



22 (3571)

# **GEOHYDROLOGICAL REPORT**

**Groundwater source development at De Villiersdale 313LR  
and Buffelshoek 261LR for stock watering.**

**For  
The Department of Agriculture**

**Blouberg Municipality  
Capricorn District  
Limpopo Province**

**REPORT-VSALEB/PR05/075  
August 2006**

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## **EXECUTIVE SUMMARY**

The position of De Villiersdale project is at latitude 23° 13' 30'' and at longitude 28° 46' 35''. The position of Buffelshoek is at latitude 23° 08' 30'' and at longitude 28° 56' 45''. Both fall on the South African 1:50 000 topographical map sheet 2328BB Raditshaba.

The aim of the program was to identify existing boreholes that can be used for live stock watering. If existing sources could not be used one new source was to be developed at each project.

The groundwater source development at De Villiersdale 313LR and Buffelshoek 261LR live stock watering projects included a field visit with members of the Department of Agriculture and the beneficiaries of the project, a hydro census, satellite imagery interpretation and geophysical survey. At both projects existing boreholes were unsuitable to be used.

At the De Villiersdale livestock watering project these actions were followed with the drilling of two new holes and the testing of one. At Buffelshoek one existing borehole was tested and found to have a construction problem. It was re-drilled and tested.

**H11-2282 at De Villiersdale can be equipped for domestic and live stock watering.** The recommendation is that the hole can be utilized at 0.22 l/s for a 10hr/day or at 0.14 l/s for a 24hr/day pumping cycle. Installation depth 84m. Water Class 2. A total volume of 7.9m<sup>3</sup> can be abstracted per day from H11-2282 (De Villiersdale) when using the 24hrs/day recommendation compared to the 12m<sup>3</sup>/day when using the 10hrs/day pumping cycle.

**H11-2280 at Buffelshoek can be equipped for live stock watering.** The chemical classification of the water is unsuitable for domestic use if not treated. The community must be informed and a notice board erected next to the borehole. The recommendation is that the hole can be utilized at 0.31 l/s for a 10hr/day or at 0.2 l/s for a 24hr/day pumping cycle. Installation depth 66m. Water Class 3. A total volume of 17.2m<sup>3</sup> can be abstracted per day from H11-2280 (Buffelshoek) when using the 24hrs/day recommendation compared to the 11.1m<sup>3</sup>/day when using the 10hrs/day pumping cycle.

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MAP E: Buffelshoek Aster satellite imagery interpretation and geophysical traverses.



## **1 INTRODUCTION:**

### **1.1 Background:**

The Department of Agriculture appointed VSA Leboa Consulting in October 2005 as geohydrological consultant for the development of groundwater sources using tender numbers W8426, W8424 and W8425. These tender numbers are for the 24-month contract issued by the Department of Water Affairs and Forestry for Hydro geological Consulting Services, drilling and test pumping in various Service Centres. This tender is used by various other Government Departments and Municipalities for appointments.

The groundwater source development at **De Villiersdale 313LR and Buffelshoek 261LR live stock watering** projects included a field visit with members of the Department of Agriculture and the beneficiaries of the project, a hydro census, satellite imagery interpretation and geophysical survey.

At the **De Villiersdale** livestock watering project these actions were followed with the drilling of two new holes and the testing of one. At **Buffelshoek** one existing borehole was tested and found to have a construction problem. It was re-drilled and tested.

On completion of the projects a data report was compiled. One copy was forwarded to The Department of Agriculture Central office, one to the Blouberg District office and one to The Department of Water Affairs and Forestry. This data will be captured electronically to update the National Ground Water Data Base and GRIP web site.

### **1.2 Location:**

The projects are located in the Capricorn District Municipality and are under management of the Blouberg Municipality. The position of De Villiersdale project is at latitude 23° 13' 30'' and at longitude 28° 46' 35''. The position of Buffelshoek is at latitude 23° 08' 30'' and at longitude 28° 56' 45''. Both falls on the South African 1:50 000 topographical map sheet 2328BB Raditshaba.

### **1.3 Objective:**

The aim of the program was to investigate existing sources and to develop new sources if needed in a short distance from the areas as shown by the beneficiaries of the projects.

#### 1.4 Methodology:

- VSA Leboa Submitted a phased approach quotation according to the DWAF tenders W8424, W8425 and W8426 for this project.
- Appointment by The Department of Agriculture for the testing and drilling contractor and geohydrological Consultant.
- Hydro Census and meeting with members of the beneficiaries.
- Satellite imagery interpretation followed by a geophysical field survey.
- Investigation of existing sources, drilling and testing of the new sources.
- Chemical analysis of the water.
- Management recommendations.
- Final Geohydrological data report.

## 2 HYDROCENSUS

The hydro census was done in a within a 500m radius from the position indicated the beneficiaries of the projects. This data was verified with existing borehole information from the Provincial database, VSA Leboa Consulting database and information from the GRIP web site managed by the Department of Water Affairs and Forestry.

*Table 1: Summary of boreholes liased*

BOREHOLE NUMBER AND PROJECT NAME	CURRENT STATUS	EQUIPMENT	ACTIONS AGREED ON WITH BENEFICIARIES BEFORE DRILLING	NUMBER POLE PLANTED	COMMENTS
H11-2260 De Villiersdale	Not in use	No equipment	To test	yes	Casing, not sealed, filled with rocks, was a hand pump, diameter too small to rehab.
H11-0999 Buffelshoek	Not in use	Hand pump	To test	yes	Could not remove the pipes, the hole has collapsed.

### 3 REGIONAL GEOLOGY

Table 2 : Regional geology as from the 1:250 000 geological map 2328 Pietersburg.

Age	Supergroup	Formation	Lithological description	Intrusives
Quaternary			Soil, sand, scree and alluvium	
Mokolian				Diabase
	Waterberg group	Mogalakwena (Mm)	Coarse-grained purplish brown sandstone: conglomerate and boulder conglomerate.	
		Makgabeng (Mma)	Medium grained, yellowish, laminated sandstone	

#### 3.1 Makgabeng formation (Mma):

This overlies the Setlaole formation conformably and is characterised by medium-grained, thinly laminated, yellowish sandstone that displays large-scale cross bedding and sparingly, asymmetrical ripple marks (De Bruijn 1971).

#### 3.2 Mogalakwena formation:

Usually it rests conformable on the Makgabeng formation but in the Blouberg area it unconformably overlies the Blouberg formation and rocks of Swazian and Randian age. It is characterized by purplish brown, coarse-grained sandstone with interbedded conglomerate and boulder conglomerate. The well-rounded clasts may attain a diameter of 80cm but in general they measure between 3 and 10 cm (Brandl 1996).

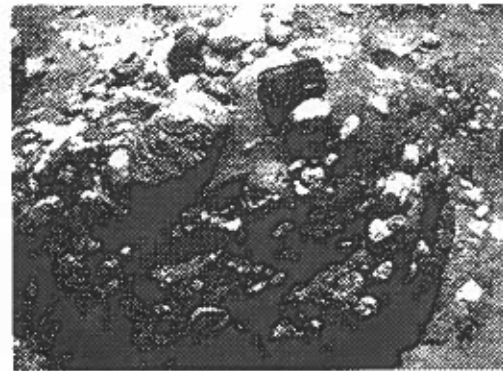


Figure 1: Conglomerate of the Mogalakwena formation.

### 3.3 Diabase intrusions:

Diabase intrusions and other inferred lineaments indicated on the 1:250 000 geological map mainly transects the area from southwest to northeast with minor intrusions transecting the area from southeast to northwest. These intrusions were mainly targeted in the search for groundwater as secondary fracturing in the sandstone can occur near or at the contact with the diabase

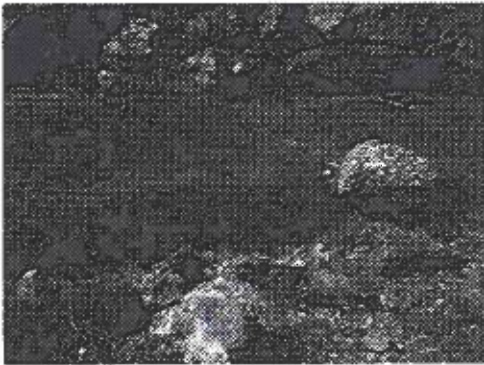


Figure 2: Diabase sill, Brodie Hill.

### 3.4 Quaternary deposits:

Regolith is a general term used for the loose, incoherent, or unconsolidated rock material, of whatever origin (residual or transported) and of varied character that covers the land surface and overlies the more coherent bedrock. Regolith in the investigation area includes residual soils, sand, scree and alluvial deposits.

Residual soils are formed from the *in situ* weathering of the country rock. Soil formation involves addition and removal of material to and from the soil body, transfer of material within the soil body, and the transformations of material (both organic and inorganic) from one form to another. Very clayey soils are locally found covering the diabase sills with slightly clayey sandy soils covering the gneiss in the eastern part of the study area. The sandstone formations are usually covered with predominantly reddish sandy soils

Extensive scree is found along the slopes of the Blouberg.

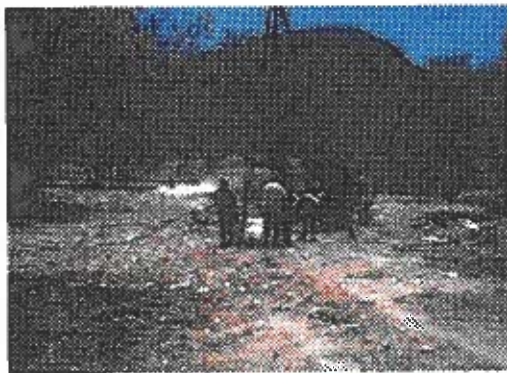


Figure 3: Colluvial deposits-scree -Madibeng.



Figure 4: Calcrete-Brodie Hill

Scree deposits foreground, testing rig background.

Alluvium results from the transportation and deposition of sediments by perennials and associated streams and is restricted to the watercourses of the main streams. The composition of these deposits depends on the geology of the catchment area. In the study area it is mostly a fine grained to very coarse-grained sand with pebbles and boulders consisting of quartz, sandstone and diabase. This alluvial is restricted to the watercourses of the main streams. A localized very fine to fine slightly clayey alluvium were encountered in De Villiersdale at borehole H11-1990 during a previous project.

#### **4 REMOTE SENSING:**

ASTER (Advanced Spaceborne Thermal Emission and Radiometer) is an imaging instrument on board Terra - the first Earth Observing System (EOS) satellite. Terra was launched on December 18, 1999 from the Vandenberg Air Force Base in California and flies in a sun synchronous polar orbit, crossing the equator in the morning at 10:30.

ASTER is one of the five state-of-the-art instrument sensor systems onboard Terra with a unique combination of wide spectral coverage and high spatial resolution in the visible near infrared through short wave infrared to the thermal infrared regions. It was build by a consortium consisting of the Japanese government, industry, and research groups. ASTER data is expected to contribute to a wide array of global change-related application areas including vegetation and ecosystem dynamics, hazard monitoring, geology and soils, land surface climatology, hydrology, and land cover change.

ASTER consists of three different subsystems; the Visible and Near Infrared (VNIR), the Short wave Infrared (SWIR) and the Thermal Infrared (TIR). The VNIR subsystem consists of two independent telescope assemblies. One is vertical looking and has three detector arrays collecting data in the visible green, visible red and near Infrared wavelengths, while a backward looking telescope has one detector array in the same spectral band as the near infrared of the vertical array. These infrared arrays (3N and 3B) generate an along-track stereo image pair with a base-to-height ratio of 0.6 and an intersection angle of 27.7 degrees and can be used to create Digital Elevation Models (DEM's).

#### **5 GEOPHYSICAL INVESTIGATION:**

The position, direction and length of the geophysical traverses at each project was influenced by the project boundary, field observations, the results of the satellite imagery interpretation, the required yield, the geology and man made influences such as fences and power lines.

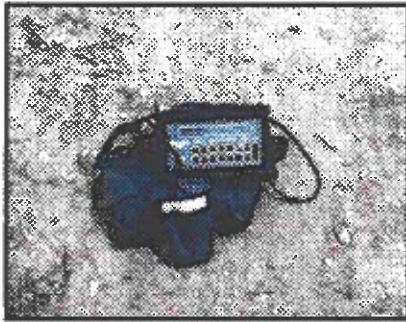
The geophysical methods that were employed are the magnetic and electromagnetic methods. This combination has proven over time to be very effective to find geological features that might have a bearing on the occurrence of groundwater.

Field readings were measured at intervals of 10m for the EM-34 (20 and 40m coil separation) and 5m for the magnetometer. This data was plotted and anomalies interpreted to locate the most promising

sites that could lead to the successful development of production boreholes. At De Villiersdale three geophysical survey lines were done ranging in lengths from 260 to 410m with a total line length of 1070m completed. At Buffelshoek five geophysical survey lines were done ranging in lengths from 200 to 700m with a total line length of 1800m completed.

### 5.1 The Magnetic method:

The different magnetic susceptibilities of different rock types result in contrasting magnetic signatures. Analysis of the amplitude or intensity of the magnetic anomalies as well as its graphical shape taking in



account the traverse direction bears some relationship to magnetic mineral content, size, depth, shape and orientation of the buried body or structure. Hence, the magnetic data may be interpreted to represent dykes, geological contacts and faults that may have a bearing on the occurrence, storage and movement of the groundwater. A Chemtron model G5 proton-precision magnetometer (Fig.5) was used, measuring directly the strength of the total magnetic field at a given locality.

Figure 5: The Chemtron model G5 proton-precision magnetometer.

### 5.2 Frequency Domain Electromagnetic Methods:

The operating principles of the EM-34 system are briefly discussed below. The technique provides rapid and easy measurement of terrain conductivities and facilitates the detection of steeply dipping



conductor type targets such as dykes, fracture zones, faults etc. through electromagnetic coupling. The EM-34 (Fig.6) is a moving source-moving receiver system, which measures the ratio of the quadrature component of the secondary magnetic field to the free space primary magnetic field. A cable connects the transmitter and receiver units, acting as a reference to the primary magnetic field.

Figure 6:: The EM-34 System.

The twenty and forty metres coil separations used for the EM-34 profiling allowed relatively rapid surveying and, in general, low noise levels. The receiver unit is calibrated to indicate apparent conductivity (1-300 mS/m). At low values of terrain conductivity (<100 mS/m), apparent conductivities are linearly proportional to actual conductivities. For resistive terrains (low conductivities), the vertical depth of exploration over the homogeneous or horizontally stratified earth for coil separations of 10, 20 or 40m are 15, 30 and 60m (horizontal coils) and 7.5, 15 and 30m (vertical coils) respectively. The lateral extent of the volume of the earth, whose conductivity is sensed, approximates the vertical depth and small changes in conductivity (5 to 10 mS/m) are readily

and accurately measured. The detectability of fracture zones depends on their width, thickness and conductivity of the overburden layer, the quality of the groundwater and the depth of the ground water level.

### 5.3 Results of the geophysical investigation:

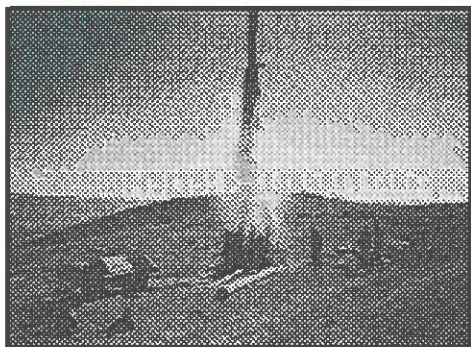
Table 3: Summary of geophysical investigation:

Project Name	Traverse Number	Length (m)	Co-ordinates Start	Co-ordinates End	Position chosen from interpretation of the data	Borehole number
De Villiersdale	Line 1	410	23° 13' 29.8" 28° 46' 40.5"	23° 13' 32.3" 28° 46' 26.9"	150 280	H11-2282
De Villiersdale	Line 2	260	23° 13' 29.0" 28° 46' 38.0"	23° 13' 37.1" 28° 46' 40.1"	190	Station 190
De Villiersdale	Line 3	400	23° 13' 44.1" 28° 46' 36.0"	23° 13' 34.7" 28° 46' 26.2"	110	H11-2281
Buffelshoek	Line 1	200	23° 08' 26.8" 28° 56' 47.0"	23° 08' 25.3" 28° 56' 53.7"		No site
Buffelshoek	Line 2	300	23° 08' 27.3" 28° 56' 56.8"	23° 08' 22.4" 28° 56' 48.0"		No site
Buffelshoek	Line 3	200	23° 08' 23.5" 28° 56' 52.7"	23° 08' 29.4" 28° 56' 50.5"		No site
Buffelshoek	Line 4	700	23° 08' 30.4" 28° 57' 20.1"	23° 08' 49.5" 28° 57' 07.1"	195 330 440 463	Not drilled
Buffelshoek	Line 5	400	23° 08' 30.8" 28° 57' 14.5"	23° 08' 35.6" 28° 57' 27.3"	210	Not drilled

## 6 PERCUSSION DRILLING:

Boreholes were drilled and marked to specifications as laid down by the Department of Water Affairs and Forestry in the: "Minimum Standards and Guidelines for Groundwater Resource Development for the community Water Supply and Sanitation Program".

The method employed for the sinking of water supply boreholes was that of rotary air percussion drilling employing a down-the-hole (TDH) hammer. This drilling technique is ideally suited for hard rock formations.



The cuttings brought to the surface by air return from the bore were collected and described for each metre drilled. The lithologies described are presented in borehole logs in the Appendix, together with all other relevant information pertaining to and obtained from the boreholes.

Figure 7 : The rotary air percussion drill rig

Water intersections were recorded, and blow yields measured using a V-notch. By using a dip meter, the static water level of the boreholes was determined.

Members of the Department of Agriculture and beneficiaries responsible for each project identified areas for source development. At De Villiersdale an area was indicated near H11-2260. Previously this was a hand pump. The hole is filled with rocks. The casing condition is poor and the diameter less than 165mm. No attempt at rehabilitation was made and a new hole was drilled at the first possibility. During the drilling process members of the community stopped the drilling as it was on an area that was to be ploughed. After consultation with the beneficiaries another peg was successfully drilled.

At Buffelshoek an existing hand pump was to be tested before drilling started. The pipes could not be removed as the hole collapsed on depth. This hole was successfully re-drilled and casing installed to 66m.

### 6.1 Drilling Results:

Table 4: Summary of drilling results:

Project Name	Borehole Number	Depth (m)	Water strike (m)	Aquifer/comment	Blow yield (l/s)
De Villiersdale	H11-2260	Blocked		Existing hole could not be rehabilitated.	
De Villiersdale	H11-2281	90		Members of the community stopped the drilling of this hole.	Dry
De Villiersdale	H11-2282	124	89,100	Fractures	0.4

Project Name	Borehole Number	Depth (m)	Water strike (m)	Aquifer/comment	Blow yield (l/s)
Buffelshoek	H11-0999	Blocked		Existing hand pump could not be removed due to collapsing of the hole on depth.	
Buffelshoek	H11-2280	114	25.8, 48.2, 54, 58, 76	Contact and fractures	1.00

## 7 TEST PUMPING AND RESULTS:

The correct operation and utilisation of boreholes result from the assessment of the productive capacity (sustainable yield) of the borehole as well as the productivity of the aquifer supporting the borehole. Such knowledge is provided by data analysis of boreholes subjected to detailed pumping test programs. Test pumping provides a means of identifying potential constraints on the performance of a borehole and on the exploitation of the groundwater resource. The recognition and understanding of these constraints would result in proper groundwater utilization and management.

**At De Villiersdale one new production borehole was subjected to the full testing program consisting of a step draw down tests and a constant discharge test.**

**At Buffelshoek an attempt was made to test existing H11-0999. The pipes could not be removed. After re-drilling of this hole is was tested.**

The recommendations on the available abstraction volumes for the tested boreholes were calculated using the **FC-method**. This method calculates the available volume of abstraction. The calculation provides that the static water level will not reach the main water strikes in a 2-year period without any recharge to the aquifer.

### 7.1 Step draw down test:

The **step draw down test** is performed to assess the efficiency of the borehole, and to determine at which rate a longer duration test (constant discharge test) can be performed. It entails pumping the hole at two or more sequentially higher pumping rates each maintained for an equal length of time (generally not less than 60 minutes and seldom longer than 120 minutes). The magnitude by which the water level in the borehole drops (known as the **draw down**) in response to these known pumping rates is measured and recorded in accordance with a prescribed time schedule. The water level is also measured and recorded, again to a prescribed time schedule, for a period of time immediately following the period of pumping. This represents the period of recovery in which the water level rises towards its starting level before pumping.

## 7.2 Constant Discharge test:

The **constant discharge test** is performed to determine aquifer parameter values (transmissivity and storativity) and to determine the possible existence of groundwater barrier boundaries. The test entails pumping the borehole at a single pumping rate, which is kept constant for the entire duration of the test (8-72 hours). The draw-down in water level in the borehole during the course of the test is again measured and recorded according to a prescribed time schedule. In the case of the constant discharge test the recovery period is also measured and recorded.

The data obtained from the constant discharge test permits the calculation of the specific capacity of the borehole at the set-pumping rate after a substantially longer period of pumping. A comparison of this value with those obtained from the step draw-down test offers a means of assessing the more realistic productivity of the borehole under operating conditions.

## 7.3 Testing Results:

*Table 5: Summary of testing results:*

PROJECT NAME	BOREHOLE NUMBER	TESTING PROGRAM	RECOVERY	RECOMMENDATION/ COMMENT
De Villiersdale	H11-2282	3 x 60 min multi rate tests and a 12hrs constant discharge test with recovery measurements.	99% recovery in pumping time	0.22 l/s for 10 hrs/day or 0.14 l/s for 24 hrs/day
Buffelshoek	H11-2280	3 x 60 min multi rate tests and a 12hrs constant discharge test with recovery measurements.	93% recovery in pumping time	0.31 l/s for 10 hrs/day or 0.2 l/s for 24 hrs/day.

## 8 HYDROCHEMISTRY:

Groundwater samples were collected during the final stages of the testing program in order to get a representative sample of the aquifer. The samples were sent to UIS Analytical Services (PTY) Ltd for the preliminary analysis as well as to the DWAF Laboratory in Pretoria for a full analysis of the main hydro chemical concentrations (macro elements) in the groundwater samples. Elements analysed for include: F, Fe, Mn, Ca, Mg, Na, K, Cl, NO<sub>3</sub> and NO<sub>2</sub> as N, SO<sub>4</sub>, PO<sub>4</sub>, NH<sub>4</sub>, CO<sub>2</sub>, HCO<sub>3</sub>.

At the time of reporting only the preliminary analysis was available. The laboratory analyses expressed in mg/l are presented in Table 7.

### 8.1 Water quality:

Although the boreholes were developed to supply livestock, people might use the water for drinking purposes. The chemical class was therefore evaluated according to domestic parameters. Water

quality of domestic water, used for human consumption and food preparation, must be safe to use if the consumers' health is to be protected. For this reason the "Quality of Domestic Water Supplies" (Second edition, 1998)" was set forward by the Department of Water Affairs and Forestry, Department of Health and the Water Research Commission in 1998. This document facilitates the evaluation of water on the basis of five water quality classes:

Table 6: Classification parameters.

Class	PH	TDS	EC	Total Hardness	Ca	Mg	Cl	SO <sub>4</sub>	NO <sub>3</sub>	Na	K	F
Class 0	5.00-9.50	<450	<70	0-200	0-80	<30-70	<100	<100-200	<6	<100	<25	<0.7
Class 1	4.50-5.00	450-1000	70-150	200-300	80-150	70-100	100-200	200-400	6-10	100-200	25-50	0.7-1.00
Class 2	4-4.50	1000-2400	150-370	300-600	150-300	100-200	200-600	400-600	10-20	200-400	50-100	1.00-1.50
Class 3	3.00-4.00	2400-3400	370-520	>600	>300	200-400	600-1200	600-1000	20-40	400-1000	100-500	1.50-3.50
Class 4	<3->11	>3400	>520			>400	>1200	>1000	>40	>1000	>500	>3.50

Class 0: Ideal water quality. Suitable for lifetime use.

Class 1: Good water quality. Suitable for use, rare instances of negative effects.

Class 2: Marginal water quality-conditionally acceptable. Negative effects may occur in some sensitive groups.

Class 3: Poor water quality. Unsuitable for use without treatment. Chronic effects may occur.

Class 4: Dangerous water quality, totally unsuitable for use. Acute effects may occur.

## 8.2 Chemical Results:

Table 7: Preliminary hydro chemical results:

BOREHOLE	Ph	EC	TDS	Fe	Mn	Cl	N	SO <sub>4</sub>	F	CLASS
H11-2282	6.64	26	144	<0.05	0.91	27.7	0	6.8	0.2	Class 2
H11-2280	6.74	112	748	<0.05	0.32	93.3	22.8	19.6	0.3	Class 3

**Domestic use:** Hydro chemical results of H11-2282 De Villiersdale are classified as a Class 2 for domestic use. (Marginal water quality-conditionally acceptable. Negative effects may occur in some sensitive groups.) The reason for the classification is due to the concentration of Manganese (Mn)

Hydro chemical results of H11-2280 Buffelshoek are classified as a Class 3 for domestic use. (Poor water quality. Unsuitable for use without treatment. Chronic effects may occur.) The reason for the classification is due to the concentration Nitrate (NO<sub>3</sub>) and Nitrite (NO<sub>2</sub>) reported as N. The concentration of Manganese (Mn) falls in class 2. The reported electrical conductivity (EC) and Total dissolved salts (TDS) falls under class 1.

## 8.2.1 Health effects in humans

### 8.2.1.1 TDS AND EC

**EC: 70-150 and TDS: 450-1000:** Insignificant effect on sensitive groups.

### 8.2.1.2 Nitrate (NO<sub>3</sub>) + Nitrite (NO<sub>2</sub>) reported as N:

**N range 6-10mg/l:** Insignificant risk.

**N range 10-20mg/l:** Slight chronic risk to some babies.

**N range 20-40mg/l:** Possible chronic risk to some babies.

**N range >40mg/l:** Increasing acute health risk to babies.

Nitrate has the potential to cause tiredness and failure to thrive. This is the most common effect and is chronic in nature. In extreme case cyanosis and difficulty in breathing in bottle fed infants under the age of 1 year may occur. This rare condition is due to reduction of nitrate to nitrite, which then combines with the red blood pigment, haemoglobin to form methaemoglobin in the presence of an abnormal gut flora.

### 8.2.1.3 Manganese (Mn):

**Manganese range < 0.05 mg/l:** No health or aesthetic effects:

**Manganese range 0.05-0.1mg/l:** Negligible health effects. Aesthetic effects: Slight taste or colour.

**Manganese range 0.1-0.4mg/l:** Insignificant health effects. Aesthetic effects: Increasing taste and colour.

**Manganese range 0.4-1.0mg/l:** Slight health risks to sensitive groups only. (Infants less than 2 years, patients with kidney disease and individuals with high water intakes.

Aesthetic effects: increasing taste and colour, pale brown discolouration of the water, moderate staining of clothes.

## 8.2.2 Effects Agriculture: Livestock watering

With the available data available on the chemical analysis there will be no adverse effects on animals if the water is used for livestock watering.

### ➤ CONCLUSIONS:

- The aim of the program was to identify existing boreholes that can be used for livestock watering. If existing sources could not be used one new source was to be developed at each project.

- The groundwater source development at **De Villiersdale 313LR and Buffelshoek 261LR live stock watering** projects included a field visit with members of the Department of Agriculture and the beneficiaries of the project, a hydro census, satellite imagery interpretation and geophysical survey.
- At both projects existing boreholes were unsuitable to be used.
- At **De Villiersdale** livestock watering project these actions were followed with the drilling of two new holes and the testing of one. At **Buffelshoek** one existing borehole was tested and found to have a construction problem. It was re-drilled and tested.
- Although the boreholes will supply the needs of livestock, people might use the water for drinking purposes. The chemical class was therefore also evaluated according to domestic parameters.
- Hydro chemical results of **H11-2282 De Villiersdale** are classified as a **Class 2 for domestic use**. (Marginal water quality-conditionally acceptable. Negative effects may occur in some sensitive groups.) The reason for the classification is due to the concentration of Manganese (Mn)
- Hydro chemical results of **H11-2280 Buffelshoek** are classified as a **Class 3 for domestic use**. (Poor water quality. Unsuitable for use without treatment. Chronic effects may occur.) The reason for the classification is due to the concentration Nitrate (NO<sub>3</sub>) and Nitrite (NO<sub>2</sub>) reported as N. The concentration of Manganese (Mn) falls in class 2. The reported electrical conductivity (EC) and Total dissolved salts (TDS) falls under class 1.
- Hydro chemical results of both boreholes indicate that the groundwater is suitable for stock watering.

## 9 RECOMMENDATIONS:

- **H11-2282 at De Villiersdale can be equipped for domestic and livestock watering.** The recommendation is that the hole can be utilized at 0.22 l/s for a 10hr/day or at 0.14 l/s for a 24hr/day pumping cycle. Installation depth 84m. Water Class 2.
- **H11-2280 at Buffelshoek can be equipped for livestock watering. The chemical classification of the water is unsuitable for domestic use if not treated.** The community must be informed and a notice board erected next to the borehole. The recommendation is that the hole can be utilized at 0.31 l/s for a 10hr/day or at 0.2 l/s for a 24hr/day pumping cycle. Installation depth 66m. Water Class 3.
- A total volume of 7.9m<sup>3</sup> can be abstracted per day from H11-2282 (De Villiersdale) when using the 24hrs/day recommendation compared to the 12m<sup>3</sup>/day when using the 10hrs/day pumping cycle.
- A total volume of 17.2m<sup>3</sup> can be abstracted per day from H11-2280 (Buffelshoek) when using the 24hrs/day recommendation compared to the 11.1m<sup>3</sup>/day when using the 10hrs/day pumping cycle.

## 10 REFERENCE:

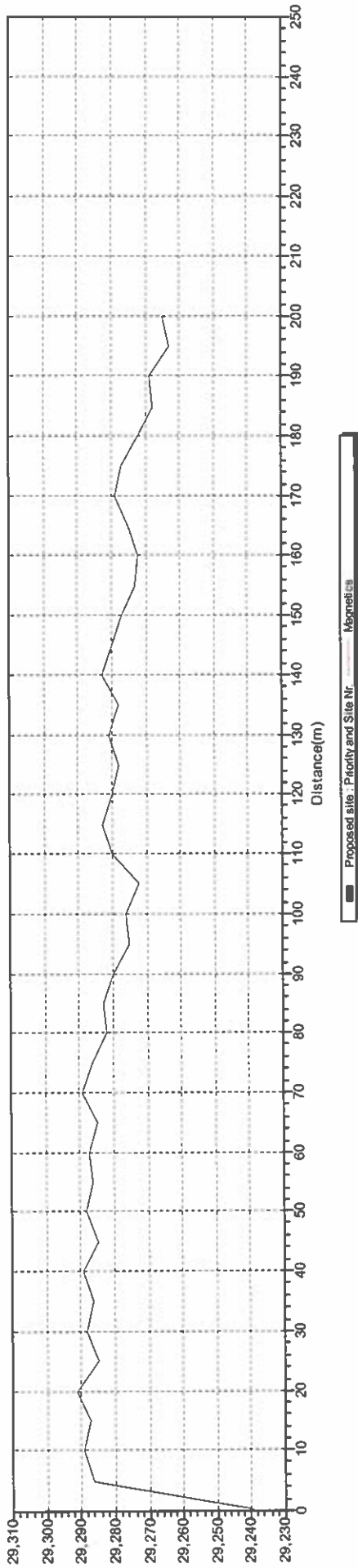
- Existing information from the GRIP web site, The National Groundwater Data Base and The Limpopo Aquabase Data Base. This information sites are updated and maintained by The Department of Water Affairs and Forestry.
- BRANDL, G. (1986). The geology of the Pietersburg area: Expl. Sheet geol. Surv. S. Afr., 2328 (Pietersburg),
- Department of Water Affairs and Forestry, 1996. South African Water Quality Guidelines (Second edition). Volume 5: Agricultural Use: Livestock Watering.
- Department of Water Affairs and Forestry, 1996. South African Water Quality Guidelines (Second edition). Volume 4: Agricultural Use: Irrigation.
- Water Research Commission No TT101/98 (1998). Quality of domestic water supplies. Volume 1 Assessment Guide.

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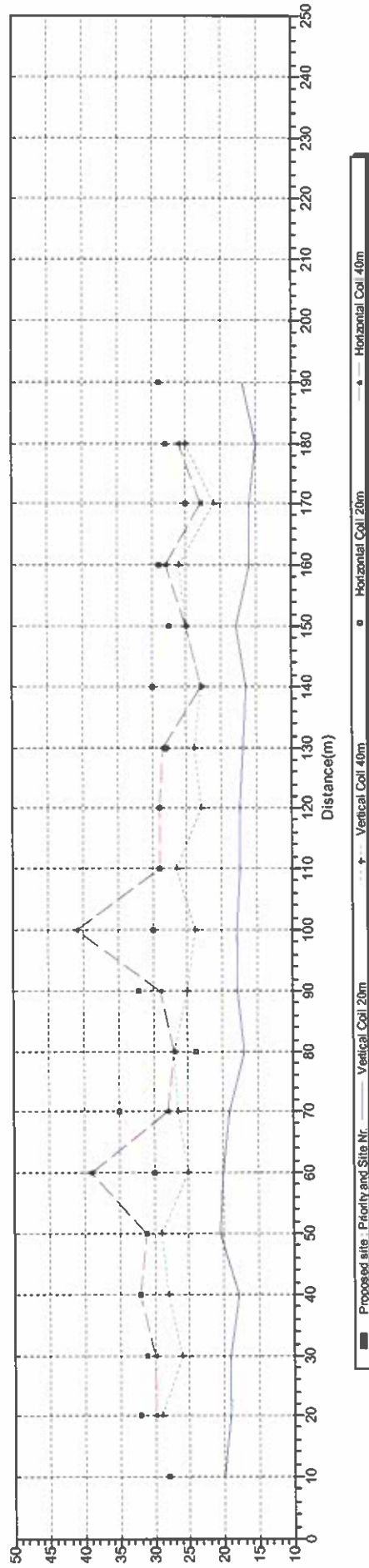
# Appendix

# Geophysical Traverse

Magnetic Traverse: 20050926TRAV/0001  
BUFFEL.SHOEK/PR05/075/LINE1



EM34 Traverse: 20050926TRAV/0001  
BUFFEL.SHOEK/PR05/075/LINE1

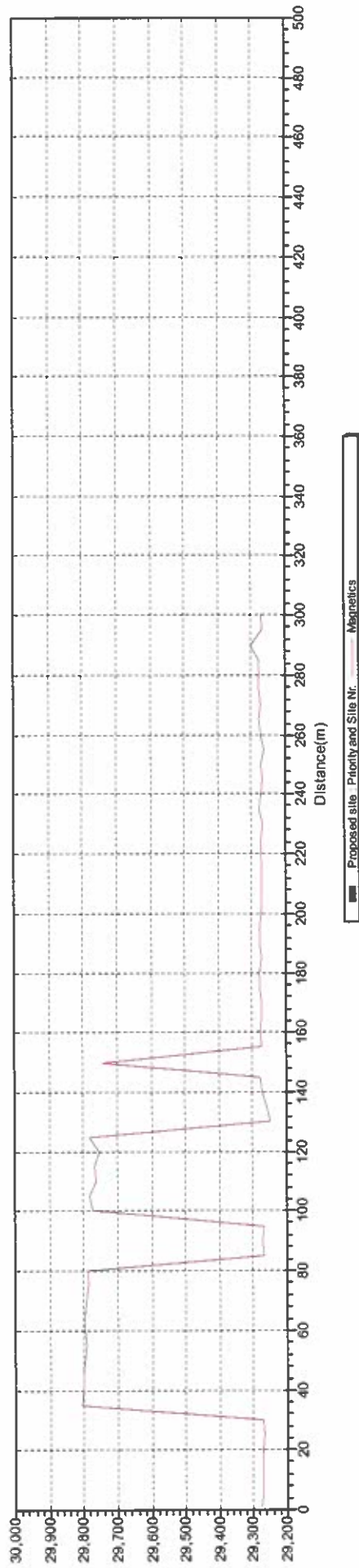


PROJECT DESCRIPTION  
topo Province/Buffelshoek  
28 BB  
Easting start: 23° 08' 26.8"  
Easting end: 28° 56' 47.0"  
Magnetic start: 28° 56' 47.0"  
Magnetic end: 28° 56' 53.7"  
Magnetic declination: 76° W-E  
Sheet: 1

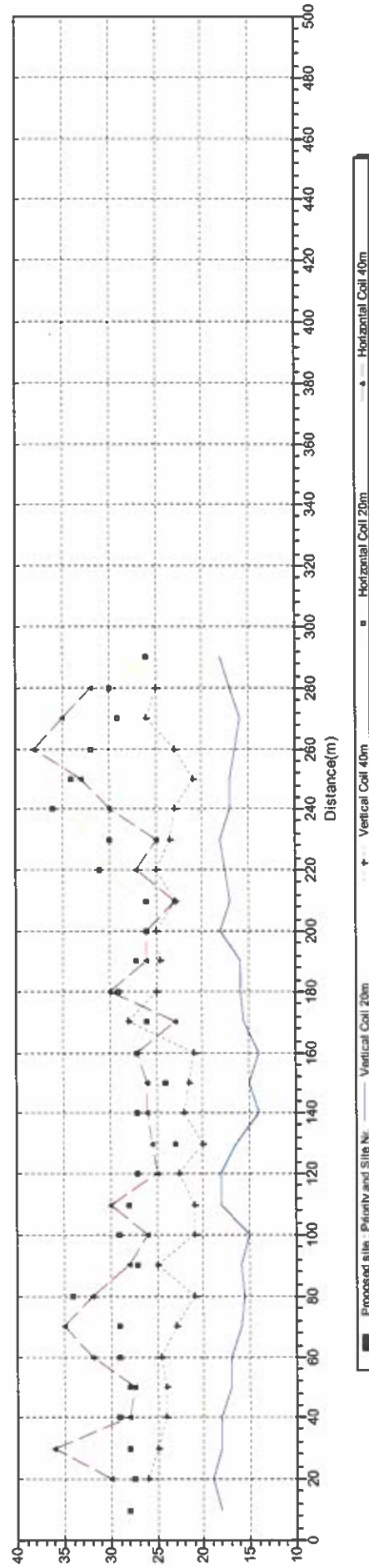


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Fax: 015 296 2300 / 298 8847  
E-mail: vsaleboa@mweb.co.za

Magnetic Traverse: 20050926TRAV0002  
BUFFELSHOEK/FR05/75/LINE 2



EM64 Traverse: 20050926TRAV0002  
BUFFELSHOEK/FR05/75/LINE 2

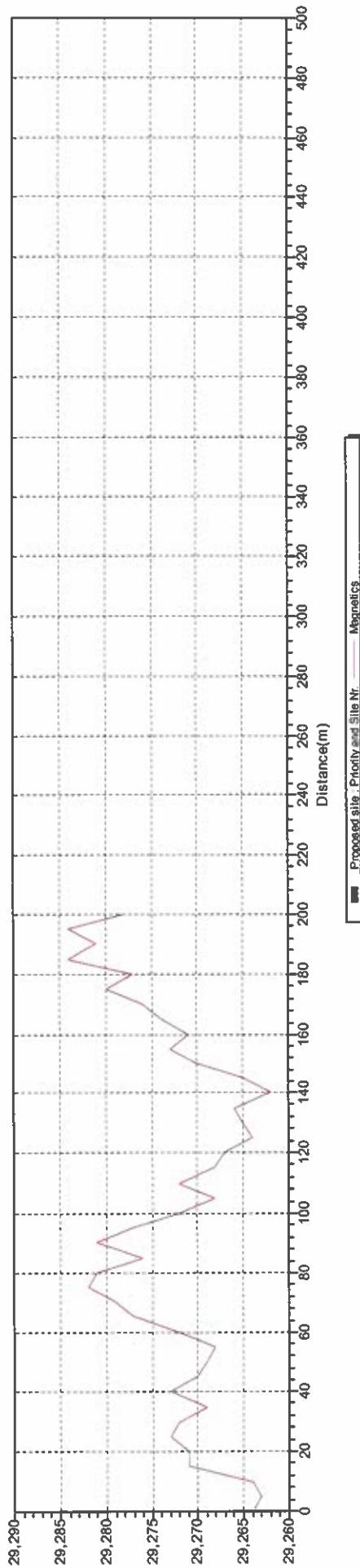


OBJECT DESCRIPTION:  
wopo Province/Buffelshoek  
28 BB  
start: 23° 08' 27.6" Lat end: 23° 08' 22.4"  
'g start: 28° 56' 56.8" Long end: 28° 56' 48.0"  
e 2

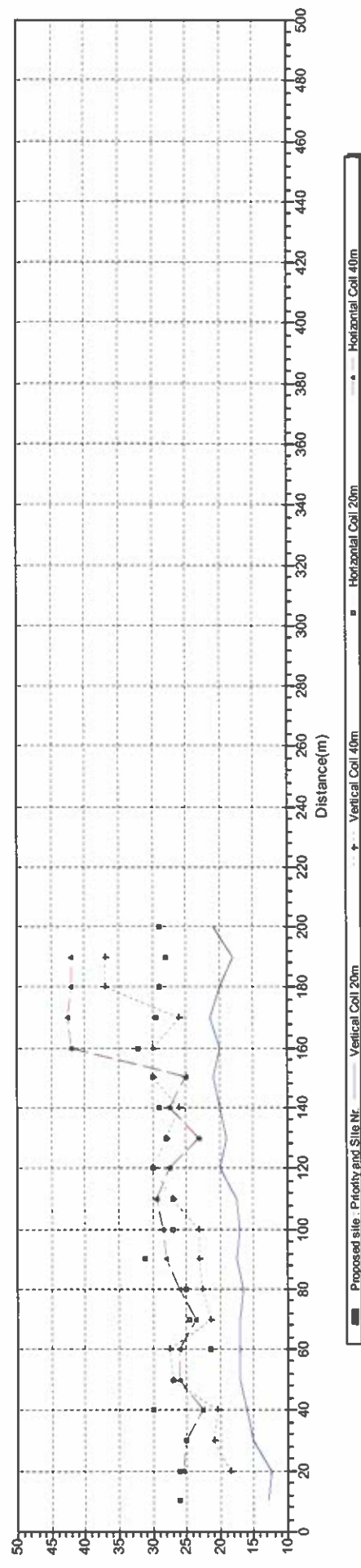


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Magnetic Traverse: 20050926TRAV0003  
 BUFFELSHOBK/PR05/075/LINE 3



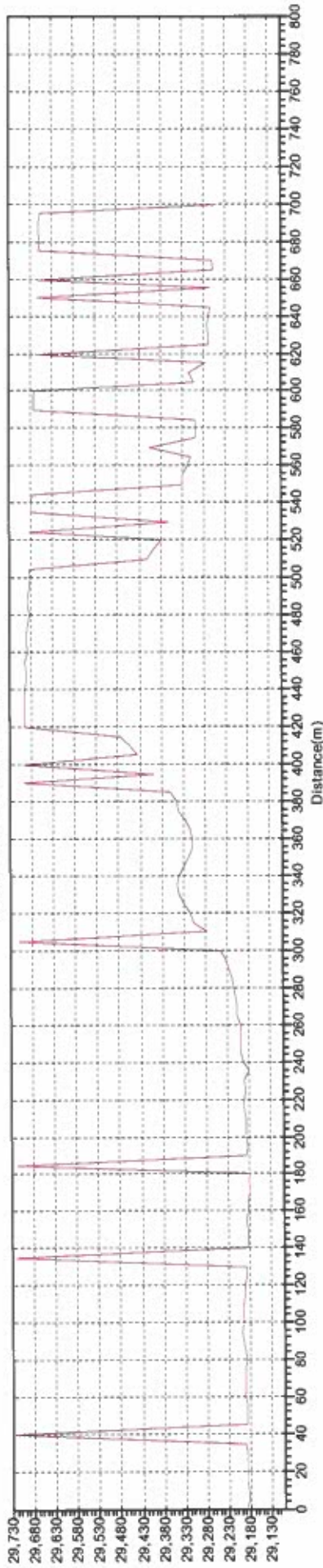
EM34 Traverse: 20050926TRAV0003  
 BUFFELSHOBK/PR05/075/LINE 3



PROJECT DESCRIPTION:  
 Popo Province/Buffelshoek  
 8 BB  
 start: 23° 08' 23.5" Lat end: 23° 08' 29.4"  
 195° N-S 28° 56' 52.7" Long end: 28° 56' 50.5"

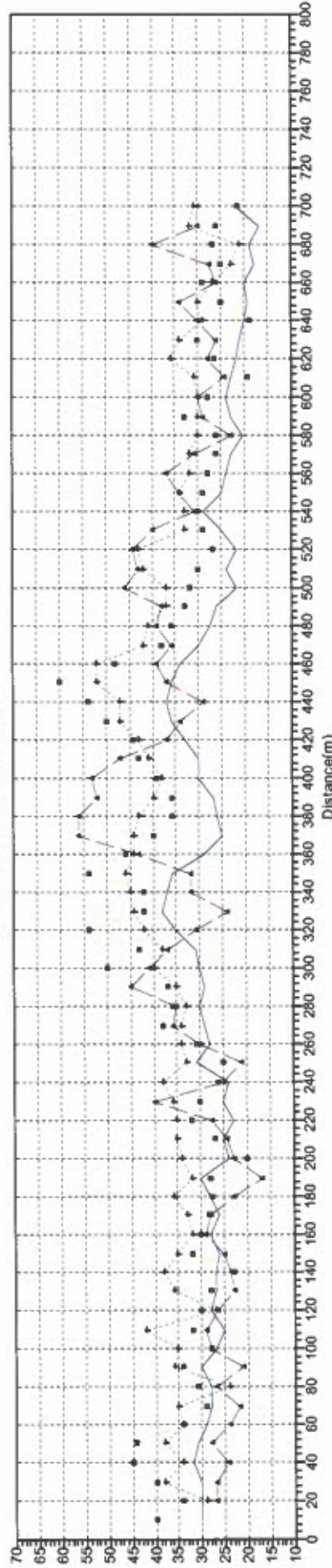
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 E-mail: vsaleboa@imweb.co.za

Magnetic Traverse: 20050926TRAV0004  
 BUFFELSHOEB/CASP 3/LINE 4



Proposed site, Priority and Site Nr. Magnetics

EM34 Traverse: 20050926TRAV0004  
 BUFFELSHOEB/CASP 3/LINE 4



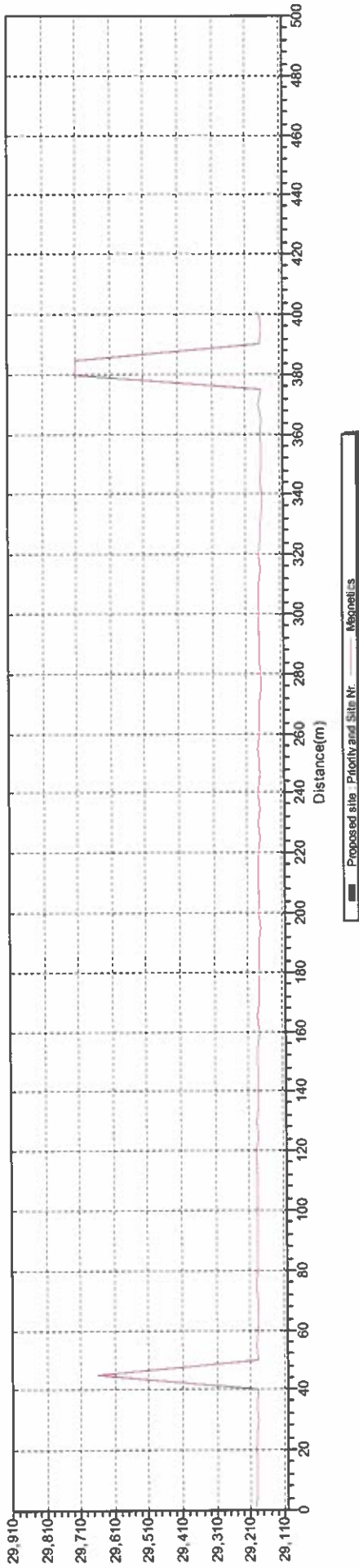
Proposed site, Priority and Site Nr. Vertical Coil 20m, Horizontal Coil 20m, Horizontal Coil 40m

PROJECT DESCRIPTION:  
 Mpopo Province/Buffelshoek  
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 ng start: 28° 57' 20.1"  
 ng end: 23° 08' 49.5"  
 Long end: 28° 57' 07.1"  
 r: 210° NE-SW  
 ve 4

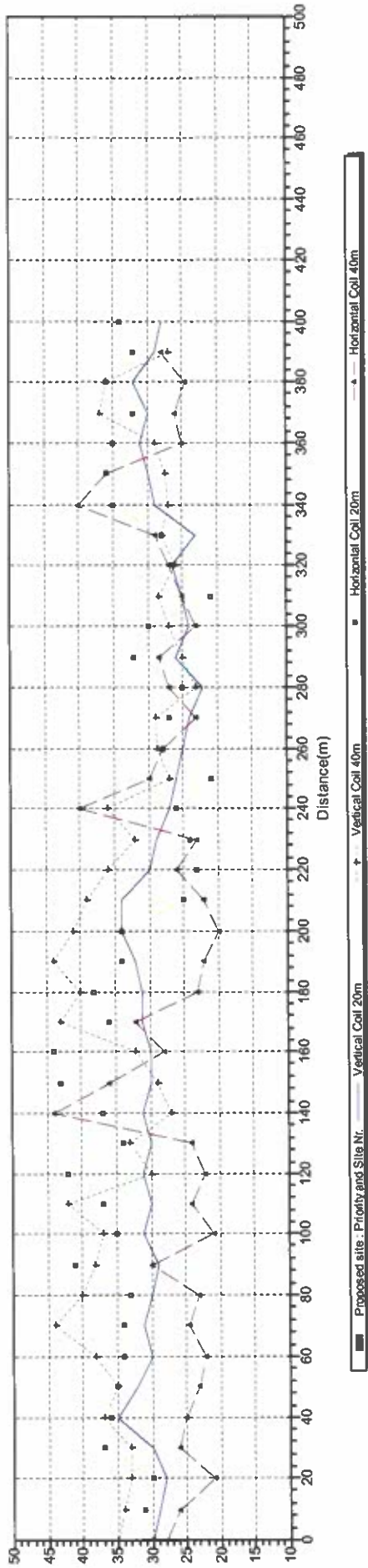


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Magnetic Traverse: 20050926TRAV/0005  
 BUFFELSHOEK/PR05/075/LINE 5



EM64 Traverse: 20050926TRAV/0005  
 BUFFELSHOEK/PR05/075/LINE 5

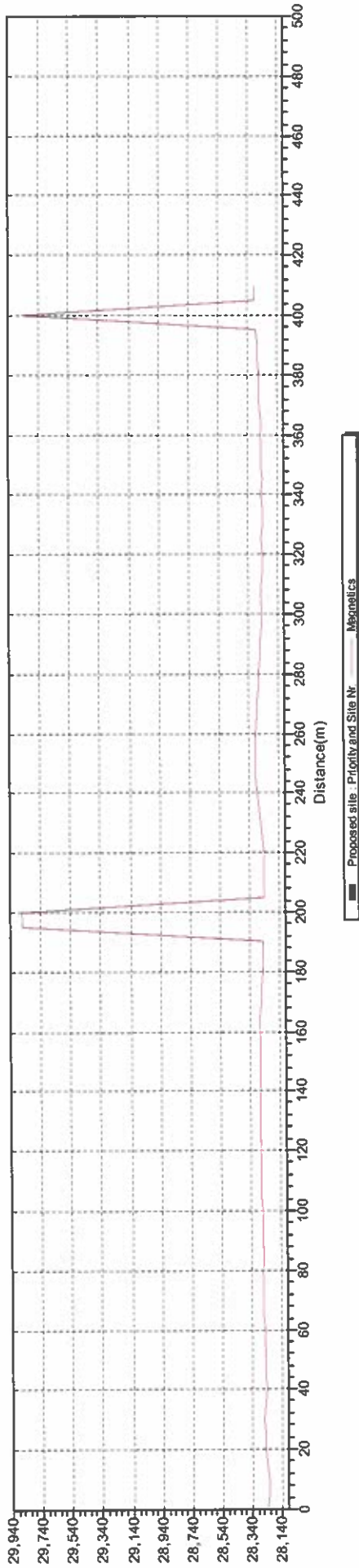


PROJECT DESCRIPTION:  
 Koppo Province/Burfeisshoek  
 28 BB  
 Start: 23° 08' 30.8" Lat end: 23° 08' 35.6"  
 Long start: 28° 57' 14.5" Long end: 28° 57' 27.3"  
 Scale: 100' W-E  
 Line 5

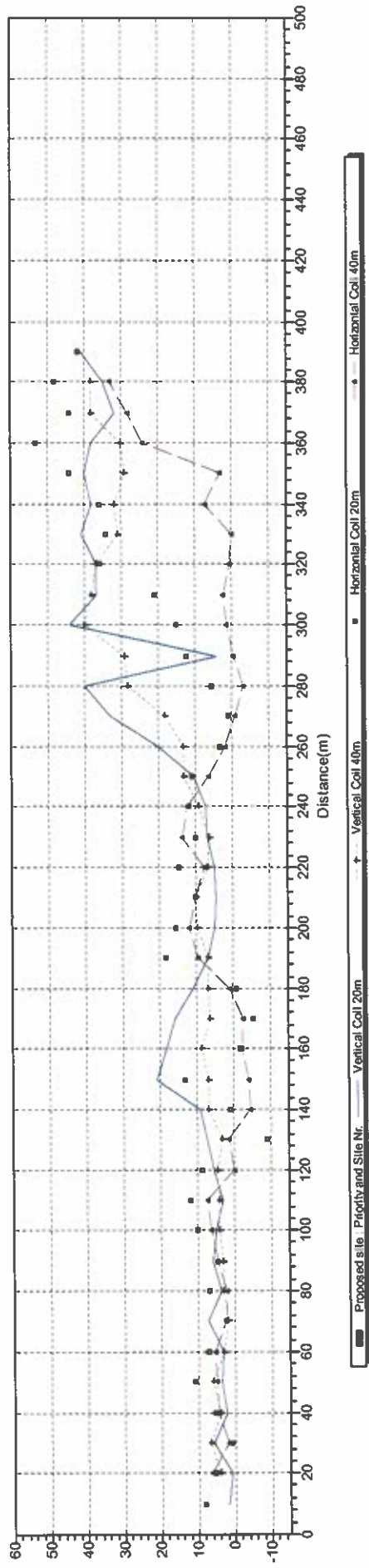


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Magnetic Traverse: 20050927TRAV0001  
DE VILLIERSDALE/FR05/075/LINE 1



EM34 Traverse: 20050927TRAV0001  
DE VILLIERSDALE/FR05/075/LINE 1

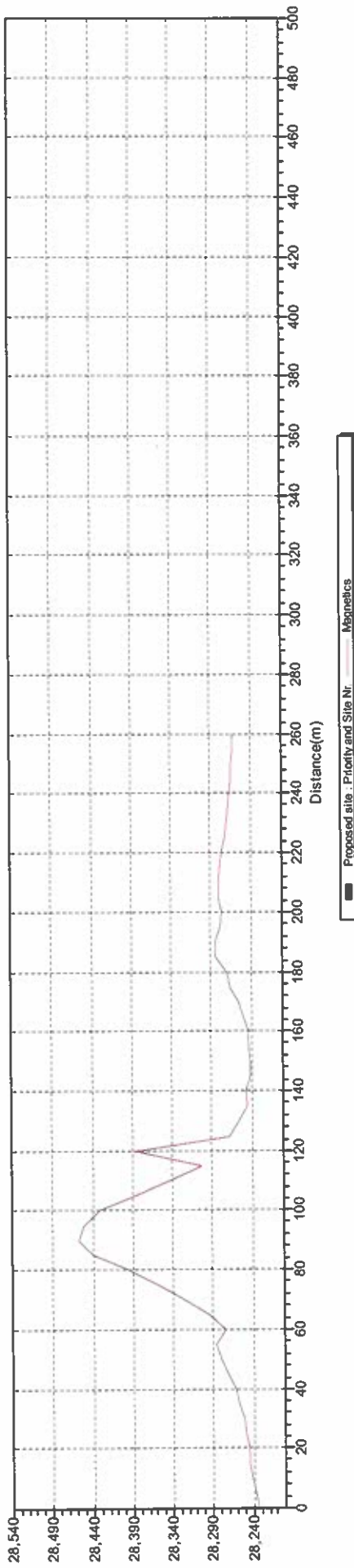


PROJECT DESCRIPTION:  
 Mpumalanga Province/De Villiersdale  
 28 BB  
 Name: De Villiersdale 313 LR  
 Easting start: 23° 13' 29.8" Long end: 28° 46' 40.5"  
 Northing start: 23° 13' 32.3" Lat end: 28° 46' 26.9"  
 Zone: 285 E-W  
 File 1

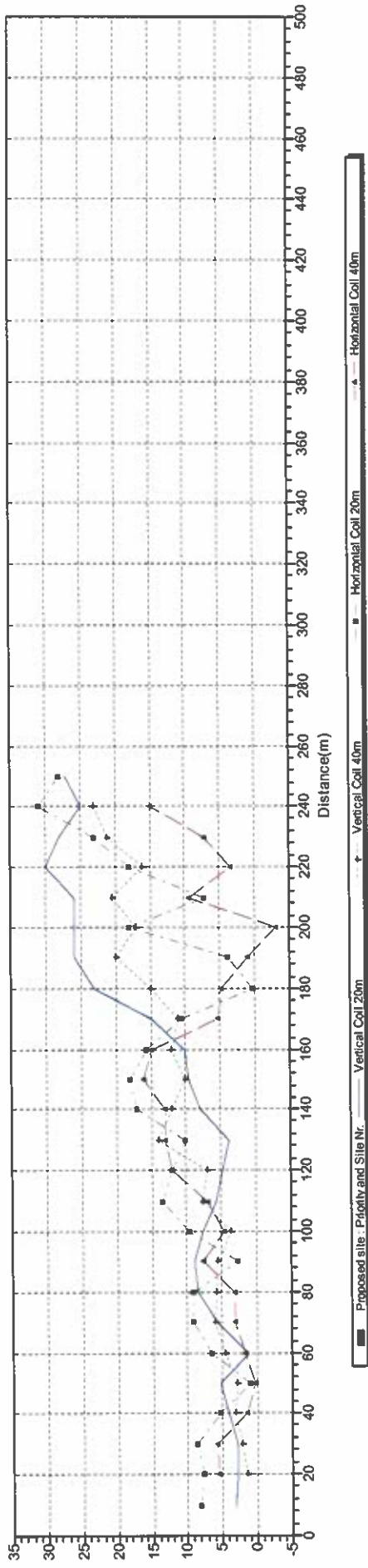


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Magnetic Traverse: 20050927TRAV0002  
DE VILLIERSDALE/FR05/075/LINE 2



EM34 Traverse: 20050927TRAV0002  
DE VILLIERSDALE/FR05/075/LINE 2

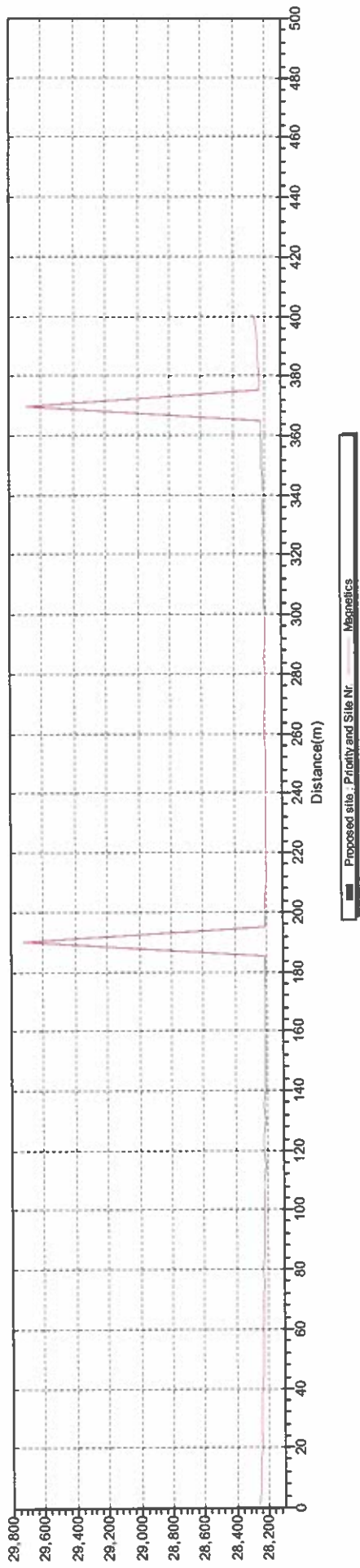


PROJECT DESCRIPTION  
topo Province/De Villiersdale  
28 BB  
firm name: De Villiersdale 313 LR  
lat start: 23° 13' 29.0" Lat end: 23° 13' 37.1"  
long start: 28° 46' 38.0" Long end: 28° 46' 40.1"  
r: 165° N-S

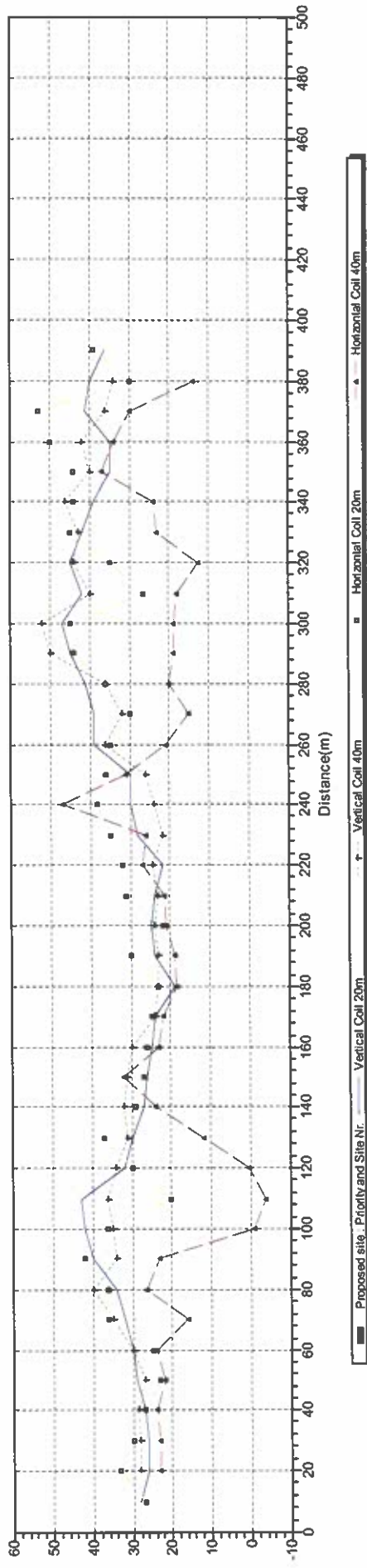


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Magnetic Traverse: 20050927TRAV0003  
DE VILLERSDALE/RR05/075/LINE 3



EM34 Traverse: 20050927TRAV0003  
DE VILLERSDALE/RR05/075/LINE 3



OBJECT DESCRIPTION:  
popo Province/De Villiersdale  
18 BB start: 23° 13' 44.1" Lat end: 23° 13' 34.7"  
19 start: 28° 46' 36.0" Long end: 28° 46' 26.2"  
313° SE-NW  
8 3



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# **Borehole Logs**

**(Per Borehole)**

**BASIC SITE INFORMATION:** Site Identifier: 2328BBV8073 Number: H11-2280 Site type: Borehole

Distr./Farm No.: LPLR261

Site Name/Des.: BUFFELSHOEK/BUFFELSHOEK STOCK WATERING

Region Type: District Council

Region Descr.: CAPRICORN/BLOUBERG

Latitude [°]: 23.139000

Reg./BB.:

Topo-set.: Hillside (slope)

Depth [m]: 114.53

Longitude [°]: 28.948083

G-Nr.:

Site status: Unused

Col. ht. [m]: 0.38

Altitude [m]:

Site purp.: Production (water supply)

Diam. [mm]: 165

Coord. acc.: Accurate to within 100 units

Use applic.: Domestic - all purposes

Drain. reg.: A72A

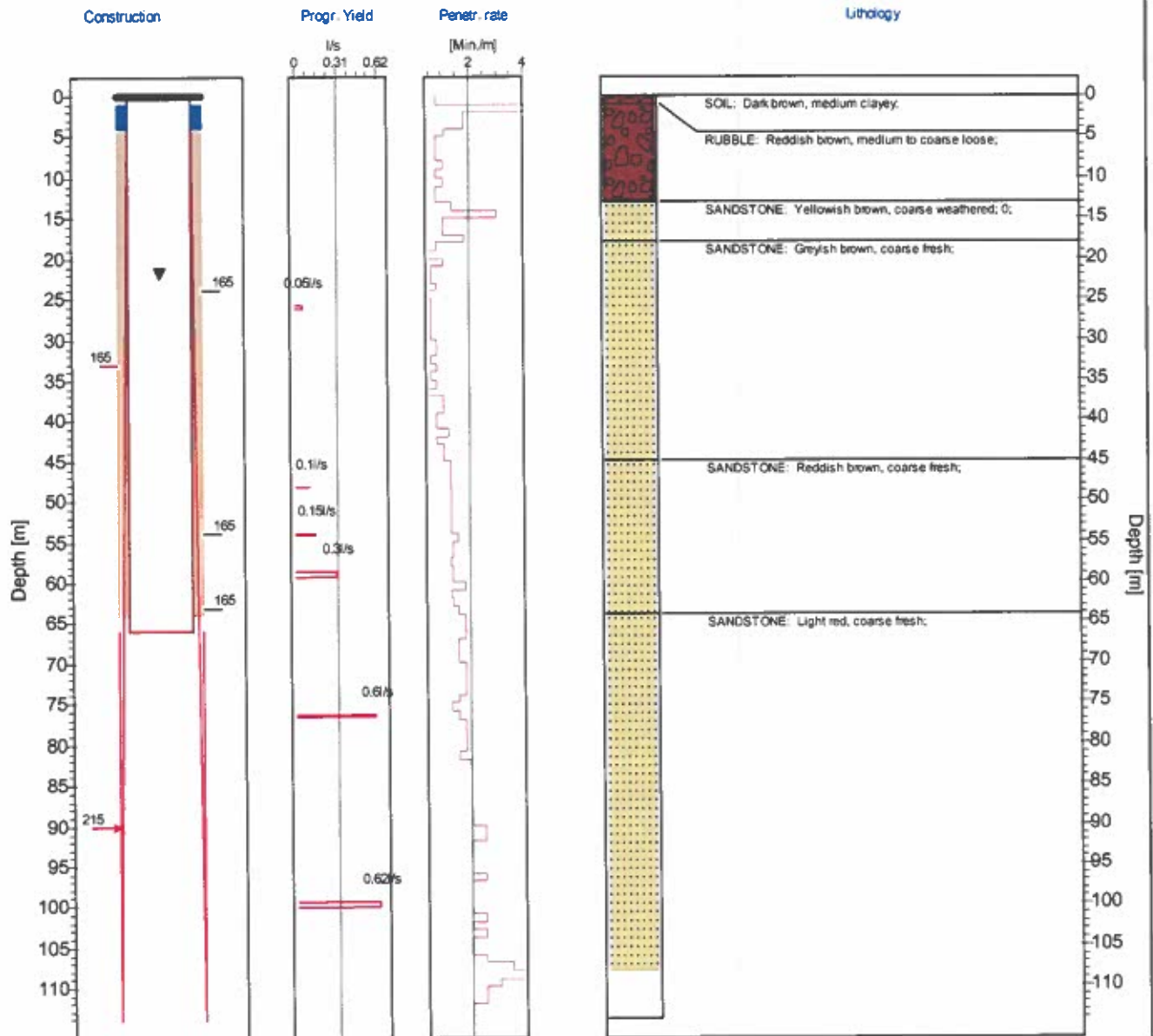
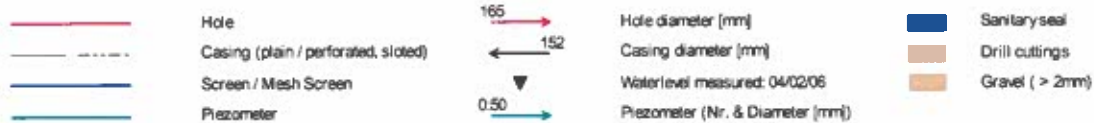
Coord. meth.: Global Positioning System

Equipment: No equipment

Rep. inst.: VSA

Coordinate System: Geographic Decimal Degrees (Longitude/Latitude), WGS 1984

**Construction and Geohydrological Legend**



COMMENT:



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**Borehole Construction and Geological Log**

Date compiled: 7/20/2006

**BASIC SITE INFORMATION:** Site Identifier: 2328BBV8074 Number: H11-2281 Site type: Borehole

Distr./Farm No.: LPLR313

Site Name/Des.: DE VILLIERSDALE/DE VILLIERSDALE LIVESTOCK

Region Type: District Council

Region Descr.: CAPRICORN/BLOUBERG

Latitude [°]: 23.228166

Reg./BB.:

Topo-set.: Flat surface, plain

Depth [m]: 90.00

Longitude [°]: 28.775888

G-Nr.:

Site status: Destroyed

Col. ht. [m]:

Altitude [m]:

Site purp.: Exploration

Diam. [mm]: 165

Coord. acc.: Accurate to within 100 units

Use applic.: Agricultural - stock watering

Drain. reg.: A62J

Coord. meth.: Global Positioning System

Equipment:

Rep. inst.: VSA

Coordinate System: Geographic Decimal Degrees (Longitude/Latitude), WGS 1984

**Construction and Geohydrological Legend**

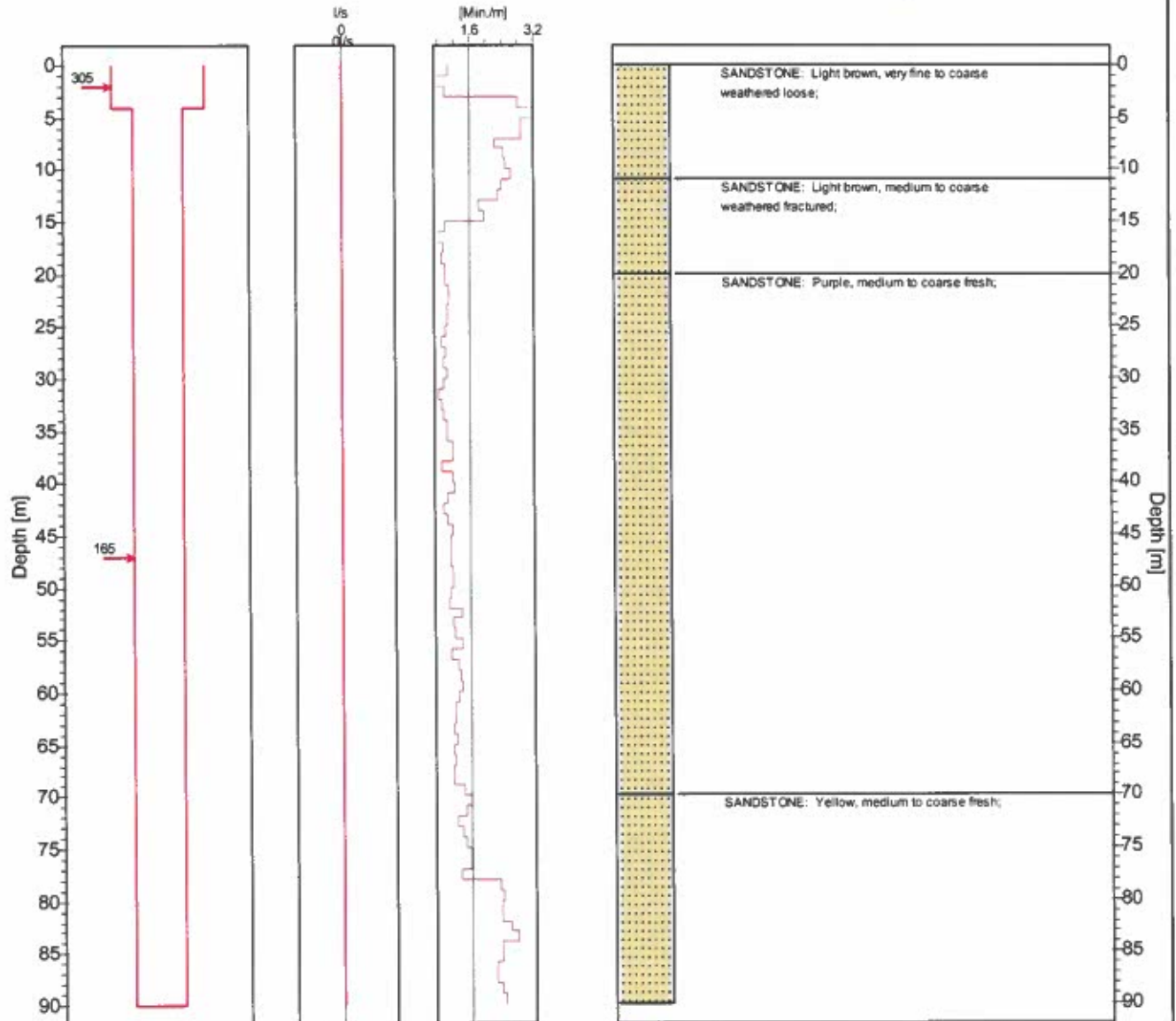
-  Hole
-  Casing (plain / perforated, slotted)
-  Screen / Mesh Screen
-  Piezometer
-  165 Hole diameter [mm]
-  152 Casing diameter [mm]
-  Waterlevel with date meas.
-  0:50 Piezometer (Nr. & Diameter [mm])

Construction

Progr. Yield

Penetr. rate

Lithology



COMMENT:



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**Borehole Construction and Geological Log**

Date compiled: 7/20/2006

**BASIC SITE INFORMATION:** Site Identifier: 2328BBV8076 Number: H11-2282 Site type: Borehole

Distr./Farm No.: LPLR313

Site Name/Des.: DE VILLARSDALE/DE VILLIERSDALE

Region Type: District Council

Region Descr.: CAPRICORN/BLOUBERG

Latitude [°]: 23.225166

Reg./BB.:

Topo-set: Flat surface, plain

Depth [m]: 124.66

Longitude [°]: 28.776500

G-Nr.:

Site status: Unused

Col. ht. [m]: 0.59

Altitude [m]:

Site purp.: Production (water supply)

Diam. [mm]: 165

Coord. acc.: Accurate to within 100 units

Use applic.: Agricultural - stock watering

Drain. reg.: A62J

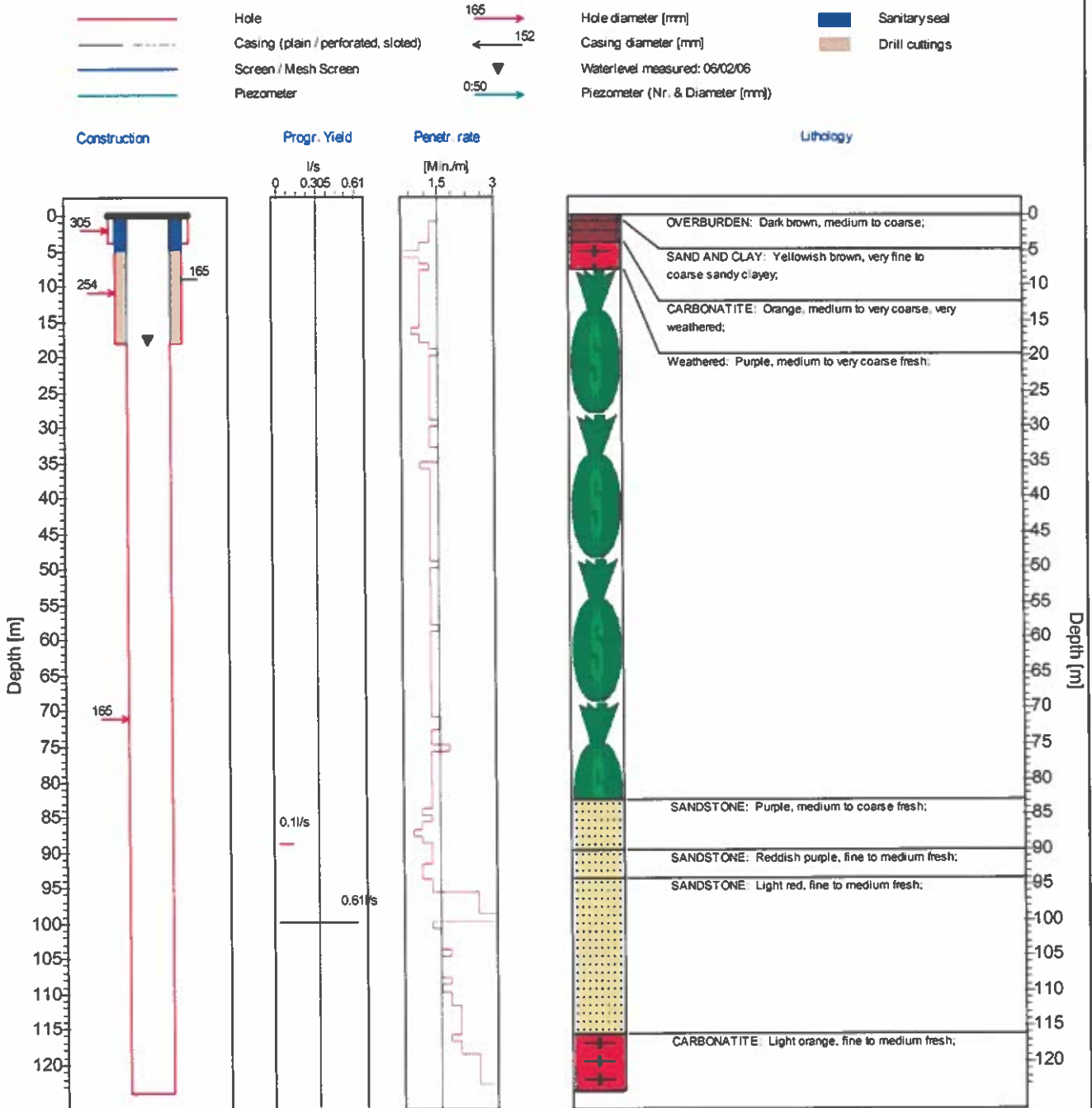
Coord. meth.: Global Positioning System

Equipment: No equipment

Rep. inst.: VSA

Coordinate System: Geographic Decimal Degrees (Longitude/Latitude), WGS 1984

**Construction and Geohydrological Legend**



COMMENT:



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**Test Pumping Results**  
**(Per Borehole)**

**PUMPING TEST REPORT**

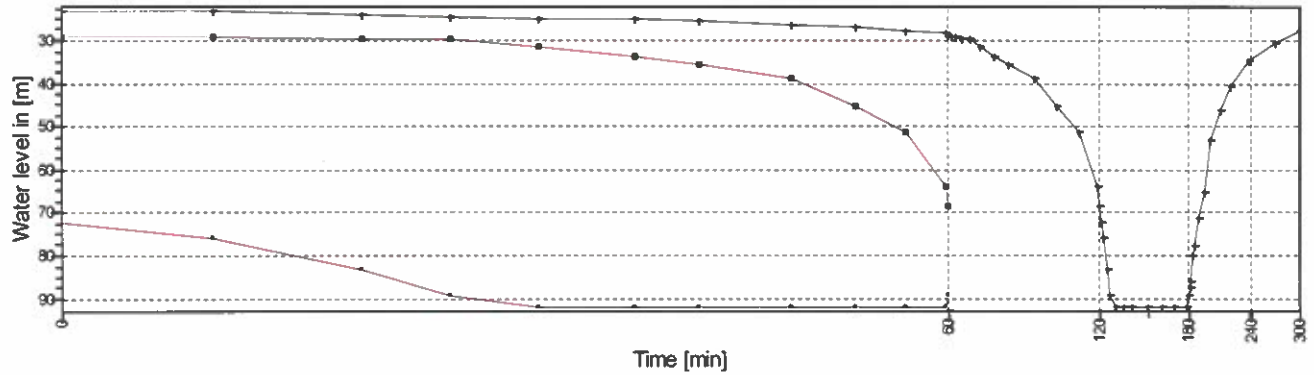
Date compiled: 7/20/2006

**BASIC SITE INFORMATION:** Site Identifier: 2328BBV8073 Number: H11-2280 Site type: Borehole  
 Distr./Farm No.: LPLR261 Site Name/Des.: BUFFELSHOEK/BUFFELSHOEK STOCK WATERING

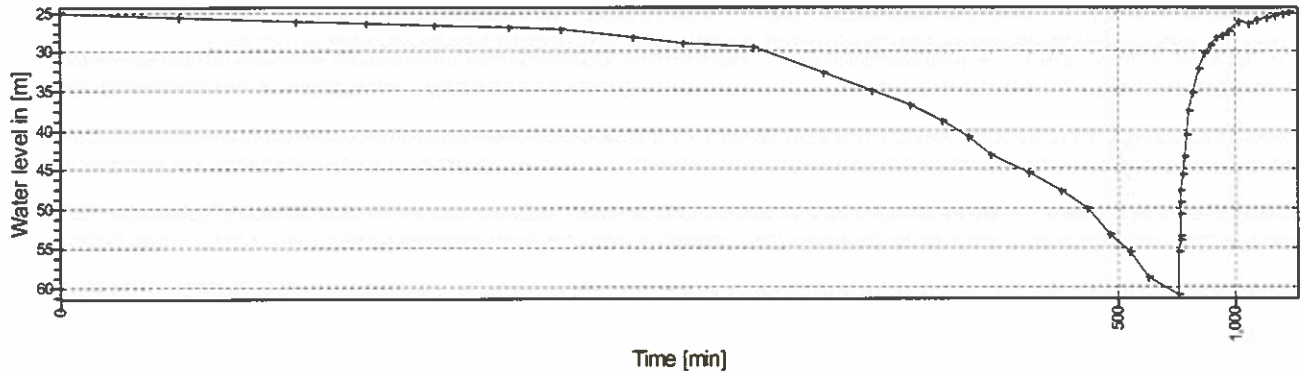
Latitude [°]	23.139000	Alt. No. 1:	Diam. [mm]:	165	Water lev. [m]:	21.78
Longitude [°]	28.948083	Alt. No. 2:	Depth [m]:	114.53	Piezometer:	0
Altitude [m]:		Rep. inst.: VSA	Col. ht. [mm]:	0.38	Date WL meas.:	20060204

Coordinate System: Geographic Decimal Degrees (Longitude/Latitude), WGS 1984

Multirate Test



Constant Rate Test



**PUMPING TEST:**

Rep. Inst.	Meth. tested	Depth to intake [m]	Starting Date	Time	Ending Date	Time	Transmis. [m <sup>2</sup> /d]	Storativ.	Rec. abs. [l/s]
VSA	Multirate test	93.00	20060204	1101	20060204	1600			
VSA	Constant rate test	93.00	20060204	1831	20060205	1730			

**TESTING DETAILS:**

Description	Time start	Durat. [min]	Depth to intk. [m]	Disch. rate[l/s]	Drawd. [m]	Recov. [m]	%	Rec. Dur. [min]	Trans. [m <sup>2</sup> /d]	Perm. [m/d]	Storat.	Q/st
MULTI STEP 1	1101	60	93.00	0.57	28.18							0.02
MULTI STEP 2	1201	60	93.00	1.10	63.74							0.02
MULTI STEP 3	1301	60	93.00	0.62	92.02	27.51	92	120				0.01
CONSTANT RATE	1831	720	93.00	0.51	61.12	24.84	93	72				0.01



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**PUMPING TEST REPORT**

Date compiled: 7/20/2006

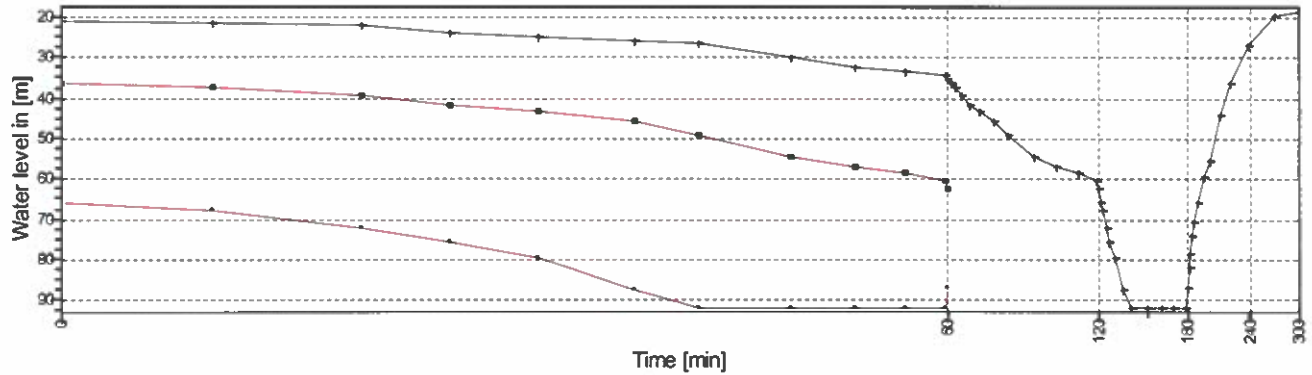
**BASIC SITE INFORMATION:** Site Identifier: 2328BBV8076 Number: H11-2282 Site type: Borehole

Distr./Farm No.: LPLR313 Site Name/Des.: DE VILLARSDALE/DE VILLIERSDALE

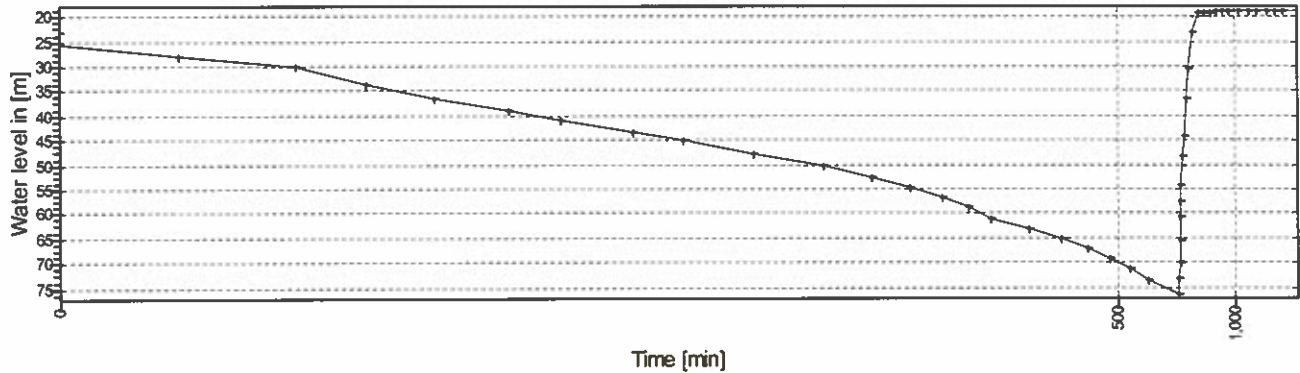
Latitude [°]	23.225166	Alt. No. 1:	Diam. [mm]:	165	Water lev. [m]:	17.59
Longitude [°]	28.776500	Alt. No. 2:	Depth [m]:	124.66	Piezometer:	0
Altitude [m]:		Rep. inst.: VSA	Col. ht. [mm]:	0.59	Date WL meas.:	20060206

Coordinate System: Geographic Decimal Degrees (Longitude/Latitude), WGS 1984

Multirate Test



Constant Rate Test



PUMPING TEST:		Depth to intake [m]	Starting Date	Ending Date	Transmis. [m <sup>2</sup> /d]	Storativ.	Rec. abs. [l/s]
Rep. Inst.	Meth. tested		Time	Time			
VSA	Multirate test	93.00	20060206 1311	20060206 1810			
VSA	Constant rate test	93.00	20060206 1821	20060207 1820			

TESTING DETAILS:		Durat. [min]	Depth to intk. [m]	Disch. rate[l/s]	Drawd. [m]	Recov. [m]	Rec. Dur. [min]	Trans. [m <sup>2</sup> /d]	Perm. [m/d]	Storat.	Q/st
Description	Time start.					%					
MULTI STEP 1	1311	60	93.00	0.31	34.36						0.01
MULTI STEP 2	1411	60	93.00	0.62	60.13						0.01
MULTI STEP 3	1511	60	93.00	0.61	91.80	18.60	100	120			0.01
CONSTANT RATE	1821	720	93.00	0.51	76.39	18.68	99	720			0.01



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**Management**  
**Recommendation**  
**(Per Borehole)**

## MANAGEMENT RECOMMENDATIONS

**BASIC SITE INFORMATION:** Site Identifier: 2328BBV8073 Number: H11-2280 Site type: Borehole

Distr./Farm No.: LPLR261 Site Name/Descr.: BUFFELSHOEK/BUFFELSHOEK STOCK WATERING

Latitude [°]:	23.139000	Alt. No. 1:	Diam. [mm]:	165	Water lev. [m]:	21.78
Longitude [°]:	28.948083	Alt. No. 2:	Depth [m]:	114.53	WL status:	Static
Altitude [m]:		Rep. inst.: VSA	Col. ht. [m]:	0.38	Date WL meas.:	20060204

Coordinate System: Geographic Decimal Degrees (Longitude/Latitude), WGS 1984

### EXISTING EQUIPMENT:

<b>Pump:</b>			
Type of Inst.:	No equipment	Pulley Diam. [mm]:	
Manufacturer:		Depth to Intk. [m]:	
<b>Engine:</b>			
Manufacturer:		Power Rating [kW]	
Type of Power:		Pulley Diam. [mm]:	

### USE APPLICATION:

Site Status: Unused  
 Purpose: Production (water supply)  
 Consumer: Non-urban  
 Application: Domestic - all purposes

### WATER CHEMISTRY:

Sample No.:	61/2006	Date sampled:	20060205	Depth sampl. [m]:	0	Comment:	
<b>Main Parameters:</b>			<b>Calculated Parameters:</b>			<b>Bacteriol. Parameters:</b>	
pH:	6.74	Na:		Cl:	93.3	Langel.:	E.Coli:
EC: [mS/m]	112 †	K:		NO3 as N:	22.8 ‡	Aggr-Ind:	7.14
TDS:	748 †	Si:		SO4:	19.6	Ion-bal:	-100.00
T. Alk.:		Al:		F:	0.3	CaCO3:	
Ca:		Fe:	0.05	Concentrations in [mg/l]; Bact. param. in counts/100ml; Chemistry Standard: SABS for human consumption			
Mg:		Mn:	0.32 †	† Value exceeds recommended maximum limit ‡ Value exceeds maximum allowable limit			
				! Value exceeds recommended minimum limit ; Value exceeds minimum allowable limit			

### AQUIFER INFORMATION:

Depth to Top [m]	Depth to Bot. [m]	Yield [l/s]	Method meas.	Aquifer type	Comment
25.80	26.20	0.05	Notch (V- or U-notch)	Weathered basin	
48.20	48.30	0.10	Notch (V- or U-notch)	Contact zone	
54.10	54.30	0.15	Notch (V- or U-notch)	Fractured	
58.80	59.30	0.30	Notch (V- or U-notch)	Fractured	
76.50	76.70	0.60	Notch (V- or U-notch)	Fractured	
99.40	100.20	0.62	Notch (V- or U-notch)	Fractured	TESTED

### CASING DETAILS:

Depth to Top [m]	to Bot. [m]	Diam. [mm]	Material	Thickn. [mm]	Type of openings	Openings [mm]:		Hor. Dist.	Vert. Dist.
						Length	Width		
0.00	48.00	165	Steel	4	Plain casing				
48.00	60.00	165	Steel	4	Perforated or slotted				
60.00	66.20	165	Steel	4	Plain casing				

### TESTING DETAILS:

Description	Date	Durat. [min]	Depth to Intk. [m]	Disch. rate [l/s]	Drawd. [m]	Recovery %	[min]	T [m³/d]	Storage	Comment
MULTI STEP 1	20060204	60	93.00	0.57	28.18					
MULTI STEP 2	20060204	60	93.00	1.10	63.74					
MULTI STEP 3	20060204	60	93.00	0.62	92.02	27.51	92	120		
CONSTANT RATE	20060204	720	93.00	0.51	61.12	24.84	93	72		

### RECOMMENDATIONS:

Prior.	Rec. equipm.	Depth to Intk. [m]	Type of power	Duty cyc. [hrs]	Disch. rate [l/s]	Water quality	Dyn. water level [m]	Crit. water level [m]
1		66.00		10	0.31			
<b>Note:</b>								
2		66.00		24	0.20	CLASS 3		77.00



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**MANAGEMENT RECOMMENDATIONS**

**Note:** Equip for live stock watering and erect a notice board informing the community of the water quality for domestic use.



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Summary

Main

H11-2280

Applicable	Method	Sustainable yield (l/s)	Std. Dev	Early T (m <sup>2</sup> /d)	Late T (m <sup>2</sup> /d)	S	AI used
	Basic FC	0.15	0.08	1	0.8	2.20E-03	37.0
	Advanced FC	0.21		1	0.8	1.00E-03	37.0
	FC inflection point	0.16	0.08				27.7
	Cooper-Jacob	0.17	0.11		0.8	2.18E-03	37.0
	FC Non-Linear	0.24	0.22	1.0		1.00E-03	37.0
	Barker	0.13	0.05	K <sub>1</sub> = 100		S <sub>s</sub> = 1.06E-03	37.0
	Average Q sust (l/s)	0.18	0.04	b = 0.20	Fractal dimension n =	1.61	

Recommended abstraction rate (L/s) **0.20** for 24 hours per day

Hours per day of pumping **10** 0.31 L/s for 10 hours per day  
**0.4l/s for 8 hours/day**  
**0.3l/s for 12 hours/day**

Amount of water allowed to be abstracted per month 518.4 m<sup>3</sup>

Borehole could satisfy the basic human need of 691 persons

Is the water suitable for domestic use (Yes/no) **Yes**

Comments

This double porosity aquifer is characterised by a fracture network, consisting of fractures with limited extent within the fresh sandstone formation.  
 Skin effects and well losses have an influence on early time data.  
 Bilinear flow dominated drawdown levels for the first 60 minutes of the test where water was leaking from the matrix to the fractures.  
 After 420 minutes in the test, the network dewatered and the test was terminated after 12 hours with small signs of dewatering of the aquifer in the recovery data.  
 The influence of the no-flow boundaries were reflected in the slower recovery of the borehole, emphasizing the limited extent of the aquifer.

The T-value of the formation is in the order of 0.8  
 According to the step drawdown test, the maximum yield of the borehole is 0.62l/s

**The aim of the recommended maximum safe yield is to prevent the deeper waterstrike within the fresh sandstone formation from dewatering.**

**Recommended depth of pump = 66m**  
 Critical depth = 77m (deeper waterstrike at 77m and 100m depth)  
 Static water level used during test = 22.37m  
 Casing depth = 66m

**Assumptions**  
 Two no-flow boundaries at 200m  
 No rainfall recharge  
 No other production boreholes in the same aquifer

## MANAGEMENT RECOMMENDATIONS

**BASIC SITE INFORMATION:** Site Identifier: 2328BBV8076 Number: H11-2282 Site type: Borehole

Distr./Farm No.: LPLR313 Site Name/Descr.: DE VILLARSDALELIVE STOCK/DE VILLIERSDALE

Latitude [°]:	23.225166	Alt. No. 1:	Diam. [mm]:	165	Water lev. [m]:	17.59
Longitude [°]:	28.776500	Alt. No. 2:	Depth [m]:	124.66	WL status:	Static
Altitude [m]:		Rep. inst.: VSA	Col. ht. [m]:	0.59	Date WL meas.:	20060206

Coordinate System: Geographic Decimal Degrees (Longitude/Latitude), WGS 1984

### EXISTING EQUIPMENT:

**Pump:**

Type of Inst.: No equipment Pulley Diam. [mm]:  
 Manufacturer: Depth to Intk. [m]:

**Engine:**

Manufacturer: Power Rating [kW]  
 Type of Power: Pulley Diam. [mm]:

### USE APPLICATION:

Site Status: Unused  
 Purpose: Production (water supply)  
 Consumer: Non-urban  
 Application: Agricultural - stock watering only

### WATER CHEMISTRY:

Sample No.: H11-2282 Date sampled: 20060705 Depth sampl. [m]: 0 Comment:

**Main Parameters:**

pH: 6.64 Na: Cl: 27.7  
 EC: [mS/m] 26 K: NO3 as N: 0  
 TDS: 144 Si: SO4: 6.8  
 T. Alk.: Al: F: 0.2  
 Ca: Fe: 0.05  
 Mg: Mn: 0.91 †

**Calculated Parameters:**

Langel.: Aggr-Ind: 7.04  
 Ion-bal: -100.00  
 CaCO3:

**Bacteriol. Parameters:**

E.Coli:  
 Faec. co:  
 Total Co:  
 SPC:

Concentrations in [mg/l]; Bact. param. in counts/100ml; Chemistry Standard: SABS for human consumption  
 † Value exceeds recommended maximum limit ‡ Value exceeds maximum allowable limit  
 † Value exceeds recommended minimum limit ‡ Value exceeds minimum allowable limit

### AQUIFER INFORMATION:

Depth to Top [m]	Depth to Bot. [m]	Yield[l/s]	Method meas.	Aquifer type	Comment
89.00	89.01	0.10	Notch (V- or U-notch)	Fractured	
100.00	100.01	0.61	Notch (V- or U-notch)	Fractured	PUMP SUCTION

### CASING DETAILS:

Depth to Top [m]	to Bot. [m]	Diam. [mm]	Material	Thickn. [mm]	Type of openings	Openings [mm]:		Hor. Dist.	Vert. Dist.
						Length	Width		
0.00	18.10	165	Steel	4					

### TESTING DETAILS:

Description	Date	Durat. [min]	Depth to intk. [m]	Disch. rate[l/s]	Drawd. [m]	Recovery		T [m <sup>2</sup> /d]	Storage	Comment
						%	[min]			
MULTI STEP 1	20060206	60	93.00	0.31	34.36					
MULTI STEP 2	20060206	60	93.00	0.62	60.13					
MULTI STEP 3	20060206	60	93.00	0.61	91.80	18.60	100	120		
CONSTANT RATE	20060206	720	93.00	0.51	76.39	18.68	99	720		

### RECOMMENDATIONS:

Prior.	Rec. equipm.	Depth to intk. [m]	Type of power	Duty cyc. [hrs]	Disch. rate [l/s]	Water quality	Dyn. water level [m]	Crit. water level [m]
1		84.00		10	0.22			
<b>Note:</b>								
2		84.00		24	0.14	CLASS 2		89.00
<b>Note:</b> FC PRIORITY 2								



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Summary

Main

H11-2282

Method	Sustainable yield (l/s)	Std Dev	Early T (m <sup>2</sup> /d)	Late T (m <sup>2</sup> /d)	S	AD used
Basic FC	0.14	0.08	0	0.4	2.20E-03	60.0
Advanced FC	0.19		0	0.4	1.00E-03	60.0
FC inflection point	0.09	0.06				35.0
Cooper-Jacob	0.15	0.10		0.4	2.01E-03	60.0
FC Non-Linear	0.16	0.14	1.0		1.00E-03	60.0
Barker	0.13	0.07	K <sub>f</sub> = 100	S <sub>s</sub> =	1.06E-03	60.0
Average Q <sub>sust</sub> (l/s)	0.14	0.04	b = 0.20	Fractal dimension n =	1.57	

Recommended abstraction rate (L/s) **0.14** for 24 hours per day

Hours per day of pumping **10** 0.22 L/s for 10 hours per day  
**0.3l/s for 8 hours/day**  
**0.2l/s for 12 hours/day**

Amount of water allowed to be abstracted per month 362.88 m<sup>3</sup>

Borehole could satisfy the basic human need of 484 persons

Is the water suitable for domestic use (Yes/No)

Comments

This double porosity aquifer is characterised by a fracture network, consisting of fractures with limited extent within the fresh sandstone-conglomerate contact zone.

Skin effects and well losses have an influence on early time data.

Radial flow dominated drawdown levels for the first 120 minutes before the influence of one no-flow boundary could be detected in the drawdown levels.

The test was terminated after 12 hours with no sign of dewatering of the aquifer in the recovery data.

The deeper waterstrikes at 89m(0.1l/s) and 100m(0.4l/s) depth within the fresh sandstone formation were not reached during the test.

Because of the presence of the no-flow boundary, the extent of the aquifer is limited.

The T-value of the formation is in the order of 0.4, indicating limited aquifer potential.

According to the step drawdown test, the maximum yield of the borehole is 0.6l/s

**The aim of the recommended maximum safe yield is to prevent the deeper waterstrikes at 89m and 100m depth from dewatering.**

**Recommended depth of pump = 84m**

Critical depth = 89m (waterstrike)

Static water level used during test = 18.6m

Casing depth = 18m

**Assumptions**

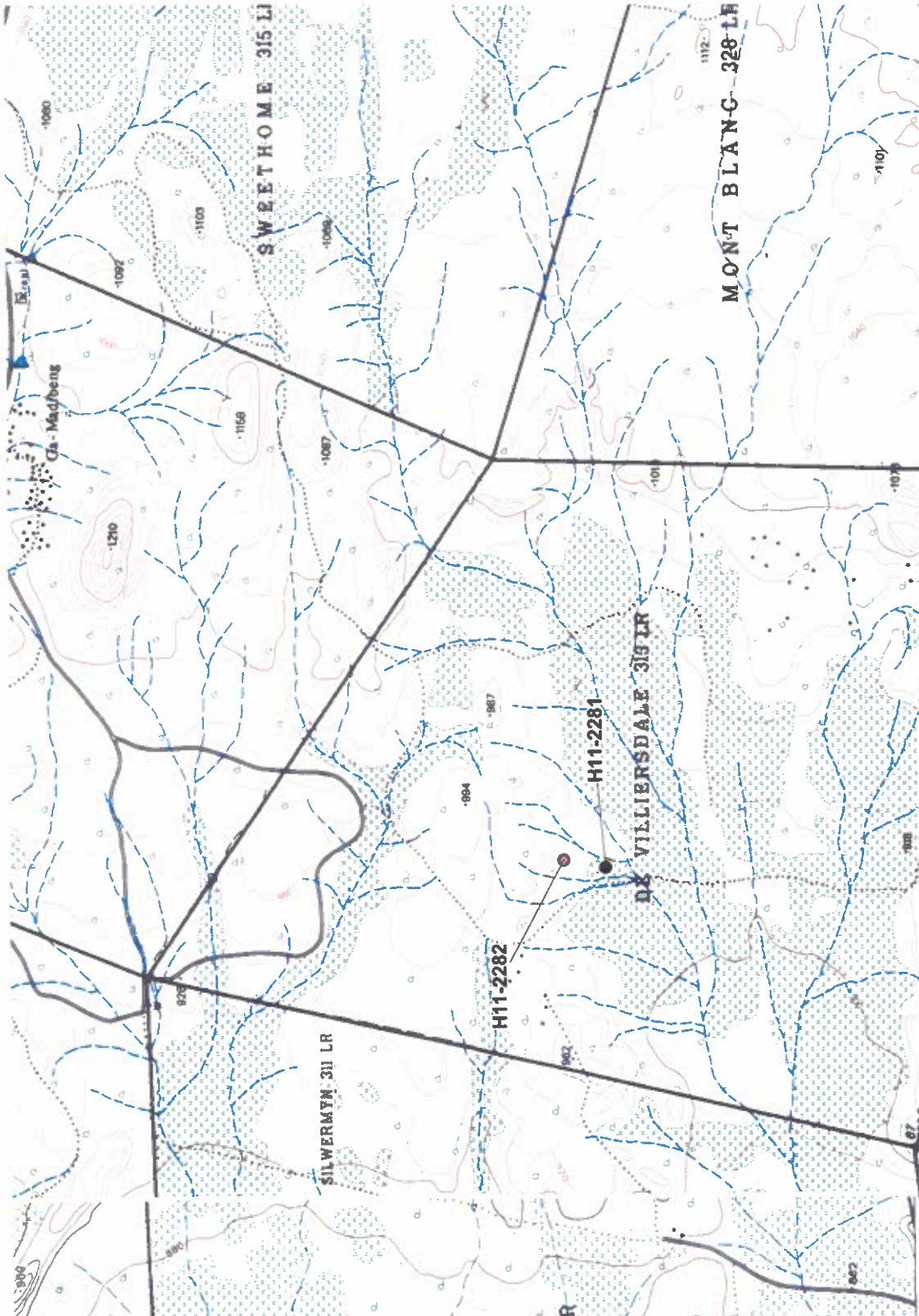
One no-flow boundary at 200m

No rainfall recharge

No other production boreholes in the same aquifer

# Maps

# Map B : De Villiersdale - Borehole positions and recommended abstraction yield.



Recommended Yield  
(m<sup>3</sup>/Day)

- 0 to 0.99 (1)
- 1 to 14.99 (1)



Scale & Projection

Projection - Ungeographic (Longitude, Latitude)  
UTM (Zone 32S)



kilometres  
1 : 50 000

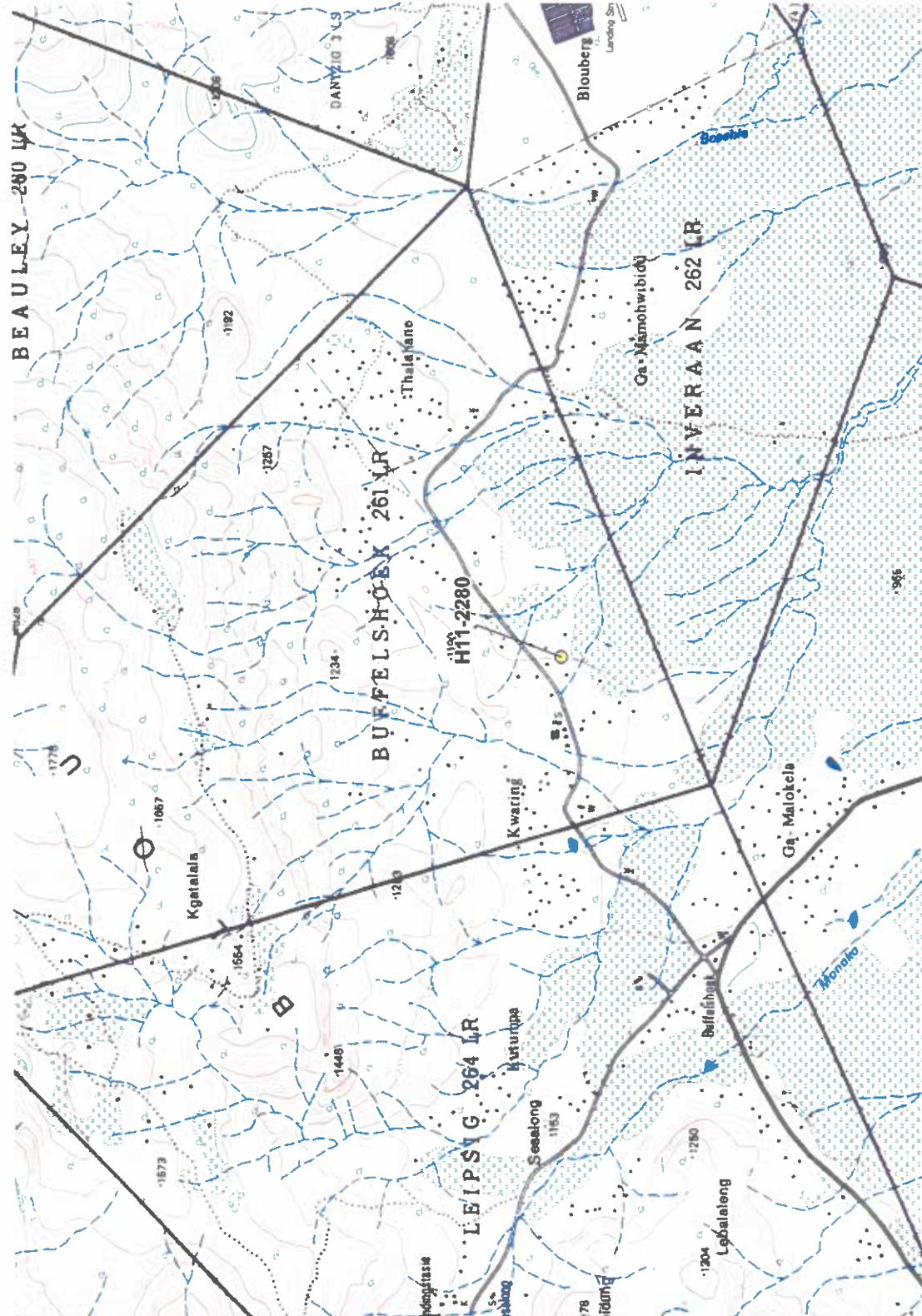
Prepared by:



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# Map C : Buffelshoek - Borehole positions and recommended abstraction yield.



Recommended Yield  
(m<sup>3</sup>/Day)  
 15 to 29.99 (1)



Scale & Projection

Projection: Oblique Conical Degree Summits (LUMATI)  
 1:50000 Projection



kilometres  
1 : 50 000

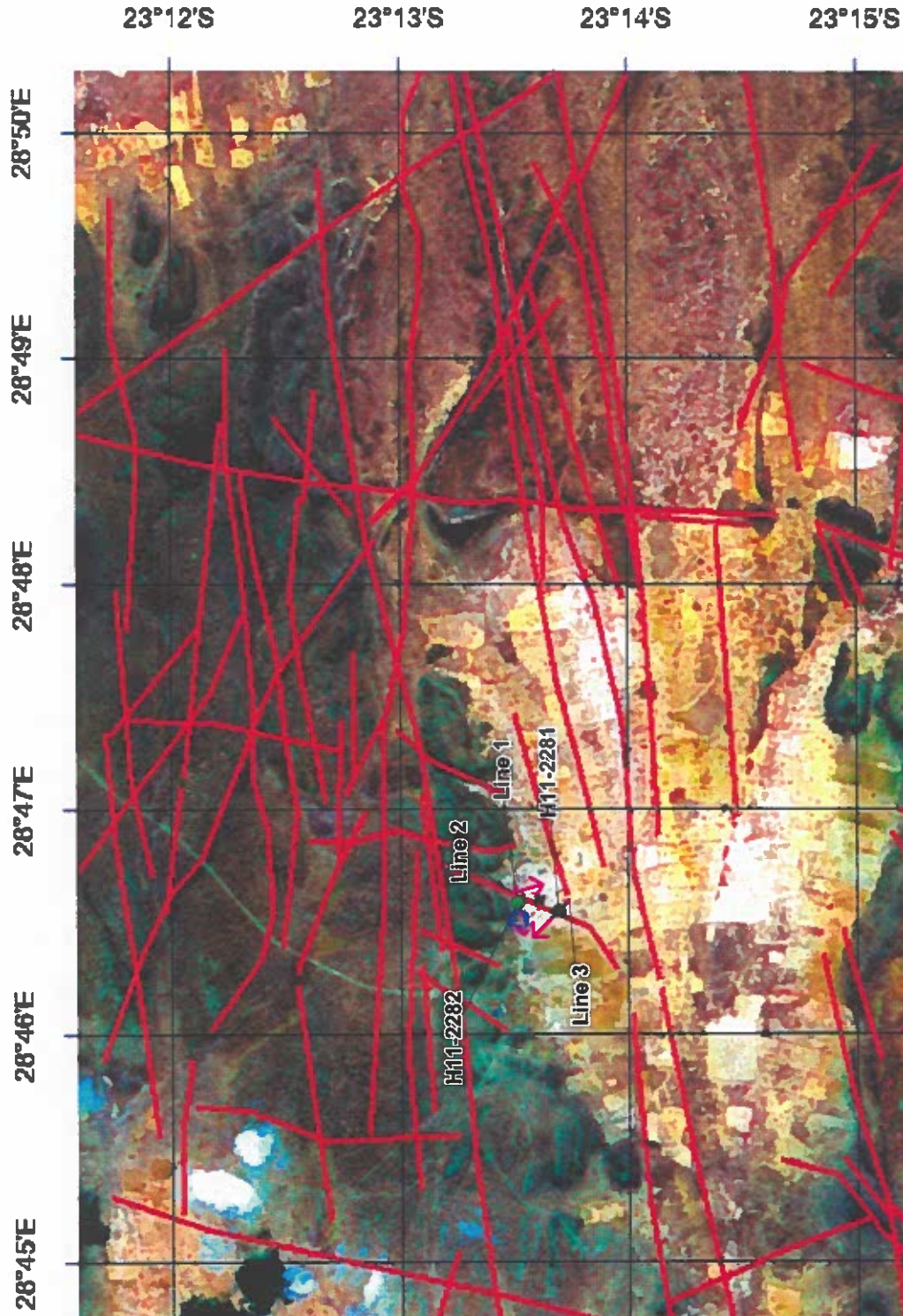
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# Map D : De Villiersdale astersat imagery interpretation and geophysical traverse.



Chemical classification  
 ● Not sampled (1)  
 ● Class 2 (1)



Prepared By

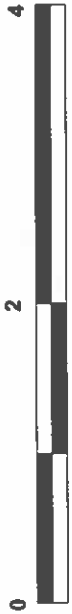


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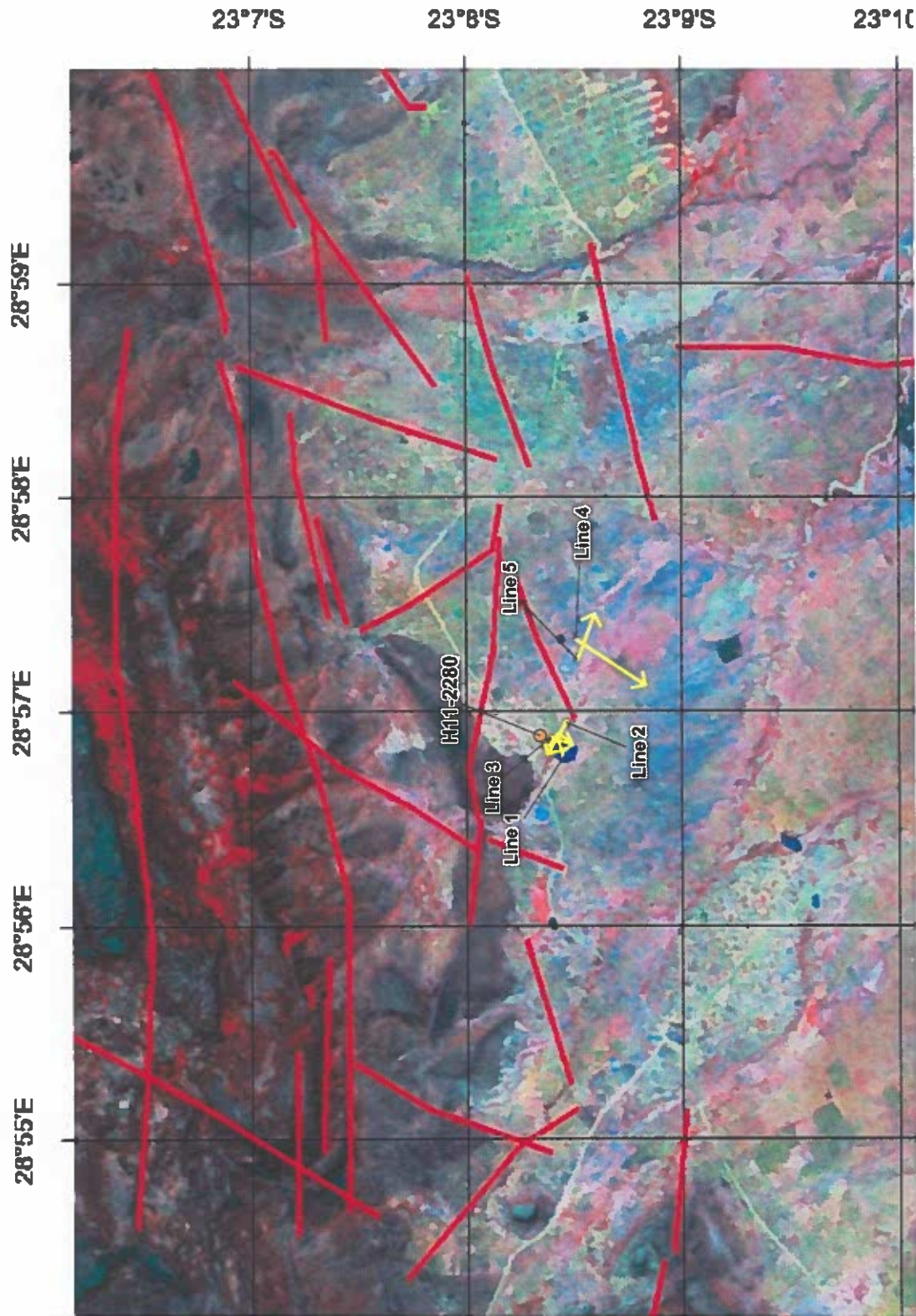
Scale & Projection

Projection: Geographical Co-ordinates (Longitude, Latitude)  
 WGS84 (Utm Zone 30S)



kilometres  
 1 : 50 000

# Map E : Astersat imagery interpretation, geophysical traverse and chemical classification.



## Scale & Projection

Projection: Conformal Conic (Dynes & Hughes Lambert)  
WGS84 (EPSG:31466)



kilometres  
1 : 50 000

Chemical classification  
● Class 3 (1)



Prepared By

