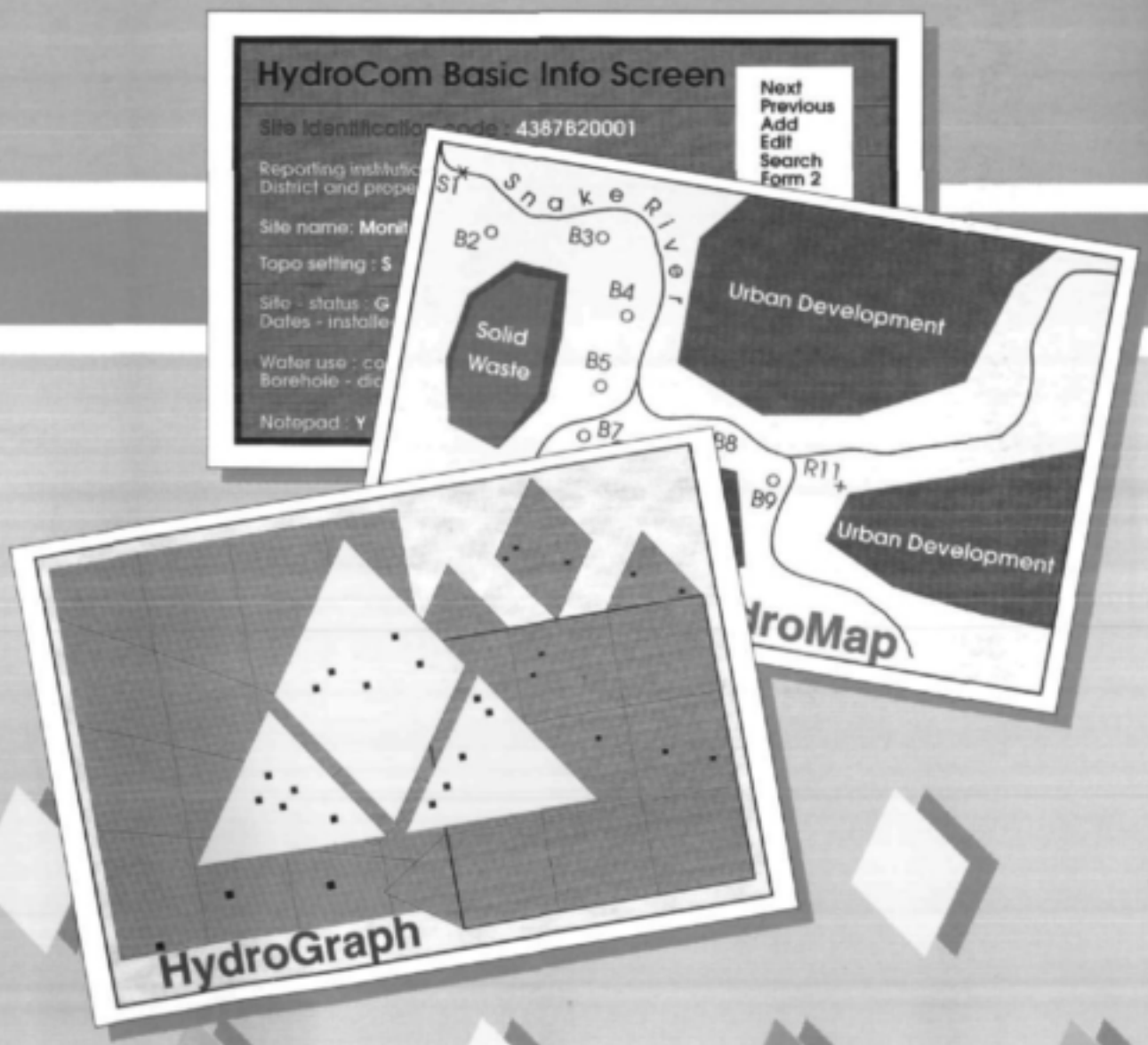
Enhancement of the National Groundwater Data Base Facilities

Extended Executive Summary



FDI HODGSON
JOG KIRCHNER
E LUKAS
G FOURIE

ENHANCEMENT OF THE NATIONAL GROUND-WATER DATA BASE FACILITIES

Extended Executive Summary

Report to the
WATER RESEARCH COMMISSION
by the
INSTITUTE FOR GROUND-WATER STUDIES
UNIVERSITY OF THE ORANGE FREE STATE

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CONTENTS

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The Steering Committee responsible for this project, consisted of the following persons:

Mr. A.G. Reynders	Water Research Commission (Chairman)
Mr. P.W. Weideman	Water Research Commission (Secretary)
Mr. H.M. du Plessis	Water Research Commission
Prof. H.J. Potgieter	University of the Orange Free State
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Mr. J.D. du Toit	Department of Water Affairs and Forestry
Dr. M.C. Dent	Computing Centre for Water Research (CCWR)
Mr. J. Easton	Chamber of Mines of South Africa
Mr. M.D. Piche	Borehole Water Association

The financing of the project by the Water Research Commission and the University of the Orange Free State, and the contributions of the members of the Steering Committee are gratefully acknowledged.

Many individuals, organizations and companies have contributed to the success of this project by suggestions for enhancement of the software and other constructive criticism. Without them, the value of the final product would have been reduced significantly. The Department of Water Affairs and Forestry has to be mentioned specifically for their assistance during this project.

Personnel of the Institute for Ground-water Studies are thanked for assistance and making programmes available for this project.

1 INTRODUCTION

In 1987, the Institute for Ground-water Studies (IGS) at the University of the Orange Free State completed the development of a National Ground-water Data Base (NGDB) facility on the mainframe computer of the Department of Agriculture in Pretoria. This was a three-year research contract between the Institute for Ground-water Studies, the Department of Water Affairs and Forestry (DWAF) and the Water Research Commission (WRC). Upon completion of this contract, it was felt that additional software would be required to enable the geohydrologist to enter and process the data within the data base and display this information in the form of graphs and tables. In this respect, it was felt that the existing G-Base software, which has been developed in-house at the IGS, could serve as a basis for enhancing the NGDB. Subsequently, a follow-up research programme was motivated by the Institute for Ground-water Studies. The aims of this study were:

- Determine requirements of users for the immediate future.
- Update of software written for the previous project, according to requirements of users.
- Adapt software to match hardware requirements.
- Train people concerned with ground water to generate information for input into the data base.
- Actively promote the use of the data base facilities by giving demonstrations, distributing brochures and presenting papers.
- Train personnel in the DWAF, so that they would continue with geohydrological data base programming and data input after this project ceased.
- During this time, the DWAF would continue to do data base programming for the existing ground-water data base (NGDB).

These aims can conveniently be combined into the following main points:

- The *enhancement* of the National Ground-water Data Base (NGDB) facilities by providing suitable software for the interpretation of data in the data base.

- The identification of *needs* amongst data base users and accommodating these needs within the present research project.

- Active *promotion* of the use of the NGDB facilities amongst geohydrologists and others interested in ground water and related data.

Details on work completed during this exercise are available in two volumes, namely:

Volume 1 : User's Manual for the NGDB.
Volume 2 : HydroCom Manual.

Both these volumes are technical manuals, and are intended for use only by those working with either of the two data bases. Further details on these can be obtained from the IGS.

This executive summary is accompanied by a demonstration diskette, which should, together with the summary, provide sufficient information for the non-data base user.

2 STRUCTURE OF THE NGDB AND HYDROCOM

2.1 The NGDB

The NGDB on the mainframe computer in Pretoria has not been altered in any significant way from that which was developed by Cogho *et al.* (1989). The structure of the NGDB is illustrated in Figure 1.

Since the completion of their research, the numbers of sites in this data base have increased from approximately 35 000 to more than 100 000. The Department of Water Affairs and Forestry, in particular, has been entering vast amounts of data into the data base. Water levels as digitized monthly from continuous strip chart recorders, comprise a large portion of the data presently within the data base.

Presently, only the Department of Water Affairs and Forestry has direct access to the data base. Others may request information on diskette. It is envisaged that this situation will continue to exist, because:

- very few organizations, institutions or individuals are linked to the mainframe,

- ground water is regarded as private water under present South African legislation and not everybody may have direct access to the data base facility,

- the system whereby data are requested through the Director, Directorate of Geohydrology, Department of Water Affairs and Forestry, is presently functioning satisfactorily, and

- not everybody has the technical expertise to interact with the data base via a terminal.

The NGDB, in its present form, is primarily intended to store data into an organized structure, from where this data can be accessed and withdrawn with the provision of certain variable specifications. A large range of specifications is possible, of which the most important are:

- Extraction of data by area
- Extraction of data by date
- Extraction of data by site numbers.

The NGDB does not allow processing of this data in any way. It merely writes data, which fall within the specified range, to a file that can later be accessed for visual inspection, or which can be processed by the HydroCom package.

2.2 HydroCom

HydroCom is the name for an ensemble of programs that has been written during the course of the present research contract. In total, it comprises more than 300 different programs, all linked together, so that passing from one programme to the other becomes transparent to the user. In size, these programmes constitute about 4 Mbyte. This software is presently available on 4 high-density diskettes and can only be run after installation of the software onto a hard disk in an IBM compatible computer.

The HydroCom software consists of two basic units, namely HydroBase and HydroCad. HydroBase is the equivalent of the NGDB on the mainframe in Pretoria. All the variables that may presently be entered into the NGDB may also be entered into the HydroBase module. The HydroCad portion is used to display the data as various graphs and maps. Examples of output from HydroCom are included in Appendix A.

2.2.1 HydroBase

The HydroBase data base has been written in Clipper and all data base files are therefore dBase III compatible. As far as possible, the same data base structures, as in the case of the NGDB, have been provided for within HydroBase. The screen layouts are different though, because of better screen handling facilities that are available on IBM compatible computers.

A major difference between HydroBase and the NGDB is that HydroBase allows entry of many additional variables, such as surface hydrology, full weather station information and data, water quality data and user selectable variables.

The addition of these data bases to the HydroBase data base is the result of requests received from the geohydrological community for these variables to be added to the data base. It was felt that ground water could not be studied in isolation from surface water, meteorological data and water quality. The present HydroBase structure is illustrated in Figure 2.

In view of the comprehensive list of hydrological variables that may be entered into HydroBase, this data base, in its present structure, provides the geohydrologist, as well as the surface hydrologist, hydrochemist, water resources developer and geologist with the means to cross-correlate between these different disciplines. On mainframe computers in Pretoria, the information relating the different disciplines is presently stored in separate data bases. There are for instance:

- the National Ground-water Data Base
- the HIS Data Base for Surface Water
- the Water Quality Data Base
- the Pollution Monitoring Data Base
- the Meteorological Data Base by the Weather Bureau, and
- the Geological Data Base by the Geological Survey.

These data bases are presently not interlinked and it is therefore impossible for the researcher to combine and process data from these data bases simultaneously.

In HydroBase, however, once the data have been incorporated within the data base, several means of simultaneous processing of interrelated data become available. Because of this facility which HydroBase provides, it is envisaged that compatibility between

HydroBase and some of the above-mentioned data bases will, in future, be established. Presently, HydroBase is fully compatible with the NGDB and about 60 per cent compatible with the National Water Quality Data Base.

2.2.2 HydroCad

Graphic displays of data, the drafting of maps and depicting data within the data base on these maps, have always been considered a high priority of the present research project. Several graphics drivers were available at the outset of this project. After inspection of the facilities and opportunities presented by each of these packages, it was decided to standardize on a CAD driver that, at that stage, held several advantages above other existing packages. Some of these are:

- The CAD drivers have been developed locally and the development of additional drivers, should this become necessary for the present investigation, would be possible.

- Permission was granted by suppliers of the CAD software that it may be incorporated into the HydroCom module, with the proviso that royalties will be paid on each package provided to an end-user.

- Editing tools to display graphs and edit them afterwards, are available through the CAD system.

The present structure of the graphics programmes, developed during this contract and how they interrelate with the total software package, is depicted in Figure 3. The programmes to draw and analyse data from the data base are interlinked and switching from one programme to the other is transparent to the user.

2.2.3 HydroCom usage

HydroCom, apart from being the package to process NGDB data, can operate as a data base on its own. The format of the data within HydroCom is compatible with that of the NGDB and any data presently entered into the HydroCom System, can be transferred to the NGDB. HydroCom can therefore be regarded as the intermediate data base solution to those individuals and companies who do not have direct access to the NGDB facilities or who wish to keep their data separate from that on the NGDB.

To date, more than 60 HydroCom packages have been implemented on IBM compatible computers throughout Southern Africa.

An interesting pattern has developed amongst the users of these data base facilities. A large percentage is individuals or organizations outside the field of geohydrology. This creates an additional awareness of the importance of water conservation.

3 DATA CAPTURING PROCEDURES

The Department of Water Affairs and Forestry and the Institute for Ground-water Studies have routinely entered data into the NGDB since 1987. Since 1989, the Institute for Ground-water Studies has not been contributing data to the NGDB, but has been entering new data into the HydroCom System, as part of the present system.

Water levels from continuous strip chart recorders, as well as levels measured by hand, have contributed to by far the largest portion of the data presently available on the NGDB. The strip charts are digitized at the Department of Water Affairs and Forestry and after verification of the data, it is added routinely to the NGDB.

Data capturing within HydroCom is accomplished by making a series of selections from menus on the computer screen. Data are usually entered into various subdirectories in which data for specific clients, aquifers or drainage basins will be kept separately. It is the responsibility of the individual, working with the data base, to ensure that his or her data are of high quality as very few checks have been built into the HydroCom System. Certain information, such as the site type and the co-ordinates of a site, must be provided before subsequent information may be entered. Once the essential information for a specific site has been entered, practically unlimited amounts of information relating to the site may be entered. The only limitation in this respect is the capacity of the hard disk in the personal computer. Data are automatically sorted and indexed.

4 DATA REQUEST FROM THE NGDB

A request for data contained within the NGDB may presently be made to:

The Director
Directorate of Geohydrology
Department of Water Affairs and Forestry
Private Bag X313
PRETORIA 0001

Details on data conversion from the NGDB format to the HydroCom format are provided in a README.DOC file which comes with the data conversion programme.

More details on the information required by the Directorate of Geohydrology during a request for data are provided in Chapter 6.

5 DATA SUBMISSION TO THE NGDB

Presently, all data submission to the Department of Water Affairs and Forestry is on a voluntary basis. Those individuals and institutions that are not using the HydroCom software, are free to submit information in any form available, such as geohydrological reports, for instance. The Department of Water Affairs and Forestry has forms available for those who would like to submit information in an acceptable form directly into the NGDB.

Those who have data within a subdirectory of HydroCom and who wish to submit this data for incorporation into the NGDB, will obtain more information on data submission procedures in the README.DOC file on the data conversion diskette.

6 MANAGEMENT OF THE NGDB

6.1 Introduction

A data base manager has been appointed by the DWAF. This is an important link in the future successful administration of the NGDB. Apart from this manager, support staff to provide in the back-up facilities for data entry and verification of data are also available within the DWAF.

6.2 Tasks of the Data Base Manager

6.2.1 Data input co-ordination

The quality of the data within the NGDB has to be of a high standard at all times. All data therefore have to be scrutinized, before they are finally incorporated in the NGDB.

One of the main functions of the data base manager and his team is therefore the verification of especially data that are to be transferred from HydroCom. During uploading of HydroCom data, the following actions are required:

- Verification of the HydroCom data
- Query and rectify HydroCom data which cannot be verified
- Check for duplicates of HydroCom and NGDB data
- Import of HydroCom data into the NGDB.

6.2.2 Requests for data

Requests for data by organizations or individuals outside the Department of Water Affairs and Forestry should be addressed to the Director of the Directorate of Geohydrology, for attention of the data base manager.

The following information must be provided within such a request:

- The name of the institution requesting the information
- The purpose for which this information will be used
- The area for which information is requested
- A variable list
- Starting date and end date of data sequence
- An indication of whether or not this data will be processed by means of the HydroCom software package

- If processed by means of the HydroCom package, whether or not the eventual data base will again be made available for use by the Department of Water Affairs and Forestry

- Whether or not reports relating to the data provided will be made available to the Department of Water Affairs and Forestry.

After consideration of a request for data from the NGDB, the Director of the Directorate of Geohydrology will have the authority to make available, or refuse the data. Should the data be made available, this will be dispatched in the form of a computer diskette, in an ASCII file, which may be transferred to the HydroCom package.

A charge may be made for services rendered by the Directorate of Geohydrology and for computer time.

6.2.3 Overviews

An important facet of any data base is the production of information circulars, specifying what data are available and what the end-user can expect and gain by making use of this information. The data base manager should issue annual reports specifying progress with data entry, providing statistics on interesting aspects regarding data capturing and also a discussion of scientific achievements during the year by people using the NGDB facilities.

The data base manager should actively promote the use of the NGDB and encourage users to submit data to the NGDB.

6.2.4 Assistance and training

Many people may presently not be using the NGDB facilities, because of a feeling of uncertainty with regard to what the data base can do for them. The data base manager should be in a position to provide assistance and training to individuals requiring such services. Regular workshops should be organized during which hands-on training in the use of the NGDB and the HydroCom software will be provided.

7 RECOMMENDATIONS

Development and quality control relating to data base management will continue for as long as the data base exists. The following recommendations are made with this view in mind:

- A technical committee, constituting geohydrological experts in various fields, under chairmanship of the Director of Geohydrology, should be established. Their main task should be extension and enhancement of the existing data base facilities, as the need arises.

- The tasks of the data base manager, as described above, should be revised annually by the technical committee with the aim to encourage usage of the data base facilities.

- The use of either the NGDB or HydroCom should be made a condition of all ground-water projects within the DWAF and the Water Research Commission.

8 SUMMARY AND CONCLUSIONS

The study spanned three years of research and development and the main benefits deriving from this work, can be summarized as follows:

- The NGDB facilities on the mainframe computer have been supplemented by the creation of an equivalent data base system which runs on IBM compatible personal computers.

- A link has been provided between the NGDB and HydroCom, so that data may be extracted from the NGDB and used within HydroCom.

- Data may also be entered directly into HydroCom, and later be uploaded to the NGDB, under supervision of the NGDB manager.

- All data processing and creation of displays, such as graphs and maps, are performed within the HydroCom package and not within the NGDB. The latter is merely a data storage facility.

- Apart from ground-water data, HydroCom also allows entry and processing of hydrological, meteorological and hydrochemical data.

- Many individuals within the private and public sectors, have contributed ideas for the enhancement of the data base during the past three years. These suggestions have all been incorporated within the HydroCom package.

- Active promotion of the use of the HydroCom package, in conjunction with the NGDB, has been an ongoing feature of this project. Brochures have been printed and distributed, demonstrations given at conferences and private tuition given in the use of the software.

- The HydroCom package is presently being used in more than 80 ground-water projects throughout South Africa, by the Directorate of Geohydrology, mining companies, other industries and ground-water consultants.

- Information regarding the NGDB may be obtained from: The Director, Directorate of Geohydrology, Department of Water Affairs and Forestry, Private Bag X313, Pretoria 0001. Information on HydroCom may be obtained from: The Director, Institute for Ground-water Studies, University of the Orange Free State, P.O. Box 339, Bloemfontein 9300, South Africa.

8 REFERENCE

Cogho, V.E., Kirchner, J. and Morris, J.W. (1989). A National Ground-water Data Base for South Africa. *WRC Report No. 150/1/89, 3 Volumes.*

Figure 1

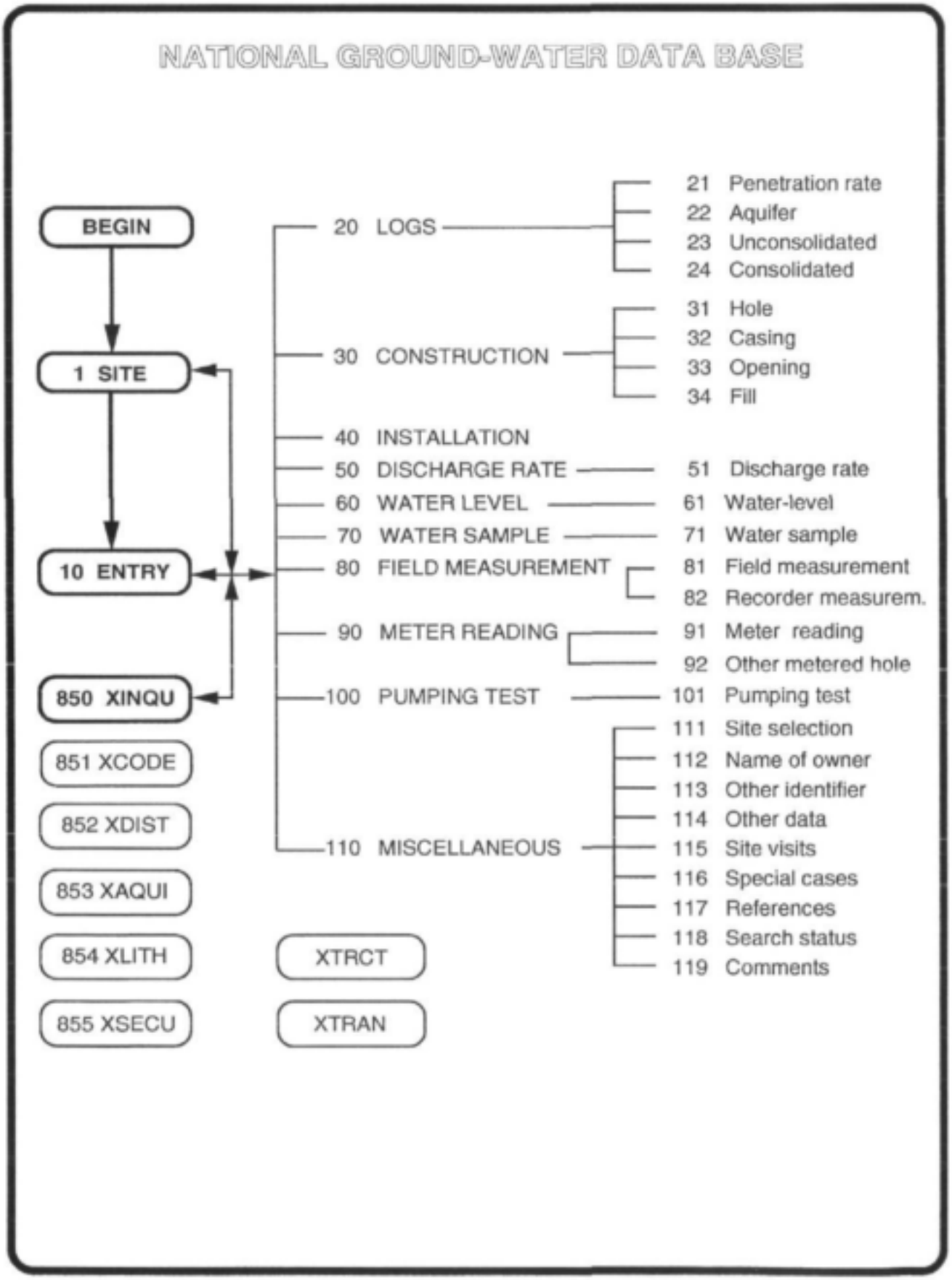
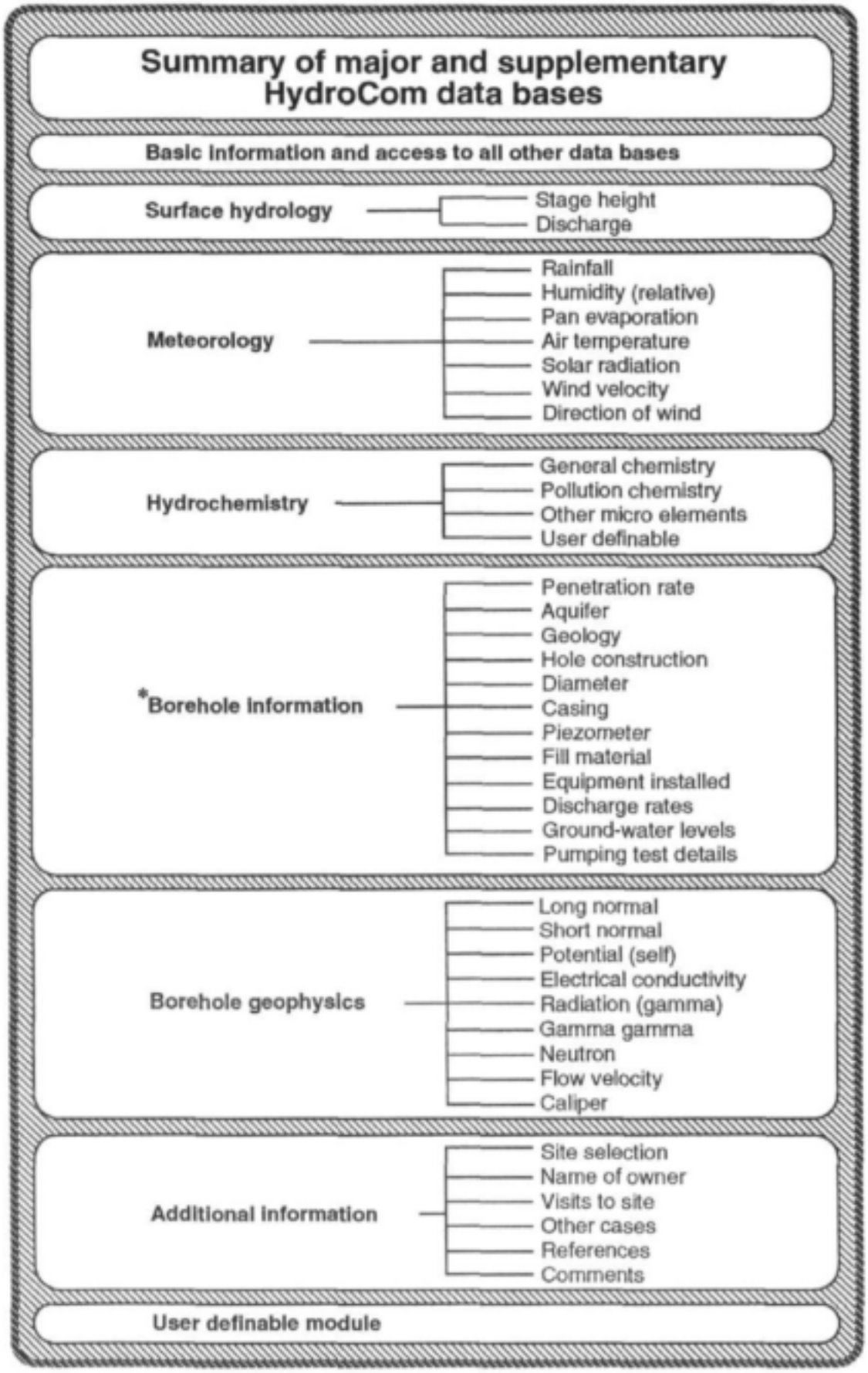
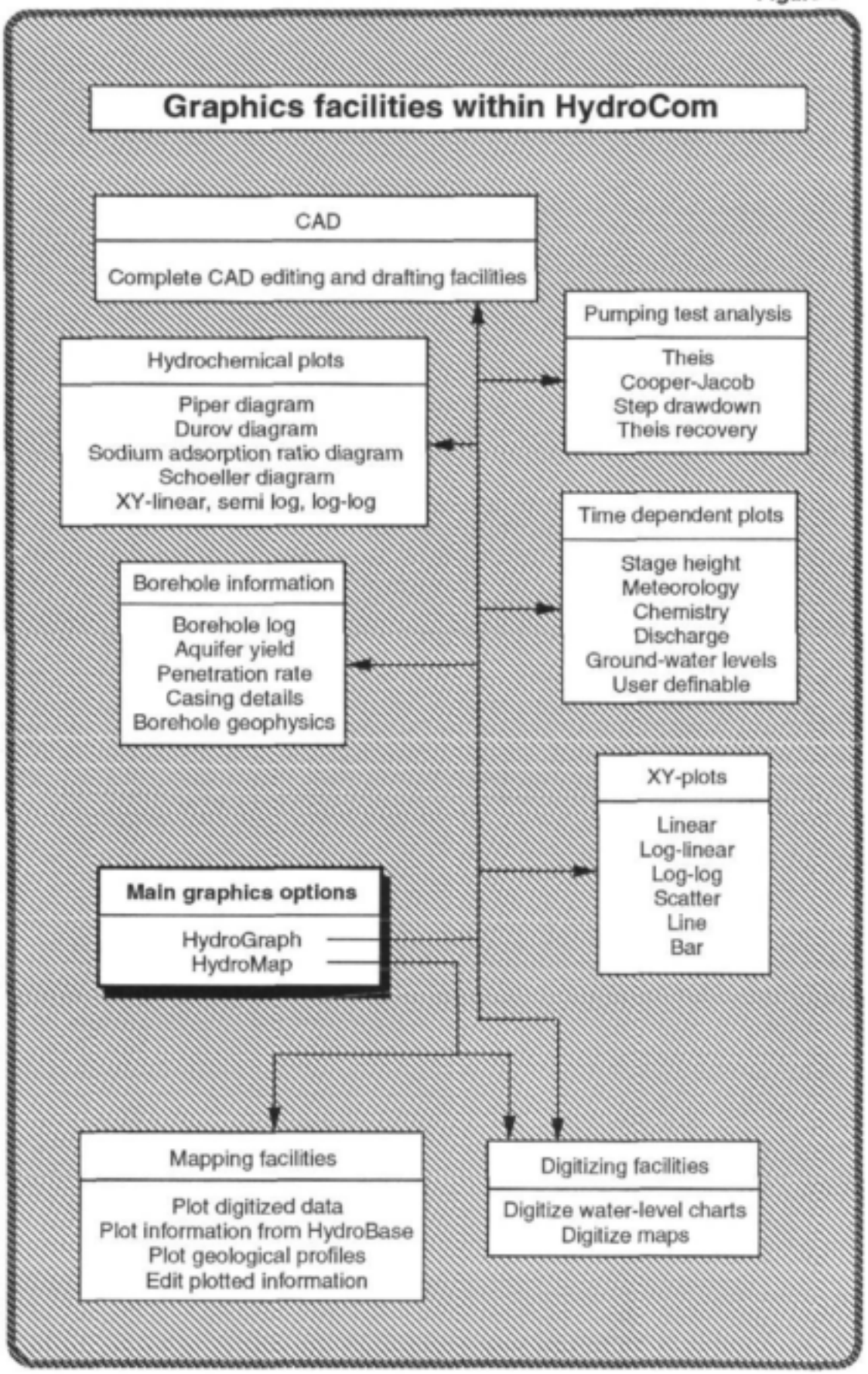

NATIONAL GROUND-WATER DATA BASE
BEGIN
1 SITE
10 ENTRY
850 XINQU
851 XCODE
852 XDIST
853 XAQUI
854 XLITH
855 XSECU
20 LOGS
21 Penetration rate
22 Aquifer
23 Unconsolidated
24 Consolidated
30 CONSTRUCTION
31 Hole
32 Casing
33 Opening
34 Fill
40 INSTALLATION
50 DISCHARGE RATE
51 Discharge rate
60 WATER LEVEL
61 Water-level
70 WATER SAMPLE
71 Water sample
80 FIELD MEASUREMENT
81 Field measurement
82 Recorder measurem.
90 METER READING
91 Meter reading
92 Other metered hole
100 PUMPING TEST
101 Pumping test
110 MISCELLANEOUS
111 Site selection
112 Name of owner
113 Other identifier
114 Other data
115 Site visits
116 Special cases
117 References
118 Search status
119 Comments
XTRCT
XTRAN

Figure 2



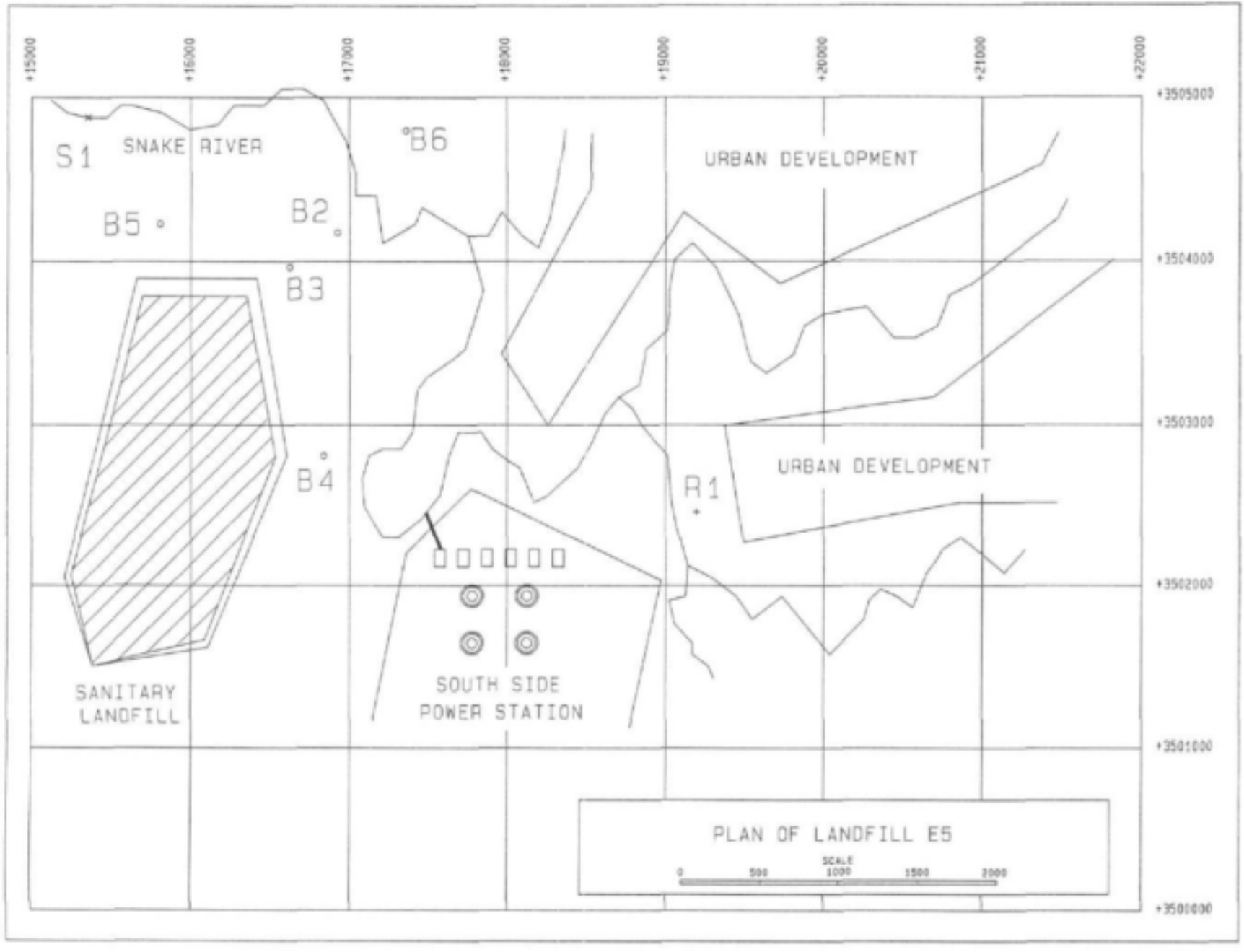
* Common to HydroCom and NGDB

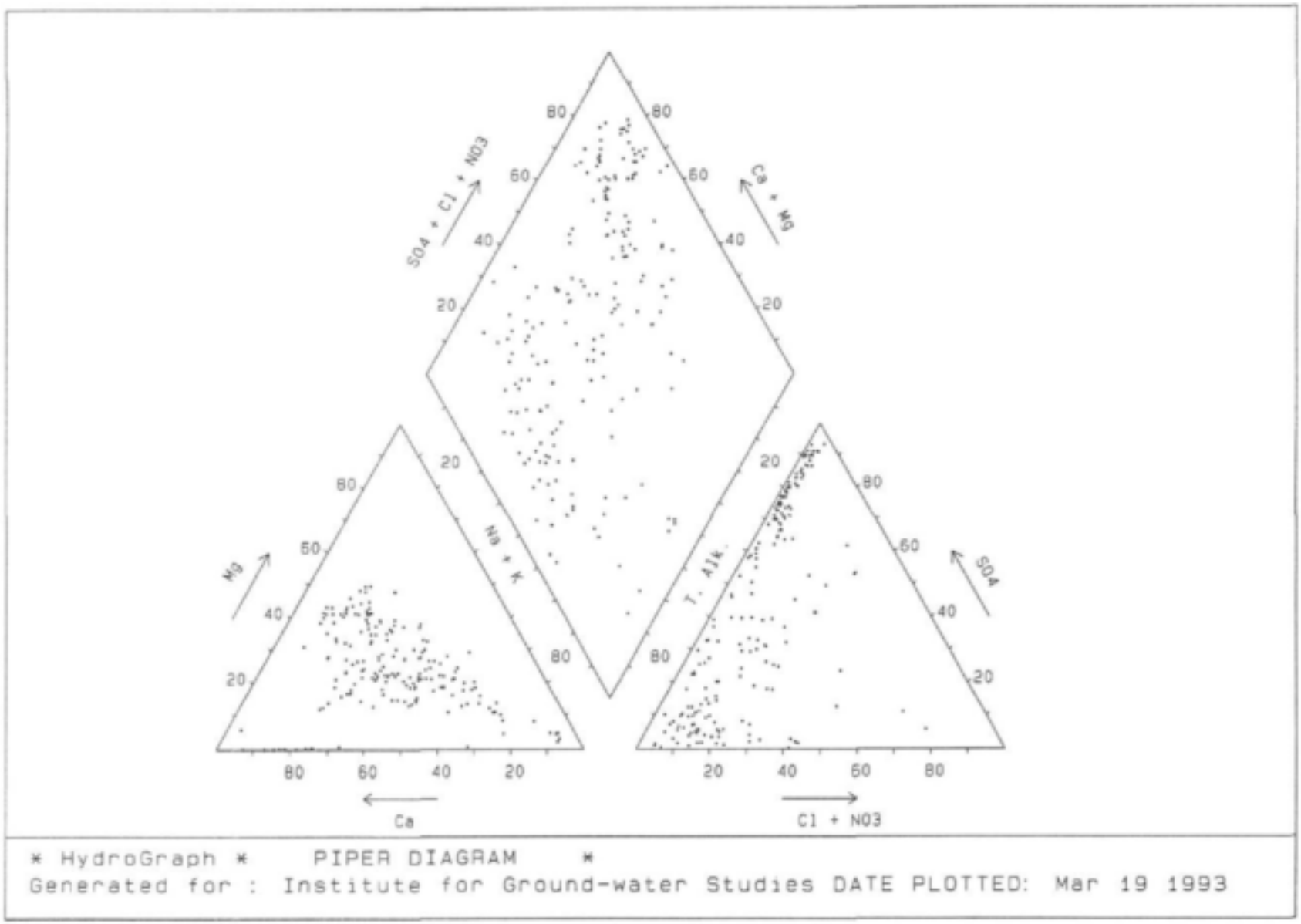
Figure 3


Graphics facilities within HydroCom
CAD
Complete CAD editing and drafting facilities
Pumping test analysis
Theis
Cooper-Jacob
Step drawdown
Theis recovery
Hydrochemical plots
Piper diagram
Durov diagram
Sodium adsorption ratio diagram
Schoeller diagram
XY-linear, semi log, log-log
Time dependent plots
Stage height
Meteorology
Chemistry
Discharge
Ground-water levels
User definable
Borehole information
Borehole log
Aquifer yield
Penetration rate
Casing details
Borehole geophysics
XY-plots
Linear
Log-linear
Log-log
Scatter
Line
Bar
Main graphics options
HydroGraph
HydroMap
Mapping facilities
Plot digitized data
Plot information from HydroBase
Plot geological profiles
Edit plotted information
Digitizing facilities
Digitize water-level charts
Digitize maps

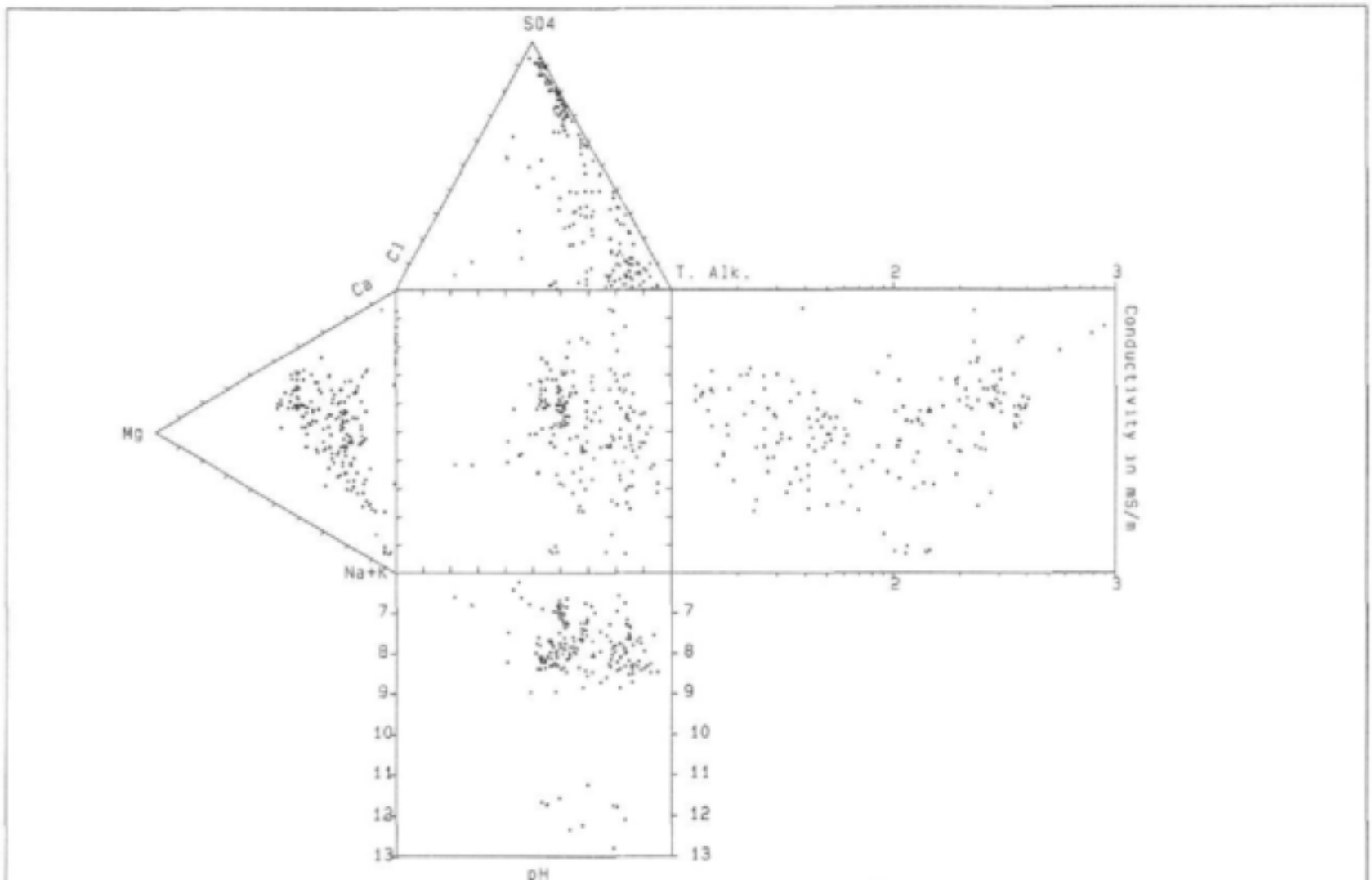
Appendix A

Examples of output from HydroCom

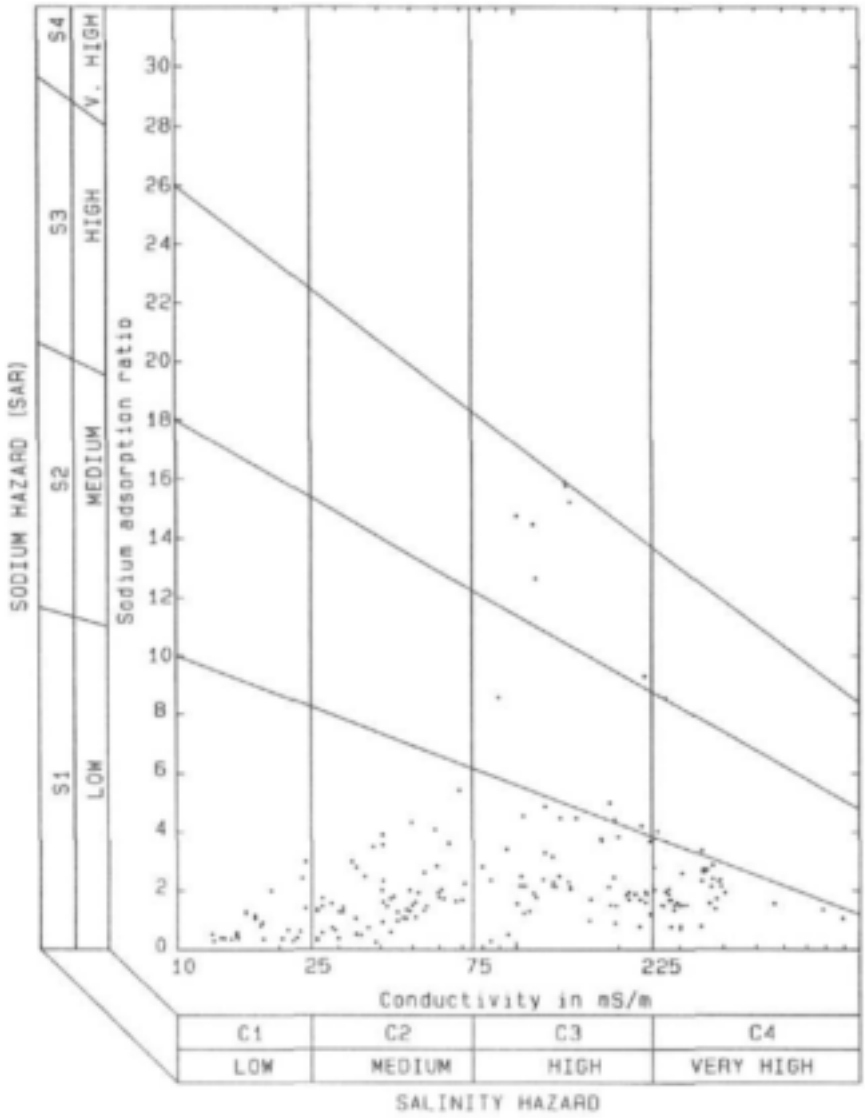

+15000
+16000
+17000
+18000
+19000
+20000
+21000
+22000
+3505000
+3504000
+3503000
+3502000
+3501000
+3500000
S1
SNAKE RIVER
B6
B5
B2
B3
B4
R1
URBAN DEVELOPMENT
URBAN DEVELOPMENT
SANITARY LANDFILL
SOUTH SIDE POWER STATION
PLAN OF LANDFILL E5
SCALE
0
500
1000
1500
2000



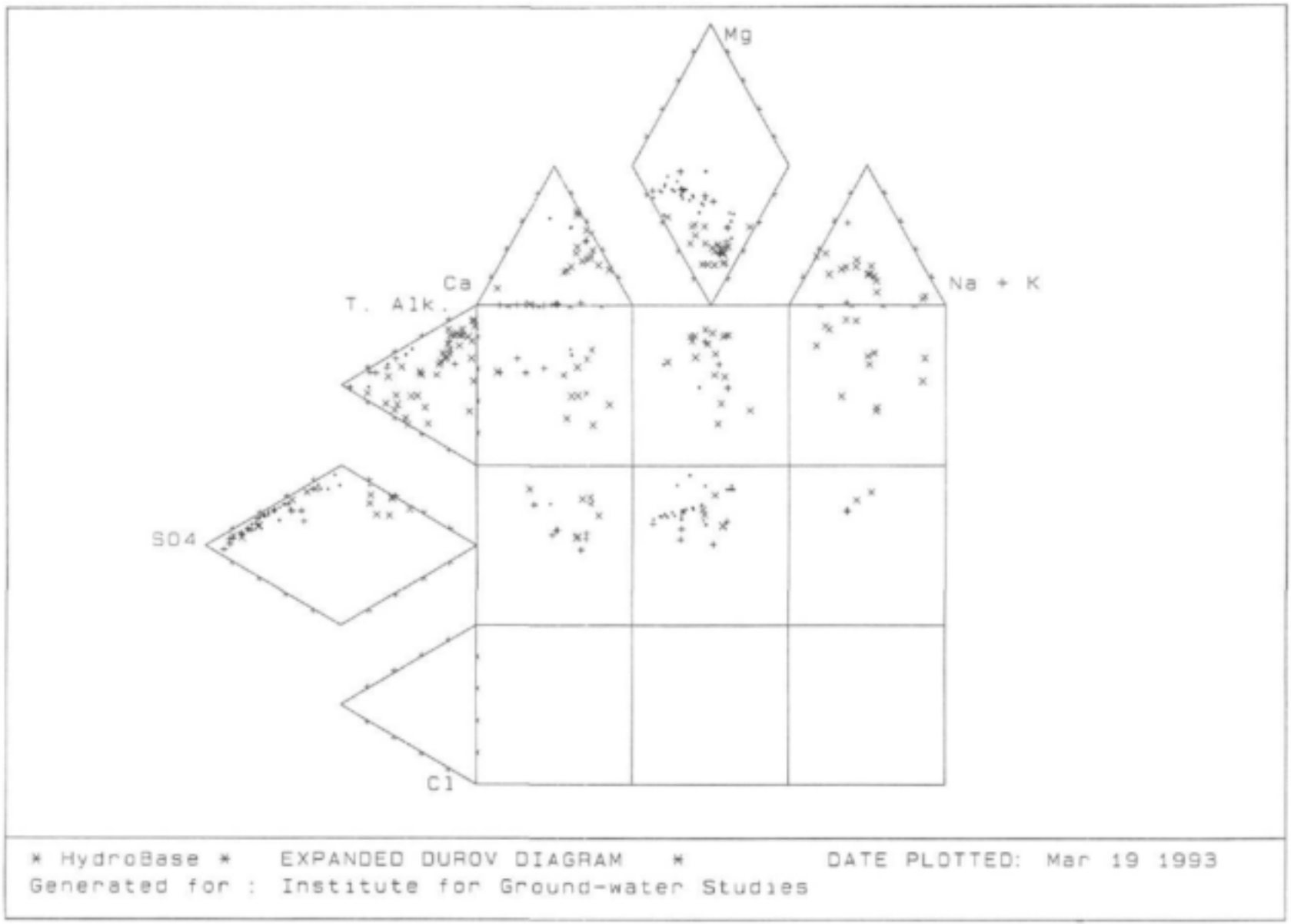
* HydroGraph * PIPER DIAGRAM *
Generated for : Institute for Ground-water Studies DATE PLOTTED: Mar 19 1993



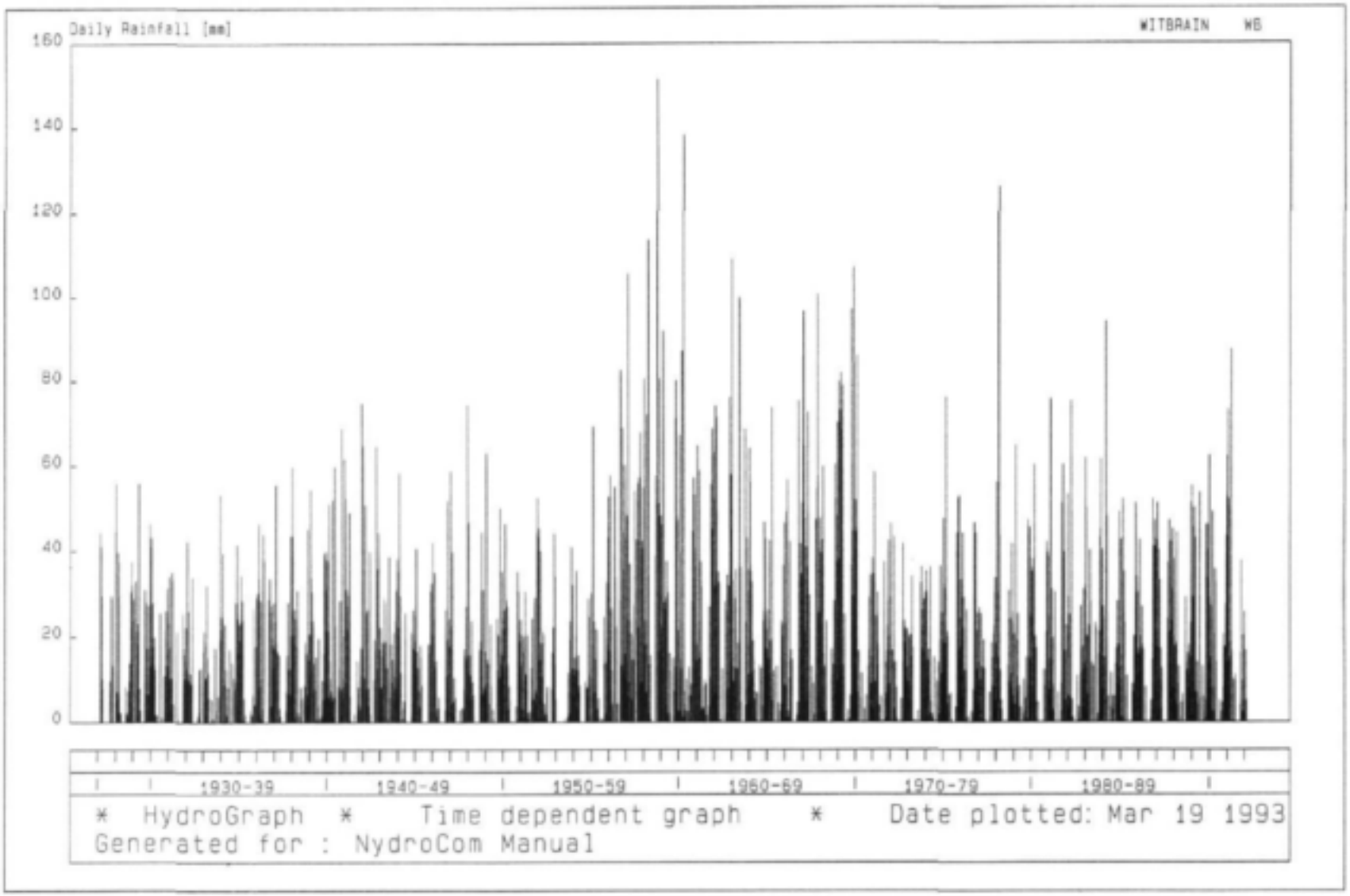
* HydroGraph * DUROV DIAGRAM *
Generated for : Institute for Ground-water Studies DATE PLOTTED: Mar 19 1993

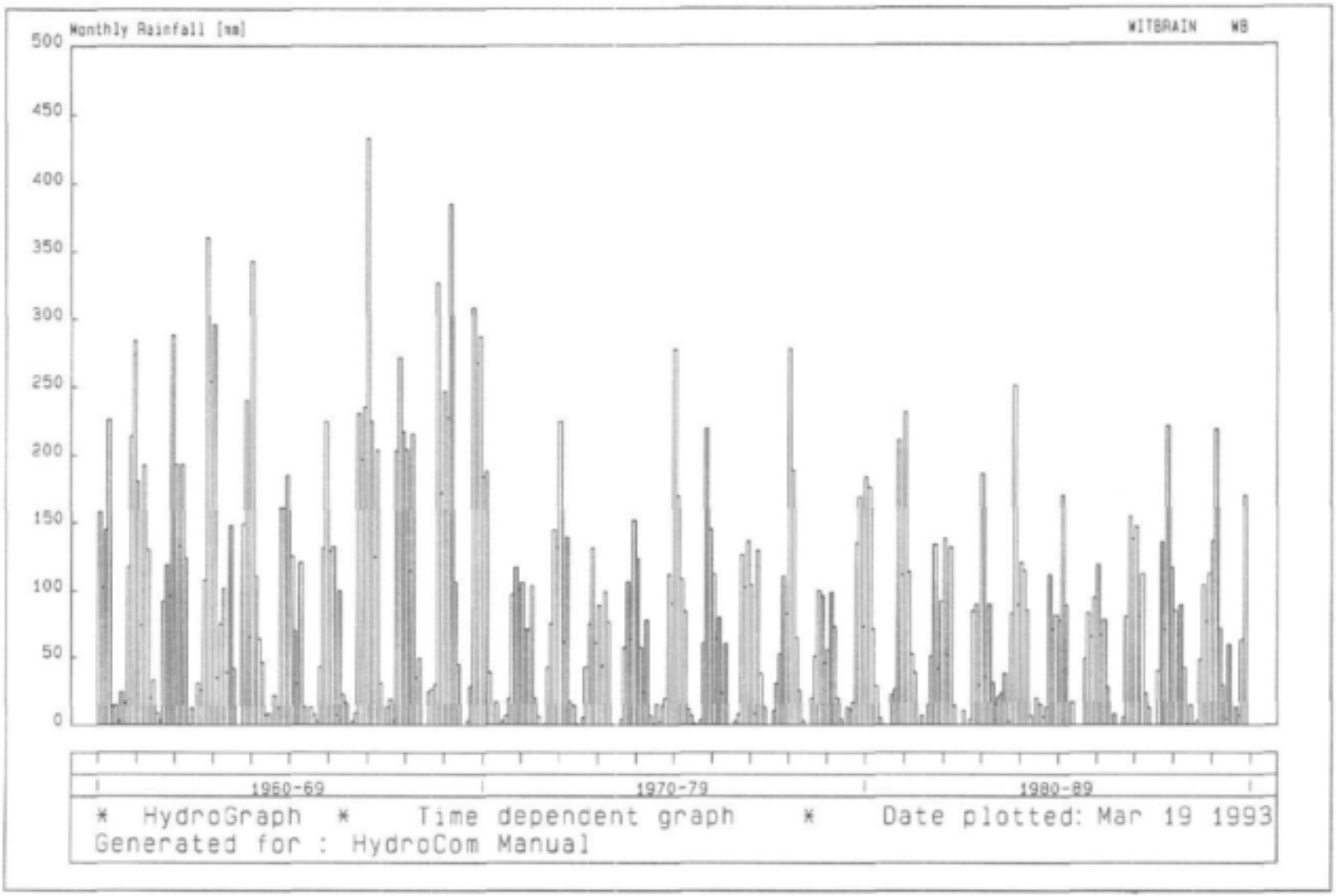


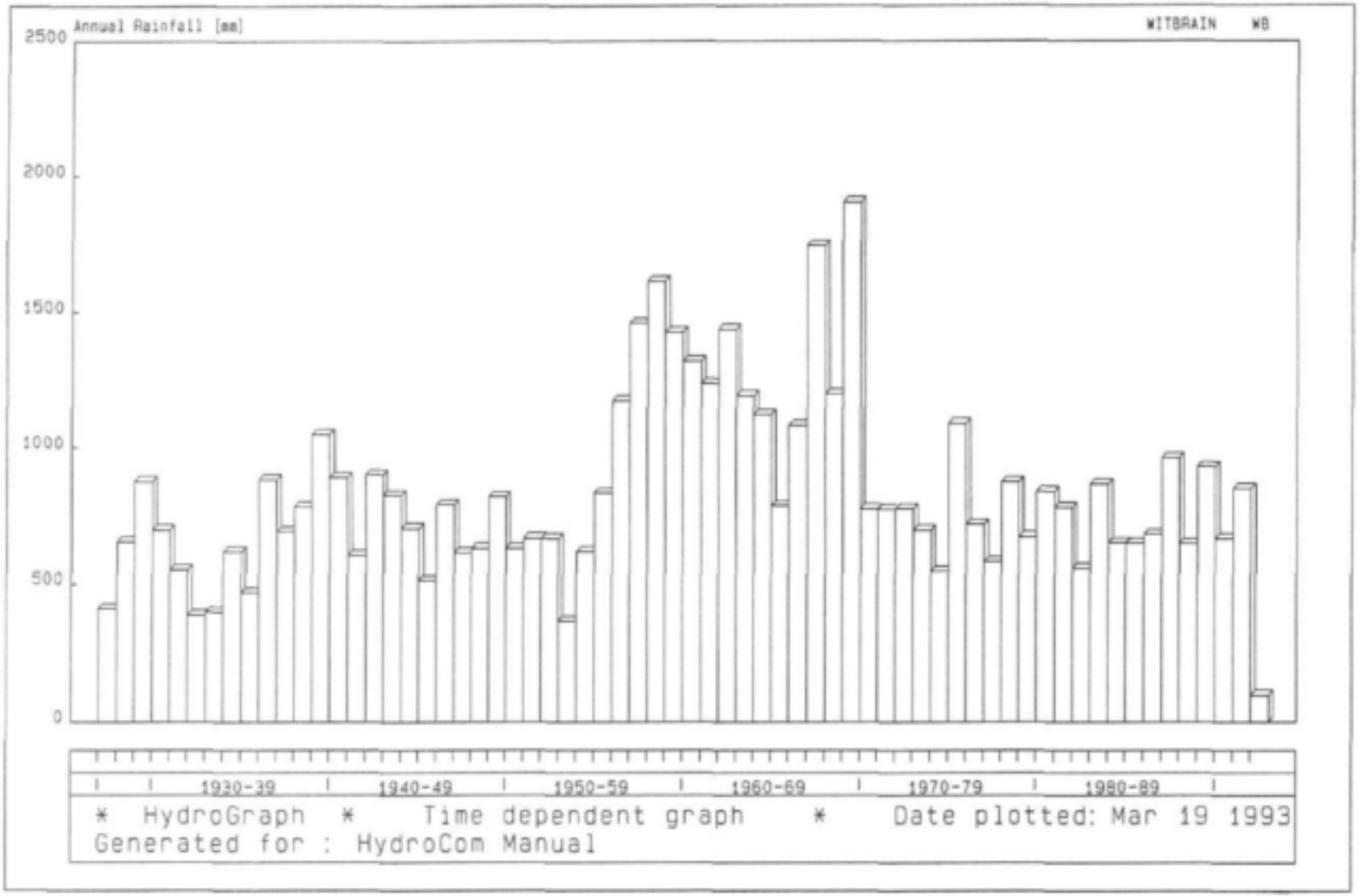
* HydroGraph * SODIUM ADSORPTION RATIO DIAGRAM *
Generated for : Institute for Ground-water Studies
DATE PLOTTED: Mar 19 1993

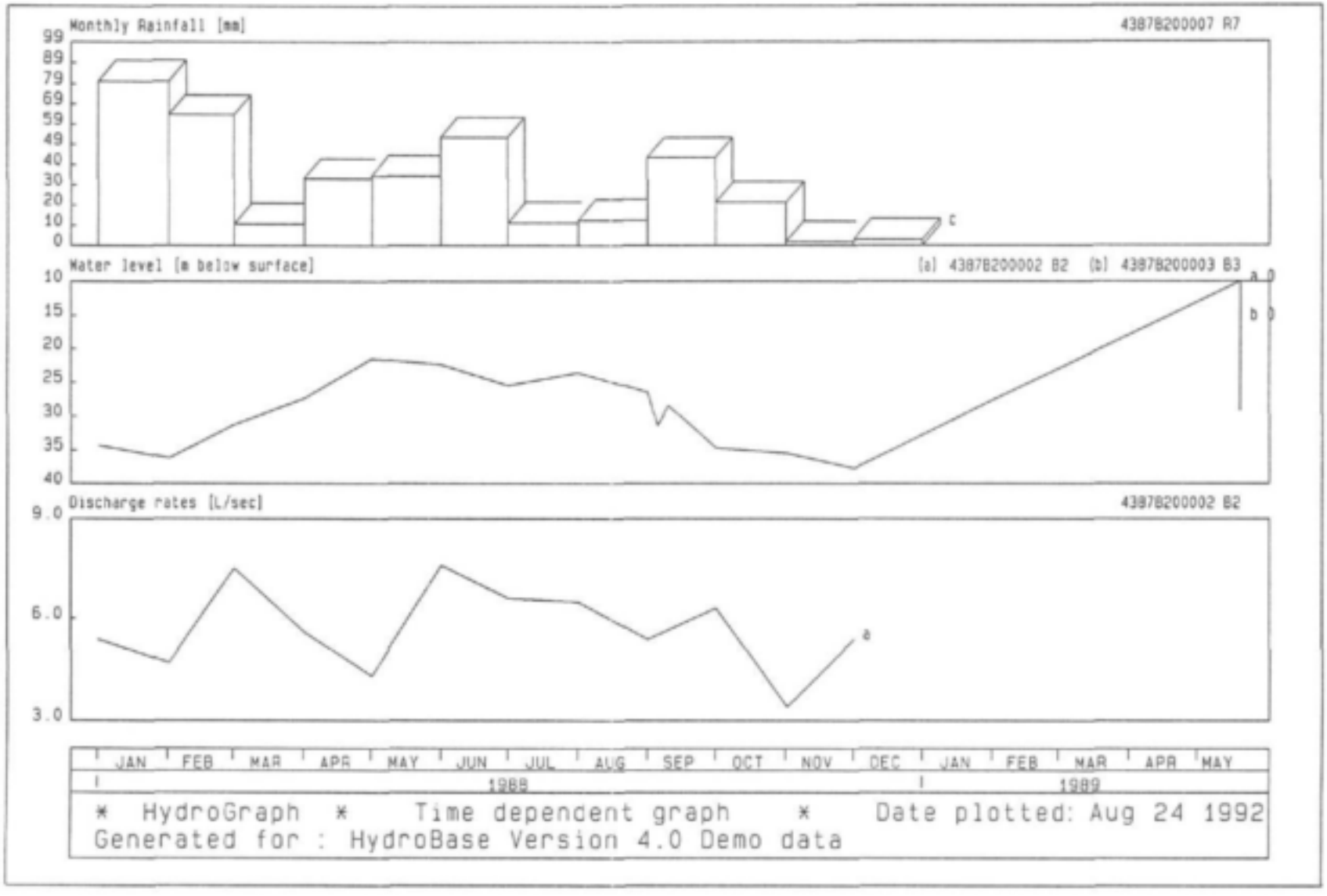


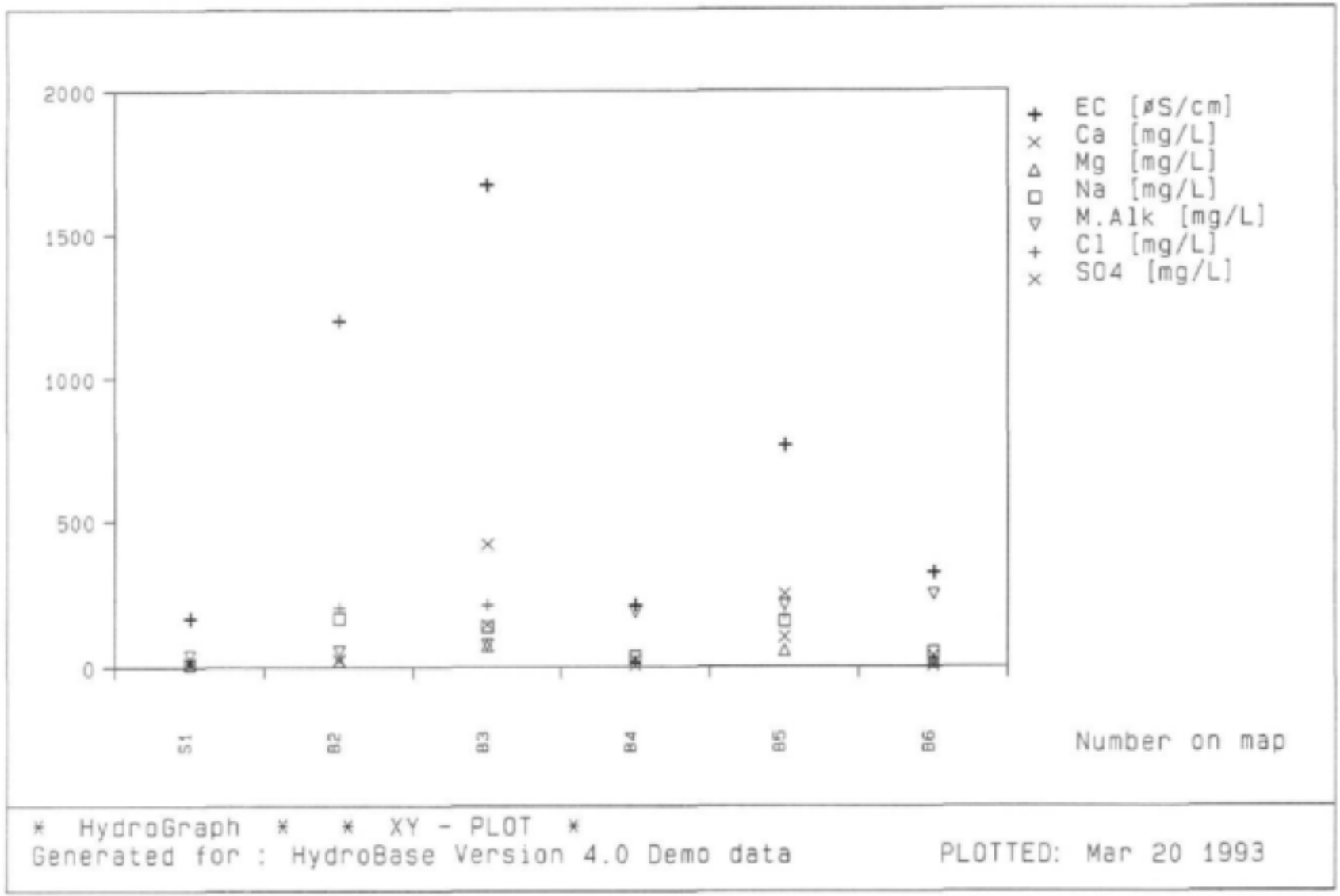
* HydroBase * EXPANDED DUROV DIAGRAM * DATE PLOTTED: Mar 19 1993
Generated for : Institute for Ground-water Studies

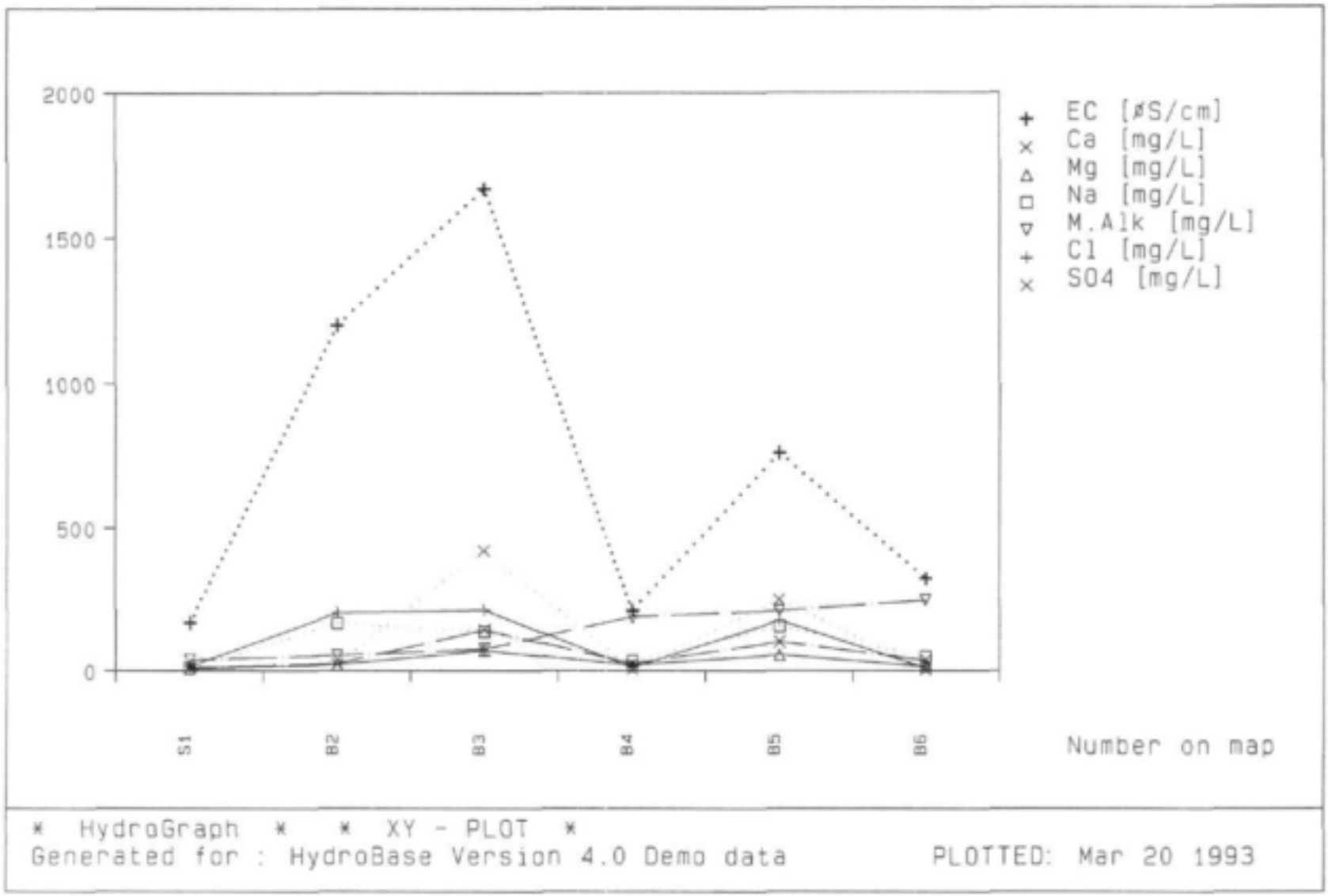

Daily Rainfall [mm]
WITBRAIN WB
160
140
120
100
80
60
40
20
0
1930-39
1940-49
1950-59
1960-69
1970-79
1980-89
* HydroGraph * Time dependent graph * Date plotted: Mar 19 1993
Generated for : NydroCom Manual


Monthly Rainfall [mm]
WITBRAIN WB
500
450
400
350
300
250
200
150
100
50
0
1960-69
1970-79
1980-89
* HydroGraph * Time dependent graph * Date plotted: Mar 19 1993
Generated for : HydroCom Manual

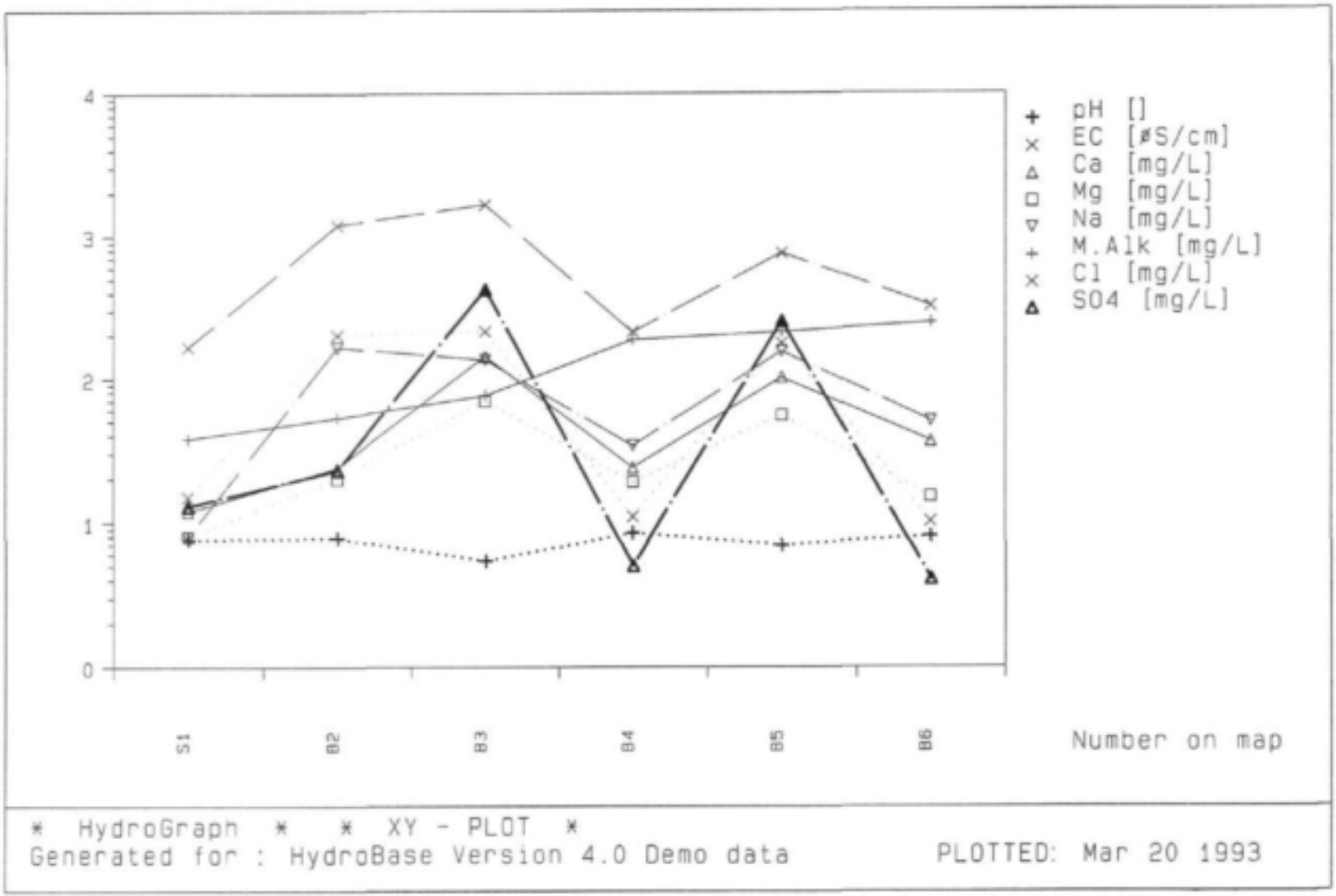

Annual Rainfall [mm]
WITBRAIN WB
2500
2000
1500
1000
500
0
1930-39
1940-49
1950-59
1960-69
1970-79
1980-89
* HydroGraph * Time dependent graph * Date plotted: Mar 19 1993
Generated for : HydroCom Manual


Monthly Rainfall [mm]
43878200007 R7
99
89
79
69
59
49
40
30
20
10
0
c
Water level [m below surface]
(a) 43878200002 B2 (b) 43878200003 B3
10
15
20
25
30
35
40
a
b
Discharge rates [L/sec]
43878200002 B2
9.0
6.0
3.0
a
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC JAN FEB MAR APR MAY
1988
1989
* HydroGraph * Time dependent graph * Date plotted: Aug 24 1992
Generated for : HydroBase Version 4.0 Demo data

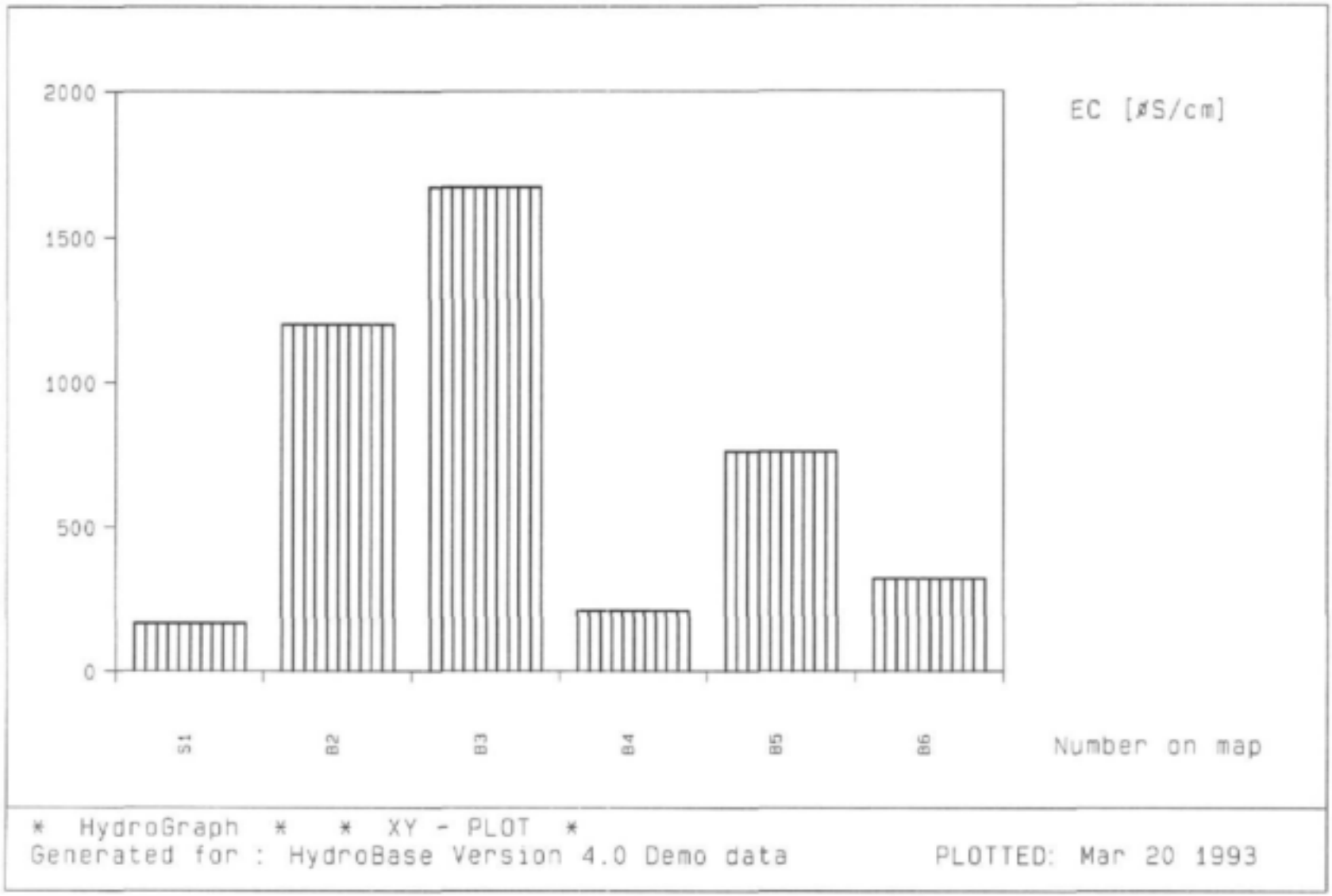

2000
1500
1000
500
0
EC [øS/cm]
Ca [mg/L]
Mg [mg/L]
Na [mg/L]
M.Alk [mg/L]
Cl [mg/L]
SO4 [mg/L]
S1
B2
B3
B4
B5
B6
Number on map
* HydroGraph * * XY - PLOT *
Generated for : HydroBase Version 4.0 Demo data
PLOTTED: Mar 20 1993



* HydroGraph * * XY - PLOT *
Generated for : HydroBase Version 4.0 Demo data PLOTTED: Mar 20 1993



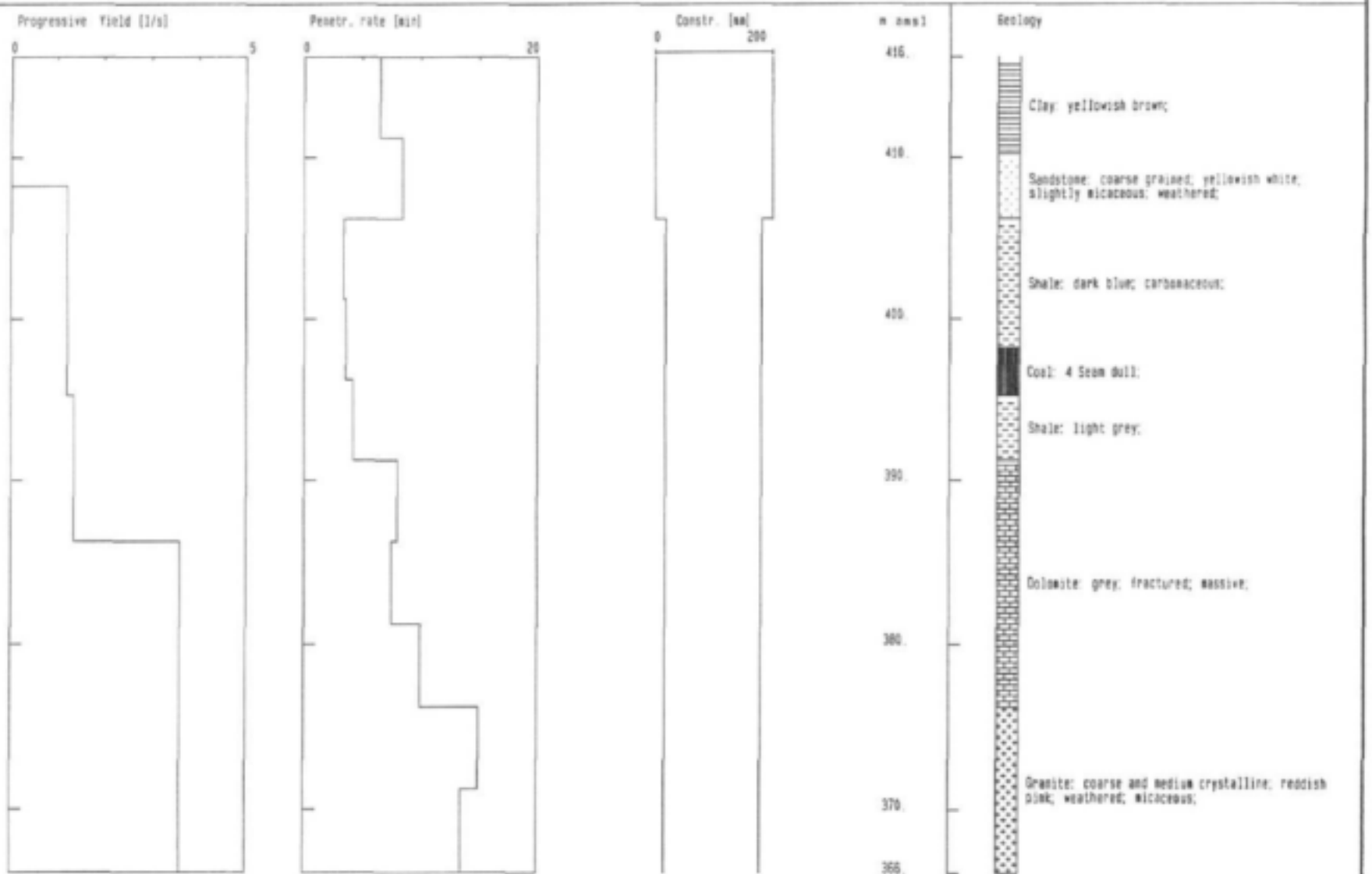
* HydroGraph * * XY - PLOT *
Generated for : HydroBase Version 4.0 Demo data PLOTTED: Mar 20 1993

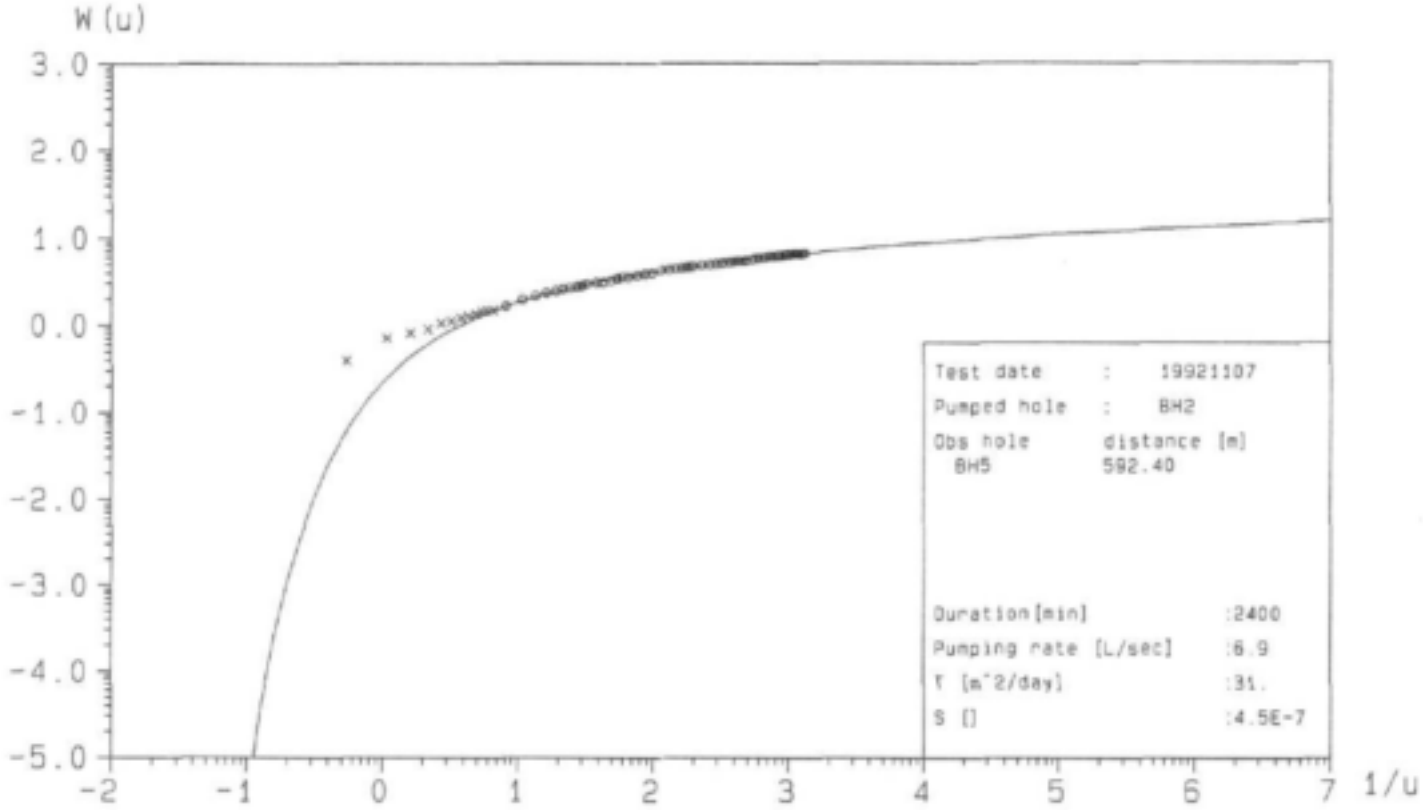

2000
1500
1000
500
0
EC [µS/cm]
S1
B2
B3
B4
B5
B6
Number on map
* HydroGraph * * XY - PLOT *
Generated for : HydroBase Version 4.0 Demo data
PLOTTED: Mar 20 1993

Site-ID : 43878200002 Nr on Map : B2

* HydroGraph * Borehole log : HydroBase Version 4.0 Demo data

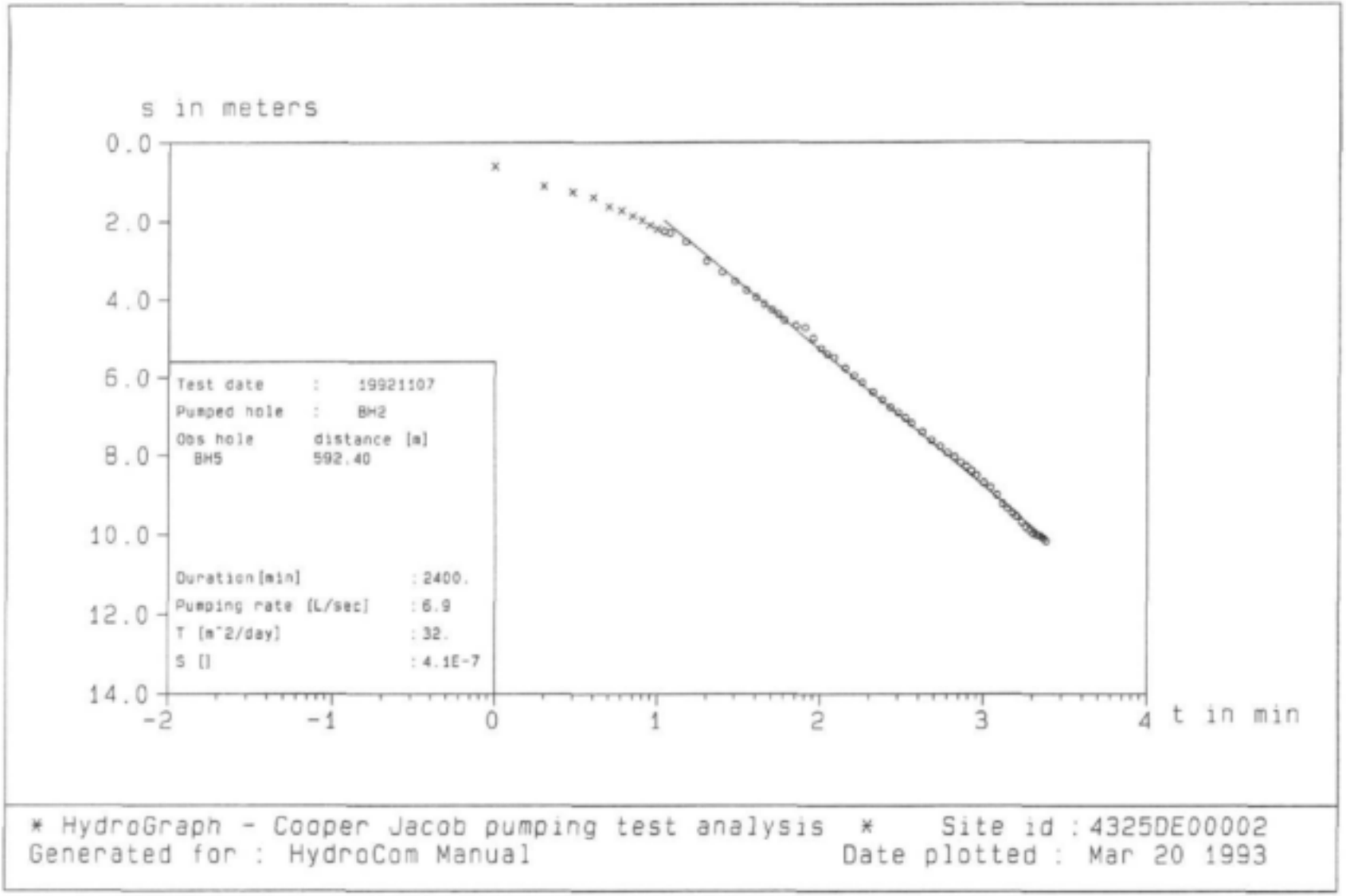
Coordinates : 16921.75(E-W) 3504183.75(N-S) 416.23(Ground elevation) Date Plotted: Mar 20 1993

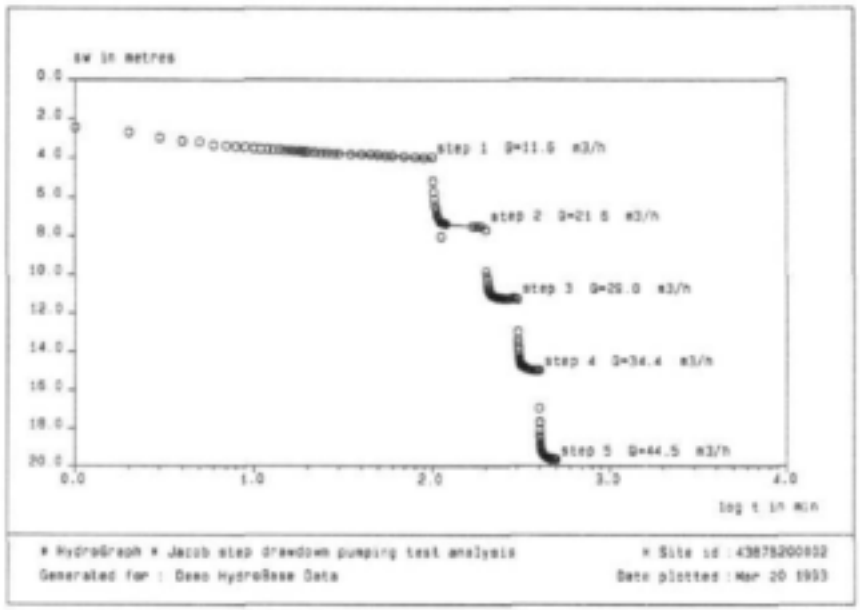




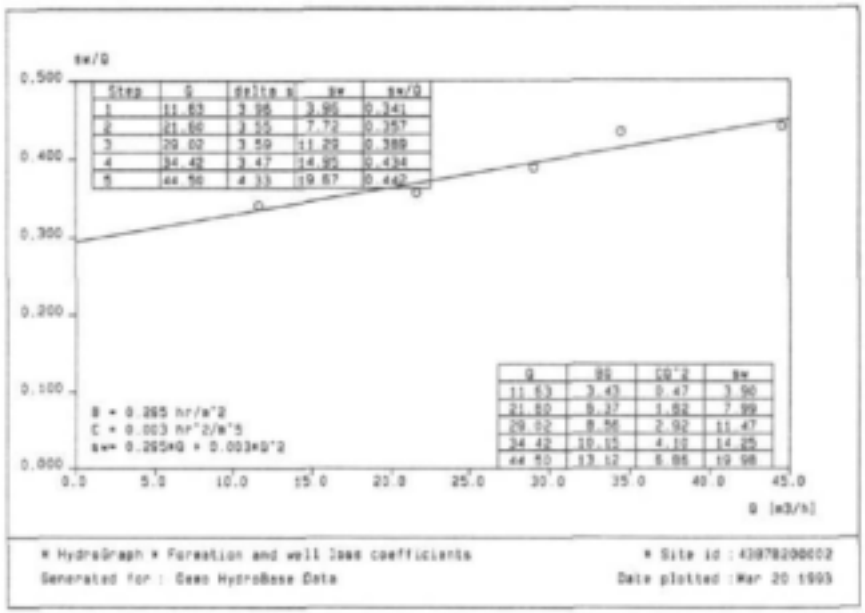
* HydroGraph - Theis pumping test analysis
Generated for : HydroCom Manual

* Site id : 4325DE00002
Date plotted : Mar 20 1993

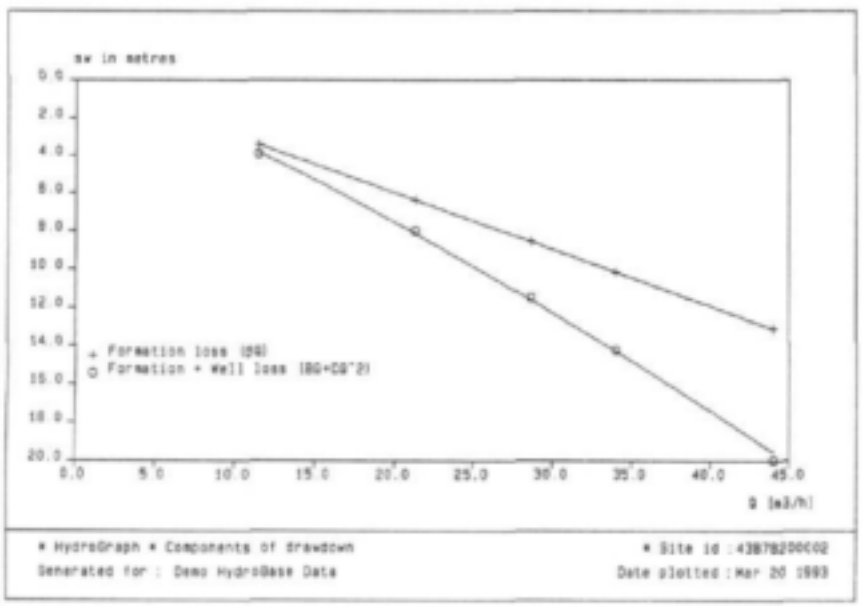

s in meters
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
-2
-1
0
1
2
3
4
t in min
Test date : 19921107
Pumped hole : BH2
Obs hole distance [m]
BH5 592.40
Duration [min] : 2400.
Pumping rate [L/sec] : 6.9
T [m^2/day] : 32.
S [] : 4.1E-7
* HydroGraph - Cooper Jacob pumping test analysis *
Site id : 4325DE00002
Generated for : HydroCom Manual
Date plotted : Mar 20 1993



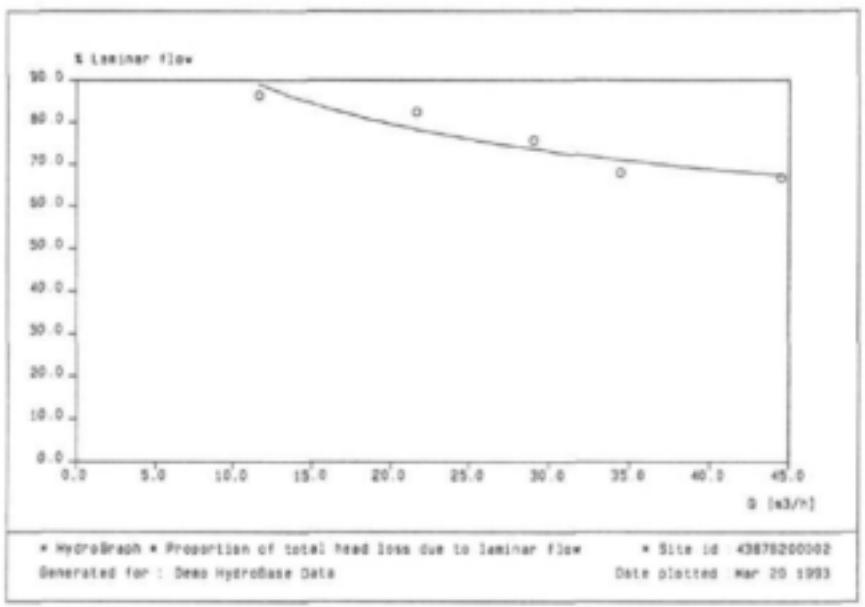
* HydroGraph * Jacob step drawdown pumping test analysis * Site id : 43878200002
Generated for : Demo HydroBase Data Date plotted : Mar 20 1993



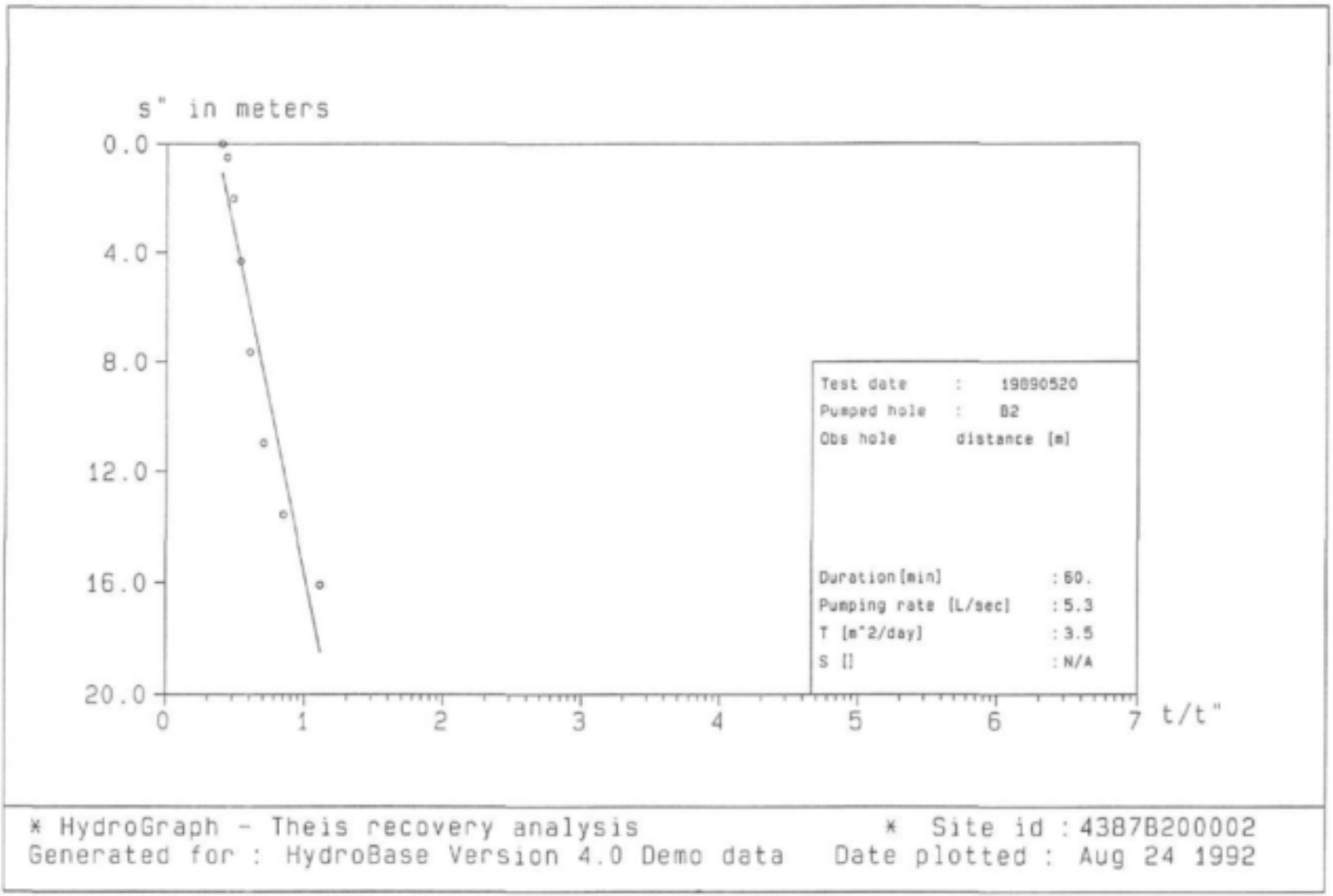
* HydroGraph * Formation and well loss coefficients * Site id : 43878200002
Generated for : Demo HydroBase Data Date plotted : Mar 20 1993



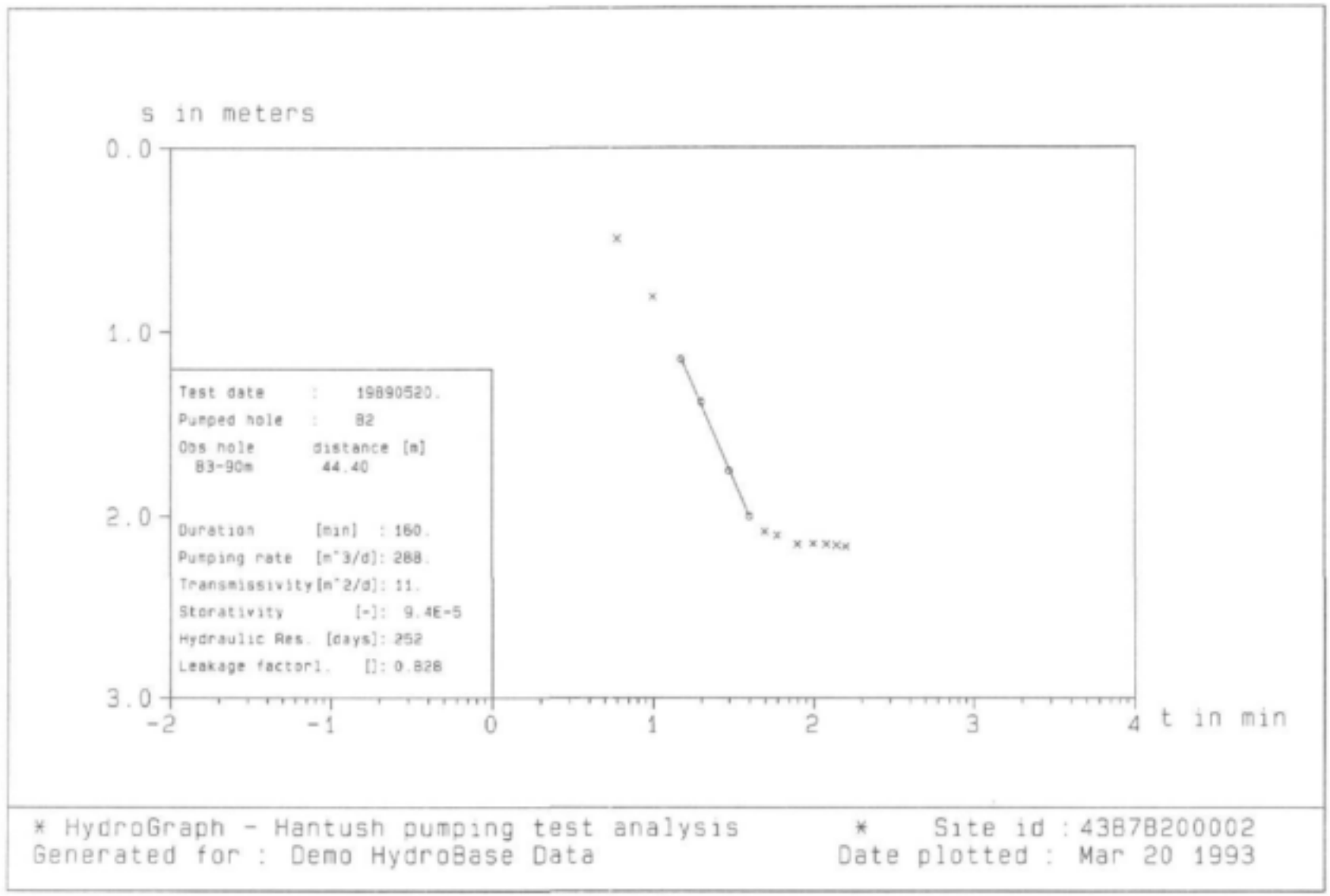
* HydroGraph * Components of drawdown * Site id : 43878200002
Generated for : Demo HydroBase Data Date plotted : Mar 20 1993



* HydroGraph * Proportion of total head loss due to laminar flow * Site id : 43878200002
Generated for : Demo HydroBase Data Date plotted : Mar 20 1993



* HydroGraph - Theis recovery analysis * Site id : 4387B200002
Generated for : HydroBase Version 4.0 Demo data Date plotted : Aug 24 1992



* HydroGraph - Hantush pumping test analysis * Site id : 43878200002
Generated for : Demo HydroBase Data Date plotted : Mar 20 1993

Site name : Monitoring borehole
Notes :

Site ID: 4387B200002 Number on map: B2

E-W coordinate : 16921.75 N-S coordinate : 3504183.75
Ground Elevation: 416.23 mamsl Collar Height: 0.20 m
Depth of Casing: 10.00 m Diameter of Hole: 165 mm
Logged by: WSC Date Drilled: 19890427

Depth (m) from	to	Thickness (m)	Description
Geology			
0.00	6.00	6.00	CLAY : yellowish brown.
6.00	10.00	4.00	SANDSTONE : coarse grained; yellowish white; slightly micaceous; weathered.
10.00	18.00	8.00	SHALE : dark blue; carbonaceous.
18.00	21.00	3.00	COAL : 4 Seam dull.
21.00	25.00	4.00	SHALE : light grey.
25.00	40.00	15.00	DOLOMITE : grey; fractured; massive.
40.00	50.00	10.00	GRANITE : coarse and medium crystalline; reddish pink; weathered; micaceous.
Geohydrology			
8.00	9.00	1.00	1.20 L/sec measured by current meter. Water in fracture.
21.00	21.00	0.00	1.35 L/sec measured by current meter. Water on coal contact.
30.00	40.00	10.00	3.60 L/sec measured by current meter. Water in fractured dolomite.

Site id	Date	Time	Discharge (L/sec)	Nr on map
4387B200002	19880101	12h00	5.40	B2
4387B200002	19880201	12h00	4.70	B2
4387B200002	19880301	12h00	7.50	B2
4387B200002	19880401	12h00	5.60	B2
4387B200002	19880501	12h00	4.30	B2
4387B200002	19880601	12h00	7.60	B2
4387B200002	19880701	12h00	6.60	B2
4387B200002	19880801	12h00	6.50	B2
4387B200002	19880901	12h00	5.40	B2
4387B200002	19881001	12h00	6.30	B2
4387B200002	19881101	12h00	3.40	B2
4387B200002	19881201	12h00	5.40	B2
4387B200002	19890520	08h00	5.34	B2
4387B200002	19930126	08h00	100.00	B2

Site id	Date	Time	Water level (m)	Water-level Elevation (mamsl)	Number on map	Piezo nr.
4387B200002	19880101	12h00	34.30	382.13	B2	0
4387B200002	19880201	12h00	36.20	380.23	B2	0
4387B200002	19880301	12h00	31.20	385.23	B2	0
4387B200002	19880401	12h00	27.40	389.03	B2	0
4387B200002	19880501	12h00	21.43	395.00	B2	0
4387B200002	19880601	12h00	22.30	394.13	B2	0
4387B200002	19880701	12h00	25.43	391.00	B2	0
4387B200002	19880801	12h00	23.50	392.93	B2	0
4387B200002	19880901	12h00	26.40	390.03	B2	0
4387B200002	19880905	12h00	31.43	385.00	B2	0
4387B200002	19880910	12h00	28.50	387.93	B2	0
4387B200002	19881001	12h00	34.76	381.67	B2	0
4387B200002	19881101	12h00	35.47	380.96	B2	0
4387B200002	19881201	12h00	37.65	378.78	B2	0
4387B200002	19890520	08h00	10.00	406.43	B2	0
4387B200002	19890520	08h01	12.50	403.93	B2	0
4387B200002	19890520	08h02	14.00	402.43	B2	0
4387B200002	19890520	08h05	17.32	399.11	B2	0
4387B200002	19890520	08h10	20.65	395.78	B2	0
4387B200002	19890520	08h20	23.98	392.45	B2	0
4387B200002	19890520	08h40	26.56	389.87	B2	0
4387B200002	19890520	09h00	29.10	387.33	B2	0
4387B200002	19890520	09h05	26.10	390.33	B2	0
4387B200002	19890520	09h10	23.56	392.87	B2	0
4387B200002	19890520	09h15	20.98	395.45	B2	0
4387B200002	19890520	09h20	17.65	398.78	B2	0
4387B200002	19890520	09h25	14.32	402.11	B2	0
4387B200002	19890520	09h30	12.00	404.43	B2	0
4387B200002	19890520	09h35	10.50	405.93	B2	0
4387B200002	19890520	09h40	10.00	406.43	B2	0
4387B200002	19930126	08h00	10.00	406.43	B2	0
4387B200002	19930126	08h01	11.00	405.43	B2	0
4387B200002	19930126	08h05	12.00	404.43	B2	0
4387B200002	19930126	08h15	13.00	403.43	B2	0
4387B200002	19930126	08h30	14.00	402.43	B2	0
4387B200003	19890520	08h00	11.45	398.05	B3	0
4387B200003	19890520	08h05	11.46	398.04	B3	0
4387B200003	19890520	08h10	12.65	396.85	B3	0
4387B200003	19890520	08h20	13.74	395.76	B3	0
4387B200003	19890520	08h40	14.83	394.67	B3	0
4387B200003	19890520	09h00	15.67	393.83	B3	0

Data from file BASICINF :

SITE_ID_NR	NR_ON_MAP	TOPO_SETTG	Y_COORD	X_COORD	ALTITUDE	SITE_TYPE	COLLAR_HI	DEPTH	SITE_STATU
4387B200001	S1	In or along river	15355.75	3504879.75	401.12	River or stream	0.00	0.00	In use
4387B200002	B2	Flat surface, plain	16921.75	3504183.75	416.23	Borehole	0.20	40.00	In use
4387B200003	B3	Flat surface, plain	16617.25	3503966.25	407.00	Borehole	2.50	40.00	In use
4387B200004	B4	Flat surface, plain	16834.75	3502806.25	404.54	Borehole	0.30	40.00	In use
4387B200005	B5	Flat surface, plain	15805.25	3504227.25	410.00	Borehole	0.32	40.00	In use
4387B200006	B6	Flat surface, plain	17356.75	3504807.25	411.65	Borehole	0.35	40.00	In use
4387B200007	R7	Flat surface, plain	19197.46	3502458.48	412.81	Other	0.00	0.00	In use
4387B200008	L8	In or along pan	16250.00	3503900.00	407.00	Seepage pond	0.00	0.00	In use

Data from file CASING__ :

SITE_ID_NR	DATE_INST	DEPTH_TOP	DEPTH_BOT	DIAMETER	MATERIAL	THICKNESS	OPEN_TYPE	OPEN_LEN	OPEN_WIDTH	OPEN_MADE
4387B200002	19891001	-0.25	10.00	200	Steel	4.0	Screen	400	3.0	Machine cut

Data from file CONSTRCT :

SITE_ID_NR	DATE_CONST	CONTRACTOR	CONST_METH	TYPE_FINIS	METH_DEVEL	SPEC_TREAT
4387B200002	19870426	ROCKY MOUNTAIN DRILLERS	Air percussion	Open bottom (partially cased)	None	Brushing

Data from file GENEQUIP :

SITE_ID_NR	DATE_INST	DATE_ENTRY	TYPE_INST	PARAM_MEAS	MANUFACTUR	SERIAL_NR	INFO_SOURC
4387B200007	19890526	19890526	Rain gauge	Rainfall	Weatherman, Inc.	WM234/1-4AB	Field checked
4387B200007	19890526	19890526	Other	Pan evaporation	Weatherman, Inc.	354ET	Field checked

Site id number		4387B200001	4387B200002	4387B200003
Number on map		S1	B2	B3
Sample number		FDI/S001	FDI/0001	FDI/0002
Alternative number 1				
Alternative number 2				
Alternative number 3				
Alternative number 4				
Depth of sample	(m)	0.000	23.000	25.000
Sample date		19880120	19890504	19890504
Sample time		0800	1000	1200
Date of analysis		19880121	19890504	19890504
Analytical laboratory		WSC	WSC	WSC
Sampling method		B	B	B
Time after start pump		0	0	0
Aluminum	(mg/L)	0.03	-1.00	-1.00
Bicarbonate	(mg/L)	46	64	93
Calcium	(mg/L)	12	24	142
Calcium hardness	(mg/L)	30	60	355
Carbonate	(mg/L)	0	0	0
Chloride	(mg/L)	15	201	212
Electrical conductivity	(µS/cm)	16.6	120.0	167.0
Fluoride	(mg/L)	1.1	1.5	1.8
Ion-balance error	(%)	0.45	3.47	-1.16
Iron (total)	(mg/L)	1.23▲	-1.00	-1.00
Langelier index		-1.03	-0.59	-2.15
Magnesium	(mg/L)	8	20	70
Magnesium hardness	(mg/L)	33	82	288
Manganese	(mg/L)	0.234▲	0.100<	-1.000
Methyl orange alkalinity	(mg/L)	38	53	76
Nitrate as nitrogen	(mg/L)	2.3	30.0▲	45.0▲
pH		7.68	7.80	5.40▼
Phenolphthalein alk.	(mg/L)	0	0	0
Potassium	(mg/L)	1.2	3.5	15.0
Silicon	(mg/L)	5.4	-1.0	-1.0
Sodium	(mg/L)	8	165	135
Sulphate	(mg/L)	13	23	420▲
Total diss. solids (EC*7)	(mg/L)	12	84	-1
Total diss. solids (Σ)	(mg/L)	113	623	1270
Total dissolved solids	(mg/L)	120	-1	-1
Σ Anions	(meq/L)	1.676	9.429	19.552
Σ Cations	(meq/L)	1.691	10.107	19.103

Comment 1 : Note high Boron content.
Comment 2 :
Comment 3 :

Selected standard : US drinking water
▲ = Exceeds max acceptable value ↓ = Below min guideline value
↑ = Exceeds max guideline value ▼ = Below min acceptable value
< = Below detection limit

Site id number		438782000001	438782000002	438782000003	438782000004	438782000005	438782000006
Number on map		S1	B2	B3	B4	B5	B6
Sample number		FDI/S001	FDI/0001	FDI/0002	FDI/0003	FDI/0004	FDI/0005
Alternative number 1							
Alternative number 2							
Alternative number 3							
Alternative number 4							
Depth of sample	(m)	0.000	23.000	25.000	31.000	28.000	36.000
Sample date		19880120	19890504	19890504	19890504	19890504	19890504
Sample time		0800	1000	1200	1300	1400	1500
Date of analysis		19880121	19890504	19890504	19890504	19890504	19890504
Analytical laboratory		WSC	WSC	WSC	WSC	WSC	WSC
Sampling method		B	B	B	B	B	B
Time after start pump		0	0	0	0	0	0
Aluminum	(mg/L)	0.03					
Bicarbonate	(mg/L)	46	64	93	221	256	296
Calcium	(mg/L)	12	24	142	24	101	36
Calcium hardness	(mg/L)	30	60	355	60	252	90
Carbonate	(mg/L)	0	0	0	3	0	1
Chloride	(mg/L)	15	201	212	11	176	10
Electrical conductivity	(µS/cm)	16.6	120.0	167.0	21.0	76.0	32.0
Fluoride	(mg/L)	1.1	1.5	1.8	0.8	1.8	0.5
Ion-balance error	(%)	0.45	3.47	-1.16	-0.20	-0.82	-0.99
Iron (total)	(mg/L)	1.23▲					
Langelier index		-1.03	-0.59	-2.15	0.65	-0.33	0.42
Magnesium	(mg/L)	8	20	70	19	55	15
Magnesium hardness	(mg/L)	33	82	288	78	226	62
Manganese	(mg/L)	0.234▲	0.100<				
Methyl orange alkalinity	(mg/L)	38	53	76	187	210	245
Nitrate as nitrogen	(mg/L)	2.3	30.0▲	45.0▲	2.0	34.0▲	1.6
pH		7.68	7.80	5.40▼	8.40	6.90	7.90
Phenolphthalein alk.	(mg/L)	0	0	0	9	0	0
Potassium	(mg/L)	1.2	3.5	15.0	3.2	12.2	3.7
Silicon	(mg/L)	5.4					
Sodium	(mg/L)	8	165	135	34	154	50
Sulphate	(mg/L)	13	23	420▲	5	248	4
Total diss. solids (EC*7)	(mg/L)	12	84		15	53	22
Total diss. solids (Σ)	(mg/L)	113	623	1270	293	1108	371
Total dissolved solids	(mg/L)	120					
Σ Anions	(meq/L)	1.676	9.429	19.552	4.339	16.850	5.406
Σ Cations	(meq/L)	1.691	10.107	19.103	4.322	16.577	5.300

Comment 1 : Note high Boron content.
Comment 2 :
Comment 3 :
Comment 4 :
Comment 5 :
Comment 6 :

Selected standard : US drinking water
▲ = Exceeds max acceptable value ↓ = Below min guideline value
↑ = Exceeds max guideline value ▼ = Below min acceptable value
< = Below detection limit

Appendix B

Data Input Screens

HydroCom

BASIC INFORMATION DATA BASE SHEET

Site id code

Number on map

Alt. No. 1: Alt. No. 2

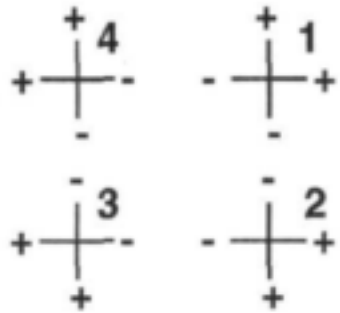
E-W coord.

N-S coord.

Coordinate system Ground elevation

Coordinate accuracy Survey method Site type

Select coordinate system according to diagrams



Reporting institution

District and farm number

Site name:

Topo setting Drainage region

Site - status purpose selector equipment

Dates - completed entered updated

Water use - consumer application Potability

Borehole: diameter completed depth collar height

Notepad Information source

Basic Information

Coordinate Accuracy

0 Accurate to within 1 unit
1 Accurate to within 10 units
2 Accurate to within 100 units
3 Accurate to within 1 000 units
4 Accurate to within 10 000 units
No information

Survey Method

A Altimeter
L Levelled or surveyed
M Interpolated from map
No information

Site Type

B Borehole
C Canal or trench
D Dug well
E Effluent from industries
F Fountain
H Sinkhole
I Interconnected or drainage well
N Meteorological station
M Multiple boreholes
O Seepage from opencast mine
P Pan or dam
R River or stream
S Seepage pond
T Tunnel, shaft or drain
U Flow from underground mine
W Well point
Z Other

Topographic Setting

A Alluvial fan
B Dry river bed
D Dunes
E Ephemeral stream
F Flat surface, plain
H In or along sinkhole
I Irrigated field
L Along dam, lake or swamp
M On mountain or hill
O At or in opencast mine
P In or along pan
R In or along river
S Hillside (slope)
T Terrace
V Valley
W At or in waste disposal
No information

Site Status

D Destroyed

Site Purpose

D Drainage
E Exploration
O Observation
P Production (water supply)
R Recharge
S Standby
W Waste disposal
Z Other
No information

Site Selector

DRL Driller
ENG Engineer
ENV Environmentalist
GEO Earth Scientist
GHD Geohydrologist
GPH Geophysicist
HDR Hydrologist
MRL Meteorologist
OTR Other
OWN Owner
No information

Equipment

A Airlift
C Centrifugal pump
G Gravity suction
H Hand pump
J Jet
M Mono-type pump
N No equipment
O Observation tube
P Piston pump
Q Powerhead
R Recorder
S Submersible pump
T Turbine
W Windpump
X Windpump with powerhead
Z Other
No information

Water Use - Consumer

D Water disposed
U Urban
N Non-urban
No information

Water Use - Application

AD Agricultural and domestic use
AI Agricultural - irrigation only
AS Agricultural - stock watering only
DA Domestic - all purposes
DG Domestic - garden only

TE Industrial and mining - evaporated
TI Industrial - industrial
TM Industrial - mining
TP Industrial - power generation
No information

Potability (from chemistry)

V Very good
G Good for human consumption
M Marginal for human consumption
A For animals only
U Unsuitable for all consumption

Potability (from taste)

F Fresh
B Brack
S Salty
No information

Information Source

C Construction data
F Field checked
M Memory
O Owner's record
R Report or file
No information

Surface Hydrology

Information Source

E Engineer
F Field checked
H Hydrologist
M Memory
O Owner's record
R Report or file
P Pump operator
No information

Meteorology

Information Source

F Field checked
M Memory
O Owner's record
R Report or file
S Meteorologist (scientist)
No information

Hydrochemistry

Sampling Method

A Airlift
B Bail
P Pump
No information

Ground Water

Penetration Rate

Information Source

See Basic Information

Aquifer

Information Source

See Basic Information

Geology

Information Source

See Basic Information

Lithology Code

AOLN Aeolian deposits
AGLM Agglomerate
ALVM Alluvium
APBL Amphibolite
ADST Andesite
ANDR AnhydriteE
ANRS Anorthosite
ARKS Arkose
BDIS Banded ironstone
BSLT Basalt
BNTN Bentonite
BLCL Boulder clay
BLDR Boulders
BLSD Boulders and clay
BLSC Boulders, silt and clay
BRCC Breccia
BNZT Bronzitite
CCTF Calc tufa
CLCT Calcite
CLCR Calcrete
CBNT Carbonatite
CHLK Chalk
CHRT Chert
CLAY Clay
CLSD Clay and sand
CLSN Claystone
COAL Coal
COBB Cobbels
COSD Cobbles and sand
COSC Cobbles, silt and clay
DIBS Diabase
DMCT Diamictite
DORT Diorite
DLRT Dolerite
DLMT Dolomite
DNSD Dune sand
ECGT Eclogite
ELVM Eluvium
EVPR Evaporite
FULT Fault
FLST Felsite
FCRT Ferricrete
FGSN Flagstone
GBBR Gabbro
GBNR Gabbro-norite
GLCL Glacial
GNSS Gneiss
GRNT Granite
GRGN Granite-gneiss
GDGS Granitoid-gneiss
GRDR Granodiorite
GNPR Granophyre
GRVL Gravel
GRCL Gravel and clay
GRDS Gravel, sand and clay
GRSC Gravel, silt and clay
GNST Greenstone
GRCK Greywacke
GRIT Grit
GPSM Gypsum
HRDP Hard pan
HZBG Harzburgite
HNFL Hornfels
IGBR Ignimbrite
JSPR Jasper
JPLT Jaspilite
KLNT Kaolinite
KBLT Kimberlite
LTRT Laterite
LAVA Lava
LGNT Lignite
LMSN Limestone
LMDM Limestone and dolomite
LOAM Loam
LOSS Loess
MGGB Magnetite gabbro
MRBL Marble
MARL Marl
MRLS Marlstone
MCSC Mica schist
MUD Mud
MDSN Mudstone
MLNT Mylonite
NPHL Nepheline
N.S. No sample
NORT Norite
NRAR Norite-anothosite
OVDR Olivine diorite
OTSH Outwash
OBDN Overburden
PEAT Peat
PGMT Pegmatite
PNLT Phonolite
QZPR Quartz porphyry
QZSC Quartz schist
QRTZ Quartzite
RSDM Residual
RYLT Rhyolite
RBBL Rubble
SAND Sand
SDCL Sand and clay
SDGL Sand and gravel
SDST Sand and silt
SGVC Sand, gravel and clay
SNDS Sandstone
SDSL Sandstone and shale
SCST Schist
SCRE Scree
SRPN Serpentine
SPTC Serpentine talc
SHLE Shale
SHSL Shale and siltstone
SLCT Silcrete
SILT Silt
STCL Silt and clay
SLSN Siltstone
SLSH Siltstone and shale
SLTE Slate
SOIL Soil
SYNT Syenite
SNGS Syenite-gneiss
TALC Talc
TLUS Talus
TILL Till
TLLT Tillite
TRCT Trachyte
TUFF Tuff
VNQZ Vein-quartz

Primary Colours

S Black
B Blue
C Brown
G Green
H Grey
M Purple
O Orange
P Pink
R Red
W White
Y Yellow
No information

Secondary Colours

B Bluish
C Brownish
D Dark
G Greenish
H Greyish
L Light
M Purple
O Orange
P Pinkish
R Reddish

Texture

00 Crypto
01 Micro
11 Very fine
12 Very fine to fine
13 Very fine to medium
14 Very fine to coarse
15 Very fine to very coarse
21 Fine and very fine
22 Fine
23 Fine to medium
24 Fine to coarse
25 Fine to very coarse
31 Medium and very fine
32 Medium and fine
33 Medium
34 Medium to coarse
35 Medium to very coarse
41 Coarse and very fine
42 Coarse and fine
43 Coarse and medium
44 Coarse
45 Coarse to very coarse
51 Very coarse and very fine
52 Very coarse and fine
53 Very coarse and medium
54 Very coarse and coarse
55 Very coarse
No information

Primary and Secondary Features

AG Argillaceous
AR Arenaceous
BD Banded
BE Bedded
BK Baked
BR Broken
BT Bright
CA Calcareous
CB Carbonaceous
CE Cemented
CL Chloritic
CR Cross-bedded
CS Consolidated
CY Clayey
DK Dark
DL Dull
FC Fractured
FE Ferruginous
FR Fresh
FS Feldspathic
GL Glauconitic
GR Gritty
GV Gravel-bearing
HD Hard
HM Heavy minerals
IL Interlaminated
JT Jointed
LM Laminated
LS Loose
LT Light
LU Lustrous
MC Micaceous
MN Mineralised
MS Massive
OO Oolitic
PB Pebbly
PO Phosphoritic
PR Primary
PT Peaty
SC Siliceous
SD Solid
SF Soft
SH Shelly
SI Silicified
SL Silty
SN Sandy
SR Secondary
UC Unconsolidated
WT Weathered

Feature Attributes

\+ Very
\- Slightly
No information

Sorting

11 Unsorted
22 Poorly sorted
23 Poorly to moderately sorted
32 Moderately to poorly sorted
33 Moderately sorted
34 Moderately to well sorted
43 Well to moderately sorted
44 Well sorted
No information

Roundness

11 Angular
12 Angular to subangular
13 Angular to subrounded
14 Angular to rounded
22 Subangular
23 Subangular to subrounded
24 Subangular to rounded
33 Subrounded
34 Subrounded to rounded
44 Rounded
No information

Construction

Method of Construction

A Air-rotary
C Cable-tool
D Dug
H Hydraulic rotary
J Jetted
P Air percussion
R Reverse rotary
Z Other
No information

Information Source

C Construction data
D Driller's logs
F Field checked
G Geologist, technician
M Memory
O Owner's record
R Report or file
P Pump operator's record
No information

Method of Development

A Pumped with air lift (no inductor)
B Bailed
C Compressed air
I Air lifted with inductor
J Jetted or washed
N None
P Pumped
S Surged
No information

Type of Finish

B Brickwork
C Porous concrete
F Filter (gravel pack with perforations)
G Gravel pack with screen
H Horizontal gallery
O Open bottom (partially cased)
P Perforated or slotted
S Screen
W Well point
X Open hole
Z Other
No information

Special Development Treatment

B Brushing
C Chemical (acid, etc.)
D Dry ice
E Explosives
H Hydrofracturing
Z Other
No information

Hole Casing and Piezometer

Material

B Brass
C Concrete
D Copper
P PVC
O Plastic
S Steel
X Stainless steel
Z Other material
No information

Type of Openings

F Perforated or slotted with fibre mesh
M Mesh screen
P Perforated or slotted
S Screen
W Well point
X Open hole
Z Other
No information

Method Openings Made

A Sawn
D Drilled
E Electric cut
G Gas cut
M Machine cut
P Punched
S Screen
W Well point
X Wire wound
Z Other
No information

Fill Material

Type of fill

B Bentonite or clay
C Cement
G Gravel (> 2mm)
S Sand (≤ 2mm)
X Bottom closed
No information

Equipment

Type of Installation

A Airlift
C Centrifugal pump
G Gravity suction
H Hand pump
J Jet
M Mono-type pump
N No equipment
O Observation tube
P Piston pump
Q Powerhead
R Recorder
S Submersible pump
T Turbine
W Windpump
X Windpump with powerhead
Z Other
No information

Type of Power

D Diesel engine
E Electric motor
H Hand
W Windpump
Z Other
No information

Monitoring Facility

A Airline
I Piezometer inside casing
O Piezometer outside casing
T Pressure Transducer
No information

Information Source

See Basic Information

Reservoir Type

C Cement dam
E Earth dam
P Pond
T Tank
Z Zink dam
No information

Discharge Rates

Type of discharge

F Flow
P Pump
No information

Method Discharge Measured

C Current meter
E Estimated
F Flume
M Totalling meter
N Notch (V- or U-notch)
S Submerged orifice
V Volumetric measurement (container + stop-watch method)
U Venturi meter
W Weir
Z Other
No information

Information Source
See Construction

Water Levels

Method Measured

A Airline
E Electrical contact meter
P Pressure gauge measurement
R Recorder
S Steel tape
U Reported, unknown
X Estimate
No information

Water-level Status

A Water level affected by near-by pumped hole or drilling
D Dry
F Flowing
O Obstruction, no water level measured
P Pump water level
R Recovering water level
S Static water level
No information

Pumping Tests

Method Tested

A Air test
B Bailer test
F Free flow test
O Owner test
P Controlled pumping test (step or main)
R Pumping test with recovery
S Slug test
No information

Borehole Geophysics

Information Source

F Field checked
G Geophysicist
M Memory
O Owner's record
R Report or file
No information

Instrumentation

Type of installation

C Conductivity probe
G Gas sampler
H pH probe
L Water-level recorder
M Measuring weir
P Pump
R Rain gauge
S Water sampler
T Temperature probe
W Weather station
Z Other
No information

Information Source

C Construction data
F Field checked
G Geologist, technician
H Hydrologist
M Memory
O Owner's record
R Report or file
P Pump operator's record
No information

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SURFACE HYDROLOGY/METEOROLOGY DATA SHEET

PARAMETER MEASURED

SITE ID	INFO SOURCE	DATE	TIME	VALUE ( )

HydroCom

PUMPING TEST DATA SHEET

Pumped hole site ID [ ] Method tested [ ]

Depth to intake [( )] Discharge units [Metric/U.S./Imp. ( )]

General information			Water level				Discharge rate			
Site ID	Date	Time	Meth.	Stat.	Piezo	Level ( )	Type	Meth.	Info.	Disch.
		h		P	0					
		h		P	0					
		h								
		h								
		h								
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HydroCom

GEOLOGICAL LOG DATA SHEET

SITE ID CODE
NUMBER ON MAP
INFO. SOURCE

Date drilled Depth to top Depth to bottom Lithology code Unit
Color - primary secondary Texture Feature - primary secondary attribute Notepad Sorting Roundness

Date drilled Depth to top Depth to bottom Lithology code Unit
Color - primary secondary Texture Feature - primary secondary attribute Notepad Sorting Roundness

Date drilled Depth to top Depth to bottom Lithology code Unit
Color - primary secondary Texture Feature - primary secondary attribute Notepad Sorting Roundness

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Color - primary secondary Texture Feature - primary secondary attribute Notepad Sorting Roundness

Date drilled Depth to top Depth to bottom Lithology code Unit
Color - primary secondary Texture Feature - primary secondary attribute Notepad Sorting Roundness

HydroCom

PENETRATION RATE DATA SHEET

SITE ID	NUMBER ON MAP	DATE ENTERED	REPORTING INSTITUTION	DEPTH TO TOP ( )	DEPTH TO BOTTOM ( )	BOREHOLE DIAMETER ( )	PENETRATION RATE ( )	INFO SOURCE	COMMENT

HydroCom

CASING AND PIEZOMETER DATA SHEET

SITE ID CODE _____ NUMBER ON MAP _____

Piezometer tube number (if applicable) ☐ Date casing installed _____

Casing/piezometer depth below surface: top _____ bottom _____

Diameter of casing/piezometer _____ Material ☐ Material thickness _____

For slotted casing/piezometer tube -

Openings: type ☐ length _____ width _____

Distance between openings: horizontal _____ vertical _____

Method openings made ☐ Comment _____

Piezometer tube number (if applicable) ☐ Date casing installed _____

Casing/piezometer depth below surface: top _____ bottom _____

Diameter of casing/piezometer _____ Material ☐ Material thickness _____

For slotted casing/piezometer tube -

Openings: type ☐ length _____ width _____

Distance between openings: horizontal _____ vertical _____

Method openings made ☐ Comment _____

Piezometer tube number (if applicable) ☐ Date casing installed _____

Casing/piezometer depth below surface: top _____ bottom _____

Diameter of casing/piezometer _____ Material ☐ Material thickness _____

For slotted casing/piezometer tube -

Openings: type ☐ length _____ width _____

Distance between openings: horizontal _____ vertical _____

Method openings made ☐ Comment _____

HydroCom

AQUIFER INFORMATION DATA SHEET

SITE ID CODE **NUMBER ON MAP**

Date entered Rep. Inst. Depth: top bottom
Aquifer code Yield Method measured
Info. Source Comment

Date entered Rep. Inst. Depth: top bottom
Aquifer code Yield Method measured
Info. Source Comment

Date entered Rep. Inst. Depth: top bottom
Aquifer code Yield Method measured
Info. Source Comment

Date entered Rep. Inst. Depth: top bottom
Aquifer code Yield Method measured
Info. Source Comment

Date entered Rep. Inst. Depth: top bottom
Aquifer code Yield Method measured
Info. Source Comment

Date entered Rep. Inst. Depth: top bottom
Aquifer code Yield Method measured
Info. Source Comment

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BOREHOLE WATER LEVEL DATA SHEET

SITE ID	METHOD MEASURED	WL STATUS	PIEZO #	DATE	TIME	WL DEPTH ( ) BELOW CASING

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WATER DISCHARGE DATA SHEET

SITE ID	TYPE	METHOD MEASURED	INFO SOURCE	DATE	TIME	DISCHARGE ( )