REPORT

Hydrogeological Investigation - Eskom Komati Power Station
WSP Group Africa (Pty) Ltd

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1.0 INTRODUCTION

Eskom Holdings SOC Limited (Eskom) appointed WSP (Pty) Ltd (WSP) to undertake the Environmental & Social Impact Assessment (ESIA), and Water Use Licence Application (WULA) processes for the Solar Photovoltaics (PV) and Battery Energy Storage System (BESS) Project at Komati Power Station (KPS) - Request for Quote (RFQ): Task Order: 00211.

This report provides the hydrogeological investigation and impact assessment of Eskom KPS as part of the Environmental & Social Impact Assessment (ESIA). It is understood that a Water Use License Application (WULA) authorization process will follow for potential (c) and (i) water uses.

1.1 Background

The KPS is about 37 km from Middelburg, 43 km from Bethal and 40 km from Witbank via Vandyksdrift in the Steve Tshwete Municipality, Mpumalanga Province of South Africa. The regional setting is provided in Figure 1.

KPS was initially commissioned in 1961 and operated until 1990. The power station was mothballed in 1990 but was returned to service in December 2005 (Eskom, 2021, Mochesane & Brummer, 2015). The station has a total of nine units, five 100 MW units on the east (Units 1 to 5) and four 125 MW units on the west (Units 6 to 9), with a total installed capacity of 1000 MW but will reach its end-of-life expectancy in September 2022. The regional layout is presented in Figure 1.

Water is supplied via pipeline by the Komati Government Water Scheme which originates from the Nooitgedacht dam, (Mochesane & Brummer, 2015).

1.2 Proposed activity

Eskom is proposing the establishment of a solar electricity generating facility and associated infrastructure as part of its repurposing programme for KPS. The plan is to install 100 MW of Solar Photovoltaics (PV) and 150 MW of Battery Energy Storage System (BESS). The proposed development (refer Figure 2) is located within the property owned by Eskom termed the Project Area for reporting purposes. KPS is located in the east of the Project Area with Komati town in the north. The areas of investigation within the Project Area include:

Block A – located in the south-west corner of the Eskom property with the R542 to the south, Komati town to the north, agricultural land and the Goedehoop Colliery (an underground coal mine) to the west and the Eskom Komati Ash dumps and dams (termed the Ashing area) to the east,

Block B – located in the north-west corner of the Eskom property with Goedehoop Colliery to the west and north and Komati town to the east and

Four smaller portions are located around the KPS plant. These include:

- Block C: Between Komati town and south-west of the KPS,
- Block D: South-west of the KPS,
- Block E: North-east of KPS in the coal stockyard bounded to the north-east by the Koringspruit River,
- Block F: East of KPS and down-gradient of the KPS ash dams.

Further information on the proposed infrastructure and specifications are provided in the ESIA report.

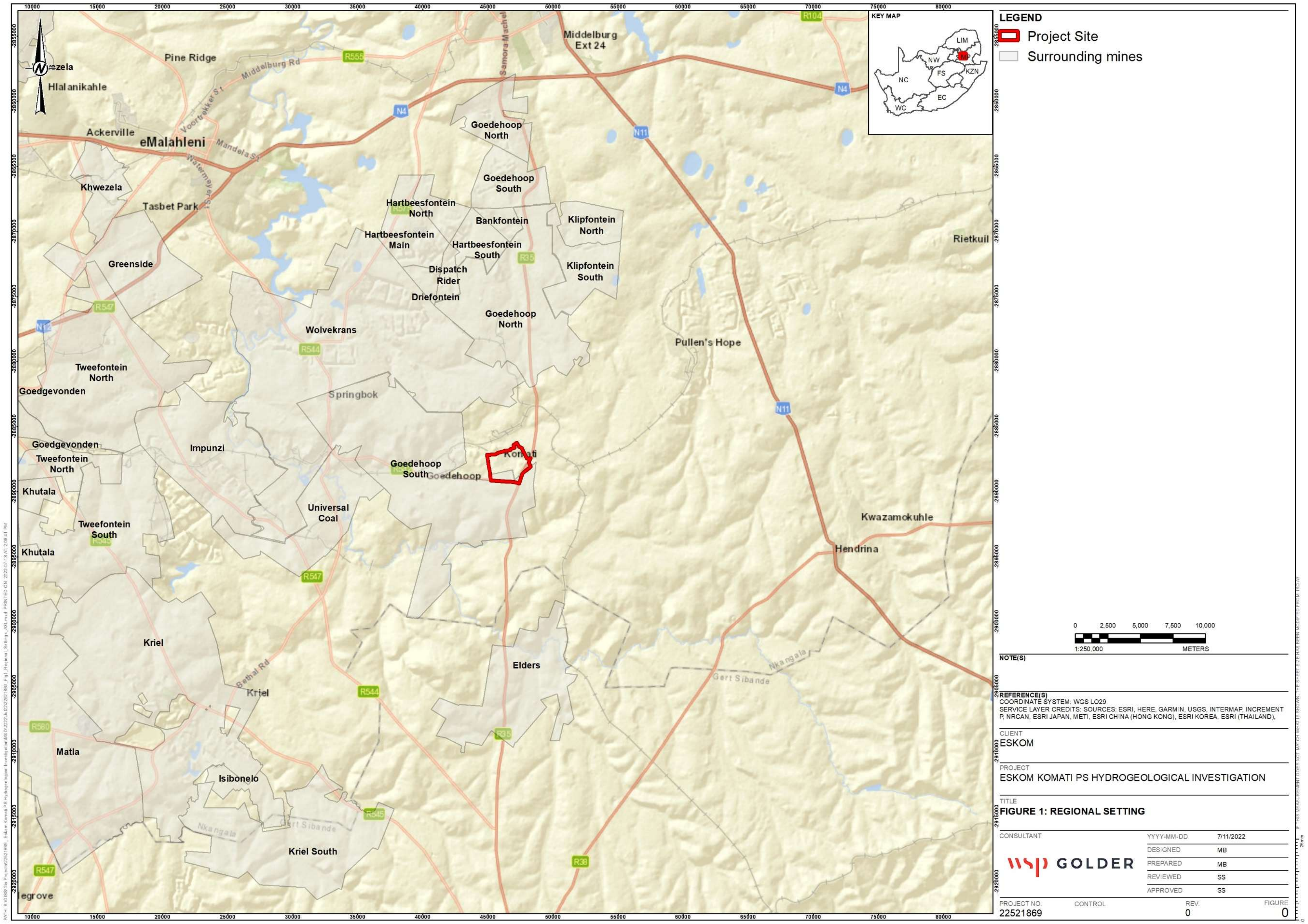

Figure 1: Regional setting

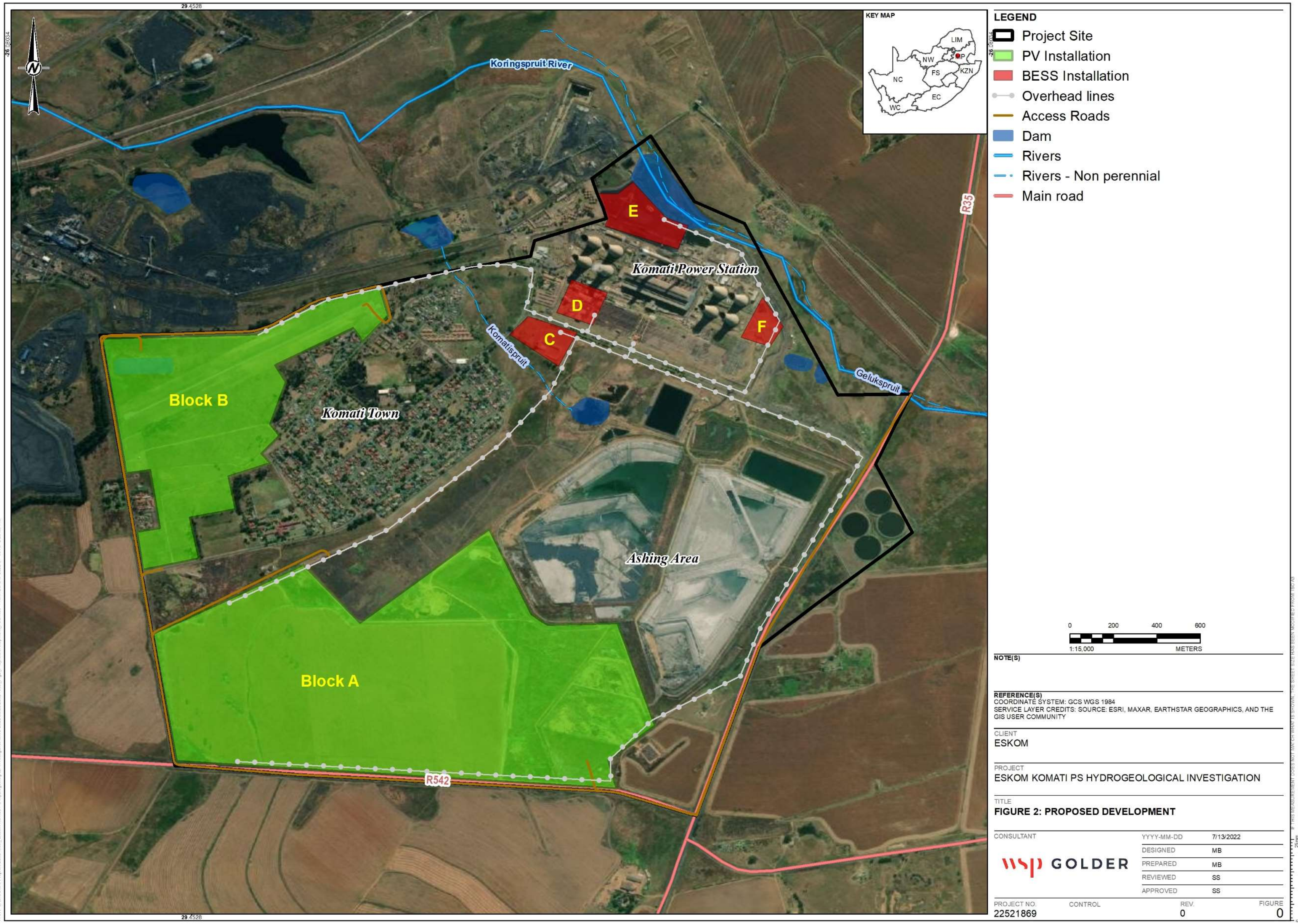

Figure 2: Proposed Development

1.3 Legislative context

Eskom has an existing Water Use License (WUL) and an amendment (WULA):

- Water Use License number 04/B11B/BCGI/1970 dated 2 February 2014 – Eskom KPS facility. The groundwater reserve is provided in this License.
- Water Use License number 04/B11B/CI/2556 dated 11 January 2015 – c and I construction of Komati storage facility within 500m from a boundary of an unchanneled valley bottom wetland and seepage wetland.
- Amendment License in terms of Section 50 and 158 of the NWA, 7/08/2017.
- Amendment of Eskom holdings SOC (Pty) Limited: KPS WUL in terms of Section 50 and 158 of the NWA, 22 February 2021.
- Waste Management Facility: KPS Ash Disposal facility (License #: 12/9/11/L1010/6), and

Decommissioning Waste Management License (License #12/9/11/L73467/6).

1.4 Objectives

The main objective of the hydrogeological investigation is to provide a report including:

- Detailed baseline description of groundwater conditions,
- Identification and high-level screening of impacts,
- Recommendations for potential mitigation measures.

1.5 Scope of Work

The scope of work includes the following:

- Review of available information,
- Compilation of a qualitative IA for the proposed new activities, and
- Reporting on the current site groundwater conditions, conceptual model understanding.

1.6 Limitations and data gaps

The following limitations were noted as part of the study:

- The study is based on available data and has not been verified.
- The available monitoring data is limited to the area surrounding the KPS. Groundwater monitoring data is therefore limited in the PV and BESS areas with no information for Block B, C, D and F. This was resolved following the completion of the study carried out as part of the Contaminated Land Scope of work (WSP Report 41103965 dated 16 August 2022) which included the drilling of 10 shallow boreholes.
- Water level data for 2022 was not available and the borehole elevation has not been surveyed for the monitoring boreholes. The 2021 water level data was obtained from the monitoring reports, but it is noted that the latest data is handwritten, and the sample IDs are not verified. For example, there is no monitoring borehole AB08, it is assumed that this point is PB08. An update on water levels was provided from the boreholes drilled as part of the Contamination Land Scope of Work as discussed above.

- Borehole logs are limited to 9 of the 26 boreholes. There was no water strike nor yield information supplied at the time of drilling. Depth to weathering has therefore been assumed. This was confirmed by the study carried out during the Contaminated Land Study.

There is little distinction between a shallow perched aquifer and deeper fractured rock aquifer in the monitoring data.

2.0 GEOGRAPHICAL SETTING

2.1 Topography and drainage

Topography information was sourced from the 1:50 000 topographic map series, Mathetsa, 2021 and Mathetsa, & Swatz, 2019. The Project Area is a generally undulating with Block A located in the higher lying areas and sloping towards the small drainage line of the Koringspruit River to the north (towards Block B) approximately 1585 mamsl in the floodplain. The highest points lie near the junction of R35 and R542 provincial roads at approximately 1655 mamsl in the southern portion of the site (Block A). The ashing area (east of Block A) is situated at 1650 to 1615 mamsl.

The Project Area is located in the Olifants River quaternary sub-catchment B11B. The Koringspruit River flows past the northern boundary. The Koringspruit River also passes the Koornfontein and Goedehoop Coal mines and joins the Olifants River some 15 km downstream of the Project Area. The Komati spruit originates in the Ashing area (east of Block A) and drains the area west of the Ashing Area to the Koringspruit River. The Power Plant and Coal Stockyard (Area E) are situated on a topographic flat ±1605 mamsl with a poor drainage pattern. The Gelukspruit flows in a northwesterly direction and drains the area east and north of the Project Area towards the Koringspruit River. According to Mathetsa, & Swatz, 2019, this stream was diverted to prevent ingress into power plant areas and remains so due to the location of the current KPS activities. Several drains and dams have been constructed around the Ashing area, Power Plant area and Coal Stockyard area. A seepage area/drainage line within the dirty water area of the existing ash dams is noted by Mathetsa, 2021 and probably contains seepage off the ash dams which have been used as water storage facilities. Surface run-off from the KPS is in the order of 5% of the annual rainfall. An artificial wetland has developed to the east of the Coal stockyard area and is locally present along the Komati spruit between the KPS and Komati town (Mochesane & Brummer, 2015).

2.2 Climate

The Project Area experiences summer rainfall (Eastern Highveld) with cold dry and mild winters and warm, wet summers. Temperatures vary from maximum temperatures from 27 ^{0}C in January to 17 ^{0}C in July. Frost occurs frequently between May and September. The area also hosts to dust storms during prolonged dry periods.

Rainfall is seasonal with a Mean Annual Precipitation (MAP) of 687 mm and Mean Annual Evaporation (MAE) is 1550 mm per annum, (Mathetsa, 2021). A higher rainfall of approximately 735 mm was estimated by Halenyane, 2019.

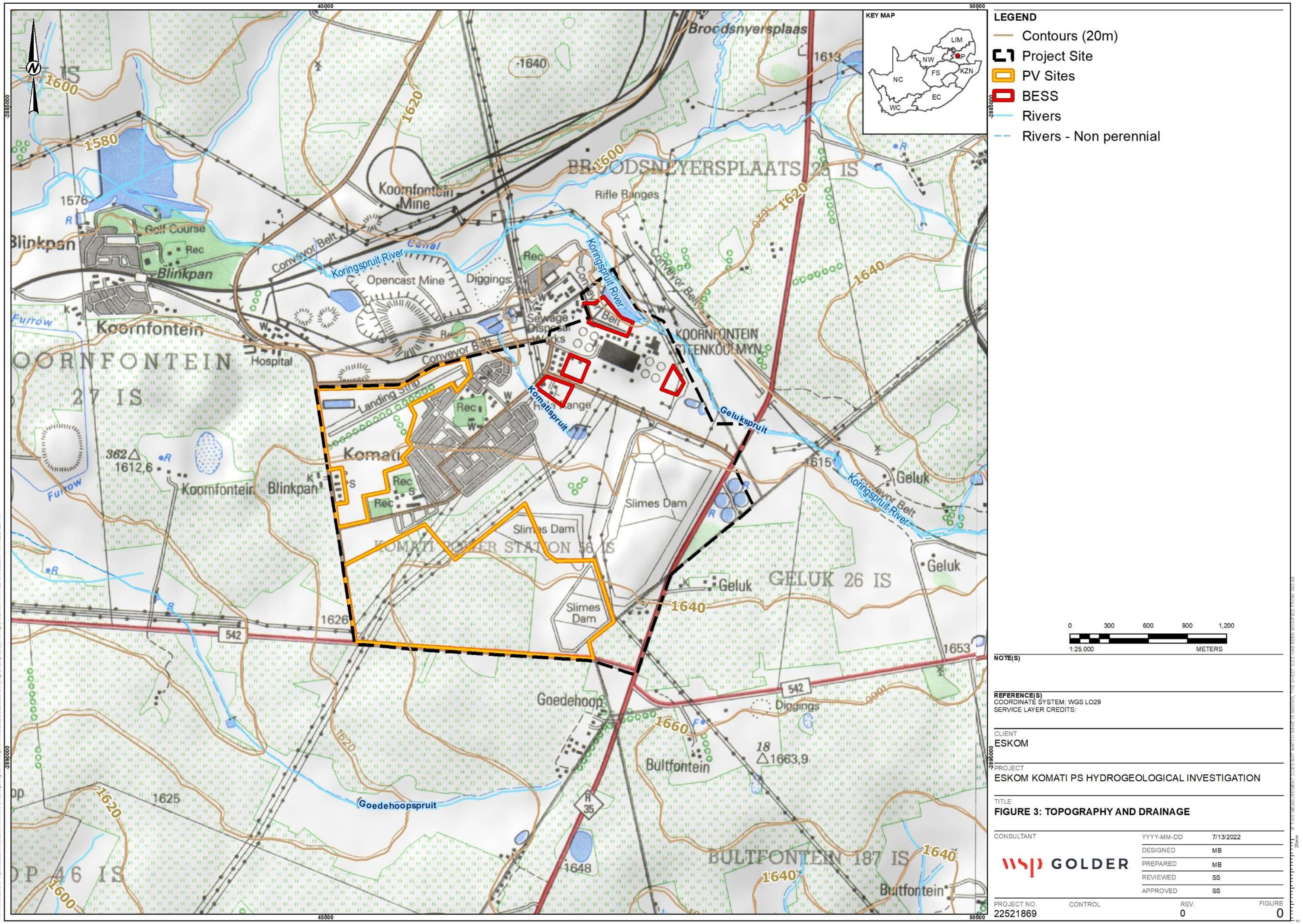

Figure 3: Topography and drainage

3.0 METHODOLOGY

3.1 Desk study

Previous groundwater studies focused on the KPS area. A summary of information provided by Eskom is presented in Table 1. Additional information is pending from the contaminant land investigation currently in progress.

A report (SRK 566657, 2021) was sourced from public information on the adjacent Goedehoop Colliery. The report is referenced as Jeffrey, L and Wertz M, March 2021, Independent Competent Person's Report on Goedehoop Colliery, SRK Report reference 566657. *https://thungela.s3.eu-west-1.amazonaws.com/downloads/investors/Goedehoop-Colliery-CPR-dated-25-March-2021.pdf.*

Table 1: Summary of available information

Type of information	Report Reference
Baseline information and hydrocensus	Van Niekerk, L.J. and Staats, S, July 2009, Komati Power Station Hydrological & geohydrological baseline study, GHT Consulting Scientists, RVN 537.5/909
IWWMP	Mochesane, M & Brummer, D, December 2015, Integrated water and waste management plan for Komati Power Station, Mpumalanga Province, Lidwala Consulting Engineers (SA) (PTY) Ltd, 16906 PRO_ENV
Numerical model	Halenyane, K September 2019, Numerical modelling and geochemistry assessment, Eskom Komati Power Station, Gauteng, Kimopax (Pty) Ltd, KIM-WAT-2018-233
2019 hydrocensus	Mathetsa, S & Swatz, N, August 2019, Komati Hydrocensus Report - 2019, Applied chemistry and microbiology section: sustainability Division Eskom, RTD/ACM/19/240-149029270
Groundwater quality	Komati WISH data – groundwater database supplied 15 June 2022.
Water level and quality monitoring Reports	Mathoho, G & Khuzwayo, L, Oct 2017, Komati Surface and Groundwater Monitoring Report, Phase 4, Eskom Sustainability Division, Research, Testing and Development Technical report, RTD/ACM/17/04
	Mathoho, G, Khuzwayo, L, and Samuels, V, Oct 2017, Komati Surface and Groundwater Monitoring Report, Phase 3, Eskom Sustainability Division, Research, Testing and Development Technical report. RTD/ACM/16/240-118739170
	Mathoho, G, April 2016, Komati Surface and Groundwater Monitoring Report, Phase 01, Eskom Sustainability Division, Research, Testing and Development Technical report. 240-112294332
	Mathoho, G, January 2017, Komati Surface and Groundwater Monitoring Report, Phase 02, Eskom Sustainability Division, Research, Testing and Development Technical report. Rrtm/acm/16/240-118739170
	Mathoho, G & Khuzwayo, L, April 2018, Komati Surface and Groundwater Monitoring Report, Phase 5, Eskom Sustainability Division, Research, Testing and Development Technical report, RTD/ACM/17/05
	Mathoho, G & Khuzwayo, L, May 2018, Komati Surface and Groundwater Monitoring Report, Phase 6, Eskom Sustainability Division, Research, Testing and Development Technical report, RTD/ACM/17/06
	Mathoho, G & Khuzwayo, L, May 2018, Komati Surface and Groundwater Monitoring Report, Phase 7, Eskom Sustainability Division, Research, Testing and Development Technical report, RTD/ACM/18/240-140434399
	Mathetsa, S & Swartz, N, August 2018, Komati Surface and Groundwater Monitoring Report, Phase 8, Eskom Sustainability Division, Research, Testing and Development Technical report, RTD/ACM/18/240-140434709

Type of information	Report Reference
	Mathetsa, S & Swartz, N, September 2019, Komati Surface and Groundwater Monitoring Report, July to September 2019, Eskom Sustainability Division, Research, Testing and Development Technical report, RTD/ACM/19/240-152749979
	Mathetsa, S & Swartz, N, September 2019, Komati Surface and Groundwater Monitoring Report, April to June 2019, Eskom Sustainability Division, Research, Testing and Development Technical report, RTD/ACM/19/240-150762666
	Sinthumule, N & Mathetsa, S, May 2020, Komati Surface and Groundwater Monitoring Annual Report, 2020/2021, Eskom Sustainability Division, Research, Testing and Development Technical report, RTD/ACM/20/240-163860231
	Mathetsa, S, November 2020, Komati Surface and Groundwater Monitoring - Quarter 2 of 2020/2021, Eskom Sustainability Division, Research, Testing and Development Technical report, RTD/ACM/20/240-160324741
Latest Water quality reports by Eskom	Mathetsa, S, January 2021, Komati Surface and Groundwater Monitoring - Quarter 3, Eskom Sustainability Division, Research, Testing and Development Technical report, RTD/ACM/21/240-1615539477
Latest Water quality reports by Eskom	Sinthumule, N, March 2022, Komati Surface and Groundwater Monitoring - Quarter 3, Eskom Sustainability Division, Research, Testing and Development Technical report, RTD/ACM/21/240-190000008

3.2 Hydro-census

A hydrocensus was carried out in 2008 (Van Niekerk & Staats, 2009) with selected points (thirteen) resampled in 2019 (Mathetsa & Swatz, 2019), Refer Figure 4. These covered an approximate 15 km radius around KPS. The census boreholes are focused in the area to the north-east of KPS and are presented in Table 2. The results of the hydrocensus confirmed the following:

- The hydrocensus area is mainly underlain by the Ecca sediments of Karoo Supergroup.
- Water level information was limited as most boreholes were installed with infrastructure which blocks access to water levels.
- Water quality analyses was carried out on the hydrocensus boreholes. This confirmed that concentrations were generally below the SANS 241:2015 limits for domestic use and is therefore suitable for drinking (based on the parameters analysed).
- Groundwater is utilized for domestic use with *ad hoc* use for irrigation.

Table 2: Hydrocensus boreholes (2008) with 2019 update indicated in blue text

SiteID	Longitude (ºE)	Latitude (ºS)	Farm Name	Farmer/ Owner	Bore-hole Depth (m)	Casing Height (m)_2008	Equipment	Use	WL Below Collar (mbcl)	Condition
BB10	29.42091	-26.04868	Welverdiend 23/2	Engelbreght	~	0.200	Submersible	Domestic Drink	~	Good
BB11	29.45898	-26.06239		G.F. Grobler	~	0.520	Hand pump	Domestic Drink	~	Good
BB12	29.46227	-26.06161		G.F. Grobler	~	0.300	Submersible	Domestic Drink	~	Broken
BB13	29.44845	-26.06403	Koornfontein 27/6	G.F. Grobler	27.2	0.280	Submersible	Domestic Drink	16.20	Blackish water
BB14	29.48485	-26.05469	Broodsnyers-plaas 25/10	Siyavuma Vervoer	~	0.000	Submersible	Domestic Drink	11.80	Good
BB15	29.49044	-26.05852	Broodsnyers-plaas 25/28	H De Beer	~	0.350	Submersible	Domestic Drink	~	Good
BB16	29.50683	-26.07076	Broodsnyers-plaas 25/1	P Storm	~	0.320	Hand pump	Domestic Drink	~	Good
BB17	29.49821	-26.07593	Broodsnyers-plaas 25/5	P Storm	66.0	0.000	Submersible	Domestic Drink	24.00	Good
BB18	29.49867	-26.07736		P Storm	85.0	0.000	None (2008), Pump (2019)	~	Dry	Dry hole (2008), in use in 2019

SiteID	Longitude (ºE)	Latitude (ºS)	Farm Name	Farmer/ Owner	Bore-hole Depth (m)	Casing Height (m)_2008	Equipment	Use	WL Below Collar (mbcl)	Condition
BB19	29.49741	-26.07693		P Storm	~	0.100	Hand pump	Domestic Drink	~	Good
BB20	29.48213	-26.08393	Broodsnyers-plaas 25/3	D Lee	26.1	0.100	Submersible	Domestic Drink	14.10	Good
BB21	29.47954	-26.10598	Geluk 26/7	MCL Dippenaar	26.8	0.200	None (2008), Windmill (2019)	~	2.20 (2008); 1.76 (2019)	Windmill (2019)
BB22	29.47907	-26.10586	Geluk 26/7	MCL Dippenaar	~	0.000	Submersible	Domestic Drink	~	Good
BB23	29.47905	-26.10632	Geluk 26/7	MCL Dippenaar	11.0	0.230	Submersible	Domestic Drink	4.50	Broken (2008) indicated to be in use 2019
BB24	29.47125	-26.11574	Goedehoop 46/3	F Schoeman	~	0.300	Submersible	Domestic Drink	15.00	Good
BB25	29.47127	-26.11574	Goedehoop 46/3	F Schoeman	26.5	0.300	Submersible	Domestic Drink, Livestock	20.50	Good
BB26	29.47783	-26.11699	Bultfontein 187/2	K Van Rensburg	6.1	0.100	None	~	Dry	Dry hole
BB27	29.47912	-26.11710	Bultfontein 187/2	K Van Rensburg	42.0	0.440	Submersible	Domestic Drink, Livestock	32.00	Good
BB28	29.50721	-26.11221	Bultfontein 187/11	Van Niekerk	~	0.680	Mono pump	Domestic Drink	~	Good
BB29	29.49529	-26.12859	Bultfontein 187/12	Von Wielligh	52.0	0.520	Submersible	Domestic Drink, Livestock	13.00	Good
BB30	29.50947	-26.13509	Bultfontein 187/6	E Erasmus	40.0	0.480	None	~	8.50	No Equipment
BB31	29.50961	-26.13511	Bultfontein 187/6	E Erasmus	~	0.120	Mono pump	Domestic Drink	~	Good
BB32	29.53378	-26.14317	Hartebeestkuil 185/2	D Van Woutenberg	~	0.370	None	~	5.00	No Equipment
BB33	29.53470	-26.14244	Hartebeestkuil 185/2	D Van Woutenberg	8.0	0.360	None	~	2.00	No Equipment
BB34	29.53840	-26.14023	Hartebeestkuil 185/2	D Van Woutenberg	~	0.100	Mono pump	Domestic Drink, Livestock	~	Good
BB35	29.49518	-26.15330	Wilmansrust 47/3	C.J. Van der Merwe	15.0	0.180	Submersible	Domestic Drink, Livestock	3.00	Works only in dry season
BB36	29.49503	-26.16079	Wilmansrust 47/3	C.J. Van der Merwe	32.0	0.170	Submersible	Domestic Drink, Livestock	18.00	Good
BB37	29.51189	-26.17976	Dunbar 189/2	Proefplaas	12.0	0.150	Submersible	Domestic Drink	3.50	Good
BB38	29.48366	-26.17902	Middelkraal 50/1	BJ Grobler	~	0.450	Windmill	~	~	2019: in use
BB39	29.48336	-26.17877		BJ Grobler	~	0.300	Mono pump	Livestock	~	Occasional use for domestic
BB40	29.48339	-26.17864		BJ Grobler	~	0.280	Submersible	Domestic Drink, Livestock	3.00 (2008), 2.72 (2019)	Not in use
BB41	29.47363	-26.16277	Leeufontein 48/3	BJ Grobler	~	0.450	Windmill	~	~	Not in use for a long time
BB42	29.47537	-26.16495	Leeufontein 48/16	BJ Grobler	~	0.000	Windmill	~	~	Not in use for a long time
BB43	29.42195	-26.12209	Goedehoop 46/7	J Harmse	15.0	0.300	Submersible	Domestic Drink	8.00	Good
BB44	29.42193	-26.12198		J Harmse	55.0	0.100	Submersible	Domestic Drink, Livestock	5.00	Good
BB45	29.41625	-26.11591		J Harmse	~	0.300	Windmill	~	~	Not in use for a long time
BB46	29.42719	-26.11853		J Harmse	~	0.600	Windmill	~	~	Not in use for a long time

It should be noted that groundwater is abstracted from the adjacent Goedehoop Colliery where groundwater is also utilized for supply, (SRK 566657, 2021).

Monitoring boreholes are also present on the site (Refer Figure 4). Additional boreholes were drilled as part of a concurrent study which is still in progress (Figure 4). A summary of the information from the monitoring boreholes is included in Section 4.4 to follow.

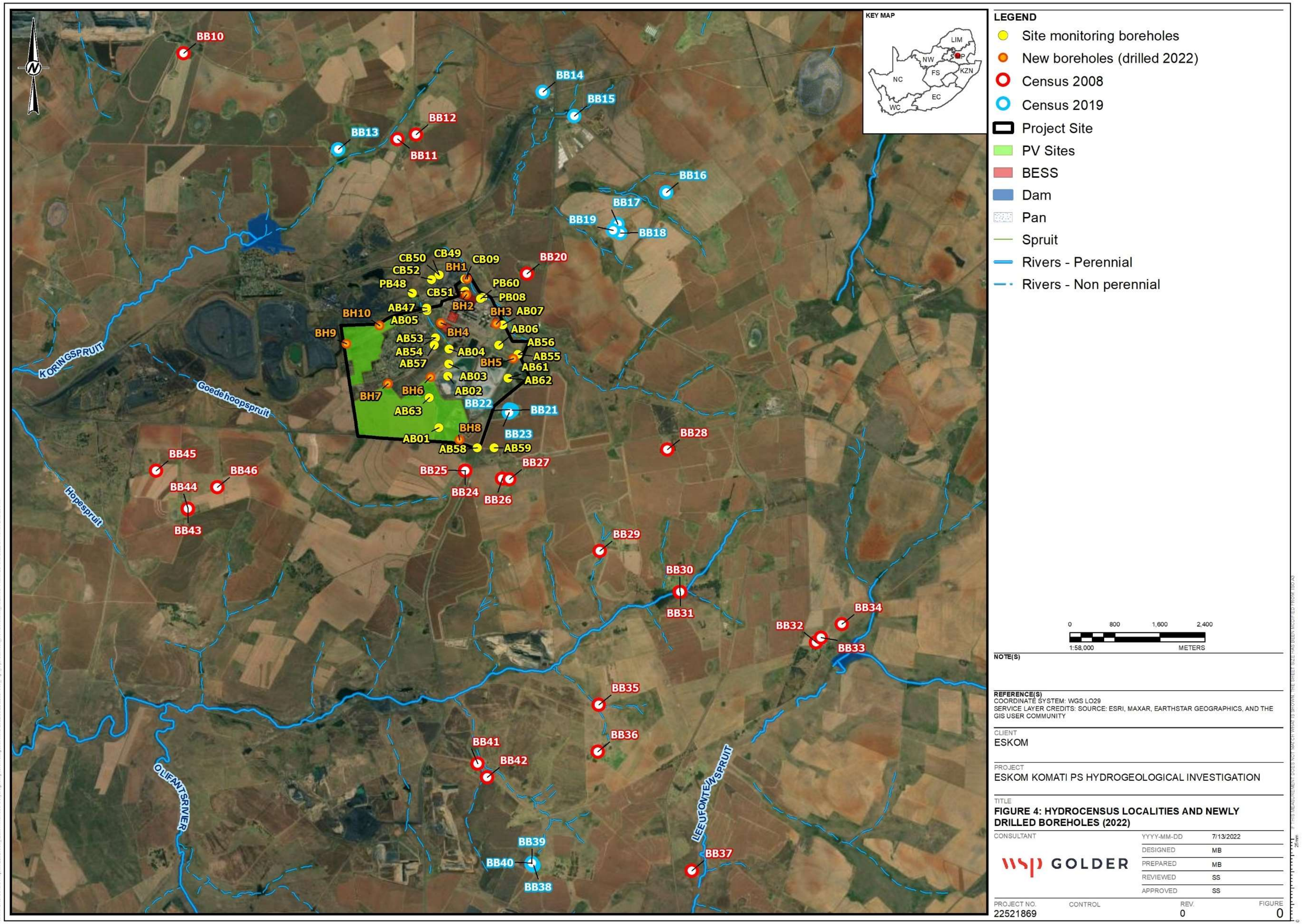

Figure 4: Hydrocensus localities and newly drilled boreholes (2022)

3.3 Geophysical survey and results

Geophysics was carried out for the 2008 baseline (Van Niekerk & Staats, 2009) and the geophysical survey focused on the boundaries of the ashing facility. The survey delineated potential drill sites for the ashing facilities for pollution remediation or management of pollution plumes from the facilities. The survey was conducted using the magnetic method to identify intrusive magmatic rocks, primarily dolerites sills or dykes, in the vicinity of the Project Area.

3.4 Drilling and siting of boreholes

A monitoring program has been established for the KPS. While some information is available from (Van Niekerk & Staats, 2009), borehole logs were unavailable for all the points. Monitoring points located in or near the vicinity of the proposed activities are included in blue text in Table 3 below with additional information from the remaining monitoring points provided for reference. here are no monitoring boreholes located in or around Blocks B, C and D.

Based on the data provided, it is inferred that shallow boreholes are drilled to depths of < 10 m below ground level (mbgl) whilst deeper boreholes are drilled to a depth of > 30 mbgl.

Table 3: Data for Monitoring boreholes (boreholes located in or adjacent to the proposed activities are indicated in blue text)

Locality	Sample ID	Latitude (°S)	Longitude (°E)	Eleva-tion [5]	Bore-hole depth	Sample depth (mbgl)(1)	Lithology
Ambient upstream (south) of Ashing area and Block A T junction - Witbank road.	AB58	-26,1121	29,473	1662	ND		
	AB59	-26,1121	29,476	1662	ND-shallow		
Inside Block A - Western boundary of Ashing Area and downstream of old rehabilitated domestic waste site.	AB01	-26.10885	29.4665	1652	35.5	15	Clay to 7,5m, weathered Sandstone to 17,5m, Siltstone and shale to 25m, coal to 26m, Siltstone and sandstone to 40m
	AB63	-26,1040	29,465	1643	ND		
Outside Eastern boundary Block A - West of Ashing Area north of small ash dam as well as west of large ash dams.	AB02	-26.10053	29.4681		32.5	20	Clay to 5m, weathered sandstone to 13m, shale and siltstone layers to 26m Dolerite at base.
Outside Eastern boundary Block A - West of Ashing Area. West of ash dam and in town area	AB53	-26,0944	29,466	1617	ND-deep		
Outside but adjacent to Block F (east of KPS boundary) downstream of seepage recovery dam AP03.	AB07	-26.09225	29.47787	1612	37.0	15	Gravel to 1m, clay to 3m, weathered sandstone to 12m, Sandstone, siltstone and shale layers to 28m, coal to 29m, sandstone to 39m
Inside Block E - Coal Stockyard Area (water is black)	CB51	-26,0868	29,471	1601	ND		
Outside Block F on north-eastern corner of boundary & downstream of Coal Stockyard Area & dirty water dam	CB09	-26.08481	29.47110		36.5	31	Soil/Clay to 2m, shale to 12m, siltsone and sandstone to 17m, shale to 20, coal to 21, shale to 23m, sandstone and siltstone to 37m, shale and coal layers at base.
Outside Block F on eastern boundary - downstream KPS Area	PB60	-26,0880	29,474	1608	ND		
Ashing Area- Monitoring borehole downstream and north of small ash dam as well as west of large ash dams.	AB03	-26.09855	29.46826		7.5 (collapsed)	-	Clay to 12m.

Locality	Sample ID	Latitude (°S)	Longitude (°E)	Eleva-tion [5]	Bore-hole depth	Sample depth (mbgl)(1)	Lithology
Ashing Area north-west of ash dams and south of dam AP02.	AB04	-26.09615	29.46831	1621	38.0	8.5	Clay to 8m, weathered sandstone to 11m, Shale and siltstone to 33m, dolerite at base
Ashing Area next to Komati Spruit west of KPS.	AB05	-26.08999	29.46438		8.5 (collapsed)	-	Clay to 8m, weathered sandstone to 16m
Ashing Area north and downstream of ash dams.	AB06	-26.09551	29.47715	1620	37.0		
KPS & Sewage Plant Area	PB08	-26.08780	29.47429	1604	35.5	13	Clay to 5m, coal to 6m, siltstone and shale to 11m, sandstone to 15m, shale and coal to 18m, shale to 40m
Not indicated – probably incorrectly labelled	AB08	ND	ND	ND			
Ashing Area close to Komati Spruit, west of KPS.	AB47	-26,8096	29.464304	1609	ND		
Ashing Area west of ash dam, next to AB53	AB54	-26,0944	29,466	1617	ND - Shallow		
Ashing Area North of ash dam. Next to tar road at Entrance road to KPS	AB55	-26,0970	29,481	1621	ND - Deep		
Ashing Area- North of ash dam. Next to tar road at Entrance road to KPS	AB56	-26,0970	29,481	1621	ND- shallow		
Ashing Area - West of ash dam	AB57	-26,0955	29,466	1621	ND		
Ashing Area - East of ash dam.	AB61	-26,1008	29,479	1634	ND- deep		
Ashing Area east of Ash Area – Shallow borehole and artesian	AB62	-26,1008	29,479	1634	ND- shallow		
Coal Stockyard Area	CB49	-26,0841	29,466		ND- deep		
Coal Stockyard Area	CB50	26,0842	29,467		ND- shallow		
Coal Stockyard Area	CB52	-26,0850	29,465	1603	ND		
KPS Area- north of sewage plant	PB48	-26,0871	29,462	1608	ND		

Notes: ND – no data
(1) – Van Niekerk & Staats, 2009
(1) – Mathetsa & Swart, 2018
(2) – Mathetsa & Swart, 2018
(3) - Sinthumule & Mathetsa, 2019
(4) – Sinthumule, 2022. Note that water levels were interpolated from hand written notes in appendix.
(5) - 1 Mathoho, G & Khuzwayo, 2017

An additional ten shallow boreholes were drilled as part of the current contaminated land study. This information will be included in that report once complete.

3.5 Aquifer testing

The baseline report (Van Niekerk & Staats, 2009) carried out falling head tests on eight of the nine monitoring boreholes available at the time. Hydraulic conductivity was estimated as ranging from 0,007 m/d at AB07 to 2.4 m/d for AB04 with an average of 0,51 m/d. No further testing has been done.

3.6 Sampling and chemical analysis

Eskom has an extensive monitoring network covering an area of 10 km^2 (Mathetsa, 2021) and is focused on the KPS. According to Eskom's monitoring data, the monitoring boreholes include:

- Boreholes (AB58 and AB59) monitoring the ambient (upstream groundwater quality);
- Boreholes (AB61, AB62, AB01, CB51, and PB48) were delineated as source monitoring boreholes and

- Boreholes (AB02, AB03, AB63, AB55 and AB56) are used to track the groundwater plume.

Sampling is carried out by Eskom. Eskom reports that it follows a groundwater sampling guideline which includes bailing of water samples at a discrete interval from pre-determined sampling depths. This was provided for a few monitoring boreholes from the baseline report in 2008 but is not stated in subsequent monitoring reports. It is noted that some of the boreholes appear to have collapsed over the preferred sample depth.

Groundwater quality parameters that need to be analysed are specified in the WUL (Appendix IV, Table 6 Clause 3.6) as pH, Electrical conductivity (EC), Total Dissolved Solids (TDS), Total Suspended Solids (SS), Total Alkalinity, chloride (as Cl), sodium (as Na), sulphate, nitrate, ammonia, orthophosphate, fluoride, potassium, manganese, copper, iron, zinc, arsenic and chromium.

As noted above, groundwater monitoring in the areas proposed for the BESS and PV are limited with monitoring boreholes located in Block A (area west of Ash dams) and in Block E (coal stock yard). Ten shallow boreholes have been drilled as part of a congruent study being carried out to assess the potential for contaminated land in the areas of investigation. This study is still pending, and the results were not available at the time of reporting.

3.7 Groundwater recharge calculations

The regional recharge distribution (37 – 50 mm/a), as provided by the hydrogeological map series information for South Africa, is presented in Figure 6. This is slightly higher than provided by the available reports which provide the following estimates:

- 3% of annual rainfall (20,6 mm/a based on 687 mm/a) in undisturbed areas Mathetsa, 2021.
- 36,5 mm/a estimated by Halenyane, 2019 based on the chloride method.

3.8 Groundwater modelling

Groundwater modelling was not carried out for this investigation as no pollution dams or 21 (g) water use are required for the PV and BESS plants. A comprehensive numerical groundwater model has been compiled for the KPS area as detailed by Halenyane, 2019.

The model considered the potential existing sources for KPS of the existing ash dams, coal stock yard, new ash return water dam and raw water dams.

Conclusions and recommendations from the model report are summarized as follows:

- The groundwater contaminant plume is expected to migrate post closure past the KPS boundary to the Koringspruit. It was recommended that the coal stockyard area be removed upon closure and disposed to an approved waste disposal facility pending confirmation of waste classification results (not provided).
- All water in contact with the ash dams should be contained and treated within the footprint area.
- The raw water and new ash return water dams need to be removed on closure, contaminated soil removed, and the footprints rehabilitated.
- Additional monitoring points were recommended, and it was noted that monitoring should continue for at least ten years following closure.

3.9 Groundwater availability assessment

Groundwater is utilized by the surrounding communities and the adjacent Goedehoop Colliery for water supply.

Groundwater availability is described as “d2” being primarily from an intergranular and fractured rock aquifer with an anticipated yield of between 0,1 and 0,5 l/s.

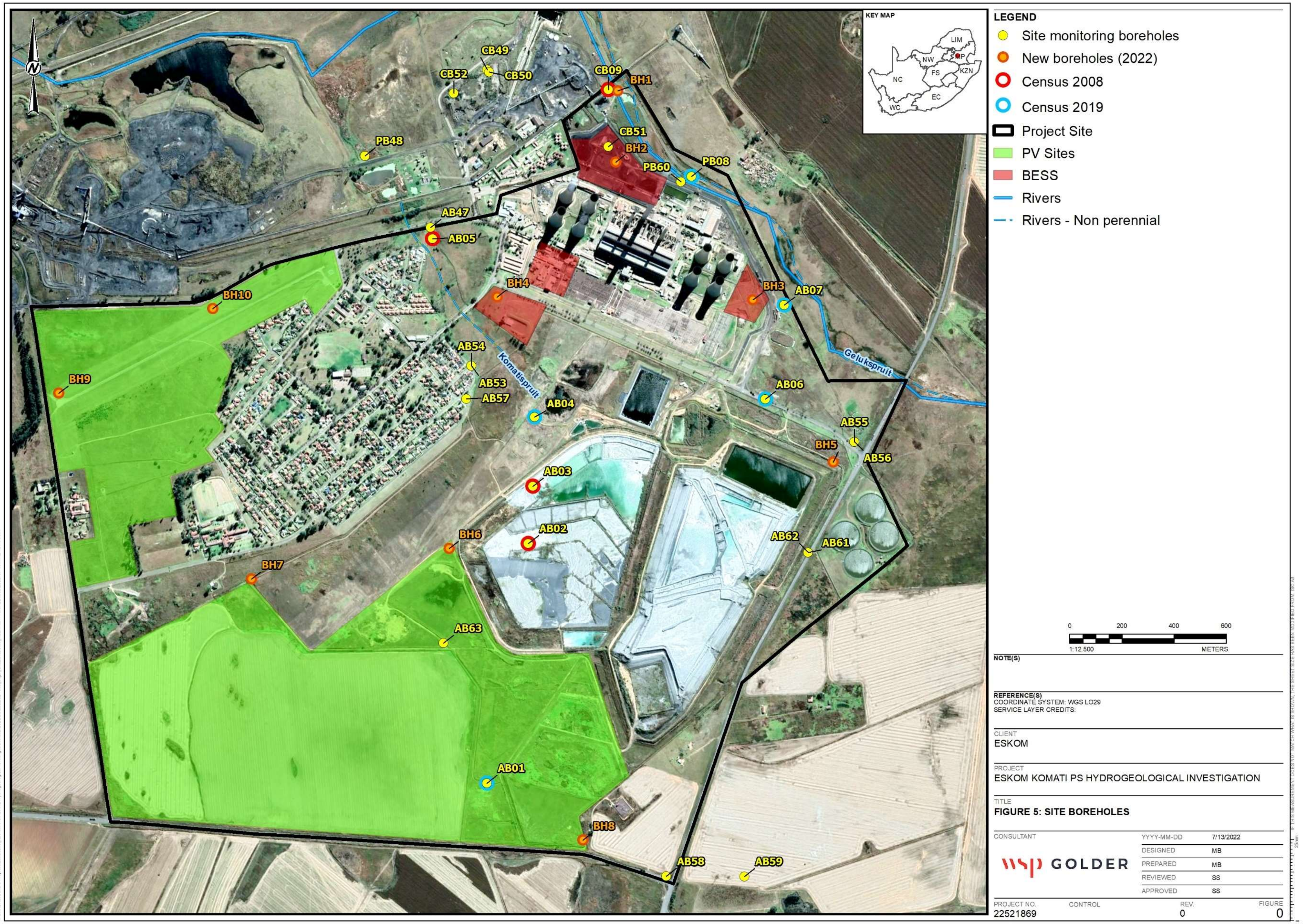

Figure 5: Site boreholes

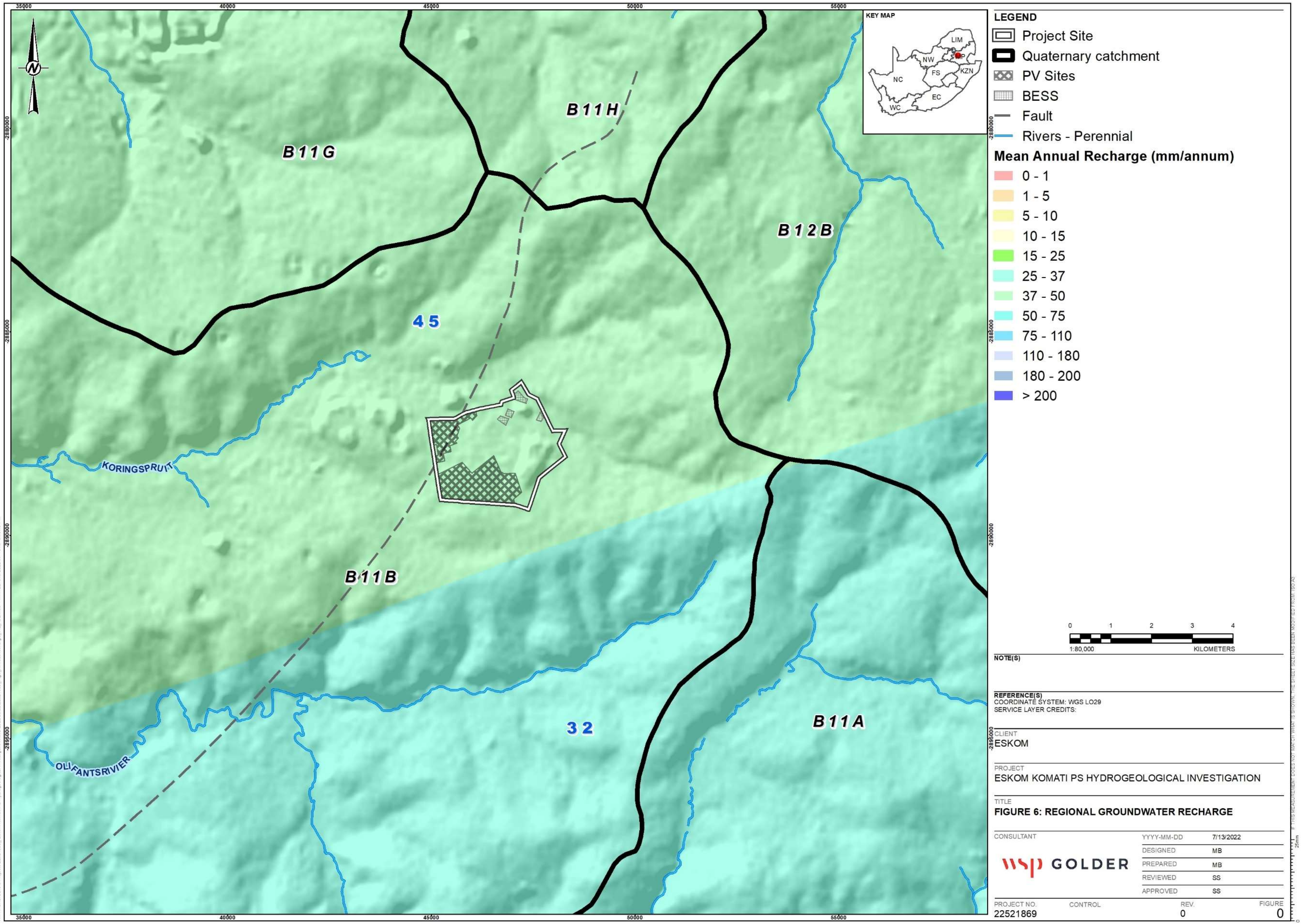

Figure 6: Regional recharge distribution

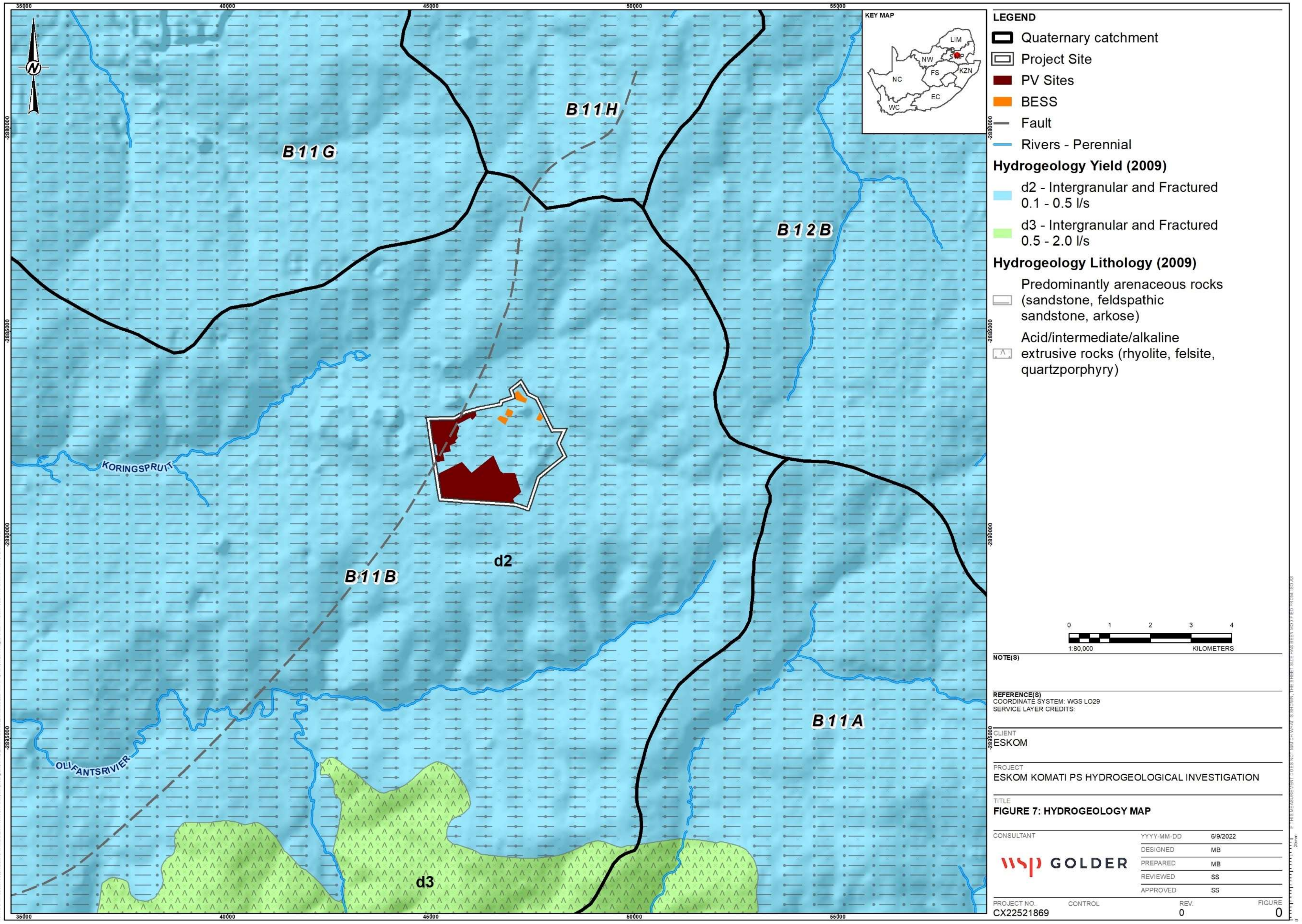

Figure 7: Groundwater availability

4.0 PREVAILING GROUNDWATER CONDITIONS

4.1 Geology

4.1.1 Regional geology

The Project Area is located within the Highveld (Witbank) Coalfield. The regional geology is described (Mathetsa, 2021, Halenyane, 2019) as falling within the Carboniferous to early Jurassic aged Karoo Basin. The Karoo Supergroup comprises, from oldest to youngest, the Dwyka, Ecca and Beaufort Groups, with the coal seams generally hosted within the Vryheid Formation of the Middle Ecca Group. The Vryheid Fromation includes interbedded sandstone, siltstone, shales and coal seams. Five coal seams are present within the Vryheid Formation and are numbered (from base up as the Number 1, 2, 3, 4 and 5 Seams. The zone of undermining (Bohlweki Environmental, 2005) indicated as underlying the Block B is noted to be associated with the No 4. and No. 2 coal seams. The No 2 Seam ranges in between 1.5 and 4.0 m in thickness where it is laterally continuous whilst the No 4 Seam averages 4.0 m, varying from 1 – 12 m in thickness at Goedehoop mine (SRK 566657, 2021). The depth below ground level should be confirmed but based on the general stratigraphy is likely to be > 50 m below surface (SRK 566657, 2021). The coal seams are mined by the adjacent Goedehoop colliery. The coal seams are mined by the adjacent collieries. The Vryheid Formation overlies the Dwyka formation. A summary of the Lithostratigraphy is provided in Table 4. The regional geological map is presented in Figure 8.

Table 4: Lithostratigraphy

Age	Supergroup	Subsuite	Lithology
Quaternary		Q	Surficial alluvial deposits to the north associated with the Koringspruit River
Jurassic		Jd	Fine-grained dolerite
Permian	Karoo	Pv (Vryheid)	Sandstone, shale and coal beds
Carboniferous		C-pd (Dwyka)	Diamictite and shale

4.1.2 Local geology

There is no information on the residual soils for the investigation areas. Additional investigations are, however, in progress. The following information is inferred from the available reports and borehole logs. All the groundwater monitoring and several hydrocensus sites are sitting on the Vryheid formation.

The local geology generally comprises weathering products of the sandstones, siltstones and mudstones of the Vryheid Formation, with isolated patches of dolerite. The top layer consists of reddish-brown sandy soil, with clayey-sandy subsoil comprising yellowish to brown clays residual of the underlying sandstone formations. Weathering is not, based on the available borehole logs, expected to extend deeper than approximately 10 m. Surficial ash and coal is likely present within Block A associated with the historical ash footprint and in the coal stockyard area.

A linear structure is indicated on the regional geological maps (Refer Figure 8) to be striking north-east to south-west through Block B.

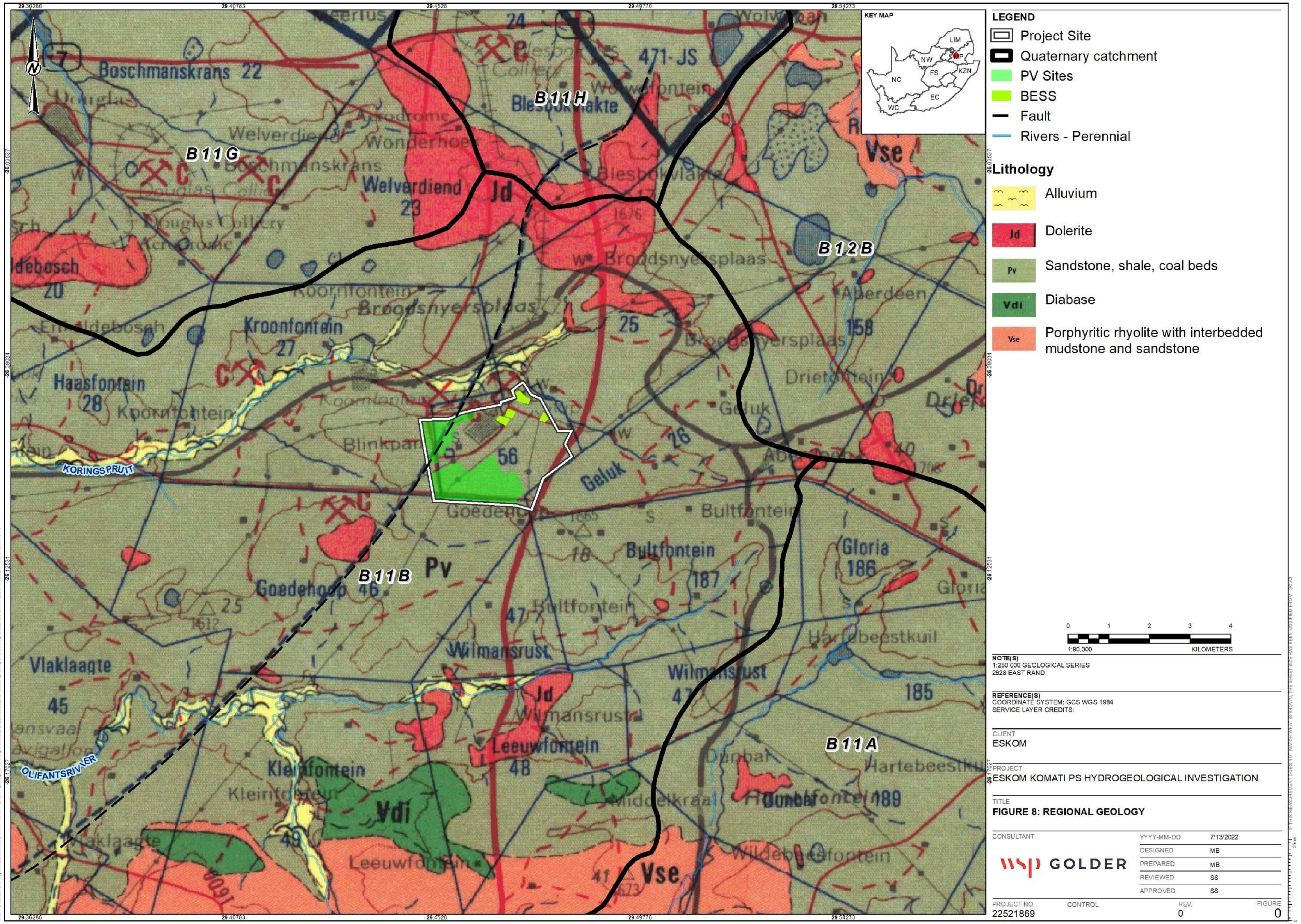

Figure 8: Regional Geology

4.2 Acid generation capacity

Not applicable as there are no waste facilities associated with the PV and BESS plant.

4.3 Hydrogeology

4.3.1 Unsaturated zone

This zone is conceptualized (Halenyane, 2019) as an upper zone of completely weathered material to a depth of 8 to 10 m. This layer is anticipated to have a higher hydraulic conductivity (k of 1 m/d) compared to the underlying rock matrix but is generally unsaturated. However, a seasonal aquifer perched on the bedrock may occur on this layer after high rainfall events.

Further information is pending from the contaminated land report currently in progress for the areas in which the PV and BESS is proposed.

4.3.2 Saturated zone

Halenyane, 2019 and Van Niekerk & Staats, 2009 suggests that multiple aquifer types are represented at the site. These include:

- Shallow aquifer with colluvial and alluvial matrix, the shallow aquifer is composed of weathered upper Ecca formation sediments, is seasonal, discontinuous, and perched above the more competent bedrock layers.
- Semi-confined aquifers within the Vryheid Formation. These aquifers are commonly confined along essentially horizontal bedding interfaces between different lithologies but can be locally unconfined along the trend of fractures zones, which allows the aquifers to recharge seasonally. This is considered to be the regional aquifer within the Project Area occurring below the unsaturated zone in slightly weathered or fractured bedrock to a depth of approximately 30 m with a low k (0,001 – 0,1 m/d). Halenyane, 2019 notes that the permanent groundwater level resides in this unit and is about 1 to 10 metres below ground level. The groundwater flow direction in this unit is influenced by regional topography and for the site flow would be in general from high lying areas to the Koringspruit River. This aquifer is likely to be highly heterogeneous.
- Deeper confined aquifers within basement lithologies.

4.3.3 Hydraulic conductivity

Hydraulic conductivity was estimated based on falling head tests (Van Niekerk & Staats, 2009) as ranging from 0,007 m/d at AB07 to 2.4 m/d for AB04 with an average of 0,51 m/d. Porosity was estimated as 0,3.

4.4 Groundwater levels

Water levels for monitoring boreholes located near the proposed BESS and PV areas (Block A, E and F) vary from around 2 to 12 mbgl and are provided in Table 5 below. The water levels for the other monitoring boreholes located within the KPS area vary from 0 (AB62) to around 6 mbgl are provided for reference. With the exception of AB55 and AB58, water levels vary between 0,6 and 3.6 m over the period provided (2016 to 2021).

As noted, above, there is no information for Block B, C, and D. New shallow boreholes have been drilled in or near these areas and will be included in the pending contaminated land report.

SRK 5666657 (2020) report that water levels have been lowered through dewatering of mine workings at Goedehoop Collieries. Water levels in the monitoring boreholes at KPS vary only slightly over time and do not appear to have been affected by dewatering at Goedehoop at the present time. Future undermining by Goodehoop Collieries to the south-east of the Ashing area may influence the local water levels. A summary of the latest water level data around August for the past three years is provided for reference in Table 5 Ambient boreholes and boreholes in or near the PV and BESS areas are presented first.

Table 5: Water level data at KPS

Locality	Sample ID	Bore-hole depth	Sample depth (mbgl)(1)	19-Aug-2018(1)	30-Jul-19(2)	20-Aug-20(3)	26-Aug-2021(4)
Ambient upstream (south) of Ashing area and Block A T junction - Witbank road.	AB58	ND		3,68	4.85	4,29	5,04
	AB59	ND-shallow		7,62	8.3	7,58	8,54
Boreholes in or near the proposed PV and BESS plants							
Inside Block A - Western boundary of Ashing Area and downstream of old rehabilitated domestic waste site.	AB01	35.5	15	1,75	3.66		
	AB63	ND		1,72	0	2,34	3,63
Outside Eastern boundary Block A - West of Ashing Area north of small ash dam as well as west of large ash dams.	AB02	32.5	20		2.79		
Outside Eastern boundary Block A - West of Ashing Area. West of ash dam and in town area	AB53	ND-deep		11,29	11.91	11,27	11,46
Outside but adjacent to Block F (east of KPS boundary) downstream of seepage recovery dam AP03.	AB07	37.0	15	2,62		2,17	4,01
Inside Block E - Coal Stockyard Area (water is black)	CB51	ND		1,85	1.18	4,28	4,92
Outside Block F on north-eastern corner of boundary & downstream of Coal Stockyard Area & dirty water dam	CB09	36.5	31		4.59		
Outside Block F on eastern boundary - downstream KPS Area	PB60	ND		2,23		2,54	2,33
Monitoring boreholes within the surrounding KPS area							
Ashing Area- Monitoring borehole downstream and north of small ash dam as well as west of large ash dams.	AB03	7.5 (collapsed)	-				
Ashing Area north-west of ash dams and south of dam AP02.	AB04	38.0	8.5		1.46		2,16
Ashing Area next to Komati Spruit west of KPS.	AB05	8.5 (collapsed)	-		4.3		
Ashing Area north and downstream of ash dams.	AB06	37.0		1,62		1,46	1,48
KPS & Sewage Plant Area	PB08	35.5	13	2,82			
Not indicated – probably incorrectly labelled	AB08					4,83	2,95
Ashing Area close to Komati Spruit, west of KPS.	AB47	ND					2,09
Ashing Area west of ash dam, next to AB53	AB54	ND - Shallow		1,47	2.33	1,59	1,98
Ashing Area North of ash dam. Next to tar road at Entrance Road to KPS	AB55	ND - Deep		5,83	6.22	5,64	6,39
Ashing Area- North of ash dam. Next to tar road at Entrance Road to KPS	AB56	ND- shallow		1,43	1.53	1,64	2,2
Ashing Area - West of ash dam	AB57	ND		2,64	4.86	3,13	3,45
Ashing Area - East of ash dam.	AB61	ND- deep				1,68	1,72
Ashing Area east of Ash Area – Shallow borehole and artesian	AB62	ND- shallow			1.88	0	0

Locality	Sample ID	Bore-hole depth	Sample depth (mbgl)(1)	19-Aug-2018(1)	30-Jul-19(2)	20-Aug-20(3)	26-Aug-2021(4)
Coal Stockyard Area	CB49	ND- deep			2.89		
Coal Stockyard Area	CB50	ND- shallow			2.8		
Coal Stockyard Area	CB52	ND		1,64		2,58	2,75
KPS Area- north of sewage plant	PB48	ND		1,06		1,6	1,36

Mathetsa, 2021 indicates that the groundwater flow mimics the topography, and the direction of flow are towards the surface stream, particularly the Koringspruit River. There is little seasonal variation noted. The contoured groundwater level is provided after Halenyane, 2019 (Refer Figure 9).

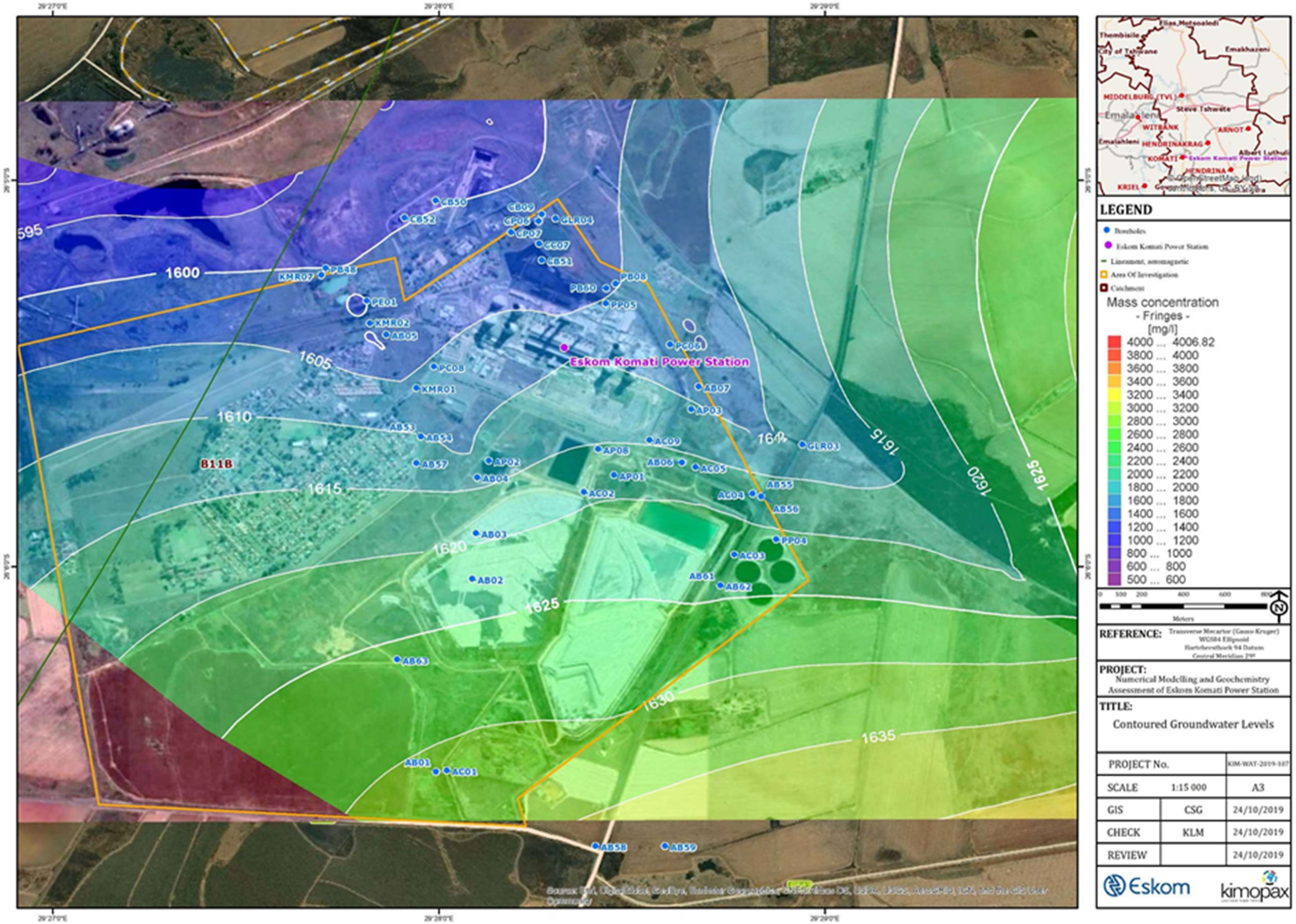

Figure 9: Groundwater contours - sourced from Halenyane, 2019

4.5 Groundwater potential contaminants

Residual contamination may be present in the PV and BESS areas due to historical activities generally related to the KPS. A contaminant land investigation is in progress to assess the potential for contamination to the groundwater. Of note is the residual ash footprint noted to the east of Block A. Block E is located in the coal stock yard area. Van Niekerk, 2009 noted that this area comprises the coal storage yard and coal stockyard pollution control dam as well as the settling ponds. Additional potential sources within the KPS area include a domestic waste dump, sewage plant and fuel depot,

4.6 Groundwater quality

Water quality data is captured in the WISH database for all parameters. Groundwater quality parameters that need to be analysed are specified in the WUL (Appendix IV, Table 6 Clause 3.6) as pH, Electrical conductivity (EC), Total Dissolved Solids (TDS), Total Suspended Solids (SS), Total Alkalinity, chloride (as Cl), sodium (as Na), sulphate, nitrate, ammonia, orthophosphate, fluoride, potassium, manganese, copper, iron, zinc, arsenic and chromium.

The groundwater reserve is provided in the WUL (Appendix IV, Table 7, Clause 4.1). Water quality is in, addition compared to the SANS 241-2015 standard for drinking water and to ambient water quality as represented by two upgradient monitoring boreholes (AB58 and AB59). The average and 95th percentile results for the upgradient ambient water quality (AB58 and AB59) and boreholes located in and around the proposed areas (Block B and Block E) are provided for reference in the table below

4.7 In summary:

The groundwater reserve is conservative and provides several determinants at concentrations which exceed baseline groundwater quality. (Refer Table 6). As a result, several parameters are not in compliance with the WUL.

The groundwater quality is generally alkaline with an average pH of 8,3 at the upstream ambient boreholes (AB58 and AB59). The 95th percentile results being higher at 9.1. pH is slightly lower in the boreholes located around the proposed areas with average pH varying from 7.2 to 8.

Electrical conductivity (EC) in the ambient boreholes (average 17 and 32 mS/m for AB58 and AB58 respectively) is below the groundwater reserve of 112 mS/m. EC is comparatively elevated at some of the boreholes in the proposed areas with the 95th percentiles for EC exceeding ambient groundwater quality and the reserve for AB01, AB07, CB51, CB09, PB60. The localized increase in salinity is associated with elevated chloride, sulfate, calcium, magnesium, and sodium. Fluoride is near the groundwater reserve of 0,4 mg/l in the ambient boreholes (95th percentile of 0,3 and 0,4 mg/l) and is locally elevated particularly in the coal stock yard area (Block E) with the 95th percentile of 1.1 mg/l at CB09 and 0,5 mg/L at the boundary of the KPS at PB60.

Metal concentrations for iron (95th percentile of 3.7 to 5.3 mg/l) and manganese (95th percentile of 6.6 mg/l) are slightly elevated compared to the ambient groundwater quality (<0,1 for iron and <0,5 for manganese) at AB07 (downgrade of the Ash dams) and in CB09 (coal stockyard). Arsenic is reported at below detection,

Water quality is locally affected by KPS activities particularly from the Ash dams (ashing area) and coal stockyard. A pollution plume is anticipated to migrate from the pollution sources towards the Koringspruit River to the north.

Table 6: Statistical Water Quality

Site Name		WUL	SANS 241-2015	Ambient Water Quality				Block A										Coal Stockyard			Block F	
				AB58		AB59		AB01		AB63		AC02		AB53		AB07		CB51		CB09	PB60	
				Ave	95th	Ave	95th	Ave	95th	Ave	95th	Ave	95th	Ave	95th	Ave	95th	Ave	95th		Ave	95th
Analyses	**Unit**			Oct-11 to Jan-22		Oct-11 to Jan-22		Aug-11 to May-21		Oct-11 to Jan-22		Jan -11 to Sep-18		Oct-11 to Jan-22		Oct-11 to Jan-22		Oct-11 to Mqy-20		Jan-11	Oct-11 to Jan-14	
pH	pH units	6.6	5.5-9.7	8,3	9,1	8,3	8,8	7,7	8,5	7,8	8,9	7,7	8,4	8,0	8,5	7,2	8,3	8,0	8,7	7,0	7,8	8,6
EC	mS/m	112	≤170AS	32	44	17	29	214	275	102	223	112	140	38	45	192	248	89	143	43	107	169
TDS	mg/l	NLG	≤1 200AS	214	290	107	189	1680	2055	706	1597	491	606	242	302	1570	2204	715	1124		819	1167
Turbidity	NTU			67	254	3	5	128	249	93	338	2	2	78	125	79	254	176	700		348	492
Ca	mg/l	96	NLG	16	25	7	12	154	225	75	222	107	125	32	39	175	286	50	150	51	52	71
Mg	mg/l	38	NLG	23	41	6	14	126	180	49	137	7	14	16	19	115	140	59	113	16	37	52
Na	mg/l	0	≤200AS	17	22	15	17	214	266	89	198	117	135	18	21	146	163	66	88	19	150	245
K	mg/l	NLG	NLG	12	15	8	11	28	37	10	33	35	43	8	9	10	12	2	3	4	5	7
TAlk as CaCO3	mg/l	NLG	NLG	165	253	75	126	480	823	197	484	100	136	112	141	169	210	197	383	156	315	484
F	mg/l	0.4	≤1.5^{CH}	0,3	0,4	0,1	0,3	3,1	0,6	1,5	1,0	0,3	0,4	0,9	0,5	2,5	0,6	0,3	0,7	0,7	0,1	0,5
Cl	mg/l	31	≤300AS	7	11	7	10	106	189	58	137	60	79	55	80	69	83	45	82	22	50	79
SO4	mg/l	0	≤500$^{A.}$ ≤250^{A}	8	21	2	8	669	999	293	940	403	497	5	15	852	1252	231	464	39	227	495
NO3-N	mgN/l	10.9	≤11^{A}	0,4	1,1	0,4	1,4	0,2	0,8	0,6	1,9	0,3	0,8	0,1	0,5	0,2	0,5	0,2	0,6	0,1	0,2	0,5
NH4-N	mgN/l	NLG	≤1.5^{AS}	0,4	1,9	0,9	1,1	0,1	0,2	0,2	0,9	<0,003	0,1	0,2	0,2	0,1	0,3	0,3	0,7		0,2	0,3
PO4	mgP/l	NLG	NLG	<0,01	0,03	<0,01	0,02	<0,01	0,02	0,46	0,10	0,003	0,10	<0,01	0,03	0,03	0,04	<0,01	0,03	0,10	<0,02	0,01
COD				16,5	51,7	16,9	55,4	23,7	70,2	26,9	79,7	31,0	59,7	12,4	31,3	28,8	69,6	34,0	71,8		29,5	52,1
Suspended Solids			<25	18,5	65,7	14,5	140,6	59,4	129,2	51,7	145,2	16,2	43,7	20,8	43,0	37,5	93,6	68,5	256,2		121,6	311,1
As	mg/l	NLG	≤0,01^{CH}	<0,03	<0,01	<0,03	<0,01	<0,04	<0,01	0,06	<0,01	1,60	3,04	<0,03	<0,01	<0,03	<0,01	<0,05	<0,01		<0,06	<0,01
Cr	mg/l	NLG	≤0,05^{CH}	<0,018	0,004	<0,018	0,004	<0,020	0,002	<0,003	0,010	0,109	0,588	<0,019	0,004	<0,015	0,006	<0,024	0,002	0,006	<0,020	0,005
Cr6+	mg/l	NLG		<0,198	<0,002	0,331	<0,002	3,331	14,999	3,616	0,031	<0,002	<0,002	1,903	<0,002	2,208	4,198	<0,002	<0,002		<0,002	<0,002
Cu	mg/l	NLG	≤2^{CH}	<0,01	0,01	<0,02	0,00	<0,02	0,03	<0,01	0,02	<0,11	0,01	<0,02	0,01	<0,01	0,03	<0,03	0,02	0,01	<0,03	0,01
Fe	mg/l	NLG	≤ 2$^{CH.}$ 0,3^{AS}	0,16	0,01	0,01	0,12	0,35	0,01	0,51	2,07	<0,03	0,17	0,02	0,07	0,98	5,28	0,16	0,01	0,1	0,0	0,0
Al	mg/l	NLG	300 (o)	0,52	0,88	0,01	0,16	0,98	0,06	0,42	0,29	1,08	5,50	0,08	0,12	1,45	0,30	<0,04	0,003	0,020	<0,037	0,003
Pb	mg/l	NLG	≤0,01^{CH}	<0,004	<0,004	<0,004	<0,004	<0,004	<0,004	0,243	<0,004			<0,004	<0,004	<0,004	<0,004	<0,004	<0,004		<0,004	<0,004
Mn	mg/l	NLG	≤0,4^{CH} and ≤0,1^{AS}	0,1	0,5	9,2	0,1	21,3	0,6	2,4	4,2	0,1	0,7	2,4	0,2	5,3	6,7	13,8	3,2	0,1	6,901	0,832
Hg	mg/l	NLG	≤0,006^{CH}	<0,004	<0,004	<0,004	<0,004	<0,004	<0,004	<0,004	<0,004			<0,004	<0,004	<0,004	<0,004	<0,004	<0,004			
Zn	mg/l	NLG	≤5AS	<0,027	0,012	<0,029	0,006	0,4	2,0	0,1	0,02	<0,3	<0,03	<0,03	<0,0002	0,7	1,8	<0,1	<0,002		<0,052	0,009
Si	mg/l	NLG	NLG	5,0	10,6	0,1	0,3	7,7	11,3	5,6	20,7	2,6	2,6	1,7	2,3	17,7	23,1	1,5	4,7		4,8	6,9

NLG: no guideline

H: Health

CH: Chronic health

A: Aesthetic

O= Operational

5.0 AQUIFER CHARACTERIZATION

5.1 Groundwater vulnerability

The Project Area is vulnerable to groundwater contamination due to the shallow water table. This is mitigated by the low k and low recharge. Due to the surrounding use of groundwater by communities, the aquifer is considered to have a high vulnerability to contamination as is indicated by the observed localised impact from existing sources.

5.2 Aquifer classification

The aquifer is classified as a Minor (Parsons[1], 1995; DWAF[2], 1998) or Poor (DEA[3], 2010) aquifer due to the low exploitation potential and low yields. It does, however, represent an important source of water for domestic supply to the local communities.

5.3 Aquifer protection classification

A weighting and rating approach is then used to decide on the appropriate level of groundwater protection (Table 7). After rating the aquifer system management and the aquifer vulnerability, the points are multiplied to obtain a Groundwater Quality Management (GQM) index.

Table 7: Ratings for the Aquifer Quality Management Classification System

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

Table 8: Appropriate level of groundwater protection required

GQM Index	Level of Protection
<1	Limited Protection
1 – 3	Low Level Protection
4 – 6	Medium Level Protection
7 – 10	High Level Protection
>10	Strictly Non-degradation

Table 9: Aquifer classification and vulnerability assessment

Description	Aquifer	Vulnerability	Rating	Protection
Regional Aquifer	Minor (2)	1-2	4	Medium

The above classification implies that the regional aquifer is less sensitive due to the low recharge and low k and hence a medium level of protection is required, (Parsons, 1995).

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1 Parsons, R, 1995, A South African Aquifer System Management Classification, WRC Report No. KV77/95.

2 Department of Water Affairs and Forestry, Second Edition, 1998. Waste Management Series, Minimum Requirements for Water Monitoring as Waste Management Facilities.

3 Department of Environmental Affairs, May 2010, Framework for the Management of Contaminated Land.

6.0 GROUNDWATER MODELLING

As stated in Section 4.5, a groundwater model is not required for this investigation as no pollution dams or 21 (g) water use are required for the PV and BESS plants. A comprehensive numerical groundwater model has been compiled for the KPS area as detailed by Halenyane, 2019.

7.0 IMPACT ASSESSMENT

The impact assessment follows the methodology as described in the EISA.

The activity is described in the EISA as follows:

The solar PV plant has a minimum design life of 25 years.

- During the life of the Solar PV facility, there will be normal maintenance of all electrical and mechanical components of the plant. In addition, there will be periodic cleaning and washing of the solar PV modules. This PV module cleaning will be performed when required, and it is estimated to occur 2-4 times a year. The water consumption during operation - estimated water required per year during operation is 10,000 kilolitres (total per year for design life of plant)".
- The site will have temporary laydown areas and offices for the construction contractors. Electrical supply could include use of generators and fuel storage (potentially diesel and oil), A concrete batching plant may be required.
- Construction could include excavation of trenches to allow for cabling and connections, foundations of the solar PV array and inverter stations.
- The main impacts considered are in terms of groundwater quality and quantity.
- Quality impacts could result from:
- Hydrocarbons associated with heavy moving equipment during site preparation and construction.
- Site equipment including transformers, solar PV modules, inverters, excavators, graders, trucks, compacting equipment and construction material etc.
- Fuel storage areas (diesel and oil for example).
- Existing contaminated footprint where washing of the panels could result in an increased leaching of contamination to the groundwater.
- The following parameters were noted as needing to be considered for the new activity: arsenic, cadmium, chromium, iron, lead, mercury, nickel, selenium, manganese, and zinc from the ash and coal storage areas; polychlorinated biphenyls, polycyclic aromatic hydrocarbon, BTEX (benzene, toluene, ethyl benzene, xylene), and other petroleum hydrocarbons from oil storage and mechanical and electrical equipment; and copper, iron, nickel, chromium, and zinc from metal cleaning and cooling tower blowdown wastewaters

Quantity impacts could result from:

- Reduced recharge as solar panels and an increased compacted/hard standing footprint will reduce the extent that rainfall can infiltrate to ground and recharge the aquifer.
- Localised ad hoc artificial recharge from water used to wash the panels and/or footprint areas.

It is noted that there is no groundwater abstraction planned from the groundwater for this activity.

The main receptors are considered to be community boreholes located in the surrounding farms and rivers both in terms of the aquatic ecology and as potential pathway of contaminated water downstream.

8.0 GEOHYDROLOGICAL IMPACTS

The impact assessment follows the methodology provided for the Scope of Works and assesses the potential significance of the impact pre- and post-mitigation for the following:

- Magnitude (M)
- Extent (E)
- Reversibility (R)
- Probability (P) and
- Duration (D)

8.1 Construction phase

There a no groundwater quantity impacts identified during construction as water will not be obtained from the groundwater resource.

Quality impacts are assessed as follows:

Impact number	Aspect	Description	Character	Ease of mitigation	Pre mitigation							Post Mitigation						
					M	E	R	D	P	S	Significance	M	E	R	D	P	S	Significance
1	Hydrocarbon spills from moving equipment	Decrease in groundwater quality	-ve	Moderate	2	1	3	2	3	24	N2 - Low	1	1	3	1	2	12	N1
2	Leachate/spills from fuel storage areas	Decrease in groundwater quality	-ve	Moderate	2	1	3	2	3	24	N2 - Low	1	1	3	1	2	12	N1
3	Spoil from excavated trenches may be contaminated and could leach to the groundwater.	Decrease in groundwater quality	-ve	Moderate	2	1	3	2	3	24	N2 - Low	1	1	3	1	2	12	N1

The following mitigation and management is recommended to manage the potential impacts:

- The low k and low recharge will limit the migration of contamination to receptors.
- Vehicles should be routinely inspected, and maintenance carried out to reduce likelihood of spillages.
- Parking should be on hard standing.
- Spill kits should be used to clean up spills when they occur.
- Fuel storage areas should be located in hard standing and bunded areas and pipelines regularly inspected to avoid leaks.

- Potentially contaminated areas should be assessed and identified such that spoil recovered from trenches in these areas can be disposed in an appropriate manner.

8.2 Operational phase

There are no groundwater quantity impacts identified during construction as water will not be obtained from the groundwater resource.

Note that the potential for leachate from contaminated land should be re-assessed following the outcome of the contaminated land investigation.

The following mitigation and management are recommended to manage the potential impacts:

- The aquifers within the proposed areas are limited and there are no groundwater users within the Project Area boundary. A reduction in recharge will therefore have a limited impact on receptors in the area. The potential for contaminated land in these areas is being assessed. However, groundwater is generally impacted (quality) by sources within the KPS, limiting the infiltration of rain through contaminated soils, particularly in the coal stock yard area which has been identified as a potential source, would reduce the leachate of contamination to the groundwater. This is therefore likely to result in a net positive benefit to the groundwater.
- The low k and low recharge will limit the migration of contamination to receptors.
- All equipment that has the potential to leach contamination to the environment should be stored on hard standing and in a bunded area (e.g., Fuel storage, soaps, greases, transformers etc.).
- Surface water controls to capture and contain wash water for re-use/management will reduce the impact to groundwater.

Quantity impacts are assessed as follows:

Impact number	Receptor	Description	Character	Ease of mitigation	Pre mitigation							Post Mitigation						
					M	E	R	D	P	S	Significance	M	E	R	D	P	S	Significance
1	Groundwater	Reduced recharge due to increase in hardstanding footprint	-ve	Moderate	3	1	3	4	3	33	N2 - Low	2	1	3	4	2	20	N2- low
2	Groundwater & Rivers	Localised artificial recharge due to washing of solar panels	-ve	Moderate	2	1	3	4	3	30	N2 - Low	1	1	3	1	2	12	N1 – very low

Quality impacts are assessed as follows:

Impact number	Receptor	Description	Character	Ease of mitigation	Pre mitigation							Post Mitigation						
					M	E	R	D	P	S	Significance	M	E	R	D	P	S	Significance
3	Groundwater	Reduced leachate from contaminated soils	+ve	Moderate	2	1	4	4	3	33	P3 - moderate	2	1	5	4	3	36	P3 - moderate
4	Groundwater & Rivers	Localised leachate from equipment	-ve	Moderate	3	1	5	4	3	39	N3 - Moderate	2	1	4	4	2	22	N2 - Low
5	Groundwater & Rivers	Localised increased leachate from contaminated soils due to following washing of solar panels	-ve	Moderate	3	1	5	4	3	39	N3 - Moderate	2	1	4	4	2	22	N2 - Low

8.3 Decommissioning phase

There are no quantity impacts identified during decommissioning. The quality impacts are anticipated to be similar to that envisaged during construction.

Impact number	Aspect	Description	Character	Ease of mitigation	Pre mitigation							Post Mitigation						
					M	E	R	D	P	S	Significance	M	E	R	D	P	S	Significance
1	Hydrocarbon spills from moving equipment	Decrease in groundwater quality	-ve	Moderate	2	1	3	2	3	24	N2 - Low	1	1	3	1	2	12	N1
2	Leachate from equipment no longer in use	Decrease in groundwater quality	-ve	Moderate	3	1	4	5	3	39	N2 - moderate	2	1	3	4	3	30	N2

The following mitigation and management are recommended to manage the potential impacts:

- The low k and low recharge will limit the migration of contamination to receptors.
- Vehicles should be routinely inspected, and maintenance carried out to reduce likelihood of spillages.
- Parking should be on hard standing.
- Spill kits should be used to clean up spills when they occur.
- Redundant equipment must be demolished and removed to an appropriate waste facility.
- Footprints should be re-assessed in terms of the Norms and Standards for Contaminated land and the areas managed accordingly. A remediation plan may be required depending on the outcome of the study.

8.4 Cumulative phase

Cumulative impacts are limited due to the low k and recharge. Monitoring and management as provided in the WUL should continue.

9.0 CONCLUSION AND RECOMMENDATIONS

The potential impacts from the PV and BESS activities are anticipated to be low to moderate and can be mitigated. A positive impact may be possible during operation where the activities could reduce the recharge through contaminated soils to groundwater.

Further monitoring requirements, other than the existing monitoring as provided by the WUL, has not been identified.

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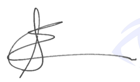

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APPENDIX A

Document Limitations