1997/19
copy3

AGSO

GABLOG: THE GREAT ARTESIAN BASIN WIRE-LINE LOGGED BOREHOLE DATABASE

BMR PUBLICATIONS COMPACTUS
(LENDING SECTION)

by

Andrew Tucker and Karen Ivkovic

GEOLOGICAL SURVEY
27 OCT 1997

AGSO Record 1997/19

AGSO

AUSTRALIAN
GEOLOGICAL SURVEY
ORGANISATION

Bmr Comp
1997/19
copy3

GABLOG: THE GREAT ARTESIAN BASIN WIRE-LINE LOGGED BOREHOLE DATABASE

Record 1997/19

by Andrew Tucker and Karen Ivkovic

Australian Geological Survey Organisation

Geohazards, Land and Water Resources Division

DEPARTMENT OF PRIMARY INDUSTRIES AND ENERGY

Minister for Primary Industries and Energy: Hon. J. Anderson, M.P.

Minsiter for Resources and Energy: Senator the Hon. W.R. Parer

Secretary: Paul Barratt

AUSTRALIAN GEOLOGICAL SURVEY ORGANISATION

Executive Director: Neil Williams

© Commonwealth of Australia, 1997

ISSN: 1039-0073

ISBN: 0 642 25026 X

This work is copyright. Apart from fair dealings for the purpose of study, research, criticism or review, as permitted under the *Copyright Act 1968*, no part may be reproduced by any process without written permission. Copyright is the responsibility of the Executive Director, Australian Geological Survey Organisation. Requests and inquiries concerning reproduction and rights should be directed to the **Manager, Corporate Publications, Australian Geological Survey Organisation, GPO Box 378, Canberra, ACT, 2601**

AGSO has endeavoured to use modern techniques and technologies to produce this information. However, users should be aware that such technologies and techniques may be imperfect, and that AGSO's interpretation may not be the best or only interpretation possible. Therefore AGSO makes no guarantees, implied or otherwise, that it may be suitable for the purpose you intend. If you have any doubts as to the purpose /suitability of this material, or if you require further information please contact the author. **YOU SHOULD NOT RELY SOLELY ON THIS INFORMATION WHEN CONSIDERING ISSUES WHICH MAY HAVE COMMERCIAL IMPLICATIONS.**

ABSTRACT

The Bureau of Mineral Resources, Geology and Geophysics (now Australian Geological Survey Organisation) carried out an extensive program of geophysical logging of waterbores in the Great Artesian Basin during the 1960s and 1970s. A total of 1235 boreholes were logged in Queensland, New South Wales and the Northern Territory.

The suite of logs obtained included one or more of: natural gamma, neutron-gamma, temperature, differential-temperature, flowmeter, caliper, spontaneous-potential, resistivity and casing-collar locator logs. The analogue traces of the wire-line logs have been digitised under funding provided by the National Landcare Program, and are to be released as digital data on CD-ROM. The CD-ROM will also include data on the logs, data on the waterbores logged, their lithostratigraphy and hydrochemistry. This data set on CD-ROM, together with maps showing the locations of the wire-line logged waterbores, will be published as AGSO Bulletin 240.

The Great Artesian Basin Wire-Line Log (GABLOG) database, the subject of this documentation, contains general data on the waterbores logged, the types of wire-line logs for each borehole, hydrochemical analyses and stratigraphic interpretations. The. GABLOG database is implemented with version 7 of the Oracle RDBMS. The data is held in five tables, and two sets of views of the data have been developed to enhance the utility of the package - one allows data conversion into enduser databases and the other is set up for conversion into enduser spreadsheets.

We expect that the user-friendly format of the GABLOG database will be of great assistance to the state water and geological authorities, and to the petroleum and mining exploration industry and other users.

CONTENTS

ABSTRACT i

CONTENTS ii

LIST OF FIGURES iii

1. INTRODUCTION 1

2. IMPLEMENTING THE GABLOG DATABASE WITH ORACLE 1

2.1 CONSTRAINTS 2
2.2 VIEWS 2

3. DATA TABLES 4

3.1 GLGEN 4
3.2 GLLOG 5
3.3 GLCHEM 6
3.4 GLSTRAT 8
3.5 GLFLOW 8

4. LOOKUP TABLES 9

4.1 GLSTATE 9
4.2 GLMAP250 9
4.3 GLOWNER 10
4.4 GLSTRATCODE 10
4.5 GLLOGTYPE 13
4.6 GLLOGUNITS 13
4.7 GLELEV 14
4.8 GLCONUNITS 14
4.9 GLCHACCU 15
4.10 GLLAB 15

5. VIEWS 18

5.1 GLVGEN 18
5.2 GLVLOG 19
5.3 GLVCHEM 20
5.4 GLVFLOW 21
5.5 GLVSTRAT 22
5.6 GLSGEN 22
5.7 GLSLOG 23
5.8 GLSCHEM 24
5.9 GLSFLOW 26
5.10 GLSSTRAT 26

6. DISTRIBUTION OF GABLOG DATA ON CD_ROM 27

7. ACKNOWLEDGMENTS 31

8. REFERENCES 32

Appendix i 33

LIST OF FIGURES

Figure 1: Diagram of relationships between GABLOG database tables.....3
Figure 2: View of GABLOG database for data conversion into endusers spreadsheets..16
Figure 3: View of GABLOG database for data conversion into endusers databases.....17
Figure 4: Directory structure of distribution disk.....30

1. INTRODUCTION

The structure and detailed layout of the Great Artesian Basin Wire-Line Log (GABLOG) database is described in this record.

The GABLOG database holds borehole data, interpreted stratigraphic data, hydrochemical data, and wire-line log availability data from approximately 1235 waterbores in the Great Artesian Basin. The data has been gathered by the Bureau of Mineral Resources, Geology and Geophysics (BMR, now AGSO) during the 1960's and 1970's (M.A. Habermehl, 1985). The database lists the availability and formats of geophysical logs (natural gamma-ray, neutron-gamma, temperature, differential temperature, flowmeter, caliper, resistivity and spontaneous potential), along with the results of hydrochemical analyses and lithostratigraphic interpretations of the wire-line logs. Data derived from the GABLOG database will be included on a CD-ROM containing the digitised wire-line logs.

The wire-line log availability data has been released previously as BMR Report 241 (Habermehl & Morrissey, 1983). Copies of the wire-line logs have been available on paper from AGSO and can be purchased on request. An earlier database designed in 1980 (Habermehl, 1980) was used to store (on 80 column computer cards) some of the information held in the GABLOG database. The earlier database is no longer accessable, though some of the information has been included in BMR Report 241. The GABLOG database is an expanded and updated dataset, which contains data on the waterbores logged, the wire-line logs, hydrochemical data and stratigraphic interpretations of the wire-line wire-line logs (the latter from B.R. Senior & Associates Pty. Ltd).

The GABLOG database described in this report has been implemented with the Oracle RDBMS (Relational Database Management System) (Oracle, 1993). The availability of Oracle version 7, with a new new feature, "constraints", has enhanced the design and implementation of the GABLOG database. The implementation of the database is described in chapter 2. No forms based interface has been implemented: end-users of the database will access the data from a variety of hardware and software platforms. A glossary of some of the terms used in this record can be seen in Lenz et. al. (1993).

The complete and current GABLOG data set, along with digital wire-line log data, will be released on CD-ROM, together with a set of three maps showing the locations of the wire-line logged waterbores, as AGSO Bulletin 240.

An overview of the development database is shown in Figure 1. Two sets of views of the data have been developed to allow the data to be readily distributed: these views can be seen in Figures 2 and 3. The database structure is discussed in more detail in Chapters 3, 4 and 5 of this document.

2. IMPLEMENTING THE GABLOG DATABASE WITH ORACLE

The GABLOG database was designed to store data and information about AGSO's collection of wire-line well logs from the Great Artesian Basin. Also, it was necessary to consider requirements that the data be internally consistent, and that control be maintained over the

data to be distributed. Consequently, the GABLOG database was implemented on AGSO's corporate database server. This is a well maintained and reliable system, that supports version 7 of the Oracle RDBMS (Lenz, 1993).

2.1 Constraints

Oracle version 7 has allowed constraints on data to be implemented during the design of the database. The use of these constraints can help ensure that:

- Data values in a given field fall within acceptable limits. For example, a check constraint can be used to ensure that a chemical concentration is null, or greater than or equal to zero

- Data in one field of a record is logically consistent with data in other fields within the same table. For example, a check constraint can be used to ensure that the data value for the top of a wire-line log is above the data value for the bottom of the wire-line log

- Referential integrity is maintained between related tables. For example, a referential integrity constraint can be used to ensure that each wire-line log record has a matching record in a table storing borehole location details

2.2 Views

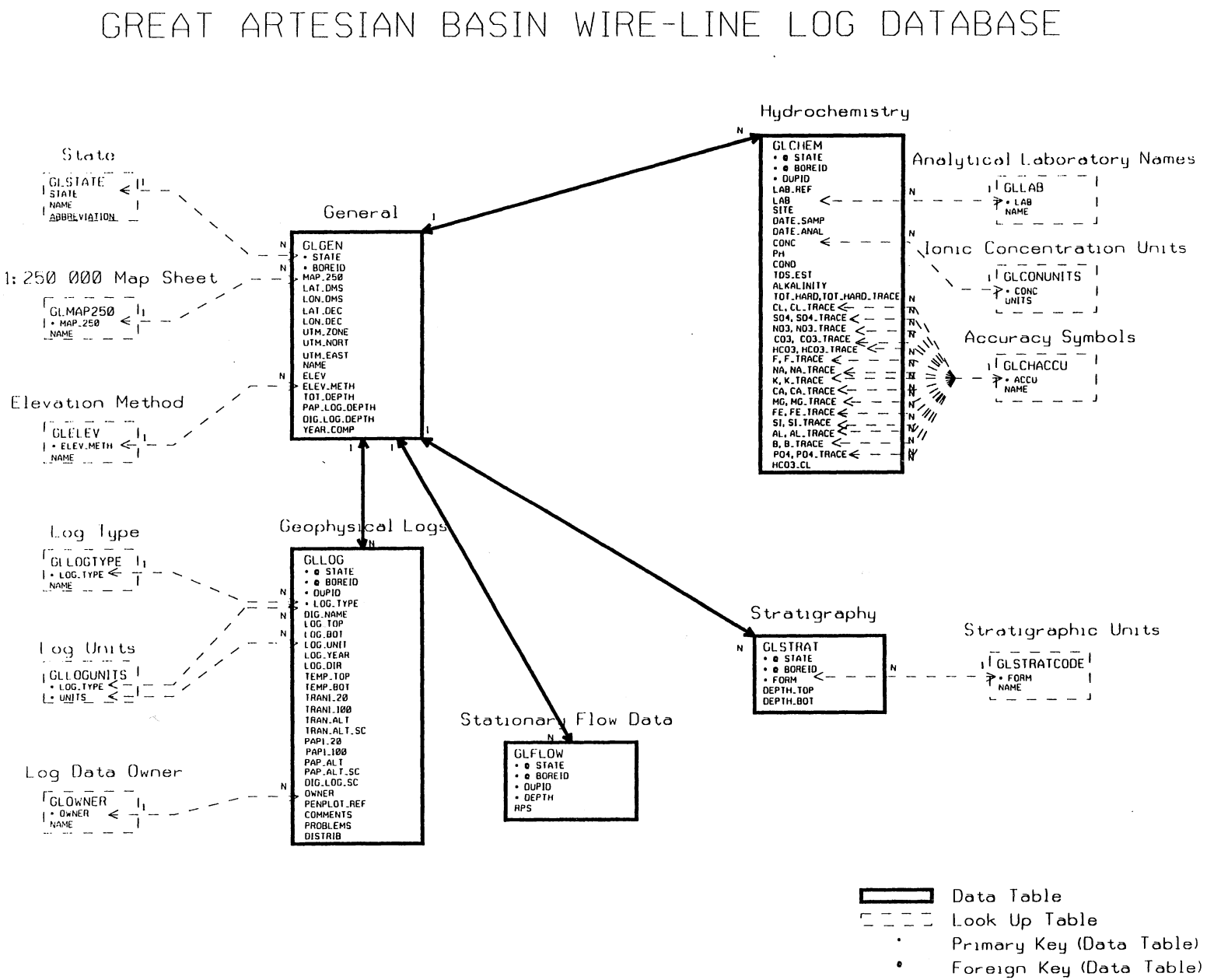
Two factors have motivated the use of Oracle views for the GABLOG database.

- Some digitised wire-line logs listed in the GABLOG database are not distributable by AGSO - these logs may, for example, have been produced for a private company.

- The end-users of the distributed data may not have access to an Oracle RDBMS - and they may be limited to any one of a number of PC or Macintosh database or spreadsheet applications. Therefore, on the distribution media for the GABLOG database and digitised wire-line logs, the database has been stored as flat files, with the definitions originally held in authority tables transferred into the data tables. The database is also stored on the distribution media as an Oracle 7 export file.

Two sets of views on the database have been defined. The first set of views is designed to aid transfer of the GABLOG data into other databases, and the second is for data conversion into spreadsheets. Neither of the two sets of views include data that is not distributable by AGSO. Both views integrate look up (or authority) table data with the data tables. The views created for spreadsheets also integrate bore location data with each record in the hydrochemistry, flow, stratigraphy and geophysical log description tables, thereby reducing the need to cross-reference spreadsheets when selecting data for spatial analysis.

Figure 1: Diagram of relationships between GABLOG database tables



3. DATA TABLES

GABLOG data is held in five tables:

GLGEN: holds general information about each bore, including bore location data.
GLLOG: holds information describing each of the digitised wire-line logs.
GLFLOW: holds stationary flow data measured during impeller flow meter tests. Interpreted
GLSTRAT: holds stratigraphic data.
GLCHEM: holds hydrochemical data.

The primary keys for the GLGEN table are the state and boreid columns, these columns are also foreign keys for each of the remaining four data tables.

These are also several look up tables, which are useful in providing consistency checks on values in the data tables:

GLSTATE: holds state names and abbreviations for those states covering portions of the GAB.
GLMAP_250: stores 1:250 000 map sheet names and codes for those map sheets covering or partially covering the GAB.
GLELEV: holds methods for measuring the elevation of the bores.
GLLOGTYPE: holds a list of the valid types of geophysical logs held in the database.
GLLOGUNITS: holds a list of the valid units for each geophysical log type.
GLSTRATCODE: holds a list of formation names and abbreviations for the GAB.
GLCHACCU: holds a list of codes representing the accuracy of data.
GLCONUNITS: holds allowable concentration units.
GLLAB: stores valid laboratory names and their abbreviations.

A diagram of the relationship between tables is shown in Figure 1.

To maintain consistency with existing hardcopy log originals, all depth measurements have been given in feet. The original chemical concentration units listed in the analytical laboratory result sheets have also been maintained.

3.1 GLGEN

The GLGEN table holds the bore location and bore name of each water-bore, the year that drilling was completed, the depth of the bore, the greatest depth reached by both the original and digitised geophysical logs, and the elevation of the bore. Note that the total depth (tot_depth) of the bore may be considerably different from the maximum depth of the digitised wire-line logs: the bore may have been deepened after its initial construction, the bore may also have become blocked at some point, preventing wire-line logging below the depth of the obstruction. The primary keys are the state and boreid fields.

state: state code, referencing **GLSTATE.STATE** look up table. One character.
boreid: state registration number or bore name. Character field with a maximum length of six characters.
lat_DMS: latitude, in degrees, minutes and seconds. Character field, format "nn nn nn" (positive southwards)
lon_DMS: longitude, in degrees, minutes and seconds, format "nnn nn nn"

lat_dec: latitude, as a decimal number, format "nn.nnnnnnnn" (positive southwards)
lon_dec: longitude, as a decimal number, format "nnn.nnnnnnnn"
utm_zone: universal transverse mercator zone, numeric, format "nn" (range 53-56)
UTM_east: UTM easting, meters, numeric, format "nnnnnnnnnnnn.nn"
UTM_nort: UTM northing, meters, numeric, format "nnnnnnnnnnnn.nn"
map_250: UTM 1:250 000 mapsheet code. References **GLMAP250.MAP_250**. Character field, format "SA_1-$5A_2$", where A_1 is in the range "C"-"I", and A_2 is in the range "3"-"6".
name: full name of bore. Character field of maximum length 35.
elev: elevation of groundsurface in feet with respect to the Australian height datum. (AHD). Numeric field with format "nnnnn.n"
elev_meth: method by of elevation measurement, referencing **GLELEV.ELEV_METH**. A character field of length one.
tot_depth: total depth of bore in decimal feet, measured from groundsurface. Numeric field with format "nnnnn.n"
pap_log_depth: greatest depth of any of the logs for this bore as shown on original wire-line logs, in decimal feet, measured from groundsurface. Numeric field with format "nnnnn.n".
dig_log_depth: greatest depth of digital copies of any of the logs for this bore, in feet, measured from groundsurface. Numeric field with format "nnnnn.n".
year_comp: year the initial drilling was completed. Numeric field, with format "nnnn", and with values in the range 1870-1999.

3.2 GLLOG

This table holds descriptions of each geophysical log, and the scales and formats in which the data is available. The primary keys are the state, boreid, and dupid fields. Most of the original geophysical logs are available in both 1 inch:20 foot and 1 inch: 100 foot scales. Some are available at another scale. The original logs were recorded on transparent film, which are stored in AGSO and paperprint copies also held at AGSO. The tran1_20, tran1_100, tran_alt, pap1_20, pap1_100, pap_alt fields indicate the media and the scale of the original logs. Where a scale other than 1 inch: 100 foot or 1 inch: 20 foot has been been used for the original log, this scale is indicated in the tran_alt_sc or pap_alt_sc fields. The scale of the original log that was digitised to produce a log for distribution on the CD-ROM is stored in the dig_log_sc field.

state: state code. Character field of length one.
boreid: state registration number or bore name. Character field with a maximum length of six characters.
dupid: code of duplicate log for the bore, null for first geophysical log recorded, "b","c","d" etc for subsequent logs. Character length 1 or 0, range "b" - "z"
log_type: type of the geophysical log, referencing **LOGTYPE.LOG_TYPE**. Character string of length 1-3.
dig_name: name of the file containing the digitised log data (MS-DOS compatible). Character field with format "ABBBBBBC.DDD" where A is the state code, BBBBBB is the bore i.d., C is the duplicate code (if present), and DDD is the log type.
log_top: highest depth logged relative to groundsurface, feet. Numeric field with format "nnnnn.n".
log_bot: lowest depth logged relative to groundsurface, feet. Numeric field with format "nnnnn.n".

log_unit: units of the geophysical log, character, length 10. Referencing **GLLOGUNIT.UNITS** look up table. Character field of maximum length 10.

log_dir: The probe movement, either upwards or downwards during logging. Character field of maximum length 4, with two permissable values, "up" or "down".

log_year: the year the bore was logged. Numeric field with format "nnnn".

temp_top: the temperature of the groundwater at groundsurface, in degrees Celsius. Is only non-null for temperature logs. Numeric field with format "nnn.nn".

temp_bot: the temperature of the groundwater at the bottom of the log, in degrees Celsius. Only used for temperature logs. Numeric field with format "nnn.nn".

tran1_20: availability as transparent original at 1"-20' depth scale. Character field with value of either "y" or "n".

tran1_100: available as transparent original at 1"-100' depth scale. Character field with value either "y" or "n".

tran_alt: available as transparent original at non-standard scale. Character field with value either "y" or "n".

tran_alt_sc: alternate depth scale of log on transparent original. Character field with maximum length 15.

pap1_20: availability as paper copy at 1"-20' depth scale. Character field with value either "y" or "n".

pap1_100: availability as paper copy at 1"-100' depth scale. Character field with value either "y" or "n".

pap_alt: availability as paper copy at non-standard scale. Character field with value either "y" or "n".

pap_alt_sc: alternate depth scale of log on paper copy. Character field with maximum length of 15 characters.

dig_log_sc: the scale of the hardcopy log from which the wire-line log was digitised. Character field with maximum length 15.

owner: the owner of the log, referencing **GLOWNER.owner**. The owner of the log is that person or organisation which aquired the original log and which controls the distribution of the log. Character field of maximum length 5.

penplot_ref: reference to the index system for disks and paper check prints of the data. Character field of maximum length 10.

comments: description of any problems encountered during the geophysical logging of the bore. Character field of maximum length 100.

problems: description of any problems encountered during digitising of the geophysical wire-line log. Character field of maximum length 100.

distrib: Distributiion status. Character field with value either "y" or "n".

3.3 GLCHEM

This table stores the results of hydrochemistry analyses data obtained in the laboratory for each water bore. The primary keys are the state, boreid and dupid fields.

state: state code. Character field of length one.

boreid: state registration number or bore name. Character field with a maximum length of six characters.

dupid: code of duplicate analysis for the bore, null for first geophysical log recorded, b,c,d etc for subsequent logs. Character field of length one, range "b"-"z".

lab_ref: laboratory reference number of the sample. Character field, maximum length of 20 characters.

lab: abbreviated name of the organisation which analysed the chemical data, referencing **GLLAB.GLLAB**. Character field of maximum length 8.

site: description of the sample site. Character field of maximum length 40.

date_samp: date of sample collection.

date_anal: date of sample analysis.

conc: concentration units for ionic analyses, referencing **GLCONUNITS.CON.** Character field of maximum length 4.

pH: pH of the sample. Numeric field with format "nn.nn"

cond: electrical conductivity of the sample, in microsiemens/cm. Numeric field with format "nnnnn".

TDS_est: estimated TDS in ppm (parts per million). Numeric field with format "nnnnnn".

alkalinity: as $CaCO_3$ in ppm. Numeric field with format "nnnnn".

tot_hard: total hardness as calcium and magnesium salts as $CaCO_3$ in ppm. Numeric field with format "nnnnn.nn".

Cl: chloride concentration. Numeric field with format "nnnnn.nn".

Cl_trace: trace symbol for chloride concentration value, referencing **GLCHACCU.ACCU**. Character field of length 1.

SO4: sulphate concentration. Numeric field with format "nnnnn.nn".

SO4_trace: trace symbol for sulphate concentration value, referencing **GLCHACCU.ACCU**. Character field of length 1.

NO3: nitrate concentration. Numeric field with format "nnnnn.nn".

NO3_trace: trace symbol for nitrate concentration value, referencing **GLCHACCU.ACCU**. Character field of length 1.

CO3: carbonate concentration. Numeric field with format "nnnnn.nn".

CO3_trace: trace symbol for carbonate concentration value, referencing **GLCHACCU.ACCU**. Character field of length 1.

HCO3: bicarbonate concentration. Numeric field with format "nnnnn.nn".

HCO3_trace: trace symbol for bicarbonate concentration value, referencing **GLCHACCU.accu**. Character field of length 1.

F: fluoride concentration. Numeric field with format "nnnnn.nn".

F_trace: trace symbol for fluoride concentration value, referencing **GLCHACCU.ACCU**. Character field of length 1.

Na: sodium concentration. Numeric field with format "nnnnn.nn".

Na_trace: trace symbol for sodium concentration value, referencing **GLCHACCU.ACCU**. Character field of length 1.

K: potassium concentration. Numeric field with format "nnnnn.nn".

K_trace: trace symbol for potassium concentration value, referencing **GLCHACCU.ACCU**. Character field of length 1.

Ca: calcium concentration. Numeric field with format "nnnnn.nn".

Ca_trace: trace symbol for calcium concentration value, referencing **GLCHACCU.ACCU**. Character field of length 1.

Mg: magnesium concentration. Numeric field with format "nnnnn.nn".

Mg_trace: trace symbol for magnesium concentration value, referencing **GLCHACCU.ACCU**. Character field of length 1.

Fe: iron concentration. Numeric field with format "nnnnn.nn".

Fe_trace: trace symbol for iron concentration value, referencing **GLCHACCU.ACCU**. Character field of length 1.

Si: silica concentration. Numeric field with format "nnnnn.nn"

Si_trace: trace symbol for silica concentration value, referencing **GLCHACCU.ACCU**. Character field of length 1.

Al: aluminium concentration. Numeric field with format "nnnnn.nn". (note: no aluminium values present in the database)

AL_trace: trace symbol for aluminium concentration value, referencing **GLCHACCU.ACCU**. Character field of length 1.

B: boron concentration. Numeric field with format "nnnnn.nn".

B_trace: trace symbol for boron concentration value, referencing **GLCHACCU.ACCU**. Character field of length 1.

PO4: phosphate concentration. Numeric field with format "nnnnn.nn".

PO4_trace: trace symbol for phosphate concentration value, referencing **GLCHACCU.ACCU**. Character field of length 1.

HCO3_Cl: bicarbonate/chloride ratio. Numeric format "nnnnn.nnnnn".

3.4 GLSTRAT

This table holds lithostratigraphic data that were interpreted from the geophysical logs by Dr B.R. Senior & Associates, Pty. Ltd while under contract to AGSO. The state, boreid, and form fields are the primary keys for the GLSTRAT table.

state: state code. Character field of length one.

boreid: state registration number or bore name. Character field with a maximum length of six characters.

depth_top: depth from groundsurface to the top of formation (feet). Numeric field with format "nnnnn.n"

depth_bot: depth from groundsurface to bottom of fromation (feet). Numeric field with format "nnnnn.n"

form: formation abbreviation. Referencing **GLSTRATCODE.FORM**. Character field with maximum length 12.

3.5 GLFLOW

This table holds stationary flow measurements made during flowmeter logging.

state: State code. Character field of length one.

boreid: state registration number or bore name. Character field with a maximum length of six characters.

dupid: code of duplicate log for the bore, null for first geophysical log recorded, "b","c","d" etc for subsequent logs. Character length 1, range "b"-"z"

depth: Depth from groundsurface in feet, at which flow measurement was made. Numeric field with format "nnnn.n".

rps: flow rate, in impellor flowmeter revolutions per second. Numeric field with format "nnnn.n".

4. LOOKUP TABLES

4.1 GLSTATE

The GLSTATE table holds valid state names for bores in the GABLOG database and their abbreviations. The state field is the primary key.

state: State code, character string, character, format "n"
name: full name of State, character string of maximum length 20
abb: abbreviated name of State, character, maximum length 3

State Abbreviation	Abbreviation	State Name
n	NSW	New South Wales
q	Qld	Queensland
s	SA	South Australia
t	NT	Northern Territory

4.2 GLMAP250

This table contains 1:250 000 AMG mapsheets that cover most of the area of the Great Artesian Basin. The map_250 field is the primary key for the table.

map_250: UTM mapsheet code. Character, format "SA_1-$5A_2$", where A_1 is in the range "C"-"I", and A_2 is in the range "3"-"6". Character field of length 6.
name: UTM 1:250 000 mapsheet name. Character field of maximum length 25.

Map No.	1:250000 Map Name	Map No.	1:250000 Map Name	Map No.	1:250000 Map Name
SC5415	JARDINE RIVER	SG5402	MACHATTIE	SH5402	STRZELECKI
SC5416	ORFORD BAY	SG5403	CONNEMARA	SH5403	TICKALARA
SD5403	WEIPA	SG5404	JUNDAH	SH5404	BULLOO
SD5404	CAPE WEYMOUTH	SG5501	BLACKALL	SH5501	EULO
SD5407	AURUKUN	SG5502	TAMBO	SH5502	CUNNAMULLA
SD5411	HOLROYD	SG5503	SPRINGSURE	SH5503	DIRRANBANDI
SD5415	RUTLAND PLAINS	SG5504	BARALABA	SH5504	ST GEORGE
SE5401	MORNINGTON	SG5601	MONTO	SH5601	GOONDIWINDI
SE5402	CAPE VAN DIEMAN	SG5306	FINKE	SH5306	COOBER PEDY
SE5403	GALBRAITH	SG5307	McDILLS	SH5307	BILLA KALINA
SE5405	WESTMORELAND	SG5308	SIMPSON DESERT SOUTH	SH5308	CURDIMURKA
SE5406	BURKETOWN	SG5405	BIRDSVILLE	SH5405	MARREE
SE5407	NORMANTON	SG5406	BETOOTA	SH5406	CALLABONNA
SE5408	RED RIVER	SG5407	CANTERBURY	SH5407	MILPARINKA
SE5505	ATHERTON	SG5408	WINDORAH	SH5408	URISINO
SE5409	LAWN HILL	SG5505	ADAVALE	SH5505	YANTABULLA
SE5410	DONORS HILL	SG5506	AUGATHELLA	SH5506	ENNGONIA
SE5411	CROYDON	SG5507	EDDYSTONE	SH5507	ANGLEDOOL
SE5412	GEORGETOWN	SG5508	TAROOM	SH5508	MOREE
SE5414	DOBBYN	SG5605	MUNDUBBERA	SH5605	INVERELL
SE5415	MILLUNGERA	SG5310	ABMINGA	SH5310	TARCOOLA
SE5416	GILBERTON	SG5311	DALHOUSIE	SH5311	KINGOONYA
SE5513	CLARKE RIVER	SG5312	POOLAWANNA	SH5312	ANDAMOOKA
SF5402	CLONCURRY	SG5409	PANDIE PANDIE	SH5409	COPLEY
SF5403	JULIA CREEK	SG5410	CORDILLO	SH5410	FROME
SF5404	RICHMOND	SG5411	BARROLKA	SH5411	COBHAM LAKE
SF5501	HUGHENDEN	SG5412	EROMANGA	SH5412	WHITE CLIFFS
SF5502	CHARTERS	SG5509	QUILPIE	SH5509	LOUTH

Map No.	1:250000 Map Name	Map No.	1:250000 Map Name	Map No.	1:250000 Map Name
	TOWERS				
SF5406	DUCHESS	SG5510	CHARLEVILLE	SH5510	BOURKE
SF5407	McKINLAY	SG5511	MITCHELL	SH5511	WALGETT
SF5408	MANUKA	SG5512	ROMA	SH5512	NARRABRI
SF5505	TANGORIN	SG5609	CHINCHILLA	SH5609	MANILLA
SF5506	BUCHANAN	SG5610	GYMPIE	SH5413	PARACHILNA
SF5409	GLENORMISTON	SG5314	WINTINNA	SH5414	CURNAMONA
SF5410	BOULIA	SG5315	OODNADATTA	SH5415	BROKEN HILL
SF5411	MACKUNDA	SG5316	NOOLYEANA	SH5416	WILCANNIA
SF5412	WINTON	SG5413	GASON	SH5515	NYNGAN
SF5509	MUTTABURRA	SG5414	INNAMINCKA	SH5516	GILGANDRA
SF5510	GALILEE	SG5415	DURHAM DOWNS	SI5503	NARROMINE
SF5315	ILLOGWA CREEK	SG5416	THARGOMINDAH	SI5504	DUBBO
SF5316	HAY RIVER	SG5513	TOOMPINE	SC5411	THURSDAY ISLAND
SF5413	MOUNT WHELAN	SG5514	WYANDRA	SC5412	CAPE YORK
SF5414	SPRINGVALE	SG5515	HOMEBOIN	SD5408	COEN
SF5415	BRIGHTON DOWNS	SG5516	SURAT	SD5412	EBAGOOLA
SF5416	MANEROO	SG5613	DALBY	SD5509	CAPE MELVILLE
SF5513	LONGREACH	SG5614	IPSWICH	SD5416	HANN RIVER
SF5514	JERICHO	SH5302	MURLOOCOPPIE	SD5513	COOKTOWN
SG5303	HALE RIVER	SH5303	WARRINA	SE5404	WALSH
SG5304	SIMPSON DESERT NORTH	SH5304	LAKE EYRE	SE5501	MOSSMAN
SG5401	BEDOURIE	SH5401	KOPPERAMANNA		

4.3 GLOWNER

The data in the GLOWNER table lists valid owners of the log data. The owner field is the primary key for the table.

Owner: abbreviated name of owner of the LOG. Character field of maximum length 8.
Name: the name of the organisation owning the log. Character field of maximum length 60.

The current values are:

OWNER	Owner Abb.
Australian Geological Survey Organisation	AGSO
American Overseas Petroleum Ltd	AOP
CYPLUS NRAP	CYPLUS
CRA	CRA
Winton Shire Council	WSC
Geological Survey of Queensland	GSQ
Zinc Corp Ltd	ZC
Mines Administration Pty Ltd	MA
North American International	NAI
Mid Eastern Oil NL	MEO
South Australian Department of Mines and Energy	SADME

4.4 GLSTRATCODE

The data in the GLSTRATCODE table is a list of allowable stratigraphic unit names and abbreviations. The form field is the primary key for the table.

form: Abbreviation for formation code. Character field of maximum length 12 characters.

name: lithostratigraphic unit name. Character field of maximum length 30.

The values in the table (the first two columns are sorted by formation name, the second two columns are ordered by formation name, and formation code) are:

ORDERED BY FORMATION NAME		ORDERED BY FORMATION CODE	
FORMATION NAME	CODE	CODE	FORMATION NAME
Adori Sandstone	Ja	Bas	Basement
Adori Sandstone/Birkhead Formation	Ja/Jmb	Bas?	Basement?
Algebuckina Sandstone	Jua	CPi	Joe Joe Formation
Allaru Mudstone	Kla	CZv	Wyaaba Beds
Allaru Mudstone equivalent	Kla=	Canp	Canaway Profile
Allaru Mudstone?	Kla?	Ck	Kuttung Formation
Basement	Bas	Ck/Ub	Kuttung Formation/Basement
Basement?	Bas?	Cz	Cainozoic
Birkhead Formation	Jmb	Cz?	Cainozoic?
Blackwater Group	Puw	Czs	Sturgeon Basalt
Blantyre Beds	Jub	DCb	Buckabie Formation
Boxvale Sandstone Member	Jlb	Dme	Etonvale Formation
Buckabie Formation	DCb	J	Undifferentiated Jurassic
Bulimba Formation	KTi	JKh	Hooray Sandstone
Bungil Formation	Klv	JKh/Klg	Hooray Sandstone/Gilbert River
Bungil Formation/Drildool Beds	Klv/Td	JKhm	Murta Member
Cadna-Owie Formation	Kco	JKhmm	Middle Member
Cainozoic	Cz	JKhn	Namur Sandstone Member
Cainozoic?	Cz?	JKk	Kumbarilla Beds
Campaspe Beds	Tc	JKr	Ronlow Beds
Canaway Profile	Canp	Ja	Adori Sandstone
Chinchilla Sand	Tpc	Ja/Jmb	Adori Sandstone/Birkhead Formation
Claraville Beds	TQc	Ji	Injune Creek Group
Clematis Sandstone	TRe	Ji?	Injune Creek Group?
Colinlea Sandstone	Plo	Jlb	Boxvale Sandstone Member
Coreena Member	Klc	Jle	Evergreen Formation
Crown Point Formation/Purni	Pc/CPo	Jlh	Hutton Sandstone
Doncaster Member	Kld	Jll	Helidon Sandstone
Drildool Beds	Td	Jlm	Marburg Sandstone
Dunda Beds	TRld	Jlp	Precipice Sandstone
Etonvale Formation	Dme	Jmb	Birkhead Formation
Eulo Queen Group	Jue	Jme	Eurombah Formation
Eurombah Formation	Jme	Jmw	Walloon Coal Measures
Evergreen Formation	Jle	Jp	Pilliga Sandstone
Evre Formation	Tee	Jp/Jug	Pilliga Sandstone/Gubberamunda
Floraville Formation	KTf	Js	Springbok Sandstone
Garraway Beds	Jw	Jua	Algebuckina Sandstone
Gilbert River Formation	Klg	Jub	Blantyre Beds
Gilbert River Formation/Undiff.	Klg/J	Jue	Eulo Queen Group
Glendower Formation	Tg	Jug	Gubberamunda Sandstone
Griman Creek Formation	Klgg	Juo	Orallo Formation

ORDERED BY FORMATION NAME		ORDERED BY FORMATION CODE	
FORMATION NAME	CODE	CODE	FORMATION NAME
Griman Creek Formation/Surat	Klgg/Kls	Juw	Westbourne Formation
Gubberamunda Sandstone	Jug	Juw/Jmb	Westbourne Formation/Birkhead
Helidon Sandstone	Jll	Jw	Garrawav Beds
Hooray Sandstone	JKh	KTam	Mornev Profile
Hooray Sandstone/Gilbert River	JKh/Klg	KTf	Floraville Formation
Hutton Sandstone	Jlh	KTi	Bulimba Formation
Iniune Creek Group	Ji	Kco	Cadna-Owie Formation
Iniune Creek Group?	Ji?	Kla	Allaru Mudstone
Joe Joe Formation	CPi	Kla=	Allaru Mudstone equivalent
Kumbarilla Beds	JKk	Kla?	Allaru Mudstone?
Kuttung Formation	Ck	Klc	Coreena Member
Kuttung Formation/Basement	Ck/Ub	Kld	Doncaster Member
Mackunda Formation	Klm	Klg	Gilbert River Formation
Mackunda Formation/Allaru Mudstone	Klm/Kla	Klg/J	Gilbert River Formation/Undiff.
Marburg Sandstone	Jlm	Klgg	Griman Creek Formation
Middle Member	JKhmm	Klgg/Kls	Griman Creek Formation/Surat
Mooga Sandstone	Klmo	Klm	Mackunda Formation
Moolavember Formation	TRm	Klm/Kla	Mackunda Formation/Allaru Mudstone
Mornev Profile	KTam	Klmo	Mooga Sandstone
Murta Member	JKhm	Klo	Toolebuc Formation
Namur Sandstone Member	JKhn	Klo=	Toolebuc Formation equivalent
Normanton Formation	Klr	Klr	Normanton Formation
Orallo Formation	Juo	Kls	Surat Siltstone
Permian	P	Klu	Wallumbilla Formation
Pilliga Sandstone	Jp	Klw	Wilgunva Sub Group
Pilliga Sandstone/Gubberamunda	Jp/Jug	Klws	Wvandra Sandstone Member
Precipice Sandstone	Jlp	Kly	Bungil Formation
Radioactive marker bed	Rmb	Kly/Td	Bungil Formation/Drildool Beds
Rolling Downs Group	Kr	Kr	Rolling Downs Group
Ronlow Beds	JKr	Kw	Winton Formation
Springbok Sandstone	Js	Kw/Klm	Winton Formation/Mackunda
Sturgeon Basalt	Czs	Kw/Klm/Kla	Winton Formation/Mackunda
Surat Siltstone	Kls	Kw?	Winton Formation?
Toolebuc Formation	Klo	P	Permian
Toolebuc Formation equivalent	Klo=	Pc/CPp	Crown Point Formation/Purni
Triassic	TR	Plo	Colinlea Sandstone
Undifferentiated Jurassic	J	Puw	Blackwater Group
Unnamed Member	U	Qw`	Wondoola Beds
Walloon Coal Measures	Jmw	Rmb	Radioactive marker bed
Wallumbilla Formation	Klu	TQc	Claraville Beds
Warang Sandstone	TRlw	TQw	Whitula Formation
Weathered zone	wz	TR	Triassic
Westbourne Formation	Juw	TRe	Clematis Sandstone
Westbourne Formation/Birkhead	Juw/Jmb	TRld	Dunda Beds
Whitula Formation	TQw	TRlw	Warang Sandstone
Wilgunva Sub Group	Klw	TRm	Moolavember Formation
Windorah Formation	XXXX	Tc	Campaspe Beds
Winton Formation	Kw	Td	Drildool Beds
Winton Formation/Mackunda	Kw/Klm	Tee	Eyre Formation

ORDERED BY FORMATION NAME		ORDERED BY FORMATION CODE	
FORMATION NAME	CODE	CODE	FORMATION NAME
Winton Formation/Mackunda	Kw/Klm/Kla	Tg	Glendower Formation
Winton Formation?	Kw?	Tpc	Chinchilla Sand
Wondoola Beds	Qw	U	Unnamed Member
Wyaaba Beds	CZv	XJlh	pre Hutton Sandstone
Wyandra Sandstone Member	Klws	XXXX	Windorah Formation
pre Hutton Sandstone	XJlh	wz	Weathered zone

4.5 GLLOGTYPE

The GLLOGTYPE field holds valid geophysical log types and their abbreviations. The log_type field is the primary key for the table.

log_type: abbreviation of the geophysical log type. Character field of maximum length 3.
name: nature of the geophysical log. Character field of maximum length of 25.

The values in the GLLOGTYPE table are:

Log Type	Name
gr	natural gamma ray
neu	neutron-gamma ray
t	temperature
dt	differential temperature
cal	caliper
fld	flowmeter logged down
flu	flowmeter logged up
rln	long normal resistivity
rlt	lateral resistivity
rsn	short normal resistivity
sp	spontaneous potential
spr	single point resistance

4.6 GLLOGUNITS

The GLLOGUNITS table lists the valid log units for each type of geophysical log. The log_type and units fields are the primary keys for the table.

log_type: log type abbreviation, referencing **GLLOGTYPE.LOG_TYPE**. Character field with maximum length 3.
units: acceptable units for the log type. Character field with maximum length 10.

The values in the GLLOGUNITS table are:

Log Type Abbreviation	Valid Units	Unit Description

Log Type Abbreviation	Valid Units	Unit Description
gr	API	American Petroleum Institute Units
gr	COUNTS/MIN	counts per minute
gr	CPS	counts per second
gr	mR/hr	milliroentgen per hour
neu	API	American Petroleum Institute Units
neu	CPS	counts per second
t	celsius	degrees Celsius
dt	diff_t	differential temperature units
cal	inches	
fld	RPS	rotations per second
flu	RPS	rotations per second
rln	ohm.m	ohm metres
rlt	ohm.m	ohm metres
rsn	ohm.m	ohm metres
sp	mV	millivolts
spr	ohms	

Units recorded as API are those defined by the American Petroleum Association for gamma-ray and neutron-gamma counts. RPS is an abbreviation for flow meter impeller revolutions per second.

4.7 GLELEV

The data in the GLELEV table lists valid elevation estimation methodologies and codes. The elev_meth field is the primary key for the table.

Elev_meth: Elevation measurement method code. Character field of length 1.
Name: Elevation measurement method name. Character field of maximum length 30.

The values in the GLELEV table are:

Elevation Measurement Method Abbreviation	Elevation Measurement Method
B	Barometer
M	Estimated from topographic map
S	Survey
U	Unknown

4.8 GLCONUNITS

The GLCONUNITS table lists valid values for concentration units of the ionic concentrations in the GLCHEM table. The conc field is the primary key for the table.

conc: abbreviation for the concentration units
name: full name of the concentration units

The values in the GLCONUNITS table are:

Conc. Units	Name
ppm	parts per million
mg/L	milligrams per litre

4.9 GLCHACCU

The GLCHACCU table lists valid accuracy or limiting symbols for the ionic concentration data held in the GLCHEM table. The accu field is the primary key for the table.

accu: symbol indicating accuracy or limit of the measurement. Character field of length 1.

name: description of the nature of the accuracy or limit. Character field of maximum length 30.

The values in the GLCHACCU table are:

Accuracy	Name
T	traces detected
N	not detected
<	actual value is less than the stated concentration value

4.10 GLLAB

The GLLAB table holds a list of the laboratories which performed the hydrochemical analyses. The lab field is the primary key for the database.

LAB: Laboratory name abbreviation. Character field of maximum length 8.

NAME: Laboratory name. Character field of maximum length 60.

The values in the GLLAB table are:

Laboratory	Name
QCGLB	Qld Government Chemical Laboratory, Brisbane
NSWDMCL	NSW Department of Mines Chemical Laboratory
NTAWRB	NT Administration Water Resources Board

Figure 2: View of GABLOG database for data conversion into endusers spreadsheets.

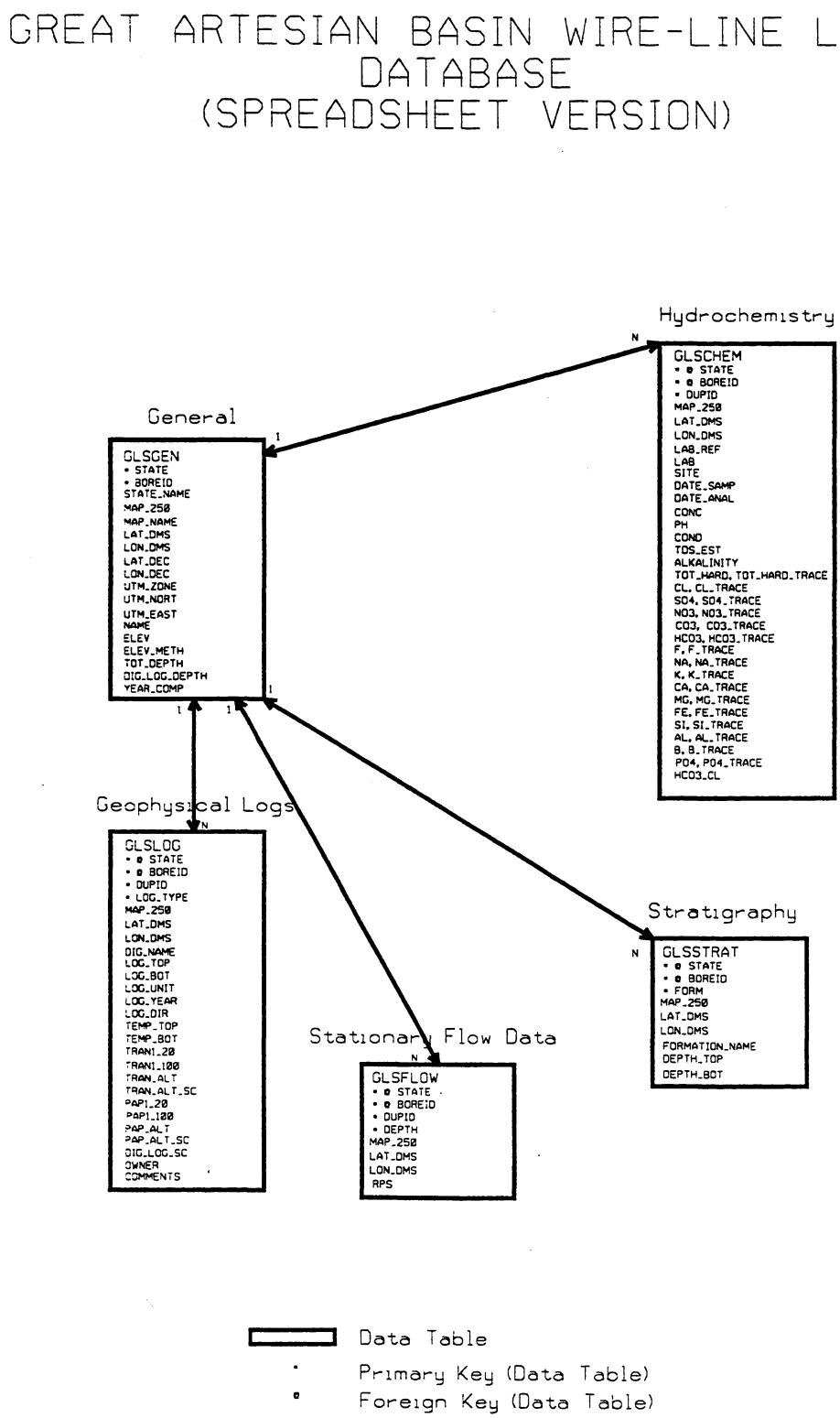
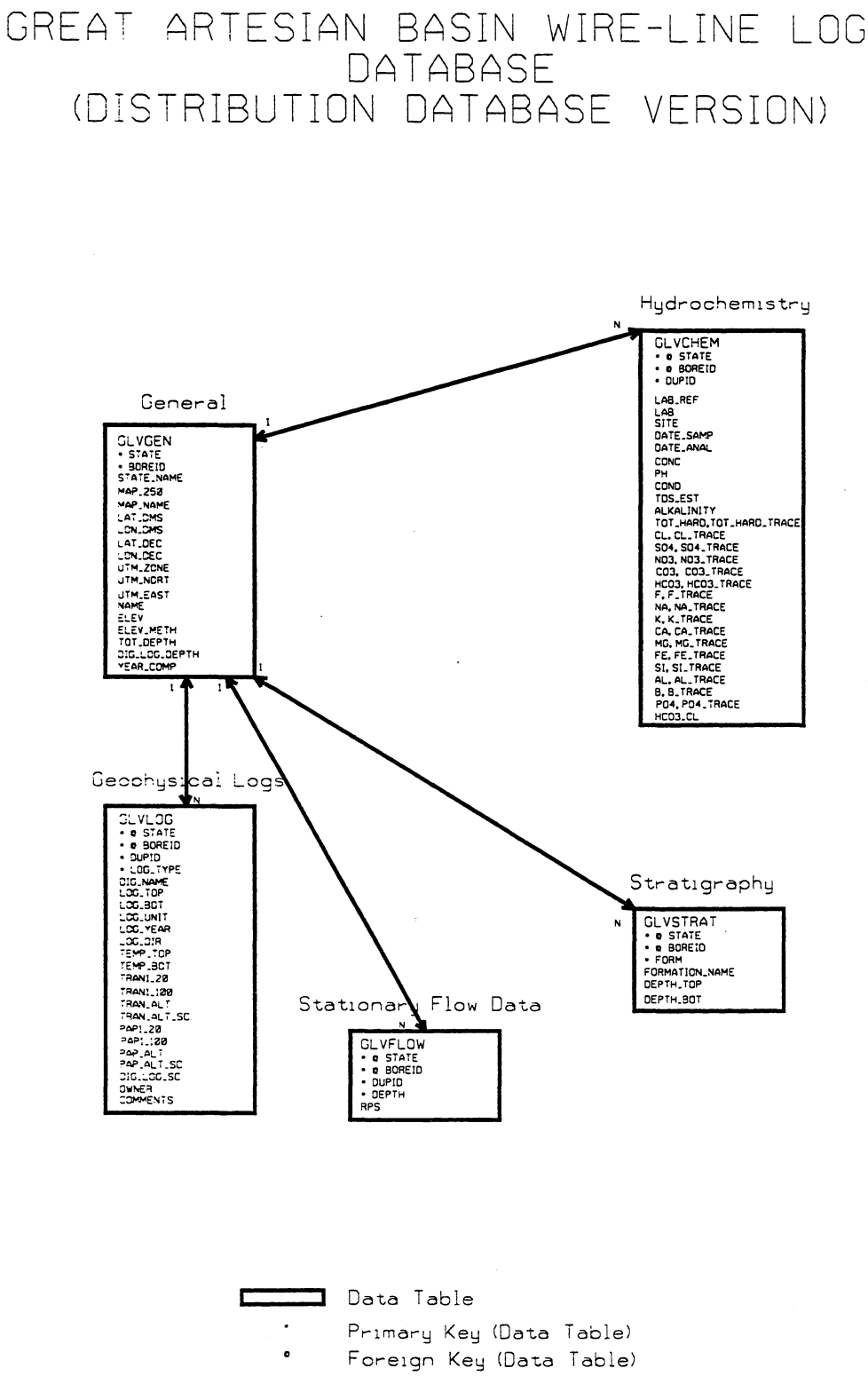


Figure 3:. View of GABLOG database for data conversion into endusers databases



5. Views

A rationale for the use of views was presented in Chapter 2. The views created for the GABLOG database fall into one of two categories:

- views suitable for spreadsheets (view name prefaced by "GLS") - Figure 2
- views suitable for databases (view name prefaced by "GLV") - Figure 3

The primary differences between the views of the data and the base tables are that:

- only data that is distributed on the CD-ROM is presented in the views.
- look up table data is merged with the data tables.
- bore hole latitudes and longitudes are included in all records of the spreadsheet views.

5.1 GLVGEN

The GLVGEN view holds the bore location and bore name of each bore, along with the year that drilling was completed, the depth of the bore, the greatest depth reached by both the original and digitised geophysical logs, and the elevation of the bore. Note that the total depth (tot_depth) of the bore may be considerably different from the maximum depth of the digitised wire-line logs: the bore may have been deepened after its initial construction, the bore may also have become blocked at some point, preventing wire-line logging below the depth of the obstruction. The primary keys are the state and boreid fields.

state: state code, (n for NSW, q for Queensland, s for South Australia, t for Northern Territory). One character.
boreid: state registration number or bore name. Character field with a maximum length of six characters.
state_name: the full name of the state.
lat_DMS: latitude, in degrees, minutes and seconds. Character field, format "nn nn nn" (positive southwards)
lon_DMS: longitude, in degrees, minutes and seconds, format "nnn nn nn"
lat_dec: latitude, as a decimal number, format "nn.nnnnnnnn" (positive southwards)
lon_dec: longitude, as a decimal number, format "nnn.nnnnnnnn"
utm_zone: universal transverse mercator zone, numeric, format "nn" (range 53-56)
UTM_east: UTM easting, meters, numeric, format "nnnnnnnnnnn.nn"
UTM_nort: UTM northing, meters, numeric, format "nnnnnnnnnnn.nn"
map_250: UTM 1:250 000 mapsheet code. A character field, format "SA_1-$5A_2$", where A_1 is in the range "C"-"I", and A_2 is in the range "3"-"6".
map_name: 1:250 000 mapsheet name, of maximum length 25 characters.
name: full name of bore. Character field of maximum length 35.
elev: elevation of groundsurface in feet with respect to the Australian Height Datum. (AHD). Numeric field with format "nnnnn.n"
elev_meth: method by which elevation was measured.
tot_depth: total depth of bore in feet, measured from groundsurface. Numeric field with format "nnnnn.n"

dig_log_depth: greatest depth of digital copies of any of the logs for this bore, in feet, measured from groundsurface. Numeric field with format "nnnnn.n".

year_comp: year the initial drilling was completed. Numeric field, with format "nnnn", and with values in the range 1870-1999.

5.2 GLVLOG

This view holds descriptions of each geophysical log, and the scales and formats in which the data is available. The original geophysical logs are in both 1 inch:20 foot and 1 inch: 100 foot scales. Some logs are available at other scales. The originals were recorded on transparent film, and paper copies and the original films are held at AGSO. The tran1_20, tran1_100, tran_alt, pap1_20, pap1_100, pap_alt fields indicate the media and scale of original logs. Where a scale other than 1 inch: 100 foot or 1 inch: 20 foot has been been used for the original log, this scale is indicated in the tran_alt_sc or pap_alt_sc fields. The scale of the original log that was digitised to produce a log for distribution on the CD-ROM is stored in the dig_log_sc field.

state: state code, (n for NSW, q for Queensland, s for South Australia, t for Northern Territory). Character field of length one.

boreid: state registration number or bore name. Character field with a maximum length of six characters.

log_type: type of the geophysical log. Character string of length 1-3. One of the following:

gr	natural gamma ray
neu	neutron gamma ray
t	temperature
dt	differential temperature
cal	caliper
fld	flow (logged downwards)
flu	flow (logged upwards)
rln	long normal resistivity
rlt	lateral resistivity
rsn	short normal resistivity
sp	spontaneous potential
spr	single point resistance

dupid: code of duplicate log for the water bore, null for first geophysical log recorded, "b","c","d" etc for subsequent logs. Character length 1 or 0, range "b" - "z"

dig_name: name of the file containing the digitised log data (MS-DOS compatible). Character field with format "ABBBBBBC.DDD" where A is the state code, BBBBBB is the bore i.d., C is the duplicate code (if present), and DDD is the log type.

log_top: highest depth logged relative to groundsurface, in decimal feet. Numeric field with format "nnnnn.n".

log_bot: lowest depth logged relative to groundsurface, in decimal feet. Numeric field with format "nnnnn.n".

log_unit: units of the geophysical log, character, length 10.

log_dir: Did the probe moved upwards or downwards during logging ? Character field of maximum length 4, with two permissable values, "up" or "down".

log_year: the year the bore was logged. Numeric field with format "nnnn".

temp_top: the temperature of the groundwater at groundsurface, in degrees Celsius. Is only non-null for temperature logs. Numeric field with format "nnn.nn".

temp_bot: the temperature of the groundwater at the bottom of the bore, in degrees Celsius. Only used for temperature logs. Numeric field with format "nnn.nn".

tran1_20: availability as transparent original at 1"-20' depth scale. Character field with value of either "y" or "n".

tran1_100: availability as transparent original at 1"-100' depth scale. Character field with value either "y" or "n".

tran_alt: availability as transparent original at non-standard scale. Character field with value either "y" or "n".

tran_alt_sc: alternate depth scale of log on transparent original. Character field with maximum length 15.

pap1_20: availability as paper copy at 1"-20' depth scale. Character field with value either "y" or "n".

pap1_100: availability as paper copy at 1"-100' depth scale. Character field with value either "y" or "n".

pap_alt: availability as paper copy at non-standard scale. Character field with value either "y" or "n".

pap_alt_sc: alternate depth scale of log on paper copy. Character field with maximum length of 15 characters.

dig_log_sc: the scale of the hardcopy log from which the wire-line log was digitised. Character field with maximum length 15.

owner: the owner of the log. Character field of maximum length 60.

comments: description of any problems encountered during the geophysical logging of the bore, or any problems encountered during digitising of the geophysical wire-line log. Character field of maximum length 100.

5.3 GLVCHEM

This view stores the results of hydrochemistry laboratory analyses for each bore sampled for hydrochemistry. The various trace fields for ionic concentration fields may have one of the following values:

T	traces detected
N	not detected
<	actual value is less than the stated value

state: state code, (n for NSW, q for Queensland, s for South Australia, t for Northern Territory). Character field of length one.

boreid: state registration number or bore name. Character field with a maximum length of six characters.

dupid: code of duplicate analysis for the bore, null for first geophysical log recorded, b,c,d etc for subsequent logs. Character field of length one, range "b"-"z".

lab_ref: laboratory reference number of the sample. Character field, maximum length of 20 characters.

lab: name of the organisation which analysed the chemical samples. Character field of maximum length 60.

site: description of the sample site. Character field of maximum length 40.

date_samp: date the sample was taken.

date_anal: date the sample was analysed.

conc: concentration units for ionic analyses, either "ppm" for parts per million, or "mg/l" for milligrams per litre. Character field of maximum length 4.

pH: pH of the sample. Numeric field with format "nn.nn"

cond: sample electrical conductivity, in microsiemens/cm. Numeric field with format "nnnnn".

TDS_est: estimated TDS in ppm (parts per million). Numeric field with format "nnnnnn".

alkalinity: as $CaCO_3$ in ppm. Numeric field with format "nnnnn".

tot_hard: total hardness as calcium and magnesium salts as $CaCO_3$ in ppm. Numeric field with format "nnnnn.nn".

Cl: chloride concentration. Numeric field with format "nnnnn.nn".

Cl_trace: trace symbol for chloride concentration value.

SO4: sulphate concentration. Numeric field with format "nnnnn.nn".

SO4_trace: trace symbol for sulphate concentration value.

NO3: nitrate concentration. Numeric field with format "nnnnn.nn".

NO3_trace: trace symbol for nitrate concentration value.

CO3: carbonate concentration. Numeric field with format "nnnnn.nn".

CO3_trace: trace symbol for carbonate concentration value.

HCO3: bicarbonate concentration. Numeric field with format "nnnnn.nn".

HCO3_trace: trace symbol for bicarbonate concentration value.

F: fluoride concentration. Numeric field with format "nnnnn.nn".

F_trace: trace symbol for fluoride concentration value.

Na: sodium concentration. Numeric field with format "nnnnn.nn".

Na_trace: trace symbol for sodium concentration value.

K: potassium concentration. Numeric field with format "nnnnn.nn".

K_trace: trace symbol for potassium concentration value.

Ca: calcium concentration. Numeric field with format "nnnnn.nn".

Ca_trace: trace symbol for calcium concentration value.

Mg: magnesium concentration. Numeric field with format "nnnnn.nn".

Mg_trace: trace symbol for magnesium concentration value.

Fe: iron concentration. Numeric field with format "nnnnn.nn".

Fe_trace: trace symbol for iron concentration value.

Si: silica concentration. Numeric field with format "nnnnn.nn"

Si_trace: trace symbol for silica concentration value.

Al: aluminium concentration. Numeric field with format "nnnnn.nn". (note: no aluminium values present in the database)

AL_trace: trace symbol for aluminium concentration value.

B: boron concentration. Numeric field with format "nnnnn.nn".

B_trace: trace symbol for boron concentration value.

PO4: phosphate concentration. Numeric field with format "nnnnn.nn".

PO4_trace: trace symbol for phosphate concentration value.

HCO3_Cl: bicarbonate/chloride ratio. Numeric format "nnnnn.nnnnn".

5.4 GLVFLOW

This view holds stationary flow measurements made during flowmeter logging.

state: state code, (n for NSW, q for Queensland, s for South Australia, t for Northern Territory). Character field of length one.

boreid: state registration number or bore name. Character field with a maximum length of six characters.

dupid: code of duplicate log for the bore, null for first geophysical log recorded, "b","c","d" etc for subsequent logs. Character length 1, range "b"-"z"

depth: Depth from groundsurface in feet, at which flow measurement was made. Numeric field with format "nnnn.n".

rps: flow rate, in impellor flowmeter revolutions per second. Numeric field with format "nnnn.n".

5.5 GLVSTRAT

This view holds lithostratigraphic data that were interpreted from the geophysical logs by Dr B.R. Senior & Associates, Pty. Ltd while under contract to AGSO.

state: state code, (n for NSW, q for Queensland, s for South Australia, t for Northern Territory). Character field of length one.

boreid: state registration number or bore name. Character field with a maximum length of six characters.

form: formation abbreviation. Character field with maximum length 12.

formation_name: name of the formation, Character field of maximum length 30.

depth_top: depth to to top of unit from groundsurface (feet). Numeric field with format "nnnnn.n"

depth_bot: depth to bottom of unit from groundsurface (feet). Numeric field with format "nnnnn.n"

5.6 GLSGEN

The GLSGEN view holds the bore location and bore name of each bore, along with the year that drilling was completed, the depth of the bore, the greatest depth reached by both the original and digitised geophysical logs, and the elevation of the bore. Note that the total depth (tot_depth) of the bore may be considerably different from the maximum depth of the digitised wire-line logs: the bore may have been deepened after its initial construction, the bore may also have become blocked at some point, preventing wire-line logging below the depth of the obstruction.

state: state code, (n for NSW, q for Queensland, s for South Australia, t for Northern Territory). One character.

boreid: state registration number or bore name. Character field with a maximum length of six characters.

state_name: the full name of the state.

lat_DMS: latitude, in degrees, minutes and seconds. Character field, format "nn nn nn" (positive southwards)

lon_DMS: longitude, in degrees, minutes and seconds, format "nnn nn nn"

lat_dec: latitude, as a decimal number, format "nn.nnnnnnnn" (positive southwards)

lon_dec: longitude, as a decimal number, format "nnn.nnnnnnnn"

utm_zone: universal transverse mercator zone, numeric, format "nn" (range 53-56)

UTM_east: UTM easting, meters, numeric, format "nnnnnnnnnnnn.nn"

UTM_nort: UTM northing, meters, numeric, format "nnnnnnnnnnnn.nn"

map_250: UTM 1:250 000 mapsheet code. A character field, format "SA_1-$5A_2$", where A_1 is in the range "C"-"I", and A_2 is in the range "3"-"6".

map_name: 1:250 000 mapsheet name, of maximum length 25 characters.

name: full name of bore. Character field of maximum length 35.

elev: elevation of groundsurface in feet with respect to the Australian height datum. (AHD). Numeric field with format "nnnnn.n"

elev_meth: method by which elevation was measured.

tot_depth: total depth of bore in feet, measured from groundsurface. Numeric field with format "nnnnn.n"

dig_log_depth: greatest depth of digital copies of any of the logs for this bore, in feet, measured from groundsurface. Numeric field with format "nnnnn.n".

year_comp: year the initial drilling was completed. Numeric field, with format "nnnn", and with values in the range 1870-1999.

5.7 GLSLOG

This view holds descriptions of each geophysical log, and the scales and formats in which the data is available. The original geophysical logs are available in both 1 inch:20 foot and 1 inch: 100 foot scales. Some logs are available at other scales. The originals were recorded on transparent film, and the original films and paper copies held at AGSO. The tran1_20, tran1_100, tran_alt, pap1_20, pap1_100, pap_alt fields indicate the media and scale of original logs. Where a scale other than 1 inch: 100 foot or 1 inch: 20 foot has been been used for the original log, this scale is indicated in the tran_alt_sc or pap_alt_sc fields. The scale of the original log that was digitised to produce a log for distribution on the CD-ROM is stored in the dig_log_sc field.

state: state code, (n for NSW, q for Queensland, s for South Australia, t for Northern Territory). Character field of length one.

boreid: state registration number or bore name. Character field with a maximum length of six characters.

map_250: UTM 1:250 000 mapsheet code. A character field, format "SA_1-$5A_2$", where A_1 is in the range "C"-"I", and A_2 is in the range "3"-"6".

lat_DMS: latitude, in degrees, minutes and seconds. Character field, format "nn nn nn" (positive southwards)

lon_DMS: longitude, in degrees, minutes and seconds, format "nnn nn nn"

log_type: type of the geophysical log. Character string of length 1-3. One of the following:

gr	natural gamma ray
neu	neutron-gamma ray
t	temperature
dt	differential temperature
cal	caliper
fld	flow (logged downwards)
flu	flow (logged upwards)
rln	long normal resistivity
rlt	lateral resistivity
rsn	short normal resistivity
sp	spontaneous potential
spr	single point resistance

dupid: code of duplicate log for the bore, null for first geophysical log recorded, "b","c","d" etc for subsequent logs. Character length 1 or 0, range "b" - "z"

dig_name: name of the file containing the digitised log data (MS-DOS compatible). Character field with format "ABBBBBBC.DDD" where A is the state code,

BBBBBB is the bore i.d., C is the duplicate code (if present), and DDD is the log type.

log_top: highest depth logged relative to groundsurface, feet. Numeric field with format "nnnnn.n".

log_bot: lowest depth logged relative to groundsurface, feet. Numeric field with format "nnnnn.n".

log_unit: units of the geophysical log, character, length 10.

log_dir: upwards or downwards movement of the probe during logging. Character field of maximum length 4, with two permissable values, "up" or "down".

log_year: the year the bore was logged. Numeric field with format "nnnn".

temp_top: the temperature of the groundwater at groundsurface, in degrees Celsius. Is only non-null for temperature logs. Numeric field with format "nnn.nn".

temp_bot: the temperature of the groundwater at the bottom of the bore, in degrees Celsius. Only used for temperature logs. Numeric field with format "nnn.nn".

tran1_20: available as transparent original at 1"-20' depth scale ? Character field with value of either "y" or "n".

tran1_100: available as transparent original at 1"-100' depth scale ? Character field with value either "y" or "n".

tran_alt: available as transparent original at non-standard scale ? Character field with value either "y" or "n".

tran_alt_sc: alternate depth scale of log on transparent original. Character field with maximum length 15.

pap1_20: available as paper copy at 1"-20' depth scale ? Character field with value either "y" or "n".

pap1_100: available as paper copy at 1"-100' depth scale ? Character field with value either "y" or "n".

pap_alt: available as paper copy at non-standard scale ? Character field with value either "y" or "n".

pap_alt_sc: alternate depth scale of log on paper copy. Character field with maximum length of 15 characters.

dig_log_sc: the scale of the hardcopy log from which the wire-line log was digitised. Character field with maximum length 15.

owner: the owner of the log. Character field of maximum length 60.

comments: description of any problems encountered during the geophysical logging of the bore, or any problems encountered during digitising of the geophysical wire-line log. Character field of maximum length 100.

5.8 GLSCHEM

This view stores the results of hydrochemistry data analyses for each bore sampled for hydrochemistry. The various trace fields for ionic concentration fields may have one of the following values:

T	traces detected
N	not detected
<	actual value is less than the stated value

state: state code, (n for NSW, q for Queensland, s for South Australia, t for Northern Territory). Character field of length one.

boreid: state registration number or bore name. Character field with a maximum length of six characters.

map_250: UTM 1:250 000 mapsheet code. A character field, format "SA_1-$5A_2$", where A_1 is in the range "C"-"I", and A_2 is in the range "3"-"6".

lat_DMS: latitude, in degrees, minutes and seconds. Character field, format "nn nn nn" (positive southwards)

lon_DMS: longitude, in degrees, minutes and seconds, format "nnn nn nn"

dupid: code of duplicate analysis for the bore, null for first geophysical log recorded, b,c,d etc for subsequent logs. Character field of length one, range "b"-"z".

lab_ref: laboratory reference number of the sample. Character field, maximum length of 20 characters.

lab: name of the organisation which analysed the chemical samples. Character field of maximum length 60.

site: description of the sample site. Character field of maximum length 40.

date_samp: date the sample was taken.

date_anal: date the sample was analysed.

conc: concentration units for ionic analyses, either "ppm" for parts per million, or "mg/l" for milligrams per litre. Character field of maximum length 4.

pH: pH of the sample. Numeric field with format "nn.nn"

cond: sample electrical conductivity, in microsiemens/cm. Numeric field with format "nnnnn".

TDS_est: estimated TDS in ppm (parts per million). Numeric field with format "nnnnnn".

alkalinity: as $CaCO_3$ in ppm. Numeric field with format "nnnnn".

tot_hard: total hardness as calcium and magnesium salts as $CaCO_3$ in ppm. Numeric field with format "nnnnn.nn".

Cl: chloride concentration. Numeric field with format "nnnnn.nn".

Cl_trace: trace symbol for chloride concentration value.

SO4: sulphate concentration. Numeric field with format "nnnnn.nn".

SO4_trace: trace symbol for sulphate concentration value.

NO3: nitrate concentration. Numeric field with format "nnnnn.nn".

NO3_trace: trace symbol for nitrate concentration value.

CO3: carbonate concentration. Numeric field with format "nnnnn.nn".

CO3_trace: trace symbol for carbonate concentration value.

HCO3: bicarbonate concentration. Numeric field with format "nnnnn.nn".

HCO3_trace: trace symbol for bicarbonate concentration value.

F: fluoride concentration. Numeric field with format "nnnnn.nn".

F_trace: trace symbol for fluoride concentration value.

Na: sodium concentration. Numeric field with format "nnnnn.nn".

Na_trace: trace symbol for sodium concentration value.

K: potassium concentration. Numeric field with format "nnnnn.nn".

K_trace: trace symbol for potassium concentration value.

Ca: calcium concentration. Numeric field with format "nnnnn.nn".

Ca_trace: trace symbol for calcium concentration value.

Mg: magnesium concentration. Numeric field with format "nnnnn.nn".

Mg_trace: trace symbol for magnesium concentration value.

Fe: iron concentration. Numeric field with format "nnnnn.nn".

Fe_trace: trace symbol for iron concentration value.

Si: silica concentration. Numeric field with format "nnnnn.nn"

Si_trace: trace symbol for silica concentration value.

Al: aluminium concentration. Numeric field with format "nnnnn.nn". (note: no aluminium values present in the database)

AL_trace: trace symbol for aluminium concentration value.

B: boron concentration. Numeric field with format "nnnnn.nn".

B_trace: trace symbol for boron concentration value.
PO4: phosphate concentration. Numeric field with format "nnnnn.nn".
PO4_trace: trace symbol for phosphate concentration value.
HCO3_Cl: bicarbonate/chloride ratio. Numeric format "nnnnn.nnnnn".

5.9 GLSFLOW

This view holds stationary flow measurements made during flowmeter logging.

state: state code, (n for NSW, q for Queensland, s for South Australia, t for Northern Territory). Character field of length one.
boreid: state registration number or bore name. Character field with a maximum length of six characters.
map_250: UTM 1:250 000 mapsheet code. A character field, format "SA_1-$5A_2$", where A_1 is in the range "C"-"I", and A_2 is in the range "3"-"6".
lat_DMS: latitude, in degrees, minutes and seconds. Character field, format "nn nn nn" (positive southwards)
lon_DMS: longitude, in degrees, minutes and seconds, format "nnn nn nn"
dupid: code of duplicate log for the bore, null for first geophysical log recorded, "b","c","d" etc for subsequent logs. Character length 1, range "b"-"z"
depth: Depth from groundsurface in feet, at which flow measurement was made. Numeric field with format "nnnn.n".
rps: flow rate, in impellor flowmeter revolutions per second. Numeric field with format "nnnn.n".

5.10 GLSSTRAT

This table holds lithostratigraphic data that were interpreted from the geophysical logs by Dr B.R. Senior & Associates, Pty. Ltd while under contract to AGSO.

state: state code, (n for NSW, q for Queensland, s for South Australia, t for Northern Territory). Character field of length one.
boreid: state registration number or bore name. Character field with a maximum length of six characters.
map_250: UTM 1:250 000 mapsheet code. A character field, format "SA_1-$5A_2$", where A_1 is in the range "C"-"I", and A_2 is in the range "3"-"6".
lat_DMS: latitude, in degrees, minutes and seconds. Character field, format "nn nn nn" (positive southwards)
lon_DMS: longitude, in degrees, minutes and seconds, format "nnn nn nn"
form: formation abbreviation. Character field with maximum length 12.
formation_name: name of the formation, Character field of maximum length 30.
depth_top: depth to to top of unit from groundsurface (feet). Numeric field with format "nnnnn.n"
depth_bot: depth to bottom of unit from groundsurface (feet). Numeric field with format "nnnnn.n"

6. DISTRIBUTION OF GABLOG DATA ON CD_ROM

All distributable data is distributed on an ISO 9970 format CDROM. All data stored in ASCII files are also stored in MS-DOS text format, with each line terminated by a carriage return character and a line feed character.

The directory structure of the wire-line log CD-ROM can be seen in Figure 4.

Database tables from the GABLOG database are stored as ASCII formatted CSV files (comma separated values), with strings enclosed in double quotes. The first line of each CSV file lists the name of each database field (or spreadsheet column). The database tables are also stored in Oracle 7 export format - this format is useful for those endusers wishing to import the data into an Oracle 7 database. The files holding the data for conversion to database systems (as described in previous sections of this document) are held in:

Table Name	CSV ASCII File
glvchem	/database/database/glvchem.csv
glvflow	/database/database/glvflow.csv
glvgen	/database/database/glvgen.csv
glvlog	/database/database/glvlog.csv
glvstrat	/database/database/glvstrat.csv

The files holding the data for conversion to spreadsheets (as described in previous sections of this document) are held in:

Table Name	CSV ASCII File
glschem	/database/spread/glvchem.csv
glsflow	/database/spread/glvflow.csv
glsgen	/database/spread/glvgen.csv
glslog	/database/spread/glvlog.csv
glsstrat	/database/spread/glvstrat.csv

Sample of a CSV database file (glvstrat.csv):

```
==========================================================================
"STATE","BOREID","FORM","FORM_NAME","DEPTH_TOP","DEPTH_BOT"
"n","10322","Cz?","Cainozoic?",0,60
"n","10322","Klc","Coreena Member",60,630
"n","10322","Kld","Doncaster Member",630,1028
"n","10322","Kco","Cadna-Owie Formation",1028,1112
"n","10322","Klws","Wyandra Sandstone Member",1028.1,1055
"n","10322","U","Unnamed Member",1055,1112
"n","10322","JKh","Hooray Sandstone",1112,1246
"n","10337","Cz","Cainozoic",0,88
"n","10337","KTam","Morney Profile",88,326
"n","10337","Kr","Rolling Downs Group",326,950
"n","10337","Kco","Cadna-Owie Formation",950,1173
"n","10337","JKh","Hooray Sandstone",1173,1390
```

"n","10415","Cz","Cainozoic",0,127
"n","10415","KTam","Morney Profile",127,189
"n","10415","Kr","Rolling Downs Group",189,1069
"n","10415","Kco","Cadna-Owie Formation",1069,1070
"n","10616","Cz","Cainozoic",0,36
"n","10616","KTam","Morney Profile",36,180
"n","10616","Klu","Wallumbilla Formation",180,834
"n","10745","Cz","Cainozoic",0,8
"n","10745","wz","Weathered zone",8,49
"n","10745","Kly","Bungil Formation",49,175
"n","10745","Klmo","Mooga Sandstone",175,225
"n","10745","Juo","Orallo Formation",225,445
"n","10957","Cz","Cainozoic",0,4
"n","10957","wz","Weathered zone",4,68
"n","10957","Kly","Bungil Formation",68,195
"n","10957","Klmo","Mooga Sandstone",195,252
"n","10957","Juo","Orallo Formation",252,667
"n","10957","Jp/Jug","Pilliga Sandstone/Gubberamunda Sandstone",667,797
"n","11718","Cz","Cainozoic",0,81

==========

The digitised wire-line logs are stored as ASCII files, with each line of data terminated with a carriage return and linefeed. The first line in the file consists of a descriptor string: this string starts with the characters "BMR GAB" (for Bureau of Mineral Resources, Great Artesian Basin Project), followed by the state in which the water bore is located, the registered number or name of the water bore, and the type of the log. The second line of the log gives the units for the depth (feet in all cases) and units for the measured parameter (for example, inches for caliper logs). The third line is always blank. On the fourth and subsequent lines, two numeric values appear, the first value is the depth of measurement from the top of the bore or kelly bushing, the second value is the value of the measured parameter.

Digitised wire-line logs are stored in directories holding all geophysical wire-line logs of a specific type. The name of each digitised wire-line log file is composed of a letter specific to the state, then the registered number (or name) of the bore, one letter indicating if the log is a duplicate, then a file name extension representing the wire-line log type. The digitised logs are held on the CD-ROM in the directories below the /logs directory.

To determine the location of a wire-line log on the CD-ROM, note the state in which the bore is located, the registered number of the bore, the type of the wire-line log, and duplicate letter of the log (if more than one wire-line log is present) from the wire-line log database. For example, if the registration number of the bore is "1946", and the bore is located in Queensland (state code "q"), and the desired log type is caliper (type code "cal"), then the digitised wire-line log will be located on the CD-ROM in "/logs/cal/q1946.cal".

Sample of a digitised geophysical wire-line log (/logs/cal/n32500.cal):

```
==========================================================================
BMR GAB NSW RN 32500 CAL                          <- line 1
  Feet     Inches                                 <- line 2
                                                  <- line 3
  0.50     5.62                                   <- line 3
  1.00     5.62                                   <- line 4
  1.50     5.82                                   <- line 5
  2.00     5.82                                   <- line 6
  2.50     5.82                                   <- line 7
  3.00     5.78                                   <- line 8
  3.50     5.78                                   <- line 9
  4.00     5.77                                   <- line 10
  4.50     5.77                                   <- line 11
  5.00     5.77                                   <- line 12
  5.50     5.77                                   <- line 13
  6.00     5.77                                   <- line 14
  6.50     5.77                                   <- line 15
  7.00     5.77                                   <- line 16
==========================================================================
```

A listing of the contents of the database is held as a text file and a postscript 2 file. The textfile (/database/report/loglist.txt) must be reformatted with a wordprocessor prior to printing. The postscript 2 version of the same file (/database/report/loglist.ps) may be printed on a compatible printer on A4 paper.

Figure 4: Directory structure of distribution disk.

```
/
├── readme.txt
└── database/
    ├── database/                (csv files of the distribution database)
    │       glvchem.csv
    │       glvflow.csv
    │       glvgen.csv
    │       glvlog.csv
    │       glvstrat.csv
    │       readme.txt
    ├── oracle7/                 (Oracle 7 dump of distribution database)
    │       glv.dmp
    │       readme.txt
    ├── report/                  (text versions of data listings)
    │       loglist.txt
    │       loglist.ps
    │       readme.txt
    ├── spread/                  (text versions of spreadsheet data)
    │       glschem.csv
    │       glsflow.csv
    │       glsgen.csv
    │       glslog.csv
    │       glsstrat.csv
    │       readme.txt
    └── readme.txt
└── logs/
    ├── cal/
    │   └── all caliper logs (*.cal)
    ├── dt/
    │   └── all differential temperature logs (*.dt)
    ├── fld/
    │   └── all flow logs logged downwards (*.fld)
    ├── flu/
    │   └── all flow logs logged upwards (*.flu)
    ├── gr/
    │   └── all gamma ray logs (*.gr)
    ├── neu/
    │   └── all neutron gamma logs (*.neu)
    ├── rln/
    │   └── all long normal resistivity logs (*.rln)
    ├── rlt/
    │   └── all lateral resistivity logs (*.rlt)
    ├── rsn/
    │   └── all short normal resistivity logs (*.rsn)
    ├── sp/
    │   └── all spontaneous potential logs (*.sp)
    ├── spr/
    │   └── all single point resistance logs (*.spr)
    ├── t/
    │   └── all temperature logs (*.t)
    └── readme.txt
```

7. Acknowledgments

Nick Revell and Aaron Sedgmen digitised the wire-line logs, and compiled some of the data for the database. Mirek Kucka provided information and comments during database design and implementation. Dr Rien Habermehl answered queries concerning the nature of the data. Both Mirek Kucka and Dr Rien Habermehl reviewed an earlier version of this record.

8. References

Habermehl, M.A., 1980, *Wire-Line Logging of Water Wells in the Great Artesian Basin - ADP Data Transcription Manual.*
Bureau of Mineral Resources, Australia, Record 1980/9

Habermehl, M.A., 1980, *The Great Artesian Basin, Australia.*
BMR Journal of Australian Geology and Geophysics, no. 5, pp. 9-38

Habermehl, M.A., Morrissey, J.A., 1983, *Index of Geophysical Well Logs Acquired by BMR from Waterwells in the Great Artesian Basin 1960-1975.*
Bureau of Mineral Resources, Australia, Report 241

Habermehl, M.A., 1985, *BMR Activities in the Great Artesian Basin, 1971-1985.*
Bureau of Mineral Resources, Australia, Record 1985/45.

Lenz, S.L., R.J.Ryburn, M.Kucka, *User's Huide to AGSO's Oracle Database System.*
Australian Geological Survey Organisation, Record 1993/81

Oracle Corporation, 1993, ORACLE7 SQL Language Reference Manual,
Oracle Corporation

Appendix i: Listings of Tables Definitions and Constraints

This appendix lists table definitions and constraints used to implement the GABLOG database.

The first column in the constraint listing is the name of the constraint. The following constraint naming convention has been used in the GABLOG database:

- The name of the table to which the constraint is applied forms the first part of the constraint name. This table_name component is separated from the rest of the constraint name by a "$".

- The next part of the constraint name is made up of the names of the fields to which the constraint is applied.

- The last portion of the constraint name is the type of the constraint. The type of the constraint and its abbreviation as used in the GABLOG database may be one of:

nn	not null constraint
pk	primary key constraint
uk	unique key constraint
rf	referential integrity constraint
fk	foreign key constraint
yn	the field is limited to either a "y" or a "n" value
low	the field value must be greater than or equal to some specified value
gt	the field value must be greater than some specified value
rn	the field value must be within a range of values

The second column in the constraint listing gives the constraint type as specified to the Oracle RDBMS during table creation. The Oracle constraint type may be "remote" for a constraint used to enforce referential integrity, "column" for a check constraint on a column, "Prim. Key" for a primary key constraint, and "Uniq. Key" for a unique key constraint.

The third column in the constraint listing gives the name of any primary or unique key constraints that have been defined for any remote constraints.

The fourth column of the constraint listing gives the search condition specified for column check constraints.

GLGEN:

```
Name                           Null?    Type
 ------------------------------ -------- ----
 STATE                          NOT NULL CHAR(1)
 BOREID                         NOT NULL VARCHAR2(6)
 LAT_DMS                        NOT NULL CHAR(8)
 LON_DMS                        NOT NULL CHAR(9)
 LAT_DEC                                 NUMBER(11,8)
 LON_DEC                                 NUMBER(12,8)
 UTM_ZONE                                NUMBER(2)
 UTM_EAST                                NUMBER(15,2)
 UTM_NORT                                NUMBER(15,2)
 MAP_250                                 CHAR(6)
 NAME                                    VARCHAR2(35)
```

```
ELEV                                    NUMBER(7,1)
ELEV_METH                               CHAR(1)
TOT_DEPTH                               NUMBER(6,1)
PAP_LOG_DEPTH                           NUMBER(6,1)
DIG_LOG_DEPTH                           NUMBER(6,1)
YEAR_COMP                               NUMBER(4)
```

```
TABLE_NAME      COMMENTS
--------------------------------------------------------------------------
GLGEN:          General data on well - location, description, depth
```

```
COLUMN_NAME     COMMENTS
--------------------------------------------------------------------------
ELEV:           Bore elevation, feet AHD
PAP_LOG_DEPTH:  Maximum probe depth reached during logging (from paper logs)
YEAR_COMP:      Year of bore completion
STATE:          Code for state containing bore, referencing GLSTATE.STATE
BOREID:         Borehole identifier, unique within each state
LAT_DMS:        Latitude in degrees, minutes, seconds, +ve southwards
LON_DMS:        Longitude in degrees, minutes, seconds
LAT_DEC:        Latitude in decimal degrees, +ve southwards
LON_DEC:        Longitude in decimal degrees
UTM_ZONE:       UTM zone, range 53-56
UTM_EAST:       UTM easting
UTM_NORT:       UTM northing
MAP_250:        1:250,000 map sheet code, referencing GLMAP250.MAP_250
NAME:           Bore name
ELEV_METH:      Method of measuring elevation, referencing GLELEV.ELEV_METH
TOT_DEPTH:      Total depth of bore, feet
DIG_LOG_DEPTH:  Maximum probe depth reached during logging (from digital logs)
```

CONSTRAINT_NAME	TYPE	R_CONSTRAINT_NAME	DEL. RULE	SEARCH_CONDITION
GLGEN$STATE_NN	Column			STATE IS NOT NULL
GLGEN$BOREID_NN	Column			BOREID IS NOT NULL
GLGEN$LAT_DMS_NN	Column			LAT_DMS IS NOT NULL
GLGEN$LON_DMS_NN	Column			LON_DMS IS NOT NULL
GLGEN$YEAR_COMP_RANGE	Column			YEAR_COMP between 1870 and 2000
GLGEN$STATE_BOREID_PK	Prim. Key			
GLGEN$STATE_FK	Remote	GLSTATE$STATE_PK	NO ACTION	
GLGEN$MAP_250_FK	Remote	GLMAP250$MAP_250_PK	NO ACTION	
GLGEN$ELEV_METH_FK	Remote	GLELEV$ELEV_METH_PK	NO ACTION	

GLLOG

```
Name                            Null?    Type
 ------------------------------ -------- ----
 STATE                           NOT NULL CHAR(1)
 BOREID                          NOT NULL VARCHAR2(6)
 LOG_TYPE                        NOT NULL VARCHAR2(3)
 DUPID                                    CHAR(1)
 DIG_NAME                                 VARCHAR2(12)
 LOG_TOP                                  NUMBER(7,1)
 LOG_BOT                                  NUMBER(7,1)
 LOG_UNIT                                 VARCHAR2(10)
 LOG_DIR                                  VARCHAR2(4)
 LOG_YEAR                                 NUMBER(4)
 TEMP_TOP                                 NUMBER(6,2)
 TEMP_BOT                                 NUMBER(6,2)
 TRAN1_20                                 CHAR(1)
 TRAN1_100                                CHAR(1)
```

TRAN_ALT	CHAR(1)
TRAN_ALT_SC	VARCHAR2(15)
PAP1_20	CHAR(1)
PAP1_100	CHAR(1)
PAP_ALT	CHAR(1)
PAP_ALT_SC	VARCHAR2(15)
DIG_LOG_SC	VARCHAR2(15)
OWNER	VARCHAR2(5)
PENPLOT_REF	VARCHAR2(10)
COMMENTS	VARCHAR2(100)
PROBLEMS	VARCHAR2(100)
DISTRIB	CHAR(1)

TABLE_NAME	COMMENTS
GLLOG:	Scales and formats of the geophysical well logs

COLUMN_NAME	COMMENTS
COMMENTS:	Description of geophysical logging of the bore
DISTRIB:	Can the log be distributed by AGSO ?
STATE:	Code for state containing bore, referencing GLSTATE.STATE
BOREID:	Borehole identifier, unique within each state
LOG_TYPE:	Log type, referencing GLLOGTYPE.LOG_TYPE
DUPID:	Code for duplicate bore logs, B-Z
DIG_NAME:	Name of file containing digitised log
LOG_TOP:	Top of log, relative to groundsurface, in feet
LOG_BOT:	Bottom of log, relative to groundsurface, in feet
LOG_UNIT:	Log units, referencing GLLOG_UNIT.LOG_UNIT
LOG_DIR:	Did the probe move up or down during logging
LOG_YEAR:	Year in which the log was created
TEMP_TOP:	Temperature at top of log, Celsius
TEMP_BOT:	Temperature at bottom of log, Celsius
TRAN1_20:	Transparent original at 1 inch to 20 feet available
TRAN1_100:	Transparent original at 1 inch to 100 feet available
TRAN_ALT:	Transparent original available at alternate scale
TRAN_ALT_SC:	Transparent original alternate scale
PAP1_20:	Paper copy at 1 inch to 20 feet available
PAP1_100:	Paper copy at 1 inch to 100 feet available
PAP_ALT:	Paper copy available at alternate scale
PAP_ALT_SC:	Paper copy alternate scale
DIG_LOG_SC:	Scale of original from which digital version was created
OWNER:	Owner of the geophysical log - referencing GLOWNER.OWNER
PENPLOT_REF:	Reference number of penplotter print of digital data
PROBLEMS:	Description of problems encountered during digitising the log

CONSTRAINT_NAME	TYPE	R_CONSTRAINT_NAME	DEL. RULE	SEARCH_CONDITION
GLLOG$STATE_NN	Column			STATE IS NOT NULL
GLLOG$BOREID_NN	Column			BOREID IS NOT NULL
GLLOG$LOG_TYPE_NN	Column			LOG_TYPE IS NOT NULL
GLLOG$LOG_DIR_UPDOWN	Column			LOG_DIR in ('up','down')
GLLOG$LOG_YEAR_RN	Column			LOG_YEAR between 1950 and 2000
GLLOG$TRAN1_20_YN	Column			TRAN1_20 in ('y','n')
GLLOG$TRAN1_100_YN	Column			TRAN1_100 in ('y','n')
GLLOG$TRAN_ALT_YN	Column			TRAN_ALT in ('y','n')
GLLOG$PAP1_20_YN	Column			PAP1_20 in ('y','n')

```
GLLOG$PAP1_100_YN            Column                                          PAP1_100 in
                                                                                   ('y','n')
GLLOG$PAP_ALT_YN             Column                                          PAP_ALT in ('y','n')
GLLOG$_YN                    Column                                          DISTRIB in ('y','n')
GLLOG$LOG_BOT_LOG_TOP_GT     Column                                          LOG_BOT > LOG_TOP
GLLOG$ST_BOR_DUP_LOGTYPE_UK Uniq. Key
GLLOG$LOG_TYPE_FK            Remote    GLLOGTYPE$LOGTYPE_PK          NO ACTION
GLOWNER$OWNER_FK             Remote    GLOWNER$OWNER_PK              NO ACTION
GLLOG$STATE_BOREID_FK        Remote    GLGEN$STATE_BOREID_PK         CASCADE
GLLOG$LOG_UNIT_LOG_TYPE_FK   Remote    GLLOGUNITS$UNITS_LOG_TYPE_PK  NO ACTION
```

GLCHEM:

```
Name                           Null?    Type
------------------------------ -------- ----
STATE                          NOT NULL CHAR(1)
BOREID                         NOT NULL VARCHAR2(6)
DUPID                                   VARCHAR2(1)
LAB_REF                                 VARCHAR2(20)
LAB                                     VARCHAR2(8)
SITE                                    VARCHAR2(40)
DATE_SAMP                               DATE
DATE_ANAL                               DATE
CONC                                    VARCHAR2(4)
PH                                      NUMBER(5,2)
COND                                    NUMBER(5)
TDS_EST                                 NUMBER(6)
ALKALINITY                              NUMBER(5)
TOT_HARD_TRACE                          VARCHAR2(1)
TOT_HARD                                NUMBER(8,2)
CL_TRACE                                VARCHAR2(1)
CL                                      NUMBER(8,2)
SO4_TRACE                               VARCHAR2(1)
SO4                                     NUMBER(8,2)
NO3_TRACE                               VARCHAR2(1)
NO3                                     NUMBER(8,2)
CO3_TRACE                               VARCHAR2(1)
CO3                                     NUMBER(8,2)
HCO3_TRACE                              VARCHAR2(1)
HCO3                                    NUMBER(8,2)
F_TRACE                                 VARCHAR2(1)
F                                       NUMBER(8,2)
NA_TRACE                                VARCHAR2(1)
NA                                      NUMBER(8,2)
K_TRACE                                 VARCHAR2(1)
K                                       NUMBER(8,2)
CA_TRACE                                VARCHAR2(1)
CA                                      NUMBER(8,2)
MG_TRACE                                VARCHAR2(1)
MG                                      NUMBER(8,2)
FE_TRACE                                VARCHAR2(1)
FE                                      NUMBER(8,2)
SI_TRACE                                VARCHAR2(1)
SI                                      NUMBER(8,2)
AL_TRACE                                VARCHAR2(1)
AL                                      NUMBER(8,2)
B_TRACE                                 VARCHAR2(1)
B                                       NUMBER(8,2)
PO4_TRACE                               VARCHAR2(1)
PO4                                     NUMBER(8,2)
HCO3_CL                                 NUMBER(11,5)

TABLE_NAME     COMMENTS
------------------------------------------------------------------------
```

GLCHEM: Chemistry data

COLUMN_NAME	COMMENTS
HCO3_CL:	Bicarbonate/chloride ratio
SITE:	Description of the site of the sample
DATE_ANAL:	Date the sample was analysed
PH:	pH of the sample
TDS_EST:	Estimated total dissolved solids, ppm
TOT_HARD_TRACE:	Total hardness: Trace or upper limit, referencing GABLOG.GLCHACCU(ACCU)
CL:	Chloride concentration, ppm
SO4:	Sulphate concentration, ppm
NO3:	Nitrate concentration, ppm
HCO3_TRACE:	Bicarbonate: Trace or upper limit, referencing GABLOG.GLCHACCU(ACCU)
F_TRACE:	Fluoride: Trace or upper limit, referencing GABLOG.GLCHACCU(ACCU)
NA_TRACE:	Sodium: Trace or upper limit, referencing GABLOG.GLCHACCU(ACCU)
K:	Potassium concentration, ppm
CA:	Calcium concentration, ppm
MG:	Magnesium concentration, ppm
FE:	Iron concentration, ppm
AL_TRACE:	Aluminium: Trace or upper limit, referencing GABLOG.GLCHACCU(ACCU)
B:	Boron concentration, ppm
PO4:	Phosphate concentration, ppm
STATE:	Code for state containing bore, referencing GLSTATE.STATE
BOREID:	Borehole identifier, unique within each state
DUPID:	Duplicate sample identifier
LAB_REF:	laboratory reference of the sample
LAB:	Name of the laboratory responsible for analysing the sample
DATE_SAMP:	Date the site was sampled
CONC:	Units for ionic concentrations, referencing GLCONUNITS.CONC
COND:	Conductivity of the sample, microseimens/cm
ALKALINITY:	Alkalinity as calcium carbonate, ppm
TOT_HARD:	Total hardness, calcium and magnesium salts as CaCO3, ppm
CL_TRACE:	Chloride: Trace or upper limit, referencing GABLOG.GLCHACCU(ACCU)
SO4_TRACE:	Sulphate: Trace or upper limit, referencing GABLOG.GLCHACCU(ACCU)
NO3_TRACE:	Nitrate: Trace or upper limit, referencing GABLOG.GLCHACCU(ACCU)
CO3_TRACE:	Carbonate: Trace or upper limit, referencing GABLOG.GLCHACCU(ACCU)
CO3:	Carbonate concentration, ppm
HCO3:	Bicarbonate concentration, ppm
F:	Fluoride concentration, ppm
NA:	Sodium concentration, ppm
K_TRACE:	Potassium: Trace or upper limit, referencing GABLOG.GLCHACCU(ACCU)
CA_TRACE:	Calcium: Trace or upper limit, referencing GABLOG.GLCHACCU(ACCU)
MG_TRACE:	Magnesium: Trace or upper limit, referencing GABLOG.GLCHACCU(ACCU)
FE_TRACE:	Iron: Trace or upper limit, referencing GABLOG.GLCHACCU(ACCU)
SI_TRACE:	Silicon: Trace or upper limit, referencing GABLOG.GLCHACCU(ACCU)
SI:	Silicon concentration, ppm
AL:	Aluminium concentration, ppm
B_TRACE:	Boron: Trace or upper limit, referencing GABLOG.GLCHACCU(ACCU)
PO4_TRACE:	Phosphate: Trace or upper limit, referencing GABLOG.GLCHACCU(ACCU)

CONSTRAINT_NAME	TYPE	R_CONSTRAINT_NAME	DEL. RULE	SEARCH_CONDITION
GLCHEM$TOT_HARD_TRACE_RF	Remote	GLCHACCU$ACCU_PK	NO ACTION	
GLCHEM$CL_TRACE_RF	Remote	GLCHACCU$ACCU_PK	NO ACTION	
GLCHEM$SO4_TRACE_RF	Remote	GLCHACCU$ACCU_PK	NO ACTION	
GLCHEM$NO3_TRACE_RF	Remote	GLCHACCU$ACCU_PK	NO ACTION	
GLCHEM$CO3_TRACE_RF	Remote	GLCHACCU$ACCU_PK	NO ACTION	
GLCHEM$HCO3_TRACE_RF	Remote	GLCHACCU$ACCU_PK	NO ACTION	
GLCHEM$F_TRACE_RF	Remote	GLCHACCU$ACCU_PK	NO ACTION	
GLCHEM$NA_TRACE_RF	Remote	GLCHACCU$ACCU_PK	NO ACTION	
GLCHEM$K_TRACE_RF	Remote	GLCHACCU$ACCU_PK	NO ACTION	
GLCHEM$CA_TRACE_RF	Remote	GLCHACCU$ACCU_PK	NO ACTION	
GLCHEM$MG_TRACE_RF	Remote	GLCHACCU$ACCU_PK	NO ACTION	

GLCHEM$FE_TRACE_RF	Remote	GLCHACCU$ACCU_PK	NO ACTION	
GLCHEM$SI_TRACE_RF	Remote	GLCHACCU$ACCU_PK	NO ACTION	
GLCHEM$AL_TRACE_RF	Remote	GLCHACCU$ACCU_PK	NO ACTION	
GLCHEM$B_TRACE_RF	Remote	GLCHACCU$ACCU_PK	NO ACTION	
GLCHEM$PO4_TRACE_RF	Remote	GLCHACCU$ACCU_PK	NO ACTION	
GLCHEM$STATE_BOREID_FK	Remote	GLGEN$STATE_BOREID_PK	CASCADE	
GLCHEM$STATE_BOREID_DUPID_UK	Uniq. Key			
GLCHEM$STATE_NN	Column			STATE IS NOT NULL
GLCHEM$BOREID_NN	Column			BOREID IS NOT NULL
GLCHEM$PH_RANGE	Column			PH between 0 and 14
GLCHEM$COND_LOW	Column			COND >= 0
GLCHEM$TDS_LOW	Column			TDS_EST >= 0
GLCHEM$ALKALINITY_LOW	Column			ALKALINITY >= 0
GLCHEM$TOT_HARD_LOW	Column			TOT_HARD >= 0
GLCHEM$CL_LOW	Column			CL >= 0
GLCHEM$SO4_LOW	Column			SO4 >= 0
GLCHEM$NO3_LOW	Column			NO3 >= 0
GLCHEM$CO3_LOW	Column			CO3 >= 0
GLCHEM$HCO3_LOW	Column			HCO3 >= 0
GLCHEM$F_LOW	Column			F >= 0
GLCHEM$NA_LOW	Column			NA >= 0
GLCHEM$K_LOW	Column			K >= 0
GLCHEM$CA_LOW	Column			CA >= 0
GLCHEM$MG_LOW	Column			MG >= 0
GLCHEM$FE_LOW	Column			FE >= 0
GLCHEM$SI_LOW	Column			SI >= 0
GLCHEM$AL_LOW	Column			AL >= 0
GLCHEM$B_LOW	Column			B >= 0
GLCHEM$PO4_LOW	Column			PO4 >= 0
GLCHEM$HCO3_CL_LOW	Column			HCO3_CL >= 0
GL$CHEM$LAB_GLLAB_LAB	Remote	GLLAB$LAB_PK	NO ACTION	
GLCHEM$CONC_FK	Remote	GLCONUNITS$CONC_PK	NO ACTION	

GLSTRAT:

Name	Null?	Type
STATE	NOT NULL	CHAR(1)
BOREID	NOT NULL	VARCHAR2(6)
FORM	NOT NULL	VARCHAR2(12)
DEPTH_TOP	NOT NULL	NUMBER(7,1)
DEPTH_BOT		NUMBER(7,1)

TABLE_NAME	COMMENTS
GLSTRAT:	Lithostratigraphic data interpreted from geophysical logs

COLUMN_NAME	COMMENTS
STATE:	Code for state containing bore, referencing GLSTATE.STATE
BOREID:	Borehole identifier, unique within each state
FORM:	Formation code, referencing GLFORMCODE.FORM
DEPTH_TOP:	Depth from ground surface to top of formation, feet
DEPTH_BOT:	Depth from ground surface to bottom of formation, feet

CONSTRAINT_NAME	TYPE	R_CONSTRAINT_NAME	DEL. RULE	SEARCH_CONDITION
GLSTRAT$STATE_NN	Column			STATE IS NOT NULL
GLSTRAT$BOREID_NN	Column			BOREID IS NOT NULL
GLSTRAT$DEPTH_BOT_DEPTH_TOP_GT	Column			DEPTH_BOT >= DEPTH_TOP
GLSTRAT$STAT_BORE_FRM_DPTH_PK	Prim. Key			
GLSTRAT$STATE_BOREID_FK	Remote	GLGEN$STATE_BOREID_PK	CASCADE	

GLFLOW:

```
Name                           Null?    Type
------------------------------ -------- ----
STATE                          NOT NULL CHAR(1)
BOREID                         NOT NULL VARCHAR2(6)
DUPID                                   CHAR(1)
DEPTH                                   NUMBER(6,1)
RPS                                     NUMBER(6,1)


TABLE_NAME     COMMENTS
-------------------------------------------------------------------------
GLFLOW:        Static flow rates as measured from logs


COLUMN_NAME    COMMENTS
-------------------------------------------------------------------------
STATE:         Code for state containing bore, referencing GLSTATE.STATE
BOREID:        Borehole identifier, unique within each state
DUPID:         Code for duplicate bore logs, B-Z
DEPTH:         Depth from ground surface in feet, at which flow measurement was made
RPS:           flow rate, in revolutions per second


CONSTRAINT_NAME              TYPE     R_CONSTRAINT_NAME              DEL. RULE SEARCH_CONDITION
---------------------------- -------- ------------------------------ --------- --------------------
GLFLOW$STATE_NN              Column                                             STATE IS NOT NULL
GLFLOW$BOREID_NN             Column                                             BOREID IS NOT NULL
GLFLOW$STATE_BORE_DUP_DEP_UK Uniq. Key
GLFLOW$STATE_BOREID_FK       Remote   GLGEN$STATE_BOREID_PK          CASCADE
```

GLSTATE:

```
Name                           Null?    Type
------------------------------ -------- ----
STATE                          NOT NULL CHAR(1)
NAME                           NOT NULL VARCHAR2(20)
ABB                            NOT NULL VARCHAR2(3)


TABLE_NAME     COMMENTS
-------------------------------------------------------------------------
GLSTATE:       Valid states and state names for the GABLOG bores


COLUMN_NAME    COMMENTS
-------------------------------------------------------------------------
STATE:         State code
NAME:          State name
ABB:           State abbreviation


S NAME                 ABB
- -------------------- ---
n New South Wales      NSW
q Queensland           Qld
s South Australia      SA
t Northern Territory   NT
```

```
CONSTRAINT_NAME           TYPE      R_CONSTRAINT_NAME       DEL. RULE SEARCH_CONDITION
------------------------- --------- ----------------------- --------- -------------------------
GLSTATE$STATE_NN          Column                                      STATE IS NOT NULL
GLSTATE$NAME_NN           Column                                      NAME IS NOT NULL
GLSTATE$ABB_NN            Column                                      ABB IS NOT NULL
GLSTATE$STATE_PK          Prim. Key
```

GLMAP250:

```
 Name                           Null?    Type
 ------------------------------ -------- ----
 MAP_250                        NOT NULL CHAR(6)
 NAME                           NOT NULL VARCHAR2(25)

TABLE_NAME     COMMENTS
---------------------------------------------------------------------
GLMAP250:      Valid 1:250 000 UTM mapsheets for the Great Artesian Basin

COLUMN_NAME    COMMENTS
---------------------------------------------------------------------
MAP_250:       Map sheet reference code
NAME:          Map sheet name

CONSTRAINT_NAME           TYPE      R_CONSTRAINT_NAME              DEL. RULE SEARCH_CONDITION
------------------------- --------- ------------------------------ --------- --------------------
--------------
GLMAP250$MAP_250_NN       Column                                             MAP_250 IS NOT NULL
GLMAP250$NAME_NN          Column                                             NAME IS NOT NULL
GLMAP250$MAP_250_PK       Prim. Key
```

GLOWNER:

```
Name                           Null?    Type
 ------------------------------ -------- ----
 OWNER                          NOT NULL VARCHAR2(8)
 NAME                           NOT NULL VARCHAR2(60)

TABLE_NAME     COMMENTS
---------------------------------------------------------------------
GLOWNER:       Valid owners of GAB geophysical logs

COLUMN_NAME    COMMENTS
---------------------------------------------------------------------
OWNER:         Owner abbreviation
NAME:          Owner name

OWNER    NAME
-------- ------------------------------------------------------------
AGSO     Australian Geological Survey Organisation
AOP      American Overseas Petroleum Ltd
CYPLUS   CYPLUS NRAP
CRA      CRA
WSC      Winton Shire Council
GSQ      Geological Survey of Queensland
ZC       Zinc Corp Ltd
MA       Mines Administration Pty Ltd
NAI      North American International
```

```
MEO      Mid Eastern Oil NL


CONSTRAINT_NAME         TYPE       R_CONSTRAINT_NAME              DEL. RULE SEARCH_CONDITION
----------------------- ---------- ------------------------------ --------- --------------------
GLOWNER$OWNER_NN        Column                                               OWNER IS NOT NULL
GLOWNER$NAME_NN         Column                                               NAME IS NOT NULL
GLOWNER$OWNER_PK        Prim. Key
```

GLSTRATCODE:

```
 Name                           Null?    Type
 ------------------------------ -------- ----
 FORM                           NOT NULL VARCHAR2(12)
 NAME                           NOT NULL VARCHAR2(55)


TABLE_NAME      COMMENTS
-------------------------------------------------------------------------
GLSTRATCODE:    Lithostratigraphic unit names and abbreviations


COLUMN_NAME     COMMENTS
-------------------------------------------------------------------------
FORM:           Formation abbreviation
NAME:           Formation name


CONSTRAINT_NAME            TYPE       R_CONSTRAINT_NAME              DEL. RULE SEARCH_CONDITION
-------------------------- ---------- ------------------------------ --------- --------------------
GLSTRATCODE$FORM_NN        Column                                               FORM IS NOT NULL
GLSTRATCODE$NAME_NN        Column                                               NAME IS NOT NULL
GLSTRATCODE$FORM_PK        Prim. Key
GLSTRATCODE$NAME_UK        Uniq. Key
```

GLLOGTYPE:

```
 Name                           Null?    Type
 ------------------------------ -------- ----
 LOG_TYPE                       NOT NULL VARCHAR2(3)
 NAME                           NOT NULL VARCHAR2(25)


TABLE_NAME      COMMENTS
-------------------------------------------------------------------------
GLLOGTYPE:      Valid geophysical log types and abbreviations


COLUMN_NAME     COMMENTS
-------------------------------------------------------------------------
LOG_TYPE:       Log type abbreviation
NAME:           Log type name


CONSTRAINT_NAME         TYPE       R_CONSTRAINT_NAME              DEL. RULE SEARCH_CONDITION
----------------------- ---------- ------------------------------ --------- --------------------
GLLOGTYPE$LOG_TYPE_NN   Column                                               LOG_TYPE IS NOT NULL
GLLOGTYPE$NAME_NN       Column                                               NAME IS NOT NULL
GLLOGTYPE$LOGTYPE_PK    Prim. Key
```

GLLOGUNITS:

```
 Name                           Null?    Type
 ------------------------------ -------- ----
 LOG_TYPE                       NOT NULL VARCHAR2(3)
 UNITS                          NOT NULL VARCHAR2(10)


TABLE_NAME     COMMENTS
-------------------------------------------------------------------------
GLLOGUNITS:    Valid units for geophysical log types


COLUMN_NAME    COMMENTS
-------------------------------------------------------------------------
LOG_TYPE:      Log type
UNITS:         Valid units


CONSTRAINT_NAME                TYPE      R_CONSTRAINT_NAME   DEL. RULE SEARCH_CONDITION
------------------------------ --------- ------------------- --------- -------------------------
GLLOGUNITS$LOG_TYPE_NN         Column                                  LOG_TYPE IS NOT NULL
GLLOGUNITS$UNITS_NN            Column                                  UNITS IS NOT NULL
GLLOGUNITS$UNITS_LOG_TYPE_PK   Prim. Key
```

GLELEV:

```
 Name                           Null?    Type
 ------------------------------ -------- ----
 ELEV_METH                      NOT NULL CHAR(1)
 NAME                           NOT NULL VARCHAR2(30)


TABLE_NAME     COMMENTS
-------------------------------------------------------------------------
GLELEV:        Elevation measurement codes and definitions


COLUMN_NAME    COMMENTS
-------------------------------------------------------------------------
ELEV_METH:     Elevation code
NAME:          Elevation method name


CONSTRAINT_NAME                TYPE      R_CONSTRAINT_NAME   DEL. RULE SEARCH_CONDITION
------------------------------ --------- ------------------- --------- -------------------------
GLELEV$ELEV_METH_NN            Column                                  ELEV_METH IS NOT NULL
GLELEV$NAME_NN                 Column                                  NAME IS NOT NULL
GLELEV$ELEV_METH_PK            Prim. Key
```

GLCONUNITS:

```
 Name                           Null?    Type
 ------------------------------ -------- ----
 CONC                           NOT NULL VARCHAR2(4)
 UNITS                          NOT NULL VARCHAR2(30)


TABLE_NAME     COMMENTS
-------------------------------------------------------------------------
GLCONUNITS:    Valid units for ionic concentration measurements
```

```
COLUMN_NAME     COMMENTS
------------------------------------------------------------------------
CONC:           Ionic concentration units (abbreviation)
UNITS:          Ionic concentration units (full)

CONSTRAINT_NAME                TYPE      R_CONSTRAINT_NAME    DEL. RULE SEARCH_CONDITION
------------------------------ --------- -------------------- --------- ------------------------
GLCONUNITS$CONC_NN             Column                                   CONC IS NOT NULL
GLCONUNITS$UNITS_NN            Column                                   UNITS IS NOT NULL
GLCONUNITS$CONC_PK             Prim. Key
```

GLCHACCU:

```
 Name                           Null?    Type
 ------------------------------ -------- ----
 ACCU                           NOT NULL VARCHAR2(1)
 NAME                           NOT NULL VARCHAR2(30)

TABLE_NAME      COMMENTS
------------------------------------------------------------------------
GLCHACCU:       Accuracy or significance of chemical ionic concentration

COLUMN_NAME     COMMENTS
------------------------------------------------------------------------
ACCU:           Accuracy or significance abbreviation
NAME:           Accuracy or significance

CONSTRAINT_NAME      TYPE      R_CONSTRAINT_NAME              DEL. RULE SEARCH_CONDITION
-------------------- --------- ------------------------------ --------- ------------------------
GLCHACCU$ACCU_NN     Column                                             ACCU IS NOT NULL
GLCHACCU$NAME_NN     Column                                             NAME IS NOT NULL
GLCHACCU$ACCU_PK     Prim. Key
```

GLLAB:

```
 Name                           Null?    Type
 ------------------------------ -------- ----
 LAB                            NOT NULL VARCHAR2(8)
 NAME                           NOT NULL VARCHAR2(60)

TABLE_NAME      COMMENTS
------------------------------------------------------------------------
GLLAB:          Valid chemistry laboratories for GABLOG hydrochemical analyses

COLUMN_NAME     COMMENTS
------------------------------------------------------------------------
LAB:            Laboratory abbreviation
NAME:           Laboratory name

CONSTRAINT_NAME         TYPE      R_CONSTRAINT_NAME              DEL. RULE SEARCH_CONDITION
----------------------- --------- ------------------------------ --------- --------------------
GLLAB$LAB_NN            Column                                             LAB IS NOT NULL
GLLAB$NAME_NN           Column                                             NAME IS NOT NULL
GLLAB$LAB_PK            Prim. Key
```