Technical Memorandum

To: Chané Coetzee	**From: Preanna Chaudhary**	
Company:	**SLR Consulting (South Africa) Proprietary Limited**	
cc: Mihai Muresan	**Date:**	4 August 2023
	Project No.	710.09002.00025

RE: High-level Groundwater Desktop Assessment

1.0 Introduction

Marula Platinum (Pty) Ltd (Marula), an existing platinum producer and a subsidiary of Impala Platinum Holdings Limited, owns and operates Marula Mine. The Marula Mine is situated along the R 37 road, approximately 30 km to the north-west of the town Burgersfort and has been operational since 2001.

Marula now proposes to change their approved surface infrastructure layout, through the establishment of a Solar Photovoltaic (PV) facility, with a generation capacity of up to 33 Megawatt (MW), within its existing Mining Right area (MRA) for self-generation only (the solar PV facility is hereafter referred to as the proposed Project, or just Project). The proposed solar PV facility will be connected through the expansion of the Marula Mine's existing transmission infrastructure and substation.

The Project also includes a Battery Energy Storage System (BESS),

Due to the nature of the Project, various legal requirements and studies are necessary to successfully develop the facility. As such, SLR was asked to undertake a high-level desktop groundwater study, to fulfil the requirements of the Department of Mineral Resources and Energy (DMRE) that a hydrogeological specialist advise if the Project will have a significant impact on local water resources and underlying aquifer(s).

2.0 Geological Setting

The eastern limb of the Bushveld Igneous Complex (BIC) underlies the farms Winnarshoek 250 KT, Driekop 253 KT, Clapham 118 KT, Forest Hill 117 KT and Hackney 116 KT. Two lithologically distinct units that are mainly intrusive into the Transvaal Supergroup make up the BIC: a lower sequence of layered mafic and ultramafic rocks, known as the Rustenburg Layered Suite (RLS), and an overlying unit of granites, known as the Lebowa Granite Suite. All the chromitite and platinum mineralisation is in the RLS. These layered rocks have a maximum thickness of up to 8 km and occur in four areas known as the western, eastern, Potgietersrus and Bethal lobes. The RLS comprises five stratigraphic zones representing the sequential fractional crystallization that accompanied the cooling of this magmatic body:

- The Marginal Zone, which comprises pyroxenites and norites with no economic potential.
- The Lower Zone which comprises ultramafic rocks, such as pyroxenites and harzburgites, containing thin, high-grade chromitite seams.

- The Critical Zone pyroxenites, norites and anorthosites that host all the significant platinum group metals chromite deposits.
- The Main Zone, which consists mainly of homogeneous norites and gabbros that are locally exploited as dimension stone.
- The Upper Zone norites, gabbros and diorites, which host over 20 massive magnetite seams, some of which are exploited for vanadium and iron ore.

The Marula project area in general is underlain by norite, leuconorite, anorthosite and pyroxenite of the Main and Critical Zone of the RLS of the BIC. The Leolo mountains to the west of Winnarshoek 250KT comprise of norite. The norite has weathered to black turf-like clay in the plains adjacent to the mountains and hills. The main rock types in the RLS (Geological Map, Sheet 2430 Pilgrim's Rest 1:250 000) include:

- Diabase: Green, fine to medium grained diabase.
- Shelter Norite: fine to medium grained norite and pyroxenite.
- Croydon Subsuite: medium to coarse grained pyroxenite and felspathic pyroxenite.
- Dwars River Subsuite: medium to coarse grained norite and anorthosite, pyroxenite - includes the Merensky Reef.
- Dsjate Subsuite: coarse grained gabbro and anorthosite.

The entire area is covered with quaternary sediments and the streambeds and floodplains consist of alluvium and unconsolidated deposits (Figure 2-1). From a structural perspective, the area cross-cut with northeast-southwest trending faults and inferred structures. These structural features typically act as flow paths of groundwater.

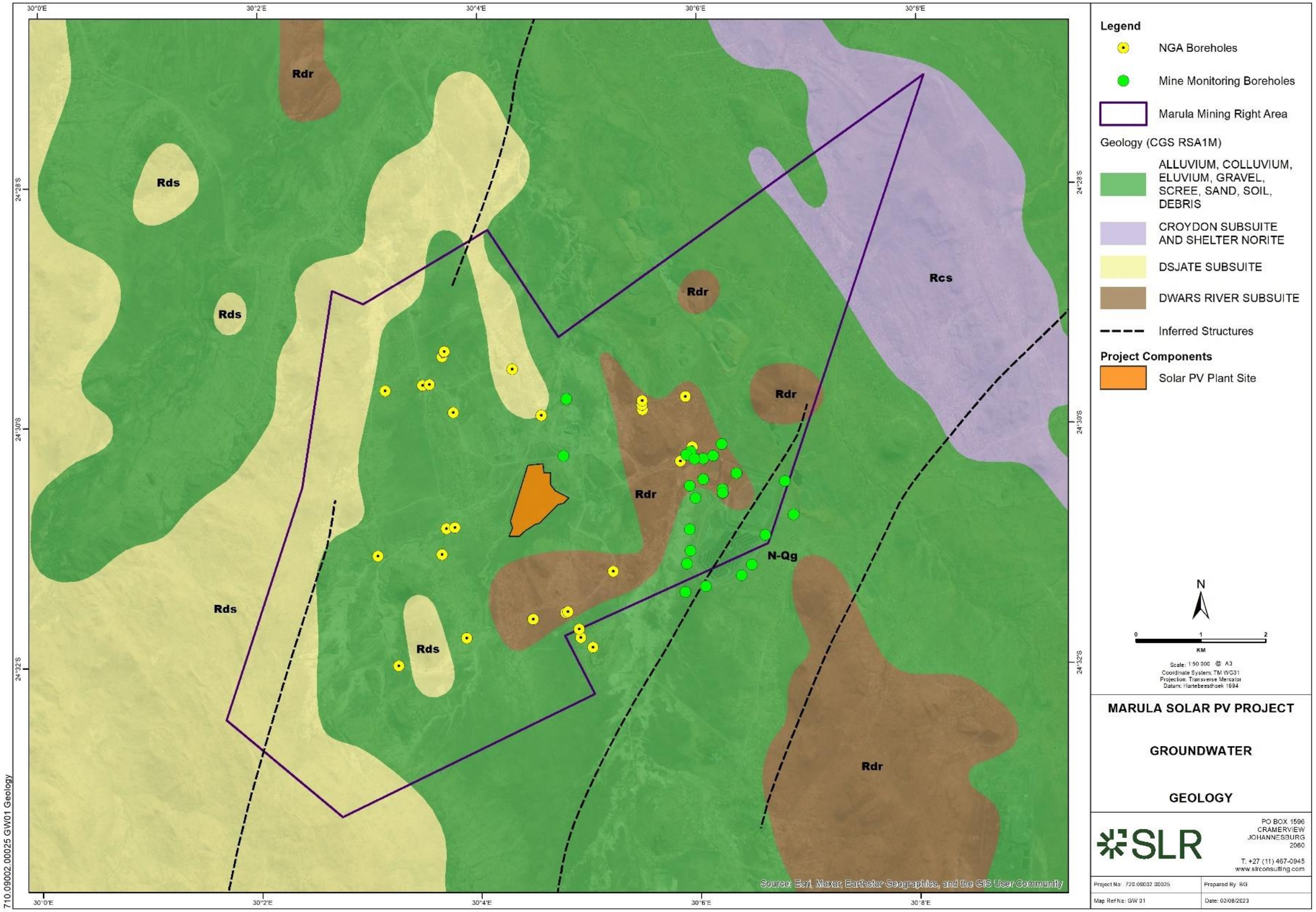

Figure 2-1: Geological map of the study area showing the subsuites and overlying unconsolidated units in relation to the site

3.0 Aquifer potential

Based on the hydrogeological characteristics of the site, aquifers in South Africa are classified as either major, minor and poor aquifer regions as well as sole source aquifers (DWAF, 2012). The Project site is underlain by a minor aquifer (see Figure 3-1). As a result, the underlying aquifer is not expected to be highly productive or heavily pumped for water supply needs in the surrounding area. Due to the lower hydraulic conductivity associated with a minor aquifer, it is expected that any contaminant spreading that could occur, would be limited in spread and relatively slow compared to that of major aquifers. The closest major aquifer is located approximately 20 km northeast of the site and deemed too far to have any significant impact in the context of the Project.

Further, the aquifer potential is defined by the potential yield and as well as type of aquifer. The project site is characterised by an intergranular and fractured rock aquifer with a regional yield potential of 2 – 5 L/s (Figure 3-2). This aquifer is flanked by a lower yielding intergranular and fractured aquifer, with a potential yield ranging from 0.5 – 2 L/s. The intergranular (or primary) aquifer is defined as a water bearing geological formation where water is stored and moves through voids between individual grains making up the aquifer material, which in this case is the unconsolidated alluvium cover. These regional yields were historically established from large datasets and are not considered site-specific as variations may occur. Faults and lineaments extending through the area are conduits of groundwater flow, and depending on their characteristics, may increase yield potential locally.

Given the geological structures and associated aquifer potentials, the study area may be separated into hydrogeological zones. Figure 3-3 shows the area surrounding the project site as characterised as low to moderate yielding formations, except where fractured, while the far east is classified as low yielding formations except where fractured. These regional zones further confirm the aquifer potential delineated. Lower hydraulic conductivity indicates from a contaminant transport point of view, that the risk is low.

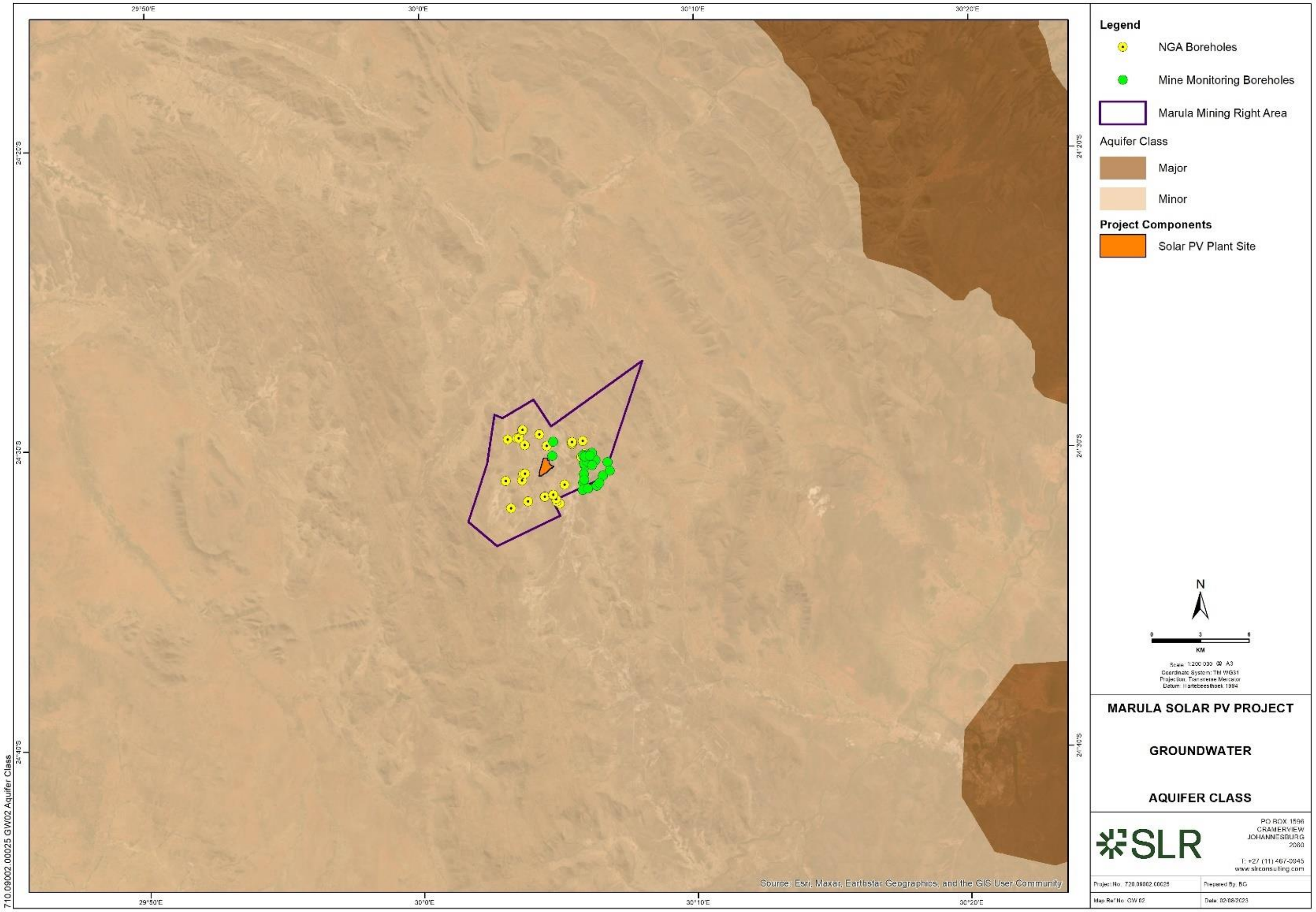

Figure 3-1: Aquifer class map for the study area showing minor and major aquifer classes in relation to the site

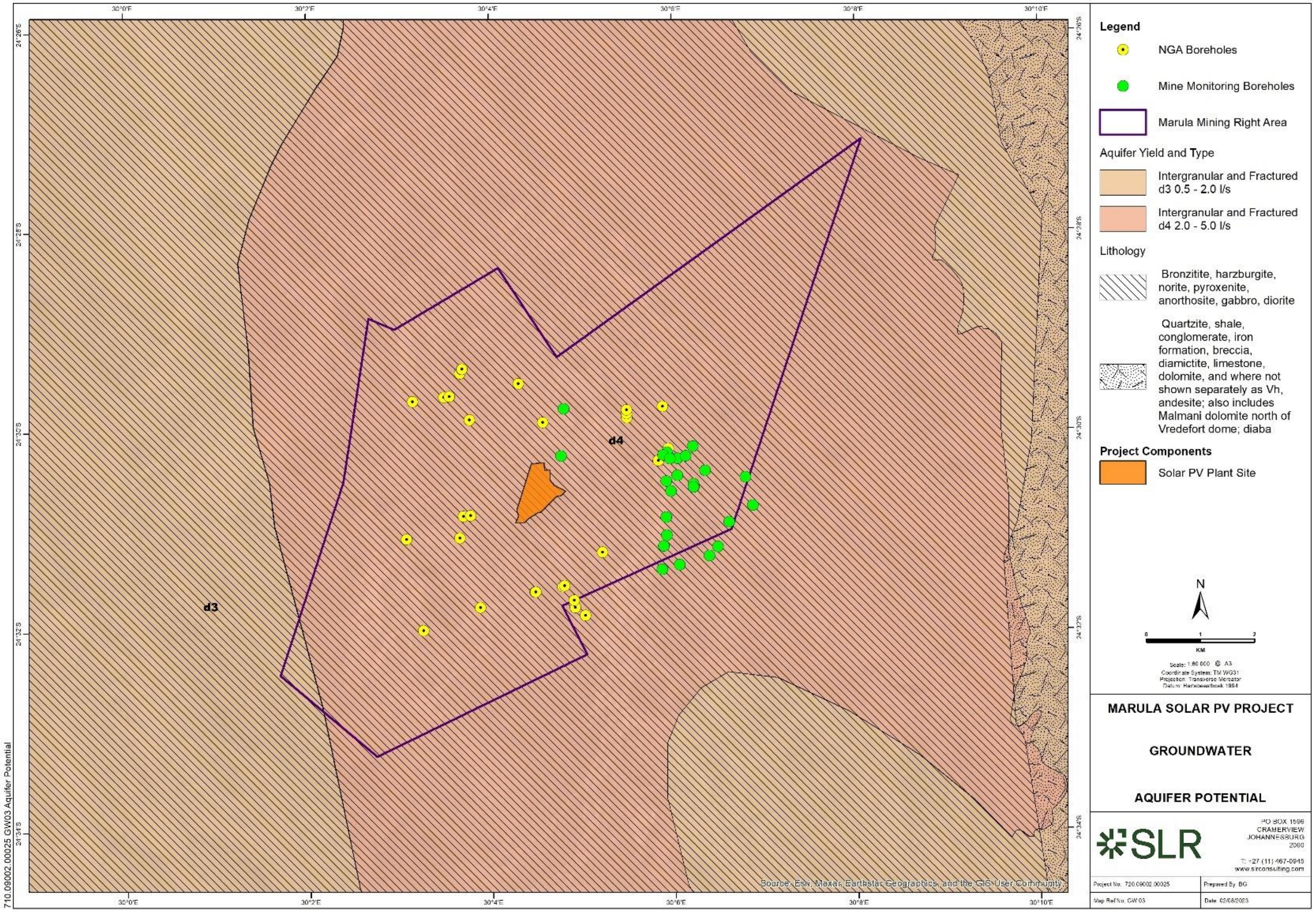

Figure 3-2: Aquifer Potential Map showing aquifer yields and types in relation to the site

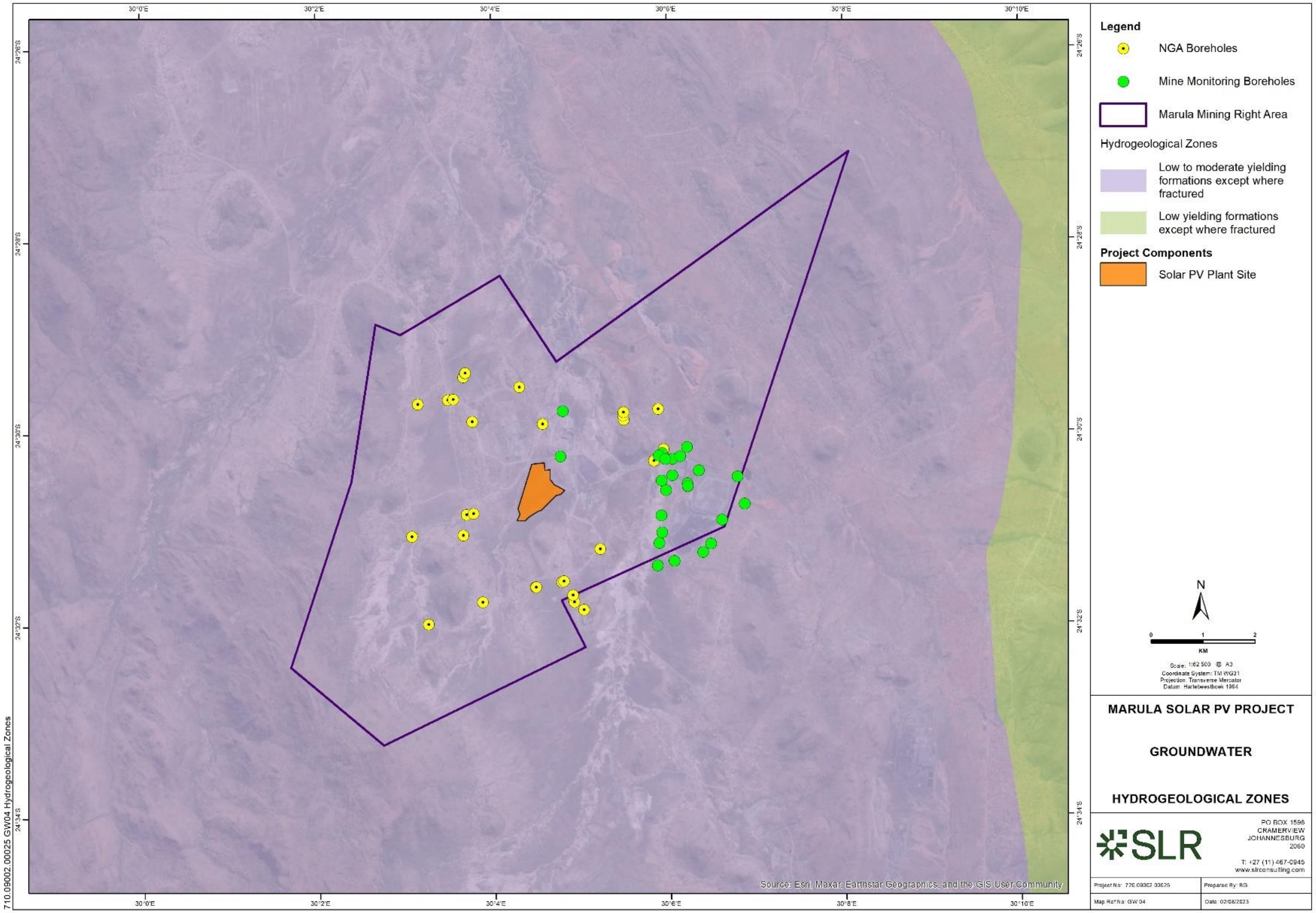

Figure 3-3: Map of Hydrogeological zones

4.0 Aquifer Vulnerability

Mapping the vulnerability of aquifers to pollution involves estimating the potential for contaminants to migrate from the land surface through the unsaturated zone to groundwater throughout areas of interest. DRASTIC is a widely used methodology in respect of aquifer vulnerability mapping and is used to identify areas that are more susceptible to contamination than others. The acronym is characterised by the following:

Depth to water table

Net **R**echarge

Aquifer media

Soil Media

Topography

Impact of Vadose zone

Hydraulic **C**onductivity

Apart from directly influencing aquifer vulnerability, the factors above also have different weightings in their overall calculation of aquifer vulnerability. Therefore, aquifer vulnerability is extremely site-specific. However, through regional data, a national DRASTIC map has been developed (DWAF, 2005). Figure 4-1 presents the DRASTIC classification in relation to the Project site and surrounding area, indicating Low Aquifer Vulnerability. As such, the area is less susceptible to groundwater contamination. Since one of the heaviest weightings are given to aquifer media, it stands to reason that the Croydon Subsuite (classified as a major aquifer) is deemed as having a high vulnerability in the northeast.

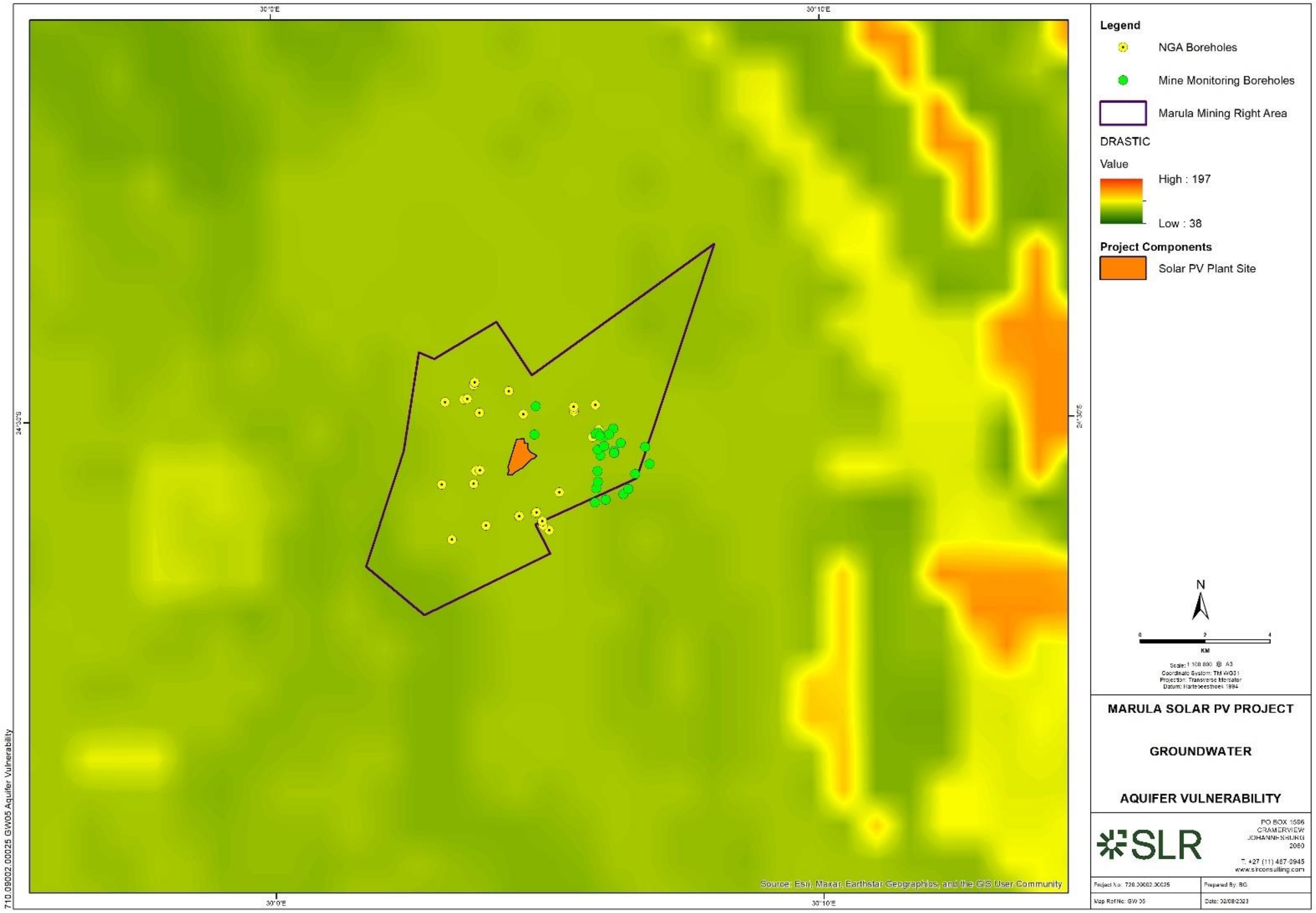

Figure 4-1: DRASTIC map representing groundwater vulnerability in the Project area and surrounds.

5.0 Desktop reconnaissance

To further the understanding of local groundwater conditions, it is necessary to undertake a desktop reconnaissance survey. Sources of information included SLR's internal database, the National Groundwater Archives, which is maintained by the Department of Water and Sanitation (DWS) and water monitoring data from the Marula Platinum Mine.

5.1 National Groundwater Archive (NGA)

A radius of 2 km from the Project site, was used to search for existing boreholes. The NGA database indicates 29 boreholes within this search radius with limited technical information available. Information pertaining to three of the boreholes, namely H12-1545, H12-1544 and H12-1546, show that the upper 0 to 15 m are characterised by either calcrete or alluvium, while pyroxenite is present to the final depth, i.e., approximately 102 m. A 10 m thick dolerite dyke was intersected in H12-1546 (15 – 25 m) thereby creating a preferential flow path for groundwater.

The water level data of 12 meters below ground level (mbgl) in these boreholes are from October 1999 and deemed outdated. H12-1546 had a reported yield of 4.1 L/s, within the regional aquifer potential range of 2 – 5 L/s.

Table 5-1: Summary of NGA boreholes located within 2 km of the project site

Borehole ID	Latitude (DD)	Longitude (DD)	Water level (mbgl)	Yield (L/s)	Lithology
H12-1883	-24.53332	30.05422	-	-	-
H12-1377	-24.53092	30.08375	-	-	-
H12-0631	-24.52956	30.08193	-	-	-
H12-1368	-24.52953	30.06458	-	-	-
H12-2698	-24.52836	30.08169	-	-	-
H12-2699	-24.52697	30.07458	-	-	-
H12-1884	-24.52697	30.07472	-	-	-
H12-1378	-24.52608	30.07964	-	-	-
H12-0634	-24.52595	30.07999	-	-	-
H12-1379	-24.52039	30.08693	-	-	-
H12-1393	-24.51806	30.05119	-	-	-
H12-1887	-24.51789	30.06092	-	-	-
H12-0653	-24.51428	30.06159	-	-	-
H12-0653	-24.51413	30.06289	-	-	-
H12-1338	-24.50511	30.09721	-	-	-

Borehole ID	Latitude (DD)	Longitude (DD)	Water level (mbgl)	Yield (L/s)	Lithology
H12-1546	-24.50311	30.09904	-	-	-
H12-1123	-24.49864	30.07614	-	-	-
H12-1128	-24.49817	30.06277	-	-	-
H12-1545	-24.49793	30.09152	12		0-4 m: Calcrete, 4-102 m: Pyroxenite
H12-1544	-24.49722	30.09145	12		0-12 m: Alluvium, 12-90 m: Pyroxenite
H12-1546	-24.49665	30.09148	12	4.1	0-15 m: Calcrete, 15-25 m: Dolerite, 25-98 m: Pyroxenite
H12-1124	-24.49611	30.09806	-	-	-
H12-1904	-24.49508	30.05242	-	-	-
H12-2703	-24.49436	30.05813	-	-	-
H12-1127	-24.49425	30.05917	-	-	-
H12-1865	-24.49219	30.07175	-	-	-
H12-1125	-24.49039	30.06110	-	-	-
H12-1857	-24.48973	30.06143	-	-	-
H12-1125	-24.48968	30.06147	-	-	-

5.2 Data from Marula Platinum Mine

The mine provided water monitoring data which forms part of their regulatory compliance. In total 26 boreholes make up the monitoring network, most of which are located 2 km east of the Project site.

Data from June 2020 shows water levels range from 2.3 to 13.88 mbgl (SRK, 2020). Due to the locations of the boreholes, it is not possible to deduce a general groundwater flow direction in relation to the Mine or the proposed Project site. According to SRK (2020), the groundwater quality locally exceeds these reference values for the B71E quaternary catchment per Government Notice 932, Gazette No. 41887, 7 September 2018 (DWS, 2002) because of the natural geology and contributions from anthropogenic sources unrelated to the mine's activities.

Table 5-2: Borehole water level data from Marula, June 2020 (SRK, 2020)

Borehole ID	Latitude (DD)	Longitude (DD)	Water level (mbgl)
TDBk	-24.51023	30.09950	-
A07_Bopt1	-24.51939	30.09814	-

Borehole ID	Latitude (DD)	Longitude (DD)	Water level (mbgl)
A07_Bopt2	-24.50794	30.11309	-
A05_B	-24.51460	30.09859	-
A01_B	-24.52331	30.09783	-
New3	-24.52252	30.10100	-
New5	-24.50478	30.10070	-
SRKM1B	-24.51759	30.09868	-
scav2	-24.50904	30.10359	-
17 Handpump	-24.52104	30.10644	-
AO11	-24.50857	30.09864	-
CL WRBhole	-24.50428	30.07947	-
CL WRD	-24.49638	30.07997	-
Frasers	-24.50764	30.10068	-
H12-1545	-24.50462	30.09922	9.45
H12-1546	-24.50376	30.09877	-
Mhandug	-24.50422	30.09810	-
MTD	-24.50682	30.10573	-
SRK10D	-24.51541	30.11008	-
SRKM16	-24.50276	30.10350	-
SRKM25	-24.51264	30.11440	13.88
SRKM26	-24.50481	30.09935	9.3
SRKM27	-24.50437	30.10220	-
A03	-24.51956	30.10798	-
SRKM3D	-24.50958	30.10364	2.34
SRKM3S	-24.50955	30.10363	2.3

6.0 Groundwater Monitoring Recommendation

While the regional aquifer vulnerability classification is Low, this is based on large datasets and best practice methods to ensure groundwater protection is still advised. The advise is as per below:

- Strategic boreholes upgradient of the Project site, (and within the mining right area) should be selected as baseline boreholes. A minimum of three boreholes should be selected for this purpose.
- The respective depths of the boreholes should be known, and water levels measured, prior to pumping/purging for sampling. Appropriate groundwater sampling should take place every quarter, to account for seasonal variations. Samples should be sent to a SANAS accredited laboratory for analyses.
- A groundwater monitoring plan and database should be created, with the information showing time-series trends in groundwater levels and water quality.
- The information should be reviewed annually by a hydrogeologist to identify any groundwater issues that may arise.

7.0 Conclusion

Based on the desktop study, the aquifer potential is **low to moderate** while the aquifer vulnerability associated with the Project site is deemed **low**. No reliable recent data could provide more site-specific information, due to the borehole distances in relation to the Project area.

Regarding the Battery Energy Storage System, it is known, at this stage, how exactly this will be designed, or various components included. However, this can be considered a low risk component of the projects, or a no risk component, as long as the BESS will be constructed on a foundation and cement slab (expected – due to the weight of such system). A special mention is made regarding the replacement and decommissioning of the BESS, which will have to adhere to the decommissioning plan and regulations in place.

Based on proposed Project activities as well as this study, the risk of groundwater contamination in the context of this solar project is low. Thus, a comprehensive groundwater assessment is not necessary. However, best practice in terms of groundwater monitoring is still advised, to guard against any potential issues and act as an early warning system.

Regards,

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