prism of 28,200,000 cub. m (Ward 1993). The Little River is connected to the ocean by an unstructured, double spit system and is one of the few tidal Inlets along the southern Maine coast that is not stabilized by either natural outcrops or artificial jetties. The force and volume of tidal action affect the salinity level of both rivers. In the Wells region, the annual mean wave height is almost 20 inches. These estuarine systems are dominated by semi-diurnal tides having a range of 8.5 to 9.8 feet. The volume of freshwater influx into both estuaries is moderate to low (on the order of 0.5 cubic meters/second), especially in the summer, because of the rivers' relatively small drainage areas and the presence of deep glacial deposits. The relatively low flows from these two rivers taken in with the 20 inch per year average runoff of the area surrounding the estuaries combine to form a fresh water flow which is dwarfed by tidal flushing. Twelve-foot tides dwarf the freshwater flow into the Webhannet estuary, which has a drainage area of 14.1 square miles. The Merriland River and Branch Brook meet south of Route 9 to form the Little River which drains an area of 10.75 sq. miles. The Webhannet estuary, fed by both Blacksmith and Depot Brooks, is adjacent to the harbor and greatly developed land. It offers a valuable opportunity for comparison with the relatively pristine Little River estuary. The land use of the Webhannet estuary include a total of 15% for wetland, fresh water, and tidal marsh; a total of 63.7 % for woodland; and a total of 18.6% for developed land compared to a total of 5.7% development in the Little River estuary (WNERR RMA 1996; Holden 1997).

The following information regarding annual weather patterns in the area was supplied by Maine State Climatologist Professor Gregory A. Zielinski extracted from "Monthly Station Normals of Temperature, Precipitation, Heating and Cooling Degree Days 1971-2000", Climatography of the United States No. 81, National Oceanic and Atmospheric Administration, National Climatic Data Center, Asheville, NC. and "Daily Normals of Temperature, Precipitation, and Heating and Cooling Degree Days, 1971-2000", Climatography of the United States No. 84: "Average monthly temperatures range from 21.6F in January to 66.7F in July with daily highs averaging just below freezing in January and lows around 11F. Daily highs in July average around 76F and daily lows around 57F. The sea breeze often keeps daily highs lower during the summer than areas inland. Annual average temperature is 44.6F. Annual precipitation is 47.07 inches, including the water equivalent of snowfall, with monthly averages ranging from 3.01 inches in July to 4.77 inches in October. August receives just 3.02 inches on average. Annual snowfall is around 66 inches." According to Zielinski, "cool ocean temperatures keep down the number of afternoon showers and

especially thunderstorms resulting in low summer precipitation amounts."

There are two sampling sites in the Webhannet River estuary. These are located at the Head of Tide (HT) and at the Webhannet Harbor Inlet (IN). The tidal range at each of these sites is 2.6-2.9 meters.

The Head of Tide site (43 deg 17' 54.05" North, 70 deg 35' 13.54" West) is located 4 miles south of the Wells Reserve, just downstream of the Webhannet Falls (freshwater) and 10 feet east of U.S. Route One. U.S. Route One is used heavily by traffic all year, especially during the summer tourist months. This site has soft mud, sand, and a rocky substrate, and the low and high tide depth is relatively shallow. Depth at mean high water is 1.1 meters. Max and min measured depths are 0.2 to 1.6 meters, giving a max tidal range of 1.4 meters. The salinity range here is 0-31 ppt, with a mean of 3.6 ppt. These headwaters of the Webhannet are relatively undeveloped. This site is located just 10 feet east of the U.S. Route One bridge, and is our roving site.

The Inlet site is located 1.5 miles south of the Wells Reserve, at the Wells Harbor pier (43 deg 19' 12.32" North, and 70 deg 33' 48.39" West). The mouth of the Webhannet estuary forms an extensive wetland/salt marsh area which is surrounded by development. Wells Harbor, which was most recently dredged in 1971, has moorings for approximately 200 commercial fishing and recreational boats. The mouth of the river flows between two jetties to the Atlantic Ocean. This channel was dredged in 1974. This site has a predominately sand substrate and is characterized by strong current during incoming and outgoing tides. Max and min measured depths at the Inlet site are 1.2 to 5.9 meters, giving a max tidal range of 4.7 meters. The maximum depth of the Inlet site is 6.8 meters. The salinity range here is 7-35 ppt, with a mean of 31 ppt. The Inlet site is heavily impacted at the Wells Harbor dock and is our long-term monitoring site.

The Skinner Mill (SM) site is located approximately 100 meters downstream from the intersection of the Merriland River (tributary to Merriland/Branch/Little River estuary) and Skinner Mill Road (at 43 deg 20’ 40.96” north and 70 deg 32’ 57.18” West). This site is approximately 70 meters downstream from the Watershed Evaluation Team (Educational water quality program at Wells NERR) site L5. Substrate is mud/sand bottom, salinities range from 0 ppt on low or outgoing tides and as high as 27ppt on high tides. Max and min measured depths are 0.1 to 1.9 meters, giving a max tidal range of 1.8 meters. Depth at mean high water is 1.3 meters. Data prior to 5/30/2006 is from the original SM site located approximately 70 meters upstream from the current site, which is approximately 20-30 meters beyond the head of the estuary where mixing between fresh and marine waters occur. Please see the 2005 Water quality metadata for a better description of the original site.

The Little River Mouth site is located 0.4 miles from the Wells Reserve. Due to problems with heavy sediment movement in the Inlet of the Little River, we were forced to relocate the site (see 2002 metadata). We designated a new location for the 2003 sampling season, and it has remained since then. It is located just off the bank of the marsh, in the main channel of the river (43 deg 20’ 24.55” North, and 70 deg 32’ 26.17” West). The first location attempted in 2002 (N 43 deg 20.176 Latitude, W 70 deg 32.497 Longitude) was located in the main channel of the river, just inland of a spit, beside a bank. The second location attempted in 2002 (N 43 deg 20.083 Latitude, W 70 deg 32.585 Longitude) was located 1/8 mi. southwest of the first site, within an Inlet, just inland of a spit. The second site was located in an area of much lower current than the first site and often drains completely during low tides. It was also placed within a pool next to incipient low marsh peat that retains calm water during low tides. Max and min measured depths at this site are 0.3 to 2.4 meters, giving a max tidal range of 2.1 meters. The Little River sites exist in a shallow and relatively pristine system with a sandy to mud bottom and a salinity range of 0-32 ppt. There are two major freshwater inputs, the Merriland and Branch Brook Rivers, which converge to form the Little River.

6). Data collection period:

Head of Tide (welhtwq):

Deploy Date	Deploy Time	Retrieve Date	Retrieve Time	Sonde Model Number (Nickname)
4/4/2014	12:00	5/1/2014	8:30	EXO2 (EXO1)
5/1/2014	8:45	6/4/2014	12:15	EXO2 (EXO3)
6/4/2014	12:30	7/8/2014	10:45	EXO2 (EXO1)
7/8/2014	11:00	8/1/2014	11:30	EXO2 (EXO3)
8/1/2014	11:45	8/25/2014	14:15	EXO2 (EXO1)
8/25/2014	14:30	10/3/2014	8:30	EXO2 (EXO5)
10/3/2014	8:45	11/12/2014	11:30	EXO2 (EXO3)
11/12/2014	11:45	12/17/2014	12:15	EXO2 (EXO1)

Inlet (welinwq):

Deploy Date	Deploy Time	Retrieve Date	Retrieve Time	Sonde Model Number (Nickname)
12/18/2013	12:00	1/14/2014	10:30	6600EDSV2(7)
1/14/2014	11:00	2/18/2014	12:45	6600EDSV2(1)
2/18/2014	13:00	3/19/2014	12:45	6600EDSV2 (10)
3/19/2014	13:15	4/25/2014	9:45	6600EDSV2 (# 7)
4/25/2014	10:00	5/28/2014	10:15	EXO2 (EXO2)
5/28/2014	10:30	6/13/2014	11:15	EXO2 (EXO4)
6/13/2014	11:30	7/25/2014	12:00	EXO2 (EXO2)
7/25/2014	12:15	8/14/2014	12:45	EXO2 (EXO4)
8/14/2014	13:00	9/19/2014	10:30	EXO2 (EXO2)
9/19/2014	10:45	10/9/2014	12:00	EXO2 (EXO4)
10/9/2014	12:30	11/6/2014	11:45	EXO2 (EXO2)
11/6/2014	12:15	12/8/2014	11:00	EXO2 (EXO4)
12/8/2014	11:30	1/20/2015	11:30	EXO2 (EXO2)

Skinner Mill (welsmwq):

Deploy Date	Deploy Time	Retrieve Date	Retrieve Time	Sonde Model Number (Nickname)
4/9/2014	13:00	5/6/2014	11:00	6600EDSV2 (10)
5/6/2014	11:15	6/9/2014	14:15	6600EDSV2 (1)
6/9/2014	14:30	6/20/2014	11:45	6600EDSV2 (# 7)
6/20/2014	12:00	7/18/2014	9:00	6600EDSV2 (10)
7/18/2014	9:15	8/8/2014	13:45	6600EDSV2 (1)
8/8/2014	14:00	9/5/2014	11:00	6600EDSV2 (10)
9/5/2014	11:30	9/29/2014	7:45	6600EDSV2 (1)
9/29/2014	8:15	10/28/2014	8:15	6600EDSV2 (10)
10/28/2014	8:30	11/20/2014	13:45	6600EDSV2 (1)

11/20/2014	14:00	12/18/2014	13:15	6600EDSV2 (10)

Little River Mouth (wellmwq):

Deploy Date	Deploy Time	Retrieve Date	Retrieve Time	Sonde Model Number (Nickname)
4/3/2014	8:15	4/25/2014	13:45	6600EDS (3)
4/24/2014	14:00	5/20/2014	11:00	6600EDS (4)
5/20/2014	11:15	6/18/2014	8:45	6600EDS (3)
6/18/2014	9:00	7/16/2014	9:15	6600EDS (4)
7/16/2014	9:30	8/18/2014	10:00	EXO2 (EXO5)
8/18/2014	10:15	9/18/2014	12:00	EXO2 (EXO3)
9/18/2014	12:15	10/17/2014	11:30	EXO2 (EXO1)
10/17/2014	11:45	11/18/2014	15:30	EXO2 (EXO5)
11/18/2014	15:45	12/15/2014	11:30	EXO2 (EXO3)

7). Distribution

According to the Ocean and Coastal Resource Management Data Dissemination Policy for the NERRS System-wide Monitoring Program:

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 2012.

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 http://cdmo.baruch.sc.edu/. Data are available in comma delimited format.

8). Associated researchers and projects

Please visit our website: www.wellsreserve.org/research.htm for further information on the Wells NERR research program

The Research Program at the Wells NERR conducts and supports research, monitoring, workshops, and research/resource management planning of relevance at local, regional and national levels. The overall aim of our work is to produce science-based information needed to sustain or restore Gulf of Maine coastal habitats and resources, especially those found in salt marsh estuaries and watersheds. During 2003-2004 many different studies involving scores of scientists, students, staff and volunteers focused on several related themes: 1) the quality of water resources in salt marsh estuaries and watersheds 2) land conservation strategies to protect coastal watersheds 3) factors controlling salt marsh accretion, erosion and plant community vigor 4) the value of salt marsh as habitat for fish, shellfish and birds, 5) restoration of salt marsh habitat degraded through human actions, and 6) understanding the ecology and functions of salt marsh habitat.

NERRS SWMP Program

As part of the SWMP long-term monitoring program, WEL NERR also monitors Meteorological and nutrient/chlorophyll data which may be correlated with this water quality dataset. These data are available from the Research Coordinator or online at http://cdmo.baruch.sc.edu/.

Estuarine Water Resource Quality

Water quality is monitored continuously at several stations with automated instruments as part of the NERRS systemwide monitoring program, as well as bimonthly at 15-20 stations through our WET volunteer monitoring program. Our water quality work has contributed to the designation of several Priority Watersheds in coastal Southern Maine by the Maine Department of Environmental Protection.

Seacoast Watershed Information Manager (Project S.W.I.M.)

The Seacoast Watershed Information Manager (Project S.W.I.M.) will be an online resource to help local planners and the public evaluate, conserve, and restore coastal watershed resources along the Maine and New Hampshire seacoast by developing a website that describes the region and its resources, provides access to GIS data and other relevant information, and includes a decision-support tool that examines the impact of growth and development on water resources. It will include:

- A Narrative that informs local resource planners and the public by describing development impacts, water resources, and land use.
- Socioeconomic Analysis focused on water resource use as it relates to human activities.
- Land Use Change Assessments focusing on shoreland and permeability.
- A Data Clearinghouse providing users access to key data needed for local and regional-scale resource management.
- A GIS-based Decision Support Tool to help communities manage and protect water resources by considering how water supply, water quality and land use change are affected by land use planning decisions.

The Project focuses on the coastal watersheds from the Cocheco and Salmon Falls River in New Hampshire to the Kennebunk River in Maine. These 15 watersheds include 38 municipalities and cover 1,800 square miles. The Wells National Estuarine Research Reserve is the lead partner with support from NOAA's Coastal Services Center Landscape Characterization and Restoration Program and the Great Bay National Estuarine Research Reserve.

Salt Marsh Habitats and Communities

Factors that control the dynamics and vigor of salt marsh plant communities and marsh peat formation consequently determine the ability of a salt marsh to persist in the face of sea level rise. Through a combination of experimental manipulations and long term monitoring, a number of multi-year studies are currently producing data to answer questions concerning the sustainability of salt marsh habitats in this region. These studies are looking at nutrient-plant relations, plant community responses to physical and hydrologic disturbance, and the relative contribution of short-term natural events (e.g. storms) and human activities (dredging, tidal restriction) on patterns of sediment accretion and erosion. The Reserve's marshes and beaches are already among the best studied sites in the U.S. with regard to long term accretion and erosion (over thousands of years).

HABITAT VALUE FOR FISH, SHELLFISH AND BIRDS

The Reserve combines long-term monitoring with periodic surveys and short-term experiments to identify species and measure trends and changes in populations of fish, crustaceans, clams and birds. We have 20 years of data on upland and shore birds with which to assess the status of resident and migratory avian populations, and several years of wading bird data that we use as a gross level indicator of salt marsh health, which appears to be stable. Our periodic larval, juvenile and adult fish surveys have produced the best available data for fish utilization of salt marsh estuaries in the Gulf of Maine. Since 1994 we have been conducting surveys and field experiments to look at the survival and growth of hatchery seed, juvenile and adult softshell clam with regard to habitat characteristics and predation by the invasive green crab. Benthic invertebrates have been sampled from a number of marshes from Wells to Casco Bay in hopes of gaining a better understanding of invertebrate assemblage and their value to higher trophic levels.

Salt Marsh Degradation and Restoration

Salt marsh ecosystems in the Gulf of Maine have sustained themselves in the face of sea-level rise and other natural disturbances for nearly five thousand years. Since colonial times large areas of salt marsh (up to half of the total area) have been lost through diking, draining and filling. Today, the remaining marshland is fairly well protected from outright destruction, but during the past 100 years, and especially since the 1950's, salt marshes have been divided into fragments by roads, causeways, culverts and tide gates. Most of these fragments have severly restricted tidal flow, leading to chronic habitat degradation and greatly reduced access for fish and other marine species. Since 1991, the Wells Reserve has been studying the impact of these restrictions on salt marsh functions and values, and the response of salt marshes to tidal restoration. We have been working to promote an awareness of the damage being done and the benefits of salt marsh restoration throughout the Gulf of Maine.

Research Program Update: In addition to the Reserve-sponsored projects outlined above, numerous visiting investigators will be involved in on-site research. Topics include: the effects of land use, sea level, and climate on estuarine productivity; the relationship between soil nutrients and plant community patterns; the influence of soil salinity on plant community interactions; the effect of tidal restriction on marsh peat accretion; the comparative ecology of fringe marshes and back barrier marshes; habitat use by upland birds, and the ecology of lyme disease.

"Ecological Functions of Fringing Salt Marshes Susceptible to Oil Spills in Casco Bay, Maine". We examined the ecological function of 9 different fringing marsh systems in Casco Bay that ranged from undisturbed to disturbed. Physical parameters measured included sedimentation rates, total suspended solids, and tidal range. Biological parameters included primary production, macroinvertebrate community composition and secondary production (4cm sediment cores), and resident and transient nekton community composition (fyke net). The project is still under way.

The Wells NERR Research Department also worked on the following project: In partnership with the York Rivers Association and the Town of York, the Wells Reserve conducted a survey of the York River watershed. In this survey, volunteers looked for sources of pollution within a 250-foot buffer of the river and its tributaries (erosion, trash and debris and runoff from roads and lawns could have a negative impact on water quality). Most pollutants entering water bodies come from such undefined sources. Therefore, this type of survey is the best way to begin to address the problems of pollution in a water body. The idea of the project was to work with the community and landowners to help them understand the problems that come from these types of pollution and learn activities they might be able to do on their own land that would help prevent this pollution from entering the water. The results of the survey will become part of a Watershed Management Plan to improve and restore the water quality of the York River.

June Ficker Project Title: Monitoring avian productivity and survivorship

Outside Researchers: Theresa Theodose, Ph.D., University of Southern Maine Project Title: Relationships between soil nutrient availability and species composition of a high salt marsh in southern Maine.

David Burdick, Ph.D. and Roelof Boumans, Ph.D. University of New Hampshire, University of Maryland Project Title: Sediment dynamics in salt marshes: functional assessment of accretionary biofilters

Peter Rand, M.D., Chuck Lubelczyk, Robert Smith, M.D. Maine Medical Center Project Title: Ecological determinants of the spread of the tick vector of Lyme disease and other pathogens.

II. Physical Structure Descriptors

9). Sensor Specifications

WEL NERR deployed 6600EDS sondes at wellmwq only from April 3rd through July 16th. 6600EDS-SV data sondes where deployed at welsmwq site for the entire year. Both welhtwq and welinwq sites used EXO2 datasondes for collection for 2014. Welinwq utilized vented 6600EDS-SV sondes until 4/25/2014 when this switch to EXO2 sondes occurred.Rapid-pulse DO sensors were deployed at wellmwq only. Optical DO sensors were deployed at all other sites.

Sequence of 6600EDS, 6600EDS-SV, and EXO2 dataloggers:
Date, Time, Temperature, Specific Conductivity, Salinity, dissolved oxygen %, dissolved oxygen mg/L, Depth (in meters), pH, Turbidity, Battery voltage

Following specifications for 6600EDS and 6600EDS-SV data loggers are taken from YSI 6-Series Environmental Monitoring Manual, Appendix M (undated).

Date
Sensor Type: NA
Range: 1-12, 1-31, 00-99 (Mo,Day,Yr)
Resolution: 1 mo, 1 day, 1 yr
Accuracy: NA

Time
Sensor Type: NA

Range: 0-24, 0-60, 0-60 (Hr,Min,Sec)
Resolution: 1 hr, 1 min, 1 s
Accuracy: NA

Temperature
Sensor Type: Thermistor
Range: -5 to 45 (c)
Resolution: 0.01 C
Accuracy: +/-0.15C
Depth: 200 m

Specific Conductivity
Sensor Type: 4 electrode cell with autoranging
Range: 0-100(mS/cm)
Resolution: 0.001 mS/cm to 0.1 mS/cm (range dependent)
Accuracy: +/-0.5% of reading + 0.001mS/Cm
Depth: 200 m

Salinity
Sensor Type: calculated from conductivity and temperature
Range: 0-70 ppt
Resolution: 0.01 ppt
Accuracy: +/-1.0% of reading or + 0.1 ppt whichever is greater

Dissolved oxygen, % saturation
Sensor Type: Rapid pulse – Clarke type, polarographic
Range: 0 – 500% air saturation
Resolution: 0.1% air saturation
Accuracy: 0-200% air saturation, +/-2% of the reading or 2% air saturation, whichever is greater; 200-500% air saturation, +/-6% of reading
Depth: 200 m

Dissolved oxygen, mg/L (calculated from % air saturation, temperature and salinity)
Sensor Type: Rapid pulse – Clarke type, polarographic
Range: 0 – 50 mg/L
Resolution: 0.01 mg/L
Accuracy: 0-20 mg/L, +/-2% of the reading or 2 mg/L, whichever is greater; 200-20-50 mg/L, +/-6% of reading
Depth: 200 m

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

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

Depth for 6600EDS (non-vented):
Sensor Type: stainless steel strain gauge
Range: 0 – 30 ft (9.1 m)
Resolution: 0.001 ft (0.001 m)
Accuracy: +/-0.06 ft (0.018 m)

Level for 6600EDS-SV (vented):
Sensor Type: stainless steel strain gauge
Range: 0 – 30 ft (9.1 m)
Resolution: 0.001 ft (0.001 m)
Accuracy, 0-10ft: +/-0.01 ft (0.003 m)
Accuracy, 10-30ft: +/-0.06 ft (0.018 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

Specifications for YSI EXO Sonde:

Parameter: Temperature
Units: Celsius (C)
Sensor Type: Thermistor
Model#: 599870-01
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: 4-electrode cell with autoranging
Model#: 599870-01
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: 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

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

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.

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:

Site definitions:

Sampling Station: Inlet at Webhannet River Mouth, at Wells Harbor
Sampling Site Code: IN
Station Code: welinwq

Sampling Station: Head of Tide of Webhannet River
Sampling Site Code: Sampling Site Code: HT
Station Code: welhtwq

Sampling Station: Little River Mouth (Merriland/Branch/Little River estuary)
Sampling Site Code: LM
Station Code: wellmwq

Sampling Station: Skinner Mill (on Merriland R, tributary to Merriland/Branch/Little R estuary)
Sampling Site Code: SM
Station Code: welsmwq

File definitions: 3 letter NERR site code (WEL for Wells NERR); 2 letter YSI deployment site code (see above); data type code (WQ for water quality), month, day, year of deployment (ex: WELINWQ071406 = Webhannet Inlet water quality data from 14 July 2006).

11) QAQC flag definitions

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

-5 Outside High Sensor Range
-4 Outside Low Sensor Range
-3 Data Rejected due to QAQC
-2 Missing Data
-1 Optional SWMP Supported Parameter
0 Data Passed Initial QAQC Checks
1 Suspect Data
2 *Open - reserved for later flag*
3 Calculated data: non-vented depth/level sensor correction for changes in barometric pressure
4 Historical Data: Pre-Auto QAQC
5 Corrected Data

12) QAQC code definitions –

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

General Errors

GIC	No instrument deployed due to ice
GIM	Instrument malfunction
GIT	Instrument recording error; recovered telemetry data
GMC	No instrument deployed due to maintenance/calibration
GNF	Deployment tube clogged / no flow
GOW	Out of water event
GPF	Power failure / low battery
GQR	Data rejected due to QA/QC checks
GSM	See metadata

Corrected Depth/Level Data Codes

GCC	Calculated with data that were corrected during QA/QC
GCM	Calculated value could not be determined due to missing data
GCR	Calculated value could not be determined due to rejected data
GCS	Calculated value suspect due to questionable data
GCU	Calculated value could not be determined due to unavailable data

Sensor Errors

SBO	Blocked optic
SCF	Conductivity sensor failure
SCS	Chlorophyll spike
SDF	Depth port frozen
SDG	Suspect due to sensor diagnostics
SDO	DO suspect
SDP	DO membrane puncture
SIC	Incorrect calibration / contaminated standard
SNV	Negative value
SOW	Sensor out of water
SPC	Post calibration out of range
SQR	Data rejected due to QAQC checks
SSD	Sensor drift
SSM	Sensor malfunction
SSR	Sensor removed / not deployed
STF	Catastrophic temperature sensor failure
STS	Turbidity spike
SWM	Wiper malfunction / loss

Comments

CAB*	Algal bloom

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

13). Post Calibration Information:

Head of Tide (welhtwq):

Deploy Date	Sonde	SpCond	ROXDO1	pH7	pH4	Turb	Turb	Depth
4/4/2014	EXO1	10	102.3	7.03	4.21	0.06(0.0)	124.06(124.0)	-0.054
5/1/2014	EXO3	9.94	102.4	7.21	3.95	0.01(0.0)	125.21(124.0)	0.01
6/4/2014	EXO1	9.99	99.8	7.12	4.09	-0.05(0.0)	123.95(124.0)	-0.097
7/8/2014	EXO3	9.96	100.9	7.16	4.14	0.02(0.0)	122.92(124.0)	0.076
8/1/2014	EXO1	9.965	102.5	7.06	4.06	-0.02(0.0)	123.45(124.0)	0.042
8/25/2014	EXO5	9.924	100.6	7.2	4.19	-0.01(0.0)	124.28(124.0)	0.058
10/3/2014	EXO3	10.05	100.5	7.03	4.03	0.03(0.0)	129.7(124.0)	-0.048
11/12/2014	EXO1	9.96	102.1	7.03	4.02	0.0(0.0)	123.76(124.0)	-0.057

Inlet (welinwq):

Deploy	Sonde	SpCond	ROXDO1	pH7	pH10	pH4	Turb	Turb	Depth	CHL(0)

Date									
1/1/2014	1	9.937	107.6	7.11	10.05	0.0(0.0)	-126		
2/18/2014	10	9.937	101	7.19	10.03	0.1(0.0)	-126	-0.005	
3/19/2014	7	10.09	100.6	7.24	10.09	-1.6(0.0)	-126	-0.002	
4/25/2014	EXO2	9.98	103.2	6.95	10.2	-0.1(0.0)	-124	0.045	-0.4
5/28/2014	EXO4	9.99	101	6.98	10.07	-0.5(0.0)	-124	0.025	-0.1
6/13/2014	EXO2	9.981	99.8	7.03	9.98	0.1(0.0)	-124	0.023	0.3
7/25/2014	EXO4	9.954	99.6	7.02	10.01	0.1(0.0)	-124	-0.493	0.39
8/14/2014	EXO2	9.961	100.9	7.07	10.04	0.1(0.0)	-124	0.147	-0.3
9/19/2014	EXO4	10.08	98.9	7.02	10.01	0.02(0.0)	-124	0.001	0.08
10/9/2014	EXO2	8.99	99.6	6.91	10.02	0.15(0.0)	-124	-0.034	-0.03
11/6/2014	EXO4	10.02	103.6	6.97	9.95	0.1(0.0)	-124	0.42	-0.3
*12/8/2014	EXO2					0	-124		

*No post calibration for 12/8 deployment due to sonde malfunction on retrieval.

Skinner Mill (welsmwq):

Deploy Date	Sonde	SpCond	ROXDO1	pH7	pH10	Turb	Turb	Depth
4/9/2014	10	10.04	100.5	7.13	10.02	0.2(0.0)	-126	0
5/6/2014	1	10.01	102.8	7.06	10.21	0.0(0.0)	-126	-0.001
6/9/2014	7	9.979	100.9	7.09	10.1	-0.1(0.0)	-126	-4.722
6/20/2014	10	9.968	101.2	7.09	10.01	0.3(0.0)	-126	0.004
7/18/2014	1	10.01	100.6	7.04	10.02	0.1(0.0)	-126	-0.002
8/8/2014	10	9.983	100.4	7.09	10.04	0.2(0.0)	-126	-0.004
9/5/2014	1	9.908	99.7	7.14	10.01	-0.1(0.0)	-126	-0.001
9/29/2014	10	9.938	101.6	12.53	12.53	0.1(0.0)	-126	0.002
10/28/2014	1	10.02	100.6	7.03	9.99	-0.4(0.0)	-126	0.018
11/20/2014	10	10.01	101	7.04	9.99	0.1(0.0)	-126	0.013

Little River Mouth (wellmwq):

Deploy Date	Sonde	SpCond	RPDO1	pH7	pH10	Turb	Turb	Depth
4/3/2014	3	9.924	53.9	7.21	10.03	0.0(0.0)	127.5(126.0)	-0.063
4/24/2014	4	9.93	79.1	6.9	9.87	-0.1(0.0)	124.9(126.0)	0.001

5/20/2014	3	9.987	53.5	7.11	9.96	-0.4(0.0)	124.3(126.0)	-0.061
6/18/2014	4	10.03	39.8	7.21	10.67	0.0(0.0)	127.5(126.0)	-0.051
7/16/2014	EXO5	9.954	100.6	7.06	10.06	0.02(0.0)	123.64(124.0)	-0.093
8/18/2014	EXO3	10.04	98.9	7.09	10.12	0.13(0.0)	125.54(124.0)	0.026
9/18/2014	EXO1	9.8957	98.6	7.08	10.08	0.32(0.0)	124.06(124.0)	-0.118
10/17/2014	EXO5	10.02	100.2	7.11	10.13	0.08(0.0)	124.22(124.0)	0.021
11/18/2014	EXO3	10	101.3	6.99	9.95	0.04(0.0)	123.8(124.0)	0.042

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.

Three of our four sites (SM, LM, and HT) are discontinued through the winter months due to icing in the rivers. See section 6 data collection period for times of site deployment.

***Webhannet Inlet (IN) Site:** Depth data from January 1st through February 18th at 13:00 has been "calculated" from previous water level data. Vertical control was enacted on this station in 2012 in the hopes of collecting accurate water level data to aid in the monitoring of sea level rise. However after 2 years of deployment and surveying, it was determined that this station and related deployment scheme was not stable enough to accurately collect level data. Therefore our offset of 3.191M was added back to the level data to provide the user with Depth data, or the height of the water in meters above the pressure sensor, which is located approx 1.1M from substrate.

***Webhannet Inlet (IN) site:** There has been some anomalous Dissolved Oxygen events occurring at our IN site in the past few years. A trend has appeared of very low DO readings during the ebbing tide and hits a low for that tide right about and hour into incoming tide then shoots back up to reasonable readings. This does not seem to be a probe malfunction in most cases, because the trend has been observed with different probes and sondes which all post calibrate acceptably. Given the magnitude of our tidal range here in the Gulf of Maine, we believe that at low tide, anoxic sediments below our deployment tube are being "stirred up" and influencing our DO data. We do not feel as if the periodically low DO values being seen at this site are representative of the larger sampling area (Webhannet Harbor). As of 5/23/08 ROX optical probes were deployed at this site to obtain more accurate data. On 9/6/2011 the tube was removed, cleaned, and additional holes were drilled in the deployment tube to allow better flushing of the water there-in. This seemed to "help" the problem but the trend was continuing to a lesser extent. Further questions regarding DO data from the Inlet site should be directed to the author of this document.

Skinner Mill (SM) Site: Over the course of this year, this site experienced some sedimentation around the sonde deployment tube due to heavy rains and washout. As the area around the site filled in with sediment we had instances on very low tides were all the probes were coming out of the water. This data was VERY hard to flag correctly as the depth sensor was often out of the water and reading negative while the other sensors were still in the water. There are also instances where the depth sensor is reading positive values

(which we assume means it is in the water), yet Sp. Cond dropped to zero. This site does see a lot of fresh water input on low tides however zero Sp. Cond data usually means that the probe is OOW…yet the depth is reading Positive. Any data surrounding these events should be considered suspect and used with discretion. We are planning on adjusting the location of this site slightly further into the channel in 2011 in an effort to avoid this issue in the coming year. We did our best to flag the data appropriately and "guess" when the probes were back in-situ and reading good data.

Using corrected depth, where the depth data is corrected using local barometric pressure, we flagged this depth data in the following ways. If the depth was negative after correction it was marked -3 SOW. If the depth was positive after correction it was marked 1 SNV CAP. Data surrounding the out of water and low tide events mentioned above was marked 1 GSM CLT. Any additional questions about depth or low water events at this site should be directed to the reserve.

Little River Mouth (LM) Site: Dissolved Oxygen data from 5/20 at 11:15 through 5/26 at 18:00 is marked suspect as the probe was put out with a high DO Charge (sensor diagnostic) and data from 5/26 at 18:15 through 6/18 at 8:45 was rejected as the data is clearly erroneous from this point forward and does not match up with historical trends in the absence of storm events or other impacts.

Head of Tide (HT) Site: During the dry summer months (July-Sept) and usually on very "mild" tides, there have been instances of Dissolved Oxygen crashes at this site. We believe that this data is real (as post-calibrations are fine), and is a result of poor mixing of tidal water at this site causing a "pocket" or "pool" of water to be trapped in the area around our sampling location for days at a time. Once the tidal range increases this water is "flushed" from the system and readings become more stable and more representative of the system around our deployment site.

Head of Tide (HT) Site: During the 11/12 deployment retrieval on 12/17 it was found that the station had leaned slightly due to impact from some sort of floating debris. Depth data may have been affected by this shift in position but all other parameters were still collected at the same depth/area of the water column.

All Sites: There was a major (VERY HEAVY) rain event on the night of 8/13. This event can be seen in all WQ data from this period. The actual rain event itself was from 8/13/2014 15:15 through 8/13/2014 21:45. This was a VERY HEAVY rain event with downpours for more than an hour straight. Turb and Ph data was affected in all files.

Webhannet Inlet (IN) site: All specific Conductance and salinity data was rejected from 7/8/2014 10:45 through 7/25/2014 12:00 as we had a failure in our Sp. cond probe. This error is associated with the factory defective probes sent out by YSI in early 2014. Awaiting word from CDMO/YSI on how to flag this data and the rest of our data.

Skinner Mill (SM) site: A series of turbidity spikes where flagged during the period from 9/5 at 15:30 through 10/16/2014 13:30. The trend is anomalous and happens at the end of low tide periods just before the tide starts to come in. Some have been rejected due to the extreme high readings (500+ NTU) while the rest have been flagged as suspect. The cause of this is unknown but it is seen throughout multiple deployments/instruments.

Head of Tide (HT) site: The unusually low pH readings from 8/13 at 20:15 through 8/18 at 07:15 are due to a high amount of freshwater runoff form recent heavy rains.

Skinner Mill (SM) site: Hurricane Arthur which hit between July 3rd and 4th impacted data at SM, these effects are seen especially in DO and pH data.

Little River Mouth (LM) Site: At some point in late December this station was impacted by ice causing the data sonde, its deployment tube, and sign post to be "uprooted" from the sediment and deposited just a few feet from its original deployment location vertically along the river bottom. The deployment of this site is such that the probes sit 6" above the sediment, and the depth probe just a few inches higher up on the bulkhead. This makes finding the event in the data difficult given the large fluctuations in tidal range for this site. We believe the data collected after the event is relatively representative of the area where the data sonde was originally deployed however felt it pertinent to flag the data around this event.

Significant rain and weather events: The following weather and rain events where significant enough for their impacts to be seen in the water quality data at most sites.

Significant Rain: June 13, 10-18. July 3-4, Aug 13 and 31, Oct 16 and 21-23, Nov 26 and Dec 9

Hurricane Arthur July 3-4th 2014

A major Nor' Easter passed by Maine from October 21-23rd.