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June 1996

US Army Corps of Engineers
Waterways Experiment Station

Water Quality Research Program

Water Quality Remote Monitor Control and Data Management Software

by Michael C. Vorwerk, Jennifer A. Moore, DynTel Corporation
Joe H. Carroll, WES

Prepared for Headquarters, U.S. Army Corps of Engineers

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Final report

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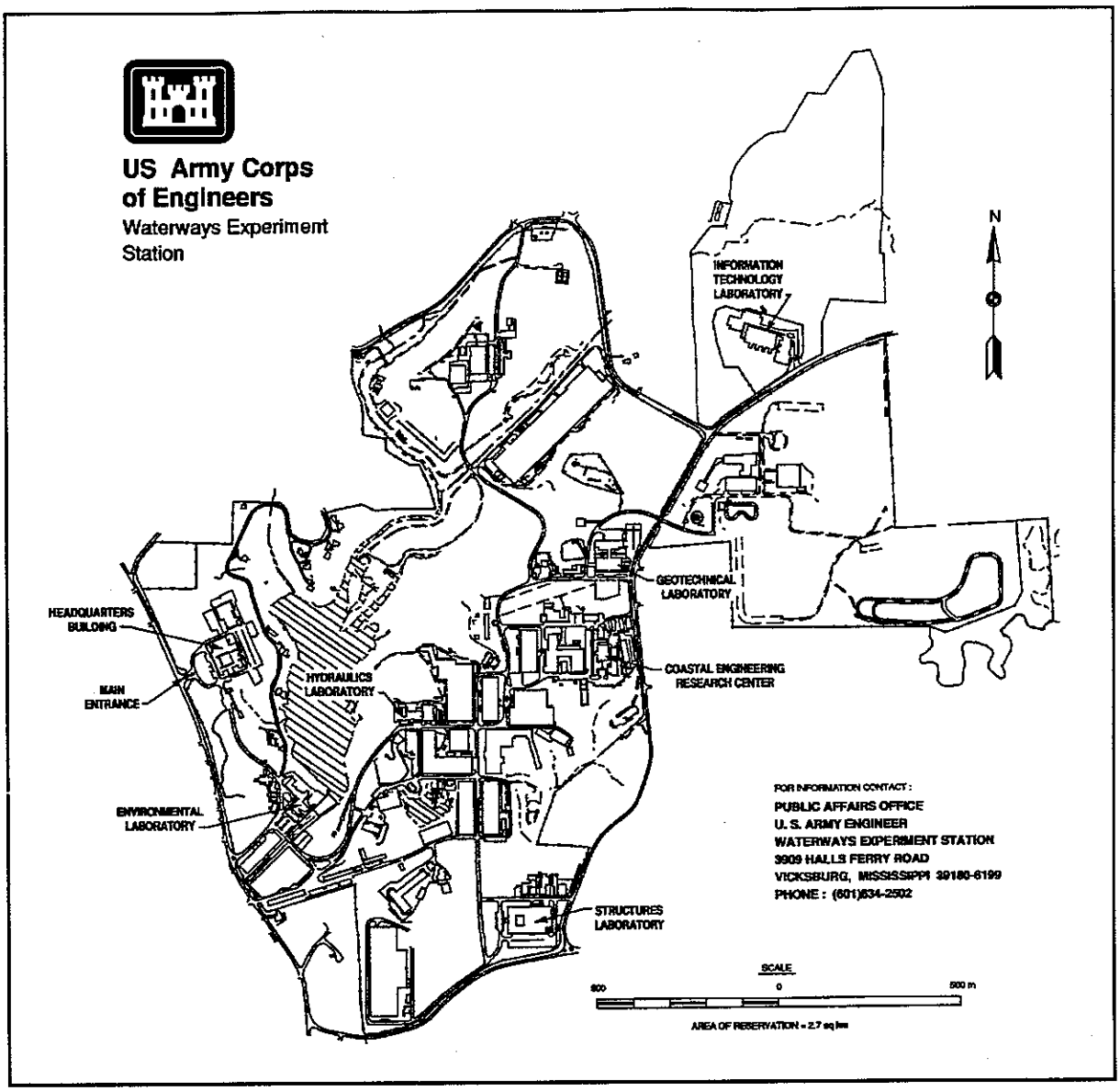

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Preface

The work reported herein was conducted as part of the Water Quality Research Program (WQRP), Work Unit 32369. The WQRP is sponsored by the Headquarters, U.S. Army Corps of Engineers (HQUSACE), and is assigned to the U.S. Army Engineer Waterways Experiment Station (WES) under the purview of the Environmental Laboratory (EL). Funding was provided under Department of the Army Appropriation No. 96X3121, General Investigation. The WQRP is managed under the Environmental Resources Research and Assistance Programs (ERRAP), Mr. J. L. Decell, Manager. Mr. Robert C. Gunkel, Jr., was Assistant Manager, ERRAP, for the WQRP. Program Monitors during this study were Mr. Fredrick B. Juhle, Mr. Rixie Hardy, and Dr. John Bushman, HQUSACE.

The report was prepared by Mr. Michael C. Vorwerk and Ms. Jennifer A. Moore of DynTel Corporation, Vicksburg, MS, under contract to the Environmental Processes and Effects Division (EPED), EL, and Mr. Joe H. Carroll, EPED. The authors gratefully acknowledge the support and assistance of personnel associated with WES's Trotters Shoals Limnological Research Facility, Calhoun Falls, SC. The authors are thankful to Messrs. John Lemons, DynTel Corporation, Jerry McSwain, U.S. Army Engineer Division, South Atlantic, and Bethel Herrold, Southwestern Power Authority, for Beta testing the software and providing helpful comments on the documentation.

This report consists of documentation for MONITOR, a remote water quality monitoring system software package. Included are the documentation, the program, and a separate program used for direct communication to a comm port. This is software Version MONITOR 8.0 and documentation Version 2.0. The software was written by Mr. Vorwerk.

The authors wish to continually improve the quality of this software. Users are encouraged to direct comments, suggestions, or questions to

Trotters Shoals Limnological Research Facility
P.O. Box 533
Calhoun Falls, SC 29628
Phone (803)447-8561
Fax (803)447-8563

If you experience difficulty using this software, please check to see that you have followed all directions correctly and that your questions are not answered in the ERRORS AND ERROR MESSAGES section before requesting assistance.

For assistance with the Hydrolab instrument only, contact Hydrolab Corporation at P.O. Box 50116, Austin, TX 78731, telephone 1-800-949-3766.

The work was performed under the general supervision of Dr. Richard E. Price, Acting Chief, Ecosystem Processes and Effects Branch, EPED; Mr. Donald L. Robey, Chief, EPED; and Dr. John W. Keeley, Director, EL.

At the time of publication of this report, Director of WES was Dr. Robert W. Whalin. Commander was COL Bruce K. Howard, EN.

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1 Introduction

This program will save data collected via a Hydrolab H20 water quality data sonde. A typical installation will have the H20 installed either in a wet well or with a flow-through cell. The H20 is connected to a data collection computer via an RS-232 connection. MONITOR.EXE and MONIINIT.DAT software that controls the sonde are installed on the computer. The computer can be accessed via modem for remote operation, data transfer, or for real-time information about water quality conditions. Included in this report are the documentation, the program (Appendix A), a program used for direct communication to a comm port (Appendix B), a sample calibration record (Appendix C), and a bibliography of suggested readings (Appendix D).

The program features are as follows:

- Program prepares H20 parameters for use.
- Program calibrates time of H20 to that of the computer.
- Program calibrates H20 interval.
- Program will record observations at whole multiples of the interval.
- Program operates from a subdirectory specified in the initialization file.
- Program stores data in a main data file, which is user prescribed in the initialization file.
- Program stores data in daily files named SSMMDDYY.DAT. The program changes file name each day. SS are the first two characters of the station specified by the user in the initialization file.
- Program can be set up to print a warning in the main file when parameters fall outside of user-specified limits set in the initialization file.
- Direct communication to the H20 is password protected, preventing "casual" users from unauthorized tampering with H20 parameters and calibration.

- Direct communication sessions are recorded and highlighted in the main file.
- Current and previous data files may be printed to the screen or saved to a disk by users having a "printer access only" password.
- Program automatically records start time and date in the main data file.
- Program can be specified in the AUTOEXEC.BAT file to automatically initiate upon boot of the computer.
- Main data file is comma delimited for ease in importing into applications.
- Main data file includes decimal hour time for ease in plotting.
- Daily files are space delimited for ease of data review.
- Each observation is "stand-alone," with all identifiers included.
- The option to quit logging is password protected, thus preventing unauthorized termination of logging.
- The main and printer-access-only passwords are user specified in the initialization file.
- Program saves temperature, dissolved oxygen, and specific conductivity data.

2 Software and Hardware Specifications

The software consists of an executable file, MONITOR.EXE, and an initialization file, MONIINIT.DAT. During use, the program will generate five temporary files called TEMPFIL1.DAT, TEMPFIL2.DAT, TEMPFIL3.DAT, TEMPFIL8.DAT, and DAILYFIL.DAT. The TEMPFIL#.DAT files may be deleted at any time while the program is not operating; however, the DAILYFIL.DAT should not be deleted. This file contains a record of the daily files generated by the program and is used by the printer feature of the program. The total size for all seven files is about 80 k-bytes.

The program generates a main data file, using a name you specify in the initialization file (MONIINIT.DAT), a daily file, and a file called DAILYFIL.DAT, which contains the names of each daily file generated. The daily files are named SSMMDDYY.DAT, where SS are the first two characters of the station name specified in the initialization file, and MMDDYY is the date of the data held in the daily file. All data storage files and temporary files are stored in a subdirectory specified by the user in the initialization file.

This program has several requirements to run. First, the program requires a dedicated IBM-compatible computer. Because the program does not require much hard drive space or a fast computer, a 286 computer with any size hard drive may be dedicated as a monitor data recording machine.

Second, the software must be installed on the hard drive in a user-specified directory reserved only for monitor information. See Software Installation for more information.

Last, this software is prepared for use only with the Hydrolab Instruments H20 (Hydrolab Corporation, Austin, TX) water quality sonde. Though there are many similar water quality sondes on the market that are capable of monitoring the same parameters as the H20, the H20 is in common use and is used extensively at DynTel Corporation. Thus, this software was written specifically for controlling an H20 and storing water quality data received from that sonde.

Monitor Setup

Typical monitor setups, as shown in Figure 1, include a Hydrolab H20 sonde deployed in a wet well, mixing chamber, or connected to a flow-through cell. The sonde is connected to a computer via a Hydrolab cable or four-wire phone cable and an RS-232 serial port. A standard 12-V deep-cycle battery provides the power for the H20. This battery is maintained at full charge by a low-amperage trickle charger. The computer uses the MONITOR program to record data from the sonde. A modem can also be connected to the computer. This allows data transfer and instantaneous readings to remote users. In addition, use of an uninterruptable power supply is recommended to prevent problems due to power failure or surges.

Initially, the header of the H20 must be disabled, and the interval should be set to zero. This prevents communication overflow during MONITOR initiation. To make these changes, you must establish a direct connection with the H20 as described in the H20 manual. After connecting the sonde to the computer cable, the program COMTALKR.EXE (code shown in Appendix B) can be used for convenient direct communications. At this time, the following changes may be made:

To disable the header, type the following:

a. Space bar to get the H20 on-line menu.

b. "V" for variable.

c. "H" for header.

d. "D" for disable.

To set the interval to zero, type the following:

a. Space bar to get the H20 on-line menu.

b. "C" for calibrate.

c. "I" for interval.

d. "000000" to set interval to zero.

e. Enter.

If you are using a factory-made Hydrolab cable to run from the sonde to the computer, there should be no difficulties in establishing communication. If you are using phone cable to run from the H20 to the computer, the RS-232 connector leading to the computer must be specially made so that the pins not actually used for communication (see the H20 manual) are jumped together to

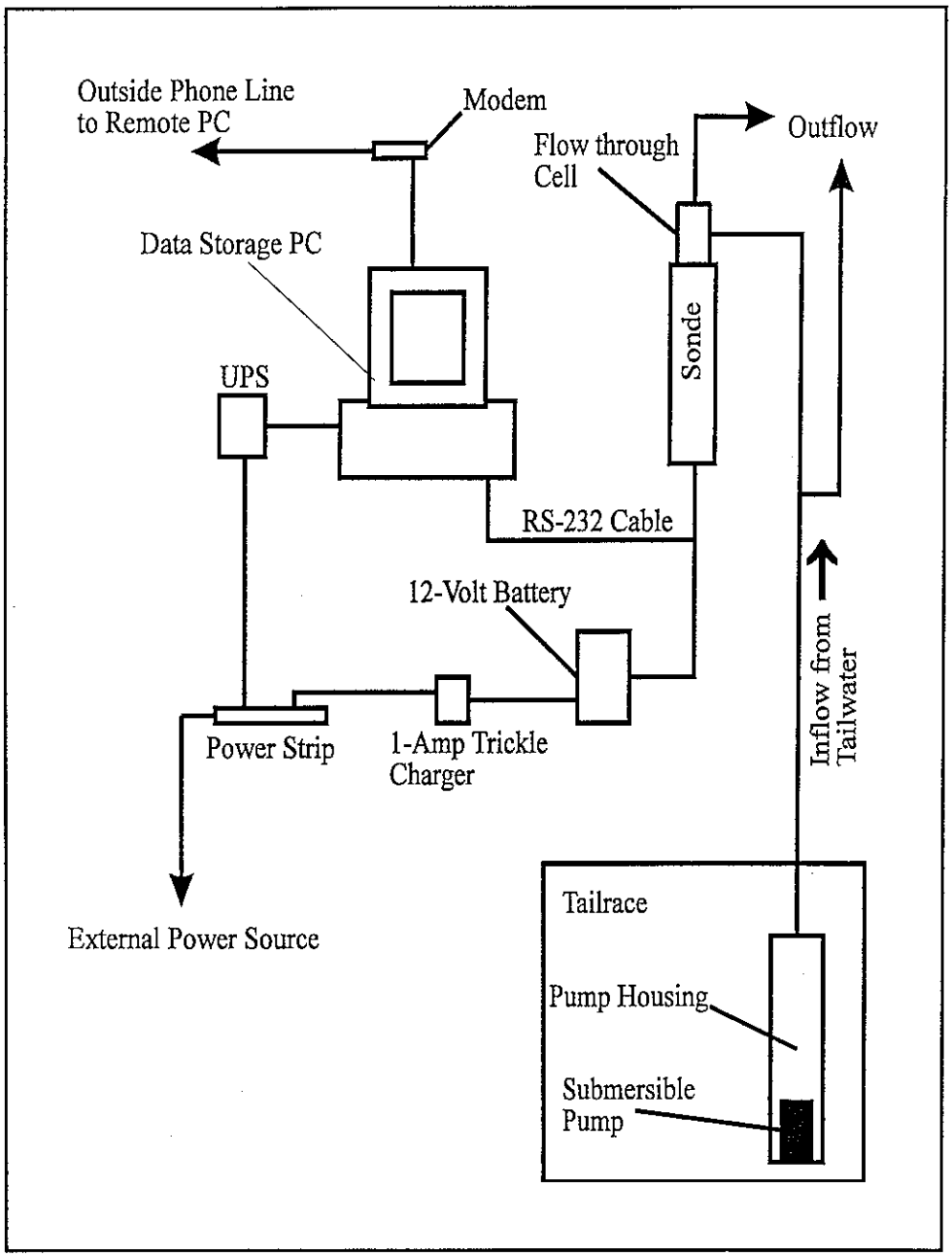

Figure 1. Schematic of typical monitor setup

make what is called a "cheater." This jump will allow the computer to detect the RS-232 connector when you plug it into the comm port. This feature is built into the H20 cable. Call Trotters Shoals Limnological Research Facility if you have problems.

Software Installation

Copy the MONITOR.EXE and MONIINIT.DAT software to the directory in which you wish to store the program and data (e.g., C:\MONITOR). The enclosed MONIINIT.DAT file is only a sample file. You must configure this initialization file for your own requirements. Edit the MONIINIT.DAT file and include the following parameters in a comma-delimited format:

Subdirectory, reservoir, station, sample interval, file name and file extension to store data in, comm port used to communicate with the H20, baud rate used for communication, floppy drive to save data to during operation, upper bound for temperature, lower bound for temperature, upper bound for dissolved oxygen, lower bound for dissolved oxygen, upper bound for specific conductivity, lower bound for specific conductivity, Y or N to use or not use DRIVESAVE, main password, and print-access-only password.

Here are two examples:

MONITOR, HW, 200, 60, MONI.DAT, 2, 1200, A:\, 30, 7, 9,1, 100, 20,Y,DATA,ELBOW

MONISYS, RB, 50, 10,DATA.DAT, 1, 1200, B:\, 30,7,9,5.5,100,20,N,DOGEAR,JUSTIN

Please note that the information above is shown on two lines because of margin limitations. In the MONIINIT.DAT file, the information should all be on one line.

The initialization information serves several purposes. The subdirectory instructs the program where to find the necessary files to run and store the data. The reservoir and station are used to identify the observations, thus making it easier to combine information from more than one monitor system. The interval (in minutes) instructs the computer to record data at the user-specified intervals. The file name instructs the computer where to store the data. This is the main data file. The comm port number (1 or 2) instructs the computer regarding which port the H20 will communicate through, and the baud rate (1200 or 2400) instructs the computer regarding which rate to use for communication to the H20. The floppy drive instructs the computer where to transfer data if the user chooses to copy data during program operation. The upper and lower bounds for the variables are simply used as "alarms." Note: If the range is too narrow, an "out of range" message will appear. Continually editing this message out of the data can be time-consuming. Using the widest range is recommended if possible. If your application value the H20 gives for the variable is outside of the range specified, a warning message will appear in the data file. The Y or N switch enables or disables DRIVESAVE, a feature that prevents the hard drive from continuously spinning. Typically, this should be set to Y. Temperature, dissolved oxygen, and specific conductivity are always enabled. The first

password is the main password, which may be used to access any portion of the program. The second password is a print-access-only password. This is used to allow others access to the data and instantaneous readings, but not direct communication with the H20 or the ability to quit the logging program.

The MONITOR.EXE file name should also be included in the AUTOEXEC.BAT file in your computer's root directory. This will allow the program to boot up upon restart of the computer in the event of power failure. Thus, no data will be lost except during the time of the power failure. An example of an AUTOEXEC.BAT file that has been modified for use in a monitoring system is illustrated in Figure 2. Note that the last line is the program name, MONITOR.EXE, and the path where the program is stored. This causes the program to start running when the computer boots up. You must also copy the initialization file, MONINIT.DAT, to the root directory (C:\MONINIT.DAT), so the computer can find the initialization file upon restart.

```
C:\WINDOWS\SMARTDRV.EXE
C:\24XMODE MONITOR
@ECHO OFF
PROMPT $P$G
SET MOUSE=C:\SW\MOUSE
C:\WINDOWS\MOUSE.COM /Y
PATH:C\SW\WINWORD;C:\SW\EXCEL;C:\WINDOWS;C:\DOS;C:\MONITOR
SET TEMP=C:\DOS
MOUSE.COM
NC
C:\DOS\SHARE.EXE
C:\MONITOR\MONITOR.EXE
```

Figure 2. AUTOEXEC.BAT file

3 Running the Program

To run the program, simply type in MONITOR at the cursor. Several screens of essential information will be displayed as the program starts up. Scrutinize these to ensure that the data are stored in the appropriate file and that the computer's time and date are correct.

The first screen of importance is the identification screen (Figure 3). This screen contains information concerning the version, contact addresses, and phone numbers. Note that the version number is located on the second line from the bottom. This should be used any time questions are addressed about the program.

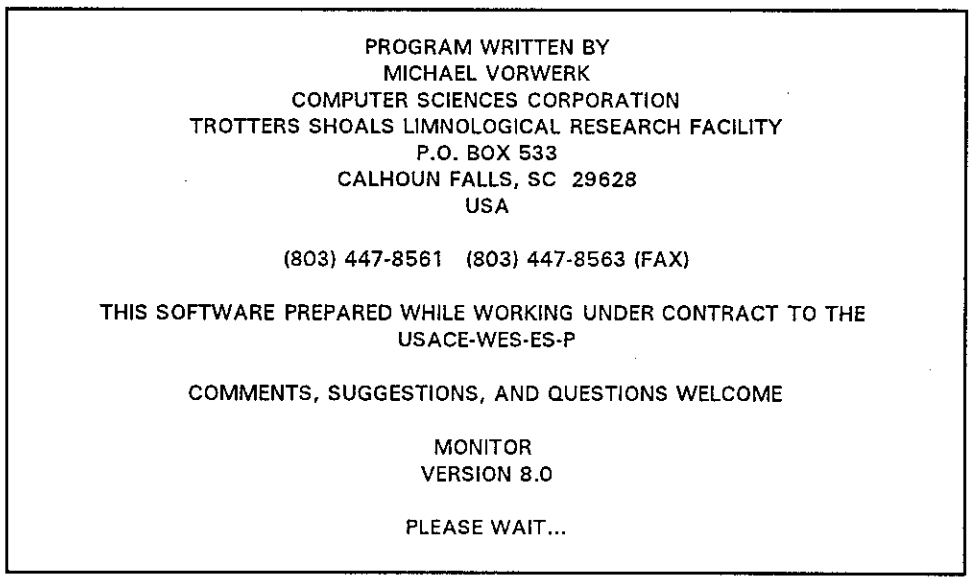

Figure 3. Identification screen

The next significant screen is the date and time screen (Figure 4). Since the program records data using the computer's built-in clock, you must be certain that the computer date and time are correct. If they are not, type CTRL-Q and exit the program.

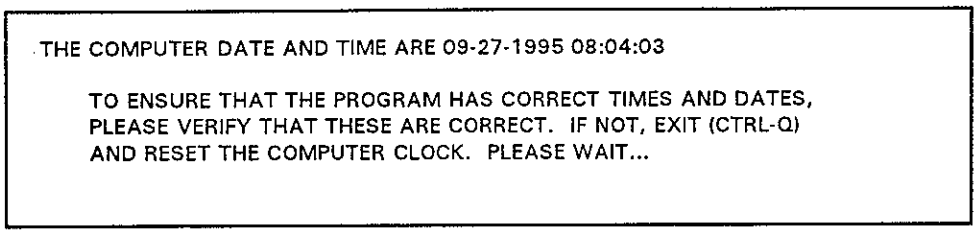

Figure 4. Time and date start-up screen

Remember to allow several seconds for the response after you type CTRL-Q. Once you are back at the C prompt, type TIME and reset the time. Next, type DATE and reset the date. To ensure that you have properly changed the time and date, type time and date again and check the computer values. If acceptable, press the ENTER key and restart MONITOR.

Next, the initialization screen, Figure 5, provides a good check to see that the values you have entered in the initialization file are in the correct order. The main data storage file name (in this case, MONIDATA.DAT) is displayed, as is the reservoir (RB), the station (S200), and the sample interval (60) in minutes. If the information shown in this screen is not what you intended when you edited the initialization file MONIINIT.DAT, type CTRL-Q and exit the program. Again, allow several seconds for the program to exit. Once back at the C Prompt, edit the MONIINIT.DAT file and format the information as described in the Software Installation section. Be aware that if the program cannot find the initialization file or if all of the parameters are not in the initialization file, the program will crash before you get to this screen. You must ensure that the initialization file and the executable program are in the same directory and that all of the parameters are specified correctly in the initialization file.

Displayed on the communications screen in Figure 6 are both the active communication port (in this case 2) and baud rate (1200). Note that the choices consist only of comm port 1 or comm port 2 and baud rate 1200 or baud rate 2400. Communication to the H20 is typically 1200 baud. The comm port required will depend on computer configuration. Usually comm port 1 is a nine pin port, and comm port 2 is a 25 pin port. Using various cables, adapters, and gender changes, the H20 can be made to talk to either type. Also, note that occasionally the program crashes while trying to open the comm port. For instance, if the H20 is not plugged into the comm port, you will get a "Device time-out" error. In addition to this error, there are several other possible errors listed in the Errors and Error Messages section of this report. Their possible solutions are also detailed in that section.

The Hydrolab preparation screen, Figure 7, serves several purposes. First, the screen enables all of the parameters. Then, it systematically disables parameters that will not be recorded. The disabled parameters include the following:

```
HERE ARE THE MONITOR PARAMETERS SPECIFIED IN THE INITIALIZATION FILE
MONIINIT.DAT:

THE MAIN DATA FILE IS:    C:\MONITOR\MONIDATA.DAT
THE RESERVOIR IS:         RB
THE STATION IS:           S200
THE INTERVAL IS:          60 MINUTES

THE UPPER TEMPERATURE BOUND IS:          30 DEGREES
THE LOWER TEMPERATURE BOUND IS:          6 DEGREES
THE UPPER DISSOLVED OXYGEN BOUND IS:     10 MG/L
THE LOWER TEMPERATURE BOUND IS:          2 MG/L

DRIVESAVE IS ON



IF THIS INFORMATION IS NOT CORRECT, (CTRL-Q) TO QUIT THIS PROGRAM,
THEN EDIT THE INITIALIZATION FILE MONIINIT.DAT TO INCLUDE THE CORRECT
PARAMETERS, PLEASE WAIT...
```

Figure 5. Initialization screen

```
COMMUNICATIONS PORT 2 IS OPEN AT 1200 BAUD RATE

DATA IS APPENDED TO MONIDATA.DAT: ^M TO MEASURE
```

Figure 6. Communications screen

```
PROGRAM WILL PREPARE HYDROLAB FOR USE. (CTRL-Q TO QUIT)

PROGRAM IS ENABLING ALL PARAMETERS, PLEASE WAIT...

PROGRAM IS DISABLING P, PLEASE WAIT...
PROGRAM IS DISABLING S, PLEASE WAIT...
PROGRAM IS DISABLING %, PLEASE WAIT...
PROGRAM IS DISABLING R, PLEASE WAIT...
PROGRAM IS DISABLING D, PLEASE WAIT...
CALIBRATING TIME ON H20, PLEASE WAIT...
PROGRAM IS PREPARING H20 INTERVAL. PLEASE WAIT...
```

Figure 7. Hydrolab preparation screen

P(pH)
S(alinity)
%(percent saturation for dissolved oxygen)
R(edox potential)
D(epth)

This leaves the parameters to be recorded, which are those of most common interest in tailwater and release monitoring. These recorded parameters are as follows:

O(dissolved oxygen, mg/ℓ)
T(emperature)
S(pecific conductivity)
B(attery)

Next, the program calibrates the H20 interval to 000000 to prevent the H20 from sending any "stray" data readings to the computer. Then the program calibrates the H20 time to match the computer time. This gives a backup timing system, so if the computer or H20 should lose power or otherwise go down, you will always be able to recover the correct time of any observation.

The main data recording screen, Figure 8, shows the data as they are logged. The date and time of the start of the program are shown first. As data are recorded over time, that information will be scrolled off the screen. The screen will always have the header and the data values for reservoir, station, month, day, year, computer time, Hydrolab time, temperature, specific conductivity, dissolved oxygen, and battery. On program start-up, the initial query of the H20 is often garbled resulting in a "Data not acquired" error. Thus, two observations are recorded to ensure that the data are captured.

```
DRIVESAVE IS ON.  SLEEPING 10 SECONDS, PLEASE WAIT FOR RESPONSE TO
KEYSTROKES....

RES STATION  MTH  DAY  YEAR  TIME  H2OTIME  TEMP   SPCOND  DO    BATT

RB    200    09   27   1995  0743  074306   21.57  107.0   3.80  12.5
RB    200    09   27   1995  0843  084306   22.65  112.0   3.66  12.5



DATA ARE APPENDED TO MONIDATA.DAT:                    ^M TO MEASURE
```

Figure 8. Main data recording screen

At the bottom of the screen in Figure 8, you are reminded that the data are being appended to the main data recording file. At anytime, CTRL-Q will quit the program, but the option to quit can only be accessed by the main

password. Thus, you can allow other users to look at the data files with less apprehension that the program might be disrupted or exited altogether.

Once the program is logging, the only active keys are CTRL-M, CTRL-Q, CTRL-P, and CTRL-T. These commands allow access to the user menus while preventing any errors associated with careless or accidental keystrokes. At any time, CTRL-M will take an instantaneous reading, and CTRL-Q will quit the program. CTRL-P will print data, detailed in the Printing a File section, and CTRL-T will allow talking to the H20 directly as detailed in the Instantaneous Readings section. Note that the computer may take up to 10 sec to respond to any commands. Please be patient before trying a second set of keystrokes.

Instantaneous Readings

Once the program is logging, instantaneous readings are available from the Hydrolab by typing CTRL-M for "measure" or by entering CTRL-T for the direct connect mode. Note that the computer screen has no prompts telling the operator this access sequence. The option to communicate directly with the H20 is password protected, accessed only via the main password. Thus, the printer-access-only password cannot communicate directly with the H20. This helps prevent casual interference by unauthorized users. Previous experience has shown that casual users may inadvertently press the space bar, accessing the H20 menu, and then walk away. This leaves the H20 waiting for a command and not logging data.

After typing CTRL-T, the screen will issue a prompt stating that you are in the direct connect mode and that CTRL-L will lock the communications and return you to the main data recording screen. In this direct connect window, you may communicate with the H20 by pressing the space bar to access the H20 on-line menu. Next, typing an "M" will give a measurement, i.e., an instantaneous reading of current water quality conditions. Any other communications that may be performed with an H20 (see H20 manual) can be carried out from this screen.

The communication will be recorded in the main data file. This communication is separated from normal recording by having a row of asterisks printed before and after the communication. The computer date and time of the communication are recorded at the beginning of the direct connect.

Below is an example of the direct connect screen, Figure 9, as it appears prior to any communication with the H20. To end the direct connect session, type CTRL-L. This will return you to the data recording screen. Please note that it may take several seconds after typing the CTRL-L to return to the main recording screen. Occasionally, you may accidentally type CTRL-T more than one time. This causes the screen to have a series of numbers at the bottom, which may be eliminated by entering CTRL-T again.

```
DIRECT COM WITH HYDROLAB, SPACEBAR(MENU), ^L(CONT. LOGGING), ^Q(QUIT)
```

Figure 9. Direct connect screen

Figure 10 is an example of a main data file that was annotated by a direct communication session. Note that the data in the file is in a comma-delimited format for easier importing into other applications, such as spreadsheets. The direct communication session is set off from the data by two rows of asterisks. The initials of the person initiating the direct connect are recorded as well as the date and time of the communication. In this example, an instantaneous reading was taken by pressing the space bar, which gives the Hydrolab an on-line menu, PCVHMI, and then typing an M to take a measurement, or instantaneous reading. This and other communication possibilities are detailed in the H20 manual.

```
RB, 200, 6470.283 ,09,27,1995,14,17,59,141758,24.94,108.7,3.11,12.5
RB, 200, 6470.3 ,09,27,1995,14,18,11,141810,24.96,108.7,3.11,12.5
RB, 200, 6470.317 ,09,27,1995,14,19,03,141902,24.96,108.7,3.11,12.5
RB, 200, 6470.333 ,09,27,1995,14,20,16,142015,24.98,108.7,3.10,12.5
RB, 200, 6470.333 ,09,27,1995,14,20,18,142017,24.98,108.7,3.11,12.5
**********************************************
DIRECT CONNECT HAS BEEN ESTABLISHED BY MCV
COMPUTER DATE IS 09-27-1995 COMPUTER TIME IS 14:20:24
PCVHMI: M
142027  24.98   108.7    3.11    12.5
**********************************************
RB, 200, 6470.333 ,09,27,1995,14,20,32,142031,24.98,108.7,3.11,12.5
RB, 200, 6470.35 ,09,27,1995,14,21,04,142103,24.99,108.7,3.11,12.5
RB, 200, 6470.367 ,09,27,1995,14,22,06,142205,24.99,108.7,3.12,12.5
RB, 200, 6470.383 ,09,27,1995,14,23,08,142307,25.01,108.7,3.12,12.5
```

Figure 10. Main data file

Calibrating the H20

To calibrate the H20, access the direct communication screen by typing CTRL-T. Then enter the main password. This will establish a direct connection to the H20, as detailed above in the section Instantaneous Readings. Refer to the H20 manual for further calibration instructions. A sample calibration record sheet is included in Appendix C. When calibration is complete, the direct connection can be ended by typing CTRL-L to lock the communications. This will return you to the main data recording screen. Alternatively, to calibrate, you may quit the program and establish a direct connection to the sonde using the COMTALKR.EXE software.

To calibrate dissolved oxygen using the percent saturation method, as detailed in the H20 manual, you must first re-enable %. To do this, establish a direct connection with the H20 using the CTRL-T command. Next, press the space bar to access the H20 menu. Type "P" for parameters, "%" for percent saturation, and "E" for enable. This will cause the H20 to have five enabled parameters. This can be verified by taking an instantaneous reading (pressing space bar followed by "M"). Next calibrate according to the H20 procedures detailed in the H20 manual. Disable the % parameter by pressing the space bar, followed by "P", "%", and "D". This will cause the H20 to again have four parameters. Verify this by taking another instantaneous reading. If you do not disable %, the program will not correctly log data.

Another common method of calibration is to calibrate the H20 to a Winkler titration standard. This is a method of determining the concentration of dissolved oxygen in the water using titration techniques. This is detailed in the current issue of *Standard Methods for the Analysis of Water and Wastewater.*

Note: It is convenient to have a spare sonde that is calibrated in the office. Then you need only take the sonde to the monitor site, exchange sondes, and restart the MONITOR program. This restart is necessary to ensure correct calibration of the H20 time. The sonde that was in the field can be brought to the office, cleaned, serviced, and prepared for redeployment.

Printing a File

To print a file, type CTRL-P from the main data recording screen. You will be prompted for the printing password and your initials. Then the print screen will appear, and you will be reminded of the main data file name and the current daily data file name. If you wish to view one of these two file names, simply type the name at the prompt and press enter. Also, you may enter any previous data file for printing. However, caution is in order, because the program may crash if you enter an invalid (nonexisting) file name. If the program crashes, simply restart the MONITOR program.

The printing screen, Figure 11, displays several important pieces of information. It shows the main data file name, in this case, MONIDATA.DAT, and the current daily file name, which is SS092795.DAT for this example. To view or save one of these files, or any previous daily file, simply type the name at the prompt and press return. If you wish to return to the main program, type "R" and press ENTER.

After you have entered the file name and pressed return, you will be given the option to (V)iew the file on the screen, to (S)ave the file to disk, or to (R)eturn to the main data recording screen as shown in Figure 12. Choose an option. If you view the file on the screen and the file is too long to fit on the screen, you need to hit return to scroll through the entire file. At the

```
                WELCOME TO THE MONITOR PRINTER SUBROUTINE

PLEASE ENTER THE NAME OF THE FILE YOU WISH TO VIEW OR SAVE
THE MAIN FILE YOU SPECIFIED FOR DATA STORAGE IS C:\MONITOR\MONIDATA.DAT

DAILY FILES ARE STORED AS STMMDDYY.DAT,
THE LAST DAILY FILE WAS   C:\MONITOR\SS092795.DAT


TYPE THE FILE NAME WITHOUT PATH.  FOR EXAMPLE, FILENAME.DAT
ENTER FILENAME HERE:
```

Figure 11. Printing screen

```
TYPE V TO VIEW, S TO SAVE TO DISK, OR R TO RETURN TO PROGRAM.
THE FILE SELECTED IS:  S2051595.DAT
```

Figure 12. Output selection screen

completion of either print option, the program will return to the main data recording screen.

Data File Use

The program saves data in two different types of files, a main data file and daily files. The daily files are intended only as a convenient way to look at current and previous data while recording data with the MONITOR program (Figure 13). The daily files are space delimited and have the same information as you see on the computer screen when the program is running. No records of direct connections, printings, or calibrations are shown on the daily files.

```
05 02 1995 1031 DATA NOT ACQUIRED
RB S200 05 02 1995 1031 103147 19.89 1.0 4.14 12.3
05 02 1995 1034 DATA NOT ACQUIRED
RB S200 05 02 1995 1034 103452 19.89 0.9 4.15 12.3
RB S200 05 02 1995 1035 103519 19.90 0.9 4.17 12.3
RB S200 05 02 1995 1035 103525 19.90 1.0 4.16 12.3
RB S200 05 02 1995 1035 103538 19.90 1.0 4.17 12.3
RB S200 05 02 1995 1035 103552 19.90 1.0 4.16 12.3
RB S200 05 02 1995 1037 103701 19.90 1.0 4.18 12.3
RB S200 05 02 1995 1037 103707 19.90 1.0 4.18 12.3
```

Figure 13. Daily file

The other type is a main data file (Figure 14). The main data file is the one to be used for inclusion in any master data set or for any data analysis. The main data file has a header and comma-delimited data for easy import into various applications such as spreadsheets or graphics packages. Note that the file has the date and time of initiation, the date and time of ending, and the initials of the person ending the program; in this particular example, there is also an asterisked region containing a direct connect log, as discussed in Instantaneous Readings.

```
PROGRAM INITIATED 09-27-1994 14:10:50

RES STATION DECHOUR MTH DAY YEAR HOUR MIN SEC H2OTIME TEMP SPCOND DO BATT

RB,200, 6470.167 ,09,27,1994,14,10,52,141050,24.86,108.7,3.11,12.5
RB,200, 6470.167 ,09,27,1994,14,10,54,141053,24.85,108.7,3.11,12.5
**********************************************
DIRECT CONNECT HAS BEEN ESTABLISHED BY MCV
COMPUTER DATE IS 09-27-1994 COMPUTER TIME IS 14:11:02 _PCVHMI: M
141107  24.86   108.7    3.10    12.5
PCVHMI: M
141110  24.86   108.7    3.10    12.5
**********************************************
RB,200,6470.183,09,27,1994,14,11,15,141114,24.86,108.7,3.10,12.5
RB,200,6470.183,09,27,1994,14,11,17,141116,24.86,108.7,3.10,12.5
RB,200,6470.2,09,27,1994,14,12,09,141208,24.86,108.7,3.11,12.5
RB,200,6470.283,09,27,1994,14,17,57,141755,24.96,108.7,3.11,12.5
RB,200,6470.283,09,27,1994,14,17,59,141758,24.94,108.7,3.11,12.5
RB,200,6470.3,09,27,1994,14,18,11,141810,24.96,108.7,3.11,12.5
RB,200,6470.317,09,27,1994,14,19,03,141902,24.96,108.7,3.11,12.5
RB,200,6470.333,09,27,1994,14,20,16,142015,24.98,108.7,3.10,12.5
RB,200,6470.333,09,27,1994,14,20,18,142017,24.98,108.7,3.11,12.5
**********************************************
PROGRAM ENDED BY QUIT ON 09-27-1994 14:24:03
PROGRAM ENDED BY MCV
```

Figure 14. Main data file

Unless the data requires special manipulation (e.g., the time being off or the necessity of some postrecording calibration change), the data can be imported for use as soon as the data set is cleaned. This is accomplished by first saving a backup copy of the data set in a safe place, such as a write-protected floppy disk or separate directory and then editing the file with a DOS text editor. Editing will consist of removing extraneous information so that only the header and data remain. Thus, initiation and program quit information should be deleted, as well as records of any direct connections or print sessions.

Finally, the edited main data file, Figure 15, now contains only the header and data. This data set includes the variables reservoir, station, decimal hour, month day, year, computer hour, computer minute, computer second, Hydrolab time, temperature, specific conductivity, dissolved oxygen, and battery voltage. The decimal hour is used for plotting data. Note that the decimal

```
RES STATION DECHOUR MTH DAY YEAR HOUR MIN SEC H2OTIME TEMP SPCOND DO BATT
RB,200,6470.167,09,27,1995,14,10,52,141050,24.86,108.7,3.11,12.5
RB,200,6470.167,09,27,1995,14,10,54,141053,24.85,108.7,3.11,12.5
RB,200,6470.183,09,27,1995,14,11,15,141114,24.86,108.7,3.10,12.5
RB,200,6470.183,09,27,1995,14,11,17,141116,24.86,108.7,3.10,12.5
RB,200,6470.2,09,27,1995,14,12,09,141208,24.86,108.7,3.11,12.5
RB,200,6470.283,09,27,1995,14,17,57,141755,24.96,108.7,3.11,12.5
RB,200,6470.283,09,27,1995,14,17,59,141758,24.94,108.7,3.11,12.5
RB,200,6470.3,09,27,1995,14,18,11,141810,24.96,108.7,3.11,12.5
RB,200,6470.317,09,27,1995,14,19,03,141902,24.96,108.7,3.11,12.5
RB,200,6470.333,09,27,1995,14,20,16,142015,24.98,108.7,3.10,12.5
RB,200,6470.333,09,27,1995,14,20,18,142017,24.98,108.7,3.11,12.5
```

Figure 15. Example of edited main data file

hour is the time, measured in hours, from the beginning of the year. Using this variable, you can plot any data versus time throughout the year.

Errors and Error Message

Device time-out

- Can be caused by not having the Hydrolab connected to the serial port, mislabeling the serial port in the MONIINIT.DAT file, or by not having proper wiring connected to the H20.

Data not acquired

- Normally caused by a dead H20 battery or a fault in the connection between the H20 and the computer.

Communications overflow

- Interval on H20 not set to 000000. This fills the communications buffer and overloads the communication.
- Header not disabled. From command menu of H20, type (v)ariable, v(h)eader, and (d)isable.

Appendix A
MONITOR Software

The MONITOR Software was written using BASIC language with QUICKBASIC software.

```
1 REM THIS PROGRAM WILL READ H20 DATA FROM A MACHINE AND PLACE IT IN A FILE
2 REM WRITTEN BY MICHAEL VORWERK, TSLRF, PO BOX 533, CALHOUN FALLS, SC 29628
3 REM
6 REM  GOTO 24000
7  CLEAR , , 10000
10 SCREEN 0, 0: WIDTH 80
15 KEY OFF: CLS : CLOSE
20 DEFINT A-Z
25 LOCATE 25, 1

'*****************MAIN BEGINS HERE *********************

100 GOSUB 10000 'INITIALIZES H20 AND GETS THE FILES AND SCREEN READY
110 LOCATE 1, 1
200 PRINT "PROGRAM INITIATED "; DATE$; " "; TIME$
    PRINT ""
201 OPEN DSKFIL$ FOR APPEND AS #5
202 PRINT #5, "PROGRAM INITIATED "; DATE$; " "; TIME$
    PRINT #5, ""
    PRINT #5, "RES STATION DECHOUR MTH DAY YEAR HOUR MIN SEC H20TIME TEMP SPCOND DO BATT"
    PRINT #5, ""
203 CLOSE (5)
    M$ = INPUT$(LOC(1), #1) 'CLEARS BUFFER
204 GOSUB 1000 'GETS A FIRST READING ON THE H20
210 IF DRIVESAVE$ = "Y" THEN
       LOCATE 1, 1: PRINT "COMPUTER CHECKING FOR INPUT.  PLEASE WAIT FOR RESPONSE TO KEYSTROKE...    "
    END IF
    IF DRIVESAVE$ <> "Y" THEN LOCATE 1, 1: PRINT "COMPUTER CHECKING FOR KEYBOARD INPUT."
       LOCATE 2, 1: PRINT "RES STATION MTH DAY YEAR TIME  H20TIME TEMP   SPCOND DO    BATT          "
215 KEYSTROKEENTRY$ = INKEY$: IF KEYSTROKEENTRY$ = "" THEN 240
220 IF KEYSTROKEENTRY$ = CHR$(17) THEN GOSUB 30000 'CTRL Q TO QUIT PROGRAM
230 IF KEYSTROKEENTRY$ = CHR$(20) THEN GOSUB 3000  'CTRL T TO TALK TO H2O
```

```
235 IF KEYSTROKEENTRY$ = CHR$(16) THEN GOSUB 9000  'CTRL P TO PRINT OUT A DATA FILE
236 IF KEYSTROKEENTRY$ = CHR$(13) THEN GOSUB 1000  'CTRL M TO TAKE A MEASUREMENT
240 GOSUB 4000 'CAUSES THE H20 TO BE READ EACH INTERVAL
    IF DRIVESAVE$ = "Y" THEN
       LOCATE 1, 1: PRINT "DRIVESAVE IS ON. SLEEPING 10 SECONDS, PLEASE WAIT FOR RESPONSE TO KEYSTROKES..."
       LOCATE 2, 1: PRINT "RES STATION MTH DAY YEAR TIME  H20TIME TEMP   SPCOND DO    BATT          "
       SLEEP (10)
    END IF
270 GOTO 210

999 STOP 'END OF MAIN

'*****************************************************************

REM SUBROUTINES FOLLOW BELOW

1000 REM ****THIS SUB WILL TAKE A HYDROLAB MEASUREMENT
     REM NEXT LINES PROMPT USER NOT TO ENTER KEYSTROKES AND PROVIDE A HEADER
     ON ERROR GOTO 210
     LOCATE 1, 1: PRINT "COMPUTER TAKING A MEASUREMENT.  DO NOT ENTER KEYSTROKES OR SONDE WON'T RECORD "
        LOCATE 2, 1: PRINT "RES STATION MTH DAY YEAR TIME  H20TIME TEMP   SPCOND DO    BATT                "
        PRINT #1, CHR$(27)
        A$ = INPUT$(LOC(1), #1) 'GETS RID OF OLD BUFFER TRASH
        A$ = INPUT$(LOC(1), #1)
1010 PRINT #1, " " 'SENDS SPACE TO COMPORT
1020 SLEEP (3) 'WAITS FOR H20 TO RETURN MENU
1040 PRINT #1, "M" 'SENDS M TO COMPORT TO HAVE H20 MEASURE
1042 SLEEP (3)
1090 IF LOC(1) > 128 THEN PAUSE = TRUE: PRINT #1, XOFF$;
1100 A$ = INPUT$(LOC(1), #1) 'GETS RESPONSE FROM COMPORT
        REM DATAAVAILABLE$ = "YES" 'INITIAL COND ALLOWS POSSIBILITY OF H20 NOT TALKING
        IF (LEFT$(A$, 8) <> "PCVHMI: " OR MID$(A$, 10, 1) <> "M") THEN
           DATAAVAILABLE$ = "NO" 'SENDS TO DATA NOT ACQUIRED
           GOTO 1150
```

```
    ELSE

    REM C$ = MID$(A$, 38) 'LINE IS REMOVED FOR H20,WAS USED FOR REPORTER
       C$ = MID$(A$, 42) 'LINE IS REMOVED FOR H20,WAS USED FOR REPORTER
       CNUM = VAL(C$)

       IF CNUM < 0 OR CNUM > 15 THEN 'CHECKS TO SEE THAT TEMPERATURE PARAMETER IS PRESENT
          DATAAVAILABLE$ = "NO" 'IF NOT, DATA NOT ACQUIRED
          GOTO 1150
       ELSE DATAAVAILABLE$ = "YES"
       END IF

    END IF

1105 TEMPFIL4NAME$ = "C:\" + SUBDIRECTORYNAME$ + "\TEMPFIL4.DAT"
1110 OPEN TEMPFIL4NAME$ FOR OUTPUT AS #4
1115 GOSUB 8000
1120 PRINT #4, MONTH$; " "; DAY$; " "; YEAR$; " "; HOUR$; " "; MIN$; " "; SEC$; " "; A$;
1140 CLOSE #4
1150 IF PAUSE THEN PAUSE = FALSE: PRINT #1, XON$;
1151 CLOSE (4)
1152 IF DATAAVAILABLE$ = "YES" THEN GOSUB 5000 'SENDS DATA LINE TO BE ORGANIZED
1157 GOSUB 6000 'CLEANS DATA AND ADDS RES AND STATION
1170 RETURN

'*************************************************************************
2000 REM THIS SUB PUTS IN HEADERS EVERY 11 LINES FOR THE SCREEN
    IF COUNTAROOSKI = 0 THEN
       PRINT "RES STATION MTH DAY YEAR TIME  H20TIME TEMP   SPCOND DO    BATT"
       REM , CHR$(10)
       PRINT ""
    END IF
    COUNTAROOSKI = COUNTAROOSKI + 1
    IF COUNTAROOSKI = 20 THEN COUNTAROOSKI = 0
       RETURN
```

```
'*************************************************************************
3000 REM THIS SUB WILL ALLOW COMMUNICATION WITH THE HYDROLAB
3110 CLS
     ON ERROR GOTO 210
     PRINT TIME$; " THIS IS THE START TIME"
     INPUT "PLEASE ENTER MAIN PASSWORD:  ", PASSWORD$
     PASSWORD$ = LCASE$(PASSWORD$)
     IF PASSWORD$ = "" THEN GOTO 3155 'TAKES CARE OF RETURN WITH NO CHARACTER
     IF PASSWORD$ = MAINPASSWORD$ THEN GOTO 3115
     IF PASSWORD$ <> MAINPASSWORD$ THEN 'AND IS NOT AN EMPTY PLACE
        PRINT "THIS PASSWORD IS INVALID.  YOU WILL BE RETURNED TO PROGRAM"
        SLEEP (2)
     GOTO 3155
     END IF
3115 INPUT "PLEASE ENTER YOUR INITIALS:  ", INITIALS$
     CLS 'GETS SCREEN CLEAR SO HEADER IS ALL THAT IS ON PAGE
3120 LOCATE 25, 1: PRINT "DIRECT COM WITH HYDROLAB, SPACEBAR(MENU), ^ L(CONT. LOGGING), ^ Q(QUIT)"
     PRINT #1, " "
     SLEEP (2)
     PRINT #1, "H"  'THE ORDER OF THIS AND THE NEXT LINE HAVE BEEN SWITCHED 10/11/94
     A$ = INPUT$(LOC(1), #1)
3125 OPEN DSKFIL$ FOR APPEND AS #5 'PUTS DATE AND TIME IN MAIN DATA FILE
3126 PRINT #5, "*******************************************"
     PRINT #5, "DIRECT CONNECT HAS BEEN ESTABLISHED BY "; INITIALS$
3127 PRINT #5, "COMPUTER DATE IS "; DATE$; " COMPUTER TIME IS "; TIME$; " "; A$;
3128 CLOSE (5)
3129 OPEN DSKFIL$ FOR APPEND AS #5    'SECTION GETS DATE ON CORRECT LINE
3130 A$ = INKEY$
     IF A$ = "" THEN
     GOTO 3170
     END IF
3140 IF A$ = CHR$(17) THEN
     CLOSE (5) 'CLOSES DSKFIL$ INCASE QUIT UNSUCCESSFULL
     GOSUB 30000 'QUITS PROGRAM
```

```
      OPEN DSKFIL$ FOR APPEND AS #5 'IF 30000 IS UNSUCCESSFUL, PROGRAM RETURNS HERE
      GOTO 3151
      END IF
3150 IF A$ = CHR$(12) THEN 'QUITS TALKING TO H20
3151      PRINT #5, "*****************************************"
3155      PRINT "COMMUNICATION TO H20 IS LOCKED OFF"
          SLEEP (2)
          CLS
          CLOSE (5)
          LOCATE 25, 1: PRINT "DATA IS APPENDED TO  "; SHORTDSKFIL$; ": ^M TO MEASURE"
          A$ = INPUT$(LOC(1), #1)
          COUNTAROOSKI = 0
          GOSUB 1000
          GOTO 210 'THIS CAUSES PROGRAM TO RETURN TO THE MAIN PORTION
      END IF
3160 PRINT #1, A$;        'SENDS INFO TO COM PORT
3170 IF EOF(1) THEN 3130
3180 IF LOC(1) > 128 THEN PAUSE = TRUE: PRINT #1, XOFF$;
3190 A$ = INPUT$(LOC(1), #1) 'GETS RESPONSE FROM COMPORT
3220 PRINT #3, A$;
3225 PRINT #5, A$;
3230 CLOSE (5)
3240 IF PAUSE THEN PAUSE = FALSE: PRINT #1, XON$;
3250      GOTO 3129
          PRINT TIME$; " THIS IS THE STOP TIME"
          CLOSE (4)
3300 RETURN


4000 REM SUBROUTINE CONTROLS THE TIMING OF THE H20 READING

4010 GOSUB 8000 'GETS CURRENT TIME

     IF INTERVAL = 60 THEN 'THIS SAMPLES ON EVEN HOURS, I.E, NO MINS OR SECS
        IF HOUR$ < > PREVIOUSHOUR$ THEN
```

```
            GOSUB 1000
            PREVIOUSHOUR$ = HOUR$
         END IF
      END IF

      IF INTERVAL = 1 THEN 'THIS SAMPLES ON EVEN MINUTES, I.E., NO SECONDS
         IF MIN$ < > PREVIOUSMIN$ THEN
            GOSUB 1000
            PREVIOUSMIN$ = MIN$
         END IF
      END IF

      IF INTERVAL = 10 THEN 'THIS SAMPLES ON EVEN TEN MINUTES, I.E., 10, OR 20 OR...I.E., NO EXTRA MINUTES OR SEC
      TENS = INT(MIN / 10)
      IF TENS = (MIN / 10) THEN
      IF MIN$ < > PREVIOUSMIN$ THEN
      GOSUB 1000
      PREVIOUSMIN$ = MIN$
      END IF
      END IF
      END IF

      IF INTERVAL < > 1 AND INTERVAL < > 10 AND INTERVAL < > 60 THEN 'CASE WHERE NOT ROUNDED SAMPLE TIME
      IF MIN < > PREVIOUSMIN THEN SAMPLE$ = "YES" 'CUTS ON SAMPLER
      IF MIN = PREVIOUSMIN THEN SAMPLE$ = "NO" 'CUTS OFF SAMPLER
      IF DECHOUR>=NEXTSAMPLETIME! AND SAMPLE ="YES" THEN  'SAMPLES IF SAMPLER ON AND MIN=INITIAL
         MINUTEON  GOSUB 1000                                    'INTERVAL ADDITIVE THEREOF
      NEXTSAMPLETIME! = DECHOUR! + (INTERVAL / 60)
      END IF
      PREVIOUSMIN = MIN
      END IF
4030 RETURN
```

```
'*************************************************************************
5000 REM SUB WILL READ IN TEMPMONI FILE AND CLEAN ERRORS AND OUTPUT
5002 REM IT AS TEMPFIL8.DAT
     ON ERROR GOTO 210
     CONST LINEFEED = 10, CARRETURN = 13, TABCHAR = 9, COLON = 58
     REM COMMA=44 ZERO=48 NUMBERS = 44 TO 58
     TEMPFIL4NAME$ = "C:\" + SUBDIRECTORYNAME$ + "\TEMPFIL4.DAT"
     TEMPFIL8NAME$ = "C:\" + SUBDIRECTORYNAME$ + "\TEMPFIL8.DAT"
     OPEN TEMPFIL4NAME$ FOR INPUT AS #4
     OPEN TEMPFIL8NAME$ FOR OUTPUT AS #8
     CHARACTERLAG1 = 48 'INITIAL VALUE OF ZERO FOR PREVIOUS CHARACTER
     CHARACTERLAG2 = 48
     CHARACTERLAG3 = 48

     WHILE NOT EOF(4)
        CHARACTER$ = INPUT$(1, #4) 'READS IN ONE CHARACTER
        CHARVAL = ASC(CHARACTER$) 'ASSIGNS CHARACTER'S ASCI VALUE TO CHARVAL
        IF CHARACTERLAG1 = 58 AND CHARACTERLAG2 = 73 THEN GOTO 5200 ' IF I:
        IF CHARACTERLAG1 = 73 AND CHARACTERLAG2 = 77 THEN GOTO 5200 ' IF MI
        IF CHARVAL = 58 OR CHARVAL = 9 OR CHARVAL = 32 OR CHARVAL = 45 THEN
        CHARVAL = 44      'COLON OR TAB BECOME COMMAS
        CHARACTER$ = ","
        END IF

        IF (CHARVAL < 59 AND CHARVAL > 43) THEN 'PRINT DATA TO FILE
        IF CHARACTERLAG1 = 44 AND CHARACTER$ = "," THEN GOTO 5200
        IF CHARACTERLAG1 = 13 AND CHARVAL = 13 THEN GOTO 5200
        PRINT #8, CHARACTER$; 'SENDS DATA TO TEMPFIL5.DAT 'A TEMPORARY STORAGE FILE
        IF CHARVAL = 44 THEN CHARACTER$ = "  " 'PUTS SPACES AND NOT COMMAS IN SCREEN FILE
        END IF

5200    CHARACTERLAG3 = CHARACTERLAG2
5210    CHARACTERLAG2 = CHARACTERLAG1
5220    CHARACTERLAG1 = CHARVAL
    WEND
```

```
      PRINT #8, CHR$(13)
      CLOSE (4)
      CLOSE (8)
      RETURN

6000 REM*************************************************************************
6001 REM ***************SUBROUTINE WILL MAKE GOOD DATA FILE***************
      ON ERROR GOTO 210
6021 IF DATAAVAILABLE$ = "YES" THEN 'IMPLIES THAT H20 GAVE A READING
      CLOSE (5) 'THESE LINES ENSURE THAT NO OPEN FILES REMAIN
      CLOSE (8)
      CLOSE (13)
      OPEN DSKFIL$ FOR APPEND AS #5       ' TO SEND OUTPUT TO MAIN FILE

      TEMPFIL8NAME$ = "C:\" + SUBDIRECTORYNAME$ + "\TEMPFIL8.DAT"
      OPEN TEMPFIL8NAME$ FOR INPUT AS #8
      OPEN DAILYFILE$ FOR APPEND AS #13   ' TO SEND OUTPUT TO DAILY FILE

      INPUT #8, MONTH$, DAY$, YEAR$, HOUR$, MIN$, SEC$, H20TIME$, TEMP$, SPCOND$, DOX$, BATT$
      DECHOURSTRING$ = STR$(DECHOUR!)
      PRINT #5, RES$; ","; STATION$; ","; LTRIM$(DECHOURSTRING$); ","; MONTH$; ","; DAY$; ","; YEAR$; ","; HOUR$; ","; MIN$;
            ","; SEC$; ","; H20TIME$; ","; TEMP$; ","; SPCOND$; ","; DOX$; ","; BATT$ 'This line and the above line should be one line.
      LOCATE 24, 1'THIS PUTS THE COMPUTER PRINT OF DATA AT THE 2ND LINE FROM BOTTOM OF SCREEN
      REM****NEXT LINE PRINTS DATA TO SCREEN
      PRINT #3, RES$; "   "; STATION$; "    "; MONTH$; "  "; DAY$; "  "; YEAR$; " "; HOUR$; MIN$; "  "; H20TIME$; "  "; TEMP$; "
         "; SPCOND$; "  "; . DOX$; "  "; BATT$ 'This should be on the above line.
      PRINT #13, RES$; "   "; STATION$; "    "; MONTH$; "  "; DAY$; "  "; YEAR$; " "; HOUR$; MIN$; "  "; H20TIME$; "  "; TEMP$; "
         "; SPCOND$; "  "; . DOX$; "  "; BATT$ 'This should be on the above line

      CLOSE (8) 'THIS GIVES ALL THE VARIABLES IN CHARACTER FORM FOR OUTPUT TO THE DSKFIL

      TEMPFIL8NAME$ = "C:\" + SUBDIRECTORYNAME$ + "\TEMPFIL8.DAT"
      OPEN TEMPFIL8NAME$ FOR INPUT AS #10
      INPUT #10, MONTH!, DAY!, YEAR!, HOUR!, MIN!, SEC!, H20TIME!, TEMP!, SPCOND!, DOX!, BATT!
```

```
    IF MONTH! <= 0 OR MONTH! >= 13 THEN
       PRINT #5, "MONTH IS OUT OF RANGE" 'AND NOT FROM 8 ABOVE
    END IF
    IF DAY! <= 0 OR DAY! >= 32 THEN
       PRINT #5, "DAY IS OUT OF RANGE"
    END IF
    IF YEAR! <= 1993 OR YEAR! >= 2000 THEN
       PRINT #5, "YEAR IS OUT OF RANGE"
    END IF
    IF HOUR! < 0 OR HOUR! >= 24 THEN
       PRINT #5, "HOUR IS OUT OF RANGE"
    END IF
    IF MIN! < 0 OR MIN! >= 60 THEN
       PRINT #5, "MIN IS OUT OF RANGE"
    END IF
    IF SEC! < 0 OR SEC! >= 60 THEN
       PRINT #5, "SEC IS OUT OF RANGE"
    END IF
    COMPUTERTIME! = ((HOUR! * 10000) + (MIN! * 100) + SEC!)

REM THE FOLLOWING SECTION MAY BE USED TO DETECT WHEN COMPUTER AND SONDE ARE OUT OF SYNCH.
REM    F (COMPUTERTIME! + 100 - H20TIME!) <= 0 THEN
REM    PRINT #5, "H20 OR COMPUTER TIME IS OUT OF SYNCH"
REM        END IF
REM    IF (COMPUTERTIME! - 100 - H20TIME!) >= 0 THEN
REM        PRINT #5, "H20 OR COMPUTER TIME IS OUT OF SYNCH"
REM        END IF
    IF DOX! > UBDOX OR DOX! < LBDOX THEN
       PRINT #5, "OXYGEN VALUE OUT OF REASONABLE RANGE"
    END IF
    IF TEMP! > UBTEMP OR TEMP! < LBTEMP THEN
       PRINT #5, "TEMPERATURE OUT OF RANGE"
    END IF
6050 CLOSE #10
6051 CLOSE #5
```

```
6052 CLOSE #13
     END IF

     IF DATAAVAILABLE$ = "NO" THEN 'IMPLIES THAT H20 DID NOT GIVE A READING
          OPEN DSKFIL$ FOR APPEND AS #5       ' TO SEND OUTPUT TO MAIN FILE
          OPEN DAILYFILE$ FOR APPEND AS #13   ' TO SEND OUTPUT TO DAILY FILE
          PRINT #5, MONTH$; ","; DAY$; ","; YEAR$; ","; HOUR$; ","; MIN$; ","; "DATA NOT ACQUIRED"
          LOCATE 24, 1
          PRINT #3, MONTH$; "  "; DAY$; "  "; YEAR$; " "; HOUR$; MIN$; "  "; "DATA NOT ACQUIRED"
          PRINT #13, MONTH$; "  "; DAY$; "  "; YEAR$; " "; HOUR$; MIN$; "  "; "DATA NOT ACQUIRED"
          CLOSE #5
          CLOSE #13
     END IF
6070 RETURN

REM*************************************************************************
REM THE FOLLOWING SECTION HAS SUBROUTINES THAT WILL PREPARE H20
REM FOR USE BY CONTROLLING VARIABLES AND CALIBRATING THE TIME
REM TO MATCH THE COMPUTER TIME

7000 REM THIS SUB ENABLES/DISABLES APPROPRIATE PARAMETERS
7001 CLS
     PRINT ""
7002 PRINT "PROGRAM WILL PREPARE HYDROLAB FOR USE. (CTRL-Q TO QUIT)"
     PRINT ""
7010 VARIABLE$ = "A" 'ENABLE ALL PARAMETERS TO BEGIN
7020 GOSUB 7200
7030 VARIABLE$ = "P" 'DISABLE PH
7040 GOSUB 7300
7050 VARIABLE$ = "S" 'DISABLE SALINITY
7060 GOSUB 7300
7070 VARIABLE$ = "%" 'DISABLE DO SATURATION
7080 GOSUB 7300
7090 VARIABLE$ = "R" 'DISABLE REDOX
```

```
7100 GOSUB 7300
7110 VARIABLE$ = "D" 'DISABLE DEPTH
7120 GOSUB 7300
REM 7125 VARIABLE$ = "C" 'DISABLE CONDUCTIVITY
REM 7126 GOSUB 7300
7130 GOSUB 7500 'CALIBRATES THE H20 TIME
7180 GOSUB 7600
     PRINT #1, CHR$(27)
     B$ = INPUT$(LOC(1), #1) 'CLEANS ANY EXTRA STUFF IN COMMUNICATIONS BUFFER
     B$ = INPUT$(LOC(1), #1)
     CLS
7190 RETURN

7199 REM*************************************************************************
7200 REM SUBROUTINE WILL TALK TO H20 AND ENABLE PARAMETERS INDICATED IN 7000
7205 PRINT #3, "PROGRAM IS ENABLING ALL PARAMETERS, PLEASE WAIT... "
     PRINT ""
7210 PRINT #1, " "
7220 SLEEP (1)
7230 PRINT #1, "P"
     SLEEP (1)
7240 PRINT #1, VARIABLE$
7250 SLEEP (1)
7255 PRINT #1, "E"
7260 SLEEP (1)
7265 KEYSTROKEENTRY$ = INKEY$: IF KEYSTROKEENTRY$ = "" THEN 7270
7266 IF KEYSTROKEENTRY$ = CHR$(17) THEN GOSUB 30000  'CTRL S TO QUIT PROGRAM
7270 RETURN

7299 REM*************************************************************************
7300 REM SUBROUTINE WILL TALK TO H20 AND DISABLE PARAMETER INDICATED IN 7000
7305 PRINT #3, "PROGRAM IS DISABLING  "; VARIABLE$; ",  PLEASE WAIT... "
7310 PRINT #1, " "
7320 SLEEP (1)
7330 PRINT #1, "P"
```

```
      SLEEP (1)
 7340 PRINT #1, VARIABLE$
 7350 SLEEP (1)
 7355 PRINT #1, "D"
 7360 SLEEP (1)
 7365 KEYSTROKEENTRY$ = INKEY$: IF KEYSTROKEENTRY$ = "" THEN 7370
 7366 IF KEYSTROKEENTRY$ = CHR$(17) THEN GOSUB 30000  'CTRL Q TO QUIT PROGRAM
 7370 RETURN

 7499 REM*************************************************************************
 7500 REM  SUBROUTINE CALIBRATES THE TIME ON THE HYDROLAB
      A$ = INPUT$(LOC(1), #1) 'DUMPS BUFFER SO H20 CAN TALK CLEARLY
      PRINT "CALIBRATING TIME ON H20, PLEASE WAIT..."
      PRINT #1, " " 'COMMUNICATES TO H20
      SLEEP (1)
      PRINT #1, "C"
      SLEEP (1)
      PRINT #1, "T";
      SLEEP (1)
      GOSUB 8000 'GETS M,D,Y,H,M,S
      PRINT #1, HOUR$; MIN$; SEC$ 'SENDS CORRECT TIME TO SONDE
      SLEEP (1)
      B$ = INPUT$(LOC(1), #1)
      SLEEP (1)
      RETURN

 7599 REM*************************************************************************
 7600 REM SUBROUTINE WILL SET INTERVAL TO ZERO
 7605 PRINT #3, "PROGRAM IS PREPARING H20 INTERVAL.  PLEASE WAIT... "
      A$ = INPUT$(LOC(1), #1)
      A$ = INPUT$(LOC(1), #1)
 7610 PRINT #1, " ";
 7620 SLEEP (2)
```

```
7630 PRINT #1, "C";
     SLEEP (2)
7640 PRINT #1, "I";
7650 SLEEP (2)
7655 PRINT #1, "000000";
7660 SLEEP (2)
     A$ = INPUT$(LOC(1), #1)'DUMPS BUFFER FROM H20
     PRINT #1, CHR$(27)
7665 KEYSTROKEENTRY$ = INKEY$: IF KEYSTROKEENTRY$ = "" THEN 7370
7666 IF KEYSTROKEENTRY$ = CHR$(17) THEN GOSUB 30000  'CTRL Q TO QUIT PROGRAM
7670 RETURN


REM ************************************************************************

8000 REM SUB WILL FIND TIME AND DATE AND PRINT IN A CONVENIENT FORMAT.
     REM IT WILL ALSO GENERATE A DECIMAL HOUR.
     TEMPFIL1NAME$ = "C:\" + SUBDIRECTORYNAME$ + "\TEMPFIL1.DAT"
     OPEN TEMPFIL1NAME$ FOR OUTPUT AS #6
8020 PRINT #6, DATE$; "-"; TIME$;
8030 CLOSE #6
8040 OPEN TEMPFIL1NAME$ FOR INPUT AS #6
     TEMPFIL2NAME$ = "C:\" + SUBDIRECTORYNAME$ + "\TEMPFIL2.DAT"
     OPEN TEMPFIL2NAME$ FOR OUTPUT AS #7
8060 WHILE NOT EOF(6)
8070 CHARACTER$ = INPUT$(1, #6)
8080 IF CHARACTER$ = "-" THEN CHARACTER$ = ","
8090 IF CHARACTER$ = " " THEN CHARACTER$ = ","
8095 IF CHARACTER$ = ":" THEN CHARACTER$ = ","
8100 PRINT #7, CHARACTER$;
8110 WEND
8120 CLOSE #6
8130 CLOSE #7
     TEMPFIL2NAME$ = "C:\" + SUBDIRECTORYNAME$ + "\TEMPFIL2.DAT"
     OPEN TEMPFIL2NAME$ FOR INPUT AS #7
```

```
8150 INPUT #7, MONTH$, DAY$, YEAR$, HOUR$, MIN$, SEC$
8160 CLOSE #7
     OPEN TEMPFIL2NAME$ FOR INPUT AS #7
8180 INPUT #7, MONTH, DAY, YEAR, HOUR, MIN, SEC
8190 CLOSE #7
8200 GOSUB 25000
     SHORTYEAR$ = RIGHT$(YEAR$, 2)
     SHORTSTATION$ = LEFT$(STATION$, 2)
     DAILYFILE$ = "C:\" + SUBDIRECTORYNAME$ + "\" + SHORTSTATION$ + MONTH$ + DAY$ + SHORTYEAR$ + ".DAT"
     IF OLDDAILYFILE$ <> DAILYFILE$ THEN
        DAILYFIL$ = "C:\" + SUBDIRECTORYNAME$ + "\DAILYFIL.DAT"
        OPEN DAILYFIL$ FOR APPEND AS #16
        PRINT #16, DAILYFILE$
        OLDDAILYFILE$ = DAILYFILE$
        CLOSE (16)
     END IF
8210 RETURN

' ************************************************************************
9000 REM THIS SUB WILL PRINT OUT DATA FILES
     ON ERROR GOTO 24000
     CLOSE (5)
     CLOSE (15)
     CLOSE (16)
     FILESWITCH$ = "NO"
     CLS
     PRINT ""
     INPUT "PLEASE ENTER PASSWORD FOR ACCESS TO PRINTING:  ", PASSWORD$
     PASSWORD$ = LCASE$(PASSWORD$)
     IF PASSWORD$ = MAINPASSWORD$ OR PASSWORD$ = PRINTPASSWORD$ THEN GOTO 9010
     IF PASSWORD$ <> MAINPASSWORD$ AND PASSWORD$ <> PRINTPASSWORD$ THEN
        PRINT "THIS PASSWORD IS INVALID.  YOU WILL BE RETURNED TO PROGRAM"
        SLEEP (2)
        GOTO 9100
```

```
    END IF
9010 INPUT "PLEASE ENTER YOUR INITIALS:  ", INITIALS$
    GOSUB 8000 'GETS CURRENT TIME
    GOSUB 25000 'GETS CURRENT DECIMAL HOUR
    SUBSTARTTIME = DECIMALHOUR

    CLS
    PRINT "          WELCOME TO THE MONITOR PRINTER SUBROUTINE"
    PRINT ""
    PRINT "PLEASE ENTER THE NAME OF THE FILE YOU WISH TO VIEW OR SAVE."
    PRINT "THE MAIN FILE SPECIFIED FOR DATA STORAGE IS "; DSKFIL$
    DSKFIL$ = LCASE$(DSKFIL$)
    PRINT ""
    PRINT "DAILY FILES ARE STORED AS  STMMDDYY.DAT,"
    PRINT ""
    PRINT "THE LAST DAILY FILE WAS    "; DAILYFILE$; "."
    PRINT ""
    PRINT ""
    PRINT "TYPE THE FILENAME WITHOUT PATH.  FOR EXAMPLE, FILENAME.DAT."
    INPUT "ENTER FILENAME HERE:  ", FILENAME$
    FILENAME$ = LCASE$(FILENAME$)
9050
    CHECKFILENAME$ = "C:\" + SUBDIRECTORYNAME$ + "\" + FILENAME$
    CHECKFILENAME$ = LCASE$(CHECKFILENAME$)
    CLS

    DSKFIL$ = LCASE$(DSKFIL$)
    DAILYFILE$ = LCASE$(DAILYFILE$)

    IF CHECKFILENAME$ = DSKFIL$ THEN GOTO 9070
    IF CHECKFILENAME$ = DAILYFILE$ THEN GOTO 9070
    IF FILENAME$ = "R" THEN GOTO 9100
    REM NEXT LINES CAN BE USED TO PREVENT ERROR WHEN TYPING EMPTY RETURN
    REM IF FILENAME$ = "" THEN  'THIS TAKES CARE OF RETURN W/O TYPING A NAME
    REM   FILENAME$ = DAILYFILE$ 'AND IS SORT OF A DEFAULT VALUE
```

```
      REM   GOTO 9070
      REM   END IF
      IF CHECKFILENAME$ <> DSKFIL$ AND FILENAME$ <> "R" AND CHECKFILENAME$ <> DAILYFILE$ THEN
         DAILYFILENAME$ = "C:\" + SUBDIRECTORYNAME$ + "\DAILYFIL.DAT"
         OPEN DAILYFILENAME$ FOR INPUT AS #16 'LOOKS IN RECORD OF RECORDED FILES
      WHILE NOT EOF(16)                    'TO SEE IF FILE IS VALID.
         INPUT #16, OLDFILENAMES$
         IF OLDFILENAMES$ = CHECKFILENAME$ THEN FILESWITCH$ = "YES"
      WEND
      CLOSE (16)
      END IF

         IF FILESWITCH$ = "NO" THEN
         GOTO 9060
         ELSEIF FILESWITCH$ = "YES" THEN GOTO 9070
      END IF

9060  REM THIS IS THE MESSAGE FOR INVALID FILE NAMES
      PRINT ""
      PRINT ""
      PRINT "FILENAME '"; FILENAME$; "' IS INVALID."
      PRINT ""
      PRINT "THE FILE YOU ENTERED WAS: "; FILENAME$; "."
      PRINT ""
      PRINT "THE CURRENT DAILY FILE IS: "; DAILYFILE$; "."
      PRINT "THE MAIN DATA FILE IS:    "; DSKFIL$; "."
      PRINT ""
      INPUT "ENTER VALID FILENAME HERE (WITHOUT PATH) OR R TO RETURN TO PROGRAM:  ", FILENAME$
      FILENAME$ = LCASE$(FILENAME$)
      IF FILENAME$ = "R" THEN GOTO 9100
      IF FILENAME$ = "" THEN GOTO 9100
      CLS
      GOTO 9050
```

```
9070 REM THIS IS THE PART FOR GOOD FILE NAMES
     IF FILENAME$ = "R" THEN GOTO 9100 'R TO RETURN TO PROGRAM
     IF FILENAME$ = "" THEN GOTO 9100' RETURN AT PROMPT WITH NO NAME
     OPEN CHECKFILENAME$ FOR INPUT AS #11

     DO
     CLS
     LOCATE 2, 1, 1
     PRINT "TYPE V TO VIEW, S TO SAVE TO DISK, OR R TO RETURN TO PROGRAM "
     PRINT "THE FILE SELECTED IS: "; FILENAME$; "."
     LOCATE 2, 47, 1
     CHOICE$ = UCASE$(INPUT$(1))
     PRINT CHOICE$
     LOOP WHILE CHOICE$ <> "S" AND CHOICE$ <> "V" AND CHOICE$ <> "R" AND CHOICE$ <> ""

     IF CHOICE$ = "" THEN GOTO 9100  'RETURNS TO PROGRAM IF RETURN IS HIT W/ NO CHARACTER
     IF CHOICE$ = "R" THEN GOTO 9100 'R TO RETURN TO PROGRAM
     IF CHOICE$ = "S" THEN
        CLS
        EXPORTDATAFILE$ = FLOPPYDRIVE$ + FILENAME$
        PRINT ""
        PRINT "MAKE SURE THE DISK IS IN THE 3.5 DRIVE OR PROGRAM WILL CRASH."
        INPUT "PRESS RETURN WHEN READY", DRIVEOK$
        OPEN EXPORTDATAFILE$ FOR OUTPUT AS #12
        PRINT "SAVING FILE "; EXPORTDATAFILE$; " TO DISK."
     END IF

     IF CHOICE$ = "V" THEN
        CLS
        CLOSE (3)
        OPEN "SCRN:" FOR OUTPUT AS #12
        PRINTCOUNTER = 1 'SETS INITIAL CONDITION
        PRINTANSWER$ = "YES" 'SETS INITIAL CONDITION
     END IF
```

```
WIDTH #12, 80
IF CHOICE$ = "S" THEN
   CLS
   PRINT ""
   PRINT "PLEASE WAIT..."
   SLEEP (2)
END IF

DO UNTIL EOF(11)
   IF CHOICE$ = "S" THEN
      LINE INPUT #11, LINEBUFFER$
      PRINT #12, LINEBUFFER$
   END IF
   IF CHOICE$ = "V" THEN
   IF PRINTANSWER$ = "YES" THEN
   LINE INPUT #11, LINEBUFFER$
   IF PRINTCOUNTER = 1 THEN
   PRINT #12, "RES STATION MTH DAY YEAR TIME  H20TIME TEMP   SPCOND DO    BATT"
   END IF
   PRINT #12, LINEBUFFER$
   PRINTCOUNTER = PRINTCOUNTER + 1
END IF
IF PRINTANSWER$ = "NO" THEN
   INPUT "PRESS RETURN TO VIEW MORE DATA.", MOREANSWER$
   PRINTANSWER$ = "YES"
END IF
IF PRINTCOUNTER = 23 THEN
   PRINTANSWER$ = "NO"
   PRINTCOUNTER = 1
END IF
END IF
LOOP
```

```
      IF CHOICE$ = "V" THEN
      INPUT "END OF DATA.  PRESS RETURN TO EXIT TO PROGRAM.", ANSWER$
      CLOSE (12)
      OPEN "SCRN:" FOR OUTPUT AS #3
      END IF
      IF CHOICE$ = "S" THEN CLOSE (12)
      CLOSE (11)

9100 CLS
      PRINT "CONTINUING DATA COLLECTION..."  'FOLLOWING RETURNS TO PROGRAM OPERATION
      SLEEP (3)
      CLS
      COUNTAROOSKI = 0
      CLOSE (11)
      CLOSE (12)
      LOCATE 25, 1: PRINT "DATA IS APPENDED TO  "; SHORTDSKFIL$; ": ^M TO MEASURE"
      OPEN DSKFIL$ FOR APPEND AS #16
      PRINT #16, "***********************************************"
      PRINT #16, "PRINTER SUBROUTINE ACCESSED BY: "; INITIALS$; " ON "; DATE$; " "; TIME$; " ."
      PRINT #16, "FILE "; FILENAME$; "; "; WAS; PRINTED OR SAVED.; ""
      PRINT #16, "***********************************************"
      CLOSE (16)
      GOSUB 1000
9999 RETURN

REM ************************************************************************
10000 REM THIS SUB STARTS THE PROGRAM
      DATAAVAILABLE$ = "YES"'INITIAL CONDITION TO PREVENT PROGRAM CRASH WHEN NO DATA
10020 OLDDAILYFILE$ = "1"
10030 COUNTAROOSKI = 0 'GIVES INITIAL CONDITION FOR 2000
10040 PREVIOUSHOUR$ = "INITIALHOUR" 'GIVES INITIAL CONDITION FOR 4000
10050 PREVIOUSMIN$ = "INITIALMIN"
      PREVIOUSMIN = 0
      NEXTSAMPLETIME! = 0
```

```
10051 LOCATE 5, 1
      PRINT "    M          M   OOOOO    N     N  II  TTTTTTTT   OOOOO    RRRRRR  "
      PRINT "    MM        MM  O     O  NN    N  II     TT      O     O  R     R  "
      PRINT "    M  M    M  M  O     O  N N   N  II     TT      O     O  RRRRR   "
      PRINT "    M   M  M   M  O     O  N  N  N  II     TT      O     O  RR  RR  "
      PRINT "    M          M  O     O  N   N N  II     TT      O     O  RR   RR "
      PRINT "    M          M   OOOOO   N     N  II     TT       OOOOO   RR    RR "
      SLEEP (3)
      LOCATE 20, 20
      PRINT "TYPE S FOR SHORT INITIALIZATION"
      SLEEP (4)
      INITIALIZATIONTYPE$ = INKEY$
      IF INITIALIZATIONTYPE$ = "S" THEN GOTO 10128
      CLS
      LOCATE 1, 1
      PRINT ""
      PRINT "  THIS PROGRAM WILL RECORD HYDROLAB REPORTER DATA FROM A COMPORT,"
      PRINT "  BAUDRATE, AND INTERVAL SPECIFIED IN THE MONIINIT.DAT FILE. "
      PRINT ""
      PRINT "  THE DATA WILL BE SAVED TO A FILE AND SUBDIRECTORY SPECIFIED "
      PRINT "  IN THE MONIINIT.DAT FILE."
      PRINT ""
      PRINT "  PLEASE WAIT..."
      SLEEP (10)
      CLS
      PRINT ""
      PRINT "                    PROGRAM WRITTEN BY"
      PRINT ""
      PRINT "                      MICHAEL VORWERK"
      PRINT "                       DynCorp Corporation"
      PRINT "          TROTTERS SHOALS LIMNOLOGICAL RESEARCH FACILITY"
      PRINT "                         P.O. BOX 533"
      PRINT "                      CALHOUN FALLS, SC  29628"
      PRINT "                            USA"
```

```
      PRINT ""
      PRINT "            (803) 447-8561     (803) 447-8563 FAX "
      PRINT ""
      PRINT ""
      PRINT "THIS SOFTWARE PREPARED WHILE WORKING UNDER CONTRACT TO THE USACE-WES-ES-P"
      PRINT ""
      PRINT ""
      PRINT "          COMMENTS, SUGGESTIONS, AND QUESTIONS WELCOME"
      PRINT ""
      PRINT "                        V.MONITOR.BAS"
      PRINT "                            Version 8.0"
      PRINT
      PRINT "                        PLEASE WAIT...."
      SLEEP (6)
      CLS
      PRINT ""
      PRINT ""
      PRINT "THE COMPUTER DATE AND TIME ARE  "; DATE$; " "; TIME$
      PRINT ""
      PRINT ""
      PRINT "    TO ENSURE THAT THE PROGRAM HAS CORRECT TIMES AND DATES, "
      PRINT "    PLEASE VERIFY THAT THESE ARE CORRECT.  IF NOT, EXIT (CTRL-Q)"
      PRINT "    AND RESET THE COMPUTER CLOCK.  PLEASE WAIT..."
      SLEEP (15)
10128 KEYSTROKEENTRY$ = INKEY$: IF KEYSTROKEENTRY$ = "" THEN GOTO 10129
10129 IF KEYSTROKEENTRY$ = CHR$(17) THEN GOSUB 30000   'CTRL S TO QUIT PROGRAM
      CLS
      PRINT ""
      PRINT ""
10149 PRINT "OPENING INITIALIZATION FILE "
      PRINT ""
10150 OPEN "MONIINIT.DAT" FOR INPUT AS #8
10151 INPUT #8, HEADERLINE$
      INPUT #8, SUBDIRECTORYNAME$, RES$, STATION$, INTERVAL, DSKFIL$, COMPORTNUMBER, BAUDRATE, FLOPPYDRIVE$,
        UBTEMP, LBTEMP, UBDOX, LBDOX, DRIVESAVE$, MAINPASSWORD$, PRINTPASSWORD$ 'This should be on the above line.
```

```
      DSKFIL$ = LCASE$(DSKFIL$)
      PRINT ""
      PRINT ""
      MAINPASSWORD$ = LCASE$(MAINPASSWORD$)
      PRINTPASSWORD$ = LCASE$(PRINTPASSWORD$)
      DSKFIL$ = LCASE$(DSKFIL$)
      SHORTDSKFIL$ = LCASE$(DSKFIL$)
      DSKFIL$ = "C:\" + SUBDIRECTORYNAME$ + "\" + SHORTDSKFIL$
10153
      PRINT "HERE ARE THE MONITOR PARAMETERS SPECIFIED IN THE INITIALIZATION FILE"
      PRINT "MONIINIT.DAT: "; ""
      PRINT ""
      PRINT "THE MAIN DATAFILE IS:  "; DSKFIL$; "."
      PRINT "THE RESERVOIR IS:      "; RES$; "."
      PRINT "THE STATION IS:        "; STATION$; "."
      PRINT "THE INTERVAL IS:       "; INTERVAL; " MINUTES."
      PRINT ""
      PRINT "THE UPPER TEMPERATURE BOUND IS:      "; UBTEMP; " DEGREES."
      PRINT "THE LOWER TEMPERATURE BOUND IS:      "; LBTEMP; " DEGREES."
      PRINT "THE UPPER DISSOLVED OXYGEN BOUND IS: "; UBDOX; " MG/L."
      PRINT "THE LOWER DISSOLVED OXYGEN BOUND IS: "; LBDOX; " MG/L."
      PRINT ""
      IF DRIVESAVE$ = "Y" THEN PRINT "DRIVESAVE IS ON."
      IF DRIVESAVE$ = "N" THEN PRINT "DRIVESAVE IS OFF."
      IF DRIVESAVE$ < > "Y" AND DRIVESAVE$ < > "N" THEN PRINT "CAUTION!!!! INVALID DRIVESAVE PARAMETER."
      PRINT ""
      PRINT ""
      PRINT "IF THIS INFORMATION IS NOT CORRECT, (CTRL-Q) TO QUIT THIS PROGRAM,"
      PRINT "THEN EDIT THE INITIALIZATION FILE MONIINIT.DAT TO INCLUDE THE CORRECT"
      PRINT "PARAMETERS, PLEASE WAIT..."
      PRINT ""
      SLEEP (15)
      CLS
```

```
10155 CLOSE (8)
      LOCATE 25, 1: PRINT "DATA IS APPENDED TO  "; SHORTDSKFIL$; ": ^M TO MEASURE"
10160 OPEN "SCRN:" FOR OUTPUT AS #3 'THESE LINES OPEN THE FILES FOR COMMUNICATION
10170 REM THIS PART OPENS THE COMPORT FOR COMMUNICATION
      IF COMPORTNUMBER = 2 AND BAUDRATE = 1200 THEN OPEN "COM2:1200,N,8,1" FOR RANDOM AS #1
      IF COMPORTNUMBER = 2 AND BAUDRATE = 2400 THEN OPEN "COM2:2400,N,8,1" FOR RANDOM AS #1
      IF COMPORTNUMBER = 1 AND BAUDRATE = 1200 THEN OPEN "COM1:1200,N,8,1" FOR RANDOM AS #1
      IF COMPORTNUMBER = 1 AND BAUDRATE = 2400 THEN OPEN "COM1:2400,N,8,1" FOR RANDOM AS #1
      PRINT ""
      PRINT "COMMUNICATIONS PORT "; COMPORTNUMBER; " IS OPEN AT "; BAUDRATE; " BAUD RATE."
      SLEEP (10)
      CLS
      IF INITIALIZATIONTYPE$ = "S" THEN GOTO 10180
      GOSUB 7000 'PREPARES H20 FOR USE
10180 GOSUB 8000     'GETS TIME
      INITIALMIN = MIN 'SETS INITIAL MINUTE FOR READINGS IN 4000
      B$ = INPUT$(LOC(1), #1) 'CLEANS ANY EXTRA STUFF IN COMMUNICATIONS BUFFER
      B$ = INPUT$(LOC(1), #1)
      LOCATE 25, 1: PRINT "DATA IS APPENDED TO  "; SHORTDSKFIL$; ": ^M TO MEASURE"
      RETURN 'END OF INITIALIZATION SUBROUTINE

'*************************************************************************
24000 REM ERROR SUBROUTINE
      REM THIS SUB IS AN EFFORT TO PREVENT PROGRAM CRASHES WHEN ERRORS OCCUR
      REM PROGRAM REBOOTS UPON FINDING AN ERROR
      CLS
      PRINT "AN ERROR IN PROGRAM EXECUTION HAS OCCURRED."
      PRINT ""
      PRINT "HERE ARE SOME POSSIBLE CAUSES FOR ERRORS:"
      PRINT ""
      PRINT "1. INTERFACE CABLE IS DISCONNECTED FROM COMPORT"
      PRINT "2. WRONG COMPORT IS SPECIFIED IN INITIALIZATION FILE, MONIINIT.DAT"
      PRINT "3. KEYS WERE INADVERTANTLY PRESSED WHILE THE UNIT WAS TAKING A MEASUREMENT"
      PRINT "4. TRYING TO SAVE THE DATA WHEN THE DISK IS WRITE PROTECTED"
      PRINT "5. TRYING TO SAVE THE DATA WHEN THE DISK IS NOT IN THE DRIVE"
```

```
        PRINT ""
        PRINT "CORRECT THE ERROR AND RESTART THE PROGRAM.  YOU WILL NOW BE RETURNED TO DOS."
        PRINT "20 SEC PAUSE, PLEASE WAIT...; "
        PRINT ""
        PRINT "IF THIS PROGRAM IS STUCK IN AN ENDLESS LOOP ATTEMPTING TO RESTART, "
        PRINT "IT MAY BE TERMINATED BY ENTERING <CTRL> BREAK."
        SLEEP (20)
        CLS
        GOTO 10
        RETURN

REM ************************************************************************
25000 REM THIS SUBROUTINE MAKES A JULIAN DATE
25010 IF MONTH = 1 THEN BJULDAT = 0 'THIS WILL GIVE THE NUMBER OF DAYS BEFORE
25020 IF MONTH = 2 THEN BJULDAT = 31 'THE BEGINING OF THE MONTH
25030 IF MONTH = 3 THEN BJULDAT = 59
25040 IF MONTH = 4 THEN BJULDAT = 90
25050 IF MONTH = 5 THEN BJULDAT = 120
25060 IF MONTH = 6 THEN BJULDAT = 151
25070 IF MONTH = 7 THEN BJULDAT = 181
25080 IF MONTH = 8 THEN BJULDAT = 212
25090 IF MONTH = 9 THEN BJULDAT = 243
25100 IF MONTH = 10 THEN BJULDAT = 273
25110 IF MONTH = 11 THEN BJULDAT = 304
25120 IF MONTH = 12 THEN BJULDAT = 334
25130 JULDAY = BJULDAT + DAY 'THIS CALCULATES THE JULIAN DAY
25135 DECHOUR! = (((JULDAY - 1) * 24) + HOUR + (MIN / 60))
25140 RETURN

REM ************************************************************************
30000 REM THIS IS A PASSWORD PROTECT SUBROUTINE TO PREVENT
        REM UNAUTHORIZED EXIT OF PROGRAM
        CLS
        INPUT "ENTER MAIN PASSWORD TO QUIT PROGRAM:  ", PASSWORD$
```

```
      PASSWORD$ = LCASE$(PASSWORD$) 'MAKES ALL ENTRIES UPPER CASE
      IF PASSWORD$ = MAINPASSWORD$ THEN
         INPUT "ENTER INITIALS:  ", INITIALS$
         CLOSE 'CLOSES ANY OPEN FILES
         OPEN DSKFIL$ FOR APPEND AS #15
         PRINT #15, "PROGRAM ENDED BY QUIT ON "; DATE$; " "; TIME$
         PRINT #15, "PROGRAM ENDED BY "; INITIALS$
         CLOSE (15)
         GOTO 99999
      END IF

      IF PASSWORD$ <> MAINPASSWORD$ THEN
         PRINT "INVALID PASSWORD.  YOU MUST USE THE MAIN PASSWORD TO QUIT LOGGING."
         PRINT ""
         PRINT "YOU WILL BE RETURNED TO THE PROGRAM.  PLEASE WAIT..."
         SLEEP (3)
         CLS
         LOCATE 25, 1: PRINT "DATA IS APPENDED TO  "; SHORTDSKFIL$; ": ^M TO MEASURE"
         COUNTAROOSKI = 0
         GOSUB 1000
      END IF
      RETURN
REM*****************************************************************************
99999 END 'THIS IS THE END OF THE PROGRAM
```

Appendix B
Comm Port Software

This software allows direct communication with the Hydrolab. Lines 10-13 allow communication through two different ports and with two different baud rates. If Line 10 is not the correct setting for your computer, REM it out and edit out the REM for the line that matches your communication setup.

```
10 OPEN "COM1:1200,N,8,1,DS5000" FOR RANDOM AS #1  ' Opens comm port for communication.
11 REM OPEN "COM1:2400,N,8,1,DS5000" FOR RANDOM AS #1
12 REM OPEN "COM2:1200,N,8,1,DS5000" FOR RANDOM AS #1
13 REM OPEN "COM2:2400,N,8,1,DS5000" FOR RANDOM AS #1
20 CLS
30 A$ = INKEY$: IF A$ = "" THEN 90
31 LOCATE 25, 1:  PRINT "CTRL Q TO QUIT"
40 IF A$ = CHR$(17) THEN GOTO 999 'QUITS PROGRAM
50 PRINT #1, A$;              'SENDS INFO TO COM PORT
60 A$ = INPUT$(LOC(1), #1) 'GETS RESPONSE FROM COMPORT
70 PRINT A$;
80 GOTO 30
999 END 'THIS IS THE END OF THE PROGRAM
```

Appendix C
Calibration Record

Generation? Y N

Arrival Time:
Departure Time:

Hydrolab Unit: WES___ H20 DS3
Date deployed:

Initial Readings:
Temp:____°C SpCond:____µS

DO:____mg/l Bat Volt:____V

Replacement Unit: WES____ H20 DS3

Final Readings:
Temp:____°C SpCond:____µS

DO:____mg/l Bat Volt:____V

Comments:

Appendix D
Additional Readings

American Public Health Association. (1992). *Standard methods for the examination of water and wastewater*. 19th ed., American Public Health Association, Washington, DC., 4-98 - 4-105. *Standard Methods* sets the standards for proper laboratory procedures for water quality chemical analysis. This section is an informative discourse on various techniques for measuring dissolved oxygen in water.

Hydrolab Corporation. (1991). *H20® Multiparameter water quality data transmitter operating manual*. Hydrolab Corporation, Austin, TX. The H20 manual provides information on the operation and maintenance of the H20 water quality sonde.

Lemons, J. W., and Vorwerk, M. C. "Remote downstream monitoring of Savannah River hydropower releases," Miscellaneous Paper, in preparation, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS. This report details the installation of monitor systems in a series of three hydropower projects located on the Savannah River. The report includes details on calibration schedules, maintenance, and data handling.

Lettenmaier, D. P. (1978). "Design considerations for ambient stream quality monitoring," *Water Resources Bulletin* 14(4), 884-902. This paper discusses proper monitor program design to ensure samples that allow water quality trend assessment.

Loftis, J. C., and Ward, R. C. (1980). "Water quality monitoring--some practical sampling frequency considerations," *Environmental Management* 4(6), 521-526. Sampling frequency determinations affect the statistical analysis of water quality data. This paper discusses a case study and several frequency effects that may be applied to other systems.

Loftis, J. C., and Ward, R. C. (1980). "Sampling frequency selection for regulatory water quality monitoring," *Water Resources Bulletin* 16(3), 501-507. This paper discusses the selection of sampling frequency to achieve small confidence intervals about annual sample means. This information is used for regulatory purposes such as compliance monitoring.

Microsoft QuickBasic. (1990). Microsoft Corporation, Redmond, WA. This book and accompanying software provide a user-friendly programming system. The programs written in this miscellaneous paper were written using Microsoft QuickBasic.

Montgomery, R. H., and Reckhow, K. H. (1984). "Techniques for detecting trends in lake water quality," *Water Resources Bulletin* 20(1), 43-52. This paper discusses techniques for detecting water quality trends. A method is presented that provides steps for hypothesis formulation, data preparation, data analysis, and statistical tests.

Valiela, D., and Whitfield, P. H. (1989). "Monitoring strategies to determine compliance with water quality objectives," *Water Resources Bulletin* 25(1), 63-69. This paper discusses water quality compliance monitoring with respect to acute and chronic problems.

Vorwerk, M. C., and Carroll, J. H. (1994). "Implications of reservoir release and tailwater monitor placement," *Lake and Reservoir Management* 9(1), 170-172. This paper discusses a case study of how to determine the representativeness of a water monitor location. Several important considerations for monitoring releases are discussed.

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13. ABSTRACT ***(Maximum 200 words)***

The increased need to monitor hydroproject releases and tailwaters has resulted in the need for simple, inexpensive water quality monitoring systems. The water quality parameters that are of primary importance to the Corps of Engineers are dissolved oxygen and temperature. These parameters are easily measured with off-the-shelf multiparameter data sondes. Many sondes can be programmed to record data, but sonde control, data storage, and data reporting to the end user are typically complicated.

The software described in this documentation and the BASIC programs written in the accompanying appendix will communicate with and record temperature and dissolved oxygen data from a Hydrolab Instruments H20 multiparameter water quality data sonde. The password-protected program instantaneously stores data in daily and main data files, thus avoiding data loss due to buffer storage limitations. The program allows the operator to view previous files and to copy files onto a disk. The data are comma delimited allowing easy import into various database management programs. Each observation is "stand alone" and includes all identifiers (station, date, time, etc.). A special variable, decimal hour, is calculated to represent time from the beginning of the year, in hours. This allows easy plotting and comparison of data.

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