# USER'S GUIDE FOR
# 8200 ACOUSTIC GAUGE
## (Installation and Operation)

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## BACKGROUND INFORMATION

The Sutron 8200 digital acoustic water level gauge has been developed to replace the traditional float/stilling well ADR gauges which were used to support the water level data collection efforts for hydro operations. Figure 1 describes the main components of the new gauge. The following lists the significant attributes of the gauge:

! Water level measurements are determined by an air-acoustic water level sensor, Aquatrak®. This sensor provides digitally averaged water level measurements which provide improved accuracy over the float gauge. Each six minute measurement represents a three minute average of water level samples and includes data quality information such as standard deviation along with the average water level. The acoustic sensor incorporates a self-calibrating measurement technique which provides excellent long term stability which eliminates the need for gauge staff comparisons. In addition, the sensor can be leveled to local benchmarks which allows the water level measurements to be corrected to the local tidal datum.

! The data collection platform (DCP) is a Sutron 8200 digital data logger which controls the water level sensor and stores over 60 days of data. The 8200 can be setup either with the front panel controls and display, or a laptop computer. Data can be retrieved from the 8200 by a variety of methods including a laptop computer, small RAM pack modules, or via line-of-sight radio.

! Most of these 8200 DCPs have been equipped with a Geostationary Operational Environmental Satellite (GOES) telemetry module which transmits the collected water level data every three hours over the GOES satellite to a ground station at Wallops, VA. Satellite telemetry provides near real-time gauge status and water level data which is readily available to the hydrographic survey ship(s) and the National Ocean Service (NOS) headquarters. Data can be retrieved from Wallops via telephone with laptop computer or contacting Oceanographic Products and Services Division (OPSD) via Internet at http://WWW.OPSD.NOS.GOV

! Since the data is available over GOES, the information is automatically collected and processed by the computers of the Oceanographic Products and Services Division OPSD in Silver Spring, MD, which substantially reduces the time required to provide the processed water level information required for hydrographic survey operations.

! The system is designed to operate in remote locations and is powered by an internal 40 AHr battery which is recharged by a solar panel. Under most conditions, the gauge should operate unattended up to a year.

The development of the portable digital acoustic water level gauge is a cooperative program between OPSD and Coast Survey (CS) with the equipment costs provided by CS. This manual provides the basic  information needed to install and operate the gauge.  As the system design evolves, the manual will be revised and enhanced.

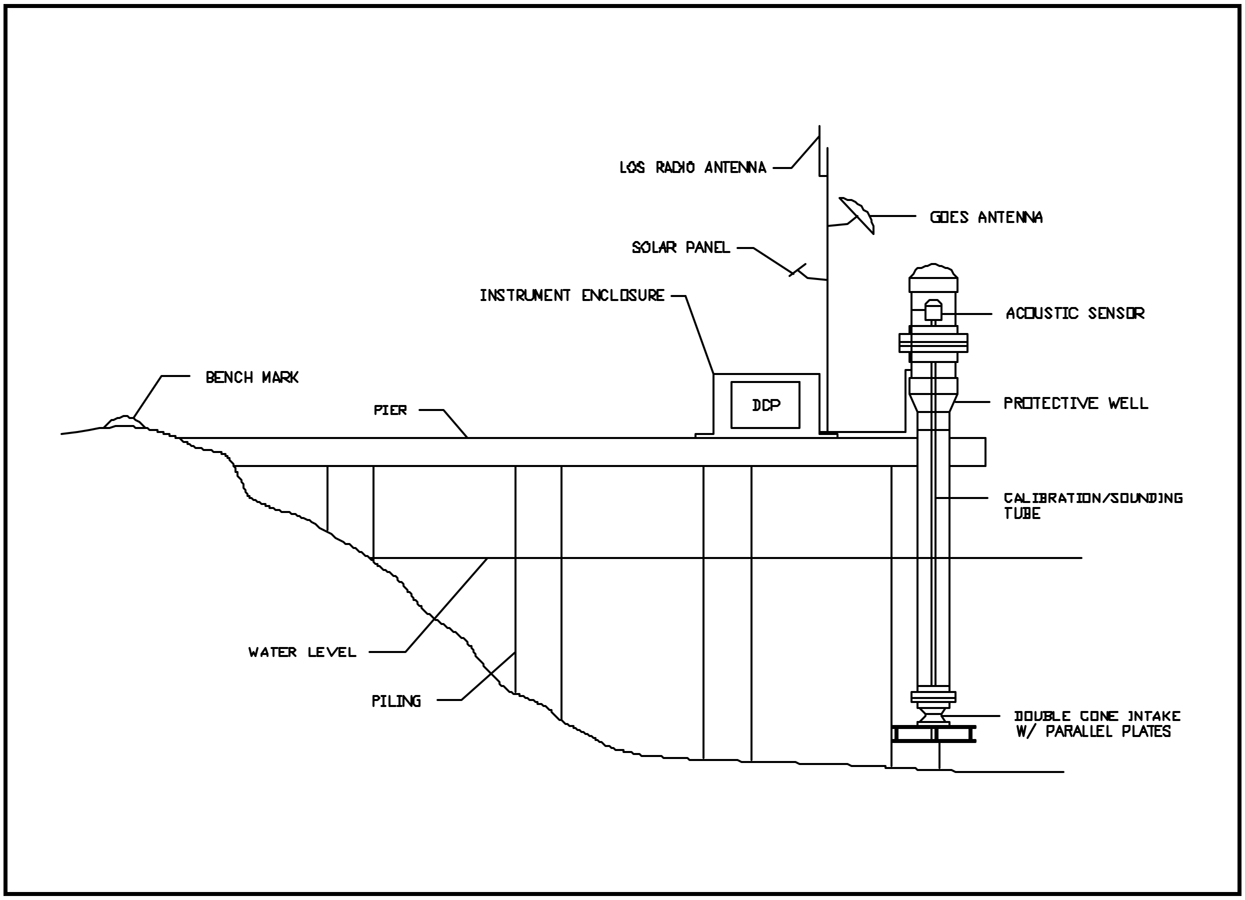



Figure 1. 8200 DCP with Acoustic Sensor

## SYSTEM TRANSPORTATION

! The battery is heavy and **<u>must</u>** be removed and packaged in a separate box prior to transporting the gauge.

! Secure loose components within the enclosure, tools, mounting brackets, desiccant bags, etc.

! Insert foam padding or bubble pack material if necessary to avoid damage during shipment.

! Use shipping containers (cardboard boxes) and packing material to protect the enclosure and other system components from shipping damage.

# SYSTEM INSTALLATION

General

The portable digital water level gauge is self-contained within a weatherproof aluminum enclosure. The electronics enclosure contains a Sutron 8200 DCP with GOES radio, a Bartex Model 4100 Aquatrak® acoustic water level sensor control unit, a 40 AHr rechargeable battery and, if equipped, a line-of-sight (LOS) radio with PacComm packet controller. The water level sensor consists of an Aquatrak® sensor with cable and installation kit and two temperature sensors with cable. In addition, each gauge has a GOES antenna with cable, an 18 watt solar panel with cable and, if equipped, a LOS antenna with cable.

System Installation

The installation involves three main system components: the water level sensor (Protective well and Aquatrak sensor), the electronics enclosure, and a mast which has a solar panel and GOES antenna. It is recommended that the electronics enclosure and the mast be installed first to allow the electronics to be powered up as soon as possible so the system might make at least one GOES transmission prior to completing the installation. Since the first time transmitted leveling and sensor coefficients are stored in the OPSD's Data Processing and Analysis Subsystem (DPAS), refer to section on Transmission of leveling coefficients later under Leveling to the Aquatrak Acoustic Sensor under Appendix B.

Mounting Electronics Enclosure - The electronics enclosure has mounting tabs which allow the enclosure to be mounted on a wall, FOB fabricated aluminum stand, or other suitable structure. The cables from the sensors and mast enter the enclosure through the two holes provided in the bottom right of the enclosure. For most installations the cables should run from the protective well and mast in 1 ½" conduit with the Aquatrak and its temperature sensor cables in one and the solar panel, GOES antenna, and LOS radio, if applicable, in the second.

Antenna/Solar Panel Mast - The third element of the installation is a mast for mounting the solar panel, GOES antenna, and a LOS antenna. This mast can be simply a 1 ½" galvanized pipe which is tall enough such that both the solar panel and the GOES antenna are not obstructed when pointed in the general direction of south. The exact pointing angles for the GOES and solar panel will be provided for each installation.

Water Level Sensor - The water level sensor is an air acoustic sensor which is installed in a 4" diameter protective well. This sensor is similar to that used with the NOS Next Generation Water Level Measurement System (NGWLMS).

Appendix B contains the information for the installation of the support components which involve the protective well assembly, the sounding tube assembly, Aquatrak sensor and its temperature sensors, GOES satellite telemetry system, and solar panel.

Cable Connections

The system has been designed such that each cable has a connector which, with the exception of the GOES and LOS radio, will mate only to the appropriate panel connector in the electronics enclosure. The location of the various connectors in the enclosure are shown in figure 2.

Start-Up

Once the electronics and the mast have been installed and the sensor, solar panel and antenna connections completed, the system can be started. Virtually all of the 8200 DCP operating parameters such as sensor setups and measurement schedule should be stored in 8200's non-volatile memory before shipment to the deployment site. The steps required to start the 8200 are to install and connect the battery, power up the system, set the system date and time, and enable data recording and GOES transmissions. The following describes each of the steps necessary to start and verify the proper operation of the 8200. A detailed description of the 8200 and its operation is contained in the SUTRON 8200 Data Recorder Operations Manual. Appendix A contains an excerpt from the 8200 manual diagram which describes the 8200 menu tree that is accessed by using the front panel buttons.

The 8200 front panel menus have been set up such that if the display is in capital letters, then there is an additional menu selection available by pressing the right arrow.

1. Check the system power switch to assure that it is in the **OFF** (down) position. Connect the red wire to the positive (+) terminal of the battery then connect the black wire to the negative (-) battery terminal. **The enclosure is electrically connected to the negative battery lead, therefore, the positive battery connection should be connected first to avoid the possibility of shorting the battery during installation.** After both battery leads are connected, turn on the system by moving the power switch located on the right side of the enclosure to the up position. The 8200 display will be activated and the unit will perform a self-test then the display will turn off.

2. The date and time of the 8200 must be checked and reset if necessary. Press "ON/OFF" button to activate the display. Press the "DOWN" arrow twice to display the date. If the date needs to be changed, press the "SET" button then use the "UP", "DOWN", "LEFT", "RIGHT" arrows and the "SET" button to adjust the date. Once the date has been set, press the "DOWN" to display the time and adjust if needed using the same technique as for the date. The time **must be referenced to UTC (Universal Coordinated Time or Greenwich Mean**

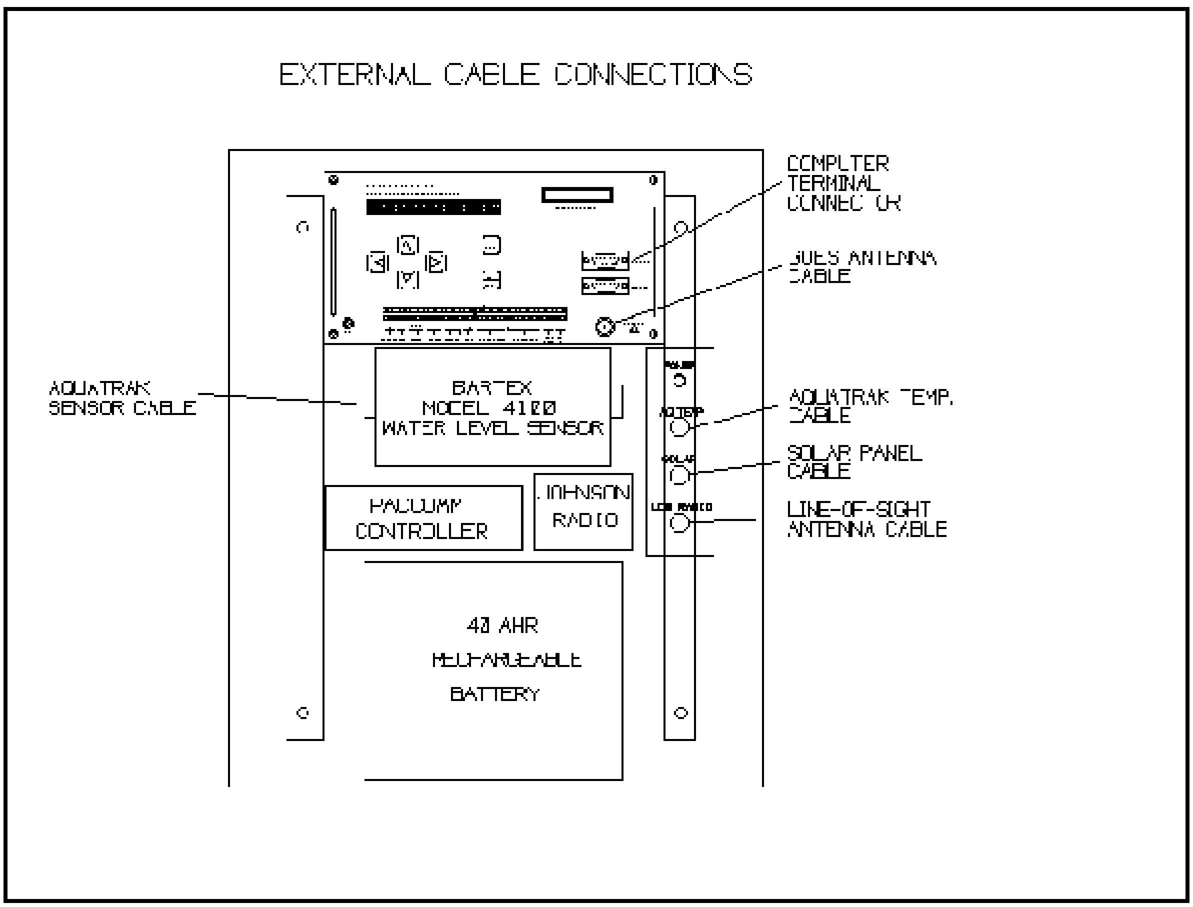



Figure 2. External Cable Connections

**Time**). UTC time is 5 hours ahead of Eastern Standard Time (4 hours ahead while in daylight savings time) and 8 hours ahead of Pacific Standard Time (7 hours ahead while in daylight savings time). **The GOES transmissions are scheduled for a one minute time slot every three hours, therefore, the system clock must be set accurately, i.e. within a couple seconds of the exact time.**

3. When the system is initially powered up, it is necessary to reset the GOES transmitter hardware failsafe. The bottom of the 8200 enclosure has a rubber grommet which must be removed and using a small plastic probe similar to a pencil, reach in through the hole and press the failsafe reset button. This will take a little practice as the push button switch is located on a circuit board which is about 2" from the bottom of the enclosure.

4. Verify the 8200 has recording enabled by pressing the "DOWN" arrow once after setting the time. The display should indicate "Recording ON&TX". If recording is off, press "SET" to enable recording.

5. With the recording on, the system status can be verified by pressing the "DOWN" arrow to the last menu option "INSPECT SYSTEM". Next press the "RIGHT" arrow and the "DOWN" arrow twice to the "Display Status". Now press "SET" and the system status will scroll across the 8200 display. Verify that there are no system errors and that the GOES transmitter has been enabled. In addition to the status to the GOES, the display will indicate the times of the last and next GOES transmission. The status display can be activated again if you are not able to read all the information as it scrolled across the screen.

The 8200 can also be initialized by using a laptop computer rather than the front panel.  The computer will provide full page menus which will make it easier and quicker than using the single line 8200 display.  To use the laptop, connect the it as specified in the following section and use the menus to perform the setups as specified in steps 1-4 above.

## DATA RETRIEVAL

The 8200 offers a variety of methods for retrieving data from the system.  While at the gauge site the system data can be collected by connecting a laptop computer to the RS-232 front panel connector and downloading the data to the computer or by dumping the data to a RAM pack cartridge which can later be read with a RAM pack reader and IBM compatible computer.  These units are equipped with GOES satellite transmitters which send the system data over the satellite to a ground station located at Wallops Island, VA, where it can be retrieved by a computer with a modem using dial-up telephone lines.  The following describes each method of data collection.

<u>On-Site Download and System Setup with a Laptop Computer</u>

To retrieve data from the 8200 with a laptop, connect the RS-232 serial port of the laptop to the RS-232 port on the 8200 front panel.  The laptop must have a communication software program such as PROCOMM.  This procedures describe data collection using PROCOMM.

Once the computer is connected to the 8200, start the program PROCOMM and check the PROCOMM setups to verify that the communications setups are correct.  Press an "Alt P" to display the communication parameter settings.  The settings should be as shown below:

| | |
|---|---|
| Baud Rate | Set to 9600, unless the system has a LOS radio in which case the baud rate should be set to 1200. |
| Parity | None |
| Bits | 8 |
| Stop Bits | 1 |
| Com Port | Computer dependent |

After the proper settings have been selected, it is suggested they be saved by entering "24" from this menu.  PROCOMM should also be set up to emulate a VT-100 terminal.  Press an "Alt S" and select the "Terminal" settings to verify/set the emulation.  Item "1" from this menu allows the selection of emulation mode.  Again it is recommended that this setup is saved as the default by selection to menu option to simplify future data collection.

Now that the software is setup correctly, the 8200 should output its main menu which is shown below. If the menu is not displayed, press "Enter" and if this does not display the main menu disconnect the cable from the RS-232 port on the 8200 and then reconnect it.

**8200 DATA RECORDER SETUP**
G3.8 Data Recorder Software

| MAIN MENU | |
|---|---|
| N - Unit Name | Station & DCP# |
| D - Set Date | 02/18/1998 |
| T - Set Time | 16:46:24 |
| R - Recording Status | ON/TX |
| C - Clear Alarm | NORMAL |
| V - View Sensor Data | |
| S - System Setup Options | |
| U - Upload/Download Data | |
| E - EEROM Setup Options | |
| P - Protocol Setup Options | |
| G - GOES Radio Setup | |
| I - Inspect System | |
| A - Application Menu | |
| X - Exit | |
| Choose: | |

Once communications is established with the 8200, select menu item "U" to Upload data. Immediately after entering the selection the "Upload/Download Data Menu" will be displayed.

| Upload/Download Data Menu | |
|---|---|
| D - Start Date | 09/22/1993 |
| C - Send to Ram Cartridge | |
| S - Send to Serial Port or Modem | |
| R - Read Setup from Ram Cartridge | |
| W - Write Setup to Ram Cartridge | |
| T - Transfer Setup | |
| B - Transfer Basic Program | |
| Choose: | |

From this menu, select the date on which the data download should start by selecting the "D" menu option. Each parameter of the date is a separate entry which must be followed by an "Enter". After the date has been selected, press "S" to send the data to the serial port. At this point, PROCOMM must initiate an Xmodem data transfer.  This is accomplished by pressing the "Pg Dn" key, selecting the Xmodem transfer protocol and then entering a file name.

It is suggested that the data be stored on a floppy disk and that the file name be specified by the eight digit station and DCP number and LOG as three digit extension number so that DPAS can accept the data. If more than one log file exists then rename the other data files as with the same eight digit station and DCP number but with different three digit extensions such as lg1, lg2, lg3, etc.

For example: for a station number 9414290 and DCP # 1, the file name should be saved as 94142901.log; or for more than one data files, save them as 94142901.lg1, 94142901.lg2, etc.

The data transfer should start immediately after entering the file name with PROCOMM displaying a transfer status window on the computer screen. The amount of data transferred is approximately 2600 bytes per day. When the transfer is completed, the computer will beep and the screen will return to the Upload/Download Data menu. Press "Esc" which will then return to the main menu.

Before leaving the station the system status and measurements should be checked to assure the system is operating properly. First check the data being stored to verify that the water level sensor and its temperature sensors are operating. Press a "V" to enter the View Sensor Data menu.

```
View Sensor Data Menu
        L - Live Data
        N - Newest Data
        O - Oldest Data
        A - Alarm Status
Choose:
```

From this menu select "N" to display the most recent sensor measurements which were recorded. The 8200 will display the two Aquatrak temperature measurements, AQTEMP1 and AQTEMP2. These measurements are in volts and require an equation to convert to Degrees C, however, they should be in the range of 1 to 3 volts with 2.5 volts equivalent to approximately 25 Degrees C. The water level measurements include the average water level in meters referenced to the station or site datum, the standard deviation from the sensor measurement average, and the number of outliers - bad data points - which were omitted from the water level average.

After the measurements have been verified, press "Esc" twice to return to the main menu then select menu item "I" to view the Inspect System menu.

```
Inspect System and Test
        S - Perform Selftest
        D - Display Status
        C - Clear Status
        E - Enter SDI-12 Commands
        G - GOES Radio Test
        P - Production Test
Choose:
```

From this menu select "D" to display the system status. This will display the various system status parameters as well as the status of the GOES transmitter. After verifying that the system is operating properly, press "Esc" to return to the main menu. Check that the recording status is "ON&TX" which indicates the 8200 is recording data and that the GOES transmitter is enabled. Now exit the menu by pressing "X" and disconnect the cable from the 8200 RS-232 port. If the system has a LOS radio, reconnect the radio cable to the RS-232 port and close the enclosure.

On-Site Download to RAM Pack Cartridge

The data from the 8200 can be quickly retrieved using a RAM pack to temporarily hold the data so that it can be read later with a RAM pack reader connected to a computer. The advantage of this method is that it is fast, easy and does not require additional equipment such as a laptop computer.

To dump to the RAM pack, turn on the 8200 by pressing the "ON/OFF" button on the front panel. Next press the "DOWN" arrow until "DUMP DATA" is displayed. Press the "RIGHT" arrow and the display will now show the start date for the data download. This can be changed by pressing the "SET" button and using the "UP" and "DOWN" arrows to change each parameter of the start date.

Once the start date is correct, press the "DOWN" arrow to display the word "Cartridge". Insert a RAM pack into the slot located on the top right of the 8200 front panel. The cartridge must be inserted, Sutron label up. Press "SET" to start the dump to the data cartridge and when the display returns to "Cartridge" the download is complete. This process takes only a few seconds. Once completed, remove the cartridge and press the "LEFT" arrow to return to the start up display "Sutron 8200 v 3.2". (in this example v 3.2 is the version of the 8200 software.) Press the "DOWN" arrow several times until "VIEW DATA" is displayed. Press the "RIGHT" arrow once then the "DOWN" arrow twice to display "NEWEST DATA". By using a similar procedure, "RIGHT" arrow and "UP" and DOWN" arrows you will be able to view the most recent data which was logged for each sensor.

After verifying that the sensors are operating properly, press the "LEFT" arrow a couple times then "DOWN" to the "INSPECT SYSTEM" menu. Next press the "RIGHT" arrow and the "DOWN" arrow twice to the "Display Status". Now press "SET" and the system status will scroll across the 8200 display. Verify that there are no system errors and that the GOES transmitter has been enabled. In addition to the status of the GOES, the display will indicate the times of the last and next GOES transmission. The status display can be activated again if you were not able to read all the information as it scrolled across the screen. If all looks ok, press the "ON/OFF" to shut off the 8200 display.

Retrieval of GOES Satellite Data

These water level gauges are equipped with GOES satellite transmitters which transmit the water level data over the satellite every 3 hours. This data is received at the NOAA National Environmental Satellite, Data, and Information Service (NESDIS) ground station located at Wallops, VA. NESDIS receives and temporarily stores (3-5 days) all data transmitted over the GOES. This data can be retrieved from the NESDIS computer by telephone modem. A program, HDAPS123, written by Phil Libraro (OPSD/FOB) which runs on an IBM compatible computer equipped with a modem that would phone NESDIS and retrieve data from a specific gauge.

The program, HDAPS123.EXE, also converts the satellite data to a standard ASCII format which is compatible with most spreadsheet programs such as Excel or Lotus 123. The following describes the installation and operation of this program.

The first step is to install the software on the hard disk drive of the computer which would be used for the data retrieval. A separate directory should be created which would store the program and the data files created from the data retrieval. To create a directory type the following command sequence, which are shown in **BOLD** print, from the DOS "C:" prompt:

| | |
|---|---|
| **CD** | (switch to the disk root directory) |
| **MD HDAPS123** | (create a directory HDAPS123) |
| **CD HDAPS123** | (switch to the directory HDAPS123) |
| **COPY A:HDAPS*.*** | (copy the program (HDAPS123.EXE) and its two supporting files (HDAPS123.INF & HDAPSSTA.INF) from a floppy disk to the hard drive. Depending on the computer and type of floppy disk, you may load the program from the B drive rather than the A drive.) |

The HDAPS123.INF file contains the configuration for the most recent data retrieval and the file HDAPSSTA.INF is a table of GOES Platform IDS and their corresponding NOS Station Id. The 8200 does not transmit an eight-digit Station and DCP number, therefore, the program requires this file to assign the eight-digit Station and DCP number (e.g. 84482081 as shown in the next exmple). Additional stations can be added by using any "TEXT" editor. Once the files have been successfully copied, the program can be executed by typing the program name, **HDAPS123.EXE**.

Below is the menu which is generated by the program HDAPS123.EXE.

DIAL NESDIS FOR HYDRO 8200 DAT
D. Dial NESDIS
C. Change Configuration
Q. Quit

Enter Selection (DCQ)

| **C O N F I G U R A T I O N** | |
|---|---|
| **Telephone No:** | **7578240105** |
| **User ID:** | **NOSAOG** |
| **Com Port:** | **1** |
| **Platform ID:** | **3342f214** |
| **OutFile (.PRN):** | **84482081** |
| **Baud Rate:** | **9600** |

In the above configuration, platform ID (3342f214) listed corresponds to a particular eight-digit station and DCP number (84482081).

To change the configuration enter **C** followed by the **Enter** (Carriage return). The program menu software requires that you type the entire new entry for a configuration change.

Telephone No: - NESDIS has several telephone lines which can be used to retrieve GOES data. The list of phone numbers below are all 9600 baud modems. The telephone number to be dialed must include any access codes necessary to make a long distance call.

| | | |
|---|---|---|
| Main Rotary | (757)824-0105 (MNP Level #5) | |
| | (757)824-0125 | (757)824-0126 |
| | (757)824-0127 | (757)824-0145 |
| | (757)824-0149 | (757)824-0156 |

User Id - The program has been modified to use the ID of the OPSD/FOB Atlantic Regional Office; this field should not be modified.

Com Port - This is the communications port on the computer which has been assigned to the modem. For HDAPS123 program the Com Port has to be 1 or 2.

Platform ID - The platform ID is the ID assigned by NESDIS to a gauge which will transmits over the GOES satellite.

OutFile - This is the file name which would be assigned to the various data files that are generated by the program. The file name must be eight characters and the file name extension is assigned by the program. It is recommended that the format for the file name should be the eight digit station and DCP number that corresponds to the platform ID. For example, a data file from a station number 8448208 and DCP number 1 would have a file name of "84482081". Blanks are not allowed for the file name.

Baud Rate - The baud rate is determined by the modem of the computer which is running this software. However, if problems are encountered while attempting to retrieve data at the higher baud rates, retry at a lower rate or try a different NESDIS phone line.

After all the necessary configuration changes have been made, type **D** followed by **Enter** to initiate the telephone call. The software would now send the necessary commands to the computer modem to make the call. Once the NESDIS computer answers, the program would log into the system and retrieve all the data available for the particular platform. NESDIS normally stores from 3 to 5 days of data. At the end of the data retrieval, the program would then automatically decode the GOES data messages and return to the menu. At this point another platform ID can be selected and retrieved or type **Q** to exit the program. For each data retrieval from NESDIS, for each platform ID provided, the following three files are created, FILENAME.MES, FILENAME.STS and FILENAME.PRN.

The file with the ".MES" extension contains the raw GOES messages which were sent over the satellite and the file is in a binary format. An example is shown below.


```
3352A5F698091153309G44-1NN071EFF00520M86645451AM|@@@@C]^0KgN1MGb@E@
CUCUGA@E@CVCUF_@E@CWCVE|@E@CXCWE\@D@CYCXD~@E@C\C[Db@D@C^
C^DH@D@C_C^Ck@D@C`C_CQ@D@CbCa0KgM1OFr@D@CMCNF[@C@CMCNEG@
J@CNCODW@F@COCPCo@F@CPCPCF@G@CRCRBU@F@CSCSAi@G@CTCT@y@F
@CTCT@Q@E@CUCT0KgL1PLt@B@CKCLLW@D@CKCKIjAn@CJCJGf@F@CICJF|@
G@CHCIFT@F@CHCIEm@D@CICIEC@V@CICJDJ@E@CJCKCX@E@CKCL0KgK>SB
DBBA?A{AxAsAoAhA`AS0KgJ>RCOCyD[DvEHEQEhEpEyE}0KgI>PC_DSEFE{FoGdHYIIIuJ
^0KgH>NB_CWDKE@E|FtGlHjIdJ^0KgG>L@\CXDKDpE[FMGCGxHpId0KgF>JCmCrCuCx
CzD@DSDbDqEN0KgE>JCLCJCLCMCMCMCNCQCbCi0KgD>JDNDCCzCrCkCdC]CWCR
CO
```

A second file which has the ".STS" extension contains a one line status for each gauge transmission. Below is a sample of this file and a description of the various parameters.

```
3352A5F6G09115330986645451  4988   0  0 3 ]^44-1NN071E519
3352A5F6G09112330986645451  4988   0  0 3 ]^46-1NN071E519
```

Where:

| | | |
|---|---|---|
| 3352A5F6 | = | GOES PLATFORM ID |
| G | = | MESSAGE QUALITY |
| 091 | = | JULIAN DAY |
| 15 OR 12 | = | HOUR (GMT) |
| 33 | = | MINUTE |
| 09 | = | SECOND |
| 86645451 | = | NOS STATION ID AND DCP NUMBER |
| 4988 | = | COMBINED SENSOR AND DATUM OFFSET (4.988 METERS) |
| 0 0 | = | SENSOR OFFSET AND STATUS BYTE (UNUSED FOR 8200) |
| 3 | = | NUMBER OF RESETS |
| ]^ | = | CHARACTER REPRESENTATION OF SYSTEM CHECKSUM. THIS IS THE SAME FOR ALL 8200'S RUNNING THE SAME REVISION OF CODE. |

The third file which has the ".PRN" extension contains the decoded gauge data. This file is in a delimited ASCII format which can be imported into most data analysis software packages such as Lotus 123. The following is an example of this file structure and a description of the various data values.

```
"84482081","93299"
"JULIAN D","   PWLA","   PSIG","   POUT","   PAT1","   PAT2"
299.4250,   0.616,   0.025,     0,   9.6,   9.7
299.4208,   0.611,   0.029,     0,   9.6,   9.7
```

| | |
|---|---|
| Top Header line | - NOS Station ID and the date of the data call (year and Julian day). |
| Second Header | - Data column labels. |
| Julian D | - Measurement time (Julian Day). |
| PWLA | - Six minute Aquatrak® water level measurement (Meters). |
| PSIG | - Standard Deviation of water level average (Meters). |
| POUT | - Outliers deleted from water level average (Number). |
| PAT1 | - Top Aquatrak® temperature sensor (Deg C). |
| PAT2 | - Bottom Aquatrak® temperature sensor (Deg C). |

NOTE The file contains data as it was received, i.e. the most recent measurements first.

DATA DISPLAY

Data uploaded to a disk file can be displayed in the form of a screen plot with "LOGPLOT.EXE", also written by Sutron. This program reads the compressed binary data file created by the "Xmodem" dumps or the RAM Pack data retrieval, allows selection of parameters to be displayed, and allows selection of scaling on the vertical axis. The following steps demonstrate how to generate the screen plot on the laptop computer.

- Select option "A" from the HYDRO MENU. The program will prompt for the data file to be graphed such as "94142901" <**Enter**>, where "94142901" is the name of the data file to be plotted. It is not necessary to include the file extension (.log). The screen will display the measured parameters available to be plotted:

  ```
  >AQTEMP1
   AQTEMP2
   AQAVG
   AQSTD
   AQOUT
  ```

- Press <**cursor down**> to AQAVG and press <**Enter**>. This selects water level to be plotted.

- Press <**P**> to initiate plotting.

- The program will request a y-axis minimum value. Type **0** <**Enter**>.

- The program will next request a y-axis maximum value. Type **50** <**Enter**>.

- The program will display a graph of the tide in meters, with the horizontal axis being date and time. With this software you can change the time scale which is plotted by typing "1" for one day, "2" for two days, ..., "W" for a week and "M" for a month of data. The tide height scale can be change manually or, if the plot is re-initiated, the software will automatically select a vertical scale based on the data range:

  - Press <**Esc**>. This will bring back the parameter selection screen.

  - Press <**P**>.

  - The program will request a minimum value (it will display the actual minimum found in the data file). Press <**Enter**>.

  - The program will request a maximum value (it will display the actual maximum found in the data file). Press <**Enter**>.

! The program will display a graph with an expanded vertical scale, depending on the actual minimum and maximum values in the data file.

! To exit the "LOGPLOT" program, press <**Esc**>.

The screen plot can be printed on an Epson-compatible printer. To do this, the DOS program "GRAPHICS.COM" must be run <u>before</u> running the "LOGPLOT" software. This program has been included in the laptop startup program (autoexec.bat). While the plot is displayed,

! Press <**print_screen**>. On some computers, you must press both the <**Shift**> and the <**print_screen**> keys simultaneously; on others, pressing <**print_screen**> alone is adequate.

Two other Sutron-authored programs which can be run from the DOS prompt that may by helpful in examining the data are:

<u>LOGPRN.EXE</u> converts the compressed binary ".LOG" data files into ASCII files (".PRN" extension) to allow import into a spreadsheet program. This program has been included in the HYDRO MENU, selection "B". When the program is run, the file name should be followed with " /z/j", example ("94142901 /z/j"). These options will insert zeros for non-recorded data and display the Julian day numbers.

<u>LOGSTAT.EXE</u> reads the compressed binary (".LOG") files and displays daily statistics (maximum, minimum, mean, and number of data points) on the computer screen.

## APPENDIX A

## 8200 DATA RECORDER SETUP

**Main Menu: Sutron 8200 G3.8 Data Recorder Software**

```
MAIN MENU
        N - Unit Name                 Station & DCP#
        D - Set Date                  02/18/1998
        T - Set Time                  16:46:24
        R - Recording Status          ON&TX
        C - Clear Alarm               NORMAL
        V - View Sensor Data
        S - System Setup Options
        U - Upload/Download Data
        E - EEROM Setup Options
        P - Protocol Setup Options
        G - GOES Radio Setup
        I - Inspect System
        A - Application Menu
        X - Exit
Choose:
```

**System Setup:**

```
System Setup Menu
        M - Measurement Schedules
        E - Enable Sensors
        C - Configure Sensors
        A - Alarm Options
        B - Basic Program
        P - Change Password
        S - Save Setup
        R - Restore Setup
        I - Init Setup
        Z - Zero Counters
Choose:
```

**System Setup - Measurement Schedule:**

```
Measurement Schedules
        M - Measurement Interval        00:06:00
        I - Sampling Interval           00:00:01
        T - Measurement Time    00:04:30
        S - Sampling Time               00:07:40
        P - Switched Power Time         00:07:40
        A - Samples to Average          5
        L - Measurements per Log        1
        B - Basic Run Interval  00:06:00
        R - Basic Run Time              00:00:00
        O - Switched Power Options      OFF
Choose:
```

**System Setup - Enable Sensors:**

```
SELECT SENSORS
Choose [U]p [D]own [L]eft [R]ight [ENTER] [N]ame [M]ore:
```

| | | | | |
|---|---|---|---|---|
| *AQTEMP1 | Counter2 | Windspeed2 | *DEVIATION | Datapack |
| *AQTEMP2 | Counter3 | Windspeed3 | Serial | Excitation |
| *ANALOG1 | Counter4 | Windspeed4 | Battery | Ground |
| *AIRTEMP | Frequency | *WINDDIR | Shaft8500 | Reference |
| *BARO | *FREQ1 | Winddir2 | *#BUF | Amplifier |
| Encoder1 | Frequency2 | Winddir3 | Org100 | Optional |
| Encoder2 | Frequency3 | *WATERTEMP | Org700 | Goesclock |
| Counter | Frequency4 | *WATERLEVEL | Timer1 | |
| Counter1 | *WINDSPD | *OUTLIERS | Timer2 | |

**System Setup - Enable Sensors (m - more):**

| SELECT SENSORS<br>Choose [U]p [D]own [L]eft [R]ight [ENTER] [N]ame [M]ore: |
|---|

| | | | | |
|---|---|---|---|---|
| >*AQAVG | SDI2_1 | SDI4_1 | SDI6_1 | SDI8_1 |
| *AQSTD | SDI2_2 | SDI4_2 | SDI6_2 | SDI8_2 |
| *AQOUT | SDI2_3 | SDI4_3 | SDI6_3 | SDI8_3 |
| *AQCAL | SDI2_4 | SDI4_4 | SDI6_4 | SDI8_4 |
| *AQSTAT | SDI2_5 | SDI4_5 | SDI6_5 | SDI8_5 |
| SDI0_6 | SDI2_6 | SDI4_6 | SDI6_6 | SDI8_6 |
| SDI0_7 | SDI2_7 | SDI4_7 | SDI6_7 | SDI8_7 |
| SDI0_8 | SDI2_8 | SDI4_8 | SDI6_8 | SDI8_8 |
| SDI0_9 | SDI2_9 | SDI4_9 | SDI6_9 | SDI8_9 |
| SDI1_1 | SDI3_1 | SDI5_1 | SDI7_1 | SDI9_1 |
| SDI1_2 | SDI3_2 | SDI5_2 | SDI7_2 | SDI9_2 |
| SDI1_3 | SDI3_3 | SDI5_3 | SDI7_3 | SDI9_3 |
| SDI1_4 | SDI3_4 | SDI5_4 | SDI7_4 | SDI9_4 |
| SDI1_5 | SDI3_5 | SDI5_5 | SDI7_5 | SDI9_5 |
| SDI1_6 | SDI3_6 | SDI5_6 | SDI7_6 | SDI9_6 |
| SDI1_7 | SDI3_7 | SDI5_7 | SDI7_7 | SDI9_7 |
| SDI1_8 | SDI3_8 | SDI5_8 | SDI7_8 | SDI9_8 |
| SDI1_9 | SDI3_9 | SDI5_9 | SDI7_9 | SDI9_9 |

**System Setup - Config Sensors:**

```
CONFIG SENSORS
Choose [U]p [D]n [M]es [L]og [A]vg [I]nt [V]al S]lo O]fs [E]lev R]d:
```

*NOTE:* *For each of the sensors marked as “>” below, ensure the appropriate configuration shown by selecting/adding choices as appropriate.*

Active Sensors

- >AQTEMP1
- >AQTEMP2
- ANALOG1
- AIRTEMP
- BARO
- FREQ1
- WINDSPD
- WINDDIR
- WTRTEMP
- WATERLEVEL
- OUTLIERS
- DEVIATION
- #BUF
- AQAVG
- AQSTD
- AQOUT
- AQCAL
- AQSTAT

| | |
|---|---|
| Configuration | |
| M - Measure | OFF |
| L - Log | ON |
| A - Average | ON |
| I - Interval | 00:00:00 |
| Calibration | |
| V - Value | _.____ |
| S - Slope | 1.0000 |
| O - Offset | 0.000 |
| E - Elevation | 0 |
| R - Right Digits | 3 |

**System Setup - Config Sensors: (continued)**

| |
|---|
| CONFIG SENSORS<br>Choose [U]p [D]n [M]es [L]og [A]vg [I]nt [V]al S]lo O]fs [E]lev R]d: |

*NOTE:* *For each of the sensors marked as ">" below, ensure the appropriate configuration shown by selecting/adding choices as appropriate.*

Active Sensors

AQTEMP1
AQTEMP2
ANALOG1
AIRTEMP
BARO
FREQ1
WINDSPD
WINDDIR
WTRTEMP
WATERLEVEL
OUTLIERS
DEVIATION
#BUF
AQAVG
>AQSTD
AQOUT
AQCAL
AQSTAT

| | |
|---|---|
| Configuration | |
| M - Measure | ON |
| L - Log | ON |
| A - Average | OFF |
| I - Interval | 00:00:00 |
| Calibration | |
| V - Value | _.____ |
| S - Slope | 1.0000 |
| O - Offset | 0.000 |
| E - Elevation | 0 |
| R - Right Digits | 3 |

**System Setup - Config Sensors: (continued)**

```
CONFIG SENSORS
Choose [U]p [D]n [M]es [L]og [A]vg [I]nt [V]al S]lo O]fs [E]lev R]d:
```

*NOTE:* *For each of the sensors marked as ">" below, ensure the appropriate configuration shown by selecting/adding choices as appropriate.*

Active Sensors

AQTEMP1
AQTEMP2
>ANALOG1
>AIRTEMP
>BARO
>FREQ1
>WINDSPD
>WINDDIR
>WTRTEMP
>WATERLEVEL
>OUTLIERS
>DEVIATION
>#BUF
AQAVG
AQSTD
AQOUT
>AQCAL
>AQSTAT

| | |
|---|---|
| Configuration | |
| M - Measure | OFF |
| L - Log | OFF |
| A - Average | OFF |
| I - Interval | 00:00:00 |
| Calibration | |
| V - Value | _.____ |
| S - Slope | 1.0000 |
| O - Offset | 0.000 |
| E - Elevation | 0 |
| R - Right Digits | 0 |

**System Setup - Config Sensors: (continued)**

```
CONFIG SENSORS
Choose [U]p [D]n [M]es [L]og [A]vg [I]nt [V]al S]lo O]fs [E]lev R]d:
```

*NOTE:* *For each of the sensors marked as ">" below, ensure the appropriate configuration shown by selecting/adding choices as appropriate.*

Active Sensors

AQTEMP1
AQTEMP2
ANALOG1
AIRTEMP
BARO
FREQ1
WINDSPD
WINDDIR
WTRTEMP
WATERLEVEL
OUTLIERS
DEVIATION
#BUF
>AQAVG
AQSTD
AQOUT
AQCAL
AQSTAT

Note: The AQAVG offset value is determined for each station based on leveling information. (See Appendix B.)

| | |
|---|---|
| Configuration | |
| M - Measure | ON |
| L - Log | ON |
| A - Average | OFF |
| I - Interval | 00:00:00 |
| Calibration | |
| V - Value | _.____ |
| S - Slope | -1.0000 |
| O - Offset | 0.000 |
| E - Elevation | 0 |
| R - Right Digits | 3 |

**System Setup - Config Sensors: (continued)**

```
CONFIG SENSORS
Choose [U]p [D]n [M]es [L]og [A]vg [I]nt [V]al S]lo O]fs [E]lev R]d:
```

<u>*NOTE:*</u> <u>*For each of the sensors marked as ">" below, ensure the appropriate configuration shown by selecting/adding choices as appropriate.*</u>

Active Sensors

AQTEMP1
AQTEMP2
ANALOG1
AIRTEMP
BARO
FREQ1
WINDSPD
WINDDIR
WTRTEMP
WATERLEVEL
OUTLIERS
DEVIATION
#BUF
AQAVG
AQSTD
>AQOUT
AQCAL
AQSTAT

| | |
|---|---|
| Configuration | |
| M - Measure | ON |
| L - Log | ON |
| A - Average | OFF |
| I - Interval | 00:00:00 |
| Calibration | |
| V - Value | _.____ |
| S - Slope | 1.0000 |
| O - Offset | 0.000 |
| E - Elevation | 0 |
| R - Right Digits | 0 |

**Alarm Options:**

| |
|---|
| ALARM SENSOR OPTIONS |
| Choose [U]p [D]own [E][G] [C] [1] [2] [3] [H] [L] [R] [B]: |

*NOTE:* *For each of the sensors marked as ">" below, ensure the appropriate configuration shown by selecting/adding choices as appropriate.*

Active Sensors

>AQTEMP1
>AQTEMP2
ANALOG1
AIRTEMP
BARO
FREQ1
WINDSPD
WINDDIR
WTRTEMP
WATERLEVEL
OUTLIERS
DEVIATION
#BUF
>AQAVG
>AQSTD
>AQOUT

AQCAL
AQSTAT

**Alarm Options: (continued)**

```
Alarm Options
        E - Enable              GOES
        G - Groups              0001
        C - Control             OFF
        1 - High Alarm OFF
        2 - Low Alarm OFF
        3 - ROC Alarm           OFF
Alarm Limits
        H - High Limit  0.000
        L - Low Limit           0.000
        R - ROC Limit   0.000
        B - Deadband            0.000
```

```
ALARM SENSOR OPTIONS
Choose [U]p [D]own [E][G] [C] [1] [2] [3] [H] [L] [R] [B]:
```

*<u>NOTE:</u>* *<u>For each of the sensors marked as ">" below, ensure the appropriate configuration shown by selecting/adding choices as appropriate.</u>*

Active Sensors
AQTEMP1
AQTEMP2
>ANALOG1
>AIRTEMP
>BARO
>FREQ1
>WINDSPD
>WINDDIR
>WTRTEMP
>WATERLEVEL
>OUTLIERS
>DEVIATION

```
>#BUF
AQAVG
AQSTD
AQOUT
>AQCAL
>AQSTAT
```

```
Alarm Options
        E - Enable              OFF
        G - Groups              0001
        C - Control             OFF
        1 - High Alarm OFF
        2 - Low Alarm OFF
        3 - ROC Alarm           OFF
Alarm Limits
        H - High Limit  0.000
        L - Low Limit           0.000
        R - ROC Limit  0.000
        B - Deadband            0.000
```

**GOES Radio Setup:**

```
GOES Setup Menu
        T - Transmit Mode              BASIC
        S - Satellite ID        ________
        I - International              OFF
        F - Format              (ST)   BINARY
        C - Carrier             (ST)   SHORT
        1 - Channel             (ST)   ________
        2 - TX Time             (ST)   ________
        3 - TX Rate             (ST)   03:00:00
        4 - # Data Items/TX     (ST)   31
        5 - Data Time           (ST)   00:00:00
        6 - Data Interval       (ST)   00:06:00
        R - Random Setup Menu
Choose:
```

NOTE:

1. The satellite ID, channel #, and TX (Transmit) time information needs to be updated for each deployment.

**EEROM Setup:**

EEROM Setup Menu

| | |
|---|---|
| M - Serial Port Mode | USER |
| U - User Baud Rate | 9600 |
| T - Transfer Baud Rate | 9600 |
| S - SDI-12 Baud Rate | 1200 |
| E - Entry Key Required | OFF |
| D - Log Dump Mode | ALL-BIN |
| L - User Time Limit (sec) | 300 |
| O - Power on Delay (10*ms) | 1 |
| P - Pressure Delay (10*ms) | 5 |
| A - Analog Delay (10*ms) | 5 |
| K - Auto Startup Keys | |
| 1 - Time Format | 24 HOUR |
| 2 - Date Format | MDY |
| B - Basic Prog Sixe (KB) | 6 |
| G - Amplifier Gain | ______ |

NOTE:

1. The AMP gain info will be different for each unit, see additional slope/offset sheet provided.

**Sutron 8200 v3.5 Data Recorder Software**

For 8200 DCPs without the GOES capability such as version 3.5 and earlier, the configuration should be selected as shown on the next three pages.

```
MAIN MENU
        N - Unit Name                Station & DCP#
        D - Set Date                 02/18/1998
        T - Set Time                 16:46:24
        R - Recording Status         ON
        C - Clear Alarm              NORMAL
        V - View Sensor Data
        S - System Setup Options
        U - Upload/Download Data
        E - EEROM Setup Options
        P - Protocol Setup Options
        I - Inspect System
        A - Application Menu
        X - Exit
Choose:
```

**System Setup:**

```
System Setup Menu
        M - Measurement Schedules
        E - Enable Sensors
        C - Configure Sensors
        A - Alarm Options
        B - Basic Program
        P - Change Password
        S - Save Setup
        R - Restore Setup
        I - Init Setup
        Z - Zero Counters
Choose:
```

**System Setup - Measurement schedule:**

| Measurement Schedules | |
|---|---|
| M - Measurement Interval | 00:06:00 |
| I - Sampling Interval | 00:00:01 |
| T - Measurement Time | 00:04:30 |
| S - Sampling Time | 00:07:40 |
| P - Switched Power Time | 00:07:40 |
| A - Samples to Average | 5 |
| L - Measurements per Log | 1 |
| B - Basic Run Interval | 00:06:00 |
| R - Basic Run Time | 00:00:00 |
| O - Switched Power Options | OFF |
| Choose: | |

**EEROM Setup**:

| EEROM Setup Menu | |
|---|---|
| M - Serial Port Mode | USER |
| U - User Baud Rate | 9600 |
| T - Transfer Baud Rate | 9600 |
| S - SDI-12 Baud Rate | 1200 |
| E - Entry Key Required | OFF |
| D - Log Dump Mode | ALL-BIN |
| L - User Time Limit (sec) | 300 |
| O - Power on Delay (10*ms) | 1 |
| P - Pressure Delay (10*ms) | 5 |
| A - Analog Delay (10*ms) | 5 |
| K - Auto Startup Keys | |
| 1 - Time Format | 24 HOUR |
| 2 - Date Format | MDY |
| B - Basic Prog Sixe (KB) | 6 |
| G - Amplifier Gain | ______ |

NOTE:

1. The AMP gain info will be different for each unit, see additional slope/offset sheet provided.

**Alarm Options:**

```
ALARM SENSOR OPTIONS
Choose [U]p [D]own [E][G] [C] [1] [2] [3] [H] [L] [R] [B]:
```

*NOTE:* *For each of the sensors marked as “>” below, ensure the appropriate configuration shown by selecting/adding choices as appropriate.*

Active Sensors

>AQTEMP1
>AQTEMP2
>ANALOG1
>AIRTEMP
>BARO
>FREQ1
>WINDSPD
>WINDDIR
>WTRTEMP
>WATERLEVEL
>OUTLIERS
>DEVIATION
>#BUF
>AQAVG
>AQSTD
>AQOUT
>AQCAL
>AQSTAT

```
Alarm Options
        E - Enable          OFF
        G - Groups          OFF
        C - Control         OFF
        1 - High Alarm OFF
        2 - Low Alarm OFF
        3 - ROC Alarm       OFF
Alarm Limits
        H - High Limit  0.000
        L - Low Limit       0.000
        R - ROC Limit  0.000
        B - Deadband        0.000
```

## APPENDIX B

## 8200 ACOUSTIC GAUGE
## SUPPORT COMPONENT INSTALLATION

### SITE RECONNAISSANCE

General

The best and most thorough method of assembling all the design information required is a reconnaissance. The primary objective of the reconnaissance is to determine the optimal location and configuration for the 8200 Data Collection Platform (DCP), antenna, sensors, and support components. The reconnaissance consists of personnel visiting the site well enough in advance of the station installation to:

- Locate an acceptable site.
- Obtain measurements and information necessary to design the station.
- Arrange for any permits/license agreements required.
- Prepare costs estimate and work schedule.
- Allow time for procurement and fabrication of support components (if necessary).
- Allow time for GOES Telemetry Platform ID and Transmit Time Allocation (if applicable).

Advanced Preparations

Property owners should be contacted well in advance to obtain oral or written permission to use or modify the site. An advance letter of permission, permit, security clearance, or some other documentation may be required by the owner. A license agreement may have to be executed before any work can be done.

If GOES Satellite Telemetry will be used for data transmissions, a number of additional things need to be considered and advance preparations are required. Specifically, a unique platform ID, channel, and transmit time must be assigned for each station installation where data will be transmitted via GOES. Refer to Appendix E “Guidelines for Operation and Documentation of Hydro Gauges with GOES Capability” for further details.

Accurate measurements and information can best be obtained onsite. The locality should be investigated to determine which particular site will best accommodate all Next Generation Water Level Measurement System (NGWLMS) site requirements.

The following equipment is recommended to effectively conduct an accurate and thorough site reconnaissance.

- Sample License Agreement
- Published Bench Mark Sheet
- NGWLMS Well/Sounding Tube Worksheet
- Chart Section
- Engineering sketch pad
- Predicted tide tables
- Plumb bob
- Steel tape
- Weighted tape
- Compass
- Camera/Videotape Recorder
- Inclinometer

Specific observations and measurements that should be made during a reconnaissance include, but are not limited to, the following:

The Structure

Distinguish if the structure is a pier with pilings, a solid bent or breakwater, or a shoreline bulkhead. Try to ascertain the constructional elements of the site. This would include not only what the structure is made of, but how it is made.

Write a general description of the structure including its size, construction, condition and apparent use, e.g., "The structure is a 1 m x 10 m, wood foot-bridge, used as a fishing pier and appears to be in good condition", or, "it is a new, solid concrete breakwater, 5 m wide, and extending 100 m from the shore".

Assure that the structure will be able to provide the absolute stability necessary for a tide station. Note if additional bracing or support construction will be required.

Consider how the structure is used, and what impact its use may have upon a tide station. For example, if the structure is a pier at a ferry terminal, and vessels frequently use the exposed wooden pilings to tie up along side, it may not be suitable for a tide gage installation.

Examine the face of the structure, especially where you plan to install the NGWLMS Protective Well. The Protective Well should be installed within 15 m (49.2 ft) of the 8200 DCP and be mounted vertically; plumb within 1 cm/m (c inch/ft). Some considerations include: Are there solid pilings available that could be fitted with long arm piling clamps? Are there wooden beams, bracing members, stringers, or a solid concrete face where a face clamp could be attached? Is it a metal sheet-pile bulkhead? Are there obstructions, either on the structure face or on the bottom, which could interfere with the installation or operation of the tide recording station?, etc.

How many clamps will be required? For planning purposes, it is recommended that at least one clamp be installed every 1.2 m (4.0 ft) to 1.8 m (6.0 ft).

The Surroundings

Qualitatively, the site for a tide station must be one that will allow the 8200 DCP to accurately measure, record, and relay the full range of tide including storm surge and wave action which is representative of the general area. Appendix C lists the approximate wave heights for various geographical areas. A safety factor for storm surge is discussed in Well Assembly section of this text.

Assure that the structure will be subjected to the full range of tide, representative of the tidal regime. This includes both extreme high and low waters. Examples of hydrographic conditions which may have an effect on the local tide phenomena include large breakwaters which could obstruct tidal flow, substantial water outflows which could artificially elevate the water level, or strong currents which could cause excessive drawdown in the well. Remember to consider placement of the DCP itself, as it will have to be installed in a protective housing safely above any extreme high water.

Confirm that there are no structures overhead or nearby which will interfere with the operation of a GOES satellite antenna or solar panel.

Consider any temperature gradients which may exist. Since the Acoustic Sensor requires a homogenous temperature throughout the well, structure faces which will normally be only partly shaded, and therefore experience a thermal gradient, should be avoided.

Measurements

When recording dimensions and measurements for the structure, a sketch is often helpful. Specific measurements that should be recorded include the following:

- Structure surface dimensions (width, length, shape, and directional orientation).
- Location and horizontal distance between pilings or between bulkheads.
- Vertical distance between wales or stringers.
- Vertical distance between the structure surface and the water surface.
- Distance between the structure surface and the harbor bottom.

Record the date and time when the water level related measurements are made. Using published tide tables, calculate the height of tide for the time that the measurements are taken. Correlate the height of structural elements to the local datum.

General

The *Protective Well* is the pipe that surrounds the Aquatrak® Acoustic Sensor and *Sounding Tube Assembly*. Use the *NGWLMS Well/Sounding Tube Worksheet* to design and document the well/sounding tube elevations. The NGWLMS Well/Sounding Tube Worksheet was designed for a 15 cm (6 inch) well, some interpretation is required for 10 cm (4 inch) well adaptation.

Qualitatively, the Protective Well and Sounding Tube Assembly must be sufficiently long enough to measure the full range of tide. Complex requirements govern the upper and lower well elevations. The highest/lowest water level elevations, coupled with the wave allowance, are critical determinants. Constraints imposed by the sounding tube must also be considered. Ideal top and bottom elevations are calculated using these determinants, and then modified as necessary by the physical constraints of the site.

Protective Well Assembly Length Requirements

The largest component of the Protective Well is the 10 cm (4 inch) dia., white, SCH 40 PVC pipe. Its total length is determined from onsite reconnaissance measurements and local datums. To compute the required elevation for the top of the well, arithmetically add the Wave Allowance from Appendix D to the Highest Observed Tide (HOT). The top of the well must be at least 1.5 m (5.0 ft) above the HOT plus wave allowance. Similarly, to find the required elevation for the bottom of the well, subtract the wave allowance from the Lowest Observed Tide (LOT).

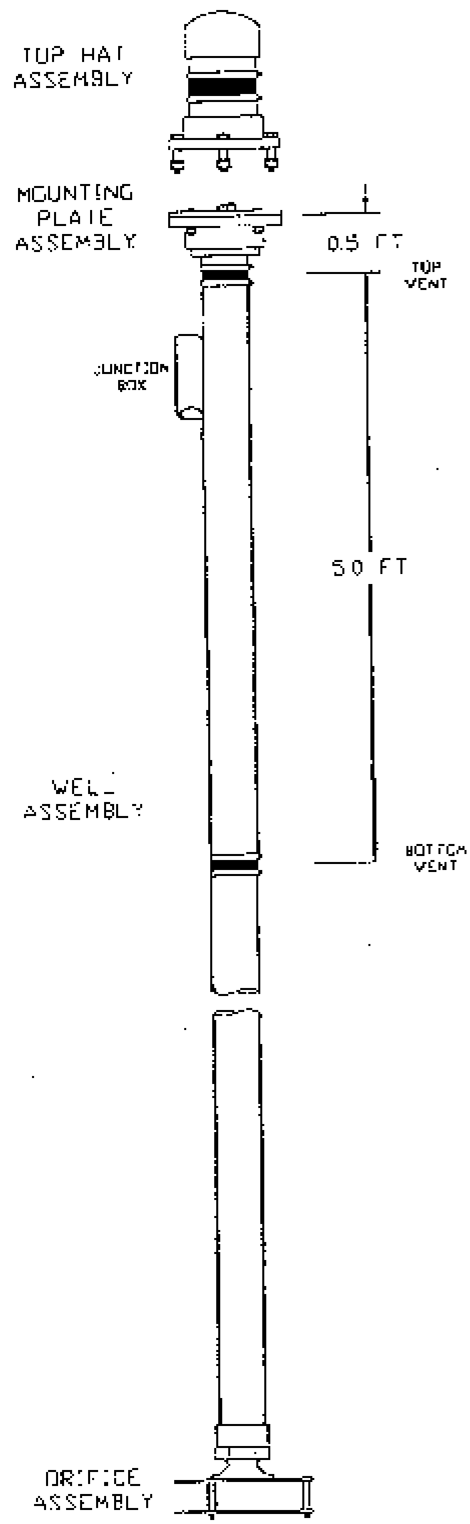



Figure B1. Protective Well Assembly

Generally, the HOT and LOT values are listed on the

Published Bench Mark Sheet. Ideally, the top flange should be 1.0 m (3.3 ft) above the deck level to facilitate leveling and maintenance.

Protective Well Assembly Design

The Protective Well may have some variations in its design, but is made up of four basic components; *Top Hat Assembly, Acoustic Sensor Mounting Plate Assembly, Well Assembly,* and *Orifice Assembly*. (see figure B1).

Top Hat Assembly

The Top Hat is the removable "cover" which permits access inside the Protective Well. The top of the Top Hat is a slip cap fitted to a 0.3 m (1.0 ft) long section of 15 cm (6 inch) dia., white SCH 80 PVC pipe. One set of four 4 cm (1.5 inch) diameter vent holes is drilled 90º apart horizontally, and positioned around the midpoint of the Top Hat pipe. A modified stainless steel mesh, NO HUB "M" vent screen covers the vent holes. The base of the Top Hat is connected to a 15 cm (6 inch) diameter slip flange. The base of the Top Hat Assembly, the Acoustic Sensor Mounting Plate Assembly and the top flange on the Well Assembly are held together with four ¾ inch thru bolts. (See figure B2).

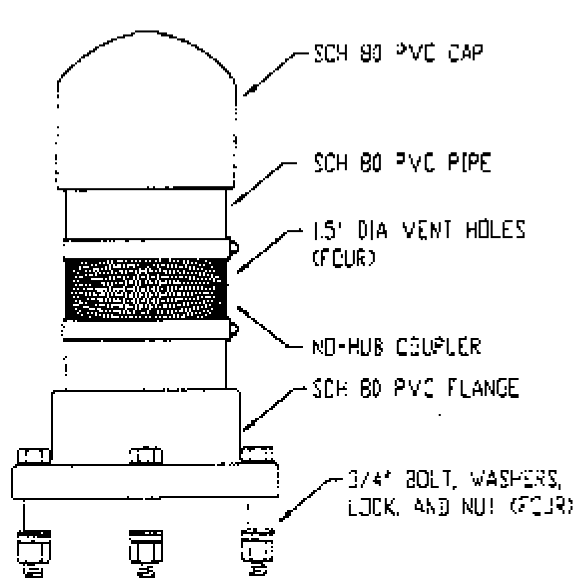



Figure B2. Top Hat Assembly

Acoustic Sensor Mounting Plate Assembly

The Acoustic Sensor Mounting Plate Assembly consists of a flat, split, aluminum plates with bolt and vent holes, an aluminum tube stop clamp, and associated hardware. The larger plate is called the Removable spacer

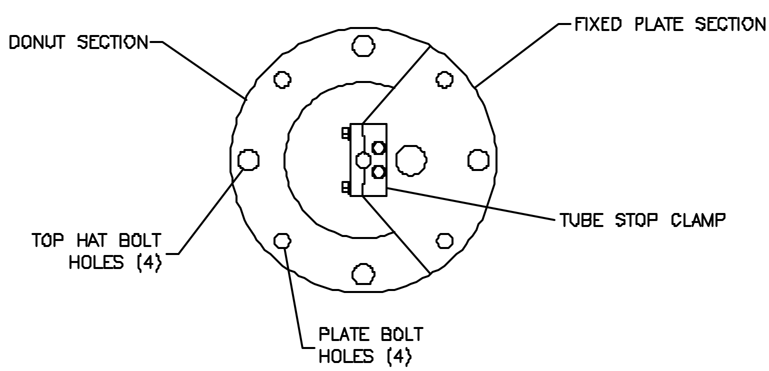



Figure B3. Acoustic Sensor Mounting Plate Assembly

Section and the smaller one is called the Fixed Plate Section.

The Acoustic Sensor Mounting Plate Assembly is designed such that the elevation of the Aquatrak® Leveling Point will be preserved, even if the Sounding Tube is removed, as long as the Fixed Plate Section and Tube Stop are not moved. (see figure B3).

The aluminum has an anodized protective coating. Four ½ inch bolts secure the Acoustic Sensor Mounting Plate Assembly to the top of the Well Assembly.

<u>Well Assembly</u>

Near the top of the Well Assembly, the 10 cm (4 inch) dia. pipe is connected to a 15 cm (6 inch) dia. flange with 6 x 4 inch S.S. Reducer Bushing. The flange will also require the following modifications:

! It should be shaved or filed to a flat surface to allow for proper alignment of the Acoustic Sensor Mounting Plate Assembly.

! A ¾ inch to ½ inch reducer bushing insert should be installed into every other bolt hole to accommodate the ½ inch Acoustic Sensor Mounting Plate Assembly bolts.

Two sets of four, 2.5 cm (1 inch) diameter vent holes, drilled 90º apart horizontally, are positioned in the 10 cm (4 inch) diameter pipe. The first set shall be 0.2 m (0.5 ft) below the top flange. The second set is generally positioned 1.5 m (5.0 ft) below the upper vent holes, but may be positioned at a greater separation if an exceptionally long well is used. Both sets of vent holes are covered with the same modified stainless steel mesh screen as the Top Hat to prevent foreign materials from entering the well.

At the bottom of the well a 10 cm (4 inch) diameter, 0.6 m (2 ft) long, copper sleeve is inserted inside and is flush with the end of the 10 cm (4 inch) diameter pipe. Also at the bottom end, the pipe is connected to a 10 cm (4 inch) female adapter which will mate to the Orifice Assembly.

<u>Orifice Assembly</u>

The Orifice Assembly is the bottom portion of the Protective Well designed to dampen wave action and minimize current drawdown. It has a 10 cm (4 inch) female adapter connected to a double cone intake which is connected to a pair of 12" parallel plates. (See figure B4).

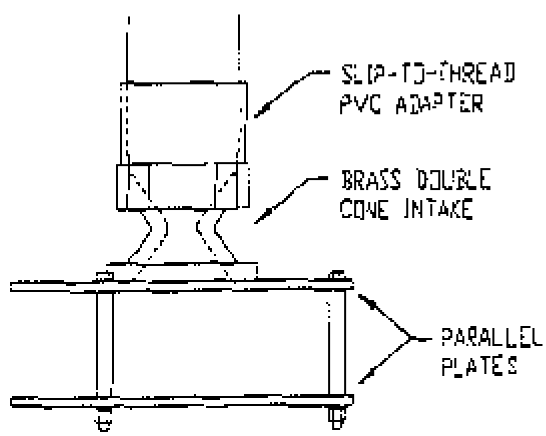



Figure B4. Orifice Assembly

Installation Recommendations

Once the overall length for the Protective Well is determined, the well can be assembled. When fabricating the Protective Well use PVC primer and cement to join the well pipe, slip cap, flange, bushing, and/or reducer components together. The Top Hat Assembly and Orifice Assembly can be fabricated in advance. If a thorough reconnaissance is conducted, the Protective Well Assembly can be prepared in advance by cutting the pipe to length and drilling vent holes as appropriate. If the elevation on the well for a junction box or cable conduit connection is known, then it can be drilled in advance as well. Frequently however, it is advisable to drill the cable conduit connection on site.

The particulars on how the Protective Well is installed are site dependent. Utilize any available resources. It is frequently necessary to use a variety of clamps together. For example, on many pier faces, greater stability is achieved by using long arm piling clamps to attach to a piling, and using a face clamp to secure the well to the pier above the top of the piling. Use ingenuity. Qualitatively, the well needs to be secured to the structure securely, and clamped at intervals so as to ensure absolute stability.

The Protective Well should be installed within 15 m (45 ft) of the 8200 DCP and be mounted vertically; plumb within 1 cm/m ( c inch/ft). Ensure that the well is straight throughout its length, as buckling or bending may occur, especially with the less rigid SCH 40 pipes generally used for the 8200 DCPs, compared to the SCH 80 pipes used for Sutron 9000 DCPs.

It is usually easiest to secure the Orifice Assembly to the bottom of the Well Assembly before clamping the Well Assembly to the structure. However, long well lengths or difficult work environments may require that the orifice be secured to the Well Assembly by divers subsequent to its clamping. In either case, do not install the Acoustic Sensor Mounting Plate Assembly, the Top Hat Assembly or insert the Sounding Tube Assembly until after the Well Assembly is secured to the structure. Details on the Sounding Tube Assembly design and installation are addressed in the Sounding Tube Assembly section.

Cable Conduit

All cables exterior to the 8200 DCP protective housing, with the exception of the antenna cable(s), shall be protected by rigid or flexible conduit. This conduit may be made from PVC, galvanized steel pipe, or any other corrosion resistant material. It is often simplest to use Liquid-Tight flexible conduit for mating to the well. This eliminates the need for precisely constructing bends and curves in a rigid conduit system. In either case, the conduit connection to the Protective Well should junction through a service elbow or junction box, below the upper well vent cover. The service elbow shall be bolted, screwed, or glued to the well. The number and type of cables to be used determine the minimum conduit diameter size required. However, 8200 DCPs housed in the standard Hennessey enclosure are typically fabricated with two 4 cm (1.5 inch) cable access holes. In this case, installation of two CANTEX™ 1½ inch t/s couplers, number 5140107 with lock washers, or similar connection, is recommended.

If a rigid conduit system is used, it is recommended that large radius, sweep type, bends be used wherever possible to facilitate pulling cable through angles in the conduit. All PVC connections shall be primed and joined with PVC cement. Junction boxes shall be used when the conduit run is long or intricate. The conduit shall be securely fastened to the support structure. Galvanized omega clamps are recommended for securing the conduit to wood and concrete surfaces.

It is recommended that a "pull through" line be left inside the conduit to facilitate threading the cables.

Even a small amount of moisture can adversely effect the operation of the 8200 DCP. Therefore, it is necessary to block off the DCP end of the cable conduit to minimize the air moisture inside the Hennessey cabinet. This can be accomplished in a variety of ways, utilizing conduit, duct putty or environmental connectors. Ensure that desiccant is placed inside the cabinet.

## SOUNDING TUBE ASSEMBLY

Sounding Tube Assembly Design

The *(Aquatrak®) Sounding Tube Assembly* is the name for the 1 cm (½ inch) diameter pipe assembly through which the acoustic sensor transmits a sound pulse. It is comprised of three distinct components; the *Cal Tube*, *Sounding Tube Sections*, and brass *Antifouling Tube*. (See figure B5).

Cal Tube

The Cal Tube is the top portion of the Sounding Tube Assembly. It is a 1.3 m (4.4 ft) CPVC section with a small Calibration Hole drilled into the side. Every Cal Tube is precisely calibrated for use with one specific Acoustic Sensor. A label is affixed to each Cal Tube and Sensor Head, identifying them as a matched pair.

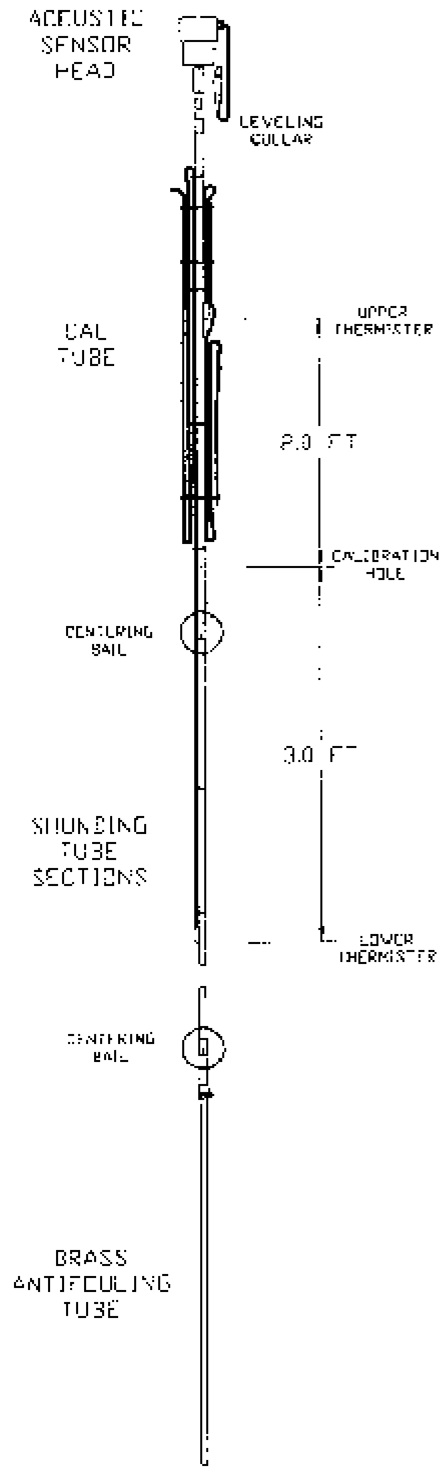



Figure B5. Sounding Tube Assembly

Sounding Tube Sections

The Sounding Tube Sections make up the longest portion of the Sounding Tube Assembly. They are also made of CPVC, and look similar to the Cal Tube, but are not precisely measured and do not have a Calibration Hole. The Sounding Tube Sections come in 1.5 m (5 ft) lengths, which may be joined together, or have lengths cut, to meet the total Sounding Tube Assembly length requirement.

Antifouling Tube

The Antifouling Tube is the bottom portion of the Sounding Tube Assembly. It is typically a 0.9 m (3 ft) length of brass pipe with the inner diameter sized to the same inner diameter as the sounding tube, but may be shortened if required.*

Sounding Tube Assembly Length Requirements

In order for the 8200 DCP to record tide data, **the water level must always be below the Cal Tube "blanking zone" and above the top of the brass Antifouling Tube.** The Cal Tube "blanking zone" is the area extending upward from 0.5 m (1.6 ft) below the Calibration Hole.

Since the Cal Tube and brass Antifouling Tube are each a fixed length, overall Sounding Tube Assembly length requirements should be met by adjusting the Sounding Tube Section lengths only.*

Computing the Sounding Tube Assembly Length

The protective well length is defined as the distance from the top surface of the top Well Assembly flange (not the Top Hat or Acoustic Sensor Mounting Plate) to the bottom surface of the bottom Well Assembly slip to thread adapter).

When installed inside the Protective Well, the Sounding Tube Assembly must terminate 0.2 m (0.5 ft) above the orifice. Since the orifice is recessed about 0.1 m (0.2 ft) into the adapter, the offset is 0.1 m (0.3 ft) above the well bottom. Therefore the total Sounding Tube Assembly length is 0.1 m (0.3 ft) shorter than the Protective Well length.

Although the Cal Tube total length is 1.3 m (4.4 ft), 0.1 m (0.4 ft) extends above the top of the well flange. Therefore, use 1.2 m (4.0 ft) to calculate the total Sounding Tube Assembly length.

* Recall that the Protective Well requirements include positioning the bottom of the well at least 1.0 m (3.3 ft) below the LOT (plus wave allowance). Occasionally, site constraints make this requirement impossible. If it is not possible to position the well as required, the Antifouling Tube may be cut to a shorter length to assure that the water does not go below Antifouling Tube/Sounding Tube Section joint. In this case, adjust the Sounding Tube length computation appropriately.

The CPVC sounding tube length is computed as follows:

| | | | |
|---|---|---|---|
| Protective Well length | + (_._) | (_._) | (flange to flange) |
| Orifice offset | - 0.1 m | (0.3 ft) | |
| Sounding Tube Assembly total length | = (_._) | (_._) | |
| | | | |
| Cal Tube | - 1.2 m | ( 4.0 ft) | |
| Antifouling Tube | - 0.9 m | ( 3.0 ft)* | |
| Sounding Tube Section length | = (_._) | (_._) | |

As an example, consider a 6.1 m (20.0 ft) Protective Well with a standard length Antifouling Tube. The Sounding Tube Section length calculation is as follows:

| | | | |
|---|---|---|---|
| Protective Well length | + 6.1 | (20.0 ft) | (flange to flange) |
| Orifice offset | - 0.1 m | (0.3 ft) | |
| Sounding Tube Assembly total length | = 6.0 m | (19.7 ft) | |
| | | | |
| Cal Tube | - 1.2 m | (4.0 ft) | |
| Antifouling Tube | - 0.9 m | (3.0 ft) | |
| Sounding Tube Section length | = (3.9 ) | (12.7 ft ) | |

Therefore, use two 1.5 m (5.0 ft) sections with couplers, and cut one 1.5 m (5.0 ft) trim section (no coupler) to 0.9 m (2.7 ft), to provide the required 3.9 m (12.7 ft) Sounding Tube section length.

Constructing the Sounding Tube Assembly

The Aquatrak® installation kit was specifically fabricated for use with the NOS/NGWLMS Aquatrak® sensor of the 3000 series labeled NOS-NG. The kit is used to standardize installations. The kit contains enough CPVC tubing to construct a 9.7 m (31.9 ft) long Sounding Tube Assembly. If a longer assembly is required, use Sounding Tube Sections from other kits.

The following parts comprise a complete Aquatrak® Installation Kit:

| Description | Part No. | QTY |
|---|---|---|
| Sound Tube, CPVC, 1.5 m (5.0 ft) | NPN | 5 |
| Sound Tube, Red Brass, 0.9 m (3.0 ft) | NPN | 1 |
| Center Bail, S.S., 10 cm (4 inch) | 4-18002-1 | 5 |
| Tube cutting guide, Aluminum | NPN | 1 |
| Sleeve Coupling, CPVC | NPN | 1 |
| Cable Ties Panduit, | #PLT 1.51-M | 12 |

Additionally the following tools and materials will be required:

- CPVC primer (typically purple)
- CPVC cement (typically orange)
- hacksaw
- trimming knife or flat file
- approximately 6 hose clamps (Ideal™ S.S. 300) wide and expandable to at least 2.5 cm (1.0 inch)
- flat head screwdriver
- sand paper

Construct the Sounding Tube Assembly using the Aquatrak® Installation Kit as follows:

A. Inspect the lower edge of the grey, top coupler on the Cal Tube for any beads of CPVC cement. Sand down any beads that exist as they will prevent the coupler from seating flush against the Acoustic Sensor Mounting Plate.

B. Using the cutting guide, cut the trim end (without the coupler) of a Sounding Tube Section as required to meet total Sounding Tube section length requirement. Ensure that the cut is straight and exactly perpendicular to the axis of the tube. Carefully deburr the inside and outside of the cut end.

C. Connect all required Sounding Tubes Sections by inserting the "tube end" of one length into the next adjoining section's coupler. Assure that the Sounding Tube Sections will seat tightly together. Install a hose clamp over each grey CPVC coupling, but do not tighten.

D. Examine the grey CPVC Sounding Tube Section couplings. If the couplings are split or notched, skip to step (E).

   I If the Sounding Tube Section couplings are NOT split then they will have to be glued together. Apply a CPVC primer to the tube of each Sounding Tube Section to be connected. DO NOT apply primer or cement to the Cal Tube, or to the inside of the Sounding Tube Section couplers. Apply the primer in an even band, approximately 1 cm (0.5 inch) from the end.

   II After the CPVC primer has dried, sparingly apply CPVC cement over the primed area and insert the tube end into the coupling. Go to step (e).

E. Position the hose clamp over the lower end of each Sounding Tube Coupling (over the split if present), and tighten securely.

F. Connect the Cal Tube to the uppermost Sounding Tube Section and secure with a tight fitting hose clamp as described in step (E). DO NOT use cement.

G. Apply CPVC primer to the end of the bottom Sounding Tube Section in an even band, approximately 1 cm (0.5 inch) from the end the tube. After the primer is dry, sparingly apply CPVC cement over the primed area. Insert the cement covered end into the (red sleeved) coupling attached to the Antifouling Tube.

H. Position a hose clamp over the (red sleeved) Antifouling Tube coupler. Assure that the two sections are tightly seated, then tighten the hose clamp securely.

I. Wait at least 30 minutes after the joint(s) is/are cemented before handling.

J. Place a hand on either side of each joint and give a firm twist to test the integrity of each connection before deployment.

K. Measure and mark directly on the Sounding Tube Sections the appropriate locations for the temperature sensors: 0.6 m (2.0 ft) above the calibration hole for the upper thermistor and 0.9 m (3.0 ft) below the calibration hole for the lower thermistor.

L. Connect the upper (shorter cable) and lower (longer cable) thermistors to their matched connectors on the thermistor Y-split cable. When connecting the cables, apply silicon gel to the mating surfaces. The silicon gel works as both a lubricant and provides additional water resistance.

M. Attach the lower thermistor to the marked location and use cable ties to secure the cable up along the sounding tube to where the upper sensor is to be attached. Do not attach the cable tie directly to the thermistor, as it may damage the sensor.

N. Attach the upper thermistor and use cable ties to secure both cables the rest of the way up to the junction elbow.

O. Using cable ties, secure the excess cable by either running it up and down the sounding tube between the sensors, or by attaching it as a coiled loop.

P. **Ensure that the cables do not cover the calibration hole**.

Q. Attach a centering bail so that it straddles each CPVC coupler, with each one oriented 90º in the vertical plane to the previous/next bail. Place the lowest bail just above the brass Antifouling Tube joint. **Do not place the last bail on the Antifouling Tube** so as to avoid problems caused by the galvanic corrosion of dissimilar metals. "Snap" the bails onto to Sounding Tube Assembly and secure with cable ties.

R. Test the Acoustic Sensor/Sounding Tube Assembly.

Testing the Acoustic Sensor/Sounding Tube Assembly

Test the Acoustic Sensor/Sounding Tube Assembly before continuing with the installation. Appendix C provides instruction on the Ping Test method 1 a to be used for SUTRON 8200 DCP's. After the ping test has been completed, do not disassemble the Sounding Tube Assembly. However, the Aquatrak® Sensor Head may be removed.

Mounting the Assembly in the Protective Well

The stainless steel hardware used with the acoustic mounting plate must use nylon washers and have a heat shrink material applied to that part of the shaft that will be in contact with the plate. This is to prevent galvanic corrosion between dissimilar metals.

The Aquatrak® and thermistor cables must be protected by conduit when exterior to the shelter. It is typically easiest to feed the cables through the conduit starting at the well end since this avoids having to feed through both thermistor connectors. Use of a pull through line or metal fish tape may facilitate this procedure.

S. Attach the stationary (smaller) section of the Acoustic Sensor Mounting Plate Assembly to the top well flange using two 1.0 cm (0.5 inch) bolts.

T. Insert the Sounding Tube Assembly into the Protective Well so that the bottom edge of the top collar of the cal tube ends up flush with the top of the mounting plate block. Secure the block around the tube. (Note: Push the sounding tube in a little deeper than is required and then pull it back up to seat appropriately. This technique helps to prevent bends or kinks in the sounding tube.)

U. Pull the temperature sensor plugs out through the junction box, or up through the plate, depending on the well configuration. Feed the acoustic sensor mating cable in through the junction box and up through the plate.

V. Attach the removable (larger) section of the Acoustic Sensor Mounting Plate Assembly using two 1.0 cm (½ inch) bolts and tighten.

W. Attach the Aquatrak® Sensor Head to the top of the Sounding Tube Assembly. Connect the Aquatrak® cable to the Aquatrak® Sensor Head. When connecting the cable, apply silicon gel to the mating surfaces of both connectors. The silicon gel works as both a lubricant and a moisture resistant.

X. Secure Aquatrak® Sensor Head to the top of the sounding tube with the hexhead set screws. Tighten securely but do not over tighten as damage to the Cal Tube may result.

Y. Set the top hat on the mounting plate and adjust the positioning so that all four 1.0 cm (½ inch) bolt heads fit flush into the top hat's flange holes.

Z. Secure the top hat in position using four 2.0 cm (¾ inch) bolts. Do not fully tighten down the top hat until the field unit installation has been completed and the levels run.

## LEVELING TO THE AQUATRAK® ACOUSTIC SENSOR

The Aquatrak® Leveling Point

To access the Aquatrak® Leveling Point (ALP), remove the Top Hat Assembly to expose the Aquatrak® Acoustic Sensor. The leveling point for the acoustic sensor is defined as the top shoulder of the upper coupler on the Cal Tube. It is exposed by loosening the lower one or two hex screws of the metal coupler on the acoustic sensor transducer head. The upper hex screw on the coupler is not to be disturbed. The upper screw head has been coated with paint and covered with shrink wrap, to detect any disturbance. **Any time the upper Allen screw is accidentally loosened, or found loose, the transducer head shall be replaced and the disturbance documented.**

The system is designed so that the elevation of the leveling point will be preserved as long as the aluminum Tube Stop and Fixed Plate Section of the Acoustic Sensor Mounting Plate Assembly is not removed. (See figure B3).

Two types of leveling fixtures have been fabricated to facilitate leveling to the acoustic sensor head.

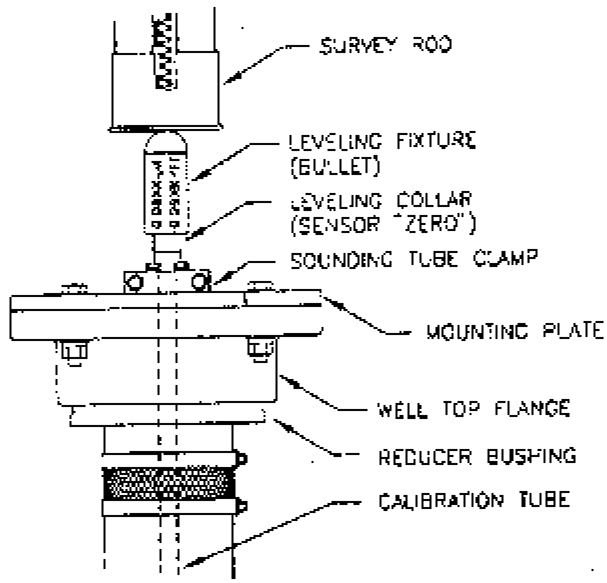



Figure B6. Use of a Standard Leveling Fixture

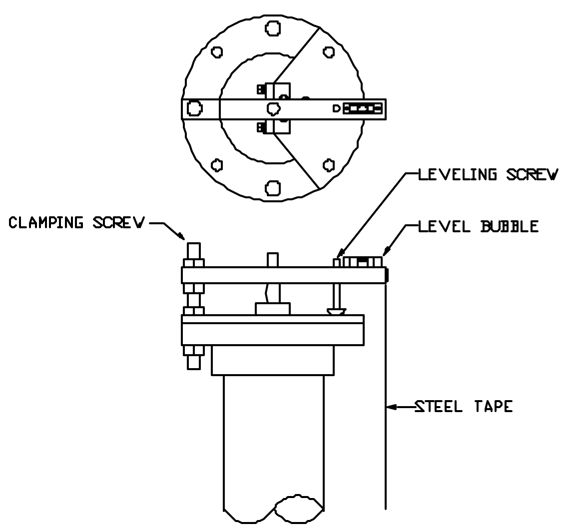



Figure B7. Use of a Downshot Leveling Fixture

Calculating the Offset Coefficient

Standard Fixture (Also referred to as a "leveling bullet")

This fixture is designed to slip snugly over the short section of CPVC tube extending above the mounting plate block. The fixture has a rounded high point on which to hold the survey rod, and has the fixture length measured and engraved on its side. Figure B6 illustrates the use of the leveling fixture. The length of the leveling fixture shall be properly compensated for in the leveling record.

Downshot Fixture

A second type of fixture called a Downshot fixture is used in cases where the leveling point is too high for a normal rod shot. This fixture transfers the leveling point horizontally beyond the edge of the Mounting Plate Assembly so that a tape may be attached down and the level sight taken accordingly. The Downshot fixture is comprised of a square aluminum bar, circular level bubble, and a precise steel tape (Metric/English units in hundredths). The downshot fixture bar has three holes, one in the middle and one at each end. The middle hole snuggly fits on the collar of the CPVC tube at the ALP, and the bar is clamped to the removable portion of the mounting plate with a 3/4" threaded rod and nuts on one end, and the hole at the other end of the bar has a carriage bolt inserted that can be adjusted such that the bubble can be centered in the circular level. A steel tape is inserted at the end of the bar (beyond the circular level bubble) and is held in place in a vertical plane with two bolts on the side of the bar so that zero on the tape is aligned with the ALP horizontally. The level sight is made directly on the tape.

The Offset is computed combining the Sensor Offset and Datum Offset for 8200 acoustic gauges. The following terms are defined below and information about them is required to calculate the Offset.

! <u>ALP above PBM</u>

The difference in elevation between the ALP and the Primary Bench Mark (PBM). This information is calculated from the levels. If the ALP is physically higher than the PBM, then add this difference to the PBM elevation; if the ALP is physically lower than the PBM then subtract this difference from the PBM elevation to compute the value.

! <u>PBM above Site Datum</u>

The difference in elevation between the PBM and the Site Datum. This information is available from REB for historic sites; for new sites where site datum has not been computed or published, an arbitrary value (10 to 20 m) is often selected. In most circumstances the PBM is physically higher than the Site Datum, and therefore has a (+) value. If the locality has a PBM lower than the Site Datum use a (-) value.

! <u>Sensor Offset C1</u>

Sensor Offset Coefficient 1 is also designated as C1. This is printed on the Acoustic Sensor Head and matched Cal Tube. This value represents the distance between the ALP and the actual sensor transducer recessed inside the sensor head from where acoustic pulses are sent to measure the water level. If this value is negative then it means the senor zero is above the ALP.

! <u>Datum Offset C2</u>

Qualitatively, the Datum Offset, also designated as C2, represents the elevation of the ALP above the site datum. This Datum Offset is calculated arithmetically, and should be included with the leveling record and with the NGWLMS Site Report.

| |
|---|
| For ALP above PBM :<br>Datum Offset = (PBM above Site Datum) + (ALP above PBM)<br><br>For ALP below PBM :<br>Datum Offset = (PBM above Site Datum) - (ALP below PBM) |

! <u>Offset</u>

The Sensor offset and Datum Offset are combined as shown in the following relationship to derive the Offset.  When this OFFSET is entered correctly, the water level data collected by the DCP would be relative to the site datum.

Use the following equation to calculate the OFFSET:

| |
|---|
| Offset = Datum Offset - Sensor Offset<br>= C2 - C1 |

Example:

To illustrate, consider the following example:

- ! From the levels, the ALP is determined to be 0.2536 m (0.832 ft) above the PBM.
- ! From the Published Benchmark Sheet the PBM is known to be 4.3586 m (14.30 ft) above MLLW, which is the Site Datum.
- ! The value for the Coefficient 1 Sensor Offset printed on the Cal Tube and Acoustic Sensor Head is -0.1035 m (-0.340 ft).

Therefore:

C2 = (0.2536 m) + (4.3586 m) = 4.6122 m
C1 = -0.1035 m
Offset = (4.6122 m) - (-0.1035 m)
Offset = +4.7157 m . +4.716 m

This Offset is then to be entered into the DCP as the AQAVG OFFSET. See APPENDIX A for details on the DCP setup and input procedures.

**Note:** Whenever the Offset is changed in the DCP, carefully note the exact UTC time (Universal Coordinated Time or Greenwich Mean Time) that the change is made, as well as the new value of the Offset. This information needs to be relayed promptly to Oceanographic Products and Services Division (OPSD) (see the point of contacts information in APPENDIX E), so that the OFFSET change can be noted in the Data Processing and Analysis Subsystem (DPAS). Data that is collected with an incorrect OFFSET will be posted on the OPSD website relative to an incorrect datum until it is corrected in the DCP and manual corrections will also have to be made in DPAS.

<u>Water level computation above Site Datum</u>

The preliminary water level with reference to the Site Datum can be computed using the following equation.

Water level above the Site Datum = (Offset) - (raw water level measured by the Aquatrak).

**FORM S1: ALP ABOVE PBM**
(use **FORM S2 if ALP is below PBM**)
5/10/96

***DRAFT 5/10/96***

## *OFFSET COMPUTATION*

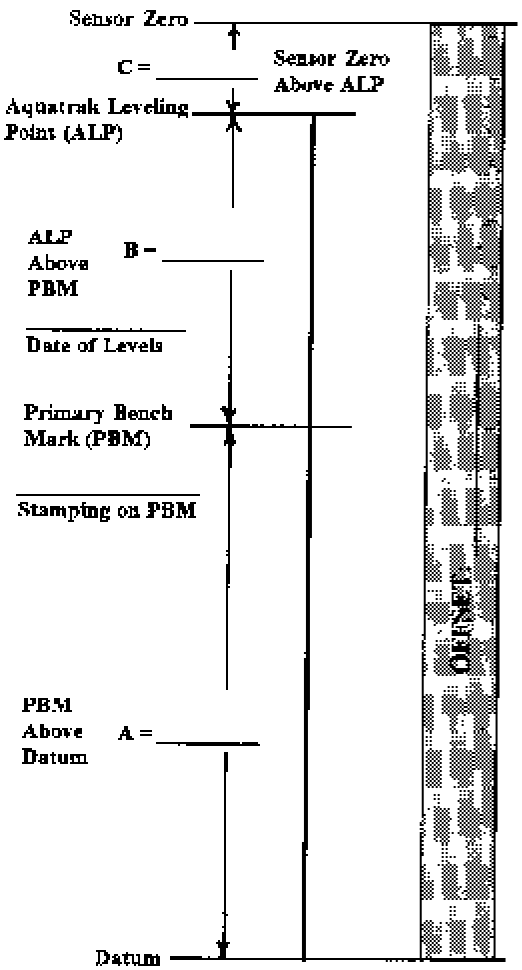
SUTRON 8200 w/AQUATRAK

Please use and provide comments to N/OES212 in Silver Spring, MD. 301-713-2897

**Station name:** ______________________________

**Station number:** ________________

**Project:** ______________________________




**Datum Reference (circle one):**
- Station Datum
- MLLW
- NAVD88
- Arbitrary
- Other ________________
  (Describe)

**NOTE: Use this form only if the ALP is Above the PBM.**

The Primary Bench Mark (PBM) may be designated one of several ways: 1) historical PBM for that site with a published elevation above either the station datum or MLLW; 2) arbitrary selection by field crew at time of installation for a new site; 3) NGS mark with a published elevation above NAVD88.

In cases where a new station is established, the designated PBM is assigned an arbitrary elevation above the station datum (not MLLW since it has not been established). If the datum being used is a geodetic datum such as NAVD88, and water level heights shall be referred to that datum, the elevation of the station PBM is derived from the leveling to the station bench marks from a geodetic mark with a published elevation.

The Aquatrak sensor used with the SUTRON 8200 DCP typically has a sensor offset of about -0.104 m. In this example it means that the sensor zero is physically 0.104m above the Aquatrak leveling point (ALP). The actual value is determined during the calibration procedure and is written on the sensor head. **THE NEGATIVE SIGN IS NOT USED IN THE CALCULATION OF THE ONE OFFSET WHICH IS ENTERED IN THE DCP.**

**Offset = A (PBM above datum)**
**− B (ALP above PBM)**
**+ C (Sensor Zero above ALP)**

**Offset =** ________ + ________ + ________
(A, B, C)

**Offset =** ________________***

**The offset is the elevation of the sensor zero (transducer face) above the datum of choice.**

***** The Offset is a number to the thousandths of a meter and is entered in the DCP System Setup/ Configure Sensors/AQAVG menu as a value with a decimal.**

Figure B7. Offset Computation AQLP Above PBM

FORM S2: PBM Above ALP
(use FORM S1 if ALP is above PBM)
5/10/96

## *OFFSET COMPUTATION*

SUTRON 8200 w/AQUATRAK

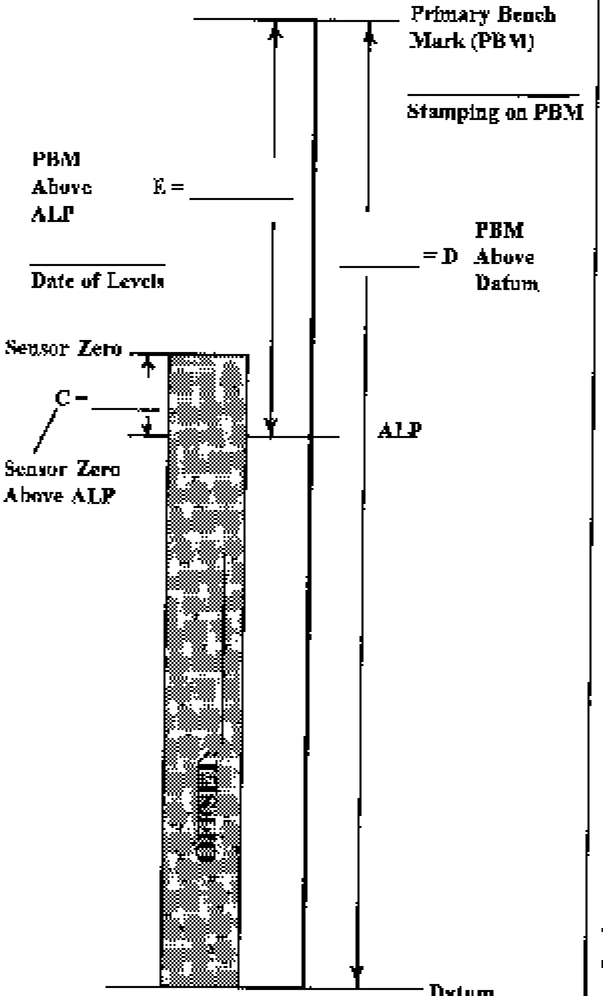
***DRAFT 5/10/96***

Please use and provide comments to N/OES212 in Silver Spring, MD. 301-713-2897

**Station name:** ______________________

**Station number:** ______________

**Project:** ____________________




**Datum Reference (circle one):**
**Station Datum**
**MLLW**
**NAVD88**
**Arbitrary**
**Other** ______________
**(Describe)**

**NOTE: Use this form only if the PBM is Above the ALP.**

The Primary Bench Mark (PBM) may be designated one of several ways: 1) historical PBM for that site with a published elevation above either the station datum or MLLW; 2) arbitrary selection by field crew at time of installation for a new site; 3) NGS mark with a published elevation above NAVD88.

In cases where a new station is established, the designated PBM is assigned an arbitrary elevation above the station datum (not MLLW since it has not been established). If the datum being used is a geodetic datum such as NAVD88, and water level heights shall be referred to that datum, the elevation of the station PBM is derived from the leveling to the station bench marks from a geodetic mark with a published elevation.

The Aquatrak sensor used with the SUTRON 8200 DCP typically has a sensor offset of about -0.104 m. In this example it means that the sensor zero is physically 0.104m above the Aquatrak leveling point (ALP). The actual value is determined during the calibration procedure and is written on the sensor head. **THE NEGATIVE SIGN IS NOT USED IN THE CALCULATION OF THE ONE OFFSET WHICH IS ENTERED IN THE DCP.**

**Offset = D (PBM above datum)**
**- E (ALP above PBM)**
**+ C (Sensor Zero above ALP)**

**Offset =** ______ - ______ + ______
**D E C**

**Offset =** ______________ ***

**The offset is the elevation of the sensor zero (transducer face) above the datum of choice.**

****** The Offset is a number to the thousandths of a meter and is entered in the DCP System Setup/ Configure Sensors/AQAVG menu as a value with a decimal.***

Figure B8. Offset Computation ALP Below PBM

Transmission of Coefficients

At new water level station installations, the coefficients transmitted initially are stored automatically in OPSD's DPAS. If changed later in the DCP, they need to be manually updated in DPAS. Hence, if initial test transmissions or preliminary coefficients are transmitted over GOES and are changed later for whatever reason, OPSD needs to be informed immediately. Refer to Appendix E for point of contacts in OPSD. Fax the level abstract to OPSD for verification of coefficients before entering the coefficients in the DCP. Figure B8 and B9 show two forms (one for each case, as applicable) that can be used to compute the offset coefficients and these forms can be faxed to OPSD for verification before entering the coefficients in the DCPs.

## GOES SATELLITE TELEMETRY SYSTEM INSTALLATION

Not all of Portable Digital Acoustic Water Level Gauge systems are designed to use GOES Satellite Telemetry. If GOES Satellite Telemetry would be used, and therefore a GOES antenna installed, then the following sections address issues pertaining to the GOES satellite requirements.

Every 8200 DCP that utilizes GOES Satellite Telemetry has its own, unique Platform ID, channel assignment, and Transmit Time. These parameters, as well as the desired antenna azimuth and inclination, are assigned by NESDIS. In some cases NOS has obtained preassigned blocks of platform IDs which are provided for specific installations (See Appendix E for additional information on GOES Satellite allocation requirements.) Allow enough lead time for NESDIS to allocate the GOES parameters for the station. (Note: the DCP time must be set exactly to UTC Time. Use any official time tick to set the DCP time. Tel 303-499-7111 is one source of a time tick. The UTC Time is 5 hours ahead of the Eastern Standard Time (4 hours ahead of the Eastern Daylight Time), and 8 hours ahead of the Pacific Standard Time (7 hours ahead of the Pacific Daylight Time).

There are two types of satellite antennas typically utilized for the 8200 DCPs. They are the Seavey Flat Plate Antenna and the Vitel V2-TH Antenna. Regardless of which type of antenna used, the installation involves the following:

- Mounting the Antenna
- Running the cable to the 8200 DCP
- Documentation

The specifics of how the antennas are mounted are site dependent. Frequently, the antennas are mounted to a mast specially erected for the antenna and/or solar panel. The mast is typically made from a 5 cm (2 inch) diameter steel pipe, mounted to the structure deck with a flange and/or side braces. However, the antenna may be affixed to a vertical wall, a protected piling, or any other suitable surface. The determining factors are that the antenna is in a protected place, pointed in the correct direction, and without obstructions. The antenna cable provides an additional limitation. The standard antenna cable length is 10 m (30 ft). Therefore, the antenna must be located close enough to the 8200 DCP to allow the cable to safely reach the antenna. Ensure that the antenna is well secured to the antenna mast or structure surface.

Mounting the Antenna

Hardware is provided with each antenna. The Seavey antenna bracket consists of a 5.0 cm (2.0 inch) diameter adjustable angle end cap. The Vitel antenna consists of two flat plate brackets and a pair of U-bolts. Documentation on the Vitel antenna bracket can be found in Appendix F.
When aiming either antenna, remember that the angle of inclination should be measured from horizontal. That is, an inclination of 90º would be pointed straight up into the air.

Running Cable to the 8200 DCP

Attach one end of the cable to the jack on the antenna. Be especially careful not to cross thread the connectors when attaching. Waterproof the connection by using coaxial cable putty or vulcanized rubber tape layered over by electrical tape. Run the cable over to the 8200 DCP being careful to avoid sharp bends. (The minimum bend radius for the standard cable is 2.5 cm (1.0 inch)).

Conduit is not required unless the antenna cable is exposed to possible physical damage. Use fasteners at least every 0.6 m (2.0 ft) to adequately secure the cable. Use of black cable ties recommended over white ties because they are less likely to degrade due to ultraviolet rays (sunlight). Excessive cable length shall be coiled together and secured in place. (Note: Too tightly coiled cable may result in line loss within the cable.)

Connect the other end of the cable to the antenna jack on the 8200 DCP to complete the installation.

Documentation

Document the antenna model and serial number, the cable length, antenna azimuth and inclination, etc., as appropriate.

## SOLAR PANEL INSTALLATION (OPTIONAL)

A solar Panel may be used in lieu of, or in addition to, AC power at appropriate locations to recharge the 8200 DCP Battery. If a solar panel is used in addition to AC, a decision must be made whether or not to leave the AC cable plugged in. In general, it is preferred to have the AC power connected as the constant charge is better for the battery than the cyclical "exercising" from the solar panel. It may not be desirable to have the AC power connected in areas of high lightening risk as power surges from nearby lightening hits can enter the 8200 DCP through the AC line and cause extensive damage.

Some assembly or prewiring may be necessary.  Refer to the manufacturer's instruction sheet enclosed with the panel (Appendix G).  Ensure that the wiring box and connections on the panel are adequately protected against the environment.

A mounting bracket is provided with each solar panel.  The solar panel may be mounted on the same mast as the GOES antenna or on a separate mast or structure.

Panel orientation should be towards the equator with the back edge titled up from the horizon as specified below.

| **LATITUDE (Degrees)** | **TILT ANGLE (Degrees)** |
|---|---|
| 0N to 15N | 15N |
| 15N to 25N | Latitude |
| 25N to 30N | Latitude + 5N |
| 30N to 35N | Latitude + 10N |
| 35N to 40N | Latitude + 15N |
| > 40N | Latitude + 20N |

Figure B7. Solar Panel Tilt Angle

## APPENDIX C

## SUTRON 8200 AQUATRAK FIELD PERFORMANCE CHECK PROCEDURE

**EQUATION**: [**A - AQAVG + C1 ] = Error**

| | |
|---|---|
| A = | Measured Distance between the Aquatrak® Leveling Point (ALP) and the end of the sounding tube. |
| C1 = | Sensor Offset Coefficient 1; Distance between ALP and the transducer face. C1 is printed on the Cal Tube. (Should be a negative number but use absolute value only in this equation.) |
| AQAVG = | Aquatrak water level average found in the 8200 data log for the sounding tube with one end taped. |
| Error = | Difference (Aquatrak measurement - Tape measurement of sounding tube). |

1) Place the sounding tube, with sensor head in place, flat and straight on the ground.
2) Tape or cap the end of the sounding tube. (Use of cap is preferred.)
3) Measure the distance between the ALP and the end of the sounding tube. The ALP is the top shoulder of the upper coupler on the cal tube. (A)
4) Subtract the AQAVG obtained from 8200 DCP for the taped/capped measurement of sounding tube.
5) Add the Absolute value of C1 (without sign) to the results obtained in step four above.
6) To meet the required field check specifications the result must be within +/- 0.1 M.

**Closure Requirement: The "*Error*" from the above equation must be within +/- .1 M.**

# APPENDIX D

## MEAN WAVE HEIGHT AT COASTAL LOCALITIES OF CONTERMINOUS UNITED STATES

| Location | Mean Annual Wave Height | Location | Mean Annual Wave Height |
|---|---|---|---|
| | **ATLANTIC COAST** | | |
| **Maine** | | (cont) | |
| Moose Peak | 0.5 m (1.5') | Ludlam Island^ | 0.6 m (1.9') |
| **New Hampshire** | | **Maryland** | |
| Hampton Beach | 0.4 m (1.4') | Ocean City | 0.6 m (1.8') |
| **Massachusetts** | | **Virginia** | |
| Nauset | 0.6 m (1.8') | Assateague^ | 0.8 m (2.6') |
| Cape Cod^ | 0.8 m (2.5') | Virginia Beach* | 0.6 m (1.8') |
| **Rhode Island** | | Virginia Beach | 0.6 m (2.0') |
| Point Judith | 0.6 m (1.8') | **North Carolina** | |
| Misquamicut^ | 0.4 m (1.4') | Nags Head* | 0.9 m (3.0') |
| **New York** | | Nags Head | 1.2 m (3.9') |
| Southampton^ | 0.6 m (1.9') | Wrightsville^ | 0.7 m (2.3') |
| Westhampton^ | 0.8 m (2.6') | Oak Island | 0.4 m (1.2') |
| Jones Beach^ | 0.8 m (2.6') | Holden Beach^ | 0.5 m (1.7') |
| Short Beach | 0.5 m (1.7') | **Georgia** | |
| **New Jersey** | | St. Simon Is. | 0.1 m (0.4') |
| Monmouth | 0.5 m (1.7') | **Florida** | |
| Deal^ | 0.7 m (2.3') | Daytona Beach* | 0.6 m (1.9') |
| Toms River | 0.8 m (2.3') | Ponce deLeon | 0.7 m (2.2') |
| Brigatine^ | 0.7 m (2.2') | Lake Worth* | 0.7 m (2.3') |
| Atlantic City* | 0.8 m (2.8') | Palm Beach* | 0.7 m (2.3') |
| Atlantic City (BEP) | 0.4 m (1.3') | Boca Raton^ | 0.6 m (1.9') |
| Atlantic City USCG | 0.6 m (1.9') | Hillsboro | 0.4 m (1.3') |
| | **GULF COAST** | | |
| **FLORIDA** | | (cont) | |
| Naples* | 0.3 m (1.0') | Navaree Beach+ | 0.7 m (2.3') |
| Cape San Blas | 0.2 m (0.7') | Santa Rosa | 0.4 m (1.4') |
| Panama City+ | 0.5 m (1.7') | **Louisiana** | |
| Greyton Beach+ | 0.5 m (1.7') | Grand Island | 0.4 m (1.4') |
| Crystal Beach+ | 0.5 m (1.7') | **Texas** | |
| Beasley Park+ | 0.6 m (1.8') | Galveston* | 0.4 m (1.4') |
| | **PACIFIC COAST** | | |
| **California** | | (cont) | |
| Point Loma | 0.6 m (2.1') | Point Arguello | 0.8 m (2.5') |
| South Carlsbad+ | 0.8 m (2.7') | Natural Bridges+ | 0.9 m (2.9') |
| Carlsbad+ | 0.9 m (2.9') | Thornton+ | 1.2 m (4.1') |
| Huntington Beach* | 0.5 m (1.7') | Goat Rock+ | 1.4 m (4.6') |
| Huntington+ | 0.8 m (2.6') | Point Arena | 0.8 m (2.6') |
| Bolsa Chica+ | 0.7 m (2.2') | Prairie Creek+ | 1.1 m (3.7') |
| Leo Carrillo+ | 0.7 m (2.3') | **Oregon** | |
| Pt. Mugu (PEG)+ | 0.9 m (3.0') | Umpqua River | 1.0 m (3.3') |
| Pt. Mugu* | 0.8 m (2.7') | Yaquina River | 1.0 m (3.3') |
| McGrath+ | 1.1 m (3.5') | **Washington** | |
| Carpinteria+ | 0.6 m (1.9') | Willapa Bay | 0.6 m (1.8') |
| Point Conception | 0.8 m (2.8') | Cape Flattery | 0.5 m (1.7') |
| El Capitan+ | 0.6 m (2.0') | | |

^CERC Beach Evaluation Program *CERC Wave Gage Records +CERC Littoral Environmental Observation Program

## APPENDIX E

## GUIDELINES FOR OPERATION AND DOCUMENTATION OF HYDRO GAGES WITH GOES CAPABILITY

The following guidelines shall be followed by hydrographic field parties regarding the operation and documentation of portable 8200A digital and digibub gages transmitting data using GOES. It is critical that these lines of communication be followed and that time allowances be considered in the field planning. Lack of advance notification may cause a delay in the permission to start transmissions, or the possible loss of data during the first few days of data collection.

1. Assignment of platform IDs and station numbers for tide station installations:

   In general, unless the platform IDs have been preassigned to gauge units as done for the West Coast hydro operations, request in writing[1] by fax or via telephone, the platform IDs for each gauge scheduled to collect and transmit data by GOES at least one month prior to the start of the hydro survey. The request must include the station number, name, latitude, and longitude of each upcoming installation. If an exact station location is unknown and no station number has been assigned, provide the name of the general area and an approximate latitude and longitude if site reconnaissance has been performed. The request will be forwarded for platform ID assignment and Radio Frequency Authorization; a response is usually made within two weeks, at which time the installation log sheets will be faxed to the appropriate field party.

   In cases where platform IDs have been preassigned to data collection platforms (DCPs), such as Sutron 8200 hydro gauges, the field party needs to provide information such as location and the appropriate gauge number (and the corresponding platform ID). For new station installations, request the assignment of station numbers as stated above.

2. Record and documentation requirements:

   Prior to the start of data transmission at a site, confirm the gage platform ID, related transmission parameters such as channel and transmit time, station installation date, gage and all sensor serial numbers, by faxing the Next Generation Water Level Measurement System (NGWLMS) Site Report and Field Tide Note to headquarters[1]. This facilitates the configuration of that station in the Data Processing and Analysis Subsystem (DPAS) prior to the receipt of the first data transmission before the beginning of the hydro operations.

   **NOTE: failure to provide advance confirmation as stated in Section 2 above may result in the loss of transmitted data until the station is configured in DPAS.**

3. Removal of tide stations and reinstallation of gauges:

Always contact headquarters and inform in advance the date of removal of a hydro gauge. Generally, the data collection efforts are monitored and if a platform transmission ceases from a particular site, then it would be difficult to judge whether the loss of transmission is caused by malfunction of a gauge or actual removal.

If an installed gauge at an original site is to be removed and reinstalled at a different site, then the following additional information shall be provided at least one month prior to the reinstallation of that gauge at the new site:

- Station number, name, and expected date of removal of the existing gauge.
- Station number, name, latitude, longitude, and expected date of installation of the gauge at the new location. If the new location is uncertain, but within a specified area, provide an estimated latitude and longitude to the nearest minute.

If deemed necessary, a new installation log sheet will be issued, as appropriate, with the same GOES ID and different related parameters, such as pointing angle of the antenna. The new log sheet will then be faxed to the field party requesting the information. Otherwise, all other information remains the same except for the station number, name, latitude and longitude.

CAUTION: transmission of data by GOES requires advance planning and absolute certainty regarding the documentation requirements. Please follow these guidelines and all should go well. If there are any questions or help needed, please contact the following personnel.

### [1]COMMUNICATIONS CONTACTS

<u>EAST COAST HYDRO PARTIES</u>

Thomas F. Landon
Tel: 301-713-2897x191
Fax: 301-713-4465 or 4435

<u>WEST COAST HYDRO PARTIES</u>

Manoj R. Samant
Tel: 301-713-2897x190
Fax: 301-713-4465 or 4435

Common address:

NOAA/NOS - N/CS41
1305 East-West Highway SSMC4,
Sta. 6432 (Tom) or Sta. 6350 (Manoj)
Silver Spring, MD 20910-3281

# APPENDIX F

## VITEL ANTENNA BRACKETS INFORMATION SHEETS

# APPENDIX G

## SOLAREX SOLAR PANEL INFORMATION SHEETS