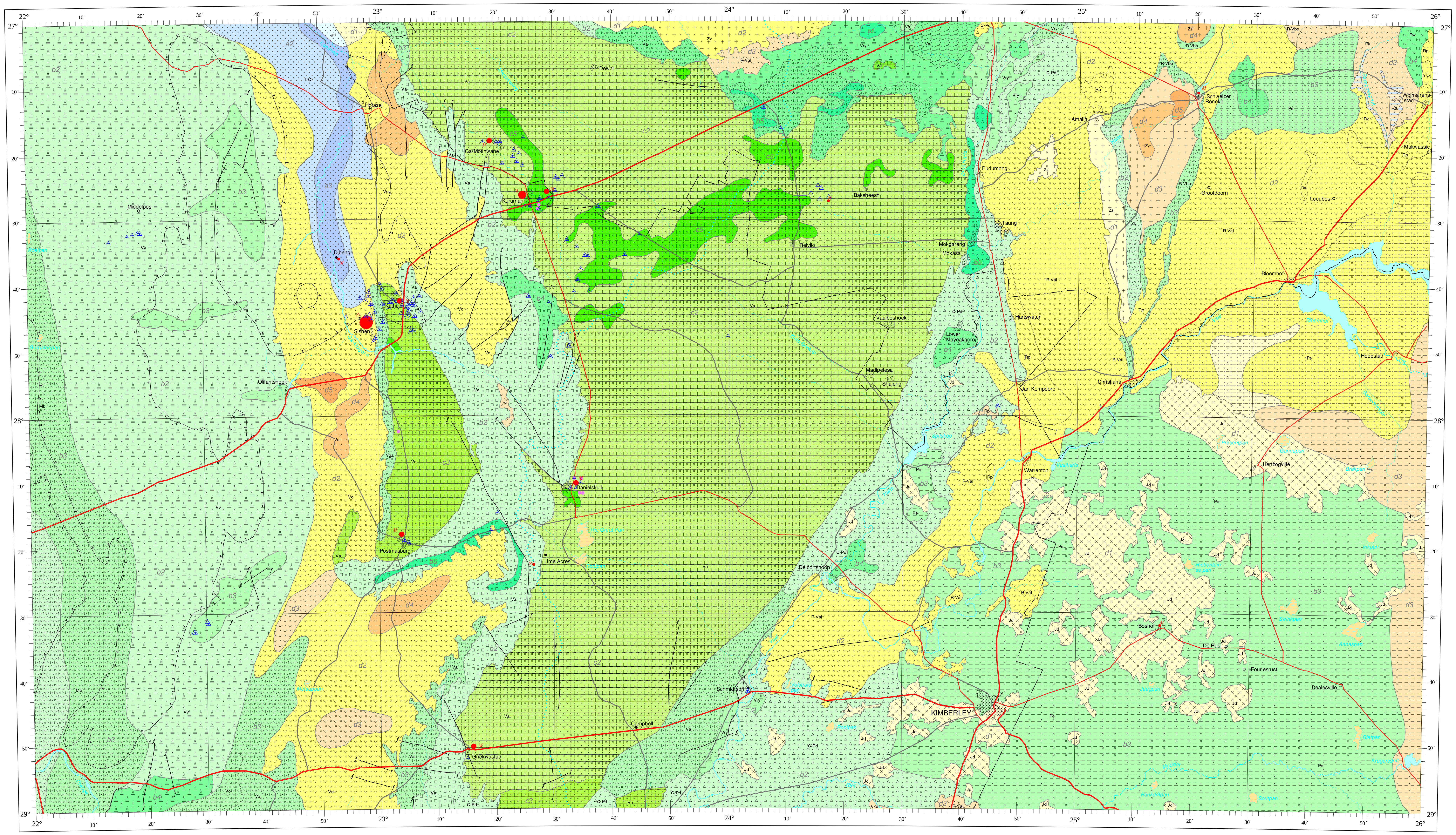
Sheet 2722

1:500 000 Hydrogeological map series of the Republic of South Africa



KIMBERLEY

2003

Lambert's conformal conic projection. Standard parallels 26°40' & 33°20'. Central meridian 24°. Spheroid Clarke 1880.

Map Authors - M.C. Moseki and P.S. Meyer

GIS Specialist - T. Chetty

Cartographer - F. Jonck

Assisted by:

Mapping Management Team:
P.S. Meyer (Consultant), F. Jonck and E. Botes

Editorial Board:
E. Braune, J. Girman, P. Seward and Z.M. Dziembowski (Consultant)

This map was approved by the Director-General of the Department: Water Affairs and Forestry.

The groundwater occurrence and groundwater quality maps, and the schematic cross-sections of groundwater occurrence were compiled by M.C. Moseki. The lithology was adapted by M.C. Moseki from the 1:1 000 000 scale published Geological map (1984). T. Chetty was responsible for the compilation of the borehole distribution map.

Precipitation and elevation data were obtained from the Computing Centre for Water Research, University of Natal, and compiled by H. Mullin. Information on roads, rivers, towns and provincial boundaries were obtained from the Chief Directorate: Surveys and Mapping, Department: Land Affairs, and edited by the Department Water Affairs and Forestry. Permission from these respective institutions to make use of their information is gratefully acknowledged. Borehole data were obtained from the National Groundwater Data Base (NGDB).

Principal groundwater occurrence

Borehole yield class (median l/s)(excluding dry boreholes)

Aquifer type	0.0 - 0.1	0.1 - 0.5	0.5 - 2.0	2.0 - 5.0	> 5.0
Intergranular	a1	a2	a3	*	*
Fractured	*	b2	b3	b4	b5
Karst	*	c2	c3	*	c5
Intergranular and fractured	d1	d2	d3	d4	d5
Two-layered	a2/d3	Upper aquifer: Intergranular (0.1 - 0.5 l/s) Lower aquifer: Intergranular and fractured (0.5 - 2.0 l/s)			

Borehole yield boundary (main map only)

Note: Groundwater occurrence depicts the aquifer type(s) with the highest borehole yield, and does not always correlate with surface lithology. The two-layered type however, always depicts the upper two aquifers.

Surface / Sub-surface lithology

(Unconsolidated sediments which are unsaturated, have been omitted from the map)

- Undifferentiated inland deposits (unconsolidated to semi-consolidated sediments including sand, calcrete, aeolianite, gravel, clay and silcrete)
- Predominantly argillaceous rocks (shale, mudstone and subordinate siltstone)
- Predominantly arenaceous rocks (sandstone) and subordinate shale
- Predominantly carbonate rocks (dolomite and subordinate limestone), shale and chert
- Predominantly diamictite (tillite)
- Predominantly iron formation (banded ironstone and jaspillite)
- Basic intrusive rocks (dolerite)
- Acid intrusive rocks (various granites)
- Basic and intermediate extrusive rocks (basalt, andesite)
- Acid and intermediate extrusive rocks (quartz porphyry)
- Predominantly meta-argillaceous rocks (slate)
- Predominantly meta-arenaceous rocks (quartzite)
- Various lithologies: Sedimentary rocks: R-Vbo, Vga, Vo, Va and Rw; Metamorphic rocks: Mb; Metamorphic and extrusive rocks: Zk
- Lithological / stratigraphical boundary
- Fault
- Isopach (15m) of Kalahari Group (Groundwater Resources of the Republic of South Africa, Vegter 1995). The sediments thicken in the direction of the arrows. In areas mapped as intergranular the sediments form significant aquifers
- Dolerite / diabase intruded

Large scale groundwater abstraction

- > 10 million m³/a
- 2-5 million m³/a
- 1-2 million m³/a
- 0.1-1 million m³/a
- D Domestic
- Mining
- M Municipal
- Industrial

- Spring (>5 l/s)
- Waterlevel recorder
- Waterlevel monitoring point
- Primary catchment boundary
- Water course
- Primary perennial river
- Secondary perennial river
- Non-perennial river
- Dam
- Dry pan, water course
- City / town area
- Village
- Reference point
- National road
- Main road; Inset map: National road
- Inset map: Main road
- Additional secondary road (orientation purposes)
- Provincial boundary
- * Not applicable on this map

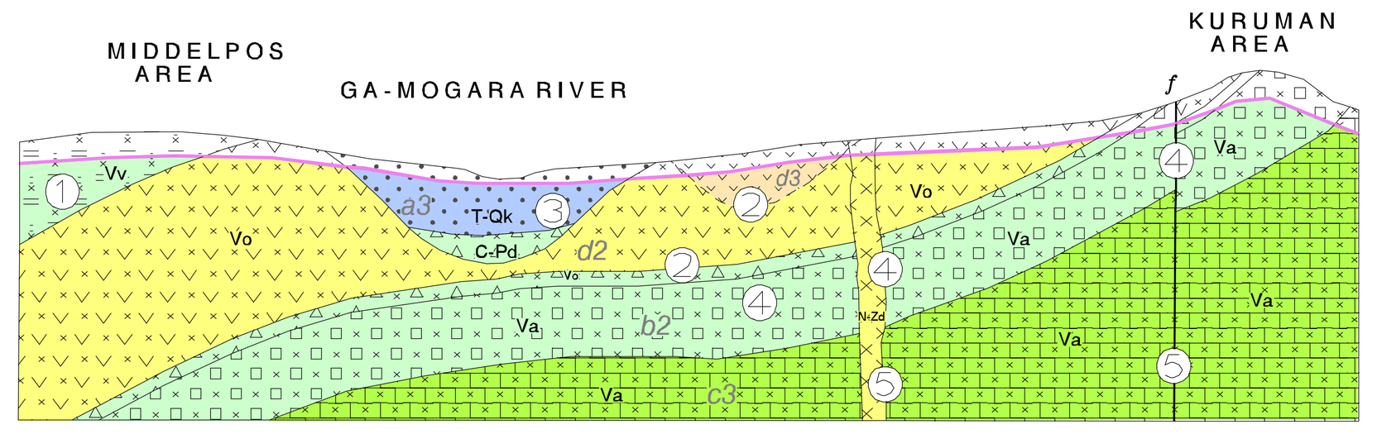
Chronostratigraphy

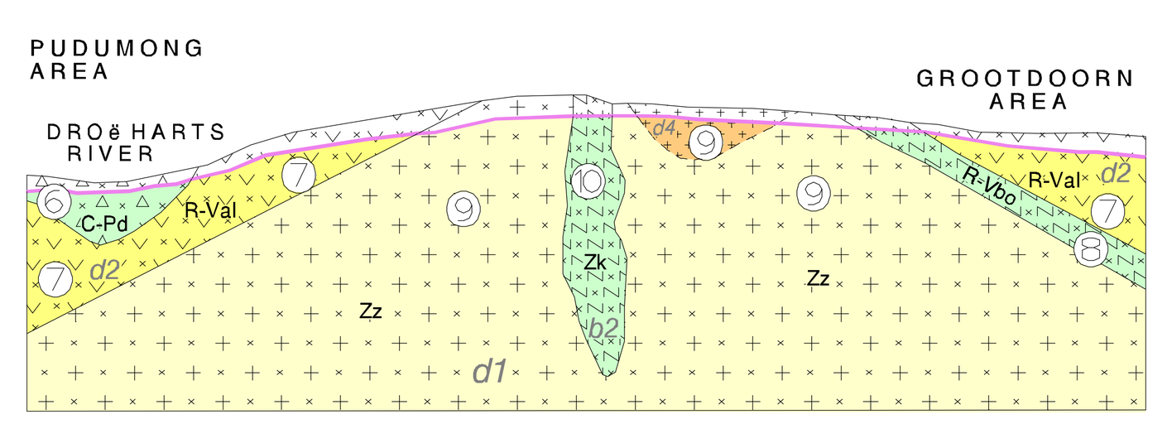
1	2	3	4	5	6
	PHANEROZOIC	Cenozoic	Quaternary	Q	Kalahari G. (T-Qk)
1.8			Tertiary	T	
65		Mesozoic	Cretaceous	K	Dolerite (Jd)
142			Jurassic	J	
205			Triassic	Tr	
248		Palaeozoic	Permian	P	Ecca G. (Pe)
290			Carboniferous	C	Dwyka G. (C-Pd)
354			Devonian	D	
417			Silurian	S	
443			Ordovician	O	
495			Cambrian	Є	
545	PROTEROZOIC	Namibian		N	Diabase (N-Zd) Note: only appears on the cross-section
900		Mokolian		M	Brulpan G. (Mb)
2050		Vaalian		V	Volop G. (Vv); Postmasburg G. (Vo); Ghaap G. (Va); Vryburg F. (Vry); Gamagara F. (Vga)
2650	ACHAEOZOIC				Allanridge F. (R-Val); Bothaville F. (R-Vbo)
		Randian		R	Platberg G. (Rp); Klipriviersberg G. (Rk); West Rand G. (Rw)
3100		Swazian		Z	Kraaipan G. (Zk); Unnamed Swazian rocks (Zz)

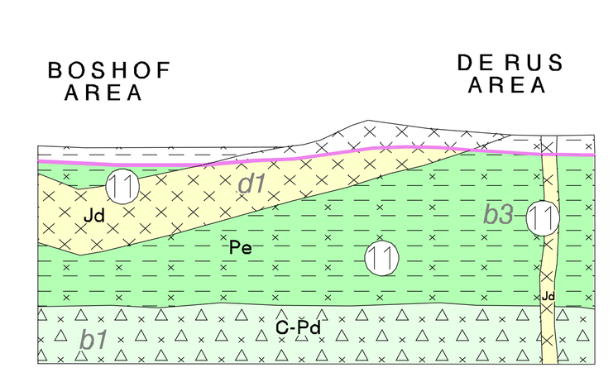
1 = Million years before present (Council for Geoscience, 1997); 2 = Eonothem (Eon); 3 = Erathem (Era); 4 = System (Period); 5 = Symbol; 6 = Complex (C), Suite (S), Group (G), Formation (F) (with symbol)

Schematic cross-sections to illustrate typical groundwater occurrence

Not to scale







1. Joints and fractures in the quartzites that dominate the Volop Group (Vv) can be targeted for groundwater development. Yields of up to 2 l/s can be obtained. Better quality groundwater is associated with higher yielding areas
2. Weathered zones and occasional joints and fractures in the andesitic lava and infrequent interbeds of chert and jasper, as well as basal (Makganyene Formation) diamictite, all of the Postmasburg Group (Vo), can be recommended for groundwater development. Yields generally not exceeding 2 l/s and electrical conductivities (ECs) of less than 300 mS/m can be anticipated
3. Glacial valleys formed during Dwyka Group (C-Pd) times and filled with tillite and subseqeuntly with Kalahari Group (T-Qk) sediments offer useable groundwater with yields of up to 2 l/s and ECs averaging less than 300 mS/m
4. The groundwater potential of the banded iron formation of the Ghaap Group (Va) is limited, but yields of up to 2 l/s can be obtained in joints and fractures associated with faults and diabase dykes
5. Dolomite of the Ghaap Group (Va) has generally good groundwater potential and yields in excess of 2 l/s are common. Groundwater can be developed from fractures, joints, and solution cavities commonly associated with faults and diabase dykes, as well as from fractured, sub-ordinate carbonaceous shale beds. Faults and dykes can often easily be targeted due to the occurrence of calcrete mounds and trees along these structures. Solid, structureless dolomite, however, should be avoided when siting boreholes
6. The diamictite and sub-ordinate shale of the Dwyka Group (C-Pd) is dense and massive, and its groundwater potential is low. Yields of up to 0.5 l/s can, however, be obtained from occasional joints and fractures. Groundwater quality tends to be rather poor
7. The andesitic lava of the Allanridge Formation (R-Val) can yield groundwater in excess of 2 l/s if fractures associated with faults and diabase or dolerite dykes are intersected. Zones of deeper weathering can also be targeted
8. The groundwater potential of the fractured conglomerate and sandstone of the Bothaville Formation (R-Vbo) is as a whole limited, and yields of less than 2 l/s can be expected
9. Boreholes with yields of up to 2 l/s can be obtained in weathered zones, in joints in the transitional zone between weathered and solid granite, and in occasional fractures in the unnamed Swazian granite (Zz)
10. The Kraaipan Group (Zk) consists of chert, banded ironstone, jaspilite, schist and lava. Groundwater can be developed from joints, fractures and lithological contacts, notably from the contact between the Kraaipan Group (Zk) rocks and the Swazian granite (Zz). Yields of up to 0.5 l/s can be expected
11. Boreholes targeting joints and intersecting bedding planes in the shale and sub-ordinate sandstone of the Ecca Group (Pe) away from dolerite (Jd) intrusions commonly yield less than 0.5 l/s. Yields in excess of 0.5 l/s can, however, be expected where dolerite sill and dyke contact zones are intersected

Weathered zone — Groundwater level

Note: For additional information concerning groundwater occurrence refer to accompanying brochure.

Digital data, copies of this map and accompanying brochure are obtainable from:
Department: Water Affairs and Forestry
Private Bag X313
Pretoria
0001

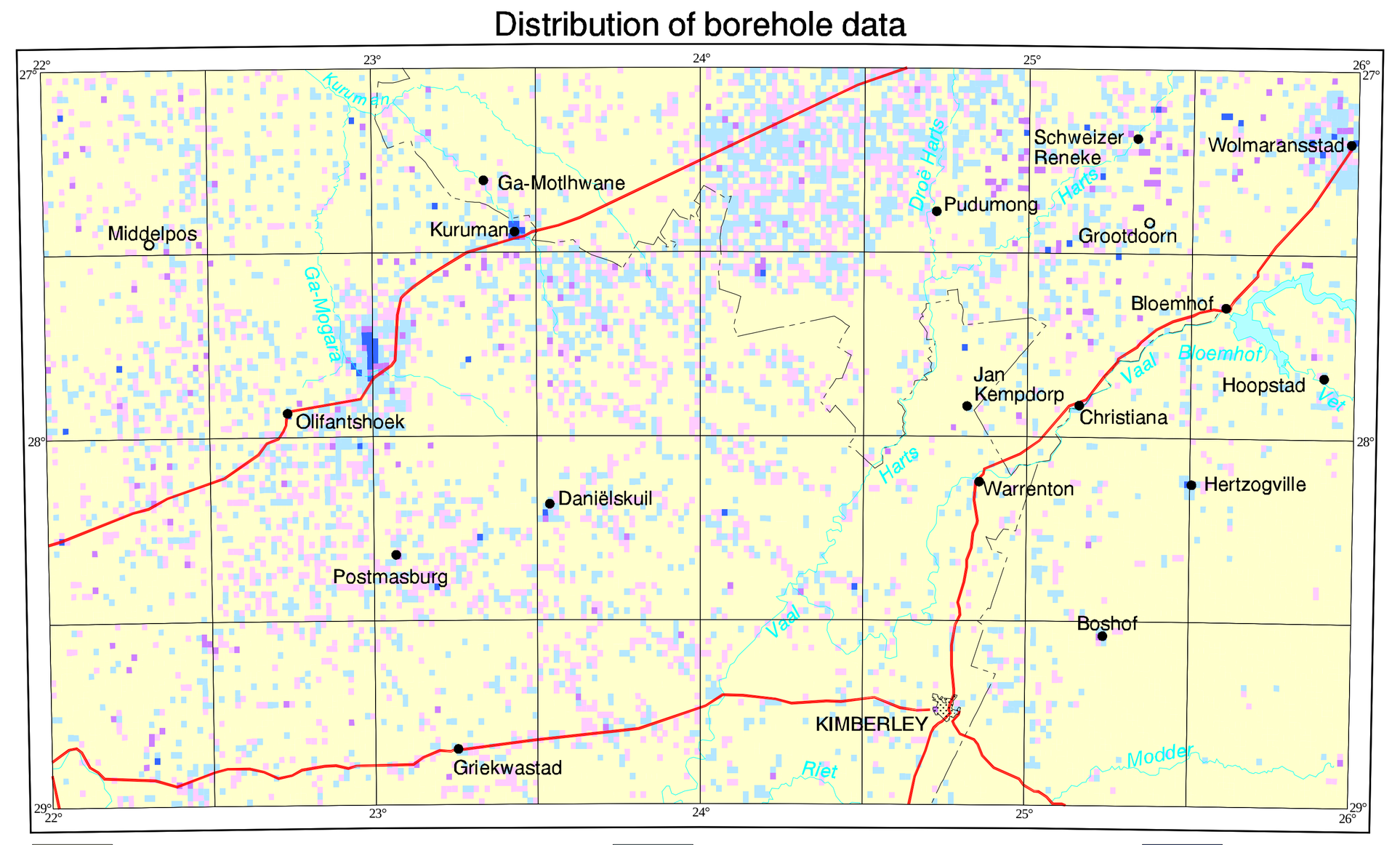
Web site: http://www-dwaf.pwv.gov.za/geohydrology/index.htm

Published by: Department: Water Affairs and Forestry

Printed by: Associated Printing, Cape Town

First Edition 2003

Distribution of borehole data

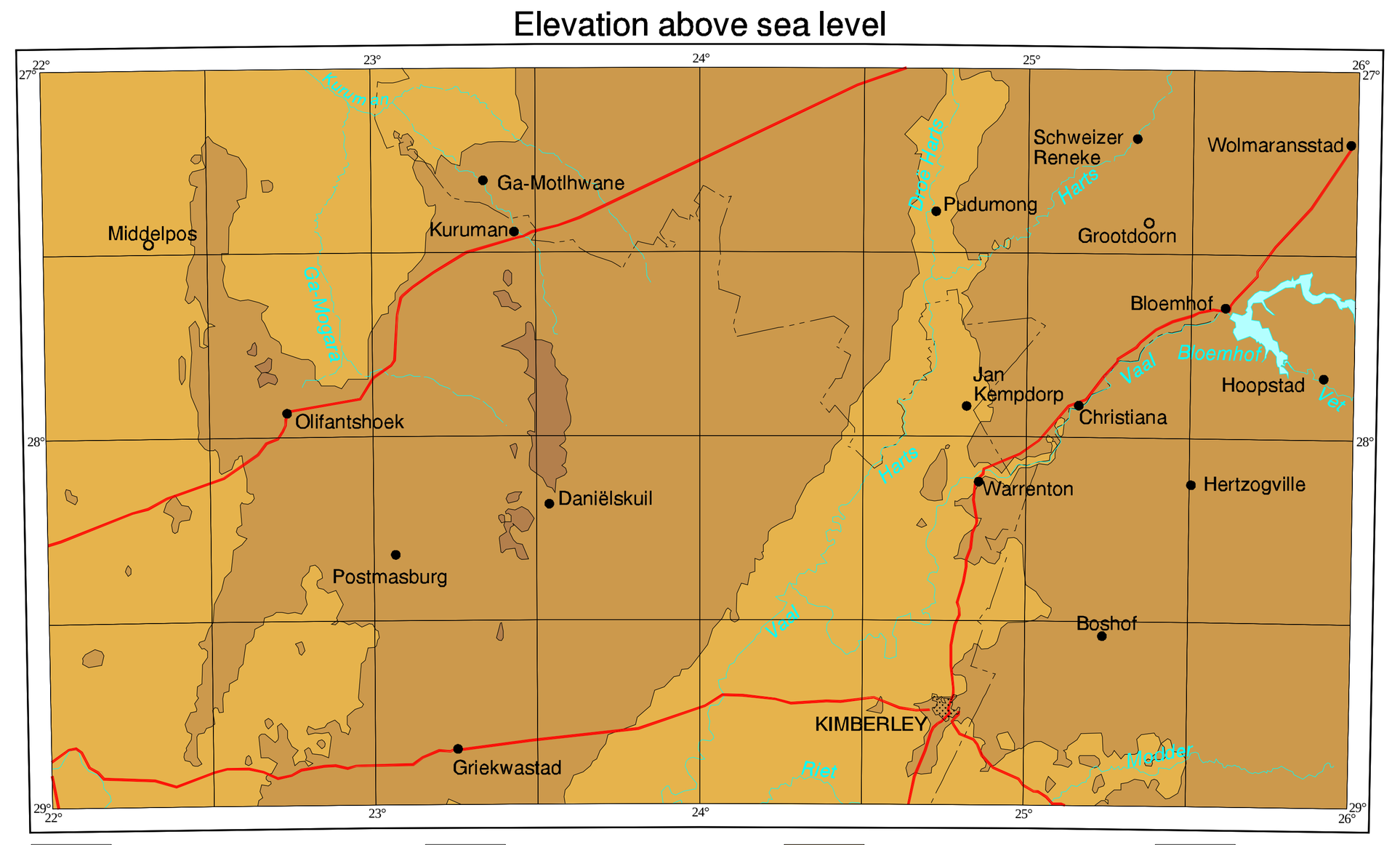


- No borehole information
- 1 Borehole
- 2 - 10 Boreholes
- 11 - 20 Boreholes
- > 20 Boreholes

Borehole data points per 1 minute grid

1:2 000 000

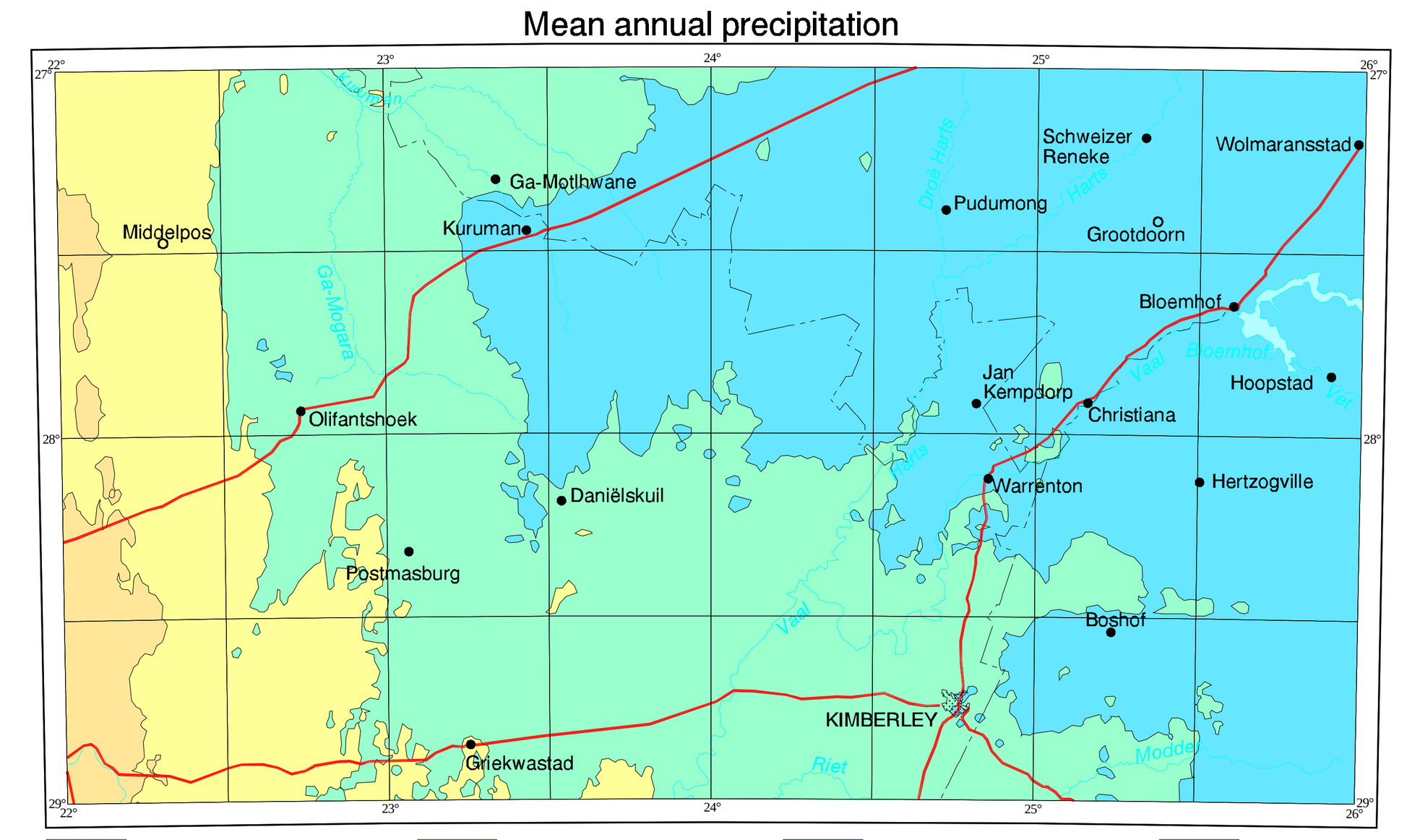
Elevation above sea level



- sea level - 200 m
- 200 - 400 m
- 400 - 800 m
- 800 - 1200 m
- 1200 - 1600 m
- 1600 - 2000 m
- 2000 - 2500 m
- > 2500 m

1:2 000 000

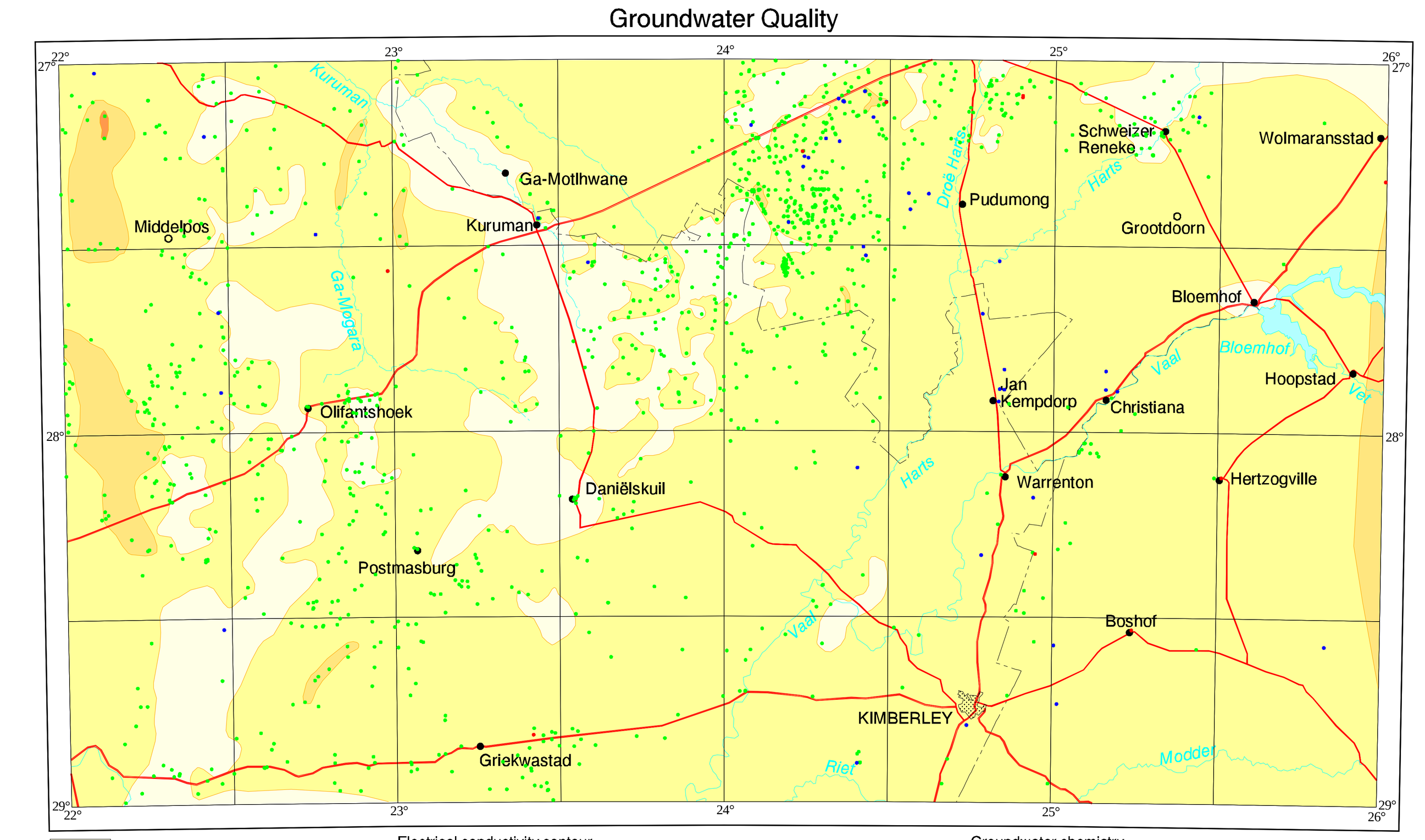
Mean annual precipitation



- 0 - 100 mm
- 100 - 200 mm
- 200 - 300 mm
- 300 - 400 mm
- 400 - 600 mm
- 600 - 800 mm
- 800 - 1000 mm
- > 1000 mm

1:2 000 000

Groundwater Quality



- 0 - 70 mS/m
- 70 - 300 mS/m
- 300 - 1000 mS/m
- > 1000 mS/m

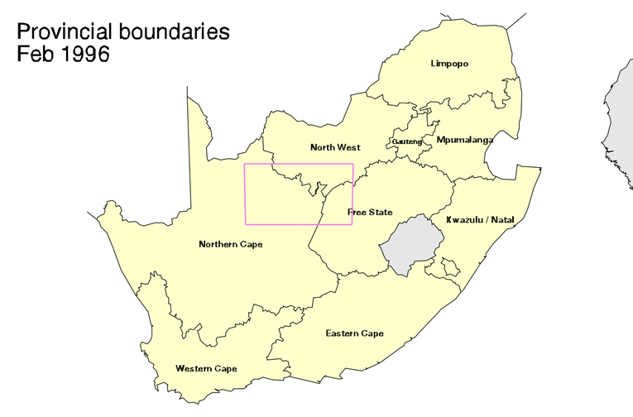
Electrical conductivity contour

Groundwater chemistry
- Nitrate > 10mg/l
- Fluoride > 1.5mg/l
- Nitrate > 10mg/l & Fluoride > 1.5mg/l

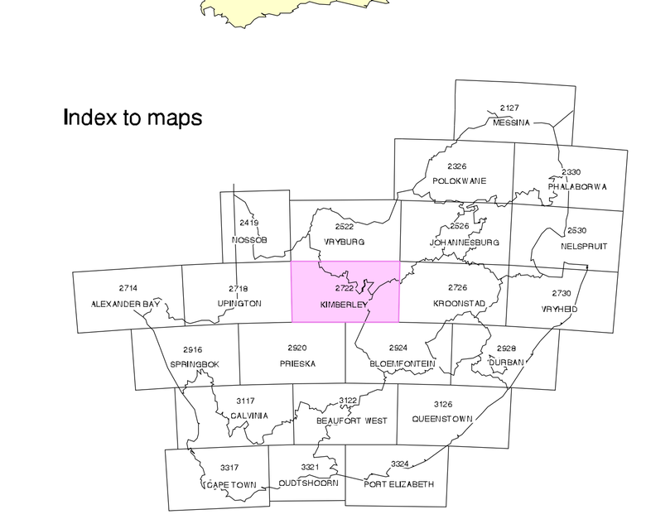
Note:
Nitrate and fluoride concentrations are shown only where the maximum allowable limits are exceeded and data are available. There may be other localities where concentrations of fluoride and nitrate exceed the above limits. Unfortunately no groundwater analyses are available to prove or disprove this.
For additional information concerning groundwater chemistry refer to accompanying brochure.

1:1 500 000

Provincial boundaries Feb 1996



Index to maps



DEPARTMENT: WATER AFFAIRS AND FORESTRY

KIMBERLEY 2722