Waquoit Bay (WQB) NERR Water Quality Metadata
May - July, 1996
Latest Update: August 1, 2002

I. Data set and Research Descriptors

1. Principal investigators and contact persons:

Dr. Rick Crawford, Research Coordinator (PI)
Jennifer Burnes, Research Assistant (contact person)
PO Box 3092 Waquoit, MA 02536
(508) 457-0495
wbnerr@capecod.net

2. Entry verification

The data are uploaded from the YSI 6000 datalogger, to a PC with the YSI PC6000 data transfer software. Each file is uploaded in three formats, in the YSI (.dat) format, in comma delimited(labeled .csv) format, and in space delimited (labeled .txt) format. Three copies of each file in all three formats are then archived. The PC6000 software is used to plot the data which are then subject to preliminary review to detect questionable data, outliers, or probe malfunction.
The dataloggers are tested for performance regarding field deployment, fouling and calibration. Copies of the plots from each deployment as well as the tests are filed with the respective field log.

Each comma delimited file is imported into Excel 5.0 where it is processed according to the NERRS CDMO operations manual. Files are merged to contain data on a monthly basis. Missing date and time stamps, along with the known or probable cause are documented in the missing data section of the metadata. If for any reason the time stamps of a file are incorrect, they are corrected and documented in anomalous data. Using a CDMO Excel 5.0 macro data collected at fifteen minute intervals are sieved to contain data collected at 30 minute intervals. When possible, the Import.xls macro is run to fill in missing date and time stamps. If for some reason the Import.xls macro will not run this part of the editing procedure is performed manually. The pre and post-deployment data records or data-tails are removed and then the Import.xls macro is again used to put periods in all cells missing data. At this point the files are saved in comma delimited format with the .csv extension. These files are considered to be the WQBNERR raw data files and are sent to the CDMO for archival.

The CDMO macros are then run to check that every day of each month has the appropriate number of date and time stamps, and to highlight data outliers. All data outliers are documented in the anomalous data section and are removed from the data set at the discretion of the research coordinator. At this point the files are saved in the Excel workbook format with the .xls extension. A graphing program is used to graph each file and run statistical analyses to determine if any other anomalous data is present and needs removing. Any data that is deemed anomalous is documented in the anomalous data section. All removed data is also documented in the missing data section, and replaced with periods. When the editing process is complete the final CDMO Column Reformat macro is run and the file is saved in ASCII text format (with the .txt extension). These files are then sent electronically by FTP to CDMO.

Data files are archived at the Reserve as follows. Three copies of the WQBNERR monthly raw data files are archived in comma delimited format (with the .csv extension). Three copies of each final monthly data file are archived in the Excel workbook format (with the xls extension), as well as in ASCII format (with the .txt extension).

3. Research objectives:

It is well known that eutrophication is occurring in many temperate, shallow, coastal estuaries of North America, as well as around the world. Waquoit Bay is representative of shallow coastal embayments that occur from Cape Cod to Sandy Hook, New Jersey. It is within the Virginian biogeographic province, on the transitional border (Cape Cod) between the Virginian and the more northern Acadian biogeographic province. It functions as a natural laboratory from which base line data can be collected to document trends associated with coastal development near these fragile habitats.

The temperate, shallow, coastal estuaries of this region are surrounded by sandy soils. Studies have indicated that non-point sources are the major contributors of nitrogen to these receiving waters. Waquoit Bay receives nitrogen from several non-point sources, including private on-site septic systems (their leachate percolates into groundwater which then enters the bay), run off (domestic and agricultural fertilizers, roads, animals), and atmospheric sources. On-site septic systems have been identified as the major contributing non-point source in these highly developed coastal regions.

Dense housing developments cover two peninsulas that form the western shore of the Childs and Seapit rivers, major contributors of fresh water to the reserve complex. Although these developments are outside of the Reserve boundaries, nitrogen discharged from septic systems, and in fertilizers has significant effects on the functioning of the Waquoit Bay ecosystem. The impacts of this nitrogen loading has been a subject of extensive study by researchers associated with the Reserve since its designation (1988).

It is well known that eutrophication of these ecosystems has led to alterations of habitat, negatively affecting important commercial fin and shellfisheries. In Waquoit Bay, for example, bay scallops (Argopecten irradians) were historically an important shellfishery. It has been shown that scallop survival is related to the vertical structure of eel grass (Zostera marina), and in 1951, vast meadows of eelgrass were documented throughout Waquoit Bay. At this time, eel grass has essentially disappeared from the bay. Thick mats of seaweeds (benthic macroalgae such as Cladophora sp. And Gracilaria sp.) now cover the bottom of the bay where eelgrass meadows thrived two decades ago. As a result, the commercial harvest of bay scallops has collapsed. Unfortunately, the documentation of these changes is minimal, which makes evaluation of the rates of change resulting in these altered habitats difficult. A long term data base will make possible analyses of this type in the future.

Two sites are used to characterize conditions in Waquoit Bay. The control site is located in the central bay (CB). Data from this unit is considered to reflect the general conditions in the bay. This site is well flushed by the tides, is sufficiently exposed to winds from all directions, and is adequately removed from the navigation channel and mooring basins to be minimally affected by boating activities (relative to the rest of the bay). It is not a popular shellfishing spot. The Aimpacted@ site is located in the north basin (NB) at the head of Waquoit Bay. This area is slightly deeper than the rest of the bay, and is sheltered from winds, particularly prevailing southwesterly winds during the summer months. It is presumably less mixed than the rest of the bay. It is located away from any channels, but is the site of more than 200 boat moorings, and is also a popular site for shellfishing. A second data logger has also been deployed at the North Basin site. However, this datalogger is suspended directly from a mooring, placing the probes at a water depth of approximately 0.9m. Data files collected in this manner are labeled North Basin Surface (NS). When examined with reference to the NB data these files have the potential to document stratification of measured water quality parameters occurring in the North Basin.

Research and environmental monitoring at the Reserve is being conducted to expand our knowledge of the impacts of human activities in coastal areas. In addition to the contribution to the general body of knowledge, this work is intended to provide resource managers with information needed to formulate plans and regulations that will foster enhanced management and utilization of coastal resources. The scope of this research and monitoring includes efforts to understand ecosystem response to stresses, either natural or anthropogenic. It also includes the development of techniques to evaluate ecosystem changes, and methods and goals for habitat restoration.

During the last decade, there have been fish kills in the northern basin, as

evidenced by sightings of dead and dying fish and shellfish along the shore.
Preliminary data indicate that very low concentrations of dissolved oxygen occur near dawn (daybreak hypoxia). Low dissolved oxygen levels are a result of respiration by, among other biota, the seaweeds which have become exceedingly abundant throughout the bay.

Because the bay is so shallow, sufficient sunlight for photosynthesis usually reaches the bottom and dissolved oxygen concentrations increase quickly after sunrise. However, daybreak hypoxia is exacerbated during foggy, calm mornings.
If fog sufficiently reduces insolation, oxygen production by photosynthesis may be insufficient to raise dissolved oxygen concentration levels. If such conditions persist, a fish kill is likely to occur. Several species of fish and shellfish have been found to be impacted by fish kills in the bay, including the commercially-important juvenile winter flounder (Pleuronectes americanus), and the hard shell clam, or quahog (Mercenaria mercenaria). Data from the north basin site and the WBNERR meteorological station will document the frequency, and dynamics of these events. Reserve staff will also collect dissolved oxygen concentration profiles with other instruments in order to define the areal extent of the North Basin habitat that experiences unusually low levels of dissolved oxygen.

In Waquoit Bay, the primary producer community has been dominated by macroalgae since the 1970's, unlike other more typical temperate shallow coastal embayments, which are dominated by phytoplankton. Seaweed-dominated systems are thought to rely on the energy subsidy provided by eutrophication. It is thought that the shift in trophic energy flow through this ecosystem (caused by nutrient loading) may have altered the delicate system equilibrium, allowing macroalgae to proliferate.

It is possible that the system may eventually revert to a phytoplankton-dominated system. Increased phytoplankton productivity results in increased turbidity. Consequently, long-term measurements of turbidity will provide baseline measurements of this important parameter that is not only affected by biological phenomena, but also by weather, land use, hydrography, and boating. The addition of the WBNERR meteorological station (anticipated in Spring 1998), and ongoing studies concerning sediment resuspension due to boating, will aid in the analysis. This information will facilitate evaluation of changes as they occur. In the future, these records may be useful for evaluating the efficacy of remediation efforts intended to reduce nitrogen loading to the bay.

4. Research Methods

The 1996 monitoring season began on May 5, 1996, with the deployment of two sondes. One was deployed at the control site (CB) and the other was placed at the northern end of the bay (NB). During the month of June, the NB data logger generated some large swings in dissolved oxygen concentration values. Because of a lack of experience with using the instruments and interpreting the data (knowing what was reasonable and what was not), a third logger (NS) was placed next to the NB logger on July 10, 1996 so their outputs could be compared. The comparison of two logger was equivocal so monitoring was suspended in August for testing whereby all three loggers were deployed from a moored platform and the similarities or differences in their outputs could be judged. These data were not collected according to the NERRS monitoring protocol so they are not reported here.

Each datalogger records measurements of temperature, specific conductivity, dissolved oxygen, depth, pH, and turbidity at fifteen minute intervals during deployment periods of approximately two weeks. During the winter months, the deployment period is limited to two weeks by battery life; during summer months the period is limited by biofouling. The sampling period is therefore held constant for the entire sampling season. The sampling season generally runs from March to December. It is, however, dependent on weather, the amount of ice on the bay, and the operational availability of the boat that serves as tender for the loggers. Unfortunately, because the data logger tender is small, the specifications of this system can exceed the limits of safety for data logger deployment/retrieval operations on windy days. As such, data logger deployment and retrieval are limited to fair weather. This contingency may result in interruptions in data collection that exceed those required for routine maintenance and calibration. Every effort is made to keep down time to a minimum. Routine maintenance usually results in a twenty-four to forty-eight hour lapse in data.

Each data logger is anchored with a 75 pound mooring to which two lines are attached. One line is attached to a surface float that marks the location. The other line is also attached to a float but the line is shorter so that the float remains submerged throughout tidal changes. The data logger is attached to the shorter line in a vertical manner so that the sensors (pointing downward) are suspended 0.75 m from the bottom. This system was chosen to minimize opportunities for vandalism, which has been a problem in the past.

After each deployment, dataloggers are brought back to the laboratory for downloading, instrument and sensor cleaning, calibration and testing. These procedures are carried out according to the methods described in the following excerpt from the WBNERR standard operating procedures.

5. Site location and character

The Waquoit Bay National Estuarine Research Reserve (WBNERR) is located in the northeastern United States on the southern shore of Cape Cod, Massachusetts. About 8,000 people maintain permanent residency in Waquoit Bay's drainage area, which covers parts of the towns of Falmouth, Mashpee, and Sandwich. During summer months, the population swells 2-3 fold. Like many embayments located on glacial outwash plains, Waquoit Bay is shallow, fronted by prominent barrier beaches of South Cape (State Park) Beach and Washburn Island beach, and backed by salt marshes and upland forests. Two narrow, navigable inlets, reinforced with granite jetties, have been constructed through the two barrier beaches to connect Waquoit Bay with Nantucket Sound to the south. A third shallow and generally unnavigable inlet opened through the Washburn Island barrier beach during Hurricane Bob in August 1991. It has not been reinforced and its fate remains uncertain.

The western shore of uninhabited Washburn Island, with its low, steep bluffs and forested uplands, forms the western boundary of the reserve. However, tidal waters enter and leave the bay proper (and the Reserve) via the so-called Seapit and Eel rivers, which funnel tidal flows along the western shore of Washburn Island, through Eel Pond and ultimately to Nantucket Sound.

At the northern end of the Bay, an area comprising a separate subwatershed, coastal bluffs of glacial till rise 30 feet above sea level, the highest land within the Reserve. Adjacent to the bluffs, the northern basin of the bay is its deepest area (2 m). Much of the remainder of the bay is only slightly shallower (e.g., 1.6 m). Bourne, Bog, and Caleb ponds are freshwater kettle hole ponds on the northern-most shore of the bay. As components of the same sub-watershed, they have a common albeit minor freshwater outflow into the bay's northern basin via a narrow channel through a brackish marsh. Although small, centuries of this flow has created a significant delta of sand that overlies much finer sediments found at comparable distances offshore. The source of this sand is the sandy beach over which this fresh water discharge must travel.

To the east and south, land in other subwatersheds surrounds several salt and freshwater ponds, including Hamblin and Jehu Ponds, brackish ponds that are connected to the Bay by the tidal waters of Little and Great rivers, respectively. The shorelines of these ponds are developed with residences which are occupied by both permanent and seasonal residents. Hamblin Pond and Little River are components of one subwatershed, and Jehu Pond and Great River are elements of a separate subwatershed. Further south lies Sage Lot Pond. It is in the least developed subwatershed which also contains the barrier beach and salt marsh system of South Cape Beach State Park (also a component of the Reserve). To the east, in the same subwatershed, lies the highly brackish Flat Pond. It receives minimal tidal flows of salt water from Sage Lot Pond through a narrow, excavated channel. The remainder of the input to Flat Pond is largely groundwater, and run off, both of which are likely affected by an adjacent golf course and an up-scale residential development.

The tidal range of Waquoit Bay is approximately 0.5 m. The salinity in most of the by ranges from 26 to 31 psu. The largest source of freshwater to Waquoit Bay is the Quashnet/Moonakis River. Quashnet applies to that portion of the river within the town of Mashpee, and "Moonakis" refers to the brackish estuary at the river's mouth, lying in the town of Falmouth. Quashnet will be used hereafter to refer to the entire river. A component of an additional subwatershed, it originates in Johns Pond situated north of the bay and traverses Reserve lands, forests, cranberry bogs, residential areas, and the Quashnet Valley Golf Course before joining the Bay, south of the southern boundary of the bay's northern basin. Although it is the largest source of fresh water, the Quashnet River delivers significantly less nitrogen to Waquoit Bay than does the Childs River, which also originates in Johns Pond.

The Childs River is the second largest input of freshwater to the Bay. A component of an additional subwatershed, it runs through densely developed residential areas. The Childs River subwatershed receives the highest nitrogen loading (and is the largest nitrogen contributor to the Waquoit Bay system) of all the subwatersheds.. Another source of freshwater is the discharge of Red Brook through brackish marshlands into Hamblin Pond. Additional freshwater enters the bay elsewhere through groundwater seepage, precipitation and smaller stream flows. There is little surface water runoff entering directly into the bay due to the high percolation rates of Cape Cod's coarse, sandy soils.

The "control site", considered the baseline unit, is located in the central bay (CB) at latitude 41deg. 34' 00" N, longitude 70 deg. 31' 47" W. The water depth at this site ranges between 1.2 m to 1.7 m. The benthic habitat is primarily characterized by a muck and organic ooze substrate, with prolific benthic macroalgae.

The Massachusetts Military Reservation (MMR) has been designated a Superfund Site with at least one or two toxic plumes traveling in the ground water, having direct impact on Johns and Ashumet Ponds in the upper part of the watershed. Crops of cranberries from commercial bogs located on the Quashnet River have been deemed unfit for consumption due to contamination from ethylene dibromide (EDB) a jet fuel additive. The Quashnet River and the upper Childs River (north of Route 28) components of the Reserve complex have both been found to have sufficient numbers of coliform bacteria to close them to shellfishing. Two probable source of this contamination are failing septic systems, and storm water runoff. Pesticide and herbicide applications on cranberry bogs, golf courses and lawns also impact this ecosystem.

The CB site is southwest of the mouth of the Quashnet River, a small stream fed primarily by groundwater. The stream's freshwater discharge into Waquoit Bay is typically 5-10 cubic feet per second. The resultant discharge plume at these levels has an undetectable influence on salinity at the CB site. However, occasional releases of impounded water at an upstream cranberry bog significantly increases discharges to upwards of 30 cubic feet per second. The stream's discharge plume from these events results in slight reductions in salinity at the CB site. These discharges occur in the fall (harvest time) and in the coldest periods of winter. They should be of minimal and traceable influence on the data set obtained by the CB data logger.

The north basin (NB and NS) at latitude 41deg. 34' 44" N, longitude 70 deg. 31' 58" W is characterized by water depths of 1.6 - 2.4 m. The benthic habitat is similar to the CB site, characterized by muck or organic ooze substrate and benthic macroalgae. This site is subject to the portion of contaminant loading noted above that is mixed and cycled in to this basin. This site is sampled at two depths to document the stratification of dissolved oxygen content especially in respect to daybreak hypoxia.

6. Data collection period

Data collection at CB and NB began on May 2, 1996. The NS data collection commenced on July 7, 1996. Monitoring was suspended on July 25, 1996. Testing of the three loggers at the same location began soon afterward but those data were not collected according to NERRS protocol so they are not reported.

(It is now apparent that the NS logger worked fine while NB had problems in June and July. (Whether this was due to instrument malfunction or operator error is not clear.) At the time, however, it was decided to deploy all three in a series of tests to ascertain how the instruments were behaving and to learn more about deployment procedures. Shortly after the side-by-side tests began, the test platform dragged its mooring during a violent storm and one of the loggers was severely damaged. Tests with the other two continued and eventually the damaged logger was repaired. However the technician running the tests subsequently resigned and monitoring did not resume until 1997 when a replacement technician was hired.)

7. Associated researchers and projects

None to report.

II. Physical Structure Descriptors

8. Variable sequence, range of measurements, units, resolution, accuracy:

YSI 6000 datalogger

Variable Range of Measurements (units) Resolution Accuracy

Date	1-12,1-31,00-99, (Mo,Day,Yr)	1 month, 1 day, 1 year	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
SpCond	0-100(mS/cm)	0.01mS/cm	+/- 0.5% of reading + 0.001 mS/cm
Salinity	0-70 Parts per thousand (ppt)	0.01 ppt	+/- 1.0% of reading or 0.1 ppt, whichever is greater
DO	0-200 % (air saturation)	0.1% @ air saturation	+/-2% @ air saturation
DO	200-500 (% air saturation)	0.1% @ air saturation	+/-6% @ air saturation
DO	0-20 (mg/l)	0.01 mg/l	+/- 0.2mg/l
DO	20-50 (mg/l)	0.01mg/l	+/- 0.6mg/l
Depth	0-9.1 (m)	0.001m	+/- 0.018m
pH	2-14 units	0.01 units	+/- 0.2 units
Turb	0-1000 NTU	0.1 NTU	+/-5% of reading or 2 NTU, whichever is greater

Data Columns are separated by tabs.

9.Coded variable indicator and variable code definitions

The Waquoit Bay file naming convention is as follows: WQBNERR raw data files are named as follows: The first two characters are for the day of the month, the third, fourth, and fifth are for the first three letters of the month, the sixth is for the last number of the year, and the seventh and eighth are for the site description (central bay (CB), north basin (NB), or north basin surface (NS)). These files are archived as described above.

After the WQBNERR raw data files are merged into monthly blocks they are named according to the CDMO Operations Manual. The first two characters are the site description, the second and third stand for the month, and the fourth and fifth for the year. The raw unedited monthly files are saved in comma delimited format (with the .csv extension), and are to be archived by the CDMO as the WQBNERR raw

data. Outlier files created while running the macros are saved with the same
file name but with the .out extension. Final edited files are saved in Excel
workbook format (with the .xls extension) and also in ASCII format (with the
.txt extension). The raw unedited monthly files, and the final ASCII formatted
final files are sent by FTP to the CDMO.

10. Data anomalies

May

CB: logger deployed: 05/02/96 17:00 to 05/22/96 11:30
05/24/96 15:30 to 05/31/96 23:30

1. Many negative spikes in the turbidity data. Unknown cause. They have not been deleted.

2. High turbidity spikes (>1000) on 5/13/96 07:30, 05/15/96 03:30

NB: logger deployed: 05/02/96 17:00 to 05/22/96 12:30
05/24/96 16:00 to 05/31/96 23:30

1. During the May 24-31 deployment, Dissolved Oxygen data were bad, possibly due to a bad membrane installation (e.g., wrinkled or bubbles underneath). Data were not removed to enable comparison with pH data which reveal a low DO event.

2. Also during the May 24-31 deployment, the logger was incorrectly set roughly 0.2 m deeper than during the earlier deployment.

June

CB: logger deployed: 06/01/96 00:00 to 06/12/96 10:00
06/13/96 16:00 to 06/30/96 23:30

1. Early on the 28th -- roughly between 03:00 & 05:00 -- the salinity began to steadily decline through the remainder of the deployment. Salinity, Specific conductivity and DO mg/L were deleted from: 06/28/96 13:00 to 06/30/96 23:30. Cause was unknown but may have been due to an organism occupying the salinity sensor chamber.

2. There was a large negative spike in turbidity data (-922 NTU) 06/29 @ 02:00. It has not been deleted.

NB: logger deployed: 06/01/96 00:00 to 06/12/96 09:30
06/13/96 16:00 to 06/30/96 23:30

1. Dissolved Oxygen data were very strange (large swings to very high values) but since they were consistent with the following deployment in July the

data were not removed. (Given the fact that this consistency did not appear in
the output of a second logger used at NB in July--see NS file for July--these
data swings are probably spurious.)

2. The Dissolved Oxygen Saturation data at the following records were
deleted by the old CDMO macro that deleted values greater than 200 percent (raw
data files are missing):

06/30/96 10:30
13:00
14:00
15:00 - 16:00
17:00 - 20:30
22:00 - 23:00

3. Salinity and specific conductivity data were incorrect during the
June 13-30 deployment apparently due to a bad calibration and were removed.

4. There was one negative turbidity datum, -450 NTU 06/22/96 at
06:00.

July

CB: logger deployed: 07/10/96 15:30 to 07/25/96 13:30

1. Data were collected during 07/01 - 07/08 (note that the logger was
operating at the end of June). These data are missing.

2. Dissolved oxygen data are suspect and were deleted from :
07/10/96 14:00 to 07/25/96 13:30

3. At 07/10/96 15:00 the logger was apparently lifted from the water
(depth = 0 m). The data for this time period was deleted.

4. The first sample (07/10/96 14:00) was the highest turbidity
recorded. It is probably due to the sediment cloud raised by disturbing the
mooring during deployment. 07/11/96 through 7/25/96 there were small negative
turbidity values perhaps due to a calibration error.

NB: logger deployed: 07/10/96 15:00 to 07/25/96 13:30.

1. Dissolved Oxygen data started at very high values and slowly
declined to normal ranges. Since this pattern was consistent with the previous
deployment in June, the data were not removed. (Given the fact that this
consistency did not appear in the output of a second logger used at NB in July--
see NS file for July--the high data values are probably spurious.)

2. The pH probe apparently began to fail on about 07/20/96. Data from
that day onward are considered erroneous.

NS: logger deployed: 07/10/96 13:30 to 07/25/96 12:30.

1. There are no data anomalies to report for this deployment.

11. Missing Data

May

CB: 1. 05/01/96 00:00 to 05/02/96 16:30 sonde not deployed

2. 05/22/96 12:00 to 05/24/96 15:00 Interruption in data collection due to cleaning & recalibration

NB: 1. 05/01/96 00:00 to 05/02/96 16:30 sonde not deployed

2. 05/22/96 13:00 to 05/24/96 15:30 Interruption in data collection due to cleaning and recalibration.

June

CB: 1. 06/12/96 10:30 to 06/13/96 15:30 Interruption in data collection due to cleaning & recalibration

2. Salinity, Specific conductivity and DO mg/L were deleted from: 06/28/96 13:00 to 06/30/96 23:30.

NB: 1. 06/12/96 10:00 to 06/13/96 15:30 Interruption in data collection due to cleaning & recalibration

2. The Dissolved Oxygen Saturation data at the following records were deleted by the old CDMO macro that deleted values greater than 200 percent (raw data files are missing):

06/30/96 10:30
13:00
14:00
15:00 - 16:00
17:00 - 20:30
22:00 - 23:00

3. Salinity and specific conductivity data were incorrect during the June 13-30 deployment apparently due to a bad calibration and were removed.

July

CB: 1. 07/25/96 14:00 to 07/31/96 end of monitoring for remainder of year

2. Data were collected during 07/01 - 07/08 (note that the logger was operating at the end of June). These data are missing.

3. 2. Dissolved oxygen data are suspect and were deleted from : 07/10/96 14:00 to 07/25/96 13:30

4. At 07/10/96 15:00 the logger was apparently lifted from the water (depth = 0 m). The data for this time period was deleted.

NB: 1. 07/01/96 00:00 to 07/13/96 14:30 Interruption in data collection
due to cleaning & recalibration
2. 07/25/96 14:00 through 07/31/96 23:30 end of monitoring for remainder of year

NS: 1. 07/01/96 00:00 to 07/10/96 13:00 sonde not deployed
2. 07/25/96 13:00 through 07/31/96 23:30 end of monitoring for remainder of year