WELLS (WEL) National Estuarine Research Reserve
Water Quality Metadata
January-December 2009
Latest Update: October 1, 2013

I. Data Set & Research Descriptors

**1). Principal investigator & contact persons:**

Address:
Wells NERR, 342 Laudholm Farm Road Wells, ME 04090
Phone: (207)646-1555
FAX: (207)646-2930

Contact Persons:
Dr. Michele Dionne, Research Coordinator
E-mail: dionne@wellsnerr.org
Phone: (207) 646-1555 ext. 136

Jeremy Miller, Research Associate
E-mail: jmiller@wellsnerr.org
Phone: (207) 646-1555 ext. 122

**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 QA/QC.

**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 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.

* 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

below. 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."

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 in case 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:
Two 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 30 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 (123 NTU). The pH standards are purchased from Fisher Scientific. 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, an 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 3.0) National Estuarine Research Reserve (NERR) System-Wide

Monitoring Program (SWMP) YSI 6-Series Multi-Parameter Water Quality Monitor Standard Operating Procedures began in December 2000 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. 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 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. 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 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. 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 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. The tidal range of the Little River estuary is 2.6-3.0 meters (Mariano and FitzGerald, 1988). The Little River sites existed 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:**

Deployment and retrieval dates and times, model YSI 6-series sonde used for 2009:

| BEGAN | ENDED | SONDE MODEL |
|---|---|---|
| Inlet Site (site code: IN) | | |

| | | |
|---|---|---|
| 01/01/09, 00:00 | 01/08/09, 09:45 | 6600EDS-V2 |
| 01/08/09, 10:00 | 01/30/09, 13:30 | 6600EDS-SV |
| 01/30/09, 13:45 | 02/26/09, 12:00 | 6600EDS-SV |
| 02/26/09, 12:15 | 03/23/09, 10:00 | 6600EDS-SV |
| 03/23/09, 10:15 | 04/24/09, 09:45 | 6600EDS-SV |
| 04/24/09, 10:00 ** | 05/07/09, 09:30 | 6600EDS-SV |
| 05/07/09, 09:45 | 06/03/09, 09:15 | 6600EDS-SV |
| 06/03/09, 09:45 | 06/24/09, 12:30 | 6600EDS-SV |
| 06/24/09, 13:00 | 07/13/09, 13:15 | 6600EDS-SV |
| 07/13/09, 13:30 | 08/04/09, 11:30 | 6600EDS-SV |
| 08/04/09, 11:45 | 09/01/09, 10:00 | 6600EDS-SV |
| 09/01/09, 10:15 | 09/29/09, 08:45 | 6600EDS-SV |
| 09/29/09, 09:00 | 10/22/09, 12:30 | 6600EDS-SV |
| 10/22/09, 12:45 | 11/19/09, 19:45 | 6600EDS-SV |
| 12/02/09, 11:15 | 12/22/09, 13:15 | 6600EDS-SV |
| 12/22/08, 13:30 | 01/20/10, 12:45 | 6600EDS-SV |

Head of Tide Site (site code: HT)

| | | |
|---|---|---|
| 03/13/09, 09:00 | 04/03/09, 11:45 | 6600EDS |
| 04/03/09, 12:15 | 05/06/09, 13:00 | 6600EDS |
| 05/06/09, 13:105 | 06/02/09, 09:15 | 6600EDS |
| 06/02/09, 09:30 | 06/26/09, 12:45 | 6600EDS |
| 06/26/09, 13:00 | 07/16/09, 15:15 | 6600EDS |
| 07/16/09, 15:30 | 08/07/09, 09:30 | 6600EDS |
| 08/07/09, 09:45 | 09/04/09, 08:45 | 66600EDS |
| 09/04/09, 09:015 | 09/30/09, 08:30 | 6600EDS |
| 09/30/09, 08:45 | 10/23/09, 11:15 | 6600EDS |
| 10/23/09, 11:45 | 11/23/09, 13:00 | 6600EDS |
| 11/23/09, 13:15 | 12/16/09, 13:45 | 6600EDS |

Skinner Mill Site (site code: SM)

| | | |
|---|---|---|
| 04/02/09, 11:15 | 04/30/09, 12:15 | 6600EDS |
| 04/30/09, 12:30 | 05/28/09, 08:15 | 6600EDS |
| 05/28/09, 08:45 | 06/30/09, 10:30 | 6600EDS |
| 06/30/09, 15:45 | 07/17/09, 10:15 | 6600EDS-SV |
| 07/17/09, 10:30 | 08/10/09, 10:45 | 6600EDS |
| 08/10/09, 11:00 | 09/02/09, 12:15 | 6600EDS |
| 09/02/09, 12:45 | 09/28/09, 13:45 | 6600EDS |
| 09/28/09, 14:00 | 10/27/09, 10:15 | 6600EDS |
| 10/27/09, 10:45 | 11/25/09, 11:00 | 6600EDS |
| 11/25/09, 11:15 | 12/16/09, 15:00 | 6600EDS-SV |

Little River Mouth Site (site code: LM)

| | | |
|---|---|---|
| 04/01/09, 10:15 | 04/29/09, 09:00 | 6600EDS |
| 04/29/09, 09:15 | 05/20/09, 12:45 | 6600EDS |
| 05/20/09, 13:00 | 06/12/09, 08:00 | 6600EDS |
| 06/12/09, 08:15 | 07/14/09, 09:15 | 6600EDS |
| 07/14/09, 09:30 | 08/05/09, 16:15 | 6600EDS |
| 08/05/09, 16:45 | 09/03/09, 15:15 | 6600EDS |
| 09/03/09, 15:30 | 09/25/09, 11:30 | 6600EDS |
| 09/25/09, 12:00 | 10/15/09, 14:15 | 6600EDS |

10/15/09, 14:30 11/24/09, 10:00 6600EDS
11/24/09, 10:15 12/16/09, 15:30 6600EDS

**Rapid Pulse DO probe used

**7).Distribution**

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

NOAA/ERD retains the right to analyze, synthesize and publish summaries of the NERRS System-wide Monitoring Program data. The PI retains the right to be fully credited for having collected and processed the data. Following academic courtesy standards, the PI and NERR site where the data were collected will be contacted and fully acknowledged in any subsequent publications in which any part of the data are used. Manuscripts resulting from this NOAA/OCRM supported research that are produced for publication in open literature, including refereed scientific journals, will acknowledge that the research was conducted under an award from the Estuarine Reserves Division, Office of Ocean and Coastal Resource Management, National Ocean Service, National Oceanic and Atmospheric Administration. The data set enclosed within this package/transmission is only as good as the quality assurance and quality control procedures outlined by the enclosed metadata reporting statement. The user bears all responsibility for its subsequent use/misuse in any further analyses or comparisons. The Federal government does not assume liability to the Recipient or third persons, nor will the Federal government reimburse or indemnify the Recipient for its liability due to any losses resulting in any way from the use of this data.

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 http://cdmo.baruch.sc.edu/. Data are available in text tab-delimited format.

**8). Associated researchers and projects**

WELLS NATIONAL ESTUARINE RESEARCH RESERVE RESEARCH AT THE RESERVE for 2007 (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. 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.

Estuarine Water Resource Quality

Water quality is monitored continuously at several stations with automated instruments as part of a NERRS systemwide monitoring program, as well as bimonthly at 15-20 stations through our WET volunteer monitoring program. The WET program also monitors two important biological parameters: fecal coliform bacterial contamination (an indicator of human health risk) and phytoplankton productivity (an indicator of estuarine health). These data have 1) allowed us to identify several bacterial "hot spots" that we will be working to eliminate, 2) are used to identify and open areas safe for shellfishing, and 3) have uncovered a relation between tides and low dissolved oxygen (a stressful condition for marine life) that needs further study. 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 10 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.

The Wells NERR Research Dept. is involved with the following CICEET* Projects:

Project Title: Estuarine Responses to Dredging: Analysis of Sedimentary and Morphological Change in Back Barrier Marsh to Aid Local Management and Develop a Regional Management Tool Principal Investigator (s): Michele Dionne, Wells NERR, ME; Duncan Fitzgerald, Boston University; Joe Kelley, University of Maine; David Burdick and Larry Ward, University of New Hampshire
Management Issue: Coastal management tool for assessing the impacts of dredging in estuaries. Project Summary: An adequate supply of sediment is essential for maintaining salt marshes. Human activities, such as channel dredging and tidal restriction due to road construction, can alter water flows in estuaries and result in dramatic changes in salt marsh sediment supply, affecting the speed of salt marsh erosion. The objective of this project is to determine the impact of dredging and tidal restriction on salt marshes in the Wells NERR. A digital coastal management guide will be created on CD ROM, providing coastal managers with useful conceptual models for predicting the impacts of dredging and other activities that affect water flow and sediment deposition in salt marshes.

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). Variable sequence, range of measurements, units, resolution, and accuracy; and Depth Qualifiers:

**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.

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

Wells NERR Deployed only 6600EDS sondes in 2009. The Webhannet inlet site used ROX Optical DO Probes for the entire year (Except for the 042409 deployment). All remaining sites use rapid pulse DO probes for oxygen data.

Sequence of both 6600EDS and 6600EDS-SV 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

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

Level for 6600EDS shallow (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:
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)

pH
Sensor Type: Glass combination electrode
Range: 0-14 units
Resolution: 0.01 units
Accuracy: +/-0.2 units
Depth: 200 m

Turbidity (probe model 6136)
Sensor Type: Optical, 90 degree scatter, with mechanical cleaning
Range: 0-1000 NTU
Resolution: 0.1 NTU
Accuracy: +/- 5% of reading or 2 NTU (whichever is greater), relative to calibration standards
Depth: 66 m

Chlorophyll
Sensor Type: Optical, fluorescence, with mechanical cleaning
Range: 0-400µg/L Chl; 0-100 Percent Full Scale (%FS) Fluorescence Units
Resolution: 0.1 µg/L Chl; 0.1 %FS
Accuracy: No specifications provided
Depth: 66 m

**10). Coded variable indicator and variable code 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** – This section details the secondary QAQC Code definitions used in combination with the flags above.

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

General Errors

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

Corrected Depth/Level Data Codes

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

Sensor Errors

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

Comments

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

**13). Post Calibration Information:**

End of Deployment “post-calibration” readings in the following standard solutions:

DO% is recorded in a 5 gallon bucket of water with two air stones (100% saturated water)

SpCond (specific conductivity) solution is 10 mS/cm.
pH solution is 7.0
turb (turbidity) is recorded in deionized water (pre-deployment calibrated to 0.0).

| site | Date | SpCond | DO% | level | pH | Turb |
|---|---|---|---|---|---|---|
| IN | 1/30/09 | 10.07 | 100 | -0.006 | 6.91 | -0.3 |
| IN | 2/26/09 | 9.907 | 101.2 | -0.005 | 6.99 | 0 |
| IN | 3/23/09 | 9.69 | 101.9 | -0.006 | 6.96 | 400* |
| IN | 4/24/09 | 9.99 | 101.3 | -0.004 | 6.55 | -0.6 |
| IN | 5/7/09 | 9.92 | 100.4 | -0.003 | 7.05 | 0.1 |
| IN | 6/3/09 | 9.89 | 103.3 | -0.002 | 6.91 | 1.4 |
| IN | 6/24/09 | 9.98 | 105 | -0.001 | 7 | 0.2 |
| IN | 7/13/09 | 9.95 | 100.1 | -0.001 | 6.98 | 0.4 |
| IN | 8/4/09 | 10.01 | 99.1 | -0.001 | 7.02 | 0 |
| IN | 9/1/09 | 9.96 | 101.8 | 0 | 6.92 | 0.5 |
| IN | 9/29/09 | 9.89 | 95.6 | -0.001 | 7.03 | -0.3 |
| IN | 10/22/09 | 9.95 | 99.3 | -0.002 | 6.98 | 0.2 |
| IN | 12/2/09 | 9.94 | 101 | -0.002 | 6.67 | 0.2 |
| IN | 12/22/09 | 9.98 | 100.2 | -0.004 | 7.05 | 0.2 |
| IN | 1/20/10 | 9.98 | 101.4 | 0.004 | 7.05 | -0.1 |

NOTES on IN post deployment information:
**This site uses the ROX DO probes so DO Charge is not used for diagnostics.**
***There was a very high post calibration on turb for this deployment. Most of data marked as suspect**

| Site | Date | DO % | DO Charge | Depth | mS/cm | pH | NTU |
|---|---|---|---|---|---|---|---|
| HT | 4/3/09 | 103.1 | 54.3 | -0.145 | 9.934 | 7.10 | 0.0 |
| HT | 5/6/09 | 107.9 | 53.3 | 0.035 | 9.960 | 6.83 | -0.1 |
| HT | 6/2/09 | 99.8 | 44.1 | -0.020 | 10.03 | 7.02 | 0.1 |
| HT | 6/26/09 | 89.4 | 39.0 | -0.121 | 10.03 | 7.10 | 0.0 |
| HT | 7/16/09 | 100.6 | 57.4 | -0.079 | 10.01 | 7.00 | 0.0 |
| HT | 8/7/09 | 105.6 | 44.1 | -0.01 | 9.973 | 7.02 | 0.0 |
| HT | 9/4/09 | 109.8 | 32.9 | 0.022 | 9.970 | 6.91 | 1.1 |
| HT | 9/30/09 | 102.0 | 40.0 | -0.117 | 9.977 | 7.04 | 0.2 |
| HT | 10/23/09 | 104.3 | 50.2 | 0.083 | 9.946 | 7.09 | 0.3 |
| HT | 11/23/09 | 107.9 | 44.1 | 0.169 | 10.01 | 6.98 | 0.0 |
| LM | 12/16/09 | 92.3 | 40.0 | 0.031 | 10.01 | 6.83 | 0.2 |

| Site | Date | DO % | DO Charge | Depth | mS/cm | pH | NTU |
|---|---|---|---|---|---|---|---|
| LM | 4/29/09 | 104.1 | 43.1 | 0.173 | 10.00 | 7.07 | 0.0 |
| LM | 5/20/09 | 107.3 | 59.4 | 0.1 | 10.07 | 7.03 | 0.0 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| LM | 6/12/09 | 102.0 | 52.3 | -0.099 | 10.01 | 7.03 | 0.0 |
| LM | 7/14/09 | 54.1 | 32.9 | 0.00 | 10.06 | 7.18 | -0.1 |
| LM | 8/5/09 | 42.6 | 30.8 | -0.041 | 10.08 | 6.88 | 0.0 |
| LM | 9/3/09 | 101.3 | 51.2 | 0.043 | 10.09 | 6.77 | -0.2 |
| LM | 9/25/09 | 102.4 | 41.0 | 0.099 | 9.736 | 6.98 | 0.0 |
| LM | 10/15/09 | 102.2 | 34.9 | 0.030 | 10.00 | 7.29 | 0.5 |
| LM | 11/24/09 | 102.3 | 43.1 | 0.097 | 10.02 | 7.07 | 0.1 |
| LM | 12/16/09 | 94.5 | 41.0 | 0.021 | 9.98 | 6.89 | -0.1 |

NOTES on LM post deployment information: weird DO issue happening during the July and August deployments. See section 14 for further info.

| site | Date | DO% | DO Charge | Level | mS/cm | pH | Turb |
|---|---|---|---|---|---|---|---|
| SM | 4/30/09 | 110.8 | 47.1 | 0.135 | 9.95 | 7.10 | 0.2 |
| SM | 5/28/09 | 107.3 | 43.1 | 0.023 | 10.02 | 7.15 | 0.2 |
| SM | 6/30/09 | 106.1 | 57.4 | -0.109 | 10.02 | 7.03 | -0.4 |
| SM | 7/17/09 | 108.8 | 46.1 | -0.002 | 9.93 | 7.03 | 1.5 |
| SM | 8/10/09 | 108.3 | 56.3 | -0.066 | 10.04 | 7.02 | 0.6 |
| SM | 9/2/09 | 105.5 | 44.1 | 0.108 | 9.98 | 7.10 | 0.4 |
| SM | 9/28/09 | 100.2 | 49.2 | -0.180 | 9.960 | 6.98 | -0.1 |
| SM | 10/27/09 | 110.6 | 46.1 | 0.059 | 10.11 | 6.89 | 0.4 |
| SM | 11/25/09 | 114.1 | 54.3 | 0.024 | 10 | 7.12 | 0.1 |
| SM | 12/16/09 | 101.8 | 44.1 | 0.002 | 9.99 | 7.02 | 0.2 |

**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:** There has been an anomalous Dissolved Oxygen trend happening at our IN site for a good part of the deployment season. A trend has appeared of very low DO readings during the ebbing tide and hits a low for that tide right about an 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 pst 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). The deployment tube was inspected by a diver and pulled and cleaned on 5/5/08. As of 5/23/08 ROX optical probes were deployed at this site to obtain more accurate data. The old rapid pulse probes seemed to be adversely effected by the conditions in-situ as the DO charge almost always came back way too high and the post cal numbers on the percent saturation were usually way off as well. DO from 7/13 13:30 to 9/29 8:45 is marked suspect. This data is particularly off. The rest of the year is marked 0 CSM. Further question regarding DO data from the Inlet site should be directed to the author of this document.

**Webhannet Inlet (IN) site:** All DO and turb data from 2/26 @12:00 to 3/23 @ 10:00 is rejected due to optical port issues.

**Webhannet Inlet (IN) site:** There was a turbidity sensor malfunction from 8/4 11:45 to 9/1 9:45, turbidity data during this time is marked -3 SSM CSM. We believe DO data during this time was also affected by the turbidity sensor malfunction.

**Webhannet Inlet (IN) site:** Turbidity data remained relatively high for an extended period of time from 9/11 at 5:30 through 10/22 at 12:30 in the absence of any major rain event.

**Head of Tide (HT):** During 8/16 to 8/25 this site experienced huge tides which made for some interesting readings.

**Little River Mouth (LM):** During the months of July and August, we saw DO readings at this site start to "tail off" toward the end of deployments. Post calibration were VERY low. There is no evidence to show why this may have happened. Membranes were not punctured. Data from the end of these deployments have been marked as suspect.

**Little River Mouth (LM):** The post for the deployment ending 7/14 9:15 was 54.1 and there was algae on the probes. Data from 6/19 00:45 to7/6 23:00 is marked 1 GSM CBF and data from 7/6 23:15 to 7/14 9:15 is marked -3 GSM CBF.

**Little River Mouth (LM):** Turbidity data from 12/9 2:00 to 12/12 18:20 rises steadily and remains relatively high for this site for a number of days and throughout tidal cycles. This is likely an issue with the wiper or a partially blocked optic/something in front of the sensor.

**Skinner Mill (SM):** There were many instances of OOW events (or slightly negative depth values) for this site. Some abnormally low tides coupled with minor "shifting" of this station due to an earlier storm may be causing these slightly negative depth readings.

**Skinner Mill (SM):** Depth data from 6/30 15:45 to 7/17 10:15 was rejected due to an issue with the sensor.

**Skinner Mill (SM):** From 7/17 10:30 to 8/10 10:45 there is an unknown error in the instrumentation, all data is marked -3 GIM CCU.

**Skinner Mill (SM):** pH from 8/10 11:00 to 9/2 12:15 is odd. The deployment is marked 1 CSM, with pH values between 0 and 2 marked -3 SSM CSM. There appears to be a correlation with these pH crashes and low tide. However, there also seems to be an issue with the sensor in this case as well.

**SM071709:** Entire deployment was flagged as suspect as there seems to be a failure of the Sp. Cond probe, however the probe calibrated fine upon retrieval so data was not rejected.

**Skinner Mill (SM):** From 11/25 11:15 to 14:30 the sonde was deployed, went in, and we believe it "sat" on top of sediment that had collected in the tube. At the returning tide the sediment was flushed out and the sonde "fell into place".

The following rain events are considered significant and are visible in the corresponding data sets. The parameters affected most are turbidity, pH, and depth. However, there may be other changes in the aforementioned parameters (and others) which were effected by smaller rain events **NOT** listed below
***June 2009 was the 6th rainiest June in Maine History. Many periods of heavy or extended rain**.

*** The following dates also saw significant rain events:**
**April 6, June 11-12, July 23 & 31, Oct 3, Nov 14-15,**