

M2 Environmental Connections

HYDROGEOLOGICAL ASSESSMENT FOR A WATER USE LICENSE APPLICATION

DRAFT

June 2025



June 2025

EXECUTIVE SUMMARY

NOA8 Pty Ltd (NOA8) was commissioned by M2 Environmental Connections on behalf of Astron Energy to conduct a hydrogeological assessment as part of a water use license application (WULA).

The groundwater assessment identified that the main risks associated with the proposed abstraction are:

- Over utilisation of the borehole, which could lead to the dewatering of the fracture network and ultimately the borehole failure (drying up through fracture dewatering).
- Over abstraction of borehole which could influence receptors
 - Other borehole users
 - A hillslope seep wetland within 100-meter radius of proposed abstraction borehole

The following actions are recommended to ensure sustainable water management practices:

- The recommended yield is 70 m³ in a 16-hr pumping cycle, which equates to 25 638 m³/a. The borehole should be allowed to recover for at least 8 hours after a 16-hour pumping schedule.
- To protect borehole failure and dewatering, water level should not reach a maximum allowable drawdown of 30 metres
- If the maximum allowable drawdown is reached, the pumps should be switched off and allowed to recover to 90 % of the static ground water level.
- Daily monitoring of abstraction volumes (preferably with automated flow meters)
- Monthly capturing of groundwater levels in an electronic database, for long-term trend analysis)
- It is recommended to do a comprehensive bi-annual analysis at an accredited laboratory for parameters pH, Electrical Conductivity, total dissolved solids, major anions and cations (Ca, Mg, Na, NO₃, Cl, SO₄,) as well as Total Petroleum Hydrocarbons, Benzene, Toluene, Ethylbenzene and Xylene.

Although 24 hour constant rate tests were completed on both boreholes, it is not entirely possible to predict the long-term response of an aquifer to pumping. It is therefore of utmost importance to adhere to the recommended management and mitigation measures to monitor the long term behaviour of the aquifer in response to the recommended pumping rate.

Yours truly,

Noa8 Pty Ltd



Compiled by:
Anniko Koekemoer

Reviewed by:
Morne Burger

Noa8 (Pty) Ltd
Nika House (BLOCK D)
Glenfield Office Park
C/o Glenwood Road & Oberon Avenue
Faerie Glen
Pretoria, 0081
Email: morne@noa8.co.za

REPORT DISTRIBUTION LIST

Name	Institution
Reuhl Lombard	M2 Environmental Connections

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 Nika House (Block D)
Glenfield Office Park
C/O Glenwood Road & Oberon Ave
Faerie Glen, Pretoria, 0018

Director: Morne Burger
 morne@noa8.co.za
 +27 (0) 82 821 3147

Director: Stephan Meyer
 stephan@noa8.co.za
 +27 (0) 72 570 7186

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LIST OF ABBREVIATIONS

BHN	Basic Human Needs
CRD	Cumulative Rainfall Departure
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
EC	Electrical Conductivity
EIA	Environmental Impact Assessment
ET	Evapotranspiration
GMU	Groundwater Management Unit
GRDM	Groundwater Resource Directed Measures
GRU	Groundwater Resource Unit
ICM	Integrated Catchment Management
IFR	Instream Flow Requirements
IWRM	Integrated Water Resource Management
K	Hydraulic Conductivity
MAP	Mean Annual Precipitation
MAR	Mean Annual Runoff
NGDB	National Groundwater Data Base
NWA	National Water Act (Act 36 of 1998)
NWRS	National Water Resource Strategy
RDM	Resource Directed Measures
RQO	Resource Quality Objectives
RU	Resource Unit
S	Storativity
T	Transmissivity
WARMS	Water Use Authorization and Registration Management System
WEM	Water Environment Management
WMA	Water Management Area
WMS	Water Management System

1 INTRODUCTION

NOA8 (Pty) Ltd was appointed to undertake a groundwater assessment in fulfilment of a water use license application (WULA) for the abstraction of groundwater from an existing borehole at the proposed Service Station. The groundwater will be used as a domestic source for the proposed Service Station.

The groundwater assessment was prepared in accordance with the water use license (WUL) requirements set forth by the Department of Water and Sanitation (DWS) under the National Water Act [Act No 36 of 1998].

1.1 Proposed Activity

The proposed Service Station is located along the N4 highway, opposite to Milly's Service Station. The proposed development will include a filling station and overnight parking facility for trucks. The applicant intends to utilise the groundwater supply to the Service Station from the existing borehole REB 228. The borehole, along with three additional ones, was strategically located using geophysical survey techniques. The boreholes were subsequently drilled and equipped as part of a previous hydrogeological study (VSA Rebotile Metsi Consulting Pty Ltd, 2018). Borehole REB 228 was the only borehole with a viable blow yield.

1.2 Scope of Work

To address the objective of this assessment the following scope of services was proposed:

- Desktop Study
- Hydrocensus and groundwater sampling
- Aquifer Test and sustainable yield analysis
- Groundwater Reserve Determination (GRDM)
- Identification of risks associated with proposed abstraction

2 REGULATORY FRAMEWORK

2.1 National Water Act

The National Water Act [Act No. 36 of 1998] sets out principles for regulating water use. The water uses which require authorisation are stipulated in Section 21 of the NWA. The water uses are broadly defined as taking, storing, activities which impede stream flow, waste discharges and disposals, controlled activities, altering a watercourse, removing water found underground for certain purposes, and recreation. In general, a water use must be licensed unless it is listed in Schedule I, is an existing lawful use, is permissible under a general authorisation, or if a responsible authority waives the need for a license. The different water use conditions are described in the bullet section below:

- Schedule I – uses are generally low volume, low impact activities that are consistent with domestic use, livestock watering, recreational use, and the use of water for emergencies. This water is permissible and does not require licensing or registration.
- Existing Lawful Use – are uses that were commencing prior to the promulgation of the NWA in 1998.
- General Authorisations – is an authorisation to use water without a licence, provided that the water use is within the limits and complies with conditions set out in the Gazetted General Authorisation. The authorisation requires a registration prior to exercising the water use(s).

The groundwater assessment was conducted in accordance with Section 21 (a) (taking water from a water resource) and requires a water use licence application written in accordance with the requirements as stipulated in Annexure D of the NWA¹.

¹ National Water Act, 1998 (Act No. 36 of 1998): Regulations regarding the procedural requirements for Water Use Licence Applications and Appeals

3 PROJECT SETTING

3.1 Project Location

The proposed Service Station is located along the N4 Highway opposite to the existing Milly's Service Station, approximately 4 kilometres southeast of the town eNtokozweni, in the Mpumalanga Province (Figure 3-1). The area under study is located within the Emakhazeni Local Municipality, within the Nkangala District Municipality.

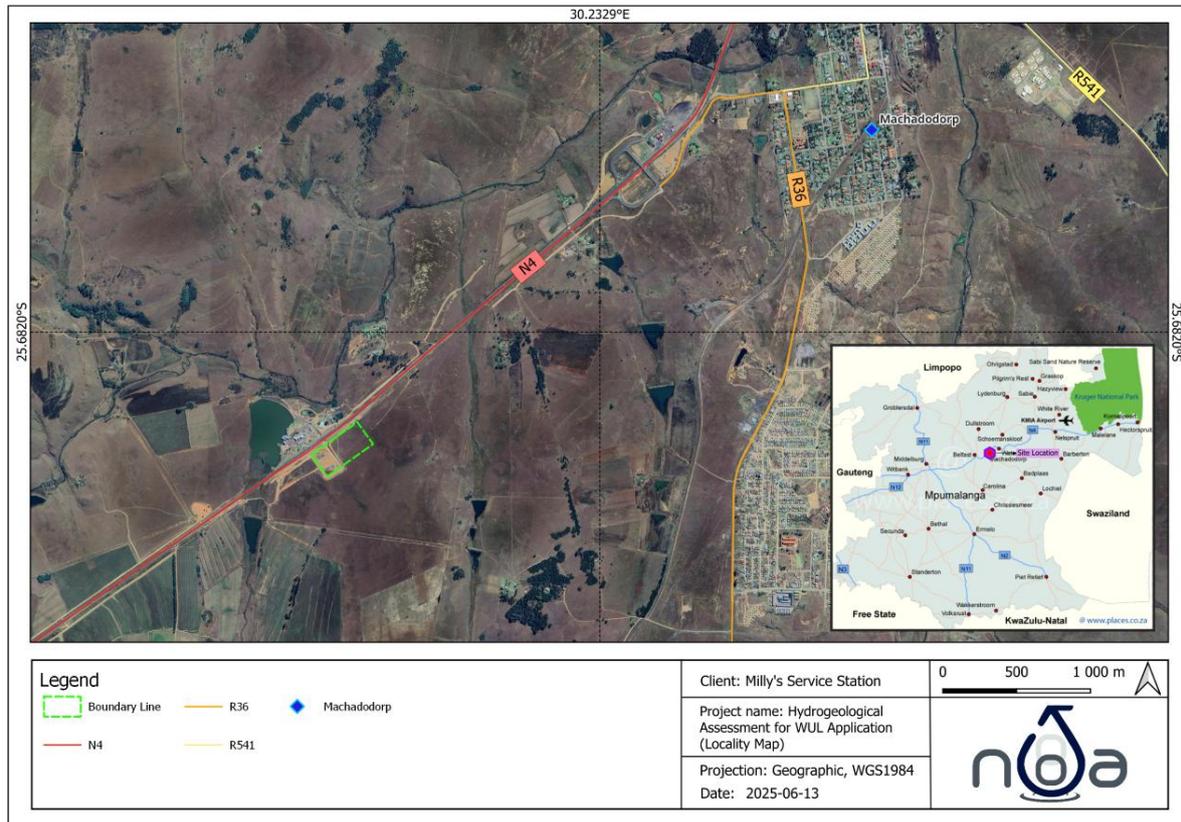


Figure 3-1 Site Locality

3.2 Topography and Drainage

The proposed service station is situated within the Inkomati-Usuthu Water Management Area (WMA) within quaternary catchment X21F. The perennial Elands River, a tributary of the Crocodile River, rises on the grassland plateau near eNtokozweni and flows in a general west to east direction. The study area forms part of the Highveld region and is situated on the edge of the escarpment, with elevations ranging from 1 750 to 1 550 metres above mean sea level (mamsl). The topography is known for its mountainous terrain and terraced hills, as well as rolling grasslands.

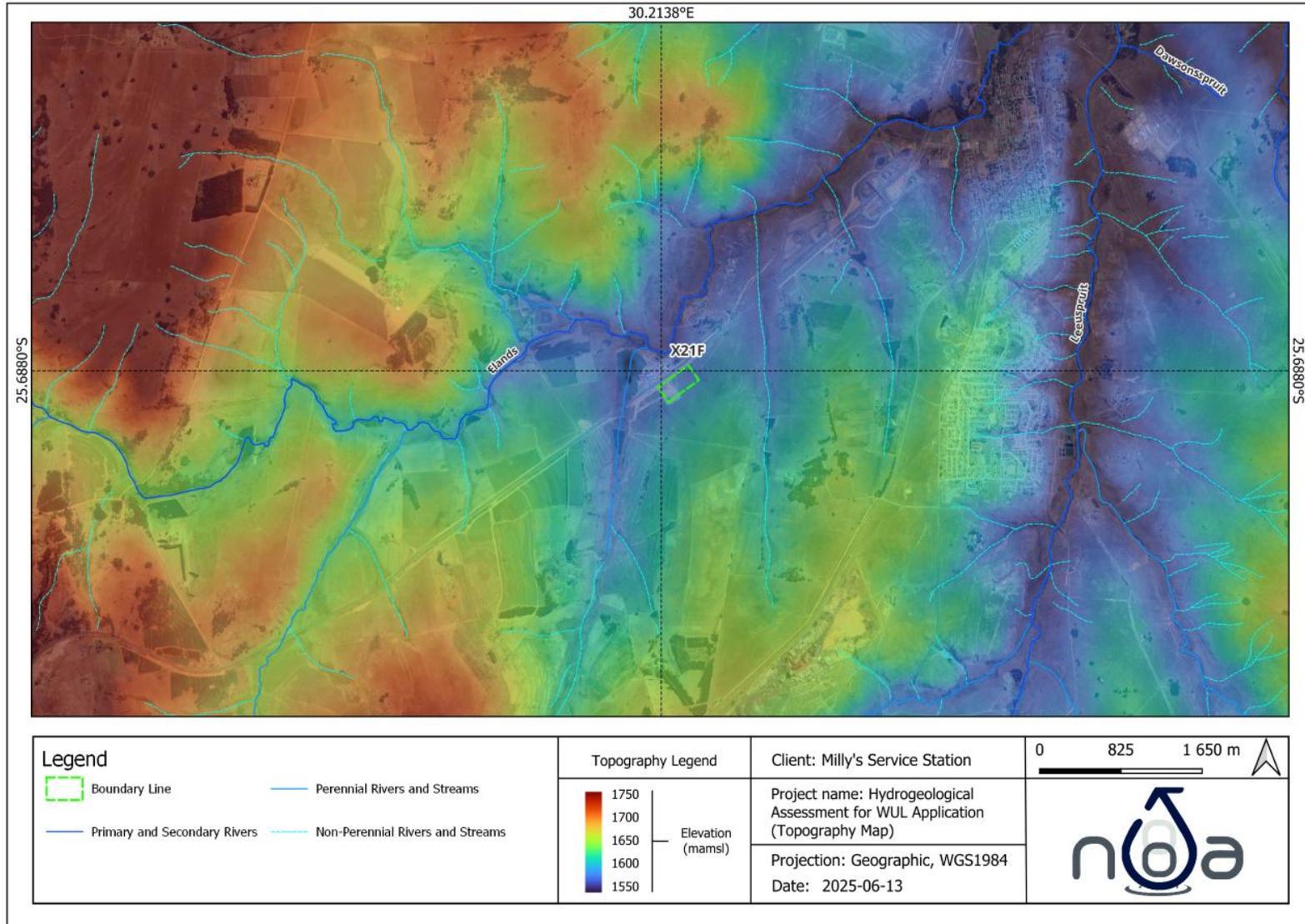


Figure 3-2 Topography and drainage within study area

3.3 Climate and Rainfall

The climate in the study area is characterised as a mild and moderate. The area experiences summer rainfall, between November and February with the highest rainfall occurring in December. Rainfall occurs as thunderstorms, characteristically brief and intense. The longer-term mean annual precipitation is 918 mm. Winter months are cool and dry, with minimum and maximum temperatures ranging from 3°C to 14 °C. Climate data for eNtokozweni was sourced from Meteoblue (Meteoblue, 2025) and is summarised in Table 3-1 and Figure 3-3 below.

Table 3-1 Mean annual precipitation and minimum and maximum temperature for the eNtokozweni area (Meteoblue, 2025)

Month	Temperature		Average Precipitation (mm)
	Min (°C)	Max (°C)	
January	14	24	154
February	14	24	130
March	12	23	100
April	10	21	55
May	6	19	19
June	3	17	5
July	3	17	7
August	5	20	11
September	8	23	27
October	10	23	87
November	12	23	139
December	13	23	184
Mean Annual Precipitation (mm/a)			918

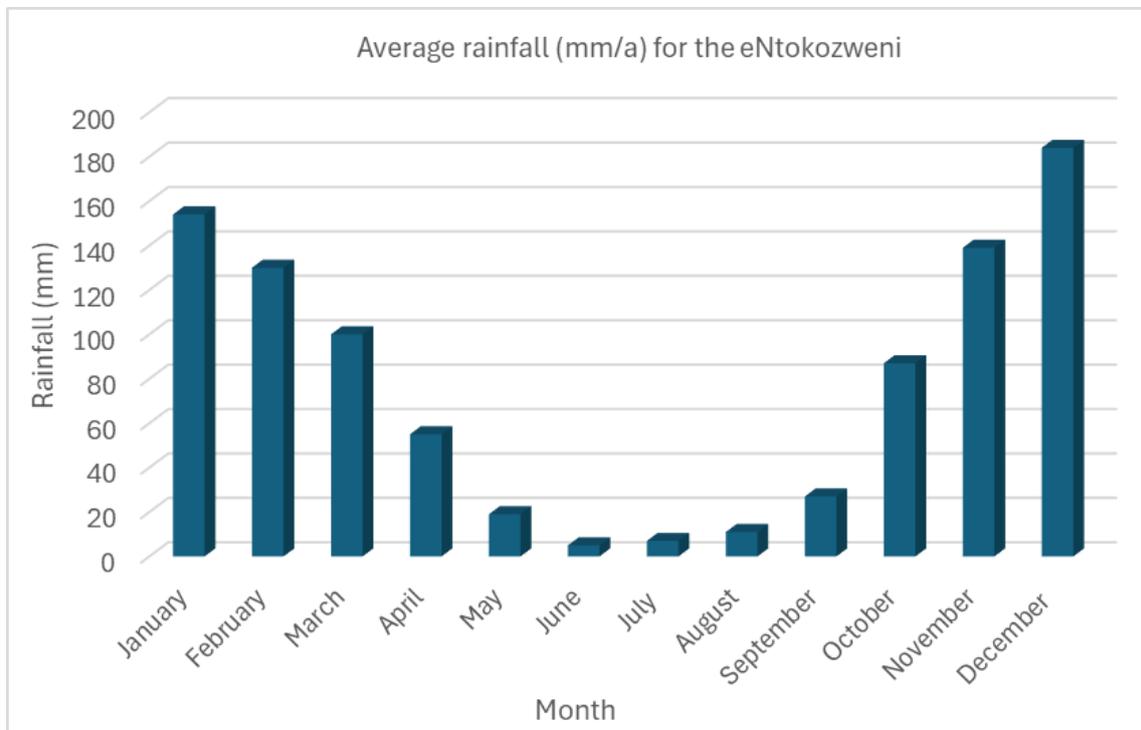


Figure 3-3 Mean annual precipitation for the eNtokozweni as obtained from Meteoblue (Meteoblue, 2025)

4 HYDROGEOLOGICAL CONTEXT

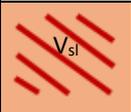
4.1 Geology

The 1:250 000 geological map (2530 Barberton), geophysical, and drilling data (VSA Rebotile Metsi Consulting Pty Ltd, 2018) was used to conceptualise the local geology.

The area is underlain by the sedimentary units of the Lydenburg Member of the Silverton Formation, Transvaal Supergroup. The site is underlain by weathered and fractured shale, and subordinate mudstone. Data from the drilling logs indicate a shallow highly weathered zone within the upper 3 metres, which transitions to fine grained weathered shale.

The Silverton Formation is especially known to be extensively intruded by diabase in the form of sills and dykes (Du Toit & Sonnekus, 2014). A diabase dyke exists approximately 450 m southwest of the western boundary of the property. The geophysical survey also indicates that the western side of the property is underlain by a diabase sill. Drilling logs indicate deep red clayey soil with occasional diabase boulders. The clay is from secondary mineralisation from the weathering of the diabase sill.

Table 4-1 Description of geological units

Map Identifier	Lithology	Formation	Group	Supergroup
	Greenish, fine grained, laminated shale and subordinate mudstone, interlayered carbonate layers rare, hornfels in places	Silverton	Pretoria Group	Transvaal Supergroup

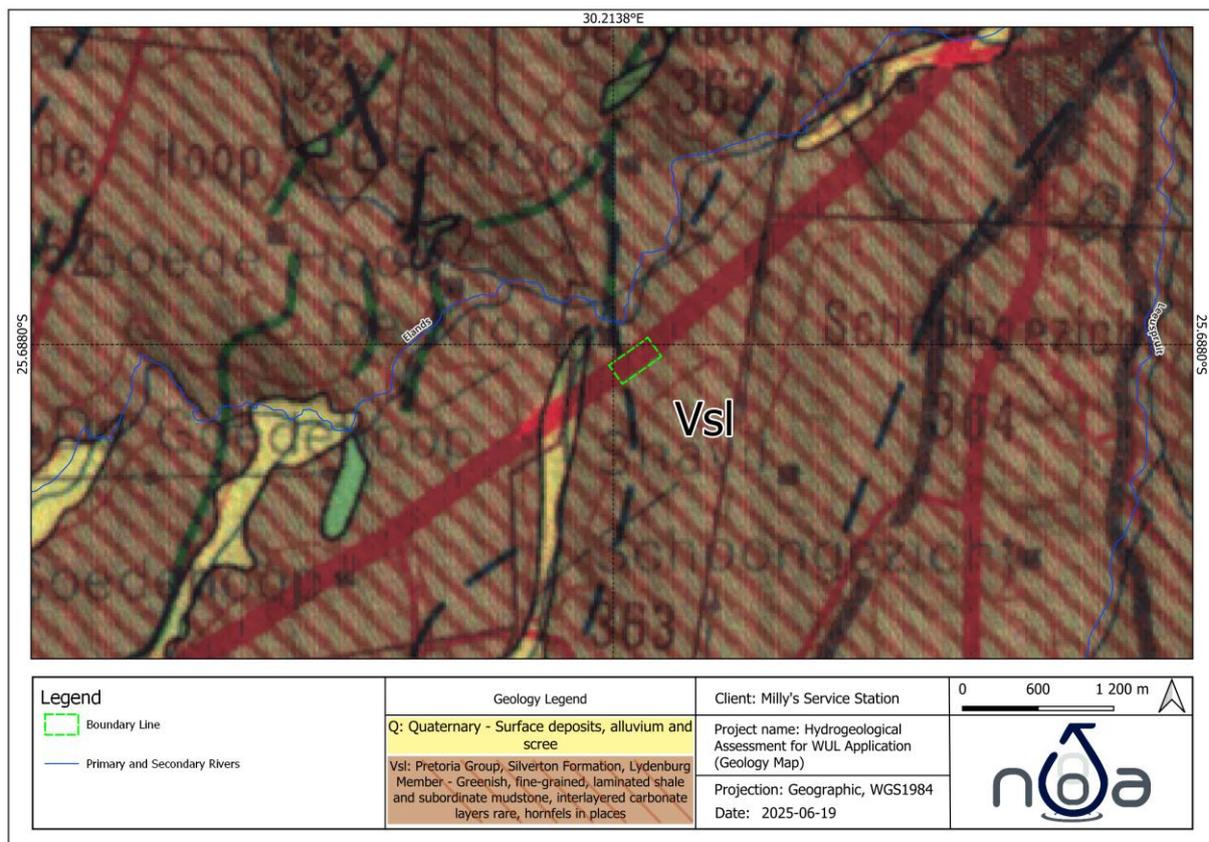


Figure 4-1 Geological map underlying project area.

4.2 Hydrogeology

Based on the understanding of the underlying geology, and the borehole logs from the four boreholes drilled on site, the hydrogeological units are conceptualised as follows:

4.2.1 Weathered

According to the borehole logs attached the weathered zone consists light brown, fine grained shale material which extends to a maximum depth of 20 metres below ground level. The first water strike in borehole REB 228 was observed at 15 m (0.01 l/s), and the second water strike at 18 m (1.50 l/s). The other two boreholes REB 229 and REB 230 had 0.2 l/s strikes at 13 and 14 mbgl. The weathered zone is laterally discontinuous and is for that reason not expected to yield sustainable volumes of groundwater.

4.2.2 Fractured/Contact Zone Aquifer

Although both shale and diabase lack significant primary porosity, water-bearing zones were encountered at 30 m and 50 m below ground level (REB 228) associated with fractures along the shale–diabase contact. In borehole REB 228, a substantial water strike of 1.80 L/s occurred at the interface between shale and the dark grey, fine- to medium-grained diabase.

According to the hydrogeological classification map series the aquifer is classified as Intergranular and Fractured type with low to moderately yield (estimated yields to be between 0.5 – 2 l/s) as illustrated in the Principal Groundwater Occurrence map of South Africa in Figure 4-2. Static water levels were available at 79 sources ranging between 0.1 – 49.14 mbgl and averaged at 7.66 mbgl (Du Toit & Sonnekus, 2014).

Table 4-2 Borehole yield statistics for the Pretoria Group (Du Toit & Sonnekus, 2014)

Intergranular and Fractured (207 boreholes)							
Formation	No of Records	<0.1 l/s	0.1 -0.5 l/s	0.5 - 2.0 l/s	2.0-5.0 l/s	> 5.0 l/s	Max Yield (l/s)
Pretoria Group	207	6.8	27.1	44.0	20.8	1.4	35

4.2.3 Recharge

Groundwater recharge is defined as the process by which water is added from outside to the zone of saturation of an aquifer, either directly into a formation, or indirectly by way of another formation. The Groundwater Resource Assessment estimated a recharge percentage 7.1 % of the Mean Annual Precipitation for catchment X21F (DWAF, 2006), however considering the low permeability clay material in the upper part of the weathering profile the true recharge is expected to be less.

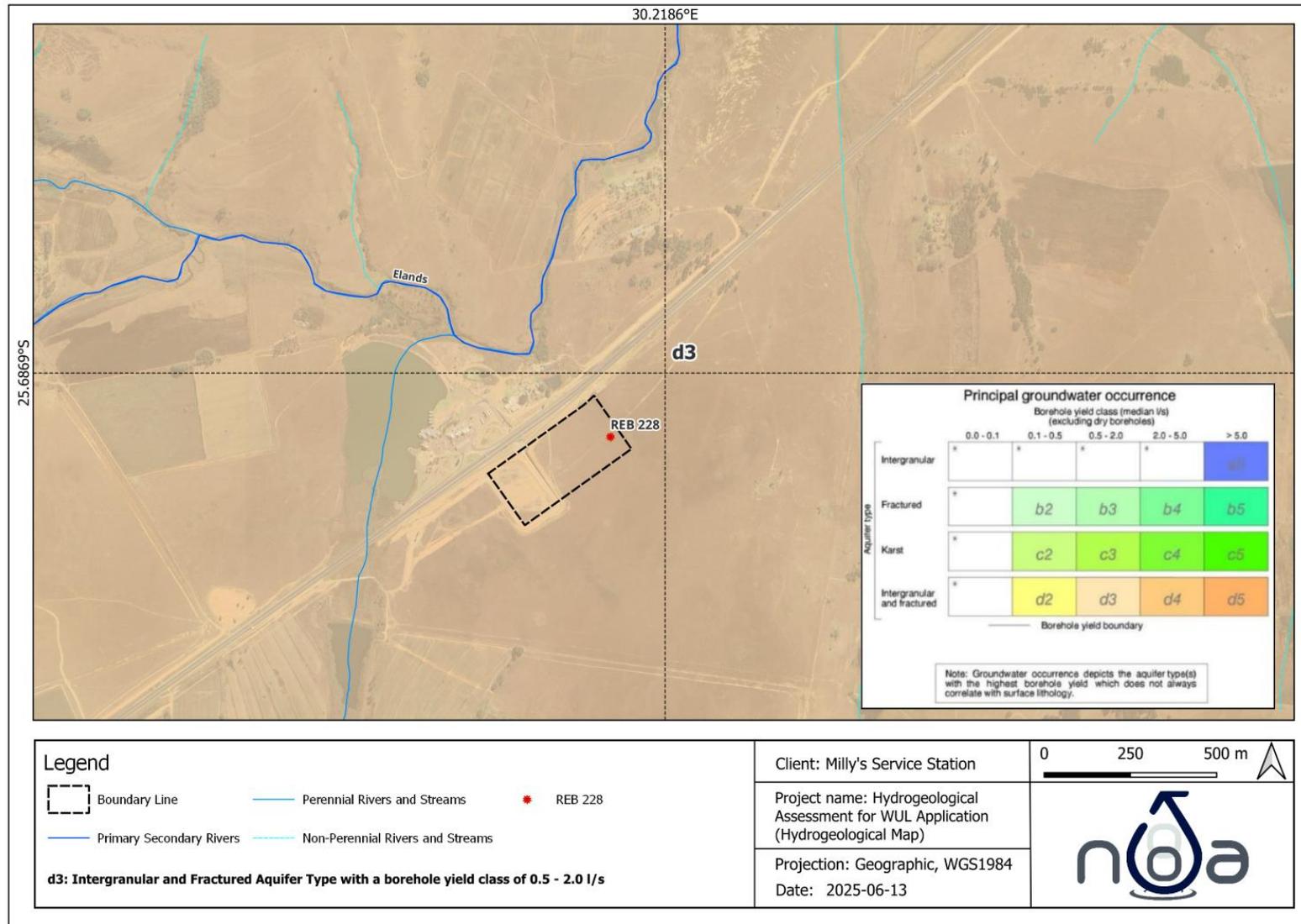


Figure 4-2 Principal Groundwater Occurrence according to Vegter (1995)

5 DESKTOP STUDY

The National Groundwater Archive (NGA), the DWS Chart database, and the National Integrated Water Information System (NIWIS) was consulted to identify any registered groundwater users within the vicinity of the proposed service station. The NGA database offers details such as borehole locations, yield, groundwater levels, and borehole geology. However, no registered boreholes were identified within a 1 km radius of the project area.

6 FIELD INVESTIGATION

6.1 Hydrocensus

A hydrocensus was conducted on the 4th of June 2025 within a 1 km radius of the proposed site boundary. One borehole (MBH1) was identified within a 1 km radius of the proposed abstraction borehole REB 228. The borehole is currently equipped with a submersible pump and is abstracted for domestic and irrigation purposes. The borehole was sealed, and the static groundwater level measurement could not be measured. The information obtained is summarised in Table 6-1 below.

- The land use surrounding the proposed service station is farming land, specifically agriculture and cattle grazing. It is expected that majority of groundwater in the area is used for household and domestic purposes.
- There are a few constructed dams that capture water from the Elands River and the De Kroonspruit and its tributaries. The water from the dams is likely used for irrigation and livestock watering.
- Borehole REB 228 was installed with a solid steel casing to a depth of 16.7 metres, and slotted casing to a depth of 32.6 metres. Borehole was drilled to a depth of 56 metres with a blow yield of 1.8 L/s.

Table 6-1 Hydrocensus Details

BH ID	Coordinates		Z mamsl	Water Level (mbgl)	Water level Elevation	Depth (m)	Pump Type	Casing type	Water Use	Comments	Sampled
	Latitude	Longitude		Static	(mamsl)			Steel/uPVC			
MBH01	-25.681703	30.217909	1560.00	NM	NM	40	Submersible	Steel	Domestic Irrigation	Borehole sealed	Yes
REB 228	-25.68855	30.216990	1588.00	4.14	1583.86	56	Not equipped	Steel	Not in use	Borehole sealed with cap. Not equipped	Yes



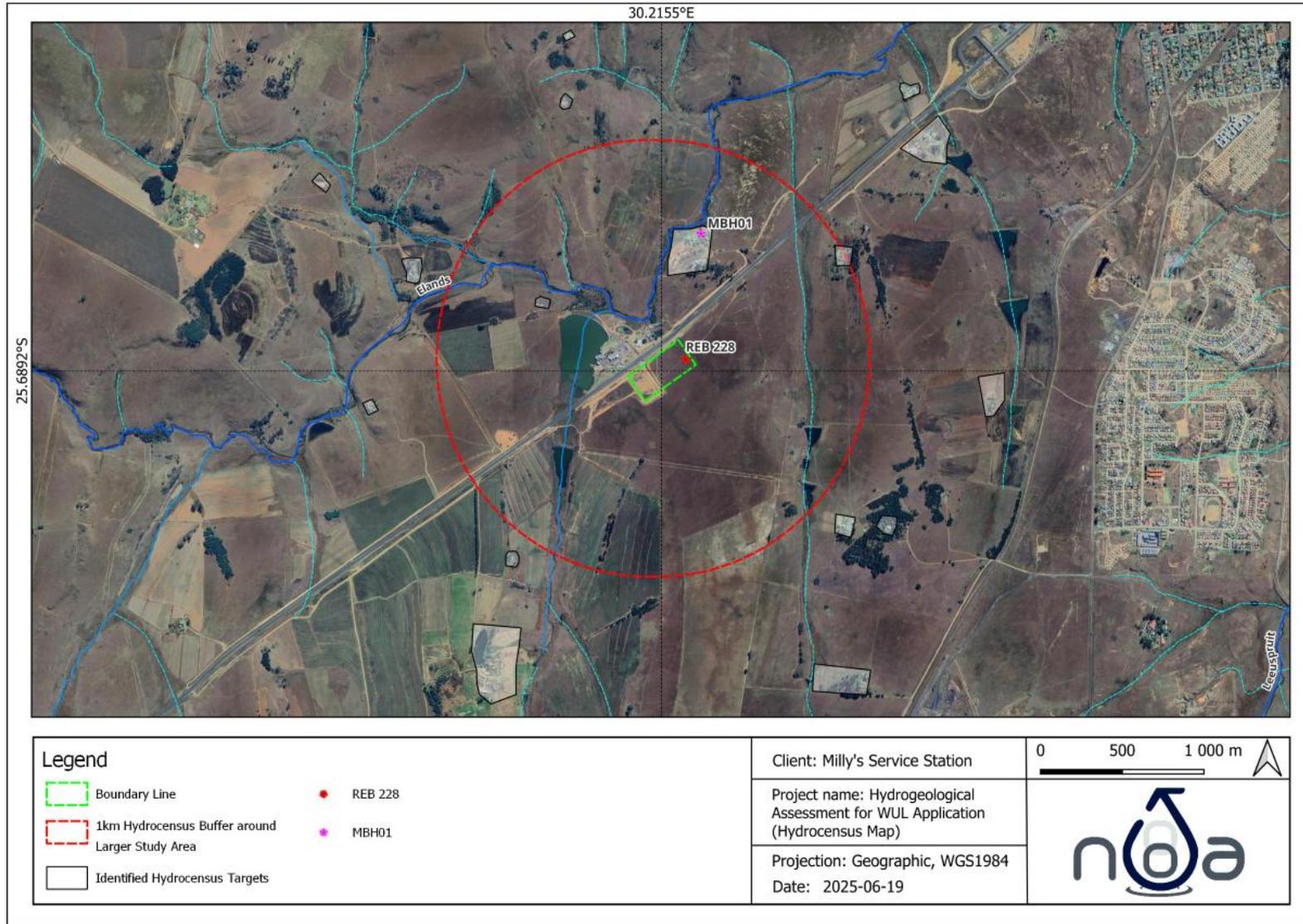


Figure 6-1 Hydrocensus boreholes map

6.2 Aquifer Testing Program

An aquifer testing program was conducted on 10th of June 2025. The test was conducted using a mobile submersible pump test unit. The results of the aquifer tests are attached as Appendix A. A summary of the aquifer tests conducted on the site are provided in Table 6-2. The parameters/hydrogeological characteristics that are generally calculated from aquifer tests include:

- *Hydraulic conductivity (K)*: The volume of water that will move through a porous medium in unit time under a unit hydraulic gradient through a unit area measured perpendicular to the area.
- *Transmissivity (T)*: Measure of the rate of flow under a unit hydraulic gradient through a cross-section of unit width over the saturated thickness of the aquifer. The unit of measurement is (m²/day).
- *Storativity* – The storativity (S) of an aquifer is the volume of water released from storage per unit surface area per unit change in head. This parameter is a dimensionless quality.

6.2.1 Extended Step Test

An extended step-drawdown test is a single well test that is frequently conducted after well development to determine well efficiency. A step-drawdown is generally defined as a constant-rate pumping rate starting from an initial constant rate while observing the water level that successively reaches quasi-steady state. The pumping rate is then increased to a higher constant-discharge rate until the drawdown stabilizes once more (Kruseman & de Ridder, 1994). By standards, the process is recommended to be repeated at least three times.

REB 228

A total of three (3) step tests were performed on borehole REB 228 at the following rates and are graphically illustrated in Figure 6-2:

- Step 1: 5 400 L/hr (1.50 l/s)
- Step 2: 10 800 L/hr (3.00 l/s)
- Step 3: 15 120 L/hr (4.20 l/s)

Step 1 and Step 2 lasted 60 minutes each, and Step 3 lasted 210 minutes. The drawdown decreased exponentially at the start of each step but stabilised rapidly. The final step was conducted at a discharge rate of 4.20 l/s, the water level dropped with 2 metres within the first 5 minutes, linear flow is observed between 125 to 200 minutes, after which the water level stabilised at 13 metres below ground level for the remainder of the test. After 330 minutes of testing (5 hours) a total drawdown of 13.53 metres (9.39 metres residual drawdown) was achieved. Drill logs indicated that the main water strike was at 31 and 49 metres below ground level. Therefore, a total available drawdown of 27 metres was available. The static water level recovered to 90 % after 180 minutes of recovery.

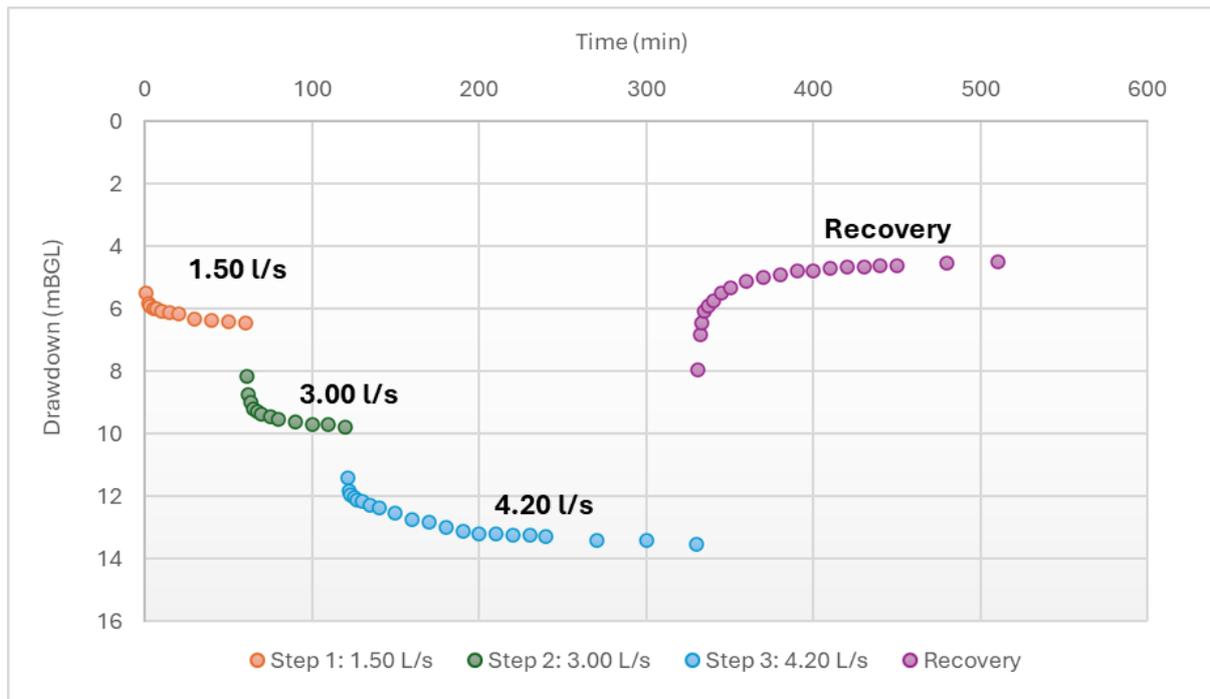


Figure 6-2 Extended step drawdown borehole REB 228

Table 6-2 Summary of the extended step test

Borehole ID	Coordinates		Water level (mbgl)	Water level (mamsl)	Water Strike (mbgl)	Pump inlet depth (mbgl)	Extended Step Test			Recovery Test		
	Latitude	Longitude					No. of Steps	Duration (min)	Yield (L/s)	Drawdown obtained (m)	(min)	%
REB 228	-25.68855	30.21699	4.14	1583.86	16,19,31 50	51	3	60	1.50	6.45	180	88
								60	3.00	9.79		
								210	4.20	13.53		
<p><i>*Notes:</i></p> <ul style="list-style-type: none"> - <i>mamsl: metres above mean sea level</i> - <i>m: metre</i> - <i>mbgl: metres below ground level</i> - <i>min: minutes</i> - <i>L/s: litres per second</i> 												

6.2.2 Analysis And Results

The extended step test was interpreted using AQTESOLV software, applying the Theis solution. While aquifer tests are typically analysed under the assumption of homogeneity, it is important to note that aquifers are inherently heterogeneous. This assumption presents a significant limitation in the interpretation of pumping test results. Therefore, it is recommended that the estimated yield be monitored over time once the borehole is put into production.

A summary of the hydraulic parameters derived from the aquifer testing program is presented in Table 6-3, with detailed test reports included in Appendix A. The Theis method yielded a transmissivity of 34.72 m²/day for borehole REG 228. Since longer duration tests yield tend to produce more reliable results the aquifer parameters obtained from the 24-hour constant rate test conducted by VSA Rebotile Metsi Consulting are also summarized below.

Table 6-3 Summary of the calculated aquifer parameters

Software/Source	ID	Aquifer Thickness* [m]	Theis Method		
			Transmissivity [m ² /d]	Hydraulic Conductivity [m/d]	Storativity N/A
			VSA Rebotile Metsi Consulting	REB 228	48
Aqtesolv	REB 228	48	34.72	0.77	9.2E-05

Notes:
 meters - m
 m/d - meters per day
 m²/d - Squared meters per day
 N/A - Not Applicable
 Aquifer thickness is the difference between main strike and static water level

6.3 Sustainable Yield

As a general principle, the total abstraction from a borehole should not exceed the natural groundwater recharge rate. Additionally, it is important to pump the borehole in a way that prevents the water level from dropping to the main water strike level, typically associated with the fracture. If this occurs, the yield will be compromised, and the borehole may eventually run dry due to the dewatering of the fracture and the loss of hydrostatic pressure.

Water strikes were intersected at 16 m, 18 m, 30 m and 49 m (main water strike). It is recommended that borehole REB 228 is pumped to a maximum drawdown of 30 meters below ground level (critical depth). If the water level reaches this critical level of 30 meters, it is recommended that pumping should only resume once the groundwater level has recovered to 90% of its static level. Table 6-4 summarises the recommended yields with different pumping cycle scenarios. An optimal abstraction rate that aligns with the client's requirements and storage capacity should be selected from the recommended sustainable yields below. However, it is essential to monitor the water level over time to better understand the long-term response of the aquifer. If the groundwater level declines over time, it is recommended that the abstraction rate should be lowered, or to modify the pumping schedule to include shorter pumping durations and extend recovery periods.

Table 6-4 Summary of borehole REB 228 sustainable yield

Borehole ID	Coordinates		Borehole Depth (m)	Critical Water Level (mbgl)	Sustainable Yield			
	Latitude	Longitude			Pump inlet depth (mbgl)	Recommended yield (L/s)	Pumping cycle (hr)	Abstraction in pumping cycle (m ³)
REB 228	-25.68855	30.216990	56	30	36 - 45	1.80	8	52.00
						1.40	12	60.90
						1.22	16	70.24
<p><i>*Notes:</i></p> <ul style="list-style-type: none"> - <i>m: metre</i> - <i>mbgl: metres below ground level</i> - <i>L/s: litre per second</i> - <i>hr: hour</i> - <i>m³: cubic metres</i> 								

6.4 Groundwater Quality

A groundwater sample was obtained from the identified borehole MBH01. The sample was collected in 1L sample bottles and sent for analysis at EPL laboratories, a SANAS accredited laboratory. Lab results are attached in Appendix B. The groundwater samples were screened against the SANS 241-1:2015 specifications for drinking water. Groundwater use in the area is predominantly domestic, and irrigation use and therefore groundwater was also screened against the South Africa Water Quality Guidelines Volume 4: Agricultural Use: Irrigation, and Volume 5: Agricultural Use: Livestock Watering (DWAF, 1996).

The groundwater quality in the area is generally good, characterized by circum-neutral pH and low salinity. All parameters comply with the SANS 241 drinking water guidelines for proposed abstraction borehole REG228, except for elevated levels of microbiological indicators. As a precaution, it is recommended that the water be treated before human consumption. Once the service station becomes operational it will be important to monitor the abstraction borehole for Total Petroleum Hydrocarbons, and other volatile hydrocarbons that are found in petroleum products.

Table 6-5 Groundwater chemistry from study area

Sample ID	Unit	SANS 241	DWS Irrigation 1996	DWS Livestock	MBH01	REG 228
					04/06/2025	11/06/2025
pH	pH	<5 & >9.7	<6.5 & >8.4	NG	7.8	7.24
EC	mS/m	170	40	NG	22.6	9.70
TDS	mg/l	1200	NG	<1000	141	72
Total Alkalinity	CaCO ₃	NG	NG	NG	90	40
Chloride	mg/l Cl	300	100	<1500	4.6	2.28
Sulphate	mg/l SO ₄	500	NG	<1000	<2	<2
Fluoride	mg/l F	<1.5	NG	NG	0.28	0.09
Nitrate as N	mg/l N	11	5	100	<0.5	<0.5
Free Ammonia as N	mg/l N	1.5	NG	NG	<0.02	0.28
Phosphate	mg/l PO ₄	NG	NG	NG	<0.20	<0.2
Calcium	mg/l Ca	NG	NG	<1000	17.31	5.10
Magnesium	mg/l Mg	NG	NG	<500	10.45	6.14
Sodium	mg/l Na	<200	70	<2000	9.87	5.37
Potassium	mg/l K	NG	NG	NG	0.56	0.51
Iron	mg/l Fe	2	5	<10	<0.05	0.06
Manganese	mg/l Mn	0.4	0.02	< 10	<0.05	<0.05
Zinc	mg/l Zn	5	NG	NG	<0.05	0.09
E.coli (colonies)	colonies/100ml	0	1	NG	30	0
Total Coliform	colonies/100ml	<10	NG	NG	190	9
Total Plate Count	colonies/ml	NG	NG	NG	17	17

7 AQUIFER CHARACTERISATION

7.1 Aquifer Vulnerability

The Aquifer Vulnerability Map, based on the Borehole Prospects map provided by Vegter, indicates that the proposed project area falls within the moderately vulnerable area in South Africa and is illustrated in Figure 7-1. The aquifer is considered moderately vulnerable to some pollutants, but only when continuously discharged or leached.

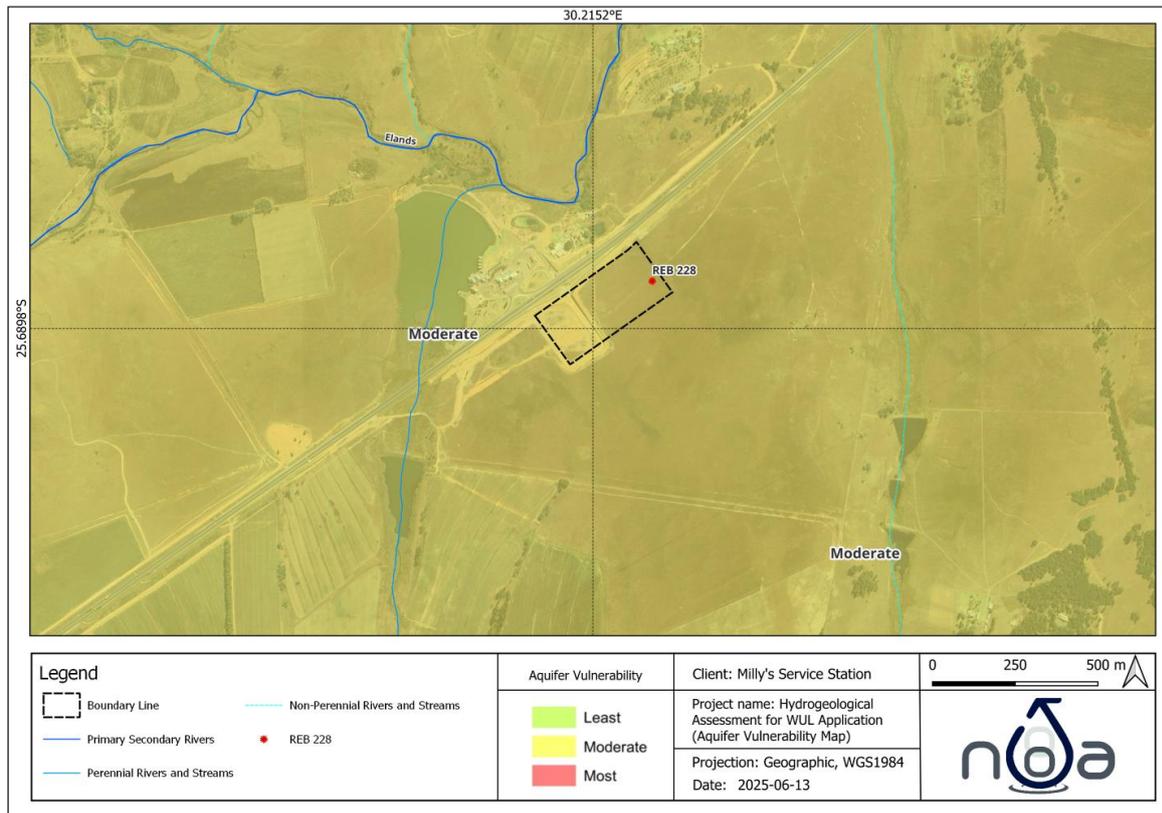


Figure 7-1 Aquifer vulnerability map of South Africa.

7.2 Aquifer Classification

The aquifer(s) underlying the subject area were classified in accordance with: A South African Aquifer System Management Classification, December 1995 (Parsons, 1995). The aquifers are classified according to the following definitions:

- **Sole Aquifer System:** An aquifer which is used to supply 50% or more of domestic water for a given area, and for which there is no reasonably available alternative sources should the aquifer be impacted upon or depleted. Aquifer yields and natural water quality are immaterial.
- **Major Aquifer System:** Highly permeable formations, usually with a known or probable presence of significant fracturing. They may be highly productive and able to support large abstractions for public supply and other purposes. Water quality is generally very good (Electrical Conductivity of less than 150 mS/m).
- **Minor Aquifer System:** These can be fractured or potentially fractured rocks which do not have a high primary permeability, or other formations of variable permeability. Aquifer extent may be limited and water quality variable. Although these aquifers seldom produce large quantities of water, they are important for local supplies and in supplying base flow for rivers.
- **Non-Aquifer System:** These are formations with negligible permeability that are regarded as not containing groundwater in exploitable quantities. Water quality may also be such that it

renders the aquifer unusable. However, groundwater flow through such rocks, although imperceptible, does take place, and needs to be considered when assessing the risk associated with persistent pollutants.

The aquifer system underlying the site is a “minor aquifer system” which is a moderately-yielding aquifer system of variable water quality.

In order to achieve the Aquifer System Management and Second Variable Classifications, as well as the Groundwater Quality Management Index, a points scoring system as presented in Table 7-1 and Table 7-2 was used.

Table 7-1 Ratings – Aquifer System Management and Second Variable Classifications

Aquifer System Management Classification		
Class	Points	Study area
Sole Source Aquifer System:	6	
Major Aquifer System:	4	
Minor Aquifer System:	2	2
Non-Aquifer System:	0	
Special Aquifer System:	0 – 6	
Second Variable Classification (Weathering/Fracturing)		
Class	Points	Study area
High:	3	
Medium:	2	2
Low:	1	

Table 7-2 Ratings - Groundwater Quality Management (GQM) Classification System

Aquifer System Management Classification		
Class	Points	Study area
Sole Source Aquifer System:	6	
Major Aquifer System:	4	
Minor Aquifer System:	2	2
Non-Aquifer System:	0	
Special Aquifer System:	0 – 6	
Aquifer Vulnerability Classification		
Class	Points	Study area
High:	3	
Medium:	2	2
Low:	1	

As part of the aquifer classification, a Groundwater Quality Management (GQM) Index is used to define the level of groundwater protection required. The GQM Index is obtained by multiplying the rating of the aquifer system management and the aquifer vulnerability. The GQM index for the study area is presented in Table 7-3.

The level of groundwater protection based on the Groundwater Quality Management Classification:

$$\begin{aligned} \text{GQM Index} &= \text{Aquifer System Management} \times \text{Aquifer Vulnerability} \\ &= 2 \times 2 = 4 \end{aligned}$$

Table 7-3 GQM Index for the Study Area

GQM Index	Level of Protection	Study Area
<1	Limited	
1 – 3	Low Level	
3 – 6	Medium Level	4
6 – 10	High Level	
>10	Strictly non-degradation	

Minor aquifers may not yield large volumes of sustainable flow but is potentially important for local supply and baseflow contribution to rivers. For this reason, this aquifer should be protected against over-abstraction and contamination.

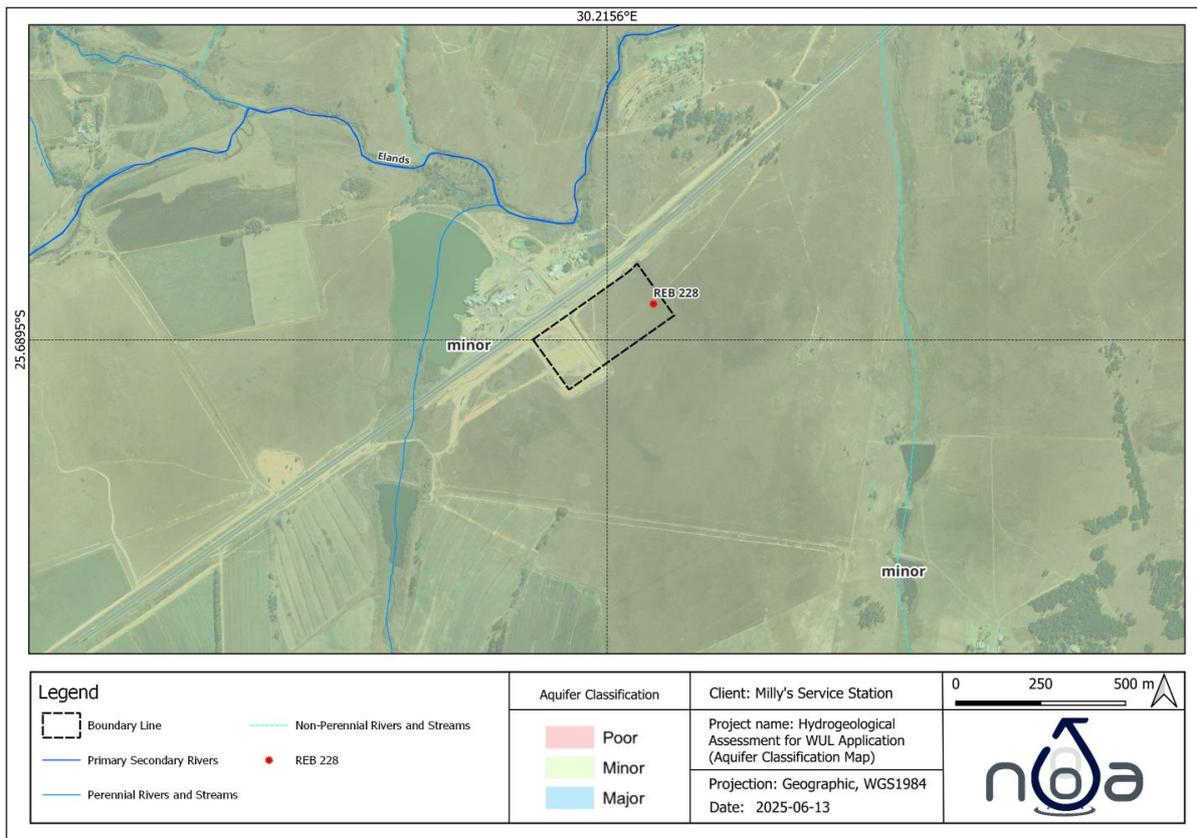


Figure 7-2 Aquifer classification map of South Africa

8 RAPID GROUNDWATER RESOURCE DETERMINATION

A groundwater resource determination (GRD) was conducted for the proposed abstraction EG-BH02. The GRD aims to establish a groundwater reserve (GW) to help quantify the likely impacts of the groundwater abstraction. To be able to quantify the groundwater component of the Reserve, the following relationship must be solved:

$$GW_{\text{ALLOCATE}} = (\text{Re} + \text{GW}_{\text{in}} - \text{GW}_{\text{out}}) - \text{BHN} - \text{GW}_{\text{Bf}}$$

Where: GW allocate = groundwater allocation
 Re = recharge from rainfall
 Gwin = groundwater inflow
 GWout = groundwater outflow
 BHN = basic human needs
 GWbf = groundwater contribution to baseflow

The volume of groundwater that can be abstracted from a resource without impacting the ability of groundwater to sustain the reserve is called the Groundwater Allocation.

8.1 Calculation of Recharge

Effective groundwater recharge is the portion of rainfall that replenishes the aquifer, while the rest flows as surface water, evaporates, or is stored in the soil. Geology, soil properties, surface runoff, and stream characteristics all influence recharge rates. The estimated recharge for the area is detailed in Table 8-1.

Table 8-1 Estimated recharge calculation summary

Description	Unit	Quaternary Catchment X21F
Annual Total Rainfall	mm	918
Recharge (~4 % of MAP)	(mm/a)	36.72
Delineated Catchment Area	(km ²)	397
Delineated Project Area	(km ²)	0.05
Catchment Annual Recharge Volume	(m³/a)	14 292 000
Project Area Annual Recharge Volume	(m³/a)	1 800

8.2 Catchment Area Delineation

The site is located within the X21F quaternary catchment, covering an area of 397 km².

8.2.1 Total Abstraction

Based on the sustainable yield analysis, a total abstraction volume of 25 638 m³/a is required and is summarised in Table 8-2. According to the Proposed Reserve Determination of Water Resources in the Inkomati Catchment, the current groundwater use for quaternary catchment X21F is estimated to be 0.83 Mm³/a. Data was obtained from the Groundwater Resource Assessment Project Phase II (DWAF, 2006) and the WARMS 2013 dataset (DWS, 2025).

Table 8-2 Groundwater Abstraction Summary

Use	Groundwater Requirement	
	m ³ /month	m ³ /annum
Proposed Abstraction	2 109	25 638
Current Use	-	830 000
WARMS database	-	696 204

8.3 Groundwater Contribution to Baseflow

Baseflow is the sustained low flow in a river during dry or fair-weather conditions. It primarily consists

of water slowly released from groundwater and interflow, not directly from recent precipitation. The groundwater contribution to baseflow calculated for catchment X21F is summarised in Table 8-3 below. In quaternary catchment X21F, groundwater contributes approximately 3.17 Mm³/a to baseflow.

Table 8-3 Groundwater contribution to baseflow

Groundwater Contribution to Baseflow	
Baseflow for Quaternary Catchment (X21F)	3.17 (Mm ³ /a)

8.4 Delineated Catchment Area Water Balance Calculation

The rapid groundwater reserve determination is summarised in Table 8-4 below. The groundwater component of the Reserve is the part of the groundwater resource that sustains the basic human needs and aquatic ecosystem. **Groundwater can only be allocated to users and potential users once the volume of groundwater that contributes to sustaining the reserve has been quantified.** According to the rapid/desktop reserve determination, the surplus amount of groundwater in catchment X21F is estimated to be 9 570 246 m³/a.

A more conservative surplus was also found on the DWS National Integrated Water Information System (NIWIS) Groundwater Availability Status catchment X21F has an estimated groundwater surplus in the order of 4 764 386 m³/a (GRA2) or 8 773 796 m³/a (GWR). This volume is calculated by considering the available groundwater (GRA2), recharge to groundwater, Reserve (GWR), and volume of abstracted water from registered groundwater users (WARMS Database) (DWS, 2025)

Table 8-4 Catchment water balance summary (DWS, 2025)

Water Balance		
Description	Quaternary Catchment X21F	Unit
Recharge through Precipitation	14 292 000	(m ³ /a)
WARMS Database	696 204	(m ³ /a)
Current Use	830 000	(m ³ /a)
Proposed Abstraction	25 638	(m ³ /a)
Baseflow	3 170 000	(m ³ /a)
Surplus Amount	9 570 158	(m ³ /a)

8.5 Scale of Abstraction

The Department of Water and Sanitation (DWS) categorises groundwater abstraction license applications based on their complexity (21(a)). Categories A, B, and C each have specific information requirements that applicants must provide to the DWS. The category of abstraction is summarised in Table 8-5.

$$AREA_{\text{property}} * RE = RE_{\text{AREA}} \text{ (m}^3\text{/a)}$$

$$ABS_{\text{EX}} + ABS_{\text{NEW}} = ABS_{\text{TOTAL}} \text{ (m}^3\text{/a)}$$

$$ABS_{\text{SCALE}} = (ABS_{\text{TOTAL}}/RE_{\text{AREA}}) * 100$$

The proposed groundwater abstraction from borehole REG 228 represents large-scale abstraction in relation to the 1 809 m³/a recharge to the property. This falls under the Department of Water and Sanitation (DWS) classification of "**Class C: Large-scale abstraction**" (refer to Table 8-5).

Table 8-5 Categories of abstraction

Category	Description
A	Small-scale abstractions (<60% Recharge)
B	Medium-scale abstractions (60 - 100% Recharge)
C	Large-scale abstractions (>100% Recharge)

8.6 Stress Index

A stress index (Table 8-6) was developed, dividing the proposed abstraction volume by the estimated recharge for the catchment area (Parsons & Wentzel, 2007). This calculation was applied to quaternary catchment X21F, the calculation formula is as follows:

$$\text{Stress Index} = \text{Total Delineated Catchment Abstraction} / \text{Delineated Catchment Recharge}$$

Table 8-6 Stress Index

STRESS INDEX		
Present Status Category	Description	Stress Index
A	Unstressed or low level of stress	<5%
B		5% - 20%
C	Moderate levels of stress	20% - 50%
D		50% - 75%
E	Highly Stressed	75% - 95%
F	Critically stressed	> 95%

The *total catchment abstraction* (proposed abstraction + WARMS database total abstraction) accounts for less than 5 % of the catchment recharge and is expected to introduce a low level of stress on a catchment scale.

9 HYDROGEOLOGICAL RISK ASSESSMENT

Based on the groundwater assessment the following potential risks are identified with regards to the proposed abstraction.

- Over abstraction of the borehole which could lead to fracture dewatering. Over time the borehole may dry up or may yield significant lower yield.
- Over abstraction of borehole which may impact on identified receptors
 - Abstraction of groundwater which may intercept interflow contribution to the hill slope seep wetland
 - Over abstraction of borehole which could influence receptors (other borehole users)

9.1 Assessment Criteria

The criteria for the description and assessment of environmental impacts were drawn from the EIA Guidelines (DEAT, 1998) and as amended from time to time (DEAT, 2002) (Table 9-1).

The level of detail as depicted in the EIA Guidelines (DEAT, 1998) (DEAT, 2002)) was fine-tuned by assigning specific values to each impact. In order to establish a coherent framework within which all impacts could be objectively assessed, it was necessary to establish a rating system, which was applied consistently to all the criteria. For such purposes each aspect was assigned a value, ranging from one (1) to five (5), depending on its definition. This assessment is a relative evaluation within the context of all the activities and the other impacts within the framework of the project.

An explanation of the impact assessment criteria is defined below.

Table 9-1 Impact Assessment Criteria

EXTENT	
Classification of the physical and spatial scale of the impact	
Footprint	The impacted area extends only as far as the activity, such as footprint occurring within the total site area.
Site	The impact could affect the whole, or a significant portion of the site.
Regional	The impact could affect the area including the neighbouring farms, the transport routes and the adjoining towns.
National	The impact could have an effect that expands throughout the country (South Africa).
International	Where the impact has international ramifications that extend beyond the boundaries of South Africa.
DURATION	
The lifetime of the impact that is measured in relation to the lifetime of the proposed development.	
Short term	The impact will either disappear with mitigation or will be mitigated through a natural process in a period shorter than that of the construction phase.
Short to Medium term	The impact will be relevant through to the end of a construction phase (1.5 years).
Medium term	The impact will last up to the end of the development phases, where after it will be entirely negated.
Long term	The impact will continue or last for the entire operational lifetime i.e. exceed the years of the development, but will be mitigated by direct human action or by natural processes thereafter.
Permanent	This is the only class of impact, which will be non-transitory. Mitigation either by man or natural process will not occur in such a way or in such a time span that the impact can be considered transient.
INTENSITY	
The intensity of the impact is considered by examining whether the impact is destructive or benign, whether it destroys the impacted environment, alters its functioning, or slightly alters the environment itself. The intensity is rated as	
Low	The impact alters the affected environment in such a way that the natural processes or

	functions are not affected.
Medium	The affected environment is altered, but functions and processes continue, albeit in a modified way.
High	Function or process of the affected environment is disturbed to the extent where it temporarily or permanently ceases.
PROBABILITY	
This describes the likelihood of the impacts actually occurring. The impact may occur for any length of time during the life cycle of the activity, and not at any given time. The classes are rated as follows:	
Improbable	The possibility of the impact occurring is none, due either to the circumstances, design or experience. The chance of this impact occurring is zero (0 %).
Possible	The possibility of the impact occurring is very low, due either to the circumstances, design or experience. The chances of this impact occurring is defined as 25 %.
Likely	There is a possibility that the impact will occur to the extent that provisions must therefore be made. The chances of this impact occurring is defined as 50 %.
Highly Likely	It is most likely that the impacts will occur at some stage of the development. Plans must be drawn up before carrying out the activity. The chances of this impact occurring is defined as 75 %.
Definite	The impact will take place regardless of any prevention plans, and only mitigation actions or contingency plans to contain the effect can be relied on. The chance of this impact occurring is defined as 100 %.

The status of the impacts and degree of confidence with respect to the assessment of the significance must be stated as follows:

- **Status of the impact:** A description as to whether the impact would be positive (a benefit), negative (a cost), or neutral.
- **Degree of confidence in predictions:** The degree of confidence in the predictions, based on the availability of information and specialist knowledge.

Other aspects to take into consideration in the specialist studies are:

- Impacts should be described both before and after the proposed mitigation and management measures have been implemented.
- All impacts should be evaluated for the full-lifecycle of the proposed development, including construction, operation and decommissioning.
- The impact evaluation should take into consideration the cumulative effects associated with this and other facilities which are either developed or in the process of being developed in the region.
- The specialist studies must attempt to quantify the magnitude of potential impacts (direct and cumulative effects) and outline the rationale used. Where appropriate, national standards are to be used as a measure of the level of impact.

9.1.1 Mitigation

The impacts that are generated by the development can be minimised if measures are implemented to reduce the impacts. The mitigation measures ensure that the development considers the environment and the predicted impacts to minimise impacts and achieve sustainable development.

Determination of Significance-Without Mitigation

Significance is determined through a synthesis of impact characteristics as described in the above paragraphs. It provides an indication of the importance of the impact in terms of both tangible and intangible characteristics. The significance of the impact “without mitigation” is the prime determinant of the nature and degree of mitigation required. Where the impact is positive, significance is noted as “positive”. Significance is rated on the following scale:

Table 9-2 Significance-Without Mitigation

NO SIGNIFICANCE	The impact is not substantial and does not require any mitigation action.
LOW	The impact is of little importance but may require limited mitigation.
MEDIUM	The impact is of importance and is therefore considered to have a negative impact. Mitigation is required to reduce the negative impacts to acceptable levels.
HIGH	The impact is of major importance. Failure to mitigate, with the objective of reducing the impact to acceptable levels, could render the entire development option or entire project proposal unacceptable. Mitigation is therefore essential.

Determination of Significance- With Mitigation

Determination of significance refers to the foreseeable significance of the impact after the successful implementation of the necessary mitigation measures. Significance with mitigation is rated on the following scale:

Table 9-3 Significance- With Mitigation

NO SIGNIFICANCE	The impact will be mitigated to the point where it is regarded as insubstantial.
LOW	The impact will be mitigated to the point where it is of limited importance.
LOW TO MEDIUM	The impact is of importance, however, through the implementation of the correct mitigation measures such potential impacts can be reduced to acceptable levels.
MEDIUM	Notwithstanding the successful implementation of the mitigation measures, to reduce the negative impacts to acceptable levels, the negative impact will remain of significance. However, taken within the overall context of the project, the persistent impact does not constitute a fatal flaw.
MEDIUM TO HIGH	The impact is of major importance but through the implementation of the correct mitigation measures, the negative impacts will be reduced to acceptable levels.
HIGH	The impact is of major importance. Mitigation of the impact is not possible on a cost-effective basis. The impact is regarded as high importance and taken within the overall context of the project, is regarded as a fatal flaw. An impact regarded as high significance, after mitigation could render the entire development option or entire project proposal unacceptable.

9.1.2 Assessment Weighting

Each aspect within an impact description was assigned a series of quantitative criteria. Such criteria are likely to differ during the different stages of the project’s life cycle. To establish a defined base upon which it becomes feasible to make an informed decision, it was necessary to weigh and rank all the criteria.

Ranking, Weighting and Scaling

For each impact under scrutiny, a scaled weighting factor is attached to each respective impact (refer to Table 9-4). The purpose of assigning weights serves to highlight those aspects considered the most critical to the various stakeholders and ensure that each specialist’s element of bias is considered. The weighting factor also provides a means whereby the impact assessor can successfully deal with the complexities that exist between the different impacts and associated aspect criteria.

Simply, such a weighting factor is indicative of the importance of the impact in terms of the potential effect that it could have on the surrounding environment. Therefore, the aspects considered to have a relatively high value will score a relatively higher weighting than that which is of lower importance.



Table 9-4 Description of assessment parameters with its respective weighting

EXTENT		DURATION		INTENSITY		PROBABILITY		WEIGHTING FACTOR (WF)		SIGNIFICANCE RATING (SR)	
Footprint	1	Short term	1	Low	1	Improbable	1	Low	1	Low	0-19
Site	2	Short to Medium	2			Possible	2	Low to Medium	2	Low to Medium	20-39
Regional	3	Medium term	3	Medium	3	Likely	3	Medium	3	Medium	40-59
National	4	Long term	4			Highly Likely	4	Medium to High	4	Medium to High	60-79
International	5	Permanent	5	High	5	Definite	5	High	5	High	80-100
MITIGATION EFFICIENCY (ME)				SIGNIFICANCE FOLLOWING MITIGATION (SFM)							
High				0.2		Low		0 - 19			
Medium to High				0.4		Low to Medium		20 - 39			
Medium				0.6		Medium		40 - 59			
Low to Medium				0.8		Medium to High		60 - 79			
Low				1.0		High		80 - 100			

Identifying the Potential Impacts Without Mitigation Measures (WOM)

Following the assignment of the necessary weights to the respective aspects, criteria are summed and multiplied by their assigned weightings, resulting in a value for each impact (prior to the implementation of mitigation measures).

Equation 1:

$$\text{Significance Rating (WOM)} = (\text{Extent} + \text{Intensity} + \text{Duration} + \text{Probability}) \times \text{Weighting Factor}$$

Identifying the Potential Impacts with Mitigation Measures (WM)

To gain a comprehensive understanding of the overall significance of the impact, after implementation of the mitigation measures, it was necessary to re-evaluate the impact.

Mitigation Efficiency (ME)

The most effective means of deriving a quantitative value of mitigated impacts is to assign each significance rating value (WOM) a mitigation efficiency (ME) rating (refer to Table 9-3). The allocation of such a rating is a measure of the efficiency and effectiveness, as identified through professional experience and empirical evidence of how effectively the proposed mitigation measures will manage the impact.

Thus, the lower the assigned value the greater the effectiveness of the proposed mitigation measures and subsequently, the lower the impacts with mitigation.

Equation 2

$$\text{Significance Rating (WM)} = \text{Significance Rating (WOM)} \times \text{Mitigation Efficiency}$$

$$\text{or WM} = \text{WOM} \times \text{ME}$$

Significance Following Mitigation (SFM)

The significance of the impact after the mitigation measures are taken into consideration. The efficiency of the mitigation measure determines the significance of the impact. The level of impact is therefore seen in its entirety with all considerations considered (DEAT, 2002).



9.2 Risk Assessment Outcomes

The main risk associated with the proposed abstraction of the borehole is the over abstraction of the borehole, which could lead to the continuous fracture dewatering which will inevitably cause the borehole to dry up. With the appropriate mitigation measures, such as pumping the borehole at the recommended sustainable yield, the risk is reduced from medium-low to low.

According to Wet Earth Eco-Specs (Wet Earth Eco-Specs, 2022) a hillslope seep wetland is situated approximately 70 meters from the groundwater abstraction borehole REG 228. Investigations have determined that this wetland is primarily sustained by groundwater inputs. To mitigate potential impacts from the borehole's operation, a 30-meter buffer zone has been established around the wetland. Since the borehole lies outside this designated buffer, it is anticipated that groundwater abstraction will have minimal influence on the hydrological processes sustaining the hillslope seep.

The risk assessment was completed taking cognisance of the fact that there are no boreholes within the immediate vicinity of the proposed abstraction borehole. The only abstraction borehole identified during the hydrocensus was borehole MBH01 which is 1 km from the proposed abstraction borehole. The risk assessment also takes into consideration that the underlying aquifer is a minor aquifer, with a moderate vulnerability rating because of the shallow depth to groundwater level.

9.3 Mitigation Measures

The proposed mitigation measures to minimise the risks are:

- That the borehole should be pumped at the recommended sustainable pumping rate not exceeding 70 m³/day in a 16-hour cycle.
- Monitor flow in the hillslope valley seep in response to abstraction of borehole REG 228.
- Groundwater level should not reach critical groundwater level of 30 metres below ground level.
- Implementation of a level logger to record when the groundwater level reaches the critical groundwater level and automatically switches off the pump.
- Should the groundwater level reach the critical groundwater level, the borehole shall be allowed to recover to static groundwater level.
- Daily monitoring of abstraction volumes
- Monthly manual measuring of groundwater levels
- Monthly capturing of groundwater levels in an electronic database, for long-term trend analysis
- If there is any indication that the groundwater level is decreasing over time, the sustainable abstraction rate will be reduced and/or the pumping duration will be shortened to allow for recovery of the groundwater level.

Table 9-5 Risk Assessment Rating

Risk	Impact	Extent	Duration	Intensity	Probability	Weighting factor (WF)	Significance rating without mitigation	Mitigation Measure	Mitigation efficiency (ME)	Significance following mitigation (SFM)
Over Abstraction	Fracture dewatering	2	4	3	3	3	36	<ul style="list-style-type: none"> • Pump boreholes at recommended sustainable abstraction rate, to maximum allowable drawdown. • Allow ground water level to recover to 90 % of pre-test ground water level if maximum drawdown was surpassed. • Monitor daily abstraction volumes • Monitoring of water level to determine when maximum allowable drawdown has been achieved. • Monthly manual groundwater level measurements for long-term trend analysis 	0.4	14.4
	Drawdown of receptor boreholes	2	4	3	2	2	22	<ul style="list-style-type: none"> • Pump boreholes at recommended sustainable abstraction rate, to the maximum allowable drawdown depth. • Allow ground water level to recover to 90 % of the static ground water level if maximum drawdown was surpassed. • Monitor daily abstraction volumes • Monitoring of water level to determine when maximum allowable drawdown has been achieved. • Monthly manual groundwater level measurements for long-term trend analysis 	0.4	8.8

Risk	Impact	Extent	Duration	Intensity	Probability	Weighting factor (WF)	Significance rating without mitigation	Mitigation Measure	Mitigation efficiency (ME)	Significance following mitigation (SFM)
Impact on identified receptor	Intercept interflow that sustains hillslope seep wetland	2	4	3	2	3	36	<ul style="list-style-type: none"> Borehole is situated outside of a 30-metre width buffer zone and aligns with Mpumalanga Tourism and Parks Agency (2006). 	0.4	14.4

10 MONITORING

A monitoring network should be developed to the guidelines documented in the best practice guideline G3 Water Monitoring Systems (DWS, 2007). The guidelines stipulated the steps that are required for an appropriate monitoring programme such as:

- Defining Location of Monitoring Points
- Defining the Parameters that need to be Monitored
- Defining the Frequency of Measurement
- Defining Data/Information Reporting Requirements

The following is recommended in terms of monitoring:

- The monitoring of daily abstraction volumes from the proposed abstraction borehole (preferably with automated flow meters).
- Monthly groundwater level measurements should be documented and stored in an electronic database.
- Installation of a float switch/level logger to automatically switch off pump when drawdown reaches critical water level (30 mbgl)
- The licensee must keep records of the volume of water taken and water level measurements and a copy must be submitted to the competent authority on a quarterly basis
- It is recommended to do a bi-annual analysis at an accredited laboratory for parameters pH, Electrical Conductivity, total dissolved solids, major anions and cations (Ca, Mg, Na, NO₃, Cl, F, SO₄, PO₄) Si, COD, Total Petroleum Hydrocarbons, Benzene, Toluene, Ethylbenzene and Xylene.

11 CONCLUSIONS

NOA8 (Pty) Ltd was commissioned by M2 Environmental Connections to undertake a groundwater assessment in fulfilment of a water use license application (WULA) for the abstraction of groundwater from an existing borehole at the proposed service station. The borehole is located on the Remaining Extent of Portion 8 of the farm De Kroon 363-JT.

The proposed abstraction borehole (REB 228) was subject to a six-hour extended step test and FC Program for aquifer test analysis to determine the long-term sustainable abstraction rate. The recommended sustainable yield was calculated to be 70 m³ in a 16-hr pumping cycle, which equates to 25 638 m³/a (assuming a 365-day pumping schedule).

The main risk associated with the proposed abstraction is the over exploitation of the borehole, which could lead to the lowering of the local groundwater table, and continuous fracture dewatering which will inevitably cause the borehole to dry up. With the appropriate mitigation measures, such as pumping the borehole at the recommended sustainable rate, allowing sufficient recovery time, and regular monitoring of the ground water level, the risk is reduced to low.

The risk associated with the over-abstraction which could impact receptors is considered low, since the only identified borehole is located approximately 800 metres of the proposed abstraction borehole. The borehole is also located 70 metres from a hillslope seep wetland, well outside of the assigned 30-meter buffer zone. It is however still recommended that strict adherence to the mitigation and monitoring measures are followed.

The proposed mitigation measures to minimise the risks are:

- That the boreholes should be pumped at a maximum recommended rate of 1.2 L/s in a 16-hour cycle (25 550 m³/annum).
- To protect borehole failure and dewatering, water levels should not reach a maximum allowable drawdown of 30 meters.

- It is recommended to install a level logger to measure the groundwater level during abstraction to automatically switch off the pump when the groundwater levels reach the critical water level.
- Once the maximum allowable drawdown has been achieved, the pumps should be switched off and allowed to recover to 90 % of the pre-test ground water level.
- Daily monitoring of abstraction volumes (preferably with automated flow meters)
- Monthly capturing of groundwater levels in an electronic database, for long-term trend analysis)
- It is recommended to do a comprehensive bi-annual analysis at an accredited laboratory for parameters pH, Electrical Conductivity, total dissolved solids, major anions and cations (Ca, Mg, Na, NO₃, Cl, SO₄,) as well as Total Petroleum Hydrocarbons, Benzene, Toluene, Ethylbenzene and Xylene.

12 ASSUMPTIONS AND LIMITATIONS

The pump test analysis was done using the Theis method which is based on the following assumptions:

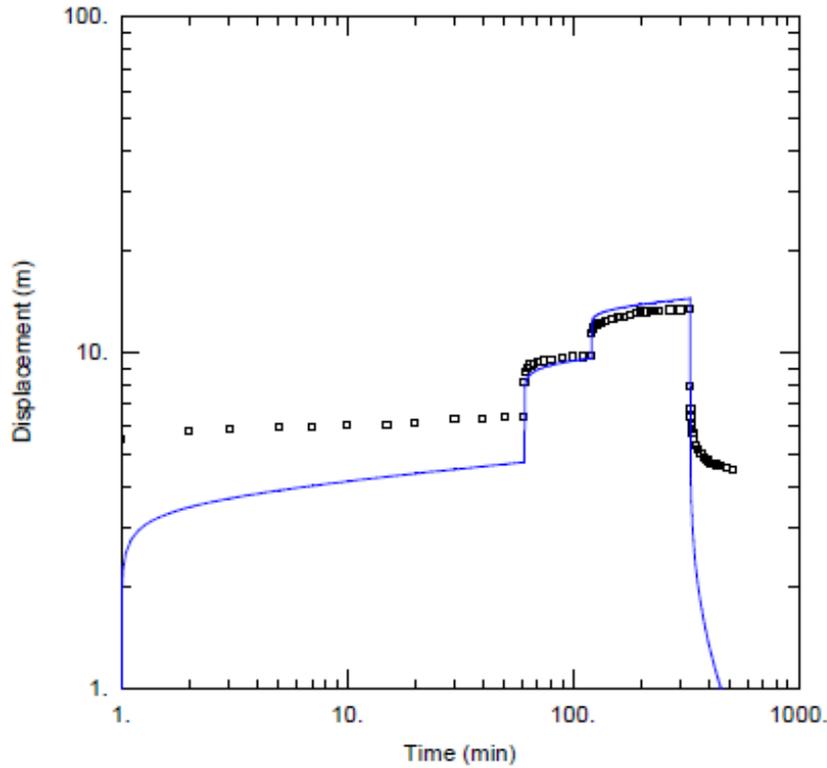
- The pumped well is fully penetrated
- The aquifer is confined
- The aquifer is homogenous
- The aquifer is isotropic

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APPENDIX A AQTESOLV ANALYSIS





<u>WELL TEST ANALYSIS</u>					
Data Set:			Time: <u>10:49:01</u>		
Date: <u>06/19/25</u>					
<u>PROJECT INFORMATION</u>					
Company: <u>NOA8</u>					
Client: <u>Menco</u>					
Test Well: <u>REG 228</u>					
Test Date: <u>2025/06/18</u>					
<u>AQUIFER DATA</u>					
Saturated Thickness: <u>45</u> m			Anisotropy Ratio (Kz/Kr): <u>1</u>		
<u>WELL DATA</u>					
Pumping Wells			Observation Wells		
Well Name	X (m)	Y (m)	Well Name	X (m)	Y (m)
REG 228	0	0	REG 228	0	0
<u>SOLUTION</u>					
Aquifer Model: <u>Confined</u>			Solution Method: <u>Theis (Step Test)</u>		
T = <u>33.81</u> m ² /day			S = <u>8.446E-5</u>		
Sw = <u>0</u>			C = <u>0</u> min ² /m ⁵		
P = <u>2</u>					
Step Test Model: <u>Jacob-Rorabaugh</u>			s(t) = <u>0.Q + 0.Q²</u>		
Time (t) = <u>1</u> min Rate (Q) in <u>cu. m/min</u>			W.E. = <u>0</u> % (Q from last step)		

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APPENDIX B

LAB CERTIFICATES





TEST REPORT
58518A

Client and Project Information

Client: NOA8 (Pty) Ltd
Address: Oberon Avenue
Gauteng
0081

Attention: Lauren van der Linde
Tel: (082) 821-3147
Email: Lauren@noa8.co.za

Project number: WLW_145
Project name: Milly's

Sample Information

Sample ID: MBH01
Units: mg/l [ppm] (unless stated elsewhere)

Matrix: Water
Container: Plastic

Date Received: 2025/06/08
Date Analysed: 2025/06/09
Date Issued: 2025/06/12

Cations and Metals

Ca	17.31	Mg	10.45
Cu	0.02	Mn	<0.05
Fe	<0.05	Na	9.87
K	0.58	Zn	<0.05

Anions (Discrete Analyser)

Cl	4.60	NO3 as N	<0.5	SO4	<2
F	0.28	PO4 as P	<0.2		

Other Parameters

pH	7.80	P-Alk as CaCO3	<0.6	E.coli (colonies/100ml)*	30
EC (µs/cm)	228	M-Alk as CaCO3	90.00	Total Coliforms (colonies/100ml)*	190
TDS	141	NH3 as N*	<0.02	Total Plate Count (colonies/ml)*	17

Disclaimers

- The results only relate to the test items provided, in the condition as received.
- This report may not be reproduced, except in full, without the prior written approval of the laboratory.
- Parameters marked "*" are not included in the SANAS Schedule of Accreditation for this laboratory.
- A = Concentration outside calibration range, ** = Outsourced analysis, UTD = Unable to Determine, RTF = Results To Follow, NR = Not Requested.
- Methods: EPL-WL-001 (Conductivity), EPL-WL-002 (Alkalinity), EPL-WL-003 (pH), EPL-WL-004 (TDS), EPL-WL-005 (Anions by IC), EPL-WL-006 (Cations by IC), EPL-WL-007 (Metals), EPL-WL-008 (Cr(VI)), EPL-WL-009 (TOC), EPL-WL-010 (Hg by DMA), EPL-WL-011 (Anions by Discrete Analyser), EPL-HPLC-001 (Formaldehyde), EPL-ML-001 (Micro).
- Uncertainty of measurement for all methods included in the SANAS Schedule of Accreditation is available on request.
- Cr(III) and Cr(VI) are assumed to be the two major oxidative states of Chromium.

Miche Kannemeyer
Authorised Signatory

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www.epl.co.za

13 Sovereign Drive Route21 Corporate Park Irene South Africa

Tel: +27 12 345 1004 info@epl.co.za





TEST REPORT
58633A

Client and Project Information

Client: NOA8 (Pty) Ltd	Attention: Mome Burger - NOA8	Project number: WL-W146
Address: Oberon Avenue Gauteng 0081	Tel: (082) 821-3147	Project name: Millys
	Email: Mome@noa8.co.za	

Sample Information

Sample ID: REB228	Matrix: Water	Date Received: 2025/08/11
Units: mg/l [ppm] (unless stated elsewhere)	Container: Plastic	Date Analysed: 2025/08/12
		Date Issued: 2025/08/20

Cations and Metals

Ca	5.10	Mg	6.14
Cu	0.02	Mn	<0.05
Fe	0.06	Na	5.37
K	0.51	Zn	0.09

Anions (Discrete Analyser)

Cl	2.28	NO3 as N	<0.5	SO4	<2
F	0.09	PO4 as P	<0.2		

Other Parameters

pH	7.24	P-Alk as CaCO3	<0.6	E.coli (colonies/100ml)*	0
EC (µs/cm)	97	M-Alk as CaCO3	40.00	Total Coliforms (colonies/100ml)*	9
TDS	72	NH3 as N*	0.28	Total Plate Count (colonies/ml)*	17

Disclaimers

- 1) The results only relate to the test items provided, in the condition as received.
- 2) This report may not be reproduced, except in full, without the prior written approval of the laboratory.
- 3) Parameters marked " + " are not included in the SANAS Schedule of Accreditation for this laboratory.
- 4) A = Concentration outside calibration range, ** = Outsourced analysis, UTD = Unable to Determine, RTF = Results To Follow, NR = Not Requested.
- 5) Methods: EPL-WL-001 (Conductivity), EPL-WL-002 (Alkalinity), EPL-WL-003 (pH), EPL-WL-004 (TDS), EPL-WL-005 (Anions by IC), EPL-WL-006 (Cations by IC), EPL-WL-007 (Metals), EPL-WL-008 (Cr(VI)), EPL-WL-009 (TOC), EPL-WL-010 (Hg by DMA), EPL-WL-011 (Anions by Discrete Analyser), EPL-HPLC-001 (Formaldehyde), EPL-ML-001 (Micro).
- 6) Uncertainty of measurement for all methods included in the SANAS Schedule of Accreditation is available on request.
- 7) Cr(III) and Cr(VI) are assumed to be the two major oxidative states of Chromium.

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