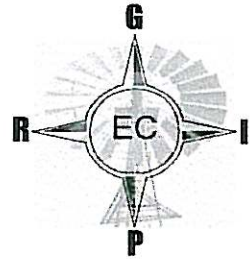


GROUNDWATER RESOURCE INFORMATION PROJECT EASTERN CAPE PROVINCE

GROUNDWATER INFORMATION SOURCE REFERENCE SHEET



SOURCE REF NR:	SR 225	Own Archive		Copy attached	✓
		Sourced	✓	Copy at source	

A: SOURCE DESCRIPTION

District Municipality:	Amatole		Chris Hani		O R Tambo	✓
	Ukhahlamba		Cacadu		Alfred Nzo	
Local Municipality:	KING SABATA DALINYEBO					
Institution where Information is held:	TOENS & PARTNERS					
Branch of Institution:	WYNBERG, CAPE TOWN					
Contact details:	Contact person:	DES VISSER				
	Contact Tel:	021-7625815				
	Contact Email:	toens@mweb.co.za				

B: TYPE OF INFORMATION

Information format:	Hard copy	✓	Data Summary		Electronic Report	
	Specify Other:					
Report / Info Title:	MQANDULI GROUNDWAT INVESTIGATION RDP 2					
Report Nr:	N/A	Date:	Nov-96			
Author Details:	JM RASMUSSEN					
Author's Qualification:	Hydrogeologist	✓	Govt Dept		Project Manager	
	Engineer		Technician		Other	
	Specify Other:					
Captured by:	PS Nel		Date:	17/03/2004		Signed:

C: GEOHYDROLOGICAL CATEGORIZATION

Project Type	Source development	✓	Feasibility Study		Sanitation Study	
	Specify Other:					
Reference Co-ordinate:	Latitude	Longitude				
	31° 17' 42.0"	28° 52' 30"				
Lithological & Construction Logs	Yes	No	Complete	Incomplete		
Hydrocensus Data	✓	✓	NGDB SERACH			
Pump Testing Data		✓				
Chemical Water Analysis Data	✓				✓	
Geohydrological Data	✓		✓			
Spring Data		✓				
Remote Sensing Data	✓		✓			
Map Data	✓		✓			

Comments:

Reviewed by: **JU du Plooy** Date: **17/03/2004** Signed:





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**MQANDULI GROUNDWATER
INVESTIGATION**

RDP X 2

JM RASMUSSEN

NOVEMBER 1996

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MQANDULI RURAL AREA

WATER SUPPLY FOR THE VILLAGES OF LUTUBENI, MNCWASA AND MANCAM

PHASE 1

1.0 INTRODUCTION

1.1 TERMS OF REFERENCE

In a letter dated 08 November 1996 (ref.no. 7006 AH\GG\ncm) from Liebenberg and Stander, Toens and Partners were appointed as specialist hydrogeological sub-consultants for Phase 1 of the rural water supply to the villages of Lutubeni, Mancam and Mcwasa in the Mqanduli District of the Transkei. The terms of reference were as follows:

- to assess the groundwater potential of the study area by means of a desktop study
- to carry out a site visit to make general observations with regard to current water supplies
- to compile a preliminary report

2.0 LOCATION

The Mqanduli Magisterial District is located in the Eastern Cape Province, with the main service town of Mqanduli located approximately 30 km south of Umtata. The villages of Mancam, Luthubeni and Mncwasa are located roughly 7.5, 14 and 17 km south east of Mqanduli respectively on the main road to Coffee Bay (Figure 1). Each village is spread over a relatively wide area of about 10 km².

3.0 REGIONAL GEOLOGY

From a regional perspective the study area is underlain by rocks of the Karoo Sequence consisting of mudstones and sandstones of the Adelaide Subgroup of the Beaufort Group, and mudstones and shales of the Ecca Group. In places these rocks have been intruded by dolerite dykes and sheets (Figure 2).

4.0 HYDROGEOLOGY

According to Smart (*pers.comm.*, 1996) optimal drilling targets in the Transkei area are restricted to fractured and intergranular aquifers. The fractured aquifers are associated with

joints, fractures, faults and fissure systems within the more competent host rocks (e.g. sandstones), whereas intergranular aquifers are associated with zones of weathered material resulting from the decomposition of solid crystalline rock (e.g. dolerite). In general boreholes drilled into weathered zones containing residual clay weathering products tend to be relatively lower yielding, whereas the highest yields can be expected in the less weathered but fractured zones.

4.1 PREVIOUS HYDROGEOLOGICAL INVESTIGATIONS IN THE MQANDULI AREA

A summary of all the borehole information in the Mqanduli District sourced from recent drought relief drilling records and from the Department of Water Affairs and Forestry National Groundwater Data Base is attached in Appendix 1. Based on the information available, the bulk of the drilling which has taken place in the past has been restricted to an area to the north west of Mqanduli town, with no drilling having taken place at either Mancam, Lutubeni or Mncwasa.

Based on the available information it is apparent that boreholes drilled into dyke contacts were found to give superior yields compared to those drilled into dolerite sheets. It is speculated that this could be due to an absence of tectonic-related fracturing as a result of the rigidity of these thick dolerite sheets, whereas structural movements/adjustments and associated fracturing along dykes would have enhanced the possibility of aquifer development.

In general, although dolerite is a favourable target, the degree of fracturing is highly variable as evidenced by the number of dry boreholes drilled by DWAF during the drought-relief drilling of 1995/1996 to the west of Mqanduli town. Based on the drilling results the average yield for boreholes drilled into dolerite is approximately 0.50 l/s.

It is interesting to note that in those areas which are dolerite poor, successful boreholes have been drilled into fractures within the sandstones. In general yields are in the order of 1.0 l/s, although yields of up to 10 l/s have been recorded.

According to DWAF records the optimal drilling depth is estimated to be approximately 25 m below groundwater level (mean water level 17 m) as it is postulated that water bearing structures are more "open" at these shallower depths, with the chances of striking water becoming progressively less with depth (Smart, 1996).

4.2 LIMITATIONS IN THE PAST

One of the limitations envisaged with regard to the optimal siting of boreholes in this area is the generally rugged nature of the terrain. In this part of the Transkei, due to limited financial resources available for reticulation, drilling in the past has taken place in or very close to the villages which are generally located on hill tops. Furthermore, due to poor accessibility for drilling rigs, drilling has not taken place in the topographic lows which are considered more favourable for groundwater development (Smart, 1996). The relatively

good results obtained in topographic lows are possibly due to the following:

- topographic lows often coincide with more easily erodible fracture zones
- weathering is often more pronounced in the topographic lows.

4.3 WATER QUALITY

By all indications the groundwater quality in the Mqanduli area is good, with low concentrations of total dissolved solids (TDS), and can be considered potable in its raw state. However, taking cognisance of the shallow water table (mean water level is 15 m bgl) in the area the groundwater is particularly vulnerable to bacteriological contamination sourced from pit latrines and/or animal faeces.

5.0 SITE INVESTIGATION

A site investigation was carried out on the 30 and 31 October 1996 during which time each of the target areas were visited and general observations made with regard to current water supply, geological conditions and potential for groundwater development.

5.1 MANCAM

The village is underlain by brownish, fine-medium grained sandstone of the Beaufort Group which dips approximately 15° to the north-west (Figure 2). The sandstone outcrops in the valley downslope of the dam on the KuVutuza River to the south of the village.

Water supply is from the dam on the KuVutuza River (Figure 1) and according to villagers and available DWAF reports no drilling, either private or governmental, has ever taken place in this area and hence no private boreholes or wells exist.

5.2 LUTUBENI

Lutubeni is underlain by sandstone of the Beaufort Group which, based on field evidence, have been intruded by dolerite sheets and dykes. The community gets water from 3 springs which appear to be located up-gradient of the north-south striking dyke which parallels the main road to Elliotdale. Springs of this sort are known to occur wherever the water table coincides with the ground surface. Common spring sites include where dykes cross drainage lines, at the basal contact of sheets and within weathered basin (usually weathered dolerite sheets). No drilling has reportedly been carried out in this area in the past and no boreholes exist in the area.

5.3 MNCWASA

The geology in the vicinity of Mncwasa includes sandstones of the Beaufort Group and shales and mudstones of the Ecca Group which have been intruded by a broad dolerite

sheet coupled with numerous intrusive dolerite dykes.

Water supplies are sourced from a spring in the wet season and from the Mbozisa River located to the north in the dry season. No drilling has ever been carried out by either DWAF or privately in this area.

6.0 DESKTOP STUDY

This phase of the investigation involved an assessment of the following

- 1: 50 000 scale aerial photography (Job 983 -strip 19, photo 254 and strip 20, photo 174)
- landsat imagery
- aeromagnetic data
- the published 1:250 000 geological sheet no 3128 Umtata
- the 1:50 000 Topographical sheet no 3128DD Mqanduli.

6.1 AEROMAGNETIC INTERPRETATION

The aeromagnetic data used for the study was acquired in 1995/6 as part of a larger survey. The area selected for investigation is 35 km² in size with the centre at 28°51' east and 31°55' south. The lineament interpretation that is posted on top of the colour display of the magnetic data is based on the calculation of different horizontal gradients for various directions, coupled with sunshading (Figure 3).

Four lineament directions dominate (i.e. E-W, NE-SW, N-S and ENE-WSW. Some of the NE-SW trending lineaments may be dolerite dykes with other lineaments being associated with faulting.

6.2 LINEAMENT MAPPING

Lineaments were mapped using the following image data sets:

- Landsat Thematic Mapper TM satellite data (Scene ID 169-0-82 dated 05/01/95)
- the published 1:250 000 geological map No 3128 Umtata
- 1:50 000 aerial photography (Job 983 -strip 19, photo 254 and strip 20, photo 174)
- 1:50 000 Topographical Sheet No 3128DD Mqanduli

The relevant information was scanned and imported into the ERDAS image processing system. All image data sets were georeferenced to the Transverse Mercator coord system (Clark 1880 LO 29) and rectified.

The landsat image was then processed and enhanced to produce a false colour composite image to facilitate lineament mapping. Lineaments were then mapped from the digital satellite and aerial photographs, coupled with those lineaments and dolerite dykes from the published geological map and the aeromagnetic interpretation. The result is displayed in Figure 4.

7.0 IDENTIFICATION OF EXPLORATION TARGETS

The exploration targets were selected as close to villages as possible, based on the lineaments, the presence of dolerite sheets and the regional stress regime. The sites were ranked (A, B or C) in order of preference for intercepting groundwater (i.e. site A has a higher probability of intercepting groundwater of a higher yield than has site C). However, it is pertinent to point out that the exploration targets need to be verified and drilling targets pin-pointed by means of field observations and additional ground geophysics (Woodford, 1996).

To facilitate the identification of the target zones in relation to topographical and man-made features, the lineaments and exploration targets have been overlain onto topographical coverages of the Mancam (Figure 5) and Lutubeni/Mncwasa (Figure 6) areas.

7.1 MANCAM

There are several intersecting lineaments in the Mancam area (Figure 5), with 3 priority (A) targets having been identified. All of these sites appear accessible and it is suggested that follow-up ground work be carried out to pin point drilling sites.

7.2 LUTUBENI

Although a number of potential exploration areas have been identified in the Lutubeni area (Figure 6), the most promising are located to the south of the main Coffee Bay road where the rugged nature of the topography is limiting with regard to access. However, some targets are present on the flatter, more accessible area to the north which certainly warrant additional ground geophysics.

7.3 MNCWASA

The topographic situation in the Mncwasa area is also restricting with regard to accessibility, particularly to the south of the Coffee Bay road. The optimal exploration areas to the south of the village (Figure 6) are all located in deep valleys and it is unlikely that drilling machinery could access these sites without road construction. However, there are a number of priority target areas to the north of the main road which should prove

accessible, and it is recommended that these areas be subjected to further field work.

8.0 CONCLUSIONS

It can be concluded that the mapping of lineaments from the aeromagnetic data set, coupled with those identified from the digital satellite imagery and aerial photographs, has proved to be a valuable tool in identifying the numerous lineaments which would not normally have been located using standard mapping and interpretive techniques. By identifying areas of potential groundwater accumulation the required field studies can now be concentrated on specific target areas. Furthermore, water supply planners have been given a starting point from which to plan and cost the required reticulation system/s.

Based on previous drilling in the Transkei area, the importance of siting boreholes in topographic lows is considered critical, and it is believed that the chances of obtaining high yields can be maximised by coinciding dolerite and fracture-related targets with these topographic lows.

9.0 RECOMMENDATIONS

It is recommended that boreholes should be sited close to lineaments or intersections of lineaments. Ground magnetic profiling should help to pin point the lineament positions thus facilitating the siting of drilling targets in suitable doleritic structures and/or tectonically induced fracturing of the sedimentary rocks.

It is recommended that drilling should be carried out to at least 40 m below ground level as drilling to this depth is likely to give the best results. However, if during drilling the formations encountered show promise of further water strikes beyond 40 m, drilling should be continued at the discretion of the supervising hydrogeologist to depths not exceeding 100 m.

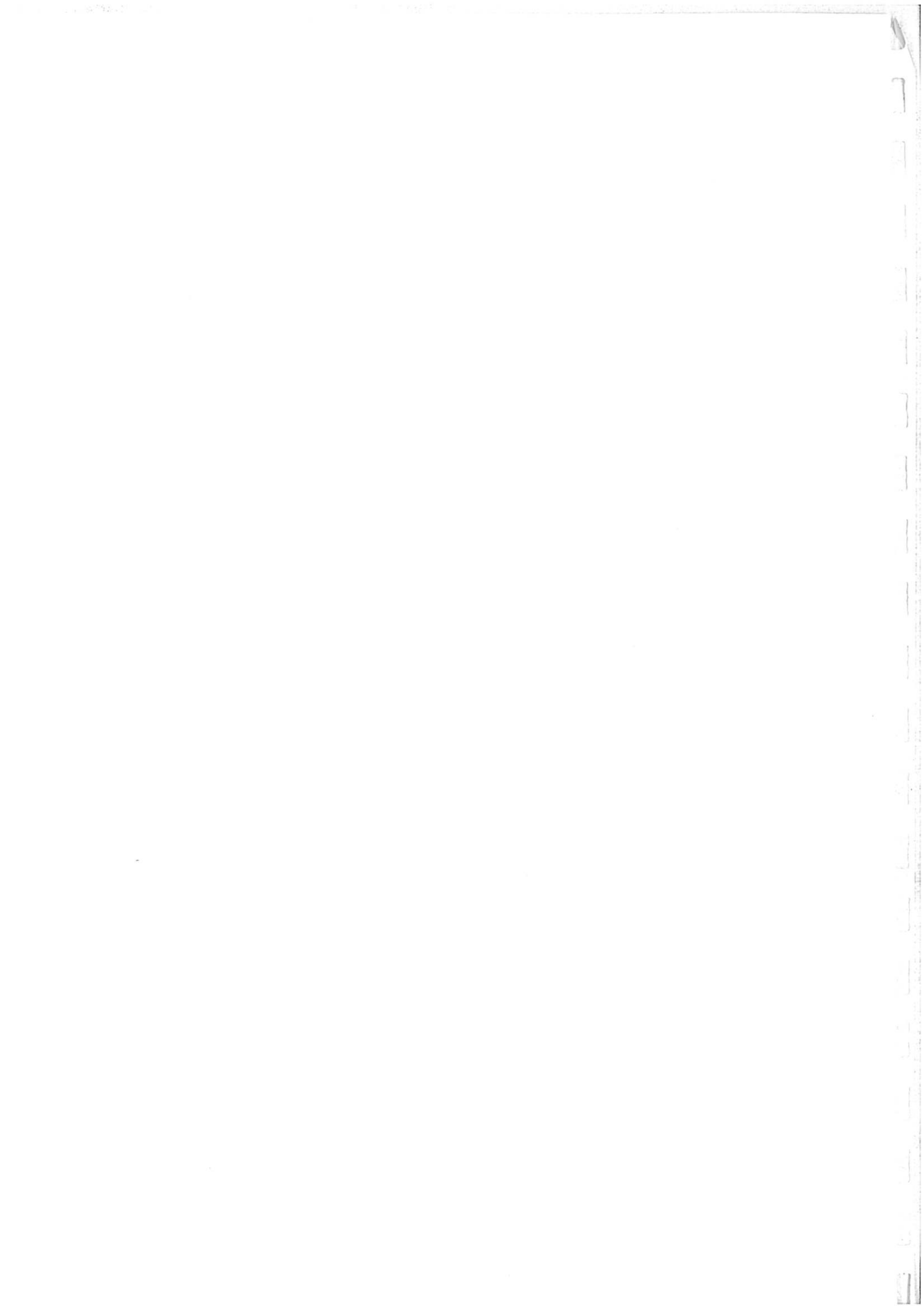
JM RASMUSSEN Pr.Sci.Nat.

REFERENCES

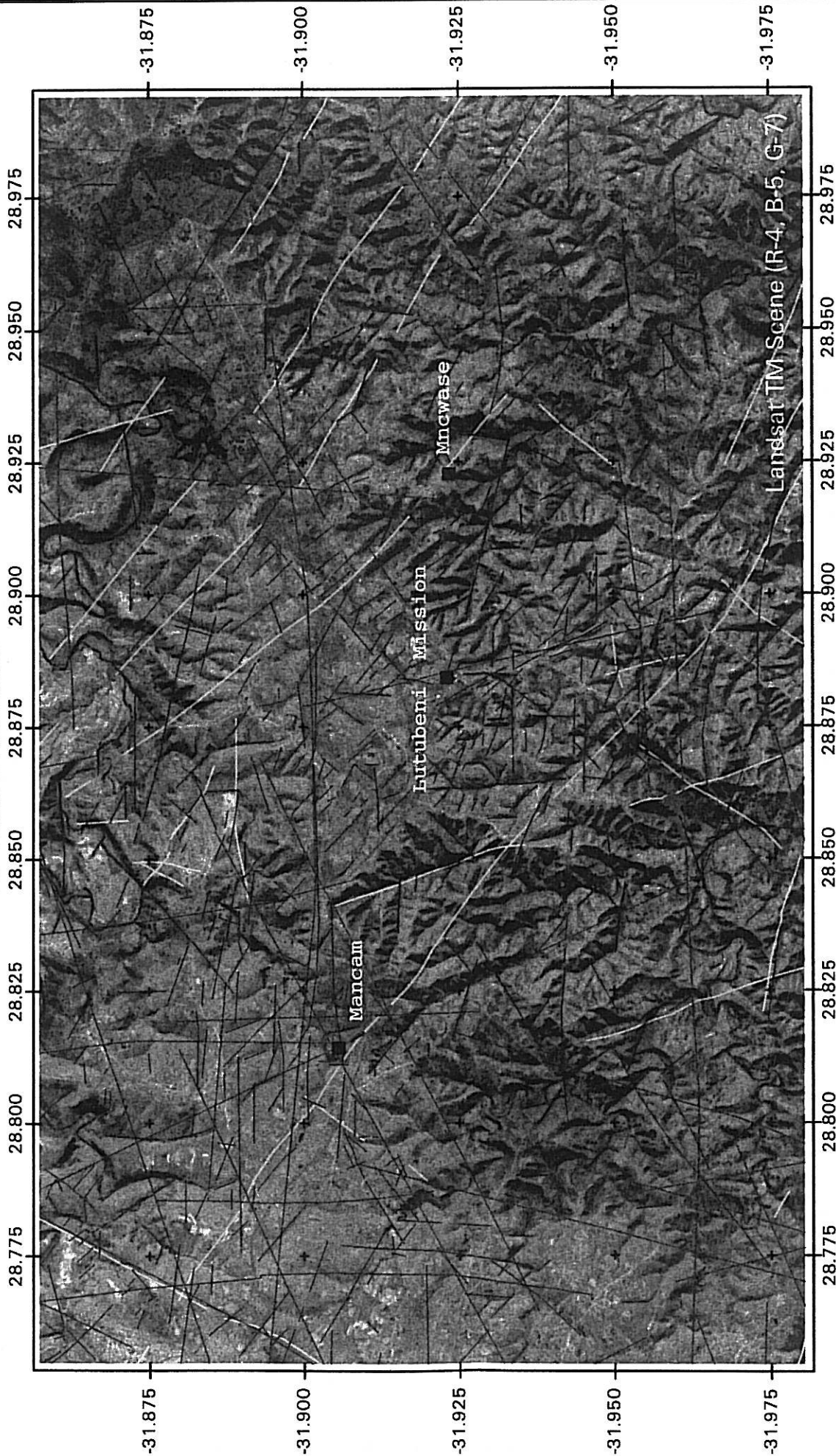
SMART, M., *pers.comm.*, 1996: Hydrogeologist, Department of Water Affairs and Forestry, Directorate: Geohydrology, Bellville

WOODFORDE, A., *pers.comm.*, 1996: Hydrogeologist, Department of Water Affairs and Forestry, Directorate: Geohydrology, Bellville

LIST OF FIGURES



PD Toens & Associates



Landsat TM Scene (R-4, B-5, G-7)

Dolerite dykes (Geological Survey 1/250 000 mapsheet)
Aeromagnetic Lineaments
Satellite / Air-Photo Lineaments

Scale
0 2 4
Kilometers

FIGURE 1 : MOANDULI WATER SUPPLY PROJECT - LINEAMENT MAP

PD Toens & Associates

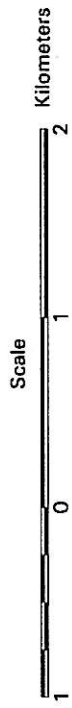
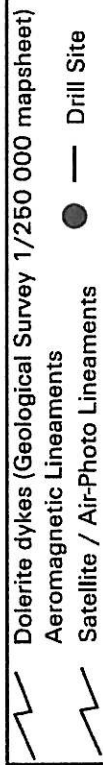
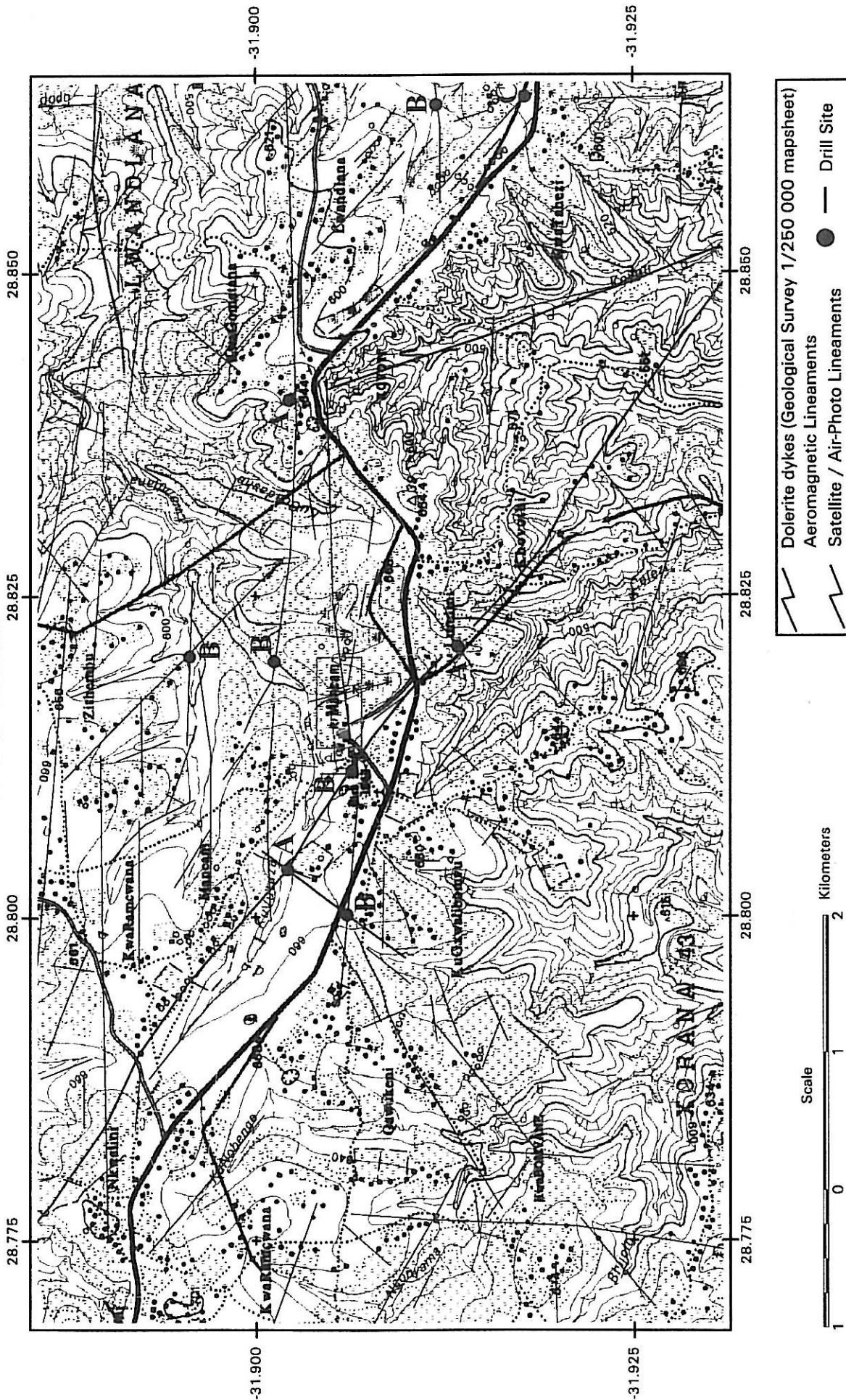
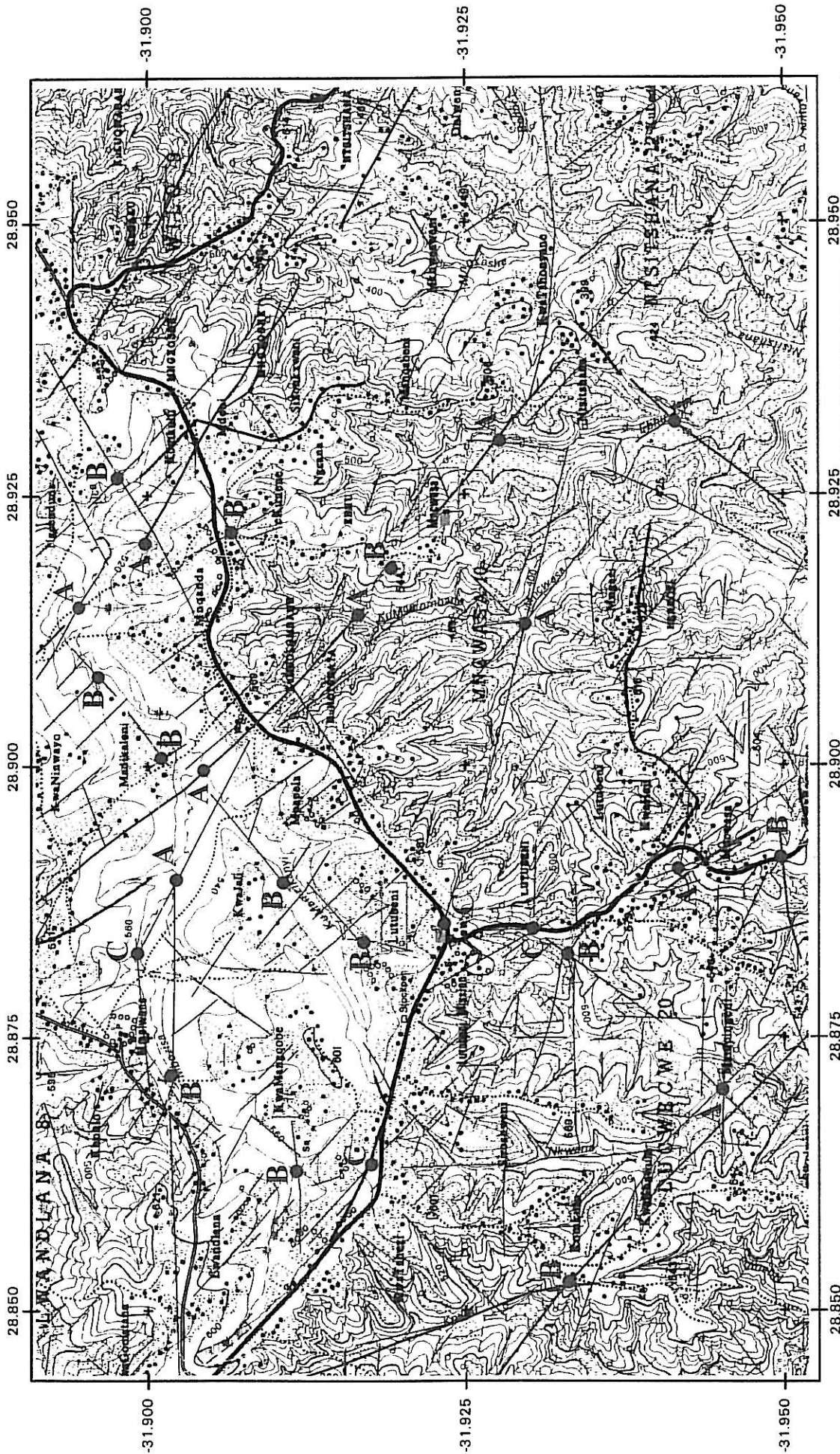


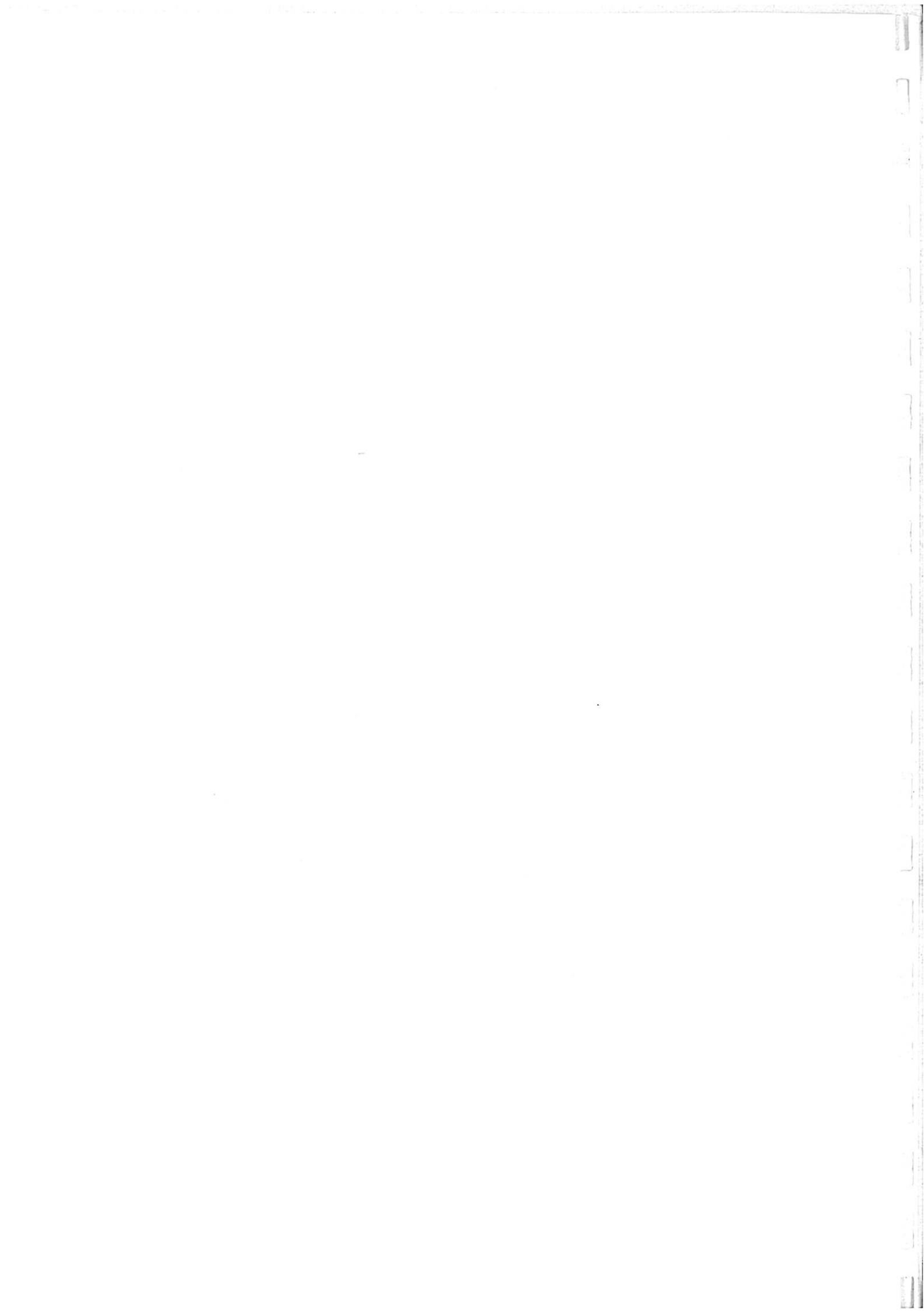
FIGURE 3 : MANCAM : EXPLORATION DRILLING TARGETS ON LINEAMENT MAP



- Dolerite dykes (Geological Survey 1/250 000 mapsheet)
- Aeromagnetic Lineaments
- Satellite / Air-Photo Lineaments
- Drill Site



FIGURE 2 : LUTUBENI / MNCWASE : EXPLORATION DRILLING TARGETS ON LINEAMENT MAP



LIST OF APPENDICES

APPENDIX 1

SUMMARY OF BOREHOLE INFORMATION

Mqanduli Groundwater Investigation

G - number	T - number	Latitude	Longitude	Other numbers	Map number	Farm name	Depth (m bgl)	W/S (m bgl)	EC (ns/cm)	Yield (l/s)	Diam (mm)	Elev. (m amsl)	SWL (m bgl)	District	Village	Tribal Chief	Geology	Siting criteria
Toens - 01		31° 48' 37.2"	28° 58' 00"		3128DD Mqanduli	Nqanda B 20B	37	dry	not taken	dry	203	800	dry	Mqanduli	Gohohl	unknown	unknown	unknown
Toens - 02		31° 48' 21.8"	28° 45' 40.2"		3128DD Mqanduli	Mqanduli	0	unknown	not taken	dry	0	745	unknown	Mqanduli	Mqanduli	unknown	unknown	unknown
Toens - 03		31° 52' 30"	28° 52' 30"		3128DD Mqanduli	Lwandiana B	94	dry	not taken	dry	200	800	dry	Mqanduli	Kubemvu	unknown	unknown	unknown
Toens - 04		31° 47' 43.8"	28° 55' 09.8"		3128DD Mqanduli	Nqanda A 20 A	30	dry	not taken	dry	186	400	dry	Mqanduli	Gohwane	unknown	unknown	unknown
Toens - 05		31° 48' 33.98"	28° 50' 02"		3128DD Mqanduli	Zanci 26	103	unknown	not taken	unknown	186	888	unknown	Mqanduli	Magabeni	unknown	unknown	unknown
G-43203	T-31723	31° 46' 22"	28° 43' 53"		3128DC Elliotdale	Ngowara 28	103	7	114	0.28	186	800	5	Mqanduli	Kufusa	unknown	Dol. & Ssl	unknown
G-43204	T-31720	31° 47' 34"	28° 42' 31"		3128DC Elliotdale	Cazu 28	167	11	not taken	0.2	166	820	3.74	Mqanduli	Kudigiba	unknown	Dol. & Ssl	unknown
G-43205	T-31721	31° 47' 20"	28° 41' 55"		3128DC Elliotdale	Cazu 28	109	8	not taken	2.9	186	940	4.8	Mqanduli	Kudigiba	unknown	Dol. & Ssl	unknown
G-43206	T-31722	31° 47' 25"	28° 42' 52"		3128DC Elliotdale	Cazu 29	109	8	30	0.4	186	835	1.1	Mqanduli	Mavundleni	unknown	Dol.	unknown
G-43210	T-31726	31° 45' 44"	28° 42' 48"		3128DC Elliotdale	Cazu 29	85	8	37	6	186	785	2	Mqanduli	Mavundleni	unknown	Mud.	unknown
G-43211	T-31728	31° 48' 03"	28° 42' 58"		3128DC Elliotdale	Cazu 29	103	20	109	5.7	186	835	Artesian (2 1/2)	Mqanduli	Cazu	unknown	unknown	unknown
G-44111	T-31730	31° 50' 09"	28° 41' 06"	W-4726; G-43215	3128DC Elliotdale	Cazu 29	91	12	not taken	10	186	820	7	Mqanduli	Macosa	unknown	Sst	unknown
G-44112	T-31731	31° 47' 56.7"	28° 48' 37.74"	W-4728	3128DC Elliotdale	Cazu 29	72	14	"good"	10	186	700	4.42	Mqanduli	Behakana	D. P. Nkonyama	Mud, Sst, and Shale	Geol.
G-44113	T-32195	31° 50' 00"	28° 37' 30"	W-4722	3128DC Mqanduli	Ngowara 28	103	65	"good"	0.19	186	710		Mqanduli	Magabeni	Mduyehwa	Sst	Geol.
G-44113A	T-32195B	31° 50' 00"	28° 37' 30"		3128DC Elliotdale	Chanil 13	26	dry	not taken	dry	186	795	dry	Umtata	Kuchanil	Daluxolo	Dol.	Geol.
G-44113B	T-32195C	31° 50' 00"	28° 37' 30"	G-43214A; W-4723	3128DC Elliotdale	Chanil 13	115	Dry	not taken	Dry	155	790	Dry	Umtata	Kuchanil	Daluxolo	Dol.	Geol.
G-44113C	T-32195D	31° 50' 00"	28° 37' 30"	G-43214B; W-4724	3128DC Elliotdale	Chanil 13	91	14	not taken	0.14	186	790	8.8	Umtata	Kuchanil	Daluxolo	Dol.	Geol.
G-44114	T-31730	31° 52' 50"	28° 40' 08"	G-43214C; W-4725	3128DC Elliotdale	Chanil 13	103	Dry	not taken	Dry	186	790	Dry	Umtata	Kuchanil	Daluxolo	Dol.	Geol.
G-44398		31° 51' 00"	28° 41' 00"	G-4321E	3128DC Elliotdale	Dudbe 30	103	27	"good"	6	186	800	4.2	Mqanduli	KuGanga	unknown	Dol.	Geol.
G-44399		31° 51' 00"	28° 41' 00"		3128DC Elliotdale	Cacado 40	115	2.4	10	0.19	186	680	2.4	Mqanduli	KuHoipe	N. Ngxisha	Dol. & Ssl	Geol.
G-44399		31° 51' 00"	28° 41' 00"		3128DC Elliotdale	Cacado 40	115	105	10	0.19	186	720	2.4	Mqanduli	KuHoipe	N. Ngxisha	Dol. & Ssl	Geol.

Note: Dol. Dolerite
 Sst. Sandstone
 W/S Water strike
 SWL Static water level
 EC Electrical Conductivity
 mS/m millisiemens per met
 m bgl, meters below ground
 l/s liters per second
 diam. diameter

APPENDIX 2

COST ESTIMATE FOR PHASE 2 OF THE PROGRAMME