A HYDROMETEOROLOGY DATA MANAGEMENT PACKAGE WITS DATA MANAGEMENT SYSTEM WITDMS

By JJ Lambourne

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by

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EFFECTS OF URBANIZATION ON CATCHMENT WATER BALANCE

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ABSTRACT

This report decribes the current implementation of an integrated hydrological management and reporting system on a micro-computer. The user can enter data to the system via a number of peripheral devices; namely the keyboard, a digitising platen and two proprietary electronic media devices. The data is stored on disk in compact formats which allow easy retrieval for display or for further processing and analysis of the data. Menu drivers of user interfacing allow semi-skilled operators to use the system. An on-line screen help facility is an integral part of the user interface. Each segment of the software (primary menu options) is described together with operation details as to input required and action to take in given situations.

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CHAPTER 1 : INTRODUCTION

There has been a major trend since the early 1960's to the growing use of computers for data capture, storage and analysis. The development of computerised storage and analytical systems have become the central core of many water management and research programmes. These systems range in size (and usually complexity) from large national and international systems on mainframes to small in-house systems on micro-computers.

Prior to the widespread use of computers, hydro-meteorological data were stored in tabular or graphical format on paper media. The early developers of Hydro-Met database systems persisted with the storage of the information in 'spreadsheet' tables using the computer hardware as a fast speed accessing device. Unfortunately many of this type of system are still developed, or are in existence today. With this type of approach the Hydro-Met data manager has to develop complex data retrieval routines to access the relevant information, as it does not recognise the true 'time series' of most Hydro-Met data.

Apart from small in-house systems to store and retrieve data in tabular format, most complex data management systems have been confined to mainframe applications (Boorman, 1986; Dent and Willis, 1986; Herald *et al*, 1986). With the development of both improved performance and increased storage capacity (hard or fixed disks, optical disks (WORM - Write Once, Read Many devices, and tape streamers) with micro-computers, the cost effectiveness of micro-computers have proved their worth for use with Hydro-Met data management systems. The development of a Hydro-Met data management system on a micro-computer requires special considerations which are not necessarily incurred on a mainframe computer. The graphics handling, low cost and user friendliness of a micro-computer, however, aids semi-skilled staff in processing and management of data.

1.1 : Requirements of a Hydro-Met database System

It is important to define the objectives of a Hydro-Met database system to be implemented on a micro-computer system. These are summarised below.

1. Entry of Hydro-Met data into the system from any media (i.e. tables, charts or electronic media currently used). This data entry should be

able to be facilitated using a user-friendly format and enable the user to work at his own speed and not wait for the system to 'catch-up' (a common problem unless mult-pass processing techniques are used with the data). The ability to allow the user to spot errors in the data (especially in keyboard and digitised chart entry) and correct them is also important.

2. Editing of raw data once entered into the system's scratch-pad file storage. This enables further errors to be corrected before the data is loaded into the database files. Editing of data is prehaps one of the most tedious but necessary aspects of data management. Even with sophisicated electronic data logging methods, data still will require checking and possible editing.

3. Storage of Hydro-Met data in compacted database files which allow for rapid access for retrieval of data and optimization in terms of space on the disk. The difference between null data and data not recorded as a result of recorder malfunction should be included in the database design.

4. Have the ability to perform routine analysis and provide report quality output of both data and summary information in either tabular (i.e. hydrological year books) or graphical format.

5. Be able to output requested data in a form rapidly accessible (e.g. ASCII format) by other types of hydrological software (e.g. hydrological rainfall-runoff models or water balance calculations).

6. The software is designed in a modular approach to enable upgrades to be undertaken without recourse to complete software revision. Also the concept of an implemented open ended structure to allow attaching user-defined software would aid expansion of the package.

7. Ability to allow import and export of database files in the correct compacted format between machines.

These objectives formed the basis for the development of the Hydro-Met database management and reporting system. It was decided that in-order to produce software that was extremely user-friendly and allowed Hydrologists

and Engineers who are reasonably conversant with computer programming, to update and take advantage of the open-ended module system, that product database systems would not be used.

1.2 : Brief system description

This software package was based around currently available micro-computer hardware which is both cost-effective and widely used in hydrological applications. The system is designed around an IBM™ or compatible micro-computer and associated peripheral devices operating under MS-DOS™. A schematic of the hardware is presented in figure 1.1. Perpherals include a hard disk, floppy drive for management of data; digitising platen and RAM/EPROM readers for input of data. Extra software could be included which would permit the use of a tape streamer.

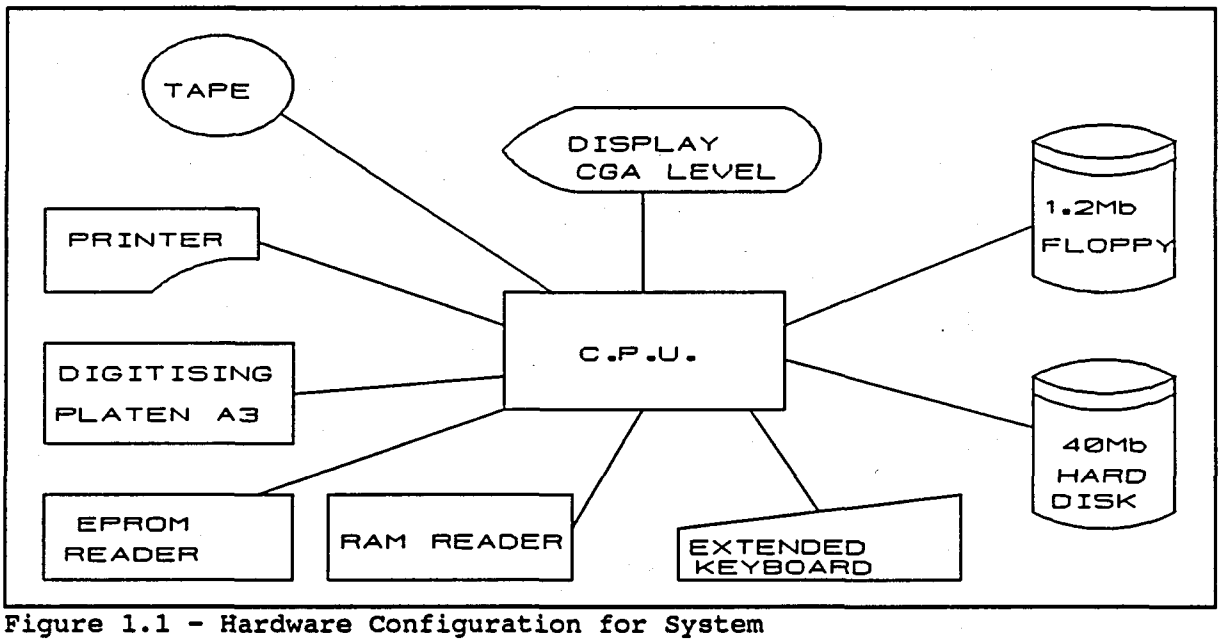


Figure 1.1 - Hardware Configuration for System

The system logo is displayed whilst initialisation and the loading of the main software is performed. A simple password control system is then enabled.

The ability to control both access and manipulation of the hydrological data within the system is paramount in preserving the quality of the information. This ensures that certain operations (e.g. deletion of datasets, editing of data) can only be carried out by a skilled member of the Hydro-Met data management team. The password and operator's name are linked to a status

level which determines the level of constraint of the user on the database, temporary and system files. The presence of status levels is to inspire confidence in the semi-skilled user since he cannot do anything to the system files by accident.

The system is driven through a series of menus whose options are selected by cursor and pressing of either the space bar or carriage return keys. The main menu is presented in figure 1.2.

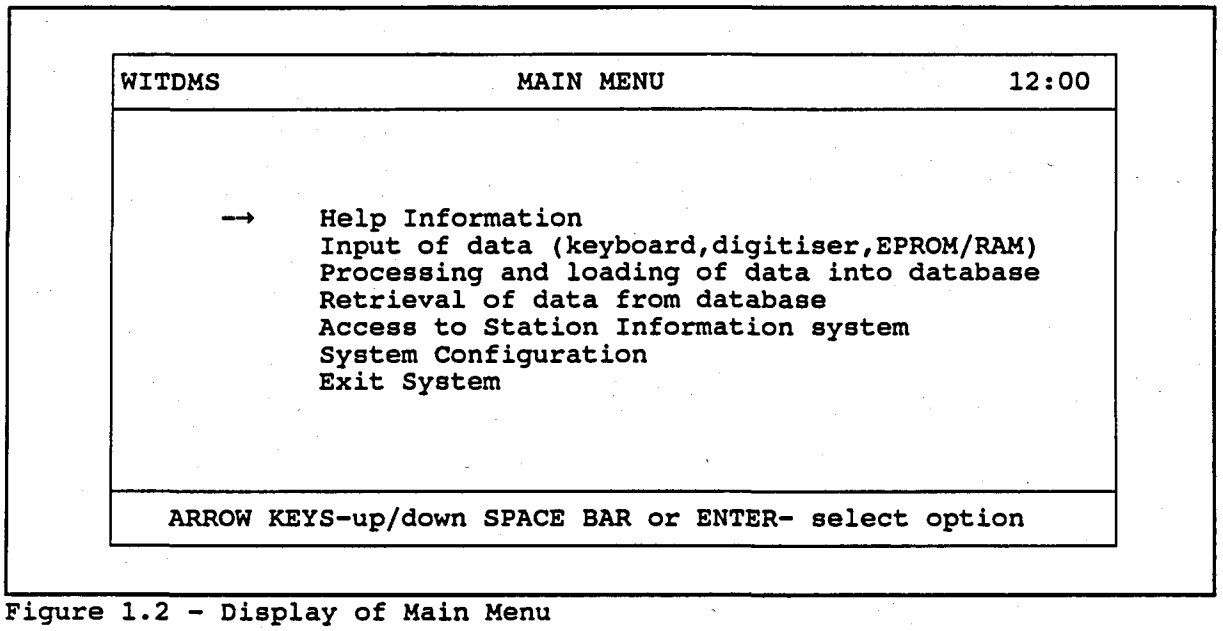


Figure 1.2 - Display of Main Menu

Exiting from the system returns the user to the MS-DOS™ command level and database directories are closed. This then allows further closed-end packages to be loaded and executed (i.e. simulation models that use data that has been extracted from the database).

Where there is a menu requiring a choice to be made by the user, help information is available. This consists of one or more full screens of informatino stored in the file suffixed by .HLP and stored on the system directory. These on-line help screens are not a complete substitute for this report but provide enough information for the user whilst 'on-line' with regard to menu choices.

The following five chapters in this report apply to the different options of the main menu and specific entry requirements.

CHAPTER 2 : DATA ENTRY SUB-SYSTEM

Data input to the Hydro-Met data management system is through three different input peripherals namely; keyboard, digitising platen (or digitiser) and electronic media reader. The electronic media reader comprises two machines namely; an EPROM (Eraseable Programmable Memory) system of MC Systems (of Cape Town) and a battery backed RAM (Random Access Memory) system of Digitial Data Systems (of Randburg). An IBM™ compatible PC or AT type keyboard with either separate or combined cursor and number keypad entry may be used for keyboard entry. The digitising platen is A3 (420mm x 300mm) size with a stylus pen for input (obviously the A3 size is more efficient).

Prior to input of data the relevant information on the recording station should be entered into the station database file using the Station Information Sub-system (see chapter 5 for further details). Stations that are not registered with the system will not be permitted to be entered or loaded into the database files.

There are four different data configurations that can be stored by the Hydro-Met data management system. These are single data (daily), breakpoint, fixed interval and rating table formats (see table 2.1 for cross-reference between data configuration and input peripherals).

Input Type	Single Data	Breakpoint	Fixed TIme	Rating Table
Keyboard	YES	YES	YES	YES
Digitiser	NO	YES	NO	NO
EPROM	NO	YES	YES	NO
RAM	NO	YES	YES	NO

Table 2.1 - Table of Input Combinations

Single Data (daily) — This type of format is for daily data where one piece of data is required (e.g. totaliser rainfall).

Breakpoint — This type of format is for use with continuous data

which is to be recorded at random intervals of time, usually on chart media (e.g. autographic rainfall records).

Fixed Interval — This type of format is used with continuous data which is recorded at a fixed time interval (e.g. temperature records).

Rating Table — This type of format is used with tables for transfer of data from one type of parameter to another (e.g. transfer of stage to discharge measurements).

2.1 : Keyboard Entry Description

The station is selected from a cursor indicated list to which data will be entered. Once the system has loaded the station information record, the user is presented with a full screen input mask which allows both entry and editing of data on the screen with cursor keys. Once the data has been entered into the system using the screen accept key, it can only be edited again using the raw data editor (see chapter 3). The entered data is then stored in a scratch-pad file (on the primary data disk - see chapter 6 for hardware configuration details) which is erased once the data has been loaded into the database files (using the processing sub-system).

2.2 : DIgitiser Entry Description

Data that are to be entered from an analogue source have to be first converted to digital input. The digitising software component of the system coupled with the use of a digitising platen as the major peripheral allows the user to transfer the breakpoints of the chart trace to the micro-computer.

The station is selected from a cursor driven list together with the start and end times of the chart (chart type and scales are loaded from the station database files by the system - see chapter 5 for details on digitiser parameters required by the station information sub-system).

The trace that is being digitised is displayed on the screen to allow any

input errors to be detected. A series of programmed digitiser 'softkeys' allow the user to indicate observations that will be needed in the processing of the chart (e.g. missing traces, start of new segment of chart in the case of strip charts, and end of traces etc..).

The system will allow entry from many available hydro-meteorological charts. Each 'frame' of the chart (that portion of the chart that covers the digitising platen) can be erased from memory prior to storage in a scratch-pad file. Major use of digitising was envisaged for processing of previous autographic rainfall and water level recorder's charts. The transformed analogue to digital data held on the primary disk can be further checked using the raw data editor (see chapter 3). This data is in mm so that a direct comparision with the chart can be made by the operator.

2.3 : EPROM and RAM Data Entry Description.

The data stored on either EPROM or RAM module is first read and translated into ASCII character format by the reader software and hardware. Transmission of ASCII format data from the data reader and the micro-computer is via a RS232 link. EPROM derived data is directly stored in a scratch-pad file, wherease RAM data is translated into the EPROM data format before being placed into the scratch file. This scratch-pad file can then be edited by the raw data editor (see chapter 3). During the downloading process, the data is presented in scrolling mode on a screen window.

2.4 : Data Entry Menus

This sub-system is driven by a main menu and a series of supplementary menu and list structures. The main sub-system menu is shown in figure 2.1. This menu lists the different input methods and allows the user to select the one relevant to his or her application.

In the case of the digitiser, EPROM and RAM entry options, the system first checks whether these peripherals have been configured (see chapter 6 for more details). When it is determined by the system, that configuration to a specific peripheral, has not taken place no data entry is allowed from

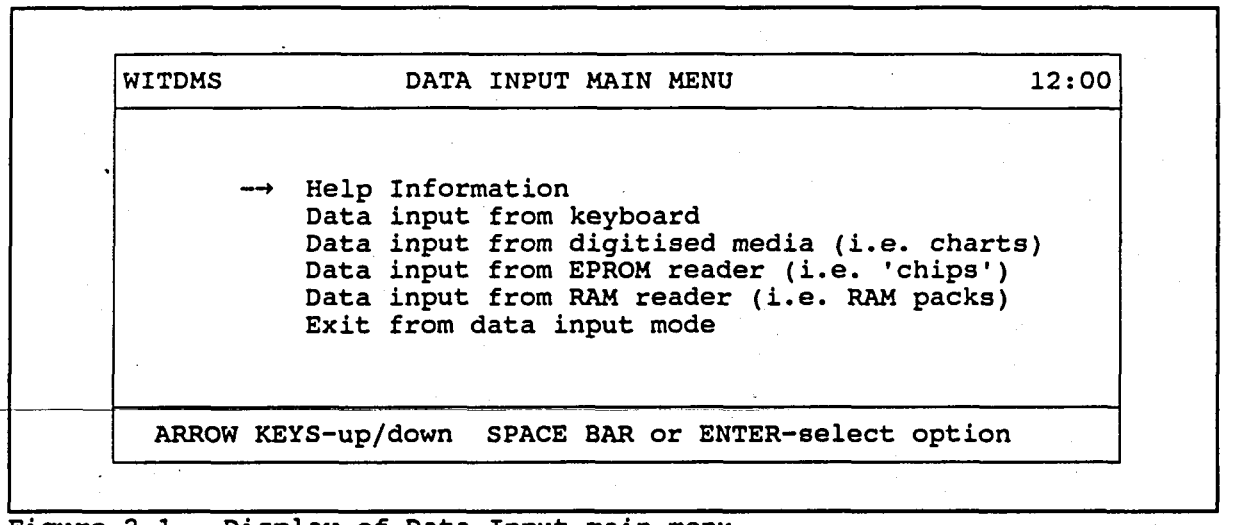


Figure 2.1 - Display of Data Input main menu

that device.

2.4.1 : Data input from the keyboard

All types of data can be entered from the keyboard peripheral device of the micro-computer. Each type will be dealt with in turn giving a description and operation to achieve error-free data entry. On selecting the keyboard as the peripheral used for entry, the data capture operator will have to select whether the data is either station data (parameter data e.g. temperature values) or rating table values (which can be directly entered or translated from a DWA rating table file on disk) (figure 2.2).

2.4.1.1 : Station Parameter data

Single data

The user selects the station for which single value (daily) data is to be entered from a scrolling list of stations (Station DWA or code characters and place name). The system then loads the station information file specific to the chosen station and checks to see if the station is designated for keyboard entry (if not then the user is unable to proceed further and is returned to the sub-system main menu).

The user is then presented with a screen with details of

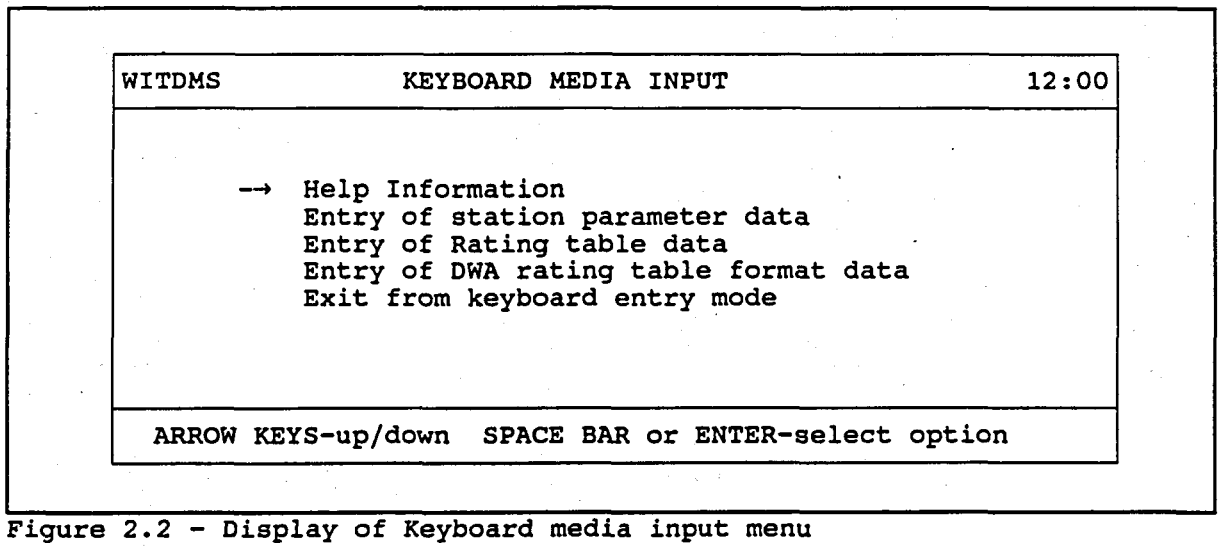


Figure 2.2 - Display of Keyboard media input menu

station id, parameter and place name, together with an input mask with year and month input fields. The rest of the screen is divided up into input fields for the day value and the data value (figure 2.3).

The concept behind the full screen is that one screen should represent a calendar month. The user enters the year in the format YYYY and the month in the format MM. Day and data values are entered in tabular format in a left to right direction. It is not necessary to enter data for every day if the data value is null. An example of an input screen is given in figure 2.4. The cursor keys are used to locate the position for data entry or editing.

N.B. No more than ONE calendar month should be entered per screen.

The screen is entered to the system by pressing of the SPACE BAR. The user is then presented with a new screen (figure 2.3) with current year and month values. The month value is then re-entered by the user (and year if necessary). To finish data entry to a specific station the ESC key is pressed and the user is prompted as to whether input for another station is required.

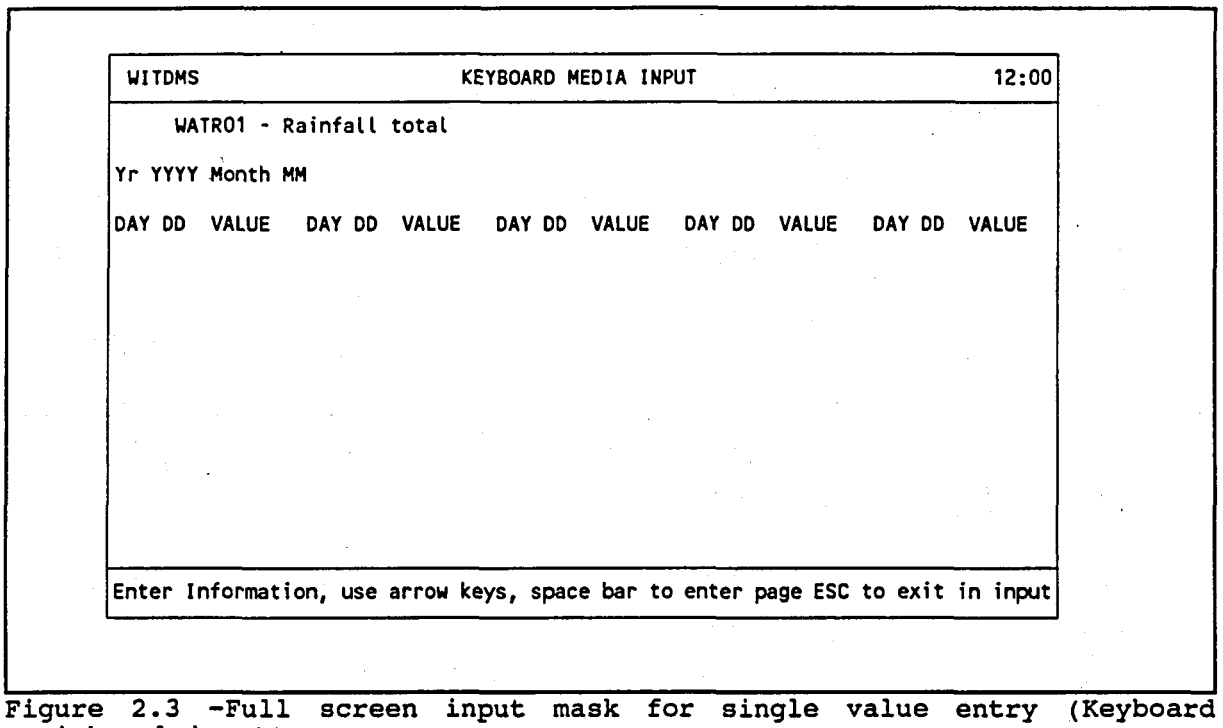


Figure 2.3 -Full screen input mask for single value entry (Keyboard peripheral input)

Breakpoint

The user selects the station for which breakpoint data is to be entered from a scrolling list of stations (station code and place name). The system then loads the station information file specific to the chosen station and checks to see if the station is designated for keyboard entry (if not the user is returned to the sub-system main menu).

The user is then presented with a screen with details of the station id, parameter and place name, together with an input mask with year, month and day input fields. The rest of the screen is divided up into input fields for the time and data values (figure 2.5).

The user enters the year in the format YYYY, the month in the format MM and the day in the format DD. The day is defined as the period from 08H01 till 08H00 the next morning. Time and data values are entered in tabular

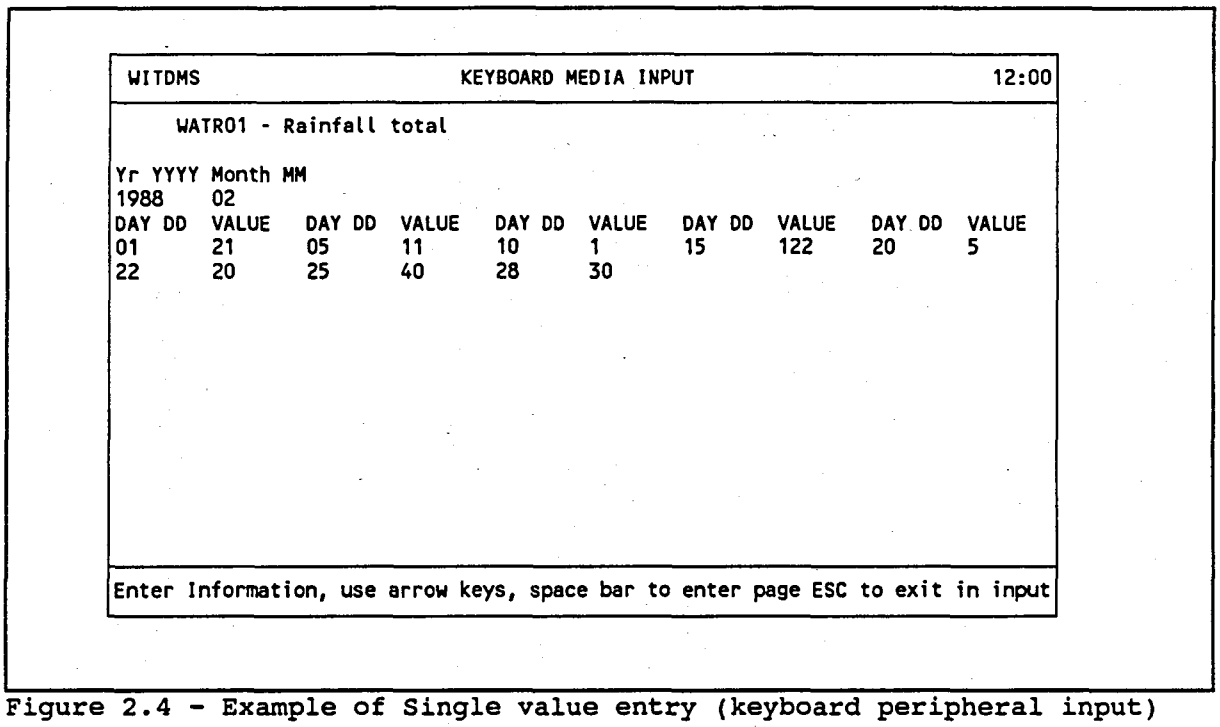


Figure 2.4 - Example of Single value entry (keyboard peripheral input)

format in a left to right direction. As the values are at breakpoint times, insignificant values have been removed implicitly in the concept of breakpoint positions. An example of an input screen is given in figure 2.6. The cursor keys are used to locate the position for data entry or editing of specific data locations on the screen.

There may be a situation where the number of breakpoints for a specific day may exceed that of locations on the screen. To continue entering data for the same date, press SPACE BAR and continue adding time and value data to the new screen (the year, month and day data on the screen should not be re-entered).

The screen is entered to the system by pressing the SPACE BAR. The user is then presented with a new screen (figure 2.5) with current year, month and day value. The day value is then re-entered for a new day of breakpoint data (year and month if necessary). To finish data entry to a

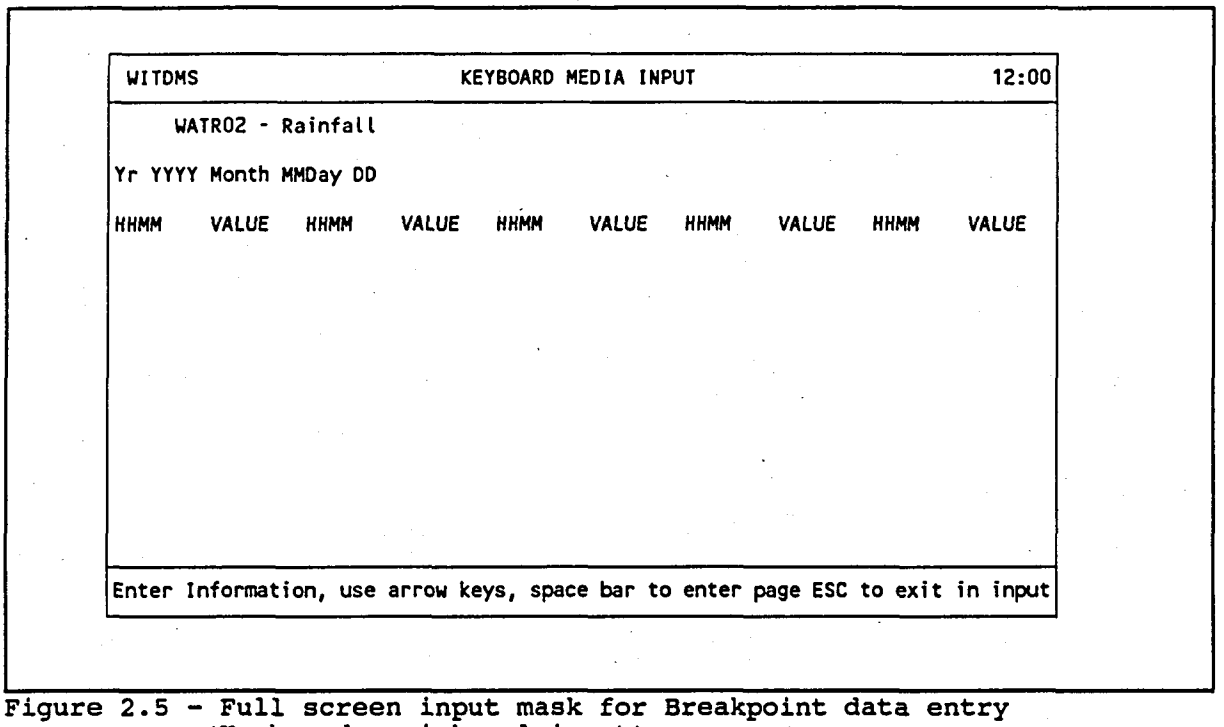


Figure 2.5 - Full screen input mask for Breakpoint data entry (Keyboard peripheral input)

specific station the ESC key is pressed and the user is prompted as to whether input from another station is required.

Fixed Interval

The user selects the station for which fixed interval data is to be entered from a scrolling list of stations (station code and place name). The system then loads the station information file specific to the chosen station and checks to see if the station is designated for keyboard entry (if not then the user is returned to the sub-system main menu).

The user is then presented with a screen with details of station id, parameter and place name, together with an input mask with year, month and day input fields. The rest of the screen is divided up into input fields for the time and data values (figure 2.7).

The user enters the year in the format YYYY, the month in the format MM, the day in the format DD and the time

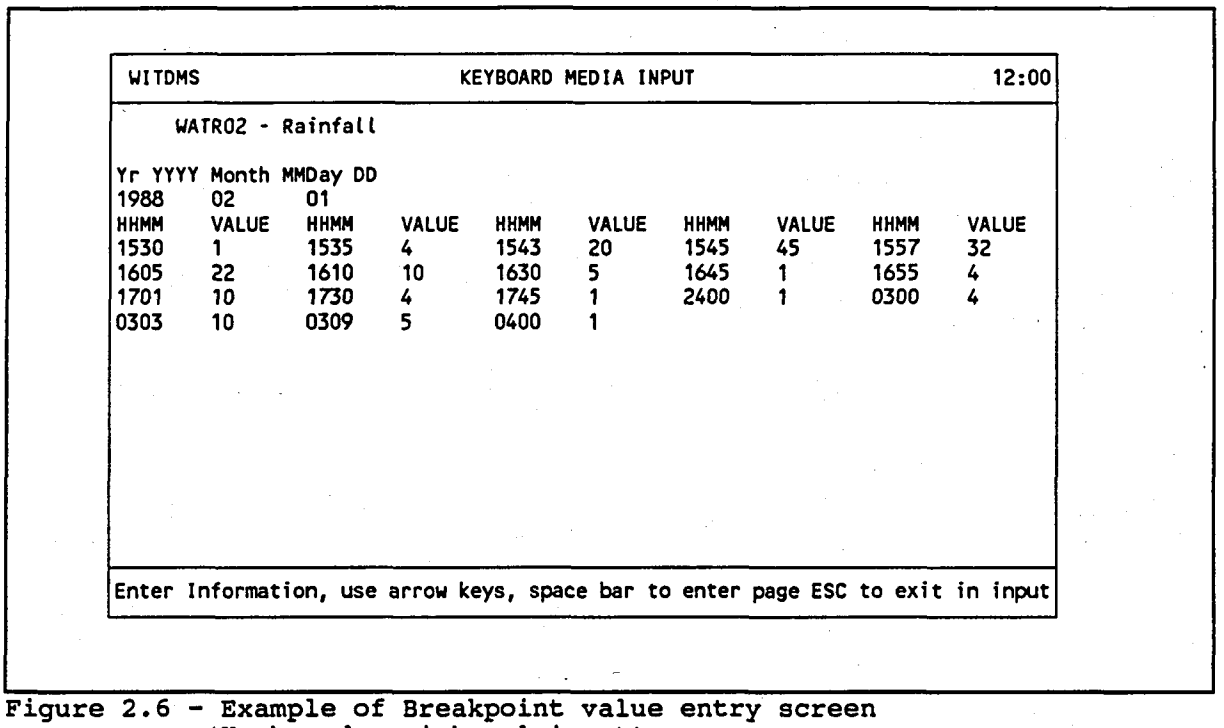


Figure 2.6 - Example of Breakpoint value entry screen (Keyboard peripheral input)

interval in the format TTTT (in minutes). The day is defined as the period between 08h01 and 08h00 the next morning. Data values are then entered in tabular format in a left to right direction. IT IS necessary to enter the data at every time interval. An example of an input screen is given in figure 2.8. The cursor keys are used to locate the position for data entry or editing.

There may be a situation where the number of fixed interval values for a specific day may exceed that of the locations on the screen. To continue entering data for the same date, press the SPACE BAR and continue adding data values to the new screen (the year, month, day and time interval on the screen should not be re-entered).

The screen is entered to the system by pressing of the SPACE BAR. The user is then presented with a new screen (figure 2.7) with current year, month, day and fixed time interval values. The day value then is re-entered by the user (the year, month and fixed time interval may be

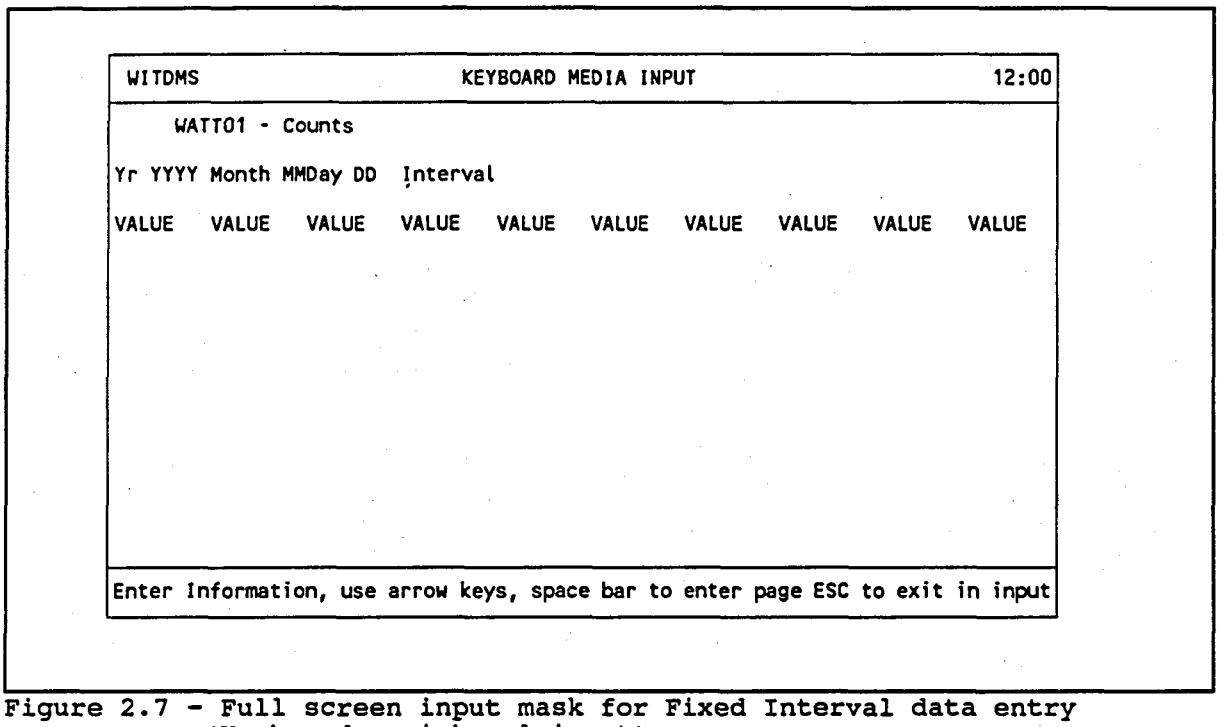


Figure 2.7 - Full screen input mask for Fixed Interval data entry (Keyboard peripheral input)

changed if required). To finish data entry to a specific station the ESC key is pressed and the user is prompted as to whether input for another station is required.

2.4.1.2 : RATING TABLE DATA

Rating table data specifically relates to a set of data that is used to convert one parameter to another (e.g. converting stage (depth of water) data to discharge). Rating table data may be entered either directly from the keyboard in tabular format or by accessing a DWA (Department of Water Affairs) rating table data file on disk. The data entry is similar to the standard keyboard entry for parameter data. The user is presented with a list of stations that measure stage (water depth) and selects the appropriate station.

Keyboard Entry of rating table data

The user is prompted to enter the following information.

Start year The start year when the particular rating table being

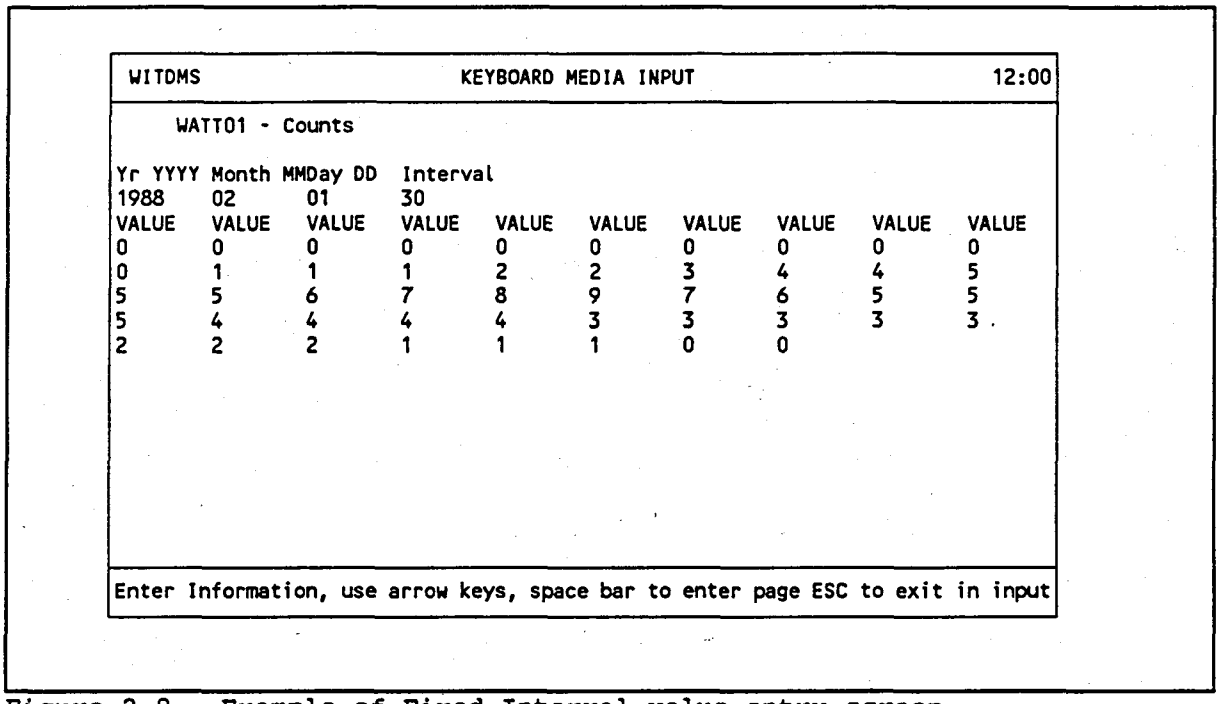


Figure 2.8 - Example of Fixed Interval value entry screen (Keyboard peripheral input)

entered is to apply. This is entered in the format YYYY.

Start month — The start month of the rating table entered in the format MM.

Start Day — The start day of the rating table entered in the format DD.

End Year — The end year when the particular rating table being entered is to apply. This is entered in the format YYYY.

End Month — The end month of the rating table entered in the format MM.

End Day — The end day of the rating table entered in the format DD.

Once this information is entered the user is presented with a screen with details of station code, parameter and place name, together with an input mask with start of row value, end of row value and row increment fields. The rest of the screen is divided up into input fields for data values (figure

2.9).

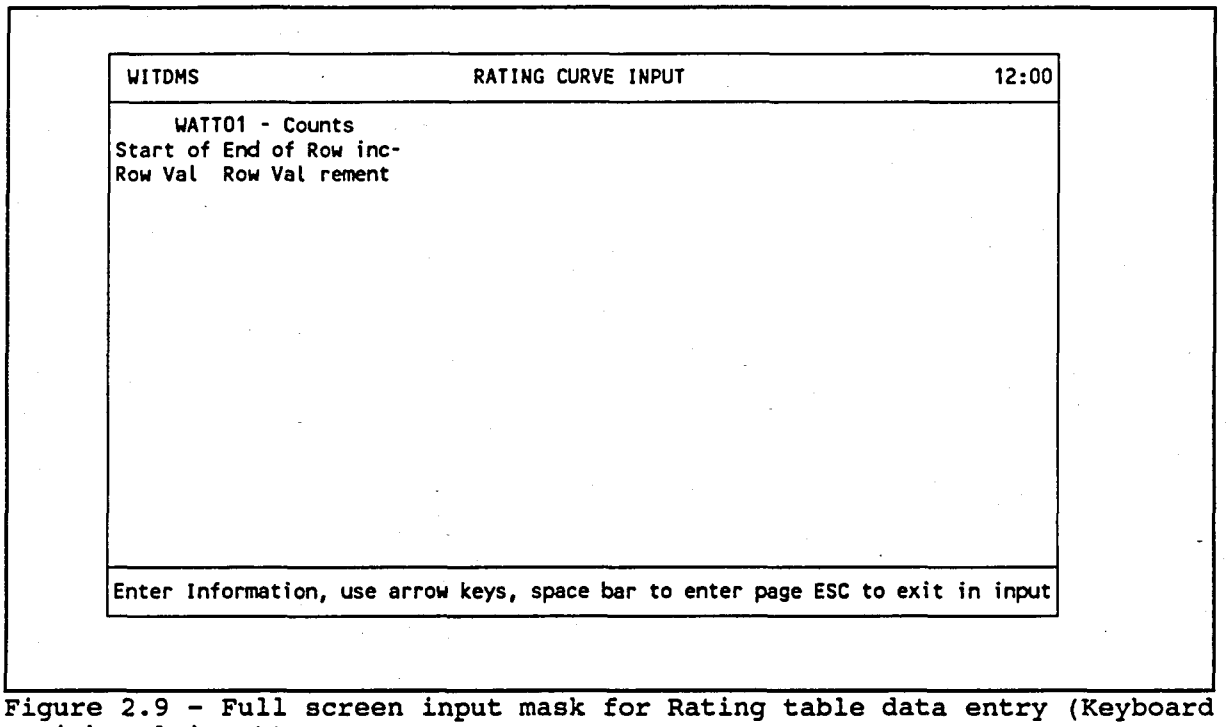


Figure 2.9 - Full screen input mask for Rating table data entry (Keyboard peripheral input)

The major input fields at the top of the input mask define the number of rows of the table and the increment in depth for each row. The columns start and end and increment is set by the system. The major input fields at the top of the screen are defined below.

Start of Row — The base value of stage (usually zero). Any value of stage less than this value (when stage is converted to discharge - see chapter 3) will result in an error flag being substituted in the generated data.

End of Row — The maximum value of stage (although an extra .9 times the increment of row is added to achieve an absolute maximum). Any value greater than the absolute maximum (when stage is converted to discharge - see chapter 3) will result in an error flag being substituted in the generated data.

Row Increment — The row increment is defined as the difference in depth

between each row. Easier table formation and input is achieved if the increment is in base 10 steps (i.e. row increment value of 0.01, 0.1, 1, 10). A schematic of a rating table prepared for input is presented in Table 2.2.

Rows (down page)	Columns (across page/screen)									
	0	.1	.2	.3	.4	.5	.6	.7	.8	.9
0	0	.001	.001	.002	.003	.003	.004	.005	.005	.006
1	.007	.009	.1	.11	.13	.17	.19	.23	.28	.33
2	.39	.45	.5	.58	.63	.69	.77	.86	.95	1.05
⋮	⋮									⋮
25	20.3	20.8	21.4	21.9	22.4	22.8	23.5	23.9	24.6	25.4

_ indicate system generated - row increment is 1

Table 2.2 - Example of rating table prepared for data entry using keyboard peripheral device input

The column beginning, end and increment values are all deduced by the system. The number of columns MUST NOT exceed 10 as this is a physical limit to a rating table.

The actual table data is entered in the same format as is present in the schematic above (table 2.2) (i.e. 10 columns to a line). An example of input of this table to the system is presented in figure 2.10.

In a situation where the number of lines on the screen is less than the number of rows in the table to be entered, then a continuation is needed. To continue entering data for the same table, press the SPACE BAR and continue adding the table data (DO NOT re-enter the start of row, end of row or row increment data again).

To finish entry of the rating table, press the ESC key and the user is then prompted as to whether input of another rating table is required. The rating

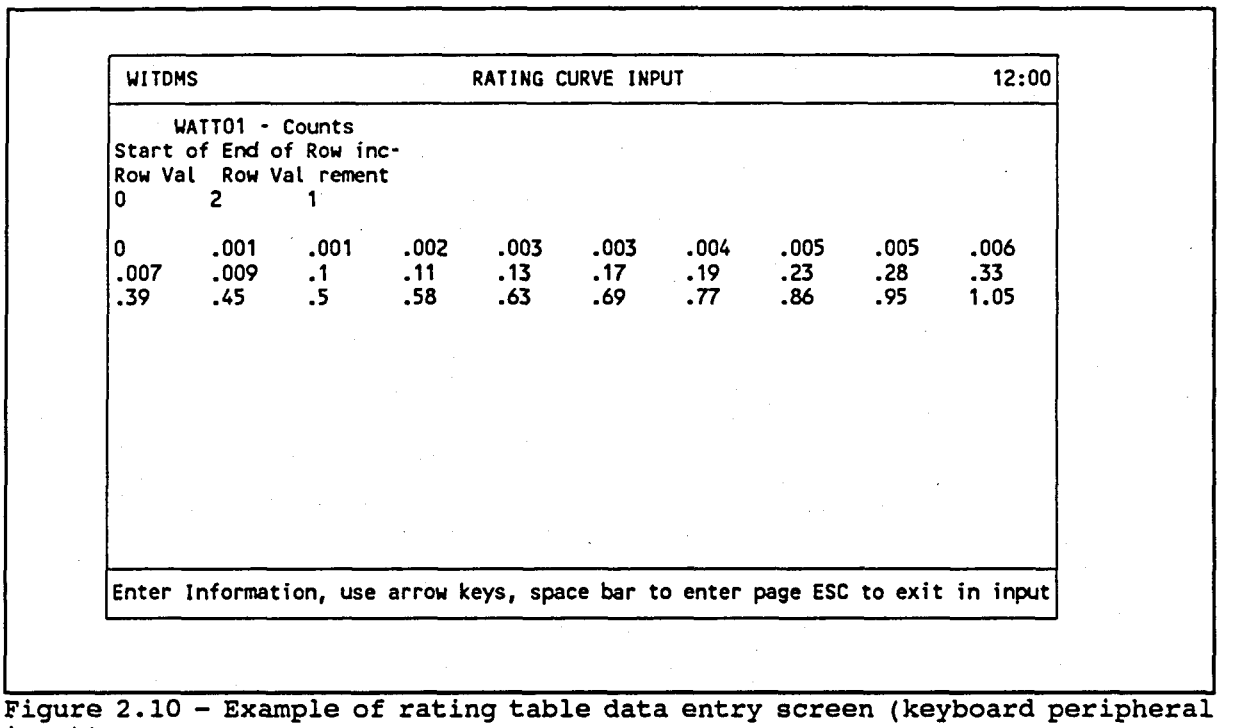


Figure 2.10 - Example of rating table data entry screen (keyboard peripheral input)

table data may be edited using the raw data editor.

DWA rating table entry from disk file

The user is then prompted to enter the file name (eight characters maximum) and ensure that the disk containing the file is in the secondary data directory (see chapter 6 for details).

The DWA formatted file is then loaded and added to the rating table scratch-pad file. This must be edited using the built-in raw data editor discussed in chapter 3.

2.4.2 DATA INPUT FROM DIGITISING PLATEN

Only breakpoint data may be entered from the digitising platen, as the data is extracted from the analogue chart at psuedo-random intervals (in terms of time scale). On selecting the digitiser as the peripheral to be used for

input, the user selects the station for which data is to be input from a scrolling list of stations (station code and place name). The system then loads the station information file specific to the chosen station and checks to see if the station is designated for digitising platen entry (if not then the user is returned to the sub-system main menu).

For the purposes of digitising, the screen changes from colour to monochromatic as a high resolution screen is required.

The user is presented with a screen giving details of the station code and chart type, and requested to provide the start and end dates and times of the chart. This information should be written on the chart by the recorder operator together with distinct markings showing the start and end of the chart recording. The start and end dates are defined as the date the chart was put on the recorder (and the date and on-mark written on the chart) and the date the chart was taken off the recorder or any date in-between.

Start Chart Year	The year in which the chart is initialised should be entered in the format YYYY.
Start Chart Month	The month in which the chart is initialised should be entered in the format MM.
Start Chart Day	THe day in which the chart is initialised should be entered in the format DD.
Start Time	The time at which the chart is initialised should be entered in the format HHMM (a 24 hour clock is assumed).

The user is then prompted to check the entered start information before continuing by pressing the Carriage return or Enter key. To re-enter the information, any other key may be pressed.

End Chart Year	The year in which the chart is removed (in the case of strip charts that run for greater than one visiting cycle, it is the next visit by the operator) should be entered in the format YYYY.

End Chart Month	The month in which the chart is removed (or visited) should be entered in the format MM.
End Chart Day	THe day in which the chart is removed (or visited) should be entered in the format DD.
End Time	The time at which the chart is removed (or visited) should be entered in the format HHMM (a 24 hour clock is assumed).

The user is then prompted to check the entered start information before continuing by pressing the Carriage return or Enter key. To re-enter the information, any other key may be pressed.

Once the start and end dates and times are entered, the user is prompted to select whether data can be digitised from that specific chart period (i.e. chart data is available or no chart data). Where a chart is missing, the selection of no chart data will result in the recording of missing data codes in the database files.

The screen display is replaced by a mimic (representation) of the digitising platen surface with softkeys lettered in the top part of the platen. The are below the softkeys is the effective platen are which can be used to digitise charts.

The user then lays the chart on the digitising platen in an approximately horizontal direction and affixes the chart with draughtman's tape (as this will not damage the chart or the digitising platen). The user then enters the four corners of the recording piece of the chart (the stylus is pressed at each corner indicated by arrows on the screen mimic) as shown in figure 2.11. A beep will sound each time the stylus is pressed on the digitiser. With stage stations, the user is prompted to enter the start and end gauge plate readings (figure 2.12). This is used to determine the baseline of the trace.

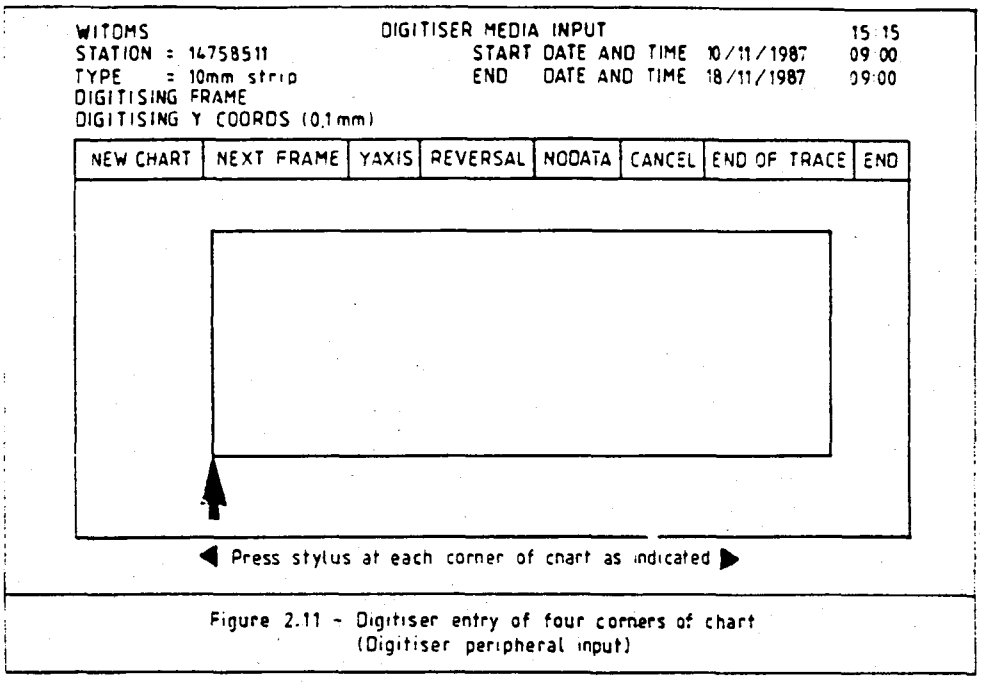


Figure 2.11 - Digitiser entry of four corners of chart (Digitiser peripheral input)

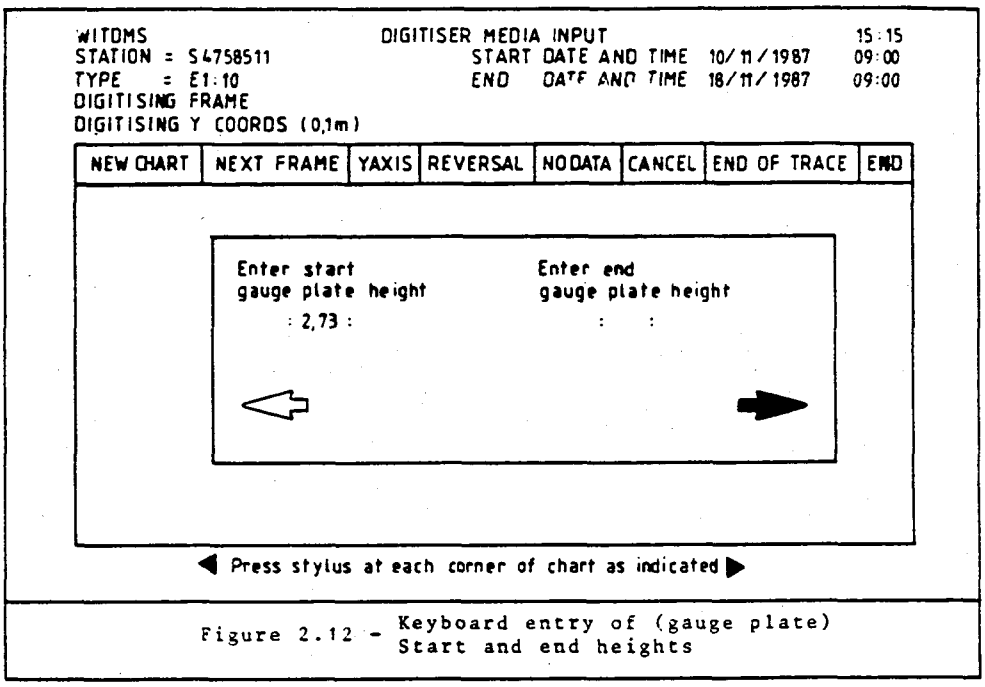


Figure 2.12 - Keyboard entry of (gauge plate) Start and end heights

The screen is cleared and the user is presented the digitising mimic but with the effective platen are scaled to the piece of chart being digitised. The user can either press the stylus on any of the softkeys to activate a menu choice or at the breakpoints on the chart trace (starting at the left hand side and working across the chart to the end at the right hand side).

As the chart trace is transferred to the micro-computer using the stylus pressed at each breakpoint, the image of the line between breakpoints is displayed on the screen (figure 2.13). The user can then tell at a glance if an inaccuracy or error has been introduced into the data entry. At the end of a trace (a trace is defined as a continuous line from left to right across the chart within the entered four corner boundaries) the user signals that the trace is complete by pressing softkey 7 (END OF HORIZONTAL TRACE). To cancel the current trace the softkey 6 (CANCEL LAST TRACE) should be pressed with the stylus. A list of softkey numbers and labels is presented in table 2.3.

At the end of a trace a further trace can be digitised (in the case of several traces on one frame) or the chart moved to the next frame.

If the chart is moved to a new frame then the softkey 2 (NEXT PORTION OF CHART) is pressed to allow entry of the four coordinates of the frame. If the new on date is reached then the softkey 1 (NEW CHART) is pressed and the start and end time information entered to the system. To change from one station's charts to another, the softkey 8 (END OF STATION CHARTS) is pressed and then the user is prompted as to whether another station is required.

Softkey Options.

The various softkeys (table 2.3) allow the user to transfer information on the chart to the system which will aid the system in processing the digitised data and subsequently loading it into the database. Each softkey option will be considered and its usage in prepartion and digitising of a chart.

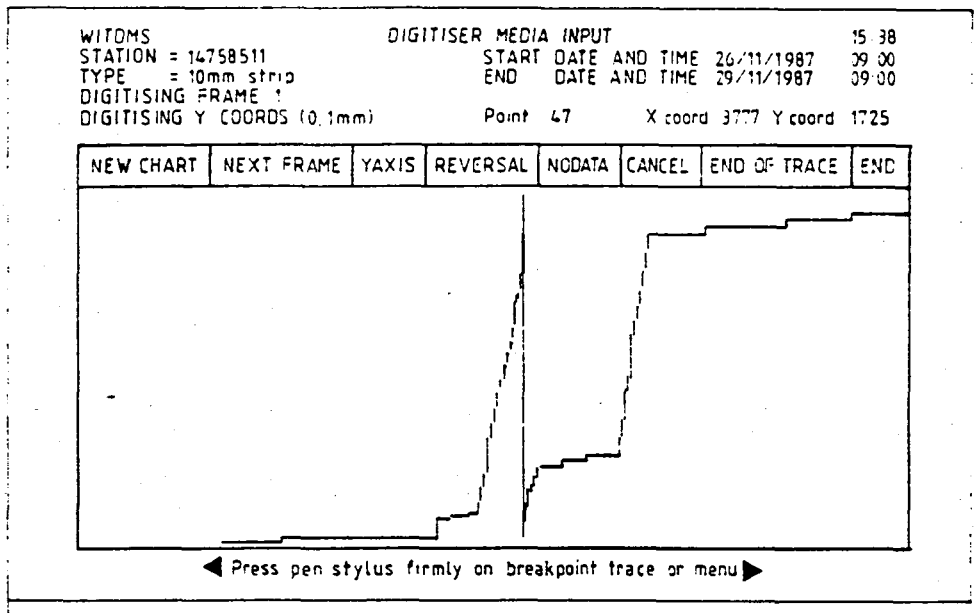


Figure 2.13 - Digitiser entry of chart trace (display)
(Digitiser peripheral input)

Softkey	Name of Key	Brief Description
1	NEW CHART / NEW START DATE & TIME	To select new chart or new start time & date written
2	NEXT PORTION OF CHART / FRAME	To select next frame or part of trace on strip/large char
3	Y-AXIS BASELINE VALUE	To set baseline to value
4	Y-AXIS OVERLAP	To switch overlap on/off
5	MISSING DATA TRACE	To indicate missing trace(s)
6	CANCEL LAST TRACE	To delete data on last trace
7	END OF HORIZONTAL TRACE	To indicate end of frame
8	END OF STATION CHARTS	To indicate end of station

New Chart/Time	A new chart is defined as a new physical chart or portion of strip chart between two operator marked periods. This softkey allows the entering of the start and end dates of the chart and the orientation of the chart on the digitiser.
Next Chart Portion	Where a chart exceeds the physical width of the digitiser (i.e. a frame is less than the chart width), this softkey indicates that the chart has been moved to a new frame. The softkey is pressed after the END OF TRACE softkey to start a new frame.
End of Trace	The end of trace softkey is pressed to signal the end of a trace across the frame of the digitiser (from the left hand side to right hand side of the digitiser platen). This softkey is pressed before NEW CHART/TIME, NEXT PORTION OF CHART or END OF STATION softkeys.
End Station Charts	When all charts have been digitised for a specific station (or the user wishes to take a break), this softkey is used to exit the digitising sub-system. This softkey is pressed after END OF TRACE or MISSING DATA softkeys.
Cancel last Trace	When a trace is digitised, a mimic of the trace is display on the screen. The user can then decide if the display matches that on the chart; if not, the trace can be deleted and re-input. This softkey should only be used before and after the END OF TRACE softkey.
Y-Axis baseline value	This correction softkey is used to indicate to the data processor that the baseline of the chart (as entered for each frame) is not set to zero. The value of the baseline (positive or negative) is entered after the softkey is pressed. The softkey

can be pressed at any time during digitising of a trace.

Y-Axis overlap — WIth the use of recording charts for level measurement, once the chart pen reaches the top of the chart the pen reverses direction. To indicate to the processing system that this 'reversal' has occurred, this softkey is pressed. Once the pen has been restored to non-reversal movement, the softkey is pressed again.

Missing data trace — The trace on the chart may be missing as a result of ink drying, clock stopping or chart paper finishing. The absence of data during the trace is indicated to the system by pressing the missing data trace softkey. END OF TRACE softkey and trace digitising can follow this softkey instruction.

DATA INPUT FROM EPROM READER

Either breakpoint or fixed time interval data may be entered using the EPROM reader downloading system. On selecting the EPROM reader as the peripheral to be used for input, the user is prompted with a list of operations that have to be performed. After each of these physical operations has been completed, the user presses the carriage return or enter key.

1. Switch on power to EPROM reader
2. Insert EPROM 'chip' into socket in reader
3. Red EPROM (8K) - type 8 8 1 and enter on reader keypad
   White EPROM (16K) - type 8 8 2 and enter on reader keypad
4. Type 8 7 and enter on reader keypad
5. Switch EPROM reader online

The system will download the data from teh EPROM 'chip' to the micro-computer, and at the same time display the raw data on the screen. Once all the data from the specific EPROM has been entered, the user is presented with a further list of instructions.

1. Switch EPROM reader offline
2. Enter the Julian day number when the EPROM 'chip' was removed from the logger. This day number is displayed on the logger in the field by pressing the day key. The number should be written ontop of the 'chip' before sending to processing site.
3. Remove EPROM 'chip' from socket of EPROM reader

The user is prompted as to whether a further EPROM 'chip' is to be downloaded.

DATA INPUT FROM RAM READER

Either breakpoint or fixed time interval data may be entered using the RAM reader downloading system. On selecting the RAM pack reader as the peripheral to be used for input, the user is presented with a list of operations that have to be performed. After each of these physical operations has been completed, the user presses the carriage return or enter key.

1. Insert RAM cartridge into socket
2. Type in GDMP and press ENTer on logger

The system will download the data from the RAM cartridge to the micro-computer, and after a small delay, display the raw data (in EPROM format) on the screen. Once all the data from the specific RAM cartridge has been entered, the user is presented with a further list of instructions.

1. Remove RAM cartridge from socket

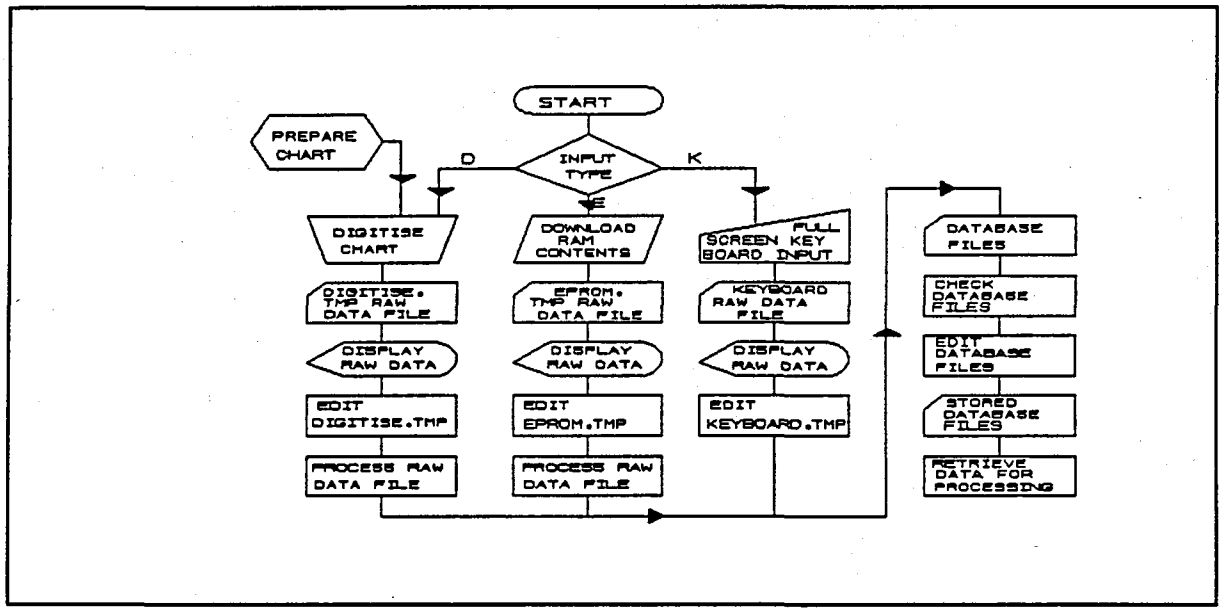
The user is then prompted as to whether further RAM data is to be downloaded.

Summary

The Data entry sub-system is a component of WITDMS which enables the data capture of Hydro-Met information in various common formats and from different types of recording media. Data can be entered to the system via the keyboard, a digitiser and electronic media (i.e. EPROM and RAM devices).

CHAPTER 3 : PROCESSING AND DATABASE LOADING SYSTEM

Since processing of the raw data and loading into the database files of the system is in all probability the most time consuming task (from the point of the micro-computer), the concept of a multi-pass system was introduced into the Data Management System. The concept is this application is best explained through use of a flow-diagram (Figure 3.1).



Data is entered to the system via the various peripherals (see chapter 2) and stored in temporary files. These files are then accessed by the raw data editor sub-system which allows changes and deletions to be made to the raw data. A backup of the file prior to editing is generated by the system. The main processing of the data and loading into the database files is then undertaken. Successful loading of the data into the database files results in the deletion of the temporary file. On entry to the Data processing and database loading system (from selection in the main menu), the user is presented with a sub menu (Figure 3.2).

The user returns to the main menu by selecting exit menu.

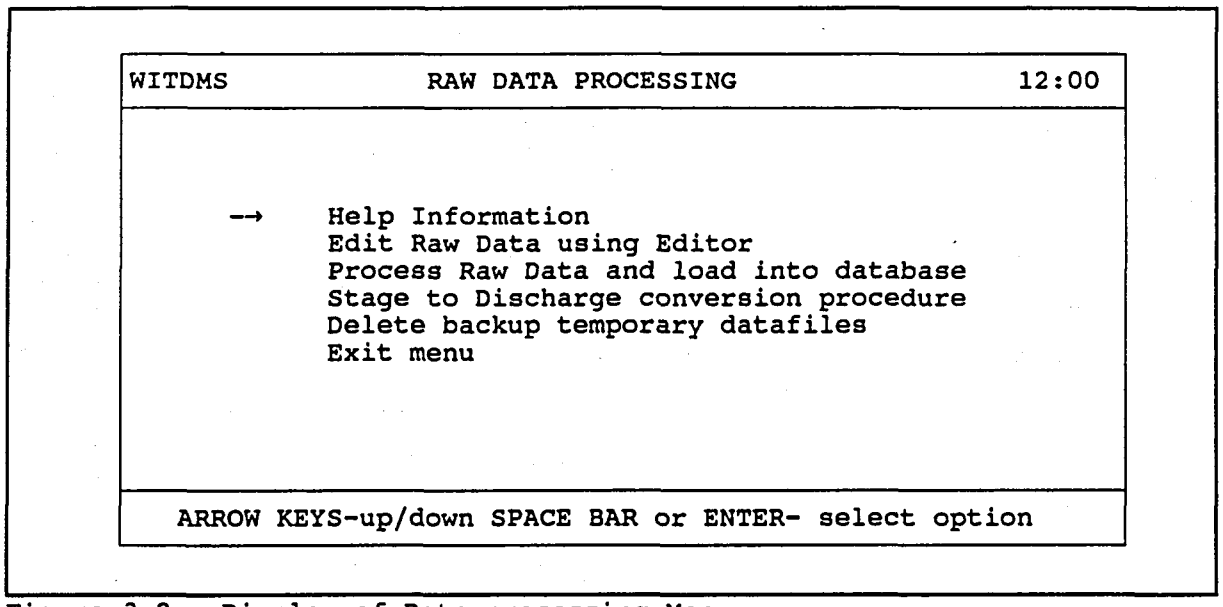


Figure 3.2 - Display of Data processing Menu

3.1 : RAW DATA EDITOR

The raw data editor is a full screen scrolling character and line editor which allows the user to modify, delete and insert information to raw data files. Each of the raw data file types may be edited by the selection of the file type on the raw data editor sub-menu (figure 3.3).

NOTE: It is important that the whole of the scratch file is edited in one sitting otherwise the changes will not be stored.

Each type of raw data file has its own characteristics which are demonstrated in the following four figures (3.4-3.7). The format of the data within the files is annotated within the figures.

There are several keys that can be used to edit the file. These are explained below, but are labelled within the bottom two lines of the editor screen. The top lines of the editor screen indicate the name of the file being currently edited and the page number, line or character edit mode or insert character/line mode.

The system is designed in such a way that the whole file must be edited.

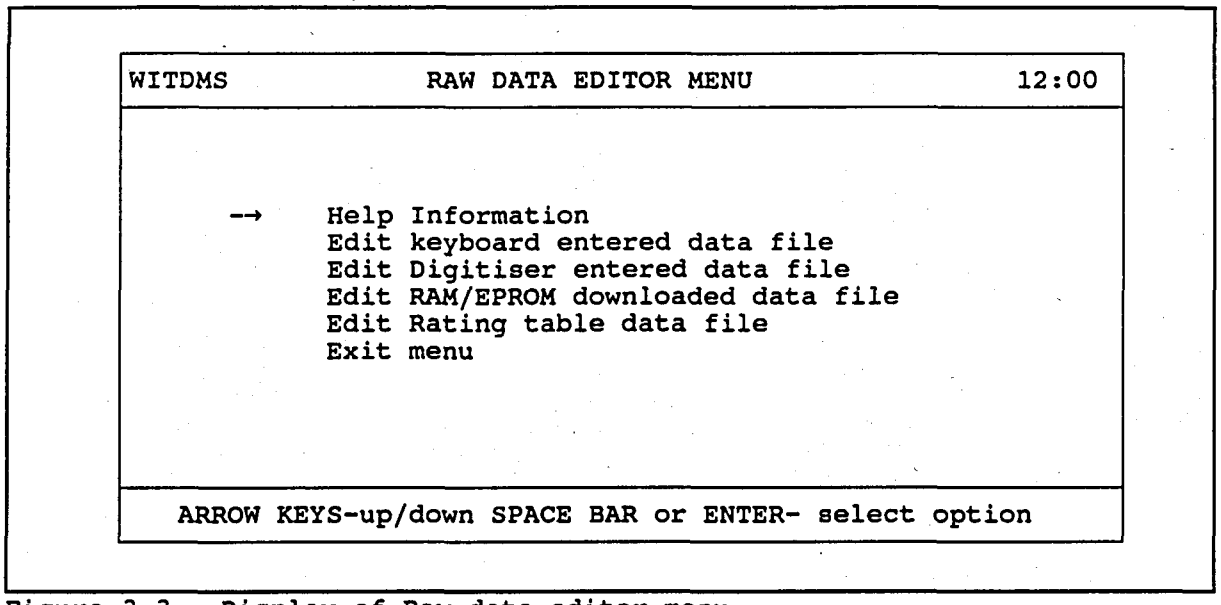


Figure 3.3 - Display of Raw data editor menu

This is to prevent half measures being applied to the important concept of data checking.

3.1.1 : Editor Keys

Arrow keys — The arrow keys (UP, DOWN, RIGHT, LEFT) move the cursor in the directions specified within the screen window (20 lines of 80 characters is defined as a window).

PGUP — The PGUP key results in the page number decreasing by one (20 lines). The previous 20 lines of file (in relation to the current page) may be displayed and edited.

PGDN — The PGDN key results in the page number increasing by one (20 lines). The next up to a maximum of 20 lines of file (in relation to the current page) may be displayed and edited.

HOME — The HOME key results in the scrolling of the window to the left (ie. if character columns 81 to 160 are present on the screen, the pressing of the HOME key will result in character columns 1 to 80 being displayed).

END — The END key results in the scrolling of the window to the right

(ie. if character columns 1 to 80 are present on the screen, the pressing of the END key will result in character columns 81 to 160 being displayed.

F1 — The pressing of the softkey F1 results in the editor being placed into LINE editing mode. This means that the INS and DEL keys result in whole lines being inserted and deleted.

F2 — The pressing of the softkey F2 results in the editor being placed into CHARACTER editing mode. This means that the INS and DEL keys result in characters being inserted and deleted.

INS — To insert text or lines this key is pressed (at the line or character where inserting is required). In the case of text insert (F2 or CHAR mode) the insert mode is left on until the INS key is pressed again to cancel insert. WARNING - The operation of the INS key depends on the editor mode.

DEL — To delete text or lines this key is pressed (at the line or character where deletion is required). WARNING - The operation of the DEL key depends on the editor mode.

On completion of the editing of the file the user is returned to the raw data editor menu (figure 3.3). The raw data files can be re-edited, but the backup of the temporary file is replaced with the temporary file at the time of the start of the edit.

3.2 : Raw Data Processor and Database loader

The processing of the raw data and loading of the relevant information into the database files is a system operation and requires no intervention from the user. Where an error is detected that cannot be corrected by the system (ie. a station cannot be found in the station index file) a message is presented and the user is returned to the processing main menu. Where a station id is not recognised, the system will prompt the user to either type in the correct station id or abort the processing. The first approach to the problem should be re-editing of the raw data.

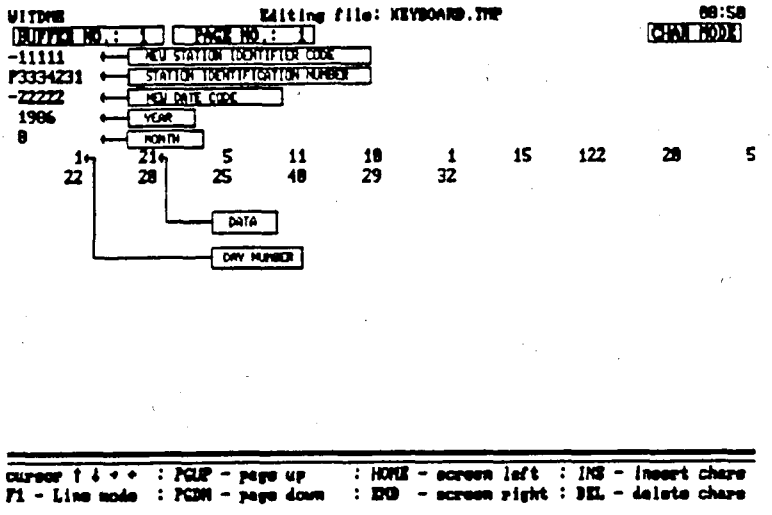


Fig. 3.4 Full screen editor - keyboard entry files

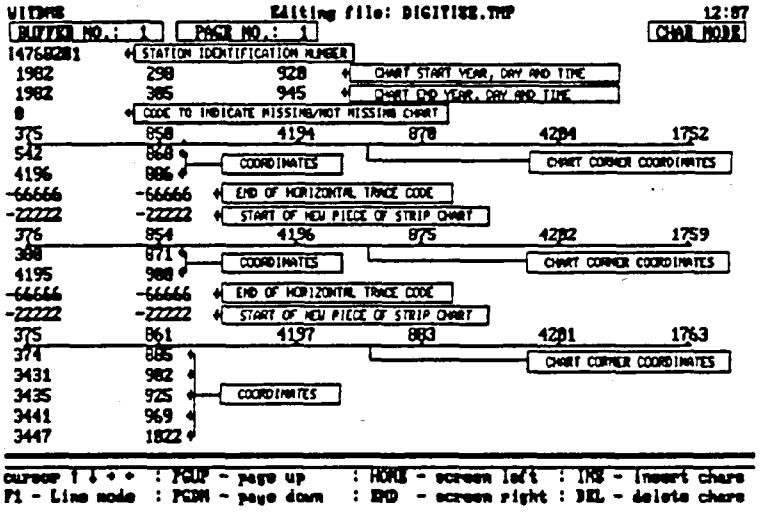


Fig. 3.5 Full screen editor - digitizer entry files

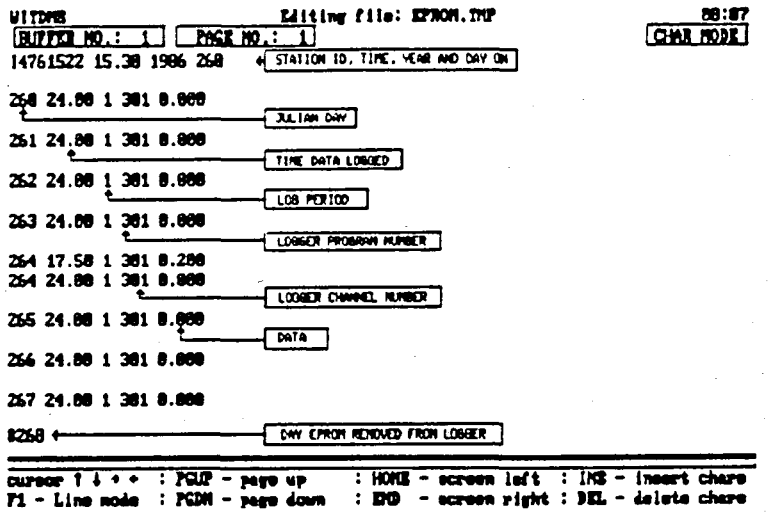


Fig. 3.6 Full screen editor - eprom down loaded files

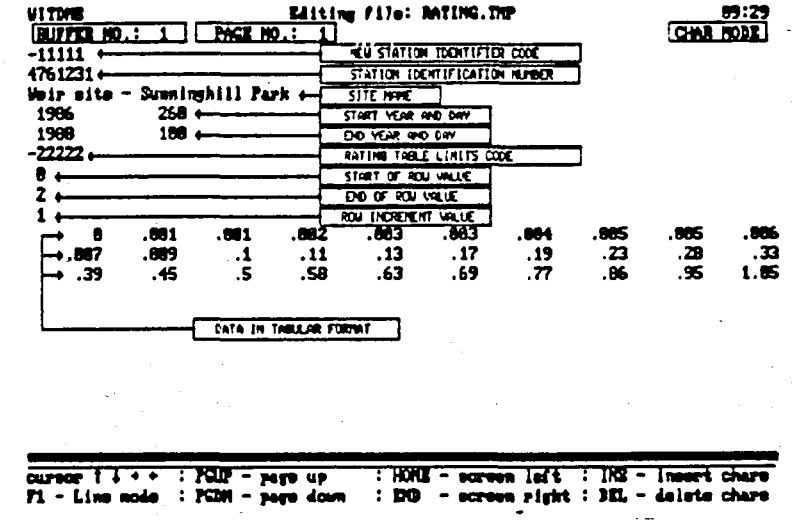


Fig. 3.7 Full screen editor - rating tables raw data files

Briefly the raw data files are processed depending on their mode of entry (ie. keyboard station data, digitised data, EPROM or RAM downloaded data or rating tables). The day in terms of the system database files is defined as the period from 08h01 on the specified day to 08h00 on the next day. The database loader loads data into the files according to the specified database format (see chapter 5 for more information). Rating tables are treated differently in that the table is stored in separate files, with an index file that has the information on the period of application of each specific rating table.

Further information on file storage is contained in the appendices.

3.3 : Stage-Discharge Conversion

With any measurement of physical parameters, it is possible that a direct assessment of the parameter is not easily obtainable. This is especially true with the measurement of discharge in rivers/canals. The usual approach is to measure the depth of water (stage relates to a value above a known datum which may not be the base of the channel) and convert this value to discharge using a 'rating' table. The production of the rating table is outside the field of this report.

The WITDMS system allows the user to enter stage data for a station and use a rating table to generate a discharge database file. The rating table is either entered from the keyboard in a tabular format or from a DWA rating table file on disk (see chapter 2). Since phenomena such as shifting bed and man's influence results in rating table only being applicable for finite time periods, provision is made to enter several rating tables for the same stage station.

Selection of stage discharge conversion from the raw data processing menu results in a further menu being displayed (figure 3.8).

Once the item on the menu is selected (figure 3.8), the user is presented with a list of stations that have rating tables (ie. stage stations). After selection of the required station, the operation that follows is dependent on the choice made in the rating table transformation menu. The conversion of stage to discharge data is made using a linear interpolation of the rating table matrix.

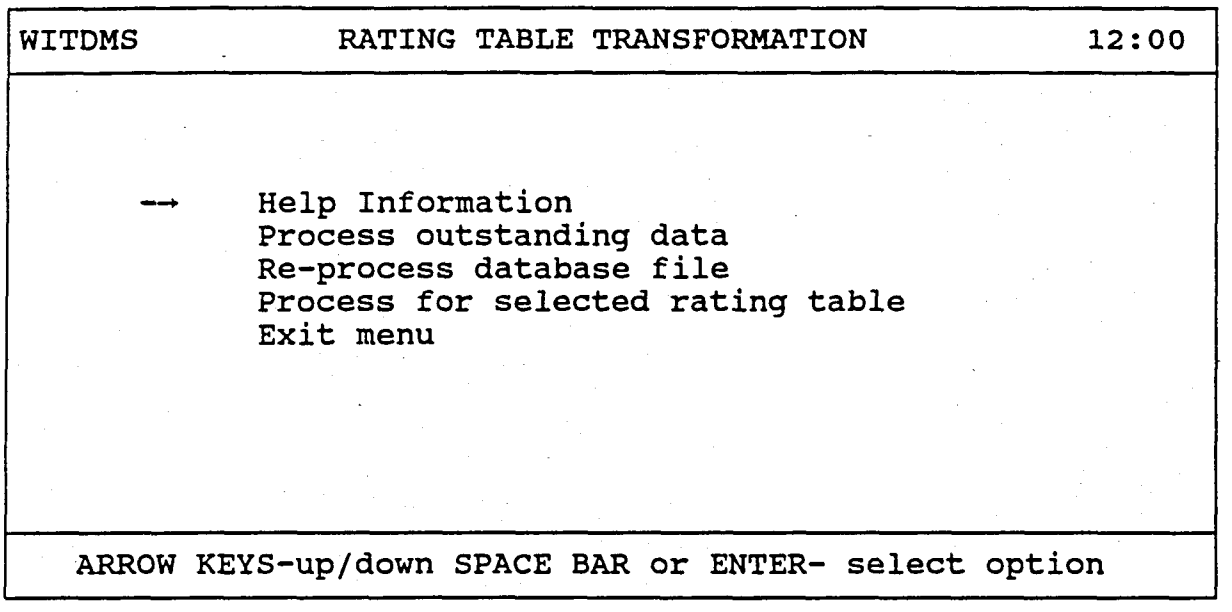


Fig. 3.8 Display of Stage-Discharge conversion menu

3.3.1 : **Outstanding Data**

Data between the last date of the discharge database and the last date of the stage database are processed.

3.3.2 : **Re-process Data**

The discharge database is erased and the stage database processed from beginning to end of the stored record.

3.3.3 : **Selected Dates**

The user is presented with a list of rating tables for the specific station and chooses the table (which contains beginning and end application dates) to be used.

3.4 **Restore of Backup Temporary files**

The backup temporary files that are created by the raw data editor may be restored as the current temporary file. The user is requested to select the temporary file (eg. keyboard, or digitise) to be restored from the list in the menu.

3.5 : Summary

Raw data processing and loading of the processed data into the main database files of the system requires little effort on the part of the user. Editing of the raw data prior to this operation is very user intensive and is a necessary part of data management. The full screen editing system described allows the user to modify, add and delete information within the raw data files. Stage to discharge conversion using rating tables is described.

CHAPTER 4 : RETRIEVAL OF DATA FROM DATABASE

The objective of a Hydro-Met data management system is that information can be entered, stored and retrieved in an efficient manner. The effective use of the data management system is dependent on the methods of retrieval and presentation of the data. This chapter describes the reporting sub-system that is an integrated part of WITDMS.

Selection of the retrieval option from the main menu results in the display of a retrieval menu (Figure 4.1).

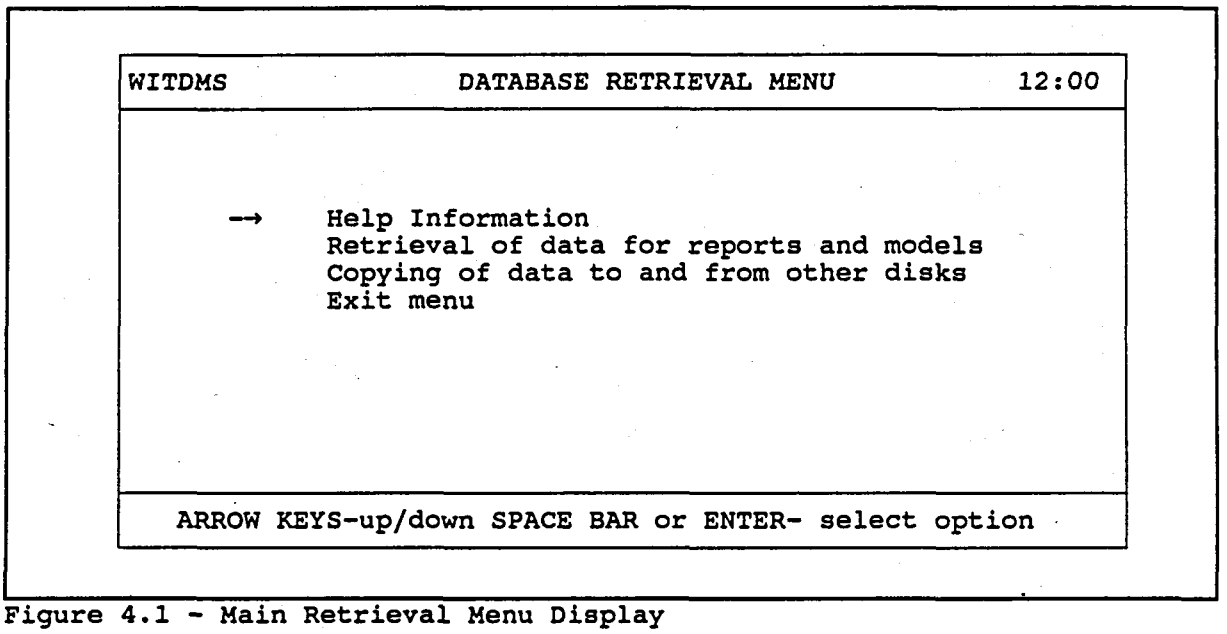


Figure 4.1 - Main Retrieval Menu Display

4.1 : RETRIEVAL OF DATA FOR REPORTS AND MODELS

The major option of the retrieval menu is to provide printouts of data and information files, graphical images of data, and convert database information into ASCII format suitable to porting to other software.

A series of sub-menus is displayed to allow the user to request data from the database files in pre-defined formats. The Reporting system main menu is presented in Figure 4.2. This requires the user to select the mode of output of the data (ie. printout, graphics, ASCII data). Once the mode of output is selected the user is presented with a further menu requiring

selection of the time period of the data (ie. monthly, daily, or event).

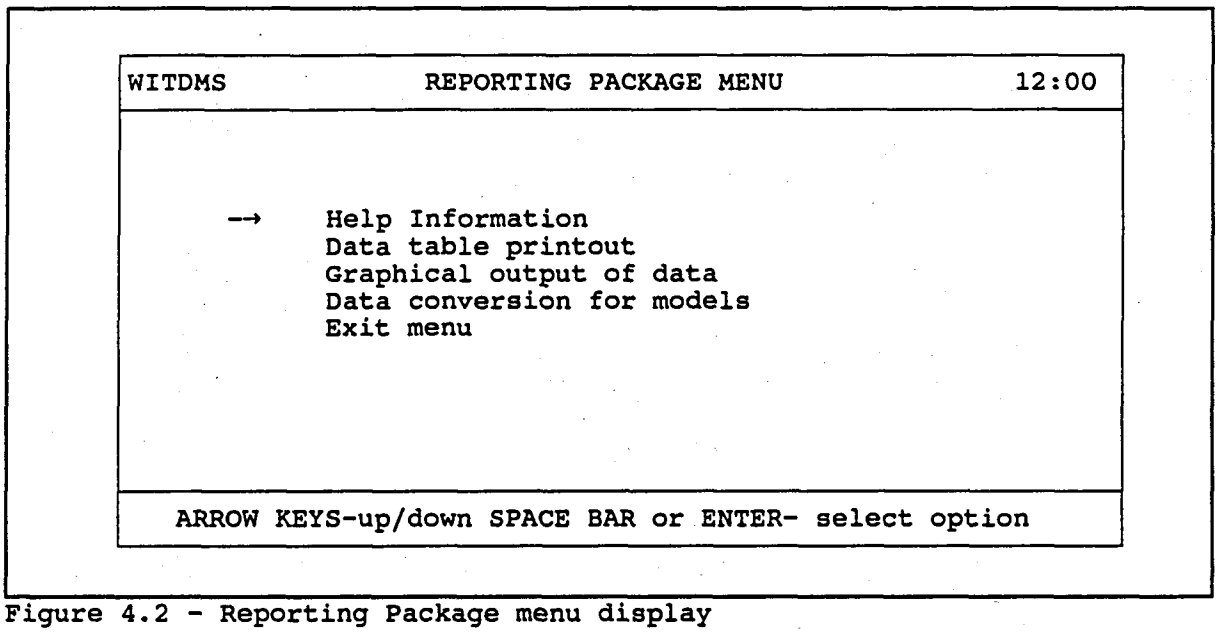


Figure 4.2 - Reporting Package menu display

4.1.1 : DATA TABLE PRINTOUTS

Many organisations (National Water Authorities and University research Units) produce reports (or year books) containing tables of Hydro-Met data. These tables can contain data on a monthly or daily basis. The data tables produced by this Hydro-Met data management system are detailed as follows.

4.1.1.1 : Monthly data

Any Hydro-Met parameter may be produced as a monthly tabulation. Rainfall data is expressed as a total value, whereas other parameters are tabulated with maximum, minimum and mean values for each month. Examples of monthly data printouts are presented in figures 4.3.

4.1.1.2 : Daily data

Any Hydro-Met parameter may be produced as a daily tabulation. The type of output is similar to that of the monthly data printouts. Examples of daily data printouts are presented in figures 4.4.

MONTHLY VALUES FOR STATION I4761?2?

MEASURED PARAMETER: Rainfall UNITS: Ø.1mm
SITE OF MEASUREMENT: South Park - Sunninghill

LATITUDE : 26 DEG 2 MIN
LONGITUDE: 28 DEG 5 MIN

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTAL
1986	1442	1678	EP FAIL	EP FAIL	2882	1798	138	0	0	0	288	1192	8594

MONTHLY VALUES FOR STATION T4761523

MEASURED PARAMETER: Temperature UNITS: deg C
SITE OF MEASUREMENT: Weather Station, Waterval

LATITUDE : 26 DEG 1 MIN
LONGITUDE: 28 DEG 6 MIN

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	AVERAGE
1985	-	-	-	-	-	-	-	24.3	21.84	23.49	23.19	30.66	30.44
1986	-	-	-	-	-	-	-	17.6	11.52	8.16	8.92	15.38	18.26
1988	-	-	-	-	-	-	-	-1.3	-1.1	-.164	-.11	0	-1.3

Fig. 4.3 Example of Monthly data printout tables

DAILY VALUES FOR STATION I4761?4

MEASURED PARAMETER: Rainfall UNITS: 0.1mm

SITE OF MEASUREMENT: Microlite Site - Waterval

LATITUDE : 26 DEG 1 MIN
LONGITUDE: 28 DEG 5 MIN

YEAR 1986 / 1987

Rainfall TOTALS

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	0	0	12	0	EP FAIL		0	EP FAIL	EP FAIL	EP FAIL	0	0
2	9	0	24	24	EP FAIL		0	EP FAIL	EP FAIL	EP FAIL	0	0
3	0	0	10	42	EP FAIL		0	EP FAIL	EP FAIL	EP FAIL	0	0
4	0	0	76	EP FAIL	EP FAIL		0	EP FAIL	EP FAIL	EP FAIL	0	0
5	0	56	0	EP FAIL	0		62	EP FAIL	EP FAIL	EP FAIL	0	0
6	10	170	0	0	EP FAIL		0	EP FAIL	EP FAIL	EP FAIL	0	0
7	0	70	80	216	EP FAIL		0	EP FAIL	EP FAIL	EP FAIL	0	0
8	0	146	10	30	0		110	EP FAIL	EP FAIL	EP FAIL	0	0
9	0	0	0	200	0		10	EP FAIL	EP FAIL	EP FAIL	0	0
10	0	0	114	44	0		0	EP FAIL	EP FAIL	EP FAIL	0	0
11	0	0	0	102	0		0	EP FAIL	EP FAIL	EP FAIL	0	0
12	0	0	0	18	0		0	EP FAIL	EP FAIL	EP FAIL	0	0
13	0	0	0	42	0		16	EP FAIL	EP FAIL	EP FAIL	0	0
14	0	0	0	32	0		0	EP FAIL	EP FAIL	EP FAIL	0	0
15	60	0	0	56	112		4	EP FAIL	EP FAIL	EP FAIL	0	0
16	196	0	12	0	0		54	EP FAIL	EP FAIL	EP FAIL	0	EP FAIL
17	2	186	196	0	0		554	EP FAIL	EP FAIL	EP FAIL	0	0
18	2	0	0	2	0		238	EP FAIL	EP FAIL	EP FAIL	0	0
19	126	14	2	276	0		12	EP FAIL	EP FAIL	EP FAIL	0	0
20	0	198	0	240	0		0	EP FAIL	EP FAIL	EP FAIL	0	0
21	0	16	0	2	18		328	EP FAIL	EP FAIL	EP FAIL	0	0
22	0	0	12	0	0		134	EP FAIL	EP FAIL	EP FAIL	0	0
23	0	0	134	4	0		4	EP FAIL	EP FAIL	EP FAIL	0	0
24	0	40	142	0	0		0	EP FAIL	EP FAIL	EP FAIL	0	0
25	0	0	72	80	0		60	EP FAIL	EP FAIL	EP FAIL	0	0
26	0	28	24	0	0		110	EP FAIL	EP FAIL	EP FAIL	0	0
27	24	0	64	0			44	EP FAIL	EP FAIL	EP FAIL	0	0
28	666	198	138	0			228	EP FAIL	EP FAIL	EP FAIL	0	0
29	0	94	2	0	-		-	EP FAIL	EP FAIL	EP FAIL	0	0
30	0	0	0	EP FAIL	-		-	EP FAIL	EP FAIL	EP FAIL	0	0
31	10	-	-	EP FAIL	-		-	EP FAIL	-	EP FAIL	-	-
TOTAL	1129	1410	1152	1688	514	1740	0	0	0	0	0	1272

Fig. 4.4 Example of Daily data printout tables

4.1.1.3 : Rating Tables

Rating tables in a similar tabular format to the data entry of rating table data (see chapter 2) can be produced. If several rating tables exist for a given station, then the user can select part or all the tables to be printed.

4.1.1.4 : Station Info

Each station has a set of information specific to that parameter. This information is stored in a station information database which is accessed from the station information option on the main menu (see chapter 5 for more details). This information can be printed out for inclusion in reports or for archive purposes. Example of a printout for a specific station is presented in figure 4.5.

```
WITDMS          STATION INFORMATION SHEET          14758201

SITENAME  : Bowling Green, Montpark

LATITUDE  :  26 Deg  9 Min
LONGITUDE :  27 Deg  58 Min

PARAMETER : Rainfall          (0.1mm)

     START RECORD                    END RECORD
 DAY    MONTH    YEAR          DAY    MONTH    YEAR
   6     11       87            22     11       82

INPUT DEVICE           -   Digitiser platen
DATABASE STORAGE TYPE  -   Breakpoint data

CHART TYPE/DESCRIPTON  -   10mm strip
X AXIS SCALE           -    2.919 mins / mm
Y AXIS SCALE           -    1.25 mm / 0.1mm
FRAMESIZE              -    1158.7 mins

GEOMETRIC GRID ON CHART  - Linear
```

Fig. 4.5 Example of Station information printouts

4.1.2 : Graphical Displays

Graphical display of data in most cases is preferable to tabulated as the eye can perceive more information at a glance. Therefore a graphical output routine was integrated into the data management system to achieve this observation. Graphical displays also have the option of being 'dumped' to the printer (either as a several shades of grey or a black and white printout). Graphical display options are detailed below.

4.1.2.1 : Monthly data

Any Hydro-Met parameter may be graphical displayed in the form of monthly data values. Rainfall data is expressed as monthly totals and graphically illustrated as bar charts. Other parameters which contain maximum and minimum values as well as the mean, are displayed as line graphics. Examples of graphical output are presented in figure 4.6a and 4.6b.

4.1.2.2 : Daily data

Any Hydro-Met parameter may be graphically displayed in daily format. The output is similar to that for the monthly data. Examples of daily data graphic displays are presented in figure 4.7.

4.1.2.3 : Event data

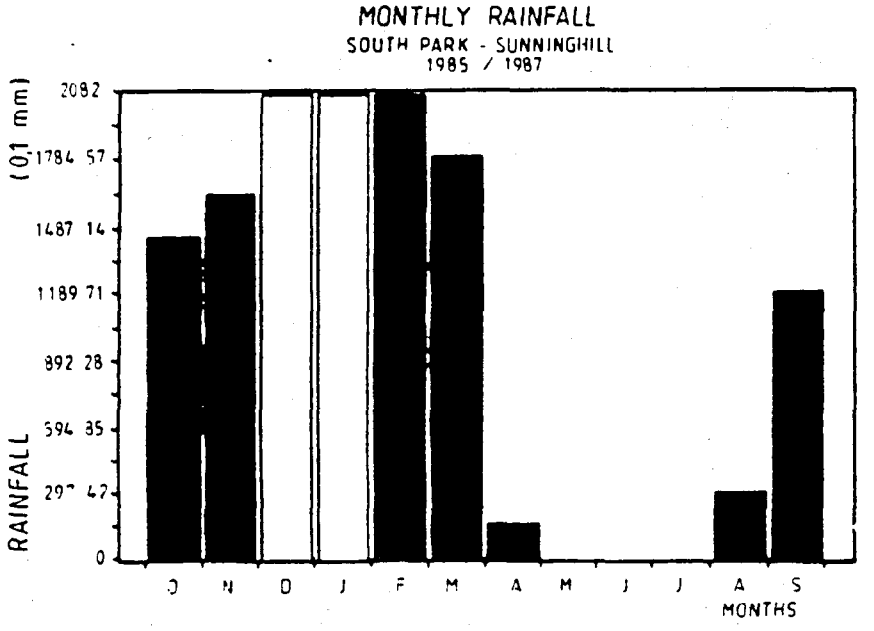
Most Hydro-Met parameters are recorded on a frequency of less than daily (sometimes every 5 minutes). The graphical display of time variant data during an 'event' is therefore an important aspect to a data management system. Examples would be the variation of atmospheric pressure which would show the passage of a frontal event, or the variation of rainfall during a storm. The system allows the user to select periods of 1 to 5 days (pentad is 5 days) for display of a parameter. Examples of event graphical displays are presented in figure 4.8.

4.1.2.4 : Rating Table

Some rating tables that are published in the literature are in the form of graphical displays. The data management system allows the user to produce a graphical display of the rating table.

4.1.3 : Data Conversion for Models

A further essential requirement for an effective Hydro-Met data management system is the ability to transfer the data from the database files to other software. Examples of other software would be rainfall-runoff models and water balance calculations. Since the data is stored within binary database files, it becomes necessary to convert this to a simple ASCII format file. Not only does this mean that the file can be printed, displayed or edited, but a simple (if larger and slower access) format.



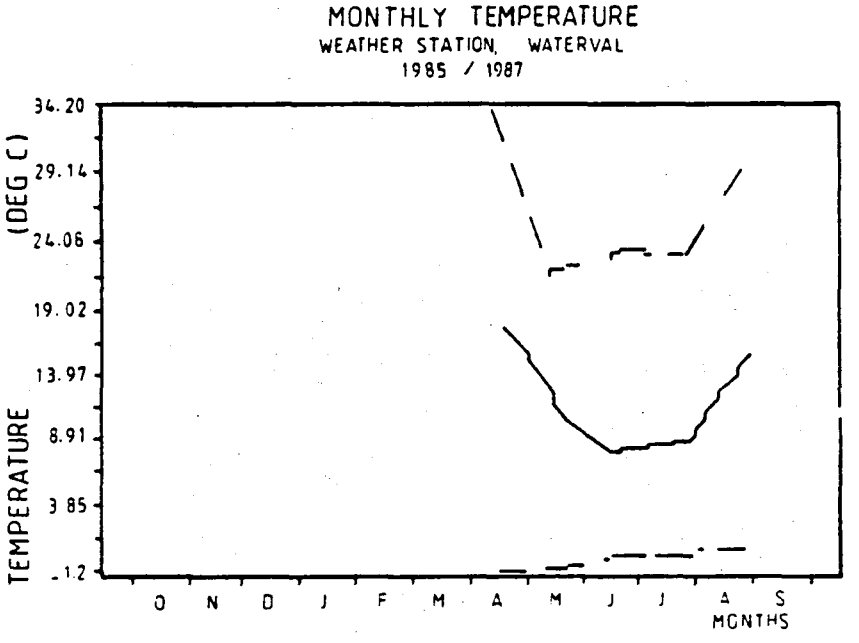
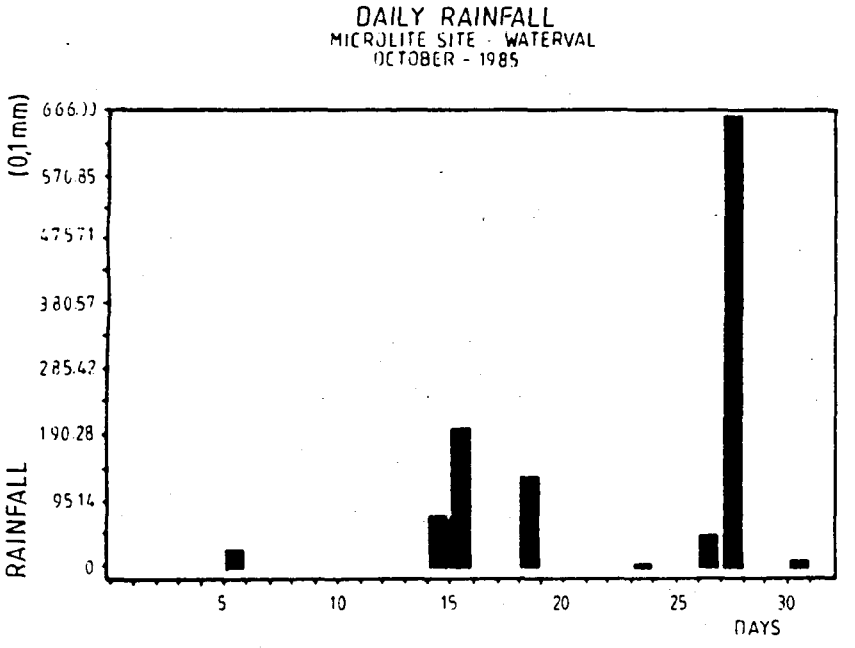


Fig. 4.6 Examples of Monthly data graphical displays



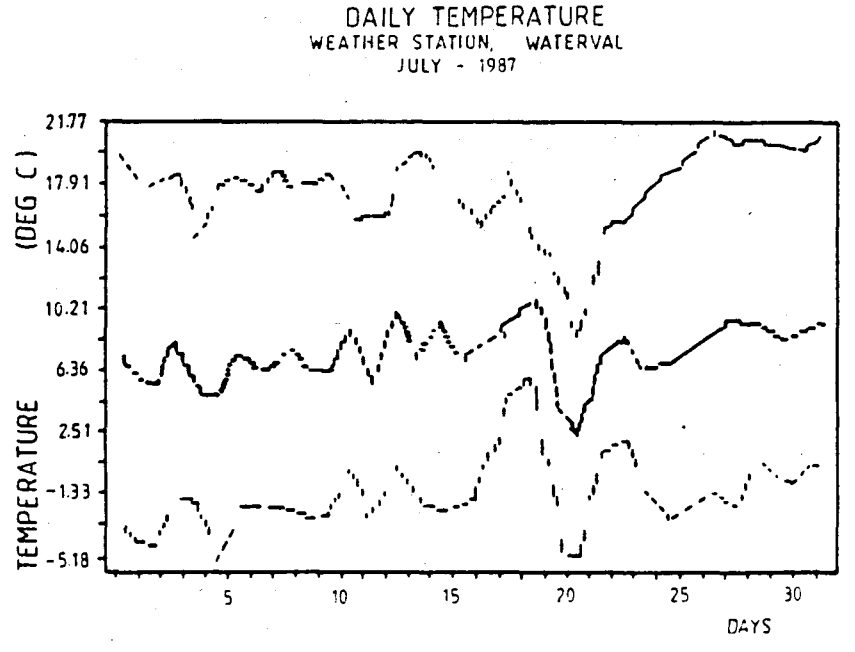
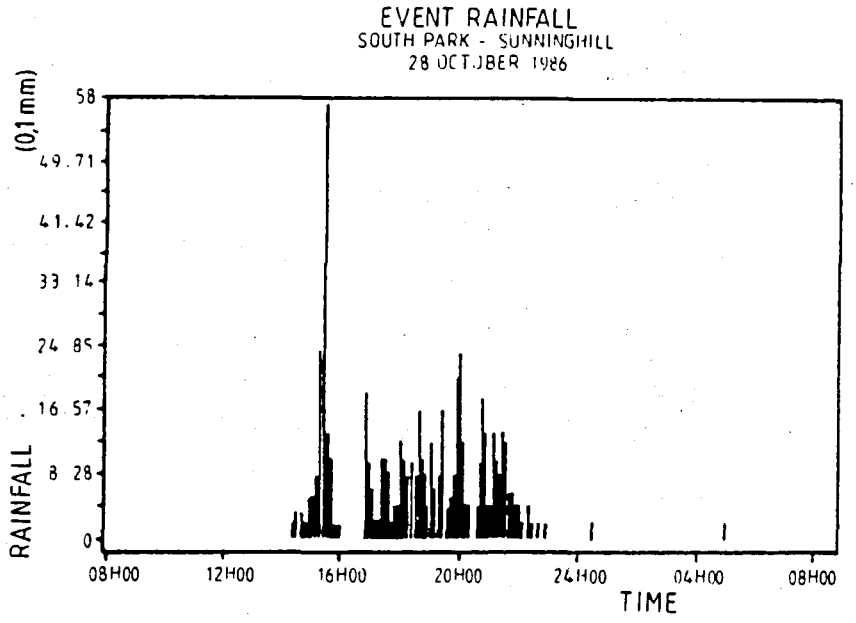


Fig. 4.7 Examples of Daily data graphical displays



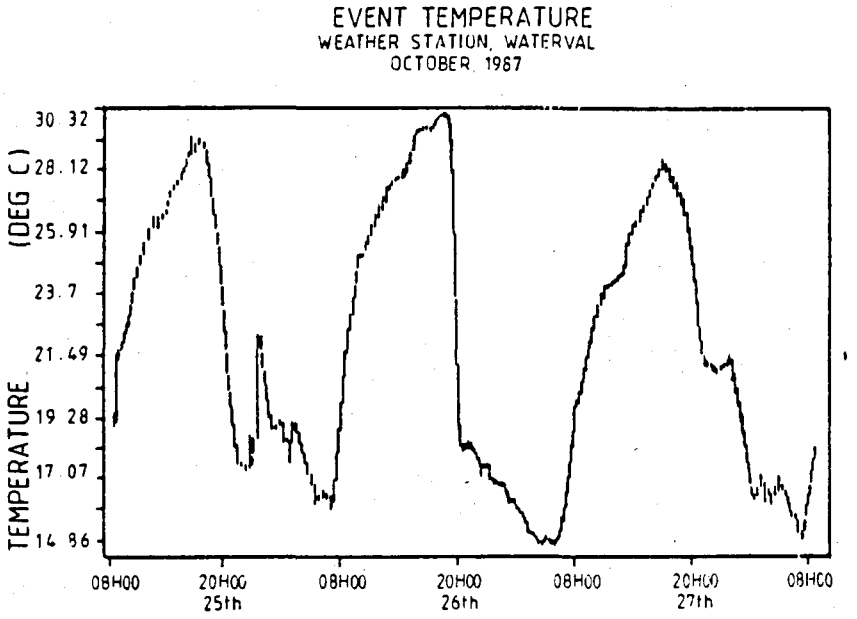


Fig. 4.8 Example of Event data graphical displays

Three different types of format are produced by the conversion process and are listed as follows. Descriptions of the format of the ASCII files are presented in figures 4.9 - 5.1.

Monthly data
Daily data
Event data

Time period selection for retrieval

Once the user has selected the type of output (and station selected from a list of stations) that is required (printout, graphical, or ASCII files), the system determines the start and end of the record present within the database for a particular station. With monthly and daily data selections, the user is presented with the month and year (in MM and YY format) for the start and end of the record. These values can be changed if the user does not require the whole record. With event data selected, the dates are not displayed and user is required to enter these (a maximum of five days or pentad is allowed).

With the graphical displays, not all the data will be presented on the screen at one time, as in the case of monthly and daily selections. In this instance only one year or one month will be displayed at any one time.

4.2 : Copying of data to other disks and/or tape drives

There is an added facility for the 'import' (to the primary disk) and 'export' (to the secondary disk) of database files. This operation is accessed from the Data Base Retrieval menu (see figure 4.1). This aids the backup or input of database files generated by the same software on another machine. Most files in the system can be copied using this sub-system and include the following.

1. Database files (containing Hydro-Met parameter data)
2. Rating table files
3. Station information database files
4. Temporary files (those containing raw input data)

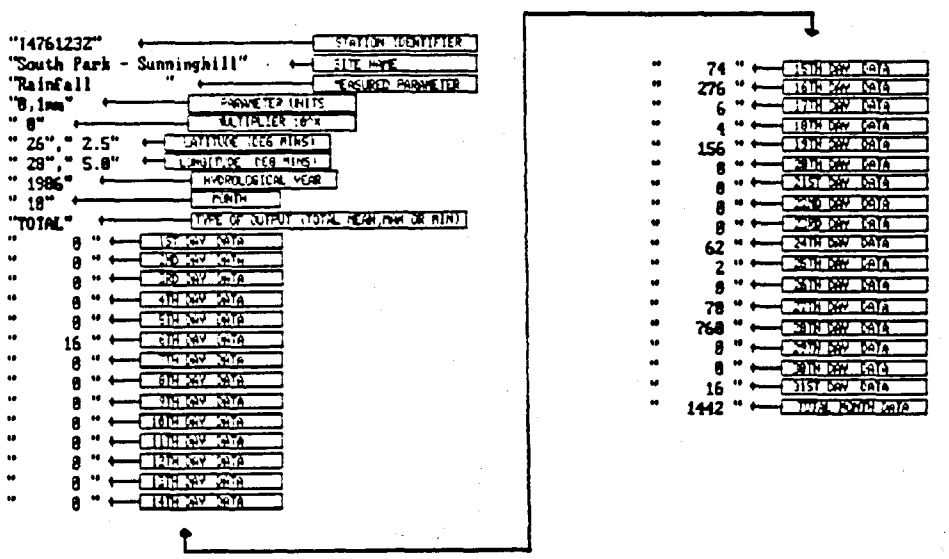


Fig. 5.0 Format of Daily data ASCII files

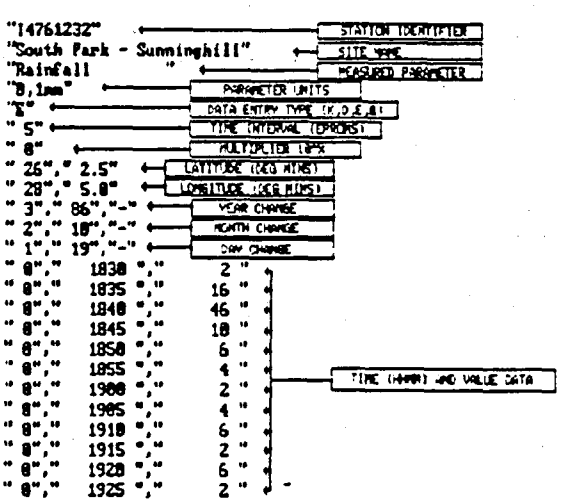


Fig. 5.1 Format of Event data ASCII files

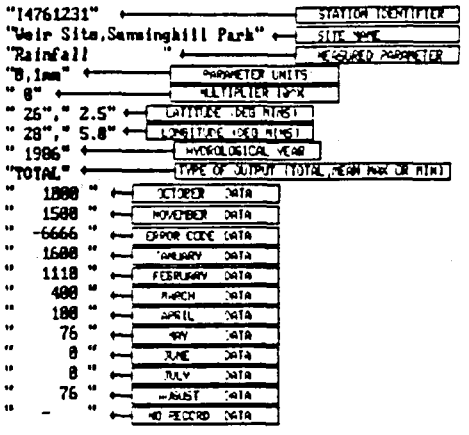


Fig. 4.9 Format of Monthly data ASCII files

WARNING: The system does not check to see if the file exists on the disk that the file is being copied to, and will automatically overwrite that file.

4.3 : Summary

The data retrieval sub-system of the Hydro=Met Data management system is described together with the options of retrieval from the database files. Data can be printed in tabular format, graphically displayed on the screen (and a screen dump to the printer given), converted to ASCII files, and system database files copied to other disks.

CHAPTER 5 : STATION INFORMATION DATABASE SYSTEM

Each recording gauge parameter in the Hydro-Met system has certain features that make it unique. These features are stored in a separate database file and accessed using a station information sub-system (Option 5 on the main menu). To facilitate fast access to a particular recording gauge information (each recording gauge parameter is designated a 'station') an index file is used which stores the station identifier and place name. The station information can be accessed directly for reports or by other sub-systems of the overall data management system. It is possible for status level 1,2 and 3 users to change, delete or add to these station information files.

Each station has both a DWA designation (or code) and an unique internal identification code of eight alpha-numeric characters. DWA designation codes have to be obtained from the Department of Water Affairs on registration of the station and before entry to the WITDMS system.

The composition of the internal station identifier is described in figure 5.1.

Apart from the station identifier, further information is contained in the station information files. This can be divided into two parts; namely physical data and information required for processing the raw input data (eg. chart sizes and scales for digitised input). The physical data comprises name of site, start date of gauge recording, type of input (keyboard, Digitiser, RAM/EPROM or generated), type of data storage format (Daily, Breakpoint or fixed time interval), unit specifier and multiplier. With digitising input, information on the chart type, X-axis and Y-axis scaling factors and time interval of chart that can be fitted to digitiser at any one time are required. The EPROM or RAM input requires information on the channel number of the data and the logging time interval.

WITDMS can also perform an automatic filtering of the input data using a band threshold defined on the Y-axis. This is especially applicable to digitised data where small variations as a result of chart miss-alignment or 'noise' occur. The filtering out of this data results in a more compact database. Parameters controlling the filtering are defined within the station information database (see later in this chapter for more details).

Character	Description
I	Key letter for parameter being measured
476	Section number (0,5 x 0,5 degree grid squares)
123	Position number (1 x 1 minute grid squares)
1	nth station opened within a given position number

Table 5.1 - Station Identifier Description.

The middle six digits relate to the latitude and longitude of the station. The section number grid squares are numbered west to east across the country starting at the bottom left hand corner of the country (Latitude xx° yy', Longitude xx° yy'. Each section number is then sub-divided into 900 grid squares (increasing from the bottom left hand corner in north direction and then Eastwards).

In a situation where there are more than one recording gauge at a site, the digits remain the same but the prefix character changes according to the parameter being measured. A list of Hydro-Met parameters and their codes are given in Table 5.2. It can be seen that the codes have chosen to relate to the physical parameter.

Code	Description	Code	Description
A	Atmospheric Pressure	B	Borehole Levels
C	Electrical Conductivity	D	Wind Direction
E	Evaporation	F	Sewage Outflow
G		H	Relative Humidity
I	Precipitation	J	
K		L	Hours of Sunshine
M	Soil Moisture	N	
O		P	Precipitation Totaliser
Q	Streamflow (discharge)	R	Solar Radiation
S	Streamflow (stage)	T	Temperature
U		V	Reservoir level
W	Wind Speed	X	Multi-channel logger
Y		Z	

Table 5.2 - Station Identifier prefix codes.

Figure 5.1 - Composition of Internal Station Identifier

5.1 : Station Information Menus

This sub-system is driven by a single menu screen which allows the user to add, browse, update and delete station information (Figure 5.2).

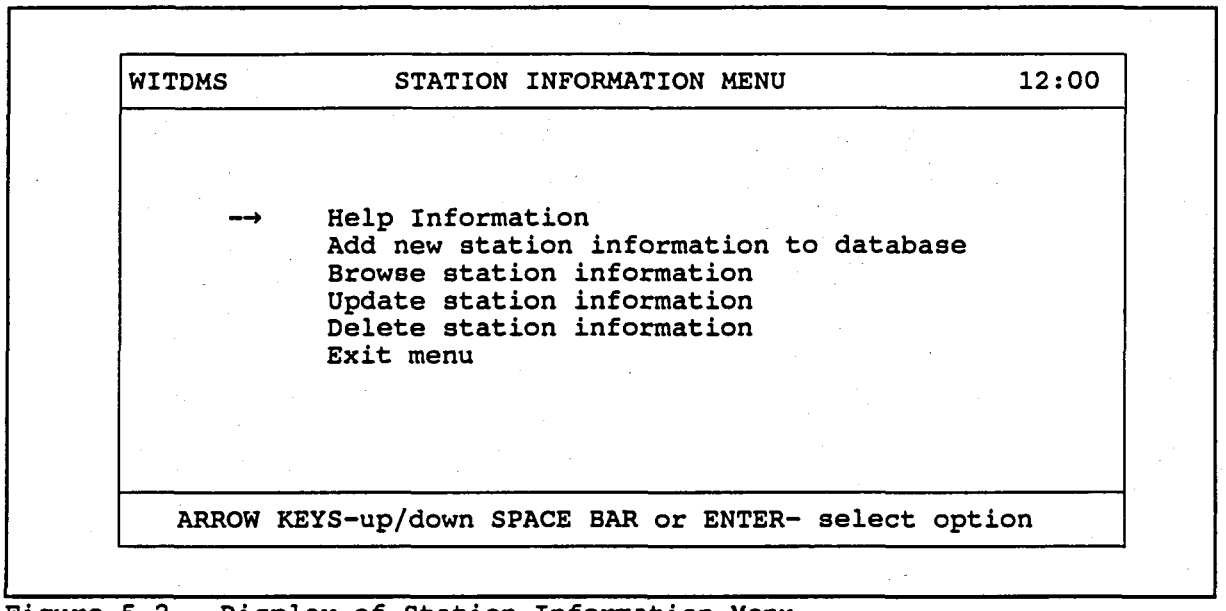


Figure 5.2 - Display of Station Information Menu

5.1.1 : Add new station information

The information that is required by the system is tabulated and pointers given as to the obtaining of these requirements.

Basic Information (and for Keyboard entry)

Station code — The user is presented with a screen containing the station prefix codes (as shown in Table 5.2). The relevant code is then typed into the system (eg. if temperature was the parameter to be recorded, then a T is entered to the system).

Latitude — The latitude of the site of the parameter is given in degrees, minutes and seconds (eg. 25° 45' 30").

Longitude — The longitude of the site of the parameter is given in degrees, minutes and seconds (eg. 32° 33' 30").

The user is then presented with two options:

Option 1 New site

Completely new site with no existing parameters (stations).

DWA Code A DWA designation of 6 characters as defined by the Department of Water Affairs is entered.

Site Name A series of up to 25 characters may be input to describe the site name (other organisation codes can be put within this field). This information is displayed to the user whenever a station is to be selected.

Option 2 New parameter at existing site

A site exists with parameters (stations) (ie. a further parameter is being added at the site). The user is presented with a scrolling list of existing sites that occur within the same position number (ie. latitude and longitude). The site to which the new parameter station is to be added is then selected by cursor movement. Both the site name and DWA code are preserved.

The system then generates the eight alpha-numeric identifier from the information given above. Further basic information on the station is now required by the system.

Parameter A series of up to 16 characters may be input to describe the name of the parameter being recorded. This should correspond to the first letter of the station identifier (eg. T is Temperature).

Start Date The date of the first en try of data for this specific station should be entered in a format YYMMDD (YY is the year, MM is the month, DD is the day; eg. 22/12/1987 bcomes 871222). This value is at a later stage updated (before the date) by the system.

End Date — The date of the last entry of data for this specific station should be entered in a format YYMMDD (YY is the year, MM is the month, DD is the day; eg. 22/12/1987 bcomes 871222). If this date is not known then use the same value as the start date. This value is at a later stage updated (after the date) by the system.

Input type — The input type defines the peripheral that is to be used to enter the raw data. The choices are K for KEYBOARD, D for DIGITISER, E for EPROM or RAM, or G for GENERATED entry. The latter code (G) is for system generation of the data (ie. resultant data from use of station data with a rating table).

Database Type — The database type defines the size and configuration of a specific station database. The choices are D for a daily data, B for breakpoint data, or F for fixed interval data. Daily data is defined as one ordinate per 08:01 to 08:00 meteorological day (eg. precipitation totaliser records). Breakpoint data is data recorded at discrete times (ie. a series of data ... 14:05 2.4mm; 14:08 3.4mm; 16:00 2.2mm; 16:05 0.2mm ...). Fixed interval data is recorded at regular intervals throughout the day (i.e. ... 12:00 12°C; 12:30 14°C; 13:00 15°C..).

Unit Spec. — The name of the units of which the parameter is measured can be described in up to 5 characters (e.g. °C or mm).

Multiplier — The size of the number may mean that the number needs to be scaled by the user (eg. a frequent example would be a volume of water which is usually quoted as 10^6). Zero (0) is the standard form and positive value indicate decimal place movements to the right and negative values indicate decimal place movements to the left.

Digitising Information

Chart name — A series of up to 12 characters can be used to define the type of chart (eg. 10mm strip).

X-Axis Scale — The scale factor of the X or time axis of the chart entered as the number of minutes per measured mm.

Y-Axis Scale — The scale factor of the Y axis of the chart entered as the number of parameter units per measured mm. If the true depth of 10 metres corresponds to 100 millimetres on the chart, the scaling factor is 0.1 if the units are 1 metre (see above).

Frame Width — A fixed value of measured length of chart that will fit onto the digitiser at any one time. This value is in minutes as the time axis is considered. It may be convenient to limit this value to some whole number (eg. 12*60 minutes or 24*60 minutes or 5*24*60 minutes).

Linear/Polar — The type of grid lines on the chart have to be described to the system. If the grid lines are perpendicular to each other then the type is linear and a letter L is entered. In the case where the grid lines form an arc in the Y-axis direction then the type is polar and a letter P must be entered. A diagrammatic representation of the two different types of grid lines is shown in Figure 5.3.

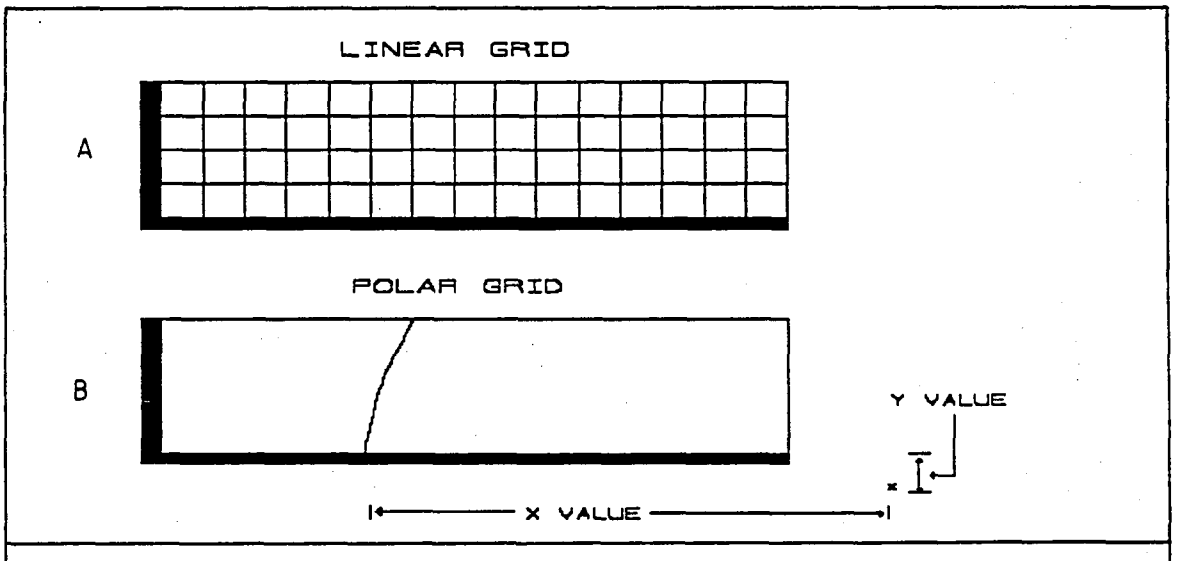


Figure 5.3 - Definition of Linear and Polar Grid lines

With the Polar type grid lines on the chart, two extra scaling factors are required.

X-Axis coord — The x-axis polar coordinate is defined as the distance in the x direction from the arc to the centre of the circle that forms the arc (see Figure 5.3a). This distance is measured in mm.

Y-Axis coord — The y-axis polar coordinate is defined as the distance in the y-direction from the base line of the arc to the centre of the circle that forms the arc (see figure 5.3b). This distance is measured in mm.

EPROM or RAM information

Log time Interval — The time interval in minutes that the data is to be recorded on the EPROM/RAM for the specific parameter.

Channel Number — The channel number of the electronic data logger that records this station parameter. For a single channel system use 01.

Program Code — A code which gives the user information on the type of logger activity of the channel (e.g. 02 for analogue and 04 for digital or 09 for 360° cross-over).

Filters for Digitising and Eprom data

Filter Application — A choice is given as to whether a filter is applied to the data (digitising and EPROM/RAM entered data only). The options are F for applied filtration and N for no filter applied. The filter is only applied for the y-axis data (see figure 5.4).

Minimum value — The minimum value of the filter. Values below this figure are kept, whereas data between this value and the maximum are filtered out. The value should be in the same units as the station data being recorded.

Maximum value — The maximum value of the filter. Values above this figure are kept, whereas data between this value and the minimum are filtered out. The value should be in the same units as the station data being recorded.

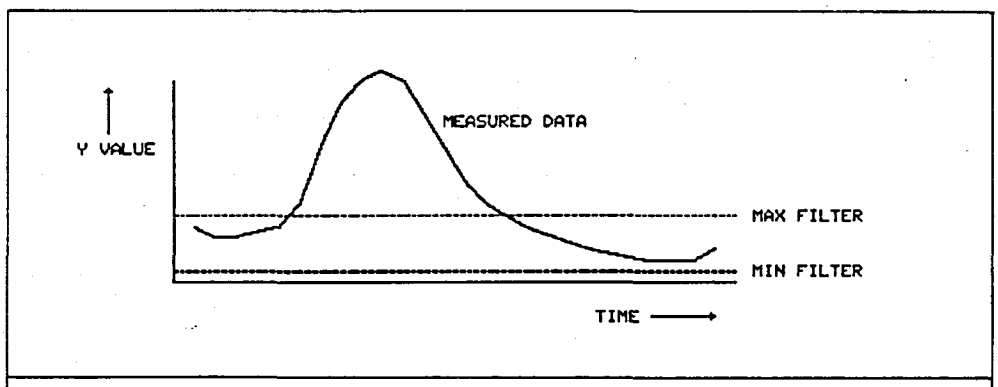


Figure 5.4 - Concepts of filtering of y-axis data

5.1.2 : Browse station information

The browse option allows the user to 'scan' through all the entries in the station information database. The information is presented as a full screen per station (parameter) (see figure 5.5). The use of cursor keys and the carriage return or enter key, allow the information to be changed.

5.1.3 : Update Station Information

This option allows the changing of information for a specific station (parameter). A scrolling list of stations currently in the database is presented to the user and a station can be selected from this list. The system presents the information on the screen for the requested station (see Figure 5.5). The use of cursor keys and the carriage return or enter key allow information to be changed.

5.1.4 : Delete Station Information

This option allows the deletion of information for a specific station (parameter). A scrolling list of stations currently in the database is presented to the user and a station can be selected from this list. On confirmation, the station name is deleted from the station database and hence the station information. Once deleted, this information cannot be recalled. If the station information is deleted and data exists in database files this data can be retrieved if the station information is re-entered.

5.2 : Summary

The station information database sub-system is a component of WITDMS which enables creation, editing and deletion of data related to each station (parameter measurement) within the Hydro-Met network. This information provides a complete picture on the site, type of data and how it was captured, together with the length of record.

Each item of information required by the sub-system is detailed and where possible examples are suggested or given.

CHAPTER 6 : SYSTEM CONFIGURATION

The WITDMS software package relies on peripherals to enter and retrieve data. The system also uses a simple password system to enable access status levels to be instituted. There are two components to the system configuration; namely hardware (involving the peripherals) and liveware (involving the users).

6.1 : Hardware Configuration

The hardware configuration is driven by a menu (Figure 6.1) listing all the peripherals that can be attached and their individual parameter requirements.

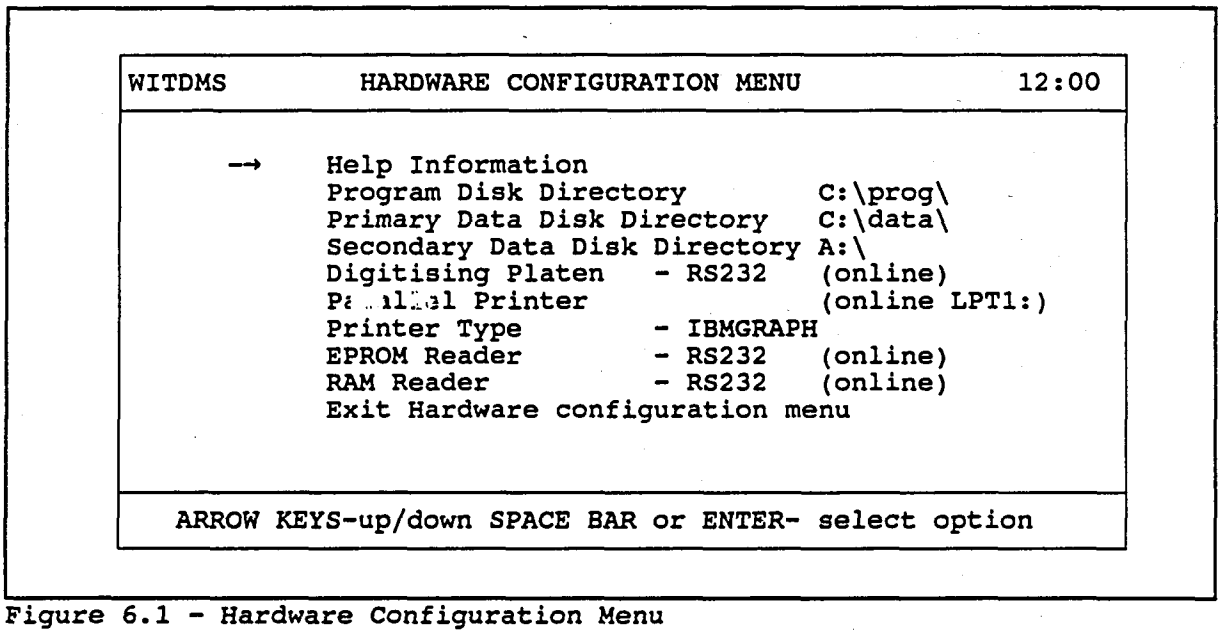


Figure 6.1 - Hardware Configuration Menu

Tabulated below is a list of the individual peripherals.

6.1.1 : Program Directory

The letter (and colon) of the disk drive, coupled to a directory that contains the software package (including the system and help information files). If a floppy disk system is used for the program then the program directory should be designated A:\.

6.1.2 : Primary data Directory

The letter (and colon) of the disk drive, coupled to a directory on which the database files (and scratch-pad files) will reside. Obviously a hard disk drive is needed to store the large amounts of data that accrue with a Hydro-Met network so either a C: or D: drive should be used (with the directory format appended). For small datasets the software can be used to store data on floppy disk systems (especially if the export mode has been used), so B:\ designation should be used.

6.1.3 : Secondary data Directory

The letter (and colon) of the disk drive, coupled to a directory on which the databases, scratch-pad or ASCII datafiles are to be exported to or imported from (except for ASCII files). Usually this will designated as the B:\ or A:\ system.

6.1.4 : Digitising Platen

The digitising platen or digitiser is preferably of an A3 size format with a pen stylus only (button cursors are not supported). The data transmission between the digitising platen and the micro-computer is through an RS232 interface. To configure the digitising platen, select the item on the menu and enter information as requested.

Device Number — This refers to the port number in the rear of the micro-computer panel. The micro-computer systems can support more than one RS232 interface so the device number is of the form COMn: where n is either 1, 2 or 3 depending on the port number.

Baud rate — The baud rate indicates the speed of the transfer of data between the digitising platen and the micro-computer. The baud rate has to be set on the digitising platen and the rate entered here MUST correspond to that value. An effective value to be entered here for a Calcomp digitiser is 9600 baud.

Parity — The parity should again be set to correspond to that set on the digitising platen. Possible choices are E, M, N, P or S. For most devices of this nature, N is applicable.

Data Bits — The data bits are the number of bits in the transfer signal that contain the data. This value should correspond to that setting on the digitising platen. Possible values are 7 or 8.

Stop Bits — The stop bits are the total bits in the transfer signal minus the number of data bits. This value again should correspond to that set on the digitising platen. Possible values are therefore 0, 1 or 2.

To cancel or set the digitising platen offline, the digitising platen option is selected from the menu and a null string (press enter or carriage return) is entered for the device number.

6.1.5 : Parallel Printer

The printout device MUST have a parallel interface as serial or RS232 interfaces are not selectable for this software package. To configure the parallel printer, select the item on the menu and enter information as requested.

Device Number — The device number is the parallel port number in the rear panel of the micro-computer. If only one printer is attached via a parallel interface then the device number is LPT1:. For further parallel interface ports, then the device number is of the form LPTn: where n is either 1, 2 or 3.

Printer name — The printer name has to be entered so that a file containing the printer codes can be loaded. The printer name is checked against a list of printers in an index file. Examples include IBMGRAPH, EPLQ800, FUJITSU9....

6.1.6 : MCS EPROM Reader

The MCS EPROM reader is at present one of the systems supported by the software. The data transmission between the EPROM reader and the micro-computer is through an RS232 interface. To configure the EPROM reader, select the item on the menu and enter information as requested.

Device Number — This refers to the port number in the rear of the micro-computer panel. The micro-computer systems can support more than one RS232 interface so the device number is of the form COMn: where n is either 1, 2 or 3 depending on the port number.

Baud rate — The baud rate indicates the speed of the transfer of data between the EPROM reader and the micro-computer. The baud rate has to be set on the EPROM reader and the rate entered here MUST correspond to that value. The MCS EPROM reader is set by default to 1200 baud and so 1200 should be entered here.

Parity — The parity should again be set to correspond to that set on the EPROM reader. Possible choices are E, M, N, P or S. The MCS EPROM reader is set by default to N parity.

Data Bits — The data bits are the number of bits in the transfer signal that contain the data. This value should correspond to that setting on the EPROM reader. Possible values are 7 or 8. The MCS EPROM reader is set by default to 8 data bits.

Stop Bits — The stop bits are the total bits in the transfer signal minus the number of data bits. This value again should correspond to that set on the EPROM reader. Possible values are therefore 0, 1 or 2. The MCS EPROM reader is set by default to 1 stop bit.

To cancel or set the EPROM reader offline, the EPROM reader option is selected from the menu and a null string (press enter or carriage return) is entered for the device number.

6.1.7 : DDS RAM Reader

The DDS RAM reader is at present one of the systems supported by the software. The data transmission between the RAM reader and the micro-computer is through an RS232 interface. To configure the RAM reader, select the item on the menu and enter information as requested.

Device Number — This refers to the port number in the rear of the micro-computer panel. The micro-computer systems can support more than one RS232 interface so the device number is of the form COMn: where n is either 1, 2 or 3 depending on the port number.

Baud rate — The baud rate indicates the speed of the transfer of data between the RAM reader and the micro-computer. The baud rate has to be set on the RAM reader and the rate entered here MUST correspond to that value. The DDS RAM reader is set by default to 9600 baud and so 9600 should be entered here.

Parity — The parity should again be set to correspond to that set on the RAM reader. Possible choices are E, M, N, P or S. The DDS RAM reader is set by default to N parity.

Data Bits — The data bits are the number of bits in the transfer signal that contain the data. This value should correspond to that setting on the RAM reader. Possible values are 7 or 8. The DDS RAM reader is set by default to 7 data bits.

Stop Bits — The stop bits are the total bits in the transfer signal minus the number of data bits. This value again should correspond to that set on the RAM reader. Possible values are therefore 0, 1 or 2. The DDS RAM reader is set by default to 2 stop bit.

To cancel or set the RAM reader offline, the RAM reader option is selected from the menu and a null string (press enter or carriage return) is entered for the device number.

6.2 : Liveware Configuration

The liveware configuration controls the entry of personnel to the system and the levels of access to the primary functions of the software. This menu selection can only be accessed by the Hydro-Met data Manager who has overall responsibility for the system and the data. On entry to the liveware configuration, the system presents a menu allowing the Data Manager to add, browse, update or delete information related to a user (Figure 6.2).

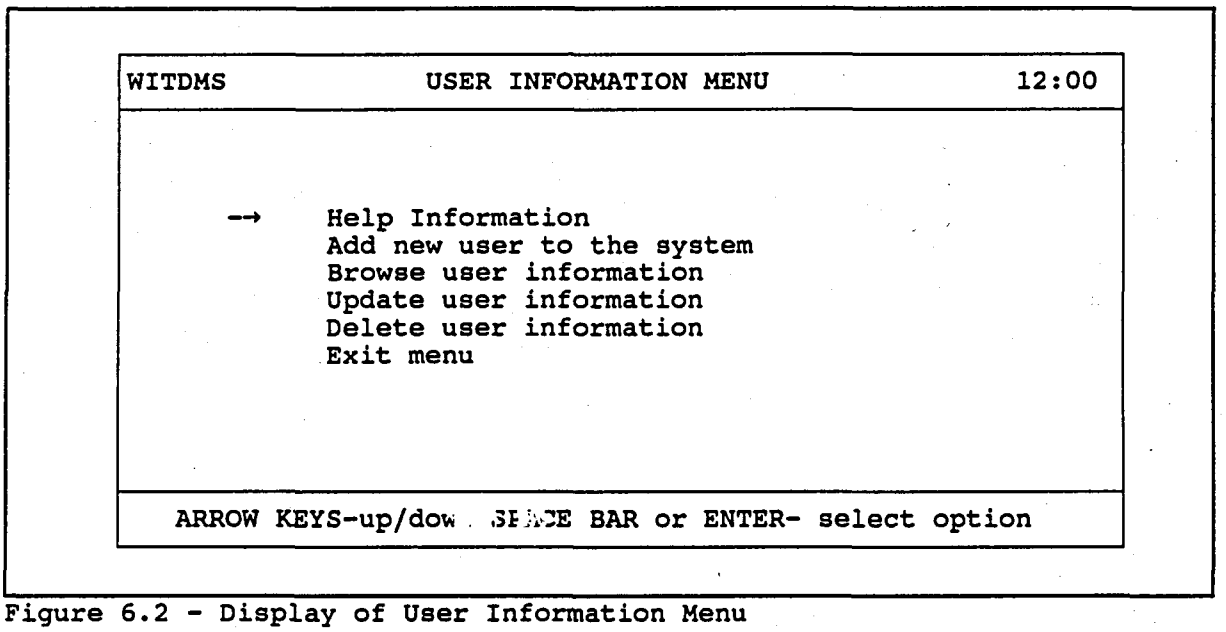


Figure 6.2 - Display of User Information Menu

6.2.1 : Add New user to the system

Up to 10 users may be configured to the system at any one time. The Data Manager is prompted for the information required by the system for the purpose of registering a new user.

User first name — The first name of the user is to be entered in the format that will be presented on the screen in the password control segment. A maximum of eight characters can be used so with longer names this must be truncated or a nickname used.

User Password — A password specific to the user is to be entered which is automatically translated to upper case. A maximum of four non-blank characters are to be entered (preferably alpha characters).

Status Level — The status level determines the type of access the user may have to the different functions of the software package. Table 6.1 gives details of the possible values.

Once entered this information is then stored in the User information system.

Level	Name	Description of Access
1	Hydro-Met Data Manager	All files for creation, editing, deletion and retrieval
2	Hydrological Staff	Database and scratch files for creation, editing, deletion & retriev
3	Data Process Staff	Database and scratch files for creation, editing and retrieval
4	Data Capture Staff	Input ONLY of data from keyboard, digitiser, EPROM and RAM readers

Table 6.1 - Status levels for Hydro-Met Management System

6.2.2 : Browse User Information

User information that has previously been entered can be browsed to check for correctness or to change one of the variables (eg. upgrade the status or change the passwords, the latter should be done on a regular basis). The Data Manager is presented with a full screen display of the name, password and status level. Using the cursor keys and carriage return or enter key, allows data to be changed. The ESC key is used to exit the browse routine.

6.2.3 : Delete User Information

This option allows the Data Manager to delete a user from the system simply by specifying the first name or nickname (in the case of users with names longer than 8 characters) of the user. The system then prompts the Data Manager to affirm whether the user's information is to be removed from the user information.

6.3 : Summary

The System Configuration sub-system is a component of WITDMS which enables both hardware and liveware (users) to be 'registered' with the software package. The hardware configuration also sets up the interface drivers. The liveware (users) configuration allows the Data Manager to assign passwords and status levels which prevent the individual user from accessing some of the software routines.

TECHNICAL APPENDIX

The technical reference is primarily intended for those familiar with DOS and micro-computers. It is not to be used by data capture operators. The reference covers the files used by the WITDMS system, together with explanation of common errors and how these can be overcome.

System Files

The WITDMS system consists of the following files -

1.	WITDMSX.EXE	- Main driver system *
2.	DATINPUT.EXE	- Data capture routines
3.	RATING.EXE	- Rating table entry (DWA)
4.	RAWEDIT.EXE	- Raw data editor routines
5.	PROCESS.EXE	- Database loader system
6.	DPPRES.EXE	- Output System (printouts & graphics)
7.	STATION.EXE	- Station information system
8.	LOGO.SCR	- Start-up screen logo *
9.	WITDMS.CNF	- Peripheral device configurations
10.	******.HLP	- Online screen display help files
11.	PRINTER.INX	- Index of installed printer types
12.	******,PAT	- Printer files
13.	WITDMS01.SYS	- System file 1
14.	WITDMS02.SYS	- System file 2
15.	WITDMS03.SYS	- System file 3
16.	STATION.INX	- Station information index file
17.	STATION.DBF	- Station information database file
18.	******.TMP	- Temporary raw data files
19.	******.BK1	- Temporary raw data backup files
20.	******.I**	- Database index files
21.	******.D**	- Database data files

The items marked by an asterisk (*) are essential to the correct loading of the main driver system (i.e. WITDMSX) and should not be removed from the

directory. The three system files (files 11-13) have special significance as explained below.

WITDMS01.SYS

This system file contains four flags which indicate the status of the data that the system has captured. These four flags represent the keyboard entered data, digitised entered data, RAM entered data and rating table data respectively.

If any of the data input routines are used, then the flag for that specific type of data is set to 1 (one). For example, data transferred from the digitiser only will result in the flags being set to 0,1,0,0 respectively. Processing and loading of the data into the databases can only be done when the flag being set to 2.

The use of the raw data editor to scan through all the data will result in the flag for that data entry type being set to 2. For example, the editing of the digitiser raw data file (used in the example above will result in the flags being set to 0,2,0,0.

NOTE: If a situation occurs where processing is not enabled and all files have been edited, then the flag system can be reset by the erasure of the file WITDMS01.SYS.

WITDMS02.SYS

This system file contains the information on the user names, passwords and status levels. The user information should only be changed within the liveware configuration system of WITDMS. External changes could result in being locked out of the system. Where the WITDMS02.SYS becomes corrupted, the file can be deleted. At the next loading of WITDMSX, the user will be prompted to enter new users and their information.

WITDMS03.SYS

This system file contains IDLE logger messages supplied by the supplementary program MESSGEN.EXE. These messages can be changed ONLY

for the WITDMS software using the MESSGEN program. Running the MESSGEN program will display the current messages and allow editing.

MES01	Date OK
MES02	Time OK
MES03	ST test OK
MES04	All OK
MES05	Date incorrect
MES06	Time incorrect
MES07	Insects in box
MES08	MM NOT ERASED !!!
MES09	Battery low
MES10	Pressure transducer damaged
MES11	Rain gauge damaged
MES12	RH/Temp. sensor damaged
MES13	Wind dirn. sensor damaged
MES14	Wind speed sensor damaged
MES15	Evaporation pan damaged
MES16	Solar panel damaged
MES17	Term. board damaged
MES18	
MES19	Logging continued
MES20	Logging reset by RST
MES21	Date changed
MES22	Time changed
MES23	Battery changed
MES24	Station ID changed
MES25	
MES26	
MES27	
MES28	
MES29	
MES30	Term. board changed

System Errors

The number of system errors generated by the WITDMS system is kept to a minimum. The majority of errors produced by the system are self-explanatory (i.e. in-correct password supplied). A list of errors generated together

with suggestions for correction are given below.

1. "Your Password is invalid"
   Reload the system and type in the correct password.
   OR
   Erase the system file WITDMS02.SYS since it has become corrupted.

2. "There is raw data that has not been checked"
   The flags in WITDMS01.SYS indicate that there are files waiting to be edited.
   Edit the files (keyboard, Digitise, EPROM, or Rating).
   OR
   Erase the system file WITDMS01.SYS since it has become corrupted.

3. "You are not authorised to overwrite datafiles"
   The status level that has been assigned to you is at a too low a level to overwrite files.
   Ask your system administrator to help you.

4. "There is unprocessed data not contained in the database"
   This is a warning that data is still in temporary files awaiting processing and loading into the database system. This warning does not prevent you from accessing data already stored in the database.

5. "Not a valid Printer"
   The printer name that you have entered does not correspond with that contained in files on disk.
   Enter the name of a file on disk.
   OR
   Use the supplied Printer setup program to install a new printer.

6. "There is no rating table for station"
   Rating tables for the station specified do not exist.
   Check that rating tables do not exist in the raw data files - if so process the data.
   OR
   Enter the rating table for the station via the keyboard routines and process the data.
   NOTE: Only stage stations can have rating tables.

7. "There are no stations in the index file."
The index file has been deleted, corrupted or no station information data has been entered.
Enter the station information data.

8. "There are no stage stations in the index file"
Enter the stage station required into the station information system.

9. "Maximum of 10 users exceeded"
Only 10 users can be introduced to the WITDMS system.
Remove one of the users from the system using the Liveware configuration system.

10. "Name not found"
The requested user's name is not found in the database.
Type in the correct name
OR
The WITDMS02.SYS file has become corrupted and must be erased. Then re-type in all the user information again (this is requested on re-entry to WITDMSX).

11. "Please switch data reader ONLINE and press enter on keyboard"
The RAM data device is not connected to the computer.
Check all cables and that GDMP is being used on the data reader to transfer data.

12. "Primary Disk Full"
The primary disk to which data is being downloaded on transferred from digitiser is full.
Erase or backup some files to make more space available on the hard disk.

13. "Station information shows non-keyboard input"
You are trying to add new data to a station that requires data from digitiser or RAM input. The station could also have its data generated from a stage and rating table input.
Re-configure your station file to solve the problem.

14. "file to big - 40m range allowed"
In entering a DWA rating table file, the range is too big for the system to handle.
Reduce the range on the rating table file and re-enter routine.

15. "DIgitiser device not configured"
The digitiser has not been set-up in the hardware configuration system.
Check that your configuration is comparable with that of the digitiser. An improperly configured device will lead to a device error occurring.

16. "Station information shows non-digitising input"
Similar type of error to error number 13 -

17. "DDS data logger not configured"
Similar type of error to error number 15.

18. "Requested period is outside record duration"
The period of record that you wish to view is not within the duration of the record held in the database system.
Re-enter the correct period.
OR
Check that no data is waiting to be processed.

19. "A maximum of five days event data are allowed"
Only a maximum of five days of event data are allowed to be accessed for graphics display or transfer to an ASCII type file.
Reduce the period required for abstraction.

20. "There is no KEYBOARD.TMP file on disk"
You are trying to edit a file that does not exist.
If the file DID exist then you have either processed it or it has become corrupted. In the latter case there are two options.
Re-enter the data through the keyboard entry system.
OR
If you had edited the file then a backup (KEYBOARD.BK1) will exist.
Use the backup transfer system to convert the file to KEYBOARD.TMP.

21. "There is no DIGITISE.TMP file on disk"
Similar type of error to error number 20.

22. "There is no EPROM.TMP file on disk"
Similar type of error to error number 21.

23. "There is no RATING.TMP file on disk"
Similar type of error to error number 22.

24. "There is no data in temporary files to be processed"
Similar type of error to error numbers 20-23.

25. "The temporary files have not been check edited"
One or more of the temporary files have not been edited prior to processing.
Edit the files (KEYBOARD, DIGITISE, EPROM or RATING).
OR
The file WITDMS01.SYS has become corrupted and therefore should be erased. This does not affect the status of the *.TMP files which can now be processed.

26. "Station ######### not found in in[illegible]"
The station name found in the raw data stream does not match any station on file at present.
If the error is in the supplied name then correct the error and continue the processing.
OR
Escape from the processing and enter the new station data using the station information system.

27. "Switch Printer ONLINE before continuing"
The printer is not online or not physically connected to the computer.

28. "Printer is not configured for system"
"Data table printouts not available"
A printer type must be selected using the Hardware configuration system. If the printer *.PAT file does not exist then one must be created using the supplied printer setup program.

29. "No data exists for period of record requested"
Raw data may still be awaiting processing.

30. "Station ####### is not a valid station"
Re-enter the correct station name.

31. "Maximum of 250 stations exceeded"
There is a limit to the number of stations (parameters) that can be used in the present system.

32. "Station/parameter already exists"
Self-explanatory error.

33. "You are not allowed to delete a station"
The status level that has been assigned to you is at a too low a level to delete files.
Ask your system administrator to help you.

34. "Error number #### detected"
The major error that will occur under this heading is error number 57. This is a non-recoverable error which means that the system has to be re-started.
a) Return to the DOS prompt, switch off the computer and the peripheral devices.
b) Check the connections to the peripherals from the computer.
c) Switch on the peripheral devices, then the computer and reload the WITDMS software.
d) Check the peripheral device configurations.
If this error persists after carrying out the above instructions then a fault in the cable is possible.

If other errors occur - namely of the type ...
"##### ###### ##### ##### in module ###### at ####:####"
then note down the error and circumstances that led to the error.