A DATA MANAGEMENT PROGRAM PACKAGE FOR AUTOMATICALLY RECORDED WATER LEVEL DATA

By J.W. Smith and G.A. Bartle

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ABSTRACT

Management of automatically recorded water level data from large numbers of boreholes, requires the user to spend a lot of time and care in keeping track of all individual data files, and in organising the final output data for analysis. This is inefficient in time and disk storage. A data management program has been designed which allows the management of all the data input files, from a group of holes, and the generation of calculated water levels, from within a single environment.
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Fig. 1. Program management structure.
1. INTRODUCTION

Many agencies are using the economical Western Australian produced 'WESDATA' range of data loggers and capacitive water level probes. When many loggers are used over long periods of time large amounts of data may be generated, and for the user, the management of data files and calibration data can be difficult and very time consuming. This Technical Memorandum describes a convenient data management program package which is aimed at minimising errors and data handling time. It allows a continuously updating database with ready access to all site and hole information and water level data. Information and data can be output to screen or line printer as text or graphics. Water level data output may also be in the form of an ASCII readable file for further data processing when required. Data can be handled from multiplexed, single and multichannel loggers and are loaded by the program from the data file dumped from the loggers without requiring any conversion and are stored in binary format for disk economy. The program has been developed (and is being used) for the management of three experimental sites for the Division of Water Resources; the sites have 13, 20 and 30 holes being monitored and have been operating for just over one year.

2. SITE WATER LEVEL DATA MANAGEMENT PROGRAM

2.1 Program Description

The program is designed to allow the user to manage, add and retrieve the water level data in a single environment without having to keep track of individual data file names and their physical locations within the computer disk system being used. This includes the backing up and retrieving of the generated information and water level data. The program management structure (see Fig. 1) is a SITE which will have a number of HOLES installed (max. 30). Each hole will have raw data files(names) attached to it (max. 30) and one hole data file which will eventually contain the water level data from all that hole's attached files. The data management package consists of three executable programs; all are interactive and menu driven and require minimum learning by the user. SMAN.EXE manages the input and output of site and hole information and the water level data generated by the logging devices installed in each hole. PCAL.EXE is used to produce a water level probe calibration file which is used by SMAN when calculating the actual water levels. UPDATE.EXE creates a new site management file from
an existing one, this function is used when the existing file contains up to two years of data (see text).

The programs were written and compiled using Microsoft QUICK BASIC version 4.5.

2.2 Management Program SMAN.EXE

SMAN consists of 4500 lines of source code contained in four modules. Module 1 contains the main line program and the procedures which manage the site and hole information i/o and water level data output. Module 2 contains the screen and keyboard i/o procedures. Module 3 procedures control the water level data input; these input routines have been specifically written to read data dumped from WESDATA data loggers which are extensively used by this Division, other manufacturers' loggers could be used by adding the appropriate input routines. Module 4 contains various date manipulating and recording procedures. A listing of the main line program is given in Appendix A.

A SITE can have a maximum of 30 installed HOLES, each of which may have a maximum of 30 raw data files recorded against it. Each SITE has a limited running time which has been set at two years and will not accept data which have a date later than Julian day 365 or 366 of the second year. If an experiment runs for more than two years then a new site must be created which will accept another two years of data. This keeps the water level data files created by the program to a manageable level. The program UPDATE can be used to create the new site file; all hole names and hole information are copied but existing water level data and data files are not.

SMAN creates a site management file, named by the user with an extension of .MAN appended by the program and is 33 k-bytes long regardless of the number of holes installed or data files recorded. The management file contains information on the site, the information is entered by the user or generated by the program when performing water level data i/o. All information fields are of fixed length and their locations within the file are indexed by the program allowing direct access to any information without the program having to search for it. This allows extremely fast response for information retrieval. All information entered by the user or generated by the program can be displayed on screen or output in report format to a printer.
Water level data management, the primary function of the program, is contrived by firstly recording a filename against an installed hole. This is the name of an original data file dumped by the data logger in the named hole. Once recorded the file is then loaded, a hole data file is created by the program when the first original data file is loaded, and any further data files recorded against this hole when loaded are appended to this hole data file. The original data files once loaded are no longer required for use by the program and can be archived as the original data backup. The hole data file is named by the program the same as the holename with an extension of `.HDF`. Hole information is generated during the loading of data files and the `.MAN` file updated with this information: for each data file, its start and end date, its location and number of records within the `.HDF` file, and for the `.HDF` file, its start and latest date and total number of records written to it.

An operational site will have a `.MAN` file and one `.HDF` file for each installed hole in the site; these are binary files and are not readable by displaying the contents to the screen or printer. The data written to the `.HDF` file is the JULIAN date, e.g. 123.5643 which uses four bytes for storage and the water level count as retrieved from the logger which uses two bytes; thus each record occupies six bytes. If data were logged at one hour intervals then one year’s data for the hole would produce a file 52 560 bytes in size; as one log per hour or more frequent logging intervals are not uncommon, the reason for limiting the running time to two years becomes apparent.

Also for sites with many holes installed, the requirement for using a computer with a hard disk drive facility becomes almost a necessity.

The raw count data contained in the `.HDF` file may be viewed or retrieved in several ways, to the screen, printer or to a disk file. The format of the output data is JULIAN date, calculated actual water levels and the raw count. The disk file output will be written to a file called 'holename' and an extension of `.PRN` it is in ASCII format and will be approximately 4.5 times the size of the `.HDF` file for that hole. Screen graphics displaying a plot of the data are also available providing the computer being used has this capability, the program automatically selects the best graphics mode available on the computer being used. A printout of the displayed plot can also be obtained.
WESDATA data logger files that can be read by SMAN are the 885 multichannel data logger (8 inputs), the 389 single channel logger with or without remote start, 389 loggers with 3 input multiplexer attachment, 390 single channel and 490 multichannel.

\[ \text{Eq. 1} \quad WL = \text{AHD} - \text{PD} + \Delta WL \]
\[ \text{Eq. 2} \quad WL = \text{PD} + \Delta WL \]
\[ \text{Eq. 3} \quad WL = \Delta WL \]

![Diagram showing water level calculation](image)

Fig. 2. Water level calculation.

Input count is the raw logged value; intercept and slope values are extracted from the probe calibration file for the water level probe ID recorded against the input data file (see Fig. 2). If Height Above Datum (AHD) is recorded for the hole then water levels are calculated as height in metres above mean sea level (Eq. 1). If AHD is not recorded against the hole for which the water levels are being calculated, the output water levels will be relative to ground level (Eq. 2) assuming the probe depth recorded is depth of probe from ground level. If no probe depth or AHD is recorded the output will be the change in water level referenced to the probe zero (Eq. 3). If AHD is recorded but no probe depth then the output is not valid.

Line editing of data fields within the SMAN environment. Any alpha numeric characters may be entered. If the data field requires numeric only, and alpha characters have been entered by error, the resulting data field will be zero. To edit existing data fields the left and right arrow keys may be used to move within the field. Unwanted characters can be deleted using the <DEL> key or by over typing. Any unwanted characters must be removed from the field before pressing the <ENTER> key. Once the data have been typed and any unwanted characters
removed, the <ENTER> key must be pressed to insert the data into the field. The backspace key has no effect when entering or editing text.

The program has a built-in SYSTEM command line interpreter which allows the user several options when initiating SMAN. The interpreter reads the entered command line and uses the information in several ways. Directly after SMAN in the command line, the site filename then the probe calibration filename may be typed. The program responses to these filenames are as follows:

1. Both site file and probe calibration file names entered. The site file will automatically be opened and when required the probe calibration file will be used.

2. Only the site file name entered. The site file will be opened and when required for water level data output the user will be prompted for the probe calibration file name.

3. No file names in command line after SMAN. The user will be required to open a site file before any functions can be performed. The exception to this is for retrieving a site file and its hole data files from previous back up. The user will also be prompted for the probe calibration file.

The various command line options are shown in the section System Hardware Requirements and Setting Up.

2.3 Probe Calibration Program PCAL.EXE

PCAL allows the creation of a probe calibration file and the entering and editing of the calibrations. The calibration file is used by the site management program when calculating the water level data for output. A calibration file can have a maximum of 200 probe calibrations entered. The information entered is the intercept and slope values, calculated when doing a calibration for the probe, and the unique three alpha numeric character identifier (probe ID) for the particular probe, the probe length is an optional field. A single calibration file can contain probe calibrations for one or several sites.

2.4 Site File Duplicating Program UPDATE.EXE

UPDATE is used to copy the relevant information from an old .MAN file to a new one. This becomes necessary if a site has run over the allowed two year period, or can be used for shorter periods. When a new site file is created by UPDATE, the existing holes with the attached hole
information are transferred to the new site file but the attached data files and information on them are not. An option during the creation of the new file is to delete unwanted holes. Creating a new site file with UPDATE where hole information from the old file is relevant saves the user from having to re-enter all the existing information.

3. SYSTEM HARDWARE REQUIREMENTS AND SETTING UP

SMAN requires an IBM XT or AT compatible PC, with at least two floppy disk drives and 512 kilobytes of available memory. For best performance and ease of operation a hard disk with one or two floppy disk drives is recommended. The time taken to generate the data for graphics will be considerably reduced if a math co-processor is also installed. For graphics print-out an EPSON FX,MX series or SEIKOSHA BP-50241 type printer.

3.1 Installing SMAN for Two Floppy Drive Configuration

The SMAN.EXE, PCAL.EXE and the probe calibration file .WLC are on a separate disk (program disk) from the .MAN, .HDF files (site disk), a separate site disk being required for each site being managed and the user will need to be careful not to exceed the 362 k-byte capacity when designing each site. The expected size can be calculated from file size information given in the program description.

For floppy disk drives A: and B: the following configurations should be used:

1. Program disk containing SMAN.EXE, PCAL.EXE and .WLC probe calibration file run in drive A:
2. Site disk containing sitefile sitename.MAN and hole data files holename.HDF run in drive B:
3. Input data files are read from drive A:
4. Output data files written to drive A:
5. Backup of site and data files written to drive A:
6. See program instructions for prompts requiring disk changes.

Program initialization methods. Optional command lines which can be entered at the DOS system prompt B:>
1. A:SMAN sitename A:calibration filename <ENTER>
SMAN will open the sitename file and use the probe calibration file named when required.

2. A:SMAN sitename <ENTER>
SMAN will open the sitename file and prompt the user when the probe calibration file is required.

3. A:SMAN <ENTER>
The user will need to open a site file and will be prompted for the probe calibration file when required.

3.1.1 Installing SMAN on a hard disk

Create a program directory (parent) to contain the executable programs SMAN and PCAL and the probe calibration file .WLC. Create a site subdirectory (child) for each site being managed which will contain the .MAN and .HDF files SMAN creates. If site files are used in the same directory, the user must ensure that holenames in different sites do not have the same name because the .HDF file produced for these holes in each site will have the same name and will be overwritten each time a data file is loaded by either site. Back-up of site and data files usually to drive A:

Assuming hard disk drive is C:, then; Copy SMAN.EXE, PCAL.EXE and probe calibration file to parent directory, each child subdirectory will contain a site.MAN and holname.HDF files as they are created. Input and output water level data can be read from or written to either the hard disk or floppy disk drive(s)

Program initialisation methods for hard disk. For these examples the parent directory is called SITMAN and the child subdirectory SITE1. Log to sub-directory SITE1 and use one of the command line entries shown below to initialise SMAN.

Command lines entered at the system prompt C:\SITMAN\SITE1>
1. C:\SITMAN\SMAN sitename C:\SITMAN\calibration file name <ENTER>
2. C:\SITMAN\SMAN sitename <ENTER>
3. C:\SITMAN\SMAN <ENTER>
The program responses will be the same as 1, 2 and 3 for floppy drives. Users familiar with the MS-DOS operating system may wish to
construct .BAT files which contain the above DOS commands and run it from the site subdirectory.

Options 1 and 2 for both hard and floppy drive setups can only be used with an existing site file; option 3 is when a new site file has to be created and with existing site files.

4. PROGRAM OPERATION

4.1 Site Management Program (SMAN.EXE)

Operation

NOTES: 1. This program recognises upper or lower case lettering.
        2. All menu selection options can be addressed either by shifting the cursor onto the required item and pressing <ENTER> or by typing the item number.
        3. Information enclosed in <<......>> applies only when two floppy disk program setup is used.

To EXECUTE type SMAN at the DOS prompt and press <ENTER>.
Screen shows: Acknowledgements, press <ENTER>.
Screen shows:

```
--- BOREHOLE MANAGEMENT PROGRAM ---

MENU  1  Site name: DUG89

Open a site management file........... 1
Install, edit hole names.............. 2
Enter, edit hole information......... 3
Display hole information........... 4
Add a data file for hole............ 5
Display data file information....... 6
Print site file information......... 7
W.level data input/output........... 8
Exit from program................... 9

Screen 2.0
```
2.1. To CREATE a new or OPEN an existing site management file, select option 1.

Screen shows:

```
BOREHOLE MANAGEMENT PROGRAM

MENU 3  Site name..CUB89

Open an existing site file........ 1
Create a new site file........... 2
Return to MENU 1.................. 3
```

Screen 2.1

2.11. Option 1 from menu 1 must be addressed each time the operator uses the program or swaps from one site to another (i.e. to open an existing file). Failure to open a site file prompts a warning before continuing.

However if the hard disk setup option outlined in the program description section is used then by typing the batch file name the program will automatically open the named site file and use the named probe calibration file. The currently opened site file name is displayed in all menu screens. On selecting option 1 to open an existing site file.

Screen shows:

```
Open a site file.

Enter name of site file..cub89

To return to MENU 1 press <ENTER> for site file.
```

Screen 2.11

Enter filename, no extension and press <ENTER>

2.12. Select option 2 from menu 3 to create a new site file.
Screen shows:

Create a site file.

The site file should be 8 characters or less. Do not enter the file extension to the filename.
Enter name of site file..cubB9

To return to MENU 1 press <ENTER> for site file.

Screen 2.12

Enter filename and press <ENTER>

Once a site file has been created or opened program returns to menu 1.

2.2 To INSTALL or EDIT hole names select 2 from menu 1.

Screen shows:

<table>
<thead>
<tr>
<th>Hole no.</th>
<th>Name</th>
<th>Hole no.</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>C7B9</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>C7C</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>C9B9</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>C9C</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>C9B9</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>C8C</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>CDR1</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>C11C</td>
<td>23</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>C10C</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>C5B</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>C2A</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>C4</td>
<td>27</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td></td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td></td>
<td>29</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
<td>30</td>
<td></td>
</tr>
</tbody>
</table>

There are 12 holes installed for site --> cubB9

To install a hole, type the name (max 4 chars.) and <ENTER>.

Use the ARROW keys to move UP or DOWN the list.

To CHANGE a name type over then <ENTER>.

To DELETE a name use DEL key then <ENTER>.

Press <ESC> when finished. WARNING!! once data files and hole information have been added ONLY the last hole can be DELETED else the site file WILL be corrupted..............!!!

Screen 2.2

The sample given shows some holes having been installed. Note the warning!! A hole must be left there if it becomes redundant.
2.3. To ENTER or EDIT hole information select 3 from menu 1.

Screen shows:

There are 12 holes installed for site -> cub89

<table>
<thead>
<tr>
<th>Hole no.</th>
<th>Name</th>
<th>Hole no.</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>C7B8</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>C7C</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>C9B8</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>C9C</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>CB88</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>CBC</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>CDR1</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>C11C</td>
<td>23</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>C1OC</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>C5G</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>C2A</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>C4</td>
<td>27</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td></td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td></td>
<td>29</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
<td>30</td>
<td></td>
</tr>
</tbody>
</table>

Select a hole by typing the required holenumber or use the ARROW KEYS to highlight the holename. Then press <ENTER>

Press the <ESC> key to return to previous MENU

Screen 2.31

This is the hole selection screen which allows the user to address a hole for which an operation will be carried out. In this case the hole information. This screen will be referred to frequently in the text for other options.

Select the required hole.

Screen shows:

<table>
<thead>
<tr>
<th>Site name</th>
<th>cub89</th>
<th>Hole name</th>
<th>C7B8 Holenumber</th>
<th>l</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. data files.</td>
<td>8</td>
<td>Ht. above Datum..m</td>
<td>376.89 Screen material... pvc</td>
<td></td>
</tr>
<tr>
<td>Start day.</td>
<td>13/ 4/89</td>
<td>Probe depth at installation..m</td>
<td>9.17 Screen diameter..mm</td>
<td>40</td>
</tr>
<tr>
<td>End day...</td>
<td>30/ 4/90</td>
<td>Bentonite seal...m</td>
<td>10 Screen length....m</td>
<td>1.85</td>
</tr>
<tr>
<td>Low level...</td>
<td></td>
<td>Pipe material..... pvc</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recorded...</td>
<td></td>
<td>Pipe diameter...mm</td>
<td>40 Screen at depth..m</td>
<td>12.00</td>
</tr>
<tr>
<td>High level...</td>
<td></td>
<td>Pipe depth.......m</td>
<td>13.85 Screen construction...</td>
<td>slotted</td>
</tr>
<tr>
<td>Recorded...</td>
<td></td>
<td>Above ground....cm</td>
<td>40 Density factor..</td>
<td>1.000</td>
</tr>
</tbody>
</table>

Comments.
Replacement for D.of A. well 7b which is slotted to the top.

Location on the site...
upslope below laterite ridge

Date of installation...
14/12/88

Screen 2.32
This operation allows the user to enter some brief descriptive details of the particular borehole and also some values to be used in the water level calculations.

The figures in the left hand column are all updated by the program and cannot be accessed by the user; all other data, comment fields must be input by the user.

There are three important figures on the screen for calculation, the rest are informative records for the hole and are fairly obvious.

Line one on the central column is for the AHD figure if required. This allows data to be output referenced to AHD.

Line two central column is the depth from the top of borehole to a datum point on the probe. In our case it is point 0 as defined in our calibration. This allows output as depth below top of borehole and obviously if the figure you enter here has the height of borehole above ground deducted then depth below ground would be the output.

If this figure is not required then enter 0 and the output will be change in water level referenced to the probe zero.

Line six on the third column allows for correction to values based on the difference in borehole water density. A value of 1 is entered by the program and must be changed by the user if required otherwise leave as 1.

2.4. To DISPLAY hole information select 4 from menu 1.
Screen shows: Hole selection screen 2.31. Select required hole and the hole information data will be displayed as in 2.32.

2.5 To ENTER or EDIT data files select 5 from menu 1.
Screen shows: Hole selection screen 2.31, select required hole.
Screen shows:

<table>
<thead>
<tr>
<th>Type in file name, type, data column number, depth to water and probe ID. Typing DELETE at any filename removes THAT file and ALL following it</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 c7b12999 sc 0  9.17 1</td>
</tr>
<tr>
<td>2 c7b18889 sc 0  9.17 1</td>
</tr>
<tr>
<td>3 c7b21589 sc 0  9.17 1</td>
</tr>
<tr>
<td>4 c7b26289 sc 0  9.17 1</td>
</tr>
<tr>
<td>5 c7b31389 sc 0  9.17 1</td>
</tr>
<tr>
<td>6 c7b6090  sc 0  9.17 1</td>
</tr>
<tr>
<td>7 c7b9990  sc 0  9.17 1</td>
</tr>
<tr>
<td>8 c7b12990 sc 0  9.17 1</td>
</tr>
</tbody>
</table>

Press <ESC> at filename when finished.

Screen 2.5

This option allows the user to enter the names of data files which are to be attached to that hole. Files already attached will be displayed on the screen and these can be edited if required.

The data fields are a data file number appended by the program followed by:

- **(column 2)** Data file name (eight characters maximum).
- **(column 3)** Logger type i.e. single channel 389 or 390 (sc), multi channel 885 (mc) or multiplexed 389,390 or 490 (mx)
- **(column 4)** The channel number if the logger is a multi channel or multiplexed.
- **(column 5)** If there is any alteration to the original installed probe depth then the new installed depth must be entered in this column. For example in the screen 2.32, the installed depth for hole CCR1 is
15.52 m. If user had to raise the probe 30 cms then 15.82 would be typed in column 5 opposite the data file to which it applies and alongside all subsequent files until another change. Alternatively if the probe was lowered 30 cm then 15.22 m would be inserted.

*** NOTE: the program will automatically install the last height recorded in this space and must be overtyped to change the value. *** If no change then press <ENTER>.

(column 6) The probe ID. appropriate to the data file being addressed. The probe ID can be three alpha-numeric characters and multiple calibrations can be stored for the one probe so as to keep a performance history of the probe, e.g. probe 1, 1a 1b etc. as long as there is a calibration in the probe calibiration file for each. Similarly probe IDs can be changed if a new probe must be installed in a hole; simply install the new probe ID adjacent to the data file(s) to which it applies.

To RECORD a data file type file name in column 1 then <ENTER>, cursor moves to column 2. If sc(single channel) is typed in column 2 then the cursor will automatically jump to column 4, bypassing the data column number required for the multiplexed or multi channel recorders. If the data file being recorded is from a mx or mc logger then a number corresponding to the input channel (1-8 mc),(1-4 mx) must be recorded in column 3.

The depth to water column will display either the initial probe depth value entered in the hole information section 2.3, or the last value entered if changed in the previous file. The probe ID is entered in column 5.

To DELETE a data file place the cursor on the relevant filename and type delete and this file and all the subsequent files will be removed. The data file information must then be retyped in this section and the raw data reloaded (section 2.81) to restore.

2.6. To DISPLAY the data file information which has been added for a hole, select 6 from menu 1.

The screen shows hole selection screen 2.31. Highlight the hole with the cursor and press <ENTER> or type in the hole number and the relevant data will be displayed.
2.7. A summary of all information for a bore hole can be printed out by selecting 7 from menu 1.

Screen shows:

```
<table>
<thead>
<tr>
<th>MENU 2</th>
<th>Site name...cub89</th>
</tr>
</thead>
<tbody>
<tr>
<td>Select a single hole................... 1</td>
<td></td>
</tr>
<tr>
<td>Select a range of holes............... 2</td>
<td></td>
</tr>
<tr>
<td>Select all holes...................... 3</td>
<td></td>
</tr>
<tr>
<td>Return to MENU 1..................... 4</td>
<td></td>
</tr>
<tr>
<td>Screen 2.7</td>
<td></td>
</tr>
</tbody>
</table>
```

Select the required option. If option 1 or 2 is selected user will be required to select a hole or range of holes from the hole selection screen 2.31. The default printout page length of 66 lines is adjustable by the user. An example of the detail printed out is shown.

**REPORT FOR BOREHOLE NUMBER 1 IN SITE cub89**

**Hole... C7BB was installed... 14/12/88**

**DETAILS OF BOREHOLE AND SCREEN.....**

- Height above Datum.............. 376.09m.
- Depth of bore.................. 13.85 m.
- Probe depth at installation... 9.17 m.
- Height protruding above ground.. 0.40 m.
- Diameter of pipe used........ 40mm.
- Pipe material.................. pvc
- Water density factor for hole... 1.000

**LOCALITY DESCRIPTION..upslope below laterite ridge**

**COMMENTS...** Replacement for D.of A. well 7b which had slotted to the top

**RECORDED INFORMATION FOR HOLE.**

- Number of data files since installation........... 8
- First record date.......................... 12/4/89
- Last record date......................... 30/4/90
- Lowest water level........ 0.00 m. Date recorded........... 0/1/0
- Highest water level........ 0.00 m. Date recorded........... 0/1/0
- Number of records in hole file C7BB.HDF.................. 6480

**DATA FILES RECORDED FOR HOLE.**

<table>
<thead>
<tr>
<th>File No.</th>
<th>File Name</th>
<th>Day no. Start...Last</th>
<th>File Data type</th>
<th>Col no.</th>
<th>Probe depth</th>
<th>ID.</th>
<th>.HDF file No. recs...position</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>c7b12989</td>
<td>103 129</td>
<td>sc</td>
<td>0</td>
<td>9.17</td>
<td>1</td>
<td>458 1</td>
</tr>
<tr>
<td>2</td>
<td>c7b18689</td>
<td>129 186</td>
<td>sc</td>
<td>0</td>
<td>9.17</td>
<td>1</td>
<td>995 5</td>
</tr>
<tr>
<td>3</td>
<td>c7b21898</td>
<td>186 215</td>
<td>sc</td>
<td>0</td>
<td>9.17</td>
<td>1</td>
<td>560 1454</td>
</tr>
<tr>
<td>4</td>
<td>c7b26229</td>
<td>215 262</td>
<td>sc</td>
<td>0</td>
<td>9.17</td>
<td>1</td>
<td>823 2786</td>
</tr>
<tr>
<td>5</td>
<td>c7b31399</td>
<td>262 313</td>
<td>sc</td>
<td>0</td>
<td>9.17</td>
<td>1</td>
<td>1866 3674</td>
</tr>
<tr>
<td>6</td>
<td>c7b60000</td>
<td>314 60</td>
<td>sc</td>
<td>0</td>
<td>9.17</td>
<td>1</td>
<td>634 5840</td>
</tr>
<tr>
<td>7</td>
<td>c7b6990</td>
<td>60 99</td>
<td>sc</td>
<td>0</td>
<td>9.17</td>
<td>1</td>
<td>307 6174</td>
</tr>
<tr>
<td>8</td>
<td>c7b12990</td>
<td>99 120</td>
<td>sc</td>
<td>0</td>
<td>9.17</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>
2.8. Option numbers 1 - 7 from menu 1 deal with site or hole information. Option number 8 from menu 1 deals with the inputting and outputting of water level data and backing up of all site information. Select option 8 from menu 1. Screen shows:

```
--- BOREHOLE MANAGEMENT PROGRAM ---

MENU 4  Site name..cub89

Load logged water level data...... 1
Write water levels to .PRN file.... 2
Screen print of water levels....... 3
Line print of water levels......... 4
Graph of data..................... 5
Edit .HDF file..................... 6
Back up all files for site........ 7
Recover backed up files for site... 8
Return to MENU 1.................. 9
```

Screen 2.8

2.81. To LOAD data select 1 from menu 4.

<< Place data file disk in drive A: >> See note!!! 3.

Select the required hole from the hole selection screen 2.31. Two messages can appear on the screen now: If the data files described in section 2.5 have already been loaded, the screen will give that message; if not the screen will display the data file or files required for loading. On the bottom line of the screen user is prompted for the data file source drive, if on current drive type <Y> if not type <N> and the user is now prompted to enter the path, i.e. A:, C:\PATHNAME\, D: etc. If you make an error in choice of path or there is a discrepancy between the name entered in 2.5 and the name of the data file on the disk, then an error message will appear. If the program correctly addresses the file the data will appear on the screen as per example.
1  116.3848  276
2  116.3652  4681
3  116.3756  4681
4  116.3860  4680
5  116.3964  4680
6  116.4068  4681
7  116.4173  4681
8  116.4277  4681
9  116.4381  4681
10 116.4485  4681
11 116.4589  4681
12 116.4693  4681
13 116.4797  4682
14 116.4902  4682
15 116.5006  4682
16 116.5110  4683
17 116.5214  4683
18 116.5318  4683
19 116.5422  4683
20 116.5526  4684
21 116.5630  4684
22 116.5734  4684

Data files for hole... DDA
965 records.
11250 .dat
1 data files.

Displayed is the record number, Julian date and the raw count data. The screen also shows the number of records in the file it is addressing, the name of that file (highlighted) and of other unloaded files.

There are sometimes spurious data records, e.g. if probe is out of water in instant start mode or probe disconnect values (0). In this mode user may scroll up and down the data file and, using the edit commands displayed at the bottom of the screen, either remove all the records (A), the page of records being viewed (P) or a particular record (R). To assist the search for odd records a small flag will mark any record which differs by more than 40 counts from the last record. Scroll up or down the data file until satisfied that there are no erroneous records as it is much easier to remove them now. When satisfied data is OK, press <L> to LOAD the data file or <C> to CANCEL the operation.

<< When finished remove the data disk from drive A: and replace with program disk. >> See note!!! 3.

2.82. To output data to a readable ASCII file with .PRN extension for use with further data manipulation select 2 from menu 4.
Screen shows the hole selection screen as in 2.31. Select hole and type <ENTER>.

Screen shows:

<table>
<thead>
<tr>
<th>Site name</th>
<th>c7b210</th>
<th>Hole name</th>
<th>C788</th>
<th>Hole number</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data</td>
<td>Start</td>
<td>End</td>
<td>Record</td>
<td></td>
<td></td>
</tr>
<tr>
<td>filename</td>
<td>day</td>
<td>day</td>
<td>numbers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c7b12987</td>
<td>103</td>
<td>129</td>
<td>1... 438</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c7b13899</td>
<td>129</td>
<td>156</td>
<td>459... 1452</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c7b21587</td>
<td>186</td>
<td>215</td>
<td>1854... 1962</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c7b20289</td>
<td>215</td>
<td>262</td>
<td>1963... 2783</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c7b31389</td>
<td>262</td>
<td>313</td>
<td>2784... 3673</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c7b6090</td>
<td>314</td>
<td>60</td>
<td>3674... 5539</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c7b9990</td>
<td>60</td>
<td>99</td>
<td>5540... 6173</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c7b12990</td>
<td>99</td>
<td>120</td>
<td>6174... 6480</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Output water levels relative to DATUM <Y/N> N
Select start record, or <ENTER> for all..6174 End record..6480

Screen 2.82

All the facts relating to the data files are displayed and user is prompted to type <ENTER> to continue or <ESC> to return to menu. On pressing <ENTER> user is prompted for a probe calibration filename and path if this has not previously been entered or initiated by the command line options described in the program description section. The next prompt asks user whether output is required relative to datum (if AHD has not been entered then this prompt will not be displayed). If AHD value has been entered then user has the option to use it or ignore it, the water level output will be as shown in the program description section. No sensible answer can be derived from an AHD if no value is entered for depth of probe.
<< Before responding to the next prompt place an empty disk in drive A: to receive the output file. >> See note!!! 3.

User is now prompted to select either all the records for output or identify the range. *** Note: this is done by the record number not by the start and finish date. ***

The next prompt allows the user to select the destination drive \ path for the output and finally this output can be appended to an existing .PRN file or become a new file on its own. On completion of this task the data will be written to the file showing record number, Julian date, calibrated water level data and raw data counts.

<< remove output disk from drive A: and replace with program disk >> See note!!! 3.

2.83. To do a SCREEN PRINT of the data for checking, select 3 from menu 4. Select a hole from the hole selection screen 2.31. Screen now displays screen 2.82. User is prompted for the same information as in section 2.82. On completion the record number,Julian days, calibrated or datum data and raw data will be displayed one screen at a time.

2.84. To do a LINE PRINT of the data select 4 from menu 4 and user will be prompted to enter information as in section 2.82. Ensure the printer is on line before initiating the printout.

2.85. To have a SCREEN GRAPH of the data and finally a PRINTED GRAPH of the data select 5 from menu 4. User will be prompted to enter information as in section 2.82 except that an option is offered to average the data. If this option is selected, then enter the averaging period, minimum of one day or multiples of days. When user has finished this section a new screen will be displayed:

<table>
<thead>
<tr>
<th>WL-axis can be set manually by entering new WL-high WL-low values at the prompts below, or press &lt;ENTER&gt; for no change...</th>
</tr>
</thead>
<tbody>
<tr>
<td>WL-high..[ 7.96] -&gt;</td>
</tr>
<tr>
<td>WL-low ..[</td>
</tr>
</tbody>
</table>

To clear graph from screen press <ENTER>

To obtain a printout of the graph, when the graph is displayed make sure the printer is ON LINE then press the <SPACE BAR>..

Screen 2.85
This allows user to manually select the x,y axis range. It is sometimes necessary to do this in order to compare several different holes by having them drawn to the same axis specifications. Either change the displayed axis values by over typing or accept them by pressing <ENTER> to the two questions. Once the graph is displayed on the screen, press <ENTER> to return to hole selection screen 2.31 or if a printout of the graph is required, press the <SPACE BAR>, making sure the printer is on line.

2.86. To EDIT any spurious points shown on the graph select 6 from menu 4. Occasionally some erroneous data points go unnoticed when loading the data file and these will become apparent when the graph is viewed. To further edit these points it becomes necessary to identify the approximate record number. This can be done by estimating from the graph or using the screen data print of item 2.83.

*** NOTE: At this point the offending numbers can only be changed they cannot be removed. ***

Having typed 6, the screen will show the hole selection menu as in 2.31, select the required hole.

User is now prompted to identify the record number then press <ENTER> and the screen will show five records with the problem value marked with the cursor. Interpreting from the values either side, type in a new value or <ENTER> to leave unchanged. User is now prompted for another record number, or just <ENTER> for the next record or <Q> to quit.

*** NOTE: The only way to move backwards through the file is to nominate a new record number. ***

2.87. To BACK UP data and site management files select 7 from menu 4.

<< This facility is only for the hard disk setup >> *** Note: The command files BACKUP.COM and RESTORE.COM must be in the DOS directory. *** This allows data backup onto floppy disks and uses the DOS backup command. The facility overwrites the entire disk each time the backup command is invoked but has advantages in that it 'manages' the transfer of data, asking for new disk when one is full. It eliminates the problem of overlooking files when they are backed up as individuals or being uncertain whether files will or will not fit onto a disk as in
normal wildcopy backup run when disks fill. To be ultra conservative it is best to run two sets of backup disks and alternate their use. Having typed 7, the screen will show:

```
Back up uses the DOS backup command to save all the files in the current directory. You will be prompted to enter the drive designators for the drive containing the files to backed up and the destination drive. Type drive letter, eg. A:, C: or D:
Press <ENTER> to start...
Enter the source drive designator.......c:
Enter the destination drive designator...a:
Press <ENTER> to begin back-up, or <ESC> to abort
```

Screen 2.87

Press <ENTER> to start and then enter the source drive designator (usually c: in the case of hard disk setup). Next enter the destination drive designator (usually a: for floppy disks). Backup may be aborted at this stage by pressing <ESC> or press <ENTER> to begin.

Follow the prompts as they appear on the screen.

*** Note: the warning that the existing contents of the disk will be overwritten. *** !! Be sure the correct disk is inserted. !!

When the first disk is full, the same warning sign will be shown but it will be asking user to insert the next disk into the destination drive. Do so and strike any key to continue the backup until the screen shows that all data have been transferred. For further information see the backup procedure in the DOS manual for the system being used.

2.88. To RECOVER backed up files select 8 from menu 4. This function allows the recovery of previously backed up data should the user require to restore the complete database. It uses the DOS restore command, and is the reverse of the backup procedure. User will be asked to enter the source and destination drive designators and prompted to insert the backup disks in the order required.
4.2 Probe Calibration Program (PCAL.EXE)

Operation

1. Calibration Data Entry: When large numbers of data loggers are being used, it has been found more convenient to use probe numbers rather than logger serial numbers as a means of labelling calibration data. Data loggers are often swapped and the task of keeping track of their data becomes risky whereas water level probes usually stay with the hole.

The calibration program is called PCAL.EXE and this allows the user to create calibration data files which will be called (user supplied file name, maximum eight characters and an extension of .WLC appended by the program), e.g. PCALIB.WLC.

To begin type PCAL at the DOS system prompt and <ENTER> Screen shows:

```
WATER LEVEL PROBE CALIB.data

MENU

Create a calibration file.......... 1
Add, edit, view a probe cal....... 2
Print out probe cal.data.......... 3
Exit from program................ 4
```

Screen 1.0

1.1. Select 1 to create a calibration file.
Screen shows:

```
Create a probe calibration file.

Enter name of calibration file.

To return to MENU press <ENTER> for site file.
```

Screen 1.1
Type file name, no extension.

1.2. Select 2 to add, edit or view probe calibration data.

Screen shows:

Open a probe calibration file.
Enter name of calibration file.

To return to MENU press <ENTER> for site file.

Screen 1.21

Type file name and <ENTER>

Screen shows:

File pcalib contains... 70 records

SELECT a record by entering the probe ID or
Press <INSERT> key to ADD record to file or
Press <ENTER> to display the FIRST record
Enter choice...

Screen 1.22

User is prompted to address a particular record, record 1 or
add another probe calibration value to end of file.

Make appropriate selection and <ENTER>.

Screen shows:

<table>
<thead>
<tr>
<th>Record number</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probe ID</td>
<td>1</td>
</tr>
<tr>
<td>Slope value</td>
<td>2.313</td>
</tr>
<tr>
<td>Intercept value</td>
<td>214.000</td>
</tr>
<tr>
<td>Probe length</td>
<td>2.000</td>
</tr>
</tbody>
</table>

Key functions...

Pg Dn ...next record
Pg Up ...previous record.
..next data field.
ENTER ..accept entered value
Press the <END> key at the
Probe ID entry when finished.

Edit existing record.

To enter a value into a data field, type the value and press ENTER

Screen 1.23
The record number (range 1 - 200) is updated from the program. The probe ID is the name ascribed to the probe by the user (note hole number may be used instead of probe number provided that is consistent through the program), the intercept and slope values represent the regression values independently determined and the probe length as a record.

Press the <END> key when cursor on the probe ID field to return to main menu.

1.3. To print out all the calibration data from a file select 3.

Screen prompts for the name of calibration file as in 1.21, and then allows user to select number of lines per page in the printout for which the default number is usually adequate.

The resultant printout will be as per example shown on page 25.
<table>
<thead>
<tr>
<th>Record No</th>
<th>X</th>
<th>Y</th>
<th>Slope</th>
<th>Intercept</th>
<th>Length</th>
<th>Record No</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.313</td>
<td>214.000</td>
<td>2.00</td>
<td>2.00</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>2.317</td>
<td>228.000</td>
<td>2.00</td>
<td>2.00</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>2.323</td>
<td>216.000</td>
<td>2.00</td>
<td>2.00</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>2.316</td>
<td>230.000</td>
<td>2.00</td>
<td>2.00</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>2.324</td>
<td>241.000</td>
<td>2.00</td>
<td>2.00</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>2.496</td>
<td>239.000</td>
<td>2.00</td>
<td>2.00</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td>2.396</td>
<td>232.000</td>
<td>2.00</td>
<td>2.00</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>8</td>
<td>2.339</td>
<td>237.000</td>
<td>2.00</td>
<td>2.00</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>9</td>
<td>2.460</td>
<td>222.000</td>
<td>2.00</td>
<td>2.00</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>10</td>
<td>2.283</td>
<td>226.000</td>
<td>1.00</td>
<td>2.00</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>11</td>
<td>2.372</td>
<td>127.330</td>
<td>1.00</td>
<td>1.00</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>12</td>
<td>2.555</td>
<td>286.167</td>
<td>2.00</td>
<td>2.00</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>13</td>
<td>2.332</td>
<td>234.630</td>
<td>2.00</td>
<td>2.00</td>
<td>13</td>
<td>13</td>
</tr>
<tr>
<td>14</td>
<td>2.332</td>
<td>223.450</td>
<td>2.00</td>
<td>2.00</td>
<td>14</td>
<td>14</td>
</tr>
<tr>
<td>15</td>
<td>2.519</td>
<td>220.000</td>
<td>2.00</td>
<td>2.00</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>16</td>
<td>2.380</td>
<td>232.160</td>
<td>2.00</td>
<td>2.00</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>17</td>
<td>2.330</td>
<td>234.830</td>
<td>2.00</td>
<td>2.00</td>
<td>17</td>
<td>17</td>
</tr>
<tr>
<td>18</td>
<td>2.320</td>
<td>222.500</td>
<td>2.00</td>
<td>2.00</td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>19</td>
<td>2.340</td>
<td>230.670</td>
<td>2.00</td>
<td>2.00</td>
<td>19</td>
<td>19</td>
</tr>
<tr>
<td>20</td>
<td>2.320</td>
<td>249.330</td>
<td>2.00</td>
<td>2.00</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>21</td>
<td>2.320</td>
<td>232.170</td>
<td>2.00</td>
<td>2.00</td>
<td>21</td>
<td>21</td>
</tr>
<tr>
<td>22</td>
<td>2.330</td>
<td>218.500</td>
<td>2.00</td>
<td>2.00</td>
<td>22</td>
<td>22</td>
</tr>
<tr>
<td>23</td>
<td>2.337</td>
<td>239.667</td>
<td>2.00</td>
<td>2.00</td>
<td>23</td>
<td>23</td>
</tr>
<tr>
<td>24</td>
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APPENDIX A
MAIN CONTROL PROGRAM LISTING

SMAN a borehole site data management program

Author J W Smith
CSIRO Division of Water Resources
Floreat Laboratories
Western Australia

19.01.90
Microsoft QuickBasic Compiler version 4.5

Module 1 of 4 SMAN.BAS (main module)

Module 1 SUBRoutine and FUNction declarations

Calls to module 1
Management of site file routines

DECLARE SUB adf (st$) '........record original hole data files info
DECLARE SUB ahd (st$) '........controls input of original data files
DECLARE SUB ahi (st$) '.........add hole information input / edit
DECLARE SUB csf (st$) '................creates a new site file
DECLARE SUB ddfi (st$, hn$, nf$) '.......display hole data file info
DECLARE SUB df (xs%, rw%, cl%) '.......scrn display of recorded data

DECLARE SUB dfl (dn$, nb$) '......read / write data file info to site
DECLARE SUB dhi (hb%, st$) '.......scrn display recorded hole info
DECLARE SUB hi (rr$, hl%) '......read / write hole info to site file
DECLARE SUB osf (ft$, st$) '...............opens a site file
DECLARE SUB pi (sn$, en$, st$) '.....lprint site/hole info reports
DECLARE SUB prl (st$, ds$, cf$) '......output water level data to file,

DECLARE SUB sah (nm%, rw%, st$) '......select hole for i/o operation
DECLARE SUB sh () '..........................displays hole list to screen
DECLARE SUB usf (st$) '....................install holes for site

' External routines used

Calls to module 2 (SMANM2.BAS)

Screen and keyboard routines

DECLARE SUB bkp (brs$) '.........backup/restore site & HDF data files
DECLARE SUB csc (cl%) '............screen video attributes switch
DECLARE SUB db (rs%, cs%, nr%, nc%) '........border drawing routine
DECLARE SUB gki (nc%, cs$, ln%, mt$, ar%, ac%).............keyboard input
DECLARE SUB gpd (gd!(), ha%, h%, av%, inc%, sd&, np&, hn$, st$)

'........screen and printer graphics
DECLARE SUB lt (rw%, cl%) ' cursor positioning
DECLARE SUB pw1 () ' no site file open message
DECLARE SUB pw2 () ' no holes installed message
DECLARE SUB pw3 () ' select graphics axis prompt screen
DECLARE SUB sv () ' display acknowledgments and version
DECLARE SUB edt (hn%) ' HDF data file editor

DECLARE FUNCTION menu1$ (fl$)
DECLARE FUNCTION menu2$ (fl$) ' program
DECLARE FUNCTION menu3$ (fl$) ' menus
DECLARE FUNCTION menu4$ (fl$)

Calls to module 3 (SMANM3.BAS)

Original water level data input routines

DECLARE SUB gmc (hn%, odf%, cn%) ' read multi channel format
DECLARE SUB gmx (hn%, odf%, cn%) ' read 3inp multiplexed format
DECLARE SUB gs (hn%, odf%) ' read single channel format

Shared variables with module 1 and module 2

Arrays of information of original data
files and .HDF file for one hole (dimensioned in each module)
This information read or written to site file (.MAN)

COMMON SHARED d2() AS STRING * 2 'I...start date of each recorded
'......and loaded data file
COMMON SHARED d3() AS STRING * 2 'I..end date of each recorded file
COMMON SHARED d4() AS STRING * 4 'IL.....its 1st record position in
'.....the hole data file (HDF)
COMMON SHARED d5() AS STRING * 2 'I..no. of records written to HDF
COMMON SHARED bb AS STRING * 2 'I.....date of first data record
COMMON SHARED bc AS STRING * 2 'I.....date of last data record
COMMON SHARED bw AS STRING * 4 'IL.....no. recds written to HDF

Calls to module 4 (SMANM4.BAS)

Date conversion and indexing routines

DECLARE SUB gdt (jul%, dayno%, mnth%, year%) ' Julian date to
'...Gregorian conversion
DECLARE SUB pyr (hol%, first&, last&) '....insert 1st & last recd no.
DECLARE SUB geyr (hol%, year%, first&, last&, ndays%) '....get the
'.....latest year
DECLARE SUB gsr (hol%, year%) '....get the start year number
DECLARE SUB gyr (hol%, year%, atrcd&) '....get year of specified
'..........................record
DECLARE SUB whl (hol%, high%, low%) '....delete high/low level record
'..........................position indicator
DECLARE SUB frec (hol%, high%, low%) '....get 1st record of selected
'..........................year
DECLARE SUB wipe (hol%, last&)  '...delete 1st & last records for year
DECLARE SUB gend (hol%, last&, yrnum%)  '...get last rec no. for year
DECLARE SUB cmd1 (sfil$, cfil$)  '...setup command line interpreter

' Main module shared variables

' Arrays of information of original data
files and .HDF file for one hole (dimensioned module 1 only)

'$_DYNAMI
DIM SHARED hp(30) AS LONG  'IL......lst recd. position in site file
DIM SHARED d1(30) AS STRING * 8  'S......names of original data files
DIM d2(30) AS STRING * 2  'I....................file start date
DIM d3(30) AS STRING * 2  'I....................file end date
DIM d4(30) AS STRING * 4  'IL......position of 1st recd. in .HDF file
DIM d5(30) AS STRING * 2  'I......no. recds written to .HDF file
DIM SHARED d6(30) AS STRING * 2  'S......format of input file e.g., mx.mc
DIM SHARED d7(30) AS STRING * 2  'I.data column no. if not single ch
DIM SHARED d8(30) AS STRING * 4  'R.......depth to probe if changed
DIM SHARED d9(30) AS STRING * 3  'S......probe ID for each data file

' Site information variables

DIM SHARED al AS STRING * 2  'I.............number of installed holes
DIM SHARED a2(30) AS STRING * 4  'S.array of names of installed holes

' Hole information variables (contains info for selected hole)

DIM SHARED ba AS STRING * 2  'I.no. of original data files recorded
DIM SHARED bd AS STRING * 4  'R.......highest recorded water level
DIM SHARED be AS STRING * 2  'I..................date of occurrence
DIM SHARED bf AS STRING * 4  'R.......lowest recorded water level
DIM SHARED bg AS STRING * 2  'I..................date of occurrence
DIM SHARED bh AS STRING * 4  'R.......height above DATUM
DIM SHARED bi AS STRING * 4  'R.height surface to initial probe depth
DIM SHARED bj AS STRING * 4  'S.......bore pipe material
DIM SHARED bk AS STRING * 2  'I.............bore pipe diameter
DIM SHARED bl AS STRING * 4  'R....................bore depth
DIM SHARED bm AS STRING * 2  'I.............pipe height above ground
DIM SHARED bn AS STRING * 4  'S........screen material
DIM SHARED bo AS STRING * 2  'I..................screen diameter
DIM SHARED bp AS STRING * 4  'R....................screen length
DIM SHARED bq AS STRING * 4  'R........screen at depth
DIM SHARED br AS STRING * 8  'S........screen construction
DIM SHARED bs AS STRING * 2  'I.............depth to bentonite seal
DIM SHARED bt AS STRING * 30  'S........landscape description of bore
DIM SHARED bu AS STRING * 160  'S........comment space
DIM SHARED bv AS STRING * 8  'S.......bore hole installation date
DIM SHARED bx AS STRING * 4  'R........water density factor
DIM SHARED ert AS INTEGER  '...error trapping flag used by SMAN pgm
module 1 constant declarations

CONST false = 0, true = NOT false
CONST maxh% = 30  '............max permitted holes per site
CONST maxf% = 30  '..max permitted input data files per hole
CONST fhpos% = 123 '......1st hole record position in site file
CONST reclin% = 1109 '.......length of hole record in site file
CONST doffset% = 269 '..offset into hole record to 1st data file

ON ERROR GOTO loc1  ' error trapping label

SMAN main program begins

PALETTE 15, 19
PALETTE 7, 1
PALETTE 0, 7
sv
CLS
CLS
read input command line for site file
IF st$ <> "" THEN  'and calibration file names
  lt 12, 35
  PRINT "Opening ";st$;
  ft$=""
  osf ft$, st$
END IF
exitodos% = false
UNTIL operator exits program (D1)

SELECT CASE menu1$(st$)  'select from MENU 1
CASE "1"  'selection 1 MENU 1
  SELECT CASE menu4$(st$)  'select from MENU 4
  CASE "1"  'selection 1 MENU 4
    ft$ = ""
    st$ = ""
    osf ft$, st$
  CASE "2"  'open a site file
    ft$ = "CREATE"  'CREATE a site file
    exitodos% = false
    osf ft$, st$
    IF st$ <> "" THEN
      csf st$
    END IF
    END CASE
  END SELECT
CASE "2"  'finished with menu
  'selection 2 MENU 1
  usf st$
  'instal holes
END SELECT
CASE "3" 'selection 3 MENU 1
  ahi st$
  csc 0
CASE "4" 'selection 3 MENU 1
  CLS 'display hole information to screen
  IF st$ = "" THEN 'check site file open
    pw1 'display not open message
  ELSE
    GET #1, 1, al 'get no. holes installed
    IF CVI(al) > 0 THEN
      hn% = 1 'if holes are installed
      rw% = 7
      DO CLS
        sah hn%, rw%, st$ 'select a hole for display
        IF hn% <= 30 THEN
          hi "READ", hn% 'read hole info from site file
          dhi hn%, st$ 'display info to screen
          lt 25, 1
          PRINT "Press <ENTER>...":
          hn%= INPUT$(1)
        END IF
        LOOP WHILE hn% <= 30
      ELSE
        "no holes installed"
      END IF
      pw2 'display no holes message
    END IF
  END IF
CASE "5" 'selection 5 MENU 1
  adf st$ 'attach original data file to hole
CASE "6" 'selection 6 MENU 1
  CLS 'display data files info
  IF st$ = "" THEN
    pw1
  ELSE
    GET #1, 1, al
    IF CVI(al) > 0 THEN
      hn% = 1
      rw% = 7
      DO CLS
        sah hn%, rw%, st$
        IF hn% <= 30 THEN
          dfi "READ", hn% 'read data file info from site file
          nf% = CVI(ba)
          ddfi st$, hn%, nf% 'display info
        END IF
        LOOP WHILE hn% <= 30
      ELSE
        pw2
      END IF
      csc 0
    END IF
END IF
CASE "7"  ' selection 7 MENU 1 print report
  IF st$ = "" THEN  ' check file open, holes installed
    pw1
  ELSE
    GET #1, 1, al
    n% = CVI(al)
    IF n% = 0 THEN
      pw2
    ELSE
      doprint% = true
      sn% = 1
      rwx% = 7
      SELECT CASE menu2$(st$)  ' select from MENU 2
        CASE "1"  ' selection 1 MENU 2
          CLS
          sah sn%, rwx%, st$'single hole report
          en% = sn%
        CASE "2"  ' selection 2 MENU 2
          lt 25, 1  ' report for range of holes
          PRINT "Select first hole number...";
          sah sn%, rwx%, st$
          IF sn% <= 30 THEN
            lt 25, 1
            PRINT "Select last hole number...";
            en% = sn%
            sah en%, rwx%, st$
            IF en% > 30 THEN
              sn% = 60
            END IF
          END IF
        END IF
      CASE "3"  ' selection 3 MENU 2
        sn% = 1
        GET #1, 1, al  ' report for all holes
        en% = CVI(al)
      CASE "4"
        doprint% = false
      CASE ELSE
        END SELECT  ' MENU 2
        IF doprint% AND sn% <= 30 THEN
          pr sn%, en%, st$  'print the selected
          END IF
        END IF
      END IF
    END IF
  END IF
CASE "8"  ' selection 8 MENU 1
  DO  ' water level data i/o and data backup
    don% = false
    SELECT CASE menu3$(st$)  ' select from MENU 3
      CASE "1"  ' selection 1, input water level
        and st$  ' data from original data files
      CASE "2"  ' selection 2, output w/l data
        prl st$, "F", cf$  ' to a disk file
      CASE "3"  ' selection 3, output w/l data
        prl st$, "S", cf$  ' to screen
      CASE "4"  ' selection 4, output w/l data
        prl st$, "P", cf$  ' to printer
      END SELECT
CASE "5" ' selection 5, display w/l data
prl st$, "G", cf$ ' as graphics,scrn & prntr
CASE "6"
  GET #1, 1, al ' edit .HDF file wlevels
  IF CVI(al) > 0 THEN
    CLS
    hn% = 1
    rw% = 7
    sah hn%, rw% st$
    IF hn% <= 30 THEN
      edt hn%
    END IF
  ELSE
    pw1
  END IF
CASE "7" ' selection 6
  brs% = true ' backup site and hole data
  bkp (brs%) ' files
CASE "8" ' selection 7
  brs% = false ' recover backed up files
  bkp (brs%)
CASE "9" ' selection 9 MENU 1
  don% = true
CASE ELSE
END SELECT ' MENU 3
LOOP UNTIL don%
CASE "9" ' selection 9 MENU 1
  exitodos% = true
  LOCATE , , 1, 6, 7' EXIT program
  csc 0
  CLS
CASE ELSE
END SELECT ' MENU 1
LOOP WHILE NOT exitodos'%loop (D1)
PALETTE
SCREEN 0 'reset system and screen
CLOSE #1
END ' main program SMAN
' error trapping
loc1:

  ert = false
  RESUME NEXT
END 'error trapping