

***Report to Ukuza Consulting (Pty) Ltd on the Results of a
Feasibility Hydrogeological Investigation for the
Abstraction of Groundwater at the Proposed Makhaza
Police Station Site on Erf 75169 Portion of Erf 59037
Khayelitsha, Makhaza, Western Cape Province***

Reference: GW007-23.R01

Dated: 13 October 2023

LEVEL 1 BEE CONTRIBUTOR

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Report Title		Report to Ukuza Consulting (Pty) Ltd on the Results of a Feasibility Hydrogeological Investigation for the Abstraction of Groundwater at the Proposed Makhaza Police Station Site on Erf 75169 Portion of Erf 59037 Khayelitsha, Makhaza, Western Cape Province		
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Glossary

Abstraction: The act of removing water from a groundwater resource.

Aquifer: A formation, group of formations, or part of a formation that contains sufficient saturated permeable material to store and transmit water; and to yield economical quantities of water to boreholes or springs. An aquifer is the storage medium from which groundwater is abstracted.

Available Drawdown: Available drawdown in a borehole is the difference between the static water level or piezometric surface and the main water strike (in fractured aquifers) and the pump depth (in porous aquifers).

Blow yield: The volume of water per unit of time blown from the borehole during drilling. Blow yield gives an indication of the rate at which groundwater can be abstracted from a borehole.

Collar: Top of borehole casing.

Drawdown: The distance between the static water level and the surface of the cone of depression. Drawdown is the lowering of the water table or piezometric surface caused by the extraction of groundwater by pumping a borehole(s).

Electrical conductivity (EC): Electrical conductivity is a measure of how well a material accommodates the transport of electric charge. The more salts dissolved in the water, the higher the EC value. It is used to estimate the amount of total dissolved salts, or the total amount of dissolved ions in the water.

Fault: A zone of displacement in rock formations resulting from forces of tension or compression in the earth's crust. Faults can form conduits for groundwater movement and groundwater contamination; as well as impermeable zones where metamorphism of the rocks has taken place.

Formation: A body of rock identified by lithic characteristics and stratigraphic position. Different formations have different geohydrological properties.

Fracture: Any break in a rock including cracks, joints and faults. Fractures can form the main conduits for groundwater flow. They can also form pathways for the movement of contamination.

Geophysics: The study of the earth's physical characteristics by the use of instruments to determine physical properties such as relative density, electrical conductivity, magnetic susceptibility, seismic wave propagation, electrical and gravitational fields, etc.

Groundwater: Water found in the subsurface in the saturated zone below the water table. Groundwater is a source of water and is an integral part of the hydrological system.

Hydrogeology: In South Africa the term geohydrology and hydrogeology are used interchangeably and refers to the study of groundwater.

pH: pH is the negative logarithm of the hydrogen ion concentration in solution. pH is the measure of the acidity or alkalinity of a solution.

Quaternary catchment: A fourth order catchment in a hierarchal classification system in which a primary catchment is the major unit. Catchments are a basic hydrological unit. The quaternary catchment is the basic unit for water resource management in South Africa.

Recharge area: An area over which recharge occurs. Recharge is crucial for the ongoing replenishment of aquifers and their sustainable use, and recharge areas thus require protection.

Recharge: The addition of water to the saturated zone, either by the downward percolation of precipitation or surface water and/or the lateral migration of groundwater from adjacent aquifers. Recharge is crucial for the ongoing replenishment of aquifers.

Rest water level sometimes referred to as **static water level:** The groundwater level in a borehole not influenced by abstraction or artificial recharge and is the natural groundwater level measured in a borehole. No groundwater levels are ever truly static as they continually respond to recharge, discharge and abstraction.

Secondary aquifer: An aquifer in which groundwater moves through secondary openings and interstices, which developed after the rocks were formed. Approximately 90 % of aquifers in South Africa are secondary in nature.

Sustainable yield / safe yield: Sustainable yield is defined as the maximum rate of withdrawal that can be sustained by an aquifer without causing an unacceptable decline in the hydraulic head or deterioration in water quality in the aquifer.

Water table: The upper surface of a groundwater body in an unconfined aquifer at which pore pressure is equal to that of the atmosphere.

For further technical terms visit www.dwa.gov/groundwater/GroundwaterDictionary.aspx.

The Groundwater Dictionary – Second Edition, published by the Department of Water Affairs & Sanitation.

Abbreviations and definitions

<i>Abbreviation</i>	<i>Definition</i>
µg/L	micrograms/litre
µS/m	microSiemens/metre
cm/s	centimetres/second
DWA	Department of Water Affairs
E	East
EC	Electrical conductivity
EGL	existing ground level
FC	Flow Characteristic
Geosure	Geosure Groundwater (Pty) Ltd
hrs	hours
IGS	Institute for Groundwater Studies
L/hr	litres/hour
L/s	litres/second
m	metres
m begl	metres below existing ground level
mS/m	Millisiemens per metre
mg/L	milligrams/litre
N	North
NGA	National Groundwater Archive
No.	Number
NT	nanoTesla
S	South
SANS	South African National Standards
Temp	Temperature
W	West
WRC	Water Research Commission

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Appendix A: GW007-23.S01 Geophysical Survey Results

Report to Ukuza Consulting (Pty) Ltd on the Results of a Feasibility Hydrogeological Investigation for the Abstraction of Groundwater at the Proposed Makhaza Police Station Site on Erf 75169 Portion of Erf 59037 Khayelitsha, Makhaza, Western Cape Province

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1. TERMS OF REFERENCE

Geosure Groundwater (Pty) Ltd, hereafter referred to as “Geosure”, was requested by Mr N. Sissel on behalf of Ukuza Consulting (Pty) Ltd to provide a proposal and cost estimate to carry out a hydrogeological survey at the proposed Makhaza Police Station site, Western Cape Province, hereafter referred to as “the site”.

Geosure provided a proposal and cost estimate under cover of a letter referenced pGW047-23 (Makhaza Police Station)/am and dated 28 August 2023.

Subsequently, Ukuza Consulting (Pty) Ltd, hereafter referred to as the “Client”, appointed Geosure to carry out the work as proposed by providing a signed appointment letter referenced SAPS/MPS/GHS/001 and dated 18 September 2023.

2. SCOPE OF WORK

The scope of work for this project is to determine the feasibility of installing a successful borehole for the abstraction of groundwater at the site.

This feasibility report comments on the geology and hydrogeology of the site and the potential to drill a successful borehole as well as recommendations for further investigation.

3. GUIDELINES FOR INVESTIGATION

The services performed by Geosure were conducted in a manner consistent with the level of care and skill ordinarily exercised by members of the groundwater profession practising under similar conditions in the locality of the project. No other warranty, expressed or implied, is made.

The investigation was carried out according to standard practice codes and guidelines as indicated in the South African National Standards (SANS) 10299:2003, titled “*Development, Maintenance and Management of Groundwater Resources*”.

Our opinions can only be based on what was visible at the time the investigation was conducted. This report was prepared for use by the Client and their professional team for the purpose stated and should not be relied upon for any other purpose.

4. AVAILABLE INFORMATION

The following information was referenced:

- i. The 1:500 000 Hydrological Map titled “3317 Cape Town”, published by the Department of Water Affairs, 1998;
- ii. The 1:250 000 Geological Map titled “3318 Cape Town”, published by the Geological Survey of South Africa, 1988;
- iii. Report by the Umvoto Africa (Pty) Ltd titled “*Cape Flats Aquifer: Situation Assessment & Potential for Successful Urban Groundwater Development and Management*”, referenced Report No. 830/1/1/2014 and dated March 2014;
- iv. Hydrogeological maps indicating groundwater level, quality and yield from the Department of Water and Sanitation; and
- v. Aerial images and GPS coordinates sourced from Google Earth 2023.

5. LOCATION OF STUDY AREA

The site is in Makhaza within the Khayelitsha Township, approximately 38 km southeast of Cape Town Central and 3 km north of the coastline at approximate latitude and longitude 34.048299° S and 18.704719° E, respectively.

Access to the site is via Cekeca Road which forms the eastern boundary of the site. Dibana Road is located to the south of the site where there are also formal dwellings. The site is bounded by a wire fence.

At the time of investigation, construction had commenced along the southern portion of the site where several prefabricated structures and paved areas were in the process of being constructed.

The site is relatively flat lying and is covered with grass and shrubs.

Figure 1 shows the general layout of the site.



Figure 1: Site Plan (sourced from Google Earth, 2023)

6. SITE INVESTIGATION METHODOLOGY

6.1 Desktop Study

Prior to commencing with the field investigation, a review of the site was carried out at a desktop level to identify the topography and associated landforms, geology, hydrogeology and related features of hydrogeological significance. The information used in the desktop was sourced from various databases as indicated in Section 4.

6.2 Geophysical Survey

Geophysical methods are commonly used to locate suitable borehole drilling targets and a geophysical survey was carried out on 26 and 27 September 2023. The magnetic method using the Geotron Precision Proton Memory Magnetometer was utilised for this project.

The investigation was undertaken to accurately delineate any lithological and in some cases structural anomalies. These anomalies may be but not limited to the following: dykes, faults, geological contact zones and fracture zones.

The profile of magnetic anomalies contains information on the locations, geometries and orientations of subsurface magnetic bodies.

Five traverses, designated T1 to T5, were carried out. The geophysical survey results and the approximate position of these traverses are given in Appendix A.

7. GEOLOGY AND HYDROGEOLOGY

7.1 Geology

According to the geological map of the area, an extract of which is given in Figure 2 below, the site is underlain by the Springfontyn, Langebaan and Witzand Formations.

These formations consist of aeolian, fine to coarse calcareous sand, limestone and calcrete layers.

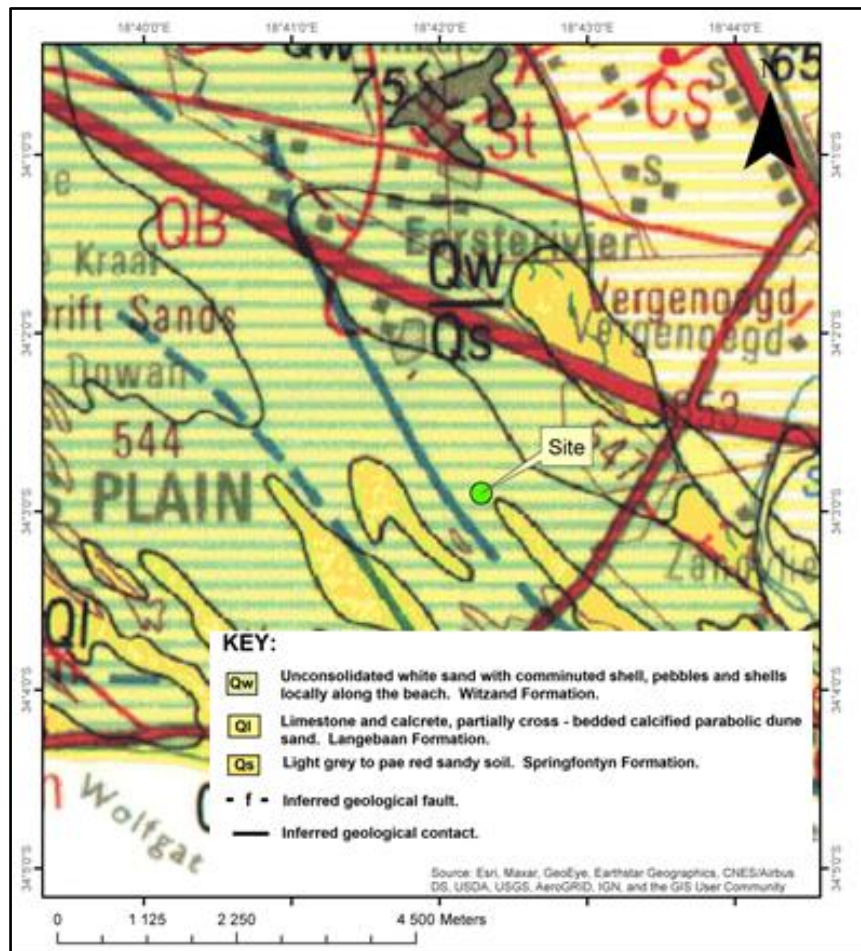


Figure 2: Geological Map of the study area “3318 Cape Town”, Council for Geoscience

7.2 Hydrogeology

According to the hydrogeological map given in Figure 3 published by the Department of Water Affairs (DWA, 1998), the area's regional hydrogeology features an intergranular aquifer system (a4) with median borehole yields ranging from 2.0L/s to 5.0L/s. The site is underlain by the Cape Flats Aquifer, with a maximum thickness of approximately 55 metres and an average groundwater level situated between 1-3 metres below EGL. The aquifer demonstrates an average hydraulic conductivity of 30-40 m/d (Umvoto, 2014).

This aquifer is classified as a major aquifer according to the South African Aquifer Classification System and is highly susceptible to contamination, as indicated by the Aquifer Susceptibility of South Africa classification.

The inferred water quality in the area is generally of marginal quality, with Electrical Conductivity values ranging from 150-300 mS/m, as shown in Figure 4. The groundwater chemistry is categorized as Na-Cl type water (Umvoto, 2014). To meet the SANS 241-1 2015 Drinking Water Standards, groundwater treatment might be necessary to ensure the water quality is compliant.

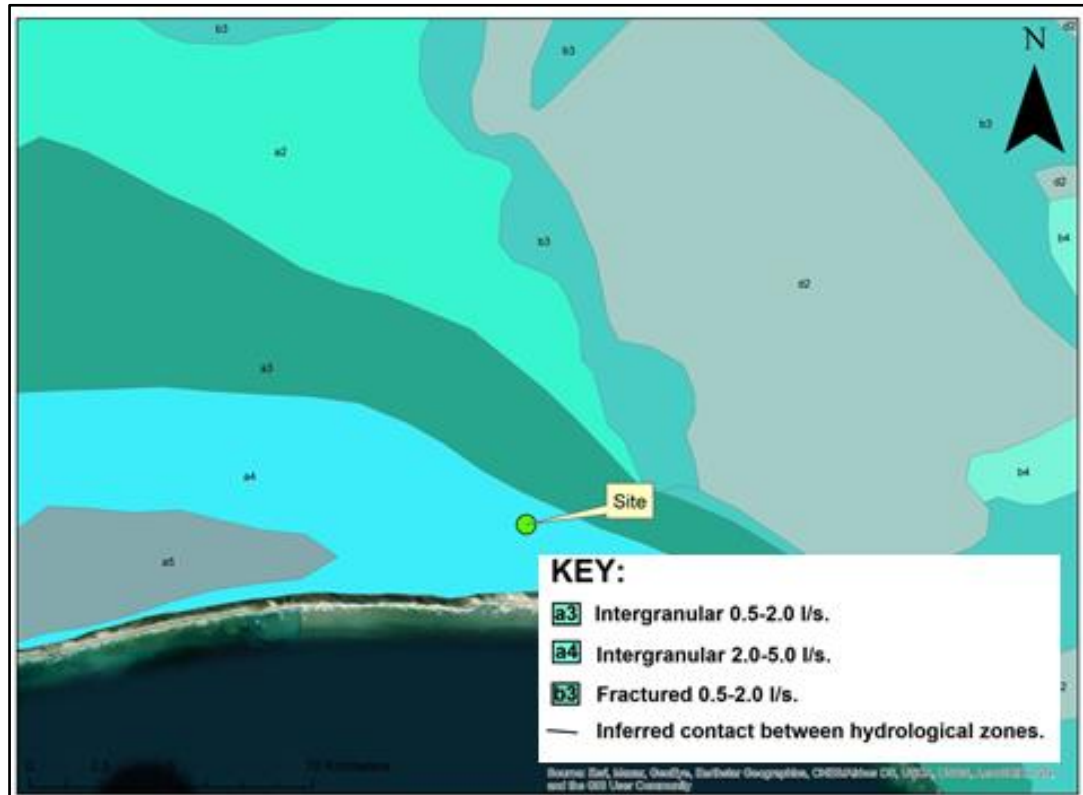


Figure 3: Hydrogeology Map of the study area sourced from 1:500 000 hydrogeological map series (DWA, 1998)

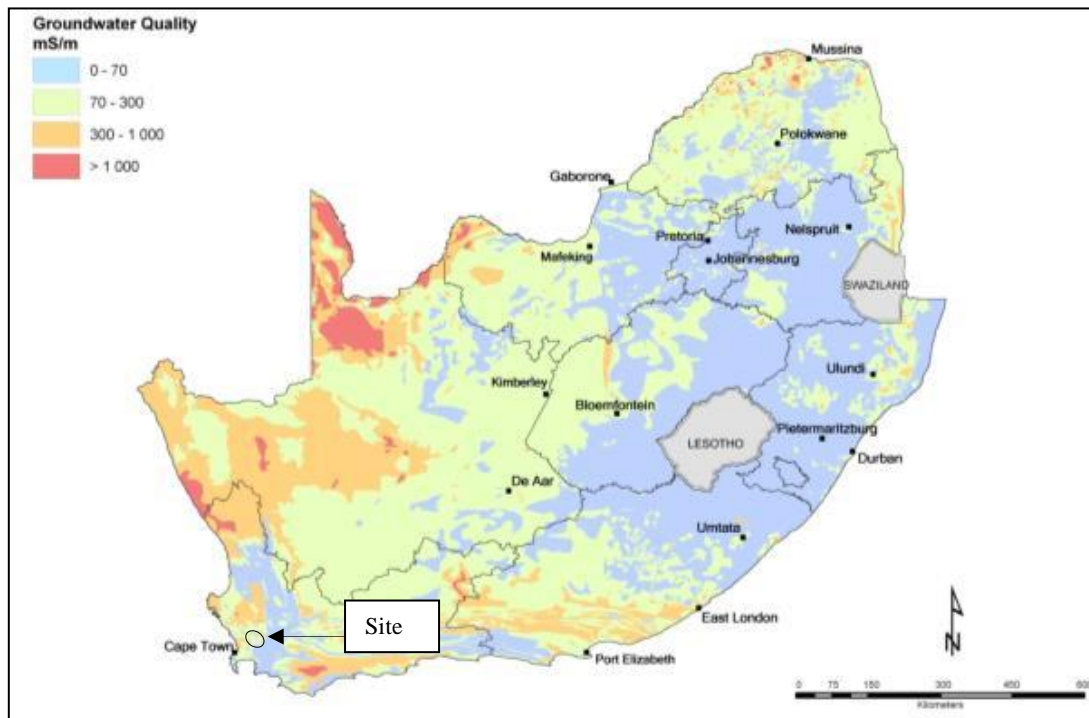


Figure 4: Groundwater Quality Map (sourced from Department of Water Affairs)

8. HYDROCENSUS

On 26 September a hydrocensus and site assessment was conducted. This was to identify existing groundwater resources, identify potential groundwater contamination sources, and identify potential surveying points and any infrastructure to be considered.

Two existing groundwater resources were identified from the NGA within a 3km radius of the site, and 2 No. boreholes were identified as shown in Table 1. None of these boreholes were verified on site.

Table 1: Summary of Boreholes identified on Hydrocensus

Borehole ID	Latitude (S)	Longitude (E)	EC ($\mu\text{S}/\text{cm}$)	Water level (m)	Discharge rate (L/s)
3418BA00024	-34.02603	18.71457	301.0	1.48	-
3418BA00319	-34.02602	18.71457	301.0	1.48	-

– Information Not Available

One borehole was identified approximately 100m to the west of the site in the neighbouring sports field (refer to Figure 7 on Page 8). According to the site caretaker, the borehole is equipped with a submersible pump and is currently not in use due to the pump being “faulty”.

9. GEOPHYSICAL SURVEY RESULTS

A combination of criteria was used to determine a suitable drilling target and not entirely reliant on the geophysical investigation. The following criteria were utilised:

- The accessibility for the drilling rig at the site;
- Restriction to within property boundary; and
- The anomalies identified in the geophysical survey.

Figure 5 below provides a summary of traverse 5. Anomalies were observed between intervals 75m and 85m.

These are assumed to be fractures beneath the surface and are considered a suitable drilling target for further investigation.

Detailed results of the geophysical survey are given in Appendix A.

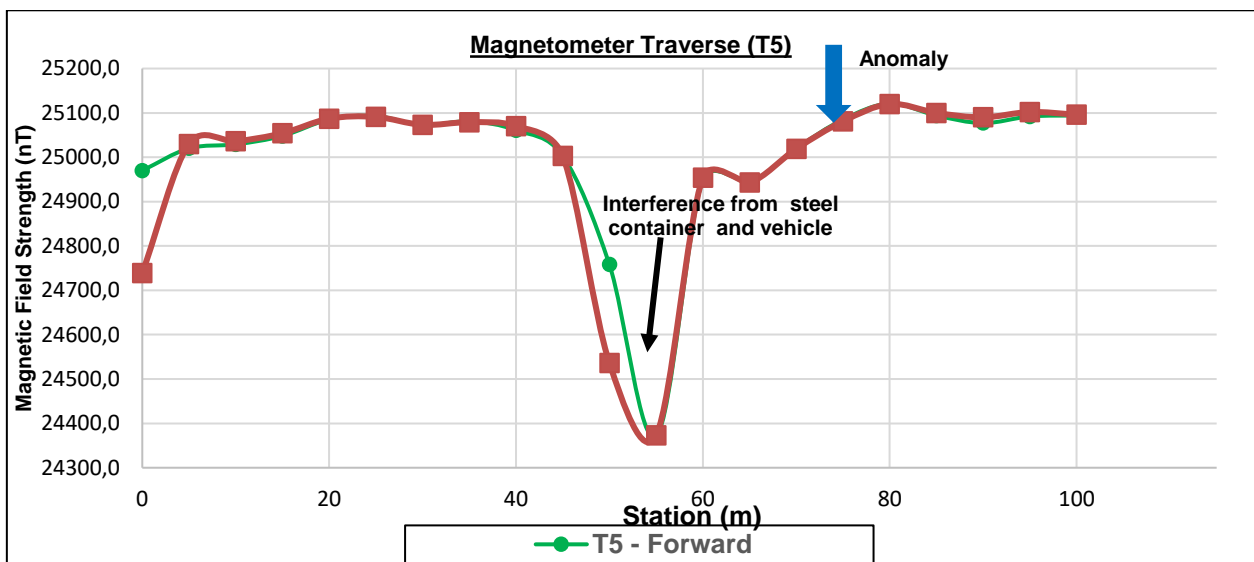


Figure 5: Geophysical Survey results, Traverse 5 at the proposed Makhaza Police station.

Based on the results of the geophysical investigation, two suitable drilling targets, designated BH1 and BH2, was identified and the approximate position is shown in Figure 7 below with the co-ordinates provided in Table 2.

Table 2: Borehole Drilling Co-ordinates

Proposed Drilling Targets	Latitude (S)	Longitude (E)
BH1	34,048511	18,7046
BH2	34,04846	18,70448



Figure 7: Locality of proposed borehole BH1 and BH2 (sourced from Google Earth, 2023)

10. SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

This report provides the results of a feasibility hydrogeological investigation for the drilling of a borehole for groundwater abstraction at the proposed Makhaza Police Station on Erf 75169 Portion of Erf 59037 Khayelitsha, Western Cape Province.

The following conclusions and recommendations can be made about the site:

- i. The site is underlain by the Springfontyn, Langebaan and Witzand Formations that constitute the Cape Flats Aquifer System.
- ii. Hydrogeologically, the site is underlain by an intergranular aquifer system with approximate yields in the range 2.0 L/s to 5.0 L/s which would be regarded as a moderate to high yielding aquifer.
- iii. Groundwater treatment may be required to ensure water quality complies with the SANS 241-1 2015 drinking water standards.
- iv. Considering the location of the site and the geophysical survey results, no guarantee can be given that the identified fracture/s will have groundwater.
- v. Two positions, designated BH1 and BH2, have been identified as potential drilling targets for the proposed abstraction of groundwater.
- vi. The borehole/s should be drilled to a depth of between 80 and 100 m below ground level using symmetrix or ODEX drilling method due to the unconsolidated nature of the underlying geological formations. This should be allowed for during quotation process.

-
- vii. As no guarantee can be given for the presence of groundwater at the proposed drilling positions, it is recommended that a contingency amount be allowed for the drilling of a second borehole.
 - viii. Borehole drilling should be carried out according to the Development, Maintenance and Management of Groundwater Sources. Part 2: The design, construction and drilling of boreholes. SANS 10299-2:2003.
 - ix. Successful boreholes should be test pumped according to the Development, Maintenance and Management of Groundwater Sources. Part 4: test-pumping of water boreholes. SANS 10299-4: 2003.

Furthermore, the following precautions are recommended to ensure that a new borehole is protected from potential contamination posed by human activities:

- No on site sanitation systems must be installed within 100m up-gradient of the new borehole;
- No activity should be allowed within 30m of the borehole other than those associated with collecting water;
- The borehole must be properly equipped to allow for sampling; and
- The borehole must be adequately protected, and periodically tested for chemical and bacteriological quality (on a bi-annual basis due to the aquifer's susceptibility to contamination).

The ground conditions given in this report refer specifically to the positions of field tests carried out on site. It is therefore possible that conditions at variance with those given in this report could be encountered elsewhere on site.

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APPENDIX A



GW007-23.S01 GEOPHYSICAL SURVEY RESULTS

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GEOPHYSICAL SITING REPORT

Client:	Ukuza Consulting	Our Ref.	GW007-23.S01
Project:	Makhaza Police Station	Client Ref.	
Attention:	Mr N. Sissel		

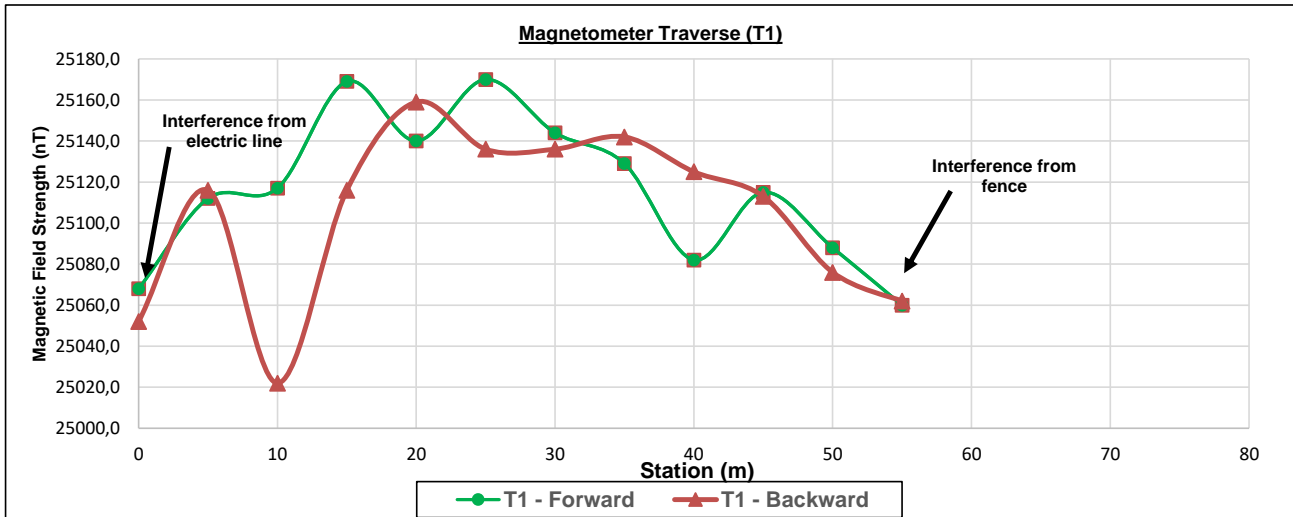
SITE INFORMATION				
Erf	75169		Site ID	Makhaza Police Station
Town / City / Region	Makhaza , Western Cape		Geology	Springfontyn, Langebaan & Witzand Formations
Approx. GPS Location (°)	Latitude (S)	34,048299	Longitude (E)	18, 704719
Existing Water Sources	Municipal Water Supply			
Site Description	The site is located in Makhaza within Khayelitsha Township , approximately 38 km South east of Cape Town.			

HYDROCENSUS DATA					
TYPE (e.g BH, Dam etc)	BH Depth (m)	Static Level (m)	Use and Status / Remarks	GPS Location (°)	
				Latitude (S)	Longitude (E)
Borehole	-	-	Irrigation of sportsfield	34,04808	18,70405

SITING DATA									
Survey Method		Magnetic			Siting Equipment Used			Geotron G5	
Inferred Groundwater Quality		Marginal Water Quality. Treatment may be required to meet SANS 241-1 2015 Drinking water standard.							
Borehole Feasibility		Moderate feasibility							
Traverse No. / ID	Traverse Length (m)	GPS Location (°)				BH ID	Approx. Elevation (m)	GPS Location (°)	
		Start		End				Latitude (S)	Longitude (E)
		Latitude (S)	Longitude (E)	Latitude (S)	Longitude (E)				
T1	55	34,04853	18,70491	34,04856	18,704332				
T2	80	34,04838	18,70452	34,049	18,70406				
T3	90	34,04801	18,70477	34,048128	18,704242	BH1		34,048511	18,7046
T4	120	34,04799	18,70399	34,04908	18,70378				
T5	100	34,04775	18,70457	34,04861	18,70445	BH2		34,04846	18,70448

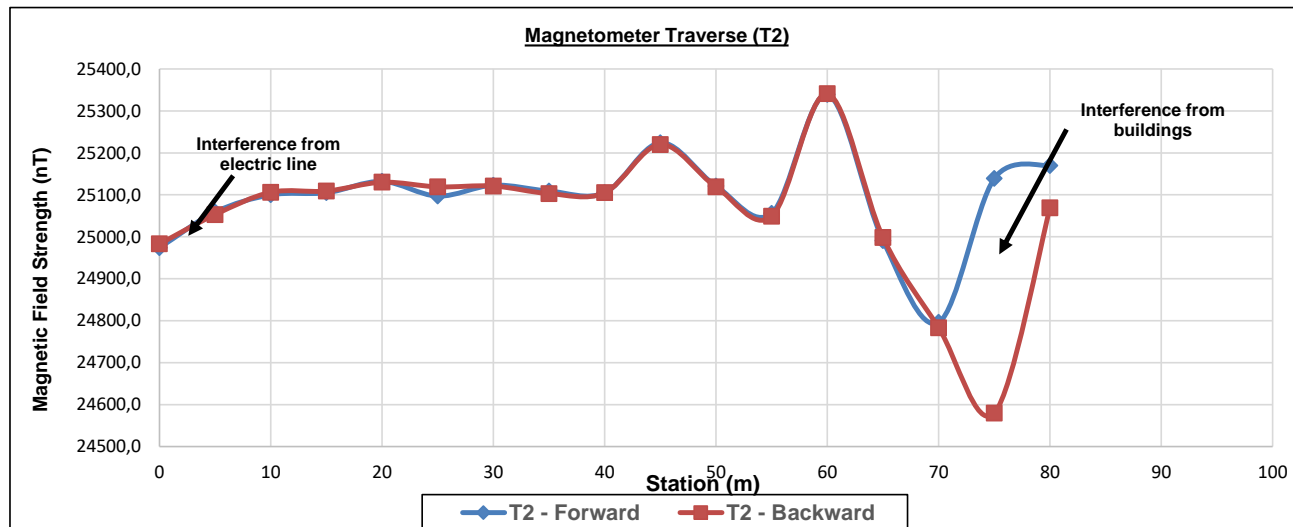


TRAVERSE ID - T1



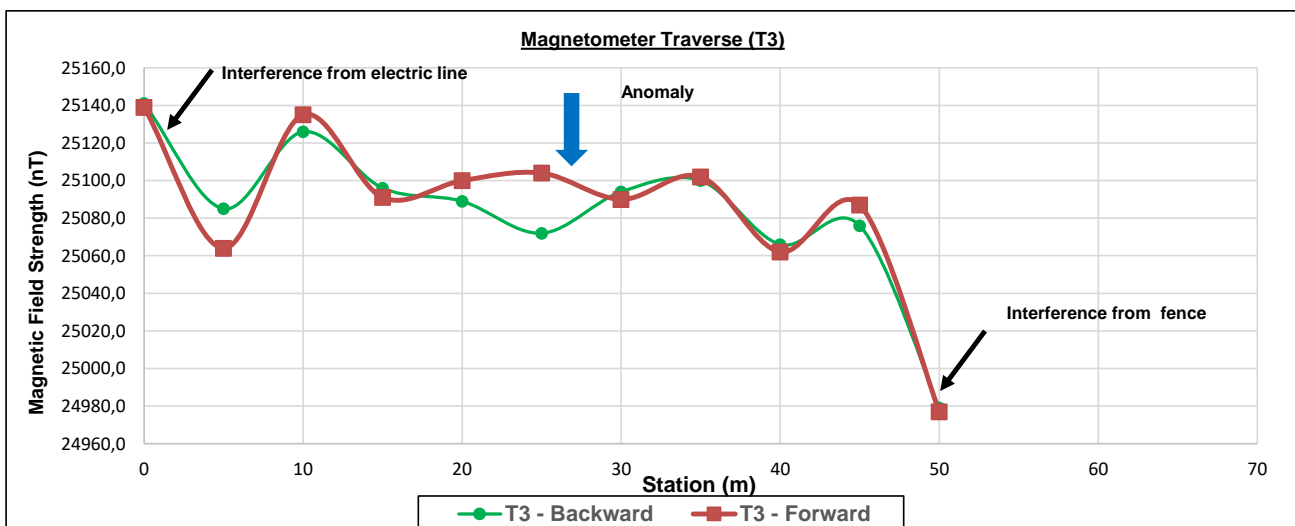
Remarks: The drill position was selected on interpretation of the anomalies detected during the magnetometer traverse. Anomalies indicate the presence of a geological structure that may be water-bearing. The presence of groundwater is not guaranteed.

TRAVERSE ID - T2



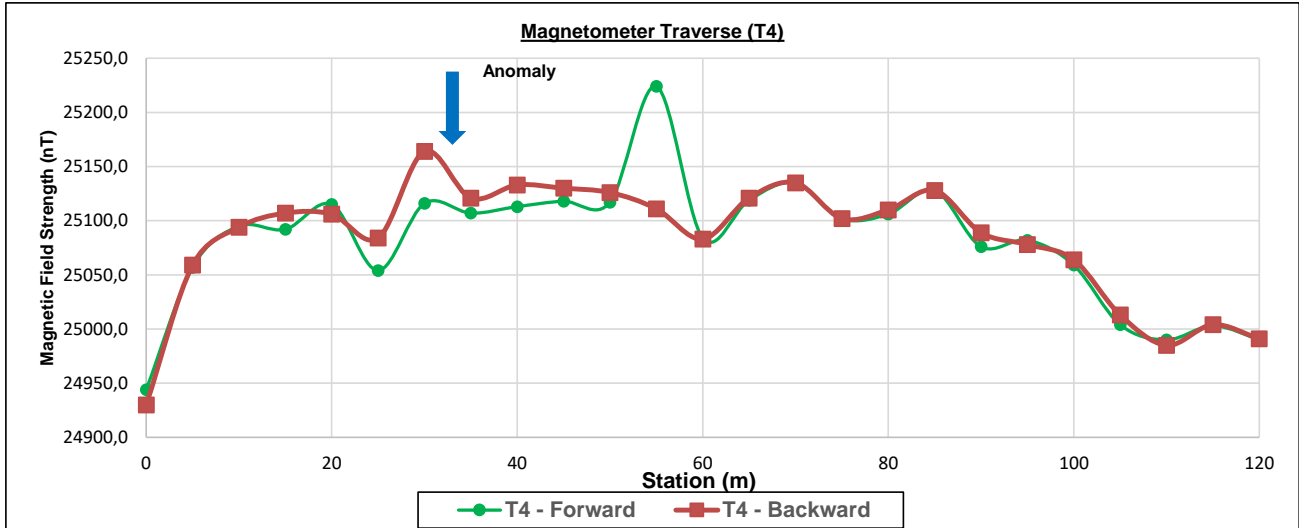
Remarks: The drill position was selected on interpretation of the anomalies detected during the magnetometer traverse. Anomalies indicate the presence of a geological structure that may be water-bearing. The presence of groundwater is not guaranteed.

TRAVERSE ID - T3



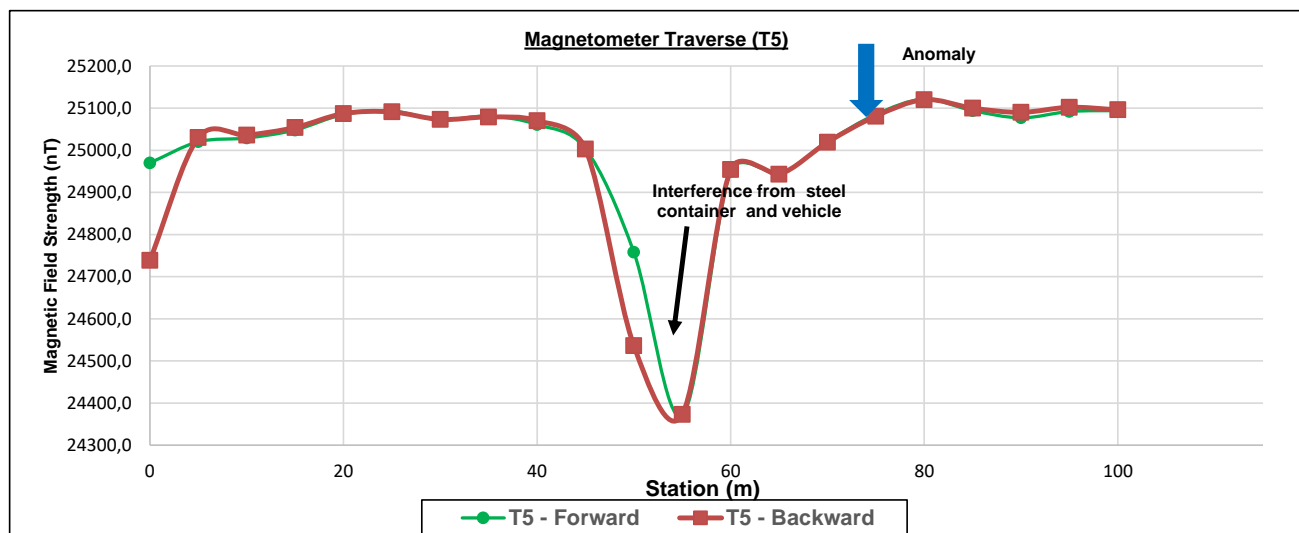
Remarks: The drill position was selected on interpretation of the anomalies detected during the magnetometer traverse. Anomalies indicate the presence of a geological structure that may be water-bearing. The presence of groundwater is not guaranteed.

TRAVERSE ID - T4



Remarks: The drill position was selected on interpretation of the anomalies detected during the magnetometer traverse. Anomalies indicate the presence of a geological structure that may be water-bearing. The presence of groundwater is not guaranteed.

TRAVERSE ID - T5



Remarks: The drill position was selected on interpretation of the anomalies detected during the magnetometer traverse. Anomalies indicate the presence of a geological structure that may be water-bearing. The presence of groundwater is not guaranteed.