JG AFRIKA
EXPERIENCE QUALITY INTEGRITY

GEOHYDROLOGICAL ASSESSMENT FOR THE PAARDEVLEI SOLAR PV SITE CLOSE TO SOMERSET WEST, WESTERN CAPE

OCTOBER 2024
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Prepared by:

JG AFRIKA (PTY) LTD

DURBAN BRANCH

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[redacted]	[redacted]

AUTHOR	CLIENT CONTACT PERSON
Priantha Subrayen	Muhammad Imran

SYNOPSIS

Geohydrological assessment for the proposed Paardevlei Solar PV facility

KEY WORDS:

Geology, geohydrology, hydrocensus, water quality, groundwater flow, risk and impact

QUALITY VERIFICATION

This report has been prepared under the controls established by a quality management system that meets the requirements of ISO9001: 2015 which has been independently certified by DEKRA Certification

Verification	Capacity	Name	Signature	Date
Written by	Engineering Geologist	Priantha Subrayen	[redacted]	15 October 2024
Reviewed and Authorised by	Executive Associate	Robert Schapers	[redacted]	15 October 2024
Filename:	V:\Active Projects\006049 - Paardevlei Solar PV Project (RR)\04-Documents-Reports\Reports (JG Afrika)\006049_Paardevlei Solar PV Site_Geohydrological Assessment Final.docx			

GEOHYDROLOGICAL ASSESMENT FOR THE PAARDEVLEI SOLAR PV SITE CLOSE TO SOMERSET WEST, WESTERN CAPE

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DECLARATION OF THE SPECIALIST

I Robert Schapers, as the appointed Specialist hereby declare/affirm the correctness of the information provided or to be provided as part of the application, and that:

- In terms of the general requirement to be independent:
    - other than fair remuneration for work performed in terms of this application, have no business, financial, personal or other interest in the development proposal or application and that there are no circumstances that may compromise my objectivity; or
    - ~~am not independent, but another specialist (the "Review Specialist") that meets the general requirements set out in Regulation 13 of the NEMA EIA Regulations has been appointed to review my work (Note: a declaration by the review specialist must be submitted);~~
- I have disclosed to ~~the applicant~~, the EAP, ~~the Review EAP (if applicable), the Department and I&APs~~ all material information that has or may have the potential to influence the decision of the Department or the objectivity of any Report, plan or document prepared or to be prepared as part of the application; and
- I am aware that a false declaration is an offence in terms of Regulation 48 of the EIA Regulations.

	02 August 2024
Signature of the Specialist:	Date:

JG AFRIKA (PTY) LTD

Name of company (if applicable):

GEOHYDROLOGICAL ASSESMENT FOR THE PAARDEVLEI SOLAR PV SITE CLOSE TO SOMERSET WEST, WESTERN CAPE

1 INTRODUCTION

This report presents the results of a geohydrological assessment carried out for the Paardevlei Solar PV site close to Somerset West in the Western Cape. The geohydrological report has been prepared as a specialist study in support of the Environmental Impact Assessment as per the National Environmental Management Act of 1889 (Act 107 of 1998) and Appendix 6 of the Environmental Impact Regulations of 2014 (as amended).

We refer to our proposal reference 005938 2317065/P1, titled "Quotation for A Geohydrological Assessment at the Proposed Paardevlei Solar PV Project, Somerset West", dated 14 August 2023. JG Afrika were appointed to proceed with the assessment via email on 08 September 2023.

2 INFORMATION SUPPLIED

The following information has been used in the preparation of this report:

Reports, Documents and Guidelines

- Government Notice R267 of March 2017. National Water Act, 1998 (Act No. 36 of 1998). Regulations Regarding the Procedural Requirements for Water Use Licence Applications and Appeals
- Government Notice GNR of December 2014, as mended April 2017. Environmental Impact Regulations
- Parsons RP (1995). A South African Aquifer System Management Classification. WRC Report No. 77/95, Water Research Commission, Pretoria
- Report reference 525170/2 of SRK Consulting (Pty) Ltd, titled "Hydrogeological Overview of the Paardevlei Site (formerly AECI Factory), Somerset West", dated October 2018
- Report reference 525170/1 Rev 4 of SRK Consulting (Pty) Ltd, titled "Contamination Status: Paardevlei Precinct 2 Development Area", dated January 2019
- Specialist Terms of Reference for the Paardevlei Solar PV Project prepared by Integration Environment & Energy, titled "Specialist Terms of Reference", dated August 2023
- The Department of Water Affairs, First Edition, February 2010. Operational Guideline: Integrated Water and Waste Management Plan.

Maps and Drawings

- Drawing numbered PAARD-SIT-PLN-01 of Single Destination Engineering, titled "Site Plan Solar Field – Fixed Tilt", at a scale of 1: 5000, dated 02 October 2023
- Drawing numbered PAARD-SIT-PLN-02 of Single Destination Engineering, titled "Site Plan Solar Field – Single Axis Tracker", at a scale of 1: 5000, dated 02 October 2023
- Drawing numbered PAARD-SIT-PLN-03 of Single Destination Engineering, titled "Site Plan Solar Field – East West Sheds", at a scale of 1: 5000, dated 02 October 2023
- Map Sheet titled, "3318 Cape Town", at a scale of 1:250 000, dated 1988, of the Geological Map Series, supplied by the Department of Mineral and Energy Affairs
- Map Sheet titled, "Cape Town 3317", at a scale of 1:500 000, first edition, dated 1998, of the Hydrogeological Map Series of the Republic of South Africa, supplied by the Directorate: Geohydrology, of the Department of Water Affairs and Forestry.

Data

- National Groundwater Archive (NGA) digital information, as supplied by The Department of Water and Sanitation (DWS) as at December 2023
- Water Use Authorization and Registration Management System (WARMS) as supplied by The Department of Water and Sanitation (DWS) as at December 2023
- Google Earth Pro version 7.3.3 of July 2021

3 SITE DESCRIPTION

The Paardevlei Solar PV Site is located on the former Africa Explosives and Chemical Industries (AECI) factory owned property across Portions 10 and 11 of Farm 787 (Helderberg Sleeper Plantation), Remainder of Portion 792 and Portion 37, as well as the Remainder of Portion 38 of Farm 794, close to Somerset West in the Western Cape. All farm portions are currently owned by the City of Cape Town. The site is approximately 152ha in extent and is to include a 30MW to 60 MW PV facility and Battery Energy Storage System (BESS). Access to the study area can be gained off the N2 Highway which buffers its north eastern boundary. The location of the site is presented in Figure 1.

The Paardevlei Solar PV site has an elevation range of 21 to 17 maMSL, with the highest areas being along the northern boundary, and the low point being in the south, towards False Bay. There are no major rivers within the site boundary, however, tributaries of Lourens and Eerste Rivers flow within 4 km of the eastern and western boundaries of the Paardevlei Solar PV site respectively. Additionally, several surface water bodies have been identified within the north eastern, south western and southern portions of the site.

The site is at present vacant with several active and non-active monitoring boreholes present throughout. The activities associated with the project include site establishment of contractors and set-up of site camps and operation and maintenance buildings, the construction of temporary access roads and other construction related activities including site clearing, excavation, stock piling of materials and civil engineering works. Domestic waste generated during the course of the construction phase would be collected and stored in suitable receptacles onsite for collection and disposal at an appropriately licensed municipal waste site or acceptable disposal facility. Water would be required for dust suppression (on stockpiles and the access roads) and ancillary activities associated with the construction operations (washing of vehicles and equipment) and general use. A generalised site layout is provided in Figure 2.

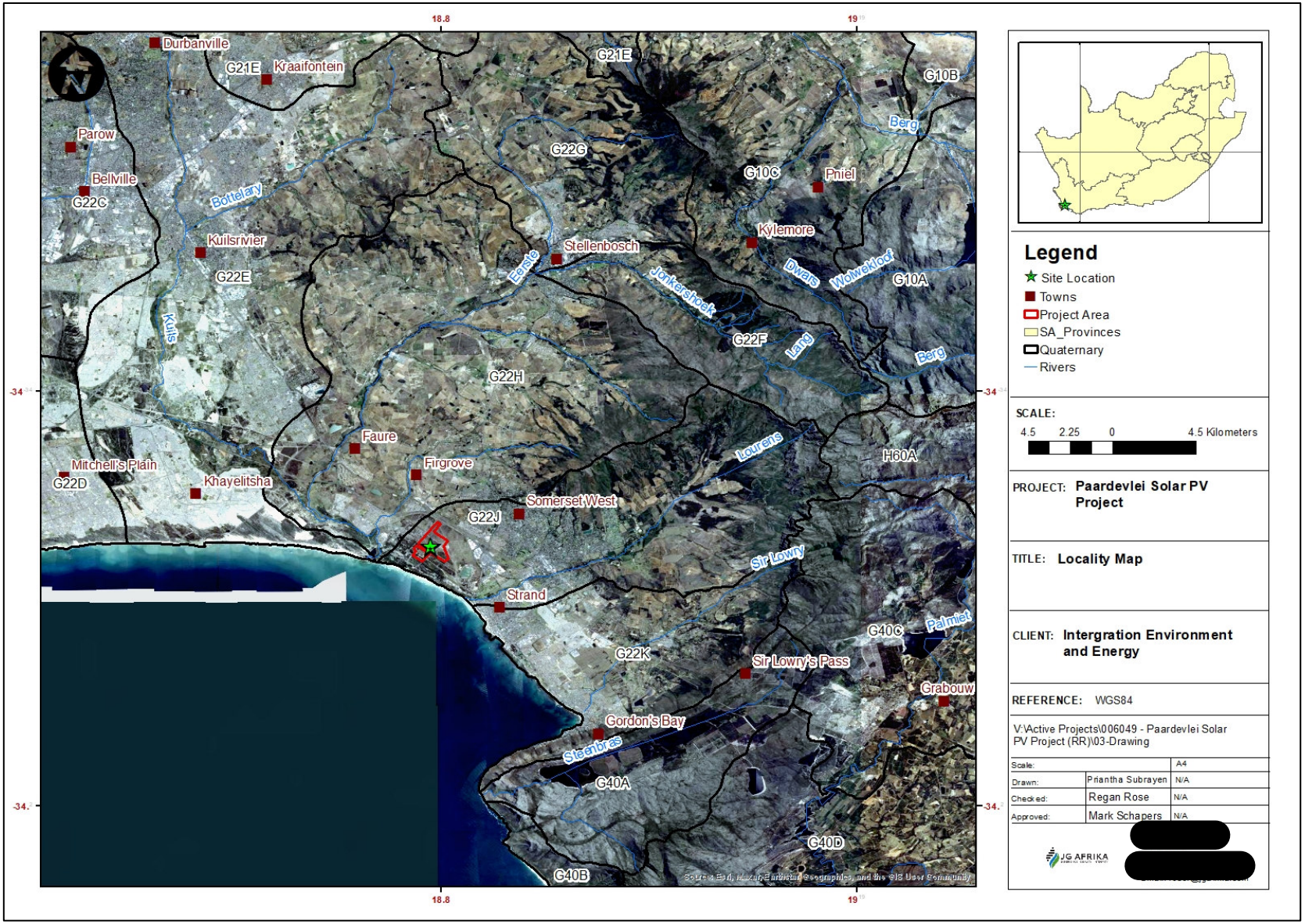


Figure 1: Locality Plan

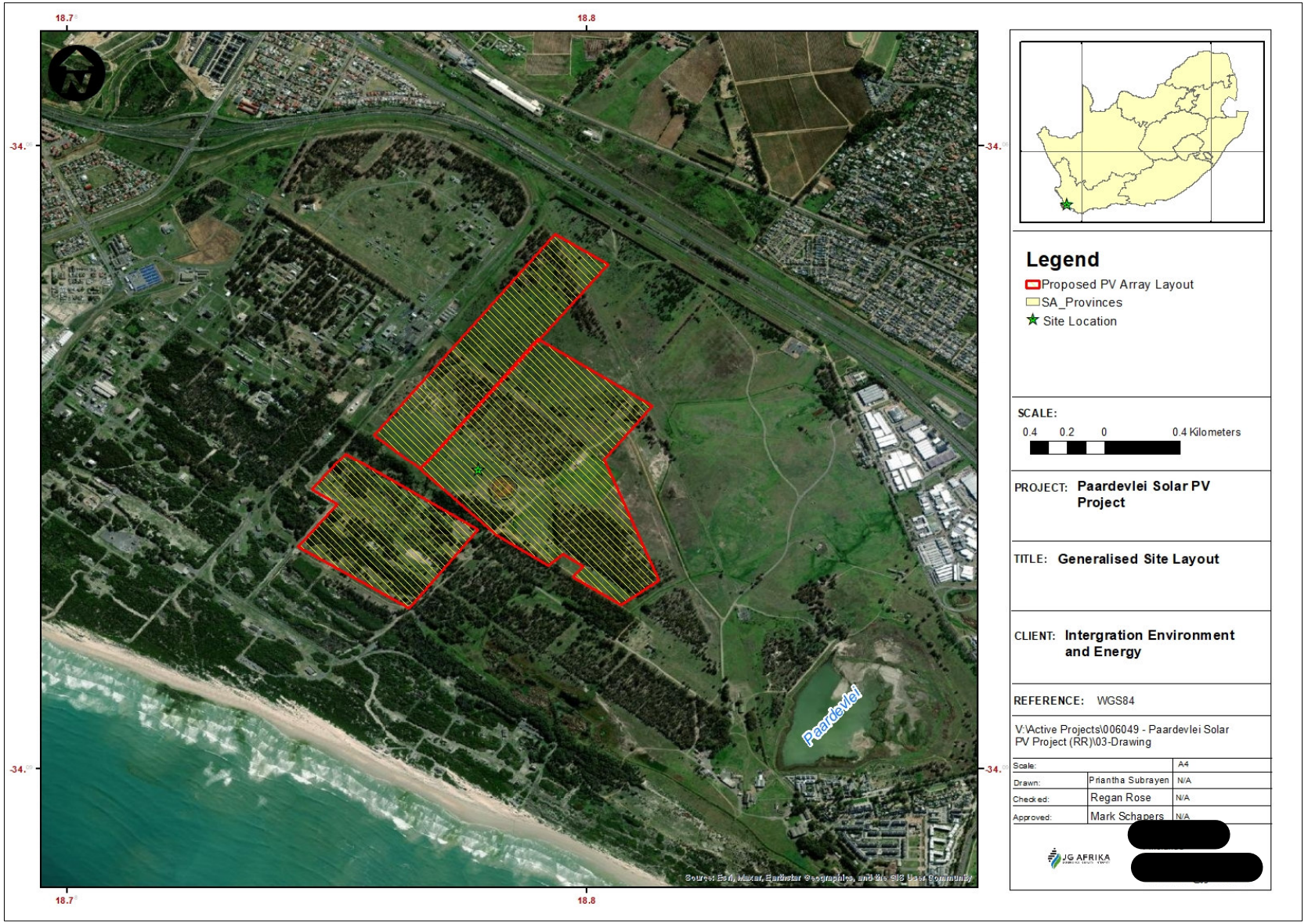


Figure 2: Generalised Site Layout

4 DESKTOP AND SITE ASSESSMENT

4.1 Regional Geology and Structures

The regional geology of the area comprises greywacke, phyllite, quartzitic sandstone and interbedded lava of the Tygerberg Formation (Nt). Plutons of the Cape Granite Suite (N-Ck) have intruded the Tygerberg Formation to the north of the study area. These rock units mainly comprise porphyritic, leucocratic, hybridic or tourmaline bearing biotic granite. Additionally, localised Post Karoo dolerite intrusions (do) are present to the north west of the site. These intrusions are however mostly confined to the Tygerberg Formation shale. The unconsolidated to semi-consolidated, heterogenous Quaternary deposits of the Sandveld Group including the basal Springfontyn Formation (Qs) and younger Langebaan (Ql) and Witzand Formations (Qw), respectively, overlie the Tygerberg Formation and Cape Granite Suite in the area. Occurring in the immediate vicinity of the Paardevlei Solar PV development area, the Langebaan Formation is composed of limestone and calcrete and partially cross bedded parabolic dune sands, together with alluvium (along riverbeds) and underlies the south western boundary. The central and north eastern margins are underlain by the Springfontein Formation with gravelly clay and loam soils (Qg) characterising areas to the north and north east.

In order of priority, faults, dykes, lineaments and geological contacts typically provide zones of heightened groundwater potential. No faults or lineaments were identified within a 5km radius of the site however, mapped dolerite intrusions were noted to the north west on the extremity of the 5km buffer.

A summary of the regional geology is presented Table 1 and shown in Figure 3.

Table 1: Summary of Lithology

Map Symbol	Age	Group	Intrusive	Formation/ Intrusive	Lithology Description
Q	Quaternary	-	-	-	Alluvium
Ogg					Gravelly clay or loam soil
Qg					Loam and sandy loam
Qb					Brackish calcareous soil
Qw		Sandveld	-	Witzand	Unconsolidated white sand with pebbles and shells
Ql				Langebaan	Limestone and calcrete and partially cross-bedded; calcified parabolic dune sand
Qs				Springfontyn	Light grey to pale red sandy soil
do	Cambrian	-	Dolerite	Dolerite	Dolerite
N-Ck	Namibian	-	Cape Granite Suite	Kuils River Pluton	Granite, mainly coarse grained porphyritic with porphyritic biotitic, leucocratic, fine-grained leucocratic, hybridic and medium-grained tourmaline bearing variants
Nt		Malmesbury		Tygerberg	Greywacke, phyllite and quarzitic sandstone; interbedded lava and tuff

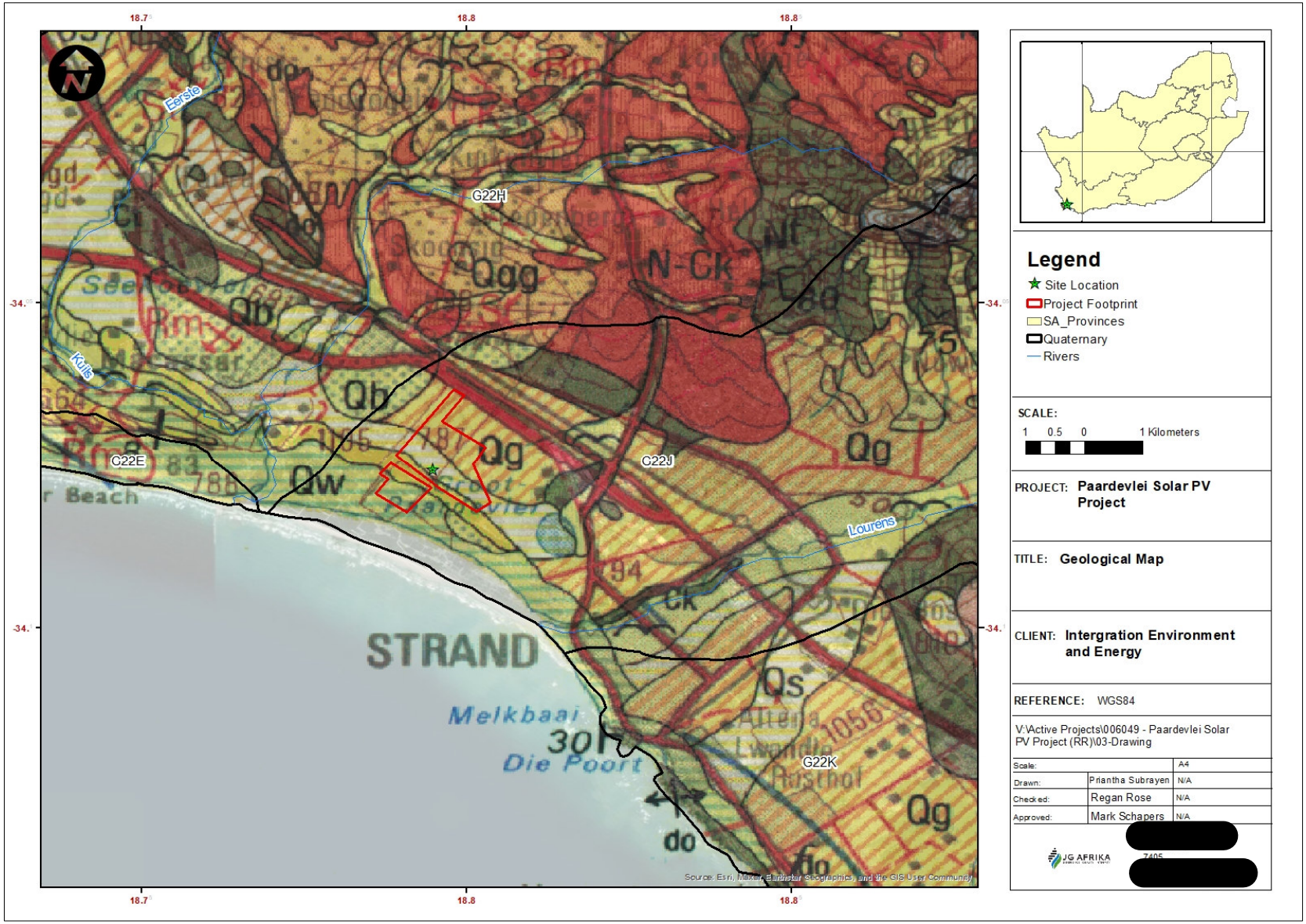


Figure 3: Regional Geology

4.2 Regional Geohydrology

The regional geohydrology of the study area comprises of a two layered aquifer system. A primary intergranular aquifer which is characterised by undifferentiated coastal deposits and a secondary, fractured aquifer belonging to the deeper seated Tygerberg Formation. Median borehole yields in the range of 0.5l/s to 2.0l/s can be expected for both the primary and secondary aquifers which are considered to be moderate to high yielding aquifers in terms of the South African Aquifer Classification System. Electrical Conductivity as indicated in the 1: 5000 Hydrogeological Map of Cape Town indicates ranges from 70 mS/m to 300 mS/m. The regional geohydrology of the site is presented in Figure 4.

The site is located within the G22J quaternary catchment. Based on WR90 data (WRC; Surface Water Resources of South Africa 1990 Study) the Mean Annual Precipitation (MAP) and recharge for this catchment is 1002mm/annum and 102.2mm/annum. The project area comprises a single aquifer class unit which is characterised as *Major* in terms of the South African Aquifer Classification System.

Evidence of groundwater seepage is prevalent across the site. Observations made during a previous study indicate the presence of a vlei or marshy area to the south east of the development footprint and three additional water bodies, one within the north eastern boundary of site, one to the south east and one to the south west. The latter two water bodies are likely as a result of rainfall and stormwater ingress into the old AECI Slimes and Return Water Dams. Based on inferred data the groundwater flow direction across the site is in a south westerly direction, towards False Bay.

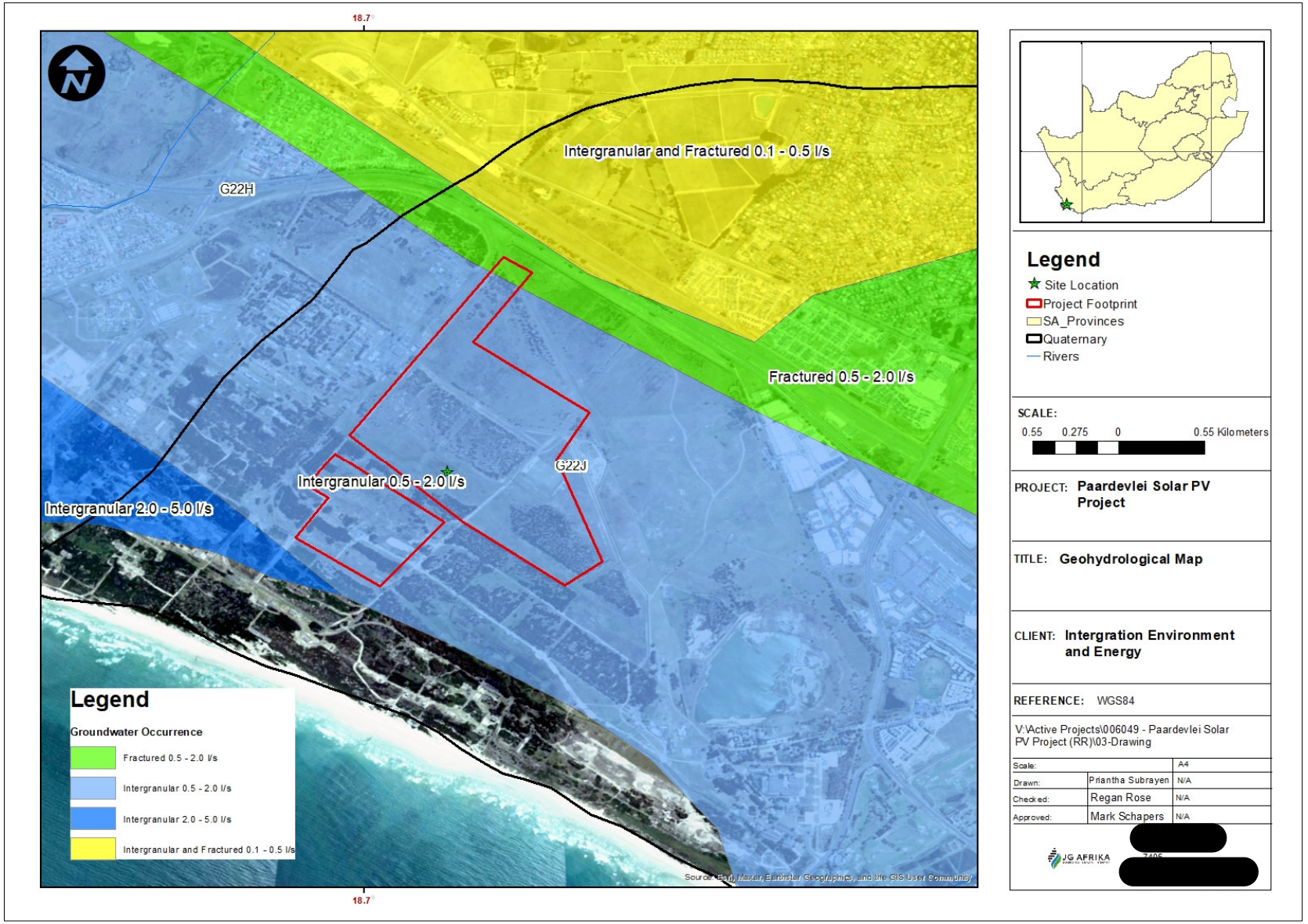


Figure 4: Regional Geohydrology

4.3 Hydrocensus

The National Groundwater Archive (NGA) and Water Use Authorization and Registration Management System (WARMS) of the DWS were interrogated to establish the existence of any groundwater resources and groundwater use in proximity to the site. The NGA reported twenty-two (22 No.) resources within 5 km of the site, while the WARMS reported seven (7 No.) resources. The resources are summarised in Table 2. The locations of these resources as presented in the DWS databases are shown in Figure 5. Field verified resources are included in Table 2, with seven (7 No.) boreholes being identified within 300m of the Paardevlei Solar PV site. These boreholes are mainly monitoring boreholes. The field verified groundwater resources are provided in Annexure B.

The measured depth to groundwater was recorded to range between 0.0mbgl to 8.2mbgl at boreholes near the site (Figure 6). The inferred groundwater flow direction is from northeast to southwest towards the Atlantic Ocean and is presented in Figure 7.

Based on the field observations and previous studies conducted at the site the groundwater quality across the development area is considered to be poor with elevated concentrations of certain hydrochemical parameters of concern reported in the majority of the boreholes sampled. Hydrochemical data obtained from five (5 No.) boreholes during the field investigation and laboratory analysis conducted on groundwater samples retrieved from three (3 No.) boreholes reiterate the presence of poor quality, high salinity groundwater across the site. The results of analysis are included in Table 2 with the laboratory certificates included in Annexure C.

Table 2: Summary Hydrocensus Information

Source	ID	Latitude	Longitude	Distance to Site (m)	Status	Depth (m)	Water Level (m)	Discharge (l/s)	Comment (Equipment, condition, observed use, etc.)	Field Data					Laboratory Analysis				
										pH	EC (mS/m)	DO (mg/l)	Osat. (%)	Temp (°C)	EC (mS/m)	Cl (mg/l)	K (mg/l)	Na (mg/l)	T. Alkalinity (mg/l)
NGA	3418BB00069	-34.09270	18.80762	>2000	Unknown	69.19	-	-	-	-	-	-	-	-	-	-	-	-	-
NGA	3418BB00068	-34.09269	18.80762	>2000	Unknown	57.91	-	-	-	-	-	-	-	-	-	-	-	-	-
NGA	3418BB00070	-34.09269	18.80763	>2000	Unknown	63.40	-	-	-	-	-	-	-	-	-	-	-	-	-
NGA	3418BB00065	-34.05577	18.83540	>2000	Unknown	46.94	23.47	0.82	-	-	-	-	-	-	-	-	-	-	-
NGA	3418BB00063	-34.05576	18.83540	>2000	Unknown	14.94	4.27	0.05	-	-	-	-	-	-	-	-	-	-	-
NGA	3418BB00062	-34.05575	18.83540	>2000	Unknown	51.82	-	-	-	-	-	-	-	-	-	-	-	-	-
NGA	3418BB00064	-34.05575	18.83541	>2000	Unknown	22.86	1.83	0.11	-	-	-	-	-	-	-	-	-	-	-
NGA	3418BB00028	-34.05436	18.80651	>2000	Unknown	13.34	3.34	2.22	Domestic	-	-	-	-	-	-	-	-	-	-
NGA	3418BB00041	-34.05298	18.80485	>2000	Unknown	42.37	-	-	-	-	-	-	-	-	-	-	-	-	-
NGA	3418BB00029	-34.05297	18.78484	>2000	Unknown	30.00	0.76	-	Irrigation	-	-	-	-	-	-	-	-	-	-
NGA	3418BB00039	-34.05297	18.80485	>2000	Unknown	35.66	9.14	1.51	Domestic	-	-	-	-	-	-	-	-	-	-
NGA	3418BB00040	-34.05297	18.80486	>2000	Unknown	49.07	3.05	0.30	Agriculture	-	-	-	-	-	-	-	-	-	-
NGA	3418BB00060	-34.05021	18.80485	>2000	Unknown	35.66	19.51	0.05	Domestic	-	-	-	-	-	-	-	-	-	-
NGA	3418BB00058	-34.05020	18.80485	>2000	Unknown	32.31	10.36	1.26	Agriculture	-	-	-	-	-	-	-	-	-	-
NGA	3418BB00057	-34.05019	18.80485	>2000	Unknown	59.13	25.91	0.10	Agriculture	-	-	-	-	-	-	-	-	-	-
NGA	3418BB00059	-34.05019	18.80486	>2000	Unknown	49.07	-	-	-	-	-	-	-	-	-	-	-	-	-
NGA	3418BB00061	-34.05019	18.80487	>2000	Unknown	18.90	-	-	-	-	-	-	-	-	-	-	-	-	-
NGA	3418BB00047	-34.04463	18.80207	>2000	Unknown	47.85	9.14	0.76	Agriculture	-	-	-	-	-	-	-	-	-	-
NGA	3418BB00027	-34.04213	18.82290	>2000	Unknown	30.00	8.40		Agriculture	-	-	-	-	-	-	-	-	-	-
NGA	3418BB00049	-34.03631	18.81596	>2000	Unknown	103.63	60.96	0.04	Agriculture	-	-	-	-	-	-	-	-	-	-
NGA	3418BB00048	-34.03630	18.81596	>2000	Unknown	92.96	2.44	1.36	-	-	-	-	-	-	-	-	-	-	-
NGA	3418BB00050	-34.03630	18.81597	>2000	Unknown	103.63	60.96	0.04	-	-	-	-	-	-	-	-	-	-	-
WARMS	22028431	-34.0015	18.3783	>2000	Unknown	-	-	-	Agriculture	-	-	-	-	-	-	-	-	-	-
WARMS	24039103	-34.04825	18.77823	>2000	Unknown	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WARMS	24039023	-34.05115	18.77883	>2000	Unknown	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WARMS	24037677	-34.03790	18.81152	>2000	Unknown	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WARMS	26078734	-34.04167	18.81528	>2000	Unknown	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WARMS	26062796	-34.04167	18.81528	>2000	Unknown	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WARMS	22128635	-34.08490	18.82590	>2000	Unknown	-	-	-	Industrial	-	-	-	-	-	-	-	-	-	-
FIELD	SBH6	-34.076954	18.803354	133	Unknown	3.80	1.13	-	-	-	-	-	-	-	-	-	-	-	-
FIELD	SBH5	-34.07581	18.802893	136	Unknown	2.29	1.16	-	-	-	-	-	-	-	-	-	-	-	-
FIELD	SBH4	-34.075099	18.802591	126	Unknown	2.78	0.90	-	-	-	-	-	-	-	-	-	-	-	-
FIELD	SBH3	-34.073532	18.802622	47	Unknown	3.14	1.19	-	-	-	-	-	-	-	-	-	-	-	-
FIELD	SBH2	-34.073312	18.801986	Within site	Unknown	2.75	1.23	-	-	-	-	-	-	-	-	-	-	-	-
FIELD	BH913B	-34.081328	18.806778	288	Unknown	4.44	0.76	-	-	7.56	2320.0	2.76	36.90	19.60	1743.50	7406.00	20.10	3973.00	807.50
FIELD	BH913A	-34.081313	18.806769	289	Unknown	16.50	0.59	-	-	7.31	2770	1.10	15.40	21.50	1819.10	8867.00	19.72	4415.00	805.00
FIELD	BH39A	-34.081642	18.806672	286	Unknown	35.65	0.75	-	In accessible	-	-	-	-	-	-	-	-	-	-
FIELD	BH EP213	-34.081785	18.806881	310	Unknown	5.54	0.94	-	In accessible	-	-	-	-	-	-	-	-	-	-
FIELD	BH near electric pole	-34.089158	18.807667	970	Unknown	6.21	0.95	-	-	7.35	90.50	2.43	36.20	25.20	70.60	30.34	3.46	31.55	270.00
FIELD	ANBH7	-34.089954	18.806811	>2000	Unknown	4.88	1.20	-	-	-	-	-	-	-	-	-	-	-	-
FIELD	ANBH6	-34.089789	18.806478	988	Unknown	5.22	1.18	-	-	-	-	-	-	-	-	-	-	-	-
FIELD	ANBH5	-34.089575	18.80627	960	Unknown	6.21	1.03	-	-	-	-	-	-	-	-	-	-	-	-

Source	ID	Latitude	Longitude	Distance to Site (m)	Status	Depth (m)	Water Level (m)	Discharge (l/s)	Comment (Equipment, condition, observed use, etc.)	Field Data					Laboratory Analysis				
										pH	EC (mS/m)	DO (mg/l)	Osat. (%)	Temp (°C)	EC (mS/m)	Cl (mg/l)	K (mg/l)	Na (mg/l)	T. Alkalinity (mg/l)
FIELD	ANBH4	-34.089394	18.806608	936	Unknown	6.76	1.07	-	-	-	-	-	-	-	-	-	-	-	-
FIELD	ANBH3	-34.089544	18.806908	936	Unknown	5.60	1.43	-	-	-	-	-	-	-	-	-	-	-	-
FIELD	ANBH1	-34.089758	18.807111	>2000	Unknown	7.62	1.14	-	-	-	-	-	-	-	-	-	-	-	-
FIELD	BH downstream river	-34.093369	18.804444	>2000	Dry	3.11	0.00	-	-	-	-	-	-	-	-	-	-	-	-
FIELD	BH upstream river	-34.093085	18.804587	>2000	Dry	5.37	0.00	-	-	-	-	-	-	-	-	-	-	-	-
FIELD	BH ACMW6	-34.093003	18.804875	>2000	Unknown	11.70	7.37	-	-	6.97	1788	1.62	18.7	21.7	-	-	-	-	-
FIELD	BH12	-34.092675	18.804847	>2000	Unknown	9.30	7.03	-	-	6.78	1681	1.84	19.2	19.7	-	-	-	-	-

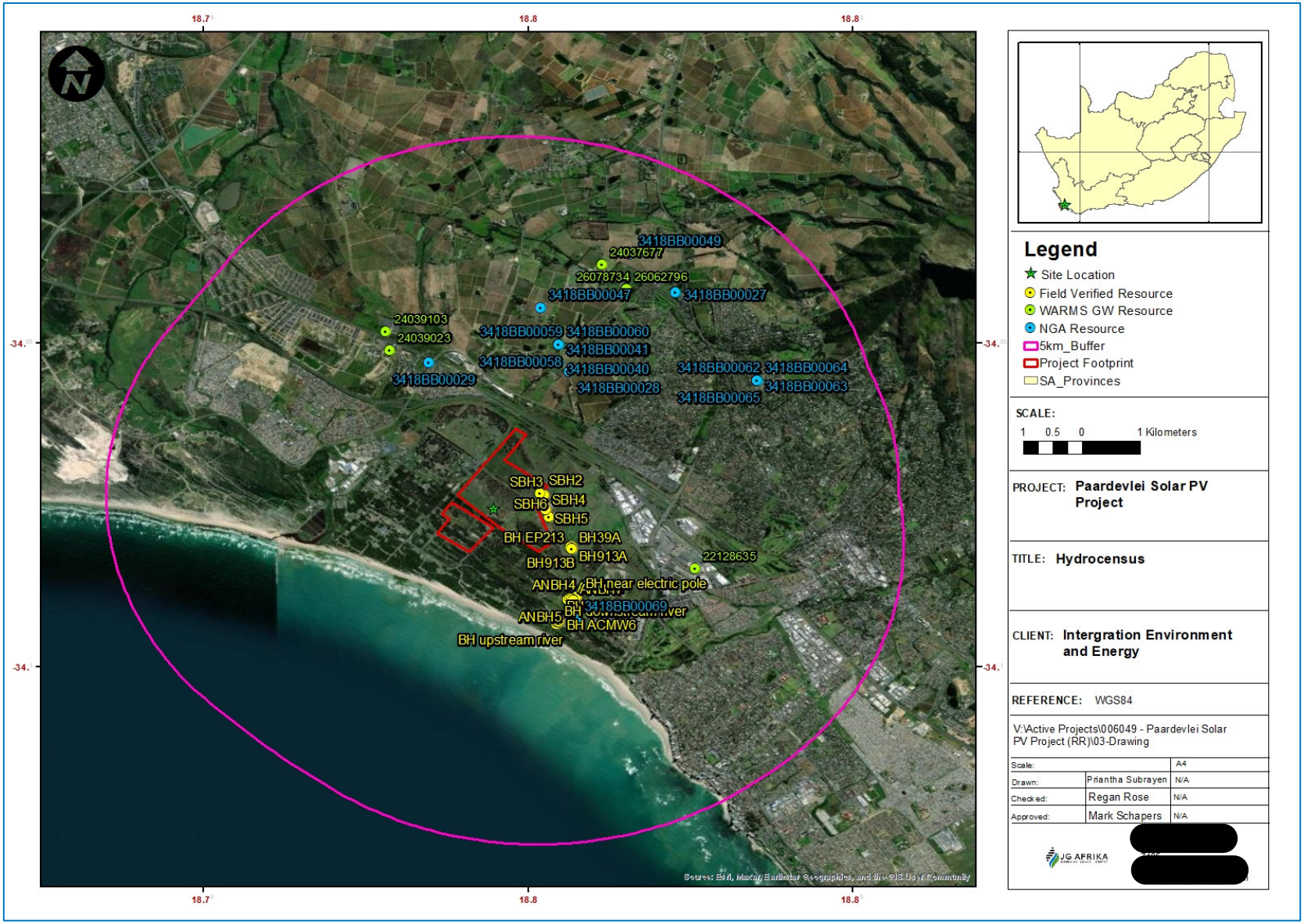


Figure 5: Hydrocensus

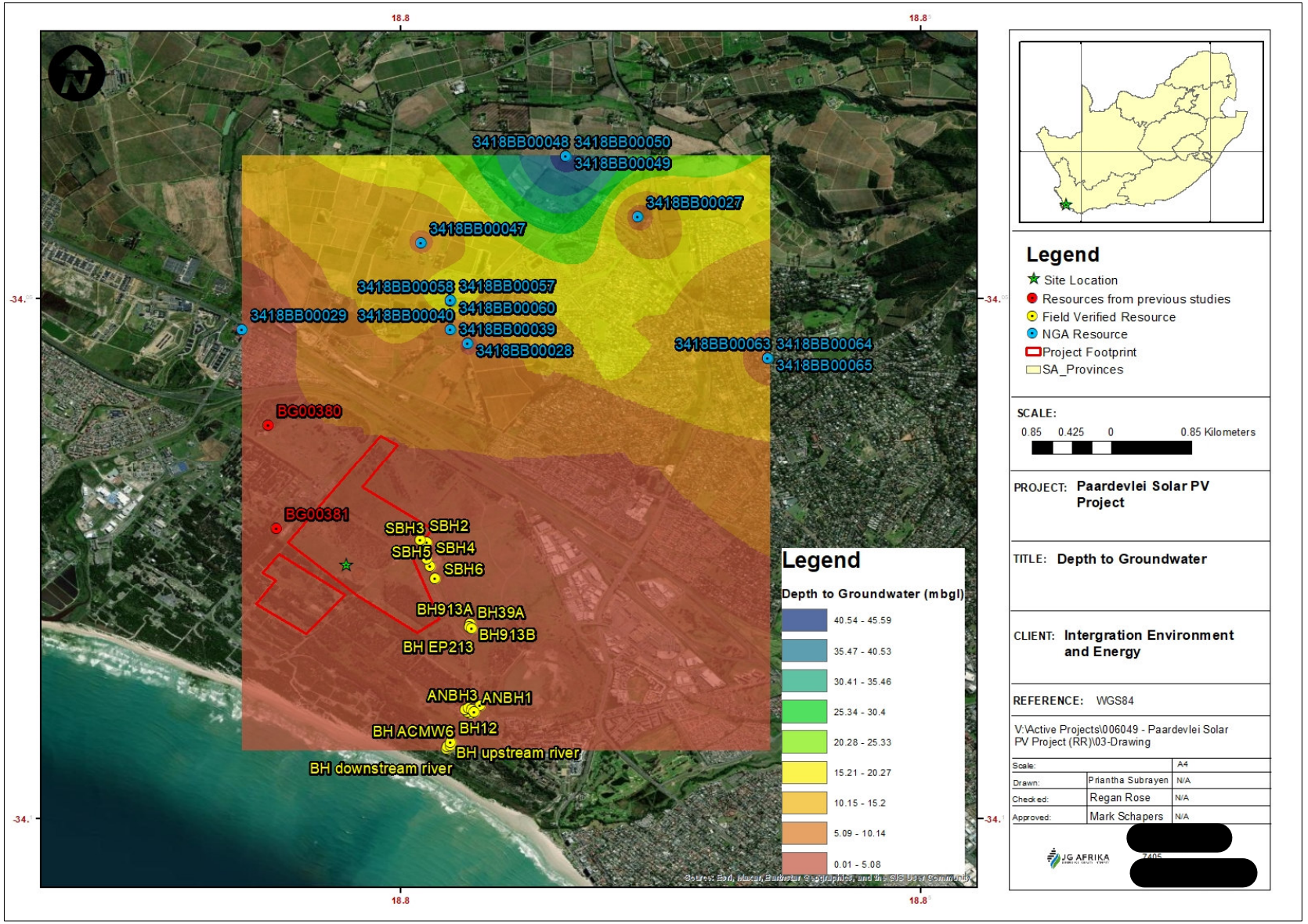


Figure 6: Depth to Groundwater

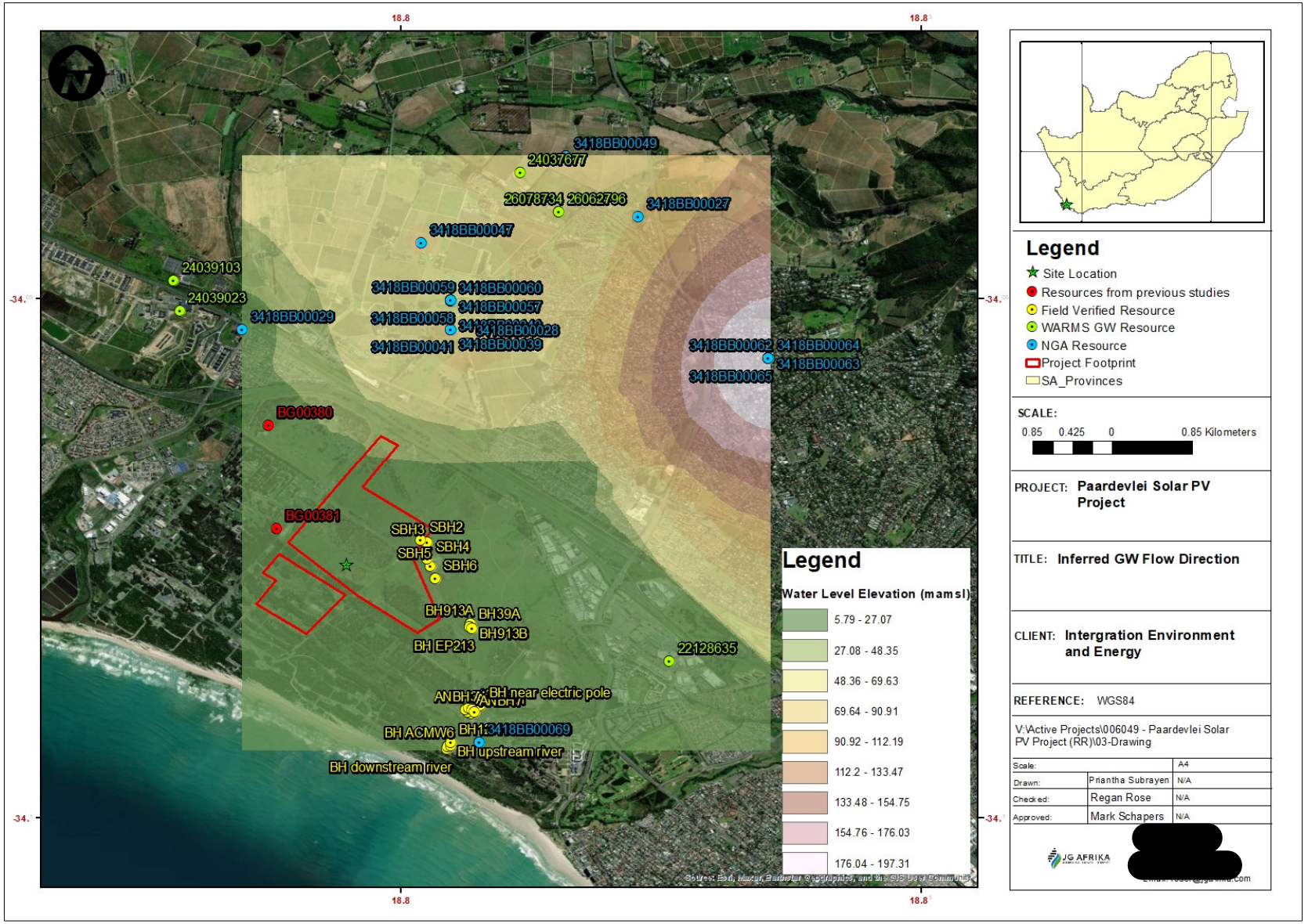


Figure 7: Groundwater contours indicating flow Direction

5 CONCEPTUAL SITE MODEL

The source-pathway-receptor model is used to assess risks of activities on the groundwater receiving environment. A summary of the source pathway receptor conceptual review is presented in Table 3.

Table 3: Source-Pathway-Receptor Conceptual Model Summary

Activity Description	Source	Pathway	Receptor	Comment
Construction Related Activities	Surface water ingress of contaminants during excavation, hauling and stockpiling. Contaminants of concern include hydrocarbons from plant, turbidity and microbiological loading from stormwater quality and ablution facilities Site clearing and removal of Eucalyptus trees, resulting in reduced groundwater uptake and evapotranspiration, and potential rising of groundwater table and emergent water / wetland development	Pathway to groundwater system created through recharge from stockpile leachate and on site ablution facilities. Emergent groundwater to the surface water receiving environment	Groundwater potential is good however there are no downstream users identified. The possibility of contributions from baseflow to local streams and rivers is possible. Surface water receptors	Source concentrations can be controlled through mitigation techniques. Receptors are likely to be both the surface water and groundwater receiving environments. Due to the groundwater potential regular monitoring is advisable. Emergent water may be contaminated from historical activities, and may create problematic surface water conditions that will need to be managed
BESS Operations	Surface water ingress of contaminants during installation and changing of batteries and related infrastructure. Contaminants of concern include the liquid metals comprising the various battery components	Pathway to groundwater system created through possible recharge from BESS facility runoff and stormwater ingress, or loss of containment.	Groundwater potential is good however there are no downstream users identified. The possibility of contributions from baseflow to local streams and rivers is possible.	Source concentrations can be controlled through mitigation techniques. Receptors are likely to be both the surface water and groundwater receiving environments. Due to the groundwater potential regular monitoring is advisable.
PV Farm Operations	Surface water ingress of contaminants during cleaning of the PV arrays and from run-off. Contaminants of concern include hydrocarbons from plant, turbidity from stormwater quality	Pathway to groundwater system created through recharge from run-off	Groundwater potential is good however there are no downstream users identified. The possibility of contributions from baseflow to local streams and rivers is possible.	Source concentrations can be controlled through mitigation techniques. Receptors are likely to be both the surface water and groundwater receiving environments. Due to the groundwater potential regular monitoring is advisable.
Office and Operation and Maintenance	Surface water ingress of contaminants from chemical stores,	Pathway to groundwater system created through	Groundwater potential is good however there are no downstream	Source concentrations can be controlled through mitigation techniques.

Activity Description	Source	Pathway	Receptor	Comment
Facility Operations	hydrocarbons (diesel storage), maintenance areas and sanitation facilities. Contaminants of concern include hydrocarbons and microbiological loading.	possible recharge from office facility runoff and stormwater ingress, or loss of containment.	users identified. The possibility of contributions from baseflow to local streams and rivers is possible.	Receptors are likely to be both the surface water and groundwater receiving environments. Due to the groundwater potential regular monitoring is advisable.

The inferred groundwater flow direction in the project footprint is from north east to south west across the area as indicated in Figure 6. None of the groundwater resources that were identified during the hydrocensus are therefore considered to be potential receptors.

6 GEOHYDROLOGICAL IMPACT ASSESSMENT MATRIX

6.1 Geohydrological Potential

The project area is underlain by a two layered aquifer comprising intergranular sands underlain by massive igneous rocks. The geohydrology is a moderate to high yielding intergranular aquifer underlain by a fractured rock aquifer. No groundwater targets were identified in the vicinity of the site. The contact between the upper intergranular aquifer and lower fracture rock aquifer is expected to be the primary target. The aquifer system is classified as Minor.

6.2 Vulnerability

Vulnerability is considered *Medium to High*. Factors considered in the vulnerability rating include depth to groundwater and contaminant loading. The depth to groundwater is expected to be not more than 10 mbgl, and was recorded at a maximum of 7.85 mbgl in a downstream borehole. The associated Parsons Groundwater Quality Management System gives the site a Medium Level of Protection index when comparing vulnerability as the second variable.

TABLE A and B: Ratings for the Groundwater Quality Management classification system.			
AQUIFER SYSTEM MANAGEMENT CLASSIFICATION		SECOND VARIABLE CLASSIFICATION	
		AQUIFER VULNERABILITY CLASSIFICATION	
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 C: Appropriate level of groundwater protection required, based on the Groundwater Quality Management classification	
GQM INDEX	LEVEL OF PROTECTION
< 1	Limited protection
01-03	Low level protection
03-06	Medium level protection
06-10	High level protection
> 10	Strictly non-degradation

Variable 1	Variable 2
Aquifer System	Second Variable Description
Minor Aquifer System	Vulnerability
	Medium High
2	2.5
GQM Index	Level of Protection
5.0	Medium level protection

6.3 Strategic Value

The strategic value is considered *Low*. The strategic value of groundwater is based on existing groundwater use. Very limited use of the groundwater resource was identified near the site, with reticulated municipal supply being the main source in the area. The primary use for the groundwater is for monitoring applications. The associated Parsons Groundwater Quality Management System gives the site a *Low Level of Protection* index when comparing strategic value as the second variable.

TABLE A and B: Ratings for the Groundwater Quality Management classification system.			
AQUIFER SYSTEM MANAGEMENT CLASSIFICATION		SECOND VARIABLE CLASSIFICATION	
		AQUIFER VULNERABILITY CLASSIFICATION	
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 C: Appropriate level of groundwater protection required, based on the Groundwater Quality Management classification	
GQM INDEX	LEVEL OF PROTECTION
< 1	Limited protection
01-03	Low level protection
03-06	Medium level protection
06-10	High level protection
> 10	Strictly non-degradation

Variable 1	Variable 2
Aquifer System	Second Variable Description
Minor Aquifer System	Strategic Value
	Low Medium
2	1.5
GQM Index	Level of Protection
3.0	Low level protection

Other contaminant sources are limited in the area and may include historical contributions from the previously operational explosives factory, along with domestic sanitation activities. These activities may already have impacted on water quality in the area.

6.4 Quantitative Environmental Risk Assessment and Mitigation

The quantitative environmental risk assessment (ERA) is presented in Annexure D. The ERA identifies operational phase activities that may impact on the groundwater receiving environments. The Significance Points (SP) score is calculated from the following equation using ranking scales:

SP = probability x (duration + scale + magnitude)

The ERA for the operation phase for the groundwater receiving environment is summarised in Table 4. Most activities identified scored *LOW* or *MODERATE* for the pre mitigation ratings. Most scores can be reduced with the introduction of mitigation measures included in Table 4. With all ratings being reduced to *LOW*.

Table 4: Summary Risk Assessment Scoring

Activity	Aspect	Impact	Significance	Probability	Duration	Scale	Magnitude	PRE MITIGATION SP SCORE and RATING	>60 indicates high environmental significance <30 indicates low environmental significance	Mitigation	POST MITIGATION SP SCORE and RATING	>60 indicates high environmental significance <30 indicates low environmental significance	SP Reduction
Construction Phase													
BESS Facility, PV Farm and Office and Maintenance Facilities	Mobilisation of contractor and construction of contrators camp	quality	low negative	low to medium	short	site to local	minor to low	2.5(2+1.5+3) = **16**	**LOW**	Controlled earthworks and spoil management	2(2+1.5+3) = **13**	**LOW**	**-3**
	Excavation areas and mobilisation of existing elevated compounds in the soils matrix and impacts on groundwater quality		low negative	low to medium	short	site	minor to low	2.5(2+1+3) = **15**	**LOW**	Controlled earthworks and spoil management	2(2+1+3) = **12**	**LOW**	**-3**
	Contamination of soils from plant and equipment (hydrocarbons) from breakdowns and impacts on groundwater quality		medium negative	medium to high	short	site	moderate to high	3.5(2+1+7) = **35**	**MODERATE**	Use of drip trays, good vehicle maintenance	2.5(2+1+5) = **20**	**LOW**	**-15**
	Chemical stores and hydrocarbon stores and contamination of subsoils and groundwater		medium negative	medium	short	site	moderate to high	3(2+1+7) = **30**	**LOW**	Bunded storage areas	2.5(2+1+6) = **23**	**LOW**	**-8**
	Washday, workshop and plant storage areas and contamination of subsoils and groundwater		medium negative	medium	short	site	moderate to high	3(2+1+7) = **30**	**LOW**	Concrete hardstand and oil trap collection system	2.5(2+1+6) = **23**	**LOW**	**-8**
	Waste storage areas and contamination of subsoils and groundwater		medium negative	medium	short	site	moderate to high	3(2+1+7) = **30**	**LOW**	Hard stand storage area	2(2+1+5) = **16**	**LOW**	**-14**
	Prolonged leaks from sanitation infrastructure and contamination of subsoils and groundwater		medium negative	low to medium	short	site	moderate to high	2.5(2+1+7) = **25**	**LOW**	Maintenance	2(2+1+5) = **16**	**LOW**	**-9**
	Major loss of containment from sanitation infrastructure and contamination of subsoils and groundwater		medium negative	medium	short	site	moderate to high	3(2+1+7) = **30**	**LOW**	Routine emptying of conservancy tanks and appropriate disposal by certified company, rapid response clean up	2(2+1+6) = **18**	**LOW**	**-12**
	Stormwater runoff from impervious areas and increased turbidity loads and contamination of subsoils and groundwater		low negative	low to medium	short	site	low	2.5(2+1+4) = **18**	**LOW**	Stormwater management	2(2+1+4) = **14**	**LOW**	**-4**
	Removal of Eucalyptus forest and resultant rising groundwater table and emergent contaminated water and wetland development		low medium negative	medium	short	site	low to moderate	3(2+1+5) = **24**	**LOW**	surface water management plan, and appropriate drainage infrastructure	2.5(2+1+5) = **20**	**LOW**	**-4**
	Removal of Eucalyptus forest and resultant reduction in groundwater uptake and evapotranspiration resulting in increased groundwater mass balance component	quantity	low negative	medium	short	site	minor to low	3(2+1+3) = **18**	**LOW**	surface water management plan, and appropriate drainage infrastructure	3(2+1+3) = **18**	**LOW**	**0**
	Impacts on groundwater quantity during construction		low negative	improbable	immediate	site	minor	1(1+1+2) = **4**	**LOW**	Municipal supply, none required	1(1+1+2) = **4**	**LOW**	**0**
Operational Phase													
BESS Facility and PV Farm	Changing removal, reinstallation and disposal of batteries and contamination of subsoils and groundwater	quality	low negative	low to medium	medium to long	site	minor to low	2.5(3.5+1+3) = **19**	**LOW**	Operational plan	2(3+1+3) = **14**	**LOW**	**-5**
	Cleaning of PV arrays and contamination of subsoils and groundwater		low negative	low	medium to long	site	minor to low	2(3.5+1+3) = **15**	**LOW**	Operational plan, clean water source	1.5(3+1+3) = **11**	**LOW**	**-5**
	Surface water ingress due to run-off from PV arrays		low negative	low to medium	medium to long	site	minor to low	2.5(3.5+1+3) = **19**	**LOW**	Stormwater management	2(3.5+1+3) = **15**	**LOW**	**-4**
	Contamination of soils from plant and equipment (hydrocarbons) from breakdowns and impacts on groundwater quality		medium negative	medium	medium to long	site	moderate to high	3(3.5+1+7) = **35**	**MODERATE**	Maintenance plan, rapid response clean up	2.5(3.5+1+6) = **26**	**LOW**	**-8**
	Removed Eucalyptus forest and resultant rising groundwater table and emergent contaminated water and wetland development		low medium negative	medium	short	site	low to moderate	3(2+1+5) = **24**	**LOW**	surface water management plan, and appropriate drainage infrastructure, Surface water quality monitoring and appropriate remedial action	2.5(2+1+5) = **20**	**LOW**	**-4**
	Removed Eucalyptus forest and resultant reduction in groundwater uptake and evapotranspiration resulting in increased groundwater mass balance component	quantity	low negative	medium	short	site	minor to low	3(2+1+3) = **18**	**LOW**	surface water management plan, and appropriate drainage infrastructure	3(2+1+3) = **18**	**LOW**	**0**
	Impacts on groundwater quantity during operation		low negative	improbable	immediate	site	minor	1(1+1+2) = **4**	**LOW**	Municipal supply, none required	1(1+1+2) = **4**	**LOW**	**0**

Table 4: Continued

Activity	Aspect	Impact	Significance	Probability	Duration	Scale	Magnitude	PRE MITIGATION SP SCORE and RATING	>60 indicates high environmental significance <30 indicates low environmental significance	Mitigation	POST MITIGATION SP SCORE and RATING	>60 indicates high environmental significance <30 indicates low environmental significance	SP Reduction
Office and Maintenance Facilities	Chemical stores and hydrocarbon stores and contamination of subsoils and groundwater	quality	medium negative	medium	medium to long	site	moderate to high	3(3.5+1+7) = **35**	**MODERATE**	Bunded storage areas, rapid response clean up	2(3.5+1+6) = **21**	**LOW**	**-14**
	Washday, workshop and plant storage areas and contamination of subsoils and groundwater		medium negative	medium	medium to long	site	moderate to high	3(3.5+1+7) = **35**	**MODERATE**	Concrete hardstand and oil trap collection system	2.5(3.5+1+6) = **26**	**LOW**	**-8**
	Waste storage areas and contamination of subsoils and groundwater		medium negative	medium	medium to long	site	moderate to high	3(3.5+1+7) = **35**	**MODERATE**	Hard stand storage area, waste management plan	2(3.5+1+5) = **19**	**LOW**	**-16**
	Prolonged leaks from sanitation infrastructure and contamination of subsoils and groundwater		medium negative	medium to high	medium to long	site	moderate to high	3.5(3.5+1+7) = **40**	**MODERATE**	Maintenance	3(3+1+6) = **30**	**LOW**	**-10**
	Major loss of containment from sanitation infrastructure and contamination of subsoils and groundwater		medium negative	medium	medium	site	moderate to high	3(3+1+7) = **33**	**MODERATE**	Routine emptying of holding tanks and appropriate disposal by certified company, rapid response clean up	2(3+1+6) = **20**	**LOW**	**-13**
	Stormwater runoff from impervious areas and increased turbidity loads and contamination of subsoils and groundwater		low negative	low to medium	medium to long	site	low	2.5(3.5+1+4) = **21**	**LOW**	Stormwater management	2(3.5+1+3) = **15**	**LOW**	**-6**
	Impacts on groundwater quantity during operation	quantity	low negative	improbable	immediate	site	minor	1(1+1+2) = **4**	**LOW**	Municipal supply, none required	1(1+1+2) = **4**	**LOW**	**0**
Decommissioning Phase													
BESS Facility, PV Farm and Office and Maintenance Facilities	Removal of site infrastructure and contrators camp		low negative	medium to high	short	site to local	minor to low	3.5(2+1.5+3) = **23**	**LOW**	Effective and controlled site clearing and waste disposal	3.5(2+1.5+2) = **19**	**LOW**	**-4**
	Disposal of batteries and contamination of subsoils and groundwater		low negative	medium to high	short	site to local	minor to low	3.5(2+1.5+3) = **23**	**LOW**	Disposal to approved facility	2.5(2+1.5+3) = **16**	**LOW**	**-7**
	Chemical stores and hydrocarbon stores and contamination of subsoils and groundwater		medium negative	medium	short	site	moderate to high	3(2+1+7) = **30**	**LOW**	Bunded storage areas and limit spillage during removal of chemicals, rapid response clean up	2(3.5+1+6) = **21**	**LOW**	**-9**
	Washday, workshop and plant storage areas and contamination of subsoils and groundwater	quality	medium negative	medium	short	site	moderate to high	3(2+1+7) = **30**	**LOW**	Concrete hardstand and oil trap collection system and ensure containment during removal	2.5(3.5+1+6) = **26**	**LOW**	**-4**
	Waste storage areas and contamination of subsoils and groundwater		medium negative	medium	short	site	moderate to high	3(2+1+7) = **30**	**LOW**	Hard stand storage area and ensure containment during removal, rapid response clean up	2(3.5+1+5) = **19**	**LOW**	**-11**
	Major loss of containment from sanitation infrastructure and contamination of subsoils and groundwater		medium negative	medium	short	site	moderate to high	3(2+1+7) = **30**	**LOW**	Routine emptying of conservancy tanks and appropriate disposal by certified company, rapid response clean up	2.5(3+1+6) = **25**	**LOW**	**-5**
	Stormwater runoff from impervious areas and increased turbidity loads and contamination of subsoils and groundwater		low negative	low to medium	short	site	low	2.5(2+1+4) = **18**	**LOW**	Stormwater management	2(3.5+1+3) = **15**	**LOW**	**-3**
	Removal of Eucalyptus forest and resultant rising groundwater table and emergent contaminated water and wetland development		low medium negative	medium	short	site	low to moderate	3(2+1+5) = **24**	**LOW**	surface water management plan, and appropriate drainage infrastructure, Surface water quality monitoring and appropriate remedial action	2.5(2+1+5) = **20**	**LOW**	**-4**
	Removed Eucalyptus forest and resultant reduction in groundwater uptake and evapotranspiration resulting in increased groundwater mass balance component	quantity	low negative	medium	short	site	minor to low	3(2+1+3) = **18**	**LOW**	surface water management plan, and appropriate drainage infrastructure	3(2+1+3) = **18**	**LOW**	**0**
	Impacts on groundwater quantity during decommissioning		low negative	improbable	immediate	site	minor	1(1+1+2) = **4**	**LOW**	Municipal supply, none required	1(1+1+2) = **4**	**LOW**	**0**

6.5 Mitigation Measures

Significance scores can in most instances be reduced by applying suggested mitigation measures. The mitigations for operation phase activities suggested in Table 4 are not exhaustive. In summary the measures include the following, with a focus on reducing the probability and magnitude factors:

- Apply appropriate controlled earthworks, spoil and stockpile management and minimise excavation areas with appropriate stormwater diversion and return water recycling for dust suppression
- Ensure regular inspections of BESS facility particularly during removal and reinstallation of batteries. Ensure that the facility is equipped with an effective stormwater management system to prevent surface water ingress into the underlying subsoils. Ensure that used batteries are appropriately disposed of and not stockpiled site
- Cleaning of PV arrays must be done in a controlled manner to prevent percolation of contaminated water into the underlying subsoils and containment of spillage of cleaning chemicals
- Apply appropriate operational measures including restricted areas for refuelling and maintenance of earthworks machinery, with hardstand, bunds and oil water separators. Parked equipment should make use of drip trays as a precautionary measure
- Confine chemical and waste storage areas with appropriate compacted subsurface layering or hardstand and bunds, spill kits, with waste removal to appropriate disposal facility
- Routine inspection, maintenance and monitoring should be carried out on all site infrastructure to ensure leaks and loss of containment are minimised. Timeous repairs of infrastructure should be carried out
- Any leaks, spills or loss of containment of any kind should be cleaned up immediately to limit the impact on the receiving environment. Clean up protocols should be drafted as part of the EMP, and may include immediate removal of impacted soils
- Desludging of conservancy tanks by approved operators with authorised disposal at waste disposal facilities. A desludging schedule needs to be drafted as part of the EMP.

7 CONCLUSIONS

This report presents the results of a geohydrological assessment carried out for the Paardevlei Solar PV site located close to Somerset West in the Western Cape. The geohydrological report has been prepared as a specialist study in support an Environmental Impact Assessment. The infrastructure include a PV and BESS facility, . The aim of the assessment was to characterise the geohydrological setting, and to determine the risk of potential impacts by the infrastructure on the receiving groundwater environment.

The project area is underlain by a two layered aquifer system comprising a primary intergranular aquifer which is underlain by a fractured aquifer. Both aquifers are considered to be moderate to high yielding and can be classified as Minor. The average observed depth to groundwater was recorded at < 10mbgl. The aquifer vulnerability is medium to high. The Parsons Groundwater Quality Management System gives the site a Medium Level of Protection index for the second variable vulnerability. The strategic value is Low to Medium. The Parsons Groundwater Quality Management System gives the site a Low Level of Protection index for the second variable strategic value.

The risk and impact of the activities was reviewed by means of a quantitative environmental risk assessment (ERA) as developed for by the Operational Guideline: Integrated Water and Waste

Management Plan. The ERA identified most listed activities to score LOW to MODERATE. All activity scores can be significantly reduced with the application of appropriate mitigation measures, by focusing on the probability and magnitude factors. All mitigation measures (Table 4 and Section 6.4) should be considered to reduce potential impacts and risk.

Annexure A: Field Hydrocensus Data

GROUNDWATER RESOURCES LOCATED AND ASSESSED IN THE HYDROCENSUS		
Resource ID	**BH913A**	
Latitude	-34.081313	
Longitude	18.806769	
Resource Type	Monitoring Borehole	
NGA/GRIP No	-	
Sample No.	-	
Current Use	Not in use	
Depth to GW (m)	1.05	
Final Depth (mbgl)	16.5	
BH Diameter (mm)	140	
Casing Diameter (mm)	140	
Casing Revealed (cm)	0	
Comments	Water was pumped out at 0.25 l/s for 20 minutes. All the water in the borehole column was pumped out after 20 minutes which means the recovery rate is very low.	
Resource ID	**BH913B**	
Latitude	-34.081328	
Longitude	18.806778	
Resource Type	Monitoring Borehole	
NGA/GRIP No	-	
Sample No.	-	
Current Use	Not In use	
Depth to GW (mbgl)	1.17	
Final Depth (mbgl)	4.44	
BH Diameter (mm)	140	
Casing Diameter (mm)	140	
Casing Revealed (cm)	0	
Comments	Water was pumped out at 0.25 l/s for 10 minutes. All the water in the borehole column was pumped out after 10 minutes which means the recovery rate is very low.	

GROUNDWATER RESOURCES LOCATED AND ASSESSED IN THE HYDROCENSUS		
Resource ID	**SBH6**	
Latitude	-34.076954	
Longitude	18.803354	
Resource Type	Monitoring Borehole	
NGA/GRIP No	-	
Sample No.	-	
Current Use	Not In use	
Depth to GW (mbgl)	1.59	
Final Depth (mbgl)	3.8	
BH Diameter (mm)	130	
Casing Diameter (mm)	130	
Casing Revealed (cm)	0	
Comments	The borehole was pumped for 5 minutes and dried up using a low flow sampling pump. The yield is not reported. There is a surface water body opposite the borehole	
Resource ID	**SBH5**	
Latitude	-34.075810	
Longitude	18.802893	
Resource Type	Monitoring Borehole	
NGA/GRIP No	-	
Sample No.	-	
Current Use	Not In use	
Depth to GW (mbgl)	1.64	
Final Depth (mbgl)	2.29	
BH Diameter (mm)	130	
Casing Diameter (mm)	130	
Casing Revealed (cm)	-	
Comments	The yield is not reported. Sample was taken with bailer where water was purged 3 times the volume water of the borehole.	

GROUNDWATER RESOURCES LOCATED AND ASSESSED IN THE HYDROCENSUS		
Resource ID	**SBH4**	
Latitude	-34.075099	
Longitude	18.802591	
Resource Type	Monitoring Borehole	
NGA/GRIP No	-	
Sample No.	-	
Current Use	Not In use	
Depth to GW (mbgl)	1.32	
Final Depth (mbgl)	2.78	
BH Diameter (mm)	130	
Casing Diameter (mm)	130	
Casing Revealed (cm)	0	
Comments	The yield is not reported. Sample was taken with bailer where water was purged 3 times the volume water of the borehole.	
Resource ID	**SBH3**	
Latitude	-34.073532	
Longitude	18.802622	
Resource Type	Monitoring Borehole	
NGA/GRIP No	-	
Sample No.	-	
Current Use	Not In use	
Depth to GW (mgbl)	1.84	
Final Depth (mgbl)	3.14	
BH Diameter (mm)	130	
Casing Diameter (mm)	130	
Casing Revealed (cm)	-	
Comments	The yield is not reported. Sample was taken with bailer where water was purged 3 times the volume of water the borehole.	

GROUNDWATER RESOURCES LOCATED AND ASSESSED IN THE HYDROCENSUS		
Resource ID	**SBH2**	
Latitude	-34.073312	
Longitude	18.801986	
Resource Type	Monitoring Borehole	
NGA/GRIP No	-	
Sample No.	-	
Current Use	Not In use	
Depth to GW (mgbl)	1.71	
Final Depth (mgbl)	2.75	
BH Diameter (mm)	130	
Casing Diameter (mm)	130	
Casing Revealed (cm)	0	
Comments	The yield is not reported. Sample was taken with bailer where water was purged 3 times the volume of water the borehole.	
Resource ID	**BH39A**	
Latitude	-34.081642	
Longitude	18.806672	
Resource Type	Monitoring Borehole	
NGA/GRIP No	-	
Sample No.	-	
Current Use	Not In use	
Depth to GW (mbgl)	1.03	
Final Depth (mbgl)	35.65	
BH Diameter (mm)	130	
Casing Diameter (mm)	120	
Casing Revealed (cm)	-	
Comments	The yield is not reported. Sample was taken with bailer where water was purged 3 times the volume of water in the borehole.	

GROUNDWATER RESOURCES LOCATED AND ASSESSED IN THE HYDROCENSUS		
Resource ID	**BH EP213**	
Latitude	-34.081785	
Longitude	18.806881	
Resource Type	Monitoring Borehole	
NGA/GRIP No	-	
Sample No.	-	
Current Use	Not In use	
Depth to GW (mgbl)	1.48	
Final Depth (mgbl)	5.54	
BH Diameter (mm)	120	
Casing Diameter (mm)	120	
Casing Revealed (cm)	0	
Comments	Used bailer and purged 20 L of water. Sustainable yield unknown.	
Resource ID	**BH near electric pole**	
Latitude	-34.089158	
Longitude	18.807667	
Resource Type	Monitoring Borehole	
NGA/GRIP No	-	
Sample No.	-	
Current Use	Not In use	
Depth to GW (mbgl)	1.36	
Final Depth (mbgl)	6.21	
BH Diameter (mm)	130	
Casing Diameter (mm)	170	
Casing Revealed (cm)	-	
Comments	Water was pumped out at 0.25 l/s for 10 minutes. All the water in the borehole column was pumped out after 10 minutes which means the recovery rate is very low.	

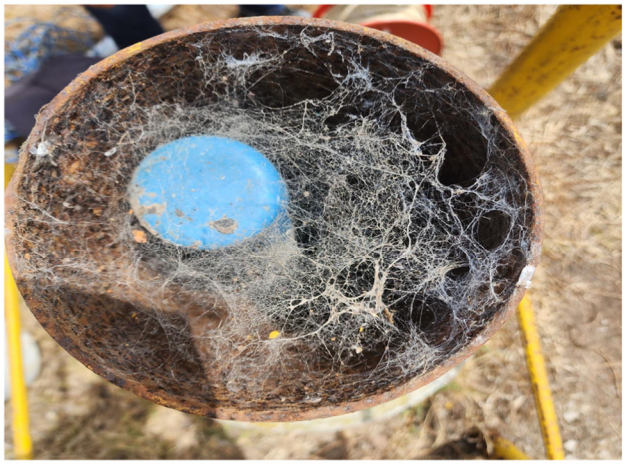
GROUNDWATER RESOURCES LOCATED AND ASSESSED IN THE HYDROCENSUS		
Resource ID	**ANBH7**	
Latitude	-34.089954	
Longitude	18.806811	
Resource Type	Monitoring Borehole	
NGA/GRIP No	-	
Sample No.	-	
Current Use	In use	
Depth to GW (mgbl)	2.04	
Final Depth (mgbl)	4.88	
BH Diameter (mm)	165	
Casing Diameter (mm)	170	
Casing Revealed (cm)	0	
Comments	Borehole drilled at 6.21 m. The yield of the borehole is unknown.	
Resource ID	**ANBH6**	
Latitude	-34.089789	
Longitude	18.806478	
Resource Type	Monitoring Borehole	
NGA/GRIP No	-	
Sample No.	-	
Current Use	In use	
Depth to GW (mbgl)	2.07	
Final Depth (mbgl)	5.52	
BH Diameter (mm)	165	
Casing Diameter (mm)	170	
Casing Revealed (cm)	-	
Comments	Grass growing around and within the borehole casing. Sustainable yield unknown.	

GROUNDWATER RESOURCES LOCATED AND ASSESSED IN THE HYDROCENSUS		
Resource ID	**ANBH5**	
Latitude	-34.089575	
Longitude	18.806270	
Resource Type	Monitoring Borehole	
NGA/GRIP No	-	
Sample No.	-	
Current Use	Not In use	
Depth to GW (mbgl)	1.48	
Final Depth (mbgl)	6.21	
BH Diameter (mm)	165	
Casing Diameter (mm)	170	
Casing Revealed (cm)	0	
Comments	Grass growing around and within the borehole casing. Sustainable yield unknown. Borehole is poorly maintained and managed.	
Resource ID	**ANBH4**	
Latitude	-34.089394	
Longitude	18.806608	
Resource Type	Monitoring Borehole	
NGA/GRIP No	-	
Sample No.	-	
Current Use	Not In use	
Depth to GW (mbgl)	1.84	
Final Depth (mbgl)	6.76	
BH Diameter (mm)	165	
Casing Diameter (mm)	170	
Casing Revealed (cm)	-	
Comments	Grass growing around and within the borehole casing. Sustainable yield unknown. Borehole is poorly maintained and managed.	

GROUNDWATER RESOURCES LOCATED AND ASSESSED IN THE HYDROCENSUS		
Resource ID	**ANBH3**	
Latitude	-34.089544	
Longitude	18.806908	
Resource Type	Monitoring Borehole	
NGA/GRIP No	-	
Sample No.	-	
Current Use	Not In use	
Depth to GW (mbgl)	1.48	
Final Depth (mbgl)	6.21	
BH Diameter (mm)	165	
Casing Diameter (mm)	170	
Casing Revealed (cm)	0	
Comments	Grass growing around and within the borehole casing. Sustainable yield unknown. Borehole is poorly maintained and managed.	
Resource ID	**ANBH1**	
Latitude	-34.089758	
Longitude	18.807111	
Resource Type	Monitoring Borehole	
NGA/GRIP No	-	
Sample No.	-	
Current Use	Not In use	
Depth to GW (mbgl)	1.36	
Final Depth (mbgl)	7.62	
BH Diameter (mm)	165	
Casing Diameter (mm)	170	
Casing Revealed (cm)	-	
Comments	Dried up	

ROUNDWATER RESOURCES LOCATED AND ASSESSED IN THE HYDROCENSUS		
Resource ID	**BH ACMW6**	
Latitude	-34.093003	
Longitude	18.804875	
Resource Type	Monitoring Borehole	
NGA/GRIP No	-	
Sample No.	-	
Current Use	In use	
Depth to GW (mbgl)	8.2	
Final Depth (mbgl)	11.7	
BH Diameter (mm)	165	
Casing Diameter (mm)	170	
Casing Revealed (cm)	0	
Comments	Sustainable yield unknown	
Resource ID	**BH12**	
Latitude	-34.092675	
Longitude	18.804847	
Resource Type	Borehole	
NGA/GRIP No	-	
Sample No.	-	
Current Use	Not In use	
Depth to GW (mbgl)	7.85	
Final Depth (mbgl)	9.3	
BH Diameter (mm)	165	
Casing Diameter (mm)	170	
Casing Revealed (cm)	-	
Comments	Borehole was reported to be drilled to 38m, but now only measures 33.67mbgl. The yield is reported as 6.67l/s for 24hrs/day.	

GROUNDWATER RESOURCES LOCATED AND ASSESSED IN THE HYDROCENSUS		
Resource ID	**BH downstream river**	
Latitude	-34.093085	
Longitude	18.804587	
Resource Type	Borehole	
NGA/GRIP No	-	
Sample No.	-	
Current Use	Not In use	
Depth to GW (mbgl)	0 (dried up/collapsed)	
Final Depth (mbgl)	3.11	
BH Diameter (mm)	130	
Casing Diameter (mm)	130	
Casing Revealed (cm)	0	
Comments	Borehole was reported to be drilled to 35m, but is now blocked and filled with debris. The yield is not reported	
Resource ID	**BH upstream river**	
Latitude	-34.093369	
Longitude	18.804444	
Resource Type	Borehole	
NGA/GRIP No	-	
Sample No.	-	
Current Use	Not In use	
Depth to GW (mbgl)	0 (dried up/collapsed)	
Final Depth (mbgl)	5.37	
BH Diameter (mm)	115	
Casing Diameter (mm)	115	
Casing Revealed (cm)	-	
Comments	Borehole was reported to be drilled to 38m, but now only measures 33.67mbgl. The yield is reported as 6.67l/s for 24hrs/day.	

GROUNDWATER RESOURCES LOCATED AND ASSESSED IN THE HYDROCENSUS		
Resource ID	**KFBH83E**	
Latitude	-34.075989	
Longitude	18.810791	
Resource Type	Borehole	
NGA/GRIP No	-	
Sample No.	-	
Current Use	Not In use	
Depth to GW (mbgl)	3.24	
Final Depth (mbgl)	3.77	
BH Diameter (mm)	130	
Casing Diameter (mm)	170	
Casing Revealed (cm)	0	
Comments	Sustainable yield unknown. Dried up after 15 L of water was removed with bailer and did not recover. Poorly maintained.	
Resource ID	**Polluted surface water**	
Latitude	-34.063293	
Longitude	18.797981	
Resource Type	Surface water	
NGA/GRIP No	-	
Sample No.	-	
Current Use	Not In use	
Depth to GW (mbgl)	N/A	
Final Depth (mbgl)	N/A	
BH Diameter (mm)	N/A	
Casing Diameter (mm)	N/A	
Casing Revealed (cm)	-	
Comments	Water body was observed near the northern boundary of the site. Algal blooms observed within the water with a high dissolved oxygen concentration.	

Annexure B: Laboratory Certificates

EPL
ENVIRONMENTAL POLLUTION LABORATORY

sanas
Testing Laboratory

TEST REPORT
47381A

Client and Project Information

Client: JG Afrika
Address: [redacted]

Attention: Mfundo Nhuzela
Tel: [redacted]
Email: [redacted]

Project number: 5980
Project name: Paardevlei (Cape Town)

Sample Information

Sample ID: 913A
Units: mg/l [ppm] (unless stated elsewhere)

Matrix: Water
Container: Plastic

Date Received: 2023/11/03
Date Analysed: 2023/11/03
Date Issued: 2023/11/17

Cations and Metals

As	<0.5	K	19.72	Zn	<0.5
Ca	321.90	Mg	824.30		
Cr	<0.5	Mn	<0.5		
Cu	<0.5	Na	4415.00		
Fe	<0.5	Pb	<0.5		

Anions (Discrete Analyser)

Cl	8867.00	NO2 as N	<0.13	SO4	1011.00
F	5.50	NO3 as N	<0.5		

Other Parameters

pH	7.53	Turbidity (NTU)*	3.38
EC (µs/cm)	18191	P-Alk as CaCO3	<0.6
NH3 as N*	0.19	M-Alk as CaCO3	805.00
NH3*	0.23	CO3*	0.00
Colour (hazen)*	11.47	HCO3*	982.10

Balance

Total Cation (meq/l)*	276.64
Total Anion (meq/l)*	287.83
Cation - Anion Difference (meq/l)*	-11.19
% Difference*	-1.98

Disclaimers

Miche Kannemeyer
Authorised Signatory

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4) A = Concentration outside calibration range, ** = Outsourced analysis, UTD = Unable to Determine, RTF = Results To Follow, NR = Not Requested.
5) Methods: EPL-WL-001 (Conductivity), EPL-WL-002 (Alkalinity), EPL-WL-003 (pH), EPL-WL-004 (TDS), EPL-WL-006 (Anions by IC), EPL-WL-006 (Cations by IC), EPL-WL-007 (Metals), EPL-WL-008 (Cr(VI)), EPL-WL-009 (TOC), EPL-WL-010 (Hg by DMA), EPL-WL-011 (Anions by Discrete Analyser), EPL-HPLC-001 (Formaldehyde).
6) Uncertainty of measurement for all methods included in the SANAS Schedule of Accreditation is available on request.

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TEST REPORT
47381A

Client and Project Information

Client: JG Afrika
Address: [redacted]

Attention: Mfundo Nhuzela
Tel: [redacted]
Email: [redacted]

Project number: 5980
Project name: Paardevlei (Cape Town)

Sample Information

Sample ID: 913B
Units: mg/l [ppm] (unless stated elsewhere)

Matrix: Water
Container: Plastic

Date Received: 2023/11/03
Date Analysed: 2023/11/03
Date Issued: 2023/11/17

Cations and Metals

As	<0.5	K	20.10	Zn	<0.5
Ca	333.40	Mg	836.80		
Cr	<0.5	Mn	<0.5		
Cu	<0.5	Na	3973.00		
Fe	<0.5	Pb	<0.5		

Anions (Discrete Analyser)

Cl	7406.00	NO2 as N	<0.13	SO4	1812.00
F	4.60	NO3 as N	15.37		

Other Parameters

pH	7.70	Turbidity (NTU)*	1.13
EC (µs/cm)	17435	P-Alk as CaCO3	<0.6
NH3 as N*	0.10	M-Alk as CaCO3	807.50
NH3*	0.12	CO3*	0.00
Colour (hazen)*	28.95	HCO3*	985.20

Balance

Total Cation (meq/l)*	258.98
Total Anion (meq/l)*	264.46
Cation - Anion Difference (meq/l)*	-5.48
% Difference*	-1.05

Disclaimers

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EPL
ENVIRONMENTAL POLLUTION LABORATORY

sanas
Testing Laboratory

TEST REPORT
47381A

Client and Project Information

Client: [redacted]
Address: [redacted]

Attention: Mfundo Nhuzela
Tel: [redacted]
Email: [redacted]

Project number: 5980
Project name: Paardevlei (Cape Town)

Sample Information

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

Matrix: Water
Container: Plastic

Date Received: 2023/11/03
Date Analysed: 2023/11/03
Date Issued: 2023/11/17

Cations and Metals

As	<0.05	K	3.46	Zn	<0.05
Ca	116.30	Mg	19.44		
Cr	<0.05	Mn	0.07		
Cu	0.05	Na	31.55		
Fe	0.38	Pb	<0.05		

Anions (Discrete Analyser)

Cl	30.34	NO2 as N	<0.13	SO4	103.70
F	1.22	NO3 as N	3.93		

Other Parameters

pH	7.38	Turbidity (NTU)*	25.79
EC (µs/cm)	706	P-Alk as CaCO3	<0.6
NH3 as N*	0.12	M-Alk as CaCO3	270.00
NH3*	0.14	CO3*	0.00
Colour (hazen)*	57.53	HCO3*	329.40

Balance

Total Cation (meq/l)*	9.00
Total Anion (meq/l)*	8.84
Cation - Anion Difference (meq/l)*	0.15
% Difference*	0.87

Disclaimers

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Annexure C: Quantitative Environmental Risk Assessment (ERA) Guideline

Ref: Department of Water Affairs ***February 2010***
Operational Guideline: Integrated Water and Waste Management Plan

In terms of a quantitative environmental risk assessment (ERA), the assessment will be based on:

- Probability of occurrence which describes the likelihood of the impact actually occurring and is indicated as:-
  - Improbable, where the likelihood of the impact is very low;
  - Probable, where there is a distinct possibility of the impact to occur;
  - Highly probable, where it very likely that the impact will occur;
  - Definite, where the impact will occur regardless any management measure.
- Consequence of occurrence in terms of:
  - Nature of the impact;
  - Extent of the impact, either local, regional, national or across international borders;
  - Duration of the impact, either short term (0-5 years), medium term (6-15 years) or long-term (the impact will cease after the operational life of the activity) or permanent, where mitigation measures by natural processes or human intervention will not occur;
  - Intensity of the impact, either being low, medium or high effect on the natural, cultural and social functions and processes.
- Significance level of the risk posed by the water use, which is determined through a synthesis of the probability of occurrence and consequence of occurrence.

The applicant will have to rank the risks based on the quantitative assessment as described above into high, medium, or low risks. Management measures need to be identified to mitigate, prevent and /or reduce the risk. These measures will primarily be focussed on the risks identified as high in the ranking matrix, but will also include measures for medium and low risks. The management measures will be taken forward in the IWMP as part of the water use authorisation process.

In order to assess each of the factors for each impact the ranking scales as contained in Table 7-1 could be used. Once the factors had been ranked for each impact, the environmental significance of each impact could be assessed by applying the following formula:

SP = (magnitude + duration + scale) x probability

where SP is defined as significance points.

Table 7-1: Ranking Scales for ERA

PROBABILITY = P 5 – Definite / don't know 4 – High probable 3 – Medium probability 2 – low [probability 1 – Improbable 0 - None	**DURATION** = D 5 – Permanent 4 – Long-term ceases with operational life) 3 – Medium-term (5 – 15 years) 2 – Short-term (0-5 years) 1 - Immediate
SCALE = S 5 – International 4 – National 3 – Regional 2 – Local 1 – Site 0 – None	**MAGNITUDE** = M 10 – Very high / Don't know 8 – High 6 – Moderate 4 – Low 2 – Minor

The maximum value of significance points (SP) is 100. Environmental effects could therefore be rated as either high (H), moderate (M), or low (L) significance on the following basis:

- More than 60 points indicates high (H) environmental significance
- Between 30 – 60 points indicate moderate (M) environmental significance
- Less than 30 points indicates low (L) environmental significance.