WELLS (WEL) National Estuarine Research Reserve Water Quality Metadata
January-December 2001
Latest Update: December 9, 2002

I. Data Set & Research Descriptors

1). Principal investigator & contact persons:

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2). Entry verification:

The data are directly downloaded in the YSI-PC6000 format (as a .dat file) and the Comma Delimited format (as a .csv file) from the dataloggers to a PC laptop. The data are reviewed using the PC6000 software (Eco-Watch). Graphs and basic statistics are then generated with the Eco-Watch program and the information is printed out for each data file. These graphs are used to determine any obvious data outliers and sonde and/or probe malfunction. All downloaded data files from the dataloggers (both raw unedited .dat and .csv files) are then transferred via disk to a Power Mac G3, where all files are reviewed and formatted for CDMO and stored. Here the raw unedited .csv data files are imported into Microsoft Excel 98. After a complete month of data has been recorded, each file is ready to review, which requires several steps. The NERR CDMO QA/QC Excel Macintosh macros; and the newly developed Macintosh import.xls macro (by Michele Cordrey, Tijuana NERR-July 2001) are used for all data.

The CDMO cdmomac3.xls macro will allow the user to automatically format column widths to the correct number of decimal places based on YSI sensor specifications. It also allows the user to QA/QC each data logger generated file for missing data points, fill all cells that do not contain data with periods, and find all data points that fall outside the range of what the data logger is designed to measure (i.e. outliers). The CDMO import.xls macro will allow PC users and Mac users (see above) with 30-minute data to automatically create a monthly Excel file from a two-week deployment and insert periods for missing data. In addition, in November 1999 a graphing capability was added to this macro allowing users to produce single parameter and missing data point graphs on a monthly basis.

A data file is created (from the merged raw unedited .csv data files) in Excel format with a full month of data. The first step is to make sure that the parameter columns are in the correct order, specified by the NERR CDMO. If any parameters are not collected due to probe failure or other causes, the cells with this missing data are filled in with periods (.) and documented and explained in the appropriate section of the metadata. Secondly, missing dates and times are inserted in the data file where data were not collected due to maintenance, sonde failure, etc., and the cells with this missing data are filled in with periods (.) and documented and explained in the appropriate section of the metadata. The first NERR CDMO QA/QC Excel macro is then run to determine if there are any missing dates and times; and if so these missing dates and times are inserted. Next, the second NERR CDMO QA/QC Excel macro is used to find and filter all data readings outside the sonde specification measuring range for each parameter. Here the outlier data generated by the second macro are examined and determined as either explained or unexplained anomalies, as specified by NERR CDMO Operations Manual (Version 4.0). All anomalous data (explained and unexplained) are documented and explained in the

appropriate sections of the metadata. The explained anomalous data are then removed from the data file and replaced by periods. The unexplained anomalous data are investigated for validity based on weather data, field observations, instrument diagnostics, and Eco-Watch printouts. If these data are rejected from the file then these are removed and replaced by periods. Lastly, the third and final NERR CDMO QA/QC Excel macro is used to reformat all the columns in the data file to the correct number of significant digits. After this last step, once the file has been completely formatted and edited as specified by NERR CDMO, the file is saved as a Tab delimited (.txt) text file and sent by FTP to the CDMO. The metadata form is also submitted with the data file to the CDMO, sent also as a text file (text only with line breaks). Jim Dochtermann and Scott Orringer are responsible for this task of entry verification with the analyses of suspect and anomalous data. Michele Dionne supervises, proofs and answers questions with the evaluation of suspect and anomalous data.

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.

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 unimpacted, located just east of the Route One bridge, and is our roving site.

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. The two data loggers are installed with bottom moorings, as described below. Both data loggers have 1/4 inch black vector mesh placed on the outside (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 CHANGES TO NOTE AT THE INLET SITE (IN); where our telemetry unit is stationed: A new vented level YSI 6600 with its new vented level cable was deployed to collect its first data on 5/4/99 at 12:00. The YSI telemetry unit

began collecting its first data on 3/16/98 at 10:30:00.

The Inlet site (IN) deployment methods are different than the other site (HT), due to the installation of a YSI telemetry unit. 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 cable. The collection of data parameters at the Inlet (IN) site are slightly different then at the roving (HT) site, due to the telemetry unit installation. Two to four week variable sampling periods were chosen due to limitations created by the life of the dissolved oxygen membrane and probe fouling. Battery power is not needed anymore within the sonde itself (although, battery power is needed during calibrations and downloading) at the time of deployment at this site because of the telemetry unit¹s solar batter power. Measurements of temperature, specific conductivity, salinity, percent saturation, dissolved oxygen, depth, pH, and turbidity are recorded at 30 minute intervals throughout the deployment period. Time, date, and battery voltage are no longer programmed to be recorded by the sonde, since these parameters are

already programmed with the Eco-Watch Program (see YSI¹s Eco-Watch Users Guide).

The other site, Head of Tide (HT), is deployed similarly, except for sonde height off the bottom (see below). This site uses 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 the Head of Tide site (HT) is such that the probe-end of the data logger is secured 0.30 meters (1.0 ft) off the bottom.

Two to four week variable sampling periods were chosen for the data sonde due to limitations created by the life of the dissolved oxygen membrane, probe fouling, and limited battery power. Measurements of temperature, specific conductivity, salinity, percent saturation, dissolved oxygen, depth, pH, and turbidity are recorded at 30 minute intervals throughout the deployment period.

After the deployment period, the data logger is brought back into the

Wells Reserve Laboratory for downloading, cleaning, and calibration. These procedures are carried out to the methods described in the YSI Operating Manual. Calibration standards are needed and used for only specific conductivity (10 mS/cm), pH (buffer solutions of pH 4, 7, and 10), and turbidity (100 NTU). Conductivity and pH standards are purchased from Fisher Scientific. Turbidity standards are purchased from Advanced Polymer Systems, Inc. (Redwood City, CA). The dissolved oxygen membranes are replaced and sit 6-24 hours before each deployment. After approximately 6-24 hours of down time for cleaning, maintenance and recalibration, the YSI Data logger is redeployed for another sampling period. Also, with our extra data sonde, we have been reducing the amount of time of missing data from calibrations and maintenance for this site.

Note: The Wells NERR two Drakes Island sites (see 1996-1997 metatdata) are currently being monitored (since 1996), but we are using the data for another project (CICEET-Wells Harbor dredge; see Section 7-Associated Researchers and Projects); and are not collecting the dissolved oxygen, percent saturation, and pH parameters.

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 Œ00 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 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 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 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. The estuarine system is 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 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).

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

The Head of Tide site is located 4 miles south of the Wells Reserve, just downstream of the Webhannet Falls (freshwater) and 10 feet east of Route One (43 deg 17' 54.25227" Latitude, 70 deg 35' 13.82728" Longitude). Route One is used heavily with 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 head waters of the Webhannet are relatively undeveloped. This site is located just 10 feet east of the 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' 12.44804" Latitude, 70 deg 33' 13.82728" Longitude). 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 3 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.

6). Data collection period:

The Webhannet River Head of Tide (HT) site data collection was re-deployed (after being pulled in every December from 1995-2000) on March 21, 16:00 and pulled after December 27, 10:00 for the winter months to prevent ice damage.

This site gets a large amount of ice coverage from December through late March.

The Webhannet River Inlet (IN) site data collection began May 29, 1995, 13:00. The IN datalogger is ongoing throughout the year and is considered our long-term monitoring site, as this site remains relatively ice-free.

Deployment and retrieval dates and times for 2001:

BEGAN	ENDED
Head of Tide Site	
03/21/01, 16:00	05/08/01, 12:30
05/09/01, 16:00	06/21/01, 08:30
06/22/01, 17:00	08/01/01, 08:30
08/02/01, 11:30	09/05/01, 12:00
09/06/01, 10:00	10/19/01, 10:00
10/19/01, 10:30	11/16/01, 14:30
11/16/01, 14:00	12/11/01, 14:00
12/11/01, 14:30	12/27/01, 09:30
Inlet Site	
11/17/00, 12:30	01/29/01, 09:30
01/30/01, 10:30	03/21/01, 16:00
03/22/01, 14:00	05/07/01, 12:30
05/09/01, 16:30	06/20/01, 14:30
06/23/01, 09:30	-Data Sonde Crash-
08/03/01, 15:30	09/13/01, 08:30
09/14/01, 10:00	09/17/01, 09:00
09/18/01, 17:00	10/17/01, 13:30
10/17/01, 15:30	11/15/01, 13:00
11/15/01, 12:30	12/21/01, 11:00
12/21/01, 11:30	01/08/02, 11:00

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 the 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 of third persons, nor will the Federal government reimburse or indemnify the Recipient for its liability due to any losses resulting in any way from the use of this data.

NERR water quality data and metadata can be obtained from the Research Coordinator at the individual NERR site (please see section 1. Principal investigators and contact persons), from the Data Manager at the Centralized Data Management Office (please see personnel directory under general information link on CDMO homepage) and online at the CDMO homepage http://cdmo.baruch.sc.edu. Data are available in text tab-delimited format, Microsoft Excel spreadsheet format and comma-delimited format.

8). Associated researchers and projects

WELLS NATIONAL ESTUARINE RESEARCH RESERVE RESEARCH AT THE RESERVE for 2000-2001:

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 2000-2001 twenty-three different studies (involving 79 scientists, students, and staff from the Reserve, 26 academic institutions and 19 resource management groups) 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, and 5) restoration of salt

marsh habitat degraded through human actions.

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.

Coastal Conservation Strategies

The Coastal Mosaic Project is a new program developed in response to requests for support from the conservation community to increase the quantity, quality and ecological integrity of conserved lands in our region. Research staff organize and facilitate meetings, workshops, and communications for 18 partner conservation groups. A key element of the Project is the Conservation Resource Center, a Reserve staffed GIS facility with a growing database able to provide maps of property, natural features and other data needed to develop effective conservation goals and strategies. The Project is nearing completion of conservation lands maps for 13 Southern Maine coastal towns, and is undertaking an initiative to develop coastal watershed conservation strategies for 12 coastal watersheds within these towns. The Reserve has a particular interest in educating communities about the ecologic and economic benefits of land conservation, especially along estuarine and riverine shorelines.

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 Reserve¹s 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 8 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. In the coming year we plan to develop a long-term monitoring program for finfish that will be coordinated with other sites within the Gulf of Maine and along the east coast. 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.

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 1950¹s, 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.

€ The Wells NERR Research Dept. completed the work on the following project:
"Community-based plan to manage current and future threats from point and non-source point pollution in the Merriland River and Branch Brook Watersheds of the Little River Estuary". There was a shoreline survey of the Little River and its Watershed this past March. The goal of this project was a)to produce a community-based watershed management plan for the Branch Brook, Merriland River, Little River combined watersheds, and b)to convey the elements of the plan to critical audiences through a succinct "road show", culminating in a public event

to showcase the plan. The project results are currently being written up.

€ The Wells NERR Research Dept. also completed the work on the following project:
"Measuring the Health of the York River Ecosystem using Fish as Indicators".
The results of this study have provide information on the ecology and fisheries of the York River that is essential for wise stewardship of this precious but threatened community resource. The goal of this project was to assist the York Rivers Association and partners in their work as stewards of the York River and its watershed, through an assessment of the current and potential fish habitat value of this exemplary coastal ecosystem. The project results are currently being written up.

€The Wells NERR Research Dept. is involved with the following two CICEET* Projects-

I. 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.

II. Project Title: Application of a Continuous Imaging Flow Cytometer for Monitoring Estuarine Microplankton Principal Investigators: Mike Sieracki and
Chris. Sieracki, Bigelow Laboratory for Ocean Studies

Management Issue: New technology for detecting harmful algal blooms
Project Summary: Marine plankton is a significant component of highly productive
estuaries, affecting the distribution of oxygen, nutrients, and contaminants.
Estuarine marine plankton is also the primary food for the larvae of many commercially and ecologically important finfish and shellfish. In addition to
their highly productive role, some species of plankton occasionally form nuisance or toxic blooms that affect human health as well as fish and shellfish.
This project is developing an imaging system, called FlowCam, to continuously
monitor plankton for the presence and abundance of harmful algal species. The
same technology could also be used to monitor the effects of harbor dredging on
plankton.

€The Wells NERR Research Dept. is assisting with the maintenance and data collection of the FlowCAM instrument and FlowCAM computer.

*The following information on CICEET taken directly from its website: (http://www.ciceet.unh.edu)
Wells NERR Past Graduate Research Fellowships (GRF¹s):
1)Patrick Ewanchuck and Mark Bertness, Ph.D.; Brown University
Project Title: Patch persitence and seedling dynamics in a Southern Maine
marsh and the process and pattern in western Atlantic salt marsh plant
communities: a biogeographical perspective.
2)Lindsay Whitlow, University of Michigan
Project Title: Integration of individual behavior and community dynamics
to determine mechanisms by which the invasive green crab impacts
populations of the native soft-shell clam.
3)Pamela Morgan, University of New Hampshire
Project Title: Functions and values of salt marshes in northern New
England: a comparison of fringing marshes and back barrier marshes.

Other Onsite Research:
Michele Dionne, Wells NERR, Nancy McReel, Chuck Lubelczyk
Project Title: Effect of herbivory by deer on forest regeneration

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 Centerm
Project Title: Ecological determinants of the spread of the tick vector of Lyme
disease and other pathogens.

ÝThis summary was taken from summaries written by Michele Dionne, Research
Director, and
put together and updated from Scott Orringer, Research Associate

Abstracts, Reports and Publications 1997-1999

The following titles describe research, management, education and outreach
activities to which Reserve staff, visiting investigators, interns, or volunteers made contributions. The nature of these contributions include data
collection, manangement, or analysis; authorship; or workshop/committee participation.

Bayse, N. and M. Smith (1999) Landowner options for creating great communities.
Coastal
Mosaic Project, Wells National Estuarine Research Reserve. 4 pages.

Belknap, D. F., and J. T. Kelley (1998) Development of Holocene relative sea-
level curves in Maine: Geological Society of America Abstracts with Programs,
v. 30, p. 4-5.

Boumans, R., D. Burdick, and M. Dionne (1999) Modeling habitat change in salt
marshes following tidal restoration. Manuscript in review.

Bryan, R., M.Dionne, R. Cook, J. Jones and A. Goodspeed (1997) Maine citizens
guide to evaluating, restoring, and managing tidal marshes. Maine Audubon
Society, Falmouth, ME.

Buchsbaum, R., D.M. Burdick, R. Cook, T. Diers, M. Dionne, K. Hughes, R. Milton,
H. A. Neckles, L. Roberts, C.T. Roman, J. Taylor, and D. Thompson (1999) Standards and criteria for evaluating tidal wetland restoration in the Gulf of
Maine: workshop results. Estuarine Research Federation Abstracts with Programs.

Burdick, D. M. , R. M. Boumans, M. Dionne and F. T. Short (1999) Impacts to salt
marshes from tidal restrictions and ecological responses to tidal restoration .
Report submitted to the Estuarine Reserves Division, National Oceanic and Atmospheric Administration. 51 pages plus figures and appendices.

Burdick, D. M., R. M. Boumans, and M. Dionne (1999) Modeling habitat change
following tidal restoration in New England salt marshes. Estuarine Research
Federation Abstracts with Programs.

Burdick, D., M. Dionne, R. Boumans and F. Short (1997) Ecological responses to
tidal restoration in two New England salt marshes. Wetlands Ecology and Management 4:129-144.

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II. Physical Structure Descriptors

9). Variable sequence, range of measurements, units, resolution, and accuracy:

YSI 6000/6600 datalogger

Variable	Range of Measurements	Resolution	Accuracy
Date	1-12, 1-31, 00-99 (Mo,Day,Yr)	1 mo, 1 day, 1 yr	NA
Time	0-24, 0-60, 0-60 (Hr,Min,Sec)	1 hr, 1 min, 1 s	NA
Temp	-5 to 45 (c)	0.01 C	+/- 0.15C
Sp COND	0-100(mS/cm)	0.01mS/cm	+/-0.5% Of reading + 0.001mS/Cm
Salinity	0-70 Parts per thousand (ppt)	0.01 ppt	+/- 1% of Reading or 0.1 ppt, (whichever is greater)
DO	0-200 (% air saturation)	0.1% @air sat	+/-2% @air Saturation
DO	200-500 (% air saturation	0.1% @ air sat	+/- 6% @ Saturation
DO	0-20 (mg/l)	0.01 mg/l	+/- 0.2mg/l
DO	20-50 (mg/l)	0.01 mg/l	+/- 0.6mg/l
Depth (shallow)	0-9.1 (m)	0.001m	+/- 0.018m
PH	2-14 units	0.01 units	+/- 0.2units

Turb 0-1000 NTU 0.1 NTU +/- 5% of
Reading or 2 NTU (whichever is greater)

Data columns are separated by tabs. Each file contains a two line column header at the top of the page which identifies measurements and units for each column.

10). Coded variable indicator and variable code definitions:

Site definitions: HT = Head of Tide of Webhannet River
IN = Inlet at Webhannet River Mouth

File definitions: YSI deployment site/waterquality/month/year (ex: INWQ0700 =
Webhannet Inlet data from July 2000).

11). Data anomalies:

January, 2001 Sampling Period
Head of Tide: None to report; sonde not deployed until March.

Inlet:
a) There is missing dissolved oxygen and percent saturation data from 1/1 0:00
through 1/29 9:30 due to a suspected DO membrane puncture or tear and probe
malfunction; and a high DO charge on retrieval (a continuation from the 11/18/00
2:00 probe crash (see Wells NERR 2000 Metadata).
b) The following were two high positive turbidity spikes that were not consistent with the overall data record. These suspect data were not deleted,
as we are not absolutely sure that these values were bad.
1/6 17:00 (1,064)-17:30 (1,379)

February, 2001 Sampling Period
a) Head of Tide: None to report; sonde not deployed until March.

Inlet:
a) Small negative turbidity values were collected sporadically throughout the
following time span: 2/19 11:00 to 2/23 0:00 (logging period recorded 91 anomalies), possibly due to a small calibration error. These data were not
deleted.
b) The following was a high positive turbidity spike that was not consistent
with the overall data record. This suspect datum was not deleted, as we are not
absolutely sure that this value was bad.
2/6 23:00 (296.0)

c) The following were a range of high dissolved oxygen (12.4 to 19.2 mg/l; mean of 16.0 mg/l) and percent saturation (120.1 to 185.0 percent; mean of 152.0 percent) spikes that were not consistent with the overall data record. These suspect data were not deleted, as we are not absolutely sure that these values are bad (the post calibration checked out normal).
2/6 16:00
2/10 11:30-12:30, 13:30-14:30
2/13 15:00-16:00

March, 2001 Sampling Period
Head of Tide:
a) No data on 3/1 0:00 to 3/21 15:30; this was the first logger deployment (3/21 at 16:00) at this site for 2001.
b) There was a sharp increasing and decreasing range of high positive turbidity spikes that occurred during the deployment, from 3/22 6:30 through 3/24 1:30 (82 values with a range from 6.7 to 950.6 NTU; mean of 99.9 NTU); [not including the five values > 1000 NTU listed below]; that were not consistent with the overall data record. These suspect data were not deleted, as we are not absolutely sure that these values are bad (the post calibration checked out normal).
3/23 4:00 (1035.6); 6:00 (1035.6); 8:00 (1035.6); 13:30 (1035.8); 21:00 (1035.7)

Inlet:
a) Small negative turbidity values were collected sporadically throughout the following time span: 3/29 03:30 to 3/30 6:30 (logging period recorded 52 anomalies), possibly due to a small calibration error. These data were not deleted.
b) The following were sporadic high positive turbidity spikes (>50 NTU) that were not consistent with the overall data record (range from 63.4 to 851.4 NTU, mean of 355.7 NTU). This suspect data were not deleted, as we are not absolutely sure that these values were bad. This may have been due to the snowmelt accompanied by the astronomical high tides.
3/7 7:00-7:30, 20:30
3/23 0:30
3/24 11:00-11:30
3/25 17:00-17:30
c) The following are episodes of high dissolved oxygen (range from 12.5 to 38.3 mg/l, mean of 16.7 mg/l) and percent saturation (range from 120.0 to 351.1

percent, mean of 157.8 percent) during several low tide and high tide fluctuations that were not consistent with the overall data record (at high tide the readings returned to the consistency of the overall data record). These suspect data were not deleted, as we are not absolutely sure that these values are bad. Other parameters, the dissolved oxygen post-cal, and recalibration were good. This may have been due to the snowmelt accompanied by the astronomical high tides.
3/23 13:30-14:30, 18:00-18:30, 20:00-23:30
3/24 0:00-2:00, 8:30-17:30
3/25 8:30-17:30
3/26 9:30-11:00, 12:30-17:30
3/27 8:30-18:00
3/28 11:30-18:00
3/29 13:30-18:00
d) No data from 3/14 11:30 to 3/16 14:30; needed to use sonde for a separate project (and re-deployed when finished (without recalibration)).

April, 2001 Sampling Period
Head of Tide:
a) There was a continuous range of high positive turbidity spikes that occurred after an initial high spike of 16.7 NTU on 4/12 19:00, from 4/12 19:00 through 4/30 23:30 (873 values with a range from 7.9 to 580.3 NTU; mean of 79.4) that were not consistent with the overall data record. These suspect data were not deleted, as we are not absolutely sure that these values are bad (the post calibration checked out normal). (Although this value range would not normally be labeled anomalous as they are not considerably high spikes, they are included in this range because of continuously stabilized values after the initial high spike on 4/12 19:00). This may have been due to the snowmelt.
b) No dissolved oxygen data or percent saturation data during the time span of 4/13 1:30 through 4/30 23:30 due to a suspected DO membrane puncture or tear and probe malfunction.
c) No data collected on 4/5 19:00 and 4/17 12:00 due to a data gap. Logger did not record data.

Inlet:
a) Small negative turbidity values were collected sporadically throughout the

following time span: 4/14 05:30 to 4/30 23:30 (logging period recorded 527
anomalies), possibly due to a small calibration error. These data were not
deleted.
b) The following were eight sporadic high positive turbidity spikes that were
not consistent with the overall data record (range from 168.5 to 854.8 NTU, mean
of 482.5 NTU). This suspect data were not deleted, as we are not absolutely
sure that these values were bad. This may have been due to the snowmelt
accompanied by the astronomical high tides.
4/1 7:00-7:30, 18:00-18:30
4/3 17:00-17:30
4/14 1:00-1:30
d) The following are episodes of high dissolved oxygen (range from 11.7 to 27.5
mg/l, mean of 15.2 mg/l) and percent saturation (range from 120.6 to 268.3
percent, mean of 147.0 percent) during several low tide and high tide
fluctuations that were not consistent with the overall data record (at high tide
the readings returned to the consistency of the overall data record). These
suspect data were not deleted, as we are not absolutely sure that these values
are bad. Other parameters, the dissolved oxygen post-cal, and recalibration
were good. This may have been due to the snowmelt accompanied by the
astronomical high tides.
4/2 13:30-17:00
4/3 8:30-17:00
4/4 12:30-17:30
4/7 13:30-14:00
4/9 15:00-16:00
4/10 16:00-18:30
4/13 12:00-18:00
4/14 10:30-15:30

May, 2001 Sampling Period
Head of Tide:
a) No dissolved oxygen data or percent saturation data during the time span of
5/1 0:00 through 5/8 12:30 due to a suspected DO membrane puncture or tear and
probe malfunction. This is a continuation from April 2001 (see above).
There was a continuous range of high positive turbidity spikes that occurred
from 5/1 0:00 through 5/8 12:30 (a continuation from the initial high spike on
4/12 19:00-see above), (364 values with a range from 32.7 to 75.4 NTU; mean of

47.9) that were not consistent with the overall data record. These suspect data were not deleted, as we are not absolutely sure that these values are bad (the post calibration checked out normal). (Although this value range would not normally be labeled anomalous as they are not considerably high spikes, they are included in this range because of continuously stabilized values after the initial high spike on 4/12 19:00). This may have been due to the snowmelt.
b) The following were high positive turbidity spikes that were not consistent with the overall data record. This suspect data were not deleted, as we are not absolutely sure that these values were bad.
5/27 1:30 (56.3); 3:30 (29.7); 14:00 (74.6)

Inlet:
a) Small negative turbidity values were collected sporadically throughout the following time span: 5/1 1:30 to 5/7 12:30 (logging period recorded 231 anomalies), possibly due to a small calibration error. These data were not deleted.
b) The following was a high positive turbidity spike that was not consistent with the overall data record. This suspect datum was not deleted, as we are not absolutely sure that this value was bad.
5/14 9:00 (93.4)

June, 2001 Sampling Period
Head of Tide:
a) The following were high negative turbidity spikes that occurred that were not consistent with the overall data record. These suspect data were not deleted, as we are not absolutely sure that these values are bad (the post calibration checked out normal).
6/03 18:00 (-72.2)
6/06 21:00 (-5.4); 21:30 (-111.8)
6/17 16:30 (-80.5)
b) The following were high negative turbidity spikes that occurred that were not consistent with the overall data record. These data were deleted due to animal in probe compartment.
6/17 19:00 (-743.7); 20:30 (-863.9); 21:00 (-103.8)
c) Small negative and/or zero turbidity values were collected sporadically throughout the following time span: 6/26 11:00-6/28 11:00 (logging period

recorded 30 anomalies), possibly due to a small calibration error. These data
were not deleted.
d) The following are episodes of low dissolved oxygen (range from 0.4 to 2.8
mg/l, mean of 1.1 mg/l) and percent saturation (range from 3.9 to 30.5%, mean of
12.6%) during several low tide and high tide fluctuations that were not consistent with the overall data record (at high tide the readings returned to
the consistency of the overall data record). These suspect data were deleted from 6/19 16:30-6/21 0830.

Inlet:
a)No data from 6/23 9:30 through 6/30 23:30 due to a major data sonde crash.
All data was erroneous, and the logged dates were erratic. The pre-deployment
calibration was accepted, and the raw data file consisted of the following dates
(only) with erroneous data:
6/27/01, 10/6/91, 6/28/01, 6/28/01, 6/28/01, 6/29/01, 6/29/01, 7/16/01, 7/16/01,
8/2/01. This crash continued until 8/2 15:00 when the logger was retrieved.

July, 2001 Sampling Period
Head of Tide:
a) The following are episodes of low and high dissolved oxygen (low-range from
1.0 to 3.3 mg/l, mean of 2.5 mg/l; high-range from 7.7 to 13.8 mg/l, mean of
10.4 mg/l) and percent saturation (low-range from 11.6 to 36.9%, mean of 28.1%;
high-range from 110.7 to 166.3%, mean of 131.8%) during several low tide and
high tide fluctuations that were not consistent with the overall data record (at
normal tides the readings returned to the consistency of the overall data record). These suspect data were not deleted, as we are not absolutely sure
that these values are bad. Other parameters, the dissolved oxygen post-cal,
and recalibration were good. These fluctuations were consistent with extremely
high and low tide events, with high and low specific conductivity and salinity
readings.
Low readings:
7/7 4:00
7/8 5:00-6:00
7/9 5:30-6:30
7/21 4:00-4:30
7/22 10:00, 20:00-22:30

7/23 21:30-23:30
7/24 0:00-1:00
7/25 0:30-2:00, 8:30
7/26 2:00-2:30, 7:30-13:30, 22:00-23:30
7/27 0:00-2:30, 7:00-8:00, 9:30, 23:30
7/29 1:00-6:00, 7/29 7:00-8:30, 10:00
7/30 4:30, 5:30-10:30
7/31 5:30-9:00, 10:00, 18:30, 19:30-20:30
High readings:
7/24 14:30-17:30
7/27 17:30-20:00
7/28 18:30-21:30
7/29 19:30-22:00
7/30 20:30-22:00
b) The following were three high positive turbidity spikes that were not consistent with the overall data record. These suspect data were not deleted,
as we are not absolutely sure that these values were bad.
7/7 13:00 (201.9)
7/10 19:00 (284.0); 19:30 (58.7)
c) The following are shallow positive depth data (160 values with a range of
0.00 to 0.09 m; mean of 0.06 m). Sonde probes suspected to be underwater as
other parameters check out normal. These data were not deleted. These fluctuations were consistent with extremely high and low tide events, with high
and low specific conductivity and salinity readings.
7/1 0:00-7:30, 10:30-19:00
7/2 0:00-0:30
7/5 14:00-14:30
7/9 17:00-19:30, 20:30, 21:30-23:30
7/10 0:00-1:00, 5:00-14:00, 17:00-18:30
7/23 19:30-23:30
7/24 0:00-0:30, 6:00-13:30, 17:30-23:30
7/25 0:00-1:30, 6:00-14:00, 18:30-23:30
7/26 0:00-2:30, 7:00-9:30

Inlet:
a) No data from 7/1 0:00 through 7/31 23:30 due to a major data sonde crash
(continued from the 6/23 9:30 crash-see above). All data was erroneous, and the
logged dates were erratic. The pre-deployment calibration was accepted, and the
data file consisted of the following dates (only) with erroneous data:
6/27/01, 10/6/91, 6/28/01, 6/28/01, 6/28/01, 6/29/01, 6/29/01, 7/16/01, 7/16/01,
8/2/01. This crash continued until 8/2 15:00 when the logger was retrieved.

August, 2001 Sampling Period
Head of Tide:

a) The following are shallow positive depth data (803 values with a range of 0.0
to 0.099 m; mean of 0.046 m). Sonde probes suspected to be underwater as other
parameters check out normal. These data were not deleted
8/2 12:30-21:30
8/3 1:30-9:30, 11:00, 13:00
8/4 2:00-11:30, 14:00-22:30
8/5 3:00-12:00, 15:00-23:30
8/6 3:30-12:30, 15:00-23:30
8/7 0:00, 3:30-8:00, 13:30, and 15:30
8/8 1:00, 4:00, 7:30-12:30, 14:00, 16:00
8/9 14:30
8/10 3:00, 5:00, 16:00
8/11 4:00, 5:00-16:00, 18:30-23:30
8/12 0:00-4:30, 6:00-12:00, 19:30-23:30
8/13 0:00-17:00, 20:30-23:30
8/14 0:00-6:30, 7:30-17:30, 21:30-23:30
8/15 0:00-7:30, 9:30-18:30, 23:30
8/16 0:00-8:00, 10:30-19:30
8/17 0:00-9:00, 12:00-19:00, 20:30
8/18 1:30-9:30, 13:00-17:30, 19:30-21:00
8/19 2:30-10:30, 14:30-22:00
8/20 4:00-11:00, 15:30-23:00
8/21 4:30-12:00, 16:30-23:30
8/22 0:00, 5:00-13:00, 17:30-23:30
8/23 0:00-1:00, 5:30-13:30, 18:00-23:30
8/24 0:00-2:00, 6:00-14:30, 19:00-23:30
8/25 0:00-3:30, 14:00-15:30, 20:00-23:30
8/26 0:00-4:30, 7:30-16:30, 20:30-21:30
8/27 6:30, 8:00, 21:30
8/28 7:30, 8:30-9:00
8/29 6:30-8:30, 9:30-19:30, 23:30
8/30 0:00-9:00, 11:30-20:30
8/31 0:30-9:30, 12:00
b) The following are shallow negative and/or zero depth data (269 values with a
range of -0.08 to -0.001 m; mean of -0.04 m). Sonde probes suspected to be
underwater as other parameters check out normal. These data were not deleted
8/3 10:00-10:30, 13:30-22:00
8/7 8:30-13:00, 16:00-23:30
8/8 0:00-0:30, 4:30-7:00, 13:00-13:30, 16:30-23:30
8/9 0:00-1:30, 5:00-14:00, 17:00-23:30
8/10 0:00-2:30, 5:30-15:00, 17:00-23:30
8/11 0:00-3:30
8/17 19:30-20:00
8/18 18:00-19:00
8/26 22:00-23:30
8/27 0:00-6:00, 8:30-17:30, 22:00-23:30
8/28 0:00-7:00, 9:30-18:30, 22:30-23:30
8/29 0:00-6:00
8/31 12:30-21:00

c) The following are episodes of low dissolved oxygen (range from 1.4 to 3.4 mg/l, mean of 2.6 mg/l) and percent saturation (range from 15.6 to 36.3%, mean of 28.9%) during several low tide and high tide fluctuations that were not consistent with the overall data record (at high tide the readings returned to the consistency of the overall data record). These suspect data were not deleted, as we are not absolutely sure that these values are bad. Other parameters, the dissolved oxygen post-cal, and recalibration were good. These fluctuations were consistent with extremely high and low tide events, with high and low specific conductivity and salinity readings.

8/1 5:00-8:30
8/2 20:30-22:00
8/3 6:30-8:30, 20:30, 23:00
8/4 5:00-13:00, 18:30-23:30
8/5 5:30-12:00, 19:30-23:30
8/6 0:00-0:30, 5:30-9:30, 11:00, 19:30-23:30
8/7 0:00-1:00, 7:00-9:00, 22:30, 23:30
8/8 0:00-1:30, 6:30-7:00, 8:00-9:30
8/9 0:00-2:00, 6:00-9:00
8/10 6:00-9:00, 22:30-23:30
8/11 0:00-9:30, 20:30, 21:30
8/12 0:30-5:00, 6:30-12:00
8/15 1:30-2:00, 3:00-7:30
8/29 6:30

d) The following are episodes of high dissolved oxygen (range from 10.3 to 12.6 mg/l, mean of 11.5 mg/l) and percent saturation (range from 135.0 to 160.3%, mean of 144.9%) during several low tide and high tide fluctuations that were not consistent with the overall data record. These suspect data were not deleted, as we are not absolutely sure that these values are bad. Other parameters, the dissolved oxygen post-cal, and recalibration were good. These fluctuations were consistent with extremely high and low tide events, with high and low specific conductivity and salinity readings.

8/8 15:30
8/25 16:30-17:00
8/26 17:30-18:00
8/27 18:30-19:00
8/28 19:30-20:00

Inlet:

a) Small negative turbidity values were recorded throughout the following time

span: 8/3 16:30 to 8/31 13:30 (logging period recorded 847 anomalies), possibly
due to a small calibration error. These data were not deleted.
The following were 7 high positive turbidity spikes (>50 NTU) that were not
consistent with the overall data record (range from 52.1-70.4 NTU, mean of 60.2
NTU). This suspect data were not deleted, as we are not absolutely sure that
these values were bad.
8/22 4:30, 5:30, 6:30, 8:30
8/23 9:00
8/25 23:00
8/30 20:30
b) There is missing specific conductivity and salinity readings from 8/23 15:00
through 8/31 23:30 due to a catastrophic probe failure. Normally observed
values decreased quickly to negative values, which was consistent with a post-
calibration failure. Since a YSI 6600 was being used at this site, all other
data were not deleted (separate probes; depth values checked out normal).
c) No data from 8/1 0:00 to 8/3 15:00; due to the major data sonde crash
(continued from the 6/23 9:30 crash-see above), and due to downtime for
calibration, maintenance and downloading.

September, 2001 Sampling Period
Head of Tide:
a) Small negative turbidity values were recorded throughout the following time
span: 9/9 7:30 to 9/30 22:30 (logging period recorded 260 anomalies), possibly
due to a small calibration error. These data were not deleted.
b) The following are shallow negative depth data (20 values with a range of
-0.09 to -0.01 m; mean of -0.06 m). Sonde probes suspected to be underwater as
other parameters check out normal. These data were not deleted
9/1 1:00-10:00
9/4 15:30
c) The following are shallow positive depth data (177 values with a range of
0.01 to 0.09 m; mean of 0.06 m). Sonde probes suspected to be underwater as
other parameters check out normal. These data were not deleted
9/1 10:30, 13:00-22:00
9/2 1:30-10:30, 14:00-22:30
9/3 2:30-11:30, 14:00-23:00
9/4 3:00-12:00, 14:30-15:00-23:30
9/5 0:00, 3:00-12:00
9/11 0:00-4:00, 15:00-16:00
9/13 12:00-18:00

d) The following are episodes of low dissolved oxygen (range from 1.7 to 3.1 mg/l, mean of 2.67 mg/l) and percent saturation (range from 19.3 to 37.8%, mean of 32.76%) during several low tide fluctuations that were not consistent with the overall data record (at high tide the readings returned to the consistency of the overall data record). These suspect data were not deleted, as we are not absolutely sure that these values are bad. Other parameters, the dissolved oxygen post-cal, and recalibration were good. These fluctuations were consistent with high and low specific conductivity and salinity readings.
9/1 8:00-9:30, 20:00-22:00
9/2 3:30-9:00, 21:00-23:00
9/3 6:30
9/5 6:00, 7:00, 8:00
9/21 11:00-13:00
9/22 6:30-8:30, 19:30-23:30
9/23 0:00-3:00, 4:00, 6:30-10:00, 21:30, 23:00-23:30
9/24 0:00-5:30, 6:30-13:00
9/25 1:30, 2:30-6:00, 7:30-12:00, 16:30-18:00
9/30 3:00-4:30

Inlet:
a) There is missing specific conductivity and salinity readings from 9/1 0:00 through 9/13 8:30 due to a catastrophic probe failure (a continuation of the 8/23 15:00 probe crash-see above). Since a YSI 6600 was being used at this site, all other data were not deleted (separate probes; depth values checked out normal).
b) Small negative turbidity values were recorded throughout the following time span: 9/1 0:30 and 9/28 08:00-09:00 (logging period recorded 16 anomalies), possibly due to a small calibration error. These data were not deleted.
c) No turbidity data from 9/5 3:00 to 9/13 8:30 due to a turbidity probe malfunction. Turbidity values began to fluctuate inconsistently, ranging from -6.5 to 1940 NTU. This was also consistent with a post-calibration failure.
There is missing dissolved oxygen and percent saturation data from 9/18 17:00 through 9/30 23:30 due to a suspected DO membrane puncture or tear and probe malfunction. This may have been a result of using sonde for the other NOAA project (see Sec 14-Other Remarks/Notes).

d) There is missing data from 9/17 9:30 to 9/18 16:30; logger was needed for
another NOAA project (see Sec 14-Other Remarks/Notes).
e) There is missing dissolved oxygen and percent saturation data from 9/18 17:00
through 9/30 23:30 due to a suspected DO membrane puncture or tear and probe
malfunction. This may have been a result of using sonde for the other NOAA
project (see Sec 14-Other Remarks/Notes).

October, 2001 Sampling Period
Head of Tide:
a) Small negative turbidity values were recorded throughout the following time
span: 10/1 10:00 to 10/31 23:30 (logging period recorded 626 anomalies),
possibly due to a small calibration error. These data were not deleted.
b) The following are shallow negative depth data (5 values, all -0.01 m). Sonde
probes suspected to be underwater as other parameters check out normal. These
data were not deleted.
10/25 14:30-16:30
c) The following are shallow positive depth data (159 values with a range of
0.01 to 0.09 m; mean of 0.06 m). Sonde probes suspected to be underwater as
other parameters check out normal. These data were not deleted
10/6 4:00-12:30, 16:30-18:30
10/24 1:00-5:00, 7:30-16:30, 20:30-23:30
10/25 0:00-6:00, 8:00-14:00, 17:00-17:30, 21:00-23:30
10/26 0:00-7:30, 9:00-19:00, 22:00-23:30
10/27 0:00-7:30, 15:00
d) The following are episodes of low dissolved oxygen and percent saturation
during several low tide and high tide fluctuations that were not consistent with
the overall data record (at high tide the readings returned to
the consistency of the overall data record). These suspect data were not
deleted, as we are not absolutely sure that these values are bad. Other
parameters, the dissolved oxygen post-cal, and recalibration were good.
10/16 09:00
10/20 19:00
e) The following deployment recorded negative turbidity data due to small
calibration error. All turbidity data were deleted for the following deployment.
10/19 11:00 - 11/16 14:30

Inlet:
a) There is missing dissolved oxygen and percent saturation data from 10/1 0:00
to 10/17 13:30 due to a suspected DO membrane puncture or tear and probe

malfunction (This is a continuation from the 9/18 17:00 through 9/30 23:30 probe
malfunction-see above). This may have been a result of using sonde for the other NOAA project (see Sec 14-Other Remarks/Notes).
b) Small negative turbidity values were recorded throughout the following time
span: 10/2 21:00 to 10/31 23:00 (logging period recorded 513 anomalies), possibly due to a small calibration error. These data were not deleted.
c) The following were high positive turbidity spikes (>50 NTU), that were not
consistent with the overall data record (range from 54.8-145.7 NTU, mean of 83.4
NTU). This suspect data were not deleted, as we are not absolutely sure that
these values were bad.
10/12 19:30
10/13 18:30
10/15 6:00, 16:00, 21:00
10/25 20:00
d) The following were high negative turbidity spikes that occurred that were not
consistent with the overall data record. These data were deleted due to animal
in probe compartment.
10/5 1:00 (-803.3), 1:30 (-907.1)
10/13 19:00 (-862.5)
e) There is missing specific conductivity and salinity readings from 10/17 15:30
through 10/31 23:30 due to a catastrophic probe failure. Although all the data
values within this deleted period were not anomalous (outside the probe¹s range
of measurement -- 56 values, sporadically throughout 10/17 22:30 to 10/31 13:00; range of -35.9 to -0.01 mS/cm, mean of -10.86 mS/cm), it was decided to
delete all the data within this time range due to suspected probe failure. From
observing the graph of this time span; it could not be believed that these data
values were real. Since a YSI 6600 was being used at this site, all other data
were not deleted (separate probes).
f) There is missing depth data from 10/17 15:30 through 10/31 23:30 due to a
suspected vented-level depth failure. Although all the data values within this
deleted period were not anomalous (outside the probe's range of measurement -
127 values, sporadically throughout 10/18 13:30 to 10/28 22:00; range of -2.79
to 17.72 m, mean of 0.94 m), it was decided to delete all the data within this
time range due to suspected parameter failure. From observing the graph of this

time span; it could not be believed that these data values were real.

November, 2001 Sampling Period
Head of Tide:
a) Small negative turbidity values were recorded throughout the following time span: 11/1 0:00 to 11/29 9:00 (logging period recorded 1,035 anomalies), possibly due to a small calibration error. These data were not deleted.
b) The following are shallow positive depth data (57 values with a range of 0.0 to 0.09 m; mean of 0.06 m). Sonde probes suspected to be underwater as other parameters check out normal. These data were not deleted:
11/10 23:30
11/11 0:00-5:00
11/19 17:00-23:30
11/20 0:00-1:30, 3:30-13:00, 16:30-19:30
c) There is missing dissolved oxygen and percent saturation data from 11/20 20:30 to 11/30 23:30 due to a suspected DO membrane puncture or tear and probe malfunction. Although post-calibration results were normal, readings increased from 13.4 mg/l and 106.5 percent to a constant 17.6 mg/l and 136.5 percent.
d) There are no missing data due to downtime for calibration, maintenance and downloading. However, there was an overlap with a 1-hour time span. Previous deployed sonde was pulled after its 14:30 data log (11/16 14:30), and newly deployed sonde took its first true reading at (11/16) 14:00. We decided to use the previous sonde up to 14:30, and the newly deployed sonde at 15:00.

Inlet:
a) There is missing specific conductivity and salinity readings from 11/1 0:00 through 11/15 13:00 (a continuation from 10/17 15:30 through 10/31 23:30-see above) due to a catastrophic probe failure. Although all the data values within this deleted period were not anomalous (outside the probe¹s range of measurement -- 14 values, sporadically throughout 11/1 23:00 to 11/14 7:00; range of -26.0 to -0.67 mS/cm, mean of -8.92 mS/cm), it was decided to delete all the data within this time range due to suspected probe failure. From observing the graph of this time span; it could not be believed that these data values were real.

Since a YSI 6600 was being used at this site, all other data were not deleted
(separate probes).
b) There is missing depth data from 11/1 0:00 through 11/15 13:00 (a continuation from 10/17 15:30 through 10/31 23:30-see above) due to a suspected
vented-level depth failure. Although all the data values within this deleted
period were not anomalous (outside the probe¹s range of measurement - 7 values,
sporadically throughout 11/2 18:00 to 11/11 15:00; range of -0.241 to -0.024 m,
mean of -0.128 m), it was decided to delete all the data within this time range
due to suspected parameter failure. From observing the graph of this time span;
it could not be believed that these data values were real.
c) Small negative turbidity values were recorded sporadically throughout the
following time span: 11/1 0:30 to 11/30 06:00 (logging period recorded 249
anomalies), possibly due to a small calibration error. These data were not
deleted.
d) The following were 73(almost continuous) high positive "rollover" turbidity
spikes (>1000 NTU), that were not consistent with the overall data record (range
from 1000.2 to 2031.0 NTU), mean of 1497.5 NTU. This suspect data were not
deleted, as we are not absolutely sure that these values were bad (post-calibration checked out normal).
11/10 16:00
11/11 8:00-9:30, 11:30, 14:00, 15:00, 17:00-17:30, 23:00-23:30
11/12 0:00
11/14 2:30-3:00, 10:00, 11:00-11:30, 12:30-13:30, 14:30-15:00, 16:30, 17:30,
18:30-21:00
11/15 0:30, 2:00-3:00, 4:00-4:30, 6:00-6:30, 7:30-8:00
11/22 19:00-20:00
11/24 3:30-17:00
e) The following were 430 (almost continuous) high positive turbidity spikes
(>50 NTU), that were not consistent with the overall data record (range from
50.4 to 996.4 NTU), mean of 222.0 NTU. This suspect data were not deleted, as
we are not absolutely sure that these values were bad (post-calibration checked
out normal).
11/1 14:00
11/4 5:30-6:00, 7:00-7:30, 9:00-10:00, 16:00, 17:00, 18:00, 19:00, 20:00-20:30,
21:30, 22:30-23:00

11/5 0:00, 6:00, 8:00, 9:30, 18:30-19:00, 20:30-21:00, 22:00-23:00
11/6 0:00, 3:00, 5:00-11:00, 12:00, 16:00-17:30, 20:30-21:00, 22:00, 23:00-
23:30
11/7 0:00-0:30, 4:30-5:30, 7:00-10:00, 13:30, 14:30-22:30
11/8 0:30-1:30, 2:30-9:00, 10:30-13:30, 15:30-17:30, 18:30-23:30
11/9 0:00-3:00, 4:00-5:30, 7:00, 8:00-12:00, 14:00-15:00, 16:00-16:30, 18:00-
23:00
11/10 0:00-1:00, 2:00- 15:30, 16:30-18:00, 20:00-23:30
11/11 0:00-1:00, 7:30, 10:00-11:00, 12:00-13:30, 14:30, 15:30-16:30, 19:00,
20:00-22:30
11/13 10:00-19:30, 20:30, 21:30, 22:30, 23:30
11/14 0:00-2:00, 3:30-9:00, 10:30, 12:00, 14:00, 15:30-16:00, 17:00, 18:00,
21:30-22:00, 23:00-23:30
11/15 0:00, 1:00-1:30, 3:30, 5:00, 7:00, 8:30-10:00, 12:00-13:00
11/21 18:00-23:30
11/22 0:00-18:30, 20:30
11/23 7:00-23:30
11/24 0:00-3:00
11/25 12:00-23:30
11/26 0:00-10:30, 12:30, 13:30, 15:30
f) No data collected on the following dates/times; due to a data gap. Logger
either (1) did not record data within this time range, possibly due to an overwrite of data; or (2) did record the same data values because of an overwrite (these data were deleted).
11/11 1:30-7:00
11/12 0:30-23:30
11/13 0:00-7:00

December, 2001 Sampling Period
Head of Tide:
a) There is missing dissolved oxygen and percent saturation data from 12/1 0:00
to 12/11 14:00 due to a suspected DO membrane puncture or tear and probe malfunction. Although post-calibration results were normal, readings increased
from 13.4 mg/l and 106.5 percent to a constant 17.6 mg/l and 136.5 percent.
(This is a continuation from November 2001; where values increased in the December part of the deployment to an increased constant of 19.65 mg/l and 143.1
percent).
b) Small negative turbidity values were recorded throughout the following time
span: 12/2 4:00 to 12/27 9:30 (logging period recorded 1,088 anomalies), possibly due to a small calibration error. These data were not deleted.
c) The following was a range of low negative dissolved oxygen and percent saturation data. These suspect data were deleted (although the post calibration

checked out normal), as these readings were out of the probe's acceptable range.
12/12 12:00-14:30
12/13 13:00-14:00
These readings led to a decision to delete all dissolved oxygen and percent saturation data within this time span, from 12/11 14:30 to 12/27 9:30 a probe malfunction.
d) There is missing pH data from 12/11 14:30 to 12/27 9:30 due to a probe malfunction prior to sonde deployment-we were unable to calibrate the probe.
e) No data from 12/27 10:00 to 12/31 23:30. This datalogger was pulled for the year (winter months) to prevent ice damage.

Inlet:
a) Small negative turbidity values were recorded throughout the following time span: 12/1 18:30 to 12/31 22:00 (logging period recorded 55 anomalies), possibly due to a small calibration error. These data were not deleted.
b) The following were 14 high positive "rollover" turbidity spikes (>1000 NTU), that were not consistent with the overall data record (range from 1121.2 to 1740.8 NTU), mean of 1344.1 NTU. This suspect data were not deleted, as we are not absolutely sure that these values were bad (post-calibration checked out normal).
12/19 19:00
12/22 17:30
12/23 0:30, 10:00, 15:00
12/24 4:00
12/25 16:30
12/26 6:00
12/27 10:00, 13:30
12/28 23:00
12/29 20:30
12/30 1:30, 8:00
c) The following were 42 (almost continuous) high positive turbidity spikes (>50 NTU), that were not consistent with the overall data record (range from 50.4 to 917.6 NTU), mean of 239.9 NTU. This suspect data were not deleted, as we are not absolutely sure that these values were bad (post-calibration checked out normal).
12/19 21:00, 23:00
12/20 0:30, 1:30, 7:30, 11:30-12:00, 14:30, 15:30, 16:30
12/21 10:30, 12:00, 14:00-14:30, 16:30, 17:30, 20:00
12/22 1:00, 16:30
12/23 4:30

12/24 15:00, 19:30
12/25 6:30
12/26 13:00, 22:30
12/27 0:30, 4:30, 5:30, 7:30
12/28 12:30, 15:30, 18:00
12/29 15:30, 22:00
12/30 5:30, 6:30, 13:00, 15:00, 18:00
12/31 7:30, 13:30, 20:30
d) The following were three high positive percent saturation and dissolved oxygen spikes that were not consistent with the overall data record. These suspect data were not deleted, as we are not absolutely sure that these values were bad.
12/24 16:00 (166.7, 16.6)
12/27 5:00 (145.5, 14.7)
12/28 22:30 (143.0, 14.4)
e) The following DO (% and mg/L) data were deleted due to a torn membrane toward end of deployment.
12/19 14:00 - 12/21 11:00

12). Missing data:

Missing data are denoted by a period in the data set. Data are missing due to equipment failure where no probes were deployed, maintenance/calibration of equipment, elimination of obvious outliers or elimination of data due to calibration problems (both pre and post). For more details on deleted data, see the Data Anomalies Section. To find out more details about missing data, contact the Research Coordinator at the site submitting the data.

13). Post deployment information

End of Deployment Post-calibration Readings in Standard Solutions:

Site	Date	Sp.Cond(mS) (Std: 10.0)	DO (%) (Std: 100)	Dochg(mv) (Std: Variable)	Depth(m)	pH (Std:7)	Turbidity(NTU) (Std: 0.0)
HT	05/09/01	10.89	101.1	59.4	0.039	7.14	0.4
HT	06/21/01	9.77	96.4	51.2	-0.003	7.17	1.1
HT	08/01/01	10.22	98.1	48.7	0.078	7.36	-0.4
HT	09/05/01	11.00	96.2	48.2	-0.040	7.05	1.4
HT	10/18/01	9.68	92.0	48.2	-0.027	7.30	-0.8
HT	11/15/01	10.33	92.2	59.4	-0.122	6.90	0.0
HT	12/10/01	9.85	110.6	30.8	-0.146	7.28	0.3
HT	12/27/01	10.06	102.6	-	-0.239	-	-0.4
IN	01/29/01	8.28	-3.8	96.2	-0.001	7.00	1.5
IN	03/21/01	10.02	100.4	60.4	0.002	7.07	-1.6

IN	05/07/01	8.95	94.2	53.3	0.000	6.83	-1.1
IN	06/20/01	9.64	92.7	48.2	0.002	6.41	1.2
IN	08/02/01 (Crash)	-	-	-	-	-	-
IN	09/13/01	-1.36	87.5	52.3	-0.002	7.10	7.0
IN	10/17/01	9.99	120.7	35.7	0.006	6.92	1.7
IN	11/16/01	10.23	85.3	72.7	-0.307	7.24	-0.1
IN	12/20/01	10.09	91.6	47.6	-0.067	6.97	-4.3
IN	01/08/02	10.53	108.4	39.4	0.028	7.09	-0.1

14). Other Remarks/Notes:

A) IMPORTANT CHANGES TO NOTE AT THE INLET SITE (IN): where our telemetry unit is stationed: A new vented level YSI 6600 with its new vented level cable was deployed to collect its first data on 5/4/99 at 12:00. The YSI telemetry unit began collecting its first data on 3/16/98 at 10:30:00 (see Section 4-Research Methods).

B) IMPORTANT CHANGES TO NOTE AT THE INLET SITE (IN): No data collected from 9/17 9:30 through 9/18 16:30, as the logger was used for another NOAA project. The logger was calibrated on 9/13 for its 9/14 10:00 deployment; deployed until 9/17 9:00, removed for the NOAA project, and then replaced without re-calibration for 9/18 17:00 through 10/17 13:30 deployment.

C) IMPORTANT CHANGES TO NOTE AT THE INLET SITE (IN): For all data collected from 9/14 10:00 through 10/17 13:30, a non-vented YSI 6000 was used.

D) IMPORTANT CHANGES TO NOTE AT THE INLET SITE (IN): After the telemetry unit was finally fixed in October 2001, the first telemetry deployment of 2001 began on 10/17 15:00. Note: All of 2001 did use the vented-level cable for the accurate depth (and the solar panel did power the sonde), but we were unable to download telemetry-the YSI 1240 radio boxes were sent back for repairs.

Note: The Wells NERR two Drakes Island sites (see 1996-1997 metatdata) are currently being monitored (since 1996), but we are using the data for another project (CICEET-Wells Harbor dredge; see Section 7-Associated Researchers and

Projects); and are not collecting the dissolved oxygen, percent saturation, and
pH parameters.

E) 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 Œ00 when they
became available.

F) With our extra data sonde, we have been reducing the amount of time of missing data from calibrations and maintenance for all sites. Some months have
no missing data from the use of this extra sonde.

G) Any time a reference is made to turbidity data being negative and/or zero, it
was recorded as a negative in the raw data file and a zero in the edited data
file due to the formatting of Excel. The technician edited none of these data
points by hand nor did he/she delete any of them.