Basic Assessment for the proposed development of a 115 MW Solar Photovoltaic Facility (Vryburg Solar 2) and associated electrical infrastructure near Vryburg in the North West Province: DRAFT BASIC ASSESSMENT REPORT

APPENDIX D: SPECIALIST REPORTS (incl. TORs)

Soils and agriculture (Johann Lanz)

Ecological Assessment (terrestrial and aquatic) (Reinier Terblanche)

Avifauna (Chris van Rooyen)

Heritage (Dr Johnny van Schalkwyk)

Palaeontology (Dr Francois Durand)

Social Impact Assessment (Rudolph du Toit)

Visual Impact Assessment (Henry Holland)

Traffic Statement (Surina Laurie)

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SOIL AND AGRICULTURAL IMPACT ASSESSMENT:

Basic Assessment for the proposed construction of the Vryburg Solar 2 Photovoltaic (PV) Facility and associated electrical infrastructure, near Vryburg, in the North-West Province

Report prepared for:
CSIR – Environmental Management Services
PO Box 320
Stellenbosch
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Report prepared by:
Johann Lanz – Soil Scientist (Pr.Sci.Nat.)
P.O. Box 6209
Stellenbosch, 7599
South Africa

16 July 2018

Johann Lanz
Curriculum Vitae

Education

M.Sc. (Environmental Geochemistry)	University of Cape Town	1996 - June 1999
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:

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: Aurecon; CSIR; SiVEST; SRK Consulting; Juwi Renewable Energies; Mainstream Renewable Power; Subsolar; Tiptrans; Planscape; Afrimat; Savannah Environmental; Red Cap Investments; MBB Consulting Engineers; Enviroworks; Haw & Inglis.

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; Vogelfontein Citrus; De Grendel Estate; Zewenwacht Wine Estate; Goedgedacht Olives;, Lourensford Fruit Company; Kaarsten Boerdery; Wedderwill Estate; Thelema Mountain Vineyards; Rudera Wines; Flagstone Wines; Solms Delta Wines; Dornier Wines.

I have conducted several research projects focused on conservation farming, soil health and carbon sequestration.

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.

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*.

SPECIALIST DECLARATION

I, Johann Lanz, as the appointed independent specialist, in terms of the 2014 EIA Regulations, hereby declare that I:

- I act as the independent specialist in this application;
- I 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;
- regard the information contained in this report as it relates to my specialist input/study to be true and correct, and do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act;
- 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 have no vested interest in the proposed activity proceeding;
- 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;
- I have ensured that information containing all relevant facts in respect of the specialist input/study was distributed or made available to interested and affected parties and the public and that participation by interested and affected parties was facilitated in such a manner that all interested and affected parties were provided with a reasonable opportunity to participate and to provide comments on the specialist input/study;
- I have ensured that the comments of all interested and affected parties on the specialist input/study were considered, recorded and submitted to the competent authority in respect of the application;
- all the particulars furnished by me in this specialist input/study 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.

Name of Specialist: Johann Lanz

Signature of the specialist:

Date: 16 July 2018

EXECUTIVE SUMMARY

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 crop production. This assessment has found that the proposed development is on land which is of low agricultural potential and is unsuitable for cultivation.

The key findings of this study are:

- Soils of the proposed development site are predominantly very shallow, sandy soils on underlying hardpan carbonate, classified as Coega and Gamoep soil forms.
- The proposed development site is classified with a predominant land capability evaluation value of 6, which is low to moderate.
- The limitations to land capability are the limited climatic moisture availability and the shallow soils.
- As a result of these limitations, the study area is unsuitable for cultivation and agricultural land use is limited to grazing.
- There are no agriculturally sensitive areas and no parts of the site need to be avoided by the development.
- The significance of all agricultural impacts is kept low by the fact that the proposed site is on land of limited agricultural potential.
- 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 development footprint;
    - Soil degradation resulting from erosion and topsoil loss.
- One potential positive impact of the development on agricultural resources and productivity was identified as:
    - Generation of alternative / additional land use income through the energy facility, which will improve cash flow and financial sustainability of farming enterprises on site.
- All impacts were assessed as having low or very low significance.
- Cumulative impact is also assessed as low, predominantly because of the low agricultural potential of the area. The development is located within a REDZ which has been declared precisely because it is an environment that can accommodate numerous renewable energy developments without exceeding acceptable levels of agricultural land use loss.
- Recommended mitigation measures include implementation of an effective system of storm water run-off control; the maintenance of vegetation cover to mitigate erosion; and topsoil stripping, stockpiling and re-spreading to mitigate loss of topsoil on disturbed areas.
- Due to the low agricultural potential of the site, and the consequent low agricultural impact,

there are no restrictions relating to agriculture which preclude authorisation of the proposed development and 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.
- The overall significance of the impact on agriculture for the construction, operation and decommissioning phase is assessed as **low to very low** (with mitigation actions applied effectively).

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Table 1: Compliance with the Appendix 6 of the 2014 EIA Regulations (as Amended)

Requirements of Appendix 6 – GN R326 EIA Regulations 7 April 2017	**Addressed in the Specialist Report**
1. (1) A specialist report prepared in terms of these Regulations must contain- a) 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;	Title page CV in the beginning of report
b) 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;	Section 1.1 & 1.2
(cA) an indication of the quality and age of base data used for the specialist report;	Section 2.1
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 4.5,4.6 & 6.4
d) the date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 1.3
e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 2
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 4.8
g) an identification of any areas to be avoided, including buffers;	Section 4.8
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 2.2
j) a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Section 6
k) any mitigation measures for inclusion in the EMPr;	Section 9
l) any conditions for inclusion in the environmental authorisation;	Section 11.1
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 9
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 11 Section 11 Section 9
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	Section 2.3

1 Introduction

1.1 Scope and objectives

This report presents the Soil and Agricultural Impact Assessment undertaken by Johann Lanz (an independent consultant), appointment by the CSIR, as part of the Basic Assessment (BA) Process for the proposed construction of the Vryburg Solar Photovoltaic Facilities, in the North-West Province. (see Figure 1.)

The objectives of the study are to identify and assess all potential impacts of the proposed development on agricultural resources including soils and agricultural production potential, and to provide recommended mitigation measures, monitoring requirements, and rehabilitation guidelines for all identified potential impacts.

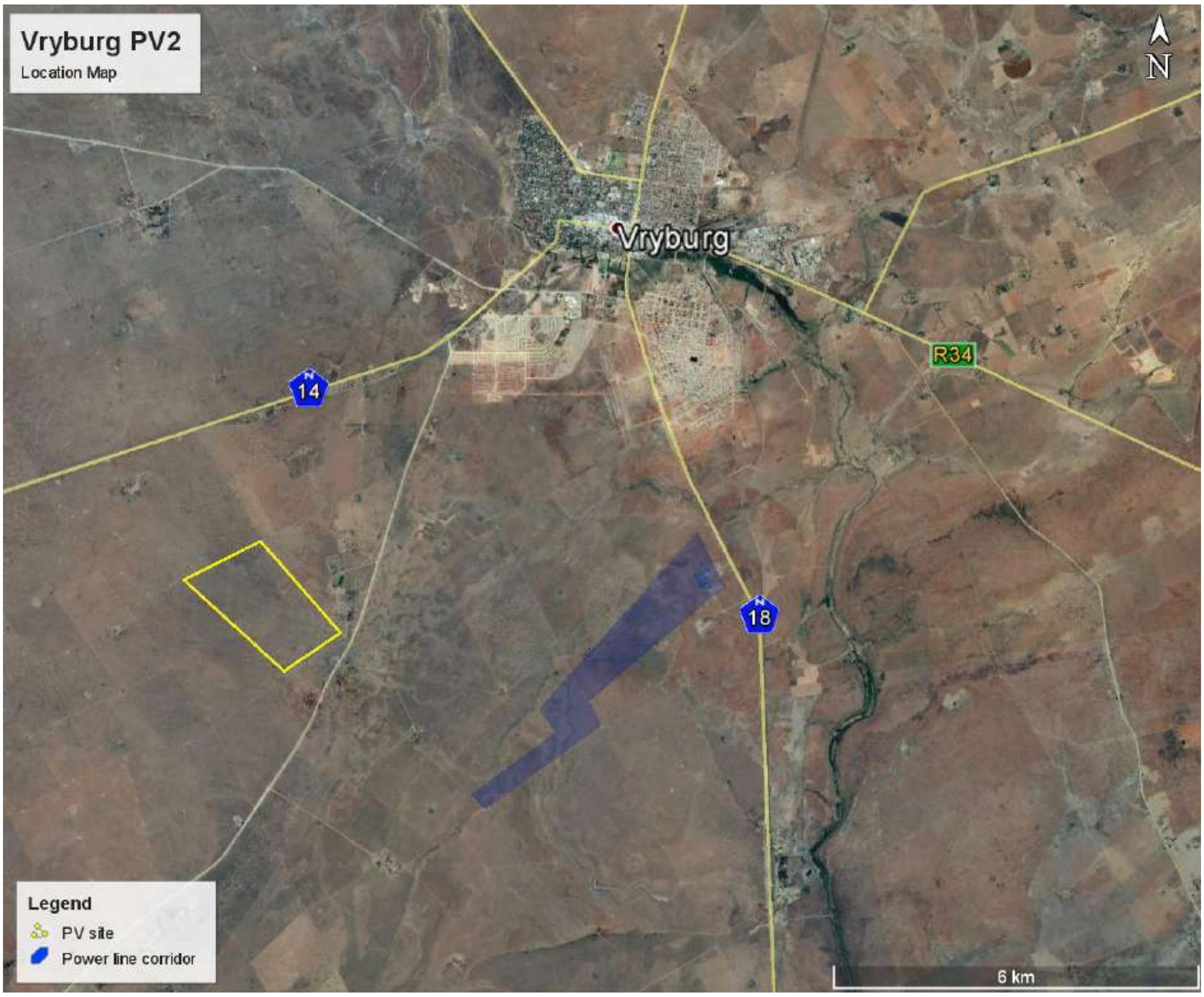

Figure 1: Location of the proposed Vryburg Solar 2 facility, south-west of Vryburg in the Northwest Province

1.2 Terms of Reference

The following terms of reference apply to this study:

- Describe the existing environment in terms of soils, geology, land-use and agricultural potential. Significant soils and agricultural features or disturbances should be identified, as well as sensitive features and receptors within the project area. The description must include surrounding agricultural land uses and activities, to convey the local agricultural context.
- Describe and map soil types (soil forms), soil characteristics (soil depth, soil colour, limiting factors, and clay content of the top and sub soil layers), and degradation and erodibility of soils etc to the extent necessary to inform this assessment.
- Varying sensitivities of the soils and agricultural potential must be mapped and highlighted.
- The assessment is to be based on existing information, findings of the Wind & Solar PV SEA for the Vryburg REDZ (CSIR, 2015), and professional experience and field work conducted by the specialist, as considered necessary and in accordance with relevant legislated requirements.
- Identify and assess the potential impacts of the proposed development on soils and agriculture, including impacts of associated infrastructure, such as the buildings, fencing etc.
- Identify any protocols, legal and permit requirements relating to soil and agricultural potential impacts that are relevant to this project and the implications thereof.
- The report needs to fulfil the terms of reference for an agricultural study as set out in the National Department of Agriculture's document, Regulations for the evaluation and review of applications pertaining to renewable energy on agricultural land, dated September 2011, with an appropriate level of detail for the agricultural suitability and soil variation on site (which may therefore be less than the standardised level of detail stipulated in the above regulations).

The study applies an appropriate level of detail for the agricultural suitability on site and for the level of impact of the proposed development on agricultural land. A detailed soil survey, as per the requirement in the above document, is appropriate for a significant footprint of impact on arable land. It is not appropriate for this site, where soil and climate constraints make cultivation completely non-viable. Conducting a soil survey at the required level of detail would be very time consuming but would also be unnecessary as it would add no value to the impact assessment. The level of soil assessment that was conducted for this report (reconnaissance ground proofing of land type data) is considered more than adequate for a thorough assessment of all agricultural impacts.

1.3 Assessment details

Type of Specialist Investigation	Soil and agricultural impact assessment
Date and Duration of Specialist Site Investigation	3 October 2016, 1 day
Season	Spring
Relevance of Season	An assessment of soils (soil mapping) and long term agricultural potential is in no way affected by the season in which the assessment is made, and the timing of the assessment therefore has no bearing on its results.

2 Approach and Methodology

The pre-fieldwork assessment was based on existing information for the site (see following section). The existing data was supplemented by a field soil survey. This was aimed at ground-proofing the data and achieving an understanding of specific soil and agricultural conditions, and the variation of these across the site. The field investigation utilised existing soil exposures where possible and supplemented these with auger samples. Soils were classified according to Soil Classification Working Group (1991). The ratings of impacts are based on the specialist's knowledge and experience of the field conditions and the impact of disturbances on those.

2.1 Information sources

All data on land types, land capability, grazing capacity etc. was sourced from the online Agricultural Geo-Referenced Information System (AGIS), produced by the Institute of Soil, Climate and Water (Agricultural Research Council, 2007). Current and historical satellite imagery was all sourced from Google Earth. Rainfall and temperature data was sourced from The World Bank Climate Change Knowledge Portal (2015).

Soil data on AGIS 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 DAFF (2017).

2.2 Assumptions, knowledge gaps and Limitations

The following assumptions were used in this specialist study:

- The study assumes 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.
- The formal assessment of the cumulative impact of the Vryburg PV facility has been assessed by consideration of all renewable energy projects within 30 km that have received an Environmental Authorisation at the time of starting this Basic Assessment (i.e. by 18 June 2018). However, because it is a REDZ, there are likely to be numerous future renewable energy developments in the area. This is taken into account in considering the cumulative impacts of this project.

The following limitation was identified in this 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.

There are no other specific limitations or knowledge gaps relevant to this study.

2.3 Consultation processes undertaken

Information regarding agricultural activity on the site was obtained in discussion with the farmer of the land, Adele Oberholzer.

3 Description of project aspects relevant to agricultural impacts

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

- Occupation of the land by the total physical footprint of the proposed project.
- Construction activities that may disturb the below surface soil profile, for example for levelling, excavations, etc.

The facility will comprise the normal infrastructure that makes up a solar PV facility including solar arrays with foundations, internal roads, buildings, a substation, and 132 kV overhead transmission line to connect to the existing Eskom Mookodi substation. For agricultural impacts, the exact nature of the different infrastructure within the facility has very little bearing on the significance of impacts. What is of most relevance is simply the occupation of the land, and whether it is being occupied by a solar panel, a building or a substation makes no difference. What is of relevance therefore is simply the total footprint of the facility. The total maximum footprint including the PV facility and infrastructure such as roads will be 250 hectares. The overhead transmission line has a much lower impact on agriculture than the infrastructure within the facility because the agricultural land is not occupied by a transmission line, and all agricultural activities that are viable within the project area (mainly grazing) can continue unhindered underneath it.

4 Description of the soils and agricultural capability of the receiving environment

This section is organised in sub headings based on the requirements of an agricultural study as detailed in section 1.2 of this report.

A satellite image map of the study site is given in Figure 3 and photographs of site conditions are given in Figures 4 to 5.

4.1 Climate and water availability

Rainfall for the site is given as 468 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 1). The site falls on the boundary between the 4th and 5th categories, which are labelled as a moderate to severe limitation and a severe limitation to agriculture respectively.

The farm uses wind pumps for stock watering. There is no access to water for irrigation.

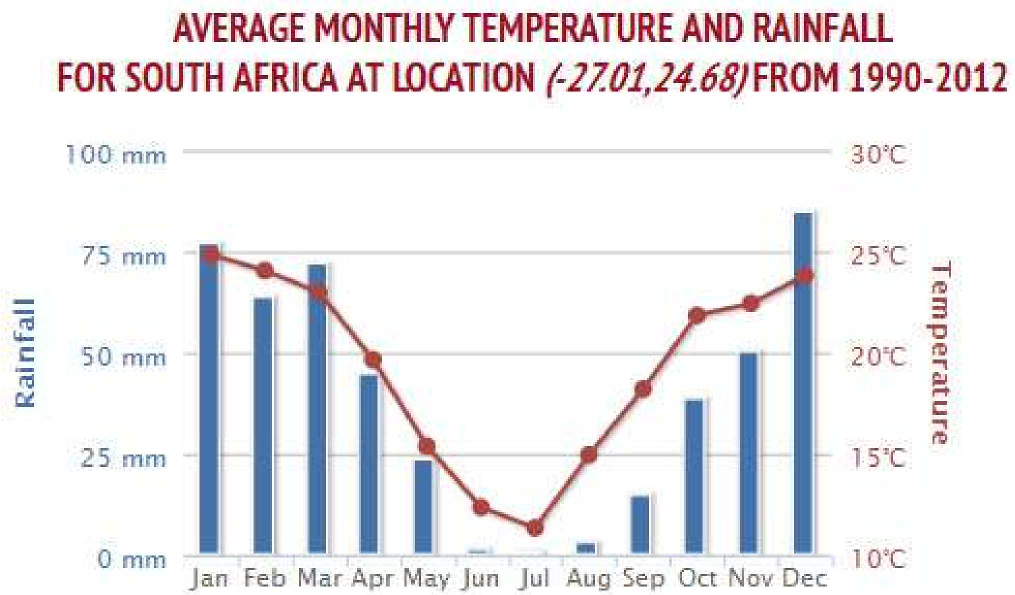

Figure 2: Average monthly temperature and rainfall for the site (The World Bank Climate Change Knowledge Portal, 2015).

Table 2: The classification of moisture availability climate classes for summer rainfall areas across South Africa (Agricultural Research Council, 2007)

Climate class	Moisture availability (Rainfall/0.25 Potential evapotranspiration (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

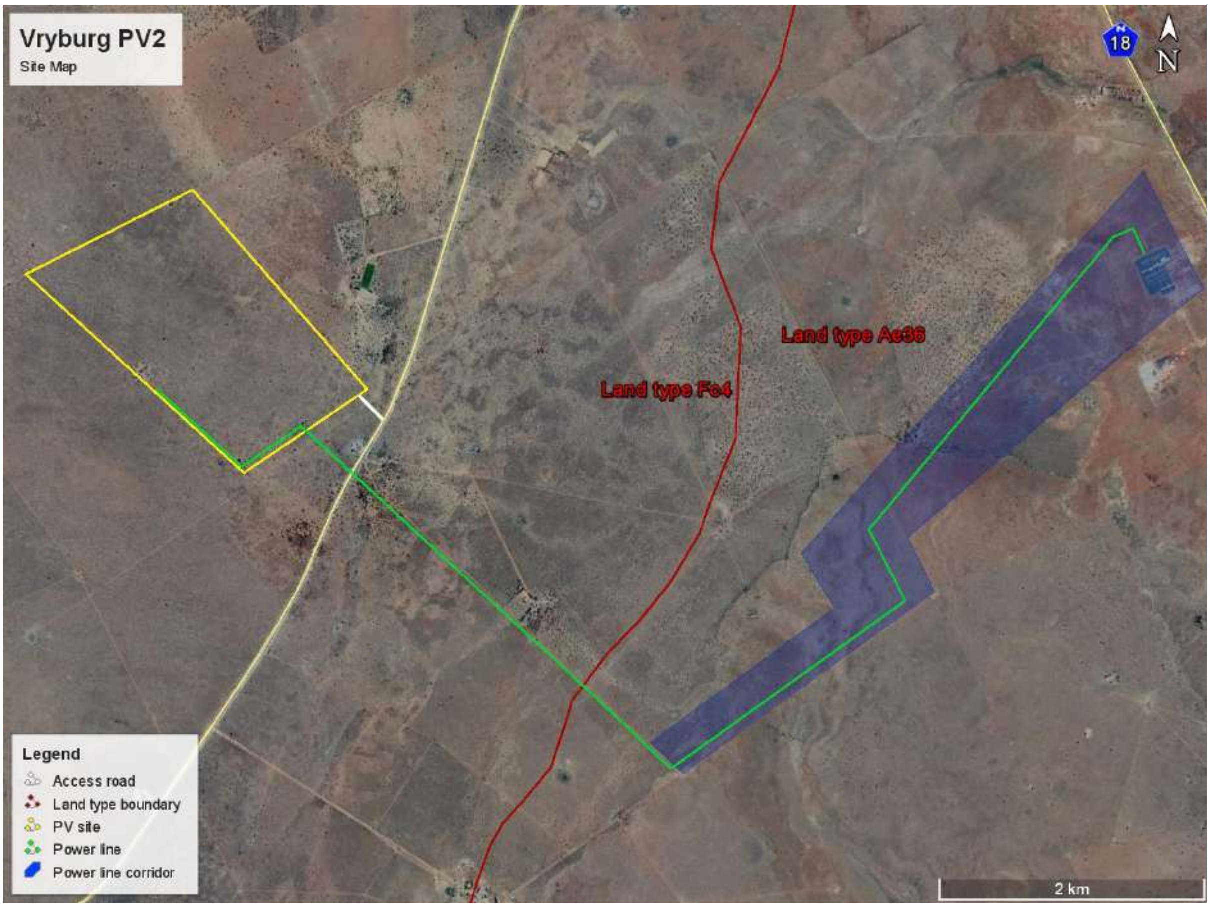

Figure 3: Satellite image map of the proposed PV development.

Figure 4: Photograph showing typical site conditions with sandy soils and shallow hardpan carbonate

Figure 5: Photograph showing an exposure of the hardpan carbonate layer that is dominant across the site.

4.2 Terrain, topography and drainage

The proposed development is located on a terrain unit of level plains with some relief at an altitude of around 1,230 meters. Slope is less than 2% across the sites.

The surface geology is red to flesh-coloured wind-blown sand and surface limestone of Tertiary to Recent age. The underlying geology is dolomite of the Ghaap Group of the Traansvaal Supergroup. This is flat lying and without prominent outcrops.

There are no drainage courses on the site. There is a small pan feature in the middle of the site.

4.3 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 only one land type across the PV site namely Fc4 but the transmission line runs onto a second land type (Ae36). Soils of both these land types are predominantly very shallow, sandy soils on underlying hardpan carbonate. In the older classification system, used in the land type data, they are classified as Mispah soil form, but are now classified as Coega and Gamoep. The land type also includes some soils on underlying rock and a small proportion of deeper, sandy soils of the Hutton soil form. The soils of this land type fall predominantly into the Calcic soil group according to the classification of Fey (2010). A summary detailing soil data for the land type is provided in Table 13. The field investigation showed a distinction between the shallow, sandy soils on underlying hardpan carbonate (Coega and Gamoep forms) and the deeper, sandy soils (Hutton and Clovelly forms). The spatial patterning of these two soil types is fairly complex with the hardpan carbonate covering much of the surface and the deeper soils occurring in small gaps where there has not been shallow hardpan formation.

The soils are classified as having low to moderate susceptibility to water erosion (class 5), but because of the sandy texture, are classified as susceptible to wind erosion.

4.4 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 of below 8 are generally not suitable for production of cultivated crops. Detail of this land capability scale is shown in Table 2.

The proposed project site is predominantly classified with a land capability evaluation value of 6. This varies to 5 in places and to 7 in a few isolated pixels of raster data. The land capability of the project area is therefore classified as being entirely unsuitable for the rainfed production of cultivated crops.

The limitations to land capability are both climate and soil related. The moisture availability class 4/5 classification, with high variability of rainfall is a severe limitation to cultivation, which is not viable without irrigation. The shallow soils are completely unsuitable for cultivation, but the deeper Hutton and Clovelly soils would be suitable under suitable climate conditions or irrigation. The low water holding capacity of the sandy soils would however further limit the dryland potential. Potential Schulz maize yield on AGIS (Agricultural Research Council, 2007) is given as low at 1.43 tons per hectare. The grazing capacity is given as 14 to 17 hectares per large stock unit.

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	

4.5 Land use and development on and surrounding the site

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

There is no agricultural infrastructure on site apart from fencing. Elsewhere across the farm there is a farmstead with buildings, wind pumps, and stock watering points.

4.6 Status of the land

The biome classification for the site is Ghaap Plateau Vaalbosveld. The vegetation is grazed but there is no evidence of erosion or other land degradation on the site.

4.7 Possible land use options for the site

Because of the climate limitations, lack of access to water for irrigation, and soils with limited depth and limited water holding capacity, the site is not suitable for cultivated crops. Viable agricultural land use is limited to grazing only.

The site is within one of South Africa's eight proposed renewable energy development zones (REDZs) that were Gazetted in February 2018, 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.

4.8 Agricultural sensitivity

Agricultural sensitivity is directly related to 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. Also, arable land is a scarce resource in South Africa and is therefore preservation worthy, and as a result has a high sensitivity. Land that is only suitable as grazing land however is not a particularly scarce resource and therefore has a low sensitivity. Because the land is not suitable for cultivation, it has a low agricultural sensitivity to development. In terms of the sensitivity categories used in the REDZ sensitivity analysis, this site was assessed as low sensitivity (DEA, 2015).

Agricultural conditions and potential are uniform across the site and the choice of placement of infrastructure therefore has no influence on the significance of agricultural impacts. No agriculturally sensitive areas occur within the investigated site and no parts of it therefore need to be avoided by the development. There are no required buffers.

5 Issues, risks and impacts

5.1 Identification of potential impacts

The potential impacts identified during the assessment are:

5.1.1 Construction phase

- Loss of agricultural land use;
- Soil degradation.

5.1.2 Operational phase

- Loss of agricultural land use;
- Generation of alternative land use income.

5.1.3 Decommissioning phase

- Loss of agricultural land use;
- Soil degradation.

5.1.4 Cumulative impact

- Regional loss of agricultural land.

6 Impact assessment

The significance of all potential agricultural impacts is kept low by the fact that the proposed site is on land of limited agricultural potential that is only viable for grazing. Impacts are assessed in table format below.

6.1 Construction phase

6.1.1 Loss of agricultural land use

Aspect / Activity	Occupation of the land by the project infrastructure
Type of impact	Direct
Potential Impact	Loss of agricultural land use. Agricultural grazing land directly occupied by all of the development infrastructure will be unavailable for agricultural use.

Status	Negative
Mitigation Required	None possible
Impact Significance (Pre-mitigation)	Low
Impact Significance (Post-Mitigation)	Not applicable because there is no possible mitigation
I&AP Concern	No

6.1.2 Soil degradation

Aspect / Activity	Soil disturbance
Type of impact	Direct
Potential Impact	Soil degradation resulting from erosion and topsoil loss. Erosion may be by wind or water. It 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 PV panels and roads. Loss of topsoil can result from poor topsoil management during construction related soil profile disturbance.
Status	Negative
Mitigation Required	Soil degradation can be effectively managed through mitigation measures. Implement an effective system of storm water run-off control. Maintain, where possible, all vegetation cover and facilitate re-vegetation of denuded areas throughout the site, to stabilize the soil against erosion. Strip, stockpile and re-spread topsoil during rehabilitation.
Impact Significance (Pre-mitigation)	Very low
Impact Significance (Post-Mitigation)	Very low
I&AP Concern	No

6.2 Operational phase

6.2.1 Loss of agricultural land use

Aspect / Activity	Occupation of the land by the project infrastructure
Type of impact	Direct
Potential Impact	Loss of agricultural land use. Agricultural grazing land directly occupied by all of the development infrastructure will be unavailable for agricultural use.

Status	Negative
Mitigation Required	None possible
Impact Significance (Pre-mitigation)	Low
Impact Significance (Post-Mitigation)	Not applicable because there is no possible mitigation
I&AP Concern	No

6.2.2 Alternative land use income

Aspect / Activity	Payment of rental by the energy facility
Type of impact	Indirect
Potential Impact	Additional land use income will be generated by the farming enterprise through the lease of the land to the energy facility. This will provide the farming enterprise with increased cash flow and rural livelihood, and thereby improve its financial sustainability.
Status	Positive
Mitigation Required	None
Impact Significance (Pre-mitigation)	Low
Impact Significance (Post-Mitigation)	Not applicable because there is no possible mitigation
I&AP Concern	No

6.3 Decommissioning phase

6.3.1 Loss of agricultural land use

Aspect / Activity	Occupation of the land by the project infrastructure
Type of impact	Direct
Potential Impact	Loss of agricultural land use. Agricultural grazing land directly occupied by all of the development infrastructure will be unavailable for agricultural use.
Status	Negative
Mitigation Required	None possible
Impact Significance (Pre-mitigation)	Low

Impact Significance (Post-Mitigation)	Not applicable because there is no possible mitigation
I&AP Concern	No

6.3.2 Soil degradation

Aspect / Activity	Soil disturbance
Type of impact	Direct
Potential Impact	Soil degradation resulting from erosion and topsoil loss. Erosion may be by wind or water. It 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 PV panels and roads. Loss of topsoil can result from poor topsoil management during construction related soil profile disturbance.
Status	Negative
Mitigation Required	Soil degradation can be effectively managed through mitigation measures. Implement an effective system of storm water run-off control. Maintain, where possible, all vegetation cover and facilitate re-vegetation of denuded areas throughout the site, to stabilize the soil against erosion. Strip, stockpile and re-spread topsoil during rehabilitation.
Impact Significance (Pre-mitigation)	Very low
Impact Significance (Post-Mitigation)	Very low
I&AP Concern	No

6.4 Cumulative impacts

The cumulative impact of a development is the impact that development will have when its impact is considered together with the impacts of other proposed developments 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 sum of proposed developments that impact an environment will cause an acceptable level of change to be exceeded.

For formal assessment purposes, in terms of the NEMA regulations, cumulative impacts are assessed by taking all known, proposed, similar developments within a certain distance of the development being assessed, into account. Restricting the cumulative impacts to similar developments is entirely arbitrary (but perhaps administratively necessary), because all developments, regardless of their type and similarity, will contribute to exceeding an acceptable level of change.

The formal assessment of the cumulative impact of the Vryburg PV facility has been assessed by consideration of all renewable energy projects within 30 km that have received an Environmental Authorisation at the time of starting this Basic Assessment (i.e. by 18 June 2018). Only one project (Waterloo 75 MW) has been identified as having definitely received a positive Environmental Authorisation. This development has very similar impacts within a very similar agricultural environment, within the same Renewable Energy Development Zone (REDZ). Because it is a REDZ, there are likely to be numerous future renewable energy developments in the area. This is taken into account in considering the cumulative impacts of this project.

The potential cumulative impact of importance is a regional loss of agricultural land use. What is important in assessing this impact is that the cumulative impact is affecting an agricultural environment that has been declared a REDZ precisely because it is an environment that can accommodate numerous renewable energy developments without exceeding acceptable levels of agricultural land use loss. This is primarily because of the low agricultural capability of land across the REDZ, and the fact that such land is not a scarce resource in South Africa. It is far more preferable to incur a cumulative loss of agricultural land in such a region, without cultivation potential, than to lose scarce arable land to renewable energy development elsewhere in the country.

The cumulative impact is assessed in table format below.

Aspect / Activity	Occupation of the land by the project infrastructure of multiple developments
Type of impact	Direct
Potential Impact	Cumulative impacts are likely to occur as a result of the regional loss of agricultural land and production because of other developments on agricultural land in the region. Because the land is of low agricultural potential, the cumulative loss of agricultural resources is of low significance.
Status	Negative
Mitigation Required	None
Impact Significance (Pre-mitigation)	Very low
Impact Significance (Post-Mitigation)	Not applicable because there is no possible mitigation
I&AP Concern	No

6.5 Assessment of the no-go alternative

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 enterprise will come under increased pressure in terms of economic viability.

There are therefore both advantages and disadvantages to the development. These are more or less equal which results in their being, from an agricultural impact perspective, no preferred alternative between the development and the no-go.

7 Impact assessment tables

Table 4: Impact assessment summary table - Construction phase

Impact pathway	Nature of potential impact/risk	Status	Extent	Duration	Consequence	Probability	Reversibility of impact	Irreplace-ability of receiving environment/ resource	Potential mitigation measures	Significance of impact/risk = consequence x probability (before mitigation)	Significance of residual risk/impact (after mitigation)	Ranking of residual impact/ risk	Confidence level
Occupation of the land by the project infrastructure	Loss of agricultural land use	Negative	Site	Long term	Moderate	Very Likely	High	Replaceable	None	Low	Not applicable (no mitigation)	4	High
Land disturbance	Soil degradation	Negative	Site	Long term	Slight	Unlikely	Moderate	Low	Implement an effective system of storm water run-off control. Maintain vegetation cover. Strip, stockpile and re-spread topsoil during rehabilitation.	Very low	Very low	5	Medium

Table 5: Impact assessment summary table - Operational phase

Impact pathway	Nature of potential impact/risk	Status	Extent	Duration	Consequence	Probability	Reversibility of impact	Irreplace-ability of receiving environment/ resource	Potential mitigation measures	Significance of impact/risk = consequence x probability (before mitigation)	Significance of residual risk/impact (after mitigation)	Ranking of residual impact/ risk	Confidence level
Occupation of the land by the project infrastructure	Loss of agricultural land use	Negative	Site	Long term	Moderate	Very Likely	High	Replaceable	None	Low	Not applicable (no mitigation)	4	High
Project land rental	Improvement of financial sustainability through additional land use income	Positive	Site	Long term	Moderate	Very Likely	High	Low	None	Low	Not applicable (no mitigation)	4	Medium

Table 6: Impact assessment summary table - Decommissioning phase

Impact pathway	Nature of potential impact/risk	Status	Extent	Duration	Consequence	Probability	Reversibility of impact	Irreplace-ability of receiving environment/ resource	Potential mitigation measures	Significance of impact/risk = consequence x probability (before mitigation)	Significance of residual risk/impact (after mitigation)	Ranking of residual impact/ risk	Confidence level
Occupation of the land by the project infrastructure	Loss of agricultural land use	Negative	Site	Long term	Moderate	Very Likely	High	Replaceable	None	Low	Not applicable (no mitigation)	4	High
Land disturbance	Soil degradation	Negative	Site	Long term	Slight	Unlikely	Moderate	Low	Implement an effective system of storm water run-off control. Maintain vegetation cover. Strip, stockpile and re-spread topsoil during rehabilitation.	Very low	Very low	5	Medium

Table 7: Impact assessment summary table - Cumulative impacts

Impact pathway	Nature of potential impact/risk	Status	Extent	Duration	Consequence	Probability	Reversibility of impact	Irreplace-ability of receiving environment/ resource	Potential mitigation measures	Significance of impact/risk = consequence x probability (before mitigation)	Significance of residual risk/impact (after mitigation)	Ranking of residual impact/ risk	Confidence level
Occupation of the land by the project infrastructure of multiple developments	Regional loss of agricultural land	Negative	Regional	Long term	Slight	Very Likely	High	Low	None	Very low	Not applicable (no mitigation)	5	High

7.1 Impact assessment summary

The overall impact significance of the proposed development is shown in Table 5 below:

Table 8: Overall Impact Significance (Post Mitigation)

Phase	**Overall Impact Significance**
Construction	Low to Very Low
Operational	Low
Decommissioning	Low to Very Low
Nature of Impact	**Overall Impact Significance**
Cumulative - Construction	Very Low
Cumulative - Operational	Very Low
Cumulative - Decommissioning	Very Low

8 Legislative and Permit Requirements

A change of land use (re-zoning) for the development on agricultural land needs to be approved in terms of the Subdivision of Agricultural Land Act (Act 70 of 1970) (SALA). This is required for long term lease, even if no subdivision is required. 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. The Department of Agriculture, Forestry and Fisheries (DAFF) reviews and approves applications in terms of these Acts according to their *Guidelines for the evaluation and review of applications pertaining to renewable energy on agricultural land*, dated September 2011.

9 Environmental Management Programme Inputs

The following mitigation measures are proposed for inclusion in the EMPr:

- Implement an effective system of storm water run-off control, where it is required - that is at points 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.
- Maintain where possible all vegetation cover and facilitate re-vegetation of denuded areas throughout the site, to stabilize the soil against erosion.
- If an activity will significantly disturb the soil below surface for example through excavation, then any available topsoil should first be stripped from the entire surface to be disturbed and stockpiled for re-spreading during rehabilitation. It is not necessary to strip topsoil from the entire site, for example under the PV panels. it is only necessary to strip from places where

the soil profile will be significantly disturbed. Topsoil stockpiles must be conserved against losses through erosion by establishing vegetation cover on them. During rehabilitation, the stockpiled topsoil must be evenly spread over the entire disturbed surface. Any subsurface spoils from excavations must be disposed of where they will not bury the topsoil of agricultural land.

The following monitoring requirements are proposed for inclusion in the EMPr:

- Undertake a periodic site inspection to verify and inspect the effectiveness and integrity of the storm water run-off control system and to specifically record the occurrence of any erosion on site or downstream. Corrective action must be implemented to the run-off control system in the event of any erosion occurring.
- Photograph all disturbed areas prior to disturbance and periodically thereafter to record the state of vegetation cover.
- Establish an effective record keeping system for each area where soil is disturbed for construction and decommissioning purposes. The following things should be recorded: location, date of topsoil stripping, date of topsoil return, photograph prior to disturbance, photograph after topsoil return.

The management actions are specified in the following Tables, with further implementation details provided in accordance with the requirements of the EIA Regulations.

Table 9: Management Plan for the Planning and Design Phase

Impact	Mitigation / Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
Aspect: Protection of agricultural and soil resources					
Erosion	That disturbance causes no erosion on or downstream of the site.	Design an effective system of storm water run-off control, where it is required - that is at points 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.	Ensure that the storm water run-off control is included in the engineering design.	Once-off during the design phase.	Project Developer (Veroniva)

Table 10: Management Plan for the Construction Phase

Impact	Mitigation / Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	*Frequency*	*Responsibility*
Aspect: Protection of agricultural and soil resources					
Erosion	That disturbance causes no erosion on or downstream of the site.	Implement an effective system of storm water run-off control, where it is required - that is at points 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.	Undertake a periodic site inspection to verify and inspect the effectiveness and integrity of the storm water run-off control system and to specifically record the occurrence of any erosion on site or downstream. Corrective action must be implemented to the run-off control system in the event of any erosion occurring.	Monthly	Environmental Control Officer (ECO)
Loss of topsoil	That topsoil is retained	If an activity will significantly disturb the soil below surface for example through excavation, then any available topsoil should first be stripped from the entire surface to be disturbed and stockpiled for re-spreading during rehabilitation. It is not necessary to strip topsoil from the entire site, for example under the PV panels. it is only necessary to strip from places where the soil profile will be significantly disturbed. Topsoil stockpiles must be conserved against losses through	Establish an effective record keeping system for each area where soil is disturbed for construction purposes. The following things should be recorded: location, date of topsoil stripping, date of topsoil return, photograph prior to disturbance,	Each time an area requires soil stripping or re-spreading	Environmental Control Officer (ECO)

Impact	Mitigation / Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	*Frequency*	*Responsibility*
		erosion by establishing vegetation cover on them. During rehabilitation, the stockpiled topsoil must be evenly spread over the entire disturbed surface. Any subsurface spoils from excavations must be disposed of where they will not bury the topsoil of agricultural land.	photograph after topsoil return.		

Table 11: Management Plan for the Operational Phase

Impact	Mitigation / Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	*Frequency*	*Responsibility*
Aspect: Protection of agricultural and soil resources					
Erosion	That no erosion on or downstream of the site occurs as a result of run-off from the site.	Monitor erosion and remedy the storm water control system in the event of any erosion occurring.	Undertake a periodic site inspection to verify and inspect the effectiveness and integrity of the storm water run-off control system and to specifically record the occurrence of any erosion on site or downstream. Corrective action must be implemented to the run-off control system in the event of any erosion occurring.	Once every 6 months	Facility Environmental Manager

Table 12: Management Plan for the Decommissioning Phase

Impact	Mitigation / Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
Aspect: Protection of agricultural and soil resources					
Erosion	That disturbance causes no erosion on or downstream of the site.	Implement an effective system of storm water run-off control, where it is required - that is at points 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.	Undertake a periodic site inspection to verify and inspect the effectiveness and integrity of the storm water run-off control system and to specifically record the occurrence of any erosion on site or downstream. Corrective action must be implemented to the run-off control system in the event of any erosion occurring.	Monthly	Environmental Control Officer (ECO)
Loss of topsoil	That topsoil is retained	If an activity will significantly disturb the soil below surface for example through excavation, then any available topsoil should first be stripped from the entire surface to be disturbed and stockpiled for re-spreading during rehabilitation. It is not necessary to strip topsoil from the entire site, for example under the PV panels. it is only necessary to strip from places where the soil profile will be significantly disturbed. Topsoil stockpiles must be conserved against losses through erosion by	Establish an effective record keeping system for each area where soil is disturbed for decommissioning purposes. The following things should be recorded: location, date of topsoil stripping, date of topsoil return, photograph prior to disturbance,	Each time an area requires soil stripping or re-spreading	Environmental Control Officer (ECO)

Impact	Mitigation / Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	*Frequency*	*Responsibility*
		establishing vegetation cover on them. During rehabilitation, the stockpiled topsoil must be evenly spread over the entire disturbed surface. Any subsurface spoils from excavations must be disposed of where they will not bury the topsoil of agricultural land.	photograph after topsoil return.		

10 Conclusions and recommendations

South Africa has very limited arable land and it is therefore critical to ensure that development does not lead to an inappropriate loss of potentially arable land. The assessment has found that the proposed development will only impact agricultural land which is of low agricultural potential and only suitable for grazing.

All agricultural impacts of the proposed development are assessed as being of low or very low significance. This is predominantly because of the limited agricultural potential of the proposed development site, which is a function of both the climate and the predominantly shallow soils. The study area has low agricultural sensitivity because of its low potential and no parts of the site need to be avoided by the proposed development. No buffers are required. There are no recommended alterations to the proposed layout.

11 Final Specialist Statement and Authorisation Recommendation

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

11.1 EA Condition Recommendations

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

12 References

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DEA, 2015. Strategic Environmental Assessment for wind and solar photovoltaic development in South Africa. CSIR Report Number CSIR: CSIR/CAS/EMS/ER/2015/001/B. Stellenbosch.

Fey, M. 2010. Soils of South Africa. Cambridge University Press, Cape Town.

Soil Classification Working Group. 1991. Soil classification: a taxonomic system for South Africa. Soil and Irrigation Research Institute, Department of Agricultural Development, Pretoria.

The World Bank Climate Change Knowledge Portal. 2015. available at http://sdwebx.worldbank.org/climateportal/

APPENDIX A: SOIL DATA

Table 13: Land type soil data for site.

Land type	Land capability class	Soil series (forms)	Depth (mm)			Clay % A horizon			Clay % B horizon			Depth limiting layer	% of land type
Ib236	8	Rock outcrop											71
		Hutton	50	-	300	2	-	6	4	-	10	R	22
		Hutton	300	-	1200	2	-	6	4	-	10	R	6
Ae2	5	Hutton	600	>	1200	2	-	6	4	-	10	R	26
		Hutton	750	>	1200	2	-	6	4	-	9	R,ka	23
		Hutton	300	-	600	2	-	6	4	-	10	R	16
		Hutton	100	-	300	4	-	8	4	-	10	R	15
		Hutton	300	-	600	2	-	6	4	-	9	R,ka	10
		Rock outcrop											4
		Hutton	450	-	750	10	-	15	15	-	20	R,ka	2
		Clovelly	750	-	1200	2	-	6	4	-	10	ka	1
		Mispah	50	-	250	4	-	10				ka	1

Land capability classes: 5 = non-arable, moderate potential grazing land; 8 = non-utilisable wilderness land.
Depth limiting layers: R = hard rock; ka = hardpan carbonate.

ECOLOGICAL ASSESSMENT
(TERRESTRIAL AND AQUATIC)

Basic Assessment for the proposed construction of Solar Photovoltaic (PV) Facility, Vryburg Solar 2 and associated electrical infrastructure, near Vryburg, in the North-West Province

Report prepared for:
CSIR – Environmental Management Services
P O Box 320
Stellenbosch
7599
South Africa

Report prepared by:
Reinier F. Terblanche
Anthene Ecological cc
PO Box 20488
Noordbrug (Potchefstroom)
2522
South Africa

02 August 2018

SPECIALIST EXPERTISE

SYNOPTIC CV: REINIER. F. TERBLANCHE

Reinier is an ecologist and in particular a habitat specialist with an exceptional combination of botanical and zoological expertise which he keeps fostering, updating and improving. He is busy with a Ph.D for which he registered at the Department of Conservation Ecology at the University of Stellenbosch in July 2013. Reinier's experience includes being a lecturer in ecology and zoology at the North West University, Potchefstroom Campus (1998-2008). Reinier collaborates with a number of institutes, organizations and universities on animal and plant research.

Qualifications:

Qualification	Main subject matter	University
M.Sc ***Cum Laude*****, 1998:** Botany: Ecology	Quantitative study of invertebrate assemblages and plant assemblages of rangelands in grasslands.	North-West University, Potchefstroom
B.Sc Honns ***Cum Laude*****, 1992** Botany: Taxonomy	Distinctions in all subjects: Plant Anatomy 75, Taxonomy 84, Modern Systematics 82, System Modelling 75, Plant Ecology 75, Taxonomy Project 77, Statistics Attendance Course.	North-West University, Potchefstroom
B.Sc Botany, Zoology	Main subjects: Botany, Zoology.	North-West University, Potchefstroom
Higher Education Diploma, 1990	Numerous subjects aimed at holistic training of teachers.	North-West University, Potchefstroom

In research Reinier specializes in conservation biology, threatened butterfly species, vegetation dynamics and ant assemblages at butterfly habitats as well as enhancing quantitative studies on butterflies of Africa. He has published extensively in the fields of taxonomy, biogeography and ecology in popular journals, peer-reviewed scientific journals and as co-author and co-editor of books (see 10 examples beneath).

Reinier practices as an ecological consultant and has been registered as a Professional Natural Scientist by SACNASP since 2005: Reg. No. 400244/05. His experience in consultation includes: Flora and fauna habitat surveys, Threatened species assessments, Riparian vegetation index surveys, Compilation of Ecological Management Plans, Biodiversity Action Plans and Status quo of biodiversity for Environmental Management Frameworks, Wetland Assessments, Management of Rare Wetland Species.

Recent activities/ awards: Best Poster Award at Oppenheimer De Beers Group Research Conference 2015, Johannesburg. One of the co-authors of Standardised Global Butterfly Monitoring, 2015, Group on Earth Observations Biodiversity Observation Network, Leipzig, Germany (UNEP-WCMC), GEO BON Technical Series 1. Most recent award: Awarded the prestigious Torben Larsen Memorial Tankard in October 2017; one is awarded annually to the person responsible for the most outstanding written account on Afrotropical Lepidoptera.

EXPERIENCE

Lecturer: Zoology 1998-2008	**Main subject matter and level**	**Organization**
Lectured subjects	- 3rd year level Ecology, Plantparasitology - 2nd year level Ethology - *Master's degree* Evolutionary Ethology, Systematics in Practice, Morphology and Taxonomy of Insect Pests, Wetlands.	North-West University, Potchefstroom and University of South Africa
Co-promoter	Ph.D. Edge, D.A. 2005. Ecological factors that influence the survival of the Brenton Blue butterfly	North-West University, Potchefstroom
Study leader/ assistant study leader	Six M.Sc students, One B.Sc Honn student: Quantitative biodiversity studies.	North-West University, Potchefstroom
Teacher 1994-1998	Biology and Science, Secondary School	Afrikaans Hoër Seunskool, Pretoria
Owned Anthene Ecological CC 2008 – present	- Flora and Fauna habitat surveys - Highly specialized ecological surveys - Riparian vegetation index surveys - Ecological Management Plans - Biodiversity Action Plans - Biodiversity section of Environmental Management Frameworks - Wetland assessments	Private Closed Corporation that has been subcontracted by many companies
Herbarium assistant 1988-1991	- Part-time assistant at the A.P. Goossens herbarium, Botany Department, North-West University, 1988, 1989, 1990 and 1991 (as a student).	North-West University, Potchefstroom

10 EXAMPLES OF PUBLICATIONS OF WHICH R.F. TERBLANCHE IS AUTHOR/ CO-AUTHOR
(Three books, two chapters in books and five articles are listed here as examples)

1. HENNING, G.A., **TERBLANCHE, R.F.** & BALL, J.B. (eds) **2009.** *South African Red Data Book: butterflies. SANBI Biodiversity Series* 13. South African National Biodiversity Institute, Pretoria. 158p. ISBN 978-1-919976-51-8
2. MECENERO, S., BALL, J.B., EDGE, D.A., HAMER, M.L., HENNING, G.A., KRÜGER, M, PRINGLE, E.L., **TERBLANCHE, R.F.** & WILLIAMS, M.C. (eds). 2013. *Conservation Assessment of Butterflies of South Africa, Lesotho and Swaziland: Red List and atlas.* Saftronics (Pty) Ltd., Johannesburg & Animal Demography Unit, Cape Town.
3. VAN SWAAY, C., REGAN, E., LING, M., BOZHINOVSKA, E., FERNANDEZ, M., MARINI-FILHO, O.J., HUERTAS, B., PHON, C.-K., KŐRÖSI, A., MEERMAN, J., PE'ER, G., UEHARA-PRADO, M., SÁFIÁN, S., SAM, L., SHUEY, J., TARON, D., **TERBLANCHE, R.F**. & UNDERHILL, L. 2015. Guidelines for Standardised Global Butterfly Monitoring. Group on Earth Observations Biodiversity Observation Network, Leipzig, Germany. GEO BON Technical Series 1.
4. **TERBLANCHE, R.F.** & HENNING, G.A. **2009.** *A framework for conservation management of South African butterflies in practice.* In: Henning, G.A., Terblanche, R.F. & Ball, J.B. (eds). *South African Red Data Book: Butterflies. SANBI Biodiversity Series 13.* South African National Biodiversity Institute, Pretoria. p. 68 – 71.
5. EDGE, D.A., **TERBLANCHE, R.F**., HENNING, G.A., MECENERO, S. & NAVARRO, R.A. 2013. Butterfly conservation in southern Africa: Analysis of the Red List and threats. In: Mecenero, S., Ball, J.B., Edge, D.A., Hamer, M.L., Henning, G.A., Krüger, M., Pringle, E.L., Terblanche, R.F. & Williams, M.C. (eds). *Conservation Assessment of Butterflies of South Africa, Lesotho and Swaziland: Red List and Atlas.* pp. 13-33. Saftronics (Pty) Ltd., Johannesburg & Animal Demography Unit, Cape Town.
6. **TERBLANCHE, R.F.**, SMITH, G.F. & THEUNISSEN, J.D. **1993.** Did Scott typify names in *Haworthia* (Asphodelaceae: Alooideae)? *Taxon* **42**(1): 91–95. (International Journal of Plant Taxonomy).
7. **TERBLANCHE, R.F.**, MORGENTHAL, T.L. & CILLIERS, S.S. **2003.** The vegetation of three localities of the threatened butterfly species *Chrysoritis aureus* (Lepidoptera: Lycaenidae). *Koedoe* **46**(1): 73-90.
8. EDGE, D.A., CILLIERS, S.S. & **TERBLANCHE, R.F. 2008**. Vegetation associated with the occurrence of the Brenton blue butterfly. *South African Journal of Science* **104**: 505 - 510.
9. GARDINER, A.J. & **TERBLANCHE, R.F. 2010.** Taxonomy, biology, biogeography, evolution and conservation of the genus *Erikssonia* Trimen (Lepidoptera: Lycaenidae) *African Entomology* **18**(1): 171-191.
10. **TERBLANCHE, R.F.** 2016. *Acraea trimeni* Aurivillius, [1899], *Acraea stenobea* Wallengren, 1860 and *Acraea neobule* Doubleday, [1847] on host-plant *Adenia repanda* (Burch.) Engl. at Tswalu Kalahari Reserve, South Africa. *Metamorphosis* 27: 92-102.

SPECIALIST DECLARATION

I, Reinier F. Terblanche, as the appointed independent specialist, in terms of the 2014 EIA Regulations (as amended), hereby declare that I:

- I act as the independent specialist in this application;
- I 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;
- regard the information contained in this report as it relates to my specialist input/study to be true and correct, and do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 (as amended) and any specific environmental management Act;
- 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 have no vested interest in the proposed activity proceeding;
- 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;
- I have ensured that information containing all relevant facts in respect of the specialist input/study was distributed or made available to interested and affected parties and the public and that participation by interested and affected parties was facilitated in such a manner that all interested and affected parties were provided with a reasonable opportunity to participate and to provide comments on the specialist input/study;
- I have ensured that the comments of all interested and affected parties on the specialist input/study were considered, recorded and submitted to the competent authority in respect of the application;
- all the particulars furnished by me in this specialist input/study 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.

Name of Specialist: Reinier F. Terblanche

Signature of the specialist
Date: 27 July 2018

EXECUTIVE SUMMARY

Vegetation at the Vryburg Solar 2 site (including the distribution line corridor) is an open savanna consisting of largely indigenous vegetation. This vegetation contains a visible abundance of shrub-height *Tarchonanthus camphoratus* (Camphor Bush) and *Grewia flava* (Velvet Raisin). Indigenous *Vachellia, Searsia* and *Ziziphus* trees are dotted or in clumps across the flat landscape. The declared alien invasive plant species, *Prosopis glandulosa* (Mesquite) are encountered at some parts of the site. Alien invasive weeds are found at hitherto cleared or ecologically disturbed areas. The site is at very gentle slopes (flat). No rocky ridges appear to be present at the site. Wetlands such as floodplain wetlands, channelled valley-bottom wetlands, unchannelled valley-bottom wetlands, depressions, seeps and wetland flats appear to be absent at the site. Typical infrastructure associated with farming such as tracks, roads, small concrete dams and fences are present at the site.

The vegetation type that represents the Savanna Biome at the site, Ghaap Plateau Vaalbosveld (SVk 7), is not listed as threatened ecosystem according to the National List of Threatened Ecosystems (2011). Also the footprint proposed for the photovoltaic facility as well as for the largest part of distribution line corridor is situated at Other Natural Areas (ONAs). This means that the proposed photovoltaic footprint and most of the distribution line corridor are in fair ecological condition but fall outside the protected area network and have not been identified as CBAs or ESAs (SANBI, 2017). At the eastern extension of the distribution line corridor there is a part that extends into an Ecological Support Area 1. This eastern section of the distribution line corridor is currently in fair ecological condition, for which the objective is to retain it in at least fair ecological condition (SANBI, 2017). This eastern section of the distribution line area will remain as a functional ecosystem in fair ecological condition. In summary the footprint proposed for the photovoltaic facility and the distribution line corridor are not part of a threatened ecosystem or freshwater ecosystem priority area.

Presence of resident Threatened or Near-threatened animal (see separate report for assessments of avifauna) or plant species are unlikely. One Protected tree species, *Vachellia erioloba* (Camel Thorn) is found at the site and occurs in relatively ow numbers (average 0,3 trees/ha) at the site. Protected Tree species are listed under the National Forests Act No. 84 of 1998. In terms of a part of section 15(1) of Act No. 84 of 1998, no person may cut, disturb, damage or destroy any protected tree or possess, collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, except under a license granted by the Minister.

The footprint proposed for the proposed development is not part of a corridor of particular conservation importance.

Ecological sensitivity at the site is overall medium. There are no indications of any particular ecosystems of conservation importance, any particular conservation corridors or a significant impact on any plant, mammal, reptile, amphibian or invertebrate species of particular conservation concern if the site is developed. At the site impacts on habitat loss, sensitive species and connectivity appear to be moderate and within scope of mitigations.

Cumulative effects of solar power plants are considered with special reference to habitat loss and fragmentation. Habitat loss and fragmentation are known to be the main threats to biodiversity (Fahrig, 2003; Wilcove *et al*., 1998; IUCN, 2004; Primack, 2006). In cases such as the study where proposed footprints are relatively small parts of fairly similar habitat the focus could be on the fragmentation of the natural landscape and having enough corridors and linkages that enhance connectivity of biodiversity.

Given the proposed footprint, avoidance of sensitive ecosystems, avoidance of particular habitat of sensitive species and proposed mitigation measures there are no distinct reasons in terms of National Water Act (Act No 36 of 1998) and water uses which are defined in Section 21(c) or Section 21 (i) and in terms of threatening processes in listed ecosystems such as noted for Section 53 (Biodiversity Act No. 10 of 2004) which must be regarded as a specified activity contemplated in section 24(2)(b) of the National Environmental Management Act (Act No. 107 of 1998) that the proposed development and listed could be a threat to such sensitive ecosystems.

A key issue, if the development is approved, is to avoid the establishment of alien invasive plant species in particular Declared Weeds such as *Prosopis* (Mesquite). If the development is approved, a monitoring and rehabilitation plan would be valuable to assess the prosperity of indigenous animal and plant species at photovoltaic facilities. Conservation of corridors with indigenous vegetation adjacent to photovoltaic facilities in the larger area would be vital for conserving indigenous biodiversity in the larger area.

Finally, this ecological study shows that the ecological impacts can be reduced to low and medium significance with effective mitigation measures being applied. Mitigation measures have been specified. There is therefore no prohibitive distinct reason or objection from an ecological perspective for the project being given Environmental Authorisation.

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LIST OF ABBREVIATIONS

BGIS Biodiversity Geographic Information System
CBA Critical Biodiversity Area
CSIR Council of Scientific and Industrial Research
DWA Department of Water Affairs
DWAF Department of Water Affairs and Forestry
DWS Department of Water and Sanitation
EAP Environmental Assessment Practitioner
EIA Environmental Impact Assessment
EIS Ecological Importance and Sensitivity
ESA Ecological Support Area
FEPA Freshwater Ecosystem Priority Area
GIS Geographic Information System
GPS Global Positioning System
IUCN International Union for the Conservation of Nature
MAP Mean Annual Precipitation
NEMA National Environmental Management Act
NFEPA National Freshwater Ecosystem Priority Areas project
NWA National Water Act
ONA Other Natural Area
PES Present Ecological State
SANBI South African National Biodiversity Institute
WMA Water Management Area
WRC Water Research Commission
WUL Water Use Licence

COMPLIANCE WITH THE APPENDIX 6 OF THE 2014 EIA REGULATIONS (AS AMENDED)

Requirements of Appendix 6 – GN R982	Addressed in the Specialist Report
1. (1) A specialist report prepared in terms of these Regulations must contain- a) 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;	p. 1-3
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	p. 4
c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 1
(cA) an indication of the quality and age of base data used for the specialist report;	Section 1
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 4.1
d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 1.3 Section 2
e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 2
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 4.2
g) an identification of any areas to be avoided, including buffers;	Section 6 (Cumulative)
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 6
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 1.3 Section 2
j) a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Section 6 Section 7
k) any mitigation measures for inclusion in the EMPr;	Section 6 Section 7
l) any conditions for inclusion in the environmental authorisation;	Section 8 Section 10 Section 11
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 9
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 10 Section 11
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	Not applicable
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 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

ECOLOGICAL ASSESSMENT (TERRESTRIAL AND AQUATIC)

This report presents the Terrestrial and Aquatic (Wetland) Impact Assessment that was prepared by Reinier F. Terblanche of Anthene Ecological cc as part of the Basic Assessment (BA) Process for the proposed construction of the Vryburg Solar Photovoltaic Facilities, in the North-West Province.

1. INTRODUCTION AND METHODOLOGY

1.1 Scope, Purpose and Objectives of this Specialist Report

An ecological habitat survey is required for a proposed photo-voltaic development, Vryburg Solar 2, situated in the Dr Ruth S Mompati District Municipality, Province of the North-West, 8 km southwest of the centre of Vryburg in the North West Province (elsewhere referred to as the site).

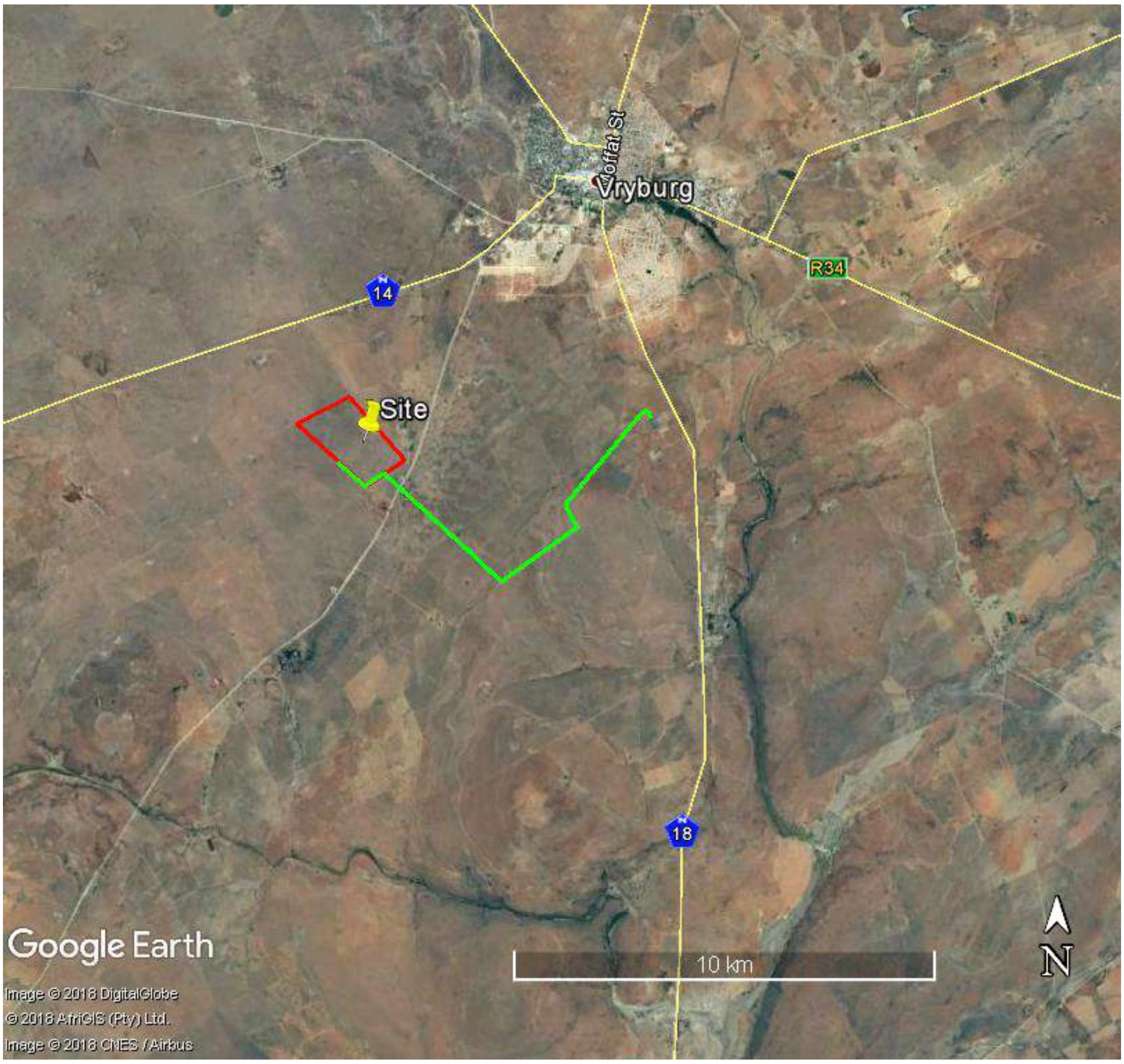

Figure 1 Map with indication of the location of the site.

(red line)	Red outline	Boundaries of the site
(green line)	Green outline	Indication of Powerline route

Grid references and altitudes were taken at site with a GPS Garmin E-trex 20 ® instrument. Map information were analysed and depicted on Google images with the aid of Google Earth Pro (US Dept. of State Geographer, MapLink/ Tele Atlas, Google, 2018).

The objectives of the habitat study are to provide:

- A detailed fauna and flora habitat survey;
- A detailed habitat survey of possible threatened or localised plant species, vertebrates and invertebrates;
- Evaluate the conservation importance and significance of the site with special emphasis on the current status of threatened species;
- Evaluate the conservation importance and significance of the site by considering the current status of threatened ecosystems;
- Literature investigation of possible species that may occur on site;
- Identification of potential ecological impacts on fauna and flora that could occur as a result of the development; and
- Make recommendations to reduce or minimise impacts, should the development be approved.

1.2 Terms of Reference

Ecology: Terrestrial and Wetlands

- Describe the terrestrial and aquatic ecology features of the project area, with focus on features that are potentially impacted by the proposed project. The description should include the major habitat forms within the study site, giving due consideration to terrestrial ecology (flora), terrestrial ecology (fauna) and freshwater ecosystems/wetlands.
- Consider seasonal changes and long-term trends, such as due to climate change.
- Identify any species of special concern or protected species on site (e.g. protected tree species).
- Map the sensitive ecological features within the proposed project area, showing any “no go” areas (i.e. “very high” sensitivity). Specify set-backs or buffers and provide clear reasons for these recommendations. Also map the extent of disturbance and transformation of the site.
- Identify and delineate wetlands that may occur on the site, using the relevant protocols established by DWAF (2005).
- Determine if a Water Use License (WUL) is required and if so, determine the requirements thereof.
- Identify and assess the potential impacts of the project on the terrestrial and aquatic environment.
- The assessment should be based on existing information, national and provincial databases , SANBI mapping, mapping in the Wind and Solar SEA (CSIR, 2015), professional experience and field work conducted.

1.3 Assessment Details

Type of Specialist Investigation	Site surveys, desktop surveys and extensive literature surveys of potential existence of threatened species, threatened ecosystems and corridors of conservation importance.
Date and Duration of Specialist Site Investigation	Site visits by R.F. Terblanche were conducted on 17 September 2016, 7 October 2016, 28-30 June 2018 and 7, 18 July 2018.
Season	Spring, Winter.
Relevance of Season	The site surveys were conducted during September 2016, October 2016, June 2018 and July 2018 which include optimal and sub-optimal times of the season to find sensitive plant and animal species of high conservation priority. Weather conditions during the surveys were favourable for recording fauna and flora. The focus of the present survey remains a habitat survey that concentrates on the possibility that species of particular conservation priority occur on the site or not. It is unlikely that any more visits would reveal information that would change the outcome of this assessment both in terms of ecosystems of special conservation concern or suitable habitats of species of particular conservation concern. Visits that were conducted therefore appear to be sufficient to address the objectives of this study.

2. APPROACH AND METHODOLOGY

A desktop study comprised not only an initial phase, but also it was used throughout the study to accommodate and integrate all the data which became available during the field observations.

Site visits by R.F. Terblanche were conducted on 17 September 2016, 7 October 2016, 28-30 June 2018 and 7, 18 July 2018.

Notes and experience from earlier surveys at the larger study area of the Taung-Vryburg area by R.F. Terblanche that had taken place such as in July 2011, November 2011, January 2012, February 2012, August 2013, December 2013, January 2014, November 2014, November 2015 and January 2016 were also taken into account where applicable. Experience from visits or research at areas where Camel Thorn forests are find such as Kathu and Witsand Nature Reserve are also taken into account. The main purpose of the site visits was ultimately to serve as habitat surveys that concentrated on the possible presence or not of threatened species and other species of high conservation priority.

2.1 Materials and methods applicable for environmental aspects

The following sections highlight the materials and methods applicable to different aspects that were observed.

2.1.1 Habitat characteristics and vegetation

The habitat was investigated by noting habitat structure (rockiness, slope, plant structure/ physiognymy) as well as floristic composition. Voucher specimens of plant species were only taken where the taxonomy was in doubt and where the plant specimens were of significant relevance for invertebrate conservation. In this case no plant specimens were needed to be collected as voucher specimens or to be send to a herbarium for identification. A wealth of guides and detailed works of plant identifications, ecology and conservation is fortunately available and very useful. Field guides, biogeographic works, species lists, diagnostic outlines, conservation statuses and detail on specific plant groups were sourced from Court (2010), Germishuizen (2003), Germishuizen, Meyer & Steenkamp (2006), Goldblatt (1986), Goldblatt & Manning (1998), Jacobsen (1983), Manning (2003), Manning (2009), McMurtry, Grobler, Grobler & Burns (2008), Pooley (1998), Retief & Herman (1997), Smit (2008), Van Ginkel, Glen, Gordon-Gray, Cilliers, Muasya & Van Deventer (2011), Van Jaarsveld (2006), Van Oudtshoorn (1999), Van Wyk (2000), Van Wyk & Smith (2001), Van Wyk & Smith (2003), Van Wyk & Malan (1998) and Van Wyk & Van Wyk (2013). Lists of species, species names and the conservation status of species were mainly sourced from Raimondo, von Staden, Victor, Helme, Turner, Kamundi & Manyama (2009) and updated versions of red lists and species from the Threatened Species Programme of SANBI and the Red List of South African Plants (sanbi.org.za).

2.1.2 Mammals

Mammals were noted as sight records by day. For the identification of species and observation of diagnostic characteristics Smithers (1986), Skinner & Chimimba (2005), Cillié, Oberprieler and Joubert (2004) and Apps (2000) are consulted. Sites have been walked, covering as many habitats as possible. Signs of the presence of mammal species, such as calls of animals, animal tracks (spoor), burrows, runways, nests and faeces were recorded. Walker (1996), Stuart & Stuart (2000) and Liebenberg (1990) were consulted for additional information and for the identification of tracks and signs. Because of the type of threatened mammals that are assessed in the local area such as the blackfooted cat and golden moles or rough-haired golden moles which are not to be trapped in normal way, the poor trapping records of species in question such as the White-tailed Mouse as well as the similarity of terrestrial habitats and lack of unique habitats at the sites, trapping was not done since it was not deemed necessary in the case of this study. The focus has been on signs and surveying habitat characteristics to note potential occurrences of mammals of particular conservation concern. Habitat characteristics were also surveyed to note potential occurrences of mammals. Many mammals can be identified from field sightings but, with a few exceptions bats, rodents and shrews can only be reliably identified in the hand, and even some species needs examination of skulls, or even chromosomes (Apps, 2000).

2.1.3 Avifauna

A specific avifaunal study has been conducted for the assessment of birds at the site (see avifaunal study).

2.1.4 Reptiles

Reptiles were noted as sight records in the field. Binoculars (10x30) can also be used for identifying reptiles of which some are wary. For practical skills of noting diagnostic characteristics, the identification of species and observation techniques, Branch (1998), Marais (2004), Alexander & Marais (2007) and Cillié, Oberprieler and Joubert (2004) were followed. The Atlas and Red List of Reptiles of South Africa, Lesotho and South Africa (Bates, Branch, Bauer, Burger, Marais, Alexander & de Villiers, 2014) has been used as the main source to compile the list for assessment. Sites were walked, covering as many habitats as possible. Smaller reptiles are sometimes collected for identification, but this practice was not necessary in the case of this study. Habitat characteristics are surveyed to note potential occurrences of reptiles.

2.1.5 Amphibians

Frogs and toads are noted as sight records in the field or by their calls. For practical skills of noting diagnostic characteristics, the identification of species and observation techniques Carruthers (2001), Du Preez (1996), Conradie, Du Preez, Smith & Weldon (2006) and the recent complete guide by Du Preez & Carruthers (2009) are consulted. CD's with frog calls by Carruthers (2001) and Du Preez & Carruthers (2009) are used to identify species by their calls when applicable. Sites are walked, covering as many habitats as possible. Smaller frogs are often collected by pitfall traps put out for epigeal invertebrates (on the soil), but this practice falls beyond the scope of this survey. Habitat characteristics are also surveyed to note potential occurrences of amphibians.

2.1.6 Butterflies

Butterflies were noted as sight records or voucher specimens. Voucher specimens are mostly taken of those species of which the taxa warrant collecting due to taxonomic difficulties or in the cases where species can look similar in the veldt. Many butterflies use only one species or a limited number of plant species as host plants for their larvae. Myrmecophilous (ant-loving) butterflies such as the *Aloeides*, *Chrysoritis*, *Erikssonia, Lepidochrysops* and *Orachrysops* species (Lepidoptera: Lycaenidae), which live in association with a specific ant species, require a unique ecosystem for their survival (Deutschländer & Bredenkamp, 1999; Terblanche, Morgenthal & Cilliers, 2003; Edge, Cilliers & Terblanche, 2008; Gardiner & Terblanche, 2010). Known food plants of butterflies were therefore also recorded. After the visits to the site and the identification of the butterflies found there, a list was also compiled of butterflies that will most probably be found in the area in all the other seasons because of suitable habitat. The emphasis of this study remains a habitat survey that focuses on the likelihood of occurrence of threatened, near threatened or rare butterfly species.

2.1.7 Fruit chafer beetles

Different habitat types in the areas were explored for any sensitive or special fruit chafer species. Selection of methods to find fruit chafers depends on the different types of habitat present and the species that may be present. Fruit bait traps would probably not be successful for capturing *Ichnestoma* species in a grassland patch (Holm & Marais 1992). Possible chafer beetles of high conservation priority were noted as sight records accompanied by the collecting of voucher specimens with grass nets or containers where deemed necessary.

2.1.8 Rock scorpions

Relatively homogenous habitat / vegetation areas were identified and explored to identify any sensitive or special species. Selected stones that were lifted to search for Arachnids were put back very carefully resulting in the least disturbance possible. All the above actions were accompanied by the least disturbance possible.

2.1.9 Wetland assessment

A desktop study comprised not only an initial phase, but also it was used throughout the study to accommodate and integrate all the data that became available during the field observations.

Classification of any inland wetland systems that could be present at the site is according to the Classification System for Wetlands and other Aquatic Ecosystems in South Africa (Ollis *et al*., 2013). One of the major advantages of the Classification System for South Africa (Ollis *et al*., 2013) is that the functional aspects of wetlands are the focal point of the classification. Wetlands are very dynamic systems and their functionality weighs high against the rapid changes in their appearance often witnessed (Terblanche *In prep*). In this document the main guideline for the delineation and identification of wetlands where present is the practical field procedure for identification and delineation of wetlands by DWAF (2005).

The following sections highlight the materials and methods applicable to different aspects that were observed.

Classification of wetlands (SANBI: Ollis *et al*., 2013)

System, regional setting and landscape unit (Levels 1, 2 and 3)

Three broad types of Inlands Systems are dealt with in the Classification System namely rivers, open waterbodies and wetlands. These Inland Systems are then classified according to a six-tiered structure that includes six levels.

At the systems level (Level 1) of wetland classification, a distinction is made between Marine, Estuarine and Inland ecosystems using the level of connectivity to the open ocean as discriminator of the biophysical character of each (Ollis *et al*., 2013). Inland wetland systems are aquatic ecosystems with no no existing connection to the ocean (i.e. characterised by the complete absence of marine exchange and/ or tidal influence (Ollis *et al*., 2013). In this case if any wetland is present it obviously qualifies as an Inland wetland system.

At Level 2 the regional setting is a spatial framework that is preferred by the investigator to allow for gaining an understanding of the broad ecological context within which an aquatic system occurs (Ollis *et al*., 2013). A regional setting can be identified according to the DWA ecoregion classification of Kleynhans *et al.* (2005).

A distinction is made between four landscape units at Level 3 of the Classification System for Inland Systems on the basis of the landscape setting (i.e. topographical position) (Ollis *et al*., 2013). Four landscape units are recognized: slope, valley floor, plain and bench.

Hydrogeomorphic units (Level 4)

Seven primary hydrogeomorphic (HGM) units are recognised for Inland Systems at Level 4A of the Classification System for Wetlands and other Aquatic Ecosystems in South Africa, on the basis of hydrology and geomorphology (Ollis *et al*., 2013). These are a River, Channeled valley-bottom wetland, Unchannelled valley-bottom wetland, Floodplain wetland, Depression, Seep and Wetland flat.

Hydrological regime (Level 5)

While the hydrogeomorphic unit (HGM) is influenced by the source of water and how it moves into, through and out of an Inland System, the hydrological regime (as catergorised by the Classification System) describes the behaviour fo the water within the system and, for wetlands, in the underlying soil (Ollis *et al.,* 2013). Together with the hydrogeomorphology the hydrological regime are used to describe the wetland as a functional unit (Ollis *et al*., 2013). In the case of Inland wetlands which are classified as rivers, perenniality is an important characteristic to describe the hydrological regime. For Inland Systems other than rivers, five categories relating to the frequency and duration of inundation have been provided: Permanently inundated, Seasonally inundated, Intermittently inundated, Never inundated/ rarely inundated and unknown (Ollis *et al*., 2013). Period of saturation within the upper 0.5 m of the soil is a very important discriminator that also links to the wetland delineation system of DWAF (2005). The following categories for saturation of wetland soils are recognised: Permanently saturated, Seasonally saturated, Intermittently saturated and unknown. These categories of period of saturation correspond to the permanent, seasonal and temporary zones of wetlands respectively.

Wetland descriptors (Level 6)

At Level 6 several “descriptors” are included for the structural/ chemical/ biological characterisation of Inland Systems (Ollis *et al.,* 2013). These descriptors are non-hierarchical to one another and can be applied in any order depending on the purpose of a study and the availability of information. Descriptors include natural vs. artificial, salinity, substratum type, pH, geology and vegetation cover (Ollis *et al*., 2013). Various definitions are given for the descriptors which are likely to increase the consistency and use of the system.

Delineation of wetland

Together with terrain unit, indirect indicators of prolonged saturation by water: wetland plants (hydrophytes) and wetland (hydromorphic) soils are identified and used to delineate the wetland (DWAF 2005). Three zones, which may not all three be present in all wetlands, namely the permanent zone of wetness, the seasonal zone and the temporary zone are identified. The temporary zone is the outer zone and is saturated for only a short period of the year that is sufficient, under normal circumstances, for the formation of hydromorphic soils and the growth of wetland vegetation (DWAF 2005). Hydromorphic soils must display signs of wetness within 50cm of the soil to qualify as wetland soil that can support hydrophytic vegetation. Grid references and altitudes are taken on site with a GPS Garmin E-trex 20 ® instrument. Map information are analysed and depicted on Google images with the aid of Google Earth Pro (US Dept. of State Geographer, MapLink/ Tele Atlas, Google, 2018).

2.1.10 Limitations

For each site visited, it should be emphasized that surveys can by no means result in an exhaustive list of the plants and animals present on the site, because of the time constraint. Also, for the counts of trees an approximation rather than exact abundances is given though some quantitative counts were conducted to groundtruth the estimates. There are many invertebrate groups with huge taxonomic and biogeographic impediments which further add to limitations of present surveys.

The site surveys were conducted during September 2016, October 2016, June 2018 and July 2018 which include optimal and sub-optimal times of the season to find sensitive plant and animal species of high conservation priority. Weather conditions during the surveys were favourable for recording fauna and flora. Notes and experience from earlier surveys at the Taung-Vryburg area by R.F. Terblanche that had taken place on July 2011, November 2011, January 2012, February 2012, August 2013, December 2013, January 2014, November 2014, November 2015 and January 2016 were also taken into account where applicable. Visits and research of the past at areas where Camel Thorn Forests are found such as Kathu and Witsand Nature Reserve were also valuable as benchmarks for the assessments of Camel Thorn trees at the site. The focus of the present survey remains a habitat survey that concentrates on the possibility that species of particular conservation priority occur on the site or not. It is unlikely that any more visits would reveal information that would change the outcome of this assessment both in terms of ecosystems of special conservation concern or suitable habitats of species of particular conservation concern. Visits that were conducted therefore appear to be sufficient to address the objectives of this study.

2.2 Information Sources

THREATENED ECOSYSTEMS, ECOSYSTEM/ BIODIVERSITY AREAS OF SPECIAL IMPORTANCE

- Key literature and maps: Threatened Ecosystems, Vegetation types and Regions of Floristic Endemism.
    - SANBI BGIS (South African National Biodiversity Institute: Biodiversity GIS. 2018. bgis.sanbi.org/. North West Biodiversity Sector Plan, 2015. Planning Units, Terrestrial Critical Biodiversity Areas and Aquatic Critical Biodiversity Areas.
    - North West Department of Rural, Environmental and Agricultural Development (READ). 2015. North West Biodiversity Sector Plan. North West Provincial Government, Mahikeng, December 2015.
    - National Vegetation Map beta 2. 2012. SANBI BGIS (South African National Biodiversity Institute: Biodiversity GIS). 2018. bgis.sanbi.org/.
    - Mucina, L. & Rutherford, M.C. eds. 2006. The vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19. Pretoria: South African National Biodiversity Institute.
    - Mucina, L., Rutherford, M.C., and Powrie, L.W. eds. 2005. Vegetation map of South Africa, Lesotho and Swaziland, 1:1 000 000 scale sheet maps. Pretoria: South African National Biodiversity Institute.
    - Mucina, L., Rutherford, M.C., Powrie, L.W., van Niekerk, A. & van der Merwe, J.H. (eds.). 2014. Vegetation Field Atlas of Continental South Africa, Lesotho & Swaziland. Strelitzia 33. South African National Biodiversity Institute, Pretoria.

- Van Wyk, A.E. & Smith, G.F. 2001. Regions of floristic endemism in Southern Africa: a review with emphasis on succulents, Umdaus Press, Pretoria.
- Nel, J.L., Driver, A., Strydom, W.F., Maherry, A.M., Petersen, C.P., Hill, L., Roux, D.J., Nienaber, S., Van Deventer, H., Swartz, E.R. & Smith-Adao, L.B. 2011a. Atlas of Freshwater Ecosystem Priority Areas in South Africa: Maps to support sustainable development of water resources. WRC Report No. TT 500/11. Water Research Commission, Pretoria.
- Nel, J.L., Murray, K.M., Maherry, A.M., Petersen, C.P., Roux, D.J., Driver, A., Hill, L., Van Deventer, H., Funke, N., Swartz, E.R., Smith-Adao, L.B., Mbona, N., Downsborough, L. & Nienaber, S. 2011b. Technical Report for the Freshwater Ecosystem Priority Areas Project. WRC Report No. TT 1801/2/11. Water Research Commission, Pretoria.

SENSITIVE SPECIES

- Key literature about red listing and extinction risk assessments of species (Threatened, Near-threatened, Rare, Declining, Data Deficient and Least Concern) and updates of the extinction risk assessments on the internet:
  - Bates, M.F., Branch, W.R., Bauer, A.M., Burger, M., Marais, J., Alexander, G.J. & De Villiers, M.S. (eds). 2014. Atlas and Red List of the Reptiles of South Africa, Lesotho and Swaziland. *Suricata* 1. South African National Biodiversity Institute, Pretoria.
  - Henning, G.A., Terblanche, R.F. & Ball, J.B. (eds) 2009. South African Red Data Book: butterflies. *SANBI Biodiversity Series No 13.* South African National Biodiversity Institute, Pretoria.
  - Mecenero, S., Ball, J.B., Edge, D.A., Hamer, M.L., Henning, G.A., Krüger, M, Pringle, E.L., Terblanche, R.F. & Williams, M.C. 2013. *Conservation Assessment of Butterflies of South Africa, Lesotho and Swaziland: Red List and Atlas.* Saftronics, Johannesburg & Animal Demography Unit, Cape Town.
  - Minter, L.R., Burger, M., Harrison, J.A., Braack, H.H., Bishop, P.J. & Kloepfer, D. *eds.* 2004. Atlas and Red Data Book of the Frogs of South Africa, Lesotho and Swaziland. SI/MAB series 9, Smithsonian Institution, Washington DC.
  - Raimondo, D., Von Staden, L., Foden, W., Victor, J.E., Helme, N.A., Turner, R.C., Kamundi, D.A. & Manyama, P.A. (eds). 2009. Red list of South African Plants 2009. *Strelitzia* 25. South African National Biodiversity Institute, Pretoria.
  - IUCN Red List: Mammals: www.iucnredlist.org/initiatives/mammals. Examples: Coetzee, N. & Monadjem, A. 2008. *Mystromys albicaudatus*. In: IUCN 2012. IUCN Red List of Threatened Species. Version 2012.2. <www.iucnredlist.org>. Sliwa, A. 2008. *Felis nigripes*. In: IUCN 2012. IUCN Red List of Threatened Species.

SPECIES: EXAMPLES OF LITERATURE ABOUT IDENTIFICATIONS AND HABITAT INFORMATION

- Literature about habitat information of particular threatened species or species of a taxonomic group:
  - Deutschländer, M.S. & Bredenkamp, C.J. 1999. Importance of vegetation analysis in the conservation management of the endangered butterfly *Aloeides dentatis* subsp. *dentatis* (Swierstra) (Lepidoptera: Lycaenidae). *Koedoe* 42(2): 1-12.
  - Edge, D.A., Cilliers, S.S. & Terblanche, R.F. 2008. Vegetation associated with the occurrence of the Brenton blue butterfly. *South African Journal of Science* 104: 505 - 510.
  - Du Preez, L.H. & Carruthers, V. 2009. A complete guide to the frogs of southern Africa. Struik Nature, Cape Town. CD with calls included.
  - Terblanche, R.F., Morgenthal, T.L. & Cilliers, S.S. 2003. The vegetation of three localities of the threatened butterfly species *Chrysoritis aureus* (Lepidoptera: Lycaenidae). *Koedoe* 46(1): 73-90.
  - Terblanche, R.F. & Taylor, J.C. 2000. Notes on the butterflies of Witsand – a unique terrestrial island in the Northern Cape Province, South Africa – with special reference to two RED DATA BOOK butterfly species. *Metamorphosis* 11(3): 122-131.

2.3 Assumptions, Knowledge Gaps and Limitations

For each site visited, it should be emphasized that surveys can by no means result in an exhaustive list of the plants and animals present on the site, because of the time constraint. There are many invertebrate groups with huge taxonomic and biogeographic impediments which further add to limitations of conservation status and ecological assessments. Any ecological assessment, given the infinite number of ecological factors and the unique history of each site, could never be considered totally complete.

2.4 Consultation Processes Undertaken

No specific consultation process has been undertaken.

3. DESCRIPTION OF PROJECT ASPECTS RELEVANT TO ECOLOGICAL IMPACTS

No specific aspects of other specialist studies are in particular added to the impact assessments. Mitigations from Avifauna study should be taken into account for the ecological part of the environmental impact assessment. A separate avifauna study has been undertaken and should be consulted.

4. DESCRIPTION OF THE RECEIVING ENVIRONMENT

4.1 Baseline Environmental Description

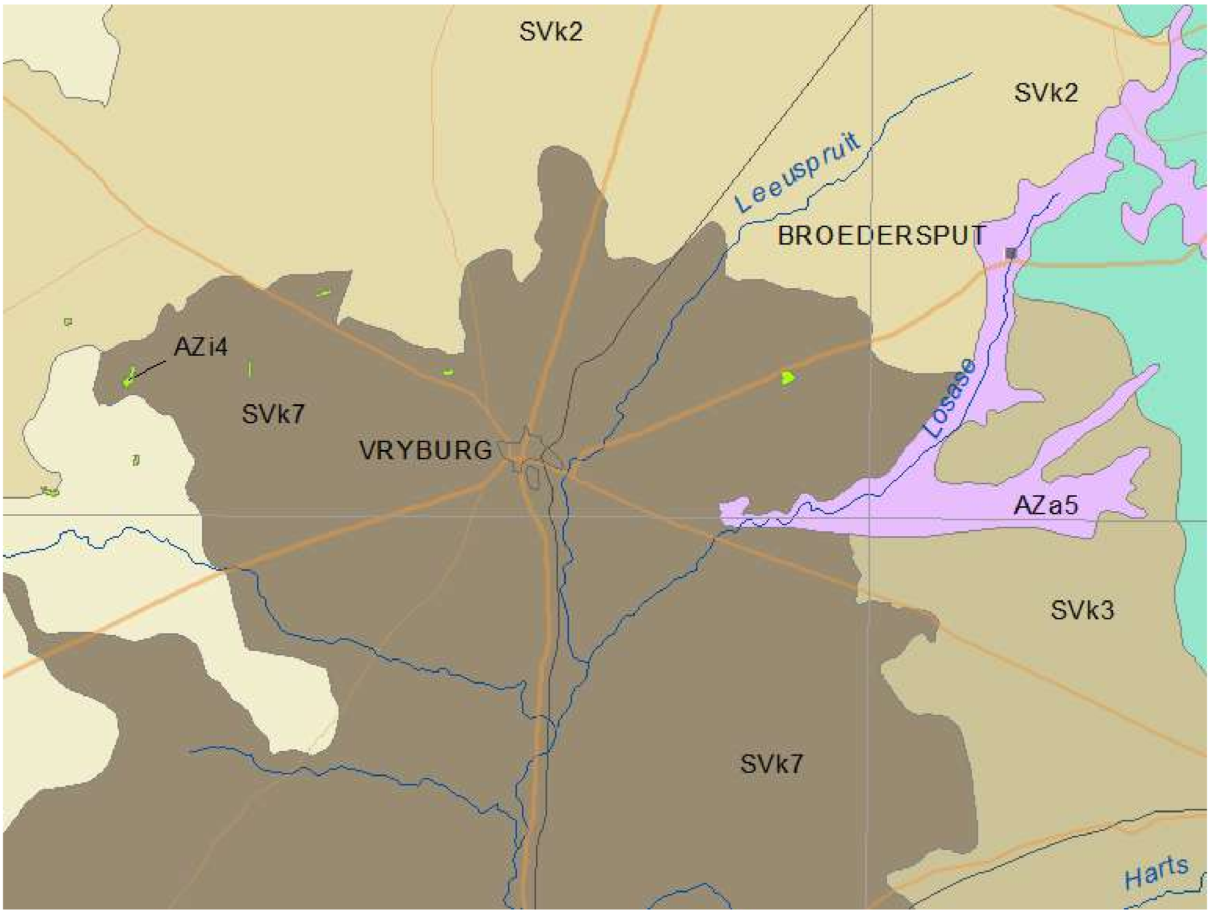

Figure 2 Map with indication of vegetation types in the Vryburg area (Mucina & Rutherford, 2006). Vegetation type at site, which is located southwest and south-southwest of Vryburg, is SVk 7, Ghaap Plateau Vaalbosveld (indicated by dark brown on the map).

Sources:

- National Vegetation Map beta 2. 2012. SANBI BGIS (South African National Biodiversity Institute: Biodiversity GIS). 2018. bgis.sanbi.org/.
- Mucina, L. & Rutherford, M.C. *eds*. 2006. The vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19. Pretoria: South African National Biodiversity Institute.
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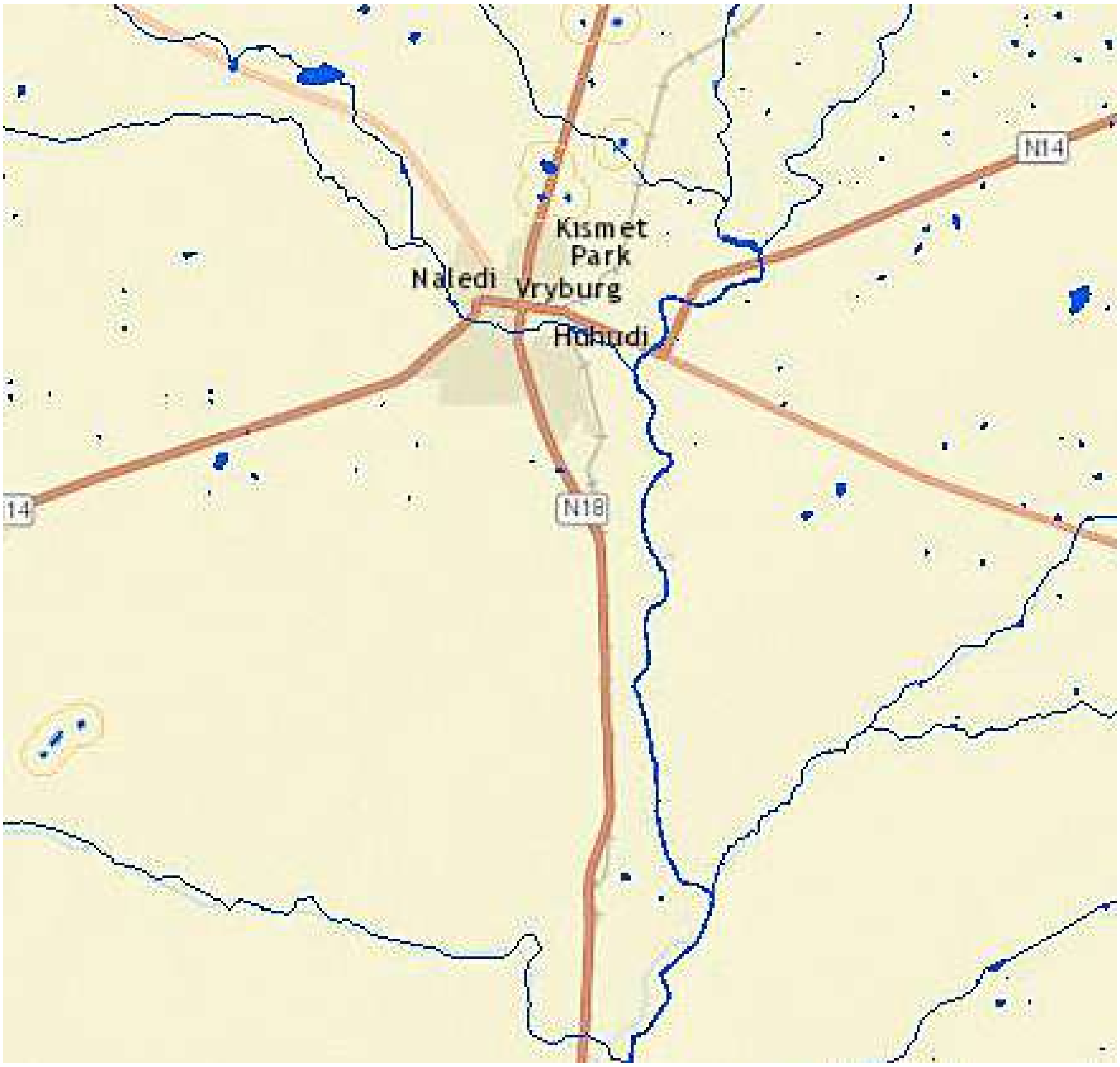

Figure 3 Map with indications of wetlands of freshwater ecosystem priority areas in the larger area. Site is part of the Lower Vaal Water Management Area (WMA 10). The site is not part of a Freshwater Ecosystem Priority Area (FEPA) or wetland cluster (Nel et al., 2011a; Nel et al., 2011b). By no means could the small depression at the site be classified or regarded as anything similar in scale to for example Southern Kalahari Salt Pans or Southern Kalahari Mekgacha which are described in Mucina & Rutherford (2006).

Sources:

- North West Department of Rural, Environmental and Agricultural Development (READ). 2015. North West Biodiversity Sector Plan. North West Provincial Government, Mahikeng, December 2015.
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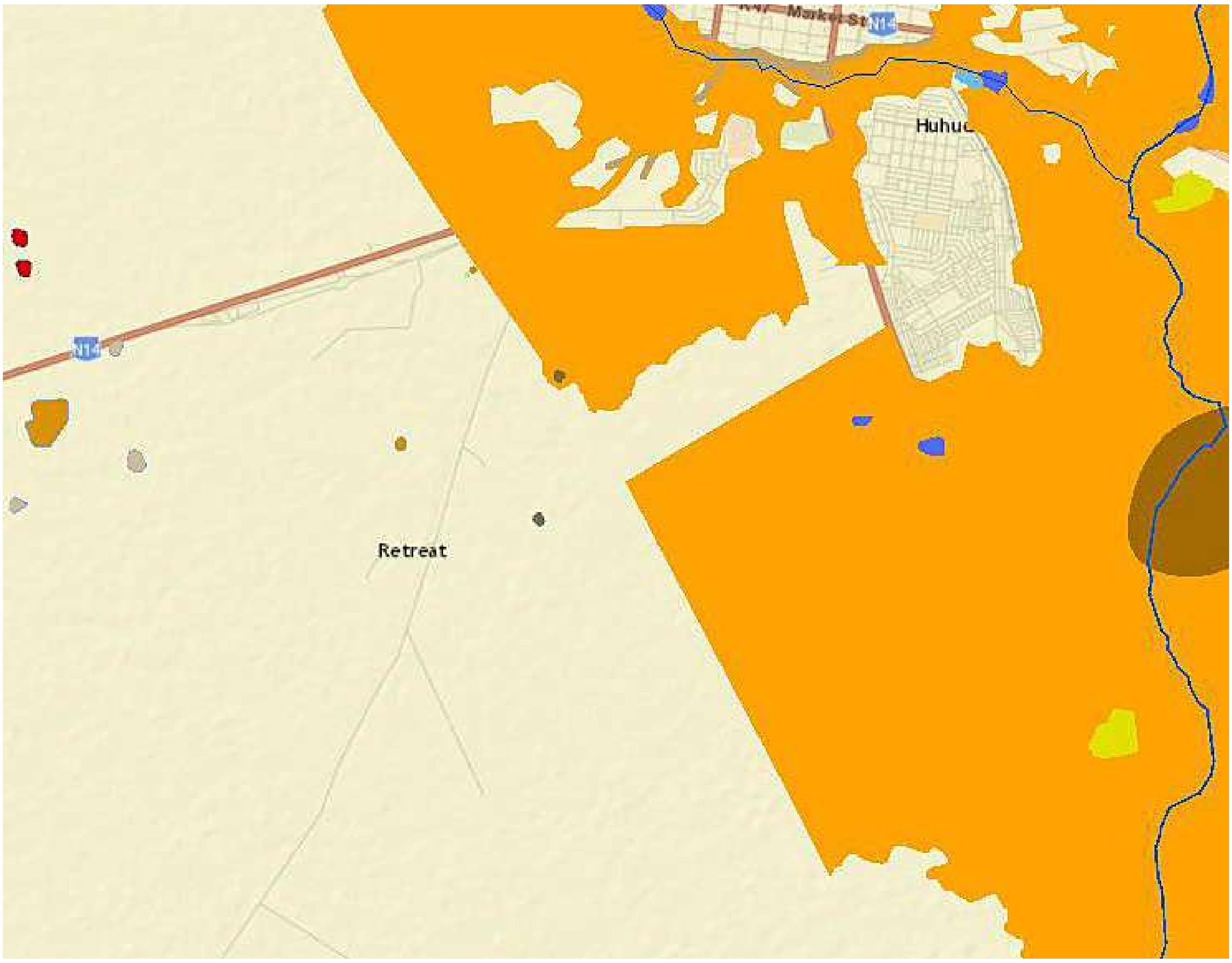

Figure 4 Map with indications of Biodiversity Areas according to North West Biodiversity Sector Plan (2015). According to North West Biodiversity Sector Plan (2015) the site is part of other natural areas (pale areas in map) and is not part of any Critical Biodiversity Area. A small section of the proposed powerline infrastructure reaches into an Ecological Support Area 2 and not any Critical Biodiversity Area (orange area in map).

Sources:
- North West Department of Rural, Environmental and Agricultural Development (READ). 2015. North West Biodiversity Sector Plan. North West Provincial Government, Mahikeng, December 2015.
- SANBI BGIS (South African National Biodiversity Institute: Biodiversity GIS. 2018. bgis.sanbi.org/.

The study area is 8 km southwest of Vryburg in the North West Province. The site is situated at the Savanna Biome which is represented by the Ghaap Plateau Vaalbosveld vegetation type (Mucina & Rutherford 2006). A brief overview of SVk 7, the Ghaap Plateau Vaalbosveld vegetation type in which the site is located, follows:

SVk 7 Ghaap Plateau Vaalbosveld

Distribution: In South Africa the Ghaap Plateau Vaalbosveld is found in the Northern Cape and North-West Provinces: Flat plateau from around Campbell in the south, east of Danielskuil through Reivilo to around Vryburg in the north. Altitude at the Ghaap Plateau Vaalbosveld is 1100 – 1500 m.

Vegetation and landscape features: Flat plateau with well-developed shrub layer with *Tarchonanthus camphoratus* and Vachellia *karroo* [*Acacia karroo*]. Open tree layer has *Olea europaea* subsp. *africana*, *Vachellia tortilis* [*Acacia tortilis*], *Ziziphus mucronata* and *Searsia lancea* [*Rhus lancea*]. *Olea europaea* subsp. *africana* is more important in the southern parts of the unit, while *Vachellia tortilis* [*Acacia tortilis*], *Vachellia hebeclada* [*Acacia hebeclada*] and *Senegalia mellifera* [*Acacia mellifera*] are more important in the north and part of the west of the unit. Much of the south-central part of this unit has remarkably low cover of *Vachellia* [Acacia] and *Senegalia* [*Acacia*] species for an arid savanna and is dominated by the nonthorny *Tarchonanthus camphoratus*, *Searsia lancea*, and *Olea europaea* subsp. *africana* (Mucina & Rutherford 2006).

Geology and soils: Surface limestone of Tertiary to Recent age, and dolomite and chert of the Campbell Group (Griqualand West Supergroup, Vaalian Erathem) support shallow soils (0.1-0.25 m) of Mispah and Hutton soil forms. Land types mainly Fc with some Ae and Ag (Mucina & Rutherford, 2006).

Climate: Climate is characterized by summer and autumn rainfall and very dry winters. Mean annual precipitation from about 300 mm in the southwest to about 500 mm in the northeast. Frost is frequent to very frequent in winter (Mucina & Rutherford 2006).

Important taxa of the Ghaap Plateau Vaalbosveld listed by Mucina & Rutherford (2006): Tall Tree: *Vachellia* erioloba [*Acacia erioloba*]. Small Trees: *Senegalia mellifera* subsp. *detinens* [*Acacia mellifera* subsp. *detinens*], *Searsia lancea, Vachellia karroo* [*Acacia karroo*], *Vachellia tortilis* subsp. *heteracantha* [*Acacia tortilis* subsp. *heteracantha*], *Boscia albitrunca.* Tall Shrubs: *Olea europaea* subsp. *africana, Rhigozum trichotomum, Tarchonanthus camphoratus, Ziziphus mucronata, Diospyros pallens*, *Ehretia rigida* subsp. *rigida* (this species complex has been revised and the *Ehretia alba* is the species that occurs at the vegetation type, R.F. Terblanche pers. obs.), *Euclea crispa* subsp. *ovata, Grewia flava, Gymnosporia buxifolia, Lessertia frutescens, Searsia tridactyla.* Low Shrubs: *Acacia hebeclada* subsp. *hebeclada, Aptosimum procumbens, Chrysocoma ciliata, Helichrysum zeyheri, Hermannia comosa, Lantana rugosa, Leucas capensis, Melolobium microphyllum, Peliostomum leucorrhizum, Pentzia globosa, Pentzia viridis, Zygophyllum pubescens.* Succulent Shrubs: *Hertia pallens, Lycium cinereum.* Semi-parasitic Shrub: *Thesium hystrix*. Woody Climber: *Asparagus africanus*. Graminoids: *Anthephora pubescens, Cenchrus ciliaris, Digitaria eriantha* subsp. *eriantha, Enneapogon scoparius, Eragrostis lehmanniana, Schmidtia pappophoroides, Themeda triandra, Aristida adscensionis, Aristida congesta, Aristida diffusa, Cymbopogon pospischilii, Enneapogon cenchroides, Enneapogon desvauxii, Eragrostis echinochloidea, Eragrostis obtusa, Eragrostis rigidior, Eragrostis superba, Fingerhutia africana, Heteropogon contortus, Sporobolus fimbriatus, Stipagrostis uniplumis, Tragus racemosus.* Herbs: *Barleria macrostegia, Geigeria filifolia, Geigeria ornativa, Gisekia africana, Helichrysum cerastoides, Heliotropium ciliatum, Hermbstaedtia odorata, Hibiscus marlothianus, Hibiscus pusillus, Jamesbrittenia aurantiaca, Limeum fenestratum, Lippia scaberrima, Selago densiflora, Vahlia capensis* subsp. *vulgaris.* Succulent herb: *Aloe grandidentata*.

Note: Though many of the above plant species occur at the site, not all of them necessarily occur at the site.

4.2 Site specific outline of vegetation and habitat

- Vegetation at the site is an open savanna where *Tarchonanthus camphoratus* (Camphor Bush) and *Grewia flava* (Velvet Raisin) are visibly frequent while some taller indigenous *Vachellia* and *Searsia* are dotted or in clumps across the flat landscape. Other indigenous tree species at the site include *Vachellia tortilis* subsp. *heteracantha* (Umbrellla Thorn), *Searsia lancea* (Karee), *Senegalia mellifera* subsp. *detinens* (Black Thorn), *Ziziphus mucronata* (Buffalo-thorn), *Vachellia erioloba* (Camel Thorn), *Ehretia alba* (White Puzzlebush), *Vachellia karroo* (Sweet Thorn) *Vachellia hebeclada* subsp. *hebeclada* (Candlepod Thorn). The declared alien invasive plant species, *Prosopis glandulosa* (Mesquite) are encountered at some parts of the site. Shrublets *Ziziphus zeyheriana* (Dwarf Buffalo-thorn) and *Gnidia polycephala* are present at the site. Dwarf shrub *Pentzia calcarea* is widespread at the site. Indigenous herbaceous plant species at the site include *Helichrysum cerastoides*, *Barleria macrostegia* and *Salvia disermas*. Indigenous grass species include *Eragrostis lehmanniana, Schmidtia pappophoroides, Digitaria eriantha, Aristida congesta, Cymbopogon pospischilii, Stipagrostis uniplumis, Themeda triandra, Cynodon dactylon, Fingerhuthia africana, Aristida adscensionis, Enneapogon cenchroides, Elionurus muticus* and *Tragus racemosus.*
- Site is at very gentle slopes (flat). No rocky ridges appear to be present at the site.
- No wetlands appear to be present at the site.
- Typical infrastructure being associated with a farming area, such as tracks, roads, small concrete dams and fences are present at the site. The declared alien invasive species, *Prosopis glandulosa* (Mesquite) is found singly or in small clumps at some places at the site. Alien invasive weeds are found at hitherto cleared or ecologically disturbed areas.

Photo 1 Site is on very gentle slopes (flat). Open grassland patches are found in between mainly shrub-height savanna.

Photo: R.F. Terblanche.

Photo 2 View of part of the site where a taller *Vachellia karroo* (Sweet Thorn) tree is found among shrub-height *Tarchonanthus camphoratus* (Camphor Bush) and *Grewia flava* (Velvet Raisin).

Photo: R. F. Terblanche.

Photo 3 Concrete farm dam and *Searsia lancea* (Karee) trees at the site.

Photo: R.F. Terblanche.

Photo 4 Alien invasive *Prosopis glandulosa* (Mesquite) trees at concrete structure and fence at the site.

Photo: R.F. Terblanche.

Photo 5 Alien invasive *Prosopis glandulosa* tree at the site.

Photo: R.F. Terblanche.

Photo 6 Small *Vachellia erioloba* (Camel Thorn Tree) at the site.

Photo: R.F. Terblanche.

4.2.1 Wetland assessment: Absence of wetlands at the site

Wetlands such as floodplain wetlands, channelled valley-bottom wetlands, unchannelled valley-bottom wetlands, depressions, seeps and wetland flats appear to be absent at the site.

4.3 Identification of Environmental Sensitivities

Ecological sensitivity at the site is medium (Figure 6).

Rationale for this ecological sensitivity assessment:

- Terrestrial ecosystems: There are no distinct indications of any terrestrial ecosystems of particular conservation concern at the site. The vegetation type that represents the Savanna Biome at the site, Ghaap Plateau Vaalbosveld (SVk 7), is not listed as threatened ecosystem according to the National List of Threatened Ecosystems (2011). According to North West Biodiversity Sector Plan (2015) the site is part of other natural areas and is not part of any Critical Biodiversity Area. A small section of the proposed powerline infrastructure reaches an Ecological Support Area 1 and not any Critical Biodiversity Area (Figure 4).
- Aquatic ecosystems: Wetlands such as floodplain wetlands, channelled valley-bottom wetlands, unchannelled valley-bottom wetlands, depressions, seeps and wetland flats appear to be absent at the site.
- Sensitive species: Presence of Threatened or Near-Threatened Mammals, Reptiles, Amphibians and Invertebrates at the site appear to be unlikely. The Protected tree species found at the site, *Vachellia erioloba* (Camel Thorn), is listed as a Declining (not Threatened) plant species. *Vachellia erioloba* occurs in low numbers at the site. A total of 80 individual *Vachellia erioloba* trees higher than 2 m has been counted at the proposed footprint of the photovoltaic facility which amounts to an average of 0,3/ ha. Less than 100 trees are present at the footprint proposed for the photovoltaic facility which is much lower than many areas around Vryburg and many other parts of the Eastern Kalahari Bushveld Bioregion (Terblanche pers. obs.). *Vachellia erioloba* individuals at the site are not particularly large (no tree taller than 10 m) and are not part of a camel thorn forest of note (Reference points: large camel thorn forest at Kathu and smaller Camel Thorn forest at Witsand Nature Reserve visited by R.F. Terblanche in the past). It is recommended that a permit should be applied for at the relevant authorities in case any removal or damage of Camel Thorn trees.
- Connectivity and corridors: There are no indications of any particular linked or stepping stone corridors of particular conservation importance at the site.

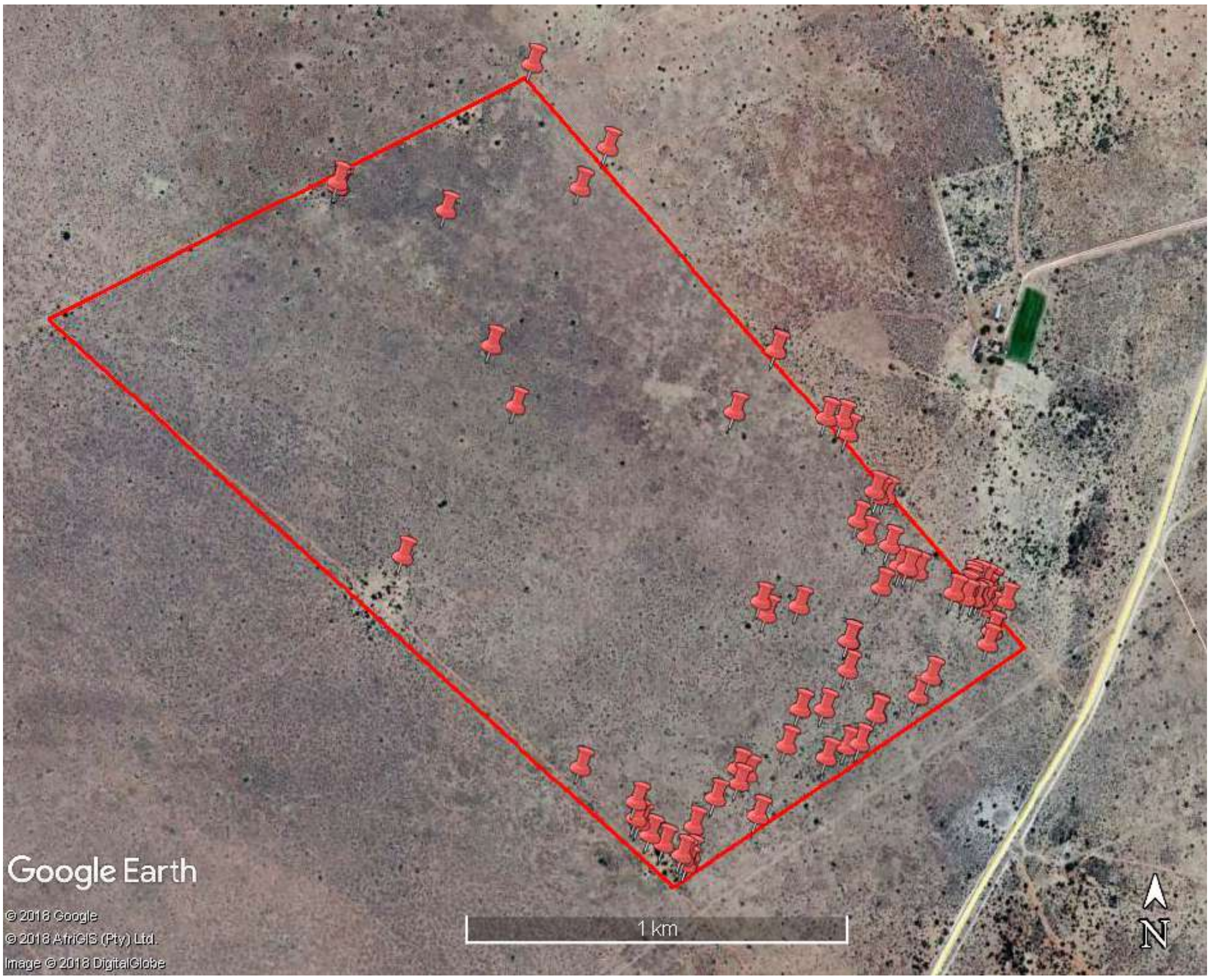

Figure 5 Indication of presence of individuals of *Vachellia erioloba*, Camel Thorn, above 2 m in height, at the site. *Vachellia erioloba* is a Protected tree species which is not Threatened but which is listed as Declining.

Red Markers: Indication of presence of individual *Vachellia erioloba* trees > 2 m in height.

▬▬	Red outline	Boundaries of the site

Grid references and altitudes were taken at site with a GPS Garmin E-trex 20 ® instrument. Map information were analysed and depicted on Google images with the aid of Google Earth Pro (US Dept. of State Geographer, MapLink/ Tele Atlas, Google, 2018).

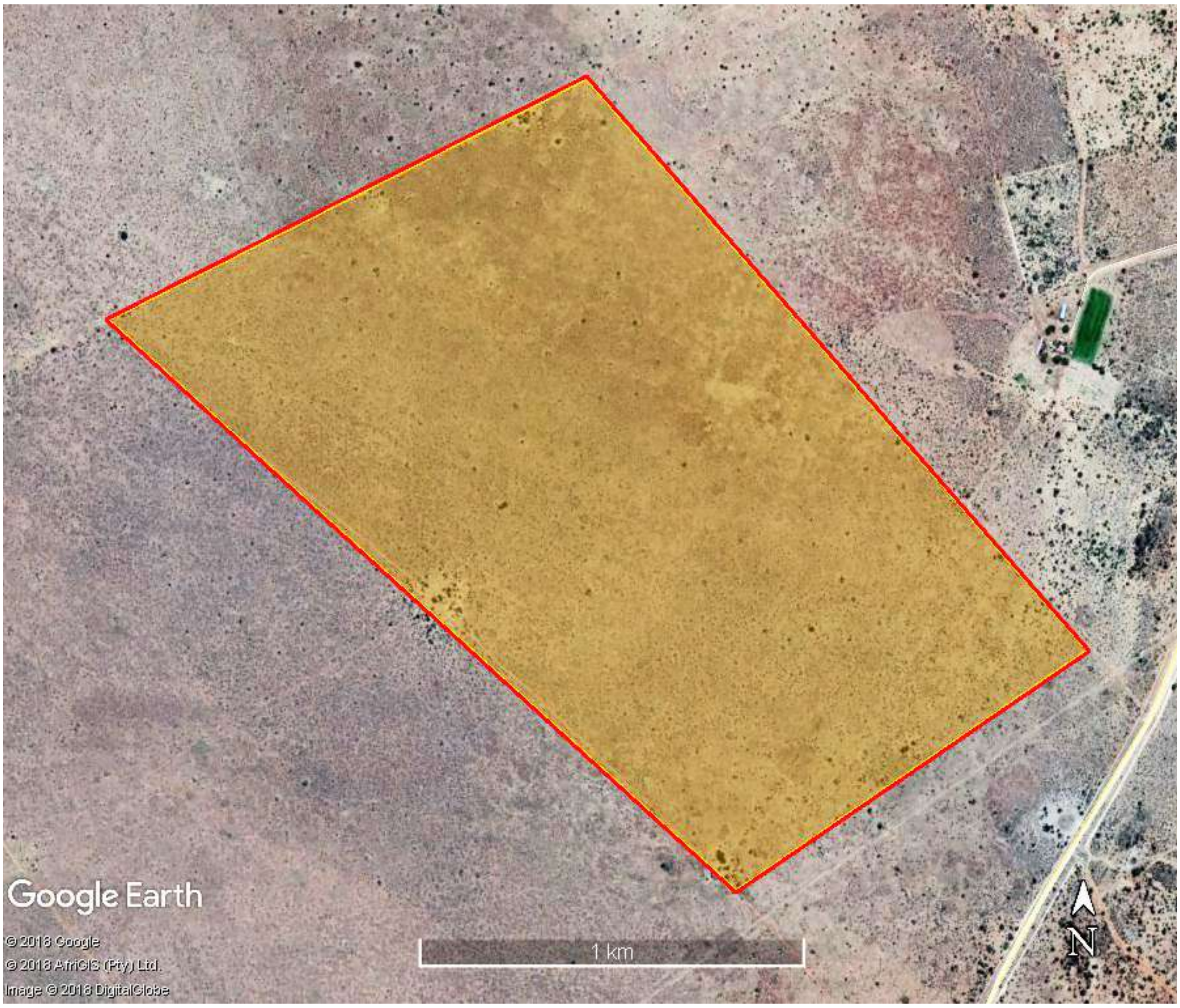

Figure 6 Ecological sensitivity at the site. Ecological sensitivity at the entire site is regarded as medium.

—	Red outline	Boundaries of the site
—	Orange-brown outline and shading	Medium Sensitivity

Grid references and altitudes were taken at site with a GPS Garmin E-trex 20 ® instrument. Map information were analysed and depicted on Google images with the aid of Google Earth Pro (US Dept. of State Geographer, MapLink/ Tele Atlas, Google, 2018).

5. ISSUES, RISKS AND IMPACTS

5.1 Summary of Issues identified during the Project Notification Phase

The potential ecological (botanical and zoological excluding avifauna) issues identified during the BA Process include:

- Loss of habitat owing to the removal of vegetation at the proposed photovoltaic facility.
- Loss of sensitive species (Threatened, Near-Threatened, Rare, Declining or Protected species).
- Loss of connectivity and conservation corridor networks in the landscape.
- An increased infestation of exotic or alien invasive plant species owing to disturbance.
- Contamination of soil during construction.

5.2 Identification of Potential Impacts/Risks

The potential impacts identified during the BA are:

Construction Phase
- Potential impact 1 Loss of habitat owing to the removal of vegetation at the proposed photovoltaic facility.
- Potential impact 2 Loss of sensitive species (Threatened, Near-Threatened, Rare, Declining or Protected species) during the construction phase.
- Potential impact 3 Loss of connectivity and conservation corridor networks in the landscape.
- Potential impact 4 An increased infestation of exotic or alien invasive plant species owing to disturbance.
- Potential impact 5 Contamination of soil during construction in particular by hydrocarbon spills.
- Potential impact 6 Killing of vertebrate fauna during the construction phase.

Operational Phase
- Potential impact 7 Continued loss of indigenous vegetation to poor recovery of vegetation at the proposed photovoltaic facility.
- Potential impact 8 An increased infestation of exotic or alien invasive plant species owing to disturbance.

Decommissioning Phase
- Potential impact 9 Poor recovery of habitat owing to clearance of site.
- Potential impact 10 An increased infestation of exotic or alien invasive plant species owing to clearance or disturbance where the footprint took place.
- Potential impact 11 Contamination of soil during decommissioning.

Cumulative Impacts
- Cumulative impact 1 Cumulative impacts to unique and sensitive habitats.
- Cumulative impact 2 Cumulative impacts to habitat fragmentation.
- Cumulative impact 3 Cumulative impacts of emissions and pollutants into air, water and soil.

6. IMPACT ASSESSMENT

6.1 Potential Impacts during the Construction Phase

Aspect/Activity	**Establishing access to site in site preparation process**
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Internal access roads will be required to access the individual components within the WEF and electrical infrastructure during the construction and operational phases. Use of existing farm tracks will be maximised, however, in some areas this might require the stripping of existing vegetation. This will entail the partial destruction of moderately sensitive habitat.
Status	Negative
Mitigation Required	Restrict stripping of existing vegetation for access roads. Maximise use of existing farm roads/ tracks or use shortest new route where practical.
Impact Significance (Pre-Mitigation)	Moderate (Level 3)
Impact Significance (Post-Mitigation)	Low (Level 4)
I&AP Concern	

Aspect/Activity	**Site clearance in preparation of site for inserting photovoltaic units**
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Clearing of vegetation at the proposed Photovoltaic Facility footprint. This will entail the partial destruction of moderately sensitive habitat.
Status	Negative
Mitigation Required	Rehabilitation and monitoring of vegetation following construction.
Impact Significance (Pre-Mitigation)	High (Level 2)
Impact Significance (Post-Mitigation)	Moderate (Level 3)
I&AP Concern	

Aspect/Activity	**Removal of sensitive species**
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Sensitive species: Presence of Threatened or Near-Threatened Mammals, Reptiles, Amphibians and Invertebrates at the site appear to be unlikely. Protected tree species at the site, *Vachellia erioloba* (Camel Thorn), is listed as a Declining (not Threatened) plant species. *Vachellia erioloba* occurs in low numbers at the site. Camel Thorn forests containing particularly large *Vachellia erioloba* individuals are absent at the site (Reference sites for such special Camel Thorn trees are Witsand Nature Reserve and Kathu Camel Thorn Forest visited/ researched in the past by the specialist).
Status	Negative
Mitigation Required	Planting of individual *Vachellia erioloba* trees at area which will not be affected and where practical.
Impact Significance (Pre-Mitigation)	Moderate (Level 3)
Impact Significance (Post-Mitigation)	Low (Level 4)
I&AP Concern	

Aspect/Activity	**Fragmentation of corridors of particular conservation concern**
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	There are no indications of any particular linked or stepping stone corridors of particular conservation importance at the site.
Status	Negative
Mitigation Required	Restrict impacts to proposed footprints.
Impact Significance (Pre-Mitigation)	Moderate (Level 3)
Impact Significance (Post-Mitigation)	Low (Level 4)
I&AP Concern	

Aspect/Activity	Contamination of soil by leaving rubble/ waste or spilling petroleum fuels or any pollutants on soil which could infiltrate the soil
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Rubble or waste could lead to infiltration of unwanted pollutants into the soil. Spilling of petroleum fuels and unwanted chemicals onto the soils that infiltrate these soils could lead to pollution of soils.
Status	Negative
Mitigation Required	Rubble or waste that could accompany the construction effort, if the development is approved, should be removed during and after construction. Measures should be taken to avoid any spills and infiltration of petroleum fuels or any chemical pollutants into the soil during construction phase.
Impact Significance (Pre-Mitigation)	Moderate (Level 3)
Impact Significance (Post-Mitigation)	Low (Level 4)
I&AP Concern	

Aspect/Activity	Possible disturbance, trapping, hunting and killing of vertebrates during construction phase
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	During the construction phase animal species could be disturbed, trapped, hunted or killed.
Status	Negative
Mitigation Required	If the development is approved, contractors must ensure that no animal species are disturbed, trapped, hunted or killed during the construction phase.
Impact Significance (Pre-Mitigation)	Moderate (Level 3)
Impact Significance (Post-Mitigation)	Low (Level 4)
I&AP Concern	

6.2 Potential Impacts during the Operational Phase

Aspect/Activity	An increased infestation of exotic or alien invasive plant species owing to clearance or disturbance where the footprint took place.
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Infestation by alien invasive species could replace indigenous vegetation or potential areas where indigenous vegetation could recover. It is in particular declared alien invasive species such as *Prosopis glandulosa* (Honey Mesquite) that should not be allowed to establish because once established these combatting these alien invasive plant species may become very expensive in the long term.
Status	Negative
Mitigation Required	Continued monitoring and eradication of alien invasive plant species are imperative. It is in particular declared alien invasive species such as *Prosopis glandulosa* (Honey Mesquite) that should not be allowed to establish.
Impact Significance (Pre-Mitigation)	Moderate (Level 3)
Impact Significance (Post-Mitigation)	Low (Level 4)
I&AP Concern	

Aspect/Activity	**Continued loss of indigenous vegetation owing to poor recovery of vegetation at the proposed photovoltaic facility.**
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Poor recovery of indigenous vegetation could lead to further loss of indigenous vegetation at the site.
Status	Negative
Mitigation Required	A monitoring and rehabilitation plan for vegetation at the site are to be implemented to make sure that indigenous vegetation recover at hitherto cleared areas where possible.
Impact Significance (Pre-Mitigation)	Moderate (Level 3)
Impact Significance (Post-Mitigation)	Low (Level 4)
I&AP Concern	

6.3 Potential Impacts during the Decommissioning Phase

Aspect/Activity	**An increased infestation of exotic or alien invasive plant species owing to clearance or disturbance where the footprint took place.**
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Infestation by alien invasive species could replace indigenous vegetation or potential areas where indigenous vegetation could recover. It is in particular declared alien invasive species such as *Prosopis glandulosa* (Honey Mesquite) that should not be allowed to establish because once established these combatting these alien invasive plant species may become very expensive in the long term.
Status	Negative
Mitigation Required	Continued monitoring and eradication of alien invasive plant species are imperative. It is in particular declared alien invasive species such as *Prosopis glandulosa* (Honey Mesquite) that should not be allowed to establish.
Impact Significance (Pre-Mitigation)	Moderate (Level 3)
Impact Significance (Post-Mitigation)	Low (Level 4)
I&AP Concern	

Aspect/Activity	**Continued loss of indigenous vegetation owing to poor recovery of vegetation.**
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Poor recovery of indigenous vegetation could lead to further loss of indigenous vegetation at the site.
Status	Negative
Mitigation Required	A monitoring and rehabilitation plan for vegetation at the site are to be implemented to make sure that indigenous vegetation recover at hitherto cleared areas where possible.
Impact Significance (Pre-Mitigation)	Moderate (Level 3)
Impact Significance (Post-Mitigation)	Low (Level 4)
I&AP Concern	

Aspect/Activity	**Contamination of soil by leaving rubble/ waste or spilling petroleum fuels or any pollutants on soil which could infiltrate the soil during rehabilitation**
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Rubble or waste could lead to infiltration of unwanted pollutants into the soil. Spilling of petroleum fuels and unwanted chemicals onto the soils that infiltrate these soils could lead to pollution of

	soils.
Status	Negative
Mitigation Required	Rubble or waste that could accompany the construction effort, if the development is approved, should be removed during and after construction. Measures should be taken to avoid any spills and infiltration of petroleum fuels or any chemical pollutants into the soil during construction phase.
Impact Significance (Pre-Mitigation)	Moderate (Level 3)
Impact Significance (Post-Mitigation)	Low (Level 4)
I&AP Concern	

6.4 Cumulative Impacts

Aspect/Activity	**Habitat loss owing to clearing of vegetation (cumulative effects)**
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Clearing of vegetation at the proposed Photovoltaic Facility footprint. This will entail the partial destruction of moderately sensitive habitat.
Status	Negative
Mitigation Required	Rehabilitation and monitoring of vegetation following construction are imperative.
Impact Significance (Pre-Mitigation)	High (Level 2)
Impact Significance (Post-Mitigation)	Moderate (Level 3)
I&AP Concern	

Aspect/Activity	**Removal of sensitive species (cumulative effects)**
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Cumulative impacts could have an amplified effect on the loss of sensitive species. Sensitive species: Presence of Threatened or Near-Threatened Mammals, Reptiles, Amphibians and Invertebrates at the site appear to be unlikely. This means by avoidance highly sensitive species are not impacted by the proposed development and therefore do not contribute to the cumulative impacts on highly sensitive species such as threatened species. Protected tree species at the site, *Vachellia erioloba* (Camel Thorn), is listed as a Declining (not Threatened) plant species. *Vachellia erioloba* occurs in low numbers at the site. Camel Thorn forests containing particularly large *Vachellia erioloba* individuals are absent at the site (Reference sites for such special Camel Thorn trees are Witsand Nature Reserve and Kathu Camel Thorn Forest visited/ researched in the past by the specialist). When considering cumulative impacts in the Vryburg area possibly posed by photovoltaic facilities the planting of *Vachellia erioloba* trees are essential. This could be nearby the site.
Status	Negative
Mitigation Required	Planting of individual *Vachellia erioloba* trees at area which will not be affected and where practical.
Impact Significance (Pre-Mitigation)	Moderate (Level 3)
Impact Significance (Post-Mitigation)	Low (Level 4)
I&AP Concern	

Aspect/Activity	**Fragmentation of corridors of particular conservation concern (cumulative effects)**
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Owing to the possibility of a number of photovoltaic facilities to be developed in the local area the possible impact to fragmentation of the landscape and loss of corridors are real. At the site there are no indications of any particular linked or stepping stone corridors

	of particular conservation importance at the site.
Status	Negative
Mitigation Required	Restrict impacts to proposed footprints and leave corridors with indigenous vegetation adjacent to the proposed footprints.
Impact Significance (Pre-Mitigation)	Moderate (Level 3)
Impact Significance (Post-Mitigation)	Low (Level 4)
I&AP Concern	

Regionally landscape fragmentation could create barriers to the movement of species and their genes (Saunders *et al.*, 1991). The answer to the width and extent of corridors depends on the conservation goal and the focal species (Samways, 2005). Corridors for mammalian species are especially important for migratory species (Mwalyosi, 1991, Pullin 2002). For an African butterfly assemblage this is about 250m when the corridor is for movement as well as being a habitat source (Pryke and Samways 2003). Hill (1995) found a figure of 200m for dung beetles in tropical Australian forest. In the agricultural context, and at least for some common insects, even small corridors can play a valuable role (Samways, 2005).

At the study area of which the site is part:

Corridors and linkages of areas with similar habitat are present in the local district where a number of solar power plants are planned. Watercourses and wetlands are avoided by the proposed footprint so that stepping stone corridors (pans) and a network of linked corridors (active channels with riparian zones) remain. No particular habitats of threatened species that are easily isolated (e.g. beetles with flightless females) are known to be impacted locally in the larger study area where a number of solar power plants are planned to be developed. Overall because most of the Vryburg area appears to be ideal to avoid very sensitive habitats such as larger pristine wetlands and also avoid highly sensitive habitat pockets of Threatened species the development of a number of photovoltaic facilities appear to be more ideal on a national scale than at other areas. Therefore, an important mitigation measure is to leave corridors with indigenous vegetation in between photovoltaic facilities and their associated infrastructure.

Aspect/Activity	**Emissions and pollutants into air, water and soil (cumulative impacts)**
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Overall because emissions and pollutants from photovoltaic facilities are limited when operational. During the operational phase cumulative impacts to the pollution of soils could happen. Rubble or waste could lead to infiltration of unwanted pollutants into the soil. Spilling of petroleum fuels and unwanted chemicals onto the soils that infiltrate these soils could lead to pollution of soils and if this happens at a number of photovoltaic facilities in an area the cumulative effect could be detrimental to the local environment.
Status	Negative
Mitigation Required	Rubble or waste that could accompany the construction effort, if the development is approved, should be removed during and after construction. Measures should be taken to avoid any spills and infiltration of petroleum fuels or any chemical pollutants into the soil during construction phase.
Impact Significance (Pre-Mitigation)	Moderate (Level 3)
Impact Significance (Post-Mitigation)	Low (Level 4)
I&AP Concern	

Overall because of the restricted nature of photovoltaic facilities and few or no emissions and pollutants into air when operational, soil and water cumulative impacts to the environment are limited (if compared for example to emissions from fossil fuel burning). Ultimately power plants could reprieve the pressures to use fossil fuels that are associated with numerous cumulative impacts and habitat losses.

7. IMPACT ASSESSMENT TABLES

Table 7.1 Impact Assessment Summary Table for the Construction Phase

Construction Phase													
Direct Impacts													
Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk		Ranking of Residual Impact/ Risk	Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)		
Clearing of vegetation for access roads	Loss of habitat, loss of indigenous species	Negative	Site	Long-Term	Moderate	Very likely	Moderate	Moderate	Limit development of new access roads. Maximise use of existing farm roads.	Moderate	Low	4	Medium
Clearing of vegetation	Habitat loss, loss of indigenous species	Negative	Site	Long-Term	Substantial	Very likely	Moderate	Moderate	Rehabilitation and monitoring of indigenous vegetation following clearance.	High	Moderate	3	High
Clearing of vegetation	Exposed soil susceptible to erosion	Negative	Site	Medium-Term	Moderate	Likely	Moderate	Moderate	Ecological Management Plan should include measures for erosion control	Low	Very low	5	High

Construction Phase													
Direct Impacts													
Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk		Ranking of Residual Impact/ Risk	Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)		
Loss of sensitive species	Loss of sensitive species (Note no Threatened species or Near-threatened species)	Negative	Site	Long-Term	Moderate	Very likely	Moderate	Moderate	Planting of indigenous *Vachellia erioloba* (Camel Thorn Trees) at areas nearby footprint where these will not be affected.	Moderate	Low	4	High
Loss of corridors of particular conservation concern	Fragmentation of landscape and loss of connectivity	Negative	Site	Long-Term	Moderate	Very unlikely	Moderate	Moderate	Leave areas with indigenous vegetation adjacent to proposed footprints.	Low	Very low	5	High

Table 7.2 Impact Assessment Summary Table for the Operational Phase

Operational Phase													
Direct Impacts													
Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk		Ranking of Residual Impact/ Risk	Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)		
Increased infestation of exotic or alien invasive plant species	Loss of habitat quality	Negative	Site	Long-Term	Substantial	Likely	Moderate	Moderate	Monitoring and eradication of alien invasive plant species	Moderate	Low	3	High
Continued loss of indigenous vegetation	Loss of habitat integrity	Negative	Site	Long-Term	Substantial	Likely	Moderate	Moderate	Rehabilitation and monitoring of indigenous vegetation following clearance.	High	Moderate	3	High
Rubble. Waste and spills of petroleum oils or other unwanted chemicals	Contamination of soil	Negative	Site	Medium-Term	Moderate	Likely	Moderate	Moderate	Measures to avoid spilling of any petroleum fuels or unwanted chemicals. Clearing of any rubble or waste.	Moderate	Low	3	High

Table 7.3: Impact Assessment Summary Table for the Decommissioning Phase

Decommissioning Phase													
Direct Impacts													
Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk		Ranking of Residual Impact/ Risk	Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)		
Increased infestation of exotic or alien invasive plant species	Loss of habitat quality	Negative	Site	Long-Term	Substantial	Likely	Moderate	Moderate	Rehabilitation with monitoring and eradication of alien invasive plant species	Moderate	Low	3	High
Continued loss of indigenous vegetation	Loss of habitat integrity	Negative	Site	Long-Term	Substantial	Likely	Moderate	Moderate	Rehabilitation and monitoring of indigenous vegetation following clearance.	High	Moderate	3	High
Rubble. Waste and spills of petroleum oils or other unwanted chemicals	Contamination of soil	Negative	Site	Medium-Term	Moderate	Likely	Moderate	Moderate	During rehabilitation measures should be taken to avoid spilling of any petroleum fuels or unwanted chemicals.	Moderate	Low	3	High

Table 7.4 Cumulative Impact Assessment Summary Table

Cumulative impacts (Construction, Operational and Decommissioning Phases)													
Direct Impacts													
										Significance of Impact and Risk			
Aspect/ Impact Pathway	**Nature of Potential Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of Impact**	**Irreplaceability**	**Potential Mitigation Measures**	**Without Mitigation/ Management**	**With Mitigation/ Management (Residual Impact/ Risk)**	**Ranking of Residual Impact/ Risk**	**Confidence Level**
Clearing of vegetation	Habitat loss, loss of indigenous species	Negative	Site	Long-Term	Substantial	Very likely	Moderate	Moderate	Rehabilitation and monitoring of indigenous vegetation following clearance.	High	Moderate	3	High
Loss of sensitive species	Loss of sensitive species (Note no Threatened species or Near-threatened species)	Negative	Site	Long-Term	Moderate	Very likely	Moderate	Moderate	Planting of indigenous *Vachellia erioloba* (Camel Thorn Trees) at areas nearby footprint where these will not be affected.	Moderate	Low	4	High
Loss of corridors of particular conservation concern	Fragmentation of landscape and loss of connectivity	Negative	Site	Long-Term	Moderate	Very unlikely	Moderate	Moderate	Leave areas with indigenous vegetation adjacent to proposed footprints.	Low	Very low	5	High

7.1. Impact Assessment Summary

Overall impact significance findings, following the implementation of the proposed mitigation measures are shown in Table 7.5 below:

Table 7.5 Overall Impact Significance (Post Mitigation)

Phase	**Overall Impact Significance**
Construction	Moderate
Operational	Low
Decommissioning	Low
Nature of Impact	**Overall Impact Significance**
Cumulative - Construction	Low
Cumulative - Operational	Low
Cumulative - Decommissioning	Low

8. LEGISLATIVE AND PERMIT REQUIREMENTS

A Protected Tree species, *Vachellia erioloba* (also listed as Declining) is found at the site. Protected Tree species are listed under the National Forests Act No. 84 of 1998. In terms of a part of section 15(1) of Act No. 84 of 1998, no person may cut, disturb, damage or destroy any protected tree or possess, collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, except under a license granted by the Minister. The Applicant for the photovoltaic project has commissioned the specialist to obtain this permit for the Camel Thorn trees, and this application is currently in progress.

9. ENVIRONMENTAL MANAGEMENT PROGRAMME INPUTS

The management actions are specified in the following Tables, with further implementation details provided in accordance with the requirements of the EIA Regulations.

Table 9.1 Management Plan for the Planning and Design Phase

Impact	Mitigation / Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
Aspect: Protection of terrestrial and aquatic ecological features of sensitivity					
	Design project layout and access roads with minimum disturbance to remaining natural vegetation.	Lay-out of access roads should strive for maximum use of existing roads. Corridors of natural vegetation adjacent to proposed footprint should be indicated as such in the lay-out plans.	Qualified Project Developer	Once-off during the design phase	Project Developer

Table 9.2 Management Plan for the Construction Phase

Impact	Mitigation / Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
Aspect: Protection of terrestrial and aquatic ecological features of high sensitivity					
	Demarcate access roads with minimum disturbance to remaining natural vegetation.	Fence off access roads and proposed footprint so that corridors of natural vegetation adjacent to proposed footprint should not be impacted.	Qualified Project Developer	Once-off during the design phase	Project Developer

Table 9.3 Management Plan for the Operational Phase

Impact	Mitigation / Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
Aspect: Protection of terrestrial and aquatic ecological features of high sensitivity and value					
	Ongoing rehabilitation plan	Establish indigenous vegetation and use mechanic means or insertion of brushpacks/mulch to loosen upper soil if necessary.	Appoint qualified environmental officer	Tri-annual review of outcomes before, in the middle and end of growth season (August, December, April)	Project Operator and Environmental Officer
	Monitor and avoid the establishment of alien invasive plant species at the site	Inspection of site and noting alien invasive species Noting and putting high alert on alien invasive species which are aggressive and could result in considerable costs in long-term such as *Prosopis* (Mesquite).	Environmental Officer	Project Operator and Environmental Officer	Project Operator and Environmental Officer

Table 9.4 Management Plan for the Decommissioning Phase

Impact	Mitigation / Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
Aspect: Rehabilitation of ecological features which approaches restoration as far as practical					
	Detailed restoration plan to be prepared	Ensure that an open savanna with a grass layer which include a number of indigenous grass species and also a woody layer recover. Vegetation structure and composition should be similar to the ecological state before the construction.	Appoint a suitable qualified botanist/ecologist with some experience in rehabilitation. Environmental Officer (monitoring)	Once-off during the design phase. Regular during operational phase of rehabilitation	Project Operator Qualified Botanist/Ecologist with experience in rehabilitation. Environmental Officer (monitoring)

10. CONCLUSION AND RECOMMENDATIONS

- Vegetation at the site is an open savanna where *Tarchonanthus camphoratus* (Camphor Bush) and *Grewia flava* (Velvet Raisin) are visibly frequent while some taller indigenous *Vachellia* and *Searsia* are dotted or in clumps across the flat landscape. Other indigenous tree species at the site include *Vachellia tortilis* subsp. *heteracantha* (Umbrellla Thorn), *Searsia lancea* (Karee), *Senegalia mellifera* subsp. *detinens* (Black Thorn), *Ziziphus mucronata* (Buffalo-thorn), *Vachellia erioloba* (Camel Thorn), *Ehretia alba* (White Puzzlebush), *Vachellia karroo* (Sweet Thorn) *Vachellia hebeclada* subsp. *hebeclada* (Candlepod Thorn). Individuals of the declared alien invasive plant species, *Prosopis glandulosa* (Mesquite) are encountered at some parts of the site. Shrublets *Ziziphus zeyheriana* (Dwarf Buffalo-thorn) and *Gnidia polycephala* are present at the site. Dwarf shrub *Pentzia calcarea* is widespread at the site. Indigenous herbaceous plant species at the site include *Helichrysum cerastoides*, *Barleria macrostegia* and *Salvia disermas*. Indigenous grass species include *Eragrostis lehmanniana, Schmidtia pappophoroides, Digitaria eriantha, Aristida congesta, Cymbopogon pospischilii, Stipagrostis uniplumis, Themeda triandra, Cynodon dactylon, Fingerhuthia africana, Aristida adscensionis, Enneapogon cenchroides, Elionurus muticus* and *Tragus racemosus.*
- Site is at very gentle slopes (flat). No rocky ridges appear to be present at the site.
- Wetlands such as floodplain wetlands, channelled valley-bottom wetlands, unchannelled valley-bottom wetlands, depressions, seeps and wetland flats appear to be absent at the site.
- Typical infrastructure such as being associated farming such as tracks, roads, small concrete dams and fences are present at the site. The declared alien invasive species, *Prosopis glandulosa* (Mesquite) is found singly or in small clumps at some places at the site. Alien invasive weeds are found at hitherto cleared or ecologically disturbed areas.
- The vegetation type that represents the Savanna Biome at the site, Ghaap Plateau Vaalbosveld (SVk 7), is not listed as threatened ecosystem according to the National List of Threatened Ecosystems (2011).
- Presence of Threatened or Near-threatened animal (see separate report for assessments of avifauna) or plant species are unlikely.
- One Protected tree species, *Vachellia erioloba* (Camel Thorn) is found at the site.
- Protected Tree species are listed under the National Forests Act No. 84 of 1998. In terms of a part of section 15(1) of Act No. 84 of 1998, no person may cut, disturb, damage or destroy any protected tree or possess, collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, except under a license granted by the Minister.
- A total of 80 individual *Vachellia erioloba* trees taller than 2 m has been counted at the proposed footprint of the photovoltaic facility which amounts to an average of 0,3/ ha. Less than 100 trees are present at the footprint proposed for the photovoltaic facility which is much lower than many areas around Vryburg and many other parts of the Eastern Kalahari Bushveld Bioregion (Terblanche pers. obs.). *Vachellia erioloba* individuals at the site are not particularly large (no tree taller than 10 m) and are not part of a camel thorn forest of note (Benchmarks: Large camel thorn forest at Kathu and smaller Camel Thorn forest at Witsand Nature Reserve (visited by R.F. Terblanche in the past). It is recommended that a permit should be applied for at the relevant authorities in case any removal or damage of Camel Thorn trees. If *Vachellia erioloba* is impacted

upon it is also recommended that new (nursery) Camel Thorn trees could be planted on site outside the present footprint.

- Ecological sensitivity at the site is medium. There are no indications of any particular ecosystems of conservation importance, any particular conservation corridors or a significant impact on any plant, mammal, reptile, amphibian or invertebrate species of particular conservation concern if the site is developed.
- Cumulative effects of solar power plants are considered with special reference to habitat loss and fragmentation. Habitat loss and fragmentation are known to be the main threats to biodiversity (Fahrig, 2003; Wilcove *et al*., 1998; IUCN, 2004; Primack, 2006). In cases such as the study where proposed footprints are relatively small parts of fairly similar habitat the focus could be on the fragmentation of the natural landscape and having enough corridors and linkages that enhance connectivity of biodiversity.

11. FINAL SPECIALIST STATEMENT AND AUTHORISATION RECOMMENDATION

The footprint proposed for the development is not part of a threatened ecosystem or freshwater ecosystem priority area. Presence of resident Threatened or Near Threatened plants, mammals, reptiles, amphibians and invertebrates at the site is unlikely. A Protected tree species, which is not Threatened but listed as Declining, *Vachellia erioloba* (Camel Thorn) occurs in relatively low numbers (average 0,3 trees/ha) at the site. Camel Thorn forests or any large Camel Thorn individuals of note are absent at the site. Overall the sensitivity at the site appears to be moderate. Overall impacts on habitat loss, sensitive species and connectivity appear to be moderate and within scope of mitigations. In cases such as the study where proposed footprints are relatively small parts of fairly similar habitat in the larger area, there is no distinct reason why the proposed developments cannot take place and reprieve pressure to use other energy sources which are perhaps more detrimental to sensitive environments. A key issue, if the development is approved, is to avoid the establishment of alien invasive plant species in particular Declared Weeds such as *Prosopis* (Mesquite). If the development is approved, a monitoring and rehabilitation plan should be valuable to assess the prosperity of indigenous animal and plant species at photovoltaic facilities. Conservation of corridors with indigenous vegetation adjacent to photovoltaic facilities in the larger area would be vital for conserving indigenous biodiversity in the district.

11.1. EA Condition Recommendations

Two key issues in terms of recommendations are included 1) a permit application for the Protected (but not threatened) tree species Vachellia *erioloba* (Camel Thorn) which occurs in relatively low numbers at the site and 2) control of alien invasive plant species.

A Protected Tree species, *Vachellia erioloba* (also listed as Declining) is found at the site. Protected Tree species are listed under the National Forests Act No. 84 of 1998. In terms of a part of section 15(1) of Act No. 84 of 1998, no person may cut, disturb, damage or destroy any protected tree or possess, collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, except under a license granted by the Minister. Such a permit should be applied for if the development is approved.

Finally, this ecological study shows that the ecological impacts can be reduced to low and medium significance with effective mitigation measures being applied. Mitigation measures have been specified. There is therefore no prohibitive distinct reason or objection from an ecological perspective for the project being given Environmental Authorisation.

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ANNEXURE 1: PLANT SPECIES LIST

Plant species recorded or likely to occur at the site.
Plant species are listed alphabetically under life forms that are generally recognizable.
Plant species marked with an asterisk (*) are exotic.

Sources: Germishuizen (2003), Manning (2003), Manning (2009), Van Oudtshoorn (1999), Van Wyk (2000), Van Wyk & Malan (1998), Van Wyk & Van Wyk (2013), Crouch, Klopper, Burrows & Burrows (2011), Goldblatt (1986), Goldblatt & Manning (1998), Jacobsen (1983), McMurtry, Grobler, Grobler & Burns (2008), Smit (2008), Van Ginkel *et al*. (2011), Van Jaarsveld (2006), Van Wyk & Smith (2003).

TAXON	COMMON NAMES	FAMILY
ANGIOSPERMAE: MONOCOTYLEDONS		
Albuca setosa	Fibrous Slime Lily	HYACINTHACEAE
Anthephora pubescens	Wool Grass	POACEAE
Aristida adscensionis	Annual Three-awn	POACEAE
Aristida congesta subsp. ***congesta***	Tassel Three-awn	POACEAE
Aristida meridionalis	Giant Three-awn	POACEAE
Asparagus africanus		ASPARAGACEAE
Asparagus laricinus	Common Wild Asparagus	ASPARAGACEAE
Bulbine frutescens		ASPHODELACEAE
Bulbine narcissifolia		ASPHODELACEAE
Cenchrus ciliaris	Foxtail Buffalo Grass	POACEAE
Chloris virgata	Feather-top Chloris	POACEAE
Chlorophytum fasciculatum		ANTHERICACEAE
Commelina africana		COMMELINACEAE
Cymbopogon pospischilii	Narrow-leaved Turpentine Grass	POACEAE
Cynodon dactylon	Couch Grass	POACEAE
Digitaria eriantha	Common Finger Grass	POACEAE
Eleusine coracana	Goose Grass	POACEAE
Elionurus muticus	Wire Grass	POACEAE
Enneapogon cenchroides	Nine-awned Grass	POACEAE
Enneapogon scoparius	Bottlebrush Grass	POACEAE
Eragrostis curvula	Weeping Love Grass	POACEAE
Eragrostis lehmanniana	Lehmann's Love Grass	POACEAE
Eragrostis superba	Saw-toothed Love Grass	POACEAE
Fingerhuthia africana	Thimble Grass	POACEAE
Heteropogon contortus	Spear Grass	POACEAE
Ledebouria marginata		HYACINTHACEAE
Melinis repens	Natal Red Top	POACEAE
Panicum coloratum	Small Buffalo Grass	POACEAE
Pogonarthria squarrosa	Herringbone Grass	POACEAE
Schmidtia pappophoroides	Sand Quick	POACEAE
Setaria sphacelata *var.* ***torta***	Creeping Bristle Grass	POACEAE
Setaria verticillata	Bur Bristle Grass	POACEAE

TAXON	COMMON NAMES	FAMILY
Sporobolus fimbriatus	Dropseed Grass	POACEAE
Stipagrostis uniplumis	Silky Bushman Grass	POACEAE
Themeda triandra	Red Grass	POACEAE
Tragus racemosus		POACEAE
Trichoneura grandiglumis	Small Rolling Grass	POACEAE
ANGIOSPERMS: DICOTYLEDONS		
Acrotome inflata		LAMIACEAE
**** Alternanthera pungens***	Duwweltjie	AMARANTHACEAE
Amaranthus thunbergii		AMARANTHACEAE
Aptosimum procumbens	Karoo Violet	SCROPHULARIACEAE
**** Argemone ochroleuca***	White-flowered Mexican poppy	PAPAVERACEAE
Barleria macrostegia		ACANTHACEAE
Berkheya onopordifolia var. ***onopordifolia***		ASTERACEAE
Ceratotheca triloba	Wild Foxglove	PEDALIACEAE
Chamaecrista species	Cassia	CAESALPINIACEAE
Chamaesyce hirta	Red Milkweed	EUPHORBIACEAE
**** Chenopodium album***	White Goosefoot	CHENOPODIACEAE
Chrysocoma ciliata	Bitterbush	ASTERACEAE
Clematis brachiata	Traveller’s Joy	RANUNCULACEAE
Cleome angustifolia	Yellow Mouse-whiskers	BRASSICACEAE (or Capparaceae)
Convolvulus sagittatus	Wild Bindweed	CONVOLVULACEAE
**** Conyza bonariensis***	Fleabane	ASTERACEAE
Deverra denudata subsp. ***aphylla***	Wild Celery	APIACEAE
Diospyros lycioides subsp. ***lycioides***	Karoo Bluebush	EBENACEAE
Ehretia alba	White Puzzle Bush	BORAGINACEAE
Elephantorrhiza elephantina	Eland’s Bean	MIMOSACEAE
**** Eucalyptus camaldulensis***	Red Gum	MYRTACEAE
Felicia muricata		ASTERACEAE
Gazania krebsiana subsp. ***krebsiana***		ASTERACEAE
Geigeria filifolia		ASTERACEAE
Geigeria ornativa		ASTERACEAE
Geigeria obtusifolia		ASTERACEAE
Gisekia africana		GISEKIACEAE
Gnidia polycephala		THYMELAEACEAE
Gomphocarpus tomentosus		APOCYNACEAE
**** Gomphrena celosioides***	Bachelor’s Button	AMARANTHACEAE
Grewia flava	Velvet Raisin	SPARRMANNIACEAE
Helichrysum argyrosphaerum		ASTERACEAE
Helichrysum cerastioides		ASTERACEAE
Helichrysum zeyheri		ASTERACEAE
Heliotropium ciliatum		BORAGINACEAE

TAXON	COMMON NAMES	FAMILY
Hermbstaedtia odorata	Wild Cockscomb	AMARANTHACEAE
Hertia pallens	Springbokbos	ASTERACEAE
Hilliardiella oligocephala		ASTERACEAE
Indigofera daleoides		FABACEAE
Ipomoea bolusiana		CONVOLVULACEAE
Jamesbrittenia aurantiaca	Cape Saffron	SCROPHULARIACEAE
Lantana rugosa		VERBENACEAE
Lepidium africanum	Pepperweed	BRASSICACEAE
**** Lepidium bonariense***	Pepperweed	BRASSICACEAE
Lippia scaberrima		VERBENACEAE
Lycium horridum		SOLANACEAE
**** Malva parviflora***	Small Mallow	MALVACEAE
Nidorella resedifolia		ASTERACEAE
**** Opuntia ficus-indica***	Sweet Prickly Pear	CACTACEAE
**** Opuntia imbricata***	Sweet Prickly Pear	CACTACEAE
Pentzia calcarea		ASTERACEAE
Pollichia campestris	Waxberry	ILLECEBRACEAE
**** Prosopis glandulosa***	Mesquite	FABACEAE
Salvia disermas	Large Blue Sage	LAMIACEAE
Scabiosa columbaria	Wild Scabious, Morning Bride	DIPSACACEAE
**** Schkuhria pinnata***	Dwarf Marigold	ASTERACEAE
Searsia lancea	Karee	ANACARDIACEAE
Selago densiflora		SCROPHULARIACEAE
Senecio coronatus	Sybossie	ASTERACEAE
Senecio consanguineus	Starvation Senecio	ASTERACEAE
Senegalia mellifera subsp. ***detinens***	Black Thorn	MIMOSACEAE
Senna italica subsp. ***arachoides***	Wild Senna	CAESALPINIACEAE
Sida cordifolia	Heart-leaf Sida/ Flannel Weed	MALVACEAE
Sida rhombifolia	Arrowleaf Sida	MALVACEAE
Solanum incanum	Bitter Apple	SOLANACEAE
Tarchonanthus camphoratus	Wild Camphor Bush	ASTERACEAE
Thesium sp.		SANTALACEAE
Tribulus terrestris	Devil's Thorn	ZYGOPHYLLACEAE
Vachellia erioloba (= *Acacia erioloba*)	Camel Thorn	MIMOSACEAE
Vachellia hebeclada subsp. ***hebeclada***	Candlepod Thorn	MIMOSACEAE
Vachellia karroo	Sweet Thorn	MIMOSACEAE
Vachellia tortilis susbp. ***heteracantha***	Umbrella Thorn	MIMOSACEAE
Vahlia capensis		VAHLIACEAE
Viscum rotundifolium	Round-leaved Mistletoe	VISCACEAE
Ziziphus mucronata	Buffalo-thorn	RHAMNACEAE
Ziziphus zeyheriana	Dwarf Buffalo-thorn	RHAMNACEAE

BIRD SPECIALIST STUDY:

Basic Assessment for the proposed construction of the Vryburg Solar 2 Photovoltaic (PV) Facility and associated electrical infrastructure, near Vryburg, in the North-West Province

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Report prepared for:
CSIR – Environmental Management Services
P O Box 320
Stellenbosch
7599
South Africa

Report prepared by:
Chris van Rooyen Consulting
30 Roosevelt Street
Robindale
Randburg

03 August 2018

SPECIALIST EXPERTISE

Curriculum vitae: Chris van Rooyen

Profession/Specialisation	:	Avifaunal Specialist
Highest Qualification	:	BA LLB
Nationality	:	South African
Years of experience	:	22 years

Key Experience

Chris van Rooyen has twenty-two years' experience in the assessment of avifaunal interactions with industrial infrastructure. He was employed by the Endangered Wildlife Trust as head of the Eskom-EWT Strategic Partnership from 1996 to 2007, which has received international acclaim as a model of co-operative management between industry and natural resource conservation. He is an acknowledged global expert in this field and has consulted in South Africa, Namibia, Botswana, Lesotho, New Zealand, Texas, New Mexico and Florida. He also has extensive project management experience and he has received several management awards from Eskom for his work in the Eskom-EWT Strategic Partnership. He is the author and/or co-author of 17 conference papers, co-author of two book chapters, several research reports and the current best practice guidelines for avifaunal monitoring at wind farm sites. He has completed around 130 power line assessments; and has to date been employed as specialist avifaunal consultant on more than 50 renewable energy generation projects. He has also conducted numerous risk assessments on existing power lines infrastructure. He also works outside the electricity industry and he has done a wide range of bird impact assessment studies associated with various residential and industrial developments. He serves on the Birds and Wind Energy Specialist Group which was formed in 2011 to serve as a liaison body between the ornithological community and the wind industry.

Key Project Experience

Bird Impact Assessment Studies for Solar Energy Plants:

1. Concentrated Solar Power Plant, Upington, Northern Cape.
2. Globeleq De Aar and Droogfontein Solar PV Pre- and Post-construction avifaunal monitoring
3. JUWI Kronos PV project, Copperton, Northern Cape
4. Sand Draai CSP project, Groblershoop, Northern Cape
5. Biotherm Helena PV Project, Copperton, Northern Cape
6. Biotherm Letsiao CSP Project, Aggeneys, Northern Cape
7. Biotherm Enamandla PV Project, Aggeneys, Northern Cape
8. Biotherm Sendawo PV Project, Vryburg, North-West
9. Biotherm Tlisitseng PV Project, Lichtenburg, North-West
10. JUWI Hotazel Solar Park Project, Hotazel, Northern Cape
11. Veld Solar One Project, Aggeneys, Northern Cape
12. Brypaal Solar Power Project, Kakamas, Northern Cape

Bird Impact Assessment Studies for the following overhead line projects:

1. Chobe 33kV Distribution line
2. Athene - Umfolozi 400kV
3. Beta-Delphi 400kV
4. Cape Strengthening Scheme 765kV
5. Flurian-Louis-Trichardt 132kV
6. Ghanzi 132kV (Botswana)
7. Ikaros 400kV
8. Matimba-Witkop 400kV
9. Naboomspruit 132kV
10. Tabor-Flurian 132kV
11. Windhoek - Walvisbaai 220 kV (Namibia)
12. Witkop-Overyssel 132kV

13. Breyten 88kV
14. Adis-Phoebus 400kV
15. Dhuva-Janus 400kV
16. Perseus-Mercury 400kV
17. Gravelotte 132kV
18. Ikaros 400 kV
19. Khanye 132kV (Botswana)
20. Moropule – Thamaga 220 kV (Botswana)
21. Parys 132kV
22. Simplon –Everest 132kV
23. Tutuka-Alpha 400kV
24. Simplon-Der Brochen 132kV
25. Big Tree 132kV
26. Mercury-Ferrum-Garona 400kV
27. Zeus-Perseus 765kV
28. Matimba B Integration Project
29. Caprivi 350kV DC (Namibia)
30. Gerus-Mururani Gate 350kV DC (Namibia)
31. Mmamabula 220kV (Botswana)
32. Steenberg-Der Brochen 132kV
33. Venetia-Paradise T 132kV
34. Burgersfort 132kV
35. Majuba-Umfolozi 765kV
36. Delta 765kV Substation
37. Braamhoek 22kV
38. Steelpoort Merensky 400kV
39. Mmamabula Delta 400kV
40. Delta Epsilon 765kV
41. Gerus-Zambezi 350kV DC Interconnector: Review of proposed avian mitigation measures for the Okavango and Kwando River crossings
42. Giyani 22kV Distribution line
43. Liqhobong-Kao 132/11kV distribution power line, Lesotho
44. 132kV Leslie – Wildebeest distribution line
45. A proposed new 50 kV Spoornet feeder line between Sishen and Saldanha
46. Cairns 132kv substation extension and associated power lines
47. Pimlico 132kv substation extension and associated power lines
48. Gyani 22kV
49. Matafin 132kV
50. Nkomazi_Fig Tree 132kV
51. Pebble Rock 132kV
52. Reddersburg 132kV
53. Thaba Combine 132kV
54. Nkomati 132kV
55. Louis Trichardt – Musina 132kV
56. Endicot 44kV
57. Apollo Lepini 400kV
58. Tarlton-Spring Farms 132kV
59. Kuschke 132kV substation
60. Bendstore 66kV Substation and associated lines
61. Kuiseb 400kV (Namibia)
62. Gyani-Malamulele 132kV
63. Watershed 132kV
64. Bakone 132kV substation
65. Eerstegoud 132kV LILO lines
66. Kumba Iron Ore: SWEP - Relocation of Infrastructure
67. Kudu Gas Power Station: Associated power lines
68. Steenberg Booysendal 132kV
69. Toulon Pumps 33kV
70. Thabatshipi 132kV
71. Witkop-Silica 132kV

72. Bakubung 132kV
73. Nelsriver 132kV
74. Rethabiseng 132kV
75. Tilburg 132kV
76. GaKgapane 66kV
77. Knobel Gilead 132kV
78. Bochum Knobel 132kV
79. Madibeng 132kV
80. Witbank Railway Line and associated infrastructure
81. Spencer NDP phase 2 (5 lines)
82. Akanani 132kV
83. Hermes-Dominion Reefs 132kV
84. Cape Pensinsula Strengthening Project 400kV
85. Magalakwena 132kV
86. Benficosa 132kV
87. Dithabaneng 132kV
88. Taunus Diepkloof 132kV
89. Taunus Doornkop 132kV
90. Tweedracht 132kV
91. Jane Furse 132kV
92. Majeje Sub 132kV
93. Tabor Louis Trichardt 132kV
94. Riversong 88kV
95. Mamatsekele 132kV
96. Kabokweni 132kV
97. MDPP 400kV Botswana
98. Marble Hall NDP 132kV
99. Bokmakiere 132kV Substation and LILO lines
100. Styldrift 132kV
101. Taunus – Diepkloof 132kV
102. Bighorn NDP 132kV
103. Waterkloof 88kV
104. Camden – Theta 765kV
105. Dhuva – Minerva 400kV Diversion
106. Lesedi –Grootpan 132kV
107. Waterberg NDP
108. Bulgerivier – Dorset 132kV
109. Bulgerivier – Toulon 132kV
110. Nokeng-Fluorspar 132kV
111. Mantsole 132kV
112. Tshilamba 132kV
113. Thabamoopo - Tshebela – Nhlovuko 132kV
114. Arthurseat 132kV
115. Borutho 132kV MTS
116. Volspruit - Potgietersrus 132kV
117. Neotel Optic Fibre Cable Installation Project: Western Cape
117. Matla-Glockner 400kV
118. Delmas North 44kV
119. Houwhoek 11kV Refurbishment
120. Clau-Clau 132kV
121. Ngwedi-Silwerkrans 134kV
122. Nieuwehoop 400kV walk-through
123. Booysendal 132kV Switching Station
124. Tarlton 132kV
125. Medupi - Witkop 400kV walk-through
126. Germiston Industries Substation
127. Sekgame 132kV
128. Botswana – South Africa 400kV Transfrontier Interconnector
129. Syferkuil – Rampheri 132kV
130. Queens Substation and associated 132kV powerlines

131. Oranjemond 400kV Transmission line
132. Aries – Helios – Juno walk-down

Professional affiliations

I work under the supervision of and in association with Albert Froneman (MSc Conservation Biology) (SACNASP Zoological Science Registration number 400177/09) as stipulated by the Natural Scientific Professions Act 27 of 2003.

SPECIALIST DECLARATION

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	12/12/20/ or 12/9/11/L
NEAS Reference Number:	DEA/EIA
Date Received:	

Application for integrated environmental authorisation and waste management licence in terms of the-

(1) National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2014; and

(2) National Environmental Management Act: Waste Act, 2008 (Act No. 59 of 2008) and Government Notice 921, 2013

PROJECT TITLE

Basic Assessment Process for the Proposed Development of a 115 MW Solar Photovoltaic Facility (**Vryburg Solar 2**) and Associated 132 kV Transmission Line near Vryburg, North West Province.

Specialist:	Chris van Rooyen Consulting		
Contact person:	Chris van Rooyen		
Postal address:	30 Roosevelt Street, Robindale, Randburg		
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Professional affiliation(s) (if any)	-		

Project Consultant:	Council for Scientific and Industrial Research		
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Telephone:	021 888 2486	Fax:	021 888 2693
E-mail:	PLochner@csir.co.za		

4.2 The specialist appointed in terms of the Regulations_

I, Chris van Rooyen , declare that -- General declaration:

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:

Chris van Rooyen Consulting

Name of company (if applicable):

Date: 03 August 2018

EXECUTIVE SUMMARY

The habitat where the proposed Vryburg Solar 2 facility and associated powerline corridor are situated is moderately sensitive from an avifaunal perspective and consists largely of natural savanna. The development is too far away from any Important Bird Areas (IBAs) to have any direct impact on them. An estimated 189 species, belonging to 79 families could potentially occur in the broader study area. Of these, an estimated 160 species could occur in the development footprint, of which 27 are classified as priority species i.e. South African Red List species; South African endemics and near-endemics; waterbirds and raptors.

The following environmental sensitivities were identified at the proposed development footprint:

- Medium sensitivity: The natural savanna at the proposed development footprint and powerline corridor supports a moderate variety of avifauna.
- High sensitivity: Drinking troughs at boreholes are a source of surface water and serve as focal points for avifauna.
- Very high sensitivity: Clusters of medium-sized to large trees are important in this landscape where trees are sparse (a patch of trees with “very high” sensitivity occurs on the southern corner of the site for the PV facility as shown in Figure 6). They serve as potential roosting and breeding habitat for a variety of birds, including raptors.

The following potential pre-mitigation impacts were identified:

Construction Phase

- Impact 1: Displacement due to disturbance caused by the construction activities associated with the solar panels and associated infrastructure (buildings, roads, internal powerlines and substation).
- Impact 2: Displacement due to disturbance during the construction of the 132kV powerline.

Operational Phase

- Impact 3: Displacement due to habitat transformation caused by the solar panels and associated infrastructure (buildings, roads, internal powerlines and substation);
- Impact 4: Mortality due to collisions with the solar panels;
- Impact 5: Mortality due to entrapment between perimeter fences;
- Impact 6: Mortality due to collisions with the 132kV powerline;
- Impact 7: Mortality due to electrocution on the 132kV powerline;
- Impact 8: Mortality due to electrocution on the internal 33kV powerlines;

Decommissioning Phase

- Impact 9: Displacement due to disturbance caused by the de-commissioning activities associated with the solar panels and associated infrastructure (buildings, roads, internal powerlines and substation).

Cumulative Impacts

- Cumulative Impact 1: Displacement due to habitat transformation caused by the solar panels and associated infrastructure (buildings, roads, powerlines and substation);
- Cumulative Impact 2: Mortality due to electrocutions on and collisions with the 132kV powerlines.

The risk ratings for the impacts associated with the various phases of the project are as follows:

Phase	Overall Impact Significance – pre mitigation	Overall Impact Significance – post mitigation
Construction	4 (Low risk)	4 (Low risk)
Operational	3.3 (Moderate to low)	4.5 (Low to very low risk
Decommissioning	4 (Low)	5 (Very low risk)
Nature of Impact		**Overall Impact Significance**
Cumulative - Operational	4 (Low)	5 (Very low risk)
Average	3.8 (Moderate to low)	4.6 (Low to very low)

The following key management actions and mitigation measures are proposed to reduce the impact of the proposed facility:

Construction Phase

- Construction activity should be restricted to the immediate footprint of the infrastructure.
- Measures to control noise and dust should be applied according to current best practice in the industry.
- Access to areas outside the construction footprint should be strictly controlled and limited as much as possible.
- Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum as far as practical.
- The recommendations of the ecological specialist study must be strictly implemented, especially as far as limitation of the construction footprint is concerned.
- Prior to construction, an avifaunal specialist should conduct a site walkthrough, covering the final power line route, to identify any nests/breeding/roosting activity of Red List species, the results of which may inform the final construction schedule in close proximity to that specific area, including abbreviating construction time where possible, scheduling activities around avian breeding and/or movement schedules where possible, and lowering levels of associated noise.

Operational Phase

- The recommendations of the ecological specialist study must be strictly implemented, especially as far as limitation of the construction footprint, the retention of natural vegetation and rehabilitation of transformed areas is concerned.
- Areas with large trees should be retained as much as possible as they serve as potential roosting and breeding habitat for a variety of birds, including raptors.
- Audits must be performed by an external rehabilitation specialist to assess the success of the rehabilitation programme and recommend changes or additions to the programme if need be.
- The two fences constituting the double perimeter fence should be placed far apart enough for birds to able to take off if they end up between the two fences.
- Staff should be sensitised to not panic birds when they discover birds trapped between the fences but to approach them with caution to give them time to escape by taking off in a lengthwise direction.
- The 132kV powerline should be marked with Bird Flappers on the earthwire for the entire length of the line
- Vulture friendly structures (pylon or lattice) must be employed for the 132kV powerline. The structures (either single or double circuit) must be approved as vulture friendly by the Endangered Wildlife Trust’s Wildlife and Energy Programme.
- The placing the 33kV lines underground is strongly recommended.

Decommissioning Phase

- Decommissioning activity should be restricted to the immediate footprint of the infrastructure.
- Measures to control noise and dust should be applied according to current best practice in the industry.
- Access to areas outside the footprint should be strictly controlled and limited as much as possible.
- Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum as far as practical.
- The recommendations of the ecological specialist study must be strictly implemented, especially as far as limitation of the footprint is concerned.
- Prior to the commencement of the dismantling activities, an avifaunal specialist should conduct a site walkthrough, covering the powerline, to identify any nests/breeding/roosting activity of Red List species, the results of which may inform the final dismantling schedule in close proximity to that specific area, including abbreviating dismantling time where possible, scheduling activities around avian breeding and/or movement schedules, and lowering levels of associated noise.

Final Specialist Statement and Authorisation Recommendation

The proposed Vryburg Solar 2 facility should have a low to very low impact on avifauna, provided the management recommendations listed in this report and the EMPr (Appendix 3) are strictly implemented. No fatal flaws were identified from an avifaunal perspective – it is therefore recommended that the project is authorised to go ahead.

EA Condition Recommendations

The following recommendations should be included as conditions in the EA:

- Prior to construction, an avifaunal specialist should conduct a site walkthrough, covering the final power line route, to identify any nests/breeding/roosting activity of Red List species, the results of which may inform the final construction schedule in close proximity to that specific area, including abbreviating construction time where possible, scheduling activities around avian breeding and/or movement schedules where possible, and lowering levels of associated noise.
- Areas with large trees (as shown in Figure 6) should be retained as much as possible as they serve as potential roosting and breeding habitat for a variety of birds, including raptors.
- The 132kV powerline should be marked with Bird Flappers on the earthwire for the entire length of the line
- Vulture friendly structures (pylon or lattice) must be employed for the 132kV powerline. The structures (either single or double circuit) must be approved as vulture friendly by the Endangered Wildlife Trust's Wildlife and Energy Programme.
- It is strongly recommended that the internal 33kV lines is placed underground.

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LIST OF ABBREVIATIONS

AEWA	Africa – Eurasia Waterbird Agreement
BA	Basic Assessment
BLSA	BirdLife South Africa
CBD	Convention on Biological Diversity
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CMS	Convention on the Conservation of Migratory Species of Wild Animals
DEA	Department of Environmental Affairs
EIA	Environmental Impact Assessment
IBA	Important Bird Area
IUCN	International Union for the Conservation of Nature
kV	Kilovolt
NEMA	National Environmental Management Act (Act 107 of 1998, as amended)
REDZ	Renewable Energy Development Zone (REDZ).
SABAP 1	Southern African Bird Atlas Project 1
SABAP 2	Southern African Bird Atlas Project 2

GLOSSARY

Definitions	
Pentad	A pentad grid cell covers 5 minutes of latitude by 5 minutes of longitude (5'× 5'). Each pentad is approximately 8 × 7.6 km.
Broader study area	The 9 pentads surrounding the proposed development footprint
Survey areas	The land parcels where the bird surveys were conducted
Development footprint	The land parcel where the actual solar development will be situated

COMPLIANCE WITH THE APPENDIX 6 OF THE 2014 EIA REGULATIONS (AS AMENDED)

Requirements of Appendix 6 – GN R982	**Addressed in the Specialist Report**
1. (1) A specialist report prepared in terms of these Regulations must contain- a) 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;	Pg 2-5
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Pg 6-7
c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 1
(cA) an indication of the quality and age of base data used for the specialist report;	Section 2
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 3 and 6
d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 1 and Appendix 1
e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 2
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 4
g) an identification of any areas to be avoided, including buffers;	Section 4
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;	Section 4
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 2
j) a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Sections 6 and 7
k) any mitigation measures for inclusion in the EMPr;	Sections 6, 7 and Appendix 3
l) any conditions for inclusion in the environmental authorisation;	Section 11
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 9 and Appendix 3
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 11
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	Section 2
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	None were received
q) any other information requested by the competent authority.	
(2) Where a government notice 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

BIRD SPECIALIST STUDY

This report presents the bird specialist study that was prepared by Chris van Rooyen of Chris van Rooyen Consulting as part of the Basic Assessment (BA) Process for the proposed construction of the Vryburg Solar 2 Photovoltaic Facility, in the North-West Province.

1. INTRODUCTION AND METHODOLOGY

ABO Wind Renewable Energies (Pty) Ltd with support from Veroniva (Pty) Ltd (the project developers), are proposing to develop three 115 MW Solar PV Facilities and associated electrical infrastructure (including a 132kV distribution line from each PV Facility to the Eskom Mookodi Substation), near Vryburg in the North West Province. The proposed projects are referred to as "Vryburg Solar 1, Vryburg Solar 2, and Vryburg Solar 3". The Applicants will be: Vryburg Solar 1 (Pty) Ltd; Vryburg Solar 2 (Pty) Ltd; and Vryburg Solar 3 (Pty) Ltd.

The proposed project will make use of PV solar technology to generate electricity from the sun's energy. The Applicant is proposing to develop a facility with a possible maximum installed capacity of 115 MW Direct Current (DC) which produces 100 MW Alternating Current (AC) of electricity from PV solar energy. The proposed projects are planned on the following farm portions:

- Portion 1 of Farm Retreat Number 671
- Portion 0 (Remaining Extent) of Farm Frankfurt 672
- Portion 1 of Farm Frankfurt Number 672 ("Edin")
- Portion 2 of Farm Frankfurt Number 672 ("Erica')
- Remainder of Farm Rosendal 673, IN.

This report deals only with Vryburg Solar 2.

Once a Power Purchase Agreement (PPA) is awarded, the proposed facility will generate electricity for a minimum period of 20 years. The proposed solar facility will consist of the following components:

- Solar Field, comprising Solar Arrays with a maximum height of 10m, including the following:
  - PV Modules;
  - Single Axis Tracking structures (aligned north-south), Fixed Axis Tracking (aligned east-west), Dual Axis Tracking (aligned east-west and north-south) or Fixed Tilt Mounting Structure (all options will be considered in the design);
  - Solar module mounting structures comprised of galvanised steel and aluminium; and
  - Foundations which will likely be drilled and concreted into the ground.

- Building Infrastructure, with footprint of 25 000 m^2:
  - Offices (maximum height 7m and footprint of 1000 m^2);
  - Operational and maintenance control centre (maximum height 7m and footprint 500 m^2);
  - Warehouse/workshop (maximum height 7m and footprint 500 m^2);
  - Ablution facilities (maximum height 7m and footprint 50 m^2);
  - 32 Converter/Inverter stations (height from 2.5m to 7m and footprint 3300 m^2);
  - On-site substation building (maximum height 30m, footprint 20 000 m^2).; and
  - Guard Houses (height 3m, footprint 40 m^2, possible guard tower of up to 10 m height).

- Associated Infrastructure
    - 132 kV overhead transmission line to connect to the existing Eskom Mookodi substation
    - Associated electrical infrastructure at the Eskom Mookodi Substation (including but not limited to feeders, Busbars, transformer bay and extension to the platform at the Eskom Mookodi Substation)
    - On-site substation;
    - Internal 33 kV transmission lines/underground cables (either underground to maximum depth of 1m or above ground with height of 9m);
    - Underground low voltage cables or cable trays (underground to maximum depth of 1m);
    - Access roads would be the gravel road coming out of the N14, running SW away from Vryburg. The width and total length of the access road will be confirmed once the EPC contractor has been selected and the design is finalized;
    - Internal gravel roads (width of 4m);
    - Fencing (see specifications below);
    - Panel maintenance and cleaning area;
    - Stormwater channels (Details to be confirmed once the EPC contractor has been selected and the design is finalised. A detailed stormwater management plan would need to be developed); and
    - Temporary work area during the construction phase (i.e. laydown area of maximum 5 ha).

- Additional specifications
    - Fences: maximum height of 3m
    - Water: It is proposed that panel cleaning will take place quarterly; however this may be revised should the site conditions warrant more frequent cleaning. It is estimated that the panel washing process will require approximately 5 million to 8 million litres of water per year during operations, to be sourced from Municipality. At this stage, no water is planned to be abstracted from or discharged to any surface water systems.

- High Voltage 132 kV Overhead Transmission Lines from PV site to Mookodi substation, to be located within a corridor of approximately 300m width
    - Height = 22.5m to 30m
    - Length from site to grid connection = 9km

The total maximum project footprint is 255 hectares including the PV facility and infrastructure (see Figure 1).

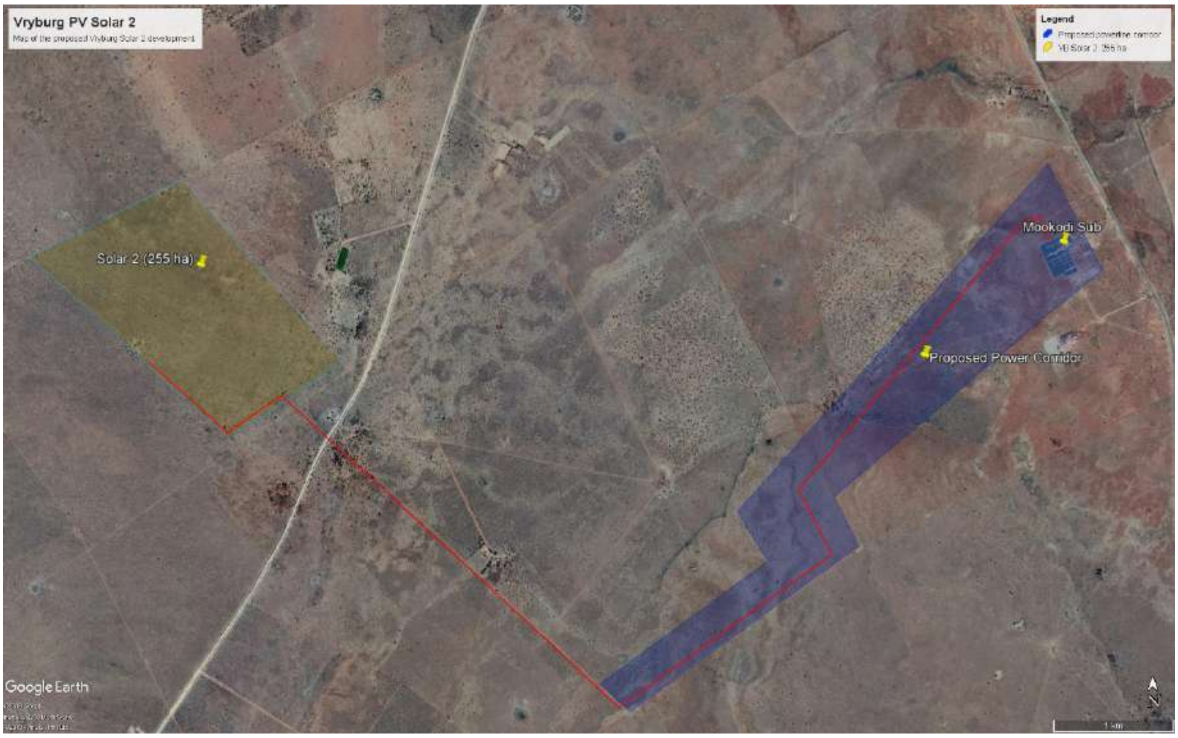

Figure 1: Location of Vryburg Solar 2 project and 132kV powerline to Mookodi substation showing powerline corridor (blue) and preferred powerline route (red).

The project is located in the Vryburg Renewable Energy Development Zone (REDZ). The REDZs represent areas where wind and solar photovoltaic development is being incentivised from resource, socio-economic and environmental perspectives. The Wind and Solar SEA REDZs were identified in five provinces, namely the Eastern Cape, Western Cape, Northern Cape, Free State and North West, as defined in Notice No. 114 – *Notice for Renewable Energy Development Activities procedure to apply for Environmental Authorisation* - in Government Gazette No 41445 of 16 February 2018.

In terms of the National Environmental Management Act (Act 107 of 1998, as amended) (NEMA) and the 2014 NEMA EIA Regulations promulgated in Government Gazette 40772 and Government Notice (GN) R326, R327, R325 and R324 on 7 April 2017, wind and solar PV projects located within a REDZs are subject to a Basic Assessment (BA) and reduced decision-making period by the authorities. The requirements for Specialist Studies remain the same, as specified in Appendix 6 of the EIA Regulations.

1.1 Scope, Purpose and Objectives of this Specialist Report

The objective of the report is to assess the impact that the proposed facility will have on avifauna and to assess whether impacts can be sufficiently mitigated in order for the project to proceed.

1.2 Terms of Reference

The terms of reference for this assessment report are as follows:

- Describe the affected environment from an avifaunal perspective;
- Discuss gaps in baseline data and other limitations;
- List and describe the expected impacts associated with the solar facility and associated infrastructure;
- Assess the potential impacts on avifauna;
- Recommend mitigation measures to reduce the impact of the expected impacts.

1.3 Assessment Details

Type of Specialist Investigation	Avifauna
Date and Duration of Specialist Site Investigation	3 – 5 July 2018
Season	Winter
Relevance of Season	Bird surveys were conducted on the neighbouring properties in November 2015, January and February 2016 during the summer season, in accordance with Regime 2 of the draft version (November 2015) of Birdlife South Africa Best Practice Guidelines for assessing and monitoring the impact of solar energy facilities on birds in southern Africa (Jenkins *et al.* 2015). Thanks to the comprehensive dataset gathered in this manner, and the fact that the area proved not to be particularly sensitive, it was decided, in consultation with BirdLife South Africa (BLSA) that a Regime 1 survey will be adequate, to supplement the data gathered previously in the summer season.

2. APPROACH AND METHODOLOGY

- Bird distribution data from the Southern African Bird Atlas Project 2 (SABAP 2) was obtained from the University of Cape Town, in order to ascertain which species occur in the pentads where the proposed development is located. A pentad grid cell covers 5 minutes of latitude by 5 minutes of longitude (5'× 5'). Each pentad is approximately 8 × 7.6 km. In order to get a more representative impression of the birdlife, a consolidated data set was obtained for a total of 9 pentads around the proposed development. From 6 November 2009 to 24 June 2018, 79 full protocol cards (i.e. surveys lasting a minimum of two hours or more each) have been completed for this area. An additional 27 ad hoc protocol cards (surveys lasting less than two hours but still yielding valuable data) and 70 incidental records were also completed for this area (see Figure 2).

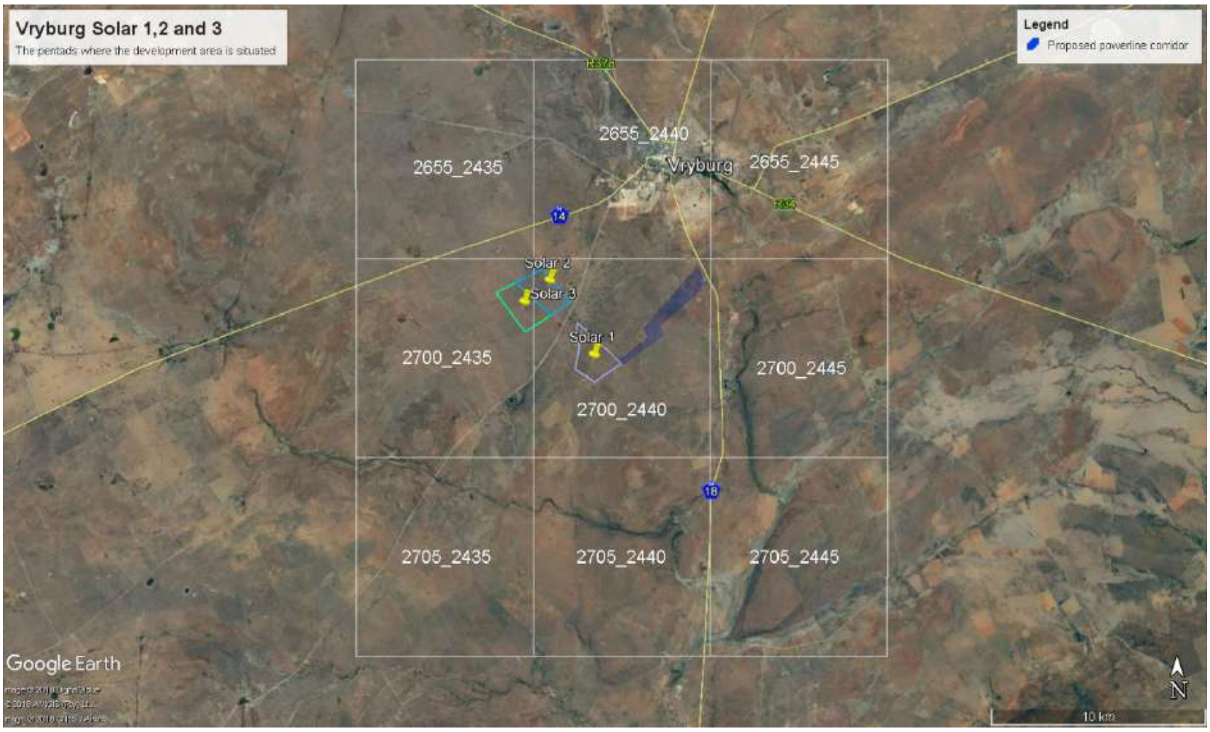

Figure 2: The 9 pentads which comprises the greater study area.

- A distinction was drawn between the broader study area i.e. the 9 pentads surrounding the proposed development footprint, the survey areas i.e. the land parcels where the bird surveys were conducted, and the development footprint i.e. the land parcel where the actual solar development will be situated (see Figure 3).

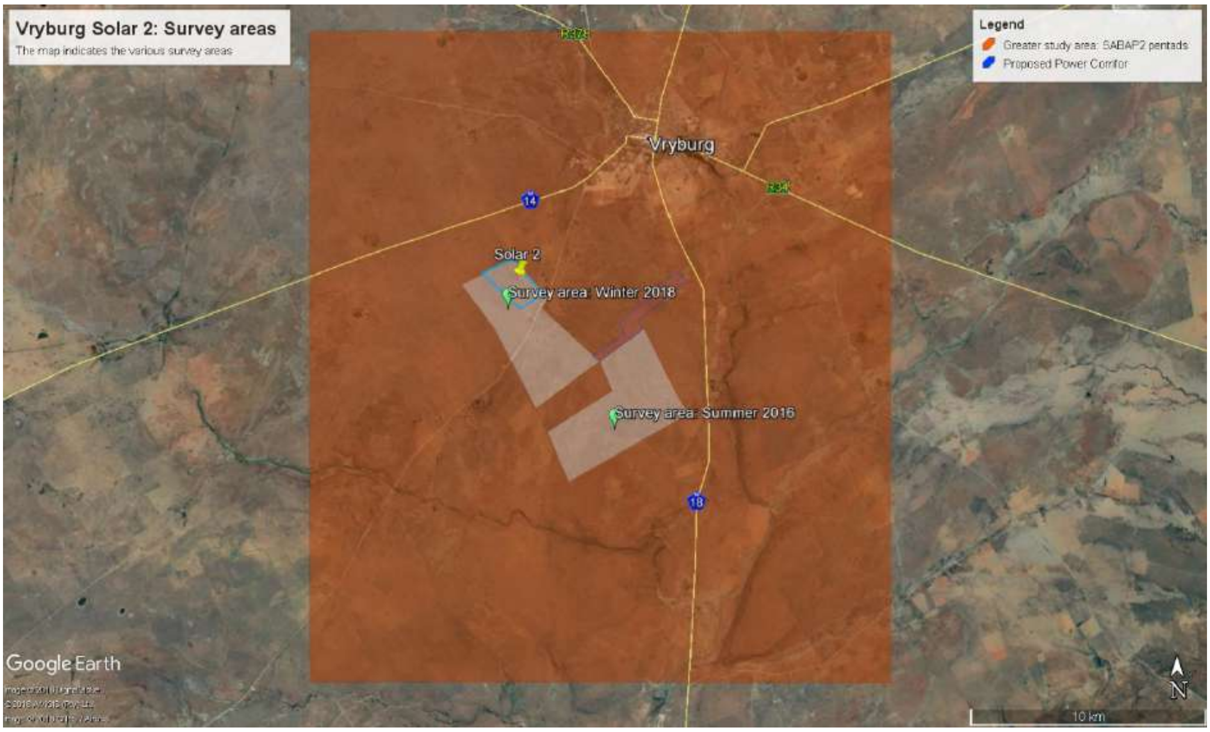

Figure 3: The greater study area and survey areas relative to the development footprint

- A classification of the vegetation types in the greater study area was obtained from the Atlas of Southern African Birds 1 (SABAP1) and the National Vegetation Map compiled by the South African National Biodiversity Institute (Mucina & Rutherford 2006).
- The national threatened status of all priority species was determined with the use of the most recent edition of the Red Data Book of Birds of South Africa, Lesotho and Swaziland (Taylor et al. 2015), and the latest authoritative summary of southern African bird biology (Hockey et al. 2005).
- The global threatened status of all priority species was determined by consulting the latest (2018.1) IUCN Red List of Threatened Species.
- The Important Bird and Biodiversity Areas of South Africa (Marnewick et al. 2015) was consulted for information on potentially relevant Important Bird Areas (IBAs).
- Google Earth satellite imagery was used in order to view the broader area on a landscape level and to help identify bird habitat on the ground.
- A desktop investigation was conducted to source information on the impacts of solar facilities on avifauna.
- A visit to the survey areas was conducted on 2 July 2018, followed up by on-site surveys from 3 - 5 July 2018. Surveys were conducted according to Regime 1 of Birdlife South Africa Best Practice Guidelines for assessing and monitoring the impact of solar energy facilities on birds in southern Africa, compiled by BirdLife South Africa (BLSA) in 2017 (Jenkins et al. 2017). Surveys were also previously conducted on the neighbouring properties in November 2015, January and February 2016 during the summer season, in accordance with Regime 2 of the draft version (November 2015) of the guidelines.
- The main source of information on avifaunal abundance and species diversity was the on-site surveys conducted in 2018, and the on-site surveys on the neighbouring properties conducted previously in 2015/16. Data was collected through a combination of drive transects, walk transects, point counts and focal point surveys (Please see Appendix 1 for a detailed exposition of the methodology used in the surveys).
- Several potential focal points of bird activity (all related to surface water e.g. boreholes and wetlands) were identified and monitored during both the summer and winter surveys. The Ferrum – Mercury 400kV powerline was also inspected for bird nests.
- All birds were recorded during both the summer and winter surveys to determine the variety and abundance of avifauna at the survey areas. Birds were classified as priority or non-priority species. Priority species were defined as South African Red List species; South African endemics and near-endemics; waterbirds and raptors.

2.1 Information Sources

The following sources of information were consulted to compile the study:

- Southern African Bird Atlas Project 2 (SABAP 2) (ADU 2018).
- The Atlas of Southern African Birds 1 (SABAP1)(Harrison et al. 1997)
- The National Vegetation Map compiled by the South African National Biodiversity Institute (Mucina & Rutherford 2006).
- The Red Data Book of Birds of South Africa, Lesotho and Swaziland (Taylor et al. 2015),
- Robert's Birds of Southern Africa, seventh edition (Hockey et al. 2005).
- The IUCN Red List of Threatened Species v. 2018.1. (IUCN 2018)
- The Important Bird and Biodiversity Areas of South Africa (Marnewick et al. 2015).
- Google Earth @ 2018.
- Guidelines for assessing and monitoring the impact of solar power generating facilities on birds in southern Africa. BirdLife South Africa (Jenkins et al. 2017).
- The main source of information on avifaunal abundance and species diversity was the on-site surveys conducted in 2018, and the on-site surveys on the neighbouring properties conducted

previously in 2015/16. Data was collected through a combination of drive transects, walk transects, point counts and focal point surveys (Please see Appendix 1 for a detailed exposition of the methodology used in the surveys).

- MSc thesis "Solar energy in the spotlight". Minor Dissertation presented in partial fulfilment of the requirements for the degree of Master of Science in Conservation Biology Percy FitzPatrick Institute of African Ornithology, University of Cape Town (Visser 2016).
- A list of potential solar projects within 30km of the proposed Vryburg 2 project to be considered for purposes of cumulative impacts was provided by the CSIR.

2.2 Assumptions, Knowledge Gaps and Limitations

This study assumed that the sources of information used in this report are reliable. In this respect, the following must be noted:

- From 6 November 2009 to 24 June 2018, 79 full protocol cards, 27 ad hoc protocol cards and 70 incidental records were completed for the greater study area. It was assumed that this comprehensive dataset, together with the surveys which were conducted in 2015/16 and 2018, provide a representative snapshot of the avifauna which could be present in the development footprint.
- The focus of the study is primarily on the potential impacts on priority species i.e. South African Red List species, South African endemics and near-endemics, waterbirds and raptors.
- The impact of solar installations on avifauna is a new field of study, with only one scientific study published to date (McCrary *et al*. 1986), and one unpublished scientific study on the impact of PV facilities on avifauna in South Africa (Visser 2016). Strong reliance was therefore placed on expert opinion and data from existing monitoring programmes at solar facilities in the USA where monitoring has been ongoing since 2013. The pre-cautionary principle was applied throughout as the full extent of impacts on avifauna at solar facilities is not presently known.
- The assessment of impacts is based on the baseline environment as it currently exists at the proposed development footprint and surrounding area and does not take into account potential future changes in land use.
- It is assumed that the CSIR list of potential solar projects within 30km of the proposed Vryburg 1 project to be considered for purposes of cumulative impacts is complete.
- Conclusions in this study are based on experience of these and similar species in different parts of South Africa, but bird behaviour can never be predicted with 100% accuracy.

2.3 Consultation Processes Undertaken

The landowner, Ms. Adele Oberholzer, was found to be knowledgeable on the avifauna and was consulted on the avifauna occurring on her properties.

3. DESCRIPTION OF PROJECT ASPECTS RELEVANT TO AVIFAUNAL IMPACTS

The following aspects of the project are relevant from an avifaunal impact perspective:

- Solar Field: Displacement due to habitat transformation and collisions with the solar panels;
- Building infrastructure: Displacement due to habitat transformation;
- Perimeter fences: Mortality due to entrapment between double fences;
- 132kV powerline: Displacement due to disturbance during the construction phase, and mortality due to collisions and electrocutions; and

- 33kV powerline: Displacement due to disturbance during the construction phase, and mortality due to collisions and electrocutions (if these lines are located above ground and not buried).

4. DESCRIPTION OF THE RECEIVING ENVIRONMENT

An estimated 189 species, belonging to 79 families could potentially occur in the broader study area. Of these, an estimated 160 species could occur in the development footprint (see Appendix 2). Of these, an estimated 160 species could occur in the development footprint, of which 27 are classified as priority species i.e. South African Red List species; South African endemics and near-endemics; waterbirds and raptors.

4.1 Baseline Environmental Description

4.1.1 Biomes and vegetation types

The proposed development footprint is located in the savanna (woodland) biome and situated in a transitional zone between grassland and savanna approximately 10km south of the town of Vryburg in the North-West Province. The habitat in the survey areas is homogenous and consists of extensive plains with a well-developed grass layer and a shrub layer of varying density, with scattered, stunted trees, mostly *Vachellia* species. While most of the development footprint is covered in fairly dense low shrubs, there are also extensive open areas of grassland with only a few scattered shrubs present. In the development footprint, trees are generally clustered around boreholes, but there are also stands of trees not associated with boreholes.

The natural vegetation type at the development footprint and the proposed powerline corridor (and in the greater study area) is Ghaap Plateau Vaalbosveld. Ghaap Plateau Vaalbosveld consists of a well-developed shrub layer of variable density, comprising mostly Camphor Bush *Tarchonanthus camphoratus* with very few trees. Rainfall is in summer and autumn ranging from 300mm – 500mm, with temperatures ranging from -7.5°C to 36°C (Mucina & Rutherford 2006). Ghaap Plateau Vaalbosveld is a form of arid woodland. Arid woodland occurs where there is intermediate, though variable rainfall with hot, wet summers and cool, dry winters.

4.1.2 Important Bird Areas (IBAs)

The closest Important Bird Areas (IBAs), the Baberspan and Leeupan SA026 and the Sandveld and Bloemhof Dam Nature Reserves SA039 are located approximately 100km away (Marnewick *et al.* 2015). The development is too far away from these IBAs to have any direct impact on them.

4.1.3 Habitat classes and avifauna in the study area

Whilst much of the distribution and abundance of the bird species in the study area can be explained by the description of the natural vegetation, it is as important to examine the modifications which have changed the natural landscape, and which may have an effect on the distribution of avifauna. These are sometimes evident at a much smaller spatial scale than the biome or vegetation types.

The following bird habitat classes have been identified at the development footprint and immediate surroundings:

Natural savanna

This habitat class is described above under 4.1.1.

Priority species that could be found in the natural savanna on the development footprint are listed in Table 1 below. Species recorded in the survey areas are listed as "Confirmed".

Table 1: Priority species potentially associated with savanna in the development footprint

Species	Taxonomic name	Likelihood of occurrence	Comments
Heron, Black-headed	*Ardea melanocephala*	Medium	Open grassland areas
Bustard, Kori	*Ardeotis kori*	Confirmed	
Eagle, Martial	*Polemaetus bellicosus*	Confirmed	Occasional visitor
Roller, European	*Coracias garrulus*	Low	Occasional visitor
Egret, Cattle	*Bubulcus ibis*	Confirmed	In association with cattle
Secretarybird	*Sagittarius serpentarius*	Confirmed	Breeding in the surrounding area according to the landowner
Eagle-Owl, Spotted	*Bubo africanus*	High	
Falcon, Amur	*Falco amurensis*	Medium	Only in years of high rainfall
Falcon, Lanner	*Falco biarmicus*	Confirmed	
Goshawk, Gabar	*Melierax gabar*	Medium	
Goshawk, Southern Pale Chanting	*Melierax canorus*	Confirmed	Landowner confirmed
Harrier-Hawk, African	*Polyboroides typus*	Medium	
Kestrel, Greater	*Falco rupicoloides*	Confirmed	
Kestrel, Lesser	*Falco naumanni*	Medium	Numbers will fluctuate depending on conditions
Kestrel, Rock	*Falco rupicolus*	High	
Kite, Black-shouldered	*Elanus caeruleus*	Confirmed	
Kite, Yellow-billed	*Milvus aegyptius*	Confirmed	
Owl, Barn	*Tyto alba*	Confirmed	
Owlet, Pearl-spotted	*Glaucidium perlatum*	High	
Snake-eagle, Black-chested	*Circaetus pectoralis*	Confirmed	
Flycatcher, Fiscal	*Sigelus silens*	Confirmed	
Thrush, Karoo	*Turdus smithi*	Confirmed	
White-eye, Cape	*Zosterops virens*	High	

Surface water

The ephemeral rivers, particularly the Dry Harts River which is situated east of the development footprint, is important for a variety of waterbirds which could be attracted to pools in the river, as well as the dry river channel itself. Open water troughs are important sources of surface water in arid areas and may be used extensively by various species for drinking and bathing, including large raptors. The presence of trees around surface water often attracts woodland species.

The development footprint contains no wetlands. There is one borehole on the development footprint, but it was dry at the time of the field surveys and looked like it had not been used for a long time. The closest surface water is a borehole and water trough approximately 600m south-east of the development footprint. There are three boreholes in the proposed powerline corridor.

Priority species that could be attracted to surface water are listed in Table 2 below. Species recorded in the survey areas are listed as “Confirmed”.

Table 2: Priority species potentially attracted to surface water

Species	Taxonomic name	Likelihood of occurrence	Comments
Eagle, Martial	*Polemaetus bellicosus*	Confirmed	
Falcon, Lanner	*Falco biarmicus*	Confirmed	May also hunt small birds around water holes
Kite, Yellow-billed	*Milvus aegyptius*	Confirmed	
Snake-eagle, Black-chested	*Circaetus pectoralis*	Confirmed	
Heron, Black-headed	*Ardea melanocephala*	Medium	
Secretarybird	*Sagittarius serpentarius*	Confirmed	
Goshawk, Gabar	*Melierax gabar*	Medium	May also hunt small birds around water holes
Harrier-Hawk, African	*Polyboroides typus*	Medium	
Egret, Cattle	*Bubulcus ibis*	Confirmed	
Lapwing, Blacksmith	*Vanellus armatus*	Confirmed	
Goose, Egyptian	*Alopochen aegyptiacus*	Medium	
Hamerkop	*Scopus umbretta*	Medium	
Bustard, Kori	*Ardeotis kori*	Confirmed	

High voltage lines

High voltage lines are an important potential roosting and breeding substrate for raptors in the greater study area. In some areas of the country, high-voltage lines are used extensively by large raptors, especially Martial Eagles, for breeding purposes (Jenkins *et al*. 2006), but also smaller species such as Lanner Falcon and Greater Kestrel which often breeds in abandoned corvid nests. High voltage lines therefore hold a special importance for large raptors, but also for Sociable Weavers which often construct their giant nests within the lattice work or cross-arms of high voltage structures. One high-voltage line, the Ferrum – Mercury 400kV line, runs in an east – west direction on the southern border of the proposed development footprint. The section of the line which runs parallel to the development footprint was inspected in February 2016 and again in July 2018, but no nests were recorded on any of the towers.

The proposed 132kV line will run along the western border of the development footprint, will turn sharply east, turn south again, cross the road and run along the eastern border of the proposed Vryburg Solar 1 development and will then follow a north-easterly course to the Mookodi Substation. Priority species that could be attracted to the proposed 132kV powerline on the development footprint and powerline corridor are listed in Table 3 below. Species recorded during in the survey areas are listed as “Confirmed”.

Table 3: Priority species potentially attracted to the 132kV powerline in the development footprint and the powerline corridor

Species	**Taxonomic name**	**Likelihood of occurrence**	**Comments**
Eagle, Martial	*Polemaetus bellicosus*	Confirmed	Roosting/perching
Falcon, Lanner	*Falco biarmicus*	Confirmed	Roosting/perching
Snake-eagle, Black-chested	*Circaetus pectoralis*	Confirmed	Roosting/perching
Heron, Black-headed	*Ardea melanocephala*	Medium	Roosting/perching
Stork, Black	*Ciconia nigra*	Low	Roosting/perching
Kestrel, Greater	*Falco rupicoloides*	Confirmed	Roosting/perching
Owl, Barn	*Tyto alba*	Confirmed	Perching
Roller, European	*Coracias garrulus*	Low	Perching
Eagle-Owl, Spotted	*Bubo africanus*	Confirmed	Perching
Falcon, Amur	*Falco amurensis*	Medium	Perching
Goshawk, Southern Pale Chanting	*Melierax canorus*	Confirmed	Roosting/perching
Kestrel, Lesser	*Falco naumanni*	Medium	Perching
Kestrel, Rock	*Falco rupicolus*	High	Roosting/perching
Kite, Yellow-billed	*Milvus aegyptius*	Confirmed	Perching

Results of the field surveys

Figures 4 and 5 below lists the densities and variety of priority species recorded during transect counts at the survey areas during summer 2016 and winter 2018. The densities of priority species are indicated as individuals per kilometre (index of kilometric abundance - IKA).

Figure 4: Index of Kilometric Abundance of all species recorded during transect counts in the Summer 2015/16. The densities of priority species are indicated as individuals per kilometre (index of kilometric abundance - IKA).

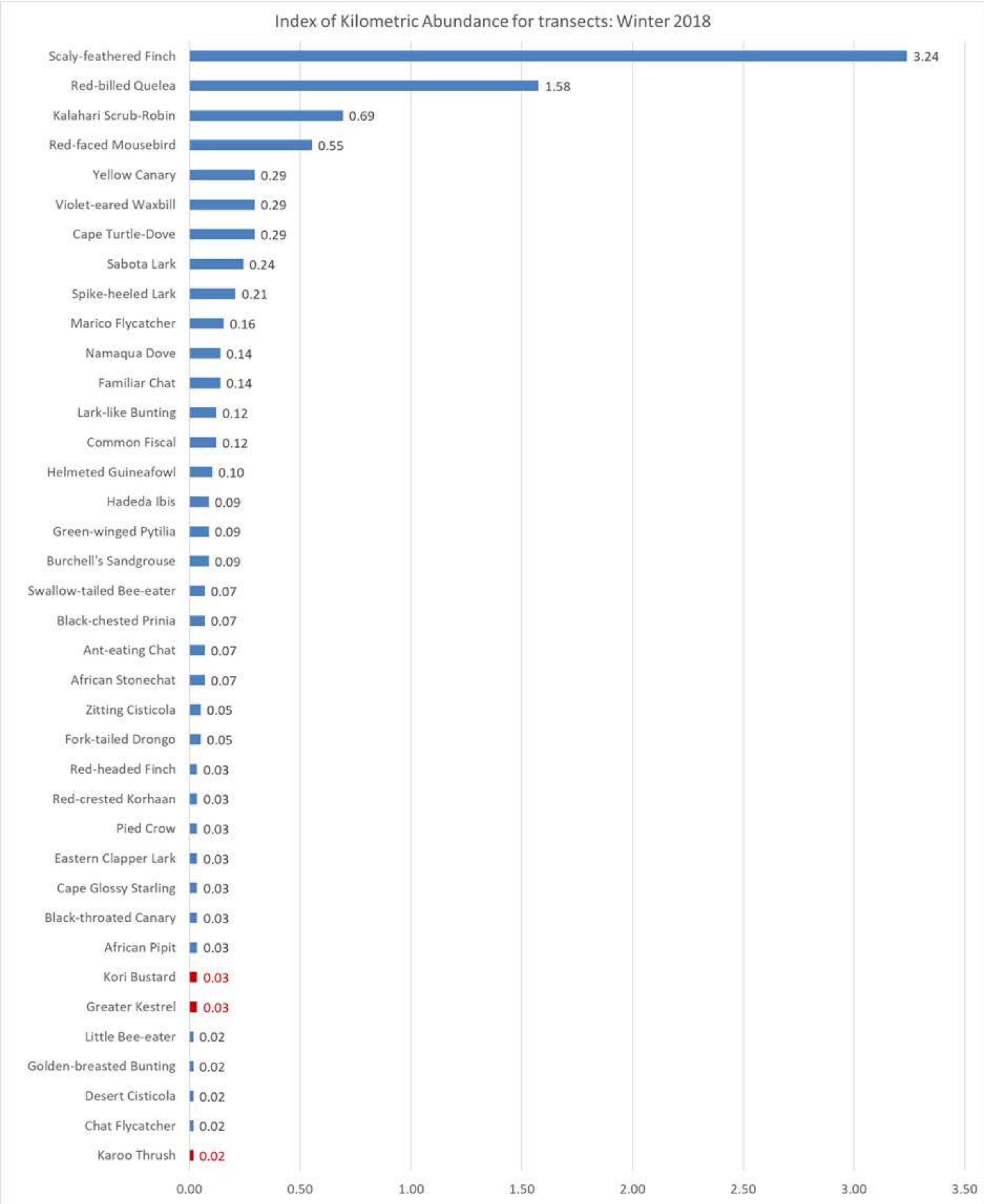

Figure 5: Index of Kilometric Abundance of all species recorded during transect counts in the Winter 2018. The densities of priority 16% species are indicated as individuals per kilometre (index of kilometric abundance - IKA).

As can be seen in Figures 4 and 5 above, the variety of priority species recorded during transect counts at the survey areas was lower in winter than in summer (38 vs 43 species). This is even more pronounced when the incidental counts, focal point counts and vantage point observations are also taken into account, with a total of 74 species recorded from all sources in summer vs 48 in winter. However, the number of individual birds per kilometre was almost double in winter than in summer (9.42 birds/km vs 4.98 birds/km).

Normally summer be the period of most bird activity at the survey areas, as it is in the middle of the rainy season. However, the area was experiencing drought conditions with high temperatures at the time, which is the most logical explanation for the low numbers.

Overall, the development footprint is moderately sensitive from an avifaunal perspective. During the summer surveys, priority species comprised 16% of all species recorded, and 8.3% of all species recorded during the winter surveys. In the greater study area, the number of priority species are estimated to be about 24% of the total number of species which are likely to occur.

4.2 Identification of Environmental Sensitivities

The following environmental sensitivities were identified at the proposed development footprint and powerline corridor (see Figure 6):

- Medium sensitivity: The natural savanna at the proposed development footprint and powerline corridor supports a moderate variety of the avifauna.
- High sensitivity: Drinking troughs at boreholes are a source of surface water and serves as focal points for avifauna. Large raptors descending to drink at troughs could be at risk of colliding with the proposed powerline.
- Very high sensitivity: Clusters of medium-sized to large trees are important in this landscape where trees are sparse. They serve as potential roosting and breeding habitat for a variety of birds, including raptors. These trees should be preserved if at all possible. Roads can be constructed in these areas provided the trees are not harmed, especially if there are already an

existing road running through such an area.

Figure 6: The identified sensitivities at Vryburg Solar 2, with yellow being savannah of medium sensitivity for birds, light brown circles being boreholes of high sensitivity for birds and the dark brown areas being patches of medium-sized to large trees with very high sensitivity for birds.

5. ISSUES, RISKS AND IMPACTS

5.1 Summary of Issues identified during the Project Notification Phase

The following issues have been identified as potentially relevant to avifauna:

- Displacement due to disturbance and habitat transformation associated with the construction activities associated with the solar panels and associated infrastructure (buildings, roads, internal powerlines and substation).
- Mortality due to collisions with the solar panels;
- Mortality due to entrapment between perimeter fences;
- Displacement due to disturbance and habitat transformation associated with the construction of the 132kV powerline;
- Mortality due to collisions with the 132kV powerline;
- Mortality due to electrocutions on the 132kV powerline
- Mortality due to electrocution on the internal 33kV powerlines;

No comments were received emanating from the public to date.

5.2 Identification of Potential Impacts/Risks

The potential impacts identified during the BA are:

Construction Phase

- Impact 1: Displacement due to disturbance caused by the construction activities associated with the solar panels and associated infrastructure (buildings, roads, internal powerlines and substation).
- Impact 2: Displacement due to disturbance during the construction of the 132kV powerline;

Operational Phase

- Impact 3: Displacement due to habitat transformation caused by the solar panels and associated infrastructure (buildings, roads, internal powerlines and substation);
- Impact 4: Mortality due to collisions with the solar panels;
- Impact 5: Mortality due to entrapment between perimeter fences;
- Impact 6: Mortality due to collisions with the 132kV powerline;
- Impact 7: Mortality due to electrocution on the 132kV powerline;
- Impact 8: Mortality due to electrocution on the internal 33kV powerlines;

Decommissioning Phase

- Impact 9: Displacement due to disturbance caused by the de-commissioning activities associated with the solar panels and associated infrastructure (buildings, roads, internal powerlines and substation).

Cumulative Impacts

- Cumulative Impact 1: Displacement due to habitat transformation caused by the solar panels and associated infrastructure (buildings, roads, powerlines and substation);
- Cumulative Impact 2: Mortality due to electrocutions on and collisions with the 132kV powerlines.

6. IMPACT ASSESSMENT

Increasingly, human-induced climate change is recognized as a fundamental driver of biological processes and patterns. Historic climate change is known to have caused shifts in the geographic ranges of many plants and animals, and future climate change is expected to result in even greater redistributions of species (National Audubon Society 2015). In 2006 WWF Australia produced a report on the envisaged impact of climate change on birds worldwide (Wormworth, J. & Mallon, K. 2006). The report found that:

- Climate change now affects bird species' behaviour, ranges and population dynamics;
- Some bird species are already experiencing strong negative impacts from climate change;
- In future, subject to greenhouse gas emissions levels and climatic response, climate change will put large numbers bird species at risk of extinction, with estimates of extinction rates varying from 2 to 72%, depending on the region, climate scenario and potential for birds to shift to new habitat.

Using statistical models based on the North American Breeding Bird Survey and Audubon Christmas Bird Count datasets, the National Audubon Society assessed geographic range shifts through the end of the century for 588 North American bird species during both the summer and winter seasons under a range of future climate change scenarios (National Audubon Society 2015). Their analysis showed the following:

- 314 of 588 species modelled (53%) lose more than half of their current geographic range in all three modelled scenarios.
- For 126 species, loss occurs without accompanying range expansion.
- For 188 species, loss is coupled with the potential to colonize new areas.

Climate sensitivity is an important piece of information to incorporate into conservation planning and adaptive management strategies. The persistence of many birds will depend on their ability to colonize climatically suitable areas outside of current ranges and management actions that target climate change adaptation.

South Africa is among the world's top 10 developing countries required to significantly reduce their carbon emissions (Seymore *et al.* 2014), and the introduction of low-carbon technologies into the country's compliment of power generation will greatly assist with achieving this important objective (Walwyn & Brent 2015). Given that South Africa receives among the highest levels of solar radiation on earth (Fluri 2009; Munzhedi *et al*. 2009), it is clear that solar power generation should feature prominently in future efforts to convert to a more sustainable energy mix in order to combat climate change, also from an avifaunal impact perspective. However, while the expansion of solar power generation is undoubtedly a positive development for avifauna in the longer term in that it will help reduce the effect of climate change and thus habitat transformation, it must also be acknowledged that renewable energy facilities, including solar PV facilities, in themselves have some potential for negative impacts on avifauna.

A literature review reveals a scarcity of published, scientifically examined information regarding large-scale PV plants and birds. The reason for this is mainly that large-scale PV plants are a relatively recent phenomenon. The main source of information for these types of impacts are from compliance reports and a few government-sponsored studies relating to recently constructed solar plants in the south-west United States. In South Africa, only one unpublished scientific study has been completed on the impacts of PV plants in a South African context (Visser 2016).

In summary, the potential impacts of PV plants on avifauna which have emerged so far include the following:

- Displacement due to disturbance and habitat transformation associated with the construction of the solar PV plant and associated infrastructure;
- Collisions with the solar panels;
- Entrapment in perimeter fences;
- Collisions with the associated power lines; and
- Electrocutions on the associated power lines.

6.1 Potential Impacts during the Construction Phase

6.1.1 Impact 1: Displacement due to disturbance caused by the construction activities associated with the solar panels and associated infrastructure (buildings, roads, internal powerlines and substation).

6.1.1.1 <u>Nature</u>

The activities listed below are typically associated with the construction of solar facilities and could lead to temporary displacement of avifauna due to disturbance (County of Merced 2014):

- Preparation of solar panel areas for installation, including vegetation clearing, grading, cut and fill;
- Excavation/trenching for water pipelines, cables, fibre-optic lines, and the septic system;
- Construction of piers and building foundations;
- Construction of new dirt or gravel roads and improvement of existing roads;
- Temporary stockpiling and side-casting of soil, construction materials, or other construction wastes;
- Increased vehicle traffic;
- Short-term construction-related noise (from equipment) and visual disturbance;

These activities could have an impact on birds breeding, foraging and roosting in or in close proximity through disturbance, which could result in temporary displacement.

6.1.1.2 Significance of impact without mitigation

The displacement of avifauna due to construction activities is usually a temporary impact, of **low** significance. The following priority species could potentially be affected by this impact:

- Cattle Egret
- Greater Kestrel
- Kori Bustard
- Karoo Thrush
- Barn Owl
- Black-chested Snake-Eagle
- Black-shouldered Kite
- Fiscal Flycatcher
- Lanner Falcon
- Martial Eagle
- Yellow-billed Kite
- Blacksmith Lapwing
- South African Cliff-Swallow
- African Harrier-Hawk
- Amur Falcon
- Black-headed Heron
- Cape White-eye
- European Roller
- Gabar Goshawk
- Lesser Kestrel
- Pearl-spotted Owlet
- Rock Kestrel
- Secretarybird
- Southern Pale Chanting Goshawk
- Spotted Eagle-Owl
- Egyptian Goose
- Hamerkop

6.1.1.3 Proposed mitigation measures

The proposed mitigation measures to reduce the impact of displacement due to disturbance are as follows:

- Construction activity should be restricted to the immediate footprint of the infrastructure.
- Measures to control noise and dust should be applied according to current best practice in the industry.
- Access to areas outside the construction footprint should be strictly controlled and limited as much as possible.
- Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum as far as practical.
- The recommendations of the ecological and botanical specialist studies must be strictly implemented, especially as far as limitation of the construction footprint is concerned.

6.1.1.4 Significance of impact with mitigation

The implementation of the mitigation measures should reduce the impact to a very low level.

Aspect	**Construction of solar facility and associated infrastructure**
Type of Impact	Direct
Potential Impact	Displacement of avifauna due to disturbance caused by the construction activities associated with the solar panels and associated infrastructure (buildings, roads, internal powerlines and substation).
Status	Negative
Mitigation Required	• Construction activity should be restricted to the immediate footprint of the infrastructure. • Measures to control noise and dust should be applied according to current best practice in the industry. • Access to areas outside the construction footprint should be strictly controlled and limited as much as possible. • Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum as far as practical. • The recommendations of the ecological specialist study must be strictly implemented, especially as far as limitation of the construction footprint is concerned.
Impact Significance (Pre-Mitigation)	Low (4)
Impact Significance (Post-Mitigation)	Very low (5)
I&AP Concern	No

6.1.2 Impact 2: Displacement due to disturbance during the construction of the 132kV powerline;

6.1.2.1 Nature

Some birds could be displaced due to disturbance during the construction phase of the powerline. While this is usually temporary, if it results in the interruption of a breeding cycle, at the critical time, could result in the death of the eggs or nestlings. In the case of slow reproducing species with long breeding seasons, e.g. large eagles, the interruption of a single breeding season could have a more marked effect than for smaller, fast reproducing species, e.g. passerines, which can more easily lay a replacement clutch.

6.1.2.2 Significance of impact without mitigation

The displacement of avifauna in the powerline corridor due to construction activities is likely to be a temporary impact, of **low** significance. The following priority species could potentially be affected by this impact:

- Cattle Egret
- Greater Kestrel
- Kori Bustard
- Karoo Thrush
- Barn Owl
- Black-chested Snake-Eagle
- Black-shouldered Kite
- Fiscal Flycatcher
- Lanner Falcon
- Martial Eagle
- Yellow-billed Kite
- Blacksmith Lapwing
- South African Cliff-Swallow
- African Harrier-Hawk
- Amur Falcon
- Black-headed Heron
- Cape White-eye
- European Roller
- Gabar Goshawk
- Lesser Kestrel
- Pearl-spotted Owlet
- Rock Kestrel
- Secretarybird
- Southern Pale Chanting Goshawk
- Spotted Eagle-Owl
- Egyptian Goose
- Hamerkop

6.1.2.3 Proposed mitigation measures

The proposed mitigation measures to reduce the impact of displacement due to disturbance are as follows:

- No off-road driving;
- Maximum use of existing roads;
- Measures to control noise
- Restricted access to the rest of the property;
- Prior to construction, an avifaunal specialist should conduct a site walkthrough, covering the final power line route, to identify any nests/breeding/roosting activity of Red List species, the results of which may inform the final construction schedule in close proximity to that specific area, including abbreviating construction time, scheduling activities around avian breeding and/or movement schedules, and lowering levels of associated noise.

6.1.2.4 Significance of impact with mitigation

The implementation of the mitigation measures should reduce the impact to a **very low** level.

Aspect	**Construction of solar facility and associated infrastructure**
Type of Impact	Direct
Potential Impact	Displacement of avifauna due to disturbance caused by the construction of the 132kV line.
Status	Negative
Mitigation Required	• No off-road driving; • Maximum use of existing roads; • Measures to control noise • Restricted access to the rest of the property; • Prior to construction, an avifaunal specialist should conduct a site walkthrough, covering the final power line route, to identify any nests/breeding/roosting activity of Red List species, the results of which may inform the final construction schedule in close proximity to that specific area, including abbreviating construction time where possible, scheduling activities around avian breeding and/or movement schedules where possible, and lowering levels of associated noise.
Impact Significance (Pre-Mitigation)	Low (4)
Impact Significance (Post-Mitigation)	Very low (5)
I&AP Concern	No

6.2 Potential Impacts during the Operational Phase

6.2.1 Impact 3: Displacement due to habitat transformation caused by the construction of the solar panels and associated infrastructure (buildings, roads and substation).

6.2.1.1 Nature

Ground-disturbing activities affect a variety of processes in arid areas, including soil density, water infiltration rate, vulnerability to erosion, secondary plant succession, invasion by exotic plant species, and stability of cryptobiotic soil crusts. These processes, together with weed removal, brush clearing, soil compaction, dust, and water runoff from construction sites, and activities related to the ongoing operation of the project have the ability – individually and together – to alter habitat quality, often to the detriment of wildlife, including avifauna. Any disturbance and alteration to the landscape, including the construction and decommissioning of utility-scale solar energy facilities, has the potential to increase soil erosion. Erosion can physically and physiologically affect plant species and can thus adversely influence primary production and food availability for wildlife (Lovich & Ennen 2011).

Solar energy facilities require substantial site preparation (including the removal of vegetation) that alters topography and, thus, drainage patterns to divert the surface flow associated with rainfall away from facility infrastructure. Channelling runoff away from plant communities can have dramatic negative effects on water availability and habitat quality in arid and semi-arid areas. Areas deprived of runoff from sheet flow support less biomass of perennial and annual plants relative to adjacent areas with uninterrupted water-flow patterns (Lovich & Ennen 2011).

In a study comparing the avifaunal habitat use in PV arrays with adjoining managed grassland at airports in the USA, DeVault et al. (2014) found that species diversity in PV arrays was reduced compared to the grasslands (37 vs 46), supporting the view that solar development is generally detrimental to wildlife on a local scale.

There has only been one study done thus far in South Africa to assess the impact of habitat transformation at PV facilities on avifauna. In order to identify functional and structural changes in bird communities in and around the development footprint, Visser (2016) gathered bird transect data at the 180 hectares, 96MW Jasper PV solar facility in the Northern Cape, representing the solar development, boundary, and untransformed landscape. She found both bird density and diversity per unit area was higher in the boundary and untransformed landscape, however, the extent therefore was not considered to be statistically significant. This indicates that the PV facility matrix is permeable to most species. However, key environmental features, including available habitat and vegetation quality are most likely the overriding factors influencing species' occurrence and their relative density within the development footprint. Her most significant finding was that the distribution of birds in the landscape changed, from a shrubland to open country and grassland bird community, in response to changes in the distribution and abundance of habitat resources such as food, water and nesting sites. These changes in resource availability patterns were detrimental to some bird species and beneficial to others. Shrubland specialists appeared to be negatively affected by the presence of the PV facility. In contrast, open country/grassland and generalist species, were favoured by its development (Visser 2016).

6.2.1.2 Significance of impact without mitigation

The construction of the PV plant and associated infrastructure will result in the radical transformation of the existing natural habitat. The vegetation will be cleared prior to construction commencing. Once operational, less sunlight will reach the vegetation below the solar panels, which is likely to result in stunted vegetation growth and possibly complete eradication of some plant species. The natural vegetation is likely to persist in the rows between the solar panels, but it will be different to what was available before the construction of the plant, in that it will contain few shrubs.

It is highly likely that a pattern of reduced avifaunal densities and possible changes in densities and composition favouring grassland species will manifest itself within the development footprint. It is expected that the variety of the priority species currently occurring within the proposed footprint will not be significantly reduced post-construction, as it does not contain many priority species which are shrubland specialists. It is however likely that priority species will occur at lower overall densities post-construction, due to physical habitat loss. Priority species likely to be least impacted by the habitat transformation would be grassland species such as Black-shouldered Kite, Greater Kestrel, Amur Falcon, Lesser Kestrel, Rock Kestrel and Black-headed Heron, although this may not be true for larger species such as Secretarybird and Kori Bustard.

In the case of some priority raptors (e.g. Southern Pale Chanting Goshawk, Rock Kestrel, Greater Kestrel and Lanner Falcon) the potential availability of carcasses or injured birds due to collisions with the solar panels, and enhanced prey visibility (e.g. insects, reptiles and rodents) in the short grassland between the solar panels may attract them to the area (Visser 2016). Jeal (2017) recorded large numbers of Barn Owls at the Bokpoort parabolic trough CSP facility near Groblershoop in the Northern Cape, roosting in the 'torque tubes' that support the parabolic mirrors – while this influx of owls may have been because of a lack of suitable roosting substrate in the surrounding range land, the enhanced prey visibility due to the sparse vegetation cover in the plant itself may also have played a role in attracting the owls.

Cape Sparrows and Laughing Doves and other small birds will very likely attempt to nest underneath the solar panels to take advantage of the shade, but this should not adversely affect the operation of the equipment. However, these would most likely be removed as they might pose a potential fire risk.

The associated infrastructure (buildings, roads, and the on-site substation) also cause physical transformation and fragmentation of the habitat, resulting in physical or effective habitat loss. The physical encroachment increases the disturbance and barrier effects that contribute to the overall habitat fragmentation effect of the infrastructure, resulting in effective habitat loss and displacement (Raab *et al*. 2010), e.g. Shaw (2013) found that Ludwig's Bustard generally avoid the immediate proximity of roads within a 500m buffer.

The displacement of priority species in the development footprint due to habitat transformation associated with the construction of the solar panels and associated infrastructure is rated as being of **moderate** significance. The following priority species could potentially be affected by this impact:

- Kori Bustard
- Karoo Thrush
- Martial Eagle
- African Harrier-Hawk
- Cape White-eye
- Gabar Goshawk
- Pearl-spotted Owlet
- Egyptian Goose
- Hamerkop
- Secretarybird

6.2.1.3 Proposed mitigation measures

The proposed mitigation measures to reduce the impact of displacement due to habitat transformation are as follows:

- The recommendations of the ecological and botanical specialist studies must be strictly implemented, especially as far as limitation of the construction footprint, retention of natural vegetation and rehabilitation of transformed areas is concerned.
- Areas with large trees should be retained as much as possible as they serve as potential roosting and breeding habitat for a variety of birds, including raptors. (see Figure 6).
- Audits must be performed by an external rehabilitation specialist to assess the success of the rehabilitation programme and recommend changes or additions to the programme if need be.

6.2.1.4 Significance of impact with mitigation

While the mitigation will have some effect, the transformation of the habitat in the development footprint will inevitably still be significant, therefore the impact is likely to remain at a **moderate** level post-mitigation.

Aspect	**Habitat transformation due to the construction of the solar facility and associated infrastructure**
Type of Impact	Direct
Potential Impact	Displacement of avifauna due to habitat transformation caused by the construction of the solar panels and associated infrastructure (buildings, roads and substation).
Status	Negative
Mitigation Required	• The recommendations of the ecological specialist study must be strictly implemented, especially as far as limitation of the construction footprint, the retention of natural vegetation and rehabilitation of transformed areas is concerned. • Areas with large trees should be avoided as much as possible as they serve as potential roosting and breeding habitat for a variety of birds, including raptors
Impact Significance (Pre-Mitigation)	Moderate (3)
Impact Significance (Post-Mitigation)	Moderate (3)
I&AP Concern	No

6.2.2 Impact 4: Mortality due to collisions with the solar panels

6.2.2.1 Nature of impact

This impact refers to collision-related fatality i.e. fatality resulting from the direct contact of the bird with a project structure(s). This type of fatality has been occasionally documented at solar projects of all technology types (McCrary *et al.* 1986; Hernandez *et al.* 2014; Kagan *et al*. 2014). In some instances, the bird is not killed outright by the collision impact, but succumbs to predation later, as it cannot avoid predators due to its injured state.

Sheet glass used in commercial and residential buildings has been well established as a hazard for birds. When the sky is reflected in the sheet glass, birds fail to see the building as an obstacle and attempt to fly through the glass, mistaking it for empty space (Loss *et al*. 2014). Although very few cases have been reported, it is possible that the reflective surfaces of solar panels could constitute a similar risk to avifauna.

An extremely rare but potentially related problem is the so-called “lake effect” i.e. it seems possible that reflections from solar facilities’ infrastructure, particularly large sheets of dark blue photovoltaic panels, may attract birds in flight across the open desert, who mistake the broad reflective surfaces for water (Kagan *et al.* 2014) . The unusually high percentage of waterbird mortalities at the Desert Sunlight PV facility (44%) may support the “lake effect” hypothesis (West 2014). Although in the case of Desert Sunlight, the proximity of evaporation ponds may act as an additional risk increasing factor, in that birds are both attracted to the water feature and habituated to the presence of an accessible aquatic environment in the area. This may translate into the misinterpretation of diffusely reflected sky or horizontal polarised light source as a body of water. However, due to limited data it would be premature to make any general conclusions about the influence of the lake effect or other factors that contribute to fatality of water-dependent birds. The activity and abundance of water-dependent species near solar facilities may depend on other site-specific or regional factors, such as the surrounding landscape (Walston *et al.* 2015). Until such time that enough scientific evidence has been collected to discount the “lake effect” hypothesis, it must be considered as a potential source of impacts.

Weekly mortality searches at 20% coverage were conducted at the 250MW, 1300ha California Valley Solar Ranch PV site (Harvey & Associates 2014a and 2014b). According to the information that could be sourced from the internet (two quarterly reports), 152 avian mortalities were reported for the period 16 November 2013 – 15 February 2014, and 54 for the period 16 February 2014 – 15 May 2014, of which approximately 90% were based on feathers spots which precluded a finding on the cause of death. These figures give an estimated unadjusted 1 030 mortalities per year, which is obviously an underestimate as it does not include adjustments for carcasses removed by scavengers and missed by searchers. The authors stated clearly that these quarterly reports do not include the results of searcher efficiency trials, carcass removal trials, or data analyses, nor does it include detailed discussions.

In a report by the National Fish and Wildlife Forensic Laboratory (Kagan *et al.* 2014), the cause of avian mortalities was estimated based on opportunistic avian carcass collections at several solar facilities, including the 550MW, 1 600ha Desert Sunlight PV plant. Impact trauma emerged as the highest identifiable cause of avian mortality, but most mortality could not be traced to an identifiable cause.

Walston *et al*. (2015) conducted a comprehensive review of avian fatality data from large scale solar facilities (all technology types) in the USA. Collision as cause of death (19 birds) ranked second at Desert Sunlight PV plant and California Valley Solar Ranch (CVSR) PV plant, after unknown causes. Cause of death could not be determined for over 50% of the fatality observations and many carcasses included in these analyses consisted only of feather spots (feathers concentrated together in a small area) or partial carcasses, thus making determination of cause of death difficult. It is anticipated that some unknown fatalities were caused by predation or some other factor unrelated to the solar project. However, they found that the lack of systematic data collection and standardization was a major impediment in establishing the actual extent and causes of fatalities across all projects.

The only scientific investigation of potential avifaunal impacts that has been performed at a South African PV facility was completed in 2016 at the 96MW Jasper PV solar facility which is located on the Humansrus Farm, approximately 4 km south-east of Groenwater and 30km east of Postmasburg in the Northern Cape Province (Visser 2016). The Jasper PV facility contains 325 360 solar panels over a footprint of 180 hectares with the capacity to deliver 180 000 MWh of renewable electricity annually. The solar panels face north at a fixed 20° angle, reaching a height of approximately 1.86 m relative to ground level with a distance of 3.11 m between successive rows of panels. Mortality surveys were conducted from the 14th of September 2015 until the 6th of December 2015, with a total of seven mortalities recorded among the solar panels which gives an average rate of 0.003 birds per hectare surveyed per month. All fatalities were inferred from feather spots. The study concluded inter alia that the short study period, and lack of comparable results from other sources made it difficult to provide a meaningful assessment of avian mortality at PV facilities. It further stated that despite these limitations, the few bird fatalities that were recorded might suggest that there is no significant collision-related mortality at the study site. The conclusion was that to fully understand the risk of solar energy development on birds, further collation and analysis of data from solar energy facilities across spatial and temporal scales, based on scientifically rigorous research designs, is required (Visser 2016).

The results of the available literature lack compelling evidence of collisions as a cause of large-scale mortality among birds at PV facilities. Incidental and informal evidence suggests that the collision risk presented by solar panels to birds is low but not impossible. It is likely that the infrastructure associated with transporting electricity (e.g. powerlines) presents more of a collision risk for birds than the solar arrays themselves (Harrison *et al.* 2017). However, it is clear from this limited literature survey that the lack of systematic and standardised data collection is a major problem in the assessment of the causes and extent of avian mortality at all types of solar facilities, regardless of the technology employed. Until statistically tested results emerge from existing compliance programmes and more dedicated scientific research, conclusions will inevitably be largely speculative and based on professional opinion.

6.2.2.2 Significance of impact without mitigation

The absence of any hard evidence in both scientific and grey literature that birds are prone to collisions, with solar panels is a strong indicator that this impact is insignificant. The lack of major waterbodies with large waterbird populations in close vicinity to the proposed development footprint greatly reduces the probability of collisions with the solar panels due to the lake effect as a source of mortality at the development. The risk is therefore rated as **very low**.

6.2.2.3 Proposed mitigation measures

No mitigation is required due to the lack compelling evidence of collisions as a cause of large-scale mortality among birds at PV facilities.

6.2.2.4 Significance of impact with mitigation

No mitigation is required as the risk is already **very low.**

Aspect/Activity	Bird collisions with the solar panels
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Mortality of avifauna due to collisions with the solar panels
Status	Negative
Mitigation Required	None
Impact Significance (Pre-Mitigation)	Very low (5)
Impact Significance (Post-Mitigation)	Very low (5)
I&AP Concern	No

6.2.3 Impact 5: Mortality due to entrapment between perimeter fences

6.2.3.1 Nature of the impact

Visser (2016) recorded a fence-line fatality (Orange River Francolin *Scleroptila gutturalis*) resulting from the bird being trapped between the inner and outer perimeter fence of the facility. This was further supported by observations of large-bodied birds unable to escape from between the two fences (e.g. Red-crested Korhaan *Lophotis ruficrista*) (Visser 2016). Considering that one would expect the birds to be able to take off in the lengthwise direction (parallel to the fences), it seems likely that the birds panicked when they were approached by observers and thus flew into the fence.

6.2.3.2 Significance of impact without mitigation

Priority species such as Kori Bustard and Secretarybird may be vulnerable to entrapment between double perimeter fences. However, it’s likely to be a fairly rare occurrence. The risk is therefore rated as **low**.

6.2.3.3 Proposed mitigation measures

The following mitigation measures are proposed:

- The two fences should be placed far apart enough for birds to able to take off if they somehow end up between the two fences.
- Staff should be sensitised to not panic birds when they discover them trapped between the fences bit to approach them with caution to give them time to escape by taking off in a lengthwise direction.

6.2.3.4 Significance of impact with mitigation

The mitigation should reduce the significance of the impact to **very low.**

Aspect/Activity	**Entrapment in the double perimeter fence**
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Mortality of avifauna due to entrapment in the double perimeter fence.
Status	Negative
Mitigation Required	• The two fences should be placed far apart enough for birds to able to take off if they somehow end up between the two fences. • Staff should be sensitised to not panic birds when they discover them trapped between the fences bit to approach them with caution to give them time to escape by taking off in a lengthwise direction.
Impact Significance (Pre-Mitigation)	Low (4)
Impact Significance (Post-Mitigation)	Very low (5)
I&AP Concern	No

6.2.4 Impact 6: Mortality due to collisions with the 132kV powerline

6.2.4.1 Nature of impact

Collision mortality is the biggest threat posed by transmission lines to birds in southern Africa (Van Rooyen 2004). Most heavily impacted upon are bustards, storks, cranes and various species of waterbirds. These species are mostly heavy-bodied birds with limited manoeuvrability, which makes it difficult for them to take the necessary evasive action to avoid colliding with transmission lines (Van Rooyen 2004, Anderson 2001). In her PhD study study, Shaw (2013) provides a concise summary of the phenomenon of avian collisions with transmission lines:

"The collision risk posed by power lines is complex and problems are often localised. While any bird flying near a power line is at risk of collision, this risk varies greatly between different groups of birds, and depends on the interplay of a wide range of factors (APLIC 1994). Bevanger (1994) described these factors in four main groups – biological, topographical, meteorological and technical. Birds at highest risk are those that are both susceptible to collisions and frequently exposed to power lines, with waterbirds, gamebirds, rails, cranes and bustards usually the most numerous reported victims (Bevanger 1998, Rubolini et al. 2005, Jenkins et al. 2010).

The proliferation of man-made structures in the landscape is relatively recent, and birds are not evolved to avoid them. Body size and morphology are key predictive factors of collision risk, with large-bodied birds with high wing loadings (the ratio of body weight to wing area) most at risk (Bevanger 1998, Janss 2000). These birds must fly fast to remain airborne, and do not have sufficient manoeuvrability to avoid unexpected obstacles. Vision is another key biological factor, with many collision-prone birds principally using lateral vision to navigate in flight, when it is the lower-resolution, and often restricted, forward vision that is useful to detect obstacles (Martin & Shaw 2010, Martin 2011, Martin et al. 2012). Behaviour is important, with birds flying in flocks, at low levels and in crepuscular or nocturnal conditions at higher risk of collision (Bevanger 1994). Experience affects risk, with migratory and nomadic species that spend much of their time in unfamiliar locations also expected to collide more often (Anderson 1978, Anderson 2002). Juvenile birds have often been reported as being more collision-prone than adults (e.g. Brown et al. 1987, Henderson et al. 1996).

Topography and weather conditions affect how birds use the landscape. Power lines in sensitive bird areas (e.g. those that separate feeding and roosting areas, or cross flyways) can be very dangerous (APLIC 1994, Bevanger 1994). Lines crossing the prevailing wind conditions can pose a problem for large birds that use the wind to aid take-off and landing (Bevanger 1994). Inclement weather can disorient birds and reduce their flight altitude, and strong winds can result in birds colliding with power lines that they can see but do not have enough flight control to avoid (Brown et al. 1987, APLIC 2012).

The technical aspects of power line design and siting also play a big part in collision risk. Grouping similar power lines on a common servitude, or locating them along other features such as tree lines, are both approaches thought to reduce risk (Bevanger 1994). In general, low lines with short span lengths (i.e. the distance between two adjacent pylons) and flat conductor configurations are thought to be the least dangerous (Bevanger 1994, Jenkins et al. 2010). On many higher voltage lines, there is a thin earth (or ground) wire above the conductors, protecting the system from lightning strikes. Earth wires are widely accepted to cause the majority of collisions on power lines with this configuration because they are difficult to see, and birds flaring to avoid hitting the conductors often put themselves directly in the path of these wires (Brown et al. 1987, Faanes 1987, Alonso et al. 1994a, Bevanger 1994).”

From incidental record keeping by the Endangered Wildlife Trust, it is possible to give a measure of what species are generally susceptible to power line collisions in South Africa (see Figure 7 below).

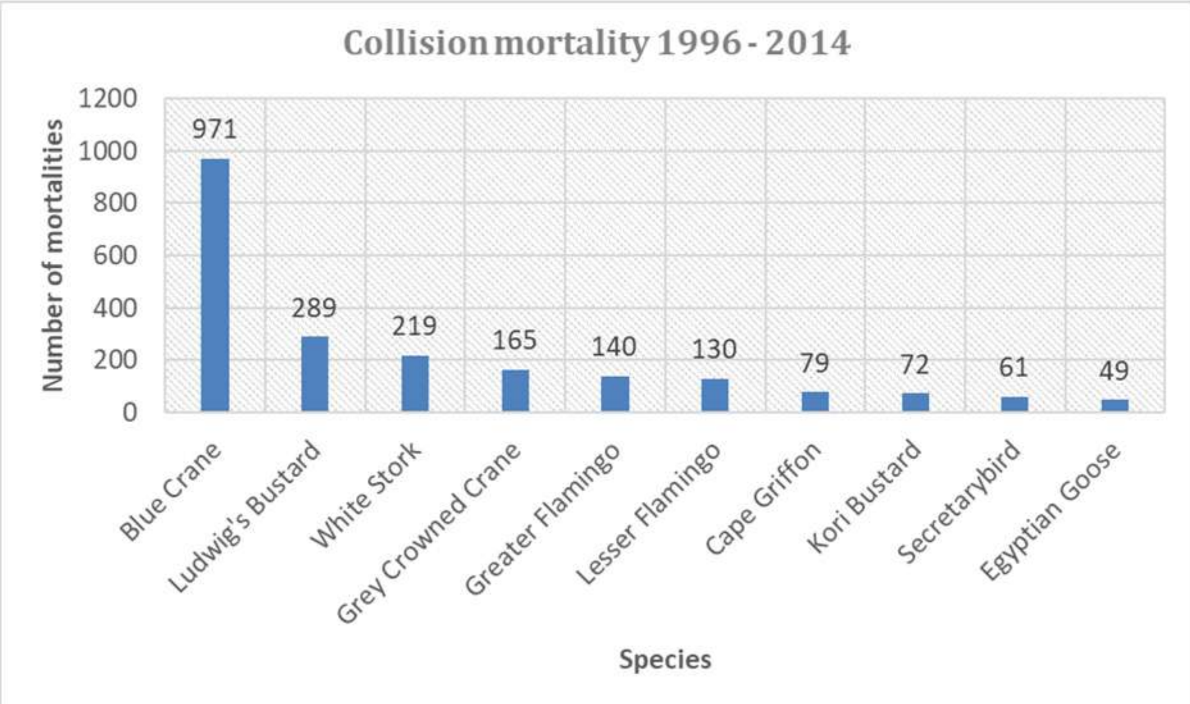

Figure 7: The top ten collision prone bird species in South Africa, in terms of reported incidents contained in the Eskom-EWT Strategic Partnership central incident register 1996 - 2014 (EWT unpublished data).

Power line collisions are generally accepted as a key threat to bustards (Raab *et al.* 2009; Raab *et al.* 2010; Jenkins & Smallie 2009; Barrientos *et al.* 2012, Shaw 2013). In a comprehensive study, carcass surveys were performed under high voltage transmission lines in the Karoo for two years, and low voltage distribution lines for one year (Shaw 2013). Ludwig’s Bustard was the most common collision victim (69% of carcasses), with bustards generally comprising 87% of mortalities recovered. Total annual mortality was estimated at 41% of the Ludwig's Bustard population, with Kori Bustards also dying in large numbers (at least 14% of the South African population killed in the Karoo alone). Karoo Korhaan was also recorded, but to a much lesser extent than Ludwig's Bustard. The reasons for the relatively low collision risk of this species probably include their smaller size (and hence greater agility in flight) as well as their more sedentary lifestyles, as local birds are familiar with their territory and are less likely to collide with power lines (Shaw 2013).

Several factors are thought to influence avian collisions, including the manoeuvrability of the bird, topography, weather conditions and power line configuration. An important additional factor that previously has received little attention is the visual capacity of birds; i.e. whether they are able to see obstacles such as power lines, and whether they are looking ahead to see obstacles with enough time to avoid a collision. In addition to helping explain the susceptibility of some species to collision, this factor is key to planning effective mitigation measures. Recent research provides the first evidence that birds can render themselves blind in the direction of travel during flight through voluntary head movements (Martin & Shaw 2010). Visual fields were determined in three bird species representative of families known to be subject to high levels of mortality associated with power lines i.e. Kori Bustards, Blue Cranes *Anthropoides paradiseus* and White Storks *Ciconia ciconia*. In all species the frontal visual fields showed narrow and vertically long binocular fields typical of birds that take food items directly in the bill under visual guidance. However, these species differed markedly in the vertical extent of their binocular fields and in the extent of the blind areas which project above and below the binocular fields in the forward-facing hemisphere. The importance of these blind areas is that when in flight, head movements in the vertical plane (pitching the head to look downwards) will render the bird blind in the direction of travel. Such movements may frequently occur when birds are scanning below them (for foraging or roost sites, or for conspecifics). In bustards and cranes pitch movements of only 25° and 35°, respectively, are sufficient to render the birds blind in the direction of travel; in storks, head movements of 55° are necessary. That flying birds can render themselves blind in the direction of travel has not been previously recognised and has important implications for the effective mitigation of collisions with human artefacts including wind turbines and power lines. These findings have applicability to species outside of these families especially raptors (*Accipitridae*) which are known to have small binocular fields and large blind areas similar to those of bustards and cranes and are also known to be vulnerable to power line collisions.

6.2.4.2 Significance of impact without mitigation

The species most at risk of this impact in the powerline corridor are large terrestrial priority species, and large raptors. The following species are at risk of collisions:

- Kori Bustard
- Martial Eagle
- African Harrier-Hawk
- Secretarybird
- Black-chested Snake-Eagle
- Black-headed Heron

The pre-mitigation risk of collision mortality is rated as **moderate**.

6.2.4.3 Proposed mitigation measures

Despite doubts about the efficacy of line marking to reduce the collision risk for bustards (Jenkins *et al.* 2010; Martin *et al.* 2010), there are numerous studies which prove that marking a line with PVC spiral type Bird Flight Diverters (BFDs) generally reduce mortality rates (e.g. Barrientos *et al.* 2011; Jenkins *et al.* 2010; Alonso & Alonso 1999; Koops & De Jong 1982), including to some extent for bustards (Barrientos *et al.* 2012; Hoogstad 2015 pers.comm). Beaulaurier (1981) summarised the results of 17 studies that involved the marking of earth wires and found an average reduction in mortality of 45%. Barrientos *et al.* (2011) reviewed the results of 15 wire marking experiments in which transmission or distribution wires were marked to examine the effectiveness of flight diverters in reducing bird mortality. The presence of flight diverters was associated with a decrease of 55–94% in bird mortalities. Koops and De Jong (1982) found that the spacing of the BFDs was critical in reducing the mortality rates - mortality rates are reduced up to 86% with a spacing of 5m, whereas using the same devices at 10m intervals only reduces the mortality by 57%. Barrientos *et al.* (2012) found that larger BFDs were more effective in reducing Great Bustard collisions than smaller ones. Line markers should be as large as possible, and highly contrasting with the background. Colour is probably less important as during the day the background will be brighter than the obstacle with the reverse true at lower light levels (e.g. at twilight, or during overcast conditions). Black and white interspersed patterns are likely to maximise the probability of detection (Martin *et al.* 2010).

It is proposed that the 132kV grid connection should be marked with Bird Flappers, on the earthwire, for the entire length of the line.

6.2.4.4 Significance of impact with mitigation

The post - mitigation risk of collision mortality is rated as **low**.

Aspect/Activity	**Collisions with the 132kV powerline**
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Mortality of priority species due to collisions with the earthwire of the 132kV powerline
Status	Negative
Mitigation Required	The 132kV powerline should be marked with Bird Flappers on the earthwire for the entire length of the line
Impact Significance (Pre-Mitigation)	Moderate (3)
Impact Significance (Post-Mitigation)	Low (4)
I&AP Concern	No

6.2.5 Impact 7: Mortality due to electrocution on the 132kV powerline;

6.2.5.1 Nature of the impact

Electrocution refers to the scenario where a bird is perched or attempts to perch on the electrical structure and causes an electrical short circuit by physically bridging the air gap between live components and/or live and earthed components (van Rooyen 2004). Electrocution risk is strongly influenced by the power line voltage and design of the pole structure and mainly affects larger, perching species, such as vultures, eagles and storks, easily capable of spanning the spaces between energized components on smaller distribution lines, or energized and earthed components.

The preferred structure type will be either a single circuit steel monopole or lattice tower (either self-supporting or stayed as deemed technically necessary). In the case of more than one solar farm being authorised, a double-circuit twin tern structure may need to be employed.

6.2.5.2 Significance of impact without mitigation

The only species that could conceivably be at risk of electrocution on the 132kV structures, are large raptors or vultures. Vultures do not occur regularly in the area, although Cape Vulture *Gyps coprotheres* and White-backed Vulture *Gyps africanus* can occur sporadically (VulPro unpublished data 2018). The proposed structures do not pose a significant electrocution risk to solitary large eagles, but the guyed steel monopole can pose an electrocution risk to vultures if they congregate in numbers on a pole. In such an instance, they might attempt to perch on the stand-off insulators, which may lead them to bridge the air gap between the live conductor and the earthed steel pole. Such an occurrence is likely to be a very rare occurrence, and only likely to happen when they descend to a carcass in the vicinity of the powerline. The pre-mitigation significance of this impact is rated to be **moderate.**

6.2.5.3 Proposed mitigation measures

The following mitigation measures are proposed to reduce the risk of electrocution:

- Vulture friendly structures (pylon or lattice) must be employed for the 132kV powerline. The structures (either single or double circuit) must be approved as vulture friendly by the Endangered Wildlife Trust's Wildlife and Energy Programme.

6.2.5.4 Significance of impact with mitigation

The significance of the potential impact can be reduced to **very low** through the employment of a vulture friendly design.

Aspect/Activity	Electrocutions on the 132kV powerline
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Mortality of priority species due to electrocutions on the 132kV powerline
Status	Negative
Mitigation Required	• Vulture friendly structures (pylon or lattice) must be employed for the 132kV powerline. The structures (either single or double circuit) must be approved as vulture friendly by the Endangered Wildlife Trust's Wildlife and Energy Programme.
Impact Significance (Pre-Mitigation)	Moderate (3)
Impact Significance (Post-Mitigation)	Very low (5)
I&AP Concern	No

6.2.6 Impact 8: Mortality due to electrocution on the internal 33kV powerlines;

6.2.6.1 Nature of the impact

Electrocution refers to the scenario where a bird is perched or attempts to perch on the electrical structure and causes an electrical short circuit by physically bridging the air gap between live components and/or live and earthed components (van Rooyen 2004). Electrocution risk is strongly influenced by the power line voltage and design of the pole structure and mainly affects larger, perching species, such as vultures, large raptors and storks, easily capable of spanning the spaces between energized components on smaller distribution lines, or energized and earthed components.

No information is currently available on the design of the proposed 33kV lines.

6.2.6.2 Significance of the impact without mitigation

The risk of electrocution on the 33kV network is **high** for several priority species, which include two South African Red List species:

- Martial Eagle
- African Harrier-Hawk
- Black-chested Snake-Eagle
- Greater Kestrel
- Barn Owl
- Black-shouldered Kite
- Lanner Falcon
- Amur Falcon
- Lesser Kestrel
- Rock Kestrel
- Spotted Eagle-Owl
- Yellow-billed Kite
- Southern Pale Chanting Goshawk

6.2.6.3 Proposed mitigation measures

The alternative option of placing the 33kV lines underground is strongly recommended.

6.2.6.4 Significance of the impact with mitigation

The proposed mitigation measures should reduce the risk to **very low**.

Aspect/Activity	**Electrocutions on the 33kV powerline**
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Mortality of priority species due to electrocutions on the 33kV powerline
Status	Negative
Mitigation Required	• The alternative option of placing the 33kV lines underground is strongly recommended.
Impact Significance (Pre-Mitigation)	High (2)
Impact Significance (Post-Mitigation)	Very low (5)
I&AP Concern	No

6.3 Potential Impacts during the Decommissioning Phase

6.3.1 Impact 9: Displacement due to disturbance caused by the de-commissioning activities associated with the solar panels and associated infrastructure (buildings, roads, internal powerlines and substation).

6.3.1.1 Nature of the impact

The noise and movement associated with the dismantling of the solar panels and 132kV powerline could have an impact on birds breeding, foraging and roosting in or in close proximity through disturbance, which could result in temporary displacement.

6.3.1.2 Significance of impact without mitigation

The displacement of avifauna in the powerline corridor due to disturbance caused by the dismantling activities is likely to be a temporary impact, of **low** significance. The following priority species could potentially be affected by this impact:

- Cattle Egret
- Greater Kestrel
- Kori Bustard
- Karoo Thrush
- Barn Owl
- Black-chested Snake-Eagle
- Black-shouldered Kite
- Fiscal Flycatcher
- Lanner Falcon
- Martial Eagle
- Yellow-billed Kite
- Blacksmith Lapwing
- South African Cliff-Swallow
- African Harrier-Hawk
- Amur Falcon
- Black-headed Heron
- Cape White-eye
- European Roller
- Gabar Goshawk
- Lesser Kestrel
- Pearl-spotted Owlet
- Rock Kestrel
- Secretarybird
- Southern Pale Chanting Goshawk
- Spotted Eagle-Owl
- Egyptian Goose
- Hamerkop

6.3.1.3 Proposed mitigation measures

The proposed mitigation measures to reduce the impact of displacement due to disturbance are as follows:

- No off-road driving;
- Maximum use of existing roads;
- Measures to control noise
- Restricted access to the rest of the property;

- Prior to the dismantling commencing, an avifaunal specialist should conduct a site walkthrough, covering the existing power line route, to identify any nests/breeding/roosting activity of Red List species, the results of which may inform the final work schedule in close proximity to that specific area, scheduling activities around avian breeding and/or movement schedules where possible, and lowering levels of associated noise.

6.3.1.4 Significance of impact with mitigation

The implementation of the mitigation measure should reduce the impact to a **very low** level.

Aspect	**Decommissioning of solar facility and associated infrastructure**
Type of Impact	Direct
Potential Impact	Displacement of avifauna due to disturbance caused by the decommissioning activities associated with the solar panels and associated infrastructure (buildings, roads, internal powerlines and substation).
Status	Negative
Mitigation Required	• No off-road driving; • Maximum use of existing roads; • Measures to control noise • Restricted access to the rest of the property; • Prior to the dismantling commencing, an avifaunal specialist should conduct a site walkthrough, covering the existing power line route, to identify any nests/breeding/roosting activity of Red List species, the results of which may inform the final work schedule in close proximity to that specific area, scheduling activities around avian breeding and/or movement schedules where possible, and lowering levels of associated noise.
Impact Significance (Pre-Mitigation)	Low (4)
Impact Significance (Post-Mitigation)	Very low (5)
I&AP Concern	No

6.4 Cumulative Impacts

Cumulative impacts are impacts that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities. Cumulative impacts can occur from the collective impacts of individual minor actions over a period of time and can include both direct and indirect impacts.

The approach for this basic assessment is that all renewable energy projects within 30km that have received an Environmental Authorisation at the time of starting this Basic Assessment (i.e. by 18 June 2018) are included for purposes of the cumulative assessment. The following projects fall within this category:

Tiger Kloof Solar PV energy facility	14/12/16/3/3/2/535	Environmental authorisation (EA) received	Kabi Solar (Pty) Ltd.	75 MW	2.5km²	Portions 3 & 4 of the Farm Waterloo 730
Sediba Power Plant 75MW PV Solar Facility and associated infrastructure	14/12/16/3/3/2/390AM1	EA received	Sediba Power Plant (Pty) Ltd	75 MW	1.5km²	A portion of the remaining extent of the Farm Rosendal 673
Sediba Power Plant 75MW PV Solar Facility and associated infrastructure	14/12/16/3/3/2/390AM2	EA received	Sediba Power Plant (Pty) Ltd	75 MW	1.5km²	A portion of the remaining extent of the Farm Rosendal 673
Waterloo Solar Park	14/12/16/3/3/2/308AM3	EA and awarded preferred bidder status (REIPPP window 4).	DPS79 Solar Energy (Pty) Ltd	75 MW	1.5km²	Southern portion of the Farm Waterloo 992
Cronos Energy Renewable Energy Generation Project	14/12/16/3/3/2/750	EA received	Cronos Energy (Pty) Ltd	75 MW	?	Remainder of the Farm Elma No 575
75MW Carocraft PV Solar Park and associated infrastructure	14/12/16/3/3/2/374	EA received 29 June 2013. Amended to 75 MW on 4 April 2014.	Carocraft (Pty) Ltd	75 MW	1.75km²	Portion 1 and the Remainder of the Farm Weltevrede 681

6.4.1 Cumulative Impact 1: Displacement due to habitat transformation caused by the solar panels and associated infrastructure (buildings, roads, powerlines and substation);

6.4.1.1 Nature if the impact

The habitat transformation associated with construction of solar energy facilities in the savanna biome can lead to effective habitat loss for certain species of avifauna. The distribution of birds in the landscape changes, from a shrubland to open country and grassland bird community, in response to changes in the distribution and abundance of habitat resources such as food, water and nesting sites. These changes in resource availability patterns are detrimental to some bird species and beneficial to others. Shrubland specialists appeared to be negatively affected by the presence of the PV facility. In contrast, open country/grassland and generalist species, are less affected or even favoured by its development (Visser 2016).

6.4.1.2 Significance without mitigation

The maximum total footprint which are currently authorised for solar development within the 30km radius around the proposed development footprint comes to a maximum of approximately 10km², with the town of Vryburg comprising another approximate 19km² of transformed habitat. Should the proposed Vryburg Solar 1 project be constructed, the total area of natural savanna which will be in a transformed state will therefore amount to about 32km² within an area of 2 898km². This comprises approximately 1.1% of the available natural savanna habitat available to birds. The cumulative displacement impact of habitat transformation is therefore rated as having a **low** significance, due to the small size of the total transformed area within the context of the available natural habitat.

6.4.1.3 Proposed mitigation measures

- All the standard best practice measures as described in the impact assessment reports to restrict the habitat destruction should be diligently implemented e.g. the recommendations of the ecological and botanical specialist studies must be strictly implemented, especially as far as limitation of the construction footprint, retention of natural vegetation and rehabilitation of transformed areas is concerned.

6.4.1.4 Significance with mitigation

The proposed mitigation measures should reduce the cumulative impact of habitat transformation to **very low**.

Aspect/Activity	**Cumulative impacts: Displacement due to habitat transformation**
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Displacement due to habitat transformation caused by the solar panels and associated infrastructure (buildings, roads, powerlines and substation)
Status	Negative
Mitigation Required	• All the standard best practice measures as described in the impact assessment reports to restrict the habitat destruction should be diligently implemented e.g. the recommendations of the ecological and botanical specialist studies must be strictly implemented, especially as far as limitation of the construction footprint, retention of natural vegetation and rehabilitation of transformed areas is concerned.
Impact Significance (Pre-Mitigation)	Low (4)
Impact Significance (Post-Mitigation)	Very low (5)
I&AP Concern	No

6.4.2 Cumulative Impact 2: Mortality due to electrocutions on and collisions with the internal 33kV powerlines and 132kV grid connection.

6.4.2.1 Nature of the impact

Any additional high voltage and medium voltage lines will increase the risk of mortality through collisions with the powerlines, and in the case of the 33kV lines specifically, electrocution.

6.4.2.2 Significance without mitigation measures

The proposed Vryburg Solar 2 project and the other two approved solar facilities will add 10 – 20km of additional high voltage powerlines to the existing grid within the 30km radius around the proposed development footprint, which currently contains at least 100km of high voltage lines, and an unknown number of 11-22kV reticulation lines. No information could be sourced on the proposed 33kV and 132KV powerline structures to be used by the other developments, as the Environmental Impact Reports do contain that information. It is therefore difficult to assess the cumulative impact, but the small length of additional HV lines is indicative of a **low** cumulative impact.

6.4.2.3 Proposed mitigation measures

The application of the proposed mitigation measures should reduce the cumulative impact to **very low**:

- Mark the 132kV powerline with Bird Flapper for its entire length
- The 33kV internal powerlines must be placed underground

Aspect/Activity	**Cumulative impacts: Mortality 33kV and 132kV powerlines**
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Any additional high voltage and medium voltage lines will increase the risk of mortality through collisions with the powerlines, and in the case of the 33kV lines specifically, electrocution.
Status	Negative
Mitigation Required	• Mark the 132kV powerline with Bird Flapper for its entire length • The 33kV internal powerlines must be placed underground
Impact Significance (Pre-Mitigation)	Low (4)
Impact Significance (Post-Mitigation)	Very low (5)
I&AP Concern	No

6.5 No-go option

The no-go alternative will result in the current status quo being maintained as far as the avifauna is concerned. The low human population in the area is definitely advantageous to avifauna. The no-go option would therefore eliminate any additional impact on the ecological integrity of the proposed development footprint as far as avifauna is concerned.

7. IMPACT ASSESSMENT TABLES

The assessment of impacts and recommendation of mitigation measures as discussed above are collated in Tables 4 to 7 below.

Table 4: Impact Assessment Summary Table for the Construction Phase

Construction Phase													
Direct Impacts													
Aspect/ Impact Pathway	**Nature of Potential Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of Impact**	**Irreplaceability**	**Potential Mitigation Measures**	**Significance of Impact and Risk**		**Ranking of Residual Impact/ Risk**	**Confidence Level**
										Without Mitigation/ Management	**With Mitigation/ Management (Residual Impact/ Risk)**		
Construction of solar facility and associated infrastructure	Displacement of avifauna due to disturbance caused by the construction activities associated with the solar panels and associated infrastructure (buildings, roads, internal powerlines and substation).	Negative	Site specific	Short term	Moderate	Very likely	High reversibility	Replaceable	Construction activity should be restricted to the immediate footprint of the infrastructure. Measures to control noise and dust should be applied according to current best practice in the industry. Access to areas outside the construction footprint should be strictly controlled and limited as much as possible. Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum as far as practical. The recommendations of the ecological specialist studies must be strictly implemented, especially as far as limitation of the construction footprint is concerned.	Low risk	Very low	4	High

Construction Phase													
Direct Impacts													
Aspect/ Impact Pathway	**Nature of Potential Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of Impact**	**Irreplaceability**	**Potential Mitigation Measures**	**Significance of Impact and Risk**		**Ranking of Residual Impact/ Risk**	**Confidence Level**
										Without Mitigation/ Management	**With Mitigation/ Management (Residual Impact/ Risk)**		
Construction of solar facility and associated infrastructure	Displacement of avifauna due to disturbance caused by the construction of the 132kV line.	Negative	Site specific	Short term	Moderate	Very likely	High reversibility	Replaceable	No off-road driving Maximum use of existing roads Measures to control noise Restricted access to the rest of the property Prior to construction, an avifaunal specialist should conduct a site walkthrough, covering the final power line route, to identify any nests/breeding/roosting activity of Red List species, the results of which may inform the final construction schedule in close proximity to that specific area, including abbreviating construction time where possible, scheduling activities around avian breeding and/or movement schedules where possible, and lowering levels of associated noise.	Low risk	Very low	4	High

Table 5: Impact Assessment Summary Table for the Operational Phase

Operational Phase													
Direct Impacts													
Aspect/ Impact Pathway	**Nature of Potential Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of Impact**	**Irreplaceability**	**Potential Mitigation Measures**	**Significance of Impact and Risk**		**Ranking of Residual Impact/ Risk**	**Confidence Level**
										Without Mitigation/ Management	**With Mitigation/ Management (Residual Impact/ Risk)**		
Habitat transformation due to the construction of the solar facility and associated infrastructure	Displacement of avifauna due to habitat transformation caused by the construction of the solar panels and associated infrastructure (buildings, roads and substation).	Negative	Site specific	Long term	Substantial	Very likely	High	Moderate	The recommendations of the ecological specialist studies must be strictly implemented, especially as far as limitation of the construction footprint, the retention of natural vegetation and rehabilitation of transformed areas is concerned. Areas with large trees should be retained as much as possible as they serve as potential roosting and breeding habitat for a variety of birds, including raptors Audits must be performed by an external rehabilitation specialist to assess the success of the rehabilitation programme and recommend changes or additions to the programme if need be.	Moderate	Moderate	3	Medium
Bird collisions with the solar panels	Mortality of avifauna due to collisions with the solar panels	Negative	Site specific	Long term	Slight	Very unlikely	High	Replaceable	No mitigation is required due to the lack of compelling evidence of collisions as a cause of large-scale mortality among birds at PV facilities.	Very low	Very low	5	Medium
Entrapment in the double perimeter fence	Mortality of avifauna due to entrapment in the double perimeter fence.	Negative	Site specific	Long term	Moderate	Unlikely	High	Moderate	The two fences should be placed far apart enough for birds to able to take off if they somehow end up between the two fences. Staff should be sensitised to not panic birds when they discover them trapped between the fences bit to approach them with caution to give them time to escape by taking off in a lengthwise direction.	Low	Very low	5	Medium

Operational Phase													
Direct Impacts													
Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk		Ranking of Residual Impact/ Risk	Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)		
Collisions with the 132kV powerline	Mortality of priority species due to collisions with the earthwire of the 132kV powerline	Negative	Local	Long term	Substantial	Likely	High	Moderate	The 132kV powerline should be marked with Bird Flappers on the earthwire for the entire length of the line	Moderate	Low	4	Medium
Electrocutions on the 132kV powerline	Mortality of priority species due to electrocutions on the 132kV powerline	Negative	Local	Long term	Substantial	Unlikely	High	Moderate	Vulture friendly structures (pylon or lattice) must be employed for the 132kV powerline. The structures (either single or double circuit) must be approved as vulture friendly by the Endangered Wildlife Trust's Wildlife and Energy Programme.	Moderate	Very low	5	High
Electrocutions on the 33kV powerline	Mortality of priority species due to electrocutions on the 33kV powerline	Negative	Local	Long term	Severe	Very likely	High	Moderate	The alternative option of placing the 33kV lines underground is strongly recommended	High	Very low	5	High

Table 6: Impact Assessment Summary Table for the Decommissioning Phase

Decommissioning Phase													
Direct Impacts													
Aspect/ Impact Pathway	**Nature of Potential Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of Impact**	**Irreplaceability**	**Potential Mitigation Measures**	**Significance of Impact and Risk**		**Ranking of Residual Impact/ Risk**	**Confidence Level**
										Without Mitigation/ Management	**With Mitigation/ Management (Residual Impact/ Risk)**		
Displacement due to disturbance related to de-commissioning	Displacement of avifauna due to disturbance caused by the decommissioning activities associated with the solar panels and associated infrastructure (buildings, roads, powerlines and substation).	Negative	Site specific	Short term	Moderate	Very likely	High	Replaceable	No off-road driving Maximum use of existing roads Measures to control noise Restricted access to the rest of the property Prior to the dismantling commencing, an avifaunal specialist should conduct a site walkthrough, covering the existing power line route, to identify any nests/breeding/roosting activity of Red List species, the results of which may inform the final work schedule in close proximity to that specific area, scheduling activities around avian breeding and/or movement schedules whe4re possible, and lowering levels of associated noise.	Low	Very low	5	High

Table 7: Cumulative Impact Assessment Summary Table

Cumulative Impacts (Construction, Operational and Decommissioning Phases)													
Direct Impacts													
Aspect/ Impact Pathway	**Nature of Potential Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of Impact**	**Irreplaceability**	**Potential Mitigation Measures**	**Significance of Impact and Risk**		**Ranking of Residual Impact/ Risk**	**Confidence Level**
										Without Mitigation/ Management	**With Mitigation/ Management (Residual Impact/ Risk)**		
Cumulative impacts: Displacement due to habitat transformation	Displacement due to habitat transformation caused by the solar panels and associated infrastructure (buildings, roads, powerlines and substation)	Negative	Regional	Long term	Moderate	Likely	High	Moderate	All the standard best practice measures as described in the impact assessment reports to restrict the habitat destruction should be diligently implemented e.g. the recommendations of the ecological specialist studies must be strictly implemented, especially as far as limitation of the construction footprint, retention of natural vegetation and rehabilitation of transformed areas is concerned.	Low	Very low	5	High
Cumulative impacts: Mortality 33kV and 132kV powerlines	Any additional high voltage and medium voltage lines will increase the risk of mortality through collisions with the powerlines, and in the case of the 33kV lines specifically, electrocution.	Negative	Regional	Long term	Moderate	Likely	High	Moderate	Mark the 132kV powerline with Bird Flapper for its entire length The 33kV internal powerlines should be placed underground	Low	Very low	5	High

7.1 Impact Assessment Summary

Table 8: Overall Impact Significance (Post Mitigation)

Phase	**Overall Impact Significance**
Construction	4 (Low risk)
Operational	4.5 (Low to very low risk
Decommissioning	5 (Very low risk)
Nature of Impact	**Overall Impact Significance**
Cumulative - Operational	2 (Very low risk)

8. LEGISLATIVE AND PERMIT REQUIREMENTS

8.1 Legislative Framework

There is no legislation pertaining specifically to the impact of wind facilities and associated electrical infrastructure on avifauna. There are best practice guidelines available which were compiled under the auspices of Birdlife South Africa (BLSA) i.e. Jenkins, A.R., Ralston-Patton, Smit- Robinson, A.H. 2017. Guidelines for assessing and monitoring the impact of solar power generating facilities on birds in southern Africa. BirdLife South Africa.

8.1.1 Agreements and conventions

Table 9: Agreements and conventions which South Africa is party to and which is relevant to the conservation of avifauna.

Convention name	**Description**	**Geographic scope**
African-Eurasian Waterbird Agreement (AEWA)	The Agreement on the Conservation of AEWA is an intergovernmental treaty dedicated to the conservation of migratory waterbirds and their habitats across Africa, Europe, the Middle East, Central Asia, Greenland and the Canadian Archipelago. Developed under the framework of the Convention on Migratory Species (CMS) and administered by the United Nations Environment Programme (UNEP), AEWA brings together countries and the wider international conservation community in an effort to establish coordinated conservation and management of migratory waterbirds throughout their entire migratory range.	Regional
Convention on Biological Diversity (CBD), Nairobi, 1992	The Convention on Biological Diversity (CBD) entered into force on 29 December 1993. It has 3 main objectives: • The conservation of biological diversity • The sustainable use of the components of biological diversity; and • The fair and equitable sharing of the benefits arising out of the utilization of genetic resources.	Global
Convention on the Conservation of Migratory Species of Wild Animals, (CMS), Bonn, 1979	As an environmental treaty under the aegis of the UNEP, CMS provides a global platform for the conservation and sustainable use of migratory animals and their habitats. CMS brings together the States through which migratory animals pass, the Range States, and lays the legal foundation for internationally coordinated conservation measures throughout a migratory range.	Global
Convention on the International Trade in	CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) is an international agreement between governments. Its aim	Global

Endangered Species of Wild Flora and Fauna, (CITES), Washington DC, 1973	is to ensure that international trade in specimens of wild animals and plants does not threaten their survival.	
Ramsar Convention on Wetlands of International Importance, Ramsar, 1971	The Convention on Wetlands, called the Ramsar Convention, is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.	Global
Memorandum of Understanding on the Conservation of Migratory Birds of Prey in Africa and Eurasia	The Signatories will aim to take co-ordinated measures to achieve and maintain the favourable conservation status of birds of prey throughout their range and to reverse their decline when and where appropriate.	Regional

8.2 National legislation

8.2.1.1 Constitution of the Republic of South Africa, 1996

The Constitution of the Republic of South Africa provides in the Bill of Rights that: Everyone has the right –

(a) to an environment that is not harmful to their health or well-being; and

(b) to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that –

- (i) prevent pollution and ecological degradation;
- (ii) promote conservation; and
- (iii) secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

8.2.1.2 The National Environmental Management Act 107 of 1998

The National Environmental Management Act 107 of 1998 (as amended) (NEMA) creates the legislative framework for environmental protection in South Africa and is aimed at giving effect to the environmental right in the Constitution. It sets out a number of guiding principles that apply to the actions of all organs of state that may significantly affect the environment. Sustainable development (socially, environmentally and economically) is one of the key principles, and internationally accepted principles of environmental management, such as the precautionary principle and the polluter pays principle, are also incorporated.

NEMA also provides that a wide variety of listed developmental activities (via the promulgation of the EIA Regulations (2014, as amended), which may significantly affect the environment, may be performed only after an EIA has been done and authorisation has been obtained from the relevant authority. Many of these listed activities can potentially have negative impacts on bird populations in a variety of ways. The clearance of natural vegetation, for instance, can lead to a loss of habitat and may depress prey populations, while erecting structures needed for generating and distributing energy, communication, and so forth can cause mortalities by collision or electrocution.

8.2.1.3 The National Environmental Management: Biodiversity Act 10 of 2004 and the Threatened or Protected Species Regulations, February 2007

The most prominent statute containing provisions directly aimed at the conservation of birds is the National Environmental Management: Biodiversity Act (Act 10 of 2004, as amended) read with the Threatened or Protected Species Regulations, February 2007 (TOPS Regulations). Chapter 1 sets out the objectives of the Act, and they are aligned with the objectives of the Convention on Biological Diversity, which are the conservation of biodiversity, the sustainable use of its components, and the fair and equitable sharing of the benefits of the use of genetic resources. The Act also gives effect to CITES, the Ramsar Convention, and the Bonn Convention on Migratory Species of Wild Animals (as noted in Table 7 above). The State is endowed with the trusteeship of biodiversity and has the responsibility to manage, conserve and sustain the biodiversity of South Africa.

9. ENVIRONMENTAL MANAGEMENT PROGRAMME

The EMPr, which includes the monitoring requirements, is provided in Appendix 3.

10. CONCLUSION AND RECOMMENDATIONS

The habitat where the proposed Vryburg Solar 2 facility and associated powerline corridor are situated is moderately sensitive from an avifaunal perspective and consists largely of natural savanna. The development is too far away from any Important Bird Areas (IBAs) to have any direct impact on them. An estimated 189 species, belonging to 79 families could potentially occur in the broader study area. Of these, an estimated 160 species could occur in the development footprint, of which 27 are classified as priority species i.e. South African Red List species; South African endemics and near-endemics; waterbirds and raptors.

The following environmental sensitivities were identified at the proposed development footprint:

- Medium sensitivity: The natural savanna at the proposed development footprint and powerline corridor supports a moderate variety of avifauna.
- High sensitivity: Drinking troughs at boreholes are a source of surface water and serve as focal points for avifauna.
- Very high sensitivity: Clusters of medium-sized to large trees are important in this landscape where trees are sparse. They serve as potential roosting and breeding habitat for a variety of birds, including raptors.

The following potential pre-mitigation impacts were identified:

Construction Phase

- Impact 1: Displacement due to disturbance caused by the construction activities associated with the solar panels and associated infrastructure (buildings, roads, internal powerlines and substation).
- Impact 2: Displacement due to disturbance during the construction of the 132kV powerline.

Operational Phase

- Impact 3: Displacement due to habitat transformation caused by the solar panels and associated infrastructure (buildings, roads, internal powerlines and substation);
- Impact 4: Mortality due to collisions with the solar panels;
- Impact 5: Mortality due to entrapment between perimeter fences;
- Impact 6: Mortality due to collisions with the 132kV powerline;
- Impact 7: Mortality due to electrocution on the 132kV powerline;
- Impact 8: Mortality due to electrocution on the internal 33kV powerlines;

Decommissioning Phase

- Impact 9: Displacement due to disturbance caused by the de-commissioning activities associated with the solar panels and associated infrastructure (buildings, roads, internal powerlines and substation).

Cumulative Impacts

- Cumulative Impact 1: Displacement due to habitat transformation caused by the solar panels and associated infrastructure (buildings, roads, powerlines and substation);
- Cumulative Impact 2: Mortality due to electrocutions on and collisions with the 132kV powerlines.

The risk ratings for the impacts associated with the various phases of the project are as follows:

Phase	**Overall Impact Significance – pre mitigation**	**Overall Impact Significance – post mitigation**
Construction	4 (Low risk)	4 (Low risk)
Operational	3.3 (Moderate to low)	4.5 (Low to very low risk
Decommissioning	4 (Low)	5 (Very low risk)
Nature of Impact		**Overall Impact Significance**
Cumulative - Operational	4 (Low)	5 (Very low risk)
Average	3.8 (Moderate to low)	4.6 (Low to very low)

The following key management actions and mitigation measures are proposed to reduce the impact of the proposed facility:

Construction Phase

- Construction activity should be restricted to the immediate footprint of the infrastructure.
- Measures to control noise and dust should be applied according to current best practice in the industry.
- Access to areas outside the construction footprint should be strictly controlled and limited as much as possible.
- Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum as far as practical.
- The recommendations of the ecological specialist studies must be strictly implemented, especially as far as limitation of the construction footprint is concerned.
- Prior to construction, an avifaunal specialist should conduct a site walkthrough, covering the final power line route, to identify any nests/breeding/roosting activity of Red List species, the results of which may inform the final construction schedule in close proximity to that specific area, including abbreviating construction time where possible, scheduling activities around avian breeding and/or movement schedules where possible, and lowering levels of associated noise.

Operational Phase

- The recommendations of the ecological specialist studies must be strictly implemented, especially as far as limitation of the construction footprint, the retention of natural vegetation and rehabilitation of transformed areas is concerned.
- Areas with large trees (as shown in Figure 6) should be retained as much as possible as they serve as potential roosting and breeding habitat for a variety of birds, including raptors.
- Audits must be performed by an external rehabilitation specialist to assess the success of the rehabilitation programme and recommend changes or additions to the programme if need be.
- The two fences constituting the double perimeter fence should be placed far apart enough for birds to able to take off if they end up between the two fences.
- Staff should be sensitised to not panic birds when they discover birds trapped between the fences but to approach them with caution to give them time to escape by taking off in a lengthwise direction.
- The 132kV powerline should be marked with Bird Flappers on the earthwire for the entire length of the line
- Vulture friendly structures (pylon or lattice) must be employed for the 132kV powerline. The structures (either single or double circuit) must be approved as vulture friendly by the Endangered Wildlife Trust's Wildlife and Energy Programme.
- The placing the 33kV lines underground is strongly recommended.

Decommissioning Phase

- Decommissioning activity should be restricted to the immediate footprint of the infrastructure.
- Measures to control noise and dust should be applied according to current best practice in the industry.
- Access to areas outside the footprint should be strictly controlled and limited as much as possible.
- Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum as far as practical.
- The recommendations of the ecological specialist studies must be strictly implemented, especially as far as limitation of the footprint is concerned.
- Prior to the commencement of the dismantling activities, an avifaunal specialist should conduct a site walkthrough, covering the powerline, to identify any nests/breeding/roosting activity of Red List species, the results of which may inform the final dismantling schedule in close proximity to that specific area, including abbreviating dismantling time, scheduling activities around avian breeding and/or movement schedules, and lowering levels of associated noise.

11. FINAL SPECIALIST STATEMENT AND AUTHORISATION RECOMMENDATION

The proposed Vryburg Solar 2 facility should have a low to very low impact on avifauna, provided the management recommendations listed in this report and the EMPr (Appendix 3) are strictly implemented. No fatal flaws were identified from an avifaunal perspective – it is therefore recommended that the project is authorised to go ahead.

11.1 EA Condition Recommendations

The following recommendations should be included as conditions in the EA:

- Prior to construction, an avifaunal specialist should conduct a site walkthrough, covering the final power line route, to identify any nests/breeding/roosting activity of Red List species, the results of which may inform the final construction schedule in close proximity to that specific area, including abbreviating construction time, scheduling activities around avian breeding and/or movement schedules, and lowering levels of associated noise.
- Areas with large trees (as shown in Figure 6) should be retained as much as possible as they serve as potential roosting and breeding habitat for a variety of birds, including raptors.
- The 132kV powerline should be marked with Bird Flappers on the earthwire for the entire length of the line
- Vulture friendly structures (pylon or lattice) must be employed for the 132kV powerline. The structures (either single or double circuit) must be approved as vulture friendly by the Endangered Wildlife Trust's Wildlife and Energy Programme.
- The placing of the 33kV lines underground is strongly recommended.

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13. APPENDIX 1: BIRD SURVEYS

BIRD MONITORING AT SENDAWO SOLAR ENERGY FACILITIES

1. Objectives

The objective of the pre-construction monitoring at the proposed Sendawo Solar Facilities was to gather baseline data over a period of six months on the following aspects pertaining to avifauna:

- The abundance and diversity of birds at the solar farm sites to measure the potential displacement effect of the wind farm.
- Flight patterns of priority species at the solar farm sites to measure the potential impact on flight activity of the solar farms.

2. Methods

The monitoring protocol for the site was designed according to the draft version (November 2015) of Birdlife South Africa *Best Practice Guidelines for assessing and monitoring the impact of solar energy facilities on birds in southern Africa (Jenkins et.al).*

Monitoring surveys were conducted at the proposed PV sites by one field monitor during November 2015, January 2016 and February 2016.

Monitoring was conducted in the following manner:

- Two walk transects of 1km each were identified at the PV sites and counted 8 times per sampling session. All birds were recorded during walk transects.
- The following variables were recorded:
    - Species;
    - Number of birds;
    - Date;
    - Start time and end time;
    - Distance from transect (0-50 m, 50-100 m, >100 m);
    - Wind direction;
    - Wind strength (calm; moderate; strong);
    - Weather (sunny; cloudy; partly cloudy; rain; mist);
    - Temperature (cold; mild; warm; hot);
    - Behaviour (flushed; flying-display; perched; perched-calling; perched-hunting; flying-foraging; flying-commute; foraging on the ground); and
    - Co-ordinates (priority species only).

- One vantage point (VP) was identified to record the flight altitude and patterns of priority species. A total of 12 hours per sampling session was spent doing vantage point watches. The following variables were recorded for each flight:
    - Species;
    - Number of birds;
    - Date;
    - Start time and end time;
    - Wind direction;
    - Wind strength (estimated Beaufort scale 1-7);
    - Weather (sunny; cloudy; partly cloudy; rain; mist);
    - Temperature (cold; mild; warm; hot);
    - Flight altitude (high i.e. >200m; medium i.e. 20m – 200m; low i.e. <20m);

- Flight mode (soar; flap; glide; kite; hover); and
- Flight time (in 15 second-intervals).

The objective of the transect monitoring was to gather baseline data on the use of the site by birds in order to measure potential displacement by the wind farm activities. The objective of vantage point counts was to measure the potential collision risk with the PV arrays, and to see how flight behaviour is influenced by the PV arrays. Waterbirds, raptors, South African Red Data species and Southern African endemics and near-endemics were classified as priority species.

A potential focal point (FP) of bird activity was identified at the proposed site itself, namely a natural spring with open water (a small concrete impoundment). The impoundment was monitored for the presence of priority species during each of the three surveys.

All incidental sightings of priority species at the core study area and immediate surroundings were also recorded.

Figure 1 below indicates the area where monitoring was performed.

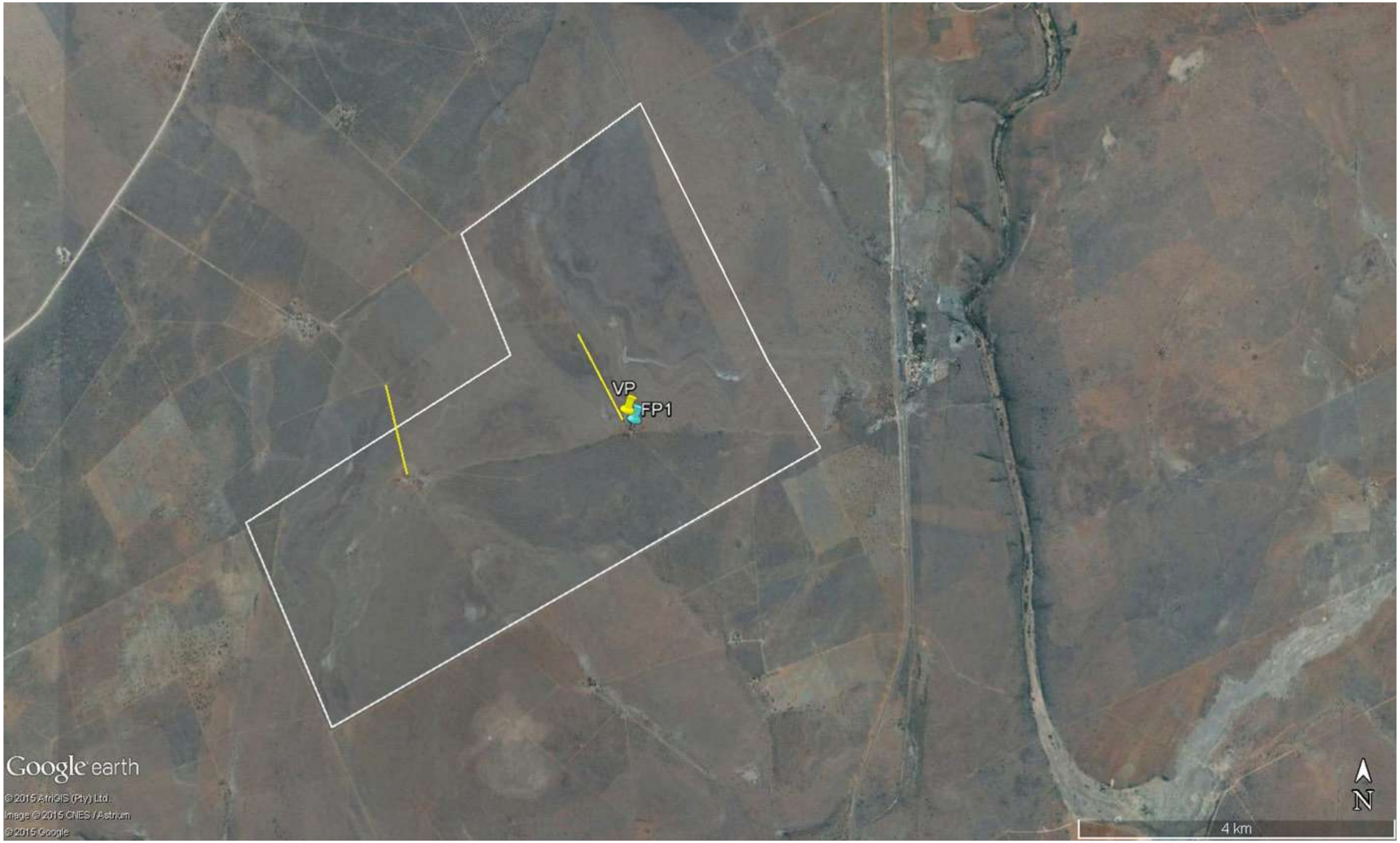

Figure 1: Area where monitoring was performed in November 2015, January 2016 and February 2016, with position of VP (yellow placemark), focal point (FP1 - blue placemark), walk transects (yellow lines) and land parcel boundaries (white polygon).

BIRD MONITORING AT VERINOVA VRYBURG 1, 2 AND 3 SOLAR PV ENERGY FACILITIES

Objectives

The objective of the pre-construction monitoring at the proposed Vryburg 1,2 and 3 Solar Facilities was to gather baseline data over a period of six months on the following aspects pertaining to avifauna:

- The abundance and diversity of birds at the solar farm sites to measure the potential impact of the solar farms and associated 132kV powerline on avifauna.

Methods

The monitoring protocol for the site was designed according to the BirdLife South Africa *Best Practice Guidelines for assessing and monitoring the impact of solar energy facilities on birds in southern Africa (Jenkins et.al 2017).*

Monitoring surveys were conducted at the proposed PV sites by one field monitor during 3-5 July 2018.

Monitoring was conducted in the following manner:

- Three transects of 4.7km, 5.8km and 8.7km respectively were identified at the PV sites and counted 3 times. All birds were recorded by slowly crawling along in a vehicle with frequent stops to do point counts every couple of hundred metres.
- The following variables were recorded:
    - Species;
    - Number of birds;
    - Date;
    - Start time and end time;
    - Distance from transect (estimated);
    - Wind direction;
    - Wind strength (calm; moderate; strong);
    - Weather (sunny; cloudy; partly cloudy; rain; mist);
    - Temperature (cold; mild; warm; hot); and
    - Behaviour (flushed; flying-display; perched; perched-calling; perched-hunting; flying-foraging; flying-commute; foraging on the ground);

The objective of the transect monitoring was to gather baseline data on the use of the site by birds. Waterbirds, raptors, South African Red Data species and endemics and near-endemics were classified as priority species, but all birds were recorded.

Four potential focal points (FPs) of bird activity was identified namely three boreholes and one natural wetland, which were counted three time each. All incidental sightings of priority species were also recorded.

Figure 2 below indicates the area where monitoring was performed.

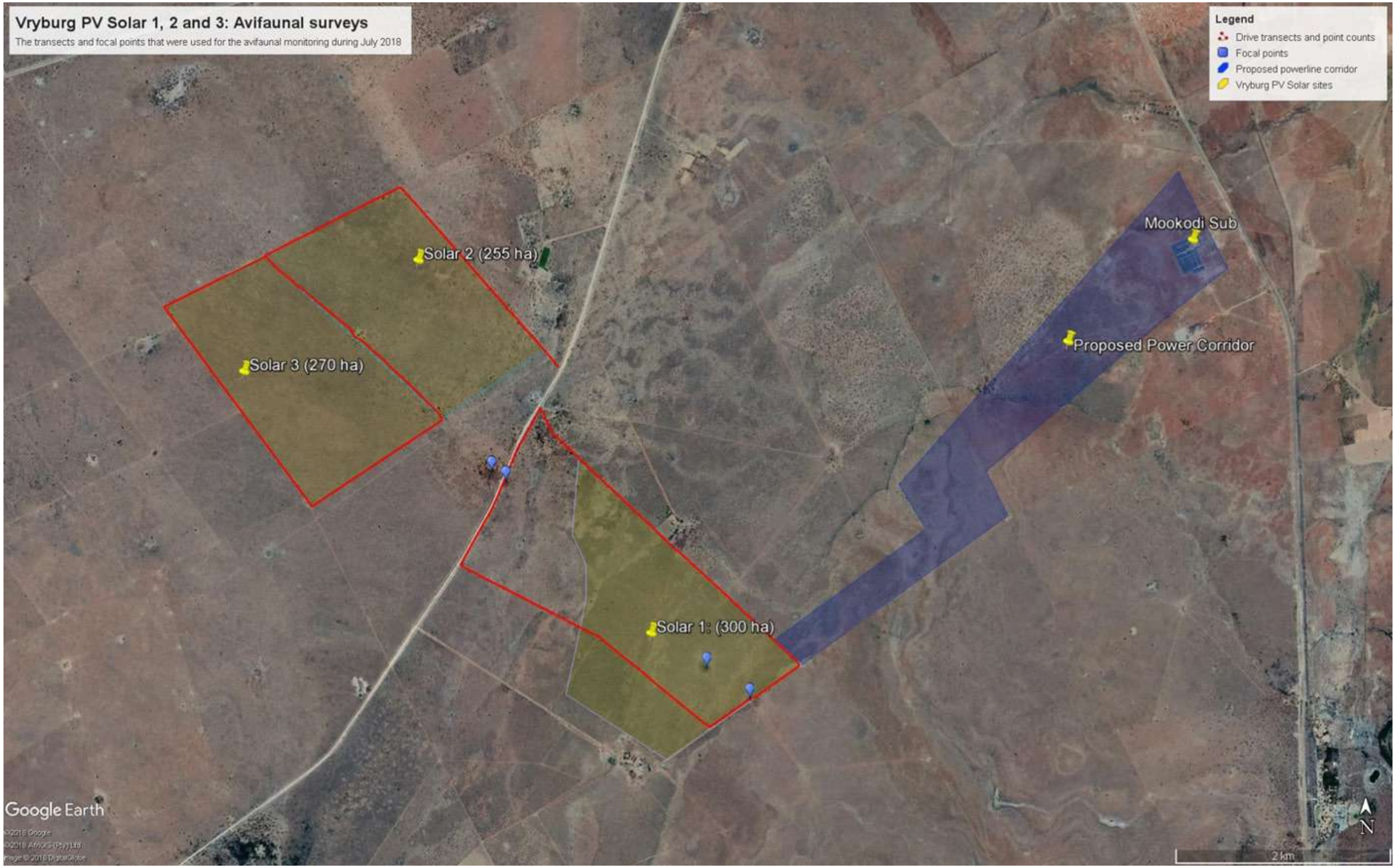

Figure 2: The area where monitoring was performed during July 2018

14. APPENDIX 2: SPECIES RECORDED IN THE BROADER STUDY AREA

LC = Least concern VU = Vulnerable NT = Near threatened EN = Endangered

			Status					Occurrence		
Species	**Taxonomic name**	**SABAP2 reporting rate**	**Global Status**	**Regional status**	**Endemic - Southern Africa**	**Class**	**Priority species**	**Recorded during monitoring 2018 (winter)**	**Recorded during monitoring 2016 (summer)**	**Could occur at the development area**
Acacia Pied Barbet	*Tricholaema leucomelas*	66.67			Near-endemic			x	x	x
African Black Swift	*Apus barbatus*	2.56								x
African Fish-Eagle	*Haliaeetus vocifer*	1.28				Raptor	x			
African Grey Hornbill	*Tockus nasutus*	19.23								x
African Harrier-Hawk	*Polyboroides typus*	2.56				Raptor	x			x
African Hoopoe	*Upupa africana*	83.33							x	x
African Palm-Swift	*Cypsiurus parvus*	62.82							x	x
African Paradise-Flycatcher	*Terpsiphone viridis*	5.13								x
African Pipit	*Anthus cinnamomeus*	10.26						x		x
African Purple Swamphen	*Porphyrio madagascariensis*	1.28				Waterbird	x			
African Quailfinch	*Ortygospiza atricollis*	14.1								x
African Red-eyed Bulbul	*Pycnonotus nigricans*	89.74			Near-endemic			x	x	x
African Sacred Ibis	*Threskiornis aethiopicus*	7.69								x
African Stonechat	*Saxicola torquatus*	2.56						x		x
Amur Falcon	*Falco amurensis*	5.13				Raptor	x			x
Anteating Chat	*Myrmecocichla formicivora*	3.85			Endemic			x	x	x
Ashy Tit	*Parus cinerascens*	11.54			Near-endemic					x
Barn Owl	*Tyto alba*	39.74				Raptor	x		x	x
Barn Swallow	*Hirundo rustica*	30.77							x	x
Black Crake	*Amaurornis flavirostris*	1.28								
Black Stork	*Ciconia nigra*	1.28	LC	VU		Waterbird	x			x
Black-chested Prinia	*Prinia flavicans*	53.85			Near-endemic			x	x	x
Black-chested Snake-Eagle	*Circaetus pectoralis*	2.56				Raptor	x		x	x
Black-collared Barbet	*Lybius torquatus*	60.26							x	x
Black-faced Waxbill	*Estrilda erythronotos*	12.82								x
Black-headed Heron	*Ardea melanocephala*	11.54				Waterbird	x			x
Black-shouldered Kite	*Elanus caeruleus*	15.38				Raptor	x		x	x
Blacksmith Lapwing	*Vanellus armatus*	69.23				Waterbird	x		x	x
Black-throated Canary	*Crithagra atrogularis*	35.9						x		x
Blue Waxbill	*Uraeginthus angolensis*	10.26							x	x

			Status					Occurrence		
Species	**Taxonomic name**	**SABAP2 reporting rate**	**Global Status**	**Regional status**	**Endemic - Southern Africa**	**Class**	**Priority species**	**Recorded during monitoring 2018 (winter)**	**Recorded during monitoring 2016 (summer)**	**Could occur at the development area**
Bokmakierie	*Telophorus zeylonus*	7.69			Near-endemic				x	x
Bradfield's Swift	*Apus bradfieldi*	1.28			Near-endemic					x
Bronze Mannikin	*Spermestes cucullatus*	23.08								x
Brown-crowned Tchagra	*Tchagra australis*	11.54								x
Brown-hooded Kingfisher	*Halcyon albiventris*	15.38								x
Brown-throated Martin	*Riparia paludicola*	2.56								x
Brubru	*Nilaus afer*	5.13								x
Buffy Pipit	*Anthus vaalensis*	1.28								x
Burchell's Coucal	*Centropus burchellii*	29.49			Near-endemic					x
Burchell's Sandgrouse	*Pterocles burchelli*	1.28			Near-endemic			x		x
Cape Crow	*Corvus capensis*	1.28							x	x
Cape Glossy Starling	*Lamprotornis nitens*	65.38						x	x	x
Cape Penduline-Tit	*Anthoscopus minutus*	7.69			Near-endemic					x
Cape Robin-Chat	*Cossypha caffra*	57.69								x
Cape Sparrow	*Passer melanurus*	93.59			Near-endemic			x	x	x
Cape Teal	*Anas capensis*	1.28				Waterbird	x			
Cape Turtle-Dove	*Streptopelia capicola*	39.74						x	x	x
Cape Wagtail	*Motacilla capensis*	75.64								x
Cape White-eye	*Zosterops virens*	5.13			Endemic	Near endemic	x			x
Capped Wheatear	*Oenanthe pileata*	3.85							x	x
Cardinal Woodpecker	*Dendropicos fuscescens*	8.97								x
Cattle Egret	*Bubulcus ibis*	15.38				Waterbird	x	x	x	x
Chat Flycatcher	*Bradornis infuscatus*	7.69			Near-endemic			x		x
Chestnut-vented Tit-Babbler	*Parisoma subcaeruleum*	32.05			Near-endemic				x	x
Cinnamon-breasted Bunting	*Emberiza tahapisi*	5.13								x
Common Fiscal	*Lanius collaris*	24.36						x	x	x
Common Moorhen	*Gallinula chloropus*	6.41				Waterbird	x			
Common Myna	*Cisticola fulvicapilla*	48.72						x	x	x
Common Myna	*Acridotheres tristis*	82.05							x	x
Common Ostrich	*Struthio camelus*	11.54								x
Common Sandpiper	*Actitis hypoleucos*	1.28				Waterbird	x			
Common Scimitarbill	*Rhinopomastus cyanomelas*	7.69							x	x
Common Waxbill	*Estrilda astrild*	6.41								x
Crested Barbet	*Trachyphonus vaillantii*	76.92								x

			Status					Occurrence		
Species	**Taxonomic name**	**SABAP2 reporting rate**	**Global Status**	**Regional status**	**Endemic - Southern Africa**	**Class**	**Priority species**	**Recorded during monitoring 2018 (winter)**	**Recorded during monitoring 2016 (summer)**	**Could occur at the development area**
Crimson-breasted Shrike	*Laniarius atrococcineus*	20.51			Near-endemic			x	x	x
Crowned Lapwing	*Vanellus coronatus*	73.08							x	x
Desert Cisticola	*Cisticola aridulus*	14.1						x	x	x
Diderick Cuckoo	*Chrysococcyx caprius*	44.87							x	x
Eastern Clapper Lark	*Mirafra fasciolata*	7.69			Near-endemic			x	x	x
Egyptian Goose	*Alopochen aegyptiacus*	3.85				Waterbird	x			x
European Bee-eater	*Merops apiaster*	51.28							x	x
European Roller	*Coracias garrulus*	1.28	LC	NT		Red Data	x			x
Familiar Chat	*Cercomela familiaris*	7.69						x		x
Fawn-coloured Lark	*Calendulauda africanoides*	7.69							x	x
Fiscal Flycatcher	*Sigelus silens*	67.95			Endemic	Near endemic	x		x	x
Fork-tailed Drongo	*Dicrurus adsimilis*	28.21						x		x
Gabar Goshawk	*Melierax gabar*	14.1				Raptor	x			x
Glossy Ibis	*Plegadis falcinellus*	1.28				Waterbird	x			
Golden-breasted Bunting	*Emberiza flaviventris*	7.69						x	x	x
Golden-tailed Woodpecker	*Campethera abingoni*	11.54								x
Greater Kestrel	*Falco rupicoloides*	8.97				Raptor	x	x	x	x
Greater Striped Swallow	*Hirundo cucullata*	60.26								x
Green Wood-Hoopoe	*Phoeniculus purpureus*	19.23								x
Green-backed Heron	*Butorides striata*	1.28				Waterbird	x			
Green-winged Pytilia	*Pytilia melba*	7.69						x		x
Grey Go-away-bird	*Corythaixoides concolor*	1.28								x
Grey Heron	*Ardea cinerea*	19.23				Waterbird	x			
Grey-backed Sparrowlark	*Eremopterix verticalis*	1.28			Near-endemic					x
Grey-headed Gull	*Larus cirrocephalus*	3.85								
Groundscraper Thrush	*Psophocichla litsipsirupa*	62.82							x	x
Hadeda Ibis	*Bostrychia hagedash*	79.49						x	x	x
Hamerkop	*Scopus umbretta*	2.56				Waterbird	x			x
Helmeted Guineafowl	*Numida meleagris*	66.67						x	x	x
House Sparrow	*Passer domesticus*	78.21								x
Jacobin Cuckoo	*Clamator jacobinus*	5.13								x
Kalahari Scrub-Robin	*Cercotrichas paena*	73.08			Near-endemic			x	x	x
Karoo Thrush	*Turdus smithi*	80.77			Endemic	Near endemic	x	x		x
Klaas's Cuckoo	*Chrysococcyx klaas*	7.69								x

			Status					Occurrence		
Species	**Taxonomic name**	**SABAP2 reporting rate**	**Global Status**	**Regional status**	**Endemic - Southern Africa**	**Class**	**Priority species**	**Recorded during monitoring 2018 (winter)**	**Recorded during monitoring 2016 (summer)**	**Could occur at the development area**
Kori Bustard	*Ardeotis kori*	1.28	NT	NT		Red Data	x	x	x	x
Lanner Falcon	*Falco biarmicus*	0		VU		Raptor	x		x	x
Lark-like Bunting	*Emberiza impetuani*	1.28			Near-endemic			x		x
Laughing Dove	*Streptopelia senegalensis*	94.87						x	x	x
Lesser Grey Shrike	*Lanius minor*	20.51							x	x
Lesser Honeyguide	*Indicator minor*	1.28								x
Lesser Kestrel	*Falco naumanni*	6.41				Raptor	x			x
Lesser Swamp-Warbler	*Acrocephalus gracilirostris*	6.41								
Levaillant's Cisticola	*Cisticola tinniens*	7.69								
Lilac-breasted Roller	*Coracias caudatus*	15.38								x
Little Bee-eater	*Merops pusillus*	7.69						x	x	x
Little Egret	*Egretta garzetta*	2.56				Waterbird	x			
Little Grebe	*Tachybaptus ruficollis*	5.13								
Little Swift	*Apus affinis*	62.82							x	x
Long-billed Crombec	*Sylvietta rufescens*	7.69								x
Long-tailed Paradise-Whydah	*Vidua paradisaea*	26.92								x
Long-tailed Widowbird	*Euplectes progne*	3.85							x	x
Maccoa Duck	*Oxyura maccoa*	1.28	NT	NT		Red Data	x			
Marico Flycatcher	*Bradornis mariquensis*	7.69			Near-endemic			x	x	x
Marico Sunbird	*Cinnyris mariquensis*	37.18								x
Marsh Sandpiper	*Tringa stagnatilis*	1.28				Waterbird	x			
Martial Eagle	*Polemaetus bellicosus*	1.28	VU	EN		Red Data	x		x	x
Namaqua Dove	*Oena capensis*	37.18						x	x	x
Namaqua Sandgrouse	*Pterocles namaqua*	1.28			Near-endemic					x
Northern Black Korhaan	*Afrotis afraoides*	69.23			Endemic				x	x
Orange River Francolin	*Scleroptila levaillantoides*	10.26								x
Orange River White-eye	*Zosterops pallidus*	66.67			Endemic					x
Pearl-spotted Owlet	*Glaucidium perlatum*	38.46				Raptor	x			x
Pied Crow	*Corvus albus*	76.92						x		x
Pied Kingfisher	*Ceryle rudis*	1.28				Waterbird	x			
Pin-tailed Whydah	*Vidua macroura*	38.46								x
Plain-backed Pipit	*Anthus leucophrys*	3.85							x	x
Pririt Batis	*Batis pririt*	10.26			Near-endemic			x	x	x
Purple Roller	*Coracias naevius*	1.28								x

			Status					Occurrence		
Species	**Taxonomic name**	**SABAP2 reporting rate**	**Global Status**	**Regional status**	**Endemic - Southern Africa**	**Class**	**Priority species**	**Recorded during monitoring 2018 (winter)**	**Recorded during monitoring 2016 (summer)**	**Could occur at the development area**
Rattling Cisticola	*Cisticola chiniana*	10.26								x
Red-backed Shrike	*Lanius collurio*	12.82								x
Red-billed Firefinch	*Lagonosticta senegala*	51.28								x
Red-billed Quelea	*Quelea quelea*	37.18						x	x	x
Red-billed Teal	*Anas erythrorhyncha*	8.97				Waterbird	x			
Red-breasted Swallow	*Hirundo semirufa*	15.38							x	x
Red-capped Lark	*Calandrella cinerea*	3.85								x
Red-crested Korhaan	*Lophotis ruficrista*	3.85			Near-endemic			x		x
Red-eyed Dove	*Streptopelia semitorquata*	83.33							x	x
Red-faced Mousebird	*Urocolius indicus*	79.49						x	x	x
Red-headed Finch	*Amadina erythrocephala*	44.87			Near-endemic			x		x
Red-knobbed Coot	*Fulica cristata*	10.26				Waterbird	x			
Reed Cormorant	*Phalacrocorax africanus*	1.28								
Rock Dove	*Columba livia*	41.03								x
Rock Kestrel	*Falco rupicolus*	1.28				Raptor	x			x
Rock Martin	*Hirundo fuligula*	14.1								
Rufous-naped Lark	*Mirafra africana*	28.21							x	x
Sabota Lark	*Calendulauda sabota*	11.54			Near-endemic			x		x
Scaly-feathered Finch	*Sporopipes squamifrons*	67.95			Near-endemic			x	x	x
Secretarybird	*Sagittarius serpentarius*	0	VU	VU		Red Data	x			x
Shaft-tailed Whydah	*Vidua regia*	12.82			Near-endemic				x	x
South African Cliff-Swallow	*Hirundo spilodera*	16.67			Breeding-endemic	Endemic	x		x	x
Southern Grey-headed Sparrow	*Passer diffusus*	29.49								x
Southern Masked-Weaver	*Ploceus velatus*	92.31							x	x
Southern Pale Chanting Goshawk	*Melierax canorus*	6.41			Near-endemic	Raptor	x			x
Southern Pochard	*Netta erythrophthalma*	1.28								
Southern Red Bishop	*Euplectes orix*	39.74							x	x
Southern Yellow-billed Hornbill	*Tockus leucomelas*	1.28			Near-endemic					x
Speckled Mousebird	*Colius striatus*	3.85								x
Speckled Pigeon	*Columba guinea*	91.03							x	x
Spike-heeled Lark	*Chersomanes albofasciata*	6.41			Near-endemic			x	x	x
Spotted Eagle-Owl	*Bubo africanus*	6.41				Raptor	x			x
Spotted Flycatcher	*Muscicapa striata*	6.41								x

			Status					Occurrence		
Species	**Taxonomic name**	**SABAP2 reporting rate**	**Global Status**	**Regional status**	**Endemic - Southern Africa**	**Class**	**Priority species**	**Recorded during monitoring 2018 (winter)**	**Recorded during monitoring 2016 (summer)**	**Could occur at the development area**
Spotted Thick-knee	*Burhinus capensis*	53.85								x
Spur-winged Goose	*Plectropterus gambensis*	2.56				Waterbird	x			
Steppe Buzzard	*Buteo vulpinus*	10.26							x	x
Swainson's Spurfowl	*Pternistis swainsonii*	51.28								x
Swallow-tailed Bee-eater	*Merops hirundineus*	7.69						x		x
Three-banded Plover	*Charadrius tricollaris*	1.28				Waterbird	x			
Tinkling Cisticola	*Cisticola rufilatus*	1.28								x
Village Indigobird	*Vidua chalybeata*	10.26								x
Violet-eared Waxbill	*Granatina granatina*	19.23						x	x	x
Wattled Starling	*Creatophora cinerea*	11.54							x	x
White-backed Mousebird	*Colius colius*	25.64			Endemic			x	x	x
White-bellied Sunbird	*Cinnyris talatala*	19.23								
White-browed Sparrow-Weaver	*Plocepasser mahali*	32.05						x	x	x
White-faced Duck	*Dendrocygna viduata*	7.69								
White-rumped Swift	*Apus caffer*	52.56							x	x
White-throated Swallow	*Hirundo albigularis*	5.13								
Willow Warbler	*Phylloscopus trochilus*	2.56								x
Yellow Canary	*Crithagra flaviventris*	56.41			Near-endemic			x	x	x
Yellow-bellied Eremomela	*Eremomela icteropygialis*	7.69							x	x
Yellow-billed Duck	*Anas undulata*	15.38				Waterbird	x			
Yellow-billed Kite	*Milvus aegyptius*	1.28				Raptor	x		x	x
Yellow-crowned Bishop	*Euplectes afer*	2.56								x
Zitting Cisticola	*Cisticola juncidis*	7.69						x	x	x

15. APPENDIX 3: ENVIRONMENTAL MANAGEMENT PROGRAM

Management Plan for the Construction Phase (Including pre- and post-construction activities)

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
Avifauna					
Displacement of avifauna due to disturbance caused by the construction activities associated with the solar panels and associated infrastructure (buildings, roads, internal powerlines and substation).	To ensure that the disturbance of avifauna is minimized	Construction activity should be restricted to the immediate footprint of the infrastructure. Measures to control noise and dust should be applied according to current best practice in the industry. Access to areas outside the construction footprint should be strictly controlled and limited as much as possible. Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum as far as practical. The recommendations of the ecological and botanical specialist studies must be strictly implemented, especially as far as limitation of the construction footprint is concerned.	Frequent inspections to ensure compliance with the EMPr	Weekly or bi-weekly	Construction Manager and ECO
Avifauna					
Displacement of avifauna due to disturbance caused by the construction of the 132kV line.	To ensure that the disturbance of avifauna is minimized during the construction phase.	No off-road driving must be allowed Measures to control noise and dust should be applied according to current best practice in the industry Measures to control noise Access to areas outside the construction footprint should be strictly controlled and	Frequent inspections to ensure compliance with the EMPr Powerline walk-through	Weekly or bi-weekly Once prior to construction commencing	Construction Manager and ECO Avifaunal specialist

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
		limited as much as possible. Prior to construction, an avifaunal specialist should conduct a site walkthrough, covering the final power line route, to identify any nests/breeding/roosting activity of Red List species, the results of which may inform the final construction schedule in close proximity to that specific area, including abbreviating construction time, scheduling activities around avian breeding and/or movement schedules, and lowering levels of associated noise.			

Management Plan for the Operational Phase

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	*Frequency*	*Responsibility*
Avifauna					
Displacement of avifauna due to habitat transformation caused by the construction of the solar panels and associated infrastructure (buildings, roads and substation).	The minimization of habitat loss for avifauna	The recommendations of the ecological and botanical specialist studies must be strictly implemented, especially as far as limitation of the footprint, the retention of natural vegetation and rehabilitation of transformed areas is concerned. Areas with large trees should be retained as much as possible as they serve as potential roosting and breeding habitat for a variety of birds, including raptors. Audits must be performed by an external rehabilitation specialist to assess the success of the rehabilitation programme and recommend changes or additions to the programme if need be.	Inspections to ensure compliance with the EMPr Audits to review the success of the rehabilitation programme	Weekly or bi-weekly Twice a year	Facility Operational Manager Facility Environmental Manager Rehabilitation specialist
Avifauna					
Mortality of avifauna due to entrapment in the double perimeter fence.	Minimization of avifaunal mortality	Staff should be sensitized to not panic birds when they discover them trapped between the fences bit to approach them with caution to give them time to escape by taking off in a lengthwise direction.	Staff sensitization	Weekly or bi-weekly	Facility Environmental Manager
Avifauna					
Mortality of priority species due to collisions with the earthwire of the 132kV powerline	Minimization of avifaunal mortality	The 132kV powerline should be marked with Bird Flappers on the earthwire for the entire length of the line	Powerline inspections to assess the condition of the Bird Flappers and to note any broken or missing ones who need to be replaced	Once a quarter	Facility Environmental Manager Facility Operational Manager

Management Plan for the Decommissioning Phase

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
Avifauna					
Displacement of avifauna due to disturbance caused by the decommissioning activities associated with the solar panels and associated infrastructure (buildings, roads, powerlines and substation).	To ensure that the disturbance of avifauna is minimized	No off-road driving must be permitted Measures to control noise and dust should be applied according to current best practice in the industry. Access to areas outside the construction footprint should be strictly controlled and limited as much as possible. Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum as far as practical. The recommendations of the ecological and botanical specialist studies must be strictly implemented, especially as far as limitation of the footprint is concerned. Prior to the dismantling commencing, an avifaunal specialist should conduct a site walkthrough, covering the existing power line route, to identify any nests/breeding/roosting activity of Red List species, the results of which may inform the final work schedule in close proximity to that specific area, scheduling activities around avian breeding and/or movement schedules, and lowering levels of associated noise.	Frequent inspections to ensure compliance with the EMPr Avifaunal specialist	Weekly or bi-weekly	Construction Manager and ECO Once before the dismantling activities commence

CULTURAL HERITAGE IMPACT ASSESSMENT:

FOR THE PROPOSED DEVELOPMENT OF A 100 MW AC (115 MW DC) SOLAR PHOTOVOLTAIC FACILITY (VRYBURG SOLAR 2) AND ASSOCIATED 132KV TRANSMISSION LINE NEAR VRYBURG, NORTH WEST PROVINCE

Report prepared for:
CSIR – Environmental Management Services
P O Box 320
Stellenbosch
7599
South Africa

Report prepared by:
J van Schalkwyk
62 Coetzer Avenue
Monument Park, 0181

03 August 2018

CULTURAL HERITAGE IMPACT ASSESSMENT FOR THE PROPOSED DEVELOPMENT OF A 100MW AC (115 MW DC) SOLAR PHOTOVOLTAIC FACILITY (VRYBURG PV 2) AND ASSOCIATED 132KV TRANSMISSION LINE NEAR VRYBURG, NORTH WEST PROVINCE

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J A van Schalkwyk (D Litt et Phil)
Heritage Consultant
July 2018

SPECIALIST COMPETENCY

Johan A van Schalkwyk, D Litt et Phil, heritage consultant, has been working in the field of heritage management for more than 40 years. Originally based at the National Museum of Cultural History, Pretoria, he has actively done research in the fields of anthropology, archaeology, museology, tourism and impact assessment. This work was done in Limpopo Province, Gauteng, Mpumalanga, North West Province, Eastern Cape Province, Northern Cape Province, Botswana, Zimbabwe, Malawi, Lesotho and Swaziland. Based on this work, he has curated various exhibitions at different museums and has published more than 70 papers, most in scientifically accredited journals. During this period, he has done more than 2000 Phase 1 and Phase 2 impact assessments (archaeological, anthropological, historical and social) for various government departments and developers. Projects include environmental management frameworks, roads, pipeline-, and power line developments, dams, mining, water purification works, historical landscapes, refuse dumps and urban developments.

SPECIALIST DECLARATION

I, J A van Schalkwyk, as the appointed independent specialist, in terms of the 2014 EIA Regulations (as amended), hereby declare that I:

- I act as the independent specialist in this application;
- I 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;
- regard the information contained in this report as it relates to my specialist input/study to be true and correct, and do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 (as amended) and any specific environmental management Act;
- 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 have no vested interest in the proposed activity proceeding;
- 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;
- I have ensured that information containing all relevant facts in respect of the specialist input/study was distributed or made available to interested and affected parties and the public and that participation by interested and affected parties was facilitated in such a manner that all interested and affected parties were provided with a reasonable opportunity to participate and to provide comments on the specialist input/study;
- I have ensured that the comments of all interested and affected parties on the specialist input/study were considered, recorded and submitted to the competent authority in respect of the application;
- all the particulars furnished by me in this specialist input/study 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

J A van Schalkwyk
July 2018

EXECUTIVE SUMMARY

CULTURAL HERITAGE IMPACT ASSESSMENT FOR THE PROPOSED DEVELOPMENT OF A 100MW AC (115 MW DC) SOLAR PHOTOVOLTAIC FACILITY (VRYBURG PV 2) AND ASSOCIATED 132KV TRANSMISSION LINE NEAR VRYBURG, NORTH WEST PROVINCE

Veroniva (Pty) Ltd, together with ABO Wind (the Project Applicant, hereinafter referred to as Veroniva), is proposing to develop three 115 MW Solar Photovoltaic (PV) power generation facilities and associated electrical infrastructure (132 kV transmission lines for each 115 MW facility) south west of Vryburg in the Dr Ruth Mompati District Municipality in the North West Province.

In accordance with Section 38 of the NHRA, an independent heritage consultant was appointed by the *CSIR* (the Environmental Practitioners for the study) to conduct a cultural heritage assessment to determine if the proposed development would have an impact on any sites, features or objects of cultural heritage significance.

This report describes the methodology used, the limitations encountered, the heritage features that were identified and the recommendations and mitigation measures proposed relevant to this. It should be noted that the implementation of the mitigation measures is subject to SAHRA/PHRA's approval.

The cultural landscape qualities of the region essentially consist of two components. The first is a rural area in which the human occupation is made up of a pre-colonial (Stone Age and Iron Age) occupation and a much later colonial (farmer) component. The second component is an urban one consisting of a number of smaller towns, most of which developed during the last 150 years or less.

<u>Identified sites</u>

- Stone tools were identified to occur on a low ridge to the east of the substation. It mostly dates to the Middle Stone Age, although some smaller ones might date to the Later Stone Age. Cores, tools and flakes (debitage) were identified, indicating that the tools were manufactured on site.

- Originally some graves (c. 6) occurred west of the substation. They were very old and only marked with low stone cairns. As they were located next to the laydown area for the construction of the substation, they were fenced off. They could not be located during the current site visit (possibly due to incorrect coordinates). It is also possible that they were relocated during the construction activities.

<u>Impact assessment and proposed mitigation measures</u>

Impact analysis of cultural heritage resources under threat of the proposed development, is based on the present understanding of the development:

Heritage sites	Significance of impact	Mitigation measures
Vryburg 1 Solar PV Development: Construction Phase		
Without mitigation	Low	n/a
With mitigation	Low	n/a

Heritage sites	Significance of impact	Mitigation measures
Vryburg 1 Solar PV Development: Operation Phase		
Without mitigation	n/a	n/a
With mitigation	n/a	n/a

Heritage sites	Significance of impact	Mitigation measures
Vryburg 1 Solar PV Development: Decommissioning Phase		
Without mitigation	n/a	n/a
With mitigation	n/a	n/a

Heritage sites	Significance of impact	Mitigation measures
Vryburg 1 Solar PV Transmission Line: Construction Phase		
Without mitigation	Low	Avoid sites
With mitigation	n/a	n/a
Heritage sites	Significance of impact	Mitigation measures
Vryburg 1 Solar PV Transmission Line: Operation Phase		
Without mitigation	n/a	n/a
With mitigation	n/a	n/a

Heritage sites	Significance of impact	Mitigation measures
Vryburg 1 Solar PV Transmission Line: Decommissioning Phase		
Without mitigation	n/a	n/a
With mitigation	n/a	n/a

Legal requirements

The legal requirements related to heritage specifically are specified in Appendixes 3 and 4. For this proposed project, the assessment has identified two sites of heritage significance. It is calculated that the potential impact of the proposed development on these sites would be low. Therefore, no heritage permits are required, unless indicated otherwise by SAHRA. If heritage features are identified during construction, as stated in the management recommendation, these finds would have to be assessed by a specialist, after which a decision will be made regarding the application for relevant permits.

Reasoned opinion as to whether the proposed activity should be authorised:

- From a heritage point of view, it is recommended that the development be allowed to continue on acceptance of the measures proposed below.

Conditions for inclusion in the environmental authorisation:

- Should archaeological sites or graves be exposed during construction work, it must immediately be reported to a heritage practitioner so that an investigation and evaluation of the finds can be made.

J A van Schalkwyk
Heritage Consultant
July 2018

TECHNICAL SUMMARY

Property details						
Province	North West					
Magisterial district	Vryburg					
District municipality	Dr Ruth Mompati District Municipality					
Topo-cadastral map	2724BA					
Farm name	Retreat 671-IN, Frankfort 672-IN & Rosendal 673-IN					
Closest town	Vryburg					
Coordinates	Centre point					
	No	Latitude	Longitude	No	Latitude	Longitude
	1	-27,01482	24,67291			

Development criteria in terms of Section 38(1) of the NHR Act	Yes/No
Construction of road, wall, power line, pipeline, canal or other linear form of development or barrier exceeding 300m in length	Yes
Construction of bridge or similar structure exceeding 50m in length	No
Development exceeding 5000 sq m	Yes
Development involving three or more existing erven or subdivisions	No
Development involving three or more erven or divisions that have been consolidated within past five years	No
Rezoning of site exceeding 10 000 sq m	Yes
Any other development category, public open space, squares, parks, recreation grounds	No

Development	
Description	Development of a solar photovoltaic facility
Project name	Vryburg Solar 2 (Pty) Ltd

Land use	
Previous land use	Farming
Current land use	Farming

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GLOSSARY OF TERMS AND ABBREVIATIONS

TERMS

Study area: Refers to the entire study area as indicated by the client in the accompanying Fig. 1 - 2.

Stone Age: The first and longest part of human history is the Stone Age, which began with the appearance of early humans between 3-2 million years ago. Stone Age people were hunters, gatherers and scavengers who did not live in permanently settled communities. Their stone tools preserve well and are found in most places in South Africa and elsewhere.

Early Stone Age	2 000 000 - 150 000 Before Present
Middle Stone Age	150 000 - 30 000 BP
Later Stone Age	30 000 - until c. AD 200

Iron Age: Period covering the last 1800 years, when new people brought a new way of life to southern Africa. They established settled villages, cultivated domestic crops such as sorghum, millet and beans, and they herded cattle as well as sheep and goats. As they produced their own iron tools, archaeologists call this the Iron Age.

Early Iron Age	AD 200 - AD 900
Middle Iron Age	AD 900 - AD 1300
Late Iron Age	AD 1300 - AD 1830

Historical Period: Since the arrival of the white settlers - c. AD 1840 - in this part of the country.

ABBREVIATIONS

ADRC	Archaeological Data Recording Centre
ASAPA	Association of Southern African Professional Archaeologists
CS-G	Chief Surveyor-General
EIA	Early Iron Age
ESA	Early Stone Age
LIA	Late Iron Age
LSA	Later Stone Age
HIA	Heritage Impact Assessment
MSA	Middle Stone Age
NASA	National Archives of South Africa
NHRA	National Heritage Resources Act
PHRA	Provincial Heritage Resources Agency
SAHRA	South African Heritage Resources Agency

COMPLIANCE WITH THE APPENDIX 6 OF THE 2014 EIA REGULATIONS (AS AMENDED)

Requirements of Appendix 6 – GN R982	**Addressed in the Specialist Report**
1. (1) A specialist report prepared in terms of these Regulations must contain- a) 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;	 Front page Page i Appendix Section 6
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Page ii
c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 1
(cA) an indication of the quality and age of base data used for the specialist report;	Section 4
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 5
d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 4.2.2
e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 4
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;	Appendix Section 5 Fig. 3
g) an identification of any areas to be avoided, including buffers;	Section 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 8
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 2
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 8
l) any conditions for inclusion in the environmental authorisation;	Section 9
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 9
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 9 Section 8, 9
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	Section 4.3
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	-
q) any other information requested by the competent authority.	-
(2) Where a government notice 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.	-

CULTURAL HERITAGE IMPACT ASSESSMENT FOR THE PROPOSED DEVELOPMENT OF A 100MW AC (115 MW DC) SOLAR PHOTOVOLTAIC FACILITY (VRYBURG PV 2) AND ASSOCIATED 132KV TRANSMISSION LINE NEAR VRYBURG, NORTH WEST PROVINCE

1. INTRODUCTION

Veroniva (Pty) Ltd, together with ABO Wind (the Project Applicant, hereinafter referred to as Veroniva), is proposing to develop three 115 MW Solar Photovoltaic (PV) power generation facilities and associated electrical infrastructure (132 kV transmission lines for each 115 MW facility) south west of Vryburg in the Dr Ruth Mompati District Municipality in the North West Province.

South Africa's heritage resources, also described as the 'national estate', comprise a wide range of sites, features, objects and beliefs. However, according to Section 27(18) of the National Heritage Resources Act (NHRA), No. 25 of 1999, no person may destroy, damage, deface, excavate, alter, remove from its original position, subdivide or change the planning status of any heritage site without a permit issued by the heritage resources authority responsible for the protection of such site.

In accordance with Section 38 of the NHRA, an independent heritage consultant was appointed by the *CSIR* (the Environmental Practitioners for the study) to conduct a cultural heritage assessment to determine if the proposed development would have an impact on any sites, features or objects of cultural heritage significance.

This report forms part of the Environmental Impact Assessment (EIA) as required by the EIA Regulations in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) as amended and is intended for submission to the South African Heritage Resources Agency (SAHRA).

2. TERMS OF REFERENCE

The aim of a full HIA investigation is to provide an informed heritage-related opinion about the proposed development by an appropriate heritage specialist. The objectives are to identify heritage resources (involving site inspections, existing heritage data and additional heritage specialists if necessary); assess their significances; assess alternatives in order to promote heritage conservation issues; and to assess the acceptability of the proposed development from a heritage perspective.

The result of this investigation is a heritage impact assessment report indicating the presence/ absence of heritage resources and how to manage them in the context of the proposed development.

Depending on SAHRA's acceptance of this report, the developer will receive permission to proceed with the proposed development, on condition of successful implementation of proposed mitigation measures.

2.1 Scope of work

The aim of this study is to determine if any sites, features or objects of cultural heritage significance occur within the boundaries of the area where the solar power facility and transmission line is to be developed. This included:

- Conducting a desk-top investigation of the area;
- A visit to the proposed development site.

The objectives were to

- Identify possible archaeological, cultural and historic sites within the proposed development areas;
- Evaluate the potential impacts of construction, operation and maintenance of the proposed development on archaeological, cultural and historical resources;
- Recommend mitigation measures to ameliorate any negative impacts on areas of archaeological, cultural or historical importance.

2.2 Limitations

The investigation has been influenced by the following factors:

- It is assumed that the description of the proposed project, provided by the client, is accurate.
- The unpredictability of buried archaeological remains.
- No subsurface investigation (i.e. excavations or sampling) were undertaken, since a permit from SAHRA is required for such activities.
- It is assumed that the public consultation process undertaken as part of the Environmental Impact Assessment (EIA) is sufficient and that is does not have to be repeated as part of the heritage impact assessment.
- This report does not consider the palaeontological potential of the site. It should also be noted that a palaeontological study has been commissioned and will be included by the CSIR in the Basic Assessment Report, alongside this Cultural Heritage Study.

3. HERITAGE RESOURCES

3.1 The National Estate

The NHRA (No. 25 of 1999) defines the heritage resources of South Africa which are of cultural significance or other special value for the present community and for future generations that must be considered part of the national estate to include:

- places, buildings, structures and equipment of cultural significance;
- places to which oral traditions are attached or which are associated with living heritage;
- historical settlements and townscapes;
- landscapes and natural features of cultural significance;
- geological sites of scientific or cultural importance;
- archaeological and palaeontological sites;
- graves and burial grounds, including-
  - ancestral graves;
  - royal graves and graves of traditional leaders;
  - graves of victims of conflict;
  - graves of individuals designated by the Minister by notice in the Gazette;
  - historical graves and cemeteries; and
  - other human remains which are not covered in terms of the Human Tissue Act, 1983 (Act No. 65 of 1983);
- sites of significance relating to the history of slavery in South Africa;
- movable objects, including-
  - objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens;
  - objects to which oral traditions are attached or which are associated with living heritage;
  - ethnographic art and objects;

- military objects;
- objects of decorative or fine art;
- objects of scientific or technological interest; and
- books, records, documents, photographic positives and negatives, graphic, film or video material or sound recordings, excluding those that are public records as defined in section 1(xiv) of the National Archives of South Africa Act, 1996 (Act No. 43 of 1996).

3.2 Cultural significance

In the NHRA, Section 2 (vi), it is stated that ‘‘cultural significance’’ means aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance. This is determined in relation to a site or feature’s uniqueness, condition of preservation and research potential.

According to Section 3(3) of the NHRA, a place or object is to be considered part of the national estate if it has cultural significance or other special value because of

- its importance in the community, or pattern of South Africa's history;
- its possession of uncommon, rare or endangered aspects of South Africa's natural or cultural heritage;
- its potential to yield information that will contribute to an understanding of South Africa's natural or cultural heritage;
- its importance in demonstrating the principal characteristics of a particular class of South Africa's natural or cultural places or objects;
- its importance in exhibiting particular aesthetic characteristics valued by a community or cultural group;
- its importance in demonstrating a high degree of creative or technical achievement at a particular period;
- its strong or special association with a particular community or cultural group for social, cultural or spiritual reasons;
- its strong or special association with the life or work of a person, group or organisation of importance in the history of South Africa; and
- sites of significance relating to the history of slavery in South Africa.

A matrix was developed whereby the above criteria were applied for the determination of the significance of each identified site (see Appendix 2). This allowed some form of control over the application of similar values for similar identified sites.

4. STUDY APPROACH AND METHODOLOGY

4.1 Extent of the Study

This survey and impact assessment covers the area as presented in Section 6 below and illustrated in Figure 3.

4.2 Methodology

4.2.1 Survey of the literature

A survey of the relevant literature was conducted with the aim of reviewing the previous research done and determining the potential of the area. In this regard, various anthropological, archaeological and historical sources were consulted – see list of references in Section 10.

- Information on events, sites and features in the larger region were obtained from these sources.

4.2.2 Survey of the heritage impact assessments (HIAs)

A survey of HIAs done for projects in the region by various heritage consultants was conducted with the aim of determining the heritage potential of the area – see list of references in Section 10.

- Information on sites and features in the larger region were obtained from these sources.

4.2.3 Data bases

The *Heritage Atlas Database,* various *SAHRA* databases, the *Environmental Potential Atlas*, the *Chief Surveyor General* and the *National Archives of South Africa* were consulted.

- Database surveys produced a number of sites located in the larger region of the proposed development.

4.2.4 Other sources

Aerial photographs and topocadastral and other maps were also studied - see the list of references below.

- Information of a very general nature were obtained from these sources

4.2.5 Interviews

Mrs. A Oberholzer, daughter of the current landowner. These properties have been in their family for three generations.

Authors of previous studies done in the area are all of the opinion that the number of sites identified were not as high as originally anticipated. They argue that this may be related to the fact that the development is located in less favourable occupation areas, i.e. open water is scarce in the region, therefore people used to congregated in valleys close to water, rather than on the plains.

The types of sites that have been identified in the larger region can be categorised as follows:

- Stone Age tools, dating to the MSA and LSA occur as low-density scatters on the banks of the streams and rivers and on some outcrops in the larger region;
- Rock art occur in small caves or shelters in a limited number of cases in the larger region to the north of the study region;
- Historic structures, inclusive of buildings, monuments and bridges, usually occur mostly in an urban environment although they also occur on farms or alongside infrastructure facilities such as roads and railway lines. However, as this region has only recently been occupied intensively, such features are very limited;
- Formal burial sites occur in urban settings, with a number of informal ones occurring sporadically throughout the country side;

Based on the above assessment, the probability of cultural heritage sites, features and objects occurring in the study area, i.e. solar facility and power line corridor, is deemed to be **very low**.

The results of the above investigation are summarised in Table 1 below – see list of references in Section 10.

Table 1: Pre-Feasibility Assessment

Category	Period	Probability
Early hominin	Pliocene - Lower Pleistocene	
	Early Hominin	None
Stone Age	Lower Pleistocene - Holocene	
	Early Stone Age	Low
	Middle Stone Age	Medium
	Later Stone Age	Low
	Rock Art	Low
Iron Age	Holocene	
	Early Iron Age	None
	Middle Iron Age	None
	Later Iron Age	Medium
Historic Period	Holocene	
	Contact Period	Low
	Recent Past	Medium
	Industrial Heritage	Low

4.2.6 Field survey

The field survey was done according to generally accepted archaeological practices, and was aimed at locating all possible sites, objects and structures. The area that had to be investigated was identified by the *CSIR* by means of maps and .*kml* files indicating the development area. This was loaded onto a Nexus 7 tablet and used in Google Earth during the field survey to access the areas.

The site for the proposed Solar PV facilities (VB1, VB 2 and VB3) was visited on 21 November 2016. The area was investigated by walking transects across it, giving special attention to features such as hills, outcrops, pans and clumps of trees – see Fig. 1 below. During the site visit the archaeological visibility was good due to the intense drought that the region experienced over the past few years.

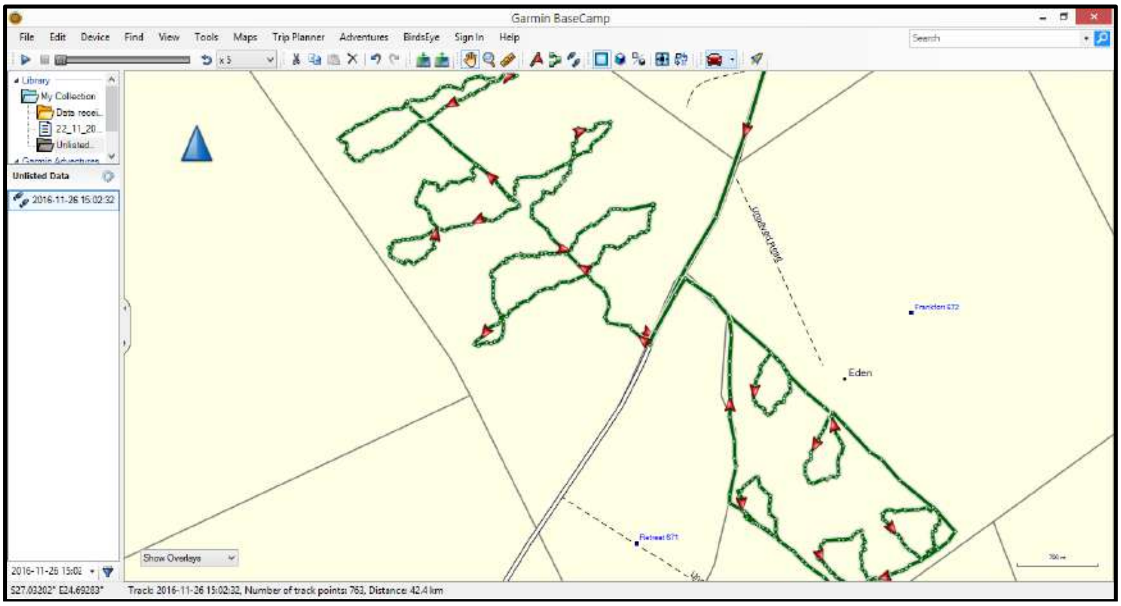

Fig. 1. Map indicating the track log of the field survey for the three Solar PV sites.

A follow up site visit was conducted on 16 July 2018 for the transmission line component of the project that connects the PV facility to the Mookodi Substation.

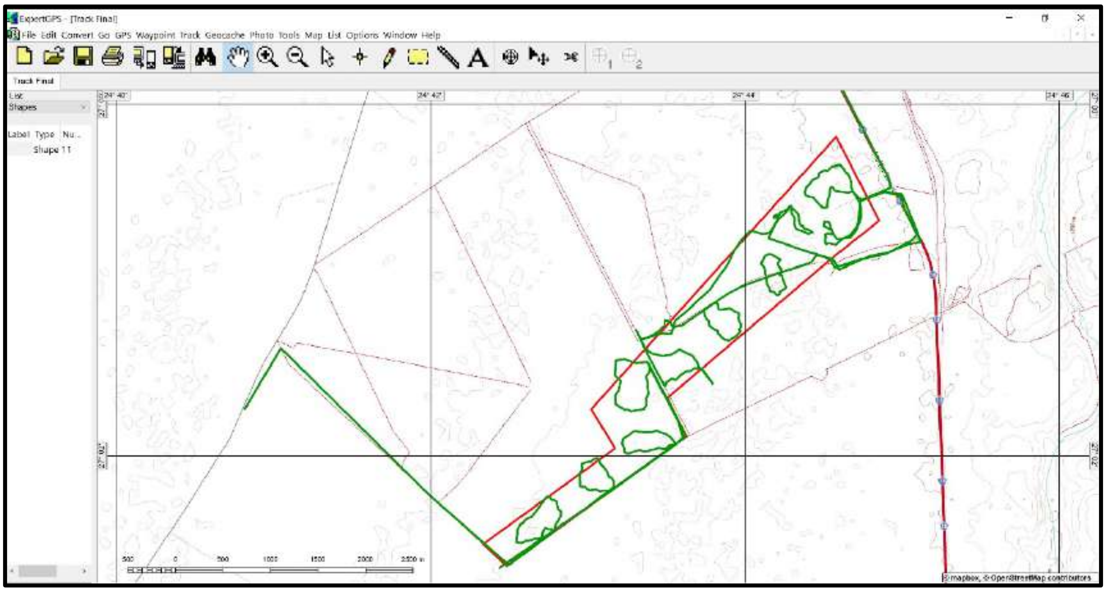

Fig. 2. Map indicating the track log of the field survey for the transmission line component

4.2.7 Documentation

All sites, objects and structures that are identified are documented according to the general minimum standards accepted by the archaeological profession. Coordinates of individual localities are determined by means of the *Global Positioning System* (GPS) and plotted on a map. This information is added to the description in order to facilitate the identification of each locality.

The track log and identified sites were recorded by means of a Garmin Oregon 550 handheld GPS device. Photographic recording was done by means of a Canon EOS 550D digital camera.

Map datum used: Hartebeeshoek 94 (WGS84).

4.3 Public participation

Since the proposed 115 MW Solar PV facilities are located within the same geographical area and constitute the same type of activity, an integrated Public Participation Process (PPP) will be undertaken for the proposed projects. However, three separate Applications for Environmental Authorisation (EA) will be lodged with the National DEA for each proposed project and as such, three separate reports (i.e. Basic Assessment Reports) will be compiled for each project. Therefore, separate specialist reports will be compiled for each project.

5. SITE SIGNIFICANCE AND ASSESSMENT

5.1 Heritage assessment criteria and grading

The National Heritage Resources Act, Act no. 25 of 1999, stipulates the assessment criteria and grading of heritage sites. The following grading categories are distinguished in Section 7 of the Act:

- **Grade I**: Heritage resources with qualities so exceptional that they are of special national significance;
- **Grade II**: Heritage resources which, although forming part of the national estate, can be considered to have special qualities which make them significant within the context of a province or a region; and
- **Grade III**: Other heritage resources worthy of conservation on a local authority level.

The occurrence of sites with a Grade I significance will demand that the development activities be drastically altered in order to retain these sites in their original state. For Grade II and Grade III sites, the applicable of mitigation measures would allow the development activities to continue.

5.2 Methodology for the assessment of potential impacts

All impacts identified during the EIA stage of the study will be classified in terms of their significance. Issues were assessed in terms of the following criteria:

- The **nature**, a description of what causes the effect, what will be affected and how it will be affected;
- The physical **extent**, wherein it is indicated whether:
  - 1 - the impact will be limited to the site;
  - 2 - the impact will be limited to the local area;
  - 3 - the impact will be limited to the region;
  - 4 - the impact will be national; or
  - 5 - the impact will be international;
- The **duration**, wherein it is indicated whether the lifetime of the impact will be:
  - 1 - of a very short duration (0–1 years);
  - 2 - of a short duration (1-5 years);
  - 3 - medium-term (5–15 years);
  - 4 - long term (> 15 years); or
  - 5 - permanent;
- The **magnitude** of impact, quantified on a scale from 0-10, where a score is assigned:
  - 0 - small and will have no effect;
  - 2 - minor and will not result in an impact;
  - 4 - low and will cause a slight impact;
  - 6 - moderate and will result in processes continuing but in a modified way;
  - 8 – high, (processes are altered to the extent that they temporarily cease); or
  - 10 - very high and results in complete destruction of patterns and permanent cessation of processes;
- The **probability** of occurrence, which describes the likelihood of the impact actually occurring and is estimated on a scale where:
  - 1 - very improbable (probably will not happen;
  - 2 - improbable (some possibility, but low likelihood);
  - 3 - probable (distinct possibility);
  - 4 - highly probable (most likely); or
  - 5 - definite (impact will occur regardless of any prevention measures);
- The **significance**, which is determined through a synthesis of the characteristics described above (refer formula below) and can be assessed as low, medium or high;

- The **status**, which is described as either positive, negative or neutral;
- The degree to which the impact can be reversed;
- The degree to which the impact may cause irreplaceable loss of resources; and
- The degree to which the impact can be mitigated.

The **significance** is determined by combining the criteria in the following formula:

S = (E+D+M) x P; where
S = Significance weighting
E = Extent
D = Duration
M = Magnitude
P = Probability

The **significance weightings** for each potential impact are calculated as follows:

Table 2: Significance ranking

Significance of impact					
Extent	**Duration**	**Magnitude**	**Probability**	**Significance**	**Weight**
-	-	-	-	-	-

Points	**Significant Weighting**	**Discussion**
< 30 points	Low	where this impact would not have a direct influence on the decision to develop in the area
31-60 points	Medium	where the impact could influence the decision to develop in the area unless it is effectively mitigated
> 60 points	High	where the impact must have an influence on the decision process to develop in the area

6. PROJECT DESCRIPTION

6.1 Site location

The town of Vryburg is located approximately 9 km northeast of the development area, in the Dr Ruth Mompati District Municipality of North West Province (Fig. 3). For more information, see the Technical Summary on p. vi above.

Fig. 3. Location of the study area in regional context

(Image: Google Earth)

6.2 Development proposal (Generic project description)

The following information was supplied by the developer - Veroniva (Pty) Ltd:

The proposed project will make use of PV solar technology to generate electricity from the sun's energy. The Applicant is proposing to develop a facility with a possible maximum installed capacity of 115 MW Direct Current (DC) which produces 100 MW Alternating Current (AC) of electricity from PV solar energy.

Once a Power Purchase Agreement (PPA) is awarded, the proposed facility will generate electricity for a minimum period of 20 years. The proposed solar facility will consist of the following components:

- Solar Field, comprising Solar Arrays with a maximum height of 10m and maximum footprint of 300 hectares per project (detailed provided below), including the following:
    - PV Modules;
    - Single Axis Tracking structures (aligned north-south), Fixed Axis Tracking (aligned east-west), Dual Axis Tracking (aligned east-west and north-south) or Fixed Tilt Mounting Structure (all options will be considered in the design);
    - Solar module mounting structures comprised of galvanised steel and aluminium; and
    - Foundations which will likely be drilled and concreted into the ground.
- Building Infrastructure, with footprint of 1500 m^2:
    - Offices (maximum height 7m and footprint of 1000 m^2);
    - Operational and maintenance control centre (maximum height 7m and footprint 500 m^2);
    - Warehouse/workshop (maximum height 7m and footprint 500 m^2);
    - Ablution facilities (maximum height 7m and footprint 50 m^2);

    - 32 Converter/Inverter stations (height from 2.5m to 7m and footprint 3300 m^2);
    - On-site substation building (footprint 20 000 m^2).; and
    - Guard Houses (height 3m, footprint 40 m^2).
- Associated Infrastructure
    - 132 kV overhead transmission line to connect to the existing Eskom Mookodi substation (distances vary for each project – refer to maps and details below)
    - Associated electrical infrastructure at the Eskom Mookodi Substation (including but not limited to feeders, Busbars, transformer bay and extension to the platform at the Eskom Mookodi Substation)
    - On-site substation;
    - Internal 33 kV transmission lines/underground cables (either underground to maximum depth of 1m or above ground with height of 9m);
    - Underground low voltage cables or cable trays (underground to maximum depth of 1m);
    - Access roads would be the gravel road coming out of the N14, running SW away from Vryburg. The width and total length of the access road will be confirmed once the EPC contractor has been selected and the design is finalized;
    - Internal gravel roads (width of 4m);
    - Fencing;
    - Panel maintenance and cleaning area;
    - Stormwater channels (Details to be confirmed once the EPC contractor has been selected and the design is finalised. A detailed stormwater management plan would need to be developed); and
    - Temporary work area during the construction phase (i.e. laydown area of maximum 5 ha).

The total maximum project footprint is 250 hectares including the PV facility and infrastructure such as roads for each PV facility.

Additional specifications

- Fences - at least 2.4m height
- Water
    - It is proposed that panel cleaning will take place quarterly; however this may be revised should the site conditions warrant more frequent cleaning. It is estimated that the panel washing process will require approximately 5 million to 8 million litres of water per year during operations, to be sourced from Municipality. At this stage, no water is planned to be abstracted from or discharged to any surface water systems.
- High Voltage 132 kV Overhead Transmission Lines from PV sites to Mookodi substation, to be located within a corridor of approximately 300m width (refer kml files and maps)
    - Height = 22.5 m to 30 m
    - Length from site to grid connection = Vryburg Solar 1 = 5 km, Vryburg Solar 2 = 9 km or Vryburg Solar 3 = 10 km
- Social & Employment
    - Construction:
        - It is difficult to specify the actual number of employment opportunities that will be created at this stage; however, between 90 and 150 skilled and 400 and 460 unskilled employment opportunities are expected be created during the construction phase.
        - Operation:
        - However, other opportunities may arise for unskilled labour to be integrated to the ancillary activities. Approximately 20 skilled and 40 unskilled employment opportunities will be created over the 20 year lifespan of the proposed facility.

The proposed projects are located near to the proposed 75 MW Waterloo Solar Park, that received preferred bidder status in the Expedited Bidding Round, with construction planned to commence in 2018.

The proposed projects are located in close proximity to the Eskom Mookodi Substation. The proposed locality of the Veroniva projects is shown in Figure 1.

Each 115 MW Solar PV facility proposed by Veroniva will cover the following maximum total areas: Vryburg 1 = 300 ha; Vryburg 2 = 255 ha; and Vryburg 3 = 270 ha. The collective footprint will therefore be approximately 825 ha and the facility will have combined power generation capacity of 345 MW Direct Current (installed capacity) and 300 MW Alternating Current (generation capacity).

Each proposed 115 MW project includes a 132kV transmission line to the Eskom Mookodi Substation. Three separate Basic Assessment Processes are being undertaken for the development of each 115 MW facility and associated 132kV transmission line to the Mookodi Substation.

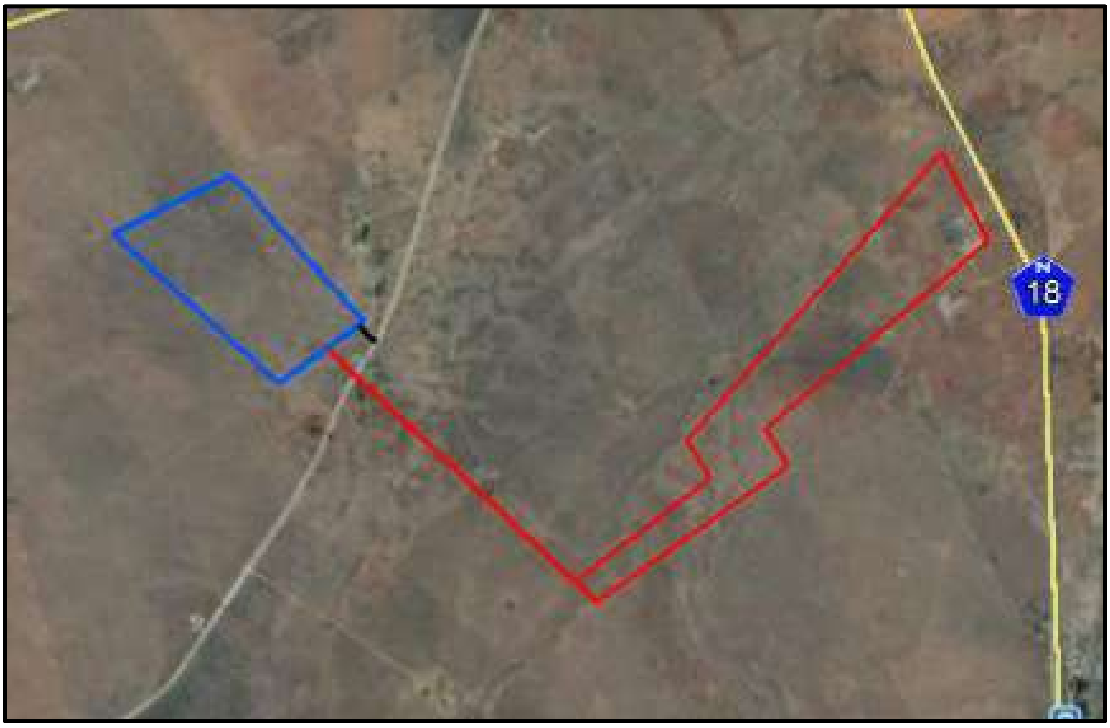

Fig. 4. Layout of the proposed development.

Site location = blue; transmission line = red; access road = black (Image: Google Earth)

7. DESCRIPTION OF THE AFFECTED ENVIRONMENT

7.1 Site description

The geology is made up of dolomite, changing to sand in the east. The original vegetation is classified as Ghaap Plateau Vaalbosveld, which form part of the Eastern Kalahari Bushveld Bioregion. The topography is described as undulating plains and pans and the Dry Harts River passes about 8km to the east of the study area.

From the graph in Figure 5 below it can be seen that the area is relatively flat, dropping off from northwest to southeast by only 23m over a distance of 5,92km.

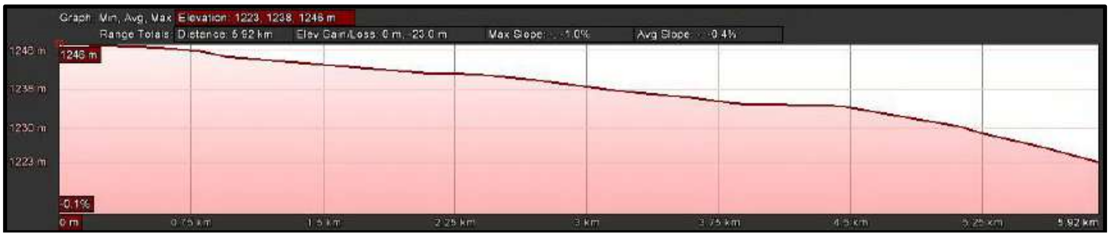

Fig. 5. Indicating the topography across the study areas

The area where the developments are to take place has mostly been used for grazing, although some sections were used as agricultural fields in the past.

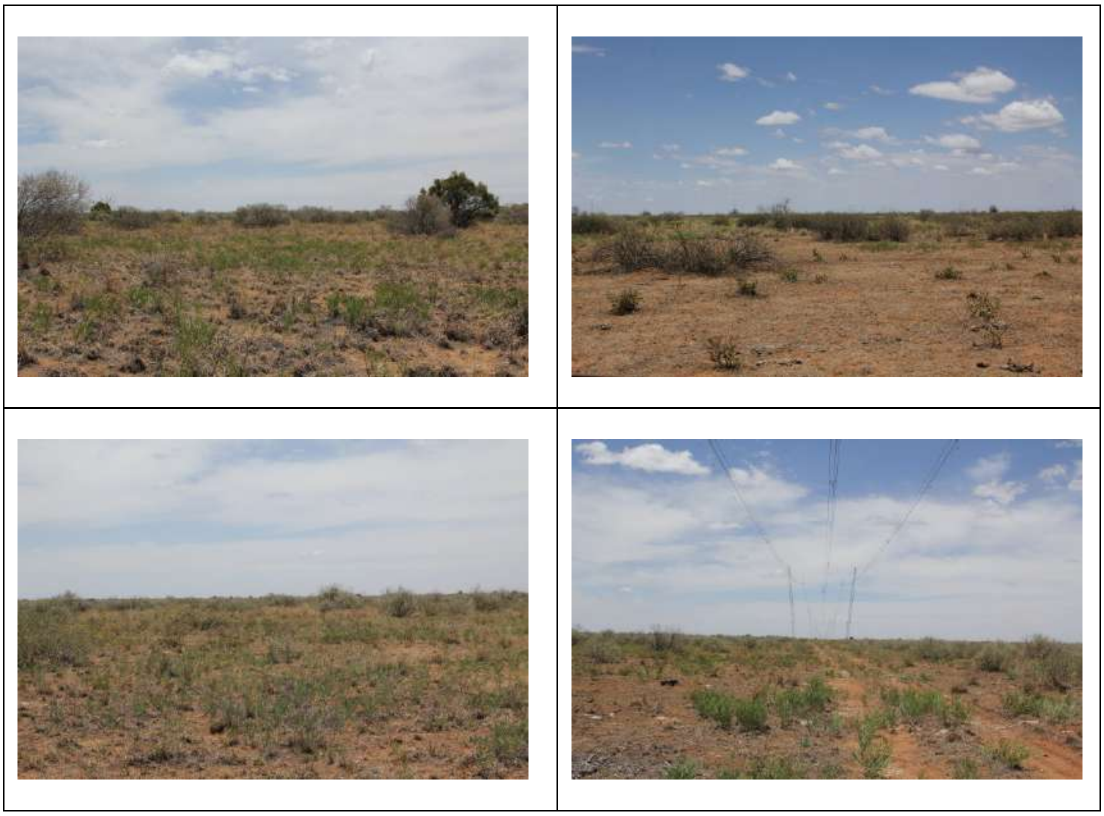

Fig. 6. Views over the study area

Northern section

Southern section

Fig. 7. Views over the power line corridor

7.2 Overview of the region

The aim of this section is to present an overview of the history of the larger region in order to eventually determine the significance of heritage sites identified in the study area, within the context of their historic, aesthetic, scientific and social value, rarity and representivity – see Section 3.2 and Appendix 2 for more information.

The cultural landscape qualities of the region essentially consist of two components. The first is a rural area in which the human occupation is made up of a pre-colonial (Stone Age and Iron Age) occupation and a much later colonial (farmer) component. The second component is an urban one consisting of a number of smaller towns, most of which developed during the last 150 years or less.

7.2.1 Geology

The lower strata of the Transvaal sequence comprise mostly of dolomite (with some chert and tillite interspersed in places) while the upper strata appear to be more varied in constituents. Dolomite consists largely of calcium carbonate and is hence vulnerable to solution, especially by the carbonic acid found in rainwater percolating downwards. The dissolution of dolomite can lead to the formation of underground caverns and horizontal chambers often filled with large volumes of groundwater.

Tillite is the result of sediment (till) that was deposited as a consequence of glacial actions and, due to subsequent burial, became solidified into solid rock.

Malmane Dolomite appears to be one of the main elements of the Transvaal sequence. It contains abundant algal stromatolites, evidence of an aquatic environment in ancient times. The algal stromatolites have a number of distinctive shapes such as domes, columns and spheres, their shape being governed by the environment in which they were formed. It is believed that the dolomites were laid down in shallow inter-tidal or sub-tidal zone of open water seas. Although these features are said to occur over a wide area, it is apparently only in a few places where they outcrop and are visible to the naked eye.

7.2.2 Early history

Very little habitation of the central highveld area took place during Stone Age times. Tools dating to the Early Stone Age period are mostly found in the vicinity of larger watercourses, e.g. the Vaal River or the Harts River and especially in sheltered areas such as at the Taung fossil site. During Middle Stone Age (MSA) times (c. 150 000 – 30 000 BP), people became more mobile, occupying areas formerly avoided. In many cases, tools dating to this period are found on the banks of the many pans that occur all over. The MSA is a technological stage characterized by flakes and flake-blades with faceted platforms, produced from prepared cores, as distinct from the core tool-based ESA technology.

Late Stone Age (LSA) people had even more advanced technology than the MSA people and therefore succeeded in occupying even more diverse habitats. Some sites are known to occur in the region. These are mostly open sites located near river and pans. For the first time we also get evidence of people’s activities derived from material other than stone tools. Ostrich eggshell beads, ground bone arrowheads, small bored stones and wood fragments with incised markings are traditionally linked with the LSA.

The LSA people have also left us with a rich legacy of rock art, which is an expression of their complex social and spiritual believes. Some of the farms in the Vryburg region known to have rock engravings are Bernauw, Content, Gemsbok Laagte, Klipfontein, Kinderdam, Melalarig, Schatkist, Verdwaal Vlakte and Wonderfontein, to mention but a few.

Iron Age people started to settle in southern Africa c. AD 300, with one of the oldest known sites at Broederstroom south of Hartebeespoort Dam dating to AD 470. Having only had cereals (sorghum, millet) that need summer rainfall, Early Iron Age (EIA) people did not move outside this rainfall zone, and neither did they occupy the central interior highveld area. Because of their specific technology and economy, Iron Age people preferred to settle on the alluvial soils near rivers for agricultural purposes, but also for firewood and water.

The occupation of the larger geographical area (including the study area) did not start much before the 1500s. By the 16th century things changed, with the climate becoming warmer and wetter, creating condition that allowed Late Iron Age (LIA) farmers to occupy areas previously unsuitable, for example the treeless plains of the Free State and North West Province.

The earliest Iron Age settlers who moved into the North West Province region were Tswana-speakers such as the Tlhaping, Hurutshe, Fokeng, Kgatla and Rolong. In the region of the study area, it was mostly the booRapulana and booRatlou sections of the Rolong (Breutz 1959).

Stone walled sites dating to the Late Iron Age and which can be linked to the Tswana occupation of the area, are found on a number of farms in the region, e.g. Waai Hoek and Brul Pan. However, the historic most important one, named Dithakong, is located some distance to the north-west. This site was first visited by early travellers such as Lichtenstein and John Campbell in the early part of the 19th century.

7.2.3 Historic period

Many early travellers, hunters and missionaries (Burchell 1824, Campbell 1822, Smith 1834-1836 (Lye 1975), Moffat 1842 and Harris 1852) either passed through the area or close to it. Their writings leave us a tantalising description of what life was in these communities before large-scale interaction with white settles took place. Some of the first whites to settle here were the missionaries Samuel Broadbent and Thomas Hodgson, who settled some distance to the east of what later became known as Wolmaransstad.

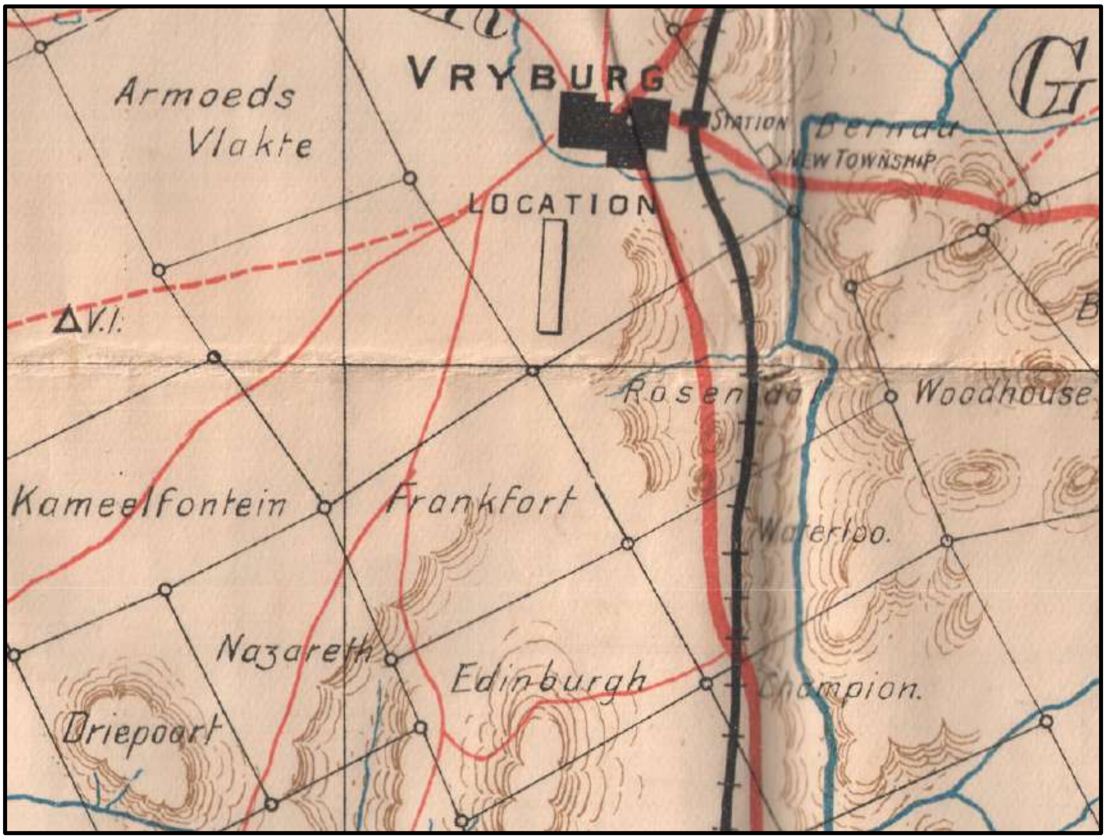

Fig. 8. *Imperial Map of South Africa*, 1900, showing the absence of regional development

White settlers moved into the area during the first half of the 19th century. They were largely self-sufficient, basing their survival on cattle/sheep farming and hunting. Few towns were established, and it remained an undeveloped area.

During the 1880s the white settlers exploited conflict between the different Tswana chiefdoms to obtain more land (Legassick 2010). Chief David Massouw gave some land to some whites in recognition for their help in his fight against the Batlhapin chief Mankoroane Molehabanque. From this developed the Republic of Stellaland, which was named for a comet ("stella" in Latin) that was visible in 1882. The town of Vryburg was to be the capital of the republic. However, due to British intervention in the area as a result of the discovery of diamonds, the republic was very short-lived.

The last chapter in the history of the region was its incorporation under the policy of homeland development, into the Republic of Bophuthatswana. This was a very fragmented 'State' and it would have needed permanent support by the central government to keep it in place. Since 1994, this has fallen away, and the people and the region were reincorporated into the larger Republic of South Africa

7.2.4 Vryburg

This town was founded in 1883 as the capital of the Republic of Stellaland, an independent Boer republic. The Boers that inhabited the area styled themselves as free citizens, or *vryburgers*, in Dutch, from which the name of the town was derived. The town achieved municipal status in 1896.

According to available data bases this town has 5 buildings listed as of provincial significance. In addition, some cemeteries and monuments also occur. During the Anglo Boer War (1899-1902) a large concentration camp was established on the outskirts of the town.

The Tierkloof Institute, located to the south of Vryburg, on the farm Waterloo, was established in 1904 and served as centre for higher education for Tswana-speaking people, especially for children of the various royal families.

7.3 Identified sites

The following sites, features and objects of cultural significance were identified in the study area – see Appendix 5 for a discussion of each individual site.

7.3.1 7.3.1 Solar site

7.3.1.1 Stone Age

- No sites, features or objects dating to the Stone Age were identified in the study area.

7.3.1.2 Iron Age

- No sites, features or objects dating to the Iron Age were identified in the study area.

7.3.1.3 Historic period

- No sites, features or objects dating to the historic period were identified in the study area.

7.3.2 Power line route

7.3.2.1 Stone Age

- Stone tools were identified to occur on a low ridge to the east of the substation. It mostly dates to the Middle Stone Age, although some smaller ones might date to the Later Stone Age. Cores, tools and flakes (debitage) were identified, indicating that the tools were manufactured on site. The material used was mostly chert, although some quartzite was also identified. The density of the stone tool scatter seems to quite consistent over the whole ridge, averaging at approximately 2 pieces per $2m^2$.

7.3.2.2 Iron Age

- No sites, features or objects dating to the Iron Age were identified in the study area.

7.3.2.3 Historic period

- Originally some graves (c. 6) occurred west of the substation. They were very old and only marked with low stone cairns. As they were located next to the laydown area for the construction of the substation, they were fenced off. They could not be located during the current site visit (possibly due to incorrect coordinates). It is also possible that they were relocated during the construction activities.

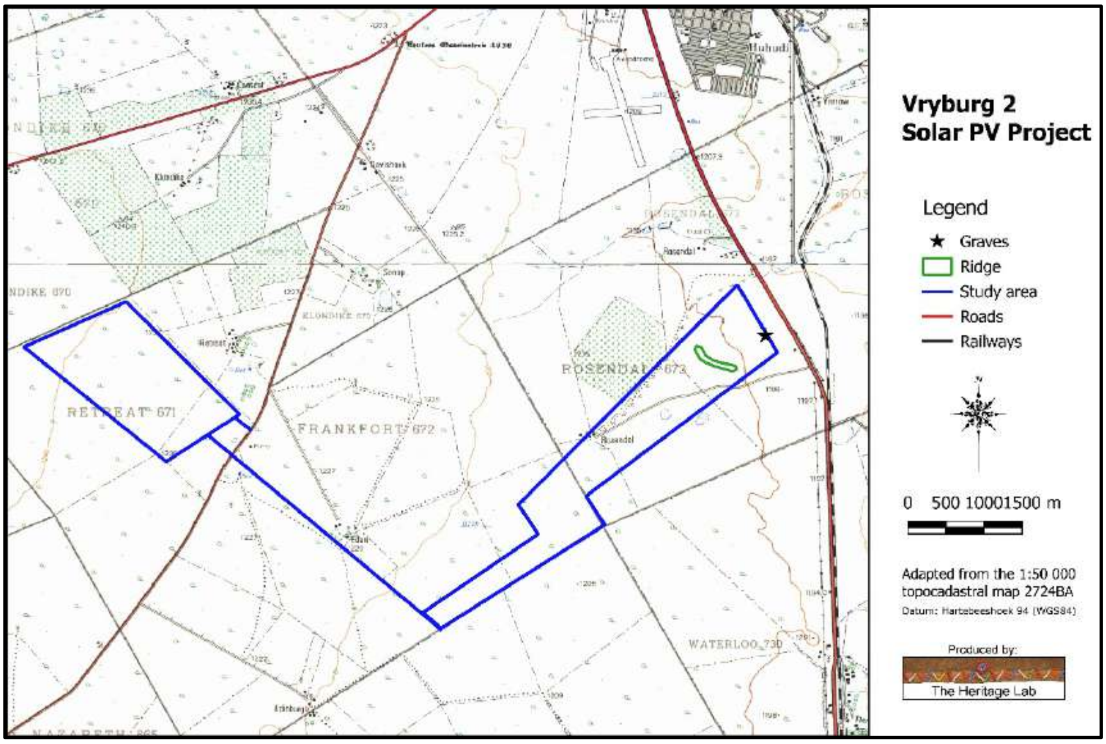

Fig. 9. Location of the identified sites.

7.4 Impact assessment

Heritage impacts are categorised as:

- Direct or physical impacts, implying alteration or destruction of heritage features within the project boundaries
- Indirect impacts, e.g. restriction of access or visual intrusion concerning the broader environment
- Cumulative impacts that are combinations of the above

The impacts of the proposed development could be direct or physical but will not be indirect and cumulative.

Impact can be managed through one or a combination of the following measures:

- Mitigation
- Avoidance
- Compensation
- Enhancement (positive impacts)
- Rehabilitation
- Interpretation
- Memorialisation

The impact could occur at three potential phases of the project:

- Construction Phase
- Operational Phase
- Decommissioning Phase

Impact analysis of cultural heritage resources under threat of the proposed development, is based on the present understanding of the development and is presented in Appendix 5 and summarised in Table 3 and 4 below:

It should be noted that impacts on heritage features are only predicted to occur during the construction phase.

Table 3: Impacts on Heritage Sites for the Construction Phase: Solar PV Site Construction

Nature: Destruction of heritage sites due to the development taking place (i.e. construction activities)		
	Without mitigation	With mitigation
Extent	Site (1)	Site (1)
Duration	Short-term (1)	Short-term (1)
Intensity	Low (1)	Low (1)
Probability	Improbable (1)	Improbable (1)
Significance	Low (3)	Low (3)
Low impact (1-30 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.	
Reversibility	Non-reversible	Non-reversible
Irreplaceable loss of resources?	No	No
Can impacts be mitigated	n/a	
Mitigation: None		
Cumulative impact: n/a		

Table 4: Impacts on Heritage Sites for the Construction Phase: Power Line Corridor

Stone Age site		
Nature: Destruction of heritage sites due to the development taking place (i.e. construction activities): The power line will pass with limited impact over a small section of the site.		
	Without mitigation	With mitigation
Extent	Site (1)	Site (1)
Duration	Permanent (4)	Permanent (4)
Intensity	Low (2)	Low (2)
Probability	Probable (3)	Probable (3)
Significance	Low (21)	Low (21)
Low impact (1-30 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.	
Reversibility	Non-reversible	Non-reversible
Irreplaceable loss of resources?	No	No
Can impacts be mitigated	n/a	
Mitigation: (1) Avoid site		
Cumulative impact: n/a		

Graves		
Nature: Destruction of heritage sites due to the development taking place (i.e. construction activities): The site is located outside of the planned high impact zone		
	Without mitigation	With mitigation
Extent	Site (1)	Site (1)
Duration	Short-term (1)	Short-term (1)
Intensity	Low (1)	Low (1)
Probability	Improbable (1)	Improbable (1)
Significance	Low (3)	Low (3)
Low impact (1-30 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.	

Reversibility	Non-reversible	Non-reversible
Irreplaceable loss of resources?	No	No
Can impacts be mitigated	n/a	
Mitigation: None		
Cumulative impact: n/a		

7.5 Cumulative assessment

Several renewable energy facilities have received environmental authorisation or are in the process of applying for authorisation in the Vryburg region:

Table 5: Renewable Energy Projects in the Region

PROPOSED DEVELOPMENT	DEA REFERENCE NO.	CURRENT EIA STATUS	PROPONENT	PROPOSED CAPACITY	EXTENT	FARM DETAILS
Sonbesie Solar Power Plant	14/12/16/3 /3/2/915	EIA ongoing	Sonbesie Solar Power Plant (RF) (Pty) Ltd.	115 MW	264 Ha	Remaining Extent of the farm Retreat 671
Gamma Solar Power Plant	14/12/16/3 /3/2/917	EIA ongoing	Gamma Solar Power Plant (RF) (Pty) Ltd.	115 MW	285 Ha	Portion 4 of the farm Champions Kloof 731
Khubu Solar Power Plant	14/12/16/3 /3/2/912	EIA ongoing	Khubu Solar Power Plant (RF) (Pty) Ltd.	115 MW	300 Ha	Portion 4 of the farm Champions Kloof 731
Alpha Solar Power Plant	14/12/16/3 /3/2/916	EIA ongoing	Alpha Solar Power Plant (RF) (Pty) Ltd.	115 MW	285 Ha	Portion 3 of the farm Vyflings Pan 598
Meerkat Solar Power Plant	14/12/16/3 /3/2/913	EIA ongoing	Meerkat Solar Power Plant (RF) (Pty) Ltd.	115 MW	250 Ha	Portion 3 of the farm Middel Pan
Protea Solar Power Plant	14/12/16/3 /3/2/914	EIA ongoing	Protea Solar Power Plant (RF) (Pty) Ltd.	115 MW	240 Ha	Remaining Extent of the farm Hartsboom 734
Tiger Kloof Solar PV energy facility	14/12/16/3 /3/2/535	Environmental authorisation received	Kabi Solar (Pty) Ltd.	75 MW	250 Ha	Portions 3 & 4 of the Farm Waterloo 730
Sediba Power Plant 75MW PV Solar Facility and associated infrastructure	14/12/16/3 /3/2/390A M1	Environmental authorisation received	Sediba Power Plant (Pty) Ltd	75 MW	150 Ha	A portion of the remaining extent of the Farm Rosendal 673
Waterloo Solar Park	14/12/16/3 /3/2/308A M3	Environmental authorisation received and preferred bidder status (REIPPP window 4).	DPS79 Solar Energy (Pty) Ltd	75 MW	150 Ha	Southern portion of the Farm Waterloo 992
Cronos Energy Renewable Energy Generation Project	14/12/16/3 /3/2/750	Environmental authorisation received	Cronos Energy (Pty) Ltd	75 MW		Remainder of the Farm Elma No 575
75MW Carocraft PV Solar Park and associated infrastructure	14/12/16/3 /3/2/374	Environmental authorisation received 29 June 2013. Amended to 75MW on 4 April 2014.	Carocraft (Pty) Ltd	75 MW		Portion 1 and the Remainder of the Farm Weltevrede 681

PROPOSED DEVELOPMENT	DEA REFERENCE	CURRENT EIA STATUS	PROPONENT	PROPOSED CAPACITY	EXTENT	FARM DETAILS
Expansion of the Carocraft Solar Park	14/12/16/3 /3/2/699	Scoping and EIA processes underway.	Carocraft (Pty) Ltd	75 MW		Southern side of the Remainder of the Farm Weltevrede 681
Woodhouse Solar 1 PV Facility	14/12/16/3 /3/2/863	EIA ongoing	Genesis Woodhouse Solar 1 (Pty) Ltd	100 MW		Remaining extent of the Farm Woodhouse 729
Woodhouse Solar 2 PV Facility	14/12/16/3 /3/2/865	EIA ongoing	Genesis Woodhouse Solar 2 (Pty) Ltd	100 MW		Remaining extent of the Farm Woodhouse 729
Delta Photovoltaic Power Plant		Scoping and EIA processes underway.	AMDA-Delta (Pty) Ltd.	75 MW	250 Ha	Remaining Extent of the farm Klondike No. 670
Echo Photovoltaic Power Plant		Scoping and EIA processes underway.	AMDA-Echo (Pty) Ltd.	75 MW	250 Ha	Remaining Extent of the farm Klondike No. 670
Foxtrot Photovoltaic Power Plant		Scoping and EIA processes underway.	AMDA-Foxtrot (Pty) Ltd.	75 MW	221 Ha	Remaining Extent of the farm Klondike No. 670
Sendawo 1	14/12/16/3 /3/2/891	EIA ongoing	BioTherm Energy	75 MW	368 Ha	Portion 1 of the Farm Edinburgh No 735
Sendawo 2	14/12/16/3 /3/2/892	EIA ongoing	BioTherm Energy	75 MW	416 Ha	Portion 1 of the Farm Edinburgh No 735
Sendawo 3	14/12/16/3 /3/2/893	EIA ongoing	BioTherm Energy	75 MW	360 Ha	Portion 1 of the Farm Edinburgh No 735
				TOTAL	**TOTAL**	**CUMULATIVE IMPACT**
				1 290 MW	3 789 Ha	**Low**

- Based on a review of the above projects, it was determined that this is a region of low heritage occurrence and it is therefore concluded that the cumulative impact of these proposed developments would be **low**.

8. MANAGEMENT MEASURES

Heritage sites are fixed features in the environment, occurring within specific spatial confines. Any impact upon them is permanent and non-reversible. Those resources that cannot be avoided and that are directly impacted by the proposed development can be excavated/recorded and a management plan can be developed for future action. Those sites that are not impacted on can be written into the management plan, whence they can be avoided or cared for in the future.

8.1 Objectives

- Protection of archaeological, historical and any other site or land considered being of cultural value within the project boundary against vandalism, destruction and theft.
- The preservation and appropriate management of new discoveries in accordance with the NHRA, should these be discovered during construction activities.

The following shall apply:

- Known sites should be clearly marked in order that they can be avoided during construction activities.
- The contractors and workers should be notified that archaeological sites might be exposed during the construction activities.
- Should any heritage artefacts be exposed during excavation, work on the area where the artefacts were discovered, shall cease immediately and the Environmental Control Officer shall be notified as soon as possible;

- All discoveries shall be reported immediately to a heritage practitioner so that an investigation and evaluation of the finds can be made. Acting upon advice from these specialists, the Environmental Control Officer will advise the necessary actions to be taken;
- Under no circumstances shall any artefacts be removed, destroyed or interfered with by anyone on the site; and
- Contractors and workers shall be advised of the penalties associated with the unlawful removal of cultural, historical, archaeological or palaeontological artefacts, as set out in the National Heritage Resources Act (Act No. 25 of 1999), Section 51. (1).

8.2 Control

In order to achieve this, the following should be in place:

- A person or entity, e.g. the Environmental Control Officer, should be tasked to take responsibility for the heritage sites and should be held accountable for any damage.
- Known sites should be located and isolated, e.g. by fencing them off. All construction workers should be informed that these are no-go areas, unless accompanied by the individual or persons representing the Environmental Control Officer as identified above.
- In areas where the vegetation is threatening the heritage sites, e.g. growing trees pushing walls over, it should be removed, but only after permission for the methods proposed has been granted by SAHRA. A heritage official should be part of the team executing these measures.

The management actions are specified in the following Tables, with further implementation details provided in accordance with the requirements of the EIA Regulations.

Table 6.1. Management Plan for the Planning and Design Phase

Impact	**Mitigation / Management Objectives and Outcomes**	**Mitigation/Management Actions**	**Monitoring**		
			Methodology	***Frequency***	***Responsibility***
Aspect: Protection of heritage and cultural resources					
Destruction of heritage sites	Protection of threatened heritage sites and features	As far as is feasible, infrastructure design and siting should be amended to remove any physical, direct impacts on identified heritage sites	Appoint a suitable specialist to determine if impacts would take place	Once-off during the design phase.	Project Developer (Veroniva)

Table 6.2. Management Plan for the Construction Phase

Impact	Mitigation / Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
Aspect: Protection of heritage and cultural resources					
Destruction of heritage sites	Protection of threatened heritage sites and features	Implement mitigation measures as proposed by specialist, accepted by SAHRA	(i) Avoid feature; (ii) investigate; excavate; (iii) relocate	Once-off prior to the construction phase	Environmental Control Officer (ECO); heritage specialist

Table 6.3. Management Plan for the Operational Phase

Impact	Mitigation / Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
Aspect: Protection of heritage and cultural resources					
No impacts are anticipated during the operational phase.	n/a	During the operational phase, no additional surface disturbance activities or impacts are expected. The majority of heritage resource have been recorded, assessed and mitigated or conserved in preceding phases.	Visual inspection	If additional construction activities are to take place on the site	Facility Operational Manager

Table 6.4. Management Plan for the Decommissioning Phase

Impact	Mitigation / Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
Aspect: Protection of heritage and cultural resources					
No impacts are anticipated during the decommissioning phase.	n/a	The heritage resources have been recorded, assessed and mitigated or conserved in preceding phases.	n/a	n/a	n/a

9. RECOMMENDATIONS

Veroniva (Pty) Ltd, together with ABO Wind (the Project Applicant, hereinafter referred to as Veroniva), is proposing to develop three 115 MW Solar Photovoltaic (PV) power generation facilities and associated electrical infrastructure (132 kV transmission lines for each 115 MW facility) south west of Vryburg in the Dr Ruth Mompati District Municipality in the North West Province.

This report describes the methodology used, the limitations encountered, the heritage features that were identified and the recommendations and mitigation measures proposed relevant to this. It should be noted that the implementation of the mitigation measures is subject to SAHRA/PHRA's approval.

The cultural landscape qualities of the region essentially consist of two components. The first is a rural area in which the human occupation is made up of a pre-colonial (Stone Age and Iron Age) occupation and a much later colonial (farmer) component. The second component is an urban one consisting of a number of smaller towns, most of which developed during the last 150 years or less.

<u>Identified sites</u>

- Stone tools were identified to occur on a low ridge to the east of the substation. It mostly dates to the Middle Stone Age, although some smaller ones might date to the Later Stone Age. Cores, tools and flakes (debitage) were identified, indicating that the tools were manufactured on site.

- Originally some graves (c. 6) occurred west of the substation. They were very old and only marked with low stone cairns. As they were located next to the laydown area for the construction of the substation, they were fenced off. They could not be located during the current site visit (possibly due to incorrect coordinates). It is also possible that they were relocated during the construction activities.

<u>Impact assessment and proposed mitigation measures</u>

Impact analysis of cultural heritage resources under threat of the proposed development, is based on the present understanding of the development:

Heritage sites	Significance of impact	Mitigation measures
Vryburg 1 Solar PV Development: Construction Phase		
Without mitigation	Low	n/a
With mitigation	Low	n/a

Heritage sites	Significance of impact	Mitigation measures
Vryburg 1 Solar PV Development: Operation Phase		
Without mitigation	n/a	n/a
With mitigation	n/a	n/a

Heritage sites	Significance of impact	Mitigation measures
Vryburg 1 Solar PV Development: Decommissioning Phase		
Without mitigation	n/a	n/a
With mitigation	n/a	n/a

Heritage sites	Significance of impact	Mitigation measures
Vryburg 1 Solar PV Transmission Line: Construction Phase		
Without mitigation	Low	Avoid sites
With mitigation	n/a	n/a
Heritage sites	Significance of impact	Mitigation measures
Vryburg 1 Solar PV Transmission Line: Operation Phase		

Without mitigation	n/a	n/a
With mitigation	n/a	n/a

Heritage sites	Significance of impact	Mitigation measures
Vryburg 1 Solar PV Transmission Line: Decommissioning Phase		
Without mitigation	n/a	n/a
With mitigation	n/a	n/a

<u>Legal requirements</u>

The legal requirements related to heritage specifically are specified in Appendixes 3 and 4. For this proposed project, the assessment has identified two sites of heritage significance. It is calculated that the potential impact of the proposed development on these sites would be low. Therefore, no heritage permits are required, unless indicated otherwise by SAHRA. If heritage features are identified during construction, as stated in the management recommendation, these finds would have to be assessed by a specialist, after which a decision will be made regarding the application for relevant permits.

<u>Reasoned opinion as to whether the proposed activity should be authorised</u>:

- From a heritage point of view, it is recommended that the development be allowed to continue on acceptance of the measures proposed below.

<u>Conditions for inclusion in the environmental authorisation</u>:

- Should archaeological sites or graves be exposed during construction work, it must immediately be reported to a heritage practitioner so that an investigation and evaluation of the finds can be made.

10. REFERENCES

10.1 Data bases

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10.2 Literature

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Wilson, M.G.C. & Anhaeusser, C.R. 1998. *The Mineral Resources of South Africa*. Sixth Edition. Handbook 16. Pretoria: Council for Geosciences.

10.3 Maps and aerial photographs

1: 50 000 Topocadastral maps:
Google Earth

APPENDIX 1: INDEMNITY AND TERMS OF USE OF THIS REPORT

The findings, results, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as available information. The report is based on survey and assessment techniques which are limited by time and budgetary constraints relevant to the type and level of investigation undertaken and the author reserve the right to modify aspects of the report including the recommendations if and when new information may become available from ongoing research or further work in this field, or pertaining to this investigation.

Although all possible care is taken to identify all sites of cultural importance during the investigation of study areas, it is always possible that hidden or sub-surface sites could be overlooked during the study. The author of this report will not be held liable for such oversights or for costs incurred as a result of such oversights.

Although the author exercises due care and diligence in rendering services and preparing documents, he accepts no liability and the client, by receiving this document, indemnifies the author against all actions, claims, demands, losses, liabilities, costs, damages and expenses arising from or in connection with services rendered, directly or indirectly by the author and by the use of the information contained in this document.

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APPENDIX 2: CONVENTIONS USED TO ASSESS THE IMPACT OF PROJECTS ON HERITAGE RESOURCES

Significance

According to the NHRA, Section 2(vi) the **significance** of a heritage sites and artefacts is determined by it aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technical value in relation to the uniqueness, condition of preservation and research potential. It must be kept in mind that the various aspects are not mutually exclusive, and that the evaluation of any site is done with reference to any number of these.

Matrix used for assessing the significance of each identified site/feature

1. Historic value			
Is it important in the community, or pattern of history			
Does it have strong or special association with the life or work of a person, group or organisation of importance in history			
Does it have significance relating to the history of slavery			
2. Aesthetic value			
It is important in exhibiting particular aesthetic characteristics valued by a community or cultural group			
3. Scientific value			
Does it have potential to yield information that will contribute to an understanding of natural or cultural heritage			
Is it important in demonstrating a high degree of creative or technical achievement at a particular period			
4. Social value			
Does it have strong or special association with a particular community or cultural group for social, cultural or spiritual reasons			
5. Rarity			
Does it possess uncommon, rare or endangered aspects of natural or cultural heritage			
6. Representivity			
Is it important in demonstrating the principal characteristics of a particular class of natural or cultural places or objects			
Importance in demonstrating the principal characteristics of a range of landscapes or environments, the attributes of which identify it as being characteristic of its class			
Importance in demonstrating the principal characteristics of human activities (including way of life, philosophy, custom, process, land-use, function, design or technique) in the environment of the nation, province, region or locality.			
7. Sphere of Significance	High	Medium	Low
International			
National			
Provincial			
Regional			
Local			
Specific community			
8. Significance rating of feature			
1. Low			
2. Medium			
3. High			

Significance of impact:

- low — where the impact will not have an influence on or require to be significantly accommodated in the project design
- medium — where the impact could have an influence which will require modification of the project design or alternative mitigation
- high — where it would have a "no-go" implication on the project regardless of any mitigation

Certainty of prediction:

- Definite: More than 90% sure of a particular fact. Substantial supportive data to verify assessment
- Probable: More than 70% sure of a particular fact, or of the likelihood of that impact occurring
- Possible: Only more than 40% sure of a particular fact, or of the likelihood of an impact occurring
- Unsure: Less than 40% sure of a particular fact, or the likelihood of an impact occurring

Recommended management action:

For each impact, the recommended practically attainable mitigation actions which would result in a measurable reduction of the impact, must be identified. This is expressed according to the following:

1 = no further investigation/action necessary

2 = controlled sampling and/or mapping of the site necessary

3 = preserve site if possible, otherwise extensive salvage excavation and/or mapping necessary

4 = preserve site at all costs

Legal requirements:

Identify and list the specific legislation and permit requirements which potentially could be infringed upon by the proposed project, if mitigation is necessary.

APPENDIX 3: RELEVANT LEGISLATION

All archaeological and palaeontological sites, and meteorites are protected by the National Heritage Resources Act (Act no 25 of 1999) as stated in Section 35:

(1) Subject to the provisions of section 8, the protection of archaeological and palaeontological sites and material and meteorites is the responsibility of a provincial heritage resources authority: Provided that the protection of any wreck in the territorial waters and the maritime cultural zone shall be the responsibility of SAHRA.

(2) Subject to the provisions of subsection (8)(a), all archaeological objects, palaeontological material and meteorites are the property of the State. The responsible heritage authority must, on behalf of the State, at its discretion ensure that such objects are lodged with a museum or other public institution that has a collection policy acceptable to the heritage resources authority and may in so doing establish such terms and conditions as it sees fit for the conservation of such objects.

(3) Any person who discovers archaeological or palaeontological objects or material or a meteorite in the course of development or agricultural activity must immediately report the find to the responsible heritage resources authority, or to the nearest local authority offices or museum, which must immediately notify such heritage resources authority.

(4) No person may, without a permit issued by the responsible heritage resources authority-

(a) destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site or any meteorite;

(b) destroy, damage, excavate, remove from its original position, collect or own any archaeological or palaeontological material or object or any meteorite;

(c) trade in, sell for private gain, export or attempt to export from the Republic any category of archaeological or palaeontological material or object, or any meteorite; or

(d) bring onto or use at an archaeological or palaeontological site any excavation equipment or any equipment which assist in the detection or recovery of metals or archaeological and palaeontological material or objects, or use such equipment for the recovery of meteorites.

In terms of cemeteries and graves the following (Section 36):

(1) Where it is not the responsibility of any other authority, SAHRA must conserve and generally care for burial grounds and graves protected in terms of this section, and it may make such arrangements for their conservation as it sees fit.

(2) SAHRA must identify and record the graves of victims of conflict and any other graves which it deems to be of cultural significance and may erect memorials associated with the grave referred to in subsection (1), and must maintain such memorials.

(3) No person may, without a permit issued by SAHRA or a provincial heritage resources authority-

(a) destroy, damage, alter, exhume or remove from its original position or otherwise disturb the grave of a victim of conflict, or any burial ground or part thereof which contains such graves;

(b) destroy, damage, alter, exhume, remove from its original position or otherwise disturb any grave or burial ground older than 60 years which is situated outside a formal cemetery administered by a local authority; or

(c) bring onto or use at a burial ground or grave referred to in paragraph (a) or (b) any excavation equipment, or any equipment which assists in the detection or recovery of metals.

(4) SAHRA or a provincial heritage resources authority may not issue a permit for the destruction or damage of any burial ground or grave referred to in subsection (3)(a) unless it is satisfied that the applicant has made satisfactory arrangements for the exhumation and re-interment of the contents of such graves, at the cost of the applicant and in accordance with any regulations made by the responsible heritage resources authority.

The National Heritage Resources Act (Act no 25 of 1999) stipulates the assessment criteria and grading of archaeological sites. The following categories are distinguished in Section 7 of the Act:

- **Grade I**: Heritage resources with qualities so exceptional that they are of special national significance;
- **Grade II**: Heritage resources which, although forming part of the national estate, can be considered to have special qualities which make them significant within the context of a province or a region; and
- **Grade III**: Other heritage resources worthy of conservation, and which prescribes heritage resources assessment criteria, consistent with the criteria set out in section 3(3), which must be used by a heritage resources authority or a local authority to assess the intrinsic, comparative and contextual significance of a heritage resource and the relative benefits and costs of its protection, so that the appropriate level of grading of the resource and the consequent responsibility for its management may be allocated in terms of section 8.

Presenting archaeological sites as part of tourism attraction requires, in terms 44 of the Act, a Conservation Management Plan as well as a permit from SAHRA.

(1) Heritage resources authorities and local authorities must, wherever appropriate, co-ordinate and promote the presentation and use of places of cultural significance and heritage resources which form part of the national estate and for which they are responsible in terms of section 5 for public enjoyment, education. research and tourism, including-

(a) the erection of explanatory plaques and interpretive facilities, including interpretive centres and visitor facilities;
(b) the training and provision of guides;
(c) the mounting of exhibitions;
(d) the erection of memorials; and
(e) any other means necessary for the effective presentation of the national estate.

(2) Where a heritage resource which is formally protected in terms of Part l of this Chapter is to be presented, the person wishing to undertake such presentation must, at least 60 days prior to the institution of interpretive measures or manufacture of associated material, consult with the heritage resources authority which is responsible for the protection of such heritage resource regarding the contents of interpretive material or programmes.

(3) A person may only erect a plaque or other permanent display or structure associated with such presentation in the vicinity of a place protected in terms of this Act in consultation with the heritage resources authority responsible for the protection of the place.

APPENDIX 4: RELOCATION OF GRAVES

If the graves are younger than 60 years, an undertaker can be contracted to deal with the exhumation and reburial. This will include public participation, organising cemeteries, coffins, etc. They need permits and have their own requirements that must be adhered to.

If the graves are older than 60 years old or of undetermined age, an archaeologist must be in attendance to assist with the exhumation and documentation of the graves. This is a requirement by law.

Once it has been decided to relocate particular graves, the following steps should be taken:

- Notices of the intention to relocate the graves need to be put up at the burial site for a period of 60 days. This should contain information where communities and family members can contact the developer/archaeologist/public-relations officer/undertaker. All information pertaining to the identification of the graves needs to be documented for the application of a SAHRA permit. The notices need to be in at least 3 languages, English, and two other languages. This is a requirement by law.
- Notices of the intention needs to be placed in at least two local newspapers and have the same information as the above point. This is a requirement by law.
- Local radio stations can also be used to try contact family members. This is not required by law, but is helpful in trying to contact family members.
- During this time (60 days) a suitable cemetery need to be identified close to the development area or otherwise one specified by the family of the deceased.
- An open day for family members should be arranged after the period of 60 days so that they can gather to discuss the way forward, and to sort out any problems. The developer needs to take the families requirements into account. This is a requirement by law.
- Once the 60 days has passed and all the information from the family members have been received, a permit can be requested from SAHRA. This is a requirement by law.
- Once the permit has been received, the graves may be exhumed and relocated.
- All headstones must be relocated with the graves as well as any items found in the grave.

Information needed for the SAHRA permit application

- The permit application needs to be done by an archaeologist.
- A map of the area where the graves have been located.
- A survey report of the area prepared by an archaeologist.
- All the information on the families that have identified graves.
- If graves have not been identified and there are no headstones to indicate the grave, these are then unknown graves and should be handled as if they are older than 60 years. This information also needs to be given to SAHRA.
- A letter from the landowner giving permission to the developer to exhume and relocate the graves.
- A letter from the new cemetery confirming that the graves will be reburied there.
- Details of the farm name and number, magisterial district and GPS coordinates of the gravesite.

APPENDIX 5: INVENTORY OF IDENTIFIED CULTURAL HERITAGE SITES

Stone Age factory site. Farm: Rosendal 673. Coordinates: c -27,01023; 24,73814 (west)
c -27,01142; 24,73696 (east)

Description

Stone tools were identified to occur on a low ridge to the east of the substation. It mostly dates to the Middle Stone Age, although some smaller ones might date to the Later Stone Age. Cores, tools and flakes (debitage) were identified, indicating that the tools were manufactured on site. The material used was mostly chert, although some quartzite was also identified. The density of the stone tool scatter seems to quite consistent over the whole ridge, averaging at approximately 2 pieces per $2m^2$.

The tools are very informal, and it was difficult to establish specific tool types – most can probably be described as scrapers, with side scrapers forming a significant number. Importantly, the types of tools and material used, as well as the surface density seems to be consistent across the whole area.

 Ridge: eastern side	 Stone tools: eastern section of ridge
 Ridge: western side	 Stone tools: western section of ridge

Significance of sites/features:	Generally protected Grade 4C: Low significance - Requires no further recording before destruction

Reasoned opinion:
Two reasons are presented for the low grading of this site:

The material, located on the ground surface, are not in an original context and therefore have low significance. In addition, the material is spread over quite a large area, with the conclusion that sufficient of the material will be retained when the power line is constructed across a small section of it.

Secondly, the impacts of a 132kV powerline on heritage resources are generally low. The size of the pylon base is very small, and generally no roads are bulldozed for maintenance of the line.

Impact assessment
It is anticipated that the impact of the construction of the power line across the ridge will only present a small footprint on a large site Furthermore, it is also possible to shift the power line more to the north, thereby by-passing the ridge completely.

Mitigation
1 = no further investigation/action necessary

Significance of impact: before/after mitigation					
Extent	**Duration**	**Intensity**	**Probability**	**Significance**	**Weight**
2	4	2	3	24	Low
1	1	2	2	8	Low

Requirements
None

References
-

Burial site. Farm: Rosendal 673. Coordinates: c -27,00901; 24,74625

Description

Originally some graves (c. 6) occurred in this area. They were very old and only marked with low stone cairns. As they were located next to the laydown area for the construction of the substation, they were fenced off. They could not be located during the current site visit (possibly due to incorrect coordinates). It is also possible that they were relocated during the construction activities.

Google Earth 2018

Google Earth: 2013

Significance of site/feature	Generally protected: High significance – Grade IV-A
Reasoned opinion: Burial sites are viewed as having high emotional and sentimental value. However, mitigation is possible if proper procedures have been followed.	

Impact assessment

This feature would be located on the eastern edge of the identified 300m buffer section. It is also at an angle of 90° away from the access point of the proposed transmission line to the substation. It is therefore anticipated that the possibility of an impact of the construction of the power line on this area is very low.

Mitigation

1 = no further investigation/action necessary

Significance of impact: before/after mitigation

Extent	Duration	Intensity	Probability	Significance	Weight
1	1	1	1	3	Low
1	1	1	1	3	Low

Requirements

Conservation by local authority. Sites should be mitigated before impact. Permit required from provincial heritage authority, as well as other institutions – see Section 4 of the Addendum.

References

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APPENDIX 6: CURRICULUM VITAE

Johan Abraham van Schalkwyk

Personal particulars

Date of birth:	14 April 1952
Identity number:	520414 5099 08 4
Marital status:	Married; one daughter
Nationality:	South African

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Qualifications

1995 DLitt et Phil (Anthropology), University of South Africa
1985 MA (Anthropology), University of Pretoria
1981 BA (Hons), Anthropology, University of Pretoria
1979 Post Graduate Diploma in Museology, University of Pretoria
1978 BA (Hons), Archaeology, University of Pretoria
1976 BA, University of Pretoria

Non-academic qualifications

12th HSRC-School in Research Methodology - July 1990
Dept. of Education and Training Management Course - June 1992
Social Assessment Professional Development Course - 1994
Integrated Environmental Management Course, UCT - 1994

Professional experience

Private Practice
2017 - current: Professional Heritage Consultant

National Museum of Cultural History
1992 - 2017: Senior researcher: Head of Department of Research. Manage an average of seven researchers in this department and supervise them in their research projects. Did various projects relating to Anthropology and Archaeology in Limpopo Province, Mpumalanga, North West Province and Gauteng. Headed the Museum's Section for Heritage Impact Assessments.
1978 - 1991: Curator of the Anthropological Department of the Museum. Carried out extensive fieldwork in both anthropology and archaeology

Department of Archaeology, University of Pretoria
1976 - 1977: Assistant researcher responsible for excavations at various sites in Limpopo Province and Mpumalanga.

Awards and grants

1. Hanisch Book Prize for the best final year Archaeology student, University of Pretoria - 1976.
2. Special merit award, National Cultural History Museum - 1986.
3. Special merit award, National Cultural History Museum - 1991.
4. Grant by the Department of Arts, Culture, Science and Technology, to visit the various African countries to study museums, sites and cultural programmes - 1993.
5. Grant by the USA National Parks Service, to visit the United States of America to study museums, sites, tourism development, cultural programmes and impact assessment programmes - 1998.
6. Grant by the USA embassy, Pretoria, under the Bi-national Commission Exchange Support Fund, to visit cultural institutions in the USA and to attend a conference in Charleston - 2000.

7. Grant by the National Research Foundation to develop a model for community-based tourism - 2001.
8. Grant by the National Research Foundation to develop a model for community-based tourism - 2013. In association with RARI, Wits University.

Publications
Published more than 70 papers, mostly in scientifically accredited journals, but also as chapters in books.

Conference Contributions
Regularly present papers at conferences, locally as well as internationally, on various research topics, ranging in scope from archaeology, anthropological, history, cultural historical and tourism development.

Heritage Impact Assessments
Since 1992, I have done more than 2000 Phase 1 and Phase 2 impact assessments (archaeological, anthropological, historical and social) for various government departments and developers. Projects include environmental management frameworks, roads, pipeline-, and power line developments, dams, mining, water purification works, historical landscapes, refuse dumps and urban developments.

Palaeontological Impact Assessment for the proposed construction of three Solar Photovoltaic (PV) Facilities (i.e. Vryburg Solar 1, Vryburg Solar 2 and Vryburg Solar 3) and associated electrical infrastructure, near Vryburg, in the North-West Province

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24 July 2018

SPECIALIST EXPERTISE

Dr Francois Durand is a palaeontologist and environmentalist and teaches at the University of Johannesburg. He specialises in the origin and evolution of mammals, early dinosaurs and cave fauna. He established cave and groundwater ecology research in South Africa and also does research on acid mine drainage in Gauteng.
He holds a PhD in Palaeontology and is a member of the Palaeontological Society of Southern Africa.

CV: DR. FRANCOIS DURAND

ACADEMIC CAREER:
BSc Botany & Zoology (Rand Afrikaans University: 1983)
BSc (Hons) Zoology (University of the Witwatersrand: 1984)
PhD Palaeontology (University of the Witwatersrand: 1990)
Post-graduate Diploma in Museology (University of Pretoria: 1993)
Higher Education Diploma (Rand Afrikaans University: 2001)

AFFILIATION TO PROFESSIONAL SOCIETIES AND BODIES:
Member of Research Committee of the Cancer Association of South Africa (2010-2011)
Member of the Suid-Afrikaanse Akademie vir Wetenskap en Kuns (1998-present)
Appointed by the Minister of the Department of Arts, Culture, Science and Technology to serve on the board of the Foundation for Education, Science & Technology (1996-1999)
Registered Professional Natural Scientist (Earth Science & Zoological Science) with the South African Council for Natural Scientific Professions
Palaeontological Society of Southern Africa (1986-present)

CAREER:
1988-1997: Palaeontologist at the Council for Geosciences.
1998-2004: Lecturer at the Rand Afrikaans University in the Zoology Department.
2005-Present: Senior Lecturer at the University of Johannesburg in the Zoology Department.

EXPERIENCE:
- Urban development in Cradle of Humankind World Heritage Site (Gauteng): Letamo, Honingklip, Windgat, Sundowners, Ekutheni
- Urban development at Goose Bay, Vereeniging, Gauteng
- Urban development on the farm Waterkloof, Rustenburg, North West Province
- Upgrade of R21 between N12 and Hans Strydom Drive, Gauteng
- Vele Colliery, Limpopo Province
- De Wildt 50 MW Solar Power Station, Gauteng
- 10 MW PV Plant Potchefstroom, North West Province
- Omega 342 50MW Solar Power Station, Viljoenskroon, Free State
- Springfontein wind and solar energy facility, Free State
- Solar power plant, Bethal, Mpumalanga
- Diamond mine on Endora, Limpopo Province
- Development at Tubatse Ext.15, Limpopo Province
- Manganese mine south of Hotazel, Northern Cape
- Wind energy facility at Cookhouse, Eastern Cape

- Energy facility at Noupoort, Northern Cape
- Fluorspar mine near Wallmannsthal, Gauteng
- ESKOM power line, Dumo, KwaZulu-Natal
- ESKOM Gamma-Omega 765KV transmission line, Western Cape
- ESKOM 44KV power line at Elandspruit near Middelburg, Mpumalanga
- ESKOM Makopane Substation, Limpopo Province
- ESKOM Platreef Substation and power lines to Borutho MTS Substation, Limpopo
- Solar energy facility at Prieska, Northen Cape.
- Marang B - a 3 x 500MVA 400/132kV Main Transmission Substation east of Rustenburg, North West Province
- Upgrading of storm water infrastructure in Valencia, Addo, Eastern Cape
- Development of a 10 MW Solar Energy facility on the Farm Liverpool 543 KQ Portion 2 at Koedoeskop, Limpopo Province
- Development of a fluorspar mine at Wallmannsthal, North of Pretoria
- Extension of limestone mine on the farms Buffelskraal 554 KQ Portion1 and Krokodilkraal 545 KQ, Limpopo Province
- Lesego Platinum Mine, Sekhukhune Area, Steelpoort, Limpopo Province
- Mine at Hotazel, Northern Cape
- Pollution control dams at Transalloys in Clewer, Emalahleni, Mpumalanga
- Erection of spill points on the Farm Kwikstaart 431 KQ Portion 2, Thabazimbi, Limpopo Province
- Construction of dam at Ethemba, Swaziland
- Construction of bridge at Busingatha, KwaZulu Natal
- Water Reticulation System - Kei Road and Berlin General, Eastern Cape
- Development at Kromdraai, COHWHS (Portion 26 of the Farm Kromdraai, West Rand Municipality)
- Construction of Nhlezi Bridge, KwaZulu Natal
- Erection of spill point and dam on the Farm Faure 72 KQ Portion 8, Makoppa near Thabazimbi, Limpopo Province
- Colliery on the Farm Goedehoop near Piet Retief, Mpumalanga
- Erection of spill points on the Farm Diepwater 302 KQ Portions 4 -8 near Thabazimbi, Limpopo Province
- Construction of 2 MW photovoltaic power plant on the farm De Hoek 32, Pixley ka Seme District Municipality, Northern Cape Province
- Road upgrade near Magogo, KwaZulu/Natal
- Construction of haul road & waste dump: Lylyveld, Sishen, Northern Cape
- Construction of 4 weirs and a road culvert on Portion 3 of the Farm Roodekrans 133JT, Dullstroom Area, Mpumalanga
- Construction of a solar energy facility on Blaubospan, Groblershoop, Northern Cape
- Construction of road from Macengeni to Macijo, KwaZulu/Natal
- Construction of the John Taole Gaetsewe school and hostels in Dithakgong, Northern Cape
- Development at Duduza Township, Gauteng
- Construction of roads near Ndanyana KwaZulu/Natal
- Development of colliery on the farm Goedehoop near Piet Retief, Mpumalanga
- Construction of Tiger Solar power plant near Windsorton, Northern Cape
- Development of Amandelbult Open Cast Mine near Thabazimbi, Limpopo
- Development at The Shed in the Cradle of Humankind World Heritage Site
- Development of 800 ha dry lands on Farm Hoylesdale 163 KQ portion 1, Makoppa, Thabazimbi Local municipality, Limpopo Province
- Construction of solar energy facility on Blauwpospan near Groblershoop, NC.

- Development of the Doornhoek Fluorspar Mine near Zeerust, Northwest.
- Development on the Farm Haakdoringdrift, 373 KQ Portion 3, Thabazimbi, Limpopo.
- Development of bulk sewer line, Motherwell, Eastern Cape.
- Erection of spill points on the Farm De Hoop, near Thabazimbi, Limpopo Province.
- Development of orchards on the Farm Kromdraai, near Thabazimbi, Limpopo.
- Upgrade of Section 3 and Section 4 of the National Route R75, Eastern Cape.
- Construction of Concentrated Power Plants at Olyvenhout Drift, Upington, NC.
- Borrow pit at New Payne in Mthatha, Eastern Cape.
- Borrow pit for rural road to Centuli Clinic, Eastern Cape.
- Juno Gromis 400kV power line (West Cape and North Cape).
- Barberton IAPS Waste Water Treatment Works, Barberton, Mpumalanga.
- Development of orchards on the Farm Kromdraai, Thabazimbi, Limpopo Province.
- Erection of spill points on the farm Knoppieskop, Limpopo Province.
- Development at O.R. Tambo International Airport, Gauteng.
- Development on Portion 12 of the Farm Tregaron, Sundays River Municipality, EC.
- Development of spill points and dam on the Farm Fairfield 306 KQ, Makoppa near Thabazimbi, Limpopo Province.
- Development at Erasmus Park (Waterkloof 378 JR), Pretoria, Gauteng.
- Development of shopping centre at Wright Park, Gauteng.
- Mining development on Thorncliffe and Helena Farms near Steelpoort, Sekhukhune District Municipality, Limpopo Province.
- Urban development at Pienaarspoort, Tshwane, Gauteng.
- Lydenburg-Merensky 132 kV Power Line within the Sekhukhune (Ward 31) and the Ehlanzeni (Wards 1, 5, 13) District Municipalities in the Limpopo and Mpumalanga Provinces.
- Mahikeng Main Transmission Substation and a 400kV Pluto-Mahikeng powerline, North West Province

Palaeontological research:
- Gauteng: Wonder Cave
- KwaZulu/Natal: Newcastle, Mooi River, Rosetta, Impendle, Himeville Underberg, Polela & Howick Districts, Sani Pass
- Eastern Cape: Cradock District, Algoa Basin
- Western Cape: Clanwilliam District
- Free State: Memel & Warden Districts
- Limpopo Province: Nyalaland (KNP), Vhembe Reserve, Pont Drift
- Zimbabwe: Sentinel Ranch, Nottingham

SPECIALIST DECLARATION

I, Jacobus Francois Durand as the appointed independent specialist, in terms of the 2014 EIA Regulations (as amended), hereby declare that I:

- I act as the independent specialist in this application;
- I 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;
- regard the information contained in this report as it relates to my specialist input/study to be true and correct, and do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 (as amended) and any specific environmental management Act;
- 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 have no vested interest in the proposed activity proceeding;
- 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;
- I have ensured that information containing all relevant facts in respect of the specialist input/study was distributed or made available to interested and affected parties and the public and that participation by interested and affected parties was facilitated in such a manner that all interested and affected parties were provided with a reasonable opportunity to participate and to provide comments on the specialist input/study;
- I have ensured that the comments of all interested and affected parties on the specialist input/study were considered, recorded and submitted to the competent authority in respect of the application;
- all the particulars furnished by me in this specialist input/study 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.

Name of Specialist: Jacobus Francois Durand

Signature of the specialist: ______________________

Date: 24 July 2018

EXECUTIVE SUMMARY

The proposed development of the Vryburg Solar 1, Vryburg Solar 2 and Vryburg Solar 3 photovoltaic facility will take place in an area which is considered to have mostly a High Palaeontological Sensitivity for the PV facility sites, and areas of Medium, High and Very High Palaeontological Sensitivity within the corridor for the distribution power lines.

The central and western sections of the proposed Power Corridor fall in the Very High Palaeontological Sensitivity category due to the probability of finding stromatolites in this region. Even though no distinct outcrops of stromatolites were found during the field assessment, the chances of exposing stromatolites during construction are good and for this reason a Chance Find Procedure has been included in the Recommendations. Even though it is not essential to salvage every piece of stromatolite exposed because of its ubiquitous distribution in the dolomites of South Africa, it will be prudent not to destroy a major stromatolite find for scientific and heritage reasons.

The areas where the proposed Solar 1, 2 and 3 PV panels are to be installed fall in the High Palaeontological Sensitivity category because of the underlying Tertiary calcrete and Quaternary alluvium, sand and soils. The Chance Find Procedure should be followed if fossils are uncovered during construction in this section.

The eastern sections of the Power Corridor are situated on rocks with a Medium Palaeontological Sensitivity. The chances of finding fossils in the High to Medium Sensitivity sections are low however and the protocol that should be followed in the unlikely case of the discovery of fossils in this section is covered in the Chance Find Procedure.

CONTENTS

LIST OF FIGURES

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LIST OF ABBREVIATIONS

SAHRA: South African Heritage Resources Agency

Glossary

Definitions	
Fossiliferous	Rocks that contain fossils or which is particularly fossil-rich.
Stromatolite	Sedimentary structure which was formed by cyanobacteria that are approximately 2.2 Ga old in South Africa.

COMPLIANCE WITH THE APPENDIX 6 OF THE 2014 EIA REGULATIONS (AS AMENDED)

Requirements of Appendix 6 – GN R982	Addressed in the Specialist Report
1. (1) A specialist report prepared in terms of these Regulations must contain- a) 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;	Page 2 - 5
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Page 5
c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 1.1 Page 12
(cA) an indication of the quality and age of base data used for the specialist report;	Page 45-46
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Page 35-42
d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Page 16
e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Page 16
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;	Page 22-34
g) an identification of any areas to be avoided, including buffers;	Page 20, 44
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;	Page 20
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Page 17
j) a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Page 44
k) any mitigation measures for inclusion in the EMPr;	Page 45
l) any conditions for inclusion in the environmental authorisation;	Page 45
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Page 45
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;	Page 44-45
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	Page 22-34
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	
q) any other information requested by the competent authority.	
(2) Where a government notice 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.	Page 14-15

PALAEONTOLOGICAL IMPACT ASSESSMENT FOR THE PROPOSED CONSTRUCTION OF THREE SOLAR PHOTOVOLTAIC (PV) FACILITIES (I.E. VRYBURG SOLAR 1, VRYBURG SOLAR 2 AND VRYBURG SOLAR 3) AND ASSOCIATED ELECTRICAL INFRASTRUCTURE, NEAR VRYBURG, IN THE NORTH-WEST PROVINCE

This report presents the Palaeontological Impact Assessment that was prepared by Dr JF Durand as part of the Basic Assessment (BA) Process for the proposed construction of the Vryburg Solar Photovoltaic Facilities, in the North-West Province.

1. INTRODUCTION AND METHODOLOGY

The palaeontological heritage of South Africa is unsurpassed and can only be described in superlatives. The South African palaeontological record gives us insight in i.e. the origin of life, dinosaurs and humans. Fossils are also used to identify rock strata and determine the geological context of the geological formations and the chronostratigraphy of Southern Africa.

Some of the oldest evidence of life on Earth came from the rocks at Barberton which contain fossilized bacteria. Stromatolites in the dolomitic regions in South Africa were formed by shallow marine mats of cyanobacteria. The cyanobacteria, which were some of the first photosynthesising organisms, provided most of the oxygen in our atmosphere.

The National Heritage Resources Act (No. 25 of 1999) of South Africa stipulates that fossils and fossil sites may not be altered or destroyed. The purpose of the Field Assessment and this report are to detail the probability of finding fossils in the study area which may be impacted by the proposed development.

The sensitive palaeontological nature of the Study Area as determined by SAHRA necessitated a site visit to assess the potential palaeontological concerns that will arise during development.

1.1 Scope, Purpose and Objectives of this Specialist Report

The Field Assessment of the farms Frankfort, Retreat and Rosendal was done to assess the palaeontological nature of the areas demarcated for development.

The sites demarcated for the Solar 1 (Frankfort Farm 672 Portion 1), Solar 2 and Solar 3 (Retreat Farm 671 Portion 1) PV installations are in areas considered to be of High Palaeontological Sensitivity. The proposed Power Corridor is situated in areas that are considered to range from Very High Palaeontological Sensitivity to Medium Palaeontological Sensitivity.

This study serves to look at these potential impacts associated with the development proposed on study site and propose a mitigation protocol for the fossiliferous sites within the study area which would be impacted on by development.

1.2 Terms of Reference

- Review detailed information relating to the project description and precisely define the environmental risks to the palaeontology and fossil heritage, and consequences thereto.
- Conduct a review of available information pertaining to the study area.

- Draw on desktop information sources, the knowledge of local experts, information published in the scientific press and information derived from relevant EIAs and similar specialist studies previously conducted within the surrounding area.
- Prepare and undertake a desktop study on the palaeontology and fossil heritage within the proposed project area, based on:
    - a review of all relevant palaeontological and geological literature, including geological maps and previous reports;
    - location and examination of fossil collections from the study area (e.g. museums); and
    - data on the proposed development (e.g. location of footprint, depth and volume of bedrock excavation envisaged).
- Undertake a detailed field examination (i.e. fieldwork) of the palaeontological features within the development area.
- Describe the type and location of known palaeontology and fossil heritage sites in the study area, and characterize all items that may be affected by the proposed project.
- Describe the baseline environment and determine the status quo in relation to the specialist study.
- Note fossils and associated sedimentological features of palaeontological relevance (photos, maps, satellite images).
- Evaluate the potential for occurrence of palaeontology and heritage features within the study area.
- Incorporate relevant information from other specialist reports/findings if required.
- Identify and rate potential direct, indirect and cumulative impacts of the proposed project on the palaeontology and fossil heritage during the construction, operational and decommissioning phases of the project. Study the cumulative impacts of the project by considering the impacts of existing industries/solar PV plants within the area (as well as those PV plants that are proposed), together with the impact of the proposed project.
- Assessment of alternatives. Provide specialist input relating to the layout, design and the associated infrastructure in terms of impacts on the surrounding environment in relation to palaeontology and fossil heritage.
- Identify and rank the highlights and sensitivities to development of fossil heritage within study area.
- Provide recommendations and suggestions regarding fossil heritage management on site, including conservation measures, as well as promotion of local fossil heritage (e.g. for public education, schools) to ensure that the impacts are limited.
- Provide input to the EMPr, including mitigation and monitoring requirements to ensure that the impacts on the archaeological features and heritage features are limited.
- Provide specific recommendations for further palaeontological mitigation (if any).
- Compile an assessment report, for inclusion in the “Draft” and “Final” Basic Assessment Reports. Three final specialist reports must be completed (i.e. one for each Solar PV Facility, namely PV 1, PV 2 and PV 3). The specialist reports must comply with the requirements of the amended 2014 EIA Regulations (Appendix 6).
- Provide input to the Basic Assessment Report National DEA Template.
- Address all review comments made by the CSIR and the client.
- Address all comments raised by organs of state, interested and affected parties and the public (during the entire Public Participation Process), in relation to the specialist study. If necessary, an amended report must be submitted to the CSIR.
- Liaise with the relevant authority in order to obtain a letter of approval, comments or a Permit in terms of National Heritage Resources Act.
- Load the relevant documents on the South African Heritage Resources Information System (SAHRIS).

The study area is used for cattle farming. Few rocky outcrops occur in this relatively flat area which is covered with natural grass and bush.

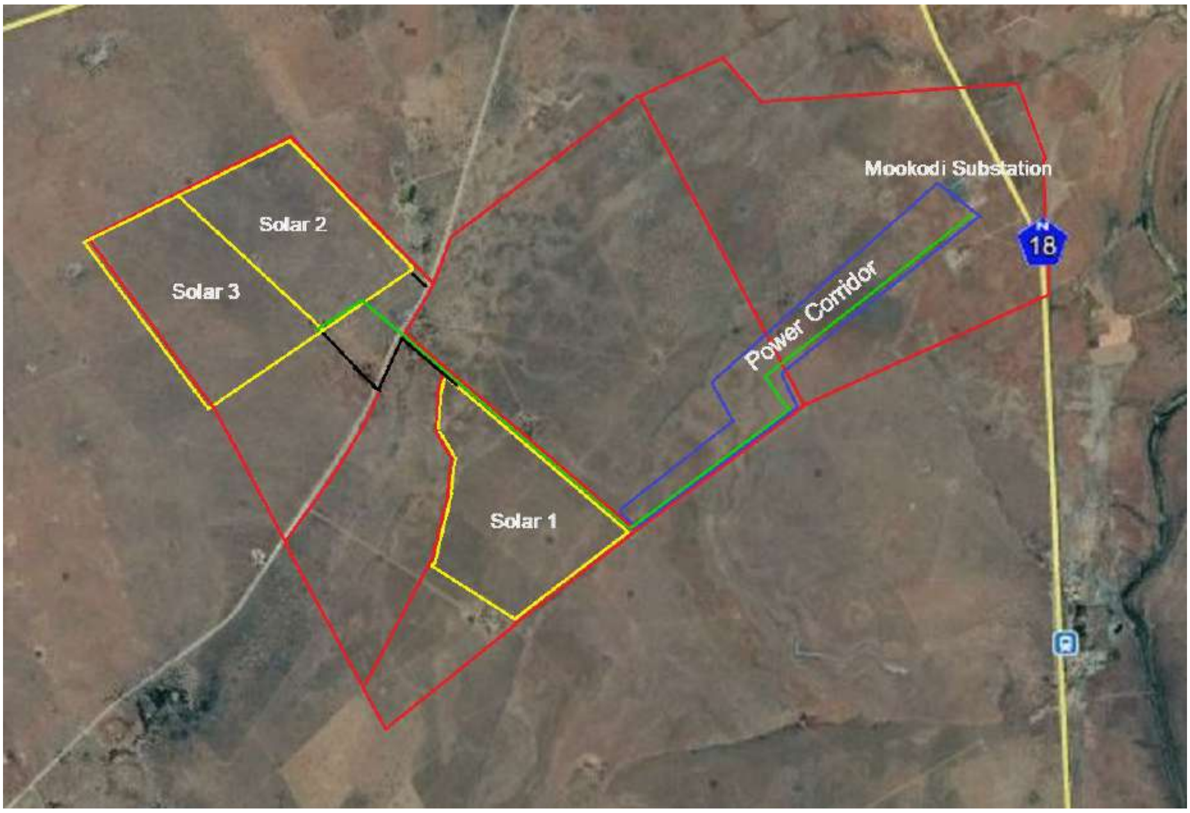


Figure 1: Google Earth photo indicating the study area

Relevant legislation and legal requirements:

According to the South African Heritage Resources Act (Act 25 of 1999) (Republic of South Africa, 1999), certain clauses are relevant to palaeontological aspects for a terrain suitability assessment.

- **Subsection 35(4)** No person may, without a permit issued by the responsible heritage resources authority-
- (a) destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site or any meteorite;
- (b) destroy, damage, excavate, remove from its original position, collect or own any archaeological or palaeontological material or object or any meteorite;
- (c) trade in, sell for private gain, export or attempt to export from the republic any category of archaeological or palaeontological material or object, or any meteorite; or
- (d) bring onto or use at an archaeological or palaeontological site any excavation equipment or any equipment which assist with the detection or recovery of metals or archaeological material or objects, or use such equipment for the recovery of meteorites.
- **Subsection 35(5)** When the responsible heritage resources authority has reasonable cause to believe that any activity or development which will destroy, damage or alter any archaeological or palaeontological site is under way, and where no application for a permit has been submitted and no heritage resources management procedures in terms of section 38 has been followed, it may-
- (a) serve on the owner or occupier of the site or on the person undertaking such development an order for the development to cease immediately for such period as is specified in the order;
- (b) carry out an investigation for the purpose of obtaining information on whether or not an archaeological or palaeontological site exists and whether mitigation is necessary;

- (c) if mitigation is deemed by the heritage resources authority to be necessary, assist the person on whom the order has been served under paragraph (a) to apply for a permit as required in subsection (4); and
- (d) recover the costs of such investigation form the owner or occupier of the land on which it is believed an archaeological or palaeontological site is located or from the person proposing to undertake the development if no application for a permit is received within two weeks of the order being served.

South Africa's unique and non-renewable palaeontological heritage is protected in terms of the NHRA. According to this act, heritage resources may not be excavated, damaged, destroyed or otherwise impacted by any development without prior assessment and without a permit from the relevant heritage resources authority.

As areas are developed and landscapes are modified, heritage resources, including palaeontological resources, are threatened. As such, both the environmental and heritage legislation require that development activities must be preceded by an assessment of the impact undertaken by qualified professionals. Palaeontological Impact Assessments (PIAs) are specialist reports that form part of the wider heritage component of:

- Heritage Impact Assessments (HIAs) called for in terms of Section 38 of the National Heritage Resources Act, Act No. 25, 1999 by a heritage resources authority.
- Environmental Impact Assessment process as required in terms of other legislation listed in s. 38(8) of NHRA;
- Environmental Management Plans (EMPs) required by the Department of Mineral Resources.

HIAs are intended to ensure that all heritage resources are protected, and where it is not possible to preserve them in situ, appropriate mitigation measures are applied. An HIA is a comprehensive study that comprises a palaeontological, archaeological, built environment, living heritage, etc specialist studies. Palaeontologists must acknowledge this and ensure that they collaborate with other heritage practitioners. Where palaeontologists are engaged for the entire HIA, they must refer heritage components for which they do not have expertise on to appropriate specialists. Where they are engaged specifically for the palaeontology, they must draw the attention of environmental consultants and developers to the need for assessment of other aspects of heritage. In this sense, Palaeontological Impact Assessments that are part of Heritage Impact Assessments are similar to specialist reports that form part of the EIA reports.
The standards and procedures discussed here are therefore meant to guide the conduct of PIAs and specialists undertaking such studies must adhere to them.
The process of assessment for the palaeontological (PIA) specialist components of heritage impact assessments, involves:

Scoping stage in line with regulation 28 of the National Environmental Management Act (No. 107 of 1998) Regulations on Environmental Impact Assessment. This involves an **initial assessment** where the specialist evaluates the scope of the project (based, for example, on NID/BIDs) and advises on the form and extent of the assessment process. At this stage the palaeontologist may also decide to compile a **Letter of Recommendation for Exemption from further Palaeontological Studies**. This letter will state that there is little or no likelihood that any significant fossil resources will be impacted by the development. This letter should present a reasoned case for exemption, supported by consultation of the relevant geological maps and key literature.

A **Palaeontological Desktop Study** – the palaeontologist will investigate available resources (geological maps, scientific literature, previous impact assessment reports, institutional fossil collections, satellite images or aerial photos , etc) to inform an assessment of fossil heritage and/or exposure of potentially fossiliferous rocks within the study area. A Desktop studies will conclude whether a further field assessment is warranted or not. Where further studies are required, the desktop study would normally be an integral part of a field assessment of relevant palaeontological resources.

A **Phase 1 Palaeontological Impact Assessment** is generally warranted where rock units of high palaeontological sensitivity are concerned, levels of bedrock exposure within the study area are adequate; large-scale projects with high potential heritage impact are planned; and where the distribution and nature of fossil remains in the proposed project area is unknown. In the recommendations of Phase 1, the specialist will inform whether further monitoring and mitigation are necessary. The Phase 1 should identify the rock units and significant fossil heritage resources present, or by inference likely to be present, within the study area, assess the palaeontological significance of these rock units, fossil sites or other fossil heritage, comment on the impact of the development on palaeontological heritage resources and make recommendations for their mitigation or conservation, or for any further specialist studies that are required in order to adequately assess the nature, distribution and conservation value of palaeontological resources within the study area.

A **Phase 2 Palaeontological Mitigation** involves planning the protection of significant fossil sites, rock units or other palaeontological resources and/or the recording and sampling of fossil heritage that might be lost during development, together with pertinent geological data. The mitigation may take place before and / or during the construction phase of development. The specialist will require a Phase 2 mitigation permit from the relevant Heritage Resources Authority before Phase 2 may be implemented.

A **'Phase 3' Palaeontological Site Conservation and Management Plan** may be required in cases where the site is so important that development will not be allowed, or where development is to co-exist with the resource. Developers may be required to enhance the value of the sites retained on their properties with appropriate interpretive material or displays as a way of promoting access of such resources to the public.

The assessment reports will be assessed by the relevant heritage resources authority, and depending on which piece of legislation triggered the study, a response will be given in the form of a Review Comment or Record of Decision (ROD). In the case of PIAs that are part of EIAs or EMPs, the heritage resources authority will issue a comment or a record of decision that may be forwarded to the consultant or developer, relevant government department or heritage practitioner and where feasible to all three.

1.3 Assessment Details

Type of Specialist Investigation	Palaeontological Impact Assessment
Date and Duration of Specialist Site Investigation	14 July 2018
Season	Winter
Relevance of Season	N/a

2. APPROACH AND METHODOLOGY

The site was visited and the relevant literature and geological maps for the region in which the development is proposed to take place, have been studied for a Palaeontological Impact Assessment.

The area in which the development is proposed to take place has been walked through in search of fossiliferous bedrock. A geological hammer was used to expose fresh rock in places.

2.1 Information Sources

The information that was used to prepare for the field assessment and the writing of the report includes the 1:250 000 geological maps: 2724 Christiana and 2624 Vryburg.

Descriptions of fossils in Tertiary calcretes are published in: Almond, J.E. & Pether, J. (2008) Palaeontological heritage of the Northern Cape. Interim SAHRA technical report, 124 pp.

A previous study (Almond, J.E. (2013) Palaeontological Heritage Assessment for the proposed PV Solar Facility on a portion of the farm Waterloo 992 near Vryburg, Naledi Local Municipality, North-West Province, SAHRA.) done on the neighbouring farm was consulted.

Descriptions of the regional geology were found in: Eriksson et al., 2009; Keyser & Du Plessis, 1993 and Schutte, 1994.

Descriptions of stromatolites in the vicinity of the study area were found in Almond, 2013; Keyser & Du Plessis, 2008 and Smit *et al*.,1991.

A Google Earth map with polygons of the proposed development was received from the CSIR.

The Palaeosensitivity Map was captured from the SAHRIS website.

2.2 Assumptions, Knowledge Gaps and Limitations

Palaeontological studies had been done on Retreat and Rosendal and the neighbouring farms Edinburgh to the south, Klondike to the north and Waterloo to the southeast of the study area previously. Although soil, sand and vegetation covered most of the bedrock in the study area, the geology of the area is well known and the geological formations described will be exposed once clearing of the area commences.

2.3 Consultation Processes Undertaken

The Palaeontological Impact Assessment (PIA) is undertaken as part of the Basic Assessment (BA) Process for the proposed Vryburg Solar projects. The BA process includes a public participation process (PPP), therefore no dedicated consultation was undertaken as part of the PIA. Interested and affected parties would have the opportunity to provide comment on the palaeontological aspects of the project during the PPP.

3. DESCRIPTION OF PROJECT ASPECTS RELEVANT TO PALAEONTOLOGICAL IMPACTS

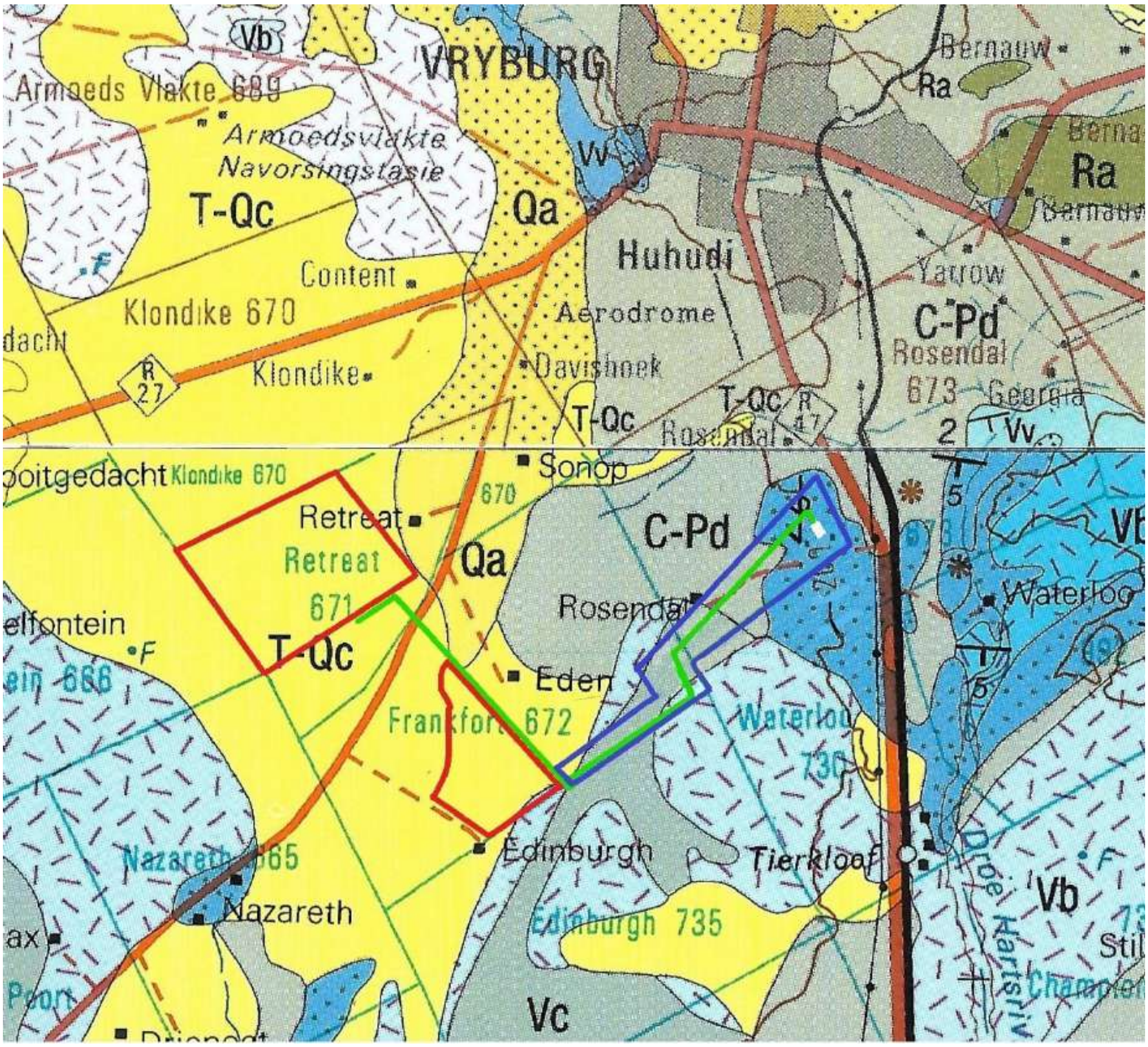
The key aspects of the Solar PV project that are relevant to palaeontological impacts are:

- Excavations on the Solar PV sites for foundations for the panel arrays, burying of 33 kV lines (to 1 m depth maximum), building foundations and shallowly buried services could affect fossil-bearing rock formations.
- Excavations in the Distribution line corridor for foundations for pylons could affect fossil-bearing rock formations.
- Clearing, levelling and scraping of the surface could affect underlying fossil-bearing rock formations.

4. DESCRIPTION OF THE RECEIVING ENVIRONMENT

4.1 Baseline Environmental Description

The study area is used for cattle farming. Few rocky outcrops occur in this relatively flat area which is covered with natural grass and bush.



<u>Figure 2: Geological Map of the study area and surroundings.</u>
Adapted from the 2624 VRYBURG and 2724 CHRISTIANA 1:250 000 Geology Maps
(Geological Survey, 1993; 1994)

LEGEND:

The study area is indicated with the green lines and blue and red polygons

	Lithology	Stratigraphy				Age
Qa	River terrace gravel.					Quaternary
T-Qc	Calcrete					Tertiary
C-Pd	Tillite, mudstone, shale, boulder shale and sandstone.	Dwyka Group			Karoo Supergroup	Carboniferous
Vc	Shale, siltstone with interbedded dolomite.	Clearwater Formation	Schmidts-drif Subgroup	Ghaap Group	Griqualand West Supergroup	Vaalian
Vb	Oolitic and stromatolitic dolomite, interbedded quartzite, shale and flagstone.	Boomplaas Formation				
Vv	Quartzite, flagstone, conglomerate, dolomite and shale. Andesitic lava.	Vryburg Formation				
Ra	Tholeiitic and calc-alkaline basalt and tuff.	Allanridge Formation			Ventersdorp Supergroup	Randium

The rocks on the eastern side of the study area resort under the Vryburg Formation which consists of quartzite, flagstone, conglomerate, dolomite, and andesitic lava (Keyser & Du Pessis, 1993; Schutte, 1994). Tabular-bedded, horizontally laminated quartzites of the lower Vryburg Formation are exposed at Site 8 (see Fig. 8). The lavas of this geological unit have been dated to 2.64 Ga (Eriksson et al., 2009)

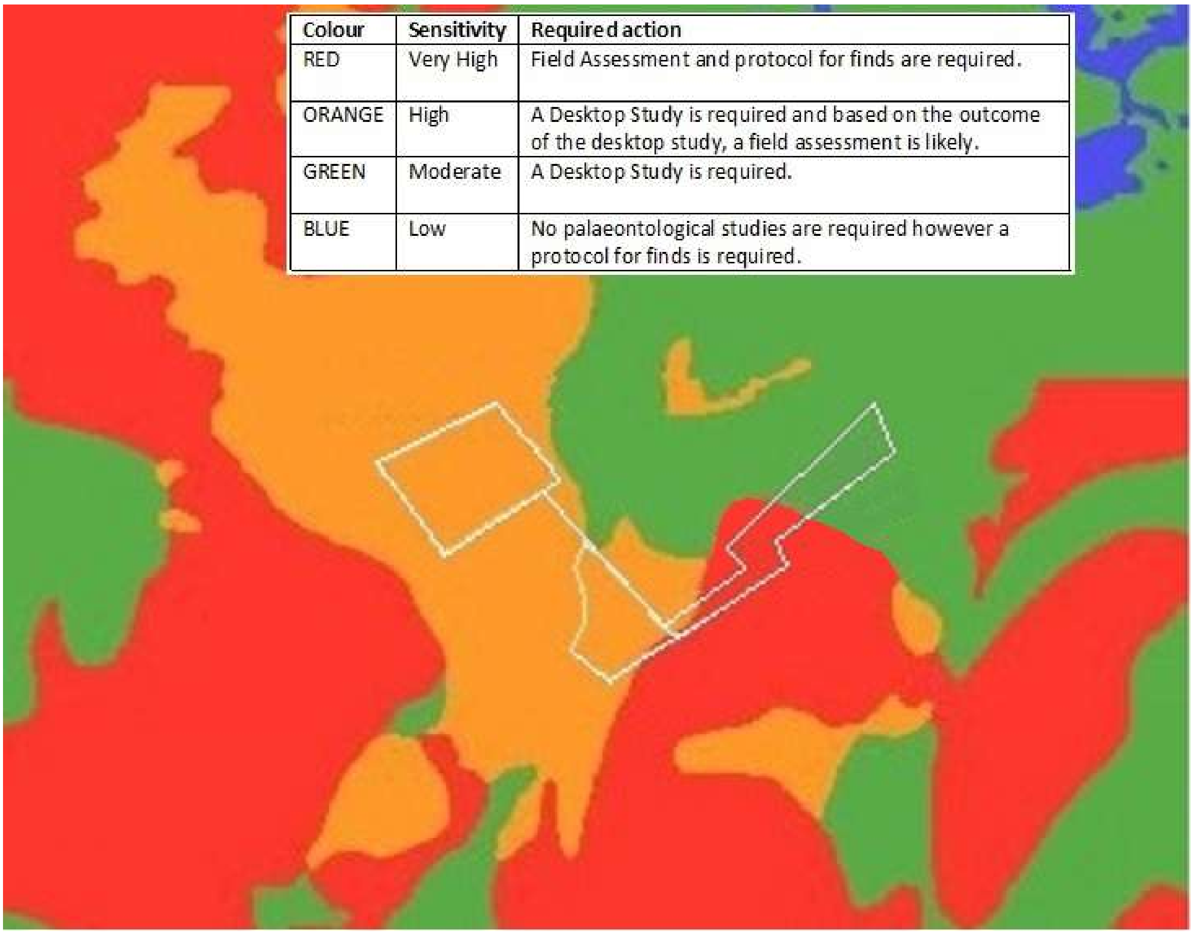
The eastern section of the study area is underlain by rocks of the Ghaap Group of the Griqualand West Supergroup. This geological unit forms the most basal part of the Late Archaean to Early Proterozoic Griqualand West Supergroup. The rock strata of the Ghaap Group in this section of the study area are subdivided into the Boomplaas and Clearwater Formations of the Schmidtsdrif Subgroup (Eriksson et al., 2009) (see Fig. 2).

The Boomplaas Formation consists of grey dolomites which weather reddish-brown giving the soil in the area its characteristic red colour. Subordinate layers of limestone which weathers blue-grey, quartzite, flagstone and shale occur in between thicker layers of oolitic and stromatolitic dolomite.

The Clearwater Formation overlies the Boomplaas Formation and consists of grey to khaki coloured mudrocks and subordinate layers of stromatolitic dolomite, flagstone, tuffites and cherts.

The western and largest part of the study area which is demarcated for the Solar 1, 2 and 3 photovoltaic development is underlain by Tertiary-aged calcrete (see Figs. 2 & 23). Vast areas of hundreds of square kilometres of calcrete occur in the Northwest and are prevalent in the Vryburg area. The calcretes are associated with recent prehistoric (Tertiary to Quaternary) drainage lines and pans where evaporation and or the loss of CO_2 caused the precipitation of calcite from the water in the sands and soils of that area. During this cementation phase rocks and bones and even stone tools in the superficial sediments were trapped as part of the calcrete that formed.

4.1. Identification of Environmental Sensitivities



(The study area is indicated with the white polygon)

Figure 3: Palaeontological sensitivity of the region (SAHRA, 2018)

During the field assessment special attention was given to the areas demarcated as having a high palaeontological sensitivity (red). These areas are underlain by dolomite and chert. Sections that are demarcated as having a high palaeontological sensitivity (orange) were also visited. These areas are underlain mostly by Quaternary aged calcrete, gravel, sand and soil.

The sections of the study area which are demarcated as having a High Palaeontological Sensitivity are underlain by calcrete (see Fig. 3). Calcrete underlies the areas for the proposed Solar 1, 2 and 3 solar panels. There are rare occurrences of fossils in Tertiary calcrete and Quaternary soil, sand and alluvium reported from other localities (Almond & Pether, 2008).

Parts of the proposed Power Corridor is underlain by rocks of the Schmidtsdrif Formation which is considered to have a Very High Palaeontological Sensitivity due to the probability of finding stromatolites (see Fig. 3). The southern margin of the Power Corridor also touches the Boomplaas Formation which has yielded many kinds and sizes of stromatolites on the neighbouring farm Waterloo (Almond, 2013).

The eastern sections of the proposed Power Corridor (which includes the power station) is situated on rocks of the Vryburg Formation which is considered to have a Moderate Palaeontological Sensitivity (see Fig. 3). Microbial stromatolites have been reported form the Vryburg Formation some 40 km south of Vryburg (Smit et al., 1991).

5. ISSUES, RISKS AND IMPACTS

5.1 Summary of Issues identified during the Project Notification Phase

The key issues have been identified through the experience of the specialist in similar projects and available databases. The public consultation process is still to be undertaken where the Draft BA Report is released for 30 days public comment.

5.2 Identification of Potential Impacts/Risks

The proposed development will take place in areas which have been demarcated by SAHRA as having a Moderate, High to Very High Palaeontological Sensitivity as depicted in Fig.2.

With the necessary mitigation protocols the impact on the fossil sites will be minimized on the one hand while new fossil sites which are important to science will be discovered and samples be donated to museums.

The potential impacts identified during the BA are:

Construction Phase
- Destruction of fossils

Operational Phase
- Destruction of fossils

Decommissioning Phase
- Destruction of fossils

Cumulative Impacts
- Destruction of fossils

6. SITE VISIT

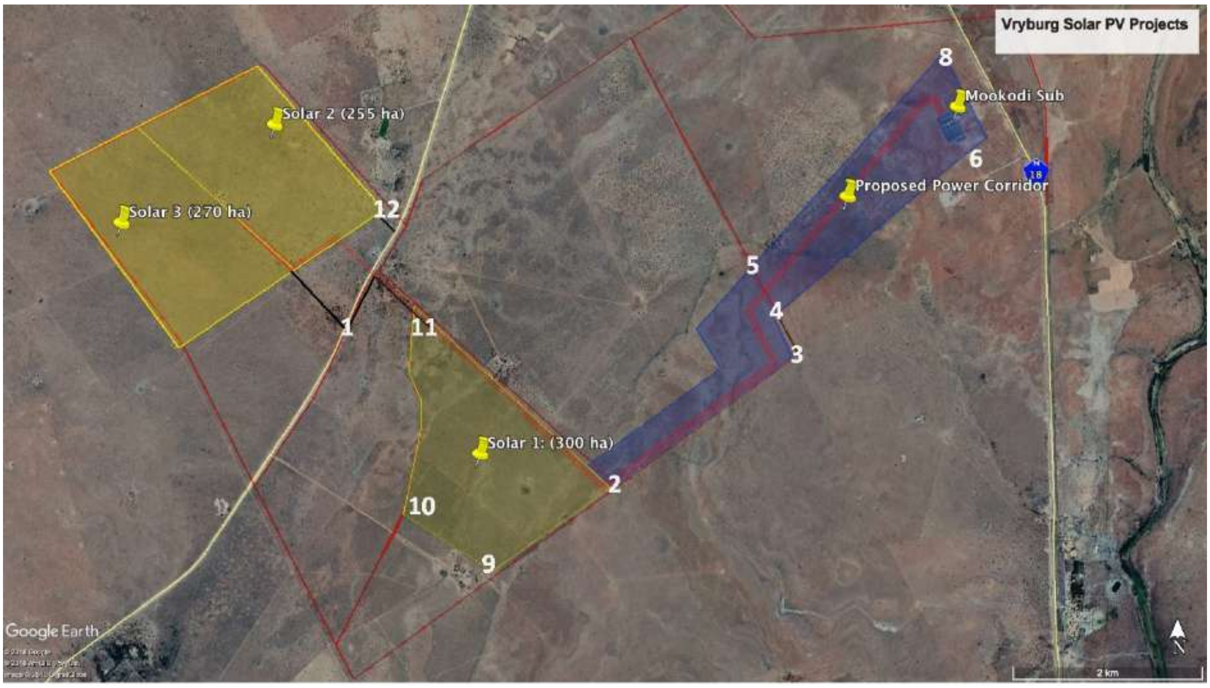


Figure 4: Site map showing picture vantage points for orientation purposes (see discussion)

Figure 5: Site 1 facing southeast

Figure 6: Site 2 facing west

Figure 7: Site 2 facing north

Figure 8: Eroded dolomite and chert between Site 2 and Site 3

Figure 9: Site 3 facing northwest

Figure 10: Site 3 facing northeast

Figure 11: Site 4 facing west

Figure 12: Site 4 facing east

Figure 13: Site 4 facing northeast

Figure 14: Site 5 facing southwest

Figure 15: Site 5 facing east

Figure 16: Site 6 facing north

Figure 17: Site 6 facing west

Figure 18: Site 6 facing south

Figure 19: Site 8 facing southwest

Figure 20: Site 9 facing north

Figure 21: Site 10 facing southeast

Figure 22: Calcrete eroding out in area demarcated for Solar 1

Figure 23: Site 11 facing south

Figure 24: Site 12 facing west

Discussion:

The study area is covered in natural vegetation with grass and shrubs and trees and is used for cattle farming. The soil cover in the study area is relatively thin and the underlying eroded bedrock is exposed in places (see Figs. 8 & 23). No distinct or remarkable fossils were found on this field trip. This however does not imply that Tertiary-aged fossils or stromatolites would not be discovered once the grass and soil are cleared and it is highly probable that they will be discovered in the study region as soon as excavations commence. Stromatolites of various kinds and sizes were found on the neighbouring farm Waterloo (Almond, 2013).

Figure 26: Example of stromatolites at Sterkfontein Caves

Stromatolites are very important from an evolutionary, environmental, ecological and geological perspective. Stromatolites were formed approximately 2.2 Ga ago when mats of cyanobacteria covered the sea floor up to a certain depth which allowed them to photosynthesize. The slimy surface caused fine grained mud and precipitates to adhere to them after which cyanobacterial strands consisting of chains of bacterial cells would continue to extend by means through the sediment in order to get enough light to photosynthesize. Very thin layers of sediments were set down during this process. In time these sedimentary layers were petrified and turned into columns of rock. Some of these columns which are stacked closely together are as thin as pencils, while others formed mushroom-like scallops (see Figs. 26 & 27) and others formed bigger domes (see Fig. 28) and even megadomes which are meters across. Keyser and Du Plessis (1993) have reported stromatolite domes of up to 2 m across in the Vryburg Map area and Almond (2013) discovered similar sized stromatolites on the farm Waterloo immediately to the east of the study site. When the soil and underlying eroded rock stratum are removed, it is expected that these domal structures will be exposed in places in the study site. When stromatolites are uncovered a palaeontologist must be appointed to assist in the evaluation of the importance of the conservation of these structures before construction continues, following the Chance Find Procedures.

These bacteria were amongst the first photosynthesizing organisms and it is thought that the chloroplast found in plants has evolved from a cyanobacterial ancestor. Cyanobacteria released oxygen as a by-product of photosynthesis in such quantities that it irrevocably changed the atmosphere from a reducing to an oxidizing atmosphere which had a devastating effect to most bacteria which were and still are anoxic. On the other hand, higher organisms such as fungi, plants and animals would not have been able to exist without the oxygen in the atmosphere and would therefore not have evolved if it were not for cyanobacteria.

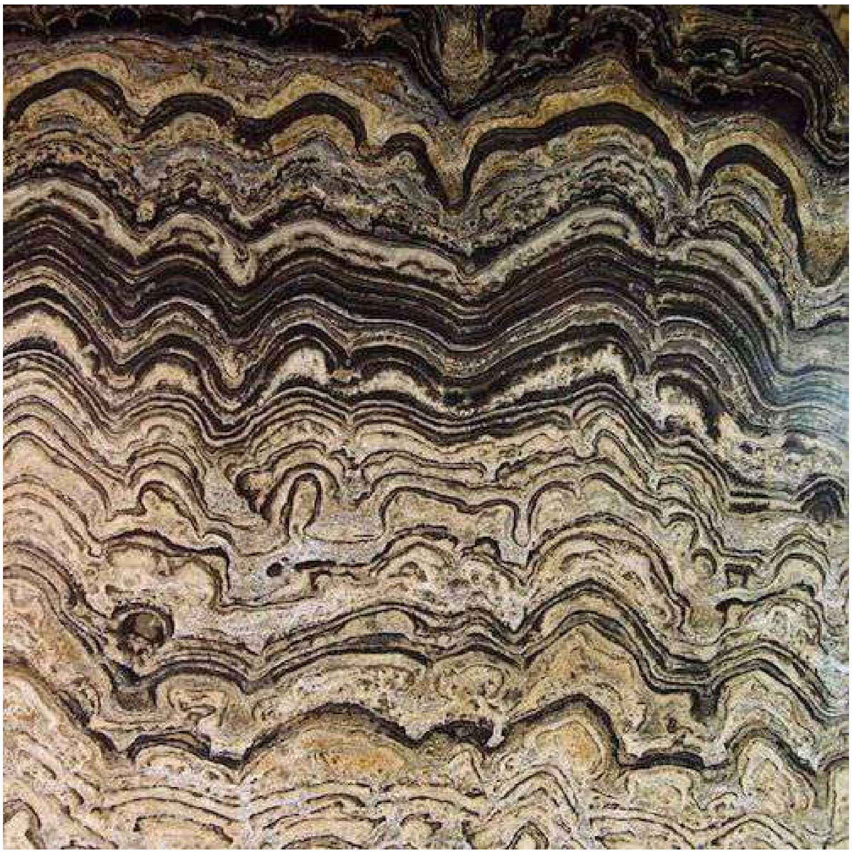


Figure 27: Polished vertical section through stromatolites

(from: https://www.google.co.za/imgres?imgurl=http%3A%2F%2Fwww.therockgallery.co.uk%2Fekmps%2Fshops%2Ftherockgallery%2Fimages%2Fstromatolite-large-polished-slice-100-million-years-old-andes-mountains-bolivia-%5B4%5D-1997-p.jpg&imgrefurl=http%3A%2F%2Fwww.therockgallery.co.uk%2Fstromatolite-large-polished-slice----100-million-years-old-----andes-mountains-bolivia-1997p. asp&docid=2vFkg_vqTH0I5M&tbnid=FQcixxQGdtBUFM%3A&vet=10ahUKEwinl8rfwqjcAhUGsKQKHf8wBy0QMwgsKAYwBg..i&w=500&h=500&bih=918&biw=1280&q=stromatolites&ved=0ahUKEwinl8rfwqjcAhUGsKQKHf8wBy0QMwgsKAYwBg&iact=mrc&uact=8)

Figure 28: Domal structures of stromatolites seen from above

(from: https://www.google.co.za/imgres?imgurl=http%3A%2F%2Fwww.kidsdiscover.com%2Fwp-content%2Fuploads%2F2015%2F04%2FBacteria_2.jpg&imgrefurl=http%3A%2F%2Fwww.kidsdiscover.com%2Fspotlight%2Fbacteria%2F%3Fmc_cid%3D97b6810d71%26mc_eid%3Df31cca173c&docid=jpZALMrhmI6d1M&tbnid=6zCWRFeJArwpQM%3A&vet=10ahUKEwioiMq6z6jcAhWisqQKHTkzCSoQMwhCKAMwAw..i&w=1000&h=683&bih=344&biw=553&q=Bacteria_2%20stromatolites&ved=0ahUKEwioiMq6z6jcAhWisqQKHTkzCSoQMwhCKAMwAw&iact=mrc&uact=8)

6.1 Potential Impacts during the Construction Phase

Sites for Solar 1, 2 and 3 PV installation

Aspect/Activity	Site preparation
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Site preparation and construction may have a negative impact on fossils which will be destroyed in the process. But on the other hand, new fresh fossiliferous material could be exposed after the removal of soil and eroded rock on the surface. Fossils in calcrete are exceptionally sparse and the chances of finding any at the study site are small.
Status	Negative if destroyed but positive if discovered and salvaged
Mitigation Required	The ECO should follow the Chance Find Procedure
Impact Significance (Pre-Mitigation)	Low (Level 4)
Impact Significance (Post-Mitigation)	Very Low (Level 5)
I&AP Concern	None (all fossils belong to the State)

Western and central part of the Power Corridor

Aspect/Activity	Site preparation
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Site preparation and construction may have a negative impact on fossils which will be destroyed in the process. But on the other hand, new fresh fossiliferous material could be exposed after the removal of soil and eroded rock on the surface. The chances of discovering stromatolites and new fossil sites are very big in this area and site preparation has to commence with care in this area.
Status	Negative if destroyed but positive if discovered and conserved
Mitigation Required	The ECO should follow the Chance Find Procedure
Impact Significance (Pre-Mitigation)	Very high (Level 1)
Impact Significance (Post-Mitigation)	Low (Level 4)
I&AP Concern	None

Eastern part of the Power Corridor

Aspect/Activity	Site preparation
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	The fossils in this area are small and difficult to collect and conserve. The fossils are not unique to the study site and hundreds of cubic kilometres of the geological layer in which they occur exist elsewhere.
Status	Negative
Mitigation Required	The ECO should follow the Chance Find Procedure if exceptional fossils are discovered.
Impact Significance (Pre-Mitigation)	Low (Level 4)
Impact Significance (Post-Mitigation)	Very Low (Level 5)
I&AP Concern	None

6.2 Potential Impacts during the Operational Phase

Sites for Solar 1, 2 and 3 PV installation

Aspect/Activity	Operational Phase
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Maintenance of the PV installation may have some moderate effect on the underlying rocky, potentially fossiliferous surface but no major problem is foreseen.
Status	Moderately negative
Mitigation Required	Fossiliferous areas may be enclosed to prevent people from damaging them.
Impact Significance (Pre-Mitigation)	Low (Level 4)
Impact Significance (Post-Mitigation)	Very Low (Level 5)
I&AP Concern	None (all fossils belong to the State)

Western and central part of the Power Corridor

Aspect/Activity	
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Maintenance of the power lines and underground cables, if any, may have some moderate effect on the underlying rocky, potentially fossiliferous surface but no major problem is foreseen.
Status	Moderately negative
Mitigation Required	Fossiliferous areas may be enclosed to prevent people from damaging them.
Impact Significance (Pre-Mitigation)	Moderate (Level 3)
Impact Significance (Post-Mitigation)	Low (Level 2)
I&AP Concern	None (all fossils belong to the State)

Eastern part of the Power Corridor

Aspect/Activity	
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Maintenance of the power lines and underground cables, if any, may have some moderate effect on the underlying rocky, potentially fossiliferous surface but no major problem is foreseen.
Status	None – very little negative impact
Mitigation Required	None
Impact Significance (Pre-Mitigation)	Very Low (Level 5)
Impact Significance (Post-Mitigation)	Very Low (Level 5)
I&AP Concern	None (all fossils belong to the State)

6.3 Potential Impacts during the Decommissioning Phase

Sites for Solar 1, 2 and 3 PV installation

Aspect/Activity	Operational Phase
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Potentially no major problem is foreseen.
Status	Moderately negative
Mitigation Required	Fossiliferous areas may be enclosed to prevent people from damaging them.
Impact Significance (Pre-Mitigation)	Low (Level 4)
Impact Significance (Post-Mitigation)	Very Low (Level 5)
I&AP Concern	None (all fossils belong to the State)

Western and central part of the Power Corridor

Aspect/Activity	
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	No major problem is foreseen.
Status	Moderately negative
Mitigation Required	Fossiliferous areas may be enclosed to prevent people from damaging them.
Impact Significance (Pre-Mitigation)	Moderate (Level 3)
Impact Significance (Post-Mitigation)	Low (Level 2)
I&AP Concern	None (all fossils belong to the State)

Eastern part of the Power Corridor

Aspect/Activity	
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	No major problem is foreseen.
Status	None – very little negative impact
Mitigation Required	None
Impact Significance (Pre-Mitigation)	Very Low (Level 5)
Impact Significance (Post-Mitigation)	Very Low (Level 5)
I&AP Concern	None (all fossils belong to the State)

6.4 Cumulative Impacts

Sites for Solar 1, 2 and 3 PV installation

Aspect/Activity	Operational Phase
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Potentially no major problem is foreseen.
Status	Moderately negative
Mitigation Required	Care should be given when development occurs in this area. Fossils may be salvaged and fossiliferous areas may be avoided during development, construction and maintenance.. .
Impact Significance (Pre-Mitigation)	Low (Level 4)
Impact Significance (Post-Mitigation)	Very Low (Level 5)
I&AP Concern	None (all fossils belong to the State)

Western and central part of the Power Corridor

Aspect/Activity	
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	No major problem is foreseen.
Status	Moderately negative
Mitigation Required	SAHRA may be approached for a permit if stromatolite formations needs to be destroyed during the clearing and construction phase, otherwise highly fossiliferous areas should be avoided.
Impact Significance (Pre-Mitigation)	Very High (Level 5)
Impact Significance (Post-Mitigation)	Moderate (Level 3)
I&AP Concern	None (all fossils belong to the State)

Eastern part of the Power Corridor

Aspect/Activity	
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	No major problem is foreseen.
Status	None – very little negative impact
Mitigation Required	None
Impact Significance (Pre-Mitigation)	Very Low (Level 5)
Impact Significance (Post-Mitigation)	Very Low (Level 5)
I&AP Concern	None (all fossils belong to the State)

7. IMPACT ASSESSMENT TABLES

Table 1: Impact Assessment Summary Table for the Construction Phase

Sites for Solar 1, 2 and 3 PV installation

Construction Phase													
Direct Impacts													
Aspect/ Impact Pathway	**Nature of Potential Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of Impact**	**Irreplaceability**	**Potential Mitigation Measures**	**Significance of Impact and Risk**		**Ranking of Residual Impact/ Risk**	**Confidence Level**
										Without Mitigation/ Management	**With Mitigation/ Management (Residual Impact/ Risk)**		
Clearing of vegetation of 300 ha for Solar 1, 255 ha for Solar 2 and 270 ha for Solar 3	Destruction of fossils	Negative	Site	Long-Term	Substantial	Not likely	Irreversible	Moderate	Follow Chance Find Procedures and salvage fossils	Moderate	Low	2.5	Medium
Service road beneath 132 kV power line for western part of Power Corridor	Destruction of fossils	Negative	Site	Long-Term	Substantial	Very likely	Irreversible	Moderate	Follow Chance Find Procedures and conserve stromatolite formations in situ.	Very High	Moderate	4	High
Service road beneath 132 kV line for eastern part of Power Corridor	Destruction of fossils	Negative	Site	Long-Term	Moderate	Not Likely	Irreversible	Moderate	Follow Chance find Procedures and report any new fossil site finds.	Low	Very low	1.5	Medium

Table 2: Impact Assessment Summary Table for the Operational Phase

Operational Phase													
Direct Impacts													
Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk		Ranking of Residual Impact/ Risk	Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)		
Clearing of vegetation of 300 ha for Solar 1, 255 ha for Solar 2 and 270 ha for Solar 3	Destruction of fossils	Negative	Site	Long-Term	Substantial	Not likely	Irreversible	Moderate	Follow Chance Find Procedures and salvage fossils	Low	Very Low	1.5	Medium
Maintenance of cleared area (300 m) beneath the 132 kV power line for western part of Power Corridor	Destruction of fossils	Negative	Site	Long-Term	Substantial	Very likely	Irreversible	Moderate	Follow Chance Find Procedures and conserve stromatolite formations in situ.	Moderate	Low	2.5	High
Maintenance of cleared area beneath the 132 kV line for eastern part of Power Corridor	Destruction of fossils	Negative	Site	Long-Term	Moderate	Not Likely	Irreversible	Moderate	Follow Chance find Procedures and report any new fossil site finds.	Very Low	Very low	1	Medium

Table 3: Impact Assessment Summary Table for the Decommissioning Phase

Decommissioning Phase													
Direct Impacts													
Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk		Ranking of Residual Impact/ Risk	Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)		
Rehabilitation of cleared areas of 300 ha for Solar 1, 255 ha for Solar 2 and 270 ha for Solar 3	Destruction of fossils	Negative	Site	Long-Term	Substantial	Not likely	Irreversible	Moderate	Follow Chance Find Procedures and salvage fossils	Low	Very Low	1.5	Medium
Rehabilitation of cleared area beneath western part of Power Corridor	Destruction of fossils	Negative	Site	Long-Term	Substantial	Very likely	Irreversible	Moderate	Follow Chance Find Procedures and conserve stromatolite formations in situ.	Moderate	Low	2.5	High
Rehabilitation of cleared area beneath for eastern part of Power Corridor	Destruction of fossils	Negative	Site	Long-Term	Moderate	Not Likely	Irreversible	Moderate	Follow Chance find Procedures and report any new fossil site finds.	Very Low	Very low	1	Medium

Table 4: Cumulative Impact Assessment Summary Table

Cumulative Impacts (Construction, Operational and Decommissioning Phases)													
Direct Impacts													
Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk		Ranking of Residual Impact/ Risk	Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)		
Clearing of vegetation of 300 ha for Solar 1, 255 ha for Solar 2 and 270 ha for Solar 3	Destruction of fossils	Negative	Site	Long-Term	Substantial	Not likely	Irreversible	Moderate	Follow Chance Find Procedures and salvage fossils	Low	Very Low	1.5	Medium
Clearing of vegetation for 3m service road beneath 132 kV line for western part of Power Corridor	Destruction of fossils	Negative	Site	Long-Term	Substantial	Very likely	Irreversible	Moderate	Follow Chance Find Procedures and conserve stromatolite formations in situ.	Very High	Moderate	4	High
Clearing of vegetation for 3 m service road under 132 kV line for eastern part of Power Corridor	Destruction of fossils	Negative	Site	Long-Term	Moderate	Not Likely	Irreversible	Moderate	Follow Chance find Procedures and report any new fossil site finds.	Very Low	Very low	1	Medium

7.1 Impact Assessment Summary

Table 5a: Overall Impact Significance (Post Mitigation) for Solar 1, 2 and 3 PV Sites

Phase	**Overall Impact Significance**
Construction	Low
Operational	Very Low
Decommissioning	Very Low
Nature of Impact	**Overall Impact Significance**
Cumulative - Construction	Low
Cumulative - Operational	Very Low
Cumulative - Decommissioning	Very Low

Table 5b: Overall Impact Significance (Post Mitigation) for Central and Western part of the Power Corridor

Phase	**Overall Impact Significance**
Construction	Very High
Operational	Moderate
Decommissioning	Low
Nature of Impact	**Overall Impact Significance**
Cumulative - Construction	Very High
Cumulative - Operational	Moderate
Cumulative - Decommissioning	Low

Table 5c: Overall Impact Significance (Post Mitigation) for eastern part of the Power Corridor

Phase	**Overall Impact Significance**
Construction	Low
Operational	Very Low
Decommissioning	Very Low
Nature of Impact	**Overall Impact Significance**
Cumulative - Construction	Low
Cumulative - Operational	Very Low
Cumulative - Decommissioning	Very Low

8. LEGISLATIVE AND PERMIT REQUIREMENTS

A qualified palaeontologist should be appointed to handle the mitigation procedure in conjunction with the ECO upon the discovery of fossils during construction.

A permit should be applied for by a qualified palaeontologist from SAHRA and issued by SAHRA to either salvage material or to destroy fossiliferous beds during construction.

9. ENVIRONMENTAL MANAGEMENT PROGRAMME INPUTS

The ECO should be aware of the palaeontological sensitivity of each of the sites where development is taking place and should familiarise themselves with the Chance Find Procedure which should be followed upon the discovery of a fossil site.

10. CONCLUSION AND RECOMMENDATIONS

Although stromatolites are considered to be fossils, there are hundreds of square kilometres of stromatolites in South Africa and it is not considered to be so scarce that every stromatolite has to be preserved. In the event of the discovery of an exceptional stromatolite formation it is advised that it should on principle not be destroyed if an alternative position for the placing of a specific pylon, pipe, service road or building can be found.

Rocks of the Schmidsdrif Formation occur in the central and western part of the proposed Power Corridor and therefore there is a very high probability of uncovering stromatolites in this section. When stromatolites are discovered at construction sites the Chance Find Procedure should be followed by the ECO.

There is a low likelihood that the Quaternary alluvium and aeolian sand and Tertiary calcrete in the study area may contain fossils. Elsewhere rare fossils of root casts, burrows, ostrich egg shells, mollusc shells, isolated bones, root casts, burrows and termitaria were found in Tertiary and Quaternary deposits (Almond & Pether 2008) and the possibility of finding similar fossils in the study area cannot be excluded.

In the unlikely event of fossils being discovered in the sands, soils, calcrete or dolomite formations in the study area, the ECO should follow the Chance Find Procedure. Although disturbed fossils should be collected and stored safely until it can be inspected by a palaeontologist, no attempt should be made to remove such accidentally discovered fossils from the rock by an unqualified person.

11. FINAL SPECIALIST STATEMENT AND AUTHORISATION RECOMMENDATION

Mitigation measures which should be followed upon the discovery of fossils:

PROCEDURE FOR CHANCE PALAEONTOLOGICAL FINDS

Extracted and adapted from the National Heritage Resources Act, 1999 Regulations Reg No. 6820, GN: 548.

The following procedure must be considered in the event that previously unknown fossils or fossil sites are exposed or found during the life of the project:

1. Surface excavations should continuously be monitored by the ECO and any fossil material be unearthed the excavation must be halted.

2. If fossiliferous material has been disturbed during the excavation process it should be put aside to prevent it from being destroyed.

3. The ECO then has to take a GPS reading of the site and take digital pictures of the fossil material and the site from which it came.

4. The ECO then should contact a palaeontologist and supply the palaeontologist with the information (locality and pictures) so that the palaeontologist can assess the importance of the find and make recommendations.

5. If the palaeontologist is convinced that this is a major find an inspection of the site must be scheduled as soon as possible in order to minimise delays to the development.

6. From the photographs and/or the site visit the palaeontologist will make one of the following recommendations:

   a. The material is of no value so development can proceed, or:

   b. Fossil material is of some interest and a representative sample should be collected and put aside for further study and to be incorporated into a recognised fossil repository after a permit was obtained from SAHRA for the removal of the fossils, after which the development may proceed, or:

   c. The fossils are scientifically important and the palaeontologist must obtain a SAHRA permit to excavate the fossils and take them to a recognised fossil repository, after which the development may proceed.

7. If any fossils are found then a schedule of monitoring will be set up between the developer and palaeontologist in case of further discoveries.

11.1 EA Condition Recommendations

The proposed development of the Vryburg Solar 1, Vryburg Solar 2 and Vryburg Solar 3 photovoltaic facility will take place in an area which is considered to have mostly a High Palaeontological Sensitivity for the PV facility sites, and areas of Medium, High and Very High Palaeontological Sensitivity within the corridor for the distribution power lines.

The central and western sections of the proposed Power Corridor fall in the Very High Palaeontological Sensitivity category due to the probability of stromatolites occurring in this region. The chances of exposing stromatolites during construction are good and for this reason a Chance Find Procedure has been included in the Recommendations. Even though it is not essential to salvage every piece of stromatolite exposed because of its ubiquitous distribution in the dolomites of South Africa, it will be prudent not to destroy a major stromatolite find for scientific and heritage reasons.

The areas where the proposed Solar 1, 2 and 3 PV panels are to be installed fall in the High Palaeontological Sensitivity category because of the underlying Tertiary calcrete and Quaternary alluvium, sand and soils. The Chance Find Procedure should be followed if fossils are uncovered during construction in this section.

The eastern sections of the Power Corridor are situated on rocks with a Medium Palaeontological Sensitivity. The chances of finding fossils in the High to Medium Sensitivity sections are low however and the protocol that should be followed in the unlikely case of the discovery of fossils in this section is covered in the Chance Find Procedure.

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Smit, P.J.; Beukes, N.J.; Johnson, M.R.; Malherbe, S.J. & Visser, J.N.J. (1991). Lithostratigraphy of the Vryburg Formation (including the Kalkput, Geelbeksdam, Rosendal, Waterloo and Oceola Members). South African Committee for Stratighraphy Lithostratigraphic Series No. 14, 1-10.

13. APPENDICES

(none required)

SOCIAL IMPACT ASSESSMENT

Basic Assessment for the proposed development of a 115 MW Solar Photovoltaic (PV) Facility (Vryburg Solar 2) and associated electrical infrastructure, near Vryburg, in the North-West Province

Report prepared for:
CSIR – Environmental Management Services
P O Box 320
Stellenbosch
7599
South Africa

Report prepared by:
Rudolph du Toit
Applied Science Associates (Pty) Ltd
3 Red Oak Lane
Stellenbosch
7600
South Africa

26 July 2018

SPECIALIST EXPERTISE

CURRICULUM VITAE: RUDOLPH DU TOIT

Personal information

Name: Rudolph du Toit

Firm: Applied Science Associates (Pty) Ltd

Position in Firm: Managing Director

Date of Birth: 23 May 1978

Email: rudolph@appliedscience.co.za

Telephone number: 076 902 6479

Employment experience

Full-time employment

1. Organisation: Applied Science Associates (Pty) Ltd

   Position: Managing Director

   Period: 2017 to present

   Experience:
   - Establishment and management of a private environmental consultancy;
   - Specialist environmental law advice to the renewable energy sector on the project implications of the Astronomy Geographic Advantage Areas Act (AGA) (Act 21 of 2007) and its Regulations;
   - Assessment of the socio-economic impacts related to the proposed national-level roll-out of aqua-culture development;
   - Record keeping and auditing in accordance with Civil Aviation Authority (CAA) requirements for licensed drone operators (Part 101 of Civil Aviation Regulations)

2. Organisation: Council for Scientific and Industrial Research (CSIR)

   Position: Senior Environmental Assessment Practitioner (EAP)

   Period: 2010 to 2017

   Experience:
   - Successfully managed the EIA/BA processes for 17 industrial-scale energy developments (14 wind energy applications and 3 oil & gas applications) both locally and internationally;
   - Initiated and established the environmental law (EIA appeals and responding statements) competency and service offering within CSIR; with a specific focus on dealing with suitability of land

complaints and socio-environmental constraints related to wind energy developments;
- Initiated and established Social Impact Assessment (SIA) as an environmental specialist service within CSIR, and successfully completed 7 SIAs;
- Research and design of Sustainability Assessments for EIA and SEA application;
- Collaborating with specialists from various disciplines during EIA/BA research and report drafting

Tertiary qualifications

Undergraduate:

- Bachelor of Arts (BA): Environmental and Development Studies
  Department of Geography and Environmental Studies
  University of Stellenbosch (US), 2003-2005
- Bachelor of Laws (LLB): Majoring in Environmental Law
  College of Law
  University of South Africa (UNISA), 2015 to present
  Note: Degree in progress, expected graduation in June 2019

Honours:

- Bachelor of Philosophy (B.Phil.): Sustainable Development Planning & Management
  School for Public Leadership
  University of Stellenbosch (US), 2006

Masters:

- Master of Philosophy (M.Phil.): Sustainable Development Planning & Management
  School of Public Leadership
  University of Stellenbosch (US), 2007-2009

Academic honours

- Golden Key International Academic Honours Association invitee: 2003 to 2007
- Stellenbosch University Dean's List (Top 10% academic achievers): 2003
- Stellenbosch University Merit Bursary: 2004 & 2005
- South African National Energy Research Institute (SANERI) Bursary: 2007 & 2008

Research publications

- Contributing author to: Dalal-Clayton, B. (2013) ***The Role of Strategic Environmental Assessment in Promoting a Green Economy: Background document for the OECD DAC SEA task Team workshop on SEA & Green Economy, Lusaka, 17- 18 January 2013***. IIED, London
- Du Toit, R. (2009). ***Developing a Scorecard for Sustainable Transport: A Cape Town Application.*** Stellenbosch University Press

- Michelle Audouin, Mike Burns, Alex Weaver, David le Maitre, Patrick O'Farrell, Rudolph du Toit, Jeanne Nel. (2015). ***An Introduction to Sustainability Science and its Links to Sustainability Assessment.*** *In Morrison-Saunders, A. and Pope, J., Eds. Handbook of Sustainability Assessment.* Edward Elgar Publishing, 321 -349.

Conference presentations & papers

- Du Toit, R. (2012). **Wind *Energy and Public Participation: A one-sided debate?*** Proceedings of the 17th Annual Conference of the International Association for Impact Assessment South Africa: "Urban Evolution", 27 - 29 August, 2012.
- Du Toit, R. & Van der Westhuizen, C. (2013). ***Strategic Environmental Assessment (SEA) as a means of building the Green Economy in South Africa: The development of a national wind and solar energy roll-out plan.*** Proceedings of the OECD DAC SEA Task Team Workshop on SEA & Green Economy, Lusaka (Zambia), 17- 18 January 2013.
- Burns, M., Du Toit, R. & Schreiner, G. (2013). ***Graphical Causal Loop modelling of socio-ecological systems to identify & evaluate key impact "strings".*** Proceedings of the 18th Annual Conference of the International Association for Impact Assessment South Africa: 16 - 18 September, 2013.

Key courses

- Advanced Facilitation: Team Building Institute (Pty) Ltd (2001)
- Clean Development Mechanism (CDM) Project Development Training: Danish Energy Management (Pty) Ltd (2008)

- Project Management Principles & Practice: University of Pretoria (2011)
- Integrating Sustainability with Environmental Assessment in South Africa (Presented by A. Morrison –Saunders & J. Pope): North-West University (2012)
- Science Communication and Working with the Media: Proof Communications/Jive Media Africa (2014)
- Sharpening the Tool: New techniques and methods in Environmental Impact Assessment: Sustainable Environmental Solutions (Pty) Ltd (2015)
- Effective Skills for Challenging Meetings & Engagements: Conflict Dynamics (2015)

Specialist expertise enabling him to compile this report:

Rudolph du Toit is the Managing Director of ASA and has been practicing as an Environmental Assessment Practitioner (EAP) for more than 9 years; primarily within South Africa and West African (Cameroon). As EAP, he managed the Environmental Impact Assessment (EIA) processes of large-scale industrial developments within the oil and gas, renewable energy, and port planning sectors. Rudolph also led several Strategic Environmental Assessments (SEA), and is a contributing author to 2 national-scale SEAs and several international publications on Sustainability, Resilience and SEA. Rudolph has been conducting socio-economic specialist studies since 2014, with a particular focus on industrial projects within the renewable energy sector. His experience as an EAP, combined with his formal training in social anthropology, development studies, and sustainability science equips him with a detailed understanding of human-environment interaction.

SPECIALIST DECLARATION

I, **Rudolph du Toit**, as the appointed independent specialist, in terms of the 2014 EIA Regulations (as amended), hereby declare that I:

- I act as the independent specialist in this application;
- I 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;
- regard the information contained in this report as it relates to my specialist input/study to be true and correct, and do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 (as amended) and any specific environmental management Act;
- 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 have no vested interest in the proposed activity proceeding;
- 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;
- I have ensured that information containing all relevant facts in respect of the specialist input/study was distributed or made available to interested and affected parties and the public and that participation by interested and affected parties was facilitated in such a manner that all interested and affected parties were provided with a reasonable opportunity to participate and to provide comments on the specialist input/study;
- I have ensured that the comments of all interested and affected parties on the specialist input/study were considered, recorded and submitted to the competent authority in respect of the application;
- all the particulars furnished by me in this specialist input/study 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.

Name of Specialist: **Rudolph du Toit**

Signature of the specialist: ______________________

Date: **26 July 2018**

EXECUTIVE SUMMARY

This Social Impact Assessment investigates the potential impact if the proposed construction and operation of the 115 MW Vryburg 2 Solar PV project on the receiving socio-economic environment. The project is located approximately 8km south-west of Vryburg. The main socio-economic aspects of the project that could have socio-economic effects for the local community are:

- Construction phase: estimated 40 to 50 skilled and 200 to 250 unskilled employment opportunities for the PV facility and transmission lines over 14 months, with associated socio-economic implications from the project development and investment.
- Operations phase: estimated 20 skilled and 40 unskilled employment opportunities will be created over the 20 year lifespan of the proposed facility, as well as effects of the social investment program that is required as part of the Renewable Energy Independent Power Producer Programme (REI4P).

The proposed project is located within the Naledi Local Municipality (NLM) which has a population of approximately 68 803 (2016, www.mumicipalities.co.za). According to the South African Government Performance Index (Good Governance Africa, 2016), the NLM is rated as an average performer in terms of service delivery (score of 79 to156), while the Price Waterhouse Coopers (PwC) Municipal Performance Index (MPI) (2017) rates the NLM as scoring slightly below average (nationally) in terms of socio-economics (4.9 out of 10) and corporate governance (4.4 out of 10). It is notable that the NLM generally appears to score higher in terms of service delivery when compared to other local municipalities immediately surrounding it in North-West Province.

The Municipality has made significant progress towards redressing unemployment, poverty, HIV/AIDS infection rates and poor education within the past 15 years. However, regardless of said progress, the NLM still faces significant challenges in terms of its socio-economic realities.

Population growth within the area (3.0%) is significantly higher than the national average (1.6%), with comparatively high dependency ratio of 56.2. Demographic information indicates that vulnerable people groups within the NLM increased in all major categories, with the exception of the young (0-14 years). In terms of education, 21.9% of the NLM population had no formal schooling. Moreover, levels of educational attendance have dropped within the NLM between 2011 and 2016 by 1%, with the NLM currently rating as the local municipality with the second lowest attendance levels within the North-West Province. In terms of early childhood development (children aged 0-4 years attending an educational institution) the NLM has the second highest total non-attendance figure (73.3%) in the North-West Province. Agriculture is the primary economic activity and employment sector within the NLM (27.8%) followed by community, social and personal services (23.4%), and the wholesale and retail trade (17.5%). These sectors however tend to employ low volumes of labour. Higher volume employers such as the construction, mining and electricity sectors are underrepresented in the NLM, at 2.6%, 0.5% and 0.5% respectively.

According to the 2008 South African National HIV Prevalence, Incidence, Behaviour and Communication Survey, the North-West Province's HIV prevalence is 11.3% in people aged 2-14 years, and 17.7% in people aged 15-49 years. In 2009 the North-West Province had the highest incidence (47%) of young women with sexual partners 5 or more years older than themselves (*i.e.* intergenerational sex), and are therefore more prone to HIV/AIDS infection. This figure is 9% higher than the South African national percentage for intergenerational sex; at 38%. More disturbing is the fact that intergenerational sex in the North-West Province increased by 19% from 28% in 2006, to 47% in 2009. These high figures creates a reasonable concern that the introduction of increased levels of disposable income, combined with an influx of a sizable force might result in an increased incidence of risky social behaviour (particularly transactional sex, and drug abuse).

When considering the above demographic data and the nature of the proposed development, the primary socio-economic sensitivities appear to be:

(i) Preservation of the integrity of existing social structures:

Existing social structures provide a socio-economic safety net for vulnerable community members, while also serving to maintain social cohesion through the practice and implementation of local cultural norms, beliefs and values.

(ii) Preservation and growth of physical and economic safety:

The asset classes, or capital, available to community members in the NLM (e.g. productive farms, infrastructure, and bulk services) must be protected, while asset classes currently in short supply need to be developed (e.g. income for the poor, improved education, and improved health). Such protection and development is vital in controlling and ultimately alleviating poverty and vulnerability. Moreover, jeopardizing physical and economic safety will serve to undermine existing social structures within the NLM.

(iii) The wellbeing of the poor and vulnerable people groups:

The NLM has a Constitutional directive to care for its poor and vulnerable citizens. Moreover, any development which fails to consider and/or attempt to improve the plight of the poor and vulnerable; runs the risk of exacerbating local poverty and/or local animosity towards said development.

Taking into consideration the proposed project development, and the receiving social context, the main impacts of the project on the socio-economic context of NLM and Vryburg area as follows:

Construction Phase

- Disruption of local social structures as a result of the construction work force and in-migration of job seekers for the 14 month construction period;
- Increased burden on existing social and bulk services as a result of workforce and job seeker influx;
- Temporary employment creation from the estimated 40 to 50 skilled jobs and 200 to 250 unskilled jobs over the 14 month construction period;
- Unrealistic expectations regarding local job creation, with associated discontent and potential negativity towards the proposed development;
- Development of locally-owned support industries to respond to construction-related activities;
- Increased risky social behaviour (including but not limited to sex work, transgenerational sex, and drug abuse) which is associated with increased levels of disposable income within a cash-poor, high unemployment area; and
- Damage to farm property/loss of livestock due to negligent and/or criminal behaviour by members of the construction work force.

Operational Phase

- Establishment of a Community Trust; and
- Potential loss of farmland due to the construction of the proposed solar energy facility.

Decommissioning Phase

- Loss of local employment and income as a result of the proposed project being decommissioned.

Cumulative Impacts

- Cumulative disruption of social structures as a result of the influx of large construction work forces from multiple renewable energy projects which serve to weaken existing social capital;

- Cumulative increase in HIV/AIDS infection rate as a result of disposable income being used to engage the services of sex workers and procure drugs; and
- Cumulative socio-economic benefit to the local community as a consequence of the combined temporary employment opportunities created by multiple renewable energy projects, as well as the combined effect of multiple community trust being established by said projects to benefit local communities.

The overall impact significance for each phase i.e. construction, operation and decommissioning) is provided in the table below:

Phase	**Overall Impact Significance. (pre-mitigation)**	**Overall Impact Significance. (post-mitigation)**
Construction	Low (negative)	Low (negative)
Operational	Very low (positive)	Very low (positive)
Decommissioning	Low (negative)	Low (negative)

1 The cumulative impacts identified for the proposed project revolve around the social change process likely to occur should more than one renewable energy project be developed within the proposed project area. The primary concern in this regard is the cumulative change that existing social structures might be exposed to due to influxes of large construction teams and job seekers, as well as the cumulative impact such influxes might have on the local HIV/AIDS infection rate. Conversely, the key positive cumulative impact is the combined benefit likely to vest in the local community as a result of the community trusts of various renewable energy projects being developed in the area.

The key management actions to avoid or mitigate the negative social impacts of the project are:

- Trends in local (within the immediate project area) HIV infection rates/ARV treatment loads must be monitored (annually) through close interaction with the local clinic. Should infections and treatment loads increase at a rate greater than the anticipated rate of increase; the Developer (or his appointed agent) must re-evaluate its HIV awareness training, take corrective action where necessary, and repeat said training. This is only required for the duration of the operational phase of the project.
- The proposed project site should be fenced off and movement of construction workers should be limited to the construction site only.
- No staff may overnight at the project location, except security personnel.
- A code of conduct, aligned with South African labour legislation, must be signed by all workers whereby workers are informed of risks on the property, and that they will be held liable for any damages or losses incurred by the property owner as a result of workers' actions not directly related to their employment.
- Contractors must clearly stipulate the disciplinary procedures applicable to workers in the case of theft, damage to property and/or trespassing.

CONTENTS

LIST OF TABLES

LIST OF ABBREVIATIONS

DRSMDM	Dr Ruth Semogotsi Mompati District Municipality
EIA	Environmental Impact Assessment
BA	Basic Assessment
DEA	Department of Environmental Affairs
IDP	Integrated Development Plan
LED	Local Economic Development
MPI	Municipal Performance Index
NLM	Naledi Local Municipality
PwC	Price Waterhouse Coopers
PV	Photovoltaic
REIPPPP	Renewable Energy Independent Power Producer Procurement
SDF	Spatial Development Framework
SIA	Social Impact Assessment
ToR	Terms of Reference

COMPLIANCE WITH THE APPENDIX 6 OF THE 2014 EIA REGULATIONS (AS AMENDED)

Requirements of Appendix 6 – GN R326	**Addressed in the Specialist Report**
1. (1) A specialist report prepared in terms of these Regulations must contain- a) 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;	Page 2
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Page 5
c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 1
(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;	Section 3
d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 1.3
e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 2
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 4
g) an identification of any areas to be avoided, including buffers;	N/A
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;	N/A
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 2.2
j) a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Sections 4 & 5
k) any mitigation measures for inclusion in the EMPr;	Sections 4 & 5
l) any conditions for inclusion in the environmental authorisation;	N/A
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 9
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	N/A
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	N/A
q) any other information requested by the competent authority.	N/A
(2) Where a government notice 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.	N/A

SOCIAL IMPACT ASSESSMENT (SIA)

This report presents the Social Impact Assessment (SIA) that was prepared by Rudolph du Toit of (Applied Science Associates (Pty) Ltd as part of the Basic Assessment (BA) Process for the proposed development of the 115 MW Vryburg Solar 1 Photovoltaic (PV) Facility and associated infrastructure, near Vryburg, in the North-West Province.

1 INTRODUCTION AND METHODOLOGY

1.1 Scope, Purpose and Objectives of this Specialist Report

A Social Impact Assessment (SIA) forms part of the suite of specialist studies required for the BA process, and is intended to investigate, analyse, and manage the intended and unintended socio-economic consequences of planned interventions and its associated social change processes.

1.2 Terms of Reference

The following Terms of Reference (ToR) will guide the SIA:

- Describe the socio-economic context of the Vryburg area, focusing on aspects that are potentially affected by a solar PV project, and taking into consideration the current situation as well as the trends, the local planning (Integrated Development Plans (IDPs) and Spatial Development Frameworks (SDFs)), other developments in the area. The study should look more broadly than the individual land parcels on which the proposed projects will developed, as most, if not all, of the anticipated social impacts may be experienced in the urban areas nearest to the proposed project.
- Comply with the SIA requirements as stipulated in the Western Cape Department of Environmental Affairs and Development Planning (DEA&DP) Guideline for Social Impact Assessment (Barbour, 2007).
- Apply a variety of appropriate options for sourcing information, such as review of analogous studies, available databases and social indicators, and use of interviews with key affected parties such as local communities, local landowners & government officials (local and regional) etc.
- The socio-economic study does not lend itself to providing a spatially based sensitivity map. Therefore, instead, the study could provide a simplified schematic mapping of the links between the project actions (i.e. interventions) and the receiving social environment (i.e. the socio-ecological system), which may occur at a local, provincial or national scale, and showing how these links can be optimized to enhance benefits and minimize negative impacts.
- Consider social issues such as potential in-migration of job seekers, opportunities offered by training and skills development, phasing of employment over the duration of the Renewable Energy Independent Power Producer Procurement program (REIPPPP), cumulative effects with other REIPPPP projects in the local area (e.g. Waterloo Solar PV), implications for local planning and resource use.
- Provide recommendations to enhance the socio-economic benefits of the proposed solar PV project and to avoid (or minimise) the potential negative impacts.

- Identify and assess potential social benefits and costs as a result of the proposed development, for all stages of the project, and including the estimated direct employment opportunities.
- Evaluate the implications of the social investment programme associated with REIPPPP projects on the local socio-economic context.

1.3 Assessment Details

Type of Specialist Investigation	Socio-Economic Impact Assessment
Date and Duration of Specialist Site Investigation	October 2016 (2 days)
Season	Spring
Relevance of Season	The season during which the site visit was conducted has no relevance on the outcomes of this assessment.

2 APPROACH AND METHODOLOGY

The Western Cape Department of Environmental Affairs and Development Planning (DEA&DP) Guideline for Social Impact Assessment (Barbour, 2007) is used to provide policy and quality control guidelines for the social assessment process used in this report. Table 1 elaborates on the guideline's key activities, objectives and areas of particular interest for assessment.

Table 1 DEA&DP Guideline for Social Impact Assessment: key activities, objectives and areas of interest (Source: Barbour, 2007)

1. Key Activities
1.1. Describe and obtain an understanding of the proposed intervention (type, scale, location), the communities likely to be affected and determine the need and scope of the SIA
1.2. Collect baseline data on the current social environment and historical social trends
1.3. Identify and collect data on the social impact assessment variables and social change processes related to the proposed intervention
1.4. Assess and document the significance of social impacts associated with the proposed intervention
1.5. Identify alternatives and mitigation measures.
2. Key Objectives
2.1 Assess the proposed development in terms of its fit with the relevant legislative, policy and planning requirements
2.2 Identify and assess the factors that contribute to the overall quality of life (social wellbeing) of people not just their standard of living
2.3 Identify and assess the needs of vulnerable, at risk, groups and/or ethnic minorities or indigenous peoples
2.4 Clearly identify which individuals, groups, organisations and communities stand to benefit from the proposed intervention and those that stand to be negatively affected. In so doing the assessment must identify and emphasize vulnerable and underrepresented groups
2.5 Recognise that social, economic and biophysical systems and impacts are inextricably

	interconnected, and identify and understand the impact pathways created when changes in one domain trigger impacts across other domains
2.6	Acknowledge and incorporate local knowledge and experience into the assessment process
2.7	Identify and assess developmental opportunities and not merely the mitigation of negative or unintended outcomes.
3.	**Key Areas of Particular Interest**
3.1	Where vulnerable communities are present
3.2	With high poverty and unemployment levels
3.3	Where access to services, mobility and community networks are affected
3.4	Where local livelihoods depend on access to and use of environmental resources and services
3.5	Of important tourism or recreation value
3.6	Where the existing character and "sense of place" will be altered.

2.1 Methodology

2.1.1 Data Collection

Data sources consulted to compile the socio-economic baseline include internet sources (e.g. Statistics South Africa website), provincial and local government reports and publications (e.g. IDPs and Spatial Development Plans (SDPs); as well as previously conducted Environmental Impact Assessments (EIAs) and Strategic Environmental Assessments (SEAs) (e.g. The Wind and Solar SEA (DEA, 2015) conducted in the study area. Where necessary, one-on-one conversation with selected informants were also used to obtain context-specific information.

2.1.2 Data Analysis

Data was analysed by consulting documents of various origins (government, academia and consultants) which dealt with similar aspects of the socio-economic environment, and which was published over different time-frames; thereby establishing a nuanced and longitudinal perspective of the receiving environment. Information thus obtained was evaluated to establish status quo socio-economic conditions, prevailing social structures, local demographic trends, and potential change processes present in the study area.

2.1.3 Impact Assessment

The relevant impact assessment methodology was provided by CSIR (the legally appointed EAP) so as to ensure uniformity of assessment across the entire suite of specialist studies commission as part of the EIA process undertaken for the proposed development. Please refer to **Section D** for a full description of the impact assessment methodology. Information Sources

2.1.4 Information sources

The data sources used in this SIA include:

- Department of Environmental Affairs (DEA). 2015. Wind and Solar SEA
- Barbour, T. 2007. DEA&DP Guideline for Social Impact Assessment.
- Cattell, V. Poor people, poor place and poor health: the mediating role of social workers and social capital. Social Science & Medicine. 2001. Vol 52 (10), 1501-1516.
- Coleman, James. 1990. The Foundations of Social Theory. Cambridge, MA: Belknap of Harvard UP.
- Dinkleman, T., Lam, D. and Leibbrandt, M. Linking Poverty and Income Shocks to Risky Sexual Behavior. South African Journal of Economy. 2008. Vol 76, 52 – 74.

- EndemicVision. 2014. Draft Environmental Impact Assessment for the Vryburg Water Treatment Works.
- Grootaert, C., & Bastelaer, T. V. 2002. Understanding and Measuring Social Capital. Washington D.C., U.S.A.: The World Bank.
- Human Sciences Research Council (HSRC). 2008. South African National HIV Prevalence, Incidence, Behaviour and Communication Survey.
- Kruger, K. 2016.Social Impact Assessment Review for the Protea Solar Power Plant (RF) (Pty) Ltd.
- Johnson, S., Kincaid, L., Laurence, S., Chikwava, F., Delate, R., & Mahlasela, L. 2009. Second National HIV Communication Survey 2009: Findings from Eastern Cape Province. Pretoria: JHHESA.
- Lin, N. 2001. Social Capital: A Theory of Social Structure and Action. Cambridge University Press.
- Naledi Local Municipality. 2017. Naledi Local Municpality IDP & Budget (2017-2022). Vryburg: Naledi Local Municipality.
- Trimpop, R. 1994. The psychology of risk taking behavior. Amsterdam: Elsevier Science.
- Statistics South Africa. 2012. Census 2011 Municipal Report - North West. Pretoria: Statistics South Africa.
- Statistics South Africa. 2016. Community Survey 2016 Provincial Report - North West. Pretoria: Statistics South Africa.

2.2 Assumptions, Knowledge Gaps and Limitations

This SEIA is based on a number of key assumptions, which are aligned with industry practice, and is consequently subject to certain limitations. When deliberating the information, opinions and findings of this report; the relevant assumptions and limitations should be considered. However, the assumptions and limitations are not expected to invalidate the findings of this report.

Key assumptions:

- The SIA is based on the technical information provided by the Applicant and which is assumed to be accurate (e.g. the proposed location, extent, scale of the project);
- The SIA is largely based on secondary data. Accordingly, with the exception of a site inspection, no primary research or social surveys have been conducted as part of this assessment. However, the level of assessment and its attendant data sources were deemed adequate for the purposes of this study;
- The accuracy of secondary data sources directly influences the quality of this SIA. However, the data used in this assessment is published by reputable authors and are therefore deemed to be of sufficient quality for the purpose of this study;
- It is assumed that the socio-economic conditions, as found during the assessment, will not undergo significant changes between the date of data collection and the release of this report; and
- Cumulative impacts are assessed by adding expected impacts from this proposed development to existing and proposed developments with similar impacts in a 30km radius. The existing and proposed developments that were taken into consideration for cumulative impacts are listed in Table 2 below:

Table 2 List of renewable energy projects in a 30km radius around the proposed development

PROPOSED DEVELOPMENT	DEA REFERENCE NO.	CURRENT EIA STATUS	PROPONENT	PROPOSED CAPACITY	EXTENT	FARM DETAILS
Sonbesie Solar Power Plant	14/12/16/3/3/2/915	EIA ongoing	Sonbesie Solar Power Plant (RF) (Pty) Ltd.	115 MW	264 Ha	Remaining Extent of the farm Retreat 671
Gamma Solar Power Plant	14/12/16/3/3/2/917	EIA ongoing	Gamma Solar Power Plant (RF) (Pty) Ltd.	115 MW	285 Ha	Portion 4 of the farm Champions Kloof 731
Khubu Solar Power Plant	14/12/16/3/3/2/912	EIA ongoing	Khubu Solar Power Plant (RF) (Pty) Ltd.	115 MW	300 Ha	Portion 4 of the farm Champions Kloof 731
Alpha Solar Power Plant	14/12/16/3/3/2/916	EIA ongoing	Alpha Solar Power Plant (RF) (Pty) Ltd.	115 MW	285 Ha	Portion 3 of the farm Vyflings Pan 598
Meerkat Solar Power Plant	14/12/16/3/3/2/913	EIA ongoing	Meerkat Solar Power Plant (RF) (Pty) Ltd.	115 MW	250 Ha	Portion 3 of the farm Middel Pan
Protea Solar Power Plant	14/12/16/3/3/2/914	EIA ongoing	Protea Solar Power Plant (RF) (Pty) Ltd.	115 MW	240 Ha	Remaining Externt of the farm Hartsboom 734
Soalr energy fascility (PV4) on Badenhost Dam	14/12/16/3/3/2/506	EIA ongoing	Dudely Janeke Environmental Consultants	75 MW	150 Ha	Proposed photovoltaic Soalr energy fascility (PV4) on Badenhost Dam Farm near De Aar in the Northren cape
Tiger Kloof Solar PV energy facility	14/12/16/3/3/2/535	Environmental authorisation (EA) received	Kabi Solar (Pty) Ltd.	75 MW	250 Ha	Portions 3 & 4 of the Farm Waterloo 730
Sediba Power Plant 75MW PV Solar Facility and associated infrastructure	14/12/16/3/3/2/390AM1	EA received	Sediba Power Plant (Pty) Ltd	75 MW	150 ha	A portion of the remaining extent of the Farm Rosendal 673
Sediba Power Plant 75MW PV Solar Facility and associated infrastructure	14/12/16/3/3/2/390AM2	EA received	Sediba Power Plant (Pty) Ltd	75 MW	150 Ha	A portion of the remaining extent of the Farm Rosendal 673
Waterloo Solar Park	14/12/16/3/3/2/308AM3	EA and awarded preferred bidder status (REIPPP window 4).	DPS79 Solar Energy (Pty) Ltd	75 MW	150 Ha	Southern portion of the Farm Waterloo 992
Cronos Energy Renewable Energy Generation Project	14/12/16/3/3/2/750	EA received	Cronos Energy (Pty) Ltd	75 MW		Remainder of the Farm Elma No 575
75MW Carocraft PV Solar Park and associated infrastructure	14/12/16/3/3/2/374	EA received 29 June 2013. Amended to 75 MW on 4 April 2014.	Carocraft (Pty) Ltd	75 MW		Portion 1 and the Remainder of the Farm Weltevrede 681
Expansion of the Carocraft Solar Park	14/12/16/3/3/2/699	EIA underway	Carocraft (Pty) Ltd	75 MW		Southern side of the Remainder of the Farm Weltevrede 681
Woodhouse Solar 1 PV Facility	14/12/16/3/3/2/863	EIA ongoing	Genesis Woodhouse Solar 1 (Pty) Ltd	100 MW		Remaining extent of the Farm Woodhouse 729

PROPOSED DEVELOPMENT	DEA REFERENCE	CURRENT EIA STATUS	PROPONENT	PROPOSED CAPACITY	EXTENT	FARM DETAILS
Woodhouse Solar 2 PV Facility	14/12/16/3/3/2/865	EIA ongoing	Genesis Woodhouse Solar 2 (Pty) Ltd	100 MW		Remaining extent of the Farm Woodhouse 729
Delta Photovoltaic Power Plant		EIA underway	AMDA-Delta (Pty) Ltd.	75 MW	250 Ha	Remaining Extent of the farm Klondike No. 670
Echo Photovoltaic Power Plant		EIA underway	AMDA-Echo (Pty) Ltd.	75 MW	250 Ha	Remaining Extent of the farm Klondike No. 670
Foxtrot Photovoltaic Power Plant		EIA underway	AMDA-Foxtrot (Pty) Ltd.	75 MW	221 Ha	Remaining Extent of the farm Klondike No. 670
Sendawo 1	14/12/16/3/3/2/891	EIA ongoing	BioTherm Energy	75 MW	368 Ha	Portion 1 of the Farm Edinburgh No 735
Sendawo 2	14/12/16/3/3/2/892	EIA ongoing	BioTherm Energy	75 MW	416 Ha	Portion 1 of the Farm Edinburgh No 735
Sendawo 3	14/12/16/3/3/2/893	EIA ongoing	BioTherm Energy	75 MW	360 Ha	Portion 1 of the Farm Edinburgh No 735

Key limitations:

- Socio-economic impacts are inherently interconnected and do not lend itself to clear disaggregation into distinct impacts;
- Socio-economic impacts are notoriously difficult to quantify, and represents differing levels of significance to different individuals. Accordingly, the same impact might be experienced in vastly different ways by different individuals within the same community;
- Socio-economic impacts, being the product of human behaviour, are derived from baseline information and anticipated project implications; as opposed to being empirically measured; and
- Humans, and the communities in which they live are adaptable, dynamic and open systems. Accordingly, the communities under investigation in this SIA might react to various factors not necessarily related to the proposed development; thereby complicating clear inference of observed social change to anticipated project impacts.

2.3 Description of Project Aspects relevant to SIA Impacts

This section describes the proposed project aspects that are relevant to the specialist study and potential impacts.

The main socio-economic aspects of the project that could have socio-economic effects for the local community are:

- Construction phase: estimated 40 to 50 skilled and 200 to 250 unskilled employment opportunities for the PV facility and transmission lines over 14 months, with associated socio-economic implications from the project development and investment.

- Operations phase: estimated 20 skilled and 40 unskilled employment opportunities will be created over the 20 year lifespan of the proposed facility, as well as effects of the social investment program that is required as part of the Renewable Energy Independent Power Producer Programme (REI4P).

- Create a local community trust or similar (as required by REI4P) which has an equity share in the project life to benefit historically disadvantaged communities.

- Initiate a skills development and training strategy to facilitate future employment from the local community.
- Give preference to local suppliers for the construction of the facility.
- Support local community upliftment projects and entrepreneurship through socio-economic and enterprise development initiatives.

3 DESCRIPTION OF THE RECEIVING ENVIRONMENT

3.1 Baseline Environmental Description

3.1.1 Regional socio-economic overview

The North-West Province consists of four District Municipalities (DMs), comprising of the Bojanala Platinum DM; Ngaka Modiri Molema DM; Dr Ruth Semogotsi Mompati DM; and the Dr Kenneth Kuanda DM. The study area (i.e. the town Vryheid and its immediate surrounds) is located within the Dr Ruth Semogotsi Mompati DM (DRSMDM).

The DRSDM is the largest of the four district municipalities in the North-West Province, but with the smallest population. Population figures in the DRSMDM has declined from 463 815 in 2011, to 459 375 in 2016 (StatsSA, 2016). The reason for this negative growth is not immediately apparent. In terms of education, the DRSMDM performs poorly when compared to provincial averages (DRSMDM education levels: No schooling=34.6%; Primary=12%; Secondary=50.6%; and Higher=2.8%) (Provincial education levels: No schooling=19.3%; Primary=11%; Secondary=65.1%; and Higher=4.6%) (StatsSA, 2016).

The major economic sectors in the DRSMDM is agriculture and hunting (21%), finance and insurance (8%), administration (8%), transport (5%), and the manufacturing (1%). Livestock farming dominates the local economy, and is centred around the town of Vryheid (Naledi Local Municipality). Economic growth in the DRSMDM is considered low, and is only present in limited economic sectors; predominantly mining and agriculture (Kruger, 2016).

3.1.2 Local socio-economic baseline

NLM is a Category B Municipality located within the central part of the DRSMDM, within the North-West Province, and covers an approximate area of 7 264 km^2. The primary urban nodes within the NLM are the towns of Vryburg and Stella, with the Vryburg also acting as the administrative centre of the local municipality. NLM is a predominantly rural area (approximately 60% rural) (EndemicVision, 2014) with a total population of 68 803 (StatsSA, 2016). The NLM is further divided into 5 main places, namely: Vryburg town, Huhudi township, Colridge township, Stella, Devondale and Dithakwaneng village (StatsSA, 2011).

According to the South African Government Performance Index (Good Governance Africa, 2016), the NLM is rated as an average performer in terms of service delivery (score of 79 to156), while the Price Waterhouse Coopers (PwC) Municipal Performance Index (MPI) (2017) rates the NLM as scoring slightly below average (nationally) in terms of socio-economics (4.9 out of 10) and corporate governance (4.4 out of 10). It is notable that the NLM generally appears to score higher in terms of service delivery when compared to other local municipalities immediately surrounding it in North-West Province.

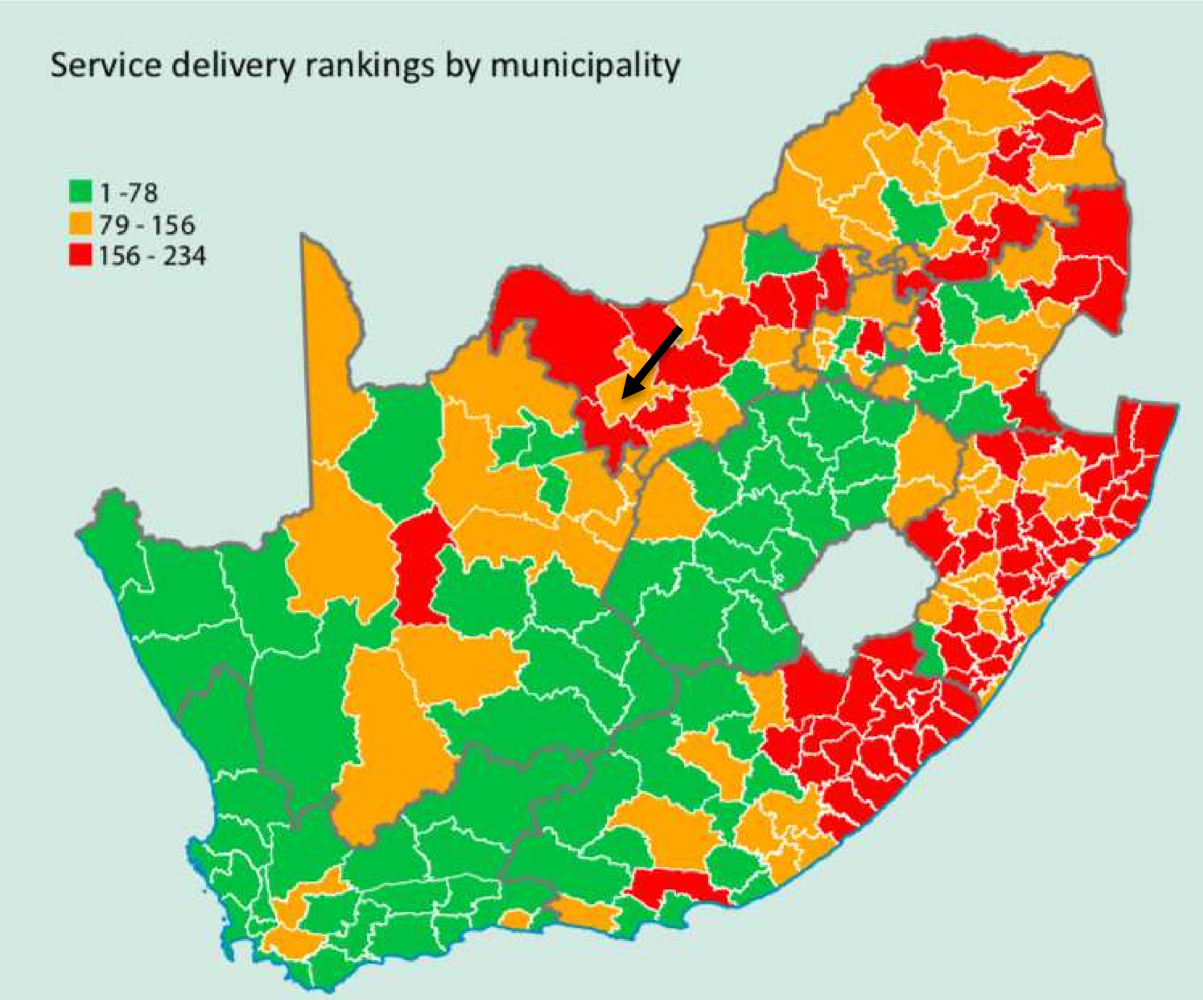

Figure 1 Service delivery rankings by regional municipality (NLM marked with arrow) (Source: Good Governance Africa, 2016)

3.1.2.1 Administrative structure

Administrative authority in NLM is derived from the DRSMDM by means of elected councillors. A total of 30 elected councillors serve in the DRSMDM, which consists of 5 tribal authority leaders; 10 proportional representation councillors; and 15 councillors representing local municipalities) (EndemicVision, 2014). Councillors represent local government in the NLM and are responsible for the management of service delivery (e.g. water, sanitation, and refuse removal) and the initiation of new projects within the relevant communities. The NLM Municipal Council consists of 20 Councilors of which 10 are ward councilors and 10 are proportional representatives (IDP, 2017).

The Integrated Development Plan (IDP) 2017-2022 objectives of the NLM are to:

- Promote sound financial management;
- Promote transparency through good governance;
- Foster good relationships with stakeholders through effective public participation;

- Foster good corporate culture;
- Accelerate the provision of basic services; and
- Create an environment conducive for local economic development.

3.1.2.2 Demographics

The NLM has a total population of 68 803 (StatsSA, 2016) with an average growth rate of 2.94% (2011 to 2016), which is notably higher than the South African national population growth rate of 1.6% per annum (StasSA, 2016). The total population consists of 74% Black Africans, 14.7% Coloured people, 9.5% White people, 9.5%, and 1.1% Asian/Indians (StasSA, 2011). The sex distribution of the NLM is 49.83% female to 50.17% male, while the age distribution is 31% for the population aged 0-14 years, 34% for those aged 15-34 years, 30% for those aged 35-60 years, and 5% for the population aged above 65 years.

An analysis of the NLM age distribution reveals a dependency ratio of 56.2 (Dependency Ratio = (Number of dependents (i.e. below 15 years and above 65 years) / Population aged 15 to 64) x 100%) (StatsSA, 2011), which is higher than the 2011 North-West provincial average dependency ratio of 55.7. In terms of demographic analysis, a higher dependency ratio means that a greater economic burden is placed in the economically active population to support a young and/or aging population.

A comparison of the 2011 and 2001 Census data reveals that the dependency ratio decreased from 58.4 in 2001 to 56.2 in 2011, while the 0-14 years population group decreased from 32.3% to 31%, the elderly (65+years) increased from 4.5% to 5%, and female headed households increased from 34.8% to 35.5% over the same period (StasSA, 2011). The young (0-14 years), the elderly, and female headed households represent key vulnerable people groups within the NLM. Based on the available demographic data, the number of vulnerable people on average increased within the NLM over a 10-year period (2001–2011); with the exception of the young which experienced a reduction of 1.3% over the same period.

3.1.2.3 Education

The NLM has 16 primary schools, 1 combined school, 1 intermediate school, and 14 secondary schools (EdemicVision, 2014).

Illiteracy and low levels of education negatively impact on the NLM, with 21.9% of the local population having had no schooling.

The number of persons aged 5-24 who attended educational institutions within the North-West Province increased from 70.4% in 2011 to 73.9% in 2016; however, this figure dropped within the NLM from 67% in 2011 to 66% in 2016; with the NLM currently rating as the local municipality with the second lowest attendance levels within the North-West Province (StatsSA, 2016).

In terms of early childhood development (children aged 0-4 years attending an educational institution), the NLM has the second highest total non-attendance figure (73.3%) in the North-West Province (StatsSA, 2016). The NLMs highest level of education for the population 20 years and older are generally better (No schooling=21.9%; Primary=10,7%; Secondary=64.3%; and Higher=3.1%) than the DRSMDM figures (No schooling=34.6%; Primary=12%; Secondary=50.6%; and Higher=2.8%). However, the NLM figures are consistently poorer than the provincial education levels (No schooling=19.3%; Primary=11%; Secondary=65.1%; and Higher=4.6%) (StatsSA, 2016). The NLMs poor performance in terms of early childhood development and primary education is of particular concern, as the local spill-over effects (i.e. benefits to society that result from providing goods and services to individuals) of these forms of education exceed that of secondary and tertiary education (Weaver *et al*, 1997). Accordingly, early childhood development and primary education are to be prioritised in a resource poor environment, to avoid perpetuating unemployment and poverty.

3.1.2.4 Economic profile

The unemployment rate in the NLM decreased from 36.6% in 2001 to 26.1% in 2011, while the youth unemployment rate also decreased from 46.1% in 2001 to 35.5% in 2011 (StatsSA, 2011). The key employment sectors within the NLM are indicated in Table 3 below.

Table 3 Sectors of employment in the Naledi Local Municipality (Source: StatsSA, 2011)

Sector of employment	
Sector	**Percentage of total employment**
Agriculture, hunting, forestry and fishing	27.8%
Community, social and personal services	23.4%
Wholesale and retail trade	17.5%
Private Households	13.9%
Manufacturing	6.0%
Financial, insurance, real estate and business	5.2%
Transport, storage and communication	2.6%
Construction	2.6%
Mining and quarrying	0.5%
Electricity, gas and water supply	0.5%

Agriculture is the primary economic activity and employment sector within the NLM (27.8%) followed by community, social and personal services (23.4%), and the wholesale and retail trade (17.5%). The NLM IDP for the 2017-2022 period, highlights cattle farming and hunting/game farming as two major components of the NLM local economic development (LED) plan, which appear to support the current employment realities of the area. However, the NLM IDP (207-2022) also identifies renewable energy as a key economic sector within its LED plan. Inclusion of renewable energy as a key sector not only plays to the natural strengths of the area (i.e. good solar irradiation levels), but also appears to be aimed at bringing parity between the existing employment sectors by providing much needed growth within the local construction (2.6%) and electricity (0.5%) employment sectors.

3.1.2.5 Health

In terms of infrastructure, the town of Vryburg has 2 hospitals, 1 mobile clinic and 1 community health centre (IDP, 2017).

Detailed HIV/AIDS and tuberculosis (TB) data for the NLM could not be obtained, but provincial-level (I.e. North-West Province) information on these health aspects are available. According to the 2008 South African National HIV Prevalence, Incidence, Behaviour and Communication Survey (HSRC, 2008) the North-West Province's HIV prevalence is 11.3% in people aged 2-14 years, and 17.7% in people aged 15-49 years.

In 2009 the North-West Province had the highest incidence (47%) of young women with sexual partners that are 5 or more years older than themselves (*i.e.* intergenerational sex), and are therefore more prone to HIV/AIDS infection (Johnson *et al*, 2010). This figure is 9% higher than the South African national percentage for intergenerational sex; at 38%. More disturbing is the fact that intergenerational sex in the North-West Province increased by 19% from 28% in 2006, to 47% in 2009 (Johnson *et al*, 2010). This increase suggests that intergenerational sex might be a growing trend within the North-West Province.

The DRSMDM showed a marginally improved TB cure rate in 2006 (67.4%) as compared to 2003 (66.5%). However, the DRSMDM still has a high TB incidence rate of 356 new cases per 100 000 members of the population (EndemicVision, 2014).

3.1.2.6 Infrastructure and Services

Water and sanitation

NLM functions as the Water Service Provider, while the DRSMDM is the Water Authority. Vryburg is the only town which is supplied with surface water, while also obtaining approximately 50% of its water demand from ground water sources. The balance of its water demand is obtained from the Prudimoe Treatment Works (EndemicVision, 2014). NLM has sufficient household water provision, with 83% of households having access to piped water supply, 5% using natural water sources, and 12 using other sources (IDP, 2017).

Approximately 14 946 households have access to flush toilets connected to either the public sewerage system, or septic/conservancy tank, while 5746 households have no access to formal sanitation (i.e. pit latrines and bucket toilets) (IDP, 2017). The sanitation backlog for the NLM appears to have increased by 2856 between 2012 (2890 backlog) and 2017 (5746 backlog).

Electricity

Of the 20 692 households in the NLM, 16 612 have access to electricity, and 3 856 have no access to electricity (i.e. use of candles/paraffin lamps for lighting and gas/wood fire for cooking). Approximately 50 households have illegal connections to the electrical grid, while 83 households have solar electrical systems (IDP, 2017).

Housing

The NLM has 17 561 households residing in formal structures, with 3131 households living in informal structures (IDP, 2017). Though accurate numbers could not be obtained, it appears as if the NLM housing backlog increased by 881 between 2012 (2250 houses) and 2017 (3131 houses).

3.2 Identification of Environmental Sensitivities

From the baseline information provided in 3.1 above, the following inferences can be drawn:

(i) The NLM has a fairly rapidly growing population with a commensurate growth in vulnerable people groups (i.e. the elderly, woman, and those suffering from HIV/AIDS and TB). As a result, social and economic pressure is likely to increase on extended family, social support networks, and local government in order to provide care for vulnerable members of the community.

(ii) The 2011 dependency ratio for the NLM (56.2%), though being lower than the 2001 figure, remains high. Furthermore, the NLM population growth rate of 2.94% exceeds even the best-case scenario expectations of local and national economic growth. Accordingly, unemployment and an increased financial burden on the economically active portion of the population will remain comparatively high; even though a relative reduction in unemployment is currently being experienced in the NLM.

(iii) Declining levels of education within the NLM suggests that the prospective workforce will struggle to find gainful employment within the local municipality. This in turn will tend to exacerbate the impacts of a high dependency ratio; as the unemployed and/or job seekers will not be generating income and will constitute a burden on the economically active portion of the community.

(iv) The primary employment sectors within the NLM (Agriculture (27.8%), Community, social and personal services (23.4%), and Wholesale and retail trade (17.5%)), are, by its very nature, limited in terms of the number of workers it can accommodate. Conversely, the poorest performing employment sectors within the NLM (Construction (2.6%), Mining (0.5%), and Electricity (0.5%)) are better suited to employing larger numbers of workers. Accordingly, parity within high employment capacity sectors of the NLM local economy is required.

(v) Available research suggests that the NLM has a high HIV/AIDS infection rate. Poor and/or declining levels of education within the NLM, combined with a comparatively high unemployment rate and dependency ratio, will tend to exacerbate risky social behaviour. Two commonly observed forms of risky social behaviour observed in poor or marginalized communities, are early sexual debut among teenagers (Dinkleman *et al*, 2008) and increased criminal behaviour. Consequently, the HIV/AIDS infection right might be expected to remain elevated within the NLM.

When considering the above inferences and the nature of the proposed development, the primary environmental sensitivities appear to be:

- **Preservation of the integrity of existing social structures:**

Existing social structures provide a socio-economic safety net for vulnerable community members, while also serving to maintain social cohesion through the practice and implementation of local cultural norms, beliefs and values.

- **Preservation and growth of physical and economic safety**:

The asset classes, or capital, available to community members in the NLM (e.g. productive farms, infrastructure, and bulk services) must be protected, while asset classes currently in short supply need to be developed (e.g. income for the poor, improved education, and improved health). Such protection and development is vital in controlling and ultimately alleviating poverty and vulnerability. Moreover, jeopardizing physical and economic safety will serve to undermine existing social structures within the NLM.

- **The wellbeing of the poor and vulnerable people groups**:

The NLM has a Constitutional directive to care for its poor and vulnerable citizens. Moreover, any development which fails to consider and/or attempt to improve the plight of the poor and vulnerable; runs the risk of exacerbating local poverty and/or local animosity towards said development.

3.3 Issues, Risks and Impacts

3.3.1 Identification of Potential Impacts/Risks

The potential impacts identified during the BA process are:

Construction Phase

- Disruption of local social structures as a result of the construction work force and in-migration of job seekers for the 14 month construction period;
- Increased burden on existing social and bulk services as a result of workforce and job seeker influx;
- Temporary employment creation from the estimated 40 to 50 skilled jobs and 200 to 250 unskilled jobs over the 14 month construction period;
- Unrealistic expectations regarding local job creation, with associated discontent and potential negativity towards the proposed development;

- Development of locally-owned support industries to respond to construction-related activities;
- Increased risky social behaviour (including but not limited to sex work, transgenerational sex, and drug abuse) which is associated with increased levels of disposable income within a cash-poor, high unemployment area; and
- Damage to farm property/loss of livestock due to negligent and/or criminal behaviour by members of the construction work force.

Operational Phase

- Establishment of a Community Trust; and
- Potential loss of farmland due to the construction of the proposed solar energy facility.

Decommissioning Phase

- Loss of local employment and income as a result of the proposed project being decommissioned.

Cumulative Impacts

- Cumulative disruption of social structures as a result of the influx of large construction work forces from multiple renewable energy projects which serve to weaken existing social capital;
- Cumulative increase in HIV/AIDS infection rate as a result of disposable income being used to engage the services of sex workers and procure drugs; and
- Cumulative socio-economic benefit to the local community as a consequence of the combined temporary employment opportunities created by multiple renewable energy projects, as well as the combined effect of multiple community trust being established by said projects to benefit local communities.

4 IMPACT ASSESSMENT

4.1 Potential Impacts during the Construction Phase

4.1.1 Disruption of local social structures as a result of the construction work force and in-migration of job seekers

It is reasonable to assume that the construction phase of the proposed development will require a sizable workforce (the developer foresees a workforce of approximately 40 to 50 skilled and 200 to 250 unskilled workers), while also serving as an economic pull factor for non-resident jobseekers. The size of the anticipated workforce is a product of the scale of the proposed development, which is significant enough to support the inference of a large labour pool. On the other hand, in-migration as a result of jobseeker influx is likely to occur as a result of the comparatively high unemployment rate in the NLM. Consequently, there exists a strong possibility that jobseekers, who reside outside of the immediate project area (i.e. Vryburg), may migrate into the immediate project area in search of employment.

The relevant workforce and potential jobseekers will, by necessary implication, be housed in or near the immediate project area for the duration of the construction phase, and, in the case of jobseekers, might remain after the conclusion of this phase. Medium to longer-term housing of such “outsiders” in Vryburg might negatively impact on the local social structures present in these areas. The basis for such an impact is the close relationship between social structure and social capital (Cattell, 2010; Lin 2001).

Social structure, at a micro-scale (i.e. local), consists of the everyday interactions between members of a community which tends to produce norms and customs and include concepts like how we interact with others, what we expect from others, and sexuality. On the other hand, social capital can be defined as the relevant benefits which emerge from cooperation, reciprocity and trust in a community. Coleman (1990), expresses social capital's functional value as any action which facilitates individual or collective action as a result of networks of relationships based on trust reciprocity and social norms.

Should the impact of "outsiders" be sufficient to influence local social capital, such an impact could undermine the benefits associated with social capital, and which is known to perform a key poverty alleviation function in poor communities (Grootaert & Bastelaer, 2002). According to the Census 2011 data, the NLM has a comparatively high unemployment rate and dependency ratio. Accordingly, the immediate project area appears to be relatively vulnerable and subsequently more dependent on social capital to create adaptive capacity in response to poverty.

However, it should be noted that the Waterloo Solar Park (located just outside Vryburg) has received preferred bidder status. As a result, it is reasonable to assume that the said project will be constructed in the near future. Furthermore, numerous solar energy developments are currently proposed near Vryburg. As a result, it is rational to infer that Vryburg will experience some disruption of social structures *before* the potential construction of the Veroniva solar energy facility. Accordingly, the influx of job seekers and the presence of a large construction workforce will not be a completely new/unknown phenomenon to the local community. It therefore follows that the relative significance of this impact will be lessened as a result of the community' prior exposure and experience with similar projects.

Aspect/Activity	**All construction-related activities and employment opportunities**
Type of Impact	Direct
Potential Impact	Disruption of local social structures as a result of the presence of the construction work force and in-migration of job seekers
Status	Negative
Mitigation Required	No effective mitigation available
Impact Significance (Pre-Mitigation)	Low (Level 4)
Impact Significance (Post-Mitigation)	Low (Level 4)
I&AP Concern	Unknown

4.1.2 Unrealistic expectations regarding local job creation, with associated discontent and potential negativity towards the proposed development

In light of the unemployment and poverty rates within the NLM, it is likely that the immediate project area might develop specific expectations regarding potential employment opportunities created by the proposed development. While the absolute elimination of employment expectations is neither possible nor desirable; a consorted effort by the developer would be required to manage such expectations to be within reasonable bounds. Importantly, early intervention would be vitally important to help shape such expectations from as early stage as possible within the project development program. In the absence of such management initiatives, communities will shape their own expectations, which is bound to be informed by their specific needs. It is in the developer's best interest to manage these expectations, as failure to do so might lead to discontent and potential negativity towards the development, with its attendant negative impacts (e.g. public opposition, potential protest action and potential damage to property).

Aspect/Activity	**All construction-related activities and employment opportunities**
Type of Impact	Direct
Potential Impact	Unrealistic expectations regarding local job creation, with associated discontent and potential negativity towards the proposed development
Status	Negative
Mitigation Required	• The Applicant, or Contractor, must engage the local community (within the immediate project area) on the nature, duration, number and availability of employment opportunities well in advance of any construction activities taking place. It is recommended that existing social structures be utilised for such interaction, and that the process be commenced once environmental authorisations has been granted. • The Contractor should establish an employment desk at the construction site to facilitate employment-related queries, and maintain a register of applicants which reflects their respective expertise, skill level and contact/residential details. Whenever planned or ad hoc employment is considered, the register should be consulted to identify appropriately qualified candidates. • The existence of the employment desk, and the relevant procedures associated with the selection and appointment of workers must be communicated to the local community. • It is strongly suggested that every effort should be made to employ local residents.
Impact Significance (Pre-Mitigation)	Medium (Level 3)
Impact Significance (Post-Mitigation)	Low (Level 4)
I&AP Concern	Unknown

4.1.3 Increased burden on existing social and bulk services as a result of workforce and job seeker influx

Increased local population, within the immediate project area, is likely to occur as a result of the proposed development. Such an increase might be significant in terms of its effect on social structures and socio-economic wellbeing, but is not expected to be significant in terms of its impact on local social and bulk services. Infrastructure services in the NLM appear to be acceptable as compared against existing population figures, and the anticipated influx cannot reasonably be assumed to significantly alter such population figures. However, it should be noted that the bulk of the construction workforce is likely to be housed in backyard dwellings within existing informal settlements, with its attendant health challenges (e.g. poor sanitation and variable access to electricity for heating and lighting purposes). These impacts are, however, expected to be *ad hoc* and unlikely to impact on the larger community.

Aspect/Activity	**All construction-related activities and employment opportunities**
Type of Impact	Direct
Potential Impact	Increased burden on existing social and bulk services as a result of workforce and job seeker influx
Status	Negative
Mitigation Required	No effective mitigation available
Impact Significance (Pre-Mitigation)	Low (Level 4)
Impact Significance (Post-Mitigation)	Low (Level 4)
I&AP Concern	Unknown

4.1.4 Increased risky social behaviour

Trimprop (1994) defines risky social behaviour as "*any consciously, or non-consciously controlled behaviour with a perceived uncertainty about its outcome, and/or about its possible benefits, or costs for the physical, economic or psycho-social well-being of oneself or others*". Two commonly observed forms of risky social behaviour observed in poor or marginalized communities, are early sexual debut among teenagers (Dinkleman *et al*, 2008) and increased criminal behaviour.

The baseline data, the socio-economic conditions present in the immediate project area appears to be comparatively challenging, with a pronounced class/income-based differentiation in terms of housing and income. It is therefore reasonable to expect that marginalized youth in the immediate project area might be at risk of increased risky social behaviour.

Disturbance of local social structures and the temporary increase in local spending power expected to result from workforce influx into the immediate project area, are likely to exacerbate the probability of risky social behaviour. Even though such influx is not expected to be a long-term feature of the local community; the impacts associated with risky social behaviour evidently are of a long-term nature. It is also important to note the NLMs apparent increase in HIV/AIDS infection rate. As such, an increased HIV infection rate and its associated socio-economic implications should be considered in combination with increased risky social behaviour.

Aspect/Activity	**All construction-related activities and employment opportunities**
Type of Impact	Direct
Potential Impact	Increased risky social behaviour such as sex work, transgenerational sex and drug abuse.
Status	Negative
Mitigation Required	• No construction workers should be allowed to sleep at the construction site. • The construction workforce should receive HIV awareness training prior to the commencement of construction. • HIV and TB testing and counselling should be made available to the construction workforce free of charge. This can be achieved in collaboration with the local clinic or treatment initiatives like Right to Care (http://www.righttocare.org) which provides HIV and TB testing on-site via mobile clinics. • Trends in local (within the immediate project area) HIV infection rates/ARV treatment loads must be monitored (annually) through close interaction with the local clinic. Should infections and treatment loads increase at a rate greater than the anticipated rate of increase; the Developer (or his appointed agent) must re-evaluate its HIV awareness training, take corrective action where necessary, and repeat said training. This mitigation is only required for the duration of the construction phase of the project.
Impact Significance (Pre-Mitigation)	Medium (Level 3)
Impact Significance (Post-Mitigation)	Low (Level 4)
I&AP Concern	Unknown

4.1.5 Damage to farm property/loss of livestock

During the construction phase of the proposed Veroniva solar energy facility, the presence of construction workers on the private property of relevant landowners may result in potential risk to property and livestock. Such risks include damage to property, theft and trespassing on areas other than the demarcated project site.

Aspect/Activity	**All construction-related activities and employment opportunities**
Type of Impact	Direct
Potential Impact	Damage to farm property/loss of livestock
Status	Negative
Mitigation Required	• The proposed project site should be fenced off and movement of construction workers should be limited to the construction site only. • No staff may stay overnight at the project location, except security personnel. • A code of conduct, aligned with South African labour legislation, must be signed by all workers whereby workers are informed of risks on the property, and that they will be held liable for any damages or losses incurred by the property owner as a result of workers' actions not directly related to their employment. • Contractors must clearly stipulate the disciplinary procedures applicable to workers in the case of theft, damage to property and/or trespassing.
Impact Significance (Pre-Mitigation)	Low (Level 4)
Impact Significance (Post-Mitigation)	Low (Level 4)
I&AP Concern	Unknown

4.1.6 Temporary employment creation

A limited number of temporary jobs might be created for residents of the immediate project area (an estimated 40 to 50 skilled and 200 to 250 unskilled employment opportunities). These jobs are expected to be for semi-skilled and unskilled labourers within the construction sector. Given the nature of the proposed development very limited permanent employment opportunities for local residents are anticipated to result from the operation of the development.

This impact, although of a limited nature, needs to be considered in the light of a comparatively small local construction sector (2.6%). Accordingly, the relative construction-related employment creation capacity of the proposed development could assist in creating parity within the poorer performing employment sectors of the NLM.

Aspect/Activity	**All construction-related activities and employment opportunities**
Type of Impact	Direct
Potential Impact	Temporary employment creation
Status	Positive
Enhancement Required	• The Contractor should establish an employment desk at the construction site to facilitate employment-related queries, and maintain a register of applicants which reflects their respective expertise, skill level and contact/residential details. Whenever planned or ad hoc employment is considered, the register should be consulted to identify

	appropriately qualified candidates. • The existence of the employment desk, and the relevant procedures associated with the selection and appointment of workers must be communicated to the local community. • It is strongly suggested that every effort should be made to employ local residents.
Impact Significance (Pre-Enhancement)	Very Low (Level 5)
Impact Significance (Post-Enhancement)	Low (Level 4)
I&AP Concern	Unknown

4.1.7 Development of locally-owned support industries to respond to construction-related activities

Limited opportunity exists for locally owned support industries to be developed in response to the construction-related activities associated with the proposed development (e.g. local accommodation, catering, and transport services). Such opportunities are anticipated to be temporary in nature.

Aspect/Activity	**All construction-related activities and employment opportunities**
Type of Impact	Direct
Potential Impact	Development of locally-owned support industries to respond to construction-related activities
Status	Positive
Enhancement Required	• The proponent to make use of local services as far as practically possible. • Procure goods and services from variety of providers as far as possible and available to promote a wide distribution of project associated benefits.
Impact Significance (Pre-Enhancement)	Low (Level 4)
Impact Significance (Post-Enhancement)	Low (Level 4)
I&AP Concern	Unknown

4.2 Potential Impacts during the Operational Phase

4.2.1 Employment creation

According to the information provided by the Applicant, 20 skilled and 40 unskilled employment opportunities will be created during the operational phase of the project. Given the relative poor educational performance of the area, skilled employment is unlikely to be obtained from within the local or even regional municipality. As a result, it is reasonable to assume that most, if not all skilled employment will be sourced from areas outside of the local/regional sphere of impact. Such employment, though being a positive impact, will accrue to skilled individuals who are socially mobile and therefore more resilient to economic changes and shocks. Given that the resource pool for skilled employment will, in all likelihood, be national in scale, the relative significance of 20 skilled employment opportunities must similarly be considered from a national perspective. An impairing factor in this regard is the uncertainty regarding the Applicant’s use of skilled foreign nationals to fill permanent and/or part-time skilled positions, this is particularly relevant given that the Applicant is a German-based company. Furthermore, the relative ratio of full-time to part-time employment within the skilled employment allocation remains uncertain. As a result, skilled employment during the operational phase has a relative low positive significance rating.

Unskilled employment during the operational phase of the project is likely to be temporary and *ad hoc* in nature. It should be noted that any employment creation within the study area is a very welcome positive contribution. However, the reality of approximately 2 temporary and *ad hoc* employment opportunities being created per year over the 20 year operational life of the project results in a relatively low positive impact.

Aspect/Activity	Operation of the solar energy facility
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Employment creation during operation of the project
Status	Positive
Mitigation Required	No effective enhancement available
Impact Significance (Pre-Mitigation)	Very Low (Level 5)
Impact Significance (Post-Mitigation)	Very Low (Level 5)
I&AP Concern	Unknown

4.2.2 Development of locally-owned support industries to respond to operational activities

Limited opportunity exists for locally owned support industries to be developed in response to the operational activities associated with the proposed development (e.g. local accommodation, catering, and transport services). Such opportunities are anticipated to be *ad hoc* in nature, but will nonetheless have a positive impact on the local economy.

Aspect/Activity	**All operational activities**
Type of Impact	Direct
Potential Impact	Development of locally-owned support industries to respond to operational activities
Status	Positive
Enhancement Required	• The proponent to make use of local services as far as practically possible. • Procure goods and services from variety of providers as far as possible and available to promote a wide distribution of project associated benefits.
Impact Significance (Pre-Enhancement)	Low (Level 4)
Impact Significance (Post-Enhancement)	Low (Level 4)
I&AP Concern	Unknown

4.2.3 Potential loss of farmland

The nature of the proposed development makes it evident that all land utilized for the housing of solar photovoltaic panels and relevant support infrastructure will not be available for agricultural purposes. Some loss of farmland is therefore inevitable.

According to the baseline information obtained for the NLM, agriculture is not only the primary employment sector in the area (27.8%), but cattle forming is also identified as the single most important form of agriculture in the NLM jurisdiction (IDP, 2017). Accordingly, the NLM identified LED programs to protect and promote cattle farming activities within the municipality. However, the same LED also contains a program to promote the establishment of renewable energy facilities within the municipal boundaries.

The potential for the proposed project to result in the loss of farmland should therefore be understood within the policy imperative as laid down by the NLM LED. It is reasonable to infer that the LED foresaw some loss of farmland in its active promotion of renewable energy facilities within the NLM. Accordingly, the limited loss of productive farmland, which appears to be actively supported by the NLM LED, cannot be construed as a significant impact from a socio-economic perspective.

Aspect/Activity	Operation of the solar energy facility
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Loss of farmland
Status	Negative
Mitigation Required	No effective mitigation available
Impact Significance (Pre-Mitigation)	Very Low (Level 5)
Impact Significance (Post-Mitigation)	Very Low (Level 5)
I&AP Concern	Unknown

4.2.4 Establishment of a Community Trust

All renewable energy projects seeking to obtain preferred bidder status must establish a community trust for the benefit of the local community where the project is to be developed. The proposed project's estimated operational lifetime of 25 years will ensure that the community trust for the proposed Veroniva solar energy facility will be capable of benefiting long-term project initiatives within the project area. However, strict community trust management controls must be implemented before the establishment of said trust, to avoid potential mismanagement of funds.

Aspect/Activity	Community trust establishment
Type of Impact	Direct
Potential Impact	Community benefits likely to emanate from the establishment of a community trust.
Status	Positive
Enhancement Required	• Potential trustees to sit on the Community Trust need to be identified with the assistance of the local municipality. • Strict financial management controls need to be in place in order to manage the funds generated for the Community Trust from the proposed project. Financial management controls may also include an annual audit. All financial management controls id subject to the requirements of the REI4P. • The criteria for identifying and the funding of community projects should be clear in order to optimally benefit the local community.
Impact Significance (Pre- Enhancement)	Medium (Level 3)
Impact Significance (Post- Enhancement)	Medium (Level 3)
I&AP Concern	Unknown

4.3 Potential Impacts during the Decommissioning Phase

4.3.1 Loss of local employment and income

Once the proposed project has reached the end of its operational life (25 years), the facility might be decommissioned. It is axiomatic that employment loss is likely to occur should the facility be decommissioned.

Very limited local employment will be available to the local community during the operational phase of the proposed project; due mainly to the low staff contingent necessary to maintain the facility, and the relatively technical nature of the work involved in said maintenance. Accordingly, employment losses as a result of decommissioning, though possible, will be of a low significance.

Aspect/Activity	Decommissioning of the facility
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Loss of employment and income due to decommissioning of the facility
Status	Negative
Mitigation Required	The Applicant must consider retraining and redeployment of local employees in an attempt to keep them in its employ.
Impact Significance (Pre-Mitigation)	Low (Level 4)
Impact Significance (Post-Mitigation)	Low (Level 4)
I&AP Concern	Unknown

4.4 Cumulative Impacts

4.4.1 Cumulative disruption of social structures

There exists a possibility that the combined effect of the preferred bidder project (Waterloo Solar Park), as well as the other proposed renewable energy projects surrounding Vryheid, might have a cumulative disruptive impact on the social structures present within the study area. However, this impact is mitigated to some extent by the current capacity of local electrical infrastructure to a maximum of 5 new developments.

As discussed earlier, the establishment of the Waterloo Solar Park is likely to *reduce* the disruptive effect future renewable energy projects might have on existing social structures within the study area. Moreover, as more projects are developed within the study area, the influx of a large construction workforce and job seekers is likely to become a “normal” aspect within the local social landscape, and the local community will become more resilient against said disruption.

Aspect/Activity	All construction-related activities and employment opportunities
Type of Impact (i.e. Impact Status)	Indirect
Potential Impact	Disruption of social structures within the study area
Status	Negative
Mitigation Required	No effective mitigation available
Impact Significance (Pre-Mitigation)	Low (Level 4)
Impact Significance (Post-Mitigation)	Low (Level 4)
I&AP Concern	Unknown

4.4.2 Cumulative increase in HIV/AIDS infection rate

As indicated in the baseline description of the study area; the NLM appears to have a high HIV infection rate, combined with high levels of intergenerational sex. In addition, the NLM has a comparatively high level of unemployment. Accordingly, the influx of workers with disposable income might result in an elevated level of transactional sex which is likely to place vulnerable women at risk of HIV\AIDS infection. It is self-evident that workers with disposable income from numerous renewable energy projects entering the study area will serve to exacerbate this risk.

Aspect/Activity	All construction-related activities and employment opportunities
Type of Impact (i.e. Impact Status)	Indirect
Potential Impact	Cumulative increase in HIV/AIDS infection rate
Status	Negative
Mitigation Required	• No construction workers should be allowed to sleep at the construction site. • The construction workforce should receive HIV awareness training prior to the commencement of construction. • HIV and TB testing and counselling should be made available to the construction workforce free of charge. This can be achieved in collaboration with the local clinic or treatment initiatives like Right to Care (http://www.righttocare.org) which provides HIV and TB testing on-site via mobile clinics. • Trends is local (within the immediate project area) HIV infection rates/ARV treatment loads must be monitored (annually) through close interaction with the local clinic. Should infections and treatment loads increase at a rate greater than the anticipated rate of increase; the Developer (or his appointed agent) must re-evaluate its HIV awareness training, take corrective action where necessary, and repeat said training. This is only required for the duration of the operational phase of the project.
Impact Significance (Pre-Mitigation)	Medium (Level 3)
Impact Significance (Post-Mitigation)	Medium (Level 3)
I&AP Concern	Unknown

4.4.3 Cumulative socio-economic benefit to the local community

In the event that numerous renewable energy projects might be developed within the project area; the combined effect of several community development trust will be available to the local community. The positive impact of more money being available for long-term socio-economic projects is self-evident.

Aspect/Activity	Operation of the proposed facility
Type of Impact (i.e. Impact Status)	Indirect
Potential Impact	Cumulative socio-economic benefit to local community
Status	Positive
Enhancement Required	No enhancement suggested
Impact Significance (Pre- Enhancement)	Medium (Level 3)
Impact Significance (Post- Enhancement)	Medium (Level 3)
I&AP Concern	Unknown

4.5 No-go alternative

The no-go alternative will result in the avoidance of risk to the integrity of existing social structures in the NLM, as no construction workforce nor job seekers will enter into the area. Potential conflict regrading job creation will similarly be avoided, as will potential strain on the exiting bulk infrastructure. Notably, the risk of an elevated HIV/AIDS infection rate will be avoided. The potential damage to farm property, stock losses and loss of productive farmland will not occur if the proposed project is not developed. In brief, all negative construction and operational phase impacts would be avoided if the no-go option is selected.

However, two important exceptions should be noted: (i) Should the no-go option be selected, all positive project impacts will fail to materialise (i.e. temporary employment, establishment of local support industries, and community trust benefits). (ii) All direct negative project impacts and negative cumulative project impacts are likely to occur even in the event that the proposed project *is not developed*. This is due to the presence of an approved bidder project (Waterloo Solar Park), and the fact that numerous other renewable energy projects are proposed in the area. Accordingly, the impacts identified in this report are likely to occur, regardless of the proposed project being approved.

5 IMPACT ASSESSMENT TABLES

The assessment of impacts and recommendation of mitigation measures as discussed above are collated in Tables 4 to 7 below.

Table 4 Impact Assessment Summary Table for the Construction Phase

Construction Phase													
Direct Impacts													
Aspect/ Impact Pathway	**Nature of Potential Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of Impact**	**Irreplaceability**	**Potential Mitigation Measures**	**Significance of Impact and Risk**		**Ranking of Residual Impact/ Risk**	**Confidence Level**
										Without Mitigation/ Management	**With Mitigation/ Management (Residual Impact/ Risk)**		
All construction related activities	Disruption of local social structures as a result of construction workforce and influx of job seekers	Negative	Local	Medium-term	Moderate	Likely	Low	Moderate	No effective mitigation available	Low	Low	4	Medium
All construction related activities	Unrealistic expectations regarding local job creation, with associated discontent and potential negativity towards the proposed development	Negative	Local	Medium-term	Moderate	Likely	Moderate	Low	• The Applicant, or Contractor, must engage the local community (within the immediate project area) on the nature, duration, number and availability of employment opportunities well in advance of any construction activities taking place. It is recommended that existing social structures be utilised for such interaction, and that the process be commenced once environmental authorisations has been granted. • The Contractor should establish an employment desk at the construction	Low	Very low	5	Medium

Construction Phase													
Direct Impacts													
									site to facilitate employment-related queries, and maintain a register of applicants which reflects their respective expertise, skill level and contact/residential details. Whenever planned or ad hoc employment is considered, the register should be consulted to identify appropriately qualified candidates. • The existence of the employment desk, and the relevant procedures associated with the selection and appointment of workers must be communicated to the local community. • It is strongly suggested that every effort should be made to employ local residents.				
All construction-related activities and employment opportunities	Increased burden on existing social and bulk services as a result of workforce and job seeker influx	Negative	Local	Medium-term	Slight	Unlikely	High	Replace-able	No effective mitigation available	Low	Low	4	
All construction-related activities and employment	Increased risky social behaviour	Negative	Local	Long-term	Medium	Likely	Non-reversible	High	• No construction workers should be allowed to sleep at the construction site. • The construction	Medium	Medium	3	Medium

Construction Phase													
Direct Impacts													
opportunities									workforce should receive HIV awareness training prior to the commencement of construction. • HIV and TB testing and counselling should be made available to the construction workforce free of charge. This can be achieved in collaboration with the local clinic or treatment initiatives like Right to Care (http://www.righttocare.org) which provides HIV and TB testing on-site via mobile clinics. • Trends in Local (within the immediate project area) HIV infection rates/ARV treatment loads must be monitored (annually) through close interaction with the local clinic. Should infections and treatment loads increase at a rate greater than the anticipated rate of increase; the Developer (or his appointed agent) must re-evaluate its HIV awareness training, take corrective action where necessary, and repeat said training. Only necessary during the				

Construction Phase													
Direct Impacts													
									construction phase of the project.				
All construction-related activities and employment opportunities	Damage to farm property/loss of livestock	Negative	Site	Short-term	Moderate	Likely	High	Replaceable	• The proposed project site should be fenced off and movement of construction workers should be limited to the construction site only. • No staff may overnight at the project location, except security personnel. • A code of conduct, aligned with South African labour legislation, must be signed by all workers whereby workers are informed of risks on the property, and that they will be held liable for any damages or losses incurred by the property owner as a result of workers' actions not directly related to their employment. • Contractors must clearly stipulate the disciplinary procedures applicable to workers in the case of theft, damage to property and/or trespassing.	Low	Low	4	High

Construction Phase													
Direct Impacts													
All construction-related activities and employment opportunities	Temporary employment creation	Positive	Local	Short-term	Moderate	Likely	N/A	N/A	• The Contractor should establish an employment desk at the construction site to facilitate employment-related queries, and maintain a register of applicants which reflects their respective expertise, skill level and contact/residential details. Whenever planned or ad hoc employment is considered, the register should be consulted to identify appropriately qualified candidates. • The existence of the employment desk, and the relevant procedures associated with the selection and appointment of workers must be communicated to the local community. • It is strongly suggested that every effort should be made to employ local residents.	Very low	Low	4	High
All construction-related activities and employment opportunities	Development of locally-owned support industries to respond to construction-related activities	Positive	Local	Short-term	Slight	Likely	N/A	N/A	• The proponent to make use o local services as far as practically possible. • Procure goods and services from variety of providers as fa as possible and available to promote a wide distribution of project associated benefits.	Low	Low	4	Medium

Table 5 Impact Assessment Summary Table for the Operational Phase

Operational Phase													
Direct Impacts													
Aspect/ Impact Pathway	**Nature of Potential Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of Impact**	**Irreplaceability**	**Potential Mitigation Measures**	**Significance of Impact and Risk: Without Mitigation/ Management**	**Significance of Impact and Risk: With Mitigation/ Management (Residual Impact/ Risk)**	**Ranking of Residual Impact/ Risk**	**Confidence Level**
Operation of the solar energy facility	Loss of productive farmland	Negative	Local	Long-term	Slight	Very likely	High	Replaceable	No effective mitigation available	Very low	Very Low	5	High
Community trust establishment	Community benefits likely to emanate from the establishment of a community trust.	Positive	Local	Long-term	Moderate	Very likely	N/A	N/A	• Potential trustees to sit on the Community Trust need to be identified with the assistance of the local municipality. • Strict financial management controls need to be in place in order to manage the funds generated for the Community Trust from the proposed project. Financial managements controls may also include an annual audit. All financial management actions to be subject to the REI4F requirements. • The criteria for identifying and the funding of community projects should be clear in order to optimally benefit the local community.	Medium	Medium	3	High

Operational Phase													
Direct Impacts													
Aspect/ Impact Pathway	**Nature of Potential Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of Impact**	**Irreplaceability**	**Potential Mitigation Measures**	**Significance of Impact and Risk**		**Ranking of Residual Impact/ Risk**	**Confidence Level**
										Without Mitigation/ Management	**With Mitigation/ Management (Residual Impact/ Risk)**		
Employment creation during operation of the project	Job creation for local community.	Positive	Local	Short-term	Moderate	Very likely	N/A	N/A	No effective enhancement available.	Very Low	Very Low	5	High
Development of locally-owned support industries to respond to operational activities	Business development opportunities for the local community.	Positive	Local	Medium-term	Moderate	Likely	N/A	N/A	• The proponent to make use of loca services as far as practically possible. • Procure goods and services from variety of providers as far as possible and available to promote a wide distribution of project associated benefits.	Low	Low	4	Medium

Table 6 Impact Assessment Summary Table for the Decommissioning Phase

Decommissioning Phase													
Direct Impacts													
Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk		Ranking of Residual Impact/ Risk	Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)		
Decommissioning of the facility	Loss of employment and income due to decommissioning of the facility	Negative	Local	Medium-term	Moderate	Very likely	Low	Moderate	The Applicant must consider retraining and redeployment of local employees in an attempt to keep them in its employ.	Low	Low	4	High

Table 7 Cumulative Impact Assessment Summary Table

Cumulative Impacts (Construction, Operational and Decommissioning Phases)													
Direct Impacts													
Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk		Ranking of Residual Impact/ Risk	Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)		
All construction-related activities and employment opportunities	Disruption of social structures within the study area	Negative	Local	Medium-term	Moderate	Likely	Moderate	Moderate	No effective mitigation available	Low	Low	4	Medium

Cumulative Impacts (Construction, Operational and Decommissioning Phases)													
Direct Impacts													
Aspect/ Impact Pathway	**Nature of Potential Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of Impact**	**Irreplaceability**	**Potential Mitigation Measures**	**Significance of Impact and Risk**		**Ranking of Residual Impact/ Risk**	**Confidence Level**
										Without Mitigation/ Management	**With Mitigation/ Management (Residual Impact/ Risk)**		
All construction-related activities and employment opportunities	Cumulative increase in HIV/AIDS infection rate	Negative	Local	Long-term	Moderate	Likely	Irreversible	High	• No construction workers should be allowed to sleep at the construction site. • The construction workforce should receive HIV awareness training prior to the commencement of construction. • HIV and TB testing and counselling should be made available to the construction workforce free of charge. This can be achieved in collaboration with the local clinic or treatment initiatives like Right to Care (http://www.righttocare.org) which provides HIV and TB testing on-site via mobile clinics. • Trends in Local (within the immediate project area) HIV infection rates/ARV treatment loads must be monitored (annually) through close interaction with the local clinic. Should infections and treatment loads increase at a rate greater than the anticipated rate of increase; the Developer (or his appointed agent) must re-evaluate its HIV awareness training, take corrective action where necessary, and repeat said training. Only required for the duration of the construction phase of the project.	Medium	Medium	3	Low

Cumulative Impacts (Construction, Operational and Decommissioning Phases)													
Direct Impacts													
Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk		Ranking of Residual Impact/ Risk	Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)		
Operation of the proposed facility	Cumulative socio-economic benefit to local community	Positive	Local	Long-term	Moderate	Very likely	N/A	N/A	No enhancement suggested	Medium	Medium	3	High

5.1 Impact Assessment Summary

The overall impact significance of pre-mitigation impacts are low negative for the construction phase, very low positive for the operational phase, and low negative for the decommissioning phase. Following the implementation of the proposed mitigation measures, the impact significance is low negative for the construction phase, very low positive for the operational phase, and low negative for the decommissioning phase (Table 8):

Table 8 Overall Impact Significance (Post Mitigation)

Phase	Overall Impact Significance. (pre-mitigation)	Overall Impact Significance. (post-mitigation)
Construction	Low (negative)	Low (negative)
Operational	Very low (positive)	Very low (positive)
Decommissioning	Low (negative)	Low (negative)

6 LEGISLATIVE AND PERMIT REQUIREMENTS

From a socio-economic perspective, no permits are required.

7 ENVIRONMENTAL MANAGEMENT PROGRAMME INPUTS

The key monitoring requirement for inclusion in the EMPr relates to the local HIV/AIDS infection rate. In this regard, the following monitoring is required during the construction-phase of the proposed project:

- Trends in local (within the immediate project area) HIV infection rates/ARV treatment loads must be monitored (annually) through close interaction with the local clinic. Should infections and treatment loads increase at a rate greater than the anticipated rate of increase; the Developer (or his appointed agent) must re-evaluate its HIV awareness training, take corrective action where necessary, and repeat said training. This is only required for the duration of the operational phase of the project.
- The proposed project site should be fenced off and movement of construction workers should be limited to the construction site only.
- No staff may overnight at the project location, except security personnel.
- A code of conduct, aligned with South African labour legislation, must be signed by all workers whereby workers are informed of risks on the property, and that they will be held liable for any damages or losses incurred by the property owner as a result of workers' actions not directly related to their employment.
- Contractors must clearly stipulate the disciplinary procedures applicable to workers in the case of theft, damage to property and/or trespassing.

The Tables for the EMPr are provided in Appendix 1.

8 CONCLUSION AND RECOMMENDATIONS

The NLM has made significant progress towards redressing unemployment, poverty, HIV/AIDS infection rates and poor education within the past 15 years. However, regardless of said progress, the NLM still faces significant challenges in terms of its socio-economic realities.

Population growth within the area (2.96%) is significantly higher than the national average (1.6%), with comparatively high dependency ration of 56.2. Demographic information indicates that vulnerable people groups within the NLM increased in all major categories, with the exception of the young (0-14 years). In terms of education, 21.9% of the NLM population had no formal schooling. Moreover, levels of educational attendance have dropped within the NLM between 2011 and 2016 by 1%, with the NLM currently rating as the local municipality with the second lowest attendance levels within the North-West Province. In terms of early childhood development (children aged 0-4 years attending an educational institution) the NLM has the second highest total non-attendance figure (73.3%) in the North-West Province. Agriculture is the primary economic activity and employment sector within the NLM (27.8%) followed by community, social and personal services (23.4%), and the wholesale and retail trade (17.5%). These sectors however tend to employ low volumes of labour. Higher volume employers such as the construction, mining and electricity sectors are underrepresented in the NLM, at 2.6%, 0.5% and 0.5% respectively.

According to the 2008 South African National HIV Prevalence, Incidence, Behaviour and Communication Survey the North-West Province's HIV prevalence is 11.3% in people aged 2-14 years, and 17.7% in people aged 15-49 years. In 2009 the North-West Province had the highest incidence (47%) of young women with sexual partners 5 or more years older than themselves (*i.e.* intergenerational sex), and are therefore more prone to HIV/AIDS infection. This figure is 9% higher than the South African national percentage for intergenerational sex; at 38%. More disturbing is the fact that intergenerational sex in the North-West Province increased by 19% from 28% in 2006, to 47% in 2009.

When considering the above demographic data and the nature of the proposed development, the primary environmental sensitivities appear to be:

(i) Preservation of the integrity of existing social structures:

Existing social structures provide a socio-economic safety net for vulnerable community members, while also serving to maintain social cohesion through the practice and implementation of local cultural norms, beliefs and values.

No effective mitigation is available to preserve the integrity of existing social structures. However, the cumulative effect of the management actions proposed for the other environmental sensitivities (see below) would serve to indirectly mitigate impacts on existing social structures.

(ii) Preservation and growth of physical and economic safety:

The asset classes, or capital, available to community members in the NLM (e.g. productive farms, infrastructure, and bulk services) must be protected, while asset classes currently in short supply need to be developed (e.g. income for the poor, improved education, and improved health). Such protection and development is vital in controlling and ultimately alleviating poverty and vulnerability. Moreover, jeopardizing physical and economic safety will serve to undermine existing social structures within the NLM.

The following management actions are proposed to preserve and grow the physical and economic safety in the NLM:

- The construction workforce should receive HIV awareness training prior to the commencement of construction.
- HIV and TB testing and counselling should be made available to the construction workforce free of charge. This can be achieved in collaboration with the local clinic or treatment initiatives like

Right to Care (http://www.righttocare.org) which provides HIV and TB testing on-site via mobile clinics.

- Trends in local (within the immediate project area) HIV infection rates/ARV treatment loads must be monitored (annually) through close interaction with the local clinic, but only for the duration of the construction phase. Should infections and treatment loads increase at a rate greater than the anticipated rate of increase; the Developer (or his appointed agent) must re-evaluate its HIV awareness training, take corrective action where necessary
- The proposed project site should be fenced off and movement of construction workers should be limited to the construction site only.
- No staff may sleep on site, except security personnel.
- A code of conduct, aligned with South African labour legislation, must be signed by all workers whereby workers are informed of risks on the property, and that they will be held liable for any damages or losses incurred by the property owner as a result of workers' actions not directly related to their employment.
- Contractors must clearly stipulate the disciplinary procedures applicable to workers in the case of theft, damage to property and/or trespassing.

(iii) The wellbeing of the poor and vulnerable people groups:

The NLM has a Constitutional directive to care for its poor and vulnerable citizens. Moreover, any development which fails to consider and/or attempt to improve the plight of the poor and vulnerable; runs the risk of exacerbating local poverty and/or local animosity towards said development.

The following management actions are proposed to preserve the poor and vulnerable people groups:

  - Potential trustees to sit on the Community Trust need to be identified with the assistance of the local municipality, at the discretion of the Applicant.
  - Strict financial management controls need to be in place in order to manage the funds generated for the Community Trust from the proposed project. Financial management controls may include an annual audit. All financial management controls must be subject to the REI4P rules.
  - The criteria for identifying and the funding of community projects should be clear in order to optimally benefit the local community, and where possible, align the economic development plan with the local municipality's IDP.
- The Applicant, or Contractor, must engage the local community (within the immediate project area) on the nature, duration, number and availability of employment opportunities well in advance of any construction activities taking place. It is recommended that existing social structures be utilised for such interaction, and that the process be commenced once the project has reached financial closures.
- The Contractor should establish an employment desk at the construction site to facilitate employment-related queries, and maintain a register of applicants which reflects their respective expertise, skill level and contact/residential details. Whenever planned or ad hoc employment is considered, the register should be consulted to identify appropriately qualified candidates.
  - The existence of the employment desk, and the relevant procedures associated with the selection and appointment of workers must be communicated to the local community.
  - It is strongly suggested that every effort should be made to employ local residents.

9 FINAL SPECIALIST STATEMENT AND AUTHORISATION RECOMMENDATION

In light of the overall low significance (post mitigation) rating of identified negative impacts, and having regard to the nature of such impacts, and the status quo socio-economic conditions present in the NLM; the socio-economic benefits of the project appear to outweigh its impacts. Should the mitigation measures be implemented as prescribed in this assessment; it is recommended that the proposed development be awarded environmental authorisation.

Please note that the mitigation measures as identified in Table 4 to 7 *must* be implemented and must form part of the EMPr. Furthermore, the monitoring requirements as prescribed in Section 9 of this report *must* be included in the EMPr. No management measures are proposed for the closure plan.

9.1 EA Condition Recommendations

No conditions are provided for inclusion in the environmental authorisation.

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APPENDIX 1: Environmental Management Programme (EMPr)

The management actions are specified in the following Tables, with further implementation details provided in accordance with the requirements of the EIA Regulations.

Table 9.1. Management Plan for the Design Phase

Impact	Mitigation / Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
Aspect: Mitigating risks associates with discontent towards the proposed project					
1. Unrealistic expectations regarding local job creation, with associated discontent and potential negativity towards the proposed development	Management of job seeker expectations to prevent unrealistic expectations.	• The Project Developer must engage the local community (within the immediate project area) on the nature, duration, number and availability of employment opportunities well in advance of any construction activities taking place. It is recommended that existing social structures be utilised for such interaction, and that the process be commenced once the project has reached financial closure	Verify community engagement and use (where possible and appropriate) of existing social structures.	Commence on receipt of financial closure and to be monitored every 3 months until the conclusion of the construction phase.	Project Developer

Table 9.2. Management Plan for the Construction Phase

Impact	Mitigation / Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	*Frequency*	*Responsibility*
Aspect: Enhancing social benefits and mitigating risks as a result of the project destabilising existing social structures and causing damages or loss to relevant land-owners.					
2. Temporary employment creation	Ensure that local jobseekers are afforded an opportunity to benefit from temporary employment opportunities, provided that such job seekers are adequately qualified for the proposed employment.	• The Contractor should establish an employment desk at the construction site to facilitate employment-related queries, and maintain a register of applicants which reflects their respective expertise, skill level and contact/residential details. Whenever planned or ad hoc employment is considered, the register should be consulted to identify appropriately qualified candidates.	• Inspect register of employment applicants and verify whether locally registered applicants are being considered identify appropriately qualified candidates.	• Every 3 months until the conclusion of the construction phase	• Contractor
		• The existence of the employment desk, and the relevant procedures associated with the selection and appointment of workers must be communicated to the local community.	• Verify that the existence of the employment desk and procedures for selection and appointment is communicated to local community.	• Every 3 months until the conclusion of the construction phase	• Contractor
3. Business development opportunities for local residents.	Development of locally owned support industries in reaction construction-related activities.	• The Project developer is to make use of local services as far as practically possible.	• Verify that local services have been utilised by proof of purchase.	• Every 3 months for the duration of the operational phase.	• Project Developer
		• Procure goods and services from variety of providers as far as possible and available to promote a wide distribution of project associated benefits.	• Verify that local services have been utilised by proof of purchase.	• Every 3 months for the duration of the operational phase.	• Project Developer

Impact	Mitigation / Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	*Frequency*	*Responsibility*
4. Damage to farm property/loss of livestock.	Preventing damage to farm property and loss of livestock	• No construction workers should be allowed to sleep at the construction site. • The proposed project site should be fenced off and movement of construction workers should be limited to the construction site only. • A code of conduct, aligned with South African labour legislation, must be signed by all workers whereby workers are informed of risks on the property, and that they will be held liable for any damages or losses incurred by the property owner as a result of workers' actions not directly related to their employment. • Contractors must clearly stipulate the disciplinary procedures applicable to workers in the case of theft, damage to property and/or trespassing.	• Night-time inspection of the construction site. • Inspection of the project site. • Inspection of signed code of conduct forms for all workers which also stipulates disciplinary procedures. • Inspection of signed code of conduct forms for all workers which also stipulates disciplinary procedures.	Every 3 months until the conclusion of the construction phase	Contractor
5. Increased risky social behaviour	Minimising the risk of HIV/AIDS infection especially among the women residing in the NLM.	• The construction workforce should receive HIV awareness training prior to the commencement of construction. • HIV and TB testing and counselling should be made available to the construction workforce free of charge.	• Verify that HIV awareness training has been conducted. • Verify that a service provider has been appointed to perform this task.	• Once-off prior to the commencement of construction • Once-off prior to the commencement of construction.	• Project Developer • Project Developer

Impact	Mitigation / Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
		• Trends in local (within the immediate project area) HIV infection rates/ARV treatment loads must be monitored (annually) through close interaction with the local clinic, but only for the duration of the construction phase. Should infections and treatment loads increase at a rate greater than the anticipated rate of increase; the Developer (or his appointed agent) must re-evaluate its HIV awareness training, take corrective action where necessary	• Project developer to obtain annual HIV infection rate/ARV treatment load data from local clinic and compare such data to previous 12 months to identify upward or downward trends.	• Every 12 months until the conclusion of the construction phase	• Project Developer

Table 9.3. Management Plan for the Operational Phase

Impact	Mitigation / Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	*Frequency*	*Responsibility*
Aspect: Enhancement of the positive socio-economic impacts associated with the establishment of a community trust and the development of local support industries.					
1. Establishment of community trust.	Ensure that the community trust is representative of local community needs and is well managed.	• Potential trustees to sit on the Community Trust need to be identified with the assistance of the local municipality, but at the discretion of the Project Developer. • Strict financial management controls need to be in place in order to manage the funds generated for the Community Trust from the proposed project. Financial managements controls may also include an annual audit. All financial management actions to be subject to the REI4F requirements. • The criteria for identifying and the funding of community projects should be clear in order to optimally benefit the local community, and should reflect the development needs of the local IDP.	• Verify that local municipality has been consulted regarding potential trustees. • Verify that RE4P requirements for the management of the community trust is prescribed. • Verify that a clear funding criteria has been proposed which is aligned with the local IDP.	• Once-off during the operational phase. • Once-off during the operational phase. • Once-off during the operational phase.	• Project Developer • Project Developer • Project Developer
2. Business development opportunities for local communities.	The development of locally owned support industries in response to the operational activities of the proposed development.	• The Project developer is to make use of local services as far as practically possible. • Procure goods and services from variety of providers as far as possible and available to promote a wide distribution of project associated benefits.	• Verify that local services have been utilised by proof of purchase. • Verify that local services have been utilised by proof of purchase.	• Every 12 months for the duration of the operational phase. • Every 12 months for the duration of the operational phase.	• Project Developer • Project Developer

Table 9.4. Management Plan for the Decommissioning Phase

Impact	Mitigation / Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
Aspect: Mitigating the impact of decommissioning the project in terms of loss of local income and employment					
Loss of employment and income as a result of decommissioning	Attempt to keep local employees in the employ of the Project Developer	• The Project Developer must consider retraining and redeployment of local employees in an attempt to keep them in its employ.	• Verify that retrenchment practices are compliant with south African labor legislation • Verify that the Project Developer implemented succession training of locally employed staff before the plant is decommissioned	• Once-off during the decommissioning phase. • Once-off after decommissioning has been completed.	• Project Developer • Project Developer

VISUAL IMPACT ASSESSMENT

Environmental Impact Assessment for the Proposed Development of a 115 MW Solar Photovoltaic Facility (Vryburg Solar 2) on Retreat Farm 671 Portion 1, south of Vryburg, North West Province

Report prepared for:
CSIR – Environmental Management Services
PO Box 320
Stellenbosch
South Africa

Report prepared by:
Henry Holland
8 Cathcart Street
Grahamstown, 6139
South Africa

26 August 2018

SPECIALIST EXPERTISE

CURRICULUM VITAE – HENRY HOLLAND

Profession: GIS Consultant
Date of Birth: 26 December 1968

BIOGRAPHICAL SKETCH

Henry has been doing GIS related work since 1992 when he started his M.Sc. in Geology. Since finishing his Masters he worked in Angola establishing a GIS department for a diamond exploration company, after which he worked on a freelance basis for eight years doing GIS related work and computer programming. In 2005 he established the Mapthis Trust which provides geospatial services for a range of environmental and geological companies and projects. Henry has been involved in Visual Impact Assessments (VIAs) since 1997.

TERTIARY EDUCATION

1996	M. Sc. Geology/GIS	Rhodes University
1986	B.Sc. Hons	OFS

KEY EXPERIENCE

The table below presents an abridged list of Henry's project experience relevant to this proposal:

Completion Date	Project Description	Role	Client
2015	Umgeni Water Lovu and Tongaat Desalination Plants EIAs, KwaZulu-Natal	Author	CSIR
2015	Inyanda-Roodeplaat WEF, Uitenhage, EC	Author	SRK
2015	OTGC Oil Storage Terminal BA – Visual Impact, Durban, KZN	Author	CSIR
2014	Mainstream Dealesville Solar Plants VIA, Freestate Province	Author	CSIR
2014	Mulilo Solar Plants VIA, Northern Cape	Author	CSIR
2014	Frontier SRMOP EIA, Saldanha, WC	Author	CSIR
2013	Ishwati Emoyeni Wind Energy Facility VIA, Western Cape	Author	CSIR
2013	Venter Fert Composting and Fertiliser Plant	Author	Public Process Consultants
2013	Kipeto Power Line, Kenya	Author	Kipeto Energy Ltd.
2012	Ngqura Manganese Export Facility VIA, Coega, Eastern Cape	Author	CSIR
2012	Toliara Sands Mining Project VIA, Toliara, Madagascar	Author	CES
2012	Mkuze Biofuel Power Plant VIA, Mkuze, KwaZulu-Natal	Author	CSIR
2012	Vleesbaai WEF VIA, Western Cape	Author	CSIR
2012	Saldanha Desalination Plant VIA, Saldanha Bay, Western Cape	Author	CSIR
2012	Mossel Bay WEF, Western Cape	Author	CES
2012	Keimoes Solar Energy Facility, NC	Author	CSIR
2012	Douglas Solar Energy Facility, NC	Author	CSIR
2012	Richards Bay WEF VIA, KZN	Author	CES
2012	Hluhluwe WEF VIA, KZN	Author	CES
2012	Plan8 Grahamstown Wind Farm VIA,	Author	CES

Completion Date	Project Description	Role	Client
	Eastern Cape		
2012	Kipeto Wind Farm VIA, Kenya	Author	Galetech Energy Developments Ltd.
2011	Coega IDZ Zone 12 Wind Farm	Author	CSIR
2011	Haverfontein Wind Farm, Mpumalanga	Author	CES
2011	Middleton Wind Farm, Cookhouse	Author	CES
2011	Broadlands PV Plant, Humansdorp	Author	CSIR
2011	Ubuntu Wind Farm, Jeffrey's Bay	Author	CSIR
2011	Lushington Park Wind Farm, East London	Author	CES
2011	Chaba Wind Farm, Komga	Author	CES
2010	Thomas River Wind Farm and PV Park VIA, Stutterheim	Author	CES
2010	Eskom Power Line VIA, Kouga	Author	CES
2010	Laguna Bay Resort VIA	Author	CES
2010	Kouga Wind Farm VIA	Author	Arcus GIBB
2010	Electrawinds Coega Wind Farm VIA	Author	CSIR
2010	Innowind Coega Wind Farm VIA	Author	CES
2010	Jeffrey's Bay Wind Farm VIA, Jeffrey's Bay	Author	CSIR
2010	Cookhouse Wind Farm VIA, Cookhouse	Author	CES
2009	Waainek Wind Farm VIA, Grahamstown	Author	CES
2009	Coega Wind Turbine BA (Visual Input)	Author	CSIR
2009	Sierra Leone Ethanol Plant VIA	Author	CSIR
2009	NamWater Desalination Plant VIA, Swakopmund, Namibia	Author	CSIR
2009	Nooitgedagt/Coega Water Supply VIA, Motherwell	Author	SRK
2009	CDM Brewery VIA, Nampula, Mozambique	Author	CES
2009	TankaTara Preliminary Visibility Analysis, Addo	Author	CES
2008	Kouga Wind Energy Project VIA, Jeffreys Bay	Author	CSIR
2008	Aston Bay VIA	Author	CES
2008	NPA Boundary Wall VIA, Port Elizabeth	Author	CSIR
2008	Elitheni Coal Mining VIA, Indwe	Author	Savannah Environmental (PTY) Ltd.
2008	Coegakamma Chicken Broiler Housing VIA	Author	Public Process Consultants
2008	Amanzi Country Lifestyle Estate VIA, Uitenhage	Author	Public Process Consultants

I, the undersigned, certify that to the best of my knowledge and belief, these data correctly describe my qualifications, my experience, and me, and that I am available to work on this project.

H. Holland.

____Date: 07/08/18
[Signature of staff member and authorized representative of the firm] Day/Month/Year
Full name of staff member: Henry Holland

SPECIALIST DECLARATION

I, Henry Holland, as the appointed independent specialist, in terms of the 2014 EIA Regulations (as amended), hereby declare that I:

- I act as the independent specialist in this application;
- I 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;
- regard the information contained in this report as it relates to my specialist input/study to be true and correct, and do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 (as amended) and any specific environmental management Act;
- 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 have no vested interest in the proposed activity proceeding;
- 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;
- I have ensured that information containing all relevant facts in respect of the specialist input/study was distributed or made available to interested and affected parties and the public and that participation by interested and affected parties was facilitated in such a manner that all interested and affected parties were provided with a reasonable opportunity to participate and to provide comments on the specialist input/study;
- I have ensured that the comments of all interested and affected parties on the specialist input/study were considered, recorded and submitted to the competent authority in respect of the application;
- all the particulars furnished by me in this specialist input/study 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.

Name of Specialist: Henry Holland

Signature of the specialist: H. Holland.

Date: 26 July 2018

EXECUTIVE SUMMARY

The Visual Impact Assessment specialist study compiled for the 115 MW Vryburg Solar 2 Photovoltaic (PV) plant proposed by ABO Wind, with support from Veroniva (Pty) Ltd, approximately 7 km south west of Vryburg, North West Province, was conducted by Henry Holland. The PV project will have an overhead 132 kV power line connecting to the existing Mookodi substation over a distance of approximately 12.5 km.

The landscape surrounding the proposed site has a peri-urban character with structures and developments associated with a large town mixed with those associated with commercial agriculture (e.g. stock farming). The landscape character has a low sensitivity to the proposed solar energy project.

The following sensitive visual receptors will potentially be affected by the introduction of a large PV plant into the landscape:

- Residents of Vryburg are low sensitivity visual receptors since their urban views contain complex and contrasting elements and patterns;
- Visitors and viewpoints in Louis Taljaard Nature Reserve. These are regarded as highly sensitive visual receptors since they have an active interest in the surrounding landscape;
- Residents and viewpoints on farms surrounding the proposed development site. These are highly sensitive visual receptors since they have an active interest in their surrounding landscape.
- Motorists using the N14, R378, and R34. Motorists are classified as low sensitivity visual receptors since they pass through the landscape and their attention is mostly focused on the road.

There are very few highly sensitive visual receptors that will experience high visual exposure. These will potentially be viewpoints on surrounding farms and visual receptors living at the Edinburg, Eden and Retreat farmsteads.

Visual intrusion will be moderate for visual receptors on surrounding farms since the landscape is already transformed by existing structures (such as the Mookodi substation south of Vryburg) associated with proximity to a large town, but the proposed solar energy facility will be clearly noticeable.

Motorists will experience low visual intrusion from the proposed solar energy facility since they will be far enough from the site to associate structures with those of the town. They will experience low visual intrusion from the overhead power lines since these will be congruent with existing views and existing electrical infrastructure.

The significance of the potential visual impact of construction activities on existing views of sensitive visual receptors will be moderate before mitigation since the consequence of the impact is substantial but its duration is short to medium term and very few highly sensitive visual receptors will be affected. Phasing preparation of the solar field area and construction of the solar field in such a way as to minimise the area of soil exposed (to reduce visual intrusion and potential dust impacts) and the duration for which it will be exposed will, among other mitigation measures discussed in the report, lower the consequence of the visual impact resulting in a low significance.

The consequence of the landscape impact is rated as slight since the surrounding landscape character is peri-urban with many elements and structures associated with a large town. The significance of the potential landscape impact is low before and after mitigation.

The significance of the visual intrusion of the solar energy development (during the operational phase) on the views of sensitive visual receptors is rated as moderate (without mitigation) since the

consequence of the impact will potentially be substantial for a small number of highly sensitive visual receptors (farmsteads such as those at Eden (2.2 km), Retreat (600 m), and Sonop (2.4 km) are potentially highly exposed to the proposed development). Successful mitigation will lower the consequence to moderate and the significance of the impact to low. Mitigation measures include rehabilitation of temporary cleared areas, management of dust generation, maintaining structures and painted surfaces and using appropriate colours for buildings and structures in order for them to better blend in with the background landscape.

The significance of the potential impact of night lighting of the development on the nightscape of the region is rated as moderate since the existing nightscape is relatively dark and new lights will be introduced into the landscape, potentially affecting a few highly sensitive visual receptors in close proximity to the site. Mitigation measures such as a lighting plan to minimize the severity of the impact will limit the potential for light pollution and glare. The significance of the impact if mitigation measures are successful will be low.

The significance of the potential visual impact of decommissioning activities is moderate before mitigation since these activities are very similar to construction activities but should be shorter in duration. Mitigation measures should lower the significance of the impact to low.

The cumulative landscape impact of various solar energy and electrical infrastructure projects in the surrounding landscape will have a slight consequence since the landscape character in proximity to Vryburg ranges from urban through peri-urban to rural-agriculture. Most of the proposed projects are within 15 km of the town, clustered around the Mookodi substation, and will be associated with large scale developments in a peri-urban landscape. The character of the landscape is therefore unlikely to change and the significance of the cumulative landscape impact is rated as very low.

The significance of the cumulative visual impact on existing views of sensitive visual receptors is rated as low since it is unlikely that there are any views of scenic value that have not already been impacted by structures and buildings associated with the proximity to Vryburg. The addition of large fields of solar arrays will be a novelty but, when in view, will be associated with the visual receptor's proximity to town, and will also in time be associated with regions in the country that receive large amounts of constant solar radiation.

This project should be authorised with adherence to mitigation measures as set out in this report, since the significance of the overall visual impact of the project is expected to be low.

LIST OF ABBREVIATIONS

DEA	Department of Environmental Affairs
EIA	Environmental Impact Assessment
CPV	Concentrated Photovoltaic
DEA&DP	Department of Environmental Affairs and Development Planning
DEM	Digital Elevation Model
IDP	Integrated Development Plan
GIS	Geographic Information System
PV	Photovoltaic
REDZ	Renewable Energy Development Zone
SDF	Spatial Development Framework
VIA	Visual Impact Assessment

GLOSSARY

Definitions	
Cumulative viewshed	A viewshed which indicates in some way how much of a development is visible from a particular viewpoint. In a raster based cumulative viewshed each pixel value will indicate how many points within the development area are visible. A power line development could, for example, use pylons as points to generate a cumulative viewshed for the development. Each pixel value in the viewshed will be a count (accumulation) of the number of pylons that will potentially be visible from that pixel.
Digital Elevation Model (DEM)	A digital or computer representation of the topography of an area.
Landscape baseline	A description of the existing elements, features, characteristics, character, quality and extent of the landscape (GLVIA, 2002).
Landscape character	The distinct and recognisable pattern of elements that occurs consistently in a particular type of landscape, and how this is perceived by people. It reflects particular combinations of geology, landform, soils, vegetation, land use and human settlement. It creates the particular sense of place of different areas of the landscape (GLVIA, 2002).
Landscape impacts	Change in the elements, characteristics, character and qualities of the landscape as the result of development (GLVIA, 2002). These effects can be positive or negative, and result from removal of existing landscape elements, addition of new elements, or the alteration of existing elements.
Sense of place	That distinctive quality that makes a particular place memorable to the visitor, which can be interpreted in terms of the visual character of the landscape. The unique quality or character of a place, whether natural, rural or urban. Relates to uniqueness, distinctiveness or strong identity (Oberholzer 2005).
Viewer sensitivity	The assessment of the receptivity of viewer groups to the visible landscape elements and visual character and their perception of visual quality and value. The sensitivity of viewer groups depends on their activity and awareness within the affected landscape, their preferences, preconceptions and their opinions.
Viewshed	A viewshed is an area of land, water, and other environmental elements that is visible from a fixed vantage point. In digital imaging, a viewshed is a binary raster indicating the visibility of a viewpoint for an area of interest. A pixel with a value of unity indicates that the viewpoint is visible from that pixel, while a value of zero indicates that the viewpoint is not visible from the pixel.
Visual exposure	Visual exposure refers to the relative visibility of a project or feature in the landscape (Oberholzer, 2005). Exposure and visual impact tend to diminish exponentially with distance.

Definitions	
Visual impact assessment	A specialist study to determine the visual effects of a proposed development on the surrounding environment. The primary goal of this specialist study is to identify potential risk sources resulting from the project that may impact on the visual environment of the study area, and to assess their significance. These impacts include landscape impacts and visual impacts.
Visual intrusion	Visual intrusion indicates the level of compatibility or congruence of the project with the particular qualities of the area – its 'sense of place'. This is related to the idea of context and maintaining the integrity of the landscape (Oberholzer 2005).
Visual receptors	Visual receptors include viewer groups such as the local community, residents, workers, the broader public and visitors to the area, as well as public or community areas from which the development is visible.
Visual resource	Visual resource is an encompassing term relating to the visible landscape and its recognisable elements which, through their coexistence, result in a particular landscape and visual character

COMPLIANCE WITH THE APPENDIX 6 OF THE 2014 EIA REGULATIONS

Requirements of Appendix 6 – GN R982	**Addressed in the Specialist Report**
1. (1) A specialist report prepared in terms of these Regulations must contain- a) 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;	Appendix A of EIA Report
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Appendix B of EIA Report
c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 1.1.1
d) the date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 1.1.3
e) a description of the methodology adopted in preparing the report or carrying out the specialised process;	Section 1.1.3
f) the specific identified sensitivity of the site related to the activity and its associated structures and infrastructure;	Section 1.3
g) an identification of any areas to be avoided, including buffers;	Section 1.3
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 1-1 and Section 1.3
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 1.1.4
j) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment;	Section 1.7
k) any mitigation measures for inclusion in the EMPr;	Section 1.9
l) any conditions for inclusion in the environmental authorisation;	None
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 1.9
n) a reasoned opinion- i. as to whether the proposed activity or portions thereof should be authorised; and ii. if the opinion is that the proposed activity 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 1.10
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	None
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	Section 1.5.1
q) any other information requested by the competent authority.	None

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TABLES AND FIGURES

APPENDIX A

MAPS IN A3 FORMAT

1 VISUAL IMPACT ASSESSMENT

This chapter presents the findings of the Visual Impact Assessment that was prepared by Mr. Henry Holland as part of the EIA for the proposed Vryburg Solar 2 project within North West Province.

1.1 INTRODUCTION AND METHODOLOGY

1.1.1 *Scope and Objectives*

The proposed project includes the development of a 115 Megawatt (MW) Solar Photovoltaic (PV) Facility (referred to as Vryburg Solar 2) on Retreat Farm 671 Portion 1. The farm is located 8 km south of Vryburg in the North West Province. As noted above, this Visual Impact Assessment is being undertaken as part of the requisite Basic Assesment Process. The overall scope and objectives of this Visual Impact Assessment are to:

- Determine the current conditions in sufficient detail so that there is a baseline against which impacts can be identified and measured;
- Identify potential impacts that may occur during the construction, operational and decommissioning phases of development, as well as impacts associated with future environmental changes if the “no-go” option is implemented (both positive and negative);
- Assess the impacts, in terms of direct, indirect and cumulative impacts;
- Provide recommendations with regard to potential monitoring programmes;
- Determine mitigation and/or management measures which could be implemented to as far as possible reduce the effect of negative impacts and enhance the effect of positive impacts; and
- Incorporate and address all issues and concerns raised by I&APs and the public.

1.1.2 *Terms of Reference*

The Terms of Reference for the Visual Impact Assessment (VIA) is as follows:

- Describe the visual character of the local area. Any significant visual features or visual disturbances should be identified and mapped, as well as any sensitive visual receptors within the proposed project area or within viewsheds of the project.
- Visual character and visual absorption capacity should be described.
- Viewsheds for various elements of the proposed development should be calculated, defined and presented, and the varying sensitivities of these viewsheds must be highlighted.
- Mapping of visual sensitivity of the site will require consideration of visual receptors outside the site, and sensitivity to development on the site for potentially affected visual receptors of “very high” sensitivity.
- Assessment to be based on findings of the Wind and Solar SEA (CSIR, 2015), a site visit, visual modelling, and a photographic survey of the surrounding region from which the landscape and visual baselines can be prepared.
- Identify and assess potential impacts from the project on the receiving environment. Schematic portrayals of the visual impact of the proposed project infrastructure on the different viewsheds identified must be presented. All impacts should be considered under varying conditions as appropriate to the study i.e. day, night, clear weather, cloudy weather etc.
- Maps depicting viewsheds/line of sight across the site should be generated and included in the reports. These maps should indicate current viewsheds/visual landscape/obstructions as well as expected visual impacts during the construction, operational and decommissioning phases of the proposed development.

1.1.3 *Approach and Methodology*

This VIA is based on guidelines for visual assessment specialist studies as set out by South Africa's Western Cape Department of Environmental Affairs and Development Planning (DEA&DP) (Oberholzer, 2005), as well as guidelines provided by the Landscape Institute of the UK (GLVIA, 2002).

A visibility analysis was conducted for the region surrounding the proposed development site and components of the development relevant to the assessment of the potential visual impact (10 km radius) to identify key representative viewpoints and sensitive visual receptors. A site visit and photographic survey of this region followed to establish a baseline for visual resources to compare the proposed developments against. Spatial Development Frameworks (SDF) and Integrated Development Plans (IDP) for the relevant municipalities were studied to align the VIA with municipal objectives in terms of landscape and visual resources.

The key steps followed in the VIA are presented below:

Site Visit and Photographic Survey

The field survey (conducted on 17-19 October 2016) provided an opportunity to:

- Determine the actual or practical extent of potential visibility of the proposed development, by assessing the screening effect of landscape features;
- Conduct a photographic survey of the landscape surrounding the development;
- Take photos for use in photomontage images;
- Identify sensitive landscape and visual receptors;
- Viewpoints were chosen using the following criteria:
    - High visibility – sites from where most of the solar facility will be visible;
    - High visual exposure – sites at various distances from the proposed site; and
    - Sensitive areas and viewpoints such as nature reserves and game farms from which turbines will potentially be seen.
- Additionally, photo sites were chosen to aid in describing the landscape surrounding, and potentially affected by, the proposed development.

Field work was conducted in spring but seasonal differences in vegetation cover and atmospheric conditions are slight and contrasts in texture and colour between development structures and landscape background will not change enough due to seasonal changes to invalidate this assessment.

Landscape Description

A desktop study was conducted to establish and describe the landscape character of the receiving environment. A combination of data analysis using a Geographic Information System (GIS), literature review and photographic survey was used to identify land cover, landforms and land use in order to gain an understanding of the current landscape within which the development will take place (GLVIA 2002). Areas of scenic interest, potential sensitive receptors (viewpoints, residences), preliminary zone of visual influence, and principal representative viewpoints were also identified. Landscape features of special interest were identified and mapped, as were landscape elements that may potentially be affected by the development.

Visual Impact Assessment

A GIS (TNTmips[1]) is used to calculate viewsheds for various components of the proposed development. The viewsheds and information gathered during the field survey were used to define

[1] http://www.microimages.com/products/tntmips.htm

criteria such as visibility, viewer sensitivity, visual exposure and visual intrusion for the proposed development. These criteria were, in turn, used to determine the intensity of potential visual impacts on sensitive viewers. All information and knowledge acquired as part of the assessment process was then used to determine the potential significance of the impacts according to the standardised rating methodology as described in Chapter 4 of the EIA Report for the project.

1.1.4 *Assumptions and Limitations*

1.1.4.1 Assumptions

Mitigation Measures

Mitigation measures in this report will assume that construction activities are managed and performed in such a way as to minimise its impact on the receiving environment. The following assumptions, in particular, apply since they are relevant to minimising visual impact during the construction phase:

- The contractor will maintain good housekeeping on site to avoid litter and minimise waste;
- Project developers will demarcate construction boundaries and minimise areas of surface disturbance;
- Vegetation and ground disturbance will be minimised and take advantage of existing clearings;
- Construction of new roads will be minimised and existing roads will be used where possible;
- Topsoil from the site will be stripped, stockpiled, and stabilised before excavating earth for the construction of the facility;
- Vegetation material from vegetation removal will be mulched and spread over fresh soil disturbances to aid in the rehabilitation process;
- Plans will be in place to control and minimise erosion risks;
- Plans will be in place to minimise fire hazards and dust generation; and
- Plans will be in place to rehabilitate cleared areas as soon as possible.

Cumulative Impacts

Cumulative impacts are assessed by adding expected impacts from this proposed development to existing and proposed developments with similar impacts in a 30 km radius of the proposed Vryburg 2 project. The existing and proposed developments that were taken into consideration for cumulative impacts are listed in Table 1-1, taken from the DEA database.[2] A map showing these projects in relation to the Vryburg Solar 1project is provided in Figure 1-21in Section 1.7.10 below.

Table 1-1 Proposed renewable energy projects within 30 km of Veroniva 1 Solar according to the national database

PROPOSED DEVELOPMENT	DEA REFERENCE NO.	CURRENT EIA STATUS	PROPONENT	PROPOSED CAPACITY	EXTENT	FARM DETAILS
Sonbesie Solar Power Plant	14/12/16/3/3/2/915	EIA ongoing	Sonbesie Solar Power Plant (RF) (Pty) Ltd.	115 MW	264 Ha	Remaining Extent of the farm Retreat 671
Gamma Solar Power Plant	14/12/16/3/3/2/917	EIA ongoing	Gamma Solar Power Plant (RF) (Pty) Ltd.	115 MW	285 Ha	Portion 4 of the farm Champions Kloof 731
Khubu Solar Power Plant	14/12/16/3/3/2/912	EIA ongoing	Khubu Solar Power Plant (RF) (Pty) Ltd.	115 MW	300 Ha	Portion 4 of the farm Champions Kloof 731

[2] https://egis.environment.gov.za/data_egis/data_download/current

PROPOSED DEVELOPMENT	DEA REFERENCE NO.	CURRENT EIA STATUS	PROPONENT	PROPOSED CAPACITY	EXTENT	FARM DETAILS
Alpha Solar Power Plant	14/12/16/3/3/2/916	EIA ongoing	Alpha Solar Power Plant (RF) (Pty) Ltd.	115 MW	285 Ha	Portion 3 of the farm Vyflings Pan 598
Meerkat Solar Power Plant	14/12/16/3/3/2/913	EIA ongoing	Meerkat Solar Power Plant (RF) (Pty) Ltd.	115 MW	250 Ha	Portion 3 of the farm Middel Pan
Protea Solar Power Plant	14/12/16/3/3/2/914	EIA ongoing	Protea Solar Power Plant (RF) (Pty) Ltd.	115 MW	240 Ha	Remaining Extent of the farm Hartsboom 734
Soalr energy fascility (PV4) on Badenhost Dam	14/12/16/3/3/2/506	EIA ongoing	Dudely Janeke Environmental Consultants	75 MW	150 Ha	Proposed photovoltaic Soalr energy fascility (PV4) on Badenhost Dam Farm near De Aar in the Northren cape
Tiger Kloof Solar PV energy facility	14/12/16/3/3/2/535	Environmental authorisation (EA) received	Kabi Solar (Pty) Ltd.	75 MW	250 Ha	Portions 3 & 4 of the Farm Waterloo 730
Sediba Power Plant 75MW PV Solar Facility and associated infrastructure	14/12/16/3/3/2/390A M1	EA received	Sediba Power Plant (Pty) Ltd	75 MW	150 ha	A portion of the remaining extent of the Farm Rosendal 673
Sediba Power Plant 75MW PV Solar Facility and associated infrastructure	14/12/16/3/3/2/390A M2	EA received	Sediba Power Plant (Pty) Ltd	75 MW	150 Ha	A portion of the remaining extent of the Farm Rosendal 673
Waterloo Solar Park	14/12/16/3/3/2/308A M3	EA and awarded preferred bidder status (REIPPP window 4).	DPS79 Solar Energy (Pty) Ltd	75 MW	150 Ha	Southern portion of the Farm Waterloo 992
Cronos Energy Renewable Energy Generation Project	14/12/16/3/3/2/750	EA received	Cronos Energy (Pty) Ltd	75 MW		Remainder of the Farm Elma No 575
75MW Carocraft PV Solar Park and associated infrastructure	14/12/16/3/3/2/374	EA received 29 June 2013. Amended to 75 MW on 4 April 2014.	Carocraft (Pty) Ltd	75 MW		Portion 1 and the Remainder of the Farm Weltevrede 681
Expansion of the Carocraft Solar Park	14/12/16/3/3/2/699	EIA underway	Carocraft (Pty) Ltd	75 MW		Southern side of the Remainder of the Farm Weltevrede 681
Woodhouse Solar 1 PV Facility	14/12/16/3/3/2/863	EIA ongoing	Genesis Woodhouse Solar 1 (Pty) Ltd	100 MW		Remaining extent of the Farm Woodhouse 729
Woodhouse Solar 2 PV Facility	14/12/16/3/3/2/865	EIA ongoing	Genesis Woodhouse Solar 2 (Pty) Ltd	100 MW		Remaining extent of the Farm Woodhouse 729
Delta Photovoltaic Power Plant		EIA underway	AMDA-Delta (Pty) Ltd.	75 MW	250 Ha	Remaining Extent of the farm Klondike No. 670
Echo Photovoltaic Power Plant		EIA underway	AMDA-Echo (Pty) Ltd.	75 MW	250 Ha	Remaining Extent of the farm Klondike No. 670
Foxtrot Photovoltaic Power Plant		EIA underway	AMDA-Foxtrot (Pty) Ltd.	75 MW	221 Ha	Remaining Extent of the farm Klondike No. 670
Sendawo 1	14/12/16/3/3/2/891	EIA ongoing	BioTherm Energy	75 MW	368 Ha	Portion 1 of the Farm Edinburgh No 735
Sendawo 2	14/12/16/3/3/2/892	EIA ongoing	BioTherm Energy	75 MW	416 Ha	Portion 1 of the Farm Edinburgh No 735
Sendawo 3	14/12/16/3/3/2/893	EIA ongoing	BioTherm Energy	75 MW	360 Ha	Portion 1 of the Farm Edinburgh No 735

1.1.4.2 Limitations

Spatial Data Accuracy

Spatial data used for visibility analysis originate from various sources and scales. Inaccuracy and errors are therefore inevitable. Where relevant these will be highlighted in the report. Every effort was made to minimize their effect.

Viewshed Calculations

Calculation of the viewsheds does not take into account the potential screening effect of vegetation and buildings. Due to the relatively low vegetation cover in the region and the size and extent of the solar energy facility, the screening potential of vegetation is likely to be minimal over most distances.

Viewsheds are calculated using Digital Elevation Model (DEM) which is derived from 1:50000 scale contour lines with a 20 m vertical distance between contours. The DEM has a pixel resolution of 20 m x 20 m and covers a 70 km x 30 km area (within which a study area is located at 10 km radius around the development site).

1.1.5 *Source of Information*

The VIA is based on the following information:

- Documentation supplied by the client and the CSIR;
- Digital topocadastral data at 1:50 000 scale from the National Geo-spatial Information database[3];
- 1:250000 Geology map sheets covering the region;
- Google Earth software and data;
- South African digital land cover dataset of 2002;
- Renewable Energy EIA Application Database for SA, 2018 Quarter 1[4];
- Protected Areas Data Release - First Quarter 2018[4]; and
- Eskom SPOT Building Count data set (de la Rey 2008).

[3] https://egis.environment.gov.za/data_egis/data_download/current
[4] https://egis.environment.gov.za/data_egis/data_download/current

1.2 DESCRIPTION OF PROJECT ASPECTS RELEVANT TO VISUAL IMPACTS

This section describes the aspects of the proposed project that are relevant in terms of potential visual impacts. Figure 1-1 below shows the proposed locality of the Vryburg Solar 2 Facility.

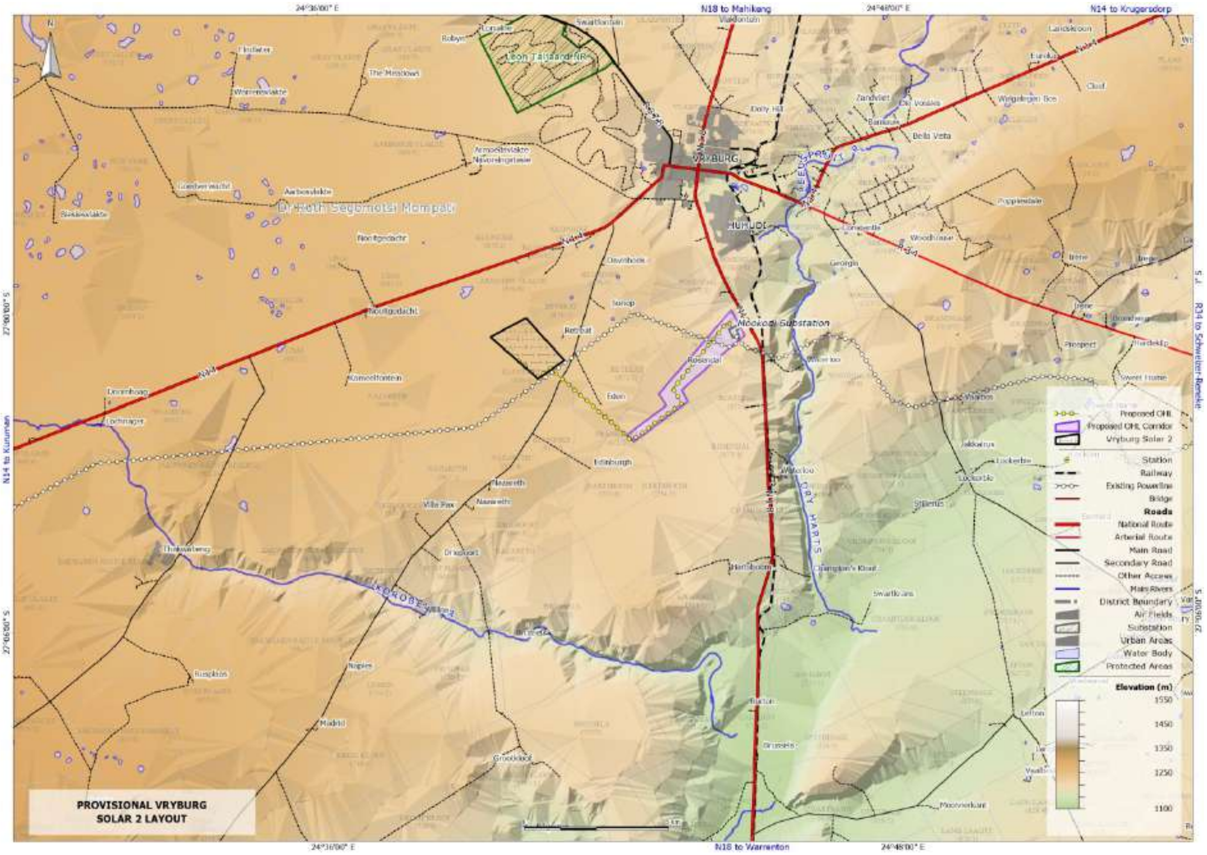


Figure 1-1 Proposed Vryburg Solar 2 plant site (A3 map provided in Appendix A).

1.2.1 *Construction and Decommissioning Phases*

It is likely that all or most components of the proposed PV plant will contribute to potential visual impact during the construction and decommissioning phases. Elements of the construction and decommission phases that will have a potential visual impact include:

- A large area will be cleared of vegetation to host the solar field and associated buildings and structures;
- Laydown areas for equipment will also be required, although these will be temporary;
- Access roads, maintenance roads and power line servitudes will require clearing of vegetation. Exposure of large tracts of soil or rock will contrast significantly with the existing mottled landscape;
- Soil stockpiles and removed vegetation heaps will potentially be visible;
- Alien invasive plant species may contrast strongly with surrounding vegetation;
- An increase in human activity in a remote area is likely to be noticed even by only a small number of visual receptors. Construction of the various components will require a large number of workers. Relatively large construction equipment and vehicles will be operating

during these phases of development, and an increase in traffic on roads in the region is likely;
- Exposure of large areas of soil, and worker and equipment traffic will increase dust generation which will increase construction visibility;
- Buried pipelines and cables will not be visible during the operational phase, but activity, equipment and soil heaps will be visible during construction; and
- Construction or improvement of access roads will be more visible than the operational roads.

Construction of the proposed power line for the PV plant will potentially cause visual intrusion on existing views of sensitive visual receptors through the following activities:

- Some construction activities will potentially be exposed above the skyline due to the height of the pylons, and as such it is likely to be more intrusive on views;
- Laydown areas for equipment will be required, although these will be temporary;
- Access roads, maintenance roads and power line servitudes will potentially require clearing of vegetation;
- Soil stockpiles and removed vegetation heaps will be visible;
- Alien invasive plant species may contrast strongly with surrounding vegetation;
- An increase in human activity in a remote area is likely to be noticed even by only a small number of visual receptors. Relatively large construction equipment and vehicles will be operating during these phases of development, and an increase in traffic on roads in the region is likely;
- Exposure of large areas of soil, and worker and equipment traffic will increase dust generation which will increase construction visibility; and
- Construction or improvement of access roads will be more visible than the operational roads.

1.2.2 *Operational Phase*

Elements of the proposed project that will potentially cause significant visual impact during the operational phase include (maximum heights were used in the analyses to model a worst case scenario):

- Solar field – solar panels of up to 10 m high. The solar field covers a large area and is likely to contrast strongly with surrounding or background vegetation, particularly when viewed from elevated positions;
- Converter station and operations buildings (i.e. operational and maintenance control centre, offices, workshop/warehouse, operations office etc.) (7 m high);
- On-site substation (height up to 15 m for the structures and up to 25m for the lightning conductor poles) and 132 kV overhead distribution line (30 m high) – these are likely to extend above the skyline for some visual receptors in the surrounding area;
- Security fencing (up to 3 m high) and the guard cabin/house (3 m high). From some viewing angles the fence is more visible than the panels;
- Solar resource measuring station (5 m high);
- Buildings and ancillary structures will likely contrast strongly with the solar field due to colour differences as well as the fact that most structures are taller than the solar panels; and
- Security and exterior lighting around buildings and parking areas could add to light pollution in the region.

Table 1-2 Heights of components used in viewshed analysis

Component	**Maximum Height**
Solar Panels	10 m
Inverter Stations	7 m
Operations Buildings	7 m
On-site Substation and 132 kV power line	Height up to 15m for the structures and up to 25m for the lightning conductor poles
Security Fencing	Up to 3 m (planned to be 2.4m)
Guard houses	3 m
Guard tower	Up to 10 m

1.3 DESCRIPTION OF THE AFFECTED ENVIRONMENT

The topography of the region surrounding the proposed solar plant development is relatively flat with the Dry Harts and Korobe Rivers cutting deep and steep valleys into the landscape south and east of the site (Figure 1-2 and Figure 1-3). The Dry Harts River is a major tributary of the Vaal River.

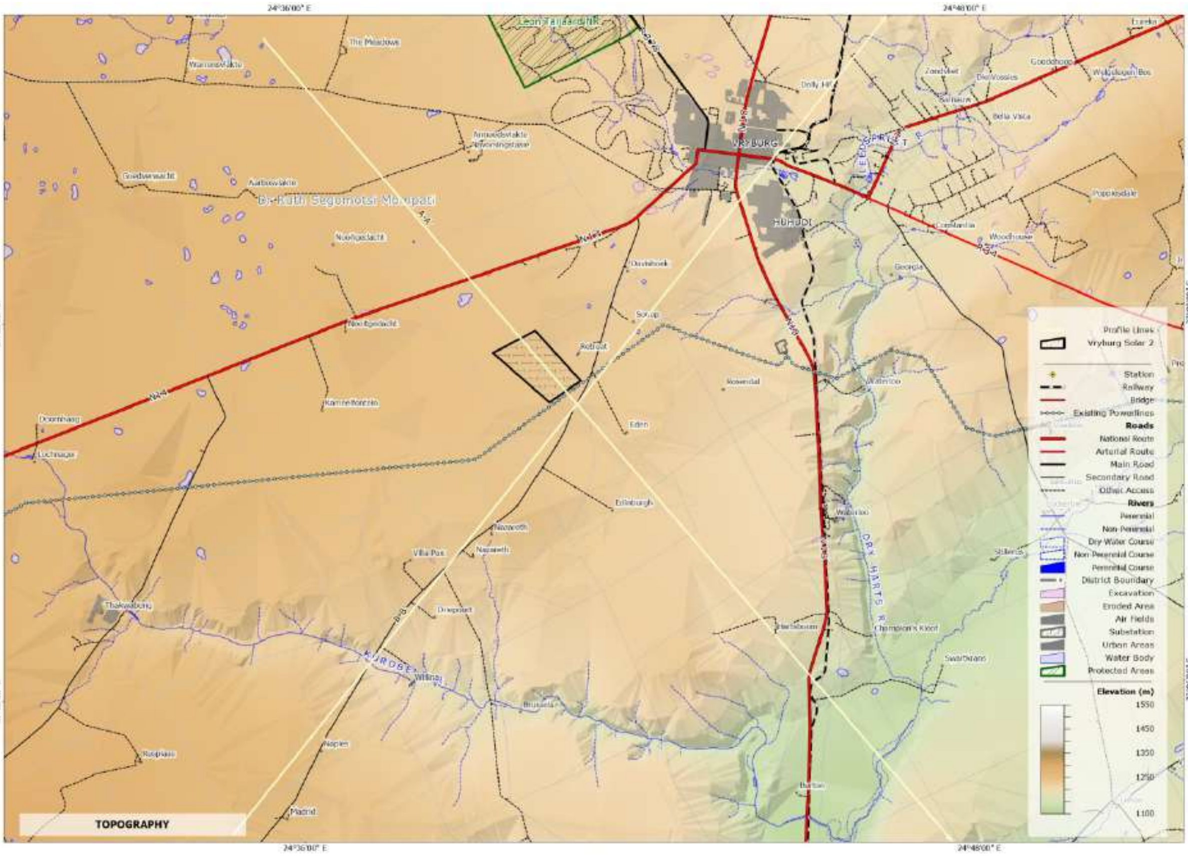
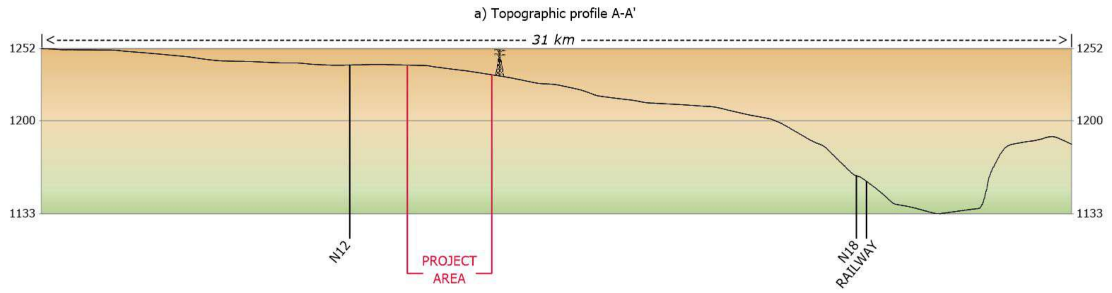


Figure 1-2 Topographic map of the region (A3 map provided in Appendix A).



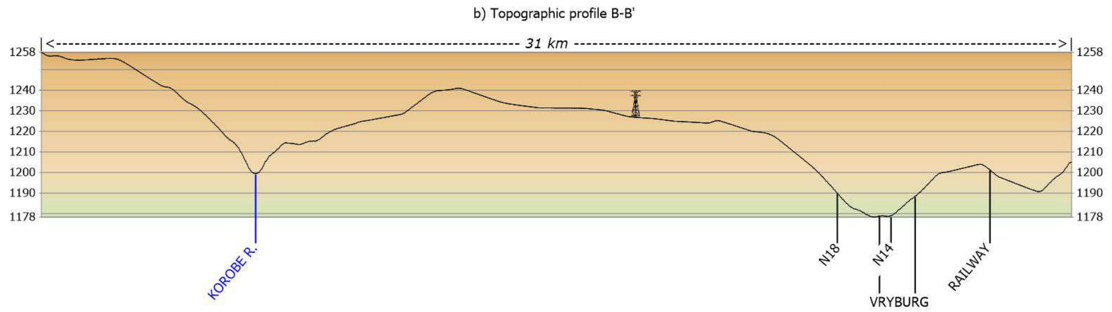


Figure 1-3 a) South-North Topographic Profile, b) East-West Topographic Profile, c) South-east North-west Topographic Profile, d) South-west – North-east Topographic Profile. Topographic profiles as indicated on the topographic map above (A3 map provided in Appendix A).

The geology of the region is varied, from basement granites through Ventersdorp lavas (Andesite) and Transvaal Supergroup layers of dolomite, banded iron formation, quartzite (arenite), shale and siltstones, to sediments overlying these rocks (Figure 1-4). The dolomites are particularly important as they host the large caverns and chambers filled with groundwater. They also limit surface flow of water and streams and rivers are often truncated where they disappear underground. It also means that the topography is subdued with large plains and few steep hills.

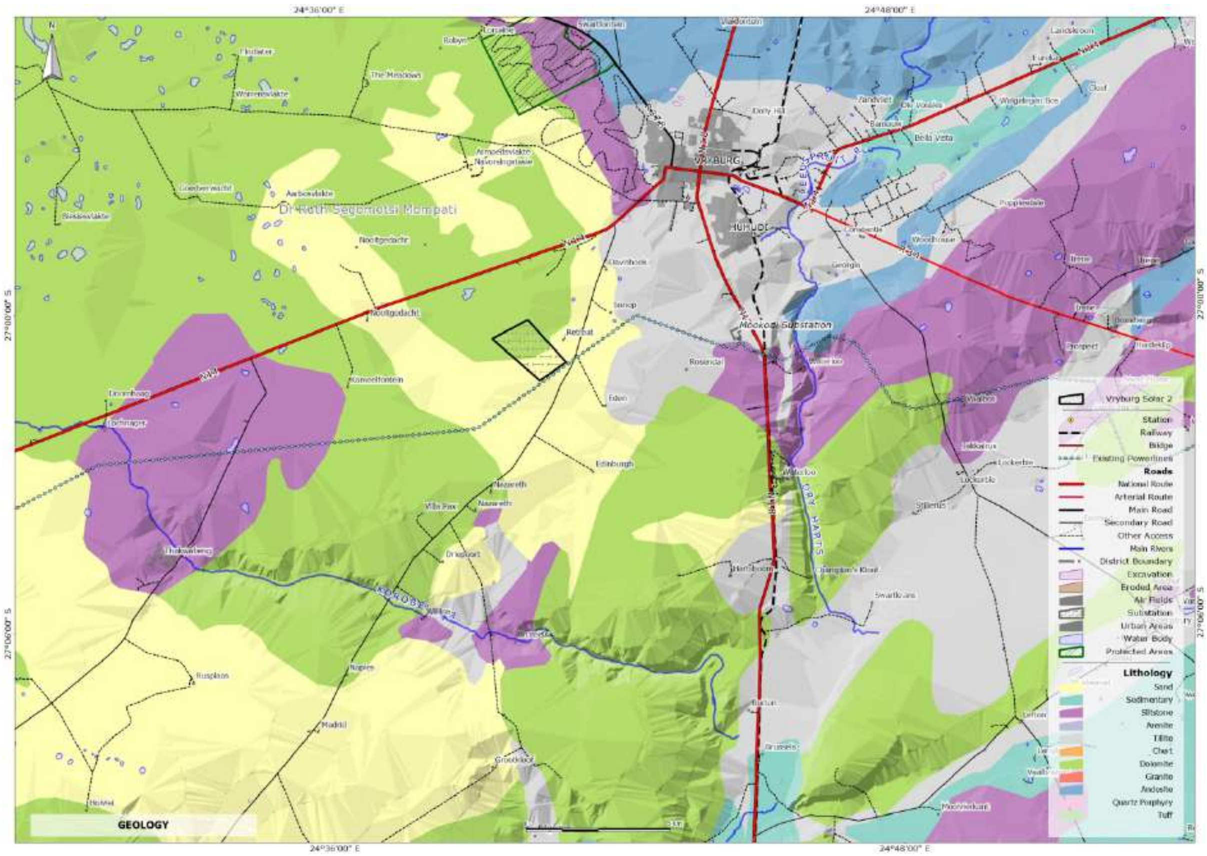


Figure 1-4 Simplified geology of the region (A3 map provided in Appendix A).

Surface cover is predominantly grassland and low shrubs (Figure 1-5) with some trees and is mainly used for stock farming (cattle) as well as for hunting and game farming. Due to the climate stock farming is very successful in the region. Some land is under irrigated cultivation of various crops such as maize, wheat, vegetables and groundnuts.

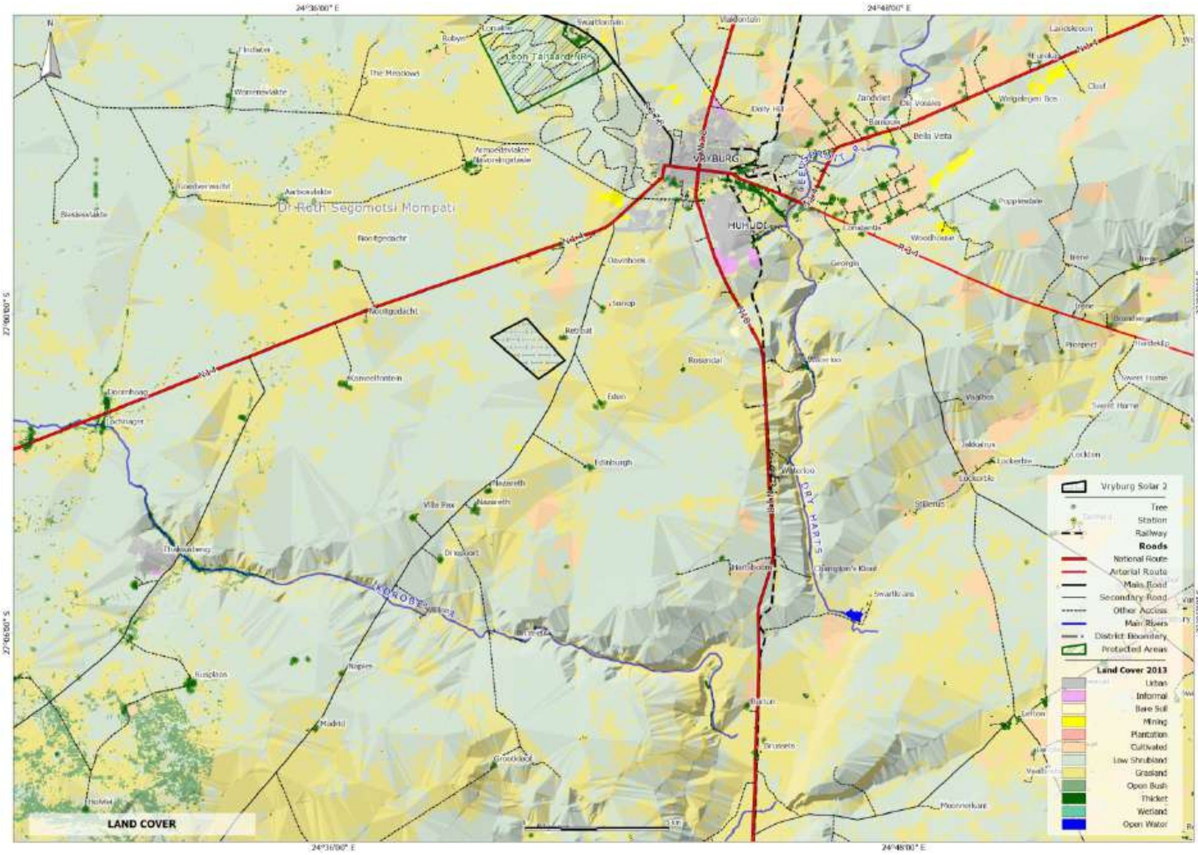


Figure 1-5 Land cover map of the region (A3 map provided in Appendix A).

According to the Provincial Development Plan for North West Province (North West Planning Commission 2013) Vryburg is a secondary node of the province. It is a service centre for the agricultural community in the surrounding region (Figure 1-6).

Two national routes pass through the town, N18 between Kimberley and Mahikeng and the N14 between Gauteng and Upington. The R34 connects Vryburg with Schweizer-Reineke (another secondary provincial node).

The Mookodi Substation and high voltage transmission lines crossing the landscape near Vryburg represent the most visible component of electrical infrastructure in the surrounding region. The railway line is a major linear structure between Kimberley and Mahikeng.

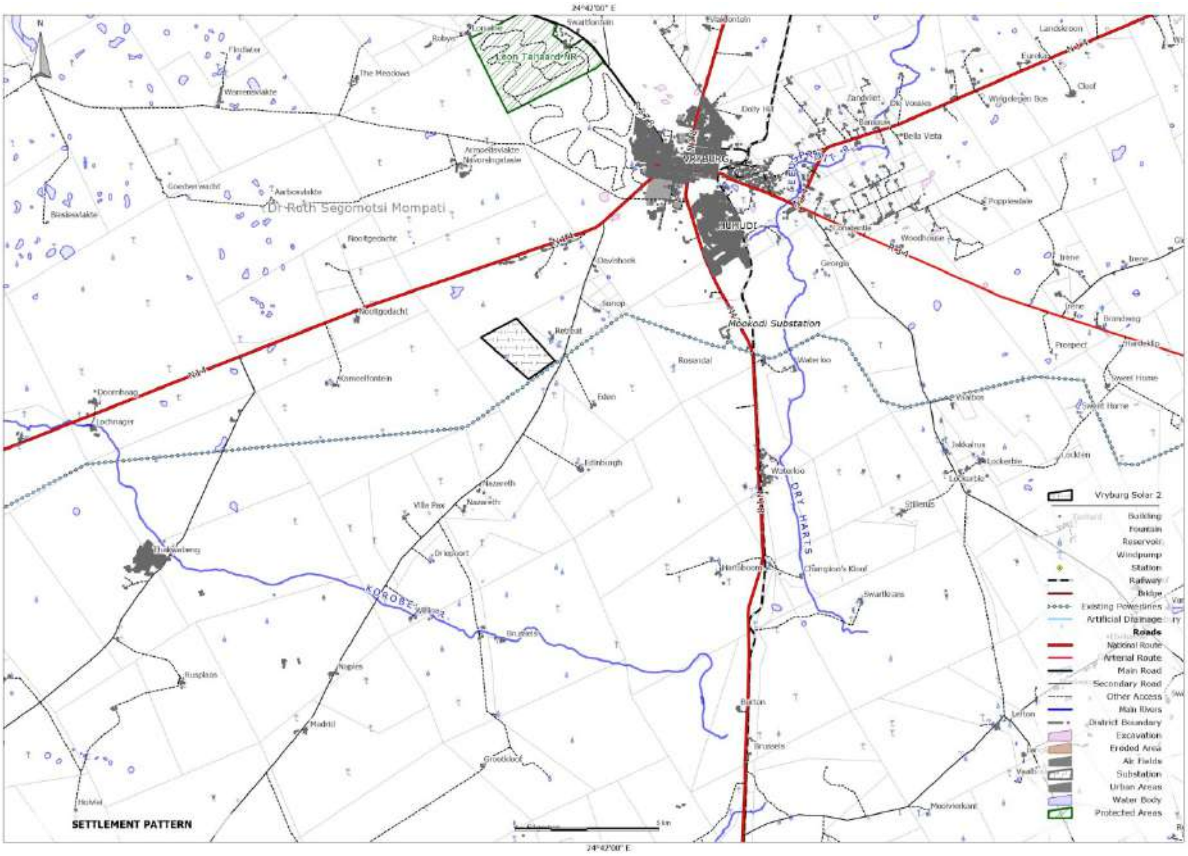


Figure 1-6 Prominent man-made structures and settlement patterns in the landscape (A3 map provided in Appendix A).

The landscape surrounding the proposed development ranges from urban to rural with most of the potentially affected landscape character designated as peri-urban. This is evident in the number of large, busy roads, power lines and substations, and buildings visible in the landscape.

Changes in the layout of the solar energy facility are unlikely to reduce the visibility of the plant significantly due to the size of the plant and the topography of the landscape (the relief does not provide much variation over the proposed study site in which to hide or screen the plant).

In light of the above there are no specific areas on the proposed site that should be avoided in terms of visual considerations.

1.4 APPLICABLE LEGISLATION AND PERMIT REQUIREMENTS

The following legislation and local and district municipal plans are applicable to the proposed project:

- The National Environmental Management Act (NEMA) and the Regulations in terms of Chapter 5 of NEMA (Act 107 of 1998);
- The Protected Areas Act (PAA) (Act 57 of 2003, Section 17) which refers to the conservation and protection of natural landscapes; and
- The Provincial Development Plan for the North West Province (North West Planning Commission 2013) – This plan does not include anything specific to visual considerations.

1.5 IDENTIFICATION OF KEY ISSUES

1.5.1 *Key Issues Identified During the Scoping Phase*

The potential visual issues identified during the Scoping Phase of this EIA Process include:

- Construction Phase: Visual intrusion of construction activities on existing views of sensitive visual receptors in the surrounding landscape.
- Construction Phase: Visual intrusion of a large area cleared of vegetation on the existing views of sensitive visual receptors;
- Construction Phase: Visual impact of night lighting during the construction phase on the nightscape of the region;
- Operational Phase: Landscape impact of introducing a large solar plant into a remote rural landscape;
- Operational Phase: Visual intrusion of a large solar field on the existing views of sensitive visual receptors;
- Operational Phase: Visual impact of night lighting of the proposed development on the relatively dark rural nightscape.

1.5.2 *Identification of Potential Impacts*

Features at risk of impact in a VIA are the landscape and sensitive visual receptors in the landscape.

1.5.2.1 Landscape

A landscape impact occurs when a development alters the existing landscape character. If the landscape character is highly sensitive to the development type then the intensity of the impact will be high. A high intensity landscape impact, for instance, will be highly significant if the landscape character type is scarce as well as highly valued by the community (local, regional, national and international). The landscape impact does not depend only on the existing sensitive visual receptors since it can also affect future visual receptors and communities beyond the local or regional context.

As noted above, the existing landscape character of the surrounding region is peri-urban with some large scale infrastructure such as various large roads, a railway and the Eskom Mookodi Substation. The proximity to a relatively large settlement is evident in the surrounding landscape. As a result the landscape character has a **low** <u>sensitivity</u> to the proposed development.

1.5.2.2 Sensitive Visual Receptors

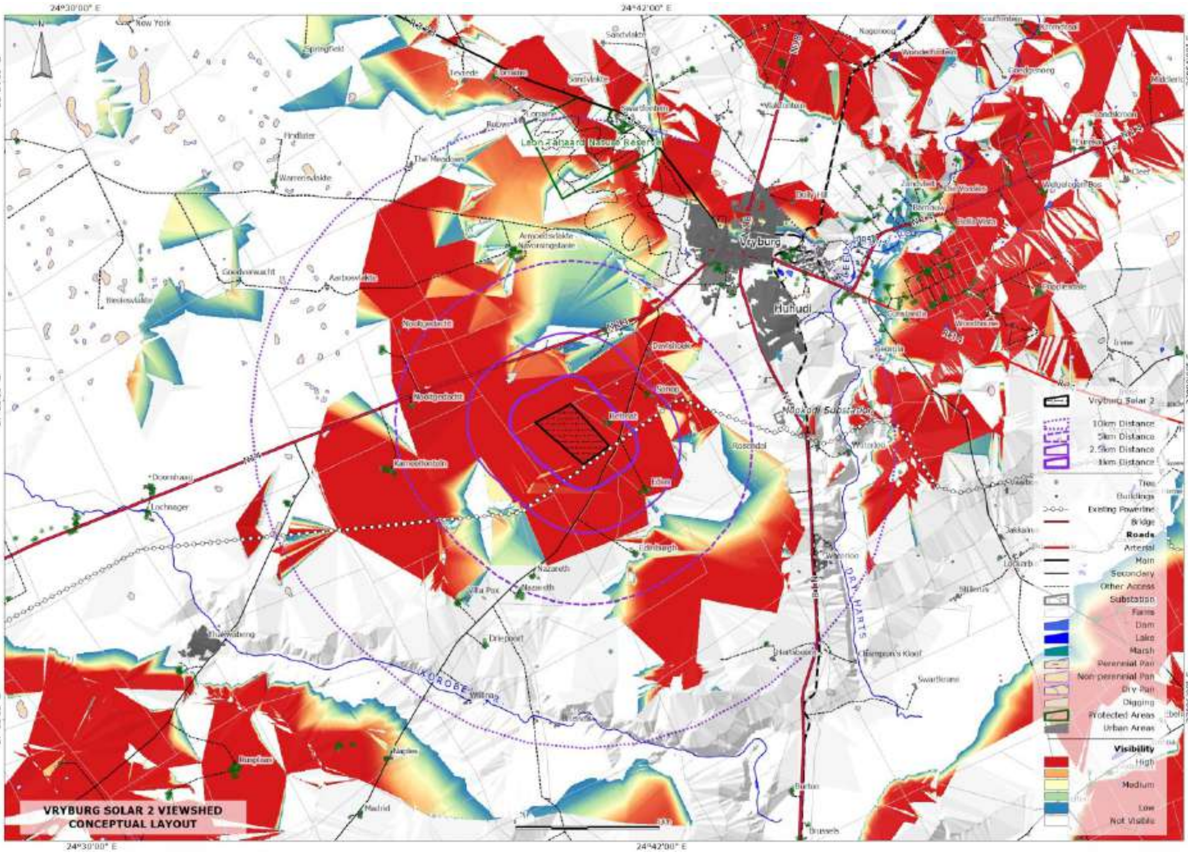


Figure 1-7 Viewshed of the proposed Vryburg Solar 2 facility (A3 map provided in Appendix A).

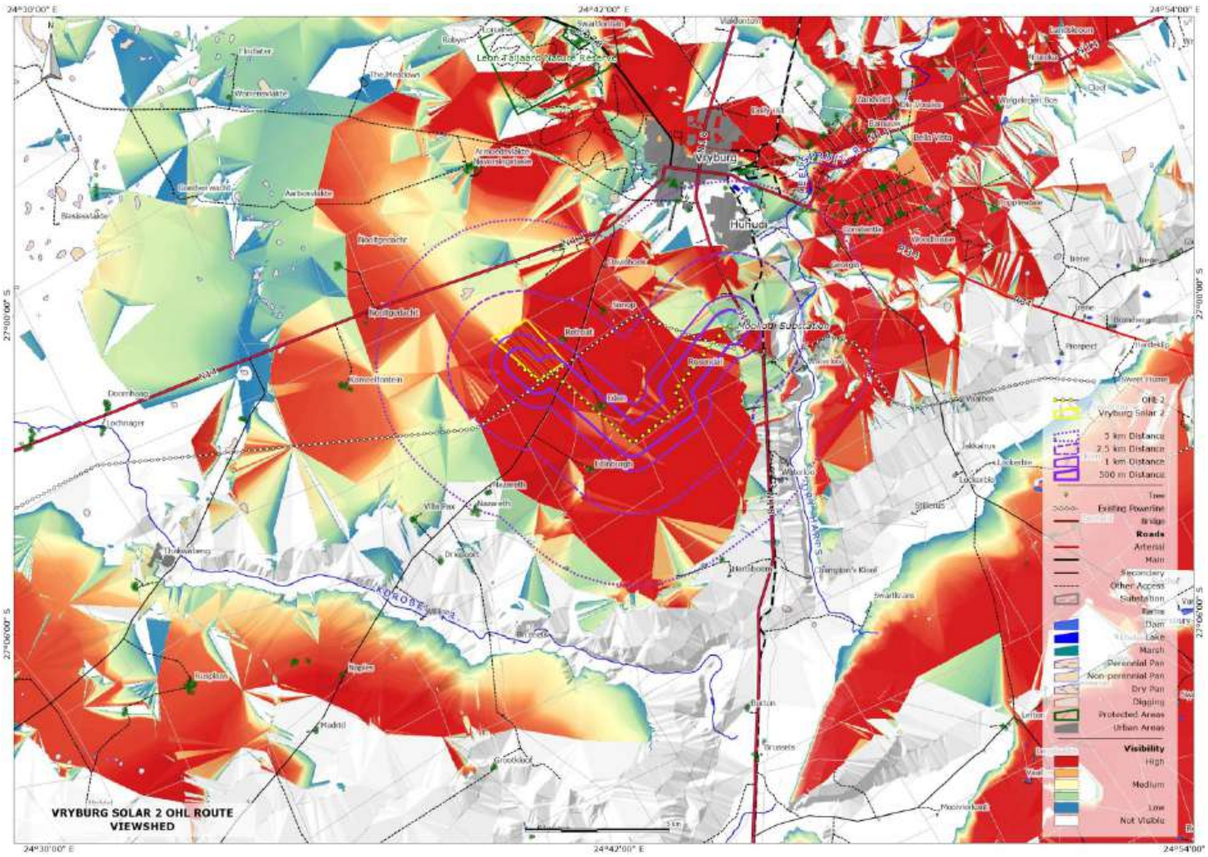


Figure 1-8 Viewshed of the proposed 132 kV power line from Vryburg Solar 2 to the Mookodi Substation (A3 map provided in Appendix A).

The viewshed map for the proposed Vryburg Solar 2 PV plant (Figure 1-7) shows that potentially affected sensitive visual receptors are mainly limited to farmsteads, dwellings and viewpoints on farms surrounding the proposed site, and motorists using the N14 east of Vryburg, the R378 north of Vryburg, and the R34. There are buildings and residences in northern Vryburg that fall within the viewshed of the proposed facility, and parts of the Leon Taljaard Nature Reserve may also be affected.

Sensitive visual receptors for the Vryburg Solar 2 PV Plant therefore include:

- Residents of Vryburg;
- Visitors and viewpoints in the Leon Taljaard Nature Reserve;
- Residents and viewpoints on farms surrounding the proposed site; and
- Motorists on the N14, R378 and R34.

The viewshed map for the proposed overhead line (OHL) from the PV Plant to Mookodi Substation indicates that visual receptors in Vryburg, residents and viewpoints on surrounding farms and motorists on the N14, N18 and R34 will potentially be affected by the power line. Parts of the Leon Taljaard Nature Reserve also fall within the OHL viewshed.

Sensitive visual receptors for the proposed overhead line include:

- Residents in Vryburg;
- Visitors and viewpoints in the Leon Taljaard Nature Reserve;
- Residents and viewpoints on farms surrounding the proposed sites; and
- Motorists on the N14, R378 and R34.

Residents of Vryburg are rated as low sensitivity visual receptors since they are surrounded by urban structures which tend to produce views of high complexity, patterns and contrasts. Visitors and viewpoints in the Leon Taljaard Nature Reserve are rated as highly sensitive visual receptors since they have an active interest in the surrounding landscape. Residents on surrounding farms are highly sensitive to changes in their views since they have an active interest in the landscape. The topography of the region is such that there are unlikely to be viewpoints of exceptional scenic value on farms immediately surrounding the proposed site.

Motorists are rated as low sensitivity visual receptors since they pass through the landscape and their attention is focused on the road. The N14, N18, R378 and R34 are also busy roads and motorists will have many urban elements related to the settlement of Vryburg in their views.

1.5.2.3 Potential Impacts Identified for the Construction Phase

- Potential visual intrusion of construction activities (discussed in Section 1.2.1) associated with a PV plant on existing views of sensitive visual receptors; and
- Potential visual intrusion of construction activities associated with a 132 kV powerline on existing views of sensitive visual receptors.

1.5.2.4 Potential Impacts Identified for the Operational Phase

- Potential landscape impact of a large solar energy facility on a peri-urban landscape;
- Potential landscape impact of a 132 kV powerline on a peri-urban landscape;
- Potential visual intrusion of the proposed solar energy facility on the views of sensitive visual receptors;
- Potential visual intrusion of a 132 kV powerline on the views of sensitive visual receptors; and
- Potential impact of night lighting of a large solar energy facility on the nightscape of the region.

1.5.2.5 Potential Impacts Identified for the Decommissioning Phase

- Potential visual intrusion of decommissioning activities (discussed in Section 1.2.1) on views of sensitive visual receptors; and
- Potential visual intrusion of decommissioning activities related to a 132 kV powerline on the existing views of sensitive visual receptors.

1.5.2.6 Potential Cumulative Impacts

- Cumulative impact of solar energy generation projects on the existing peri-urban landscape; and
- Cumulative visual impact of solar energy generation projects on existing views of sensitive visual receptors in the surrounding landscape.

1.6 VISUAL IMPACT CONCEPTS AND ASSESSMENT CRITERIA

The assessment of potential impacts for the proposed Vryburg Solar 1 project is conducted in the following steps:

- Identification of visual impact criteria (key theoretical concepts);
- Conducting a visibility analysis; and
- Assessment of impacts of the project on the landscape and on receptors (viewers) taking into consideration factors such as viewer sensitivity, visual exposure and visual intrusion.

Potential visual impacts are assessed using a number of criteria which provide the means to measure the intensity or consequence of the impacts. The intensity and other criteria such as spatial extent and duration of the impact are then used to determine its potential significance (Oberholzer, 2005). The visibility of the project is an indication of where in the region the development will potentially be visible from. The rating is based on viewshed area size and is an indication of how much of a region will potentially be visually affected by the development. A high visibility rating does not necessarily signify a high visual impact, although it can if the region is densely populated with sensitive visual receptors. Viewer (or visual receptor) sensitivity is a measure of how sensitive potential viewers of the development are to changes in their views. Visual receptors are identified by looking at the viewshed of the proposed development, and include scenic viewpoints, residents, motorists and recreational users of facilities within the viewshed. Their distance from the development (visual exposure) and the composition of their existing views (visual intrusion) will determine impact intensity/consequence.

1.6.1 *Visibility Ratings*

Visibility is the geographic area from which the proposed project will be visible, or view catchment area (Figure 1-7). The number of visual receptors in the viewshed has an influence on the visibility rating (Oberholzer, 2005).

- *High* - visible from a large area (e.g. several square kilometres).
- *Moderate* – visible from an intermediate area (e.g. several hectares).
- *Low* – visible from a small area around the project site.

The visibility of the proposed project is high in terms of the definition above since the viewshed area is approximately 190 km^2 (within a 10 km radius of the development site). The viewshed for the proposed 132 kV power line is approximately 150 km^2 within a 5 km distance from the route. The actual viewsheds are likely to be smaller than the calculated viewsheds since there are many trees in the landscape and high trees surround most farmsteads. There are 2500 buildings (within a 10 km radius of the development site) that will potentially be affected (not all of which are residences). Most of these buildings are in the northern parts of Vryburg and it is highly unlikely that many will have a view on the proposed development since adjacent buildings and trees will block most views. The visibility of the PV plant is therefor rated as **medium** rather than high.

Similarly, there are a large number of buildings (4000) in Vryburg which are in the power line viewshed but views from the settlement will be very limited due to high trees and obstructing buildings and structures. A **moderate** to low visibility is expected for the proposed power line.

1.6.2 *Visual Exposure*

Visual exposure refers to the relative visibility of a project or feature in the landscape and is related to the distance between the observer and the project (Oberholzer 2005). Exposure and visual impact tend to diminish exponentially with distance since the observed element comprises a smaller part of the view. Visual exposure is classified as follows:

- *High* – dominant or clearly noticeable;
- *Moderate* – recognisable to the viewer; and
- *Low* – not particularly noticeable to the viewer

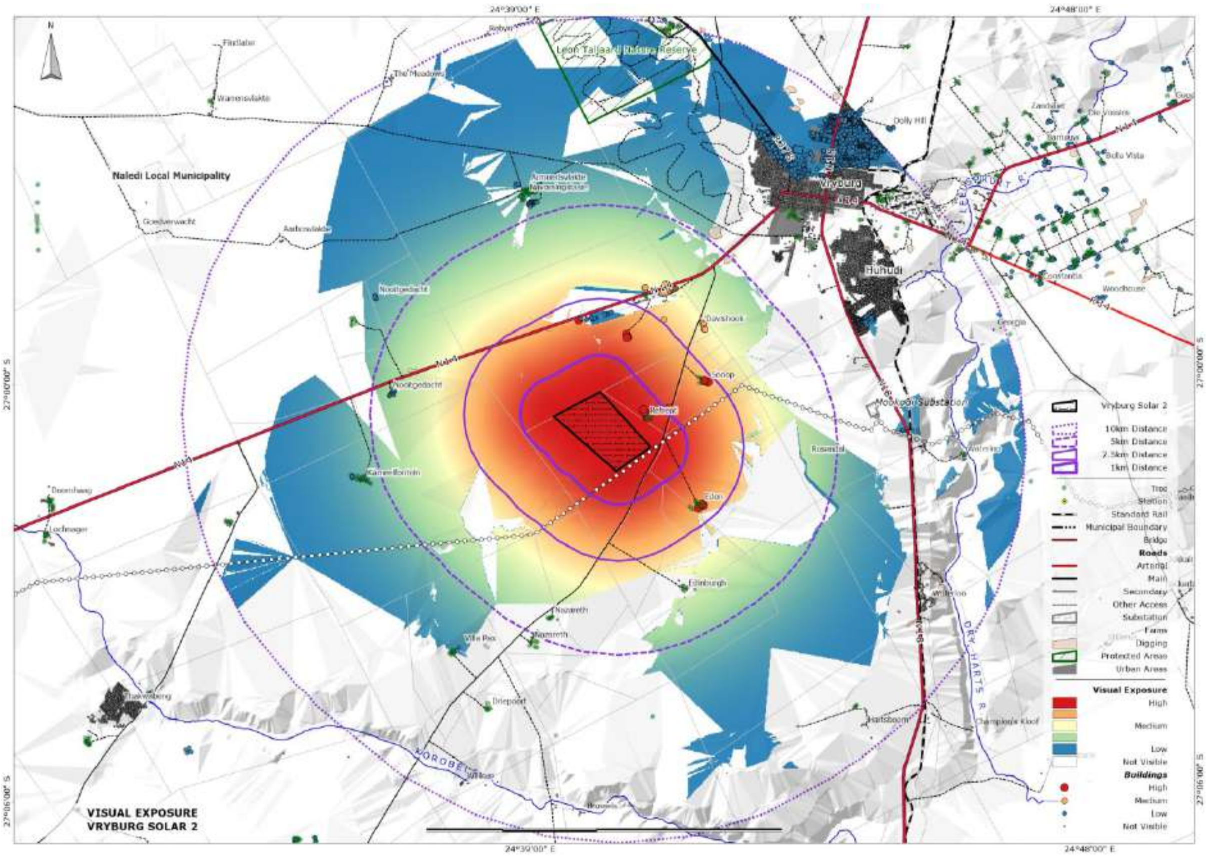


Figure 1-9 Visual exposure for sensitive visual receptors within 10 km of the development (A3 map provided in Appendix A).

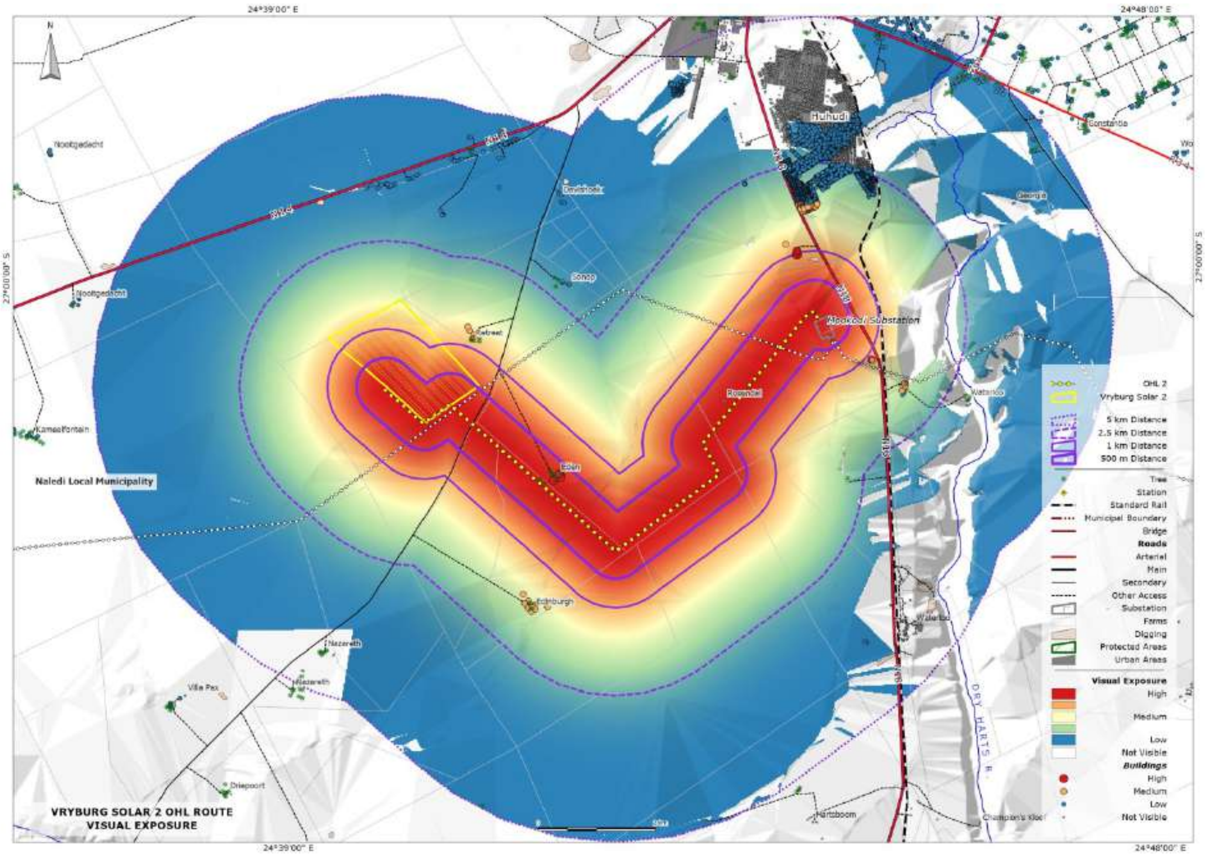


Figure 1-10 Visual exposure for sensitive visual receptors within 5 km of the proposed 132 kV powerline (A3 map provided in Appendix A).

1.6.2.1 Residents of Vryburg

Residents of northern Vryburg (i.e. those buildings in the viewshed) are more than 5 km from the proposed PV Plant and will experience **low** visual exposure to the development if they can see it at all. Residents will experience **low** visual exposure to the power line since they are more than 2.5 km from the route.

1.6.2.2 Visitors and Viewpoints in the Leon Taljaard Nature Reserve

The nature reserve is more than 7 km from the proposed development site and visual receptors will experience **low** visual exposure to the solar facility and the OHL.

1.6.2.3 Residents and Viewpoints on Surrounding Farms

There are a number of farmsteads within 2.5 km of the proposed site (Figure 1-9). Visual receptors at Eden, Sonop, and Retreat, as well as a few buildings along the N14 will be highly exposed to the development (23 buildings in total). Visual receptors at another 40 buildings will potentially experience moderate visual exposure. Visual exposure for the 132 kV powerline is limited to approximately 1 km from the proposed route. There are three buildings north of the route which will be highly exposed to power lines (it is unclear whether these buildings are occupied) and buildings at the Eden farmstead will also be highly exposed (Figure 1-10).

1.6.2.4 Motorists

Motorists using the N14 will be highly exposed to the proposed plant when it is visible, for 2.3 km - a bit more than 1 minute at 100 km/h. Those using other main roads in the region will experience low visual exposure if they are in the viewshed. Motorists using the N18 will potentially be highly exposed to the power line for a 2 km section of the road (1 minute at 100 km/h). Motorists using the other main roads will experience low visual exposure to the proposed power line when in the viewshed.

1.6.3 *Visual Intrusion*

Visual intrusion indicates the level of compatibility or congruence of the project with the particular qualities of the area – its *sense of place*. This is related to the idea of context and maintaining the integrity of the landscape (Oberholzer, 2005). It can be ranked as follows:

- *High* – results in a noticeable change or is discordant with the surroundings;
- *Moderate* – partially fits into the surroundings, but is clearly noticeable; and
- *Low* – minimal change or blends in well with the surroundings.

1.6.3.1 Photographic Survey

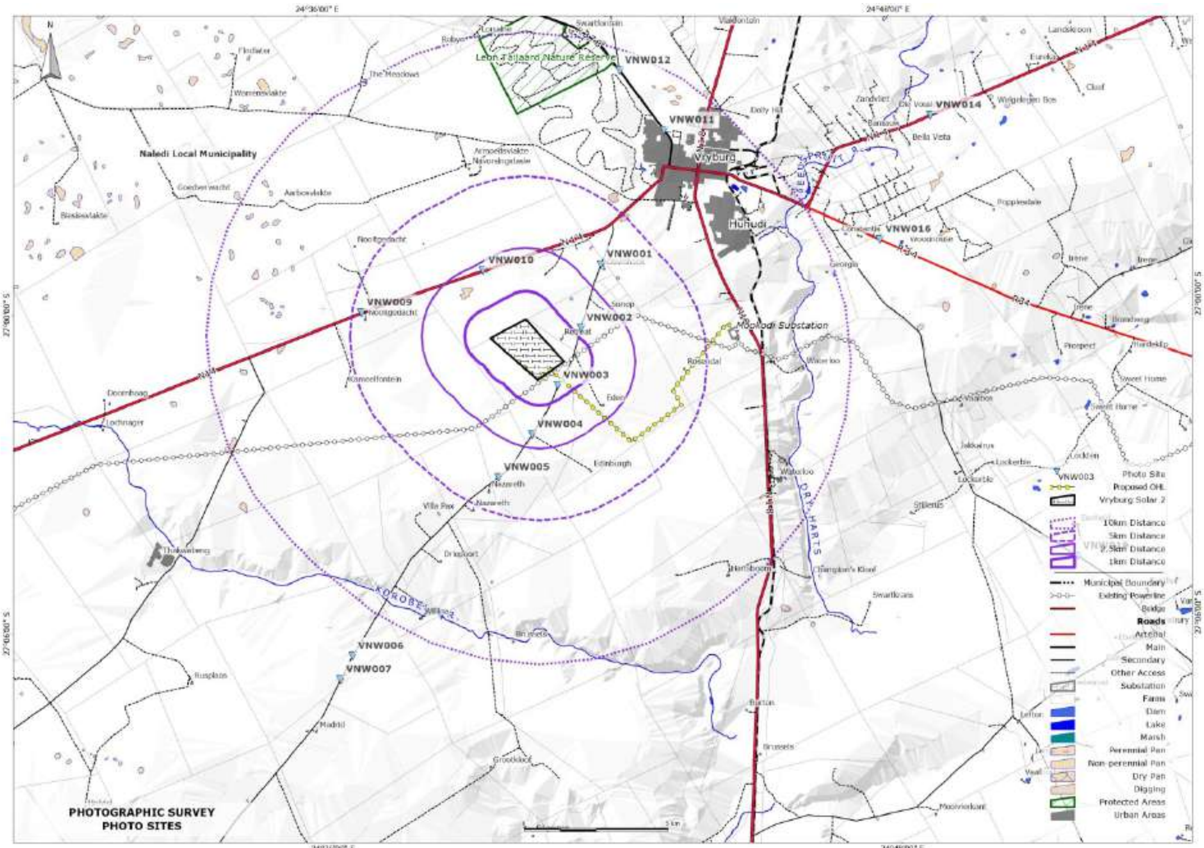


Figure 1-11 Sites visited during photographic survey (A3 map provided in Appendix A)

Sites from which landscape photographs were taken are shown in Figure 1-11. The discussion below refers to photograph sites on the map.

The proposed site is within 10 km of Vryburg and existing views in the surrounding area are likely to contain elements associated with the settlement. Urban structures are often complex in patterns, colours and textures and they tend to reduce the quality of views. The structures surrounding Vryburg include high voltage power lines and pylons, a substation, communication towers, mining/quarry activity, a number of relatively large and busy roads (N18, N14 and R34) and a railway line. The following photographs provide an indication of visual aspects of the surrounding landscape (Figure 1-12 to Figure 1-22).

Figure 1-12 View east from Photo Site VNW002 showing high voltage power lines.

Figure 1-13 View from Photo Site VNW003 showing a tall communications tower.

Figure 1-14 View from Photo Site VNW009 on the N14. Cell tower in view.

Figure 1-15 View from site VNW010 on the N14 towards proposed site.

Figure 1-16 Traffic on the N14 at Photo Site NWN010.

Figure 1-17 View from Photo Site VNW011 along the R378 in northern Vryburg, towards the proposed site.

Figure 1-18 View south from near the Louis Taljaard Nature Reserve (Photo Site VNW012) in the direction of the proposed site.

Figure 1-19 Mining activity along the N14 east of Vryburg (Photo Site VNW014).

Figure 1-20 View from Photo Site VNW014 on the N14 towards Vryburg.

Figure 1-21 Electrical infrastructure as seen from Photo Site VNW016 on the R34 south of Vryburg.

Figure 1-22 Electrical infrastructure as seen from Photo Site VNW017. The Mookodi Substation can be seen in the background.

1.6.3.2 Residents of Vryburg

Views from northern Vryburg are unlikely to include the PV Plant (due to trees and other buildings adjacent to the receptors or between them and the plant) and if any do include it the visual intrusion will be **low** since there are major structures between the proposed site and Vryburg (for instance, the Mookodi Substation and a number of power lines. The proposed development will not seem out of place. Visual intrusion will also be **low** for views of the proposed 132 kV power line since it will blend in with the surrounding landscape and the other electrical infrastructure in the area.

1.6.3.3 Visitors and viewpoints in Louis Taljaard Nature Reserve

The nature reserve is about 3 km from Vryburg and due to this proximity views from the reserve are likely to include structures and buildings associated with the town. Views of urban and peri-urban developments are complex with highly contrasting elements and patterns. The proposed solar development will not seem incongruent with other elements in these views and it is therefore expected that visual intrusion for these receptors will be **low**. For the same reason, and since the Mookodi Substation and electrical infrastructure will also be in views, visual intrusion will also be **low** for the 132 kV power line.

1.6.3.4 Residents and Viewpoints on Surrounding Farms

The proposed site is in close proximity to Vryburg and various structures associated with a settlement. There are high voltage power lines crossing the landscape and a large substation within 5 km of the site. The PV Plant will therefore be noticed by highly sensitive visual receptors but it will not be incongruent with the landscape. **Moderate** visual intrusion on existing views is expected for the PV Plant and **low** visual intrusion for the proposed power line.

1.6.3.5 Motorists

The solar energy facility and the associated power line will be congruent with other structures and buildings in close proximity to Vryburg and motorists, and as such a **low** visual intrusion is expected on motorists' existing views.

Table 1-3 Visual Impact Criteria and Impact Intensity for the Vryburg Solar 1 project.

Development Component	Sensitive Visual Receptor	Visual Sensitivity		Visual Exposure		Visual Intrusion		Impact Consequence	
Construction of a Solar PV Plant	Residents of Vryburg	Low	Urban views are contain highly contrasting elements and complex patterns.	Low	Receptors in northern Vryburg are more than 5 km from the site.	Low	Views from northern Vryburg will include many other large structures and buildings and the proposed development will be in the distant background if it is visible.	Slight	Low visual intrusion on low sensitivity visual receptors.
	Visitors and viewpoints in the Leon Taljaard Nature Reserve	High	Visual receptors in protected areas are rated as highly sensitive to changes in their views since they have an active interest in the surrounding landscape.	Low	The nature reserve is more than 7 km from the proposed site and power corridor.	Low	Views from the reserve include other structures and buildings associated with urban and peri-urban landscapes.	Slight	Low visual intrusion and low visual exposure for highly sensitive visual receptors.
	Residents and viewpoints on surrounding farms	High	Residents have an active interest in their surrounding landscape and the development will cause changes in existing views.	High	There are several farmsteads in the viewshed and within 2.5 km of the PV Plant.	Moderate	Construction activities will be noticeable but will not be incongruent with a landscape in close proximity to a large settlement.	Substantial	Moderate visual intrusion on the existing views of highly sensitive visual receptors.
	Motorists using the N14	Low	The road is not officially recognised as a scenic route. The attention of motorists will only be focussed briefly on the landscape as they pass through it and the proximity of Vryburg to the proposed site means that motorists are exposed to increasingly urban elements associated with a settlement.	High	The R14 is in a high exposure area of the viewshed for 2.3 km - a bit more than 1 minute at 100 km/h.	Moderate	Construction activities will be noticeable but will not be incongruent with a landscape in close proximity to a large settlement.	Moderate	Moderate visual intrusion on low sensitivity visual receptors' existing views.
	Motorists using the other main roads in the region	Low	The roads are not officially recognised as scenic routes. The attention of motorists will only be focussed briefly on the landscape as they pass through it and the proximity of Vryburg to the proposed site means that motorists are exposed to increasingly urban elements associated with a settlement.	Low	The proposed site is more than 5 km from any of the other main roads within the viewshed.	Moderate	Construction activities will be noticeable but will not be incongruent with a landscape in close proximity to a large settlement.	Moderate	Moderate visual intrusion on existing views.
Construction of Distribution Lines along proposed Corridor	Residents of Vryburg	Low	Urbanised views are complex with highly contrasting elements.	Low	Vryburg is more than 2.5 km from the power line route.	Low	The Mookodi Substation is located between Vryburg and the proposed power line. Construction of power lines associated with a substation will not be unexpected.	Slight	Activities associated with the construction of power lines near a large substation is unlikely to attract much attention from visual receptors in Vryburg.

Development Component	Sensitive Visual Receptor	Visual Sensitivity		Visual Exposure		Visual Intrusion		Impact Consequence	
	Residents and viewpoints on surrounding farms	High	Residents have an active interest in their surrounding landscape and the development will cause changes in existing views.	High	There are two buildings near the northern end of the corridor which are within 1 km of the proposed development	Moderate	It is very likely that these visual receptors have high voltage power lines in existing views as well as the Mookodi Substation. As such construction activities associated with power lines will not seem out of place in the landscape. However the activities will change existing views due to proximity to the activities.	Moderate	Moderate visual intrusion on views of highly sensitive visual receptors.
	Motorists using the N14	Low	The road is not officially recognised as a scenic route. The attention of motorists will only be focussed briefly on the landscape as they pass through it and the proximity of Vryburg to the proposed site means that motorists are exposed to increasingly urban elements associated with a settlement.	Low	The proposed route is more than 2.5 km from the N14.	Low	There are many power lines and electrical infrastructure in the area and construction activities associated with power lines will be congruent with the landscape.	Slight	Low visual intrusion on low sensitivity visual receptors.
	Motorists using the N18	Low	The road is not officially recognised as a scenic route. The attention of motorists will only be focussed briefly on the landscape as they pass through it and the proximity of Vryburg to the proposed site means that motorists are exposed to increasingly urban elements associated with a settlement.	High	The N18 passes within 1 km of the proposed power line route and motorists will potentially be highly exposed to construction activities for a 2 km section of the road.	Low	There are many power lines and electrical infrastructure in the area and construction activities associated with power lines will be congruent with the landscape.	Slight	Low visual intrusion on low sensitivity visual receptors.
	Motorists using the R34	Low	The road is not officially recognised as a scenic route. The attention of motorists will only be focussed briefly on the landscape as they pass through it and the proximity of Vryburg to the proposed site means that motorists are exposed to increasingly urban elements associated with a settlement.	Low	The R34 is more than 5 km from the proposed route.	Low	There are many power lines and electrical infrastructure in the area and construction activities associated with power lines will be congruent with the landscape.	Slight	Low visual intrusion on low sensitivity visual receptors.
Solar PV Power Plant	Residents and viewpoints on surrounding farms	High	Residents have an active interest in their surrounding landscape and the development will cause changes in existing views.	High	There are several farmsteads in the viewshed and within 2.5 km of the PV Plant.	Moderate	The proposed site is in close proximity to Vryburg and various structures associated with a settlement. There are high voltage power lines crossing the landscape and a large substation within 5 km of the site. The PV Plant will therefore be noticed by highly sensitive visual receptors but it will not be incongruent with the landscape	Substantial	Moderate visual intrusion on the existing views of highly sensitive visual receptors.

Development Component	Sensitive Visual Receptor	Visual Sensitivity		Visual Exposure		Visual Intrusion		Impact Consequence	
	Visitors and viewpoints in the Leon Taljaard Nature Reserve	High	Visual receptors in protected areas are rated as highly sensitive to changes in their views since they have an active interest in the surrounding landscape.	Low	The nature reserve is more than 7 km from the proposed site and power corridor.	Low	Views from the reserve include other structures and buildings associated with urban and peri-urban landscapes.	Slight	Low visual intrusion and low visual exposure for highly sensitive visual receptors.
	Motorists using the N14	Low	The road is not officially recognised as a scenic route. The attention of motorists will only be focussed briefly on the landscape as they pass through it and the proximity of Vryburg to the proposed site means that motorists are exposed to increasingly urban elements associated with a settlement.	High	The R14 is in a high exposure area of the viewshed for 2.3 km - a bit more than 1 minute at 100 km/h.	Low	The PV Plant will be associated with the settlement and its structures, particularly the high voltage power lines and substation on this side of Vryburg.	Slight	Low visual intrusion on existing views of low sensitivity visual receptors.
	Motorists using other main roads in the region	Low	The roads are not officially recognised as scenic routes. The attention of motorists will only be focussed briefly on the landscape as they pass through it and the proximity of Vryburg to the proposed site means that motorists are exposed to increasingly urban elements associated with a settlement.	Low	The proposed site is more than 5 km from any of the other main roads within the viewshed.	Low	The solar energy facility will be congruent with other structures and buildings in close proximity to Vryburg.	Slight	Low visual intrusion on low sensitivity visual receptors.
Solar PV Power Plant Nightscape	Residents and viewpoints on surrounding farms	High	Residents have an active interest in the nightscape and the development will cause changes in existing views.	High	There are several farmsteads in the viewshed and within 2.5 km of the PV Plant.	Moderate	The nightscape is relatively dark for farms surrounding the proposed site but Vryburg is in close proximity and is a large source of light pollution. Farmstead security lights are bright and lights from the PV Plant are likely to be similar to these.	Substantial	Moderate visual intrusion on the existing views of highly sensitive visual receptors.
	Motorists using the N14	Low	Motorists add their own lights to the nightscape and are likely to be more affected by other vehicle lights on the road than lights at the proposed facility.	High	The R14 is in a high exposure area of the viewshed for 2.3 km - a bit more than 1 minute at 100 km/h.	Low	The PV Plant will be associated with the settlement and its lights.	Slight	Low visual intrusion on existing views of low sensitivity visual receptors.
	Motorists using other main roads.	Low	Motorists are unlikely to notice additional lights in this area since they are more affected by other road users and their lights.	Low	The proposed site is more than 5 km from any of the main roads within the viewshed.	Low	The PV Plant will be associated with the settlement and its lights.	Slight	Low visual intrusion on existing views of low sensitivity visual receptors.
Distribution Lines along proposed Corridor	Residents of Vryburg	Low	Urbanised views are complex with highly contrasting elements.	Low	Vryburg is more than 2.5 km from the power line route.	Low	The Mookodi Substation is located between Vryburg and the proposed power line. It is unlikely that Vryburg residents will notice the additional power lines since they will be congruent with the landscape.	Slight	Existing high voltage transmission lines in the landscape and the fact that the Mookodi Substation is between Vryburg and the proposed power lines indicate a low visual intrusion on existing views from here.

Development Component	Sensitive Visual Receptor	Visual Sensitivity		Visual Exposure		Visual Intrusion		Impact Consequence	
	Residents and viewpoints on surrounding farms	High	Residents have an active interest in their surrounding landscape and the development will cause changes in existing views.	High	There are two buildings near the northern end of the corridor which are within 1 km of the proposed development	Low	It is very likely that these visual receptors have high voltage power lines in existing views as well as the Mookodi Substation. As such power lines will not seem out of place in the landscape. It is also unlikely that highly valued views in this direction will be affected since there are already similar structures in them.	Moderate	Low visual intrusion on existing views of highly sensitive visual receptors in close proximity to the proposed development.
	Motorists using the N14	Low	The road is not officially recognised as a scenic route. The attention of motorists will only be focussed briefly on the landscape as they pass through it and the proximity of Vryburg to the proposed site means that motorists are exposed to increasingly urban elements associated with a settlement.	Low	The proposed route is more than 2.5 km from the N14.	Low	There are many power lines and electrical infrastructure in the area and power lines will be congruent with views from the N14.	Slight	Low visual intrusion on low sensitivity visual receptors.
	Motorists using the N18	Low	The road is not officially recognised as a scenic route. The attention of motorists will only be focussed briefly on the landscape as they pass through it and the proximity of Vryburg to the proposed site means that motorists are exposed to increasingly urban elements associated with a settlement.	High	The N18 passes within 1 km of the proposed power line route and motorists will potentially be highly exposed to construction activities for a 2 km section of the road.	Low	There are many power lines and electrical infrastructure in the area and power lines will be congruent with views from the N18 where motorists are highly exposed to the proposed power lines.	Slight	Low visual intrusion on low sensitivity visual receptors.
	Motorists using the R34	Low	The road is not officially recognised as a scenic route. The attention of motorists will only be focussed briefly on the landscape as they pass through it and the proximity of Vryburg to the proposed site means that motorists are exposed to increasingly urban elements associated with a settlement.		The R34 is more than 5 km from the proposed route.	Low	There are many power lines and electrical infrastructure in the area and power lines will be congruent with views from the R34.	Slight	Low visual intrusion on low sensitivity visual receptors.
Renewable Energy Projects in Surrounding Landscape	Landscape	Low	Structures and developments in the landscape of this area associated with intensive commercial farming and settlements means that the landscape character is constantly changing as new developments are introduced.					Slight	The landscape is changing as the town expands and new developments are introduced. The consequence of introducing solar energy facilities into the landscape surrounding Vryburg is expected to be slight.

1.7 ASSESSMENT OF IMPACTS AND IDENTIFICATION OF MANAGEMENT ACTIONS

1.7.1 *Potential Visual Intrusion of Construction Activities associated with a PV Plant on Existing Views of Sensitive Visual Receptors*

1.7.1.1 Significance Statement

The spatial extent of the impact will be **local** since visual receptors beyond 10 km are likely to associate construction activities with other activities related to a settlement such as Vryburg. Visual intrusion beyond 10 km is likely to be low. The consequence of the impact will be **substantial** since there are highly sensitive visual receptors that will potentially experience moderate visual intrusion on their views. The impact will be of **short to medium term duration** since construction should be possible in 14 months (the Kalkbult 75 MW plant was built in 9 months, however it is understood that the construction period is subject to the final requirements of Eskom and the REIPPPP Request for Proposal provisions at that point in time).The reversibility of the impact is rated as **high** and irreplaceability of the visual resource **low** since construction activities are temporary. The impact status will be **negative** since construction is normally viewed as cluttered and untidy. The probability of the impact occurring is **very likely** since there are sensitive visual receptors in close proximity to the proposed site that will potentially be affected.

The significance of the impact is **moderate** since the impact is short to medium term and there are very few highly sensitive visual receptors that will be affected, but the consequence is substantial. Mitigation measures could reduce the consequence if it is possible to phase construction activities in such a way as not to disturb the whole solar field area in one phase.

1.7.1.2 Mitigation Measures

Assumptions regarding the management of construction activities are discussed in section 1.1.4.1. Mitigation measures in addition to the best practice guidelines are:

- Preparation of the solar field area (i.e. clearance of vegetation, grading, contouring and compacting) and solar field construction should be phased in a way that makes practical sense in order to minimise the area of soil exposed and duration of exposure;
- Parking areas should be demarcated and strictly controlled so that vehicles are limited to specific areas only;
- Night time construction should be avoided where possible; and
- Night lighting of the construction sites should be minimised within requirements of safety and efficiency.

The significance of the impact after mitigation will be **low** if mitigation measures are successfully implemented to lower the impact intensity/consequence.

1.7.2 *Potential visual intrusion of construction activities associated with a 132 kV powerline on existing views of sensitive visual receptors*

The spatial extent of the potential impact will be **local** since sensitive visual receptors further than 2 km from the proposed Distribution line route will at most experience low visual exposure. The consequence of the potential impact will be **moderate** since construction will potentially affect highly sensitive visual receptors in close proximity to the proposed corridor. The impact will be of **very short-term** duration since the proposed transmission line is only approximately 12.5 km long. The construction and decommissioning phases of the project are transitional and visual impacts are temporary – reversibility of impacts is **high** and irreplaceability of visual resources is **low**. The impact status will be **negative** since construction is normally viewed as cluttered and untidy. The probability of the impact occurring is **likely** since there are sensitive visual receptors in close proximity to the corridor.

The significance of the potential impact without the implementation of mitigation measures is rated as **low** since the impact is predicted to be very short term in nature and there are very few highly sensitive visual receptors that will be affected.

1.7.2.1 Mitigation Measures

Assumptions regarding the management of construction activities are discussed in Section 1.1.4.1 of this report. Mitigation measures in addition to the best practice guidelines are:

- Night time construction should be avoided where possible; and
- Night lighting of the construction sites should be minimised within requirements of safety and efficiency.

The significance of the impact after mitigation will remain **low** with the implementation of mitigation measures.

1.7.3 *Potential Landscape Impact of a Large Solar Energy Facility on a Peri-urban Landscape*

1.7.3.1 Significance Statement

The spatial extent of the impact will be **regional** since it will affect the surrounding landscape. The consequence of the impact will be **slight** since the landscape character has a low sensitivity to changes potentially brought about by introducing a PV Plant into the landscape. The impact duration will be **long term** and will cease only once the proposed PV plant has been removed from the landscape. The reversibility of the potential impact is rated as **high** – the landscape character will remain since it describes a landscape that is in flux. The irreplaceability of the landscape character type is rated as **low** because it is a mixture of urban and agricultural landscapes and is not generally known for its aesthetic value (i.e. peri-urban landscapes tend to be complex and constantly changing). The impact status will be **neutral** since the peri-urban landscape normally contains disparate and often large scale development types which do not fit into an urban or rural landscape. The probability of the impact occurring is un**likely** since the landscape character can absorb them.

The significance of the impact before mitigation is **very low** since although the impact is long term and regional in nature the consequence of the impact is slight. No mitigation measures are recommended.

1.7.4 *Potential landscape impact of a 132 kV powerline on a peri-urban landscape*

1.7.4.1 Significance Statement

The spatial extent of the potential impact will be **local** since it is unlikely to affect the landscape beyond 2 km from the proposed Distribution line route. The consequence of the potential impact will be **slight** since the landscape contains similar infrastructure close to the proposed corridor and another 132 kV power line is unlikely to change the landscape character. The impact will be **long term** and will cease only once the power line has been removed. The potential impact will diminish over time as other power lines to the substation are built and the electrical infrastructure becomes a more dominant element of the landscape. The reversibility of the impact is **high**. The irreplaceability of the landscape character type is **low**. The impact status will be **neutral** since the landscape character is unlikely to change due to the proposed power line. The probability of the impact occurring is **unlikely**.

The significance of the potential impact before mitigation is rated as **very low** since the impact is localized and has a slight consequence. No mitigation measures are recommended.

1.7.5 *Potential Visual Intrusion of the Proposed Solar Energy Facility on the Views of Sensitive Visual Receptors*

1.7.5.1 Significance Statement

The spatial extent of the impact will be **local** since visual receptors beyond 10 km from the proposed site will associate the PV Plant with the settlement of Vryburg and its structures and visual intrusion on their views will be low. The consequence of the impact will be **substantial** for a few highly sensitive visual receptors in close proximity to the proposed site. The impact will be of **long term** duration since it will only end once the project ends and the cleared area has been rehabilitated. The reversibility of the potential impact is rated as **high** since removal of the solar panels, structures and buildings, and subsequent recovery of vegetation will remove most of the impact (even if recovery is not a complete success the existing vegetation is not pristine and the resultant land will not appear different from it). The visual resources of the surrounding area are impacted by their close proximity to Vryburg and numerous structures associated with a large settlement and intensive stock farming. The irreplaceability of the visual resources is therefore seen as **low**. The impact status will be **negative** since highly technological structures will replace natural and/or familiar landscape over a relatively large area. The probability of the impact occurring is **likely** since there are a number highly sensitive visual receptors that will be affected.

The significance of the impact before mitigation is **moderate** since a small number of highly sensitive visual receptors are likely to be affected by the development. Mitigation measures are aimed at reducing the consequence of the impact by reducing the incongruence of the structures with the surrounding landscape (lowering visual intrusion).

1.7.5.2 Mitigation Measures

Solar Arrays

- The project developer should maintain rehabilitated surfaces until a self-sustaining stand of vegetation is established and visually adapted to the undisturbed surrounding vegetation. No new disturbance should be created during operations without approval by the Environmental Officer;
- Restoration of disturbed land should commence as soon after disturbance as possible;
- Dust and noxious weed control should be part of maintenance activities;
- Road maintenance activities should avoid damaging or disturbing vegetation; and
- Painted features should be maintained and repainted when colour fades or paint flakes.

Buildings

- Appropriate coloured materials should be used for structures to blend in with the backdrop of the project where this is technically feasible and the colour or paint will not have a deleterious effect on the functionality of the structures;
- Appropriate colours for smooth surfaces often need to be two to three shades darker than the background colour to compensate for shadows that darken most textured natural surfaces;
- Materials, coatings and paints should be chosen based on minimal reflectivity where possible; and

- Grouped structures should be painted the same colour to reduce visual complexity and contrast.

The significance of the impact after mitigation is **low** since mitigation measures will reduce the consequence from substantial to moderate.

1.7.6 *Potential visual intrusion of a 132 kV powerline on the views of sensitive visual receptors*

1.7.6.1 Significance Statement

The spatial extent of the potential impact will be **local** since only sensitive visual receptors within 2 km of the proposed development are likely to be affected and there are very few within this distance of the proposed Distribution line route. The consequence of the impact is rated as **slight** since visual intrusion is expected to be low. The potential impact is rated with **long term** duration since it will only end once the project ends. The reversibility of the potential impact is rated as **high** since it removal of the power line will remove the visual impact. The irreplaceability of visual resources is seen as **low** since existing views already contain large electrical infrastructure. The impact status is **neutral** since most existing views already contain power lines and electrical infrastructure. The probability of the impact occurring is **likely** since there are highly sensitive visual receptors that will potentially be affected.

The significance of the impact (without the implementation of mitigation measures) is rated as **very low**.

1.7.6.2 Mitigation Measures

It is recommended that, where possible, the type of power line towers used for the proposed power line should be similar to existing pylon/towers in the landscape.

The significance of the impact after mitigation will remain **very low**.

1.7.7 *Potential Impact of Night Lighting of a Large Solar Energy Facility on the Nightscape of the Region*

1.7.7.1 Significance Statement

The nightscape of the immediate region surrounding the proposed site is relatively dark with strong night glow from the Vryburg site. Where lights from Vryburg are visible they cause glare and dominate the nightscape. Farmsteads have security lights but there are not many in the landscape. Vehicles on the main roads are also a source of lights. The PV Plant will introduce more lights into this nightscape in the form of security lighting. These are likely to be similar to farmstead lights but there will be more of them.

The spatial extent of the impact will be **local** since views from distance (beyond 10 km) will be dominated by lights from Vryburg. The consequence of the potential impact will potentially be **substantial** since there are highly sensitive visual receptors that will potentially be highly exposed to bright lights from a region where there are none at the moment. The impact will be of **long term** duration since it will only end once the project ends. The reversibility of the potential impact is rated as **high** since removal of the plant will remove all lights as well. The irreplaceability of the visual resources is seen as **low** since the proposed site is in close proximity to Vryburg which is a large source of light pollution. The impact status will be **negative** since the lights will reduce the dark nightscape further. The probability of the impact occurring is **likely** since there are sensitive visual receptors that will be affected.

The significance of the impact before mitigation is **moderate** according to the rating scheme. Mitigation measures will contain the impact and minimise contribution to light pollution.

1.7.7.2 Mitigation Measures

- A lighting plan that documents the design, layout and technology used for lighting purposes should be prepared, indicating how nightscape impacts will be minimised;
- The lighting plan should include a process for promptly addressing and mitigating complaints about potential lighting impacts;
- Lighting of the facility should not exceed, in number of lights and brightness, the minimum required for safety and security;
- Uplighting and glare (bright light) should be minimised using appropriate screening;
- Low-pressure sodium light sources should be used to reduce light pollution;
- Light fixtures should not spill light beyond the project boundary;
- Timer switches or motion detectors (within safety requirements) should be used to control lighting in areas that are not occupied continuously; and
- Lights should be switched off when not in use whenever it is in line with safety and security.

The significance of the impact after mitigation will be **low** since the consequence of the impact will be lowered from substantial to moderate.

1.7.8 *Potential Visual Intrusion of Decommissioning Activities associated with a PV Plant on Views of Sensitive Visual Receptors*

1.7.8.1 Significance Statement

The spatial extent of the impact will be **local** since beyond 10 km the activities will be associated with activities related to a large settlement. The consequence of the impact will be **substantial** since there are highly sensitive visual receptors that will potentially experience moderate visual intrusion on their views. The impact duration should be shorter than for the construction phase (i.e. **short-term**). The impact is that of visual intrusion of activities associated with the decommissioning of the PV plant and includes equipment, workers, laydown areas and exposure of soil after removal of structures. It also includes activities related to rehabilitation of cleared areas. The reversibility of the impact is rated as **high** and irreplaceability of the visual resource **low** since these activities are temporary. The impact status will be **negative** since this phase will be perceived as cluttered and untidy. The probability of the impact occurring is rated as **very likely** since there are sensitive visual receptors in close proximity that will potentially be affected.

The significance of the impact before mitigation is **moderate** since the impact is short term and there are very few highly sensitive visual receptors that will be affected, but its consequence is substantial.

1.7.8.2 Mitigation Measures

- Disturbed and transformed areas should be contoured to approximate naturally occurring slopes to avoid lines and forms that will contrast with the existing landscapes;
- Stockpiled topsoil should be reapplied to disturbed areas and these areas should be re-vegetated using a mix of indigenous species in such a way that the areas will form as little contrast in form, line, colour and texture with the surrounding undisturbed landscape;
- Edges of re-vegetated areas should be feathered to reduce form and line contrasts with surrounding undisturbed landscape;
- Working at night should be avoided where possible; and

- Night lighting of reclamation sites should be minimised within requirements of safety and efficiency.

If decommissioning of the solar field and rehabilitation of the cleared area is phased in such a way that the exposed soil area is minimized in order to reduce potential dust impacts as well as to lower the contrast between the site and its surroundings, then the consequence of the impact will be lowered to moderate and the significance of the impact will then be **low**.

1.7.9 *Potential visual intrusion of decommissioning activities related to a 132 kV powerline on the existing views of sensitive visual receptors*

1.7.9.1 Significance Statement

The spatial extent of the potential impact will be **local** since sensitive visual receptors further than 2 km from the proposed Distribution line route will at most experience low visual exposure. The consequence of the impact will be **moderate** since activities similar to those during the construction phase will intrude on views of sensitive visual receptors. The impact duration should be shorter than for the construction phase – **very short-term**. The construction and decommissioning phases of the project is transitional and visual impacts are temporary – reversibility of impacts is high and irreplaceability of visual resources is low. The impact status will be **negative** since this phase will be perceived as cluttered and untidy. The probability of the impact occurring is **likely** since there are very few sensitive visual receptors that will be affected.

The significance of the impact without the implementation of mitigation measures is rated as **low** since the impact is temporary and there are very few highly sensitive visual receptors that will be affected.

1.7.9.2 Mitigation Measures

The following mitigation measures have been recommended:

- Disturbed and transformed areas should be contoured to approximate naturally occurring slopes to avoid lines and forms that will contrast with the existing landscapes;
- Stockpiled topsoil should be reapplied to disturbed areas and these areas should be re-vegetated using a mix of indigenous species in such a way that the areas will form as little contrast in form, line, colour and texture with the surrounding undisturbed landscape;
- Edges of re-vegetated areas should be feathered to reduce form and line contrasts with surrounding undisturbed landscape;
- Working at night should be avoided, where possible; and
- Night lighting of reclamation sites should be minimised within requirements of safety and efficiency.

The significance of the impact after mitigation will remain **low** with the implementation of mitigation measures.

1.7.10 *Cumulative Impact of Solar Energy Generation Projects and Large Scale Electrical Infrastructure on the Existing Peri-urban Landscape*

1.7.10.1 Significance Statement

The landscape character will be altered by the introduction of several large solar energy facilities, but the proximity of most of these proposed projects to the town of Vryburg and its associated structures and buildings means that the landscape character is already changing as the town expands (Figure 1-21). The sensitivity of the landscape character is low since it is defined as a transitional landscape which changes constantly as new developments are introduced and the town expands. The consequence of this impact is therefore expected to be **slight**.

The spatial extent of the cumulative impact is **regional** (within 20 km of the proposed Vryburg Solar 1development). The duration of the impact is rated as **long term** since the cumulative impact will last for as long as the solar fields are in the landscape. The **status** of the impact is neutral since the overall change in landscape character will not affect a highly sensitive, scarce or highly valued landscape character. The probability of it occurring is **likely** since there are a number of large projects proposed for the area.

The significance of this cumulative impact on the landscape is rated as **very low** without the implementation of mitigation measures. Mitigation measures are not recommended in this regard.

1.7.11 *Cumulative Visual Impact of Solar Energy Generation Projects and Large Scale Electrical Infrastructure on Existing Views of Sensitive Visual Receptors in the Surrounding Landscape*

1.7.11.1 Significance Statement

The visual resources of the area are not of high quality or pristine since it is in close proximity to the town of Vryburg and structures and buildings associated with it. It is clear to visual receptors that they are near the town since these elements are in most views, or become more prevalent as one approaches that town. Many of the structures associated with solar energy facilities are already present in most views (e.g. buildings, fences and electrical infrastructure). The addition of large fields of solar arrays will be a novelty but, when in view, will be associated with the visual receptor's proximity to town, and will also in time be associated with regions in the country that receive large amounts of constant solar radiation. The consequence of the potential cumulative visual impact is expected to be **slight**.

The spatial extent of the cumulative impact is **regional** (within 20 km of the proposed Vryburg Solar 1). The duration of the impact is rated as **long term** since the cumulative impact will last for as long as the solar field is in the landscape. The **status** of the impact is negative since visual resources of the region are reduced (less potential for pristine views of natural landscapes), and the probability of it occurring is **likely** since there are highly sensitive visual receptors that will be affected.

The significance of the cumulative impact is rated as **low** without the implementation of mitigation measures since the consequence of the impact is expected to be slight. Mitigation measures are not recommended in this regard.

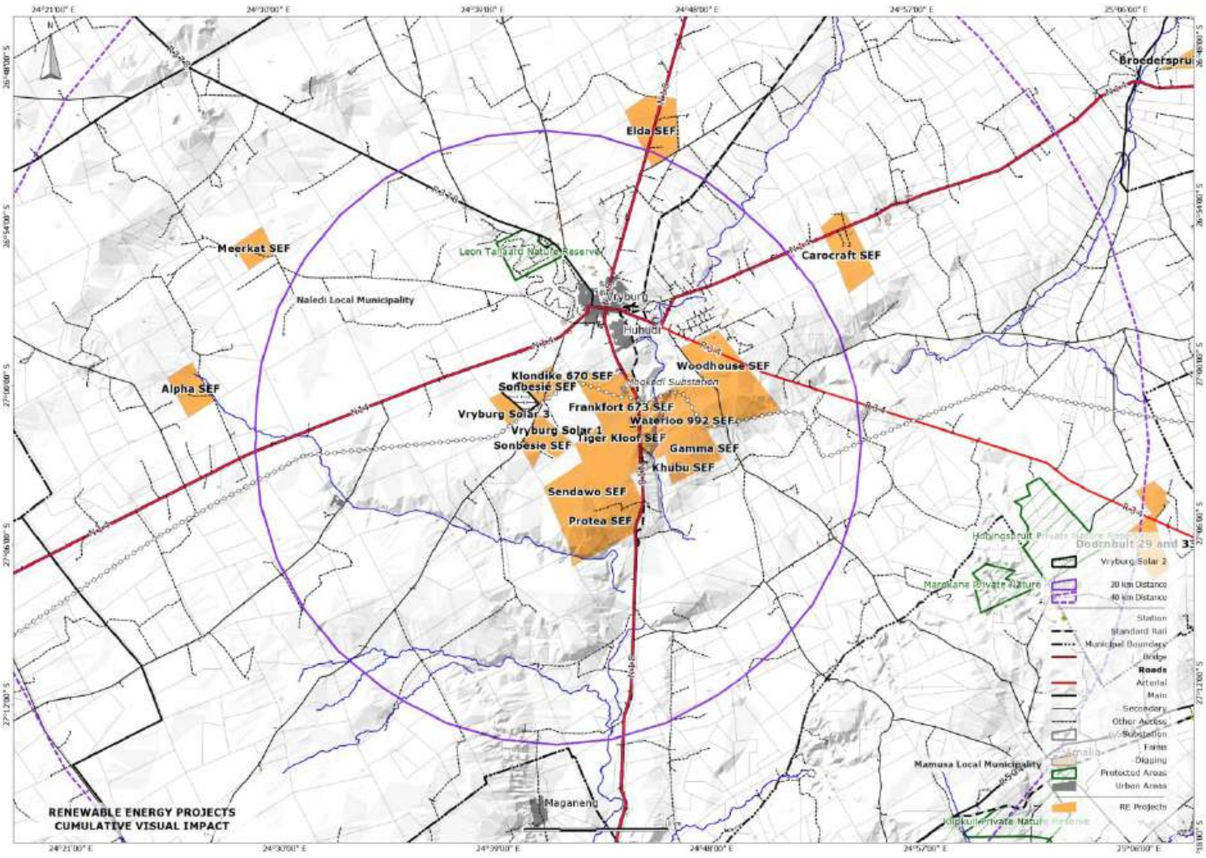


Figure 1-23 Map showing proposed solar energy projects within 40 km of Vryburg Solar 2 (A3 map provided in Appendix A). The map shows farm portions for which the projects are proposed and not project footprints.

1.8 IMPACT ASSESSMENT SUMMARY

Table 1-4 Impact assessment summary table for the Construction Phase

Construction Phase													
Direct Impacts													
Aspect/ Impact Pathway	**Nature of Potential Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of Impact**	**Irreplaceability**	**Potential Mitigation Measures**	**Significance of Impact and Risk**		**Ranking of Residual Impact/ Risk**	**Confidence Level**
										Without Mitigation/ Management	**With Mitigation/ Management (Residual Impact/ Risk)**		
Construction activities associated with a PV Plant	Loss of visual resources	Negative	Local	Short to Medium Term	Substantial	Very Likely	High	Low	Phased clearing of the area for solar field in order to reduce the amount and duration of bare soil exposure.	Moderate	Low	4	High
Construction activities associated with a 132 kV powerline	Loss of visual resources	Negative	Local	Very Short Term	Moderate	Likely	High	Low	In line with best practice construction guidelines.	Low	Low	5	High

Table 1-5 Impact assessment summary table for the Operational Phase

Operational Phase													
Direct Impacts													
Aspect/ Impact Pathway	**Nature of Potential Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of Impact**	**Irreplaceability**	**Potential Mitigation Measures**	**Significance of Impact and Risk**		**Ranking of Residual Impact/ Risk**	**Confidence Level**
										Without Mitigation/ Management	**With Mitigation/ Management (Residual Impact/ Risk)**		
Landscape impact caused by large PV Plant	Change of landscape character	Neutral	Regional	Long Term	Slight	Unlikely	High	Low	None	Very Low	Very Low	5	High
Landscape impact caused by large 132 kV powerline	Change of landscape character	Neutral	Local	Long Term	Slight	Unlikely	High	Low	None	Very Low	Very Low	5	High
Visual intrusion of a solar energy facility on views of sensitive visual receptors	Change in existing views of sensitive visual receptors.	Negative	Regional	Long Term	Substantial	Likely	High	Low	Building facades and colours such that they blend in with the landscape background where technically feasible.	Moderate	Low	4	High
Visual intrusion of a 132 kV powerline on views of sensitive visual receptors	Change in existing views of sensitive visual receptors	Neutral	Local	Long Term	Slight	Likely	High	Low	Powerline towers to be similar to those in the landscape already where possible.	Very Low	Very Low	5	High

Operational Phase													
Direct Impacts													
Aspect/ Impact Pathway	**Nature of Potential Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of Impact**	**Irreplaceability**	**Potential Mitigation Measures**	**Significance of Impact and Risk**		**Ranking of Residual Impact/ Risk**	**Confidence Level**
										Without Mitigation/ Management	**With Mitigation/ Management (Residual Impact/ Risk)**		
Impact of night lighting on the nightscape of the region	Light pollution in a dark nightscape.	Negative	Local	Long Term	Moderate	Likely	High	Low	Lighting plan should be prepared which will minimise impacts on the nightscape	Moderate	Low	4	High

Table 1-6 Impact assessment summary table for the Decommissioning Phase

Decommissioning Phase													
Direct Impacts													
										Significance of Impact and Risk			
Aspect/ Impact Pathway	**Nature of Potential Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of Impact**	**Irreplaceability**	**Potential Mitigation Measures**	**Without Mitigation/ Management**	**With Mitigation/ Management (Residual Impact/ Risk)**	**Ranking of Residual Impact/ Risk**	**Confidence Level**
Visual impact of decommissioning activities associated with a PV Plant on existing views of sensitive visual receptors	Impact on visual resources	Negative	Regional	Short Term	Substantial	Very Likely	High	Low	Rehabilitation of areas cleared for solar field	Moderate	Low	4	High
Visual impact of decommissioning activities associated with a 132 kV powerline on existing views of sensitive visual receptors	Impact on visual resources	Negative	Local	Temporary to very short term	Moderate	Likely	High	Low	Disturbed and transformed areas should be rehabilitated. Other best practice guidelines for construction activities apply.	Low	Low	4	High

Table 1-7 Cumulative impact assessment summary table

Cumulative Impacts													
Aspect/ Impact Pathway	**Nature of Potential Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of Impact**	**Irreplaceability**	**Potential Mitigation Measures**	**Significance of Impact and Risk**		**Ranking of Residual Impact/ Risk**	**Confidence Level**
										Without Mitigation/ Management	**With Mitigation/ Management (Residual Impact/ Risk)**		
Cumulative impact on the landscape of the region.	Change in landscape character	Neutral	Regional	Long term	Slight	Likely	High	Low	None	Very Low	Very Low	5	High
Cumulative impact on sensitive visual receptors.	Visual intrusion	Negative	Regional	Long Term	Slight	Likely	High	Low	None	Low	Low	4	High

1.9 INPUT TO THE ENVIRONMENTAL MANAGEMENT PROGRAMME

1.9.1 *Planning and Design*

There are some mitigation measures that require input during the design and planning phase of the project in order to reduce visual intrusion of construction activities. These include plans to minimize fire hazards and dust generation, and rehabilitation plans for areas temporarily cleared for construction purposes. A lighting plan is required to minimize light pollution, light trespass and glare during construction, operational and decommissioning phases.

Design of buildings and structures should include appropriate colours to blend into the background landscape and materials, coatings and paints should be chosen based on minimal reflectivity. Grouped structures should be painted the same colours to reduce visual complexity and contrast. These measures exclude structures and buildings for which the choice of paint and colour may have a deleterious effect on the functionality of the building or structure (in other words, those structures for which the paint and colour are pre-determined for optimal functionality are excluded).

1.9.2 *Construction Phase*

Adherence to the erosion, dust, fire and light plans is necessary to minimise visual intrusion of construction activities and should be monitored regularly by the construction manager. Construction boundaries should be clearly demarcated and monitored, and good housekeeping on site should be maintained. Rehabilitation of temporary cleared areas should commence as soon as possible and the rehabilitation process should be regularly monitored by the Environmental Officer.

Table 1-8 Management Plan for the Design Phase

Impact	Mitigation / Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
Aspect: Visual intrusion of planned project on sensitive visual receptors					
Potential Visual Intrusion of Construction Activities on Existing Views of Sensitive Visual Receptors	Reduce visual intrusion of construction activities project wide.	a) Ensure plans are in place to minimise fire hazards and dust generation. b) Ensure plans are in place to rehabilitate temporary cleared areas as soon as possible.	Ensure that this is taken into consideration during the planning and design phase by reviewing signed minutes of meetings or signed reports.	During design cycle and before construction commences.	Project Developer Environmental Control Officer
		c) Clearance of the area for the solar field should be phased in such a way that the exposed area is always at a minimum.	Ensure that this is taken into consideration prior to the commencement of construction by reviewing signed minutes of meetings or signed reports.	Once-off during the design phase.	Project Developer
	Reduce visual intrusion of the solar energy facility	d) A maintenance plan for buildings and structures should be in place. e) Colours of buildings and structures should blend in with the landscape background where this is technically feasible and where it will not affect the functionality of the structures. f) Materials, coatings and paints should be chosen based on minimal reflectivity. g) Grouped structures should be painted in the same colour where this will not affect the functionality of the structures, to reduce visual complexity and contrast. h) Appropriate coloured materials should be used for structures to	Ensure that this is taken into consideration during the planning and design phase by reviewing signed minutes of meetings or signed reports.	During design cycle and before construction commences.	Project Developer Environmental Control Officer

Impact	Mitigation / Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
		blend in with the backdrop of the project. i) Appropriate colours for smooth surfaces often need to be two to three shades darker than the background colour to compensate for shadows that darken most textured natural surfaces.			
Potential impact of night lighting of the Solar PV Facility on the nightscape of the region.	Reduce the impact of night lighting of structures and buildings associated with the solar energy facility on the surrounding nightscape and visual receptors.	j) A lighting plan for the proposed Solar PV plant that documents the design, layout and technology used for lighting purposes should be prepared, indicating how nightscape impacts will be minimised and that also demonstrates that project lighting is effectively shielded from surrounding and adjacent properties must be prepared with the design plans of the plant. The plan should minimize light spill onto neighbouring properties and glare which can affect visual receptors in the surrounding landscape. k) The lighting plan should also minimize contribution to light pollution (night glow) of the regional nightscape. l) The lighting plan should include a process for promptly addressing and mitigating complaints about potential lighting impacts. m) Lighting of the facility should not exceed, in number of lights and brightness, the minimum required for safety and security.	A lighting specialist should be contracted to design the lighting plan for the project. The plan should provide for temporary lighting during the construction and decommissioning phases of all components of the project. Ensure that this is taken into consideration during the planning and design phase by reviewing signed minutes of meetings or signed reports.	During design cycle and before construction commences. Once-off during the design phase.	Project Developer Environmental Control Officer

Impact	Mitigation / Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
		n) Uplighting and glare (bright light) should be minimised using appropriate screening. o) Low-pressure sodium light sources should be used to reduce light pollution. p) Light fixtures should not spill light beyond the project boundary. q) Timer switches or motion detectors (within safety requirements) should be used to control lighting in areas that are not occupied continuously.			

Table 1-9 Management Plan for the Construction Phase

Impact	Mitigation / Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
Aspect: Visual intrusion of construction activities on views of sensitive visual receptors.					
Potential Visual Intrusion of Construction Activities on Existing Views of Sensitive Visual Receptors	Prevent unnecessary visual clutter and focusing attention of surrounding visual receptors on the proposed development.	a) Preparation of the solar field area (i.e. clearance of vegetation, grading, contouring and compacting) and solar field construction should be phased in a way that makes practical sense in order to minimise the area of soil exposed and the shortest duration of exposure.	Ensure that this is taken into consideration prior to the commencement of construction.	Once-off during the construction phase.	Project Developer
			Conduct site inspections to monitor the phasing of construction to verify unnecessary soil disturbance and clearing and report any non-compliance.	Weekly	Environmental Control Officer
		b) Parking areas should be demarcated and strictly controlled so that vehicles are limited to specific areas only.	Carry out visual inspections to ensure the construction area and parking area is demarcated clearly, and record and report any non-compliance.	Weekly	Environmental Control Officer
			Carry out visual inspections to ensure strict control over the parking of construction vehicles and access routes in order to restrict activities to within		

Impact	Mitigation / Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
			demarcated areas.		
		c) Night time construction should be avoided where possible (however some construction work on electrical components may need to occur after dark).	Construction operation times to be monitored and managed (as well as included in the tender contract).	Weekly	Environmental Control Officer
		d) Night lighting of the construction sites should be minimised within requirements of safety and efficiency.	Complaints about night lights should be investigated and documented in a register.	Weekly or bi-weekly	Contractor and Environmental Control Officer
	Reduce the visual impact of construction activities project wide	e) Maintain good housekeeping on site to avoid litter and minimize waste. f) Monitor construction sites for strict adherence to demarcated boundaries. g) Monitor adherence to lighting plan. h) Monitor adherence to rehabilitation plan. i) Monitor adherence to erosion control plan. j) Monitor adherence to dust and fire control plans.	Carry out site visits and inspections of the construction sites and ensure good housekeeping is maintained. Record and report any non-compliance. Carry out site visits and record and report any non-compliance. Complaints about night lights should be investigated and documented in a register. Investigate any complaints about night lights and document it in a register. Visit sites requiring	Daily	Contractor and Environmental Control Officer

Impact	Mitigation / Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
			rehabilitation. Carry out site visits and record and report any non-compliance. Carry out site visits and record and report any non-compliance.		

1.9.3 *Operational Phase*

A maintenance plan for buildings and structures should be followed to ensure that structures remain as non-reflective as possible, and buildings remain as unobtrusive as possible. Maintenance of access roads should not cause further disturbance and damage to the surrounding landscape.

Table 1-10 Management Plan for the Operational Phase

Impact	**Mitigation / Management Objectives and Outcomes**	**Mitigation/Management Actions**	**Monitoring**		
			Methodology	***Frequency***	***Responsibility***
Aspect: Visual intrusion					
Potential visual intrusion of the proposed Solar Energy Facility on the views of sensitive visual receptors.	Reduce visual intrusion of the solar energy facility on the views of sensitive visual receptors as well as its impact on the surrounding landscape	a) Monitor effectiveness of the rehabilitation plan for temporarily cleared areas and erosion scarring. b) Monitor building and façade maintenance. Painted features should be maintained and repainted when colour fades or paint flakes.	Carry out visual inspections during site audits to verify the effectiveness of the rehabilitation, and record and report any non-compliance.	Monthly	Project Developer and Facility Environmental Manager
			Carry out an inspection of solar energy facility to ensure that it is being maintained in a good condition.	Annually	Project Developer and Facility Environmental Manager
		c) Maintain re-vegetated surfaces until a self-sustaining stand of vegetation is established and visually adapted to the undisturbed surrounding vegetation. No new disturbance should be created during operations without approval from the Environmental Manager.	Carry out visual inspections during site audits to verify the effectiveness of the rehabilitation and the progress of rehabilitation, and record and report any non-compliance.	Weekly during the rehabilitation phase	Project Developer and Facility Environmental Manager

Impact	Mitigation / Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
		d) Restoration of disturbed land should commence as soon after disturbance as possible.	Ensure that all vegetation removal outside of the project footprint is approved by the Environmental Manager.	Throughout the operational phase	
		e) Road maintenance activities should avoid damaging or disturbing vegetation.	Monitor the road maintenance process to ensure limited damage to vegetation.	During road maintenance activities.	
		f) Dust and noxious weed control should be part of maintenance activities.	Record and report any non-compliance. Monitor the presence of alien vegetation on site.	Throughout the operational phase	
			Monitor dust suppression mechanisms and record non-compliances.	During complaints/ incidents	
			Maintain an incidents/ complaints register, in which any complaints from the public must be logged. The date, time, nature of complaint, name of complainant and corrective actions must be logged for all complaints.		
			Complaints must be investigated and, if appropriate, acted upon.		

Impact	Mitigation / Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
Potential impact of night lighting of the proposed Solar Energy Facility on the nightscape of the region.	Reduce the impact of night lighting of the proposed PV facility on the surrounding nightscape and sensitive visual receptors.	g) Monitor the effectiveness of the lighting plan to minimize light spill and glare.	Visit surrounding neighbouring farmsteads and ensure that residents in the surrounding landscape are not affected by glaring lights from the plant. Complaints about night lights should be investigated and documented in a register. Investigate any complaints about night lights and document it in a register.	Once off at the end of the construction phase or the start of the operational Phase. As complaints arise.	Project Developer and Facility Environmental Manager
		h) Lights should be switched off when not in use whenever it is in line with safety and security.	Carry out visual inspections during site audits to monitor lighting, and record and report any non-compliance.	Weekly	Project Developer and Facility Environmental Manager

1.9.4 *Decommissioning Phase*

The decommissioning phase of the project will potentially cause similar visual impacts as that during the construction phase and as such similar mitigation measures apply. The successful completion of this phase should leave the project site in a similar condition, visually, as before construction commenced. This can be accomplished by appropriate landscaping and revegetation of disturbed areas.

Table 1-11 Management Plan for the Decommissioning Phase

Impact	**Mitigation / Management Objectives and Outcomes**	**Mitigation/Management Actions**	**Monitoring**		
			Methodology	***Frequency***	***Responsibility***
Potential Visual Intrusion of Decommissioning Activities on Existing Views of Sensitive Visual Receptors	Prevent unnecessary visual clutter and focusing attention of surrounding visual receptors on the proposed development.	a) Disturbed and transformed areas should be contoured to approximate naturally occurring slopes to avoid lines and forms that will contrast with the existing landscapes. b) Edges of re-vegetated areas should be feathered to reduce form and line contrasts with surrounding undisturbed landscape.	Conduct visual inspections to ensure that landscaping is following the rehabilitation plan.	Weekly	Environmental Control Officer.
		c) Stockpiled topsoil should be reapplied to disturbed areas and these areas should be re-vegetated using a mix of indigenous species in such a way that the areas will form as little contrast in form, line, colour and texture with the surrounding undisturbed landscape.	Complaints about night lights should be investigated and documented in a register.	Weekly or bi-weekly	Contractor and Environmental Control Officer
		d) Night lighting of decommissioning sites should be minimised within requirements of safety and efficiency.	Complaints about night lights should be investigated and documented in a register.	Weekly or bi-weekly	Contractor and Environmental Control Officer

Impact	Mitigation / Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
		e) Working at night should be avoided where possible.	Operation times for decommissioning activities to be monitored and managed (as well as included in the tender contract).	Weekly	Environmental Control Officer
	Reduce the visual impact of decommissioning activities project wide	f) Maintain good housekeeping on site to avoid litter and minimize waste. g) Monitor sites for strict adherence to demarcated boundaries. h) Monitor adherence to lighting plan. i) Monitor adherence to rehabilitation plan. j) Monitor adherence to erosion control plan. k) Monitor adherence to dust and fire control plans.	Carry out site visits and inspections of the sites and ensure good housekeeping is maintained. Record and report any non-compliance. Carry out site visits and record and report any non-compliance. Complaints about night lights should be investigated and documented in a register. Investigate any complaints about night lights and document it in a register. Visit sites requiring rehabilitation. Carry out site visits and record and report any non-compliance. Carry out site visits and record and report any non-compliance.	Daily	Construction Manager and Environmental Control Officer

1.10 CONCLUSION AND RECOMMENDATIONS

The landscape surrounding the proposed site has a peri-urban character which is typified by a mixture of urban and rural elements such as buildings, electrical infrastructure, commercial farming, as well as large scale developments which do not fit into an urban landscape. The landscape is also transitional and changes as the town expands.

The following sensitive visual receptors will potentially be affected by the introduction of a large PV plant into the landscape:

- Residents of Vryburg are low sensitivity visual receptors since their urban views contain complex and contrasting elements and patterns;
- Visitors and viewpoints in Louis Taljaard Nature Reserve. These are regarded as highly sensitive visual receptors since they have an active interest in the surrounding landscape;
- Residents and viewpoints on farms surrounding the proposed development site. These are highly sensitive visual receptors since they have an active interest in their surrounding landscape; and
- Motorists using the N14, R378, and R34. Motorists are classified as low sensitivity visual receptors since they pass through the landscape and their attention is mostly focused on the road.

Visual receptors that will potentially be affected by the proposed overhead powerlines include:

- Residents of Vryburg – low sensitivity visual receptors since they are surrounded by urban structures which tend to produce views with complex patterns and high contrasts;
- Visitors and viewpoints in Louis Taljaard Nature Reserve. These are regarded as highly sensitive visual receptors since they have an active interest in the surrounding landscape.
- Residents and viewpoints on farms surrounding the proposed sites; and
- Motorists on the N14, R378, and R34.

Visual intrusion on the existing views of highly sensitive visual receptors by the introduction of a solar energy facility into the landscape will be moderate since the development will be noticed but the quality of views is already compromised by existing structures associated with an urban and peri-urban landscape. The significance of this visual impact is expected to be moderate before mitigation and low if mitigation is successful. Mitigation measures should lower the consequence of the impact from substantial to moderate and the significance of the impact to low.

The significance of the impact of night lighting of the facility on the nightscape (during the operational phase) is likely to be moderate since the nightscape is relatively dark and new lights will be introduced. Mitigation measures will reduce the potential for light pollution and glare, and should lower the significance of the potential impact to low.

The significance of cumulative impacts on the surrounding landscape character is very low since the landscape character most likely to be affected is peri-urban which should be able to absorb the proposed developments without changing significantly.

The significance of the cumulative visual impact on sensitive visual receptors is low due to the limited potential for scenic or highly valued views in the region.

It is the opinion of the visual specialist that this project should be authorised with adherence to mitigation measures as set out in this report, since the significance of the overall visual impact of the project is expected to be low.

1.11 REFERENCES

GLVIA. 2002. *Guidelines for Landscape and Visual Impact Assessment*. 2nd ed. United Kingdom: Spon Press.

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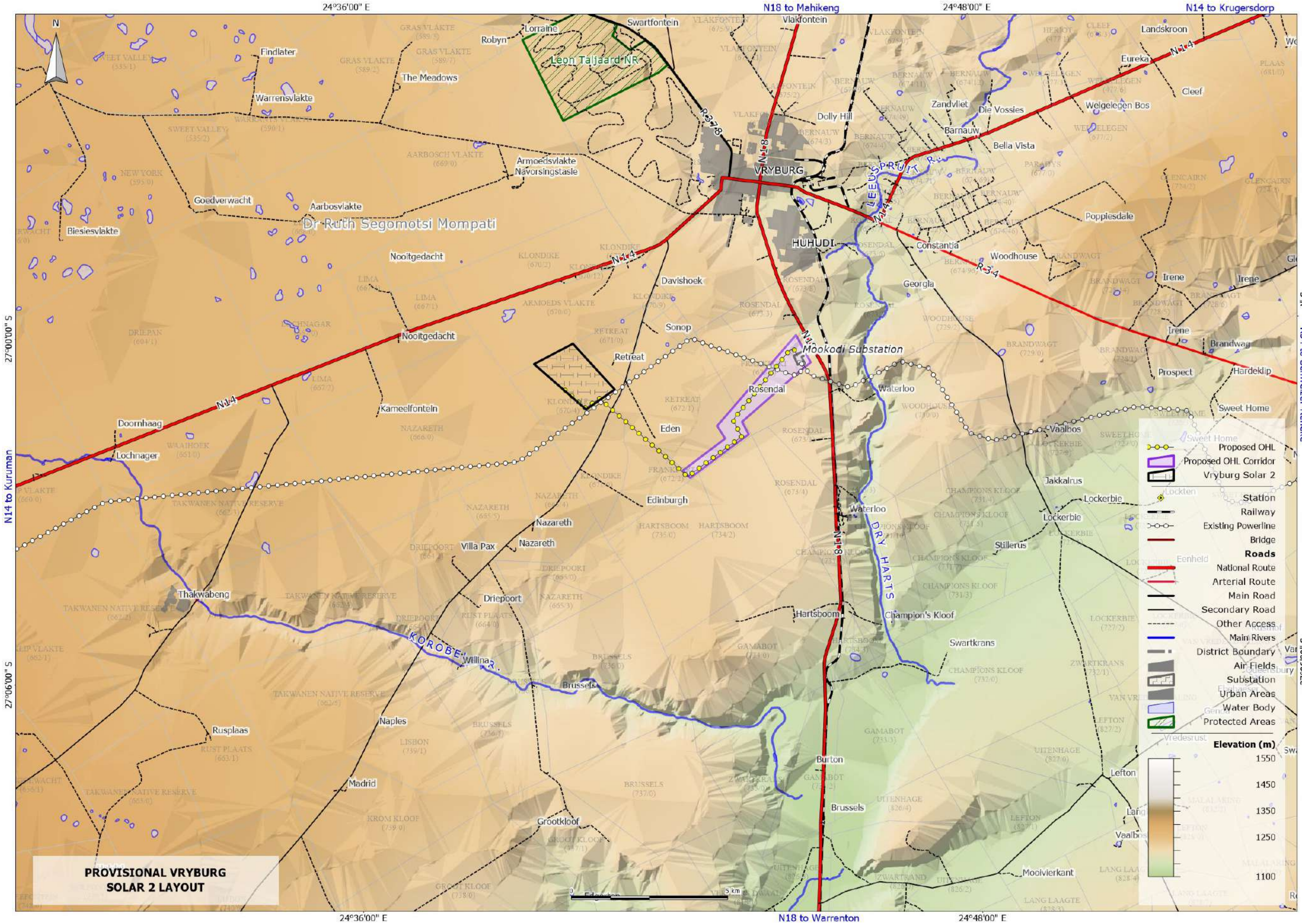
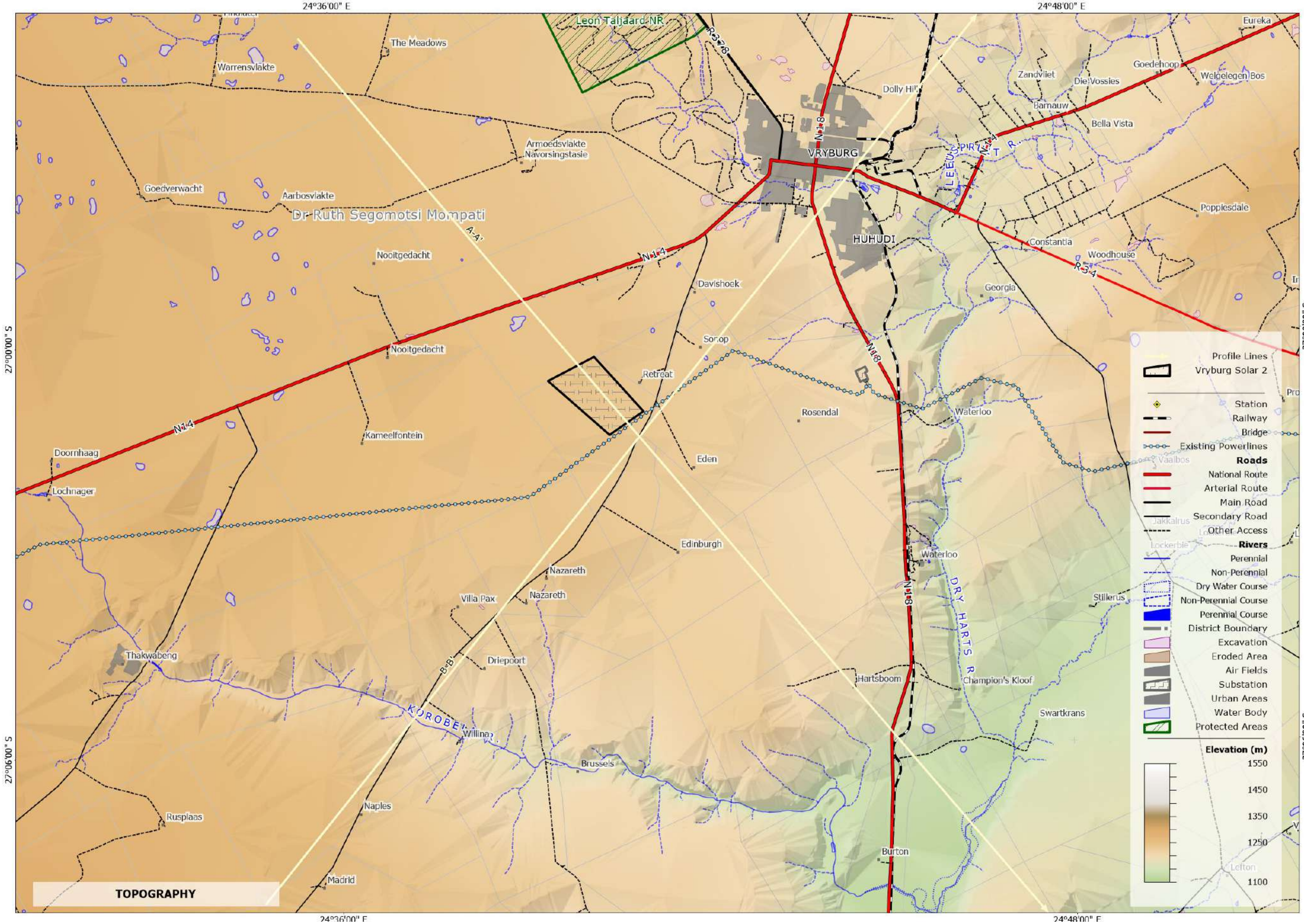
Oberholzer, Bernard. 2005. “Guideline for Involving Visual & Aesthetic Specialists in EIA Processes.” Guidelines ENV-S-C 2005 053 F. Cape Town: CSIR, Provincial Government of the Western Cape, Department of Environmental Affairs & Development. http://www.capegateway.gov.za/Text/2005/10/5_deadp_visual_guideline_june05.pdf.

1.12 APPENDICES

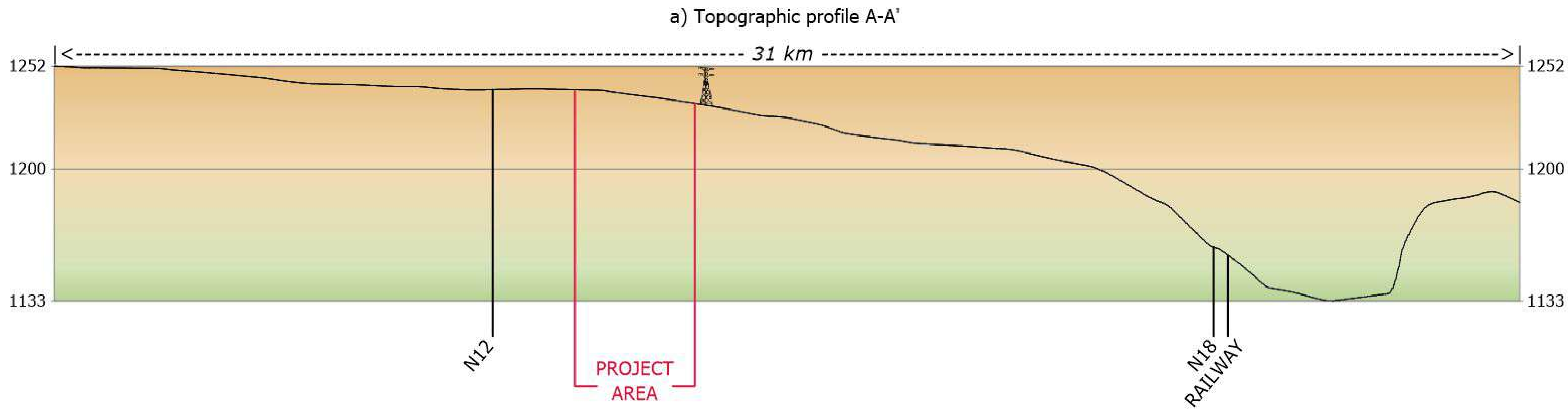
1.12.1 *Appendix A – Maps in A3 Format*

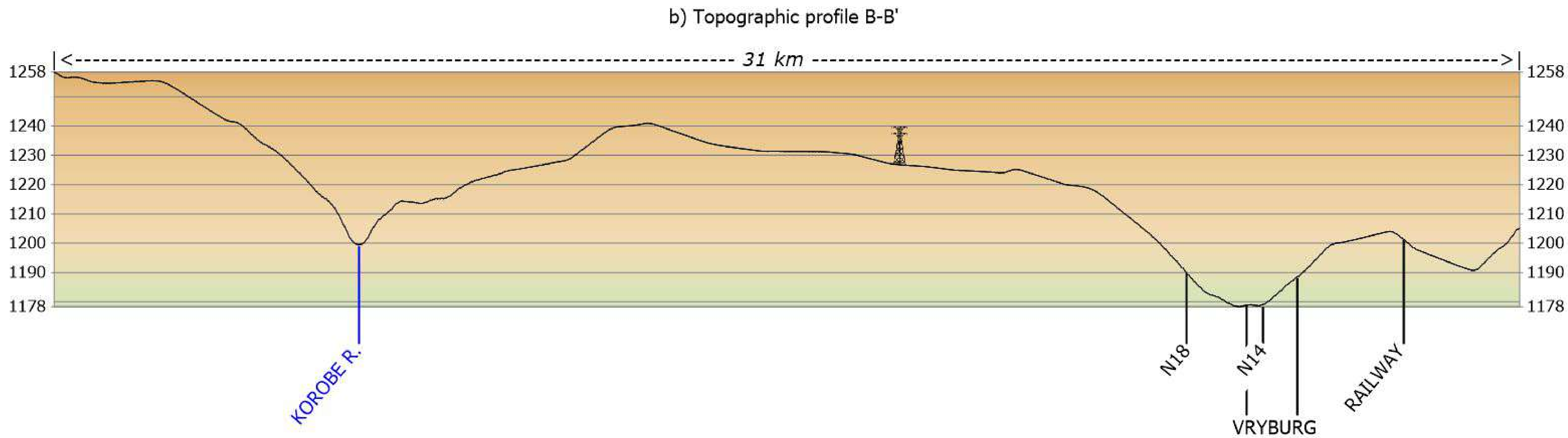


Map 1 (Figure 1-1) Proposed Vryburg Solar 2 solar energy facility site.

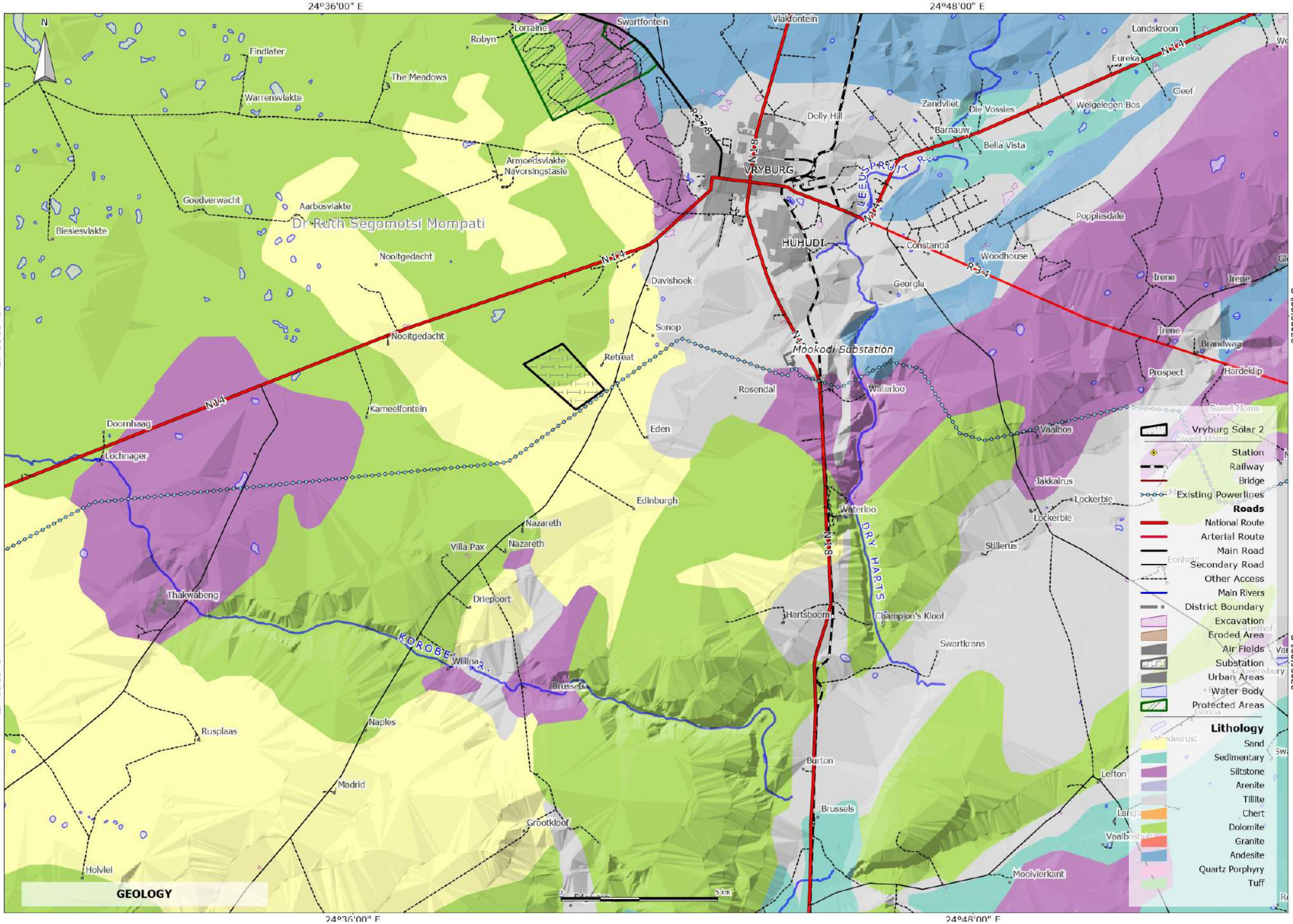


Map 2 (Figure 1-2) Topographic map of the region.

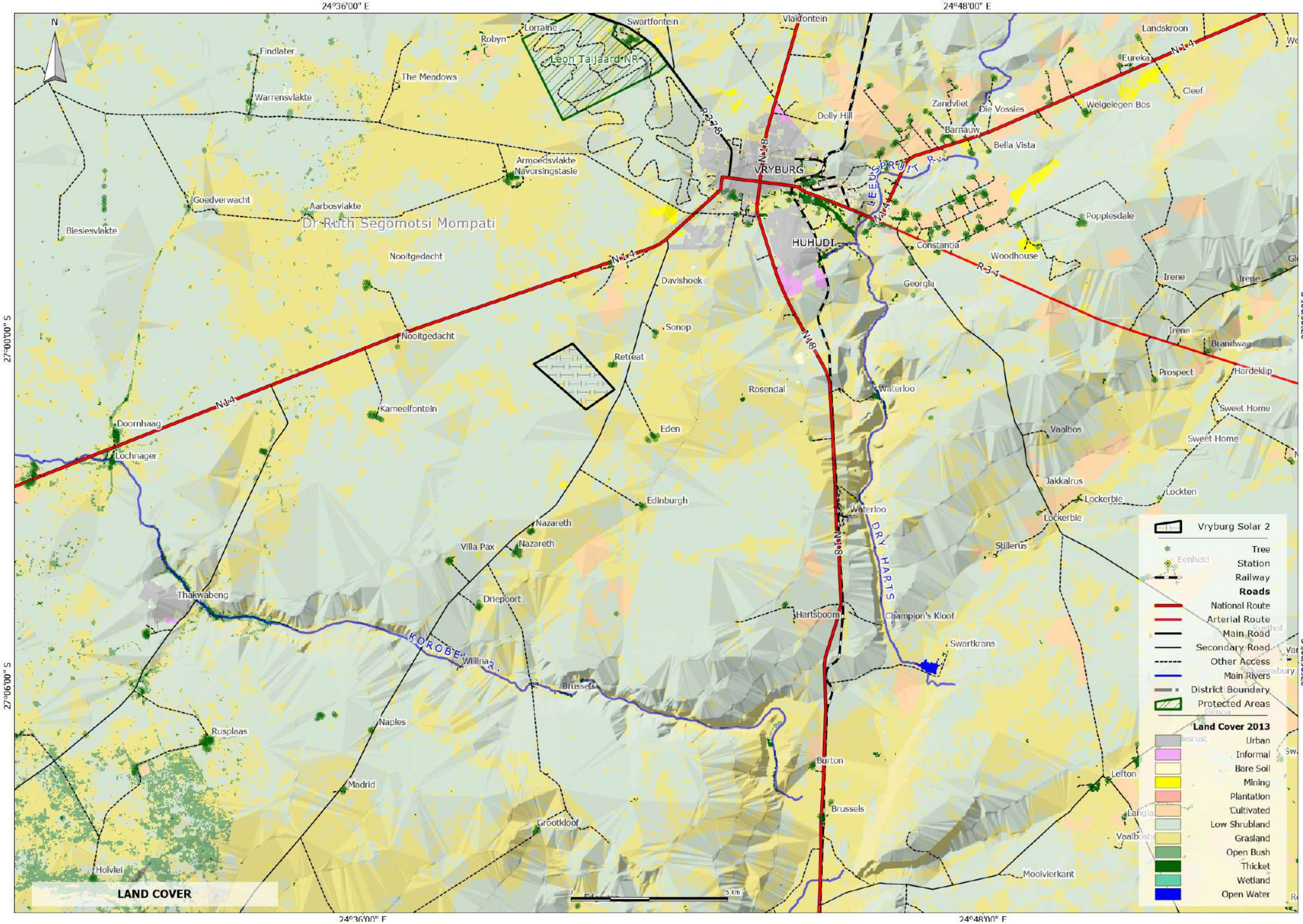




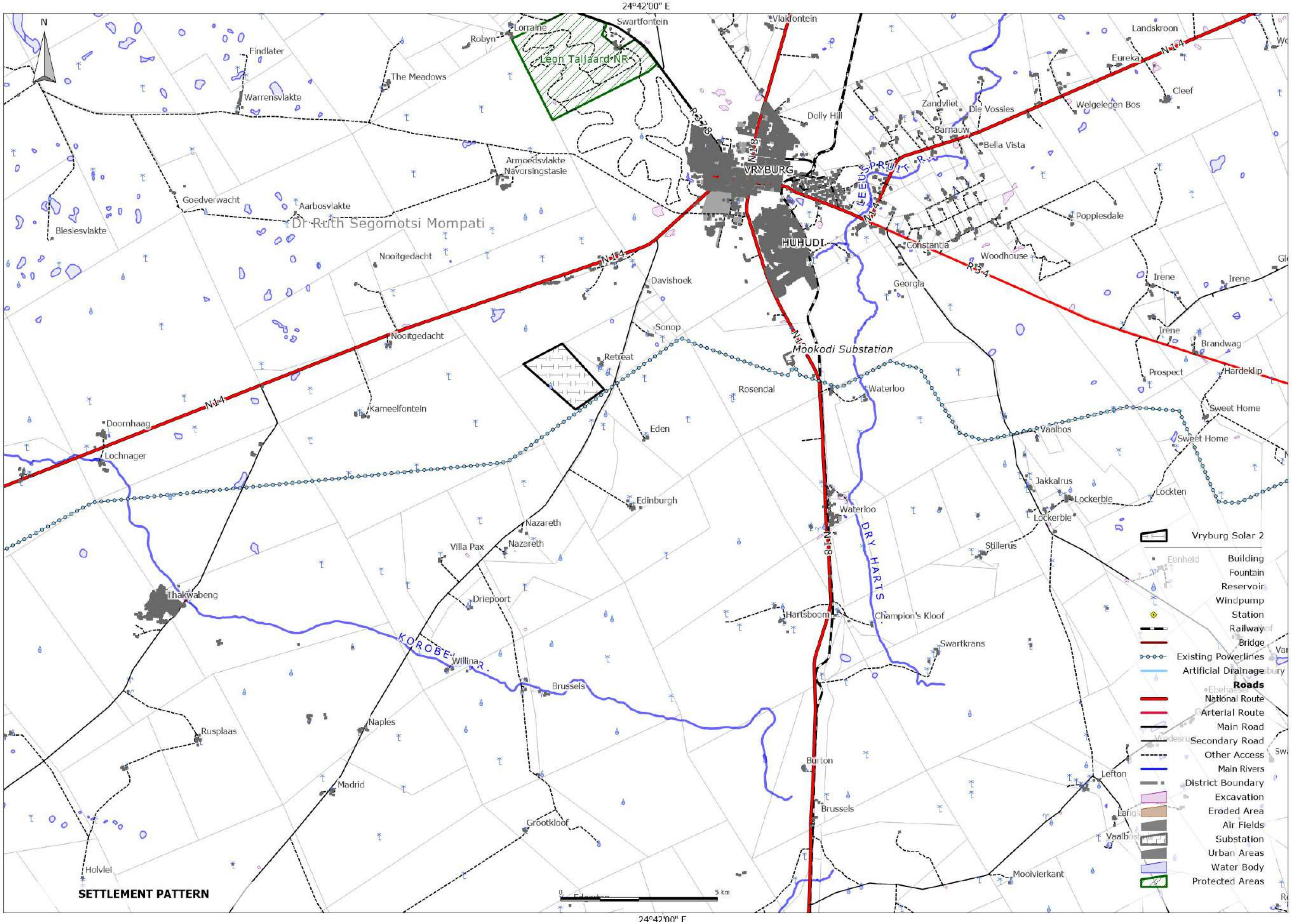
Map 3 (Figure 1-3) a) Along profile line A-A' and b) along profile line B-B'. Topographic profiles as indicated on the topographic map above.



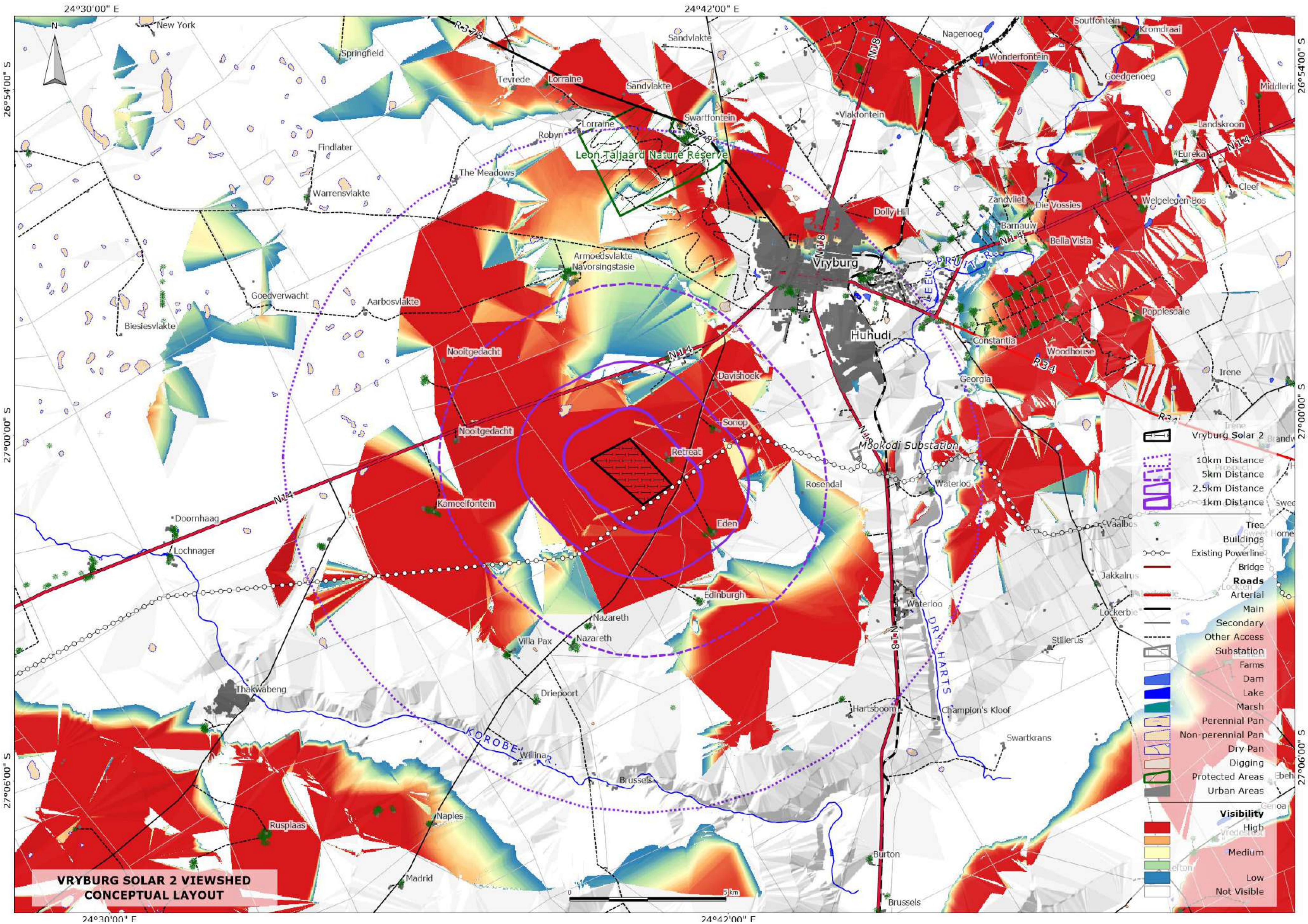
Map 4 (Figure 1-4) Simplified geology of the region.



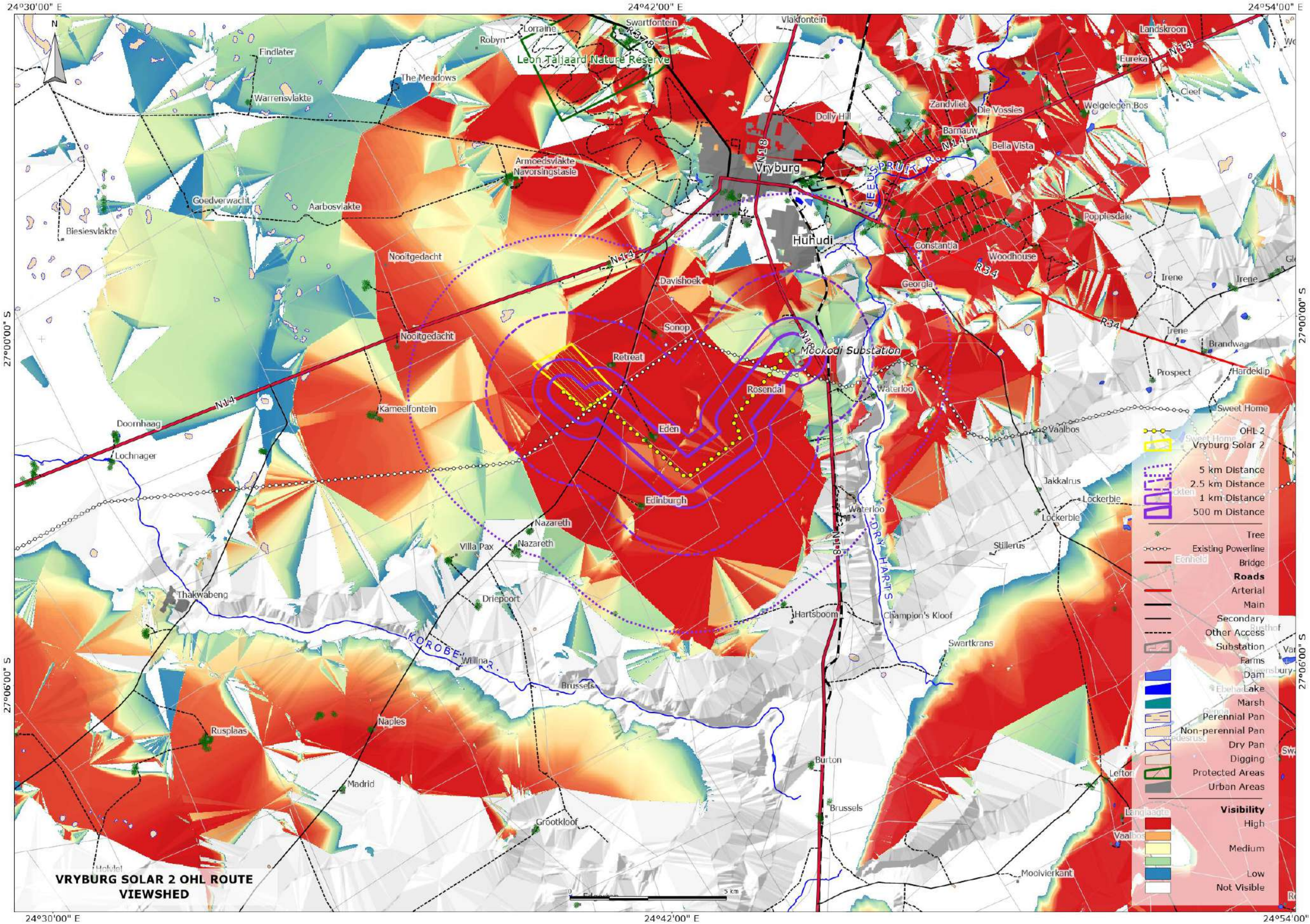
Map 5 (Figure 1-5) Land cover map of the region.



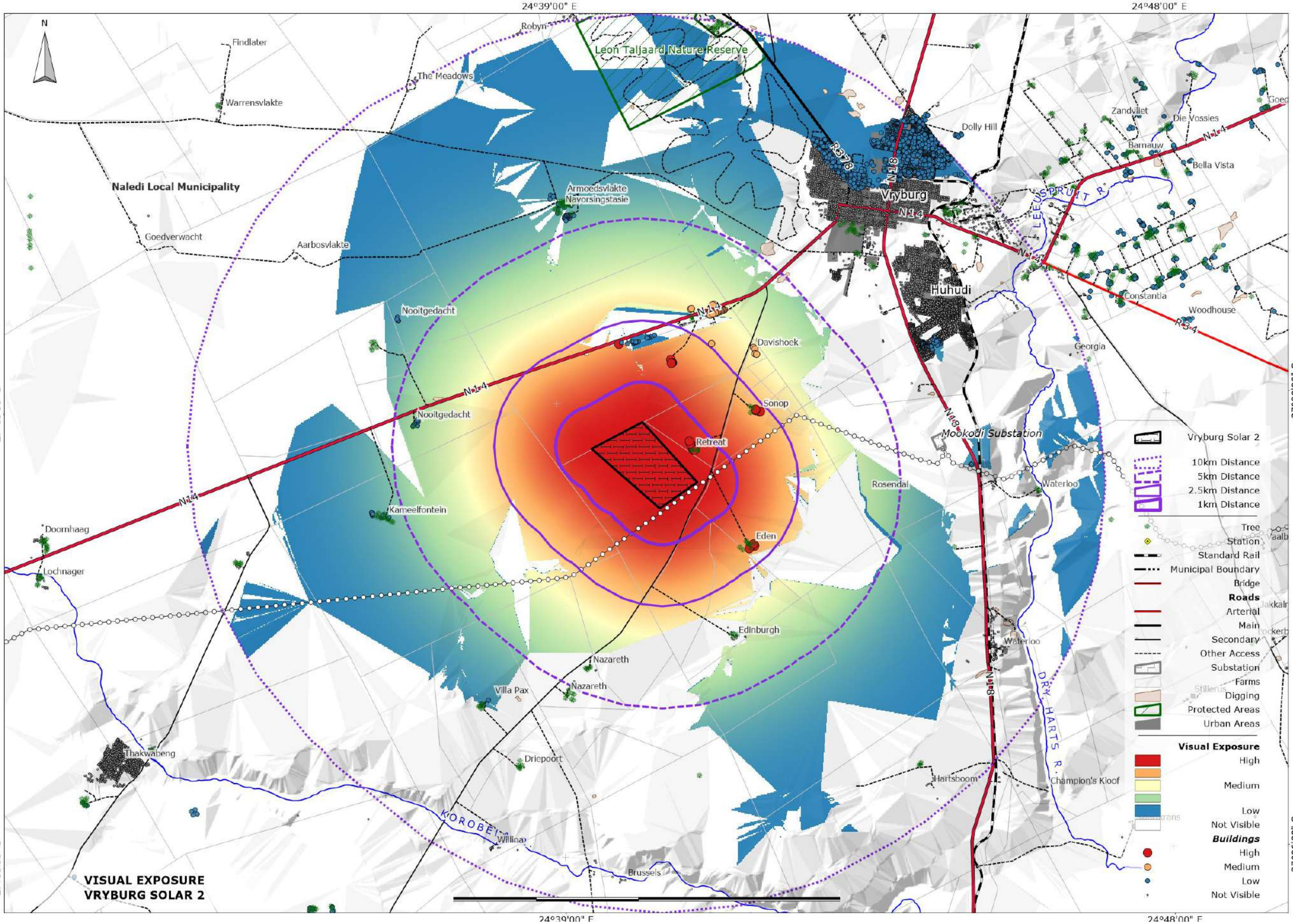
Map 6 (Figure 1-6) Prominent man-made structures and settlement patterns in the landscape.



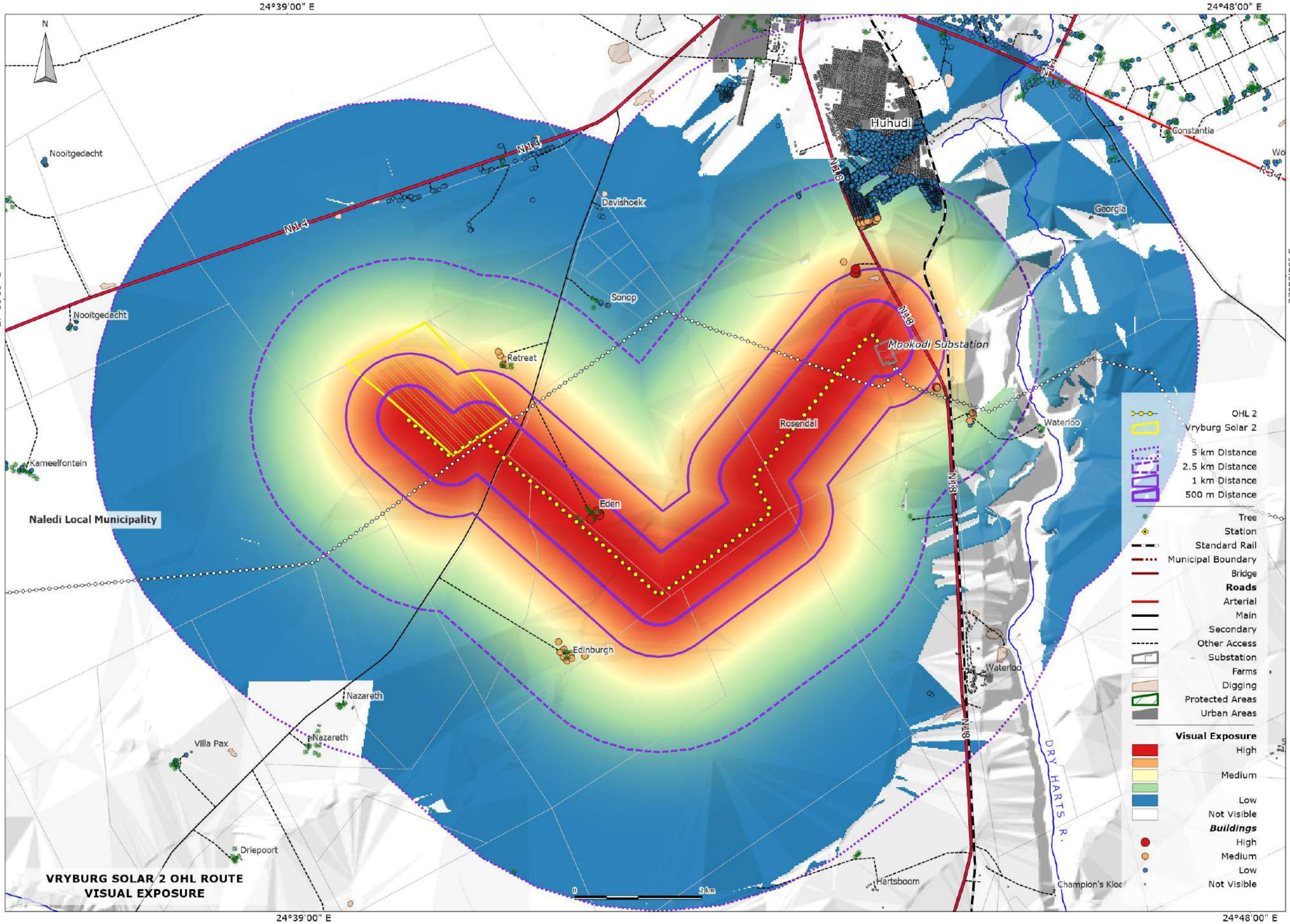
Map 7 (Figure 1-7) Viewshed of the proposed Vryburg Solar 2 facility.



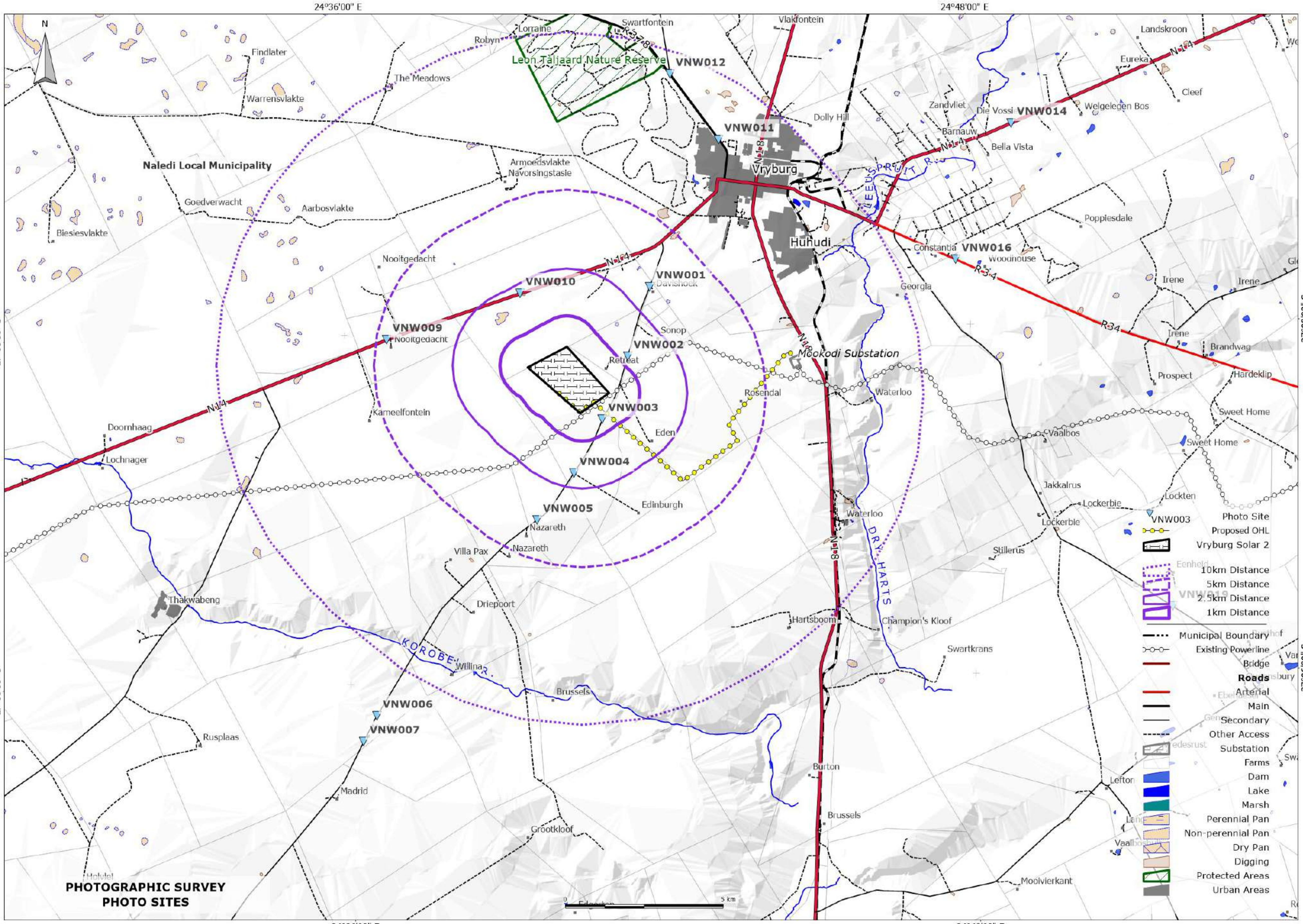
Map 8 (Figure 1-8) Viewshed of the proposed 132 kV power line from Vryburg Solar 2 SEF to Mookodi Substation.



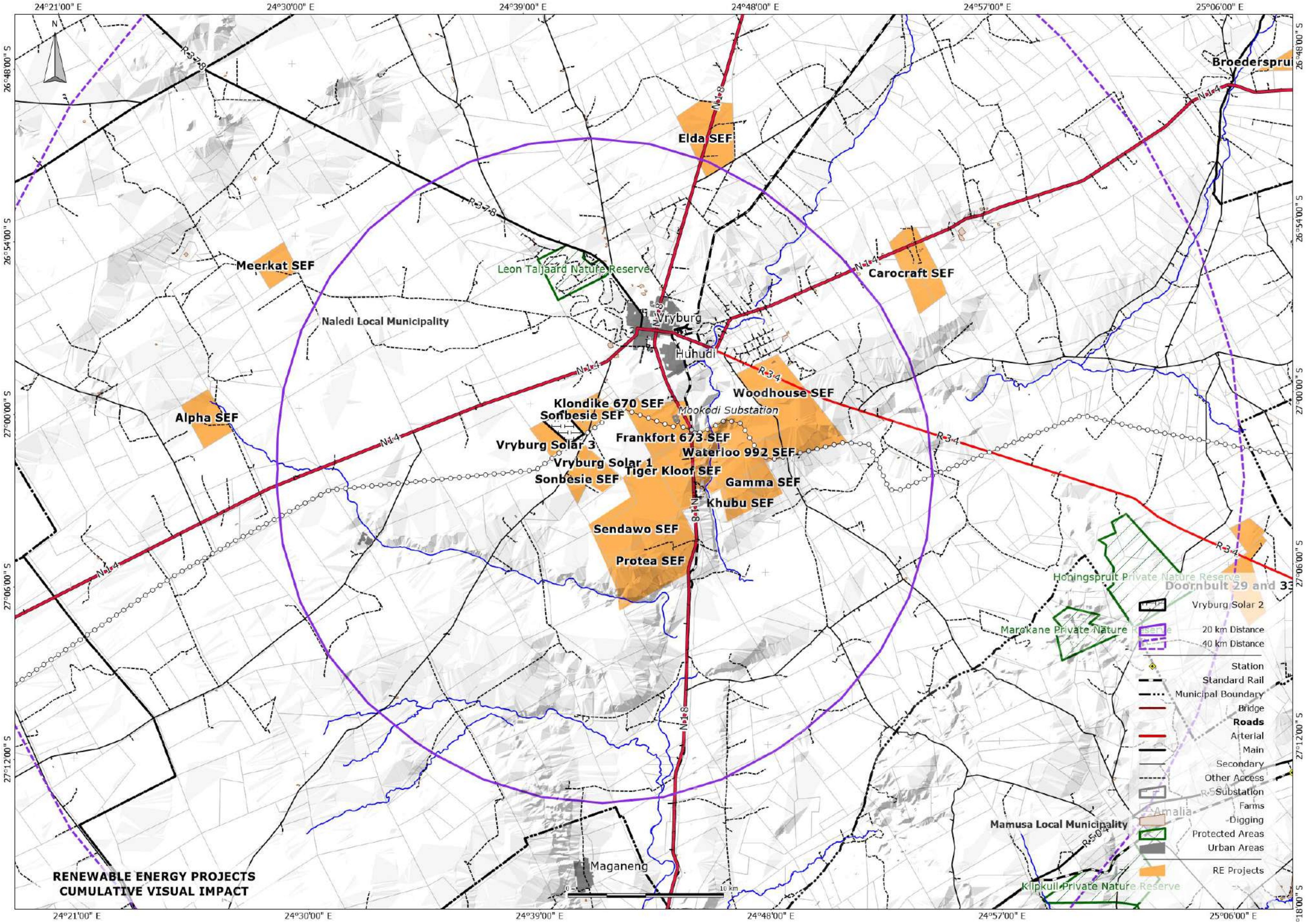
Map 9 (Figure 1-9) Visual exposure for sensitive visual receptors within 10 km of the development.



Map 10 (Figure 1-10) Visual exposure for sensitive visual receptors within 5 km of the proposed 132 kV powerline.



Map 11 (Figure 1-11) Sites visited during photographic survey



Map 12 (Figure 1-21) Map showing proposed solar energy projects in the region. The map indicates the farms proposed for the projects and not the actual project footprints which will be much smaller.

TRAFFIC IMPACT STATEMENT:

Basic Assessment for the proposed construction of Solar Photovoltaic (PV) Facility, Vryburg Solar 2 and associated electrical infrastructure, near Vryburg, in the North-West Province

Report prepared by:

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South Africa

02 August 2018

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TRAFFIC IMPACT STATEMENT

1. INTRODUCTION

Veroniva (Pty) Ltd, together with ABO Wind (the Project Applicant, hereinafter referred to as the Applicant), with support from Veroniva (Pty) Ltd, is proposing to develop three Solar Photovoltaic (PV) power generation facilities with each up to 115 MW and associated electrical infrastructure (132 kV transmission lines for each 115 MW facility) south west of Vryburg in the North West province. Each proposed project will make use of PV solar technology to generate electricity from the sun's energy.

The Applicant is proposing to develop each facility with a possible maximum installed capacity of 115 MW Direct Current (DC) each which produces about 100 MW Alternating Current (AC) of electricity from PV solar energy. The three projects are known as Vryburg Solar 1, Vryburg Solar 2 and Vryburg Solar 3.

This Traffic Impact Statement (TIS) has been produced by the CSIR and externally reviewed by WSP (review letter attached in Appendix A of this TIS) to outline the amount of traffic that can be expected during the construction, operation and decommissioning phases of the proposed **Vryburg Solar 2** project. In this regard, the study focuses on the regional setting in which this project is proposed and the roads that will be utilised.

1.1 Terms of Reference

The key traffic issues associated with the proposed solar PV project that are assessed as part of the TIS are:

- Increase in traffic generation throughout the lifetime of the project;
- Decrease in air quality; and
- Increase in road maintenance required.

1.2 Assumptions and Limitations

- The TIS has been based on the traffic information provided by Veroniva (Pty) Ltd and ABO Wind.
- No site visit was undertaken to support the TIS.
- There are various solar energy projects proposed within 30 km of the Vryburg project (as detailed within the Basic Assessment Report). However, traffic generation information for these projects are limited and can therefore not be used to inform this TIS. A suitable approach for this TIS is therefore to base the cumulative assessment on the amount of projects that can be supported by the Mookodi Substation. Eskom confirmed that currently, five solar energy projects (of approximately 75 MW each) can connect to the Mookodi Substation (refer to the SEA for Wind and Solar Energy in South Africa, DEA, 2015). Therefore, the worst case scenario in terms of traffic generation would be that five solar energy projects are constructed and operated simultaneously. This assumption has been used as part of the cumulative assessment. In addition, it is also assumed that these five solar projects will make use of the same road infrastructure, namely, the Reivilo road and the N14. This worst case scenario is very precautionary, as it is extremely unlikely that all 5 projects will be constructed simultaneously. The reason is that one project (Waterloo 75 MW

project) has already received preferred bidder status and is planned to be constructed in 2018. And it is unlikely that 4 other projects will simultaneously receive preferred bidder status in the next bidding window that the Department of Energy has suggested could be in early 2018.

- The traffic estimates and duration of the decommissioning phase are unavailable. This is due to the decommissioning phase only potentially occurring in 20 years' time. Therefore, the worst case scenario was implemented, whereby the construction phase's traffic estimates were used.

2. APPROACH AND METHODOLOGY

2.1 Objectives

- Determine the current traffic conditions in sufficient detail so that there is a baseline against which impacts can be identified and measured;
- Identify potential impacts and cumulative impacts that may occur during the project's lifetime;
- Provide recommendations with regards to potential monitoring programmes (if necessary);
- Determine mitigation and/or management measures which could be implemented to as far as possible reduce negative impacts and enhance the positive impacts; and
- Incorporate and address all issues and concerns raised by Interested and Affected Parties (I&APs) and the public (if applicable).

2.2 Methodology

Available desktop information, including the South African National Roads Agency (SANRAL) National traffic count information, google earth images and similar projects were reviewed to inform this TIS.

3. AFFECTED ENVIRONMENT

The proposed project site can be accessed via the Reivilo road off the N14 from Vryburg to Kuruman. An existing gravel road will be utilised from the Reivilo road to access the site (Figure 1).

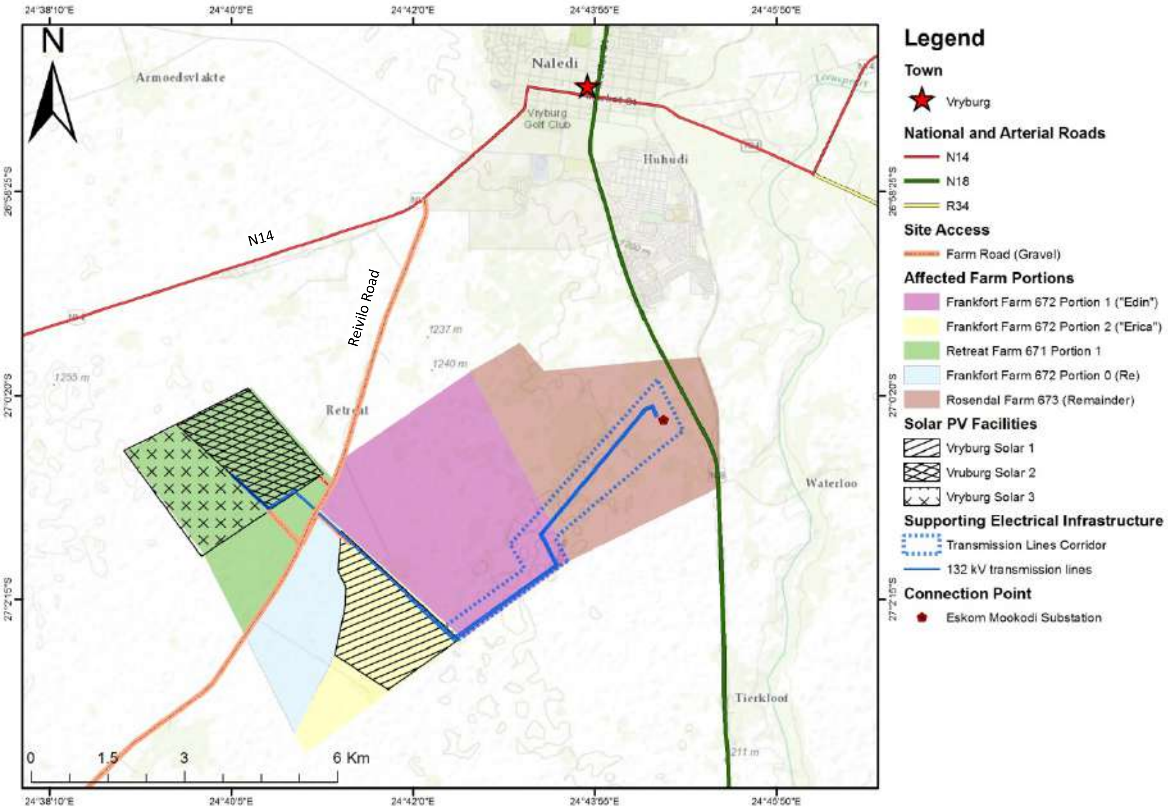

Figure 1. Locality map of the three Vryburg Projects and access roads

The Reivilo road and N14 are both 2 lane roads. The N14 is a national route in South Africa which runs from Springbok in the Northern Cape to Pretoria and is designed for a minimum daily traffic exceeding 1000 vehicle units. The Reivilo Road is an existing gravel farm road taken in a Northern Direction (Photo 1), predominantly used to access the farms located adjacent to the road. A traffic count undertaken in 2012 shows that the N14 between Vryburg and Kuruman (just past the Reivilo Road) has an Average Daily Traffic (ADT) count of 1861 and an Average Daily Truck Traffic (ADTT) count of 501. Since the 2012 data is outdated and recent traffic counts are not available, the ADT and ADTT have been adjusted by 3% per annum to provide an indication of the current traffic volumes. Therefore, the 2018 ADT is ±2222 and the ADTT is ±598.

Photo 1: Reivilo road taken in a Northern direction (towards to N14)

Where the Reivilo Road joins the N14 west of Vryburg, the roads are located adjacent to an informal settlement which means that there may potentially be pedestrians next to and/or crossing these roads. Photo 2 below shows the turnoff from the N14 to the Reivilo Road. The informal settlement is further to the left of the photo.

Photo 2: Turnoff from the N14 to the Reivilo Road (gravel road) (Image source: Google, 2018)

4. TRANSPORT INFORMATION

The general current limitations on road freight transport are:

- Axle load limitation of 7.7t on front axle, 9.0t on single rear axles;
- Axle unit limitations are 18t for dual axle unit and 24t for 3 axle unit;
- Gross vehicle mass of 56t. This means a typical payload of about 30t;
- Maximum vehicle length of 22m for interlink, 18.5m for horse and trailer and 13.5m for a single unit;
- Width limit of 2.6m; and
- Height limit 4.3m.

Abnormal permits are required for vehicles exceeding these limits.

5. SOLAR FARM FREIGHT

Materials and equipment transported to the site comprise of:

- Building materials (concrete aggregates, cement and gravel);
- Construction equipment such as piling rigs and cranes;
- Solar panels (panels and frames); and
- Transformer and cables.

The following is anticipated:

A. Building materials comprising of concrete materials for strip footings or piles will be transported using conventional trucks which would adhere to legal limits listed above.

B. Solar Panels and frames will probably be transported in containers using conventional heavy vehicles within the legal limits. The number of loads will be a function of the capacity of the solar farm and the extent of the frames (the anticipated number of loads are discussed below).

C. Transformers will be transported by abnormal vehicles.

6. TRAFFIC GENERATION

The traffic generation estimates detailed below have been determined based on a single solar energy facility and the associated electrical infrastructure.

- ***Construction Phase***

Approximately 800 x 40ft containers resulting in more or less 450 double axel trucks will come to site during the construction phase (i.e. over a period 12 months). In addition to this, more or less 20 light load trucks will come from and go to site on a daily basis during the construction phase. Municipal water will be trucked to site once every two days. In terms of workers accessing the site, the worst case estimate is that the 300 workers (50 skilled and 250 unskilled) will need to come to site on a daily basis. It is however highly unlikely that all 300 workers would need to be on site simultaneously. It is assumed that workers would commute using both personal vehicles and buses. This would amount to an estimated 6 buses and 15 personal vehicles per day to and from site once in the morning and once in the afternoon.

It is important to note that the construction period is likely to last 12 to 14 months, however the worst case scenario has been considered in this TIS i.e. 12 months.

Containers:	1.5 trucks per day = 3 trips (In + Out)
Light trucks:	40 trips per day (In + Out)
Water trucks:	1 truck every two days = 2 trips (In + Out)
Private vehicles:	30 trips (In + Out)
Buses:	12 buses (In + Out)
Total:	**87 trips per day (In + Out)**

- ***Operational Phase***

More or less 4 light load trucks will come from and go to site on a daily basis and 1 small single axel truck to and from site on a weekly basis. For water supply, the current estimate is that 2 trips per month will be made by a water truck.

The maximum possible total trips per day to site during the operational phase will only occur if all scheduled vehicles arrive on the same day, as follows:

Single axle truck:	1 truck daily = 2 trips (In + out)
Light trucks:	8 trips per day (In + Out)
Water trucks:	1 trip every month = 2 trips (In + Out)
Total:	**10 trips per day (In + out)**

This is regarded as negligible traffic.

- ***Decommissioning Phase***

As per the construction phase, approximately 800 x 40ft containers resulting in more or less 450 double axel trucks will come to site during the decommissioning phase. The decommissioning phase usually takes 12 months (estimate). In addition to this, more or less 20 light load trucks to and from site will come and go to site on a daily basis. As per the construction phase, the worst case scenario would be that 300 workers would need to access the site on a daily basis. This would amount to 6 buses and 15 personal vehicles per day to and from site once in the morning and once in the afternoon.

Containers:	1.5 trucks per day = 3 trips (In + Out)
Light trucks:	40 trips per day (In + Out)
Water trucks:	1 truck every two days = 2 trips (In + Out)
Private vehicles:	30 trips (In + Out)
Buses:	12 buses (In + Out)
Total:	**87 trips per day (In + Out)**

7. IDENTIFICATION OF IMPACTS

The traffic impacts that will be generated by the proposed facility are detailed below. The impacts will largely occur during the construction and decommissioning phases of the project, since this is when the highest amount of traffic will be generated by the proposed facility (refer to Section 6).

The impacts identified and further assessed are:

1. Increase in traffic generation.
2. Accidents with pedestrians, animals and other drivers on the surrounding tarred/gravel roads.
3. Impact on air quality due to dust generation and release of air pollutants from vehicles and construction equipment.
4. Decrease in quality of surface condition of the roads.
5. Cumulative impact of traffic generation.

8. ASSESSMENT OF IMPACTS AND IDENTIFICATION OF MANAGEMENT ACTIONS

This section assesses the significance of the impacts identified in Section 7. Appropriate mitigation and management measures to reduce the significance of the negative impacts and promote the positive impacts have been included in the EMPr.

8.1 Increase traffic generation

As discussed in Section 6 of this report, conventional trucks, conventional heavy vehicles and abnormal vehicles transporting loads will need to come to site to deliver the infrastructure required for the solar facility.

Significance of impacts without mitigation

The construction and decommissioning phases would have the greatest impact on traffic (as discussed in Section 6). Therefore, the additional traffic generated during the construction and decommissioning phases is regarded to be likely to occur and will have a substantial consequence, therefore this is regarded as a **high significance** negative impact.

The operational phase will have a lower traffic generation since only the personnel permanently employed on site would need to go to site every day. It is not expected that this would exceed 4 trips per day. This negative impact would therefore be **very low.**

Proposed mitigation

Construction and decommissioning phases:

- Abnormal vehicle routes and management plans may be required dependant on the type and route of the abnormal vehicle loads. Abnormal vehicles may require special permits and route plans from each relevant road authority. These permits are the responsibility of the developer and its logistics/freight companies;

- Workers should carpool to work or buses should be exclusively used to transport workers to site; and
- Ensure that roadworthy and safety standards are implemented at all time for all construction vehicles.
- Temporary construction phase road signage should be provided at the Reivilo/N14 intersection. The planning and approval of this signage must be obtained from SANRAL.

Operational phase:

- Limit access to site to personnel; and
- Ensure that where possible, staff members carpool to site.

Significance of impact with mitigation

By implementing the abovementioned mitigation measures the consequence of the impact occurring would be lowered which would reduce the significance of the impact to **low** negative impact during the construction and decommissioning phases.

8.2 Accidents with pedestrians, animals and other drivers on the surrounding tarred/gravel roads

During all phases, vehicles will need to access the site. As shown in Photo 1 and indicated in Section 3, the Reivilo intersects with the N14 just outside of Vryburg. There is the potential that should vehicles not indicate soon enough that they are turning off from the N14, an accident can occur. In addition, the N14 and Reivilo Road are adjacent to an informal settlement which increases the likelihood of pedestrians standing next to the road/crossing the road. There is therefore the potential that accidents with pedestrians can occur.

Significance of impacts without mitigation

The significance of causing an accident with pedestrians, animals and other drivers would have a **moderate** negative impact significance. The probability of the impact occurring would be not likely but could be fatal and therefore would cause irreplaceable loss.

Proposed mitigation

- Road kill monitoring programme (inclusive of wildlife collisions record keeping) should be established and fences installed; and
- Adhere to speed limits applicable to all roads used.

Significance of impact with mitigation

By implementing the abovementioned mitigation measures the probability of the impact occurring would be lowered which would reduce the significance of the impact to **low** negative impact during all the phases of the project.

8.3 Noise impact and impact on air quality due to dust generation and release of air pollutants from vehicles and construction equipment

During all the phases of the projects, there will be an increase in noise and a decrease in air quality due to release of pollutants from vehicles coming to site during all phases of the projects, construction activities occurring on site and dust created from driving on the Reivilo road or gravel farm road. Since the site is located in a rural setting, no sensitive receptors are present within close proximity of the proposed project. Therefore, the extent of the impact would remain local.

Significance of impacts without mitigation

As discussed above, the decrease in air quality would be local in extent. The worst case scenario for impacts on air quality is that no dust suppression is implemented on the Reivilo road, gravel access road, on site or that construction activities occur throughout very windy conditions. This negative impact would be **moderate** for all phases of the project, without mitigation.

Proposed mitigation

- Implement management strategies for dust generation e.g. apply dust suppressant on the Reivilo and gravel farm access road, exposed areas and stockpiles;
- Postpone or reduce dust-generating activities during periods with strong wind;
- Earthworks may need to be rescheduled or the frequency of application of dust control/suppressant increased;
- Ensure that all construction vehicles are roadworthy and adhere to the vehicle safety standards and speed limits implemented by the Developer; and
- Avoid using old and noisy construction equipment and ensure equipment is well maintained.

Significance of impact with mitigation

With the implementation of the mitigation measures detailed above, the probability of noise emissions and dust realised would be lowered and the impact would be of a **low** significance.

8.4 Change in quality of surface condition of the roads

The Reivilo road and farm road are going to be used as the main access road to the site. The Reivilo road and farm road are gravel roads and would require additional maintenance to ensure that the traffic generated would not decrease the surface condition of the road.

Significance of impacts without mitigation

Since the Applicant is going to use these roads during all phases of the project, it is expected that, should no mitigation measures be implemented, the road's surface condition would decrease significantly. This would have a **low** negative impact on the road (due to the local spatial extent of the impact).

Proposed mitigation

- Construction activities will have a higher impact than the normal road activity and therefore the road should be inspected on a weekly basis for structural damage;
- A Road Maintenance Plan should be developed for the section of the Reivilo road;
- Ensure that road network is maintained in a good state for the entire operational phase;
- Implement management strategies for dust generation e.g. apply dust suppressant on the Reivilo road, gravel farm access road, exposed areas and stockpiles.

Significance of impact with mitigation

Provided that the above mitigation measures are implemented, the impact would be a **low** negative impact.

8.5 Cumulative impact of traffic generation

As outlined within the assumptions and limitations section of this TIS (Section 1.2), the potential traffic generation of five solar energy projects begin developed at the same time are considered for this cumulative assessment. Based on the traffic numbers outlined above, the construction phase will generate 425 trips, the operational phase 50 trips and the decommissioning phase 425 trips on a daily basis.

Significance of cumulative impacts

It is unclear what the mitigation and management measures would be implemented by other projects. However, if all five project occur at the same time, there will be a significant increase in traffic. The cumulative negative impact is therefore **moderate** significance and will occur over the short to medium term (i.e. up to approximately 24 months).

Table 1. Traffic Impact Assessment Table

Aspect/ Impact Pathway	Nature of impact	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility	Irreplaceability	Mitigation Measures	Significance of Impact/Risk = Consequence x Probability		Ranking of Impact/ Risk	Confidence Level
										Without Mitigation	With Mitigation		
CONSTRUCTION AND DECOMMISSIONING PHASES													
Traffic generation	Increase in traffic	Negative	Regional	Short term	Substantial	Very likely	Yes	Replace -able	• Abnormal vehicle routes and management plans may be required dependant on the type and route of the abnormal vehicle loads. Abnormal vehicles may require special permits and route plans from each relevant road authority. These permits are the responsibility of the developer and its logistics/freight companies. • Ensure that roadworthy and safety standards are implemented at all time for all construction vehicles. • Workers should carpool to work or buses should be exclusively used to transport workers to site. • Temporary construction phase road signage be provided at the Reivilo/N14 intersection. The planning and approval of this signage must be obtained from SANRAL.	High	Low	4	Medium
	Accidents with pedestrians, animals and other drivers on the surrounding tarred/gravel roads	Negative	Local	Long term	Extreme	Not Likely	No	High irreplace -ability	• Road kill monitoring programme (inclusive of wildlife collisions record keeping) should be established and fences installed. • Adhere to all speed limits applicable to all roads used.	Moderate	Low	3	Medium

Aspect/ Impact Pathway	Nature of impact	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility	Irreplaceability	Mitigation Measures	Significance of Impact/Risk = Consequence x Probability		Ranking of Impact/ Risk	Confidence Level
										Without Mitigation	With Mitigation		
	Noise impact and impact on air quality due to dust generation and release of air pollutants from vehicles and construction equipment	Negative	Local	Medium term	Moderate	Not Likely	Yes	Replace -able	• Implement management strategies for dust generation e.g. apply dust suppressant on the Reivilo road, and gravel farm access road, exposed areas and stockpiles; • Postpone or reduce dust-generating activities during periods with strong wind. • Earthworks may need to be rescheduled or the frequency of application of dust control/suppressant increased. • Ensure that all construction vehicles are roadworthy and adhere to the vehicle safety standards implemented by the Developer.	Moderate	Low	4	Medium
	Change in quality of surface condition of the roads	Negative	Local	Long term	Slight	Likely	Yes	Replace -able	• Construction activities will have a higher impact than the normal road activity and therefore the road should be inspected on a weekly basis for structural damage; • Implement management strategies for dust generation e.g. apply dust suppressant on the Reivilo road, and gravel farm access road, exposed areas and stockpiles.	Low	Low	4	Medium
OPERATIONAL PHASE													
Traffic generation	Increase in traffic	Negative	Regional	Short term	Slight	Very likely	High	Replace -able	• Limit access to the site to personnel; and • Ensure that where possible, staff members carpool to site.	Very low	Very low	5	Medium
	Accidents with pedestrians, animals and	Negative	Local	Long term	Extreme	Not Likely	No	High irreplace	• Road kill monitoring programme (inclusive of wildlife collisions record keeping) should be established and	Moderate	Low	3	Medium

Aspect/ Impact Pathway	Nature of impact	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility	Irreplaceability	Mitigation Measures	Significance of Impact/Risk = Consequence x Probability		Ranking of Impact/ Risk	Confidence Level
										Without Mitigation	With Mitigation		
	other drivers on the surrounding tarred/gravel roads							-ability	fences installed. • Adhere to all speed limits applicable to all roads used.				
	Noise impact and impact on air quality due to dust generation and release of air pollutants from vehicles and construction equipment	Negative	Local	Medium term	Moderate	Unlikely	Yes	Replace -able	• Implement management strategies for dust generation e.g. apply dust suppressant on the Reivilo road, and gravel farm access road, exposed areas and stockpiles.	Moderate	Low	4	Medium
CUMULATIVE IMPACTS													
Traffic generation	Increase in traffic	Negative	Regional	Medium term	Substantial	Not Likely	High	Replace -able	n/a	Moderate	Moderate	4	Medium

9. TRAFFIC IMPACT STATEMENT

Based on the assessment of the potential impacts that can be associated with the traffic to be generated during the construction, operation and decommissioning phases of these projects, the overall impact from traffic generation is deemed to be **low** when implementing suitable mitigation measures, discussed in Section 8 of this Statement.

The measures included within the EMPr must be adhered to, with the main requirements outlined below:

- Abnormal vehicle routes and management plans may be required dependant on the type and route of the abnormal vehicle loads. Abnormal vehicles may require special permits and route plans from each relevant road authority. These permits are the responsibility of the developer and its logistics/freight companies.
- Ensure that roadworthy and safety standards are implemented at all time for all construction.
- Temporary construction phase road signage be provided at the Reivilo/N14 intersection. The planning and approval of this signage must be obtained from SANRAL.
- Adhere to all speed limits applicable to all roads used.
- Implement management strategies for dust generation e.g. apply dust suppressant on the Reivilo road, and gravel farm access road, exposed areas and stockpiles.
- Construction activities will have a higher impact than the normal road activity and therefore the Reivilo road should be inspected on a weekly basis for structural damage.
- Ensure that road network is maintained in a good state for the entire operational phase.

APPENDIX A- WSP REVIEW LETTER

--------- Forwarded message ----------
From: " Bredenhann, Christo " <Christo.Bredenhann@wsp.com>
To: Surina Laurie <SLaurie@csir.co.za>
Cc: Darren Osborne <Darren.Osborne@wsp.com>
Bcc:
Date: Thu, 2 Aug 2018 11:49:37 +0000
Subject: Vryburg Solar 1 - 3 TIS's

Hi Surina

I have reviewed the reports and provided comments (as per the letters). I have subsequently reviewed the revised reports and hereby confirm that all my comments were addressed in the report, and the necessary amendments made.

I hereby confirm that I agree to the contents of the Vryburg Solar 1 – 3 TIS reports. This TIS's are therefore adequate in evaluating potential traffic impacts of the proposed PV project on the receiving environment, provided that the recommended mitigation actions are implemented effectively.

Regards

Christo Bredenhann Pr Eng
Associate : Transport Planning
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26 July 2018

PUBLIC

Surina Laurie
CSIR
10 Jan Cilliers Road
Stellenbosch Central
7600

Dear Madam:

Subject: VRYBURG SOLAR 2 TRAFFIC IMPACT STATEMENT - REVIEW

I hereby confirm that I have undertaken an independent peer review of the above mentioned Traffic Impact Statement (TIS), undated. No specific terms of reference was received, therefore the TIS was reviewed holistically from a traffic engineering perspective.

Note that this is a desk-top review only, and no site-inspections were undertaken. In addition, this review was undertaken with limited understanding of the project and its context, other than what was written in the supplied TIS.

My findings & comments are as follows:

- Construction & Decommissioning phase traffic: No intersection capacity analysis was undertaken for the expected increased traffic volumes during these phases. However, we agree that the expected low daily traffic generation is negligible.
- The transportation of staff should also be assessed (number of vehicles per day).
- The operational traffic assessment is sufficient.
- The 2012 traffic counts are outdated and should either be recounted, newer data obtained or as a minimum revised to allow for background traffic growth of at least 3% per annum.
- The proposed mitigation to not allow construction traffic on a National Road during peak hours is impossible to enforce. This is therefore not a practical mitigating measure.
- The proposed signalisation mitigating measure is incorrect. Signalisation refers to the signalisation of a road intersection.
- It must be recommended that temporary construction phase road signage be provided at the Reivilo/N14 intersection. The planning and approval of this signage must be obtained from SANRAL.
- Increased noise due to construction traffic is not an air quality issue.

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- Note: the adherence to vehicle safety standards is the responsibility of the developer/vehicle operator. However, the setting of vehicle standards is a Government responsibility.
- The cumulative impact of all 5 developments under construction at the same time is regarded as Medium, not Low. The cumulative impacts will be short to medium term, not long term.
- The proposed road maintenance plan is primarily required for unsurfaced and low-order roads. High order roads should not be included in this onerous requirement.
- No latent development vehicle trip generation and their potential impacts were analysed, as the information was not available for the preparation of the TIS. However, the assumptions of the expected total cumulative traffic generation is acceptable.
- Abnormal vehicle routes and management plans may be required dependant on the type and route of the abnormal vehicle loads. It must be stated in the TIS that abnormal vehicles may require special permits and route plans from each relevant road authority, not just the Provincial Department. These permits are the responsibility of the developer and its logistics/freight companies.

Yours sincerely,

Digitally signed by Bredenhann, Christo
Date: 2018.07.26 14:26:00 +02'00'

Christo Bredenhann
Associate: Transport Planning