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THE PROCESSING OF SOIL MOISTURE DATA

by

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By G. Roberts

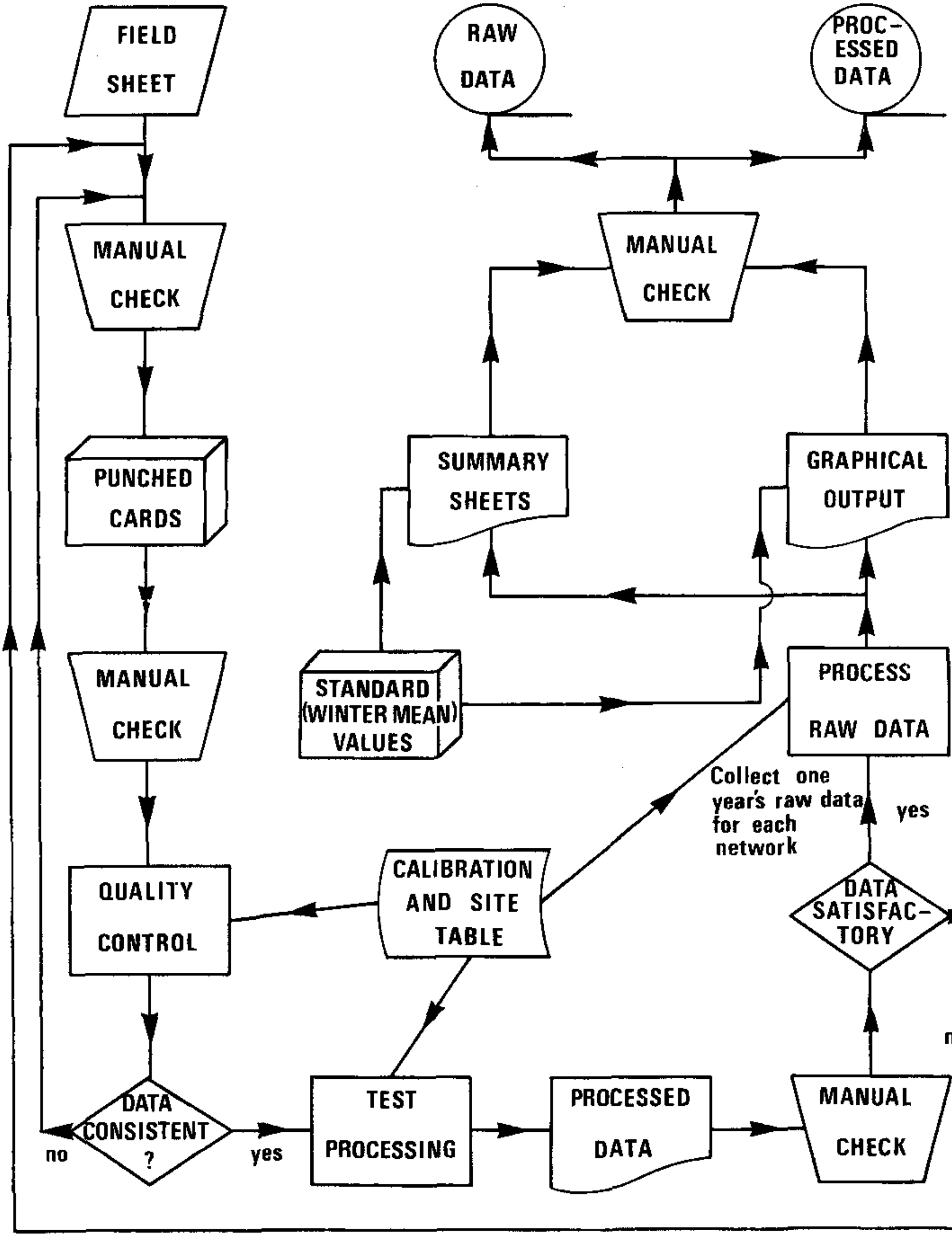
ABSTRACT

A brief account of the steps involved in testing and processing soil moisture data is given. The inputs to, functions of and outputs from all the programs used are shown.

1. INTRODUCTION

Soil moisture data is generally processed at monthly intervals. The data is quality controlled and "test" processed to determine whether it is satisfactory. If so, it is stored until a whole years' data has been collected. This is processed and output in various line printer and graphical forms and is finally stored on magnetic tape.

FIGURE 1 THE PROCESSING OF SOIL MOISTURE DATA FLOWCHART



The procedure for processing soil moisture data is outlined in the flow chart (Figure 1). The data collected at a particular site on a particular day is entered on to a field sheet (see Figure 2), designed so that the data may be punched on to cards without further coding. Both the field sheet and punched cards are checked manually for errors. The data is quality-controlled by computer using a program designed to detect any errors due to instrumentation, coding, punching etc. When the data is consistent, i.e. "error free", it is "test" processed by computer using a program which gives a line printer output of the data. As a final quality control, this output is checked manually and if found satisfactory, the punched cards are stored. The above process is repeated for every months' data.

When a whole years' data for a particular network has been satisfactorily quality-controlled and "test" processed, it is processed by computer using a program that produces a card file of processed data. This processed data card file is then used, together with standard (winter mean) values, as input data to further computer programs which produce summary sheets and graphical outputs which are checked manually. If these are found satisfactory, the raw data and processed data are output on to separate magnetic tapes.

The quality control, "test" processing and processing programs require calibration (tables 1.1 - 1.3) and site tables (2.1 - 2.13) as input data and these are stored permanently on a direct-access file. All the programs used are written in FORTRAN and, except for infrequently used programs, are stored as a binary version in the store of the computer.

2. FIELD SHEETS

The following information is entered on to the field sheet and is subsequently punched on to data cards:

FIGURE 2 FIELD SHEET

NEUTRON SCATTERING FIELD DATA FORM No.71 2

DATE	SITE

PROBE	METER	OBS	CROP	GROUND COND.	TUBE HEIGHT	SUM OF DEPTHS	SUM OF READINGS

A	B	C	GRAV M.V.F.	DEAD TIME
			O·	

No. OF RDGS.	SITE	AREA	DAY	MTH	YEAR

BOX ENTRY APPROPRIATE TO METER USED:-

BOX		A	B	C	D	E
READING TAKEN IN:-		LABORATORY WATER STANDARD (MEAN OF MONTH'S READINGS)		SOIL	TRANSPORT SHIELD (ENTER ON SITE)	
METER USED	SCALER	COUNT	TIME (Sec x10)	COUNT	COUNT	TIME (Sec x10)
	RATE-METER	TIME CONSTANT	DIAL READING	TIME CONSTANT	TIME CONSTANT	DIAL READING
	RATE-SCALER	PRESET TIME	COUNT RATE (cps)	PRESET TIME	PRESET TIME	COUNT RATE (cps)

GROUND CONDITION	
CROP	
D	
E	
OBSERVER'S SIGNATURE	

REMARKS

N.B. DEPTH BELOW G.L. = DEPTH BELOW TUBE RIM - TUBE HEIGHT

DEPTH BELOW ACCESS TUBE RIM (cm)	DEPTH BELOW GROUND LEVEL	READINGS

Sum of Depths and Readings = =

(i) Probe code - each probe used in measuring soil moisture has an associated three digit probe code, the first two digits of which are used to identify the type of probe used, as follows:

Probe code	Type of probe
1Ø3	Danbridge
19X	E.A.L.
1XX	Wallingford

The probe code determines which calibration equation is used in the quality control and processing programs.

(ii) Meter code - each meter has an associated three digit code, the first digit of which is used to identify the type of meter used.

Meter code	Type of meter
1XX	Scaler
2XX	Ratemeter
3XX	Ratescaler

The calculation of the moisture volume fraction from the observation depends on the type of meter used.

(iii) Observer code - each person collecting soil moisture data has his own code (see table 3) which serves to identify the observer but is not used in any of the programs.

(iv) Crop code - this code (see table 4) is used to identify the crop growing in the vicinity of the access tubes. It is not used in any of the programs, but is particularly useful in identifying any change of crop.

(v) Ground condition code - this code (see table 5) is used to identify the condition of the ground around the access tube at the time of measurement. It is not used in any of the programs.

(vi) Tube height - this is the height (cm) to which the access tube protrudes above ground level. This is not used in any of the programs.

(vii) Sum of depths - this is the sum of the depths at which measurements were taken and is calculated manually after completing the observations. This is used in the quality control to detect omission and mis-punching.

(viii) Sum of observations - this is the sum of the measurements taken and is calculated manually after completing the observations. This is used in the quality control to detect omission and mis-punching.

(ix) A and B - these values refer to observations made in the water standard in the laboratory. Both values depend on the type of meter used (see table 6). The mean values of A and B taken over the month are entered on the field sheet.

(x) C - this value refers to measurements taken in the soil and depends on the meter used. (See table 6).

(xi) Grav. M.V.F. - this is the gravimetric moisture volume fraction of the top 15 cms of soil as given by a core sample, if one is taken. If no sample is taken at a particular site, then the gravimetric M.V.F. is put at Ø.ØØØ.

(xii) Dead time - this is the dead time associated with a ratemeter. This is measured in the laboratory and is entered in micro-seconds. If a meter other than a ratemeter is used, then the dead time is entered as zero.

(xiii) Number of readings - this is the number of observations taken with the probe (excluding the gravimetric M.V.F). This is the integer controlling the loop used for reading the depths/observations into the quality control and processing programs.

(xiv) Site - this is the site number (see tables 7.1 - 7.13).

(xv) Area - this is the catchment (network) number (see tables 7(a) - 7(m)).

(xvi) Day - this is the number of the day in the month on which the measurements were taken.

(xvii) Month - this is the number of the month in the year in which the measurements were taken. (January = Ø1).

(xviii) Year - this is the last two digits of the year in which the measurements were taken.

(xix) Depth below ground level - this is the depth (cm) at which the measurement was taken and is calculated in the field by deducting the tube height from the depth below the access tube rim as indicated on the cable counter.

Depth below ground level = depth indicated on cable counter - tube height.

(xx) Reading - this is the measurement as indicated on the meter. (see table 6).

In addition to the above information, the following is entered on to the field sheet but is not punched on to data cards.

(i) <u>Date</u> - this is the date, in full, on which the measurements were taken.

(ii) <u>Site</u> - this is the name of the site at which the measurements were taken.

(iii) <u>Ground condition</u> - this is a verbal description of the condition of the ground around the access tube.

(iv) <u>Crop</u> - this is a verbal description of the crop growing in the vicinity of the access tube.

(v) <u>D and E</u> - refers to measurements (see table 6) taken in the transport shield which are taken at each site to confirm that the probe, meter and battery pack are working correctly.

(vi) <u>Depth below access tube rim</u> - this is the depth (cm) as indicated on the cable counter. It is entered to aid in retrospective correction of errors.

There is also space for the observer's signature and any relevant remarks, e.g. "access tube bent", "battery failure", etc. Before punching, the data on the field sheet is checked manually to ensure that no obvious errors have occurred.

3. CODING AND PUNCHING

The data is coded and punched on a monthly basis and the data from different catchments are kept separate. For a particular catchment, the months' data is preceded by lead and control cards (see figure 3).

3.1 THE LEAD CARD

The lead card has the following information punched on it:-

Figure 3. CODING OF LEAD AND CONTROL CARDS

LEAD CARD

```
04                                                   23   0270
JVAR                                                 CATCHMENT  MONTH  YEAR
```

FIRST CONTROL CARD

```
    869·2     27                                     23280270
    CATCHMENT AREA   NO. OF SITES                    CATCHMENT  DAYS IN MONTH  MONTH  YEAR
```

SECOND CONTROL CARD(S)

```
 10 11 12 13 14 15 20 21 22 23 24 25 26 30 31 32 33 34 35 36 41 42    1 23  0270
 43 44 45 46 47                                                        2 23  0270

        SITE NUMBERS READ DURING THE MONTH                             NO CATCHMENT  MONTH  YEAR
```

(i) JVAR - this is an integer constant with a value of 4 and indicates that the data refers to soil moisture. This is punched in columns 1 - 2 with format I2.

(ii) MCATCH - this is the catchment number and is punched in columns 73 - 74 with format I2.

(iii) MONTH - this is the month and last two digits of the year in which the observations were taken and is punched in columns 77 - 80 with format I4.

3.2 FIRST CONTROL CARD

The first control card has the following information punched on it:-

(i) AREA - this is the area of the catchment in hectares and is punched in columns 1 - 1Ø with format F1Ø.1.

(ii) NSITES - this indicates the number of sites read during the month at the particular catchment. This is punched in columns 12 - 15 with format I4.

(iii) NCATCH - this is the catchment number and is punched in columns 73 - 74 with format I2.

(iv) NDAYS - this indicates the number of days in the month and is punched in columns 75 - 76 with format I2.

(v) NMONTH - this is the month and last two digits of the year in which the observations were taken and is punched in columns 77 - 80 with format I4.

3.3 SECOND CONTROL CARD(S)

The following information is punched on the second control card(s):-

(i) NS(K) - these integers indicate the number of the sites which were read during the month for that particular catchment. The site numbers are arranged in date order and then in site order, and this order must be maintained when ordering the field sheets for punching, e.g. if sites 1, 4 and 6 were read on the 12th and 2, 3 and 5 on the 13th, the site order would be 1, 4, 6, 2, 3, 5 and not 1, 2, 3, 4, 5, 6.

Each card can accommodate up to 22 sites and, if need be, additional control cards may be used. The site numbers are punched in columns 1 - 66 with each individual site number having format I3.

(ii) NO - this integer indicates the ordering of the second control cards. Hence, for the first card, NO has a value of 1, for the second it has a value of 2, etc. This value is punched in columns 70 - 71 with format I2.

(iii) JCATCH - this is the catchment number and is repeated on all the second control cards used. This is punched in columns 73 - 74 with format I2.

(iv) JMONTH - this indicates the month and last two digits of the year in which the data was collected and is repeated on all the second control cards used. This is punched in columns 77 - 80 with format I4.

The following information is punched directly from the field sheet on to the information and data card(s), (see figure 4). For a

Figure 4. CODING OF INFORMATION AND DATA CARDS

INFORMATION CARD

PROBE	METER	OBSERVER	CROP	GROUND CONDITIONS	TUBE	SUM OF DEPTHS	SUM OF OBSERVATIONS	A	B	C	GRAV. M.V.F.	DEAD TIME	NO. OF READINGS	SITE	CATCHMENT	DAY	MONTH	YEAR
108	219	15	00	70	05	540	4470	4	887	4	0·719	95	9	10	23	26	02	70

DATA CARDS

DEPTH	OBSERVATION															CARD ORDER NO.	SITE	CATCHMENT	DAY	MONTH	YEAR
20	860	30	850	40	810	50	560	60	390	70	330	80	240			1	10	23	26	02	70
90	210	100	220													2	10	23	26	02	70

particular month and catchment, the sites are arranged in the same order as appears on the second control card(s), i.e. the sites are arranged in date order and then in site order.

3.4 INFORMATION CARD

This contains the probe code, meter code, observer code, crop code, ground condition code, tube height, sum of depths, sum of readings, A, B, C, grav. M.V.F., dead time, number of readings, site, area, day, month, year. The data is punched in the same format as indicated on the field sheet.

3.5 DATA CARD(S)

The following information is punched on to the data card(s):-

(i) IDEPTH(K) and OBSV(K) - these values are the depth below ground level and corresponding observation as tabulated on the field sheet. These values are punched in the order in which they appear on the field sheet (i.e. in increasing depth) and each card can accommodate seven pairs of values in the format 7(2X, I3, F4.Ø). If more than seven pairs of values were recorded at a particular site, then the remaining pairs of values were recorded at a particular site, then the remaining pairs of values are punched on other data card(s). These pairs of values take up columns 1 - 63 on any one data card.

(ii) ICARD - this integer indicates the ordering of the data card(s). Hence, for the first data card it has the value 1, for the second it has the value 2, etc. This is punched in columns 67 - 68 with format I2.

(iii) ISITE - this is the site number and is punched on all the data cards used in columns 70 - 71 with format I2.

(iv) ICATCH - this is the catchment number and is punched on all the data cards used in columns 72 - 73 with format I2.

(v) IDAY - this is the day on which the readings were taken and is punched on all the data cards used in columns 75 - 76 with format I2.

(vi) IMONTH - this is the month and last two digits of the year in which the readings were taken and is punched on all the data cards used in columns 77 - 80 with format I4.

The data collected in the above manner is termed raw data and is now ready for quality control and test processing.

4. PROGRAMS USED IN SOIL MOISTURE DATA PROCESSING

The following is a brief description of the inputs to, functions of and outputs from all the programs currently being used in soil moisture data processing.

4.1 CALIBRATION AND SITE TABLES

These tables contain information which is used as input data to the quality control, test processing and processing programs. They are stored on a direct access file called CALSITETABS under the user name: CONMOD and are edited whenever necessary. Each calibration table is a family of linear calibration curves, one for each soil type, i.e. soil code Ø1, Ø2, etc. Each has the form:-

$$M = S.\frac{R}{RW} + C$$

where M = moisture volume fraction
S = slope of calibration curve
R = measurement in medium
RW = measurement in standard (water or transport shield)
C = intercept of calibration curve

Three calibration tables (1.1 - 1.3) are used - the original calibration table (the standard is the transport shield and applies to all data pre 1.1.70), the standard calibration table (the standard is a water drum and applies to all data post 1.1.70) and the special calibration curves (for experimental purposes). Each table consists of a number of sets (each set referring to a particular curve) of four values, these values depending on the soil code and, sometimes, on the probe code. The values, in the order in which they are input, are defined as follows:-

(a) Upper limit - this is the maximum value of R/RW (or R/RS) likely to occur for a given soil. This value is used as a limit of acceptability in the quality control program.

(b) Lower limit - this is the minimum value of R/RW (or R/Rs) likely to occur for a given soil. This value also is used as a limit of acceptability in the quality control program.

(c) Slope - this is the slope, S, of the equation.

(d) Intercept - this is the intercept, C, of the equation.

The original calibration table is contained in a matrix A (2, 15, 4) and each set of values contained in the table depends on the probe code (1 or 2) and the soil code (1 - 15). The standard calibration table is contained in a matrix B(15, 4) and each set of values contained in the table depends only on the soil code (1 - 15). The special calibration table is contained in a matrix C(3, 15, 4). This table is not in use at present.

Thirteen site tables (corresponding to the thirteen catchments at which measurements are taken) are used. Each site table is contained in a matrix whose maximum dimension is (at present) 99 x 10. Each site table (see tables 2.1 - 2.13) consists of a number of sets of ten values, each set referring to a particular site within the catchment. The values, in the order in which they are input, are defined as follows:-

(a) DMC - this is the allocated depth of moisture change below which it is assumed that no seasonal variation in moisture occurs.

(b) Depth 1, depth 2, soil code - the soil code indicates the type of soil present between depth 1 and depth 2.

(c) Depth 3, depth 4, soil code - as above with reference to the soil between depth 3 and depth 4.

(d) Depth 5, depth 6, soil code - as above with reference to the soil between depth 5 and depth 6.

Input to the program

The only input data needed by the program are the calibration and site tables. Each set of four values of the calibration tables is input with format 4(F6.3, 5X). Immediately preceding the data for each site table, a card containing the catchment number and the number of sites in the catchment is input with format (I3, I6). Each set of ten values of the site tables is input with format 10I5.

Job description

The job description of the program is as follows:-

```
INPUT :CONMOD,CALDATA2
                                                  Input data
****
INPUT :CONMOD,CALIBRATE66
                                                  Source program
****
JOB GRPROGRAM66,:CONMOD
HFORTRAN *CRCALIBRATE66,*LP,ATLAS,BIN
ASSIGN *CR0,CALDATA2
ASSIGN *LP0,CALOUT
ASSIGN *ED0,CALSITETABS(OVERLAY)
TIME 300
ENTER
LF CALOUT,*LP
ERASE CALDATA2
ERASE CALOUT
ERASE CALIBRATE66
ENDJOB
****
```

The first command in the job description inputs the data following this card (the calibration and site tables) into an input file called CALDATA2 under the user name :CONMOD. This is followed by the data and a terminator card containing ****. The next input card puts the source program (written in FORTRAN) in a card file called CALIBRATE66. This is followed by the cards containing the source program and the standard terminator. The JOB card signifies the job name as GRPROGRAM66 run under the user name :CONMOD. This is followed by a compilation card which signifies that the program, held in the card file CALIBRATE66, is to be compiled using a systems macro HFORTRAN. *LP gives a listing of the program on the line printer, ATLAS signifies that the program is in ATLAS code and BIN produces a temporary file containing a binary version of the program. Following this there are three ASSIGN commands, the data held in CALDATA2 is assigned as input data, output to the line printer is assigned to the file CALOUT and output to the disc is assigned to the direct access file CALSITETABS. The parameter OVERLAY signifies that the user :CONMOD may access the file CALSITETABS in all possible modes. This is convenient for editing the file. The TIME card sets a limit of 300 secs on the running time of the job and ENTER initiates the running of the program. The next command causes a listing of the output (held in CALOUT) on the line printer. The files CALDATA2, CALOUT and CALIBRATE 66 are erased and the job terminated by ENDJOB and the standard terminator.

Function of the program

The program reads the calibration and site tables off the cards and writes the data on to a readily accessible file held on a disc. The data on the disc is held in a series of records.

Output from the program

The output is a listing of the various calibration and site tables and the respective record numbers on the disc. The three calibration tables occupy the first three records, whilst the thirteen site tables, each contained in two records, are held in the subsequent twenty-six records.

4.2 PRINTOUT OF THE CALIBRATION AND SITE TABLES

This program uses the data held in the direct access file CALSITETABS as input data and gives a line printer output of the calibration and site tables (1.1 - 1.3 and 2.1 - 2.13). No additional input data is needed and the job description is as follows:-

```
INPUT :CONMOD,CALIBRATE68
```

Source program

```
****
JOB GRPROGRAM67,:CONMOD
HFORTRAN *CRCALIBRATE68,ATLAS,*LP,BIN
ASSIGN *LP0,CALOUT
ASSIGN *ED0,CALSITETABS(OVERLAY)
TIME 300
ENTER
LF CALOUT,*LP
ERASE CALIBRATE68
ERASE CALOUT
ENDJOB
****
```

4.3 QUALITY CONTROL

This program is designed to point out any errors, observational or punching, occurring in the raw data. Several tests are made and the error messages output are worded so that the errors can be found with the minimum of difficulty.

Input to the program

The input consists of the raw data to be quality controlled preceded by a card containing an integer (with format I5 in columns 1 - 5) signifying the number of sets of data (i.e. number of catchments per month) to be quality controlled.

Job description

The job description is as follows:-

```
INPUT :SUBS.GRQCDATA6

****                                           Raw data
JOB GRPROGRAM47,:SUBS
LOAD GRQCBIN
ASSIGN *CR0,GRQCDATA6
ASSIGN *ED0,:CONMOD.CALSITETABS
ASSIGN *LP0,GRQCOUT
TIME 600
LF GRQCOUT,*LP
ERASE GRQCDATA6
ERASE GRQCOUT
ENDJOB
****
```

The job description is very similar to that used for the previous programs but, in this case, a binary version of the program already exists and there is no need to compile the source program. Instead, the binary version held in the file GRQCBIN is loaded into the core store.

Tests applied and messages output by the quality control programs

The following is a list of the tests applied to the data and the output given by the quality control program. An example of a typical output is given in figure 5. At the beginning of each set of data, the title NEUTRON SCATTER QUALITY CONTROL is printed at the top of a new page.

Lead card

The value of JVAR is tested,if it is zero the program execution is halted, if it is not equal to 4 the error message LEAD CARD INCORRECT is printed.

FIGURE 5. OUTPUT FROM THE QUALITY CONTROL PROGRAM

```
NEUTRON SCATTER QUALITY CONTROL

CATCHMENT  13  AREA  =  0.0  NO. OF SITES READ = 11
NO. OF DAYS IN MONTH  30  MONTH/YEAR  470

       1   2   3   4   5   6   7   8   9   10   11
  SITE 1
SUM OF OBSERVATIONS INCORRECT = CALCULATED = 7120.00  CARD = 712.00
METER  206 HAS DEAD TIME  190
READING 13 AT 390 CM, IS NOT WITHIN CORRECT DISTANCE OF DMC OF 570 CM
  SITE 2
DATA CONSISTENT
  SITE 3
DATA CARD IN WRONG ORDER  COUNT = 3  CARD = 2
METER 206 HAS DEAD TIME 190
  SITE 4
DATA CONSISTENT
  SITE 5
METER 206 HAS DEAD TIME 190
  SITE 6
DATA CONSISTENT
  SITE 7
SUM OF OBSERVATIONS INCORRECT = CALCULATED = 4070.00  CARD = 4050.00
METER 206 HAS DEAD TIME 0.
  SITE 8
METER 206 HAS DEAD TIME  190
  SITE 9
METER 206 HAS DEAD TIME  190
  SITE 10
METER 206 HAS DEAD TIME  190
  SITE 11
DATA CONSISTENT
```

First control card

The information held on the first control card is printed out in the form of a heading. The month (NMONTH) and catchment number (NCATCH) are checked against those on the lead card; if the values do not agree the error messages CHECK DATA or CHECK CATCHMENT NO. ON DATA CARD are output.

Second control card(s)

The card order number (NO) is compared with a count and the error message CONTROL CARD IN WRONG ORDER COUNT = *CARD = * is output when they do not agree. The month and catchment number are tested as for the first control card and, if all the sites expected have not been read, then another second control card is read and the tests repeated. The site numbers are printed in sequence for ease of checking.

The remainder of this description applies to the data at each site read during the month.

Information card

The message SITE X where X is the site number as given on the second control card is printed. The month and catchment number are tested against those on the lead card. The site number is checked against that appearing on the second control card; if it is wrong, the error message SITE NO. WRONG is printed. The day number on the card is tested, if it is less than the previous day, the error message CHECK DAY ON INFORMATION CARD - POSSIBLY WRONG SITE ORDER is printed, or, if it is greater than the number of days in the month, the error message DAY ON INFORMATION CARD NOT IN MONTH is printed.

Data card(s)

The card order number (ICARD) is checked against a count; if they do not agree, the error message DATA CARD IN WRONG ORDER COUNT =

* CARD = * is output. The month, catchment number and site number are tested as above. The day number on the card is tested; if it is less than the previous day, the error message CHECK DAY ON DATA CARD - POSSIBLY WRONG SITE ORDER is printed, or, if it is greater than the number of days in the month, the error message DAY ON DATA CARD NOT IN MONTH is printed. If all the reading depths expected have not been input, another data card is read, and the above tests repeated.

The depths and observations are summed and checked with the variables, SD and SO, respectively, on the information card. If the values do not agree, then the error message SUM OF DEPTHS INCORRECT - CALCULATED = * CARD = * or SUM OF OBSERVATIONS INCORRECT - CALCULATED = * CARD = * is printed. If the value of Grav. M.V.F. is not zero (so indicating that a core sample was taken), the message FIRST READING GRAVIMETRIC AND GMVF = * is printed. The first digit of the meter code is tested and if it is not equal to 1, 2 or 3, the error message METER CODE IS NOT 1, 2 or 3 BUT * is printed. If a ratemeter was used (first digit of meter code = 2), then the dead time is tested; if it does not lie between 50 and 150, then the error message METER * HAS DEAD TIME * is printed.

For each observation taken with the probe (i.e. excluding the Grav. M.V.F.), the ratios are calculated and tested and the depths tested, as follows:

For scaler, code 1, RATIO = (C * B) / (A * OBSV)

For ratemeter, code 2, $OBSV = OBSV + OBSV^2 \zeta + OBSV^3 \zeta^2$

(where ζ = dead time)

RATIO = OBSV/B

For ratescaler, code 3, RATIO = OBSV/B

The soil code for the particular depth is found and, if the depth in question is not in the site table, then the error message DEPTH * NOT IN TABLE is output. The depths are checked for consecutive order and, if they are not found to be so, the error message DEPTHS IN WRONG ORDER DEPTH A = * B = * is printed. The calculated ratio is compared with the lower limit (LOWLIM) and upper limit (UPLIM) found in the relevant calibration table. If the ratio is less than the lower, or greater than the upper limit, the error message RATIO (*) IS LESS THAN THE LOWER LIMIT RATIO = * LOWER LIMIT = * or RATIO (*) IS GREATER THAN THE UPPER LIMIT RATIO = * UPPER LIMIT = * is output. The last depth above the depth of moisture change (as found in the site table) is tested. If the last depth is not within 10 cm (30 cm for Kenyan data) of the DMC, the error message READING * AT * IS NOT WITHIN THE CORRECT DISTANCE OF DMC OF * CM.

Finally, when all of the readings have been tested in the above manner, an error index, KLANG, which becomes equal to one when an error is found, is tested. If it is still zero, then the statement DATA CONSISTENT is printed, so showing that no errors have been found in the checking.

4.4 TEST PROCESSING

This program converts the observations at each depth to moisture volume fractions with an associated standard deviation. The amount of water, together with an associated standard deviation, for the layer represented by each depth is given. Finally the water content of the profile above the depth of moisture change is calculated. A line printer output in the form of a table is given (see figure 6).

Input to the program

The form of the input to the program is the same as that for the quality control program.

FIGURE 6 OUTPUT FROM TEST PROCESSING PROGRAM

DATE 27.4.71 SOIL MOISTURE PROFILE, I.H., NERC, WALLINGFORD

SITE 4 - 2

PROBE 108 METER 300 OBSERVER 16 CROP 1 TOPSOIL 10 TUBE HEIGHT 3 cm

METER TYPE - RATESCALER

PRESET TIME FOR STANDARD 64 sec. COUNT RATE IN STANDARD 998.0

PRESET COUNT TIME FOR SOIL 16 sec.

DEPTH BELOW G.L. (CM)	READING	R/RW	M.V.F.	STD.DEV (MVF)	LAYER FACTOR	WATER IN LAYER (CM)	STD.DEV. (CM WATER)
10	600.	0.601	0.564	0.006	15.0	8.5	0.09
20	524.	0.525	0.491	0.006	10.0	4.9	0.06
30	520.	0.521	0.487	0.006	12.5	6.1	0.07
45	511.	0.512	0.479	0.006	15.0	7.2	0.09
60	487.	0.488	0.455	0.006	15.0	6.8	0.08
75	468.	0.469	0.437	0.005	15.0	6.6	0.08
90	446.	0.447	0.416	0.005	15.0	6.2	0.08
105	436.	0.437	0.407	0.005	15.0	6.1	0.08
120	419.	0.420	0.390	0.005	15.0	5.9	0.08
135	424.	0.425	0.395	0.005	15.0	5.9	0.08
150	432.	0.433	0.403	0.005	7.5	3.0	0.04
160	426.	0.427	0.397	0.005	0.0	0.0	0.00

WATER CONTENT OF UPPER 150 CM = 67.2 CM 68 P.C. PROBABLE RANDOM COUNTING ERROR = 0.3 CM WATER

PREVIOUS VALUE ON = CM CHANGE =

WT. MEAN MVF OF UPPER 150 CM = 0.448 +/- 0.002 (EQUIVALENT ERROR)

Job description

The job description is as follows:-

```
INPUT :SUBS,GRDATA1
                                                  Raw data
****
JOB GRPROGRAM59T,:SUBS
LOAD GRTPROCBIN
ASSIGN *CR0,GRDATA1
ASSIGN *ED0,:CONMOD.CALSITETABS
ASSIGN *LP0,GRPROCO(LIMIT12000)
TIME 900
ENTER
LF GRPROCO,*LP
ERASE GRDATA1
ERASE GRPROCO
ENDJOB
****
```

In this case, a binary version of the source program is held in a file called GRTPROCBIN. The parameter of the file GRPROCO specifies the size of the file to be 12,ØØØ lines.

Calculations made by the test processing program

The formulae used for the calculations are given in figure 7 and the abbreviations used are as follows:-

FIGURE 7 FORMULAE USED IN PROCESSING PROGRAM

1. IF FIRST OBSERVATION IS GRAVIMETRIC

$$OBSV(1) = \emptyset$$
$$RMVF(1) = GMVF$$
$$EM(1) = \emptyset.\emptyset5 \times GMVF + \emptyset.\emptyset5$$
$$RATIO(1) = \emptyset$$

2. FOR METER CODE 1

$$RATIO(I) = \frac{C \times B}{A \times OBSV(I)}$$

$$EM(I) = SLOPE \times RATIO(I) \times \sqrt{\frac{1}{C} + \frac{1}{A}}$$

3. FOR METER CODE 2

$$B = B + B^2 \times \frac{\tau}{1\emptyset^6} + B^3 \times \frac{\tau^2}{1\emptyset^{12}}$$

$$OBSV(I) = OBSV(I) + OBSV(I)^2 \times \frac{\tau}{1\emptyset^2} + OBSV(I)^3 \times \frac{\tau^2}{1\emptyset^{12}}$$

$$RATIO(I) = \frac{OBSV(I)}{B}$$

$$EM(I) = SLOPE \times RATIO(I) \times \sqrt{\frac{1}{OBSV(I) \times C} + \frac{1}{B \times A}} \times \frac{1}{\sqrt{2}}$$

4. FOR METER CODE 3

$$RATIO(I) = \frac{OBSV(I)}{B}$$

$$EM(I) = SLOPE \times RATIO(I) \times \sqrt{\frac{1}{OBSV(I) \times C} + \frac{1}{B \times A}}$$

5. FOR METER CODE 1, 2 and 3

$$RMVF(I) = SLOPE \times RATIO\ (I) + INTERCEPT$$

6. IF FIRST READING

$$WF(I) = IDEPTH(I) + \tfrac{1}{2}\ (IDEPTH\ (2) - IDEPTH(1))$$

7. IF LAST READING ABOVE DMC

$$WF(I) = \tfrac{1}{2}\ (IDEPTH(I) - IDEPTH(I-1)) + (DMC - IDEPTH(I))$$

8. READINGS BETWEEN 6 and 7

$$WF(I) = \tfrac{1}{2}\ (IDEPTH(I) - IDEPTH(I-1)) + \tfrac{1}{2}(IDEPTH(I+1) - IDEPTH\ (I))$$

9. FOR ALL READINGS

$$WW(I) = RMVF(I) \times WF(I)$$
$$EWW(I) = EM(I) \times WF(I)$$

10. SUMMARIES

$$SEWW = \sum_I EWW(I)^2 \qquad SWW = \sum_I WW(I)$$

WATER CONTENT OVER DMC = SWW, PROBABLE ERROR = SEWW

MEAN MVF OVER DMC = $\frac{SWW}{DMC}$, PROBABLE ERROR = $\frac{SEWW}{DMC}$

DEPTH (I)	= depth below ground level
OBSV (I)	= reading taken
RATIO (I)	= R/RW (or R/Rs where applicable, i.e. before 1.1.70)
RMVF (I)	= moisture volume fraction
EM (I)	= standard deviation in moisture volume fraction
WF (I)	= layer factor (the layer represented by IDEPTH (I))
WW (I)	= water in layer (cm)
EWW (I)	= standard deviation in water in layer (cm water)
SWW	= water content of profile above DMC (cm)
ERROR	= 68% probable random counting error in SWW (cm water)
AMEAN	= weighted mean MVF of profile above DMC
PLUS	= error in AMEAN.

All the other symbols in the equation are as defined previously.

4.5 PROCESSING PROGRAM

This program is basically the same as the test processing program but, in this case, the processed data is kept in a card file and not output on the line printer. The processed data card file produced can be used as input data for the display programs.

Job description

```
INPUT :SUBS,GRD7
                                              Raw data
****
JOB GRPROCESS,:SUBS
LOAD GRPROCBIN1
ASSIGN *CR0,GRD7
ASSIGN *ED0,:CONMOD.CALSITETABS
ASSIGN *CP0,GRB4(LIMIT12000)
TIME 900
ENTER
ERASE GRD7
ENDJOB
****
```

A binary version of the processing program is held in the file GRPROCBIN1.

Display programs

These programs use the output from the processing program, GRB4, as input and give summaries of the results obtained over a whole year for a particular catchment. Occasionally, standard (winter mean) values are also used as input to the programs. These are generally calculated as the mean values of moisture volume fraction at each depth and of water content above the DMC taken over the winter months (December to March).

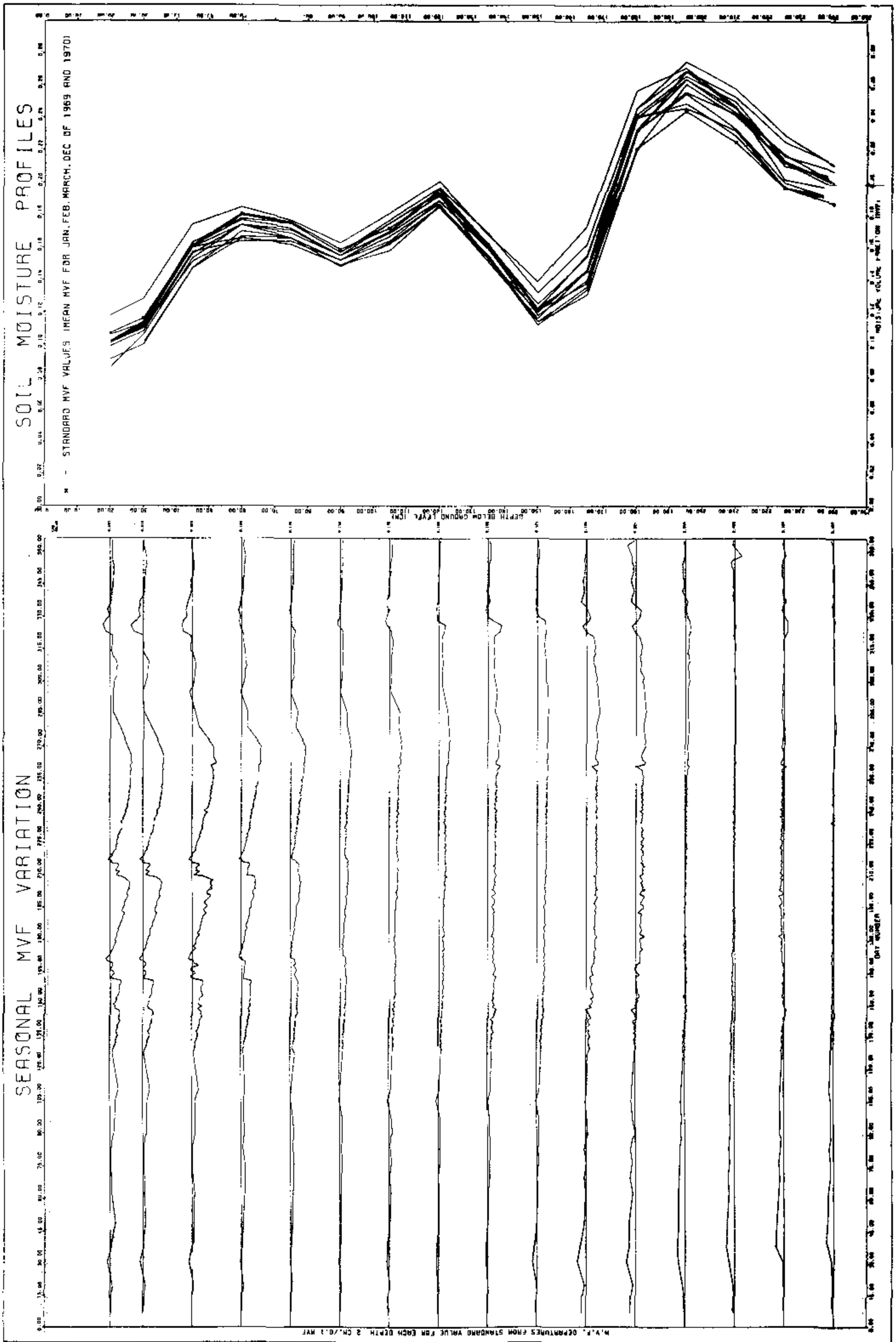
4.6 GRAPH PLOTTING PROGRAM

This program gives a graphical output (see figure 8) showing the variation of moisture volume fraction against time for various depths (time series graphs) and the variation of moisture volume fraction against depth for various times (soil moisture profiles).

Input to the program

As well as the processed data from the file GRB4, the following values, input on cards, are needed by the program:-

IPLOTSITE, NODEPTHS - these are integer values representing the site number to be plotted and the maximum number of depths read at that site during the year. They are punched on the same card with format 2I5. IDEPTH (I), WINMEAN (I) - these represent the depths and corresponding standard (winter mean) moisture volume fractions. Each data card can accommodate eight sets of values with format 8(I4, F6.3).


SOIL MOISTURE PROFILES
* - STANDARD MVF VALUES (MEAN MVF FOR JAN, FEB, MARCH, DEC OF 1969 AND 1970)
SEASONAL MVF VARIATION

```
INPUT :SUBS,GRGRAPHDATA
```

standard (winter mean) values

```
****
JOB GRPLOTS,:SUBS
LOAD BINGRPROG7
ONLINE *GP0,GRPICTUREB
ASSIGN *CR0,GRB4
ASSIGN *CR1,GRGRAPHDATA
TIME 600
ERASE GRGRAPHDATA
ENDJOB
****
```

A binary version of the program is stored in the filc BINGRPROG7. The graph plotter is made online to the program, the data to be plotted being called GRPICTUREB.

Output from the program

Two graphs are obtained:-

(i) Time series graphs - variations in moisture volume fraction (represented by a deficit from or a surfeit above the standard, winter mean, value) are drawn against time at all the reading depths. The standard value is shown as a straight line.

(ii) Soil moisture profiles - moisture volume fractions are plotted against depths for various days, the plots being superimposed on each other. If readings are taken at the site at intervals of one week or more, then all the curves are drawn, whilst if readings are taken more than once a week then a plot is drawn every fifth day.

4.7 DAILY/WEEKLY TUBE SUMMARY SHEETS

This program gives a line printer output (see figure 9) showing values of moisture volume fractions and water content for one particular tube on each occasion that readings were taken. The program is generally only used for sites which are read frequently (e.g. weekly, daily).

Input to the program

This program requires exactly the same input as the graph plotting program.

Job description

```
INPUT :SUBS,GRDATA6
                                          Standard values
****
INPUT :SUBS,GRPROG2
                                          Source program
```

INSTITUTE OF HYDROLOGY SOIL MOISTURE SUMMARY SHEET

MOISTURE VOLUME FRACTIONS AND WATER CONTENTS FOR PLYNLIMON DAILY TUBE

CATCHMENT 23 SITE 43 YEAR 1971

DEPTH DAY	20	30	40	50	60	70	WATER CONTENT
195	0.804	0.826	0.745	0.592	0.412	0.345	49.3
196	0.809	0.837	0.745	0.584	0.408	0.345	49.4
197	0.797	0.826	0.730	0.588	0.398	0.341	48.8
198	0.797	0.821	0.743	0.589	0.401	0.338	48.8
199	0.806	0.816	0.724	0.587	0.398	0.342	48.8
200	0.798	0.818	0.745	0.575	0.393	0.331	48.6
202	0.777	0.806	0.739	0.600	0.412	0.338	48.4
204	0.781	0.814	0.715	0.582	0.392	0.331	47.9
205	0.783	0.805	0.746	0.599	0.412	0.324	48.4
206	0.785	0.809	0.758	0.610	0.429	0.326	49.0
207	0.785	0.814	0.729	0.573	0.387	0.329	47.9
208	0.788	0.811	0.741	0.582	0.412	0.322	48.4
209	0.787	0.806	0.729	0.593	0.395	0.326	48.2
210	0.778	0.796	0.740	0.591	0.401	0.323	48.0
213	0.819	0.868	0.772	0.672	0.536	0.429	53.2
214	0.814	0.854	0.769	0.627	0.503	0.442	52.3
215	0.840	0.849	0.773	0.615	0.461	0.433	52.3
216	0.859	0.888	0.804	0.696	0.557	0.438	55.3
217	0.925	0.920	0.813	0.700	0.559	0.435	57.4
218	0.878	0.897	0.816	0.697	0.568	0.443	56.2
220	0.836	0.879	0.814	0.690	0.550	0.441	54.6
221	0.918	0.935	0.836	0.700	0.569	0.460	57.9
222	0.880	0.854	0.769	0.664	0.513	0.424	54.2
223	0.930	0.933	0.776	0.681	0.543	0.442	57.0
224	0.947	0.923	0.805	0.688	0.552	0.436	57.7
225	0.942	0.930	0.819	0.700	0.559	0.447	58.1
226	0.955	0.933	0.843	0.703	0.555	0.444	58.6
MEAN	0.838	0.854	0.768	0.633	0.469	0.384	52.0
STD DEV.	0.060	0.048	0.037	0.050	0.072	0.054	3.9

```
****
JOB GRTHETDAILY,:SUBS
HFORTRAN *CRGRPROG2,*LP,BIN
ASSIGN *CR0,GRB4
ASSIGN *CR1,GRDATA6
ASSIGN *LP0,GRTHETOUT
TIME 600
ENTER
LF GRTHETOUT,*LP
ERASE GRDATA6
ERASE GRPROG2
ERASE GRTHETOUT
ENDJOB
****
```

Output from the program

The output is in the form of a table showing the day number, values of moisture volume fraction for each reading depth and water content above the depth of moisture change each time the site was read. Also output are the mean water content and moisture volume fraction for each depth together with the associated standard deviations.

5.8 NETWORK SUMMARY SHEETS

This program produces line printer outputs showing the water contents and departures from the standard (winter mean) water contents for all the sites in the network throughout the year. The program is only used for sites which are read monthly.

Input to the program

As well as the processed data from the file GRB4, produced by the processing program, the following values are input on cards into the program:-

NOSITES - this is an integer showing the number of sites in the network. It is input with format I5.

SITENO (I), WCWIN (I) - these are the site number and corresponding standard, winter mean, water contents. Each card can accommodate up to ten sets of values with format 1Ø(I3, F5.1).

TEXTDATA (I, 2) - these are the names of the sites in the catchment. Each site name is input on a separate card with format 2A8.

Job description

```
INPUT :SUBS,GRNSSDATA1
                                         Input data
****
INPUT :SUBS,GRNSSPROB
                                         Source program
****
JOB GRNSS,:SUBS
HFORTRAN *CRGRNSSPROB,*LP,BIN
ASSIGN *CR0,GRB4
ASSIGN *CR1,GRNSSDATA1
ASSIGN *LP0,GRNSSOUT
TIME 300
ENTER
LF GRNSSOUT,*LP
ERASE GRNSSDATA1
ERASE GRNSSPROB
ERASE GRNSSOUT
ENDJOB
****
```

Output from the program

Two line printer outputs are obtained:-

(i) Water contents - the output is in the form of a table (figure 10.1), each row of which represents one site in the network. The date, water content and depth of moisture change each time the network was read, together with the site name and number, are printed.

(ii) Departures from standard, winter mean, water contents - this output (see figure 10.2) is similar to the above but, in this case, the date, meter code and departures each time the network was read, together with the site name, site number and standard value, are printed.

4.9 SITE SUMMARY SHEETS

This program, which is only used for infrequently (i.e. monthly) read tubes, produces a line printer output showing the moisture volume fractions and deviations from standard values at each depth and for each time that the sites were read.

Input to the program

The input to this program is the same as that for the graph plotting program.

Job description

The job description is as follows:-

```
INPUT :SUBS,GRSITEDATD
                                        standard values
****
INPUT :SUBS,GRSITED
                                        Source program
```

```
****
JOB GRSITESUM,:SUBS
HFORTRAN *CRGRSITED,*LP,BIN
CREATE !0(*ED,BUCK8,KWORDS150)
ASSIGN *ED0,!0(OVERLAY)
ASSIGN *CR0,GRB4
ASSIGN *CR1,GRSITEDATD
ASSIGN *LP0,GRSITEOUS
TIME 300
ENTER
LF GRSITEOUS,*LP
ERASE GRSITEDATD
ERASE GRSITED
ERASE GRSITEOUS
ENDJOB
****
```

The CREATE command produces a scratch direct access file of size 150,000 words and this is assigned to the program in all possible modes i.e. it is possible to write and to read from this direct access file.

Output from the program

The output from the program (see figure 11) is in the form of a series (one per site) of tables. Each table gives the day number, probe code, meter code, depth of moisture change, depth, moisture volume fraction and departure from standard, winter mean, moisture volume fraction, for each reading depth and for each time that the site was read. Also output are the standard moisture volume fraction, mean departure and standard deviation, and number of readings taken for each depth.

4.10 GRID SUMMARY SHEETS

This program gives a summary of the moisture volume fractions of the sites in a grid in a particularly useful form. It produces a series of line printer outputs showing the variation of moisture volume fraction over the grid at each depth and on each day that the grid was read.

Input to the program

In addition to the processed data from the file GRB4, the following data is input (on cards) into the program:-

NNREAD - this is the number of reading depths for the tubes in the grid.
IA(K), BB(K) - the matrix IA(9) has the values 1 - 9, whilst BB(K) represents the letters A - I. These matrices are used to label the tubes in the grid (A1, A2, etc).

Job description

The job description is as follows:-

```
INPUT :SUBS,GRGDATA
                                        Input data on cards
****
INPUT :SUBS,GGGSS
                                        Source program
****
JOB GRGRID,:SUBS
HFORTRAN *CRGGGSS,*LP,BIN
ASSIGN *CR0,GRB4
ASSIGN *CR1,GRGDATA
ASSIGN *LP0,GRGSSOUT
TIME 300
ENTER
LF GRGSSOUT,*LP
ERASE GGGSS
ERASE GRGSSOUT
ERASE GRGDATA
ENDJOB
****
```

Output from the program

Each summary sheet gives the variation in moisture volume fraction over the grid at a particular depth and time. The output (see figure 12) is in the form of a matrix, its dimensions depending on the number of tubes in the grid. Each element of the matrix represents a moisture volume fraction. Also output are the moisture volume fraction of the index tube (if one is present), the mean moisture volume fraction and the standard deviation and coefficient of variation over the grid (excluding the index tube).

MAGNETIC TAPE ROUTINES

The outputs from the display programs are studied and, if found satisfactory, the raw and processed data are copied on to different magnetic tapes. Generally the data from different catchments are kept on separate magnetic tapes. For writing to and reading from magnetic tapes the NEWCOPYOUT and NEWCOPYIN routines are used.

Newcopyout routine

This enables the user to copy out data from a specified file on to a specified file on a specified magnetic tape, e.g. if data held in a file GRB4 is to be copied on to a file GRDATA1 held on magnetic tape 133 the job description would be:-

```
JOB GRMT,:SUBS
NEWCOPYOUT (133),T####
END
GRB4,GRDATA1
####
ENDJOB
****
```

The parameter END specifies that any files on tape 133 created by the user :SUBS will not be overwritten.

Newcopyin routine

This is the reverse of the above procedure, e.g.

```
JOB GRMT1,:SUBS
NEWCOPYIN (133),T####
GRDATA1,GRB4
####
ENDJOB
****
```

FIGURE 10.1

INSTITUTE OF HYDROLOGY WATER CONTENT SUMMARY SHEET

TOTAL WATER CONTENT OF PROFILE (CM)

CATCHMENT 5 YEAR 1971

SITE	SITE CODE	DATE	15.4	21.5	8.7	2.8	16.9	12.10	19.11	23.12
WHITTLESFORD BDG.	1	DMC:	160	160	160	160	160	160	160	160
		CM WATER:	67.8	67.7	66.1	63.6	62.3	62.2	64.1	64.9
HINXTON GRANGE	2	DMC:	160	160	0	0	0	0	0	0
		CM WATER:	64.2	60.3	0.0	0.0	0.0	0.0	0.0	0.0
CHESTERFORD PARK	3	DMC:	160	160	160	160	160	160	160	160
		CM WATER:	64.0	63.7	62.1	63.2	60.4	59.1	67.1	67.7
MOLE HALL	4	DMC:	160	160	160	160	160	160	160	160
		CM WATER:	64.8	59.0	58.7	55.6	54.2	52.8	60.6	65.2
HOWE HALL	6	DMC:	160	160	160	160	160	160	160	160
		CM WATER:	69.6	70.0	62.1	65.6	63.7	63.3	70.6	71.8
ICKLETON GRANGES	7	DMC:	160	160	160	160	160	160	160	160
		CM WATER:	80.4	73.5	73.4	72.2	68.8	68.9	76.9	79.9
BROCTONS FARM	8	DMC:	160	160	160	160	160	160	160	160
		CM WATER:	66.2	62.8	61.4	61.6	57.3	56.7	68.3	69.7
NEW HINXTON GRNG	9	DMC:	0	0	0	0	0	0	0	0
		CM WATER:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

FIGURE 10.2

INSTITUTE OF HYDROLOGY WATER CONTENT SUMMARY SHEET

DEPARTURES FROM STANDARD WINTER MEAN PROFILE (1969 AND 1970)

CATCHMENT 5 YEAR 1971

SITE	SITE CODE	WINTER MEANS	DATE	15.4	21.5	8.7	2.8	16.9	12.10	19.11	23.12
WHITTLESFORD BDG	1		METER:	300	311	310	311	312	312	312	313
		70.9	DEP:	-3.1	-3.2	-4.8	-7.3	-8.6	-8.8	-6.8	-6.0
HINXTON GRANGE	2		METER:	300	311	0	0	0	0	0	0
		68.5	DEP:	-4.3	-8.2	0.0	0.0	0.0	0.0	0.0	0.0
CHESTERFORD PARK	3		METER:	300	311	310	311	312	312	312	313
		66.8	DEP:	-2.8	-3.1	-4.7	-3.6	-6.4	-7.7	0.3	0.9
MOLE HALL	4		METER:	300	311	310	311	312	312	312	313
		68.5	DEP:	-3.7	-9.5	-9.8	-12.9	-14.3	-15.7	-7.9	-3.3
HOWE HALL	6		METER:	300	311	310	311	312	312	312	313
		69.7	DEP:	-0.1	0.3	-7.6	-4.1	-6.0	-6.4	0.9	2.1
ICKLETON GRANGES	7		METER:	300	310	310	311	312	312	312	313
		78.5	DEP:	1.9	-5.0	-5.1	-6.3	-9.7	-9.6	-1.6	1.4
BROCTONS FARM	8		METER:	300	311	310	311	312	312	312	313
		67.6	DEP:	-1.4	-4.8	-6.2	-6.0	-10.3	-10.9	0.7	2.1
NEW HINXTON GRNG	9		METER:	0	0	310	311	312	312	312	313
		69.8	DEP:	0.0	0.0	-8.5	-7.2	-9.1	-8.9	-2.5	0.0

FIGURE 11.

INSTITUTE OF HYDROLOGY SOIL MOISTURE PROFILE SUMMARY SHEETS

MOISTURE VOLUME FRACTIONS AND DEPARTURES FROM STANDARD WINTER MEANS

CATCHMENT 5 SITE 1 YEAR 1971

STD. PROFILE	MEAN DEP.	STD. DEV.	NO. RDGS.	DAY	105	141	189	214	259	285	323	357
				PROBE	118	105	105	126	126	105	105	105
				METER	300	311	310	311	312	312	312	313
				DMC	160	160	160	160	160	160	160	160
				DEPTH	10	10	10	10	10	10	10	10
0.66				MVF	0.60	0.61	0.58	0.51	0.47	0.49	0.55	0.58
	-0.11	0.05	8	DEP.	-0.06	-0.04	-0.08	-0.15	-0.19	-0.17	-0.11	-0.08
				DEPTH	20	20	20	20	20	20	20	20
0.64				MVF	0.62	0.62	0.60	0.55	0.52	0.55	0.54	0.51
	-0.08	0.04	8	DEP.	-0.02	-0.02	-0.05	-0.09	-0.12	-0.10	-0.10	-0.13
				DEPTH	30	30	30	30	30	30	30	30
0.55				MVF	0.53	0.51	0.48	0.47	0.45	0.48	0.46	0.45
	-0.07	0.03	8	DEP.	-0.02	-0.04	-0.07	-0.09	-0.10	-0.08	-0.10	-0.10
				DEPTH	45	45	45	45	45.	45	45	45
0.41				MVF	0.42	0.44	0.41	0.38	0.39	0.38	0.40	0.41
	-0.01	0.02	8	DEP.	0.01	0.02	-0.01	-0.03	-0.03	-0.04	-0.02	0.00
				DEPTH	60	60	60	60	60	60	60	60
0.39				MVF	0.40	0.39	0.38	0.37	0.34	0.33	0.36	0.39
	-0.02	0.02	8	DEP.	0.01	-0.00	-0.02	-0.03	-0.05	-0.06	-0.03	-0.01
				DEPTH	75	75	75	75	75	75	75	75
0.32				MVF	0.33	0.32	0.32	0.32	0.31	0.28	0.33	0.33
	-0.00	0.02	8	DEP.	0.01	0.00	-0.000	-0.01	-0.01	-0.04	0.01	0.00
				DEPTH	90	90	90	90	90	90	90	90
0.39				MVF	0.37	0.35	0.38	0.38	0.39	0.35	0.36	0.38
	-0.02	0.01	8	DEP.	-0.02	-0.03	-0.01	-0.00	0.01	-0.03	-0.03	-0.01
				DEPTH	105	105	105	105	105	105	105	105
0.46				MVF	0.46	0.47	0.46	0.47	0.47	0.45	0.46	0.47
	0.01	0.01	8	DEP.	0.00	0.01	0.01	0.01	0.01	-0.00	0.00	0.01

FIGURE 12.

BALOAK GRID : MVF SUMMARY SHEETS

CATCHMENT 4 YEAR 1972

DATE 17.1 DEPTH 10 CMS

INDEX TUBE = 0.654

A	0.441	0.472	0.446	0.465	0.500	0.485
B	0.507	0.465	0.481	0.442	0.450	0.458
C	0.546	0.439	0.450	0.464	0.512	0.452
D	0.436	0.441	0.468	0.491	0.484	0.479
E	0.458	0.454	0.469	0.483	0.506	0.418
F	0.456	0.465	0.000	0.451	0.439	0.442
	1	2	3	4	5	6

MEAN MVF VALUE FOR DEPTH = 0.466 STANDARD DEVIATION = 0.026 COEFFICIENT OF VARIATION = 5.67

APPENDIX

The tables in this appendix contain the values and codes currently being used at the Institute of Hydrology and are not applicable elsewhere. These tables are continually being updated as new catchments, sites, etc are set up.

TABLE 1.1 ORIGINAL CALIBRATION CURVES R/RS

PROBE CODE	SOIL CODE	LOWER LIMIT	UPPER LIMIT	SLOPE	INTERCEPT
1	1	0.287	1.278	0.554	-0.010
1	2	0.250	1.450	0.547	-0.012
1	3	0.718	1.950	0.567	-0.006
1	4	0.135	1.570	0.495	-0.016
1	5	0.000	0.000	0.000	0.000
1	6	0.000	0.000	0.000	0.000
1	7	0.130	1.150	0.451	-0.024
1	8	0.470	1.630	0.563	-0.013
1	9	0.410	1.630	0.507	-0.025
1	10	0.390	1.370	0.473	-0.030
1	11	0.470	1.370	0.460	-0.038
1	12	0.000	0.000	0.000	0.000
1	13	0.000	0.000	0.000	0.000
1	14	0.000	0.000	0.000	0.000
1	15	0.000	0.000	0.000	0.000
2	1	0.415	1.365	0.576	-0.088
2	2	0.535	1.460	0.548	-0.092
2	3	0.675	1.650	0.690	-0.068
2	4	0.300	1.400	0.500	-0.100
2	5	0.000	0.000	0.000	0.000
2	6	0.000	0.000	0.000	0.000
2	7	0.340	1.330	0.452	-0.106
2	8	0.000	0.000	0.000	0.000
2	9	0.000	0.000	0.000	0.000
2	10	0.000	0.000	0.000	0.000
2	11	0.000	0.000	0.000	0.000
2	12	0.000	0.000	0.000	0.000
2	13	0.000	0.000	0.000	0.000
2	14	0.000	0,000	0.000	0.000
2	15	0.000	0.000	0.000	0.000

TABLE 1.2 STANDARD CALIBRATION CURVES R/RW

PROBE CODE	SOIL CODE	LOWER LIMIT	UPPER LIMIT	SLOPE	INTERCEPT
	1	0.164	0.730	0.970	-0.010
	2	0.143	0.828	0.958	-0.012
	3	0.410	1.113	0.993	-0.006
	4	0.077	0.896	0.867	-0.016
	5	0.000	0.000	0.000	0.000
	6	0.000	0.000	0.000	0.000
	7	0.074	0.657	0.790	-0.024
	8	0.287	0.996	0.921	-0.013
	9	0.251	0.997	0.829	-0.025
	10	0.238	0.837	0.774	-0.030
	11	0.287	0.837	0.753	-0.038
	12	0.000	0.000	0.000	0.000
	13	0.000	0.000	0.000	0.000
	14	0.000	0.000	0.000	0.000
	15	0.000	0.000	0.000	0.000

TABLE 1.3 SPECIAL CALIBRATION CURVES

PROBE CODE	SOIL CODE	LOWER LIMIT	UPPER LIMIT	SLOPE	INTERCEPT
1	1	0.000	0.000	0.000	0.000
1	2	0.000	0.000	0.000	0.000
1	3	0.000	0.000	0.000	0.000
1	4	0.000	0.000	0.000	0.000
1	5	0.000	0.000	0.000	0.000
1	6	0.000	0.000	0.000	0.000
1	7	0.000	0.000	0.000	0.000
1	8	0.000	0.000	0.000	0.000
1	9	0.000	0.000	0.000	0.000
1	10	0.000	0.000	0.000	0.000
1	11	0.000	0.000	0.000	0.000
1	12	0.000	0.000	0.000	0.000
1	13	0.000	0.000	0.000	0.000
1	14	0.000	0.000	0.000	0.000
1	15	0.000	0.000	0.000	0.000
2	1	0.000	0.000	0.000	0.000
2	2	0.000	0.000	0.000	0.000
2	3	0.000	0.000	0.000	0.000
2	4	0.000	0.000	0.000	0.000
2	5	0.000	0.000	0.000	0.000
2	6	0.000	0.000	0.000	0.000
2	7.	0.000	0.000	0.000	0.000
2	8	0.000	0.000	0.000	0.000
2	9	0.000	0.000	0.000	0.000
2	10	0.000	0.000	0.000	0.000
2	11	0.000	0.000	0.000	0.000
2	12	0.000	0.000	0.000	0.000
2	13	0.000	0.000	0.000	0.000
2	14	0.000	0.000	0.000	0.000
2	15	0.000	0.000	0.000	0.000
3	1	0.000	0.000	0.000	0.000
3	2	0.000	0.000	0.000	0.000
3	3	0.000	0.000	0.000	0.000
3	4	0.000	0.000	0.000	0.000
3	5	0.000	0.000	0.000	0.000
3	6	0.000	0.000	0.000	0.000
3	7	0.000	0.000	0.000	0.000

TABLE 1.3 continued

PROBE CODE	SOIL CODE	LOWER LIMIT	UPPER LIMIT	SLOPE	INTERCEPT
3	8	0.000	0.000	0.000	0.000
3	9	0.000	0.000	0.000	0.000
3	10	0.000	0.000	0.000	0.000
3	11	0.000	0.000	0.000	0.000
3	12	0.000	0.000	0.000	0.000
3	13	0.000	0.000	0.000	0.000
3	14	0.000	0.000	0.000	0.000
3	15	0.000	0.000	0.000	0.000

TABLE 2.1 CATCHMENT 1

SITE	DMC	DEPTH 1	DEPTH 2	SOIL CODE	DEPTH 3	DEPTH 4	SOIL CODE	DEPTH 5	DEPTH 6	SOIL CODE
1	130	0	400	2	0	0	0	0	0	0
2	250	0	350	2	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0
13	310	0	100	7	101	330	2	0	0	0
14	240	0	30	4	31	240	2	241	260	7
15	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0
17	250	0	15	4	16	150	2	151	270	7
18	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0

TABLE 2.2 CATCHMENT 2

SITE	DMC	DEPTH 1	DEPTH 2	SOIL CODE	DEPTH 3	DEPTH 4	SOIL CODE	DEPTH 5	DEPTH 6	SOIL CODE
1	150	0	200	2	0	0	0	0	0	0
2	150	0	200	2	0	0	0	0	0	0
3	150	0	200	2	0	0	0	0	0	0
4	150	0	200	2	0	0	0	0	0	0
5	150	0	200	2	0	0	0	0	0	0
6	150	0	200	2	0	0	0	0	0	0
7	150	0	200	2	0	0	0	0	0	0
8	150	0	200	2	0	0	0	0	0	0
9	150	0	200	2	0	0	0	0	0	0
10	150	0	200	2	0	0	0	0	0	0
11	150	0	200	2	0	0	0	0	0	0
12	150	0	200	2	0	0	0	0	0	0
13	150	0	200	2	0	0	0	0	0	0
14	150	0	200	2	0	0	0	0	0	0
15	150	0	200	2	0	0	0	0	0	0
16	150	0	200	2	0	0	0	0	0	0
17	150	0	200	2	0	0	0	0	0	0
18	150	0	200	2	0	0	0	0	0	0
19	150	0	200	2	0	0	0	0	0	0
20	150	0	200	2	0	0	0	0	0	0
21	150	0	200	2	0	0	0	0	0	0
22	150	0	200	2	0	0	0	0	0	0
23	150	0	200	2	0	0	0	0	0	0
24	150	0	200	2	0	0	0	0	0	0
25	150	0	200	2	0	0	0	0	0	0
26	150	0	200	2	0	0	0	0	0	0
27	150	0	200	2	0	0	0	0	0	0
28	150	0	200	2	0	0	0	0	0	0
29	150	0	200	2	0	0	0	0	0	0
30	150	0	200	2	0	0	0	0	0	0
31	150	0	200	2	0	0	0	0	0	0

TABLE 2.3 CATCHMENT 3

SITE	DMC	DEPTH 1	DEPTH 2	SOIL CODE	DEPTH 3	DEPTH 4	SOIL CODE	DEPTH 5	DEPTH 6	SOIL CODE
1	120	0	200	2	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0
11	120	0	200	2	0	0	0	0	0	0
12	120	0	200	2	0	0	0	0	0	0
13	120	0	200	2	0	0	0	0	0	0
14	120	0	200	2	0	0	0	0	0	0
15	120	0	200	2	0	0	0	0	0	0
16	120	0	200	2	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0
21	120	0	200	2	0	0	0	0	0	0
22	120	0	200	2	0	0	0	0	0	0
23	120	0	200	2	0	0	0	0	0	0
24	120	0	200	2	0	0	0	0	0	0
25	120	0	200	2	0	0	0	0	0	0
26	120	0	200	2	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0
31	120	0	200	2	0	0	0	0	0	0
32	120	0	200	2	0	0	0	0	0	0
33	120	0	200	2	0	0	0	0	0	0

TABLE 2.3 continued

SITE	DMC	DEPTH 1	DEPTH 2	SOIL CODE	DEPTH 3	DEPTH 4	SOIL CODE	DEPTH 5	DEPTH 6	SOIL CODE
34	120	0	200	2	0	0	0	0	0	0
35	120	0	200	2	0	0	0	0	0	0
36	120	0	200	2	0	0	0	0	0	0
37	0	0	0	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0
41	120	0	200	2	0	0	0	0	0	0
42	120	0	200	2	0	0	0	0	0	0
43	120	0	200	2	0	0	0	0	0	0
44	120	0	200	2	0	0	0	0	0	0
45	120	0	200	2	0	0	0	0	0	0
46	120	0	200	2	0	0	0	0	0	0
47	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0
49	0	0	0	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0	0	0	0
51	120	0	200	2	0	0	0	0	0	0
52	120	0	200	2	0	0	0	0	0	0
53	120	0	200	2	0	0	0	0	0	0
54	120	0	200	2	0	0	0	0	0	0
55	120	0	200	2	0	0	0	0	0	0
56	120	0	200	2	0	0	0	0	0	0
57	0	0	0	0	0	0	0	0	0	0
58	0	0	0	0	0	0	0	0	0	0
59	0	0	0	0	0	0	0	0	0	0
60	0	0	0	0	0	0	0	0	0	0
61	120	0	200	2	0	0	0	0	0	0
62	120	0	200	2	0	0	0	0	0	0
63	120	0	200	2	0	0	0	0	0	0
64	120	0	200	2	0	0	0	0	0	0
65	120	0	200	2	0	0	0	0	0	0
66	120	0	200	2	0	0	0	0	0	0

TABLE 2.4 CATCHMENT 4

SITE	DMC	DEPTH 1	DEPTH 2	SOIL CODE	DEPTH 3	DEPTH 4	SOIL CODE	DEPTH 5	DEPTH 6	SOIL CODE
1	150	0	200	2	0	0	0	0	0	0
2	150	0	200	2	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0
11	150	0	200	2	0	0	0	0	0	0
12	150	0	200	2	0	0	0	0	0	0
13	150	0	200	2	0	0	0	0	0	0
14	150	0	200	2	0	0	0	0	0	0
15	150	0	200	2	0	0	0	0	0	0
16	150	0	200	2	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0
21	150	0	200	2	0	0	0	0	0	0
22	150	0	200	2	0	0	0	0	0	0
23	150	0	200	2	0	0	0	0	0	0
24	150	0	200	2	0	0	0	0	0	0
25	150	0	200	2	0	0	0	0	0	0
26	150	0	200	2	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0
31	150	0	200	2	0	0	0	0	0	0
32	150	0	200	2	0	0	0	0	0	0
33	150	0	200	2	0	0	0	0	0	0

TABLE 2.4 CATCHMENT 4 (cont)

SITE	DMC	DEPTH 1	DEPTH 2	SOIL CODE	DEPTH 3	DEPTH 4	SOIL CODE	DEPTH 5	DEPTH 6	SOIL CODE
34	150	0	200	2	0	0	0	0	0	0
35	150	0	200	2	0	0	0	0	0	0
36	150	0	200	2	0	0	0	0	0	0
37	0	0	0	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0
41	150	0	200	2	0	0	0	0	0	0
42	150	0	200	2	0	0	0	0	0	0
43	150	0	200	2	0	0	0	0	0	0
44	150	0	200	2	0	0	0	0	0	0
45	150	0	200	2	0	0	0	0	0	0
46	150	0	200	2	0	0	0	0	0	0
47	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0
49	0	0	0	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0	0	0	0
51	150	0	200	2	0	0	0	0	0	0
52	150	0	200	2	0	0	0	0	0	0
53	150	0	200	2	0	0	0	0	0	0
54	150	0	200	2	0	0	0	0	0	0
55	150	0	200	2	0	0	0	0	0	0
56	150	0	200	2	0	0	0	0	0	0
57	0	0	0	0	0	0	0	0	0	0
58	0	0	0	0	0	0	0	0	0	0
59	0	0	0	0	0	0	0	0	0	0
60	0	0	0	0	0	0	0	0	0	0
61	150	0	200	2	0	0	0	0	0	0
62	150	0	200	2	0	0	0	0	0	0
63	150	0	200	2	0	0	0	0	0	0
64	150	0	200	2	0	0	0	0	0	0
65	150	0	200	2	0	0	0	0	0	0
66	150	0	200	2	0	0	0	0	0	0

TABLE 2.5 CATCHMENT 5

SITE	DMC	DEPTH 1	DEPTH 2	SOIL CODE	DEPTH 3	DEPTH 4	SOIL CODE	DEPTH 5	DEPTH 6	SOIL CODE
1	160	0	175	2	0	0	0	0	0	0
2	160	0	175	2	0	0	0	0	0	0
3	160	0	175	2	0	0	0	0	0	0
4	160	0	175	2	0	0	0	0	0	0
5	160	0	175	2	0	0	0	0	0	0
6	160	0	175	2	0	0	0	0	0	0
7	160	0	175	2	0	0	0	0	0	0
8	160	0	175	2	0	0	0	0	0	0
9	160	0	175	2	0	0	0	0	0	0

TABLE 2.6 CATCHMENT 7

SITE	DMC	DEPTH 1	DEPTH 2	SOIL CODE	DEPTH 3	DEPTH 4	SOIL CODE	DEPTH 5	DEPTH 6	SOIL CODE
1	125	0	300	7	0	0	0	0	0	0
2	220	0	240	7	0	0	0	0	0	0
3	600	0	700	7	0	0	0	0	0	0
4	600	0	700	7	0	0	0	0	0	0
5	125	0	300	7	0	0	0	0	0	0
6	95	0	100	7	0	0	0	0	0	0
7	150	0	150	7	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0
11	300	0	500	7	0	0	0	0	0	0
12	300	0	500	7	0	0	0	0	0	0
13	300	0	500	7	0	0	0	0	0	0
14	300	0	500	7	0	0	0	0	0	0
15	300	0	500	7	0	0	0	0	0	0
16	300	0	500	7	0	0	0	0	0	0
17	300	0	500	7	0	0	0	0	0	0
18	300	0	500	7	0	0	0	0	0	0
19	300	0	500	7	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0
21	300	0	500	7	0	0	0	0	0	0
22	300	0	500	7	0	0	0	0	0	0
23	300	0	500	7	0	0	0	0	0	0
24	300	0	500	7	0	0	0	0	0	0
25	300	0	500	7	0	0	0	0	0	0
26	300	0	500	7	0	0	0	0	0	0
27	300	0	500	7	0	0	0	0	0	0
28	300	0	500	7	0	0	0	0	0	0
29	300	0	500	7	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0
31	300	0	500	7	0	0	0	0	0	0
32	300	0	500	7	0	0	0	0	0	0
33	300	0	500	7	0	0	0	0	0	0
34	300	0	500	7	0	0	0	0	0	0
35	300	0	500	7	0	0	0	0	0	0
36	300	0	500	7	0	0	0	0	0	0
37	300	0	500	7	0	0	0	0	0	0
38	300	0	500	7	0	0	0	0	0	0
39	300	0	500	7	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0
41	300	0	500	7	0	0	0	0	0	0
42	300	0	500	7	0	0	0	0	0	0
43	300	0	500	7	0	0	0	0	0	0
44	300	0	500	7	0	0	0	0	0	0
45	300	0	500	7	0	0	0	0	0	0
46	300	0	500	7	0	0	0	0	0	0
47	300	0	500	7	0	0	0	0	0	0
48	300	0	500	7	0	0	0	0	0	0
49	300	0	500	7	0	0	0	0	0	0
50	0	0	0	0	0	0	0	0	0	0
51	300	0	500	7	0	0	0	0	0	0
52	300	0	500	7	0	0	0	0	0	0
53	300	0	500	7	0	0	0	0	0	0
54	300	0	500	7	0	0	0	0	0	0
55	300	0	500	7	0	0	0	0	0	0
56	300	0	500	7	0	0	0	0	0	0

TABLE 2.6 Cont'd

SITE	DMC	DEPTH 1	DEPTH 2	SOIL CODE	DEPTH 3	DEPTH 4	SOIL CODE	DEPTH 5	DEPTH 6	SOIL CODE
57	300	0	500	7	0	0	0	0	0	0
58	300	0	500	7	0	0	0	0	0	0
59	300	0	500	7	0	0	0	0	0	0
60	0	0	0	0	0	0	0	0	0	0
61	300	0	500	7	0	0	0	0	0	0
62	300	0	500	7	0	0	0	0	0	0
63	300	0	500	7	0	0	0	0	0	0
64	300	0	500	7	0	0	0	0	0	0
65	300	0	500	7	0	0	0	0	0	0
66	300	0	500	7	0	0	0	0	0	0
67	300	0	500	7	0	0	0	0	0	0
68	300	0	500	7	0	0	0	0	0	0
69	300	0	500	7	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	0	0
71	300	0	500	7	0	0	0	0	0	0
72	300	0	500	7	0	0	0	0	0	0
73	300	0	500	7	0	0	0	0	0	0
74	300	0	500	7	0	0	0	0	0	0
75	300	0	500	7	0	0	0	0	0	0
76	300	0	500	7	0	0	0	0	0	0
77	300	0	500	7	0	0	0	0	0	0
78	300	0	500	7	0	0	0	0	0	0
79	300	0	500	7	0	0	0	0	0	0
80	0	0	0	0	0	0	0	0	0	0
81	300	0	500	7	0	0	0	0	0	0
82	300	0	500	7	0	0	0	0	0	0
83	300	0	500	7	0	0	0	0	0	0
84	300	0	500	7	0	0	0	0	0	0
85	300	0	500	7	0	0	0	0	0	0
86	300	0	500	7	0	0	0	0	0	0
87	300	0	500	7	0	0	0	0	0	0
88	300	0	500	7	0	0	0	0	0	0
89	300	0	500	7	0	0	0	0	0	0
90	0	0	0	0	0	0	0	0	0	0
91	300	0	500	7	0	0	0	0	0	0
92	300	0	500	7	0	0	0	0	0	0
93	300	0	500	7	0	0	0	0	0	0
94	300	0	500	7	0	0	0	0	0	0
95	300	0	500	7	0	0	0	0	0	0
96	300	0	500	7	0	0	0	0	0	0
97	300	0	500	7	0	0	0	0	0	0
98	300	0	500	7	0	0	0	0	0	0
99	300	0	500	7	0	0	0	0	0	0

TABLE 2.7 CATCHMENT 10

SITE	DMC	DEPTH 1	DEPTH 2	SOIL CODE	DEPTH 3	DEPTH 4	SOIL CODE	DEPTH 5	DEPTH 6	SOIL CODE
1	270	0	105	8	106	300	11	0	0	0
2	270	0	105	8	106	300	11	0	0	0
3	270	0	105	8	106	300	11	0	0	0
4	270	0	105	8	106	300	11	0	0	0
5	270	0	105	8	106	300	11	0	0	0
6	270	0	105	8	106	300	11	0	0	0

TABLE 2.8 CATCHMENT 11

SITE	DMC	DEPTH 1	DEPTH 2	SOIL CODE	DEPTH 3	DEPTH 4	SOIL CODE	DEPTH 5	DEPTH 6	SOIL CODE
1	270	0	135	8	136	300	9	0	0	0
2	270	0	135	8	136	300	9	0	0	0
3	270	0	135	8	136	300	9	0	0	0
4	270	0	135	8	136	300	9	0	0	0
5	270	0	135	8	136	300	9	0	0	0
6	270	0	135	8	136	300	9	0	0	0

TABLE 2.9 CATCHMENT 13

SITE	DMC	DEPTH 1	DEPTH 2	SOIL CODE	DEPTH 3	DEPTH 4	SOIL CODE	DEPTH 5	DEPTH 6	SOIL CODE
1	450	0	590	10	0	0	0	0	0	0
2	270	0	290	10	0	0	0	0	0	0
3	450	0	470	10	0	0	0	0	0	0
4	270	0	350	10	0	0	0	0	0	0
5	450	0	470	10	0	0	0	0	0	0
6	270	0	350	10	0	0	0	0	0	0
7	270	0	290	10	0	0	0	0	0	0
8	270	0	290	10	0	0	0	0	0	0
9	270	0	290	10	0	0	0	0	0	0
10	270	0	450	10	0	0	0	0	0	0
11	270	0	350	10	0	0	0	0	0	0

TABLE 2.10 CATCHMENT 14

SITE	DMC	DEPTH 1	DEPTH 2	SOIL CODE	DEPTH 3	DEPTH 4	SOIL CODE	DEPTH 5	DEPTH 6	SOIL CODE
1	450	0	470	9	0	0	0	0	0	0
2	240	0	260	9	0	0	0	0	0	0
3	450	0	500	9	0	0	0	0	0	0
4	270	0	290	9	0	0	0	0	0	0
5	600	0	620	9	0	0	0	0	0	0
6	300	0	320	9	0	0	0	0	0	0
7	540	0	580	9	0	0	0	0	0	0
8	450	0	470	9	0	0	0	0	0	0
9	270	0	310	9	0	0	0	0	0	0
10	570	0	610	9	0	0	0	0	0	0
11	270	0	310	9	0	0	0	0	0	0

TABLE 2.11 CATCHMENT 17

SITE	DMC	DEPTH 1	DEPTH 2	SOIL CODE	DEPTH 3	DEPTH 4	SOIL CODE	DEPTH 5	DEPTH 6	SOIL CODE
1	270	0	105	8	106	135	9	136	300	10
2	270	0	165	8	166	285	9	286	300	10
3	270	0	75	8	76	225	9	226	300	10

TABLE 2.12 CATCHMENT 23

SITE	DMC	DEPTH 1	DEPTH 2	SOIL CODE	DEPTH 3	DEPTH 4	SOIL CODE	DEPTH 5	DEPTH 6	SOIL CODE
1	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0
10	110	0	55	3	56	120	4	0	0	0
11	75	0	25	3	26	170	4	0	0	0
12	75	0	29	3	30	130	4	0	0	0
13	75	0	35	3	36	180	4	0	0	0
14	145	0	170	3	0	0	0	0	0	0
15	90	0	55	3	56	160	4	0	0	0
16	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0
20	135	0	110	3	111	140	4	0	0	0
21	75	0	90	3	0	0	0	0	0	0
22	65	0	35	3	36	70	4	0	0	0
23	145	0	150	4	0	0	0	0	0	0
24	75	0	100	4	0	0	0	0	0	0
25	45	0	50	4	0	0	0	0	0	0
26	100	0	65	3	66	130	4	0	0	0
27	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0
30	45	0	50	4	0	0	0	0	0	0
31	65	0	25	3	26	80	4	0	0	0
32	55	0	60	4	0	0	0	0	0	0
33	75	0	90	4	0	0	0	0	0	0
34	65	0	25	3	26	70	1	0	0	0
35	130	0	85	3	86	190	1	0	0	0
36	75	0	65	3	66	90	1	0	0	0
37	0	0	0	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0
41	65	0	55	3	56	80	4	0	0	0
42	75	0	35	3	36	80	4	0	0	0
43	75	0	60	3	61	90	1	0	0	0
44	55	0	25	3	26	60	4	0	0	0
45	75	0	90	4	0	0	0	0	0	0
46	75	0	80	4	0	0	0	0	0	0
47	45	0	50	3	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0
49	0	0	0	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0	0	0	0
51	55	0	75	4	0	0	0	0	0	0
52	65	0	85	4	0	0	0	0	0	0
53	55	0	75	4	0	0	0	0	0	0
54	85	0	105	4	0	0	0	0	0	0
55	145	0	160	3	0	0	0	0	0	0

TABLE 2.12 Continued

SITE	DMC	DEPTH 1	DEPTH 2	SOIL CODE	DEPTH 3	DEPTH 4	SOIL CODE	DEPTH 5	DEPTH 6	SOIL CODE
56	115	0	95	3	96	130	4	0	0	0
57	85	0	70	3	71	100	4	0	0	0
58	0	0	0	0	0	0	0	0	0	0
59	0	0	0	0	0	0	0	0	0	0
60	60	0	70	4	0	0	0	0	0	0
61	90	0	110	4	0	0	0	0	0	0
62	0	0	0	0	0	0	0	0	0	0
63	160	0	170	4	0	0	0	0	0	0
64	70	0	100	4	0	0	0	0	0	0
65	40	0	60	4	0	0	0	0	0	0
66	70	0	80	4	0	0	0	0	0	0
67	80	0	100	4	0	0	0	0	0	0
68	130	0	150	4	0	0	0	0	0	0
69	30	0	30	4	0	0	0	0	0	0

TABLE 2.13 CATCHMENT 27

SITE	DMC	DEPTH 1	DEPTH 2	SOIL CODE	DEPTH 3	DEPTH 4	SOIL CODE	DEPTH 5	DEPTH 6	SOIL CODE
1	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0
11	45	0	35	3	36	60	4	0	0	0
12	55	0	70	4	0	0	0	0	0	0
13	30	0	40	4	0	0	0	0	0	0
14	90	0	100	4	0	0	0	0	0	0
15	75	0	50	3	51	170	1	0	0	0
16	140	0	125	3	126	170	1	0	0	0
17	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0
21	45	0	50	4	0	0	0	0	0	0
22	45	0	60	4	0	0	0	0	0	0
23	45	0	35	3	36	60	4	0	0	0
24	155	0	25	3	26	160	4	0	0	0
25	75	0	100	4	0	0	0	0	0	0
26	45	0	15	3	16	50	1	0	0	0
27	55	0	15	3	16	60	1	0	0	0
28	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0
31	90	0	65	3	66	100	4	0	0	0
32	75	0	65	3	66	80	4	0	0	0
33	75	0	35	3	36	100	4	0	0	0
34	55	0	25	3	26	60	4	0	0	0
35	55	0	35	3	36	60	1	0	0	0
36	55	0	35	3	36	60	1	0	0	0
37	75	0	45	3	46	100	1	0	0	0
38	75	0	90	1	0	0	0	0	0	0

TABLE 2.13 CONTINUED

SITE	DMC	DEPTH 1	DEPTH 2	SOIL CODE	DEPTH 3	DEPTH 4	SOIL CODE	DEPTH 5	DEPTH 6	SOIL CODE
39	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0
41	65	0	35	3	36	70	1	0	0	0
42	35	0	40	4	0	0	0	0	0	0
43	55	0	60	3	0	0	0	0	0	0
44	45	0	50	4	0	0	0	0	0	0
45	75	0	35	3	36	120	4	0	0	0
46	0	0	0	0	0	0	0	0	0	0
47	75	0	40	3	41	90	4	0	0	0
48	0	0	0	0	0	0	0	0	0	0
49	0	0	0	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0	0	0	0
51	95	0	100	4	0	0	0	0	0	0
52	155	0	165	3	0	0	0	0	0	0
53	125	0	110	3	111	140	4	0	0	0
54	65	0	40	3	41	70	4	0	0	0
55	0	0	0	0	0	0	0	0	0	0
56	0	0	0	0	0	0	0	0	0	0
57	0	0	0	0	0	0	0	0	0	0
58	0	0	0	0	0	0	0	0	0	0
59	0	0	0	0	0	0	0	0	0	0
60	210	0	180	3	181	220	4	0	0	0

TABLE 3 OBSERVER CODES

01	J.P. Bell
02	D.S. Biggin
03	A.J. Bucknell
04	S.W. Smith
05	J.C. Rodda
06	L. Nkemdirim
07	C.W.O. Eeles
08	A.N. Lodge
09	R. Raynor
10	G.H. Morrey
11	P.M. Holdsworth
12	B.J. Knapp
13	H. Peck
14	S. Boyle
15	P. Rosier
16	
17	J.D. Cooper
18	
19	M. Rawlings
20	J.R. Blackie
21	H.M. Gunston
22	J. Embayi
23	W.G. Michobo
24	F. Ngumi
25	F. Ngugi
26	S. Muthamia

TABLE 4 CROP CODES

00	Irrelevant (does not change)
01	Grassland
02	Weeds
03	Bare soil
04	Cereals
05	Other crops
06	Woodland - deciduous
07	Woodland - coniferous
08	Woodland - mixed
09	Hedgerow and scrub
10	Peat - consolidated firm
11	Peat bog (marsh)
12	Tea
13	Bamboo
14	Montane rain forest

TABLE 5 GROUND CONDITION CODES

00	Surface of ground dry - no obvious cracks
01	Ground dry and cracks present
03	Ground dry but grass wet (dew or slight precipitation)
10	Ground moist or wet (no standing water)
11	Ground moist but cracks still visible
12	Ground soft or muddy
20	Surface wet with water standing in pools or puddles
21	Ground flooded
30	Ground frozen
50	Ice, snow, slush or hail covering less than half ground area
60	Ice, snow, slush or hail covering more than half but not all ground area
70	Ice, snow, slush or hail covering ground completely.

TABLE 6 RELEVANT TIME AND COUNT VALUES

READING TAKEN		BOX DESIGNATION					
		A	B	C	READING	D	E
IN (MEDIUM)		Laboratory Water standard (Mean of months' readings)		SOIL		Transport Shield	
BY (METER USED)	Scaler:	Count (N)	Time (sec x 10)T	Count (N)	Time (sec x 10)T	Count (N)	Time (sec x 10)T
	Ratemeter:	Time constant (sec)	Dial reading (D)	Time constant (sec)	Dial reading (D)	Time constant (sec)	Dial reading (D)
	Ratescaler:	Preset time (sec)	Count rate (cps)	Preset time (sec)	Count rate (cps)	Preset time (sec)	Count rate (cps)

N = number of counts preset on scaler

T = time (sec x 10) for N counts to accumulate

c.p.s = count rate in counts per second

D = dial reading of ratemeter in counts per second uncorrected for loss of random counts due to dead time.

TABLE 7.1

CATCHMENT 01 - HOWBERY PARK

SITE NO.	SITE NAME
01	Test tube
13	N.13 (nearest riverside)
14	N.14 (riverside)
17	N.17 (field)

These tubes are no longer read on a routine basis.

TABLE 7.2

CATCHMENT 02 - GRENDON CRAY

SITE NO.	SITE NAME
01	Grendon Met. Site
02	Knapps Hook
03	Prune Farm
04	Finemere Hill
05	Old Middle Farm (abandoned 12.10.70 replaced by site 26)
06	Middle Farm
07	Dry Leys
08	Knowl Hill
09	Grange Farm (abandoned 20.3.70 replaced by site 24)
10	Moor Farm
11	Grendon Mission
12	Rickyard
13	Upper Greatmoor
14	Finemere Wood
15	North Farm
16	Woodside Farm
17	Woodlands Farm
18	Grange Hill
19	Upper Hogshaw
20	Greatsea Wood
21	Kitehill
22	Balmore Fir Field (abandoned 12.10.70 replaced by site 25)
23	Balmore Oak Field (abandoned 7.7.71, replaced by site 27)
24	New Grange Farm (installed 20.3.70 60ft. from site 09)

TABLE 7.2 continued

CATCHMENT 02 - GRENDON CRAY

SITE NO.	SITE NAME
25	New Balmore Fir Field (installed 12.10.70 75ft. from site 22)
26	Middle Farm 3 (installed 12.10.70)
27	Balmore Oak Field 02 (installed 7.7.71)

Site 04 is read weekly as a check, whilst the whole network (mass sampling) is read 3 or 4 times during the year after dry spells to show moisture storage.

TABLE 7.3

CATCHMENT 03 - BALPINE

GRID NETWORK GRENDON

SITE NO.	SITE NAME
01	Field tube

Site No.	Site Name	Site No.	Site Name	Site No.	Site Name	Site No.	Site Name	Site No.	Site Name	Site No.	Site Name
11	A1	21	B1	31	C1	41	D1	51	E1	61	F1
12	A2	22	B2	32	C2	42	D2	52	E2	62	F2
13	A3	23	B3	33	C3	43	D3	53	E3	63	F3
14	A4	24	B4	34	C4	44	D4	54	E4	64	F4
15	A5	25	B5	35	C5	45	D5	55	E5	65	F5
16	A6	26	B6	36	C6	46	D6	56	E6	66	F6

These tubes were no longer read after December 1969

TABLE 7.4

CATCHMENT 04 - BALOAK

GRID NETWORK GRENDON

SITE NO.	SITE NAME
01	Field tube (abandoned 7.7.71 replaced by 02)
02	New field tube

Site No	Site Name	Site No	Site Name	Site No	Site Name	Site No	Site Name	Site No	Site Name	Site No	Site Name
11	A1	21	B1	31	C1	41	D1	51	E1	61	F1
12	A2	22	B2	32	C2	42	D2	52	E2	62	F2
13	A3	23	B3	33	C3	43	D3	53	E3	63	F3
14	A4	24	B4	34	C4	44	D4	54	E4	64	F4
15	A5	25	B5	35	C5	45	D5	55	E5	65	F5
16	A6	26	B6	36	C6	46	D6	56	E6	66	F6

This grid is read once a month

TABLE 7.5

CATCHMENT 05 - CAM

Site No.	Site Name
01	Whittlesford Bridge
02	Hinxton Grange
03	Chesterford Park
04	Mole Hall
05	Rickling - discontinued
06	Howe Hall
07	Ickleton Granges
08	Broctons Farm

These tubes are read monthly

TABLE 7.6

CATCHMENT 07 - THETFORD FOREST

GRID NETWORK PRE-1970

Site No.	Site Name	Site No.	Site Name	Site No.	Site Name	Site No.	Site Name	Site No.	Site Name	Site No.	Site Name
11	A1	21	B1	31	C1	41	D1	51	E1	61	F1
12	A2	22	B2	32	C2	42	D2	52	E2	62	F2
13	A3	23	B3	33	C3	43	D3	53	E3	63	F3
		24	B4	34	C4	44	D4	54	E4	64	F4
		25	B5	35	C5	43	D5	55	E5	65	F5
		26	B6	36	C6	46	D6	56	E6	66	F6

This grid was discontinued in January 1970 and a larger network built.

NETWORK POST-1970

Site No.	Site name
01	Index tube (site 51 of old grid)
02	Dave's tube
03	Clearing tube

Name/ No.	Name/ No.	Name/ No.	Name/ No.	Name/ No.	Name/ No.	Name/ No.	Name/ No.	Name/ No.
A1(11)	B1(21)	C1(31)	D1(41)	E1(51)	F1(61)	G1(71)	H1(81)	I1(91)
A2(12)	B2(22)	C2(32)	D2(42)	E2(52)	F2(62)	G2(72)	H2(82)	I2(92)
A3(13)	B3(23)	C3(33)	D3(43)	E3(53)	F3(63)	G3(73)	H3(83)	I3(93)
A4(14)	B4(24)	C4(34)	D4(44)	E4(54)	F4(64)	G4(74)	H4(84)	I4(94)
A5(15)	B5(25)	C5(35)	D5(45)	E5(55)	F5(65)	G5(75)	H5(85)	I5(95)
A6(16)	B6(26)	C6(36)	D6(46)	E6(56)	F6(66)	G6(76)	H6(86)	I6(96)
A7(17)	B7(27)	C7(37)	D7(47)	E7(57)	F7(67)	G7(77)	H7(87)	I7(97)
A8(18)	B8(28)	C8(38)	D8(48)	E8(58)	F8(68)	G8(78)	H8(88)	I8(98)
A9(19)	B9(29)	C9(39)	D9(49)	E9(59)	F9(69)	G9(79)	H9(89)	I9(99)

Sites 01, 02 and 03 are read daily during the summer months (May - Sept) and weekly during the winter months. The grid is read monthly.

TABLE 7.7

KENYAN CATCHMENT 10 - KIMAKIA

Site No.	Site name
01	C91
02	C81
03	C61
04	FCU
05	FCMI
06	FCDI

These sites are read once every ten days during the wet periods and once every month during the dry periods.

TABLE 7.8

KENYAN CATCHMENT 11 - KIMAKIA

Site No.	Site name
01	A61
02	A611
03	A91
04	A101
05	A31
06	A41

These sites are read once every ten days during the wet periods and once every month during the dry periods.

TABLE 7.9

KENYAN CATCHMENT 13 - KERICHO

Site No.	Site name
01	JL
02	JS
03	BL
04	BS
05	CL
06	CS
07	N3
08	N4
09	HS10
10	Sambret KTD
11	Sambret KTD

These sites are read every ten days during the wet periods and once a month during the dry periods.

TABLE 7.10

KENYAN CATCHMENT 14 - KERICHO-SAOSA (LAGAN)

Site No.	Site name
01	KSD/KL
02	KSD/KS
03	KSM/JL
04	KSM/JS
05	KSU/IL
06	KSU/IS
07	TOWER 3/P1
08	TOWER 2/OL
09	TOWER 2/OS
10	TOWER 1/ML
11	TOWER 1/MS

These sites are read every ten days during the wet periods and once a month during the dry periods.

TABLE 7.11

KENYAN CATCHMENT 17 - MAKIAMA

Site No.	Site name
01	KMD
02	KMV
03	KMM

These sites are read once every ten days during the wet periods and once a month during the dry periods.

TABLE 7.12

CATCHMENT 23 - WYE (PLYNLIMON)

Site No.	Site name
10	Wye 0
11	Wye 1
12	Wye 2
13	Wye 3
14	Wye 4
15	Wye 5
20	Nant Iago 0
21	Nant Iago 1
22	Nant Iago 2
23	Nant Iago 3
24	Nant Iago 4
25	Nant Iago 5
26	Nant Iago 6
30	Cyff 0
31	Cyff 1
32	Cyff 2
33	Cyff 3
34	Cyff 4
35	Cyff 5
36	Cyff 6
41	Arwystli Low
42	Bryn Daith
43	Afon Cyff (Cyff X)
44	Cefn Brwyn
45	Cripian Eisteddfa-Fach (A44)
46	Byrn Du
47	Pen Lluest-y Carn
51	Nant Iago Cross 1
52	Nant Iago Cross 2
53	Nant Iago Cross 3
54	Nant Iago Cross 4
55	Nant Iago Extension 5
56	Nant Iago Extension 6
57	Nant Iago Extension 7

Site 43 (taken as representative of the network) is read daily whilst the whole network is read monthly.

TABLE 7.13

CATCHMENT 27 - SEVERN (PLYNLIMON)

Site No.	Site name
11	Hore 1
12	Hore 2
13	Hore 3
14	Hore 4
15	Hore 5
16	Hore 6
20*	Moel Cynnedd 1
21*	Moel Ext. (2B)
22	Moel Cynnedd 2(2A)
23	Moel Cynnedd 3
24	Moel Cynnedd 4
25	Moel Cynnedd 5
26	Moel Cynnedd 6
27	Moel Cynnedd 7
31	Y Foel 1
32	Y Foel 2
33	Y Foel 3
34	Y Foel 4
35	Y Foel 5
36	Y Foel 6
37	Y Foel 7
38	Y Foel 8
41	Plyn. Met. site
42	Carreg Wen Low
43	Carreg Wen High
45	Hore Fach
47	Arwystli High
51	Alan's Tube
52	Circle Line 1
53	Circle Line
54	Circle Line 3

Site 15 (taken as representative of the network) is read daily whilst the whole network is read monthly.

N.B. Preceding Jan 1970 Moel Ext was Site 44 and Moel Cynnedd 1 was Site 21.

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