THE CONSTRUCTION OF A CENTRALISED DATABASE FOR THE IRISH-DUTCH PEATLAND GEOHYDROLOGY AND ECOLOGY PROJECT

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SUMMARY:

This report is subdivided into two parts. The first part describes the creation of a centralised database which can be used to store multidisciplinary data gathered during the course of field work on the Irish-Dutch Peatland Geohydrology and Ecology project. This database offers an alternative approach to storing data to that currently being used. The second part describes the creation of a database for outputting graphic data using autocad.

Storage of all data using a single software package rather than using a large number of formats in a variety of applications is proposed. It is suggested that all data should be stored in both Dbase3 and Lotus 123 formats to allow access to the data by all groups involved in the project. Hardware complications encountered during the final phase of the project have meant that the alternative scheme has not been installed on the designated database computer. An alternative database, storing all hydrogeological and water quality data has been installed on the ICL DRS M55. Copies of the data files can be obtained from the groundwater section of the GSI.

Autocad has been used to create a database of spatially fixed information which allows various datasets to be overlain and compared. Graphic outputs of the different data sets have been compiled and plotted for both Clara Bog and Raheenmore Bog. Three compilation plots of botanical, hydrological and topographic data have been produced for Clara. Two plots have been produced for Raheenmore. Copies of these plots accompany this report. The compatibility of Autocad with both software packages used for storing data in the centralised database allows for more effective integration of the two databases.

Geological data has not been compiled in either section of the report although it has been arranged for this information to be entered into both autocad and the data base at a later date when a complete dataset becomes available.

It is recommended that both aspects of the database are upgraded as additional information becomes available.

CHAPTER 1

INTRODUCTION

1.1 Background

This report describes the construction and use of a centralised data base which has been created to store multidisciplinary data collected by the various groups involved in the Irish Dutch Peatland Geohydrology and Ecology Project. The report consists of two sections. The first section describes the creation of a central data base designed to contain all data collected during the course of the project. The second section describes the creation of a database for spatial data using the autocad drafting package.

1.2 Background to the Project

The Irish-Dutch Peatland Geohydrology and Ecology Project was a study initiated to investigate the relationship between peat bog hydrology and ecology. The project was a multidisciplinary investigation which examined the geology, hydrology, hydrogeology and botany of peat bogs. Work focused on two raised peat bogs, Clara Bog and Raheenmore Bog both of which are located in north Co. Offaly. Both sites are nature reserves owned by the Irish National Parks and Wildlife Service.

By gaining an understanding of peat bog hydrology and ecology and the effect of various natural and anthropogenic influences have on them long term strategies for the conservation and regeneration of raised bogs can be developed.

1.3 Organisations Involved in the Project

The Irish-Dutch peatland project involved a number of Irish and Dutch academic and governmental organisations. These are:

Office of Public Works (N.P.W.S.)

Staatsbosbeheer (Dutch State Forestry)

Geological Survey of Ireland

Trinity College Dublin

University College Galway

University of Amsterdam

Agricultural University of Waginengen

Sligo RTC

These organisations have worked in a coordinated programme of multi-disciplinary field based research throughout the project period.

1.3 The Need for a Central Database.

Investigations on Clara and Raheenmore Bogs were carried between September 1989 and July 1992. During this period large quantities of data have been collected by the various people and institutions involved in the project. Research using much of this data was on-going at the time of writing. It is widely recognised that although extensive investigations were carried out on the bog, work is far from complete. Future work will be necessary if the overall project objectives of developing a long term conservation and management policies are to be achieved.

In view of the need for future work a central database, in which all of the information gathered during the project is stored, would be of great advantage. Data from all aspects of the project could be easily retrieved, compared and compiled from a single source thus avoiding the complication of needing to contact various institutions and individuals in order to obtain particular information. The need for such a centralised system is all the more greater in view of the international nature of this project.

CHAPTER 2

A COMPUTERISED MULTI-DISCIPLINARY DATABASE FOR CLARA AND RAHEENMORE BOGS.

2.1 Introduction.

Much scientific data has been collected over the four years during which investigations were carried on the Irish-Dutch Peatland Geohydrology and Ecology Project. Data dealing with the botany, hydrology and geology of Clara and Raheenmore bogs has been gathered by a number of workers. Much of the data has already been stored on the IBM PS/2 286 computer which was based in Clara for the duration of the field based component of the project. It is proposed to use this computer as a central database for future work on National Parks and Wildlife Service peat bog reserves and on peatlands in general.

2.2 Software Packages Used for Data Storage.

Data was stored on the IBM using the Lotus 123 and DBase3 software packages. However, some institutions involved in the project stored data using alternative packages with IBM compatible and Apple Macintosh machines.

Regional water level data and hydrogeologically oriented hydrochemical data collected by the GSI were stored on Hydrocom, a specialist hydrogeological database. Much of the botanically oriented hydrochemistry data collected was stored using microsoft Excell on Apple Macintosh systems.

2.3 Objectives of the Data Base.

The objective of creating a central database was to take the data stored using the various different software applications and store them all using a single package allowing the various datasets to be more easily interfaced with one another and thus more effectively manipulated. Data not stored in the selected package therefore needed to be altered to make it compatible with the standard database format.

2.4 Software Package Selection

All of the existing hydrological data stored on the IBM PS/2 in Clara was saved using either Dbase3 or Lotus. Much geological data has also been stored using these packages. It was decided to use one of these packages to run the database for the following reasons:

(1) Data stored in these formats comprise the majority of all information collected during the project period.

(2) Data stored in Lotus and Dbase can be easily interfaced into other general purpose and specialist packages. Files in both packages can be reformatted and imported into the other.

(3) The packages are user friendly and can be easily used and manipulated after a short period of tuition.

(4) The packages and stored data can be accessed from computer networks. The utilisation of computer networks permits data to be easily transferred to other terminals and networks, to be more rapidly processed and to be simultaneously retrieved at more than one work station. This is not possible with some packages which require additional hardware to be used.

In view of the fact that all of the institutions involved in the project do not have access to a common package it was decided to format all data in both Lotus and Dbase formats. All available Dbase files were reformatted from Lotus. Unfortunately, it has not been possible to reformat all available Lotus files in Dbase format using the available software and hardware.

2.4 Difficulties with Data Storage and Retrieval

During the final phase of the project period a complication arose in the IBM PS/2 which would not allow the system to boot the hard disk of the machine. The principal consequence of this difficulty has been that it had not been possible to reformat existing files on the computer at the time of writing. Recommendations concerning the re-organisation of the existing data storage structure are outlined in sections 2.5 and 2.6.

2.5 Existing Data Structure.

The structure of hydrology database found on the ps/2 at the time of writing is shown in tree form in table 1. The file information contained in each subdirectory is indicated in parenthesis.

All data contained in this subdirectory was entered by people involved in the hydrological and engineering aspects of the project. Botanical, geological and hydrogeological data was either entered into other subdirectories or on different machines. This course of action was reasonable at the time of the investigation due to the heavy use of the computer by a number of workers. Nonetheless it is recommended that the database be reorganised now that the heavy demand for computer time no longer exists.

Many of the subdirectories shown in Table 1 were added on a temporary basis and need to be removed. Nevertheless, the overall layout of the database is easy to follow. However, many directories are empty or need to be updated. Some files contained large amounts of data with Dutch Text but no English translation. It is suggested that these files either be translated or deleted, depending on whether the data contained in them is relevant.

2.6 Changes to Existing Database.

The existing database used with the IBM PS/2 has proved to be satisfactory in storing data collected during the course of the project. However, rearrangement of the

database is now neccessary. An alternative simplified approach to organizing the data was first proposed by Blackwell(1992). It was decided to use an expanded version of this approach to reorganise the data.

Blackwells original database scheme consisted of the following principal subdirectories:

1. Piezometer, Borehole, Cobra Drilling and Domestic Well Basic Information.

2. Groundwater Level Data.

3. Rainfall and Evapotranspiration data.

4. Weir Water Level Data.

5. Hydraulic Conductivity Data.

6. Topographic Data.

The above scheme was created primarily as a hydrometric database and is consequently biased towards that aspect of the project. It has been necessary to alter the structure of some sections as follows:

1. Groundwater Level Data has been subdivided into Regional groundwater level data and bog groundwater level data. The data in the new files in this section was originally stored in the water level files stored in the Hydrocom software package.

2. Hydraulic conductivity data has been subdivided into two further subsections, one of which relates to permeability tests in the peat and the second of which deals with pumping tests carried out on the inorganic deposits surrounding the bog.

3. A seventh principal subdirectory has been created in which hydrochemical data is stored. The section is subdivided into water quality data collected by Lara Kelly during botanical investigations and data collected by various workers during hydrological and hydrogeological investigations.

It is proposed that the above scheme should be expanded to incorporate the data collected by all disciplines involved in the project. A schematic outline of the revised database is shown in table 2.

It has been agreed that geological data compiled by Mary Smyth during the course of the project will be entered into the database in a similar format to that outlined in Table 2 when a complete data set becomes available.

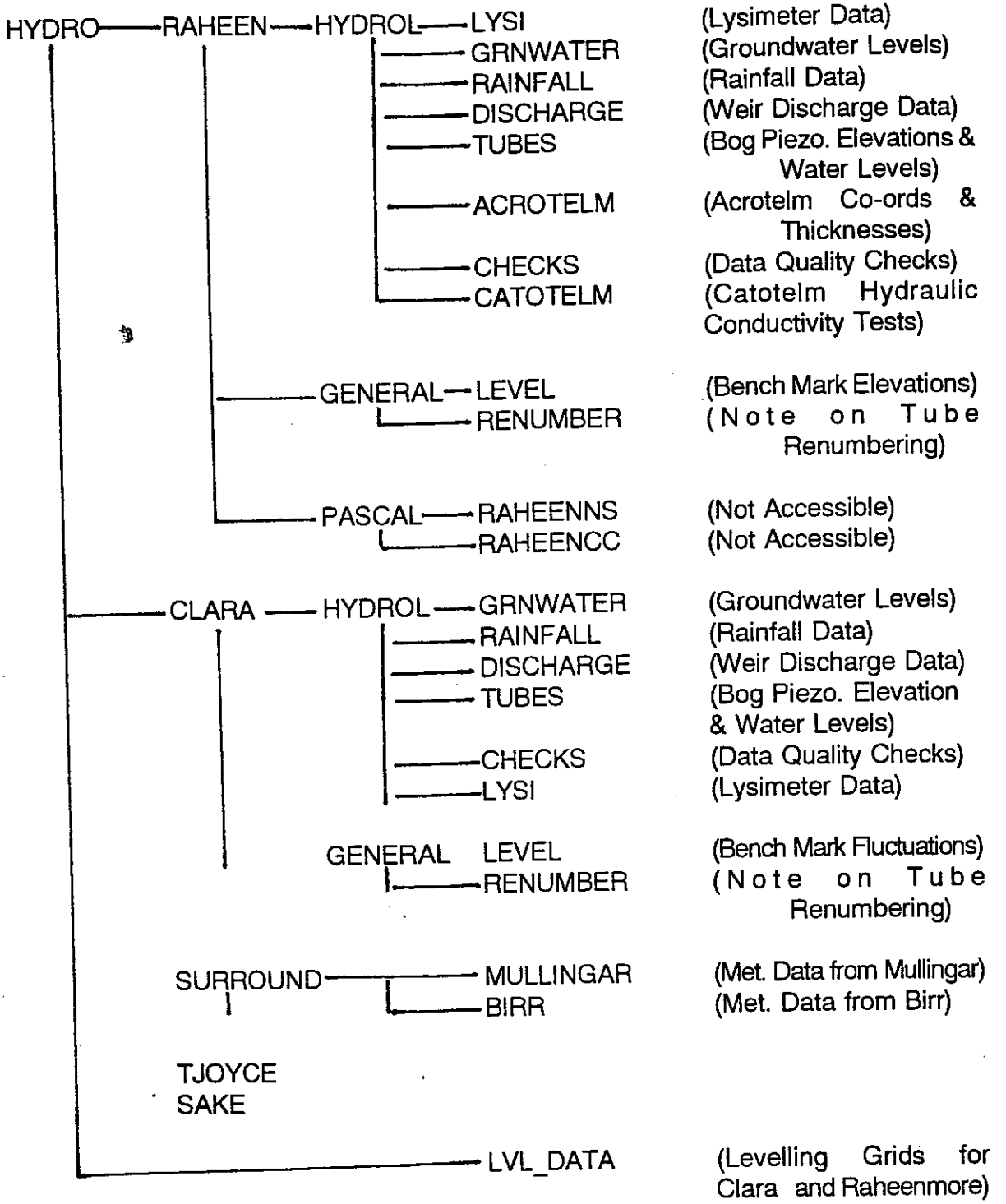


Table 1: Schematic Tree Representation of the Database Structure Stored on IBM PS/2 at Time of Writing.

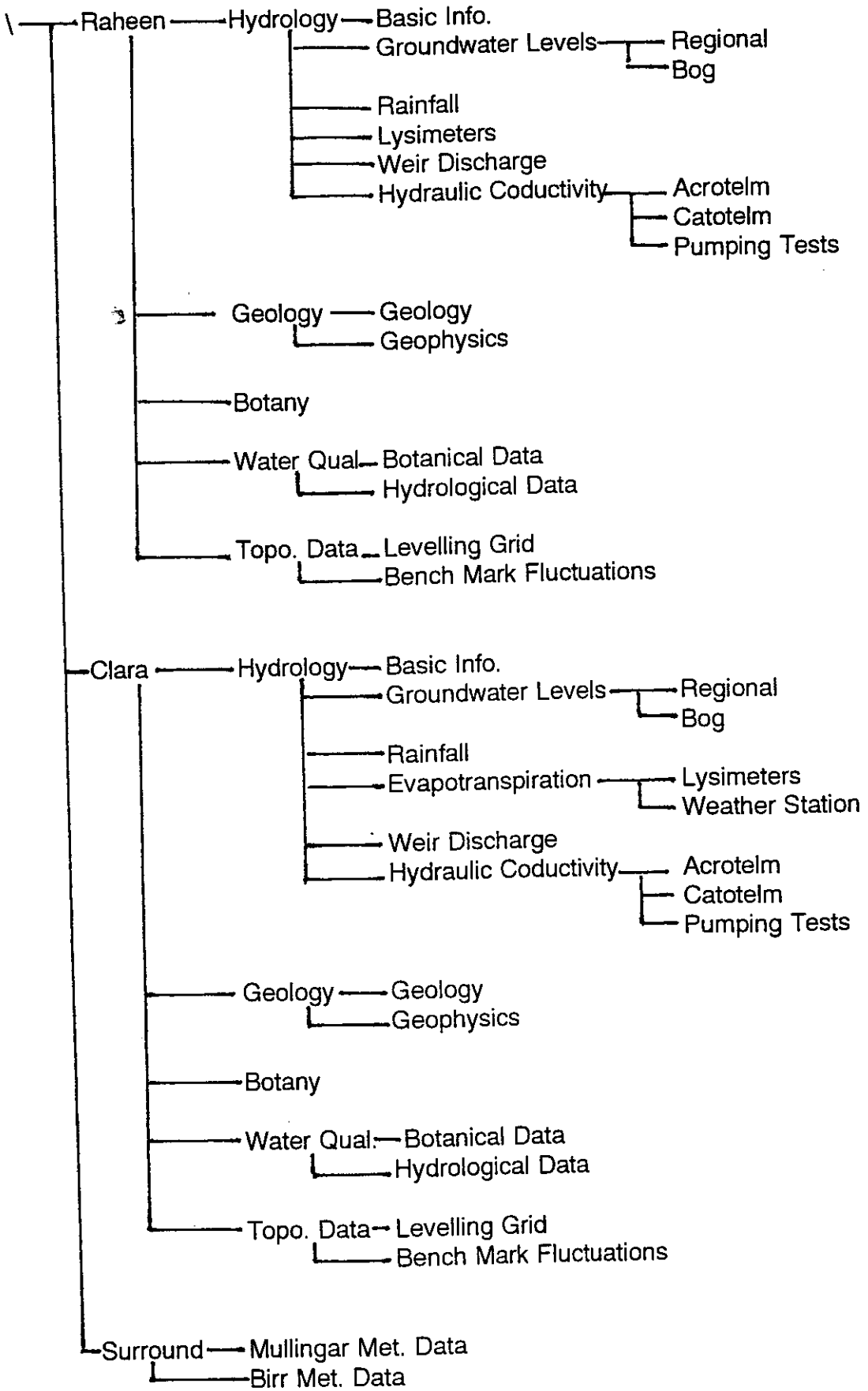
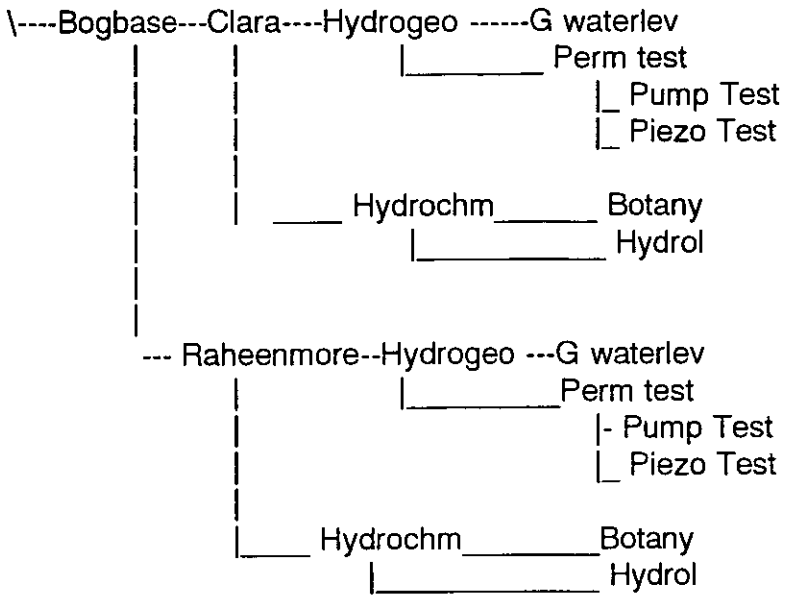


Table 2: Proposed Revised Database Structure.

2.7 An Alternative Temporary Database.

Due to the complications encountered with the IBM PS/2 an alternative temporary database has been created. The directory structure is outlined in schematic form below.



The database has been stored temporarily on the ICL 386 M55 which was formerly used in the Clara field office and is owned by the National Parks and Wildlife Service. Copies of the data files to be entered into the relevant subdirectories are contained on the disks accompanying this report. (The name of the directories into which the data must be entered are written on the disks).

The data base is site specific and subdivided into two principal sections, Hydrogeo and Hydrochm. Hydrogeological data is stored in hydrogeo and hydrochemical data is stored in Hydrochm. Both sections are further subdivided into two sections.

Data stored in hydrogeo is either stored in G waterlev or Perm test. G waterlev stores regional groundwater level data and bog water level data. The Perm test subdirectory stores permeability test data from either piezometer tests in the peat or Pumping tests in the inorganic deposits. Specific files dealing with individual tests on each piezometer in the peat or on each borehole in the inorganic deposits are contained in the Piezotest and pump test subdirectories respectively.

Data stored in hydrochm is stored either in Botany or Hydrol. The subdirectories deal with the hydrochemistry of samples taken for botanical work (Botany subdirectory) and samples taken for hydrogeological work (Hydrol subdirectory).

A copy of this database is contained on the disks accompanying this report. It is proposed to integrate the above database into the larger one proposed previously. Water level and permeability test data should be placed in the Hydrology subdirectory. Hydrochemical data should be placed in the Water Quality Subdirectory.

More detailed descriptions of the files contained in the various subdirectories are outlined in sections 2.7.1 to 2.7.4. (Note that in the following discussion the suffix .* corresponds to either .wk3 or .dbf files.)

2.7.1 Groundwater Level Data.

Groundwater Level data has been subdivided into bog ground water levels and regional groundwater levels depending on the deposits being sampled. Regional groundwater levels consist of all water levels measured in GSI boreholes, cobra boreholes and private domestic wells. Bog water-levels are those water levels measured in piezometers installed in the peat. All files in this subdirectory are reformatted hydrocom data files.

The regional groundwater data are stored in the file Piezolev.*. The file contains the following details:

1. Site ID number.
2. Piezometer number.
3. Date of measurement.
4. Water level.
5. Comments.

Abbreviations given in the comments column correspond to the initials of the people who measured the water levels.

Bog groundwater levels are stored in the file boglev.*. The format of the file is identical to that contained in the regional groundwater level file.

All records in both files are arranged by Site ID NR. (See section 2.8 for the format of this information). All files for each location are arranged by date with more recent measurements being entered after older measurements. A water level from 2021SEH2005 measured on 11/3/91 will thus come before a water level from 2023SEH2006 measured on the 04/06/92.

2.7.2 Pumping Test Data.

Information gathered from pumping tests carried out over the past year are stored in the Pump Test subdirectory. Both pumping and residual drawdown data for each borehole were stored in one file. Files containing data from each test can be identified by file name which corresponds to the borehole name. These data were originally entered as Lotus 123 files.

Each file contains the following:

1. Borehole name.
2. Date of test.
3. Pump discharge rate.
4. Static water level.
5. Time-drawdown data.

6. Dimensionless time-residual drawdown data.
7. Comments on well head hydrochemistry and time that samples for laboratory hydrochemical analyses were taken.

2.7.3 Piezometer Test Data.

Data used to calculate peat permeabilities are stored in the files contained in the Piezo Test subdirectory. Files are named with the location of the site tested followed by the number of the test at that site. A file called NW1T3 corresponds to the third permeability test carried out at NW1. Similarly, a file called SE3T6 contains the data from the sixth permeability test carried out on the site SE3. The files contain the following information:

Two files are contained in this subdirectory do not contain the same naming structure as those outlined above. These are VNW1T1 and VNW1T2 which correspond to the first and second vertical permeability tests carried out at NW1. All data contained in these files were originally stored using Lotus.

All files contain the following data:

1. Location of test.
2. Date of test.
3. Site ID number.
4. Static water level.
5. Filter length and diameter
6. Depth to centre of tube
7. Time-water level data.
8. Regression statistics for time-waterlevel plots.

2.7.4 Water Quality Data

Water quality data has been subdivided into two subdirectories based on whether the data collected has a botanical or a hydrological emphasis. All data contained in this subdirectory at the time of writing was reformatted from other software packages. Hydrogeological water quality data were originally stored using Hydrocom. Botanical hydrochemical data was originally stored using Excell on the Apple Macintosh.

Hydrogeological water quality data has been subdivided into two files which contain the results of bog groundwater and regional groundwater analyses. These files are bogchem.* and regchem.*. Data were arranged by site and ordered by date. Both files contain the following information:

1. Location.
2. Site ID number
3. Date of sampling.
4. Laboratory
5. Piezometer number sampled.
6. Results of well head and laboratory analyses.

The results of botanical hydrochemical analyses differ in their format from the hydrogeological water quality data. The results for a number of analyses for particular elements are arranged in a number of tables which state the site sampled and the date of sampling.

The files bogbot*.* contain the results of analyses taken on the bog for botanical investigations on each bog. Additional files containing hydrochemical data about the soak systems on Clara Bog are contained in the Clara subdirectory. The files called soak*.* contain the results of analyses carried out on these areas of the bog.

2.8 Note on Hydrocom Site ID and Date Formats.

Much water level and water quality data in the database was originally stored using Hydrocom. The data format used in the Hydrocom software package differs from that used in other applications. The following note describes the format used.

2.8.1 Site Identification Code.

Site identification numbers are unique numbers used to describe each borehole/well/discharge gauge in the study area. The codes have been created to facilitate the integration of data collected into a larger national data base. The numbers have the following format:

6" sheet number; Subject; Installation; Number

Each of these subheadings is discussed separately as follows:

"6" sheet number" refers to the old Ordnance Survey 6" sheets of the country on which a site is located.

"Subject" describes the purpose of installation at a particular site. H refers to hydrology / hydrogeology, G refers to geology and B refers to botany.

"Installation" is a code used to describe the type of feature found in a particular site. 0 refers to hydrological bog piezometers, 1 refers to domestic wells, 2 refers to GSI boreholes, 8 refers to cobra drillings and 9 refers to staff gauges.

"Number" is the number of a particular installation as defined on the accompanying autocad plots and previously produced maps. All hydrogeological data stored in the temporary database use this site specification.

Using the above system a site with the following site identification code 2023SEH1004 is found on the 6" sheet 2023SE, was installed for hydrological investigations and is domestic well number 4 on the associated autocad plot. The hydrocom site identification code has been added to the location codes contained in the pumping test and peat permeability test data files.

2.8.2 Date

The date of measurement in reformated hydrocom files differs from that of other files in the data base. Dates in all other files in the database are normally expressed in the following format:

Day/Month/Year.

In files reformatted from hydrocom dates are expressed:

Year/Month/Day.

It has not been possible to rectify the discrepancy between hydrocom and other location and dating formats in the allocated time. Note that the location and date formats used in water level files derived from hydrocom is also used in water quality files imported from the package.

2.9 Recommendations for Future Use of the Database.

It is recommended that the standardisation process of storing all data using one software application should be completed and rearranged into the structure outlined in table 2 to facilitate widespread access to all data. Due to the hardware complications associated with the IBM PS/2 it has not been possible to complete this task within the allocated project period.

All files should be stored in both Dbase3 and Lotus 123 formats including any new data obtained during further research. The database should be upgraded with any additional data which may become available during the course of further research. The upgraded data should be distributed to all institutions involved in the project and any other additional interested parties.

By carrying out the above recommendations, the data gathered during the course of the project will become a powerful tool for further research and should help substantially in achieving the long term project objectives.

CHAPTER 3

CONSTRUCTION OF A SPATIAL DATABASE USING AUTOCAD.

3.1 Background to Autocad

This section briefly outlines the operation of Autocad and its use in integrating various types of data gathered during the project. Autocad is a computerised drafting package which allows graphic data to be stored and displayed using a computer. Hard copy data can be obtained from the computer using a plotter. Data is represented in three forms:

(a) Point Data: Used for defining particular point features, e.g. a well site.

(b) Line Data: Used to define features which are represented as lines,e.g. roads and rivers.

(c) Polygon Data: Used to define areas by enclosing them using lines, e.g. a geological formation.

Autocad allows the above information types to be plotted on a computer screen in discrete layers. The layers may be regarded as analogous to a number of transparent overlays covering the same area. They can be represented individually or in any number of combinations by turning on and off particular layers using the computer.

3.2 Advantages of Autocad.

The layering system used in the autocad package has a number of advantages. Data sets can be easily retrieved and superimposed on one another. This technique is beneficial in the following ways:

(a) It allows various different data sets to be superimposed and spatial relationships between different subsets established. This aspect of the package is particularly useful in multi-disciplinary investigations.

(b) The absence of data in particular areas can be assessed more readily. This aspect of the package allows more representative areas of future scientific investigation to be identified. The package also allows representativeness of sampling in particular areas to be assessed in more confidence.

(c) Work can be carried out on a variety of scales provided that the reference points are taken from the same reference grid.

(d) Autocad can be easily interfaced with other widely available computer packages such as lotus 123 and Dbase.

3.3 Drafting Methodology.

Drafting is carried out using a digitiser and a digitising tablet. All data was taken from 1 to 10,000 or 1 to 5,000 base maps and was plotted using the national grid for reference. The locations of hydrological data were taken from the site reference map produced by van den Boogaard(1993), water chemistry sampling maps produced by Kelly(1993) and borehole location maps produced by Smyth(1992).

Plots were produced for both Clara and Raheenmore Bogs. These plots are held in the files Clara.dwg and Raheen.dwg. Hydrological, topographical and botanical line and point data were plotted onto separate layers. Geological data was not plotted as it has already been agreed that Mary Smyth would carry this work out at a later date as part of her Ph.D. thesis. These additional data will also be plotted using the national grid as reference thus allowing all data sets plotted to be effectively integrated.

3.4 Layer Types.

Various layers have been produced for each area. Each layer relates to a particular topic of interest in the study area and has an associated text layer to allow it to be rapidly identified directly from the computer output.

It has been attempted to give each of the data layers a different colour to allow it to be more easily distinguished in colour plots. Different shapes have been assigned to each point data set to allow information to be readily identified on monochrome outputs such as photocopies and black and white computer screens. Each plot has the following layers:

(a) Frame layer. This layer contains the basic frame and title of all layers as well as the legend to the maps.

(b) Drain layer. This layer contains the drains and rivers surrounding the bog.

(c) Botanical layer. This layer contains all the sites used for botanical hydrochemical sampling by Lara Kelly.

(d) Borehole layer. This layer contains the locations of all boreholes and cobra drilling drilled in the area by the GSI during the course of the project.

(e) Domestic well layer. This layer contains all domestic wells in the areas surrounding the bogs.

(f) Weir layer: This layer contains the location of weirs regularly monitored during the course of the project.

(g) Levelling Layer: This layer contains the topographic spot heights taken at 100m intervals over the bogs surfaces and surrounding areas during the summer of 1992.

(h) Text Layers.

3.5 Layer Plots

A number of layer plots have been produced for both Clara and Raheenmore Bogs. All plots have been produced on the same scale (1:10,000). It must be noted however that plotting in this manner tends to produce localised dense clusters of data when information has been collected from particular zones within the study area. Every effort has been made to show individual points as clearly as possible although in some cases, particularly with botanical data, it has not been possible to distinguish separate sites on the scale of interest.

The following plots have been produced for Clara Bog:

(a) A hydrological plot: This plot contains a drain layer, a borehole layer, a weir layer and a domestic well layer. The names of these sites are also shown on the map and are stored on associated text layers.

(b) A topographic plot: This plot contains a levelling layer, a drain layer and associated text layers.

(c) A botanical plot: This plot contains a botanical layer, a drain layer and associated text layers.

Two plots have been produced for Raheenmore Bog:

(a) A hydrological / botanical plot: The absence of large clusters of data on Raheenmore allowed hydrological and botanical plots to be combined into one. This plot contains borehole, drain, domestic well, weir and botany layers with their associated text.

(b) A topographic plot: This plots contains a levelling layer, a drain layer and associated text layers.

All plots contain a drain layer as it allows any plots produced to be overlain on the 1:10,000 Ordnance Suvey maps. The exact locations of various features can thus be obtained on existing topographic maps.

Alternative plots containing a different combination of data sets can be produced by switching on and off the appropriate layers.

3.6 Discussion

The storage of the various different types of fixed spatial data relating to the Irish Dutch Peatland Geohydrology and Ecology study has been carried out using autocad. The package allows for the effective integration of the spatial data collected by the various disciplines involved in the project as well as providing a user friendly means of investigating spatial further variations in data at a later date, should such a need arise.

The standardisation of scale and reference grid facilitates integration of the plots with existing hard copy maps. Compilation of existing plots with geological data can be easily achieved if the data is digitised on the same scale and using the same reference grid.

APPENDIX 1

LIST OF COMPUTER FILES, DATA AND BOOKS

REMOVED FROM CLARA FIELD OFFICE

APPENDIX 1

The following are a list of the computer disks and books taken to Holland from the Irish Dutch Peatland Ecology and Geohydrology field base in Clara in July 1993:

PACKAGES

1. Lotus 123 master disks.
2. Leesuit master disks.
3. Turbo Pascal master disks.
4. Chemprog 2.3 master disk
5. Flownet 5.0 master disk.
6. Dbase Master disks
7. Surfer (3 copies)
8. Quatro pro 4.0 master disks
9. Fortran 5.0
10. Turbo C master disks
11. Chemhydr master disks
12. Disk Utilities master disks

DATA

13. Raheenmore rainfall, groundwater recorder and weir discharge data.
14. OPW weir discharge data for Raheenmore.
15. F. Dolezal evapotranspiration data for Clara.
16. Manon van den Boogaards data for Clara.
17. Digitiser data for weirs on Clara. (From T. Joyce (OPW) 20/6/'92)
18. Digitiser data for weirs on Clara. (From T. Joyce (OPW) 12/'91)
19. Raheenmore groundwater recorder files.
20. Helen Samuels' peat subsidence data.
21. Dutch weir discharge data from Raheenmore.
22. Clara and Raheenmore topographic levelling data.
23. Gert and Twans' monitoring data.
24. Raheenmore rainfall backup files
25. Clara rainfall backup files
26. Birr-Mullingar met data
27. Raheenmore bog piezometer data
28. Clara bog piezometer data
29. Raheenmore lysimeter data

30. Raheenmore permeability data

31. Rahennmore retention data

32. Raheenmore levelling data

33. Raheenmore density data

34. Raheenmore piezometer data

35. Raheenmore peat and borehole data

36. Raheenmore acrotelm data

The following are a list of hardcopy Data files taken back to Waginengen from Clara:

1. Acrotelm data files for Clara and Raheenmore

2. Monthly Met. Office weather bulletins from May 1990 until June 1993.

3. Rainfall data and charts from Clara and Raheenmore

4. Subsidence data from Clara and Raheenmore

5. A list of computer directories on both 286 and 386 computers

6. A copy of all faxes sent and received in Clara from Dec. 1990 until the present

7. Levelling Survey data from Clara and Raheenmore

8. Lysimeter data for Clara and Raheenmore as well as notes on the piezometer methods.

9. Notes on the lysimeters and the vegetation contained within them.

10. Dutch log of hydrological investigations

11. Dutch manuals for microfem and flownet

12. Dutch engineering hydrology course manual

13. Dutch groundwater hydrology course manual.

14. Water levels on Clara and Raheenmore

15. Designs for lysimeters, Early Bord na Mona data

16. Theses on the following topics:

(1) The hydrology of Peatland - R.F. Keane UCC (1972)

(2) A comparative survey of vegetation and certain peat parameters for Lodge Bog and Ballynafagh Bog in Co. Kildare to determine their suitability for conservation & education - van der Krogt & Osinga (1987).

The following computer books were removed to Waginengen from the house in Clara:

1. Microsoft fortran manuals.
2. Dbase3 manuals.
3. Turbopascal manuals.
4. Mastering DOS.
5. DOS5.
6. Understanding Dbase3+.
7. Mastering Lotus 123.
8. 3 x Lotus quick reference guides.
9. Microfem and surfer manuals.
10. 2 x lotus123r3 manuals.

Jan,

The computer database on the disks is best accessed using the Norton computer package due to the large number of directories. If you have any problems with the data, it is probably best to contact me by fax and I'll try and get in touch with you as soon as possible with the appropriate solution

good Reis

Ray.

DX1HBAR