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Shoprite Meat Processing Plant - The Block Meat Company: Hydrogeological Assessment

Report

Version - **FINAL**

10 June 2024



The Block Meat Co.
FRESH | FROZEN | PROCESSED

GCS Project Number: 23-0528

Client Reference: The Block Meat Company Hydrogeological
Assessment



Shoprite Meat Processing Plant - The Block Meat Company: Hydrogeological Assessment


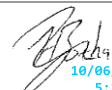
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EXECUTIVE SUMMARY

GCS was appointed by Shoprite Checkers (Pty) Ltd to conduct a hydrogeological assessment. The hydrogeological assessment will form a component of a Water Use Licence Application (WULA) for Shoprite's meat processing plant - The Block Meat Company. The project site is located at 20 Dunedin Street, Apex, Benoni, Ekurhuleni Local Municipality, in the Gauteng Province.

Based on the average monthly water consumption for June, July and August 2023, the meat processing plant has an estimated water demand of ~11 104 m³/a. There is currently one (1) borehole on site, that is equipped, and it is proposed that the water from the borehole will be used to supplement the processing plant's current water supply. Abstraction of water from the borehole will require a water use license in terms of Section 21(a) of the National Water Act, 2998 (No.36 of 1998) (NWA). The authorisation process requires that an application in the form of a Water Use License Application (WULA) be undertaken and submitted to the Department of Water and Sanitation (DWS) for approval.

This investigation comprised a desktop assessment, hydrocensus, borehole siting, hydrogeological exploration drilling and aquifer hydraulic testing to form part of a specialist report as input into a Water Use Licence Application.

Site Conceptualisation

The Block Meat Company property is situated along the eastern boundary of quaternary catchment C21D within the Upper Vaal Water Management Area at an altitude of between 1656 and 1655 mamsl.

The Block Meat Company property is underlain by low to moderate-yielding intergranular and fractured aquifer hosted within weathered and fractured Ecca Group sedimentary rocks.

The regional groundwater flow, assuming hydraulic connectivity across the aquifer system/s, is in an easterly direction, a subdued reflection of the surface topography, with groundwater levels ranging from 3.6 to 18.28 (average 12.54) mbgl. However, on a local scale, the flow is likely to be significantly more complex due to geological and structural controls resulting in potential groundwater barriers and discrete conduits to flow. Such as BH2 having a static water level of 120 mbgl which is likely due to semi-confined conditions caused by the Quartzite layer overlying the sedimentary aquifer.

The Turbidity and Manganese are the only constituents in the water pumped from BH2 that exceed the SANS241:2015 water standards for domestic use. Manganese is naturally abundant in rocks, soil and groundwater. The elevated manganese concentration in BH2 is potentially sourced from the sedimentary host rock and is therefore naturally occurring. Manganese supports the growth of certain nuisance organisms in water distribution systems, giving rise to taste, odour and turbidity problems.

Turbidity in water is caused by the presence of suspended matter which usually consists of a mixture of inorganic matter, such as clay and soil particles, and organic matter. The elevated turbidity in the water pumped from BH2 is most likely associated with the elevated manganese concentration as well as suspended soil particles.

The aquifer test results showed that BH2 has a transmissivity value of 2.35 m²/d and a hydraulic conductivity of 0.05 m/d, indicating a relatively low to intermediate-yielding aquifer system.

Borehole-Specific Sustainable Abstraction Rate

Borehole-specific sustainable abstraction rate was calculated for BH2 as 1.11 l/s for a 24-hour daily pumping schedule, and 1.56 l/s for a 16-hour daily pumping schedule.

BH2 can therefore be pumped at a rate of 1.16 l/s for 8 hours per day and sufficiently recover for sustainable abstraction. This will result in a yield of 33 408 l/d and 12 193.92 m³/a which is sufficient to satisfy the meat processing plant's estimated water demand of ~30 422 l/d and ~11 104 m³/a.

Groundwater Reserve Determination:

With no significant geological and/or hydrogeological boundaries within quaternary catchment C21D, the groundwater reserve determination was based on a delineated sub-catchment area of ~ 17.91 km² with an estimated groundwater recharge of 343 743.50 m³/a and an existing abstraction volume of 40 387.25 m³/a, resulting in a groundwater resource water availability of 68 438.09 m³/a.

This results in a surplus volume of ~ 56 244.17 m³/a available water when the Block Meat Company's proposed annual water abstraction of 12 193.92 m³ is considered.

The groundwater unit/s is considered to be at moderate levels of stress (Category C, 0.2 - 0.5 stress index) with Medium-scale abstraction (Category B, ~84% of recharge).

Based on the above, it is evident that groundwater can be abstracted as a viable source to meet the meat processing plant's proposed water demand requirements.

Hydrogeological Risk and Impact Assessment:

- In the SCM, there are 2 aquifer systems: A regional upper weathered aquifer and a deeper confined fractured aquifer.
 - The weathered aquifer has a low yield potential, and the solid rock is not fissured to an extent to promote water movement.

- The production borehole (BH2) on site draws from the deeper fractured aquifer (>150 mbgl), with a static water level recorded at 120 mbgl and a yield of 1.16 l/s

Due to the depth of the aquifer zone (>150 mbgl) the potential for pollution is low, except if poor quality runoff directly into or along the borehole casing takes place (i.e. from the site down via the weathered zone to the water table). Recharge in the confined zone will be subjected to transboundary inflows as well as recharge via the vadose and weathered zones. The extent of the fractured aquifer is however uncertain.

During the field hydrocensus, no groundwater users could be identified within a 2.5 km radius of BH2. The risk of having a potential impact on surrounding groundwater users is therefore also considered low to insignificant.

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LIST OF ACRONYMS

BF	Baseflow
BH	Borehole
BHN	Basic Human Needs
d	Day
DMEA	Department of Mineral and Environmental Affairs
DTM	Digital Terrain Model
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry
E	East
G3	Best Practice Guidelines: Monitoring
G4	Best Practice Guidelines: Impact Prediction
GCS	GCS Water and Environment (Pty) Ltd
GPS	Global Positioning System
GRAII	Groundwater Resource Assessment Ver. 2
GRDM	Groundwater Resource Directed Measures
GRIP	Groundwater Resource Information Project
GW	Groundwater
IGRD	Intermediate Groundwater Reserve Determination
IWULA	Integrated Water Use License Application
K	Potassium
km	Kilometre
K-value	hydraulic conductivity
l	Litres
m	Metres
MAE	Mean Annual Evaporation
Mag	Magnetometer
mamsl	metres above mean sea level
MAP	Mean Annual Precipitation
mbgl	metres below ground level
nT	magnetic intensity
NWA	National Water Act, 1998
Re	Recharge
Rem	Remainder
SPR	Source-Pathway-Receptor Model/Principle
SRTM	Shuttle Radar Topography Mission
T	Transmissivity
W	West
WL	Water level

1 INTRODUCTION

GCS was appointed by Shoprite Checkers (Pty) Ltd to conduct a hydrogeological assessment. The hydrogeological assessment will form a component of a Water Use Licence Application (WULA) for Shoprite's meat processing plant - The Block Meat Company. The project site is located at 20 Dunedin Street, Apex, Benoni, Ekurhuleni Local Municipality, in the Gauteng Province.

Two (2) boreholes have been drilled on site, BH1 and BH2. BH1 is dry and BH2 is equipped. It is proposed that the water from BH2 will be used to supplement the processing plant's current water supply. Abstraction of water from the borehole will require a water use license in terms of Section 21(a) of the National Water Act, 2998 (No.36 of 1998) (NWA). The authorisation process requires that an application in the form of a Water Use License Application (WULA) be undertaken and submitted to the Department of Water and Sanitation (DWS) for approval.

This investigation comprised a desktop assessment, hydrocensus, borehole siting, hydrogeological exploration drilling and aquifer hydraulic testing to form part of a specialist report as input into a Water Use Licence Application.

1.1 Project background

Based on the average monthly water consumption for June, July and August 2023, the meat processing plant has an estimated water demand of ~11 104 m³/a. A borehole was drilled for water supply, and it is proposed that the water from the borehole will be used to supplement the processing plant's current water supply.

It is understood that the hydrogeological assessment is required as part of the Water Use Licence Application (WULA) process for Shoprite's meat processing plant. This hydrogeological assessment report will therefor supplement the WULA associated with the site.

1.2 Study relevance to the season in which it was undertaken

This study was undertaken as a once-off study and relies on historical hydrogeological and climate data for the site, as well as recognized geological and water resource databases for South Africa. Data generated during the time of this study is not seasonally bound as average yearly data was applied where required and as scientifically acceptable.

1.3 Objectives of this geohydrological study

The hydrogeological study aimed to achieve the following objectives:

- Understand and characterize the geohydrological setting, to set a basis for evaluating potential impacts relating to the proposed activities.
- Produce a comprehensive geohydrological report which can be used for decision-making purposes, and input into the Water Use Licence (WUL) process.

1.4 The layout of this report

The report has been structured, as far as possible, as per *Annexure D of the Government Gazette (GN267 of 24 March 2017)* applicable to hydrogeological studies for water use license applications.

1.5 Gaps and study limitations

The following gaps and study limitations are recognized and not reported on:

- No numerical groundwater flow and transport model was construed for the development. GCS believes that groundwater impacts associated with the proposed activities were sufficiently evaluated via conceptual and analytical models. A numerical model will not add value to the investigation.

2 GEOGRAPHICAL SETTING

2.1 Location

Shoprite Checkers (Pty) Ltd.'s meat processing plant, The Block Meat Company, is located in Benoni in the Ekurhuleni Local Municipality, Gauteng Province (Figure 3.1). The project site is bordered to the north by a residential area, to the east and west by an industrial area and to the west by the R23 provincial road.

2.2 Topography and drainage

The site is located along the eastern boundary of quaternary catchment C21D within the Upper Vaal Water Management Area. The surface topography indicates slightly undulating plains which drain towards the east. The regional surface elevation ranges from 1 760 meters above mean sea level (mamsl) in the west to 1 561 mamsl in the east, while locally it ranges from 1656 and 1655 mamsl. Surface drainage from the site is towards the Blesbokspruit in the east, which drains south until it joins with the Suikerbosrand River, a tributary of the Vaal River.

2.3 Climate

The Köppen Climate classification suggests the project site is situated in an oceanic subtropical highland climate (Cwb) area that receives rainfall in the summer months (December until March). The site falls within rainfall area C2A, which has a mean annual precipitation (MAP) of 697.98 mm/a. Precipitation is the lowest in July with an average of 2 mm, with the highest rainfall occurring during the summer months peaking at 142 mm during December. At a mean daily maximum temperature of 27 °C, November, December, January and February are the hottest months of the year. June and July are the coldest months of the year with a mean daily maximum temperature of 18 °C. The Mean Annual Evaporation (MAE) is in the order of 1 625 mm/annum (S-Pan) for the catchment. Temperature and rainfall distribution for the area is shown in Figure 2.1.

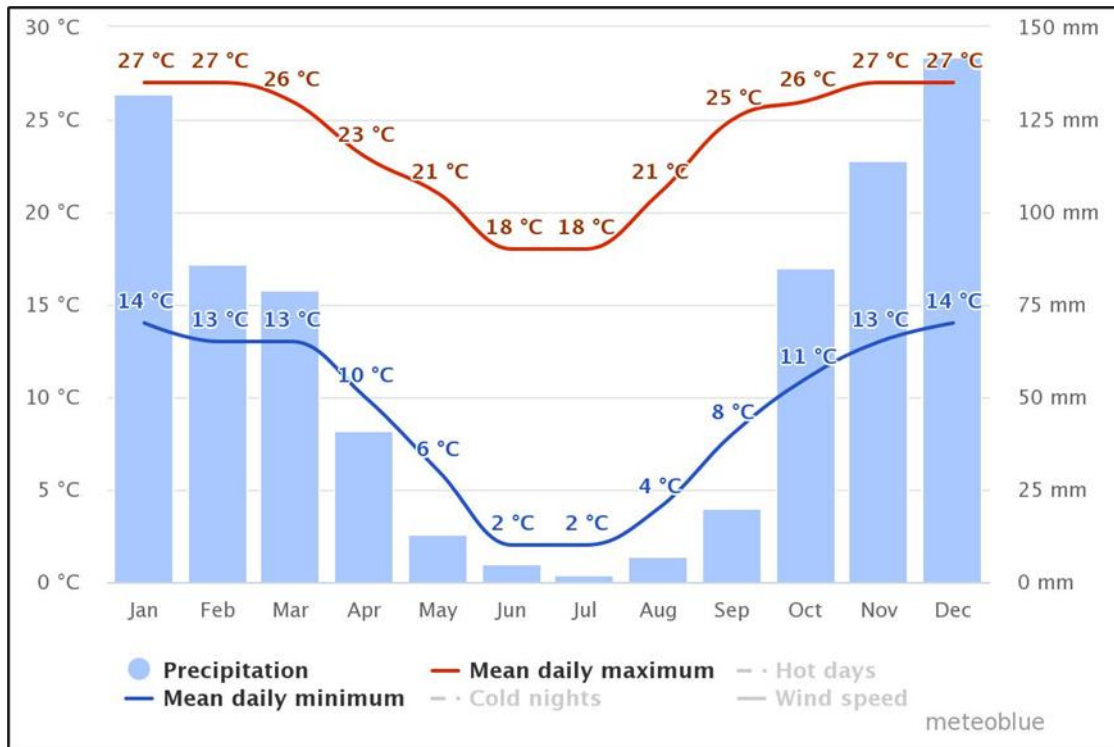


Figure 2.1: Rainfall and temperatures (Meteoblue, 2024).

3 SCOPE OF WORK

The scope of work included:

1. Desktop assessment:

- All available reports relating to the site were assessed, including a review of all hydrogeology, hydrology, hydrochemistry, and geology literature data.
- A desktop-level hydrocensus was conducted. The National Groundwater Archive (NGA, 2023), Groundwater Resource Information Project (GRIP, 2016) and the Southern African Development Community Groundwater Information Portal (SADEC GIP) databases were assessed to identify existing groundwater users in the area.

2. Field investigation:

- A groundwater hydrocensus was conducted within a 2.5 km radius of the project site.
- A geophysical survey with the use of the Electro-Magnetic (EM) and Electrical Resistivity Tomography (ERT) methods was conducted on-site.
- Two (2) boreholes were drilled (BH1 and BH2). BH1 is dry and BH2 has water.
- One (1) borehole (BH2) was subjected to a series of aquifer hydraulic tests.
- Groundwater quality data for BH2 was provided by the client.

3. Groundwater Reserve Determination:

- A desktop-level groundwater reserve determination was conducted based on the Intermediate reserve determination published by the DWS (2020).

4. Hydrogeological risk and impact assessment:

- A preliminary risk assessment was conducted based on the source-pathway-receptor principle.

5. Monitoring plan:

- A groundwater monitoring plan, with mitigation measures, was developed for the site based on the baseline assessment of the site conditions.

6. Reporting:

- This hydrogeological report encompassing all work done as well as a groundwater risk assessment and monitoring plan was compiled.

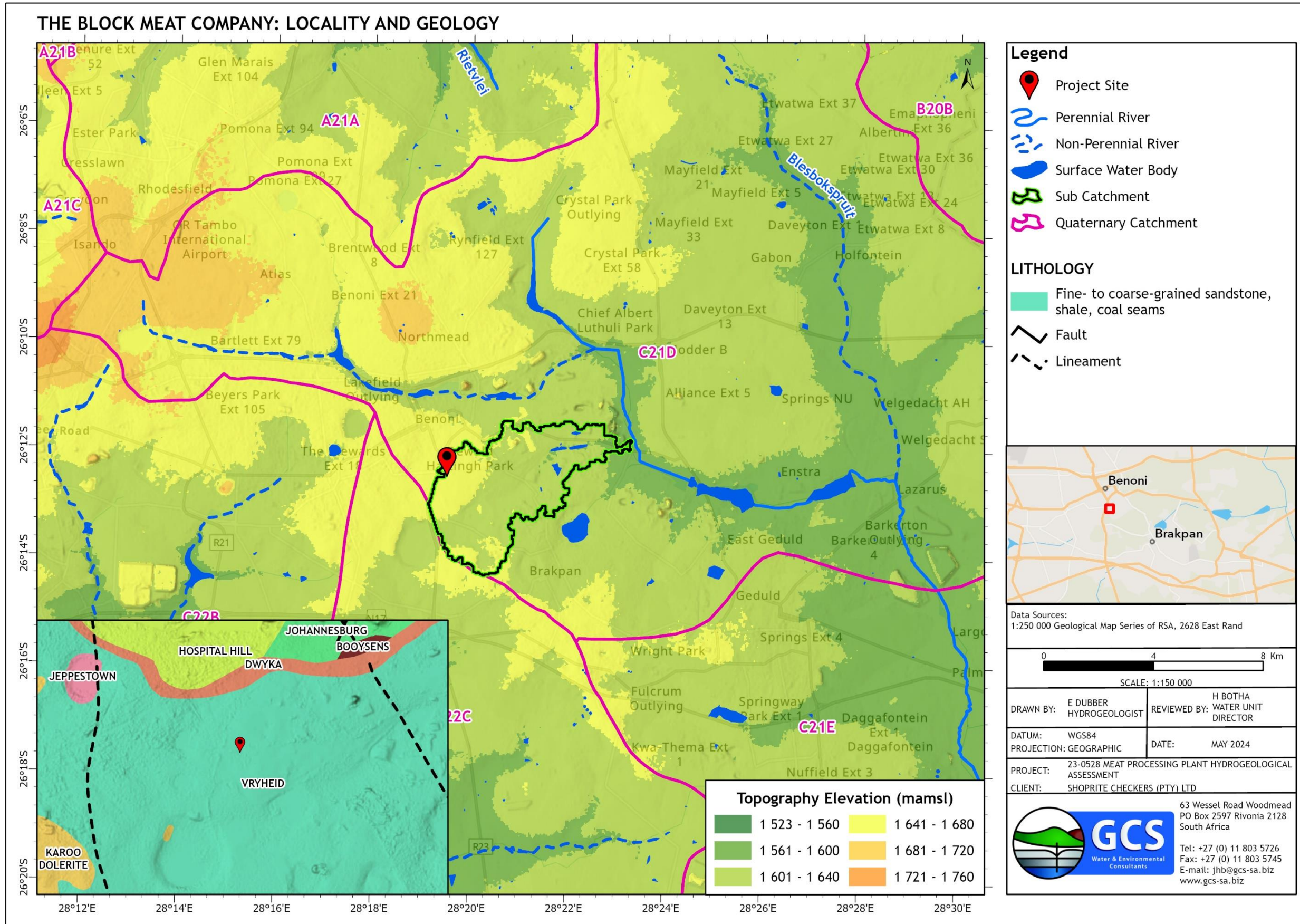
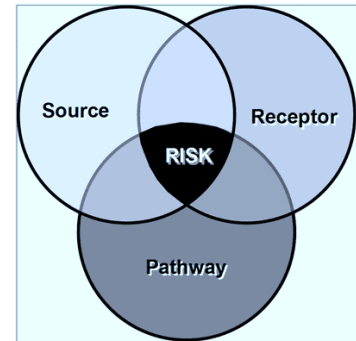


Figure 3.1: Regional setting & local geology.

4 METHODOLOGY

A logical and holistic approach was adopted to assess the study area. The Best Practice Guidelines for Impact Prediction (G4) (Department of Water Affairs and Forestry [DWA], 2008), were considered to define and understand the three basic components of the geohydrological risk associated with the site activities:

- **Source term** - The source of the risk;
- **Pathway** - The pathway along which the risk propagates; and
- **Receptor** - The target that experiences the risk.



The approach was used to assess:

1. How the existing/proposed site activities could impact groundwater *Quality*; and
2. How the existing/proposed site activities could affect the groundwater *Quantity*.

4.1 Literature review and desktop study

The following sources supply an overview of the geohydrological conditions of the project area, as per the desktop information reviewed for this assessment:

- National Groundwater Database Archives (NGA, 2024) borehole data.
- 2526 Johannesburg - 1:500 000 Hydrogeological map series (Barnard, H.C., 2000)
- 2628 East Rand- 1:250 000 Geological map series
- Literature on similar geology and hydrogeology:
 - A South African Aquifer System Management Classification (Parsons, 1995);
 - Aquifer Classification of South Africa (DWA, 2012);
- GCS internal database and reports for the Gauteng area (refer to reference list).
- Site-specific field-gathered data.

4.2 Desktop hydrocensus

According to NGA data for the area, there is only one (1) borehole situated within a 2.5 km radius of the site. The spatial distribution of the borehole identified is shown in Figure 4.1. The borehole is situated in a different drainage area and the data suggest no other groundwater users within the sub-catchment associated with the site.

Table 4-1 Groundwater users within a 2.5 km radius of the site

Borehole ID	Latitude	Longitude	Farm Name	Water Level (mbgl)
2628AB00041	-26.19027	28.30805	MORESHOFF SCHOOL	18.28

4.3 Field investigation

The field investigation took place on the 4th of August 2023. The following summarises the findings and work completed:

- Geophysical traverses with the use of the Electro-Magnetic (EM) and Electrical Resistivity Tomography (ERT) methods were completed to locate potential groundwater flow paths and site potential drilling target areas.
- A field hydrocensus was conducted within a 2.5 km radius of the proposed development.
 - No groundwater users were identified in the surrounding area, and it appears as though residents surrounding the project site get water from the local municipality.
- A 24-hour constant rate pump test was performed on BH2 with the pump that is already installed, to determine the sustainable yield as well as the likely impact on the groundwater aquifer.

4.3.1 Hydrocensus / groundwater users in the area

A field hydrocensus was conducted within 2.5 km of the project site and no boreholes were located on-site. This is because most households and industries around this area are dependent on municipal water supply sources. A further review of the NGA database indicated that ten (10) registered boreholes are situated within a 5 km radius of the project site of which six (6) are located within quaternary catchment C21D. Table 4-2 lists the boreholes identified with water level and their location is shown in Figure 4.1.

Table 4-2 Boreholes within a 5km radius of the project site

Borehole ID	Latitude	Longitude	Farm Name	Water Level (mbgl)	Quaternary Catchment
2628AB00038	-26.19027	28.30803	BENONI	-	C21D
2628AB00040	-26.19028	28.30803	BENONI	-	C21D
2628AB00041	-26.19027	28.30805	MORESHOFF SCHOOL	18.28	C21D
2628AB00480	-26.18138	28.36108	NEW MODDER.PTN BENONI	-	C21D
2628AB00484	-26.19499	28.32914	VAN RYN LANDBOUHOEWES.PTN BENONI	-	C21D
2628AB00039	-26.19027	28.30804	BENONI	18.28	C21D
2628AB00094	-26.21027	28.28581	BOKSBURG PTN. DUNSWART WASERY	3.6	C22B
2628AB00442	-26.22757	28.28311	BOKSBURG	10	C22B
2628AB00439	-26.2286	28.29997	WATTVILLE PTN. ETHOMELENG	-	C22C
2628AB00440	-26.22138	28.29942	WATTVILLE PTN. BOPANANG	-	C22C

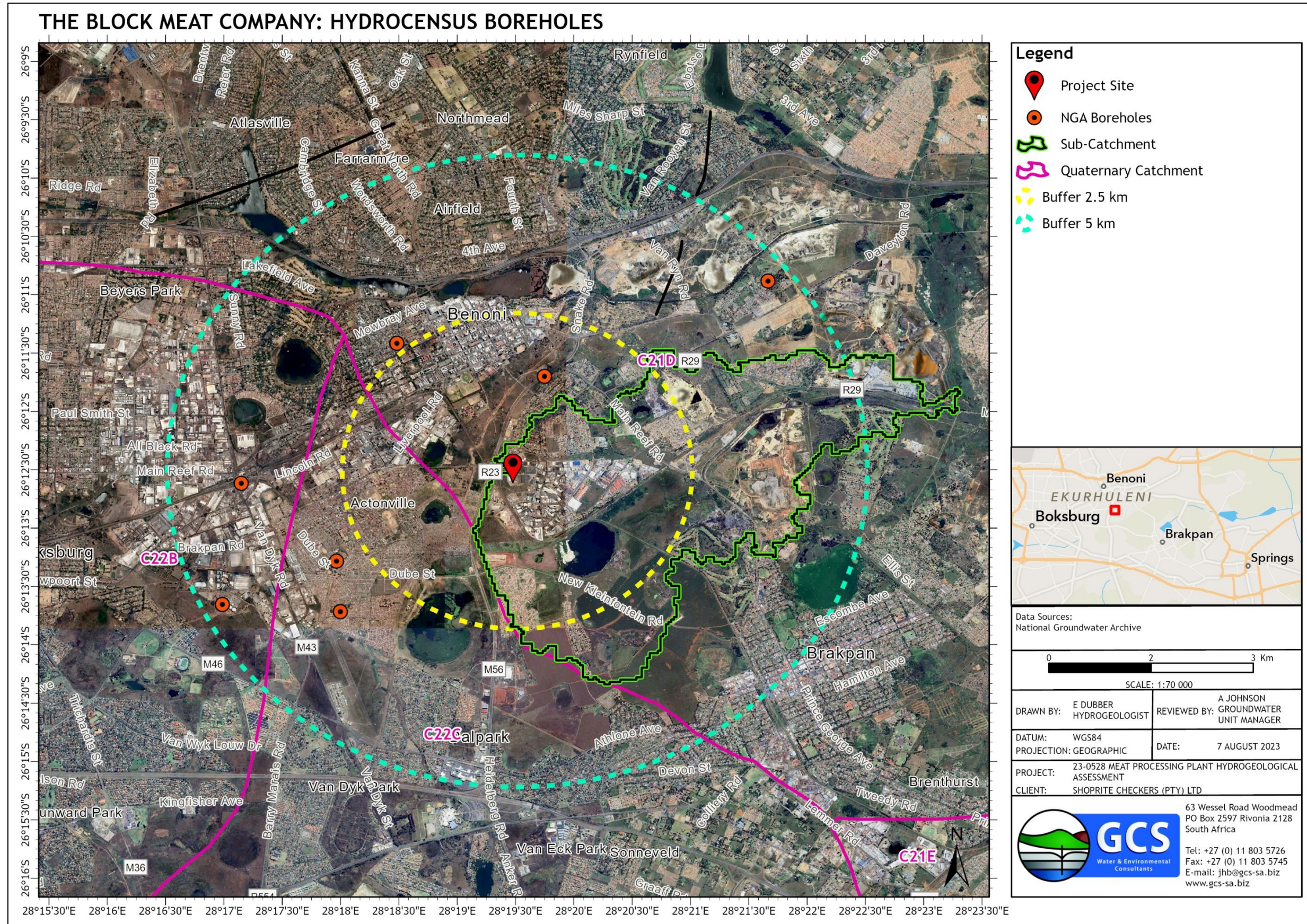


Figure 4.1: Desktop hydrocensus boreholes situated within a 5 km radius of the project site.

4.3.2 Geophysical assessment findings

Surface geophysical methods were utilised to identify potential groundwater flow paths and site potential drilling targets at the project site. Geophysical traverses were completed with the use of the Electro-Magnetic (EM) and Electrical Resistivity Tomography (ERT) methods.

The result of the ERT survey is a 2D collection of the raw resistivity measurements at different depths along a given survey line. The inversion (using the RES2Dinv inversion algorithm by Geotomo) of this 2D survey data results in a 2D resistivity inversion model along the surveyed line which is then interpreted in terms of the subsurface properties as per the requirements and/or objectives of the survey. The 2D resistivity inversion model and EM survey results along the planned traverses are shown in Figure 4.2.

- Two (2) EM survey lines were traversed. The spatial orientation of the survey and resulting profile lines are indicated in Figure 4.2. The EM results show low conductivity readings between 0 and 20 mS/m in the upper 20 m of the site. The anomalies at the start of EM line 1 and the end of EM line 2 are due to noise.
- One (1) ERT survey line was completed with 2.5 m electrode spacing. The traverse is 100 m long, starting in the northwest at 28°19'27" E; 26°12'36" S and ending in the southeast at 28°19'31" E; 26°12'37" S. The inversion model of the subsurface apparent resistivity data collected along the survey traverse is presented in Figure 4.2, while the summary for the recommended groundwater exploration borehole (and supplementary information) is presented in Table 4-3.
 - The inversion resistivity model for data obtained from the traverse surveyed indicates two principal resistivity ranges, the first being $\leq 518 \Omega\text{m}$ and the second being $\geq 1\ 157 \Omega\text{m}$.
 - The areas of the model characterised by high resistivity distributions are interpreted as being unsaturated (dry) / competent formation of the site under investigation.
 - The offset from the high resistivity distributions to low resistivity distributions is interpreted as a result of an integral discontinuity (plane of physical weakness-due to physical or chemical processes). In hydrogeology, deep weathering is a target for the placement of groundwater production boreholes.
 - The resistivity distribution offset is relatively shallow (<10 m) and at depths greater than ~15 m along the surveyed line.

One (1) prospective drilling target was identified for the hydrogeological drilling program, based on the interpreted surface geophysical survey data obtained from the Electrical Resistivity Tomography (ERT) and Electro-Magnetic (EM) geophysical techniques. Table 4-3 provides a summary of the proposed drilling target, while Figure 4.2 provides a visual depiction of the drilling target along the traverse.

The drilling target was identified based on the observed low/intermediate resistivity zones obtained from the survey. These zones are potential weathered areas associated with fracturing and are potential areas of preferential groundwater flow paths.

Table 4-3 Proposed drilling target

Traverse #	Priority List	Coordinates		Target/Motivation	Proposed Depth (m)
		Latitude	Longitude		
ERT 1	Primary	-26.210133	28.324604	Zone of low resistivity at depth	60

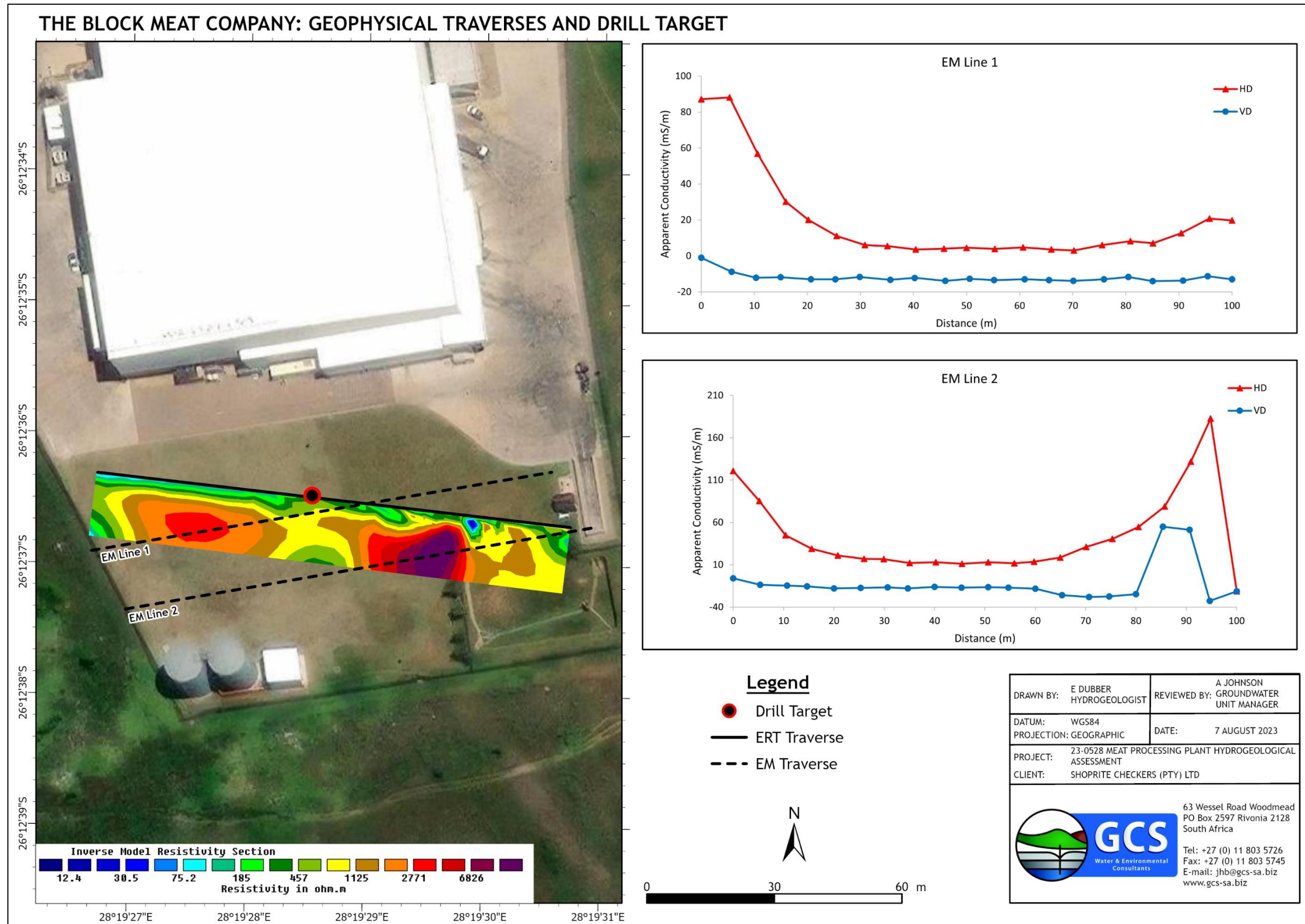


Figure 4.2: Locality and orientation of ERT and EM traverses surveyed.

4.3.3 Drilling

GASS was commissioned by GCS as the drilling contractor for the project. GCS provided on-site drilling supervision and contractor management, including hydrogeological/geological logging and coordination of program logistics.

One (1) hydrogeological exploration borehole (BH1) was drilled at 26° 12'36.57"S, 28° 19'28.44"E (refer to Figure 4.3), up to a depth of 100 m. The hydrogeological drilling and borehole construction log for BH1 is provided in **Appendix A** and summarised in Table 4-4 below.

- BH1 was drilled using a 254 mm nominal diameter drill bit from the surface to 18 mbgl and then cased with 177 mm solid steel casing (0 - 9 mbgl) and slotted steel casing (9 - 18 mbgl). After installing the casing, BH was advanced with a 165 mm nominal diameter drill bit from 18 to 100 mbgl.
- The encountered lithologies consisted of unconsolidated alluvium from 0 to 1 mbgl, and fresh solid Quartzite from 1 to 100 mbgl.
- No significant water strikes were encountered.
- A static water level of 66.55 mbgl was measured one (1) week after drilling and is interpreted as seepage water.

Table 4-4 Hydrogeological exploration drilling summary

Description			BH1	
Decision Record			Primary Target	
Status & Date Information	Status		Completed	
	Commence date		01/09/2023	
	Completion Date		04/09/2023	
Bore/Hole Type Information	Monitoring / Production Bore		Hydrogeological Exploration Borehole	
Driller/Company Information	Drilling Company		GASS	
Drilling Information	Drilling Method		Conventional Rotary Air Percussion	
	Depth Advanced		100	
	Drill Bit Size	254 mm/ (8")	From: [mbgl]	0
			To: [mbgl]	18
		165 mm/ (6.5")	From: [mbgl]	18
To: [mbgl]			100	
Hydrogeological Information	Water Strike Information	[mbgl]	-	
	Cumulative Yield Information	[l/s]	-	
Geological Information			Unconsolidated alluvium from 0 to 1 mbgl and fresh solid Quartzite from 1 to 100 mbgl.	
Spatial Survey Information	GPS/Differential GPS/LiDAR		GPS-Handheld	
	Representative/Organization		GCS	
	Coordinates	Projection		Geographic
		Datum		WGS84
		Latitude/Easting		-26.210157
		Longitude/Northing		28.324568
		Elevation*	[mamsl]	1655
<p>Note/s:</p> <ul style="list-style-type: none"> § mbgl - metres below ground level. § mm - millimetre. § " - inch. § L/s - Litres per second. § mamsl - metres above mean sea level. § N/A - not applicable. § * - elevations derived from GPS Visualiser. 				

4.3.4 Magnetotelluric (MT) Survey

Since insignificant groundwater was intersected within the hydrogeological exploration borehole and the main lithology encountered was fresh solid Quartzite and not coarse-grained sandstone and shale as suggested by regional geological (Figure 3.1) and hydrogeological (Figure 5.2) maps, a Magnetotelluric (MT) geophysical survey was conducted to identify additional potential groundwater flow zones across the area of investigation up to a depth of 100 m.

MT geophysical methods measure the electrical resistivity of subsurface materials. High electrical resistivity often indicates the presence of impermeable materials, while low resistivity suggests the presence of more conductive materials, which can be indicative of water-bearing formations. Two (2) MT survey lines were traversed. The spatial orientation of the survey lines is indicated in Figure 4.3. The inversion model of the subsurface apparent resistivity data collected at each of the surveyed stations is presented in **Appendix B**.

Traverse 1 is 100 m long and was surveyed along the same line as the ERT survey line, starting in the northwest at 28° 19'26.84"E, 26° 12'36.56"S and ending in the southeast at 28° 19'30.48"E, 26° 12'36.71"S. MT readings were taken at five (5) stations with a 20 m station interval.

Traverse 2 is 40 m long, starting in the southwest at 28° 19'28.27"E, 26° 12'37.10"S and ending in the northeast at 28° 19'28.57"E, 26° 12'36.25"S. MT readings were taken at two (2) stations with a 20 m station interval.

The results show resistivity readings greater than 1000 Ω m up to depths of 100 m at all the stations. This indicates the presence of impermeable material interpreted as competent bedrock with low to limited groundwater potential.



Figure 4.3: MT survey traverses and borehole BH1 location.

4.3.5 Aquifer testing

Following the drilling of the hydrogeological exploration borehole (BH1), The Meat Block Company drilled a hydrogeological production borehole (BH2) at 26° 12'36.64"S, 28° 19'28.38"E approximately 2 m south-west of BH1, to a depth of 164 m. According to the site representative, water was encountered at ~150 m. Figure 4.4 presents the spatial distribution of the hydrogeological production borehole (BH2) concerning the hydrogeological exploration borehole (BH1) and building site.

BH2 is equipped with a pump that yields 1.16 l/s (measured) with an installation depth of 155 m. The existing pump was used to conduct the aquifer testing. The aquifer hydraulic testing programme is summarised in Table 4-5 and Figure 4.5. Additional pump test data can be seen in **Appendix C**.

The objective of the aquifer testing programme was to estimate the sustainable yield, and in-situ aquifer hydraulic parameters, and interpret hydrogeological characteristics.

Before the commencement of the aquifer test programme, the static water level was measured in the borehole to allow drawdown calculations during the aquifer tests. A static water level of 120 mbgl was measured. All groundwater level measurements were collected from a fixed reference point (e.g., top of casing) using an "electrical contact groundwater level" meter (dip meter).

The aquifer testing programme included the following:

- **Constant-Rate Test (CRT)**- During the CRT, the groundwater level drawdown is recorded over time in the pumped borehole, and the pumping rate (yield) is kept constant by the operator. This is done by monitoring the pumping rate throughout the test and re-adjusting the pump if the observed outflow rate begins to deviate from the selected rate. The result of this test is a water-level response curve obtained under a constant rate of abstraction.
- **Recovery Test (RT)** - the RT is initiated at the cessation of the CRT where groundwater levels are allowed to recover (measured as residual drawdown) within the tested borehole. Recording of the residual drawdown is generally conducted until groundwater levels are within 90 to 100 % of pre-pumping water levels.

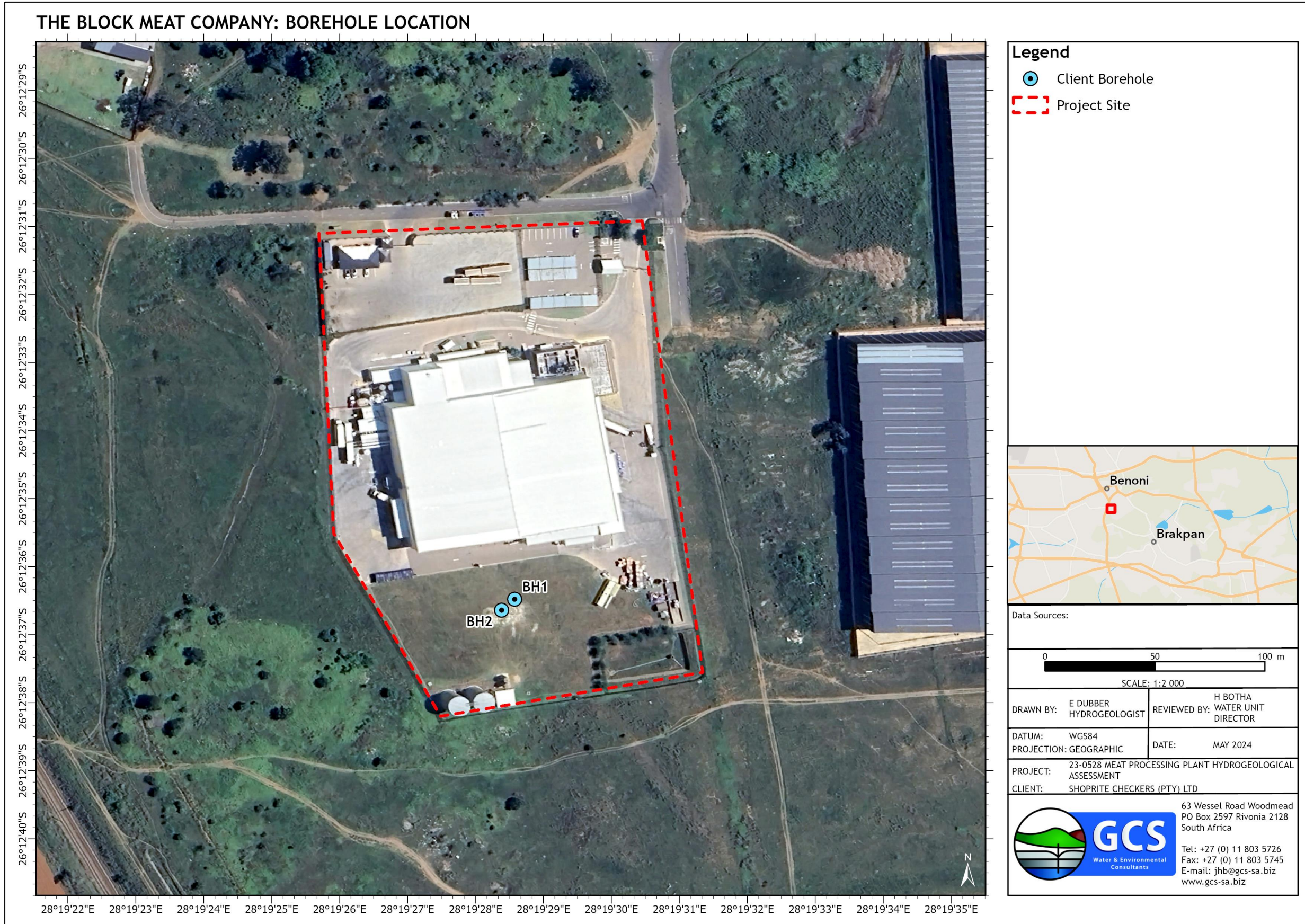


Figure 4.4: Borehole locality map.

Table 4-5 Aquifer hydraulic testing summary

Description		Borehole ID
BH2		
Aquifer Test Date Information		
Commence Date	[mm dd yyyy]	09 May 2024
Completion Date	[mm dd yyyy]	10 May 2024
Pump System and Installation Information		
Pump System		Submersible Pump
Pump Inlet Depth	[mbgl]	155
Static Water Level and Available Drawdown Information		
Static Water Level	[mbgl]	120
Available Drawdown	[m]	35
Constant-Rate Test Information		
Duration	[min]	1440
Yield	[L/s]	1.16
Drawdown Percentage	[%]	56.79
Achieved		
Recovery Information		
Duration	[min]	56
Recovery Percentage	[%]	90

4.3.5.1 Data Analysis

Interpretation of the constant-rate test and recovery monitoring data of the tested borehole was undertaken using the FC method (excel) to establish a relationship between drawdown and pumping rate and to derive preliminary aquifer parameters.

Before the commencement of the CRT, the static water level in BH2 was measured as 120 mbgl. With a pump installation depth of 155 m, 35 m of drawdown was available for the test. Figure 4.5 shows that BH2 was pumped at a constant discharge rate of 1.16 l/s for 1440 minutes (24 hours) during which a total drawdown of 19.88 m of the available 35 m drawdown was achieved at the end of the pumping period. With ~15.12 m of drawdown remaining, the data suggests BH2 can be pumped at a stronger discharge rate.

Following cessation of the 24-hour CRT test, the recovery of the water level was measured, and 90 % recovery of the pre-test static water level (120 mbgl) was reached within 56 minutes - suggesting good groundwater flow towards the borehole.

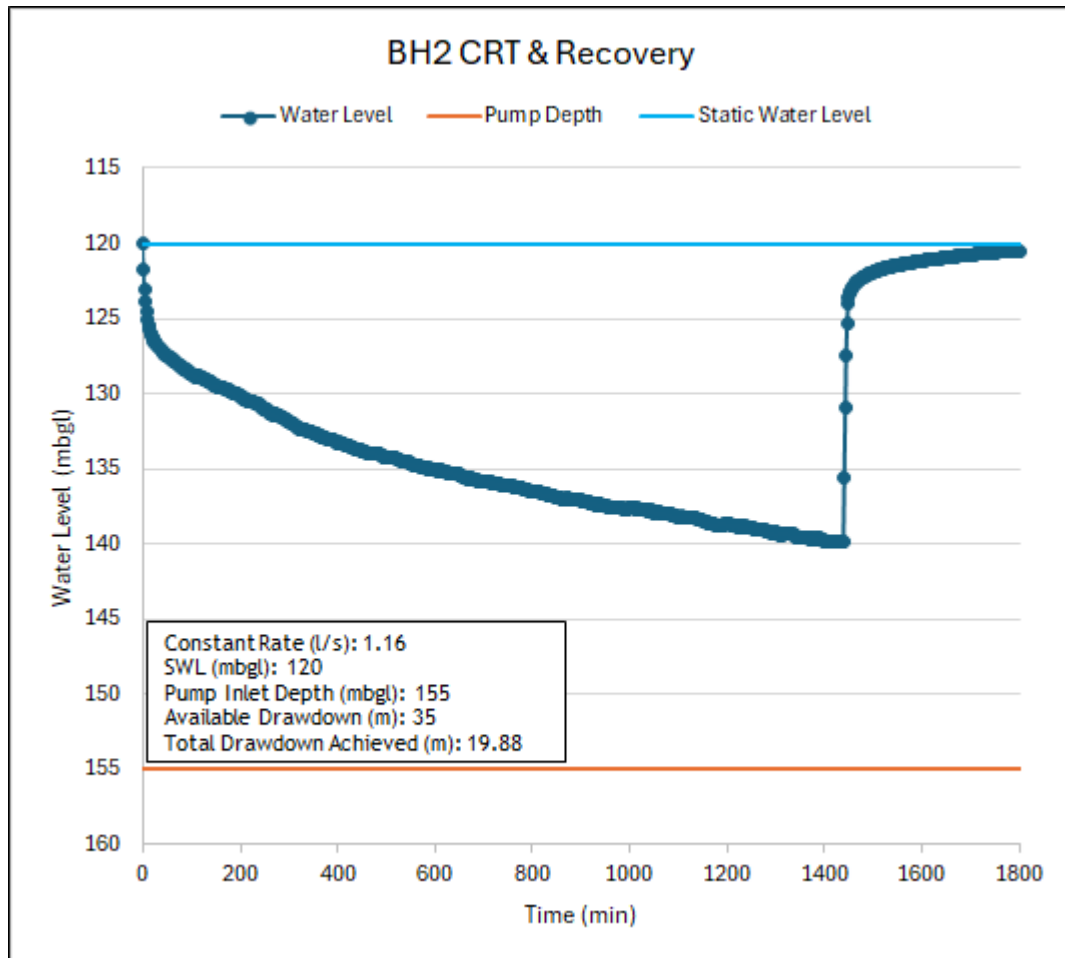


Figure 4.5: BH2 CRT and recovery summary.

4.3.5.2 Hydraulic Parameters

The aquifer parameters were estimated from the test pumping results using the Cooper-Jacob analytical solution (Cooper and Jacob, 1964). Although the applied methodology for calculating analytical parameters is based on assumptions not applicable to actual site conditions (e.g., infinite extent), the resulting hydraulic parameter from these calculations is representative of the test aquifer system within the vicinity of the test borehole. The transmissivity was calculated at 2.35 m²/d. The curve fits used to derive this value are presented in Figure 4.6 and Figure 4.7.

Additionally, transmissivity is a product of the hydraulic conductivity and saturated thickness of the aquifer; therefore, the hydraulic conductivity (K) could be determined by dividing the transmissivity by the saturated thickness (total depth of BH minus SWL). The calculated hydraulic conductivity of the aquifer is 0.05 m/d.

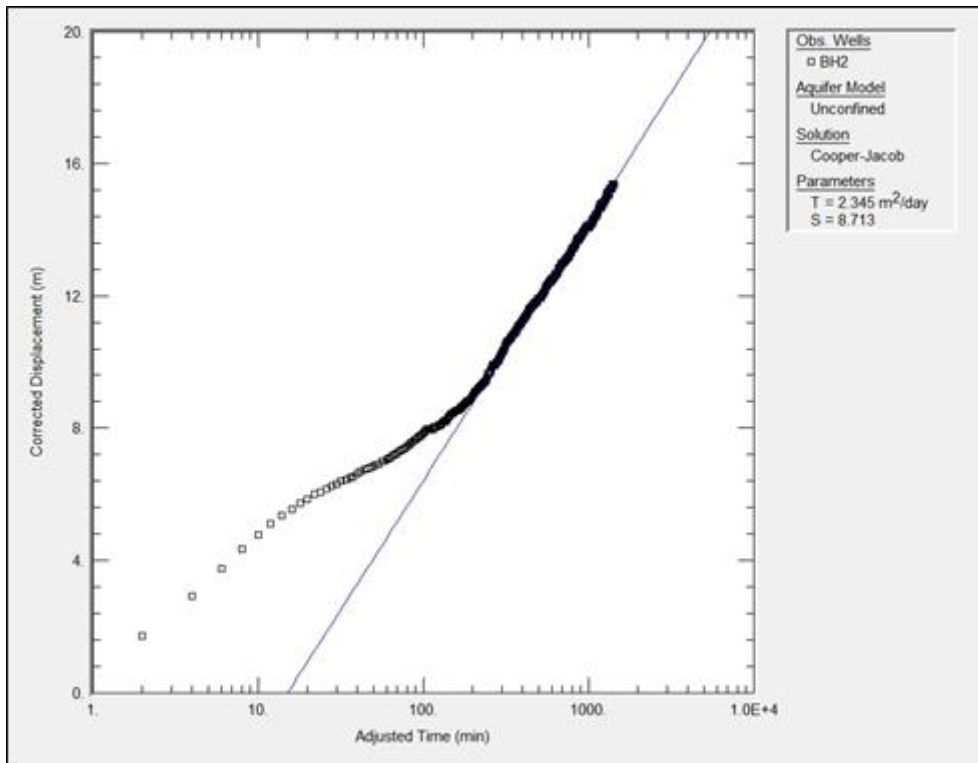


Figure 4.6: Aquifer hydraulic properties based on Cooper-Jacob unconfined aquifer analytical solution.

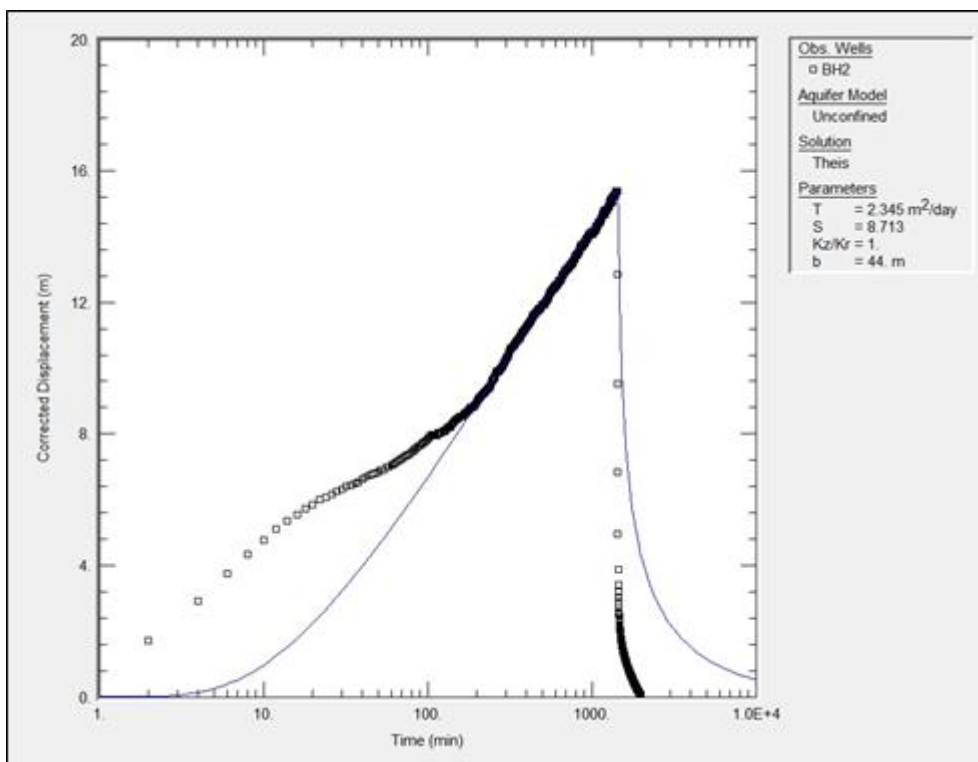


Figure 4.7: Aquifer hydraulic properties based on Theis unconfined aquifer analytical solution.

4.3.5.3 *Sustainable Abstraction Rate*

The borehole-specific sustainable abstraction rate was calculated using the Flow Characteristic (FC) Programme for Aquifer Test Analysis and the constant-rate test data was used as input.

The following criteria have been used in defining the sustainable yield:

- Sustainable yield calculations were calculated based on a twenty-four (24) hour and twelve (12) hour per day abstraction schedule.
- The groundwater level during pumping should not reach the depth of the pump inlet (e.g., ~2 m above the pump inlet depth).

The sustainable abstraction calculations contain the following limitations:

- The groundwater sustainable calculations do not consider any other abstractions in the surrounding area.
- Little information is available in terms of groundwater boundaries, including aquifer limits, low permeable barriers, and recharge flux boundaries. These boundaries will impact the medium to long-term groundwater drawdown response.
- No borehole and/or formation skin effects were considered. These skin effects could result in turbulent flow and increased drawdown.
- The estimation of the sustainable yield was determined based on the test pumping results utilising the Cooper-Jacob analytical solution, which was chosen because it accurately represents the aquifer's behaviour during the borehole testing. The Cooper-Jacob analytical solution, as proposed by Cooper and Jacob in 1964, provides valuable insights into the aquifer's performance during the testing process.

The results are summarized in Table 4-6 and indicate the calculated sustainable yield of BH2 is:

- 1.11 l/s for a 24-hour daily pumping schedule, and
- 1.56 l/s for a 16-hour daily pumping schedule.

BH2 can therefore be pumped at a rate of 1.16 l/s for 8 hours per day and sufficiently recover for sustainable abstraction. This will result in a yield of 33 408 l/d and 12 193.92 m³/a (refer to Table 4-7), which is sufficient to satisfy the meat processing plant's estimated water demand of ~30 422 l/d and ~11 104 m³/a.

Table 4-6 Calculated sustainable abstraction rate scenario summary

Description			BH2
Pump Inlet Depth		[m]	155
Sustainable Rate	24-Hour Daily Pump Schedule	[l/s]	1.11
	12-Hour Daily Pump Schedule	[l/s]	1.56

Table 4-7 Volume of water per day and per annum

8-hour pump schedule			
Borehole ID	Sustainable Yield (8-hour pump schedule - l/s)	The volume of water per day (l/day)	The volume of water per year (m ³ /annum)
BH2	1.16	33 408	12 193.92

4.4 Groundwater quantity/availability assessment

An Intermediate Groundwater Reserve Determination (IGRD) (Parsons & Wentzel, 2007) was conducted for the study area to fulfil the requirements of the Water Use License concerning groundwater use, in terms of Section 21a of the National Water Act (No. 36 of 1998) (NWA, 1998). The IGRD aims to establish the groundwater reserve thereby quantifying the safe aquifer yield. It is necessary, from a GW resource management perspective, to quantify the GW quantity and likely impact on the groundwater reserve as a result of the proposed abstraction.

The approach to quantifying groundwater is based on the water balance equation which also gives an estimate of how much GW can safely be abstracted from the aquifer for the development of additional groundwater resources.

The groundwater reserve determination takes into account the following parameters:

- Area of the sub-catchment delineated for the site;
- Effective recharge from rainfall and specific geological conditions;
- Existing abstraction
- Basic Human needs for the site;
- Groundwater contribution to surface water (baseflow); and
- Surplus, if any, is available for abstraction.

The values presented in the tables and calculations below were derived from the Department of Water and Sanitation (DWS, 2020) and the DWS' website - National Integrated Water Information System (DWS, 2024).

The IGRD considers the following parameters:

- Effective recharge from rainfall and specific geological conditions;
- Basic human needs for the sub-catchment;
- Groundwater contribution to surface water (baseflow);
- Existing and proposed abstraction; and
- Surplus reserve.

The groundwater balance and the reserve determination on a sub-catchment scale are summarised below:

- $GW_{\text{available}} = (\text{Re}) - (\text{EU} + \text{BHN} + \text{BF} + \text{PU})$

Where:

- $GW_{\text{available}}$ = Available groundwater for use.
- Re = Effective recharge to the aquifer.
- BF = Baseflow to surface water streams.
- EU = Existing groundwater abstraction/use (identified on sub-catchment, excluding applicant).
- PU = proposed use.
- BHN = Basic Human Needs.

Remaining Groundwater availability (whilst “maintaining” groundwater’s contribution to the ecological integrity of surface water, and maintaining ecological integrity in its present state)
= recharge - current use - current GWBF

The following assumptions underlie these equations:

- The aquifer has reached dynamic equilibrium in response to abstraction, where groundwater recharge is equivalent to discharge. As such, the contribution to groundwater availability from storage is not considered.
- Contribution from enhanced recharge is not accommodated (i.e. recharge is constant under abstraction).
- Abstraction is therefore met by reduced discharge (at some time). As discharge is equivalent to recharge (when at dynamic equilibrium), recharge can be used as a proxy for groundwater availability.
- The aquifer is a closed system or a fixed directional flow system.
- If the portion of discharge that is known to support surface water (GWBF) is removed from the availability equation, it is not impacted. I.e., if abstraction is at or set below recharge minus use minus GWBF, then the quantity of GWBF will not be affected.
- Abstraction occurs sufficiently distant from locations of groundwater discharge to surface water, such that abstraction can harness recharge minus use minus GWBF, before reducing GWBF. In other words, it is assumed that abstraction is sufficiently distant from surface water such that the portion of recharge discharging to surface waters, is unaffected by the abstraction.

The groundwater balance and reserve determination for the delineated sub-catchment are summarized in Table 5-5.

The following applies to the water balance conducted:

- For this reserve determination, values from the quaternary catchment C21D Groundwater Reserve were downscaled to an area of 17.91 km² related to the delineated sub-catchment.
- The Groundwater Reserve already includes the BHN and EWR (GWBF) components.

4.5 Hydrogeological risk assessment

The potential impacts and the determination of the impact significance of the proposed abstraction were assessed. The process of assessing the potential impacts of the project includes the following four activities:

1. Identification and assessment of potential impacts.
2. Prediction of the nature, magnitude, extent, and duration of potentially significant impacts.
3. Identification of mitigation measures that could be implemented to reduce the severity or significance of the impacts of the activity; and
4. Evaluation of the significance of the impact after the mitigation measures have been implemented i.e., the significance of the residual impact.

As per GNR 982 of the EIA Regulations (2014), the significance of potential impacts was assessed in terms of the following criteria:

- I. Cumulative impacts.
- II. Nature of the impact.
- III. The extent of the impact.
- IV. Probability of the impact occurring.
- V. The degree to which the impact can be reversed.
- VI. The degree to which the impact may cause irreplaceable loss of resources; and
- VII. The degree to which the impact can be mitigated.

Table 4-8 provides a summary of the criteria used to assess the significance of the potential impacts identified. An explanation of these impact criteria is provided in Table 4-9.

The net consequence is established by the following equation:

$$\text{Consequence} = (\text{Duration} + \text{Extent} + \text{Irreplaceability of resource}) \times \text{Severity}$$

The environmental significance of an impact was determined by multiplying the consequence by probability.

Table 4-8 Proposed criteria and rating scales to be used in the assessment of the potential impacts

Criteria	Rating Scales	Notes
Nature	Positive (+)	An evaluation of the effect of the impact related to the proposed development.
	Negative (-)	
Extent	Footprint (1)	The impact only affects the area in which the proposed activity will occur.
	Site (2)	The impact will affect only the development area.
	Local (3)	The impact affects the development area and adjacent properties.
	Regional (4)	The effect of the impact extends beyond municipal boundaries.
	National (5)	The effect of the impact extends beyond more than 2 regional/ provincial boundaries.
	International (6)	The effect of the impact extends beyond country borders.
Duration	Temporary (1)	The duration of the activity associated with the impact will last 0-6 months.
	Short-term (2)	The duration of the activity associated with the impact will last 6-18 months.
	Medium-term (3)	The duration of the activity associated with the impact will last 18 months or years.
	Long-term (4)	The duration of the activity associated with the impact will last more than 5 years.
Severity	Low (1)	Where the impact affects the environment in such a way that natural, cultural and social functions and processes are minimally affected.
	Moderate (2)	Where the affected environment is altered but natural, cultural and social functions and processes continue albeit in a modified way; and valued, important, sensitive, or vulnerable systems or communities are negatively affected.
	High (3)	Where natural, cultural, or social functions and processes are altered to the extent that the natural process will temporarily or permanently cease; and valued, important, sensitive, or vulnerable systems or communities are substantially affected.
Potential for impact on irreplaceable resources	No (0)	No irreplaceable resources will be impacted.
	Yes (1)	Irreplaceable resources will be impacted.
Consequence	Extremely detrimental (-25 to -33)	A combination of extent, duration, intensity, and the potential for impact on irreplaceable resources.
	Highly detrimental (-19 to -24)	
	Moderately detrimental (-13 to -18)	
	Slightly detrimental (-7 to -12)	
	Negligible (-6 to 0)	
	Slightly beneficial (0 to 6)	
	Moderately beneficial (13 to 18)	
	Highly beneficial (19 to 24)	
Extremely beneficial (25 to 33)		
Probability (the likelihood of the impact occurring)	Improbable (0)	It is highly unlikely or less than 50 % likely that an impact will occur.
	Probable (1)	It is between 50 and 70 % certain that the impact will occur.
	Definite (2)	It is more than 75 % certain that the impact will occur, or the impact will occur.
Significance	Very high - negative (-49 to -66)	A function of Consequence and Probability.
	High - negative (-37 to -48)	
	Moderate - negative (-25 to -36)	
	Low - negative (-13 to -24)	
	Neutral - Very low (0 to -12)	
	Low - positive (0 to 12)	
	Moderate - positive (13 to 24)	
	High-positive (37 to 48)	
Very high - positive (49 to 66)		

Table 4-9 Explanation of assessment criteria

Criteria	Explanation
Nature	This is an evaluation of the type of effect the construction, operation, and management of the proposed development would have on the affected environment. Will the impact of change on the environment be positive, negative, or neutral?
Extent or Scale	This refers to the spatial scale at which the impact will occur. The extent of the impact is described as footprint (affecting only the footprint of the development), site (limited to the site), and regional (limited to the immediate surroundings and closest towns to the site). The extent of scale refers to the actual physical footprint of the impact, not to the spatial significance. It is acknowledged that some impacts, even though they may be of a small extent, are of very high importance, e.g., impacts on species of very restricted range. To avoid “double counting, specialists have been requested to indicate spatial significance under “intensity” or “impact on irreplaceable resources” but not under “extent” as well.
Duration	The lifespan of the impact is indicated as temporary, short, medium, and long-term.
Severity	This is a relative evaluation within the context of all the activities and the other impacts within the framework of the project. Does the activity destroy the impacted environment, alter its functioning, or render it slightly altered?
Impact on irreplaceable resources	This refers to the potential for an environmental resource to be replaced, should it be impacted. A resource could be replaced by natural processes (e.g., by natural colonization from surrounding areas), through artificial means (e.g., by reseeding disturbed areas or replanting rescued species) or by providing a substitute resource, in certain cases. In natural systems, providing substitute resources is usually not possible, but in social systems, substitutes are often possible (e.g., by constructing new social facilities for those who are lost). Should it not be possible to replace a resource, the resource is essentially irreplaceable e.g., red data species that are restricted to a particular site or habitat to a very limited extent.
Consequence	The consequence of the potential impacts is a summation of the above criteria, namely the extent, duration, intensity, and impact on irreplaceable resources.
Probability of occurrence	The probability of the impact occurring is based on the professional experience of the specialist with environments of a similar nature to the site and/or with similar projects. It is important to distinguish between the probability of the impact occurring and the probability that the activity causing a potential impact will occur. Probability is defined as the probability of the impact occurring, not as the probability of the activities that may result in the impact.
Significance	Impact significance is defined to be a combination of the consequence (as described below) and the probability of the impact occurring. The relationship between consequence and probability highlights that the risk (or impact significance) must be evaluated in terms of the seriousness (consequence) of the impact, weighted by the probability of the impact occurring. In simple terms, if the consequence and probability of an impact are high, then the impact will have a high significance. The significance defines the level to which the impact will influence the proposed development and/or environment. It determines whether mitigation measures need to be identified and implemented and whether the impact is important for decision-making.
Degree of confidence in predictions	Specialists and the EIR team were required to indicate the degree of confidence (low, medium, or high) that there is in the predictions made for each impact, based on the available information and their level of knowledge and expertise. The degree of confidence is not taken into account in the determination of consequence or probability.
Mitigation measures	Mitigation measures are designed to reduce the consequence or probability of an impact or to reduce both consequence and probability. The significance of impacts has been assessed both with mitigation and without mitigation.

4.6 Water monitoring plan

The monitoring network is based on the principles of a monitoring network design as described by the DWAF Best Practice Guidelines: G3 Monitoring (DWAF, 2007). The methodological approach that the monitoring plan follows is represented in Figure 4.8, below.

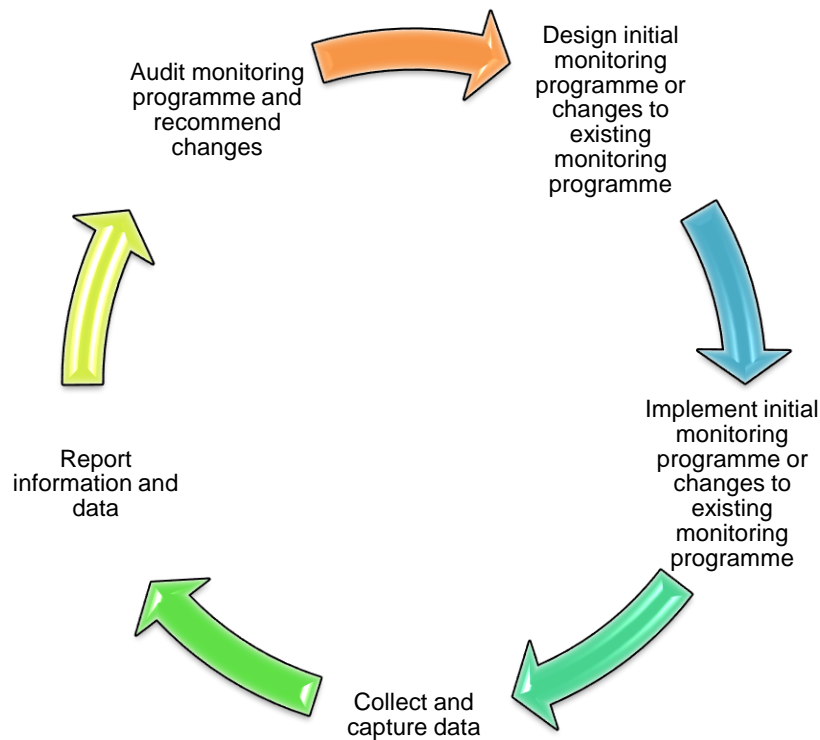


Figure 4.8: Monitoring process

A groundwater monitoring plan was drafted and is based on the site's conceptual model and risk assessment.

4.7 Groundwater management plan

Groundwater management measures were formulated based on the results of the groundwater impact assessment.

5 PREVAILING GROUNDWATER CONDITIONS

The following section supplies an overview of the prevailing hydrogeological conditions encountered in the area of the project site. The data were derived from available literature sources and completed fieldwork.

5.1 Local geology

The 2628 East Rand - 1:250 000 Geological map series (Department of Mineral and Environmental Affairs [DMEA], 1998) and the 2628AB Benoni - 1:50 000 Geological Series (Council for Geoscience, 2007) indicate the local geology is characterised by fine- to coarse-grained sandstone and shale of the Vryheid Formation in the Ecca Group of the Karoo Sequence (refer to Figure 3.1). The geophysical surveys and hydrogeological drilling confirmed that at the Block Meat Company, the sandstones are overlain by ~100 m thick Quartzite.

5.2 Aquifer characteristics, classification, and groundwater recharge

The 1:500 000 Hydrogeological map series 2526 Johannesburg (Figure 5.2) was reviewed to present the hydrogeological characterisation of the project area. The map indicates that the aquifer underlying the Block Meat Company can be regarded as a low to moderate-yielding intergranular and fractured aquifer, with reported yields ranging from 0.1 to 0.5 l/sec - Class D2 aquifer. Groundwater occurrence is typically associated with weathered and fractured sedimentary rocks (Vegter et al., 1968).

Recharge to the underlying aquifer is estimated to be in the order of 2.8% of the MAP (698 mm) which falls within quaternary catchment C21D (DWS, 2020). The aquifer is considered an important contributor to groundwater baseflow to streams and rivers (Barnard, H.C., 2000).

5.3 Depth to groundwater

A field hydrocensus was conducted within 2.5 km of the project site and no boreholes were located on-site. This is because most households and industries around this area are dependent on municipal water supply sources. A review of the NGA database indicated that ten (10) registered boreholes are situated within a 5 km radius of the project site of which six (6) are located within quaternary catchment C21D. Only four (4) of the available ten (10) boreholes have water level information and Table 4-2 lists the available information on the boreholes in the area according to the National Groundwater Archive (NGA).

The regional groundwater levels range from 3.6 meters below ground level (mbgl) and 18.28 mbgl (average 12.54 mbgl). These shallow groundwater levels indicate the NGA boreholes are drilled into the regional weathered aquifer. Whereas the deep-water level of BH2 on site (120 mbgl) indicates BH2 is drilled into a confined fractured aquifer network.

The regional spatial distribution of the existing boreholes as well as the estimated groundwater elevation in the weathered aquifer around the site is shown in Figure 5.3.

Figure 5.1 plots available groundwater elevation data for the area. There is a good relationship ($R = 85\%$), between groundwater and topography elevation which suggests that the regional groundwater table mimics the topography. The data suggest that groundwater levels are shallower close to non-perennial and perennial streams where groundwater contributes to streamflow as baseflow seepage. These areas are typically prominent groundwater-surface water interaction areas. Bayesian interpolation of available groundwater level data was applied to the area to conceptualize the groundwater flow.

Figure 5.3 indicates the generated Bayesian interpolated groundwater elevations for the area. The data suggest that the general groundwater flow direction is from west to east.

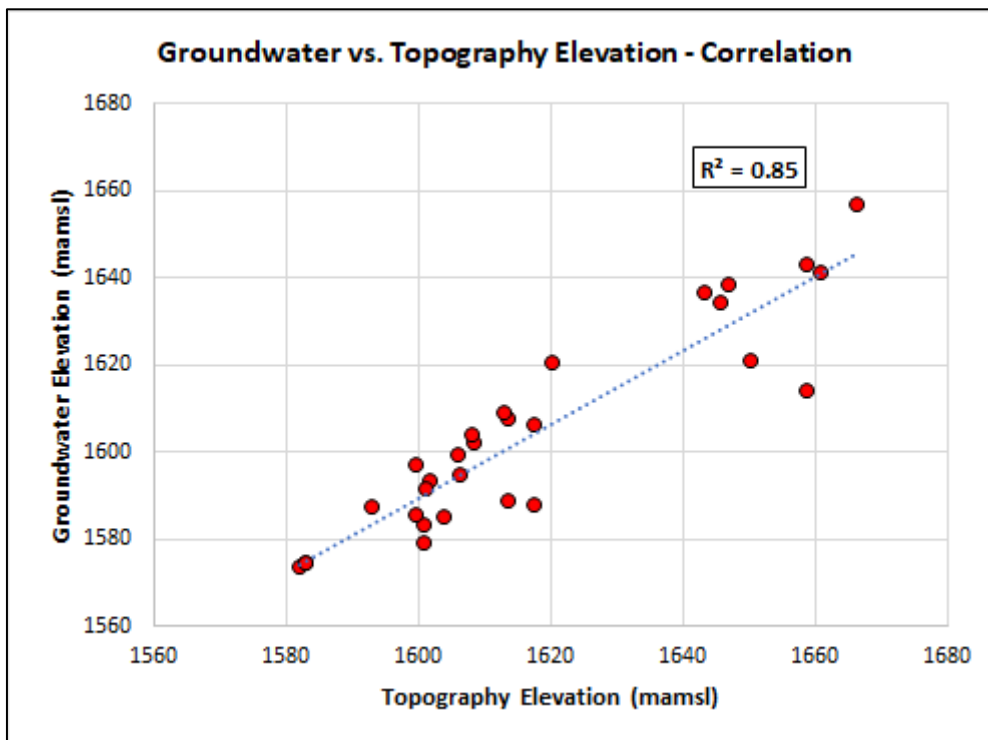


Figure 5.1: Groundwater elevation vs topography elevation correlation.

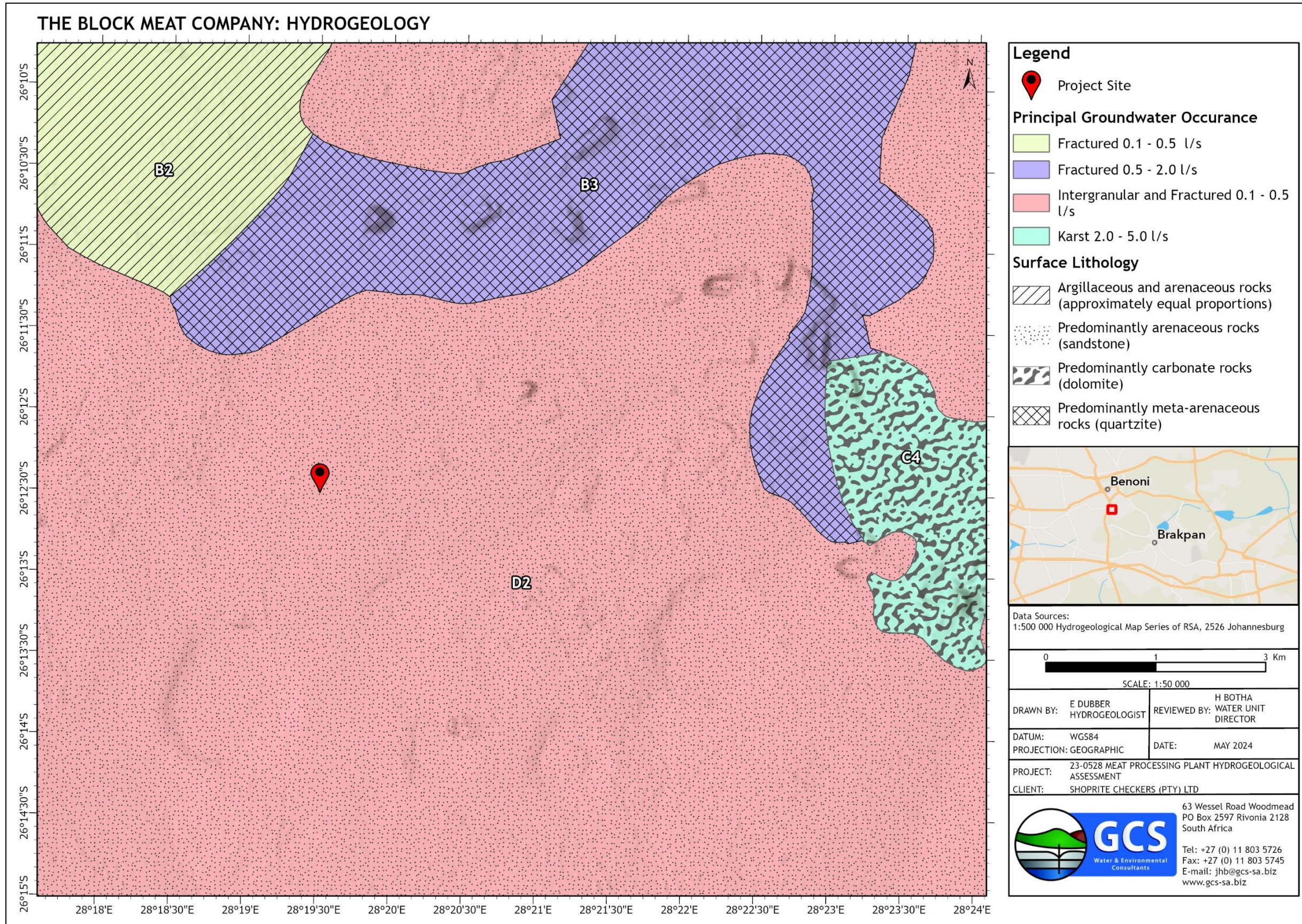


Figure 5.2: Local hydrogeology.

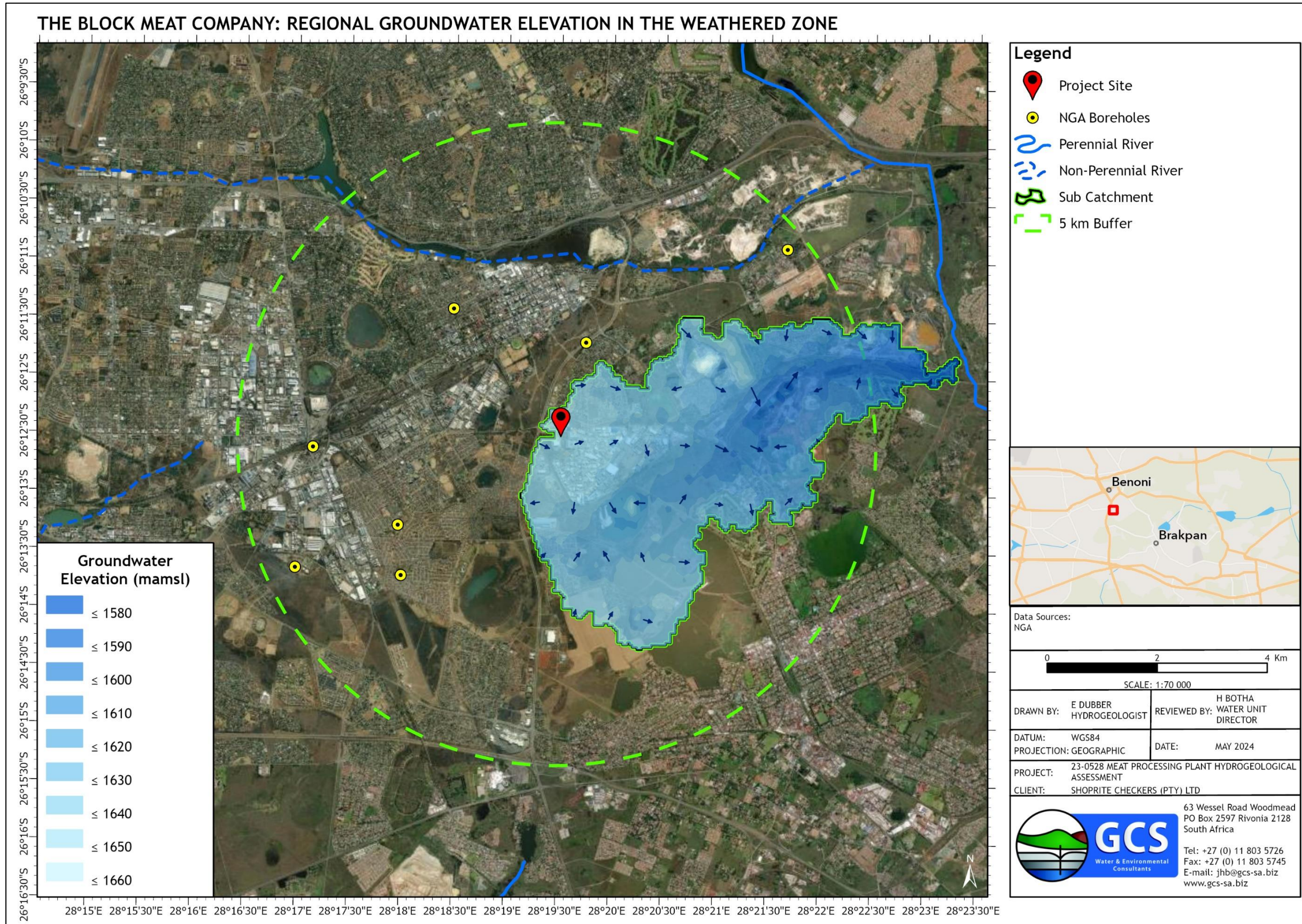


Figure 5.3: Boreholes within a 5 km radius of the project site, estimated groundwater elevation and flow direction map.

5.4 Groundwater quantity

The DWS conducted a Reserve Determination for the water resources of the Vaal Water Management Area in terms of section 16(1) of the National Water Act, 1998 (Act No. 36 of 1998) (DWS, 2020). The proposed GRD for quaternary C21D is summarized in Table 5-1. The groundwater reserve for quaternary catchment C21D consists of the volume of groundwater required to satisfy the Basic Human Needs (BHN) and to meet the Ecological Water Requirements (EWR) through groundwater contribution to baseflow (GWBF).

Table 5-1 Quaternary catchment C21D groundwater reserve (DWS, 2020)

Quaternary Catchment	Area (km ²)	Mean Annual Precipitation (mm)	Recharge (m ³ /a)	Population (minimum level)	Basic Human Needs (m ³ /a)	Groundwater Component of Baseflow (m ³ /a)	Total Reserve (m ³ /a)	Groundwater Use (WARMS, 2024) (m ³ /a)	Allocable Groundwater Total (m ³ /a)
C21D	446	698	8 560 000	180 660	1 650 000	4 200 000	5 850 000	1 005 735	1 704 265

5.4.1 Sub-catchment delineation

A sub-catchment was delineated with Global Mapper. A 3 Arc Second Resolution Shutter Radar Topography Mission (SRTM) Digital Elevation Model (DTM) was used as input, and the drainage systems were delineated for the local area (1:10 000 stream count, with 30 m DEM fill).

The delineated sub-catchment is indicated in Figure 3.1. The total sub-catchment area is in the order of 17.91 km².

The groundwater reserve determination calculation, scale of abstraction and stress index will focus on the delineated sub-catchment. Table 5-2 presents a summary of the hydrogeological information for the delineated sub-catchment.

Table 5-2 Delineated sub-catchment information summary

Description	Delineated Sub-Catchment	
Surface Area	17.91	[km ²]
Recharge	343 743.50	[m ³ /a]
Population	7 254.75	people
BHN	66 258.97	[m ³ /a]
Baseflow	168 659.19	[m ³ /a]
Groundwater Use	40 387.25	[m ³ /a]
Reserve	234 918.16	[m ³ /a]
Reserve as % of Recharge	68%	[%]

Note/s:

[km²] - squared kilometres

[m³/a] - cubic metres per annum

[%] - percentage

5.4.2 Groundwater recharge

The effective groundwater recharge from precipitation is the portion of precipitation that reaches the groundwater. The remainder of the precipitation comprises surface water runoff, evapotranspiration, and soil moisture. The effective recharge is dependent on the geology, soils, surface run-off and stream morphology but most importantly for the study area, the effective storage.

Based on values sourced from the Vaal Water Management Area Groundwater Reserve Determination (DWS, 2020), a recharge of 2.8% (8 560 000 m³/a) of the annual precipitation is estimated (refer to Table 5-1). Higher recharge is however expected along geological structural features due to their increased permeability and associated storage. Recharge data used in this study is potential direct recharge only and significant lateral or indirect recharge may occur. The precipitation recharge, for the delineated sub-catchment area, is described below and summarised in Table 5-3.

$$Re_{Catchment Area} = Re_{\%MAP} \times Area_{Catchment Area}$$

Where:

- $Re_{\%MAP}$ = Recharge (2.8 % of MAP) [mm/a] for the delineated catchment area
- $Area_{Catchment Area}$ = Area [m²]

Table 5-3 Delineated sub-catchment recharge summary

Description	Delineated Sub-Catchment	
Total Recharge (~2.8% of MAP)	8 560 000	[m ³ /a]
Delineated Catchment Area	17 910 000	[m ²]
Delineated Catchment Recharge	343 743.50	[m ³ /a]

Note/s:

MAP - mean annual precipitation

[m²] - squared metres

[m³/a] - cubic meters per annum

5.4.3 Existing GW usage (EU)

According to the latest available information from the Water Authorization Registration and Management System (WARMS) database (May 2024), the volume of groundwater allocated within quaternary catchment C21D is in the order of 1 005 735 m³/a (NIWIS, 2024). This equates to a calculated 40 387.25 m³/a existing groundwater usage within the delineated sub-catchment.

5.4.4 Basic human needs (BHN)

According to the Government Gazette no 46798 of 26 August 2022, the BHN Reserve provides for the essential needs of individuals served by the water resource in question and includes water for drinking, food preparation and personal hygiene. Basic Human need is set by the Water Service Act (Act No. 108 of 1997) at 25 litres per person per day. The reserve is calculated by multiplying the number of people living within the confines of a source unit by 25 L/d. The estimated BHN of quaternary catchment C21D is 1 650 000 m³/a (refer to Table 5-1), which equates to 66 258.97 m³/a for the delineated sub-catchment.

5.4.5 Proposed GW usage (PU)

Based on the recommended abstraction time of 8 hours, the sustainable yield of 33 408 l/day (12 193.92 m³/a) for borehole BH2 is recommended to meet the water demand for the meat processing plant.

5.4.6 Groundwater contribution to baseflow

Baseflow is the low flow in a river during dry or fair-weather conditions, but not necessarily all contributed by groundwater, baseflow includes contributions from delayed interflow and groundwater discharge. Because of the contribution of groundwater to surface water flow in certain circumstances, the volume of groundwater that could be abstracted without impacting the ability of the groundwater to sustain or contribute to the surface water Reserve has to be taken into account.

The baseflow of groundwater into surface water bodies in the quaternary catchment is 4 200 000 m³/a (DWS, 2020). The groundwater contribution to baseflow of the delineated sub-catchment is described below and summarized in Table 5-4.

$$\text{Baseflow}_{\text{Catchment Area}} = \text{Baseflow}_{\text{Catchment Area}} \times \text{Area}_{\text{Catchment}}$$

Where:

- $\text{Baseflow}_{\text{Catchment Area}}$ = value for baseflow in quaternary catchment C21D (DWS, 2020) [m³/a]
- $\text{Area}_{\text{Catchment Area}}$ - Delineated catchment area [m²]

Table 5-4 Delineated sub-catchment groundwater contribution to baseflow summary

Description	Delineated Sub-Catchment	
Baseflow for Quaternary Catchment	4 200 000	[m ³ /a]
Delineated Catchment Area	17 910 000	[m ²]
Delineated Catchment Areas Baseflow	168 659.19	[m ³ /a]

Note/s:

[m³/a] - cubic metres per annum

[m²] - squared metres

5.4.7 GW balance

The GW balance and the reserve determination on a sub-catchment scale are presented in Table 5-5 and summarised below:

- $GW_{\text{available}} = (\text{Re}) - (\text{EU} + \text{BHN} + \text{BF} + \text{PU})$

Where:

- $GW_{\text{available}}$ = Available GW for use.
- Re = Effective recharge to the aquifer.
- BF = Baseflow to surface water streams.
- EU = Existing GW abstraction/use (identified on sub-catchment, excluding applicant).
- BHN = Basic Human Needs.
- PU = Proposed Use.

Table 5-5 Delineated sub-catchment GW balance and reserve determination

Description	Delineated Sub-Catchment	
	Value	Unit
Recharge through Precipitation	343 743.50	[m ³ /a]
Groundwater Reserve	234 918.16	[m ³ /a]
Total Available Groundwater	108 825	[m ³ /a]
Existing GW Use (WARMS, 2024)	40 387.25	[m ³ /a]
Remaining Available Groundwater	68 438.09	[m ³ /a]
Proposed Abstraction	12 193.92	[m ³ /a]
Surplus Groundwater Available	56 244.17	[m ³ /a]

Note/s:

[m³/a] - cubic metres per annum

The GW balance indicates there's approximately 68 438.09 m³/a groundwater available for abstraction on a sub-catchment scale and a surplus value of approximately 56 244.17 m³/a will be available after the proposed abstraction of 12 193.92 m³/a.

5.5 Groundwater quality

Groundwater sampling was undertaken from BH2 by the client and the results were provided to GCS. The analysis of the laboratory results is shown in Table 5-6 below and the laboratory certificate of the results can be seen in **Appendix D**.

The results showed that all chemical parameters fall within the SANS241:2015 water standards for domestic use, except for turbidity and manganese. Manganese is naturally abundant in rocks, soil and groundwater. The elevated manganese concentration in BH2 is potentially sourced from the sedimentary host rock and is therefore naturally occurring. Manganese supports the growth of certain nuisance organisms in water distribution systems, giving rise to taste, odour and turbidity problems.

Turbidity in water is caused by the presence of suspended matter which usually consists of a mixture of inorganic matter, such as clay and soil particles, and organic matter. The elevated turbidity in the water pumped from BH2 is most likely associated with the elevated manganese concentration as well as suspended soil particles.

Table 5-6 Groundwater quality results

Parameter	Risk	Unit	Standard Limit	BH2
Physical and aesthetic determinants				
Colour	Aesthetic	mg/L Pt-Co	≤ 15	<5.00
Conductivity at 25 °C	Aesthetic	mS/m	≤ 170	97.5
pH at 25 °C	Operational	pH units	≥ 5 to ≤ 9.7	6.93
Total dissolved solids	Aesthetic	mg/L	≤ 1 200	846
Turbidity	Operational	NTU	≤ 1	20.5
Turbidity	Aesthetic	NTU	≤ 5	20.5
Chemical determinants – macro-determinants				
Ammonia as N	Aesthetic	mg/L	≤ 1.5	<0.005
Chloride as Cl ⁻	Aesthetic	mg/L	≤ 300	119
Combined nitrate plus nitrite	Acute health	mg/L	≤ 1	<1.00
Fluoride as F ⁻	Chronic health	mg/L	≤ 1.5	0.32
Free chlorine as Cl ₂	Chronic health	mg/L	≤ 5	0.11
Monochloramine	Chronic health	mg/L	≤ 3	0.12
Nitrate as N	Acute health	mg/L	≤ 11	0.571
Nitrite as N	Acute health	mg/L	≤ 0.9	<0.065
Sodium as Na	Aesthetic	mg/L	≤ 200	27.9
Sulphate as SO ₄ ²⁻	Acute health	mg/L	≤ 500	174
Sulphate as SO ₄ ²⁻	Aesthetic	mg/L	≤ 250	174
Zinc as Zn	Aesthetic	mg/L	≤ 5	<0.002
Chemical determinants – micro-determinants				
Aluminium as Al	Operational	mg/L	≤ 0.3	<0.002
Antimony as Sb	Chronic health	mg/L	≤ 0.02	<0.001
Arsenic as As	Chronic health	mg/L	≤ 0.01	<0.006
Barium as Ba	Chronic health	mg/L	≤ 0.7	0.04
Boron as B	Chronic health	mg/L	≤ 2.4	<0.013
Cadmium as Cd	Chronic health	mg/L	≤ 0.003	<0.002
Copper as Cu	Chronic health	mg/L	≤ 2	0.012
Cyanide (recoverable) as CN ⁻	Acute health	mg/L	≤ 0.2	<0.005
Iron as Fe	Chronic health	mg/L	≤ 2	1.9
Iron as Fe	Aesthetic	mg/L	≤ 0.3	1.9
Lead as Pb	Chronic health	mg/L	≤ 0.01	<0.004
Manganese as Mn	Chronic health	mg/L	≤ 0.4	1.07
Manganese as Mn	Aesthetic	mg/L	≤ 0.1	1.07
Mercury as Hg	Chronic health	mg/L	≤ 0.006	<0.005
Nickel as Ni	Chronic health	mg/L	≤ 0.07	0.011
Selenium Se	Chronic health	mg/L	≤ 0.04	<0.002
Total chromium as Cr	Chronic health	mg/L	≤ 0.05	<0.010
Uranium as U	Chronic health	mg/L	≤ 0.03	<0.015
Chemical determinants – organic determinants				
Bromodichloromethane	Chronic health	mg/L	≤ 0.06	<0.002
Bromoform	Chronic health	mg/L	≤ 0.1	<0.020
Dibromochloromethane	Chronic health	mg/L	≤ 0.1	<0.002
Phenols	Aesthetic	mg/L	≤ 0.01	<0.01
Total microcystin	Chronic health	mg/L	≤ 0.001	<0.0005
Total organic carbon as C	Chronic health	mg/L	≤ 10	1.75
Trihalomethanes Chloroform	Chronic health	mg/L	≤ 0.3	<0.002

Note:

Red and Bold exceed the SANS 241:2015 Standard

6 PRELIMINARY RISK AND IMPACT ASSESSMENT

In this section, the Impact on groundwater aquifer and surrounding water bodies as a result of the proposed abstraction was assessed. The Source - Pathway- Receptor (SPR) model (DWAF, 2008) was considered to quantify and illustrate the potential groundwater risks.

6.1 Site conceptual model

The Site Conceptual Model (SCM) for The Block Meat Company comprise the following:

- Two (2) aquifer systems: A regional upper weathered aquifer and a deeper confined fractured aquifer.
- The weathered aquifer has a low yield potential, and the solid rock is not fissured to an extent to promote water movement.
- The production borehole (BH2) on site draws from the deeper fractured aquifer (>150 mbgl), with a static water level recorded at 120 mbgl and a yield of 1.16 l/s

Due to the depth of the aquifer zone (>150 mbgl) the potential for pollution is low, except if poor quality runoff directly into or along the borehole casing takes place (i.e. from the site down via the weathered zone to the water table). Recharge in the confined zone will be subjected to transboundary inflows as well as recharge via the vadose and weathered zones. The extent of the fractured aquifer is however uncertain.

During the field hydrocensus, no groundwater users could be identified within a 2.5 km radius of BH2. The risk of having a potential impact on surrounding groundwater users is therefore also considered low to insignificant.

6.2 Geohydrological impacts and mitigation measures

Risk assessment entails understanding the generation of a hazard, the probability that the hazard will occur, and the consequences if it should occur. The net consequence is established by the following equation:

$$\text{Consequence} = (\text{Duration} + \text{Extent} + \text{Irreplaceability of resource}) \times \text{Severity}$$

The environmental significance of an impact was determined by multiplying the consequence by probability. The risk significance rating is summarised in Table 6-1.

Table 6-1 Risk rating scale

Criteria	Rating Scales
Significance	Very high - negative (-49 to -66)
	High - negative (-37 to -48)
	Moderate - negative (-25 to -36)
	Low - negative (-13 to -24)
	Neutral - Very low (0 to -12)
	Low-positive (0 to 12)

Criteria	Rating Scales
	Moderate-positive (13 to 24)
	High-positive (37 to 48)
	Very high - positive (49 to 66)

Key assumptions made:

- The risk/impact assessment conducted for the site is based on the topography, groundwater flow direction, groundwater levels, geology, geophysical data, and characteristics associated with the aquifer system.
- The risk/impact assessment incorporates a worst-case scenario approach.
- Groundwater mimics the topography.
- Bayesian interpolation of available groundwater data was applied to conceptualize the groundwater flow and groundwater depth in the study area.

6.2.1 Impacts on the groundwater reserve

The potential radius of influence of pumping for borehole BH2 [identified for GW use during this study] was determined by applying the Cooper-Jacob equation (1):

$$\text{Radius of Influence } (r_e) = 1.5 \sqrt{\frac{Tt}{S}} \quad \text{Equation 1}$$

Where:

T = aquifer transmissivity (m²/day)

t = exploitation time/pumping time (days); and

S = aquifer storativity.

The estimated radius of influence for the borehole is listed in Table 6-2. The predicated pumping radius of influence for BH2 is in the order of 8.58 m. During pumping, no interference in BH1 was noted. It is therefore anticipated that BH2 is drawing from the fractured aquifer network or contact zones, which are not connected.

Table 6-2 Summary of the radius of influence for borehole BH2

Parameter	Units	BH 13 (PV1)
T	m ² /day	2.35
t	days	121.67
s		8.71

Tt		285.32
Tt/s		32.75
Square Root (Tt)	m	5.72
<i>The radius of Influence</i>	<i>m</i>	<i>8.58</i>

6.2.1.1 Scale of abstraction

Based on the DWS Requirements for Water Use License Application: Groundwater Abstraction [S21(a)], the license application must be evaluated in terms of three possible categories. Categories A, B, and C, each have an applicable list of information requirements for the license application. The categories are as follows:

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

Concerning the DWS scale of abstraction categories, the scale of abstraction after the proposed abstraction from the groundwater unit, relative to recharge, across the delineated sub-catchment area is 77% and is classified as Category B “Medium Scale” abstraction.

6.2.1.2 Water quantity stress index

The status of a groundwater resource unit can be assessed in terms of sustainable use, observed ecological impacts, or water stress. As no ecological reserve is available for the affected catchment, the impact of the proposed abstraction on the ecological reserve cannot be determined.

The concept of stressed water resources is addressed by the National Water Act, 1998 (Act No. 36 of 1998) (NWA) but is not defined. Part 8 of the Act gives some guidance by providing the following qualitative examples of ‘water stress:

- Where water demands are approaching or exceed the available supply.
- Where water quality problems are imminent or already exist; or
- Where water resource quality is under threat.

To provide a quantitative means of defining stress, a groundwater stress index was developed by dividing the volume of groundwater abstracted from a groundwater unit by the estimated recharge to that unit (Parsons and Wentzel, 2007). However, this concept does not take cognisance of the impact of other land-use practices on groundwater and surface water resources. It is therefore proposed to modify the stress index by taking the groundwater contribution to baseflow into account.

The modified stress index is as follows:

$$\begin{aligned} \text{Stress Index} &= \text{Proposed Abstraction} / (\text{Recharge} - \text{Baseflow}) \\ &= 52\,581.17 \text{ m}^3/\text{a} / (343\,743.50 \text{ m}^3/\text{a} - 168\,659.19 \text{ m}^3/\text{a}) \\ &= 0.3 \end{aligned}$$

The stress index and classes described in Table 6-3 are a guide for determining the level of stress of a groundwater resource unit, based on abstraction, baseflow, and recharge (modified after (Parsons & Wentzel, 2007)).

Table 6-3 Guide for determining the level of stress of a groundwater resource unit

Present Status Category	Description	Stress Index
A	Unstressed or low level of stress	<0.05
B		0.05 - 0.2
C	Moderate levels of stress	0.2 - 0.5
D		0.5 - 0.75
E	Stressed	0.75 - 0.95
F	Critically stressed	>0.95

Based on the guide for determining the level of stress of the groundwater resource unit, the abstraction of 52 581.17 m³/a across the delineated sub-catchment area is classified as status category C. The aquifer unit will thus have a moderate level of stress after the proposed abstraction.

6.3 Geohydrological impacts and mitigation measures

Risk assessment entails the understanding of the generation of a hazard, the probability that the hazard will occur, and the consequences if it should occur. The net consequence is established by the following equation:

$$\text{Consequence} = (\text{Duration} + \text{Extent} + \text{Irreplaceability of resource}) \times \text{Severity}$$

The environmental significance of an impact was determined by multiplying the consequence by probability.

The anticipated hydrogeological impacts as a result of the proposed abstraction are discussed in Table 6-4 below.

Table 6-4 Potential hydrogeological impacts and mitigation measures

Component Being Impacted On	Activity Which May Cause the Impact	Activity	Pre- Mitigation							Recommended Mitigation Measures	Post Mitigation						
			Duration	Extent	Potential for impact on irreplaceable resources	Severity	Consequence	Probability	Significance		Duration	Extent	Severity	Potential for impact on irreplaceable resources	Consequence	Probability	Significance
Regional water table / GW aquifer	Due to the depth of the aquifer zone (>150 mbgl) the potential for pollution is low, except if poor quality runoff directly into or along the borehole casing takes place (i.e. from the site down via the weathered zone to the water table).	Site activities	Long-term (4)	Site (2)	Yes (1)	Low (-1)	Slightly detrimental (-13 to -18)	Probable (1)	Neutral – Very low (0 to -12)	Visual soil assessments for signs of contamination.	Long-term (4)	Footprint (1)	Low (-1)	Yes (1)	Negligible (-6 to 0)	Improbable (0)	Neutral – Very low (0 to -6)
										Ensure adequate stormwater systems to manage runoff.							(0)
	Over abstraction and impact on the sub-catchment	Abstracting groundwater from BH2	Long-term (4)	Local (3)	Yes (1)	Moderate (-2)	Moderately detrimental (-15 to -24)	Probable (1)	Low - negative (-13 to -24)	Do not overproduce from borehole BH2. 8 hours of pumping per day is recommended.	Long-term (4)	Footprint (1)	Low (-1)	Yes (1)	Negligible (-6 to 0)	Probable (1)	Neutral – Very low (0 to -6)
										Ensure routine water quality monitoring is undertaken.							(-6)

7 WATER MONITORING

BH2 is equipped with a flow meter which will be used to monitor the meat processing plant's daily groundwater abstraction.

Regular visual assessments of sewer infrastructure (i.e., hydraulic monitoring), parking and service areas should be adequate to monitor for obvious signs of pollution in the environment.

Monitoring the groundwater quality and quantity at BH2 should be sufficient to determine the impact on the local aquifer system. No other monitoring boreholes are proposed at this stage but can be considered if there are noted operational issues associated with the existing borehole.

7.1 Monitoring parameters and frequency

The groundwater quality and quantity monitoring frequency are summarised in Table 7-1 and should include the following for the abstraction borehole BH2:

- Monitoring of abstraction volumes from the borehole, with an installed automated flow meter;
- Monitoring of water level responses (use and/or rest periods) in the production borehole (water level devices or permanently installed data loggers); and
- Water quality analysis once a year.

Table 7-1 Proposed monitoring frequency

Monitoring Point	Interval	Purpose
BH2	Monthly	Abstraction volumes - flow meter readings
	Monthly	Water level measurement
	Annual	Sampling for water quality analysis

It is recommended that a qualified hydrogeologist evaluate the data and make the necessary adjustments to the monitoring programme after the first year's monitoring data is available.

8 CONCLUSIONS

Based on the investigation undertaken the following conclusions are made:

- The Block Meat Company property is situated along the eastern boundary of quaternary catchment C21D within the Upper Vaal Water Management Area at an altitude of between 1656 and 1655 mamsl.
- The Block Meat Company property is underlain by low to moderate-yielding intergranular and fractured aquifer hosted within weathered and fractured Ecca Group sedimentary rocks.
- The regional groundwater flow, assuming hydraulic connectivity across the aquifer system/s, is in an easterly direction, a subdued reflection of the surface topography, with groundwater levels ranging from 3.6 to 18.28 (average 12.54) mbgl.
 - However, on a local scale, the flow is likely to be significantly more complex due to geological and structural controls resulting in potential groundwater barriers and discrete conduits to flow. Such as BH2 having a static water level of 120 mbgl which is likely due to semi-confined conditions caused by the Quartzite layer overlying the sedimentary aquifer.
- The Turbidity and Manganese are the only constituents in the water pumped from BH2 that exceed the SANS241:2015 water standards for domestic use.
 - Manganese is naturally abundant in rocks, soil and groundwater. The elevated manganese concentration in BH2 is potentially sourced from the sedimentary host rock and is therefore naturally occurring. Manganese supports the growth of certain nuisance organisms in water distribution systems, giving rise to taste, odour and turbidity problems.
 - Turbidity in water is caused by the presence of suspended matter which usually consists of a mixture of inorganic matter, such as clay and soil particles, and organic matter. The elevated turbidity in the water pumped from BH2 is most likely associated with the elevated manganese concentration as well as suspended soil particles.
- The aquifer test results showed that BH2 has a transmissivity value of 2.35 m²/d and a hydraulic conductivity of 0.05 m/d, indicating a relatively low to intermediate-yielding aquifer system.
- Borehole-specific sustainable abstraction rate was calculated for BH2 as 1.11 l/s for a 24-hour daily pumping schedule, and 1.56 l/s for a 16-hour daily pumping schedule.

- With no significant geological and/or hydrogeological boundaries within quaternary catchment C21D, the groundwater reserve determination was based on a delineated sub-catchment area of ~ 17.91 km² with an estimated groundwater recharge of 343 743.50 m³/a and an existing abstraction volume of 40 387.25 m³/a, resulting in a groundwater resource water availability of 68 438.09 m³/a. This results in a surplus volume of ~ 56 244.17 m³/a available water when the Block Meat Company's proposed annual water abstraction of 12 193.92 m³ is considered.
- The groundwater unit/s is considered to be at moderate levels of stress (Category C, 0.2 - 0.5 stress index) with Medium-scale abstraction (Category B, ~84% of recharge).
- In the SCM, there are 2 aquifer systems: A regional upper weathered aquifer and a deeper confined fractured aquifer.
 - The weathered aquifer has a low yield potential, and the solid rock is not fissured to an extent to promote water movement.
 - The production borehole (BH2) on site draws from the deeper fractured aquifer (>150 mbgl), with a static water level recorded at 120 mbgl and a yield of 1.16 l/s
- Due to the depth of the aquifer zone (>150 mbgl) the potential for pollution is low, except if poor quality runoff directly into or along the borehole casing takes place (i.e. from the site down via the weathered zone to the water table). Recharge in the confined zone will be subjected to transboundary inflows as well as recharge via the vadose and weathered zones. The extent of the fractured aquifer is however uncertain.
- During the field hydrocensus, no groundwater users could be identified within a 2.5 km radius of BH2. The risk of having a potential impact on surrounding groundwater users is therefore also considered low to insignificant.
- Based on the above, it is evident that groundwater can be abstracted as a viable source to meet the meat processing plant's proposed water demand requirements.

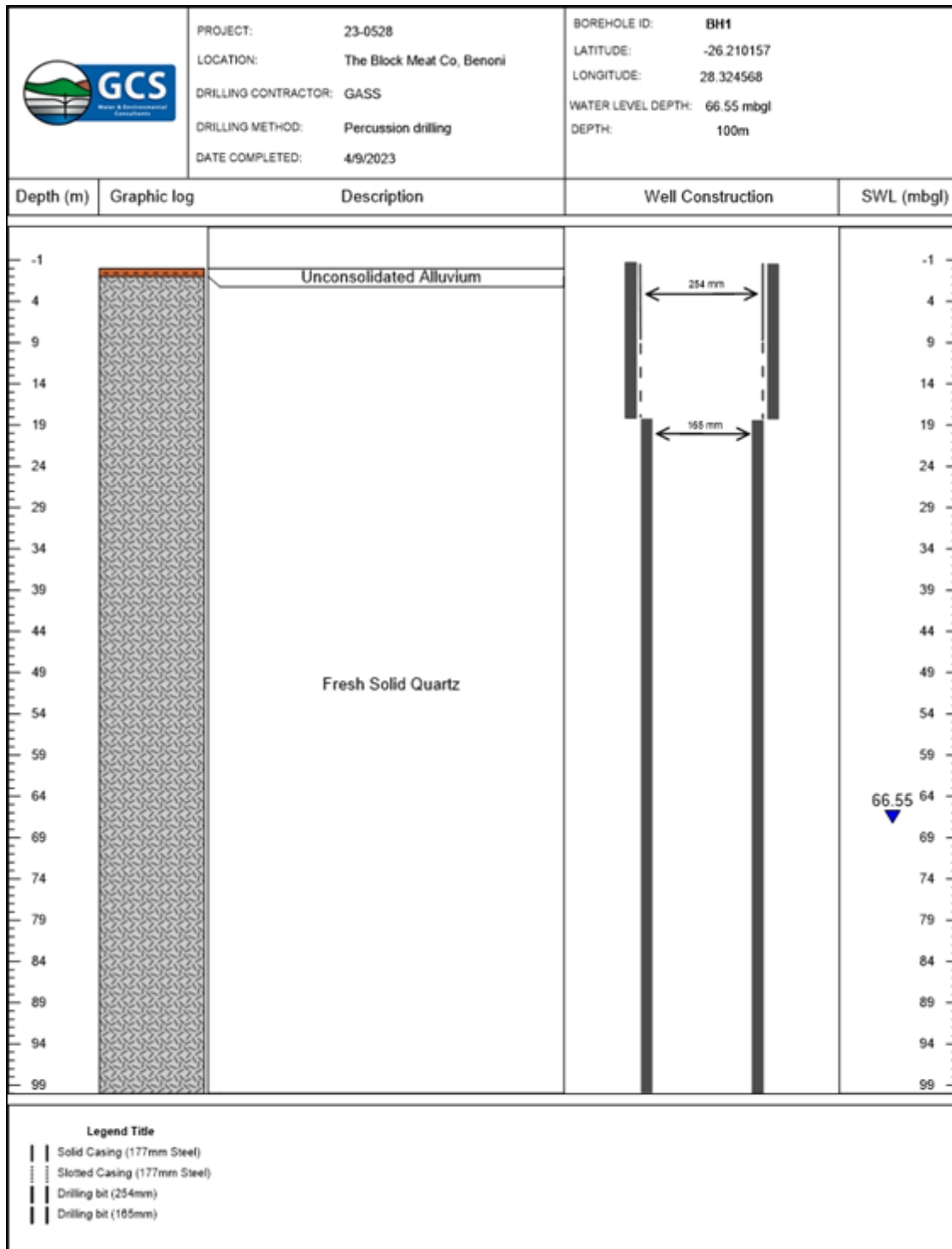
9 RECOMMENDATIONS

Based on the site-specific hydrogeological conditions and the outcome of this investigation, the sustainable abstraction rate of BH2 is recommended at 1.16 l/s for 8 hours of pumping per day. This will result in a yield of 33 408 l/d and 12 193.92 m³/a which is sufficient to satisfy the meat processing plant's estimated water demand of ~30 422 l/d and ~11 104 m³/a.

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APPENDIX A: HYDROGEOLOGICAL EXPLORATION BOREHOLE LOG

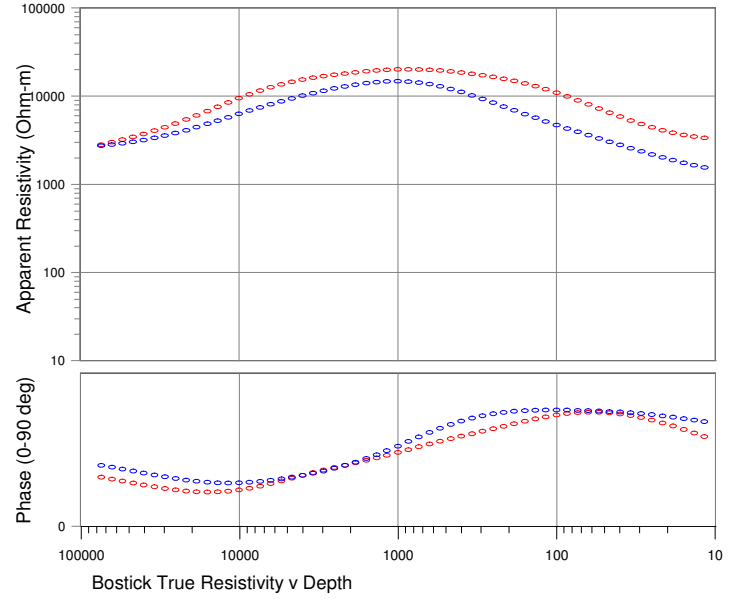
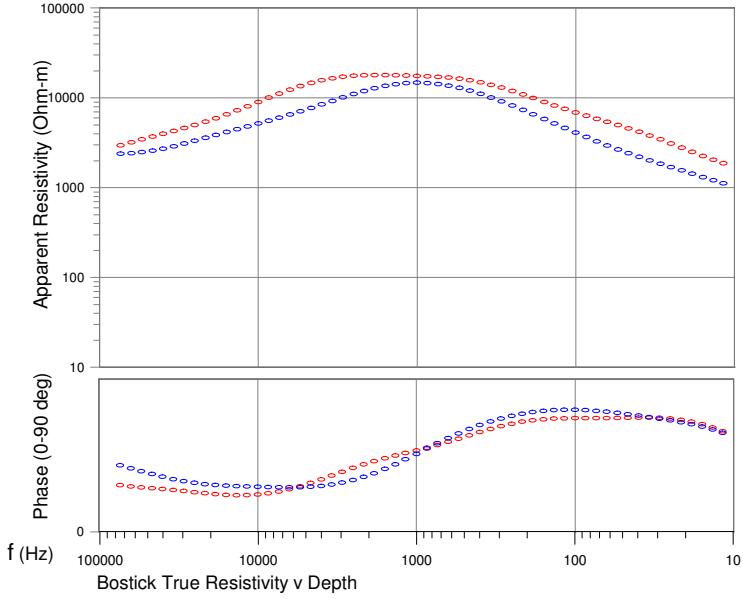


APPENDIX B: MAGNETOTELLURIC (MT) GEOPHYSICAL SURVEY RESULTS

Station 1 Record # .001 at 1m

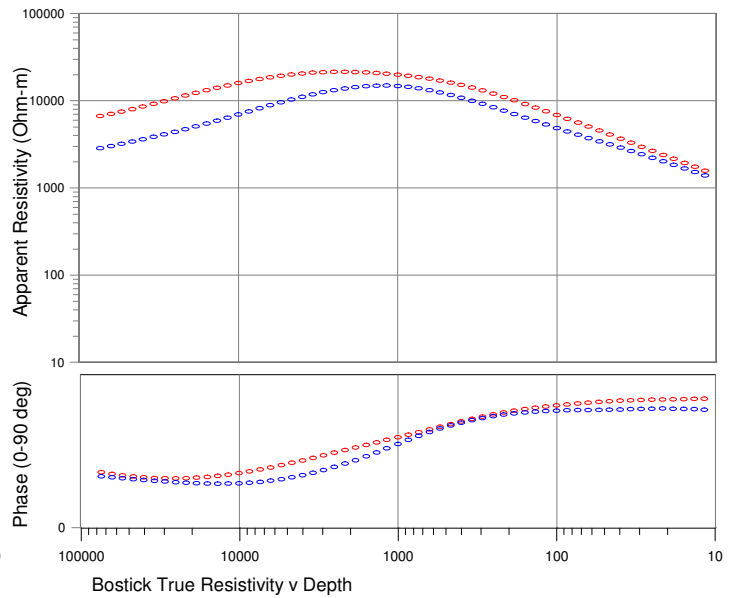
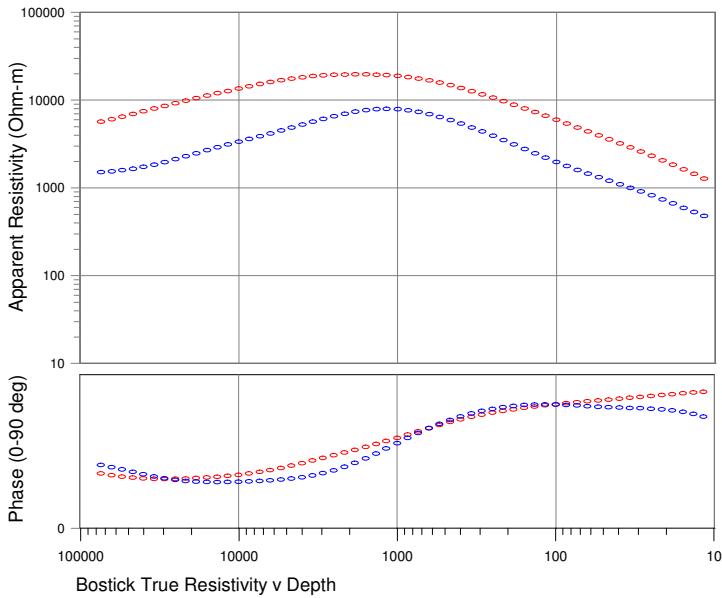
XY YX

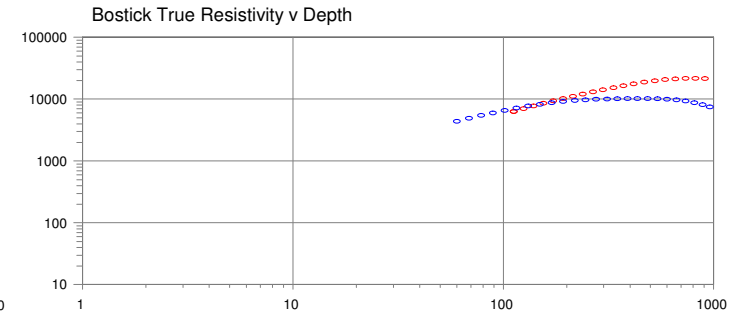
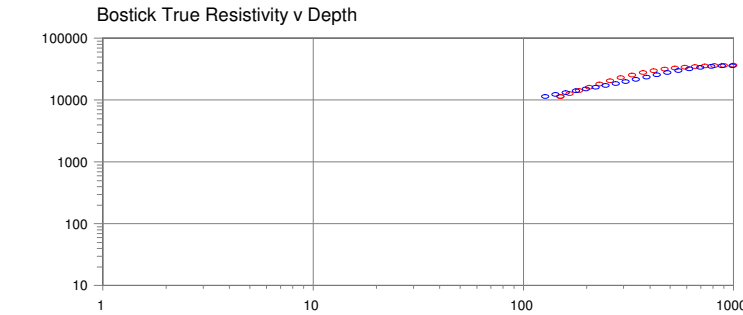
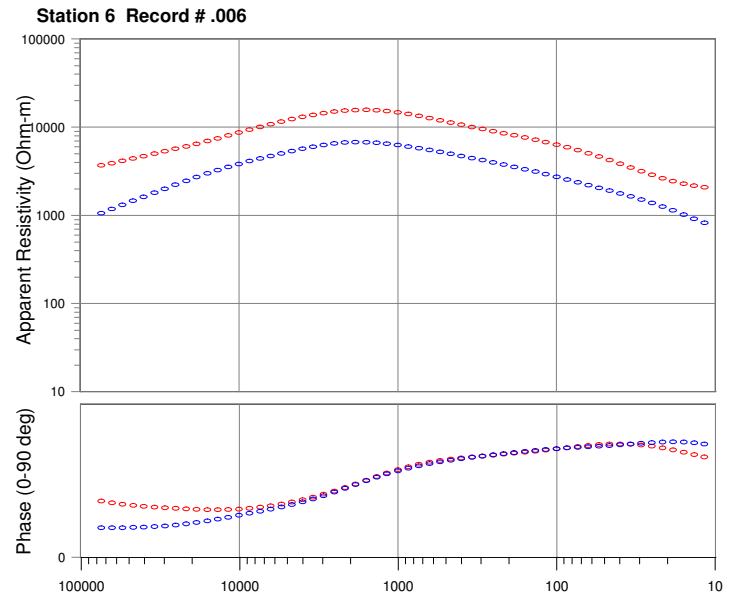
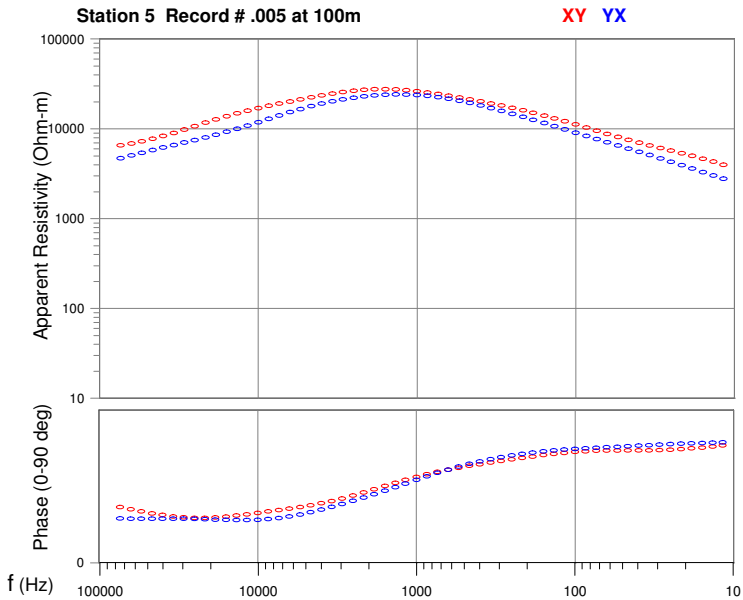
Station 2 Record # .002 at 25m



Station 3 Record # .003 at 50m

Station 4 Record # .004 at 75m





APPENDIX C: AQUIFER HYDRAULIC TESTING RESULTS

AQUIFER TEST DATA SHEET

Time (min)	Water Level above/below	L/s Yield	Recovery Water level	EC	Comments
0	120.00		135.63		
2	121.73	1.16	130.88		
4	123.03		127.49		
6	123.92		125.28		
8	124.58		124.06		
10	125.05	1.16	123.55		
12	125.46		123.31		
20	126.30		122.82		
30	126.86		122.47		
40	127.20		122.24		
50	127.47		122.06		
60	127.72		121.92		
70	127.97		121.80		
80	128.21		121.69		
90	128.45		121.60		
120	128.96		121.39		
150	129.46		121.22		
180	129.86		121.08		
210	130.34		120.95		
240	130.74		120.84		
270	131.37		120.73		
300	131.87		120.64		
330	132.39		120.55		
360	132.76		120.47		
390	133.11		120.39		
420	133.47		120.32		
450	133.81		120.25		
480	134.02		120.19		
510	134.23		120.13		
540	134.48		120.07		
570	134.86		120.02		
600	135.05				
630	135.32				
660	135.57				
690	135.80				
720	135.93				
750	136.10				
780	136.34				
810	136.55				
840	136.76				
870	136.99				

900	137.11				
930	137.38				
960	137.56				
990	137.72				
1020	137.68				
1050	137.92				
1080	138.03				
1110	138.22				
1140	138.38				
1170	138.63				
1200	138.67				
1230	138.80				
1260	139.01				
1290	139.27				
1320	139.29				
1350	139.63				
1380	139.66				
1410	139.76				
1440	139.83				

APPENDIX D: WATER QUALITY LAB CERTIFICATE

Test Report

Page 1 of 3

Client: MLS National Laboratory Pty Ltd
Address: 67 Morkels Close, c/o Le Roux Ave and Capitol Hill Commercial Park, Midrand,
Report no: 167971
Project: MLS Laboratory

Date of report: 06 November 2023
Date accepted: 27 October 2023
Date completed: 06 November 2023
Date received: 27 October 2023

Lab no:	338643		
Date sampled:	26-Oct-23		
Aquatico sampled:	No		
Sample type:	Water		
Locality description:	CR 27960 Borehole water		
	Analyses	Unit	Method
A	AQL pH @ 25°C	pH	ALM 20 6.93
A	AQL Electrical conductivity (EC) @ 25°C	mS/m	ALM 20 97.5
A	AQL Total Dissolved solids @ 180°C	mg/l	ALM 24 846 ✓
A	AQL Total Alkalinity	mg CaCO ₃ /l	ALM 01 233
A	AQL Chloride (Cl)	mg/l	ALM 02 119
A	AQL Sulphate (SO ₄)	mg/l	ALM 03 174 ✓
A	AQL Nitrate (NO ₃) as N	mg/l	ALM 06 0.571
A	AQL Total oxidised nitrogen as N	mg/l	ALM 06 0.612
A	AQL Nitrite (NO ₂) as N	mg/l	ALM 07 <0.065 ✓
A	AQL Ammonium (NH ₄) as N	mg/l	ALM 05 0.058 ✓
N	AQL Un-ionized Ammonia as N	mg/l	ALM 26 <0.005
A	AQL Fluoride (F)	mg/l	ALM 08 0.320
A	AQL Acid Soluble Sodium (Na)	mg/l	ALM 30 27.9 ✓ Within Spec
A	AQL Acid Soluble Aluminium (Al)	mg/l	ALM 31 <0.002
A	AQL Acid Soluble Iron (Fe)	mg/l	ALM 31 1.90 ✓ Within Spec
A	AQL Acid Soluble Manganese (Mn)	mg/l	ALM 31 1.07
A	AQL Total Chromium (Cr)	mg/l	ALMT 31 <0.010
A	AQL Acid Soluble Chromium (Cr)	mg/l	ALM 31 <0.003
A	AQL Acid Soluble Copper (Cu)	mg/l	ALM 31 0.012
A	AQL Acid Soluble Nickel (Ni)	mg/l	ALM 31 0.011
A	AQL Acid Soluble Zinc (Zn)	mg/l	ALM 31 <0.002
A	AQL Acid Soluble Cadmium (Cd)	mg/l	ALM 31 <0.002
A	AQL Acid Soluble Lead (Pb)	mg/l	ALM 31 <0.004
A	AQL Turbidity	NTU	ALM 21 20.5
A	AQL Free chlorine (Cl ₂)	mg/l	ALM 23 0.11

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M. Swanepoel
Technical Signatory

Test Report

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Client: MLS National Laboratory Pty Ltd
Address: 67 Morkels Close, c/o Le Roux Ave and Capitol Hill Commercial Park, Midrand,
Report no: 167971
Project: MLS Laboratory

Date of report: 06 November 2023
Date accepted: 27 October 2023
Date completed: 06 November 2023
Date received: 27 October 2023

Lab no:	338643			
Date sampled:	26-Oct-23			
Aquatico sampled:	No			
Sample type:	Water			
Locality description:	CR 27960 Borehole water			
	Analyses	Unit	Method	
A	AQL True Colour	mg/l Pt-Co	ALM 22	<5.00
A	AQL Total Cyanide (CN)	mg/l	ALM 16	<0.005
N	AQL Phenol	mg/l	ALM 71	<0.01
A	AQL Total organic carbon (TOC)	mg/l	ALM 63	1.75
A	AQL Acid Soluble Arsenic (As)	mg/l	ALM 34	<0.006
A	AQL Acid Soluble Selenium (Se)	mg/l	ALM 34	<0.002
A	AQL Acid Soluble Mercury (Hg)	mg/l	ALM 34	<0.005
A	AQL Acid Soluble Boron (B)	mg/l	ALM 33	<0.013
A	AQL Acid Soluble Barium (Ba)	mg/l	ALM 33	0.040
A	AQL Acid Soluble Uranium (U)	mg/l	ALM 37	<0.015
A	AQL Acid Soluble Antimony (Sb)	mg/l	ALM 36	<0.001
N	AQL Temperature	°C	ALM 20	24.2
A	AQL Trihalomethanes (THM)	µg/l	OLM 02	<2
A	AQL Bromoform	µg/l	OLM 02	<2
A	AQL Chloroform	µg/l	OLM 02	<2
A	AQL Dibromochloromethane	µg/l	OLM 02	<2
A	AQL Bromodichloromethane	µg/l	OLM 02	<2
A	AQL Combined Bromoform	ratio	OLM 02	<0.020
A	AQL Combined Chloroform	ratio	OLM 02	<0.007
A	AQL Combined Dibromochloromethane	ratio	OLM 02	<0.020
A	AQL Combined Bromodichloromethane	ratio	OLM 02	<0.033
A	AQL THM Sum of ratios	ratio	OLM 02	<0.080
N	AQL Monochloramine	mg/l	ALM 67	0.12
N	AQL Microcystin	µg/l	ALM 68	<0.5
N	AQL Combined Nitrate plus Nitrite	ratio	ALM 26	<1.00

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Lab no:	338643
Date sampled:	26-Oct-23
Aquatico sampled:	No
Sample type:	Water
Locality description:	CR 27960 Borehole water
Analyses	Unit Method
A AQL HNO3-Microwave digestion	mg/l ALM 90 Yes

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