Appendix B: Specialist Studies

Appendix B1: Soils and Agricultural Potential

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AGRICULTURAL AND SOILS IMPACT ASSESSMENT FOR PROPOSED BOKPOORT 10 X PV SOLAR POWER FACILITIES ON THE FARM BOKPOORT NEAR GROBLERSHOOP NORTHERN CAPE PROVINCE

BA PHASE REPORT

Report by
Johann Lanz

December 2019

Johann Lanz
Professional profile

Education

• M.Sc. (Environmental Geochemistry)	University of Cape Town	1996 - June 1997
• B.Sc. Agriculture (Soil Science, Chemistry)	University of Stellenbosch	1992 - 1995
• BA (English, Environmental & Geographical Science)	University of Cape Town	1989 - 1991
• Matric Exemption	Wynberg Boy's High School	1983

Professional work experience

I am registered as a Professional Natural Scientist (Pri.Sci.Nat.) in the field of soil science, registration number 400268/12, and am a member of the Soil Science Society of South Africa.

- **Soil Science Consultant Self employed 2002 - present**

  I run a soil science consulting business, servicing clients in both the environmental and agricultural industries. Typical consulting projects involve:

1. Soil specialist study inputs to EIA's, SEA's and EMPR's**.** These have focused on impact assessments and rehabilitation on agricultural land, rehabilitation and re-vegetation of mining and industrially disturbed and contaminated soils, as well as more general aspects of soil resource management. Recent clients include: CSIR; SRK Consulting; Aurecon; Mainstream Renewable Power; SiVEST; Savannah Environmental; Subsolar; Red Cap Investments; MBB Consulting Engineers; Enviroworks; Sharples Environmental Services; Haw & Inglis; BioTherm Energy; Tiptrans.
2. Soil resource evaluations and mapping for agricultural land use planning and management. Recent clients include: Cederberg Wines; Unit for Technical Assistance - Western Cape Department of Agriculture; Wedderwill Estate; Goedgedacht Olives; Zewenwacht Wine Estate, Lourensford Fruit Company; Kaarsten Boerdery; Thelema Mountain Vineyards; Rudera Wines; Flagstone Wines; Solms Delta Wines; Dornier Wines.

3. **Soil Science Consultant Agricultural Consultors International (Tinie du Preez) 1998 - end 2001**

   Responsible for providing all aspects of a soil science technical consulting service directly to clients in the wine, fruit and environmental industries all over South Africa, and in Chile, South America.

1. **Contracting Soil Scientist De Beers Namaqualand Mines July 1997 - Jan 1998**

   Completed a contract to make recommendations on soil rehabilitation and re-vegetation of mined areas.

Publications

- Lanz, J. 2012. Soil health: sustaining Stellenbosch's roots. In: M Swilling, B Sebitosi & R Loots (eds). *Sustainable Stellenbosch: opening dialogues*. Stellenbosch: SunMedia.
- Lanz, J. 2010. Soil health indicators: physical and chemical. *South African Fruit Journal*, April / May 2010 issue.
- Lanz, J. 2009. Soil health constraints. *South African Fruit Journal*, August / September 2009 issue.
- Lanz, J. 2009. Soil carbon research. *AgriProbe*, Department of Agriculture.
- Lanz, J. 2005. Special Report: Soils and wine quality. *Wineland Magazine.*

I am a reviewing scientist for the *South African Journal of Plant and Soil*.

environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

	(For official use only)
File Reference Number:	
NEAS Reference Number:	DEA/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

PROJECT TITLE

PROPOSED DEVELOPMENT OF BOKPOORT 10 X 200 MW PV SOLAR POWER FACILITIES, NORTHERN CAPE PROVINCE

Kindly note the following:

- This form must always be used for applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting where this Department is the Competent Authority.
- This form is current as of 01 September 2018. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the form have been published or produced by the Competent Authority. The latest available Departmental templates are available at https://www.environment.gov.za/documents/forms.
- A copy of this form containing original signatures must be appended to all Draft and Final Reports submitted to the department for consideration.
- All documentation delivered to the physical address contained in this form must be delivered during the official Departmental Officer Hours which is visible on the Departmental gate.
- All EIA related documents (includes application forms, reports or any EIA related submissions) that are faxed; emailed; delivered to Security or placed in the Departmental Tender Box will not be accepted, only hardcopy submissions are accepted.

Departmental Details

Postal address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Private Bag X447
Pretoria
0001

Physical address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Environment House
473 Steve Biko Road
Arcadia

Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at:
Email: EIAAdmin@environment.gov.za

1. SPECIALIST INFORMATION

Specialist Company Name:	Johann Lanz – Soil Scientist			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	4	Percentage Procurement recognition	100%
Specialist name:	Johann Lanz			
Specialist Qualifications:	M.Sc. (Environmental Geochemistry)			
Professional affiliation/registration:	Registered Professional Natural Scientist Member of the Soil Science Society of South Africa			
Physical address:	1a Wolfe Street, Wynberg, Cape Town, 7800			
Postal address:	1a Wolfe Street, Wynberg, Cape Town, 7800			
Postal code:	7800	Cell:	082 927 9018	
Telephone:	082 927 9018	Fax:	Who still uses a fax?	
E-mail:	johann@johannlanz.co.za			

2. DECLARATION BY THE SPECIALIST

I, **Johann Lanz**, declare that –

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the Specialist

Johann Lanz – Soil Scientist (sole proprietor)

Name of Company:

30/10/2019

Date

3. UNDERTAKING UNDER OATH/ AFFIRMATION

I, **Johann Lanz**, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Signature of the Specialist

Johann Lanz – Soil Scientist (sole proprietor)

Name of Company

30/10/2019

Date

Signature of the Commissioner of Oaths

2019 10:30.

Date

SUID-AFRIKAANSE POLISIEDIENS
STATION COMMANDER
WYNBERG KP
30 OCT 2019
STATION COMMANDER
WYNBERG CP
SOUTH AFRICAN POLICE SERVICE

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Executive Summary

The proposed development is on land zoned as 'Special'. South Africa has very limited arable land and it is therefore critical to ensure that development does not lead to an inappropriate loss of land that may be valuable for cultivation. This assessment has found that the proposed site is on land which is unsuitable for cultivation due to both climate and soil limitations.

The key findings of this study are:

- Soils on the site are shallow to moderately deep, red, sandy soils overlying hard pan carbonate and sometimes rock (Coega and Plooysburg soil forms).
- The major limitation to agriculture is the limited climatic moisture availability. The low water holding capacity of the soils is a further limitation.
- As a result, the site is unsuitable for cultivation and agricultural land use is limited to grazing.
- The project site is classified with a predominant land capability evaluation value of 5 (low). The site has a grazing capacity of 22 hectares per large stock unit.
- No agriculturally sensitive areas occur within the proposed site and no part of it is therefore required to be set aside from the development.
- The low agricultural potential of the site limits the significance of all on-site agricultural impacts.
- Two potential negative impacts of the development on agricultural resources and productivity were identified as:
    - Loss of agricultural land use caused by direct occupation of land by the energy facility footprint.
    - Soil degradation resulting from erosion, topsoil loss and contamination.
- All impacts were assessed as having low significance.
- Recommended mitigation measures include implementation of an effective system of storm water run-off control to mitigate erosion; and topsoil stripping and re-spreading to mitigate loss of topsoil.
- Because of the low agricultural potential of the site, and the consequent low agricultural impact, there are no restrictions relating to agriculture which would preclude authorisation of the proposed development. From an agricultural impact point of view, the development can be authorised.
- Despite any cumulative regional impact that may occur, it is preferable, in terms of the national mandate to conserve land for agricultural production, to incur a loss of agricultural land in such a region, without cultivation potential, than to lose agricultural land that has a higher potential, to renewable energy development elsewhere in the country.

2 **INTRODUCTION**

This report is an update of an agricultural impact assessment that was completed in 2016.

ACWA Power obtained 3 Environmental Authorisations in 2016 for 2 x 75MW PV facilities as well as a 150MW CSP facility. However, ACWA Power now proposes to, instead of the 150MW CSP facility, construct (8), 200 MW PV plants in its place on the same footprint, which was assessed in 2016. The location is shown in Figure 1. Previously, approval for 2 PV facilities was obtained, PV 1 (Ndebele) and PV 2 (Xhosa), however the proposal for these two sites did not include the battery storage energy system for either of the sites as well as the capacity increase from 75 to 200MW.

Each of the PV plants has the following components: PV panels, battery storage site of 16 ha, access routes (the access roads will be in between the PV panels), substation, water pipeline connection to the main water pipeline (note: main water pipeline already authorised) and 132kV overhead line (31m servitude) and shared infrastructure consisting of buildings, including a workshop area for maintenance, storage (i.e. fuel tanks, etc.), laydown area, parking, warehouse, and offices (previously approved). Each of the 10 PV plants will cover an area of 150 hectares. There is also a 132kv overhead line connection to the Garona substation.

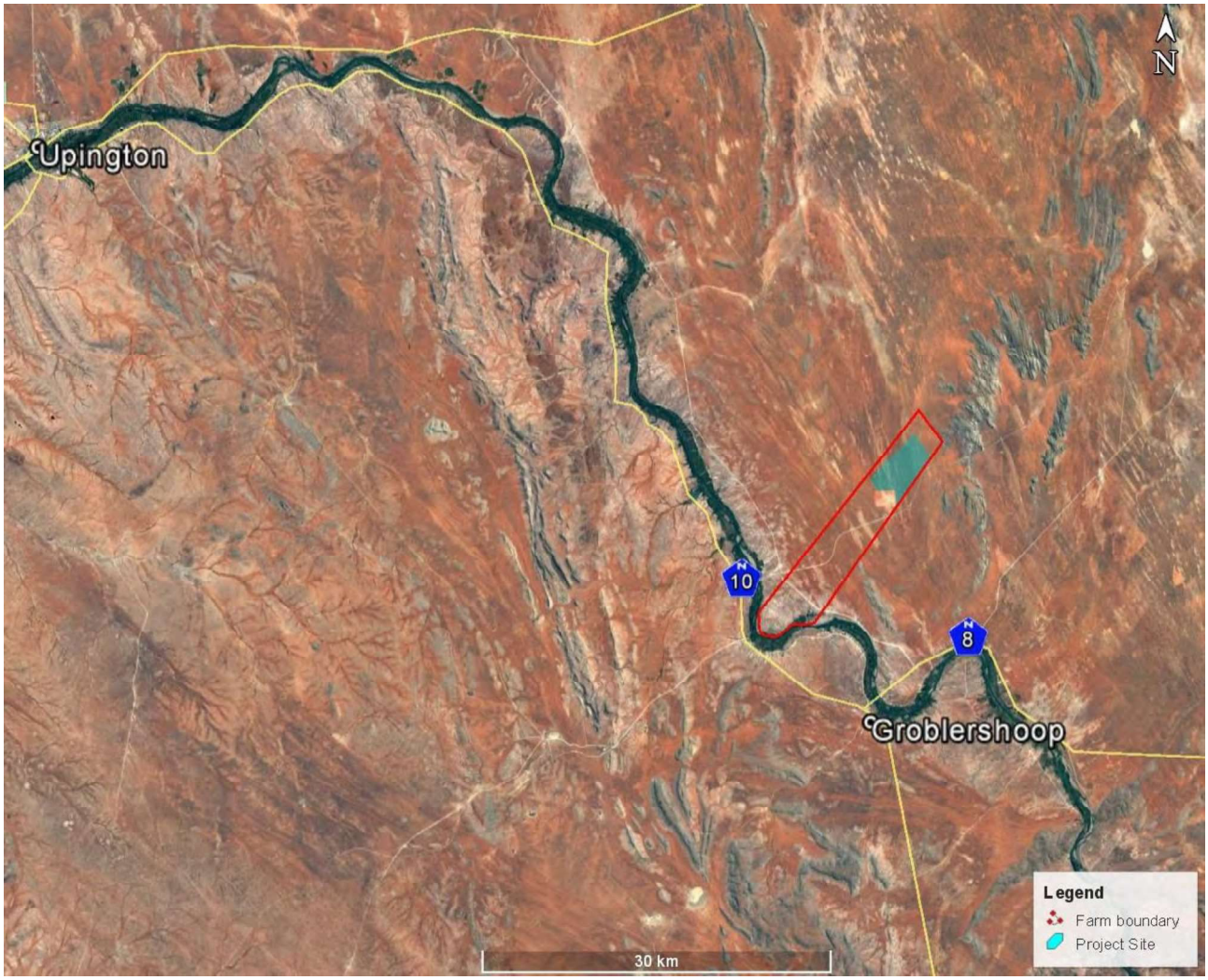

Figure 1. *Location map of the proposed site, north of the town of Groblershoop. The same site was assessed for the environmental authorisations obtained in 2016.*

The site is within one of South Africa's eight renewable energy development zones, and has therefore been identified as one of the most suitable areas in the country for renewable energy development, in terms of a number of environmental impact, economic and infrastructural factors.

3 TERMS OF REFERENCE

The scope of work for this updated report is to update the existing specialist study which was undertaken in support of the 150MW CSP Environmental Impact Assessment in 2016.

1. to reflect the project changes which are: 10 new PV developments on the already assessed CSP site
    1. Possible realignments of shared infrastructure (i.e. water pipeline, powerline, access road) on the same farm
2. to comply with the latest requirements for specialist reports according to the NEMA regulations
3. to comply with the latest Department of Agriculture protocol for agricultural assessments
4. to include updated baseline data on land capability

The terms of reference for the 2016 report were:

- Identify and assess all potential impacts (direct, indirect and cumulative) of the proposed development on soils and agricultural potential.
- Describe and map soil types (soil forms) and characteristics (soil depth, soil colour, limiting factors, and clay content of the top and sub soil layers).
- Describe the topography of the site.
- Describe the climate in terms of agricultural suitability.
- Summarise available water sources for agriculture.
- Describe historical and current land use, agricultural infrastructure, as well as possible alternative land use options.
- Describe the erosion, vegetation and degradation status of the land.
- Determine the agricultural potential across the site.
- Determine the agricultural sensitivity to development across the site.
- Provide recommended mitigation measures, monitoring requirements, and rehabilitation guidelines for all identified impacts.

Table 1. Compliance with the Appendix 6 of the 2014 EIA Regulations

Requirements of Appendix 6 – GN R326 EIA Regulations 7 April 2017	**Addressed in the Specialist Report**
(1) A specialist report prepared in terms of these Regulations must contain- • details of- i. the specialist who prepared the report; and ii. the expertise of that specialist to compile a specialist report including a curriculum vitae;	 Following title page Following title page
• a declaration that the specialist is independent in a form as may be specified by the competent authority;	Following CV
(c) an indication of the scope of, and the purpose for which, the report was prepared;	Sections 1 & 3
(cA)an indication of the quality and age of base data used for the specialist report;	Section 3
(cB)a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Sections 6.6 & 7.4
(d) the date, duration and season of the site investigation and the relevance of the season to the outcome of the assessment;	Not applicable
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 3
(f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 6.8 & 7 & Figure 3
(g) an identification of any areas to be avoided, including buffers;	Section 6.8
(h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Figure 3
(i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 4
(j) a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Section 7
(k) any mitigation measures for inclusion in the EMPr;	Section 7
(l) any conditions for inclusion in the environmental authorisation;	Section 8
(m)any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 7
(n) a reasoned opinion- (i) whether the proposed activity, activities or portions thereof should be authorised; (iA) regarding the acceptability of the proposed activity or activities and (ii) if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	 Section 8 Section 8 Section 7
(o) a description of any consultation process that was undertaken	Not applicable

during the course of preparing the specialist report;	
(p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	Not applicable
(q) any other information requested by the competent authority.	Not applicable
(2) Where a government notice *gazetted* by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	Not applicable

4 METHODOLOGY OF STUDY

The approach for this study was informed by the new protocol for the assessment and reporting of environmental impacts on agricultural resources which is linked to the national web-based environmental screening tool. The protocols have not been gazetted yet, but it is considered best practise to follow the assessment protocol because it represents the most recent thinking in this regard.

The tool identifies the entire project site as low agricultural sensitivity. The protocol therefore requires an Agricultural Compliance Statement and a field assessment is not required.

An Agricultural Compliance Statement must verify that:

1. The site is of "medium" or "low" sensitivity for agricultural resources; and
2. Whether or not the proposed development will have an unacceptable negative impact on the agricultural production capability of the site.

It must contain:

1. Details and relevant expertise as well as the SACNASP registration number of the soil scientist/agricultural specialist preparing the statement including a curriculum vita;
2. A signed statement of independence by the specialist;
3. A map showing the proposed development footprint (including supporting infrastructure) with a 50 m buffered development envelope, overlaid on the agricultural sensitivity map generated by the national environmental screening tool;
4. Calculations of the total development footprint area for each land parcel as well as the total footprint area of the development (including supporting infrastructure);
5. Confirmation as to whether the development footprint is in line with the development limits set in the assessment protocol
6. Confirmation as to whether the sensitivity of the agricultural resource coincides with that indicated on the web-based screening tool;
7. Confirmation from the specialist that all reasonable measures have been taken through micro-siting to minimize fragmentation and disturbance of agricultural activities;
8. A substantiated statement from the agricultural specialist on the acceptability of the

development and a recommendation on the approval or not of the development;

9. Any conditions to which the statement is subjected;
10. Where required, proposed impact management outcomes or any monitoring requirements for inclusion in the Environmental Management Programme (EMPr); and
11. A description of the assumptions made and any uncertainties or gaps in knowledge.

Because of the low agricultural sensitivity of the site, the assessment was a desktop analysis of existing soil and agricultural potential data for the site. This is considered entirely adequate for a thorough assessment of all the agricultural impacts of the proposed development.

The following sources of information were used:

- Soil data was sourced from the land type data set, of the Department of Agriculture, Forestry and Fisheries. This data set originates from the land type survey that was conducted from the 1970's until 2002. It is the most reliable and comprehensive national database of soil information in South Africa and although the data was collected some time ago, it is still entirely relevant as the soil characteristics included in the land type data do not change within time scales of hundreds of years.
- Land capability data was sourced from the 2017 National land capability evaluation raster data layer produced by the Department of Agriculture, Forestry and Fisheries, Pretoria.
- Field crop boundaries were sourced from the national web-based environmental screening tool.
- Rainfall and temperature data was sourced from The World Bank Climate Change Knowledge Portal.
- Grazing capacity data was sourced from the 2018 Department of Agriculture, Forestry and Fisheries long-term grazing capacity map for South Africa, available on Cape Farm Mapper.
- Satellite imagery of the site and surrounds was sourced from Google Earth.

Although a site visit is not required for low and medium agricultural sensitivity sites, this author has visited the site in 2015 for previous studies.

The potential impacts identified in this specialist study were assessed based on the criteria and methodology common to the whole impact assessment. The ratings of impacts were based on the specialist's knowledge and experience of the field conditions of the environment in which the proposed development is located, and of the impact of disturbances on that agricultural environment.

5 CONSTRAINTS AND LIMITATIONS OF STUDY

The assessment rating of impacts is not an absolute measure. It is based on the subjective considerations and experience of the specialist but is done with due regard and as accurately as possible within these constraints.

The study makes the assumption that water for irrigation is not available across the site. This is based on the assumption that a long history of farming experience in an area will result in the exploitation of viable water sources if they exist, and none have been exploited in this area.

There are no other specific constraints, uncertainties and gaps in knowledge for this study.

6 APPLICABLE LEGISLATION AND PERMIT REQUIREMENTS

The Subdivision of Agricultural Land Act (Act 70 of 1970) (SALA), requires that an application for a renewable energy facility on agriculturally zoned land be approved by the Department of Agriculture, Forestry and Fisheries (DAFF) – now Department of Agriculture, Land Reform and Rural Development (DALR&RD). Despite the name of the Act, it does not apply only to subdivision, and its purpose is to ensure productive use of agriculturally zoned land. Therefore, even if land is not being subdivided or leased, SALA approval is required to develop agriculturally zoned land for non-agricultural purposes.

Power lines require the registration of a servitude for each farm portion crossed. In terms of the Subdivision of Agricultural Land Act (Act 70 of 1970) (SALA), the registration of a power line servitude requires written consent of the Minister if the following two conditions apply:

1. if the servitude width exceeds 15 metres; and
2. if Eskom is not the applicant for the servitude.

If one or both of these conditions do not apply, then no agricultural consent is required. Eskom is currently exempt from agricultural consent for power line servitudes.

The Act 70 of 1970 consent is separate from the EIA and needs to be applied for and obtained after the EIA.

Rehabilitation after disturbance to agricultural land is managed by the Conservation of Agricultural Resources Act (Act 43 of 1983) (CARA). No application is required in terms of CARA. The EIA process covers the required aspects of this.

7 DESCRIPTION OF THE SOILS AND AGRICULTURAL CAPABILITY OF THE AFFECTED ENVIRONMENT

7.1 Climate and water availability

Rainfall for the site is given as 265 mm per annum (The World Bank Climate Change Knowledge Portal, undated). The average monthly distribution of rainfall is shown in Figure 2. One of the most important climate parameters for agriculture in a South African context is moisture availability, which is the ratio of rainfall to evapotranspiration. Moisture availability is classified into 6 categories across the country (see Table 2). The site falls into the driest of

these six categories, which is labelled as a very severe limitation to agriculture.

Theoretically there is the possibility of water from the Orange River for the site, but the distance (13km) and the height of the site above the river (over 100 metres) makes irrigation from the river completely non-viable. Water for stock on the site is supplied from wind pumps.

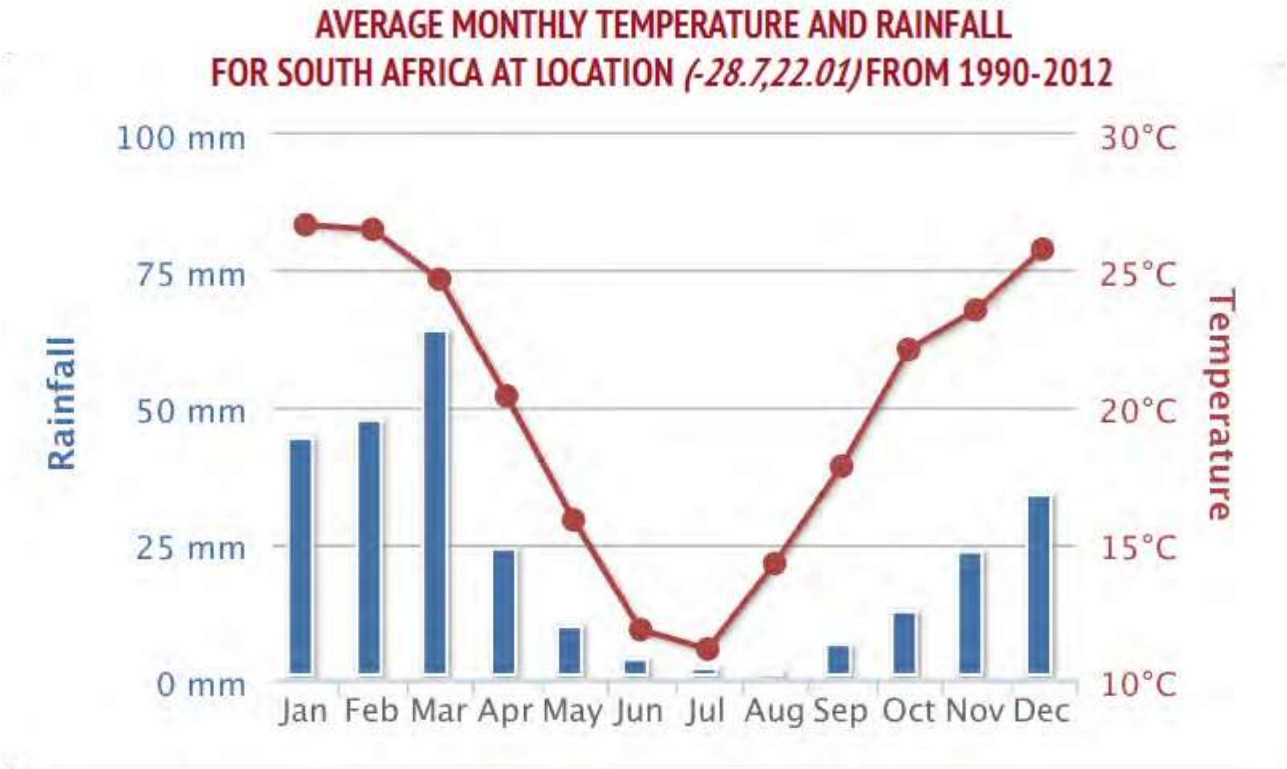

Figure 2. *Average monthly temperature and rainfall for the site (The World Bank Climate Change Knowledge Portal, undated).*

Table 2. The classification of moisture availability climate classes for summer rainfall areas across South Africa (Agricultural Research Council, Undated)

Climate class	Moisture availability (Rainfall/0.25 PET)	Description of agricultural limitation
C1	>34	None to slight
C2	27-34	Slight
C3	19-26	Moderate
C4	12-18	Moderate to severe
C5	6-12	Severe
C6	<6	Very severe

7.2 Terrain, topography and drainage

The proposed development is located on a terrain unit of plains with open low hills or ridges,

changing to rolling or irregular plains with low hills or ridges in the extreme north of the site. It is at an altitude of around 1,000 meters. Slope is less than 2% across the site. A satellite image map of the site is shown in Figure 3.

The geology is red to flesh-coloured wind-blown sand and surface limestone of Tertiary to Recent age. Occasional outcrops of quartz- sericite schist and quartzite of the Groblershoop Formation occur.

There are no water courses on or near the site.

7.3 Soils

The land type classification is a nationwide survey that groups areas of similar soil, terrain and climate conditions into different land types. There is predominantly one land type across most of the site, namely Ae4. A small part of the site in the extreme north east is on land type Af7. The soils of Ae4 are shallow to moderately deep, red, sandy soils overlying hard pan carbonate and sometimes rock. These soils fall into the Calcic and Lithic soil groups according to the classification of Fey (2010). Land type Af7 comprises deeper red sands and includes dunes. A summary detailing soil data for the land type is provided in Appendix 1. Soils are predominantly of the Coega soil form, with lesser coverage of shallow Plooysburg form. It should be noted that the land type classification presented in Appendix 1 made use of the older South African soil classification system, which did not include the Coega and Plooysburg forms. These forms would have been classified, according to the older system, as Mispah and Hutton respectively.

The soils are classified as having low to moderate susceptibility to water erosion (class 5), and as highly susceptible to wind erosion (Ae4 = class 1b; Af7 = class 1a).

7.4 Agricultural capability

Land capability is defined as the combination of soil, climate and terrain suitability factors for supporting rainfed agricultural production. It is an indication of what level and type of agricultural production can sustainably be achieved on any land. The higher land capability classes are suitable as arable land for the production of cultivated crops, while the lower suitability classes are only suitable as non-arable grazing land, or at the lowest extreme, not even suitable for grazing. In 2017, DAFF released updated and refined land capability mapping across the whole of South Africa. This has greatly improved the accuracy of the land capability rating for any particular piece of land anywhere in the country. The new land capability mapping divides land capability into 15 different categories with 1 being the lowest and 15 being the highest. Values below 8 are generally not suitable for production of any cultivated crop. Detail of this land capability scale is shown in Table 3.

The project area is classified with a predominant land capability evaluation value of 5, although it varies from 3 to 5 across the site. Agricultural limitations that result in the low land

capability classification are predominantly due to the very limited climatic moisture availability. The very sandy soils, with very limited water holding capacity are a further limitation. These factors render the site unsuitable for any kind of mainstream cultivation without irrigation, and limit it to low density grazing only.

The long-term grazing capacity of the site is fairly low at 22 hectares per large stock unit.

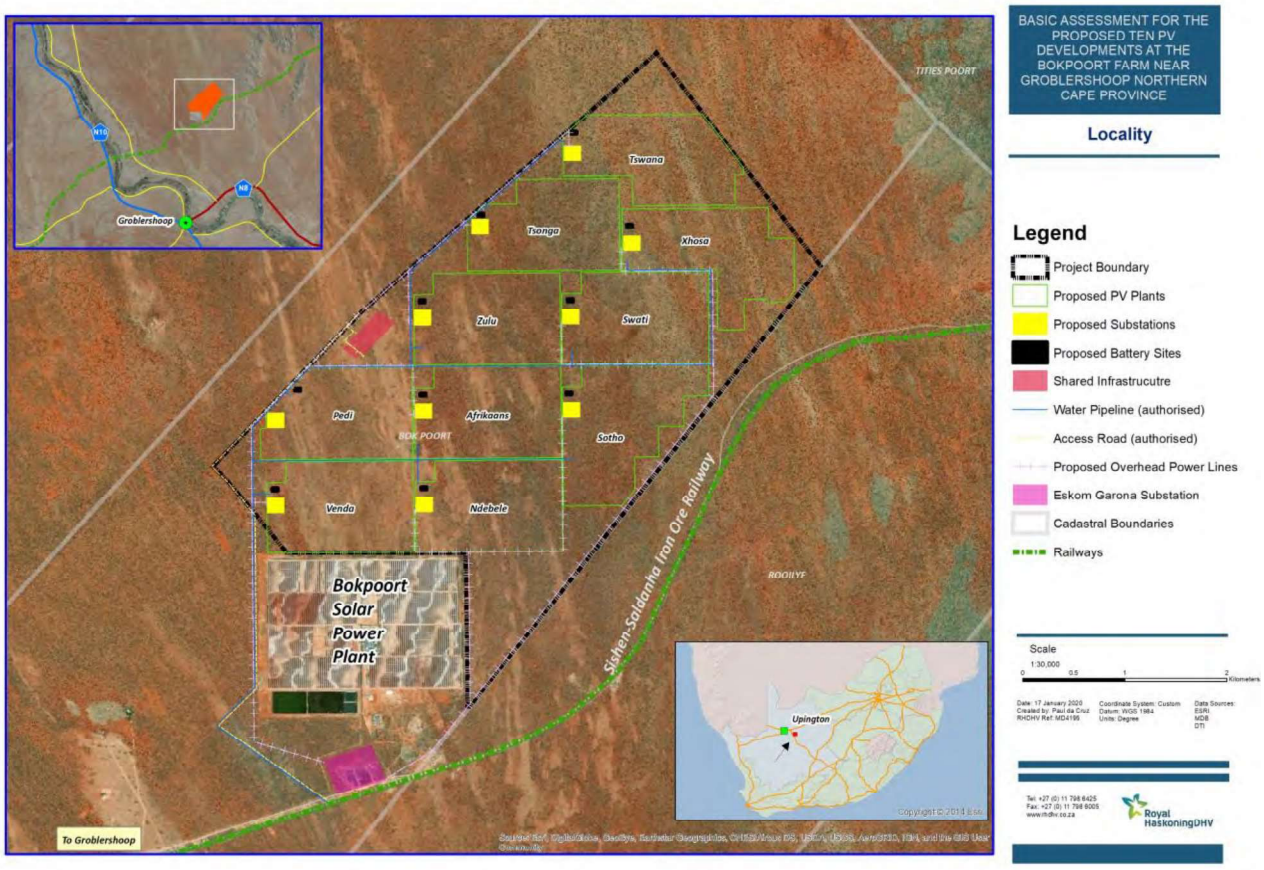

Figure 3. *Satellite image map of the proposed layout. The entire project site has low agricultural sensitivity.*

Table 3. Details of the 2017 Land Capability classification for South Africa.

Land capability evaluation value	Description
1	Very Low
2	
3	Very Low to Low
4	
5	Low
6	Low to Moderate
7	
8	Moderate
9	Moderate to High

10	
11	High
12	High to Very High
13	
14	Very High
15	

7.5 Land use and development on and surrounding the site

The site is located within a sheep farming agricultural region and currently used only for grazing. There has never been any cultivation on the site.

There are no buildings on the site. The only agricultural infrastructure on the site is fencing into grazing camps, wind pumps and stock watering points. There is an existing solar development on the farm adjacent to the proposed site, to its south.

Road access to the site is from the existing road access to the adjacent solar development.

7.6 Status of the land

The biome classification for the site is Kalahari Karroid Shrubland, with a small section of Gordonia Duneveld on land type Af7. The vegetation is grazed and sparse due to low rainfall, but there is no evidence of significant erosion or other land degradation on the site.

7.7 Possible land use options for the site

Because of predominantly the climate limitations, the site is totally unsuitable for cultivated crops, and viable agricultural land use is limited to grazing only.

The site is within one of South Africa's eight renewable energy development zones, and has therefore been identified as one of the most suitable areas in the country for renewable energy development, in terms of a number of environmental impact, economic and infrastructural factors. These factors include an assessment of the significance of the loss of agricultural land. Renewable energy development is therefore a very suitable land use option for the site.

7.8 Agricultural sensitivity

Agricultural sensitivity is a direct function of the capability of the land for agricultural production. This is because a negative impact on land of higher agricultural capability is more detrimental to agriculture than the same impact on land of low agricultural capability. A general assessment of agricultural sensitivity, in terms of loss of agricultural land in South Africa, considers arable land that can support viable production of cultivated crops, to have high sensitivity. This is because there is a scarcity of such land in South Africa, in terms of how much is required for food security. However, there is not a scarcity in the country of land that is only suitable as grazing land and such land is therefore not considered to have high agricultural sensitivity.

The national web-based environmental screening tool identifies the entire site as low agricultural sensitivity. This is confirmed by this assessment. Because no agricultural high sensitivity areas occur within the site, no parts of it need to be avoided by the development. There are no required buffers.

8 IDENTIFICATION AND ASSESSMENT OF IMPACTS ON AGRICULTURE

The change from the CSP, which had environmental authorisation, to the proposed 10 x PV facilities has no bearing on the significance of agricultural impacts, and there is therefore no change to the impact significance which received environmental authorisation.

This assessment has taken the previous EIA reports and their recommendations into account. The previous reports were done by the same specialist as this current report,

The impact assessment is also identical for all 10 PV facilities.

The focus and defining question of an agricultural impact assessment is to determine to what extent a proposed development will compromise (negative impacts) or enhance (positive impacts) current and/or future agricultural production. The significance of an impact is therefore a direct function of the degree to which that impact will affect current or future agricultural production. If there will be no impact on production, then there is no agricultural impact. Impacts that degrade the agricultural resource base pose a threat to production and therefore are within the scope of an agricultural impact assessment. Lifestyle impacts on the resident farming community, for example visual impacts, do not necessarily impact agricultural production and, if they do not, are not relevant to and within the scope of an agricultural impact assessment.

The components of the project that can impact on soils, agricultural resources and productivity are:

- Occupation of the land by the total, direct, physical footprint of the proposed project including all roads.
- Construction (and decommissioning) activities that may disturb the soil profile and vegetation, for example for levelling, excavations, etc.

The significance of all potential agricultural impacts is kept low by the fact that the proposed site is on land of extremely limited agricultural potential that is only viable for low intensity grazing. The rating of an impact is based on the extent to which that impact can potentially affect agricultural production, in line with the discussion in paragraph 1 of this section.

The following two potential impacts of the developments on agricultural resources and productivity are identified and assessed in the table formats below.

Mitigation and monitoring recommendations are included in the table for each impact.

8.1 Impacts associated with the construction phase

8.1.1 Loss of agricultural land use

Agricultural grazing land directly occupied by the development infrastructure, which includes all associated infrastructure, will become unavailable for agricultural use.		
Status	Negative	
	Without mitigation	**With mitigation**
Probability	Definite (5)	Definite (5)
Duration	Long term (4)	Long term (4)
Scale / extent	Site only (1)	Site only (1)
Magnitude / severity	Minor (2)	Minor (2)
Significance	Moderate (35)	Moderate (35)
Comment on significance: The significance rating only comes out moderate because of the way the definite probability and the long - term duration influence the calculation. In my opinion the actual significance of this impact is low, and it has little real effect and does not need to have an influence on or require modification of the project design.		
Mitigation: None possible.		
Reversibility	The impact is reversible after the life of the project, with effective topsoiling of the land during rehabilitation, where necessary.	
Irreplaceable loss of resources?	Minor because of the low value of the agricultural resource, which is not scarce	
Confidence level of assessment	Medium - determination is based on common sense and general knowledge	

8.1.2 Soil degradation

Soil degradation can result from erosion, topsoil loss and contamination. Erosion can occur as a result of the alteration of the land surface run-off characteristics, which can be caused by construction related land surface disturbance, vegetation removal, and the establishment of hard surface areas including roads. Loss of topsoil can result from poor topsoil management during construction related excavations. Hydrocarbon spillages from construction activities can contaminate soil. Soil degradation will reduce the ability of the soil to support vegetation growth.	
Comments: The water erosion risk is low due to the low slope gradients and low to moderate erodibility of the soils, but wind erosion risk is high.	
Status	Negative

	Without mitigation	With mitigation
Probability	Medium (3)	Low (2)
Duration	Medium term (3)	Medium term (3)
Scale / extent	Site only (1)	Site only (1)
Magnitude / severity	Minor (2)	Minor (2)
Significance	Low (18)	Low (12)

Mitigation:

Implement an effective system of storm water run-off control, where it is required - that is at all points of disturbance where water accumulation might occur. The system must effectively collect and safely disseminate any run-off water from all hardened surfaces and it must prevent any potential down slope erosion. Any occurrences of erosion must be attended to immediately and the integrity of the erosion control system at that point must be amended to prevent further erosion from occurring there.

If an activity will mechanically disturb the soil profile below surface, then any available topsoil should first be stripped from the entire surface to be disturbed and stockpiled for re-spreading during rehabilitation, which may be after construction or only at decommissioning. The depth of topsoil stripping is dependent on the specific field conditions. The maximum depth should be 30cm. If additional unconsolidated material exists below 30cm and needs to be removed for construction purposes, it must be stripped and stockpiled separately from the upper 30cm topsoil. Such material should only be used for fill below a topsoil layer, and not used for spreading on the surface. If there is less than 30cm of unconsolidated soil material above a limiting layer of rock or hardpan, then the entire depth must be stripped and stockpiled as topsoil, even if it contains a high proportion of course fragments.

Topsoil should be retained in the area below the panels (or mirrors). It is not desirable to strip and stockpile this topsoil for the whole of the operational phase. It will be much more effective for rehabilitation, to retain the topsoil in place. If levelling requires significant cutting, topsoil should be temporarily stockpiled and then re-spread after cutting, so that there is a covering of topsoil over the entire surface before the panels are mounted. It will be advantageous to have topsoil and vegetation cover below the panels during the operational phase for the following reasons: conservation of topsoil, dust suppression and erosion control.

It is only in areas where topsoil cannot be retained on the surface during the operational phase, and where the area will be rehabilitated back to veld after decommissioning, that it should be stripped and stockpiled for the duration of the operational phase for re-spreading during de-commissioning.

Topsoil stockpiles must be conserved against losses through erosion by establishing vegetation cover on them.

Dispose of all subsurface spoils from excavations where they will not impact on undisturbed land.

During rehabilitation, the stockpiled topsoil must be evenly spread over the entire disturbed surface.
If there is compaction, either in re-spread topsoil or in areas where topsoil was retained during the operational phase, it must be loosened through an appropriate plough action.
If topsoil has been stockpiled for the duration of the operational phase, re-vegetation is likely to require seeding and / or planting.
Erosion must be carefully controlled where necessary on topsoiled areas.

Monitoring:
Establish an effective record keeping system for each area where soil is disturbed for constructional purposes. These records should be included in environmental performance reports, and should include all the records below.
Record the GPS coordinates of each area.
Record the date of topsoil stripping.
Record the GPS coordinates of where the topsoil is stockpiled.
Record the date of cessation of constructional (or operational) activities at the particular site.
Photograph the area on cessation of constructional activities.
Record date and depth of re-spreading of topsoil.
Photograph the area on completion of rehabilitation and on an annual basis thereafter to show vegetation establishment and evaluate progress of restoration over time.

Include periodical site inspection in environmental performance reporting that inspects the effectiveness of the run-off control system and specifically records occurrence or not of any erosion on site or downstream.

Reversibility	The impact is reversible with effective rehabilitation.
Irreplaceable loss of resources?	Minor because of the low value of the agricultural resource, which is not scarce
Confidence level of assessment	Medium - determination is based on common sense and general knowledge

8.2 Impacts associated with the operational phase

Loss of agricultural land use and soil degradation occur at the start of the construction phase and are therefore not listed under operational phase impacts. There is no further loss of land that occurs in subsequent phases.

8.3 Impacts associated with the decommissioning phase

8.3.1 Soil degradation

Soil degradation can result from erosion, topsoil loss and contamination. Erosion can occur as a result of the alteration of the land surface run-off characteristics, which can be caused by

decommissioning related land surface disturbance. Loss of topsoil can result from poor topsoil management during decommissioning related excavations. Hydrocarbon spillages from decommissioning activities can contaminate soil. Soil degradation will reduce the ability of the soil to support vegetation growth.

Comments: The water erosion risk is low due to the low slope gradients and low to moderate erodibility of the soils, but wind erosion risk is high.

Status	Negative	
	Without mitigation	**With mitigation**
Probability	Medium (3)	Low (2)
Duration	Medium term (3)	Medium term (3)
Scale / extent	Site only (1)	Site only (1)
Magnitude / severity	Minor (2)	Minor (2)
Significance	Low (18)	Low (12)

Mitigation:

If an activity will mechanically disturb the soil profile below surface, then any available topsoil should first be stripped from the entire surface to be disturbed and stockpiled for re-spreading during rehabilitation, which may be after construction or only at decommissioning. The depth of topsoil stripping is dependent on the specific field conditions. The maximum depth should be 30cm. If additional unconsolidated material exists below 30cm and needs to be removed for construction purposes, it must be stripped and stockpiled separately from the upper 30cm topsoil. Such material should only be used for fill below a topsoil layer, and not used for spreading on the surface. If there is less than 30cm of unconsolidated soil material above a limiting layer of rock or hardpan, then the entire depth must be stripped and stockpiled as topsoil, even if it contains a high proportion of course fragments.

Topsoil should be retained in the area below the panels (or mirrors). It is not desirable to strip and stockpile this topsoil for the whole of the operational phase. It will be much more effective for rehabilitation, to retain the topsoil in place. If levelling requires significant cutting, topsoil should be temporarily stockpiled and then re-spread after cutting, so that there is a covering of topsoil over the entire surface before the panels are mounted. It will be advantageous to have topsoil and vegetation cover below the panels during the operational phase for the following reasons: conservation of topsoil, dust suppression and erosion control.

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Topsoil stockpiles must be conserved against losses through erosion by establishing vegetation cover on them.

Dispose of all subsurface spoils from excavations where they will not impact on undisturbed land.

During rehabilitation, the stockpiled topsoil must be evenly spread over the entire disturbed

surface.
If there is compaction, either in re-spread topsoil or in areas where topsoil was retained during the operational phase, it must be loosened through an appropriate plough action.
If topsoil has been stockpiled for the duration of the operational phase, re-vegetation is likely to require seeding and / or planting.
Erosion must be carefully controlled where necessary on topsoiled areas.

Monitoring:
Establish an effective record keeping system for each area where soil is disturbed for constructional purposes. These records should be included in environmental performance reports, and should include all the records below.
Record the GPS coordinates of each area.
Record the date of topsoil stripping.
Record the GPS coordinates of where the topsoil is stockpiled.
Record the date of cessation of constructional (or operational) activities at the particular site.
Photograph the area on cessation of constructional activities.
Record date and depth of re-spreading of topsoil.
Photograph the area on completion of rehabilitation and on an annual basis thereafter to show vegetation establishment and evaluate progress of restoration over time.

Include periodical site inspection in environmental performance reporting that inspects the effectiveness of the run-off control system and specifically records occurrence or not of any erosion on site or downstream.

Reversibility	The impact is reversible with effective rehabilitation.
Irreplaceable loss of resources?	Minor because of the low value of the agricultural resource, which is not scarce
Confidence level of assessment	Medium - determination is based on common sense and general knowledge

8.4 Cumulative impacts

The cumulative impact of a development is the impact that development will have when its impact is added to the incremental impacts of other past, present or reasonably foreseeable future activities that will affect the same environment. The most important concept related to a cumulative impact is that of an acceptable level of change to an environment. A cumulative impact only becomes relevant when the impact of the proposed development will lead directly to the sum of impacts of all developments causing an acceptable level of change to be exceeded in the surrounding area. If the impact of the development being assessed does not cause that level to be exceeded, then the cumulative impact associated with that development is not significant.

The potential cumulative agricultural impact of importance is a regional loss or degradation of

agricultural land, with a consequent decrease in agricultural production. The defining question for assessing the cumulative agricultural impact is this:

> What level of loss of agricultural land is acceptable in the area, and will the loss associated with the proposed Bokpoort PV development, cause that level in the area to be exceeded?

The loss of agricultural land in the area is highly likely to be within an acceptable limit in terms of loss of low potential agricultural land, of which there is no scarcity in the country. This is particularly so when considered within the context of the following two points:

- In order for South Africa to achieve its renewable energy generation goals, agriculturally zoned land will need to be used for renewable energy generation. It is far more preferable to incur a cumulative loss of agricultural land in a region such as the one being assessed, which has no cultivation potential, and low grazing capacity, than to lose agricultural land that has a higher potential, and that is much scarcer, to renewable energy development elsewhere in the country. The limits of acceptable agricultural land loss are therefore far higher in this region than in regions with higher agricultural potential.
- It is also preferable, from an impact point of view as well as from practical considerations, to rather have a concentrated node of renewable energy development within one area, as is the case around this project, than to spread out the same number of developments over a larger area.

Acceptable levels of change in terms of other areas of impact such as visual impact would be exceeded long before agricultural levels of change came anywhere near to being exceeded.

It should also be noted that there are few land uses, other than renewable energy, that are competing for agricultural land use in this area. The cumulative impact from developments, other than renewable energy, is therefore low.

Due to all of the considerations discussed above, the cumulative impact of loss of agricultural land use is assessed as having low significance. In terms of cumulative impact, therefore, the development can be authorised.

8.5 Comparative assessment of alternatives

No proposed technology or grid connection alternatives will have any bearing on agricultural impacts.

The no-go alternative considers impacts that will occur to the agricultural environment in the absence of the proposed development. The one identified potential such impact is that due to continued low rainfall in the area, in addition to other economic and market pressures on farming, the agricultural enterprises will come under increased pressure in terms of economic

viability, with resultant decrease in productivity.

There is not a big difference in the extent to which the development and the no-go alternative will impact agricultural production, which results in there being, from an agricultural impact perspective, no preferred alternative between the development and the no-go.

9 CONCLUSION AND RECOMMENDATIONS

The proposed development is on land zoned as 'Special'. South Africa has very limited arable land and it is therefore critical to ensure that development does not lead to an inappropriate loss of land that may be valuable for cultivation. This assessment has found that the investigated site is on land which is of low agricultural potential and is not suitable for cultivation.

It is preferable to incur a loss of agricultural land on such a site, without cultivation potential, than to lose agricultural land that has a higher potential, to renewable energy development elsewhere in the country.

No agriculturally sensitive areas occur within the proposed site and no part of it is therefore required to be set aside from the development.

Because of the low agricultural potential of the site, and the consequent low agricultural impact, there are no restrictions relating to agriculture which would preclude authorisation of the proposed development. Therefore, from an agricultural impact point of view, the development should be authorised.

There are no conditions resulting from this assessment that need to be included in the environmental authorisation.

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APPENDIX 1: SOIL DATA

Table A1. Land type soil data for site.

Land type	Land capability class	Soil series (forms)	Depth (cm)	Clay % A horizon	Clay % B horizon	Depth limiting layer	% of land type
Ae4	7	Hutton	45-100	3-6	6-8	ka	42
		Mispah	10-25	6-10		ka	40
		Hutton	20-60	3-6	6-9	R, ka	10
		Hutton	60-120	2-4	3-6	ka	5
Af7	7	Hutton	60->120	2-4	4-8	ka	58
		Hutton	>120	1-2	2-4		40

Land capability classes: 7 = non-arable, low potential grazing land.

Depth limiting layers: R = hard rock; ka = hardpan carbonate.

Appendix B2: Hydrogeology

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Hydrogeological Baseline Assessment for Photovoltaic Solar Development

Report

Version - Final

08 April 2020

Royal HaskoningDHV

GCS Project Number: 19-0993

Client Reference: Bokpoort Groundwater Baseline Assessment

GCS (Pty) Ltd. **Reg No:** 2004/000765/07 Est. 1987
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Director	Alkie Marais		April 2020

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1 INTRODUCTION

GCS (Pty) Ltd was appointed by Royal HaskoningDHV (Pty) Ltd (Royal HaskoningDHV),the Client, on behalf of ACWA Power Energy Africa (Pty) Ltd (ACWA Power) to conduct an updated hydrogeological assessment to convert the current site (which comprises of an authorised concentrated solar power (CSP) and two (2) Photovoltaic (PV) plants) into the development of ten (10) PV developments with shared infrastructure. The Bokpoort II: 2000MW PV Solar Power Development (the site) is located on the north-eastern portion of the remaining extent of the Farm Bokpoort 390, which is 20 km north-west of the town of Groblershoop within the Northern Cape Province. The site is within one of South Africa's eight renewable energy development zones and has therefore been identified as one of the most suitable areas in the country for renewable energy development in terms of a number of environmental impact, economic and infrastructural factors.

Previously, GCS conducted a hydrogeological assessment during April 2010. The previous hydrogeological assessment included a desk study, literature review, hydrocensus, collection of groundwater samples and reporting the findings and risk assessment. This report will include an updated hydrogeological investigation, hydrocensus (sensitive receptor survey) and will focus specifically on the risk assessment associated with the proposed ten (10) PV Plants. This report will also include a review of the provisions of the specialist studies conducted by Golder Associates Africa (Pty) Ltd (Golder).

1.1 Terms of Reference

ACWA Power obtained three (3) Environmental Authorisations in 2016 for the 2 x 75MW PV facilities as well as a 150MW concentrated solar power (CSP) facility. However, a strategic decision was put forward to, instead of the CSP facility, ACWA Power is proposing to develop ten (10) PV plants (eight (8) new PV plants and two (2) authorised PV plants) within the same footprint. The MW capacity of each PV Plant will be 200MW per site. A Battery Energy Storage System (BESS) will be included on all ten (10) PV sites. To allow for this proposal, a basic assessment process will be undertaken to obtain the required authorisation for the PV plants. This report will focus on the groundwater risk assessment associated with the new PV plants and a review of the surface water risk assessments conducted by Golder.

1.1.1 The Solar Plant Design Specifications

The infrastructure and specifications to the solar plant design are listed below:

- A PV Solar Development of up to 200 Megawatt (MW) that will consist of the following infrastructure:
    - Solar PV modules that will be able to deliver up to 200 MW to the Eskom National Grid;
    - Inverters that convert direct current (DC) generated by the PV modules into alternating current (AC) to be exported to the electrical grid;
    - A transformer that raises the system AC low voltage (LV) to medium voltage (MV). The transformer converts the voltage of the electricity generated by the PV panels to the correct voltage for delivery to Eskom;
    - Transformer substation; and
    - Instrumentation and control consisting of hardware and software for remote plant monitoring and operation of the facility.
- Associated infrastructure includes:
    - Mounting structures for the solar panels;
    - Cabling between the structures, to be lain underground where practical;
    - A new 132 kV overhead power line which will connect the facility to the national grid via Eskom's existing Garona Substation;
    - The powerline will be approximately 5 km in length and will be located within a servitude spanning 15.5m on both sides. The powerline towers will be 35 m high;
    - Internal access roads (4 - 6 m wide roads will be constructed but existing roads will be used as far as possible) and fencing; and
    - Shared infrastructure consisting of buildings, including a workshop area for maintenance, storage (i.e. fuel tanks, etc.), laydown area, parking, warehouse, and offices (previously approved).
- Type of technology:
    - Photovoltaic Solar Power Plant.
- The proposed PV solar facility will have the following infrastructure that are important in terms of height:
    - The PV panels disposition over support structures will be approximately 4.5 m high; and

  - The substation will be approximately 10 m high.
- Surface area to be covered:
  - The proposed PV solar facility will cover 150 ha.
- Structure orientation:
  - The PV panels will be installed perpendicular to the sun's rays, which change continuously over the course of the day and season.
- Laydown area dimensions:
  - The construction laydown area will be 5 hectares.
- Generation capacity:
  - The proposed PV solar facility will generate up to 200 MW.
- Generation capacity of the facility as a whole at delivery points:
  - The proposed PV facility will generate up to 200 MW.
- Battery energy storage system (BESS):
  - BESS capacity on each PV site: 150 MW;
  - BESS site footprint on each PV site: 16ha; and
  - The BESS combined site storage within batteries on each PV site will be 4500 m^3 of hazardous substance.

1.2 Report Assumptions and Limitations

- The scope of work addressed in this report is based on the information provided by the Client at the time the proposal was comprised. The information and investigation in this report is based on the infrastructure, site layout and site location provided by the Client at the time of reporting. Should this information change, the report will have to be updated accordingly.
- This report has been prepared for the particular purpose outlined in the proposal (Update of Hydrogeological Investigation NOMAC- Bokpoort CSP PN: 19-0993) and no responsibility is accepted for the use of this report, in whole or in part, in other contexts or for any other purpose.
- Where data supplied by the Client, including previous site investigation data, have been used, it has been assumed that the information is correct unless otherwise stated. No responsibility is accepted by GCS for incomplete or inaccurate data supplied by others.

- Where data is sources by other external sources (i.e. National Groundwater Archive and National Register of Water Use) it has been assumed that the information is correct unless otherwise stated. No responsibility is accepted by GCS for incomplete or inaccurate data supplied by others.
- Any assessments made in this report are based on the conditions indicated from published sources and the investigation described. No guarantee is included that the actual conditions will conform exactly to the assessments contained in this report.
- It is recognised that the passage of time affects the information and assessment provided in this report. The opinions and conclusions made in this report are based on information that existed at the time of the production of the report. It is understood that the services provided allowed GCS to form no more than an opinion of the actual conditions of the site at the time the site was visited and cannot be used to assess the effect of any subsequent changes in the quality of the site, or its surroundings, or any laws or regulations.
- This report is provided for sole use by the Client and is confidential to it and its professional advisers.

2 SCOPE OF WORK

The following work were set out in the proposal and accepted by Royal HaskoningDHV:

- Site walk over and hydrocensus;
- Updated reporting and risk assessment; and
- A review of two (2) existing reports, compiled by Golder, which form part of the environmental impact assessment (EIA) reports for the proposed Bokpoort II solar developments. These reports included:
    - Surface Water Baseline and Impact Assessment Report for the Proposed 75 MW PV 1 Solar Facility (Proposed Bokpoort II Solar Development) near Groblershoop, Northern Cape; and
    - Surface Water Baseline and Impact Assessment Report for the Proposed 75 MW PV 2 Solar Facility (Proposed Bokpoort II Solar Development) near Groblershoop, Northern Cape.

2.1 Project Team

The GCS staff members, along with their designation and role, involved in the project are listed in **Table 2-1**. The details and expertise of the specialists involved in this study along with the relevant declaration forms are attached in Appendix C.

Table 2-1: Proposed team members

Name	Designation	Role
Alkie Marais	Water Group Director (Pr.Sci.Nat.)	Project Director
Kobus Troskie	Snr Hydrogeologist (Pr.Sci.Nat)	Project Manager
Chantelle Schmidt	Hydrogeologist	Hydrogeological reporting and field investigation.

3 METHODOLOGY

3.1 Site Investigation and Hydrocensus

The reconnaissance of the site was done to ensure an understanding of the topography and hydrology. A hydrocensus was conducted in and around the site boundaries, to:

- Obtain up to date hydrogeological and hydrological data, i.e. groundwater levels;
- Obtain groundwater samples to establish the background groundwater quality; and
- Identify groundwater and / or surface water stakeholders and quantify the groundwater and / or surface water use in the project area.

During the hydrocensus field program, the following information will be collected, but not limited to:

  - Borehole locality (coordinates using a hand-held global positioning system – GPS);
  - Borehole status (incl. equipped) and construction details;
  - Static water level (using a depth to water level meter);
  - Olfactory and visual conditions of the water; and
  - Primary groundwater use (incl. abstraction rates).

3.2 Groundwater Sampling

The sampling procedure is undertaken in accordance to the following publications:

- ISO 5667-1: 2006 Part 1: Guidance on the design of sampling programs and sampling techniques.
- ISO 5667-3: 2003 Part 3: Guidance on preservation and handling of samples.
- ISO 5667-11: 2009 Part 11: Guidance on sampling of groundwater.
- DWAF Best Practice Guidelines Series G3: General Guidelines for Water Monitoring Systems.

The following information will be recorded during the field analysis for each sampling locality:

- Date and time of sampling;
- Coordinates of each borehole;
- General status of the borehole (locked, vandalised, etc.);
- Static water level for boreholes, using a dip meter;
- In-situ measurements for each sampling point, namely pH, electrical conductivity, total dissolved solids and temperature; and
- General characteristics of the water samples such as colour, turbidity (murky/clear) and smell, as well as visual observations of the sample site.

3.3 Water Quality Analysis

Aquatico Laboratory (a South African National Accreditation System (SANAS) accredited laboratory according to ISO / IEC 17025:2005 standards No: T0374) in Pretoria, South Africa, was commissioned to undertake the analytical testing for the collected groundwater samples.

3.4 Data Analysis and Reporting

The site assessment report will contain an updated description and evaluation of the existing groundwater quality and level based on the water analysis collected during the hydrocensus. An updated impact assessment and risk assessment was also conducted.

3.4.1 Impact Assessment

All results obtained during the hydrocensus and site investigation were compiled into a site-specific impact assessment and was utilised to conceptualise the site. This site conceptualisation was used to complete a source-pathway-receptor linkage to quantify areas of possible concern:

- Source – identification of on-site conditions and possible contaminant sources;
- Groundwater Pathway – evaluation of the geological environment, aquifer conditions and aquifer vulnerability; and
- Receptors – identification of all sensitive receptors (human and environment) within proximity of the site (including existing potable abstraction boreholes and sensitive areas).

3.4.2 Risk assessment

The identified impacts are assessed in accordance with the approach outlined below, extracted from the Golder EIR (terminology from the Department of Environmental Affairs and Tourism Guideline document on EIA Regulations, April 1998). This approach incorporates two (2) aspects for assessing the potential significance of impacts, namely occurrence and severity, which are further sub-divided as shown in Table 3-1.

Table 3-1: Potential significance of impacts.

Occurrence		**Severity**	
Probability of occurrence	Duration of occurrence	Scale/ extent of impact	Magnitude (severity) of impact

To assess each of these factors of each impact listed in Table 3-1, the four ranking scales listed in Table 3-2 are used.

Table 3-2: Ranking scale

Probability	**Duration**
5- Definite/ don't know	5-Permanent
4- Highly probable	4-Long-term
3- Medium probability	3-Medium=term (8-15 years)
2- Low probability	2-Short-term (0-7 years) (impact ceases after the operational life of the activity)
1-Improbable	1-Immediate
0-None	0-None
Scale	**Magnitude**
5-International	10-Very high/don't know
4-Natinal	8-High
3-Regional	6-Moderate
2-Local	4-Low
1-Site only	2-Minor
0-None	0-None

Once these factors have been ranked for each impact, the significance of the two (2) aspects, occurrence and severity, must be assessed using the following formula:

$$\boldsymbol{SP = (Magnitude + Duration + Scale) \times Probability}$$

Where:

SP is the significance points.

The maximum value is 100 significance points (SP). The impact significance is then rated as shown in Table 3-3.

Table 3-3: Impact significance based on SP rating.

SP Rating		Comment
SP > 75	Indicates high environmental significance	An impact could influence the decision about whether or not to proceed with the project regardless of any possible mitigation
SP 30- 75	Indicates moderate environmental significance	An impact or benefit which is sufficiently important to require management, and which could have an influence on the decision unless it is mitigated.
SP <30	Indicates low environmental significance	Impacts with little real effect and which should not have an influence on or require modification of the project design.

4 SITE DESCRIPTION

4.1 Site Locality

The site is located on the north-eastern portion of the remaining extent of the Farm Bokpoort 390, which is 20 km north-east of the town of Groblershoop within the Northern Cape Province. The locality map is shown in Figure 4-1 and the site layout with the current and proposed project expansion is shown in Figure 4-2.

4.2 Topography and Hydrology

From the 1:50 000 topographical map and observations on site, the site slopes in a western direction and drains towards the Orange River, as shown in Figure 4-3. The site is in the D73D quaternary catchment within the lower Orange Main Stem Catchment and is governed by the Orange Water Management Area (WMA).

4.3 Geological and Hydrogeological Setting

The general geology of the site mainly comprises red-brown, coarse-grained granite gneiss; and quartz-muscovite schists, quartzite, quartz-amphibole schists and greenstones of the Groblershoop formation, Brulpan group. Calcrete is also found especially on the south eastern part of the area. The geology map is shown Figure 4-4.

The aquifer vulnerability and classification maps of South Africa classifies this area as underlain by a least vulnerability, this means that this aquifer is only vulnerable to conservative pollutants in the long term when continuously discharged or leached (DWS, 2013). The metamorphic rocks represent fracted aquifer types with a moderately-yielding aquifer system of variable water quality.

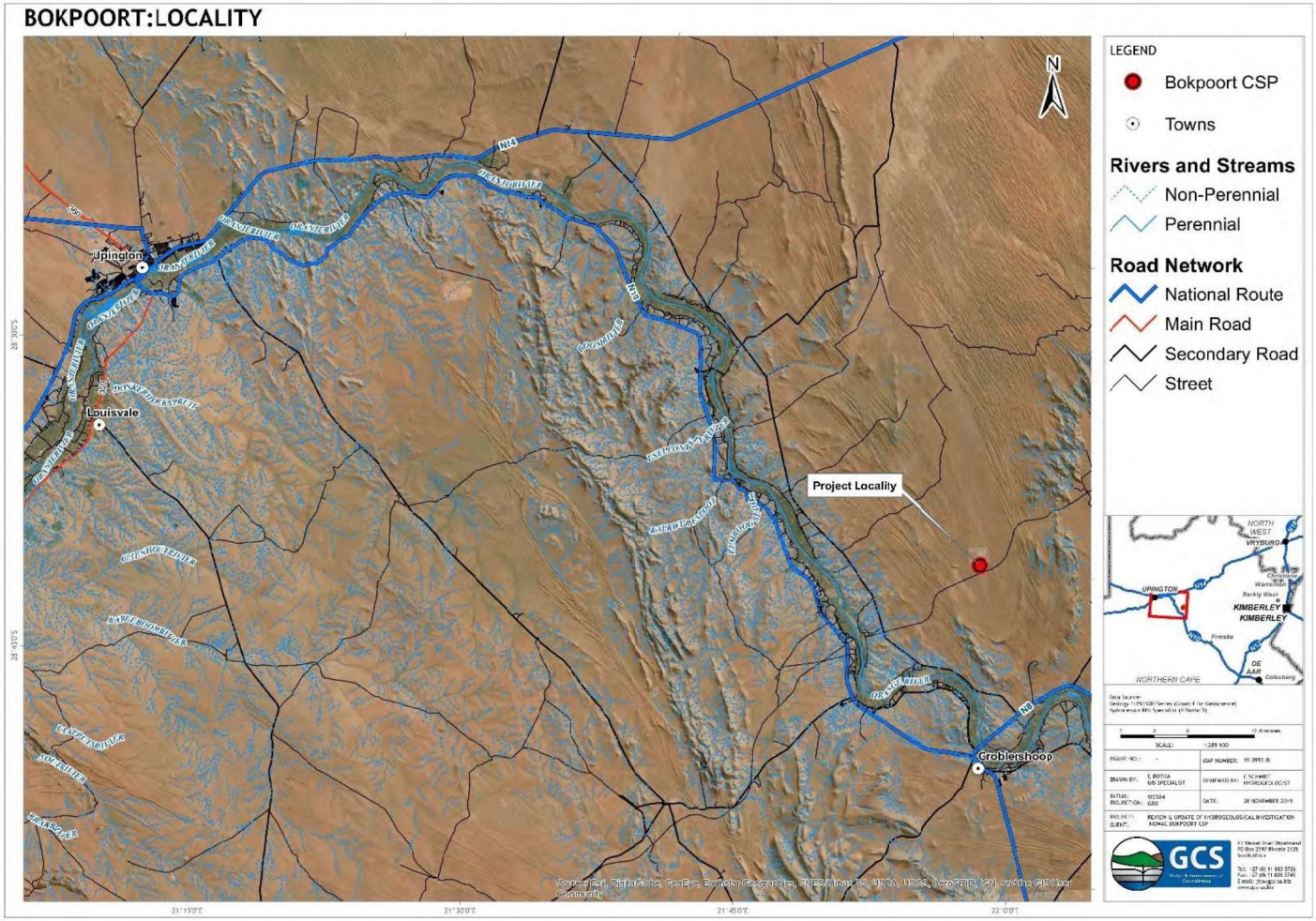

Figure 4-1: Locality map

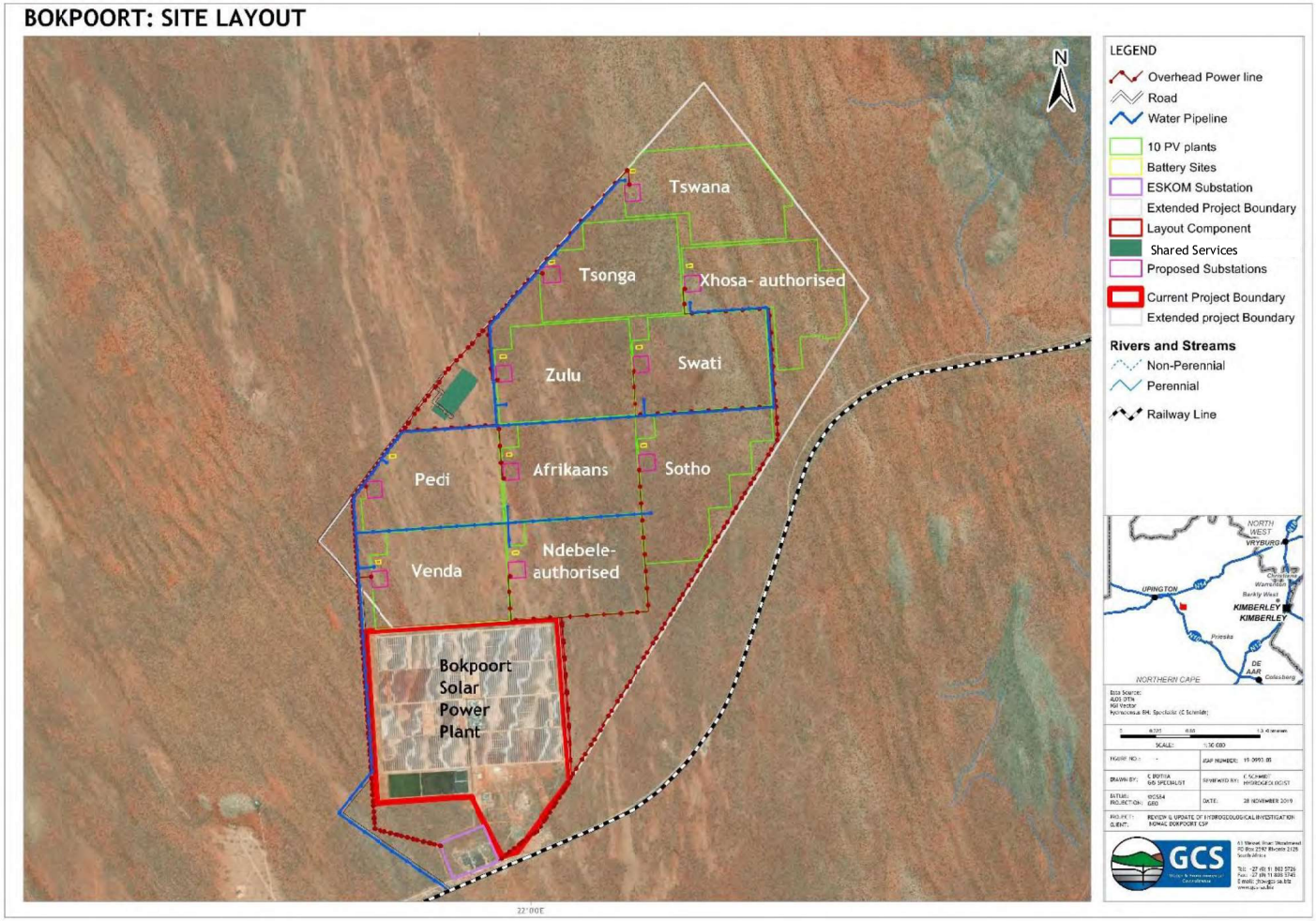

Figure 4-2: Site layout

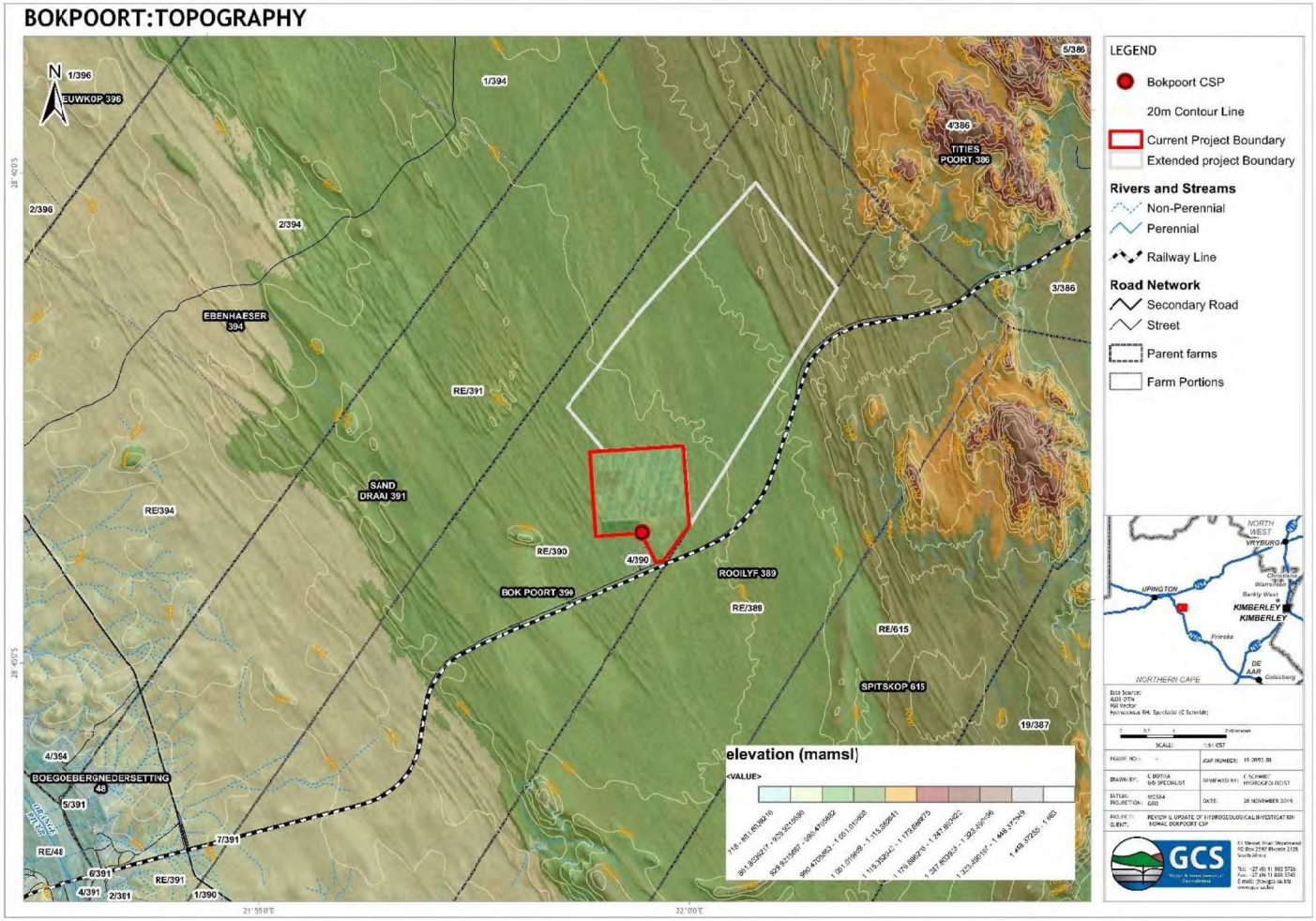

Figure 4-3: Topography map

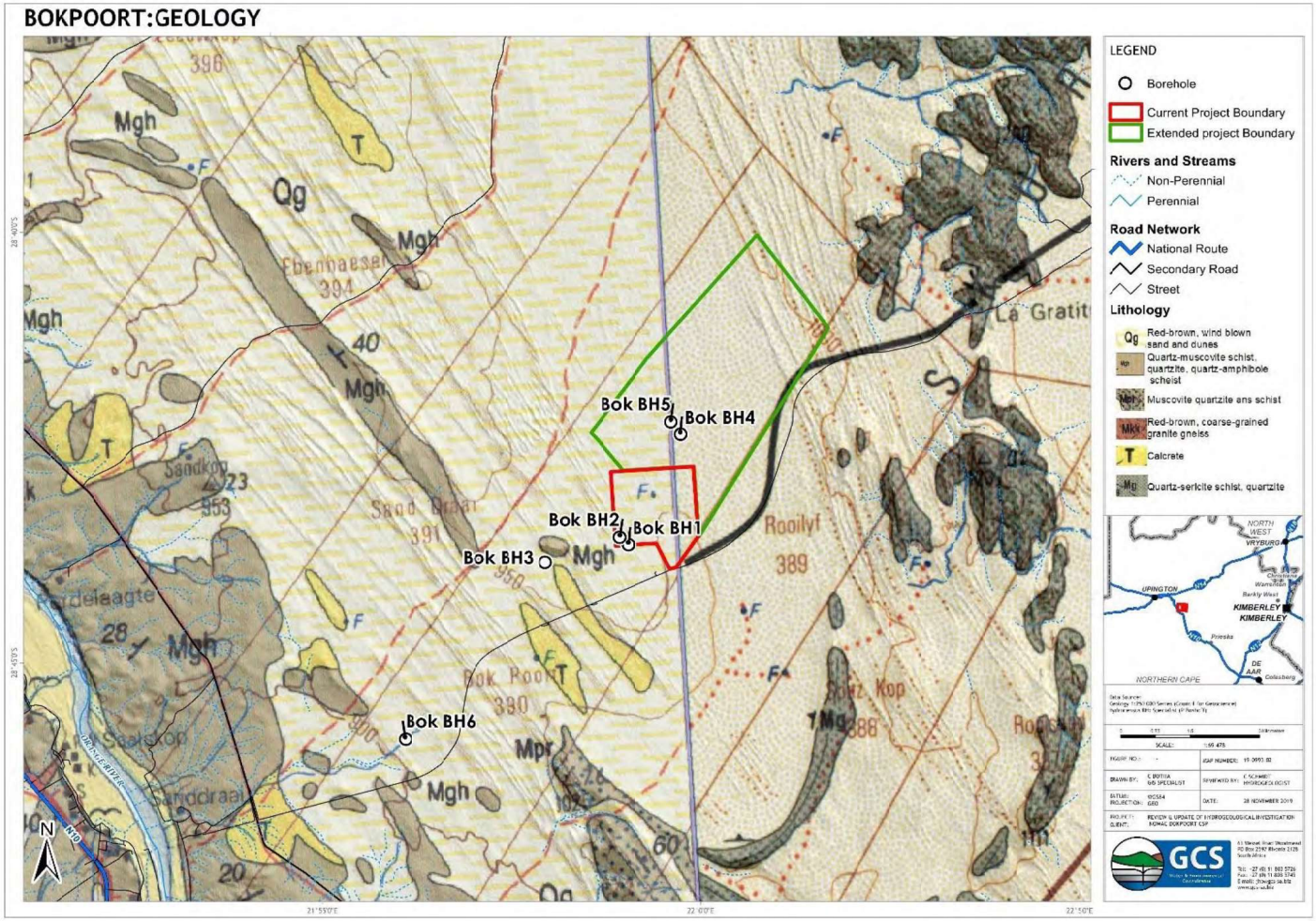

Figure 4-4: Geology map

5 HYDROCENSUS

Previously, during April 2010, GCS conducted a hydrocensus. The aim of this hydrocensus survey was to establish the extent of groundwater usage in the area. During this hydrocensus seven (7) boreholes were located. From the hydrocensus survey conducted in April 2010 it was established that the communities living on the farms rely on municipal water for domestic water supply and the farms located in proximity to the Orange River use water from the Orange River for water supply. Groundwater is utilised in farms located further away from the Orange River. Groundwater abstraction on the farms are mainly used for domestic purpose and animal (cattle and sheep) farming. Most of the boreholes were equipped with windmills and therefore no water level measurements could be taken. The water quality indicated pH ranging from 7.36 to 8.06; and the total dissolved solids (TDS) ranging from 420 to 490 mg/l.

During the hydrocensus conducted in November 2019, five (5) boreholes were identified within a ~4km radius of the study area and an additional borehole was located approximately 10 km from the study area and was included in the hydrocensus. Therefore, in total six (6) hydrocensus boreholes were identified, of which three (3) were accessible for groundwater level measurements. The results of the hydrocensus is summarised in Table 5-1. and the spatial distribution with respect to the study area is shown in Figure 5-1. Borehole Bok BH3 previously had a submersible pump installed and was utilized for domestic water supply for farm owner's house and farm village workers but this borehole is now dry. Similarly, borehole Bok BH6 previously had a windmill installed and was utilized for livestock watering but this borehole is now dry. Boreholes Bok BH1 and Bok BH2 are used for monitoring purposes around the evaporation ponds of the operational CSP. The hydrocensus field data sheets are provided in Appendix A.

Table 5-1: Hydrocensus data collected during November 2019.

Locality ID	Co-ordinate & Elevation Information			Borehole Status & Equipment Information					Water Use Application				Collar Height (m)	Groundwater Level (mbch)	Groundwater Elevation (m amsl)
					Pump Type										
	Latitude	Longitude	Surface Elevation (m amsl)	Status	Submersible	Windmill	Solar	Mono	Irrigation	Stock	Domestic	Other			
Bok BH1	-28.73413	21.98887	960	Monitoring Borehole								•	0.65	27.9	931.45
Bok BH2	-28.73262	21.98705	953	Monitoring Borehole								•	0	25.65	927.35
Bok BH3	-28.73661	21.97039	944	Not Operational									Dry		
Bok BH4	-28.71334	22.00186	953	Not Equipped									0.15	38.55	914.3
Bok BH5	-28.71084	21.99989	958	Operational		•				•			Not measured		
Bok BH6	-28.76924	21.93739	890	Not Operational									Dry		

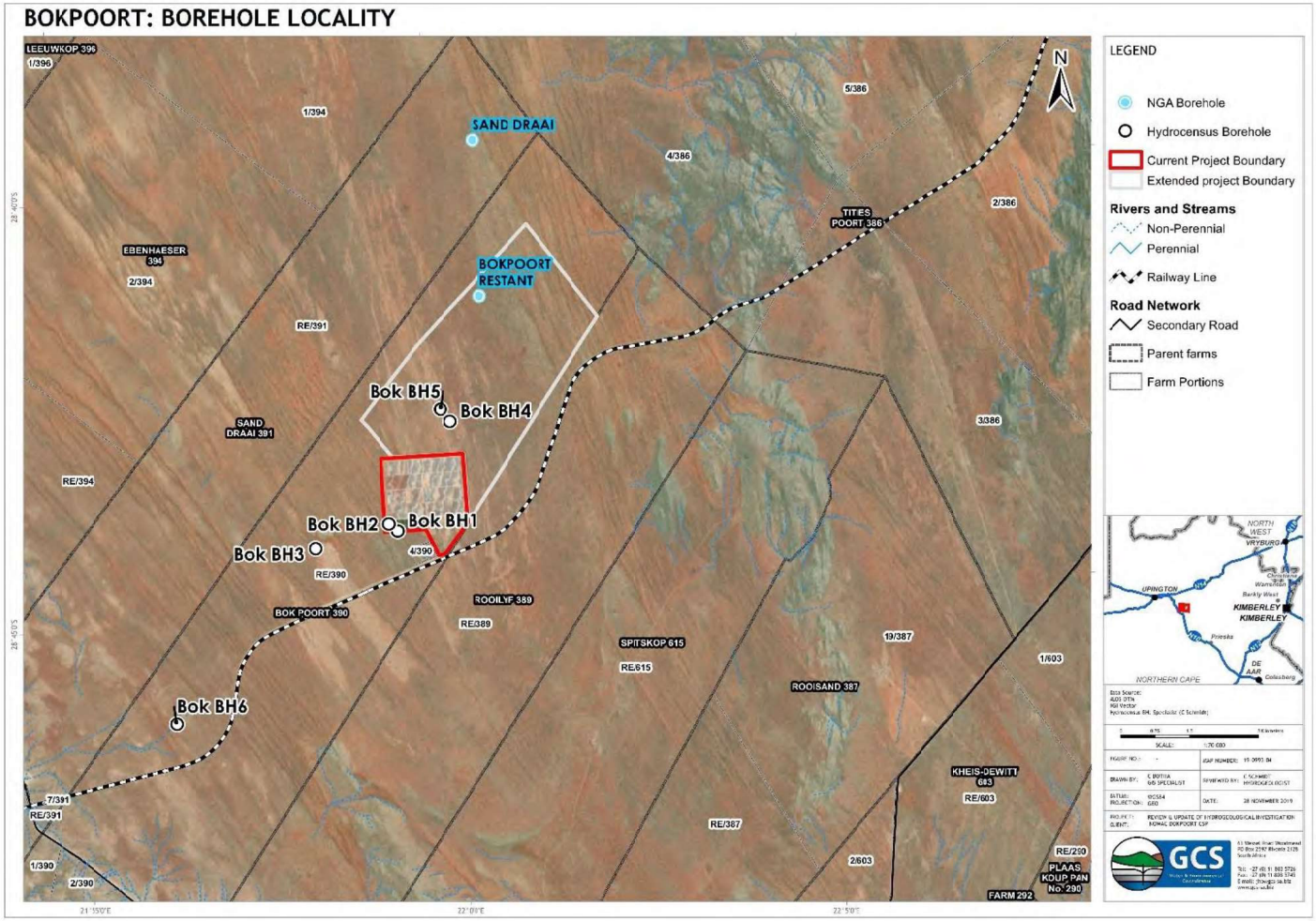

Figure 5-1: Borehole locality map

5.1 Groundwater Use

Similar to the hydrocensus conducted during April 2010, the November 2019 hydrocensus survey indicated that groundwater is mainly used for small-scale livestock watering purposes (goat and sheep farming). Table 5-2 summarises the status and use of the six (6) hydrocensus boreholes found during the 2019 hydrocensus.

Table 5-2: Borehole status and groundwater use, November 2019.

Description				Summary	
Number of Boreholes Identified			[No]	6	
Status	Operational		[No]	1	16.66%
	Equipped		[No]	1	16.66%
Primary Use	Stock Watering	small-scale	[No]	0	
		large-scale	[No]	2	33.33%
	Irrigation		[No]	0	
	Domestic		[No]	0	
	Other		[No]	2	33.33%

Notes

[No] Number

Other Monitoring borehole

5.2 Groundwater Level and Flow

Groundwater elevation recorded during the 2019 hydrocensus survey range between ~914 and ~931 metres above mean sea level (m amsl), with depth to water varying from ~25 metres below ground level (m bgl) and ~38 m bgl.

From the hydrocensus survey measured water level data, a correlation of ~ 68% exists between the topography and groundwater elevation (Figure 5-2). The relatively poor correlation is likely depictive of two (2) distinctive aquifer systems (the upper weathered aquifer and the deeper fractured aquifer).

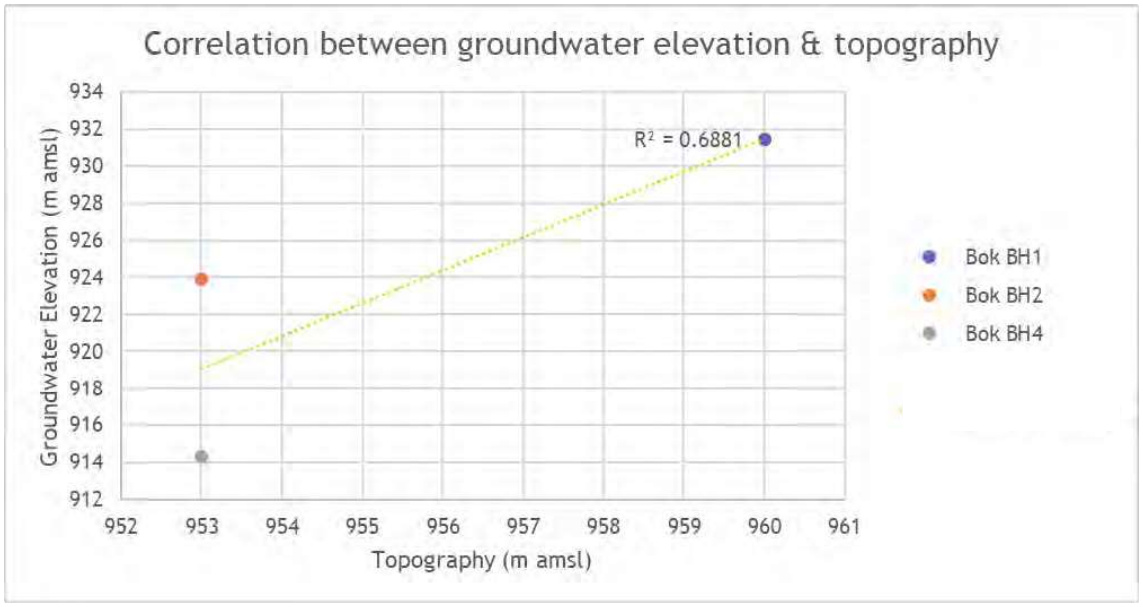

Figure 5-2: Topography and groundwater head correlation.

5.3 NGA and WARMS Databases

The National Groundwater Archive (NGA) and National Register of Water Use (WARMS) was accessed to obtain any existing groundwater data. Within a 5 km radius of the study area two (2) boreholes within the NGA were found, however, no registered boreholes on the WARMS database were found. Limited information for the two (2) NGA boreholes is available, Table 5-3. the spatial distribution of the NGA boreholes in relation to the study area is shown in Figure 5-1.

Table 5-3: Existing NGA data

Identifier	Latitude	Longitude	Farm Name	Province	Water Level	Depth
2822CA00012	-28.6892	22.00993	BOKPOORT RESTANT	Northern Cape	-	63
2822CA00042	-28.6587	22.01048	SAND DRAAI	Northern Cape	-	-

6 GROUNDWATER QUALITY

Aquatico Laboratory (a South African National Accreditation System (SANAS) accredited laboratory according to ISO / IEC 17025:2005 standards No: T0374) in Pretoria, South Africa, was commissioned to undertake the analytical testing for the collected groundwater samples.

Summary of the groundwater quality results are presented in Table 6-1; while the laboratory certificates of analyses are presented in Appendix B.

Boreholes Bok BH1 and Bok BH2 indicate water with neutral pH, electrical conductivity (EC) ranging from ~67 to ~105 mS/m, total hardness ranging from hard to very hard and low manganese concertation were recorded. Borehole Bok BH3 indicate very hard water with neutral pH, elevated EC and total dissolved solids (TDS), elevated nitrate concentration and low chromium concentration was recorded.

Table 6-1: Groundwater quality, November 2019.

Parameters	SAWQG Stock Watering	SAWQG Domestic Use	SANS 241-1:2015 Drinking Water Standard	Bok BH1	Bok BH2	Bok BH3
	Target Range	Target Values	Standard Limits	Nov-19	Nov-19	Nov-19
General Parameters						
pH at 22°C (pH units)	≤5 or ≥9	6-9	≤5 or ≥9.7 [O]	7.93	7.81	7.25
Conductivity mS/m @ 25°C	NL	NL	≥170 [A]	105	67.3	211
Total dissolved solids (TDS)	0-1000	0-450	≥1200 [A]	586	351	1373
Total suspended solids (TSS)	NL	NL	NS	17	34	890
Turbidity (NTU)	NL	0-1	≥5 [A]	28.6	59.1	1850
Total Alkalinity as $CaCO_3$	NL	NL	NS	321	244	440
Total Hardness as $CaCO_3$	NL	NL	NS	424	202	836
Anions						
Chloride, Cl	0-1500	0-100	≥300 [A]	98.8	82.6	342
Sulphate, SO_4	0-1000	0-200	≥500 [AH] ≥250 [A]	98.8	0.201	124
Fluoride, F	0-2	0-1.0	≥1.5 [CH]	0.737	0.389	0.786
Nitrogen Species						
Nitrate as N	NL	0-6	≥11 [AH]	0.261	<0.194	37
Nitrate as NO_3	0-100	NL	≥50 [AH]	1.16	<0.85	163.79
Nitrite as N	NL	0-6	≥0.9 [AH]	<0.065	<0.065	<0.065
Nitrite as NO_2	NL	NL	≥3 [AH]	<0.21	<0.21	<0.21
Ammonia (NH_3) as N	NL	0-1.0	≥1.5 [A]	0.115	0.111	<0.005
Ammonium (NH_4) as N	NL	NL	NS	3.75	4.55	0.018
Cations and Metals						
Calcium, Ca	0-1000	0-32	NS	45.9	16.8	144
Magnesium, Mg	0-500	0-30	NS	75	38.9	116
Sodium, Na	0-2000	0-100	≥200 [A]	50.9	46.7	106
Potassium, K	NL	0-50	NS	8.28	8.37	12.3
Iron, Fe	0-10	0-0.1	≥2 [CH] ≥0.3 [A]	<0.004	<0.004	<0.004
Aluminium, Al	0-5	0-0.15	≥0.3 [O]	<0.002	<0.002	<0.002
Manganese, Mn	0-10	0-0.05	≥0.4 [CH] ≥0.1 [A]	0.125	0.195	0.004
Total Chromium, Cr	NL	NL	≥0.05 [CH]	<0.01	<0.01	0.149
Lead, Pb	0-0.1	0-0.01	≥0.01 [CH]	<0.004	<0.004	<0.004
Boron, B	0-5	NL	≥2.4 [CH]	0.061	0.105	0.234
Cadmium, Cd	0-0.01	0-0.005	≥0.003 [CH]	<0.002	<0.002	<0.002
Mercury, Hg	0-0.001	0-0.006	≥0.006 [CH]	<0.004	<0.004	<0.004

Key:
All parameters in mg/l unless specified otherwise
Yellow Shading: Not meeting the target values as per SAWQG for Livestock Watering
Yellow Shading: Not meeting the target values as per SAWQG for Domestic Use
Blue Shading: Exceedance in terms of SANS 241-1:2015 Drinking Water Standard
[A] - SANS 241-1 Aesthetic Risk Limit
[CH] - SANS 241-1 Chronic Health Risk Limit
[AH] - SANS 241-1 Acute Health Risk Limit
[O] - SANS 241-1 Operational Risk Limit
NS- No Standard
NL- No Limit

6.1 Hydrogeological Characterisation

A Piper diagram, Figure 6-1, was created using the WISH software to characterize the water analysed. A Piper diagram is utilized to characterize water types in a graphical manner and to distinguish any specific water types in the area. The Piper diagram was quartered to simplify this process. The water samples can be grouped into the left, bottom, right, centre and upper quarters. The position of the water sample on the plot is based on the ratio of the various constituents measured in equivalence and is not an indication of the absolute water quality or the suitability thereof for domestic consumption. The following water types are observed in and surrounding Bokpoort II:

- Sample sites Bok BH1 and BH2 indicate predominantly Ca-Mg-HCO_3 type water; and
- Sample site Bok BH3 indicate predominantly Ca-Mg-Cl type water.

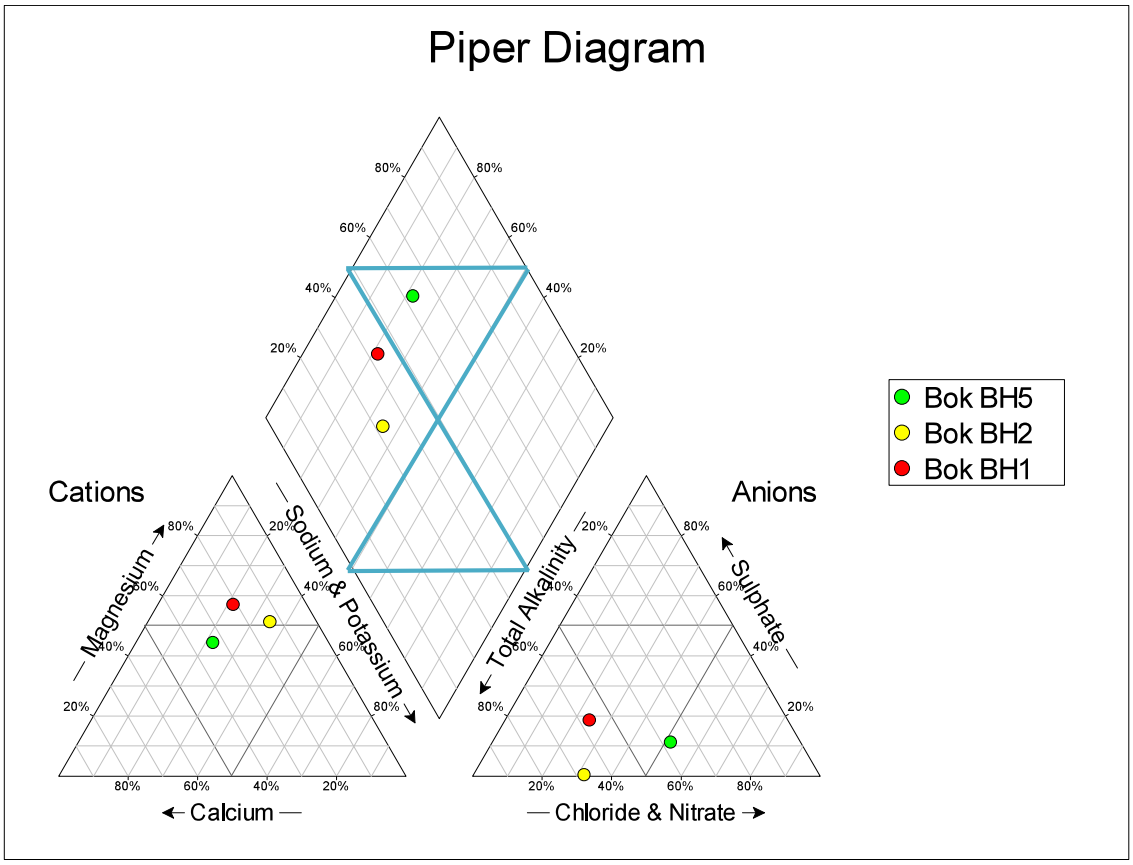

Figure 6-1: Piper diagram

6.2 Groundwater Quality Compared to Water Criteria Guidelines / Standards

Groundwater in the area is mostly used for livestock watering and is therefore compared to the Department of Water Affairs (DWA) South African Water Quality Guidelines Volume 5 for Livestock Watering Use (1996c). Additionally, the water quality will also be compared to the Department of Water Affairs (DWA) South African Water Quality Guidelines Volume 1 for Domestic Use (1996a) and South African Bureau of Standards (SABS) SANS 241-1:2011 Drinking Water Standards.

Comparison of the groundwater quality to the relevant guidelines is summarized in Table 6-2 (Livestock Watering Use) and Table 6-3 (Drinking / Domestic Use).

Table 6-2: Livestock watering use compliance and risk status

Sample ID	Compliance Status				Livestock Health Risk Status
	General Parameters	Anions	Nitrogen-Species	Cations and metals	
Bok BH1	Yes	Yes	Yes	Yes	None: based on all parameters analysed, the water adheres to SAWQG Target Values for Livestock watering.
Bok BH2	Yes	Yes	Yes	Yes	
Bok BH3	Yes	Yes	Yes	Yes	

Note/s:

Red indicates an exceedance of the DWA SAWQG Target Value for Livestock Watering Use

Table 6-3: Drinking / domestic use compliance and risk status

Sample ID	Compliance Status				Risk Status	
	General Parameters	Anions	Nitrogen-Species	Cations and metals	Health	Aesthetic
Bok BH1	No (TDS, turbidity)	Yes	Yes	No (Ca and Mn)	TDS, Ca and Mn: No health effects are likely. Turbidity: Water carries an associated risk of disease due to infectious disease agents and chemicals adsorbed onto particulate matter.	TDS: Water has a noticeable salty taste, but is well tolerated. No effects on plumbing or appliances. Turbidity: Severe aesthetic effects (appearance, taste and odour). Ca: No health effects. Increased scaling problems Lathering of soap impaired. Mn: Threshold for significant staining and taste problems.

Sample ID	Compliance Status				Risk Status	
	General Parameters	Anions	Nitrogen-Species	Cations and metals	Health	Aesthetic
Bok BH2	No (turbidity)	Yes	Yes	No (Mn)	Mn: No health effects are likely. Turbidity: Water carries an associated risk of disease due to infectious disease agents and chemicals adsorbed onto particulate matter.	Mn: Increasingly severe staining and taste problems. Turbidity: Severe aesthetic effects (appearance, taste and odour).
Bok BH3	No (EC, TDS and turbidity)	No (Cl)	No (Nitrate as N and as NO_3)	No (Ca and total Cr)	TDS/EC: Consumption of water does not appear to produce adverse health effects in the short term. Turbidity: Water carries an associated risk of disease due to infectious disease agents and chemicals adsorbed onto particulate matter. Cl and Ca: No health effects Nitrate as N: Methaemoglobinaemia occurs in infants. Occurrence of mucous membrane irritation in adults Cr: Danger of kidney damage with long-term exposure. Brief exposure, for less than one week should not cause any noticeable damage. Exposure should not exceed one week	TDS/EC: Water has a marked, salty taste and some effects on plumbing and appliances, such as increased corrosion or scaling, may be expected. Turbidity: Severe aesthetic effects (appearance, taste and odour). Cl: Water has a distinctly salty taste. Likelihood of noticeable increase in corrosion rates in domestic appliances Ca: Severe scaling problems Lathering of soap severely impaired

Note/s:
Red indicates an exceedance of the SANS 241:2011 and / or DWA SAWQG Target Value for Domestic Use

7 IMPACT ASSESMENT

The impact assessment applied the source-pathway-receptor approach to evaluate the risk associated with the proposed new PV plants. It is indicated on the Environmental Scoping Report (Jude Cobbing, 2006) that the proposed solar power facility will not use any groundwater. Water will be pumped from the Orange River to the station and used for washing of the solar cells and in the plant worker's change rooms. Therefore, overstressing of the aquifer due to over abstraction is not included as a possible impact as surface water will be utilised to meet the water demand on site.

The impact assessment is shown in Table 7-1. Sources are divided into possible impacts during the construction, operational and post closer phases. The pathway will consider factoring affecting the vulnerability of the underlying aquifer and the receptors will identify all surrounding groundwater users.

Table 7-1: Impact assessment

Aspect	Potential Impact	Notes
Source	***Construction Phase*** 1- Spillage of fuels, lubricants and other chemicals from construction equipment, vehicles and temporary workshop areas will be a likely source of pollution. 2- Increased runoff due to vegetation removal will cause a decrease in infiltration into soil and consequently decrease recharge to the underling aquifer.	1- If these hydrocarbons lubricants and other chemicals reach the groundwater, contamination can be expected. 2- Based on the Groundwater Resource Directed Measures (GRDM) the recharge within the D73D quaternary catchment is low (3.6 mm/a). The extended project area is relatively small (~1400 hectares) and increased runoff is expected to be low and sustainable drainage systems (SuDS) can also be implemented to manage the storm water thus lower the impact of increased runoff.
	Operational Phase 1- Leakage from BESS. The BESS combined site storage within batteries on each PV site will be 4500 m^3 of hazardous substance. 2- If unsatisfactory water quality (containing elevated counts of microbiological determinants or metal concentrations for example) is used to clean the solar cells this could infiltrate into the subsurface and possibly pollute the groundwater.	1- If leakage from the BESS reach the groundwater, contamination can be expected. 2- If infiltrating water with elevated counts of bacteria or metal concentrations can reach the groundwater, concentrations can be expected.
	Post Closure 1- No foreseen sources	1- The total disturbed area is relatively small, and it is likely that the impact will be minimal upon closure providing the site is properly decommissioned.

Aspect	Potential Impact	Notes
Pathway	*Infiltration potential/ aquifer vulnerability:* 1- Depth to groundwater/ unsaturated zone characteristics	1- Following the hydrocensus and data obtained from the GRDM the groundwater level ranges from ~25 m bgl to ~ 45 m bgl. The deeper groundwater level allows for a large unsaturated zone above the groundwater level which can naturally attenuate any infiltering leakage or spills. Deeper groundwater conditions lower the risk of any potential impacts infiltrating from surface.
Receptor	*Users/receptors of groundwater:* 1- Groundwater users 2- Distance to major water courses	1- Based on the hydrocensus the surrounding farmers (who are not in proximity to the Orange River) use groundwater for small-scale livestock watering purposes. There are few groundwater users within a ~5km radius of Bokpoort II. 2- Bokpoort II is located ~15km away from the Orange River. This large distance lowers the risk of the site having any impact on the down-gradient water course.

8 RISK ASSESSMENT

The risk ranking and Significance Point (SP) ranking is shown in Table 8-1. Based on the impact assessment there are three (3) main potential risks identified:

1. The groundwater quality can be impacted by spillage of fuels, lubricants, chemicals from construction equipment, vehicles and temporary workshop during the construction phase or from leakage from the BESS. Mitigations for spillage or leakages will include bunded areas to store chemicals and/or fuel, containerisation of the BESS and cleaning up spills as soon as they occur. With proper mitigations in place the significance of the impact is likely to be low.
2. Infiltration potential/ aquifer vulnerability is classified as having low environmental significance due to deeper groundwater level conditions which allow for a large unsaturated zone above the groundwater level which can naturally attenuate any infiltering leakage or spills. Unsaturated flow conditions within the upper weather zone/ unsaturated zone also involves slower movement of moisture allowing for longer periods of time for natural attenuation to occur.
3. Receptors surrounding the site are farmers who use groundwater for small-scale livestock watering purposes and the Orange River which is 15km away from the site. Most famers in the area use the Orange River for water supply and few groundwater users are within proximity to the site. The receptor is therefore classified as having low environmental significance.

Table 8-1: Ranking scale.

Potential Impact		Scale (S)	Duration (D)	Magnitude (M)	Probability (P)	Significance Point SP= (M +D+S) x P
1.Groundwater quality impact	Construction phase	1	1	6	3	24
	Operational phase	1	1	6	2	16
2.Infiltration potential/ aquifer vulnerability		1	2	2	2	10
3.Receptors		2	2	2	2	12

Note/s:

SP > 75	Indicates high environmental significance
SP 30- 75	Indicates moderate environmental significance
SP <30	Indicates low environmental significance

9 REVIEW OF PV EIA SPECIALIST REPORTS

Following the review of the two (2) reports mentioned in Section 2, it was found that the surface water impact assessment tables for the proposed 75 MW PV 1 Solar Facility and 75 MW PV 2 Solar Facility are identical. These surface water impact assessments were both corrected after an external review was performed by Mr Bruce Randell (Ilanda Water Services cc).

Following the strategic decision to develop ten (10) new PV plants each with a MW capacity of 200MW and BESS on each site the impact assessments needed to be reviewed and updated. At the time when the impact assessments were undertaken by Golder no provision was made for the inclusion of the BESS. Based on the inclusion of the BESS the following comments are made following the review of the two (2) above mentioned reports:

- The impact assessment (Table 9: Impact assessment during construction, operation and at closure each report mention in Section 2) needs to make specific mention of the BESS as an aspect and as a potential impact during the operational phase; and
- The impact/ risk assessment formula will also have to be updated as the BESS combined site storage within batteries on each PV site will be 4500 m^3 of hazardous substance.
- Table 9-1 is the recommended amendment to be included in the impact assessment table.

An additional alteration noted is the slight change in water demand which will be affected positively with the total demand changing to 0.22 million cubic metres per annum (Mm^3/a) (10 x 0.022 Mm^3/a) for the 10 PV solar facilities instead of the 0.3 Mm^3/a (0.25 + 2 x 0.025 Mm^3/a) for the CSP and two (2) PV solar facilities.

Table 9-1: Amendment to impact assessment during construction, operation and at closure (Golder, 2016a and Golder, 2016b)

Aspect	Potential Impact	Extent	Duration	Intensity	Probability	Impact	Notes
OPERATIONAL PHASE							
Water quality impacts due to chemical spills/ equipment use	Spillage of fuels, lubricants and other chemicals from the Battery Energy Storage System.	2	1	2	2	10- High Impact	It is expected that without mitigation a high negative impact can be expected. Mitigation will include: - Clean-up of spills as soon as they occur; - Maintenance of the abstraction pumps to prevent spills; -Maintenance of the Battery Energy Storage System to ensure optimal functionality and prevent fire risks; -Maintenance and quality control of firefighting equipment and systems; and - Mitigations for spillage or leakages will include bunded areas to store chemicals and/or fuel, containerisation of the BESS and cleaning up spills as soon as they occur. The significance of the impact after mitigation is likely to decrease to a medium negative impact.

10 CONCLUSION

GCS (Pty) Ltd was appointed by Royal HaskoningDHV on behalf of ACWA Power Energy Africa (Pty) Ltd (ACWA Power) to conduct a site walk over, hydrocensus and updated hydrogeological risk assessment to convert the current site (which comprises of an authorised concentrated solar power (CSP) and two (2) Photovoltaic (PV) plants) into the development of ten (10) PV developments with shared infrastructure.

The Bokpoort II: 2000MW PV Solar Power Development (the site) is located on the north-eastern portion of the remaining extent of the Farm Bokpoort 390, which is 20 km north-west of the town of Groblershoop within the Northern Cape Province. The site is within one of South Africa's eight renewable energy development zones and has therefore been identified as one of the most suitable areas in the country for renewable energy development in terms of a number of environmental impact, economic and infrastructural factors. The site slopes in a western direction and drains towards the Orange River and falls within the D73D quaternary catchment within the lower Orange Main Stem Catchment and is governed by the Orange WMA. The general geology of the site mainly comprises red-brown, coarse-grained granite gneiss; and quartz-muscovite schists, quartzite, quartz-amphibole schists and greenstones of the Groblershoop formation, Brulpan group. Two (2) distinctive aquifer systems (the upper weathered aquifer and the deeper fractured aquifer) underly the site.

During the hydrocensus conducted in November 2019, six (6) hydrocensus boreholes were identified, of which three (3) were accessible for groundwater level measurements. Groundwater is mainly used for small-scale livestock watering purposes (goat and sheep farming) and the groundwater elevation ranges between ~914 and ~931 m amsl, with depth to water varying from ~25 m bgl and ~38 m bgl. Based on all parameters analysed, the water adheres to SAWQG Target Values for Livestock watering. Boreholes Bok BH1 and Bok BH2 indicate water with neutral pH, electrical conductivity (EC) ranging from ~67 to ~105 mS/m, total hardness ranging from hard to very hard and low manganese concertation were recorded. Borehole Bok BH3 indicate very hard water with neutral pH, elevated EC and total dissolved solids (TDS), elevated nitrate concentration and low chromium concentration was recorded.

All results obtained during the hydrocensus and site investigation were compiled into a site-specific impact assessment and was utilised to conceptualise the site. This site conceptualisation was used to complete a source-pathway-receptor linkage to quantify areas of possible concern. The identified impacts are assessed in accordance with the approach extracted from the Golder EIR (terminology from the Department of Environmental Affairs and Tourism Guideline document on EIA Regulations, April 1998). This approach incorporates two (2) aspects for assessing the potential significance of impacts, namely:

- Occurrence: Probability of occurrence and duration of occurrence
- Severity: Scale/ extent of impact and magnitude (severity) of impact

A ranking scale, as shown in Table 3-2, is then used to rank the probability, duration, scale and magnitude. Once these factors have been ranked for each impact, the significance is assessed using the following formula:

$$\boldsymbol{SP = (Magnitude + Duration + Scale) \times Probability}$$

An SP ranking above 75 indicates high environmental significance, an SP between 30 to 75 indicates moderate environmental significance and an SP below 30 indicates low environmental significance.

The risk associated with Bokpoort II is of low environmental significance from a groundwater perspective. Bokpoort II will not use any groundwater as water will be pumped from the Orange River to meet the water demand on site. Overstressing of the aquifer due to over abstraction is not included as a possible impact as surface water will be utilised to meet the water demand on site. The risk identified are:

1. **Groundwater quality:** The groundwater quality can be impacted by spillage of fuels, lubricants, chemicals from construction equipment, vehicles and temporary workshop during the construction phase or from leakage from battery storage facility during the operational phase. Mitigations for spillage or leakages will include bunded areas to store chemicals and/or fuel, containerisation of the BESS and cleaning up spills as soon as they occur. With proper mitigations in place the significance of the impact is likely to be low.
2. **Infiltration potential/ aquifer vulnerability:** Due to deeper groundwater level conditions which allow for a large unsaturated zone above the groundwater level which can naturally attenuate any infiltering leakage or spills the Infiltration potential/ aquifer vulnerability is low. Unsaturated flow conditions within the upper weather zone/ unsaturated zone also involves slower movement of moisture allowing for longer periods of time for natural attenuation to occur.

3. **Receptors:** Few receptors surrounding Bokpoort II were identified during the 2019 hydrocensus. Receptors include farmers who use groundwater for small-scale livestock watering purposes and the nearest major water course is the Orange River which is 15km away from Bokpoort II. Most famers in the area use the Orange River for water supply and are not solely reliant on groundwater.

If proper management measures, together with site- and operational monitoring (refer to recommendations below), are applied, the potential impact on groundwater resources will have very low or no significance. Finding from this study conclude that the proposed Bokpoort II Development can continue as the overall accumulative risk associated with both Bokpoort I and Bokpoort II (when operational) is of low environmental significance, from a groundwater perspective, provided the proper mitigations are in place.

Following the strategic decision to develop ten (10) new PV plants each with a MW capacity of 200MW and BESS on each site the surface water impact assessments needed to be reviewed. At the time when the impact assessments were undertaken by Golder no provision was made for the inclusion of the BESS. Based on the inclusion of the BESS the following comments are made following the review of the two (2) above mentioned reports:

- The impact assessment (Table 9: Impact assessment during construction, operation and at closure each report mention in Section 2) needs to make specific mention of the BESS as an aspect and as a potential impact during the operational phase; and
- The impact/ risk assessment formula will also have to be updated as the BESS combined site storage within batteries on each PV site will be 4500 m^3 of hazardous substance.

Table 9-1 is the recommended update to be included in the impact assessment table.

An additional alteration noted is the slight change in water demand which will be affected positively with the total demand changing to 0.22 million cubic metres per annum (Mm^3/a) (10 x 0.022 Mm^3/a) for the 10 PV solar facilities instead of the 0.3 Mm^3/a (0.25+ 2 x 0.025 Mm^3/a) for the CSP and two (2) PV solar facilities.

Recommendations

The following recommendations are made:

- During the construction phase of Bokpoort II it is recommended to have bunded areas to store chemicals and/or fuel and clean-up of spills as soon as they occur. With proper mitigations in place the significance of the spillage and/or leakage is likely to be low;
- Once the construction phase has been completed it is recommended to do one monitoring routine of boreholes;
- It is recommended developing a monitoring plan including the existing monitoring boreholes on site, elements to be analysed and sampling frequency.
- It is recommended to monitor the Orange River quality used on site during the operational phase.

11 REFERENCES

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APPENDIX A: HYDROCENSUS FIELD DATA

HYDROCENSUS RECORD SHEET

Bore ID: Bok BH1

Date & Time Information:					
Hydrocensus Date:	**[dd-mmm-yyyy]**	20 November 2019	**Time:**	**[hh:mm]**	12:40

Coordinates Infromation:			Owner Infromation:	
Coordinates System:			**Owner:**	Bokpoort CSP
- Projection:		Geographic	**Contact Number/Email:**	+ 27 76 981 9202/ bmdodana@acwapower.com
- Datum:		WGS84	**Village/Farm Name:**	Farm Bokpoort 390
Coordinates:				
- Easting/Latitude:	**[m]/[DD]**	-28.734130	**Geological Information:**	
- Northing/Longitude:	**[m]/[DD]**	21.988870	Unknown (1)	
- Elevation:	**[m amsl]**	960		
Survey Method:		GPS-Handheld		

Bore/Spring Construction Information:			Bore/Spring Status & Equipment:		
Bore Installation Date	**[mmmm-yyyy]**	Unknown (1)	**Status:**		Monitoring Borehole
Bore Depth:	**[m]**	Not Applicable	**Water Application:**		
Collar Height:	**[m]**	0.65	**- Primary**		Monitoring
Reference Level Height:	**[m]**	Not Applicable	**- Other**		
Casing Diameter (ID)	**[m]**	Not Applicable	**- Domestic**		
Screen/Perforated Casinig Length:	**[m]**	Not Applicable	**- Stock Watering**		
Casing Type:		Not Applicable	**- Irrigation**		
			- Other		
			Equipment:		Not Applicable
			Equipment Status:		Not Applicable
			Abstraction Rate:	**[L/s]**	Not Applicable
			Pump Inlet:	**[m]**	Not Applicable

Hydrogeological Information:				Field Physio-Chemical Information:		
Static Water Level:	**[m brl]**	27.25		**pH:**	**[pH Unit]**	7.85
Aquifer Type:		Not Applicable		**Electrical Conductivity:**	**[µS/cm]**	1180
				Temperature:	**[°C]**	26.7
Water Strike Depth:	**[m bgl]**	Not Applicable	***(Strike 1)***			
			(Strike 2)	**Sample Information:**		
Accumulative Yield:	**[L/s]**	Not Applicable	***(Strike 1)***	**Sample Date:**	**[dd-mmm-yy]**	Wednesday, 20 November 2019
			(Strike 2)	**Sample Time:**	**[hh:mm]**	12:40
				Sample Method:		Grab sample
				Sample Depth:	**[m brl]**	Not Applicable

Comments

Note/s:

[1] Not measured / recorded
[2] Geological Map Series (1:250,000)
[3] Closed / damaged system
[4] No infromation available / made available to GCS
[5] Calculation (GCS)
[6] Borehole not sampled
[7] Dynamic Water Level

Additional Note/s:

Boreholes Bok BH1 and Bok BH2 are used for monitoring purposes around the evaporation ponds of the operational CSP.

Acronyms:

- m	-	metres
- m bgl	-	metres below ground level
- m amsl	-	metres above mean sea level
- m brl	-	metres below reference level
- L/s	-	Litres per second
- µS/m	-	micro Sieens per metre

Photo/s:

Source: GCS, 2019

Project Information:	
Project Number:	19-0993
Project:	Review and Update of Hydrogeological Investigation NOMAC- Bokpoort CSP
Hydrogeologist:	Miss C. Schmidt
Date:	November 2019

HYDROCENSUS RECORD SHEET

Bore ID: Bok BH2

Date & Time Information:					
Hydrocensus Date:	**[dd-mmm-yyyy]**	20 November 2019	**Time:**	**[hh:mm]**	13:04

Coordinates Infromation:			Owner Infromation:	
Coordinates System:			**Owner:**	Bokpoort CSP
- Projection:		Geographic	**Contact Number/Email:**	+ 27 76 981 9202/ bmdodana@acwapower.com
- Datum:		WGS85	**Village/Farm Name:**	Farm Bokpoort 390
Coordinates:				
- Easting/Latitude:	**[m]/[DD]**	-28.732620	**Geological Information:**	
- Northing/Longitude:	**[m]/[DD]**	21.987050	Unknown (1)	
- Elevation:	**[m amsl]**	953		
Survey Method:		GPS-Handheld		

Bore/Spring Construction Information:			Bore/Spring Status & Equipment:		
Bore Installation Date	**[mmmm-yyyy]**	Unknown (1)	**Status:**		Monitoring Borehole
Bore Depth:	**[m]**	Not Applicable	**Water Application:**		
Collar Height:	**[m]**	0.6	**- Primary**		Monitoring
Reference Level Height:	**[m]**	Not Applicable	**- Other**		
Casing Diameter (ID)	**[m]**	Not Applicable	**- Domestic**		
Screen/Perforated Casinig Length:	**[m]**	Not Applicable	**- Stock Watering**		
Casing Type:		Not Applicable	**- Irrigation**		
			- Other		
			Equipment:		Not Applicable
			Equipment Status:		Not Applicable
			Abstraction Rate:	**[L/s]**	Not Applicable
			Pump Inlet:	**[m]**	Not Applicable

Hydrogeological Information:				Field Physio-Chemical Information:		
Static Water Level:	**[m brl]**	27.9		**pH:**	**[pH Unit]**	7.73
Aquifer Type:		Not Applicable		**Electrical Conductivity:**	**[µS/cm]**	739
				Temperature:	**[°C]**	29.2
Water Strike Depth:	**[m bgl]**	Not Applicable	***(Strike 1)***			
			(Strike 2)	**Sample Information:**		
Accumulative Yield:	**[L/s]**	Not Applicable	***(Strike 1)***	**Sample Date:**	**[dd-mmm-yy]**	Wednesday, 20 November 2019
			(Strike 2)	**Sample Time:**	**[hh:mm]**	13:04
				Sample Method:		Grab sample
				Sample Depth:	**[m brl]**	Not Applicable

Comments

Note/s:

[1] Not measured / recorded
[2] Geological Map Series (1:250,000)
[3] Closed / damaged system
[4] No infromation available / made available to GCS
[5] Calculation (GCS)
[6] Borehole not sampled
[7] Dynamic Water Level

Additional Note/s:

Boreholes Bok BH1 and Bok BH2 are used for monitoring purposes around the evaporation ponds of the operational CSP.

Acronyms:

- m	-	metres
- m bgl	-	metres below ground level
- m amsl	-	metres above mean sea level
- m brl	-	metres below reference level
- L/s	-	Litres per second
- µS/m	-	micro Sieens per metre

Photo/s:

Source: GCS, 2019

Project Information:	
Project Number:	19-0993
Project:	Review and Update of Hydrogeological Investigation NOMAC- Bokpoort CSP
Hydrogeologist:	Miss C. Schmidt
Date:	November 2019

HYDROCENSUS RECORD SHEET

Bore ID: Bok BH3

Date & Time Information:					
Hydrocensus Date:	**[dd-mmm-yyyy]**	20 November 2019	**Time:**	**[hh:mm]**	14:59

Coordinates Infromation:			Owner Infromation:	
Coordinates System:			**Owner:**	Chris Honiball
- Projection:		Geographic	**Contact Number/Email:**	082 372 3467
- Datum:		WGS86	**Village/Farm Name:**	Farm Bokpoort 390
Coordinates:				
- Easting/Latitude:	**[m]/[DD]**	-28.736610	**Geological Information:**	
- Northing/Longitude:	**[m]/[DD]**	21.970390	Unknown (1)	
- Elevation:	**[m amsl]**	944		
Survey Method:		GPS-Handheld		

Bore/Spring Construction Information:			Bore/Spring Status & Equipment:		
Bore Installation Date	**[mmmm-yyyy]**	Unknown (1)	**Status:**		Not Operational
Bore Depth:	**[m]**	Not Applicable	**Water Application:**		
Collar Height:	**[m]**	Not Applicable	**- Primary**		-
Reference Level Height:	**[m]**	Not Applicable	**- Other**		
Casing Diameter (ID)	**[m]**	Not Applicable	**- Domestic**		
Screen/Perforated Casinig Length:	**[m]**	Not Applicable	**- Stock Watering**		
Casing Type:		Not Applicable	**- Irrigation**		
			- Other		
			Equipment:		Not Applicable
			Equipment Status:		Not Applicable
			Abstraction Rate:	**[L/s]**	Not Applicable
			Pump Inlet:	**[m]**	Not Applicable

Hydrogeological Information:				Field Physio-Chemical Information:		
Static Water Level:	**[m brl]**	DRY		**pH:**	**[pH Unit]**	Not Applicable
Aquifer Type:		Not Applicable		**Electrical Conductivity:**	**[µS/cm]**	Not Applicable
				Temperature:	**[°C]**	Not Applicable
Water Strike Depth:	**[m bgl]**	Not Applicable	***(Strike 1)***			
			(Strike 2)	**Sample Information:**		
Accumulative Yield:	**[L/s]**	Not Applicable	***(Strike 1)***	**Sample Date:**	**[dd-mmm-yy]**	Not Applicable
			(Strike 2)	**Sample Time:**	**[hh:mm]**	Not Applicable
				Sample Method:		Not Applicable
				Sample Depth:	**[m brl]**	Not Applicable

Comments

Note/s:

[1] Not measured / recorded
[2] Geological Map Series (1:250,000)
[3] Closed / damaged system
[4] No infromation available / made available to GCS
[5] Calculation (GCS)
[6] Borehole not sampled
[7] Dynamic Water Level

Additional Note/s:

Borehole Bok BH3 previously had a submersible pump installed and was utilized for domestic water supply for farm owner's house and farm village workers but this borehole is now dry.

Acronyms:

- m	-	metres
- m bgl	-	metres below ground level
- m amsl	-	metres above mean sea level
- m brl	-	metres below reference level
- L/s	-	Litres per second
- µS/m	-	micro Sieens per metre

Photo/s:

Source: GCS, 2019

Project Information:	
Project Number:	19-0993
Project:	Review and Update of Hydrogeological Investigation NOMAC- Bokpoort CSP
Hydrogeologist:	Miss C. Schmidt
Date:	November 2019

HYDROCENSUS RECORD SHEET

Bore ID: Bok BH4

Date & Time Information:					
Hydrocensus Date:	**[dd-mmm-yyyy]**	20 November 2019	**Time:**	**[hh:mm]**	14:21

Coordinates Infromation:			Owner Infromation:	
Coordinates System:			**Owner:**	Chris Honiball
- Projection:		Geographic	**Contact Number/Email:**	082 372 3467
- Datum:		WGS87	**Village/Farm Name:**	Farm Bokpoort 390
Coordinates:				
- Easting/Latitude:	**[m]/[DD]**	-28.713340	**Geological Information:**	
- Northing/Longitude:	**[m]/[DD]**	22.001860	Unknown (1)	
- Elevation:	**[m amsl]**	953		
Survey Method:		GPS-Handheld		

Bore/Spring Construction Information:			Bore/Spring Status & Equipment:		
Bore Installation Date	**[mmmm-yyyy]**	Unknown (1)	**Status:**		Not Equipped
Bore Depth:	**[m]**	Not Applicable	**Water Application:**		
Collar Height:	**[m]**	0.15	**- Primary**		None
Reference Level Height:	**[m]**	Not Applicable	**- Other**		
Casing Diameter (ID)	**[m]**	Not Applicable	**- Domestic**		
Screen/Perforated Casinig Length:	**[m]**	Not Applicable	**- Stock Watering**		
Casing Type:		Not Applicable	**- Irrigation**		
			- Other		
			Equipment:		Not Applicable
			Equipment Status:		Not Applicable
			Abstraction Rate:	**[L/s]**	Not Applicable
			Pump Inlet:	**[m]**	Not Applicable

Hydrogeological Information:				Field Physio-Chemical Information:		
Static Water Level:	**[m brl]**	38.4		**pH:**	**[pH Unit]**	Not Applicable
Aquifer Type:		Not Applicable		**Electrical Conductivity:**	**[µS/cm]**	Not Applicable
				Temperature:	**[°C]**	Not Applicable
Water Strike Depth:	**[m bgl]**	Not Applicable	***(Strike 1)***			
			(Strike 2)	**Sample Information:**		
Accumulative Yield:	**[L/s]**	Not Applicable	***(Strike 1)***	**Sample Date:**	**[dd-mmm-yy]**	Not Applicable
			(Strike 2)	**Sample Time:**	**[hh:mm]**	Not Applicable
				Sample Method:		Not Applicable
				Sample Depth:	**[m brl]**	Not Applicable

Comments

Note/s:

[1] Not measured / recorded
[2] Geological Map Series (1:250,000)
[3] Closed / damaged system
[4] No infromation available / made available to GCS
[5] Calculation (GCS)
[6] Borehole not sampled
[7] Dynamic Water Level

Additional Note/s:

Acronyms:

- m	-	metres
- m bgl	-	metres below ground level
- m amsl	-	metres above mean sea level
- m brl	-	metres below reference level
- L/s	-	Litres per second
- µS/m	-	micro Sieens per metre

Photo/s:

Source: GCS, 2019

Project Information:	
Project Number:	19-0993
Project:	Review and Update of Hydrogeological Investigation NOMAC- Bokpoort CSP
Hydrogeologist:	Miss C. Schmidt
Date:	November 2019

HYDROCENSUS RECORD SHEET

Bore ID: Bok BH5

Date & Time Information:					
Hydrocensus Date:	**[dd-mmm-yyyy]**	20 November 2019	**Time:**	**[hh:mm]**	14:29

Coordinates Infromation:			Owner Infromation:	
Coordinates System:			**Owner:**	Chris Honiball
- Projection:		Geographic	**Contact Number/Email:**	082 372 3467
- Datum:		WGS88	**Village/Farm Name:**	Farm Bokpoort 390
Coordinates:				
- Easting/Latitude:	**[m]/[DD]**	-28.710840	**Geological Information:**	
- Northing/Longitude:	**[m]/[DD]**	21.999890	Unknown (1)	
- Elevation:	**[m amsl]**	958		
Survey Method:		GPS-Handheld		

Bore/Spring Construction Information:			Bore/Spring Status & Equipment:		
Bore Installation Date	**[mmmm-yyyy]**	Unknown (1)	**Status:**		Operational
Bore Depth:	**[m]**	Not Applicable	**Water Application:**		
Collar Height:	**[m]**	Not Applicable	**- Primary**		Stock Watering (Small Scale)
Reference Level Height:	**[m]**	Not Applicable	**- Other**		
Casing Diameter (ID)	**[m]**	Not Applicable	**- Domestic**		
Screen/Perforated Casinig Length:	**[m]**	Not Applicable	**- Stock Watering**		Yes (Small Scale)
Casing Type:		Not Applicable	**- Irrigation**		
			- Other		
			Equipment:		Yes
			Equipment Status:		Windmill
			Abstraction Rate:	**[L/s]**	Unknown (1)
			Pump Inlet:	**[m]**	Unknown (1)

Hydrogeological Information:				Field Physio-Chemical Information:		
Static Water Level:	**[m brl]**	Unknown (1)		**pH:**	**[pH Unit]**	7.06
Aquifer Type:		Not Applicable		**Electrical Conductivity:**	**[µS/cm]**	2080
				Temperature:	**[°C]**	23.02
Water Strike Depth:	**[m bgl]**	Not Applicable	***(Strike 1)***			
			(Strike 2)	**Sample Information:**		
Accumulative Yield:	**[L/s]**	Not Applicable	***(Strike 1)***	**Sample Date:**	**[dd-mmm-yy]**	Wednesday, 20 November 2019
			(Strike 2)	**Sample Time:**	**[hh:mm]**	14:29
				Sample Method:		Grab sample
				Sample Depth:	**[m brl]**	Not Applicable

Comments

Note/s:

[1] Not measured / recorded
[2] Geological Map Series (1:250,000)
[3] Closed / damaged system
[4] No infromation available / made available to GCS
[5] Calculation (GCS)
[6] Borehole not sampled
[7] Dynamic Water Level

Additional Note/s:

Acronyms:

- m	-	metres
- m bgl	-	metres below ground level
- m amsl	-	metres above mean sea level
- m brl	-	metres below reference level
- L/s	-	Litres per second
- µS/m	-	micro Sieens per metre

Photo/s:

Source: GCS, 2019

Project Information:	
Project Number:	19-0993
Project:	Review and Update of Hydrogeological Investigation NOMAC- Bokpoort CSP
Hydrogeologist:	Miss C. Schmidt
Date:	November 2019

HYDROCENSUS RECORD SHEET

Bore ID: Bok BH6

Date & Time Information:					
Hydrocensus Date:	**[dd-mmm-yyyy]**	20 November 2019	**Time:**	**[hh:mm]**	15:35

Coordinates Infromation:			Owner Infromation:	
Coordinates System:			**Owner:**	Chris Honiball
- Projection:		Geographic	**Contact Number/Email:**	082 372 3467
- Datum:		WGS89	**Village/Farm Name:**	Farm Bokpoort 390
Coordinates:				
- Easting/Latitude:	**[m]/[DD]**	-28.769240	**Geological Information:**	
- Northing/Longitude:	**[m]/[DD]**	21.937390	Unknown (1)	
- Elevation:	**[m amsl]**	890		
Survey Method:		GPS-Handheld		

Bore/Spring Construction Information:			Bore/Spring Status & Equipment:		
Bore Installation Date	**[mmmm-yyyy]**	Unknown (1)	**Status:**		Not Operational
Bore Depth:	**[m]**	Not Applicable	**Water Application:**		
Collar Height:	**[m]**	Not Applicable	**- Primary**		-
Reference Level Height:	**[m]**	Not Applicable	**- Other**		
Casing Diameter (ID)	**[m]**	Not Applicable	**- Domestic**		
Screen/Perforated Casinig Length:	**[m]**	Not Applicable	**- Stock Watering**		
Casing Type:		Not Applicable	**- Irrigation**		
			- Other		
			Equipment:		Not Applicable
			Equipment Status:		Not Applicable
			Abstraction Rate:	**[L/s]**	Not Applicable
			Pump Inlet:	**[m]**	Not Applicable

Hydrogeological Information:				Field Physio-Chemical Information:		
Static Water Level:	**[m brl]**	DRY		**pH:**	**[pH Unit]**	Not Applicable
Aquifer Type:		Not Applicable		**Electrical Conductivity:**	**[µS/cm]**	Not Applicable
				Temperature:	**[°C]**	Not Applicable
Water Strike Depth:	**[m bgl]**	Not Applicable	***(Strike 1)***			
			(Strike 2)	**Sample Information:**		
Accumulative Yield:	**[L/s]**	Not Applicable	***(Strike 1)***	**Sample Date:**	**[dd-mmm-yy]**	Not Applicable
			(Strike 2)	**Sample Time:**	**[hh:mm]**	Not Applicable
				Sample Method:		Not Applicable
				Sample Depth:	**[m brl]**	Not Applicable

Comments

Note/s:

[1] Not measured / recorded
[2] Geological Map Series (1:250,000)
[3] Closed / damaged system
[4] No infromation available / made available to GCS
[5] Calculation (GCS)
[6] Borehole not sampled
[7] Dynamic Water Level

Additional Note/s:

Bok BH6 previously had a windmill installed and was utilized for livestock watering but this borehole is now dry.

Acronyms:

- m	-	metres
- m bgl	-	metres below ground level
- m amsl	-	metres above mean sea level
- m brl	-	metres below reference level
- L/s	-	Litres per second
- µS/m	-	micro Sieens per metre

Photo/s:

Source: GCS, 2019

Project Information:	
Project Number:	19-0993
Project:	Review and Update of Hydrogeological Investigation NOMAC- Bokpoort CSP
Hydrogeologist:	Miss C. Schmidt
Date:	November 2019

APPENDIX B: LABORATORY CERTIFICATES

aquatico Laboratories (Pty). Ltd.

ilac-MRA sanas Testing Laboratory T0685

Test Report

Client: Groundwater Consulting Services
Address: 63 Wessel Road, Woodmead, 2191
Report no: 78213
Project: GCS

Date of certificate: 27 November 2019
Date accepted: 22 November 2019
Date completed: 27 November 2019
Date received: 22 November 2019

Lab no:				63816	63817	63818
Date sampled:				20-Nov-19	20-Nov-19	20-Nov-19
Aquatico sampled:				No	No	No
Sample type:				Water	Water	Water
Locality description:				Bok BH1	Bok BH2	Bok BH5
Analyses		**Unit**	**Method**			
A	pH @ 25°C	pH	ALM 20	7.93	7.81	7.25
A	Electrical conductivity (EC) @ 25°C	mS/m	ALM 20	105	67.3	211
A	Total dissolved solids (TDS)	mg/l	ALM 26	586	351	1373
A	Total alkalinity	mg CaCO3/l	ALM 01	321	244	440
A	Chloride (Cl)	mg/l	ALM 02	98.8	82.6	342
A	Sulphate (SO_4)	mg/l	ALM 03	98.8	0.201	124
A	Nitrate (NO_3) as N	mg/l	ALM 06	0.261	<0.194	37.0
A	Nitrite (NO_2) as N	mg/l	ALM 07	<0.065	<0.065	<0.065
A	Ammonium (NH_4) as N	mg/l	ALM 05	3.75	4.55	0.018
N	Ammonia (NH_3) as N	mg/l	ALM 26	0.115	0.111	<0.005
A	Fluoride (F)	mg/l	ALM 08	0.737	0.389	0.786
A	Calcium (Ca)	mg/l	ALM 30	45.9	16.8	144
A	Magnesium (Mg)	mg/l	ALM 30	75.0	38.9	116
A	Sodium (Na)	mg/l	ALM 30	50.9	46.7	106
A	Potassium (K)	mg/l	ALM 30	8.28	8.37	12.3
A	Aluminium (Al)	mg/l	ALM 31	<0.002	<0.002	<0.002
A	Iron (Fe)	mg/l	ALM 31	<0.004	<0.004	<0.004
A	Manganese (Mn)	mg/l	ALM 31	0.125	0.195	0.004
A	Total Chromium (Cr)	mg/l	ALMT 31	<0.010	<0.010	0.149
A	Cadmium (Cd)	mg/l	ALM 31	<0.002	<0.002	<0.002
A	Lead (Pb)	mg/l	ALM 31	<0.004	<0.004	<0.004
A	Turbidity	NTU	ALM 21	28.6	59.1	1850
A	Total hardness	mg CaCO3/l	ALM 26	424	202	836
A	Total suspended solids (TSS)	mg/l	ALM 25	17	34	890
N	Mercury (Hg)	mg/l	ALM 34	<0.004	<0.004	<0.004
A	Boron (B)	mg/l	ALM 33	0.061	0.105	0.234
N	Temperature	°C	ALM 20	20.3	20.3	22.6
A	HNO3-Microwave digestion	mg/l	ALMT 30	Yes	Yes	Yes

A = Accredited N = Non accredited Out = Outsourced Sub = Sub-contracted NR = Not requested RTF = Results to follow NATD = Not able to determine ATR = Alternative test report ; The results relates only to the test item tested; Results reported against the limit of detection; Results marked 'Non SANAS Accredited' in this report are not included in the SANAS Schedule of Accreditation for this laboratory; Uncertainty of measurement available on request for all methods included in the SANAS Schedule of Accreditation; The report shall not be reproduced except in full without approval of the laboratory
The results apply to the sample received.

M. Swanepoel
Technical Signatory

APPENDIX C: SPECIALIST DETAILS AND DECLARATION FORMS

environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

	(For official use only)
File Reference Number:	
NEAS Reference Number:	DEA/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

PROJECT TITLE

Hydrogeological Baseline Assessment for Photovoltaic Solar Development- Bokpoort II

Kindly note the following:

1. This form must always be used for applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting where this Department is the Competent Authority.
2. This form is current as of 01 September 2018. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the form have been published or produced by the Competent Authority. The latest available Departmental templates are available at https://www.environment.gov.za/documents/forms.
3. A copy of this form containing original signatures must be appended to all Draft and Final Reports submitted to the department for consideration.
4. All documentation delivered to the physical address contained in this form must be delivered during the official Departmental Officer Hours which is visible on the Departmental gate.
5. All EIA related documents (includes application forms, reports or any EIA related submissions) that are faxed; emailed; delivered to Security or placed in the Departmental Tender Box will not be accepted, only hardcopy submissions are accepted.

Departmental Details

Postal address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Private Bag X447
Pretoria
0001

Physical address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Environment House
473 Steve Biko Road
Arcadia

Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at:
Email: EIAAdmin@environment.gov.za

1.

1. SPECIALIST INFORMATION

Specialist Company Name:	GCS (PTY) Ltd			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	4	Percentage Procurement recognition	100
Specialist name:	Jakobus Troskie			
Specialist Qualifications:	BSc (Hons) Hydrogeology			
Professional affiliation/registration:	Natural Scientist S.A (Reg. No. 400218/05)			
Physical address:	63 Wessel Road, Rivonia, 2128			
Postal address:	PO Box 2597, Rivonia			
Postal code:	2128	Cell:	+27 (0) 82 336 0069	
Telephone:	+27 (0) 11 803 5726	Fax:	+27 (0) 11 803 5745	
E-mail:	Kobus@gcs-sa.biz			

2. DECLARATION BY THE SPECIALIST

I, Jacobus Troskie, declare that –

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the Specialist

GCS (PTY) Ltd

Name of Company:

30/3/2020

Date

3. UNDERTAKING UNDER OATH/ AFFIRMATION

I, Jacobus Troskie, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Signature of the Specialist

GCS (PTY) Ltd

Name of Company

30/3/2020

Date

Signature of the Commissioner of Oaths

30/3/2020

Date

I certify that the DEPONENT has acknowledged that he/she knows and understands the contents of this affidavit, that he/she does not have any objection to taking the oath, and that he she considers it to be binding on his/her conscience, and which was sworn to and signed before me

at Rivonia on this the 30 day of 3 20 20

and that the administering oath complied with the regulations contained in Goverment Gazette No. R1258 of 21 July 1972, as amended.

COMMISSIONER OF OATH
Wendy Sherm[illegible]
63 Wessel Road, Woodmead
Johannesburg

KOBUS TROSKIE

Unit Manager Water Resources

CORE SKILLS

- Project planning and management: proposal writing,
- Conceptualisation, planning, management and coordination, financials.
- Data analysis and interpretation
- Technical report writing.
- Project and staff management.

DETAILS

Qualifications

- BSc (Biochemistry, Microbiology, Ecology)
- BSc (Hons) Hydrogeology

Memberships

- Registered Natural Scientist S.A (Reg. No. 400218/05)
- Member of: Geological Society of South Africa,
- Borehole Water Association of Southern Africa,
- Landfill Interest Group - Gauteng RSA,

Languages

- English - fluent
- Afrikaans - fluent

Countries Worked In

- South Africa, Botswana, Lesotho, Swaziland, Mozambique, Malawi, Zambia, Uganda, Tanzania, Angola, Namibia, Oman, Sierra Leone, Nigeria , DRC, Madagascar,

PROFILE

Kobus is a Senior Hydrogeologist at GCS (Pty) Ltd with 16 years' experience and manages the Groundwater Resources Unit. He has had extensive experience in water supply and well field management for a variety client base from small scale irrigation to large scale wellfield supply of up to 2500 m^3/hour. His experience include characterisation of primary as well as secondary aquifers by means of hydro geophysical surveys, exploration drilling, production borehole drilling (design and implementation) groundwater resource evaluations and groundwater reserve determinations. Waste disposal site suitability studies. Groundwater monitoring programmes – design and implementation. Groundwater and aquifer assessments, management and protection plans.

Kobus has specialist skills in the following areas:

- *Aquifer Mechanics, optimum design of boreholes and wellfields.*
- *Water supply and well field management*
- *Risk assessments with regard to soil and groundwater contamination*
- *Mine dewatering studies*
- *Waste disposal site suitability studies*
- *Groundwater monitoring programmes - design and implementation*
- *Groundwater and aquifer assessments, management and protection plan*
- *Aquifer Mechanics, optimum design of boreholes and wellfields.*

Previous Work Experience

SPECIFIC EXPERIENCE IN GROUNDWATER RESOURCES (Selective Projects a detailed project list can be made available upon request)

- Moatize Alluvial Aquifer Assessment: 2012/18 Characterization and development of an alluvial aquifer for large scale groundwater abstraction. The hydrogeological studies comprised of, Electrical resistivity geophysical surveys, exploration borehole drilling, abstraction scenario modeling and feasibility of the demand.
- Moatize Alluvial Aquifer Assessment: 2018 Remediation of production borehole within an alluvial aquifer associated with the Revubue river, the remediation included both physical and chemical treatment and resulted in a 60-85% yield recovery upon completion of the remediation.
- Steynsrus water supply (2015 – 2016): the study involved groundwater resource assessments verification of the water demand, geophysical surveys, drilling and construction of production boreholes, groundwater resource evaluations, wellfield monitoring and management plans
- Lekubu Village Water Supply (2009- 2013): Development of a water supply for a rural village in the north west, the study included verification of the water demand, geophysical surveys, drilling and construction of production boreholes, groundwater resource evaluations, wellfield monitoring and management plans
- Nestle Waters / Clover Water (2006 – 2016): Development and management of sustainable water resources over a period of 10 years, the studies involved geophysical investigations, equipping the resource, drilling testing and pump supply, management and recommendations and the Water Use License Application
- Tsitsikama Crystal Springs (2015): Development and management of sustainable water resources, the studies involved geophysical investigations, equipping the resource, drilling testing and pump supply, management and recommendations and the Water Use License Application
- McCain Foods (2013-2018): Development and management of sustainable water resources the studies involved geophysical investigations, equipping the resource, drilling testing and pump supply, management and recommendations and the Water Use License Application
- Big Concessions Agriculture: Characterization and development of a Carbonate Rock aquifer for large scale groundwater abstraction for development. The hydrogeological studies comprised of: geophysical investigations, exploration

borehole drilling, aquifer development and abstraction scenario modeling and feasibility of the demand.

- Lesotho 2004 – 2009 - Groundwater resource assessment on the Six Towns Study European Union Project Ref nr. 8.ACP.LSO 017– Teyateyaneng, Roma, Morija, Mapoteng, Maputsoe, Quthing
- Zambia, 2006 - Groundwater resource assessment, Scientific siting of drilling targets, Borehole design and construction, Aquifer testing, Hydrochemical analysis, Management options
- RSA 2006 – 2007 - Development and implementation of Sanitation Protocol
- RSA 2006 - Contamination studies for on-site sanitation
- MOZAMBIQUE 2003 - Nampula, Niassa: Water Supply investigation: The project involved water supply in villages in Nampula, Niassa, and Cappo Delgado provinces of Northern Mozambique.
- RSA 2007 – 2008, GRIP Eastern Cape Project
- RSA 2002 – 2019 - Drilling supervision, Boreholes design, Alluvial aquifers, Well field design and management for a large variety client base.

SPECIFIC EXPERIENCE IN THE MINING INDUSTRY

- ZAMBIA, 2009 – Mine Dewatering assessment of a Gold Mine
- RSA, 2008 - 2009 - EIA Application for various Gold Heap leach Pad sites, Groundwater impact assessments, site selection from a groundwater perspective.
- MALAWI, 2006 - Kayelekera Uranium Project: The project involved Geophysical investigations, designing a monitoring network, drilling supervision and Aquifer test supervision. The report compilation included commenting on catchment characteristics, identification of hydrogeological units from previous studies and borehole logs, Assess the aquifer (s) surrounding the proposed surface mine. Determine the impact of mine infrastructure including, waste rock dumps, tailings storage facilities, open pit mining on the regional aquifer (s).
- RSA, 2005 - 2006 - Six-month secondment to Anglo Gold Ashanti in Vaal Reefs, position held Senior Environmental Coordinator Lesotho, Swaziland, Mozambique, Malawi, Zambia, Tanzania, Angola, Namibia, Oman, Sierra Leonetor – Hydrogeologist. Responsibilities included management of the groundwater as part of the water unit for the Vaal Reefs, West Wits, and Ergo mining operations.
- RSA, 2003 - 2010 - Data collection, data analysis and report writing for the groundwater sections, and surface water quality of environmental management

program reports (EMPRs), for various types of mines, including: coal, gold, platinum, nickel, uranium mines.

- RSA, 2001 - 2005 - Groundwater monitoring and audit reports. The evaluation of groundwater level fluctuation and hydrochemical data and the compilation of monthly, quarterly and annual monitoring reports.
- RSA, 2006 - Site suitability studies and designing a monitoring network for permit application and closure of a Ash Disposal Facility (Rand Water)

PROFESSIONAL EXPERIENCE - IMPACT AND AUDITING STUDIES

- Tanzania 2012 – (Senior hydrogeologist) - Due Diligence Study – Organic contaminants, ESA reports phase I/II (2 sites).
- RSA 2012 (Project Manager) (Confidential Client) in-situ remediation of a hydrocarbon contaminated site.
- RSA 2012 (Project Manager) (Confidential Client) in-situ remediation of a hydrocarbon contaminated site.
- Zambia 2012 – (Senior hydrogeologist) - Due Diligence Study – Organic contaminants, ESA reports phase I/II (2 sites).
- RSA SASOL 2011- (Senior hydrogeologist) Phase I Hydrocarbon Site Characterisations and risk assessment of 130 fuel stations across South Africa.
- Sasol: Groundwater & Soil Contamination Study.
- RSA, 2011 (Phase I / 2 Hydrocarbon Site Characterization and risk assessment of 70 sites within Gauteng Province.
- RSA, 2011 - (Senior hydrogeologist) - Thabazimbi Hydrocarbon Assessment: Field work, data compilation, data interpretation, RBCA.
- RSA, February 2010 (Senior hydrogeologist) - Due Diligence Study – Organic contaminants, ESA reports phase I/II (2 sites).
- RSA, September 2009 (Project hydrogeologist) - Due Diligence Study – Organic contaminants ESA reports phase I/II (4 sites).
- RSA, September 2009 (Project hydrogeologist) - Organic contaminants, Due Diligence Study, Water quality objectives and sign off from DWAF.

- NIGERIA, September 2009 (Project hydrogeologist) - Due Diligence Study – Organic contaminants, ESA reports phase I/II.

- NIGERIA, March 2008 (Project hydrogeologist) - Due Diligence Study – Organic contaminants, ESA reports phase I/II.
- RSA, November 2007 (Project hydrogeologist) - Due Diligence Study – Organic contaminants, ESA reports phase I/II.
- RSA, October 2007 (Project hydrogeologist) - Due Diligence Study – Organic contaminants, ESA reports phase I/II.
- RSA, July 2007 (Project hydrogeologist) - Due Diligence Study, ESA reports phase I/II.
- RSA, March 2007 (Project hydrogeologist) - Organic contamination, remediation, monitoring.
- RSA, March 2007 (Project hydrogeologist) - Organic contamination, soil and water study.
- ZAMBIA, 2006 (Project hydrogeologist) - Site selection and feasibility study – Livingstone, Zambia.
- RSA, 2005 (Hydrogeologist) - Site suitability study, permit application for an Ash Disposal Facility.
- RSA, 2006 (Hydrogeologist) - Contamination studies for on-site sanitation.
- MOZAMBIQUE, 2004 (Hydrogeologist) - Temane CPF, Villunkolos Mozambique: The project involved Geophysical investigations, designing a monitoring network, drilling supervision and Aquifer test supervision.
- MOZAMBIQUE, 2003 (Hydrogeologist) - Mozal Mozambique, the project involved monitoring and evaluation of onsite conditions to a hazardous waste disposal site.

DECLARATION

I, Kobus Troskie hereby declare that the details furnished above are true and correct to the best of my knowledge and belief and I undertake to inform you of any changes therein, immediately. In case any of the above information is found to be false or untrue or misleading or misrepresenting, I am aware that I may be held liable for it.

Signature: _____ Date: 31/01/2019

environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

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Private Bag X447
Pretoria
0001

Physical address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Environment House
473 Steve Biko Road
Arcadia

Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at:
Email: EIAAdmin@environment.gov.za

1.

1. SPECIALIST INFORMATION

Specialist Company Name:	GCS (PTY) Ltd			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	4	Percentage Procurement recognition	100
Specialist name:	Chantelle Schmidt			
Specialist Qualifications:	BSc (Hons) Hydrogeology			
Professional affiliation/registration:	Registered Candidate Natural Scientist SACNASP (reg. no. 118749)			
Physical address:	63 Wessel Road, Rivonia, 2128			
Postal address:	PO Box 2597, Rivonia			
Postal code:	2128	Cell:	+27 (0) 61 454 3396	
Telephone:	+27 (0) 11 803 5726	Fax:	+27 (0) 11 803 5745	
E-mail:	Chantelles@gcs-sa.biz			

2. DECLARATION BY THE SPECIALIST

I, Chantelle Schmidt declare that –

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

CSchmidt.

Signature of the Specialist

GCS(PTY)Ltd

Name of Company:

8/4/2020

Date

3. **UNDERTAKING UNDER OATH/ AFFIRMATION**

I, Chantelle Schmidt swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

CSchmidt

Signature of the Specialist

GCS (PTY) Ltd

Name of Company

8/4/2020

Date

Signature of the Commissioner of Oaths

8/4/2020

Date

I certify that the DEPONENT has acknowledged that he/she knows and understands the contents of this affidavit, that he/she does not have any objection to taking the oath, and that he/she considers it to be binding on his/her conscience, and which was sworn to and signed before me

at Rivonia on this the 8 day of 4 20 20 and that the administering oath complied with the regulations contained in Goverment Gazette No. R1258 of [illegible] 1972, as amended.

COMMISSIONER OF OATHS (RSA)
Wendy Sherriff CA(SA)
63 Wessel Road, Woodmead
Johannesburg

Chantelle Schmidt

Hydrogeologist

CORE SKILLS

- Groundwater quality monitoring
- Groundwater impact assessments
- Hydrogeological field investigations
- Project management
- Technical report writing

DETAILS

Qualifications

- B.Sc (Hons) Hydrogeology

Memberships

- Registered Candidate Natural Scientist SACNASP (reg. no. 118749)
- Groundwater Division (GWD) of the Geological Society of South Africa (GSSA)
- Affiliated Member of South African Institute for Engineering and Environmental Geologists (SAIEG)

Languages

- English – Fluent
- Afrikaans – Fluent

Countries Worked In

- South Africa, Lesotho

PROFILE

Chantelle Schmidt is a Hydrogeologist and Candidate Natural Scientist in the field of practice Earth Science with GCS in Pretoria. She has 3 years' work experience specialising in surface and groundwater quality monitoring and hydrogeological risk assessments.

Chantelle has specialist skills in the following areas:

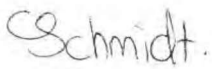
- Water quality assessment
- Data collection and analysis
- Writing and reviewing of technical reports
- Design and management of groundwater monitoring networks
- Hydrogeological impact assessments
- Rapid groundwater reserve determination and catchment delineation
- Hydrocensus, borehole drilling supervision and surface geophysical investigation
- Groundwater availability studies
- Project management and acquisition

GCS Project and Work Experience

Year	Client	Project Description	Role/Responsibility
Water Resource Unit			
2019-2020	Ledjadja Coal (Pty)-LtdBoikarabelo Coal Mine	Baseline groundwater quality and groundwater level monitoring.	Project management, client liaison, data capture, trend analysis, water quality interpretation and technical report writing.
2019-2020	SRK Consulting- Modikwa Integrated Water Management Scheme	Hydrogeological investigation and development of mitigation strategy, which will form part of the integrated water management study.	Project co-ordination and field investigation which involved borehole fluid logging, surface geophysical investigation, borehole drilling supervision, Double Ring Infiltrometer (DRI) tests, soil profiling via inspection pits/ test pits, soil sampling (disturbed and undisturbed samples) and isotope water sampling. Data interpretation and reporting.
2020	PEU Group (PTY) Ltd	Groundwater availability study for proposed development in Vaalwater.	Field investigation, groundwater reserve determination, interpretation of existing aquifer testing data ad recommendations on availability of groundwater resources for the proposed development
2020	JINDAL Mining SA (Pty) LTD	Railway Siding Hydrogeological Investigation	Data analysis of aquifer testing data and water quality results, monitoring network development and groundwater reserve determination
Monitoring Unit			
2017-2018	Anglo American Platinum-Modikwa Platinum Mine	Operational platinum mine and concentrator. Monthly water quality monitoring.	Project management, client liaison, data capture, trend analysis, water quality interpretation and technical report writing.
2017-2018	Exxaro's Thabametsi Coal Mine (Thabametsi Project)	Baseline monitoring of groundwater and surface water quality, groundwater levels and dust fallout rate. Monthly surface and groundwater quality monitoring and monthly air quality monitoring.	Project management, client liaison, data capture, trend analysis, water quality interpretation, data fallout interpretation and technical report writing.
2017-2018	Letseng Diamond Mine	Operational diamond mine. Biannual groundwater quality monitoring.	Project management, client liaison, data capture, trend analysis, water quality interpretation and technical report writing.
2017-2018	Anglo Platinum- Der Brochen Project	Baseline monitoring. Monthly surface and groundwater quality monitoring and monthly air quality monitoring.	Project management, client liaison, data capture, trend analysis, water quality interpretation, data fallout interpretation and technical report writing.

DECLARATION

I, Chantelle Schmidt hereby declare that the details furnished above are true and correct to the best of my knowledge and belief and I undertake to inform you of any changes therein, immediately. In case any of the above information is found to be false or untrue or misleading or misrepresenting, I am aware that I may be held liable for it.

Signature:  Date: 31/01/2019

Appendix B3: Surface Water (Hydrology) including Peer Review by GCS

April 2016

ACWA POWER AFRICA HOLDINGS (PTY) LTD

Surface Water Baseline and Impact Assessment Report for the Proposed 150 MW CSP Tower Facility (Proposed Bokpoort II Solar Development) near Groblershoop, Northern Cape

Submitted to:
ACWA Power Africa Holdings (Pty) Ltd

REPORT

Report Number: 1400951-299955-8
Distribution:
1 Copy - ACWA Power Africa Holdings (Pty) Ltd
1 Electronic Copy - ProjectReports@golder.co.za

Golder Associates

Table of Contents

TABLES

FIGURES

APPENDICES

1.0 INTRODUCTION

ACWA Power Africa Holdings (Pty) Ltd (hereafter referred to as ACWA Power) is proposing to establish a solar facility (proposed Bokpoort II Solar Development) on the north-eastern portion of the Remaining Extent (RE) of the Farm Bokpoort 390 near Groblershoop in the Northern Cape.

The proposed Bokpoort II Solar Development consists of three separate applications for environmental authorisation. ACWA Power is proposing to construct two (2) 75 Mega Watt (MW) photovoltaic (PV) facilities and one (1) 150 MW Concentrated Solar Power (CSP) Tower facility. The combined power generation capacity of the entire Bokpoort II solar development will be 300 MW. Each of the solar technologies will have separate associated infrastructure that will not overlap in footprint.

Golder Associates was tasked to assess the following surface water aspect associated with the proposed Bokpoort II Solar development:

- Whether the water demand requirements were able to integrate into the current and future status of the Orange Water Management Area;
- Potential sources of surface water pollution associated with the proposed development; and
- Storm water management requirements associated with the proposed development.

This report addresses the surface water baseline and impact assessment for the proposed 150 MW Concentrated Solar Power (CSP) Tower facility.

2.0 SCOPE OF WORK

- Surface Water Baseline Assessment:
  - Compiling a map showing the catchment areas, site infrastructure and the major surface water drainage lines;
  - The available daily rainfall data will be collected and checked for integrity. The rainfall data will be patched to produce a daily rainfall record for use in surface water modelling;
  - Rainfall statistics such as monthly averages, number of rain days per month, distribution of annual totals and the 2, 5, 10, 20, 50, 100 and 200 year recurrence interval 24 hour storm depths will be determined;
  - The available climate data will be collected and reviewed to produce monthly potential evaporation and temperature statistics based on regional and local climatic data;
  - The surface water resources in the study area will be mapped and described;
- Current and Future Water Requirements
- Identify current and future water demands; Assessment of potential sources of surface water pollution; and
- Assess storm water management requirements.

3.0 REGIONAL DESCRIPTION

The Bokpoort II Solar Development project is situated in the Lower Orange Main Stem Catchment (116539) and is governed by the Orange Water Management Area (WMA). The Bokpoort II Solar Development project is approximately 80km south east of Upington and approximately 10km north east of the Orange River in the iKheis Local Municipality in the ZF Mgcawu District municipality. The catchment is still largely undeveloped with limited water resources and water uses. The project site is situated in the D73D quaternary catchment.

Figure 1 illustrates the Orange WMA, Figure 2 denotes the catchment area affecting the project site and Figure 3 represents the locality map of the project site and indicates where local weather stations reside.

Figure 1: Orange Water Management Area

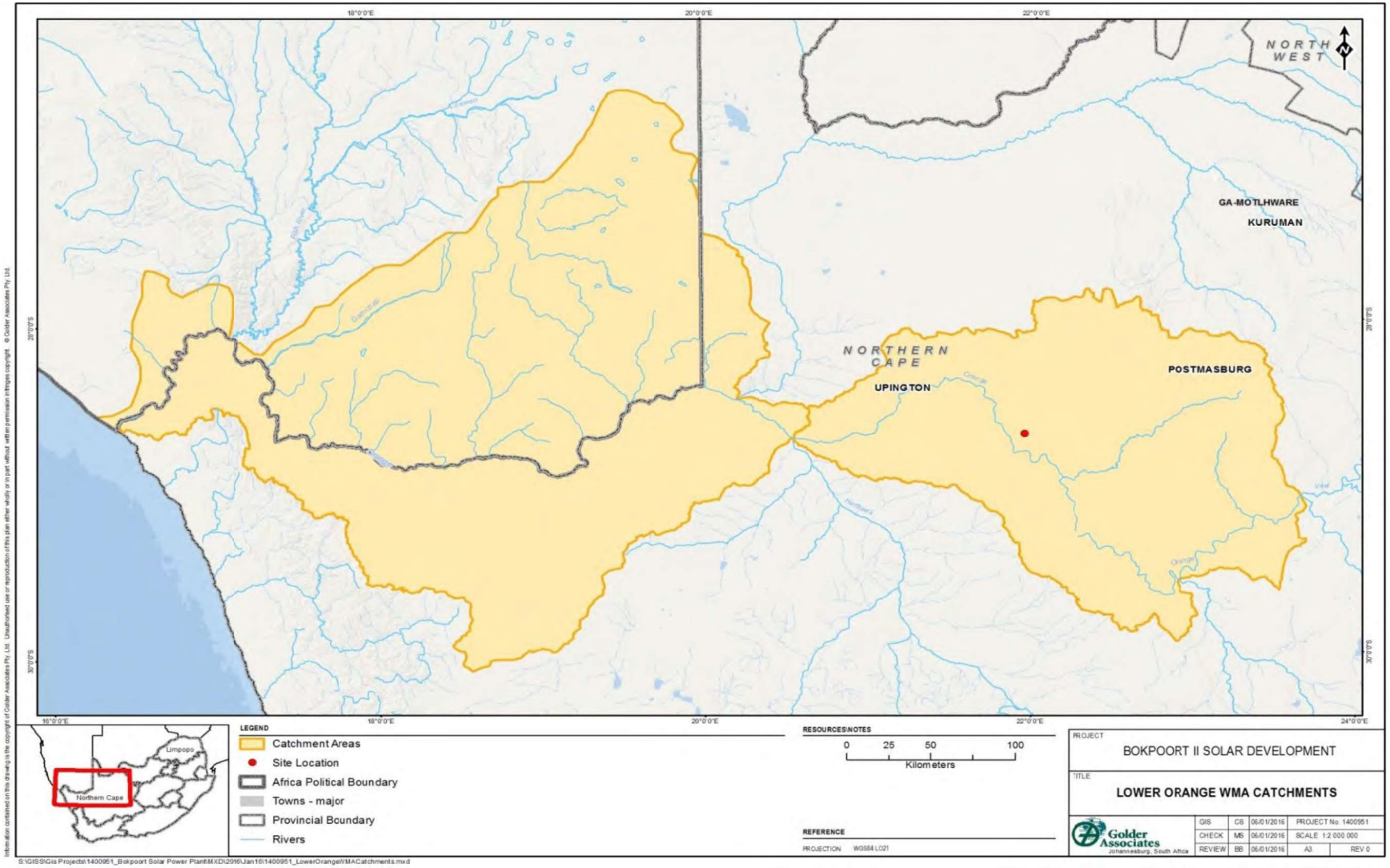


Figure 2: Lower Orange Main Stem catchment area

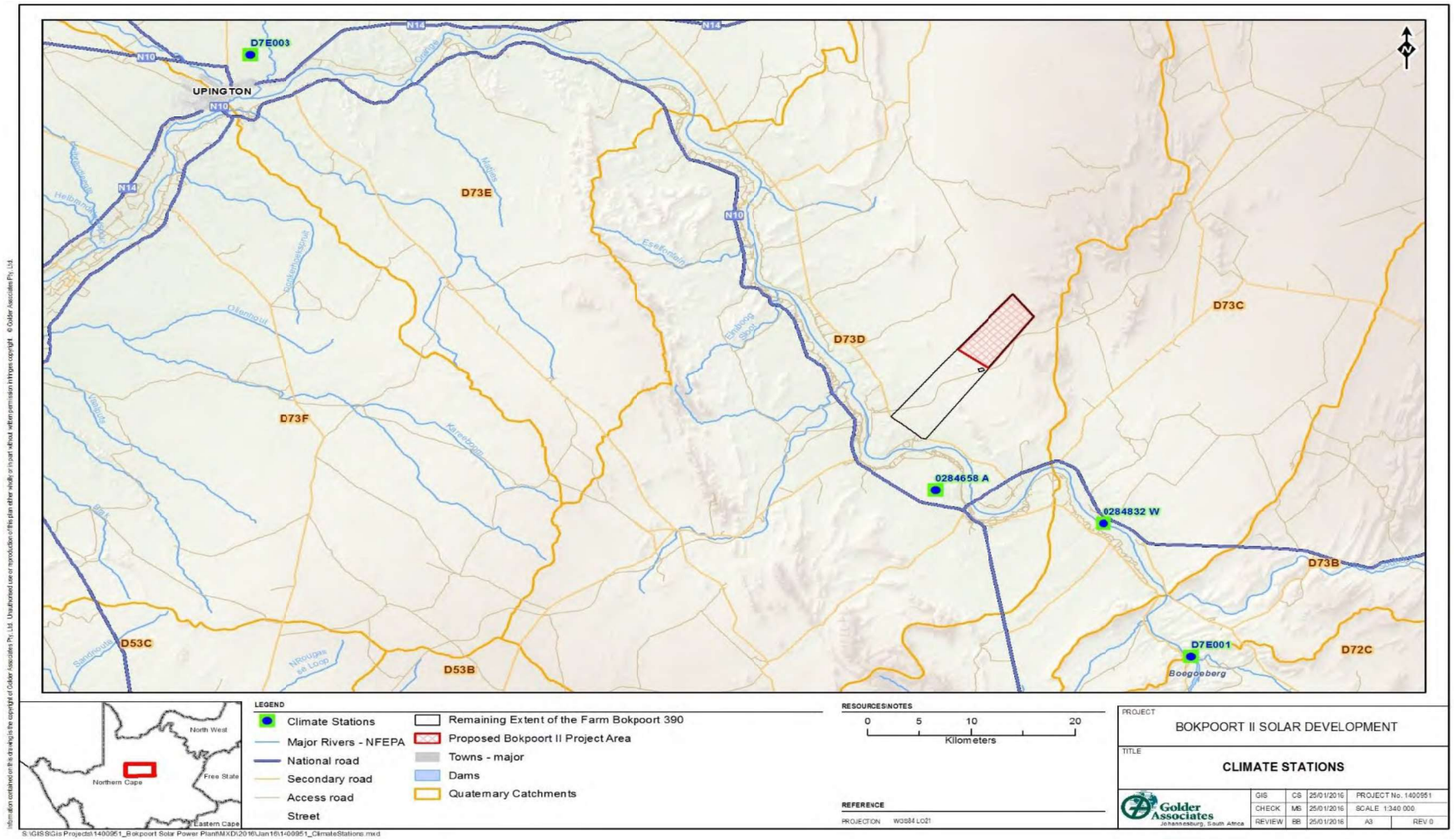


Figure 3: Locality map of the Bokpoort II Solar Development Project

4.0 WATER RESOURCE CLASSIFICATION

Classification of water resources aims to ensure that a balance is reached between the need to protect and sustain water resources on the one hand and the need to develop and use it on the other. The Water Resource Classification System (Department Of Water Affairs And Forestry, 2007) places the following principles at the forefront of implementation:

- Maximising economic returns from the use of water resources;
- Allocating and benefits of utilising the water resources fairly; and
- Promoting the sustainable use of water resources to meet social and economic goals without detrimentally impacting on the ecological integrity of the water resource.

The Resource Classification System is used to classify each quaternary catchment in South Africa in either a Class I, II or III, defined as:

- Class I - Minimally used: Water resource is one which is minimally used and the overall condition of that water resource is minimally altered from its pre-development condition;
- Class II - Moderately used: Water resource is one which is moderately used and the overall condition of that water resource is moderately altered from its pre-development condition; and
- Class III - Heavily used: Water resource is one which is heavily used and the overall condition of that water resource is significantly altered from its pre-development condition.

Water Resource Classification has not yet been undertaken in the Orange River. In this respect the Resource Water Quality Objectives (RWQO) that were developed as part of the Water Resources Planning project for the Upper and Lower Orange River in 2009 (DWAF, 2009) have been used against which to compare the water quality of the river.

5.0 WATER QUALITY

There are two Department of Water and Sanitation monitoring points in the Orange River: D7H8, upstream of the site and D7H5, downstream of the site at Upington. The water quality at both points is good when compared against the interim RWQO developed as part of the Water Resources Planning project for the Upper and Lower Orange River in 2009 (DWAF, 2009). The water is however slightly alkaline and nitrate and orthophosphate exceed the limits set which would lead to eutrophication in the river.

The water quality requirement for the proposed project may however be stricter than that abstracted so that some kind of treatment may still be needed.

Table 1: Water quality in the Orange River at DWS monitoring points compared against the interim RWQOs

Parameter	Units	Interim RWQO*	Upstream (D7H8)			Downstream (D7H5)		
			5	50	95	5	50	95
pH		7.1-8.4	7.26	8.13	8.55	7.19	8.14	8.45
Electrical Conductivity	mS/m	70	18.47	26.40	47.64	21.10	32.30	55.83
Total Dissolved Solids	mg/L	400	145.00	197.22	317.46	151.95	228.00	374.19
Calcium	mg/L	80	18.50	23.70	33.75	19.24	25.71	35.69
Chloride	mg/L	100	5.00	13.49	40.93	7.68	17.85	48.09
Fluoride	mg/L	0.7	0.12	0.20	0.34	0.16	0.23	0.41
Potassium	mg/L	15	1.26	1.92	4.26	1.40	2.24	4.29
Magnesium	mg/L	30	6.87	9.70	16.89	7.26	11.40	20.67

Parameter	Units	Interim RWQO*	Upstream (D7H8)			Downstream (D7H5)		
			5	50	95	5	50	95
Sodium	mg/L	70	7.20	13.50	33.44	9.44	18.10	44.14
Ammonia	mg/L	0.015	0.02	0.04	0.12	0.02	0.03	0.11
Nitrate	mg/L	0.2	0.02	0.24	0.67	0.02	0.18	0.81
Orthophosphate	mg/L	0.02	0.01	0.02	0.06	0.01	0.02	0.08
Silica	mg/L	20	3.22	6.80	8.55	2.60	6.71	8.63
Sulphate	mg/L	80	7.21	20.10	59.61	8.60	23.90	64.65
Total Alkalinity	mg/L	300	73.70	92.20	113.76	70.47	104.70	139.27

*the stricter of the RWQOs set at the two points has been chosen

6.0 ASSESSMENT OF CLIMATE DATA

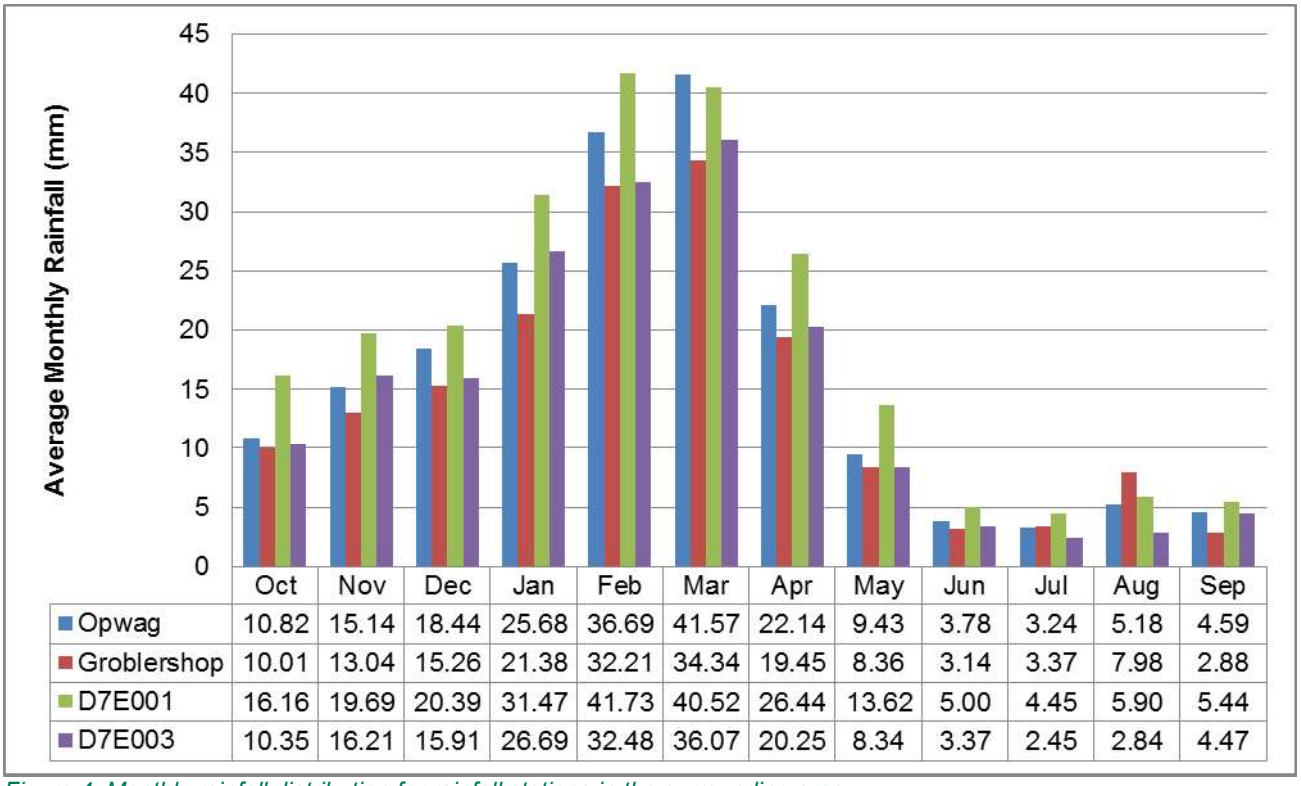
Climate data in the area around the project site was sourced from the Daily Rainfall extraction utility (Kunz, 2004) and the Department of Water and Sanitation's website (Department of Water Affairs, 2008) . The rainfall stations are presented in Table 2.

Table 2: Rainfall Stations

Station	Name	Altitude (masl)	From	To	No of Years	MAP(mm)
0284658 A	Opwag	939	1972	1999	29 (0% patched)	197
0284832 A	Grobelershop (pol)	880	1900	1999	99 (49.5% patched)	171
D7E001	Boegoeberg Res @ Boegoeberg Dam	980	1930	2014	84	231
D7E003	P V Ryneveld Airport @ Upington	830	1902	2004	102	179

Figure 4 shows the monthly rainfall distribution for the five rainfall stations in the region and Figure 5 illustrates the cumulative plots for the four rainfall stations in the region. The monthly rainfall is seen to be fairly uniform with low peaks. The D7E001 station (Boegoeberg Res @ Boegoeberg Dam) was chosen as the station used in the study for the following reasons:

- D7E001's rainfall record is of a long duration;
- The station D7E001 is seen to be still active such that recent rainfall data is available;
- The patched data applied to the D7E001 records is minimal, thus providing a reliable set of data; and
- The D7E001 station's MAP falls within a suitable range of nearby stations.



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Opwag	10.82	15.14	18.44	25.68	36.69	41.57	22.14	9.43	3.78	3.24	5.18	4.59
Groblershop	10.01	13.04	15.26	21.38	32.21	34.34	19.45	8.36	3.14	3.37	7.98	2.88
D7E001	16.16	19.69	20.39	31.47	41.73	40.52	26.44	13.62	5.00	4.45	5.90	5.44
D7E003	10.35	16.21	15.91	26.69	32.48	36.07	20.25	8.34	3.37	2.45	2.84	4.47

Figure 4: Monthly rainfall distribution for rainfall stations in the surrounding area

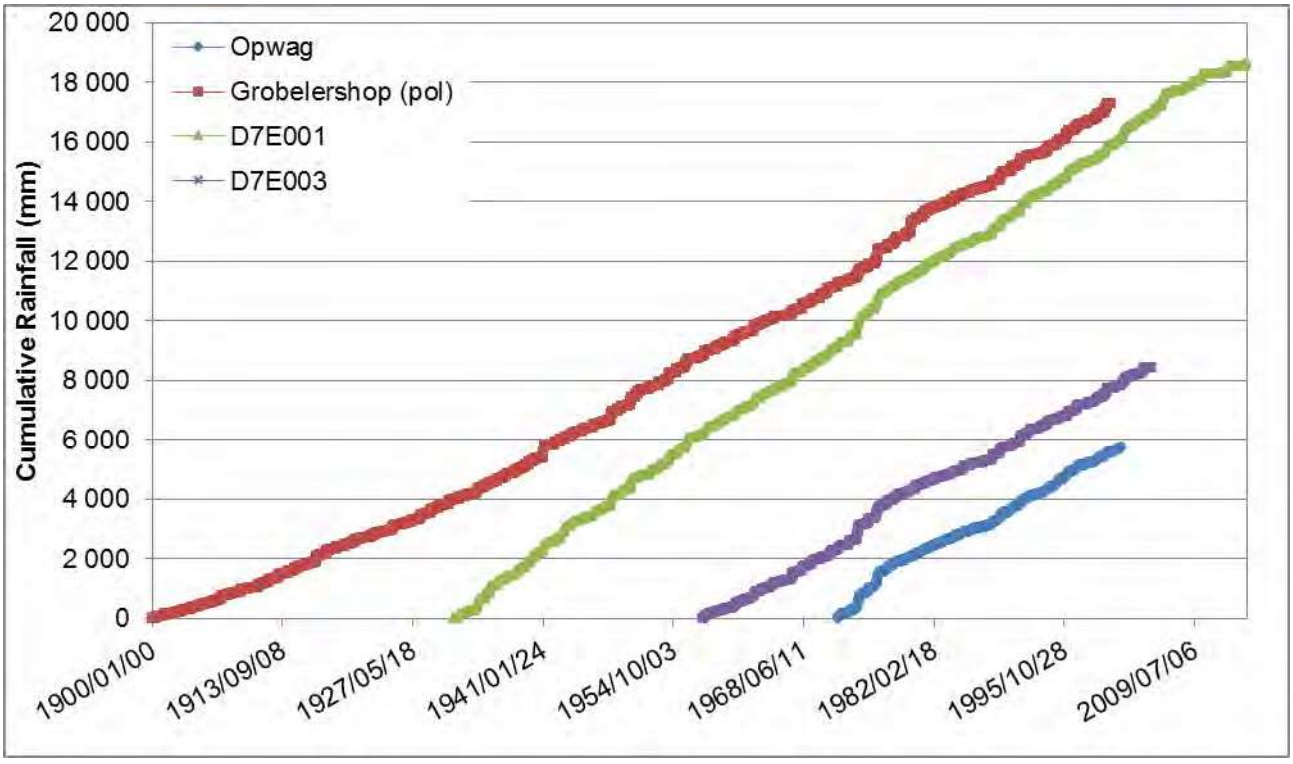


Figure 5: Cumulative rainfall for the rainfall stations in the Bokpoort area

Figure 6, Figure 7 and Figure 8 indicate the daily rainfall, monthly boxplot, and annual rainfall for the D7E001 rainfall station respectively.

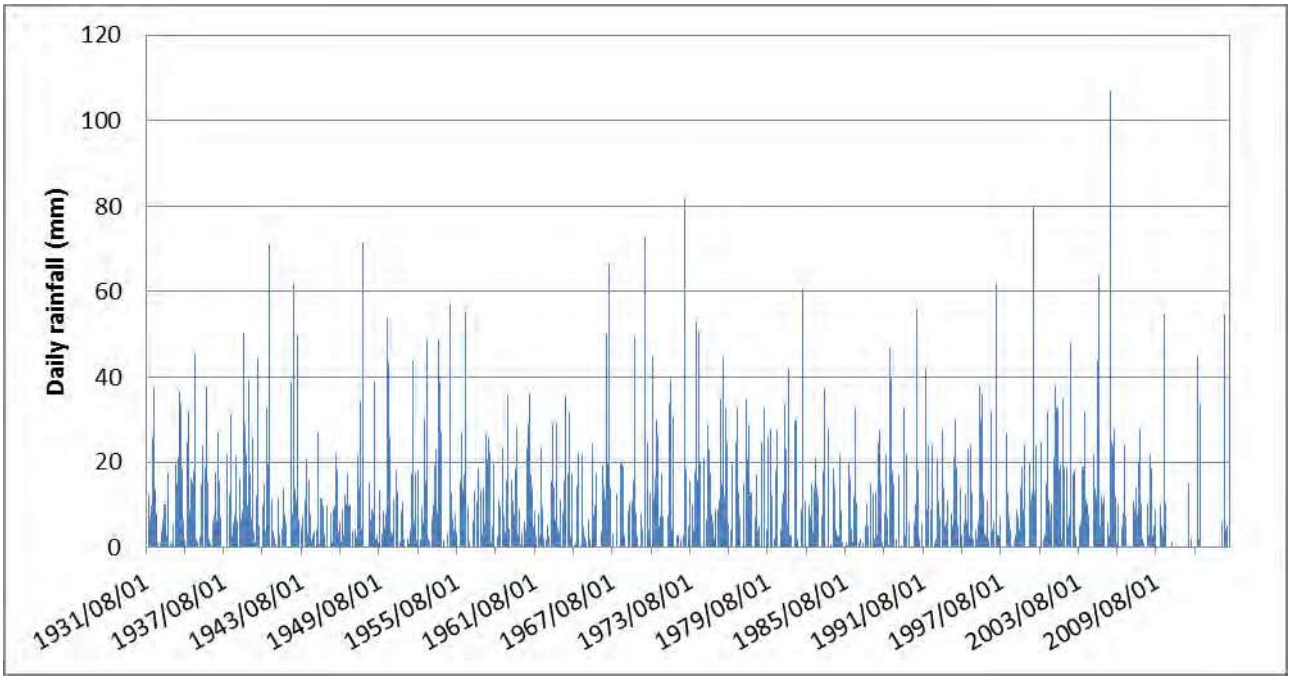


Figure 6: Daily rainfall for the D7E001 station

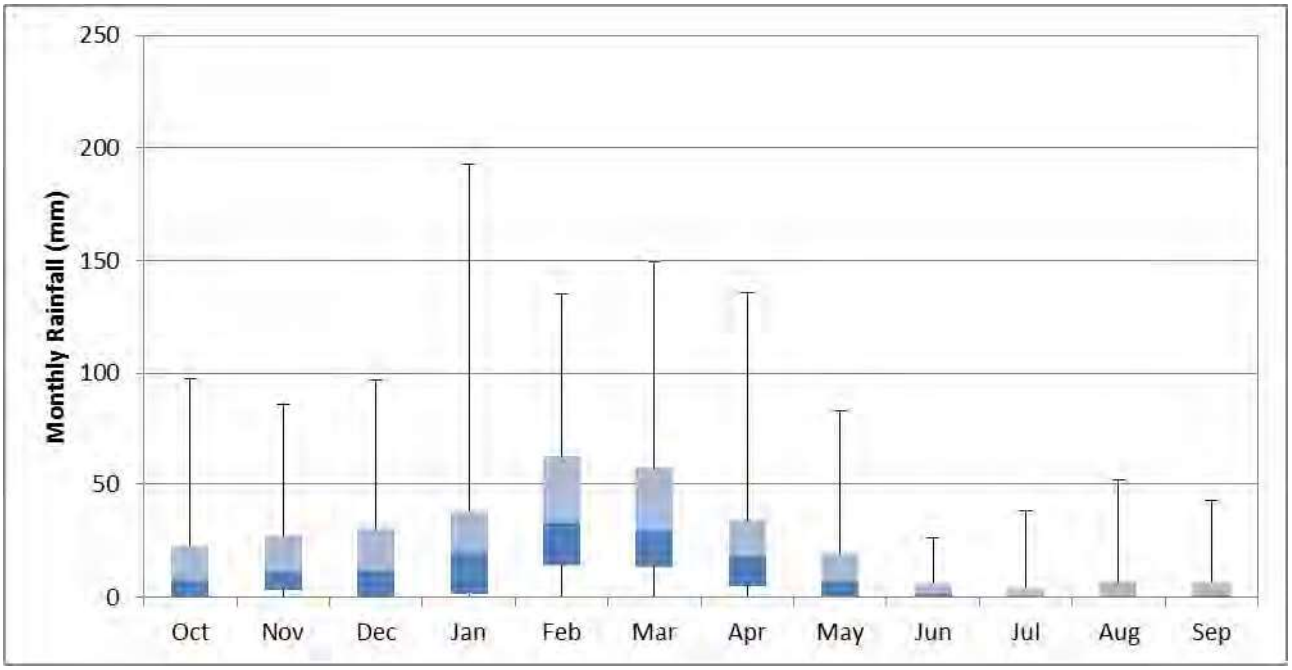


Figure 7: Monthly box plot averages for the D7E001 station

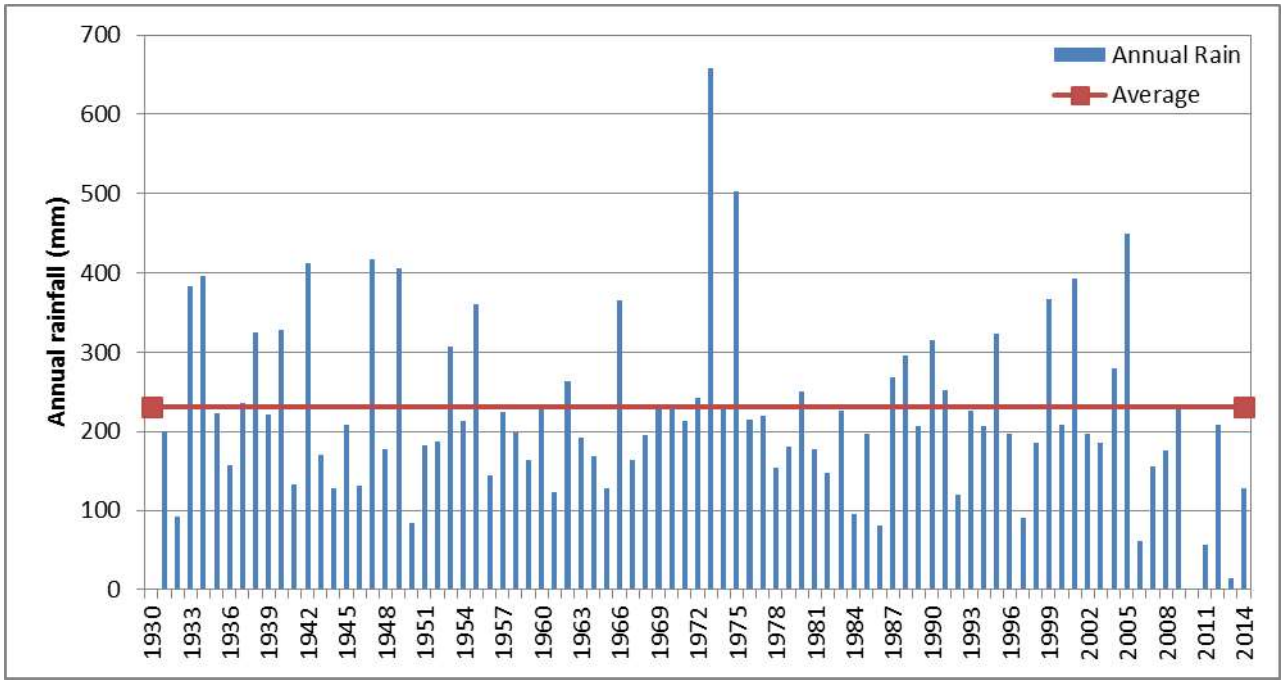


Figure 8: Annual rainfall for the D7E001 station

The highest rainfall year was in 1973 with 658 mm of rain in that year. The average Mean Annual Precipitation (MAP) for the D7E001 weather station indicates a low 190 mm.

The 5, 50 and 95 percentiles of the annual rainfall totals for the rainfall station are presented in Table 3. Figure 9 shows the cumulative distribution function of the annual rainfall totals measured at the D7E001 station.

Table 3: 5, 50, and 95 percentile of the annual rainfall totals

Station Number	Station name	5th percentile	50th percentile	95th percentile
D7E001	Boegoeberg Res.	81	208	412

Table 3 indicates the following occurrences at D7E001, based on the data collected at the station:

- There is a 95% chance that the station will experience an annual rainfall of 81 mm or more;
- There is a 50% chance that the station will experience an annual rainfall of 208 mm or more; and
- There is a 5% chance that the station will experience an annual rainfall of 412 mm or more.

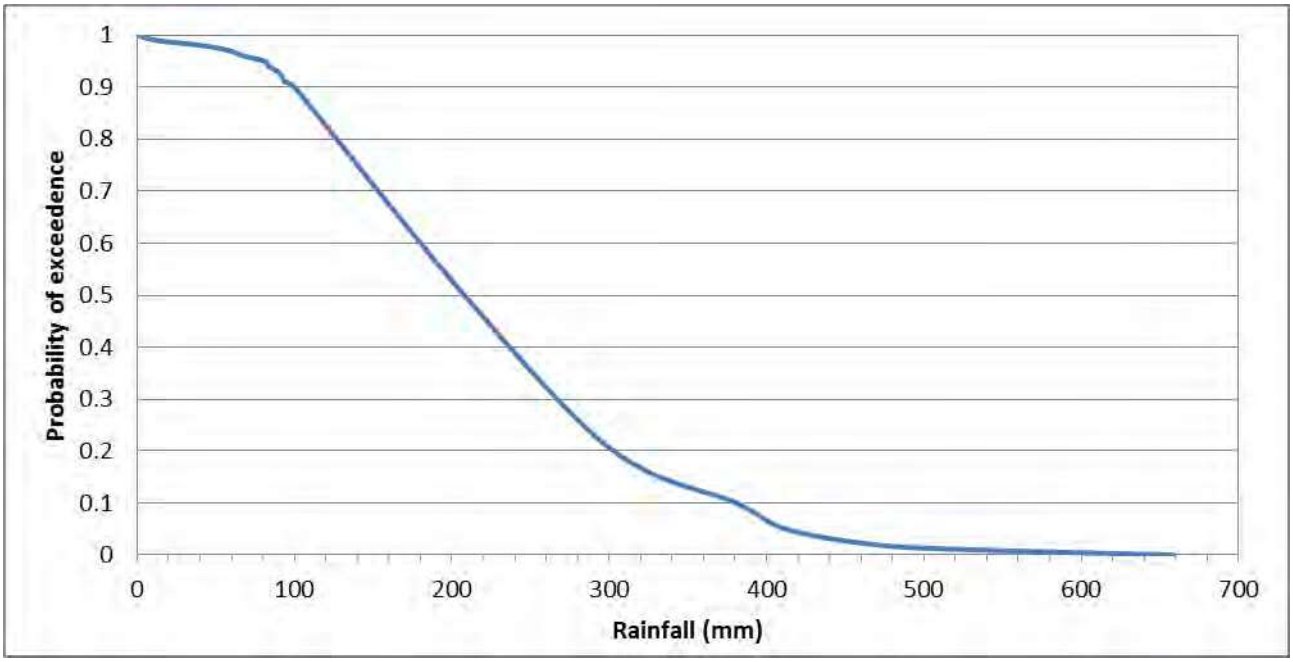


Figure 9: Probability of exceedance for the D7E001 station

At the D7E001 station, 23 events measured more than 50 mm/day and of the 23 events, 1 event measured over 100 mm/day. The following Table 4 shows the highest 5 recorded rainfall events at the D7E001 station.

Table 4: High Rainfall Events

Maximum Recorded Daily Rainfall (mm)	Date of Maximum Rainfall
107	2006/01/05
82	1973/02/15
80	2000/02/16
71.6	1948/04/16
71.1	1941/01/31

In order to determine the likely magnitude of storm events, a statistical approach, using the Reg Flood program (Alexander, van Aswegen, & Hansford, 2003) was applied to the available recorded daily rainfall depths. The maximum 24 hour rainfall depth for each year was analysed. The 24-Hour rainfall depths for the 1 in 2, 1 in 5, 1 in 10, 1 in 50, 1 in 100 and 1 in 200 recurrence intervals at the D7E001 station and is provided in Table 5

Table 5: 24 Hour Rainfall Depths for Different Recurrence Intervals (mm/day)

Recurrence Interval (years)	1 in 2	1 in 5	1 in 10	1 in 20	1 in 50	1 in 100	1 in 200
24 Hour Rainfall Depth (mm)	35	41.5	62	73	85	97	107

7.0 TEMPERATURE

Temperature data was sourced for the Groblershoop area to represent the site area (World Weather Online, 2016). Temperature data is seen graphically in Figure 10. High average summer temperatures in the months of September to March range between 29^0 C and 37^0 C with winter temperatures in the months April to August ranging between 23^0 C and 30^0 C. Low average temperatures range between 14^0 C and 20^0 C with winter temperatures ranging between 4^0 C and 9^0 C.

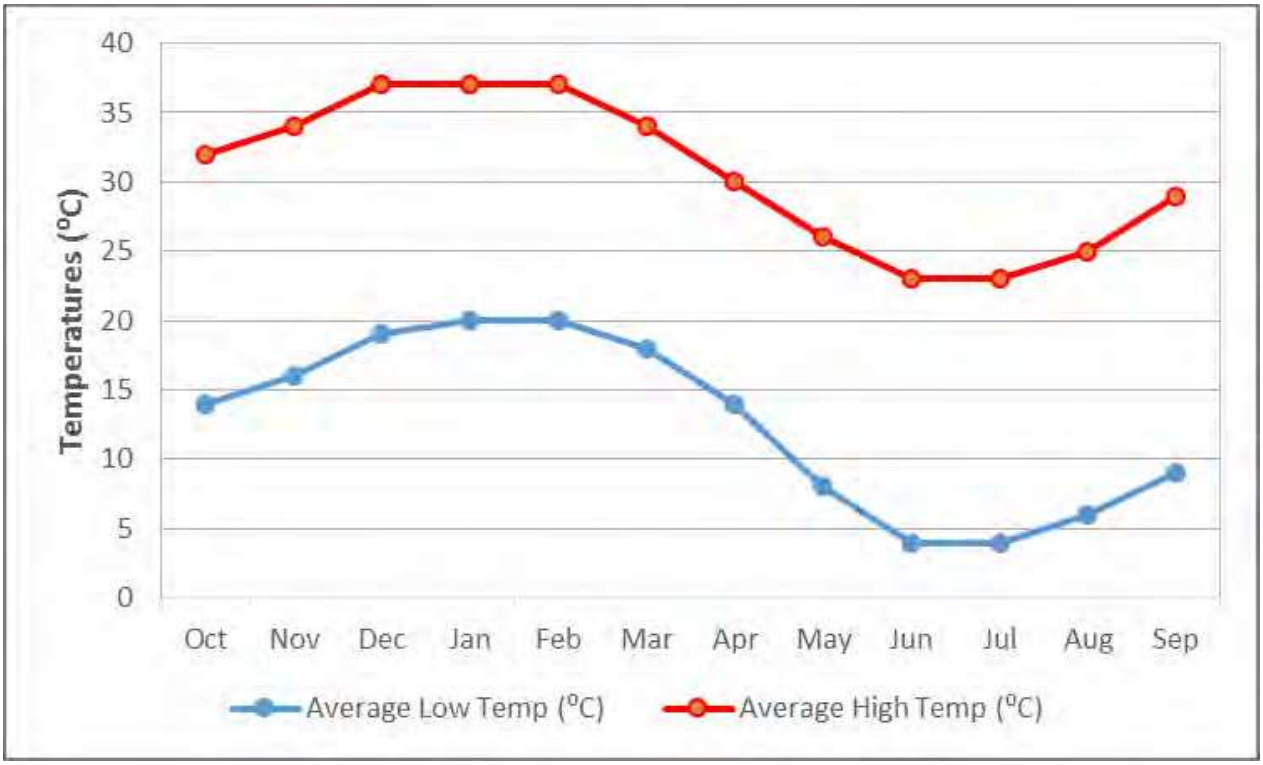


Figure 10: Average Temperature (°C) Graph for Groblershoop

8.0 POTENTIAL EVAPORATION

Monthly evaporation data were available from the DWS station D7E001, located approximately 40km south east of the project site. This station has an approximate Mean Annual Evaporation (MAE) of 2166.3 mm over a period of 1931-2008. Monthly mean, minimum and maximum evaporation depths are shown in Figure 11.

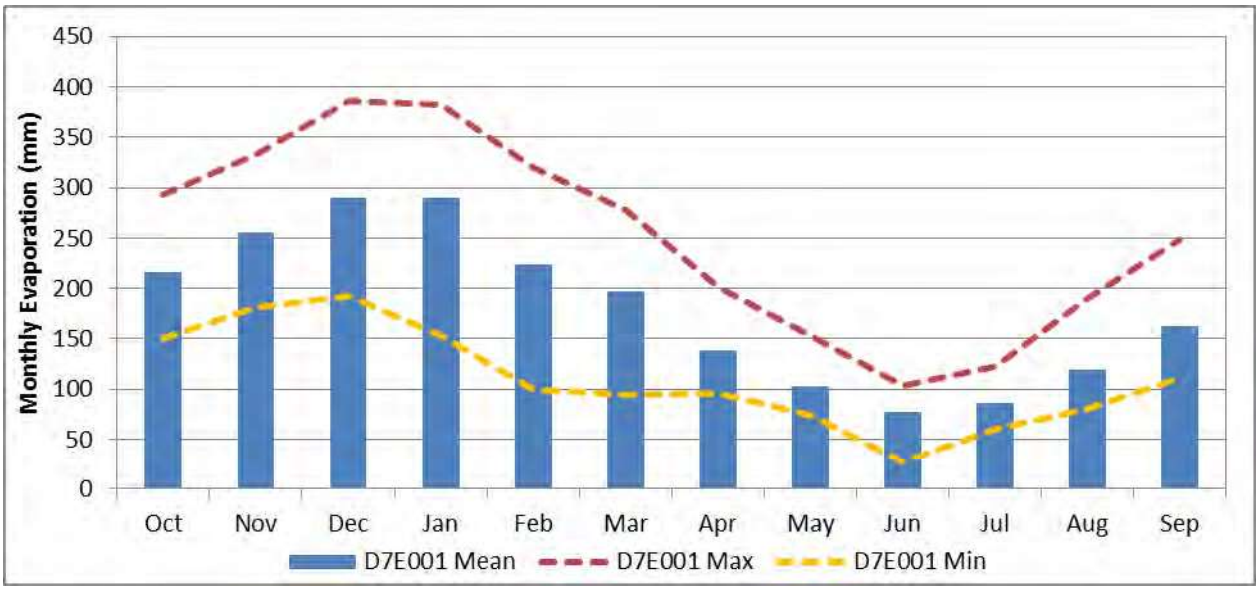


Figure 11: Monthly mean, minimum and maximum evaporation for station D7E001

Figure 11 shows that the highest evaporation occurs in the summer months of September to March. The average monthly evaporation values are shown in Table 6.

Table 6: Average month evaporation values for station D7E001

Month	Monthly Evaporation (mm)
Oct	216
Nov	255
Dec	290
Jan	290
Feb	223
Mar	197
Jun	139
Jul	103
Aug	77
Sep	87

9.0 SITE DESCRIPTION

The Orange River located west and southwest of the project area is the predominant perennial surface water feature in the vicinity of the proposed development. This section of the river falls in the Lower Orange Water Management Area (LOWMA). The Orange River is the main source of water for the ZF Mgcawu (previously referred to as the Siyanda) District and iKheis Local Municipality. The ZF Mgcawu District Environmental Management Framework cited that the evaporation rate in the LOWMA is estimated at 3000 mm which is much higher than the Mean Annual Rainfall. The banks of the Orange River are heavily used for irrigated agriculture.

The hydrological assessment conducted for the Bokpoort I EIA and satellite imagery review indicate that there are no areas of permanent surface water present on the site. Satellite imagery indicates some ephemeral drainage lines in the southern part of the proposed site, but these areas are only expected to contain flowing water during periods of exceptionally high rainfall. There are no significant wetlands, estuaries, Ramsar Sites or major dams present within the immediate vicinity of the study site. One seasonal pan occurs approximately 3km north of the Garona Substation and the Bokpoort I EIA indicates a 200m 'no development area' buffer demarcated around the pan. The smaller riparian systems in the region are impacted by livestock where natural habitats are grazed intensively.

The Orange River's water quality is categorised as Moderately Transformed (Class C) due to existing agricultural activities along the river banks. The Orange River's major inflow of water is from the Vaal River which has high nutrient levels which sometimes result in algal blooms. Slow water flow rates also cause siltation and turbidity of the water which leads to water quality degradation within the river.

A water pump will be installed in the Orange River to extract water for the proposed Bokpoort II development.

The area of quaternary D73D is 4291 km^2 (gross area). The area of the development is 24 km^2, 0.56% of the catchment. This indicates that area of development is small when compared to the quaternary catchment or to the water management area.

9.1 Potential Surface Water Impacts

The potential surface water impacts from the project, both direct and indirect, are summarised in Table 7. In summary these potential impacts contribute to overall surface water impacts and include:

- Change in surface water catchment areas;
- Changes in surface water quality;
- Change in surface water runoff; and
- Erosion.

The surface water quality impacts will ultimately impact on the Orange River and thus the downstream water users. The detailed impact assessment is outlined in Section 9.1.2.

Table 7: Summary of potential surface water impacts with respect to the Bokpoort Solar Development

Major aspect	Key Environmental Issues / Potential Impacts
Changes in surface water catchment areas	■ Disruption and reduction in land due to construction of solar and associated infrastructure, and roads.
Changes in surface water quality	■ Poor quality runoff from solar facility activities leaving residues on site such as lubricants used on cleaning panels left on site during storms; and ■ Possible fuel and lubricants spillage from equipment and other chemical spills.
Change in surface water runoff	■ Increased runoff due to vegetation and veld removal therefore decreasing infiltration into soil which may impact on downstream communities; ■ Increased runoff due to large concrete terraces and roads; and ■ Runoff impacts due to solar facility activities during operation and closure.
Erosion	■ Erosion on site and surrounding areas may be increased due to site clearance of vegetation and veld.

9.1.1 Impact Assessment Methodology

The significance rating process for impacts follows the established impact/risk assessment formula described in Figure 12.

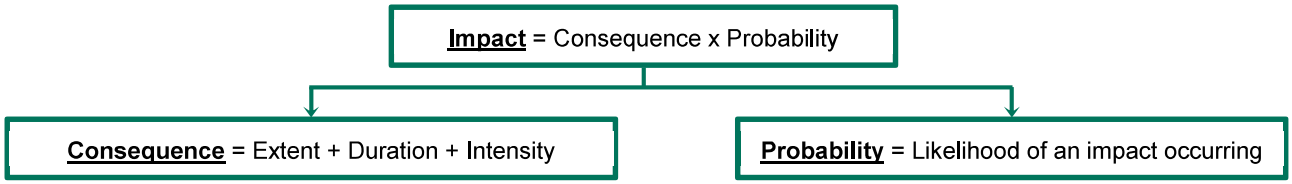


Figure 12: Impact / risk assessment formula

The significance of the impacts during the impact assessment phase was determined using the approach described in Table 8 and provides the method for defining intensity, geographic extent and duration.

Table 8: Impact assessment criteria

CRITERIA	DESCRIPTION			
EXTENT	**National (4)** The whole of South Africa	**Regional (3)** Provincial and parts of neighbouring provinces	**Local (2)** Within a radius of 2 km of the construction site	**Site (1)** Within the construction site
DURATION	**Permanent (4)** Mitigation either by man or natural process will not occur in such a way or in such a time span that the	**Long-term (3)** The impact will continue or last for the entire operational life of the development, but will be mitigated	**Medium-term (2)** The impact will last for the period of the construction phase, where after it will be entirely negated	**Short-term (1)** The impact will either disappear with mitigation or will be mitigated through natural process in a span

CRITERIA	DESCRIPTION			
	impact can be considered transient	by direct human action or by natural processes thereafter. The only class of impact which will be non-transitory		shorter than the construction phase
INTENSITY	**Very High (4)** Natural, cultural and social functions and processes are altered to extent that they permanently cease	**High (3)** Natural, cultural and social functions and processes are altered to extent that they temporarily cease	**Moderate (2)** Affected environment is altered, but natural, cultural and social functions and processes continue albeit in a modified way	**Low (1)** Impact affects the environment in such a way that natural, cultural and social functions and processes are not affected
PROBABILITY OF OCCURRENCE	**Definite (4)** Impact will certainly occur	**Highly Probable (3)** Most likely that the impact will occur	**Possible (2)** The impact may occur	**Improbable (1)** Likelihood of the impact materialising is very low

Low impact (3 - 6 points)	A low impact has no permanent impact of significance. Mitigation measures are feasible and are readily instituted as part of a standing design, construction or operating procedure.
Medium impact (7 - 9 points)	Mitigation is possible with additional design and construction inputs.
High impact (10 - 12 points)	The design of the site may be affected. Mitigation and possible remediation are needed during the construction and/or operational phases. The effects of the impact may affect the broader environment.
Very high impact (13 - 16 points)	Permanent and important impacts. The design of the site may be affected. Intensive remediation is needed during construction and/or operational phases. Any activity which results in a “very high impact” is likely to be a fatal flaw.

9.1.2 Surface Water Impacts

Table 9 sets out the detailed potential surface water impacts during construction, operation and at closure.

Table 9: Impact assessment during construction, operation and at closure

Aspect	Potential Impact	Extent	Duration	Intensity	Probability	Impact	Notes
CONSTRUCTION PHASE							
Water quality impacts due to runoff	■ Spillage of fuels, lubricants and other chemicals; and ■ Construction equipment, vehicles and temporary workshop areas will be a likely source of pollution as a non-point source. ■ Increased runoff due to vegetation and veld removal therefore decreasing infiltration into soil which may impact on downstream communities.	2	1	1	2	**8 - medium**	It is expected that without mitigation a **medium** negative impact can be expected. Mitigation will include: ■ Bunded areas to store chemicals and/or fuel; ■ Clean-up of spills as soon as they occur; and ■ Implementation of a Storm Water Management Plan (SWMP) as construction occurs. The significance of the impact after mitigation is likely to decrease to a **low** negative impact.
Decreased catchment area	Disruption and reduction in land due to construction of solar and associated infrastructure and roads.	2	2	1	1	**5 – low**	It is expected that without mitigation the impact is likely to be **low, as the percentage of the project area to the catchment is 0.56%**. Implementation of a well-designed SWMP will keep the clean water away from the project area to allow the maximum water to enter the environment, so that mitigation will reduce the impact to negligible.
Water quality impacts due to construction activities	Potential pollution transport via runoff of rainfall from disturbed areas during construction.	1	2	1	2	**8 - medium**	It is expected that without mitigation a **medium** negative impact can be expected. Mitigation will include: ■ Chemicals contained in bunded areas; ■ Spills cleaned up immediately; ■ A storm water management system that will route the clean storm water around the site Mitigation would reduce the impact to **low.**
Erosion of the watercourse	Erosion on site and surrounding areas may be increased due to site clearance of vegetation and veld.	1	1	1	1	**3 – low**	The low flow dynamics at the site will unlikely cause any surface water erosion and thus a **low** impact rating can be expected.
OPERATIONAL PHASE							
Changes in surface water quality	Potential poor quality runoff from solar panel site.	1	1	1	1	**3 – low**	Runoff from the site is expected to maintain a fair quality provided the site itself is kept in good condition.
Water quality impacts due to chemical spills/ equipment use	Spillage of fuels, lubricants and other chemicals.	2	1	1	2	**8 - medium**	It is expected that without mitigation a **medium** negative impact can be expected. Mitigation will include: ■ Clean-up of spills as soon as they occur; and ■ Maintenance of the abstraction pumps to prevent spills. The significance of the impact after mitigation is likely to decrease to a **low** negative impact.

CLOSURE PHASE							
Demolition activities	Decommissioning may leave large barren areas that may increase erosion, which might increase the amount of suspended solids in downstream surface water.	1	1	1	1	**3 – low**	The total disturbed area is relatively small and it is likely that the impact will be minimal upon closure. However, the topography of the area should be, where possible, returned to pre-construction state.

10.0 CURRENT AND FUTURE WATER REQUIREMENTS

This section summarises the current urban, industrial, agricultural and mining demands of the Lower Orange area as well as the projected future demands as determined by the Department of Water and Sanitation. During the assessment of available data, it was noted that the reports published by the Department of Water and Sanitation are dated 2014. However, the data set used for the report is based on 2013 data and is taken as the most current data available. The requirements of the Bokpoort II Solar Development project will also be described in this section.

The purpose of this section is to indicate whether there will be sufficient water supply for the proposed project.

10.1 Major Water Demands

Table 10 indicates the major water demands in the Lower Orange main stem (DWAF, 2013).

Table 10: Estimated Water Requirements of current users in the Lower Orange Main Stem (million m^3/a) (Department of Water Affairs, 2013)

Description	Area	2012	2015	2020	2025	2030	2035	2050
RSA Mining	Black Mountain Mine	1.916	13.916	13.916	13.916	13.916	13.916	13.916
RSA Mining	Alexander Bay Transhex Small Mines	5.047	5.214	2.869	3.026	3.184	3.342	3.500
RSA Urban	Prieshka Urban Demand	1.657	1.753	1.875	2.002	2.131	2.260	2.389
RSA Urban	Boegoeberg Small users	0.600	0.600	0.600	0.600	0.600	0.600	0.600
RSA Urban	Karos Geelkoppan	0.040	0.040	0.040	0.040	0.040	0.040	0.040
RSA Urban	Upington and Others	15.966	17.517	18.687	19.890	21.217	22.363	23.600
RSA Urban	Kakamas Urban Demand	2.327	2.536	2.758	2.974	3.199	3.424	3.649
RSA Urban	Pelladrift Water Board	2.035	2.078	2.118	2.163	2.209	2.255	2.302
RSA Urban	Namakwa Water Board	10.294	10.294	10.294	10.294	10.294	10.294	10.294
Namibia Mining	Haib Mine	0.000	3.000	3.000	3.000	3.000	3.000	3.000
Namibia Mining	Mines Rosh Pinah, Auchas, Skorpion	7.642	7.745	7.973	8.224	8.474	8.725	8.975
Namibia Urban	Aussenkehr Noordoewer	0.286	0.359	0.577	0.645	0.713	0.781	0.849
Namibia Urban	Urban Rosh Pinah, Skorpion, Oranjemund	8.482	8.581	8.802	8.829	8.857	8.884	8.911

10.2 New Water Users

DWS has recognised the potential for other projects in the area and have listed new projects and approved water use licenses. Table 11 represents the water requirements of new users and licenses which may impact the total water requirements in the Lower Orange Main Stem (DWAF, 2013).

Table 11: New water user requirements (million m^3/a) (Department of Water Affairs, 2013)

Project	2012	2015	2020	2025	2030
Olyvenhoutsdrift Solar park	0.01	0.249	0.488	1.716	2.907

Project	2012	2015	2020	2025	2030
(Assumed dry cooling)					
Konkoonsies Solar (License)	0.013	0.013	0.013	0.013	0.013
Aries Solar (License)	0.013	0.013	0.013	0.013	0.013
Solafrica (License)	0.875	0.875	0.875	0.875	0.875
Eskom Distribution division (License)	1.430	1.430	1.430	1.430	1.430
KaXu CSP (License)	0.011	0.011	0.011	0.011	0.011
Khi CSP (License)	0.022	0.022	0.022	0.022	0.022
Solar Capital (License)	0.028	0.028	0.028	0.028	0.028

10.3 Irrigation Water Demands

Irrigation in the Northern Cape, South Africa is considered a large consumer of the local water resources (Department of Water Affairs, 2013). Table 12 shows the total irrigation water volume estimates for the Lower Orange Catchment Management Areas. There is a base assumption that water demand for irrigation farming will not increase per annum.

Table 12: Total Irrigation Water Volume estimates (Department of Water Affairs, 2013)

Catchment	Field Requirement (million m^3/a)	Irrigated Area (ha)
Lower Orange Tributaries	19.8	1 320

10.4 Project Specific Water Demand

Once constructed, the Bokpoort II Solar Development will have specific water demands for cleaning and cooling of the proposed 150 MW CSP facility. The CSP Tower's requirements are shown in Table 13.

Table 13: 150 MW CSP Tower Facility (Bokpoort II Solar Development) Requirement

Description	Water Demand (million m^3/a)
CSP	0.25

The CSP tower facility is part of a larger proposed development project. Table 14 indicates the cumulative requirements for the entire Bokpoort II Solar Development.

Table 14: Bokpoort II Solar Development Requirements

Description	Water Demand (million m^3/a)
Bokpoort II Solar Development Requirement	0.30

10.5 Urban Return Flows

Table 15 represents the return flow for 2012. Based on the percentage return flow (DWAF, 2013) a projection was created for return flow from Upington. These estimated values are represented in Table 16.

Table 15: Main Urban Return Flows (Department of Water Affairs, 2013)

Sub System	Description	2012 Gross Demand (million m^3/a)	2012 Return Flows (million m^3/a)	Percentage Return Flow (%)
Lower Orange Main Stem	Upington	14.6	5.22	35.7

Table 16: Projected Urban return flows (million m^3/a) (DWAF, 2013).

Description	2015	2020	2025	2030	2035	2050
Upington	5.74	6.12	6.51	6.95	7.32	7.73

10.6 Environmental Flow Requirements

Environmental flow in a river is the flow required to maintain the ecosystem in a negotiated ecological condition. Environmental requirements are dependent on the natural flow generated in the upstream catchments and therefore differ from month to month and for each year. Various parties including, but not limited to, The Lesotho Highlands Development Authority (LHDA), the governments of Lesotho, South Africa, Namibia, the World Bank have agreed that environmental flows should reside between 19% and 40% of the mean annual runoff. Table 17 indicates the average runoff into the area and the environmental flow requirements.

Table 17: Environmental Requirements (Department of Water Affairs, 2013)

Description	Natural Runoff from Catchment Area (million m^3/a)	Estimated Required Environmental Flow (million m^3/a)
Lower Orange Main stem	135	25.650 – 54.000

10.7 Total Predicted Water Demand, Inflow and Water Balance

Table 18, Table 19 and Table 20 indicates the estimated total demands, estimated inflow of water into the Lower Orange WMA, and the final water balance of the known flows in the area.

Table 18: Total Predicted Water Demands on the Lower Orange WMA (Department of Water Affairs, 2013)

Description	2020 (million m^3/a)	2025 (million m^3/a)	2030 (million m^3/a)
RSA Urban industrial demands	36.4	37.9	39.6
Namibia Urban Industrial Demands	9.38	9.47	9.57
RSA Mining	16.8	16.9	17.1
Namibia Mining	10.9	11.2	11.5
Irrigation Farming	19.8	19.8	19.8
New developments	2.88	4.11	5.3
CSP	0.25	0.25	0.25
Environmental demand (Average)	39.8	39.8	39.8

Table 19: Total Return Flow to the Lower Orange WMA (Department of Water Affairs, 2013)

Description	2020 (million m^3/a)	2025 (million m^3/a)	2030 (million m^3/a)
Natural Runoff	135	135	135
Upington Return Flow	6.5	6.9	7.3

Table 20: Water Balance for the Lower Orange WMA

Description	2020 (million m^3/a)	2025 (million m^3/a)	2030 (million m^3/a)
Total Inflows	141	142	142
Total User Demands	136	140	143
Net Balance	5.2	2.4	-0.60
Net Balance with PV1 and PV2 implementation	5.2	2.3	-0.65

11.0 STORM WATER MANAGEMENT

The CSP tower facility requires a storm water management plan (SWMP) to mitigate flows to key infrastructure and to prevent clean storm water interacting with potentially polluted runoff water. There are no regulations specifically for solar power facilities giving guidance on the design criteria for sizing stormwater management infrastructure. In the absence of a specific guidelines, the mining Regulation 704 which is used in the power sector was used. Regulation 704 states that: "*every person in control of an activity must design, construct, maintain and operate any dirty water system at the activity so that it is not likely to spill into any clean water system more than once in 50 years*".

11.1 Proposed stormwater channel diversions

The proposed channel diversions are described below. The proposed region for the CSP tower facility was discretised into sub-catchments based on the topography of the region. The sub-divided catchments are shown in Figure 13.

Stormwater only diverted if required such that natural flow is not impeded unnecessarily. Key infrastructure that could generate polluted runoff was identified as the evaporation pond, local infrastructure and the onsite Eskom run substation. The evaporation pond has raised walls and stormwater runoff will flow around the evaporation pond. It was assumed that the onsite evaporation pond has been sized to retain the 1 in 50 year 24 hour storm event. The stormwater runoff being generated from the surrounding catchments will be collected, contained and diverted around the local infrastructure and substation. The locations of the channels are shown in Figure 13. The diverted water will then be discharged back into the environment which will flow naturally back to the Orange River.

- The stormwater runoff from sub-catchment S2 will be diverted away in a south westerly direction from local infrastructure by means of the channel C1;
- The stormwater runoff from sub-catchment S1 will be diverted away in a southern direction from the local infrastructure by means of the channel C2;
- The stormwater runoff from sub-catchment S3 will be diverted away in a south westerly direction from the substation by means of the channel C3;
- The stormwater runoff from sub-catchment S4 will be diverted away in a south westerly direction from the substation by means of the channel C4.

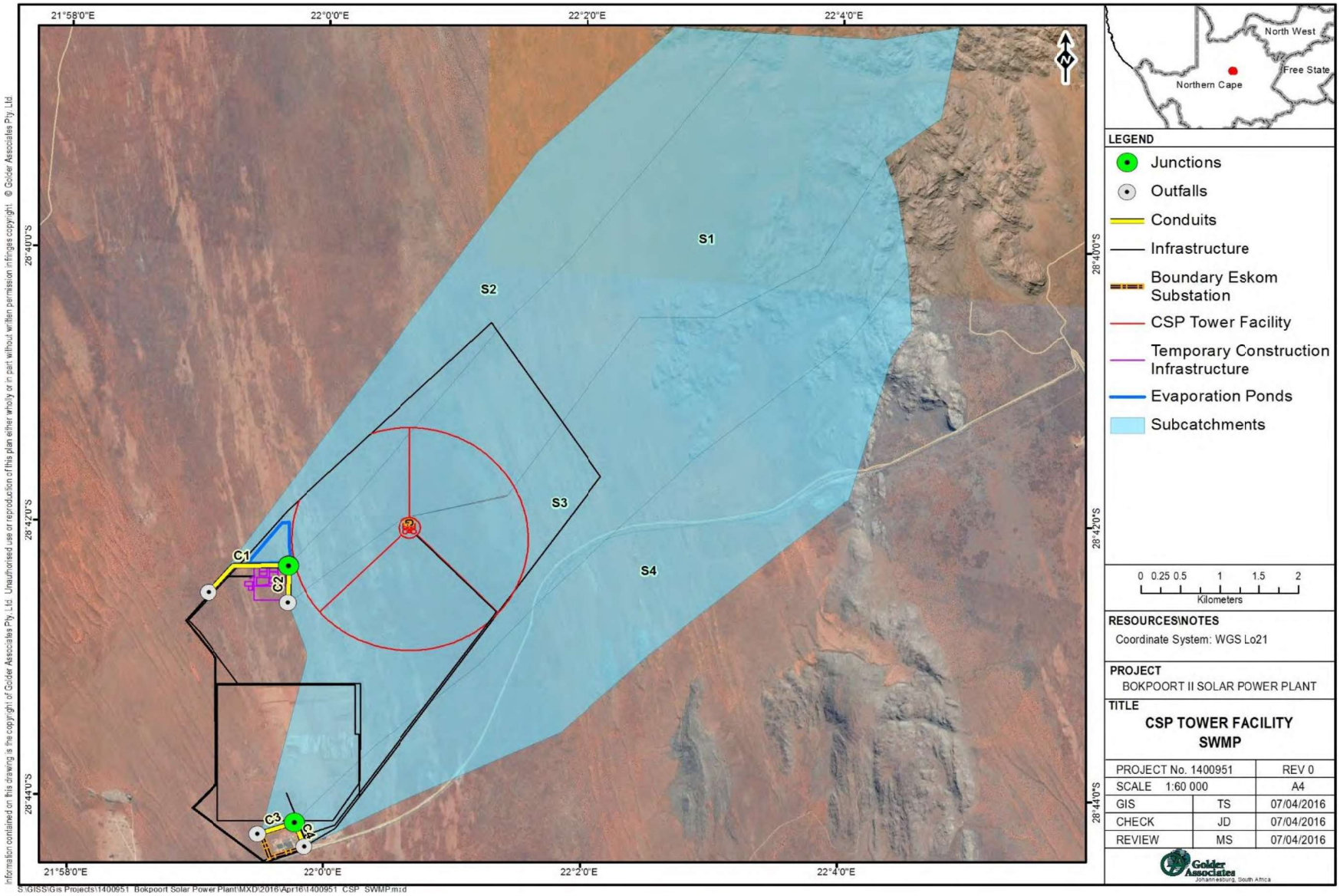


Figure 13: Proposed storm water management plan for the CSP Tower Facility

11.2 Modelling the stormwater diversion system

The PCSWMM model was used as the flood analysis model. PCSWMM is a dynamic rainfall-runoff simulation model used for single event or long-term simulation of runoff quantity (James, Rossman, & James, 2010). A model was set up for the site and the scenario described in section 11.1 was generated.

11.2.1 Sub-catchment characteristics

The parameters used to model the overland and channel flow are given in Table 21. The Manning's 'n' coefficient used in the model for the impervious areas was taken as 0.016 and the coefficient for the pervious areas was taken as 0.15. The sub-catchments soil texture were classified as sandy loam, which indicates a capillary suction of 110.1 mm and a hydraulic conductivity of 21.8 mm/h. The catchment areas and slopes together with the total runoff volume and the flood peaks for the 1:50 year 24 hour storm event are presented in Table 21.

Table 21: Catchment areas, slopes and computed runoff volumes and flood peaks for the 50 year 24 hour storm

Catchment name	Area (ha)	Slope (%)	Percentage of impervious area (%)	Total runoff volume per 24 hours (ML)	Peak Runoff (m^3/s)
S1	1671	1.63	0	22.37	5.61
S2	885	1.40	0	13.72	3.37
S3	1645	1.58	0	20.07	4.88
S4	1270	1.68	0	17.5	4.28

11.2.2 Channel characteristics

All diversion channels have been sized to convey the 50 year return period flood peak. The South African SCS 24-hour Type 3 rain gauge was associated with the rainfall on the sub-catchments (Schmidt & Schulze, 1987). The dimensions of the channels, the channel slope and the maximum velocity are listed in Table 22. Allowable freeboard standards used for channel design were: for flow less than 10 m^3/s a 0.3 m freeboard was added to the flow depth, while flows above 10m^3/s a freeboard of 0.6m was added. The channels were modelled to be earth lined channels with a Manning's 'n" coefficient of 0.03.

Table 22: Dimensions of the diversion channels required to convey the 50 year return flood peak

Channel Name	Length (m)	Cross-Section	Height (m)	Bottom width (m)	Side slopes	Channel slope (m/m)	Maximum velocity (m/s)
C1	1174	Trapezoidal	1.3	1.3	1:1.5	0.005	1.72
C2	503	Trapezoidal	1.3	1.5	1:1.5	0.008	2.16
C3	484	Trapezoidal	1.3	1.3	1:1.5	0.006	1.94
C4	354	Trapezoidal	1.3	1.3	1:1.5	0.008	2.05

11.2.3 Erosion Control

Water Affairs stipulates that necessary works must be constructed to regulate the velocities of stormwater discharge. The outlets of stormwater channels are points of erosion potential. To prevent scour at stormwater outlets, protect the out structure and minimize the potential for downstream erosion, a flow transition structure is needed to absorb the initial impact of flow and reduce the speed of flow to a non-erosive velocity.

The flow velocities associated with the 50-year storm are considered to be at the upper end of acceptability for channels C2 and C4 but no excessive erosion is foreseen. Channels should be kept free of woody vegetation and should be inspected for erosion damage periodically such that corrective measures can be taken, should high erosion damage occur.

If high erosion damage is identified, the following outlet protection devices and energy dissipaters should provide sufficient protection and should be investigated which is most appropriate:

- Rip rap outlet Basins
- Stone pitching
- Gabions

11.3 Stormwater management plan for the PV1 and PV2 implementation

The PV1 and PV2 facility will require a stormwater management plan (SWMP) should the entire Bokpoort II development be implemented. To mitigate flooding of key infrastructure and to prevent clean storm water interacting with potentially polluted runoff, diversion channels should be designed to divert the runoff back to the environment. As for the CSP, Regulation 704 has been used as a guide for sizing the channels.

No additional key infrastructure is present due to implementation of PV1 and PV2. The stormwater management plan will not to differ to the SWMP plan found in section 11.2. Figure 14 illustrates the SWMP for CSP, PV1, and PV2.

12.0 CONCLUSION

The proposed 150 MW CSP tower facility's water requirements will have a minimal impact on the total water user demands in the Lower Orange Main stem in the short to medium term (until 2025). Should the remainder of the Bokpoort II Solar Development be implemented (proposed PV1 and PV2), the total impact on water demand will remain in a similar state.

Table 20 illustrates that the projected increase in water user demands could result in the unavailability of water in the medium to long term (2030 onwards) based on gathered information from DWS (Department of Water Affairs, 2013).

A stormwater management plan was developed for the CSP tower facility to divert the 1 in 50 year storm event away from the proposed infrastructure. In order to mitigate contamination to the environment it is recommended the evaporation pond is cleaned before the rainy season such that any potential overflow from the evaporation pond will reduce contaminates to the environment

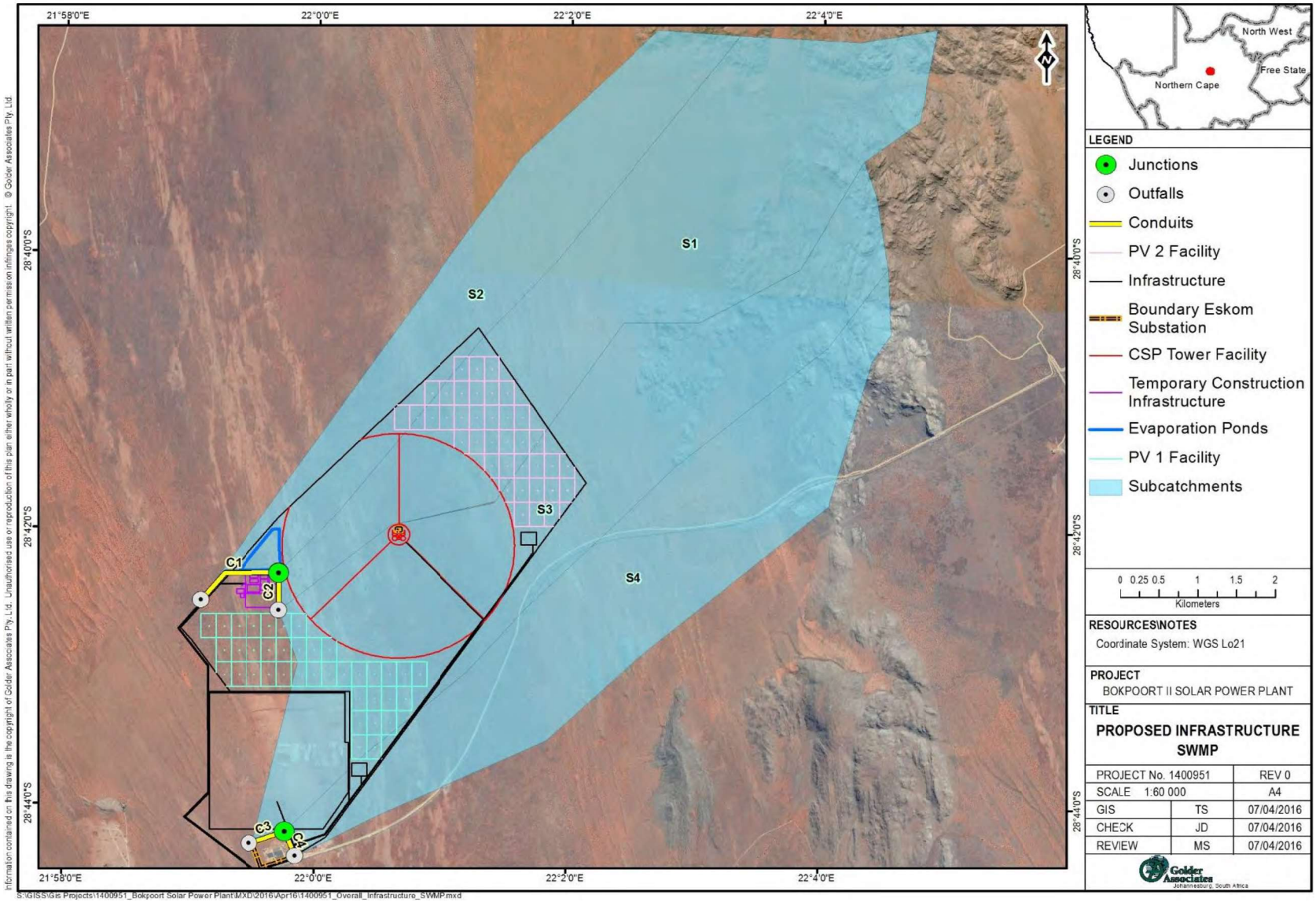


Figure 14: Stormwater management plan for CSP, PV1 and PV

.

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GOLDER ASSOCIATES AFRICA (PTY) LTD.

Jeffrey Dateling
Junior Water Resource Engineer

Lee Boyd
Water Resource Scientist

JD/LB/ck

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APPENDIX A

24 HOUR STORM RAINFALL DEPTHS STATISTICAL ANALYSIS

Table A1 shows the data used in the Reg Flood program (Alexander, et al., 2003) to produce the 24 hour rainfall depths for the 1 in 2, 1 in 10, 1 in 20, 1 in 50, 1 in 100 and 1 in 200 recurrence intervals at the D7E001 station.

Table A1: Daily recorded maximum's for every year for D7E001

Year	Daily Maximum (mm)
1930	0.3
1931	37.9
1932	17.8
1933	36.8
1934	45.5
1935	37.8
1936	27.2
1937	31.5
1938	50.8
1939	44.5
1940	71.1
1941	13.7
1942	62.2
1943	20.6
1944	27.4
1945	22.1
1946	17.3
1947	71.6
1948	39.1
1949	54.1
1950	18
1951	44.2
1952	49
1953	49
1954	57.4
1955	55.1
1956	18.5
1957	26.7
1958	36.1
1959	28.5
1960	36.1
1961	23.6
1962	29.5
1963	35.6
1964	22.1

Year	Daily Maximum (mm)
1965	24.6
1966	66.6
1967	20.1
1968	49.5
1969	73
1970	30
1971	39.5
1972	82
1973	53
1974	29
1975	45
1976	33
1977	35
1978	33
1979	28
1980	42
1981	60.5
1982	21
1983	37.5
1984	22
1985	33
1986	15
1987	28
1988	47
1989	33
1990	56
1991	42
1992	28
1993	30
1994	24
1995	38
1996	62
1997	27
1998	24
1999	80
2000	32
2001	38
2002	48

Year	Daily Maximum (mm)
2003	32
2004	64
2005	107
2006	24
2007	28
2008	22
2009	55
2010	1.5
2011	15
2012	45
2013	6
2014	55

In order to determine the likely magnitude of storm events, a statistical approach, using the Reg Flood program (Alexander, van Aswegen, & Hansford, 2003), was applied to the available recorded daily rainfall depths. The maximum 24 hour rainfall depth for each year was analysed. This method statistically analyses the maximum daily rainfall depths for each year to determine the different recurrence interval daily rainfall depths. The best fit is the Extreme Value Type 1 distribution for D7E001. Figure A1 shows Extreme Value Type 1 graph for the D7E001.

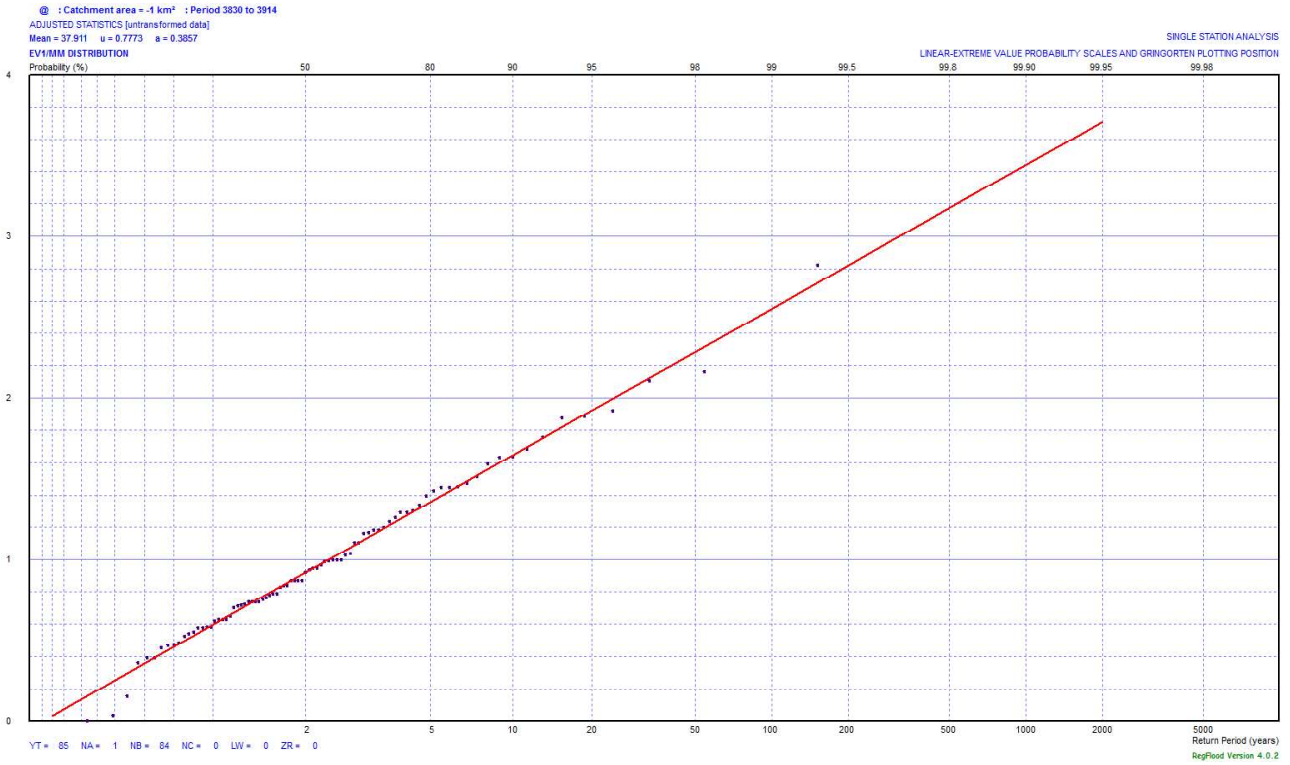

Figure A1: Extreme Value Type 1 curve for D7E001

APPENDIX B

DOCUMENT LIMITATIONS

DOCUMENT LIMITATIONS

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Peer Review - GCS

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Our Reference 19-0993-Review of Surface Water Investigation- Bokpoort II

Your Reference GCS- Review of Surface Water Investigation- Bokpoort II

Memo

To:	Royal HaskoningDHV
Attention:	Malcolm Roods
CC:	Seshni Govender, Prashika Reddy & Bongi Mdodana
Subject:	Review of Surface Water Investigation- Bokpoort II
From:	Chantelle Schmidt & Robert Verger
Date:	07/02/2020

ATTENTION: MALCOLM ROODS

REVIEW OF SURFACE WATER INVESTIGATION- BOKPOORT CSP

GCS (Pty) Ltd was appointed by Royal HaskoningDHV on behalf of ACWA Power Energy Africa (Pty) Ltd (ACWA Power) to conduct an review of the three (3) reports, compiled by Golder Associates Africa (Pty) Ltd (Golder), which form part of the environmental impact assessment (EIA) reports for the proposed Bokpoort II solar developments. The Bokpoort II: 2000MW PV Solar Power Development (the site) is located on the north-eastern portion of the remaining extent of the Farm Bokpoort 390, which is 20 km north-west of the town of Groblershoop within the Northern Cape Province. The site is within one of South Africa's eight renewable energy development zones and has therefore been identified as one of the most suitable areas in the country for renewable energy development in terms of a number of environmental impact, economic and infrastructural factors.

A strategic decision was put forward to convert the current site (which comprises of an authorised concentrated solar power (CSP) and two (2) Photovoltaic (PV) plants) into the development of ten (10) PV developments (eight (8) new PV plants and two (2) authorised PV plants) with shared infrastructure. The MW capacity of each PV Plant will be 200MW per site. A Battery Energy Storage System (BESS) will be included on all ten (10) PV sites.

This memorandum report will include a review of the provisions of the specialist studies conducted by Golder.

Project Team

The GCS staff members, along with their designation, involved in the project are listed in Table 1. The details and expertise of the specialists involved in this study along with the relevant declaration forms are attached at the end of this memorandum.

Table 1: Project team

Name	Designation
Robert Verger	Senior Water Resource Specialist
Kobus Troskie	Project Manager
Chantelle Schmidt	Hydrogeologist

Previous EIA Reports

GCS was provided with three (3) reports, compiled by Golder, which form part of the environmental impact assessment (EIA) reports for the proposed Bokpoort II solar developments. These reports included:

- Surface Water Baseline and Impact Assessment Report for the Proposed 75 MW PV 1 Solar Facility (Proposed Bokpoort II Solar Development) near Groblershoop, Northern Cape;
- Surface Water Baseline and Impact Assessment Report for the Proposed 75 MW PV 2 Solar Facility (Proposed Bokpoort II Solar Development) near Groblershoop, Northern Cape; and
- Surface Water Baseline and Impact Assessment Report for the Proposed 150 MW CSP Tower Facility (Proposed Bokpoort II Solar Development) near Groblershoop, Northern Cape.

Updated Surface Water Impact Assessment

Following the review of the three (3) above mentioned reports, it was found that the surface water impact assessment tables for the proposed 75 MW PV 1 Solar Facility, proposed 75 MW PV 2 Solar Facility and proposed 150 MW CSP Tower Facility are identical. These surface water impact assessments were also corrected after an external review was performed by Mr Bruce Randell (Ilanda Water Services cc).

Following the strategic decision to develop ten (10) PV plants each with a MW capacity of 200MW and BESS on each site the impact assessments needed to be reviewed and updated. At the time when the impact assessments were undertaken by Golder no provision was made for the inclusion of the BESS. Based on the inclusion of the BESS the following comments are made following the review of the two (2) above mentioned reports:

- The impact assessment (Table 9: Impact assessment during construction, operation and at closure) needs to make specific mention of the BESS as an aspect and as a potential impact during the operational phase; and
- The impact/ risk assessment formula will also have to be updated as the BESS combined site storage within batteries on each PV site will be 4500 m^3 of hazardous substance.
- Table 2 is the recommended amendment to be included in the impact assessment table.

Table 2: Amendment to impact assessment during construction, operation and at closure.

Aspect	Potential Impact	Extent	Duration	Intensity	Probability	Impact	Notes
OPERATIONAL PHASE							
Water quality impacts due to chemical spills/ equipment use	Spillage of fuels, lubricants and other chemicals from the BESS.	2	1	2	2	10- High Impact	It is expected that without mitigation a high negative impact can be expected. Mitigation will include: - Clean-up of spills as soon as they occur; - Maintenance of the abstraction pumps to prevent spills; -Maintenance of the BESS to ensure optimal functionality and prevent fire risks; -Maintenance and quality control of firefighting equipment and systems; and - Mitigations for spillage or leakages will include bunded areas to store chemicals and/or fuel, containerisation of the BESS and cleaning up spills as soon as they occur. The significance of the impact after mitigation is likely to decrease to a medium negative impact.

An additional alteration noted is the slight change in water demand which will be affected positively with the total demand changing to 0.22 million cubic metres per annum (Mm^3/a) (10 x 0.022 Mm^3/a) for the 10 PV solar facilities instead of the 0.3 Mm^3/a (0.25 + 2 x 0.025 Mm^3/a) for the CSP and two (2) PV solar facilities.

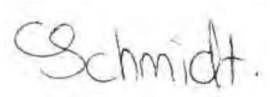
Conclusion

The significance of the impact after mitigation is likely to decrease to a medium negative impact if the proper management measures, together with site- and operational monitoring are applied.

Findings from this study conclude that the proposed Bokpoort II Development can continue as the overall accumulative risk associated with both Bokpoort I and Bokpoort II (when operational) is of medium environmental significance, from a surface water perspective, provided the proper mitigations are in place.

Please feel free to contact us if you have any questions or comments.

Yours sincerely,



_____ _____

Chantelle Schmidt
Hydrogeologist

Robert Verger
Senior Water Resource Specialist

environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

	(For official use only)
File Reference Number:	
NEAS Reference Number:	DEA/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

PROJECT TITLE

Review of Surface Water Investigation- Bokpoort II

Kindly note the following:

1. This form must always be used for applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting where this Department is the Competent Authority.
2. This form is current as of 01 September 2018. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the form have been published or produced by the Competent Authority. The latest available Departmental templates are available at https://www.environment.gov.za/documents/forms.
3. A copy of this form containing original signatures must be appended to all Draft and Final Reports submitted to the department for consideration.
4. All documentation delivered to the physical address contained in this form must be delivered during the official Departmental Officer Hours which is visible on the Departmental gate.
5. All EIA related documents (includes application forms, reports or any EIA related submissions) that are faxed; emailed; delivered to Security or placed in the Departmental Tender Box will not be accepted, only hardcopy submissions are accepted.

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Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Private Bag X447
Pretoria
0001

Physical address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Environment House
473 Steve Biko Road
Arcadia

Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at:
Email: EIAAdmin@environment.gov.za

1. SPECIALIST INFORMATION

Specialist Company Name:	GCS (PTY) Ltd			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	4	Percentage Procurement recognition	100
Specialist name:	Jakobus Troskie			
Specialist Qualifications:	BSc (Hons) Hydrogeology			
Professional affiliation/registration:	Natural Scientist S.A (Reg. No. 400218/05)			
Physical address:	63 Wessel Road, Rivonia, 2128			
Postal address:	PO Box 2597, Rivonia			
Postal code:	2128	Cell:	+27 (0) 82 336 0069	
Telephone:	+27 (0) 11 803 5726	Fax:	+27 (0) 11 803 5745	
E-mail:	Kobus@gcs-sa.biz			

2. DECLARATION BY THE SPECIALIST

I, Jacobus Troskie, declare that –

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the Specialist

GCS (PTY) Ltd

Name of Company:

30/3/2020

Date

3. UNDERTAKING UNDER OATH/ AFFIRMATION

I, Jacobus Troskie, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Signature of the Specialist

GCS (PTY) Ltd

Name of Company

30/3/2020

Date

Signature of the Commissioner of Oaths

30/3/2020

Date

I certify that the DEPONENT has acknowledged that he/she knows and understands the contents of this affidavit, that he/she does not have any objection to taking the oath, and that he she considers it to be binding on his/her conscience, and which was sworn to and signed before me

at Rivonia on this the 30 day of 3 20 20

and that the administering oath complied with the regulations contained in Goverment Gazette No. R1258 of 21 July 1972, as amended.

COMMISSIONER OF OATH
Wendy Sherm[illegible]
63 Wessel Road, Woodmead
Johannesburg

KOBUS TROSKIE

Unit Manager Water Resources

CORE SKILLS

- Project planning and management: proposal writing,
- Conceptualisation, planning, management and coordination, financials.
- Data analysis and interpretation
- Technical report writing.
- Project and staff management.

DETAILS

Qualifications

- BSc (Biochemistry, Microbiology, Ecology)
- BSc (Hons) Hydrogeology

Memberships

- Registered Natural Scientist S.A (Reg. No. 400218/05)
- Member of: Geological Society of South Africa,
- Borehole Water Association of Southern Africa,
- Landfill Interest Group - Gauteng RSA,

Languages

- English - fluent
- Afrikaans - fluent

Countries Worked In

- South Africa, Botswana, Lesotho, Swaziland, Mozambique, Malawi, Zambia, Uganda, Tanzania, Angola, Namibia, Oman, Sierra Leone, Nigeria , DRC, Madagascar,

PROFILE

Kobus is a Senior Hydrogeologist at GCS (Pty) Ltd with 16 years' experience and manages the Groundwater Resources Unit. He has had extensive experience in water supply and well field management for a variety client base from small scale irrigation to large scale wellfield supply of up to 2500 m^3/hour. His experience include characterisation of primary as well as secondary aquifers by means of hydro geophysical surveys, exploration drilling, production borehole drilling (design and implementation) groundwater resource evaluations and groundwater reserve determinations. Waste disposal site suitability studies. Groundwater monitoring programmes - design and implementation. Groundwater and aquifer assessments, management and protection plans.

Kobus has specialist skills in the following areas:

- *Aquifer Mechanics, optimum design of boreholes and wellfields.*
- *Water supply and well field management*
- *Risk assessments with regard to soil and groundwater contamination*
- *Mine dewatering studies*
- *Waste disposal site suitability studies*
- *Groundwater monitoring programmes - design and implementation*
- *Groundwater and aquifer assessments, management and protection plan*
- *Aquifer Mechanics, optimum design of boreholes and wellfields.*

Previous Work Experience

SPECIFIC EXPERIENCE IN GROUNDWATER RESOURCES (Selective Projects a detailed project list can be made available upon request)

- Moatize Alluvial Aquifer Assessment: 2012/18 Characterization and development of an alluvial aquifer for large scale groundwater abstraction. The hydrogeological studies comprised of, Electrical resistivity geophysical surveys, exploration borehole drilling, abstraction scenario modeling and feasibility of the demand.
- Moatize Alluvial Aquifer Assessment: 2018 Remediation of production borehole within an alluvial aquifer associated with the Revubue river, the remediation included both physical and chemical treatment and resulted in a 60-85% yield recovery upon completion of the remediation.
- Steynsrus water supply (2015 - 2016): the study involved groundwater resource assessments verification of the water demand, geophysical surveys, drilling and construction of production boreholes, groundwater resource evaluations, wellfield monitoring and management plans
- Lekubu Village Water Supply (2009- 2013): Development of a water supply for a rural village in the north west, the study included verification of the water demand, geophysical surveys, drilling and construction of production boreholes, groundwater resource evaluations, wellfield monitoring and management plans
- Nestle Waters / Clover Water (2006 - 2016): Development and management of sustainable water resources over a period of 10 years, the studies involved geophysical investigations, equipping the resource, drilling testing and pump supply, management and recommendations and the Water Use License Application
- Tsitsikama Crystal Springs (2015): Development and management of sustainable water resources, the studies involved geophysical investigations, equipping the resource, drilling testing and pump supply, management and recommendations and the Water Use License Application
- McCain Foods (2013-2018): Development and management of sustainable water resources the studies involved geophysical investigations, equipping the resource, drilling testing and pump supply, management and recommendations and the Water Use License Application
- Big Concessions Agriculture: Characterization and development of a Carbonate Rock aquifer for large scale groundwater abstraction for development. The hydrogeological studies comprised of: geophysical investigations, exploration

borehole drilling, aquifer development and abstraction scenario modeling and feasibility of the demand.

- Lesotho 2004 – 2009 - Groundwater resource assessment on the Six Towns Study European Union Project Ref nr. 8.ACP.LSO 017- Teyateyaneng, Roma, Morija, Mapoteng, Maputsoe, Quthing
- Zambia, 2006 - Groundwater resource assessment, Scientific siting of drilling targets, Borehole design and construction, Aquifer testing, Hydrochemical analysis, Management options
- RSA 2006 – 2007 - Development and implementation of Sanitation Protocol
- RSA 2006 - Contamination studies for on-site sanitation
- MOZAMBIQUE 2003 - Nampula, Niassa: Water Supply investigation: The project involved water supply in villages in Nampula, Niassa, and Cappo Delgado provinces of Northern Mozambique.
- RSA 2007 – 2008, GRIP Eastern Cape Project
- RSA 2002 – 2019 - Drilling supervision, Boreholes design, Alluvial aquifers, Well field design and management for a large variety client base.

SPECIFIC EXPERIENCE IN THE MINING INDUSTRY

- ZAMBIA, 2009 – Mine Dewatering assessment of a Gold Mine
- RSA, 2008 - 2009 - EIA Application for various Gold Heap leach Pad sites, Groundwater impact assessments, site selection from a groundwater perspective.
- MALAWI, 2006 - Kayelekera Uranium Project: The project involved Geophysical investigations, designing a monitoring network, drilling supervision and Aquifer test supervision. The report compilation included commenting on catchment characteristics, identification of hydrogeological units from previous studies and borehole logs, Assess the aquifer (s) surrounding the proposed surface mine. Determine the impact of mine infrastructure including, waste rock dumps, tailings storage facilities, open pit mining on the regional aquifer (s).
- RSA, 2005 - 2006 - Six-month secondment to Anglo Gold Ashanti in Vaal Reefs, position held Senior Environmental Coordinator Lesotho, Swaziland, Mozambique, Malawi, Zambia, Tanzania, Angola, Namibia, Oman, Sierra Leonetor – Hydrogeologist. Responsibilities included management of the groundwater as part of the water unit for the Vaal Reefs, West Wits, and Ergo mining operations.
- RSA, 2003 - 2010 - Data collection, data analysis and report writing for the groundwater sections, and surface water quality of environmental management

program reports (EMPRs), for various types of mines, including: coal, gold, platinum, nickel, uranium mines.

- RSA, 2001 - 2005 - Groundwater monitoring and audit reports. The evaluation of groundwater level fluctuation and hydrochemical data and the compilation of monthly, quarterly and annual monitoring reports.
- RSA, 2006 - Site suitability studies and designing a monitoring network for permit application and closure of a Ash Disposal Facility (Rand Water)

PROFESSIONAL EXPERIENCE - IMPACT AND AUDITING STUDIES

- Tanzania 2012 - (Senior hydrogeologist) - Due Diligence Study - Organic contaminants, ESA reports phase I/II (2 sites).
- RSA 2012 (Project Manager) (Confidential Client) in-situ remediation of a hydrocarbon contaminated site.
- RSA 2012 (Project Manager) (Confidential Client) in-situ remediation of a hydrocarbon contaminated site.
- Zambia 2012 - (Senior hydrogeologist) - Due Diligence Study - Organic contaminants, ESA reports phase I/II (2 sites).
- RSA SASOL 2011- (Senior hydrogeologist) Phase I Hydrocarbon Site Characterisations and risk assessment of 130 fuel stations across South Africa.
- Sasol: Groundwater & Soil Contamination Study.
- RSA, 2011 (Phase I / 2 Hydrocarbon Site Characterization and risk assessment of 70 sites within Gauteng Province.
- RSA, 2011 - (Senior hydrogeologist) - Thabazimbi Hydrocarbon Assessment: Field work, data compilation, data interpretation, RBCA.
- RSA, February 2010 (Senior hydrogeologist) - Due Diligence Study - Organic contaminants, ESA reports phase I/II (2 sites).
- RSA, September 2009 (Project hydrogeologist) - Due Diligence Study - Organic contaminants ESA reports phase I/II (4 sites).
- RSA, September 2009 (Project hydrogeologist) - Organic contaminants, Due Diligence Study, Water quality objectives and sign off from DWAF.

- NIGERIA, September 2009 (Project hydrogeologist) - Due Diligence Study - Organic contaminants, ESA reports phase I/II.

- NIGERIA, March 2008 (Project hydrogeologist) - Due Diligence Study - Organic contaminants, ESA reports phase I/II.
- RSA, November 2007 (Project hydrogeologist) - Due Diligence Study - Organic contaminants, ESA reports phase I/II.
- RSA, October 2007 (Project hydrogeologist) - Due Diligence Study - Organic contaminants, ESA reports phase I/II.
- RSA, July 2007 (Project hydrogeologist) - Due Diligence Study, ESA reports phase I/II.
- RSA, March 2007 (Project hydrogeologist) - Organic contamination, remediation, monitoring.
- RSA, March 2007 (Project hydrogeologist) - Organic contamination, soil and water study.
- ZAMBIA, 2006 (Project hydrogeologist) - Site selection and feasibility study - Livingstone, Zambia.
- RSA, 2005 (Hydrogeologist) - Site suitability study, permit application for an Ash Disposal Facility.
- RSA, 2006 (Hydrogeologist) - Contamination studies for on-site sanitation.
- MOZAMBIQUE, 2004 (Hydrogeologist) - Temane CPF, Villunkolos Mozambique: The project involved Geophysical investigations, designing a monitoring network, drilling supervision and Aquifer test supervision.
- MOZAMBIQUE, 2003 (Hydrogeologist) - Mozal Mozambique, the project involved monitoring and evaluation of onsite conditions to a hazardous waste disposal site.

DECLARATION

I, Kobus Troskie hereby declare that the details furnished above are true and correct to the best of my knowledge and belief and I undertake to inform you of any changes therein, immediately. In case any of the above information is found to be false or untrue or misleading or misrepresenting, I am aware that I may be held liable for it.

Signature:  Date: 31/01/2019

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

	(For official use only)
File Reference Number:	
NEAS Reference Number:	DEA/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

PROJECT TITLE

Review of Surface Water Investigation- Bokpoort II

Kindly note the following:

1. This form must always be used for applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting where this Department is the Competent Authority.
2. This form is current as of 01 September 2018. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the form have been published or produced by the Competent Authority. The latest available Departmental templates are available at https://www.environment.gov.za/documents/forms.
3. A copy of this form containing original signatures must be appended to all Draft and Final Reports submitted to the department for consideration.
4. All documentation delivered to the physical address contained in this form must be delivered during the official Departmental Officer Hours which is visible on the Departmental gate.
5. All EIA related documents (includes application forms, reports or any EIA related submissions) that are faxed; emailed; delivered to Security or placed in the Departmental Tender Box will not be accepted, only hardcopy submissions are accepted.

Departmental Details

Postal address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Private Bag X447
Pretoria
0001

Physical address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Environment House
473 Steve Biko Road
Arcadia

Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at:
Email: EIAAdmin@environment.gov.za

1. SPECIALIST INFORMATION

Specialist Company Name:	GCS (PTY) Ltd			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	4	Percentage Procurement recognition	100
Specialist name:	Robert Verger			
Specialist Qualifications:	B.Sc/M.Sc. Programme Civil Engineering & Management: Water Engineering & Management			
Professional affiliation/registration:	Registered Natural Scientist S.A (Reg. No 400218/15)			
Physical address:	63 Wessel Road, Rivonia, 2128			
Postal address:	PO Box 2567, Rivonia			
Postal code:	2128	Cell:	+27 (0) 76 730 9046	
Telephone:	+27 (0) 11 803 5726	Fax:	+27 (0) 11 803 5745	
E-mail:	robertv@gcs-sa.biz			

2. DECLARATION BY THE SPECIALIST

I, Robert Verger, declare that

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the Specialist

GCS (PTY) Ltd

Name of Company:

08/05/2020

Date

3. UNDERTAKING UNDER OATH/ AFFIRMATION

I, Robert Verger, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Signature of the Specialist

GCS (PTY) Ltd

Name of Company

08/05/2020

Date

Signature of the Commissioner of Oaths

8/5/2020

Date

I certify that the DEPONENT has acknowledged that he/she knows and understands the contents of this affidavit, that he/she does not have any objection to taking the oath, and that he/she considers it to be binding on his/her conscience, and which was sworn to and signed before me

at Rivonia on this the 8 day of May 2020 and that the administering oath complied with the regulations contained in Goverment Gazette No. R1258 of 21 July 1972, as amended.

COMMISSIONER OF OATHS (RSA)
Wendy Sherriff CA(SA)
63 Wessel Road, Woodmead
Johannesburg

ROBERT VERGER

Surface Water Unit Manager

CORE SKILLS

- Water Resource Management
- Hydrological Assessment
- Water Balance Modelling
- Flood Line Modelling
- Storm Water Management Planning
- Water Availability Research

DETAILS

Qualifications

- B.Sc/M.Sc. Programme Civil Engineering & Management: Water Engineering & Management, University of Twente, Enschede, The Netherlands, 2008

Memberships

- Registered Natural Scientist S.A (Reg. No 400218/15)
- Water Institute South Africa (WISA) (Member: 32144)
- IWA – International Water Association (Member: 1612320).

Languages

- Dutch - Native
- English – Fluent
- French – Intermediate fluency in reading, and elementary conversation
- German - Intermediate fluency in reading, and elementary conversation
- Afrikaans - Basic

Countries Worked In

- Belgium, Botswana, Democratic Republic of Congo, Gabon, Laos, Madagascar, Malawi, Mozambique, The Netherlands, Nigeria, South Africa, Timor Leste, USA, Zambia

PROFILE

Robert Verger is a Senior Water Resource Specialist (MSc) with GCS in Pretoria. He has 9.5 years' work experience specialising in engineering-related surface and groundwater studies. He has been mainly involved in consultancies, initially in the Netherlands and currently in South Africa. Robert has worked in 14 countries in the fields of water resources management including hydrological modelling, water and mining-related investigations and flood estimation studies.

Robert is currently the Surface Water Unit Manager within GCS and has specialist skills in the following areas:

- Water Related Feasibility Studies and Environmental Impact Assessments (EIA);
- Climatic Studies;
- Integrated and Sustainable (Mine) Water Management;
- Water Conservation and Demand Management;
- Water Availability Assessments;
- Stormwater Management;
- Hydrological Modelling; and
- Flood risk modelling and drought planning.

Year	Client	Project Description	Role/Responsibility
2007-2008	University of Hawai'i at Manoa	Hawai'i's Vanishing Streamflows, HI, USA	Research Assistant: Participation in a case/field study in Makaha Valley to determine the impact of groundwater pumping on the Makaha Streamflow. This research was part of the MSc thesis.
2008	Triangle Génération Humanitaire	Water and sanitation for internally displaced people in transitional housing sites, East Timor	Assistant project manager Water & Sanitation Offering emergency relief to people impacted by the crisis in Timor-Leste. This implies providing safe and reliable water and sanitation (WatSan) services to internally displaced populations (IDPs) living in transitional shelter sites.
2009-2010	Dienst Landelijk Gebied	Enviromental Impact Assessment 'Room for the River' at Millingerwaard, The Netherlands	Hydrogeologist/ Groundwater specialist: This EIA groundwater study was to model hydrogeological effects of extra floodplain excavations on the surrounding groundwater levels.
2011	Waterboard De Dommel	Water system analysis - Boven-Dommel, The Netherlands	Surface Water specialist Determining suitable water storage areas to prevent urban flooding in Eindhoven.
2011	Water Supply Agency Limburg (WML)	EIA Heel, Drinking Water Supply Backup, The Netherlands	Hydrogeologist/ Groundwater specialist: This EIA groundwater study was to model hydrogeological effects of a new drinking water well on the surrounding groundwater levels
2011	Brussels Environmental Institute (BIM)	Surface Water Modelling of the Neerpedebeek, Belgium	Hydrologist/ modeller: Constructing a new 2d-hydraulic model of the Neerpede stream (Brussels) and to model historical floods and define scenarios for mitigating floods.
2012	Two Rivers Platinum	Specialist study groundwater for an EIA, South Africa	Hydrogeologist/modeller
2013	The Namibian Ministry of Trade and Industry	Surface Water Assessment for the Namibia Trade and Industrial Estate in Lubumbashi, Democratic Republic of Congo	Leading hydrologist undertaking the hydrological assessment.
2014	Environmental Impact Management Services (Pty) Ltd	Surface Water Specialist Assessment for the Leiden Colliery, South Africa	Surface water specialist
2014	Tenova Bateman	Hydrology Study for the AEMR Project Area 5 (Pre-Feasibility Study), Angola	Water resource specialist undertaking the dynamic water balance which confirmed raw water supply
2014-2015	Arup Consulting	Pre-Feasibility Study (PFS) of the Grootegeluk Coal Mine, South Africa	Project manager and water resource specialist confirming dewatering requirements, water related infrastructure and confirmation of raw water supply as part of a BFS.
2014-2015	DRA Projects	Water section of the Molo Graphite Feasibility Study (FS), Madagascar	Water resource specialist confirming raw water supply, water related infrastructure requirements and stormwater management plan (SWMP) as part of the FS.
2015	DRA Projects	Morupule Unit 5&6 Coal Supply Project Pre-Feasibility Study (PFS), Botswana	GCS project manager and water resource specialist confirming raw water supply, water related infrastructure requirements and stormwater management plan (SWMP of the proposed developments as part of the PFS.

Year	Client	Project Description	Role/Responsibility
2016	Makhaotse, Narasimulu & Associates	Charlestown Bulk Services Hydrological Study	Water resource specialist and project manager - hydrological assessment to review shortlisted water supply options for the Charlestown Bulk Water Supply options and to determine the most appropriate water supply option to meet a water demand of 5 Ml/day and 10 Ml/day.
2016-2017	Exxaro Coal	Input into Final Design of the Belfast Implementation (BIP) Project	Mine water balance specialist developing a detailed mine water balance that is used to confirm overall dewatering requirements and raw water supply of the BIP.
2016-2017	DRA Projects	Morupule Unit 5&6 Coal Supply Project Bankable Feasibility Study (BFS), Botswana	GCS project manager and water resources specialist confirming raw water supply, water related infrastructure requirements and stormwater management plan (SWMP of the proposed developments as part of the BFS.
2017	DRA Projects	Morupule Unit 5&6 Coal Supply Project FEED Phase, Botswana	GCS project manager and water resource specialist confirming raw water, water related infrastructure requirements and stormwater management plan (SWMP) of the proposed developments as part of the FEED Phase.
2016-current	Eurasian Resources Group (ERG)	Comide Feasibility Study & ESIA: Hydrology and Hydrogeology, Democratic Republic of Congo	Senior water resources specialist confirming and designing open pit dewatering requirements, water related infrastructure, stormwater management plan (SWMP) and confirmation of raw water supply as part of a BFS. As part of the ESIA this also included baseline hydrology, water quality assessment and impact assessment determination.
2017-current	Enviro-Insight	Majama Zyn Koppies Coal Mine Environment Impact Assessment (EIA)	GCS project manager and hydrologist undertaking the hydrological assessment as part of an EIA
2018	Paladin Energy	Kayelekera Mine - Water Management Closure Assessment	Water management specialist providing a water management road map to a Strategic Closure and Rehabilitation Plan for the Kayelekara Mine
2018-current	ENRC	Chitima Integrated Coal Power Project - Environmental and Social Impact Assessment (ESIA)	Senior water resources specialist as part of the ESIA this also included baseline hydrology, water quality assessment and impact assessment determination.
2018-current	Agri-Africa Consultants	Pre-Feasibility Water Availability Assessment for Four (4) River Basin Development Authorities (RBDAs) in Nigeria	Water resource specialist responsible for the surface water component. Projects that are chosen comprised agricultural (irrigation), hydropower and municipality water demands
2018	First Quantum Minerals	Bwana Mkubwa Operation: Tailings Storage Facility (TSF) Water Balance and Seepage Investigation	Senior water resources specialist developing a detailed TSF water balance to determine post closure seepage rates

DECLARATION

I, Robert Verger hereby declare that the details furnished above are true and correct to the best of my knowledge and belief and I undertake to inform you of any changes therein, immediately. In case any of the above information is found to be false or untrue or misleading or misrepresenting, I am aware that I may be held liable for it.

Signature: _____ Date: 31/01/2019

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

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PROJECT TITLE

Review of Surface Water Investigation- Bokpoort II

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Departmental Details

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Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Private Bag X447
Pretoria
0001

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Attention: Chief Director: Integrated Environmental Authorisations
Environment House
473 Steve Biko Road
Arcadia

Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at:
Email: EIAAdmin@environment.gov.za

1. SPECIALIST INFORMATION

Specialist Company Name:	GCS (PTY) Ltd			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	4	Percentage Procurement recognition	100
Specialist name:	Chantelle Schmidt			
Specialist Qualifications:	B.Sc (Hons) Hydrogeology			
Professional affiliation/registration:	Registered Candidate Natural Scientist SACNASP (Reg. No 118749)			
Physical address:	63 Wessel Road, Rivonia, 2128			
Postal address:	PO Box 2567, Rivonia			
Postal code:	2128	Cell:	+27 (0) 61 454 3396	
Telephone:	+27 (0) 11 803 5726	Fax:	+27 (0) 11 803 5745	
E-mail:	chantelles@gcs-sa.biz			

2. DECLARATION BY THE SPECIALIST

I, Chantelle Schmidt, declare that

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

C Schmidt.

Signature of the Specialist

GCS (PTY) Ltd

Name of Company:

08/05/2020

Date

3. UNDERTAKING UNDER OATH/ AFFIRMATION

I, Chantelle Schmidt, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

CSchmidt

Signature of the Specialist

GCS (PTY) Ltd

Name of Company

08/05/2020

Date

Signature of the Commissioner of Oaths

8/5/2020

Date

I certify that the DEPONENT has acknowledged that he/she knows and understands the contents of this affidavit, that he/she does not have any objection to taking the oath, and that he/she considers it to be binding on his/her conscience, and which was sworn to and signed before me

at Rivonia on this the 8 day of 5 2020 and that the administering oath complied with the regulations contained in Goverment Gazette No. R1258 of 21 July 1972, as amended.

COMMISSIONER OF OATHS (RSA)
Wendy Sherriff CA(SA)
63 Wessel Road, Woodmead
Johannesburg

Chantelle Schmidt

Hydrogeologist

CORE SKILLS

- Groundwater quality monitoring
- Groundwater impact assessments
- Hydrogeological field investigations
- Project management
- Technical report writing

DETAILS

Qualifications

- B.Sc (Hons) Hydrogeology

Memberships

- Registered Candidate Natural Scientist SACNASP (reg. no. 118749)
- Groundwater Division (GWD) of the Geological Society of South Africa (GSSA)
- Affiliated Member of South African Institute for Engineering and Environmental Geologists (SAIEG)

Languages

- English - Fluent
- Afrikaans - Fluent

Countries Worked In

- South Africa, Lesotho

PROFILE

Chantelle Schmidt is a Hydrogeologist and Candidate Natural Scientist in the field of practice Earth Science with GCS in Pretoria. She has 3 **years'** work experience specialising in surface and groundwater quality monitoring and hydrogeological risk assessments.

Chantelle has specialist skills in the following areas:

- Water quality assessment
- Data collection and analysis
- Writing and reviewing of technical reports
- Design and management of groundwater monitoring networks
- Hydrogeological impact assessments
- Rapid groundwater reserve determination and catchment delineation
- Hydrocensus, borehole drilling supervision and surface geophysical investigation
- Groundwater availability studies
- Project management and acquisition