Hydrogeological Impact Assessment for Klipspruit Colliery's proposed Nwabu Project - Pit BD and Pit H Underground Mining Expansion Project

Prepared for

Seriti Power (Pty) Ltd

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- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the competent authority; and the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of Section 24F of the Act.

Signature of the EAP:	
Designation:	Hydrogeologist
Qualifications:	MSc in Hydrogeology, Master's in Environmental Management
Name of Company:	Niara Environmental Consultants (Pty) Ltd
Experience (Years):	14
Date:	15 January 2026

Executive Summary

Niara Environmental Consultants (Pty) Ltd was appointed by Seriti Power (Pty) Ltd to compile a hydrogeological impact assessment for Klipspruit Colliery. This report will form part of an Environmental Authorisation and an Integrated Water Use Licence application for Klipspruit Colliery. Mining within Klipspruit Colliery is undertaken on the farms Hartebeestlaagte 325 JS, Weltevreden 324 JS, Tweefontein 328 JS, Wildebeesfontein 327 JS, Grootpan 7 IS, Oggiesfontein 4 IS, Prinshof 2 IS, Klipfontein 3 IS, Smaldeel 1 IS, Phola Plant 830 IS, and Zwaaiwater 11 IS.

The following section provides a summary of the investigation:

- The regional geology of the area comprises the sedimentary deposits of the Karoo Supergroup. KPS is underlain by the Vryheid Formation of the Ecca Group, dolerite intrusion, the Dwyka Group, and quaternary cover.
- Geochemical assessments suggest that the majority of the samples have the potential to generate acid.
- The study area comprises three aquifer systems, namely, the shallow perched aquifer, the upper weathered aquifer, the fractured aquifer, and the pre-Karoo fractured aquifer.
- Groundwater level within KPS and immediate surroundings varies from 1 to 38 mbgl. Available water level data suggest that the majority of boreholes have a water level of less than 10 mbgl.
- Several groundwater points show guideline exceedance in terms of SANS limits: SO_4 was detected in high concentration in the groundwater sample, namely BSW 4. NH_4 was detected at high concentrations in WELBH08 and BSW 4. The concentration of F exceeds guideline limits in WELBH27 and KGM 10. The concentration of Mn is above the SANS chronic health limits in BHPSM01, BHPW05, and WELBH16. Mn also exceeds SANS aesthetic limits in BHPSM10, WELBH08, WELBH25, BSW 4, KGM13, and KGM B06.
- Several boreholes also exceeded the WUL limits, as summarised: Non-compliance in terms of EC and Mg was noted in BSW 4. Ca is present at a high concentration above the WUL limits in six boreholes that include BSW 4, KGM 10, BH 008, BHPSM01, BHPW08, and BHPSM10. The concentration of Na is high in three boreholes, namely BSW 4, WELBH26, and WELBH27. The majority of the boreholes are contaminated with SO_4, NO_3, and F. The concentration of NO_3 exceeded WUL limits in all boreholes. The concentration of F is compliant in five boreholes, namely KGM 13, KGM B06, KGM B16, WELBH 16, and WELBH 25, with the remaining boreholes being classified as non-compliant. The concentration of SO_4 was noted in high concentration above the WUL limits in the following boreholes: BSW 4, KGM 10, KGM B04, KGM B06, KGM B11, KGM B16, BH 009, BHPSM01, BHPSM08, and WELBH27.
- The result of the simulated model suggests that mine water inflow within the opencast working varies from 555 m^3/d to 2923 m^3/d, while underground working will vary from 122 m^3/d to 1334 m^3/d. Post-closure impacts suggest that decant will occur.

Table of Contents

List of Figures

List of Tables

1 Introduction

1.1 Background

This report provides a groundwater impact assessment for Klipspruit Colliery (KPS). KPS forms part of the operation owned by Seriti Power (Pty) Ltd ("Seriti Power"). The mine is currently holding a mining right with a reference number, MP 30/5/1/2/2/125 MR. The operation comprises three mining segments, namely KPS Main Pit, KPSX, and KPSS. KPS has changed the mining method for the remainder of the KPSX and KPSS reserves from opencast to underground (including all future mining areas of KPSX that fall outside of Pit BD and inclusive of Pit H). As a result, KPS intends on applying for an Environmental Authorisation (EA) and an Integrated Water Use License ("IWUL"). This report forms part of the specialist groundwater impact assessment to support both applications. The report provides a groundwater impact assessment for the proposed amendment, mainly for the KPSX and KPSS mining sections.

1.2 Description of activities

KPS comprises of three mining segments, namely:

- KPS Main Pit, which includes the Main Pit, Smaldeel, and Bankfontein Pits;
- "KPSX" or Klipspruit Extension Weltevreden, including Pit BD, Pit H, Pit G, and Pit S; and
- "KPSS," or Klipspruit South, which includes the KPSS east of the Thungela conveyor and the KPSS west of the Thungela conveyor.

The underground mining method uses the bord and pillar to access coal reserves. Access to underground is via the Pit BD highwall with a plan to mine towards the east, west, north, and south from the Pit BD area. The following activities form part of the board and pillar mining method (Seriti Power, 2022):

- Coal cutting and loading: The CM uses the rotating drum to cut the head, equipped with cutting picks to cut the coal face. The loading mechanism collects the broken coal and delivers it onto the gathering arm, which loads the coal on the CM's chain conveyor. The CM's conveyor transports the broken coal from the front to rear of the CM. The CM's chain conveyor's capability of horizontal and vertical movements allows for coal loading into the shuttle car.
- Coal hauling and tipping: The loaded shuttle car is used to haul the coal to the section feeder breaker that crushes the coal and feeds it into the conveyor belt system.
- Roof support: A roof bolt machine installs the roof bolts once the CM has finished the development face and roof support is installed on a systematic basis. Roof bolts enhance the stability of the overlying roof. The spacing between roof bolts and the length of the roof bolts is determined during geotechnical studies.
- Coal transportation: The coal is transported using a conveyor belt system from the mining sections to the coal stockpile, linked with the overland conveyor on surface via the UG adit.

Figure 1-1 shows the remaining Life of Mine (LOM) based on the proposed underground mining. According to the assessment, extraction of coal will be conducted until 2043. KPSX focusses on several mineable coal seams that include the following seams:

- 5 seam ("S5")
- 4 upper A seams ("S4A")
- 4 upper seams ("S4U")
- 4 lower seams ("S4L")
- 2A seam ("S2A")
- 2 seam ("S2")
- 1 seam ("S1")

Figure 1-2 and Figure 1-3 show the extent of the KPSX mining area in terms of S2A and S4L seams. Infrastructures to support mining at KPSX include the following (Digby Wells, 2018):

- Open-pit BD including ramps and box cuts
- Internal haul roads; and haul roads for the transport of ROM coal to KPS
- Access roads for light vehicles
- Clean water, cut off canals, and storm water berms
- Raw water tanks
- ROM stockpile and tip area
- Overland conveyor
- Overburden and topsoil stockpiles
- Substation
- PCDs and associated pipelines to the PCPP
- Diesel and oil storage tanks
- Change house facilities
- Sewage treatment plant (STP)
- Workshops and mobile offices
- High mast communication tower; and
- Electricity supply to workshops and shovel

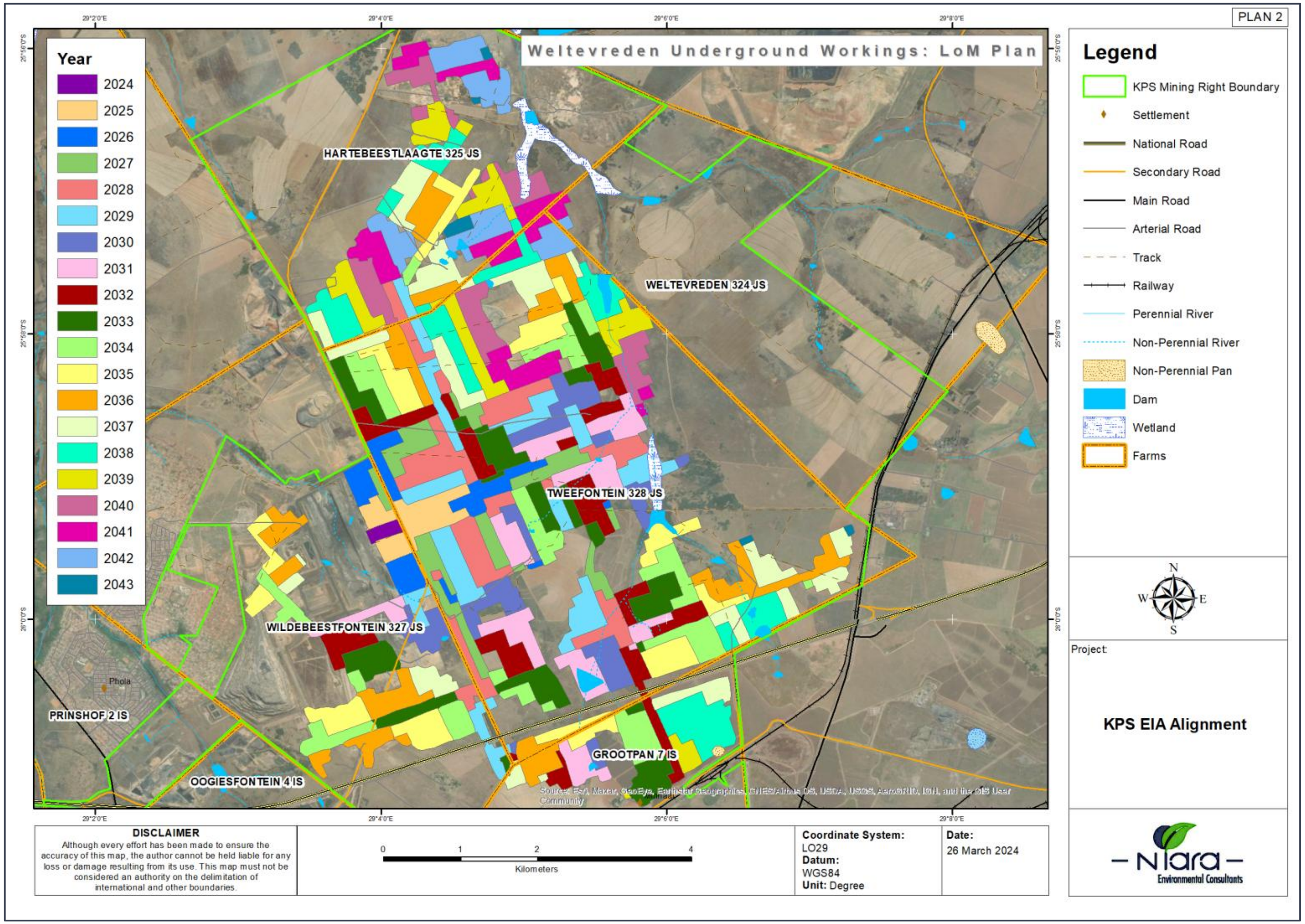

Figure 1-1: Life of Mine plan for the proposed KPSX UG mining

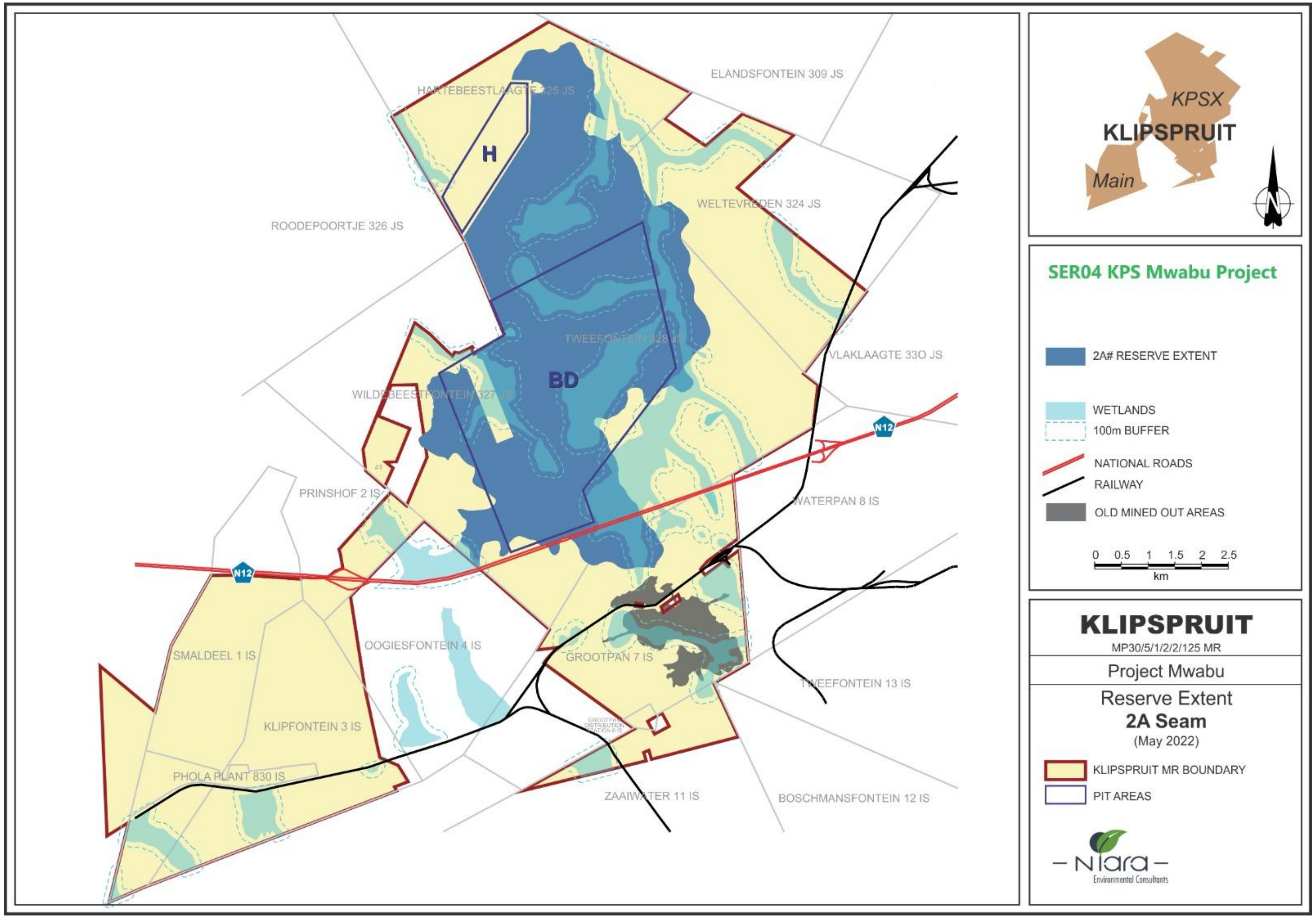

Figure 1-2: Proposed S2A mining.

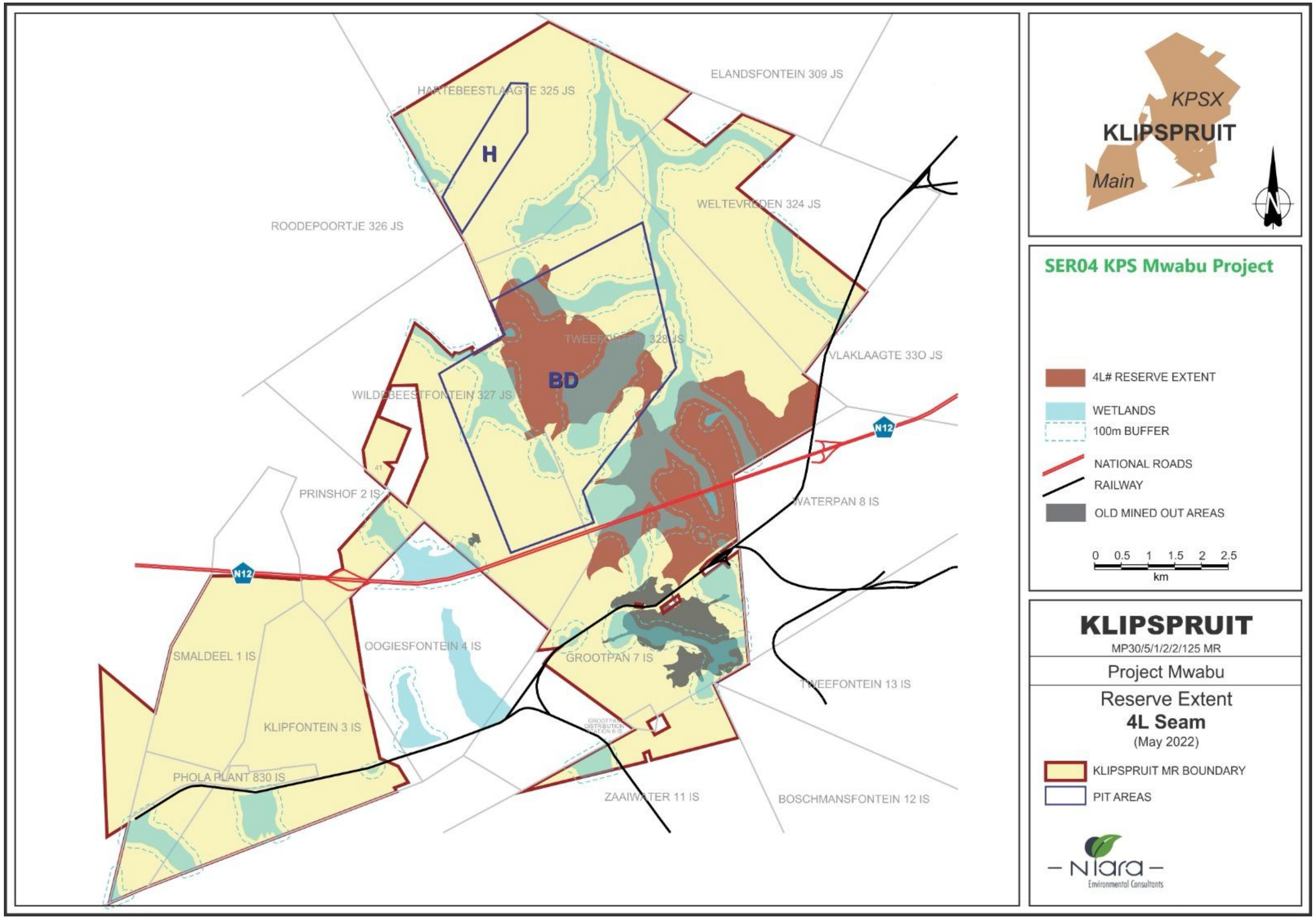

Figure 1-3: Proposed S4L Mining.

The mineable coal seams at KPSS will include the following:

- S5
- S4U
- S2
- S1.

Infrastructures to support mining at KPSS

- Open pit including ramps and box cuts
- Haul roads
- Bridge over the railway line and the public road
- Oil and refuelling facilities
- Expansion of bridge over the existing conveyor
- Coal conveyor to KPS
- PCD and associated pipelines to the KPS
- Clean water cut off berms and channels and a surface water catchment dam
- Overburden and topsoil stockpiles
- Run of Mine (ROM) stockpiles
- Hard-park area, workshops, mobile offices and fuelling bay which has since been replaced by an additional dump;
- Coal tip
- Electricity supply (22kV) to workshops and shovel.

1.3 Project Locality

The project is located under the eMalahleni Local Municipality of the Kangala District Municipality in the Mpumalanga Province. The mine lies approximately 1 km west of Ogies (KPS and KPSS) and approximately 6 km north of Ogies. Mining activities are undertaken specifically on the farms Hartebeestlaagte 325 JS, Weltevreden 324 JS, Tweefontein 328 JS, Wildebeesfontein 327 JS, Grootpan 7 IS, Oggiesfontein 4 IS, Prinshof 2 IS, Klipfontein 3 IS, Smaldeel 1 IS, Phola Plant 830 IS, and Zwaaiwater 11 IS. Access to the mine is via a network of national and provincial roads that includes N12, R555, R545, and R547. Mine locality in relation to associated municipalities and farms is depicted in Figures 1-4 and 1-5.

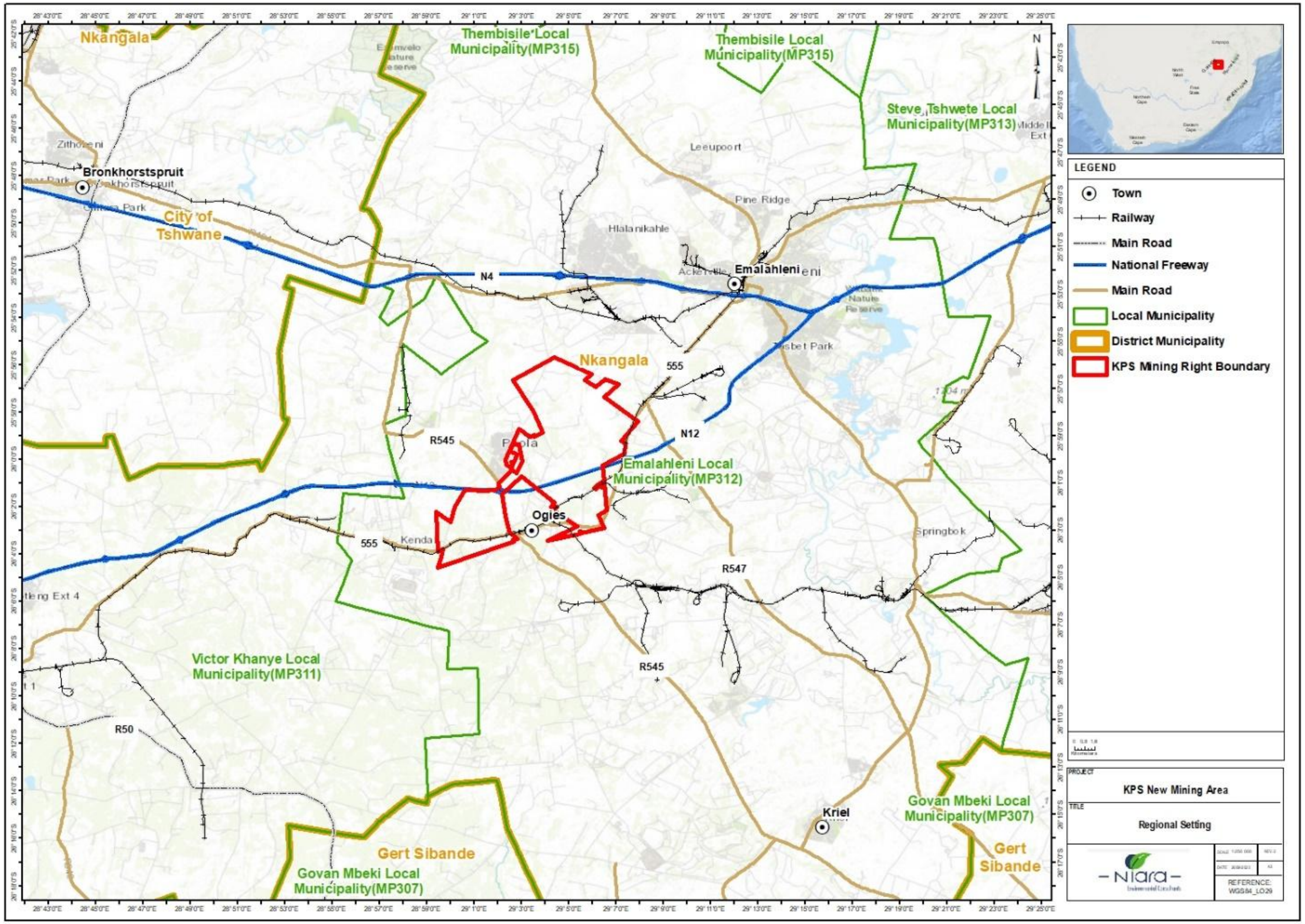

Figure 1-4: Locality Map.

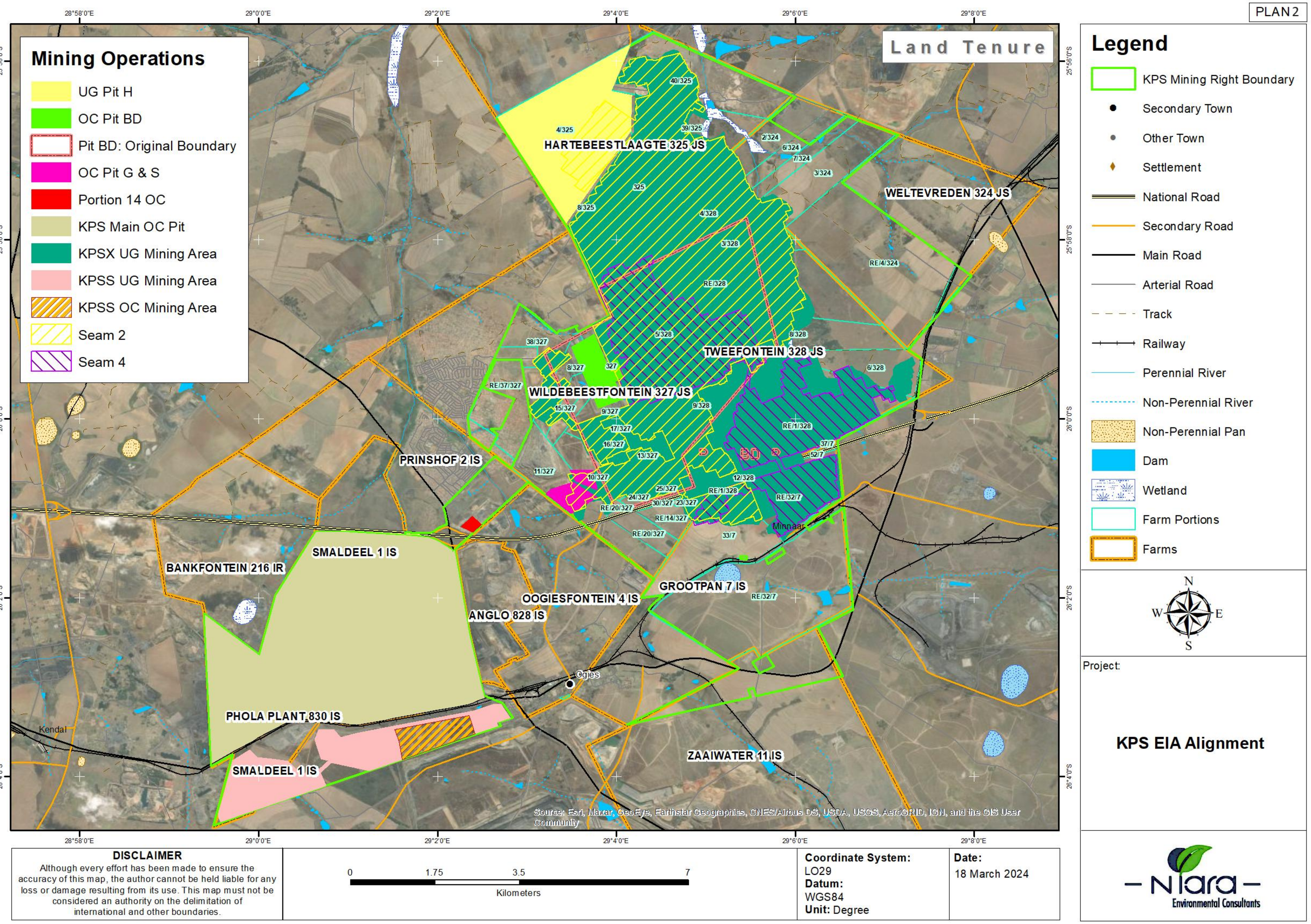

Figure 1-5: Affected farm portions over existing and proposed UG mining areas.

2 Geographical setting

2.1 Climate

Climate data used during the assessment was sourced from the EIA and EMP reports compiled by SRK (2009). The area is characterised by seasonal temperature, being warm during the summer season and cold during the winter season. The temperature of the area varies from a minimum of 0 °C in June to a maximum of 25.8 °C in January. Average monthly temperature ranges from 8.4 °C to 19.5 °C. Table 2-1 and Figure 2-1 show the summary of collected temperature data.

Table 2-1: Minimum, maximum, and average temperature (SRK, 2009).

Months	Minimum (°C)	Maximum (°C)	Average (°C)
January	13.2	25.8	19.5
February	13	25.4	19.2
March	11.4	24.5	18
April	8.1	22.1	15.2
May	3.8	19.6	11.7
June	0	16.9	8.4
July	0.2	17.1	8.5
August	2.9	20.1	11.5
September	6.5	23.1	14.5
October	9.9	24.5	17.2
November	11.4	24.5	18.8
December	12.7	25.4	19
Annual	7.7	22.5	15.1

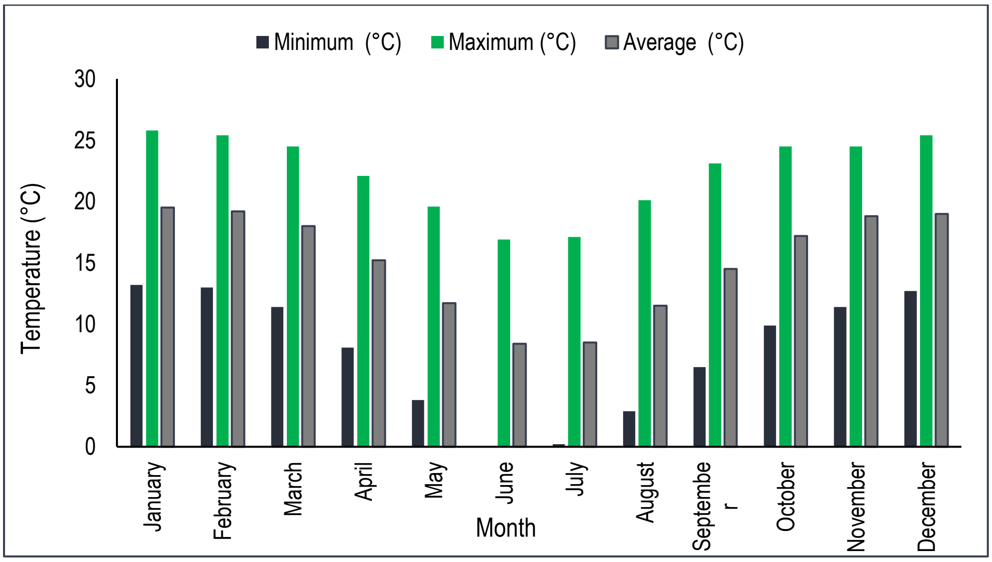

Figure 2-1: Minimum, maximum and average temperature.

The study area has an average monthly rainfall that varies from 7 mm in July to 128.1 mm in January. Annual rainfall in the area is about 719.8 mm, with the majority of the rainfall (85%) occurring between October and February. Average monthly evaporation varies from 81 mm in June to 198 mm in December. Annual evaporation is about 1729 mm, which is much higher compared to annual rainfall (Table 2-2 and Figure 2-2).

Table 2-2: Monthly rainfall and evaporation (SRK, 2009).

Months	Mean monthly rainfall (mm)	Mean monthly evaporation (mm)
January	128.1	180
February	97.6	153
March	11.6	150
April	42.1	111
May	17.5	94
June	8.5	81
July	7	90
August	9.7	135
September	23.4	176
October	72.8	191
November	116.2	170
December	119.3	198
Annual	**719.8**	**1729**

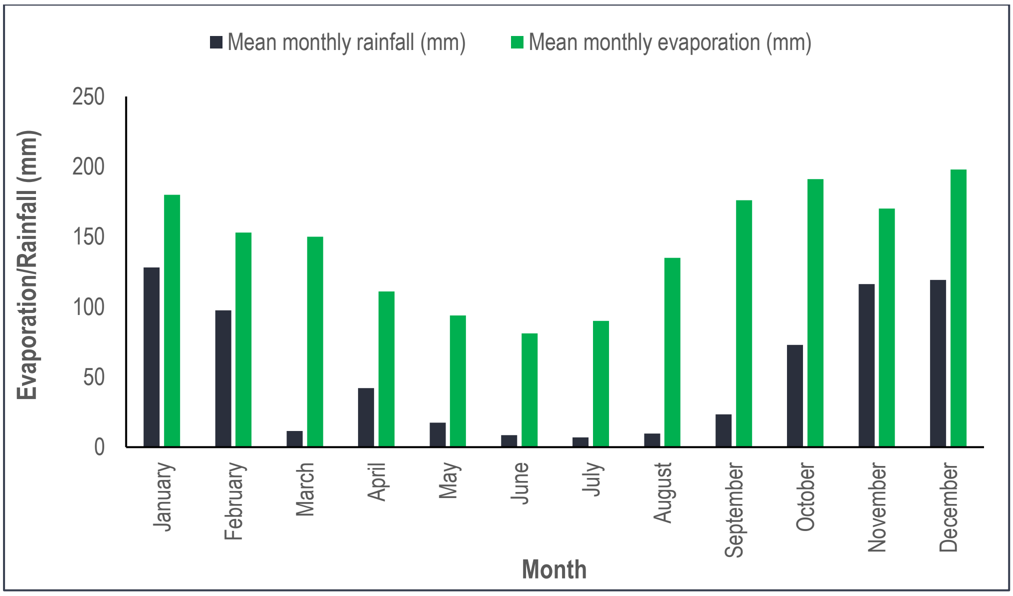

Figure 2-2: Monthly rainfall and evaporation.

2.2 Topography and drainage

Surface landform in the area is characterised by gently undulating hills and valleys. A large portion of the mining right boundary comprises a gentle slope that reaches 4°, with some localities especially along the river valley and ridges that comprise a slope varying from 4° to 11.3° (Digby Wells, 2018). Figures 2–3 show the surface elevation of the area. Surface elevation of the mine area ranges from 1415 to 1649 mamsl. The southern portion of the mining right boundary consists of high elevation that decreases towards the north and northwest of the mine. A ridge in the southern boundary of the mine is evident, with an orientation of northeast to southwest direction. A small portion of the mine boundary in the east consists of an elevation rising from an elevation of 1649 mamsl and decreasing towards the southeast of the mine.

The mine is located in the Olifants Water Management Area (WMA). The mine boundary spans across three quaternary drainage regions, namely, B20G, B11F, and B20F (Figures 2–4). The mine is drained by several rivers that include the Saalboomspruit, the Tweefonteinspruit, and the Noupoort River. A large portion of the mine is drained by northerly flowing rivers that originate within the ridge in the south. This ridge forms a surface water divide between the Saalboomspruit, Tweefonteinspruit, and Noupoort Rivers. Both the Tweefonteinspruit and Noupoort River drains towards the east of the mine (Figure 2-5).

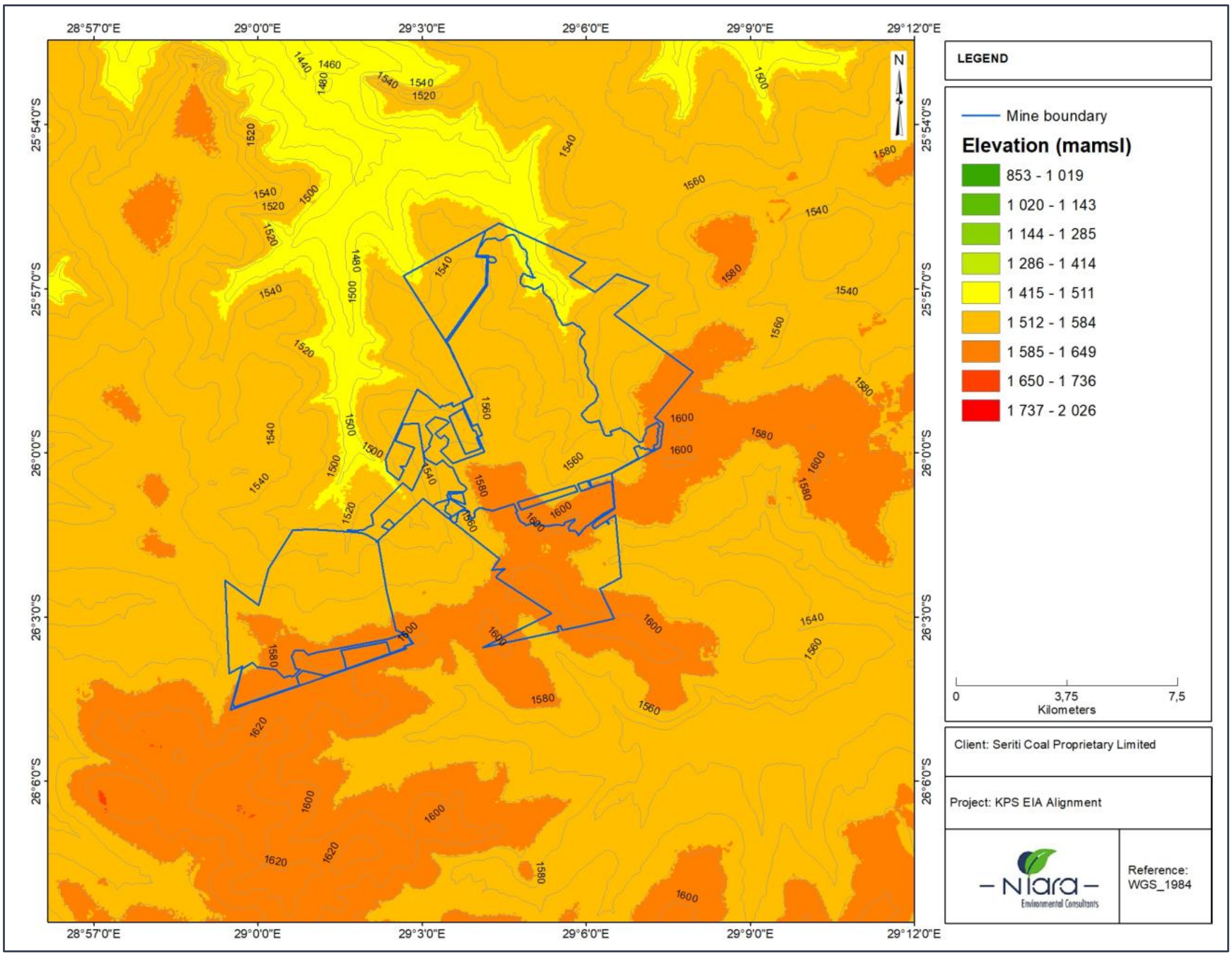

Figure 2-3: Surface elevation.

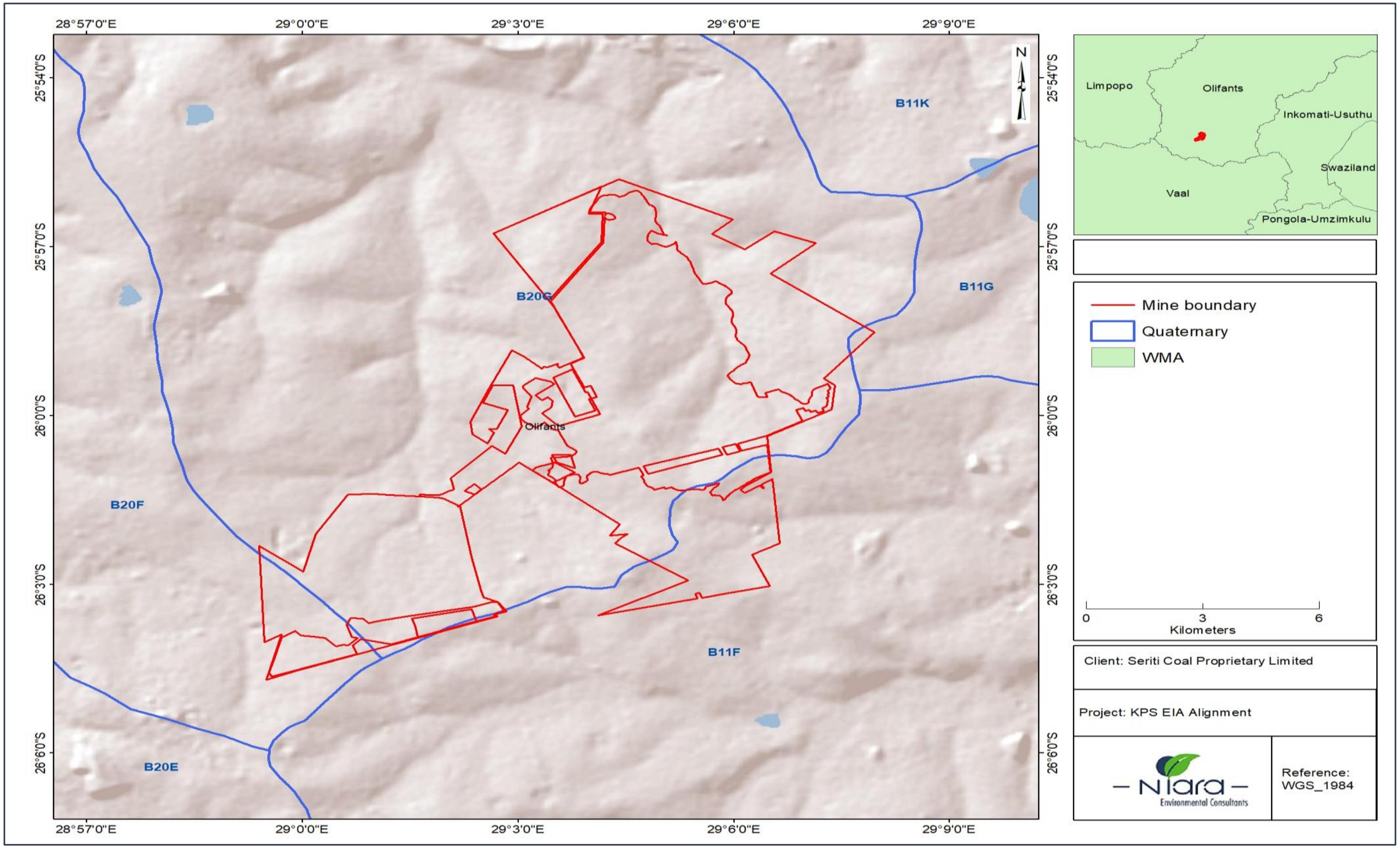

Figure 2-4: WMA and associated quaternary drainage.

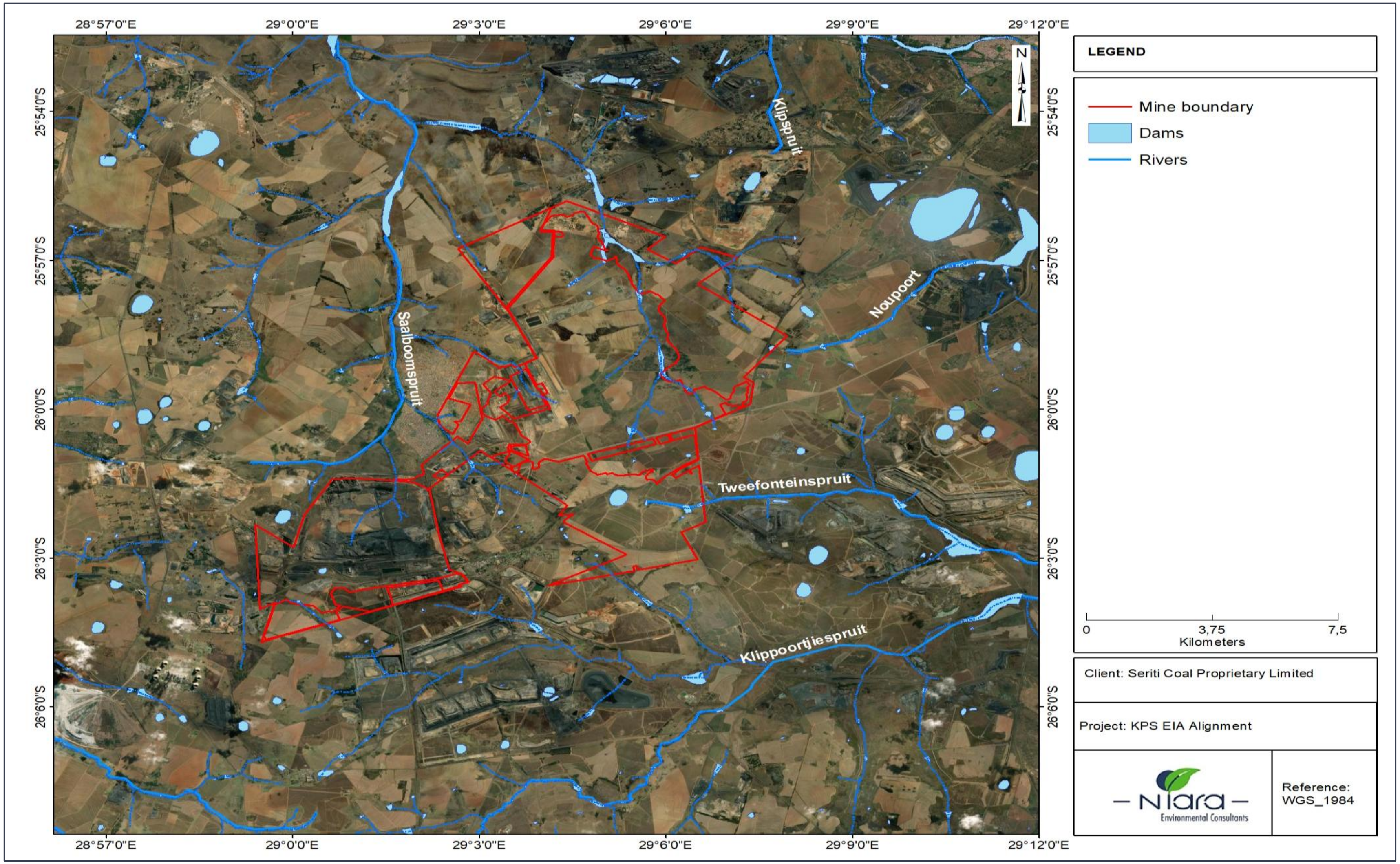

Figure 2-5: Surface drainage.

3 Scope of Work

This report provides groundwater impact assessment for Klipspruit Colliery as part of the Environmental Impact Assessment (EIA) Alignment for the mine. The purpose is to describe all hydrogeological aspects and groundwater-related impacts associated with the Klipspruit Colliery. In order to describe the hydrogeological aspects, it was necessary to subdivide the report into various sections. The following sections were covered in the hydrogeological study.

- Introduction and background of the study: objectives, scope of work, methodology, and description of the study area.
- Description of the climate, rainfall, evaporation, temperature, topography, and drainage.
- Description of the geological setting, including regional geology, local geology, and structural geology.
- Description of the hydrogeology, including aquifer type, aquifer yield, groundwater level, groundwater flow, groundwater quality, and aquifer parameters.
- Characterisation and description of the groundwater potential contaminants
- Characterisation of acid generation material, groundwater quality, and associated impacts.
- Description of aquifer characterisation, including aquifer classification, aquifer vulnerability, and aquifer susceptibility.
- Description of groundwater monitoring plan, including monitoring network, monitoring frequency, and monitoring parameters.
- Conducting groundwater modelling and predictions
- Description of the post-closure management plan, groundwater potential contaminants, geohydrological impacts, and groundwater environmental management program.

4 Methodology

4.1 Desk study

The primary methodology to conduct this study was to conduct a series of desk-top studies of a literature review nature. The section formed the basis for collecting site-specific data and information. Processed data, raw, digital, and interpreted data was collected and reviewed. The following information were critical for reviewing:

- Hydrogeological maps, data, brochures, reports, shapefiles, journal articles, and related information.
- Geological map, data, brochures, reports, shapefiles, journal articles, and related information
- Previous geophysical data, information, and reports
- Topographic maps
- Satellite images (Google Earth)
- Drilling, core logs, and overall geology information

- Groundwater data and information
- Borehole data and coordinates
- Water chemistry and natural background concentration
- 1:50 000 Topographic Map
- 1:250 000 Geology Map Series
- 1:500 000 General Hydrogeological Map Sheet
- 1:500 000 General Hydrogeological Map Brochure

4.2 Hydro –census

Information and data on groundwater users and available boreholes in the mine and immediate surroundings were assessed based on the report compiled by Digby Wells (2015), Digby Wells (2018), and Niara (2022). These reports were compiled for KPS mining sections. The following information was targeted for critical review and compilation of the report:

- Pump installation depth
- Borehole depth
- Depth to water level
- Yield of the borehole
- Depth of water strike(s)
- Volume abstracted
- Water quality
- Contact details of owners
- Farm name and portion

4.3 Geophysical survey and results

KPS has monitoring boreholes located within KPS, KPSS, and KPSX mining sections. Hence, the geophysical survey was not carried out as part of this investigation. Although existing activities have monitoring boreholes, the mine has proposed some additional activities. Monitoring boreholes have been recommended for drilling within the mine. This is to ensure that impacts of the proposed and existing activities on groundwater level, yield, and quality are monitored.

Drilling of new boreholes within the sites must follow scientific investigation, which is to conduct a geophysical survey to identify drilling targets prior to drilling. Geophysical survey is one of the methods commonly used in groundwater exploration and borehole citing. This method provides crucial guidance for identifying targets with potential for successful boreholes. The main aim of applying geophysical methods is to measure the properties of rocks, making it possible to interpret the underground occurrences of joints, fractures, and groundwater occurrence.

4.4 Drilling and siting of boreholes

Drilling of additional monitoring boreholes must be conducted, following geophysical recommendations. The following information must be collected during drilling:

- Borehole coordinate
- Borehole name
- Borehole depth
- Water strikes
- Drilling equipment
- Geological formation and material
- Groundwater conditions
- Borehole yield
- Casing above the surface

4.5 Sampling and chemical analysis

The mine has an ongoing monitoring program for KPS operations. Water quality assessment was conducted based on water quality data and a report compiled by Aquatico Scientific (Pty) Ltd. Aquatico Scientific conducted monitoring and compiled a water quality monitoring report that covers both surface water and groundwater resources.

The following provides a summary of the methods used during monitoring:

Fieldwork

Fieldwork was conducted in accordance with the code of practice, SABS ISO 5667-1-15. The document provides detailed information related to fieldwork and sampling.

Sampling procedures

Surface and groundwater samples were collected in accordance with SABS standards and DWAF guidelines. The following standards were used:

- ISO 5667-1: 2006 Part 1: Guidance on the design of sampling programs and sampling techniques
- ISO 5667-3: 2018 Part 3: Guidance on preservation and handling of samples
- ISO 5667-6: 2014 Part 6: Guidance on sampling of rivers and streams
- ISO 5667-11: 2015 Part 11: Guidance on sampling of groundwaters
- DWAF Best Practice Guidelines Series G3: General Guidelines for Water Monitoring Systems

The samples were submitted to the laboratory for the determination of physical, chemical, and microbiological analyses.

4.6 Groundwater modelling

The groundwater model was simulated based on the United States Geological Survey's (USGS) numerical groundwater modelling code, namely Model Muse and Modeflow. The aim was to predict impacts associated with the activities in question. The following procedure was followed:

- Development of the conceptual model
- Simulation of a groundwater flow model
- Simulation of the contamination transport model

The following properties form the basis for the simulation of groundwater flow and transport models:

- Groundwater recharge
- Evapotranspiration
- Hydraulic conductivity
- Porosity
- Concentration of SO4
- Aquifer thickness

The following boundary conditions were used during the simulation:

- Recharge package
- Well package
- Drain package
- Evapotranspiration package
- Time variant-specific head package

The model incorporated site-specific geology, hydrogeology, topography in the form of the Digital Elevation Model (DEM), climate, and drainage features. Calibration of the model was conducted accordingly. The measured groundwater level within the model boundary was targeted for calibration. Based on the available and previous data, reports, maps, current monitoring data, and information, a numerical model was constructed.

5 Prevailing groundwater conditions

5.1 Geology

5.1.1 Regional geology

Regional geology of the area comprises the sedimentary deposits of the Karoo Supergroup. The supergroup is famous due to the occurrence of the coal deposits in South Africa, its terrestrial vertebrates' fossils, distinctive plant assemblages, thick glacial deposits, and extensive dolerite dykes and sills (Johnson et al., 2006). The deposit is associated with the series of the Gondwana Basin developed as a result of subduction, compression, collision, and terrane accretion along the southern margin of Gondwana. In the world, other deposits of similar age are found in South America, Falkland Island, Madagascar, India, and Australia (Figure 5-1).

Figure 5–2 shows the location of the Karoo Supergroup in South Africa and adjacent territories. Apart from South Africa, the deposit is also found in Namibia, Lesotho, Botswana, Zimbabwe, and Mozambique. The deposit has been subdivided into the Main Karoo, Tuli, Springbok Flats, Tshipise, and Ellisras Basins (Johnson et al., 2006). KPS mining operations are located within the Main Karoo Basin.

The Main Karoo Basin is approximately 700 000 km^2 in area extent. The basin comprises several sedimentary deposits divided into:

- Dwyka group
- Ecca group
- Beaufort group
- Molteno, Elliot, and Clerens Formation
- Drakensburg Group

The basin also comprises the Drakensberg Group, which is characterised by basaltic lava. Figure 5-3 shows the surface geological outcrop of the KPS mining area. The following geology forms part of the surface outcrop in the area:

- Dwyka Group
- Vryheid Formation
- Karoo Dolerite
- Quaternary deposit

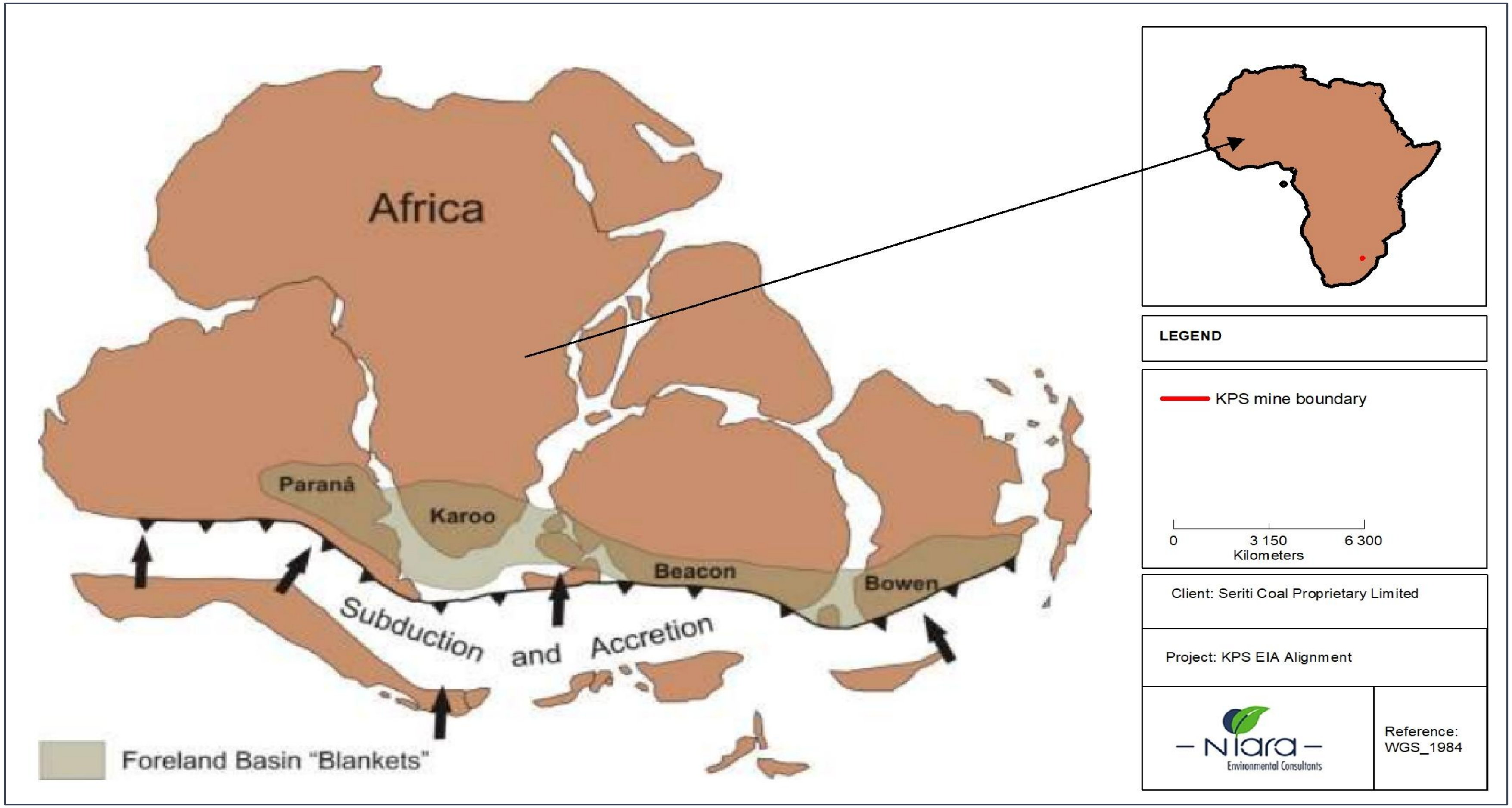

Figure 5-1: Position of the Karoo Basin in relation to the other Karoo aged depocentres of south-western Gondwana (Modified from: Hancox and Götz, 2014; de Wit and Ransome, 1992).

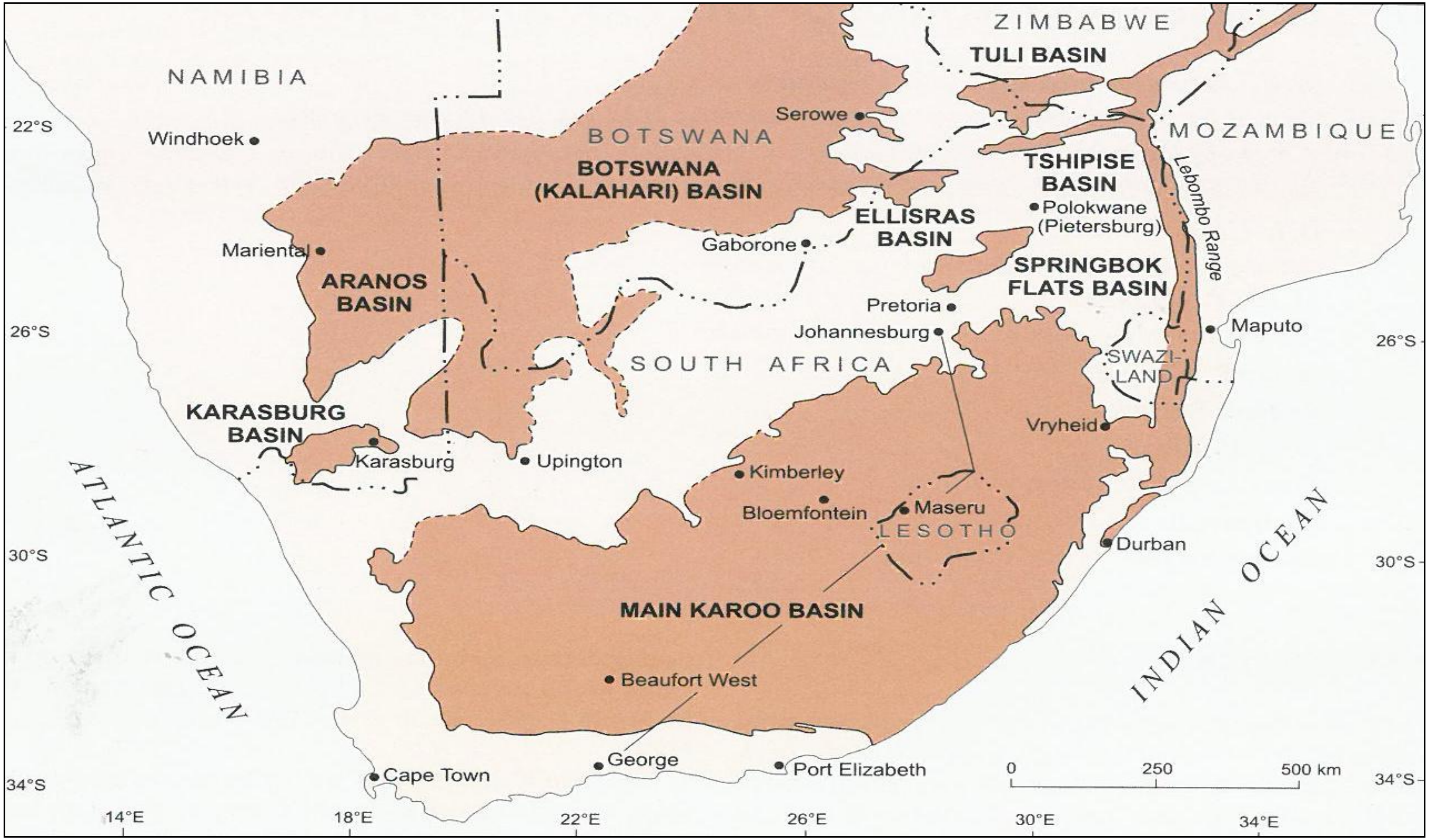

Figure 5-2: Location of the Karoo Basins in South Africa and adjacent territories (Johnson et al., 2006).

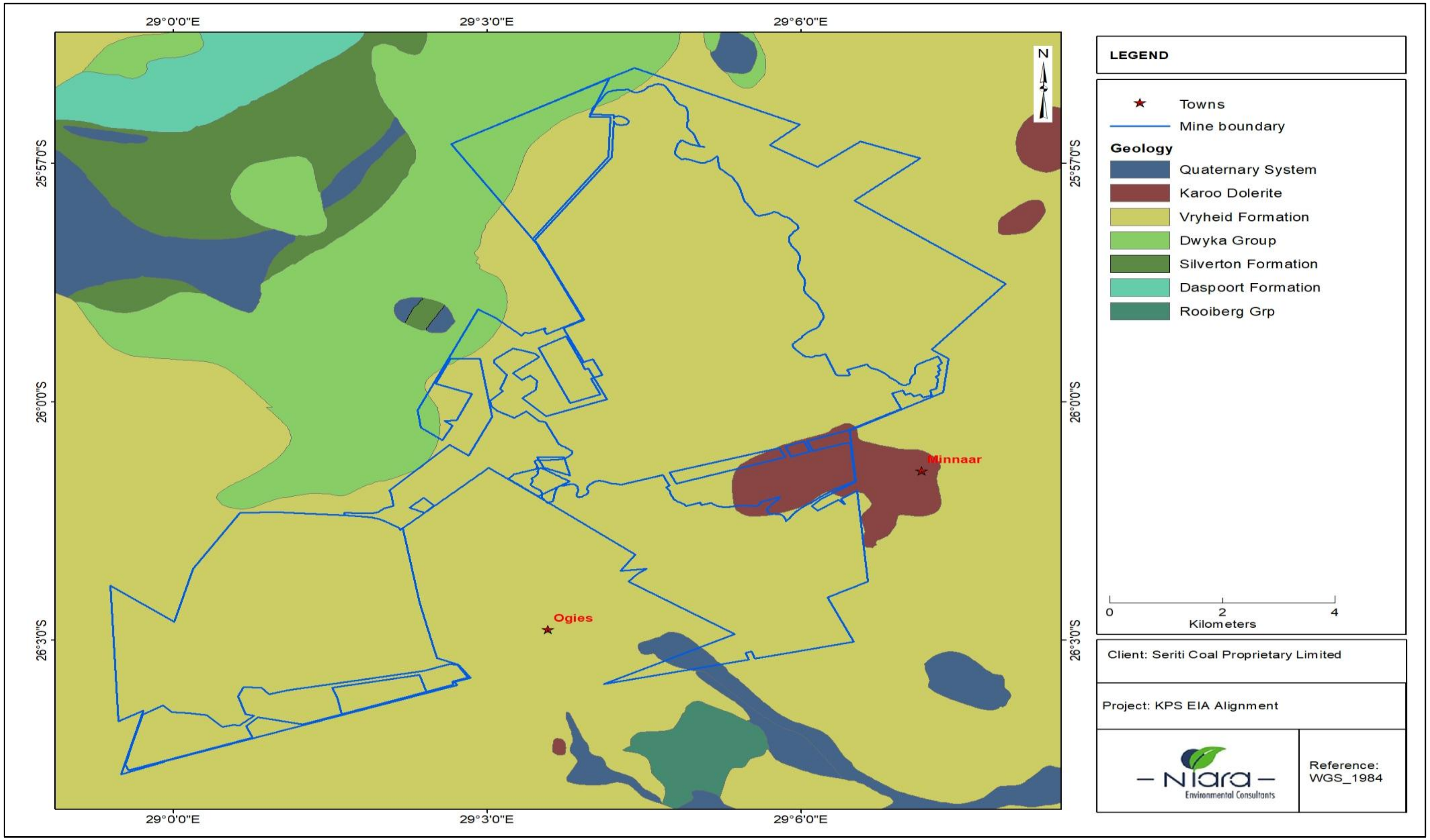

Figure 5-3: Surface geological outcrop within KPS.

5.1.2 Local geology

KPS is underlain by the Vryheid Formation of the Ecca Group, Dolerite intrusion, Dwyka Group and quaternary cover. According to South32 (2019), the surface topography of the coal resource area is characterised by flat to undulating topography with an average elevation of 1,550 m. The occurrence of soil, sand, laterite, and clay was noted mainly above the solid sediment. This unconsolidated material varies in thickness from 10 to 12 m depending on the depth of weathering (South32, 2019).

The geological log recorded during exploration comprises the following (SRK, 2009):

- Soft overburden
- Hard overburden
- 5 coal seam
- Inter burden
- 4U coal seam
- Inter burden
- 4L coal seam
- Inter burden
- 3 coal seam
- Inter burden
- 2 coal seam
- Inter burden
- 1 coal seam

No. 1 coal seam occurs above the basement deposit consisting of diamictite rock of glacial origin. The topography of the coal seam has been controlled by pre-Karoo topography that played a significant role in the distribution of coal seam No. 3, 4, and 5. Exploration records suggest that No. 4L coal seam is discontinuous within the mine, with No. 2 coal seam being continuous (SRK, 2019).

In the KPS Main pit, exploration drilling suggests the existence of six coal seam that include 5 seam, 4-Upper seam, 4- Lower seam, 3 seam (not economic), 2 seam and the 1 seam. Mapping within the section suggests that the topography slopes towards the north. Further analysis suggests that in areas with flat-lying coal seams, the coal was affected by weathering. In the area north of the Ogies Dykes, a limited extent of the No. 5 coal seam was recorded, which confirmed the effects of weathering in this region (South 32, 2019). In the southern portion of KPS, No. 5 coal seam has well developed. Figure 5-4 shows a north-south cross section of the Klipspruit mining area.

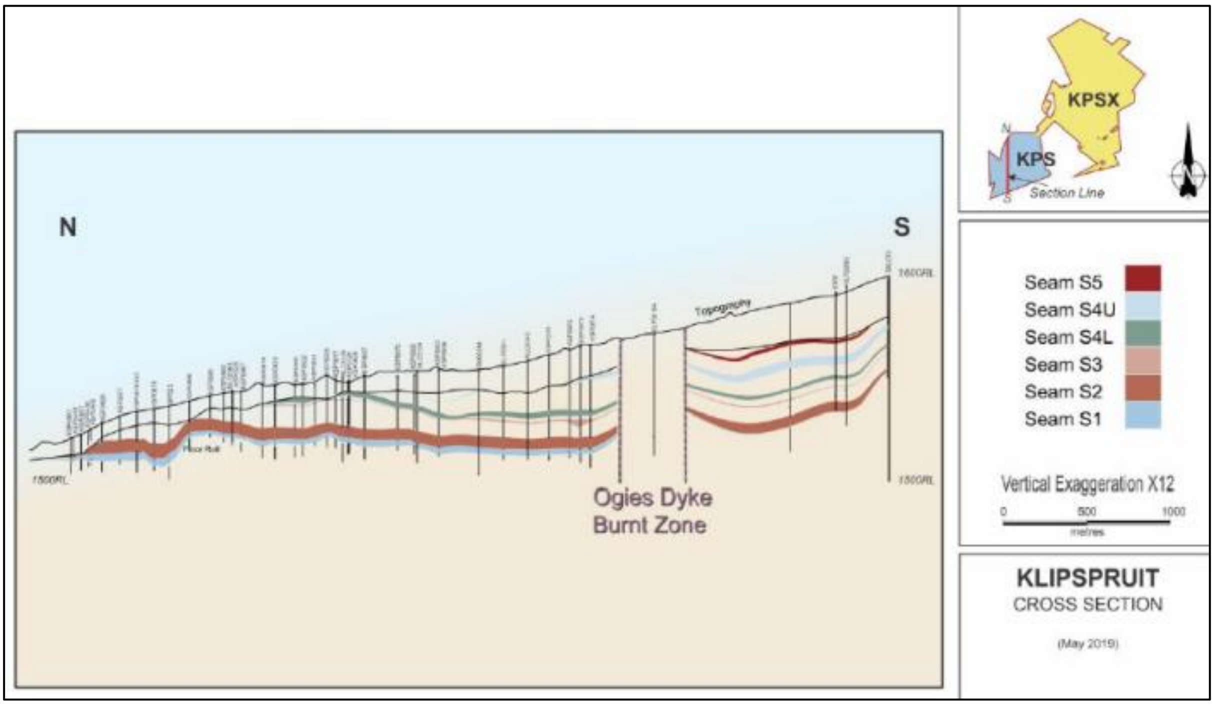

Figure 5-4: North-South cross section through Klipspruit Mining Right Area (South32, 2019).

Figure 5 – 5 shows the general stratigraphy for Klipspruit South area. The geological deposit of the Klipspruit area is that of the Witbank coalfield and comprises the white, fine- to coarse-grained sandstone layer, shale, and siltstones. The following provides a summary of the geological log:

- The top layer is composed of soil.
- The topsoil is underlain by the fine- to coarse-grained sandstones.
- No. 5 coal seam occurs below the sandstone, between the depths of 10 and 15 m below ground level.
- In some areas, such as Main Pit Ramp 4, No. 5 seam was not found. In this region, a shale was found below the sandstone, followed by No. 4 Upper Seam, with a shale below the No. 4 Upper Seam.
- An alternating shale, sandstone, and No. 4 upper and lower seam was found between the depths of 15 and 40 m below ground.
- No. 2 seam occurs between the depths of 40 and 55 m below ground, with Dwyka Group occurring at the bottom.

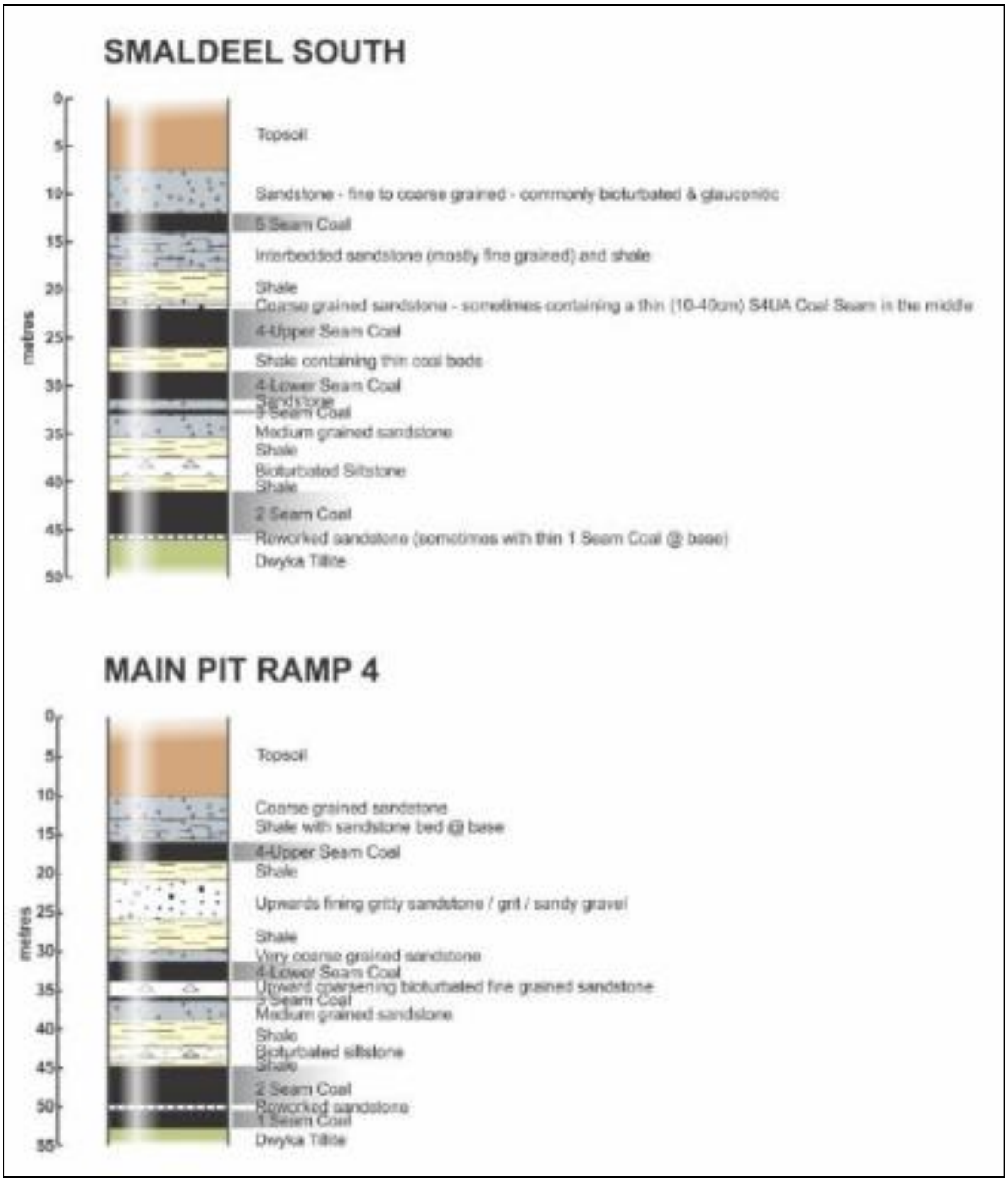

Figure 5-5: General Stratigraphic Column - Klipspruit South (South32, 2019).

The lithological sequence of the KPSX is shown in Figure 5-6. The following was observed in the KPSX mining area:

- The stratigraphy of the KPSX has some features similar to those of the KPS Main Pit.
- The No. 5 seam is different from the KPS Main pit in terms of the quality.
- The No. 4 upper seam is better developed at KPSX than KPS south.
- No 2A seam was mapped at KPSX.

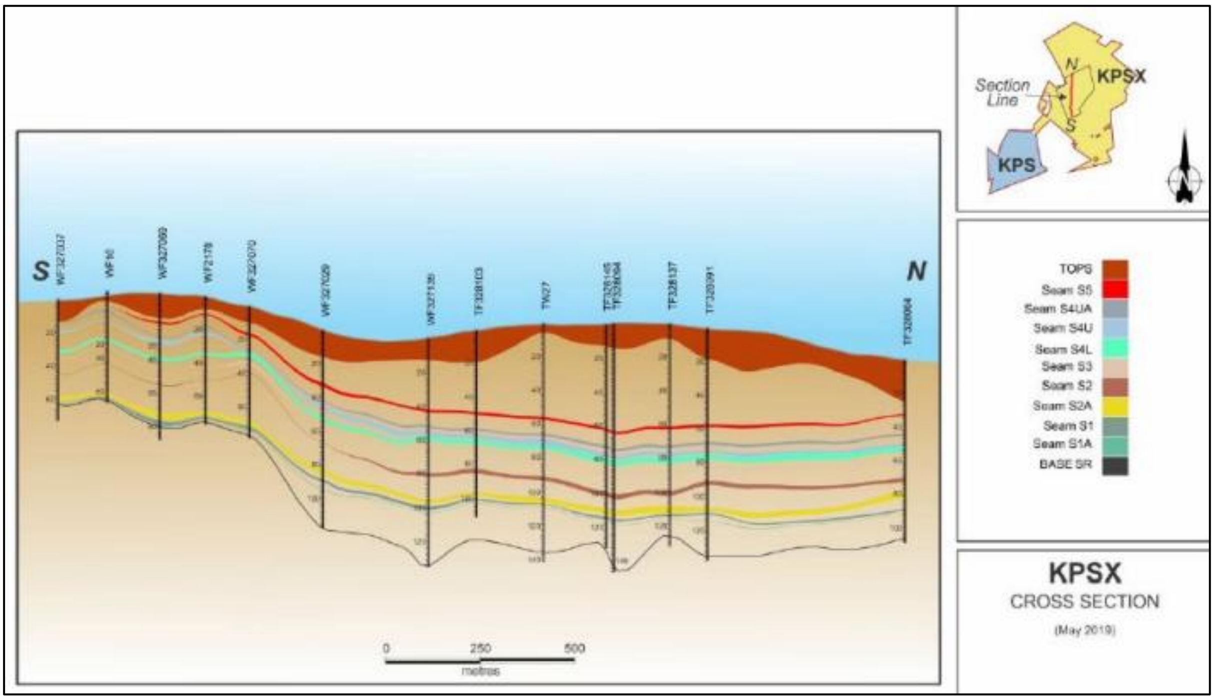

Figure 5-6: North-South cross section - KPSX area (South32, 2019).

According to SRK (2009), the underground mine section comprises the No. 2 and 4 seams, which are well developed with a parting thickness of 12 m. The coal is interbedded with material composed of sandstone and mudstones. Table 5-1 to 5-3 shows the geology of the underground mine section. Overburden soil varies from 0.42 to 11.55 m with an average of 6.27 m. Zone of weathering varies from 11.27 to 34.51 m with an average of 20.31 m. Maximum overburden from surface to No. 5, 4L, 2, and 1 is 35.4 m, 54.8 m, 66.73 m, and 69.28 m, respectively. Average coal thickness is about 1.86 m, 3.97 m, 1.51 m, and 3.92 m for No. 5, No. 4U, No. 4L, and No. 2 coal seams, respectively. Table 5-3 provides a statistical summary of the exploration.

Table 5-1: Limit of weathering and total overburden depths for the proposed underground section (SRK, 2019).

Description	Minimum	Maximum	Average
Soft soil overburden thickness (m)	0.42	11.55	6.27
Weathering Thickness (m) (This is for the total study area)	11.27	34.51	20.31
Total Overburden from surface to the No.5 coal seam – where present (m)	18.3	35.4	25.7
Total Overburden from surface to the No.4L coal seam (m)	13.56	54.8	38.95
Total Overburden from surface to the No.2 coal seam (m)	16	66.73	50.79
Total Overburden from surface to the No.1 coal seam (m)	61.1	69.28	64.93

Table 5-2: Thickness of the main coal seams for the proposed underground section (SRK, 2019).

Coal seam number	Average (m)
No.5 coal seam	1.86
No.4U coal seam	3.97
No.4L coal seam	1.51
No.2 coal seam	3.92

Table 5-3: Stratigraphic composition for the different lithological units above the No.1 coal seam, for the underground section (SRK, 2019).

Description	Count	Min (m)	Max (m)	Ave (m)	%	Weighted (%)
Overburden	27	0.42	11.55	6.27	28	18.66
Sandy gravel	3	0.07	0.12	0.09	0.4	0.03
Sandstone (Gritty)	51	0.04	12.11	1.52	6.79	8.54
Sandstone (Muddy	19	0.04	2.77	0.8	3.57	1.68
Sandstone (Coarse)	19	0.07	3.66	0.99	4.42	2.07
Sandstone (Medium grained)	29	0.04	3.8	1.51	6.74	4.83
Sandstone (Fine)	118	0.03	6.23	1.02	4.56	13.26
Mudstone	62	0.01	5	1.69	7.55	11.55
Mudstone (Pebbly	7	0.08	2.11	0.63	2.81	0.49
Mudstone (Sandy)	36	0.08	5.45	1.26	5.63	5
Fines	63	0.06	2.71	0.95	4.24	6.6
Shale	1	0.14	0.14	0.14	0.63	0.02
Coal (Other)	79	0.03	8.03	2.78	12.42	24.2
Diamictite	18	0.12	1.59	0.8	3.57	1.59
Rest	7	1.2	4.86	1.94	8.66	1.5
Total	**539**			**22.39**	**100**	**100**

The geology of the strip mining is summarised in Table 5-4 to Table 5-6. The following section provides a brief description.

Weathering and total overburden depths:

- General stratigraphy of the strip mining area is composed of overburden ranging from a minimum of 4.8 – 19.15 m with an average of 10.09 m.
- The weathering thickness ranges from 11.27 m – 34.51 m, with an average of 20.31 m.
- Maximum thickness above the No 5, 4L, 2 and 1 is about 29.23 m, 43.55 m, 57.04 m, and 56.67 m respectively.

Thickness of the main coal seams for the area north of the Ogies Dyke:

- Average thickness of No.5 coal seam ranges from 1.56 m to 6.05 m. The thickness is about 1.56 m for No 5 coal seam, 2.5 m for No 4U coal seam, 2.65 m for No 4L coal seam, and 6.05 m for No 2 coal seam.

General stratigraphy of the area is composed of the following rocks and soil:

- Overburden
- Sandy gravel
- Grit
- Sandstone (Gritty)
- Sandstone (Muddy)
- Sandstone (coarse-grained)
- Sandstone (medium-grained)
- Sandstone (fine-grained)
- Mudstone
- Mudstone (Pebbly)
- Mudstone (Sandy)
- Fines
- Shale (Carbonaceous)
- Coal (Other)
- Dolerite

Table 5-4: Limit of weathering and total overburden depths for the proposed strip mine section (SRK, 2019).

Description	Minimum	Maximum	Average
Soft soil overburden thickness (m)	4.8	19.15	10.09
Weathering Thickness (m) (This is for the total study area)	11.27	34.51	20.31
Total Overburden from surface to the No.5 coal seam – where present (m)	7.16	29.23	15.48
Total Overburden from surface to the No.4L coal seam (m)	5.1	43.55	17.33
Total Overburden from surface to the No.2 coal seam (m)	14.24	57.04	24.72
Total Overburden from surface to the No.1 coal seam (m)	18.11	56.67	31.8

Table 5-5: Thickness of the main coal seams for the area north of the Ogies Dyke (SRK, 2019).

Coal seam number	Average (m)
No.5 coal seam	1.56
No.4U coal seam	2.5
No.4L coal seam	2.65
No.2 coal seam	6.05

Table 5-6: Stratigraphic composition for the different lithological units above the No.1 coal seam, for the strip mine section (SRK, 2019).

Description	Count	Min (m)	Max (m)	Ave (m)	%	Weighted (%)
Overburden	29	4.8	19.15	10.09	29.83	17.74
Sandy gravel	1	0.52	0.12	0.52	1.54	0.03
Grit	4	0.03	3.83	2	5.91	0.48
Sandstone (Gritty)	18	0.03	3.72	1.18	3.49	1.29
Sandstone (Muddy)	79	0.08	9.73	2.01	5.94	9.63
Sandstone (Coarse grained)	53	0.06	11.9	1.59	4.7	5.11
Sandstone (Medium grained)	77	0.04	11.46	1.9	5.62	8.87
Sandstone (Fine grained)	102	0.05	17.52	2.68	7.92	16.57
Mudstone	83	0.03	7.2	1.86	5.5	9.36
Mudstone (Pebbly)	7	0.04	0.78	0.37	1.09	0.16
Mudstone (Sandy)	82	0.03	13.05	2.3	6.8	11.43
Fines	62	0.08	18.25	1.44	4.26	5.41
Shale (Carbonaceous)	1	0.25	0.25	0.25	0.74	0.02
Coal (Other)	122	0.03	8.27	1.75	5.17	12.94
Dolerite	2	1.8	3.6	2.7	7.98	0.33
Rest	9	0.04	2.4	1.18	3.49	0.64
Total	**731**			**33.82**	**99.98**	**100.01**

5.2 Acid generation capacity

5.2.1. Acid-Base Accounting

ABA is the most used technique for predicting the water quality likely to result from a mining operation (Smith & Brady, 1990). It is also a cost-effective means of predicting acid rock drainage (ARD) potential. Acid-base accounting illustrates the ultimate acidity or basicity of different rock zones in the overburden (Skousen et al., 1971). According to Price (2010), ABA is a series of compositional analyses and calculations that entail the:

- Analysis of pH.
- Analysis of sulphur species and calculation of the acid potential (AP).
- Analysis of Neutralisation Potential (NP).
- Calculation of NP/AP (Neutralisation Potential Ratio, NPR) and NP-AP (Net Neutralisation Potential, NNP).

5.2.2. Net Acid Generation

NAG is one of the static test methods used for geochemical assessment. The method assists in assessing and predicting the potential of the rock to generate acid during mining and after closure. The method can be used separately to characterise the acid generation potential of the rock or waste. However, it can also be used to predict acid generation potential as a supplementary method to ABA.

5.2.3. Sulphur Speciation

Sulphur speciation is one of the critical components of acid mine drainage formation. The presence of sulphur in waste material has major environmental risks and mpacts. One of the common impacts is the potential to generate acid mine drainage. The parameters have been analysed to support the ABA and NAG methods.

5.2.4. Geochemical assessment and classification

5.2.1.1 SRK, 2009: Klipspruit Colliery Revised and Consolidated EIA and EMP

Sampling location and description

The lithological profile was considered in collecting samples for analysis of geochemistry. Samples were collected in three boreholes drilled, and four samples were collected during exploration boreholes. These samples were critical in understanding the geochemical signature of the stratigraphic unit above No. 1 coal seam. In total, 20 samples were collected and subjected to the Modified Sobek (Lawrence) Method in order to determine the ABA and leach test analyses.

The composition of the samples collected is as follows:

- Soft overburden (soils and clays, weathered shale, mudstone, and sandstone);
- Hard overburden (unweathered sandstone, mudstone, and shale);
- ’s 5, 4, 3, 2, and 1 coal seams (some not totally developed); and
- Interburden (sandstone units, mudstone, and shale (some carbonaceous).
- The geochemical characterisation is concentrated on the overburden and the coal seams.

Acid Base Accounting Results:

- Of the total of twenty samples, three samples had a paste pH of less than 7.20, which suggests that the majority of the samples will have excess base material present in the geology of the site. Mine water drainage in this lithology will be characterised by elevated alkalinity.
- Total S% in all lithologies varies from 0.001% to 0.846%, with an average of 0.144%. In these areas, pyrite mineralisation distribution in lithology was heterogeneity.
- The value of Acid Generation Potential (AP) varied from 0.03 kg/t CaCO3 to 26.4 kg/t CaCO3, with an average of 4.5 kg/t CaCO3. Six samples are characterised by elevated AP values.
- The Potential (NP) value ranges from 0 kg/t CaCO3 to 15.5 kg/t CaCO3, with an average of 4 kg/t CaCO3. All samples comprise an average lower than the AP value.
- The Nett Neutralization Potential (NNP) was measured between -13.6 kg/t CaCO3 and 15.1 kg/t CaCO3. While the negative value suggests the presence of acid potential samples, some samples comprise a positive value suggesting the presence of neutralisation potential samples.
- The rock types assessment results suggest that six samples are Type I, which represent potential acid-forming samples, while three and eleven samples are intermediate and non-acid-forming samples.

Geochemical strata:

Geochemical strata were separated and sampled according to lithological types and soil. The following was identified and sampled according to the type of material:

- Soil profile with clay layer underneath
- Grey-pinkish, fine-weathered sandstone
- Grey-white, fine massive sandstone and greyish shale; and
- 4 and No. 2 coal seams and highly carbonaceous shale

Summary of findings, Geochemical strata (Table 5.7):

Soil profile with clay layer:

- The average value for %S is about 0.001. This value suggests that the sample is AP.
- The value of NP is present at a higher value above the value of AP.
- Average NNP value is positive, which suggests excess neutralisation potential.

Fine-grained weathered sandstone:

- The value of S varies from 0.001 to 0.133, with an average of 0.045. This suggests that the sample is AP.
- Overall NNP average value is positive, which shows excess neutralisation potential.

Fine-grained fresh sandstone and shale:

- The unit is characterised by shale and sandstone, where shale comprises a higher %S value than sandstone.
- The value of %S was less than 0.137%, with exploration borehole samples containing higher %S.
- The NNP value also suggests an excess neutralisation potential due to positive values.

No's. 2 and 4: coal seam and highly carbonaceous shale

- The coal seam is characterised by higher %S in terms of average values. The samples comprise AP, which is higher than NP values.
- The coal seam and carbonaceous shale are classified as having the potential to form acid. The shale will form acid on a medium- to long-term basis.

Table 5-7: Summary of the in-situ geochemical characteristics of the overburden and coal seams at Klipspruit (SRK, 2009).

Geochemical unit and boreholes sampled		Total % S	AP (kg/t)	NP (kg/t)	NNP (kg/t)	Ratio NP: AP
Soil profile with clay layer	Min	0.001	0.031	0	-0.031	0
	Max	0.001	0.031	0.75	0.719	24
	Ave	0.001	0.031	0.25	0.219	8
Fine grained, weathered sandstone	Min	0.001	0.031	0	-0.031	0
	Max	0.133	4.156	10.25	6.094	72
	Ave	0.045	1.406	4.167	2.76	24.822
Fine grained fresh sandstone and shale	Min	0.005	0.156	0.5	-6.406	0.117
	Max	0.357	11.156	12	11.844	76.8
	Ave	0.166	5.198	5.75	0.552	25.781
No. 4 coal seam and carbonaceous shale	Min	0.273	8.531	0.5	-13.594	0.04
	Max	0.499	15.594	13.5	4.969	1.582
	Ave	0.391	12.229	5.333	-6.896	0.583
No. 2 coal seam	Min	0.846	26.438	14.25	-12.188	0.539
	Max	0.846	26.438	14.25	-12.188	0.539
	Ave	0.846	26.438	14.25	-12.188	0.539

5.2.1.2 Groundwater Report (Dibgy Wells, 2015)

The data presented in Table 5–11 was used as a reference and sourced from an operation adjacent to Klipspruit Colliery. The results have shown similar results in terms of lithological units occurring within the area. The following provides a summary of the results:

- The maximum and average values for sandstone samples show positive value in terms of NNP. This shows that the samples have excess neutralisation potential. The samples are also classified as Rock Type III in terms of their minimum, maximum, and average values, which confirm that the samples are non-acid generation.
- Minimum and average values for carbonaceous shale and siltstone are classified as acid-forming according to rock type. NNP for both minimum and average are negative, which supports the conclusion that the samples are acid-forming.
- 4 coal seam is classified as acid-forming in terms of Rock Type I. The minimum, maximum, and average values for these coal seams are all classified as Rock Type I.
- The average value for No. 2 coal seams according to Rock classified suggests a potential forming condition. Considering the high AP value compared to the NP value and the negative results of the NNP value, the samples will most likely form acid, which supports the rock type.

Table 5-8: Beesting EMPR geochemical summary (JMA, 2005; Dibgy Wells, 2015).

Geochemical unit and boreholes sampled		Total % S	AP (kg/t)	NP (kg/t)	NNP (kg/t)	Ratio NP:AP	Rock Type
Sandstone (3 samples)	Min	0.01	0.22	1	-0.59	0.63	III
	Max	0.13	3.97	5	4.03	19.43	III
	Ave	0.06	1.93	3.42	1.49	7.11	III
Carbonaceous shale and siltstones (7 samples)	Min	0.16	4.88	0	-30.41	0	I
	Max	0.97	30.41	4.5	1.13	1.23	III
	Ave	0.39	12.02	2.07	-9.95	0.33	I
No. 4 coal seam	Min	0.39	12.03	0	-55.09	0	I
	Max	1.76	55.09	17	4.97	1.41	I
	Ave	1.06	32.96	6.55	-26.41	0.44	I
No. 2 coal seam	Ave	0.64	20.09	15	-5.094	0.75	I
No. 1 coal seam	Ave	0.39	12.03	17	4.969	1.41	II

5.2.1.3 Klipspruit South Geochemical Assessment (Digby Wells, 2015).

Samples collected:

In total, fourteen samples were collected during drilling. These samples were collected at different depths based on lithology intersected during drilling. Table 5-9 shows the breakdown of samples collected during drilling.

Table 5-9: Collected geochemical samples (Digby Wells, 2015).

Boreholes	Samples	Description
BHPS01	Overburden Coal Seam 1	Composite of soil, mudstone and shale (carbonaceous)
	Coal Seam 1	Uppermost coal seam intersected
	Interburden Coal Seam 1&2	Sandstone and carbonaceous shale
	Coal Seam 2	Second intersected coal seam
	Interburden Coal Seam 2&3	Sandstone and carbonaceous shale
	Coal Seam 3	Third intersected coal seam
	Interburden Coal Seam 3&4	Sandstone and carbonaceous shale
	Coal Seam 4	Fourth intersected coal seam
BHPS02	Overburden Coal Seam 1	Composite of soil and sandstone
	Coal Seam 1	Uppermost coal seam intersected
	Interburden Coal Seam 1&2	Sandstone and carbonaceous shale
	Coal Seam 2	Second intersected coal seam
	Interburden Coal Seam 2&3	Sandstone and carbonaceous shale
	Coal Seam 3	Third intersected coal seam

Laboratory and analysis:

The samples were submitted to M & L Laboratory for determination of ABA parameters. The following were requested from the Laboratory:

- Paste pH
- NNP
- NPR
- %S
- NAG

Results and findings:

Table 5-10 provides the results of the ABA.

Total Sulphur, S%

- Three samples are classified as non-acid generation, while eleven samples have the potential to generate acid. These samples include Overburden Coal Seam 1, Coal Seam 1, Interburden Coal Seam 1&2, Coal Seam 2, Coal Seam 3, Coal Seam 4, Coal Seam 1, Interburden Coal Seam 1&2, Coal Seam 2, Interburden Coal Seam 2&3, and Coal Seam 3.
- Three samples comprise %S of less than 0.3% and are therefore classified as not acid generation. These samples are: Interburden Coal Seam 2&3, Interburden Coal Seam 3&4, and Overburden Coal Seam 1.

Paste pH

- All samples are classified as non-acid generation with the exception of Interburden Coal Seams 1 and 2, which have a paste pH of less than 5.5. This sample has the potential to generate acid.

Net Neutralisation Potential (NNP)

- Four samples, namely Interburden Coal Seam 3&4, Overburden Coal Seam 1, Coal Seam 2, and Interburden Coal Seam 2&3, are classified as non-acid generation, while two samples, namely Overburden Coal Seam 1 and Interburden Coal Seam 1&2, are classified as acid-forming material. The remaining samples are inconclusive.

Neutralisation Potential Ratio (NPR)

- Samples Overburden Coal Seam 1, Coal Seam 1, Coal Seam 3, and Coal Seam 4 are classified as having the potential to generate acid, while samples Coal Seam 2, Interburden Coal Seam 3&4, Overburden Coal Seam 1, and Interburden Coal Seam 2&3 are classified as having non-acid formation. The remaining samples are inconclusive.

Net Acid Generation (NAG)

- Seven samples, namely Overburden Coal Seam 1, Coal Seam 1, Coal Seam 2, Coal Seam 3, Coal Seam 4, Coal Seam 1, and Interburden Coal Seam 1&2, are classified as acid-forming material, with the remaining samples classified as non-acid generation.

Classification

- Seven samples of the fourteen are classified as PAC, while the remaining are classified as NON-AG.

Table 5-10: ABA and NAG Results.

Borehole	Sample ID	Total Sulphur, S %	Paste pH	AP	NP	NNP	NPR	NAG	Classification	Rock Type
	Overburden Coal Seam 1	1.48	5.6	46.2	12.1	-34.1	0.3	13.2	PAG	I
	Coal Seam 1	0.73	5.5	22.8	14.6	-8.2	0.6	1.53	PAG	I
	Interburden Coal Seam 1&2	0.96	7.6	30	38.3	8.3	1.3	<0.1	NON-AG	II
BHPS01	Coal Seam 2	0.67	7.9	20.9	32.3	11.4	3.7	6.91	PAG	II
	Interburden Coal Seam 2&3	0.2	7.7	6.24	12.7	6.46	2	<0.1	NON-AG	III
	Coal Seam 3	0.83	7.9	25.9	11.6	14.3	0.4	19.6	PAG	II
	Interburden Coal Seam 3&4	0.24	8.1	7.49	27.7	20.2	3.7	<0.1	NON-AG	II
	Coal Seam 4	0.63	8.6	16.5	31	14.5	1.9	52.62	PAG	II
	Overburden Coal Seam 1	0.01	8.3	0.31	88	88	283.9	<0.1	NON-AG	III
BHPS02	Coal Seam 1	1.21	8	37.8	47.8	10	1.3	3.3	PAG	II
	Interburden Coal Seam 1&2	4.91	5.3	153	24.3	-129	0.2	63.6	PAG	I
	Coal Seam 2	0.83	7.9	25.9	75.1	49.2	2.9	<0.1	NON-AG	II
	Interburden Coal Seam 2&3	0.38	8.4	11.9	44.2	32.3	3.7	<0.1	NON-AG	II
	Coal Seam 3	0.38	8.3	11.9	23.5	11.6	2	<0.1	NON-AG	II
	PAG	NON-AG								

5.3 Hydrogeology

5.3.1 Aquifer types

The study area comprises of three aquifer systems, namely:

- Shallow perched aquifer
- Upper weathered aquifer
- Fractured aquifer
- Pre-Karoo fractured aquifer

The physical thicknesses for the three different aquifer types are as follows (SRK, 2009):

- Shallow perched aquifer: 1 m - 5 m
- Shallow weathered zone Karoo aquifer: 8 m - 28 m; and
- Deep Karoo aquifer (above the Dwyka Till): 20 m - 90 m.

Upper weathered aquifer

According to Hodgson and Krantz (1998), this aquifer occurs within the upper zone, ranging from 5 m to 12 m. Groundwater movement within the aquifer is lateral (Vermeulen and Usher, 2006). The shallow aquifer at Klipspruit attains a thickness of 8–28 m below ground level, with an estimated saturated thickness of 5 m–25 m (SRK, 2009). The weathered aquifer occurs above impermeable shale layer and clay. Groundwater that infiltrates to the bottom of the aquifer above this impermeable layer. Seepage in the form of fountains is common where the lateral movement of flowing groundwater encounters a barrier such as dolerite dykes, paleo topographic highs in the bedrock, or where the surface topography cuts into the groundwater level at streams (Vermeulen and Usher, 2006). The aquifer is characterised by good water quality due to rapid recharge from rainfall and dynamic groundwater flow that flushes leachable salt in the aquifer.

Fractured aquifer

The fractured aquifer occurs below shallow weathered zones. It has a physical thickness of 20 m–90 m, mainly above the Dwyka Tillite. This aquifer has a saturated thickness of 17 m–87 m (SRK, 2009). The aquifer is composed of fresh sediments that are well cemented, resulting in poor groundwater storage and movement. Groundwater occurrence within the aquifer is associated with secondary structures that enhance the flow and storage. Secondary structures are common in competent rock and best developed in sandstones. Historical exploration suggests that fractures decrease with depth. Groundwater occurrence may be lower in the fresh bedrock due to poorly connected fractures and lower permeability (Hodgson and Krantz, 1998). Groundwater quality contains a high salt load. This is due to the longer residence travel time that the water is in contact with the rock (Vermeulen and Usher, 2006).

Pre-Karoo fractured aquifer

This aquifer occurs beneath the Karoo supergroup. It forms part of the basement rocks in the area. Historical record has identified only a few instances where this aquifer was intersected by drilling. This is due to the following (Hodgson and Krantz, 1998):

- The great depth
- Low yield
- Inferior quality
- Low recharge

5.3.2 Aquifer parameters

Site-specific data related to aquifer parameters were sourced from the Digby Wells (2018) report. This data is shown in Table 5-11. The parameters are summarised as follows.

Slug Test Conducted at KPSX:

- The hydraulic conductivity of the mine section varies from 0.003 to 0.045 m/d. These tests were done on three boreholes, namely BHPW03, BHPW08, and BHPW10, which comprise hydraulic conductivity of 0.003 m/d, 0.045 m/d, and 0.004 m/d, respectively.
- Fractures have hydraulic conductivity that varies from 0.053 to 0.348 m/d.
- Aquifer yield estimated from the three boreholes is 0.017 l/s for borehole BHPW03, 0.047 l/s for borehole BHPW08, and 0.02 l/s for borehole BHPW10.

Slug Test Conducted at KPSS:

- The hydraulic conductivity of the two boreholes tested at KPSS is 0.006 m/d and 0.047 m/d for BHPS1 and BHPS2, respectively.
- Fractures are characterised by hydraulic conductivity of 0.097 m/d and 6.481 m/d estimated for borehole BHPS1 and BHPS2.
- The two boreholes comprise yield that ranges from 0.024 l/s to 0.224 l/s.

Comprehensive statistical analyses of the data documented by SRK (2009) suggest the following hydraulic conductivity:

- Arithmetic mean: 1.279 m/day
- Median: 0.030 m/day
- Minimum: 0.002 m/day
- Maximum: 10.040 m/day
- Harmonic mean: 0.010 m/day
- Geometric mean: 0.088 m/day

Aquifer porosity for fine-grained sandstones varies from 1% to 12% with an average of 5%. Medium- to coarse-grained sandstones range from 4% to 15%, with an average of 9%. Effective porosity of the shallow aquifer is 3%, while the effective porosity of the deep aquifer is 0.67%.

Table 5-11: Hydraulic Conductivities of KPSX and KPSX: South (Digby Wells, 2018)

(m2/d)	Yield of borehole (L/s)	1st estimate of sustainable yield (L/s)	T-value (m2/d)				K-value (m/d)	
			Formation in vicinity of borehole	Average for formation	Fracture estimate from Svenson-equation	Fracture	Fracture	Formation in vicinity of borehole
Slug Test Conducted at KPSX								
BHPW03	0.017	0.003	0.105	0.01	0.332	0.011	0.053	0.003
BHPW08	0.047	0.009	0.284	0.028	1.117	0.07	0.348	0.045
BHPW10	0.02	0.004	0.117	0.012	0.381	0.013	0.066	0.004
Slug Test Conducted at KPSS								
BHPS1	0.024	0.005	0.145	0.014	0.492	0.019	0.097	0.006
BHPS2	0.224	0.045	1.346	0.135	7.373	1.296	6.481	0.047

5.4 Groundwater levels

This section provides a summary of all groundwater level data available for KPS Colliery. The data was sourced from the reports compiled by Digby Wells (2015 and 2018) and Niara (2022). This data is shown in Table 5-12 and Table 5-13, as well as Figure 5-7. Borehole distribution is shown in Figure 5-8.

In total, 72 boreholes that are widely distributed within the KPS mining and adjacent area were assessed. Groundwater level within KPS and immediate surroundings varies from 1 to 38 mbgl. Available water level data suggest that the majority of boreholes have a water level of less than 10 mbgl. 44% of boreholes did not have groundwater level data due to access.

Table 5-12: Summary of water level data.

Water level range	No of boreholes	Percent
<10	25	34.72
10-20	6	8.33
20-30	7	9.72
30-40	2	2.78
No water level	32	44.44

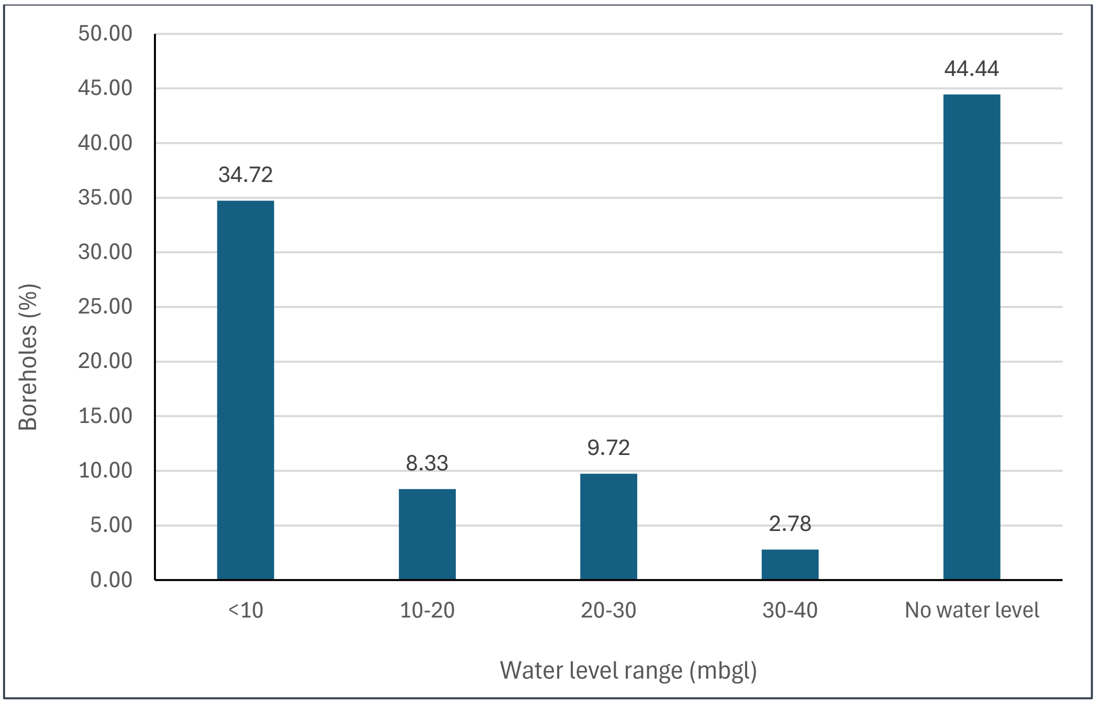

Figure 5-7: Summary of water level data.

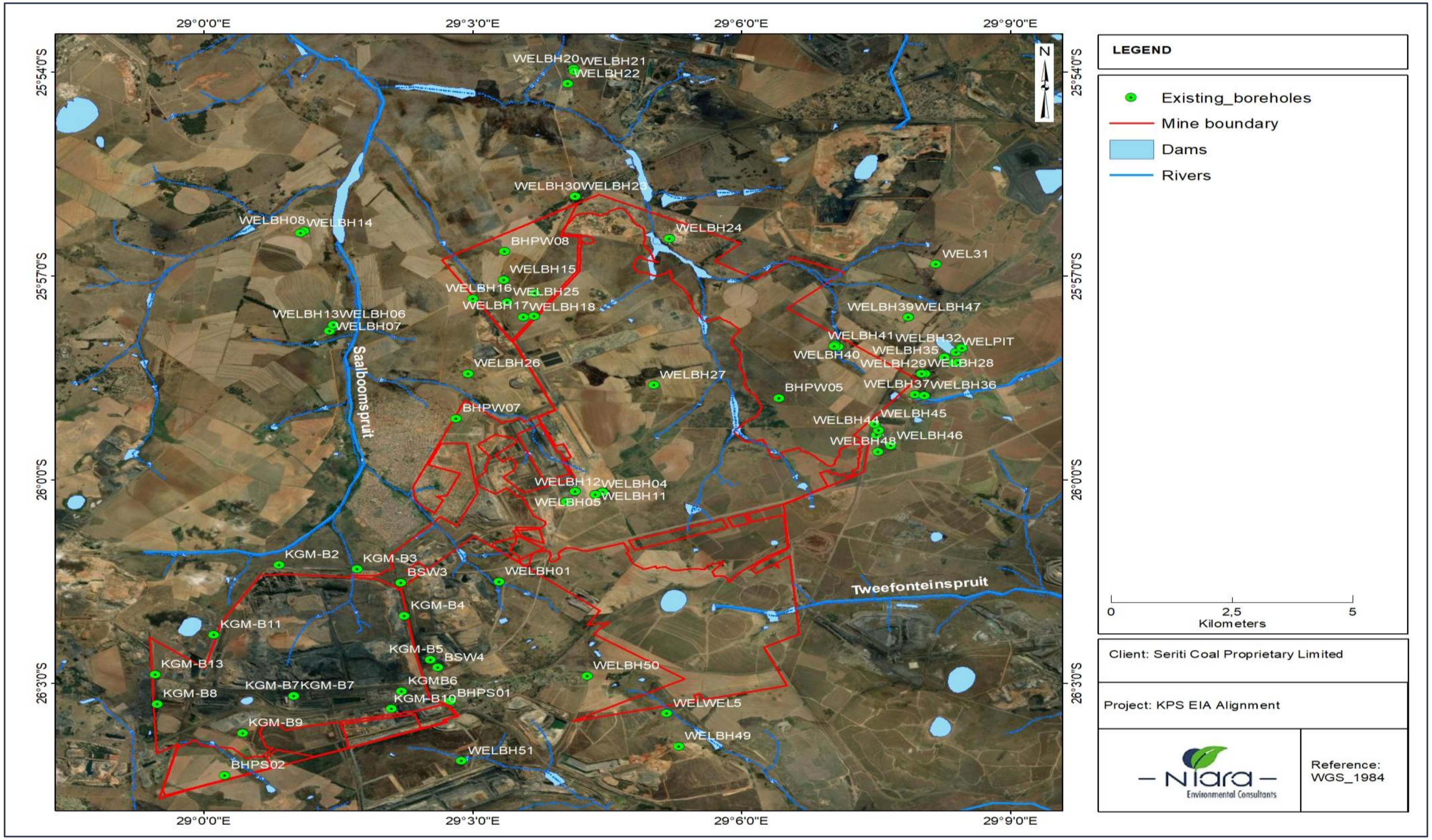

Figure 5-8: Distribution of existing boreholes.

Table 5-13: Summary of existing boreholes (Digby Wells, 2015; Digby Wells, 2018; Niara, 2022)

Site Name	Latitude	Longitude	Elevation (mamsl)	Water level (mbgl)	Farm Name	Site Use
WELBH01	-26.025	29.055	1527	15	Oggiesfontein 4 IS	Domestic
WELBH02	-26.00541	29.06751	1533	8	Wildebeestfontein 327 JS	Domestic
WELBH03	-26.00287	29.06911	1580	10	Wildebeestfontein 327 JS	Domestic - potable water supply
WELBH04	-26.00364	29.07285	1578	-	Wildebeestfontein 327 JS	Unknown - equipped
WELBH05	-26.00305	29.0742	1582	11	Wildebeestfontein 327 JS	Domestic
WELBH06	-25.962	29.0242	1580	26	Wildebeestfontein 327 JS	Domestic
WELBH07	-25.9635	29.02343	1570	1	Wildebeestfontein 327 JS	Not used
WELBH08	-25.93897	29.01865	1539	-	Oggiesfontein 4 IS	Unknown - equipped
WELBH09	-26.00541	29.06751	1532	7	Prinshof 2 IS	Monitoring
WELBH10	-26.00287	29.06911	1527	8	Prinshof 2 IS	Monitoring
WELBH11	-26.00364	29.07285	1505	23	Roodepoort 326JS	Domestic
WELBH12	-26.00305	29.0742	1506	25	Roodepoort 326JS	Domestic
WELBH13	-25.962	29.0242	1500	24	Roodepoort 326 JS	Domestic
WELBH14	-25.93952	29.01802	1501	-	Roodepoort 326 JS	Unknown - equipped
WELBH15	-25.95097	29.05588	1546	8	Hartebeestlaagte 325 JS	Not used
WELBH16	-25.95562	29.05012	1536	-	Roodepoort 326JS	Unknown
WELBH17	-25.95983	29.0615	1553	38	Hartebeestlaagte 325 JS	Domestic
WELBH18	-25.96015	29.05949	1554	-	Hartebeestlaagte 325 JS	Unknown - equipped
WELBH19	-25.95427	29.06158	1555	-	Hartebeestlaagte 325 JS	Unknown - equipped
WELBH20	-25.89924	29.06892	1510	6	Elandsfontein 309 JS	Not used
WELBH21	-25.89987	29.06894	1509	7	Elandsfontein 309 JS	Domestic
WELBH22	-25.90289	29.06771	1499	9	Hartebeestlaagte 325 JS	Not used
WELBH23	-25.93049	29.06913	1523	-	Hartebeestlaagte 325 JS	Domestic - potable water supply
WELBH24	-25.94082	29.08669	1510	25	Roodepoort 326JS	Domestic

WELBH25	-25.95648	29.05643	1555	-	Hartebeestlaagte 325 JS	Domestic - potable water supply
WELBH26	-25.97401	29.04921	1548	8	Wildebeestfontein 327 JS	Domestic
WELBH27	-25.97678	29.08376	1589	-	Tweefontein 328 JS	Unknown - equipped
WELBH28	-25.97401	29.1335	1553	16	Tweefontein 328 JS	Domestic
WELBH29	-25.97403	29.13413	1590	7	Vlaglaagte 330 JS	Domestic
WELBH30	-25.93049	29.06913	1589	5	Vlaglaagte 330 JS	Domestic
WELBH32	-25.96779	29.14109	1588	-	Vlaglaagte 330 IS	Unknown - equipped
WELBH33	-25.97121	29.14026	1590	6	Vlaglaagte 330 IS	Domestic
WELBH34	-25.97143	29.13954	1591	4	Vlaglaagte 330 IS	Domestic
WELBH35	-25.97	29.13779	1592	11	Vlaglaagte 330 JS	Domestic
WELBH36	-25.97937	29.13402	1591	28	Vlaglaagte 330 JS	Domestic
WELBH37	-25.97911	29.13225	1595	20	Vlaglaagte 330 JS	Domestic
WELBH39	-25.96014	29.13109	1574	5	Weltevreden 324 JS	Not used
WELBH40	-25.96687	29.11738	1566	3	Weltevreden 324 JS	Not used
WELBH41	-25.96723	29.11723	1567	4	Weltevreden 324 JS	Not used
WELBH42	-25.96733	29.11804	1567	2	Weltevreden 324 JS	Domestic
WELBH43	-25.98901	29.12516	1605	2	Vlaglaagte 330 JS	Domestic
WELBH44	-25.98794	29.12558	1604	2	Vlaglaagte 330 JS	Not used
WELBH45	-25.98637	29.12474	1606	-	Vlaglaagte 330 JS	Unknown
WELBH46	-25.9917	29.12778	1606	34	Vlaglaagte 330 JS	Not used
WELBH47	-25.96014	29.13109	1612	17	Vlaglaagte 330 JS	Domestic
WELBH48	-25.99313	29.12546	1609	28	Tweefontein 328 JS	Domestic
WELBH49	-26.0654	29.08832	1580	2	Zaaiwarer 11 IS	Monitoring
WELBH50	-26.04813	29.07134	1606	-	Grootpan 7 IS	Unknown - equipped
WELBH51	-26.069	29.048	1580	-	Goedevonden 10 IS	Unknown - equipped
WELPIT	-25.96872	29.13995	1587	3	Vlaglaagte 330 IS	Domestic
WELPIT01	-25.96749	29.1409	1589	3	Vlaglaagte 330 IS	Domestic
WELSPR4			1514	0	Weltevreden 324 JS	Groundwater spring

WELWEL3			1513	0	Weltevreden 324 JS	Groundwater spring
WELWEL5	-26.05738	29.08616	1570	7	Zaaiwarer 11 IS	Domestic
WEL31	-25.94717	29.13619	1576	7	Blaauwkrans 323 JS	Domestic
BHPS01	-26.05433	29.04603	1600	Not measured		Hydrogeological investigation
BHPS02	-26.07255	29.004				Hydrogeological investigation
BHPW05	-25.98	29.107				Hydrogeological investigation
BHPW07	-25.985	29.047				Hydrogeological investigation
BHPW08	-25.944	29.056				Hydrogeological investigation
BSW3	-26.02528	29.03669				Hydrogeological investigation
BSW4	-26.04609	29.04364				Hydrogeological investigation
KGM-B10	-26.0562	29.03501				Hydrogeological investigation
KGM-B11	-26.038	29.002				Hydrogeological investigation
KGM-B13	-26.04781	28.99101				Hydrogeological investigation
KGM-B2	-26.02091	29.01407				Hydrogeological investigation
KGM-B3	-26.0219	29.02858				Hydrogeological investigation
KGM-B4	-26.0334	29.03739				Hydrogeological investigation
KGM-B5	-26.04416	29.04227				Hydrogeological investigation
KGMB6	-26.0519	29.03684				Hydrogeological investigation
KGM-B7	-26.05303	29.01686				Hydrogeological investigation
KGM-B7	-26.05303	29.01686				Hydrogeological investigation
KGM-B8	-26.05506	28.99138				Hydrogeological investigation
KGM-B9	-26.06214	29.00732				Hydrogeological investigation

5.5 Groundwater Recharge

Groundwater recharge to un-impacted Karoo-type aquifer is in the order of 1% to 3% of the annual precipitation. SRK (2009) report documented groundwater recharge based on the annual precipitation of 750 mm/a. The following recharge was estimated (SRK, 2009):

- Groundwater recharge in un-impacted mining environments is between 1.5% and 3.0%. This calculates to between 11.25 mm/year and 22.5 mm/year, respectively.
- Active cuts in strip mines account for 100% of annual rainfall.
- Spoil heaps 50% of annual rainfall.
- Rehabilitated, fully re-vegetated material in strip mines accounts for 12% of annual rainfall.
- Dolerite dykes and sills are intrusion-specific. Can either act as a preferential flow zone or as a geohydrological barrier.
- Bord and pillar panels 2%-3% of annual rainfall.

5.6 Groundwater potential contaminants

KPSX and KPSS comprise both underground and opencast mining. The operations have constructed various infrastructures to support mining. The following infrastructures have been identified as areas where contamination may originate.:

Contamination sources at KPSX include the following:

- Open-pit BD, including ramps and box cuts
- Underground working
- Internal haul roads; and haul roads for the transport of ROM coal to KPS
- ROM stockpile and tip area
- Overland conveyor
- PCDs and associated pipelines to the PCPP
- Diesel and oil storage tanks
- Sewage treatment plant (STP)
- Workshops

Contamination sources at KPSS include the following:

- Open pit, including ramps and box cuts
- Underground working
- Haul roads
- Oil and refuelling facilities
- Coal conveyor to KPS
- PCD and associated pipelines to the KPS
- Run of Mine (ROM) stockpiles
- Workshops and fuelling bay
- Coal tip

These facilities comprise various contaminants. A contaminant is any physical, chemical, biological, or radiological substance that is considered hazardous in a particular environment (Hattingh, 2003). Contamination is the introduction of contaminants into water resources (Morris et al., 2011). While the impacts of these facilities are common in mining, their extent and spread will most likely depend on the water management options adopted at the mine.

It is known that the generation of Acid Mine Drainage (AMD) in coal mining is common. This is because some coal reserves are characterised by pyrite-bearing deposits that have the potential to generate acid. It must be emphasised that not all coal mining will generate AMD. The generation of AMD in individual mines will depend on water management options and strategy, mitigation measures, and an AMD strategy containing AMD prevention and prediction.

The following reaction summarised the oxidation process and formation of AMD:

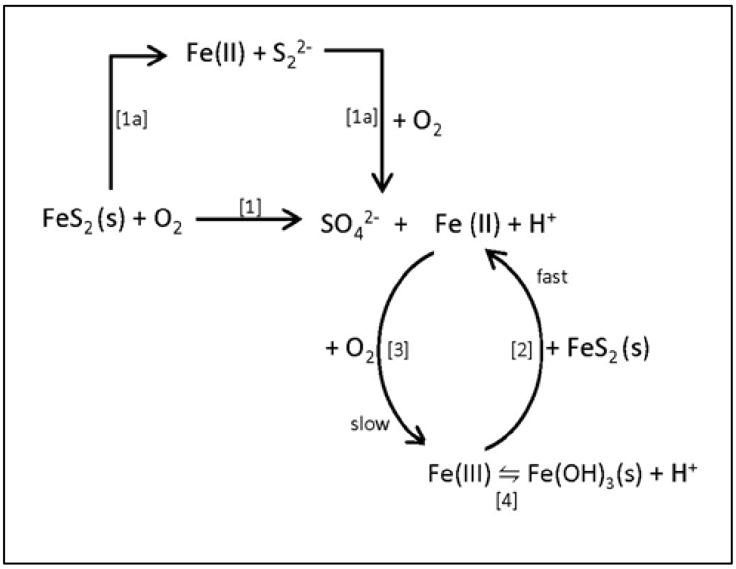

Figure 5-9: Oxidation of Pyrite (Stumm and Morgan, 1981).

Reaction and AMD generating stages:

- FeS2 + 7/2O2 + H2O = Fe2+ + 2SO42- + 2H+ [1]
- FeS2 + 14Fe3+ + 8H2O = 15Fe2+ + 2SO42- + 16H+ [2]
- Fe2+ + ¼O2 + H+ = Fe3+ +½H2O [3]
- Fe2+ + ¼O2 + 2½H2O = Fe(OH)3+ 2H+ [4]
- FeS2 + 15/4O2 + 7/2H2O = Fe(OH)3 + 2SO42- + 4H+ [5]

The resulting product of the above reactions is the generation of acidity, sulphur species, total dissolved solids (TDS), and metals. Sulphate is common in the resulting mine drainage water. It is present in association with TDS. TDS represents the amounts of dissolved species that include sulphate, chloride, and bicarbonate.

Although sulphide minerals are known for their acid-generating potential, they are commonly associated with acid-neutralising minerals. These are acid-consuming minerals that include carbonates and aluminosilicates. The reactions associated with acid-consuming minerals are summarised as follows:

Neutralisation Reactions:

$MeCO_3 + H^+ = Me^{2+} + HCO_{3-}$ [6]

$CaAl_2Si_2O_8 + 8H^+ = Ca^{2+} + 2Al^{3+} + 2H_4SiO_4$ [7]

$FeCO_3 + ¼O_2 + 2½H_2O = Fe(OH)_3 + H^+ + HCO_{3-}$ [8]

The following documents are critical for establishing water management options and strategies to prevent the generation of contamination:

- BPG A2: Water Management for Mine Residue Deposits (Department of Water Affairs and Forestry, DWAF, 2007a).
- BPG A4: Pollution control dams (DWAF, 2007b).
- BPG A6: Water Management for Underground Mines (DWAF, 2008a).
- BPG G1 Storm Water Management (DWAF, 2006).
- BPG G4: Impact Prediction (DWAF, 2008b).
- BPG G5: Water Management Aspects for Mine Closure (DWAF, 2008c).
- BPG H1: Integrated Mine Water Management (DWAF, 2008d).

The following scenarios are critical for water management at the mine site:

Mine residue deposit

Residue includes any debris, discard, tailings, slimes, screenings, slurry, waste rock, foundry sand, beneficiation plant waste, ash, and other waste product derived from or incidental to the operation of a mine or activity and which is stockpiled, stored, or accumulated for potential reuse or recycling or which is disposed of. (Government Notice 704 of 4 June 1999; DWAF, 2008c).

Residue deposits include any dump, tailings dams, slime dams, ash dump, waste rock dump, in-pit deposit, and any other heap, pile, or accumulation of residue. (Government Notice 704 of 4 June 1999; DWAF, 2008c)

Figure 5-10 provides a schematic diagram of mine residue facility. It is common that the facility will generate seepage water containing contaminants. Irrespective of whether the facility is lined or not, groundwater and surface water will be at risk of contamination. Liner design will most likely reduce the impacts, but not entirely. Hence, water management strategy and AMD strategy are critical for mining.

Common impacts expected from the mine residue deposit include:

- Contaminated seepage
- Contaminated runoff
- Infiltration of contaminated seepage water
- Contamination of groundwater
- Contamination of surface
- Discharge of contaminated baseflow to surface water
- Contaminated storm water leaving the site

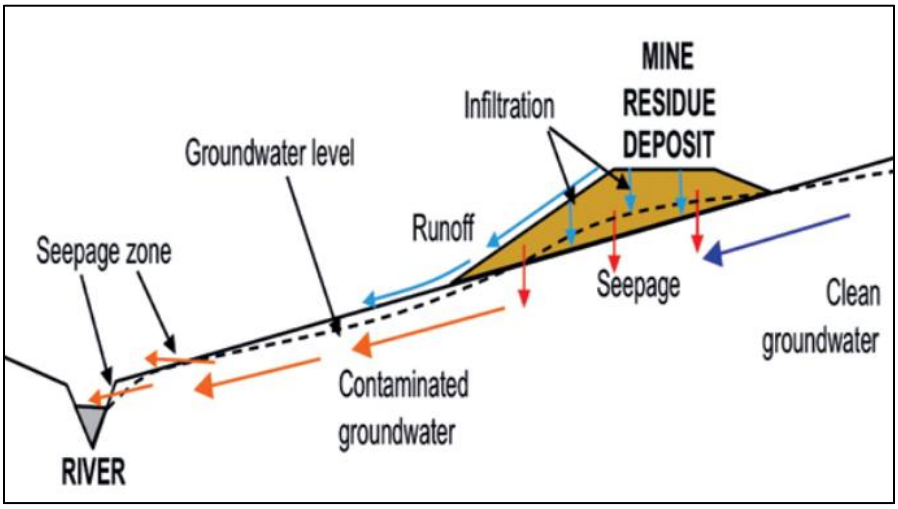

Figure 5-10: Mine residue deposit/discard dump and pathways (DWAF, 2008c).

Other scenarios in the form of schematic diagrams are shown in Figure 5-11 to Figure 5-13. These scenarios are all applicable to KPSS and KPSX mining. In an attempt to establish water management options and an AMD strategy, these aspects must be considered in order to establish measures that are site-specific. These measures will most likely determine whether a mine is able to prevent, reduce, avoid, and control the contamination generated from their facilities. Detail information is highlighted in the Best Practice Guideline (BPG) listed above.

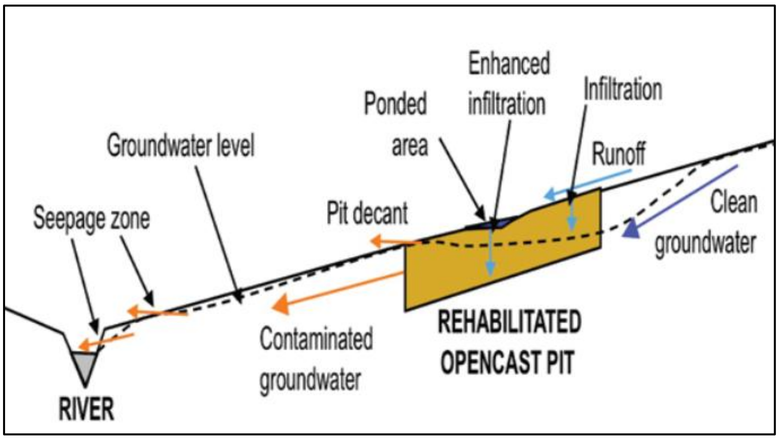

Figure 5-11: Open cast pit and pathways (DWAF, 2008c)

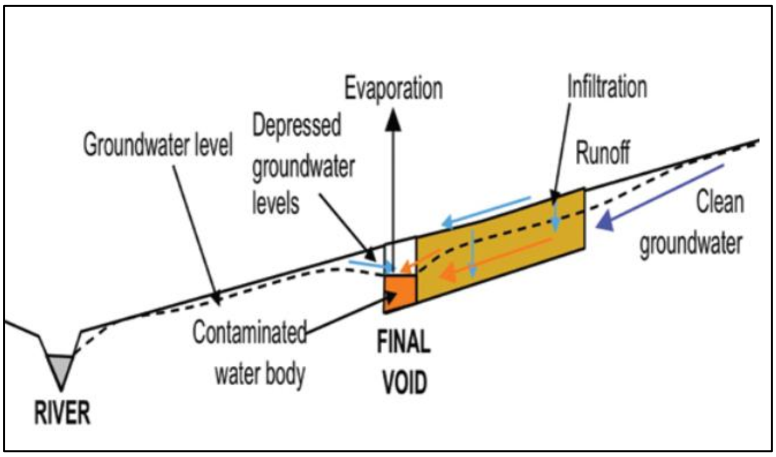

Figure 5-12: Rehabilitated area and pathways (DWAF, 2008c).

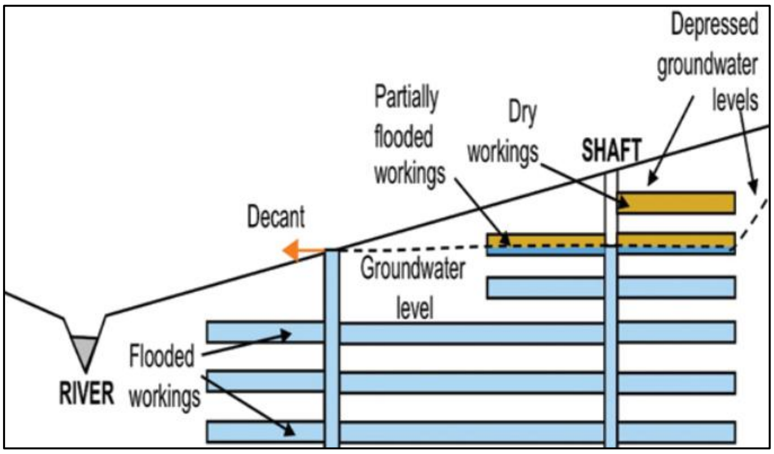

Figure 5-13: Underground mine and pathway (DWAF, 2008c).

5.7 Groundwater quality

5.7.1 Sampling points

Table 5-14 and Figure 5-14 shows the sampling points that form part of the monitoring at Klipspruit Colliery.

Table 5-14: Existing sampling points at Klipspruit Colliery.

Site name	Latitude	Longitude	Site Type
BSW 4	-26.04098	29.0395	Borehole
KGM 08	-26.054552	28.991432	Borehole
KGM 10	-26.053146	29.039991	Borehole
KGM 13	-26.052393	28.990923	Borehole
KGM B04	-26.025284	29.036629	Borehole
KGM B06	-26.052101	29.040367	Borehole
KGM B11	-26.04931	29.000103	Borehole
KGM B16	-26.05347	29.02322	Borehole
WELBH27	-26.02095	29.0258	Borehole
BHPW05	-25.98	29.107	Borehole
BHPW08	-25.944	29.056	Borehole
WELBH01	-26.026	29.056	Borehole
WELBH08	-26.012	29.05	Borehole
WELBH16	-25.956	29.05	Borehole
WELBH24	-25.941	29.087	Borehole
WELWEL03	-25.952	29.096	Borehole
BH 008	-25.99869	29.06285	Borehole
BH 009	-25.99052	29.059	Borehole
BHPSM01	-26.05722	29.04476	Borehole
BHPSM06	-26.06704	29.01697	Borehole
BHPSM08	-26.06058	28.99894	Borehole
BHPSM09	-26.06919	29.01072	Borehole
BHPSM10	-26.05306	29.04305	Borehole
BHPSM13	-26.07281	28.99976	Borehole
WELBH25	-25.95885	29.09002	Borehole
WELBH26	-26.01191	29.04647	Borehole

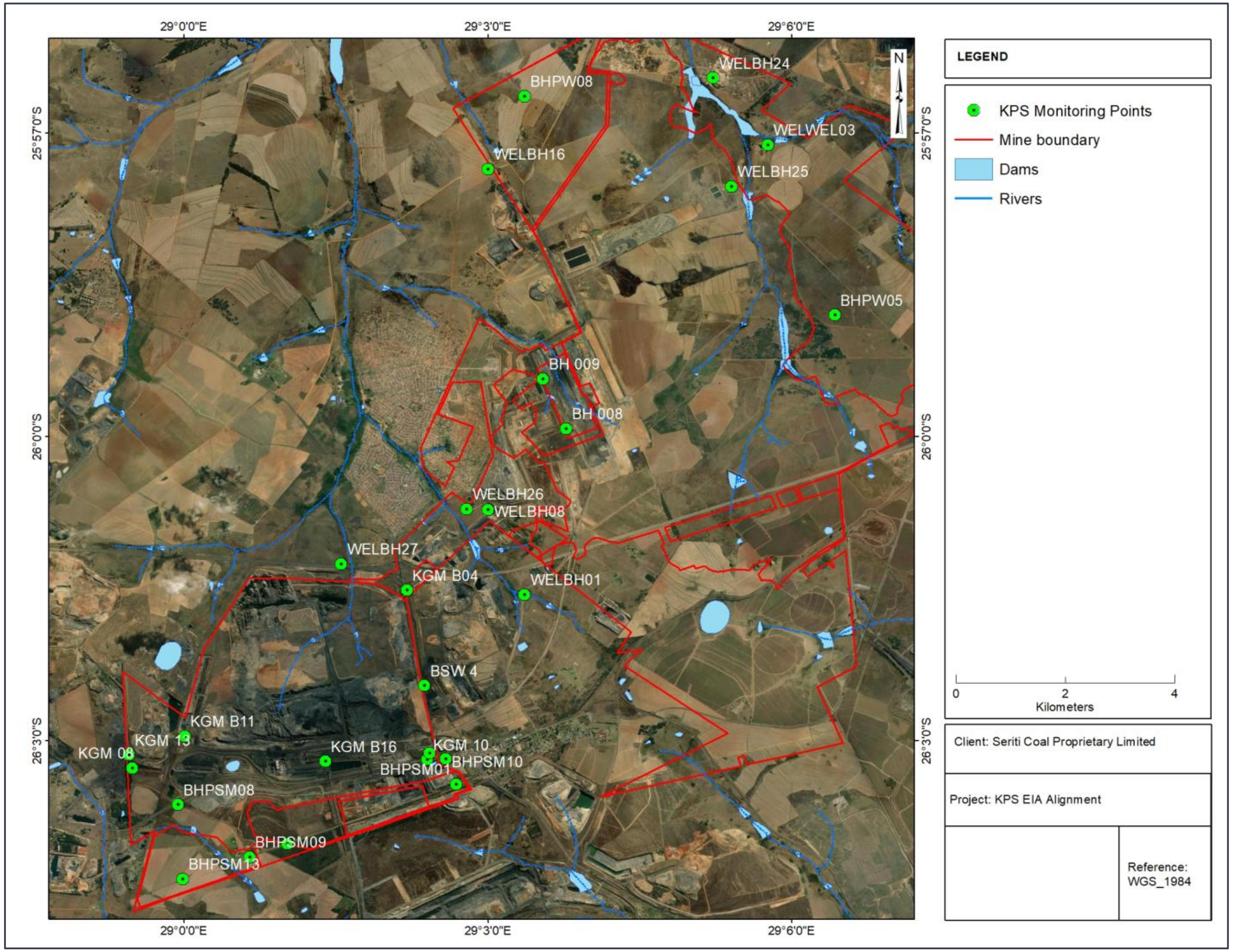

Figure 5-14: Distribution of sampling points.

5.7.2 Parameters

Groundwater sampling and analysis is currently conducted by Aquatico. All samples collected are submitted to the laboratory for the determination of all monitoring parameters. The following parameters form part of sampling and laboratory analysis for Klipspruit Colliery.

Table 5-15: Monitoring parameters.

Parameters	Parameters
pH	Na mg/l
EC mS/m	Al mg/l
TDS mg/l	Fe mg/l
TotHardness mg/l	Mn mg/l
MALK CaCO3/L	Zn mg/l
Cl mg/l	Si mg/l
SO4 mg/l	SS mg/l
PO4 mg/l	Turbidity NTU
N_Ammonium mg/l	Free Cl2 mg/l
NO3-N mg/l	LSI (Index)
NO2-N mg/l	SAR
TON mg/l	CaHardness mg/l
F mg/l	MgHardness mg/l
Ca mg/l	Bicarbalk CaCO3mgl
K mg/l	Carbalk mg/l
Mg mg/l	Halk mg/l

5.7.3 Water quality criteria

5.7.3.1 Water use licence limits

Klipspruit Colliery has an authorised water use license that contains water quality limits for selected parameters. The following table provides the parameters and WUL limits.

Table 5-16: WUL limits.

Parameters	Parameters
pH	8.79
EC mS/m	75.52
Cl mg/l	36.34
SO4 mg/l	10.36
NO3-N mg/l	0.11
F mg/l	0.14
Ca mg/l	32.56
Mg mg/l	32.71
Na (mg//)	44

5.6.3.2. *SANS Limits*

Groundwater quality results were also compared to the South African National Standards for Drinking Water Quality (SANS 241; 2006 and 2015). Table 5-17 shows the SANS limit used for the assessment.

Table 5-17: South African National Standards limits.

Parameters	Unit	Standard Limits
pH		5 - 9.7
EC	mS/m	≤ 170
TDS	mg/l	≤1200
Cl	mg/l	≤300
SO4	mg/l	≤500
	mg/l	≤250
N_Ammonium	mg/l	≤1.5
NO3-N	mg/l	≤11
NO2-N	mg/l	≤0.9
F	mg/l	≤1.5
Ca	mg/l	<150
	mg/l	150 - 300
K	mg/l	<50
	mg/l	50 - 100
Mg	mg/l	<70
	mg/l	70 - 100
Na	mg/l	≤200
Al	mg/l	≤0.3
Fe	mg/l	≤2
	mg/l	≤0.3
Mn	mg/l	≤0.4
	mg/l	≤0.1

5.7.4 Water quality results compared to SANS Limits

Table 5–18 shows a statistical summary of groundwater quality at Klipspruit Colliery. The pH of groundwater samples generally ranges from 5.43 to 8.63. All samples are confined within the SANS limit of 5–9.7. The EC in groundwater is associated with the concentration of ionised substances, excessive hardness, and contamination of groundwater. The EC of the groundwater samples of the mine ranges from 2.8 to 133.7 mS/m. This EC complies with the prescribed SANS limits of 170 mS/m. TDS in groundwater represents a range of dissolved parameters and consists of inorganic salts such as carbonates, bicarbonates, chlorides, sulphates, phosphates, and nitrates of calcium, magnesium, sodium, potassium, and iron. TDS in groundwater samples varies from 24 to 1066 mg/l. All groundwater samples are well below the guideline value of 1200 mg/l as prescribed by SANS.

The concentrations of Cl, NO3, NO2, K, Na, Al, and Fe in groundwater samples collected at Klipspruit Colliery are confined within the regulatory limits defined by SANS. The concentrations of K and Mg fell under Class II of the SANS. Poor groundwater samples were noted in terms of SO4, NH4, F, and Mn. The concentration of these parameters exceeds limits in several boreholes. These samples are summarised as follows:

SO4-SO4 was detected in high concentration in the groundwater sample, namely BSW 4. NH4 was detected at high concentrations. tion of Mn is above the SANS chronic health limits in BHPSM01, BHPW05, WELBH16, WELBH08, and BSW 4. The concentration of F exceeds guideline limits in WELBH27 and KGM 10. The concentration exceeds the SANS chronic health limits in BHPSM01, BHPW05, and WELBH16. Mn also exceeds SANS aesthetic limits in BHPSM10, WELBH08, WELBH25, BSW 4, KGM13, and KGM B06. Detail chemical parameters compared with the SANS limit are shown in Table 5-19 (Appendix 1).

Table 5-18: Minimum and maximum water quality results,

Parameters	Unit	Minimum	Maximum
pH		5.43	8.63
EC mS/m	mS/m	2.8	133.7
TDS	mg/l	24	1066
Cl	mg/l	0.299	34.388
SO4	mg/l	0.146	646.897
N_Ammonium	mg/l	0.007	8.118
NO3-N	mg/l	0.189	8.375
NO2-N	mg/l	0.006	0.188
F	mg/l	0.02	2.102
Ca	mg/l	0.93	151.554
K	mg/l	0.935	9.184
Mg	mg/l	0.596	90.236
Na	mg/l	1.47	145.592
Al	mg/l	-0.001	0.134
Fe	mg/l	-0.001	0.665
Mn	mg/l	-0.001	1.194

Table 5-19: Water quality compared to SANS Limits.

Site Name	Date Time	pH	EC mS/m	TDS mg/l	MALK CaCO3	Cl mg/l	SO4 mg/l	N_Ammonium mg/l	NO3-N mg/l	NO2-N mg/l	F mg/l	Ca mg/l	K mg/l	Mg mg/l	Na mg/l	Al mg/l	Fe mg/l	Mn mg/l
BSW 4	2024/02/27 10:52	7.08	133.7	1066	204.203	8.94	646.897	2.767	1.422	0.007	0.446	151.554	8.594	90.236	46.088	-0.001	0.665	0.354
KGM 08	2024/02/01 13:02	7.2	3.7	26	12.447	3.084	0.146	0.029	0.206	0.012	0.736	1.078	1.568	0.806	5.321	-0.001	-0.001	0.008
KGM 10	2024/02/01 13:13	8.176	38.2	214	196.088	11.654	28.936	0.029	0.804	0.017	1.625	49.02	3.386	20.944	12.29	-0.001	-0.001	0.024
KGM 13	2024/02/01 12:59	6.378	11.85	98	14.093	6.179	1.659	0.014	8.375	0.008	0.124	4.78	4.165	5.12	6.63	-0.001	-0.001	0.216
KGM B04	2024/02/01 15:16	7.94	26.2	146	79.43	16.624	31.468	0.014	0.479	0.008	0.262	25.897	3.652	9.81	19.314	-0.001	-0.001	-0.001
KGM B06	2024/02/22 10:21	6.18	49.6	306	67.446	34.388	118.664	0.051	0.339	0.016	0.13	27.561	7.337	26.969	32.78	-0.001	0.005	0.128
KGM B11	2024/02/18 19:02	6.3	14.2	102	50.103	0.802	12.516	0.049	0.422	0.018	0.298	10.413	3.634	4.782	9.878	-0.001	-0.001	0.057
KGM B16	2024/02/18 18:29	7.38	50.5	358	75.356	2.878	187.59	0.054	0.383	0.012	0.099	31.411	5.64	31.778	29.151	-0.001	-0.001	-0.001
WELBH27	2024/02/12 11:41	8.57	68.6	428	290.666	6.791	65.301	1.403	0.257	0.129	2.102	15.255	9.184	5.942	145.592	0.134	-0.001	-0.001
BHPW05	2024/02/06 12:34	6.63	8.2	42	24.326	2.18	3.022	0.172	0.311	0.006	0.414	8.087	2.94	1.265	1.47	-0.001	-0.001	0.405
BHPW08	2024/02/07 14:52	7.18	17.7	172	88.183	0.322	4.766	1.188	0.65	0.042	0.338	17.909	0.993	6.141	7.028	0.015	-0.001	0.024
WELBH01	2024/02/01 15:02	8	18.8	124	86.422	10.263	1.161	0.007	0.641	0.007	0.492	15.08	3.323	5.525	22.6	-0.001	-0.001	-0.001
WELBH08	2024/02/21 13:21	8.04	39.4	244	220.357	1.921	3.318	8.118	0.274	0.021	0.258	38.146	3.103	21.25	16.532	-0.001	0.056	0.166
WELBH16	2024/02/07 14:39	7.59	17.5	138	85.543	1.281	0.187	1.048	0.308	0.007	0.02	17.434	1.012	5.198	6.917	-0.001	-0.001	1.194
(red)	Above the SANS limit		(green)	Above SANS Aesthetic Limits			(yellow)	Class II (max. allowable for limited duration)										

Site Name	Date Time	pH	EC mS/m	TDS mg/l	MALK CaCO3	Cl mg/l	SO4 mg/l	N_Ammonium mg/l	NO3-N mg/l	NO2-N mg/l	F mg/l	Ca mg/l	K mg/l	Mg mg/l	Na mg/l	Al mg/l	Fe mg/l	Mn mg/l
WELBH24	2024/02/06 13:13	6.03	4.9	34	6.035	2.4	2.949	0.025	1.207	0.008	0.785	1.828	1.901	0.596	3.348	0.003	-0.001	0.067
WELWEL03	2024/02/06 12:09	5.43	2.8	24	3.64	1.551	0.212	0.022	0.968	0.008	0.154	0.93	0.935	0.661	1.646	0.007	-0.001	0.022
BH 008	2024/02/23 12:47	7.78	26.8	184	139.909	1.654	9.348	0.019	0.498	0.007	0.652	37.453	6.474	11.752	9.563	-0.001	-0.001	-0.001
BH 009	2024/02/23 12:43	6.66	15.6	122	49.605	5.224	20.271	0.047	0.424	0.188	0.65	15.275	4.774	5.325	5.26	-0.001	0.226	0.074
BHPSM01	2024/02/01 14:11	7.581	39.9	236	190.622	4.654	12.214	0.012	0.432	0.01	0.392	45.154	8.538	15.01	21.073	-0.001	-0.001	0.004
BHPSM06	2024/02/18 18:11	6.35	12.6	120	64.632	0.825	5.88	0.141	0.359	0.027	0.538	5.58	5.368	7.622	10.449	-0.001	-0.001	0.406
BHPSM08	2024/02/01 12:45	6.487	25.9	172	24.533	3.763	71.596	0.034	3.556	0.019	0.289	12.729	6.877	8.431	24.85	-0.001	-0.001	0.047
BHPSM09	2024/02/18 18:02	7.29	16.8	148	88.497	0.299	1.781	0.065	0.363	0.023	0.462	11.574	3.575	7.369	16.873	-0.001	-0.001	-0.001
BHPSM10	2024/02/01 14:30	8.18	44.2	324	242.284	9.56	4.681	0.06	0.189	0.022	0.559	48.78	7.103	22.577	29.634	0.008	-0.001	0.101
BHPSM13	2024/02/01 12:14	7.958	32.04	174	166.637	4.309	6.213	0.022	0.443	0.021	0.673	28.175	4.12	11.966	31.903	-0.001	-0.001	-0.001
WELBH25	2024/02/23 12:09	7.01	10.5	118	44.292	4.3	0.568	0.041	0.296	0.007	0.079	8.019	3.28	3.764	5.891	-0.001	-0.001	0.305
WELBH26	2024/02/21 13:35	8.63	33.1	194	182.535	3.554	7.397	0.067	0.446	0.013	0.998	13.74	2.677	4.394	65.728	0.022	-0.001	-0.001
	Above the SANS limit			Above SANS Aesthetic Limits				Class II (max. allowable for limited duration)										

5.7.5 Water quality results compared to WUL Limits

Groundwater analysis of samples collected at Klipspruit Colliery was compared to the WUL limits issued to the mine in the form of the water use license authorisation. While the SANS limits and criteria are critical in assessing pollution within the mine and compliance with domestic water usage, the WUL limits are critical in assessing contamination of groundwater resources within the mine. Table 5-20 shows the chemistry of groundwater samples compared with the WUL limits.

The comparison of groundwater samples with WUL limits suggests that only pH and Cl are compliant in all groundwater samples. These two parameters are well below the maximum WUL limits in all samples. Non-compliant in terms of EC and Mg was noted in BSW 4. This borehole exceeded the WUL limit of 75.52 mS/m for EC and 32.71 mg/l for Mg. Ca is present at a high concentration above the WUL limits of 32.56 mg/l in six boreholes. These boreholes include BSW 4, KGM 10, BH 008, BHPSM01, BHPW08, and BHPSM10.

The concentration of Na is high in three boreholes, namely BSW 4, WELBH26, and WELBH27. Guidelines exceeding the limits were noted in these boreholes. The majority of the boreholes are contaminated with SO4, NO3, and F. This is because the parameters were exceeded in more boreholes, especially NO3 and F, with SO4 only exceeded in ten boreholes. The concentration of NO3 exceeded WUL limits in all boreholes. The concentration of F is compliant in five boreholes, namely KGM 13, KGM B06, KGM B16, WELBH16, and WELBH25 with the remaining boreholes being classified as non-compliant. The concentration of SO4 was noted in high concentration above the WUL limits in the following boreholes: BSW 4, KGM 10, KGM B04, KGM B06, KGM B11, KGM B16, BH 009, BHPSM01, BHPSM08, and WELBH27.

Table 5-20: Water quality compared to WUL Limits.

Site Name	Date Time	pH	EC mS/m	Ca mg/l	Mg mg/l	Na mg/l	Cl mg/l	SO4 mg/l	NO3-N mg/l	F mg/l
BSW 4	2024/02/27 10:52	7.08	133.7	151.554	90.236	46.088	8.94	646.897	1.422	0.446
KGM 08	2024/02/01 13:02	7.2	3.7	1.078	0.806	5.321	3.084	0.146	0.206	0.736
KGM 10	2024/02/01 13:13	8.176	38.2	49.02	20.944	12.29	11.654	28.936	0.804	1.625
KGM 13	2024/02/01 12:59	6.378	11.85	4.78	5.12	6.63	6.179	1.659	8.375	0.124
KGM B04	2024/02/01 15:16	7.94	26.2	25.897	9.81	19.314	16.624	31.468	0.479	0.262
KGM B06	2024/02/22 10:21	6.18	49.6	27.561	26.969	32.78	34.388	118.664	0.339	0.13
KGM B11	2024/02/18 19:02	6.3	14.2	10.413	4.782	9.878	0.802	12.516	0.422	0.298
KGM B16	2024/02/18 18:29	7.38	50.5	31.411	31.778	29.151	2.878	187.59	0.383	0.099
BH 008	2024/02/23 12:47	7.78	26.8	37.453	11.752	9.563	1.654	9.348	0.498	0.652
BH 009	2024/02/23 12:43	6.66	15.6	15.275	5.325	5.26	5.224	20.271	0.424	0.65
BHPSM01	2024/02/01 14:11	7.581	39.9	45.154	15.01	21.073	4.654	12.214	0.432	0.392
BHPSM06	2024/02/18 18:11	6.35	12.6	5.58	7.622	10.449	0.825	5.88	0.359	0.538
BHPSM08	2024/02/01 12:45	6.487	25.9	12.729	8.431	24.85	3.763	71.596	3.556	0.289
BHPSM09	2024/02/18 18:02	7.29	16.8	11.574	7.369	16.873	0.299	1.781	0.363	0.462
BHPSM10	2024/02/01 14:30	8.18	44.2	48.78	22.577	29.634	9.56	4.681	0.189	0.559
BHPSM13	2024/02/01 12:14	7.958	32.04	28.175	11.966	31.903	4.309	6.213	0.443	0.673
BHPW05	2024/02/06 12:34	6.63	8.2	8.087	1.265	1.47	2.18	3.022	0.311	0.414
BHPW08	2024/02/07 14:52	7.18	17.7	17.909	6.141	7.028	0.322	4.766	0.65	0.338
WELBH01	2024/02/01 15:02	8	18.8	15.08	5.525	22.6	10.263	1.161	0.641	0.492
WELBH08	2024/02/21 13:21	8.04	39.4	38.146	21.25	16.532	1.921	3.318	0.274	0.258
WELBH16	2024/02/07 14:39	7.59	17.5	17.434	5.198	6.917	1.281	0.187	0.308	0.02

Site Name	Date Time	pH	EC mS/m	Ca mg/l	Mg mg/l	Na mg/l	Cl mg/l	SO4 mg/l	NO3-N mg/l	F mg/l
WELBH24	2024/02/06 13:13	6.03	4.9	1.828	0.596	3.348	2.4	2.949	1.207	0.785
WELBH25	2024/02/23 12:09	7.01	10.5	8.019	3.764	5.891	4.3	0.568	0.296	0.079
WELBH26	2024/02/21 13:35	8.63	33.1	13.74	4.394	65.728	3.554	7.397	0.446	0.998
WELBH27	2024/02/12 11:41	8.57	68.6	15.255	5.942	145.592	6.791	65.301	0.257	2.102
WELWEL03	2024/02/06 12:09	5.43	2.8	0.93	0.661	1.646	1.551	0.212	0.968	0.154

The piper geochemical diagram was used to display the geochemical processes of groundwater at Klipspruit Colliery (Figure 5-15). The diagram has classified groundwater into the following classes:

- Ca-HCO3 water types
- Na-HCO3 water types
- Mg-HCO3 water types
- Mg-SO4 water types
- Na-HCO3 water types
- Na-SO4 water types

Table 5-21 shows detailed summary of boreholes falling under each category.

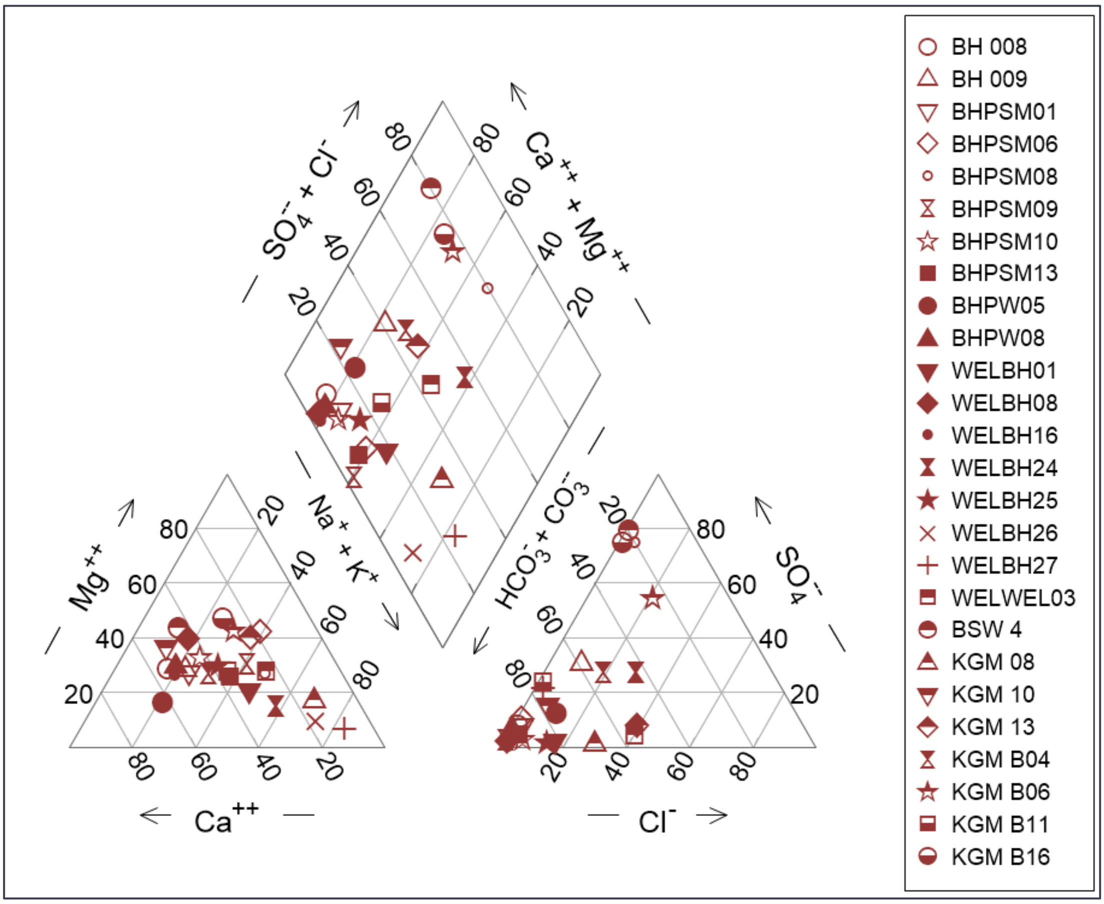

Figure 5-15: Geochemical classification using piper diagram.

Table 5-21: Water type.

Sample ID	Water type
BH 008	Ca-HCO3
BH 009	Ca-HCO3
BHPSM01	Ca-HCO3
BHPSM10	Ca-HCO3
BHPW05	Ca-HCO3
BHPW08	Ca-HCO3
WELBH08	Ca-HCO3
WELBH16	Ca-HCO3
WELBH25	Ca-HCO3
KGM 10	Ca-HCO3
KGM B04	Ca-HCO3
KGM B11	Ca-HCO3
BHPSM06	Mg-HCO3
KGM 13	Mg-HCO3
BSW 4	Mg-SO4
KGM B06	Mg-SO4
KGM B16	Mg-SO4
BHPSM09	Na-HCO3
BHPSM13	Na-HCO3
WELBH01	Na-HCO3
WELBH24	Na-HCO3
WELBH26	Na-HCO3
WELBH27	Na-HCO3
WELWEL03	Na-HCO3
KGM 08	Na-HCO3
BHPSM08	Na-SO4

6 Aquifer Characterisation

6.1. Groundwater vulnerability

Aquifer vulnerability refers to the sensitivity of the aquifer to contamination; it defines the capacity of the aquifer to become contaminated over time. Vulnerability is defined as the tendency or likelihood for contamination to reach a specified position in the groundwater system after introduction at some location above the uppermost aquifer. Aquifer vulnerability remains one of the major tools that assist in decision-making. Many methods have been developed over the past years, but the most widely used method is the destructive method. This method was developed by Aller et al. (1987). Each letter in the name represents or symbolises a parameter that is processed. These acronyms are shown below:

- D: Depth to water table
- R: Recharge
- A: Aquifer media
- S: Soil media
- T: Topography
- I: Impact on vadose zone
- C: Hydraulic Conductivity

DRASTIC method assumes that:

- A contaminant is introduced at the surface of the earth or just below it.
- A contaminant is flushed into the groundwater by precipitation.
- A contaminant has the mobility of water.
- The area evaluated is 0.4 km2 or larger.

DRASTIC Methodology:

The Drastic Vulnerability Method comprises several components, which are to assign:

- Assess hydrogeological parameters and designation of mappable units: depth to the water table, recharge, aquifer media, soil media, topography, impact on the vadose zone, and hydraulic conductivity.
- Rating of hydrogeological parameters in terms of DRASTIC parameters and relative weight established by Aller et al. (1987).
- Calculation of the DRASTIC Vulnerability Index (DVI).
- Reclassify the DVI into vulnerability classes.

Drastic DVI is calculated based on the formula:

- $DRASTIC\ Index = D_R D_W + R_R R_W + A_R A_W + S_R S_W + T_R T_W + I_R I_W + C_R C_W$

Where the subscription R and W represent rating and weight for each DRASTIC parameter. DRASTIC parameters and symbols are summarised as follows:

- Dr: ratings to the depth to the water table,
- Dw: weights assigned to the depth of the water table,
- Rr: ratings for ranges of aquifer recharge,
- Rw: weights for aquifer recharge,
- Ar: ratings assigned to aquifer media,
- Aw: weights assigned to aquifer media,
- Sr: ratings for the soil media,
- Sw: weights for the soil media,
- Tr: ratings for topography (slope),
- Tw: weights assigned to topography,
- Ir: ratings assigned to vadose zone,
- Iw: weights assigned to vadose zone,
- Cr: ratings for rates of hydraulic conductivity, and
- Cw: weights given to hydraulic conductivity.

DRASTIC DVI is then reclassified as least (low), moderate, and most (high) vulnerable to contamination. According to the aquifer vulnerability assessment and the DWA (2013) aquifer vulnerability map, the study area falls under moderate aquifer vulnerability. This results in a point scoring system of 2, as shown in Table 6-1. Figure 6-1 shows the distribution of various vulnerability classes.

Table 6-1: Rating for the Aquifer Vulnerability Classification.

Aquifer Vulnerability Classification		
Class	**Points**	**Projects area**
Most	3	**2**
Moderate	**2**	
Least	1	

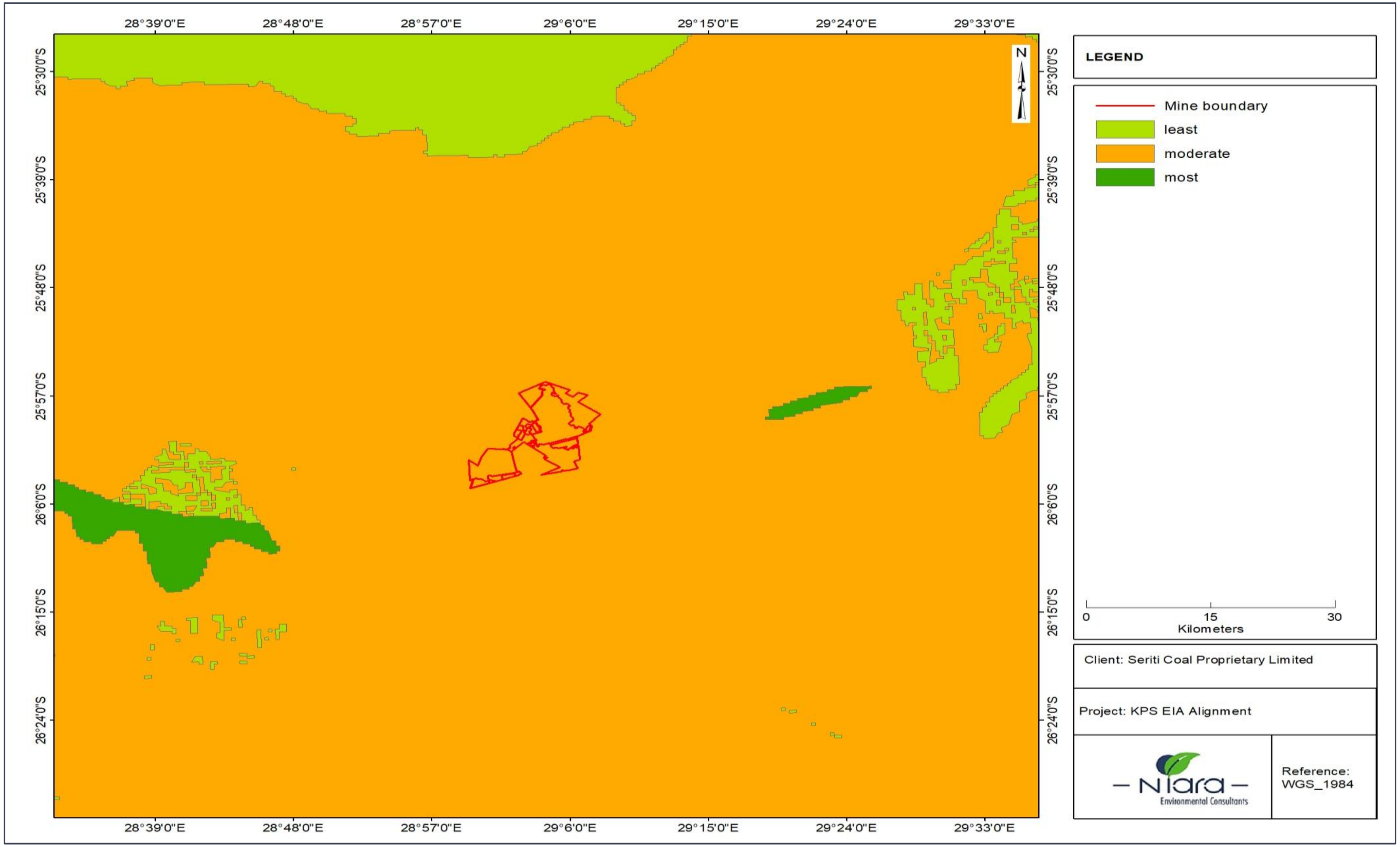

Figure 6-1: Aquifer vulnerability map.

6.2. Aquifer classification

The aquifer underlying the study area was classified in accordance with Parsons' (1995) aquifer system management classification document titled "A South African Aquifer System Management Classification." Based on the above document, the following types of aquifer systems are recognised:

- Sole Aquifer System: An aquifer that is used to supply 50% or more of domestic water for a given area and for which there are 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 (electric conductivity of less than 150 mS/m).
- Minor Aquifer System: These can be fractured or potentially fractured rocks that 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. The 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.
- Special Aquifer System: An aquifer designated as such by the Minister of Water Affairs after due process.

Based on information sourced from groundwater monitoring, water use information databases, information collected during the hydrocensus survey, and information obtained from the DWA (2012) classification, the study area is classified as a minor aquifer system. This suggests that the aquifer has variable permeability, variable water quality, and limited aquifer extent. Table 6-2 shows the point scoring system for the aquifer, while Figure 6-2 shows the distribution of the aquifer class.

Table 6-2: Ratings for the Aquifer System Management.

Aquifer System Management Classification		
Class	**Points**	**Project area**
Sole Aquifer System	6	**2**
Major Aquifer System	4	
Minor Aquifer System	**2**	
Non-Aquifer System	0	
Special Aquifer System	0 – 6	

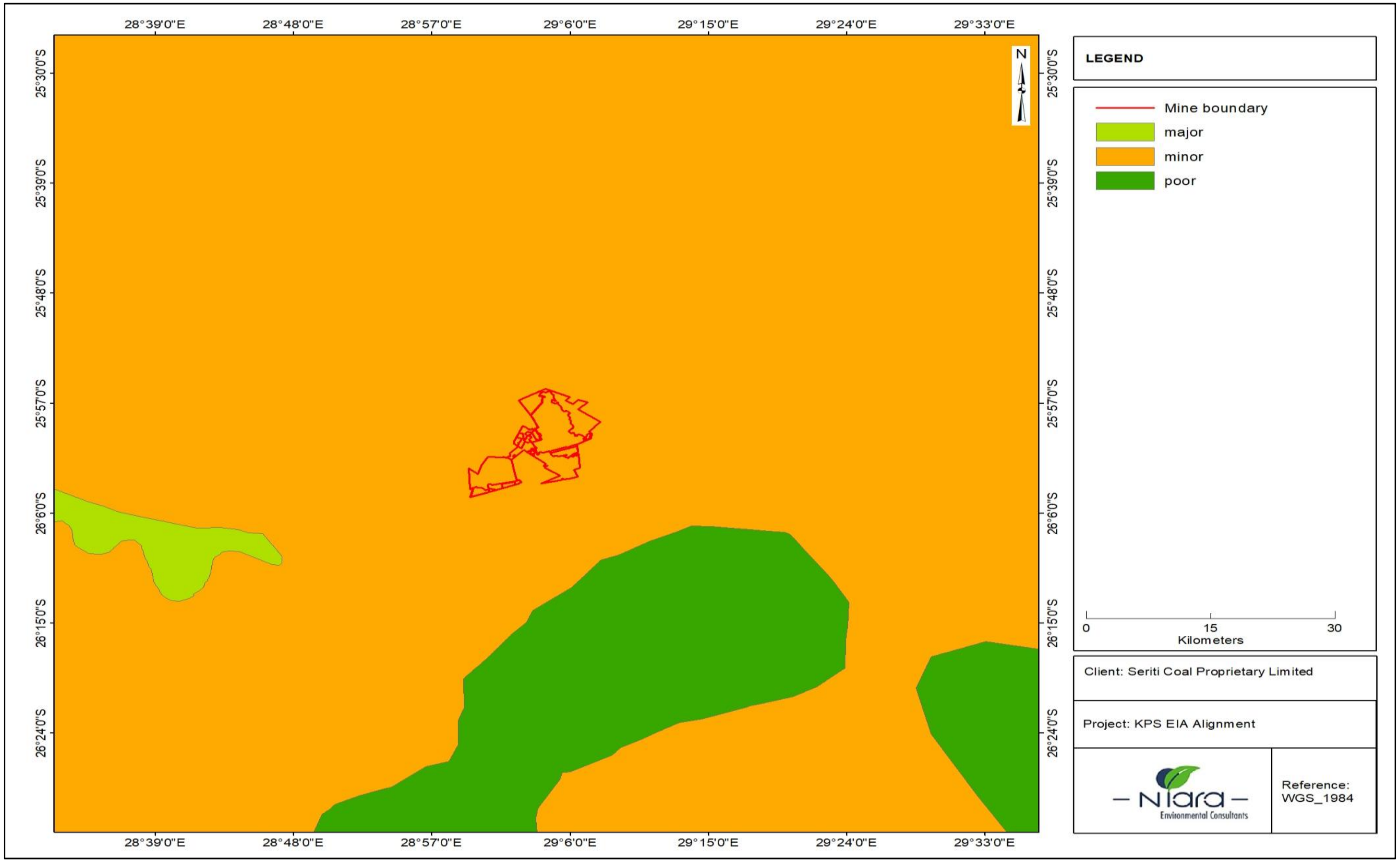

Figure 6-2: Aquifer classification map.

6.3. Aquifer protection classification

Aquifer protection classification has been discussed in detail by Parsons' (1995). Characterisation of aquifer protection comprises four components, which include:

- Determination of Aquifer System Management Classification in terms of special, non-aquifer, poor, minor, major, and sole. This allows the allocation of points from 0 to 6.
- Determination of aquifer vulnerability classifications of the site in terms of least, moderate, and most. This allows the allocation of points from 1 to 3.
- Determination or calculation of the Groundwater Quality Management (GQM) Index. This allows the calculation of the GQM index based on the formular presented below.
- Classification of GQI results in terms of Limited, Low, Medium, High, and Strictly Non-Degradation level of protection based on the point scoring of less than 1 and more than 10.

The 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 as presented above. The following formular is applicable:

GQM Index = Aquifer System Management x Aquifer Vulnerability

Table 6-3 presents ratings for groundwater management classifications based on aquifer vulnerability and aquifer system management classifications. This classification implies that the mining area falls under the medium level of aquifer protection. The points scoring system for the GQM index for the study area is presented in Table 6-4, where GQM is equal to 4.

Table 6-3: Rating for Groundwater Quality Management Classification System.

Aquifer System Management Classification		**Aquifer Vulnerability Classification**			
Both small & Large portion		**Large portion**		**Small Portion**	
Class	**Points**	**Class**	**Points**	**Class**	**Points**
Sole Aquifer System	6	Most	3	**Most**	**3**
Major Aquifer System	4	**Moderate**	**2**	Moderate	2
Minor Aquifer System	**2**	Least	1	Least	1
Non-Aquifer System	0				
Special Aquifer System	0 – 6				

Table 6-4: Rating for the GQM Index for the Study Area.

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

Aquifer susceptibility was discussed in detail by Parsons' and Conrad (1995). According to the author, aquifer susceptibility is obtained by multiplying the rating of the aquifer system management by the aquifer vulnerability. The method and formular are like the GQM Index methodology, but with different criteria to classify the results. The following procedure is applicable:

- Determination of Aquifer System Management Classification in terms of special, non-aquifer, poor, minor, major, and sole. This allows the allocation of points from 0 to 6.
- Determination of aquifer vulnerability classifications of the site in terms of least, moderate, and most. This allows the allocation of points from 1 to 3.
- Determination or calculation of aquifer susceptibility. This allows the calculation of aquifer susceptibility based on the formular presented below.
- Classification of aquifer susceptibility in terms of low, medium, and high based on a point score of 1 to 9.

This is then used to define the susceptibility of the aquifer to contamination. The following formular is applicable.

Aquifer Susceptibility = Aquifer System Management x Aquifer Vulnerability

Table 6-5 presents the applicable definitions to determine the aquifer susceptibility class. According to the table presented, a low aquifer vulnerability class and poor groundwater region will result in low susceptibility, whereas a high vulnerability class and major aquifer region will result in high susceptibility. According to the classification system, the study area falls under the medium aquifer susceptibility (Table 6-5 and Table 6-6).

The aquifer susceptibility classification and GQM Index classification have classified the study area into medium levels of aquifer protection. This classification requires reasonable and sound groundwater management strategies and mitigation measures to minimise and reduce the impacts.

DWS water quality management objectives are to protect human health and the environment. Therefore, the focus must be to:

- Prevent the introduction of contamination into the aquifer.
- Predict contamination movement and spread of plume.
- To remove the contaminants through rehabilitation and restoration of groundwater resources.

These objectives present the challenges highlighted by the National Academy of Sciences (1984) and form the basis for better dealing with contamination sources within the proposed mining facilities. Figure 6-3 shows the distribution of aquifer susceptibility in the area.

Table 6-5: Basis for assigning aquifer contamination susceptibility classis.

	Vulnerability Class		
Aquifer System Management Class	Low/Least (1)	Medium (2)	High (3)
Poor groundwater region (1)	Low susceptibility (1)	Low susceptibility (2)	Medium susceptibility (3)
Minor groundwater region (2)	Low susceptibility (2)	Medium susceptibility (4)	High susceptibility (6)
Major groundwater region (3)	Medium susceptibility (3)	High susceptibility (6)	High susceptibility (9)

Table 6-6: The following classification is applicable:

GQM Index	Susceptibility	Large portion
1 - 2	Low	
3 - 4	Medium	**4**
6 – 9	High	

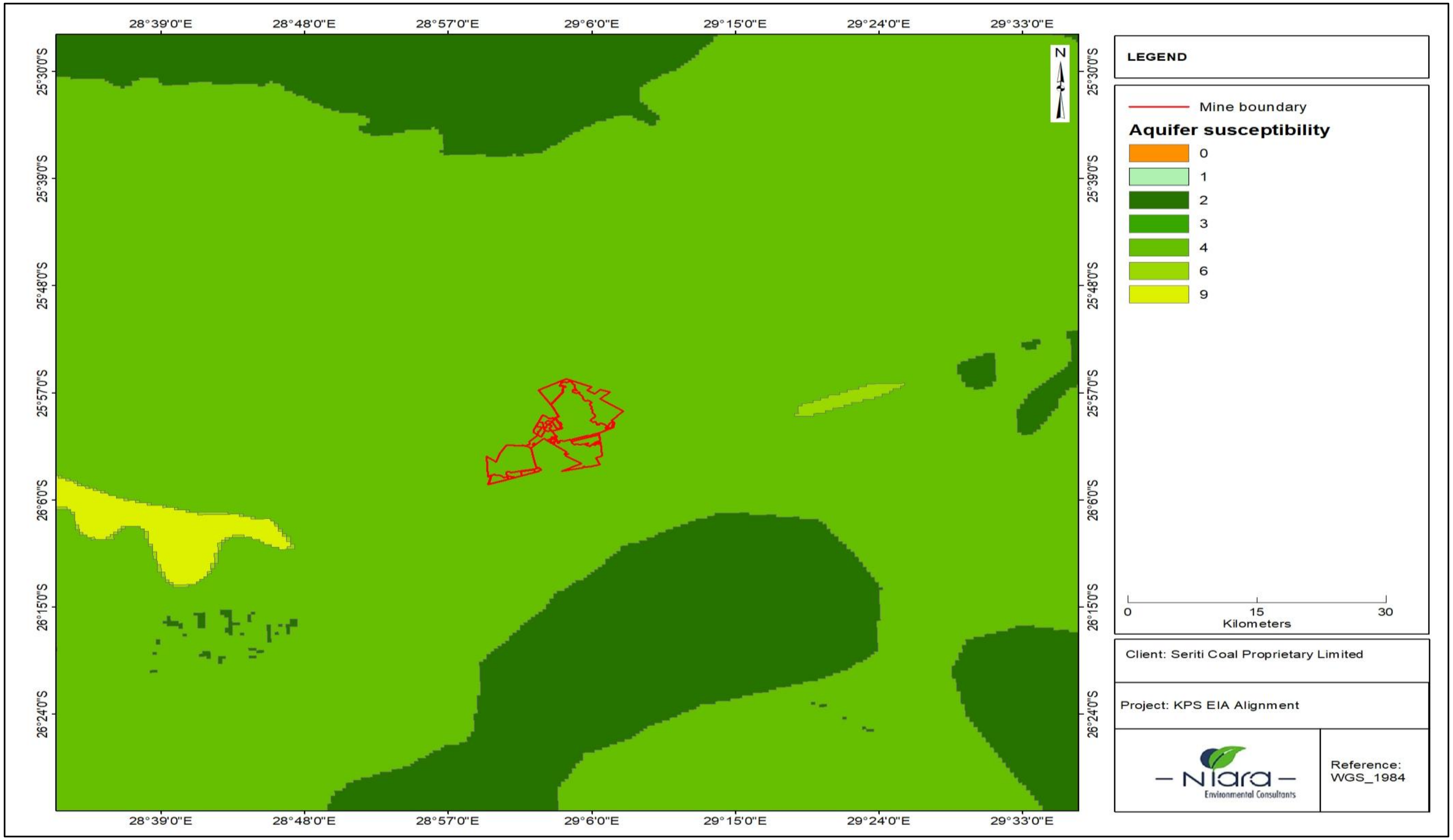

Figure 6-3: Aquifer susceptibility.

7 Groundwater Modelling

7.1 Software model choice

The groundwater model predictions were simulated using the US Geological Survey (USGS) numerical groundwater flow modelling code MODFLOW. The Model Muse was used for model construction and output visualisation. The model code is a graphical user interface (GUI) for USGS model packages, including MODFLOW 6, MODFLOW-NWT, etc. This GUI software code was used for model construction of groundwater flow, groundwater transport, and output visualisation of both flow and transport.

Modflow 6 forms part of the recently developed software packages for flow and transport modelling. The software package supports multiple models. The groundwater flow code uses a generalised control-volume finite difference method. It allows a user to specify initial conditions, hydraulic conductance, storage, constant heads, wells, recharge, rivers, general head boundaries, drains, and evapotranspiration. Groundwater transport models support a three-dimensional transport model (Winston, 2019). The package relies on numerical methods and generalised control-volume finite difference methods to solve transport equations.

7.2 Model set -up and boundaries

The model boundary has been delineated based on the catchment water divide and drainage system (Figures 7-1 and 7-2). The west, south, and north of the model boundary are based on the catchment divide, with the eastern portion bounded by the Olifant River. The boundary covered is approximately 1150 km^2. The model domain is based on a grid size of 102 by 102, with a column and row width of 100. Grid cell size for the model is about 200. The unit used in the model is in meters (m) and time in seconds (s). The model has been simulated based on site-specific data and hydrogeological and geological units. Model calibration was performed for the steady-state model simulation. This was to ensure that the resultant groundwater level mimics the natural groundwater condition.

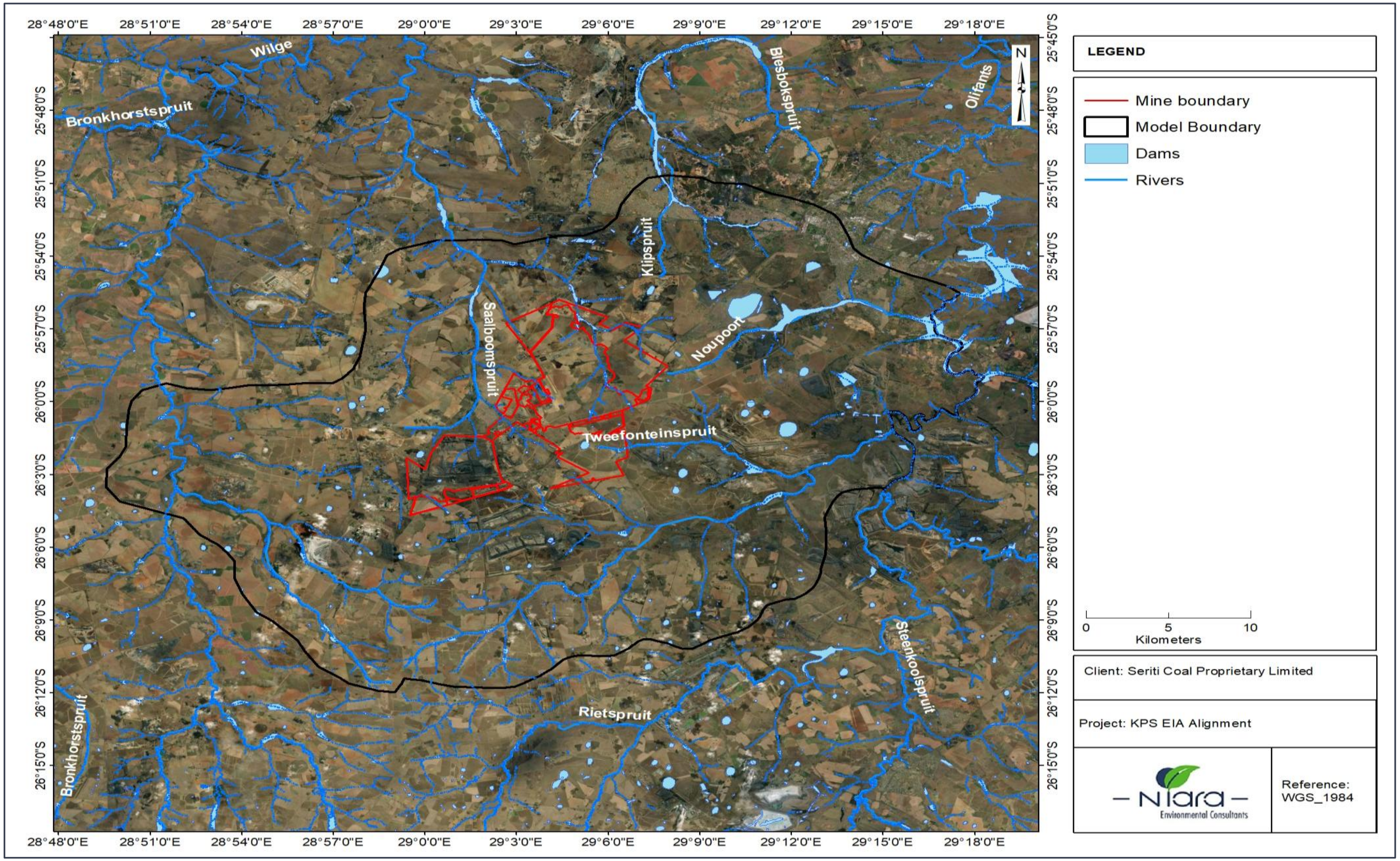

Figure 7-1: Model boundary

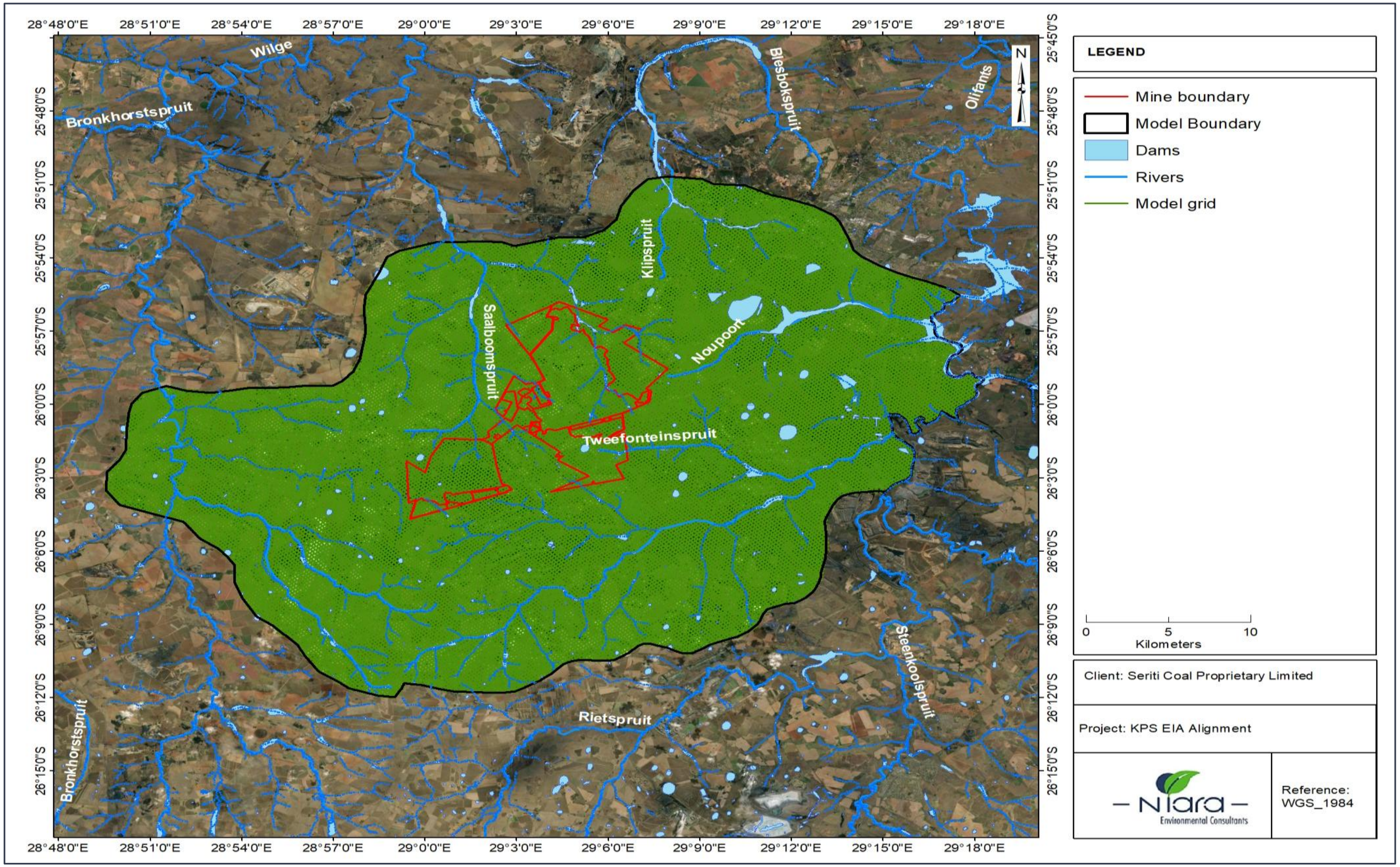

Figure 7-2: Model grid.

7.3 Groundwater elevation and gradient

Elevation data was critical in defining model top, which is represented by Layer 1. Elevation data in the form of a digital elevation model (DEM) was sourced from NASA Earth Data and the Shuttle Radar Tomography Mission (SRTM). NASA, through SRTM, contains topographic data for approximately 80% of the earth's land surface. Figure 7-3 shows the DEM map used to define the model top during simulation.

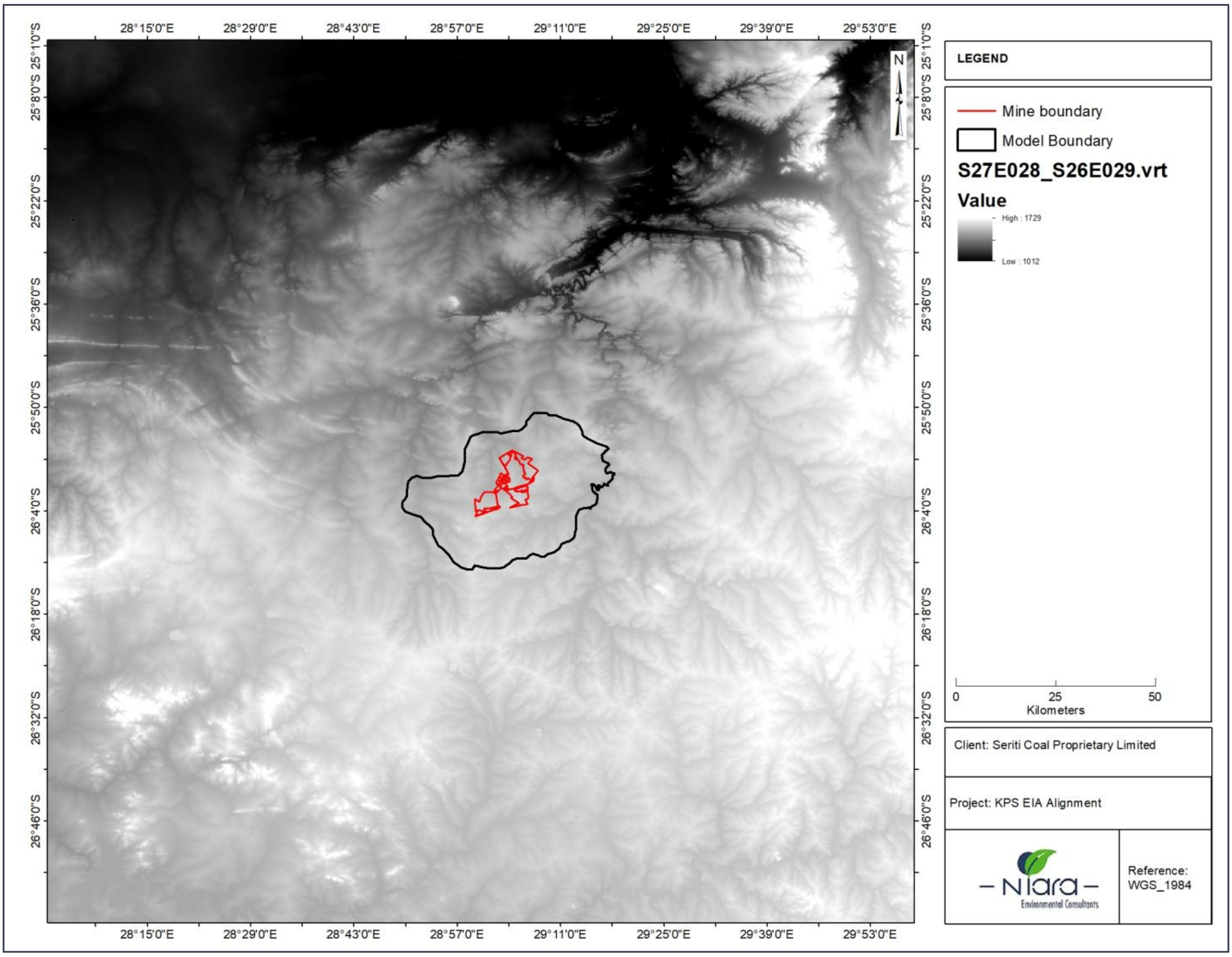

Figure 7-3: SRTM DEM map.

7.4 Geometric structure of the model

Model Layering

- The mode has two layers that represent the aquifer system, named in order from the surface as Layers 1 and 2.
- The top of layer 1 is set at the land surface, as interpolated from the SRTM DEM data.
- The thickness of the model or all layers represented in the model is about 105 m, with Layer 1 having an assigned thickness of 15 m and Layer 2 having an assigned thickness of 90 m.
- The layers are assumed to be convertible, confined-unconfined aquifers.
- Layer 2 is defined as a confined aquifer.

Table 7-1: Arrangement of model layers from the surface to the bottom.

Model layer	Thickness (m)
Model Top	Surface elevation (SRTM DEM)
1, bottom	15
2, bottom	90

Aquifer parameters

- The hydraulic conductivity used for the simulation varies from 0.02 – 0.036 m/day.
- Storativity of the fractured aquifer varies from 0.001 to 0.005 with the alluvial aquifer varying from 0.01 to 0.05 (Digby Wells, 2018).
- Estimated recharge applied into to the model is 3% of the annual rainfall (Digby Wells, 2018). This resulted in the recharge of 22 mm/a.
- Evaporation was estimated based on the USGS evapotranspiration data and 67% of the rainfall (Jovanovic et al., 2015). This result in the evapotranspiration of 482 mm/a.

Table 7-2: Aquifer parameters.

Description	Parameters
Recharge	22 mm/a
Specific storage	0.00001
Evapotranspiration	482 mm/a
Evapotranspiration depth	2 m
Hydraulic Conductivity	Layer 1: 0.02 m/d Layer 2: 0.036 m/day

7.5 Groundwater sources and sinks

The following boundary conditions were specified:

- Recharge package
- Well package
- Drain package
- Evapotranspiration package
- Time variant specific head package

The main sources and sinks applicable to the study area are:

- Surface water features such as pans and rivers were incorporated into the model as head-dependent flux specified as a drain package.
- Recharge to the aquifer: Recharge occurs within the top active layer, representing the upper layer of the unsaturated zone and weathered shallow aquifer.
- Evapotranspiration: Evapotranspiration has been incorporated into the model as a head-dependent flux-specified evapotranspiration package. Recharge was incorporated as specified flux applied as a recharge package.

7.6 Conceptual model

The groundwater flow model simulated for Klipspruit Colliery was constructed based on site-specific data, which includes hydrogeological and geological data. The conceptual model is summarised as follows:

- The mine is underlain by the Vryheid Formation of the Ecca Group, Dolerite intrusion, Dwyka Group, and quaternary cover.
- The occurrence of soil, sand, laterite, and clay was noted mainly above the solid sediment, and the thickness varies from 10 to 12 m.
- The study area comprises of three aquifer systems, namely:
  - Upper weathered aquifer
  - Fractured aquifer
  - Pre-Karoo fractured aquifer
- Upper weathered aquifer: The aquifer occurs within the upper zone, ranging from 8 m to 28 m, with the estimated saturated zone ranging from 5 m to 25 m. It is recharged by direct rainfall of less than 3%. Groundwater movement within the aquifer is lateral.

- Fractured aquifer: The fractured aquifer occurs below a shallow weathered zone between the depths of 20 m and 90 m, with an estimated saturated thickness of 17 m and 87 m. The aquifer is composed of fresh sediments that are well cemented. Groundwater occurrence within the aquifer is associated with secondary structures.
- Aquifer parameters: The hydraulic conductivity of the KPSX section varies from 0.003 to 0.045 m/d. Fractures have hydraulic conductivity that varies from 0.053 to 0.348 m/d. The hydraulic conductivity of the two boreholes tested at KPSS is 0.006 m/d and 0.047 m/d. Groundwater levels
- Groundwater level within Klipspruit and immediate surroundings varies from 1 to 38 mbgl.
- Contamination sources at KPSX include opencast, underground working, ROM stockpile, and PCD.
- Contamination sources at KPSS include the opencast, underground working, PCD, and Run of Mine (ROM) stockpiles.

7.7 Results of the model

7.7.1 Pre -facility operation

The numerical groundwater model was simulated based on the geological, hydrogeological, and conceptual models presented above. Fifteen groundwater points with water level elevation were used for model calibration. The result of the simulation and calibration matches and duplicates field observation. Observed versus simulated water level elevation has achieved a linear regression of 0.99, which suggests that the simulated water level mimics the observed water level data. Figure 7-4 shows the comparison of the observed and simulated water level data.

The resultant steady-state water level data is shown in Figure 7-5. A large portion of the mine boundary drains towards the north and northwest, with groundwater flow towards low-lying areas in the north and northwest. The southeast boundary is located within the topographic high. Groundwater level in this region is high and decreases towards the east, southeast, and also towards the north and northwest.

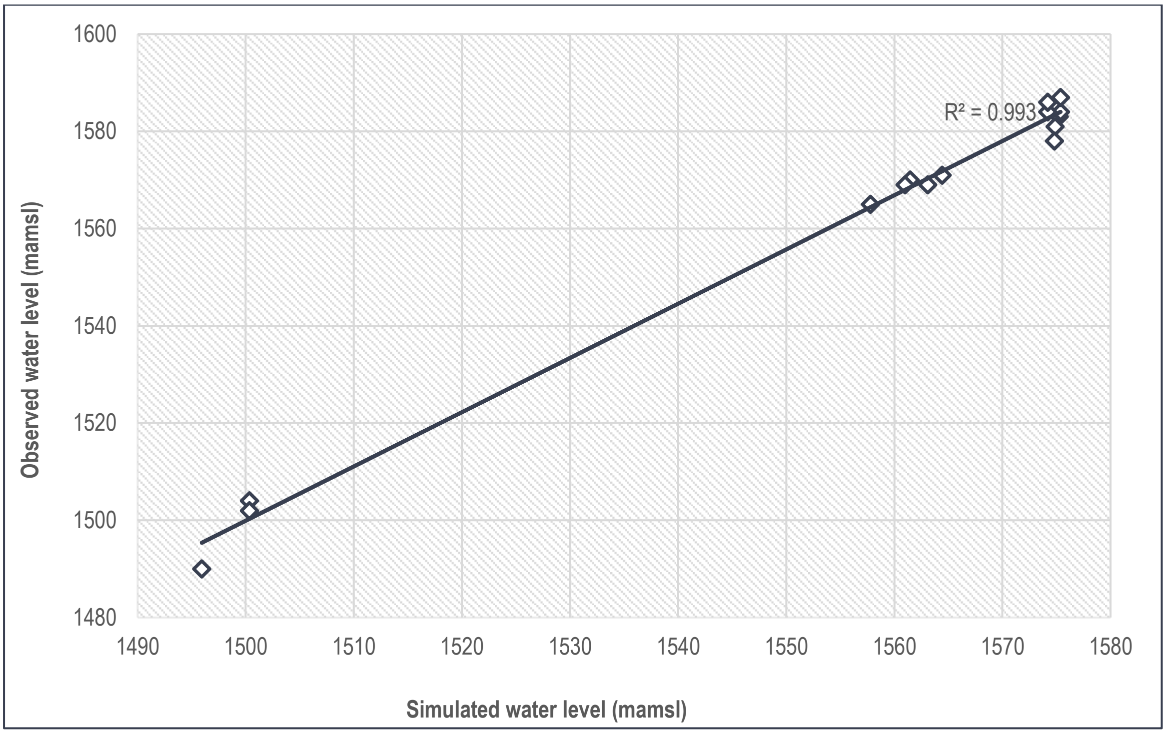

Figure 7-4: Simulated versus observed water level elevation.

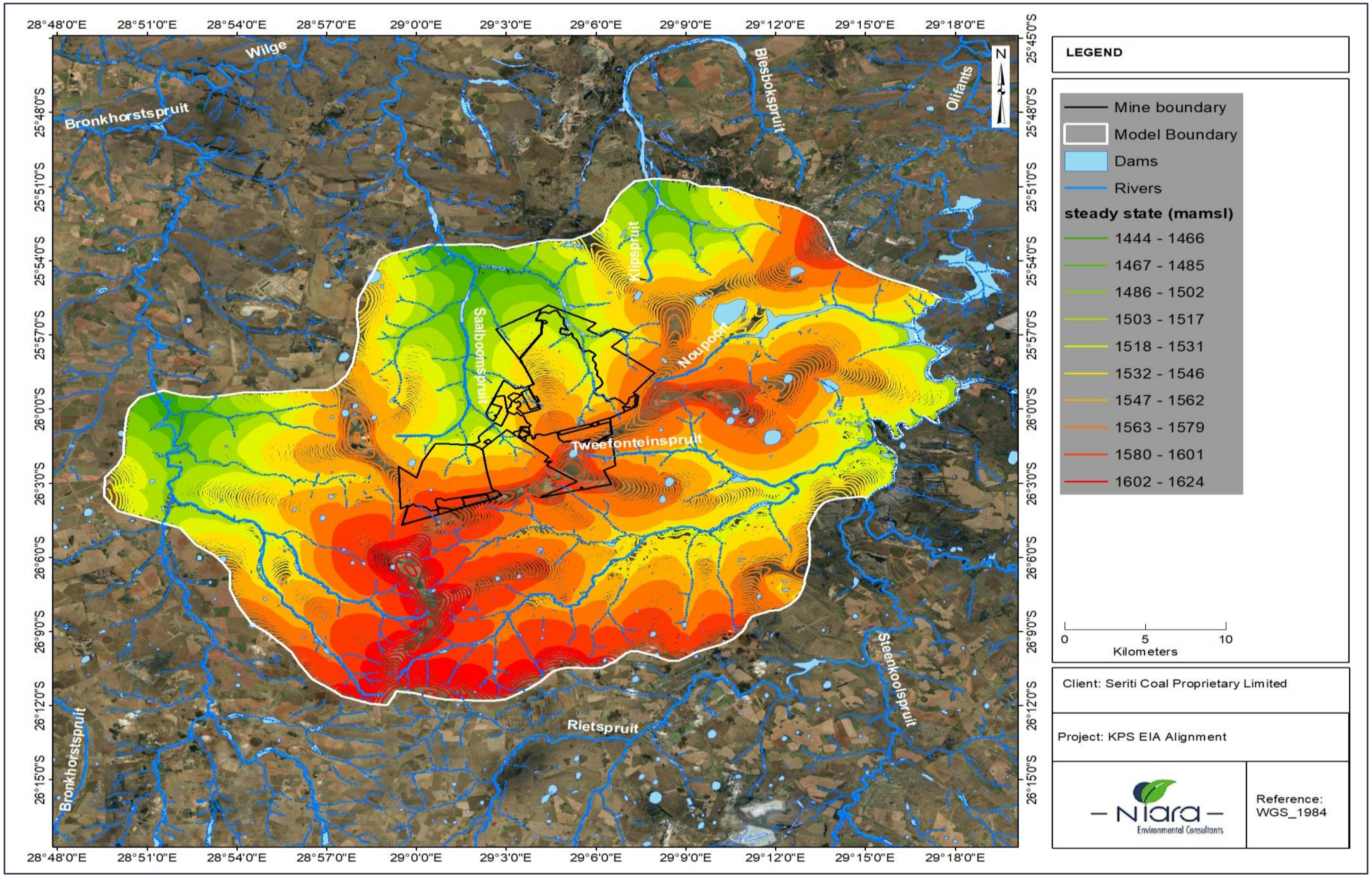

Figure 7-5: Steady state water level elevation

7.7.2 During facility operations

Operational phase is often characterised by various impacts such as the spread of the pollution plume and decline in groundwater level. Major mining activities covered under this investigation is a change in mining methods from opencast to underground. No pollution sources such as coal stockpiles and discard dumps accommodated in this investigation. This is because the application focused on the alignment of activities from opencast to underground. These activities only have an impact on groundwater level decline due to dewatering of underground.

Mine water inflow will occur during operational and post closure mining. In this investigation, it is assumed that water that enters the mine working will be removed by dewatering. These activities will eventually lower the water table resulting in groundwater level decline. Table 7-3 shows the calculated mine water inflow into opencast and underground workings. Open cast working will receive mine water inflows that varies from 555 m^3/d – 2923 m^3/d. Inflows into underground working will vary from 122 m^3/d – 1334 m^3/d. Dewatering of these volumes from individual opencast or shaft will most likely affect the groundwater level.

Table 7-3: Mine water inflow.

Open Cast	Inflow (m^3/d)
OC Pit BD	2349
OC Pit G & S	784
Portion 14 OC	555
KPS Main OC Pit	2923
KPSS OC Mining Area	2017
Underground	**Inflow (m^3/a)**
KPSS UG	122
KPSX UG	1334
OC Pit H UG	184

Impacts associated with the dewatering activities have been simulated. The resultant impacts are depicted in Figure 7-6. A large portion of the predicted drawdown is confined within the mine boundary. A high decline in groundwater level will occur mainly within the opencast and underground areas where dewatering will be occurring. The depth of decline decreases with distance away from the dewatering points. It is expected that a maximum decline of 121 m will occur mainly within the mine boundary. A decline in groundwater level is also seen outside the mine boundary, especially in the central west portion of the mine boundary and area to the southeast. Groundwater level at the edge of the predicted zone will be affected by a drawdown of 3 m, increasing towards the mine. A decline in groundwater level will also affect baseflow discharge. Several rivers occurring in the immediate vicinity will be affected by dewatering. Many of the monitoring boreholes (Figure 7-6) will be affected by dewatering, resulting in decreasing water level trends during the operational phase.

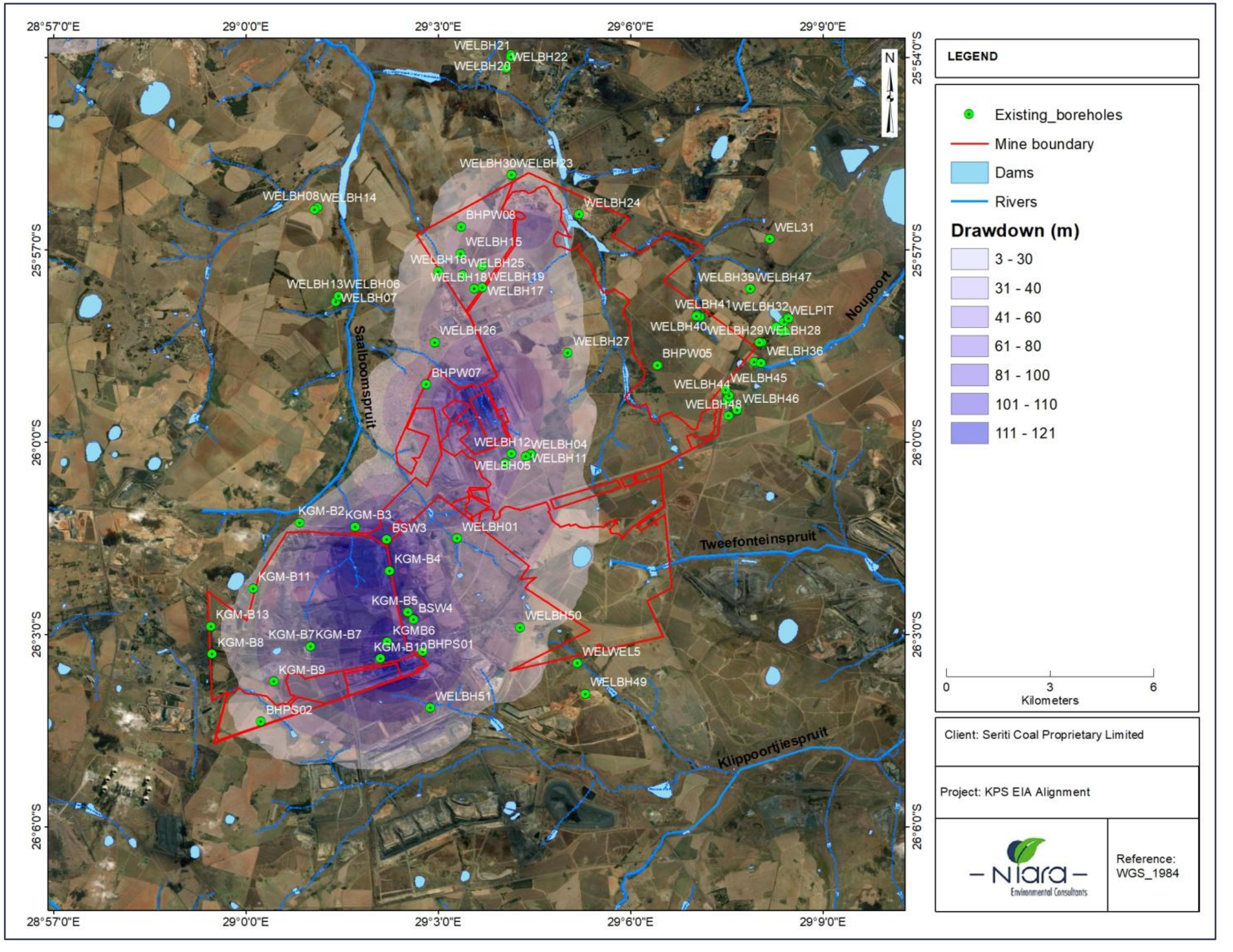

Figure 7-6: Drawdown and radius of influence

7.7.3 Post -facility operation

Mining activities are characterised by various impacts during post-closure. Common impacts during this phase include:

(1) Cumulative impacts associated with the spread of contamination plume.

(2) Mine water inflow and groundwater level rebound within the shafts and rehabilitated opencast.

(3) Decant of contaminated mine water following recharge of mine working.

While these impacts are common, only No 2 and 3 impacts are expected due to the proposed activities. It must be emphasised that this report was compiled due to changes in mining methods. Therefore, predictions simulated are associated with Section 21(j) of the NWA. This is because changes in mining methods are associated with changes in dewatering locations and associated volumes.

The model was simulated based on the assumptions that mine water that enters mine workings in the form of seepage, water ingress, recharge, and fissure during the operational phase will be removed by dewatering. However, any activities associated with Section 21(j), dewatering of mine working will cease, although the mine working and rehabilitated opencast will continue to receive mine water inflow. This implies that mine water rebound will occur during post-closure. The shafts and rehabilitated area will be recharged, resulting in water level rise within mine working and affected aquifer in the vicinity of the mine.

Post-closure impacts will include decant following groundwater rebound. In the Klipspruit Colliery, it is predicted that decant will occur. Decant locations are shown in Figure 7-7. Two potential decants have been identified based on the current mine layout:

- KPSS underground will decant on the northern portion of the shaft.
- KPS Main Pit is expected to decant in the northeastern portion of the opencast.

Table 7-4: Potential decant location.

Name	Latitude	Longitude	Description
KPSX	-25.935216	29.080902	North
KPS Main Pit	-26.023801	29.026982	Northeast

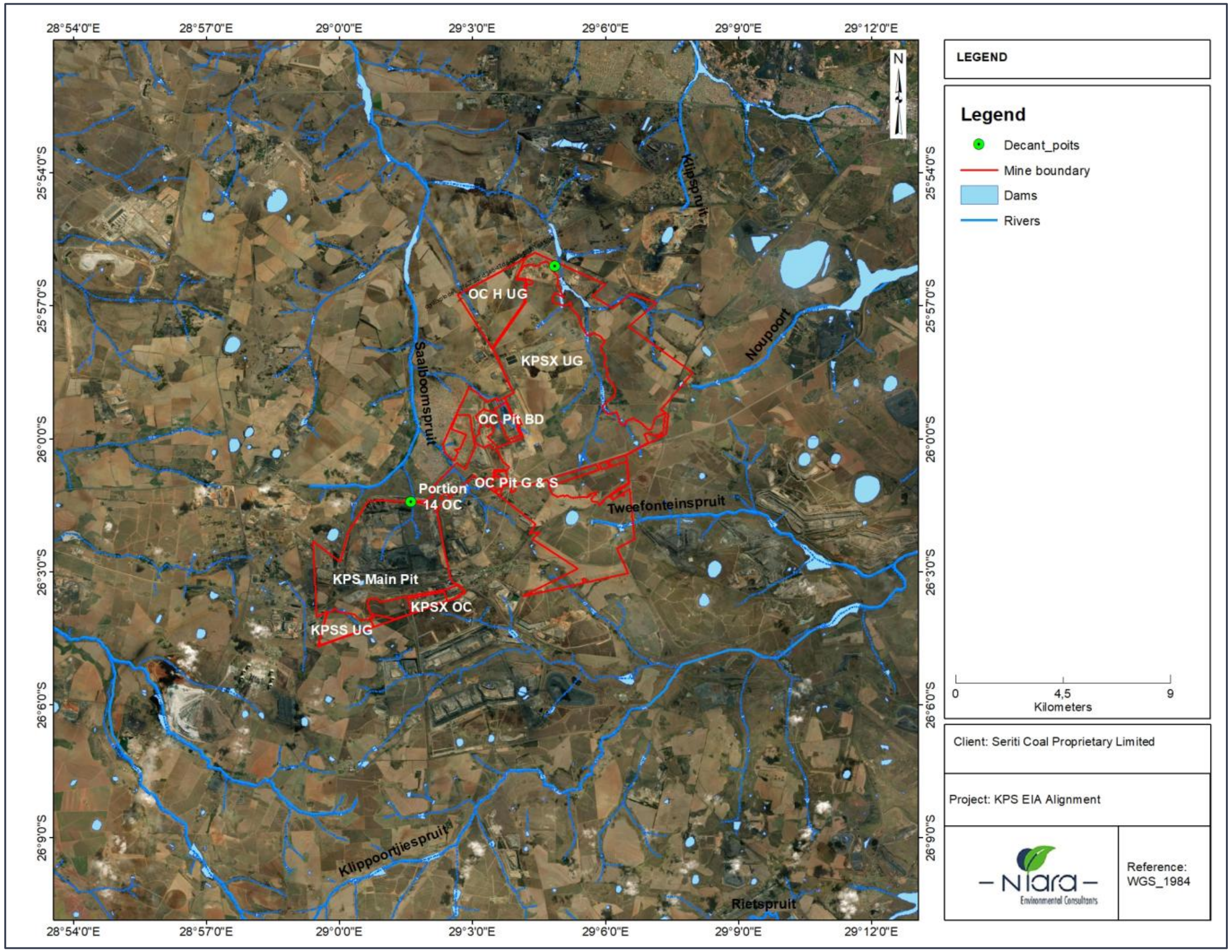

Figure 7-7: Potential decant location.

8 Geohydrological Impacts

8.1 Construction phase

This section describes a range of potential groundwater impacts that are likely to occur during the construction phase. It must be highlighted that Klipspruit Colliery is an operational mine. Major activities that involve sinking of some shafts, construction of water containment facilities, and opencast mining have been undertaken. New facilities such as opencast, and underground mining have been proposed.

8.1.1 Impacts on Groundwater Quantity

- Construction of the proposed activities is expected to cause physical disturbance. This will most likely affect the flow path and baseflow. Sinking of the shaft and stripping of topsoil will divert groundwater flow direction, resulting in diverting groundwater and forming artificial discharge.
- Physical disturbances in aquifers create barriers to groundwater flow. Structures with concrete foundations will interrupt the horizontal flow of shallow groundwater.
- Discharge of perched and shallow groundwater to trenches or excavation in the form of seepage, reducing the amount of available groundwater. Baseflow will be reduced due to seepage discharge.
- Shallow groundwater levels will be affected. Erecting structures, sinking of shafts, stripping, and removal of topsoil will result in lowering of groundwater level.

8.1.2 Impacts on Groundwater Quality

- Pollution and degradation of groundwater is expected to occur. Common contaminants include oil, diesel, petrol, grease, and lubricants from the plant and vehicles.
- Contamination of surface waters through runoff, spills, leaks, and disinfection activities. Leakages and spillages on land surfaces will eventually contaminate soil. Soil contamination due to hydrocarbons and petrochemicals.
- Solid waste will be generated, which will most likely have a negative impact on water resources.
- Disturbance of soil and excavation will most likely result in erosion and sedimentation. This may have negative impacts on groundwater quality.

8.1.3 Groundwater Management

The contamination risk can be reduced by a range of water management options. Adoption of good practices established for the mine will assist in reducing the impacts. Possible mitigation measures include the following:

- Protection of streams, wetlands, and dams by restricting activities and locating activities outside the buffer zones.
- Construction of stormwater management facilities, water containment facilities, and waste facilities in line with regulations.
- Ensures the separation of clean and dirty storm water. Collection and containment of dirty storm water.

- Establish surface and groundwater monitoring, inspection, and auditing of facilities and activities.
- Establish and implement preventative measures with the aim of preventing, avoiding, reducing, and minimising the impacts.
- Repair of equipment and vehicles in the designated area.
- Storage of hydrocarbons in a designated area.
- Excavate and remove hydrocarbon spillage from the soil during construction.
- Dispose of any contaminants at the designated facility.
- Prevent erosion on excavated surfaces.
- Report spillage and incidents for rehabilitation.

8.2 Operational phase

8.2.1 Impacts on Groundwater Quantity

Major impacts associated with the proposed activities are expected during this phase. Dewatering is expected to pose impacts on water resources, both surface and groundwater resources. It is well established that the proposed opencast and underground mining projects can have negative impacts on groundwater resources. The following impacts have been identified:

- Lowering of groundwater level in the area where the opencast and underground shafts are occurring below the water table is expected. The groundwater level in the area is shallow, and the water level will be lowered on a local basis.
- Stripping of soil and sinking of shaft below the water table will divert groundwater towards the opencast and underground void. Groundwater in the form of seepage and water ingress will discharge into the mine working in the form of mine water inflow. This water will be removed by dewatering activities.
- The mine area has several streams originating and flowing through the mine boundary. These streams will be affected. Streamside inhabitants will be destroyed.
- Over-abstraction of aquifers and negative impacts associated with dewatering.
- Lowering and decline of groundwater level.
- Decrease in available groundwater and yield.
- Physical disturbance of aquifers creates pathways for groundwater flow.
- Physical disturbance of aquifers creates barriers to groundwater flow.
- Ground settlement will occur whenever groundwater levels are lowered by abstraction.

8.2.2 Impacts on Groundwater Quality

- Contamination plume and migration of contaminants will most likely occur.
- Formation of acid mine drainage, which may migrate towards fresh groundwater resources.
- Weathering of newly exposed soil, which could cause leaching and oxidation, resulting in water resource contamination.
- Unauthorised discharge of mine-contaminated water.
- Seepage, overflow, infiltration, and runoff of mine-contaminated water into the aquifer and water resources.
- Metals leach from the material as water rushing over the surface of the rocks carries the metal downstream.

- There is an unacceptable risk of pollution of groundwater from point and diffuse sources.
- Opencast and other excavation can create the potential for discharge pathways to discharge contaminants into groundwater, with the consequent risk of pollution and degradation of groundwater quality.
- Unauthorised discharge of mine-contaminated water is common, especially during heavy rainfall. This can have a significant impact on the surrounding and underlying aquifers.
- Seepage, overflow, infiltration, and runoff of mine-contaminated water into the aquifer and water resources.
- Metals leach from the material as water rushing over the surface of the rocks carries the metal downstream.
- Opencast and other excavation can create the potential for discharge pathways to discharge contaminants into groundwater, with the consequent risk of pollution and degradation of groundwater quality.
- Blasting can create artificial flow paths that allow nitrate-rich groundwater to infiltrate to the underlying. It also exposes rocks containing soluble minerals that could potentially contaminate groundwater.
- Spills or leaks will most likely occur and will result in groundwater contamination.
- . Leakages and spillages on land surfaces will eventually contaminate soil. Soil contamination due to hydrocarbons and petrochemicals.
- Solid waste will be generated, which will most likely have a negative impact on water resources.

8.2.3 Impacts on Surface Water

- The effects of mine water on the streams are characterised by discharge and dilution, resulting in water quality degradation.
- Contamination of surface waters through runoff, spills, and leaks
- Rivers occurring in close proximity to the mine will be affected, resulting in reduced flow, reduced baseflow, and discharging of contaminated mine water.
- Storm water flowing from the mine facility will most likely discharge contaminants into surface water resources.
- It is expected that water quality downstream of the mine may be affected.
- Uncontrolled discharge associated with dam overflow and seepage will most likely affect the rivers in the west and east.
- Deterioration of surface water quality remains one of the major impacts associated with the facilities.

8.2.4 Groundwater Management

- Stormwater originating within the mine facility and other areas classified as impacted must be contained.
- Areas that require improvement in terms of stormwater collection, diversion, and separation must be identified.
- Design and improve systems to prevent, divert, and separate clean and dirty water. Separate clean and dirty water. Divert clean water away from the mine facilities. Collect dirty water generated from the mine facilities.
- Removal of silt in PCDs and cleaning of dams must form part of the regular activities. Cleaning of these facilities will improve storage capacity.
- Inspection of facilities must be conducted on a regular basis to assess compliance, dam water level, spillages, and overflow.
- Identify and clean up contaminated sites. Dispose of contaminated water or site in an appropriate manner.

- Prevent future contamination by improving environmental risk assessment and adopting a liability prevention approach to future contamination.
- Protection of streams, wetlands, and dams by restricting activities and locating activities outside the buffer zones.
- Optimise the usage of dirty water, recycle, and reuse dirty water.
- Improves facilities for hydrocarbon storage, excavates and removes hydrocarbon spillage from the soil, and disposes of contaminated hydrocarbons in designated areas or facilities.

8.3 Decommissioning and Post- mining phase

8.3.1 Groundwater Quantity

Following mine closure, groundwater level rebound is expected within mine working. Dewatering will affect groundwater levels in the immediate vicinity. It is expected that groundwater level recovery will occur. Groundwater level recovery, filling of voids, or rebound within the rehabilitated area will recover to the original water level, while in some areas, it will recover to a level above the original water level. This will result in mine water decanting within the mine. It is predicted that decanting within the mine will occur during post-closure. This remains one of the major impacts that are likely to occur post-closure.

8.3.2 Groundwater Quality

Post-closure impacts will also be characterised by the spread of the contamination from old workings. This includes the generation of contaminants from the rehabilitated area. Impacts from these facilities will migrate and spread to low-lying areas with groundwater resources. In areas with predicted decants points, impacted discharge of mine-contaminated water will occur. Artificial recharge of aquifers with mine water will occur in areas adjacent to mine voids.

8.3.3 Cumulative Impacts

This section must be reviewed with caution as the proposed activities only triggered Section 21 (j) of the water uses. It is important to note that facilities such as discard dump, coal stockpile, and PCD are already licenced, and the study conducted for these facilities also included contamination plume. Impacts discussed in this report only focused on dewatering impacts on the aquifer. Cumulative impacts associated with the proposed activities are associated with decant of mine affected water. Decant within the mine will occurs and details of such decant is discussed in the sections above.

Other cumulative impacts of concern will most likely arise from the existing and licenced PCD, discard dump and coal stockpiles. These impacts will continue during closure and post closure. While removal and rehabilitation of coal stockpile area and PCD will reduce impacts, impacted footprint will most likely act as a source of contamination. Rehabilitation will focus on the removal of facilities including removal of soil underneath. This will most likely eliminate most of the contamination sources.

8.3.4 Groundwater Management

Backfilling of opencast will reduce interaction or fresh rainwater within mined-out areas. This will reduce the rate of impact generation, especially an AMD occurrence. Major impacts during this phase are a decant of mine-affected water. Therefore, this section presents proposed preventative measures to manage the uncontrolled release of mine water into nearby watercourses during the mine's operational period, closure, and after closure. An uncontrolled outflow poses a risk to the quality of surface water, aquatic environments, and regulatory adherence. As groundwater levels recover following the cessation of dewatering, mine voids may act as preferential discharge pathways, potentially resulting in decant within or adjacent to natural drainage features.

The mitigation measures outlined in this section are informed by the hydrogeological conceptual model, numerical groundwater modelling, and predicted groundwater flow patterns. The measures are aimed at confirming the likelihood and location of decant, establishing engineered control points outside of watercourses, and implementing appropriate infrastructure and monitoring to prevent direct discharge of mine water into the river. These recommendations are intended to support responsible mine closure planning, protect surface water resources, and ensure compliance with applicable environmental and water use authorisations.

Groundwater model updates and Decant Risk Confirmation

- Ensure that the mine updates the numerical groundwater model at least every two years during operations.
- Reassess predicted potential decant locations following each model update.
- Five (5) years prior to the planned cessation of mining, conduct a comprehensive hydrogeological investigation and full model update aimed at:
    - Confirming whether post-closure mine decant is likely.
    - Identifying the most probable decant point(s) based on updated mine geometry, final pit and underground layouts, and hydrogeological conditions.
- Align the updated groundwater model with the final approved mine layout and closure landform design.
- If modelling confirms that decant is probable, initiate early post-closure decant management planning.

Identification of artificial decant points outside watercourses

- Use the hydrogeological study and updated groundwater model outputs to:
    - Map groundwater flow gradients, potentiometric surfaces, and predicted flow pathways.
    - Assess aquifer permeability and preferential flow zones that may influence decant behaviour.
- Identify the lowest hydraulic control point located outside of any river or riparian buffer zone that can safely intercept rising mine water.
- Confirm that the natural hydraulic gradient directs groundwater flow toward the identified artificial decant point rather than toward the river.

Construction of engineered decant control structures

Where decant is predicted, construct appropriate engineered infrastructure to intercept and control mine water before it reaches watercourses. Such infrastructure may include:

- Artificial decant sumps or collection basins located at the identified hydraulic low point outside the watercourse.
- Cut-off trenches, interceptor drains, or low-permeability barriers between the predicted decant zone and the river to prevent uncontrolled seepage.
- Lined channels or pipelines to convey collected decant water to containment facility.

Investigation of mine water treatment options

Should post-closure decant be confirmed by updated hydrogeological investigations and groundwater modelling, it is recommended that the mine undertake a detailed assessment of appropriate mine water treatment options to ensure that any collected decant water meets applicable discharge or reuse standards prior to release or disposal.

The investigation should evaluate both passive and active treatment systems, taking into account predicted decant volumes, water quality, long-term sustainability, land availability, operational requirements, and post-closure maintenance obligations. The selection of an appropriate treatment system should be informed by detailed geochemical characterisation of anticipated decant water, treatability studies, decant volume, and life-cycle cost assessments. Where feasible, treatment system design should favour solutions that are robust under post-closure conditions and minimise long-term operational and maintenance requirements while ensuring the protection of surface water resources.

Water quality management

- Characterise anticipated decant water quality based on:
  - Geochemical modelling.
  - Historical mine water monitoring data.
- Design decant infrastructure to accommodate either passive or active treatment system depending on the recommended methods.
- Prevent untreated mine water from entering any watercourse.

Monitoring and adaptive management

- Implement and maintain a targeted groundwater monitoring network between the mine workings and adjacent watercourses to track groundwater level recovery and identify early indications of seepage or migration toward surface water features.
- Use monitoring results to validate, calibrate, and refine the groundwater model on an ongoing basis, and to inform adaptive management decisions, including adjustments to discharge rates, decant interception infrastructure, and control measures as required.
- Integrate all decant interception and management measures into the mine closure plans, including alignment with associated financial provisioning to ensure long-term viability.
- Define and commit to long-term post-closure monitoring and maintenance requirements, including responsibilities, performance criteria, and reporting obligations.
- Periodically review the effectiveness of decant management measures and update mitigation strategies in response to changing hydrogeological conditions, monitoring results, or regulatory requirements.

8.4 Groundwater monitoring network – monitoring points with coordinates

8.4.1 Source, plume, impact and background monitoring

The concepts of background, sources, plume, and impact monitoring have been considered when drilling the monitoring points at Klipspruit Colliery. This is because the current monitoring points cover all recommended locations based on the risk-based approach:

- Background monitoring: boreholes located up gradient of activities or development to determine the actual state of groundwater quality within the aquifer. This data is critical to determining baseline groundwater quality prior to development and to collecting baseline data for future comparison.
- Source monitoring: boreholes located down gradient of activities or development, down gradient of contamination sources, to monitor impact of contamination sources.
- Plume monitoring: boreholes located within the flow path or predicted plume direction and monitor the spread and extent of contamination.
- Impact monitoring: boreholes where receptors are located, restricted to areas where impact is expected, and serves as an early warning system.

8.4.2 System response monitoring network

Groundwater level monitoring forms part of the monitoring program at Klipspruit Colliery. The monitoring provides information on aquifer response. While groundwater abstraction and dewatering may deplete groundwater resources, resulting in groundwater level decline, groundwater level monitoring serves as an early warning system to track changes associated with dewatering and abstraction.

8.4.3 Monitoring frequency

The following monitoring frequency is recommended:

- Groundwater quality: Quarterly
- Groundwater level: Monthly
- Dewatering volume: records volumes on a daily basis (flow meter) and monthly computation of dewatering volumes.

8.5 Monitoring parameters

Parameters
pH
EC mS/m
TDS mg/l
TotHardness mg/l
MALK CaCO3/L
Cl mg/l
SO4 mg/l
PO4 mg/l
N_Ammonium mg/l
NO3-N mg/l
NO2-N mg/l
TON mg/l
F mg/l
Ca mg/l
K mg/l
Mg mg/l
Na mg/l
Al mg/l
Fe mg/l
Mn mg/l
Zn mg/l
Si mg/l
SS mg/l
Turbidity NTU
Free Cl2 mg/l
LSI (Index)
SAR
CaHardness mg/l
MgHardness mg/l
Bicarbalk CaCO3mgl
Carbalk mg/l
Halk mg/l

8.6 Monitoring boreholes

The following points form part of groundwater monitoring.

Table 8-1: Monitoring points.

Site name	Latitude	Longitude	Site Type
BSW 4	-26.04098	29.0395	Borehole
KGM 08	-26.054552	28.991432	Borehole
KGM 10	-26.053146	29.039991	Borehole
KGM 13	-26.052393	28.990923	Borehole
KGM B04	-26.025284	29.036629	Borehole
KGM B06	-26.052101	29.040367	Borehole
KGM B11	-26.04931	29.000103	Borehole
KGM B16	-26.05347	29.02322	Borehole
WELBH27	-26.02095	29.0258	Borehole
BHPW05	-25.98	29.107	Borehole
BHPW08	-25.944	29.056	Borehole
WELBH01	-26.026	29.056	Borehole
WELBH08	-26.012	29.05	Borehole
WELBH16	-25.956	29.05	Borehole
WELBH24	-25.941	29.087	Borehole
WELWEL03	-25.952	29.096	Borehole
BH 008	-25.99869	29.06285	Borehole
BH 009	-25.99052	29.059	Borehole
BHPSM01	-26.05722	29.04476	Borehole
BHPSM06	-26.06704	29.01697	Borehole
BHPSM08	-26.06058	28.99894	Borehole
BHPSM09	-26.06919	29.01072	Borehole
BHPSM10	-26.05306	29.04305	Borehole
BHPSM13	-26.07281	28.99976	Borehole
WELBH25	-25.95885	29.09002	Borehole
WELBH26	-26.01191	29.04647	Borehole

9 Groundwater Environmental Management Programme

9.1 Current groundwater conditions

Several groundwater points show guideline exceedance in terms of SANS limits:

- SO4 was detected in high concentration in the groundwater sample, namely BSW 4.
- NH4 was detected at high concentrations in WELBH08 and BSW 4.
- The concentration of F exceeds guideline limits in WELBH27 and KGM 10.
- The concentration of Mn is above the SANS chronic health limits in BHPSM01, BHPW05, and WELBH16.
- Mn also exceeds SANS aesthetic limits in BHPSM10, WELBH08, WELBH25, BSW 4, KGM13, and KGM B06.

Several boreholes also exceeded WUL limits, as summarised:

- Non-compliant in terms of EC and Mg was noted in BSW 4.
- Ca is present at a high concentration above the WUL limits in six boreholes that include BSW 4, KGM 10, BH 008, BHPSM01, BHPW08, and BHPSM10.
- The concentration of Na is high in three boreholes, namely BSW 4, WELBH26, and WELBH27.
- The majority of the boreholes are contaminated with SO4, NO3, and F.
- The concentration of NO3 exceeded WUL limits in all boreholes.
- The concentration of F is compliant in five boreholes, namely KGM 13, KGM B06, KGM B16, WELBH 16, and WELBH 25, with the remaining boreholes being classified as non-compliant.
- The concentration of SO4 was noted in high concentration above the WUL limits in the following boreholes: BSW 4, KGM 10, KGM B04, KGM B06, KGM B11, KGM B16, BH 009, BHPSM01, BHPSM08, and WELBH27.

9.2 Predicted impacts of facility

Impacts associated with the proposed activities include a decline in groundwater level and a decant of mine-affected water. Dewatering of opencast and mine voids is directly related to or associated with the depletion of groundwater. This has significant impacts on groundwater levels. Dewatering of mine working will cease post-closure. This will lead to groundwater level rebound and recovery. Decant of mine working is likely to occur post closure, following a full recovery of groundwater resources.

6.1. Impact Assessment

6.1.1. Impact Assessment Methodology

The impact significance rating process serves two purposes: firstly, it helps to highlight the critical impacts requiring consideration in the management and approval process; secondly, it shows the primary impact characteristics, as defined above, used to evaluate impact significance.

Five factors need to be considered when assessing the significance of community health impacts, namely:

- Relationship of the impact to temporal scales (duration) - the temporal scale defines the significance of the impact at various time scales, as an indication of the duration of the impact.
- Relationship of the impact to spatial scales - the spatial scale defines the physical extent of the impact.
- The severity of the impact - the severity/beneficial scale is used to scientifically evaluate how severe negative impacts would be, or how beneficial positive impacts would be on a particular affected system (for ecological impacts) or a particular affected party.
- The severity of impacts can be evaluated with and without mitigation to demonstrate how serious the impact is when it is not allayed. The word 'mitigation' means not just 'compensation', but includes concepts of containment and remedy. For beneficial impacts, optimization means anything that can enhance the benefits. However, mitigation or optimization must be practical, technically feasible and economically viable.
- The likelihood of the impact occurring - the likelihood of impacts taking place as a result of Project actions differs between potential impacts. There is no doubt that some impacts would occur (e.g. loss of vegetation), but other impacts are not as likely to occur (e.g. vehicle accident), and may or may not result from the proposed development. Although some impacts may have a severe effect, the likelihood of them occurring may affect their overall significance.

Each criterion is ranked with scores assigned as presented in Table 9-1 to determine the overall **significance** of an activity. The criterion is then considered in two categories, viz. effect of the activity and the likelihood of the impact. The total scores recorded for the consequence and likelihood are then read off the matrix presented in Table 9-2, to determine the overall significance of the impact. The overall significance is either negative or positive (Table 9-3).

The ***environmental significance*** scale is an attempt to evaluate the importance of a particular impact. This evaluation needs to be undertaken in the relevant context, as an impact can either be ecological or social, or both. The evaluation of the significance of an impact relies heavily on the values of the person making the judgment. For this reason, impacts of a social nature in particular need to reflect the values of the affected society.

Prioritisation of Impacts

The evaluation of the impacts, as described above is used to prioritise which impacts require mitigation measures.

Negative impacts that are ranked as being of "**VERY HIGH**"/**CRITICAL**" and "**HIGH**" significance will need to be investigated further to determine how the impact can be minimised or what alternative activities or mitigation measures can be implemented. These impacts may also assist decision makers i.e. numerous **HIGH** negative impacts may bring about a negative decision.

For impacts identified as having a negative impact of "**MODERATE**" significance, it is standard practice to investigate alternate activities and/or mitigation measures. The most effective and practical mitigations measures will then be proposed.

For impacts ranked as "**LOW**" significance, no investigations or alternatives will be considered. Possible management measures should be investigated to ensure that the impacts remain of low significance.

Table 9-1: Ranking of Evaluation Criteria

EFFECT OF IMPACT	**Temporal Scale (Duration)**			**Score**
	Short term	Less than 5 years		1
	Short to Medium term	Between 5-10 years		2
	Medium term	Between 10-20 years		3
	Long term	Between 20 and 40 years (a generation) and from a human perspective also permanent		4
	Permanent	Over 40 years and resulting in a permanent and lasting change that will always be there		5
	Spatial Scale			
	In Situ	Isolated proposed site Only		1
	Localised	At localised scale and a few hectares in extent		2
	Study Area	The proposed site and its immediate surroundings		3
	Regional	District and Provincial level		4
	National	Country		5
	Severity	**Severity**	**Benefit**	
	Slight	Slight impacts on the affected system(s) or party(ies)	Slightly beneficial to the affected system(s) and party(ies)	1
	Slight to Moderate	Minor insignificant impact on the affected systems or party(ies)	Minor benefit to the affected system(s) and party(ies)	2
	Moderate	Moderate impacts on the affected system(s) or party(ies)	Moderately beneficial to the affected system(s) and party(ies)	3
	Severe/ Beneficial	Severe impacts on the affected system(s) or party(ies)	A substantial benefit to the affected system(s) and party(ies)	4
	Very Severe/ Beneficial	Very severe change to the affected system(s) or party(ies)	A very substantial benefit to the affected system(s) and party(ies)	5
LIKELIHOOD	**Likelihood**			
	Rare	Less than 3% likelihood of occurring. Could be incurred in a 20 – 50-year time frame.		1
	Unlikely	Between 3% and less than 10% likelihood of occurring. Could be incurred within a 5 – 20-year time frame.		2
	Possible	Between 10% and less than 30% likelihood of occurring. Could be incurred within a 5-year budget or project period.		3
	Likely	Between 30% and less than 90% likelihood of occurring.		4

		Could be incurred over a 1–2-year budget or project period.	
	Almost Certain	90% and higher likelihood of occurring. Could be incurred more than once in a year.	5

Where Effects of Impact = <u>Duration + Spatial Scale + Severity</u>

* In certain cases, it may not be possible to determine the severity of an impact thus it may be determined: Do not know/ cannot know

Significance of Impact= Likelihood x Impact

Table 9-2: Matrix used to determine the overall significance of the impact based on the likelihood and effect of the impact

Likelihood	5	5	10	15	20	25
	4	4	8	12	16	20
	3	3	6	9	12	15
	2	2	4	6	8	10
	1	1	2	3	4	5
		1	2	3	4	5
		Impact				

Table 9-3: Significance of the impact based on the likelihood and effect of the impact

Risk Rating	Risk Level	Guideline for Risk Matrix	Suggested Timelines
21 to 25	Critical/Very High	A critical risk exists that management's objectives may not be achieved. Appropriate mitigation strategy to be devised immediately.	Short term. Normally within 1 month. (Make provision for special concession for engineering type risk & those with long lead/execution times)
13 to 20	High	A high risk exists that management's objectives may not be achieved. Appropriate mitigation strategy to be devised as soon as possible.	Medium term. Normally within 3 months.
6 to 12	Moderate	A moderate risk exists that management's objectives may not be achieved. Appropriate mitigation strategy to be devised as part of the normal management process.	Normally within 1 year
1 to 5	Low	A low risk exists that management's objectives may not be achieved. Monitor risk, no further mitigation required.	Ongoing control as part of management system.

6.1.2. Impact Assessment and rating

6.1.2.1. Operational Phase Impacts

Activity	Hazard	Risk description	Causes	Impacts	Control	Impact level	Likelihood rating	RRR
Open cast Mining, Underground	Inflow of mine water	Water influx into the mine working is expected. Mine water will be removed via dewatering to reduce associated risk	Dewatering	This will result in the lowering of water table, impacts on groundwater users.	Conduct dewatering based on the calculated volumes, considering water requirement underground. Remove water when necessary to improve safe working. Minimise exceedance of volume. Remove water as authorised. Conduct groundwater monitoring.	6	3	18
	Inflow of mine water	Mine water inflow will be removed by dewatering.	Dewatering	This will most likely affect groundwater availability and yield.	Conduct dewatering based on the calculated volumes, considering water requirement underground. Remove water when necessary to improve safe working. Minimise exceedance of volume. Remove water as authorised. Conduct groundwater monitoring.	7	2	14
	Seepage and infiltration of mine water	Water seepage and infiltration to the underlying aquifer will affect groundwater quality	Uncontrolled seepage and infiltration of mine affected water	Surface and groundwater contamination, spread of pollution plume	Ensure that the underground working is dry.	9	2	18

Activity	Hazard	Risk description	Causes	Impacts	Control	Impact level	Likelihood rating	RRR
Coal Stockpiles, discard dump (Storage of ROM and Product)	Seepage and infiltration of mine water	Infiltration and seepage of mine water is expected	Uncontrolled release, seepage and infiltration of mine affected water	Surface and groundwater contamination, spread of pollution plume	Groundwater deterioration due to runoff of contaminated water, overflow, seepage, infiltration must be prevented. Groundwater monitoring plan should be implemented and conducted as discussed. Prevent hydrocarbon spillage. Store hydrocarbon on designated area. Rehabilitate impacted area, excavate and remove hydrocarbon spillage. Rehabilitate impacted area, excavate and remove hydrocarbon spillage	8	3	24
	Spillage of coal and discard	Unmonitored coal and discard storage, disposal will result in spillage and erosion	Improper disposal of coal, discard, slurry	Surface and groundwater contamination, spread of pollution plume	Groundwater deterioration due to runoff of contaminated water, overflow, seepage, infiltration must be prevented. Groundwater monitoring plan should be implemented and conducted as discussed. Prevent hydrocarbon spillage. Store hydrocarbon on designated area. Rehabilitate impacted area, excavate and remove hydrocarbon spillage. Rehabilitate impacted area, excavate and remove hydrocarbon spillage	9	1	9

Activity	Hazard	Risk description	Causes	Impacts	Control	Impact level	Likelihood rating	RRR
PCD, Mine voids, Dams (storage of mine water)	Seepage and infiltration of mine water	Infiltration and seepage of mine affected water from the water containment facility is expected to occurs	Uncontrolled release, seepage and infiltration of mine affected water	Surface and groundwater contamination, spread of pollution plume	Groundwater deterioration due to runoff of contaminated water, overflow, seepage, infiltration must be prevented. Groundwater monitoring plan should be implemented and conducted as discussed. Prevent hydrocarbon spillage. Store hydrocarbon on designated area. Rehabilitate impacted area, excavate and remove hydrocarbon spillage. Rehabilitate impacted area, excavate and remove hydrocarbon spillage	8	3	24
	Spillage/overflow of dams	Rainfall event will most likely result in spillage and overflow of mine affected water	Heavy rainfall	Surface and groundwater contamination, spread of pollution plume	Groundwater deterioration due to runoff of contaminated water, overflow, seepage, infiltration must be prevented. Groundwater monitoring plan should be implemented and conducted as discussed. Prevent hydrocarbon spillage. Store hydrocarbon on designated area. Rehabilitate impacted area, excavate and remove hydrocarbon spillage. Rehabilitate impacted area, excavate and remove hydrocarbon spillage	5	2	10
Hydrocarbon storage tanks/facilities	Spill or leak storage tanks	Spillage of hydrocarbon is common.	Un-monitoring facilities.	Hydrocarbon contamination	Chemical storage area must be lined and bunded to prevent the dilution of chemical and storm water.	5	1	5

Activity	Hazard	Risk description	Causes	Impacts	Control	Impact level	Likelihood rating	RRR
			Incidental spill					

6.1.2.2. Decommissioning and Post Closure Phase Impacts

Activity	Hazard	Risk description	Causes	Impacts	Control	Impact level	Likelihood rating	RRR
Open cast and underground Mining	Decant of mine affected mine	Groundwater level will recover during post closure	Groundwater level rebound. Dewatering have ceased	Decant of mine water	Continue with monitoring during this phase. Investigate options for treatment of contaminated water (Active/passive treatment). Rehabilitates all disturbed area. Seal all access to underground. Investigate options for storing of mine water/discharge of mine water.	8	3	24
Discard dumps, footprint, remaining water containment facility	Seepage and infiltration of mine water	Infiltration and seepage of mine water water is expected	Uncontrolled release, seepage and infiltration of mine affected water	Pollution due to mine water discharge	Continue with monitoring during this phase. Remove all remaining coal material. Investigate options for treatment of contaminated water. Rehabilitates all disturbed area. Seal all access to underground.	8	3	24

9.3 Mitigation measures

9.3.1 Lowering of groundwater levels during facility operation

- Conduct groundwater level monitoring in order to understand groundwater fluctuation and trends. This will serve as an early warning system to identify the impacts of dewatering. Groundwater monitoring must include privately owned boreholes or groundwater users in the vicinity of the mine.
- The WUL documents will most likely contain volume authorised for dewatering. Complying with the acceptable volumes or limits for dewatering will reduce impacts.
- If the mining activity is found to be the cause of impacts on water supply, it is recommended to institute a detailed investigation to understand the problem. Provide alternative water sources if water supply is affected. Identify all groundwater users affected and provide an alternative water supply.
- Ensure that dewatering and abstraction activities are limited or occurring within the authorised location.

9.3.2 Rise of groundwater levels post- facility operation

Groundwater level rebound will result in mine water decanting. The following measures are recommended:

Groundwater model

- The groundwater model must be updated to accommodate any changes in the mine plan and predict decant based on the available final mine plan.
- Changes in the mine plan will most likely change the decant location due to changes in surface elevation. This must be accommodated in the model by updating the predictions according to the mine plan.

Establish a plan to manage decant water.

- Studies conducted for Klipspruit Colliery suggest that decant will occur. Therefore, further assessment to identify the risk of the decant water, pathways, and receptors must be conducted.
- Institute an investigation to determine suitable water treatment options post-closure. This investigation must be conducted during the operational phase. A pilot test must be conducted if a passive treatment system is preferred or recommended post-closure.

Containment of decant

- Ensures that infrastructure to manage mine water decant is in place during post-closure. This includes PCDs with diversion channels that collect and discharge decanted water into PCDs.
- The mining right area has several rivers occurring in the area. Prevent decant from entering the rivers by installing collection trenches that divert water to a containment facility.

9.3.3 Spread of groundwater pollution post- facility operation

- Ensure that a water management strategy is in place and updated. Ensures that it provides a proper guide to manage mine water post-closure.
- Ensures that an AMD strategy is in place. Ensures that it provides detail information related to the management of AMD, collection of AMD, treatment of AMD, predictions of AMD, monitoring of AMS, etc.
- Conduct groundwater monitoring post closure.
- Provide alternative water sources to affected groundwater users.
- In the instance where pollution is identified, investigate options to remediate groundwater resources.

10 Post Closure Management Plan

10.1 Remediation of physical activity

- All infrastructure, buildings, and structures not intended or assigned for future usage must be demolished.
- Remove all infrastructure, equipment, plants, temporary, or mobile offices from the site.
- Remove all straps and foreign objects from the site. Remove any material that can hamper vegetation growth.
- Ensures that compacted surfaces, such as packing, and roads are ripped and ploughed, and where necessary, topsoil must be replaced and re-establish vegetation.
- Remove all waste, remaining coal, and/or any form of contamination sources from the site. Ensures that waste material is properly disposed of in a registered facility.
- Scraps and waste steel must be transported to an approved site for recycling.

10.2 Remediation of storage facilities

- Ensures that the remaining ROM and product coal is removed from the site.
- Identify PCDs that will be used to contain mine water post closure.
- Select and prepare a storage facility to contain seepage during closure.
- Remove and backfill other dams not required.
- Safe disposal of impounded, contaminated water.
- Decontamination of embankment material, including riprap and spillway material.
- Removal and safe disposal of liner material.
- Assessment and possible soil clean-up underneath the liner system.
- Reinstatement of drainage patterns, including the breaching and shaping of embankments, silt/sediment traps and routing channels.
- Disposal of demolition waste and salvage of equipment.
- Ensures that trenches and other channels to collect and discharge water into PCDs are constructed or maintained.

- Ensures that the discard dumps are covered with low-permeability material and rehabilitates the facility.
- Remove the impacted topsoil within the PCDs and coal stockpiles. Properly dispose of the material. Where required, topsoil must be replaced and re-established vegetation.
- Waste rock that satisfies geotechnical and geochemical criteria must be for backfilling.

10.3 Remediation of environmental impacts

- Contaminated surface area must be removed or excavated and replaced with topsoil and rehabilitated.
- Contaminated soil, rumbles, and other foreign material must not be used for the purpose of rehabilitation.
- All contaminated material and remaining material or aggregate must be removed from the site.
- A compacted area must be ripped and ploughed.

10.4 Remediation of water resources impacts

- In the instance where the aquifer or groundwater is contaminated, investigate the extent of contamination and identify remediation methods suitable for the mine. Implement remediation methods to reduce the impacts.
- Cleanup of all spillages that can result in aquifer contamination.
- Treatment of contaminated water through relevant and contaminant-specific methods, if deemed appropriate and feasible.

10.5 Backfilling of the pits

- Backfilling of opencast must be conducted in accordance with regulatory requirements.
- Backfilling of opencast during closure will minimise contamination.
- Ensures that all material intended for backfilling is subjected to detail assessment and authorisation as backfilling material.
- Final rehabilitation must include landscaping, particularly of sloping surfaces; drainage systems; retaining embankments; contoured furrowing to arrest erosion; regular inspections; and monitoring.

11 Conclusions and Recommendations

Niara Environmental Consultants (Pty) Ltd was appointed by Seriti Power (Pty) Ltd to apply for an Environmental Authorisation and an Integrated Water Use License that includes the compilation of hydrogeological studies and other specialist studies for Klipspruit Colliery. This report provides a hydrogeological impacts assessment for the proposed activities at Klipspruit Colliery. The Klipspruit Colliery has several segments that include the KPS, KPSX, and KPSS. The mine is located under eMalahleni Local Municipality of the Kangala District Municipality in the Mpumalanga Province, with mining activities occurring on the farms Hartebeestlaagte 325 JS, Weltevreden 324 JS, Tweefontein 328 JS, Wildebeesfontein 327 JS, Grootpan 7 IS, Oggiesfontein 4 IS, Prinshof 2 IS, Klipfontein 3 IS, Smaldeel 1 IS, Phola Plant 830 IS, and Zwaaiwater 11 IS.

Geographical setting

- The temperature of the area varies from a minimum of 0 °C in June to a maximum of 25.8 °C in January.
- The study area has an average monthly rainfall that varies from 7 mm in July to 128.1 mm in January. Annual rainfall in the area is about 719.8 mm.
- Annual evaporation is about 1729 mm, which is much higher compared to annual rainfall.
- Surface landform in the area is characterised by gently undulating hills and valleys and comprises a gently slope that reaches 4°, with surface elevation of the mine area running from 1415 to 1649 m..
- The mine is located in the Olifants Water Management Area and spans across three quaternary drainage regions, namely, B20G, B11F, and B20F. The mine is drained by several rivers that include the Saalboomspruit, Tweefonteinspruit, and Noupoort River. Geology

Geology: Regional and local geology

- The regional geology of the area comprises the sedimentary deposits of the Karoo Supergroup.
- KPS is underlain by the Vryheid Formation of the Ecca Group, Dolerite intrusion, Dwyka Group, and quaternary cover.
- The surface topography of the coal resource area is characterised by flat to undulating topography with an average elevation of 1,550 m.
- Unconsolidated material varies in thickness from 10 to 12 m depending on the depth of weathering.
- The geological log recorded the following material: soft overburden, hard overburden, No. 5 coal seam, In the KPS Main Pit, exploration drilling suggests the existence of six coal seams that include 5 seams, 4 upper seams, 4 lower seams, 3 seams, 2 seams, and 1 seam.

Geochemical assessment

- Fourteen samples were collected during drilling.
- Total Sulphur, S%: Three samples are classified as non-acid generation, while eleven samples have the potential to generate acid. Three samples comprise %S of less than 0.3% and are therefore classified as not acid generation.

- Paste pH: All samples are classified as non-acid generation with the exception of Interburden Coal Seams 1 and 2, which have a paste pH of less than 5.5. This sample has the potential to generate acid.
- Net Neutralisation Potential: Four samples, namely Interburden Coal Seam 3&4, Overburden Coal Seam 1, Coal Seam 2, and Interburden Coal Seam 2&3, are classified as non-acid generation, while two samples, namely Overburden Coal Seam 1 and Interburden Coal Seam 1&2, are classified as acid-forming material.
- Neutralisation Potential Ratio: Samples Overburden Coal Seam 1, Coal Seam 1, Coal Seam 3, and Coal Seam 4 are classified as having potential to generate acid, while samples Coal Seam 2, Interburden Coal Seam 3&4, Overburden Coal Seam 1, and Interburden Coal Seam 2&3 are classified as having non-acid formation.
- Net Acid Generation: Seven samples, namely Overburden Coal Seam 1, Coal Seam 1, Coal Seam 2, Coal Seam 3, Coal Seam 4, Coal Seam 1, and Interburden Coal Seam 1&2, are classified as acid-forming material, with the remaining samples classified as non-acid generation.

Hydrogeology

- Aquifers: The study area comprises of three aquifer systems, namely: shallow perched aquifer, upper weathered aquifer, fractured aquifer, and pre-Karoo fractured aquifer.
- Upper weathered aquifer: This aquifer occurs within the upper zone, ranging from 5 m to 12 m. Groundwater movement within the aquifer is lateral. The shallow aquifer at Klipspruit attains a thickness of 8–28 m below ground level, with an estimated saturated thickness of 5 m–25 m.
- Fractured aquifer: The fractured aquifer occurs below the shallow weathered zone. It has a physical thickness of 20 m–90 m, mainly above the Dwyka Tillite. This aquifer has a saturated thickness of 17 m–87 m.
- Pre-Karoo fractured aquifer: This aquifer occurs beneath the Karoo supergroup. It forms part of the basement rocks in the area.
- Aquifer parameters: Comprehensive statistical analyses of the data suggest the following hydraulic conductivity: arithmetic mean is 1,279 m/day, median is 0,030 m/day, minimum is 0,002 m/day, maximum is 10,040 m/day, harmonic mean is 0,010 m/day, and geometric mean is 0,088 m/day.
- Aquifer porosity for fine-grained sandstones varies from 1% to 12% with an average of 5%. Medium- to coarse-grained sandstones range from 4% to 15%, with an average of 9%. Effective porosity of the shallow aquifer is 3%, while the effective porosity of the deep aquifer is 0.67%.

Groundwater level

- Groundwater level within KPS and immediate surroundings varies from 1 to 38 mbgl. Available water level data suggest that the majority of boreholes have a water level of less than 10 mbgl.

Groundwater quality

Several groundwater points show guideline exceedance in terms of SANS limits:

- SO4 was detected in high concentration in the groundwater sample, namely BSW 4.
- NH4 was detected at high concentrations in WELBH08 and BSW 4.

- The concentration of F exceeds guideline limits in WELBH27 and KGM 10.
- The concentration of Mn is above the SANS chronic health limits in BHPSM01, BHPW05, and WELBH16.
- Mn also exceeds SANS aesthetic limits in BHPSM10, WELBH08, WELBH25, BSW 4, KGM13, and KGM B06.

Several boreholes also exceeded WUL limits, as summarised:

- Non-compliant in terms of EC and Mg was noted in BSW 4.
- Ca is present at a high concentration above the WUL limits in six boreholes that include BSW 4, KGM 10, BH 008, BHPSM01, BHPW08, and BHPSM10.
- The concentration of Na is high in three boreholes, namely BSW 4, WELBH26, and WELBH27.
- The majority of the boreholes are contaminated with SO4, NO3, and F.
- The concentration of NO3 exceeded WUL limits in all boreholes.
- The concentration of F is compliant in five boreholes, namely KGM 13, KGM B06, KGM B16, WELBH 16, and WELBH 25, with the remaining boreholes being classified as non-compliant.
- The concentration of SO4 was noted in high concentration above the WUL limits in the following boreholes: BSW 4, KGM 10, KGM B04, KGM B06, KGM B11, KGM B16, BH 009, BHPSM01, BHPSM08, and WELBH27.

Groundwater model

- The result of the simulation and calibration matches and duplicates field observation. Observed versus simulated water level elevation has achieved a linear regression of 0.99, which suggests that the simulated water level mimics the observed water level data.
- A large portion of the mine boundary drains towards the north and northwest, with groundwater flow towards low-lying areas in the north and northwest. The southeast boundary is located within the topographic high. Groundwater level in this region is high and decreases towards the east, southeast, and towards the north and northwest.
- Mine water inflow: Open-cast working will receive mine water inflows that vary from 555 m^3/d to 2923 m^3/d. Inflows into underground working will vary from 122 m^3/d to 1334 m^3/d. Dewatering of these volumes from individual opencasts or shafts will most likely affect the groundwater level.
- Post-closure impacts suggest that decant will occur. Two potential decants have been identified based on the current mine layout. KPSS underground will decant on the northern portion of the shaft,otential decants have been identified based on the current mine layout. while KPS Main Pit is expected to decant in the northeastern portion of the opencast.

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13 Appendices

Appendix 1: Water quality data (Aquatico)

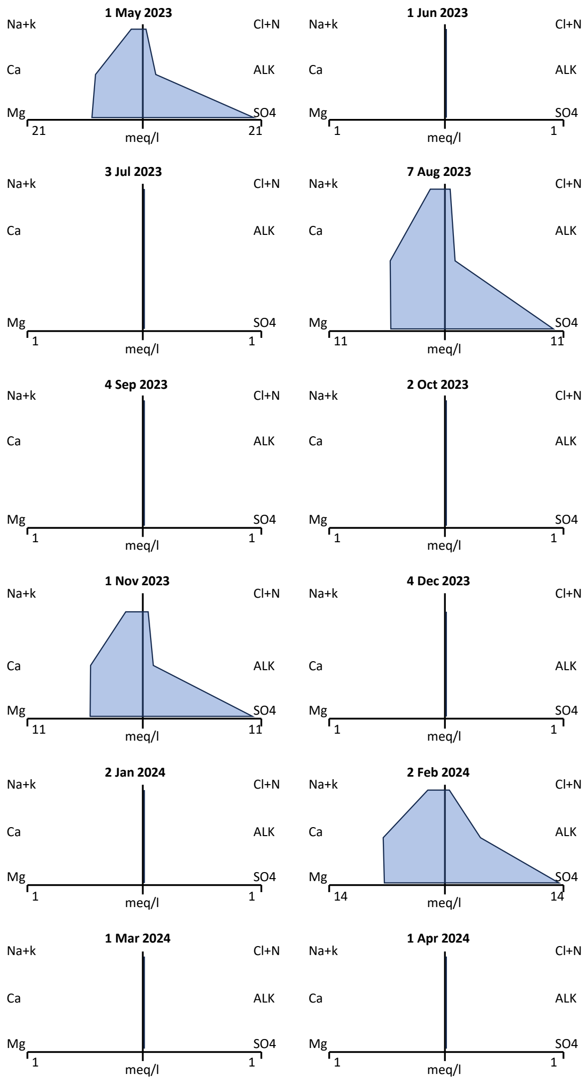
aquatico Scientific (Pty). Ltd.

Locality	BSW 4

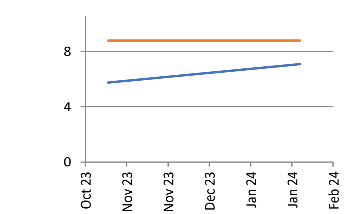
SITE REPORT

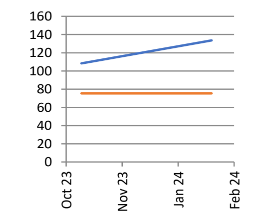
PROJECT NAME	Seriti Power Klipspruit Operations
LOCALITY NAME	BSW 4
LOCALITY DESCRIPTION	Eastern boundary borehole between Klipspruit- and Zibulo Collieries
LOCALITY TYPE	Borehole
ASSESSMENT SET	Klipspruit Groundwater IWUL (2016)

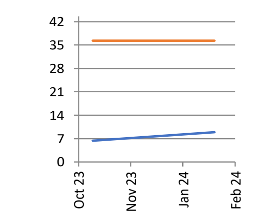
Variable		May 2023	Jun 2023	Jul 2023	Aug 2023	Sep 2023	Oct 2023	Nov 2023	Dec 2023	Jan 2024	Feb 2024	Mar 2024	Apr 2024	Current 3-sets avg	Previous 3-sets avg	Current 12-sets avg
Status		Yes	Water-level	Water-level	Yes	Water-level	Water-level	Yes	Water-level	Water-level	Yes	Water-level	Water-level			
pH pH	8.79	6.64	-	-	6.97	-	-	5.75	-	-	7.08	-	-	7.08	5.75	6.61
EC mS/m	75.52	146	-	-	98.2	-	-	108	-	-	134	-	-	134	108	122
TDS grav mg/l	None	1382	-	-	818	-	-	864	-	-	1066	-	-	1066	864	1033
Total Hardness mg $CaCO_3$/l	None	910	-	-	525	-	-	507	-	-	750	-	-	750	507	673
Total alkalinity mg $CaCO_3$/l	None	103	-	-	41.2	-	-	42.8	-	-	204	-	-	204	42.8	97.8
Cl mg/l	36.34	9.42	-	-	5.83	-	-	6.41	-	-	8.94	-	-	8.94	6.41	7.65
SO4 mg/l	10.36	943	-	-	483	-	-	489	-	-	647	-	-	647	489	641
PO4-P mg/l	None	<0.005	-	-	0.011	-	-	<0.005	-	-	0.116	-	-	0.116	*0.003*	*0.033*
NH4-N mg/l	None	0.657	-	-	0.833	-	-	0.049	-	-	2.77	-	-	2.77	0.049	1.08
NO3-N mg/l	0.11	0.461	-	-	2.79	-	-	2.64	-	-	1.42	-	-	1.42	2.64	1.83
NO2-N mg/l	None	0.129	-	-	<0.065	-	-	<0.065	-	-	<0.065	-	-	*0.033*	*0.033*	*0.057*
F mg/l	0.14	<0.263	-	-	<0.263	-	-	<0.263	-	-	0.446	-	-	0.446	*0.132*	*0.21*
Ca mg/l	32.56	176	-	-	106	-	-	101	-	-	152	-	-	152	101	134
K mg/l	None	7.16	-	-	4.25	-	-	7.1	-	-	8.59	-	-	8.59	7.1	6.78
Mg mg/l	32.71	114	-	-	63.4	-	-	61.9	-	-	90.2	-	-	90.2	61.9	82.4
Na mg/l	44	50	-	-	32.1	-	-	35.9	-	-	46.1	-	-	46.1	35.9	41
Al mg/l	None	<0.002	-	-	0.012	-	-	<0.002	-	-	<0.002	-	-	*0.001*	*0.001*	*0.004*
Fe mg/l	None	0.044	-	-	<0.004	-	-	<0.004	-	-	0.665	-	-	0.665	*0.002*	*0.178*
Mn mg/l	None	0.374	-	-	<0.001	-	-	0.028	-	-	0.354	-	-	0.354	0.028	*0.189*
Si mg/l	None	4.45	-	-	6.41	-	-	6.78	-	-	6.59	-	-	6.59	6.78	6.06
SS mg/l	None	8	-	-	40	-	-	5	-	-	13	-	-	13	5	17
Turbidity NTU	None	112	-	-	32.9	-	-	1.24	-	-	89.5	-	-	89.5	1.24	58.9

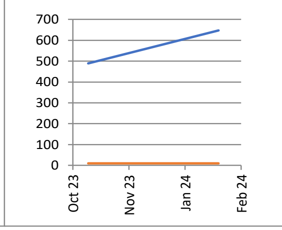


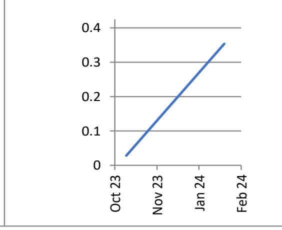
pH	Units: pH	EC	Units: mS/m	Cl	Units: mg/l	SO4	Units: mg/l	Mn	Units: mg/l	SS	Units: mg/l
	Assessment: 8.79		Assessment: 75.5		Assessment: 36.3		Assessment: 10.4		Assessment: 0		Assessment: 0

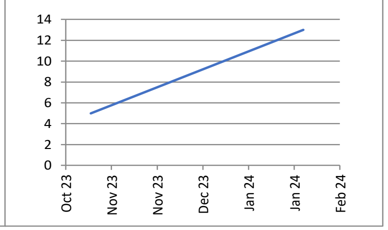












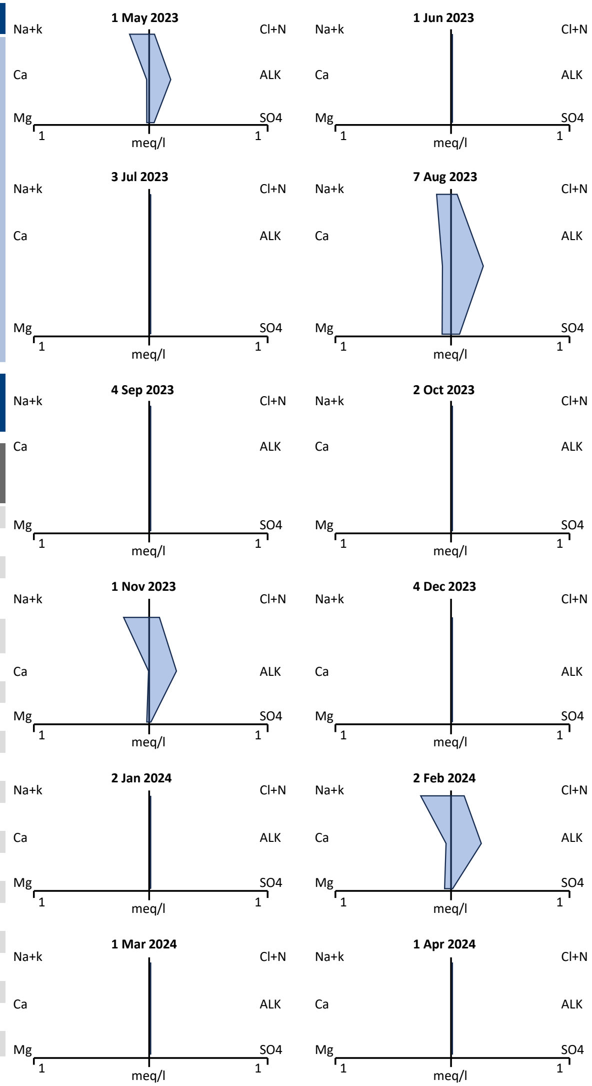
Graphs only illustrate trends

Locality	KGM 08

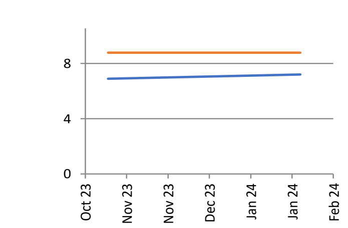
SITE REPORT

PROJECT NAME	Seriti Power Klipspruit Operations
LOCALITY NAME	KGM 08
LOCALITY DESCRIPTION	Western boundary borehole between Klipspruit- and Phola Collieries
LOCALITY TYPE	Borehole
ASSESSMENT SET	Klipspruit Groundwater IWUL (2016)

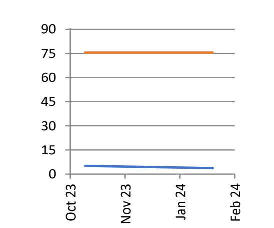
Variable		May 2023	Jun 2023	Jul 2023	Aug 2023	Sep 2023	Oct 2023	Nov 2023	Dec 2023	Jan 2024	Feb 2024	Mar 2024	Apr 2024	Current 3-sets avg	Previous 3-sets avg	Current 12-sets avg
Status		Yes	Water-level	Water-level	Yes	Water-level	Water-level	Yes	Water-level	Water-level	Yes	Water-level	Water-level			
pH pH	8.79	6.49	-	-	7.59	-	-	6.91	-	-	7.2	-	-	7.2	6.91	7.05
EC mS/m	75.52	3.45	-	-	4.26	-	-	5.2	-	-	3.7	-	-	3.7	5.2	4.15
TDS grav mg/l	None	26	-	-	34	-	-	26	-	-	26	-	-	26	26	28
Total Hardness mg $CaCO_3$/l	None	4	-	-	9	-	-	3	-	-	6	-	-	6	3	6
Total alkalinity mg $CaCO_3$/l	None	8.58	-	-	13.3	-	-	11	-	-	12.4	-	-	12.4	11	11.3
Cl mg/l	36.34	<0.557	-	-	1.21	-	-	1.62	-	-	3.08	-	-	3.08	1.62	*1.55*
SO4 mg/l	10.36	1.37	-	-	2.98	-	-	<0.141	-	-	0.146	-	-	0.146	*0.071*	*1.14*
PO4-P mg/l	None	<0.005	-	-	<0.005	-	-	<0.005	-	-	0.144	-	-	0.144	*0.003*	*0.038*
NH4-N mg/l	None	0.066	-	-	0.358	-	-	0.113	-	-	0.029	-	-	0.029	0.113	0.142
NO3-N mg/l	0.11	0.335	-	-	<0.194	-	-	0.402	-	-	0.206	-	-	0.206	0.402	*0.26*
NO2-N mg/l	None	0.083	-	-	0.095	-	-	<0.065	-	-	<0.065	-	-	*0.033*	*0.033*	*0.061*
F mg/l	0.14	<0.263	-	-	<0.263	-	-	0.313	-	-	0.736	-	-	0.736	0.313	*0.328*
Ca mg/l	32.56	0.711	-	-	1.69	-	-	0.387	-	-	1.08	-	-	1.08	0.387	0.967
K mg/l	None	1.79	-	-	<0.015	-	-	1.17	-	-	1.57	-	-	1.57	1.17	*1.13*
Mg mg/l	32.71	0.421	-	-	1.06	-	-	0.42	-	-	0.806	-	-	0.806	0.42	0.677
Na mg/l	44	3.13	-	-	3.09	-	-	4.68	-	-	5.32	-	-	5.32	4.68	4.06
Al mg/l	None	<0.002	-	-	<0.002	-	-	<0.002	-	-	<0.002	-	-	*0.001*	*0.001*	*0.001*
Fe mg/l	None	<0.004	-	-	0.249	-	-	<0.004	-	-	<0.004	-	-	*0.002*	*0.002*	*0.064*
Mn mg/l	None	<0.001	-	-	0.017	-	-	<0.001	-	-	0.008	-	-	0.008	*0.001*	*0.007*
Si mg/l	None	4.43	-	-	4.92	-	-	4.38	-	-	5.24	-	-	5.24	4.38	4.74
SS mg/l	None	12	-	-	<4.46	-	-	18	-	-	<4.46	-	-	*2.2*	18	*8.6*
Turbidity NTU	None	7.38	-	-	8.48	-	-	12.9	-	-	1.76	-	-	1.76	12.9	7.63



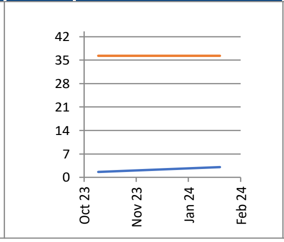
pH — Units: pH — Assessment: 8.79



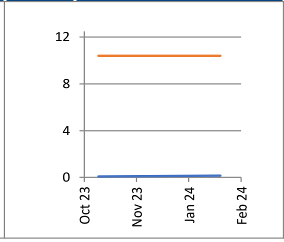
EC — Units: mS/m — Assessment: 75.5



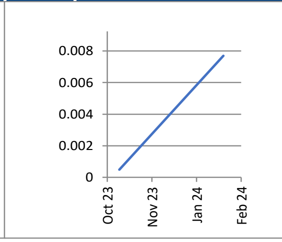
Cl — Units: mg/l — Assessment: 36.3



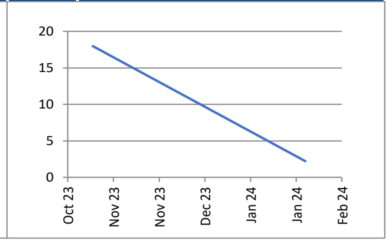
SO4 — Units: mg/l — Assessment: 10.4



Mn — Units: mg/l — Assessment: 0



SS — Units: mg/l — Assessment: 0



Graphs only illustrate trends

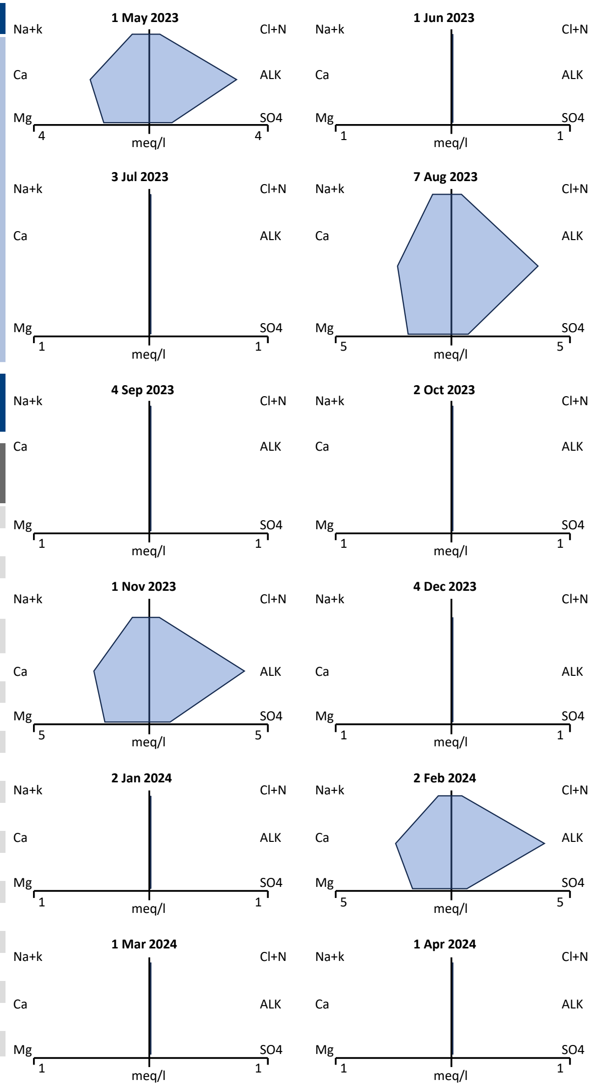
aquatico Scientific (Pty). Ltd.

Locality	KGM 10

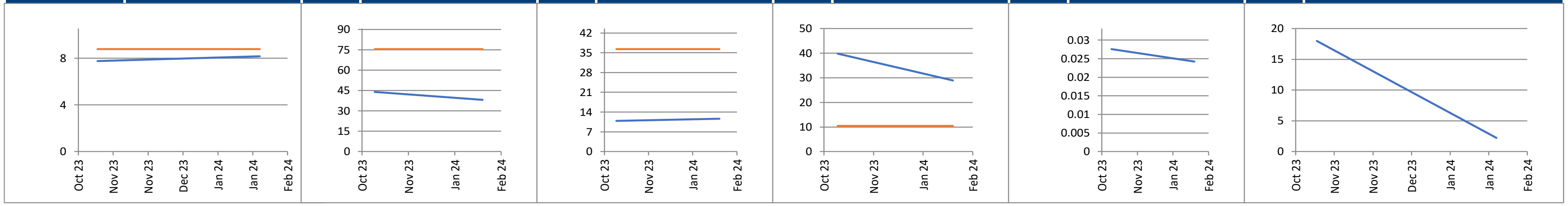
SITE REPORT

PROJECT NAME	Seriti Power Klipspruit Operations
LOCALITY NAME	KGM 10
LOCALITY DESCRIPTION	Monitoring borehole next to Afrisam
LOCALITY TYPE	Borehole
ASSESSMENT SET	Klipspruit Groundwater IWUL (2016)

Variable		May 2023	Jun 2023	Jul 2023	Aug 2023	Sep 2023	Oct 2023	Nov 2023	Dec 2023	Jan 2024	Feb 2024	Mar 2024	Apr 2024	Current 3-sets avg	Previous 3-sets avg	Current 12-sets avg
Status		Yes	Water-level	Water-level	Yes	Water-level	Water-level	Yes	Water-level	Water-level	Yes	Water-level	Water-level			
pH pH	8.79	7.89	-	-	8.12	-	-	7.76	-	-	8.18	-	-	8.18	7.76	7.99
EC mS/m	75.52	34.6	-	-	37.4	-	-	43.9	-	-	38.2	-	-	38.2	43.9	38.5
TDS grav mg/l	None	220	-	-	250	-	-	290	-	-	214	-	-	214	290	244
Total Hardness mg $CaCO_3$/l	None	184	-	-	213	-	-	220	-	-	209	-	-	209	220	207
Total alkalinity mg $CaCO_3$/l	None	147	-	-	183	-	-	200	-	-	196	-	-	196	200	182
Cl mg/l	36.34	9	-	-	10.5	-	-	10.9	-	-	11.7	-	-	11.7	10.9	10.5
SO4 mg/l	10.36	34.8	-	-	32	-	-	39.8	-	-	28.9	-	-	28.9	39.8	33.9
PO4-P mg/l	None	<0.005	-	-	<0.005	-	-	<0.005	-	-	0.117	-	-	0.117	*0.003*	*0.031*
NH4-N mg/l	None	0.194	-	-	0.22	-	-	0.032	-	-	0.029	-	-	0.029	0.032	0.119
NO3-N mg/l	0.11	0.788	-	-	1.15	-	-	0.812	-	-	0.804	-	-	0.804	0.812	0.889
NO2-N mg/l	None	0.078	-	-	0.069	-	-	<0.065	-	-	<0.065	-	-	*0.033*	*0.033*	*0.053*
F mg/l	0.14	1.61	-	-	1.43	-	-	1.15	-	-	1.63	-	-	1.63	1.15	1.46
Ca mg/l	32.56	41.6	-	-	47.2	-	-	48.7	-	-	49	-	-	49	48.7	46.6
K mg/l	None	3.96	-	-	5.24	-	-	3.8	-	-	3.39	-	-	3.39	3.8	4.1
Mg mg/l	32.71	19.6	-	-	23.1	-	-	23.8	-	-	20.9	-	-	20.9	23.8	21.9
Na mg/l	44	12.3	-	-	16.6	-	-	15.8	-	-	12.3	-	-	12.3	15.8	14.3
Al mg/l	None	<0.002	-	-	<0.002	-	-	<0.002	-	-	<0.002	-	-	*0.001*	*0.001*	*0.001*
Fe mg/l	None	<0.004	-	-	<0.004	-	-	<0.004	-	-	<0.004	-	-	*0.002*	*0.002*	*0.002*
Mn mg/l	None	0.007	-	-	<0.001	-	-	0.028	-	-	0.024	-	-	0.024	0.028	*0.015*
Si mg/l	None	2.03	-	-	1.67	-	-	1.81	-	-	2.35	-	-	2.35	1.81	1.97
SS mg/l	None	<4.46	-	-	49	-	-	18	-	-	<4.46	-	-	*2.2*	18	*18*
Turbidity NTU	None	2.29	-	-	16.8	-	-	18.9	-	-	3.8	-	-	3.8	18.9	10.4



pH	Units: pH	EC	Units: mS/m	Cl	Units: mg/l	SO4	Units: mg/l	Mn	Units: mg/l	SS	Units: mg/l
	Assessment: 8.79		Assessment: 75.5		Assessment: 36.3		Assessment: 10.4		Assessment: 0		Assessment: 0



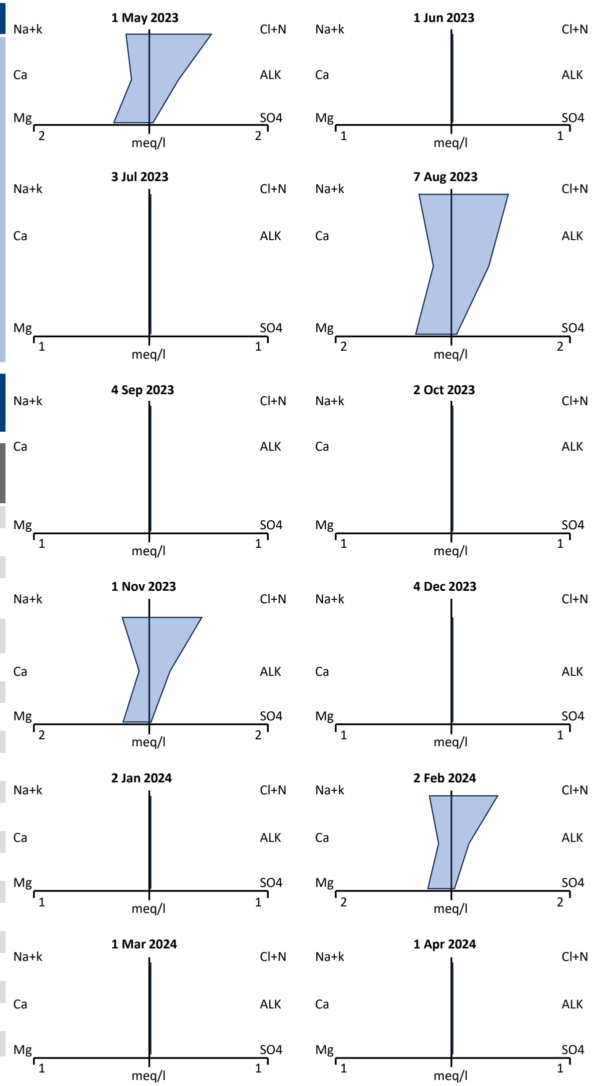
Graphs only illustrate trends

SITE REPORT

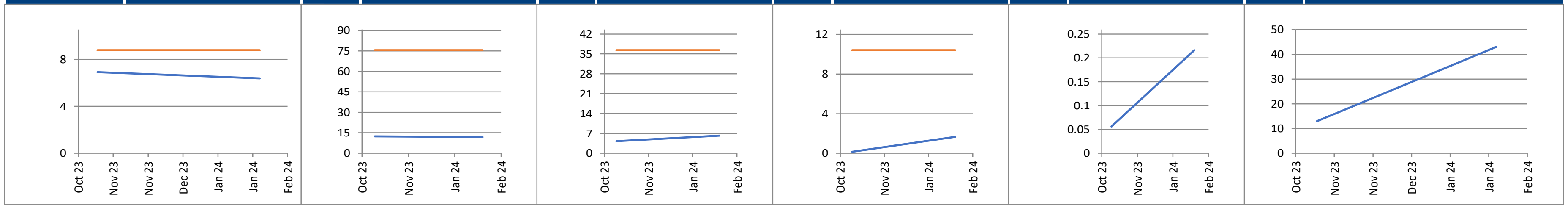
PROJECT NAME	Seriti Power Klipspruit Operations
LOCALITY NAME	KGM 13
LOCALITY DESCRIPTION	Western boundary borehole between Klipspruit- and Phola Collieries
LOCALITY TYPE	Borehole
ASSESSMENT SET	Klipspruit Groundwater IWUL (2016)

Locality	KGM 13

Variable		May 2023	Jun 2023	Jul 2023	Aug 2023	Sep 2023	Oct 2023	Nov 2023	Dec 2023	Jan 2024	Feb 2024	Mar 2024	Apr 2024	Current 3-sets avg	Previous 3-sets avg	Current 12-sets avg
Status		Yes	Water-level	Water-level	Yes	Water-level	Water-level	Yes	Water-level	Water-level	Yes	Water-level	Water-level			
pH pH	8.79	6.49	-	-	6.97	-	-	6.92	-	-	6.38	-	-	6.38	6.92	6.69
EC mS/m	75.52	16.6	-	-	14.2	-	-	12.4	-	-	11.9	-	-	11.9	12.4	13.8
TDS grav mg/l	None	128	-	-	116	-	-	106	-	-	98	-	-	98	106	112
Total Hardness mg $CaCO_3$/l	None	48	-	-	48	-	-	34	-	-	33	-	-	33	34	41
Total alkalinity mg $CaCO_3$/l	None	23.8	-	-	31	-	-	16.5	-	-	14.1	-	-	14.1	16.5	21.4
Cl mg/l	36.34	8.28	-	-	7.84	-	-	4.25	-	-	6.18	-	-	6.18	4.25	6.64
SO4 mg/l	10.36	1.86	-	-	3.23	-	-	0.165	-	-	1.66	-	-	1.66	0.165	1.73
PO4-P mg/l	None	<0.005	-	-	<0.005	-	-	<0.005	-	-	0.103	-	-	0.103	*0.003*	*0.028*
NH4-N mg/l	None	0.34	-	-	0.239	-	-	0.028	-	-	0.014	-	-	0.014	0.028	0.155
NO3-N mg/l	0.11	11.2	-	-	10.2	-	-	10.5	-	-	8.38	-	-	8.38	10.5	10.1
NO2-N mg/l	None	0.096	-	-	0.108	-	-	<0.065	-	-	<0.065	-	-	*0.033*	*0.033*	*0.067*
F mg/l	0.14	<0.263	-	-	0.359	-	-	<0.263	-	-	<0.263	-	-	*0.132*	*0.132*	*0.188*
Ca mg/l	32.56	6.58	-	-	6.66	-	-	4.03	-	-	4.78	-	-	4.78	4.03	5.51
K mg/l	None	5.48	-	-	3.33	-	-	3.81	-	-	4.17	-	-	4.17	3.81	4.2
Mg mg/l	32.71	7.67	-	-	7.71	-	-	5.77	-	-	5.12	-	-	5.12	5.77	6.57
Na mg/l	44	6.48	-	-	11.3	-	-	9.03	-	-	6.63	-	-	6.63	9.03	8.36
Al mg/l	None	<0.002	-	-	0.004	-	-	<0.002	-	-	<0.002	-	-	*0.001*	*0.001*	*0.002*
Fe mg/l	None	<0.004	-	-	<0.004	-	-	<0.004	-	-	<0.004	-	-	*0.002*	*0.002*	*0.002*
Mn mg/l	None	0.31	-	-	0.136	-	-	0.056	-	-	0.216	-	-	0.216	0.056	0.18
Si mg/l	None	2.47	-	-	3.61	-	-	4.27	-	-	5.98	-	-	5.98	4.27	4.08
SS mg/l	None	<4.46	-	-	<4.46	-	-	13	-	-	43	-	-	43	13	*15*
Turbidity NTU	None	1.39	-	-	0.581	-	-	2.08	-	-	17	-	-	17	2.08	5.26



pH	Units: pH	EC	Units: mS/m	Cl	Units: mg/l	SO4	Units: mg/l	Mn	Units: mg/l	SS	Units: mg/l
	Assessment: 8.79		Assessment: 75.5		Assessment: 36.3		Assessment: 10.4		Assessment: 0		Assessment: 0



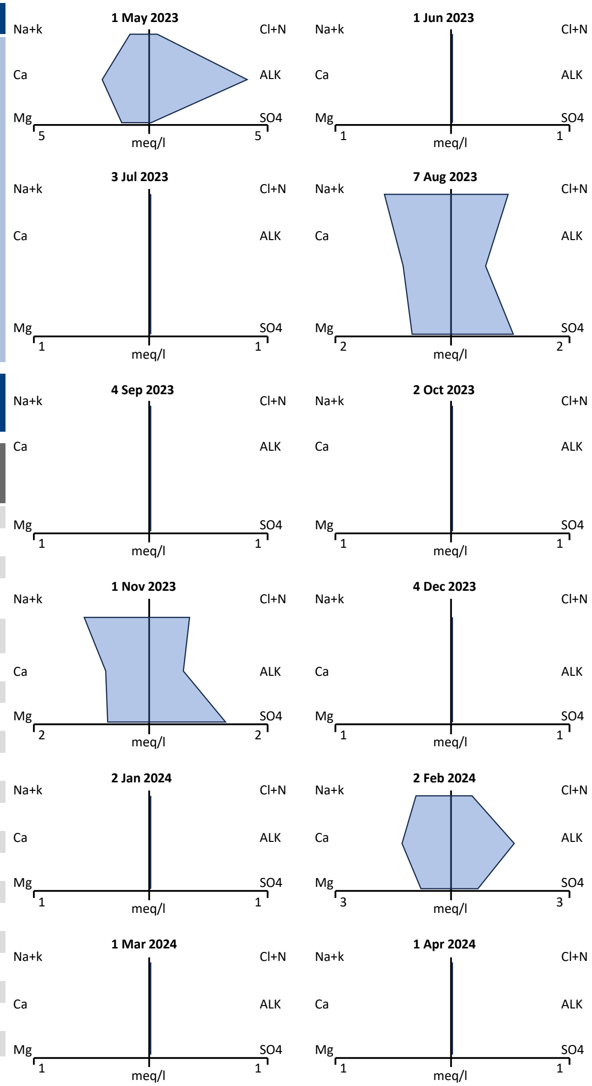
Graphs only illustrate trends

Locality	KGM B04

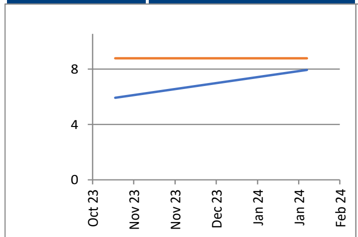
SITE REPORT

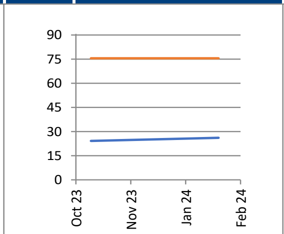
PROJECT NAME	Seriti Power Klipspruit Operations
LOCALITY NAME	KGM B04
LOCALITY DESCRIPTION	Eastern boundary borehole between Klipspruit- and Zibulo Collieries
LOCALITY TYPE	Borehole
ASSESSMENT SET	Klipspruit Groundwater IWUL (2016)

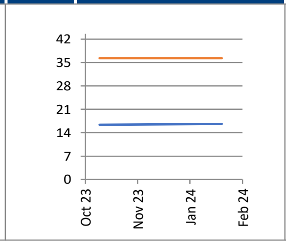
Variable		May 2023	Jun 2023	Jul 2023	Aug 2023	Sep 2023	Oct 2023	Nov 2023	Dec 2023	Jan 2024	Feb 2024	Mar 2024	Apr 2024	Current 3-sets avg	Previous 3-sets avg	Current 12-sets avg
Status		Yes	Water-level	Water-level	Yes	Water-level	Water-level	Yes	Water-level	Water-level	Yes	Water-level	Water-level			
pH pH	8.79	7.27	-	-	7.29	-	-	5.93	-	-	7.94	-	-	7.94	5.93	7.11
EC mS/m	75.52	42	-	-	25.4	-	-	24.2	-	-	26.2	-	-	26.2	24.2	29.5
TDS grav mg/l	None	252	-	-	188	-	-	180	-	-	146	-	-	146	180	192
Total Hardness mg $CaCO_3$/l	None	166	-	-	76	-	-	75	-	-	105	-	-	105	75	106
Total alkalinity mg $CaCO_3$/l	None	207	-	-	28.6	-	-	28	-	-	79.4	-	-	79.4	28	85.8
Cl mg/l	36.34	9.38	-	-	27.5	-	-	16.4	-	-	16.6	-	-	16.6	16.4	17.5
SO4 mg/l	10.36	1.02	-	-	50.2	-	-	61.6	-	-	31.5	-	-	31.5	61.6	36.1
PO4-P mg/l	None	<0.005	-	-	<0.005	-	-	<0.005	-	-	0.088	-	-	0.088	*0.003*	*0.024*
NH4-N mg/l	None	3.13	-	-	0.234	-	-	0.025	-	-	0.014	-	-	0.014	0.025	0.851
NO3-N mg/l	0.11	0.296	-	-	2.54	-	-	2.84	-	-	0.479	-	-	0.479	2.84	1.54
NO2-N mg/l	None	<0.065	-	-	0.073	-	-	<0.065	-	-	<0.065	-	-	*0.033*	*0.033*	*0.043*
F mg/l	0.14	<0.263	-	-	<0.263	-	-	<0.263	-	-	<0.263	-	-	*0.132*	*0.132*	*0.132*
Ca mg/l	32.56	41.5	-	-	16.8	-	-	15.4	-	-	25.9	-	-	25.9	15.4	24.9
K mg/l	None	6.05	-	-	3.38	-	-	2.71	-	-	3.65	-	-	3.65	2.71	3.95
Mg mg/l	32.71	15	-	-	8.34	-	-	8.95	-	-	9.81	-	-	9.81	8.95	10.5
Na mg/l	44	16.7	-	-	24.7	-	-	24.6	-	-	19.3	-	-	19.3	24.6	21.3
Al mg/l	None	<0.002	-	-	<0.002	-	-	<0.002	-	-	<0.002	-	-	*0.001*	*0.001*	*0.001*
Fe mg/l	None	0.3	-	-	<0.004	-	-	<0.004	-	-	<0.004	-	-	*0.002*	*0.002*	*0.077*
Mn mg/l	None	1.69	-	-	<0.001	-	-	0.438	-	-	<0.001	-	-	*0.001*	0.438	*0.532*
Si mg/l	None	4.58	-	-	2.25	-	-	5.27	-	-	2.78	-	-	2.78	5.27	3.72
SS mg/l	None	61	-	-	7	-	-	12	-	-	<4.46	-	-	*2.2*	12	*21*
Turbidity NTU	None	121	-	-	4.87	-	-	29.6	-	-	4.08	-	-	4.08	29.6	39.9

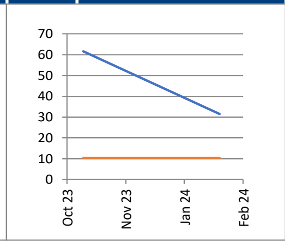


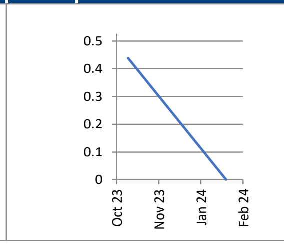
pH	Units: pH	EC	Units: mS/m	Cl	Units: mg/l	SO4	Units: mg/l	Mn	Units: mg/l	SS	Units: mg/l
	Assessment: 8.79		Assessment: 75.5		Assessment: 36.3		Assessment: 10.4		Assessment: 0		Assessment: 0

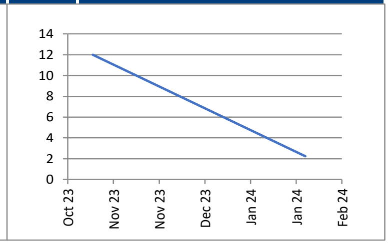










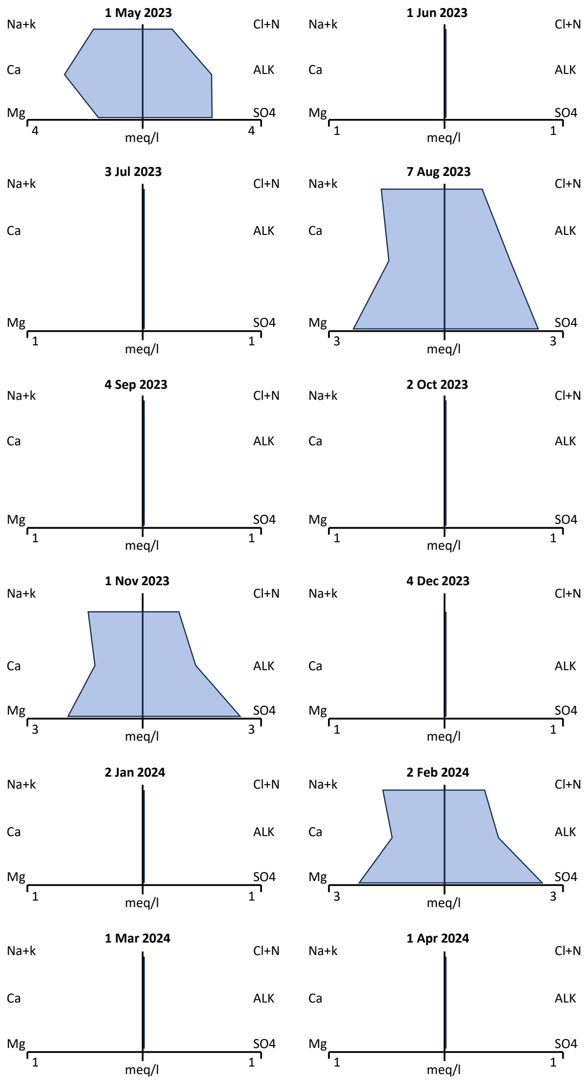


Graphs only illustrate trends

SITE REPORT

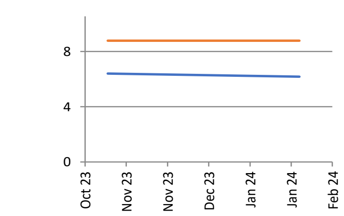
PROJECT NAME	Seriti Power Klipspruit Operations
LOCALITY NAME	KGM B06
LOCALITY DESCRIPTION	Southeastern boundary borehole
LOCALITY TYPE	Borehole
ASSESSMENT SET	Klipspruit Groundwater IWUL (2016)

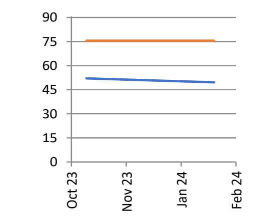
Locality	KGM B06

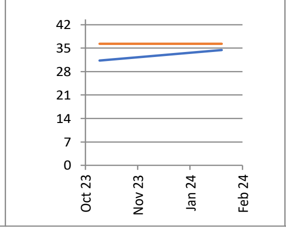


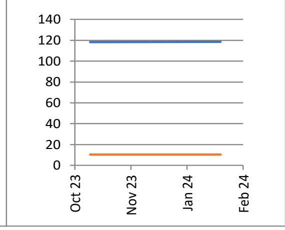
Variable		May 2023	Jun 2023	Jul 2023	Aug 2023	Sep 2023	Oct 2023	Nov 2023	Dec 2023	Jan 2024	Feb 2024	Mar 2024	Apr 2024	Current 3-sets avg	Previous 3-sets avg	Current 12-sets avg
Status		Yes	Water-level	Water-level	Yes	Water-level	Water-level	Yes	Water-level	Water-level	Yes	Bees	Bees			
pH pH	8.79	6.35	-	-	6.8	-	-	6.41	-	-	6.18	-	-	6.18	6.41	6.44
EC mS/m	75.52	50.8	-	-	62.7	-	-	52.1	-	-	49.6	-	-	49.6	52.1	53.8
TDS grav mg/l	None	314	-	-	356	-	-	352	-	-	306	-	-	306	352	332
Total Hardness mg $CaCO_3$/l	None	215	-	-	192	-	-	161	-	-	180	-	-	180	161	187
Total alkalinity mg $CaCO_3$/l	None	116	-	-	82.7	-	-	66.2	-	-	67.4	-	-	67.4	66.2	83.1
Cl mg/l	36.34	30.9	-	-	32.3	-	-	31.3	-	-	34.4	-	-	34.4	31.3	32.2
SO4 mg/l	10.36	112	-	-	114	-	-	118	-	-	119	-	-	119	118	116
PO4-P mg/l	None	<0.005	-	-	<0.005	-	-	<0.005	-	-	0.126	-	-	0.126	*0.003*	*0.033*
NH4-N mg/l	None	0.03	-	-	0.111	-	-	0.5	-	-	0.051	-	-	0.051	0.5	0.173
NO3-N mg/l	0.11	1.22	-	-	0.315	-	-	<0.194	-	-	0.339	-	-	0.339	*0.097*	*0.493*
NO2-N mg/l	None	<0.065	-	-	0.112	-	-	<0.065	-	-	<0.065	-	-	*0.033*	*0.033*	*0.052*
F mg/l	0.14	<0.263	-	-	0.352	-	-	0.597	-	-	<0.263	-	-	*0.132*	0.597	*0.303*
Ca mg/l	32.56	54.7	-	-	29.2	-	-	25.3	-	-	27.6	-	-	27.6	25.3	34.2
K mg/l	None	14.8	-	-	7.12	-	-	7.14	-	-	7.34	-	-	7.34	7.14	9.1
Mg mg/l	32.71	19.1	-	-	28.8	-	-	23.8	-	-	27	-	-	27	23.8	24.7
Na mg/l	44	31.2	-	-	33.9	-	-	28.9	-	-	32.8	-	-	32.8	28.9	31.7
Al mg/l	None	<0.002	-	-	<0.002	-	-	<0.002	-	-	<0.002	-	-	*0.001*	*0.001*	*0.001*
Fe mg/l	None	<0.004	-	-	<0.004	-	-	<0.004	-	-	0.005	-	-	0.005	*0.002*	*0.003*
Mn mg/l	None	<0.001	-	-	<0.001	-	-	0.289	-	-	0.128	-	-	0.128	0.289	*0.105*
Si mg/l	None	17.9	-	-	7.31	-	-	7.38	-	-	9.04	-	-	9.04	7.38	10.4
SS mg/l	None	5	-	-	112	-	-	600	-	-	54	-	-	54	600	193
Turbidity NTU	None	3.74	-	-	272	-	-	634	-	-	65.2	-	-	65.2	634	244

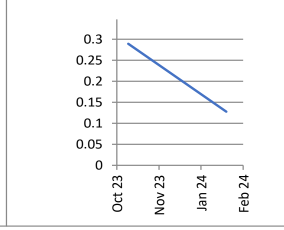
pH	Units: pH Assessment: 8.79	EC	Units: mS/m Assessment: 75.5	Cl	Units: mg/l Assessment: 36.3	SO4	Units: mg/l Assessment: 10.4	Mn	Units: mg/l Assessment: 0	SS	Units: mg/l Assessment: 0

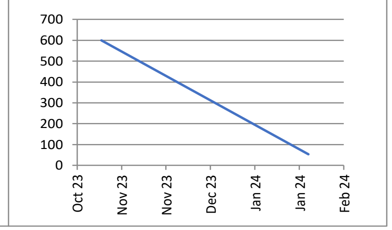












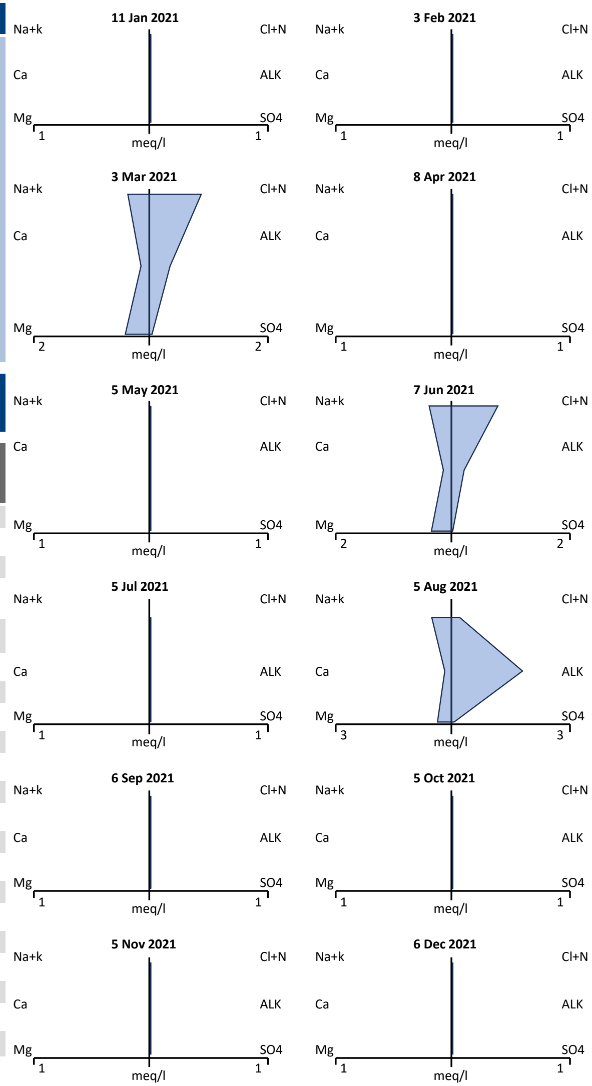
Graphs only illustrate trends

Locality	KGM B09

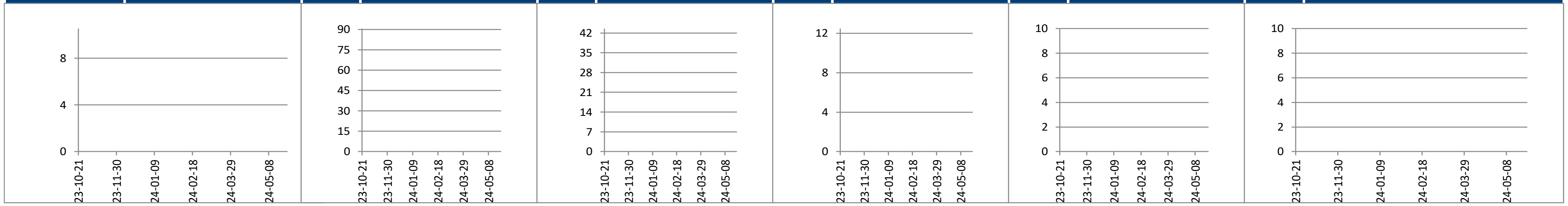
SITE REPORT

PROJECT NAME	Seriti Power Klipspruit Operations
LOCALITY NAME	KGM B09
LOCALITY DESCRIPTION	Upstream borehole on Enslin Farm
LOCALITY TYPE	Borehole
ASSESSMENT SET	Klipspruit Groundwater IWUL (2016)

Variable		Jan 2021	Feb 2021	Mar 2021	Apr 2021	May 2021	Jun 2021	Jul 2021	Aug 2021	Sep 2021	Oct 2021	Nov 2021	Dec 2021	Current 3-sets avg	Previous 3-sets avg	Current 12-sets avg
Status		Water-level	Water-level	Yes	Water-level	Water-level	Yes	Dry	Yes	Yes	Demolished	Demolished	Demolished			
pH pH	8.79	-	-	6.1	-	-	5.81	-	6.9	-	-	-	-		6.9	6.27
EC mS/m	75.52	-	-	11.9	-	-	10.5	-	19.4	-	-	-	-		19.4	13.9
TDS grav mg/l	None	-	-	114	-	-	88	-	122	-	-	-	-		122	108
Total Hardness mg $CaCO_3$/l	None	-	-	30	-	-	26	-	30	-	-	-	-		30	29
Total alkalinity mg $CaCO_3$/l	None	-	-	16.5	-	-	9.88	-	89.5	-	-	-	-		89.5	38.6
Cl mg/l	36.34	-	-	1.53	-	-	2.24	-	6.01	-	-	-	-		6.01	3.26
SO4 mg/l	10.36	-	-	0.936	-	-	<0.141	-	1.71	-	-	-	-		1.71	*0.906*
PO4-P mg/l	None	-	-	0.017	-	-	0.065	-	0.018	-	-	-	-		0.018	0.033
NH4-N mg/l	None	-	-	3.35	-	-	0.228	-	5.41	-	-	-	-		5.41	3
NO3-N mg/l	0.11	-	-	11.5	-	-	9.97	-	<0.194	-	-	-	-		*0.097*	*7.19*
NO2-N mg/l	None	-	-	0.088	-	-	<0.065	-	0.068	-	-	-	-		0.068	*0.063*
F mg/l	0.14	-	-	<0.263	-	-	<0.263	-	<0.263	-	-	-	-		*0.132*	*0.132*
Ca mg/l	32.56	-	-	3.39	-	-	3.17	-	4.09	-	-	-	-		4.09	3.55
K mg/l	None	-	-	2	-	-	2.6	-	6.2	-	-	-	-		6.2	3.6
Mg mg/l	32.71	-	-	5.32	-	-	4.42	-	4.76	-	-	-	-		4.76	4.83
Na mg/l	44	-	-	7.9	-	-	7.71	-	8.73	-	-	-	-		8.73	8.11
Al mg/l	None	-	-	<0.002	-	-	<0.002	-	0.009	-	-	-	-		0.009	*0.004*
Fe mg/l	None	-	-	<0.004	-	-	<0.004	-	11.5	-	-	-	-		11.5	*3.83*
Mn mg/l	None	-	-	0.006	-	-	0.065	-	0.295	-	-	-	-		0.295	0.122
Si mg/l	None	-	-	8.82	-	-	8.62	-	10.2	-	-	-	-		10.2	9.21
SS mg/l	None	-	-	36	-	-	150	-	2790	-	-	-	-		2790	992
Turbidity NTU	None	-	-	14.7	-	-	71.5	-	1475	-	-	-	-		1475	520



pH	Units: pH	EC	Units: mS/m	Cl	Units: mg/l	SO4	Units: mg/l	Mn	Units: mg/l	SS	Units: mg/l
	Assessment: 8.79		Assessment: 75.5		Assessment: 36.3		Assessment: 10.4		Assessment: 0		Assessment: 0



Graphs only illustrate trends

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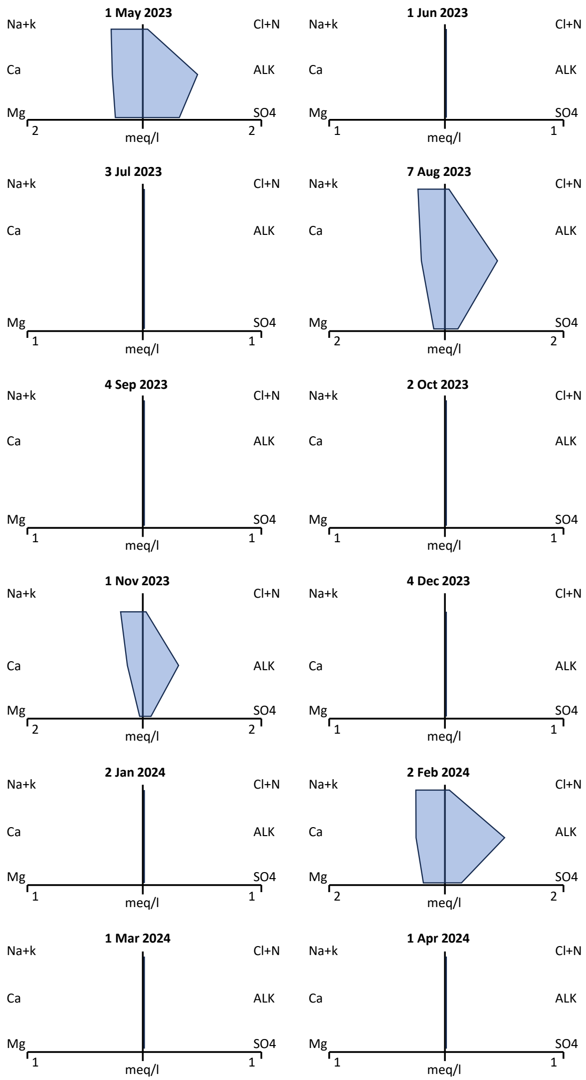
Locality	KGM B11

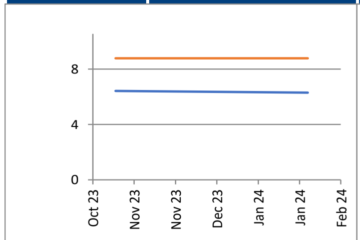
SITE REPORT

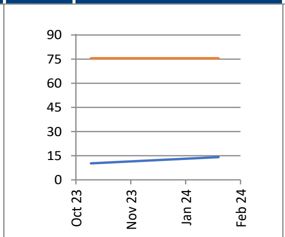
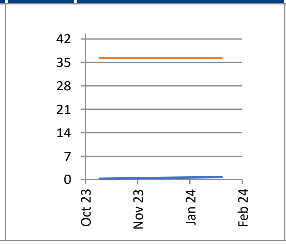
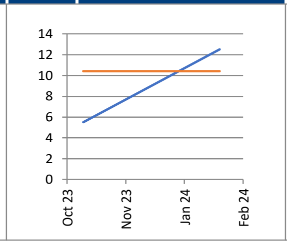
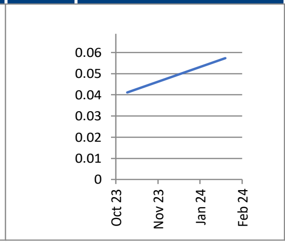
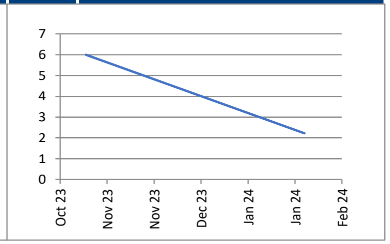
PROJECT NAME	Seriti Power Klipspruit Operations
LOCALITY NAME	KGM B11
LOCALITY DESCRIPTION	Monitoring borehole southeast of Bankfontein Dam
LOCALITY TYPE	Borehole
ASSESSMENT SET	Klipspruit Groundwater IWUL (2016)

Variable		May 2023	Jun 2023	Jul 2023	Aug 2023	Sep 2023	Oct 2023	Nov 2023	Dec 2023	Jan 2024	Feb 2024	Mar 2024	Apr 2024	Current 3-sets avg	Previous 3-sets avg	Current 12-sets avg
Status		Yes	Water-level	Water-level	Yes	Water-level	Water-level	Yes	Water-level	Water-level	Yes	Water-level	Water-level			
pH pH	8.79	6.47	-	-	6.48	-	-	6.43	-	-	6.3	-	-	6.3	6.43	6.42
EC mS/m	75.52	14.4	-	-	19.5	-	-	10.3	-	-	14.2	-	-	14.2	10.3	14.6
TDS grav mg/l	None	140	-	-	178	-	-	102	-	-	102	-	-	102	102	131
Total Hardness mg $CaCO_3$/l	None	52	-	-	32	-	-	18	-	-	46	-	-	46	18	37
Total alkalinity mg $CaCO_3$/l	None	45.6	-	-	43.8	-	-	29.3	-	-	50.1	-	-	50.1	29.3	42.2
Cl mg/l	36.34	0.676	-	-	<0.557	-	-	<0.557	-	-	0.802	-	-	0.802	*0.279*	*0.509*
SO4 mg/l	10.36	28.7	-	-	9.63	-	-	5.51	-	-	12.5	-	-	12.5	5.51	14.1
PO4-P mg/l	None	<0.005	-	-	<0.005	-	-	<0.005	-	-	0.123	-	-	0.123	*0.003*	*0.033*
NH4-N mg/l	None	0.809	-	-	0.281	-	-	0.025	-	-	0.049	-	-	0.049	0.025	0.291
NO3-N mg/l	0.11	0.52	-	-	0.554	-	-	0.314	-	-	0.422	-	-	0.422	0.314	0.453
NO2-N mg/l	None	<0.065	-	-	0.116	-	-	<0.065	-	-	<0.065	-	-	*0.033*	*0.033*	*0.053*
F mg/l	0.14	<0.263	-	-	<0.263	-	-	<0.263	-	-	0.298	-	-	0.298	*0.132*	*0.173*
Ca mg/l	32.56	11	-	-	8.48	-	-	5.77	-	-	10.4	-	-	10.4	5.77	8.91
K mg/l	None	5.19	-	-	4.77	-	-	3.65	-	-	3.63	-	-	3.63	3.65	4.31
Mg mg/l	32.71	6.03	-	-	2.58	-	-	0.955	-	-	4.78	-	-	4.78	0.955	3.59
Na mg/l	44	10	-	-	8.27	-	-	7.14	-	-	9.88	-	-	9.88	7.14	8.82
Al mg/l	None	<0.002	-	-	0.116	-	-	0.142	-	-	<0.002	-	-	*0.001*	0.142	*0.065*
Fe mg/l	None	<0.004	-	-	<0.004	-	-	<0.004	-	-	<0.004	-	-	*0.002*	*0.002*	*0.002*
Mn mg/l	None	<0.001	-	-	<0.001	-	-	0.041	-	-	0.057	-	-	0.057	0.041	*0.025*
Si mg/l	None	20.3	-	-	20.8	-	-	19.1	-	-	21.6	-	-	21.6	19.1	20.5
SS mg/l	None	12	-	-	18	-	-	6	-	-	<4.46	-	-	*2.2*	6	*9.6*
Turbidity NTU	None	21.8	-	-	13	-	-	12	-	-	6.07	-	-	6.07	12	13.2



pH	Units: pH Assessment: 8.79	EC	Units: mS/m Assessment: 75.5	Cl	Units: mg/l Assessment: 36.3	SO4	Units: mg/l Assessment: 10.4	Mn	Units: mg/l Assessment: 0	SS	Units: mg/l Assessment: 0



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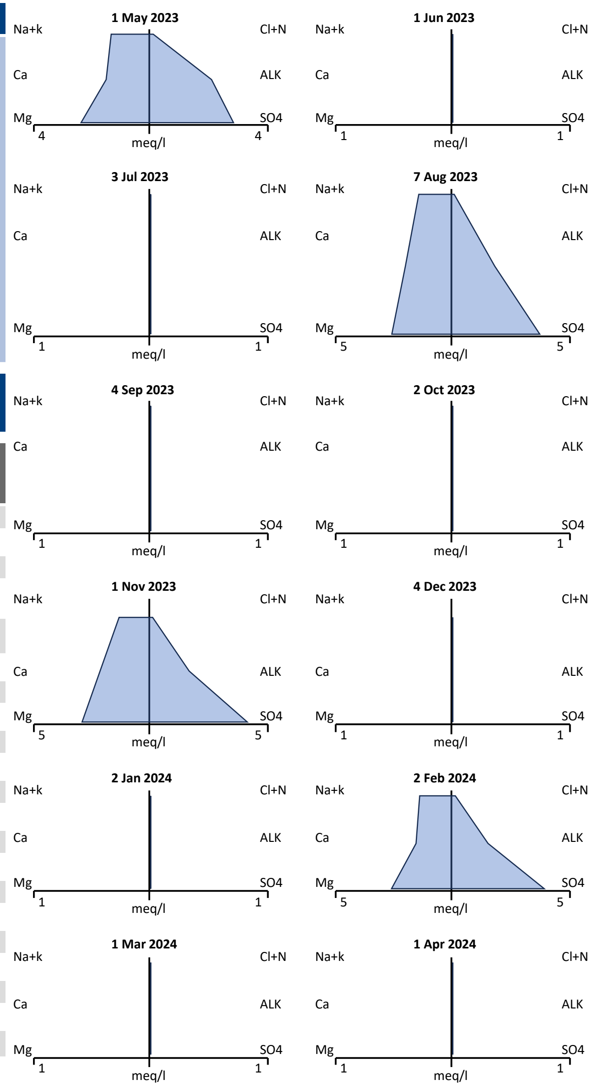
Locality	KGM B16

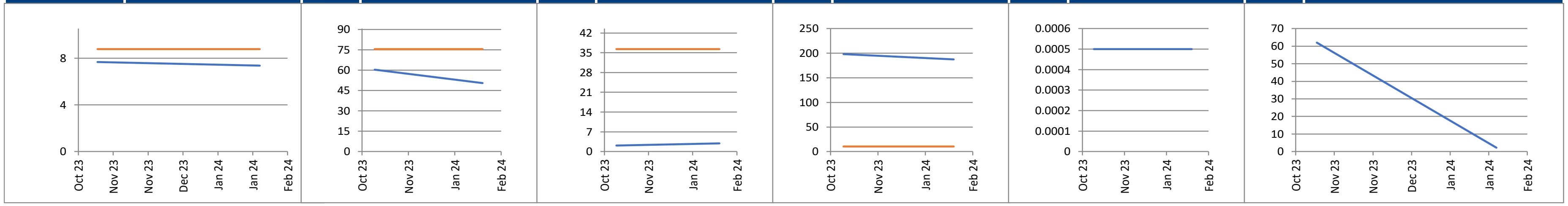
SITE REPORT

PROJECT NAME	Seriti Power Klipspruit Operations
LOCALITY NAME	KGM B16
LOCALITY DESCRIPTION	Monitoring borehole at Balancing Dam
LOCALITY TYPE	Borehole
ASSESSMENT SET	Klipspruit Groundwater IWUL (2016)

Variable		May 2023	Jun 2023	Jul 2023	Aug 2023	Sep 2023	Oct 2023	Nov 2023	Dec 2023	Jan 2024	Feb 2024	Mar 2024	Apr 2024	Current 3-sets avg	Previous 3-sets avg	Current 12-sets avg
Status		Yes	Water-level	Water-level	Yes	Water-level	Water-level	Yes	Water-level	Water-level	Yes	Water-level	Water-level			
pH pH	8.79	7.93	-	-	7.93	-	-	7.68	-	-	7.38	-	-	7.38	7.68	7.73
EC mS/m	75.52	45.5	-	-	73.3	-	-	60.4	-	-	50.5	-	-	50.5	60.4	57.4
TDS grav mg/l	None	292	-	-	390	-	-	424	-	-	358	-	-	358	424	366
Total Hardness mg $CaCO_3$/l	None	195	-	-	231	-	-	256	-	-	209	-	-	209	256	223
Total alkalinity mg $CaCO_3$/l	None	104	-	-	89.8	-	-	82.1	-	-	75.4	-	-	75.4	82.1	87.8
Cl mg/l	36.34	2.27	-	-	0.814	-	-	2.16	-	-	2.88	-	-	2.88	2.16	2.03
SO4 mg/l	10.36	136	-	-	179	-	-	198	-	-	188	-	-	188	198	175
PO4-P mg/l	None	<0.005	-	-	<0.005	-	-	<0.005	-	-	<0.005	-	-	*0.003*	*0.003*	*0.003*
NH4-N mg/l	None	<0.008	-	-	0.142	-	-	0.018	-	-	0.054	-	-	0.054	0.018	*0.055*
NO3-N mg/l	0.11	0.301	-	-	0.567	-	-	0.229	-	-	0.383	-	-	0.383	0.229	0.37
NO2-N mg/l	None	<0.065	-	-	0.114	-	-	<0.065	-	-	<0.065	-	-	*0.033*	*0.033*	*0.053*
F mg/l	0.14	0.324	-	-	0.504	-	-	<0.263	-	-	<0.263	-	-	*0.132*	*0.132*	*0.273*
Ca mg/l	32.56	30.5	-	-	40.5	-	-	43.5	-	-	31.4	-	-	31.4	43.5	36.5
K mg/l	None	6.23	-	-	6.07	-	-	6.08	-	-	5.64	-	-	5.64	6.08	6.01
Mg mg/l	32.71	28.9	-	-	31.6	-	-	35.7	-	-	31.8	-	-	31.8	35.7	32
Na mg/l	44	27.4	-	-	29.7	-	-	27.6	-	-	29.2	-	-	29.2	27.6	28.5
Al mg/l	None	<0.002	-	-	<0.002	-	-	<0.002	-	-	<0.002	-	-	*0.001*	*0.001*	*0.001*
Fe mg/l	None	<0.004	-	-	<0.004	-	-	<0.004	-	-	<0.004	-	-	*0.002*	*0.002*	*0.002*
Mn mg/l	None	<0.001	-	-	<0.001	-	-	<0.001	-	-	<0.001	-	-	*0.001*	*0.001*	*0.001*
Si mg/l	None	5.07	-	-	11.6	-	-	7.4	-	-	8.2	-	-	8.2	7.4	8.07
SS mg/l	None	5	-	-	13	-	-	62	-	-	<4.46	-	-	*2.2*	62	*21*
Turbidity NTU	None	3.02	-	-	4.8	-	-	1.63	-	-	1.86	-	-	1.86	1.63	2.83



pH	Units: pH	EC	Units: mS/m	Cl	Units: mg/l	SO4	Units: mg/l	Mn	Units: mg/l	SS	Units: mg/l
	Assessment: 8.79		Assessment: 75.5		Assessment: 36.3		Assessment: 10.4		Assessment: 0		Assessment: 0



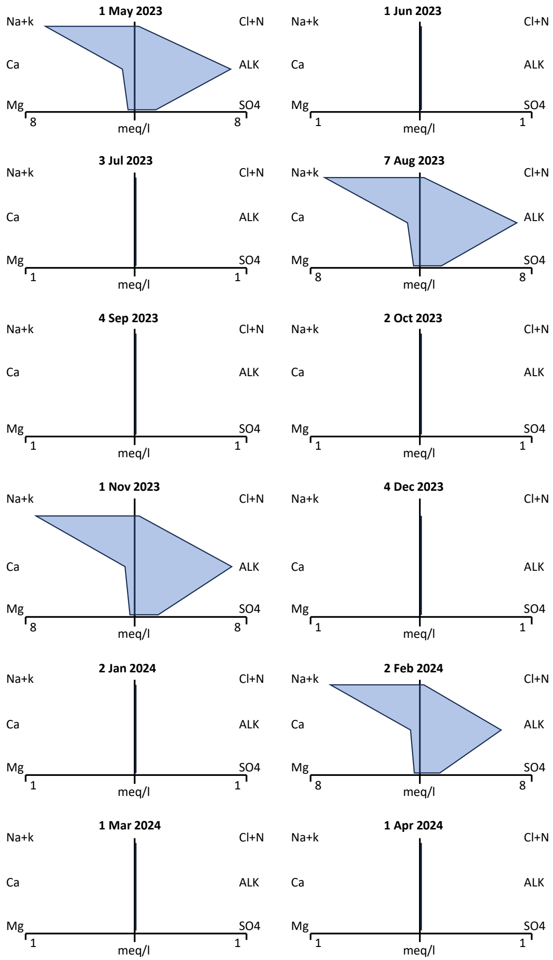
Graphs only illustrate trends

Locality	WELBH27

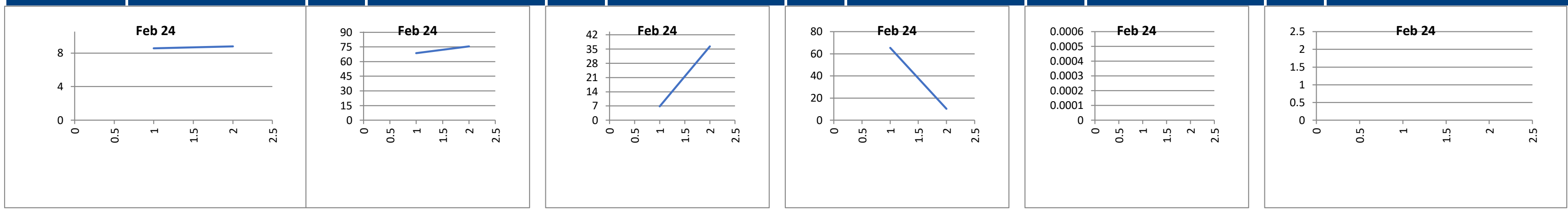
SITE REPORT

PROJECT NAME	Seriti Power Klipspruit Operations
LOCALITY NAME	WELBH27
LOCALITY DESCRIPTION	New monitoring borehole
LOCALITY TYPE	Borehole
ASSESSMENT SET	Klipspruit Groundwater IWUL (2016)

Variable		May 2023	Jun 2023	Jul 2023	Aug 2023	Sep 2023	Oct 2023	Nov 2023	Dec 2023	Jan 2024	Feb 2024	Mar 2024	Apr 2024	Current 3-sets avg	Previous 3-sets avg	Current 12-sets avg
Status		Yes	Water-level	Water-level	Yes	Water-level	Water-level	Yes	Water-level	Water-level	Yes	Water-level	Water-level			
pH pH	8.79	8.32	-	-	8.39	-	-	8.23	-	-	8.57	-	-	8.57	8.23	8.38
EC mS/m	75.52	66.7	-	-	68.9	-	-	68.1	-	-	68.6	-	-	68.6	68.1	68.1
TDS grav mg/l	None	458	-	-	412	-	-	442	-	-	428	-	-	428	442	435
Total Hardness mg $CaCO_3$/l	None	79	-	-	77	-	-	62	-	-	63	-	-	63	62	70
Total alkalinity mg $CaCO_3$/l	None	343	-	-	347	-	-	347	-	-	291	-	-	291	347	332
Cl mg/l	36.34	5.96	-	-	5.18	-	-	6.13	-	-	6.79	-	-	6.79	6.13	6.02
SO4 mg/l	10.36	68.8	-	-	70.9	-	-	77.3	-	-	65.3	-	-	65.3	77.3	70.6
PO4-P mg/l	None	1.18	-	-	0.938	-	-	0.799	-	-	0.903	-	-	0.903	0.799	0.955
NH4-N mg/l	None	4.81	-	-	11.3	-	-	1.02	-	-	1.4	-	-	1.4	1.02	4.63
NO3-N mg/l	0.11	0.265	-	-	0.804	-	-	0.746	-	-	0.257	-	-	0.257	0.746	0.518
NO2-N mg/l	None	<0.065	-	-	0.31	-	-	0.068	-	-	0.129	-	-	0.129	0.068	*0.135*
F mg/l	0.14	1.36	-	-	1.49	-	-	1.69	-	-	2.1	-	-	2.1	1.69	1.66
Ca mg/l	32.56	19.9	-	-	19.8	-	-	16	-	-	15.3	-	-	15.3	16	17.8
K mg/l	None	9.5	-	-	10.3	-	-	8.85	-	-	9.18	-	-	9.18	8.85	9.46
Mg mg/l	32.71	7.12	-	-	6.69	-	-	5.35	-	-	5.94	-	-	5.94	5.35	6.28
Na mg/l	44	145	-	-	155	-	-	161	-	-	146	-	-	146	161	152
Al mg/l	None	<0.002	-	-	<0.002	-	-	<0.002	-	-	0.134	-	-	0.134	*0.001*	*0.034*
Fe mg/l	None	<0.004	-	-	<0.004	-	-	0.081	-	-	<0.004	-	-	*0.002*	0.081	*0.022*
Mn mg/l	None	<0.001	-	-	<0.001	-	-	0.095	-	-	<0.001	-	-	*0.001*	0.095	*0.024*
Si mg/l	None	10.6	-	-	12.7	-	-	9.92	-	-	10.1	-	-	10.1	9.92	10.8
SS mg/l	None	11	-	-	<4.46	-	-	17	-	-	<4.46	-	-	*2.2*	17	*8.1*
Turbidity NTU	None	17.8	-	-	2.58	-	-	5.92	-	-	1.56	-	-	1.56	5.92	6.97



pH	Units: pH	EC	Units: mS/m	Cl	Units: mg/l	SO4	Units: mg/l	Mn	Units: mg/l	SS	Units: mg/l
	Assessment: 8.79		Assessment: 75.5		Assessment: 36.3		Assessment: 10.4		Assessment: 0		Assessment: 0



Graphs only illustrate trends

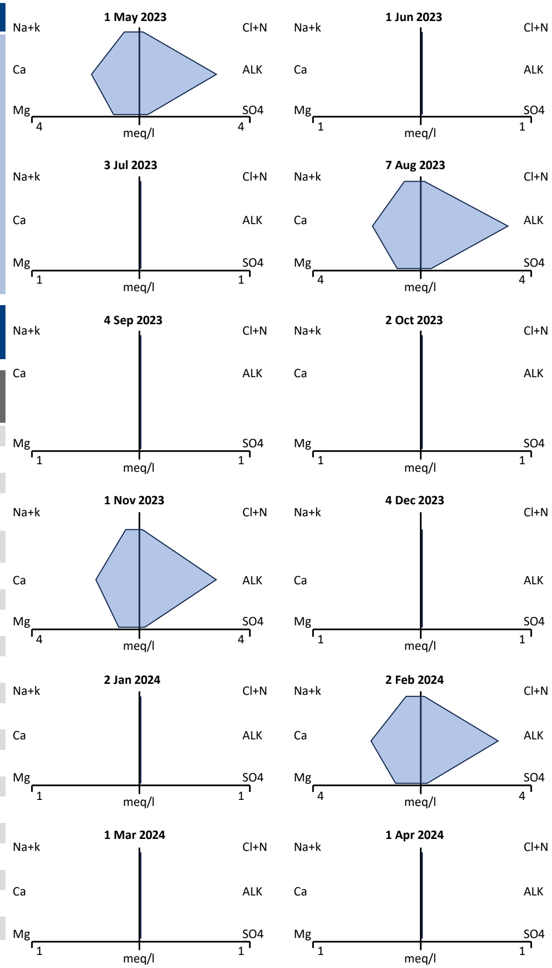
aquatico Scientific (Pty). Ltd.

Locality	BH 008

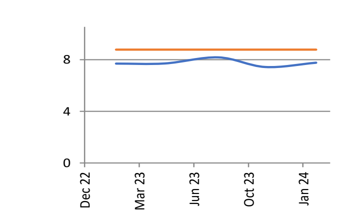
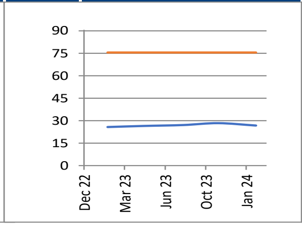
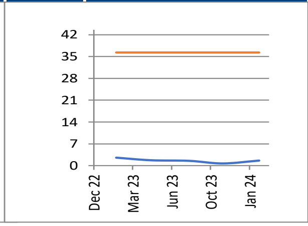
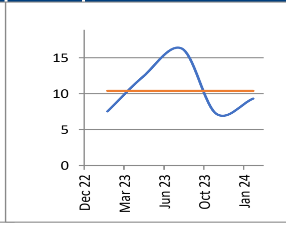
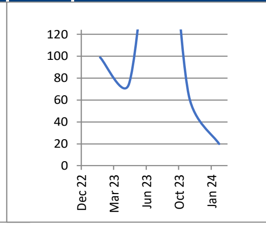
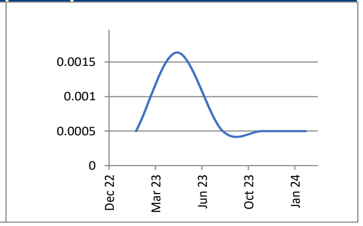
SITE REPORT

PROJECT NAME	Seriti Power Klipspruit Operations
LOCALITY NAME	BH 008
LOCALITY DESCRIPTION	New KPSX Monitoring Borehole added Aug 2021
LOCALITY TYPE	Borehole
ASSESSMENT SET	Klipspruit Groundwater IWUL (2016)

Variable		May 2023	Jun 2023	Jul 2023	Aug 2023	Sep 2023	Oct 2023	Nov 2023	Dec 2023	Jan 2024	Feb 2024	Mar 2024	Apr 2024	Current 3-sets avg	Previous 3-sets avg	Current 12-sets avg
Status		Yes	Water-level	Water-level	Yes	Water-level	Water-level	Yes	Water-level	Water-level	Yes	Locality decommissioned	Locality decommissioned			
pH pH	8.79	7.72	-	-	8.19	-	-	7.45	-	-	7.78	-	-	7.78	7.45	7.79
EC mS/m	75.52	26.5	-	-	27.1	-	-	28.4	-	-	26.8	-	-	26.8	28.4	27.2
TDS grav mg/l	None	216	-	-	186	-	-	268	-	-	184	-	-	184	268	214
Total Hardness mg $CaCO_3$/l	None	141	-	-	137	-	-	123	-	-	142	-	-	142	123	136
Total alkalinity mg $CaCO_3$/l	None	139	-	-	158	-	-	139	-	-	140	-	-	140	139	144
Cl mg/l	36.34	1.76	-	-	1.58	-	-	0.751	-	-	1.65	-	-	1.65	0.751	1.44
SO4 mg/l	10.36	12.4	-	-	16.3	-	-	7.25	-	-	9.35	-	-	9.35	7.25	11.3
PO4-P mg/l	None	<0.005	-	-	<0.005	-	-	<0.005	-	-	0.142	-	-	0.142	*0.003*	*0.037*
NH4-N mg/l	None	<0.008	-	-	0.079	-	-	0.029	-	-	0.019	-	-	0.019	0.029	*0.033*
NO3-N mg/l	0.11	0.484	-	-	0.565	-	-	0.521	-	-	0.498	-	-	0.498	0.521	0.517
NO2-N mg/l	None	0.154	-	-	0.115	-	-	<0.065	-	-	<0.065	-	-	*0.033*	*0.033*	*0.084*
F mg/l	0.14	0.431	-	-	0.328	-	-	0.586	-	-	0.652	-	-	0.652	0.586	0.499
Ca mg/l	32.56	36.4	-	-	36.5	-	-	33	-	-	37.5	-	-	37.5	33	35.9
K mg/l	None	7.37	-	-	8.43	-	-	6.79	-	-	6.47	-	-	6.47	6.79	7.27
Mg mg/l	32.71	12.2	-	-	11.1	-	-	9.82	-	-	11.8	-	-	11.8	9.82	11.2
Na mg/l	44	9.62	-	-	9.84	-	-	8.67	-	-	9.56	-	-	9.56	8.67	9.42
Al mg/l	None	<0.002	-	-	0.061	-	-	0.005	-	-	<0.002	-	-	*0.001*	0.005	*0.017*
Fe mg/l	None	<0.004	-	-	<0.004	-	-	<0.004	-	-	<0.004	-	-	*0.002*	*0.002*	*0.002*
Mn mg/l	None	0.002	-	-	<0.001	-	-	<0.001	-	-	<0.001	-	-	*0.001*	*0.001*	*0.001*
SS mg/l	None	75	-	-	273	-	-	64	-	-	20	-	-	20	64	108
Turbidity NTU	None	58.8	-	-	276	-	-	60	-	-	134	-	-	134	60	132
Si mg/l	None	10.4	-	-	10.6	-	-	10.5	-	-	10.5	-	-	10.5	10.5	10.5



pH	Units: pH / Assessment: 8.79	EC	Units: mS/m / Assessment: 75.5	Cl	Units: mg/l / Assessment: 36.3	SO4	Units: mg/l / Assessment: 10.4	SS	Units: mg/l / Assessment: 0	Mn	Units: mg/l / Assessment: 0

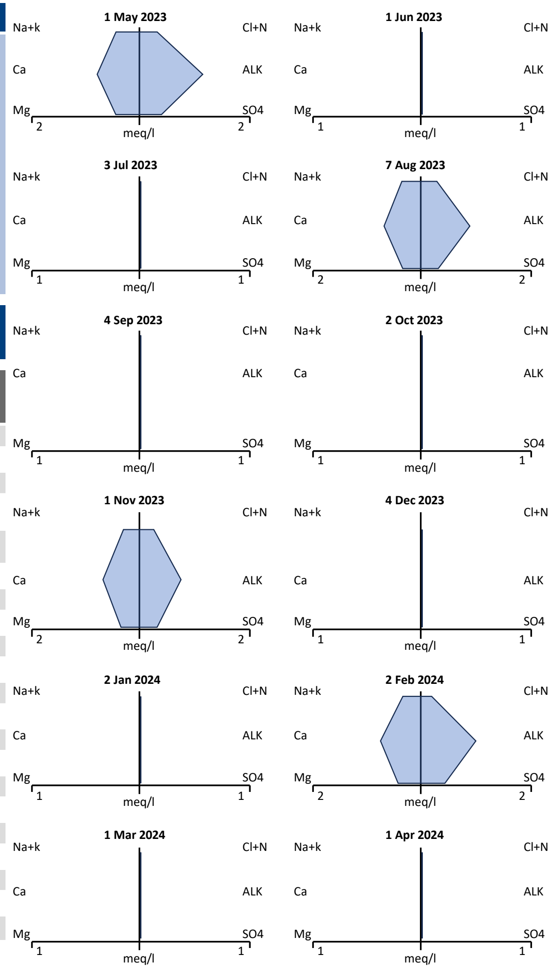







Graphs only illustrate trends

SITE REPORT

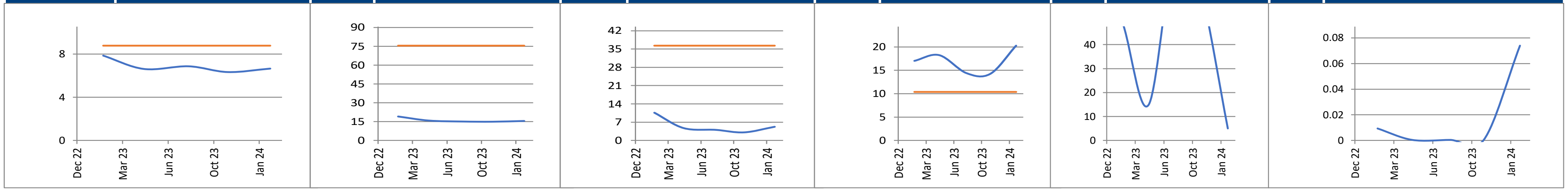
PROJECT NAME	Seriti Power Klipspruit Operations
LOCALITY NAME	BH 009
LOCALITY DESCRIPTION	New KPSX monitoring borehole
LOCALITY TYPE	Borehole
ASSESSMENT SET	Klipspruit Groundwater IWUL (2016)

Locality	BH 009



Variable		May 2023	Jun 2023	Jul 2023	Aug 2023	Sep 2023	Oct 2023	Nov 2023	Dec 2023	Jan 2024	Feb 2024	Mar 2024	Apr 2024	Current 3-sets avg	Previous 3-sets avg	Current 12-sets avg
Status		Yes	Water-level	Water-level	Yes	Water-level	Water-level	Yes	Water-level	Water-level	Yes	Locality decommissioned	Locality decommissioned			
pH pH	8.79	6.63	-	-	6.87	-	-	6.34	-	-	6.66	-	-	6.66	6.34	6.63
EC mS/m	75.52	15.9	-	-	15.2	-	-	15	-	-	15.6	-	-	15.6	15	15.4
TDS grav mg/l	None	114	-	-	120	-	-	138	-	-	122	-	-	122	138	124
Total Hardness mg $CaCO_3$/l	None	63	-	-	52	-	-	53	-	-	60	-	-	60	53	57
Total alkalinity mg $CaCO_3$/l	None	56.9	-	-	44	-	-	36.7	-	-	49.6	-	-	49.6	36.7	46.8
Cl mg/l	36.34	4.72	-	-	4.05	-	-	3.09	-	-	5.22	-	-	5.22	3.09	4.27
SO4 mg/l	10.36	18.2	-	-	14.4	-	-	14.2	-	-	20.3	-	-	20.3	14.2	16.8
PO4-P mg/l	None	<0.005	-	-	<0.005	-	-	<0.005	-	-	<0.005	-	-	*0.003*	*0.003*	*0.003*
NH4-N mg/l	None	<0.008	-	-	0.093	-	-	0.059	-	-	0.047	-	-	0.047	0.059	*0.051*
NO3-N mg/l	0.11	2.33	-	-	2.23	-	-	2.07	-	-	0.424	-	-	0.424	2.07	1.76
NO2-N mg/l	None	0.153	-	-	0.114	-	-	<0.065	-	-	0.188	-	-	0.188	*0.033*	*0.122*
F mg/l	0.14	<0.263	-	-	0.719	-	-	<0.263	-	-	0.65	-	-	0.65	*0.132*	*0.408*
Ca mg/l	32.56	16.1	-	-	13.9	-	-	13.9	-	-	15.3	-	-	15.3	13.9	14.8
K mg/l	None	6.81	-	-	6.42	-	-	5.31	-	-	4.77	-	-	4.77	5.31	5.83
Mg mg/l	32.71	5.6	-	-	4.28	-	-	4.44	-	-	5.32	-	-	5.32	4.44	4.91
Na mg/l	44	6.48	-	-	4.7	-	-	4.23	-	-	5.26	-	-	5.26	4.23	5.17
Al mg/l	None	<0.002	-	-	<0.002	-	-	<0.002	-	-	<0.002	-	-	*0.001*	*0.001*	*0.001*
Fe mg/l	None	<0.004	-	-	<0.004	-	-	<0.004	-	-	0.226	-	-	0.226	*0.002*	*0.058*
Mn mg/l	None	<0.001	-	-	<0.001	-	-	<0.001	-	-	0.074	-	-	0.074	*0.001*	*0.019*
SS mg/l	None	15	-	-	85	-	-	62	-	-	5	-	-	5	62	42
Turbidity NTU	None	18.8	-	-	121	-	-	104	-	-	4.99	-	-	4.99	104	62.2
Si mg/l	None	8.65	-	-	8.75	-	-	8.88	-	-	8.6	-	-	8.6	8.88	8.72

pH	EC	Cl	SO4	SS	Mn
Units: pH Assessment: 8.79	Units: mS/m Assessment: 75.5	Units: mg/l Assessment: 36.3	Units: mg/l Assessment: 10.4	Units: mg/l Assessment: 0	Units: mg/l Assessment: 0

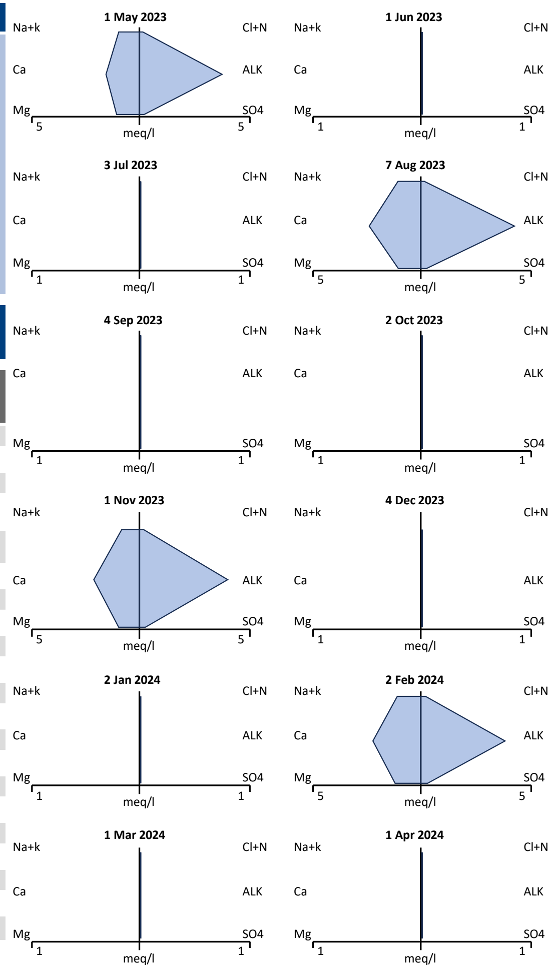


Graphs only illustrate trends

SITE REPORT

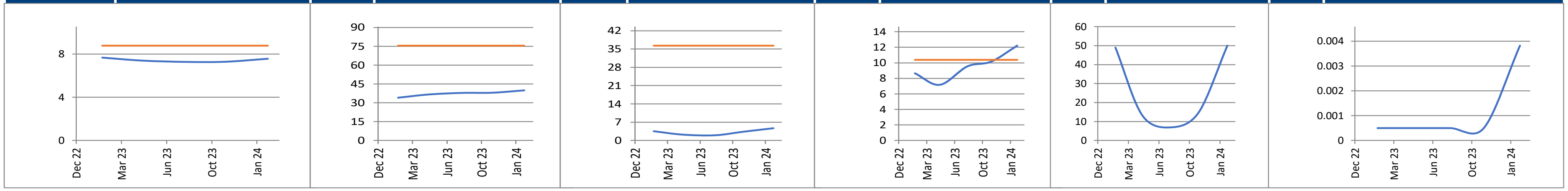
PROJECT NAME	Seriti Power Klipspruit Operations
LOCALITY NAME	BHPSM01
LOCALITY DESCRIPTION	New monitoring borehole
LOCALITY TYPE	Borehole
ASSESSMENT SET	Klipspruit Groundwater IWUL (2016)

Locality	BHPSM01



Variable		May 2023	Jun 2023	Jul 2023	Aug 2023	Sep 2023	Oct 2023	Nov 2023	Dec 2023	Jan 2024	Feb 2024	Mar 2024	Apr 2024	Current 3-sets avg	Previous 3-sets avg	Current 12-sets avg
Status		Yes	Water-level	Water-level	Yes	Water-level	Water-level	Yes	Water-level	Water-level	Yes	Water-level	Water-level			
pH pH	8.79	7.4	-	-	7.27	-	-	7.29	-	-	7.58	-	-	7.58	7.29	7.39
EC mS/m	75.52	36.6	-	-	37.9	-	-	38	-	-	39.9	-	-	39.9	38	38.1
TDS grav mg/l	None	196	-	-	224	-	-	270	-	-	236	-	-	236	270	232
Total Hardness mg $CaCO_3$/l	None	135	-	-	176	-	-	158	-	-	175	-	-	175	158	161
Total alkalinity mg $CaCO_3$/l	None	186	-	-	212	-	-	200	-	-	191	-	-	191	200	197
Cl mg/l	36.34	2.2	-	-	1.95	-	-	3.3	-	-	4.65	-	-	4.65	3.3	3.03
SO4 mg/l	10.36	7.16	-	-	9.53	-	-	10.2	-	-	12.2	-	-	12.2	10.2	9.77
PO4-P mg/l	None	0.015	-	-	0.023	-	-	0.008	-	-	0.152	-	-	0.152	0.008	0.05
NH4-N mg/l	None	<0.008	-	-	0.152	-	-	0.051	-	-	0.012	-	-	0.012	0.051	*0.055*
NO3-N mg/l	0.11	0.454	-	-	0.692	-	-	0.522	-	-	0.432	-	-	0.432	0.522	0.525
NO2-N mg/l	None	0.16	-	-	0.115	-	-	<0.065	-	-	<0.065	-	-	*0.033*	*0.033*	*0.085*
F mg/l	0.14	<0.263	-	-	<0.263	-	-	0.395	-	-	0.392	-	-	0.392	0.395	*0.263*
Ca mg/l	32.56	32	-	-	48.7	-	-	43.1	-	-	45.2	-	-	45.2	43.1	42.3
K mg/l	None	7.74	-	-	8.8	-	-	6.63	-	-	8.54	-	-	8.54	6.63	7.93
Mg mg/l	32.71	13.5	-	-	13.3	-	-	12.3	-	-	15	-	-	15	12.3	13.5
Na mg/l	44	18.7	-	-	20.3	-	-	16.1	-	-	21.1	-	-	21.1	16.1	19.1
Al mg/l	None	<0.002	-	-	0.103	-	-	<0.002	-	-	<0.002	-	-	*0.001*	*0.001*	*0.027*
Fe mg/l	None	<0.004	-	-	<0.004	-	-	<0.004	-	-	<0.004	-	-	*0.002*	*0.002*	*0.002*
Mn mg/l	None	<0.001	-	-	<0.001	-	-	<0.001	-	-	0.004	-	-	0.004	*0.001*	*0.001*
SS mg/l	None	13	-	-	7	-	-	15	-	-	50	-	-	50	15	21
Turbidity NTU	None	3.03	-	-	2.09	-	-	3.43	-	-	16.6	-	-	16.6	3.43	6.29
Si mg/l	None	23.6	-	-	23.5	-	-	18.2	-	-	21.4	-	-	21.4	18.2	21.7

Variable	Units	Assessment
pH	Units: pH	Assessment: 8.79
EC	Units: mS/m	Assessment: 75.5
Cl	Units: mg/l	Assessment: 36.3
SO4	Units: mg/l	Assessment: 10.4
SS	Units: mg/l	Assessment: 0
Mn	Units: mg/l	Assessment: 0



Graphs only illustrate trends

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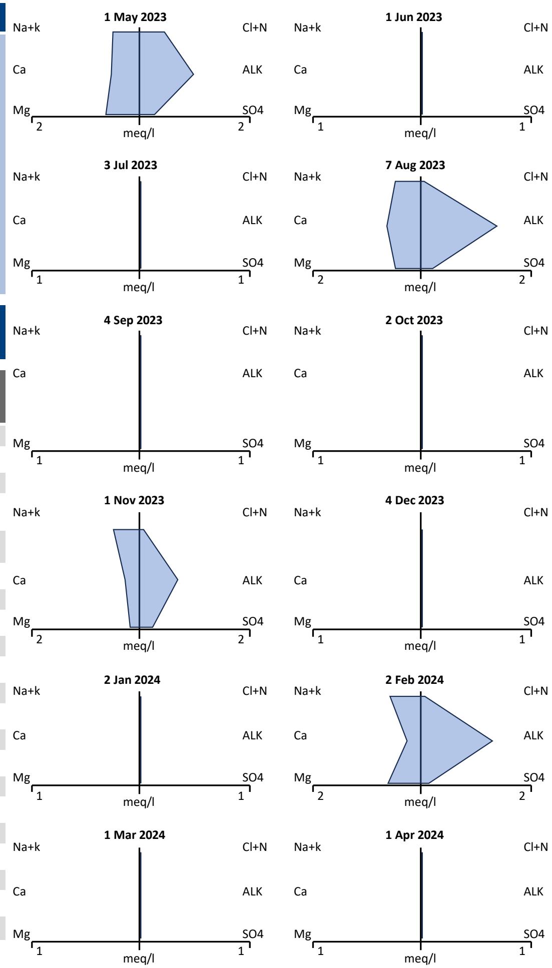
Locality	BHPSM06

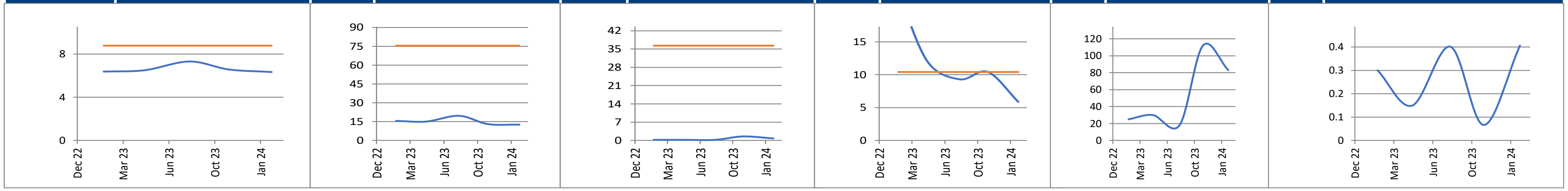
SITE REPORT

PROJECT NAME	Seriti Power Klipspruit Operations
LOCALITY NAME	BHPSM06
LOCALITY DESCRIPTION	New monitoring borehole
LOCALITY TYPE	Borehole
ASSESSMENT SET	Klipspruit Groundwater IWUL (2016)

Variable		May 2023	Jun 2023	Jul 2023	Aug 2023	Sep 2023	Oct 2023	Nov 2023	Dec 2023	Jan 2024	Feb 2024	Mar 2024	Apr 2024	Current 3-sets avg	Previous 3-sets avg	Current 12-sets avg
Status		Yes	Water-level	Water-level	Yes	Water-level	Water-level	Yes	Water-level	Water-level	Yes	Water-level	No access			
pH pH	8.79	6.51	-	-	7.31	-	-	6.58	-	-	6.35	-	-	6.35	6.58	6.69
EC mS/m	75.52	15.1	-	-	19.7	-	-	13	-	-	12.6	-	-	12.6	13	15.1
TDS grav mg/l	None	124	-	-	192	-	-	112	-	-	120	-	-	120	112	137
Total Hardness mg $CaCO_3$/l	None	59	-	-	57	-	-	24	-	-	45	-	-	45	24	46
Total alkalinity mg $CaCO_3$/l	None	48.2	-	-	68.8	-	-	34	-	-	64.6	-	-	64.6	34	53.9
Cl mg/l	36.34	<0.557	-	-	<0.557	-	-	1.58	-	-	0.825	-	-	0.825	1.58	*0.741*
SO4 mg/l	10.36	12	-	-	9.31	-	-	10.4	-	-	5.88	-	-	5.88	10.4	9.4
PO4-P mg/l	None	<0.005	-	-	<0.005	-	-	<0.005	-	-	0.113	-	-	0.113	*0.003*	*0.03*
NH4-N mg/l	None	1.09	-	-	0.105	-	-	0.027	-	-	0.141	-	-	0.141	0.027	0.341
NO3-N mg/l	0.11	5.92	-	-	0.408	-	-	<0.194	-	-	0.359	-	-	0.359	*0.097*	*1.7*
NO2-N mg/l	None	0.073	-	-	0.071	-	-	<0.065	-	-	<0.065	-	-	*0.033*	*0.033*	*0.052*
F mg/l	0.14	0.32	-	-	0.527	-	-	0.483	-	-	0.538	-	-	0.538	0.483	0.467
Ca mg/l	32.56	10.8	-	-	13	-	-	5.79	-	-	5.58	-	-	5.58	5.79	8.79
K mg/l	None	7.12	-	-	6.22	-	-	5.41	-	-	5.37	-	-	5.37	5.41	6.03
Mg mg/l	32.71	7.78	-	-	5.95	-	-	2.37	-	-	7.62	-	-	7.62	2.37	5.93
Na mg/l	44	7.56	-	-	7.64	-	-	8.34	-	-	10.4	-	-	10.4	8.34	8.49
Al mg/l	None	<0.002	-	-	<0.002	-	-	<0.002	-	-	<0.002	-	-	*0.001*	*0.001*	*0.001*
Fe mg/l	None	<0.004	-	-	<0.004	-	-	<0.004	-	-	<0.004	-	-	*0.002*	*0.002*	*0.002*
Mn mg/l	None	0.149	-	-	0.401	-	-	0.067	-	-	0.406	-	-	0.406	0.067	0.256
SS mg/l	None	30	-	-	18	-	-	112	-	-	83	-	-	83	112	61
Turbidity NTU	None	17.6	-	-	60.6	-	-	144	-	-	117	-	-	117	144	84.8
Si mg/l	None	18.4	-	-	16.2	-	-	16.1	-	-	17.6	-	-	17.6	16.1	17.1



pH	Units: pH Assessment: 8.79	EC	Units: mS/m Assessment: 75.5	Cl	Units: mg/l Assessment: 36.3	SO4	Units: mg/l Assessment: 10.4	SS	Units: mg/l Assessment: 0	Mn	Units: mg/l Assessment: 0

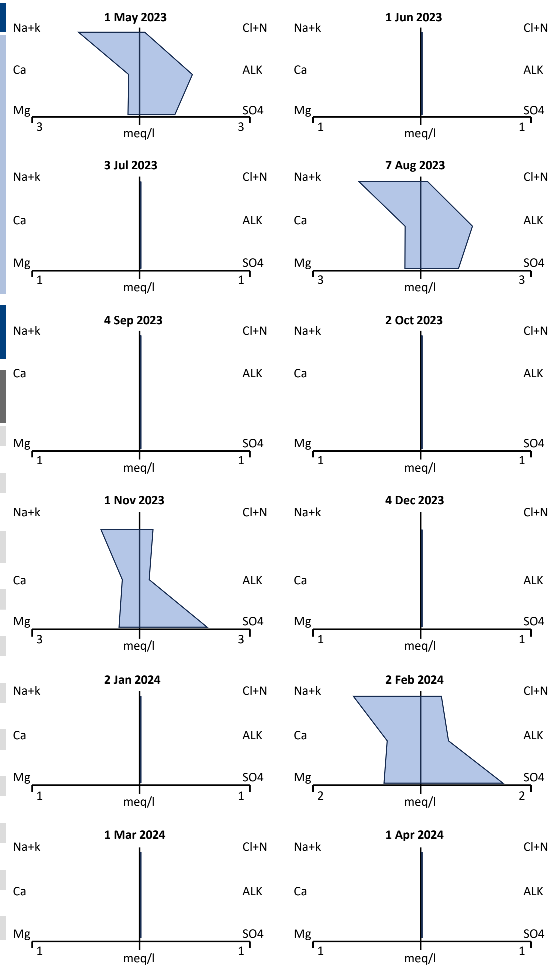


Graphs only illustrate trends

SITE REPORT

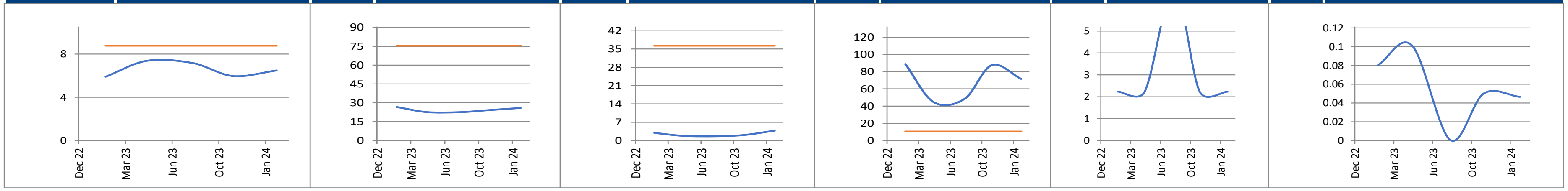
PROJECT NAME	Seriti Power Klipspruit Operations
LOCALITY NAME	BHPSM08
LOCALITY DESCRIPTION	New monitoring borehole
LOCALITY TYPE	Borehole
ASSESSMENT SET	Klipspruit Groundwater IWUL (2016)

Locality	BHPSM08



Variable		May 2023	Jun 2023	Jul 2023	Aug 2023	Sep 2023	Oct 2023	Nov 2023	Dec 2023	Jan 2024	Feb 2024	Mar 2024	Apr 2024	Current 3-sets avg	Previous 3-sets avg	Current 12-sets avg
Status		Yes	Water-level	Water-level	Yes	Water-level	Water-level	Yes	Water-level	Water-level	Yes	Water-level	Water-level			
pH pH	8.79	7.39	-	-	7.17	-	-	5.97	-	-	6.49	-	-	6.49	5.97	6.76
EC mS/m	75.52	22.6	-	-	22.6	-	-	24.2	-	-	25.9	-	-	25.9	24.2	23.8
TDS grav mg/l	None	146	-	-	172	-	-	206	-	-	172	-	-	172	206	174
Total Hardness mg $CaCO_3$/l	None	35	-	-	46	-	-	56	-	-	67	-	-	67	56	51
Total alkalinity mg $CaCO_3$/l	None	70.8	-	-	69.9	-	-	11.4	-	-	24.5	-	-	24.5	11.4	44.2
Cl mg/l	36.34	1.78	-	-	1.64	-	-	2.11	-	-	3.76	-	-	3.76	2.11	2.32
SO4 mg/l	10.36	44.8	-	-	48.5	-	-	87.6	-	-	71.6	-	-	71.6	87.6	63.1
PO4-P mg/l	None	0.104	-	-	0.01	-	-	<0.005	-	-	0.126	-	-	0.126	*0.003*	*0.061*
NH4-N mg/l	None	1.19	-	-	1.25	-	-	0.129	-	-	0.034	-	-	0.034	0.129	0.651
NO3-N mg/l	0.11	0.749	-	-	1.58	-	-	3.83	-	-	3.56	-	-	3.56	3.83	2.43
NO2-N mg/l	None	0.098	-	-	0.114	-	-	0.065	-	-	<0.065	-	-	*0.033*	0.065	*0.077*
F mg/l	0.14	<0.263	-	-	<0.263	-	-	<0.263	-	-	0.289	-	-	0.289	*0.132*	*0.171*
Ca mg/l	32.56	6.78	-	-	9.19	-	-	10.3	-	-	12.7	-	-	12.7	10.3	9.74
K mg/l	None	4.77	-	-	6.39	-	-	5.99	-	-	6.88	-	-	6.88	5.99	6.01
Mg mg/l	32.71	4.34	-	-	5.64	-	-	7.32	-	-	8.43	-	-	8.43	7.32	6.43
Na mg/l	44	36.7	-	-	36.1	-	-	21.8	-	-	24.8	-	-	24.8	21.8	29.9
Al mg/l	None	<0.002	-	-	<0.002	-	-	<0.002	-	-	<0.002	-	-	*0.001*	*0.001*	*0.001*
Fe mg/l	None	0.224	-	-	<0.004	-	-	<0.004	-	-	<0.004	-	-	*0.002*	*0.002*	*0.058*
Mn mg/l	None	0.101	-	-	<0.001	-	-	0.05	-	-	0.047	-	-	0.047	0.05	*0.05*
SS mg/l	None	<4.46	-	-	7	-	-	<4.46	-	-	<4.46	-	-	*2.2*	*2.2*	*3.4*
Turbidity NTU	None	2.9	-	-	3.94	-	-	5.71	-	-	5.34	-	-	5.34	5.71	4.47
Si mg/l	None	3.33	-	-	4.27	-	-	6.97	-	-	7.38	-	-	7.38	6.97	5.49

pH	Units: pH Assessment: 8.79	EC	Units: mS/m Assessment: 75.5	Cl	Units: mg/l Assessment: 36.3	SO4	Units: mg/l Assessment: 10.4	SS	Units: mg/l Assessment: 0	Mn	Units: mg/l Assessment: 0



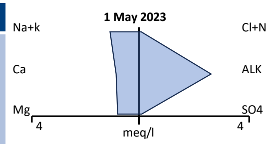
Graphs only illustrate trends

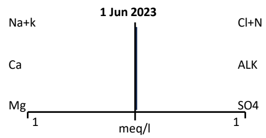
SITE REPORT

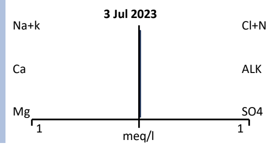
PROJECT NAME	Seriti Power Klipspruit Operations
LOCALITY NAME	BHPSM09
LOCALITY DESCRIPTION	New monitoring borehole
LOCALITY TYPE	Borehole
ASSESSMENT SET	Klipspruit Groundwater IWUL (2016)

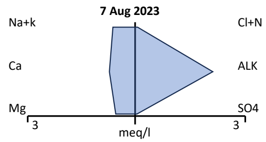
Locality	BHPSM09

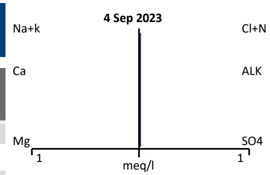
Variable		May 2023	Jun 2023	Jul 2023	Aug 2023	Sep 2023	Oct 2023	Nov 2023	Dec 2023	Jan 2024	Feb 2024	Mar 2024	Apr 2024	Current 3-sets avg	Previous 3-sets avg	Current 12-sets avg
Status		Yes	Water-level	Water-level	Yes	Water-level	Water-level	Yes	Water-level	Water-level	Yes	Water-level	No access			
pH pH	8.79	7.72	-	-	7.85	-	-	7.38	-	-	7.29	-	-	7.29	7.38	7.56
EC mS/m	75.52	22.8	-	-	21.1	-	-	17.1	-	-	16.8	-	-	16.8	17.1	19.5
TDS grav mg/l	None	128	-	-	166	-	-	148	-	-	148	-	-	148	148	148
Total Hardness mg $CaCO_3$/l	None	87	-	-	66	-	-	37	-	-	59	-	-	59	37	62
Total alkalinity mg $CaCO_3$/l	None	130	-	-	105	-	-	67.7	-	-	88.5	-	-	88.5	67.7	97.8
Cl mg/l	36.34	<0.557	-	-	<0.557	-	-	1.41	-	-	<0.557	-	-	*0.279*	1.41	*0.561*
SO4 mg/l	10.36	2.35	-	-	0.674	-	-	1.59	-	-	1.78	-	-	1.78	1.59	1.6
PO4-P mg/l	None	<0.005	-	-	0.012	-	-	<0.005	-	-	0.142	-	-	0.142	*0.003*	*0.04*
NH4-N mg/l	None	0.065	-	-	0.043	-	-	0.052	-	-	0.065	-	-	0.065	0.052	0.056
NO3-N mg/l	0.11	0.338	-	-	0.324	-	-	0.194	-	-	0.363	-	-	0.363	0.194	0.305
NO2-N mg/l	None	<0.065	-	-	0.073	-	-	<0.065	-	-	<0.065	-	-	*0.033*	*0.033*	*0.043*
F mg/l	0.14	0.434	-	-	<0.263	-	-	<0.263	-	-	0.462	-	-	0.462	*0.132*	*0.29*
Ca mg/l	32.56	17.9	-	-	15	-	-	9.35	-	-	11.6	-	-	11.6	9.35	13.5
K mg/l	None	5.17	-	-	3.69	-	-	3.44	-	-	3.58	-	-	3.58	3.44	3.97
Mg mg/l	32.71	10.2	-	-	6.94	-	-	3.24	-	-	7.37	-	-	7.37	3.24	6.94
Na mg/l	44	22.7	-	-	12.8	-	-	13.6	-	-	16.9	-	-	16.9	13.6	16.5
Al mg/l	None	<0.002	-	-	<0.002	-	-	<0.002	-	-	<0.002	-	-	*0.001*	*0.001*	*0.001*
Fe mg/l	None	0.024	-	-	0.875	-	-	<0.004	-	-	<0.004	-	-	*0.002*	*0.002*	*0.226*
Mn mg/l	None	<0.001	-	-	<0.001	-	-	<0.001	-	-	<0.001	-	-	*0.001*	*0.001*	*0.001*
SS mg/l	None	55	-	-	264	-	-	95	-	-	140	-	-	140	95	139
Turbidity NTU	None	95.8	-	-	362	-	-	111	-	-	166	-	-	166	111	184
Si mg/l	None	15.6	-	-	21.2	-	-	16.9	-	-	20.4	-	-	20.4	16.9	18.5

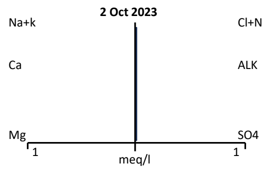


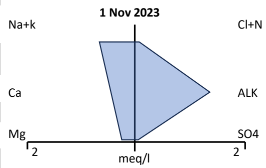


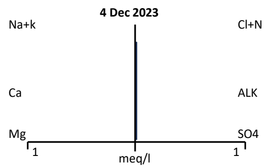


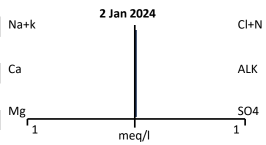


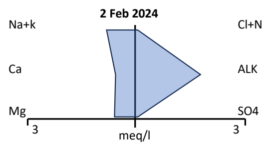


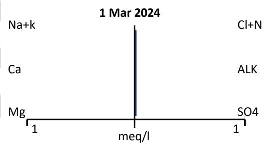


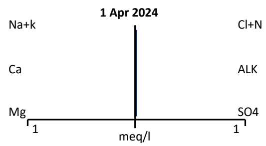




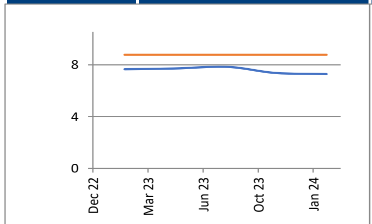


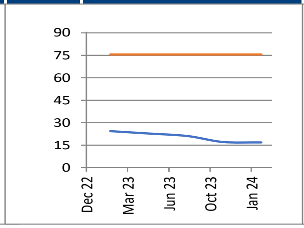


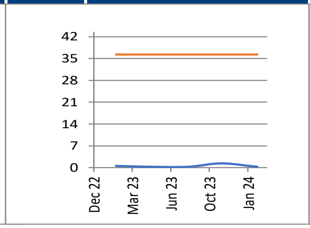


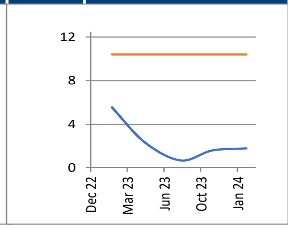


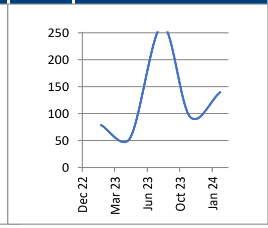
pH	Units: pH	EC	Units: mS/m	Cl	Units: mg/l	SO4	Units: mg/l	SS	Units: mg/l	Mn	Units: mg/l
	Assessment: 8.79		Assessment: 75.5		Assessment: 36.3		Assessment: 10.4		Assessment: 0		Assessment: 0

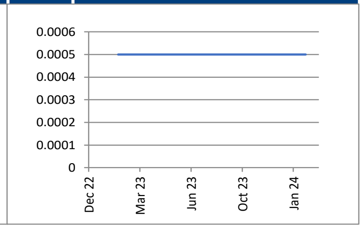












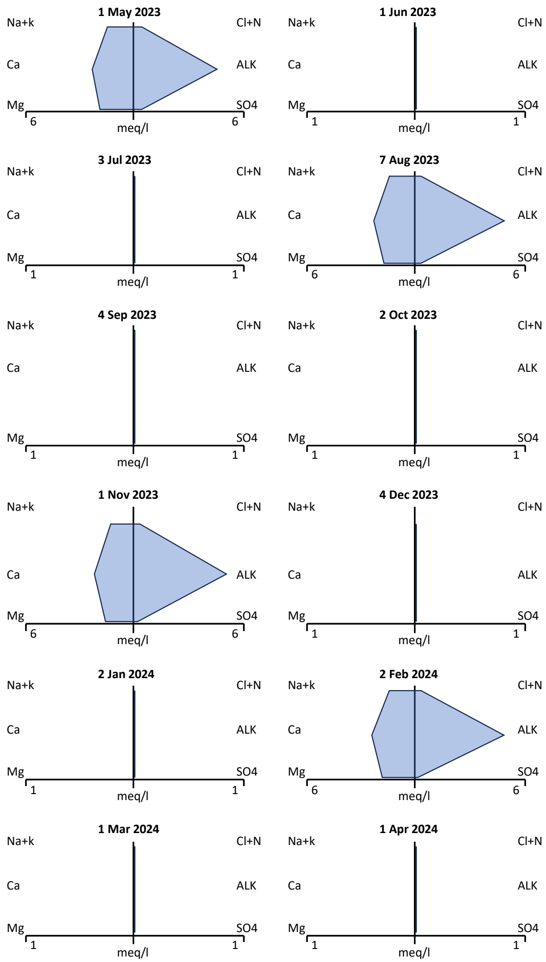
Graphs only illustrate trends

Locality	BHPSM10

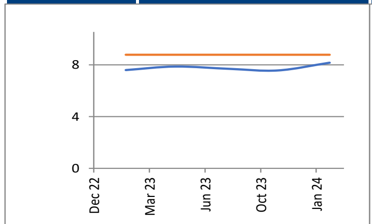
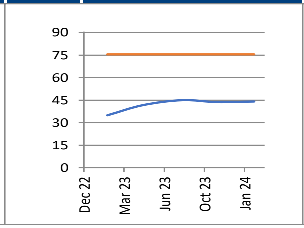
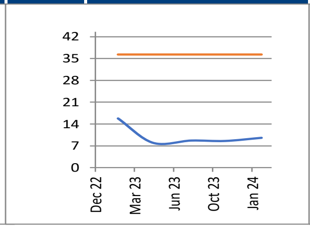
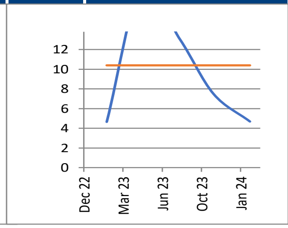
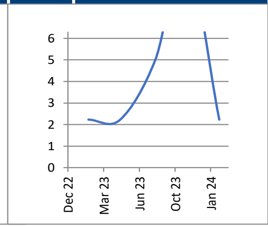
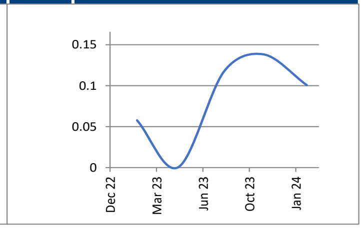
SITE REPORT

PROJECT NAME	Seriti Power Klipspruit Operations
LOCALITY NAME	BHPSM10
LOCALITY DESCRIPTION	New monitoring borehole
LOCALITY TYPE	Borehole
ASSESSMENT SET	Klipspruit Groundwater IWUL (2016)

Variable		May 2023	Jun 2023	Jul 2023	Aug 2023	Sep 2023	Oct 2023	Nov 2023	Dec 2023	Jan 2024	Feb 2024	Mar 2024	Apr 2024	Current 3-sets avg	Previous 3-sets avg	Current 12-sets avg
Status		Yes	Water-level	Water-level	Yes	Water-level	Water-level	Yes	Water-level	Water-level	Yes	Water-level	Water-level			
pH pH	8.79	7.88	-	-	7.69	-	-	7.57	-	-	8.18	-	-	8.18	7.57	7.83
EC mS/m	75.52	41.8	-	-	45.1	-	-	43.8	-	-	44.2	-	-	44.2	43.8	43.7
TDS grav mg/l	None	362	-	-	348	-	-	302	-	-	324	-	-	324	302	334
Total Hardness mg $CaCO_3$/l	None	213	-	-	205	-	-	192	-	-	215	-	-	215	192	206
Total alkalinity mg $CaCO_3$/l	None	227	-	-	243	-	-	252	-	-	242	-	-	242	252	241
Cl mg/l	36.34	7.97	-	-	8.69	-	-	8.55	-	-	9.56	-	-	9.56	8.55	8.69
SO4 mg/l	10.36	18.3	-	-	13	-	-	7.49	-	-	4.68	-	-	4.68	7.49	10.9
PO4-P mg/l	None	<0.005	-	-	<0.005	-	-	<0.005	-	-	0.143	-	-	0.143	*0.003*	*0.038*
NH4-N mg/l	None	0.085	-	-	0.177	-	-	0.125	-	-	0.06	-	-	0.06	0.125	0.112
NO3-N mg/l	0.11	2.33	-	-	0.387	-	-	0.591	-	-	<0.194	-	-	*0.097*	0.591	*0.851*
NO2-N mg/l	None	0.075	-	-	0.141	-	-	0.066	-	-	<0.065	-	-	*0.033*	0.066	*0.079*
F mg/l	0.14	<0.263	-	-	0.556	-	-	0.697	-	-	0.559	-	-	0.559	0.697	*0.486*
Ca mg/l	32.56	46.9	-	-	46.7	-	-	44.6	-	-	48.8	-	-	48.8	44.6	46.8
K mg/l	None	7.8	-	-	7.34	-	-	6.52	-	-	7.1	-	-	7.1	6.52	7.19
Mg mg/l	32.71	23.3	-	-	21.5	-	-	19.6	-	-	22.6	-	-	22.6	19.6	21.8
Na mg/l	44	30.1	-	-	29.4	-	-	26.7	-	-	29.6	-	-	29.6	26.7	29
Al mg/l	None	<0.002	-	-	0.094	-	-	<0.002	-	-	0.008	-	-	0.008	*0.001*	*0.026*
Fe mg/l	None	<0.004	-	-	<0.004	-	-	<0.004	-	-	<0.004	-	-	*0.002*	*0.002*	*0.002*
Mn mg/l	None	<0.001	-	-	0.117	-	-	0.138	-	-	0.101	-	-	0.101	0.138	*0.089*
SS mg/l	None	<4.46	-	-	5	-	-	10	-	-	<4.46	-	-	*2.2*	10	*4.9*
Turbidity NTU	None	1.81	-	-	4.8	-	-	11.2	-	-	7.32	-	-	7.32	11.2	6.28
Si mg/l	None	10.6	-	-	10.8	-	-	10.8	-	-	11.3	-	-	11.3	10.8	10.9



pH	Units: pH Assessment: 8.79	EC	Units: mS/m Assessment: 75.5	Cl	Units: mg/l Assessment: 36.3	SO4	Units: mg/l Assessment: 10.4	SS	Units: mg/l Assessment: 0	Mn	Units: mg/l Assessment: 0

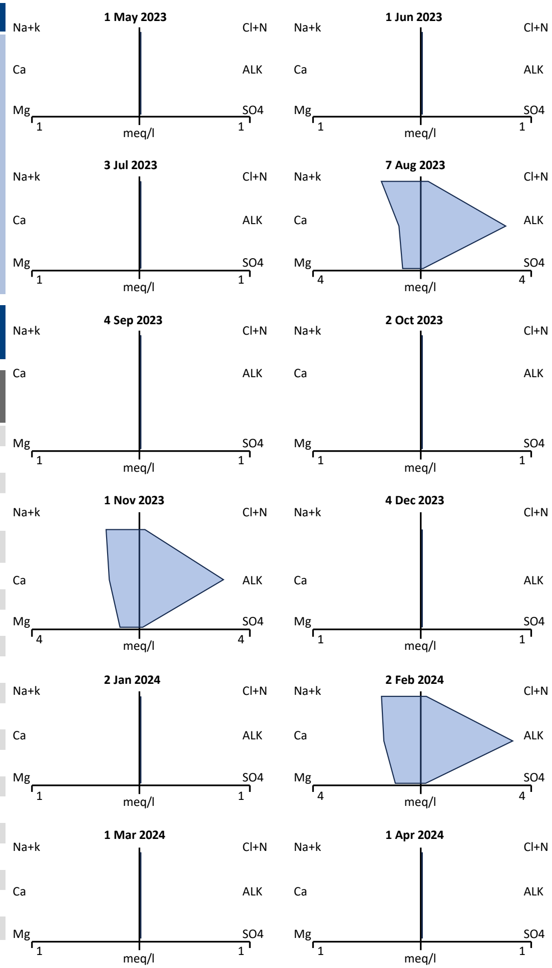
Graphs only illustrate trends

Locality	BHPSM13

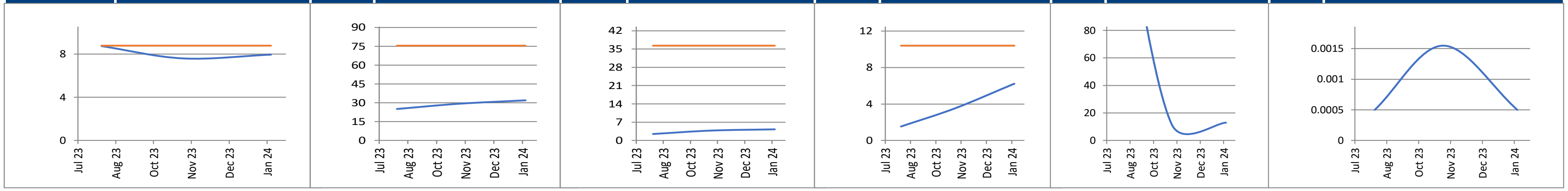
SITE REPORT

PROJECT NAME	Seriti Power Klipspruit Operations
LOCALITY NAME	BHPSM13
LOCALITY DESCRIPTION	New monitoring borehole
LOCALITY TYPE	Borehole
ASSESSMENT SET	Klipspruit Groundwater IWUL (2016)

Variable		May 2023	Jun 2023	Jul 2023	Aug 2023	Sep 2023	Oct 2023	Nov 2023	Dec 2023	Jan 2024	Feb 2024	Mar 2024	Apr 2024	Current 3-sets avg	Previous 3-sets avg	Current 12-sets avg
Status		Water-level	Blocked / Damaged	Water-level	Yes	Water-level	Water-level	Yes	Water-level	Water-level	Yes	Water-level	Water-level			
pH pH	8.79	-	-	-	8.75	-	-	7.61	-	-	7.96	-	-	7.96	7.61	8.11
EC mS/m	75.52	-	-	-	25.1	-	-	29.3	-	-	32	-	-	32	29.3	28.8
TDS grav mg/l	None	-	-	-	174	-	-	238	-	-	174	-	-	174	238	195
Total Hardness mg $CaCO_3$/l	None	-	-	-	79	-	-	96	-	-	120	-	-	120	96	98
Total alkalinity mg $CaCO_3$/l	None	-	-	-	153	-	-	152	-	-	167	-	-	167	152	157
Cl mg/l	36.34	-	-	-	2.5	-	-	3.83	-	-	4.31	-	-	4.31	3.83	3.55
SO4 mg/l	10.36	-	-	-	1.54	-	-	3.54	-	-	6.21	-	-	6.21	3.54	3.76
PO4-P mg/l	None	-	-	-	<0.005	-	-	<0.005	-	-	0.161	-	-	0.161	*0.003*	*0.055*
NH4-N mg/l	None	-	-	-	7.25	-	-	0.06	-	-	0.022	-	-	0.022	0.06	2.44
NO3-N mg/l	0.11	-	-	-	2.12	-	-	0.64	-	-	0.443	-	-	0.443	0.64	1.07
NO2-N mg/l	None	-	-	-	0.103	-	-	<0.065	-	-	<0.065	-	-	*0.033*	*0.033*	*0.056*
F mg/l	0.14	-	-	-	<0.263	-	-	<0.263	-	-	0.673	-	-	0.673	*0.132*	*0.312*
Ca mg/l	32.56	-	-	-	17.1	-	-	23.2	-	-	28.2	-	-	28.2	23.2	22.8
K mg/l	None	-	-	-	4.58	-	-	3.5	-	-	4.12	-	-	4.12	3.5	4.07
Mg mg/l	32.71	-	-	-	8.71	-	-	9.25	-	-	12	-	-	12	9.25	9.99
Na mg/l	44	-	-	-	31.8	-	-	27.2	-	-	31.9	-	-	31.9	27.2	30.3
Al mg/l	None	-	-	-	<0.002	-	-	<0.002	-	-	<0.002	-	-	*0.001*	*0.001*	*0.001*
Fe mg/l	None	-	-	-	<0.004	-	-	<0.004	-	-	<0.004	-	-	*0.002*	*0.002*	*0.002*
Mn mg/l	None	-	-	-	<0.001	-	-	0.002	-	-	<0.001	-	-	*0.001*	0.002	*0.001*
SS mg/l	None	-	-	-	178	-	-	12	-	-	13	-	-	13	12	68
Turbidity NTU	None	-	-	-	117	-	-	3.7	-	-	7.29	-	-	7.29	3.7	42.7
Si mg/l	None	-	-	-	18.4	-	-	13.4	-	-	13.6	-	-	13.6	13.4	15.1



pH	Units: pH Assessment: 8.79	EC	Units: mS/m Assessment: 75.5	Cl	Units: mg/l Assessment: 36.3	SO4	Units: mg/l Assessment: 10.4	SS	Units: mg/l Assessment: 0	Mn	Units: mg/l Assessment: 0



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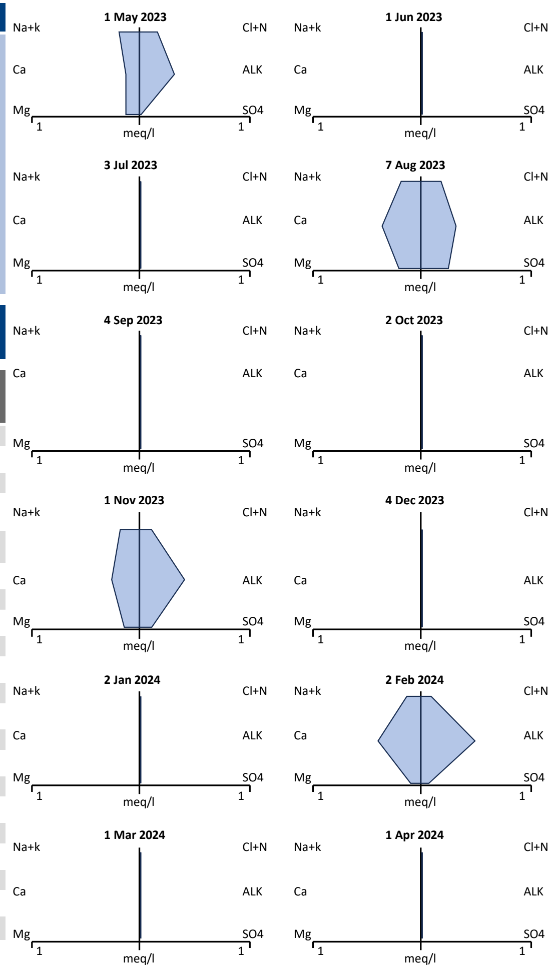
Locality	BHPW05

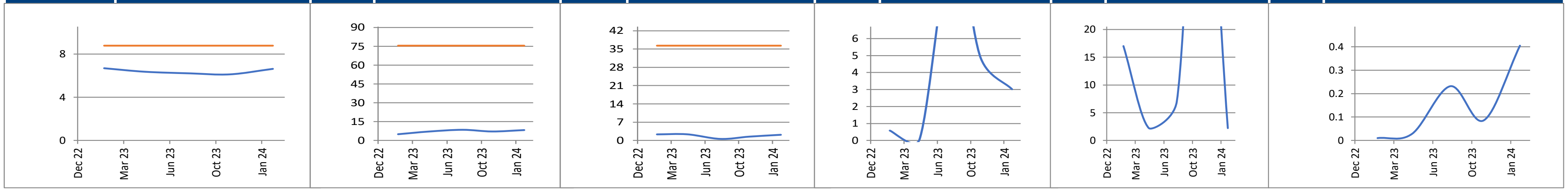
SITE REPORT

PROJECT NAME	Seriti Power Klipspruit Operations
LOCALITY NAME	BHPW05
LOCALITY DESCRIPTION	Groundwater monitoring point for KPSX Weltevreden
LOCALITY TYPE	Borehole
ASSESSMENT SET	Klipspruit Groundwater IWUL (2016)

Variable		May 2023	Jun 2023	Jul 2023	Aug 2023	Sep 2023	Oct 2023	Nov 2023	Dec 2023	Jan 2024	Feb 2024	Mar 2024	Apr 2024	Current 3-sets avg	Previous 3-sets avg	Current 12-sets avg
Status		Yes	Water-level	Water-level	Yes	Water-level	Water-level	Yes	Water-level	Water-level	Yes	Water-level	Water-level			
pH pH	8.79	6.37	-	-	6.22	-	-	6.13	-	-	6.63	-	-	6.63	6.13	6.34
EC mS/m	75.52	7.05	-	-	8.43	-	-	7.1	-	-	8.2	-	-	8.2	7.1	7.7
TDS grav mg/l	None	50	-	-	74	-	-	60	-	-	42	-	-	42	60	57
Total Hardness mg $CaCO_3$/l	None	14	-	-	29	-	-	21	-	-	25	-	-	25	21	22
Total alkalinity mg $CaCO_3$/l	None	15.4	-	-	15.7	-	-	20	-	-	24.3	-	-	24.3	20	18.9
Cl mg/l	36.34	2.37	-	-	0.595	-	-	1.47	-	-	2.18	-	-	2.18	1.47	1.65
SO4 mg/l	10.36	<0.141	-	-	11.6	-	-	4.82	-	-	3.02	-	-	3.02	4.82	*4.88*
PO4-P mg/l	None	0.115	-	-	0.244	-	-	<0.005	-	-	0.088	-	-	0.088	*0.003*	*0.112*
NH4-N mg/l	None	0.775	-	-	0.459	-	-	0.073	-	-	0.172	-	-	0.172	0.073	0.37
NO3-N mg/l	0.11	1.18	-	-	2.21	-	-	0.795	-	-	0.311	-	-	0.311	0.795	1.12
NO2-N mg/l	None	0.172	-	-	0.159	-	-	<0.065	-	-	<0.065	-	-	*0.033*	*0.033*	*0.099*
F mg/l	0.14	0.515	-	-	<0.263	-	-	<0.263	-	-	0.414	-	-	0.414	*0.132*	*0.298*
Ca mg/l	32.56	2.77	-	-	7.36	-	-	5.34	-	-	8.09	-	-	8.09	5.34	5.89
K mg/l	None	4.85	-	-	4.22	-	-	2.96	-	-	2.94	-	-	2.94	2.96	3.74
Mg mg/l	32.71	1.68	-	-	2.58	-	-	1.84	-	-	1.27	-	-	1.27	1.84	1.84
Na mg/l	44	1.77	-	-	1.93	-	-	2.57	-	-	1.47	-	-	1.47	2.57	1.94
Al mg/l	None	<0.002	-	-	<0.002	-	-	<0.002	-	-	<0.002	-	-	*0.001*	*0.001*	*0.001*
Fe mg/l	None	<0.004	-	-	<0.004	-	-	<0.004	-	-	<0.004	-	-	*0.002*	*0.002*	*0.002*
Mn mg/l	None	0.028	-	-	0.231	-	-	0.086	-	-	0.405	-	-	0.405	0.086	0.188
SS mg/l	None	<4.46	-	-	7	-	-	64	-	-	<4.46	-	-	*2.2*	64	*19*
Turbidity NTU	None	0.74	-	-	2.14	-	-	17.9	-	-	1.54	-	-	1.54	17.9	5.58
Si mg/l	None	7.28	-	-	6.72	-	-	7.37	-	-	6.61	-	-	6.61	7.37	7



pH	Units: pH / Assessment: 8.79	EC	Units: mS/m / Assessment: 75.5	Cl	Units: mg/l / Assessment: 36.3	SO4	Units: mg/l / Assessment: 10.4	SS	Units: mg/l / Assessment: 0	Mn	Units: mg/l / Assessment: 0



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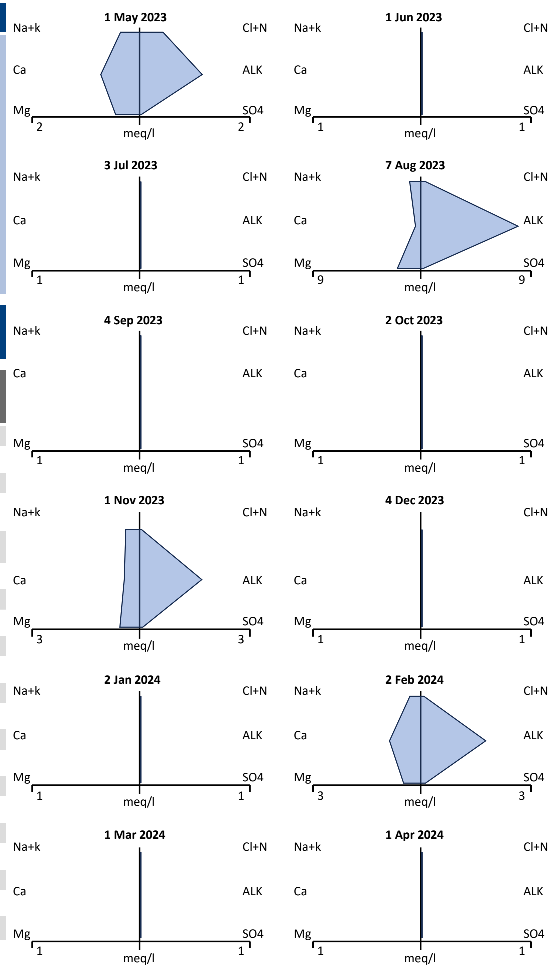
Locality	BHPW08

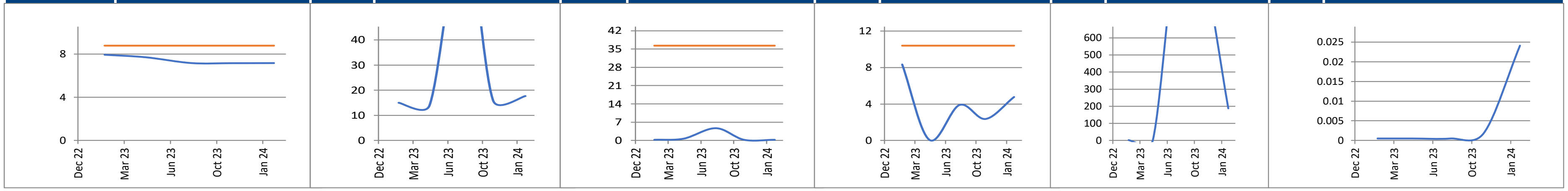
SITE REPORT

PROJECT NAME	Seriti Power Klipspruit Operations
LOCALITY NAME	BHPW08
LOCALITY DESCRIPTION	Groundwater monitoring point for KPSX Weltevreden
LOCALITY TYPE	Borehole
ASSESSMENT SET	Klipspruit Groundwater IWUL (2016)

Variable		May 2023	Jun 2023	Jul 2023	Aug 2023	Sep 2023	Oct 2023	Nov 2023	Dec 2023	Jan 2024	Feb 2024	Mar 2024	Apr 2024	Current 3-sets avg	Previous 3-sets avg	Current 12-sets avg
Status		Yes	Water-level	Blocked / Damaged	Yes	Water-level	Water-level	Yes	Water-level	Water-level	Yes	Water-level	Water-level			
pH pH	8.79	7.71	-	-	7.18	-	-	7.17	-	-	7.18	-	-	7.18	7.17	7.31
EC mS/m	75.52	14	-	-	84.9	-	-	15.9	-	-	17.7	-	-	17.7	15.9	33.1
TDS grav mg/l	None	142	-	-	466	-	-	132	-	-	172	-	-	172	132	228
Total Hardness mg $CaCO_3$/l	None	60	-	-	128	-	-	52	-	-	70	-	-	70	52	78
Total alkalinity mg $CaCO_3$/l	None	56.3	-	-	397	-	-	83.9	-	-	88.2	-	-	88.2	83.9	156
Cl mg/l	36.34	0.715	-	-	4.73	-	-	<0.557	-	-	<0.557	-	-	*0.279*	*0.279*	*1.5*
SO4 mg/l	10.36	<0.141	-	-	3.89	-	-	2.36	-	-	4.77	-	-	4.77	2.36	*2.77*
PO4-P mg/l	None	0.303	-	-	9.47	-	-	0.773	-	-	0.06	-	-	0.06	0.773	2.65
NH4-N mg/l	None	1.09	-	-	72.3	-	-	5.98	-	-	1.19	-	-	1.19	5.98	20.1
NO3-N mg/l	0.11	5.4	-	-	2.1	-	-	<0.194	-	-	0.65	-	-	0.65	*0.097*	*2.06*
NO2-N mg/l	None	0.083	-	-	0.098	-	-	<0.065	-	-	<0.065	-	-	*0.033*	*0.033*	*0.062*
F mg/l	0.14	<0.263	-	-	1.19	-	-	<0.263	-	-	0.338	-	-	0.338	*0.132*	*0.448*
Ca mg/l	32.56	14.8	-	-	10.6	-	-	9.27	-	-	17.9	-	-	17.9	9.27	13.1
K mg/l	None	1.94	-	-	8.95	-	-	1.28	-	-	0.993	-	-	0.993	1.28	3.29
Mg mg/l	32.71	5.63	-	-	24.6	-	-	7.08	-	-	6.14	-	-	6.14	7.08	10.9
Na mg/l	44	7.45	-	-	17.9	-	-	8.92	-	-	7.03	-	-	7.03	8.92	10.3
Al mg/l	None	<0.002	-	-	<0.002	-	-	<0.002	-	-	0.015	-	-	0.015	*0.001*	*0.005*
Fe mg/l	None	<0.004	-	-	0.161	-	-	0.291	-	-	<0.004	-	-	*0.002*	0.291	*0.114*
Mn mg/l	None	<0.001	-	-	<0.001	-	-	0.002	-	-	0.024	-	-	0.024	0.002	*0.007*
SS mg/l	None	<4.46	-	-	1265	-	-	1030	-	-	188	-	-	188	1030	*621*
Turbidity NTU	None	1.23	-	-	3456	-	-	1085	-	-	124	-	-	124	1085	1167
Si mg/l	None	20.5	-	-	23.5	-	-	22.4	-	-	19.3	-	-	19.3	22.4	21.4



Variable	Units	Assessment
pH	Units: pH	Assessment: 8.79
EC	Units: mS/m	Assessment: 75.5
Cl	Units: mg/l	Assessment: 36.3
SO4	Units: mg/l	Assessment: 10.4
SS	Units: mg/l	Assessment: 0
Mn	Units: mg/l	Assessment: 0



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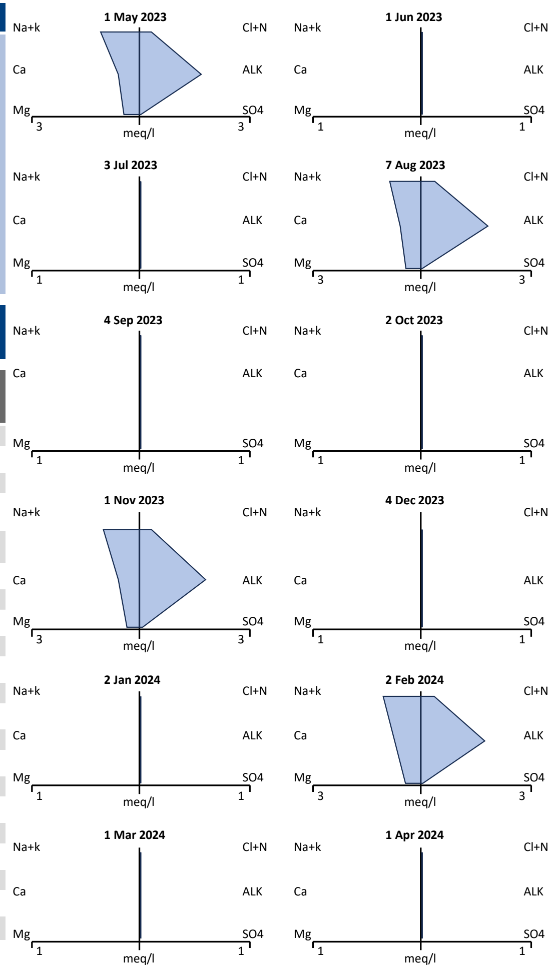
Locality	WELBH01

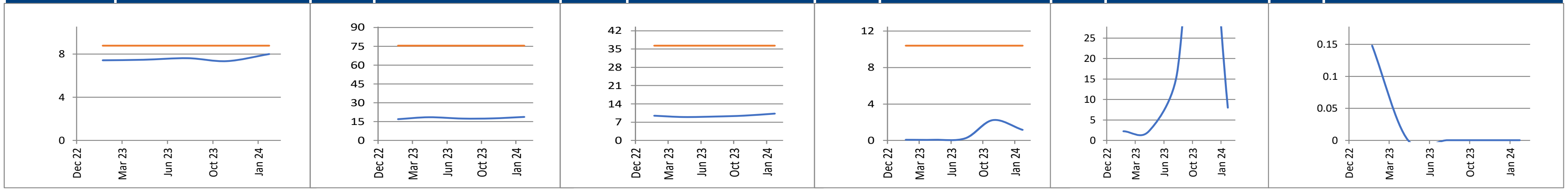
SITE REPORT

PROJECT NAME	Seriti Power Klipspruit Operations
LOCALITY NAME	WELBH01
LOCALITY DESCRIPTION	Groundwater monitoring point for KPSX Weltevreden & South
LOCALITY TYPE	Borehole
ASSESSMENT SET	Klipspruit Groundwater IWUL (2016)

Variable		May 2023	Jun 2023	Jul 2023	Aug 2023	Sep 2023	Oct 2023	Nov 2023	Dec 2023	Jan 2024	Feb 2024	Mar 2024	Apr 2024	Current 3-sets avg	Previous 3-sets avg	Current 12-sets avg
Status		Yes	Water-level	Water-level	Yes	Water-level	Water-level	Yes	Water-level	Water-level	Yes	Water-level	Water-level			
pH pH	8.79	7.48	-	-	7.62	-	-	7.35	-	-	8	-	-	8	7.35	7.61
EC mS/m	75.52	18.6	-	-	17.5	-	-	17.6	-	-	18.8	-	-	18.8	17.6	18.1
TDS grav mg/l	None	126	-	-	120	-	-	126	-	-	124	-	-	124	126	124
Total Hardness mg $CaCO_3$/l	None	54	-	-	52	-	-	51	-	-	60	-	-	60	51	54
Total alkalinity mg $CaCO_3$/l	None	83.4	-	-	90.8	-	-	89.4	-	-	86.4	-	-	86.4	89.4	87.5
Cl mg/l	36.34	9.01	-	-	9.2	-	-	9.52	-	-	10.3	-	-	10.3	9.52	9.51
SO4 mg/l	10.36	<0.141	-	-	0.24	-	-	2.23	-	-	1.16	-	-	1.16	2.23	*0.925*
PO4-P mg/l	None	<0.005	-	-	<0.005	-	-	<0.005	-	-	0.178	-	-	0.178	*0.003*	*0.046*
NH4-N mg/l	None	0.089	-	-	6.22	-	-	0.043	-	-	<0.008	-	-	*0.004*	0.043	*1.59*
NO3-N mg/l	0.11	0.541	-	-	1.28	-	-	0.33	-	-	0.641	-	-	0.641	0.33	0.698
NO2-N mg/l	None	0.122	-	-	0.097	-	-	<0.065	-	-	<0.065	-	-	*0.033*	*0.033*	*0.071*
F mg/l	0.14	0.605	-	-	0.377	-	-	<0.263	-	-	0.492	-	-	0.492	*0.132*	*0.401*
Ca mg/l	32.56	12.4	-	-	12.1	-	-	12.5	-	-	15.1	-	-	15.1	12.5	13
K mg/l	None	4.23	-	-	4.49	-	-	2.89	-	-	3.32	-	-	3.32	2.89	3.73
Mg mg/l	32.71	5.63	-	-	5.4	-	-	4.69	-	-	5.53	-	-	5.53	4.69	5.31
Na mg/l	44	22.9	-	-	17.8	-	-	22.1	-	-	22.6	-	-	22.6	22.1	21.4
Al mg/l	None	<0.002	-	-	<0.002	-	-	<0.002	-	-	<0.002	-	-	*0.001*	*0.001*	*0.001*
Fe mg/l	None	<0.004	-	-	<0.004	-	-	<0.004	-	-	<0.004	-	-	*0.002*	*0.002*	*0.002*
Mn mg/l	None	<0.001	-	-	<0.001	-	-	<0.001	-	-	<0.001	-	-	*0.001*	*0.001*	*0.001*
SS mg/l	None	<4.46	-	-	16	-	-	75	-	-	8	-	-	8	75	*25*
Turbidity NTU	None	2.38	-	-	3.65	-	-	63.5	-	-	4.97	-	-	4.97	63.5	18.6
Si mg/l	None	2.1	-	-	2.13	-	-	1.92	-	-	2.65	-	-	2.65	1.92	2.2



pH	Units: pH	EC	Units: mS/m	Cl	Units: mg/l	SO4	Units: mg/l	SS	Units: mg/l	Mn	Units: mg/l
	Assessment: 8.79		Assessment: 75.5		Assessment: 36.3		Assessment: 10.4		Assessment: 0		Assessment: 0

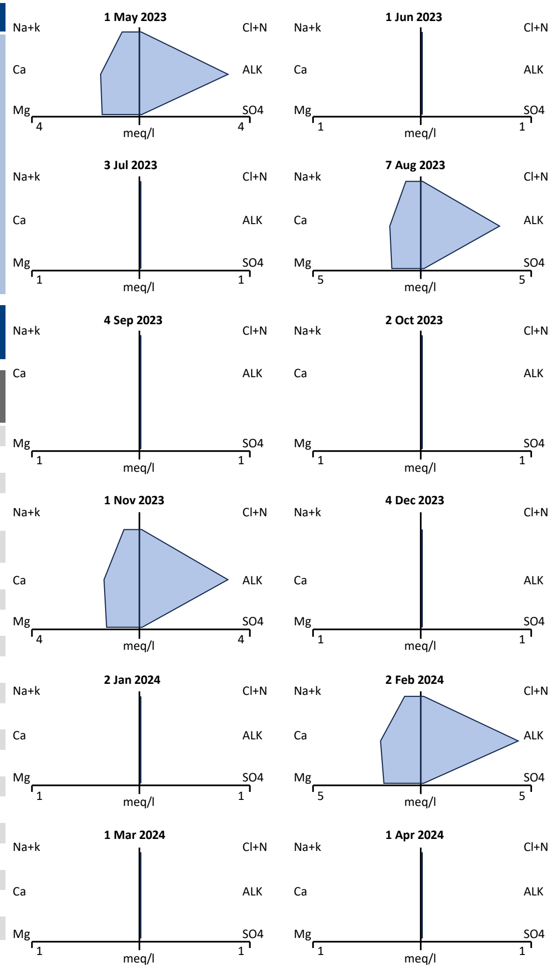


Graphs only illustrate trends

SITE REPORT

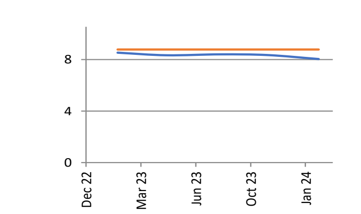
PROJECT NAME	Seriti Power Klipspruit Operations
LOCALITY NAME	WELBH08
LOCALITY DESCRIPTION	Groundwater monitoring point for KPSX Weltevreden
LOCALITY TYPE	Borehole
ASSESSMENT SET	Klipspruit Groundwater IWUL (2016)

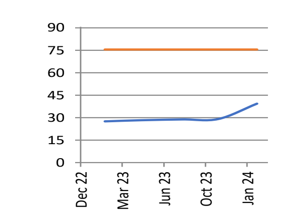
Locality	WELBH08

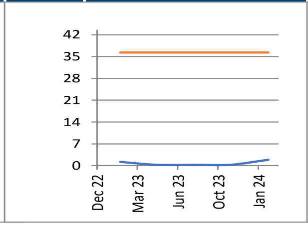


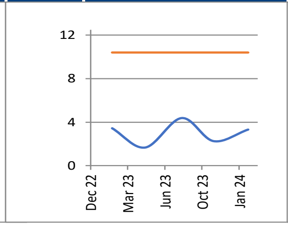
Variable		May 2023	Jun 2023	Jul 2023	Aug 2023	Sep 2023	Oct 2023	Nov 2023	Dec 2023	Jan 2024	Feb 2024	Mar 2024	Apr 2024	Current 3-sets avg	Previous 3-sets avg	Current 12-sets avg
Status		Yes	Water-level	Water-level	Yes	Water-level	Water-level	Yes	Water-level	Water-level	Yes	Water-level	Water-level			
pH pH	8.79	8.33	-	-	8.41	-	-	8.35	-	-	8.04	-	-	8.04	8.35	8.28
EC mS/m	75.52	28.3	-	-	28.8	-	-	29.1	-	-	39.4	-	-	39.4	29.1	31.4
TDS grav mg/l	None	164	-	-	204	-	-	214	-	-	244	-	-	244	214	207
Total Hardness mg $CaCO_3$/l	None	145	-	-	143	-	-	131	-	-	183	-	-	183	131	151
Total alkalinity mg $CaCO_3$/l	None	160	-	-	178	-	-	160	-	-	220	-	-	220	160	180
Cl mg/l	36.34	<0.557	-	-	<0.557	-	-	<0.557	-	-	1.92	-	-	1.92	*0.279*	*0.689*
SO4 mg/l	10.36	1.67	-	-	4.38	-	-	2.26	-	-	3.32	-	-	3.32	2.26	2.91
PO4-P mg/l	None	<0.005	-	-	<0.005	-	-	<0.005	-	-	0.21	-	-	0.21	*0.003*	*0.054*
NH4-N mg/l	None	0.132	-	-	0.199	-	-	0.148	-	-	8.12	-	-	8.12	0.148	2.15
NO3-N mg/l	0.11	<0.194	-	-	0.244	-	-	0.312	-	-	0.274	-	-	0.274	0.312	*0.232*
NO2-N mg/l	None	0.153	-	-	0.122	-	-	<0.065	-	-	<0.065	-	-	*0.033*	*0.033*	*0.085*
F mg/l	0.14	<0.263	-	-	<0.263	-	-	<0.263	-	-	<0.263	-	-	*0.132*	*0.132*	*0.132*
Ca mg/l	32.56	29.6	-	-	29.7	-	-	27.2	-	-	38.1	-	-	38.1	27.2	31.2
K mg/l	None	2.67	-	-	2.57	-	-	2.17	-	-	3.1	-	-	3.1	2.17	2.63
Mg mg/l	32.71	17.2	-	-	16.9	-	-	15.3	-	-	21.2	-	-	21.2	15.3	17.7
Na mg/l	44	14.2	-	-	15.6	-	-	13.1	-	-	16.5	-	-	16.5	13.1	14.9
Al mg/l	None	<0.002	-	-	<0.002	-	-	<0.002	-	-	<0.002	-	-	*0.001*	*0.001*	*0.001*
Fe mg/l	None	<0.004	-	-	<0.004	-	-	<0.004	-	-	0.056	-	-	0.056	*0.002*	*0.016*
Mn mg/l	None	0.087	-	-	<0.001	-	-	0.025	-	-	0.166	-	-	0.166	0.025	*0.07*
SS mg/l	None	<4.46	-	-	9	-	-	5	-	-	83	-	-	83	5	*25*
Turbidity NTU	None	7.1	-	-	8.63	-	-	1.08	-	-	57.9	-	-	57.9	1.08	18.7
Si mg/l	None	7.03	-	-	8.55	-	-	8.34	-	-	8.39	-	-	8.39	8.34	8.08

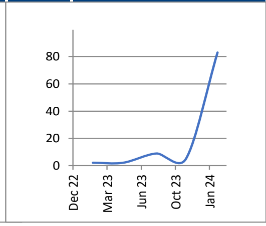
pH	Units: pH Assessment: 8.79	EC	Units: mS/m Assessment: 75.5	Cl	Units: mg/l Assessment: 36.3	SO4	Units: mg/l Assessment: 10.4	SS	Units: mg/l Assessment: 0	Mn	Units: mg/l Assessment: 0

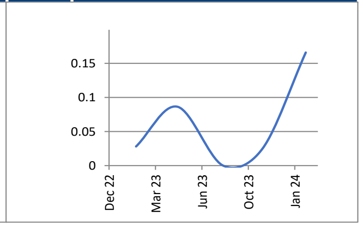












Graphs only illustrate trends

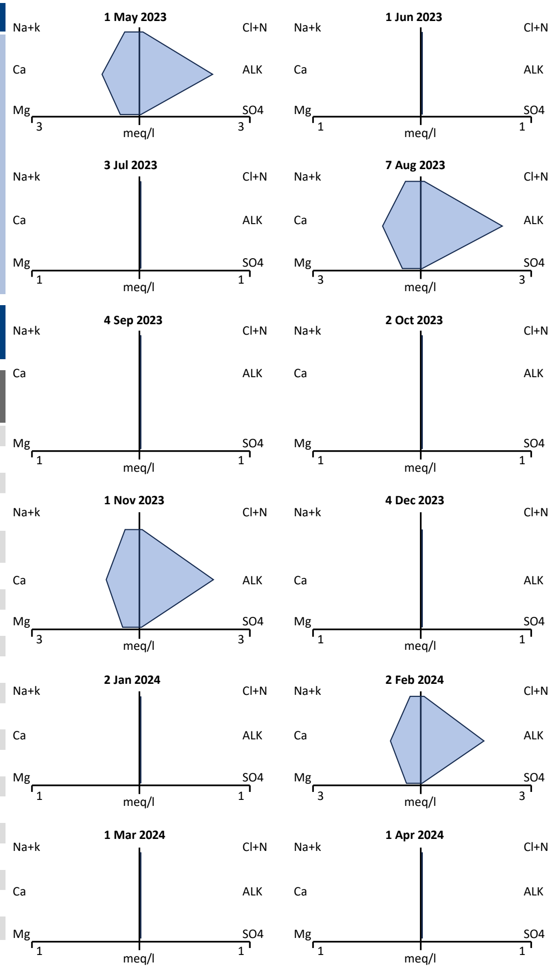
aquatico Scientific (Pty). Ltd.

Locality	WELBH16

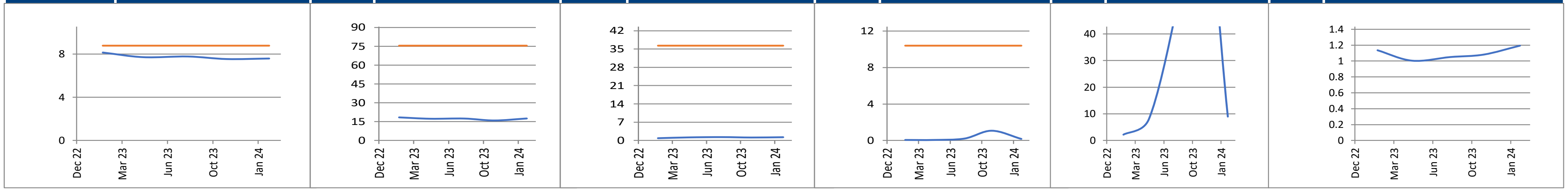
SITE REPORT

PROJECT NAME	Seriti Power Klipspruit Operations
LOCALITY NAME	WELBH16
LOCALITY DESCRIPTION	Groundwater monitoring point for KPSX Weltevreden
LOCALITY TYPE	Borehole
ASSESSMENT SET	Klipspruit Groundwater IWUL (2016)

Variable		May 2023	Jun 2023	Jul 2023	Aug 2023	Sep 2023	Oct 2023	Nov 2023	Dec 2023	Jan 2024	Feb 2024	Mar 2024	Apr 2024	Current 3-sets avg	Previous 3-sets avg	Current 12-sets avg
Status		Yes	Water-level	Water-level	Yes	Water-level	Water-level	Yes	Water-level	Water-level	Yes	Water-level	Water-level			
pH pH	8.79	7.72	-	-	7.78	-	-	7.54	-	-	7.59	-	-	7.59	7.54	7.66
EC mS/m	75.52	17.3	-	-	17.5	-	-	15.9	-	-	17.5	-	-	17.5	15.9	17.1
TDS grav mg/l	None	116	-	-	96	-	-	88	-	-	138	-	-	138	88	110
Total Hardness mg $CaCO_3$/l	None	82	-	-	81	-	-	73	-	-	65	-	-	65	73	75
Total alkalinity mg $CaCO_3$/l	None	99	-	-	111	-	-	100	-	-	85.5	-	-	85.5	100	98.9
Cl mg/l	36.34	1.2	-	-	1.33	-	-	1.15	-	-	1.28	-	-	1.28	1.15	1.24
SO4 mg/l	10.36	<0.141	-	-	0.223	-	-	1.08	-	-	0.187	-	-	0.187	1.08	*0.39*
PO4-P mg/l	None	<0.005	-	-	<0.005	-	-	<0.005	-	-	0.048	-	-	0.048	*0.003*	*0.014*
NH4-N mg/l	None	1.19	-	-	0.847	-	-	0.316	-	-	1.05	-	-	1.05	0.316	0.851
NO3-N mg/l	0.11	0.338	-	-	0.341	-	-	<0.194	-	-	0.308	-	-	0.308	*0.097*	*0.271*
NO2-N mg/l	None	0.105	-	-	0.11	-	-	<0.065	-	-	<0.065	-	-	*0.033*	*0.033*	*0.07*
F mg/l	0.14	<0.263	-	-	0.341	-	-	<0.263	-	-	<0.263	-	-	*0.132*	*0.132*	*0.184*
Ca mg/l	32.56	21.4	-	-	21.8	-	-	19.1	-	-	17.4	-	-	17.4	19.1	19.9
K mg/l	None	2.1	-	-	1.53	-	-	1.23	-	-	1.01	-	-	1.01	1.23	1.47
Mg mg/l	32.71	6.89	-	-	6.57	-	-	6.05	-	-	5.2	-	-	5.2	6.05	6.18
Na mg/l	44	8.98	-	-	9.57	-	-	9.17	-	-	6.92	-	-	6.92	9.17	8.66
Al mg/l	None	<0.002	-	-	0.067	-	-	<0.002	-	-	<0.002	-	-	*0.001*	*0.001*	*0.018*
Fe mg/l	None	<0.004	-	-	<0.004	-	-	<0.004	-	-	<0.004	-	-	*0.002*	*0.002*	*0.002*
Mn mg/l	None	1.01	-	-	1.05	-	-	1.08	-	-	1.19	-	-	1.19	1.08	1.08
SS mg/l	None	8	-	-	50	-	-	104	-	-	9	-	-	9	104	43
Turbidity NTU	None	21.6	-	-	112	-	-	109	-	-	15	-	-	15	109	64.4
Si mg/l	None	3.67	-	-	4.01	-	-	3.45	-	-	3.42	-	-	3.42	3.45	3.64



pH	Units: pH	EC	Units: mS/m	Cl	Units: mg/l	SO4	Units: mg/l	SS	Units: mg/l	Mn	Units: mg/l
	Assessment: 8.79		Assessment: 75.5		Assessment: 36.3		Assessment: 10.4		Assessment: 0		Assessment: 0

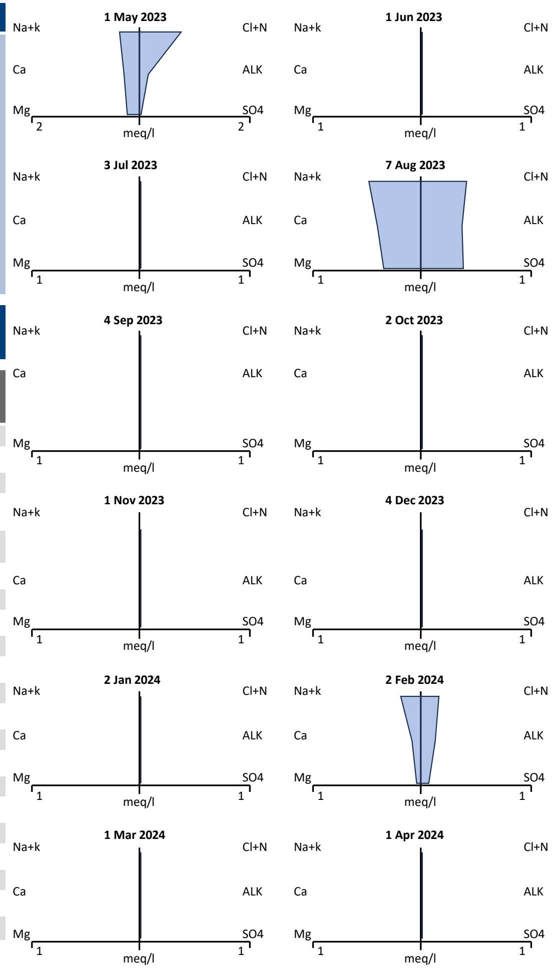


Graphs only illustrate trends

SITE REPORT

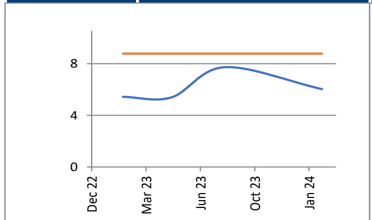
PROJECT NAME	Seriti Power Klipspruit Operations
LOCALITY NAME	WELBH24
LOCALITY DESCRIPTION	Groundwater monitoring point for KPSX Weltevreden
LOCALITY TYPE	Borehole
ASSESSMENT SET	Klipspruit Groundwater IWUL (2016)

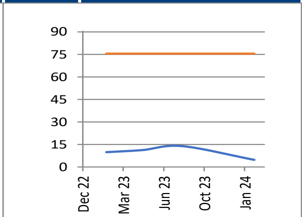
Locality	WELBH24

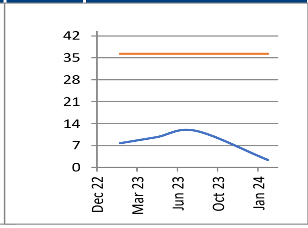


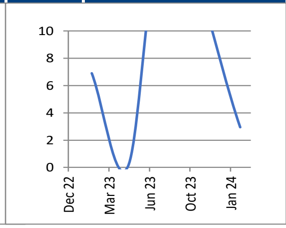
Variable		May 2023	Jun 2023	Jul 2023	Aug 2023	Sep 2023	Oct 2023	Nov 2023	Dec 2023	Jan 2024	Feb 2024	Mar 2024	Apr 2024	Current 3-sets avg	Previous 3-sets avg	Current 12-sets avg
Status		Yes	Water-level	Water-level	Yes	Water-level	Water-level	Water-level	Water-level	Water-level	Yes	Water-level	Water-level			
pH pH	8.79	5.39	-	-	7.73	-	-	-	-	-	6.03	-	-	6.03		6.38
EC mS/m	75.52	11.3	-	-	14	-	-	-	-	-	4.9	-	-	4.9		10.1
TDS grav mg/l	None	78	-	-	84	-	-	-	-	-	34	-	-	34		65
Total Hardness mg $CaCO_3$/l	None	28	-	-	38	-	-	-	-	-	7	-	-	7		24
Total alkalinity mg $CaCO_3$/l	None	6.74	-	-	18.5	-	-	-	-	-	6.04	-	-	6.04		10.4
Cl mg/l	36.34	9.61	-	-	11.7	-	-	-	-	-	2.4	-	-	2.4		7.9
SO4 mg/l	10.36	<0.141	-	-	18.3	-	-	-	-	-	2.95	-	-	2.95		*7.11*
PO4-P mg/l	None	<0.005	-	-	<0.005	-	-	-	-	-	<0.005	-	-	*0.003*		*0.003*
NH4-N mg/l	None	0.034	-	-	0.154	-	-	-	-	-	0.025	-	-	0.025		0.071
NO3-N mg/l	0.11	6.54	-	-	1.14	-	-	-	-	-	1.21	-	-	1.21		2.96
NO2-N mg/l	None	<0.065	-	-	0.089	-	-	-	-	-	<0.065	-	-	*0.033*		*0.051*
F mg/l	0.14	<0.263	-	-	<0.263	-	-	-	-	-	0.785	-	-	0.785		*0.349*
Ca mg/l	32.56	6.21	-	-	8.23	-	-	-	-	-	1.83	-	-	1.83		5.42
K mg/l	None	3.92	-	-	3.52	-	-	-	-	-	1.9	-	-	1.9		3.11
Mg mg/l	32.71	3.04	-	-	4.28	-	-	-	-	-	0.596	-	-	0.596		2.64
Na mg/l	44	6.72	-	-	9.18	-	-	-	-	-	3.35	-	-	3.35		6.42
Al mg/l	None	<0.002	-	-	<0.002	-	-	-	-	-	0.003	-	-	0.003		*0.002*
Fe mg/l	None	<0.004	-	-	<0.004	-	-	-	-	-	<0.004	-	-	*0.002*		*0.002*
Mn mg/l	None	0.234	-	-	<0.001	-	-	-	-	-	0.067	-	-	0.067		*0.101*
SS mg/l	None	9	-	-	22	-	-	-	-	-	7	-	-	7		13
Turbidity NTU	None	6.57	-	-	7.35	-	-	-	-	-	6.07	-	-	6.07		6.66
Si mg/l	None	5.24	-	-	0.078	-	-	-	-	-	6.17	-	-	6.17		3.83

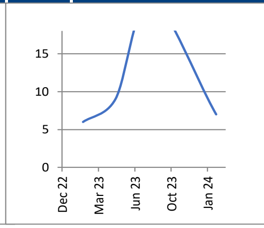
pH	Units: pH Assessment: 8.79	EC	Units: mS/m Assessment: 75.5	Cl	Units: mg/l Assessment: 36.3	SO4	Units: mg/l Assessment: 10.4	SS	Units: mg/l Assessment: 0	Mn	Units: mg/l Assessment: 0

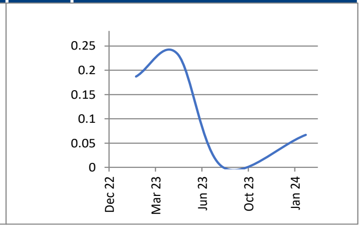












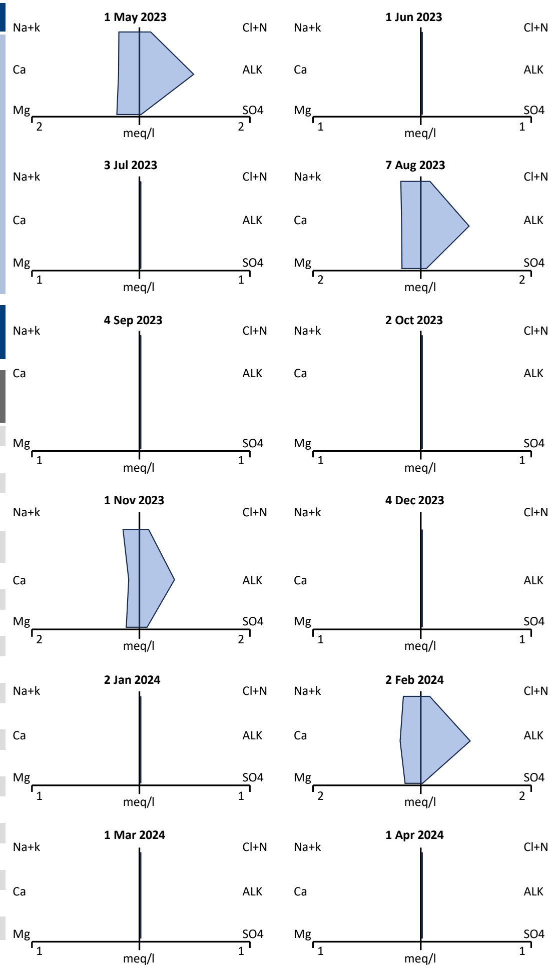
Graphs only illustrate trends

Locality	WELBH25

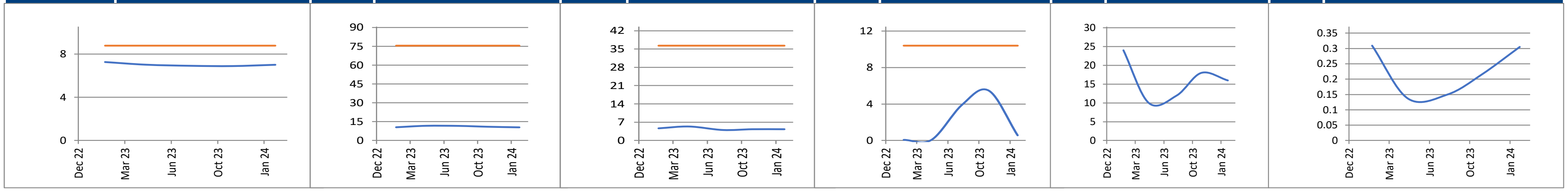
SITE REPORT

PROJECT NAME	Seriti Power Klipspruit Operations
LOCALITY NAME	WELBH25
LOCALITY DESCRIPTION	New monitoring borehole
LOCALITY TYPE	Borehole
ASSESSMENT SET	Klipspruit Groundwater IWUL (2016)

Variable		May 2023	Jun 2023	Jul 2023	Aug 2023	Sep 2023	Oct 2023	Nov 2023	Dec 2023	Jan 2024	Feb 2024	Mar 2024	Apr 2024	Current 3-sets avg	Previous 3-sets avg	Current 12-sets avg
Status		Yes	Water-level	Water-level	Yes	Water-level	Water-level	Yes	Water-level	Water-level	Yes	Water-level	Water-level			
pH pH	8.79	7.02	-	-	6.92	-	-	6.89	-	-	7.01	-	-	7.01	6.89	6.96
EC mS/m	75.52	11.7	-	-	11.6	-	-	10.9	-	-	10.5	-	-	10.5	10.9	11.2
TDS grav mg/l	None	96	-	-	88	-	-	76	-	-	118	-	-	118	76	95
Total Hardness mg $CaCO_3$/l	None	43	-	-	37	-	-	24	-	-	36	-	-	36	24	35
Total alkalinity mg $CaCO_3$/l	None	48.4	-	-	43.2	-	-	30.8	-	-	44.3	-	-	44.3	30.8	41.7
Cl mg/l	36.34	5.38	-	-	4	-	-	4.3	-	-	4.3	-	-	4.3	4.3	4.5
SO4 mg/l	10.36	<0.141	-	-	3.9	-	-	5.46	-	-	0.568	-	-	0.568	5.46	*2.5*
PO4-P mg/l	None	<0.005	-	-	<0.005	-	-	<0.005	-	-	0.113	-	-	0.113	*0.003*	*0.03*
NH4-N mg/l	None	0.305	-	-	0.244	-	-	0.023	-	-	0.041	-	-	0.041	0.023	0.153
NO3-N mg/l	0.11	0.364	-	-	0.479	-	-	0.303	-	-	0.296	-	-	0.296	0.303	0.361
NO2-N mg/l	None	0.092	-	-	0.112	-	-	<0.065	-	-	<0.065	-	-	*0.033*	*0.033*	*0.067*
F mg/l	0.14	0.44	-	-	0.289	-	-	0.305	-	-	<0.263	-	-	*0.132*	0.305	*0.291*
Ca mg/l	32.56	8.25	-	-	7.43	-	-	4.45	-	-	8.02	-	-	8.02	4.45	7.04
K mg/l	None	5.59	-	-	4.61	-	-	3.4	-	-	3.28	-	-	3.28	3.4	4.22
Mg mg/l	32.71	5.38	-	-	4.44	-	-	3.25	-	-	3.76	-	-	3.76	3.25	4.21
Na mg/l	44	6.03	-	-	6.18	-	-	5.51	-	-	5.89	-	-	5.89	5.51	5.9
Al mg/l	None	<0.002	-	-	0.157	-	-	<0.002	-	-	<0.002	-	-	*0.001*	*0.001*	*0.04*
Fe mg/l	None	<0.004	-	-	<0.004	-	-	<0.004	-	-	<0.004	-	-	*0.002*	*0.002*	*0.002*
Mn mg/l	None	0.136	-	-	0.15	-	-	0.216	-	-	0.305	-	-	0.305	0.216	0.202
SS mg/l	None	10	-	-	12	-	-	18	-	-	16	-	-	16	18	14
Turbidity NTU	None	120	-	-	64.2	-	-	15.8	-	-	113	-	-	113	15.8	78.3
Si mg/l	None	6.53	-	-	6.22	-	-	4.77	-	-	6.24	-	-	6.24	4.77	5.94



pH	Units: pH / Assessment: 8.79	EC	Units: mS/m / Assessment: 75.5	Cl	Units: mg/l / Assessment: 36.3	SO4	Units: mg/l / Assessment: 10.4	SS	Units: mg/l / Assessment: 0	Mn	Units: mg/l / Assessment: 0



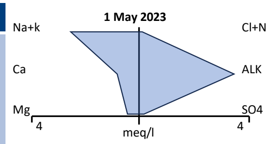
Graphs only illustrate trends

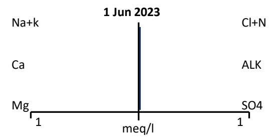
Locality	WELBH26

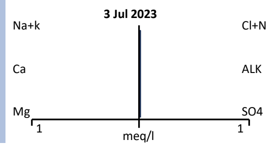
SITE REPORT

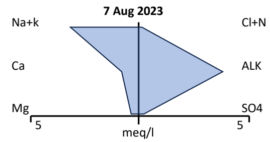
PROJECT NAME	Seriti Power Klipspruit Operations
LOCALITY NAME	WELBH26
LOCALITY DESCRIPTION	New monitoring borehole
LOCALITY TYPE	Borehole
ASSESSMENT SET	Klipspruit Groundwater IWUL (2016)

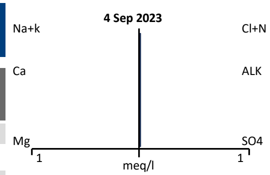
Variable		May 2023	Jun 2023	Jul 2023	Aug 2023	Sep 2023	Oct 2023	Nov 2023	Dec 2023	Jan 2024	Feb 2024	Mar 2024	Apr 2024	Current 3-sets avg	Previous 3-sets avg	Current 12-sets avg
Status		Yes	Water-level	Water-level	Yes	Water-level	Water-level	Yes	Water-level	Water-level	Yes	Water-level	Water-level			
pH pH	8.79	8.3	-	-	8.3	-	-	7.84	-	-	8.63	-	-	8.63	7.84	8.27
EC mS/m	75.52	33.6	-	-	33.2	-	-	34.8	-	-	33.1	-	-	33.1	34.8	33.7
TDS grav mg/l	None	206	-	-	232	-	-	228	-	-	194	-	-	194	228	215
Total Hardness mg $CaCO_3$/l	None	66	-	-	62	-	-	50	-	-	52	-	-	52	50	58
Total alkalinity mg $CaCO_3$/l	None	172	-	-	190	-	-	180	-	-	183	-	-	183	180	181
Cl mg/l	36.34	1.64	-	-	2.24	-	-	1.72	-	-	3.55	-	-	3.55	1.72	2.29
SO4 mg/l	10.36	6.34	-	-	8.7	-	-	7.92	-	-	7.4	-	-	7.4	7.92	7.59
PO4-P mg/l	None	<0.005	-	-	0.023	-	-	<0.005	-	-	0.086	-	-	0.086	*0.003*	*0.029*
NH4-N mg/l	None	<0.008	-	-	0.077	-	-	0.032	-	-	0.067	-	-	0.067	0.032	*0.045*
NO3-N mg/l	0.11	0.308	-	-	0.391	-	-	0.398	-	-	0.446	-	-	0.446	0.398	0.386
NO2-N mg/l	None	0.19	-	-	0.117	-	-	<0.065	-	-	<0.065	-	-	*0.033*	*0.033*	*0.093*
F mg/l	0.14	0.291	-	-	0.696	-	-	0.745	-	-	0.998	-	-	0.998	0.745	0.683
Ca mg/l	32.56	17.1	-	-	16.7	-	-	13.3	-	-	13.7	-	-	13.7	13.3	15.2
K mg/l	None	3.42	-	-	3.43	-	-	2.82	-	-	2.68	-	-	2.68	2.82	3.09
Mg mg/l	32.71	5.77	-	-	4.86	-	-	4.06	-	-	4.39	-	-	4.39	4.06	4.77
Na mg/l	44	56.9	-	-	71.2	-	-	60.7	-	-	65.7	-	-	65.7	60.7	63.6
Al mg/l	None	0.039	-	-	0.256	-	-	0.031	-	-	0.022	-	-	0.022	0.031	0.087
Fe mg/l	None	<0.004	-	-	<0.004	-	-	<0.004	-	-	<0.004	-	-	*0.002*	*0.002*	*0.002*
Mn mg/l	None	<0.001	-	-	<0.001	-	-	<0.001	-	-	<0.001	-	-	*0.001*	*0.001*	*0.001*
SS mg/l	None	<4.46	-	-	26	-	-	8	-	-	13	-	-	13	8	*12*
Turbidity NTU	None	0.632	-	-	8.17	-	-	2.01	-	-	1.87	-	-	1.87	2.01	3.17
Si mg/l	None	7.01	-	-	7.13	-	-	7.25	-	-	7.02	-	-	7.02	7.25	7.1

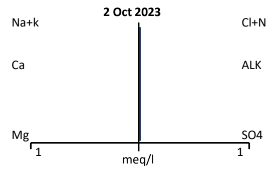


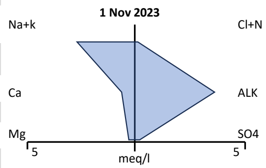


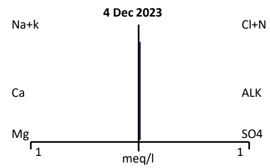


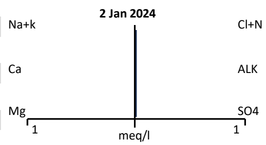


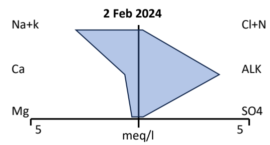


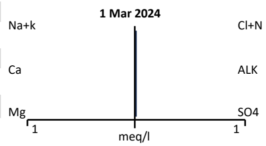


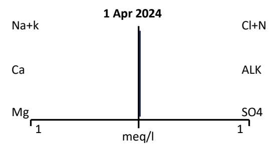




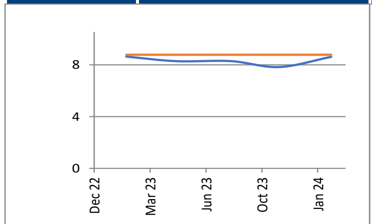


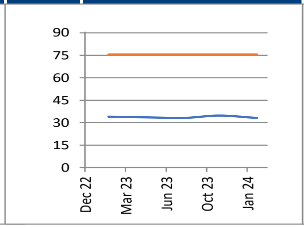


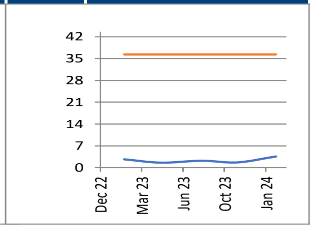


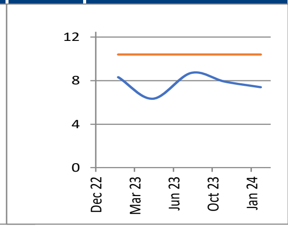


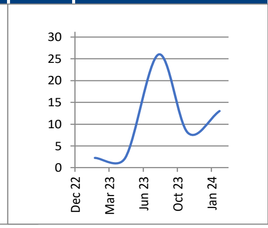
pH	Units: pH Assessment: 8.79	EC	Units: mS/m Assessment: 75.5	Cl	Units: mg/l Assessment: 36.3	SO4	Units: mg/l Assessment: 10.4	SS	Units: mg/l Assessment: 0	Mn	Units: mg/l Assessment: 0

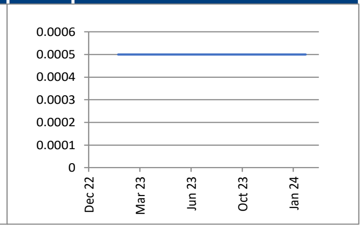










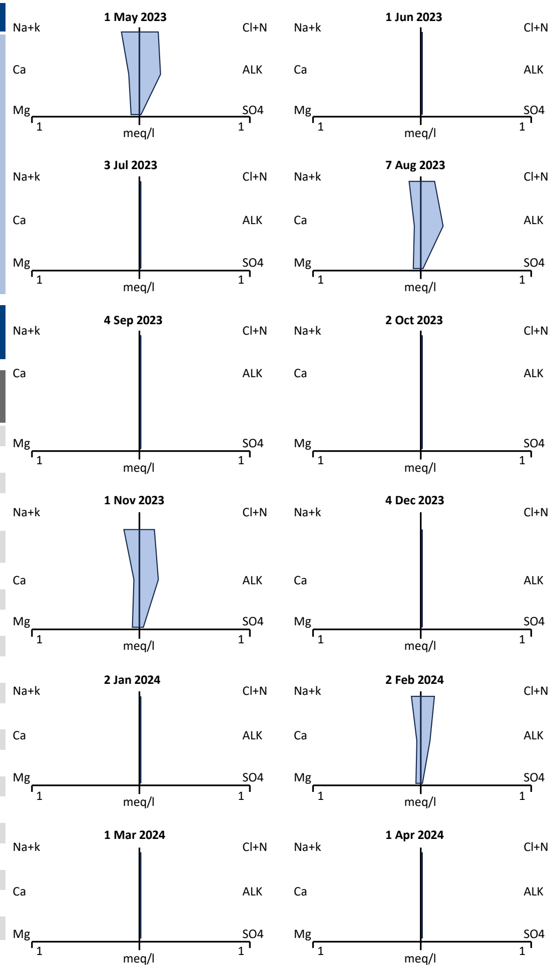


Graphs only illustrate trends

SITE REPORT

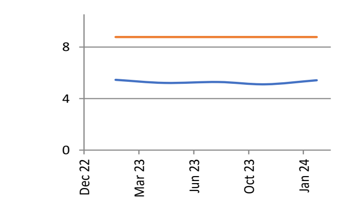
PROJECT NAME	Seriti Power Klipspruit Operations
LOCALITY NAME	WELWEL03
LOCALITY DESCRIPTION	Groundwater monitoring point for KPSX Weltevreden
LOCALITY TYPE	Borehole
ASSESSMENT SET	Klipspruit Groundwater IWUL (2016)

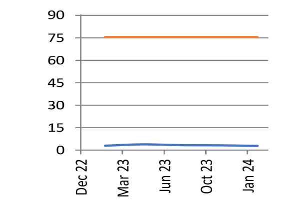
Locality	WELWEL03

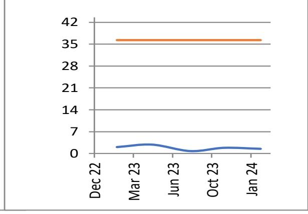


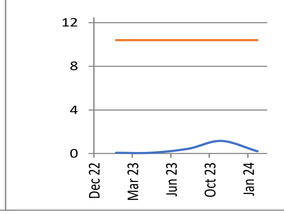
Variable		May 2023	Jun 2023	Jul 2023	Aug 2023	Sep 2023	Oct 2023	Nov 2023	Dec 2023	Jan 2024	Feb 2024	Mar 2024	Apr 2024	Current 3-sets avg	Previous 3-sets avg	Current 12-sets avg
Status		Yes	No access	Locked	Yes	Locked	Locked	Yes	Locked	Pump installed	Yes	Pump installed	Pump installed			
pH pH	8.79	5.22	-	-	5.29	-	-	5.11	-	-	5.43	-	-	5.43	5.11	5.26
EC mS/m	75.52	3.9	-	-	3.3	-	-	3.2	-	-	2.8	-	-	2.8	3.2	3.3
TDS grav mg/l	None	30	-	-	28	-	-	28	-	-	24	-	-	24	28	28
Total Hardness mg $CaCO_3$/l	None	10	-	-	8	-	-	7	-	-	5	-	-	5	7	8
Total alkalinity mg $CaCO_3$/l	None	9.07	-	-	9.7	-	-	8.09	-	-	3.64	-	-	3.64	8.09	7.63
Cl mg/l	36.34	2.87	-	-	0.835	-	-	1.87	-	-	1.55	-	-	1.55	1.87	1.78
SO4 mg/l	10.36	<0.141	-	-	0.44	-	-	1.15	-	-	0.212	-	-	0.212	1.15	*0.468*
PO4-P mg/l	None	0.135	-	-	<0.005	-	-	<0.005	-	-	0.051	-	-	0.051	*0.003*	*0.048*
NH4-N mg/l	None	0.05	-	-	0.366	-	-	0.018	-	-	0.022	-	-	0.022	0.018	0.114
NO3-N mg/l	0.11	1.11	-	-	1.29	-	-	1.02	-	-	0.968	-	-	0.968	1.02	1.1
NO2-N mg/l	None	<0.065	-	-	0.08	-	-	<0.065	-	-	<0.065	-	-	*0.033*	*0.033*	*0.044*
F mg/l	0.14	<0.263	-	-	<0.263	-	-	<0.263	-	-	<0.263	-	-	*0.132*	*0.132*	*0.132*
Ca mg/l	32.56	2.24	-	-	1.41	-	-	1.26	-	-	0.93	-	-	0.93	1.26	1.46
K mg/l	None	2.7	-	-	1.6	-	-	1.33	-	-	0.935	-	-	0.935	1.33	1.64
Mg mg/l	32.71	1.1	-	-	0.976	-	-	0.933	-	-	0.661	-	-	0.661	0.933	0.918
Na mg/l	44	2.54	-	-	1.79	-	-	2.78	-	-	1.65	-	-	1.65	2.78	2.19
Al mg/l	None	<0.002	-	-	<0.002	-	-	<0.002	-	-	0.007	-	-	0.007	*0.001*	*0.003*
Fe mg/l	None	<0.004	-	-	<0.004	-	-	<0.004	-	-	<0.004	-	-	*0.002*	*0.002*	*0.002*
Mn mg/l	None	<0.001	-	-	0.019	-	-	0.003	-	-	0.022	-	-	0.022	0.003	*0.011*
SS mg/l	None	<4.46	-	-	<4.46	-	-	<4.46	-	-	9	-	-	9	*2.2*	*3.9*
Turbidity NTU	None	0.65	-	-	0.429	-	-	0.681	-	-	3.08	-	-	3.08	0.681	1.21
Si mg/l	None	4.95	-	-	4.1	-	-	4.22	-	-	4.5	-	-	4.5	4.22	4.44

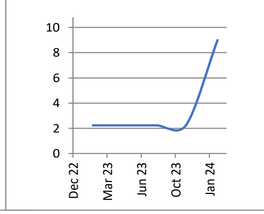
pH	Units: pH Assessment: 8.79	EC	Units: mS/m Assessment: 75.5	Cl	Units: mg/l Assessment: 36.3	SO4	Units: mg/l Assessment: 10.4	SS	Units: mg/l Assessment: 0	Mn	Units: mg/l Assessment: 0

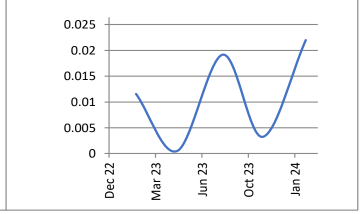












Graphs only illustrate trends

Charles Rikhotso

Senior Hydrogeologist
SACNASP Reg No. 400068/16

Address: 47 Goldenfield, 431 Furrow Road, Equestria, Pretoria, 0184
Email: info@niara.co.za
Contact No: +27 35 573 115

EDUCATION AND QUALIFICATIONS

- Master of Science (MSc): Hydrogeology, Wits University, 2023
- Master's In Environmental Management, University of Free State, 2016
- BSc Honours in Geohydrology, University of the Free State, 2012
- Baccalaureus Technologiae (B-TECH) in Geology, Tshwane University of Technology, 2011
- National Diploma in Geology, Tshwane University of Technology, 2010

ADDITIONAL TRAINING COURSES

- Groundwater management for mines, Global prospectus
- Mining and the Environment, North West University
- Vadose zone hydrology in geotechnical engineering and environmental science, University of Pretoria
- Customized ArcGIS desktop, Esri South Africa

AFFILIATIONS

- SACNASP Pr. Sci.Nat

BIOGRAPHY

I am an environmental and hydrogeological specialist currently working at NRN Consulting. I have over a decade of progressive experience in groundwater resource management, hydrogeological investigations, and environmental compliance within both the public and private sectors. I hold two Master's degrees, MSc in Hydrogeology (Wits University) and Masters in Environmental Management (University of the Free State), complemented by a solid foundation in geology and geohydrology.

My professional experience spans both public and private sectors, including NRN Consulting, Sibanye Stillwater, the Department of Water and Sanitation, and the Council for Geoscience. I have gained extensive expertise in groundwater modelling (MODFLOW, FEFLOW), hydrogeological assessment, regulatory compliance, water conservation and demand management (WCWDM), Geochemical assessment (ABA, NAG), and review of Environmental Impact Assessments (EIAs), Scoping Reports, Environmental Management Plans (EMPs), and Environmental Risk Assessments.

Over the years, I've gained hands-on experience across multiple sectors, including mining, agriculture, chemical, and municipal industries, allowing me to develop a well-rounded understanding of natural resource and water systems. I take pride in offering practical, evidence-based solutions to water and environmental challenges, and I remain committed to contributing meaningfully to sustainability efforts across the industry.

YEARS OF EXPERIENCE

- 14 years

KEY COMPETENCIES

- **Groundwater modelling –** Possess extensive experience in groundwater modelling.
- **Water Quality Monitoring** – Skilled in sampling and analysis for domestic, irrigation, and pollution assessments.
- **Hydrogeological Investigations** – Proficient in aquifer characterisation and groundwater exploration.
- **Isotope and Hydrochemical Analysis** – Experienced in stable and radioisotope techniques for groundwater studies.
- **Environmental Impact Assessment (EIA)** – Competent in reviewing and contributing to EIAs, Scoping Reports, and EMPs.
- **Mine Water Management** – Involved in mine hydrogeology, acid-base accounting, and impact hotspot identification.
- **Regulatory Compliance Reporting** – Prepares detailed water use reports including abstraction, discharge, and efficiency.
- **Proposal Development** – Capable of drafting technical proposals for environmental and water resource projects.
- **Stakeholder Engagement** – Leads WCWDM awareness and educational sessions at multiple platforms.
- **Data Interpretation** – Strong in analysing and interpreting hydrochemical and environmental monitoring data.

EMPLOYMENT HISTORY

September 2023-Present: Hydrogeological and Environmental Specialist

February 2023– August 2023: Superintendent Environmental-Water Engineer, Sibanye Stillwater

January 2017– January 2023: Scientist Production (Hydrogeologist), Department of Water and Sanitation

January 2013– December 2016: Junior Geohydrologist, Council for Geoscience

March 2011 – December 2012: Internship: Geohydrologist, Council for Geoscience

EXPERIENCE HIGHLIGHTS

The below highlight key recent and relative project experience:

- Water sampling for domestic and irrigation assessment, pollution assessment and pollution trend identification
- Water sampling for stable and radioisotope analysis
- Assessment of groundwater origin, recharge processes and age dating
- Isotope and hydrochemical analysis and interpretation
- Involvement and execution of natural resources related projects (Mine water projects, local hydrogeology of the mine, acid base accounting assessment, impacts assessment, impact hot spots)
- Hydrogeological investigation which involves aquifer characterisation and groundwater exploration
- Proposal development
- Surface and groundwater monitoring within mining, agricultural, chemical, sewage and other industries
- Review environmental impact assessment (EIA), basic and scoping assessment report, environmental management plan (EMP) and environmental risk assessment.
- Provide input to environmental management processes (review; environmental impact assessment (EIA), basic and scoping assessment report, environmental management plan (EMP) and environmental risk assessment)
- Develop monthly, quarterly and annual water use reports. (Including water withdrawal, discharge and use and associated cost)
- Driving (compiling and presenting) awareness and information sessions to report on and promote WCWDM at various platforms
- Define and report on water use context (Water abstracted, used, discharged, re-cycled, water use intensity and efficiency)

Please consult the attached appendix for a comprehensive list detailing the project experiences undertaken.

- **Sustainable Resource Use Planning** – Provides strategic input on water conservation and environmental sustainability.

COUNTRIES OF WORK EXPERIENCE

- South Africa

LANGUAGES

English (excellent),
Tsonga (excellent)

APPENDIX A: PROJECT EXPERIENCE

Duration	Assignment name/ brief description of main deliverables/outputs	Name of client and country of assignment	Role on the assignment
2025 - Ongoing	Hydrogeological impact assessment, including groundwater modelling for Mbali Colliery, South Africa	Mbali Coal (Pty) Ltd	Hydrogeologist, field work and Report Writer
2023 - Ongoing	Surface and Groundwater Monitoring Programme Service Provision at Exxaro Matla Coal	Exxaro Malta (Pty) Ltd	Project Manager and Report Writer
2024 - 2024	Groundwater modelling to simulates pollution prevention alternatives for the return water dam, Doornkop Mine	Harmony Gold Mining Company Limited , South Africa	Hydrogeologist, field work and Report Writer
2024 – 2024	Hydrogeological impact assessment, including groundwater modelling for Klipspruit Colliery, South Africa	Seriti Power (Pty) Ltd, South Africa	Hydrogeologist, field work and Report Writer
2024 – 2024	Hydrogeological impact assessment, including groundwater modelling for Middelburg Mine Services	Seriti Power (Pty) Ltd, South Africa	Hydrogeologist, field work and Report Writer
2023 – 2025	Hydrogeological impact assessment, including groundwater modelling for Doornkop Mine, Harmony	Harmony Gold Mining Company Limited , South Africa	Hydrogeologist, field work and Report Writer
2023 - 2024	Groundwater modelling for Arnot OpCo (coal mine)	Arnot OpCo (coal mine), South Africa	Hydrogeologist, field work and Report Writer
2022 - 2022	Surface and Groundwater Monitoring Programme Service Provision at Eskom Medupi Power Station	Eskom Holdings SOC Limited	Field Hydrogeologist and Report Writer
2022 - 2022	Surface and Groundwater Monitoring Programme Service Provision at Eskom Kendal Power Station	Eskom Holdings SOC Limited	Field Hydrogeologist and Report Writer

Duration	Assignment name/ brief description of main deliverables/outputs	Name of client and country of assignment	Role on the assignment
2022 - 2022	Surface and Groundwater Monitoring Programme Service Provision at Eskom Kendal Power Station	Eskom Holdings SOC Limited	Field Hydrogeologist and Report Writer
2022 - 2022	Geohydrological Source development at The Pavilion Shopping Centre	Pareto Limited	Field Hydrogeologist and Report Writer
2022 - 2022	Geohydrological Studies for Eskom Rotek Industries, Rosherville	Eskom Rotek Industries	Field Hydrogeologist and Report Writer
2021 - 2021	Eskom Duvha Hydrogeological Baseline Assessment	Eskom Holdings SOC Limited	Specialist and Report Writer
2021 - 2022	Phase 1: JB Mark LM Wastewater Treatment Works Hydrogeological Baseline Assessment	Aseda Engineering Consulting (Pty) Ltd	Field Hydrogeologist and Report Writer
2021 -2021	Geohydrological Studies for the Betrams Mutlipurpose Centre, Fleurhof Empowerment Zone and Northern Farm- Kgosihadi Consulting Engineers	Kgosihadi Engineering (PTY) LTD	Field Hydrogeologist and Report Writer
2020 - 2020	Surface and Groundwater Monitoring Programme Service Provision at Eskom Hendrina Power Station	Eskom Holdings SOC Limited	Field Hydrogeologist and Report Writer
2020 - 2020	Surface and Groundwater Monitoring Programme Service Provision at Eskom Grootvlei Power Station	Eskom Holdings SOC Limited	Field Hydrogeologist and Report Writer
2019 - 2019	Monitoring Groundwater Source verification and development for Matai	Niara Environmental Consultants Pty Ltd	Field Hydrogeologist and Report Writer
2019 - 2019	Groundwater Source Development for Phiri Secondary School-Ventersdorp Local Municipality	Aseda Engineering Consulting (Pty) Ltd	Field Hydrogeologist and Report Writer
2019 - 2019	Groundwater source verification and development Moloto Community Hall	Aseda Engineering Consulting (Pty) Ltd	Field Hydrogeologist and Report Writer

Duration	Assignment name/ brief description of main deliverables/outputs	Name of client and country of assignment	Role on the assignment
2019 -2019	Groundwater Source Verification and Source Development for Twenty-four Schools – The Mvula Trust	The Mvula Trust (NGO)	Report Writer
2018 - 2022	Surface and Groundwater Monitoring Programme Service Provision at Eskom Duvha Power Station	Eskom Holdings SOC Limited	Field Hydrogeologist and Report Writer
2017 - 2018	Surface and Groundwater Monitoring at Just Coal operations (Ferret, Fentonia and Bankfontein mines)	Just coal (Pty)Ltd	Field Hydrogeologist and Report Writer
2017 - 2021	Surface and Groundwater Monitoring Programme Service Provision at Exxaro Matla Coal	Exxaro Malta (Pty) Ltd	Field Hydrogeologist and Report Writer

SACNASP

South African Council for Natural Scientific Professions

herewith certifies that

Charles Rikhotso

Registration Number: 400068/16

is a registered scientist

in terms of section 20(3) of the Natural Scientific Professions Act, 2003
(Act 27 of 2003)
in the following field(s) of practice (Schedule 1 of the Act)

Earth Science (Professional Natural Scientist)

Effective **9 March 2016** Expires **31 March 2026**

Chairperson

Chief Executive Officer

To verify this certificate scan this code

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

At a congregation of the University

held on 26 March 2024

Charles Rikhotso

was admitted to the Degree of

Master of Science

Dean: Faculty of Science

Vice-Chancellor and Principal

Registrar

2024N00232

UNIVERSITY OF THE FREE STATE
UNIVERSITEIT VAN DIE VRYSTAAT
YUNIVESITHI YA FREISTATA

THIS IS TO CERTIFY THAT THE DEGREE

Master in Environmental Management

HAS BEEN CONFERRED UPON

RIKHOTSO, Charles

IN ACCORDANCE WITH THE STATUTES AND
RULES OF THE UNIVERSITY. AS WITNESS
OUR RESPECTIVE SIGNATURES
AND THE SEAL OF THE
UNIVERSITY BELOW.

VICE- CHANCELLOR / VISEKANSELIER

DEAN / DEKAAN

REGISTRAR / REGISTRATEUR

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2011144389

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UNIVERSITY OF THE FREE STATE
UNIVERSITEIT VAN DIE VRYSTAAT
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THIS IS TO CERTIFY THAT THE DEGREE — HIERMEE WORD VERKLAAR DAT DIE GRAAD

Baccalaureus Scientiae Honores

in GEOHYDROLOGY
in GEOHIDROLOGIE

SOUTH AFRICAN POLICE SERVICE
GARSFONTEIN
2025 -05- 12
COMMUNITY SERVICE CENTRE
SUID-AFRIKAANSE POLISIEDIENS

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RIKHOTSO, Charles

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Tshwane University of Technology

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BACCALAUREUS TECHNOLOGIAE

GEOLOGY

Awarded to

CHARLES RIKHOTSO

207079570 1984-10-18

Having complied with the
Requirements of the Act and Statute

2011-12-15

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Vice-Chancellor and Principal
On behalf of Council and Senate

Registrar

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NATIONAL IDENTITY CARD

Surname:
RIKHOTSO
Names:
CHARLES
Sex:
M
Nationality:
RSA
Identity Number:
8410185711085
Date of Birth:
18 OCT 1984
Country of Birth:
RSA
Status:
CITIZEN

Signature

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