GROUNDWATER RESOURCE INFORMATION PROJECT
EASTERN CAPE PROVINCE

GROUNDWATER INFORMATION SOURCE REFERENCE SHEET

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A: SOURCE DESCRIPTION

District Municipality:	Amatole	x	Chris Hani		O.R Tambo	
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Local Municipality:						
Institution where Information is held:	Jeffares Green Parkman Consultants (Pty) Ltd					
Branch of Institution:	Pietermaritzburg					
Contact details: Contact person:	Craig Thompson					
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Contact Email:						

B: TYPE OF INFORMATION

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	Specify Other:					
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Report Nr:	10-1206/01		Date:	Sep-03		
Author Details:	Mark Schapers					
Author's Qualification:	Hydrogeologist		Govt Dept		Project Manager	x
	Engineer		Technician		Other	
	Specify Other:					
Captured by:	Wendy Botha	Date:	30_Nov_2005	Signed:		

C: GEOHYDROLOGICAL CATEGORIZATION

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Reference Co-ordinate:	Latitude	Longitude
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	Yes	No	Complete	Incomplete
Lithological & Construction Logs	x		x	
Hydrocensus Data	x		x	
Pump Testing Data	x		x	
Chemical Water Analysis Data	x		x	
Geohydrological Data	x			
Spring Data	x			
Remote Sensing Data		x		
Map Data	x		x	

Comments:

Objectives of the study were to provide the Amatole District Municipality with all the necessary data to take an informed decisio

Reviewed by: Jane Baron Date: 30_Nov_2005 Signed:

JEFFARES GREEN PARKMAN
Consultants (Pty) Ltd

VOLUME 1 OF 2: IDUTYWA GROUNDWATER FEASIBILITY STUDY REPORT

September 2003

Project Number 101228

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Idutywa Groundwater Feasibility Study

JGP NO. : 10 – 1228 **CLIENT NO. :**	**DATE** September 2003	**REPORT No :** 10 – 1206 / 01 **REPORT REV :** 01 **REPORT STATUS :** Provisional

CARRIED OUT BY : Jeffares Green Parkman Consultants PO Box 13009 Cascades 3202	**COMMISSIONED BY :** Amatola District Municipality P.O.Box 320 East London 5200
AUTHORS : Mario Toniolo Project Co-ordinator Mark Schapers Project Leader	**CLIENT CONTACT PERSONS :** Engineering Services Directorate Mr Craig Thompson

SYNOPSIS :

A groundwater feasibility study conducted as part of the recommendations to the bulk water feasibility study conducted.

KEY WORDS :

Groundwater Feasibility Study

ISO 9001 QUALITY VERIFICATION

This report has been prepared under the controls established by a quality management system that meets the requirements of ISO9001: 2000, which has been independently certified by Bureau Veritas Quality International (BVQi), accredited by UKAS (United Kingdom Accreditation Service), under certificate number 136920.

Verification	Capacity	Name	Signature	Date
By Author	Project Leader	Mark Schapers		13.10.03
Checked by	Associate	Peter Waldron		13-10-03
Authorised by	Director	Dave Johnson		13.10.03

PREFACE:

Jeffares Green Parkman Consultants (Pty) Ltd were appointed by the Amatola District Municipality to conduct their recommendations for a groundwater feasibility study as an additional phase of work to the proposed bulk supply investigation and report for the Idutywa Tribal Authority area, commissioned earlier in the year.

The investigation was to include all technical, Institutional and Social Development (ISD), contractual, supervision, management and implementation inputs required to conduct the study. The resources within the company in all forms of rural water supply, as well as the multitude of experience (refer to Annexure 9), in this instance, groundwater supply, made this a perfectly suited project. A shortage of available contractors, as well as the limited time frame in which the project was to be completed, proved an interesting challenge, as did the hydrogeological conditions encountered, but efficient team work from contractors, ISD, and the team members involved, resulted in the initial twelve boreholes originally proposed being extended to thirty, with good success. With the extension of the anticipated implementation, a more comprehensive picture of groundwater conditions was established.

Good working relations with the local community lead to the smooth operation of the project, as well as the identification of certain politically significant areas requiring prioritisation, and the project is considered to have taken a large step in the right direction in terms of addressing the great need of water supply in the Idutywa Tribal Authority of the Eastern Cape.

The reader is referred to the contents of the attached report in which detailed findings and recommendations are made pertaining to the feasibility of using groundwater as a sustainable resource within the study area.

VOLUME 1:

CONTENTS:

ANNEXURES:

VOLUME 2:

ANNEXURES:

IDUTYWA WATER SUPPLY FEASIBILITY STUDY GROUNDWATER INVESTIGATION

1. BACKGROUND

Jeffares Green Parkman was appointed by the Amatole District Municipality to undertake a feasibility study of water supply from underground resources in the Idutywa Tribal Authority of the Eastern Cape (refer to locality sketch – Figure 1).

Objectives of the study were to provide the Amatole District Municipality with all the necessary data to take an informed decision as to the best options to supply the rural communities with potable water.

The objectives have been achieved through the following phases:

- Detailed Hydrocensus
- Geophysical survey
- Drilling 30 exploration/production boreholes
- Test Pumping
- Water Quality Analyses
- Data interpretation and recommendations

2. HYDROCENSUS

2.1 Methodology

A complete hydrocensus of all the groundwater resources (springs and boreholes) present in the Idutywa Tribal Authority area (Mbashe Municipality) was undertaken in the month of May 2003. The entire area was subdivided in 4 sub-areas. Each of the sub-areas was assigned a team comprising a Field Data Capturer and a Community Liaison Operator.

The Field Data Capturers visited all the communities in their sub-areas completing in each community a Community Capture Sheet containing the following information:

- Community name presently used by the population and name assigned to the community on the relevant 1: 50,000 sheet of the Topo Cadastral Map of South Africa. The two names are sometimes different because the most recent map sheets of the area were published in 1995 and 1996 and small communities tend to change names and to split as they grow.
- Administrative Ward number and Ward Councillor name
- Latitude and Longitude of a point central to the settlement, referred to the WGS84 geographic datum
- Number of households, according to the estimate of the headman. Although the reliability of the estimate is often uncertain it reflects however a realistic order of magnitude
- Availability of electricity
- Estimate of how many households possess some form of rudimental sanitation, according to the local headman
- Indications on the most used sources of surface water (rivers and streams)

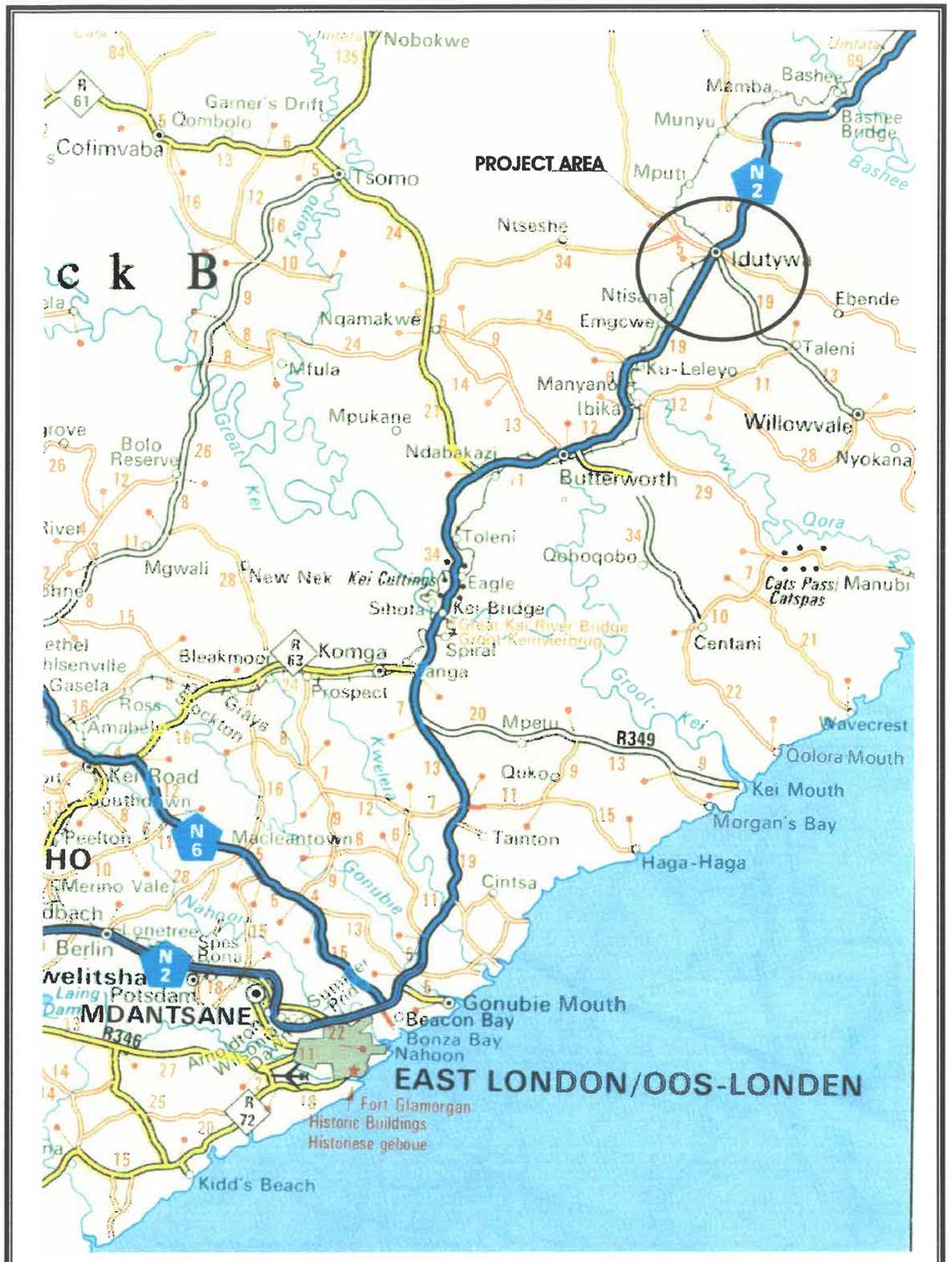


FIGURE 1: **IDUTYWA PROJECT AREA -** ***LOCALITY MAP***

The Field Data Capturers also completed a Questionnaire regarding the groundwater resources (springs and boreholes) present in the community, including those no longer used (broken down wind-mills and hand-pumps) or never used (dry boreholes).
The collected information included:

- Old borehole number, when applicable / available
- New Water Point number, formed by the 1: 50,000 map sheet number, the Field Data Capturer initials, and a progressive number starting with 001
- Capture date
- Community name
- Contact person name, either somebody living close to the Water Point or the headman of the community
- Geographic coordinates (WGS84)
- Approximate elevation (GPS)
- Locality sketch map
- Information pertaining to the Water Point, either a borehole or a spring. The spring yield was measured with a pipe and a container when the spring was situated on a slope. The yield of springs on level ground was estimated. A water quality field test (EC, pH and Nitrate content) was carried out when possible.

Three local Community Liaison Operators were designated to assist the project by Councillor Nceda Ndikinda, Chairman of the Mbashe Development Committee. After a brief induction they were assigned to their task of assisting the Field Data Capturers in dealing with the communities. The method used was to approach first the community headman or, in his absence, the sub-headman. The headman and the community elders were then informally gathered and the nature of the project was explained. After obtaining from the elders the necessary information on the community, the project field personnel then requested to be physically taken to the various water points present in the area.

2.2 Communities

The results of the Communities Survey are displayed in the annexed Table : Communities in Mbashe Municipality (Annexure 1), and Figure 2 overleaf.

2.2.1 Number of Communities

192 communities were recorded in the Idutywa area. A previous database received from UWP Consulting Engineers (East London) lists 163 communities. A possible reason for the difference might be the fact that the communities tend to split as they grow in size. The name of the new community then either stems from the old name (i.e. Ebende 1 and Ebende 2) or the community takes a completely different name (i.e. Ephikweni, Makhakha and Yekani, previously all called Laza).

2.2.2 Population

The community sizes vary as follows:
105 communities with less than 100 households
77 with between 100 and 400 households
10 with more than 400 households

IDUTYWA PROJECT AREA - COMMUNITIES

Showing Community Name

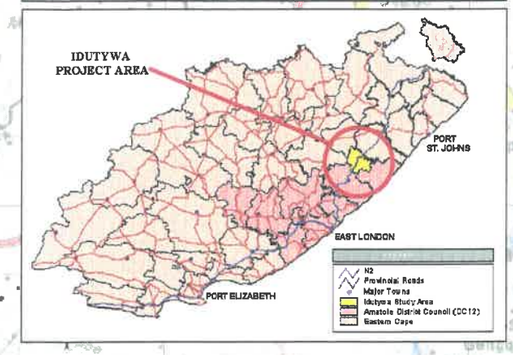
09 SEPTEMBER 2003

FIGURE 2

LEGEND

- Idutywa Project Area Boundary
- Communities

IDUTYWA LOCALITY MAP



KuMbanga
Ndulini
Singeni
Sompunzi
Matati
Ntwashini
KwaJadezweni
Makobokeni
Nkangeni
Nyandeni
Bhetani
Mahlubeni
Lalini (1)
Nqabane
KuVongo (Matshaweni)
KuSilityweni
Ntsimba
Sirosweni
Xeni
Qolweni
KwaGaba
Matholweni
Nqabane
KuGilandoda
Bhijolo
Mbashe
Ntonga (Mazangweni)
Mlenzeni
Sihlabeni
Mishini
Nkawukazi
Xeni
Lalini (2)
Mhuku
Mabheleni
Lalini
Qokama
Ngxingweni
Mazizini (KuQeqe)
Mantshilibeni
Kreweleda
Nywara
Siroshwani
KuLudondolo
Matolweni
KuVinindwa
Candu
Mgudwane
Mpozola (Upper Nyawura)
Matolweni
Loxomo
Mamfengwini
Mpozola (Nyawura)
KwaNdlambe
Chapaza (Jamda)
Rhwantsini
Mangweni
Mangweni
KuJolovu
KuMjelo (Mpozolo)
Gungululu
Eqadini
Dolopini
KuNteshe
KuMbelo
Kumsikithi
Njakazi
KwaZihlehleni
Sinqumeni (eMaxhame)
Munyu
Qokolweni
Sihlabeni
KuXholo
Komkulu (KuGxara)
Mtzansi
KwaNyoka
KuMazwayi
Zangcete
Luthutu
Mkhalalo
Elalini
Ngcolose
Ceru
Qombe
Mlindeni
Mhala
Tshwati (Mpuku)
KwaMhlati
Sopam (Thafeni)
KwaTenza
Mhlontlo
Komkhulu
Phephezela
Endulini
Umbo (Sopam)
Siyibane (KwaNzima)
Timane
Luxeni
Komkhulu
Mngutha
Bavuma
Siyibane (KwaMagansa)
Khamangweni
Komkhulu
Esithenjini
Macireni
Zambuzane
Jojweni (Munyu)
Mpuku
KwaMbunyuza
Esiteshini
Mangwevini (Mazwayi)
Esihlabeni
Chachazela (Jem)
Cilo
Gudlindlu
Chachazela (Ngqutu)
Mbonda
Mission
Nopoto
Mangqosinini
Enkolweni
KwaVutha
Khanya
Lixeni
Colosa
Falakahla
Elundweleni
Bangani
Mangwevini
Nkonxeni (Mfula)
Ngqutu
Xobojiyane (Zibomvu)
Doti
Gubevu
Xobojiyane (Mahlejana)
Seven (Nkanunu)
Mchewula (Fiya)
Mfula
Mputi (Mantlaneni)
Tyelekebende
Ndulini
Esikolweni
Nothanda (Mfula)
Qolweni
Rhwantsini
Mngayi (Ndulini)
Komkulu
Ngonyama
Bongweni
Bomela
Enkunkumeni
Cungcwini
Laza Makhakha (Laza)
Jakadu
Auckland
Mwandi
Sheshegu
Ebende 2
Tafeni
Edrayini
Mxotwa (Mfula)
Gxakagxaka
Komkulu
Makwayini
Drayini
Laza Yekani (Laza)
Mamfeneni
Ndakeni
Willow Zembe
Ebende 1
Engcwini Komkhulu (Engcw
Ngete
Gquno
Mtuvi
Lencane
Laza Ephikweni (Laza)
Fort Malan
Broadway
Msintsana
Ntotoviyane (Mtuvi)
Mpepheni
Bomvana
Ezimbuku
Qelana
Magiqweni'
Gqupu
Tholomi
Sigobelwana

Coordinate System: Geographic, Clarke 1880
Ref:E:/idutywa/idutywa_mario_Comm_09-09-03.mxd

0 2 4 8 12 16 Kilometres

Map compilation by: JGP JEFFARES GREEN PARKMAN CONSULTANTS

The total number of households in the whole area, according to the headmen's estimates for each community, is 23,825. Using a conservative ratio of 6 inhabitants per household, this amounts to a total population of 142,950 inhabitants.

When compared to the 1996 Census population figure of 64,650 inhabitants, this represents an annual population growth of almost 10%, which is highly unlikely and unrealistic. To explain this, it is necessary to take into account some facts. First, the estimate given by the headman to somebody representing a service provider to the community might well be somehow inflated. On the other hand the Census personnel were often perceived as representing the State fiscal system and figures provided to them might have been skewed in the opposite direction.

If a conclusion can be drawn, it should be that the population growth in the area has been well above the 2.5 % for the period 1996 to 2000 and 0% was from 2000 to date, as recommended by DWAF directives.

2.3 Electricity

92 of the 192 surveyed communities have been provided with electricity. However, it must be taken into account that an intensive supply programme by Eskom is underway in the area.

2.4 Sanitation

The only form of private sanitation (with the exclusion of sanitation to schools and clinics) present in the area is pit-latrines. According to the community elders, this form of sanitation is totally absent in 39 of the communities, whilst in 97 communities from 1% to 50% of the households make use of it and in 56 communities more than 50% of the households own such a facility.

2.5 Springs

The results of the Springs Survey are displayed in the annexed Table "Water Points in the Idutywa Tribal Authority" (Annexure 2), and Figure 3 overleaf.

2.5.1 Number of Springs

42 springs were recorded in the area. Of these, only one (3328AB/JM/011 in Mphepheni / Qelane) has been somehow protected in the past, although it is now in disrepair.

The majority of the springs occur on flat ground, where a superficial aquifer seated in the soil and the upper portion of the bedrock intercepts the topographic surface. This type of spring has been rudimentarily developed by communities by digging a large pit into which the water seeps from the bottom which enables the scooping of water into containers.
The hygienic conditions of these springs vary to a large degree and contamination is mainly due to livestock.

One spring presents a particular case. Spring number 3228/AB/14 located at Mhala, is considered sacred by the population and traditional rites are carried out every year on it. Particular care should be adopted so as not to offend the local traditions should this spring be developed.

IDUTYWA PROJECT AREA - HYDROCENSUS

Showing Boreholes & Springs

09 SEPTEMBER 2003

FIGURE 3

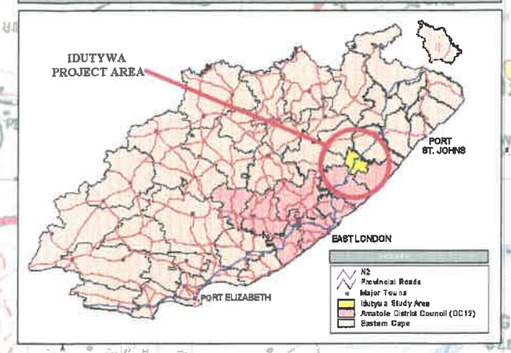
LEGEND

- Idutywa Project Area Boundary

HYDROCENSUS

- Boreholes
- Springs

IDUTYWA LOCALITY MAP



FH/022 FH/017 FH/001 FH/020 FH/021 FH/023 FH/016 FH/024 FH/014 FH/011 FH/010 FH/013 FH/019 FH/009 FH/007 FH/043 FH/025 FH/012 FH/044 FH/045 FH/026 FH/040 FH/006 FH/008 FH/035 FH/039 FH/041 FH/027 FH/034 FH/037 FH/002 FH/046 FH/038 FH/036 FH/015 FH/005 FH/032 FH/003 FH/004 FH/029 FH/033 FH/042 FH/031 FH/028

MK/003 MK/002 MK/008 MK/009 MK/014 MK/010 MK/004 MK/005 MK/006 MK/007 MK/011 MK/012 MK/013

JM/041 JM/039 JM/042 JM/040 JM/037 JM/036 MK/001 MT/002 MT/004 MT/003 MT/005 JM/038 MT/008 MT/009 MT/006 MT/007 JM/022 JM/023 JM/024 JM/032 JM/034 JM/018 JM/031 JM/025 JM/026 JM/007 JM/006 JM/015 JM/020 JM/027 JM/033 JM/035 JM/004 JM/016 JM/019 JM/017 JM/021 JM/003 JM/008 JM/010 JM/013 JM/029 JM/030 JM/012 JM/011 JM/014

IDUTYWA

DAMAKWE

Coordinate System: Geographic, Clarke 1880
Ref:E:/Idutywa/Idutywa_Hydrocensus_09-09-03.mxd

0 2 4 8 12 16 Kilometres

28°5'0"E 28°10'0"E 28°15'0"E 28°20'0"E 28°25'0"E 28°30'0"E 28°35'0"E 28°40'0"E

31°50'0"S 31°55'0"S 32°0'0"S 32°5'0"S 32°10'0"S

Map compilation by JGP JEFFARES GREEN PARKMAN CONSULTANTS

2.5.2 *Spring Yields*

Spring yields situated on a slope are normally measured by gauging the runoff flow into a pipe and measuring it with a container and a stopwatch. Unfortunately the majority of springs in the area are situated on flat ground and this method could not be used. The spring yields have therefore been estimated "by sight" only. Yields vary between 0.1 and 1.25 l/sec, this estimate being quite conservative. The springs were assessed in the dry month of May, and the communities have assured the field operators that they are perennial.

2.5.3 *Water Quality*

All springs have been tested "in situ" for Electrical Conductivity (EC), acidity (pH) and the presence of Nitrates (NO_{3-}).

EC is the ability of water to conduct an electric current and is proportional to the mass of dissolved salts (TDS). Field determinations of EC in the area vary between 9 and 129 mS/m. SABS Standards for Drinking Water (SABS 241 – 1999) define the ideal limit to 70 mS/m and the acceptable limit to 150 mS/m. The values in the area are therefore ideal to acceptable.

PH is a measurement of the concentration of hydrogen ions in solution. It is proportional to acidity and hence the corrosiveness of water. PH in springs was measured at between 6.3 and 8.2. SABS 241 ideal limits are between 6.0 and 9.0. The pH values in the area are therefore ideal.

NO_{3-} in water is a product of microbiological degradation of Ammonia (NH_4), which in turn derives from organic contamination. NO_{3-} has been measured between 10 and 100 mg/l. SABS 241 defines 20 mg/l as the maximum allowable limit. Most of the springs are therefore contaminated from use by livestock and need to be protected and disinfected.

The SABS parameters are displayed for reference in the annexed Table SABS 241 – Water Quality Classification" 1999 (Annexure 3).

2.6 Boreholes

The results of the Borehole Survey are displayed in the annexed Table "Water Points in the Idutywa Tribal Authority" (Annexure 2), and Figure 3 above.

2.6.1 *Number of Boreholes*

65 boreholes are present in the area, of which 15 are in use (2 hand-pumps, 3 submersible pumps, and 10 windmills). The total number of boreholes equipped with windmills is 38, those equipped with hand-pumps number 8 whilst 9 boreholes are equipped with submersible pumps and the balance are not equipped, either because when drilled they were found to be dry or because the previously installed equipment has been removed or vandalised.

2.6.2 *Borehole Yields*

The borehole yields could not be accurately determined because the bulk of them are not operational. The possibility of performing pump-tests on the existing boreholes

was ruled out because most of them are unusable due to the presence of old (often broken) windmill pumps and due to the time and cost constraints on the project which did not allow for the effective removal of existing equipment, test pumping thereof, and the re-installation of largely non operational equipment.

2.6.3 Water Quality

Water samples were taken from 6 boreholes still operating. The samples were analysed by Umgeni Water laboratories in Pietermaritzburg (The Analyses Certificates are attached in Annexure 4). The analytical results were compared with the SABS 241 –1999 standards for potable water (Annexure 3) and summarised in the table below.

TABLE 1: Summary of water quality analysis results of existing boreholes

IDUTYWA EXISTING BOREHOLES

					SABS 241 - 1999		
					Water Quality (Lab)		
Borehole number	Community	Lat S (deg, min, sec)	Long E (deg, min, sec)	GPS Elevation (mamsl)	Exceeding ideal limit	Exceeding acceptable limit	Exceeding maximum limit
3128CD/FH/ 21	KuGilandoda	31 53 54	28 15 20	706	NTU,Ca,Mg,Na,	Cond,Cl	NO3
3128CD/FH/ 23	Mlenzeni	31 54 09	28 17 05	658	Ca,Mg,Na,Fe	NTU,Cond,Cl	NO3
3128CD/FH/ 24	Lalini	31 55 06	28 17 19	710	Ca,Mg,Na,Fe	NTU,Cond,Cl	NO3
3128CD/FH/ 26	Mazizini	31 56 56	28 16 40	776	NTU,Ca,Mg,Na	Cond,Cl,NO3	
3128CD/FH/ 27	Mamfengwini	31 57 43	28 16 12	817	NTU,Ca,Mg	Cond, Na	Cl
3128CD/FH/ 33	Komkulu	31 59 07	28 17 02	846	NTU,Ca,Mg,NO3	Cond,Na,Cl	

Conductivity exceeds the acceptable limit in all the samples, mainly due to excessive sodium and chloride. A high conductivity always reflects as a saline taste.

The high nitrate content in 4 of the samples indicates bacterial activity from seepage of surface water into the borehole.

Iron, magnesium and calcium exceeding the ideal limit may cause stains to washed clothing, and the presence of poor taste, depending on the concentration/s thereof.

3. LOCAL CONDITIONS

3.1 Topography

The most striking feature of the area is the deeply incised Mbashe River, which forms the northeast boundary of the Idutywa study area. Near The Collywobbles, situated near the easternmost point of the area, the elevation rises from 160 metres above mean sea level[mamsl] at the river to about 600 mamsl over a horizontal distance of some 1 000m. The river elevation at the northernmost point of the area, 35km to the northwest, is 530 mamsl with the top of the gorge being in the order of 650 to 700 mamsl.

In general, about 90% of the area lies between 600 and 900 mamsl and is comprised of rugged hills. 5% lies between 160 and 600 mamsl with most of this being between 300 and 600 mamsl. These areas are confined to the gorges of the Mbashe River and its tributaries. The remaining 5% lies above

900 mamsl, and is limited to the western portion of the area with the highest point being in the order of 1 100 mamsl.

3.2 Geology

The Idutywa area is underlain by the Late Permian and Triassic age Karoo Sequence. The Beaufort Group, sediments are intruded by Jurassic age Dolerites (refer to Figure 4).
The oldest sediments (Permian) in the area are grey and brownish-red mudstones and sandstones of the Adelaide Subgroup. These are overlain by Triassic sediments belonging to the Tarkastad Subgroup, which, in turn, is comprised of the Katberg Formation overlain by the Burgersdorp Formation.
The Katberg Formation is comprised of fine to medium-grained, horizontally laminated, cross-bedded or massive sandstone with intercalating subordinate fine-grained brownish red and grey mudstones. On average, sandstone comprises about 90% of the Formation, which is 500 to 1 000m thick.
The overlying Burgersdorp Formation sediments outcrop to the immediate west of the study area.
The Karoo sediments are intruded by two main categories of dolerite, namely vertical dykes and horizontal sills of varying inclination and curvature. The dykes tend to strike in west-northwest, north, or northeast directions. Dyke thickness is generally 1 to 10m but can be much wider. Sills and sheets are usually a few metres to approx 100m thick but can reach a thickness of a few hundred metres.

Alluvium deposits occur in the deep valleys. They are typically fine to very fine (sandy silt), 1 to 10 m deep, and limited in extent over the whole area.

The sediments dip at 2 to 4 degrees in a west-northwest to east-south-east direction, with the Adelaide-Tarkastad contact varying between 500 and 800 mamsl depending on geographic location.

The area is moderately fractured and generally not faulted. Localised fracturing adjacent to dolerite intrusions occurs as the result of the intrusions. Not necessarily related to the intrusions, are open fractures formed by stress related tectonic forces.

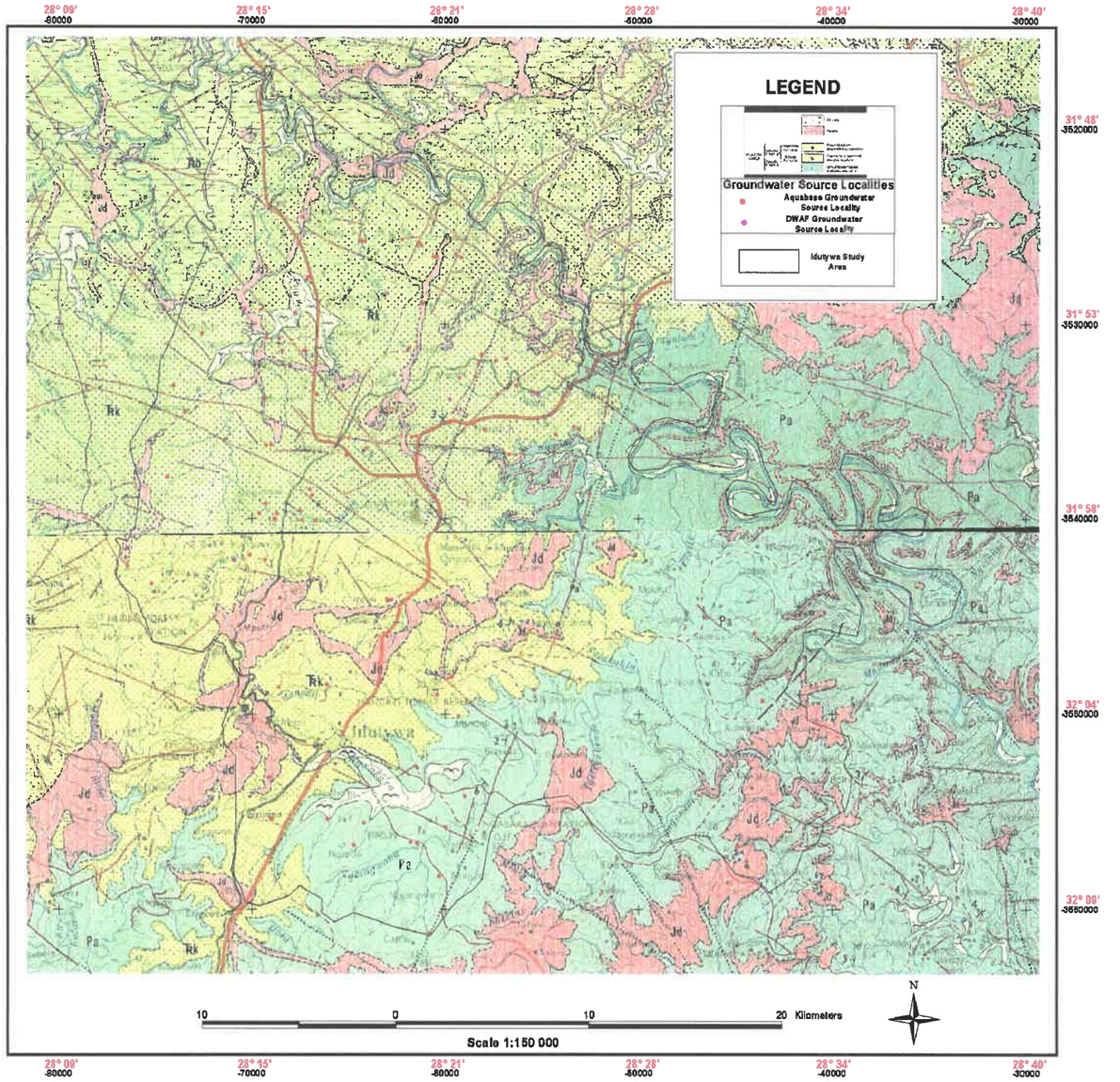
3.3 Precipitation

The mean annual precipitation typically varies between 600 and 800 mm, but can be slightly higher in the eastern portion of the area. Rains are concentrated in the summer months, with dry and cold winters.

3.4 Groundwater

According to the 1:500 000 Hydrogeological Map Series of the Republic of South Africa published by the Department of Water Affairs and Forestry (1997), The principal groundwater occurrence for the area is Classification "*d3*" which translates to the groundwater environment being "intergranular and fractured" in the yield range of 0.2 – 2.0 l/s (see figure 5 below).

FIGURE 4



AMATOLE DISTRICT MUNICIPALITY

Idutywa Feasibility Study

LOCALITY MAP

MAP DESCRIPTION

Groundwater Source Distribution and Geology

Jeffares Green Parkman Consultants Pty (Ltd.)
24 Tecoma Street
Berea 5241, East London

4. EXPLORATORY DRILLING

4.1 Introduction

A total of 30 boreholes were drilled in Idutywa (refer to Figure 6 displaying borehole positions and blow yields encountered during drilling). The main purpose of the exercise was to explore the groundwater resource and assess its potential to supply the communities. Boreholes were spatially located in the proximity of the communities and were as evenly spread as possible over the entire area. Drilled boreholes were test pumped and their water samples analysed by a qualified laboratory. Although they are mainly exploration boreholes, they can also be used as production boreholes for the installation of pumps. Recommendations for their management are enclosed.

4.2 Siting Method

No major water-bearing structure was observed in the area. The 30 boreholes drilled in Idutywa therefore were all sited in proximity of communities on minor lineaments. The geophysical investigation was carried out using the electro-magnetic method making use of an EM 34 instrument, and through the resistivity method.

The data obtained from the geophysical survey are annexed (Annexure 5).

4.3 Drilling Method

The boreholes were drilled using the compressed-air rotary percussion method (down-hole hammer) with an initial diameter of 203 mm through the overburden. This portion was then lined with ND 177 mm steel casing 4 mm thick. The lower part of the borehole in the bedrock was drilled with 177 mm diameter to the bottom and left unlined.

The average borehole depth was 90 m with the deepest measuring 122 m and the shallowest 70 m.

Boreholes were cleaned and developed by blowing compressed air through the drilling string after completion.

Blow-yield was measured at each water strike with a container and stopwatch.

After completion the upper part of the casing was cemented to provide a sanitary seal preventing seepage into the borehole.

The borehole number was welded onto the casing steel lid.

4.4 Results

Of the 30 boreholes drilled only 2 were completely dry and 3 presented some seepage. The overall success rate was thus 84%. Drilling results are summarised in Table 2 "Summary of Explanatory Drilling & Testing Results" below:

IDUTYWA PROJECT AREA - BOREHOLES

Exploratry Drilling

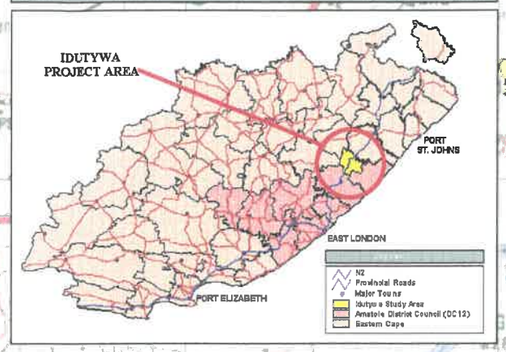
09 SEPTEMBER 2003

FIGURE 6

LEGEND

- Idutywa Project Area Boundary
- New Boreholes Drilled (Showing BH No and Blow Yield, Lt/sec)

IDUTYWA LOCALITY MAP



3128CD/SN/002
0

3128CD/SN/003
0

3128CD/SN/001
0.8

3228AB/SN/016
3.4

3128CD/SN/005
2.2

3128CD/SN/004
0.2

3128CD/SN/007
2

3228AA/SN/015
0.3

3128CD/SN/006
0.9

3128CD/SN/008
1

3228AB/SN/030
0.2

3228AB/SN/028
0

3228AA/SN/014
0.4

3228AB/SN/029
0

3228AB/SN/026
0.15

3228AB/SN/027
0.4

3228BA/SN/025
1.2

3228AB/SN/009
2

3228BA/SN/024
1.5

3228AB/SN/022
2.9

3228AB/SN/021
0.7

3228AB/SN/017
0.63

3228BA/SN/013
1.6

3228AB/SN/020
5

3228AB/SN/019
6

3228AB/SN/028
0.6

3228AB/SN/010
0.7

3228AB/SN/018
0

3228BA/SN/012
3.3

3228AB/SN/011
2

IDUTYWA

DAMAKWE

Coordinate System: Geographic, Clarke 1880
Ref:E:/idutywa/idutywa_Exploratry drilling_09-09-03.mxd

0 2 4 8 12 16 Kilometres

28°5'0"E 28°10'0"E 28°15'0"E 28°20'0"E 28°25'0"E 28°30'0"E 28°35'0"E 28°40'0"E

31°50'0"S 31°55'0"S 32°0'0"S 32°5'0"S 32°10'0"S

Map compilation by JGP JEFFARES GREEN PARKMAN CONSULTANTS

TABLE 2: Summary of Exploratory Drilling and Testing Results

Borehole NO.	Community	Latitude	Longitude	Depth	Casing	Strike	SWL	Blow yield	CD Duration	CD Rate
3128CD/SN/001	Silityiwe	-31.882944	28.289611	100	12	29	16.79	0.8	2880	1.51
3128CD/SN/002	Nyandeni	-31.855000	28.324444	100		Dry	Dry	Dry	0	0
3128CD/SN/003	Bhetai	-31.868611	28.352222	100	6	72, 98	?	Seepage	0	0
3128CD/SN/004	Matolweni	-31.932500	28.287500	122	19	23, 39	34.62	0.2	0	0
3128CD/SN/005	Mhuku	-31.913889	28.348056	90	7	44	5.51	2.2	2520	2.53
3128CD/SN/006	Nywara	-31.947500	28.371111	100	4	18, 83	14.54	0.9	1440	0.61
3128CD/SN/007	Candu	-31.935278	28.405000	80	3.5	14, 28	11.94	2	2880	3.21
3128CD/SN/008	eMabheleni	-31.980000	28.411944	90	4	14	21.14	1	360	2.02
3228AB/SN/009	Colosa/Doti	-32.076944	28.330556	80	3	24, 44	11.46	2	2880	4.24
3228AB/SN/010	Lencane	-32.147778	28.337500	80	18	23	6.2	0.7	1440	0.93
3228AB/SN/011	Qelana	-32.167528	28.335750	80	18	9, 26, 32	2.69	2	2880	2.07
3228BA/SN/012	Fort Malan	-32.153389	28.526111	90	22	12, 36, 78	0.41	3.3	2880	2.75
3228BA/SN/013	Mnandi	-32.118833	28.540000	80	19	20, 44	4.23	1.6	1440	1.52
3228AA/SN/014	KwaTenzi	-32.028750	28.220917	108	6	25, 42	13.81	0.4	720	0.15
3228AA/SN/015	KuVinindwa	-31.943778	28.224417	110	6	75	4.57	0.3	720	0.12
3228AB/SN/016	Shehegu	-31.874722	28.271111	80	6	22, 40, 64	11.19	3.4	2160	5.26
3228AB/SN/017	Mamfaneni	-32.135444	28.300222	80	6	20, 32, 51	13.37	0.63	1440	0.81
3228AB/SN/018	Msintsana	-32.153528	28.383083	100	12	Dry	?		0	0
3228AB/SN/019	Mtovi	-32.137944	28.407083	70	12	14, 36, 62	8.13	6	2880	5.79
3228AB/SN/020	Tafeni	-32.121528	28.436389	80	15	16, 64	1.36	5	2880	4.67
3228AB/SN/021	Cungweni	-32.116556	28.457528	106	6	83	19.27	0.7	1440	0.43
3228AB/SN/022	Tyekelebende	-32.098917	28.436389	92	6	57	0.37	2.9	2880	2.32
3228AB/SN/023	Cungweni/ Ebende	-32.144333	28.461556	104	9	11, 25	3.93	0.6	720	0.51
3228BA/SN/024	Mxotwa	-32.093000	28.562806	80	9	12, 30	13.81	1.5	1440	1.52
3228BA/SN/025	Kratshini	-32.076167	28.557361	80	11	9, 11, 29,59	2.35	1.2	1440	1.03
3228AB/SN/026	Kuchachazele	-32.051639	28.482861	104	6	33, 52	19.29	0.15	720	0.16
3228AB/SN/027	Fakalahla	-32.060278	28.445444	74	6	16, 51	0.61	0.4	720	0.4
3228AB/SN/028	Komkhulu	-32.016917	28.475694	94	6	14		Seepage	0	0
3228AB/SN/029	Sisnsini	-32.051167	28.361444	74	17	16, 18		Seepage	0	0
3228AB/SN/030	KuCingo	-32.015417	28.342833	80	13	12	1.2	0.2	720	0.26

The single borehole logs and penetration logs are annexed (Annexure 6).

Numbers for the new boreholes	
Borehole Number	**Regional Borehole Number**
3128CD/SN/001	EC/T12/061
3128CD/SN/002	EC/T12/062
3128CD/SN/003	EC/T12/063
3128CD/SN/004	EC/T12/064
3128CD/SN/005	EC/T13/010
3128CD/SN/006	EC/T13/011
3128CD/SN/007	EC/T13/012
3128CD/SN/008	EC/T12/065
3228AB/SN/009	EC/T90/138
3228AB/SN/010	EC/T90/139
3228AB/SN/011	EC/T90/140
3228BA/SN/012	EC/T90/141
3228BA/SN/013	EC/T90/142
3228AA/SN/014	EC/T12/066
3228AA/SN/015	EC/T12/067
3228AB/SN/016	EC/T90/153
3228AB/SN/017	EC/T90/143
3228AB/SN/018	EC/T90/144
3228AB/SN/019	EC/T90/145
3228AB/SN/020	EC/T90/146
3228AB/SN/021	EC/T90/147
3228AB/SN/022	EC/T90/148
3228AB/SN/023	EC/T90/149
3228BA/SN/024	EC/T90/150
3228BA/SN/025	EC/T13/013
3228AB/SN/026	EC/T90/151
3228AB/SN/027	EC/T90/152
3228AB/SN/028	EC/T13/014
3228AB/SN/029	EC/T13/015
3228AB/SN/030	EC/T13/016

5. PUMPING TESTS

5.1 Methodology

Of the 30 boreholes drilled 24 were subjected to Constant Discharge tests and 1 was subjected to a Step Drawdown test only.

The criteria for the length of the Constant Discharge test were as follows:

- Boreholes with a constant discharge rate up to 0.5l/s were tested for 12 hours.
- Boreholes with a constant discharge rate between 0.5 and 2.0 l/s were tested for 24 hours.
- Boreholes with a constant discharge rate greater than 2l/s were tested for 48 hours.
- Constant discharge rates were determined by typically conducting 4 steps of one hour each, although a fifth step was sometimes required.
- Recovery was set at a minimum of half the constant discharge pumping time, and to a maximum of 95% or equal to pumping time, whichever came first.

Results were typical of aquifers displaying a volume of effective storage, where recharge occurs regularly in most years but can't be readily absorbed into the aquifer because of low storage capacity. Step test results typically showed that constant discharge rates were higher than were feasible for long periods of pumping (greater than 6 hours). Even with a conservative approach in determining the rate at which the constant discharge tests should be performed, boreholes typically showed a boundary effect or point of inflection in the test analysis results, and in several cases more than one. In addition, the average main strike depths were very shallow, resulting in relatively small available drawdown levels thus significantly reducing safe yields. Multiple strikes resulted in numerous "mini dewatering" effects in several cases. Thus, analysis trends were far from classic and varied considerably, depending on the level of interpretation required by the hydrogeologist.

Results were analysed using two computer interpretation packages, namely Aquifer Test by Waterloo Hydrogeologic Software, and the FC Method developed by the University of the Orange Free State (refer to graphs of analysis and summary table of safe yield determination for all methods in Annexure 8).

Transmissivity values were determined from Aquifer tests by two means, namely fitting "curves" and best fit lines by eye ("T value own" in table below), and fitting "curves" and best fit lines as the package calculated the best mathematical fit ("T values program" in table below). Methods used to determine transmissivity values were the Cooper Jacob, Newman, Theis method, and the Theis Recovery Method.

Calculation of safe yields and transmissivity using the FC Method package included the interpretation methods Basic FC, FC Inflection Point, Cooper Jacob, FC Non-linear, and Barker. Where applicable (i.e. where there is obvious occurrence of an inflection point in the analysis), the FC inflection point method was utilised for the determination of the safe pumping yield of the borehole, otherwise, based on the variability of results, cross-checks were performed and an average safe yield was

chosen from the methods thought to be most applicable. A summary of the results is detailed in the table below and spatially represented in Figure 7:

5.2 Results

TABLE 3: Summary of test pumping results

Borehole N0.	Aquifer Test				FC Method	Average	Extrapolated Safe Yield	
	Using T Value (own)		Using T Value (program)					
	Q1 (m3/day) (Incl. Recov)	Q2 (m3/day) (Excl. Recov)	Q1 (m3/day) (Incl. Recov)	Q2 (m3/day) (Excl. Recov)	Q (m^3/day)	Q (m3/day)	**Q (m^3/day)**	Q (l/s for 24 hrs/day)
3128CD/SN/001	6.07	2.79	19.43	14.34	38.88	23.86	**47.5**	0.55
3128CD/SN/002								
3128CD/SN/003								
3128CD/SN/004								
3128CD/SN/005	11.15	6.73	179.08	128.97	181.44	156.24	**155**	1.79
3128CD/SN/006	1.00	0.93	5.66	7.17	9.50	7.34	**8.6**	0.10
3128CD/SN/007	13.38	12.27	26.60	29.59	46.66	41.74	**34.5**	0.40
3128CD/SN/008	5.38	5.39	31.74	35.13	14.69	36.21	**14.7**	0.17
3228AB/SN/009	46.53	43.47	132.02	153.74	173.67	172.50	**172.5**	2.00
3228AB/SN/010	8.28	5.31	19.23	24.02	38.88	27.65	**29.3**	0.34
3228AB/SN/011	4.29	5.07	47.69	55.17	52.70	55.12	**63**	0.73
3228BA/SN/012	13.61	3.64	15.33	18.88	18.14	33.83	**30**	0.35
3228BA/SN/013	4.60	5.71	23.43	30.59	36.29	29.79	**36.2**	0.42
3228AA/SN/014	0.24	0.24	4.18	4.25	3.46	4.10	**3.5**	0.04
3228AA/SN/015	0.12	0.13	3.11	3.42	1.73	2.83	**1.7**	0.02
3228AB/SN/016	26.90	26.83	76.32	84.57	81.22	105.96	**70**	0.81
3228AB/SN/017	9.19	8.26	12.01	13.86	47.52	20.96	**47.5**	0.55
3228AB/SN/018								
3228AB/SN/019	29.55	22.23	136.95	145.26	152.93	171.11	**153**	1.77
3228AB/SN/020	24.45	23.53	111.83	138.79	147.74	133.80	**148**	1.71
3228AB/SN/021	1.44	1.14	8.74	10.22	28.51	14.39	**29**	0.34
3228AB/SN/022	7.90	3.64	53.10	51.86	71.71	70.34	**60**	0.69
3228AB/SN/023	4.42	5.18	3.66	4.34	3.46	7.45	**3.5**	0.04
3228BA/SN/024	5.68	5.78	26.47	32.65	19.01	46.91	**14.7**	0.17
3228BA/SN/025	4.41	4.38	15.42	19.76	14.69	20.35	**16.4**	0.19
3228AB/SN/026	0.74	0.78	2.58	2.77	6.31	3.51	**6.3**	0.07
3228AB/SN/027	0.88	0.94	14.26	15.36	12.96	15.11	**13**	0.15
3228AB/SN/028								
3228AB/SN/029								
3228AB/SN/030	1.06	1.26	3.60	4.06	2.59	4.41	**2.6**	0.03

Note: only a step test was performed on borehole number 3128CD/SN/004, and the remaining boreholes shaded in grey were either dry, or yielded insufficient water to be tested.

IDUTYWA PROJECT AREA - NEW BOREHOLES DRILLED

Showing Safe Yields

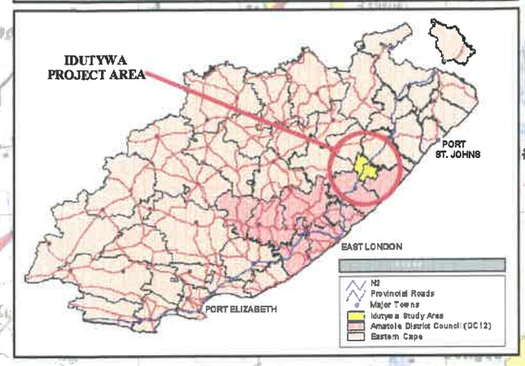
09 SEPTERMBER 2003

FIGURE 7

LEGEND

- Idutywa Project Area Boundary
- Community Footrints (Showing Population Figures)
- Boreholes (Showing Safe Yields - Lt/day)

IDUTYWA LOCALITY MAP



28°5'0"E 28°10'0"E 28°15'0"E 28°20'0"E 28°25'0"E 28°30'0"E 28°35'0"E 28°40'0"E

31°50'0"S 31°55'0"S 32°0'0"S 32°5'0"S 32°10'0"S

IDUTYWA

KWAMAKWE

Coordinate System: Geographic, Clarke 1880
Ref:E:/Idutywa/Safe_yields_09-09-03.mxd

0 2 4 8 12 16 Kilometres

Map compilation by: JGP JEFFARES GREEN PARKMAN CONSULTANTS

It is interesting to note that on comparison of blow yield, constant discharge rate, and extrapolated safe yield, generally the safe yield is the lowest, followed by the blow yield and then the constant discharge rate. These comparisons are highlighted in the table below:

TABLE 4: Comparison of test pumping results with blow yields and constant discharge rates.

Borehole N0.	Blow yield	Constant Discharge Rate	Safe Yield
3128CD/SN/001	0.8	1.51	0.55
3128CD/SN/002	Dry	0	
3128CD/SN/003	Seepage	0	
3128CD/SN/004	0.2	0	
3128CD/SN/005	2.2	2.53	1.79
3128CD/SN/006	0.9	0.61	0.10
3128CD/SN/007	2	3.21	0.40
3128CD/SN/008	1	2.02	0.17
3228AB/SN/009	2	4.24	2.00
3228AB/SN/010	0.7	0.93	0.34
3228AB/SN/011	2	2.07	0.73
3228BA/SN/012	3.3	2.75	0.35
3228BA/SN/013	1.6	1.52	0.42
3228AA/SN/014	0.4	0.15	0.04
3228AA/SN/015	0.3	0.12	0.02
3228AB/SN/016	3.4	5.26	0.81
3228AB/SN/017	0.63	0.81	0.55
3228AB/SN/018	Dry	0	
3228AB/SN/019	6	5.79	1.77
3228AB/SN/020	5	4.67	1.71
3228AB/SN/021	0.7	0.43	0.34
3228AB/SN/022	2.9	2.32	0.69
3228AB/SN/023	0.6	0.51	0.04
3228BA/SN/024	1.5	1.52	0.17
3228BA/SN/025	1.2	1.03	0.19
3228AB/SN/026	0.15	0.16	0.07
3228AB/SN/027	0.4	0.4	0.15
3228AB/SN/028	Seepage	0	
3228AB/SN/029	Seepage	0	
3228AB/SN/030	0.2	0.26	0.03

Safe yields ranged from very low (<0.05 l/s) to 2.00 l/s. It is important to remember that these yields have been determined from a single event test, and that it is imperative to establish a suitable groundwater monitoring programme if these boreholes are to be equipped. It is likely that yields will fluctuate seasonally with increased recharge and thus increased yield in the rainy season and decreased recharge and potential reduction in yield in the dry season.

Bearing the above in mind, the pumping recommendations for each of the boreholes drilled and tested to date are summarised in table 5 below:

TABLE 5: Pumping recommendations, borehole design parameters and preferable installation types.

Borehole N0.	Constant Discharge Duration (mins)	Constant Discharge rate (l/s)	Drawdown during Constant Discharge Test (m)	Extrapolated Safe Yield		Main Strike (mbgl)	Static Water Level (mbgl)	Critical Drawdown Depth (m)	Recommended pump installation depth (mbgl)	Type of Installation	Duty Cycle (hours per day)	Discharge Rate (l/s)
				Q (m^3/day)	Q (l/s for 24 hrs/day)							
3128CD/SN/001	2880	1.51	11.76	47.5	0.55	29	16.79	12	30	Motorised	12	0.78
3128CD/SN/005	2520	2.53	19.15	155	1.79	44	5.51	19.15	45	Motorised	12	2.53
3128CD/SN/006	1440	0.61	36.17	8.6	0.10	18	14.54	21	36	Motorised/ Hand		
3128CD/SN/007	2880	3.21	27.4	34.5	0.40	28	11.94	8	27	Motorised	12	0.57
3128CD/SN/008	360	2.02	39.41	14.7	0.17	14	21.14	18	42	Handpump		
3228AB/SN/009	2880	4.24	9.57	172.5	2.00	24	11.46	9.57	24	Motorised	12	2.83
3228AB/SN/010	1440	0.93	8.17	29.3	0.34	23	6.2	7.41	24	Motorised/ Hand	12	0.48
3228AB/SN/011	2880	2.07	23.87	63	0.73	26	2.69	22.96	27	Motorised	12	1.03
3228BA/SN/012	2880	2.75	62.54	30	0.35	36	0.41	37	39	Motorised/ Hand	12	0.5
3228BA/SN/013	1440	1.52	15.93	36.2	0.42	20	4.23	13.36	24	Motorised/ Hand	12	0.59
3228AA/SN/014	720	0.15	26.41	3.5	0.04	42	13.81	26.41	42	Handpump		
3228AA/SN/015	720	0.12	47.32	1.7	0.02	75	4.57	35.2	75	Handpump		
3228AB/SN/016	2160	5.26	39.47	70	0.81	22	11.19	10.18	24	Motorised	12	1.15
3228AB/SN/017	1440	0.81	6.79	47.5	0.55	32	13.37	5.93	33	Motorised	12	0.78
3228AB/SN/019	2880	5.79	16.63	153	1.77	14	8.13	16.63	24	Motorised	12	2.5
3228AB/SN/020	2880	4.67	11.49	148	1.71	16	1.36	10.84	24	Motorised	12	2.42
3228AB/SN/021	1440	0.43	18.56	29	0.34	83	19.27	15.92	84	Motorised/ Hand	12	0.48
3228AB/SN/022	2880	2.32	37.07	60	0.69	57	0.37	27.29	57	Motorised	12	0.98
3228AB/SN/023	720	0.51	36.27	3.5	0.04	11	3.93	5.17	24	Handpump		
3228BA/SN/024	1440	1.52	54.56	14.7	0.17	30	13.81	10.07	30	Handpump		
3228BA/SN/025	1440	1.03	18.82	16.4	0.19	11	2.35	10.1	24	Handpump		
3228AB/SN/026	720	0.16	10.62	6.3	0.07	52	19.29	10.62	51	Handpump		
3228AB/SN/027	720	0.4	20.74	13	0.15	51	0.61	20.74	51	Handpump		
3228AB/SN/030	720	0.26	18.47	2.6	0.03	12	1.2	8.43	24	Handpump		

6. WATER QUALITY

The 25 productive exploration boreholes were sampled at the end of each of the pump tests. The water samples were analysed by the Amatola Water Scientific Services Division. All the Certificates of Analysis are appended (Annexure 4). The results were compared with the SABS 241 Specifications for Potable Water (1999) (Annexure 3).

In the following table are reported the substances exceeding the Ideal, Acceptable and Maximum Limit respectively.

Table 6: Water Quality: Determinands Exceeding SABS Specifications

Borehole Number	Community	Date	° / ' / " Lat. S	° / ' / " Long. E	m Depth	Water Class SABS 241		
						Exc. Ideal	Exc. Acc.	Exc. Max
3128/CD/SN/001	Silityiwa	02-Jun	31 52 29	28 17 23	100	N,F	Cl,Cond.,MgNa, TDS,NTU	
3128CD/SN/002	Nyandeni	03-Jun	31 51 18	28 19 28	100			
3128CD/SN/003	Bhetai	05-Jun	31 52 07	28 21 08	100			
3128CD/SN/004	Matolweni	06-Jun	31 55 57	28 17 15	122		NO3	Cond,Mg,Na ,Fe,Cl
3128CD/SN/005	Mhuku	07-Jun	31 54 50	28 20 53	90	N,Cl,Cond,Fe, Mg,Na, TDS		
3128CD/SN/006	Nywara	08-Jun	31 56 51	28 22 16	100	N,Cl,Cond Fe		
3128CD/SN/007	Candu	09-Jun	31 56 07	28 24 18	80	Fe,Mg,TDS	Cl,Cond,Na	
3128CD/SN/008	Mabheleni	10-Jun	31 58 48	28 24 43	90	F,Fe,Mg,Na,T DS	Cl,Cond. NTU	
3228AB/SN/009	Colosa/Doti	11-Jun	32 04 37	28 19 50	80	Fe,Mg,TDS	Cl,Cond,Na	
3228AB/SN/010	Lencane	12-Jun	32 08 52	28 20 15	80	Cl,Cond,Fe,Na TDS	NTU	
3228AB/SN/011	Qelana	18-Jun	32 10 03	28 20 09	80	NTU		
3228BA/SN/012	Fort Malan	19-Jun	32 09 12	28 31 34	90	NO3,Cl,Na		Fe,NTU
3228BA/SN/013	Mnandi	21-Jun	32 07 08	28 32 24	80	Cond		NO3
3228AA/SN/014	Kwatenzi	22-Jun	32 01 43	28 13 15	108	NO3,Cl,Na		NTU
3228AA/SN/015	Kwavinindwa	24-Jun	31 56 38	28 13 28	110	Cond,Na,TDS	Cl	Fe,Mg,Ntu
3328AB/SN/016	Sheshegu	26-Jun	32 08 04	28 16 16	80	Cl,Cond,Fe,Na TDS,NTU		
3228AB/SN/017	Mamfeneni	27-Jun	32 08 08	28 18 01	80	Cond,Na,TDS, NTU	Cl,Fe	
3228AB/SN/18	Msintsana	28-Jun	32 09 12	28 23 01	100			
3228AB/SN/019	Mtovi	02-Jul	32 08 17	28 24 25	70	NO3,Fe,NTU		
3228AB/SN/020	Tafeni	04-Jul	32 07 18	28 26 11	80	NO3,Fe,NTU		
3228AB/SN/021	Cungweni	07-Jul	37 07 00	28 27 27	106	NO3,Fe		
3228AB/SN/022	Tyekelebende	08-Jul	32 05 56	28 26 37	92	NO3,Fe		
3228AB/SN/023	Cungweni/Ebende	09-Jul	32 08 40	28 27 42	104	Cl	Fe	
3228BA/SN/024	Mxotwa	10-Jul	32 05 35	28 33 46	80	Fe,NTU		NO3
3228BA/SN/025	Kratshini	11-Jul	32 04 34	28 33 27	80	Fe,NTU		
3228AB/SN/026	Kuchachazele	12-Jul	32 03 06	28 28 58	102	Cond,Mg,Na, TDS	Cl,NTU	
3228AB/SN/027	Fakalahla	14-Jul	32 03 37	28 26 44	74	NO3,Cond,Fe, Mg,TDS	Cl,Na,NTU	
3228AB/SN/028	Komkhulu	19-Jul	31 01 01	28 28 35	92			
3228AB/SN/029	Siszini	20-Jul	32 04 04	28 21 41	74			
3228AB/SN/030	Kucingo	21-Jul	32 00 55	28 20 34	80	Cl	Cond,Fe,Na,TDS	NTU

As can be noted, all the boreholes exceed at least the ideal limit, 10 also exceeding the acceptable limit and 7 exceed the maximum limit. The water quality class is represented in Figure 8. There is no apparent or definite trend with regard determinands falling into classes 2 and 3. Groundwater quality in Idutywa is generally considered to be poor.

In recommending usage of the boreholes we must take into account the scarcity of water resources in the area. For this reason, we believe that we should still utilise the water supply from those boreholes exceeding the ideal limits. In the following table we consider the possible effects of determinands exceeding the SABS parameters, and we recommend a "pragmatic" approach to the use of the boreholes.

Table 7: Water Quality: Comments and Recommendations

Borehole	Exceeded limits	Comments	Recommendations
Silitywa 3128/CD/SN/001	Acceptable: Cl, Cond, Mg, Na, TDS, NTU	Unpleasant taste, harmless to human health.	Can be used.
Matolweni 3128CD/SN/004	Acceptable: NO3 Maximum:Cl, Fe, Cond., Mg, Na	Too salty to drink, corrosive to metals, dangerous to health	**Cannot be used for human consumption**
Candu 3128CD/SN/007	Acceptable: Cl, Cond., Na	Unpleasant taste, harmless to human health.	Can be used.
Mabheleni 3128CD/SN/008	Acceptable: Cl, Cond., NTU	Unpleasant taste, harmless to human health.	Can be used.
Colosa/Doti 3228AB/SN/009	Acceptable: Cl, Cond., Na	Unpleasant taste, harmless to human health.	Can be used.
Lencane 3228AB/SN/010	Acceptable: NTU	Not perfectly clear	Can be used
Fort Malan 3228BA/SN/012	Maximum: Fe, NTU	Unclear, can stain washed cloths, harmless to human health	Can be used
Mnandi 3228BA/SN/013	Maximum: NO3	Infiltration from surface water	Can be used if borehole properly sealed and re-analysed
KwaTenzi 3228AA/SN/014	NTU	Unclear	Can be used
KwaVinindwa 3228AA/SN/015	Acceptable: Cl. Maximum: Fe, Mg, NTU	Unclear, slightly salty, can stain washed clothes, harmless to health	Can be used
Mamfeneni 3228AB/SN/017	Acceptable: Cl, Fe	Can stain washed clothes	Can be used
Cungweni/Ebende 3228AB/SN/023	Acceptable: Fe	Can stain washed clothes	Can be used
Mxotwa 3228BA/SN/024	Maximum: NO3	Infiltration from surface water	Can be used if properly sealed and re-analysed
Kuchachazele 3228AB/SN/026	Acceptable: Cl, NTU	Slightly unpleasant taste, not perfectly clear	Can be used
Fakalahla 3228AB/SN/027	Acceptable Cl, Na, NTU	Slightly unpleasant taste, not perfectly clear	Can be used
Kucingo 3228AB/SN/030	Acceptable: Con., Fe, Na, TDS. Maximum: NTU	Slightly unpleasant taste, unclear	Can be used

IDUTYWA PROJECT AREA - NEW BOREHOLES DRILLED
Showing Water Quality

09 SEPTEMBER 2003

FIGURE 8

LEGEND

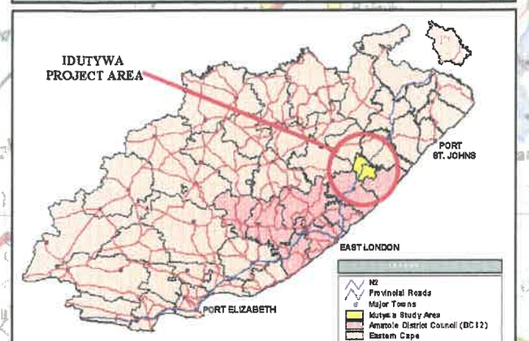
- Idutywa Project Area Boundary

Water Quality

- 1
- 2
- 3

3228AB/SN/016
3128CD/SN/005
3128CD/SN/004
3128CD/SN/007
3228AA/SN/015
3128CD/SN/006
3128CD/SN/008
3228AA/SN/014
3228AB/SN/009
3228BA/SN/025
3228BA/SN/024
3228AB/SN/022
3228AB/SN/021
3228AB/SN/020
3228BA/SN/013
3228AB/SN/017
3228AB/SN/019
3228AB/SN/023
3228AB/SN/010
3228BA/SN/012
3228AB/SN/011

IDUTYWA LOCALITY MAP



Coordinate System: Geographic, Clarke 1880
Ref:E:/Idutywa/New boreholes drilled_H20 qual-09-09.mxd

0 2 4 8 12 16 Kilometres

28°50'E 28°10'0"E 28°15'0"E 28°20'0"E 28°25'0"E 28°30'0"E 28°35'0"E 28°40'0"E

31°50'0"S 31°55'0"S 32°0'0"S 32°5'0"S 32°10'0"S

Map compilation by JGP JEFFARES GREEN PARKMAN CONSULTANTS

7. CONCLUSIONS

The groundwater resources of Idutywa have been explored both quantitatively and qualitatively.

Of the 30 boreholes sited with geophysical methods 24 produced productivity results (80% success rate). From a quantitative point of view, the safe long-term yield of the 24 boreholes drilled vary between 172.5 and 1.7 m^3/day, with an average of 48.3 m3/day. Taking into account a safe yield of 100 m^3/day as a minimum required yield to supply a reservoir/reticulation scheme for 500 people (200 l/capita/day) we note that only 4 boreholes can attain this yield. However, to meet RDP standards or 25l/cap/day, it may be economically viable to equip boreholes yielding more than 30m^3/day.

From a qualitative point of view, none of the 24 boreholes fully complies with the SABS 241 Specifications for Drinking Water. Water quality is generally poor, with excessive Chloride, Sodium, Iron and Magnesium.

Both from a quantitative and qualitative point of view, the groundwater potential of the Idutywa area is therefore considered to be poor, but in the light of the existing water resources available groundwater must still be considered a potential source of water for reticulated and definitely for rudimentary supply for human consumption.

8. RECOMMENDATIONS

8.1 Use of exploration boreholes as production boreholes

The exploration boreholes were drilled with the two-fold function of providing information on the aquifers for this report and to provide drinking water to the population. Table 5 "Pumping recommendations, borehole design parameters and preferable installation types", indicates the possible utilisation of each of the 24 productive boreholes, specifying the type of installation (hand-pump or motorised pump), installation depth, safe discharge rate, and daily duty cycle.

Table 7 "Water Quality Recommendations" indicates the possible usage of the resources in relation to the poor water quality.

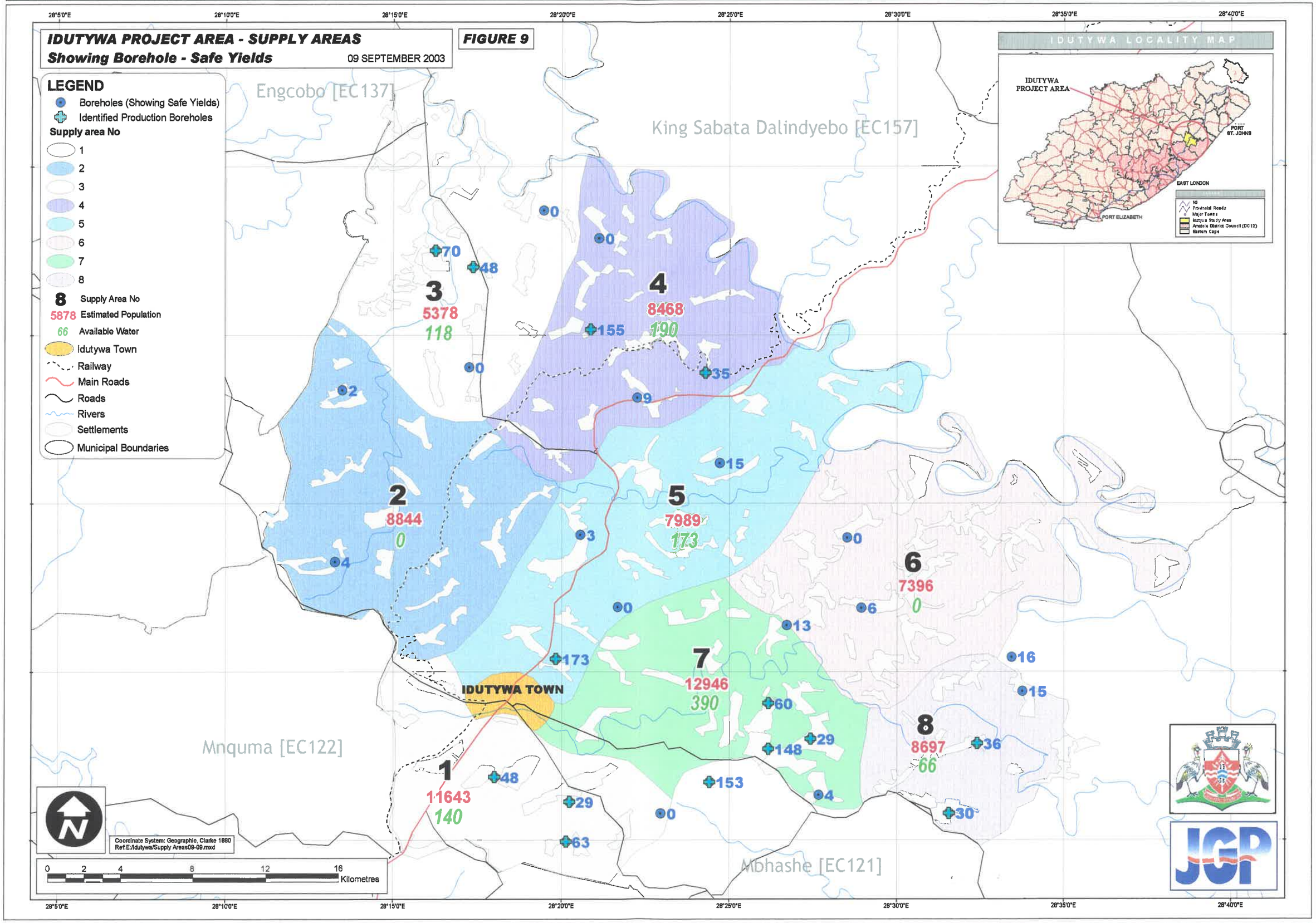
As a value added exercise to the exploratory drilling programme, the Idutywa area was briefly assessed in terms of supplying the scheme that originally was proposed by JGP in the prelude report to this report, but utilising groundwater as the water source. It is highly unlikely that the two phases originally proposed will remain "whole" as the current indication is that safe yields of groundwater do not occur in high enough quantities to warrant feeding them. It is however feasible to break each of the phases up into smaller portions of approximately 6,000 – 12,000 people and make use of groundwater to service combinations of the proposed supply reservoirs as smaller supply areas (refer to Figure 9). The table below summarizes the new proposed supply areas in terms of:

1. effective existing groundwater supply (i.e. only boreholes suitable for motorised equipment (>30m^3/day))
2. the population thought to be served by those supply areas
3. the demand attached to them (at 25l/cap/day)
4. the deficits to meet those demands.

IDUTYWA PROJECT AREA - SUPPLY AREAS
Showing Borehole - Safe Yields

09 SEPTEMBER 2003

FIGURE 9



Map compilation by JGP JEFFARES GREEN PARKMAN CONSULTANTS

TABLE 8: Summary of Supply area Criteria.

Supply Area	Reservoirs from scheme within supply area	Effective Available Groundwater (m^3/day)	Number of boreholes constituting available groundwater	Estimated Population Served	Demand (m^3/day)	Deficit (m^3/day)	Treatment Required	Estimated Additional boreholes Required (excluding unsuccessful)
1	18, 19, 20, 21	140	3	11643	291	151	Likely	3
2	10, 11, 12, 13, 14, 16, 17	0	0	8844	221	221	Likely	5
3	3, 4, 5, 6, 7	118	2	5378	134	16	Possible	1
4	2, 8, 9	190	2	8468	212	22	Possible	1
5	23, 24, 25, 26, 27	173	1	7989	200	27	Possible	1
6	32, 33, 34	0	0	7396	185	185	Likely	3
7	28, 29, 30, 31	390	4	12946	324	-66	Not Likely	0
8	35, 36, 37	66	2	8697	217	151	Definitely	3

We recommend that the drilled boreholes be utilised, at least as a temporary relief to the population, as indicated, or alternately as rudimentary groundwater supply in the form of handpump supply.

8.2 Future Strategy

Groundwater resources in Idutywa are not conducive to the construction of high-yielding boreholes to feed large reticulation schemes.

However, groundwater occurrence is widespread (80% success rate with proper siting) and water quality, albeit far from ideal, is acceptable in rural conditions with no better alternative.

In other words, it would be feasible to drill a large number of low and medium-yielding boreholes equipped with hand-pumps strategically located to serve almost all the households within reasonable distance, or to implement small scale groundwater borehole schemes.

Naturally occurring springs are also a valuable resource. There are 42 undeveloped springs presently used in the area. If properly protected and maintained they can also contribute to the water supply of the communities, predominantly on a rudimentary level.

Mario F. Toniolo Mark Schapers Peter Waldron

September 2003

ANNEXURE 1

Communities in the Idutywa Tribal Authority

Communities in Mbashe Municipality

	Capturer	Capture Date	Current Name	Ward n.	Ward Councillor	Headman	Lat D	Lat M	Lat S	Long D	Long M	Long S	Househ. (est.)	Pop. (est. hhds x 8)	Electricity available	Rudimental Sanitation % (est.)	River(s) from which abstracting	Hydrocensus Water Resource Number			
131	F.H.	16/05/03	Mzansi	5	Solontsi		31	59	41	28	19	11	54	432	N	0	Munyu				
132	F.H.	22/05/03	Munyu				31	59	18	28	20	55	0	0	N	0		3128CD/FH/042			
133	J.M.	20/05/03	Mwandi	2	Magoda	G.L.Mvuthula	32	7	7	28	32	4	330	2640	Y	10	Mntanana	3228AB/JM/028			
134	M.K	22/05/03	Mxotwa (Mfula)	12	Magodla	K.Mbusi	32	7	37	28	36	15	30	240	N	80					
135	J.M.	14/05/03	Ndakeni	6	Sangqu		32	8	13	28	19	12	350	2800	Y	30	Ngcincwane	3228AB/JM/010	3228AB/JM/009	3228AB/JM/008	3228AB/JM/007
136	F.H.	19/05/03	Ndulini	1	Matshandana		31	49	40	28	16	34	17	136	N	10	Mgwali				
137	J.M.	19/05/03	Nduliini	10	Matshaia	T.Wayini	32	5	43	28	27	3	100	800	Y	10	Tyelekebende				
138	M.K	21/05/03	Ngcolose	11	Magondo	V.Sigidi	32	0	12	28	32	42	37	296	Y	0	Mbashe, Qubusane				
139	M.K	23/05/03	Ngete	12	Magodla	W.Mngeni	32	8	27	28	34	18	30	240	N	0	Ngabara				
140	J.M.	23/05/03	Ngonyama	5	Solontsi	S.Menzina	32	6	27	28	15	19	150	1200	Y	70	Ngonyana				
141	M.K	17/05/03	Ngqutu	11	Magondo	Sigcawu	32	4	33	28	29	59	200	1600	N	1	Falakahla				
142	F.H.	23/05/03	Ngxingweni	1	Matshandana		31	55	42	28	13	26	36	288	N	0	Kutsimisane				
143	M.K	20/05/03	Njakazi	11	Magondo	V.Sigidi	31	59	21	28	30	52	42	336	N	1	Mbashe				
144	F.H.	18/05/03	Nkangeni	1	Matshandana		31	51	19	28	16	24	130	1040	Y	30	Bholotwa				
145	F.H.	16/05/03	Nkawukazi	4	Gada		31	54	56	28	23	10	78	624	Y	0	Nkawukazi	3128CD/FH/013			
146	M.K	22/05/03	Nkonxeni (Mfula)	12	Magodla	K.Mbusi	32	4	34	28	29	46	35	280	N	2					
147	M.T.	14/05/03	Nopoto	4	Gada	Zenzile	32	3	29	28	23	22	100	800	N	0	Dutywa				
148	M.K	22/05/03	Nothanda (Mfula)	12	Magodla	K.Mbusi	32	5	28	28	33	53	40	320	N	10					
149	F.H.	16/05/03	Nqabane	4	Gada		31	53	43	28	24	50	45	360	Y	0	Mbashe				
150	F.H.	17/05/03	Nqabane	1	Matshandana		31	51	58	28	22	45	60	480	N	10	Mbashe				
151	F.H.	23/05/03	Ntonga (Mazangweni)	1	Matshandana		31	54	22	28	14	1	42	336	N	0	Ntonga				
152	J.M.	19/05/03	Ntotovivane (Mtuvi)	10	Matshaia		32	9	30	28	25	23	63	504	Y	10	Mtuvi				
153	F.H.	20/05/03	Ntsimba	1	Matshandana		31	52	47	28	18	44	400	3200	Y	95	Lota				
154	F.H.	19/05/03	Ntwashini	1	Matshandana		31	50	41	28	15	**52**	29	232	N	0					
155	F.H.	20/05/03	Nyandeni	1	Matshandana		31	51	27	28	18	**47**	108	864	N	95	Mgwali	3128CD/FH/022			
156	F.H.	15/05/03	Nywara	3	Potelwa		**31**	56	8	28	21	**58**	177	1416	Y	50	Nywara	3128CD/FH/009	3128CD/FH/010		
157	M.K	19/05/03	Phephezela	11	Magondo	V.Sigidi	**32**	1	**12**	28	30	29	80	640	N	1	Dikeni				
158	J.M	15/05/03	Qelana	6	Sangqu		**32**	10	**21**	28	19	34	65	520	Y	90		3228AB/JM/012			
159	F.H	20/05/03	Qokama	3	Potelwa		**31**	55	**14**	28	17	31	203	1624	**Y**	80	Bholotwa				
160	F.H.		Qokolweni	3	Potelwa		**31**	59	14	28	22	18	95	760	**N**	60	Munyu				
161	F.H.	17/05/03	Qolweni	1	Matshandana		**31**	53	6	28	**21**	31	46	368	**N**	60	**Nqabane**				
162	M.K	22/05/03	Qolweni	12	Matshandana	K.Mbusi	**32**	5	47	28	**34**	54	70	560	**N**	5	**Nothanda**				
163	M.K	19/05/03	Qombe	11	Magondo	**V.Sigidi**	**32**	0	33	28	**31**	32	53	424	N	1	Sundwana				
164	F.H.	19/05/03	Rhwantsini	5	Solontsi		**31**	58	8	28	**17**	56	500	4000	Y	10	Munyu	3128CD/FH/034	3128CD/FH/035		
165	J.M.	21/05/03	Rhwantsini	10	Matshaia	M.Nfatywa	**32**	6	11	28	**25**	8	320	2560	Y	10	Foli	3228AB/JM/031			
166	M.K	22/05/03	Seven (Nkanunu)	12	Magodla	K.Mbusi	**32**	5	7	28	**34**	18	75	600	N	100	Mgolombane				
167	J.M.	21/05/03	Sheshegu	6	Sangqu	B.Dumezweni	32	7	32	28	**16**	29	500	4000	Y	90	Igxakaxa,Mngcunube	3228AB/JM/033	3228AB/JM/034		
168	J.M.	16/05/03	Sigobelwana	10	Matshaia		32	11	22	28	22	19	250	2000	Y	60					
169	F.H.	14/05/03	Sihlabeni	4	Gada		31	59	10	28	24	8	25	200	N	30		3128CD/FH/004			
170	F.H.	17/05/03	Sihlabeni	3	Potelwa		31	54	42	28	18	45	150	1200	Y	15		3128CD/FH/018			
171	F.H.	19/05/03	Singeni	1	Matshandana		31	49	51	28	17	45	113	904	Y	10	Mgwali				
172	F.H.	21/05/03	Singumeni (eMaxhame)	3	Potelwa		31	59	26	28	15	25	50	400	N	1	KuMaxhama	3128CD/FH/028	3128CD/FH/029	3128CD/FH/030	
173	F.H.		Siroshwani	4	Gada		31	56	18	28	28	10	32	256	N	40	Mbashee				
174	F.H.	17/05/03	Sirosweni	1	Matshandana		31	52	31	28	21	44	220	1760	N	20					
175	M.K	24/05/03	Siyibane (KwaMagamsa)	11	Magondo	V.Sigidi	32	1	41	28	37	32	20	160	N	0	Mbashe				
176	M.K	24/05/03	Siyibane (KwaNzima)	11	Magondo	V.Sigidi	32	1	37	28	37	56	30	240	N	0	Mbashe				
177	M.T.	14/05/03	Sizini	8	Mdingi	Ntlokondala	32	4	19	28	21	35	200	1600	Y	50	Idutywa, Mangata	3128CD/MT/003	3128CD/MT/004		
178	F.H.	23/05/03	Sompunzi	1	Matshandana		31	49	58	28	15	10	64	512	Y	30	Boloto				
179	M.K	21/05/03	Sopam (Thafeni)	11	Magondo	V.Sigidi	32	0	55	28	34	50		0							
180	J.M.	19/05/03	Tafeni	10	Matshaia	L.Mtombi	32	7	38	28	26	1	300	2400	Y	20		3228AB/JM/026	3228AB/JM/027		
181	J.M.		Tholomi	8	Mdingi		32	11	25	28	21	5	170	1360	Y	90					
182	J.M.	23/05/03	Timane	5	Solontsi		32	1	38	28	16	7	100	800	N	5	Timane				
183	M.K	16/05/03	Tshwati (Mpuku)	11	Magondo	M.Sigidi	32	0	48	28	27	25	73	584	N	20	Idutywa	3228AB/MK/002			
184	J.M.	19/05/03	Tyelekebende	10	Matshaia		32	6	9	28	26	18	150	1200	Y	10					
185	M.K	21/05/03	Umbo (Sopam)	11	Magondo	V.Sigidi	32	1	26	28	33	51	50	400	Y	1		3228BA/MK/009			
186	J.M.	16/05/03	Willow Zembe (Mtuvi)	6	Sangqu		32	8	39	28	23	17	350	2800	Y	20		3228AB/JM/015			
187	F.H.	17/05/03	Xeni	1	**Matshandana**		31	53	4	28	20	40	300	2400	N	10					
188	F.H.	23/05/03	Xeni	1	**Matshandana**		31	54	59	28	13	34	18	144	N	0	Bolotwa				
189	M.K	19/05/03	Xobojiyane (Mahlejana)	12	Magodla	Mtshaza	32	4	46	28	30	9	150	1200	N	1	Mahlezana				
190	M.K	19/05/03	Xobojiyane (Zibomvu)	11	Magondo	V.Sigidi	32	4	55	28	32	30	120	960	N	1	Umgagambane				
191	J.M.	19/05/03	Zambuzane	3	Potelwa	N.Mpalwa	32	2	2	28	12	36	100	800	Y	0	Komkhulu				
192	M.K	24/05/03	Zangcete	11	Magondo	V.Sigidi	31	59	46	28	27	12	10	80	N	40	Mbashe				
													23,856	190,848							

ANNEXURE 2
Water Points in the Idutywa Tribal Authority
(Hydrocensus information)

Water Points in Mbashe Municipality

	New W.P. n.											Borehole		Spring			Wat. Qual. (Field)			
	Map/Capturer/	#	Spring / Borehole	Old W.P. n.	Community	Ward n.	Capture date	Contact person	Lat S (deg, min, sec)	Long E (deg, min, sec)	GPS Elevation (mamsl)	In Use	Pump	Seal	Dev.	Prot.	Est. Yield (l/s)	EC (mS/m)	pH	NO3 (mg/l)	Remarks
1	3128CD/FH/	1	S		KuMbelo	3	14/05/03	S.N.Ralasi	31 52 41	28 22 18	760	N			N	N	0.2	19	6.9		On level ground
2	3128CD/FH/	2	S		KuMbelo	3	14/05/03	S.N.Ralasi	31 58 49	28 22 35	758	Y			N	N	0.2	15	7.1		On level ground
3	3128CD/FH/	3	S		KuMbelo	3	14/05/03	S.N.Ralasi	31 59 03	28 22 58	749	Y			N	N	0.2	14	7		On level ground, seasonal
4	3128CD/FH/	4	S		Sihlabeni	4	14/05/03	S.N.Ralasi	31 59 07	28 23 46	695	Y			N	N	0.1	9	6.7		Seepage
5	3128CD/FH/	5	B		Mabheleni	4	15/05/03	S.N.Ralasi	31 58 48	28 24 39	598	N	WM	Y							
6	3128CD/FH/	6	B		Loxomo	3	14/05/03	S.N.Ralasi	31 57 04	28 22 05	677	N	WM	Y							Was feeding ret. Scheme
7	3128CD/FH/	7	B		Candu	4	15/05/03	S.N.Ralasi	31 56 07	28 24 18	605	N	WM	N							Was feeding ret. Scheme
8	3128CD/FH/	8	B		Matolweni	4	15/05/03	S.N.Ralasi	31 57 15	28 25 59	560	Y	HP	Y				206	7	100	Salty taste
9	3128CD/FH/	9	B		Nywara	3	15/05/03	S.N.Ralasi	31 55 51	28 22 21	693	Y	WM	Y				209	7.2	25	
10	3128CD/FH/	10	B		Nywara	3	15/05/03	S.N.Ralasi	31 55 51	28 22 21	698	N	WM	Y							
11	3128CD/FH/	11	S		Mabheleni	1	16/05/03	S.N.Ralasi	31 55 13	28 22 10	755	Y			N	N	0.2	13	7.1	50	In use
12	3128CD/FH/	12	B	2530	Mabheleni	1	16/05/03	S.N.Ralasi	31 55 38	28 23 04	699	N	WM	N							Was feeding ret. Scheme
13	3128CD/FH/	13	B	T32556	Nkawukazi	4	16/05/03	S.N.Ralasi	31 55 20	28 23 56	652	N	WM	Y							
14	3128CD/FH/	14	B	T32511	Mhuku	1	16/05/03	S.N.Ralasi	31 55 04	28 20 49	761	N	WM	Y							Was feeding ret. Scheme
15	3128CD/FH/	15	B		Matolweni	1	16/05/03	S.N.Ralasi	31 58 60	28 21 05	765	N	Sub	Y							Was feeding ret. Scheme
16	3128CD/FH/	16	S		Matolweni	1	16/05/03	S.N.Ralasi	31 53 50	28 21 06	741	Y						154	7.4	25	Is still feeding a water scheme
17	3128CD/FH/	17	B	T32577B	Bhetai	1	17/05/03	S.N.Ralasi	31 52 07	28 21 06	651	N	WM	N							Was feeding ret. Scheme
18	3128CD/FH/	18	B	T32581	Sihlabeni	3	17/05/03	S.N.Ralasi	31 55 19	28 18 31	713	N	WM	N							
19	3128CD/FH/	19	B		Kweleda	3	17/05/03	M.Ndongeni	31 55 39	28 18 49	747	N	HP	N							
20	3128CD/FH/	20	B	T32549	KuSilitywa	1	19/05/03	H.Hkande	31 53 02	28 17 27	646	N	WM	Y							Was feeding ret. Scheme
21	3128CD/FH/	21	B		KuGilandoda	1	19/05/03	T.Faniso	31 53 54	28 15 20	706	Y	WM	Y				135	7	50	Was feeding ret. Scheme
22	3128CD/FH/	22	B	T32510	Nyandeni	1	20/05/03	S.Yako	31 52 03	28 19 12	609	N	WM	N							Was feeding ret. Scheme
23	3128CD/FH/	23	B		Mlenzeni	1	20/05/03	C.M.Ngwenzi	31 54 09	28 17 05	658	Y	HP	Y				167	6.6	100	
24	3128CD/FH/	24	B		Lalini	3	20/05/03	C.M.Ngwenzi	31 55 06	28 17 19	710	Y	WM	Y				153	7.3	25	Was feeding ret. Scheme
25	3128CD/FH/	25	B		Matolweni	3	20/05/03	C.M.Ngwenzi	31 56 18	28 17 47	478	N	WM	Y							Was feeding ret. Scheme
26	3128CD/FH/	26	B		Mazizini	3	20/05/03	Mhambi	31 56 56	28 16 40	776	Y	WM	Y				125	7.1	25	Is still feeding a water scheme
27	3128CD/FH/	27	B		Mamfengwini	3	21/05/03	Qokweni	31 57 43	28 16 12	817	N	Sub	Y				215	6.6	10	Is still feeding a water scheme
28	3128CD/FH/	28	S		Sinqumeni	3	21/05/03	N. Msekele	31 59 52	28 16 23	875	Y			N	N	0.5	12	6.7	10	
29	3128CD/FH/	29	B		Sinqumeni	3	21/05/03	N. Msekele	31 59 50	28 16 23	868	N	WM	Y							Was feeding a ret. Water scheme
30	3128CD/FH/	31	B		Komkulu	5	21/05/03	S.Pakamile	31 59 43	28 17 50	801	N	none	Y							Never equipped
31	3128CD/FH/	32	S		Komkulu	5	21/05/03	S.Pakamile	31 58 58	28 17 18	861	Y			N	N	0.1	62	6.8	50	On level ground
32	3128CD/FH/	33	B		Komkulu	5	21/05/03	S.Pakamile	31 59 07	28 17 02	846	Y	WM	Y				179	7.4	50	Is still feeding a water scheme
33	3128CD/FH/	34	S		Rhwantsini	5	21/05/03	E.Mbangi	31 58 07	28 18 36	812	Y			Y	N	0.2	83	7	10	
34	3128CD/FH/	35	B		Rhwantsini	5	21/05/03	E.Mbangi	31 57 33	28 18 21	862	N	WM	N							Was feeding a ret. Water scheme
35	3128CD/FH/	36	S		KuMjelo	5	22/05/03	M.Pandulo	31 58 11	28 19 35	786	Y			N	N	0.2	23	7.3	50	On level ground
36	3128CD/FH/	37	S		KuMjelo	5	22/05/03	M.Pandulo	31 58 06	28 19 37	767	Y			N	N	0.2	22	7.3	25	
37	3128CD/FH/	38	S		KuMjelo	5	22/05/03	M.Pandulo	31 58 14	28 19 31	797	Y			N	N	0.2	10	6.6	25	
38	3128CD/FH/	39	B		KuMjelo	5	22/05/03	M.Pandulo	31 57 47	28 19 14	802	N	WM	N							Was feeding ret. Scheme
39	3128CD/FH/	40	B		Mpozola	5	22/05/03	Mapukata	31 56 58	28 19 32	842	N	HP	Y							
40	3128CD/FH/	41	B		Mpozola	5	22/05/03	Tshisera	31 57 30	28 20 56	732	Y	WM	Y							Still feeding a water scheme
41	3128CD/FH/	42	B		Munyu	5	22/05/03	S.Ralasi	31 59 18	28 20 55	717	N	WM	N							No community, ex shop
42	3128CC/FH/	43	B		KuVinindwa	3	23/05/03	D.Sdali	31 56 16	28 13 43	740	Y	WM	Y				142	7	50	
43	3128CC/FH/	44	B	T32582	KuVinindwa	3	23/05/03	D.Sdali	31 56 39	28 13 15	781	N	WM	Y							
44	3128CC/FH/	45	S		KuVinindwa	3	23/05/03	D.Sdali	31 56 52	28 13 21	774	Y			N	N	0.2	33	6.9	25	on level ground
45	3128CC/FH/	46	B		KwaZihleheni	5	24/05/03	A.Golela	31 58 34	28 12 47	857	Y	WM	Y				143	6.6	10	
46	3328AB/JM/	1	S		Lencane	6	14/05/03	D.Mkombo	32 08 48	28 20 14	769	Y			N	N	0.2	93	6.9	10	On level ground
47	3328AB/JM/	3	B		Lencane	6	14/05/03	D.Mkombo	32 08 45	28 20 43	766	N	WM	Y							Was feeding ret. Scheme
48	3328AB/JM/	4	B		Lencane	6	14/05/03	D.Mkombo	32 08 21	28 21 52	750	N	Sub	Y							Was used to water veg. Garden
49	3328AB/JM/	6	S		Drayini	6	14/05/03	M.Gotyana	32 08 13	28 20 08	810	Y			N	N	0.1	25	7.4	10	On level ground
50	3328AB/JM/	7	B		Ndakeni	6	14/05/03	M.Mlotywa	32 08 14	28 19 12	775	N	Sub	Y							Was feeding ret. Scheme
51	3328AB/JM/	8	S		Ndakeni	6	14/05/03	M.Mlotywa	32 08 44	28 19 03	789	Y			N	N	0.1	25	7.7	10	On level ground
52	3328AB/JM/	10	S		Ndakeni	6	14/05/03	M.Mlotywa	32 09 13	28 19 13	789	Y			N	N	0.2	65	7.8	10	On level ground
53	3328AB/JM/	11	S		Mpephenu/Qelane	6	15/05/03	X.Sifuba	32 10 11	28 20 09	781	Y			Y	Y	0.3	32	7.3	10	In disrepair
54	3328AB/JM/	12	S		Qelane	6	15/05/03	M.N.Yatela	32 10 12	28 19 33	818	Y			N	N	0.1	32	6.3	25	
55	3328AB/JM/	13	B		Broadway	6	15/05/03	P.Sanggo	32 09 34	28 21 17	769	Y	WM	Y				71	6.3	10	In disrepair
56	3328AB/JM/	14	B		Gqupu	8	15/05/03	M.Zabezolo	32 11 17	28 20 12	810	N	WM	N							3 WMs together
57	3328AB/JM/	15	S		Willow Zembe	6	16/05/03	Sangcu	32 07 59	28 23 27		Y			N	N	1.25	20	6.9	10	Strong spring
58	3328AB/JM/	16	S		Mtuvi	10	16/05/03	Z.Madala	32 08 17	28 24 22	757	Y			N	N	0.16	23	6.3	10	
59	3328AB/JM/	17	S		Mtuvi	10	16/05/03	Z.Madala	32 08 16	28 24 40	731	Y			N	N	1	25	6.5	10	
60	3328AB/JM/	18	S		Ebende	10	16/05/03	W.Mdodana	32 07 45	28 25 43		Y			N	N	0.8	22	6.9	50	
61	3328AB/JM/	19	S		Ebende	10	17/05/03	W.Mdodana	32 08 05	28 25 27	755	Y			Y	N	0.5	25	7.6	50	
62	3328AB/JM/	20	S		Ebende	10	17/05/03	W.Mdodana	32 07 56	28 25 01	765	Y			N	N	0.5	9	7.7	10	
63	3328AB/JM/	21	S		Ebende	10	17/05/03	W.Mdodana	32 08 08	28 24 59	732	Y			N	N	0.6	21	7.5	25	
64	3328AB/JM/	22	S		Enkumkumeni	10	19/05/03	A.T.Bixa	32 06 13	28 26 03	735	Y			N	N	0.6	29	6.9	25	
65	3328AB/JM/	23	S		Mngayi	8	19/05/03	M.Meva	32 06 29	28 27 09	738	Y			N	N	0.5	15	7.2	10	
66	3328AB/JM/	24	S		Cungcwini	10	19/05/03	T.Jizana	32 06 36	28 27 48	733	Y			N	N	0.25	28	7.2	10	
67	3328AB/JM/	25	S		Cungcwini	10	19/05/03	Matshaya	32 06 59	28 27 27	760	Y			N	N	0.4	15	7.3	10	
68	3328AB/JM/	26	S		Tafeni	10	19/05/03	B.Tshopiyasi	32 07 27	28 26 50	746	Y			N	N	0.7	19	7.1	10	
69	3328AB/JM/	27	S		Tafeni	10	19/05/03	B.Tshopiyasi	32 07 49	28 26 34	740	Y			N	N	0.8	14	7.2	10	
70	3328BA/JM/	29	B		Fort Malan	1	20/05/03	D.Magodla	32 08 55	28 31 19	624	N	WM	N							Was feeding ret. Scheme
71	3328BA/JM/	30	S		Fort Malan	1	20/05/03	D.Magodla	32 09 13	28 31 35	623	Y			N	N	0.2	9	7.1	10	
72	3228AB/JM/	31	S		Rhwantsini	10	21/05/03	M.Ntalywa	32 07 07	28 25 33	773	Y			N	N	0.4	20	6.8	10	
73	3228AB/JM/	32	B		Bomela	8	21/05/03	N.Bomela	32 06 53	28 23 46	759	N	none	Y							never equipped
74	3228AB/JM/	33	B		Sheshegu	6	21/05/03	B.Dumezweni	32 08 02	28 16 16	813	N	WM	N							Was feeding ret. Scheme
75	3228AB/JM/	34	S		Sheshegu	6	21/05/03	B.Dumezweni	32 06 57	28 16 06	843	Y			N	N	0.15	51	7	10	
76	3228AB/JM/	35	B		Mamfeneni	6	22/05/03	F.Sisulu	32 08 18	28 17 46	804	N	WM	N							Was feeding ret. Scheme
77	3228AB/JM/	36	B		Lixeni	6	22/05/03	Magamda	32 04 24	28 16 28	880	N	HP	Y							Ex WM
78	3228AB/JM/	37	B		Manggosisini	6	22/05/03	Manggosisini	32 03 10	28 16 33	890	N	HP	Y							Ex WM
79	3228AB/JM/	38	B		Mputi	5	22/05/03	Mputi	32 05 15	28 16 12	879	N	none	N							Ex WM
80	3228AA/JM/	39	B	T32539	Komkhulu	3	24/05/03	L.Mbono	32 01 31	28 12 14	1010	N	WM	N							Was feeding ret. Scheme
81	3228AA/JM/	40	S		Jojweni	5	23/05/03	G.Memani	32 02 43	28 14 57	966	Y			N	N	0.25	27	6.5	10	
82	3228AA/JM/	41	B		KwaTenza	3	24/05/03	L.Mbono	32 01 19	28 12 36	934	Y	WM	Y				156	7.2	2.5	Still feeding a water scheme
83	3228AB/JM/	42	B		Tirrane	5	23/05/03	H.Foci	32 01 36	28 16 35	920	N	HP	Y							Broken HP
84	3128CD/MT/	1	B	T32558	Mission	8	14/05/03	Mr. Mokota	32 04 10	28 19 47	816	N	WM	Y							Was feeding ret. Scheme
85	3128CD/MT/	2	B	T322558	Mission	8	14/05/03	Mr. Mokota	32 04 11	28 19 47	816	N	?	N							Full of debris
86	3128CD/MT/	3	B		Sizini	8	14/05/03	Mrs. Majavu	32 04 03	28 21 40	766	N		Y							Was feeding a cattle trough
87	3128CD/MT/	4	B		Sizini	8	14/05/03	Mrs. Majavu	32 04 03	28 21 42	765	N	HP	N							Full of debris
88	3128CD/MT/	5	B	T32576	Mangati/Sizini	8	14/05/03	Mrs. Ggirana	32 04 58	28 21 46	807	N	WM	Y							Was feeding a ret. Scheme
89	3128CD/MT/	6	B	T32601	Mangati/Sizini	8	14/05/03	Mrs. Ggirana	32 05 17	28 21 38	766	N	?	N							Full of debris
90	3128CD/MT/	7	B		Mangati/Sizini	8	14/05/03	Mrs. Ggirana	32 05 17	28 21 39	766	N	WM	N							Full of debris
91	3128CD/MT/	8	B	T32575	Gubevu	8	14/05/03	Mr. Jamnda	32 04 48	28 23 00	747	N	none								Dry hole, blocked
92	3128CD/MT/	9	B	T3574	Mangwevini		14/05/03	Mrs. Nobhafu	32 04 43	28 24 44	711	N	none								Dry hole, blocked
93	3228AB/MK/	1	B	T32576	Colosa	8	15/05/03	Mrs. Ntlokondala	32 04 16	28 18 06	834	N	WM	Y							Was feeding a reticulated water scheme
94	3228AB/MK/	2	S		Tshwati	11	16/05/03	G.Mashuku	32 00 07	28 27 06	663	Y			N	N	0.2	64	7.9		
95	3128CD/MK	3	S		Luthuthu		16/05/03	Ngatshoni	31 59 46	28 28 16	546	Y			N	N	0.1	129	7.8		
96	3228AB/MK/	4	B		Chachazela	11	17/05/03	S.Marais	32 02 30	28 29 40	677	Y	Sub	Y				187	7.8	100	Private BH
97	3228BA/MK/	5	B		Siteshini	11	20/05/03	P.Cekisa	32 02 32	28 30 28	719	N	none	Y							never equipped
98	3228BA/MK/	6	B		Umbonda	11	20/05/03	M.Maphekula	32 02 58	28 30 03	592	N	none	Y							HP removed
99	3228BA/MK/	7	B		Siteshini	11	20/05/03	M.Mntuni	32 02 51	28 30 24	729	Y	Sub	Y				86	8.8	25	Private BH
100	3228BA/MK/	8	B		Ceku	11	21/05/03	V.Sigidi	32 00 13	28 34 43	554	N	none	Y							Dry borehole
101	3228BA/MK/	9	B		Sopam	11	21/05/03	Mr.Marais	32 00 32	28 34 17	630	Y	Sub	Y							Private BH, depth 110 m
102	3228BA/MK/	10	S		Lalini	11	21/05/03	V.Sigidi	32 00 55	28 31 24	607	Y			N	N	0.1	54	8	10	On slope, runoff water mixing with spring water
103	3228BA/MK/	11	S		Mfula	12	22/05/03		32 05 09	28 33 23	622	Y			N	N	7	48	8.1	50	Strong spring, used by 3 communities
104	3228BA/MK/	12	S		Mchemula	12	22/05/03	S.Masiko	32 05 36	28 33 47	621	Y			N	N	2	29	8.2	100	Strong spring
105	3228BA/MK/	13	B		Mfula	12	22/05/03	M.Masiko	32 05 36	28 34 04	637	N	Sub	Y							Private BH
106	3228AB/MK/	14	S		Mhala	5	22/05/03	S.Maqhude	32 00 51	28 23 40	666	Y			N	N	0.2	79	8.1	50	Sacred ground

ANNEXURE 3
SABS 241 – Water Quality Classifications

Water Quality
Based on South African Bureau of Standards SABS 241

SUBSTANCE	UNIT OF MEASURE	CLASS 0	CLASS 1	CLASS 2	CLASS 3
Faecal coliforms	counts/100ml	0		0 to 1	>10
Total disolved solids	mg/l	0 to 450	450 to 1000	1000 to 2450	>2450
Electrical conductivity	mS/s	0 to 70	70 to 150	150 to 370	>370
pH	pH units	6.0 to 9.0	5.0 to 6.0 9.0 to 9.5	4.0 to 5.0 9.5 to 10.0	<4.0 >10.0
Turbidity	NTU	0 to 1	1 to 5	5 to 10	>10
Arsenic	mg/lAs	0 to 0.01	0.01 to 0.005	0.05 to 0.2	>0.2
Cadmium	mg/lCd	0 to 0.005	0.005 to 0.01	0.01 to 0.02	>0.02
Calcium	mg/l$CaCo_3$	0 to 32	32	32 to 80	>80
Chloride	mg/lCl	0 to 100	100 to 200	200 to 600	>600
Fluoride	mg/lF	0 to 1.0	1.0 to 5.0	1.5 to 3.5	>3.5
Iron	mg/lFe	0 to 0.1	0.1 to 0.2	0.2 to 2.0	>2.0
Magnesium	mg/lMg	0 to 30	30 to 70	70 to 100	>100
Manganese	mg/lMn	0 to 0.05	0.5 to 0.1	0.1 ro 1.0	>10
Nitrate	mg/lN	0 to 6	6 to 10	10 to 20	>20
Potassium	mg/lK	0 to 50	50 to 100	100 to 400	>400
Sodium	mg/lNa	0 to 100	100 to 200	200 to 400	>400
Sulphate	mg/lSO_4	0 to 200	200 to 400	400 to 600	>600
Zinc	mg/l	0 to 3	3 to 5	5 to 10	>10

Note:

Class 0 = water of ideal quality
Class 1 = good quality water
Class 2 = safe for short term use
Class 3 = unacceptable water quality

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Certificate of Analysis

Submitted By: Ms. Kirsten Torr
Date Received: 01 July, 2003
Date Reported: 17 July, 2003

Certificate No: ABPUMPS_23 01-07-2003

A.B. Pumps
99 Main Road
Gonubie
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abpumps@mweb.co.za

All samples were analysed according to approved "Standard Methods"
Chemical results in milligrams per litre (unless otherwise stated)

SAMPLE NO:	16271
	A. B. Pumps
SAMPLE DESCRIPTION:	3128 CD-SN-001 Silityiwa
	3128CD00129
SAMPLED DATE:	01/07/2003
COMMENTS	
(Nitrate & Nitrite) as N	7.3
Alkalinity	368
Ammonia as N	0.19
Calcium as Ca	138
Chloride as Cl	558
Conductivity (mS/m)	259
Faecal coliforms count (CFU / 100ml)	0
Fluoride as F	0.83
Hardness (calcium)	345
Hardness (magnesium)	338
Hardness (total)	683
Iron (total) as Fe (µg/l)	167
Lead as Pb (µg/l)	<30
Magnesium as Mg	82
pH (pH units)	7.00
Potassium as K	6.3
Sodium as Na	316
Solids - dissolved	1300
Sulphate as SO4	43
Temperature (°C)	19.4
Total coliform bacteria (count / 100ml)	0
Turbidity (NTU)	1.9

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Submitted By: Ms. Kirsten Torr
Date Received: 04 July, 2003
Date Reported: 16 July, 2003

Certificate No: ABPUMPS_2304-07-2003

All samples were analysed according to approved "Standard Methods"
Chemical results in milligrams per litre (unless otherwise stated)

SAMPLE NO:	16345	16346
	A. B. Pumps	A. B. Pumps
SAMPLE DESCRIPTION:	3128CD/SN/004 - Matolwani	3128/DCSN/005 - Mhuku
SAMPLED DATE:	04/07/2003	04/07/2003
COMMENTS	3128CD00132	3128CD00133
(Nitrate & Nitrite) as N	11	6.2
Alkalinity	254	334
Ammonia as N	0.20	0.03
Calcium as Ca	342	59
Chloride as Cl	601	176
Conductivity (mS/m)	556	125
Faecal coliforms count (CFU / 100ml)	0	0
Fluoride as F	0.61	0.57
Hardness (calcium)	854	147
Hardness (magnesium)	931	144
Hardness (total)	1785	291
Iron (total) as Fe (µg/l)	19514	679
Lead as Pb (µg/l)	<30	<30
Magnesium as Mg	226	35
pH (pH units)	7.11	7.39
Potassium as K	20	2.1
Sodium as Na	511	140
Solids - dissolved	2790	624
Sulphate as SO4	103	28
Temperature (°C)	21.3	21.6
Total coliform bacteria (count / 100ml)	0	4
Turbidity (NTU)	126	1.1

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Certificate of Analysis

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Submitted By: Ms. Kirsten Torr
Date Received: 08 July, 2003
Date Reported: 17 July, 2003

Certificate No: ABPUMPS_2308-07-2003

All samples were analysed according to approved "Standard Methods"
Chemical results in milligrams per litre (unless otherwise stated)

SAMPLE NO:	16390	16391	16392
	A. B. Pumps	A. B. Pumps	A. B. Pumps
SAMPLE DESCRIPTION:	3128CD/SN/008 - Matholeni	3228A/B/SN/009 - Callisa / Doti	3128/DCSN/007 - Candu
SAMPLED DATE:	08/07/2003	08/07/2003	08/07/2003
COMMENTS	3128CD00136	3228AB00075	3128CD00135
(Nitrate & Nitrite) as N	5.4	0.97	0.94
Alkalinity	424	405	437
Ammonia as N	0.04	0.04	0.06
Calcium as Ca	118	100	121
Chloride as Cl	285	402	423
Conductivity (mS/m)	164	201	196
Faecal coliforms count (CFU / 100ml)	0	1	0
Fluoride as F	0.82	0.51	0.60
Hardness (calcium)	295	250	302
Hardness (magnesium)	198	259	247
Hardness (total)	493	509	549
Iron (total) as Fe (µg/l)	842	513	661
Lead as Pb (µg/l)	<30	<30	<30
Magnesium as Mg	48	63	60
pH (pH units)	7.83	7.26	7.11
Potassium as K	2.3	1.5	1.6
Sodium as Na	168	265	245
Solids - dissolved	821	1010	981
Sulphate as SO4	28	31	11
Temperature (°C)	20.2	21.2	20.9
Total coliform bacteria (count / 100ml)	27	1	0
Turbidity (NTU)	1.1	0.60	1.1

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Scientific Services Division

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Certificate of Analysis

Submitted By: Ms. Kirsten Torr
Date Received: 09 July, 2003
Date Reported: 17 July, 2003

Certificate No: ABPUMPS_2309-07-2003

A.B. Pumps
99 Main Road
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043 - 7321422
abpumps@mweb.co.za

All samples were analysed according to approved "Standard Methods"
Chemical results in milligrams per litre (unless otherwise stated)

SAMPLE NO:	16448	16449
	A. B. Pumps	A. B. Pumps
SAMPLE DESCRIPTION:	3128DC/SN/006 - Nywara	3228CD/SN/010 - Lencane
SAMPLED DATE:	09/07/2003	09/07/2003
COMMENTS	3128CD00134	3228AB00076
(Nitrate & Nitrite) as N	9.0	3.7
Alkalinity	312	239
Ammonia as N	<0.01	<0.01
Calcium as Ca	66	39
Chloride as Cl	130	185
Conductivity (mS/m)	95	96
Faecal coliforms count (CFU / 100ml)	0	0
Fluoride as F	0.22	0.35
Hardness (calcium)	165	97
Hardness (magnesium)	115	103
Hardness (total)	280	200
Iron (total) as Fe (µg/l)	1106	758
Lead as Pb (µg/l)	<30	<30
Magnesium as Mg	28	25
pH (pH units)	7.22	7.09
Potassium as K	2.7	0.68
Sodium as Na	92	118
Solids - dissolved	479	481
Sulphate as SO4	15	<3
Temperature (°C)	21.2	21.3
Total coliform bacteria (count / 100ml)	3	0
Turbidity (NTU)	1.3	2.1

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Submitted By: Ms. Kirsten Torr
Date Received: 11 July, 2003
Date Reported: 18 July, 2003

Certificate No: ABPUMPS_23 11-07-2003

All samples were analysed according to approved "Standard Methods"
Chemical results in milligrams per litre (unless otherwise stated)

SAMPLE NO:	16501	16502
	A. B. Pumps	A. B. Pumps
SAMPLE DESCRIPTION:	3228/AB/SN/011 - Qana	3228BA/SN/013 - Mnandi
SAMPLED DATE:	11/07/2003	11/07/2003
COMMENTS	3228AB00077	3228BA00032
(Nitrate & Nitrite) as N	<0.02	46
Alkalinity	246	133
Ammonia as N	0.12	0.11
Calcium as Ca	38	53
Chloride as Cl	82	102
Conductivity (mS/m)	60	81
Faecal coliforms count (CFU / 100ml)	0	0
Fluoride as F	0.72	0.27
Hardness (calcium)	95	132
Hardness (magnesium)	58	140
Hardness (total)	153	272
Iron (total) as Fe (µg/l)	<100	<100
Lead as Pb (µg/l)	<30	<30
Magnesium as Mg	14	34
pH (pH units)	7.75	7.16
Potassium as K	0.34	0.60
Sodium as Na	67	49
Solids - dissolved	300	404
Sulphate as SO4	8.8	11
Temperature (°C)	19.7	19.4
Total coliform bacteria (count / 100ml)	0	0
Turbidity (NTU)	0.52	0.75

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Certificate of Analysis

Submitted By: Ms. Kirsten Torr
Date Received: 15 July, 2003
Date Reported: 29 July, 2003

Certificate No: ABPUMPS_235-07-2003

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Chemical results in milligrams per litre (unless otherwise stated)
All samples were analysed according to approved "Standard Methods"

SAMPLE NO:	16561	16562	16563	16564	16565
	A. B. Pumps	A. B. Pumps	A. B. Pumps	A. B. Pumps	A. B. Pumps
SAMPLE DESCRIPTION:	016 - Sheshegu	012 - Fort Malan	017 - Mamfanen	015 - Kuvinindwa	014 - Kwatonzi
SAMPLED DATE:	15/07/2003	15/07/2003	15/07/2003	15/07/2003	15/07/2003
COMMENTS					
(Nitrate & Nitrite) as N	3.0	10	1.1	3.7	6.6
Alkalinity	271	104	374	308	248
Ammonia as N	0.19	0.20	0.12	0.22	0.19
Calcium as Ca	64	23	73	84	55
Chloride as Cl	202	29	353	308	120
Conductivity (mS/m)	115	31	153	166	82
Faecal coliforms count (CFU / 100ml)	0	8	3	0	0
Fluoride as F	0.53	0.44	0.45	0.63	0.50
Hardness (calcium)	160	57	182	210	137
Hardness (magnesium)	107	38	49	778	78
Hardness (total)	267	95	231	988	215

	16561	16562	16563	16564	16565
	A. B. Pumps	A. B. Pumps	A. B. Pumps	A. B. Pumps	A. B. Pumps
	016 - Shashegu	012 - Fort Malan	017 - Mamfanen	015 - Kuvinindwa	014 - Kwalenzi
	15/07/2003	15/07/2003	15/07/2003	15/07/2003	15/07/2003
Iron (total) as Fe (µg/l)	181	2406	239	1280	310
Lead as Pb (µg/l)	<30	<30	<30	<30	<30
Magnesium as Mg	26	9.3	12	189	19
pH (pH units)	7.36	7.79	7.38	7.48	7.60
Potassium as K	1.6	0.79	1.2	4.5	1.3
Sodium as Na	127	28	146	187	101
Solids - dissolved	575	156	766	833	409
Sulphate as SO4	3.2	<3	10	37	<3
Temperature (°C)	19.0	19.4	19.6	19.5	19.0
Total coliform bacteria (count / 100ml)	0	19	10	4	0
Turbidity (NTU)	0.53	14	0.27	17	1.9

Verified By: ..... Chemist Date: .....

Authorized By: ..... Scientific Services Manager Date: .....

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Submitted By: Ms. Kirsten Torr
Date Received: 21 July, 2003
Date Reported: 29 July, 2003

Certificate No: ABPUMPS_2321-07-2003

All samples were analysed according to approved "Standard Methods"
Chemical results in milligrams per litre (unless otherwise stated)

SAMPLE NO:	16664
	A. B. Pumps
SAMPLE DESCRIPTION:	3228AB/SN/020 - Tafoni
SAMPLED DATE:	21/07/2003
COMMENTS	3228AB000082
(Nitrate & Nitrite) as N	6.8
Alkalinity	95
Ammonia as N	0.18
Calcium as Ca	15
Chloride as Cl	17
Conductivity (mS/m)	27
Faecal coliforms count (CFU / 100ml)	0
Fluoride as F	0.09
Hardness (calcium)	37
Hardness (magnesium)	37
Hardness (total)	74
Iron (total) as Fe (µg/l)	172
Lead as Pb (µg/l)	<30
Magnesium as Mg	8.9
pH (pH units)	7.01
Potassium as K	3.1
Sodium as Na	21
Solids - dissolved	136
Sulphate as SO4	18
Temperature (°C)	19.2
Total coliform bacteria (count / 100ml)	0
Turbidity (NTU)	0.32

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Submitted By: Ms. Kirsten Torr
Date Received: 24 July, 2003
Date Reported: 31 July, 2003

Certificate No: ABPUMPS_23 24-07-2003

All samples were analysed according to approved "Standard Methods"
Chemical results in milligrams per litre (unless otherwise stated)

SAMPLE NO:	16726	16727	16728
	A. B. Pumps	A. B. Pumps	A. B. Pumps
SAMPLE DESCRIPTION:	021 - Cungwani	022 - Tyebeledenbe	023 - Ebonde
SAMPLED DATE:	24/07/2003	24/07/2003	24/07/2003
COMMENTS			
(Nitrate & Nitrite) as N	6.1	8.9	0.03
Alkalinity	112	107	192
Ammonia as N	0.16	0.16	0.18
Calcium as Ca	27	27	31
Chloride as Cl	54	49	162
Conductivity (mS/m)	41	42	83
Faecal coliforms count (CFU / 100ml)	0	0	0
Fluoride as F	0.20	0.13	0.55
Hardness (calcium)	67	67	77
Hardness (magnesium)	49	49	78
Hardness (total)	116	116	155
Iron (total) as Fe (µg/l)	197	184	425
Lead as Pb (µg/l)	<30	<30	<30
Magnesium as Mg	12	12	19
pH (pH units)	7.32	7.35	8.26
Potassium as K	0.72	0.72	0.93
Sodium as Na	39	36	101
Solids - dissolved	204	212	416
Sulphate as SO4	<3	<3	<3
Temperature (°C)	20.2	20.2	20.0
Total coliform bacteria (count / 100ml)	0	3	0
Turbidity (NTU)	0.55	0.49	3.1

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Submitted By: Ms. Kirsten Torr
Date Received: 28 July, 2003
Date Reported: 31 July, 2003

Certificate No: ABPUMPS_23 28-07-2003

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All samples were analysed according to approved "Standard Methods"
Chemical results in milligrams per litre (unless otherwise stated)

SAMPLE NO:	16760	16761	16762
	A. B. Pumps	A. B. Pumps	A. B. Pumps
SAMPLE DESCRIPTION:	024 - Umfula	025 - Mahlezana	019 - Mtovi
SAMPLED DATE:	28/07/2003	28/07/2003	28/07/2003
COMMENTS			
(Nitrate & Nitrite) as N	24	5.6	9.5
Alkalinity	93	157	111
Ammonia as N	0.17	0.17	0.17
Calcium as Ca	30	23	23
Chloride as Cl	64	60	50
Conductivity (mS/m)	51	44	39
Faecal coliforms count (CFU / 100ml)	0	0	0
Fluoride as F	0.05	0.14	0.08
Hardness (calcium)	75	57	57
Hardness (magnesium)	70	62	58
Hardness (total)	145	119	115
Iron (total) as Fe (µg/l)	272	240	118
Lead as Pb (µg/l)	<30	<30	<30
Magnesium as Mg	17	15	14
pH (pH units)	7.87	7.04	6.93
Potassium as K	0.92	1.1	0.51
Sodium as Na	40	46	32
Solids - dissolved	255	222	196
Sulphate as SO4	3.4	7.5	5.7
Temperature (°C)	19.9	19.8	19.8
Total coliform bacteria (count / 100ml)	2	0	2
Turbidity (NTU)	0.92	0.59	0.17

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Certificate of Analysis

Submitted By: Ms. Kirsten Torr
Date Received: 04 August, 2003
Date Reported: 15 August, 2003

Certificate No: ABPUMPS_23 04-08-2003

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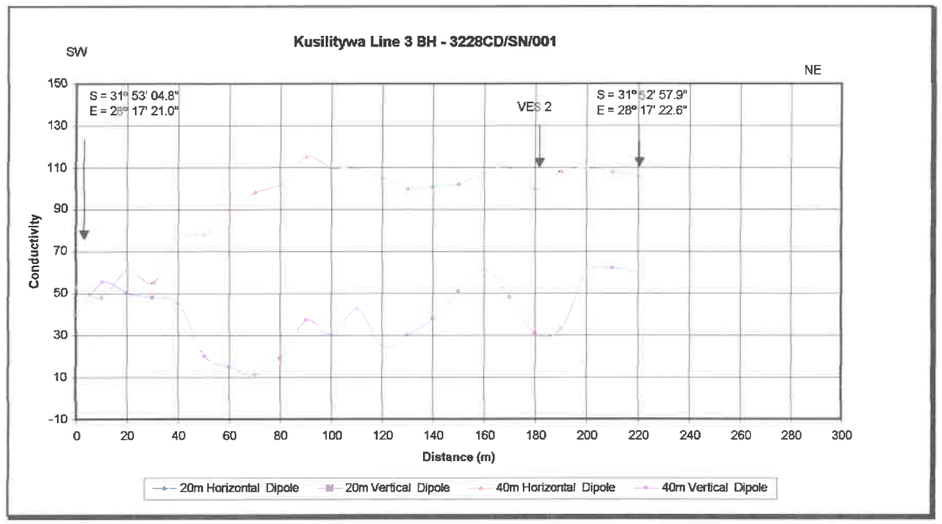
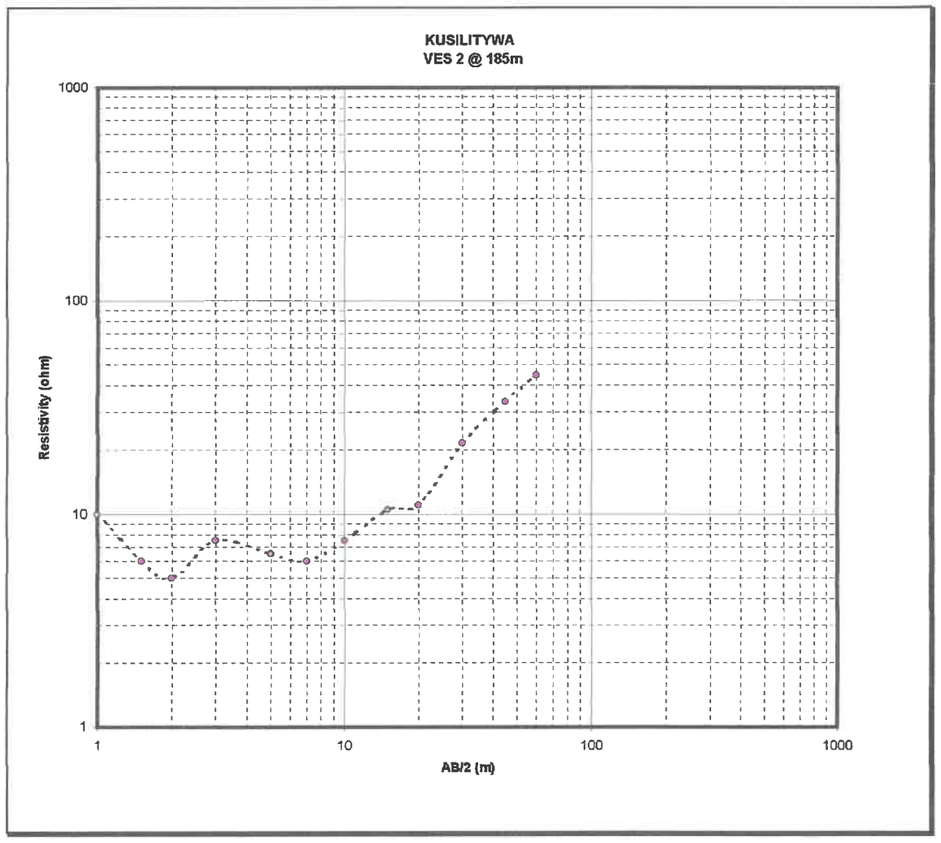
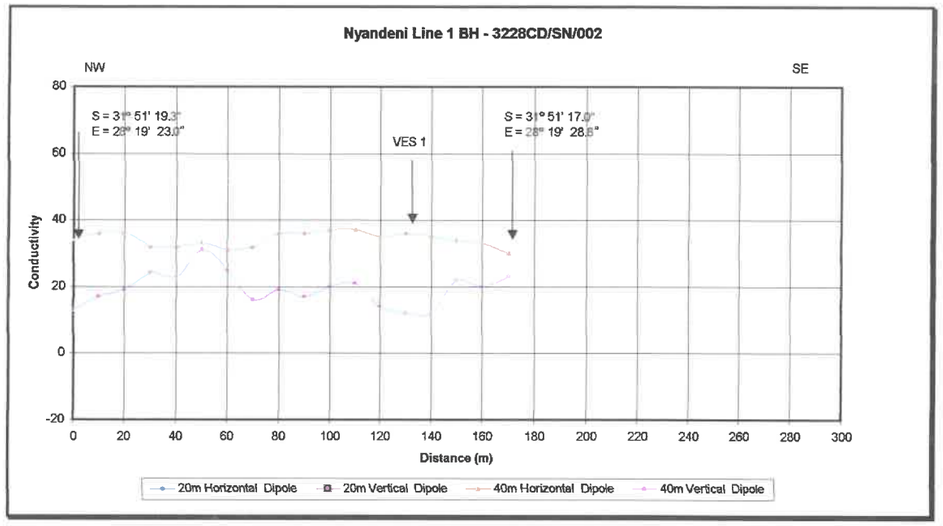
All samples were analysed according to approved "Standard Methods"
Chemical results in milligrams per litre (unless otherwise stated)

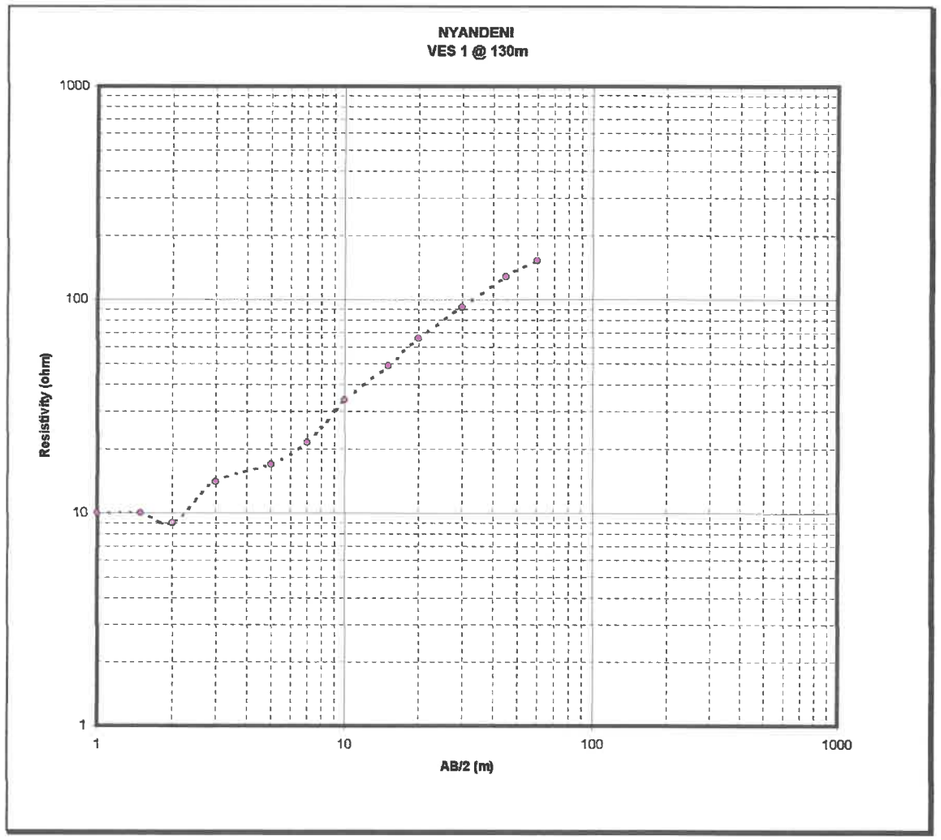
SAMPLE NO:	16858	16859	16860
	A. B. Pumps	A. B. Pumps	A. B. Pumps
SAMPLE DESCRIPTION:	026 - Kuchazela	027 - Falakahla	030 - Kucingo
SAMPLED DATE:	04/08/2003	04/08/2003	04/08/2003
COMMENTS	3228AB00086	3228AB00087	3228AB00090
(Nitrate & Nitrite) as N	3.0	9.4	3.7
Alkalinity	172	279	320
Ammonia as N	<0.01	<0.01	0.12
Calcium as Ca	53	71	105
Chloride as Cl	561	450	104
Conductivity (mS/m)	111	112	204
Faecal coliforms count (CFU / 100ml)	0	0	0
Fluoride as F	0.45	0.63	0.60
Hardness (calcium)	132	177	262
Hardness (magnesium)	136	181	243
Hardness (total)	268	358	505
Iron (total) as Fe (µg/l)	<100	198	1099
Lead as Pb (µg/l)	<30	<30	<30
Magnesium as Mg	33	44	59
pH (pH units)	7.67	7.40	7.44
Potassium as K	1.6	2.1	2.7
Sodium as Na	124	201	236
Solids - dissolved	554	559	1030
Sulphate as SO4	<3	8.7	27
Temperature (°C)	19.2	19.1	19.1
Total coliform bacteria (count / 100ml)	0	0	0
Turbidity (NTU)	3.7	3.3	17

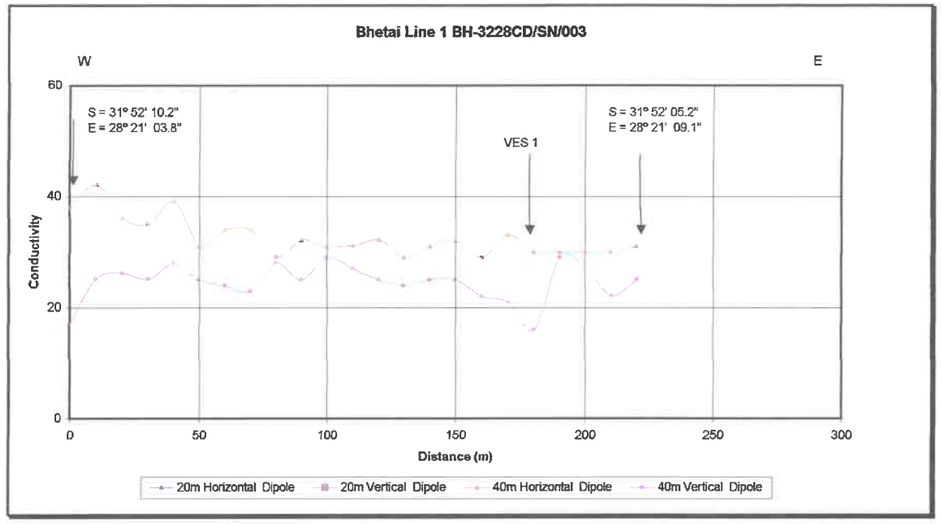
ANNEXURE 5
Geophysical Survey Results

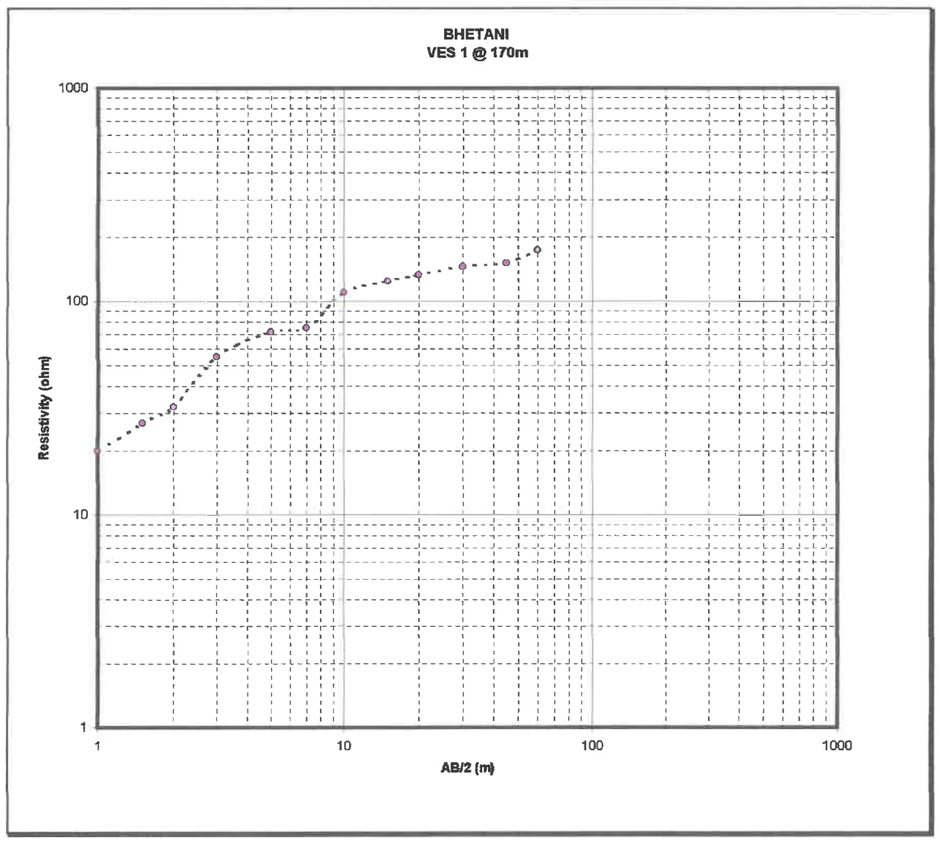

Kusilitywa Line 3 BH - 3228CD/SN/001
SW
NE
S = 31° 53' 04.8"
E = 28° 17' 21.0"
VES 2
S = 31° 52' 57.9"
E = 28° 17' 22.6"
Conductivity
150
130
110
90
70
50
30
10
-10
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
Distance (m)
20m Horizontal Dipole
20m Vertical Dipole
40m Horizontal Dipole
40m Vertical Dipole

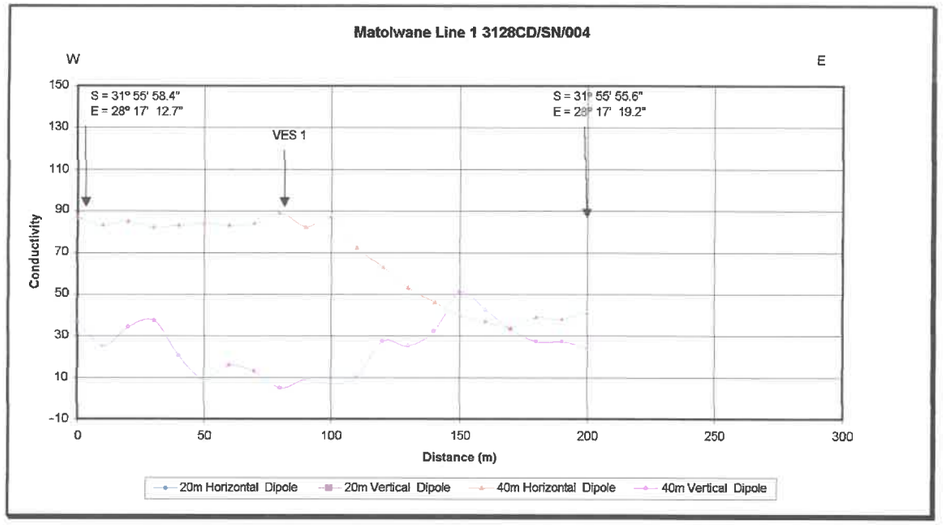

KUSILITYWA
VES 2 @ 185m
Resistivity (ohm)
1000
100
10
1
1
10
100
1000
AB/2 (m)

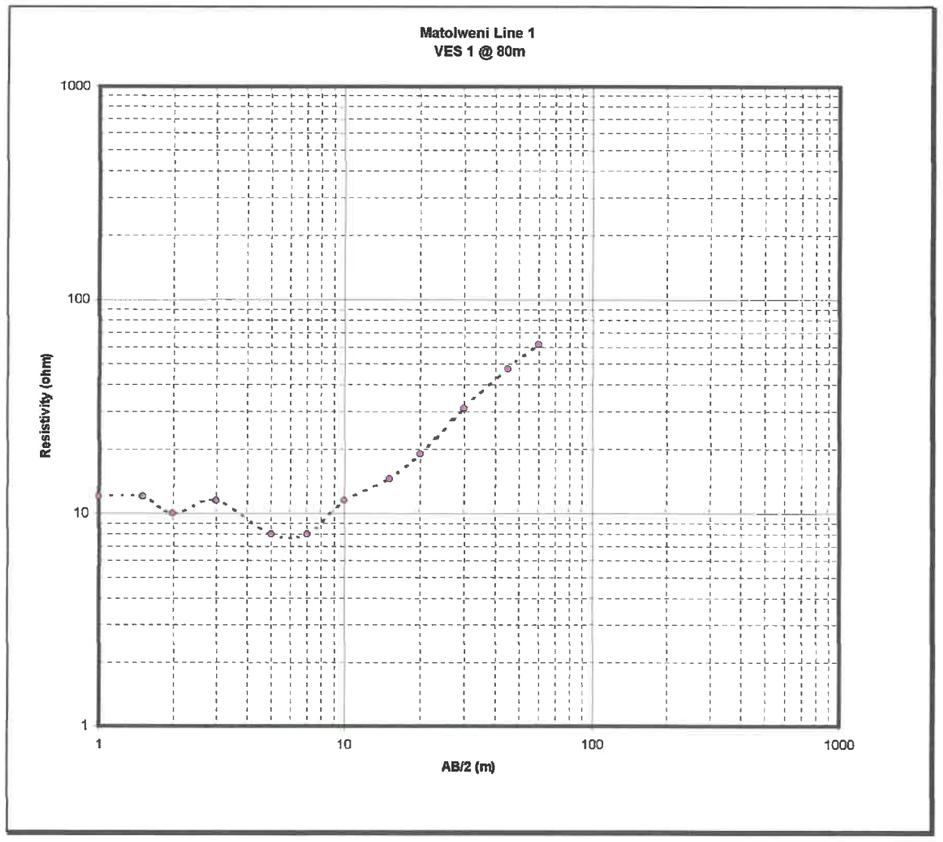

Nyandeni Line 1 BH - 3228CD/SN/002
NW
SE
S = 31° 51' 19.3"
E = 28° 19' 23.0"
VES 1
S = 31° 51' 17.0"
E = 28° 19' 28.5"
Conductivity
80
60
40
20
0
-20
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
Distance (m)
20m Horizontal Dipole
20m Vertical Dipole
40m Horizontal Dipole
40m Vertical Dipole

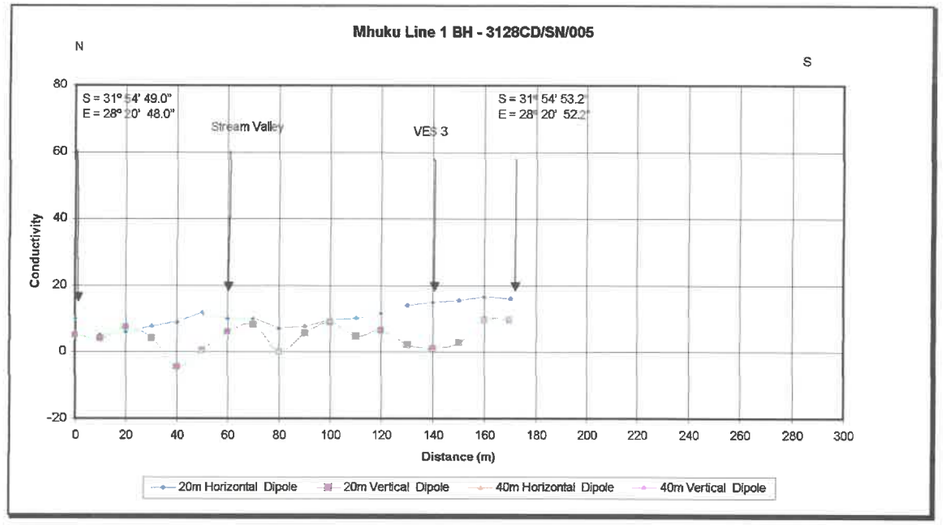

NYANDENI
VES 1 @ 130m
1000
100
10
1
Resistivity (ohm)
1
10
100
1000
AB/2 (m)

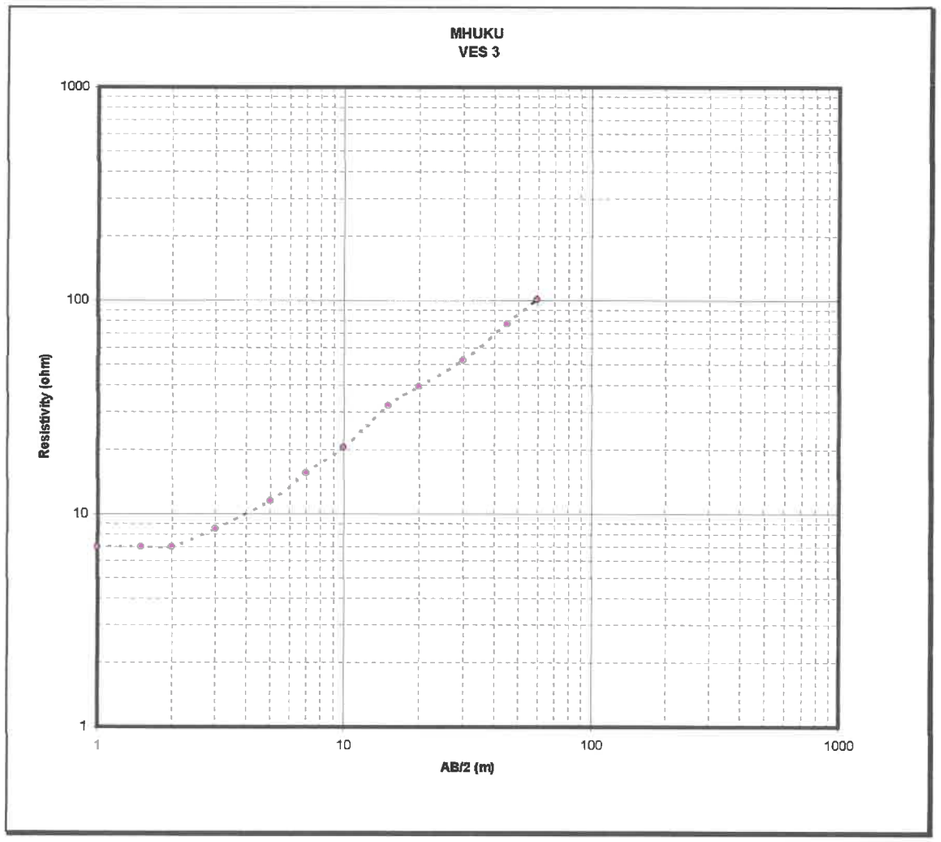

Bhetai Line 1 BH-3228CD/SN/003
W
E
S = 31° 52' 10.2"
E = 28° 21' 03.8"
VES 1
S = 31° 52' 05.2"
E = 28° 21' 09.1"
Conductivity
60
40
20
0
0
50
100
150
200
250
300
Distance (m)
20m Horizontal Dipole
20m Vertical Dipole
40m Horizontal Dipole
40m Vertical Dipole

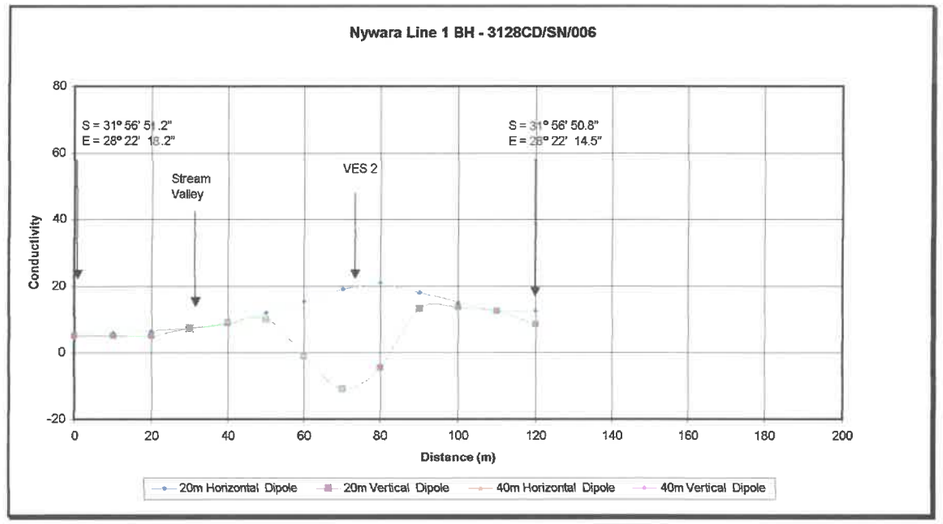

BHETANI
VES 1 @ 170m
1000
100
10
1
Resistivity (ohm)
1
10
100
1000
AB/2 (m)

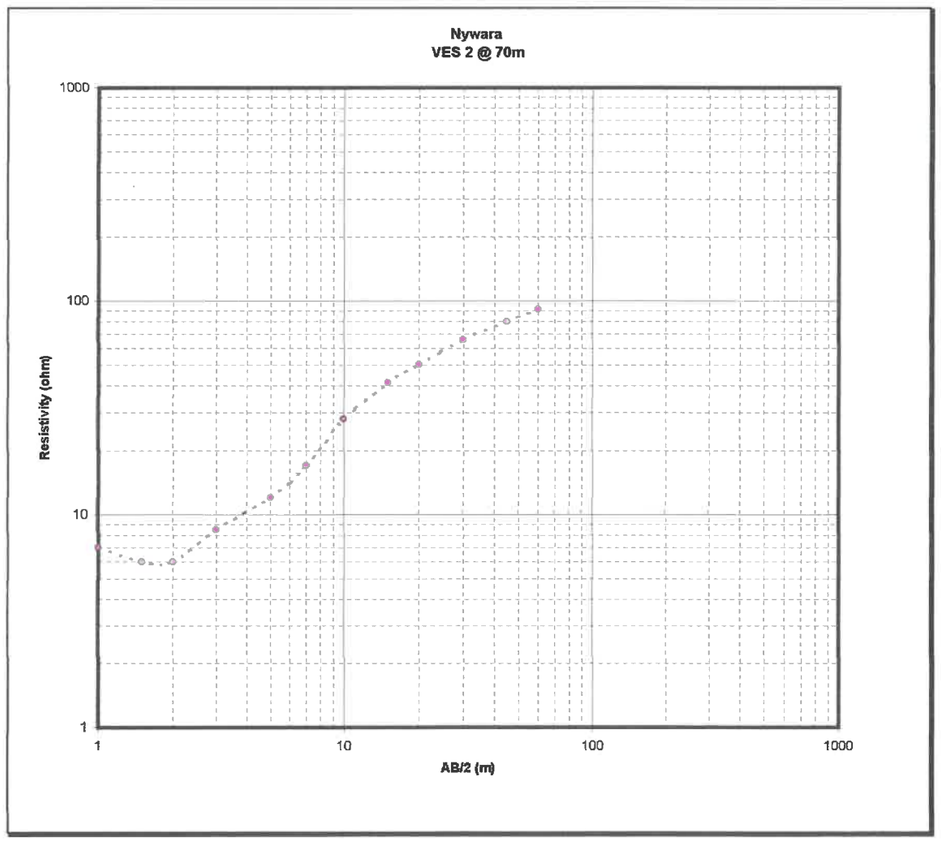

Matolwane Line 1 3128CD/SN/004
W
E
S = 31° 55' 58.4"
E = 28° 17' 12.7"
VES 1
S = 31° 55' 55.6"
E = 28° 17' 19.2"
Conductivity
150
130
110
90
70
50
30
10
-10
0
50
100
150
200
250
300
Distance (m)
20m Horizontal Dipole
20m Vertical Dipole
40m Horizontal Dipole
40m Vertical Dipole

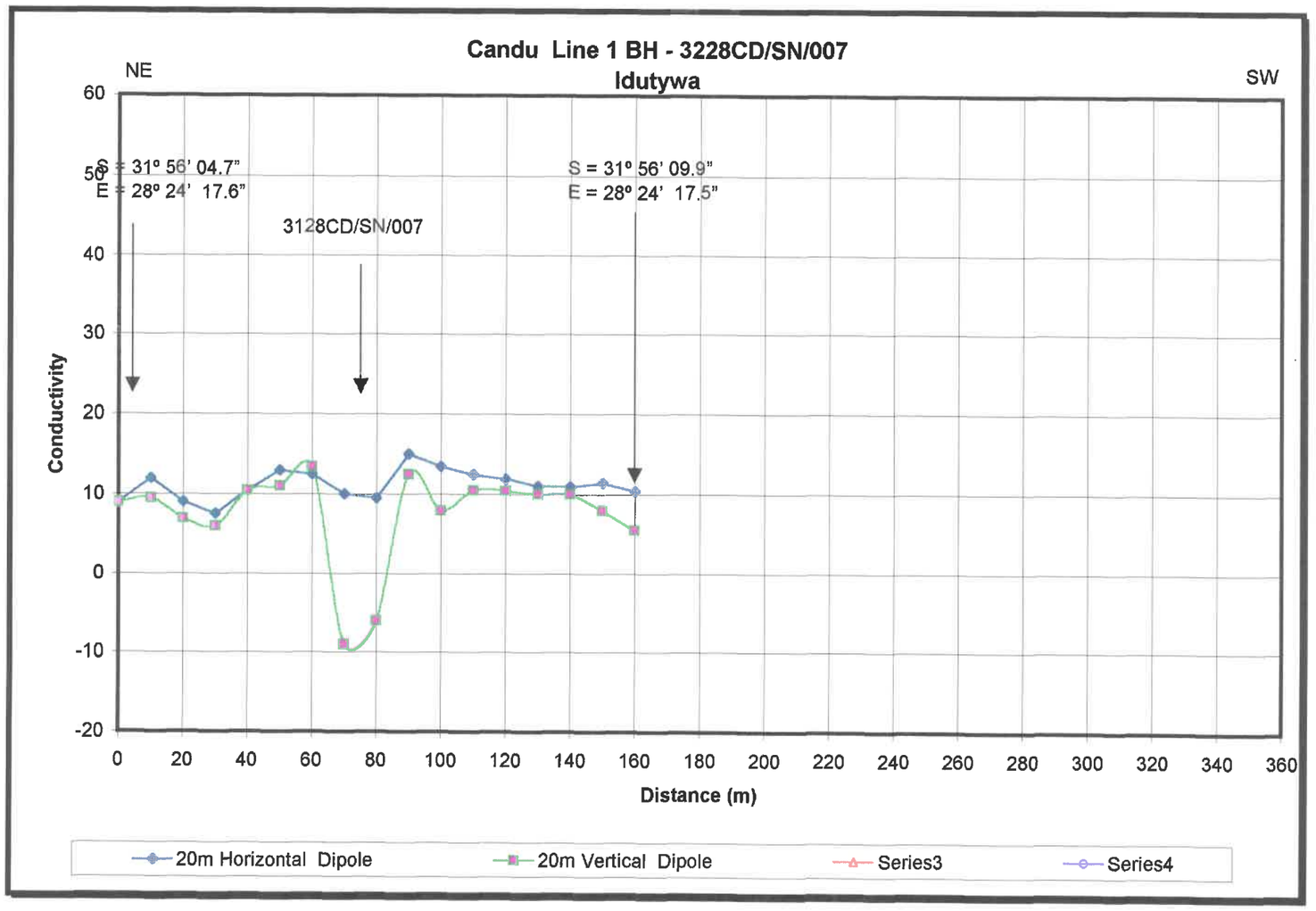

Matolweni Line 1
VES 1 @ 80m
1000
100
10
1
Resistivity (ohm)
1
10
100
1000
AB/2 (m)

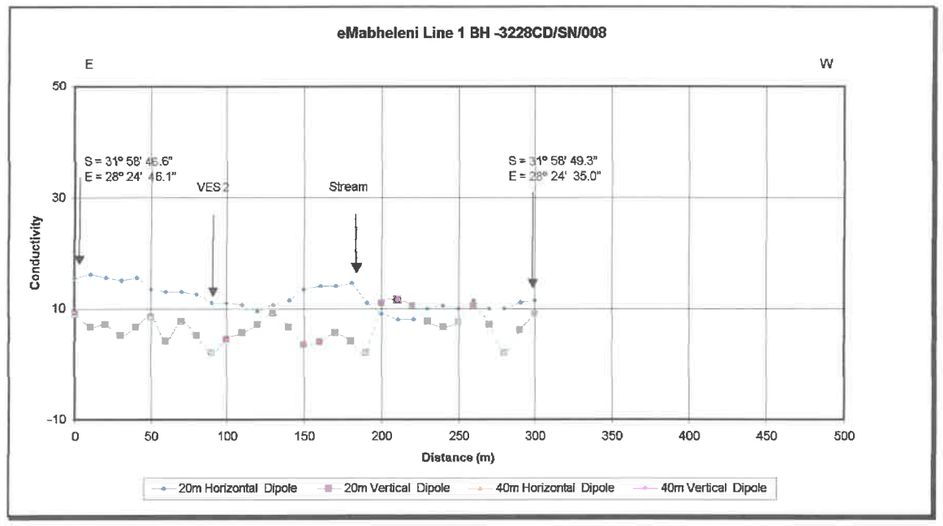

Mhuku Line 1 BH - 3128CD/SN/005
N
S
S = 31° 54' 49.0"
E = 28° 20' 48.0"
Stream Valley
VES 3
S = 31° 54' 53.2"
E = 28° 20' 52.2"
Conductivity
80
60
40
20
0
-20
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
Distance (m)
20m Horizontal Dipole
20m Vertical Dipole
40m Horizontal Dipole
40m Vertical Dipole

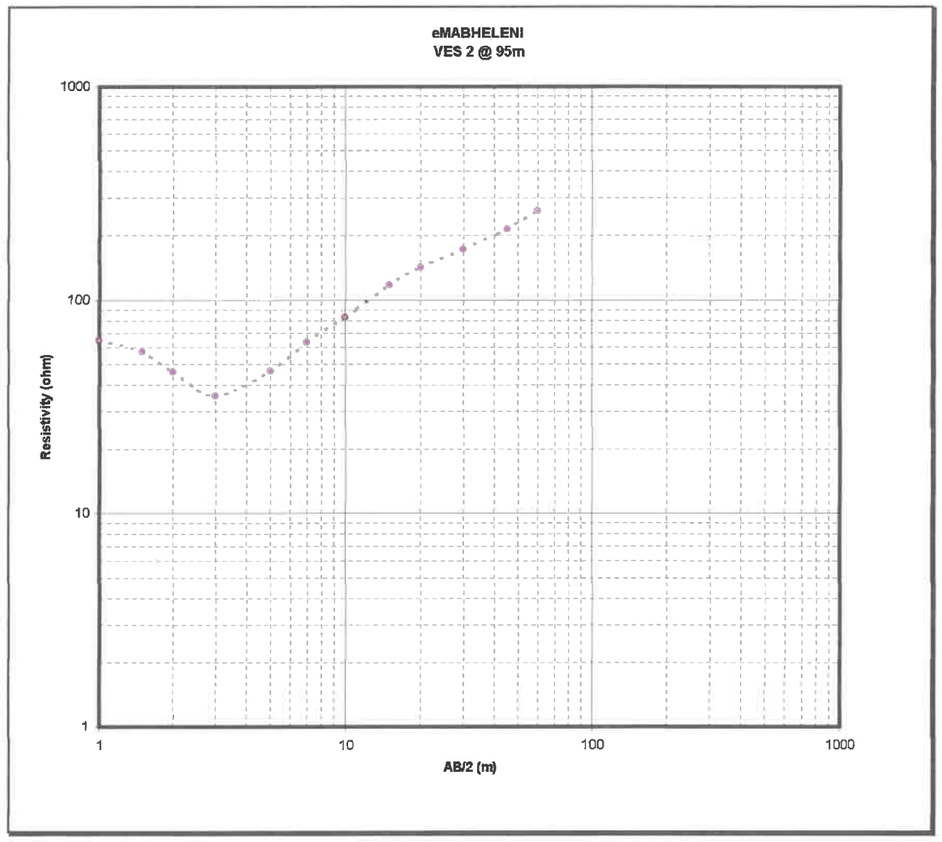

MHUKU
VES 3
1000
100
10
1
Resistivity (ohm)
1
10
100
1000
AB/2 (m)

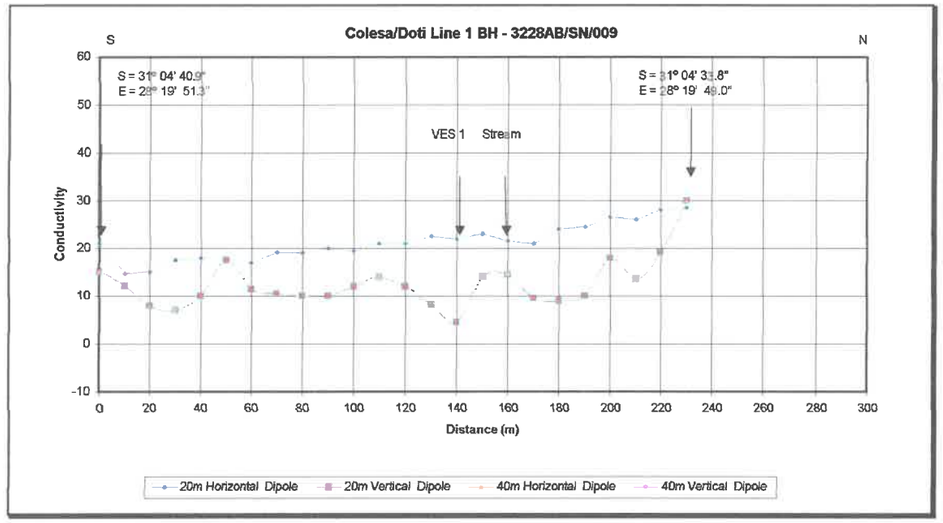

Nywara Line 1 BH - 3128CD/SN/006
S = 31° 56' 51.2"
E = 28° 22' 16.2"
Stream Valley
VES 2
S = 31° 56' 50.8"
E = 28° 22' 14.5"
Conductivity
80
60
40
20
0
-20
0
20
40
60
80
100
120
140
160
180
200
Distance (m)
20m Horizontal Dipole
20m Vertical Dipole
40m Horizontal Dipole
40m Vertical Dipole

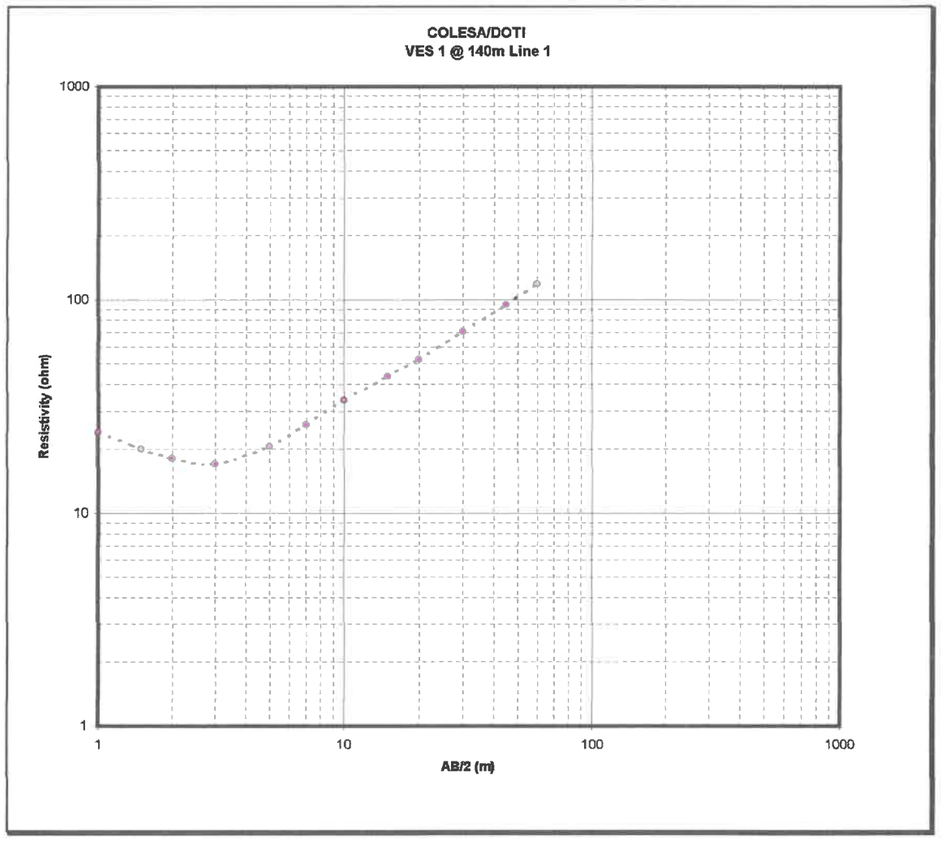

Nywara
VES 2 @ 70m
1000
100
10
1
Resistivity (ohm)
1
10
100
1000
AB/2 (m)

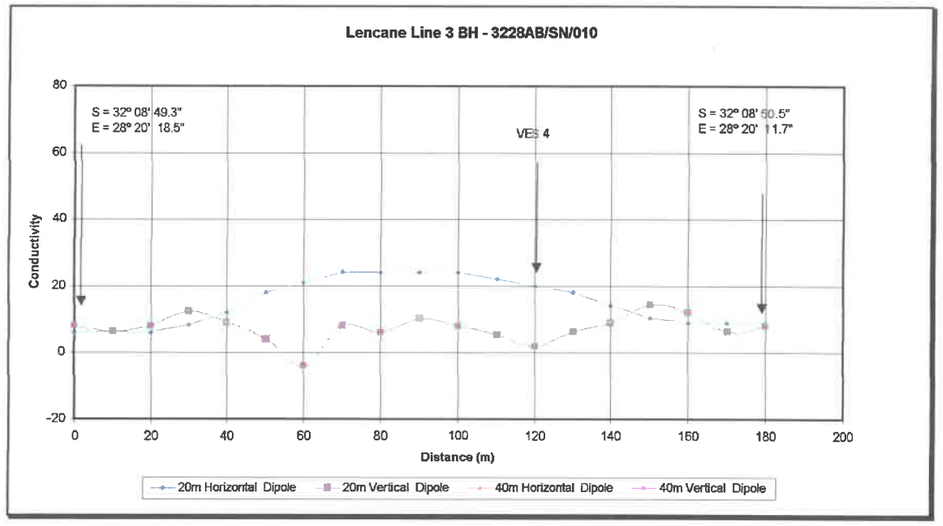

Candu Line 1 BH - 3228CD/SN/007
Idutywa
NE
SW
S = 31° 56' 04.7"
E = 28° 24' 17.6"
3128CD/SN/007
S = 31° 56' 09.9"
E = 28° 24' 17.5"
Conductivity
60
50
40
30
20
10
0
-10
-20
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320
340
360
Distance (m)
20m Horizontal Dipole
20m Vertical Dipole
Series3
Series4

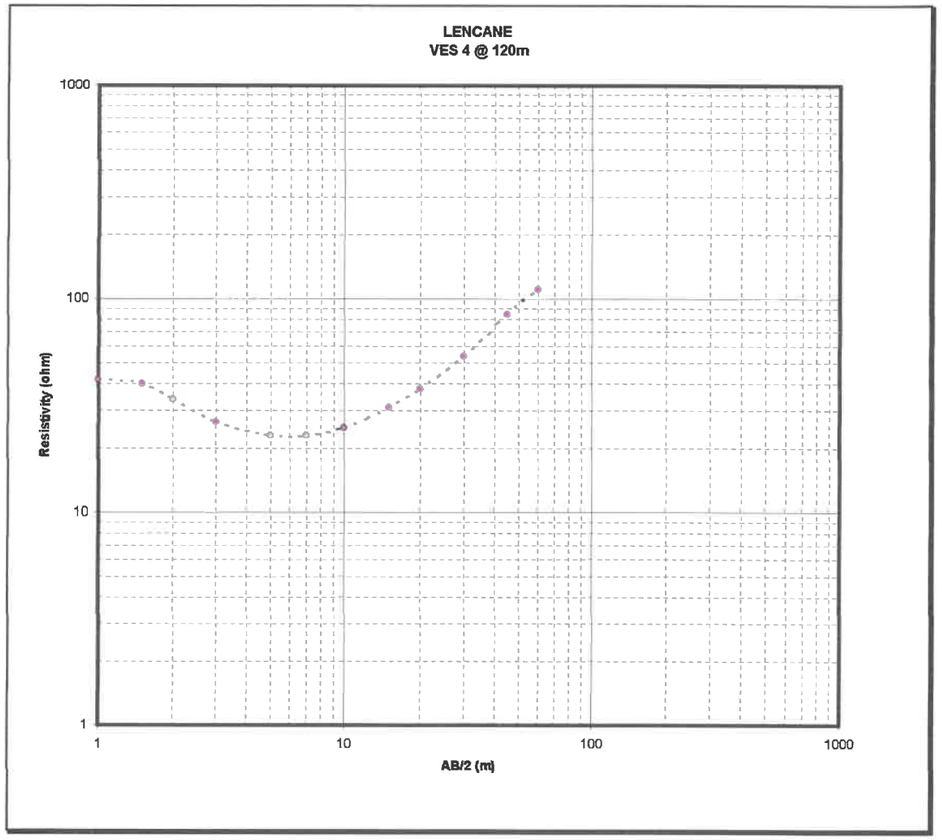

eMabheleni Line 1 BH -3228CD/SN/008
E
W
50
30
10
-10
Conductivity
S = 31° 58' 46.6"
E = 28° 24' 46.1"
VES 2
Stream
S = 31° 58' 49.3"
E = 28° 24' 35.0"
0
50
100
150
200
250
300
350
400
450
500
Distance (m)
20m Horizontal Dipole
20m Vertical Dipole
40m Horizontal Dipole
40m Vertical Dipole

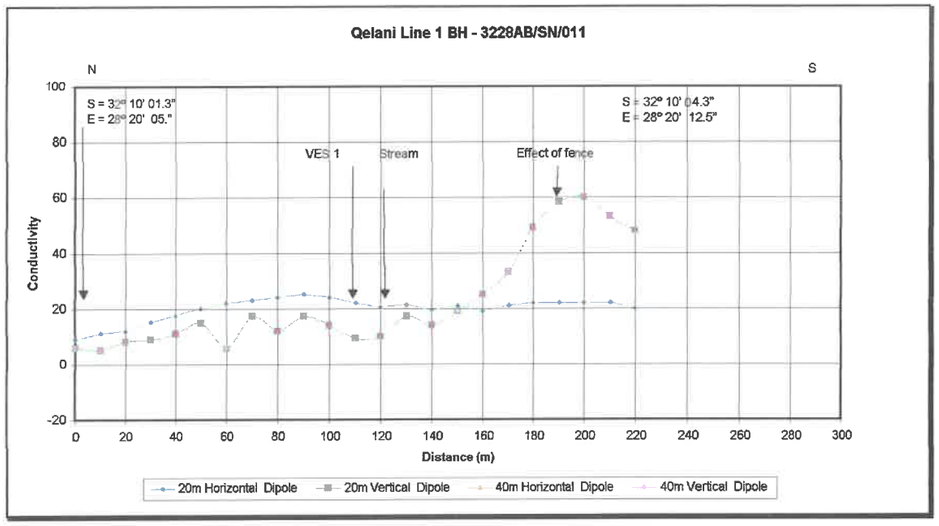

eMABHELENI
VES 2 @ 95m
1000
100
10
1
Resistivity (ohm)
1
10
100
1000
AB/2 (m)

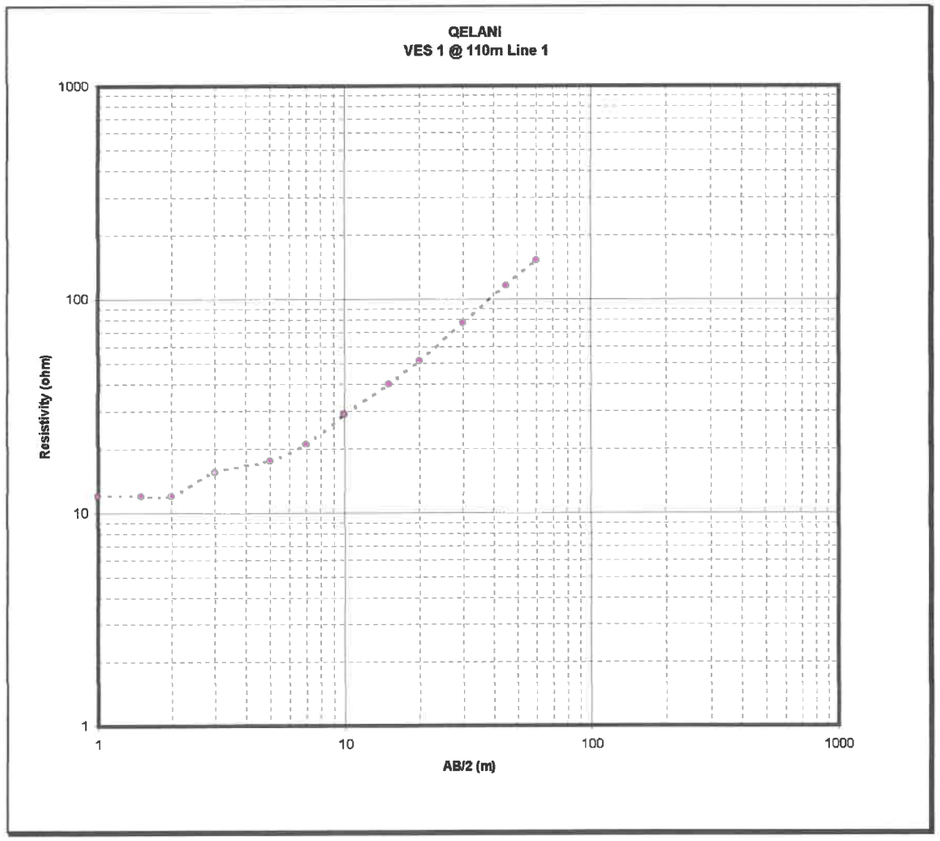

Colesa/Doti Line 1 BH - 3228AB/SN/009
S
N
S = 31° 04' 40.9"
E = 28° 19' 51.3"
S = 31° 04' 31.8"
E = 28° 19' 49.0"
VES 1
Stream
Conductivity
60
50
40
30
20
10
0
-10
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
Distance (m)
20m Horizontal Dipole
20m Vertical Dipole
40m Horizontal Dipole
40m Vertical Dipole

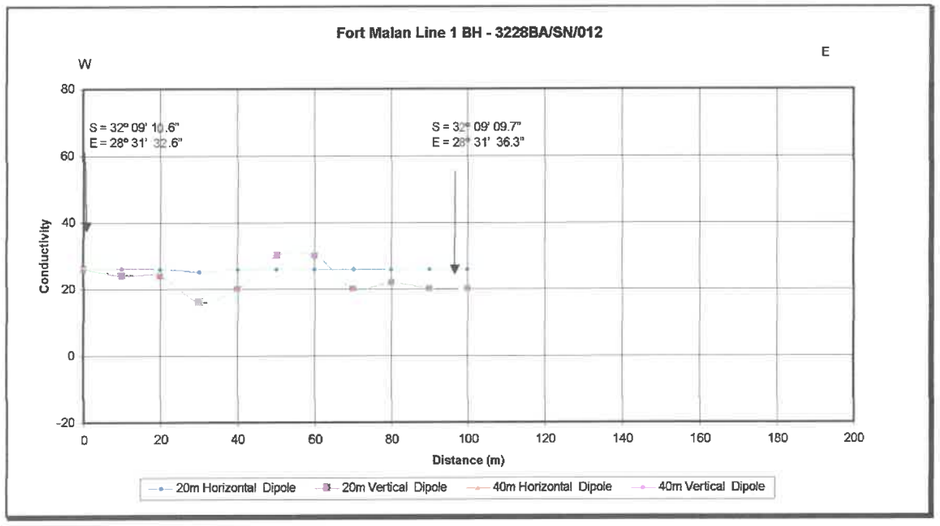

COLESA/DOTI
VES 1 @ 140m Line 1
1000
100
10
1
Resistivity (ohm)
1
10
100
1000
AB/2 (m)

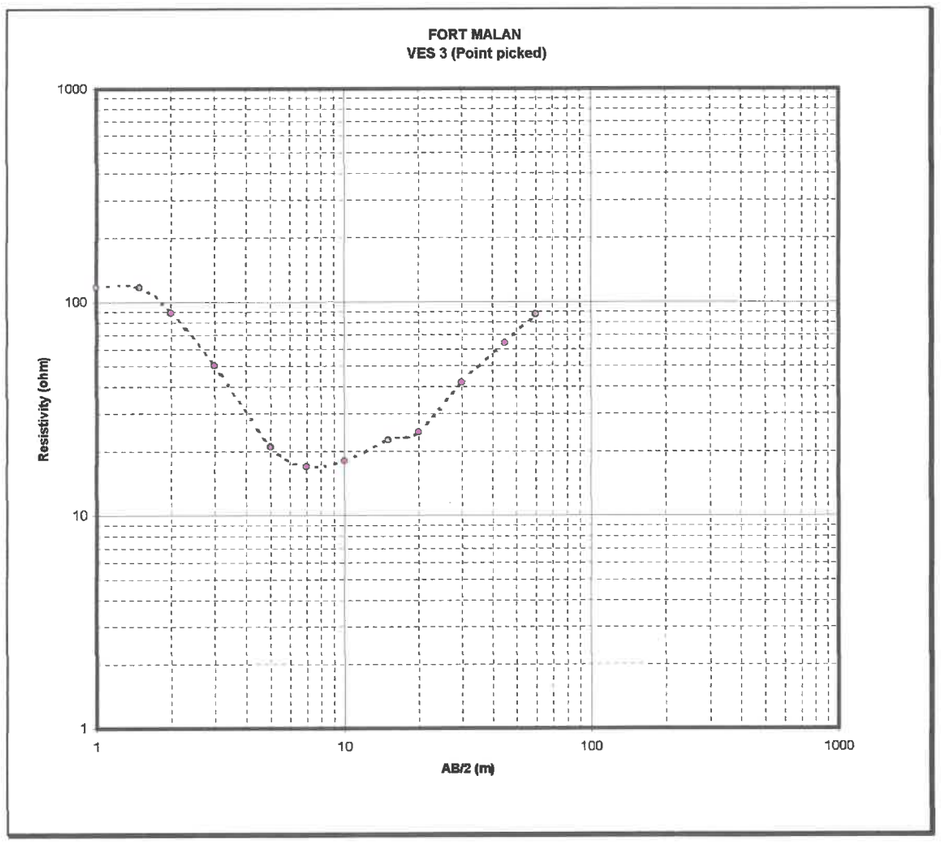

Lencane Line 3 BH - 3228AB/SN/010
S = 32° 08' 49.3"
E = 28° 20' 18.5"
VES 4
S = 32° 08' 50.5"
E = 28° 20' 11.7"
Conductivity
80
60
40
20
0
-20
0
20
40
60
80
100
120
140
160
180
200
Distance (m)
20m Horizontal Dipole
20m Vertical Dipole
40m Horizontal Dipole
40m Vertical Dipole

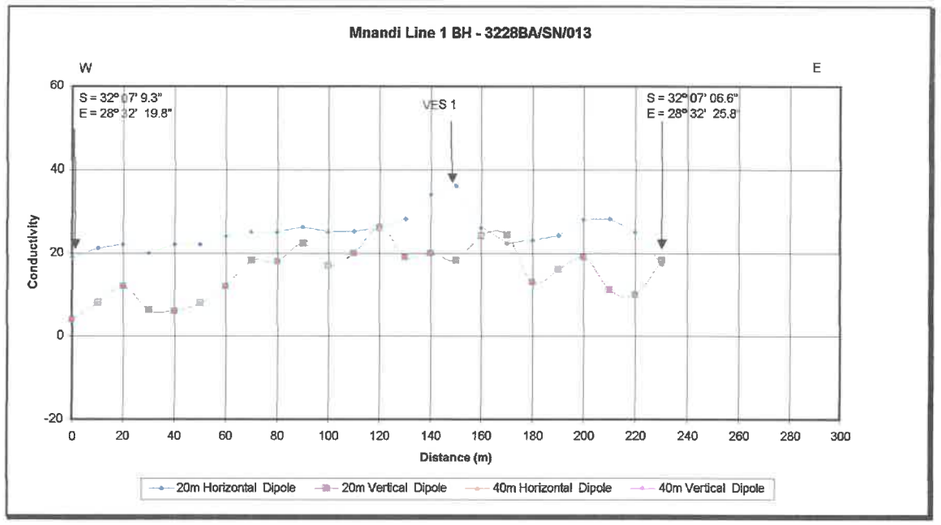

LENCANE
VES 4 @ 120m
1000
100
10
1
Resistivity (ohm)
1
10
100
1000
AB/2 (m)

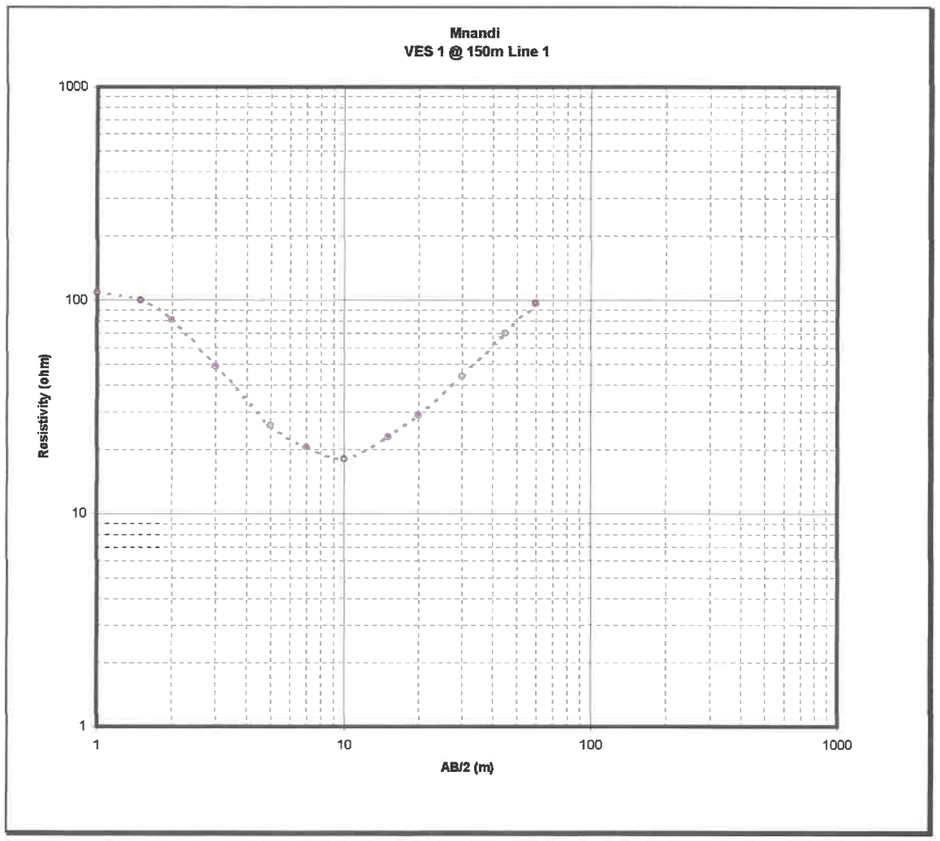

Qelani Line 1 BH - 3228AB/SN/011
N
S
S = 32° 10' 01.3"
E = 28° 20' 05."
S = 32° 10' 04.3"
E = 28° 20' 12.5"
VES 1
Stream
Effect of fence
Conductivity
100
80
60
40
20
0
-20
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
Distance (m)
20m Horizontal Dipole
20m Vertical Dipole
40m Horizontal Dipole
40m Vertical Dipole

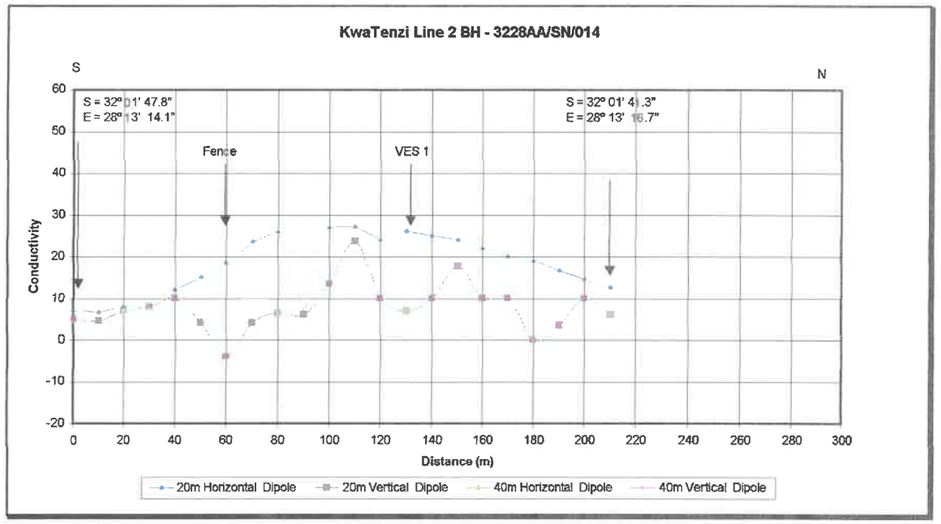

QELANI
VES 1 @ 110m Line 1
1000
100
10
1
Resistivity (ohm)
1
10
100
1000
AB/2 (m)

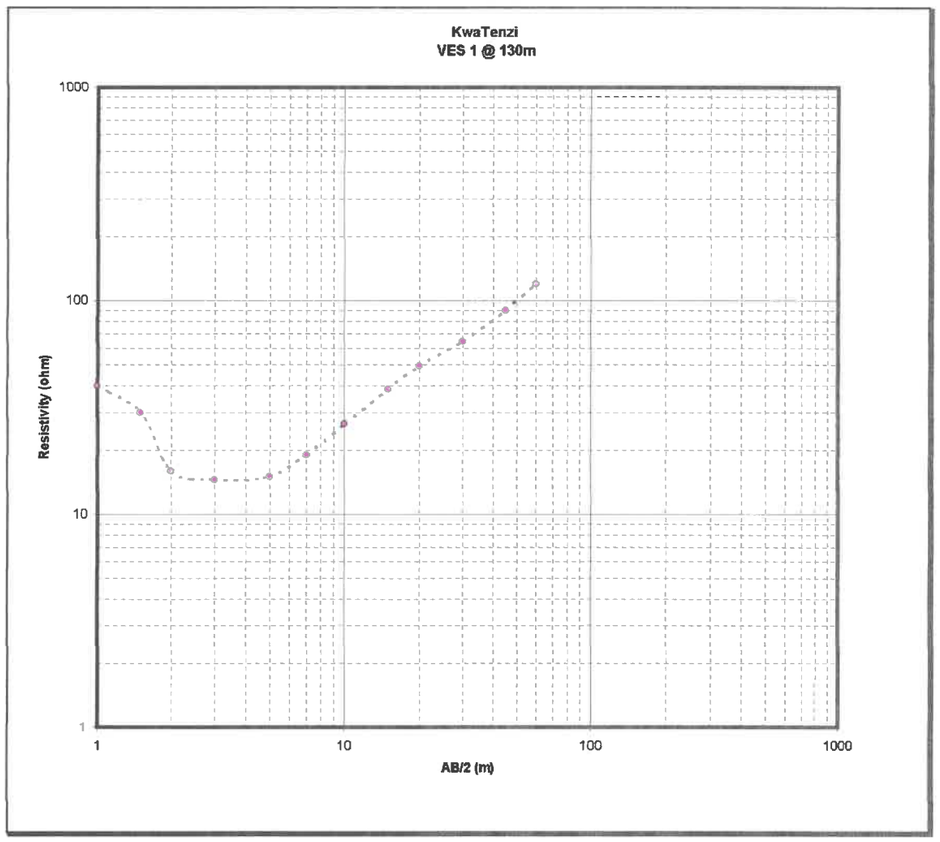

Fort Malan Line 1 BH - 3228BA/SN/012
W
E
S = 32º 09' 10.6"
E = 28º 31' 32.6"
S = 32º 09' 09.7"
E = 28º 31' 36.3"
Conductivity
80
60
40
20
0
-20
0
20
40
60
80
100
120
140
160
180
200
Distance (m)
20m Horizontal Dipole
20m Vertical Dipole
40m Horizontal Dipole
40m Vertical Dipole

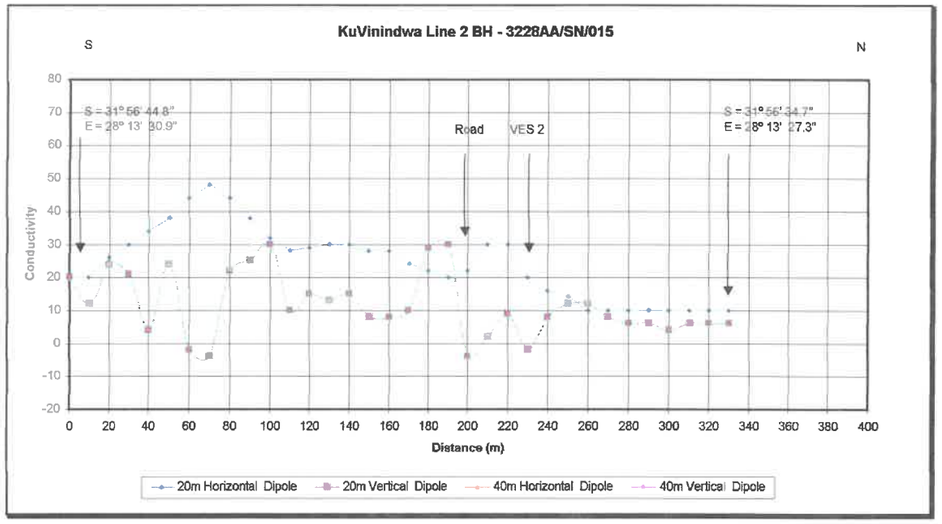

FORT MALAN
VES 3 (Point picked)
1000
100
10
1
Resistivity (ohm)
1
10
100
1000
AB/2 (m)

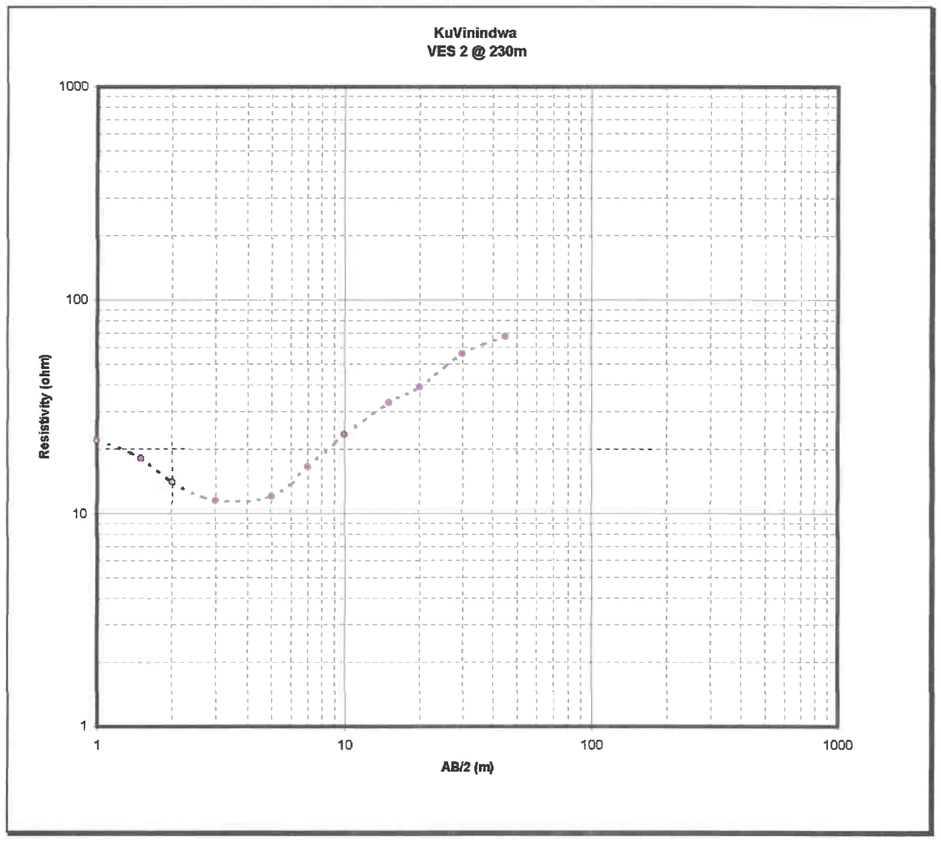

Mnandi Line 1 BH - 3228BA/SN/013
W
E
S = 32° 07' 9.3"
E = 28° 32' 19.8"
VES 1
S = 32° 07' 06.6"
E = 28° 32' 25.8'
Conductivity
60
40
20
0
-20
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
Distance (m)
20m Horizontal Dipole
20m Vertical Dipole
40m Horizontal Dipole
40m Vertical Dipole

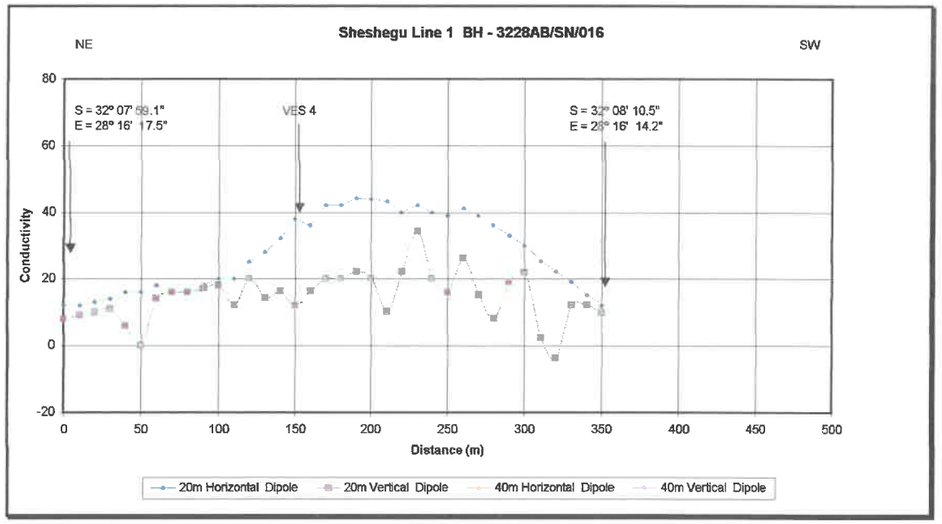

Mnandi
VES 1 @ 150m Line 1
1000
100
10
1
Resistivity (ohm)
1
10
100
1000
AB/2 (m)

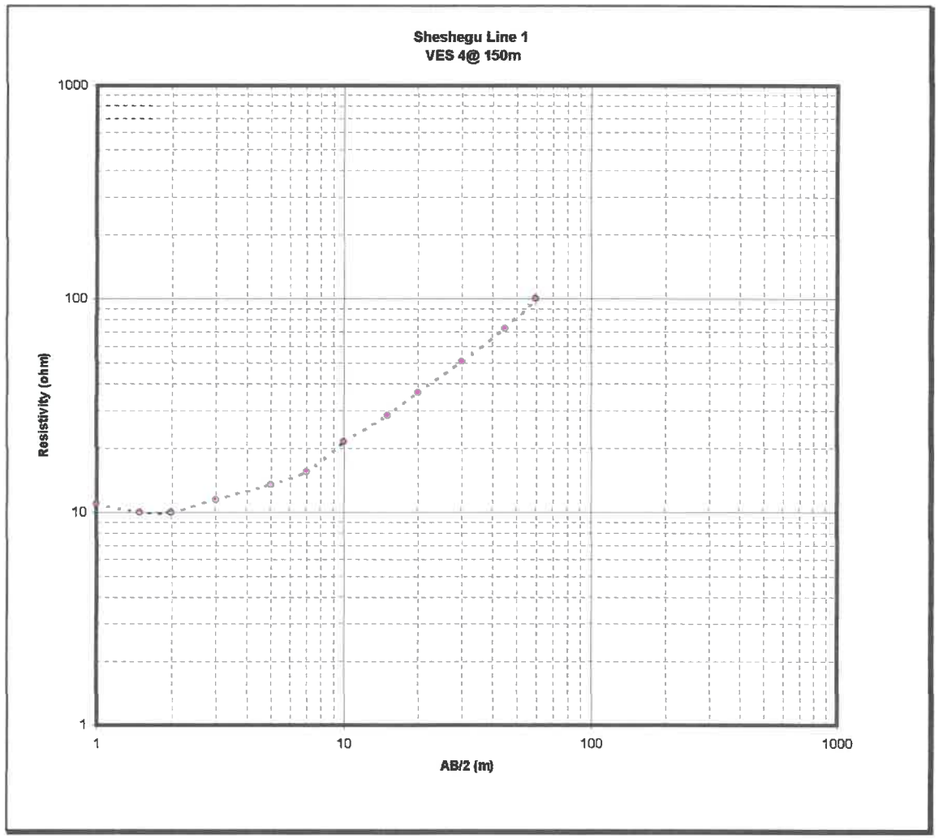

KwaTenzi Line 2 BH - 3228AA/SN/014
S
N
S = 32° 01' 47.8"
E = 28° 13' 14.1"
S = 32° 01' 41.3"
E = 28° 13' 16.7"
Fence
VES 1
Conductivity
60
50
40
30
20
10
0
-10
-20
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
Distance (m)
20m Horizontal Dipole
20m Vertical Dipole
40m Horizontal Dipole
40m Vertical Dipole

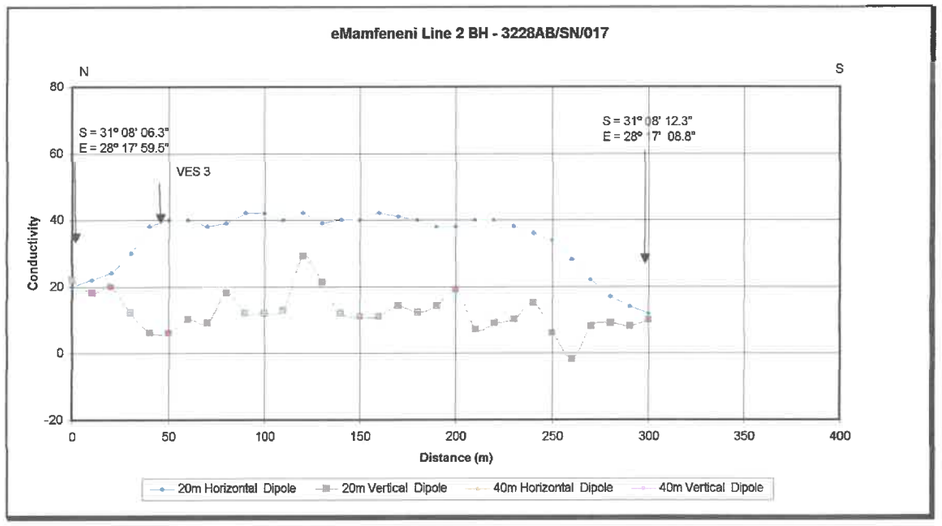

KwaTenzi
VES 1 @ 130m
1000
100
10
1
Resistivity (ohm)
1
10
100
1000
AB/2 (m)

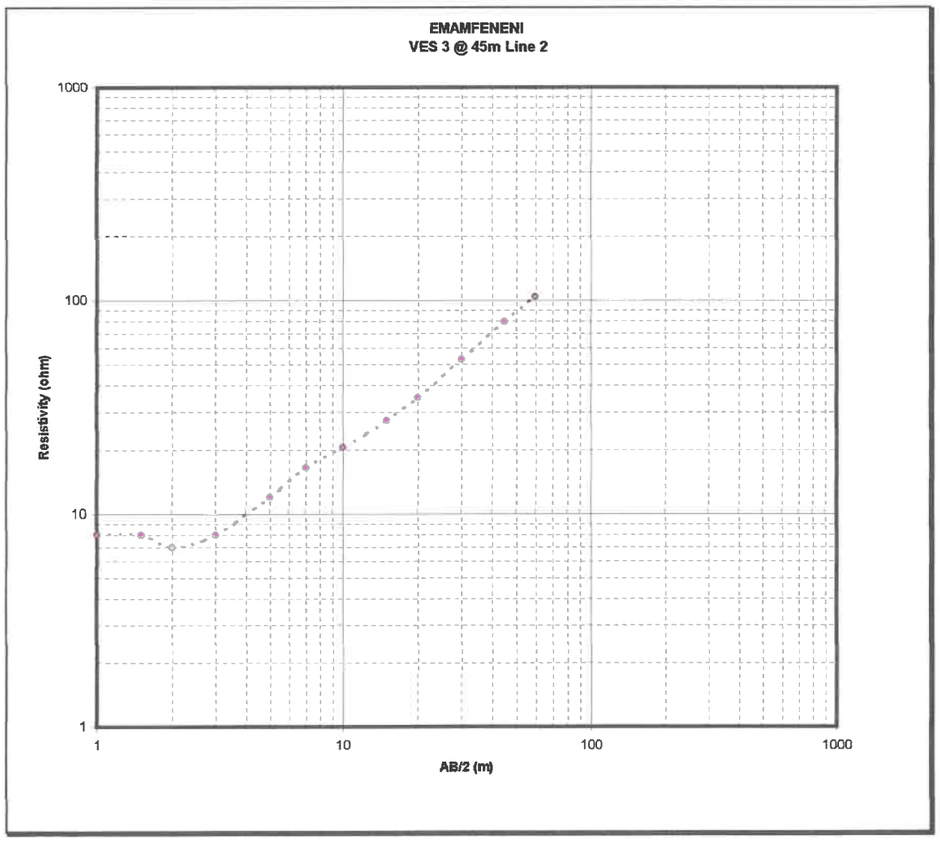

KuVinindwa Line 2 BH - 3228AA/SN/015
S
N
S = 31° 56' 44.8"
E = 28° 13' 30.9"
Road
VES 2
S = 31° 56' 54.7"
E = 28° 13' 27.3"
Conductivity
80
70
60
50
40
30
20
10
0
-10
-20
0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320 340 360 380 400
Distance (m)
20m Horizontal Dipole
20m Vertical Dipole
40m Horizontal Dipole
40m Vertical Dipole

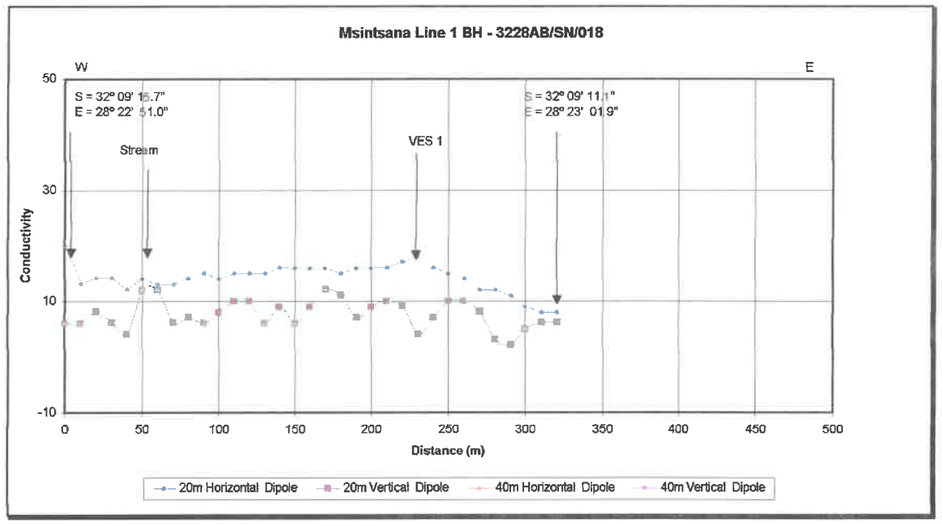

KuVinindwa
VES 2 @ 230m
1000
100
10
1
Resistivity (ohm)
1
10
100
1000
AB/2 (m)

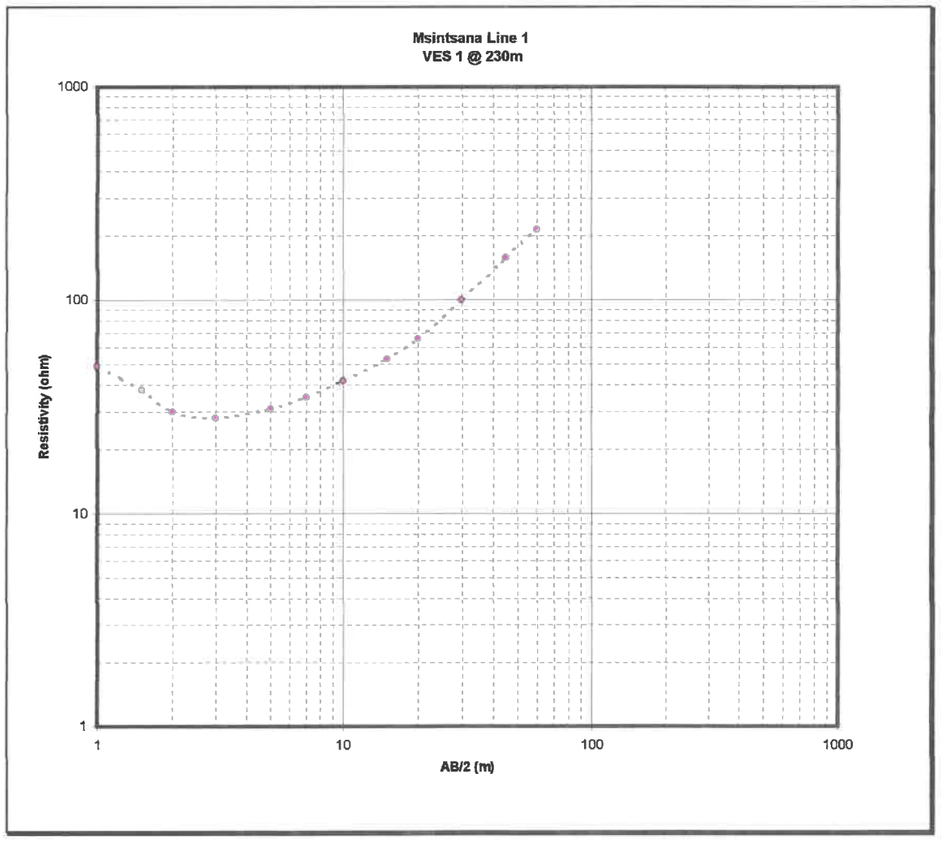

Sheshegu Line 1 BH - 3228AB/SN/016
NE
SW
S = 32° 07' 59.1"
E = 28° 16' 7.5"
VES 4
S = 32° 08' 10.5"
E = 28° 16' 14.2"
Conductivity
80
60
40
20
0
-20
0
50
100
150
200
250
300
350
400
450
500
Distance (m)
20m Horizontal Dipole
20m Vertical Dipole
40m Horizontal Dipole
40m Vertical Dipole

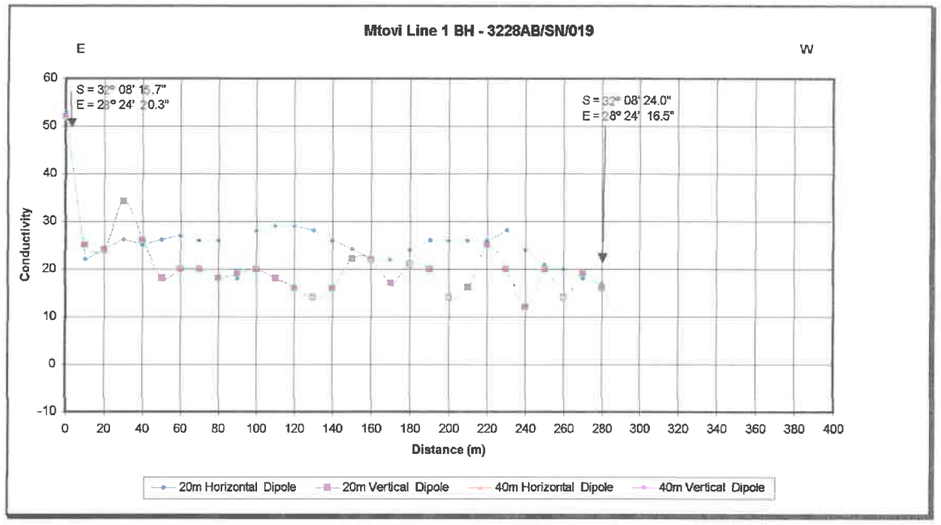

Sheshegu Line 1
VES 4@ 150m
1000
100
10
1
Resistivity (ohm)
1
10
100
1000
AB/2 (m)

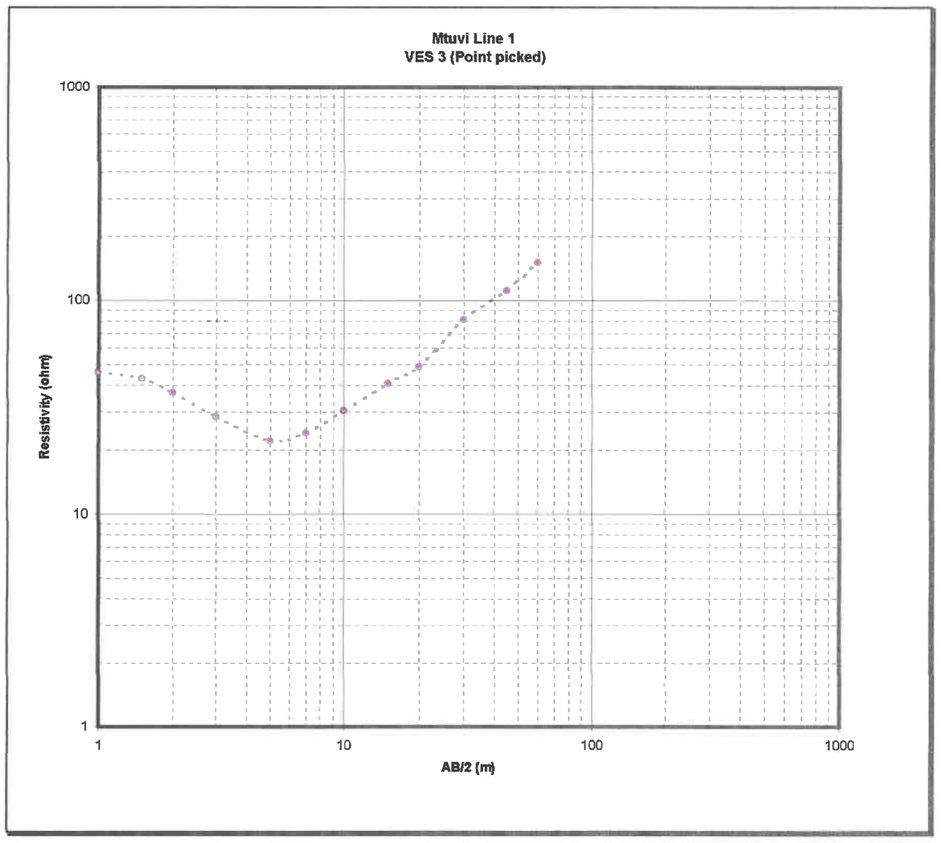

eMamfeneni Line 2 BH - 3228AB/SN/017
N
S
S = 31° 08' 06.3"
E = 28° 17' 59.5"
VES 3
S = 31° 08' 12.3"
E = 28° 17' 08.8"
Conductivity
80
60
40
20
0
-20
0
50
100
150
200
250
300
350
400
Distance (m)
20m Horizontal Dipole
20m Vertical Dipole
40m Horizontal Dipole
40m Vertical Dipole

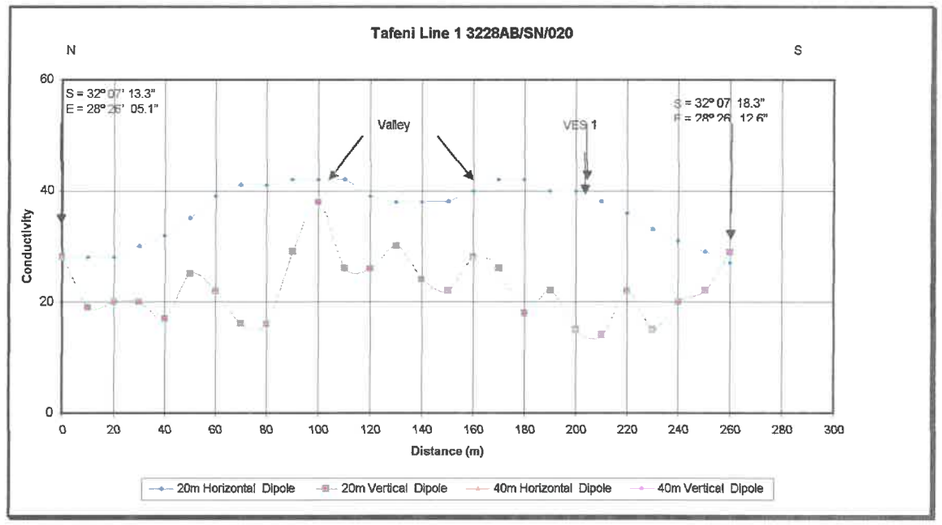

EMAMFENENI
VES 3 @ 45m Line 2
1000
100
10
1
Resistivity (ohm)
1
10
100
1000
AB/2 (m)

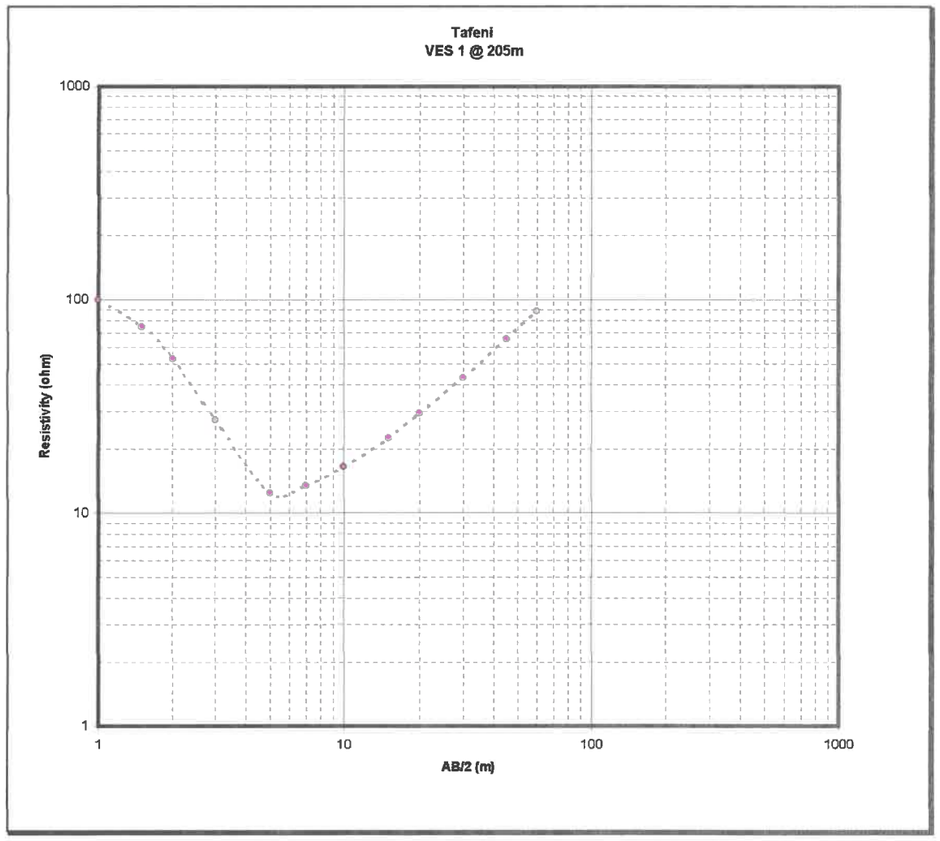

Msintsana Line 1 BH - 3228AB/SN/018
W
E
S = 32° 09' 15.7"
E = 28° 22' 51.0"
Stream
VES 1
S = 32° 09' 11.1"
E = 28° 23' 01.9"
Conductivity
50
30
10
-10
0
50
100
150
200
250
300
350
400
450
500
Distance (m)
20m Horizontal Dipole
20m Vertical Dipole
40m Horizontal Dipole
40m Vertical Dipole

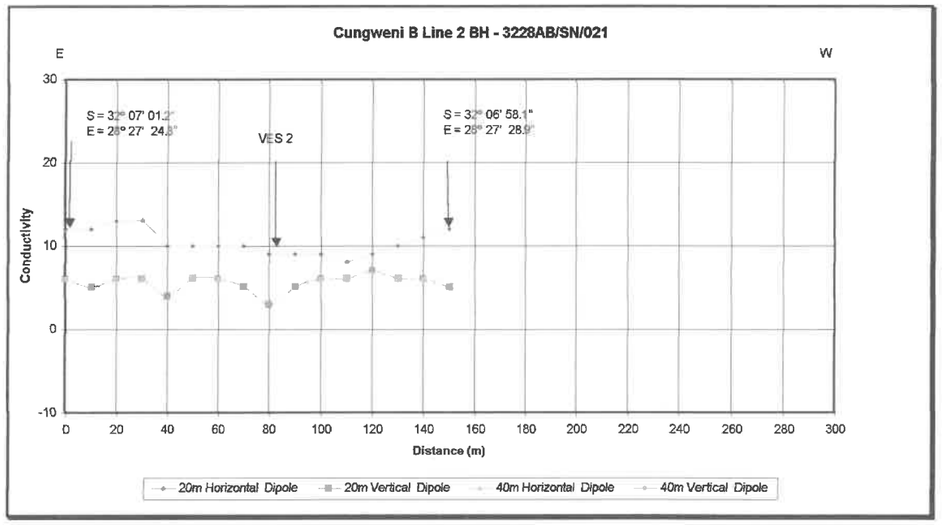

Msintsana Line 1
VES 1 @ 230m
1000
100
10
1
Resistivity (ohm)
1
10
100
1000
AB/2 (m)

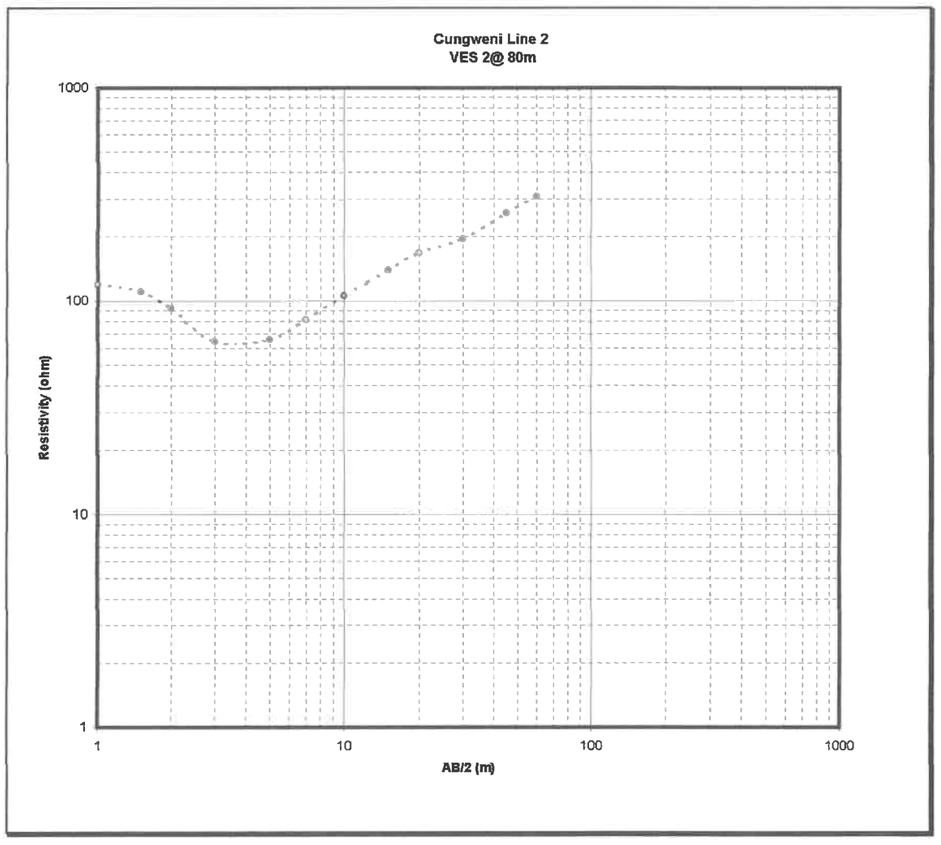

Mtovi Line 1 BH - 3228AB/SN/019
E
W
S = 32° 08' 19.7"
E = 28° 24' 20.3"
S = 32° 08' 24.0"
E = 28° 24' 16.5"
Conductivity
60
50
40
30
20
10
0
-10
0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320 340 360 380 400
Distance (m)
20m Horizontal Dipole
20m Vertical Dipole
40m Horizontal Dipole
40m Vertical Dipole

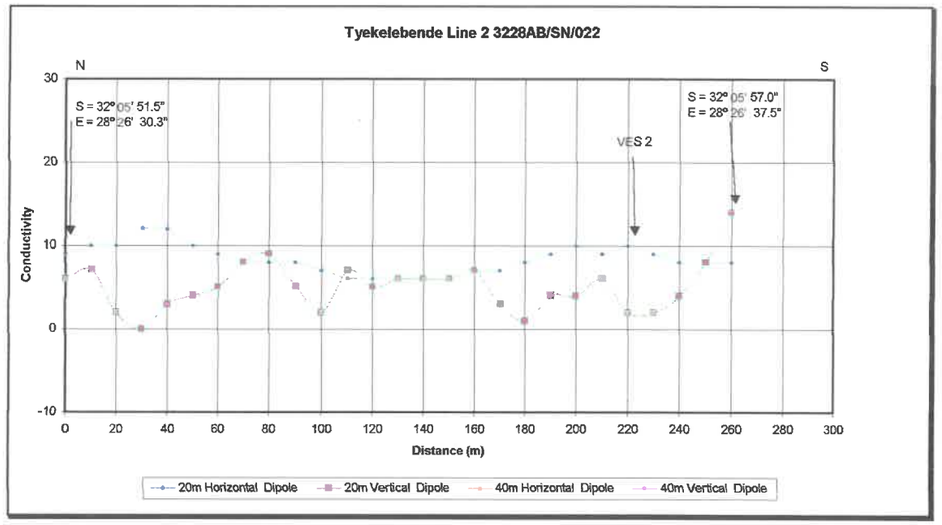

Mtuvi Line 1
VES 3 (Point picked)
1000
100
10
1
Resistivity (ohm)
1
10
100
1000
AB/2 (m)

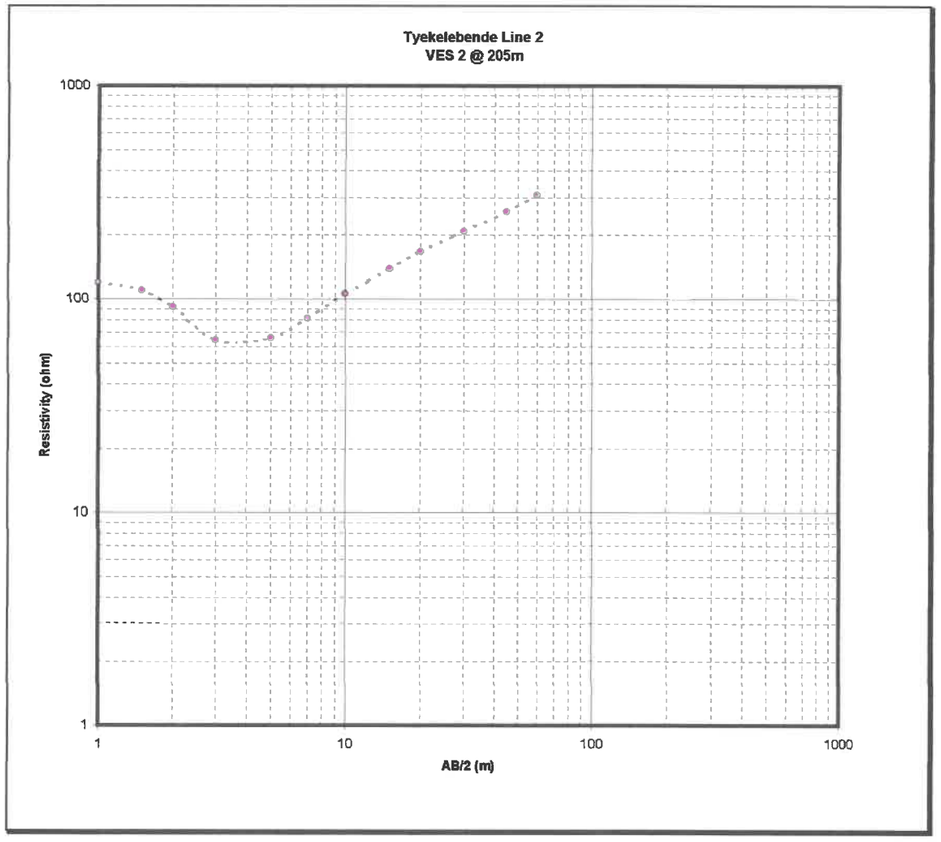

Tafeni Line 1 3228AB/SN/020
N
S
S = 32° 07' 13.3"
E = 28° 25' 05.1"
Valley
VES 1
S = 32° 07' 18.3"
E = 28° 26' 12.6"
Conductivity
Distance (m)
20m Horizontal Dipole
20m Vertical Dipole
40m Horizontal Dipole
40m Vertical Dipole

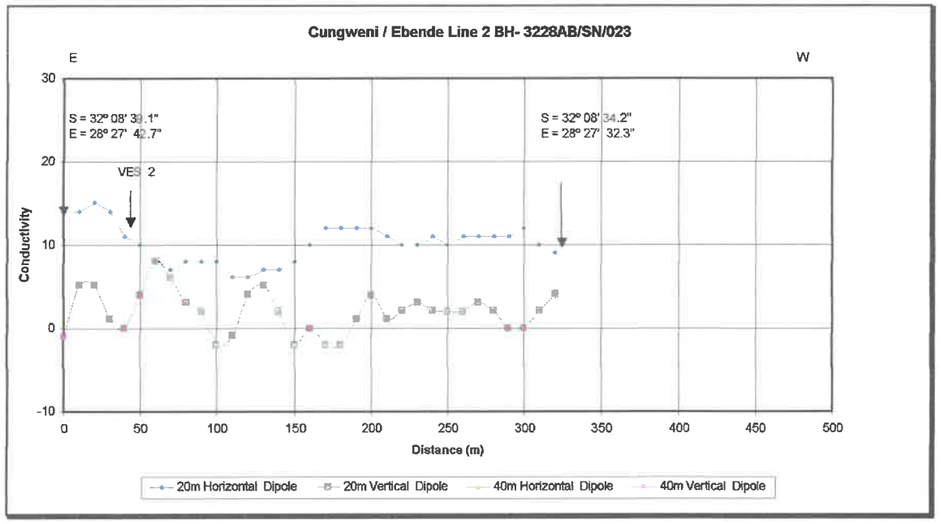

Tafeni
VES 1 @ 205m
Resistivity (ohm)
AB/2 (m)

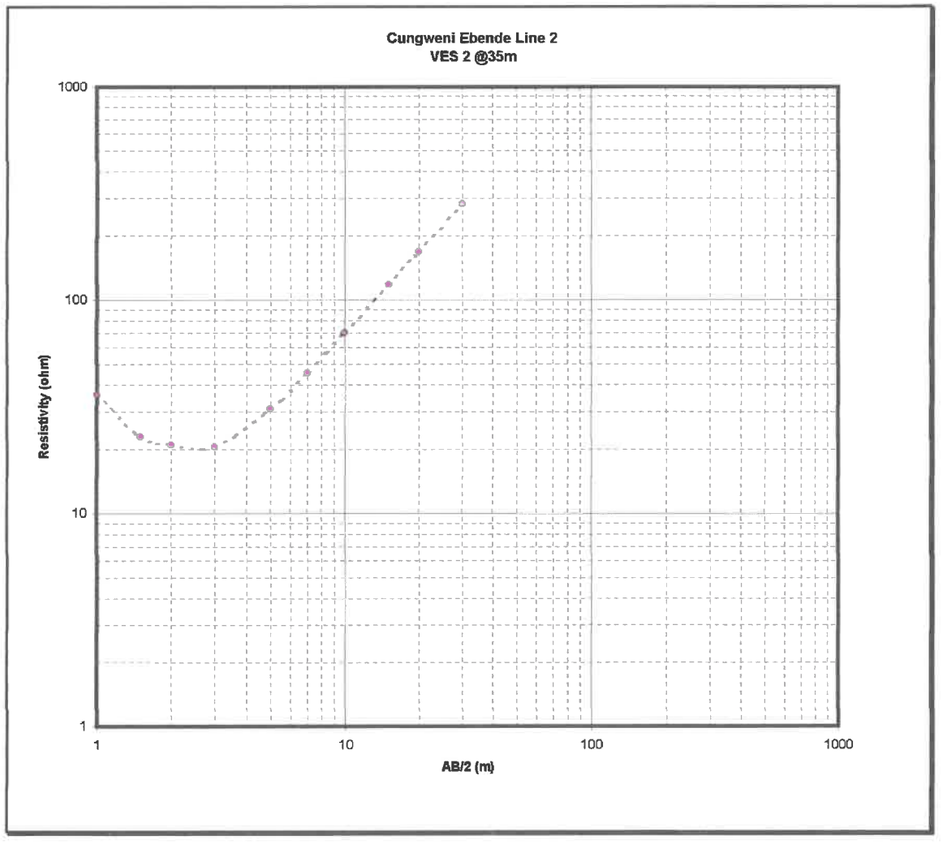

Cungweni B Line 2 BH - 3228AB/SN/021
E
W
S = 32° 07' 01.2"
E = 28° 27' 24.8"
VES 2
S = 32° 06' 58.1"
E = 28° 27' 28.9"
Conductivity
30
20
10
0
-10
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
Distance (m)
20m Horizontal Dipole
20m Vertical Dipole
40m Horizontal Dipole
40m Vertical Dipole

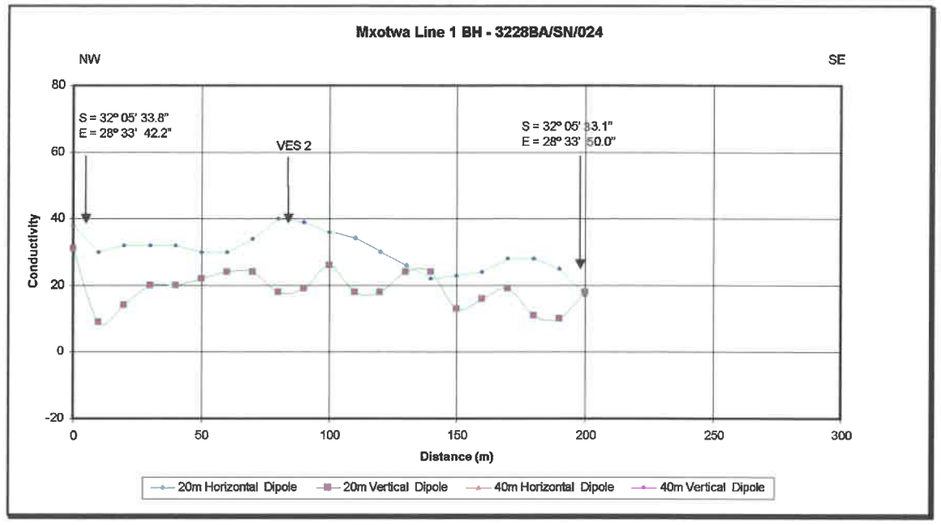

Cungweni Line 2
VES 2@ 80m
1000
100
10
1
Resistivity (ohm)
1
10
100
1000
AB/2 (m)

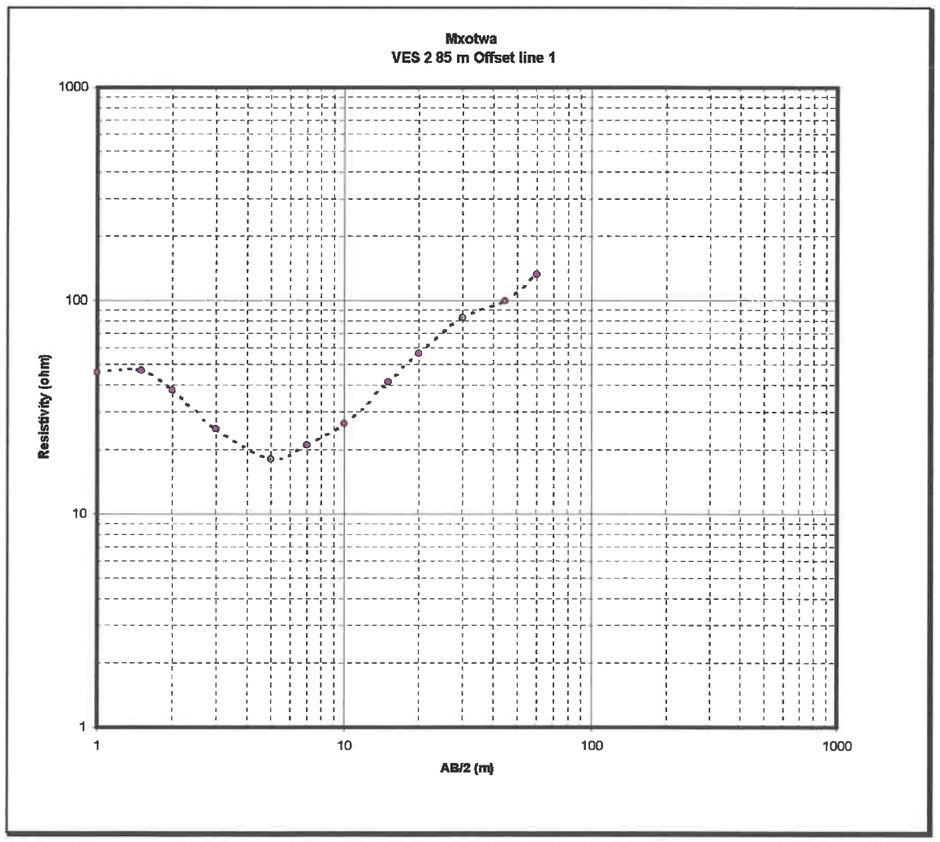

Tyekelebende Line 2 3228AB/SN/022
N
S
S = 32° 05' 51.5"
E = 28° 26' 30.3"
S = 32° 05' 57.0"
E = 28° 26' 37.5"
VES 2
Conductivity
30
20
10
0
-10
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
Distance (m)
20m Horizontal Dipole
20m Vertical Dipole
40m Horizontal Dipole
40m Vertical Dipole

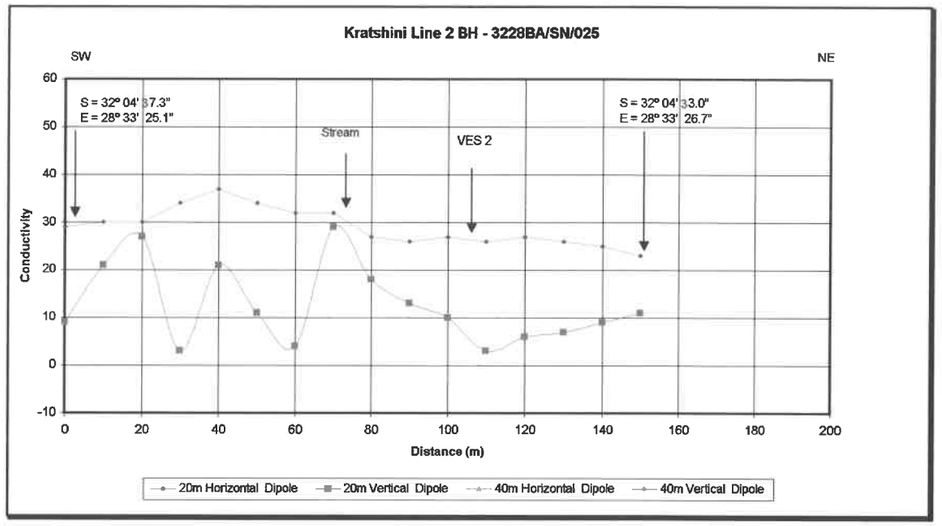

Tyekelebende Line 2
VES 2 @ 205m
1000
100
10
1
Resistivity (ohm)
1
10
100
1000
AB/2 (m)

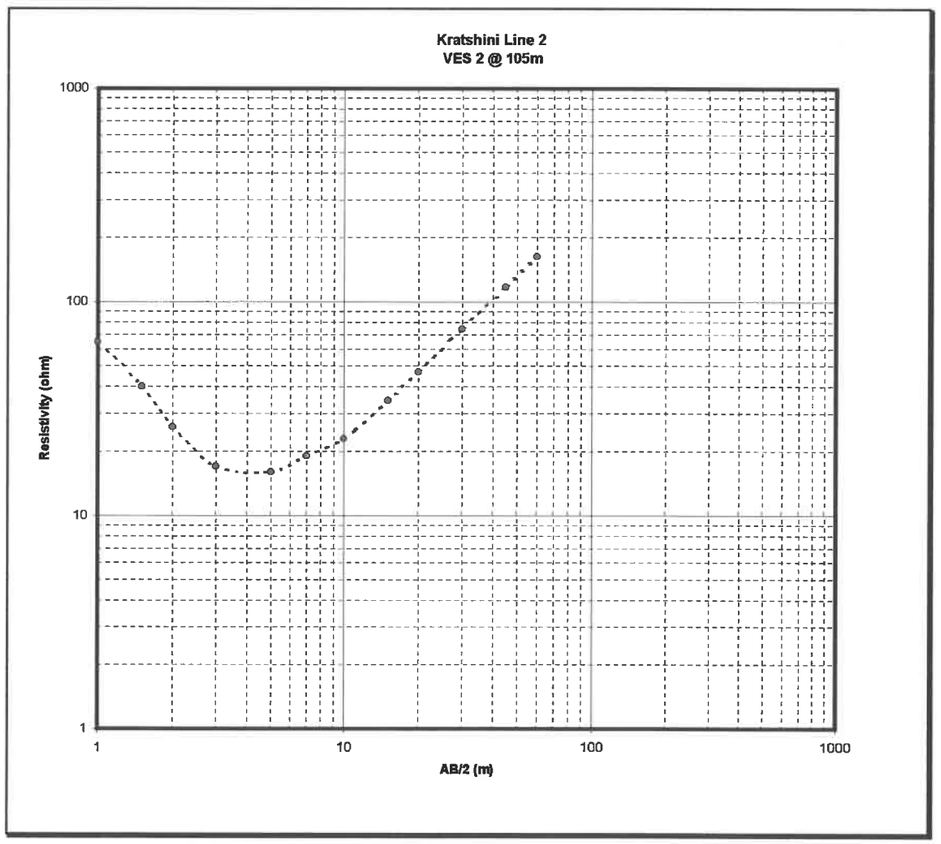

Cungweni / Ebende Line 2 BH- 3228AB/SN/023
E
W
S = 32° 08' 39.1"
E = 28° 27' 42.7"
S = 32° 08' 34.2"
E = 28° 27' 32.3"
VES 2
Conductivity
Distance (m)
20m Horizontal Dipole
20m Vertical Dipole
40m Horizontal Dipole
40m Vertical Dipole

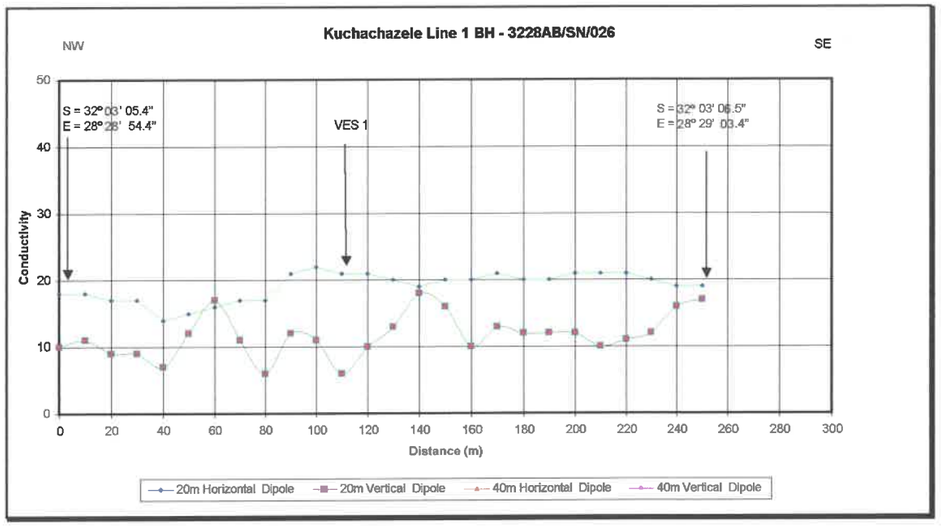

Cungweni Ebende Line 2
VES 2 @35m
Resistivity (ohm)
AB/2 (m)

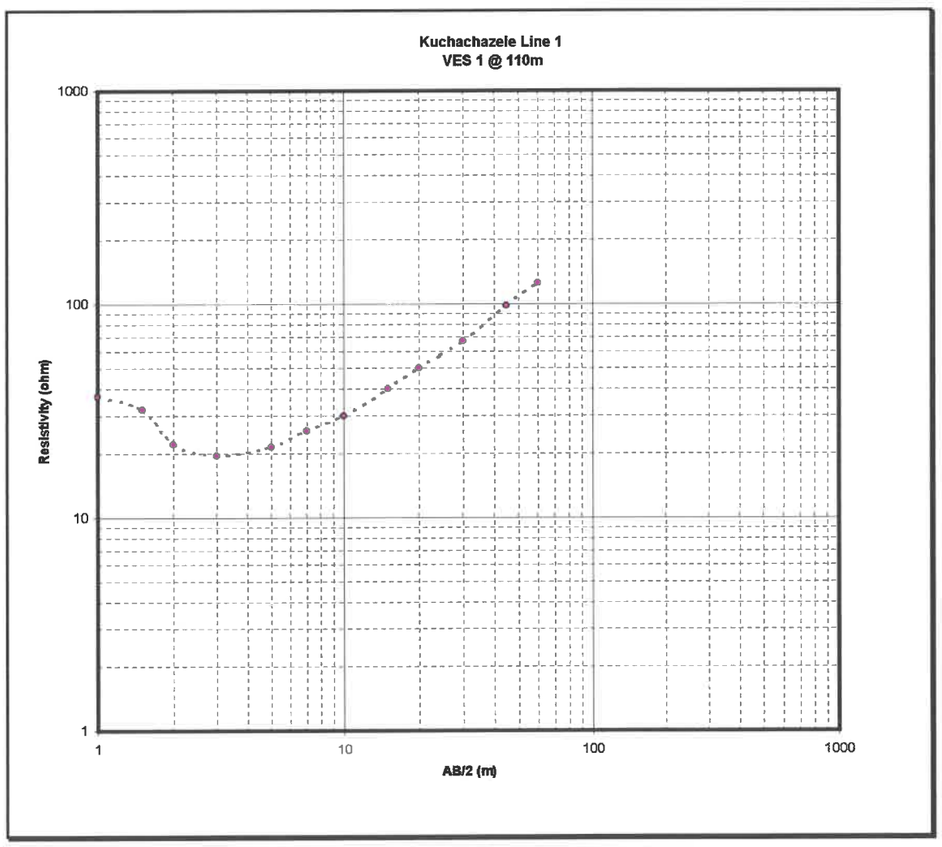

Mxotwa Line 1 BH - 3228BA/SN/024
NW
SE
S = 32° 05' 33.8"
E = 28° 33' 42.2"
VES 2
S = 32° 05' 33.1"
E = 28° 33' 50.0"
Conductivity
80
60
40
20
0
-20
0
50
100
150
200
250
300
Distance (m)
20m Horizontal Dipole
20m Vertical Dipole
40m Horizontal Dipole
40m Vertical Dipole

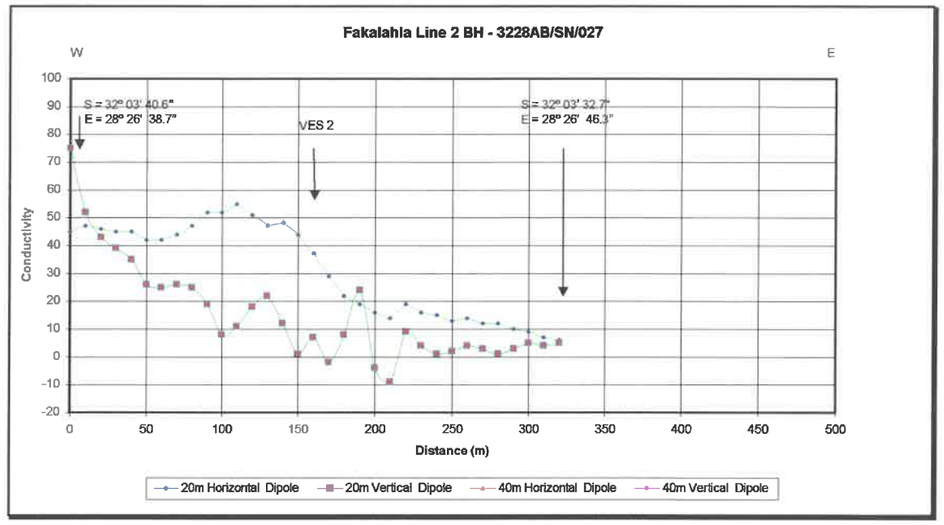

Mxotwa
VES 2 85 m Offset line 1
1000
100
10
1
Resistivity (ohm)
1
10
100
1000
AB/2 (m)

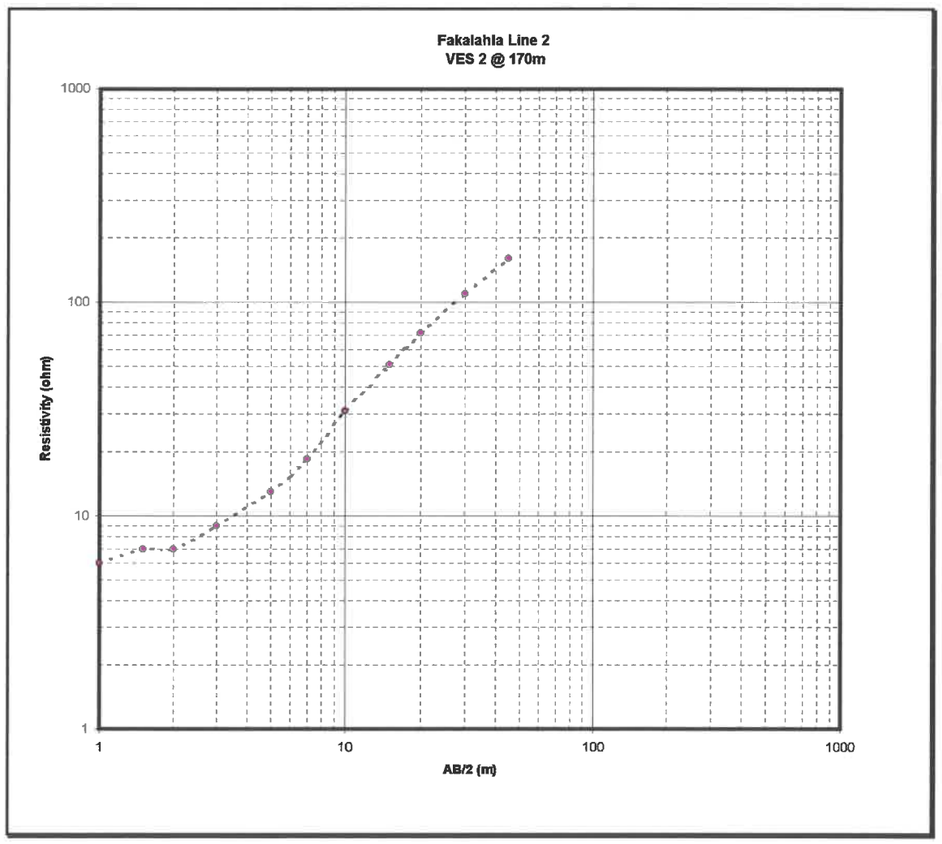

Kratshini Line 2 BH - 3228BA/SN/025
SW
NE
S = 32° 04' 37.3"
E = 28° 33' 25.1"
Stream
VES 2
S = 32° 04' 33.0"
E = 28° 33' 26.7"
Conductivity
60
50
40
30
20
10
0
-10
0
20
40
60
80
100
120
140
160
180
200
Distance (m)
20m Horizontal Dipole
20m Vertical Dipole
40m Horizontal Dipole
40m Vertical Dipole

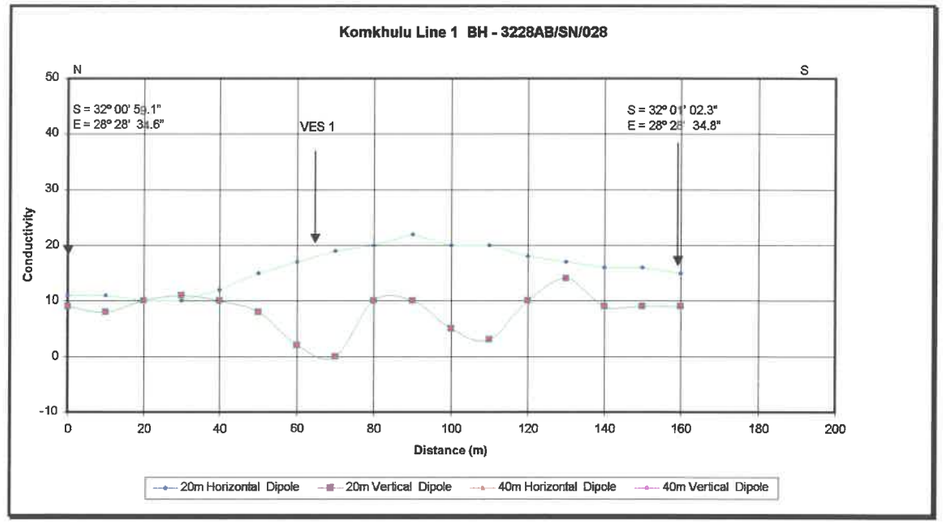

Kratshini Line 2
VES 2 @ 105m
1000
100
10
1
Resistivity (ohm)
1
10
100
1000
AB/2 (m)

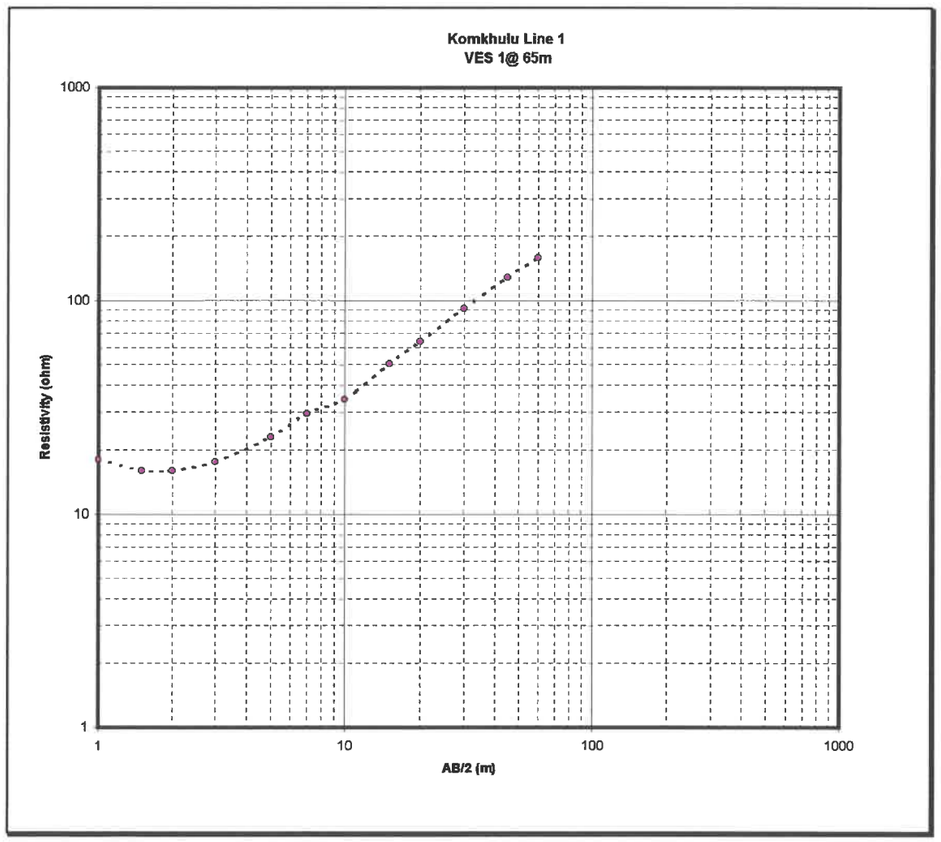

Kuchachazele Line 1 BH - 3228AB/SN/026
NW
SE
S = 32° 03' 05.4"
E = 28° 28' 54.4"
VES 1
S = 32° 03' 06.5"
E = 28° 29' 03.4"
Conductivity
Distance (m)
20m Horizontal Dipole
20m Vertical Dipole
40m Horizontal Dipole
40m Vertical Dipole

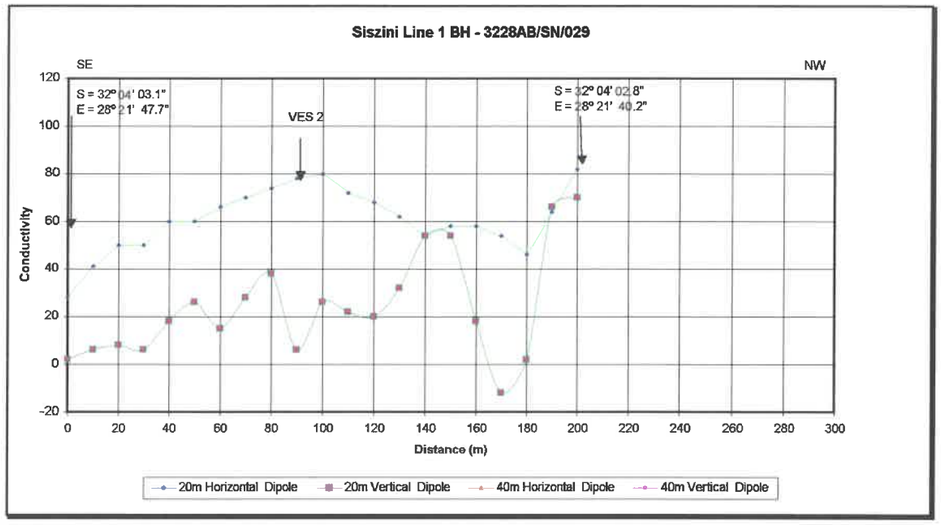

Kuchachazele Line 1
VES 1 @ 110m
Resistivity (ohm)
AB/2 (m)

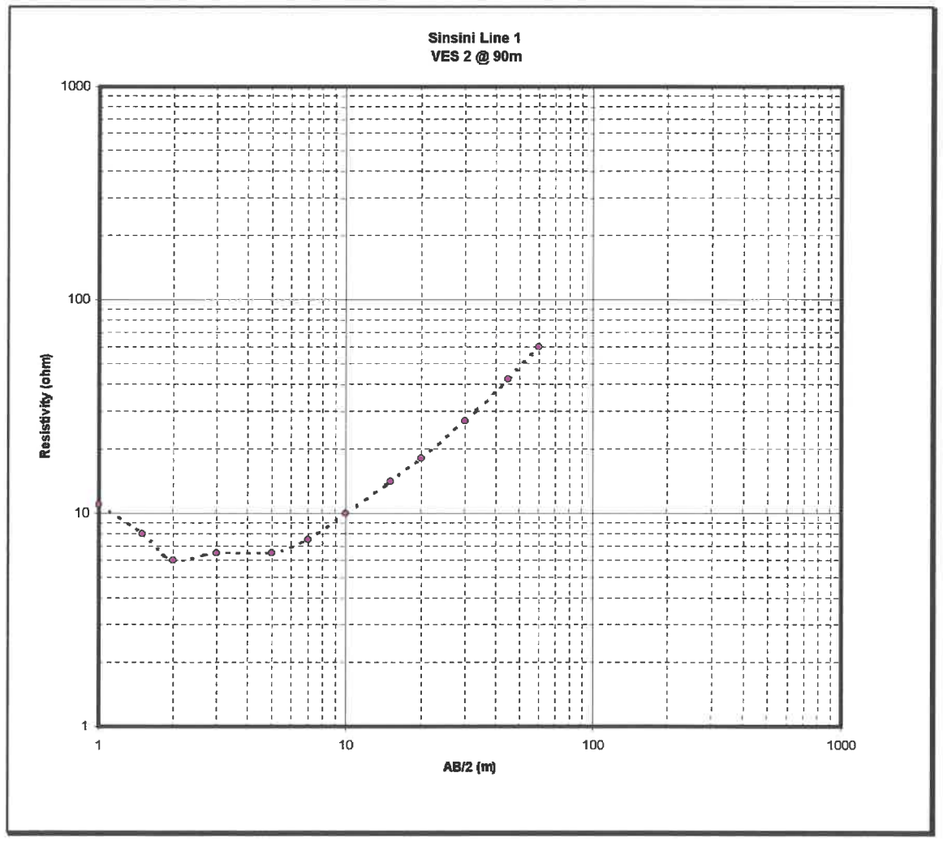

Fakalahla Line 2 BH - 3228AB/SN/027
W
E
S = 32° 03' 40.6"
E = 28° 26' 38.7"
VES 2
S = 32° 03' 32.7"
E = 28° 26' 46.3"
Conductivity
100
90
80
70
60
50
40
30
20
10
0
-10
-20
0
50
100
150
200
250
300
350
400
450
500
Distance (m)
20m Horizontal Dipole
20m Vertical Dipole
40m Horizontal Dipole
40m Vertical Dipole

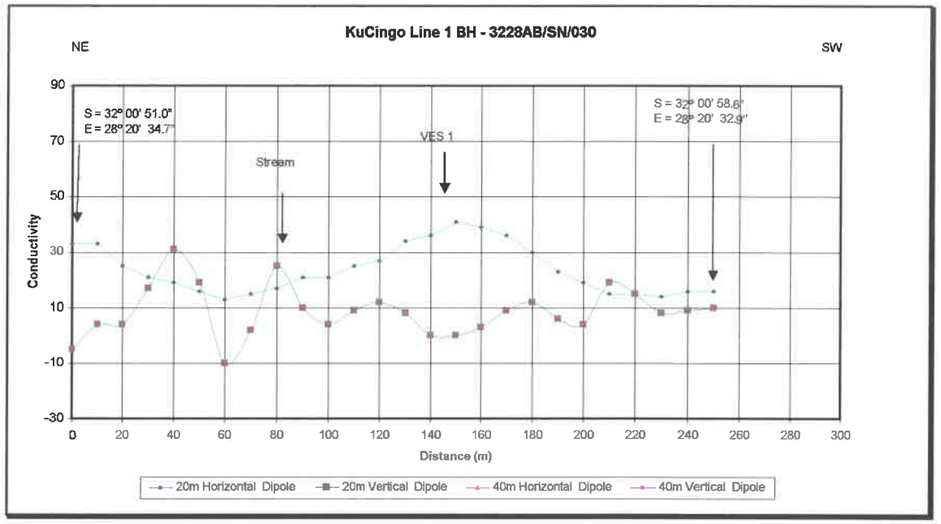

Fakalahla Line 2
VES 2 @ 170m
1000
100
10
1
Resistivity (ohm)
1
10
100
1000
AB/2 (m)

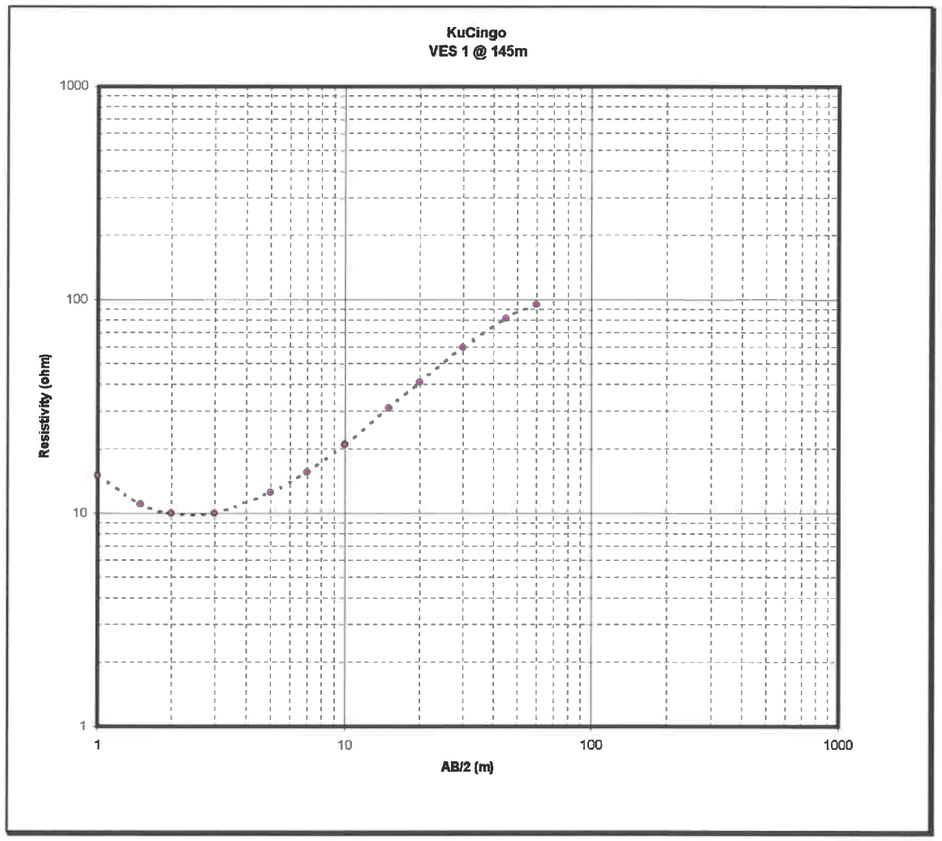

Komkhulu Line 1 BH - 3228AB/SN/028
N
S
S = 32° 00' 59.1"
E = 28° 28' 31.6"
VES 1
S = 32° 01' 02.3"
E = 28° 28' 34.8"
Conductivity
50
40
30
20
10
0
-10
0
20
40
60
80
100
120
140
160
180
200
Distance (m)
20m Horizontal Dipole
20m Vertical Dipole
40m Horizontal Dipole
40m Vertical Dipole

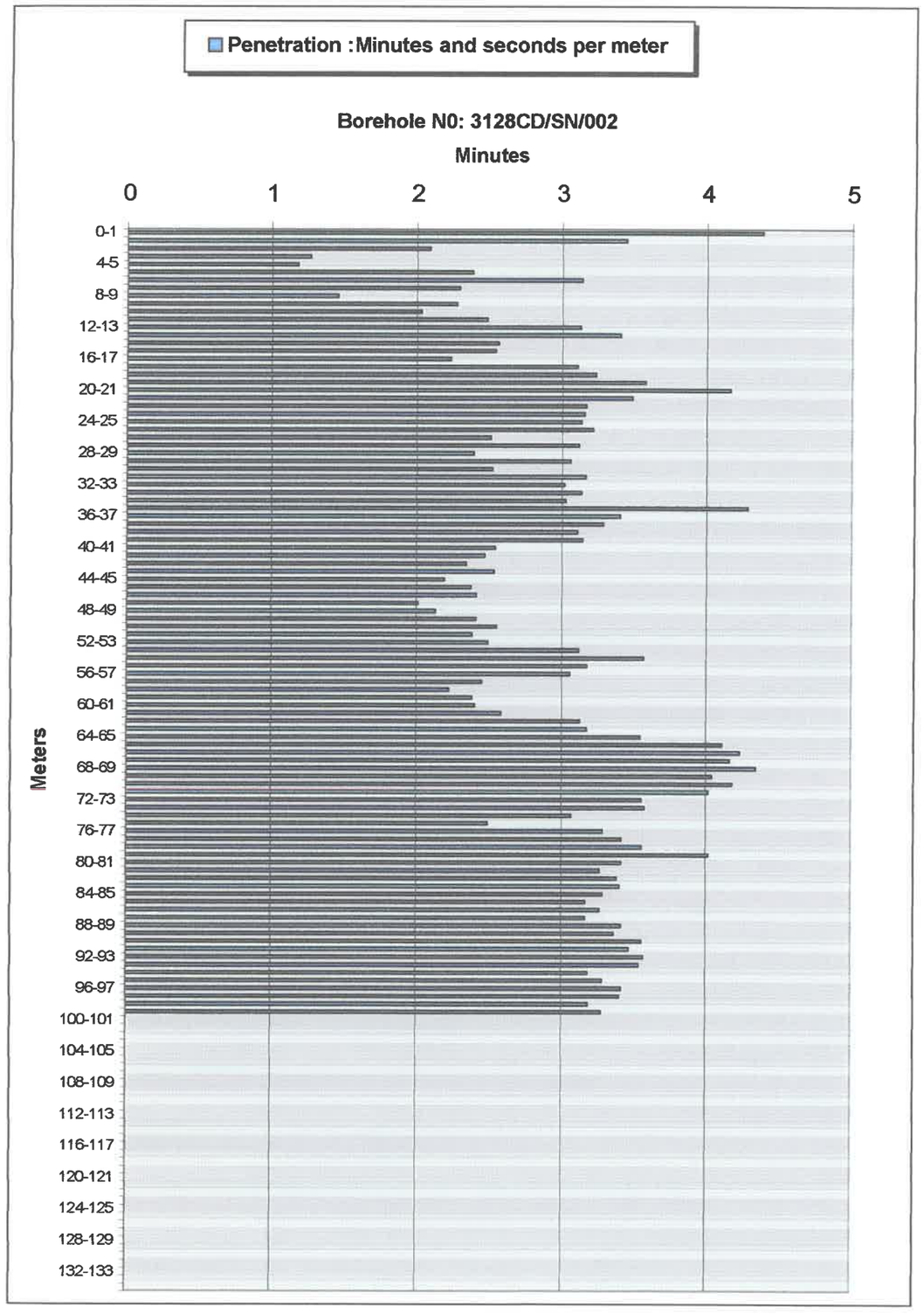

Komkhulu Line 1
VES 1@ 65m
1000
100
10
1
Resistivity (ohm)
1
10
100
1000
AB/2 (m)


Siszini Line 1 BH - 3228AB/SN/029
SE
NW
S = 32° 04' 03.1"
E = 28° 21' 47.7"
VES 2
S = 32° 04' 02.8"
E = 28° 21' 40.2"
Conductivity
120
100
80
60
40
20
0
-20
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
Distance (m)
20m Horizontal Dipole
20m Vertical Dipole
40m Horizontal Dipole
40m Vertical Dipole


Sinsini Line 1
VES 2 @ 90m
1000
100
10
1
Resistivity (ohm)
1
10
100
1000
AB/2 (m)


KuCingo Line 1 BH - 3228AB/SN/030
NE
SW
S = 32° 00' 51.0"
E = 28° 20' 34.7"
Stream
VES 1
S = 32° 00' 58.6"
E = 28° 20' 32.9"
Conductivity
90
70
50
30
10
-10
-30
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
Distance (m)
20m Horizontal Dipole
20m Vertical Dipole
40m Horizontal Dipole
40m Vertical Dipole


KuCingo
VES 1 @ 145m
1000
100
10
1
Resistivity (ohm)
1
10
100
1000
AB/2 (m)


Penetration :Minutes and seconds per meter
Borehole N0: 3128CD/SN/002
Minutes
0
1
2
3
4
5
Meters
0-1
4-5
8-9
12-13
16-17
20-21
24-25
28-29
32-33
36-37
40-41
44-45
48-49
52-53
56-57
60-61
64-65
68-69
72-73
76-77
80-81
84-85
88-89
92-93
96-97
100-101
104-105
108-109
112-113
116-117
120-121
124-125
128-129
132-133

IDUTYWA GROUNDWATER FEASIBILITY STUDY

BH : 3128CD/SN/003

COMMUNITY : Bhetai

203mm	177mm	3 m Plain	2 m	Gravel, light brown, overburden
			6 m	Sandstone, brownish, medium grained, weathered
165mm			17 m	Siltstone, purplish, fine grained, weathered.
			72 m	Sandstone, light grey, slightly weathered.
			75 m	Shale, purplish, slightly fractured.
			100 m	Sandstone, light grey, medium to fine grained, fresh
DRILLING Rotary percussion	CASING	• Drilled depth = 100 m • Blow Yield = Dry • Water Strike at : Dry		

Contractor : Olivier & Sons Diam : 165mm S-Coord : 31° 52' 06.8"

Drilled By : Philip Olivier Date : 05/06/03 E-Coord : 28° 21' 07.8"

Profiled By : Sylvester Ndoora

IDUTYWA GROUNDWATER FEASIBILITY STUDY

BH : 3128CD/SN/004

COMMUNITY : Matolweni

203mm	177mm	19 m Plain	0 – 5 m: Clay, brownish, overburden
			5 – 18 m: Sandstone, brownish, medium grained, weathered
			18 – 29 m: Dolerite, grey, slightly weathered.
165mm			29 – 55 m: Sandstone, grey-white , medium to fine grained, fresh.
			55 – 70 m: Siltstone, brownish, fractured at 56 m
			70 – 91 m: Sandstone, grey white, intercalated with brown shale between 75 – 76 m
			91 – 122 m: Siltstone, brown, fine grained fresh
DRILLING Rotary percussion	CASING		

- Drilled depth = 122 m
- Blow Yield = 0.2 l/s
- Water Strike at : 82 m

Contractor : Olivier & Sons Diam : 165mm S-Coord : 31° 55' 53.7"

Drilled By : Philip Olivier Date : 06/06/03 E-Coord : 28° 17' 15.2"

Profiled By : Sylvester Ndoora

IDUTYWA GROUNDWATER FEASIBILITY STUDY

BH : 3228CD/SN/005

COMMUNITY : Mhuku

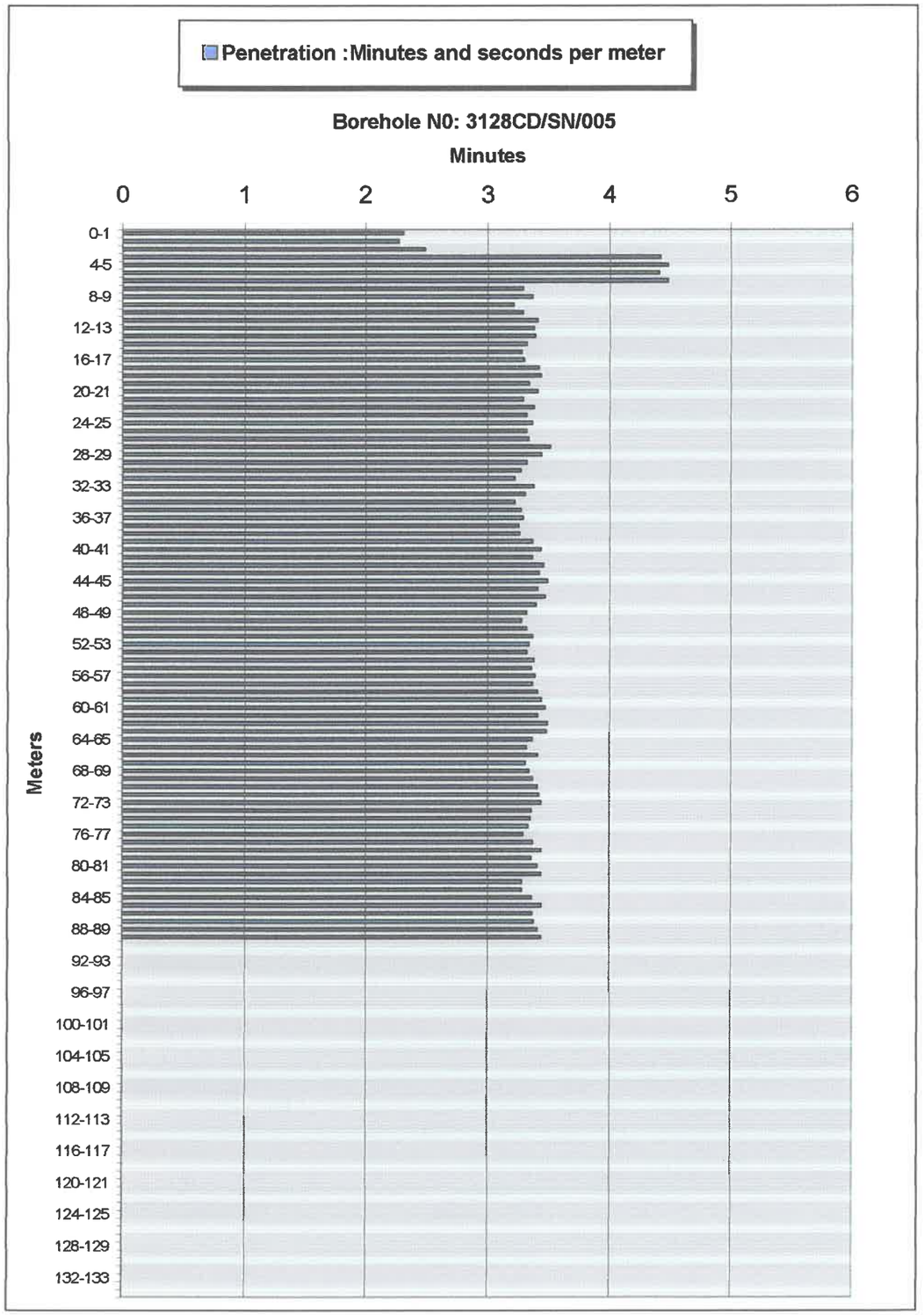
203mm.	177mm	6 m Plain	0 – 3 m: Clay, reddish, overburden
			3 – 8 m: Dolerite, brownish, fine grained, weathered
165mm			8 – 66 m: Sandstone, grey-white, medium grained, weathered to 43 m and fractured to 52 m
			66 – 71 m: Siltstone, brownish, fractured at 67 m
			71 – 74 m: Quartzitic sandstone, medium to coarse grained, fresh, medium grained, fractured at 71 m
			74 – 90 m: Shale, brownish, intercalated with sandstone at 84 – 87 m, moderately fractured
DRILLING Rotary percussion	CASING		

- Drilled depth = 90 m
- Blow Yield = 2.2 l/s
- Water Strike at : 44 m

Contractor : Olivier & Sons Diam : 165mm S-Coord : 31° 54' 50.0"

Drilled By : Philip Olivier Date : 07/06/03 E-Coord : 28° 20' 53"

Profiled By : Sylvester Ndoora


Penetration :Minutes and seconds per meter
Borehole N0: 3128CD/SN/005
Minutes
0
1
2
3
4
5
6
Meters
0-1
4-5
8-9
12-13
16-17
20-21
24-25
28-29
32-33
36-37
40-41
44-45
48-49
52-53
56-57
60-61
64-65
68-69
72-73
76-77
80-81
84-85
88-89
92-93
96-97
100-101
104-105
108-109
112-113
116-117
120-121
124-125
128-129
132-133

IDUTYWA GROUNDWATER FEASIBILITY STUDY

BH : 3228CD/SN/006

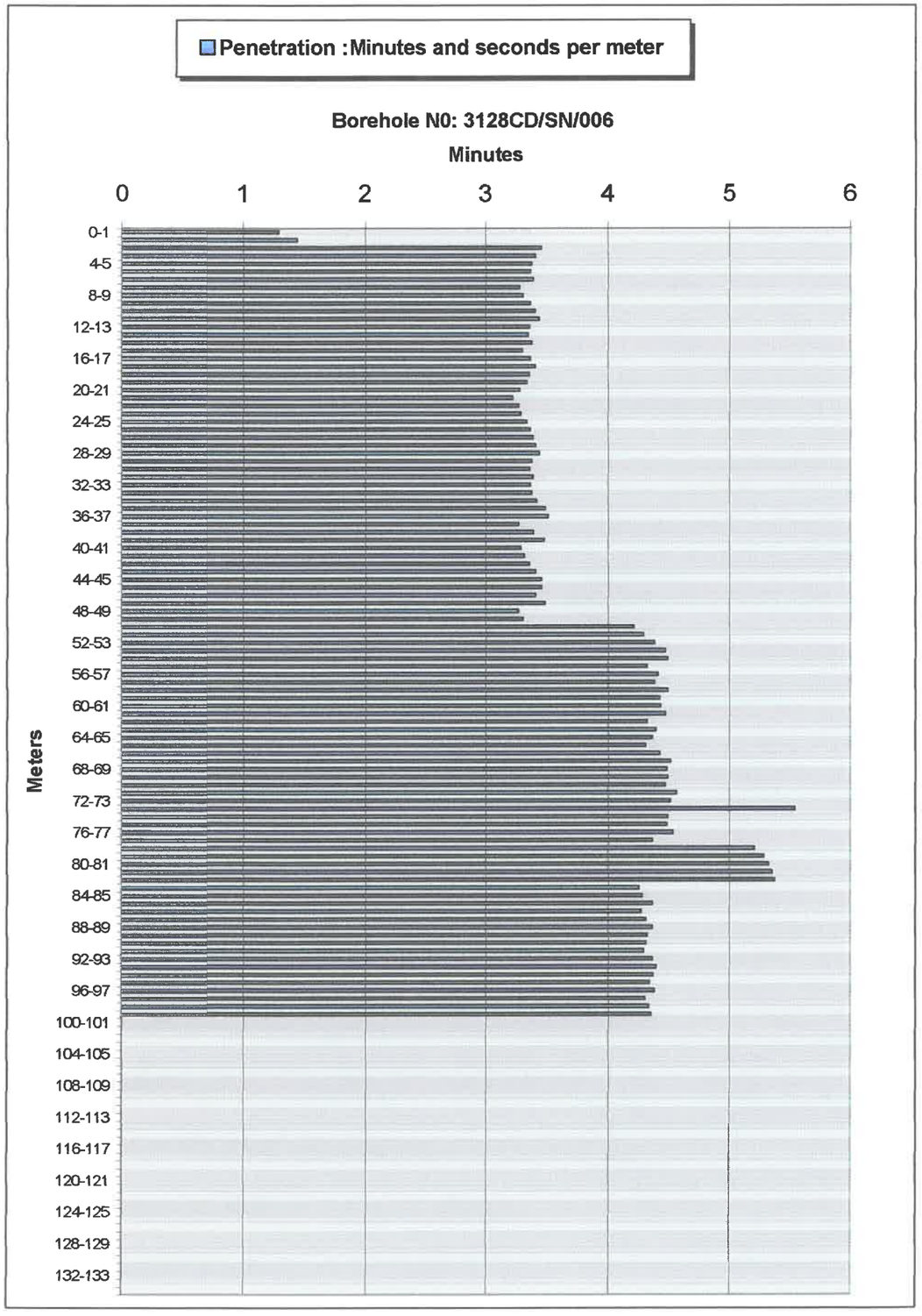
COMMUNITY : Nywara

203mm	177mm	4 m Plain	3 m	Clay, khaki, overburden
			11 m	Sandstone, whitish, fine grained, fresh
			13 m	Siltstone, purplish, fine grained, fresh
165mm			15 m	Sandstone, whitish, fine grained, fresh.
			18 m	Siltstone, purplish, fine grained, fresh.
			65 m	Sandstone, grey, medium grained, fractured at18 m, and 58 m
			83 m	Dolerite, grey to dark, medium grained, fractured at 71 m
			100 m	Sandstone, light grey, intercalated with shale at 93 – 95 m, medium grained, fresh grained.
DRILLING Rotary percussion	CASING	• Drilled depth = 100 m • Blow Yield = 0.9 l/s • Water Strike at : 18, 83 m		

Contractor : Olivier & Sons Diam : 165mm S-Coord : 32° 56' 51.3"

Drilled By : Philip Olivier Date : 08/06/03 E-Coord : 28° 22' 16.3"

Profiled By : Sylvester Ndoora


Penetration :Minutes and seconds per meter
Borehole N0: 3128CD/SN/006
Minutes
0
1
2
3
4
5
6
Meters
0-1
4-5
8-9
12-13
16-17
20-21
24-25
28-29
32-33
36-37
40-41
44-45
48-49
52-53
56-57
60-61
64-65
68-69
72-73
76-77
80-81
84-85
88-89
92-93
96-97
100-101
104-105
108-109
112-113
116-117
120-121
124-125
128-129
132-133

IDUTYWA GROUNDWATER FEASIBILITY STUDY

BH : 3228CD/SN/007

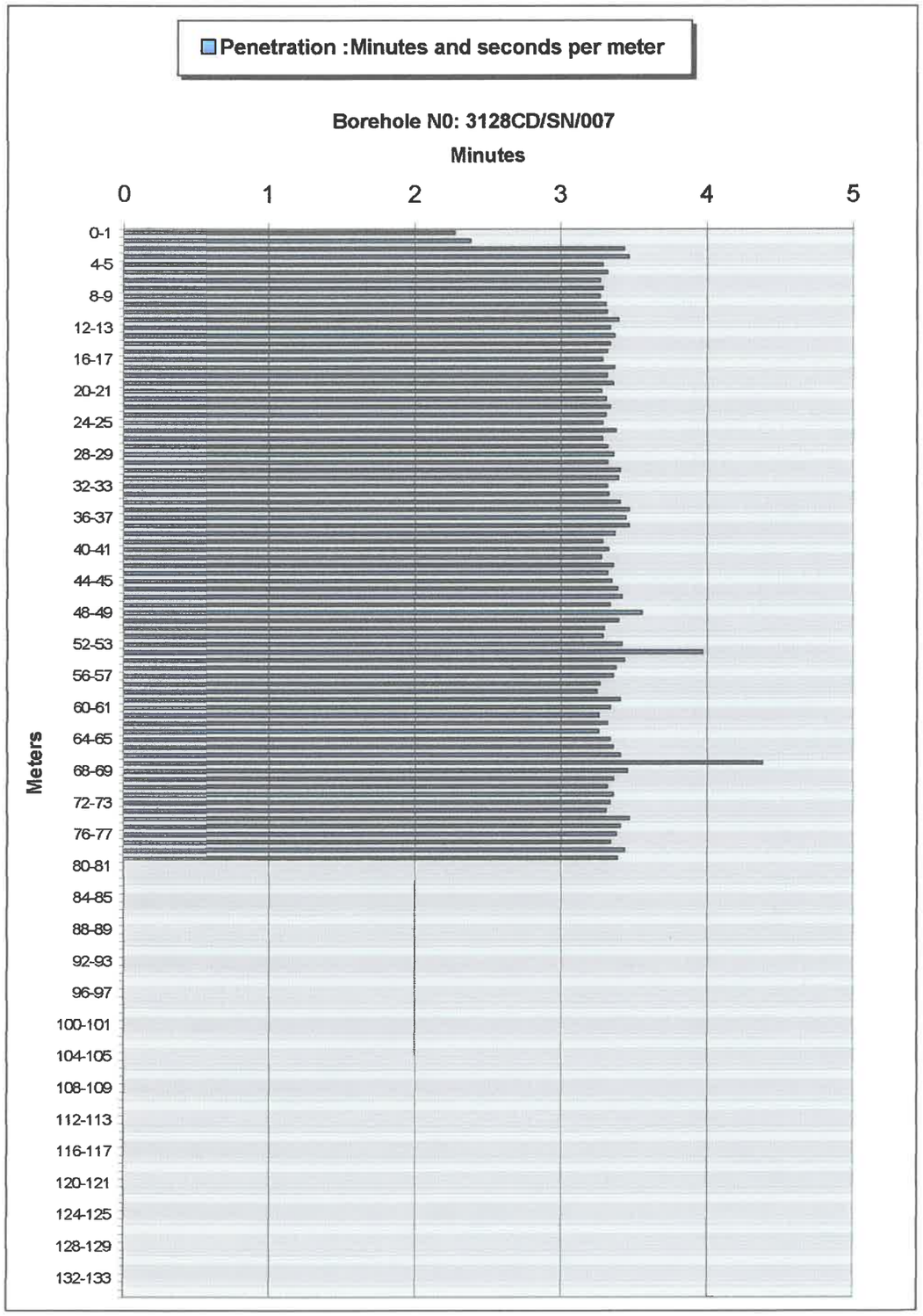
COMMUNITY : Candu

203mm	177mm	3.5 m Plain	2 m	Clayey sand, brown, fine grained overburden
165mm			13 m	Sandstone, beige, coarse to medium grained, weathered
			71 m	Sandstone, grey to dark grey, coarse grained, fractured at 45 m.
			75 m	Siltstone, brownish, fractured at 75 m
			80 m	Sandstone, grey, medium grained, moderately fractured
DRILLING Rotary percussion	CASING	• Drilled depth = 80 m • Blow Yield = 2 l/s • Water Strike at : 14, 58 m		

Contractor : Olivier & Sons Diam : 165mm S-Coord : 32° 56' 06.9"

Drilled By : Philip Olivier Date : 09/06/03 E-Coord : 28° 24' 17.6"

Profiled By : Sylvester Ndoora


Penetration :Minutes and seconds per meter
Borehole N0: 3128CD/SN/007
Minutes
0
1
2
3
4
5
Meters
0-1
4-5
8-9
12-13
16-17
20-21
24-25
28-29
32-33
36-37
40-41
44-45
48-49
52-53
56-57
60-61
64-65
68-69
72-73
76-77
80-81
84-85
88-89
92-93
96-97
100-101
104-105
108-109
112-113
116-117
120-121
124-125
128-129
132-133

IDUTYWA GROUNDWATER FEASIBILITY STUDY

BH : 3228AB/SN/008

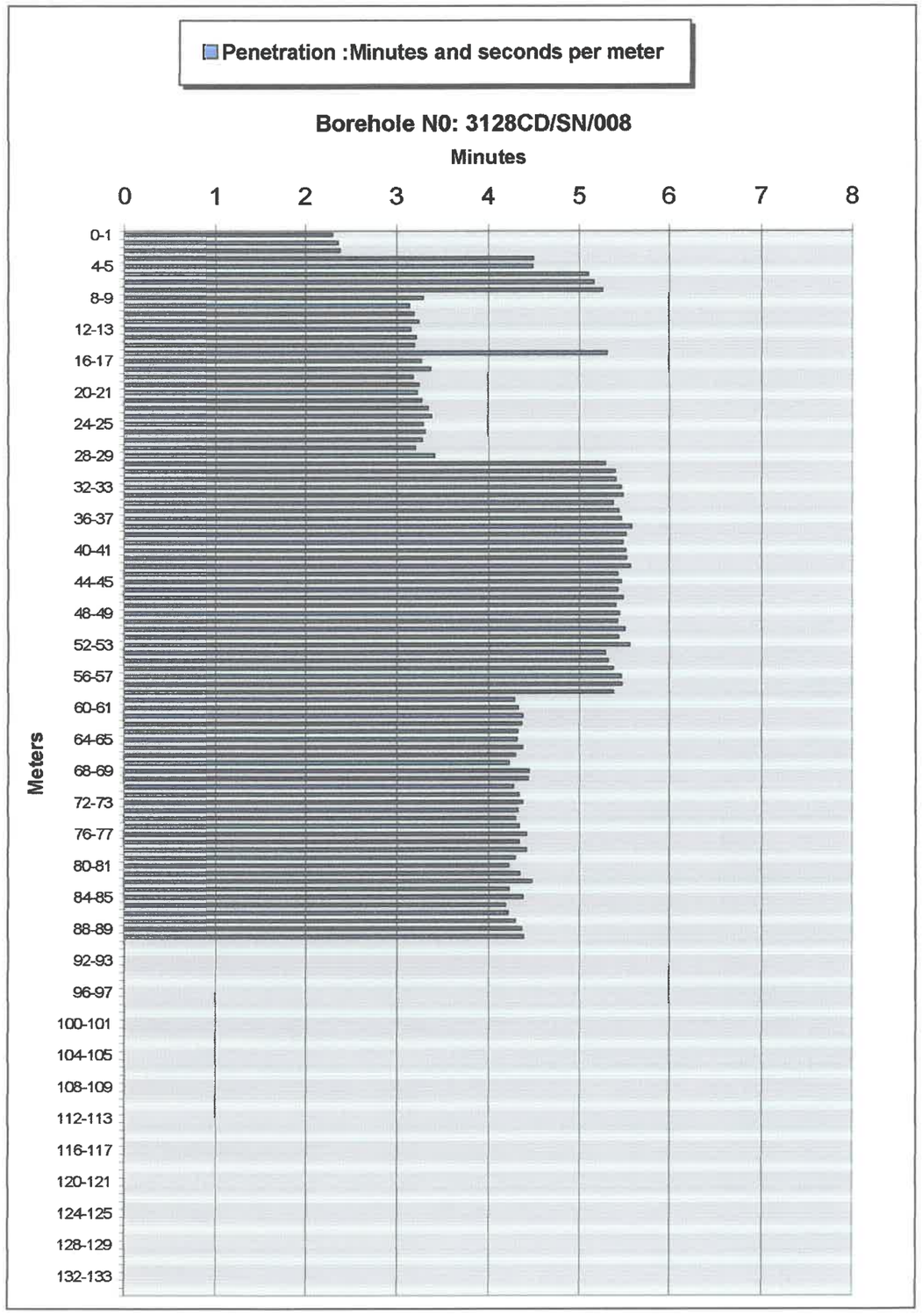
COMMUNITY : eMabheleni

203mm	177mm	4 m Plain	3 m	Clay, brown, overburden
			8 m	Dolerite, grey, fine grained, moderately weathered
			13 m	Siltstone, light grey, slightly weathered
			17 m	Siltstone, brown, fine grained, fractured
165mm			31 m	Dolerite, light grey, fresh
			43 m	Quartzitic sandstone, dark grey, coarse to medium grained, fresh
			46 m	Sandstone, light grey, coarse grained, fractured at 45 m.
			54 m	Dolerite, grey, fine grained, fresh
			80 m	Sandstone, grey, coarse to medium grained, fresh
DRILLING Rotary percussion	CASING	• Drilled depth = 80 m • Blow Yield = 0.8 l/s • Water Strike at : 14 m		

Contractor : Olivier & Sons Diam : 165mm S-Coord : 32° 58' 47.5"

Drilled By : Philip Olivier Date : 10/06/03 E-Coord : 28° 24' 42.7"

Profiled By : Sylvester Ndoora


Penetration :Minutes and seconds per meter
Borehole N0: 3128CD/SN/008
Minutes
0
1
2
3
4
5
6
7
8
Meters
0-1
4-5
8-9
12-13
16-17
20-21
24-25
28-29
32-33
36-37
40-41
44-45
48-49
52-53
56-57
60-61
64-65
68-69
72-73
76-77
80-81
84-85
88-89
92-93
96-97
100-101
104-105
108-109
112-113
116-117
120-121
124-125
128-129
132-133

IDUTYWA GROUNDWATER FEASIBILITY STUDY

BH : 3228AB/SN/009

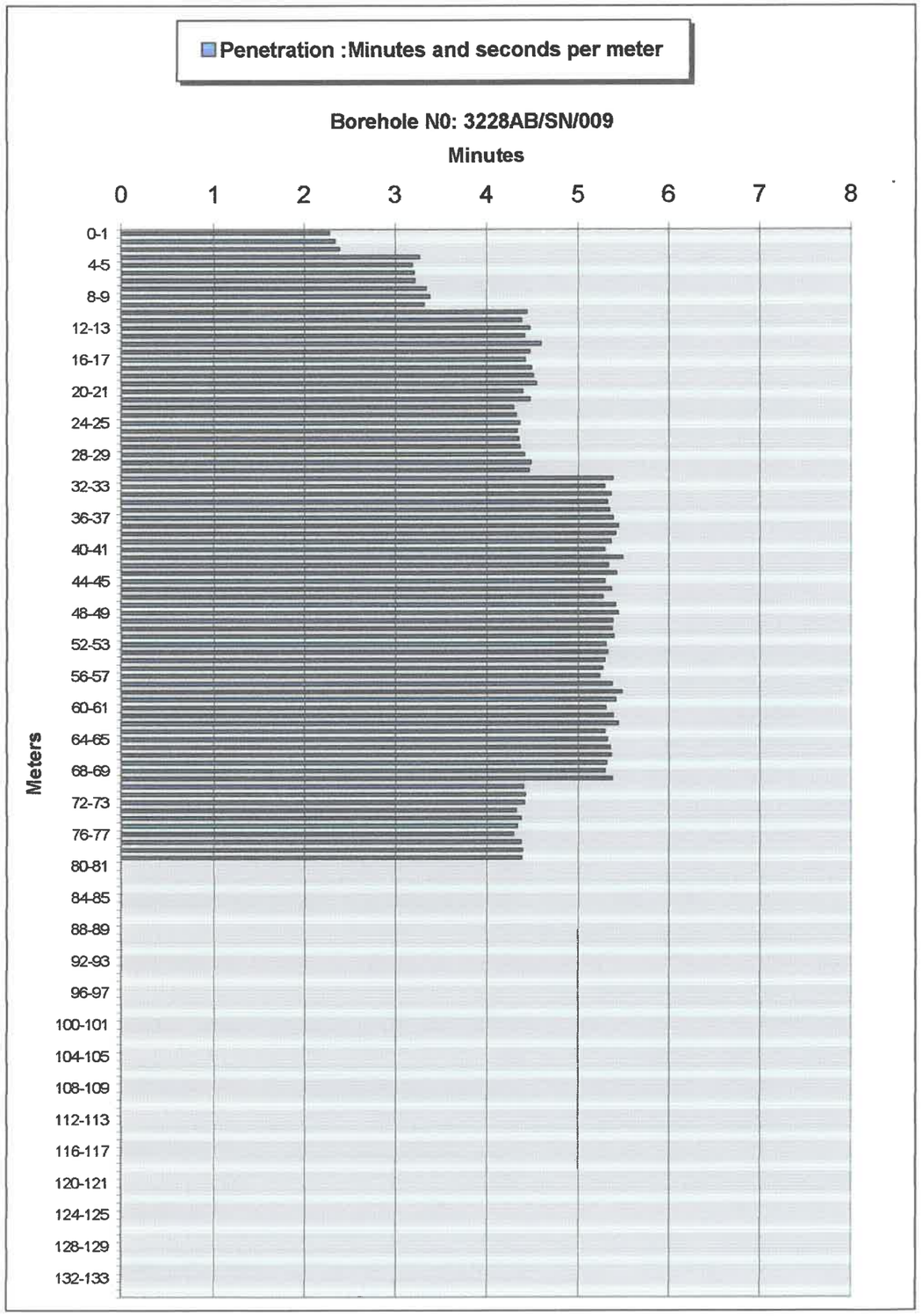
COMMUNITY : Colesa/ Doti

203mm	177mm	18 m Plain	1 m Clay. dark brown. overburden 3 m Clay, yellowish orange overburden 16 m Sandstone, yellowish, coarse grained, moderately weathered 20 m Sandstone, brownish, moderately fractured Sandstone, grey, coarse grained, fractured to 24 m 30m Siltstone, brownish, fresh. 34 m Dolerite, grey, fine grained, intercalated with brown siltstone, fresh 44 m Siltstone, brownish, intercalated with grey dolerite, fresh 52 m Dolerite, grey, fine grained, fresh 80 m
165mm			
DRILLING Rotary percussion	CASING	• Drilled depth = 80 m • Blow Yield = 2.2 l/s • Water Strike at : 18 m	

Contractor : Olivier & Sons Diam : 165mm S-Coord : 32° 04' 36.7"

Drilled By : Philip Olivier Date : 12/06/03 E-Coord : 28° 19' 49.5"

Profiled By : Sylvester Ndoora


Penetration :Minutes and seconds per meter
Borehole N0: 3228AB/SN/009
Minutes
0
1
2
3
4
5
6
7
8
Meters
0-1
4-5
8-9
12-13
16-17
20-21
24-25
28-29
32-33
36-37
40-41
44-45
48-49
52-53
56-57
60-61
64-65
68-69
72-73
76-77
80-81
84-85
88-89
92-93
96-97
100-101
104-105
108-109
112-113
116-117
120-121
124-125
128-129
132-133

IDUTYWA GROUNDWATER FEASIBILITY STUDY

BH : 3228AB/SN/010

COMMUNITY : Lencana

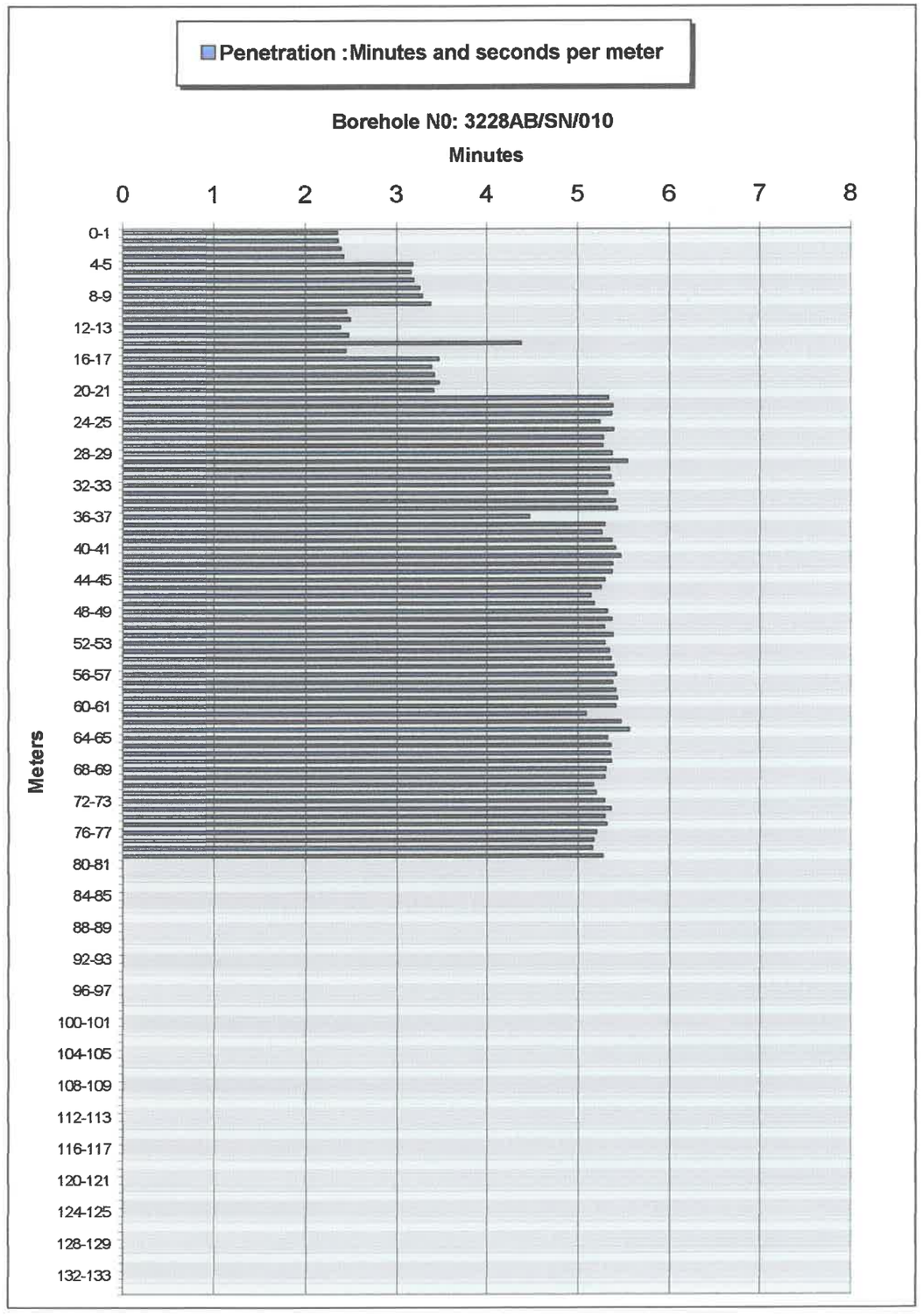
203mm	177mm	18 m Plain	0 – 4 m: Sandy clay, brown, overburden
			4 – 11 m: Clay, yellowish orange overburden
			11 – 17 m: Sandstone, beige, coarse grained, weathered
			17 – 22 m: Dolerite, light grey, fractured.
165mm			22 – 59 m: Dolerite, grey, coarse grained, fresh.
			59 – 62 m: Sandstone, light grey, coarse grained, fresh
			62 – 80 m: Dolerite, medium to fine grained, fresh
DRILLING Rotary percussion	CASING		

- Drilled depth = 80 m
- Blow Yield = 0.7 l/s
- Water Strike at : 22 m

Contractor : Olivier & Sons Diam : 165mm S-Coord : 32° 08' 52.4"

Drilled By : Philip Olivier Date : 12/06/03 E-Coord : 28° 20' 15.2"

Profiled By : Sylvester Ndoora


Penetration :Minutes and seconds per meter
Borehole N0: 3228AB/SN/010
Minutes
0
1
2
3
4
5
6
7
8
Meters
0-1
4-5
8-9
12-13
16-17
20-21
24-25
28-29
32-33
36-37
40-41
44-45
48-49
52-53
56-57
60-61
64-65
68-69
72-73
76-77
80-81
84-85
88-89
92-93
96-97
100-101
104-105
108-109
112-113
116-117
120-121
124-125
128-129
132-133

IDUTYWA GROUNDWATER FEASIBILITY STUDY

BH : 3228AB/SN/011

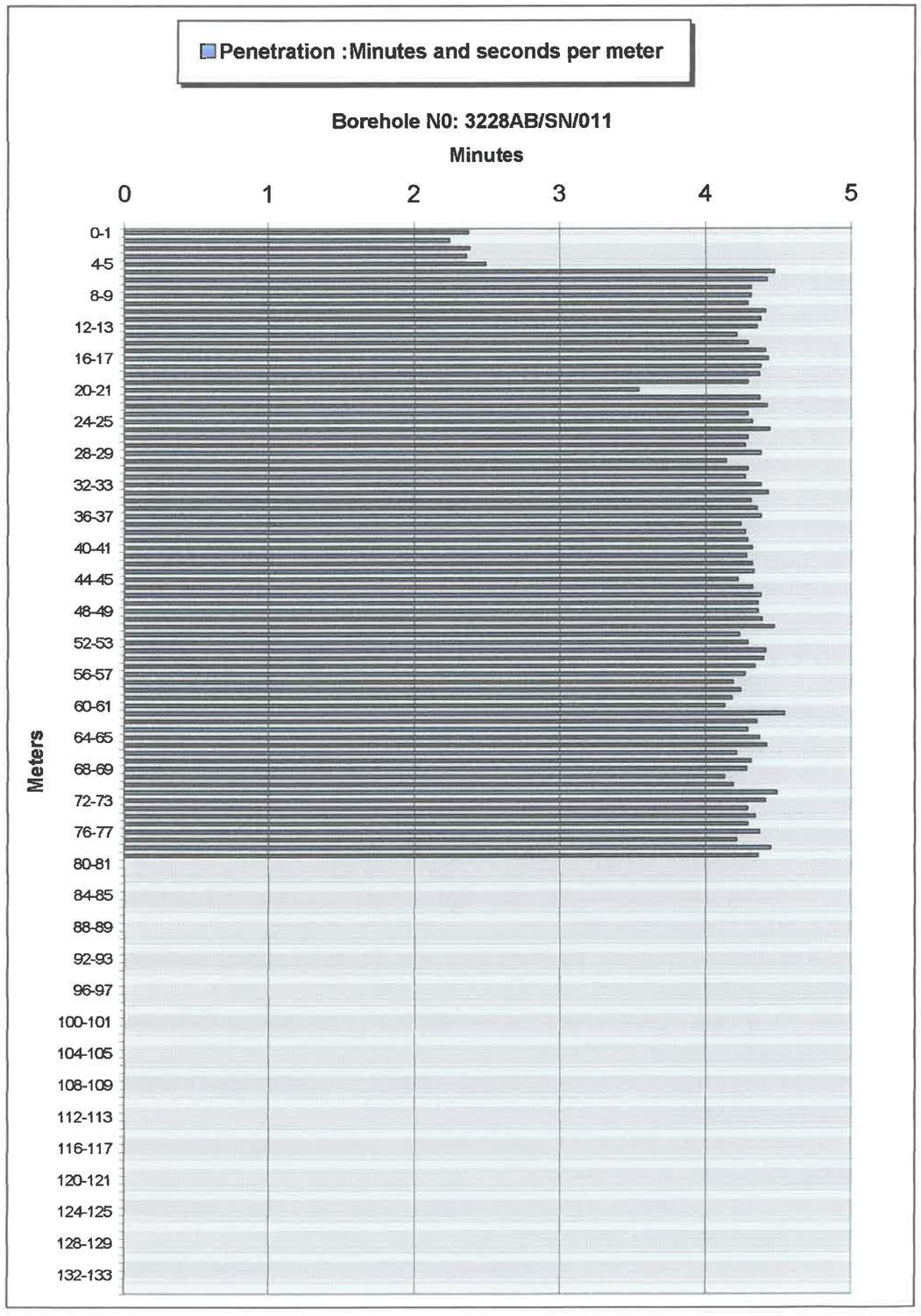
COMMUNITY : Qelana

203mm	177mm	0-12 m Plain 12-16 m Slotted	4 m	Clay, light brown, overburden
			7 m	Clayey sand, orange overburden
			12 m	Dolerite, dark grey, decomposed to 11 m and fractured at 12m,
165mm			35 m	Sandstone, light grey, coarse to medium grained, fresh to 35m and fractured to 28m
			65 m	Dolerite, dark grey, fractured at 52m
			78 m	Shale, dark grey, intercalated with coarse grained sandstone, fractured at 75 - 77 m
			80 m	Sandstone, light grey, coarse grained, fresh
DRILLING Rotary percussion	CASING	• Drilled depth = 80 m • Blow Yield = 2.0 l/s • Water Strike at : 9, 27, 52 m		

Contractor : Olivier & Sons Diam : 165mm S-Coord : 32° 10' 03.1"

Drilled By : Philip Olivier Date : 18/06/03 E-Coord : 28° 08' 08.7"

Profiled By : Sylvester Ndoora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IDUTYWA GROUNDWATER FEASIBILITY STUDY

BH : 3228BA/SN/012

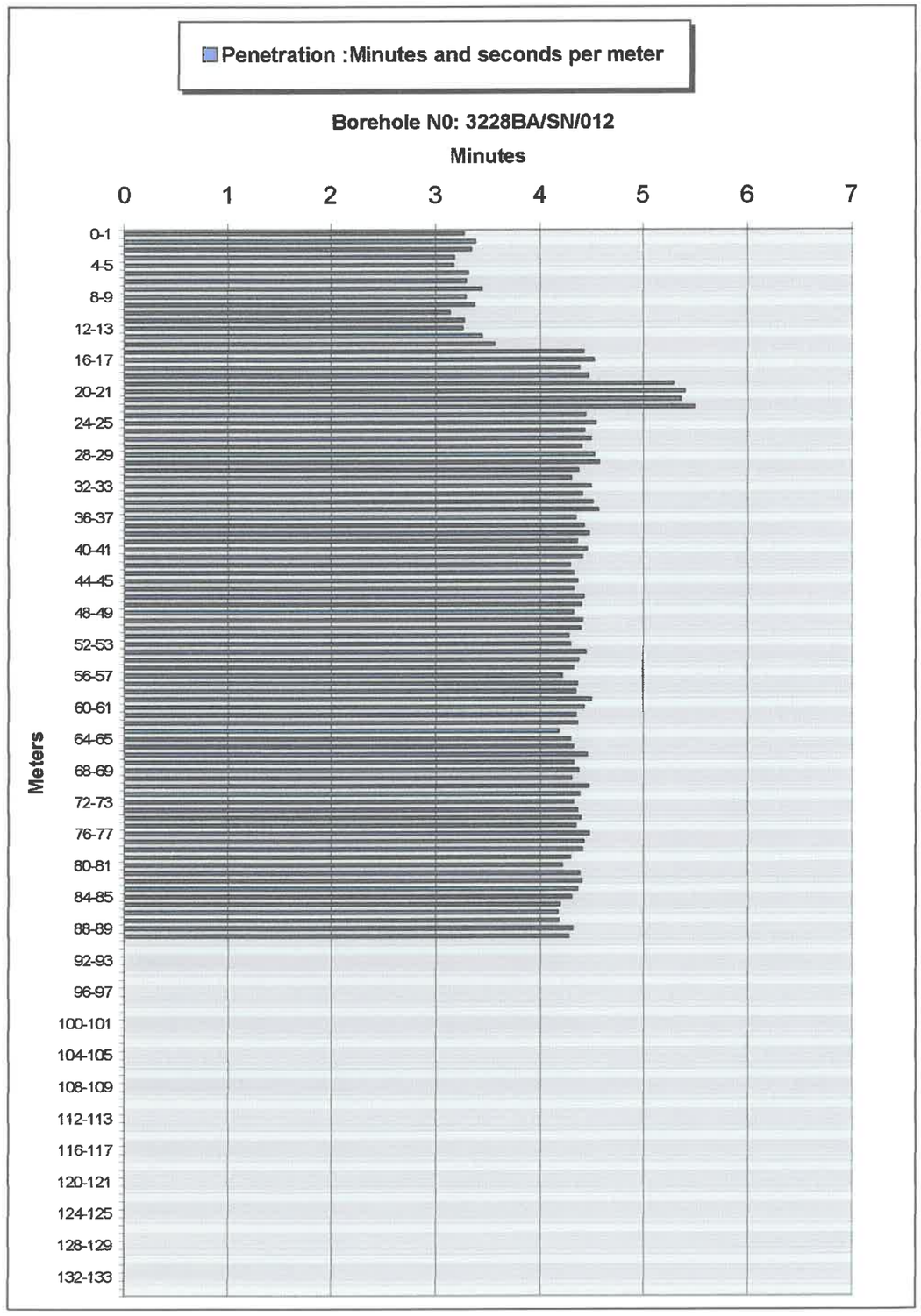
COMMUNITY : Fort Malan

203mm	177mm	0-16 m Plain 16-22 m Slotted	4 m	Clay, red, overburden
			13 m	Clay, brown, overburden
			22 m	Dolerite, brownish, decomposed, coarse grained.
165mm			38 m	Dolerite, grey with quartz fragments, fractured at 27 – 28m
			61 m	Quartzitic sandstone, coarse to medium grained, fresh.
			72 m	Dolerite, grey, intercalated with brown siltstone
			90 m	Siltstone, brownish, intercalated with grey shale, fractured at 78 – 78 m
DRILLING Rotary percussion	CASING	• Drilled depth = 90 m • Blow Yield = 3.3 l/s • Water Strike at : 12, 36, 77 – 78m		

Contractor : Olivier & Sons Diam : 165mm S-Coord : 32° 09' 12.2"

Drilled By : Philip Olivier Date : 19/06/03 E-Coord : 28° 31' 34.0"

Profiled By : Sylvester Ndoora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IDUTYWA GROUNDWATER FEASIBILITY STUDY

BH : 3228BA/SN/013

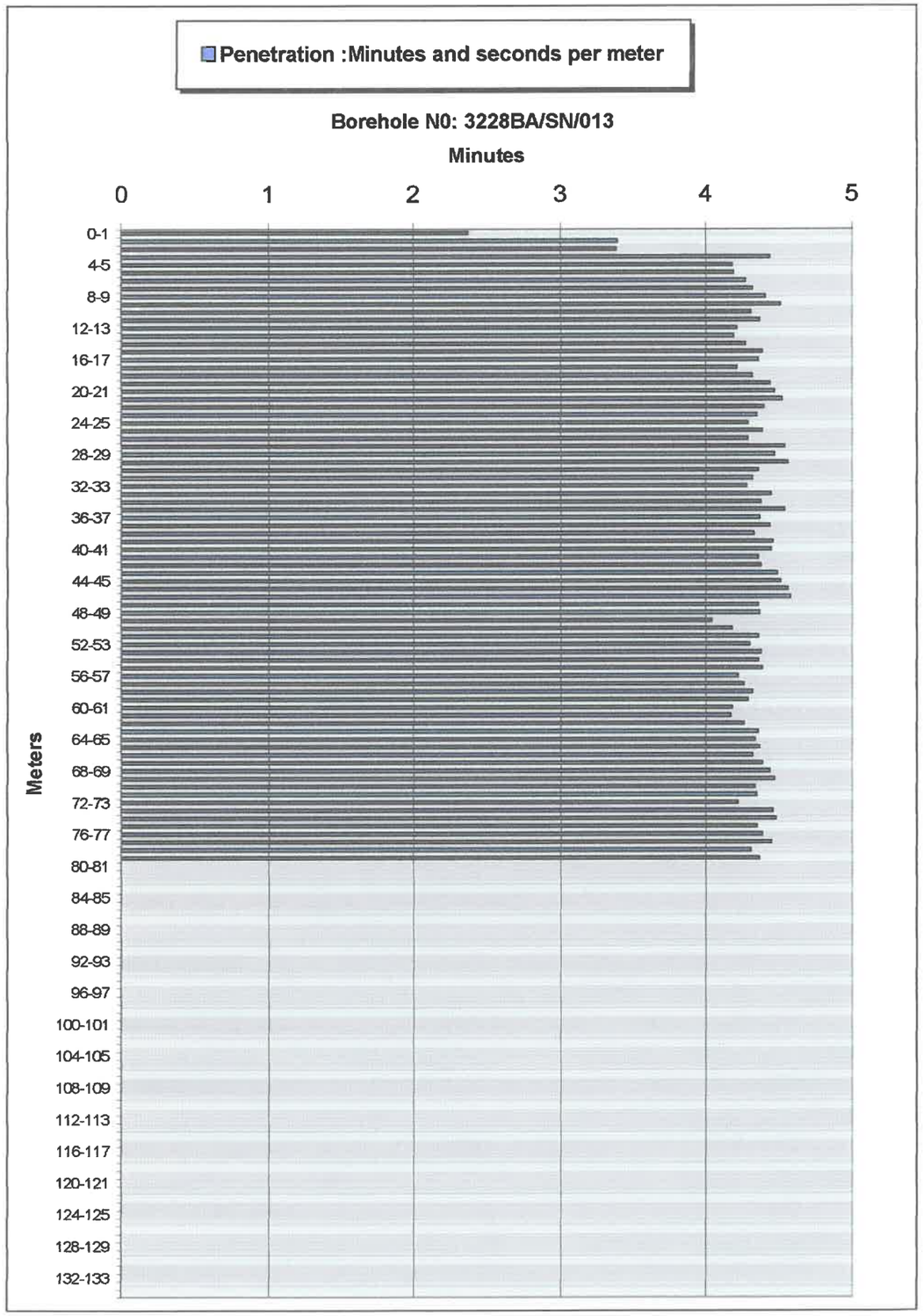
COMMUNITY : Mnandi

203mm	177mm	19 m Plain	5 m: Clay, red, overburden 15 m: Dolerite, brownish, decomposed 19 m: Dolerite, brownish, fractured 54 m: Quartzitic sandstone, grey, coarse grained, fractured at 96 m 80 m: Dolerite, grey, fine grained, fractured at 76 m.
165mm			
DRILLING Rotary percussion	CASING	• Drilled depth = 80 m • Blow Yield = 1.7 l/s • Water Strike at : 20, 44 m	

Contractor : Olivier & Sons Diam : 165mm S-Coord : 32° 07' 07.8"

Drilled By : Philip Olivier Date : 21/06/03 E-Coord : 28° 32' 24.0"

Profiled By : Sylvester Ndoora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IDUTYWA GROUNDWATER FESEAIBILITY STUDY

BH : 3228AA/SN/014

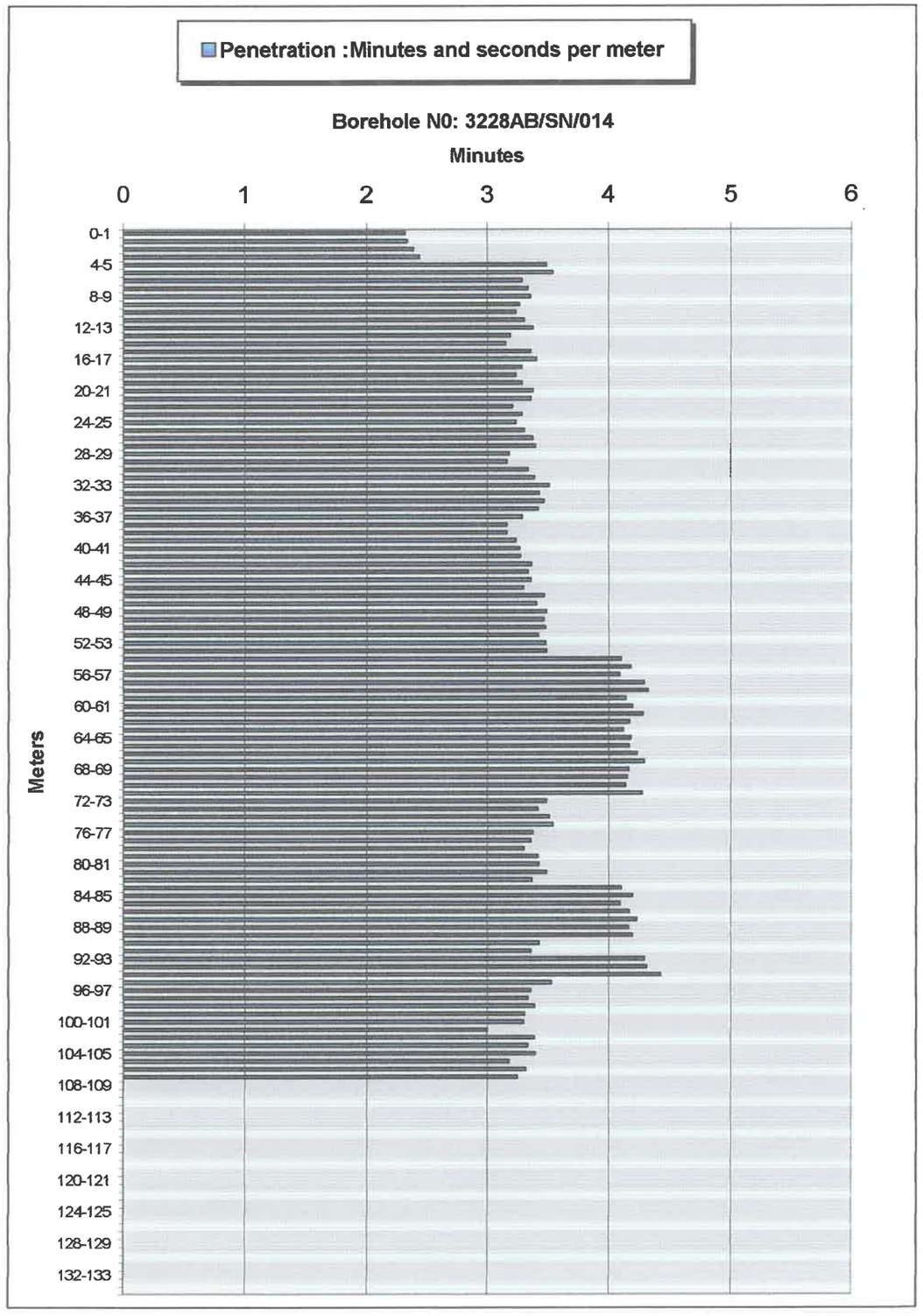
COMMUNITY : KwaTenzi

203mm	177mm	6 m Plain	4 m	Clay, brown, overburden
			7 m	Sandstone, brown, fine grained,weathered
165mm			22 m	Sandstone, grey-white, intercalated with purplish siltstone at 11 –12m, fine grained,
			30 m	Sandstone, light grey, medium to fine grained, fresh
			48 m	Sandstone, pinkish, medium to fine grained, fresh.
			96 m	Sandstone, grey, medium grained, fractured at 96 m
			101 m	Sandstone, grey intercalated with purplish siltstone, medium to fine grained
			108 m	Sandstone, grey, medium grained, fresh
DRILLING Rotary percussion	CASING	• Drilled depth = 108 m • Blow Yield = 0.4 l/s • Water Strike at : 36 m		

Contractor : Olivier & Sons Diam : 165mm S-Coord : 32° 01' 43.5"

Drilled By : Philip Olivier Date : 23/06/03 E-Coord : 28° 13' 15.3"

Profiled By : Sylvester Ndoora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132-133

IDUTYWA GROUNDWATER FEASIBILITY STUDY

BH : 3228AA/SN/015

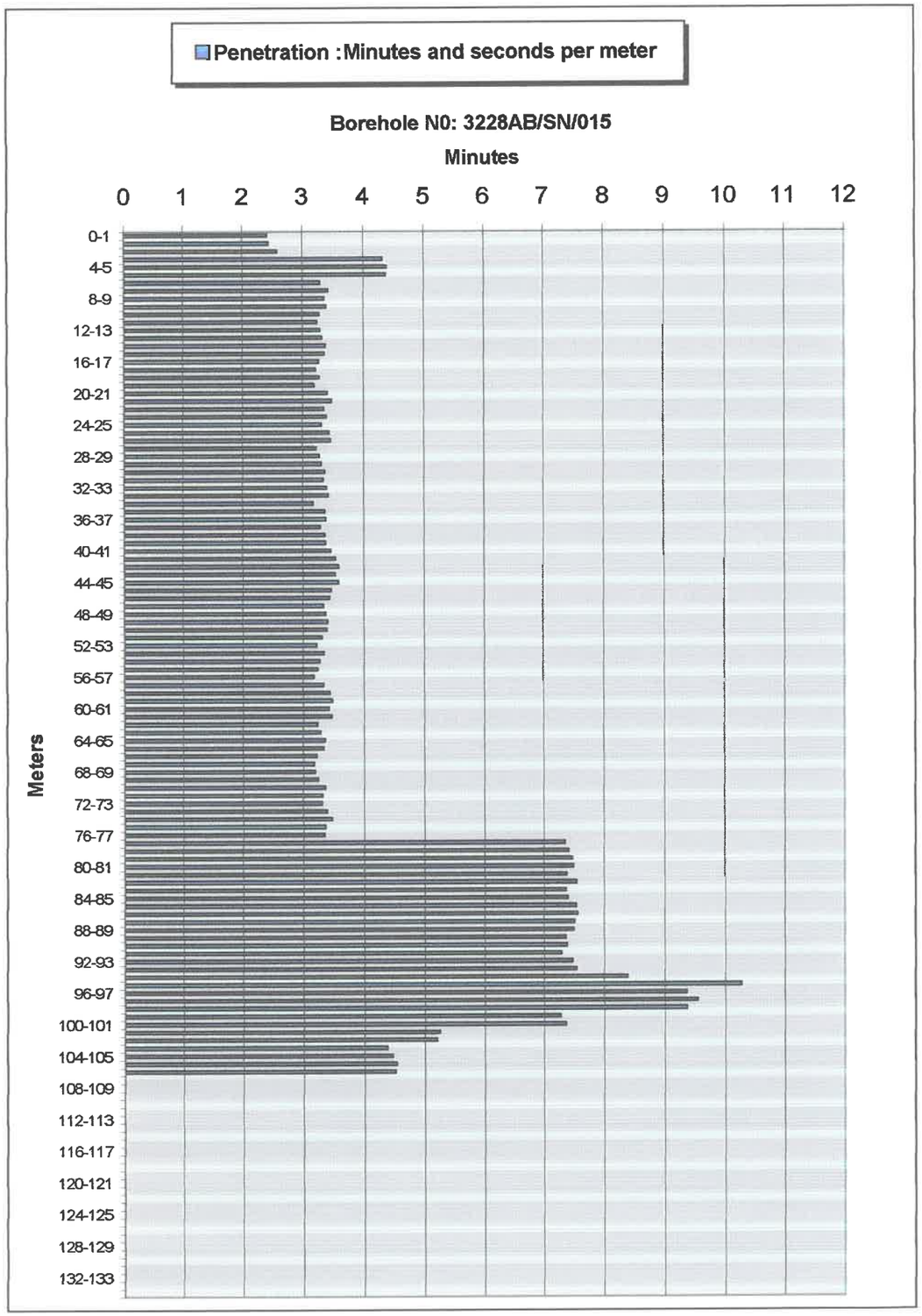
COMMUNITY : KuVinindwa

203mm	177mm	6 m Plain	4 m	Clay, light brown, overburden
			13 m	Sandstone, biege, medium grained,weathered
165mm			24 m	Sandstone, whitish, coarse grained, fresh.
			31 m	Siltstone, brownish, fine grained
			72 m	Sandstone, whitish, medium to fine grained, fresh.
			75 m	Sandstone, grey, medium to fine grained, fractured
			99 m	Dolerite, dark grey, medium to fine grained , fresh
			110 m	Sandstone, light grey, medium grained, slightly fractured
DRILLING Rotary percussion	CASING	• Drilled depth = 110 m • Blow Yield = 0.2 l/s • Water Strike at : 75 m		

Contractor : Olivier & Sons Diam : 165mm S-Coord : 32° 56' 37.6"

Drilled By : Philip Olivier Date : 25/06/03 E-Coord : 28° 13' 27.9"

Profiled By : Sylvester Ndoora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Borehole N0: 3228AB/SN/015
Minutes
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Meters
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IDUTYWA GROUNDWATER FEASIBILITY STUDY

BH : 3228AB/SN/016

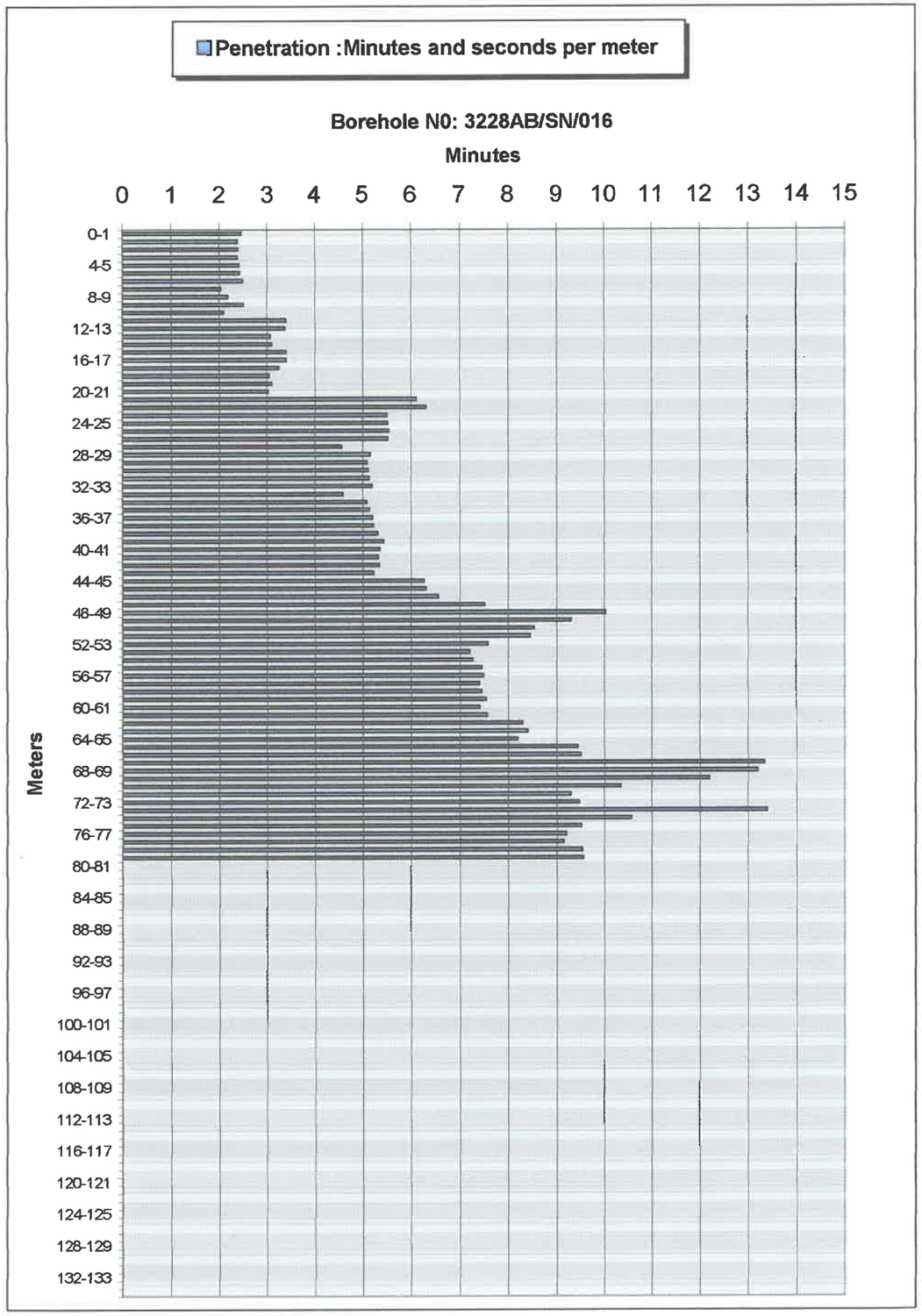
COMMUNITY : Sheshegu

203mm	177mm	6 m Plain	0 m – 3 m: Clay, brown, overburden
			3 m – 12 m: Sandstone, yellowish, weathered
165mm			12 m – 20 m: Dolerite, light grey, medium grained fractured.
			20 m – 26 m: Dolerite, grey, fractured
			26 m – 32 m: Sandstone, light grey, coarse grained, fresh.
			32 m – 42 m: Dolerite, dark grey, fresh
			42 m – 58 m: Sandstone, light grey, medium grained, fresh
			58 m – 64 m: Shale, dark grey, moderately fractured
			64 m – 80m: Sandstone, light grey to grey, medium grained, intercalated with shale, fresh
DRILLING Rotary percussion	CASING	• Drilled depth = 80 m • Blow Yield = 3.3 l/s • Water Strike at : 22, 40, 63 - 64 m	

Contractor : Olivier & Sons Diam : 165mm S-Coord : 32° 08' 07.6"

Drilled By : Philip Olivier Date : 27/06/03 E-Coord : 28° 18' 00.8"

Profiled By : Sylvester Ndoora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Borehole N0: 3228AB/SN/016
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IDUTYWA GROUNDWATER FEASIBILITY STUDY

BH : 3228AB/SN/017

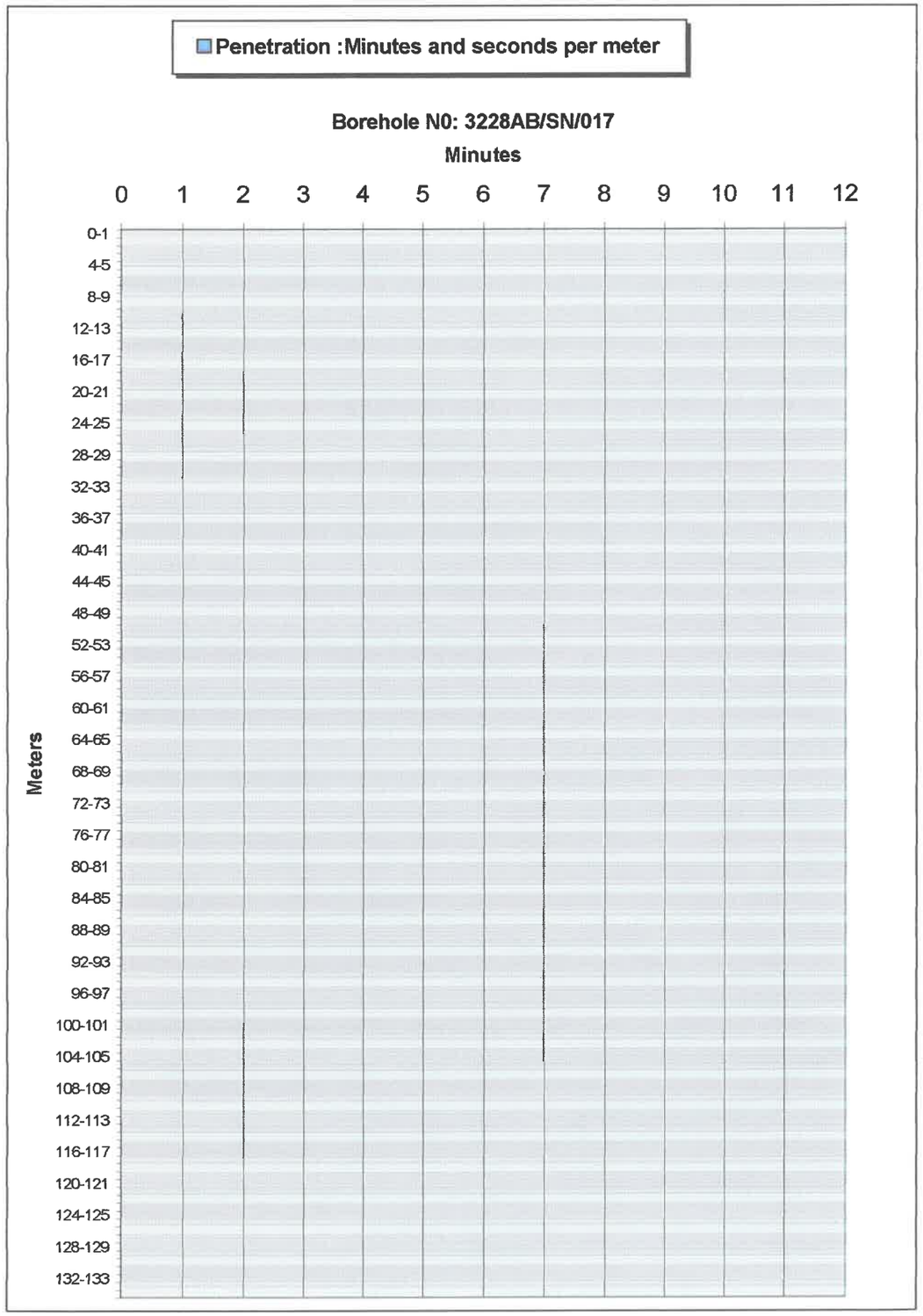
COMMUNITY : Mamfaneni

203mm	177mm	6 m Plain		Clay, yellowish brown, overburden
			4 m	Dolerite, yellowish, medium grained,weathered
			11 m	Dolerite, grey, medium grained fractured.
			18 m	Dolerite, brownish, fractured
165mm			21 m	Sandstone, light grey, coarse grained, fresh.
			30 m	Dolerite, grey, fresh
			36 m	Sandstone, light grey, coarse grained, fresh
			39 m	Dolerite, grey, medium grained
			48 m	Sandstone, light grey to grey, medium grained, intercalated with
			80m	
DRILLING Rotary percussion	CASING	• Drilled depth = 80 m • Blow Yield = 0.6 l/s • Water Strike at : 20, 32, 51 m		

Contractor : Olivier & Sons Diam : 165mm S-Coord : 32° 08' 07.6"

Drilled By : Philip Olivier Date : 27/06/03 E-Coord : 28° 18' 00.8"

Profiled By : Sylvester Ndoora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Borehole N0: 3228AB/SN/017
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IDUTYWA GROUNDWATER FEASIBILITY STUDY

BH : 3228AB/SN/018

COMMUNITY : Msintsana

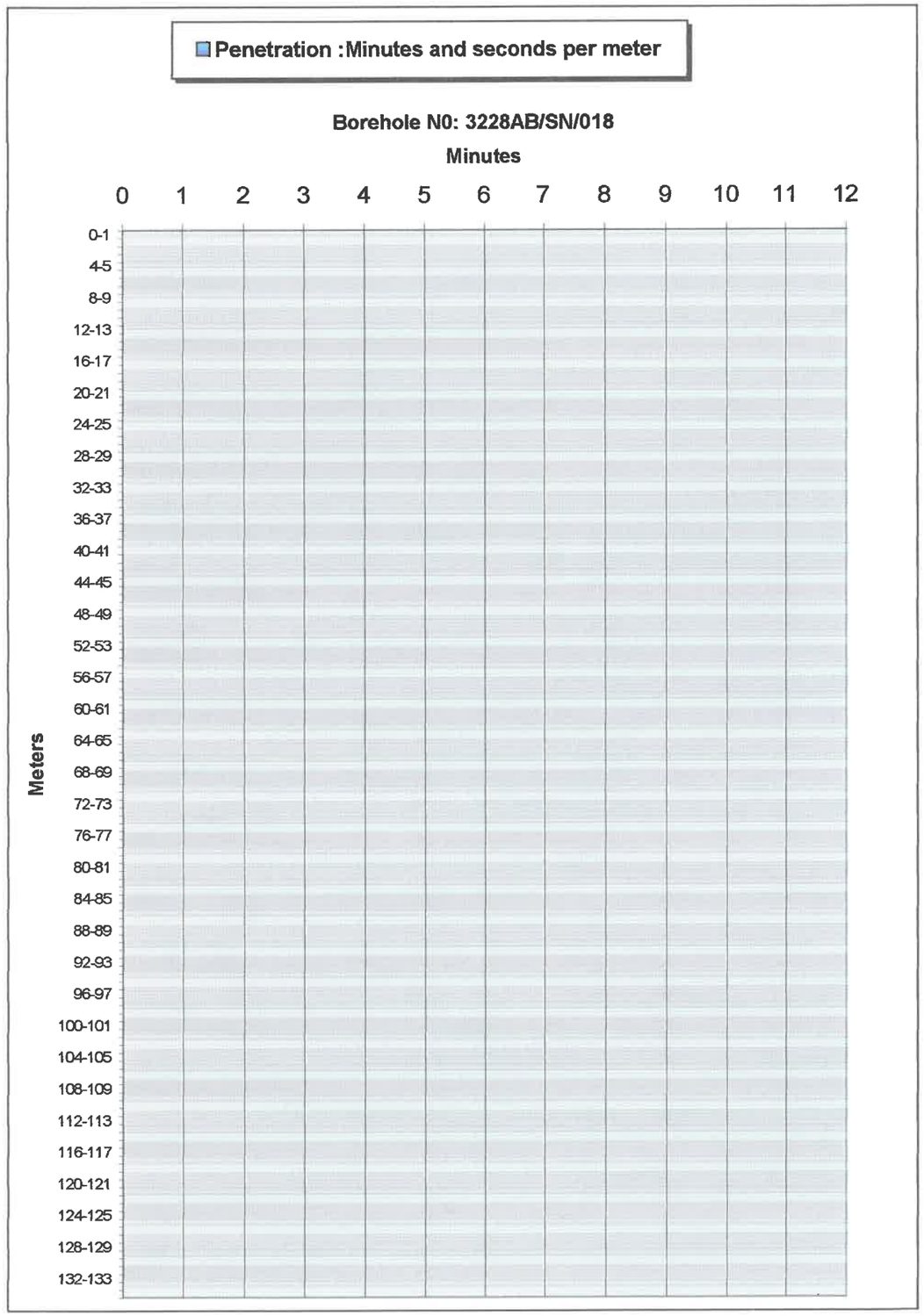
203mm	177mm	0 – 12 Plain	12 m	Gravelly sand, yellowish, overburden
			14 m	Dolerite, yellowish, fine grained, weathered
165mm			43 m	Sandstone, whitish, medium to fine grained, slightly fractured at 31-32 m.
			100 m	Sandstone, whitish, fine grained, fresh
DRILLING Rotary percussion	CASING			

- Drilled depth = 100 m
- Blow Yield = Dry
- Water Strike at : Dry

Contractor : Olivier & Sons Diam : 165mm S-Coord : 32° 09' 11.6"

Drilled By : Philip Olivier Date : 30/06/03 E-Coord : 28° 23' 01.4"

Profiled By : Sylvester Ndoora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IDUTYWA GROUNDWATER FEASIBILITY STUDY

BH : 3228AB/SN/019

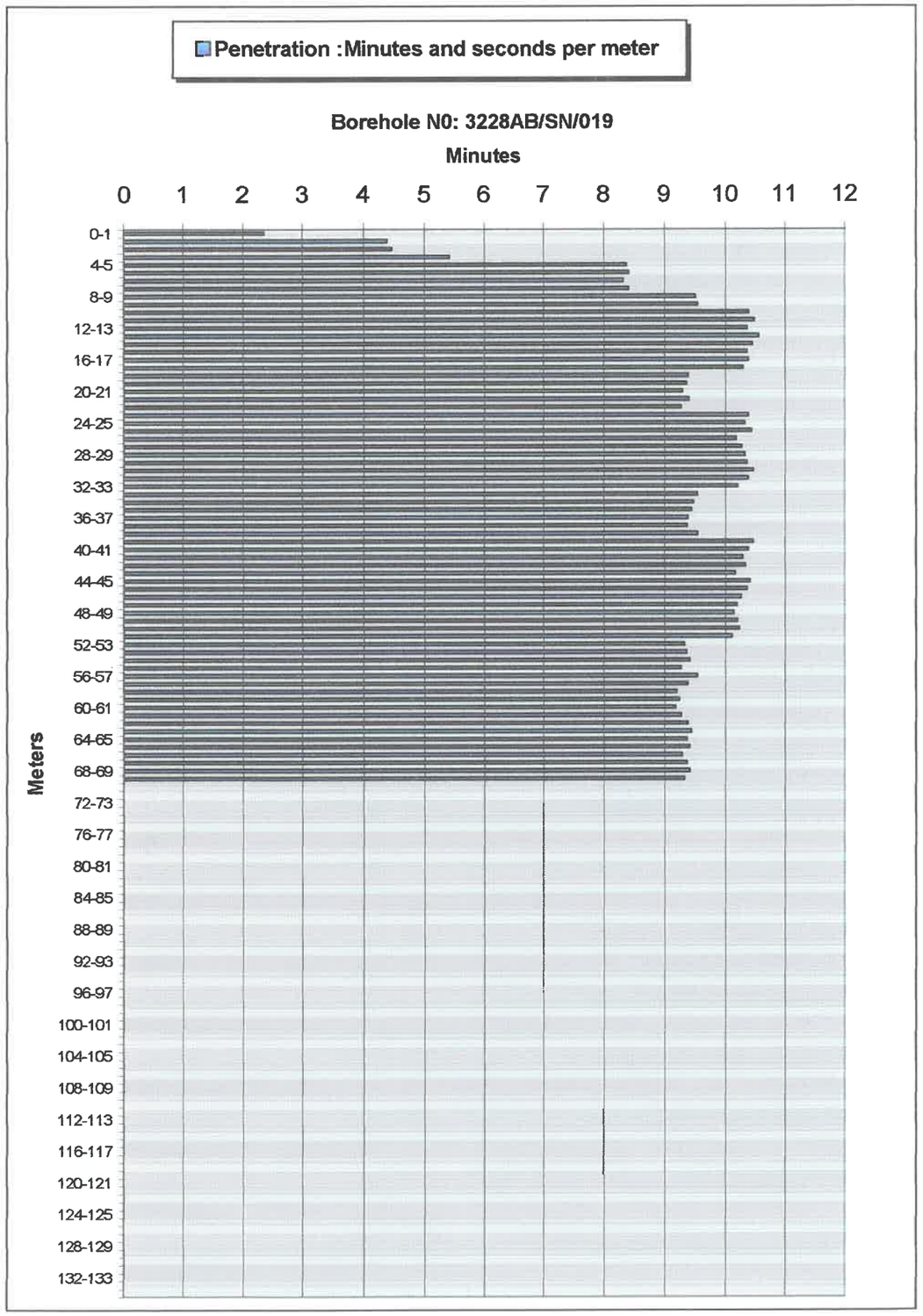
COMMUNITY : Mtovi

203mm	177mm	0 – 8 Plain 8 –14 Slotted	1 m	Clav. dark brown. overburden Clay, red, overburden
			3 m	Dolerite, khaki medium grained, decomposed
			14 m	Dolerite, grey, medium grained fractured.
165mm			16 m	Dolerite, grey, medium grained, fresh
			26 m	Sandstone, grey-white, medium grained, fractured at 36 m.
			42 m	Dolerite, grey intercalated with brown siltstone at 43 – 43 m, medium grained, fresh
			53 m	Siltstone, brownish, intercalated with brown shale, fractured at 62 m.
			65 m	Sandstone, grey, medium grained, intercalated with brown, moderately fractured
			70 m	
DRILLING Rotary percussion	CASING	• Drilled depth = 70 m • Blow Yield = 6 l/s • Water Strike at : 14, 36, 62 m		

Contractor : Olivier & Sons Diam : 165mm S-Coord : 32° 08' 16.6"

Drilled By : Philip Olivier Date : 04/07/03 E-Coord : 28° 24' 25.5"

Profiled By : Sylvester Ndoora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Borehole N0: 3228AB/SN/019
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Meters
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IDUTYWA GROUNDWATER FEASIBILITY STUDY

BH : 3228AB/SN/020

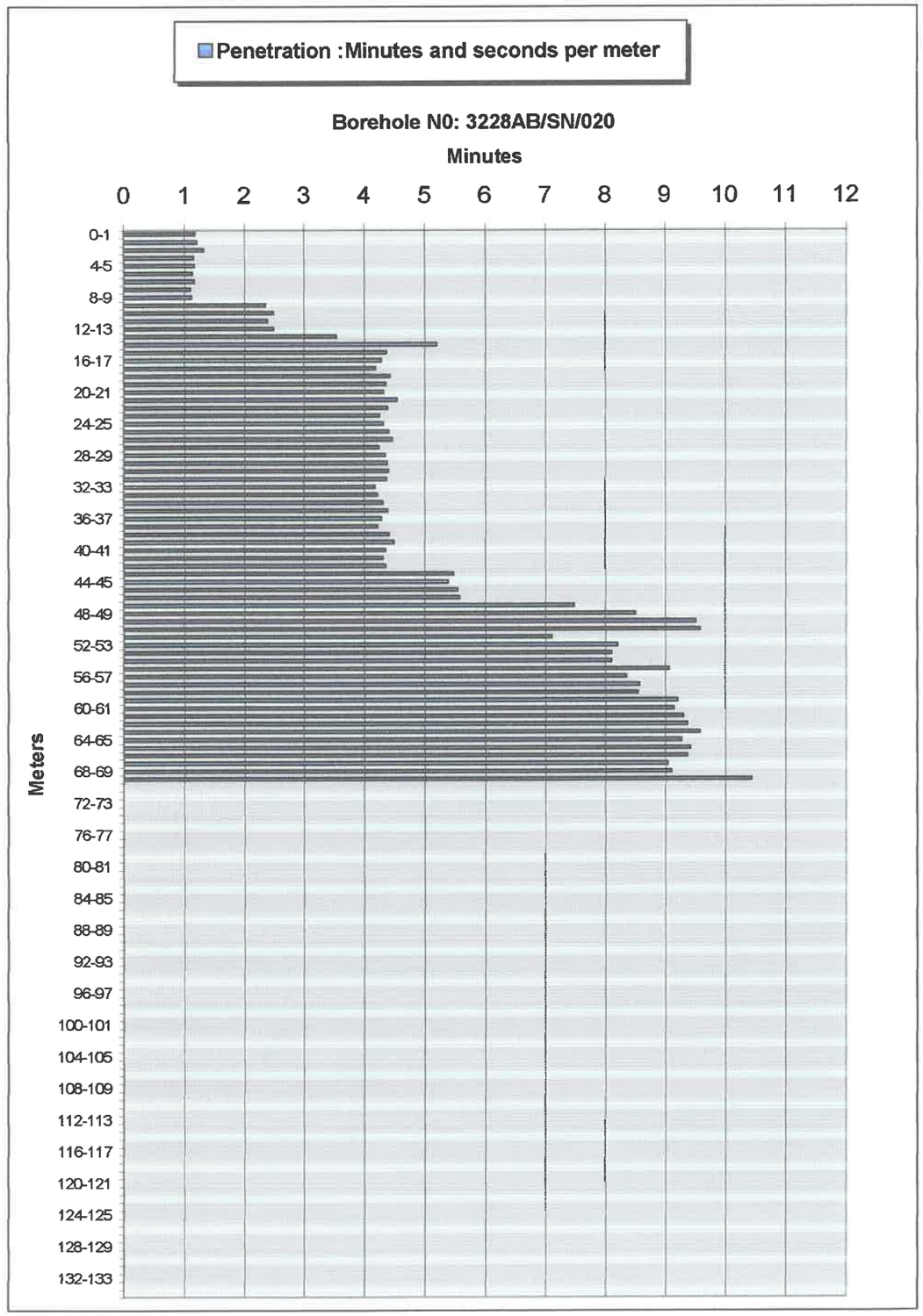
COMMUNITY : Tafeni

203mm	177mm	15m Plain	0 – 4 m: Clay, reddish, overburden 4 – 11 m: Clayey sand, medium grained, overburden 11 – 14 m: Dolerite, brownish, coarse grained, decomposed 14 – 27 m: Dolerite, grey, fractured between14 – 20 m 27 – 32 m: Sandstone, grey, medium grained, moderately fractured. 32 – 48 m: Dolerite, purplish, medium grained, fresh 48 – 57 m: Dolerite, light grey, medium grained, fresh 57 – 80 m: Dolerite intercalated with brown siltstone, moderately fractured
165mm			
DRILLING Rotary percussion	CASING	• Drilled depth = 80 m • Blow Yield = 5 l/s • Water Strike at : 16, 64 m	

Contractor : Olivier & Sons Diam : 165mm S-Coord : 32° 07' 17.5"

Drilled By : Philip Olivier Date : 04/07/03 E-Coord : 28° 26' 11.0"

Profiled By : Sylvester Ndoora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Meters
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132-133

IDUTYWA GROUNDWATER FEASIBILITY STUDY

BH : 3228AB/SN/021

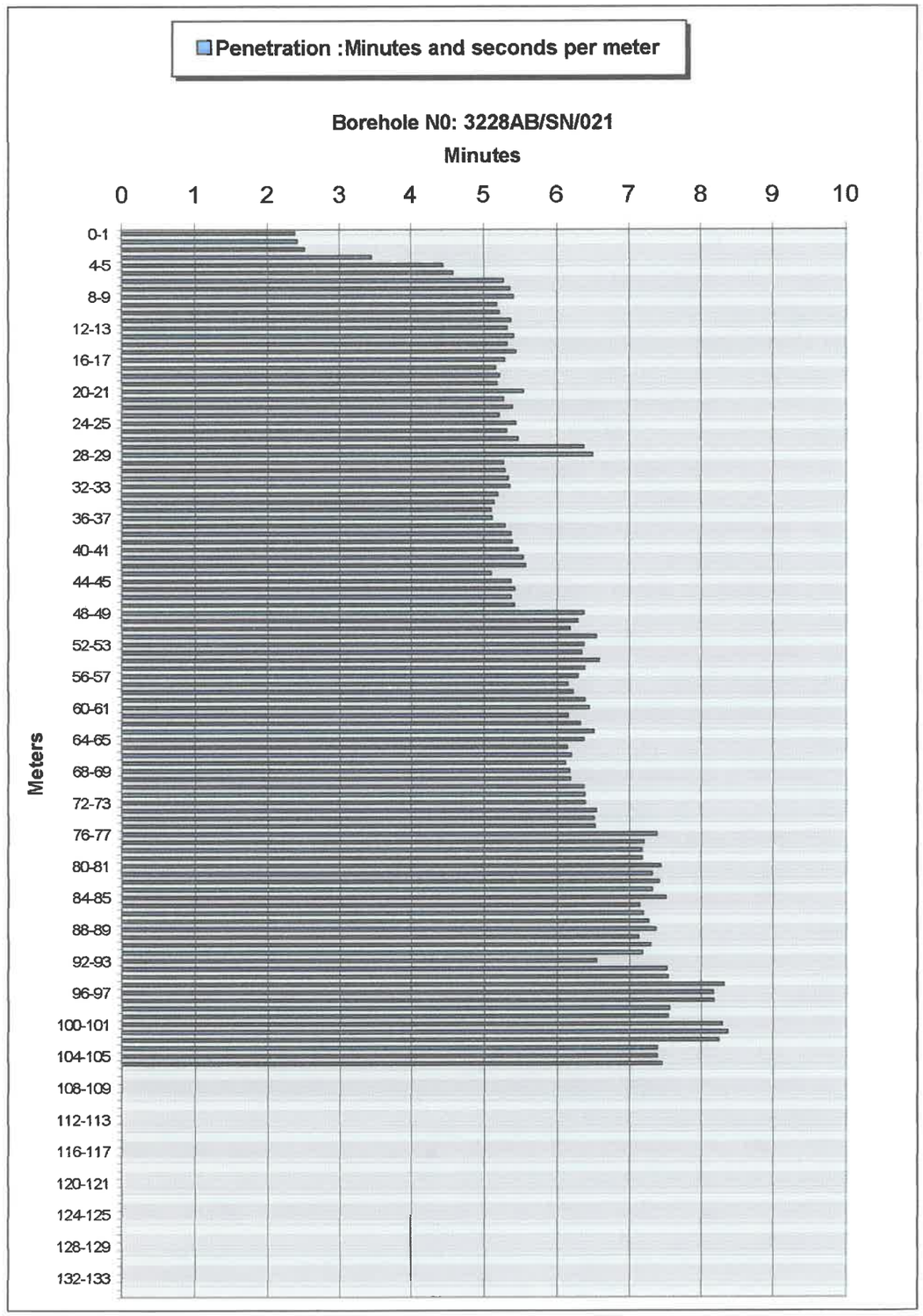
COMMUINITY : Cungweni

203mm	177mm	6 m Plain	Clay, yellowish, overburden 4 m Sandstone, light brown, medium grained, weathered 7 m Sandstone, whitish, medium grained, slightly weathered 21 m Dolerite, light grey, fresh 36 m Sandstone, grey-white, medium grained, fresh 48 m Dolerite, grey, fractured at 31 – 32 m 59 m Sandstone, grey-white, medium grained, fresh. 64 m Dolerite, grey, medium grained, fresh 69 m Sandstone, grey, medium grained, fractured at 82 – 83 m 88 m Dolerite, grey, intercalated with brown shale 96 m Sandstone, grey, coarse grained, intercalated with brown shale 106 m
165mm			
DRILLING Rotary percussion	CASING	• Drilled depth = 106 m • Blow Yield = 0.7 l/s • Water Strike at : 64, 83 m	

Contractor : Olivier & Sons Diam : 165mm S-Coord : 32° 06' 59.6"

Drilled By : Philip Olivier Date : 07/07/03 E-Coord : 28° 27' 27.1"

Profiled By : Sylvester Ndoora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132-133

IDUTYWA GROUNDWATER FEASIBILITY STUDY

BH : 3228AB/SN/022

COMMUNITY : Tyekelebende

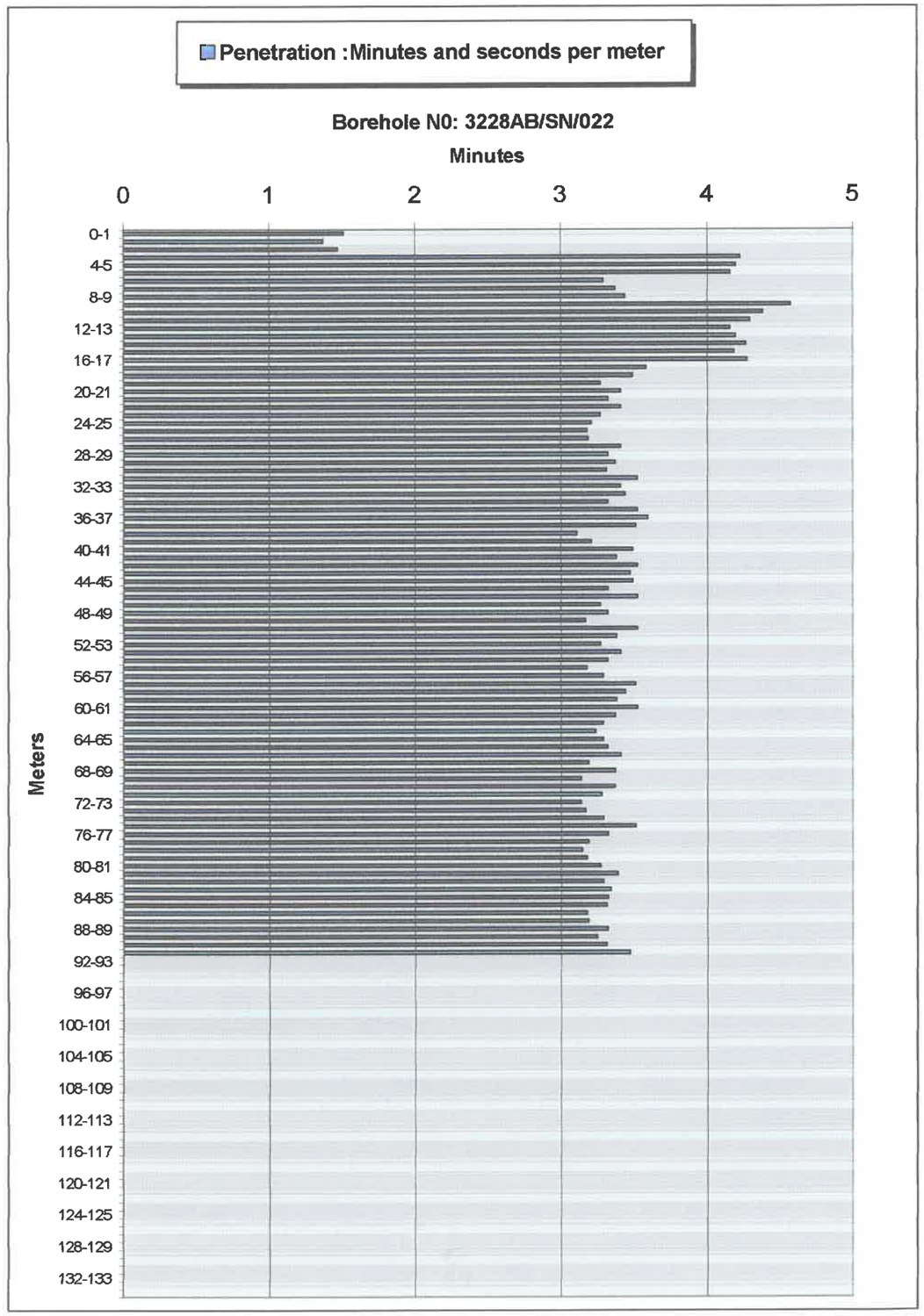
203mm	177mm	6 m Plain	2 m: Clayey sand, brown, overburden 4 m: Sandstone, yellowish, medium grained 21 m: Sandstone, grey to dark grey, medium grained fresh from 17 – 21 m 42 m: Dolerite, grey, fractured at 31 – 32 m 48 m: Sandstone, light grey, medium grained 58 m: Dolerite, dark grey, fine grained fresh. 80 m: Sandstone, grey-white, grained, fresh 92 m: Dolerite, brownish, intercalated with grey sandstone
165mm			
DRILLING Rotary percussion	CASING		

- Drilled depth = 80 m
- Blow Yield = 0.2 m^3/hr
- Water Strike at : 12 m

Contractor : Olivier & Sons Diam : 165mm S-Coord : 32° 05' 56.1"

Drilled By : Philip Olivier Date : 08/07/03 E-Coord : 28° 26' 36.7"

Profiled By : Sylvester Ndoora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Meters
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IDUTYWA GROUNWATER FEASIBILITY STUDY

BH : 3228AB/SN/023

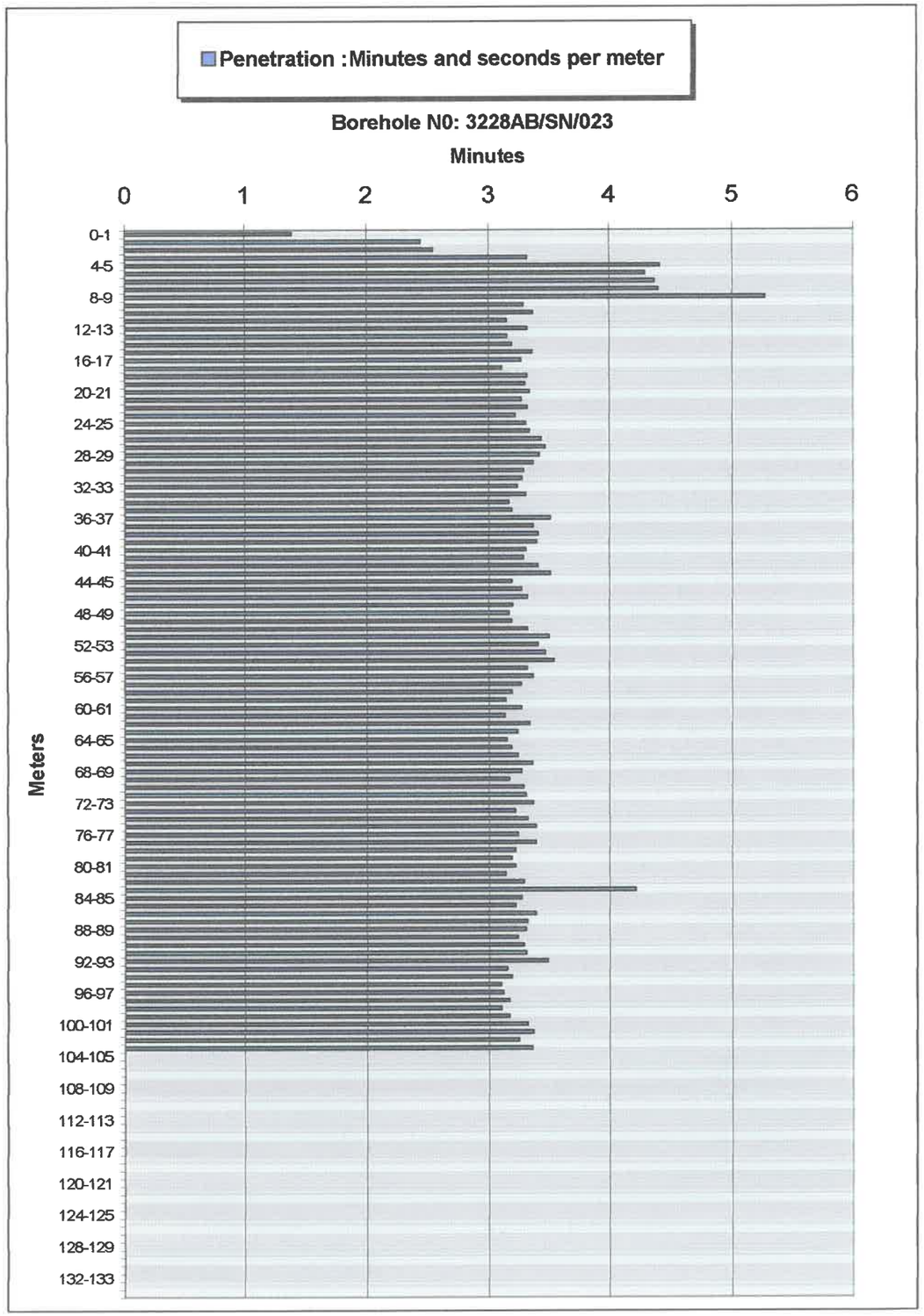
COMMUNITY : Cungweni/Ebende

203mm	177mm	9 m Plain	3 m	Clay, brown to 2m and yellowish to 3 m, overburden
			8 m	Dolerite, grey, fractured
			11 m	Sandstone, light grey, coarse grained, fresh.
165mm			35 m	Dolerite, light grey, medium to fine grained, fresh
			47 m	Dolerite, purplish to 44m and light grey to 47m, fine grained, fresh
			74 m	Dolerite, grey fine grained, intercalated with whitish sandstone at 69 – 70m, fresh
			82 m	Shale, black intercalated with dolerite, fractured at 69 – 70 m
			84 m	Calcareous shale, grey-white, slightly fractured.
			104 m	Dolerite, dark grey, fine grained, fresh
DRILLING Rotary percussion	CASING	• Drilled depth = 104 m • Blow Yield = 0.6 l/s • Water Strike at : 11, 25 m		

Contractor : Olivier & Sons Diam : 165mm S-Coord : 32° 08' 39.6"

Drilled By : Philip Olivier Date : 09/07/03 E-Coord : 28° 27' 41.6"

Profiled By : Sylvester Ndoora


Penetration :Minutes and seconds per meter
Borehole N0: 3228AB/SN/023
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Meters
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100-101
104-105
108-109
112-113
116-117
120-121
124-125
128-129
132-133

IDUTYWA GROUNDWATER FEASIBILITY STUDY

BH : 3228BA/SN/024

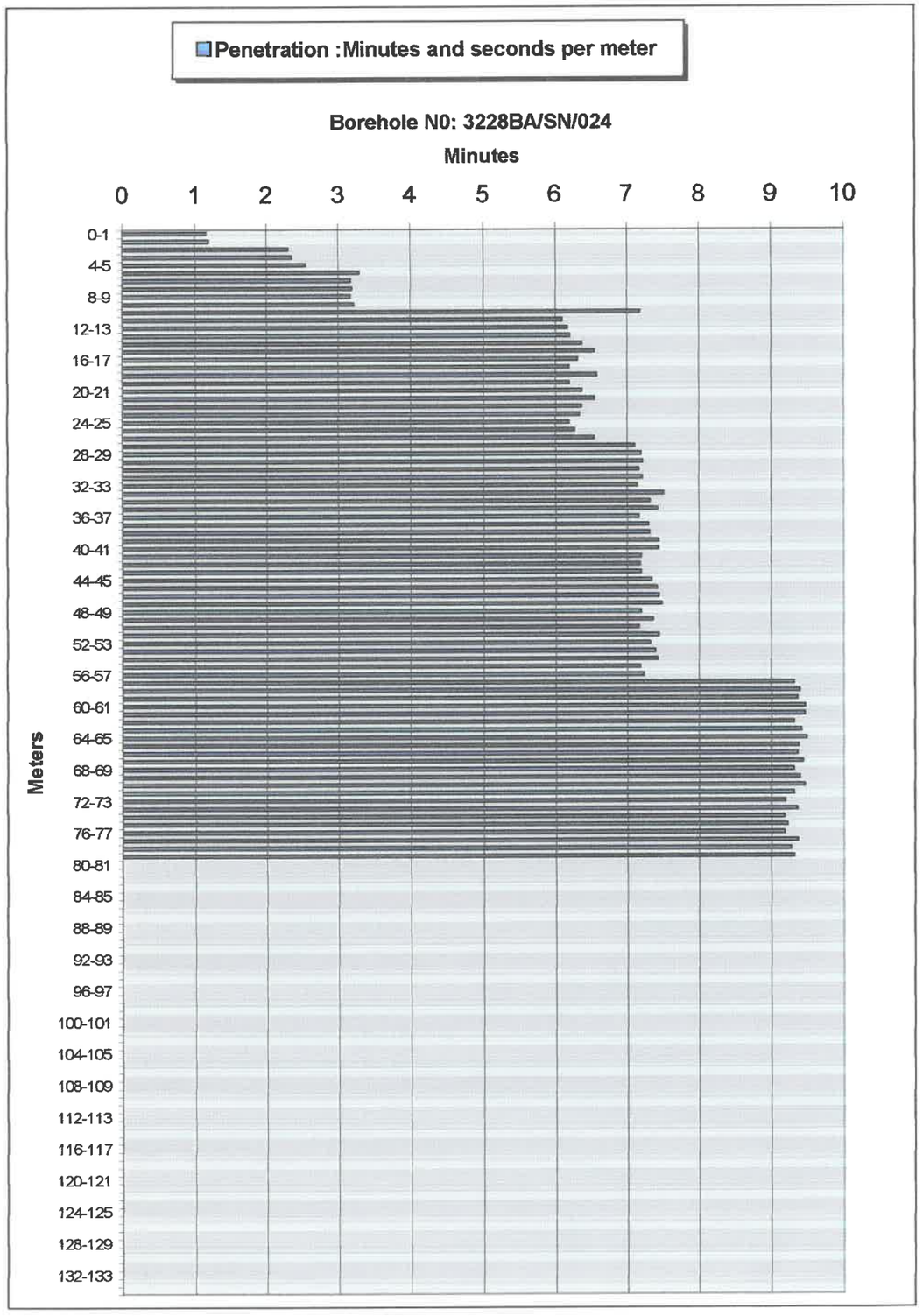
COMMUINITY : Mxotwa

203mm	177mm	9 m Plain	2 m	Clay, reddish, overburdern
			4 m	Gravelly, clay, brownish, overburden
165mm				Dolerite, grey, medium to fine grained, fractured at 9 m.
			50 m	Mudstone, purplish, fresh
			56 m	Mudstone, grey, fine grained fresh
			73 m	Dolerite, grey, fine grained, fresh
			80 m	
DRILLING Rotary percussion	CASING	• Drilled depth = 92 m • Blow Yield = Seepage • Water Strike at : 14 m		

Contractor : Olivier & Sons Diam : 165mm S-Coord : 32° 05' 34.8"

Drilled By : Philip Olivier Date : 10/07/03 E-Coord : 28° 33' 46.1"

Profiled By : Sylvester Ndoora


Penetration :Minutes and seconds per meter
Borehole N0: 3228BA/SN/024
Minutes
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Meters
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4-5
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20-21
24-25
28-29
32-33
36-37
40-41
44-45
48-49
52-53
56-57
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76-77
80-81
84-85
88-89
92-93
96-97
100-101
104-105
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112-113
116-117
120-121
124-125
128-129
132-133

IDUTYWA GROUNDWATER FEASIBILITY STUDY

BH : 3228AB/SN/025

COMMUNITY : Kratshini

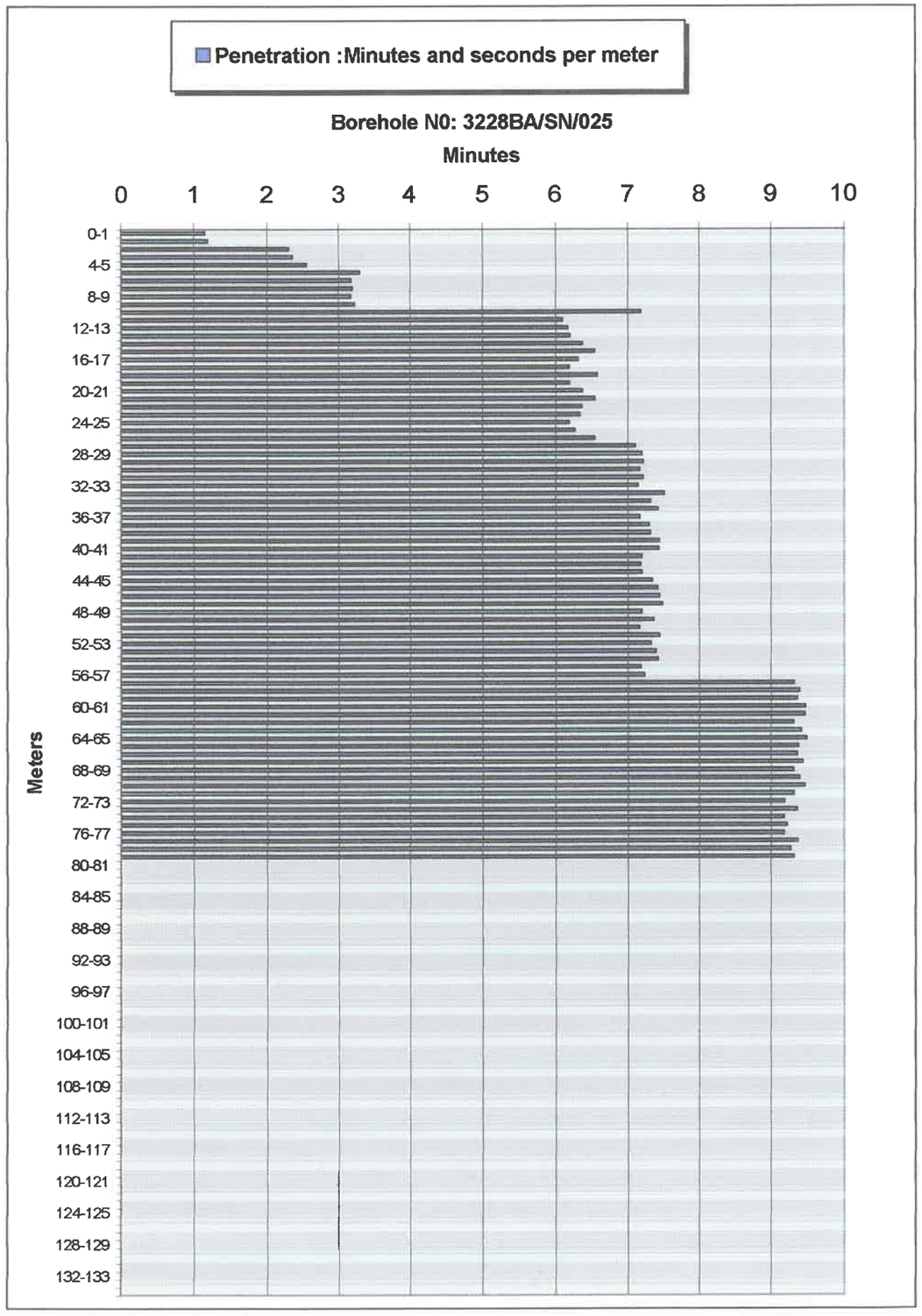
203mm	177mm	0 – 7.5 Plain 7.5 – 10.5 m Slotted	3 m 12 m 14 m 20 m 44 m 74 m 80 m	Clay, reddish, overburden Dolerite, khakhi, weathered Dolerite, brownish, fractured Quartzitic sandstone, greyish, coarse grained, fractured at 15 – 16 m Dolerite, grey, coarse grained, fresh Dolerite, grey, coarse to medium grained, fresh Dolerite, intercalated with quartzitic sandstone, coarse grained, fresh
165mm				
DRILLING Rotary percussion	CASING			

- Drilled depth = 104 m
- Blow Yield = 0.2 m^3/hr
- Water Strike at : 33, 52 m

Contractor : Olivier & Sons
Drilled By : Philip Olivier
Profiled By : Sylvester Ndoora

Diam : 165mm
Date : 11/07/03

S-Coord : 32° 04' 34.2"
E-Coord : 28° 33' 26.5"


Penetration :Minutes and seconds per meter
Borehole N0: 3228BA/SN/025
Minutes
0
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Meters
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4-5
8-9
12-13
16-17
20-21
24-25
28-29
32-33
36-37
40-41
44-45
48-49
52-53
56-57
60-61
64-65
68-69
72-73
76-77
80-81
84-85
88-89
92-93
96-97
100-101
104-105
108-109
112-113
116-117
120-121
124-125
128-129
132-133

IDUTYWA GROUNDWATER FEASIBILITY STUDY

BH : 3228AB/SN/026

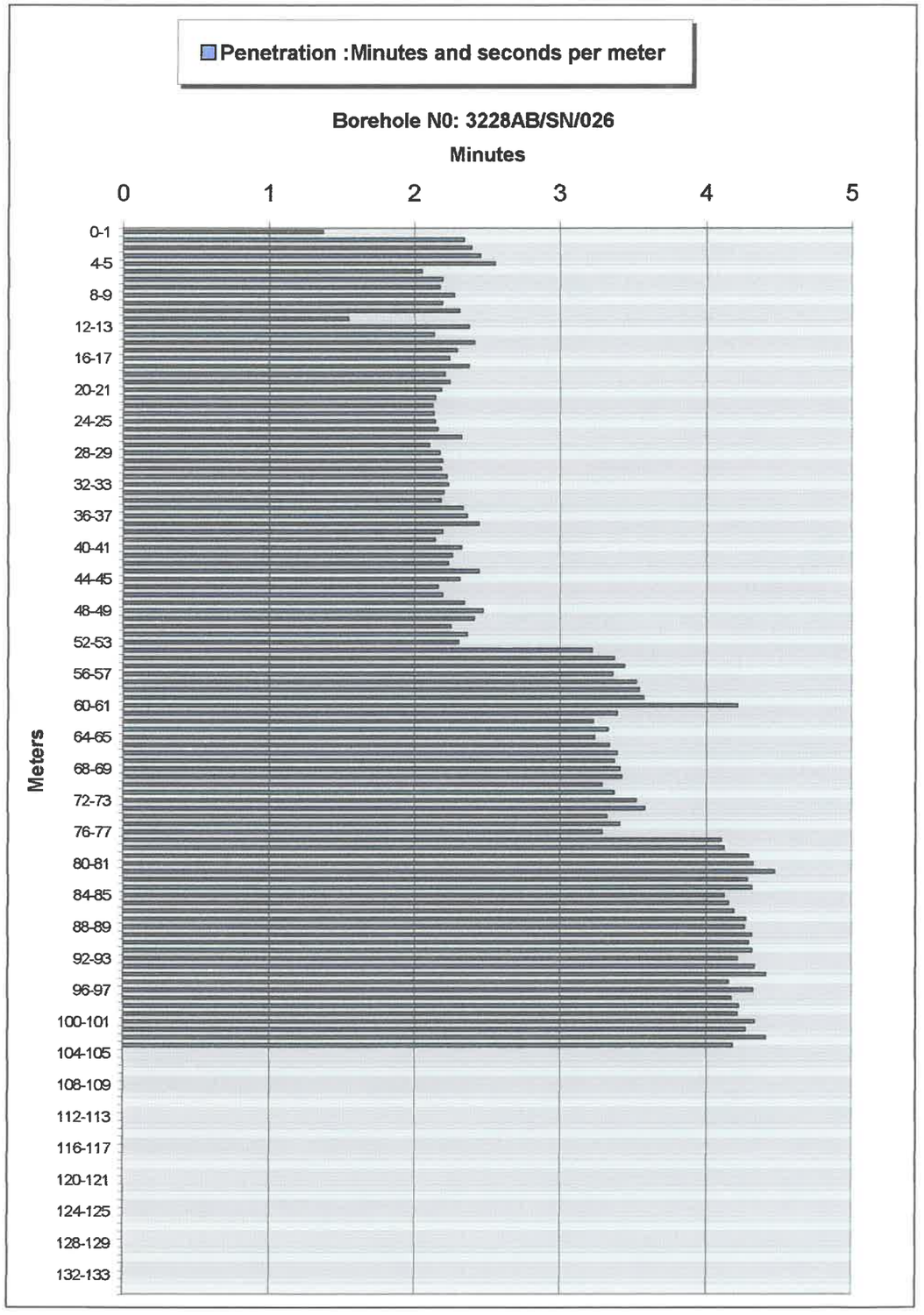
COMMUNITY :KuChachazele

203mm	177mm	6 m Plain	4 m	Clay, brown, overburden
			14 m	Sandstone, brownish, medium grained
165mm			26 m	Sandstone, whitish, medium grained, moderately weathered
			75 m	Mudstone, grey, fresh
			83 m	Sandstone, pinkish, medium to fine grained, fresh
			104 m	Mudstone, grey, fresh.
DRILLING Rotary percussion	CASING	• Drilled depth = 104 m • Blow Yield = 0.2 m^3/hr • Water Strike at : 33, 52 m		

Contractor : Olivier & Sons Diam : 165mm S-Coord : 32° 03' 05.9"

Drilled By : Philip Olivier Date : 12/07/03 E-Coord : 28° 28' 58.3"

Profiled By : Sylvester Ndoora


Penetration :Minutes and seconds per meter
Borehole N0: 3228AB/SN/026
Minutes
0
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Meters
0-1
4-5
8-9
12-13
16-17
20-21
24-25
28-29
32-33
36-37
40-41
44-45
48-49
52-53
56-57
60-61
64-65
68-69
72-73
76-77
80-81
84-85
88-89
92-93
96-97
100-101
104-105
108-109
112-113
116-117
120-121
124-125
128-129
132-133

IDUTYWA GROUNDWATER FEASIBILITY STUDY

BH : 3228AB/SN/027

COMMUNITY : Fakalahla

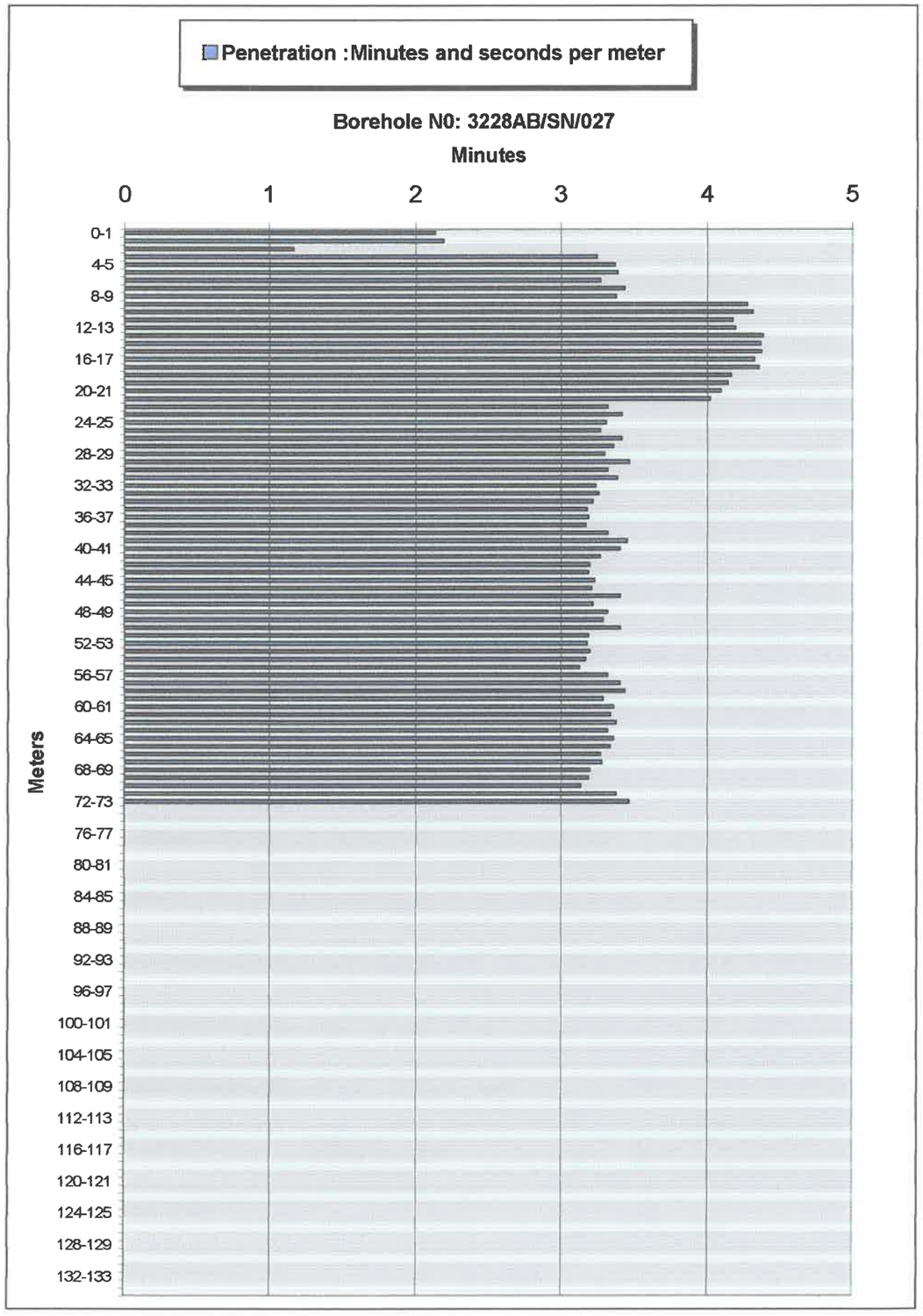
203mm	177mm	13 m Plain	0 – 2 m: Clay, brown, overburden 2 – 7 m: Sandstone, brownish, medium grained 7 – 15 m: Sandstone, whitish, medium to fine grained, moderately weathered 15 – 19 m: Dolerite, greyish, fractured 19 – 35 m: Sandstone, light grey, medium grained, fresh. 35 – 45 m: Dolerite, grey, coarse to medium grained, fresh 45 – 56 m: Sandstone, greyish, medium grained, fractured at 51 m 56 – 74m: Sandstone, light grey, medium grained fresh.
165mm			
DRILLING Rotary percussion	CASING		

- Drilled depth = 74 m
- Blow Yield = 0.33 m^3/hr
- Water Strike at : 16, 51 m

Contractor : Olivier & Sons
Drilled By : Philip Olivier
Profiled By : Sylvester Ndoora

Diam : 165mm
Date : 14/07/03

S-Coord : 32° 03' 37.0"
E-Coord : 28° 26' 43.6"


Penetration :Minutes and seconds per meter
Borehole N0: 3228AB/SN/027
Minutes
0
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4
5
Meters
0-1
4-5
8-9
12-13
16-17
20-21
24-25
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32-33
36-37
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64-65
68-69
72-73
76-77
80-81
84-85
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92-93
96-97
100-101
104-105
108-109
112-113
116-117
120-121
124-125
128-129
132-133

IDUTYWA GROUNDWATER FEASIBILITY STUDY

BH : 3228AB/SN/028

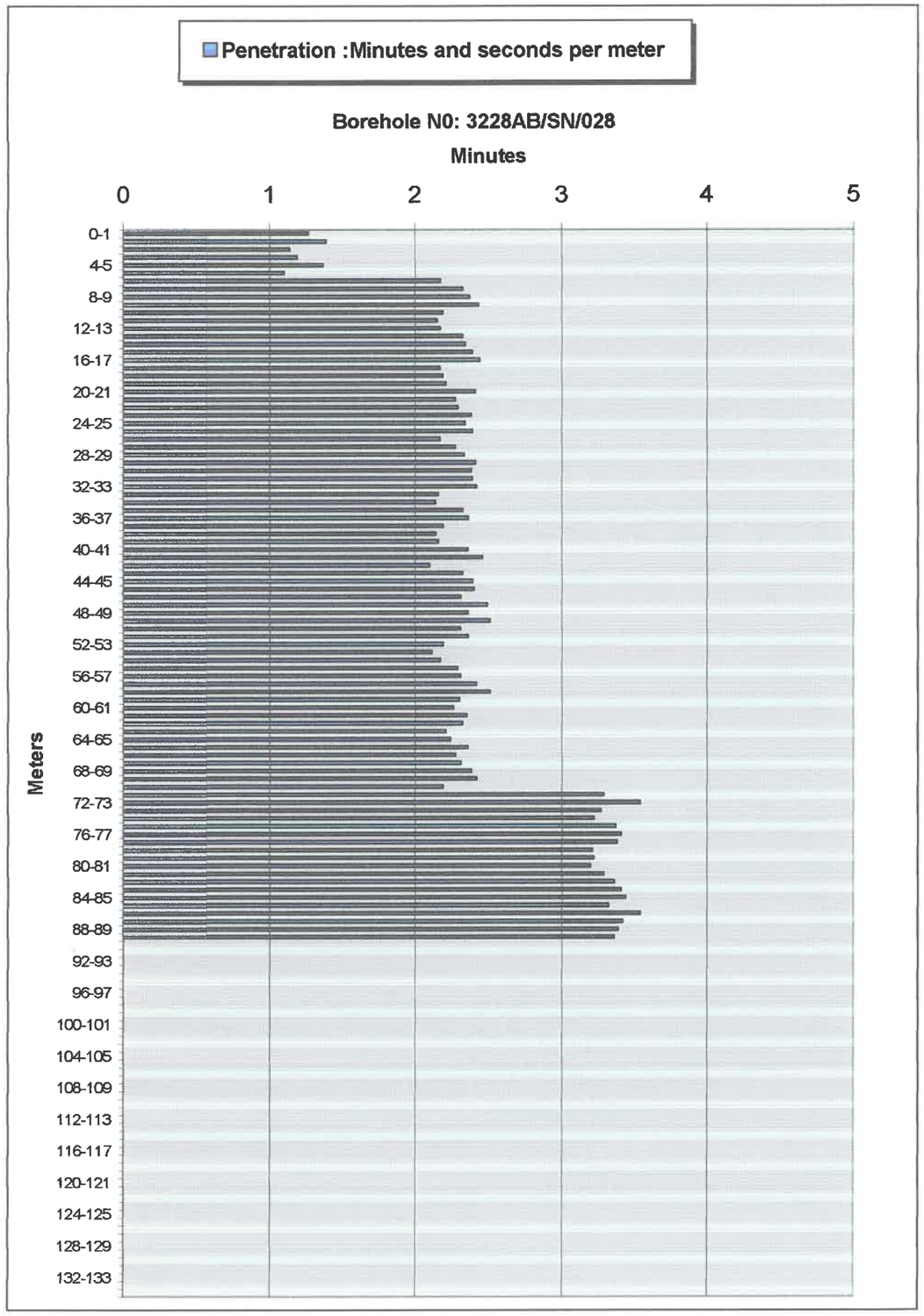
COMMUINITY : Komkhulu

203mm	177mm	6 m Plain	2 m Clav. brown. overburdern 10 m Mudstone, light brown, weathered 16 m Mudstone, grey, moderately weathered
165mm			Sandstone, grey-white, fine grained fresh 51 m Mudstone, purplish, fresh 56 m Sandstone, grey, fine grained fresh 61 m Mudstone, grey, fresh 64 m Sandstone, grey-white, fine grained, fresh 84 m Mudstone, grey, fine grained 92 m
DRILLING Rotary percussion	CASING	• Drilled depth = 92 m • Blow Yield = Seepage • Water Strike at : 14 m	

Contractor : Olivier & Sons Diam : 165mm S-Coord : 32° 01' 00.9"

Drilled By : Philip Olivier Date : 19/07/03 E-Coord : 28° 28' 34.5"

Profiled By : Sylvester Ndoora


Penetration :Minutes and seconds per meter
Borehole N0: 3228AB/SN/028
Minutes
0
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Meters
0-1
4-5
8-9
12-13
16-17
20-21
24-25
28-29
32-33
36-37
40-41
44-45
48-49
52-53
56-57
60-61
64-65
68-69
72-73
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80-81
84-85
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96-97
100-101
104-105
108-109
112-113
116-117
120-121
124-125
128-129
132-133

IDUTYWA GROUNDWATER FEASIBILITY STUDY

BH : 3228AB/SN/029

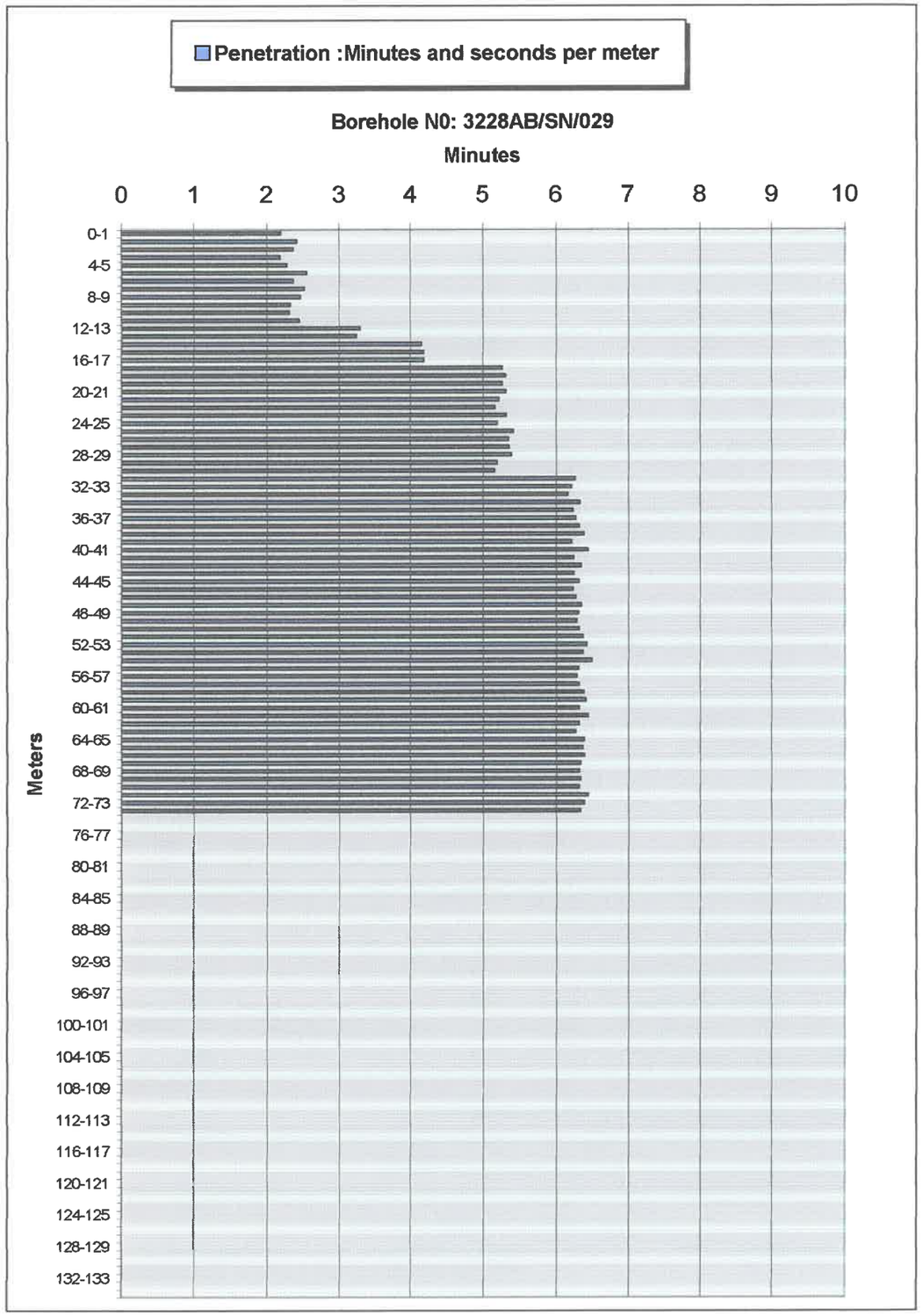
COMMUINITY : Siszini

203mm	177mm	0-14 m Plain	2 m	Clay, dark grey, overburden
			7 m	Clay, light brown, overburden
		14-17 m Slotted		Quartzitic sandstone, grey, coarse grained, fractured
165mm			23 m	Quartzitic sandstone, grey, coarse to medium grained, fresh
			74 m	
DRILLING Rotary percussion	CASING	• Drilled depth = 74 m • Blow Yield = 0.2 m^3/hr • Water Strike at : 14 m		

Contractor : Olivier & Sons Diam : 165mm S-Coord : 32° 04' 04.2"

Drilled By : Philip Olivier Date : 20/07/03 E-Coord : 28° 21' 41.2"

Profiled By : Sylvester Ndoora


Penetration :Minutes and seconds per meter
Borehole N0: 3228AB/SN/029
Minutes
0 1 2 3 4 5 6 7 8 9 10
Meters
0-1
4-5
8-9
12-13
16-17
20-21
24-25
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120-121
124-125
128-129
132-133

IDUTYWA GROUNDWATER FEASIBILITY STUDY

BH : 3228AB/SN/030

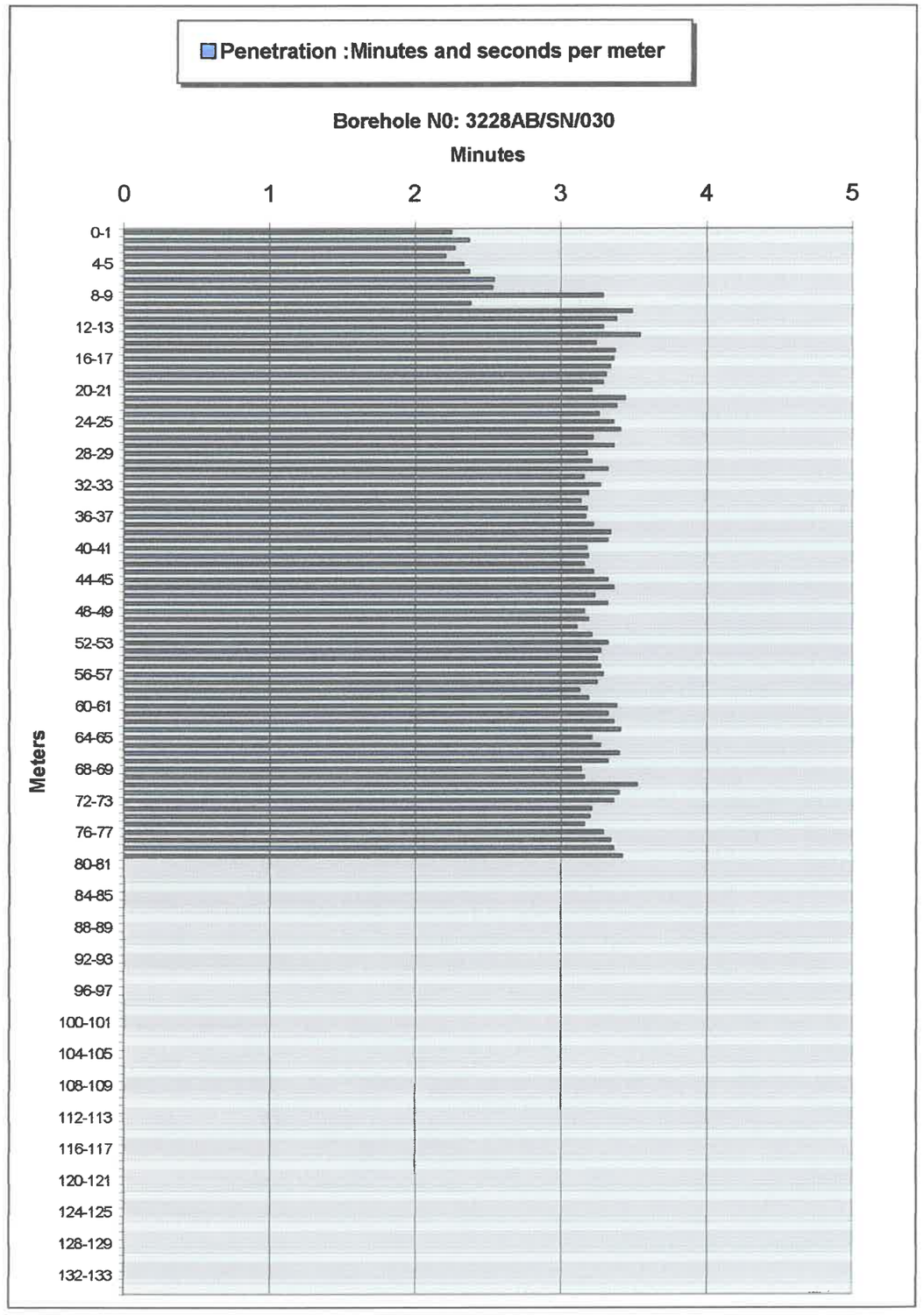
COMMUINITY : KuCingo

203mm	177mm	13 m Plain	3 m — Clay, brown, overburden
			20 m — Sandstone, brownish, medium grained
165mm			25 m — Mudstone, grey, moderately
			54 m — Sandstone, grey, coarse grained intercalated with quartzite, fractured
			63 m — Quartzitic sandstone, light grey, fractured
			76 m — Sandstone, grey, coarse grained, moderately fractured
			80 m — Sandstone, grey intercalated with quartzite
DRILLING Rotary percussion	CASING	• Drilled depth = 80 m • Blow Yield = 0.2 m^3/hr • Water Strike at : 12 m	

Contractor : Olivier & Sons Diam : 165mm S-Coord : 32° 00' 55.2"

Drilled By : Philip Olivier Date : 22/07/03 E-Coord : 28° 20' 34.2"

Profiled By : Sylvester Ndoora


Penetration :Minutes and seconds per meter
Borehole N0: 3228AB/SN/030
Minutes
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Meters
0-1
4-5
8-9
12-13
16-17
20-21
24-25
28-29
32-33
36-37
40-41
44-45
48-49
52-53
56-57
60-61
64-65
68-69
72-73
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84-85
88-89
92-93
96-97
100-101
104-105
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116-117
120-121
124-125
128-129
132-133

ANNEXURE 7
Groundwater Supply Areas

Summary table of proposed supply areas for groundwater supply.

Supply Area	Reservoirs from scheme within supply area	Effective Available Groundwater (m^3/day)	Number of boreholes constituting available groundwater	Estimated Population Served	Demand (m^3/day)	Deficit (m^3/day)	Treatment Required	Estimated Additional boreholes Required (excluding unsuccesful)
1	18, 19, 20, 21	140	3	11643	291	151	Likely	3
2	10, 11, 12, 13, 14, 16, 17	0	0	8844	221	221	Likely	5
3	3, 4, 5, 6, 7	118	2	5378	134	16	Possible	1
4	2, 8, 9	190	2	8468	212	22	Possible	1
5	23, 24, 25, 26, 27	173	1	7989	200	27	Possible	1
6	32, 33, 34	0	0	7396	185	185	Likely	3
7	28, 29, 30, 31	390	4	12946	324	-66	Not Likely	0
8	35, 36, 37	66	2	8697	217	151	Definitely	3

Table 5: Scheme 1 Reservoirs

RESERVOIR	POPULATION	RESERVOIR SIZE (kl)	COMMUNITIES
1	34,334	2,000	BULK
2	2,645	75	Esihlabeni AA, Nqabane D, Luxeni C, Bijolo A, Nqabane A, Machibini, Bethani, Njemane
3	2,597	150	Ginqi, Nyandeni C, Silityiwa, Dayimane A
4	884	50	Singeni A, Emahlubini C, Emahlubini D
5	1,066	50	Kwanxabane, KwaGaba, Gilandoda, Vonqo
6	277	15	Mdeni MM, Lalini H, Matshawebi B, Kwanxabane
7	554	15	Mbanga B, Gcina J, Ebangweni
8	5,042	150	Nqabane E, Nqabane B, Nyharha, Bashee S, Luxomo C, Mpozolo A, Upper Mnywaca, Jara B, Tseshe, Xara
9	781	25	Mbashe A, Nokoyo, Ngwemnyama F
10	3,668	100	Kweletha, Bolotwa A, Boloywa B, Qeqe, Sinqumeni A
11	671	25	Gxara A, Hlenke
12	731	25	Timane C, Timane A, Timane E, Nyoka B
13	687	25	Mfezeko, Nyakatha
14	638	25	Ngxingweni B, Eqolweni BB
15	20,487	750	BULK
16	1,310	50	Timane D, Emanqosini, Exeni C
17	1,139	50	Ntshingeni AA, Jojweni I, Khamangweni
18	2,920	100	Ngonyama C, Mputi, Nqabane C, New Rest BB
19	3,965	150	Ngxakaxa B, Emafeneni, Block C
20	267	15	Elundini B
21	4,491	150	Lencani, Grayini, Ngcingwane, Mpepeni, Qelana

Table 6: Scheme 2 Reservoirs

RESERVOIR	POPULATION	RESERVOIR SIZE (kl)	COMMUNITIES
22	37,027	2,500	BULK
23	2,182	75	Komkhulu, Timane B, Colosa A, Ezithenjini B, Ezithenjini A, Kundlambe A, Camandashe, Exeni A, Umhlala, Ndenxe C, Kundlambe B, Komkhulu H, Komkhulu I
24	2,265	75	Colosa B, Doti, Sizini
25	1,841	75	Mazwayi, Qokolweni A, Emabheleni C, Esihlabeni CC
26	987	50	Candu, Ndesi A
27	714	25	Dondolo B, Lodondolo
28	2,008	75	Nopoto, Esizini, Mangati
29	2,005	75	Mangathi, Gubevu D, Mangwevini B
30	749	25	Rwantsini, Duff
31	8,184	250	Mnqayi, Enkunkumeni A, Enkunkumeni B, Komkhulu E, Cungcwinin, Ephikweni B
32	1,881	75	Enkolweni B, Emauiqweni, Esihlabeni B, Komkhulu J, Falakahla B, Falakahla A
33	2,526	75	Ngutha, Xobo A, Xobo C, Plaasplek, Chizela, Elunweleni, Nqutu C, Idutywa, Ndyityaba, Laza Makhakha B
34	2,989	100	Jandachaphaza, Qwalweni, Enjakazi, Kutyothi, Cizele, Esingeni D, Xashimba, Ncolosa, Mhlathi, Ngcolosa
35	1,232	50	Laza Makhakha A, Makhakha, Mnandi
36	3,763	150	Nqabana, Xabajiyana B, Nothanda
37	3,702	150	Ntshatshongo, Nyanisweni G, Gxaka Gxaka, Mbethe, Jakadu A