Appendix 6

Specialist Studies

Appendix 6A

Agricultural and Soils Assessment

Johann Lanz
Soil Scientist (Pri.Sci.Nat.)
Reg. no. 400268/12

Cell: 082 927 9018
e-mail: johann@johannlanz.co.za

1A Wolfe Street
Wynberg
7800
Cape Town
South Africa

AGRICULTURAL AND SOILS IMPACT ASSESSMENT FOR PROPOSED UMSOBOMVU SOLAR PV ENERGY FACILITIES NEAR NOUPOORT AND MIDDELBURG NORTHERN CAPE AND EASTERN CAPE PROVINCES

SCOPING REPORT

Report by
Johann Lanz

30 April 2019

Johann Lanz
Professional profile

Education

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

Professional work experience

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

- **Soil Science Consultant** **Self employed** **2002 - present**
  I run a soil science consulting business, servicing clients in both the environmental and agricultural industries. Typical consulting projects involve:
- Soil specialist study inputs to EIA's, SEA's and EMPR's. These have focused on impact assessments and rehabilitation on agricultural land, rehabilitation and re-vegetation of mining and industrially disturbed and contaminated soils, as well as more general aspects of soil resource management. Recent clients include: CSIR; SRK Consulting; Aurecon; Mainstream Renewable Power; SiVEST; Savannah Environmental; Subsolar; Red Cap Investments; MBB Consulting Engineers; Enviroworks; Sharples Environmental Services; Haw & Inglis; BioTherm Energy; Tiptrans.
- Soil resource evaluations and mapping for agricultural land use planning and management. Recent clients include: Cederberg Wines; Unit for Technical Assistance - Western Cape Department of Agriculture; Wedderwill Estate; Goedgedacht Olives; Zewenwacht Wine Estate, Lourensford Fruit Company; Kaarsten Boerdery; Thelema Mountain Vineyards; Rudera Wines; Flagstone Wines; Solms Delta Wines; Dornier Wines.
- I have conducted several recent research projects focused on conservation farming, soil health and carbon sequestration.
- I have project managed the development of soil nutrition software for Farmsecure Agri Science.

- **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*.

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

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

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

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

PROJECT TITLE

Proposed Construction of the Mooi Plaats, Wonderheuvel and Paarde Valley Solar PV Energy Facilities and Associated Grid Connection Infrastructure, near Noupoort in the Northern and Eastern Cape Provinces.

Kindly note the following:

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

Departmental Details

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

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

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

1. SPECIALIST INFORMATION

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

2. DECLARATION BY THE SPECIALIST

I, **Johann Lanz**, declare that –

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

the Act.

Signature of the Specialist

Johann Lanz – Soil Scientist

Name of Company:

30 April 2019

Date

EXECUTIVE SUMMARY

The key findings of this study are:

- The proposed project area is dominated by shallow, loamy sands on underlying rock or less commonly clay. Dominant soil forms are Swartland, Hutton, Mispah, and Valsrivier.
- The major limitations to agriculture are the limited climatic moisture availability (low rainfall), the rugged terrain and the shallow, rocky soils.
- As a result of these limitations, the agricultural use of the study area is limited to low intensity grazing only, except for some isolated patches of irrigation land.
- The proposed project area is classified with land capability evaluation values between 1 (very low) and 7 (low to moderate), with 6 being most predominant.
- The significance of all agricultural impacts is kept low by the limited agricultural potential of the land.
- The only parts of the study area that do not have low sensitivity are the small patches of irrigation. These are considered no-go areas for any footprint of development that will exclude cultivation.
- Two potential negative impacts of the development on agricultural resources and productivity were identified. These are:
    - Loss of agricultural land use; and
    - Soil erosion and degradation.
- One potential positive impact of the development on agricultural resources and productivity was identified as:
    - Increased financial security of farming operations through rental income
- Soil erosion and degradation was assessed as having medium significance before and after mitigation. The other two impacts were assessed as having low significance before and after mitigation.
- The recommended mitigation measures are for implementation of an effective system of storm water run-off control; maintenance of vegetation cover; and to strip, stockpile and re-spread topsoil.
- There is no material difference between the significance of impacts of any of the proposed transmission line route alternatives. All proposed alternatives have equally low impact.
- Due to the low agricultural potential of the site, and the consequent low to medium, negative agricultural impact, there are no restrictions relating to agriculture which preclude authorisation of the proposed development (including all alternatives) and therefore, from an agricultural impact point of view, the development should be authorised.

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1 INTRODUCTION

Three Solar Photovoltaic (PV) Energy Facilities, with associated grid connection infrastructure, are proposed approximately 36 km north west of Middelburg in the Karoo.

The objectives of this 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 impacts.

2 PROJECT DESCRIPTION

The three proposed energy facilities are:

1. Mooi Plaats Solar PV Facility, on an application site (namely Remainder of Mooi Plaats No. 121 and Portion 1 of Leuwe Kop No. 120) of approximately 5303ha
2. Wonderheuvel Solar PV Facility, on an application site (namely Remainder of Mooi Plaats No. 121, Portion 3 of Wonder Heuvel No. 140 and Portion 5 of Holle Fountain No. 133) of approximately 5652ha
3. Paarde Valley Solar PV Facility, on an application site (namely Portion 2 of Paarde Valley No. 62) of approximately 2631ha comprising the following farm portion:

The three Solar PV facilities will include the following components:

- PV fields (arrays) comprising multiple PV panels. The number of panels, the generation capacity of each facility and the layout of the arrays will be dependent on the outcome of the specialist studies conducted during the EIA process.
- PV panels will be either fixed tilt mounting or single axis tracking mounting, and the modules will be either crystalline silicon or thin film technology. Each panel will be approximately 2m wide and between 1m and 4m in height, depending on the mounting type.
- Internal roads, between 4m and 10m wide, will provide access to the PV arrays. Existing site roads will be used wherever possible, although new site roads will be constructed where necessary.
- Each PV facility will include up to two temporary construction laydown/staging areas of approximately 10ha each.
- Operation and maintenance buildings will be provided for each PV field, occupying a site of approximately 2,500m^2 (50m x 50m).
- Medium voltage cabling will link the PV plant to the grid connection infrastructure. These cables will be laid underground wherever technically feasible.

The proposed grid connection infrastructure for each PV facility is being assessed as part of a separate BA application. The grid connections will include the following components:

- New on-site substations and collector substations to serve each PV facility, each occupying an area of up to 4ha.

- A new 132kV overhead power line connecting the on-site substations or collector substations to either Hydra D Main Transmission Substation (MTS) or the proposed Coleskop Wind Energy Facility (WEF) substation from where the electricity will be fed into the national grid. The type of power line towers being considered at this stage to include both lattice and monopole towers which will be up to 25m in height.
- Two grid connection infrastructure alternatives have been provided for each PV project. These alternatives essentially provide for two different route alignments with associated substations contained within an assessment corridor of approximately 400m wide.

3 TERMS OF REFERENCE

The following terms of reference apply to this study:

General requirements:

- Adherence to the content requirements for specialist reports in accordance with Appendix 6 of the EIA Regulations 2014, as amended (see Table 1);
- Adherence to all appropriate best practice guidelines, relevant legislation and authority requirements;
- Provide a thorough overview of all applicable legislation, guidelines
- Cumulative impact identification and assessment as a result of other renewable energy (RE) developments in the area (including; a cumulative environmental impact table(s) and statement, review of the specialist reports undertaken for other Renewable Energy developments and an indication of how the recommendations, mitigation measures and conclusion of the studies have been considered);
- Identification sensitive areas to be avoided (including providing shapefiles/kmls);
- Assessment of the significance of the proposed development during the Pre-construction, Construction, Operation, Decommissioning Phases and Cumulative impacts. Potential impacts should be rated in terms of the direct, indirect and cumulative:
    - Direct impacts are impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity. These impacts are usually associated with the construction, operation or maintenance of an activity and are generally obvious and quantifiable.
    - Indirect impacts of an activity are indirect or induced changes that may occur as a result of the activity. These types of impacts include all the potential impacts that do not manifest immediately when the activity is undertaken, or which occur at a different place as a result of the activity.
    - 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.
- Comparative assessment of alternatives;
- Recommend mitigation measures in order to minimise the impact of the proposed development; and
- Implications of specialist findings for the proposed development (e.g. permits, licenses etc).

Specific requirements:

- 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, 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 and provide relevant mitigation measures to include in the environmental management plan.
- Identify any protocols, legal and permit requirements relating to soil and agricultural potential impacts that are relevant to this project and the implications thereof.
- Map sensitivity of the site and clearly show no-go areas i.e. existing irrigated fields/ cultivated lands
- The report needs to fulfill 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).

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) A specialist report prepared in terms of these Regulations must contain- (α) details of- ι. the specialist who prepared the report; and ιι. the expertise of that specialist to compile a specialist report including a curriculum vitae;	page ii
(β) a declaration that the specialist is independent in a form as may be specified by the competent authority;	page iv
(c) an indication of the scope of, and the purpose for which, the report was prepared;	Sections 1 & 3
(cA)an indication of the quality and age of base data used for the specialist report;	Section 4.1
(cB)a description of existing impacts on the site, cumulative impacts of the	Sections 7.5 & 8.3

proposed development and levels of acceptable change;	
(δ) the date, duration and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 4.1
(ε) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 4
(ϕ) 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 7.7 & Figure 2
(γ) an identification of any areas to be avoided, including buffers;	Section 7.7
(η) 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 2
(ι) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 5
(φ) a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Section 8
(κ) any mitigation measures for inclusion in the EMPr;	Section 8
(λ) any conditions for inclusion in the environmental authorisation;	Section 9
(μ) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Not applicable
(ν) a reasoned opinion- (ι) 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 9 Section 8
(ο) a description of any consultation process that was undertaken during the course of preparing the specialist report;	Not applicable
(π) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	Not applicable
(θ) any other information requested by the competent authority.	Not applicable
(2) Where a government notice *gazetted* by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	Not applicable

4 METHODOLOGY OF STUDY

4.1 Methodology for assessing soils and agricultural potential

The soil investigation applied 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 DAFF document (see Section 2), is only appropriate for a significant footprint of impact on arable land. It has little relevance to an assessment of agricultural potential in this environment, where the agricultural limitations are overwhelmingly climatic, terrain is rugged, soil conditions are generally poor, and cultivation potential is non-existent. In such an environment, even where soils suitable for cultivation may occur, they cannot be cultivated because of the aridity and terrain constraints. Conducting a soil assessment at the stipulated level of detail would be very time consuming and add no value to the assessment. A field investigation was therefore not considered necessary. The assessment was based on a desktop analysis of existing soil and agricultural potential data and other data for the site, which is considered entirely adequate for a thorough assessment of all the agricultural impacts of the proposed development.

The following sources of information were used:

- Soil data was sourced from the land type data set, of the Department of Agriculture, Forestry and Fisheries. This data set originates from the land type survey that was conducted from the 1970's until 2002. It is the most reliable and comprehensive national database of soil information in South Africa and although the data was collected some time ago, it is still entirely relevant as the soil characteristics included in the land type data do not change within time scales of hundreds of years.
- Land capability data was sourced from the 2017 National land capability evaluation raster data layer produced by the Department of Agriculture, Forestry and Fisheries, Pretoria.
- Rainfall and temperature data was sourced from The World Bank Climate Change Knowledge Portal, dated 2015.
- Grazing capacity data was sourced from Cape Farm Mapper.
- Satellite imagery of the site and surrounds was sourced from Google Earth.

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

5 ASSUMPTIONS, CONSTRAINTS AND LIMITATIONS OF STUDY

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

The study makes the assumption that water for irrigation is very limited 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 only very limited irrigation water has been exploited in this area.

Cumulative impacts are assessed by adding expected impacts from this proposed development to existing and proposed developments with similar impacts in a 50 km radius. The existing and proposed developments that were taken into consideration for cumulative impacts are listed in Appendix B. SiVEST undertook every effort to obtain the information (including specialist studies, BA / EIA / Scoping and EMPr Reports) for the surrounding developments. However, many of the documents are not currently publicly available to download, and could therefore not be reviewed during this assessment.

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

6 APPLICABLE LEGISLATION AND PERMIT REQUIREMENTS

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

DAFF reviews and approves this application according to their *Guidelines for the evaluation and review of applications pertaining to renewable energy on agricultural land*, dated September 2011.

The power lines require the registration of a servitude for each farm portion crossed. In terms of SALA, the registration of a power line servitude requires written consent of the Minister if the following two conditions apply:

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

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

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

7 BASELINE ASSESSMENT OF THE SOILS AND AGRICULTURAL CAPABILITY OF THE AFFECTED ENVIRONMENT

This section is organised in sub headings based on the requirements of an agricultural study as detailed in section 2 of this report.

7.1 Climate and water availability

Rainfall for the site is given as a low 378 mm per annum (The World Bank Climate Change Knowledge Portal, 2015). The average monthly distribution of rainfall is shown in Figure 1. Rainfall and resultant moisture availability are insufficient to support viable, rainfed cultivation of crops and also limit the grazing capacity of the veld.

There are some small farm dams across the project area, and limited groundwater exploitation which support small, isolated patches of cultivation.

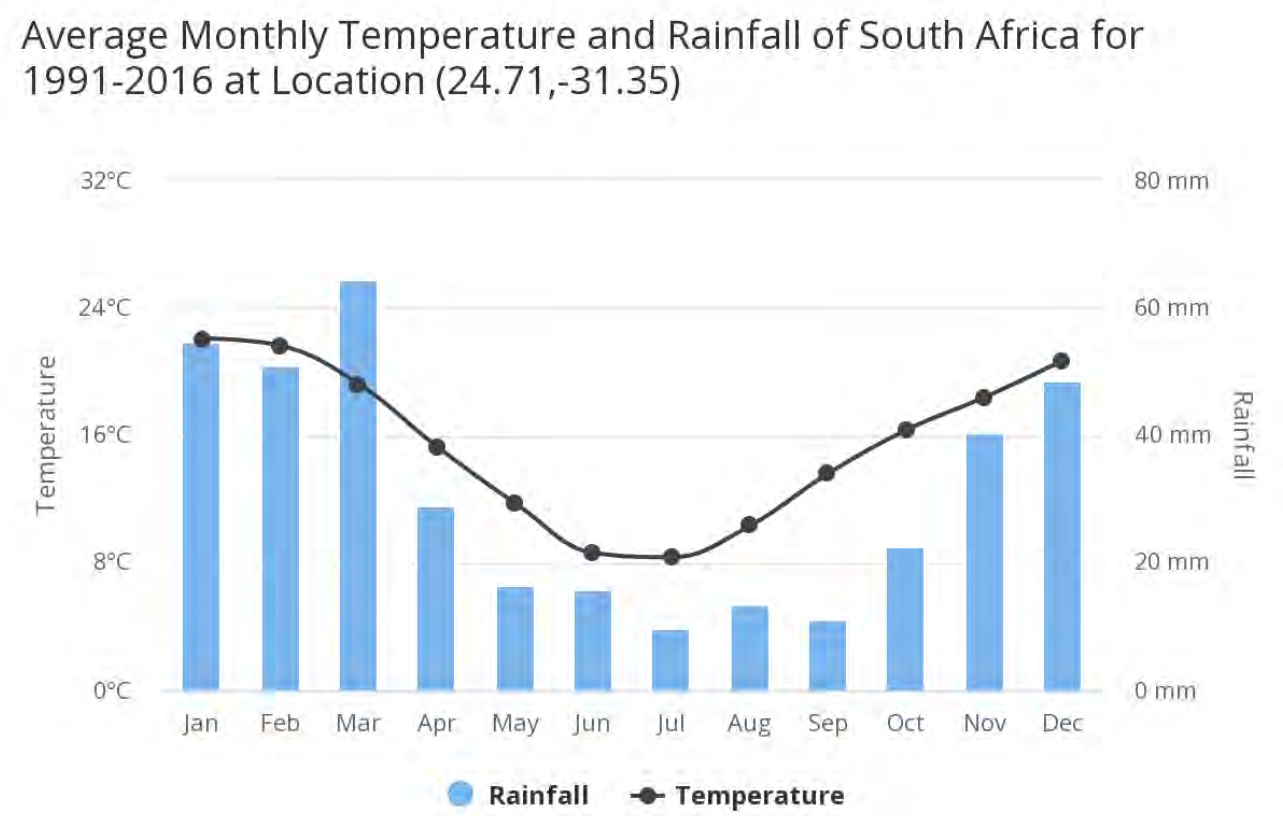

Figure 1. *Average monthly temperature and rainfall for a position approximately in the centre of the development (The World Bank Climate Change Knowledge Portal, 2015).*

7.2 Terrain, topography and drainage

The proposed development is located on plains and broken terrain with small mountains on the escarpment plateau. Altitude varies between approximately 1,440 and 1,700 metres. There is a wide range of slopes across the broken terrain of the project area. There are several non-perennial water courses, typical of arid areas, that drain the project area.

The underlying geology is shale, mudstone and sandstone of the Beaufort Group of the Karoo Supergroup. Dolerite intrusions are common.

7.3 Soils

The land type classification is a nationwide survey that groups areas of similar soil, terrain and climatic conditions into different land types. The proposed development is located on predominantly two similar land types, namely Da6 and Da77. Only a small proportion of the proposed power line routes crosses another two land types, Ib316 and Fb373, in the mountainous terrain. Soils on these land types are fairly similar and are predominantly shallow, loamy sands on underlying rock or less commonly clay. Dominant soil forms are Swartland, Hutton, Mispah, and Valsrivier. The soils would fall into the Duplex and Lithic soil groups according to the classification of Fey (2010). A summary detailing soil data for the land types is provided in Appendix 1, Table A1.

7.4 Agricultural capability

Land capability is defined as the combination of soil, climate and terrain suitability factors for supporting rainfed agricultural production. It is an indication of what level and type of agricultural production can sustainably be achieved on any land. The higher land capability classes are suitable as arable land for the production of cultivated crops, while the lower suitability classes are only suitable as non-arable grazing land, or at the lowest extreme, not even suitable for grazing. In 2017 DAFF released updated and refined land capability mapping across the whole of South Africa. This has greatly improved the accuracy of the land capability rating for any particular piece of land anywhere in the country. The new land capability mapping divides land capability into 15 different categories with 1 being the lowest and 15 being the highest. Values of below 8 are generally not suitable for production of cultivated crops. Detail of this land capability scale is shown in Table 2.

The project area is classified with land capability evaluation values that range from 1 to 7, with 6 being the predominant land capability. The land capability is limited by the very low climatic moisture availability, the rugged terrain, and the shallow, rocky soils.

Table 2: 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	

Due to the land capability constraints, agricultural land use is restricted to grazing only. The natural grazing capacity is given on Cape Farm Mapper as reasonable, at 16 to 17 hectares per large stock unit.

7.5 Land use and development on and surrounding the site

The area is a sheep farming area. The climate does not support any cultivation, except for small patches of irrigation associated with farm dams. Low intensity natural grazing is the dominant agricultural activity. There are several farmsteads (that is a residential and administrative node of buildings and infrastructure from which a farm is managed) within the study area. There is often agricultural infrastructure, including some irrigation in the proximity of the farmsteads. The only agricultural infrastructure away from the small patches of cultivation, are wind pumps, stock watering points and fencing surrounding grazing camps.

7.6 Possible land use options for the site

The low climatic moisture availability means that natural grazing is the only viable agricultural land use for most of the area, except for the small patches of irrigation.

7.7 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. A general assessment of agricultural sensitivity, in terms of loss of agricultural land in South Africa, considers arable land that can support viable production of cultivated crops, to have high sensitivity. This is because there is a scarcity of such land in South Africa, in terms of how much is required for food security. However, there is not a scarcity in the country of land that is only suitable as grazing land and such land is therefore not considered to have high agricultural sensitivity.

Agricultural sensitivity of a particular development is also a function of the severity of the impact which that type of development poses to agriculture. In the case of PV, fairly large areas of land are excluded from agricultural use, so in terms of that aspect, there is sensitivity. In the case of power lines, the impact is negligible because almost all agricultural activities can continue undisturbed beneath power lines.

The majority of the study area has low agricultural potential and therefore low agricultural sensitivity to development and consequent loss of agricultural land use. The only exception are the small patches of irrigation. These have a higher sensitivity, because of their agricultural value, and should be considered no-go areas for any footprint of development that will exclude cultivation. For power lines, the no-go only applies to centre-pivot irrigated lands. This is because there is a danger of shorting between power lines (at standard height) and the centre pivot irrigation structures. Power lines can however cross centre pivot irrigated lands if the height of the power line is raised. No-go areas require no buffers. No-go areas are shown in Figure 2.

Apart from the cultivated no-go areas, agricultural potential and conditions are very uniform across the rest of the study area and the choice of placement of facility infrastructure therefore has minimal influence on the significance of agricultural impacts.

8 IDENTIFICATION AND ASSESSMENT OF IMPACTS ON AGRICULTURE

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

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 array, a road, a building or a substation makes no difference. What is of most relevance therefore is simply the total footprint of the facility.

The ways in which the project can impact on soils, agricultural resources and productivity are:

- Occupation of the land by the total physical footprint of the proposed project including all PV panels, roads and electrical infrastructure.
- Disturbance and changes to the land surface characteristics and soil profile from constructional activities such as levelling and excavations as well as the establishment of hard surfaces. These may lead to erosion and land degradation.

The significance of all potential agricultural impacts is kept low by the low agricultural potential of the land and the consequent low agricultural sensitivity to the loss of this land for agriculture.

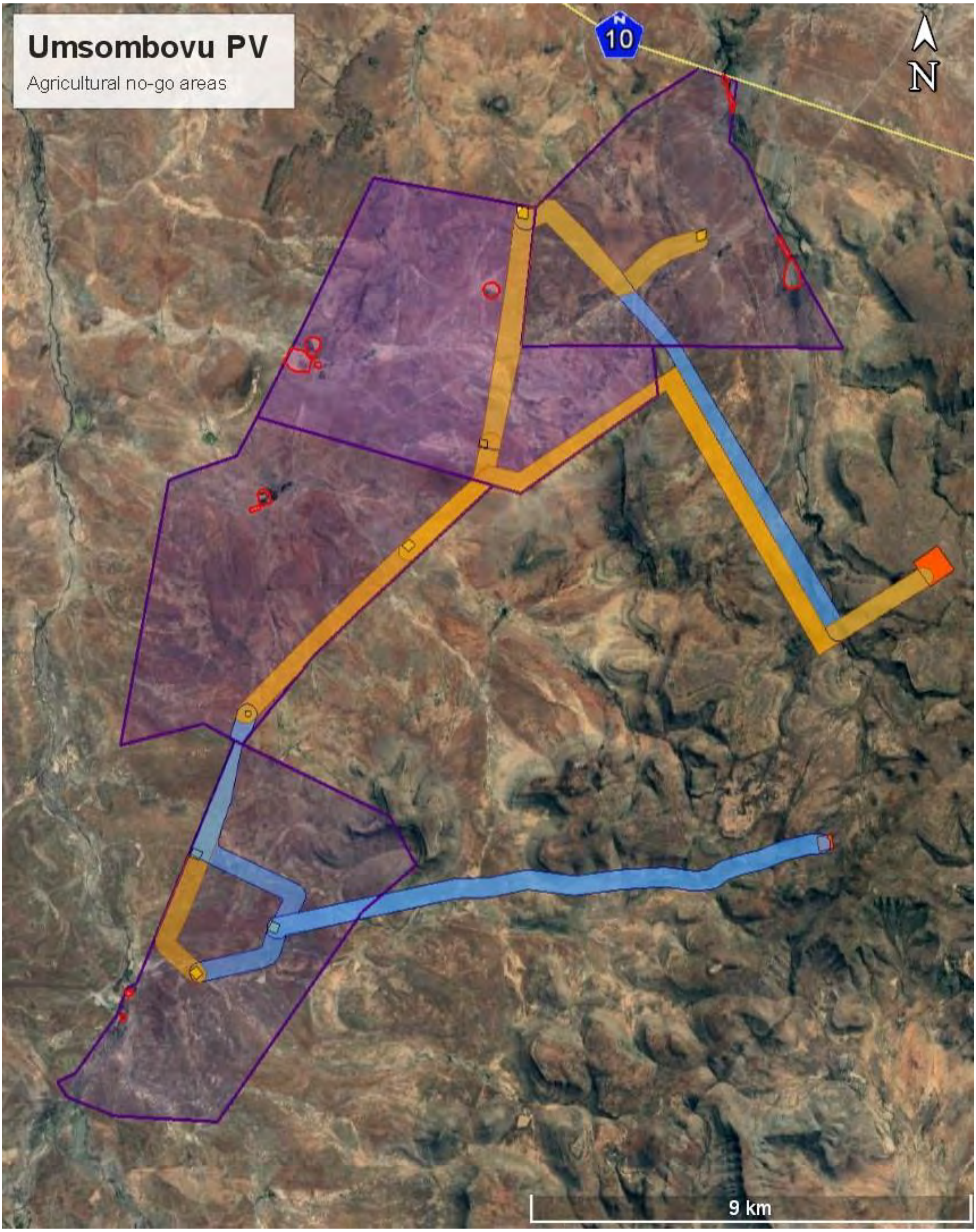

Figure 2. Map of the development area including all proposed transmission line alternatives. Agricultural no-go areas are shown with red outlines.

8.1 Impacts of the solar PV facilities

Because of the similarity of the agricultural environment across all three of the proposed project areas, the impacts are identical for all three solar PV facilities, and are therefore only presented here once.

Three potential agricultural impacts have been identified. Two of these are direct, negative impacts and apply to all three phases of the development (construction, operational and decommissioning). They are:

- Loss of agricultural land use
  Agricultural grazing land directly occupied by the development infrastructure will become unavailable for agricultural use.
- Soil degradation
  Soil degradation can result from erosion and topsoil loss. Erosion can occur as a result of the alteration of the land surface run-off characteristics, which can be caused by construction related land surface disturbance, vegetation removal, and the establishment of hard surface areas including roads. Loss of topsoil can result from poor topsoil management during construction related soil profile disturbance. Soil degradation will reduce the ability of the soil to support vegetation growth.

The third impact is a positive, indirect impact and only applies to the operational phase:

- Increased financial security for farming operations
  Reliable income will be generated by the farming enterprises through the lease of the land to the energy facility. This is likely to increase their cash flow and financial security and thereby improve farming operations.

An assessment of these impacts is presented in **Table *3***, below.

8.2 Impacts of the grid connection infrastructure

Because of the similarity of the agricultural environment across all three of the proposed project areas, the impacts are identical for all three grid connection infrastructures, and are therefore only presented here once.

Grid connection infrastructure has negligible impact on agriculture because all viable agricultural activities in this environment can continue undisturbed below transmission lines and the remaining footprint of the infrastructure (substations etc) occupies an insignificantly small proportion of the available land. Only one agricultural impact has been identified. It is a direct, negative impact that applies to two of the phases of the development (construction and decommissioning):

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

construction related land surface disturbance, vegetation removal, and the establishment of hard surface areas including roads. Loss of topsoil can result from poor topsoil management during construction related soil profile disturbance. Soil degradation will reduce the ability of the soil to support vegetation growth.

An assessment of this impact is presented in **Table 4**, below.

8.3 Cumulative impact of the solar PV facilities

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

The potential cumulative agricultural impact of importance is a regional loss or degradation of agricultural land. The defining question for assessing the cumulative agricultural impact is this:

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

DEA requires compliance with a specified methodology for the assessment of cumulative impacts. This is positive in that it ensures engagement with the important issue of cumulative impacts. However, the required compliance has some limitations and can, in my opinion, result in an over-focus on methodological compliance, while missing the more important task of answering the above defining question more broadly.

The first limitation with DEA's required methodology is that it restricts the cumulative impacts to similar developments, so in this case to renewable energy developments. In order to accurately answer the defining question above, all developments, regardless of their type and similarity, should be taken into account, because all will contribute to exceeding the acceptable level of change.

The second problem with the requirement, is that it restricts surrounding developments to those within an absolutely defined distance, in this case 35km. Again this does not allow for accurately answering the defining question. To achieve this, the distance used for cumulative impact assessment should be discipline dependent. A different distance is likely to apply for agricultural impact than for economic impact or botanical impact. And a different distance should be used in different environments, for example in high potential agricultural environments versus very low potential agricultural environments.

Given the above, this assessment focuses less on methodological compliance and more on effectively addressing the defining question above by considering the cumulative impacts more broadly than is required by DEA compliance. This includes considering a wider area than the 35 km radius, and considering the likelihood of pressure from other types of developments as well.

There are 17 renewable energy projects, with their associated transmission lines, within 35km of the proposed site (that need to be considered in terms of the DEA requirements). These are listed and mapped in Appendix 2.

All of these projects have the same agricultural impacts in a very similar agricultural environment, and in all cases the agricultural impact is assessed as low

Of all the mitigation measures proposed for all of these projects the following have not been included in this report for the reasons given. All others have been included.

- Keeping disturbed soil covered by straw, mulch, or erosion control mats. This is not considered viable in the arid environment. Straw would blow away, and there is unlikely to be any viable source of mulch. Vegetation establishment, taking into account any recommendations by the vegetation study, would be the most viable form of soil stabilisation.

In quantifying the cumulative impact, the area of land taken out of agricultural grazing as a result of all of the projects above will amount to a total of approximately 1,700 hectares. This is calculated using the industry standards of 2.5 and 0.3 hectares per megawatt for solar and wind energy generation respectively, as per DEA (2015). As a proportion of the area within a 35km radius (approximately 385,000 ha), this amounts to only 0.44% of the surface area. That is well within an acceptable limit in terms of loss of low potential agricultural land, of which there is no scarcity in the country. This is particularly so when considered within the context of the following point:

- In order for South Africa to achieve its renewable energy generation goals, agriculturally zoned land will need to be used for renewable energy generation. It is far more preferable to incur a cumulative loss of agricultural land in a region such as the one being assessed, which has no cultivation potential, and low grazing capacity, than to lose agricultural land that has a higher potential, and that is much scarcer, to renewable energy development elsewhere in the country. The limits of acceptable agricultural land loss are therefore far higher in this region than in regions with higher agricultural potential.

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

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

8.4 Cumulative impact of the grid connection infrastructures

The discussion of cumulative impacts above applies to the grid connection infrastructure as well. However, because the agricultural impacts of grid connection infrastructure are negligible, the cumulative impacts are even lower than those for the solar PV facilities. This environment could accommodate many more overhead power lines than currently exist or than are proposed, before acceptable levels of land loss and degradation as a result of transmission lines have any likelihood of being exceeded. Acceptable levels of change in terms of other areas of impact, such as visual impact, would be exceeded long before agricultural levels of change came anywhere near to being exceeded.

Table 3: Impact assessment summary for all three solar PV facilities. Because of the similarity of the agricultural environment across all three of the proposed project areas, the impacts are identical for all three solar PV facilities, and are therefore only presented here once.

3 UMSOMBOVU SOLAR PV FACILITIES																				
ENVIRONMENTAL PARAMETER	**ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE**	**ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION**									**RECOMMENDED MITIGATION MEASURES**	**ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION**								
		E	**P**	**R**	**L**	**D**	**I / M**	**TOTAL**	**STATUS (+ OR -)**	**S**		**E**	**P**	**R**	**L**	**D**	**I / M**	**TOTAL**	**STATUS (+ OR -)**	**S**
Construction Phase																				
Agricultural land	Loss of agricultural land use due to direct occupation	1	4	2	2	3	2	24	-	Medium	None	1	4	2	2	3	2	24	-	Medium
Soil	Soil degradation and erosion	1	2	2	2	2	2	18	-	Low	Control run-off; maintain vegetation cover; strip, stockpile and re-spread topsoil	1	1	2	2	2	2	16	-	Low

Operational Phase																					
Agricultural land	Loss of agricultural land use due to direct occupation	1	4	2	2	3	2	24	-	Medium	None	1	4	2	2	3	2	24	-	Medium
Soil	Soil degradation and erosion	1	2	2	2	2	2	18	-	Low	Control run-off; maintain vegetation cover; strip, stockpile and re-spread topsoil	1	1	2	2	2	2	16	-	Low
Financial security of farming operations	Increased financial security through rental income	1	4	1	1	3	2	20	+	Low	None	1	4	1	1	3	2	20	+	Low
Decommissioning Phase																					
Agricultural land	Loss of agricultural land use due to direct occupation	1	4	2	2	3	2	24	-	Medium	None	1	4	2	2	3	2	24	-	Medium
Soil	Soil degradation and erosion	1	2	2	2	2	2	18	-	Low	Control run-off; maintain vegetation cover; strip, stockpile and re-spread topsoil	1	1	2	2	2	2	16	-	Low
CumulativeAgricultural land	Regional loss of agricultural land and productivity	2	1	2	2	3	2	20	-	Low	Control run-off; maintain vegetation cover; strip, stockpile and re-spread topsoil	2	1	2	2	3	2	20	-	Low

Table 4: Impact assessment summary for all three grid connection infrastructures.

3 UMSOMBOVU GRID CONNECTON INFRASTRUCTURES																				
ENVIRONMENTAL PARAMETER	**ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE**	**ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION**									**RECOMMENDED MITIGATION MEASURES**	**ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION**								
		E	**P**	**R**	**L**	**D**	**I/M**	**TOTAL**	**STATUS (+ OR -)**	**S**		**E**	**P**	**R**	**L**	**D**	**I/M**	**TOTAL**	**STATUS (+ OR -)**	**S**
Construction Phase																				
Soil	Soil degradation and erosion	1	1	2	2	2	1	8	-	Low	Control run-off; maintain vegetation cover; strip, stockpile and re-spread topsoil	1	1	2	2	2	1	8	-	Low
Operational Phase																				
Decommissioning Phase																				
Soil	Soil degradation and erosion	1	1	2	2	2	1	8	-	Low	Control run-off; maintain vegetation cover; strip, stockpile and re-spread topsoil	1	1	2	2	2	1	8	-	Low
Cumulative																				
Soil	Soil degradation and	2	1	2	2	2	1	9	-	Low	Control run-off; maintain	2	1	2	2	2	1	9	-	Low

	erosion										vegetation cover; strip, stockpile and re-spread topsoil									

8.5 Assessment of project alternatives

No site location alternatives are considered because these have already been considered in a high-level screening of potential environmental and socio-economic issues, as well as 'fatal flaws' to determine suitable areas for project development.

The proposed project alternatives apply to the grid connection infrastructure and are:

Mooi Plaats Solar PV Grid Connection

1. Corridor Option 1 is approximately 13kms in length, linking Substations 1 and 2 to Hydra D MTS.
2. Corridor Option 2 is approximately 27kms in length, linking Substations 1 and 2 to Hydra D MTS via the proposed Central Collector substation located on the Wonderheuvel PV project application site.

Wonderheuvel Solar PV Grid Connection

1. Corridor Option 1 involves two separate grid connections to serve the northern and southern sectors of the application site. The northern connection is approximately 18kms in length, linking the proposed on-site Substation 3 to Hydra D MTS via the Northern Collector substation. The southern connection is approximately 17kms in length, linking Substation 4 to the proposed Coleskop WEF substation via the Southern Collector substation located on the Paarde Valley PV project application site.
2. Corridor Option 2 is approximately 20kms in length, linking Substations 3 and 4 to Hydra D MTS via the proposed Central Collector substation located on the Wonderheuvel PV project application site.

Paarde Valley Solar PV Grid Connection

1. Corridor Option 1 is approximately 14kms in length, linking Substation 6 to the proposed Coleskop WEF substation via the Southern Collector substation.
2. Corridor Option 2 is approximately 26kms in length, linking Substations 5 and 6 to Hydra D MTS via the proposed Central Collector substation located on the Wonderheuvel PV project application site.

Although it is possible to propose theoretical differences between the significance of the impacts of the above alternatives, there is practically no material difference of any significance between them. Therefore, from an agricultural impact perspective, there are no preferred alternatives, and all the proposed alternatives are acceptable.

Key

PREFERRED	The alternative will result in a low impact / reduce the impact / result in a positive impact
FAVOURABLE	The impact will be relatively insignificant

LEAST PREFERRED	The alternative will result in a high impact / increase the impact

NO PREFERENCE	The alternative will result in equal impacts

GRID CONNECTION INFRASTRUCTURE ALTERNATIVES (POWER LINE CORRIDORS AND ASSOCIATED SUBSTATIONS)	**Preference**	**Reasons (incl. potential issues)**
MOOI PLAATS SOLAR PV FACILITY:		
Grid Connection Option 1	No Preference	Low agricultural impacts and the agricultural uniformity of the site.
Grid Connection Option 2	No Preference	Low agricultural impacts and the agricultural uniformity of the site.
WONDERHEUVEL SOLAR PV FACILITY:		
Grid Connection Option 1	No Preference	Low agricultural impacts and the agricultural uniformity of the site.
Grid Connection Option 2	No Preference	Low agricultural impacts and the agricultural uniformity of the site.
PAARDE VALLEY SOLAR PV FACILITY:		
Grid Connection Option 1	No Preference	Low agricultural impacts and the agricultural uniformity of the site.
Grid Connection Option 2	No Preference	Low agricultural impacts and the agricultural uniformity of the site.

9 CONCLUSIONS

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 low intensity grazing.

Agricultural impacts of the proposed development are assessed as being of low to medium significance. The significance of agricultural impacts is limited by the limited agricultural potential of the proposed development site, which is a function of the climate, terrain and shallow soils. The majority of the study area has low agricultural potential and therefore low agricultural sensitivity to development and consequent loss of agricultural land use. The only exception are small patches of irrigation. These should be considered no-go areas for any footprint of development that will exclude cultivation.

This agricultural impact assessment is considered to be comprehensive and no further study is required for agricultural impact.

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 is no preference in terms of the proposed power line route alternatives and all alternatives can be supported.

There are no conditions resulting from this assessment that need to be included in the Environmental Authorisation, apart from the mitigation measures proposed above.

10 **REFERENCES**

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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 available at https://climateknowledgeportal.worldbank.org/country/south-africa/climate-data-historical

APPENDIX 1: SOIL DATA

Table A1. Land type soil data for the study area.

Land type	Soil series (forms)	Depth (mm)	Clay % A horizon	Clay % B horizon	Depth limiting layer	% of land type
Da6	Swartland	30 - 300	15 - 30	30 - 45	so	54.2
	Rock outcrop					10.8
	Hutton	100 - 600	10 - 25	10 - 30	R	9.5
	Mispah	50 - 100	10 - 25		R	9.3
	Valsrivier	60 - 400	15 - 30	35 - 45	vr,vp	6.0
	Glenrosa	100 - 200	10 - 25		R	4.0
	Oakleaf	600 > 1200	15 - 25	35 - 40	ne	3.0
	Oakleaf	600 > 1200	15 - 25	15 - 30	ne	3.0
Da77	Swartland	200 - 500	5 - 25	25 - 35	so	18.3
	Hutton	50 - 450	6 - 25	6 - 25	R	17.0
	Swartland	200 - 300	15 - 25	35 - 45	so	16.3
	Valsrivier	200 - 400	15 - 25	35 - 45	vr,vp	12.0
	Mispah	20 - 100	10 - 20		R	11.0
	Oakleaf	400 - 700	15 - 25	15 - 30	ne	5.9
	Rock outcrop					5.8
	Oakleaf	300 - 800	15 - 30	35 - 45	ne	5.3
	Glenrosa	50 - 150	10 - 20	10 - 25	R	5.0
	Sterkspruit	100 - 300	15 - 30	35 - 45	pr	2.3
	Dundee	300 - 800	10 - 30	10 - 30	ne	0.6
	Inhoek	500 - 1200	25 - 35	35 - 45	ne	0.4
	Estcourt	300 - 600	10 - 25	15 - 25	pr	0.4

Depth limiting layers: R = hard rock; so = partially weathered bedrock; lo = partially weathered bedrock (softer); ca = soft carbonate; ka = hardpan carbonate; db = dorbank hardpan; hp = cemented hardpan plinthite (laterite); sp = soft plinthic horizon; pr = dense, prismatic clay layer; vp = dense, structured clay layer; vr = dense, red, structured clay layer; gc = dense clay horizon that is frequently saturated; pd = podzol horizon; U = alluvium.

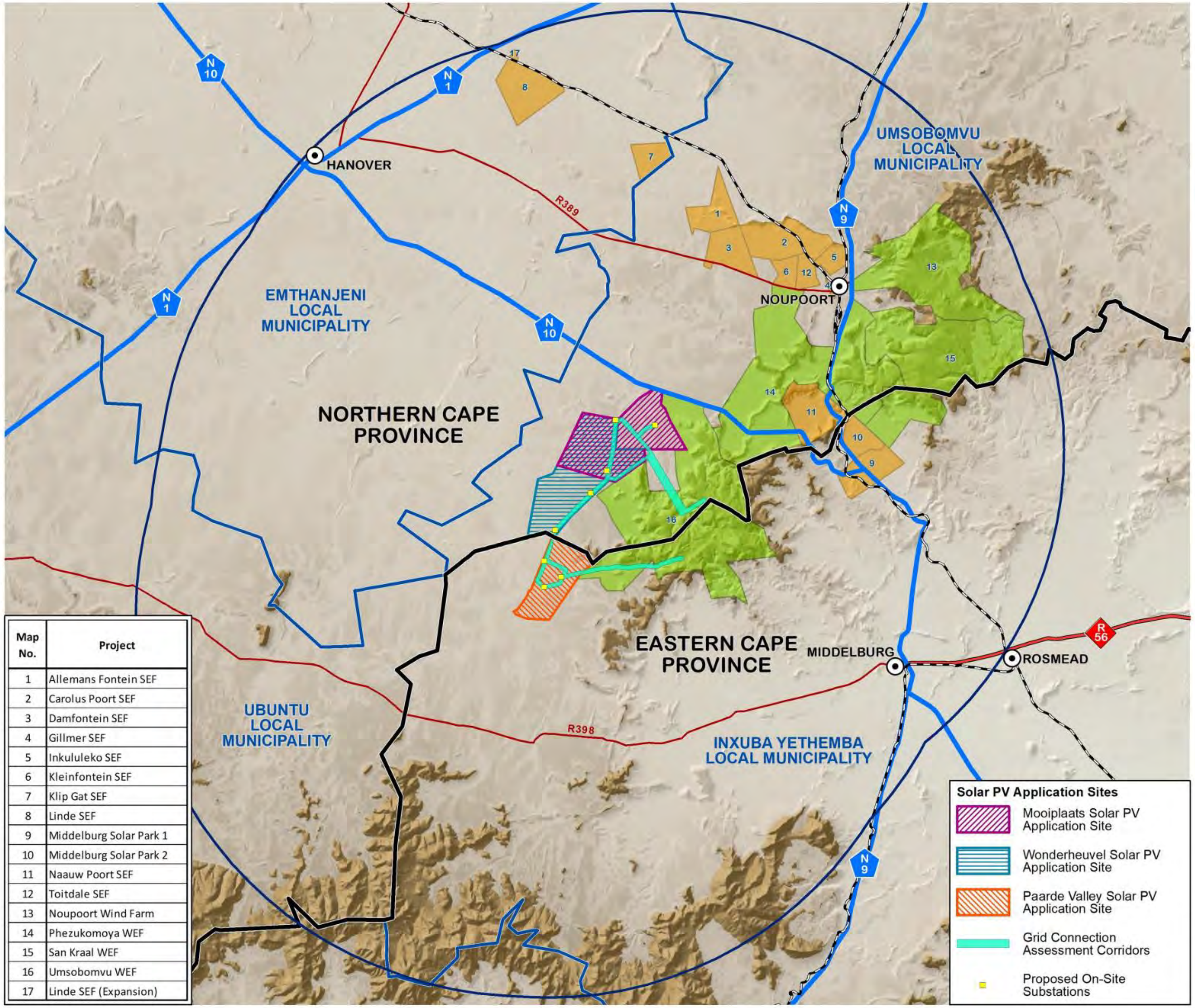
APPENDIX 2: PROJECTS CONSIDERED IN CUMULATIVE ASSESSMENT

Project	DEA Reference No	Technology	Capacity	Status of Application / Development
Allemans Fontein SEF	14/12/16/3/3/1/730	Solar	20MW	Approved
Carolus Poort SEF	14/12/16/3/3/1/729	Solar	20MW	Approved
Damfontein SEF	14/12/16/3/3/1/728	Solar	20MW	Approved
Gillmer SEF	14/12/16/3/3/1/735	Solar	20MW	Approved
Inkululeko SEF	14/12/16/3/3/1/553	Solar	20MW	Approved
Kleinfontein SEF	12/12/20/2654	Solar	20MW	Approved
Klip Gat SEF	14/12/16/3/3/2/354	Solar	75M	Approved
Linde SEF	12/12/20/2258	Solar	40MW	In Operation
Linde SEF (Expansion)	14/12/16/3/3/1/1122	Solar	75MW	Approved
Middelburg Solar Park 1	12/12/20/2465/2	Solar	75MW	Approved
Middelburg Solar Park 2	12/12/20/2465/1	Solar	75MW	Approved
Naauw Poort SEF	14/12/16/3/3/2/355	Solar	75MW	Approved
Toitdale SEF	12/12/20/2653	Solar	20MW	Approved
Noupoort Wind Farm	12/12/20/2319	Wind	188MW	In Operation
Phezukomoya WEF	14/12/16/3/3/1/1028	Wind	315MW	EIA in Process
San Kraal WEF	14/12/16/3/3/1/1069	Wind	390MW	EIA in Process
Umsobomvu WEF	14/12/16/3/3/2/730	Wind	140MW	Approved

PROPOSED CONSTRUCTION OF THREE SOLAR PHOTOVOLTAIC (PV) ENERGY FACILITIES

NEAR NOUPOORT, NORTHERN AND EASTERN CAPE PROVINCES

RENEWABLE ENERGY PROJECTS (EXISTING AND PROPOSED)



Map No.	Project
1	Allemans Fontein SEF
2	Carolus Poort SEF
3	Damfontein SEF
4	Gillmer SEF
5	Inkululeko SEF
6	Kleinfontein SEF
7	Klip Gat SEF
8	Linde SEF
9	Middelburg Solar Park 1
10	Middelburg Solar Park 2
11	Naauw Poort SEF
12	Toitdale SEF
13	Noupoort Wind Farm
14	Phezukomoya WEF
15	San Kraal WEF
16	Umsobomvu WEF
17	Linde SEF (Expansion)

Legend

- Local Municipal Boundaries
- National Routes
- Main Arterial Routes
- Main Roads
- Railways
- Main Towns
- Grid Connection Assessment Corridors
- 35km Radius

Renewable Energy Application Sites

- Solar
- Wind

SOURCE:
DEA, 2018
MUNICIPAL DEMARCATION BOARD, 2011
NGI, 2014

N

0 5 10
Kilometers

SiVEST

ENVIRONMENTAL DIVISION
51 WESSELS ROAD
RIVONIA, 2128
JOHANNESBURG
SOUTH AFRICA

Phone: +27 11 798 0600
Fax: +27 11 803 7272
e-mail: info@sivest.co.za

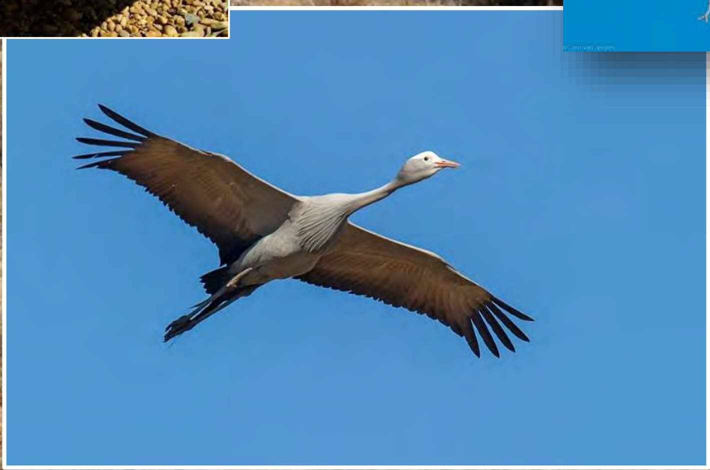
Project No	Prepared By	Date
15324	KLS	15/03/2019
Map Ref No	**Revision**	**Date**
15324/CI_01	0	______

Appendix 6B

Avifauna

AVIFAUNAL SCOPING ASSESSMENT

ENVIRONMENTAL SCOPING ASSESSMENT FOR THE PROPOSED UMSOBOMVU SOLAR PV ENERGY FACILITIES AND ASSOCIATED INFRASTRUCTURE IN THE NORTHERN AND EASTERN CAPE PROVINCES



May 2019

AFRIMAGE Photography (Pty) Ltd t/a
Chris van Rooyen Consulting
VAT#: 4580238113
email: vanrooyen.chris@gmail.com
Tel: +27 (0)82 4549570 cell

EXECUTIVE SUMMARY

SiVEST has been appointed to conduct an Environmental Authorisation Application for the proposed Umsobomvu PV Solar Energy Facility (SEF) and associated grid connection, near Middelburg and Noupoort in the Eastern and Northern Cape. Chris van Rooyen Consulting was in turn appointed by SiVEST to conduct an avifaunal impact study to assess the impact of the proposed SEF on avifauna.

It is proposed that three (3) Solar Photovoltaic (PV) Energy Facilities, with associated 132kV grid connection infrastructure, will be developed, these being Mooi Plaats, Wonderheuvel and Paarde Valley.

A total of 185 bird species could potentially occur in the broader area. Of these, 78 species are classified as solar priority solar species, and 50 as powerline priority species. Eighteen solar priority species, and fifteen powerline priority species have a high likelihood of occurring in the study area site itself.

The potential impacts of the three PV facilities on avifauna which were assessed in this report are:

- Displacement due to disturbance and habitat transformation associated with the construction of the solar PV plants and associated infrastructure;
- Collisions with the solar panels;
- Entrapment in perimeter fences;
- Displacement due to disturbance and habitat transformation associated with the construction of the 132kV grid connection and associated substations.
- Collisions with the 132kV grid connection; and
- Electrocutions on the 132kV grid connection and in associated substations.

The proposed Umsobomvu PV facilities will have some pre-mitigation impacts on avifauna at a site and local level which will range from **Medium to Low**.

The impact of displacement due to disturbance during the construction phase is rated as **Medium** and will remain at a **Medium** level after mitigation. The impact of displacement of priority species due to habitat transformation associated with the operation of the plant and associated infrastructure is rated as **Medium**. This impact can be partially reversed through mitigation, but it will remain at a **Medium** level, after mitigation. The envisaged impacts in the operational phase, i.e. mortalities due to collisions with the solar panels and entrapment in perimeter fences are both rated as **Low** pre-mitigation and could be further reduced with appropriate mitigation. The impact of displacement due to disturbance during the decommissioning phase is rated as **Medium**, and it will remain at a **Medium** level after mitigation. The cumulative impact of the proposed PV facilities within a 35km radius is rated as **Low**, both per- and post mitigation.

The impact of displacement due to disturbance associated with the construction of the proposed 132kV grid connection and substations, is assessed to be **Medium** and can be mitigated to a **Low** level. The potential for displacement due to habitat destruction associated with the construction of the substations is rated as **Low** and could be further reduced with appropriate mitigation. The impact of bird collisions with the 132kV grid connection is rated as **High** and could be reduced to **Medium** with the application of mitigation measures. The potential impact of electrocutions is assessed to be **Medium**, but it can be reduced to **Low** with appropriate mitigation. The impact of displacement due to disturbance associated with the de-commissioning of the proposed 132kV grid connection and substations, is assessed to be **Medium** and can be mitigated to a **Low** level. The cumulative impact of the proposed grid connections within a 35km radius is rated as **Medium**, but it can be reduced to **Low** with the application of appropriate mitigation.

From an avifaunal impact perspective, there is no objection to the proposed development of the Umsobomvu PV facilities and associated grid connections, provided the proposed mitigation measures are strictly implemented. No further monitoring will be required during the operational phase.

National Environmental Management Act, 1998 (Act No. 107 of 1998) and Environmental Impact Regulations 2014 (as amended) Requirements for Specialist Reports (Appendix 6)

Section in EIA Regulations 2014 (as amended)		Clause	Section in Report
Appendix 6	(1)	A specialist report prepared in terms of these Regulations must contain —	
	(a)	details of –	
		(i) the specialist who prepared the report; and	Pg. 7
		(ii) the expertise of that specialist to compile a specialist report including a curriculum vitae.	Pg. 8 - 13
	(b)	A declaration that the person is independent in a form as may be specified by the competent authority;	Pg. 14 - 18
	(c)	An indication of the scope of, and the purpose for which, the report was prepared;	Section 2
	(cA)	An indication of the quality and age of base data used for the specialist report;	Section 3
	(cB)	A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Sections 6 and 7
	(d)	The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 3 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;	Appendix 1
	(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 7
	(g)	An indication 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;	Section 8
	(i)	A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 4
	(j)	A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment or activities;	Sections 9 and 10
	(k)	Any mitigation measures for inclusion in the EMPr;	Section 7

	(l)	Any conditions for inclusion in the environmental authorization;	Section 7
	(m)	Any monitoring requirements for inclusion in the EMPr or environmental authorization;	N/A
	(n)	A reasoned opinion –	
		(i) as to whether the proposed activity, activities or portions thereof should be authorized;	Section 10
		(iA) regarding the acceptability of the proposed activity or activities; and	Section 10
		(ii) if the opinion is that the proposed activity, activities or portions thereof should be authorized, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	Section 7
	(o)	A description of any consultation process that was undertaken during the course of preparing the specialist report;	Section 3
	(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 authority.	N/A
	(2)	Where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	N/A

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DETAILS OF THE SPECIALIST AND EXPERTISE TO COMPILE A SPECIALIST REPORT 7

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DETAILS OF THE SPECIALIST AND EXPERTISE TO COMPILE A SPECIALIST REPORT

Chris van Rooyen

Chris has 21 years' experience in the management of wildlife interactions with electricity infrastructure. He was head of the Eskom-Endangered Wildlife Trust (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 worked in South Africa, Namibia, Botswana, Lesotho, New Zealand, Texas, New Mexico and Florida. Chris also has extensive project management experience and has received several management awards from Eskom for his work in the Eskom-EWT Strategic Partnership. He is the author of 15 academic papers (some with co-authors), co-author of two book chapters and several research reports. He has been involved as ornithological consultant in numerous power line and wind generation projects. Chris is also co-author of the Best Practice for Avian Monitoring and Impact Mitigation at Wind Development Sites in Southern Africa, which is the industry standard. Chris also works outside the electricity industry and had done a wide range of bird impact assessment studies associated with various residential and industrial developments.

Albert Froneman

Albert has an M. Sc. in Conservation Biology from the University of Cape Town and started his career in the natural sciences as a Geographic Information Systems (GIS) specialist at Council for Scientific and Industrial Research (CSIR). In 1998, he joined the Endangered Wildlife Trust where he headed up the Airports Company South Africa – EWT Strategic Partnership, a position he held until he resigned in 2008 to work as a private ornithological consultant. Albert's specialist field is the management of wildlife, especially bird related hazards at airports. His expertise is recognized internationally; in 2005 he was elected as Vice Chairman of the International Bird Strike Committee. Since 2010, Albert has worked closely with Chris van Rooyen in developing a protocol for pre-construction monitoring at wind energy facilities, and he is currently jointly coordinating pre-construction monitoring programmes at several wind farm facilities. Albert also works outside the electricity industry and had done a wide range of bird impact assessment studies associated with various residential and industrial developments.

SPECIALIST DECLARATION

I, Chris van Rooyen as duly authorised representative of Chris van Rooyen Consulting, and working under the supervision of and in association with Albert Froneman (SACNASP Zoological Science Registration number 400177/09) as stipulated by the Natural Scientific Professions Act 27 of 2003, hereby confirm my independence (as well as that of Chris van Rooyen Consulting) as a specialist and declare that neither I nor Chris van Rooyen Consulting have any interest, be it business, financial, personal or other, in any proposed activity, application or appeal in respect of which Sivest was appointed as environmental assessment practitioner in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), other than fair remuneration for worked performed, specifically in connection with the Environmental Impact Assessment for the proposed Umsobomvu Solar Project.

Full Name: Chris van Rooyen

Position: Director

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 and avifaunal monitoring for wind-powered generation facilities:

1. Eskom Klipheuwel Experimental Wind Power Facility, Western Cape
2. Mainstream Wind Facility Jeffreys Bay, Eastern Cape (EIA and monitoring)
3. Biotherm, Swellendam, (Excelsior), Western Cape (EIA and monitoring)
4. Biotherm, Napier, (Matjieskloof), Western Cape (pre-feasibility)
5. Windcurrent SA, Jeffreys Bay, Eastern Cape (2 sites) (EIA and monitoring)
6. Caledon Wind, Caledon, Western Cape (EIA)
7. Innowind (4 sites), Western Cape (EIA)
8. Renewable Energy Systems (RES) Oyster Bay, Eastern Cape (EIA and monitoring)
9. Oelsner Group (Kerriefontein), Western Cape (EIA)
10. Oelsner Group (Langefontein), Western Cape (EIA)
11. InCa Energy, Vredendal Wind Energy Facility Western Cape (EIA)
12. Mainstream Loeriesfontein Wind Energy Facility (EIA and monitoring)
13. Mainstream Noupoort Wind Energy Facility (EIA and monitoring)
14. Biotherm Port Nolloth Wind Energy Facility (Monitoring)
15. Biotherm Laingsburg Wind Energy Facility (EIA and monitoring)
16. Langhoogte Wind Energy Facility (EIA)
17. Vleesbaai Wind Energy Facility (EIA and monitoring)
18. St. Helena Bay Wind Energy Facility (EIA and monitoring)
19. Electrawind, St Helena Bay Wind Energy Facility (EIA and monitoring)
20. Electrawind, Vredendal Wind Energy Facility (EIA)
21. SAGIT, Langhoogte and Wolseley Wind Energy facilities
22. Renosterberg Wind Energy Project – 12-month preconstruction avifaunal monitoring project
23. De Aar – North (Mulilo) Wind Energy Project – 12-month preconstruction avifaunal monitoring project
24. De Aar – South (Mulilo) Wind Energy Project – 12-month bird monitoring
25. Namies – Aggenys Wind Energy Project – 12-month bird monitoring
26. Pofadder - Wind Energy Project – 12-month bird monitoring
27. Dwarsrug Loeriesfontein - Wind Energy Project – 12-month bird monitoring
28. Waaihoek – Utrecht Wind Energy Project – 12-month bird monitoring
29. Amathole – Butterworth Utrecht Wind Energy Project – 12-month bird monitoring & EIA specialist
30. Phezukomoya and San Kraal Wind Energy Projects 12-month bird monitoring & EIA specialist study (Innowind)
31. Beaufort West Wind Energy Facility 12-month bird monitoring & EIA specialist study (Mainstream)
32. Leeuwdraai Wind Energy Facility 12-month bird monitoring & EIA specialist study (Mainstream)
33. Sutherland Wind Energy Facility 12-month bird monitoring (Mainstream)
34. Maralla Wind Energy Facility 12-month bird monitoring & EIA specialist study (Biotherm)
35. Esizayo Wind Energy Facility 12-month bird monitoring & EIA specialist study (Biotherm)
36. Humansdorp Wind Energy Facility 12-month bird monitoring & EIA specialist study (Cennergi)
37. Aletta Wind Energy Facility 12-month bird monitoring & EIA specialist study (Biotherm)
38. Eureka Wind Energy Facility 12-month bird monitoring & EIA specialist study (Biotherm)
39. Makambako Wind Energy Faclity (Tanzania) 12-month bird monitoring & EIA specialist study (Windlab)
40. R355 Wind Energy Facility 12-month bird monitoring (Mainstream)
41. Groenekloof Wind Energy Facility 12-month bird monitoring & EIA specialist study (Mulilo)
42. Tsitsikamma Wind Energy Facility 24-months post-construction monitoring (Cennergi)
43. Noupoort Wind Energy Facility 24-months post-construction monitoring (Mainstream)
44. Kokerboom Wind Energy Facility 12-month bird monitoring & EIA specialist study (Business Venture Investments)
45. Kuruman Wind Energy Facility 12-month bird monitoring & EIA specialist study (Mulilo)
46. Dassieklip Wind Energy Facility 3 years post-construction monitoring (Biotherm)
47. Loeriesfontein 2 Wind Energy Facility 2 years post-construction monitoring (Mainstream)
48. Khobab Wind Energy Facility 2 years post-construction monitoring (Mainstream)
49. Excelsior Wind Energy Facility 18 months construction phase monitoring (Biotherm)
50. Boesmansberg Wind Energy Facility 12-months pre-construction bird monitoring (juwi)
51. Mañhica Wind Energy Facility, Mozambique, 12-months pre-construction monitoring (Windlab)

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
13. ABO Vryburg 1,2,3 Solar PV Project, Vryburg, North-West
14. NamPower CSP Facility near Arandis, Namibia

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
133. Kuruman Phase 1 and 2 Wind Energy facilities 132kV Grid connection
134. Transnet

Bird Impact Assessment Studies for the following residential and industrial developments:

1. Lizard Point Golf Estate
2. Lever Creek Estates
3. Leloko Lifestyle Estates
4. Vaaloewers Residential Development
5. Clearwater Estates Grass Owl Impact Study
6. Sommerset Ext. Grass Owl Study
7. Proposed Three Diamonds Trading Mining Project (Portion 9 and 15 of the Farm Blesbokfontein)
8. N17 Section: Springs To Leandra –“Borrow Pit 12 And Access Road On (Section 9, 6 And 28 Of The Farm Winterhoek 314 Ir)
9. South African Police Services Gauteng Radio Communication System: Portion 136 Of The Farm 528 Jq, Lindley.
10. Report for the proposed upgrade and extension of the Zeekoegat Wastewater Treatment Works, Gauteng.
11. Bird Impact Assessment for Portion 265 (a portion of Portion 163) of the farm Rietfontein 189-JR, Gauteng.
12. Bird Impact Assessment Study for Portions 54 and 55 of the Farm Zwartkop 525 JQ, Gauteng.
13. Bird Impact Assessment Study Portions 8 and 36 of the Farm Nooitgedacht 534 JQ, Gauteng.
14. Shumba’s Rest Bird Impact Assessment Study
15. Randfontein Golf Estate Bird Impact Assessment Study
16. Zilkaatsnek Wildlife Estate
17. Regenstein Communications Tower (Namibia)
18. Avifaunal Input into Richards Bay Comparative Risk Assessment Study
19. Maquasa West Open Cast Coal Mine
20. Glen Erasmia Residential Development, Kempton Park, Gauteng
21. Bird Impact Assessment Study, Weltevreden Mine, Mpumalanga
22. Bird Impact Assessment Study, Olifantsvlei Cemetery, Johannesburg
23. Camden Ash Disposal Facility, Mpumalanga
24. Lindley Estate, Lanseria, Gauteng
25. Proposed open cast iron ore mine on the farm Lylyveld 545, Northern Cape
26. Avifaunal monitoring for the Sishen Mine in the Northern Cape as part of the EMPr requirements
27. Steelpoort CNC Bird Impact Assessment Study

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.

Chris van Rooyen
06 May 2019

Curriculum vitae: Albert Froneman

Profession/Specialisation	:	Avifaunal Specialist
Highest Qualification	:	MSc (Conservation Biology)
Nationality	:	South African
Years of experience	:	18 years

Key Qualifications

Albert Froneman **(**Pr.Sci.Nat) has more than 18 years' experience in the management of avifaunal interactions with industrial infrastructure. He holds a M.Sc. degree in Conservation Biology from the University of Cape Town. He managed the Airports Company South Africa (ACSA) – Endangered Wildlife Trust Strategic Partnership from 1999 to 2008 which has been internationally recognized for its achievements in addressing airport wildlife hazards in an environmentally sensitive manner at ACSA's airports across South Africa. Albert is recognized worldwide as an expert in the field of bird hazard management on airports and has worked in South Africa, Swaziland, Botswana, Namibia, Kenya, Israel, and the USA. He has served as the vice chairman of the International Bird Strike Committee and has presented various papers at international conferences and workshops. At present he is consulting to ACSA with wildlife hazard management on all their airports. He also an accomplished specialist ornithological consultant outside the aviation industry and has completed a wide range of bird impact assessment studies. He has co-authored many avifaunal specialist studies and pre-construction monitoring reports for proposed renewable energy developments across South Africa. He also has vast experience in using Geographic Information Systems to analyse and interpret avifaunal data spatially and derive meaningful conclusions. Since 2009 Albert has been a registered Professional Natural Scientist (reg. nr 400177/09) with The South African Council for Natural Scientific Professions, specialising in Zoological Science.

Key Project Experience

Renewable Energy Facilities –avifaunal monitoring projects in association with Chris van Rooyen Consulting

1. Jeffrey's Bay Wind Farm – 12-months preconstruction avifaunal monitoring project
2. Oysterbay Wind Energy Project – 12-months preconstruction avifaunal monitoring project
3. Ubuntu Wind Energy Project near Jeffrey's Bay – 12-months preconstruction avifaunal monitoring project
4. Bana-ba-Pifu Wind Energy Project near Humansdorp – 12-months preconstruction avifaunal monitoring project
5. Excelsior Wind Energy Project near Caledon – 12-months preconstruction avifaunal monitoring project
6. Laingsburg Spitskopvlakte Wind Energy Project – 12-months preconstruction avifaunal monitoring project
7. Loeriesfontein Wind Energy Project Phase 1, 2 & 3 – 12-months preconstruction avifaunal monitoring project
8. Noupoort Wind Energy Project – 12-months preconstruction avifaunal monitoring project
9. Vleesbaai Wind Energy Project – 12-months preconstruction avifaunal monitoring project
10. Port Nolloth Wind Energy Project – 12-months preconstruction avifaunal monitoring project
11. Langhoogte Caledon Wind Energy Project – 12-months preconstruction avifaunal monitoring project
12. Lunsklip – Stilbaai Wind Energy Project – 12-months preconstruction avifaunal monitoring project
13. Indwe Wind Energy Project – 12-months preconstruction avifaunal monitoring project
14. Zeeland St Helena bay Wind Energy Project – 12-months preconstruction avifaunal monitoring project
15. Wolseley Wind Energy Project – 12-months preconstruction avifaunal monitoring project
16. Renosterberg Wind Energy Project – 12-months preconstruction avifaunal monitoring project
17. De Aar – North (Mulilo) Wind Energy Project – 12-months preconstruction avifaunal monitoring project (2014)
18. De Aar – South (Mulilo) Wind Energy Project – 12-months bird monitoring
19. Namies – Aggenys Wind Energy Project – 12-months bird monitoring
20. Pofadder - Wind Energy Project – 12-months bird monitoring
21. Dwarsrug Loeriesfontein - Wind Energy Project – 12-months bird monitoring
22. Waaihoek – Utrecht Wind Energy Project – 12-months bird monitoring
23. Amathole – Butterworth Utrecht Wind Energy Project – 12-months bird monitoring & EIA specialist study
24. De Aar and Droogfontein Solar PV Pre- and Post-construction avifaunal monitoring
25. Makambako Wind Energy Faclity (Tanzania) 12-month bird monitoring & EIA specialist study (Windlab)
26. R355 Wind Energy Facility 12-month bird monitoring (Mainstream)
27. Groenekloof Wind Energy Facility 12-month bird monitoring & EIA specialist study (Mulilo)
28. Tsitsikamma Wind Energy Facility 24-months post-construction monitoring (Cennergi)
29. Noupoort Wind Energy Facility 24-months post-construction monitoring (Mainstream)
30. Kokerboom Wind Energy Facility 12-month bird monitoring & EIA specialist study (Business Venture Investments)
31. Kuruman Wind Energy Facility 12-month bird monitoring & EIA specialist study (Mulilo)
32. Mañhica Wind Energy Facility 12-month bird monitoring & EIA specialist study (Windlab)

Bird Impact Assessment studies and / or GIS analysis:

1. Aviation Bird Hazard Assessment Study for the proposed Madiba Bay Leisure Park adjacent to Port Elizabeth Airport.
2. Extension of Runway and Provision of Parallel Taxiway at Sir Seretse Khama Airport, Botswana Bird / Wildlife Hazard Management Specialist Study
3. Maun Airport Improvements Bird / Wildlife Hazard Management Specialist Study
4. Bird Impact Assesment Study - Bird Helicopter Interaction – The Bitou River, Western Cape Province South Africa
5. Proposed La Mercy Airport – Bird Aircraft interaction specialists study using bird detection radar to assess swallow flocking behaviour
6. KwaZulu Natal Power Line Vulture Mitigation Project – GIS analysis
7. Perseus-Zeus Powerline EIA – GIS Analysis
8. Southern Region Pro-active GIS Blue Crane Collision Project.
9. Specialist advisor ~ Implementation of a bird detection radar system and development of an airport wildlife hazard management and operational environmental management plan for the King Shaka International Airport
10. Matsapha International Airport – bird hazard assessment study with management recommendations
11. Evaluation of aviation bird strike risk at candidate solid waste disposal sites in the Ekurhuleni Metropolitan Municipality

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

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

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

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

PROJECT TITLE

Proposed Construction of the Mooi Plaats, Wonderheuvel and Paarde Valley Solar PV Energy Facilities and Associated Grid Connection Infrastructure, near Noupoort in the Northern and Eastern Cape Provinces.

Kindly note the following:

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

Departmental Details

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

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

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

1. SPECIALIST INFORMATION

Specialist Company Name:	Afrimage Photography (Pty) Ltd t/a Chris van Rooyen Consulting			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	Contribution level (indicate 1 to 8 or non-compliant)	Contribution level (indicate 1 to 8 or non-compliant)	Contribution level (indicate 1 to 8 or non-compliant)
Specialist name:	Chris van Rooyen			
Specialist Qualifications:	BA LLB			
Professional affiliation/registration:	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.			
Physical address:	30 Roosevelt Street, Robindale, Randburg			
Postal address:	30 Roosevelt Street, Robindale, Randburg			
Postal code:	2194			
Telephone:	0824549570			
E-mail:	Vanrooyen.chris@gmail.com			

2. DECLARATION BY THE SPECIALIST

I, Chris van Rooyen, declare that –

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

Signature of the Specialist

Chris van Rooyen Consulting

Name of Company:

6 May 2019

Date

Details of Specialist, Declaration and Undertaking Under Oath

Page 2 of 3

3. UNDERTAKING UNDER OATH/ AFFIRMATION

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

Signature of the Specialist

Chris van Rooyen Consulting

Name of Company

6 May 2019

Date

(MEED) WO

Signature of the Commissioner of Oaths

6 May 2019

Date

SOUTH AFRICAN POLICE SERVICE
COMMUNITY SERVICE CENTRE
2019 -05- 06
C.S.C
LINDEN
SUID-AFRIKAANSE POLISIEDIENS

30 BOUNDARY ROAD
ROBINDALE
LINDEN
WARRANT OFFICER

12. Gateway Airport Authority Limited – Gateway International Airport, Polokwane: Bird hazard assessment; Compile a bird hazard management plan for the airport
13. Bird Specialist Study - Evaluation of aviation bird strike risk at the Mwakirunge Landfill site near Mombasa Kenya
14. Bird Impact Assessment Study - Proposed Weltevreden Open Cast Coal Mine Belfast, Mpumalanga
15. Avian biodiversity assessment for the Mafube Colliery Coal mine near Middelburg Mpumalanga
16. Avifaunal Specialist Study - SRVM Volspruit Mining project – Mokopane Limpopo Province
17. Avifaunal Impact Assessment Study (with specific reference to African Grass Owls and other Red List species) Stone Rivers Arch
18. Airport bird and wildlife hazard management plan and training to Swaziland Civil Aviation Authority (SWACAA) for Matsapha and Sikhupe International Airports
19. Avifaunal Impact Scoping & EIA Study - Renosterberg Wind Farm and Solar PV site
20. Bird Impact Assessment Study - Proposed 60 year Ash Disposal Facility near to the Kusile Power Station
21. Avifaunal pre-feasibility assessment for the proposed Montrose dam, Mpumalanga
22. Bird Impact Assessment Study – Proposed ESKOM Phantom Substation near Knysna, Western Cape
23. Habitat sensitivity map for Denham's Bustard, Blue Crane and White-bellied Korhaan in the Kouga Municipal area of the Eastern Cape Province
24. Swaziland Civil Aviation Authority – Sikhuphe International Airport – Bird hazard management assessment
25. Avifaunal monitoring – extension of Specialist Study - SRVM Volspruit Mining project – Mokopane Limpopo Province
26. Avifaunal Specialist Study – Rooikat Hydro Electric Dam – Hope Town, Northern Cape
27. The Stewards Pan Reclamation Project – Bird Impact Assessment study
28. Airports Company South Africa – Avifaunal Specialist Consultant – Airport Bird and Wildlife Hazard Mitigation

Geographic Information System analysis & maps

1. ESKOM Power line Makgalakwena EIA – GIS specialist & map production
2. ESKOM Power line Benficosa EIA – GIS specialist & map production
3. ESKOM Power line Riversong EIA – GIS specialist & map production
4. ESKOM Power line Waterberg NDP EIA – GIS specialist & map production
5. ESKOM Power line Bulge Toulon EIA – GIS specialist & map production
6. ESKOM Power line Bulge DORSET EIA – GIS specialist & map production
7. ESKOM Power lines Marblehall EIA – GIS specialist & map production
8. ESKOM Power line Grootpan Lesedi EIA – GIS specialist & map production
9. ESKOM Power line Tanga EIA – GIS specialist & map production
10. ESKOM Power line Bokmakierie EIA – GIS specialist & map production
11. ESKOM Power line Rietfontein EIA – GIS specialist & map production
12. Power line Anglo Coal EIA – GIS specialist & map production
13. ESKOM Power line Camcoll Jericho EIA – GIS specialist & map production
14. Hartbeespoort Residential Development – GIS specialist & map production
15. ESKOM Power line Mantsole EIA – GIS specialist & map production
16. ESKOM Power line Nokeng Flourspar EIA – GIS specialist & map production
17. ESKOM Power line Greenview EIA – GIS specialist & map production
18. Derdepoort Residential Development – GIS specialist & map production
19. ESKOM Power line Boynton EIA – GIS specialist & map production
20. ESKOM Power line United EIA – GIS specialist & map production
21. ESKOM Power line Gutshwa & Malelane EIA – GIS specialist & map production
22. ESKOM Power line Origstad EIA – GIS specialist & map production
23. Zilkaatsnek Development Public Participation –map production
24. Belfast – Paarde Power line - GIS specialist & map production
25. Solar Park Solar Park Integration Project Bird Impact Assessment Study – avifaunal GIS analysis.
26. Kappa-Omega-Aurora 765kV Bird Impact Assessment Report – Avifaunal GIS analysis.
27. Gamma – Kappa 2nd 765kV – Bird Impact Assessment Report – Avifaunal GIS analysis.
28. ESKOM Power line Kudu-Dorstfontein Amendment EIA – GIS specialist & map production.
29. Proposed Heilbron filling station EIA – GIS specialist & map production
30. ESKOM Lebatlhane EIA – GIS specialist & map production
31. ESKOM Pienaars River CNC EIA – GIS specialist & map production
32. ESKOM Lemara Phiring Ohrigstad EIA – GIS specialist & map production
33. ESKOM Pelly-Warmbad EIA – GIS specialist & map production
34. ESKOM Rosco-Bracken EIA – GIS specialist & map production
35. ESKOM Ermelo-Uitkoms EIA – GIS specialist & map production
36. ESKOM Wisani bridge EIA – GIS specialist & map production
37. City of Tswane – New bulkfeeder pipeline projects x3 Map production
38. ESKOM Lebohang Substation and 132kV Distribution Power Line Project Amendment GIS specialist & map production
39. ESKOM Geluk Rural Powerline GIS & Mapping
40. Eskom Kimberley Strengthening Phase 4 Project GIS & Mapping
41. ESKOM Kwaggafontein - Amandla Amendment Project GIS & Mapping
42. ESKOM Lephalale CNC – GIS Specialist & Mapping
43. ESKOM Marken CNC – GIS Specialist & Mapping
44. ESKOM Lethabong substation and powerlines – GIS Specialist & Mapping
45. ESKOM Magopela- Pitsong 132kV line and new substation – GIS Specialist & Mapping

Professional affiliations

South African Council for Natural Scientific Professions (SACNASP) registered Professional Natural Scientist (reg. nr 400177/09) – specialist field: Zoological Science. Registered since 2009.

1 BACKGROUND

SiVEST has been appointed to conduct an Environmental Authorisation Application for the proposed Umsobomvu PV Solar Energy Facility (SEF) and associated grid connection, near Middelburg and Noupoort in the Eastern and Northern Cape. Chris van Rooyen Consulting was in turn appointed by SiVEST to conduct an avifaunal impact study to assess the impact of the proposed SEF on avifauna.

It is proposed that three (3) Solar Photovoltaic (PV) Energy Facilities, with associated grid connection infrastructure, will be developed, these being:

- ***Mooi Plaats Solar PV Facility***, on an application site of approximately 5 303ha, comprising the following farm portions:
  - Portion 1 of Leuwe Kop No 120
  - Remainder of Mooi Plaats No 121

- ***Wonderheuvel Solar PV Facility***, on an application site of approximately 5 652ha, comprising the following farm portions:
  - Remainder of Mooi Plaats No 121
  - Portion 3 of Wonder Heuvel No 140
  - Portion 5 of Holle Fountain No 133

- ***Paarde Valley Solar PV Facility***, on an application site of approximately 2 631ha, comprising the following farm portion:
  - Portion 2 of Paarde Valley No 62

The solar PV projects are shown in Figures 1, 2 and 3, below.

1.1 SOLAR PV COMPONENTS

The three Solar PV facilities will include the following components:

- PV fields (arrays) comprising multiple PV panels. The number of panels, the generation capacity of each facility and the layout of the arrays will be dependent on the outcome of the specialist studies conducted during the EIA process.
- PV panels will be either fixed tilt mounting or single axis tracking mounting, and the modules will be either crystalline silicon or thin film technology. Each panel will be approximately 2m wide and between 1m and 4m in height, depending on the mounting type.
- Internal roads, between 4m and 10m wide, will provide access to the PV arrays. Existing site roads will be used wherever possible, although new site roads will be constructed where necessary.
- Each PV facility will include up to two (2) temporary construction laydown/staging areas of approximately 10ha each.
- Operation and maintenance (O&M) buildings will be provided for each PV field, occupying a site of approximately 2 500m^2 (50m x 50m).
- Medium voltage cabling will link the PV plant to the grid connection infrastructure. These cables will be laid underground wherever technically feasible.

1.2 GRID CONNECTION INFRASTRUCTURE

The proposed grid connection infrastructure for each PV facility is being assessed as part of a separate BA application. The grid connections will include the following components:

- New on-site substations and collector substations to serve each PV facility, each occupying an area of up to 4ha.

- A new 132kV overhead power line connecting the on-site substations or collector substations to either Hydra D Main Transmission Substation (MTS) or the proposed Coleskop Wind Energy Facility (WEF) substation from where the electricity will be fed into the national grid. The type of power line towers being considered at this stage to include both lattice and monopole towers which will be up to 25m in height.

Two grid connection infrastructure alternatives have been provided for each PV project. These alternatives essentially provide for two different route alignments with associated substations contained within an assessment corridor of approximately 400m wide. These alternatives are as follows:

- ***Mooi Plaats Solar PV Grid Connection***
  - Corridor Option 1 is approximately 13kms in length, linking Substations 1 and 2 to Hydra D MTS.
  - Corridor Option 2 is approximately 27kms in length, linking Substations 1 and 2 to Hydra D MTS via the proposed Central Collector substation located on the Wonderheuvel PV project application site.

- ***Wonderheuvel Solar PV Grid Connection***
  - Corridor Option 1 involves two separate grid connections to serve the northern and southern sectors of the application site. The northern connection is approximately 18kms in length, linking the proposed on-site Substation 3 to Hydra D MTS via the Northern Collector substation. The southern connection is approximately 17kms in length, linking Substation 4 to the proposed Coleskop WEF substation via the Southern Collector substation located on the Paarde Valley PV project application site.
  - Corridor Option 2 is approximately 20kms in length, linking Substations 3 and 4 to Hydra D MTS via the proposed Central Collector substation located on the Wonderheuvel PV project application site.

- **Paarde Valley Solar PV Grid Connection**
  - Corridor Option 1 is approximately 14kms in length, linking Substation 6 to the proposed Coleskop WEF substation via the Southern Collector substation.
  - Corridor Option 2 is approximately 26kms in length, linking Substations 5 and 6 to Hydra D MTS via the proposed Central Collector substation located on the Wonderheuvel PV project application site.

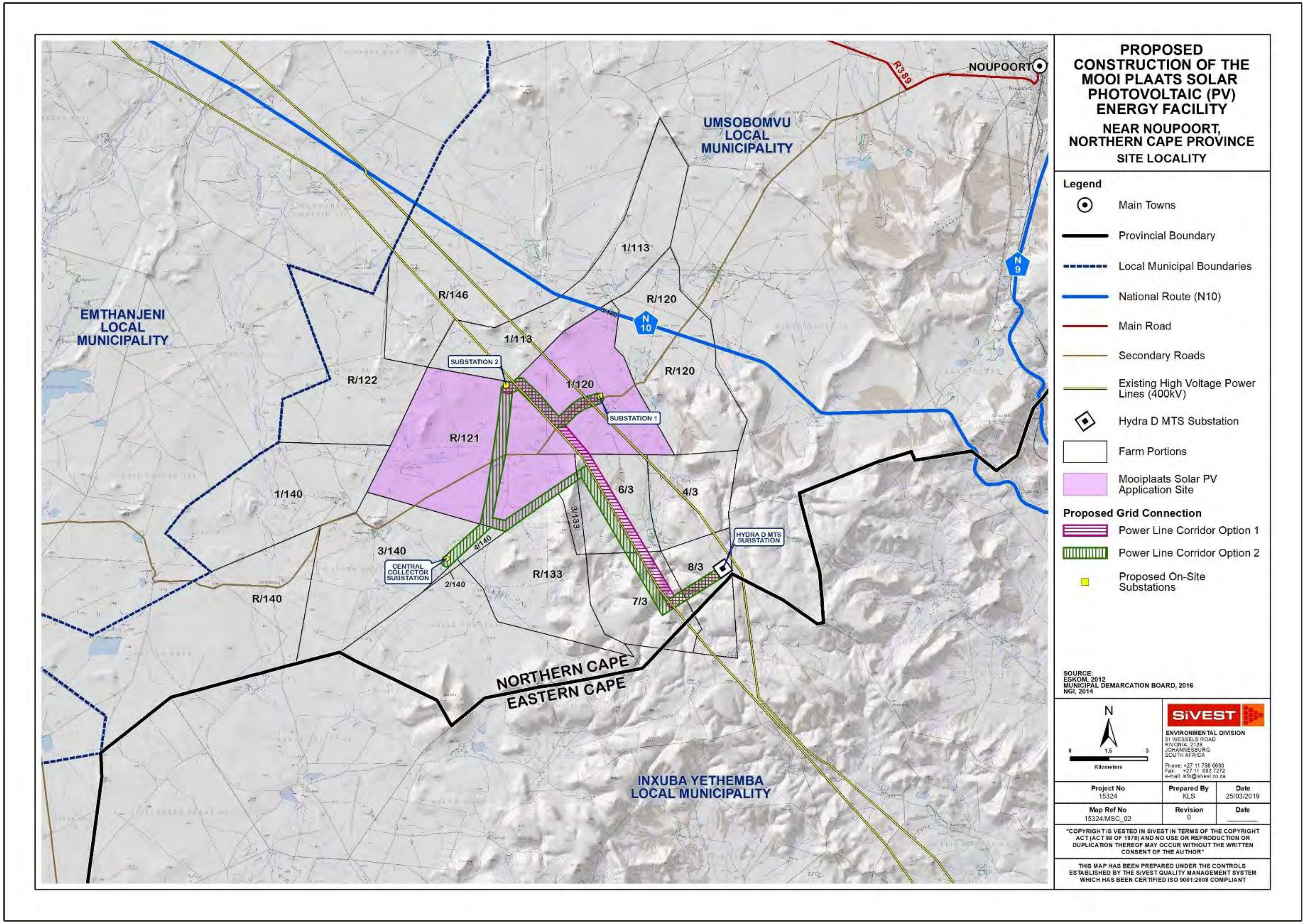

Figure 1: Mooi Plaats Solar PV Facility

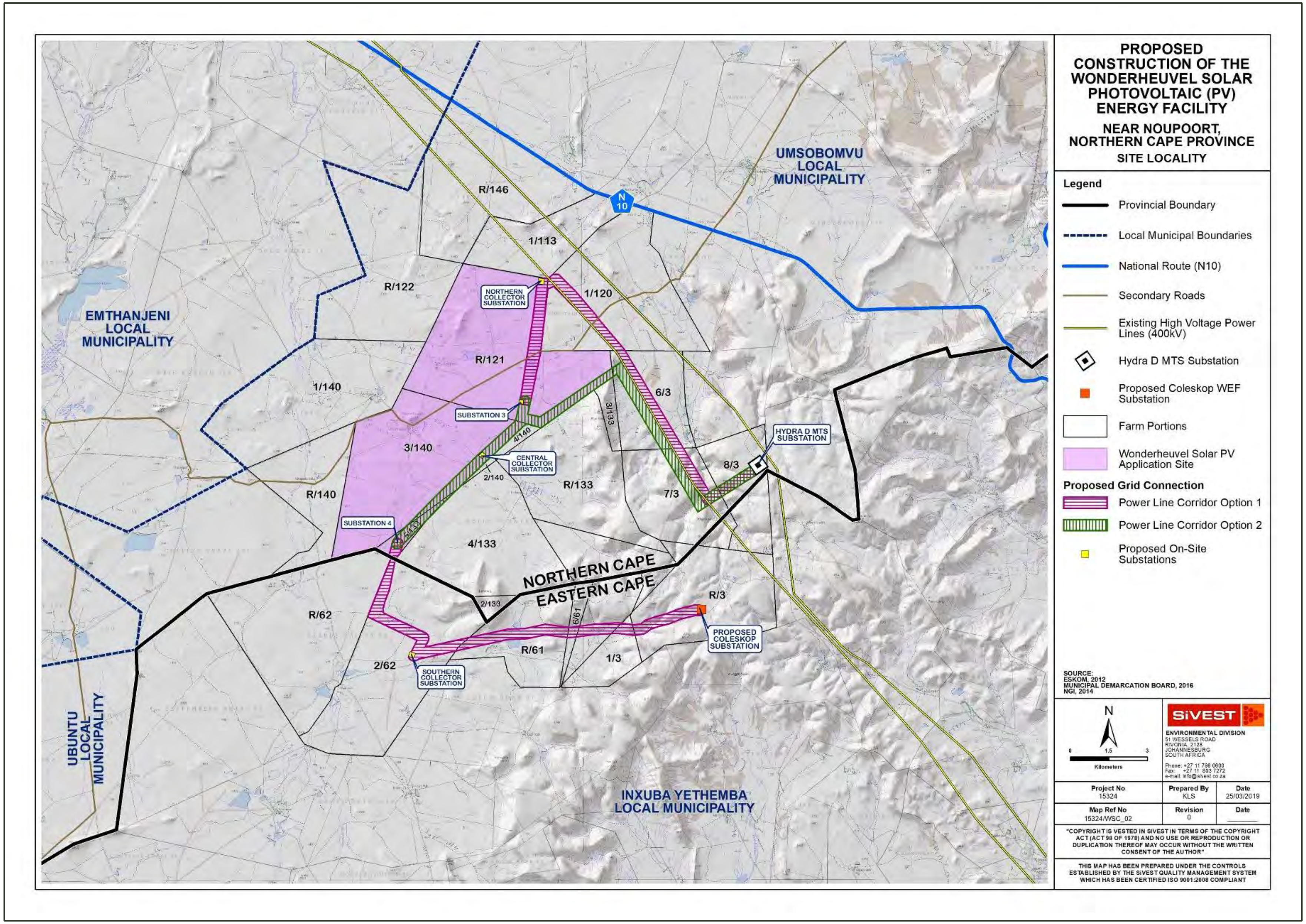

Figure 2: Wonderheuvel Solar PV Facility

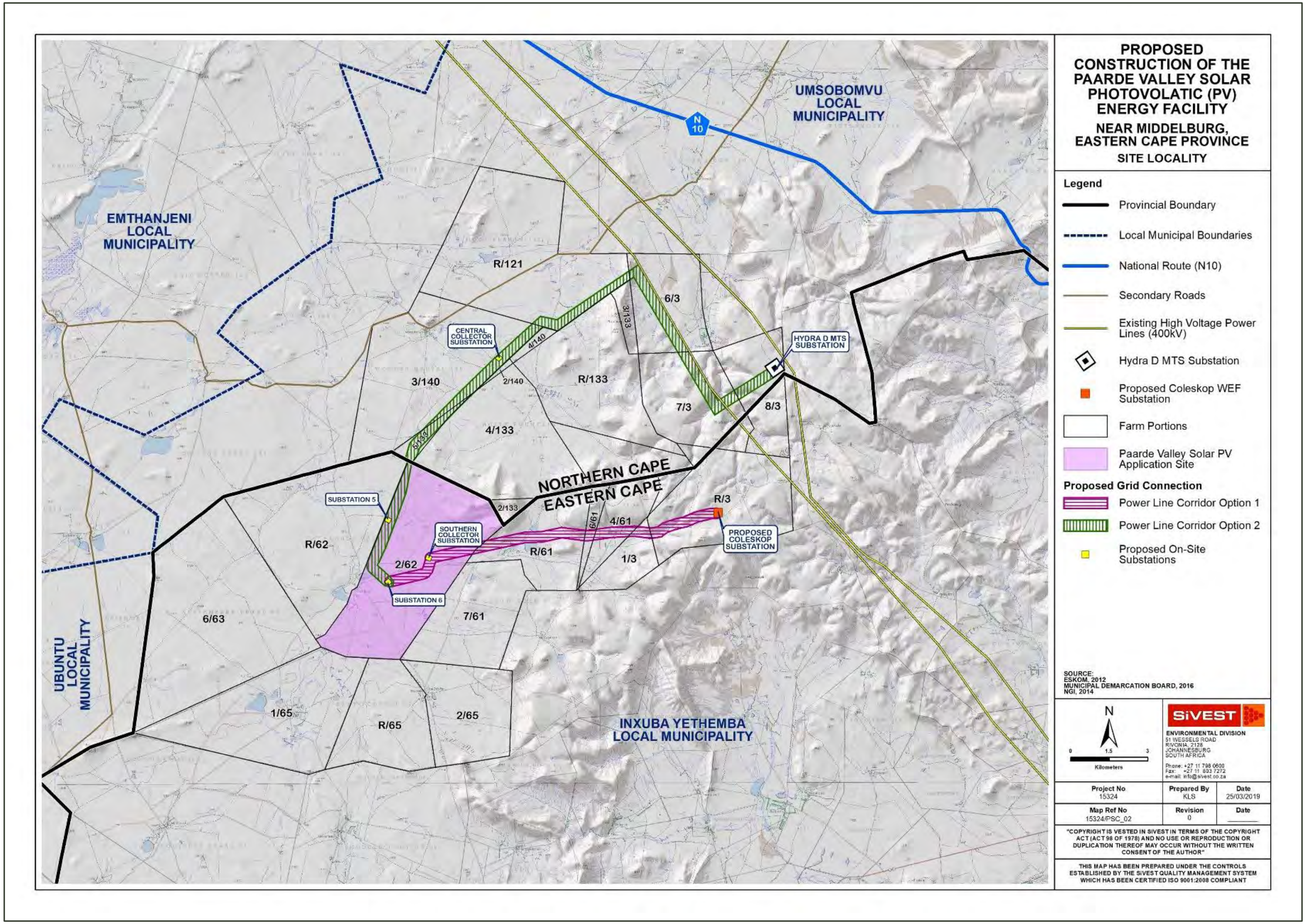

Figure 3: Paarde Valley Solar PV Energy Facility

2 PROJECT SCOPE

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 facilities and associated infrastructure;
- Assess the potential impacts;
- Recommend mitigation measures to reduce the impact of the expected impacts.

3 OUTLINE OF METHODOLOGY AND INFORMATION REVIEWED

The following information sources were consulted in order to conduct this study:

- Bird distribution data from the Southern African Bird Atlas Project 2 (SABAP 2) was obtained (http://sabap2.adu.org.za/), in order to ascertain which species occur in the pentads where the proposed development areas are 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 some of which intersect and others that are in the vicinity of the development, henceforth called the broader area. The SABAP2 data covers the period 2007 to 2019. The relevant pentads are 3115_2435, 3115_2440, 3110_2445, 3120_2435, 3120_2440, 3115_2445, 3125_2435, 3125_2440, 3125_2445.
- A classification of the vegetation types in the development 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 (2019.1) 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).
- 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 site and general area was conducted on 15 and 16 January 2019, followed up by on-site surveys from 17 - 19 January 2019. Another round of surveys is planned for May 2019. Surveys were conducted according to the best practice guidelines for avifaunal impact studies at solar developments, compiled by BirdLife South Africa (BLSA) in 2017 (Jenkins *et al*. 2017). Please see Appendix 1 for the methodology used in the surveys.

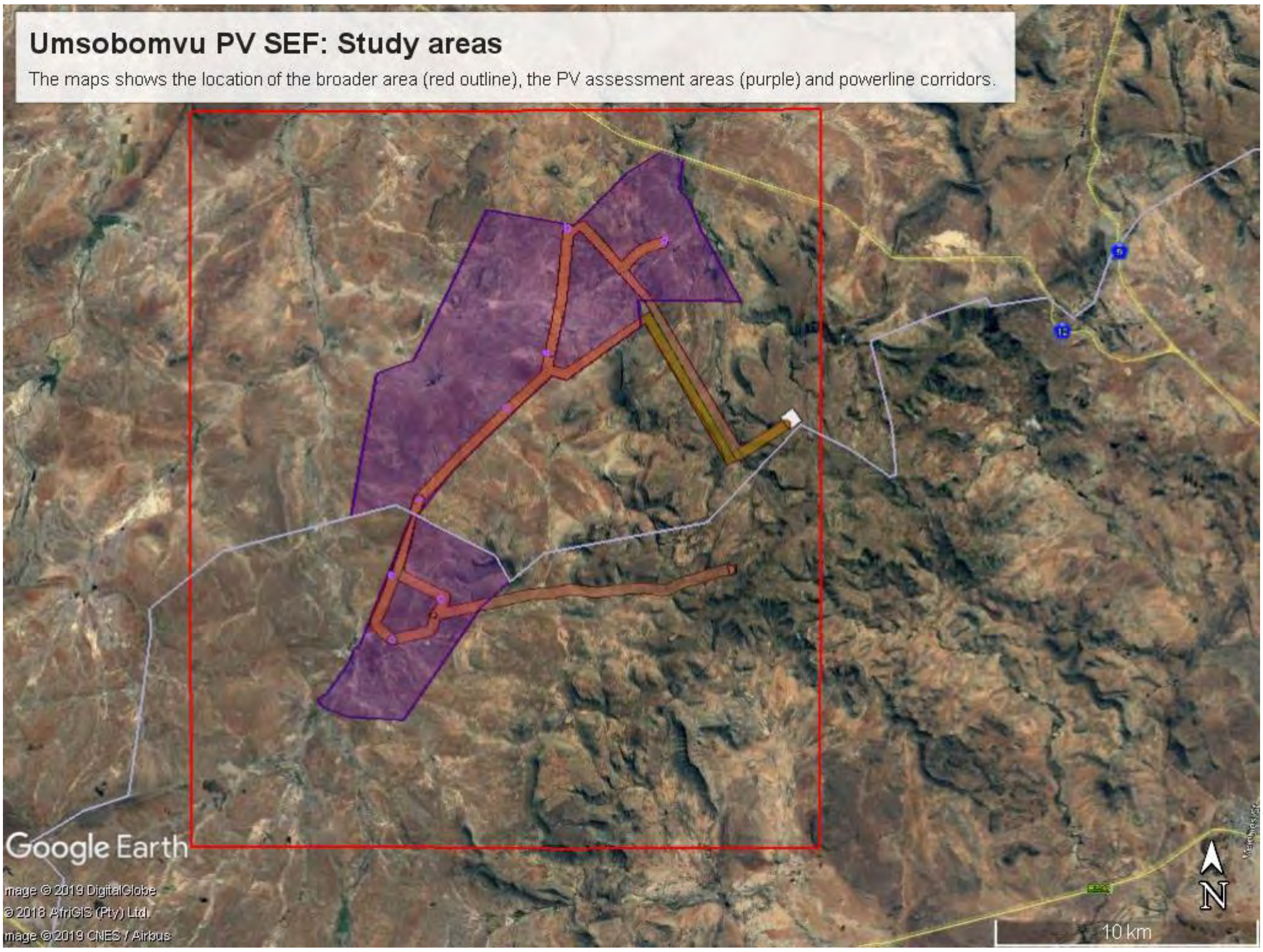

Figure 4: Area covered by the nine SABAP 2 pentads (red outline), the PV assessment areas (purple areas) and the powerline corridors.

4 ASSUMPTIONS AND LIMITATIONS

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

- A total of 40 SABAP2 full protocol lists has been completed to date for the broader area where the proposed project is located (i.e. bird listing surveys lasting a minimum of two hours each). In addition,12 ad hoc protocol lists (i.e. bird listing surveys lasting less than two hours but still giving useful data) and 684 incidental sightings were also recorded. The SABAP2 data was therefore regarded as a good indicator of the avifauna which could occur at the proposed development area, and it was further supplemented by data collected during the on-site surveys.
- The focus of the study is primarily on the potential impacts on priority solar and powerline species.
- Priority solar species were defined as follows:
    - South African Red Data species;
    - South African endemics and near-endemics;
    - Raptors
    - Waterbirds
- Priority powerline species were defined as those species which could potentially be impacted by powerline collisions or electrocutions, based on morphology and/or behaviour.

- The impact of solar installations on avifauna is a new field of study, with only one published scientific study on the impact of PV facilities on avifauna in South Africa (Visser *et al*. 2019). 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 area.
- Cumulative impacts include all proposed and existing renewable energy projects within a 35km radius around the proposed development areas[1].
- Conclusions in this study are based on experience of these and similar species in different parts of South Africa. Bird behaviour can never be entirely reduced to formulas that will be valid under all circumstances.
- The **broader area** is defined as the area encompassed by the 9 pentads where the project is located (see Figure 4). The **study area** is defined as the combined area of the Mooi Plaats, Wonderheuvel, and Paarde Valley PV assessment areas, and the powerline corridors (see Figure 4). The **PV development footprint** is defined as the combined area covered by the solar fields, internal roads, lay-down areas and O&M buildings.

5 LEGISLATIVE CONTEXT

There is no specific legislation pertaining specifically to the impact of solar facilities on avifauna. Guidelines for assessing and monitoring the impact of solar power generating facilities on birds in southern Africa (Jenkins *et al.* 2017), compiled by BirdLife South Africa, was followed in the compilation of this report.

5.1 AGREEMENTS AND CONVENTIONS

Table 1 below lists agreements and conventions which South Africa is party to and which is relevant to the conservation of avifauna (BirdLife International 2019).

Table 1: 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 African-Eurasian Migratory Waterbirds (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 The fair and equitable sharing of the benefits arising out of the utilization of genetic resources.	Global
Convention on the Conservation of Migratory	As an environmental treaty under the aegis of the United Nations Environment Programme, CMS provides a global platform for the conservation and sustainable	Global

[1] The list of projects was provided by SiVEST.

Species of Wild Animals, (CMS), Bonn, 1979	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.	
Convention on the International Trade in Endangered Species of Wild Flora and Fauna, (CITES), Washington DC, 1973	CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) is an international agreement between governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival.	Global
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

5.2 NATIONAL LEGISLATION

5.2.1 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.

5.2.2 The National Environmental Management Act 107 of 1998 (NEMA)

The National Environmental Management Act 107 of 1998 (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, which may significantly affect the environment, may be performed only after an environmental impact assessment has been done and authorization 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.

5.2.3 The National Environmental Management: Biodiversity Act 10 of 2004 (NEMBA) and the Threatened or Protected Species Regulations, February 2007 (TOPS Regulations)

The most prominent statute containing provisions directly aimed at the conservation of birds is the National Environmental Management: Biodiversity Act 10 of 2004 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. The State is endowed with the trusteeship of biodiversity and has the responsibility to manage, conserve and sustain the biodiversity of South Africa.

6 BASELINE ASSESSMENT

6.1 IMPORTANT BIRD AREAS

The Platberg-Karoo Conservancy Important Bird Area (IBA) SA037 is located approximately 3 - 4km north-west of the PV study area and proposed powerline corridors (see Figure 5). The Platberg–Karoo Conservancy IBA covers the entire districts of De Aar, Philipstown and Hanover, including suburban towns. The landscape consists of extensive flat to gently undulating plains that are broken by dolerite hills and flat-topped inselbergs. The ephemeral Brak River flows in an arc from south-east to north-west, eventually feeding into the Orange River basin. Other ephemeral rivers include the Hondeblaf, Seekoei, Elandsfontein and Ongers rivers with a network of tributaries. Vanderkloof Dam is on the north-eastern boundary (Marnewick *et al.* 2015).

This IBA is in the Nama Karoo and Grassland Biomes. The eastern Nama Karoo has the highest rainfall of all the Nama Karoo vegetation types and is thus ecotonal to grassland, with a complex mix of grass- and shrub-dominated vegetation types. Eight broad vegetation types are present; seven are Least Threatened and the Upper Gariep Alluvial Vegetation type is classified as Vulnerable (Marnewick *et al*. 2015).

The land is used primarily for grazing and agriculture. Commercial livestock farming is mostly extensive wool and mutton production, with some cattle and game farming. Less than 5% of this IBA is cultivated under dry-land or irrigated conditions, and includes lucerne and prickly pear *Opuntia ficus-indica* orchards (Marnewick *et al.* 2015).

This IBA contributes significantly to the conservation of large terrestrial birds and raptors. These include Blue Crane *Anthropoides paradiseus*, Ludwig's Bustard *Neotis ludwigii*, Kori Bustard *Ardeotis kori*, Blue Korhaan *Eupodotis caerulescens*, Black Stork *Ciconia nigra*, Secretarybird *Sagittarius serpentarius*, Martial Eagle *Polemaetus bellicosus*, Verreauxs' Eagle *Aquila verreauxii* and Tawny Eagle *A. rapax* (Marnewick *et al.* 2015).

In summer, close to 10% of the global population of Lesser Kestrels *Falco naumanni* roost in this IBA. Amur Falcons *F. amurensis* are also abundant and forage and roost with Lesser Kestrels. This IBA is seasonally important for White Stork *Ciconia ciconia*, with high numbers of this species recorded during outbreaks of brown locusts *Locustana pardalina* and armoured ground crickets *Acanthoplus discoidalis* (Marnewick *et al.* 2015).

IBA trigger species are the globally threatened Blue Crane, Ludwig's Bustard, Kori Bustard, Secretarybird, Martial Eagle, Blue Korhaan, Black Harrier *Circus maurus* and Denham's Bustard *Neotis denhami*. Regionally threatened species are Black Stork, Lanner Falcon *Falco biarmicus*, Tawny Eagle, Karoo Korhaan and Verreaux's' Eagle (Marnewick *et al*. 2015).

Biome-restricted species include Karoo Lark *Calendulauda albescens*, Karoo Long-billed Lark *Certhilauda subcoronata*, Karoo Chat *Cercomela schlegelii*, Tractrac Chat *C. tractrac*, Sickle-winged Chat *C. sinuata*, Namaqua Warbler *Phragmacia substriata*, Layard's Tit-Babbler *Sylvia layardi*, Pale-winged Starling *Onychognathus nabouroup* and Black-headed Canary *Serinus alario*. Congregatory species include Lesser Kestrel and Amur Falcon.

Due to the proximity of the IBA to the study area, it is possible that the proposed project could impact on some of the trigger species in the IBA. Far ranging birds that move in and out of the IBA could be impacted, namely powerline sensitive species such as Blue Crane, Ludwig's Bustard, Kori Bustard, Black Stork, Secretarybird, Martial Eagle, Verreaux's Eagle and Tawny Eagle, which could be at risk of electrocutions on and/or collisions with the proposed 132kV grid connection.

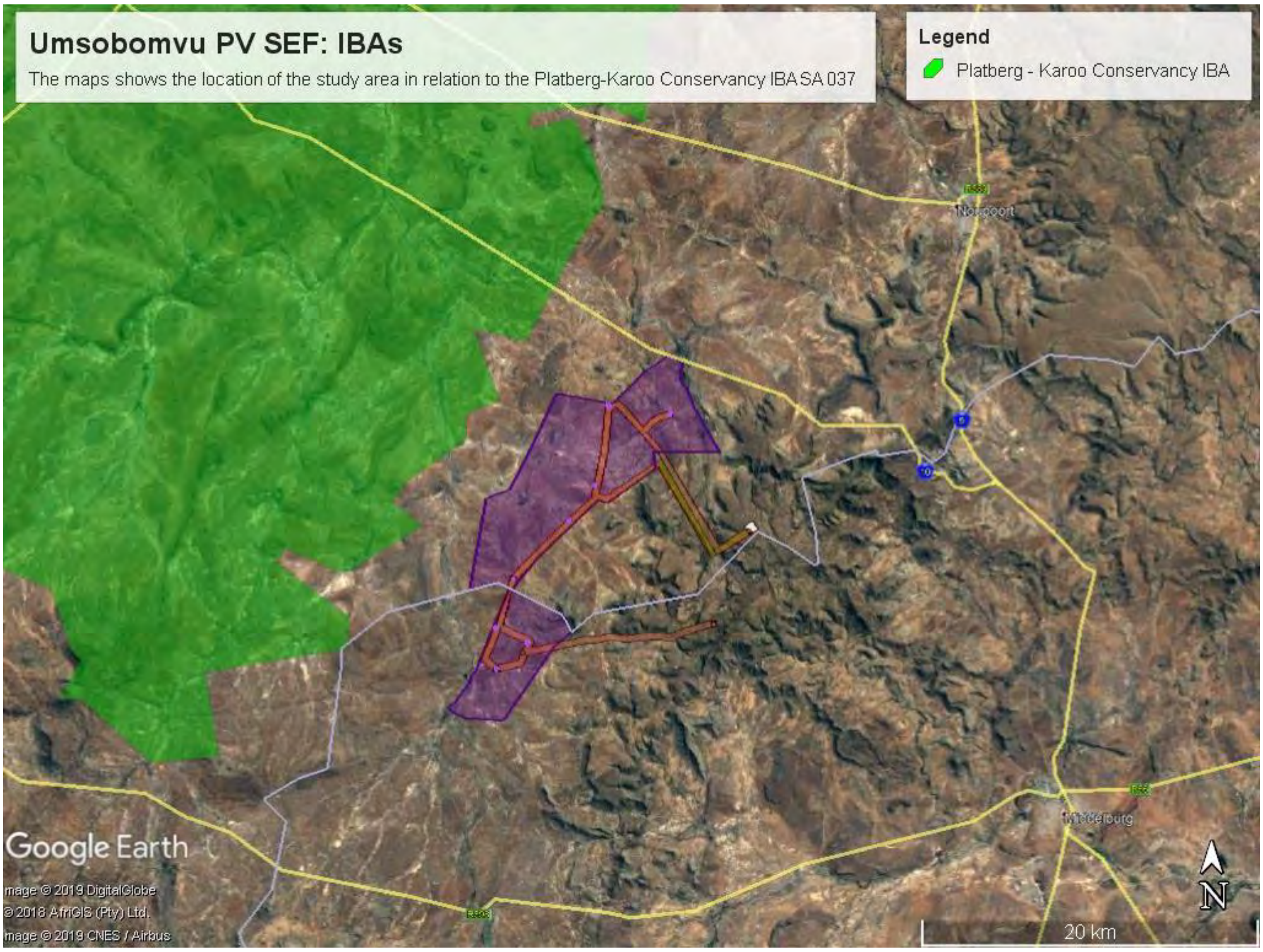

Figure 5: The location of the Platberg – Karoo Conservancy IBA relative to the study area.

6.2 HABITAT CLASSES

Vegetation structure, rather than the actual plant species, is more significant for bird species distribution and abundance (Harrison *et al.* 1997). The description of the vegetation types occurring in the study area largely follows the classification system presented in the Atlas of southern African birds (SABAP1) (Harrison *et al*. 1997). The criteria used to amalgamate botanically defined vegetation units, or to keep them separate were (1) the existence of clear differences in vegetation structure, likely to be relevant to birds, and (2) the results of published community studies on bird/vegetation associations. It is important to note that no new vegetation unit boundaries were created, with use being made only of previously published data. The description of vegetation presented in this study therefore concentrates on factors relevant to the bird species present and is not an exhaustive list of plant species present.

Whilst the distribution and abundance of the priority bird species in the study area are closely tied to natural features e.g. vegetation structure and topography/relief, it is also necessary to examine external modifications to the environment that might have relevance for priority species. Anthropogenic avifaunal-relevant habitat modifications which could potentially influence the avifaunal community that were recorded in or close to the study area are dams and water reservoirs, high voltage transmission lines, agriculture, fences and alien trees. The habitat classes are discussed in more detail below.

The solar and powerline priority species associated with each habitat class are listed in Tables 2 and 3.

6.2.1 Grassy Karoo

The study area lies at the intersection between Nama Karoo and Grassland biomes (Mucina & Rutherford 2006), described by Harrison et al. (1997) as Grassy Karoo. The dominant vegetation type in the study area is Eastern Upper Karoo, which occurs on the plains where all of the PV assessment areas are located, and is dominated by dwarf microphyllous shrubs, with 'white' grasses of the genera Aristida and Eragrostis (these become prominent especially in the early autumn months after good summer rains). Rainfall occurs mainly in autumn and summer, peaking in March. The mean annual precipitation ranges from about 180 mm to 430 mm. Incidence of frost is relatively high. Mean maximum and minimum monthly temperatures in Middelburg (Grootfontein) are 36.1°C and –7.2°C for January and July, respectively (Mucina & Rutherford, 2006). Small sections of some of the proposed powerline corridors are located in Besemkaree Koppies Shrubland, which occurs on slopes of koppies, butts and tafelbergs covered by two-layered karroid shrubland. The lower (closed-canopy) layer is dominated by dwarf small-leaved shrubs and, especially in precipitation-rich years, also by abundant grasses, while the upper (loose canopy) layer is dominated by tall shrubs (Mucina & Rutherford, 2006).

Figure 6: An example of Eastern Upper Karoo (Grassy Karoo) occurring on the plains where the proposed PV areas are located.

Figure 7: An example of Besemkaree Koppies Shrubland which occurs on the slopes.

6.2.2 Surface water

Surface water is of specific importance to avifauna in this semi-arid environment. The study area contains many boreholes with open water troughs that provide drinking water to livestock. Open water troughs are important sources of surface water and could potentially be used extensively by various bird species, including large raptors, to drink and bath. There are also a number of dams and natural waterbodies in the study area, which are located in drainage lines (see Figure 8). The dams and waterbodies were mostly dry when the surveys were conducted, but it could hold water after good rains, when it could be attractive to various bird species, including large raptors, to drink and bath. It could also serve as an attraction to waterbirds when it contains water.

Figure 8: A dam in the study area

6.2.3 Cliffs

The south-eastern part of the broader area contains several cliffs which is utilised by a number of cliff-nesting raptors for breeding, including Booted Eagle, Verreaux's Eagle (see Figure 9) and possibly Jackal Buzzard. Figure 10 below shows the location of known nests in the study area.

Figure 9: A Verreaux's Eagle nest on a cliff in the study area

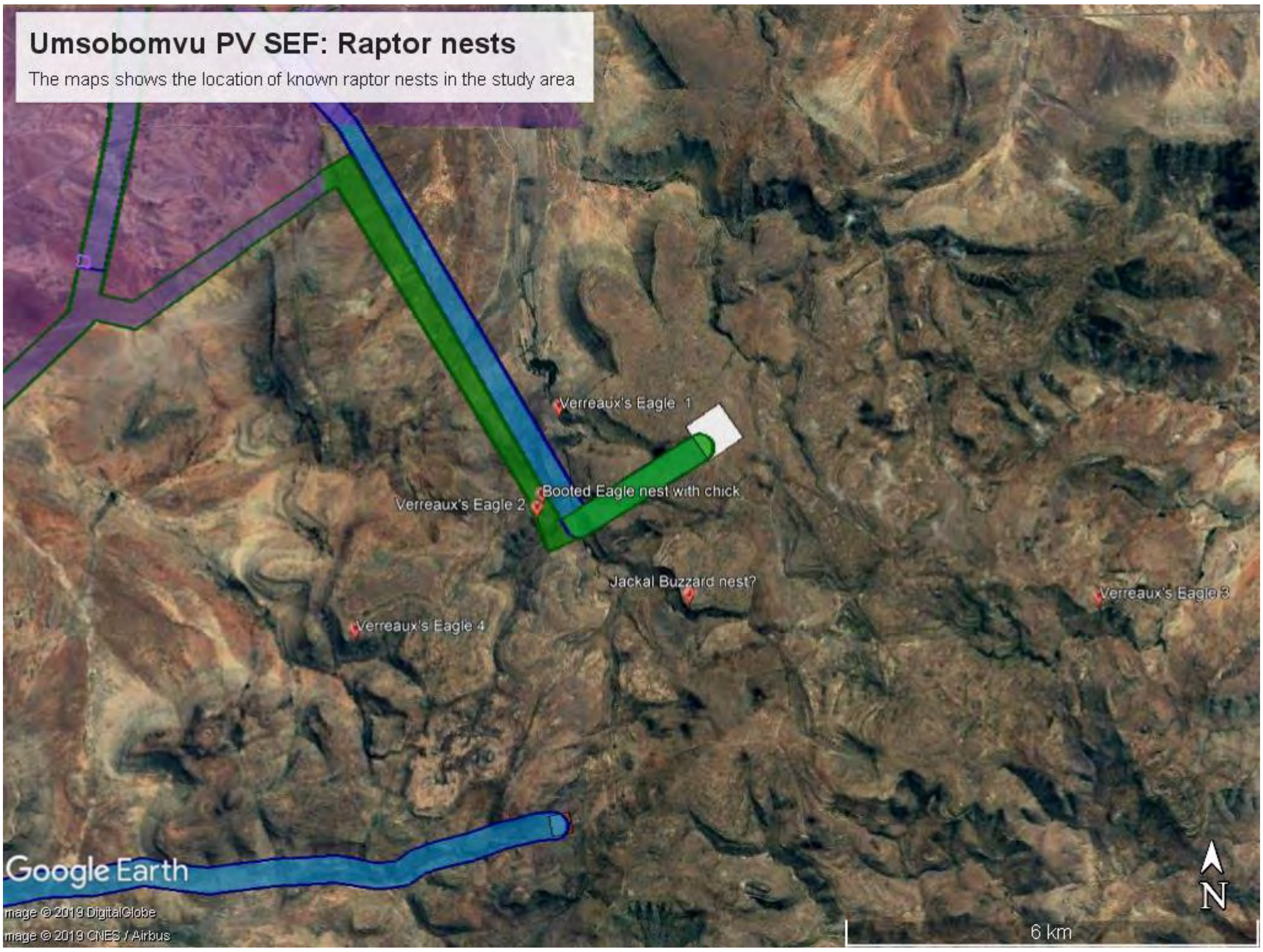

Figure 10: The location of raptor nests in the study area.

6.2.4 High voltage lines

High voltage lines are an important roosting and breeding substrate for large raptors in the tree-less Karoo habitat (Jenkins *et al.* 2006). There are two 400kV transmission lines running through the study area, namely the Hydra-Poseidon 400kV 1 and 2 (see Figure 11 below). So far, no large raptor nests were recorded during the first surveys, but the inspection will be repeated in the next survey in May 2019.

Figure 11: The Hydra-Poseidon 400kV 1 high voltage line running through the site.

6.2.5 Fences

The study area is fenced off into grazing camps (see Figure 12). Farm fences provide important perching substrate for a wide range of birds in this treeless environment where natural perches are scarce, as a staging post for territorial displays by small birds and also for perch hunting for raptors such as Greater Kestrel, Rock Kestrel, Black-winged Kite and Southern pale Chanting Goshawk.

Figure 12: The study area contains many fences.

6.2.6 Agriculture

The study area contains a number of agricultural clearings and irrigated pivots (see Figure 13). These areas may attract several solar and powerline priority species, including Ludwig's Bustard, Blue Crane, Spurwing Goose, Egyptian Goose, Helmeted Guineafowl, White Stork and Blue Korhaan.

Figure 13: Irrigated fields in the study area.

6.2.7 Alien trees

Large indigenous trees are rare in the Karoo, therefore alien trees of the genus *Pinus*, *Populus* and *Eucalyptus* have been introduced in many areas, often around homesteads, but also at boreholes (see Figure 14). In some places, these alien species have become an invasive threat in drainage lines. Many solar and powerline priority species use alien trees for nesting and roosting.

Figure 14: Alien trees in the study area

6.3 AVIFAUNA

6.3.1 Southern African Bird Atlas 2

The SABAP2 data indicate that a total of 185 bird species could potentially occur in the broader area – Appendix 2 provides a comprehensive list of all the species, including those recorded during the pre-construction monitoring. Of these, 78 species are classified as priority solar species, and 50 as powerline priority species (see Section 4 for the definition of a priority species). The probability of a priority species occurring in the study area is indicated in Tables 2 and 3.

Table 2 below lists all the solar priority species and the possible impact on the respective species by the proposed solar energy infrastructure. Table 3 does the same for powerline sensitive species and powerline infrastructure. The following abbreviations and acronyms are used:

- EN = Endangered
- VU = Vulnerable
- NT = Near-threatened

6.3.2 Pre-construction surveys

A visit to the study area was conducted on 15 and 16 January 2019, followed up by on-site surveys from 17 - 19 January 2019. Another round of surveys is planned for May 2019. Surveys were conducted according to the best practice guidelines for avifaunal impact studies at solar developments, compiled by BirdLife South Africa (BLSA) in 2017 (Jenkins *et al.* 2017). Please see Appendix 1 for the methodology used in the surveys.

6.3.2.1 Priority species abundance

The abundance of solar priority species (birds/km) recorded during the first of two seasonal surveys are displayed in Figure 15 below.

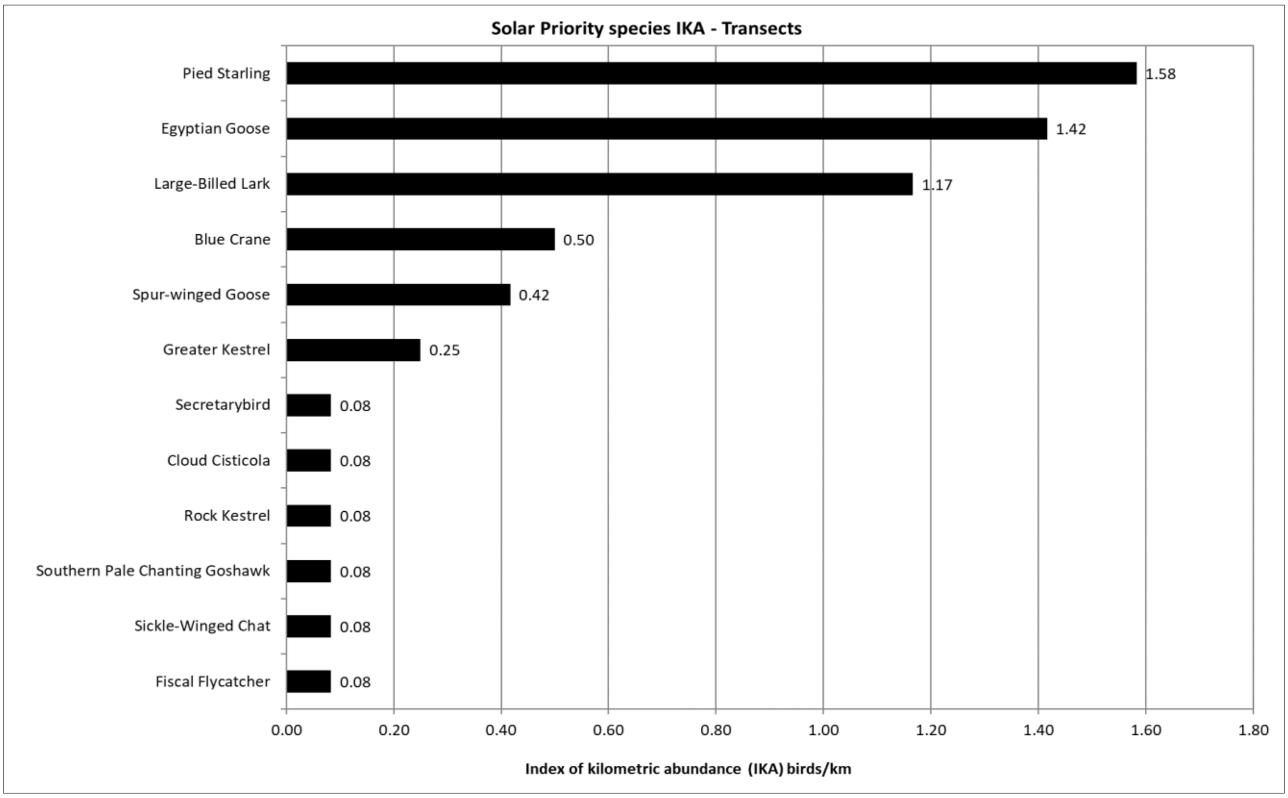

Figure 15: The abundance of solar priority species recorded during the first round of surveys

Table 2: Solar priority species potentially occurring at the site, conservation status, priority criteria, SABAP reporting rates, probability of occurrence, habitat use and potential impacts.

Species	Taxonomic name	Solar priority species	SABAP2 Average reporting rate: full protocol	Red Data status: International	Red Data status: Regional	Endemic - South Africa	Endemic - Southern Africa	Possibility of occurrence	Recorded during surveys	Grassy Karoo	Surface water	Alien trees	Cliffs	Powerlines	Agriculture	Fences	PV panel collisions	Displacement - disturbance	Displacement - habitat loss	Entrapment in fences
Avocet, Pied	*Recurvirostra avosetta*	*x*	15.48					Low			x						x			
Bustard, Ludwig's	*Neotis ludwigii*	*x*	25.67	EN	EN		Near-endemic	High	x	x					x			x	x	x
Buzzard, Jackal	*Buteo rufofuscus*	*x*	22.22			Near endemic	Endemic	High	x	x	x	x	x	x	x	x	x	x		
Canary, Black-headed	*Serinus alario*	*x*	14.56			Near endemic	Endemic	Low		x	x					x	x	x		
Chat, Sickle-winged	*Cercomela sinuata*	*x*	48.81			Near endemic	Endemic	High	x	x						x	x	x		
Cisticola, Cloud	*Cisticola textrix*	*x*	0.00			Near endemic	Near-endemic	High	x	x							x	x		
Coot, Red-knobbed	*Fulica cristata*	*x*	14.41					Low			x						x			
Cormorant, Reed	*Phalacrocorax africanus*	*x*	13.49					Low			x						x			
Crane, Blue	*Anthropoides paradiseus*	*x*	73.41	VU	NT		Endemic	High	x	x	x				x			x	x	x
Duck, African Black	*Anas sparsa*	*x*	8.33					Low			x						x			
Duck, Maccoa	*Oxyura maccoa*	*x*	1.59	NT	NT			Low			x						x			
Duck, White-faced	*Dendrocygna viduata*	*x*	2.78					Low			x						x			
Duck, Yellow-billed	*Anas undulata*	*x*	50.92					Low			x						x			
Eagle, Martial	*Polemaetus bellicosus*	*x*	7.14	VU	EN			Medium		x	x	x		x	x			x	x	
Eagle, Verreaux's	*Aquila verreauxii*	*x*	18.26	LC	VU			High	x	x		x	x	x						
Eagle-owl, Spotted	*Bubo africanus*	*x*	12.43					High		x		x	x		x	x	x	x		
Egret, Cattle	*Bubulcus ibis*	*x*	4.63					Low		x		x			x			x		
Egret, Great	*Egretta alba*	*x*	0.00					Low			x						x			
Falcon, Lanner	*Falco biarmicus*	*x*	2.78	LC	VU			Medium		x	x	x	x	x	x	x	x	x		
Falcon, Peregrine	*Falco peregrinus*	*x*	1.59					Low			x	x	x	x			x			
Fish-eagle, African	*Haliaeetus vocifer*	*x*	3.18					Low			x	x					x			

Species	Taxonomic name	Solar priority species	SABAP2 Average reporting rate: full protocol	Red Data status: International	Red Data status: Regional	Endemic - South Africa	Endemic - Southern Africa	Possibility of occurrence	Recorded during surveys	Grassy Karoo	Surface water	Alien trees	Cliffs	Powerlines	Agriculture	Fences	PV panel collisions	Displacement - disturbance	Displacement - habitat loss	Entrapment in fences
Flamingo, Greater	*Phoenicopterus ruber*	x	3.18	LC	NT			Low			x						x			
Flycatcher, Fiscal	*Sigelus silens*	x	34.40			Near endemic	Endemic	High	x	x		x				x	x	x		
Goose, Spur-winged	*Plectropterus gambensis*	x	34.79					High	x		x			x	x		x			
Goshawk, Southern Pale Chanting	*Melierax canorus*	x	34.66				Near-endemic	High	x	x	x	x		x		x	x	x		
Grebe, Black-necked	*Podiceps nigricollis*	x	0.00					Low			x						x			
Grebe, Great Crested	*Podiceps cristatus*	x	1.59					Low			x						x			
Grebe, Little	*Tachybaptus ruficollis*	x	9.12					Low			x						x			
Greenshank, Common	*Tringa nebularia*	x	12.70					Low			x						x			
Hamerkop	*Scopus umbretta*	x	1.86					Low			x						x			
Harrier, Black	*Circus maurus*	x	2.78	VU	EN	Near endemic	Endemic	Low		x	x					x	x			
Harrier-Hawk, African	*Polyboroides typus*	x	1.59					Low		x	x	x	x							
Heron, Black-headed	*Ardea melanocephala*	x	17.33					Medium		x	x	x		x	x			x		
Heron, Grey	*Ardea cinerea*	x	23.93					Low			x	x					x			
Ibis, African Sacred	*Threskiornis aethiopicus*	x	20.23					Low			x	x			x		x			
Kestrel, Greater	*Falco rupicoloides*	x	21.30					High	x	x		x		x		x		x		
Kestrel, Lesser	*Falco naumanni*	x	20.37					Medium		x				x	x			x		
Kestrel, Rock	*Falco rupicolus*	x	27.41					High	x	x		x	x	x	x	x		x		
Kingfisher, Malachite	*Alcedo cristata*	x	2.78					Low			x						x			
Kingfisher, Pied	*Ceryle rudis*	x	2.78					Low			x						x			
Kite, Black-shouldered	*Elanus caeruleus*	x	15.44					High	x	x		x		x	x					
Korhaan, Blue	*Eupodotis caerulescens*	x	56.34	NT	LC	Endemic (SA, Lesotho, Swaziland)	Endemic	High	x	x					x			x		x
Korhaan, Karoo	*Eupodotis vigorsii*	x	13.10	LC	NT		Endemic	High	x	x								x		x

Species	Taxonomic name	Solar priority species	SABAP2 Average reporting rate: full protocol	Red Data status: International	Red Data status: Regional	Endemic - South Africa	Endemic - Southern Africa	Possibility of occurrence	Recorded during surveys	Grassy Karoo	Surface water	Alien trees	Cliffs	Powerlines	Agriculture	Fences	PV panel c ollisions	Displacement - disturbance	Displacement - habitat loss	Entrapment in fences
Lapwing, Blacksmith	*Vanellus armatus*	*x*	49.33					Low			x				x		x	x		
Lark, Large-billed	*Galerida magnirostris*	*x*	75.27			Near endemic	Endemic	High	x	x						x		x		
Moorhen, Common	*Gallinula chloropus*	*x*	17.07					Low			x						x			
Night-Heron, Black-crowned	*Nycticorax nycticorax*	*x*	0.00					Low			x						x			
Owl, Barn	*Tyto alba*	*x*	7.41					Medium		x		x			x	x	x	x		
Pipit, African Rock	*Anthus crenatus*	*x*	11.11	LC	NT	Endemic (SA, Lesotho, Swaziland)	Endemic	Low					x							
Plover, Kittlitz's	*Charadrius pecuarius*	*x*	28.70					Low			x						x			
Plover, Three-banded	*Charadrius tricollaris*	*x*	57.68					Low			x						x			
Pochard, Southern	*Netta erythrophthalma*	*x*	1.59					Low			x						x			
Prinia, Karoo	*Prinia maculosa*	*x*	76.19			Near endemic	Endemic	Medium		x							x	x		
Ruff	*Philomachus pugnax*	*x*	3.18					Low			x						x			
Sandpiper, Wood	*Tringa glareola*	*x*	3.18					Low			x						x			
Secretarybird	*Sagittarius serpentarius*	*x*	19.44	VU	VU			High	x	x								x	x	x
Shelduck, South African	*Tadorna cana*	*x*	51.86				Endemic	Medium			x						x			
Shoveler, Cape	*Anas smithii*	*x*	7.14				Near-endemic	Low			x						x			
Snake-eagle, Black-chested	*Circaetus pectoralis*	*x*	1.86					High	x	x	x	x		x	x			x	x	
Snipe, African	*Gallinago nigripennis*	*x*	1.59					Low			x						x			
Sparrowhawk, Black	*Accipiter melanoleucus*	*x*	0.00					Low			x	x								
Sparrowhawk, Rufous-chested	*Accipiter rufiventris*	*x*	2.78					Low			x	x								
Sparrowlark, Black-eared	*Eremopterix australis*	*x*	2.78			Near endemic	Endemic	Low		x	x						x	x	x	
Spoonbill, African	*Platalea alba*	*x*	5.96					Low			x						x			

Species	Taxonomic name	Solar priority species	SABAP2 Average reporting rate: full protocol	Red Data status: International	Red Data status: Regional	Endemic - South Africa	Endemic - Southern Africa	Possibility of occurrence	Recorded during surveys	Grassy Karoo	Surface water	Alien trees	Cliffs	Powerlines	Agriculture	Fences	PV panel c ollisions	Displacement - disturbance	Displacement - habitat loss	Entrapment in fences
Starling, Pied	*Spreo bicolor*	*x*	*94.44*	94.44		Endemic (SA, Lesotho, Swaziland)	Endemic	High	x	x	x	x			x	x	x	x		
Stilt, Black-winged	*Himantopus himantopus*	*x*	23.01					Low			x						x			
Stint, Little	*Calidris minuta*	*x*	9.12					Low			x						x			
Stork, Black	*Ciconia nigra*	*x*	0.00	LC	VU			Low			x		x							
Stork, White	*Ciconia ciconia*	*x*	0.00					Medium		x	x				x			x	x	
Sunbird, Southern Double-collared	*Cinnyris chalybeus*	*x*	5.56			Near endemic	Endemic	Low		x							x	x		
Teal, Cape	*Anas capensis*	*x*	8.73					Low			x						x			
Teal, Red-billed	*Anas erythrorhyncha*	*x*	13.37					Low			x						x			
Thrush, Karoo	*Turdus smithi*	*x*	34.12			Near endemic	Endemic	Low				x								
Tit, Grey	*Parus afer*	*x*	10.19			Near endemic	Endemic	Low		x							x	x	x	
Vulture, Cape	*Gyps coprotheres*	*x*	2.78	EN	EN		Near-endemic	Low		x				x						
Weaver, Cape	*Ploceus capensis*	*x*	7.14			Near endemic	Endemic	Low				x								
White-eye, Cape	*Zosterops virens*	*x*	25.40			Near endemic	Endemic	Low				x								
Woodpecker, Ground	*Geocolaptes olivaceus*	*x*	1.86			Endemic (SA, Lesotho, Swaziland)	Endemic	Low					x							

Table 3: Powerline priority species potentially occurring at the site, conservation status, priority criteria, SABAP reporting rates, probability of occurrence, habitat use and potential impacts.

Species	Taxonomic name	SABAP2 Average reporting rate: full protocol	Red Data status: International	Red Data status: Regional	Endemic - South Africa	Endemic - Southern Africa	Possibility of occurrence	Recorded during surveys	Grassy Karoo	Surface water	Alien trees	Cliffs	Powerlines	Agriculture	Fences	Collisions	Displacement - disturbance	Displacement - habitat loss	Electrocution (substations)
Bustard, Ludwig's	*Neotis ludwigii*	25.67	EN	EN		Near-endemic	High	x	X					x		x	x		
Buzzard, Jackal	*Buteo rufofuscus*	22.22			Near endemic	Endemic	High	x	X	x	x	x	x	x	x	x	x		
Buzzard, Steppe	*Buteo vulpinus*	10.59					Medium		X	x	x		x	x	x	x	x		
Coot, Red-knobbed	*Fulica cristata*	14.41					Low			x						x			
Cormorant, Reed	*Phalacrocorax africanus*	13.49					Low			x						x			
Crane, Blue	*Anthropoides paradiseus*	73.41	VU	NT		Endemic	Low	x	X	x				x		x	x		
Crow, Pied	*Corvus albus*	88.89					High	x	x		x		x	x	x				x
Duck, African Black	*Anas sparsa*	8.33					Low			x						x			
Duck, Maccoa	*Oxyura maccoa*	1.59	NT	NT			Low			x						x			
Duck, White-faced	*Dendrocygna viduata*	2.78					Low			x						x			
Duck, Yellow-billed	*Anas undulata*	50.92					Low			x						x			
Eagle, Booted	*Aquila pennatus*	16.67					High	x	x	x	x	x	x			x	x		
Eagle, Martial	*Polemaetus bellicosus*	7.14	VU	EN			Medium		x	x	x		x	x		x	x		
Eagle, Verreaux's	*Aquila verreauxii*	18.26	LC	VU			High	x		x	x	x	x			x	x		
Eagle-owl, Spotted	*Bubo africanus*	12.43					High	x	x		x	x		x	x	x	x		
Egret, Great	*Egretta alba*	0.00					Low			x						x			
Falcon, Lanner	*Falco biarmicus*	2.78	LC	VU			Low		x	x	x	x	x	x	x	x	x		x
Falcon, Peregrine	*Falco peregrinus*	1.59					Low				x	x	x			x			
Fish-eagle, African	*Haliaeetus vocifer*	3.18					Low			x						x			
Flamingo, Greater	*Phoenicopterus ruber*	3.18	LC	NT			Low			x						x			
Goose, Egyptian	*Alopochen aegyptiacus*	77.78					High	x		x			x	x		x			x

Species	Taxonomic name	SABAP2 Average reporting rate: full protocol	Red Data status: International	Red Data status: Regional	Endemic - South Africa	Endemic - Southern Africa	Possibility of occurrence	Recorded during surveys	Grassy Karoo	Surface water	Alien trees	Cliffs	Powerlines	Agriculture	Fences	Collisions	Displacement - disturbance	Displacement - habitat loss	Electrocution (substations)
Goose, Spur-winged	*Plectropterus gambensis*	34.79					High	x		x				x		x			
Goshawk, Southern Pale Chanting	*Melierax canorus*	34.66				Near-endemic	High	x	x	x	x		x	x	x	x	x		x
Grebe, Black-necked	*Podiceps nigricollis*	0.00					Low			x						x			
Grebe, Great Crested	*Podiceps cristatus*	1.59					Low			x						x			
Guineafowl, Helmeted	*Numida meleagris*	63.22					Low	x	x		x		x	x	x	x			x
Hamerkop	*Scopus umbretta*	1.86					Low			x	x	x				x			
Harrier, Black	*Circus maurus*	2.78	VU	EN	Near endemic	Endemic	Low		x	x					x	x			
Harrier-Hawk, African	*Polyboroides typus*	1.59					Low		x	x	x	x			x	x			x
Heron, Black-headed	*Ardea melanocephala*	17.33					Medium		x	x	x		x	x		x			
Heron, Grey	*Ardea cinerea*	23.93					Low			x						x			
Ibis, African Sacred	*Threskiornis aethiopicus*	20.23					Low			x						x			
Ibis, Hadeda	*Bostrychia hagedash*	51.46					Medium				x			x		x			x
Korhaan, Blue	*Eupodotis caerulescens*	56.34	NT	LC	Endemic (SA, Lesotho, Swaziland)	Endemic	High	x	x							x			
Korhaan, Karoo	*Eupodotis vigorsii*	13.10	LC	NT		Endemic	High	x	x							x			
Korhaan, Northern Black	*Afrotis afraoides*	74.21				Endemic	High	x	x							x			
Night-Heron, Black-crowned	*Nycticorax nycticorax*	0.00					Low			x									
Pochard, Southern	*Netta erythrophthalma*	1.59					Low			x						x			
Raven, White-necked	*Corvus albicollis*	19.18					Medium					x				x			x
Sandgrouse, Namaqua	*Pterocles namaqua*	34.52				Near-endemic	High	x	x	x				x		x			
Secretarybird	*Sagittarius serpentarius*	19.44	VU	VU			High	x	x	x						x			
Shelduck, South African	*Tadorna cana*	51.86				Endemic	Medium			x						x			

Species	Taxonomic name	SABAP2 Average reporting rate: full protocol	Red Data status: International	Red Data status: Regional	Endemic - South Africa	Endemic - Southern Africa	Possibility of occurrence	Recorded during surveys	Grassy Karoo	Surface water	Alien trees	Cliffs	Powerlines	Agriculture	Fences	Collisions	Displacement - disturbance	Displacement - habitat loss	Electrocution (substations)
Shoveler, Cape	*Anas smithii*	7.14				Near-endemic	Low			x						x			
Snake-eagle, Black-chested	*Circaetus pectoralis*	1.86					High	x	x				x	x		x			
Spoonbill, African	*Platalea alba*	5.96					Low			x						x			
Stork, Black	*Ciconia nigra*	0.00	LC	VU			Low			x		x				x			
Stork, White	*Ciconia ciconia*	0.00					Medium		x	x				x		x			
Teal, Cape	*Anas capensis*	8.73					Low			x						x			
Teal, Red-billed	*Anas erythrorhyncha*	13.37					Low			x						x			
Vulture, Cape	*Gyps coprotheres*	2.78	EN	EN		Near-endemic	Low		x							x			x (powerline)

6.3.2.2 Discussion

The overall abundance of solar priority species at the site was fairly high, with an average of 5.83 birds/km being recorded in summer. For all birds combined, the IKA for summer was 10.97 birds/km. This indicates that the impact of human activities on the natural habitat has been limited.

6.4 IMPACTS OF SOLAR PV FACILITIES AND ASSOCIATED INFRASTRUCTURE ON AVIFAUNA

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 published scientific study has been completed on the impacts of PV plants in a South African context (Visser *et al.* 2019).

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.

6.4.1 Impacts associated with PV plants

6.4.1.1 Impact trauma (collisions)

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)[2]. 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). However, 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

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[2] This could either result in birds colliding directly with the solar panels or getting stranded and unable to take off again because many aquatic bird species find it very difficult and sometimes impossible to take off from dry land e.g. grebes and cormorants. This exposes them to predation, even if they do not get injured through direct collisions with the panels.

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 (28°17′53″S, 23°21′56″E) 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 *et al*. 2019). 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. Extrapolated bird mortality within the solar field at the Jasper PV facility was 435 birds/yr (95% CI 133 - 805). The broad confidence intervals result from the small number of birds detected. The mortality estimate is likely conservative because detection probabilities were based on intact birds, and probably decrease for older carcasses and 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 *et al*. 2019).

The results of the available literature lack compelling evidence of collisions as a cause of large-scale mortality among birds at PV facilities. 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.

6.4.1.2 Entrapment in perimeter fences

Visser *et al* (2019) 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 *et al.* 2019). 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.

6.4.1.3 Displacement due to disturbance and habitat transformation associated with the construction of the solar PV facility

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 have the ability – individually and together – to alter habitat quality, often to the detriment of wildlife, including avifauna. Any disturbance and alteration to the desert 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 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).

The activities listed below are typically associated with the construction and operation of solar facilities and could have direct impacts on avifauna (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;
- Soil compaction, dust, and water runoff from construction sites;
- Increased vehicle traffic;
- Short-term construction-related noise (from equipment) and visual disturbance;
- Degradation of water quality in drainages and other water bodies resulting from project runoff;
- Maintenance of fire breaks and roads; and
- Weed removal, brush clearing, and similar land management activities related to the ongoing operation of the project.

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

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.

In order to identify functional and structural changes in bird communities in and around the development footprint, Visser *et al.* (2019) 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. The study 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 *et al.* 2019).

It is highly likely that the same pattern of reduced avifaunal densities and possible changes in densities and composition favouring grassland species will manifest itself at the proposed Umsobomvu SEFs.

6.4.2 Impacts associated with powerlines

Negative impacts on birds by electricity infrastructure generally take two principal forms, namely electrocution and collisions (Ledger & Annegarn 1981; Ledger 1983; Ledger 1984; Hobbs and Ledger 1986a; Hobbs & Ledger 1986b; Ledger, Hobbs & Smith, 1992; Verdoorn 1996; Kruger & Van Rooyen 1998; Van Rooyen 1998; Kruger 1999; Van Rooyen 1999; Van Rooyen 2000; Van Rooyen 2004; Jenkins *et al.* 2010). Birds also impact on the infrastructure through nesting and streamers, which can cause interruptions in the electricity supply (Van Rooyen *et al.* 2002). During the construction phase of power lines and substations, displacement of birds can also happen due to disturbance and habitat transformation.

6.4.2.1 Electrocutions

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). The electrocution risk is largely determined by the design of the electrical hardware.

6.4.2.2 Collisions

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, 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 16** below – EWT unpublished data).

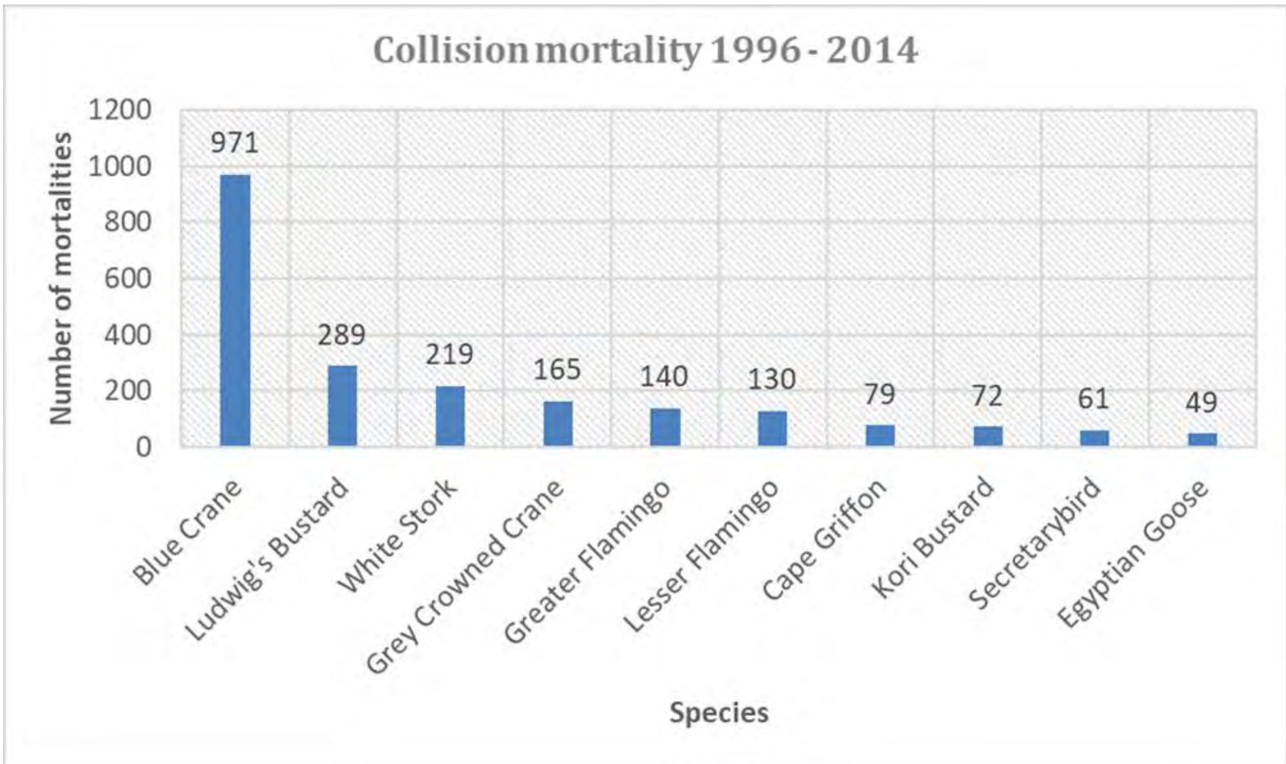

Figure 16: The top 10 collision prone bird species in South Africa, in terms of reported incidents contained in the Eskom/EWT Strategic Partnership central incident register 1996 - 2014 (EWT unpublished data).

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.

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. Bernardino *et al*. 2019; Sporer *et al.* 2013; 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 2018 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).

6.4.2.3 Displacement due to habitat destruction and disturbance associated with the construction of the powerlines and substation

During the construction phase and maintenance of power lines and substations, some habitat destruction and transformation inevitably takes place. This happens with the construction of access roads, the clearing of servitudes and the levelling of substation yards. These activities have an impact on birds breeding, foraging and roosting in or in close proximity of the substation and power line servitudes through transformation of habitat, which could result in temporary or permanent displacement.

Apart from direct habitat destruction, the above-mentioned construction and maintenance activities also impact on birds through disturbance; this could lead to breeding failure if the disturbance happens during a critical part of the breeding cycle. Construction activities in close proximity to breeding locations could be a source of disturbance and could lead to temporary breeding failure or even permanent abandonment of nests.

7 DISCUSSION OF IMPACTS: UMSOBOMVU PV FACILITIES AND GRID CONNECTIONS

The section below provides an overview of the envisaged impacts of the proposed Umsobomvu PV facilities and grid connections on solar and powerline priority species. Separate impact tables are provided which summarises the impacts and proposed mitigation on an individual basis for each PV facility and grid connection.

7.1 PV FACILITIES

7.1.1 Displacement due to disturbance associated with the construction and de-commissioning of the PV plants and associated infrastructure (construction and de-commissioning)

The construction (and de-commissioning) of the PV plants and associated infrastructure will result in a significant amount of movement and noise, which will lead to displacement of avifauna from the development footprints. It is highly likely that most priority species potentially occurring on the site will vacate the development footprints for the duration of these activities.

7.1.2 Displacement due to habitat transformation associated with the PV plant and associated infrastructure (operation)

The construction of the PV plants 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 be short grassland with few (if any) shrubs.

Small to medium-sized birds are often capable of surviving in small pockets of suitable habitat and are therefore generally less affected by habitat fragmentation than larger species. It is, therefore, possible that the smaller and medium-sized species (e.g. passerines) recorded at the site will continue to use the habitat available within the solar facility, albeit at reduced densities for some, especially as far as shrubland specialists are concerned e.g. Rufous-eared Warbler *Malcorus pectoralis*.

Larger priority species which require contiguous, un-fragmented tracts of suitable habitat (e.g. large raptors, korhaans and bustards) are likely to occur at vastly reduced densities in the proposed facilities or may even be totally displaced. The only larger priority species, which was regularly encountered during surveys at the site, was the locally Near Threatened Blue Crane. According to Marnewick *et al.* (2015) the Karoo population is estimated to be around 10 800 birds and relatively stable in largely untransformed landscapes. The displacement impact on the regional population, should it occur, should therefore be low. Two other large terrestrial species were recorded in the study area, namely the locally Endangered Ludwig's Bustard and locally Vulnerable Secretarybird. None of these two wide ranging species is likely to be severely impacted on a regional level by the likely displacement resulting from the transformation of 4 800ha of Grassy Karoo habitat.

In the case of some priority raptors (e.g. Southern Pale Chanting Goshawk, Lanner Falcon, Jackal Buzzard, Black-shouldered Kite and Steppe Buzzard) 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. 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. Greater Kestrel and Rock Kestrel could also be attracted to the solar panels as perches from where to hunt for rodent and insect prey.

Cape Sparrows *Passer melanurus*, Cape Turtle Doves *Streptopelia capicola* 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.

Table 2 lists the solar priority species that could potentially be displaced due to habitat transformation[3].

7.1.3 Collisions with the solar panels (operation)

The priority species that may possibly occur in the development area which could potentially be exposed to collision risk are listed in Table 2. In addition, the so-called "lake effect" could act as a potential attraction to waterbirds. It is not possible to tell whether this will happen until post-construction monitoring reveals actual mortality at the site, but the lack of permanent waterbodies with large waterbird populations in close vicinity to the proposed development area decreases the probability of the lake effect being a major source of mortality.

7.1.4 Entrapment in perimeter fences

Priority species such as Karoo Korhaan, Northern Black Korhaan, Blue Korhaan and Ludwig's Bustard may be vulnerable to entrapment between double perimeter fences. The possibility of using a single perimeter fence should be investigated. Alternatively, 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. In addition, staff should be sensitised to not panic birds when they discover them trapped between the fences but to approach them with caution to give them time to escape by taking off in a lengthwise direction.

7.1.5 Impact on the solar infrastructure

An impact that could potentially materialise is the pollution of the solar panels by faecal deposits of large birds, particularly Pied Crows and raptors, if they regularly perch on the panels. It is expected that the regular cleaning and maintenance activities should prevent this from becoming a problem.

7.2 GRID CONNECTIONS

7.2.1 Electrocutions

Clearance between phases on the same side of the 132kV mono-pole structure is approximately 2.2m for this type of design, and the clearance on strain structures is 1.8m. This clearance should be sufficient to reduce the risk of phase – phase electrocutions of most birds on the poles to negligible. The length of the stand-off insulators is approximately 1.6m. If a very large species attempts to perch on the stand-off insulators, they are potentially able to touch both the conductor and the earthed pole simultaneously potentially resulting in a phase – earth electrocution. This is particularly likely when more than one bird attempts to sit on the same pole, which is an unlikely occurrence, except occasionally with vultures. Vultures are likely to occur very sporadically within the study core areas, but due to the presence of the two Hydra-Poseidon 400kV perch-friendly transmission lines in the study area, the chances of the birds perching on the steel monopoles of the new grid connection line are relatively low.

Electrocutions within the proposed substation yards are possible, but should not affect the majority of the more sensitive Red Data and powerline sensitive bird species as these species are unlikely to use the infrastructure within the substation yards for perching or roosting, except possibly Spotted Eagle-Owl and Barn Owl. Other species which could potentially be exposed to electrocution risks in the proposed substations are corvids, Egyptian Geese, Hadeda Ibis, Helmeted Guineafowl and a few medium-sized raptors (see Table 3).

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[3] In some instances, the displacement will not be complete, but will result in lower densities.

7.2.2 Collisions

See Table 3 for potential candidates for collision mortality in the Nama Karoo habitat on the proposed power line. The species most at risk will be Blue Crane, Ludwig's Bustard, Secretarybird and Karoo Korhaan. The risk will be exacerbated if the line is positioned near a large waterbody, as the larger dams are most likely used by Blue Crane and possibly White Storks for roosting, when water levels are higher. These dams could also attract a variety of collision-prone waterbirds, including Greater Flamingo, when full. Other areas of heightened risk are agricultural clearings, particularly irrigated fields, which attract Blue Crane, Ludwig's Bustard, Egyptian Goose, Spurwing Goose, Hadeda Ibis and Sacred Ibis.

7.2.3 Displacement due to the habitat transformation in the proposed substations

In the present instance, the risk of permanent displacement of priority species due to habitat transformation in the footprint of the proposed substations and powerline servitudes is likely to be very limited given the small size of the footprint. The displacement is likely to only affect small, locally common species and should have a negligible impact on local populations.

7.3 IMPACT RATING CRITERIA

The impact criteria used to assess the potential impacts are set-out in detail in Appendix 3.

7.3.1 Assessment of impacts for the PV facilities

The impacts of the proposed PV facilities are detailed below separately for each facility.

MOOI PLAATS SOLAR PV FACILITY																				
ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Construction Phase																				
Avifauna	Displacement of priority species due to disturbance associated with the construction of the PV plants and associated infrastructure	1	3	3	4	1	3	36	-	Medium	• 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. • 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 and rehabilitation of disturbed areas is concerned.	1	3	3	2	1	3	30	-	Medium

MOOI PLAATS SOLAR PV FACILITY																					
ENVIRONMENTAL PARAMETER	**ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE**	**ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION**									**RECOMMENDED MITIGATION MEASURES**	**ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION**									
		E	**P**	**R**	**L**	**D**	**I / M**	**TOTAL**	**STATUS (+ OR -)**	**S**		**E**	**P**	**R**	**L**	**D**	**I / M**	**TOTAL**	**STATUS (+ OR -)**	**S**	
Operational Phase																					
Avifauna	Displacement of priority avifauna due to habitat transformation associated with the PV plant and associated infrastructure	1	4	3	3	3	3	42	-	Medium	The recommendations of the ecological and botanical specialist studies must be strictly implemented, especially as far as limitation of the construction footprint and rehabilitation of transformed areas is concerned.	1	3	2	3	3	3	36	-	Medium	
Avifauna	Entrapment in perimeter fences resulting in the mortality of priority species.	1	3	1	2	3	1	10	-	Low	A single perimeter fence should be used. Alternatively, the two fences should be at least 4 metres apart to allow medium to large birds enough space to take off.	1	1	1	2	3	1	8	-	Low	
Avifauna	Collisions of priority avifauna with the solar panels resulting in the mortality of priority species.	1	2	2	2	3	1	10	-	Low	No mitigation is required due to the very low expected magnitude	1	2	2	2	3	1	10	-	Low	

MOOI PLAATS SOLAR PV FACILITY

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Decommissioning Phase																				
Avifauna	The de-commissioning of the PV plant and associated infrastructure will result in a significant amount of movement and noise, which will lead to displacement of priority avifauna from the site due to disturbance. It is highly likely that most priority species will temporarily vacate the site footprint.	1	3	3	4	1	3	36	-	Medium	• 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. • 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 and rehabilitation of disturbed areas is concerned.	1	3	3	2	1	3	30	-	Medium

MOOI PLAATS SOLAR PV FACILITY																					
ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Cumulative																				
Avifauna	• 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	1	4	2	3	3	1	13	-	Low	Implement all the mitigation measures as detailed in this bird impact assessment report	1	4	2	2	3	1	12	-	Low

WONDERHEUVEL SOLAR PV FACILITY																				
ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Construction Phase																				
Avifauna	Displacement of priority species due to disturbance associated with the construction of the PV plants and associated infrastructure	1	3	3	4	1	3	36	-	Medium	• 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. • 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 and rehabilitation of disturbed areas is concerned.	1	3	3	2	1	3	30	-	Medium

WONDERHEUVEL SOLAR PV FACILITY																					
ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Operational Phase																				
Avifauna	Displacement of priority avifauna due to habitat transformation associated with the PV plant and associated infrastructure	1	4	3	3	3	3	42	-	Medium	The recommendations of the ecological and botanical specialist studies must be strictly implemented, especially as far as limitation of the construction footprint and rehabilitation of transformed areas is concerned.	1	3	2	3	3	3	36	-	Medium
Avifauna	Entrapment in perimeter fences resulting in the mortality of priority species.	1	3	1	2	3	1	10	-	Low	A single perimeter fence should be used. Alternatively, the two fences should be at least 4 metres apart to allow medium to large birds enough space to take off.	1	1	1	2	3	1	8	-	Low
Avifauna	Collisions of priority avifauna with the solar panels resulting in the mortality of priority species.	1	2	2	2	3	1	10	-	Low	No mitigation is required due to the very low expected magnitude	1	2	2	2	3	1	10	-	Low

WONDERHEUVEL SOLAR PV FACILITY																				
ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Decommissioning Phase																				
Avifauna	The de-commissioning of the PV plant and associated infrastructure will result in a significant amount of movement and noise, which will lead to displacement of priority avifauna from the site due to disturbance. It is highly likely that most priority species will temporarily vacate the site footprint.	1	3	3	4	1	3	36	-	Medium	• 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. • 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 and rehabilitation of disturbed areas is concerned.	1	3	3	2	1	3	30	-	Medium

WONDERHEUVEL SOLAR PV FACILITY																				
ENVIRONMENTAL PARAMETER	**ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE**	**ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION**									**RECOMMENDED MITIGATION MEASURES**	**ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION**								
		E	**P**	**R**	**L**	**D**	**I / M**	**TOTAL**	**STATUS (+ OR -)**	**S**		**E**	**P**	**R**	**L**	**D**	**I / M**	**TOTAL**	**STATUS (+ OR -)**	**S**
Cumulative																				
Avifauna	• 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	1	4	2	3	3	1	13	-	Low	Implement all the mitigation measures as detailed in this bird impact assessment report	1	4	2	2	3	1	12	-	Low

PAARDE VALLEY SOLAR PV FACILITY

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Construction Phase																				
Avifauna	Displacement of priority species due to disturbance associated with the construction of the PV plants and associated infrastructure	1	3	3	4	1	3	36	-	Medium	• 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. • 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 and rehabilitation of disturbed areas is concerned.	1	3	3	2	1	3	30	-	Low

PAARDE VALLEY SOLAR PV FACILITY																					
ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION									
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S	
Operational Phase																					
Avifauna	Displacement of priority avifauna due to habitat transformation associated with the PV plant and associated infrastructure	1	4	3	3	3	3	42	-	Medium	The recommendations of the ecological and botanical specialist studies must be strictly implemented, especially as far as limitation of the construction footprint and rehabilitation of transformed areas is concerned.	1	3	2	3	3	3	36	-	Medium	
Avifauna	Entrapment in perimeter fences resulting in the mortality of priority species.	1	3	1	2	3	1	10	-	Low	A single perimeter fence should be used. Alternatively, the two fences should be at least 4 metres apart to allow medium to large birds enough space to take off.	1	1	1	2	3	1	8	-	Low	
Avifauna	Collisions of priority avifauna with the solar panels resulting in the mortality of priority species.	1	2	2	2	3	1	10	-	Low	No mitigation is required due to the very low expected magnitude	1	2	2	2	3	1	10	-	Low	

PAARDE VALLEY SOLAR PV FACILITY																					
ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Decommissioning Phase																				
Avifauna	The de-commissioning of the PV plant and associated infrastructure will result in a significant amount of movement and noise, which will lead to displacement of priority avifauna from the site due to disturbance. It is highly likely that most priority species will temporarily vacate the site footprint.	1	3	3	4	1	3	36	-	Medium	• 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. • 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 and rehabilitation of disturbed areas is concerned.	1	3	3	2	1	3	30	-	Medium

PAARDE VALLEY SOLAR PV FACILITY																				
ENVIRONMENTAL PARAMETER	**ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE**	**ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION**									**RECOMMENDED MITIGATION MEASURES**	**ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION**								
		E	**P**	**R**	**L**	**D**	**I / M**	**TOTAL**	**STATUS (+ OR -)**	**S**		**E**	**P**	**R**	**L**	**D**	**I / M**	**TOTAL**	**STATUS (+ OR -)**	**S**
Cumulative																				
Avifauna	• 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	1	4	2	3	3	1	13	-	Low	Implement all the mitigation measures as detailed in this bird impact assessment report	1	4	2	2	3	1	12	-	Low

7.3.2 Assessment of impacts for the grid connections

The impacts of the proposed grid connections are detailed below separately for each facility.

MOOI PLAATS GRID CONNECTION INFRASTRUCTURE																				
ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Construction Phase																				
Avifauna	Displacement of priority species due to disturbance associated with the construction of the powerline and substations	1	3	1	3	1	3	27	-	Medium	• Activity should be restricted to the immediate footprint of the infrastructure. • Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of avifauna. Measures to control noise should be applied according to current best practice in the industry. • Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum. • The recommendations of the ecological and botanical specialist studies must be strictly implemented. • A walk-through must be conducted by the avifaunal specialist to assess whether there are any Red Data species, and/or large raptors breeding in the vicinity of the powerline, which could be displaced by the dismantling	1	1	1	1	1	1	5	-	Low

											activities. Should this be the case, appropriate measures must be put in place to prevent the displacement of the breeding birds, through the timing of activities.									
Avifauna	Displacement of priority species due to habitat destruction associated with the construction of the substations	1	2	4	2	3	1	12	-	Low	• Activity should be restricted to the immediate footprint of the infrastructure. • Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of avifauna. Measures to control noise should be applied according to current best practice in the industry. • Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum. • The recommendations of the ecological and botanical specialist studies must be strictly implemented.	1	2	2	2	3	1	10	-	Low

MOOI PLAATS GRID CONNECTION INFRASTRUCTURE																					
ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION									
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Operational Phase																					
Avifauna	Collisions of priority species with the earthwire of the proposed 132kV grid connection.	2	4	2	4	3	3	45	-	High	• The 132kV grid connection should be marked with Bird Flappers, on the earthwire for the entire length of the line. • A 500m powerline - free zone should be implemented around dams and agricultural areas.	2	2	2	4	3	2	26	-	Medium
Avifauna	Electrocutions on the proposed 132kV powerline and in the substations	2	2	1	4	3	3	36	-	Medium	• The final pole design must be signed off by the bird specialist to ensure that a bird-friendly design is used. • With regards to the infrastructure within the substation yard, the hardware is too complex to warrant any mitigation for electrocution at this stage. It is rather recommended that if any impacts are recorded once operational, site specific mitigation be applied reactively.	2	1	1	4	3	1	11	-	Low

MOOI PLAATS GRID CONNECTION INFRASTRUCTURE

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Decommissioning Phase																				
Avifauna	Displacement of priority species due to disturbance associated with the dismantling of the powerline and substations	1	3	1	3	1	3	27	-	Medium	• Activity should be restricted to the immediate footprint of the infrastructure. • Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of avifauna. • Measures to control noise should be applied according to current best practice in the industry. • Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum. • The recommendations of the ecological and botanical specialist studies must be strictly implemented. A walk-through must be conducted by the avifaunal specialist to assess whether there are any Red Data species, and/or large raptors breeding in the vicinity of the powerline, which could be displaced by the dismantling activities. Should this be the case, appropriate measures must be put in place to prevent the displacement of the	1	1	1	1	1	1	5	-	Low

											breeding birds, through the timing of activities.									

WONDERHEUVEL GRID CONNECTION INFRASTRUCTURE

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Construction Phase																				
Avifauna	Displacement of priority species due to disturbance associated with the construction of the powerline and substations	1	3	1	3	1	3	27	-	Medium	• Activity should be restricted to the immediate footprint of the infrastructure. • Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of avifauna. Measures to control noise should be applied according to current best practice in the industry. • Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum. • The recommendations of the ecological and botanical specialist studies must be strictly implemented. • A walk-through must be conducted by the avifaunal specialist to assess whether there are any Red Data species, and/or large raptors breeding in the vicinity of the powerline, which could be displaced by the dismantling activities. Should this be the case, appropriate measures must be put in place to prevent the displacement of the breeding birds, through the timing of activities.	1	1	1	1	1	1	5	-	Low

Avifauna	Displacement of priority species due to habitat destruction associated with the construction of the substations	1	2	4	2	3	1	12	-	Low	• Activity should be restricted to the immediate footprint of the infrastructure. • Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of avifauna. Measures to control noise should be applied according to current best practice in the industry. • Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum. • The recommendations of the ecological and botanical specialist studies must be strictly implemented.	1	2	2	2	3	1	10	-	Low

WONDERHEUVEL GRID CONNECTION INFRASTRUCTURE																						
ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Operational Phase																				
Avifauna	Collisions of priority species with the earthwire of the proposed 132kV grid connection.	2	4	2	4	3	3	45	-	High	• The 132kV grid connection should be marked with Bird Flappers, on the earthwire for the entire length of the line. • A 500m powerline - free zone should be implemented around dams and agricultural areas.	2	2	2	4	3	2	26	-	Medium
Avifauna	Electrocutions on the proposed 132kV powerline and in the substations	2	2	1	4	3	3	36	-	Medium	• The final pole design must be signed off by the bird specialist to ensure that a bird-friendly design is used. • With regards to the infrastructure within the substation yard, the hardware is too complex to warrant any mitigation for electrocution at this stage. It is rather recommended that if any impacts are recorded once operational, site specific mitigation be applied reactively.	2	1	1	4	3	1	11	-	Low

WONDERHEUVEL GRID CONNECTION INFRASTRUCTURE																				
ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Decommissioning Phase																				
Avifauna	Displacement of priority species due to disturbance associated with the dismantling of the powerline and substations	1	3	1	3	1	3	27	-	Medium	• Activity should be restricted to the immediate footprint of the infrastructure. • Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of avifauna. • Measures to control noise should be applied according to current best practice in the industry. • Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum. • The recommendations of the ecological and botanical specialist studies must be strictly implemented. • A walk-through must be conducted by the avifaunal specialist to assess whether there are any Red Data species, and/or large raptors breeding in the vicinity of the powerline, which could be displaced by the dismantling activities. Should this be the case, appropriate measures must be put	1	1	1	1	1	1	5	-	Low

											in place to prevent the displacement of the breeding birds, through the timing of activities.									

PAARDE VALLEY GRID CONNECTION INFRASTRUCTURE																				
ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Construction Phase																				
Avifauna	Displacement of priority species due to disturbance associated with the construction of the powerline and substations	1	3	1	3	1	3	27	-	Medium	• Activity should be restricted to the immediate footprint of the infrastructure. • Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of avifauna. Measures to control noise should be applied according to current best practice in the industry. • Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum. • The recommendations of the ecological and botanical specialist studies must be strictly implemented. • A walk-through must be conducted by the avifaunal specialist to assess whether there are any Red Data species, and/or large raptors breeding in the vicinity of the powerline, which could be displaced by the dismantling activities. Should this be the case, appropriate measures must be put in place to prevent the displacement of the breeding birds, through the timing of activities.	1	1	1	1	1	1	5	-	Low

Avifauna	Displacement of priority species due to habitat destruction associated with the construction of the substations	1	2	4	2	3	1	12	-	Low	• Activity should be restricted to the immediate footprint of the infrastructure. • Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of avifauna. Measures to control noise should be applied according to current best practice in the industry. • Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum. • The recommendations of the ecological and botanical specialist studies must be strictly implemented.	1	2	2	2	3	1	10	-	Low

PAARDE VALLEY GRID CONNECTION INFRASTRUCTURE																					
ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION									
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S	
Operational Phase																					
Avifauna	Collisions of priority species with the earthwire of the proposed 132kV grid connection.	2	4	2	4	3	3	45	-	High	• The 132kV grid connection should be marked with Bird Flappers, on the earthwire for the entire length of the line. • A 500m powerline - free zone should be implemented around dams and agricultural areas.	2	2	2	4	3	2	26	-	Medium	
Avifauna	Electrocutions on the proposed 132kV powerline and in the substations	2	2	1	4	3	3	36	-	Medium	• The final pole design must be signed off by the bird specialist to ensure that a bird-friendly design is used. • With regards to the infrastructure within the substation yard, the hardware is too complex to warrant any mitigation for electrocution at this stage. It is rather recommended that if any impacts are recorded once operational, site specific mitigation be applied reactively.	2	1	1	4	3	1	11	-	Low	

PAARDE VALLEY GRID CONNECTION INFRASTRUCTURE																				
ENVIRONMENTAL PARAMETER	**ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE**	**ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION**									**RECOMMENDED MITIGATION MEASURES**	**ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION**								
		E	**P**	**R**	**L**	**D**	**I / M**	**TOTAL**	**STATUS (+ OR -)**	**S**		**E**	**P**	**R**	**L**	**D**	**I / M**	**TOTAL**	**STATUS (+ OR -)**	**S**
Decommissioning Phase																				
Avifauna	Displacement of priority species due to disturbance associated with the dismantling of the powerline and substations	1	3	1	3	1	3	27	-	Medium	• Activity should be restricted to the immediate footprint of the infrastructure. • Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of avifauna. • Measures to control noise should be applied according to current best practice in the industry. Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum. • The recommendations of the ecological and botanical specialist studies must be strictly implemented. A walk-through must be conducted by the avifaunal specialist to assess whether there are any Red Data species, and/or large raptors breeding in the vicinity of the powerline, which could be displaced by the dismantling activities. Should this be the case, appropriate measures must be put in place to prevent the displacement of the	1	1	1	1	1	1	5	-	Low

										breeding birds, through the timing of activities.										

7.4 CUMULATIVE IMPACTS

Cumulative effects are commonly understood to be impacts from different projects that combine to result in significant change, which could be larger than the sum of all the individual impacts. The assessment of cumulative effects therefore needs to consider all renewable energy developments (wind and solar) within at least a 35km radius of the proposed site. The 17 renewable projects which are planned or authorised are displayed in Figure 17. Appendix 4 lists the projects together with the relevant recommended mitigation measures pertaining to birds.

7.4.1 PV sites

In the case of solar projects, the potentially most significant impact from an avifaunal perspective is the transformation of the natural habitat. The total land parcel area taken up by existing and proposed solar energy projects are approximately 13 000ha, and the wind energy projects come to approximately 47 000ha. The three Umsobomvu SEF's will add another approximately 13 500ha of land parcel to these. The total area of the 35km radius around the proposed projects equates to about 400 000ha. The total combined size of the land parcels taken up by SEF's and WEF's, including the three Umsobomvu projects, equates to about 60 500ha, which is just over 15% of the available land in the 35km radius. However, the actual footprint of the solar facilities will be much smaller that the land parcel area, between 20 - 40% of the land parcel area. In the case of the WEF's the situation is much the same. The total area to be taken up by renewable energy developments will therefore comprise less than 10% of the land surface within the 35km radius around the proposed Umsobomvu projects. The cumulative impact of the habitat transformation which will come about as a result of the three proposed Umsobomvu projects should therefore be **low**.

7.4.2 Grid connection

In the case of the grid connections, the existing high voltage grid (66 - 400kV) in the 35km radius around the proposed Umsobomvu SEF's comes to about 300km. The existing and proposed renewable energy projects add approximately 60km of sub-transmission lines to this. The three Umsobomvu SEF's will add another approximately 34 – 40km of sub-transmission line, depending which alternative is used. This translates into an 11% increase in the length of existing and proposed high voltage line within the 35km radius around the proposed Umsobomvu projects. The most significant potential impact of high voltage lines within the aforesaid 35km radius is bird collisions with the earth wires of the lines. An 11% increase in line length should represent a **medium** increase in cumulative risk, which could be mitigated to a **low** level with the application of appropriate mitigation measures. This is on the assumption that the proposed mitigation measures as detailed in the EIA reports, namely the marking of lines, will be implemented at all the relevant sites.

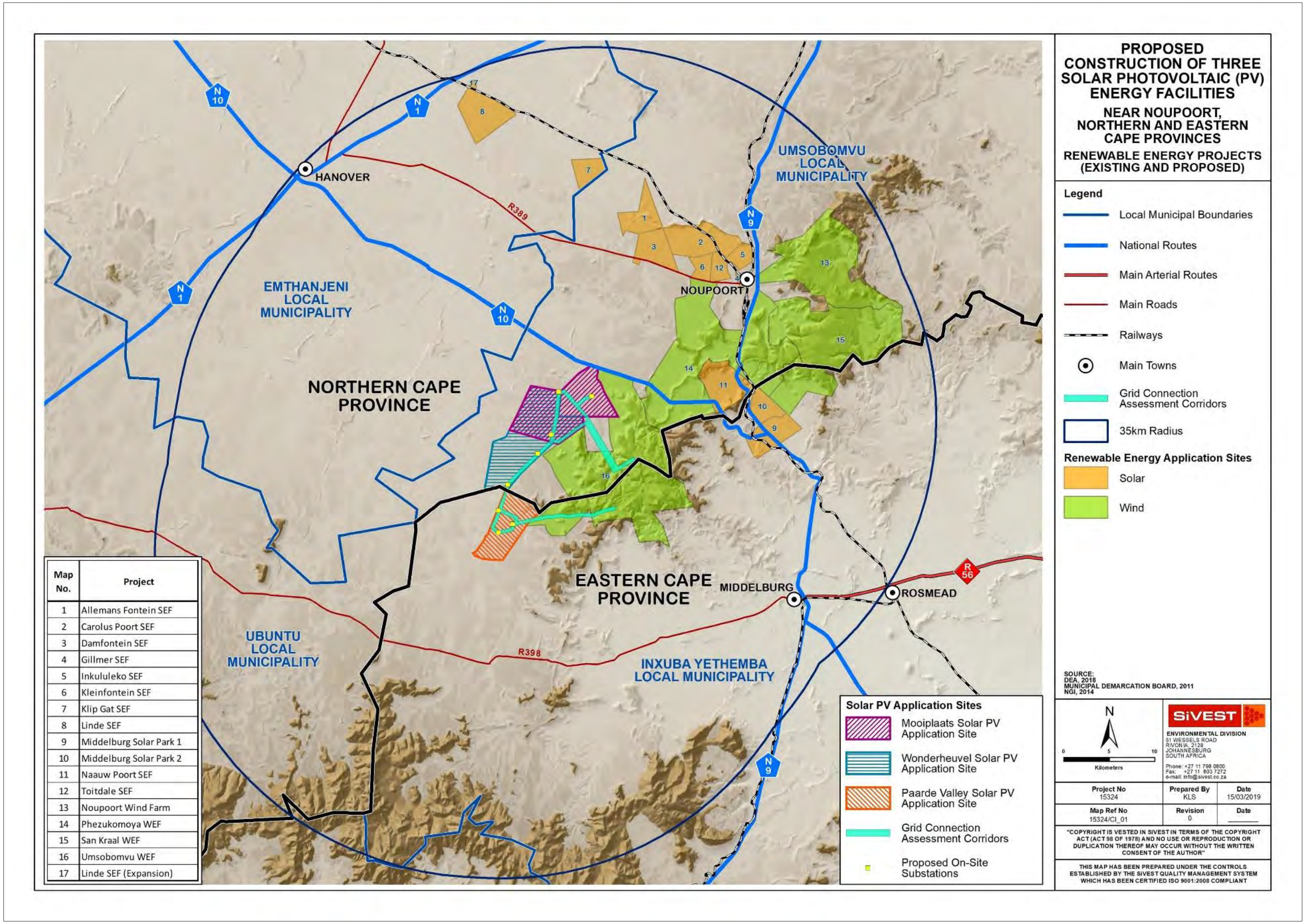

Figure 17: The locality of existing and proposed renewable energy projects within a 35km radius around the proposed Umsobomvu SEFs

7.5 NO-GO ALTERNATIVE

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 area as far as avifauna is concerned.

8 NO-GO AREAS

No no-go areas have been identified for the solar fields or road network. For the grid connection, two types of no-go areas have been identified, both based on the risk of powerline collisions. These areas are dams and agricultural fields. Both these habitat classes serve as focal points for powerline sensitive avifauna, which includes Red Data species such as Blue Cranes, Ludwig's Bustard and Greater Flamingo, large raptors and various non-Red Data waterbirds. It is suggested that a 500m powerline-free buffer is created around all these potential hot-spots, to minimise the risk of collision mortality. See Figure 18 for the location of the proposed powerline-free zones.

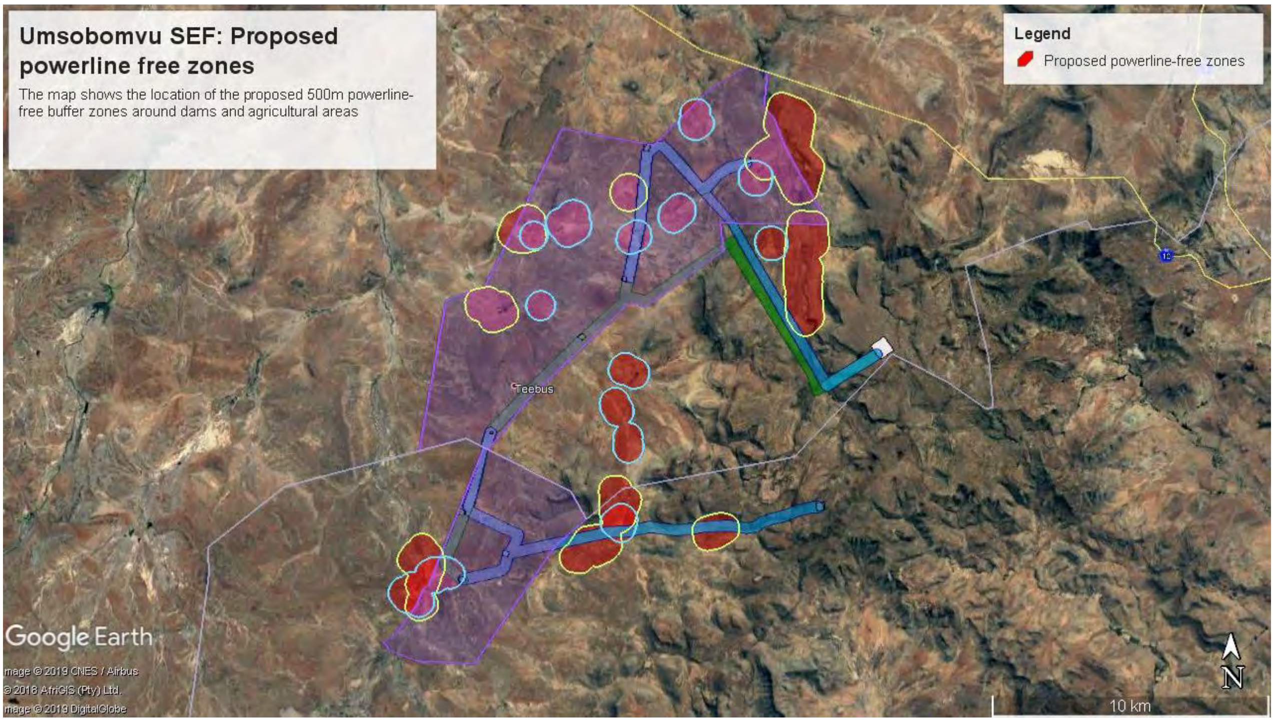

Figure 18: Location of the proposed powerline-free buffer zones around dams and agricultural areas

9 ASSESSMENT OF ALTERNATIVES

Two alternative options have been put forward for the proposed grid connections, for each PV facility. These options are evaluated in the assessment tables below.

Key

PREFERRED	The alternative will result in a low impact / reduce the impact
FAVOURABLE	The impact will be relatively insignificant
LEAST PREFERRED	The alternative will result in a high impact / increase the impact
NO PREFERENCE	The alternative will result in equal impacts

GRID CONNECTION INFRASTRUCTURE ALTERNATIVES (POWER LINE CORRIDORS AND ASSOCIATED SUBSTATIONS)	Preference	Reasons (incl. potential issues)
MOOI PLAATS SOLAR PV FACILITY:		
Grid Connection Option 1	Preferred	Mostly avoids no-go areas
Grid Connection Option 2	Least preferred	Traverses at least two no-go areas
WONDERHEUVEL SOLAR PV FACILITY:		
Grid Connection Option 1	Least preferred	Traverses several no-go areas
Grid Connection Option 2	Preferred	Avoids all no-go areas
PAARDE VALLEY SOLAR PV FACILITY:		
Grid Connection Option 1	Least preferred	Traverses several no-go areas
Grid Connection Option 2	Preferred	Mostly avoids no-go areas, except one

10 CONCLUSIONS

The proposed Umsobomvu PV facilities will have some pre-mitigation impacts on avifauna at a site and local level which will range from **Medium to Low**.

The impact of displacement due to disturbance during the construction phase is rated as **Medium** and will remain at a **Medium** level after mitigation. The impact of displacement of priority species due to habitat transformation associated with the operation of the plant and associated infrastructure is rated as **Medium**. This impact can be partially reversed through mitigation, but it will remain at a **Medium** level, after mitigation. The envisaged impacts in the operational phase, i.e. mortalities due to collisions with the solar panels and entrapment in perimeter fences are both rated as **Low** pre-mitigation and could be further reduced with appropriate mitigation. The impact of displacement due to disturbance during the decommissioning phase is rated as **Medium**, and it will remain at a **Medium** level after mitigation. The cumulative impact of the proposed PV facilities within a 35km radius is rated as **Low**, both per- and post mitigation.

The impact of displacement due to disturbance associated with the construction of the proposed 132kV grid connection and substations, is assessed to be **Medium** and can be mitigated to a **Low** level. The potential for displacement due to habitat destruction associated with the construction of the substations is rated as **Low** and could be further reduced with appropriate mitigation. The impact of bird collisions with the 132kV grid connection is rated as **High** and could be reduced to **Medium** with the application of mitigation measures. The potential impact of electrocutions is assessed to be **Medium**, but it can be reduced to **Low** with appropriate mitigation. The impact of displacement due to disturbance associated with the de-commissioning of the proposed 132kV grid connection and substations, is assessed to be **Medium** and can be mitigated to a **Low** level. The cumulative impact of the proposed grid connections within a 35km radius is rated as **Medium**, but it can be reduced to **Low** with the application of appropriate mitigation.

11 IMPACT STATEMENT

From an avifaunal impact perspective, there is no objection to the proposed development of the Umsobomvu PV facilities and associated grid connections, provided the proposed mitigation measures are strictly implemented. No further monitoring will be required during the operational phase.

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APPENDIX 1: FIELD SURVEYS

1 Methodology

Monitoring was conducted in the following manner:

- A visit to the site and general area was conducted on 15 and 16 January 2019, followed up by on-site surveys from 17 - 19 January 2019. Eighteen walk transects were identified totalling 1km each in the proposed PV development area (see Figure 1 below).
- One observer walking slowly recorded all species on both sides of the transect. The observer stopped at regular intervals to scan the environment with binoculars.
- Each transect was counted twice over a period of three days.
- The following variables were recorded:
  - Species;
  - Number of birds;
  - Date;
  - Start time and end time;
  - Estimated distance from transect (m);
  - Wind direction;
  - Wind strength (estimated Beaufort scale 1 - 7);
  - 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.
- All incidental sightings of priority species were recorded.
- The sections of the Hydra – Poseidon 1 and 2 400kV transmission lines running through to the study area was inspected for evidence of breeding raptors on the towers.

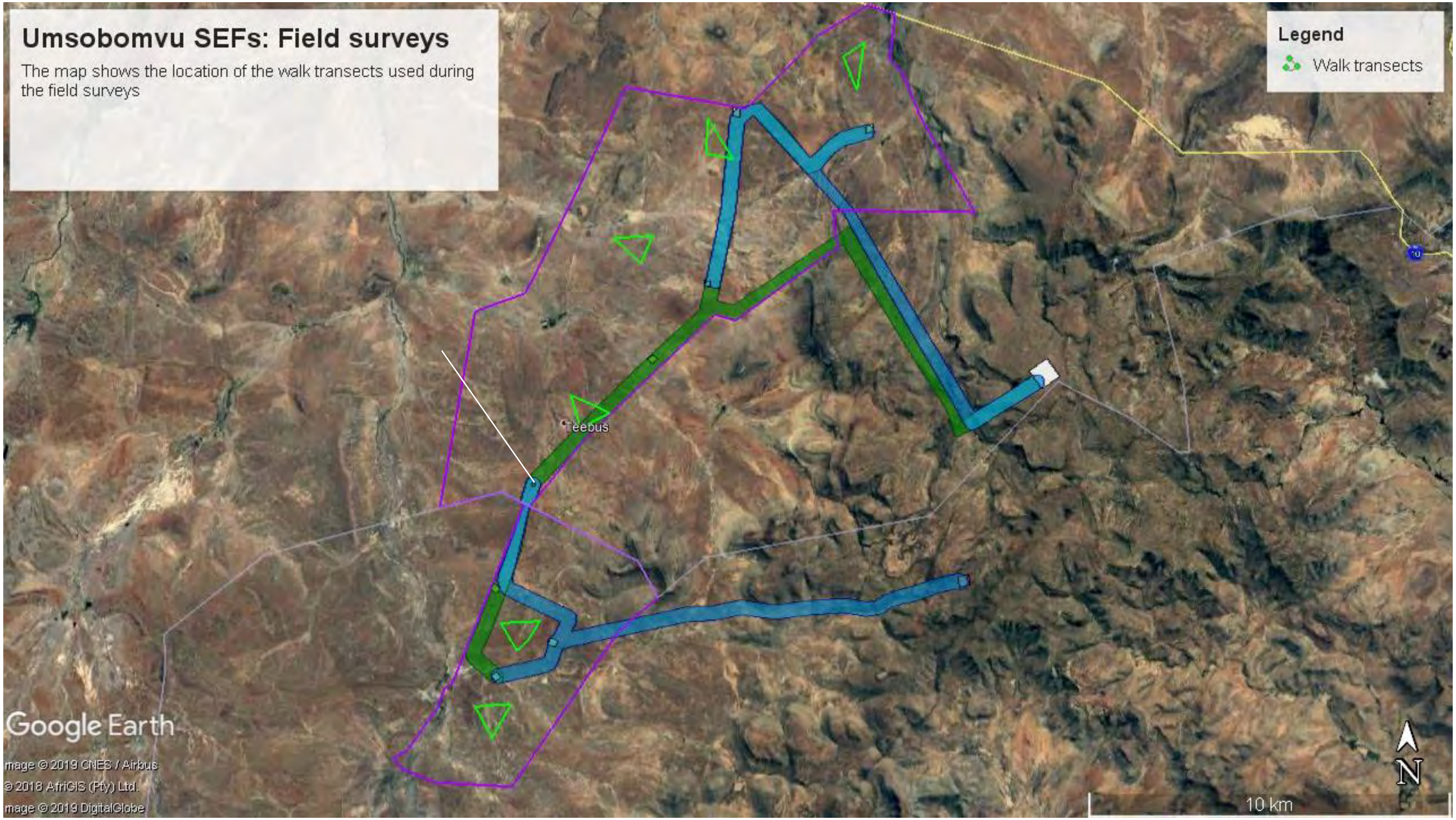

Figure 1: Walk transects used during field surveys. The purple polygon is the PV assessment areas, and the blue and green corridors are the proposed powerline corridor alternatives.

APPENDIX 2: AVIFAUNA IN THE BROADER AREA

Species	Taxonmic name	Solar priority species	Powerline sensitive species	SABAP2 Average reporting rate: full protocol	Red Data status: International	Red Data status: Regional	Endemic - South Africa	Endemic - Southern Africa
Apalis, Bar-throated	*Apalis thoracica*			1.86				
Avocet, Pied	*Recurvirostra avosetta*	x		15.48				
Barbet, Acacia Pied	*Tricholaema leucomelas*			75.00				Near-endemic
Batis, Pririt	*Batis pririt*			1.86				Near-endemic
Bee-eater, European	*Merops apiaster*			21.96				
Bishop, Southern Red	*Euplectes orix*			69.99				
Bishop, Yellow-crowned	*Euplectes afer*			2.78				
Bokmakierie	*Telophorus zeylonus*			88.49				
Bulbul, African Red-eyed	*Pycnonotus nigricans*			81.48				Near-endemic
Bunting, Cape	*Emberiza capensis*			52.78				Near-endemic
Bunting, Cinnamon-breasted	*Emberiza tahapisi*			7.41				
Bunting, Lark-like	*Emberiza impetuani*			63.49				Near-endemic
Bustard, Ludwig's	*Neotis ludwigii*	x	x	25.67	EN	EN		Near-endemic
Buzzard, Jackal	*Buteo rufofuscus*	x	x	22.22			Near endemic	Endemic
Buzzard, Steppe	*Buteo vulpinus*		x	10.59				
Canary, Black-headed	*Serinus alario*	x		14.56			Near endemic	Endemic
Canary, Black-throated	*Crithagra atrogularis*			25.00				
Canary, Cape	*Serinus canicollis*			3.44				Endemic
Canary, White-throated	*Crithagra albogularis*			59.26				Near-endemic
Canary, Yellow	*Crithagra flaviventris*			20.51				Near-endemic
Canary, Yellow-fronted	*Crithagra mozambicus*			0.00				
Chat, Anteating	*Myrmecocichla formicivora*			11.57				Endemic
Chat, Familiar	*Cercomela familiaris*			92.59				
Chat, Karoo	*Cercomela schlegelii*			0.00				Near-endemic
Chat, Sickle-winged	*Cercomela sinuata*	x		48.81			Near endemic	Endemic
Cisticola, Cloud	*Cisticola textrix*	x		0.00			Near endemic	Near-endemic
Cisticola, Desert	*Cisticola aridulus*			17.33				
Cisticola, Grey-backed	*Cisticola subruficapilla*			45.77				Near-endemic
Cisticola, Levaillant's	*Cisticola tinniens*			30.43				
Cisticola, Zitting	*Cisticola juncidis*			1.86				
Cliff-swallow, South African	*Hirundo spilodera*			6.33			Endemic (SA, Lesotho, Swaziland) Breeding	Breeding-endemic
Coot, Red-knobbed	*Fulica cristata*	x	x	14.41				
Cormorant, Reed	*Phalacrocorax africanus*	x	x	13.49				
Cormorant, White-breasted	*Phalacrocorax carbo*			4.77				
Courser, Double-banded	*Rhinoptilus africanus*			2.78				
Crane, Blue	*Anthropoides paradiseus*	x	x	73.41	VU	NT		Endemic
Crane, Grey Crowned	*Balearica regulorum*	x	x	0.00	EN	EN		
Crombec, Long-billed	*Sylvietta rufescens*			14.96				
Crow, Cape	*Corvus capensis*			1.86				
Crow, Pied	*Corvus albus*		x	88.89				
Cuckoo, Diderick	*Chrysococcyx caprius*			10.19				
Dove, Laughing	*Streptopelia senegalensis*			42.22				
Dove, Namaqua	*Oena capensis*			27.51				
Dove, Red-eyed	*Streptopelia semitorquata*			60.44				
Drongo, Fork-tailed	*Dicrurus adsimilis*			1.86				
Duck, African Black	*Anas sparsa*	x	x	8.33				

Species	Taxonmic name	Solar priority species	Powerline sensitive species	SABAP2 Average reporting rate: full protocol	Red Data status: International	Red Data status: Regional	Endemic - South Africa	Endemic - Southern Africa
Duck, Maccoa	*Oxyura maccoa*	x	x	1.59	NT	NT		
Duck, White-faced	*Dendrocygna viduata*	x	x	2.78				
Duck, Yellow-billed	*Anas undulata*	x	x	50.92				
Eagle, Booted	*Aquila pennatus*		x	16.67				
Eagle, Martial	*Polemaetus bellicosus*	x	x	7.14	VU	EN		
Eagle, Verreaux's	*Aquila verreauxii*	x	x	18.26	LC	VU		
Eagle-owl, Spotted	*Bubo africanus*	x	x	12.43				
Egret, Cattle	*Bubulcus ibis*	x		4.63				
Egret, Great	*Egretta alba*	x	x	0.00				
Eremomela, Yellow-bellied	*Eremomela icteropygialis*			20.37				
Falcon, Lanner	*Falco biarmicus*	x	x	2.78	LC	VU		
Falcon, Peregrine	*Falco peregrinus*	x	x	1.59				
Finch, Red-headed	*Amadina erythrocephala*			13.89				Near-endemic
Fiscal, Common (Southern)	*Lanius collaris*			96.82				
Fish-eagle, African	*Haliaeetus vocifer*	x	x	3.18				
Flamingo, Greater	*Phoenicopterus ruber*		x	3.18	LC	NT		
Flycatcher, Chat	*Bradornis infuscatus*			20.38				Near-endemic
Flycatcher, Fiscal	*Sigelus silens*	x		34.40			Near endemic	Endemic
Flycatcher, Spotted	*Muscicapa striata*			4.63				
Francolin, Grey-winged	*Scleroptila africanus*			10.84			Endemic (SA, Lesotho, Swaziland)	Endemic
Goose, Egyptian	*Alopochen aegyptiacus*		x	77.78				
Goose, Spur-winged	*Plectropterus gambensis*	x	x	34.79				
Goshawk, Southern Pale Chanting	*Melierax canorus*	x	x	34.66				Near-endemic
Grebe, Black-necked	*Podiceps nigricollis*	x	x	0.00				
Grebe, Great Crested	*Podiceps cristatus*	x	x	1.59				
Grebe, Little	*Tachybaptus ruficollis*	x		9.12				
Greenshank, Common	*Tringa nebularia*	x		12.70				
Guineafowl, Helmeted	*Numida meleagris*		x	63.22				
Hamerkop	*Scopus umbretta*	x	x	1.86				
Harrier, Black	*Circus maurus*	x	x	2.78	VU	EN	Near endemic	Endemic
Harrier-Hawk, African	*Polyboroides typus*	x	x	1.59				
Heron, Black-headed	*Ardea melanocephala*	x	x	17.33				
Heron, Grey	*Ardea cinerea*	x	x	23.93				
Hoopoe, African	*Upupa africana*			51.86				
Ibis, African Sacred	*Threskiornis aethiopicus*	x	x	20.23				
Ibis, Hadeda	*Bostrychia hagedash*		x	51.46				
Kestrel, Greater	*Falco rupicoloides*	x		21.30				
Kestrel, Lesser	*Falco naumanni*	x		20.37				
Kestrel, Rock	*Falco rupicolus*	x		27.41				
Kingfisher, Malachite	*Alcedo cristata*	x		2.78				
Kingfisher, Pied	*Ceryle rudis*	x		2.78				
Kite, Black-shouldered	*Elanus caeruleus*	x		15.44				
Korhaan, Blue	*Eupodotis caerulescens*	x	x	56.34	NT	LC	Endemic (SA, Lesotho, Swaziland)	Endemic
Korhaan, Karoo	*Eupodotis vigorsii*	x	x	13.10	LC	NT		Endemic
Korhaan, Northern Black	*Afrotis afraoides*		x	74.21				Endemic
Lapwing, Blacksmith	*Vanellus armatus*	x		49.33				
Lapwing, Crowned	*Vanellus coronatus*			28.44				
Lark, Eastern Clapper	*Mirafra fasciolata*			82.01				Near-endemic
Lark, Large-billed	*Galerida magnirostris*	x		75.27			Near endemic	Endemic
Lark, Red-capped	*Calandrella cinerea*			28.97				
Lark, Sabota	*Calendulauda sabota*			8.33				Near-endemic
Lark, Spike-heeled	*Chersomanes albofasciata*			70.23				Near-endemic

Species	Taxonmic name	Solar priority species	Powerline sensitive species	SABAP2 Average reporting rate: full protocol	Red Data status: International	Red Data status: Regional	Endemic - South Africa	Endemic - Southern Africa
Longclaw, Cape	*Macronyx capensis*			17.07				Endemic
Martin, Brown-throated	*Riparia paludicola*			29.89				
Martin, Rock	*Hirundo fuligula*			58.19				
Masked-weaver, Southern	*Ploceus velatus*			80.81				
Moorhen, Common	*Gallinula chloropus*	x		17.07				
Mousebird, Red-faced	*Urocolius indicus*			17.59				
Mousebird, Speckled	*Colius striatus*			41.93				
Mousebird, White-backed	*Colius colius*			62.30				Endemic
Neddicky	*Cisticola fulvicapilla*			23.54				
Night-Heron, Black-crowned	*Nycticorax nycticorax*	x	x	0.00				
Owl, Barn	*Tyto alba*	x		7.41				
Paradise-flycatcher, African	*Terpsiphone viridis*			2.78				
Penduline-tit, Cape	*Anthoscopus minutus*			36.78				Near-endemic
Pigeon, Speckled	*Columba guinea*			73.41				
Pipit, African	*Anthus cinnamomeus*			70.89				
Pipit, African Rock	*Anthus crenatus*	x		11.11	LC	NT	Endemic (SA, Lesotho, Swaziland)	Endemic
Pipit, Long-billed	*Anthus similis*			13.89				
Pipit, Plain-backed	*Anthus leucophrys*			5.56				
Plover, Kittlitz's	*Charadrius pecuarius*	x		28.70				
Plover, Three-banded	*Charadrius tricollaris*	x		57.68				
Pochard, Southern	*Netta erythrophthalma*	x	x	1.59				
Prinia, Karoo	*Prinia maculosa*	x		76.19			Near endemic	Endemic
Quail, Common	*Coturnix coturnix*			12.70				
Quailfinch, African	*Ortygospiza atricollis*			43.66				
Quelea, Red-billed	*Quelea quelea*			18.26				
Raven, White-necked	*Corvus albicollis*		x	19.18				
Reed-warbler, African	*Acrocephalus baeticatus*			10.84				
Robin-chat, Cape	*Cossypha caffra*			66.00				
Ruff	*Philomachus pugnax*	x		3.18				
Sandgrouse, Namaqua	*Pterocles namaqua*		x	34.52				Near-endemic
Sandpiper, Wood	*Tringa glareola*	x		3.18				
Scrub-robin, Karoo	*Cercotrichas coryphoeus*			84.26				Endemic
Secretarybird	*Sagittarius serpentarius*	x	x	19.44				
Shelduck, South African	*Tadorna cana*	x	x	51.86				Endemic
Shoveler, Cape	*Anas smithii*	x	x	7.14				Near-endemic
Snake-eagle, Black-chested	*Circaetus pectoralis*	x	x	1.86				
Snipe, African	*Gallinago nigripennis*	x		1.59				
Sparrow, Cape	*Passer melanurus*			89.81				Near-endemic
Sparrow, House	*Passer domesticus*			22.62				
Sparrow, Southern Grey-headed	*Passer diffusus*			46.16				
Sparrowhawk, Black	*Accipiter melanoleucus*	x		0.00				
Sparrowhawk, Rufous-chested	*Accipiter rufiventris*	x		2.78				
Sparrowlark, Black-eared	*Eremopterix australis*	x		2.78			Near endemic	Endemic
Sparrowlark, Grey-backed	*Eremopterix verticalis*			25.79				Near-endemic
Spoonbill, African	*Platalea alba*	x	x	5.96				
Starling, Cape Glossy	*Lamprotornis nitens*			17.59				
Starling, Common	*Sturnus vulgaris*			5.56				
Starling, Pale-winged	*Onychognathus nabouroup*			2.78				Near-endemic
Starling, Pied	*Spreo bicolor*			94.44			Endemic (SA, Lesotho, Swaziland)	Endemic
Starling, Red-winged	*Onychognathus morio*			48.01				
Starling, Wattled	*Creatophora cinerea*			4.37				

Species	Taxonmic name	Solar priority species	Powerline sensitive species	SABAP2 Average reporting rate: full protocol	Red Data status: International	Red Data status: Regional	Endemic - South Africa	Endemic - Southern Africa
Stilt, Black-winged	*Himantopus himantopus*	x		23.01				
Stint, Little	*Calidris minuta*	x		9.12				
Stonechat, African	*Saxicola torquatus*			26.19				
Stork, Black	*Ciconia nigra*	x	x	0.00	LC	VU		
Stork, White	*Ciconia ciconia*	x	x	0.00				
Sunbird, Malachite	*Nectarinia famosa*			1.86				
Sunbird, Southern Double-collared	*Cinnyris chalybeus*	x		5.56			Near endemic	Endemic
Swallow, Barn	*Hirundo rustica*			51.71				
Swallow, Greater Striped	*Hirundo cucullata*			69.31				
Swallow, White-throated	*Hirundo albigularis*			31.34				
Swamp-warbler, Lesser	*Acrocephalus gracilirostris*			13.10				
Swift, African Black	*Apus barbatus*			0.00				
Swift, Alpine	*Tachymarptis melba*			4.63				
Swift, Little	*Apus affinis*			28.70				
Swift, White-rumped	*Apus caffer*			27.28				
Teal, Cape	*Anas capensis*	x	x	8.73				
Teal, Red-billed	*Anas erythrorhyncha*	x	x	13.37				
Thick-knee, Spotted	*Burhinus capensis*			23.54				
Thrush, Karoo	*Turdus smithi*	x		34.12			Near endemic	Endemic
Tit, Grey	*Parus afer*	x		10.19			Near endemic	Endemic
Tit-babbler, Chestnut-vented	*Parisoma subcaeruleum*			38.37				Near-endemic
Tit-babbler, Layard's	*Parisoma layardi*			30.56			Near endemic	Endemic
Turtle-dove, Cape	*Streptopelia capicola*			98.14				
Vulture, Cape	*Gyps coprotheres*	x	x	2.78	EN	EN		Near-endemic
Wagtail, Cape	*Motacilla capensis*			90.73				
Warbler, Rufous-eared	*Malcorus pectoralis*			92.46				Endemic
Warbler, Willow	*Phylloscopus trochilus*			1.86				
Waxbill, Common	*Estrilda astrild*			24.87				
Weaver, Cape	*Ploceus capensis*	x		7.14			Near endemic	Endemic
Wheatear, Capped	*Oenanthe pileata*			34.40				
Wheatear, Mountain	*Oenanthe monticola*			71.69				Near-endemic
White-eye, Cape	*Zosterops virens*	x		25.40			Near endemic	Endemic
Whydah, Pin-tailed	*Vidua macroura*			26.71				
Woodpecker, Cardinal	*Dendropicos fuscescens*			2.78				
Woodpecker, Ground	*Geocolaptes olivaceus*	x		1.86			Endemic (SA, Lesotho, Swaziland)	Endemic

APPENDIX 3: IMPACT CRITERIA

1 ENVIRONMENTAL IMPACT ASSESSMENT (EIA) METHODOLOGY

The Environmental Impact Assessment (EIA) Methodology assists in evaluating the overall effect of a proposed activity on the environment. Determining of the significance of an environmental impact on an environmental parameter is determined through a systematic analysis.

1.1 Determination of Significance of Impacts

Significance is determined through a synthesis of impact characteristics which include context and intensity of an impact. Context refers to the geographical scale (i.e. site, local, national or global), whereas intensity is defined by the severity of the impact e.g. the magnitude of deviation from background conditions, the size of the area affected, the duration of the impact and the overall probability of occurrence. Significance is calculated as shown in **Table 1**.

Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The total number of points scored for each impact indicates the level of significance of the impact.

1.2 Impact Rating System

The impact assessment must take account of the nature, scale and duration of effects on the environment and whether such effects are positive (beneficial) or negative (detrimental). Each issue / impact is also assessed according to the various project stages, as follows:

- Planning;
- Construction;
- Operation; and
- Decommissioning.

Where necessary, the proposal for mitigation or optimisation of an impact should be detailed. A brief discussion of the impact and the rationale behind the assessment of its significance has also been included.

The significance of Cumulative Impacts should also be rated (As per the Excel Spreadsheet Template).

1.2.1 Rating System Used to Classify Impacts

The rating system is applied to the potential impact on the receiving environment and includes an objective evaluation of the possible mitigation of the impact. Impacts have been consolidated into one (1) rating. In assessing the significance of each issue the following criteria (including an allocated point system) is used:

Table 4: Rating of impacts criteria

ENVIRONMENTAL PARAMETER		
A brief description of the environmental aspect likely to be affected by the proposed activity (e.g. Surface Water).		
ISSUE / IMPACT / ENVIRONMENTAL EFFECT / NATURE		
Include a brief description of the impact of environmental parameter being assessed in the context of the project. This criterion includes a brief written statement of the environmental aspect being impacted upon by a particular action or activity (e.g. oil spill in surface water).		
EXTENT (E)		
This is defined as the area over which the impact will be expressed. Typically, the severity and significance of an impact have different scales and as such bracketing ranges are often required. This is often useful during the detailed assessment of a project in terms of further defining the determined.		
1	Site	The impact will only affect the site
2	Local/district	Will affect the local area or district

3	Province/region	Will affect the entire province or region
4	International and National	Will affect the entire country
PROBABILITY (P)		
This describes the chance of occurrence of an impact		
1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
2	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).
3	Probable	The impact will likely occur (Between a 50% to 75% chance of occurrence).
4	Definite	Impact will certainly occur (Greater than a 75% chance of occurrence).
REVERSIBILITY (R)		
This describes the degree to which an impact on an environmental parameter can be successfully reversed upon completion of the proposed activity.		
1	Completely reversible	The impact is reversible with implementation of minor mitigation measures
2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible and no mitigation measures exist.
IRREPLACEABLE LOSS OF RESOURCES (L)		
This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.		
1	No loss of resource.	The impact will not result in the loss of any resources.
2	Marginal loss of resource	The impact will result in marginal loss of resources.
3	Significant loss of resources	The impact will result in significant loss of resources.
4	Complete loss of resources	The impact is result in a complete loss of all resources.
DURATION (D)		
This describes the duration of the impacts on the environmental parameter. Duration indicates the lifetime of the impact as a result of the proposed activity.		
1	Short term	The impact and its effects will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase (0 – 1 years), or the impact and its effects will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	Medium term	The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
3	Long term	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 50 years).
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered transient (Indefinite).
INTENSITY / MAGNITUDE (I / M)		
Describes the severity of an impact (i.e. whether the impact has the ability to alter the functionality or quality of a system permanently or temporarily).		
1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.

2	Medium	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).
3	High	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.
4	Very high	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired (system collapse). Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.

SIGNIFICANCE (S)

Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. This describes the significance of the impact on the environmental parameter. The calculation of the significance of an impact uses the following formula:

Significance = (Extent + probability + reversibility + irreplaceability + duration) x magnitude/intensity.

The summation of the different criteria will produce a non-weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.

Points	Impact Significance Rating	Description
5 to 23	Negative Low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
5 to 23	Positive Low impact	The anticipated impact will have minor positive effects.
24 to 42	Negative Medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
24 to 42	Positive Medium impact	The anticipated impact will have moderate positive effects.
43 to 61	Negative High impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
43 to 61	Positive High impact	The anticipated impact will have significant positive effects.
62 to 80	Negative Very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
62 to 80	Positive Very high impact	The anticipated impact will have highly significant positive effects.

APPENDIX 4: LIST OF EXISTING AND PROPOSED RENEWABLE ENERGY PROJECTS

Project	DEA Reference No	Technology	Capacity	Status of Application / Development	Avifaunal specialist study conducted	Recommendations pertaining to avifauna
Allemans Fontein SEF	14/12/16/3/3/1/730	Solar	20MW	Approved	Yes	Micro-siting of infrastructure to avoid Blue Crane habitat. Strict control of construction activities to limit damage to the vegetation.
Carolus Poort SEF	14/12/16/3/3/1/729	Solar	20MW	Approved	Yes	Micro-siting of infrastructure to avoid Blue Crane habitat. Strict control of construction activities to limit damage to the vegetation.
Carolus Poort SEF	14/12/16/3/3/1/730	Solar	20MW	Approved	Yes	Micro-siting of infrastructure to avoid Blue Crane habitat. Strict control of construction activities to limit damage to the vegetation.
Gillmer SEF	14/12/16/3/3/1/735	Solar	20MW	Approved	No	Mark powerlines with bird flappers. Record electrocutions and collisions. Use bird-friendly tower designs.
Inkululeko SEF	14/12/16/3/3/1/553	Solar	20MW	Approved	No	None
Kleinfontein SEF	12/12/20/2654	Solar	20MW	Approved	No	None
Klip Gat SEF	14/12/16/3/3/2/354	Solar	75M	Approved	No	Mark powerlines with bird flappers. Do nest searches
Linde SEF	12/12/20/2258	Solar	40MW	In Operation	No	None
Linde SEF (Expansion)	14/12/16/3/3/1/1122	Solar	75MW	Approved	No	None
Middelburg Solar Park 1	12/12/20/2465/2	Solar	75MW	Approved	No	None
Middelburg Solar Park 2	12/12/20/2465/1	Solar	75MW	Approved	No	None
Naauw Poort SEF	14/12/16/3/3/2/355	Solar	75MW	Approved	No	Mark powerlines with bird flappers. Do nest searches
Toitdale SEF	12/12/20/2653	Solar	20MW	Approved	No	Do nest searches. Pre- and post-construction surveys

Noupoort Wind Farm	12/12/20/2319	Wind	188MW	In Operation	Yes	• Ensuring that key areas of conservation importance and sensitivity are avoided, in this instance slopes and potential funnels of bird flight activity. • Habitat destruction should be limited to what is absolutely necessary for the construction of the infrastructure, including the construction of new roads. In this respect, the recommendations from the Ecological Specialist Study (see Chapter 12 of the EIR) should be applied strictly. Personnel should be adequately briefed on the need to restrict habitat destruction, and must be restricted to the actual construction area. • The proposed power line should be routed as far as possible from high risk areas (e.g. Blue Crane nest, agricultural lands, and dams). In addition, the proposed alignment must be assessed for potential collision risks and those sections must be marked with Bird Flight Diverters. • The proposed pole design must be assessed by the author of this report to ensure that the power line design poses no potential electrocution risk of large raptors, particularly Martial Eagle, which may use the poles as hunting perches. • A 500m exclusion zone should be implemented around the existing Blue Crane breeding pair where no construction activity should take place. Ideally, construction of turbines within a 1km line of sight around the nest should not take place during the sensitive part of the breeding cycle i.e. October to December. • Once the turbines have been constructed, post-construction monitoring should be implemented as part of the continuation of the current monitoring programme, to assess displacement and actual collision rates. If actual collision and displacement levels are deemed too high, the following mitigation measures would need to be considered: - Negotiating appropriate off-set compensation for turbine related displacement and collision mortality; - As a last resort, halting operation of specific turbines during peak flight periods, or reducing rotor speed, to reduce the risk of collision mortality.

Phezukomoya WEF	14/12/16/3/3/1/1028	Wind	315MW	EIA in Process		• Restrict the construction activities to the wind farm construction footprint area. • Do not allow any access to the remainder of the property during the construction period. Measures to control noise and dust should be applied according to current best practice in the industry. • Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum • It is recommended that a 2.5km pre-cautionary no-go buffer is implemented around the Verreaux's Eagle nest at FP1 (31°12'59.66"S 24°57'26.08"). • The appointed Environmental Control Officer (ECO) should be trained by an avifaunal specialist to identify the signs that indicate possible breeding by priority species. The ECO must then, during audits/site visits, make a concerted effort to look out for such breeding activities of such species, and such efforts may include the training of construction staff to identify such species, followed by regular questioning of staff as to the regular whereabouts on site of the species. If any priority species are confirmed to be breeding (e.g. if a nest site is found), construction activities within 500m of the breeding site must cease, and the avifaunal specialist will be contacted immediately for further assessment of the situation and instruction on how to proceed. • Restrict the construction activities to the powerline construction footprint area. • Do not allow any access to the remainder of the property during the construction period. • Measures to control noise and dust should be applied according to current best practice in the industry. • Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum. • Use Alternative A or B for the 400kV turn-in to the proposed Umsobomvu MTS • The final powerline route should be assessed by the avifaunal specialist way of a walk-down to identify any priority species nests which could be impacted by the construction activities. Should a nest be discovered, the avifaunal specialist must have input into the construction schedule to assess how and which of the construction activities can be timed to minimize the disturbance potential to the occupants of the nest. • The final powerline design and associated electrocution mitigation measures (if necessary) must be approved and signed off by the avifaunal specialist. • The recommendations of the specialist ecological study must be strictly adhered to. Maximum used should be made of existing access roads and the construction of new roads should be kept to a minimum. • Following construction, rehabilitation of all areas disturbed (e.g. temporary access tracks and laydown areas) must be undertaken and to this end a habitat restoration plan is to be developed by a rehabilitation specialist. • Once the turbines have been constructed, post-construction monitoring should be implemented to compare actual collision rates with predicted collision rates. • The avifaunal specialist, in consultation with external experts and relevant NGO's such as BLSA, should determine annual mortality thresholds for priority anticipated to be at risk of collision mortality, prior to the wind farm going operational. • If actual collision rates exceed the pre-determined threshold levels, curtailment of turbines should be implemented for high risk situations. • A 150m no-turbine set-back buffer zone (infrastructure is allowed) is required around the escarpment to minimise the risk of collisions for slope soaring species. • It is recommended that a 2.5km pre-cautionary no-go buffer is implemented around the Verreaux's Eagle nest at FP1 (31°12'59.66"S 24°57'26.08"). • In addition, it is recommended that turbines 7, 62 and 63 are relocated to the top of the plateau as they pose a high collision risk on the slopes where they are situated. • Care should be taken not to create habitat for prey species that could draw priority raptors into the area and expose them to collision risk. Rock piles must be removed from site or covered with topsoil to prevent them from becoming habitat for Rock Hyrax (Dassie).

San Kraal WEF	14/12/16/3/3/1/1069	Wind	390MW	EIA in Process		• Restrict the construction activities to the wind farm construction footprint area. • Do not allow any access to the remainder of the property during the construction period. • Measures to control noise and dust should be applied according to current best practice in the industry. • Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum. • Implement a 500m no development buffer zone around each of the two pans at FP3 at31°14'15.02"S 25° 2'44.17"E and FP4 at 31°13'55.42"S 25° 2'50.37"E to protect the pair of Blue Cranes from disturbance. • The appointed Environmental Control Officer (ECO) should be trained by an avifaunal specialist to identify the signs that indicate possible breeding by priority species. The ECO must then, during audits/site visits, make a concerted effort to look out for such breeding activities of such species, and such efforts may include the training of construction staff to identify such species, followed by regular questioning of staff as to the regular whereabouts on site of the species. If any priority species are confirmed to be breeding (e.g. if a nest site is found), construction activities within 500m of the breeding site must cease, and the avifaunal specialist will be contacted immediately for further assessment of the situation and instruction on how to proceed. • The final powerline design and associated electrocution mitigation measures (if necessary) must be approved and signed off by the avifaunal specialist. • Once the turbines have been constructed, post-construction monitoring should be implemented to compare actual collision rates with predicted collision rates. • The avifaunal specialist, in consultation with external experts and relevant NGO's such as BLSA, should determine annual mortality thresholds for priority species anticipated to be at risk of collision mortality, prior to the wind farm going operational. • If actual collision rates exceed the pre-determined threshold levels, curtailment of turbines should be implemented for high risk situations. • A 150m no-turbine set-back buffer zone (infrastructure is allowed) is required around the escarpment to minimise the risk of collisions for slope soaring species. • Care should be taken not to create habitat for prey species that could draw priority raptors into the area and expose them to collision risk. Rock piles must be removed from site or covered with topsoil to prevent them from becoming habitat for Rock Hyrax (Dassie). • The final power line route should be assessed by way of a walk-through and those sections requiring Bird Flight Diverters (BFDs) must be identified. • Use the Preferred Alternative or Alternative 1 for the grid connection in order to avoid the No-Go zone around the Verreaux's Eagle nest at FP1.

Umsobomvu WEF	14/12/16/3/3/2/730	Wind	140MW	Approved		• No infrastructure should be built in the areas identified as HIGH sensitivity. • There may be a requirement to avoid construction of certain infrastructure during Verreaux's Eagle breeding season (approximately May to September-October). This will be determined by the avifaunal walk through prior to construction and once the infrastructure layout is final. All power line linking the turbines and linking turbine strings to the on-site substation should be placed underground. • The power line linking the site to the Eskom grid will be above ground but must conform to all Eskom standards in terms of bird friendly pole monopole structures with Bird Perches on every pole top (to mitigate for bird electrocution), and anti-bird collision line marking devices (to mitigate for bird collision). It is particularly important that the collision mitigation devices used are durable and remain in place on the line for the full lifespan of the power line. It will be InnoWind/Eskom's responsibility to maintain these devices in effective condition for this period. • Systematic patrols of this power line should be conducted during post construction bird monitoring for the wind energy facility, in order to monitor the impacts, the effectiveness of mitigation, and the durability of the mitigation measures. • An avifaunal walk down will need to be conducted to assess the route of this power line once available. • A final avifaunal walk through should be conducted prior to construction to ensure that all the avifaunal aspects have been adequately managed and to ground truth the final layout of all infrastructure. This will most likely be done as part of the site specific Environmental Management Plan. This will also allow the development of specific management actions for the Environmental Control Officer during construction and training for relevant on site personnel if necessary. • The post-construction bird monitoring programme outlined by this report should be implemented by a suitably qualified avifaunal specialist, in accordance with the latest available best practice guidelines at the time (see Jenkins et al. 2014). As mentioned above this monitoring should include the grid connection power line. • The findings of post-construction monitoring should be used to measure the effects of this facility on birds. If significant impacts are identified the wind farm operator will have to identify and implement suitable mitigation measures.

SiVEST

Appendix 6C

Geotechnical

UMSOBOMVU PV ENERGY FACILITIES
GEOTECHNICAL DESKTOP STUDY

APRIL 2019
REVISION 1

Prepared for:

MOOI PLAATS SOLAR POWER (PTY) LTD
WONDERHEUVEL SOLAR POWER (PTY) LTD
PAARDE VALLEY SOLAR POWER (PTY) LTD

and

Prepared by:

JG AFRIKA (PTY) LTD

Johannesburg
JG Afrika House,
37 Sunninghill Office Park
Peltier Drive
Sunninghill
2191

Telephone: + 27 11 231 2200

Email: jhb@JGAfrika.com

Project director: Cecilia Canahai

VERIFICATION PAGE

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UMSOBOMVU PV ENERGY FACILITIES
GEOTECHNICAL DESKTOP STUDY

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CARRIED OUT BY:	COMMISSIONED BY:
JG AFRIKA (PTY) LTD JG Afrika House 37 Sunninghill Office Park, Peltier Drive Sunninghill 2191 Tel.: +27 11 231 2200 Email: jhb@jgafrika.com	**SIVEST Environmental Division** Sivest 51 Wessels Road Rivonia 2128 Tel.: +27 11 798 0638 Email: AndreaG@sivest.co.za
AUTHOR	**CLIENT CONTACT PERSON**
S Kullen	Andrea Gibb

SYNOPSIS

High-level geotechnical desktop study for the proposed Umsobomvu PV Facility.

KEY WORDS:

Solar Energy, Geotechnical Study, Umsobomvu, Inxuba Yethemba, Northern Cape, Eastern Cape, South Africa

QUALITY VERIFICATION

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

Verification	Capacity	Name	Signature	Date
By Author	Engineering Geologist	S. Kullen		24/04/2019
Checked by:	Associate	S. Bok Pr. Sci. Nat		24/04/2019
Authorised by:	Technical Director	C. Canahai Pr. Sci. Nat		24/04/2019

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National Environmental Management Act, 1998 (Act No. 107 of 1998) and Environmental Impact Regulations 2014 (as amended) Requirements for Specialist Reports (Appendix 6)

Section in EIA Regulations 2014 (as amended)		**Clause**	**Section in Report**
Appendix 6	(1)	A specialist report prepared in terms of these Regulations must contain —	
	(a)	details of –	
		(i) the specialist who prepared the report; and	Verification Page
		(ii) the expertise of that specialist to compile a specialist report including a curriculum vitae.	Annexure B
	(b)	A declaration that the person is independent in a form as may be specified by the competent authority;	Declaration of interest form
	(c)	An indication of the scope of, and the purpose for which, the report was prepared;	1, 2
	(cA)	An indication of the quality and age of base data used for the specialist report;	11
	(cB)	A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Non-Applicable
	(d)	The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Non-Applicable
	(e)	A description of the methodology adopted in preparing the report or carrying out the specialised process; inclusive of equipment and modelling used;	5
	(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;	7, 8, 9
	(g)	An indication of any areas to be avoided, including buffers;	7
	(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;	7
	(i)	A description of any assumptions made and any uncertainties or gaps in knowledge;	1,8
	(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 or activities;	8, 9, 10
	(k)	Any mitigation measures for inclusion in the EMPr;	8
	(l)	Any conditions for inclusion in the environmental authorization;	8
	(m)	Any monitoring requirements for inclusion in the EMPr or environmental authorization;	8
	(n)	A reasoned opinion –	
		(i) as to whether the proposed activity, activities or portions thereof should be authorized;	8, 9
		(iA) regarding the acceptability of the proposed activity or activities; and	8, 9
		(ii) if the opinion is that the proposed activity, activities or portions thereof should be authorized, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	9

	(o)	A description of any consultation process that was undertaken during the course of preparing the specialist report;	Non-Applicable
	(p)	A summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	Non-Applicable
	(q)	Any other information requested by the authority.	Non-Applicable
	(2)	Where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	Non-Applicable

UMSOBOMVU PV ENERGY FACILITIES

GEOTECHNICAL DESKTOP STUDY

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ANNEXURES

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Annexure B: SPECIALIST'S CURRICULUM VITARUM

UMSOBOMVU PV ENERGY FACILITIES GEOTECHNICAL DESKTOP STUDY

1 INTRODUCTION

This report presents the high-level, scoping phase, geotechnical desktop study, undertaken for SiVEST Environmental Division, for the proposed construction of Photovoltaic (PV) Energy Facilities. The proposed development crosses the Northern Cape / Eastern Cape provincial border and comprises of three PV Energy facilities with associated grid infrastructure.

The information provided in this report is based on published geological maps, published geological and geotechnical information, the interpretation of aerial photography and the review of existing environmental study reports. Site verification was not undertaken. This information is provided for planning purposes only and as part of the environmental Basic Assessment process.

2 PROJECT DESCRIPTION

We understand that the scoping phase geotechnical desktop study will form part of the Environmental Impact Assessment to be undertaken by the Sivest Environmental Division. From the information provided by Sivest, there are three proposed PV facilities (with associated grid infrastructure) namely; Mooi Plaats Solar PV Facility, Wonderheuvel Solar PV Facility and Paarde Valley Solar PV Facility. These facilities are to comprise of:

- PV fields (arrays) comprising multiple PV panels. The number of panels, the generation capacity of each facility and the layout of the arrays will be dependent on the outcome of the specialist studies conducted during the EIA process.
- PV panels will be either fixed tilt mounting or single axis tracking mounting, and the modules will be either crystalline silicon or thin film technology. Each panel will be approximately 2m wide and between 1m and 4m in height, depending on the mounting type.
- Internal roads, between 4m and 10m wide, will provide access to the PV arrays. Existing site roads will be used wherever possible, although new site roads will be constructed where necessary.
- Each PV facility will include up to two temporary construction laydown/staging areas of approximately 10ha each.
- Operation and maintenance (O&M) buildings will be provided for each PV field, occupying a site of approximately 2 500m^2 (50m x 50m).
- Medium voltage cabling will link the PV plant to the grid connection infrastructure. These cables will be laid underground wherever technically feasible.

There are two grid alternatives (referred to as corridor options) proposed for each facility. These corridor options will be comparatively assessed from a geotechnical perspective. The proposed grid infrastructure for each facility is being assessed as part of a separate BA application. The grid connections will comprise of:

- New on-site substations and collector substations to serve each PV facility, each occupying an area of up to 4ha.
- A new 132kV overhead power line connecting the on-site substations or collector substations to either Hydra D Main Transmission Substation (MTS) or the proposed Coleskop Wind Energy Facility (WEF) Substation, from where the electricity will be fed into the national grid. The type of power line towers being considered at this stage are to include both lattice and monopole towers, which will be up to 25m in height.

The scoping phase geotechnical desktop study will comprise of an Impact Assessment (from a geotechnical /geological perspective) of each proposed PV facility, a Comparative Assessment of the grid alternatives and a Cumulative Impact Assessment for each proposed PV facility (should other Energy facility / large infrastructure be developed within a 35 km radius).

3 APPOINTMENT

JG Afrika submitted a quotation on the 18th September 2018 to Sivest and were appointed via email, by Sivest's Andrea Gibb, on the 11th January 2019.

4 AVAILABLE INFORMATION

Sivest provided the location of the three proposed sites with associated grid infrastructure alternatives. No other detailed drawings or designs were available at the time of undertaking this scoping phase report.

The following sources of information were used during the study:

- 1:250 000 scale Geological Map titled 3124 Middleburg published by the Council for Geoscience.
- Engineering Geology of South Africa Volume 4 (Brink, 1985).
- Aerial photography (Google Earth imagery).

5 METHODOLOGY

Sivest provided the following guidelines / format for assessing the sites and grid infrastructure:

- "Proposed Umsobomvu Solar PV Energy Facilities Comparative Assessment of Alternatives Grid Connection Infrastructure"
- "Updated Environmental Impact Assessment Methodology_Ver1 - 2019 SJ"

Areas with steep slopes and potential talus deposits were identified using available satellite imagery and 20m contour data.

6 SITE LOCATION

Three areas have been identified for the proposed PV facilities namely; Mooi Plaats Solar PV Facility, Wonderheuvel Solar PV Facility and Paarde Valley Solar Facility. These areas lie adjacent to each other, in a north east / south west trending line, and are located approximately 35 km north west of Middelburg and 31 km south west of Noupoort. The entire study area crosses over the Northern Cape / Eastern Cape provincial border. The following location information was provided by Sivest:

- Mooi Plaats Solar PV Facility, on an application site of approximately 5 303ha, comprising the following farm portions:
    - Portion 1 of Leuwe Kop No 120
    - Remainder of Mooi Plaats No 121

- Wonderheuvel Solar PV Facility, on an application site of approximately 5 652ha, comprising the following farm portions:
    - Remainder of Mooi Plaats No 121
    - Portion 3 of Wonder Heuvel No 140
    - Portion 5 of Holle Fountain No 133

- Paarde Valley Solar PV Facility, on an application site of approximately 2 631ha, comprising the following farm portion:
    - Portion 2 of Paarde Valley No 62

Note that the Remainder of Mooi Plaats No 121 forms part of both the Mooi Plaats Solar PV Facility and Wonderheuvel Solar PV Facility i.e., there is overlap between these sites.

As mentioned above, two corridor options are to be comparatively assessed for each PV facility:

- Mooi Plaats Solar PV Grid Connection
    - Corridor Option 1 is approximately 13kms in length, linking Substations 1 and 2 to Hydra D MTS.
    - Corridor Option 2 is approximately 27kms in length, linking Substations 1 and 2 to Hydra D MTS via the proposed Central Collector substation located on the Wonderheuvel PV project application site.

- Wonderheuvel Solar PV Grid Connection
    - Corridor Option 1 involves two separate grid connections to serve the northern and southern sectors of the application site. The northern connection is approximately 18kms in length, linking the proposed on-site Substation 3 to Hydra D MTS, via the Northern Collector substation. The southern connection is approximately 17kms in length, linking Substation 4 to the proposed Coleskop WEF substation, via the Southern Collector substation located on the Paarde Valley PV project application site.
    - Corridor Option 2 is approximately 20kms in length, linking Substations 3 and 4 to Hydra D MTS, via the proposed Central Collector substation, located on the Wonderheuvel PV project application site.

- Paarde Valley Solar PV Grid Connection
    - Corridor Option 1 is approximately 14kms in length, linking Substation 6 to the proposed Coleskop WEF substation. via the Southern Collector substation.

- Corridor Option 2 is approximately 26kms in length, linking Substations 5 and 6 to Hydra D MTS, via the proposed Central Collector substation located on the Wonderheuvel PV project application site.

A regional locality map is provided in Figure 1 and locality maps showing the locations of the proposed PV facilities with corresponding corridor options are provided in Figures 2 to 4.

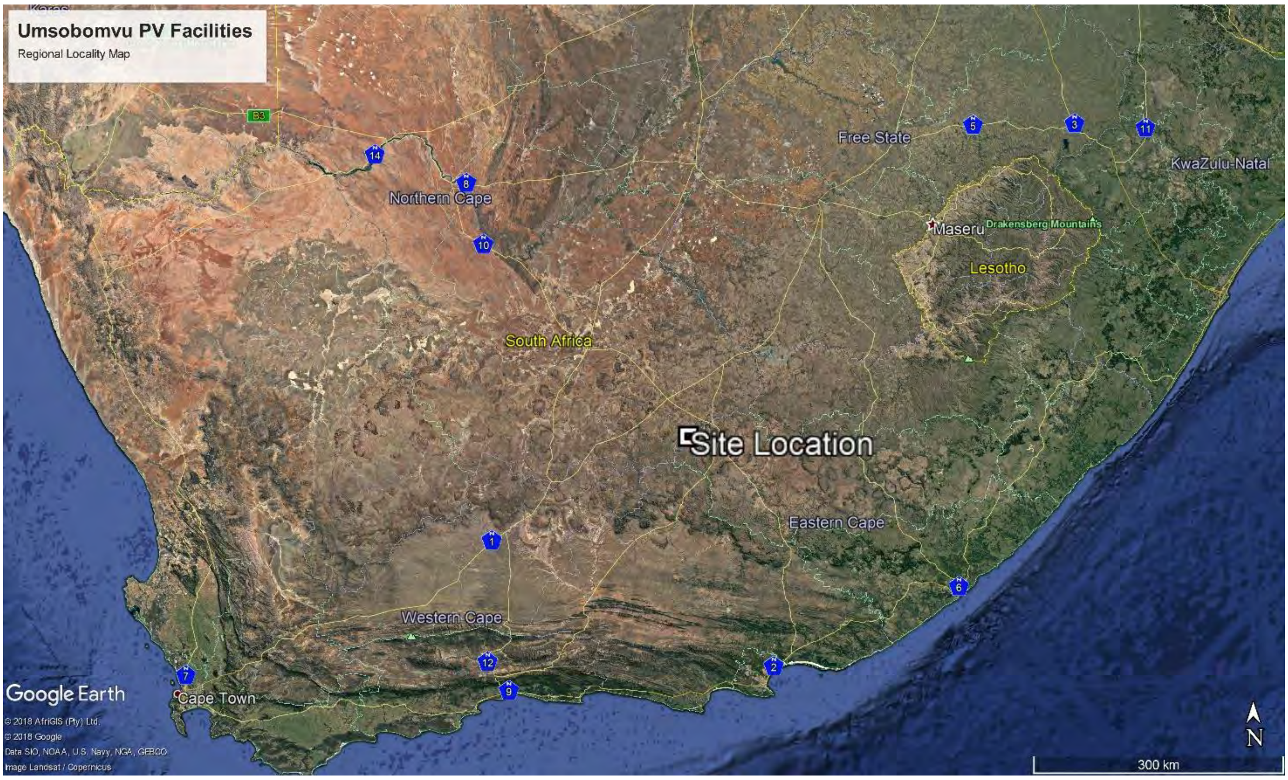

Figure 1 Regional Location Map (Google Earth)

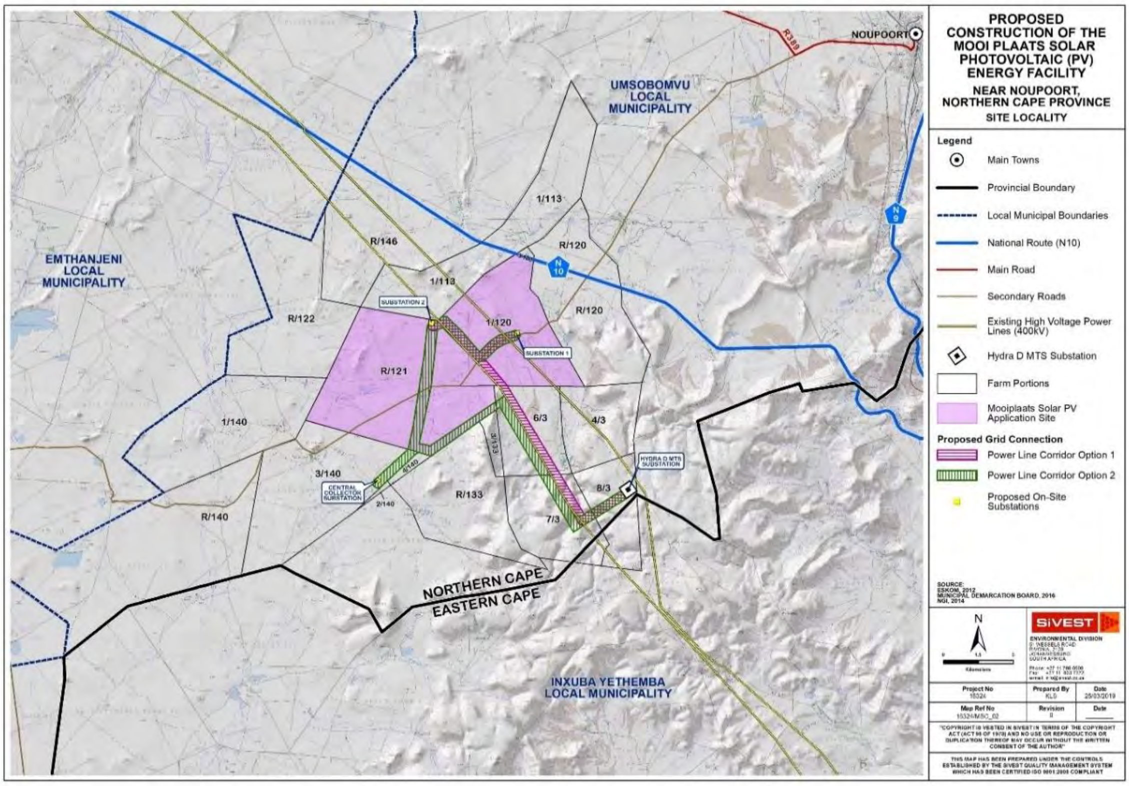

Figure 2 Mooi Plaats PV Facility Locality Map (as provided by Sivest)

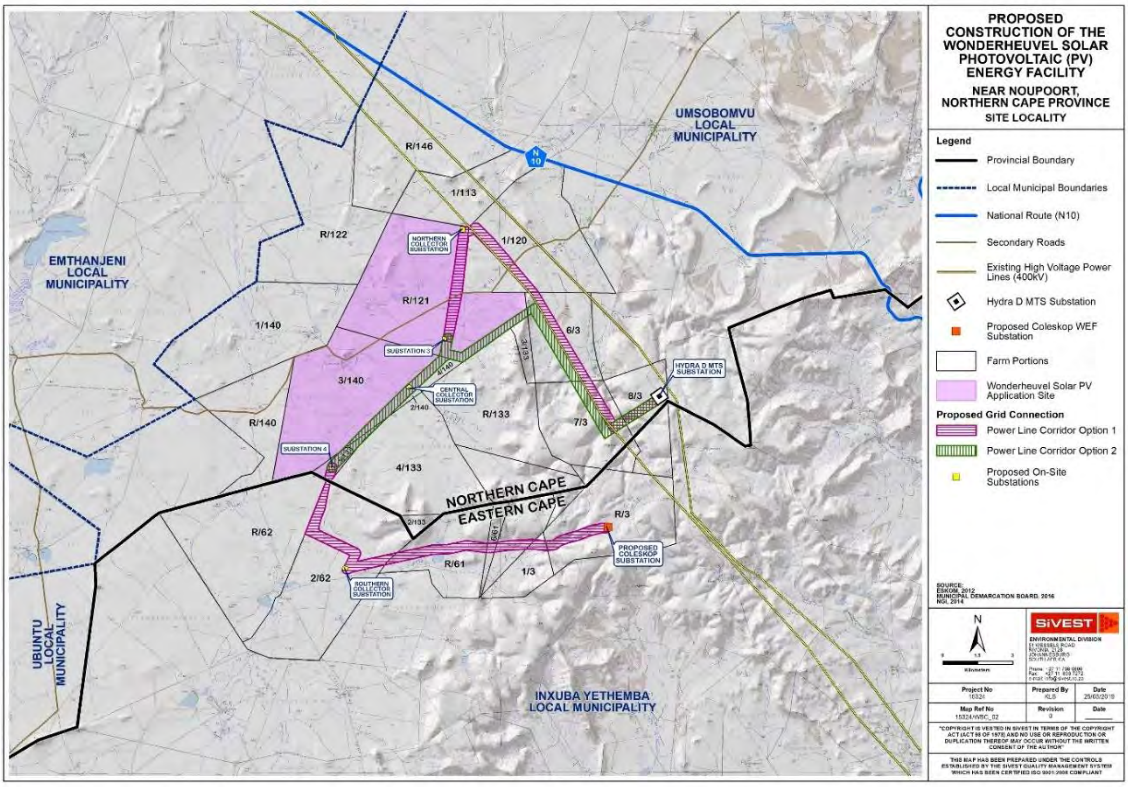

Figure 3 Wonderheuvel PV Facility Locality Map (as provided by Sivest)

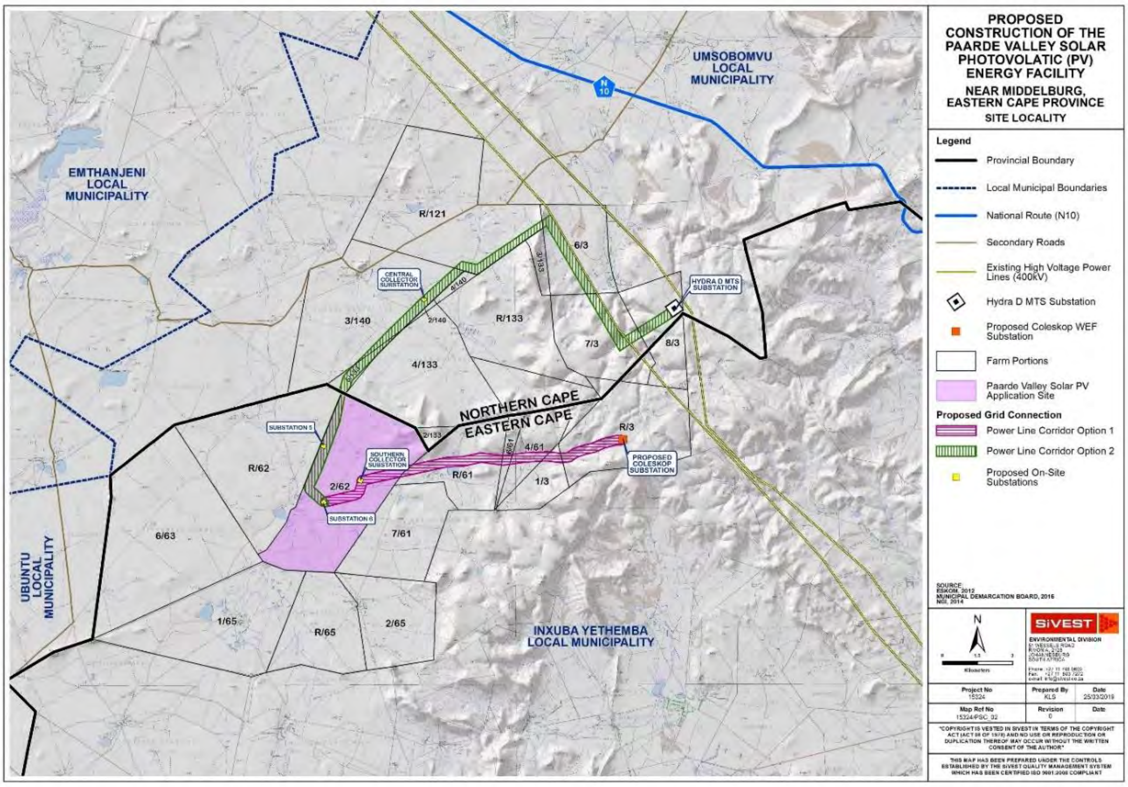

Figure 4 Paarde Valley PV Facility Locality Map (as provided by Sivest)

7 SITE CONDITIONS

7.1 Geology

According to the 1:250 000 series Geological Map 3124 Middelburg, the entire study area is predominantly underlain by sedimentary rock units of the Adelaide Subgroup and the Katberg Formation (which forms part of the Tarkastad Subgroup). The Adelaide Subgroup is overlain by the Tarkastad Subgroup. Together these Subgroups make up the Beaufort Group, which forms part of the Karoo Supergroup. The sedimentary rocks are often intruded by volcanic rocks - dolerite, of the Jurassic age. In addition to the above rock types, the study area is also underlain by scattered quaternary deposits associated with valley lines and lower lying areas.

The geology and stratigraphy of the site is given in Table 1 below.

Table 1 Geology and Stratigraphy of the site

Stratigraphy	**Map Symbol**	**Lithology**
Quaternary		Alluvium, Colluvium
Quaternary	**Qc**	Calcrete
Jurassic	**Jd**	Dolerite
Katberg Formation, Tarkastad Subgroup, Beaufort Group, Karoo Supergroup	**Rk**	Sandstone, Mudrock
Adelaide Subgroup, Beaufort Group, Karoo Supergroup	**Pa**	Mudrock, subordinate sandstone

The geological map of the study area is depicted in Figure 5 overleaf.

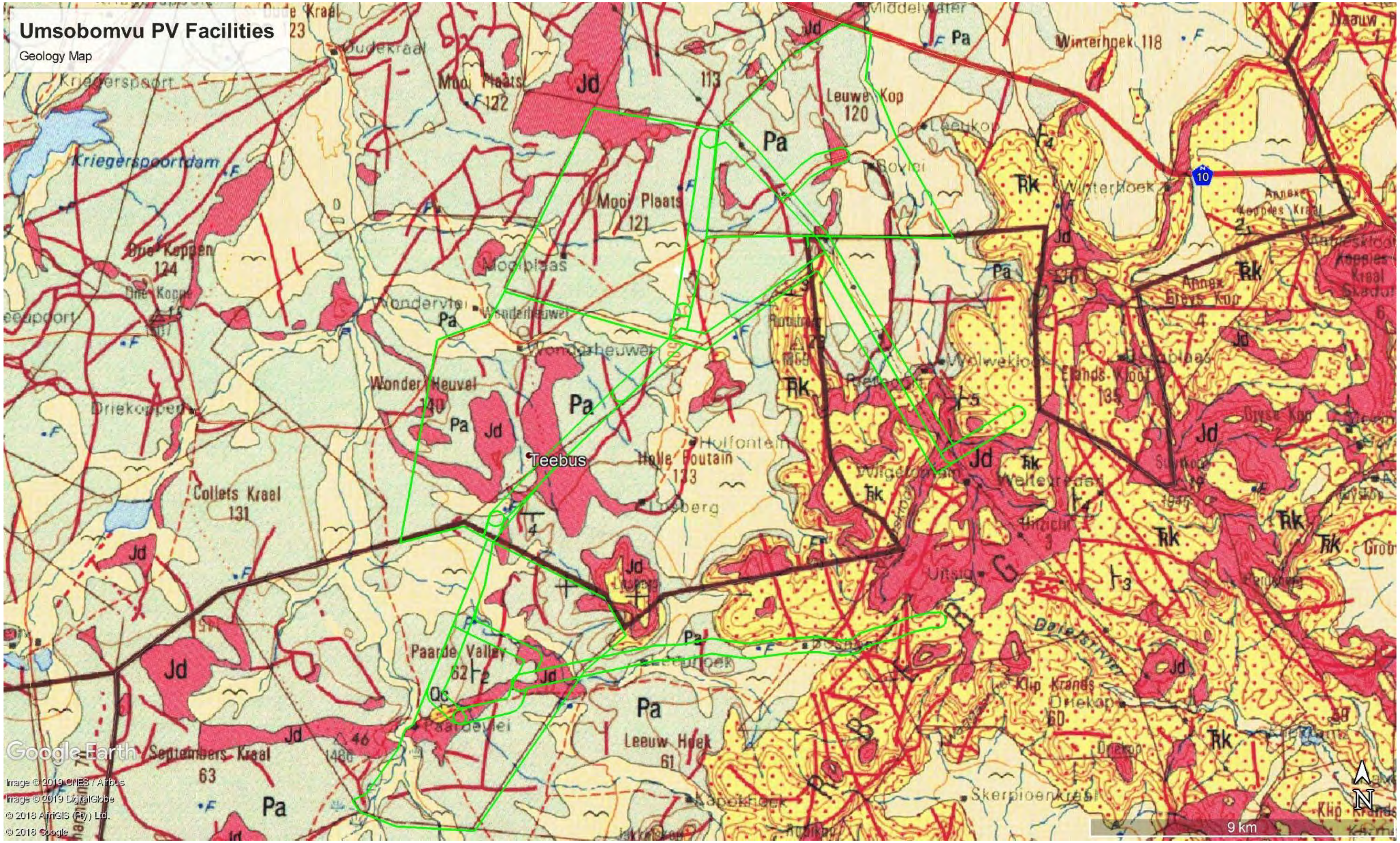

Figure 5 Geology Map

7.2 Topography and Drainage

From satellite imagery, it is observed that all three sites exhibit similar topography. The general topography of area is gentle with localised undulations, hills and occasional koppies. There are scattered hilly/mountainous regions with steep slopes in the study area. Brink (1979) mentions 4 slope elements on concave slopes namely; crest, free face, talus and foot slope. Talus deposits are a type of colluvial deposits that accumulate on talus element of slopes. Numerous rock outcrops and potential talus deposits were identified and highlighted in red in Figures 6 - 8.

Various localised drainage features are to be expected given the undulating nature of the topography. The topographical and drainage features will need to be confirmed by site investigation.

7.2.1 Mooi Plaats PV Facility

The topography is generally mildly undulating, with a few isolated ridges and koppies. There are numerous scattered rock outcrops. Talus deposits can be anticipated on the slopes of ridges and koppies. A water point/spring (with small reservoir) was identified in the north eastern section of the study area. A prominent drainage feature / river (approximately east-west trending) was identified in the central region of the site. Another drainage feature borders the eastern boundary of the site.

7.2.1.1 Mooi Plaats Grid Option 1

The northern section of the corridor has generally mildly undulating topography with a few isolated ridges. Talus deposits can be anticipated on the slopes of ridges and koppies (see red outlined areas).

The southern portion of the corridor traverses a number of drainage features as it moves into a hilly / mountainous region in the south. Thereafter it is making a turn to the north east and crosses a prominent drainage feature before meeting the Hydra D substation.

7.2.1.2 Mooi Plaats Grid Option 2

The northern and southern sections of the Option 2 corridor overlap or runs parallel to a large extent to sections of Option 1. Therefore, in the north, the topography is generally mildly undulating topography with a few isolated ridges. Talus deposits can be anticipated on the slopes of ridges and koppies (see red outlined areas). In the south the corridor traverses several drainage features as it moves into a hilly / mountainous region in the south. Thereafter it is making a turn to the north east and crosses a prominent drainage feature before meeting the Hydra D substation

The middle section moves to the south west towards the central collector substation from where it moves back north east to join the southern section of the corridor. The topography is mildly undulating, except for a ridge roughly in the middle of the section (see red outlines on Figure 4).

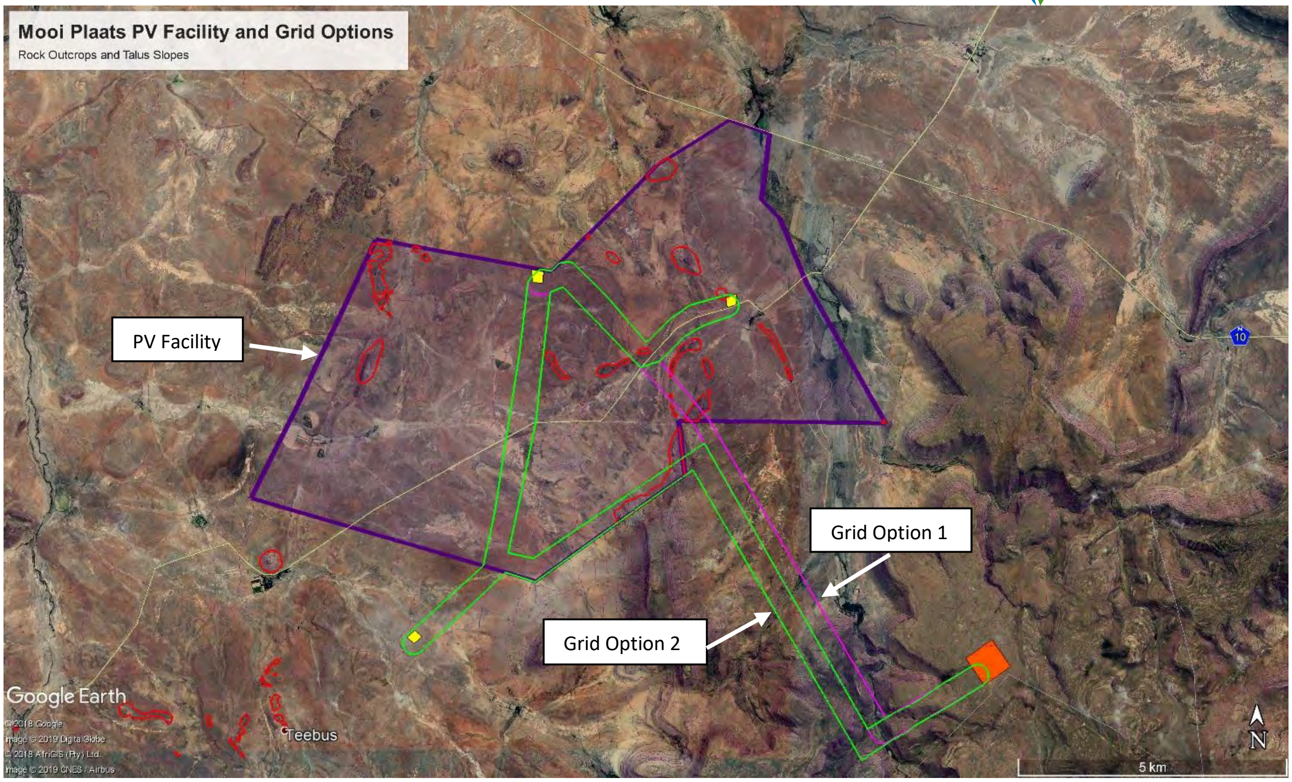

Figure 6 Mooi Plaats PV Facility and Grid Options Rock Outcrops and Talus Slopes

7.2.2 Wonderheuvel PV Facility and Grid Infrastructure

The topography is generally mildly undulating with a few localised ridges and koppies scattered across the site. There are a number of scattered outcrops/boulders across the site (especially in the north western corner of the site). A hilly/ mountainous region was identified in the north eastern section of the site. A prominent ridge was also identified in the north western section of the site. Steep slopes and talus may be expected in these areas. Prominent drainage features / rivers were identified in the central and northern region of the site.

7.2.2.1 Wonderheuvel Grid Option 1

Grid Option 1 consists of two limbs a northern and a southern limb. The northern limb has predominantly mildly undulating topography with a few isolated ridges and koppies and drainage valleys especially in the north. Towards the south, the corridor traverses over a prominent drainage feature before it moves into a mountainous/hilly region, towards the Hydra D substation.

The southern limb of the corridor has very similar topography in the west i.e. mildly undulating with a few isolated ridges. Moving east, the corridor tends to follow existing valley lines with steep side slopes before it climbs to the Coleskop Substation. Talus deposits may be expected in this region. The extreme eastern section, close to the Coleskop Substation, traverses a hilly/mountainous region. Steep slopes and talus deposits may be expected.

7.2.2.2 Wonderheuvel Grid Option 2

Corridor Option 2 runs in a north easterly direction with predominantly mildly undulating topography with a few isolated ridges and koppies. Boulders and/or a possible rock outcrop was identified in the southern most region of the corridor. The corridor route traverses a hilly / mountainous region in the northern section, just before the route makes a turn to the south east, form where it follows parallel to Option 1 northern limb, and at the eastern most section overlaps with Option 1 northern limb. Steep slopes and talus deposits may be expected in this region. The eastern/south eastern portion of the corridor, as it meets the Hydra D substation, has a hill/mountainous topography. Steep slopes and talus deposits may be expected in this region. Option 2 traverses a number of drainage features in the southern, central and northern sections.

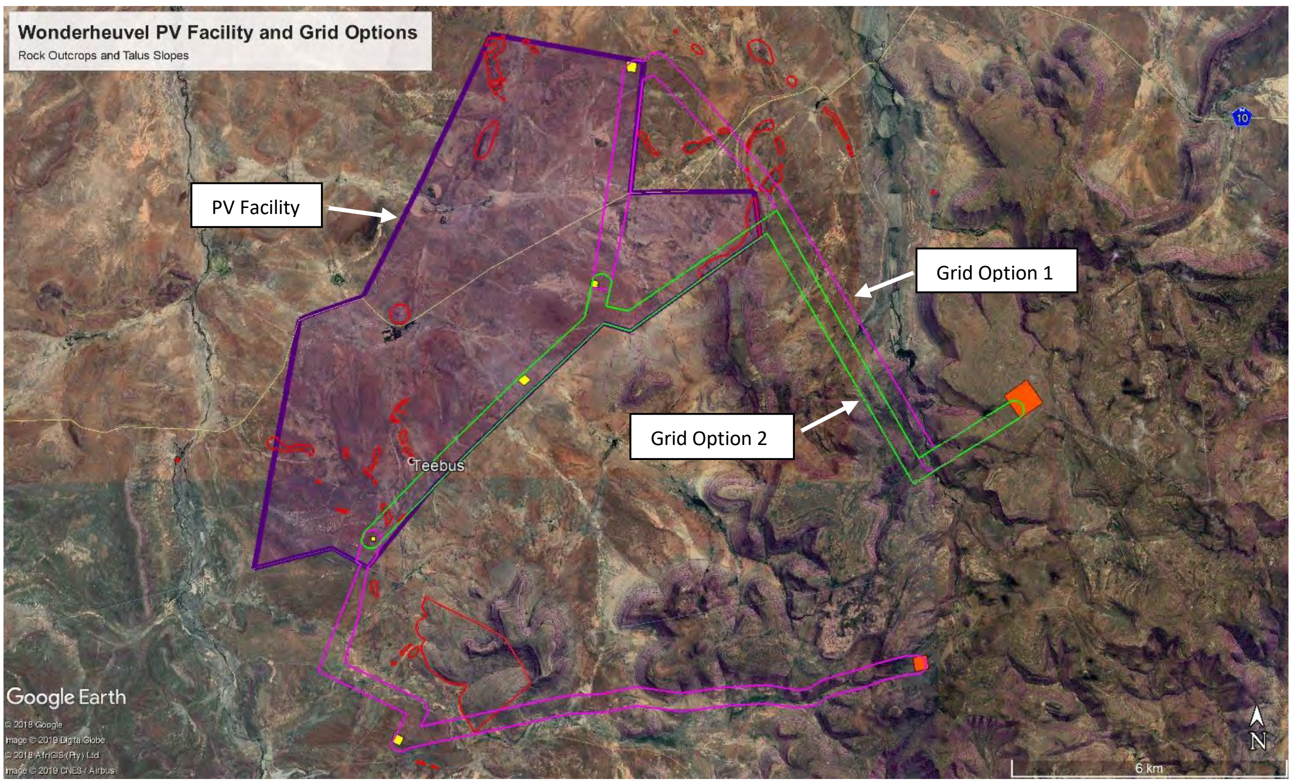

Figure 7 Wonderheuvel PV Facility and Grid Options Rock Outcrops and Talus Slopes

7.2.3 Paarde Valley PV Facility and Grid Infrastructure

The topography is generally mildly undulating with a few localised ridges and koppies scattered across the site. There are a number of scattered outcrops/boulders across the site. The north eastern section of the site is situated on a hilly/mountainous zone with steep slopes. There could potentially be talus deposits in this hilly region.

There are a number of drainage features in the southern, central and north eastern regions of the site. A prominent river channel runs parallel to the south western border of the proposed site. The site may be located in or in close proximity to the river flood plains. An approximately east-west trending stream/ small river was identified in the northern region of the study area.

7.2.3.1 Paarde Valley Grid Option 1

The extreme western portion of the Option 1 corridor has mildly undulating topography with a few isolated ridges. Moving east, the corridor traverses and then runs parallel to a stream/ small river. The central and eastern portion of the corridor runs along a valley flanked by steeper side slopes. Talus deposits (on side slopes) or alluvial deposits (in the valley bottoms) may be expected in this region. The extreme eastern section, close to the Coleskop Substation, traverses a hilly/mountainous region. Steep upslopes and talus deposits may be expected.

7.2.3.2 Paarde Valley Grid Option 2

Corridor Option 2 runs in a north easterly direction with predominantly mildly undulating topography with a few isolated ridges and koppies. Boulders and/or a possible rock outcrop was identified in the southern/central region of the corridor. The corridor route traverses a hilly / mountainous region in the northern section with a steep valley, just before the route makes a turn to the south east. Steep slopes and talus deposits may be expected in this mountainous region. The eastern/south eastern portion of the corridor, before it meets the Hydra D substation, has a steep hilly/mountainous topography with incised valleys. Steep slopes and talus deposits may be expected in this region. The grid Option 2 traverses a number of drainage features in the southern, central and northern sections.

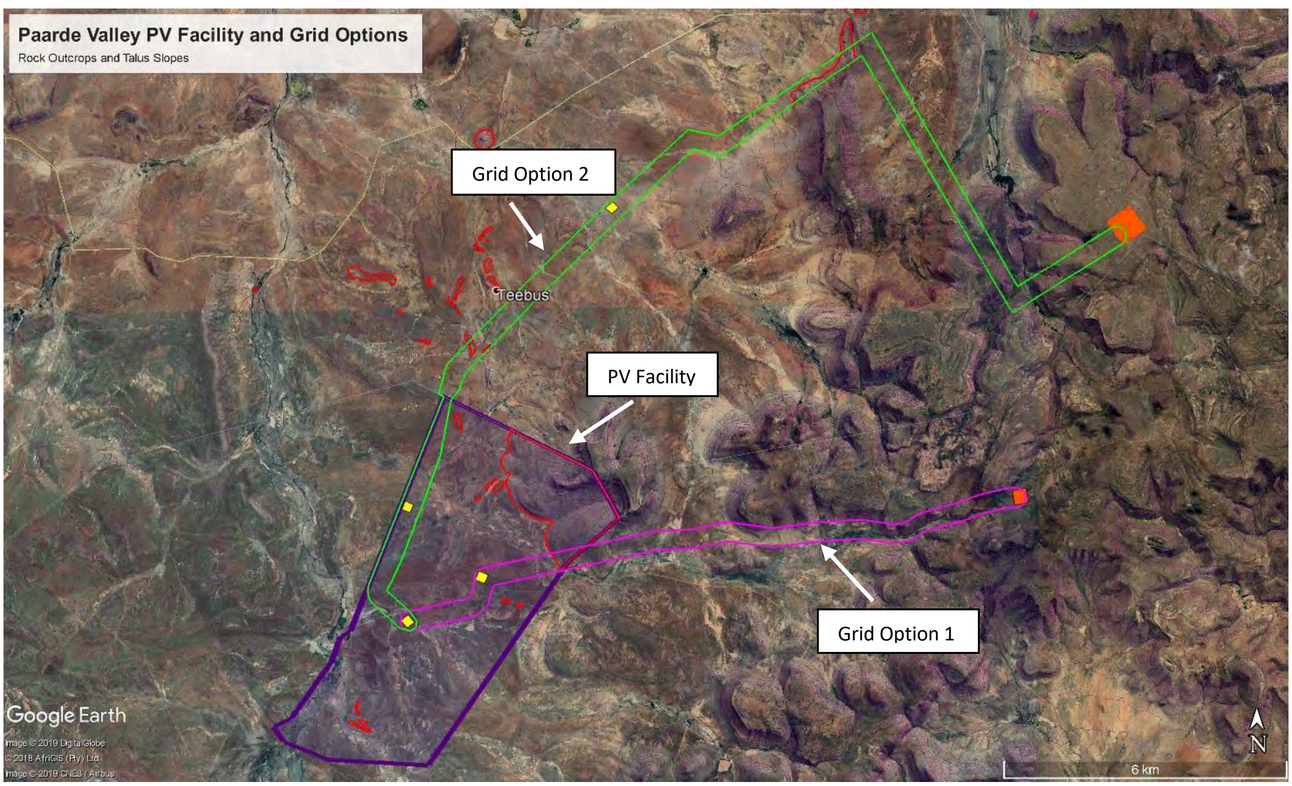

Figure 8 Paarde Valley PV Facility and Grid Options Rock Outcrops and Talus Slopes

7.3 Climate

The climatic regime plays a fundamental role in the development of a soil profile. Weinert (1964) demonstrated that mechanical disintegration is the predominant mode of rock weathering in areas where his climatic “N-value” is greater than 5, while chemical decomposition predominates where the N-value is less than 5. Weinert’s climatic N-value for the site ranges between 5 – 10. This implies that mechanical disintegration is the dominant mode of weathering at the site.

7.4 Geotechnical Characteristics and Potential Constraints

From the 1:250 000 Geology map, the following near surface conditions may be encountered on site:

7.4.1 Beaufort Group

The Beaufort Group, which forms part of the Karoo Supergroup, is represented by the Adelaide Subgroup across all six sites. As mentioned above, the Adelaide Formation is comprised of mud stone with subordinate sandstone. The geotechnical characteristics of these rock types are discussed below:

7.4.2 Sandstone

The sandstones of the Karoo Supergroup are closely intercalated with mudrock. The sandstones usually poorly sorted (often containing rock fragments) and have a matrix comprised of clay or iron oxide, and occasionally calcite.

Due to the local climatic conditions, mechanical disintegration is the predominate form of weathering. This typically results in the formation of a relatively thin residual soil mantle overlying the bedrock.

Brink (1983) highlights this variability in the Beaufort Group, where similarly aged thick quartz rich (more resistant to weathering) sandstones are found adjacent to thin, poorly sorted sandstone.

Karoo Sandstone is also noted for have a non-uniform weathering pattern. Dense competent layers are sometimes underlain by less competent layers of lower consistency, therefore, founding conditions in feldspathic sandstones may not always improve with depth (Brink, 1983).

Slope instability may also be encountered in the Karoo sandstones. Brink (1983) notes four main instability types namely; Disintegration of intercalated mudrock, Pore water pressures on intercalated siltstone, Erosion of underlying strata and Block and wedge failures. Slope instability will be assessed during the detailed site investigation however, weathering and erosion of the intercalated mudstone and block/wedge failures are anticipated be the primary instability types.

7.4.3 Mudrock

The mudrocks of the Karoo Supergroup are known to break down upon exposure. The mechanisms of breakdown are still unclear, however changes in temperature, humidity, moisture content and stress relief are believed to be possible causes. Three main responses to the breakdown are highlighted by Brink (1983) namely; very little break down of the rock, disintegration of the rock into pieces of various sizes and shapes and lastly, slaking into silt and clay sized particles.

Brink (1983) also noted moisture content related volumetric changes in the Karoo mudrock. Fresh mudrock samples from the Beaufort group were observed to swell upon exposure to water. This property should be considered when founding any structures in or in close proximity to flood plains.

Slope instability may also be encountered in the Karoo mudrock. Brink (1983) highlight two main types of instability namely: the movement of completely weathered / colluvial material and the sliding of rock on bedding planes. Although these instability events were predominantly noted in Kwa Zulu Natal, care should be taken when working with cuttings and long / deep excavations. As mentioned above, mudrock is closely intercalated with sandstone. Undercutting of more weathering resistant sandstone may also occur, which could cause slope instability.

Due to the dry climate, a deep weathering profile/thick residual soils are not expected on site. Residual mudrock soils are also known to be potentially expansive and laboratory tests will need to be undertaken to confirm this.

7.4.4 Dolerite

The Karoo Supergroup contains many Jurassic aged dolerite intrusions. The magma predominantly intruded into the weaker argillaceous horizons in the form of sills and occasionally dykes (Brink, 1983).

Fresh/solid dolerite typically forms boulder/fractured dolerite during the initial stages of weathering. Due to mechanical breakdown being the predominate form of weathering in this region, further weathering results in the formation of gravel and/or granular dolerite with sandy soils (Brink, 1983).

Founding conditions on residual dolerite are generally non-problematic in areas with a dry climate. Care should be taken in areas with calcrete, as calcrete powder has being noted to increase the Plasticity Index of the residual dolerite (Brink, 1983).

Dolerite boulders will cause difficult excavation conditions due to their size and scattered occurrences. Hard excavation conditions are also expected in areas with shallow bedrock. Additional site clearing may be required to remove boulders from potential development sites.

Potentially unstable talus deposits formed from dolerite corestones may be encountered on slopes.

Weathered dolerite may be targeted for use during construction of internal roads etc. The identification of potential borrow pits and the usage of the dolerite for construction material will need to be confirmed during a more comprehensive site investigation with laboratory testing.

Figure 9 Dolerite weathering profile with corestones and surface boulders (N10 near the Mooi Plaats site – Google Earth)


Figure 10 Dolerite profile with boulders on the surface (N10 near the Mooi Plaats site – Google Earth)


Figure 11 Dolerite Ridge with Boulders on surface (N10 near the Mooi Plaats site– Google Earth)

7.4.5 Quaternary Deposits

7.4.5.1 Alluvium / Colluvium/Talus

Alluvial deposits are created when sediments are transported and deposited by water. Alluvial deposits may be quite thick, variable in composition and be prone to settlement.

Colluvial deposits are created when sediments are transported and deposited by gravity. As mentioned above, talus deposits are a type of colluvial deposits that accumulate on talus element of slopes Talus deposits generally occur where there are steep slopes below a stronger caprock. The caprock on this site is expected to be dolerite and/or sandstone. Talus deposits accumulate at their natural angle of repose and the upper part of talus slopes have a factor of safety that is close to 1.0. Due to weathering and colluvial action, talus deposits are generally poorly sorted, with large/coarse particles occurring with a finer matrix. The finer matrix has less strength than the surrounding unweathered rock fragments/debris, therefore the properties of this matrix influence the stability of the slope. With time, deterioration and weathering of the talus deposits results in instability. In addition to potential slope instability, difficult excavation conditions may be expected due to the large unweathered boulders.

7.4.5.2 Calcrete

According to the geology map, calcrete underlies a small portion of the proposed Paarde Valley PV facility and the associated grid options.

Calcrete is a deposit formed when soils have been cemented and/or replaced by carbonates. Calcretes are either formed by percolating groundwater or by pedogenic methods. Calcrete deposits may have thicknesses of over 30 m, however they are usually not continuous over depths exceeding 1 – 2 m (Brink, 1979).

Caution should be exercised when founding heavy structures on pedocretes (calcrete) as hard calcrete layers may be underlain by less competent material. Calcretes may also be laterally discontinuous over short distances (in occurrence, composition and degree of development/ cementation).

Brink (1979) notes that a collapsible fabric has been suspected in some powder and nodular calcrete and cemented soils. Small scale karst structures and evidence of small sinkholes have also been observed in weathered calcretes.

Hard excavation conditions are expected in well developed, cemented, calcretes.

Calcrete may be used for wearing course and all layers within the road prism for unpaved roads.

8 PRELIMINARY GEOLOGICAL & GEOTECHNICAL IMPACT ASSESSMENT

From a geological / geotechnical perspective, no fatal flaws have been identified that would prevent the construction of the proposed development at this site.

Further intrusive investigation is recommended for detailed design purposes.

8.1 Impact of the Project on the Geological Environment

The impact of the project alternatives on the geological environment will predominantly relate to the impact that the development will have on the soils / rock units beneath the site. Various outcrops/ boulders have been noted across the sites generally associated with ridges. Removal of the boulders (during site clearing) and construction on hilltops and ridge tops, may have a negative (aesthetic / visual) impact on the environment (besides increasing the cost of site preparation in these areas). It is assumed that a visual impact will be undertaken by others.

Both vertebrate and invertebrate fossils have also been found in the Beaufort Group of the Karoo Supergroup. Reptiles, mammal-like reptile (therapsid), amphibian, fish, insect and plant fossils have been discovered (Johnson, 2006). Excavation into the rock and removal of the material will potentially result in damage/destruction of the fossils. The locations of the fossils will have to be determined during an archaeological / palaeontological investigation.

The main potential impact of the project on the geological environment will be the increased ***potential for soil erosion***, caused by the removal of vegetation and the construction activities. Removal of vegetation for terrace preparation and compaction during earthworks will reduce the infiltration of rainwater and therefore increase surface runoff. An increase in runoff will lead to an increase in erosion. Potential impacts of the project on the soils are provided in Sections 8.2 to 8.4 below. The proposed duration of the construction phase was not provided at the time that this report was compiled. For the purpose of the assessment, a construction duration of 1 year was assumed. Please note that the impact rating will change should the construction duration increase. A description of the weighting system and description of terms used is attached in Annexure A.

8.2 Mooi Plaats PV Facility and Grid Infrastructure

The impact of the Mooi Plaats PV facility on the general environment was found to be ***"Low"***. The scoring was based on Sivest guidelines / format for assessing the sites and grid infrastructure:

- "Updated Environmental Impact Assessment Methodology_Ver1 - 2019 SJ"

Areas with steep slopes associated with slope instability and surface bedrock / boulders associated with ridges, where construction will be difficult, have been outlined in red in Figure 4.

It is our professional opinion that the Mooi Plaats PV Facility project may go ahead, if all mitigation measures given in this report are implemented.

Table 2: Mooi Plaats Solar PV Facility Impact Rating Table

MOOI PLAATS SOLAR PV FACILITY																				
ENVIRONMENTAL PARAMETER	**ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE**	**ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION**									**RECOMMENDED MITIGATION MEASURES**	**ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION**								
		E	**P**	**R**	**L**	**D**	**I / M**	**TOTAL**	**STATUS (+ OR -)**	**S**		**E**	**P**	**R**	**L**	**D**	**I / M**	**TOTAL**	**STATUS (+ OR -)**	**S**
Construction Phase																				
Soils	Soil disturbance during construction at the PV Facility may destabilise the soil and lead to soil erosion. - Increased soil erosion / runoff due to clearing of vegetation - Construction and use of access roads by heavy duty vehicles and construction equipment may destabilise the soil and lead to soil erosion. - There may be spillages (petroleum/lubricants) from the vehicles - There may be siltation of watercourses due to increased runoff and dust	1	4	2	1	1	1	9	-	Low	- Use of berms and drainage channels to direct water away from the construction areas where necessary - Minimise earthworks and levelling - Use existing access roads wherever possible - Rehabilitate disturbed areas as soon as possible after construction - Correct engineering design of stream and water course crossings - Correct engineering design of any new access roads - Maintain vehicles and only undertake repairs and maintenance work in designated areas - Implement groundcover measures to prevent erosion such as keeping as much natural vegetation as possible, straw mulch, erosion control mats etc. - Contain and control stormwater flow	1	2	1	1	1	1	6	-	Low
Operational Phase																				
Soils	Increased soil erosion / runoff due to clearing of vegetation and alteration of natural drainage (paved areas) - There may be spillages (petroleum/lubricants) from the vehicles	1	2	1	1	1	1	6	-	Low	- Use existing access roads wherever possible - Correct engineering design of stream and water course crossings - Correct engineering design of access roads - Maintain vehicles and only undertake repairs and maintenance work in designated areas - Implement groundcover measures to prevent erosion such as keeping as much natural vegetation as possible, straw mulch, erosion control mats etc. - Contain and control stormwater flow	1	2	1	1	1	1	6	-	Low
Decommissioning Phase																				
Soils	Soil disturbance during decommissioning/deconstruction at the PV Facility may destabilise the soil and lead to soil erosion. - Contamination of soil due to chemical spillages from equipment - Construction and use of access roads by heavy duty vehicles and construction equipment may destabilise the soil and lead to soil erosion. - There may be spillages (petroleum/lubricants) from the vehicles - There may be siltation of watercourses due to increased runoff and dust	1	4	2	1	1	1	9	-	Low	Use of berms and drainage channels to direct water away from the decommissioning/deconstruction areas where necessary - Minimise earthworks and levelling - use existing access roads wherever possible - Rehabilitate disturbed areas as soon as possible - Add as much natural vegetation back as possible - Try reinstate natural drainage patterns - Have chemical spill kits on site and remove all spill material when decommissioning any substations. - Maintain vehicles and only undertake repairs and maintenance work in designated areas - Contain and control stormwater flow	1	2	1	1	1	1	6	-	Low
Cumulative																				
Soils	No cumulative effect							0			No cumulative effect							0		

Table 3: Mooi Plaats Grid Connection Impact Rating Table

MOOI PLAATS GRID CONNECTION INFRASTRUCTURE																				
ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Construction Phase																				
Soils	Soil disturbance during construction at the PV Facility may destabilise the soil and lead to soil erosion. - Increased soil erosion / runoff due to clearing of vegetation - Construction and use of access roads by heavy duty vehicles and construction equipment may destabilise the soil and lead to soil erosion. - There may be spillages (petroleum/lubricants) from the vehicles - There may be siltation of watercourses due to increased runoff and dust	1	4	2	1	1	1	9	-	Low	- Use of berms and drainage channels to direct water away from the construction areas where necessary - Minimise earthworks and levelling - Use existing access roads wherever possible - Rehabilitate disturbed areas as soon as possible after construction - Correct engineering design of stream and water course crossings - Correct engineering design of any new access roads - Maintain vehicles and only undertake repairs and maintenance work in designated areas - Implement groundcover measures to prevent erosion such as keeping as much natural vegetation as possible, straw mulch, erosion control mats etc. - Contain and control stormwater flow	1	2	1	1	1	1	6	-	Low
Operational Phase																				
Soils	Increased soil erosion / runoff due to clearing of vegetation and alteration of natural drainage (paved areas) - There may be spillages (petroleum/lubricants) from the vehicles	1	2	1	1	1	1	6	-	Low	- Use existing access roads wherever possible - Correct engineering design of stream and water course crossings - Correct engineering design of access roads - Maintain vehicles and only undertake repairs and maintenance work in designated areas - Implement groundcover measures to prevent erosion such as keeping as much natural vegetation as possible, straw mulch, erosion control mats etc. - Contain and control stormwater flow	1	2	1	1	1	1	6	-	Low
Decommissioning Phase																				
Soils	Soil disturbance during decommissioning/deconstruction at the PV Facility may destabilise the soil and lead to soil erosion. - Contamination of soil due to chemical spillages from equipment - Construction and use of access roads by heavy duty vehicles and construction equipment may destabilise the soil and lead to soil erosion. - There may be spillages (petroleum/lubricants) from the vehicles - There may be siltation of watercourses due to increased runoff and dust	1	4	2	1	1	1	9	-	Low	Use of berms and drainage channels to direct water away from the decommissioning/deconstruction areas where necessary - Minimise earthworks and levelling - use existing access roads wherever possible - Rehabilitate disturbed areas as soon as possible - Add as much natural vegetation back as possible - Try reinstate natural drainage patterns - Have chemical spill kits on site and remove all spill material when decommissioning any substations. - Maintain vehicles and only undertake repairs and maintenance work in designated areas - Contain and control stormwater flow	1	2	1	1	1	1	6	-	Low
Cumulative																				
Soils	No cumulative effect							0			No cumulative effect							0		

8.3 Wonderheuvel PV Facility and Grid Infrastructure

The impact of the Wonderheuvel PV facility and Grid Infrastructure on the general environment was found to be ***"Low"***. The scoring was based on Sivest guidelines / format for assessing the sites and grid infrastructure:

- "Updated Environmental Impact Assessment Methodology_Ver1 - 2019 SJ"

Areas with steep slopes associated with slope instability and surface bedrock / boulders associated with ridges, where construction will be difficult, have been outlined in red in Figure 5.

It is our professional opinion that the Wonderheuvel PV Facility and Grid Infrastructure project may go ahead, if all mitigation measures given in this report are implemented.

Table 4: Wonderheuvel Solar PV Facility Impact Rating Table

WONDERHEUVEL SOLAR PV FACILITY																				
ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Construction Phase																				
Soils	Soil disturbance during construction at the PV Facility may destabilise the soil and lead to soil erosion. - Increased soil erosion / runoff due to clearing of vegetation - Construction and use of access roads by heavy duty vehicles and construction equipment may destabilise the soil and lead to soil erosion. - There may be spillages (petroleum/lubricants) from the vehicles - There may be siltation of watercourses due to increased runoff and dust	1	4	2	1	1	1	9	-	Low	- Use of berms and drainage channels to direct water away from the construction areas where necessary - Minimise earthworks and levelling - Use existing access roads wherever possible - Rehabilitate disturbed areas as soon as possible after construction - Correct engineering design of stream and water course crossings - Correct engineering design of any new access roads - Maintain vehicles and only undertake repairs and maintenance work in designated areas - Implement groundcover measures to prevent erosion such as keeping as much natural vegetation as possible, straw mulch, erosion control mats etc. - Contain and control stormwater flow	1	2	1	1	1	1	6	-	Low
Operational Phase																				
Soils	Increased soil erosion / runoff due to clearing of vegetation and alteration of natural drainage (paved areas) - There may be spillages (petroleum/lubricants) from the vehicles	1	2	1	1	1	1	6	-	Low	- Use existing access roads wherever possible - Correct engineering design of stream and water course crossings - Correct engineering design of access roads - Maintain vehicles and only undertake repairs and maintenance work in designated areas - Implement groundcover measures to prevent erosion such as keeping as much natural vegetation as possible, straw mulch, erosion control mats etc. - Contain and control stormwater flow	1	2	1	1	1	1	6	-	Low
Decommissioning Phase																				
Soils	Soil disturbance during decommissioning/deconstruction at the PV Facility may destabilise the soil and lead to soil erosion. - Contamination of soil due to chemical spillages from equipment - Construction and use of access roads by heavy duty vehicles and construction equipment may destabilise the soil and lead to soil erosion. - There may be spillages (petroleum/lubricants) from the vehicles - There may be siltation of watercourses due to increased runoff and dust	1	4	2	1	1	1	9	-	Low	Use of berms and drainage channels to direct water away from the decommissioning/deconstruction areas where necessary - Minimise earthworks and levelling - use existing access roads wherever possible - Rehabilitate disturbed areas as soon as possible - Add as much natural vegetation back as possible - Try reinstate natural drainage patterns - Have chemical spill kits on site and remove all spill material when decommissioning any substations. - Maintain vehicles and only undertake repairs and maintenance work in designated areas - Contain and control stormwater flow	1	2	1	1	1	1	6	-	Low
Cumulative																				
Soils	No cumulative effect							0			No cumulative effect							0		

Table 5: Wonderheuvel Grid Connection Impact Rating Table

WONDERHEUVEL GRID CONNECTION INFRASTRUCTURE																						
ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION										
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		
Construction Phase																						
Soils	Soil disturbance during construction at the PV Facility may destabilise the soil and lead to soil erosion. - Increased soil erosion / runoff due to clearing of vegetation - Construction and use of access roads by heavy duty vehicles and construction equipment may destabilise the soil and lead to soil erosion. - There may be spillages (petroleum/lubricants) from the vehicles - There may be siltation of watercourses due to increased runoff and dust	1	4	2	1	1	1	9	-	Low	- Use of berms and drainage channels to direct water away from the construction areas where necessary - Minimise earthworks and levelling - Use existing access roads wherever possible - Rehabilitate disturbed areas as soon as possible after construction - Correct engineering design of stream and water course crossings - Correct engineering design of any new access roads - Maintain vehicles and only undertake repairs and maintenance work in designated areas - Implement groundcover measures to prevent erosion such as keeping as much natural vegetation as possible, straw mulch, erosion control mats etc. - Contain and control stormwater flow	1	2	1	1	1	1	6	-	Low		
Operational Phase																						
Soils	Increased soil erosion / runoff due to clearing of vegetation and alteration of natural drainage (paved areas) - There may be spillages (petroleum/lubricants) from the vehicles	1	2	1	1	1	1	6	-	Low	- Use existing access roads wherever possible - Correct engineering design of stream and water course crossings - Correct engineering design of access roads - Maintain vehicles and only undertake repairs and maintenance work in designated areas - Implement groundcover measures to prevent erosion such as keeping as much natural vegetation as possible, straw mulch, erosion control mats etc. - Contain and control stormwater flow	1	2	1	1	1	1	6	-	Low		
Decommissioning Phase																						
Soils	Soil disturbance during decommissioning/deconstruction at the PV Facility may destabilise the soil and lead to soil erosion. - Contamination of soil due to chemical spillages from equipment - Construction and use of access roads by heavy duty vehicles and construction equipment may destabilise the soil and lead to soil erosion. - There may be spillages (petroleum/lubricants) from the vehicles - There may be siltation of watercourses due to increased runoff and dust	1	4	2	1	1	1	9	-	Low	Use of berms and drainage channels to direct water away from the decommissioning/deconstruction areas where necessary - Minimise earthworks and levelling - use existing access roads wherever possible - Rehabilitate disturbed areas as soon as possible - Add as much natural vegetation back as possible - Try reinstate natural drainage patterns - Have chemical spill kits on site and remove all spill material when decommissioning any substations. - Maintain vehicles and only undertake repairs and maintenance work in designated areas - Contain and control stormwater flow	1	2	1	1	1	1	6	-	Low		
Cumulative																						
Soils	No cumulative effect							0			No cumulative effect							0				

8.4 Paarde Valley PV Facility and Grid Infrastructure

The impact of the Paarde Valley PV facility and Grid Infrastructure on the general environment was found to be ***"Low"***. The scoring was based on Sivest guidelines / format for assessing the sites and grid infrastructure:

- "Updated Environmental Impact Assessment Methodology_Ver1 - 2019 SJ"

Areas with steep slopes associated with slope instability and surface bedrock / boulders associated with ridges, where construction will be difficult, have been outlined in red in Figure 6.

It is our professional opinion that the Paarde Valley PV Facility project may go ahead, if all mitigation measures given in this report are implemented.

The grid options are discussed separately in Section 9.

Table 6: Paarde Valley Solar PV Facility Impact Rating Table

PAARDE VALLEY SOLAR PV FACILITY																				
ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Construction Phase																				
Soils	Soil disturbance during construction at the PV Facility may destabilise the soil and lead to soil erosion. - Increased soil erosion / runoff due to clearing of vegetation - Construction and use of access roads by heavy duty vehicles and construction equipment may destabilise the soil and lead to soil erosion. - There may be spillages (petroleum/lubricants) from the vehicles - There may be siltation of watercourses due to increased runoff and dust	1	4	2	1	1	1	9	-	Low	- Use of berms and drainage channels to direct water away from the construction areas where necessary - Minimise earthworks and levelling - Use existing access roads wherever possible - Rehabilitate disturbed areas as soon as possible after construction - Correct engineering design of stream and water course crossings - Correct engineering design of any new access roads - Maintain vehicles and only undertake repairs and maintenance work in designated areas - Implement groundcover measures to prevent erosion such as keeping as much natural vegetation as possible, straw mulch, erosion control mats etc. - Contain and control stormwater flow	1	2	1	1	1	1	6	-	Low
Operational Phase																				
Soils	Increased soil erosion / runoff due to clearing of vegetation and alteration of natural drainage (paved areas) - There may be spillages (petroleum/lubricants) from the vehicles	1	2	1	1	1	1	6	-	Low	- Use existing access roads wherever possible - Correct engineering design of stream and water course crossings - Correct engineering design of access roads - Maintain vehicles and only undertake repairs and maintenance work in designated areas - Implement groundcover measures to prevent erosion such as keeping as much natural vegetation as possible, straw mulch, erosion control mats etc. - Contain and control stormwater flow	1	2	1	1	1	1	6	-	Low
Decommissioning Phase																				
Soils	Soil disturbance during decommissioning/deconstruction at the PV Facility may destabilise the soil and lead to soil erosion. - Contamination of soil due to chemical spillages from equipment - Construction and use of access roads by heavy duty vehicles and construction equipment may destabilise the soil and lead to soil erosion. - There may be spillages (petroleum/lubricants) from the vehicles - There may be siltation of watercourses due to increased runoff and dust	1	4	2	1	1	1	9	-	Low	Use of berms and drainage channels to direct water away from the decommissioning/deconstruction areas where necessary - Minimise earthworks and levelling - use existing access roads wherever possible - Rehabilitate disturbed areas as soon as possible - Add as much natural vegetation back as possible - Try reinstate natural drainage patterns - Have chemical spill kits on site and remove all spill material when decommissioning any substations. - Maintain vehicles and only undertake repairs and maintenance work in designated areas - Contain and control stormwater flow	1	2	1	1	1	1	6	-	Low
Cumulative																				
Soils	No cumulative effect							0			No cumulative effect							0		

Table 7: Paarde Valley Grid Connection Impact Rating Table

PAARDE VALLEY GRID CONNECTION INFRASTRUCTURE																				
ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Construction Phase																				
Soils	Soil disturbance during construction at the PV Facility may destabilise the soil and lead to soil erosion. - Increased soil erosion / runoff due to clearing of vegetation - Construction and use of access roads by heavy duty vehicles and construction equipment may destabilise the soil and lead to soil erosion. - There may be spillages (petroleum/lubricants) from the vehicles - There may be siltation of watercourses due to increased runoff and dust	1	4	2	1	1	1	9	-	Low	- Use of berms and drainage channels to direct water away from the construction areas where necessary - Minimise earthworks and levelling - Use existing access roads wherever possible - Rehabilitate disturbed areas as soon as possible after construction - Correct engineering design of stream and water course crossings - Correct engineering design of any new access roads - Maintain vehicles and only undertake repairs and maintenance work in designated areas - Implement groundcover measures to prevent erosion such as keeping as much natural vegetation as possible, straw mulch, erosion control mats etc. - Contain and control stormwater flow	1	2	1	1	1	1	6	-	Low
Operational Phase																				
Soils	Increased soil erosion / runoff due to clearing of vegetation and alteration of natural drainage (paved areas) - There may be spillages (petroleum/lubricants) from the vehicles	1	2	1	1	1	1	6	-	Low	- Use existing access roads wherever possible - Correct engineering design of stream and water course crossings - Correct engineering design of access roads - Maintain vehicles and only undertake repairs and maintenance work in designated areas - Implement groundcover measures to prevent erosion such as keeping as much natural vegetation as possible, straw mulch, erosion control mats etc. - Contain and control stormwater flow	1	2	1	1	1	1	6	-	Low
Decommissioning Phase																				
Soils	Soil disturbance during decommissioning/deconstruction at the PV Facility may destabilise the soil and lead to soil erosion. - Contamination of soil due to chemical spillages from equipment - Construction and use of access roads by heavy duty vehicles and construction equipment may destabilise the soil and lead to soil erosion. - There may be spillages (petroleum/lubricants) from the vehicles - There may be siltation of watercourses due to increased runoff and dust	1	4	2	1	1	1	9	-	Low	Use of berms and drainage channels to direct water away from the decommissioning/deconstruction areas where necessary - Minimise earthworks and levelling - use existing access roads wherever possible - Rehabilitate disturbed areas as soon as possible - Add as much natural vegetation back as possible - Try reinstate natural drainage patterns - Have chemical spill kits on site and remove all spill material when decommissioning any substations. - Maintain vehicles and only undertake repairs and maintenance work in designated areas - Contain and control stormwater flow	1	2	1	1	1	1	6	-	Low
Cumulative																				
Soils	No cumulative effect							0			No cumulative effect							0		

9 COMPARATIVE ASSESSMENT OF ALTERNATIVES GRID CONNECTIONS

A comparative assessment of the alternative grid connections and substation is given in Table 7 below.

Construction over mountainous and steep/hilly areas has a higher risk of causing erosion than construction over flatter areas (roads in steep areas are more prone to erosion and require longer routes to be constructed, not just straight roads along the route). Longer routes will have a greater impact on the soils, as there will be a greater area affected by the construction activities, greater distance for vehicles to travel, etc.

Construction on, or in close proximity to mountainous and steep/hilly areas, has a higher risk of slope instability. Loose/unstable talus deposits are expected to be present in these areas. Mitigation measures, to allow construction in these areas, will increase the construction costs.

Therefore, from a geological and geotechnical perspective the following corridor options are preferred:

- Mooi Plaats PV Facility – Option1
- Wonderheuven PV Facility – Option 2
- Paarde Valley PV Facility – Option 1

Table 8: Grid Line Connection Infrastructure Alternatives (Power Line Corridors and Associated Substations)

Key

PREFERRED	The alternative will result in a low impact / reduce the impact
FAVOURABLE	The impact will be relatively insignificant
LEAST PREFERRED	The alternative will result in a high impact / increase the impact
NO PREFERENCE	The alternative will result in equal impacts

GRID CONNECTION INFRASTRUCTURE ALTERNATIVES (POWER LINE CORRIDORS AND ASSOCIATED SUBSTATIONS)	Preference	Reasons (including potential issues)
MOOI PLAATS SOLAR PV FACILITY:		
Grid Connection Option 1	**PREFERRED**	Shorter Route

GRID CONNECTION INFRASTRUCTURE ALTERNATIVES (POWER LINE CORRIDORS AND ASSOCIATED SUBSTATIONS)	Preference	Reasons (including potential issues)
		Both routes underlain by similar bedrock Both routes traverse drainage features/small rivers From an engineering perspective, both options will have similar founding conditions Smaller section of this route traverses near / over mountainous / hilly topography in the north west region of the corridors. Therefore, the corridor Option 1 has less risk of slope instability, possibly less talus deposits, less chance of soil erosion, possibly lower construction cost.
Grid Connection Option 2	**FAVOURABLE**	Longer Route Both options underlain by similar bedrock Both routes traverse drainage features/small rivers From an engineering perspective, both options will have similar founding conditions Therefore, the corridor option has more risk of slope instability, possibly more talus deposits, higher chance of soil erosion, possibly higher construction cost.
WONDERHEUVEL SOLAR PV FACILITY:		
Grid Connection Option 1	**FAVOURABLE**	Longer Route (two limbs) Both options underlain by similar bedrock Both routes traverse drainage features / small rivers

GRID CONNECTION INFRASTRUCTURE ALTERNATIVES (POWER LINE CORRIDORS AND ASSOCIATED SUBSTATIONS)	Preference	Reasons (including potential issues)
		From an engineering perspective, both options will have similar founding conditions This route traverses more mountainous / hilly topography than corridor Option 2 Therefore, the corridor Option 1 has more risk of slope instability, possibly more talus deposits, higher chance of soil erosion, possibly higher construction cost.
Grid Connection Option 2	**PREFERRED**	Shorter Route Both options are underlain by similar bedrock Both routes traverse drainage features / small rivers From an engineering perspective, both options will have similar founding conditions Smaller section of this route traverses near / over more mountainous / hilly topography than corridor Option 1. Therefore, the corridor Option 2 has less risk of slope instability, possibly less talus deposits, less chance of soil erosion, possibly lower construction cost.
PAARDE VALLEY SOLAR PV FACILITY:		
Grid Connection Option 1	**PREFERRED**	Shorter Route Both options are underlain by similar bedrock Both routes traverse drainage features / small rivers From an engineering perspective, both options will have similar founding conditions

GRID CONNECTION INFRASTRUCTURE ALTERNATIVES (POWER LINE CORRIDORS AND ASSOCIATED SUBSTATIONS)	Preference	Reasons (including potential issues)
		Smaller section of this route traverses near / over more mountainous/hilly topography than corridor Option 1. Therefore, the corridor Option 1 has less risk of slope instability, possibly less talus deposits, less chance of soil erosion, possibly lower construction cost.
Grid Connection Option 2	**FAVOURABLE**	Longer Route Both options underlain by similar bedrock Both routes traverse drainage features / small rivers From an engineering perspective, both options will have similar founding conditions This route traverses more mountainous / hilly topography (north eastern portion) than corridor Option 2 Therefore, the corridor Option 2 has more risk of slope instability, possibly more talus deposits, higher chance of soil erosion, possibly higher construction cost.

10 CONCLUSIONS

The desktop geotechnical assessment did not identify any fatal flaws that, from a geological and geotechnical perspective, would prevent the construction of the proposed Usombomvu PV Energy Facilities.

The potential impacts the project may have on the geology, relate to soils that could be impacted by the construction activities. There may be a potential for soil erosion, due to removal of vegetation and exposure of the soils to the elements, during construction. The impacts were found to be of "***negative low impact***".

Two corridor options were studied for each PV facility. While all options are considered suitable for development, the following options were found to be preferable from a geological and geotechnical perspective:

- Mooi Plaats PV Facility – Grid Option 1
- Wonderheuven PV Facility – Grid Option 2
- Paarde Valley PV Facility – Grid Option 1

The geological impacts will be similar.

Due the very similar bedrock geology, similar geotechnical conditions are expected across all options.

From a geological and geotechnical perspective, based on the minimal negative impacts on the geology and soils and the recommendations for mitigation measures, it is recommended that the **Usombomvu PV Energy Facilities** project receives the go ahead from the Competent Authority.

--oOo—

11 REFERENCES

1. Brink, A.B.A. (1983). *Engineering Geology of South Africa Volume 1-4*. Building Publications Pretoria.
2. Johnson, C.R., Anhaeusser, C.R. and Thomas, R.J. (2006). *The Geology of South Africa*. Council for Geoscience.

Annexure A: Impact Assessment Methodology

1 ENVIRONMENTAL IMPACT ASSESSMENT (EIA) METHODOLOGY

The Environmental Impact Assessment (EIA) Methodology assists in evaluating the overall effect of a proposed activity on the environment. Determining of the significance of an environmental impact on an environmental parameter is determined through a systematic analysis.

1.1 Determination of Significance of Impacts

Significance is determined through a synthesis of impact characteristics which include context and intensity of an impact. Context refers to the geographical scale (i.e. site, local, national or global), whereas intensity is defined by the severity of the impact e.g. the magnitude of deviation from background conditions, the size of the area affected, the duration of the impact and the overall probability of occurrence. Significance is calculated as shown in **Table 1**.

Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The total number of points scored for each impact indicates the level of significance of the impact.

1.2 Impact Rating System

The impact assessment must take account of the nature, scale and duration of effects on the environment and whether such effects are positive (beneficial) or negative (detrimental). Each issue / impact is also assessed according to the various project stages, as follows:

- Planning;
- Construction;
- Operation; and
- Decommissioning.

Where necessary, the proposal for mitigation or optimisation of an impact should be detailed. A brief discussion of the impact and the rationale behind the assessment of its significance has also been included.

The significance of Cumulative Impacts should also be rated (As per the Excel Spreadsheet Template).

1.2.1 Rating System Used to Classify Impacts

The rating system is applied to the potential impact on the receiving environment and includes an objective evaluation of the possible mitigation of the impact. Impacts have been consolidated into one (1) rating. In assessing the significance of each issue the following criteria (including an allocated point system) is used:

Table 1: Rating of impacts criteria

ENVIRONMENTAL PARAMETER		
A brief description of the environmental aspect likely to be affected by the proposed activity (e.g. Surface Water).		
ISSUE / IMPACT / ENVIRONMENTAL EFFECT / NATURE		
Include a brief description of the impact of environmental parameter being assessed in the context of the project. This criterion includes a brief written statement of the environmental aspect being impacted upon by a particular action or activity (e.g. oil spill in surface water).		
EXTENT (E)		
This is defined as the area over which the impact will be expressed. Typically, the severity and significance of an impact have different scales and as such bracketing ranges are often required. This is often useful during the detailed assessment of a project in terms of further defining the determined.		
1	Site	The impact will only affect the site
2	Local/district	Will affect the local area or district
3	Province/region	Will affect the entire province or region
4	International and National	Will affect the entire country
PROBABILITY (P)		
This describes the chance of occurrence of an impact		
1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
2	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).
3	Probable	The impact will likely occur (Between a 50% to 75% chance of occurrence).
4	Definite	Impact will certainly occur (Greater than a 75% chance of occurrence).
REVERSIBILITY (R)		
This describes the degree to which an impact on an environmental parameter can be successfully reversed upon completion of the proposed activity.		
1	Completely reversible	The impact is reversible with implementation of minor mitigation measures
2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible and no mitigation measures exist.
IRREPLACEABLE LOSS OF RESOURCES (L)		
This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.		
1	No loss of resource.	The impact will not result in the loss of any resources.
2	Marginal loss of resource	The impact will result in marginal loss of resources.
3	Significant loss of resources	The impact will result in significant loss of resources.
4	Complete loss of resources	The impact is result in a complete loss of all resources.

DURATION (D)		
This describes the duration of the impacts on the environmental parameter. Duration indicates the lifetime of the impact as a result of the proposed activity.		
1	Short term	The impact and its effects will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase (0 – 1 years), or the impact and its effects will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	Medium term	The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
3	Long term	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 50 years).
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered transient (Indefinite).
INTENSITY / MAGNITUDE (I / M)		
Describes the severity of an impact (i.e. whether the impact has the ability to alter the functionality or quality of a system permanently or temporarily).		
1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
2	Medium	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).
3	High	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.
4	Very high	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired (system collapse). Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.
SIGNIFICANCE (S)		

Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. This describes the significance of the impact on the environmental parameter. The calculation of the significance of an impact uses the following formula: **Significance = (Extent + probability + reversibility + irreplaceability + duration) x magnitude/intensity.** The summation of the different criteria will produce a non-weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.		
Points	**Impact Significance Rating**	**Description**
5 to 23	Negative Low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
5 to 23	Positive Low impact	The anticipated impact will have minor positive effects.
24 to 42	Negative Medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
24 to 42	Positive Medium impact	The anticipated impact will have moderate positive effects.
43 to 61	Negative High impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
43 to 61	Positive High impact	The anticipated impact will have significant positive effects.
62 to 80	Negative Very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
62 to 80	Positive Very high impact	The anticipated impact will have highly significant positive effects.

The table below is to be represented in the Impact Assessment section of the report. The excel spreadsheet template can be used to complete the Impact Assessment.

Table 2: Rating of impacts template and example

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Construction Phase																				
Vegetation and protected plant species	Vegetation clearing for access roads, turbines and their service areas and other infrastructure will impact on vegetation and protected plant species.	2	4	2	2	3	3	39	-	Medium	**Outline/explain the mitigation measures to be undertaken to ameliorate the impacts that are likely to arise from the proposed activity. These measures will be detailed in the EMPr.**	2	4	2	1	3	2	24	-	Low
Operational Phase																				

Fauna	Fauna will be negatively affected by the operation of the wind farm due to the human disturbance, the presence of vehicles on the site and possibly by noise generated by the wind turbines as well.	2	3	2	1	4	3	36	-	Medium	**Outline/explain the mitigation measures to be undertaken to ameliorate the impacts that are likely to arise from the proposed activity. These measures will be detailed in the EMPr.**	2	2	2	1	4	2	22	-	Low
Decommissioning Phase																				
Fauna	Fauna will be negatively affected by the decommissioning of the wind farm due to the human disturbance, the presence and operation of vehicles and heavy machinery on the site and the noise generated.	2	3	2	1	2	3	30	-	Medium	**Outline/explain the mitigation measures to be undertaken to ameliorate the impacts that are likely to arise from the proposed activity. These measures will be detailed in the EMPr.**	2	2	2	1	2	2	18	-	Low
Cumulative																				

Broad-scale ecological processes	Transformation and presence of the facility will contribute to cumulative habitat loss and impacts on broad-scale ecological processes such as fragmentation.	2	4	2	2	3	2	26	-	Medium	**Outline/explain the mitigation measures to be undertaken to ameliorate the impacts that are likely to arise from the proposed activity. These measures will be detailed in the EMPr.**	2	3	2	1	3	2	22	-	Low

Annexure B: Specialist's Curriculum Vitarum

CECILIA CANAHAI

Profession	*Engineering Geologist / Scientist*
Position in Firm	*Technical Director*
Area of Specialisation	*Geotechnical, Environmental, Waste Management*
Qualifications	*Pr.Sci.Nat., MSc (Eng Geol), BSc (Eng Geology)*
Years of Experience	*31 Years*
Years with Firm	*20 Years*

SUMMARY OF EXPERIENCE

Cecilia Canahai gained her first site experience working as a site geologist for oil and gas exploration, in Romania, in 1988. She completed drilling supervision, sampling, gas chromatography, borehole logging and interpretation, report writing and made recommendations for drilling parameters.

Cecilia joined Moore Spence Jones (Pty) Ltd in 1997 as an engineering geologist, where she completed numerous geotechnical investigations for township and industrial development, sports facility developments, private residential properties and pipeline investigations. She has completed slope stability analyses with recommendations for rehabilitation. Other aspects of her experience include dam and tunnel geotechnical investigations. She acquired her first experience as an environmentalist while carrying out groundwater pollution monitoring, at SAPREF.

All projects have included fieldwork, on site testing, site supervision of works, material sampling, interpretation of laboratory results, client liaison, and reporting.

Cecilia joined JG Afrika (Pty) Ltd in 1999 as an environmentalist / engineering geologist.

As an engineering geologist she has worked on various projects, inter alia, geotechnical investigations for rural water supply schemes, housing developments, roads investigations, materials investigations, lateral support design and geotechnical investigations for dams and tunnels.

As an environmental practitioner she has successfully completed numerous Environmental Impact Assessment Scoping and EIA reports, Solid Waste Management, Environmental Management Programme Reports and Closure Reports for various mines/ borrow pits and Environmental Audits. She was also involved in other aspects of the environmental field such as scoping and public participation, impact assessment, mitigation and monitoring and preparation of environmental management plans (EMP).

Cecilia was the Pietermaritzburg Branch Quality System Manager, involved in the maintaining the office' quality standard in terms of ISO 9001 (JG Afrika is ISO 9001 certified) between 2002 and 2007, when work commitments required her to hand over this particular task to someone else.

Cecilia became a shareholder in 2010 and a partner in 2012. Since 2010 her duties are business development and marketing in the fields of engineering geology geotechnical engineering; waste management; environmental science, aquatic health and water resources management, as well as managing various multi- disciplinary projects.

PROFESSIONAL REGISTRATIONS & INSTITUTE MEMBERSHIPS

Pr.Sci.Nat.	-	Registered with the South African Council for Natural Scientific Professions - Registration No 400011/00: Environmental Science & Geological Science
SAIEG	-	Member of the South African Institute for Engineering and Environmental Geologists - Membership No 03/211
IAIA	-	Member of the International Association of Impact Assessment; Membership No 1686

EDUCATION

1983 – Certificate of Baccalaureate – Pitesti, Romania
1987 – BSc (Hons) (Eng Geol) – University of Bucharest, Romania
1988 – MSc (Eng Geol) – University of Bucharest, Romania

SPECIFIC EXPERIENCE

JG Afrika (Pty) Ltd (Previously Jeffares & Green (Pty) Ltd)

2010 - 2019
Position – Technical Director

Sicello Bulk Water Main: EIA & EMPR for water main al Sicello

Kumba Iron Ore Biomonitoring Programme for aquatic health

Kriel Power Station – Geotechnical Investigation for ash dam complex stability and stability monitoring for a period of 11 months

New Ash Facility at Tutuka Power Station for Eskom detail design for water return dams and appurtenant structure and infrastructure as part of an ADF team

New Ash Facility at Kusile Power Station for Eskom detail design for water return dams and appurtenant structure and infrastructure as part of an ADF team

Camden New Ash Dam Facility detail design, encompassing geotechnical investigation for the new ADF, water return dams and appurtenant structure and infrastructure

New Ash Facility at Kendal Power Station for Eskom

Hendrina Step-In and Go-Higher Ash Dam Facility detail design, encompassing geotechnical investigation for the extension of the existing ADF

Mathjabeng Solar Park

Atlas Substation EIA for Closure and Risk Assessment and Due Diligence

Gauteng Department of Roads and Transportation: Environmental assessment for 15 Intersection upgrades

Geotechnical Investigation in support of the Feasibility Study for a **5 GW power Solar Park** in the Northern Cape Province of South Africa (presidential project)

Feasibility Study for the potential sources of water for the **Tikwa Wind Farm**

N11 Sections 6 & 7 Borrow Pit Closure

Various **Water Use Licence Applications**

Basic Assessment for the installation of **Fibre Optic Cable between Aliwal North and George**

Baseline study for Eskom WTW and WWTW for readiness for Blue Drop / Green Drop Certification

Basic Assessment for the installation of **Fibre Optic Cable between Johannesburg and Cape Town**

Various Geotechnical Investigations for Rand Water Pipelines

Various **Environmental Basic Assessments** for Rand Water Pipelines

Various **Geotechnical Investigations** for various Eskom towers (3 year Contract)

2009 – 2010
Position –Executive Associate

N4 Rustenburg to Swartruggens: Geotechnical investigation for N4 road rehabilitation

Pikitup OSH Legal Audits

Dumbe Coalline Geotechnical investigation for Transnet (stability of proposed cuttings)

Various **Geotechnical Investigations** for Rand Water Pipelines

Various **Environmental Basic Assessments** for Rand Water Pipelines

Various **Geotechnical Investigations** for various Eskom towers (3 year Contract)

Basic Assessment for the installation of **Fibre Optic Cable** between Pretoria and Rustenburg

Materials recovery facility in **Ekandustria Waste Licence Application** and Basic assessment

2008 – 2009
Position – Associate

Pikitup Environmental Compliance

Rand Water G25 Pipeline Basic Assessment study downgraded to and Environmental Management Plan; Saved the Client R100 000,00 in fees.

Pikitup Garden sites and Depot sites Application for Waste Licences & Basic Assessment studies

Pretoria North Modal Interchange: full Environmental Impact Assessment for intermodal facility

N11 Section 4: Environmental services for obtaining Authorization for road rehabilitation and borrow pits

Various Geotechnical Investigations for Eskom towers (3 year Contract)

N6: Environmental services and Applications for Borrow Pits Closures

N12 Section 12: Environmental Auditing for road construction

2007 – 2008
Position – Associate

N6 Section 8 Closure Documentation for quarry and borrow pits for Road Rehabilitation

Lesotho Lowlands Water Supply Scheme: Geotechnical Investigation

Lusikisiki Police Station Geotechnical Investigation

Toscana Ridge Geotechnical Investigation for Housing development

Phinda Game Reserve: Geotechnical investigation for Housing development

Lusikisiki Police Station: Geotechnical Investigation.

Pretoria North Station Modal Interchange: full Environmental Impact Assessment for various road realignments, modal interchange and railway refurbishment in Pretoria.

N1 Section 14: Full Environmental Impact Assessment for the N1 rehabilitation.

Mt Ayliff & Mt Frere Access Roads – Environmental services for obtaining authorization from DEAET and DME for 12 access roads and associated borrow pits.

N2 Pongola Borrow pits: Application for borrow pits Closure

N2 Section 32: environmental services for obtaining Authorization for road rehabilitation and borrow pits

Umzimkhulu Municipality: Various environmental services for the upgrade of roads in Umzimkhulu

Environmental Management Plan for the rehabilitation of Dorpspruit River, Pietermaritzburg

Kwamashu Police Station Basic Assessment Report

2006 – 2007
Position – Associate

Elliottdale Landfill Site Classification and Permitting

Impendle Housing Development (1500 units): Geotechnical Investigation.

Lesotho Lowlands Bulk Water Supply Scheme: Geotechnical Investigation

Environmental Impact Assessment for various access roads in the Mt Frere and Mt Ayliff areas for the Umzimvubu Municipality.

Bubu Access Road : Geotechnical and materials investigation

Erf 3 Bishopstowe: Geotechnical Investigation for housing development

Willowton Proposed Shopping Centre: Geotechnical Investigation

Black Umfolozi River Bridge: Basic Assessment for environmental authorization

Mtwalume River sand mining Environmental Management Plan

Vulindlela Access Road: Environmental Management Plan for construction

Inhlazuka CWSS Environmental Management Plan for construction

Ladysmith Development: Preliminary Geotechnical & Environmental assessments

Black Umfolozi River Bridge - Basic Assessment Report as per NEMA Regulations 386.

Erf 3 Bishopstowe Geotechnical investigation for housing development

Vulindlela Access Roads – Environmental services for road rehabilitation.

2005 – 2006
Position – Engineering & Environmental Geologist

Closure of Landfill Site Hluhluwe & Identification of new Landfill Site to replace the old Landfill Site

N11 Sections 6 and 7 Borrow Pits and Quarry Permitting: environmental services (EIA & EMPR's) 10 borrow pits and one quarry

N12 Section 12 Borrow Pits & Quarry Permitting: environmental services (EIA & EMPR's) for 8 borrow pits and one quarry

Impendle Community Water Supply Schemes – Environmental services for obtaining authorization from DAEA for the construction of a community pipeline and associated structures.

Masomonco Community Water Supply Scheme - Environmental services for obtaining authorization from DAEA for the construction of a community pipeline and associated structure.

KwaNovuka Community Water Supply Scheme - Environmental services for obtaining authorization from DAEA for the construction of a community pipeline and associated structure.

Umtshezi Municipality Land Use Management System – Broad Environmental Scan

Vryheid Housing Development – Geotechnical Investigation

Illovo River Mining Right – environmental services for a sand mining operation on the Illovo River

Kwa Gqugquma Community Water Supply Scheme - Environmental services for obtaining authorization from DAEA for the construction of a community pipeline and associated structure.

2004 – 2005
Position – Engineering & Environmental Geologist

Georgedale development – environmental services for sand mining

God's Haven Housing Development – Geotechnical Investigation

Kwa Senge Clinic – Geotechnical Investigation

Umdoni Municipality Cemetery – Geotechnical & Environmental Assessments

N6 Borrow Pits and Quarry Permitting: environmental services (EIA & EMPR's) 10 borrow pits and one quarry

Umkomaas River Mining Right – environmental services for sand mining operations on the Umkomaas River

Umkomaas River Footbridge – Geotechnical Investigation

Marburg Prison – Geotechnical Investigation

Enkanyezini Community Water Supply Scheme - Environmental services for obtaining authorization from DAEA for the construction of a community pipeline and associated structures.

Shemula Community Water Supply Scheme - Environmental services for obtaining authorization from DAEA for the construction of a community pipeline and associated structures.

Mtwalume River Mining Permit – environmental services for sand mining operation on the Mtwalume River.

Umzimkulu River Mining Right – environmental services for sand mining operations on the Umzimkulu River

Umvoti River Mining Rights and Permits – environmental services for various sand mining operations on the Umvoti River

N2 Pongola quarry – Geotechnical Investigation

Rugged Glen - Environmental services for upgrading and construction of new structures.

2003 – 2004
Position – Engineering & Environmental Geologist

Kwa Mpande Geotechnical Investigation for school

St Ives Environmental Scoping for tourism development on the Midlands Meander

Ladysmith Petrol Station – Geotechnical Investigation and Scoping report

Kwa Ngwanase Community Water Supply Scheme – Geotechnical investigation for pipeline and associated structures.

Kwa Ngwanase Community Water Supply Scheme Environmental Scoping for proposed pipeline and associated structures.

Emkhuzeni & Mhlangana Community Water Supply Schemes – Geotechnical investigation for pipelines and associated structures.

Emkhuzeni & Mhlangana Community Water Supply Schemes Environmental Scoping for proposed pipelines and associated structures.

Inanda Dam Mining Permit – environmental services for a sand mining operation on the Inanda Dam.

Mdloti River Mining Conversion of old right to Mining Right.

Edwin Swales – Environmental Managemnt Plan compilation and Auditing.

Estcourt Prison – Geotechnical Investigation

Kombuzi Environmental Management Programme report for mining

Umhlumayo Community Water Supply Scheme – Geotechnical Investigation

2002 – 2003
Position – Engineering & Environmental Geologist

Dumbe Housing Development – Geotechnical Investigation.

Clouds oh Hope – Children's Home – Geotechnical Investigation

C4 Water Pipeline – Johennesburg – Geotechnical Investigation.

Kombuzi Community Water Supply Scheme – Geotechnical investigation for pipeline and associated structures.

Hlahlindlela Community Water Supply Scheme – Geotechnical investigation for pipeline and associated structures.

Shemula Community Water Supply Scheme – Geotechnical investigation for pipeline and associated structures.

Mt Frere rehabilitation of 3 roads – Geotechnical Investigation

Mbono Community Water Supply Scheme – Geotechnical investigation for pipeline and associated structures.

Camperdown Spar - Geotechnical Investigation for failed pavement.

Thokoza Community Water Supply Scheme – Geotechnical investigation for pipeline and associated structures.

Nqutu Community Water Supply Scheme – Geotechnical investigation for pipeline and associated structures.

Taxi Rank at Lusikisiki – Geotechnical Investigation

Kwa Hlope Community Water Supply Scheme – Geotechnical investigation for pipeline and associated structures.

Mbazwane Community Water Supply Scheme – Geotechnical investigation for pipeline and associated structures.

2001 – 2002
Position – Engineering & Environmental Geologist

Amangwe Community Water supply Scheme Enviornmental Scoping for Pipeline and associated structure

Black Umfolozi River Bridge - Basic Assessment Report as per NEMA Regulations 386.

Mt Ayliff & Mt Frere Access Roads – Environmental services for obtaining authorization from DEAET and DME for access roads and associated borrow pits.

Erf 3 Bishopstowe Geotechnical investigation for housing development

2000 – 2001
Position – Engineering & Environmental Geologist

Black Umfolozi River Bridge - Basic Assessment Report as per NEMA Regulations 386.

Mt Ayliff & Mt Frere Access Roads – Environmental services for obtaining authorization from DEAET and DME for access roads and associated borrow pits.

Erf 3 Bishopstowe Geotechnical investigation for housing development

1999 – 2000
Position – Engineering & Environmental Geologist

Nzinga and Langkloof CWSS: Geotechnical Investigation for pipeline and reservoirs, Environmental Scoping: & Environmental Management Programme reports for mining

Mbazwana CWSS: Geotechnical Investigation for pipeline and reservoirs, & Environmental Scoping

Nhlangano to Sicunusa Road: Geotechnical & Materials Investigation

Edendale Hospital New Wing: Geotechnical Investigation

Spandikroon, Dival & Mhlabathini CWSS: Geotechnical Investigations for pipeline and reservoirs, Environmental Scoping: reports

Tugela Estates CWSS: Geotechnical Investigations for pipeline and reservoirs

Debep Quarry Drilling Investigation for materials for road Construction

N2 Road Rehabilitation at Kei River Geotechnical investigation for road rehabilitation

Moore Spence Jones (Pty) Ltd

1998 – 1999
Position – Engineering & Environmental Geologist

Indian Ocean Fertilizers (Richards Bay): Geotechnical Investigation for new plant

Housing Development at Hammarsdale: Geotechnical investigation for foundations, earthworks, suitability of materials for road construction, etc.

Zimbali Housing Development: Geotechnical investigation for foundations, earthworks, suitability of materials for road construction, etc.

Cato Manor: Stability Investigation of platform cuttings

Mpophomeni Housing Development: Geotechnical investigation for foundations, earthworks, suitability of materials for road construction, etc.

Fleetguard Pmb: Geotechnical investigation for warehouse foundations, earthworks, suitability of materials for road construction, etc.

Stukenberg Water Pipeline: Geotechnical investigation for slope stability, pipeline re-routing and tunnel investigation, etc.

Booth Road Housing Development: Geotechnical investigation for foundations, earthworks, suitability of materials for road construction, etc.

1996 – 1998
Position – Engineering & Environmental Geologist

Gateway Development: Geotechnical Investigation for founding conditions, Assessment of waste, Site stability, etc.

Azalea Housing Development Geotechnical investigation for foundations, earthworks, suitability of materials for road construction, etc.

Matatiele Housing Development Geotechnical investigation for foundations, earthworks, suitability of materials for road construction, etc.

Kwa Dabeka Housing Development Geotechnical investigation for foundations, earthworks, suitability of materials for road construction, etc.

Newlands West: Geotechnical Investigation at cracked houses

AECI: Geotechnical Investigation into the stability of the slimes dams at AECI

SAPREF: Groundwater Pollution monitoring

Craiova Drilling Company Romania

1988 – 1992
Position – Site Geologist

Site geologist - Responsible for Drilling supervision at various oil & gas exploration & exploitation boreholes. Main duties included sample and core analysis and description, data logging and interpretation, down-the-hole logging and on site interpretation, gas chromatography and geo-service logging, compilation of reports and recommendations for drilling parameters.

A major project Mrs Canahai was involved in, was the drilling supervision of a 6000 m deep exploration hole. Responsibilities included liaison with design engineers and contractors, gas chromatography and geo-service logging, compilation of reports and recommendations for drilling parameters.

CONTINUED PROFESSIONAL DEVELOPMENT

Courses

2000 - Integrated Environmental Management Course – (University of KwaZulu Natal)
2001 - Environmental Auditing Course - (University of KwaZulu Natal)
2003 - ISO 9001:2000; Registered Internal and Suppliers Auditors Course - (Wynleigh International)
2003 - Waste Management Course – (University of Pretoria)
2005 SHEQMAN Course – (Advance A.C.T.)

2017 Resource Efficiency Cleaner Production - 2-Day End User Training CSIR Pretoria
2018 Energy Management Systems Implementation - End User Training CSIR Pretoria

Published Papers

1988 - "Mineralogical Study of Devonian Deposits of the Hercinic Orogen, Dobrogea", *MSc Thesis*, University of Bucharest (Engineering Geology), 1988.

PERSONAL DETAILS

Nationality – South African
Date of Birth – 1965-03-30
Domicile – Johannesburg, South Africa

Languages
English – Very Good
Romanian – Excellent

SALVERSAN KULLEN

Profession	*Engineering Geologist*
Position in Firm	*Engineering Geologist*
Area of Specialisation	*Engineering Geology / Geotechnical*
Qualifications	*BSc. (Hons)(Geology), BSc. (Geology)*
Years of Experience	*4,5 Years*
Years with Firm	*3 Years*

SUMMARY OF EXPERIENCE

Salversan Kullen is an Engineering Geologist at JG Afrika and has 4.5 years of experience in the Engineering Geology field. He has worked as a student geologist at Sky Chrome (International Ferro Metals (SA) Ltd). He then worked as a junior geologist at Raft Foundation Solutions (Pty) Ltd.

He has experience in various aspects of engineering geology namely: Slope stability analyses (kinematic analysis), geotechnical site investigations, geotechnical report writing, soil testing (foundation indicators), geological mapping, rock identification, soil profiling, Dynamic Cone Penetrometer Testing (DCP) , soil resistivity surveys, soil percolation tests and geotechnical borehole logging. He also has experience working with geology related software: Rocscience Dips, 3D Field and Arc GIS and Dot plot.

EDUCATION

2007 - Matric – Northwood School
2012 – B Sc (Geology) – University of Pretoria
2013 – B Sc (Hons)(Geology) – University of Pretoria

SPECIFIC EXPERIENCE

JG Afrika (Pty) Ltd (Previously Jeffares & Green (Pty) Ltd)

2016 – Date
Position – Engineering Geologist

Stormvoel Toll Plaza Gantries
The geotechnical investigation was undertaken for the proposed construction of three overhead gantries along Stormvoel road, Pretoria. The objectives of the investigation were to provide an overview of the founding conditions for the proposed gantries, provide founding recommendations, identify the presence of problematic ground conditions and assess the excavation conditions for earthworks. The field work comprised of the excavation of 5 tests pits at the foundation footprints of the proposed gantries.

Bakwena N4 Upgrade - Section 9 Km 23.300 to Section 10 Km 18.00
The detailed geotechnical investigation was conducted for the proposed upgrade of the N4 highway between Ga-Rankuwa and Brits. The upgrade consists of the construction of a second carriageway adjacent to the existing carriageway, the extension of structures to accommodate the second carriageway and the realignment of interchange ramps to tie into the new carriageway. A centreline and materials investigation was carried out which comprised of 144 test pits as well as DCP testing at selected locations.

Buffer Tank at Simba, Isando
A geotechnical investigation was conducted for the proposed construction of a buffer tank at the Simba Isando facility in Isando, Johannesburg. The objective of the investigation was to determine the founding conditions and the founding specifications for the buffer tank. The investigation comprised of 2 test pits and 2 DCP tests.

164 Eugene Street house, Grootfontein Country Estate, Pretoria
The geotechnical investigation was undertaken for the proposed construction of a house within the Grootfontein Country Estate. Due to the proximity of the house to dolomitic land, the Council for geosciences was consulted to determine whether a specialized dolomitic stability investigation would be required. Fortunately, the location of the house fell out of the dolomitic land region and a conventional geotechnical investigation was carried out. The investigation comprised of 6 test pits and 6 DCPs at critical locations beneath the footprint of the house. A percolation test was also carried out to determine whether the site would be suitable for the construction of a Septic tank/French drain system.

Eskom Hendrina Power Station Ash dam: Step-in and Go-Higher
The overall objective of the project was to investigate the potential to extend the life of the existing ash dam complex at Hendrina Power Station (Mpumalanga) by increasing the final height, above the current design height, and assess whether a step-in would be required to maintain stability. The objective of this geotechnical investigation is to provide the project design engineers with the relevant geotechnical information for them to assess the feasibility of increasing the dam height. The investigation comprised of drilling 3 boreholes including Standard Penetration tests (drilled through the ash dam using a sonic drill rig), 22 Dynamic Probe Super Heavy (DPSH) tests and 30 test pits.

Sedimentation and Flocculation Plant at Vereeniging Pumping Station
The investigation was carried out to assess the soil and rock profile across the site to determine the geotechnical and geohydrological conditions for the proposed construction of a new sedimentation and flocculation plant at the Vereeniging Pumping Station in Vereeniging, Gauteng. The investigation comprised of drilling 8 boreholes, 3 test pits, 3 DCP tests and a field resistivity survey. The borehole data and the resistivity survey data were used in combination to produce a cross section of the sub-surface lithology.

Eskom Marathon Substation Extension
The geotechnical investigation was carried out for the proposed extension of the Marathon Substation in Nelspruit. The main objectives of the investigation were to assess the suitability of the site, from a geotechnical perspective, to provide an overview of the founding conditions for the proposed substation extension, provide founding recommendations, identify the presence of problematic ground conditions, assess the resistivity of the soil, identify possible sources of construction materials and assess the excavation conditions for earthworks. The investigation comprised of 6 test pits, 6 DCP tests and 4 soil resistivity traverses.

Anglo American Mafube Life Extension Project
Additional geotechnical investigations were carried out for the life extension project of the Mafube Coal Mine. The objective of the additional investigation was to undertake "footprint investigations" beneath selected structures, to provide "infill investigations" between previous investigation points and to provide additional information on the subgrade conditions beneath haul roads and access roads, to allow for the detailed design of the infrastructure. A materials utilization investigation was also carried out to assess the feasibility of using material from the initial box cut of the mine during construction. In addition to the above investigations, fulltime on-site geotechnical services are also provided during the construction phase of the project.

Ekuphumuleni Informal Settlement
The investigation was carried out to assess the suitability of the site from a geotechnical perspective and provide an overview of the founding conditions for the proposed ablution facilities and other future developments, identify the presence of problematic ground conditions and assess the excavation conditions at the site. The investigation comprised of 13 test pits.

Cosmo City Sewer Pipeline
The geotechnical investigation was undertaken for the proposed upgrade on 1590 m of existing sewer line. The first 770 m section of the upgrade, from South Africa Drive to Kanas Crescent, required that the existing 200 mm uPVC sewer line be upgraded to 300 mm. The second 820 m section, from Kanas Crescent to the existing 600 mm diameter AC outfall sewer line, required that the existing 315 mm also be upgraded. Johannesburg Water indicated that the preferred method of upgrading the existing sewer line would be trenchless. The geotechnical investigation was tailored to provide sufficient information for the trenchless methodology (pipe bursting).

Talavera Bulk Water Line
The geotechnical site investigation undertaken for the proposed construction of a bulk water pipeline that will pass through the Bloubosrand, Needwood and Maroeladal suburbs, in Northern Johannesburg. The project is necessary, to increase the bulk supply capacity of the area, and involves the construction of approximately 3130 m of new 600 mm diameter bulk supply pipeline that will replace an existing bulk supply pipeline. Test pits and geophysics (seismic refraction soundings) were undertaken for this project.

Eskom Kriel Power Station Ash Dam Geotechnical Investigation And Stability Risk Assessment
The geotechnical site investigation was undertaken as part of the Kriel Ash Dam Geotechnical Investigation and Stability Risk Assessment Project. JG Afrika (Pty) Ltd were appointed by Eskom Holdings SOC Limited to conduct geotechnical investigation and stability risk assessment of Ash Dams at Kriel Power Station, in the Mpumalanga Province. The work included all field and laboratory testing necessary, stability and Rate of Rise (RoR) analyses including report writing, and provision of recommendations to allow the dams to continue ashing with a minimum risk of failure. The investigation comprised of the drilling of boreholes (with SPT testing), CPTu, tests pits and pressure meter testing.

Rand Water H43 Pipeline Design Level Dolomite Hazard Study
The geotechnical investigation was undertaken for the proposed H43 Pipeline in Centurion, Gaauteng. The proposed pipeline traverses dolomitic land. The investigation entailed a gravity survey on a 30 m grid and, where feasible, trenching, to explore the areas where shallow dolomite, or bedrock, was expected. The trenching has more accurately defined the extent of dolomite land in the southern section of the route and further assessed the bedrock profiles. The gravity survey has delineated several major anomalies indicating both shallow and very deep bedrock along the length of the line.

Raft Foundation Solutions (Pty) Ltd)

2014 – 2016
Position – Junior Geologist

Geotechnical site investigations
Geotechnical report writing
Soil sampling and testing
Geotechnical research and academic report writing

Sky Chrome (International Ferro Metals SA Ltd)

2013
Position – Student Geologist

Slope stability analysis of a (scan line survey and kinematic analysis)

CONTINUED PROFESSIONAL DEVELOPMENT

Courses

2016 - Geotechnical Borehole Core Logging (presented by profiling presented by the South African Institute of Engineering and Environmental Geologists)
2016 - Level 1 First Aid training HIRAC – Risk Assessment training , Fire Fighting training.
2015 - Geotechnical Soil Profiling (presented by profiling presented by the South African Institute of Engineering and Environmental Geologists)

PERSONAL DETAILS

Nationality – South African
Date of Birth – 1989-09-17
Domicile – Johannesburg, South Africa

Languages
English – Good
Afrikaans – Fair

Appendix 6F

Social Impact Assessment

PROPOSED UMSOBOMVU SOLAR PV ENERGY FACILITIES AND ASSOCIATED GRID INFRASTRUCTURE PROJECT EASTERN AND NORTHERN CAPE PROVINCES

SOCIAL IMPACT ASSESSMENT SCOPING REPORT
April 2019

Prepared by:

Dr Neville Bews & Associates
SOCIAL IMPACT ASSESSORS

PO Box 145412
Bracken Gardens
1452

Submitted to:

SiVEST

4 Pencarrow Crescent,
La Lucia Ridge Office Estate,
Umhlanga Rocks,
4320

DETAILS OF PROJECT

Report Title	:	Social Impact Assessment Scoping Report for the Umsobomvu Solar PV Facilities and Associated Grid Infrastructure
Author	:	Dr Neville Bews
DEA Reference Number	:	
Project Developer	:	Mooi Plaats, Wonderheuvel, Paarde Valley Solar Power (Pty) Ltd
Environmental Consultant	:	**SiVEST Environmental Division**
Review Period	:	15 April, 2019
Status of Report	:	First Draft Report

EXECUTIVE SUMMARY

INTRODUCTION

Three separate solar photovoltaic facilities with associated grid connection infrastructure are proposed to be developed under separate Special Purpose Vehicles (SPV) as follows:

- Wonderheuvel Solar PV Facility under Wonderheuvel Solar Power (Pty) Ltd
- Mooi Plaats Solar PV Facility under Mooi Plaats Solar Power (Pty) Ltd
- Paarde Valley Solar PV Facility under Paarde Valley Solar Power (Pty) Ltd.

In this regard SiVEST Environmental Division has been contracted to undertake the environmental impact assessment of the project and in turn has appointed Dr Neville Bews & Associates to undertake the social impact assessment.

APPROACH TO STUDY

Data was gathered by means of the following techniques.

Collection of data

Data was gathered through:

- The project description prepared by the project proponent.
- Statistics South Africa, Census 2011 and other relevant demographic data generated by Stats SA such as the Quarterly Labour Force Survey and Mid-year population estimates.
- Discussions with the project proponents and Environmental Impact Assessment Consultants.
- A literature review of various documents such as the relevant Municipal Integrated Development Plans (IDPs) and other specialist reports and documents.
- A broader literature scan.

Impact assessment technique

The assessment technique used to evaluate the social impacts was provided by SiVEST Environmental Division and is attached in Appendix 1.

PROJECT DESCRIPTION

It is proposed that the following three solar photovoltaic (PV) energy facilities, with associated grid connection infrastructure, be developed on the following farm portions:

- ***Mooi Plaats Solar PV Facility***, on an application site of approximately 5 303 ha, comprising the following farm portions:
  - Portion 1 of Leuwe Kop No 120
  - Remainder of Mooi Plaats No 121.
- ***Wonderheuvel Solar PV Facility***, on an application site of approximately 5 652 ha, comprising the following farm portions:
  - Remainder of Mooi Plaats No 121
  - Portion 3 of Wonder Heuvel No 140
  - Portion 5 of Holle Fountain No 133.
- ***Paarde Valley Solar PV Facility***, on an application site of approximately 2 631 ha, comprising the following farm portion:
  - Portion 2 of Paarde Valley No 62.

Solar PV Components

The three Solar PV facilities will include the following components:

- PV fields (arrays) comprising multiple PV panels. The number of panels, the generation capacity of each facility and the layout of the arrays will be dependent on the outcome of the specialist studies conducted during the EIA process.
- PV panels will be either fixed tilt mounting or single axis tracking mounting, and the modules will be either crystalline silicon or thin film technology. Each panel will be approximately 2 m wide and between 1 m and 4 m in height, depending on the mounting type.
- Internal roads, between 4 m and 10 m wide, will provide access to the PV arrays. Existing site roads will be used wherever possible, although new site roads will be constructed where necessary.
- Each PV facility will include up to two (2) temporary construction laydown/staging areas of approximately 10 ha each.
- Operation and maintenance (O&M) buildings will be provided for each PV field, occupying a site of approximately 2 500 m^2 (50 m x 50 m).
- Medium voltage cabling will link the PV plant to the grid connection infrastructure. These cables will be laid underground wherever technically feasible.

Grid Connection Infrastructure

The proposed grid connection infrastructure for each PV facility is being assessed as part of a separate BA application. The grid connections will include the following components:

- New on-site substations and collector substations to serve each PV facility, each occupying an area of up to 4 ha.
- A new 132 kV overhead power line connecting the on-site substations or collector substations to either Hydra D Main Transmission Substation (MTS) or the proposed Coleskop Wind Energy Facility (WEF) substation from where the electricity will be fed into the national grid. The type of power line towers being considered at this stage to include both lattice and monopole towers which will be up to 25 m in height.

Two grid connection infrastructure alternatives have been provided for each PV project. These alternatives essentially provide for two different route alignments with associated substations contained within an assessment corridor of approximately 400 m wide. These alternatives are as follows:

- ***Mooi Plaats Solar PV Grid Connection***
  - Corridor Option 1 is approximately 13 km in length, linking Substations 1 and 2 to Hydra D MTS.
  - Corridor Option 2 is approximately 27 km in length, linking Substations 1 and 2 to Hydra D MTS via the proposed Central Collector substation located on the Wonderheuvel PV project application site.
- ***Wonderheuvel Solar PV Grid Connection***
  - Corridor Option 1 involves two separate grid connections to serve the northern and southern sectors of the application site. The northern connection is approximately 18 kms in length, linking the proposed on-site Substation 3 to Hydra D MTS via the Northern Collector substation. The southern connection is approximately 17 km in length, linking Substation 4 to the proposed Coleskop WEF substation via the Southern Collector substation located on the Paarde Valley PV project application site.
  - Corridor Option 2 is approximately 20 km in length, linking Substations 3 and 4 to Hydra D MTS via the proposed Central Collector substation located on the Wonderheuvel PV project application site.

- **Paarde Valley Solar PV Grid Connection**
  - Corridor Option 1 is approximately 14 km in length, linking Substation 6 to the proposed Coleskop WEF substation via the Southern Collector substation.
  - Corridor Option 2 is approximately 26 km in length, linking Substations 5 and 6 to Hydra D MTS via the proposed Central Collector substation located on the Wonderheuvel PV project application site.

Location

The project is situated across the Northern and Eastern Cape provinces with Mooi Plaats, and Wonderheuvel falling within the Umsobomvu local and Pixley ka Seme district municipalities in the Northern Cape Province. Paarde Valley falls within the Inxuba Yethemba local and Chris Hani district municipalities in the Eastern Cape Province.

IMPACTS IDENTIFIED

The impacts discussed above are assessed below in respect of the following three photovoltaic facilities and their respective associated grid infrastructure:

- Mooi Plaats Solar PV Facility
- Wonderheuvel Solar PV Facility
- Paarde Valley Solar PV Facility.

From a social perspective it makes far more sense to assess each of the solar PV facilities together with their respective associated grid infrastructure based on the following reasons:

1. The solar PV facilities and associated grid infrastructure are interdependent. If the one was not to exist neither would the other. In this sense each is an integral part of the other and cannot function independently.
2. The focus at a social level is far broader than is the case with certain other specialist studies that may have a narrower, project footprint specific emphasis.
   a. For instance, to consider certain aspects such as job creation; the influx of workers; socio-economic stimulation and the transformation of the sense of place in isolation would deter from the actual impact that may occur when considered on a combined basis and in essence would not make logical sense.
3. Any site specific implications associated with the grid infrastructure alternatives can be specifically addressed and mitigated as well as noted when discussing the motivation for selecting the socially preferred grid connection alternatives.

These impacts are assessed in respect of the following phases of the project:

- Planning and design
- Construction
- Operational
- Decommissioning, and
- The ‘no go” option.

Construction phase

Most of the impacts discussed above apply over the short-term to the construction phase of the project and include:

- Annoyance, dust and noise
- Increase in crime
- Increased risk of HIV infections
- Influx of construction workers and job seekers
- Hazard exposure
- Disruption of daily living patterns
- Disruptions to social and community infrastructure
- Job creation and skills development
- Socio-economic stimulation.

Operational phase

The social impacts that apply to the operational phase of the project are:

- Transformation of the sense of place and
- Economic
  - Job creation and skills development
  - Socio-economic stimulation

Decommissioning

If the project was to be completely decommissioned the major social impacts likely to be associated with this would be the loss of jobs and revenue stream that stimulated the local economy and flowed into the municipal coffers.

‘No Go’ Alternative

The ‘no go’ option would mean that the social environment is not affected as the status quo would remain. On a negative front it would also mean that all the positive aspects associated with the project would not materialise. Considering that Eskom’s coal fired power stations are a huge contributor to carbon emissions the loss of a chance to supplement the National Grid through renewable energy would be significant at a national, if not at a global level.

Cumulative impacts

In this regard the following cumulative impacts are addressed below:

- Risk of HIV
- Sense of place
- Service supplies and infrastructure, and
- The economic benefit.

No fatal flaws associated with the cumulative impacts are evident at a social level. The findings support the recommendations of the various reports undertaken for the different renewable energy projects in the region that, on an overall basis, the social benefits of renewable energy projects outweigh the negative benefits and that the negative social impacts can be mitigated.

COMPARATIVE ASSESSMENT OF LAYOUT ALTERNATIVES

As no social preference emerged in respect of any of the grid connection option the other specialist reports were perused to establish if there was any preference that would have an influence on the social. Based on this analysis the following preferences were identified and supported on a social basis:

- **Mooi Plaats Solar PV Facility:**
  - Grid Connection Option 1 — Preferred
  - Grid Connection Option 2 — Favourable
- **Wonderheuvel Solar PV Facility:**
  - Grid Connection Option 1 — Favourable
  - Grid Connection Option 2 — Preferred
- **Paarde Valley Solar PV Facility:**
  - Grid Connection Option 1 — Preferred
  - Grid Connection Option 2 — Favourable

CONCLUSION AND RECOMMENDATIONS

In assessing the social impact of the Umsobomvu Solar PV Facilities, it was found that in respect of the energy needs of the country and South Africa's need to reduce its carbon emissions that the project fits with national, provincial and municipal policy.

Regarding the social impacts associated with the project it was found that most apply over the short term to the construction phase of the project. Of these impacts all can be mitigated to within acceptable ranges and there are no fatal flaws associated with the construction or operation of the project.

On a cumulative basis it is evident that the cumulative impacts associated with changes to the social environment of the region are more significant than those attached to the project in isolation. On a negative front there are two issues associated with developments in the region that are of most concern. The first of these issues is the change to the sense of place of an area that was once considered a pristine region of South Africa. The second is the potential, through an influx of labour and an increase in transportation to constructions sites, of the risk for the prevalence of HIV to rise in an area that has a relatively low HIV prevalence rate. In this regard it is important that the relevant authorities recognise these issues and find ways of mitigating them to ensure that they do not undermine the benefit that renewable energy projects bring, both to the region as well as to the country as a whole. These issues are beyond a project specific basis and as such will need to be addressed at a higher level.

Impact statement

The project site and surrounding areas are sparsely populated with the agricultural potential of the area being low. Accordingly, the negative social impacts associated with the proposed Mooi Plaats, Wonderheuvel and Paarde Valley solar PV facilities and associated grid connection infrastructure are of low to moderate significance with most occurring over the short term construction phase. The project has a positive element which outweighs the negative in that it will contribute towards the supply of renewable energy into a grid system heavily reliant on coal powered energy generation. In this sense the projects form part of a national effort to reduce South Africa’s carbon emissions and thus carries with it a significant social benefit and is thus supported and should proceed.

EIA phase

As the area is sparsely populated and the negative social impacts associated with all three solar PV facilities and associated grid infrastructure of moderate significance it is most unlikely that any further social study will be necessary. This will, however, be dependent on the outcome of the public participation process which may result in a need to update the current report by incorporating the comments recorded and updating the social impacts accordingly.

PRE AND POST MITIGATION COMPARISON OF IMPACTS FOR ALL THREE SOLAR PV FACILITIES AND ASSOCIATED GRID INFRASTRUCTURE

Environmental parameter	Issues	Rating prior to mitigation	Average	Rating post mitigation	Average
Construction Phase					
Health & social wellbeing	Annoyance, dust and noise	-16 low	**Health & social wellbeing -27 medium**	-8 low	**Health & social wellbeing -20 low**
	Increase in crime	-33 medium		-22 low	
	Increased risk of HIV infections	-48 high		-32 medium	
	Influx of construction workers and job seekers	-22 low		-20 low	
	Hazard exposure.	-20 low		-18 low	
Quality of the living environment	Disruption of daily living patterns	-20 low	**Quality of the living environment -20 low**	-18 low	**Quality of the living environment-18 low**
	Disruptions to social and community infrastructure	-20 low		-18 low	
Economic	Job creation and skills development	+22 low	**Economic +23 low**	+24 medium	**Economic +25 medium**
	Socio-economic stimulation	+24 medium		+24 medium	
Operational Phase					
Quality of the living environment	Transformation of the sense of place	-51 high	**Quality of the living environment -51 high**	-34 medium	**Quality of the living environment -34 medium**
Economic	Job creation and skills development	+24 medium	**Economic +26 medium**	+24 medium	**Economic +33 medium**
	Socio-economic stimulation	+28 medium		+42 medium	
No Project Alternative					
No project	Status quo will remain	-51 high	**-51 high**	No mitigation measures	
Cumulative Impacts					
Health & social wellbeing	Risk of HIV	-51 high	**Health & social wellbeing -51 high**	-32 medium	**Health & social wellbeing -32 medium**
Quality of the living environment	Transformation of sense of place	-51 high	**Quality of the living environment -36.5 medium**	-34 medium	**Quality of the living environment -27 medium**
	Services, supplies & infrastructure	-22 low		-20 low	
Economic	Job creation, skills development and socio-economic stimulation	+36 medium	**Economic +36 medium**	+48 high	**Economic +48 high**

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LIST OF ABBREVIATIONS

AIDS	Acquired immunodeficiency syndrome
BID	Background Information Document
DBSA	Development Bank of South Africa
DEA	Department of Environmental Affairs
DM	District Municipality
EIA	Environmental Impact Assessment
GPS	Global Positioning System
HIA	Heritage Impact Assessment
HIV	Human Immunodeficiency Virus
I&AP	Interested and Affected Party
IDP	Integrated Development Plan
IRP	Integrated Resource Plan
IRR	Issues Response Report
kV	Kilovolt
LM	Local Municipality
MW	Megawatt
NBA	Dr. Neville Bews & Associates
NEMA	National Environmental Management Act (No. 107 of 1998)
NERSA	The National Energy Regulator of South Africa
NGO	Non-Governmental Organisation
NU	Non-urban area
OHS	Occupational Health and Safety
PA	Per Annum (Yearly)
PGDS	Provincial Growth and Development Strategy
PPP	Public Participation Process
PV	Photovoltaic
REIPPPP	Renewable Energy Independent Power Producer Procurement Program
SACPVP	South African Council for the Property Valuers Profession
SAHRA	South African Heritage Resources Agency
SAHRIS	South African Heritage Resources Information System
SDF	Spatial Development Framework
SIA	Social Impact Assessment

SIPs	Strategic Integrated Projects
SMME	Small Medium and Micro Enterprises
SPV	Special Purpose Vehicles
Stats SA	Statistics South Africa
STDs	Sexually Transmitted Diseases
ToR	Terms of Reference
UNESCO	United Nations Educational, Scientific and Cultural Organization
WEF	Wind Energy Facility
WHO	World Health Organisation
WWF	World Wild Fund for Nature

QUALIFICATIONS AND EXPERIENCE OF SPECIALIST

Qualifications:

University of South Africa: B.A. (Honours) – 1984

Henley Management College, United Kingdom: The Henley Post-Graduate Certificate in Management – 1997

Rand Afrikaans University: M.A. (cum laude) – 1999

Rand Afrikaans University: D. Litt. et Phil. – 2000

Projects:

The Social Impact Assessment (SIA) for the Gautrain Rapid Rail Link; The impact assessment for the Australian – South African sports development programme; SIA for Kumba Resources, Sishen South Project; Evaluation of a Centre for Violence Against Women for The United Nations Office on Drugs and Crime; SIAs for the following Exxaro Resources Ltd.'s mines, Leeuwpan Coal Mine Delmas, Glen Douglas Dolomite Mine Henley-on-Klip, Grootegeluk Open Cast Coal Mine Lephalale; SIA for the South African National Road Agency Limited (SANRAL) on Gauteng Freeway Improvement Project; SIA for SANRAL on the N2 Wild Coast Toll Highway; Research into research outputs of the University for the University of Johannesburg; SIA for Waterfall Wedge housing and business development in Midrand Gauteng; SIA for the Environmental Management Plan for Sedibeng District Municipality; Social and Labour Plan for the Belfast Project on behalf of Exxaro Resources Ltd; SIA for the Transnet New Multi-Product Pipeline (Commercial Farmers) on behalf of Golder Associates Africa (Pty) Ltd; SIA for the Proposed Vale Moatize Power Plant Project in Mozambique on behalf of Golder Associates Africa (Pty) Ltd; SIA for Kumba Resources Ltd.'s proposed Dingleton Resettlement Project at Sishen Iron Ore Mine on behalf of Water for Africa (Pty) Ltd; SIA for Gold Fields West Wits Project for EcoPartners; SIA for the Belfast Project for Exxaro Resources Ltd; SIA for Eskom Holdings Ltd.'s Proposed Ubertas 88/11kV Substation on behalf of KV3 Engineers (Pty) Ltd; SIA for the Mokolo and Crocodile River (West) Water Augmentation Project for the Department of Water and Sanitation on behalf of Nemai Consulting and the Trans Caledonian Water Authority; Assisted Octagon Consulting with the SIA for Eskom's Nuclear 1 Power Plant on behalf of Arcus GIBB Engineering & Science. SIA for the 150MW Photovoltaic Power Plant and Associated Infrastructure for Italgest Energy (Pty) Ltd, on behalf of Kalahari Survey Solutions cc. SIA for Eskom Holdings Limited, Transmission Division's Neptune-Poseidon 400kV Power Line on behalf of Nemai Consulting. Ncwabeni Off-Channel Storage Dam for security of water supply in Umzumbe, Mpumalanga.

Social Impact assessment for Eskom Holdings Limited, Transmission Division, Forskor-Merensky 275kV ±130km Powerline and Associated Substation Works in Limpopo Province. Social impact assessment for the proposed infilling of the Model Yacht Pond at Blue Lagoon, Stiebel Place, Durban.ABC Prieska Solar Project; Proposed 75 MWp Photovoltaic Power Plant and its associated infrastructure on a portion of the remaining extent of ERF 1 Prieska, Northern Cape.Sekoko Wayland Iron Ore, Molemole Local Municipalities in Limpopo Province.Langpan Chrome Mine, Thabazimbi, Limpopo; Jozini Nodal Expansion Implementation Project, Mpumalanga, on behalf of Nemai Consulting; SIA for Glen Douglas Dolomite Burning Project, Midvaal Gauteng, on behalf of Afrimat Limited; SIA for Lyttelton Dolomite mine Dolomite Burning Project, Marble Hall Limpopo on behalf of Afrimat Limited; Tubatse Strengthening Phase 1 – Senakangwedi B Integration for Eskom Transmission on behalf of Nsovo Environmental Consulting; Department of Water and Sanitation, South Africa (2014). Environmental Impact Assessment for the Mzimvubu Water Project: Social Impact Assessment DWS Report No: P WMA 12/T30/00/5314/7. Umkhomazi Water Project Phase 1 – Raw Water Component Smithfield Dam - 14/12/16/3/3/3/94; Water Conveyance Infrastructure - 14/12/16/3/3/3/94/1; Balancing Dam - 14/12/16/3/3/3/94/2. Umkhomazi Water Project Phase 1 – Potable Water Component: 14/12/16/3/3/3/95. Expansion of Railway Loops at Arthursview; Paul; Phokeng and Rooiheuwel Sidings in the Bojanala Platinum District Municipality in the North West Province for Transnet Soc Ltd; Basic Social Impact Assessment for the Cato Ridge Crematorium in Kwazulu-Natal Province; SIA for the Kennedy Road Housing Project, Ward 25 situated on 316 Kennedy Road, Clare Hills (Erf 301, Portion 5); Eskom's Mulalo Main Transmission Substation and Power Line Integration Project, Secunda;

Regularly lecture in the Department of Sociology at the University of Johannesburg and collaborated with Prof.Henk Becker of Utrecht University, the Netherlands, in a joint lecture to present the Social Impact Assessment Masters course via video link between the Netherlands and South Africa. Presented papers on Social Impact Assessments at both national and international seminars. Published on both a national and international level.

Affiliation:

The South African Affiliation of the International Association for Impact Assessment.
Registered on the database for scientific peer review of iSimangaliso GEF project outputs.

DECLARATION OF INDEPENDENCE

I, Neville Bews, 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 favorable to the applicant;
- I 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.

Signature of the specialist: 

Name of Specialist: Neville Bews

Date: 26 April 2019

1. INTRODUCTION

Three separate solar photovoltaic facilities with associated grid connection infrastructure are proposed to be developed under separate Special Purpose Vehicles (SPV) as follows:

- Wonderheuvel Solar PV Facility under Wonderheuvel Solar Power (Pty) Ltd
- Mooi Plaats Solar PV Facility under Mooi Plaats Solar Power (Pty) Ltd
- Paarde Valley Solar PV Facility under Paarde Valley Solar Power (Pty) Ltd.

The proposed site for these facilities and associated grid connection infrastructure is located some 32 km northwest of Middleburg in the Eastern Cape Province and approximately 19 km southwest of Noupoort in the Northern Cape Province.

In this regard SiVEST Environmental Division has been contracted to undertake the environmental impact assessment of the project and in turn has appointed Dr Neville Bews & Associates to undertake the social impact assessment.

1.1. PURPOSE OF REPORT

The purpose of the report is to identify the social baseline conditions in which the proposed Umsobomvu Project will unfold and to acquire an understanding of the proposed project. Against this background to identify the social impacts associated with the proposed project and suggest mitigation measures to limit the effect of these impacts on the social environment within which the project is placed.

1.2. STRUCTURE OF REPORT

This specialist study is undertaken in compliance with Requirements of Appendix 6 – GN R326 EIA Regulations 2014, as amended on of 7 April 2017. **Table 1** indicates how the requirements of Appendix 6 have been fulfilled in this report.

Table 1: Report content requirements in terms of EIA Regulations

Requirements of Appendix 6 – GN R326 EIA Regulations 2014, as amended on 7 April 2017	Section of 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 xviii
(b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Page xx
(c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 1.1 & 1.2 Page 1
(cA) an indication of the quality and age of base data used for the specialist report;	Section: 1.5.2 Page 5
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 5, 6, 7 & 8 Pages 40-80
(d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	N/A
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 1.4 Page 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;	Section 5-9 Pages 40-80
(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;	Figures 1, 2 & 3 Pages 8-10
(i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 1.5 Pages 4-5
(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]** or activities;	Sections 6 & 8 Pages 47-65 & 66-79
(k) any mitigation measures for inclusion in the EMPr;	N/A
(l) any conditions for inclusion in the environmental authorisation;	N/A
(m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Sections 6 & 8 Pages 47-65 & 66-79
(n) a reasoned opinion- (i) **[as to]** 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 Page 84
(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 *gazetted* by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	N/A

1.3. TERMS OF REFERENCE

To undertake a SIA in respect of the proposed Umsobomvu Project, and accordingly to consider the extent of the proposed project and its likely effect on the social environment within which the project will be placed.

General requirements:

- Adherence to all appropriate best practice guidelines, relevant legislation and authority requirements;
- Adherence to the content requirements for specialist reports in accordance with Appendix 6 of the EIA Regulations 2014, as amended;
- Identification sensitive areas to be avoided (if any) including providing shapefiles/kmls;
- Separate assessment and impact significance ratings for each phase of the six (6) proposed PV developments noting the impacts of the Pre-construction, Construction, Operation, Decommissioning Phases (according to SiVEST's impact rating methodology);
- Cumulative impact identification and assessment as a result of other renewable energy (RE) developments in the area (including; a cumulative environmental impact table(s) and statement, review of the specialist reports undertaken for other Renewable Energy developments and an indication of how the recommendations, mitigation measures and conclusion of the studies have been considered);
- Assessment of the significance of the cumulative impacts (according to SiVEST's impact rating methodology);
- Comparative assessment of alternatives to be provided for each of the six (6) phases and grid connection;
- Recommend mitigation measures in order to minimise the impacts of the proposed development and note any specific mitigation measures for a particular phase; and
- Implications of specialist's findings for the proposed development (e.g. permits, licences etc.).

1.4. APPROACH TO STUDY

Data was gathered by means of the following techniques.

1.4.1. COLLECTION OF DATA

Data was gathered through:

- The project description prepared by the project proponent.
- Statistics South Africa, Census 2011 and other relevant demographic data generated by Stats SA such as the Quarterly Labour Force Survey and Mid-year population estimates.
- Discussions with the project proponents and Environmental Impact Assessment Consultants.
- A literature review of various documents such as the relevant Municipal Integrated Development Plans (IDPs) and other specialist reports and documents.
- A broader literature scan.

1.4.2. IMPACT ASSESSMENT TECHNIQUE

The assessment technique used to evaluate the social impacts was provided by SiVEST Environmental Division and is attached in Appendix 1.

1.5. ASSUMPTIONS AND LIMITATIONS

The following assumptions and limitations apply in respect of this report.

1.5.1. ASSUMPTIONS

It is assumed that the technical information provided by the project proponent and the environmental consultants SiVEST, is credible and accurate at the time of compiling the report.

It is also assumed that the data provided by the various specialists as used in this report are credible and accurate.

1.5.2. Limitations

The demographic data used in this report was sourced from Statistics South Africa and is based on data gathered during Census 2011. This data is somewhat outdated but where possible is supplemented with the latest Stats SA's survey data such as the Mid-year population estimates and the Quarterly Labour Force Survey. The limitation of this is that this survey data is restricted to a provincial level and does not extend to a municipal level.

Some of the information in the documentation available from the district and local municipalities was somewhat outdated but where ever possible that information was aligned with that available from Stats SA.

2. Project Description

It is proposed that the following three solar photovoltaic (PV) energy facilities, with associated grid connection infrastructure, be developed on the following farm portions:

- ***Mooi Plaats Solar PV Facility***, on an application site of approximately 5303 ha, comprising the following farm portions:
    - Portion 1 of Leuwe Kop No 120
    - Remainder of Mooi Plaats No 121.
- ***Wonderheuvel Solar PV Facility***, on an application site of approximately 5652 ha, comprising the following farm portions:
    - Remainder of Mooi Plaats No 121
    - Portion 3 of Wonder Heuvel No 140
    - Portion 5 of Holle Fountain No 133.
- ***Paarde Valley Solar PV Facility***, on an application site of approximately 2631 ha, comprising the following farm portion:
    - Portion 2 of Paarde Valley No 62.

2.1. Solar PV Components

The three Solar PV facilities will include the following components:

- PV fields (arrays) comprising multiple PV panels. The number of panels, the generation capacity of each facility and the layout of the arrays will be dependent on the outcome of the specialist studies conducted during the EIA process.
-

- PV panels will be either fixed tilt mounting or single axis tracking mounting, and the modules will be either crystalline silicon or thin film technology. Each panel will be approximately 2 m wide and between 1 m and 4 m in height, depending on the mounting type.
- Internal roads, between 4 m and 10 m wide, will provide access to the PV arrays. Existing site roads will be used wherever possible, although new site roads will be constructed where necessary.
- Each PV facility will include up to two (2) temporary construction laydown/staging areas of approximately 10 ha each.
- Operation and maintenance (O&M) buildings will be provided for each PV field, occupying a site of approximately 2 500 m^2 (50 m x 50 m).
- Medium voltage cabling will link the PV plant to the grid connection infrastructure. These cables will be laid underground wherever technically feasible.

2.2. Grid Connection Infrastructure

The proposed grid connection infrastructure for each PV facility is being assessed as part of a separate BA application. The grid connections will include the following components:

- New on-site substations and collector substations to serve each PV facility, each occupying an area of up to 4 ha.
- A new 132 kV overhead power line connecting the on-site substations or collector substations to either Hydra D Main Transmission Substation (MTS) or the proposed Coleskop Wind Energy Facility (WEF) substation from where the electricity will be fed into the national grid. The type of power line towers being considered at this stage to include both lattice and monopole towers which will be up to 25 m in height.

Two grid connection infrastructure alternatives have been provided for each PV project. These alternatives essentially provide for two different route alignments with associated substations contained within an assessment corridor of approximately 400 m wide. These alternatives are as follows:

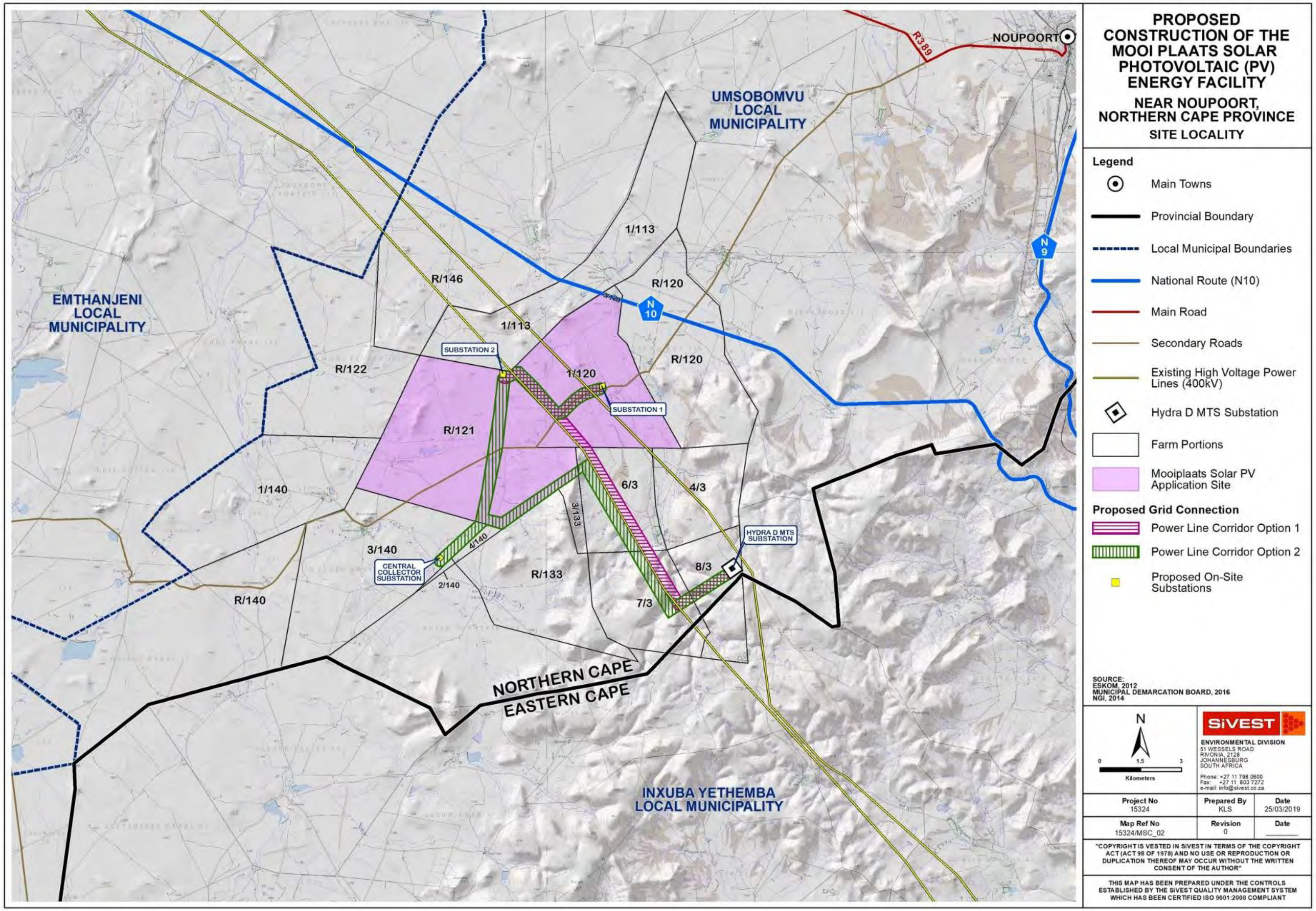
- ***Mooi Plaats Solar PV Grid Connection***
  - Corridor Option 1 is approximately 13 km in length, linking Substations 1 and 2 to Hydra D MTS.
  - Corridor Option 2 is approximately 27 km in length, linking Substations 1 and 2 to Hydra D MTS via the proposed Central Collector substation located on the Wonderheuvel PV project application site.

- ***Wonderheuvel Solar PV Grid Connection***
  - Corridor Option 1 involves two separate grid connections to serve the northern and southern sectors of the application site. The northern connection is approximately 18 kms in length, linking the proposed on-site Substation 3 to Hydra D MTS via the Northern Collector substation. The southern connection is approximately 17 km in length, linking Substation 4 to the proposed Coleskop WEF substation via the Southern Collector substation located on the Paarde Valley PV project application site.
  - Corridor Option 2 is approximately 20 km in length, linking Substations 3 and 4 to Hydra D MTS via the proposed Central Collector substation located on the Wonderheuvel PV project application site.

- **Paarde Valley Solar PV Grid Connection**
  - Corridor Option 1 is approximately 14 km in length, linking Substation 6 to the proposed Coleskop WEF substation via the Southern Collector substation.
  - Corridor Option 2 is approximately 26 km in length, linking Substations 5 and 6 to Hydra D MTS via the proposed Central Collector substation located on the Wonderheuvel PV project application site.

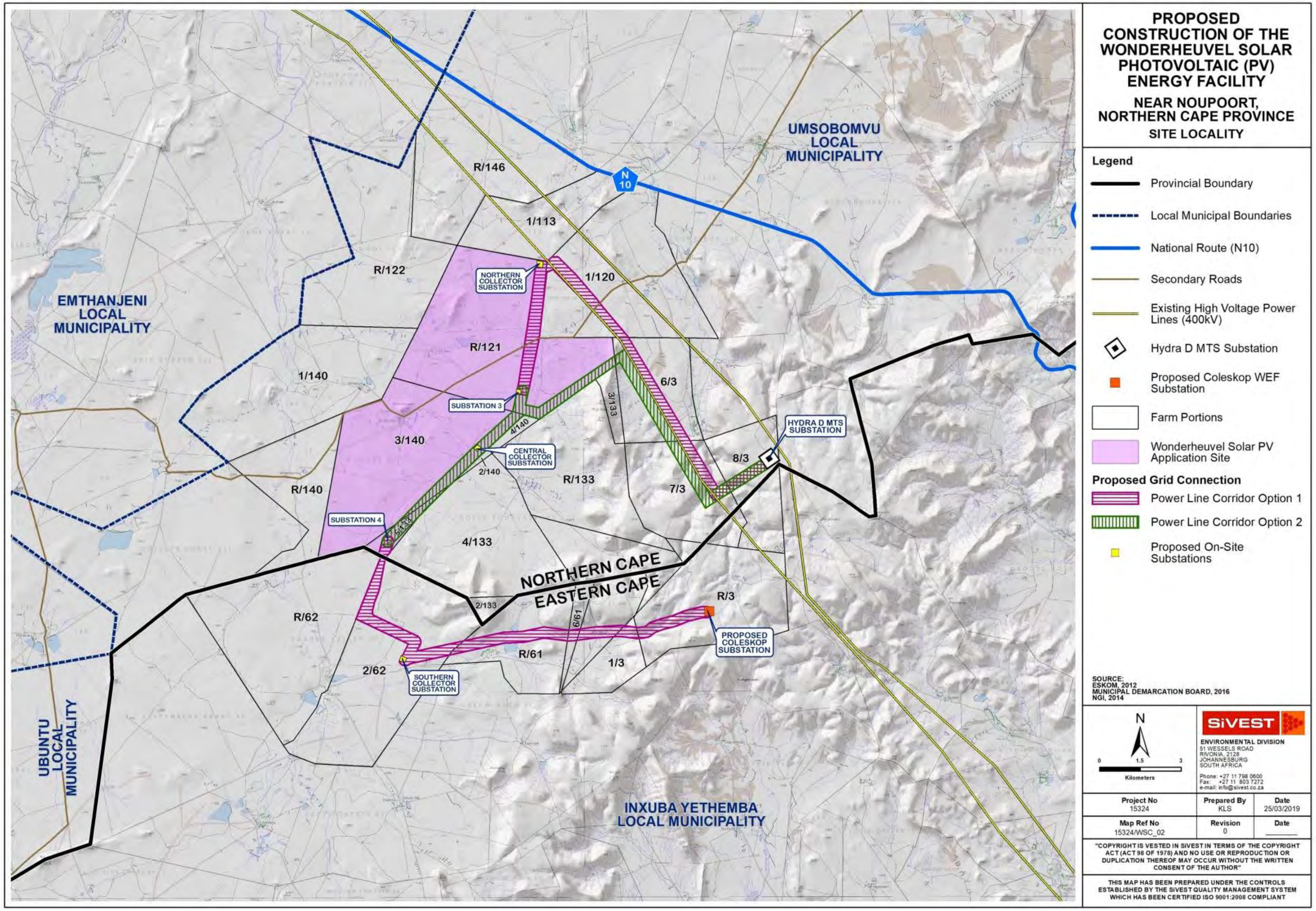
2.3. LOCATION

The project is situated across the Northern and Eastern Cape provinces with Mooi Plaats, illustrated in **Figure 1**, and Wonderheuvel, illustrated in **Figure 2**, falling within the Umsobomvu local and Pixley ka Seme district municipalities in the Northern Cape Province. Paarde Valley falls within the Inxuba Yethemba local and Chris Hani district municipalities in the Eastern Cape Province as illustrated in **Figure 3**.



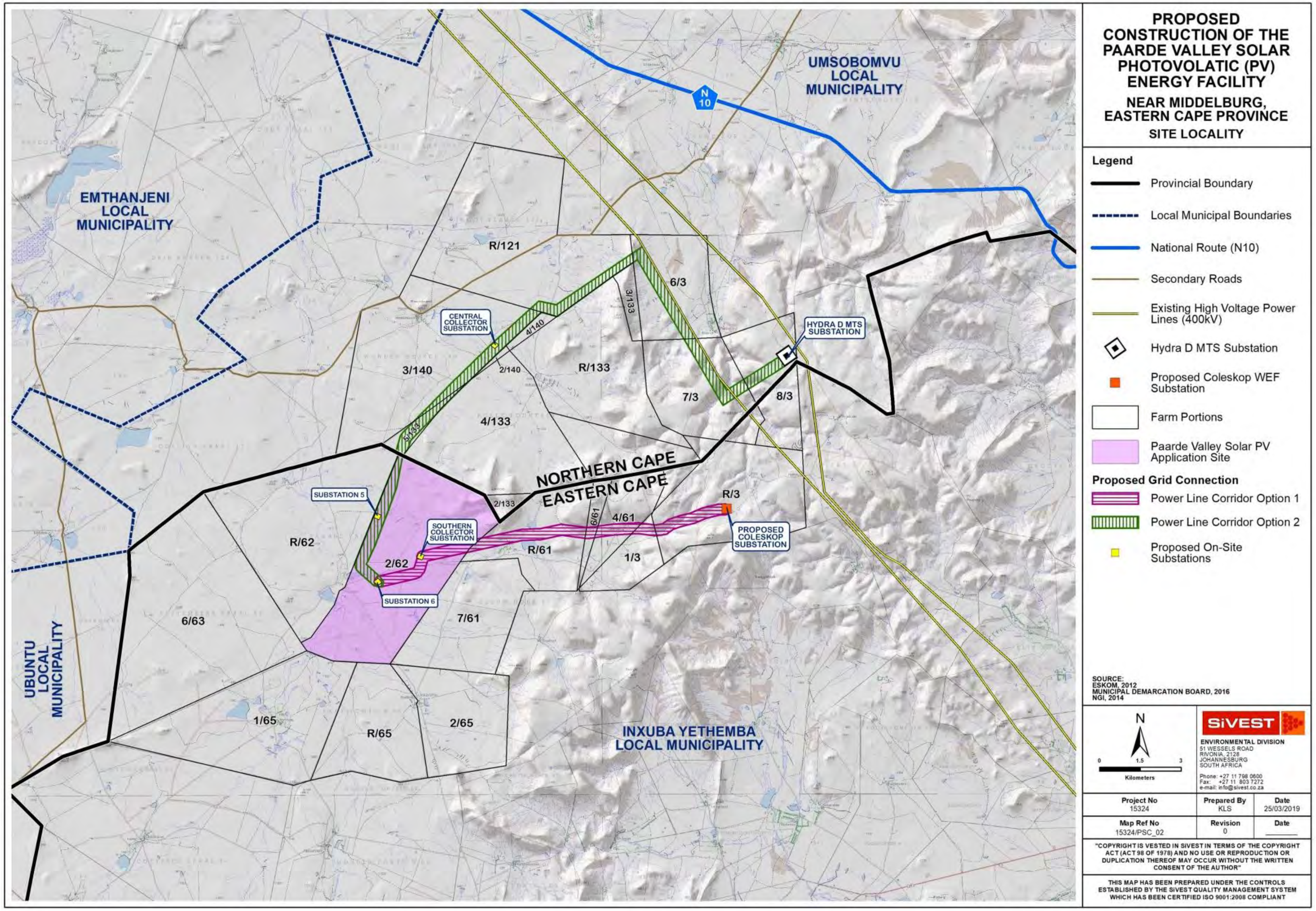
Source: SiVEST Environmental Division

Figure 1: Mooi Plaats Solar PV Facility – Locality map



Source: SiVEST Environmental Division

Figure 2: Wonderheuvel Solar PV Facility – Locality map



Source: SiVEST Environmental Division

Figure 3: Paarde Valley Solar PV Facility – Locality map

2.4. EIA ALTERNATIVES

No location, technological and layout alternatives are considered in respect of all three solar photovoltaic (PV) energy facilities. In respect of the grid connection infrastructure two corridor options are considered for each of the three solar photovoltaic (PV) energy facilities and in each case are labelled Option 1 and Option 2. Each of these options is described above under 2.2 Grid connection infrastructure.

2.4.1. NO-GO ALTERNATIVE

It is mandatory to consider the 'no-go' option in the EIA process. The 'no-go' alternative assumes that the site remains in its current state, i.e. there is no construction of any of the solar photovoltaic (PV) energy facilities and associated grid connection infrastructure and that the status quo would proceed.

3. APPLICABLE POLICY AND LEGISLATION

Legislation and policy serve to guide the authorities in undertaking and agreeing on projects that are in the interest of the country as a whole. Consequently, the fit of the project with the relevant national, provincial and municipal legislation and policy is an important consideration. In this respect the following legislation and policy is applicable to the project.

International

- Climate Change Action Plan, 2016-2020, World Bank Group (2016)
- Renewable Energy Vision 2030 – South Africa; World Wildlife Fund for Nature-SA (formerly World Wildlife Fund-SA) (2014)
- REthinking Energy 2017: Accelerating the global energy transformation. International Renewable Energy Agency, (2017)
- Renewable Energy Policies in a Time of Transition. International Renewable Energy Agency (2018)
- Global Warming of 1.5 °C. An IPCC special report on the impacts of global warming of 1.5 °C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty. Summary for Policymakers. Subject to copy edit: Intergovernmental Panel on Climate Change (2018).

National

- White Paper on the Energy Policy of the Republic of South Africa (1998)
- White Paper on Renewable Energy (2003)
- A National Climate Change Response Strategy for South Africa (2004)
- National Energy Act (2008)
- Integrated Resource Plan (IRP) for South Africa (2010-2030)
- The Environmental Impact Assessment and Management Strategy for South Africa (2014)
- Government Gazette Vol. 632; 16 February 2018 No. 41445. Department of Environmental Affairs, No. 114, Page No. 92 (2018)
- New Growth Path Framework (2010)
- The National Development Plan (2011)
- National Infrastructure Plan (2012).

Provincial

- Eastern Cape Provincial Integrated Sustainable Development Planning Framework (PISDPF)
- Eastern Cape Provincial Growth and Development Plan (2004-2014)
- Eastern Cape Strategic Plan (2015-2020)
- Northern Cape Provincial Growth and Development Strategy (2004-2014)
- Northern Cape Province Twenty Year Review (2014)
- Northern Cape Climate Change Response Strategy
- Northern Cape Spatial Development Framework
- Northern Cape Department of Environment & Nature Conservation Annual Report (2016/17)
- Norther Cape Department of Economic Development & Tourism Annual Report (2017)
- Northern Cape State of the Province Address (2018).

District and local

- Chris Hani District Municipality, 2019-2020 Draft Integrated Development Plan Review
- Inxuba Yethemba Local Municipality, 2013/14 Integrated Process Plan Programme
- Pixley ka Seme District Municipality, Integrated Development Plan Draft 2018-2019
- Pixley ka Seme District Municipality, Spatial Development Framework / Land Development Plan 2013 – 2018
- Umsombomvu District Municipality, Integrated Development Plan 2017-2020 1st Review: 2018/19.

3.1. POLICY AND LEGISLATION FIT

Considering the nature and location of the project there is a clear fit with international, national, provincial and local, at both district and municipal levels, policy and legislation. For instance, the World Wild Life Fund for Nature (WWF)

> "…*calls for a more ambitious plan, suggesting that the IRP* [Integrated Resource Plan for Electricity] *should provide for an 11-19% share of electricity capacity by 2030, depending on the country's growth rate over the next fifteen years*" (Sager, 2014, p. 5).

The issue of climate change is high on the agenda of all levels of government in South Africa with the Department of Environmental Affairs and Tourism indicating that:

> "*The efforts of all stakeholders will be harnessed to achieve the objectives of the Government's White Paper on Renewable Energy (2003) and the Energy Efficiency Strategy, promoting a sustainable development path through coordinated government policy* (Department of Environmental Affairs and Tourism, 2004, p. 23) "

DEAT goes further in specifically listing renewable energy sources, including solar, wind power and biomass, as a tool in promoting mitigation against climate change.

In terms of the capacity determinations of the Minister of Energy, in consultation with the National Energy Regulator (NERSA), it has been established that South Africa required:

> "*14 725 MW of renewable energy (comprising of solar PV: 6 225 MW, wind: 6 360 MW, CSP: 1 200 MW, small hydro: 195 MW, landfill gas: 25 MW, biomass: 210 MW, biogas: 110 MW and the small scale renewable energy programme: 400 MW)*" (Independent Power Producer Office, 2018a, p. 5).

With the Northern Cape contributing 8 652 GWh in respect of solar (Independent Power Producers Procurement Office, 2018b, p. 3) and the Eastern Cape contributing 684 GWh (Independent Power Producers Procurement Office, 2018c, p. 3).

On 16 February 2018 the boundaries of eight Renewable Energy Zones (REZs) that are of strategic importance for large scale solar photovoltaic and wind for the country were gazetted (Government Gazette No. 41445, 2018). Although the project falls outside of these zones it will nevertheless contribute towards the requirement of renewable energy highlighted by the development of these zones.

The Northern Cape Department of Economic Development and Tourism identifies six economic development opportunities, one of which is renewable energy, and states that:

> "*During the financial year* [2017/18] *the intension* (sic) *is to focus on additional opportunities such as, Renewable Energy, a focus area of the 9-Point Plan*" (Northern Cape Province. Department of Economic Development & Tourism, 2017, p. 10 & 15).

The importance of renewable energy facilities within the Northern Cape has been recognised in the province's Twenty Year Review 2014 where it is indicated that:

> "*The New Growth Path that was adopted by national government in 2010 identified the green economy as a new economic sector that will be key to the creation of jobs. The focus of the green economy is on renewable energy and the Northern Cape was identified as the solar hub of the country with a number of solar plants being established across the province*" (Northern Cape Province, 2014, p. 153).

On a municipal level wide support is also evident across the affected municipalities. The IDP of the Chris Hani DM states that:

> " …*we can see that CHDM is now ready to address the scourge of climate change and make it beneficial to the citizens of this region through greening, recycling, and renewable energy initiatives…* [and the Renewable Energy Sector is listed] *As a Special Development Area* [as follows] *Manufacturing, Industry Mining and Renewable Energy Sectors*" (Chris Hani District Municipality, 2019, p. 171 & 254).

The Pixley ka Seme DM also recognises the potential of renewable energy initiatives and states in its Spatial Development Plan that:

> "*The Pixley Ka Seme District area with its abundance of sunshine and vast tracts of available land has been attracting considerable interest from solar energy investors of late. The high solar index of the area, as indicated by the Solar Index Diagram, provides many opportunities in terms of the development of renewable energy.*
>
> *The growth and development context in the district has also changed radically since 2013 (after it had been stagnant for decades) owing mainly to private and public investments in the area as a hub for renewable energy generation and*

astronomy, respectively" (Pixley Ka Seme District Municipality, 2014, p. 44 & 52).

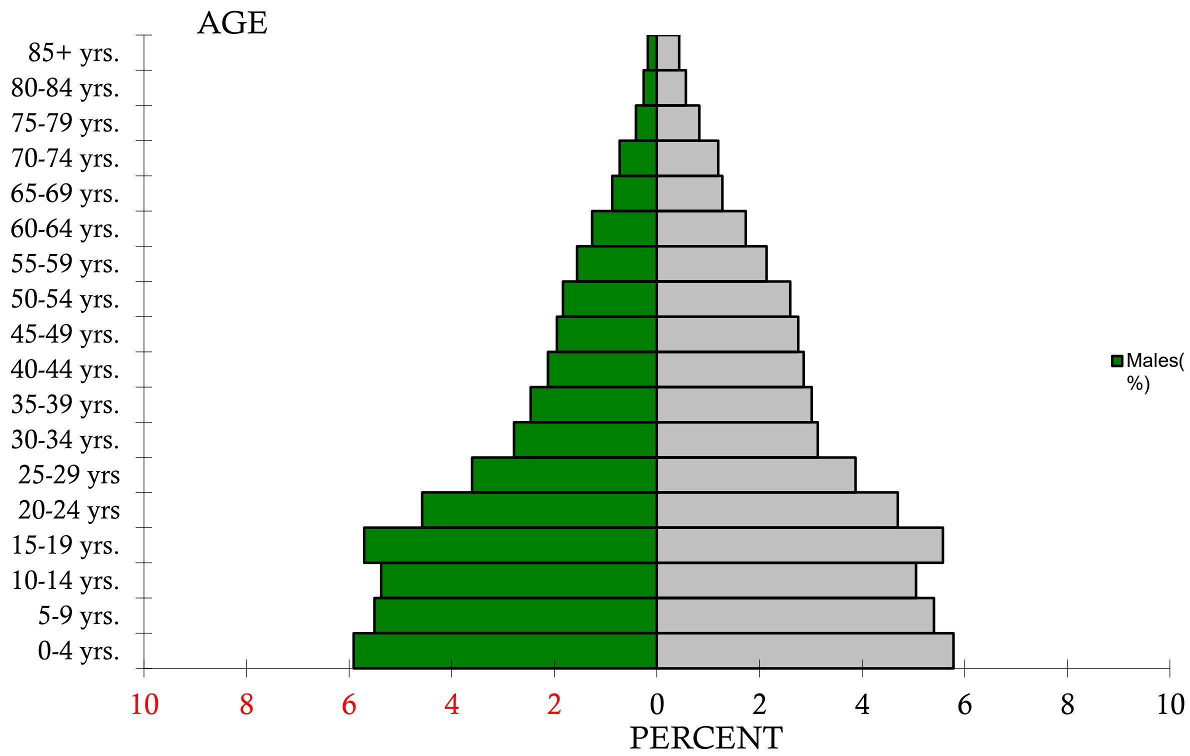
Considering the policy and legislation referred to above it seems that the project largely aligned with this framework. Notwithstanding this, however, the provision that the project conforms to appropriate scale and form, particularly considering the cumulative impacts associated with similar such projects in the area, will need to be considered on a broader basis than can be done as far as this report is concerned. In this regard attention will need to be given to the cumulative impacts at a later point in the report in as far as they relate to the social environment. In the following section a description of the affected environment is provided.

4. Description of the Affected Environment

The Mooi Plaats and Wonderheuvel solar PV facilities fall within the Northern Cape Province while the Paarde Valley Solar PV Facility is located within the Eastern Cape Province. In the Northern Cape the Pixley ka Seme (DC7) district and Umsobomvu (NC072) local municipalities are affected by the project while in the Eastern Cape the project impacts the Chris Hani district (DC13) and Inxuba Yethemba (EC131) local municipalities. The closest towns to the project are Noupoort and Hanover in the Northern Cape and Middelburg in the Eastern Cape, all of which fall within the Karoo Region. The demographics pertaining to these areas, as sourced from Statistics South Africa Census 2011, are described below.

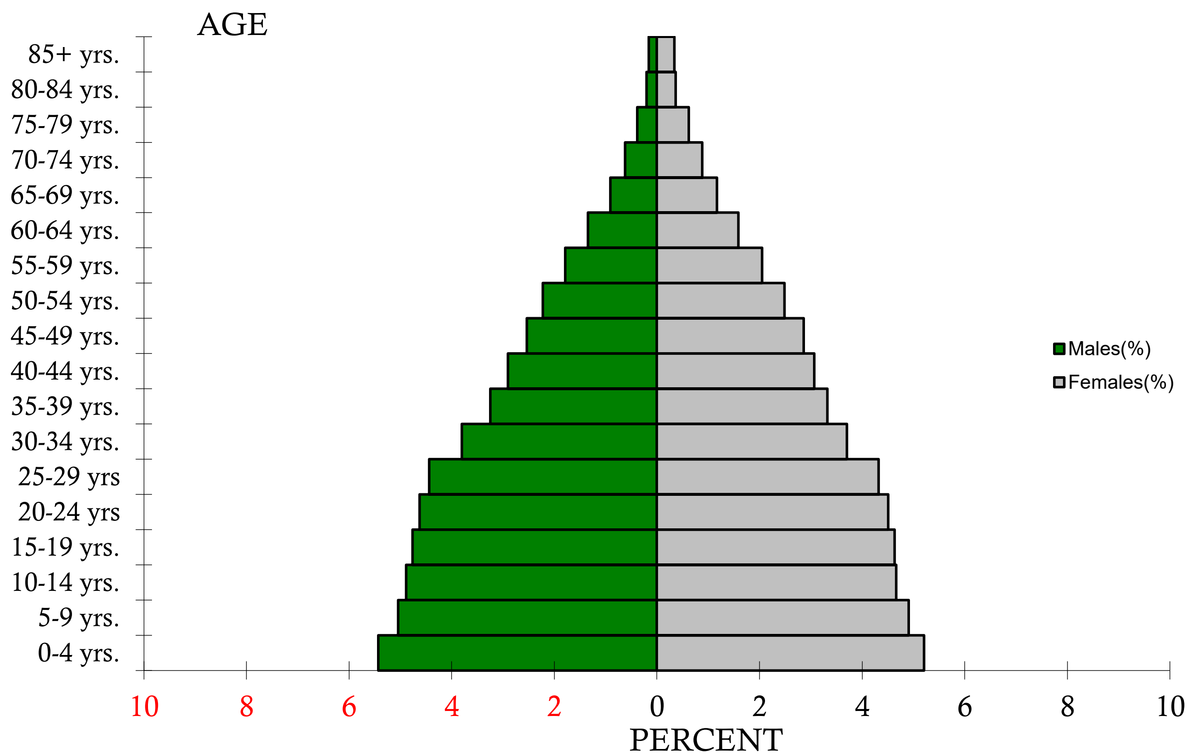
4.1. Provincial

The Eastern Cape Province covers an area of 168 965.98 km² and has a population of 6 562 053 people, resulting in a population density of 38.84 people per km² according to Census 2011 (Statistics South Africa, 2011). The Northern Cape Province covers an area of 372 889.36 km² and, over the same period, had a population of 1 145 861 people giving it a population density of 3.07 people per km². In respect of age structure 33% of the population of the Eastern Cape are below 16 years while 60.2% are between 15 and 64 years of age and 6.7% are above 64 years. The corresponding figures pertaining to the Northern Cape are as follows; below 16 years = 30.1%, between 15 and 64 years = 64.2% and above 64 years = 5.7%. The population pyramids of the Eastern and Northern Cape provinces are illustrated in **Figure 4** and **Figure 5** respectively.



Source: (Statistics South Africa, 2011)

Figure 4: Population pyramid Eastern Cape Province



Source: (Statistics South Africa, 2011)

Figure 5: Population pyramid Northern Cape Province

According to the 2018 Mid-year population estimates (Statistics South Africa, 2018a), with a population of 6 522 700 in 2018, the Eastern Cape accounts for 11.3% of the total population across the country marginally below the Western Cape with an estimated population of 6 621 100 or 11.5% of the total population of South Africa. The Northern Cape Province has the smallest population with an estimated population of 1 225 600 in 2018. As the Mid-year population estimates remain at a provincial level and are not projected to the district and local municipal levels, for comparative purposes, data gathered during Census 2011, will be used where appropriate, notwithstanding it being somewhat outdated.

On this basis and in respect of population groupings at 86.26%, the dominant population group in the Eastern Cape is black African with the dominant population of the Northern Cape, at 50.35%, also being black African people. At 49.7% and 53.8% respectively Afrikaans is the dominant home language spoken across both provinces.

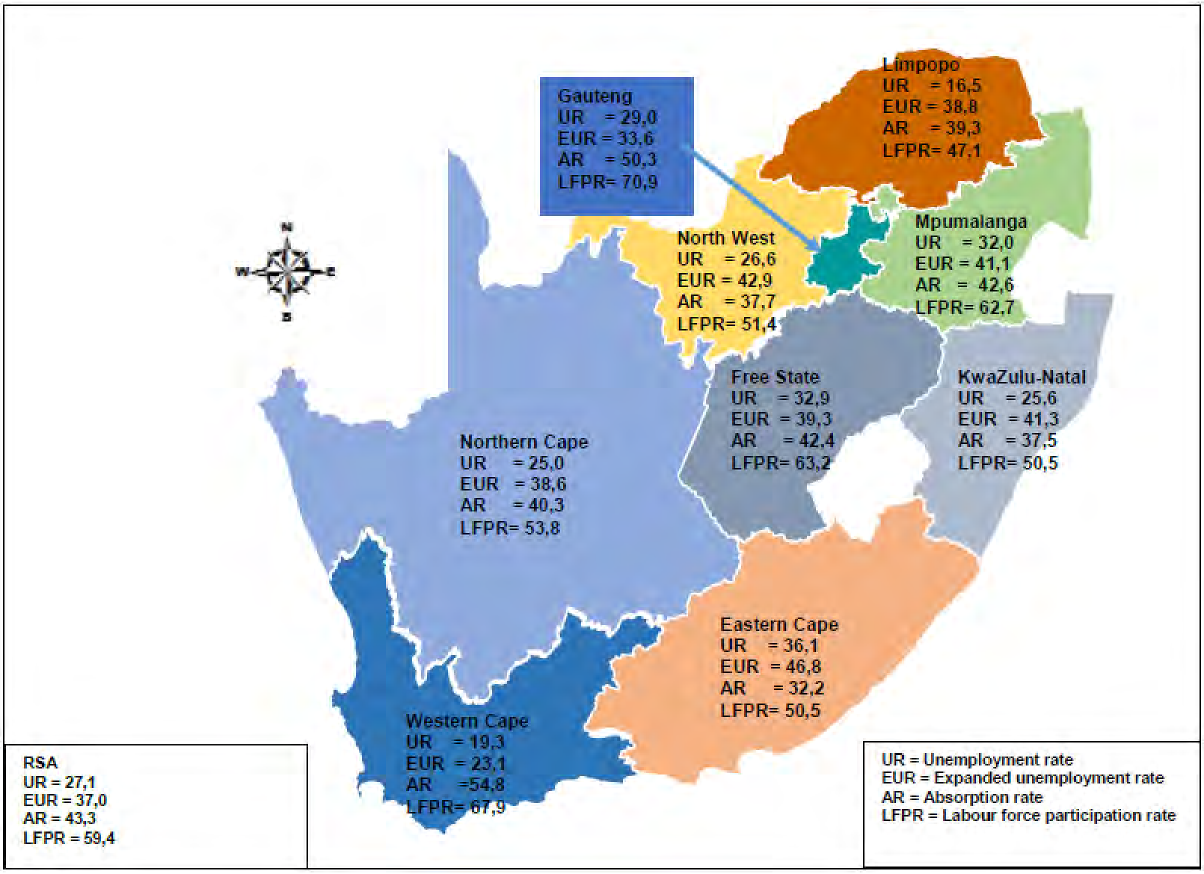
The dependency ratio of the Eastern Cape, which indicates the burden placed on the population of working age, between 15 and 64 years, who support children under 15 years and people over 65 years, is 66.0 while that of the Northern Cape is 55.7. The sex ratio, which measures the proportion of males to females, in the Eastern Cape is 89.0 indicating a higher number of females in the province while that of the Northern Cape is 97.3 also indicating a higher female to male ratio across the province. Between 1996 and 2001 the population growth rate of the Eastern Cape was 0.42% p.a. while between 2001 and 2011 it was 0.44% p.a. The corresponding data for the Northern Cape was -0.40 between 1996 and 2001 and 1.44 between 2001 and 2011.

In 2011 the official unemployment rate in the Eastern Cape was 37.4% with the official unemployment rate amongst the youth, aged between 15 and 34 years, being 47.3%. The corresponding figures for the Northern Cape are 27.4% and 34.5% respectively. In the 4th Quarter of 2018 the official unemployment rate in the Eastern Cape had dropped to 36.1% while that in the Northern Cape had dropped to 25%. These figures must, however, be considered with caution as the official unemployment rate is defined by Stats SA as follows;

> "*Unemployed persons are those (aged 15–64 years) who:*
> *a) Were not employed in the reference week and;*
> *b) Actively looked for work or tried to start a business in the four weeks preceding the survey interview and;*
> *c) Were available for work, i.e. would have been able to start work or a business in the reference week or;*

d) Had not actively looked for work in the past four weeks but had a job or business to start at a definite date in the future and were available." (Statistics South Africa, 2018b, p. 17).

Considering this in the 4th Quarter of 2018, the expanded unemployment rate in the Eastern Cape was 46.8% while that in the Northern Cape stood at 38.6%. During this period the labour absorption rate in the Eastern Cape was 32.2% while the labour force participation rate was 50.5%. In the Northern Cape the labour force absorption rate was 40.3% and the labour force participation rate was 53.8%. A summary of the labour market indicators illustrated on a comparative basis across South Africa is provided in **Figure 6**.



Source: (Statistics South Africa, 2018b, p. 9)

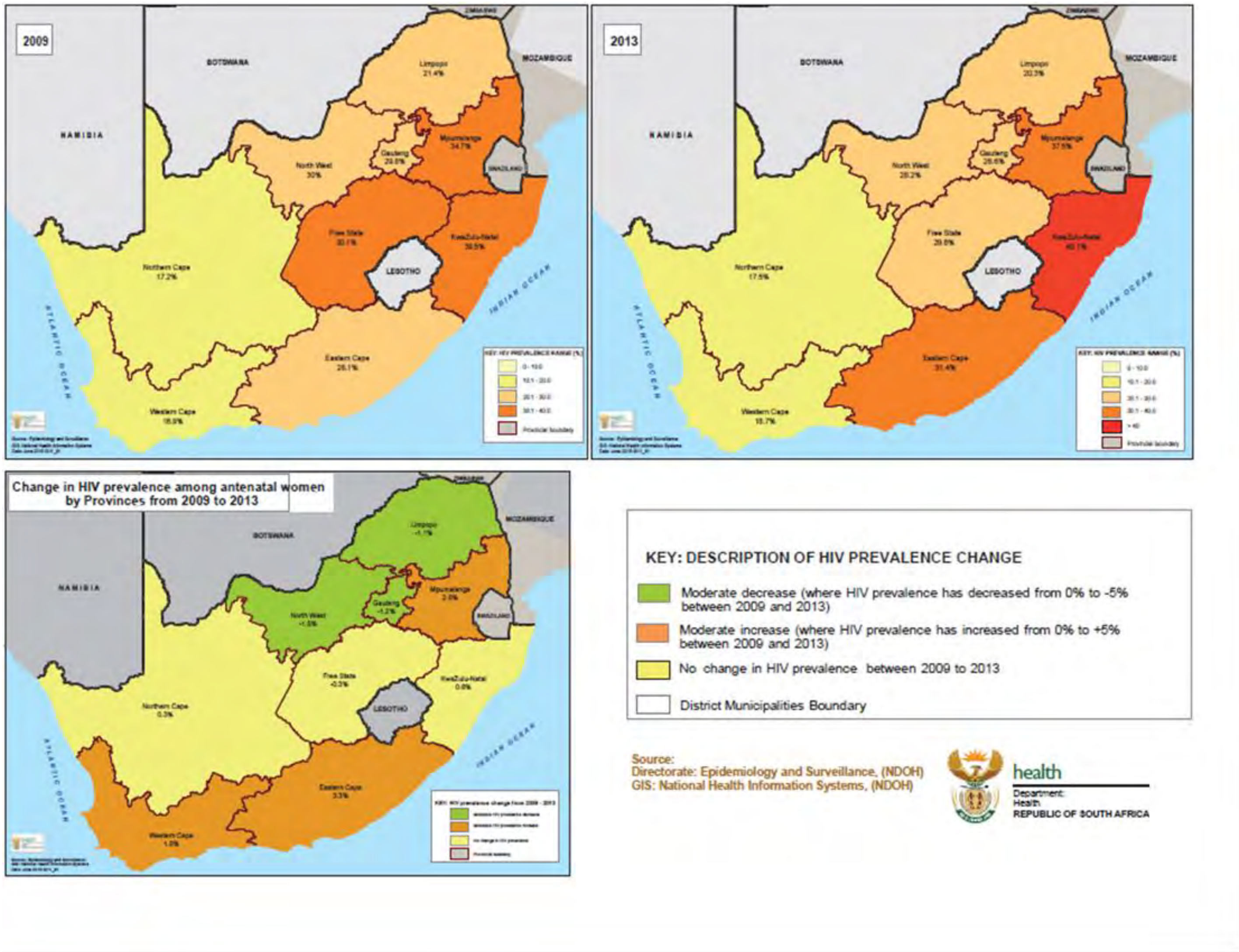
Figure 6: Labour market indicators 4th Quarter 2018

In respect of households, the 2011 Census indicated that there were 1 687 385 households in the Eastern Cape with an average household size of 3.9 and 301 405 households in the Northern Cape with an average household size of 3.8. Of the households in the Eastern Cape, 49.6% were female headed, 63.2% lived in formal dwellings and 59.6% either owned or were paying off their dwelling. The corresponding figures for the Northern Cape are 38.8% female headed households with 82.4% living in formal dwellings and 55.1% having either owned or were paying off their dwelling.

Regarding household services in 2011, 40.4% of households in the Eastern Cape and 60.1% in the Northern Cape had flush toilets connected to the sewerage system. In respect of refuse removal 41% of households in the Eastern Cape and 64% in the Northern Cape had their refuse removed on a weekly basis. Piped water was delivered to 32.8% and 45.8% of households in the Eastern and Northern Cape respectively while 75% of households in the Eastern Cape and 85.4% in the Northern Cape used electricity as a means of energy for lighting.

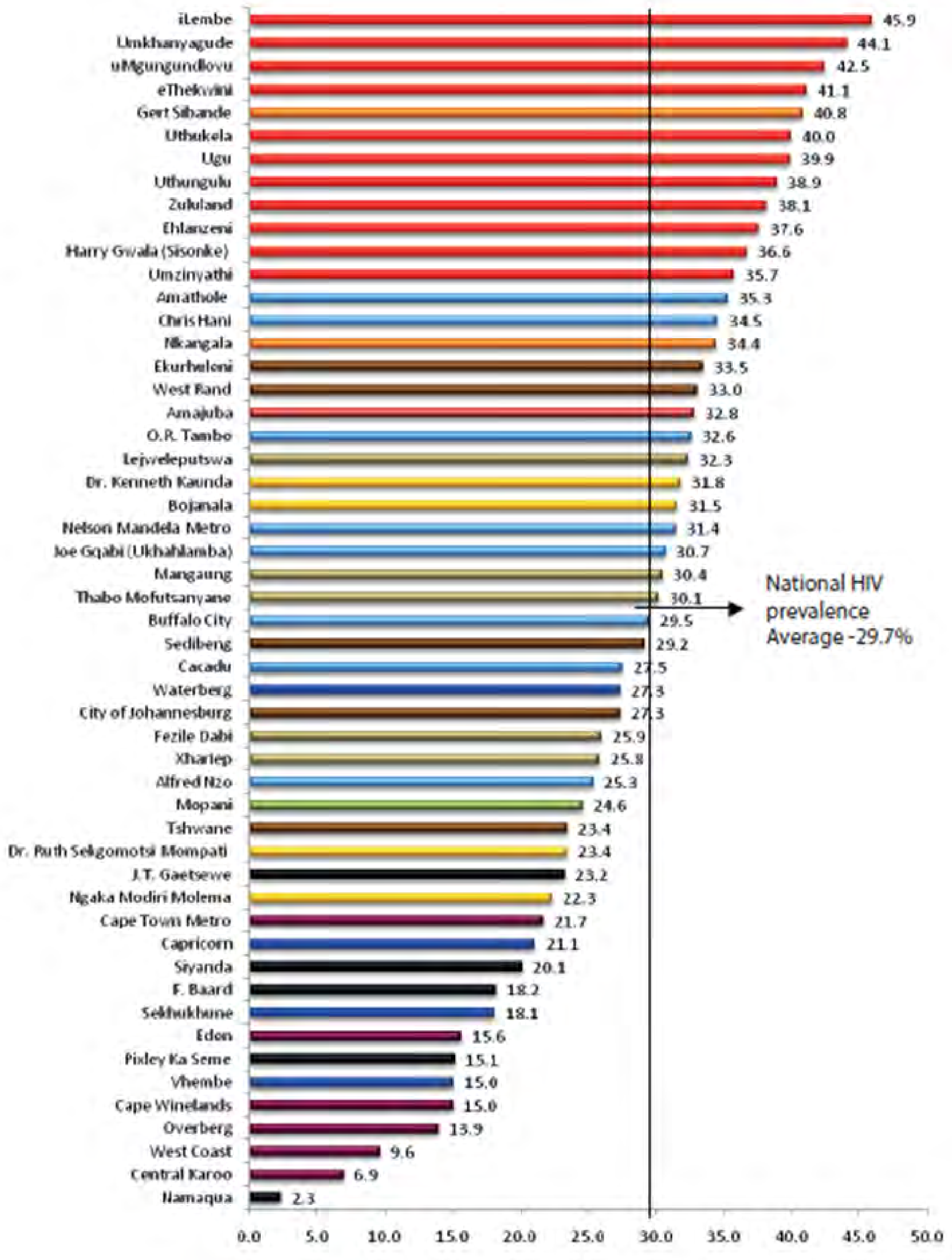
Concerning HIV prevalence amongst prenatal women in both the Eastern and Northern Cape provinces, in 2013 the Northern Cape had the lowest prevalence rate across South Africa at 17.5% followed by the Western Cape at 18.7% while the Eastern Cape had an HIV prevalence rate of 31.4%. At the same point the highest level of HIV prevalence amongst antenatal women was in KwaZulu-Natal with a prevalence rate of 40.1% while the national rate was 29.7%. HIV prevalence amongst antenatal women across South Africa is illustrated in **Figure 7**.

The 2013 National Antenatal Sentinel HIV Prevalence Survey extended to the district level which indicated that the Namaqua District Municipality had the lowest level of HIV prevalence across the country at 2.3% followed by the Central Karoo District at 6.9%. Of the 52 districts surveyed the Pixley Ka Seme district had the seventh lowest level of HIV prevalence at 15.0% while the Chris Hani district had a relatively high level at 34.5%. As the project falls within a remote area of the Chris Hani district and Inxuba Yethemba local municipalities it is likely that the level of HIV prevalence will be somewhat low in the vicinity of the project. It is probable that the high HIV levels in the district will be associated with the more densely populated urban areas of Cradock and Middelburg amongst others and is also due to the fact that the Chris Hani district serves as a linking node to all regions in the Eastern Cape. It is well documented that the spread of HIV is associated with transport corridors (Singh & Malaviya, 1994; Ramjee & Gouws, 2002; Djemai, 2018; Strauss, et al., 2018). The prevalence of HIV amongst antenatal women as it occurred across the district municipalities in 2013 is illustrated in **Figure 8**.



Source: (National Department of Health, 2015, p. 27)

Figure 7: HIV prevalence amongst antenatal women – South Africa 2009 – 2013



Source: (National Department of Health, 2015, p. 29)

Figure 8: HIV prevalence across the 52 districts – 2013

Attention is now turned towards the district and local municipalities which are compared together with both the provinces in **Table 2** to **Table 5**.

4.2. MUNICIPAL

The project impacts the two district municipalities of Pixle ka Seme and Chris Hani as well as their respective local municipalities of Umsobomvu and Inxuba Yethemba. On a district level Pixley ka Seme covers the greatest land area and has the lowest population density at 1.80/km^2, while at a local municipal level although the Inxuba Yethemba covers the largest geographical area it also has the largest population resulting in a population density of 5.62/km^2. In respect of population grouping, at 93.35% black African people are the dominant population group across all districts and the Umsobomvu Local Municipality while the coloured population group dominates within the Pixdley ka Seme Local Municipality. isiXhosa is the dominant home language spoken across all municipalities except Pixley ka Seme where Afrikaans is the dominant home language. Demographic data pertaining to the district and local municipalities is compared together with that applicable to the Northern and Eastern Cape Provinces in **Table 2**.

The Pixley ka Seme region is primarily a sheep farming area, also renown for stud farms where high-quality race horses are bred. The towns of Colesberg, Norvalspont and Noupoort all fall within the Umsobomvu Local Municipality. The economy of the area revolves around agriculture, the services industry, tourism and hospitality.

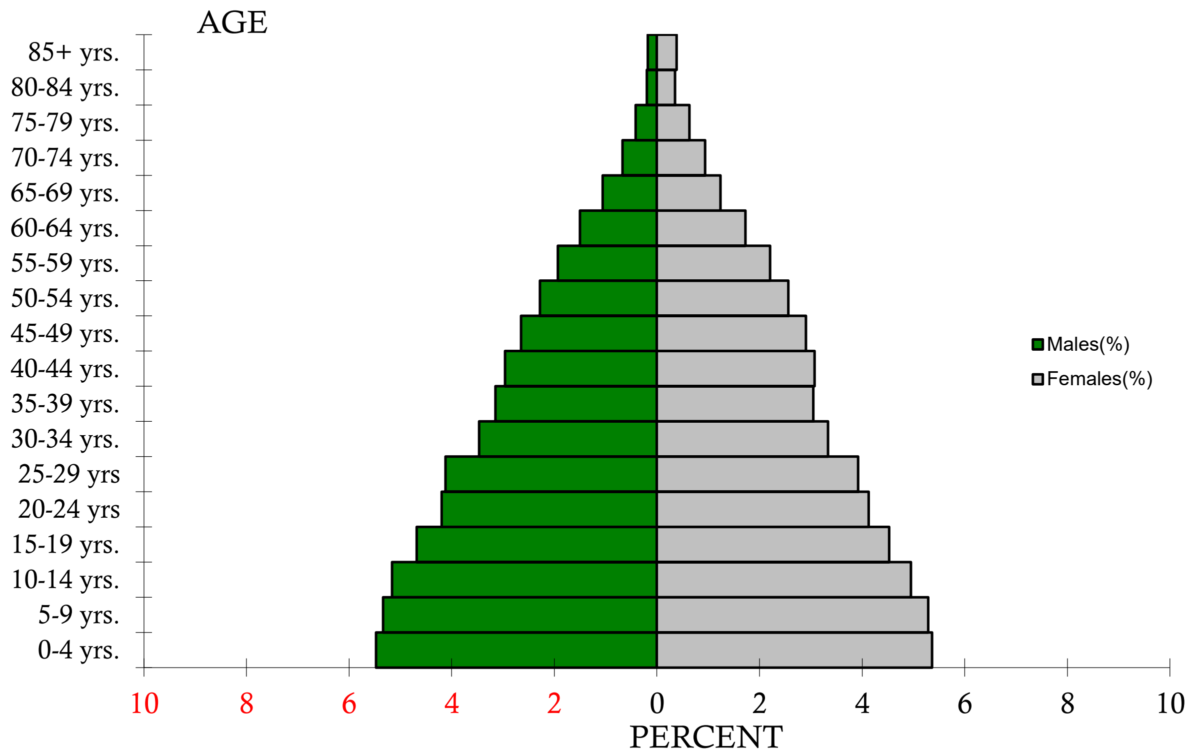
The Inxuba Yethemba Local Municipality incorporates the towns of Cradock and Middelburg and the surrounding rural areas comprise mainly of commercial farms and small settlements. The economic drivers in the area are community and financial services, trade, transportation and agriculture with some tourism with the Mount Zebra National Park falling within the area.

Table 2: Geographic and demographic data

	EASTERN CAPE	DC13: Chris Hani	EC131: Inxuba Yethemba	NORTHERN CAPE	DC7: Pixley ka Seme	NC072: Umsobomvu
Geographical Area	168,965.98 km²	36,143.54 km²	11,662.69 km²	372,889.36 km²	103,409.91 km²	6,818.53 km²
Population	6,562,053	795,461	65,560	1,145,861	186,351	28,376
Households	1,687,385	210,852	18,463	301,405	49,193	7,841
Population Density	38.84/km²	22.01/km²	5.62/km²	3.07/km²	1.80/km²	4.16/km²
Household Density	9.99/km²	5.83/km²	1.58/km²	0.81/km²	0.48/km²	1.15/km²
Female	52.92%	52.65%	51.69%	50.69%	50.59%	51.76%
Male	47.08%	47.35%	48.31%	49.31%	49.41%	48.24%
Black African	86.26%	93.35%	56.21%	50.35%	31.45%	62.56%
Coloured	8.26%	4.12%	32.17%	40.31%	59.17%	30.57%
White	4.73%	2.02%	10.51%	7.09%	8.08%	5.66%
Other	0.33%	0.29%	0.82%	1.56%	0.74%	0.66%
Indian/Asian	0.43%	0.22%	0.29%	0.68%	0.56%	0.55%
Home Language	isiXhosa 78.85%	isiXhosa 88.58%	isiXhosa 49.97%	Afrikaans 53.76%	Afrikaans 76.79%	isiXhosa 55.16%
	Afrikaans 10.58%	Afrikaans 6.10%	Afrikaans 44.61%	Setswana 33.08%	isiXhosa 17.48%	Afrikaans 38.58%
	English 5.61%	English 2.62%	English 3.10%	isiXhosa 5.34%	Setswana 1.71%	Sesotho 1.91%
	Sesotho 2.46%	Sign language 0.70%	Other 0.55%	English 3.36%	English 1.63%	English 1.76%

Source: (Statistics South Africa, 2011)

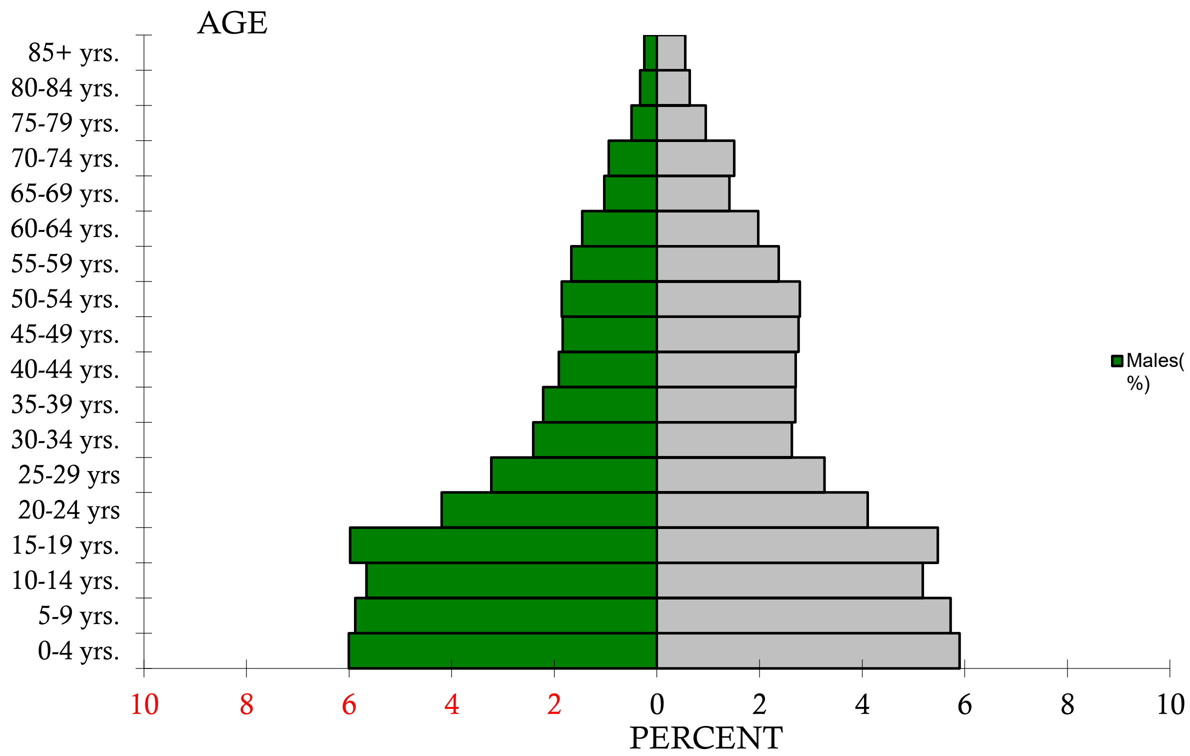
In the Pixley ka Seme district 31.6% of the population, which amounted to 186 351 people in 2011, were under 16 years of age while 62.4% were between 15 and 64 years and 6.1% were over the age of 64. Based on this data the population pyramid of Pixley ka Seme is illustrated in **Figure 9**.



Source: (Statistics South Africa, 2011)

Figure 9: Population pyramid Pixley ka Seme

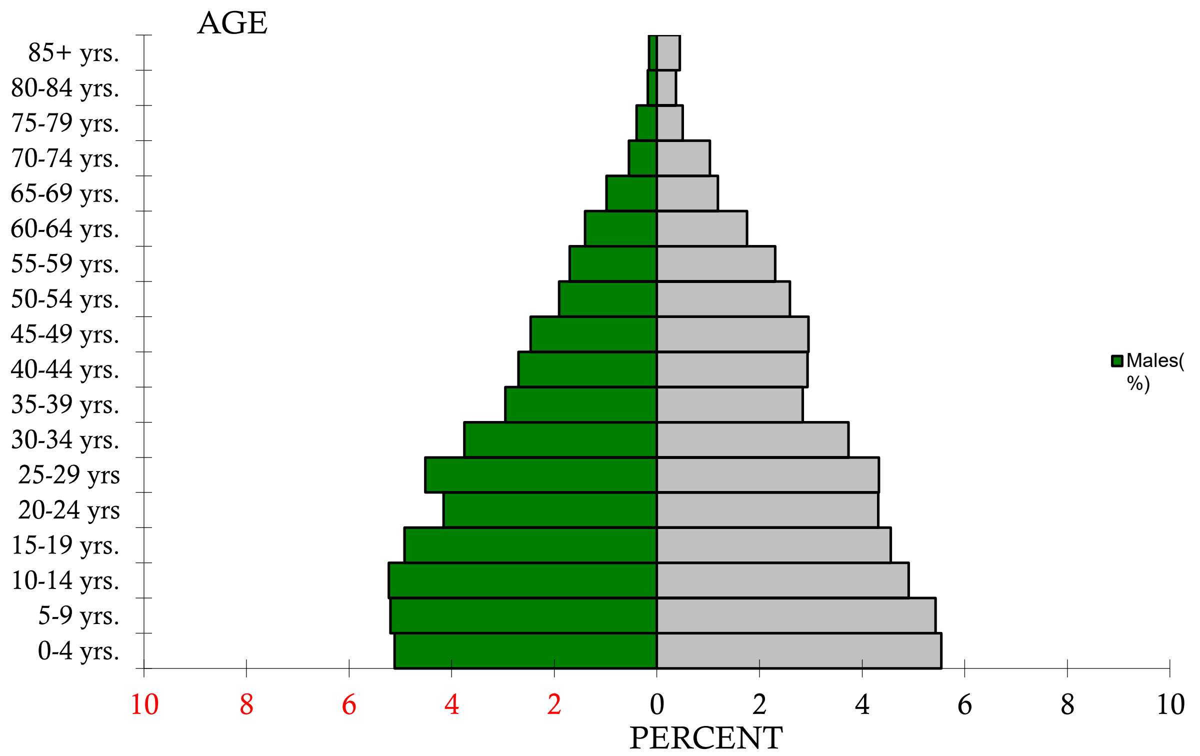
In the Chris Hani district, which had a population of 795 461 people in 2011, 34.4% were under 16 years of age while 67.6% were between 15 and 64 years and 8.1% were over the age of 64. The population pyramid of the Chris Hani district is represented in **Figure 10**.



Source: (Statistics South Africa, 2011)

Figure 10: Population pyramid Chris Hani

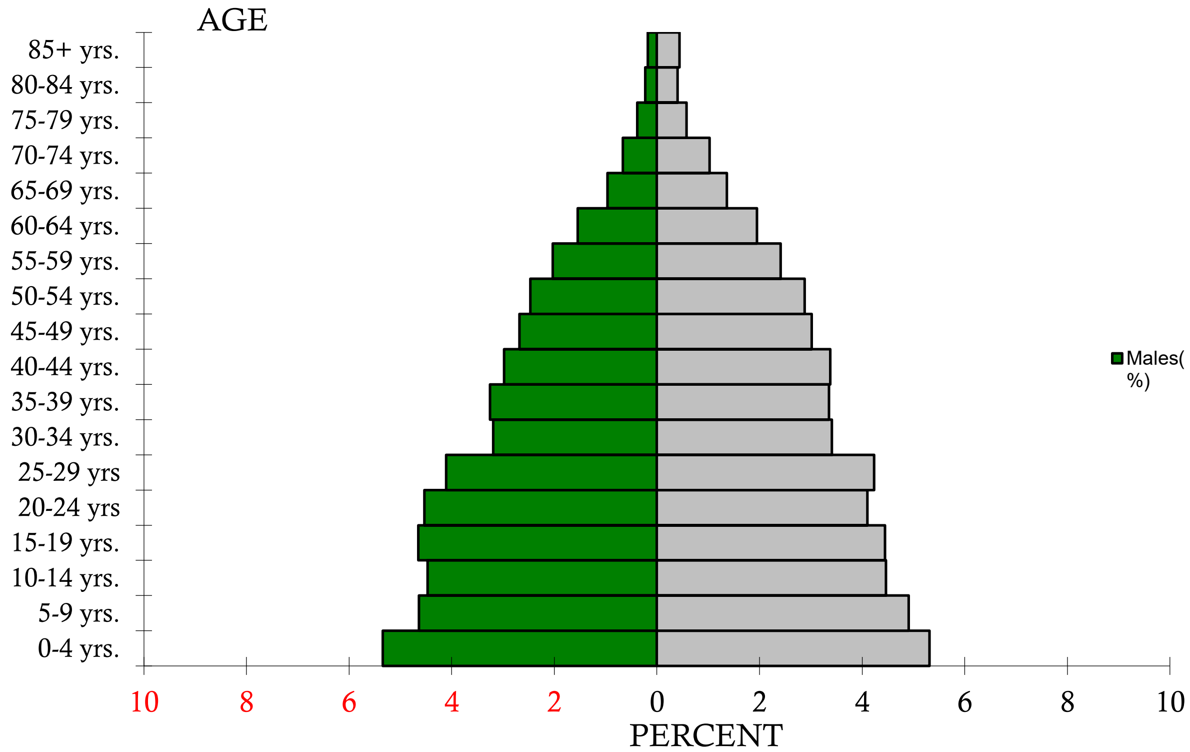
In the Umsobomvu Local Municipality 31.4% of the population of 28 376 people were under 16 years of age, while 62.8% fell between 15 and 64 years and 5.8% were over the age of 64. The population pyramid of the Umsobomvu municipality is represented in **Figure 11**.



Source: (Statistics South Africa, 2011)

Figure 11: Population pyramid Umsobomvu

Of the population of 65 560 people in the Inxuba Yethemba Local Municipality, 29.1% were under 16 years of age in 2011 while 64.6% were between 15 and 64 years and 6.2% were over the age of 64 years. The population pyramid of the Inxuba Yethemba is represented in **Figure 12**.



Source: (Statistics South Africa, 2011)

Figure 12: Population pyramid Inxuba Yethemba

The dependency ratio, which indicates the burden of support for children under 16 years and people over 64 years placed on the working population aged between 15–64 years, is highest in the Chris Hani district at 73.8% and in Ixuba Yethemba at 54.7%. In respect of sex ratio Pixley ka Seme has a higher proportion of males to females in the population at 97.6 while, at 89.9, the Chris Hani has the highest proportion of females to males. Between 2001 and 2011 the Umsobomvu LM had the highest population growth rate at 1.83% while the Chris Hani district had a negative population growth rate at -0.06%. This data is compared across the region in **Table 3**.

Table 3: Age structure, dependency ratio, sex ratio and population growth

Municipality	Age Structure						Dependency Ratio		Sex Ratio		Population Growth (% p.a.)	
	<15		15-64		65+		Per 100 (15-64)		Males per 100 females			
	2001	2011	2001	2011	2001	2011	2001	2011	2001	2011	2001	2011
EASTERN CAPE	36.6	33.0	57.1	60.2	6.3	6.7	75.0	66.0	86.2	89.0	0.42	0.44
DC13: Chris Hani	38.8	34.4	53.9	57.6	7.3	8.1	85.5	73.8	85.9	89.9	-0.34	-0.06
EC131: Inxuba Yethemba	30.1	29.1	64.0	64.6	5.9	6.2	56.1	54.7	92.7	93.5	0.84	0.83
NORTHERN CAPE	32.1	30.1	62.5	64.2	5.4	5.7	60.1	55.7	93.7	97.3	-0.40	1.44
DC7: Pixley ka Seme	32.6	31.6	61.5	62.4	5.9	6.1	62.7	60.4	94.2	97.6	-1.27	1.12
NC072: Umsobomvu	33.7	31.4	61.0	62.8	5.3	5.8	63.8	59.3	91.8	93.2	-1.41	1.83

Source: (Statistics South Africa, 2011)

The unemployment rate in the area is highest in the Chris Hani district and Umsobomvu local municipalities at 39 and 33 percent respectively. The level of unemployment is lowest in the Inxuba Yethemba Local Municipality at 25.7%. In respect of education, at 10.75% Inxuba Yethemba has the lowest percentage of the population that has no schooling with the Umsobomvu having the highest percentage with no schooling at 16.31%. Surprisingly Umsobomvu has the highest percentage of the population having a matric level of education at 23.2% while the Inxuba Yethemba municipality has the highest percentage of the population with an education level higher than matric at 8.6%. Data pertaining to education as discussed above is compared across the municipalities and at the provincial levels in
Table 4.

In respect of the local municipalities associated with the project, Umsobomvu has the fewest number of households at 7 841 compared to the 18 463 households in the Inxuba Yethemba municipality. The average household size across both local municipalities is the same at 3.6. There is a slightly higher percentage of female headed households in Umsobomvu at 41.5% compared to 40.9% in Inxuba Yethemba. Most households in the Inxuba Yethemba LM, at 97%, live in formal dwellings. A relatively low number of households across the study region ranging, between 60.3 and 46.7 percent, either own or are paying off their dwellings. Data pertaining to household dynamics across the region is presented in **Table 5**.

Table 4: Labour market and education aged 20 +

Municipality	Labour Market				Education (age 20 +)					
	Unemployment Rate (official)		Youth Unemployment Rate (Official) 15-34 years		No Schooling		Matric		Higher Education	
	2001	2011	2001	2011	2001	2011	2001	2011	2001	2011
EASTERN CAPE	54.3	37.4	64.3	47.3	22.8	10.5	14.3	20.0	6.3	8.5
DC13: Chris Hani	58.8	39.0	69.4	48.5	29.7	13.9	9.4	14.9	5.5	7.0
EC131: Inxuba Yethemba	43.2	25.7	53.7	33.2	16.5	10.7	14.0	20.2	6.0	8.6
NORTHERN CAPE	35.6	27.4	44.1	34.5	19.3	11.3	15.8	22.9	5.9	7.2
DC7: Pix ka Seme	36.4	28.3	44.1	35.4	26.3	14.6	12.5	20.6	5.5	5.9
NC072: Umsobomvu	51.9	33.0	60.6	40.4	26.6	16.3	12.5	23.2	5.2	6.2

Source: (Statistics South Africa, 2011)

Table 5: Household dynamics

Municipality	Household dynamics									
	Households		Average household size		Female headed households		Formal dwellings		Housing owned/paying off	
	2001	2011	2001	2011	2001	2011	2001	2011	2001	2011
EASTERN CAPE	1 481 640	1 687 385	4.2	3.9	50.9	49.6	51.5	63.2	57.1	59.6
DC13: Chris Hani	185 297	210 852	4.2	3.8	53.6	51.6	53.1	61.9	58.3	60.3
EC131: Inxuba Yethemba	16 002	18 463	3.6	3.6	36.9	40.9	97.1	97.0	40.2	46.7
NORTHERN CAPE	245 086	301 405	3.9	3.8	37.7	38.8	81.0	82.4	60.8	55.1
DC7: Pix ka Seme	41 707	49 193	3.9	3.8	33.8	36.9	84.7	86.3	50.2	52.0
NC072: Umsobomvu	5 848	7 841	3.9	3.6	43.1	41.5	81.8	88.2	52.4	52.7

Source: (Statistics South Africa, 2011)

4.3. PROJECT FOOT PRINT

At a project foot print specific level the Mooi Plaats and Woderheuvel facilities fall within the Umsobomvu non-urban (NU) area which is sparsely populated with a population density of 0.38 people per square kilometre. The demographic data in respect of the Umsobomvu NU listed as Sub Place 370003002 according to Census 2011 is as follows:

Geographic area = 6 516.10 km²
Population = 2 452 people
Population density = 0.38/km²
Households = 892
Household density = 0.14/km²

Gender	**People**	**Percentage**
Male	1,267	51.67%
Female	1,185	48.33%
Population group		
Black African	1,037	42.29%
Coloured	993	40.50%
White	411	16.76%
Indian or Asian	6	0.24%
Other	5	0.20%
First language		
Afrikaans	1,447	61.65%
isiXhosa	759	32.34%
English	81	3.45%
Sesotho	17	0.72%
Setswana	16	0.68%
Sepedi	15	0.64%
Sign language	7	0.30%
isiZulu	4	0.17%
Xitsonga	1	0.04%

Age group	
Young (0-14)	29,5%
Working Age (15-64)	66,1%
Elderly (65+)	4,4%
Young (0-14)	29,5%
Dependency ratio	51,4
Sex ratio	107,2
Education	
No schooling aged 20+	21,4%
Higher education aged 20+	12%

Matric aged 20+	10,5%
Households and services	
Average household size	2,6
Female headed households	11%
Formal dwellings	95,7%
Housing owned/paying off	16,5%
Flush toilet connected to sewerage	34,7%
Weekly refuse removal	3,5%
Piped water inside dwelling	52,3%
Electricity for lighting	86,6%

The Paarde Valley facility falls within the Inxuba Yethemba NU, Sub Place 278002001 according to Census 2011. With a population density of 0.89 people per square kilometre the area has a slightly higher population density than Umsobomvu NU. The demographic data in respect of Inxuba Yethemba NU, listed as Sub Place 278002001 in accordance with Census 2011, is as follows:

Geographic area = 11,491.97 km²
Population = 10,208
Population density = 0.89/km²
Households = 2,567
Household density = 0.22/km²

Gender		
Male	5,466	53.80%
Female	4,694	46.21%
Population group		
Black African	4,987	48.85%
Coloured	3,561	34.88%
White	1,389	13.61%
Other	262	2.57%
Indian or Asian	9	0.09%
First language		
Afrikaans	5,405	53.60%
isiXhosa	4,070	40.36%
English	383	3.80%
Other	99	0.98%
Sesotho	39	0.39%
Setswana	32	0.32%
Sign language	15	0.15%
Xitsonga	13	0.13%

isiNdebele	9	0.09%
isiZulu	9	0.09%
Sepedi	7	0.07%
Tshivenda	2	0.02%
SiSwati	2	0.02%
Not applicable	124	
Age group		
Young (0-14)		28,3%
Working Age (15-64)		68,8%
Elderly (65+)		2,9%
Dependency ratio		45,5
Sex ratio		116,2
Education		
No schooling aged 20+		10,7%
Higher education aged 20+		8%
Matric aged 20+		9,5%
Households and services		
Average household size		3,4%
Female headed households		10,5%
Formal dwellings		94,9%
Housing owned/paying off		12%
Flush toilet connected to sewerage		20,2%
Weekly refuse removal		5,9%
Piped water inside dwelling		37,1%
Electricity for lighting		86,1%

The closest urban areas to the Umsobomvu Solar PV Facilities are the towns of:

- Noupoort and satellite settlement of Kwazamuxolo
- Hanover, and
- Middleburg.

Noupoort and Kwazamuxolo

Calculated in a straight line, the project is located about 19 km southwest of the town of Noupoort and the adjoining settlement of Kwazamuxolo which are situated in the Umsobomvu Local Municipality and Pixley ka Seme District Municipality in the Northern Cape Province. Attaining municipal status in 1942, Noupoort functioned as a traction changeover facility on the Noupoort-Bloemfontein railway line and was commercially dependent on rail activity. A decline in demand for rail services resulted in an economic decline and the degradation of the town. The satellite settlement of Kwazamuxolo is located alongside Noupoort and the demographics of Noupoort and Kwazamuxolo are provided separately below:

Noupoort – Main Place 370005 from Census 2001:
Geographic area = 9.42 km²
Population = 4 514 people
Population density = 479.3/km²
Households = 1 036
Household density = 110.0/km²

Gender	**People**	**Percentage**
Female	1,803	54.08%
Male	1,531	45.92%
Population group		
Black African	3,289	98.65%
Coloured	26	0.78%
Indian or Asian	13	0.39%
Other	5	0.15%
First language		
isiXhosa	3,175	95.23%
Afrikaans	52	1.56%
English	37	1.11%
Sepedi	15	0.45%
Other	12	0.36%
Setswana	11	0.33%
Sign language	10	0.30%
Sesotho	9	0.27%
isiZulu	8	0.24%
isiNdebele	4	0.12%
Xitsonga	1	0.03%

Age group	
Young (0-14)	34,6%
Working Age (15-64)	58,8%
Elderly (65+)	6,6%
Dependency ratio	70,1
Sex ratio	92,7
Education	
No schooling aged 20+	12,8%
Higher education aged 20+	5,5%
Matric aged 20+	21,4%
Households and services	
Average household size	4,2

Female headed households	39,2%
Formal dwellings	95,1%
Housing owned/paying off	48,9%
Flush toilet connected to sewerage	97,4%
Weekly refuse removal	86,9%
Piped water inside dwelling	45,1%
Electricity for lighting	92,4%

Kwazamuxolo – Main Place 370006 from Census 2011:
Geographic area = 0.74 km²
Population = 3 334 people
Population density = 4 534.56/km²
Households = 913
Household density = 1 241.77/km²

Gender	**People**	**Percentage**
Female	1,803	54.08%
Male	1,531	45.92%
Population group		
Black African	3,289	98.65%
Coloured	26	0.78%
Indian or Asian	13	0.39%
Other	5	0.15%
First language		
isiXhosa	3,175	95.23%
Afrikaans	52	1.56%
English	37	1.11%
Sepedi	15	0.45%
Other	12	0.36%
Setswana	11	0.33%
Sign language	10	0.30%
Sesotho	9	0.27%
isiZulu	8	0.24%
isiNdebele	4	0.12%
Xitsonga	1	0.03%

Age group	
Young (0-14)	29%
Working Age (15-64)	63,3%
Elderly (65+)	7,7%
Dependency ratio	57,9
Sex ratio	84,9
Education	
No schooling aged 20+	11,6%

Higher education aged 20+	2,1%
Matric aged 20+	19,9%
Household services	
Average household size	3,6
Female headed households	51,6%
Formal dwellings	96,3%
Housing owned/paying off	60%
Flush toilet connected to sewerage	79,5%
Weekly refuse removal	98,6%
Piped water inside dwelling	35,2%
Electricity for lighting	94,2%

Hanover

Calculated along a straight line, the project lies some 35 km southwest of Hanover which is situated in the Emthanjeni Local Municipality and Pixley ka Seme District Municipality in the Northern Cape Province. The town was established in 1854 and served as an administrative, educational and religious centre for the surrounding area. Hanover was named after Hanover in Germany and is now situated on the N1, virtually halfway between Cape Town and Johannesburg. Prior to 1884 and due to its central position Hanover also served as a central point for travellers travelling to the various towns and cities across South Africa. However, with the arrival of the railway, this function was to diminish changing the fortunes of the town and its inhabitants. Today the town has a certain tourist attraction with a natural spring, Anglo Boer War history, its central position and location along the N1 and within the Karoo. Demographic data pertaining to Hanover is presented below.

Hanover – Main Place 371006 from Census 2011:
Geographic area = 80.77 km²
Population = 4 594 people
Population density = 56.88/km²
Households = 1 083
Household density = 13.41/km²

Gender	People	Percentage
Female	2,362	51.41%
Male	2,232	48.59%
Population group		
Black African	2,255	49.09%
Coloured	2,133	46.43%
White	156	3.40%
Other	25	0.54%
Indian or Asian	25	0.54%

First language		
Afrikaans	2,438	54.91%
isiXhosa	1,746	39.32%
English	68	1.53%
Sesotho	61	1.37%
Other	35	0.79%
Setswana	34	0.77%
Sign language	20	0.45%
isiZulu	12	0.27%
Sepedi	10	0.23%
isiNdebele	8	0.18%
Xitsonga	3	0.07%
Tshivenda	3	0.07%
SiSwati	3	0.07%
Not applicable	154	

Age group	
Young (0-14)	34%
Working Age (15-64)	60,6%
Elderly (65+)	5,4%
Dependency ratio	65,1
Sex ratio	94,5
Education	
No schooling aged 20+	16,8%
Higher education aged 20+	4,4%
Matric aged 20+	18,1%
Households and services	
Average household size	3,9
Female headed households	43,7%
Formal dwellings	98%
Housing owned/paying off	38%
Flush toilet connected to sewerage	58,8%
Weekly refuse removal	82,3%
Piped water inside dwelling	34,2%
Electricity for lighting	94,3%

Middelburg

The project lies 32 km northwest of Middelburg when calculated along a straight line. Established in 1852 Middelburg falls within the Inxuba Yethemba Local Municipality in the Chris Hani District Municipality of the Eastern Cape Province and serves as an administrative, educational and religious centre for the surrounding areas. Middelburg also has a certain tourist attraction due to its rich Anglo Boer War history, with the Third Manchester Regiment having been stationed just outside the town, and its central position within the Great Karoo. Demographic data relating to Middelburg is presented below.

Middelburg – Main Place 370006 from Census 2011:
Geographic area = 44.76 km²
Population = 18 681 people
Population density = 417.38/km²
Households = 5 337
Household density = 119.24/km²

Gender	People	Percentage
Female	9,939	53.20%
Male	8,742	46.80%
Population group		
Black African	9,192	49.21%
Coloured	8,197	43.88%
White	1,167	6.25%
Other	74	0.40%
Indian or Asian	50	0.27%
First language		
Afrikaans	9,508	52.31%
isiXhosa	7,921	43.58%
English	345	1.90%
Sesotho	86	0.47%
Setswana	83	0.46%
Sign language	78	0.43%
Other	53	0.29%
isiZulu	34	0.19%
Sepedi	23	0.13%
isiNdebele	19	0.10%
SiSwati	13	0.07%
Xitsonga	7	0.04%
Tshivenda	6	0.03%
Not applicable	506	

Age group	
Young (0-14)	31,3%
Working Age (15-64)	62,2%
Elderly (65+)	6,5%
Dependency ratio	60,7
Sex ratio	88
Education	
No schooling aged 20+	10,6%

Higher education aged 20+	5,9%
Matric aged 20+	19,5%
Households and services	
Average household size	3,4
Female headed households	44,7%
Formal dwellings	95,4%
Housing owned/paying off	51,7%
Flush toilet connected to sewerage	97%
Weekly refuse removal	92,2%
Piped water inside dwelling	89,8%
Electricity for lighting	96,5%

5. IDENTIFICATION OF POTENTIAL IMPACTS

The social impact variables considered across the project are in accordance with Vanclay's list of social impact variables clustered under the following main categories as adapted by Wong (Vanclay, 2002; Wong, 2013) and include;

1. Health and social well-being
2. Quality of the living environment (Liveability)
3. Economic
4. Cultural.

These categories are not exclusive and at times tend to overlap as certain processes may have an impact within more than one category.

Under the following section each of the solar photovoltaic (PV) energy facilities and associated grid connection infrastructure is separately considered and assessed in respect of these impacts.

5.1. HEALTH AND SOCIAL WELLBEING

The health and social wellbeing impacts related to the project include.

- Annoyance, dust noise and shadow flicker
- Increase in crime
- Increased risk of HIV infections
- Influx of construction workers and job seekers
- Hazard exposure.

5.1.1. ANNOYANCE, DUST AND NOISE

Annoyance, dust and noise will be more evident during the construction phase of the project, as construction activities will result in disruptions and the generation of dust and noise from construction vehicles and equipment. Site specific activities such as site clearance and the deliveries of materials, equipment, plant and the transportation of the workforce along unsealed access roads will generate the most dust and noise. Dust that accumulates on foliage and grasses that is used for grazing may result in the foliage and those grasses becoming unpalatable for livestock and/or game. This may in turn have an effect on farming activities within the vicinity of the project site and along the access road over the construction period. This impact will negatively impact sensitive receptors situated within or in close proximity to the project site, and could also potentially impact surrounding land users. The impact of noise and dust on surrounding land users and local farmsteads can be reduced to acceptable levels through the application of appropriate mitigation measures.

Over the operational phase of the project far less disruptions, dust and noise is expected in the vicinity of the project site, however, along the unsealed access road dusts and noise can be generated by traffic travelling to and from the project site. Even at low speeds heavy vehicles could generate noise in what is a remote area, particularly if they need to at times engage low gear ratios.

5.1.2. INCREASE IN CRIME

The projects fall within the Noupoort Precinct which, according to Crime Stats SA, has a relatively high level of crime with a total of 530 reported crimes in 2018[1]. The surrounding precincts of Hanover and Middelburg also have relatively high levels of reported crime at 428 and 1 474 respectively. It is likely that these crimes are associated with the more densely populated urban areas and that the level of crime in the sparsely populated urban areas would be lower, however, there are no available statistics to confirm this. It is often opportunistic crime, stock theft, the abuse of alcohol and relationship related crimes that are associated with construction activities.

Considering the relative remoteness of the project it is unlikely that the project will lead to any significant increase in crime levels in the area, however, it would be prudent for the developers to ensure that processes are put in place through which any suspected criminal activates associated with the project can be easily communicated and swiftly addressed. The

[1]According to Crime Stats SA as at 28 April 2018 www.crimestatssa.com/precinct.php?id=798

construction phase carries with it a higher risk of associated criminal activates than would be associated with the operational phase.

5.1.3. INCREASED RISK OF HIV INFECTIONS

At 17.5%, the Northern Cape Province has the lowest HIV prevalence rate when compared to all other South African provinces. At a district level the Pixley ka Seme DM has the seventh lowest HIV prevalence rate when compared against all district municipalities across the country. In contrast the Eastern Cape Province has the third highest provincial HIV prevalence rate and the Chris Hani DM the 14th highest district level prevalence rate, each with relative HIV prevalence rates of 31.4 and 34.5 percent. These higher prevalence rates are likely to occur within the higher density urban areas and along transport corridors. As all three project sites fall within sparsely populated rural areas the HIV prevalence rate within the immediate vicinity of the projects is likely to be low. Considering this together with the fact that sexually transmitted diseases tend to be spread by construction and transport workers (Singh & Malaviya, 1994; Ramjee & Gouws, 2002; Meintjes, Bowen, & Root, 2007; World Bank Group, 2016; Bowen, Dorrington, Distiller, Lake, & Besesar, 2008; Bowen P. , Govender, Edwards, & Cattell, 2016; Kikwasi & Lukwale, 2017; Bowen P. , Govender, Edwards, & Lake, 2018) and the high prevalence of HIV across the Eastern Cape, opens the area to a high risk of HIV infections. This risk is likely to peak during the construction phase of the project as the conduction workforce increases and material and equipment is delivered to site but is likely to subside during the operational phase.

Due to the low HIV prevalence in the area it is important that this issue be given serious attention and that the appropriate mitigation measures are implemented and the situation is closely monitored throughout the construction and operational phases of the project. The risk of the spread of HIV is most prevalent on a cumulative basis and is addressed as such under section 9: Cumulative impacts below.

5.1.4. INFLUX OF CONSTRUCTION WORKERS AND JOB SEEKERS

It is estimated that over the construction period of each of the three solar PV facilities, the construction workforce will average ~126 workers peaking at ~297 workers. It is likely that 75% of this workforce will be recruited from within local communities. The influx of workers could lead to the disruption of social networks with the formation of temporary relationships and an increase in pregnancy which may place pressures on local family units. Apart from this the arrival of construction workers may result in the formation of a subculture that could manifest in antisocial behaviour which conflicts with the expectations of local communities. This may result in these local communities, who are accustomed to a quiet, rural environment, becoming dissatisfied with the neighbourhood. These disruptions are, however, more likely to occur in the nearby urban areas such as Noupoort, Hanover and to a lesser degree due to the size of the population, in Middleburg, when workers seek recreational activities.

During the operational phase of the project the workforce will be comprised of ~16 workers who will be accommodated off site. Consequently, the risks associated with disruptions to social networks will be minimal over the operation phase of the project.

5.1.5. HAZARD EXPOSURE

The use of heavy equipment and vehicles and an increase in vehicle traffic within the vicinity of all construction sites will result in an increased risk to the personal safety of people and animals. Of particular concern are increased hazards faced by pedestrians, cyclists and motorists with emphasis on vulnerable groups such as children and the elderly. Excavation work and trenches also pose a hazard to the safety of people, particularly children and animals, who may fall into these works and may have difficulty in getting out. However due to the low population numbers within the vicinity of the proposed development this risk is likely to be low and the appropriate mitigation measure, such as fencing, can reduce the impact further. There will also be an increased risk of fires brought about through construction workers lighting fires for cooking and for warmth during cold periods. Nevertheless, with the recommended mitigation measures being successfully put in place this can be controlled.

5.2. QUALITY OF THE LIVING ENVIRONMENT

The following quality of the living environment impacts are related to the project.

- Disruption of daily living patterns
- Disruptions to social and community infrastructure
- Transformation of the sense of place.

5.2.1. DISRUPTION OF DAILY LIVING PATTERNS

If there are any disruptions to daily living patterns these are likely to be minimal and restricted to the construction phase of the project. This impact will be mainly associated with the site and the main access roads. These disruptions are only likely to be associated with the delivery of materials and machinery to site and the transportation of workers to and from site.

Disruptions of daily living patterns are likely to be negligible during the operation phase of the project as these will be associated with maintenance and repair activities which will be far less frequent and intense than construction activities are likely to be.

5.2.2. DISRUPTION TO SOCIAL AND COMMUNITY INFRASTRUCTURE

An increase in the population of the area as a result of the workforce associated with the project has the potential to place pressure on existing community services supplies and infrastructure such as schools, health care facilities, access to water, electricity and sanitary services. With the workforce associated with the construction phase of each of the solar PV facilities peaking at ~297 people, of which 75% are likely to be recruited locally, it is unlikely that in isolation the project will have any significant effect on social and community infrastructure in the area. However, on a cumulative basis, considering the activities taking place and planned for the area, there is likely to be a significant impact in this regard. This impact is dealt with in greater depth under section 8.3: Cumulative Impacts below.

Over the operational phase of the project, with a smaller workforce being recruited locally, it is unlikely that there will be significant disruptions to community and social infrastructure.

5.2.3. TRANSFORMATION OF THE SENSE OF PLACE

Within a social context a sense of place includes a wide range of criteria, all or some of which add meaning to a particular area for individuals and groups. These criteria may include the vista, geography, urban layout, flora and fauna, community, history and fragrance of a place amongst many others and are uniquely interpreted on an individual basis. Some individuals may embrace changes to the sense of place that others may reject and for some it may merely be a change in the demographics of an area that leaves them feeling threatened, vulnerable and insecure. Groups and group membership can help to reinforce the sense of place of an area and can also serve to reinforce fears and suspicions associated with pending changes to the sense of place. A sense of place has much to do with unique individual perceptions attached to the location and is subjective by nature.

One of these criteria is the visual aspect, which was the subject of the Visual Impact Assessment specialist report in which it is indicated that:

> "*The area is not typically valued for its tourism significance and there is limited human habitation resulting in relatively few potentially sensitive receptors in the area. A total of twenty six (26) potentially sensitive receptors were identified in*

the combined study area, three (3) of which are considered to be sensitive receptors as they are linked to leisure/nature-based tourism activities in the area. None of the receptors are however expected to experience high levels of visual impact from any of the proposed PV facilities or the grid connection infrastructure. Although the N10 receptor road traverses the study area, motorists travelling along this route are only expected to experience moderate impacts from the proposed Mooi Plaats solar PV facility and from the grid connection infrastructure associated with all three projects" (SiVEST SA (Pty) Ltd, 2019b, p. 116).

Notwithstanding this, however, the issue regarding the sense of place is likely to remain controversial as a sense of place is personal and subjective with some accepting changes to the landscape in support of renewable energy while others may reject them (Farhar, Hunter, Kirkland, & Tierney, 2010; Carlisle, Kane, Solan, & Joe, 2014).

5.3. ECONOMIC

The economic impacts related to the project include.

- Job creation and skills development
- Socio-economic stimulation

5.3.1. JOB CREATION AND SKILLS DEVELOPMENT

The project will lead to the creation of both direct and indirect job which will have a positive economic benefit within the region. In this regard there are ~297 jobs associated with the construction phase of each of the solar PV facilities and 16 with the operational phase of each facility. During construction ~3 569 person-months are likely to be created of which ~2 679 or ~75% will be allocated to local communities creating employment opportunities for residents of Middelburg, Noupoort and Hanover. Many of the beneficiaries are likely to be historically disadvantaged members of the community and the project will provide opportunities to develop skills amongst these people. The operational phase will employ approximately 16 people full time for a period of up to 20 years.

5.3.2. SOCIO-ECONOMIC STIMULATION

Apart from these jobs the project is also likely to stimulate the local economy and again this is likely to be most significant at a cumulative level. Nevertheless, there will be a significant economic contribution attached to all three of the solar PV facilities. This contribution will be in the form of disposable salaries and the purchases of services and supplies from the local communities in and around the towns of Noupoort, Hannover and Middleburg estimated at 40% of the total project value yet to be finalised.

Apart from job creation and procurement spend the project will also have broader positive socio-economic impacts as far as socio-economic development contributions are concerned. Although, at the point of writing, the project developer had not as yet put a corporate social responsibility plan in place the intention is to either, fall in line with the REIPPP BID guidelines or put an equivalent plan in place. This will create an opportunity to support the local community over the life span of the operational phase of the project which will stretch over a 20 year period. At a national level the project also has the potential to contribute towards the national grid requirements as part of the Government's vision to source 10.5% of the country's energy through solar power by 2030 (Department of Energy Republic of South Africa, 2018, p. 41).

5.4. CULTURAL IMPACTS

At a social level it is likely that any cultural impacts would be associated with sensitive archaeological and/or heritage sites that may be found. In this regard a Heritage Impact Assessment was undertaken and it was found that:

> "*The projected impact assessment indicates that unmitigated impacts during construction can be MEDIUM to HIGH but reduced to LOW with the implementation of management measures. Impacts during the operational and decommissioning phase is projected to be LOW with the implementation of management measures.*
>
> *These findings provide the basis for the recommendation:*
>
> - *further field truthing through an archaeological walk down and palaeontological study covering the site. The aim of this will be to compile a comprehensive database of heritage sites in the study areas, with the aim of developing a heritage management plan for*

> *inclusion in the Environmental Management Plan as derived from the EIA* (PGS Heritage (Pty) Ltd, 2019, p. 37).

At this point no heritage resources have been identified that could have cultural significance. If these are identified at a later point they can be addressed in the heritage report and as such will not be pursued any further at the social level.

6. Impact Assessment

The impacts discussed above are assessed below in respect of the following three photovoltaic facilities and their respective associated grid infrastructure:

- Mooi Plaats Solar PV Facility
- Wonderheuvel Solar PV Facility
- Paarde Valley Solar PV Facility.

From a social perspective it makes far more sense to assess each of the solar PV facilities together with their respective associated grid infrastructure based on the following reasons:

4. The solar PV facilities and associated grid infrastructure are interdependent. If the one was not to exist neither would the other. In this sense each is an integral part of the other and cannot function independently.
5. The focus at a social level is far broader than is the case with certain other specialist studies that may have a narrower, project footprint specific emphasis.
    a. For instance, to consider certain aspects such as job creation; the influx of workers; socio-economic stimulation and the transformation of the sense of place in isolation would deter from the actual impact that may occur when considered on a combined basis and in essence would not make logical sense.
6. Any site specific implications associated with the grid infrastructure alternatives can be specifically addressed and mitigated as well as noted when discussing the motivation for selecting the socially preferred grid connection alternatives.

These impacts are assessed in respect of the following phases of the project:

- Planning and design
- Construction
- Operational
- Decommissioning, and
- The ‘no go” option.

6.1. PLANNING AND DESIGN PHASE

It is evident that the project fits with legislation and key planning and policy documentation. In this regard renewable energy facilities are supported on a national, provincial and municipal level as indicated under section 3.1: Policy and legislation fit.

However, provincial and municipal documentation also regards tourism as an important resource for the area. In addition to this there have been concerns raised regarding the cumulative effect of the proliferation of renewable energy in the region and the impact that this may have on the sense of place of the area. In this regard see section 8.3: Transformation of sense of place.

6.2. CONSTRUCTION PHASE

Most of the impacts discussed above apply over the short-term to the construction phase of the project and include:

- Annoyance, dust and noise
- Increase in crime
- Increased risk of HIV infections
- Influx of construction workers and job seekers
- Hazard exposure
- Disruption of daily living patterns
- Disruptions to social and community infrastructure
- Job creation and skills development
- Socio-economic stimulation.

In this respect the construction phase of each of the three solar PV facilities including the associated grid infrastructure is separately assessed with suggested mitigation and optimisation measures being presented in the following tables:

- Mooi Plaats Solar PV Facility and associated grid connection infrastructure – **Table 6**
- Wonderheuvel Solar PV Facility and associated grid connection infrastructure – **Table 7**
- Paarde Valley Solar PV Facility and associated grid connection infrastructure – **Table 8**.

Table 6: Mooi Plaats Solar PV Facility and associated grid connection infrastructure – Construction phase

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Annoyance, dust and noise	Annoyance, dust and noise generated through construction activities.	1	3	1	2	1	2	16	-	Low	Apply appropriate dust suppressant to gravel roads on a regular basis Ensure that vehicles used to transport sand and building materials are fitted with tarpaulins or covers. Ensure all vehicles are roadworthy and drivers are qualified and made aware of the potential noise and dust issues. Appoint a community liaison officer to deal with complaints and grievances from the public.	1	3	1	2	1	1	8	-	Low
Increase in crime	An increase in crime associated with the construction phase of the project.	2	3	2	2	2	3	33	-	Medium	All workers should carry identification cards and wear identifiable clothing. Fence off the construction site and control access to the site. Appoint an independent security company to monitor the site. Appoint a community liaison officer. Encourage local people to report any suspicious activity associated with the construction site to the community liaison officer. A grievance mechanism must be prepared and communicated to surrounding landowners and local communities, to ensure that the project proponent, EPC contractor and sub-contractors remain responsible and accountable. This will also facilitate the	2	3	2	2	2	2	22	-	Low

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
											identification and implementation of additional mitigation measures if required. Prevent loitering within the vicinity of the construction camp as well as construction sites by recruiting off site via an offsite recruiting office/agent, whatever is most appropriate.									
Increased risk of HIV and AIDS	Increased risk of HIV and AIDS due to the influx of workers, job seekers and deliveries and availability of disposable income.	3	3	3	3	4	3	48	-	High	Ensure that an onsite HIV and AIDS policy is in place and that construction workers are exposed to a health and HIV/AIDS awareness educational programme within the first month of construction. Provide voluntary and free counselling, free testing and condom distribution services to the workforce. Where feasible extend the HIV/AIDS programme into the community with specific focus on schools and youth clubs.	3	3	3	3	4	2	32	-	Medium
Influx of construction workers and job seekers	Influx of construction workers and job seekers resulting in a temporary change in demographics	2	3	2	2	2	2	22	-	Low	Communicate, through Community Leaders and Ward Councillors, the limitation of opportunities created by the project to prevent an influx of job seekers. Develop and implement a local procurement policy which prioritises “locals first” to reduce the movement of people into the area in search of work. Draw up a recruitment policy in conjunction with Community Leaders	2	2	2	2	2	2	20	-	Low

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
											and Ward Councillors and ensure compliance with this policy.									
Hazard exposure	Exposure to hazards associated with construction activities and the delivery of heavy machinery and equipment to site.	2	3	2	2	1	2	20	-	Low	Ensure all construction equipment and vehicles are properly maintained at all times. Ensure that operators and drivers are properly trained and make them aware, through regular toolbox talks, of any risk they may pose to the community. Place specific emphasis on the vulnerable sector of the population such as children and the elderly. Ensure that fires lit by construction staff are only ignited in designated areas and that the appropriate safety precautions, such as not lighting fires in strong winds and completely extinguishing fires before leaving them unattended, are strictly adhered to. Make staff aware of the dangers of fire during regular tool box talks. A grievance mechanism must be prepared and communicated to surrounding landowners and local communities, to ensure that the project proponent, EPC contractor, and sub-contractors remain responsible and accountable and to facilitate the identification and implementation of	2	2	2	2	1	2	18	-	Low

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
											additional mitigation measures if required. Where necessary training should be provided on the implementation of the grievance mechanism to ensure that those who are most likely to be affected by the project are suitably equipped in the mechanism of raising concerns and having these addressed. Compile and implement a Fire Management and Emergency Preparedness Response Plan.									
Disruption of daily living patterns	Disruption of daily living patterns due to construction activities and deliveries of machinery and heavy equipment to site.	2	3	2	2	1	2	20	-	Low	Ensure that, at all times, people have access to their properties as well as to social facilities. All vehicles must be roadworthy and drivers must be qualified, obey traffic rules, follow speed limits and be made aware of the potential road safety issues. Heavy vehicles should be inspected regularly to ensure their road safety worthiness. The developer and EPC Contractor must ensure that the roads utilised for construction activities are either maintained in the present condition or upgraded if damaged due to construction activities.	2	2	2	2	1	2	18	-	Low

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Disruption of services supplies and infrastructure	Disruptions of community facilities and infrastructure due to construction activities and an influx of workers.	2	3	2	2	1	2	20	-	Low	Regularly monitor the effect that the construction activities is having on public infrastructure and immediately report any damage to infrastructure to the appropriate authority.	2	2	2	2	1	2	18	-	Low
Job creation and skills development	The creation of job opportunities and the development of skills amongst the workforce.	3	3	2	2	1	2	22	+	Low	Wherever feasible, local residents should be recruited to fill semi and unskilled jobs. Women should be given equal employment opportunities and encouraged to apply for positions. A skills transfer plan should be put in place at an early stage and workers should be given the opportunity to develop skills which they can use to secure jobs elsewhere post-construction. A procurement policy promoting the use of local business should, where possible, be put in place to be applied throughout the construction phase.	3	3	2	2	2	2	24	+	Medium
Socio-economic development	Potential for positive socio-economic opportunities for the region associated with downstream business opportunities and corporate social responsibility initiatives.	3	3	2	2	2	2	24	+	Medium	A procurement policy promoting the use of local business should, where possible, be put in place to be applied throughout the construction phase.	3	3	2	2	3	2	26	+	Medium

Table 7: Wonderheuvel Solar PV Facility and associated grid connection infrastructure – Construction phase

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Annoyance, dust and noise	Annoyance, dust and noise generated through construction activities.	1	3	1	2	1	2	16	-	Low	Apply appropriate dust suppressant to gravel roads on a regular basis. Ensure that vehicles used to transport sand and building materials are fitted with tarpaulins or covers. Ensure all vehicles are roadworthy and drivers are qualified and made aware of the potential noise and dust issues. Appoint a community liaison officer to deal with complaints and grievances from the public.	1	3	1	2	1	1	8	-	Low
Increase in crime	An increase in crime associated with the construction phase of the project.	2	3	2	2	2	3	33	-	Medium	All workers should carry identification cards and wear identifiable clothing. Fence off the construction site and control access to the site. Appoint an independent security company to monitor the site. Appoint a community liaison officer. Encourage local people to report any suspicious activity associated with the construction site to the community liaison officer. A grievance mechanism must be prepared and communicated to surrounding landowners and local communities, to ensure that the project proponent, EPC contractor and sub-contractors remain responsible and accountable. This will also facilitate the	2	3	2	2	2	2	22	-	Low

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
											identification and implementation of additional mitigation measures if required. Prevent loitering within the vicinity of the construction camp as well as construction sites by recruiting off site via an offsite recruiting office/agent, whatever is most appropriate.									
Increased risk of HIV and AIDS	Increased risk of HIV and AIDS due to the influx of workers, job seekers and deliveries and availability of disposable income.	3	3	3	3	4	3	48	-	High	Ensure that an onsite HIV and AIDS policy is in place and that construction workers are exposed to a health and HIV/AIDS awareness educational programme within the first month of construction. Provide voluntary and free counselling, free testing and condom distribution services to the workforce. Where feasible extend the HIV/AIDS programme into the community with specific focus on schools and youth clubs.	3	3	3	3	4	2	32	-	Medium
Influx of construction workers and job seekers	Influx of construction workers and job seekers resulting in a temporary change in demographics	2	3	2	2	2	2	22	-	Low	Communicate, through Community Leaders and Ward Councillors, the limitation of opportunities created by the project to prevent an influx of job seekers. Develop and implement a local procurement policy which prioritises “locals first” to prevent the movement of people into the area in search of work. Draw up a recruitment policy in conjunction with Community Leaders	2	2	2	2	2	2	20	-	Low

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
											and Ward Councillors and ensure compliance with this policy.									
Hazard exposure	Exposure to hazards associated with construction activities and the delivery of heavy machinery and equipment to site.	2	3	2	2	1	2	20	-	Low	Ensure all construction equipment and vehicles are properly maintained at all times. Ensure that operators and drivers are properly trained and make them aware, through regular toolbox talks, of any risk they may pose to the community. Place specific emphasis on the vulnerable sector of the population such as children and the elderly. Ensure that fires lit by construction staff are only ignited in designated areas and that the appropriate safety precautions, such as not lighting fires in strong winds and completely extinguishing fires before leaving them unattended, are strictly adhered to. Make staff aware of the dangers of fire during regular tool box talks. A grievance mechanism must be prepared and communicated to surrounding landowners and local communities, to ensure that the project proponent, EPC contractor, and sub-contractors remain responsible and accountable and to facilitate the identification and implementation of	2	2	2	2	1	2	18	-	Low

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
											additional mitigation measures if required. Where necessary training should be provided on the implementation of the grievance mechanism to ensure that those who are most likely to be affected by the project are suitably equipped in the mechanism of raising concerns and having these addressed. Compile and implement a Fire Management and Emergency Preparedness Response Plan.									
Disruption of daily living patterns	Disruption of daily living patterns due to construction activities and deliveries of machinery and heavy equipment to site.	2	3	2	2	1	2	20	-	Low	Ensure that, at all times, people have access to their properties as well as to social facilities. All vehicles must be road worthy and drivers must be qualified, obey traffic rules, follow speed limits and be made aware of the potential road safety issues. Heavy vehicles should be inspected regularly to ensure their road safety worthiness. The developer and EPC Contractor must ensure that the roads utilised for construction activities are either maintained in the present condition or upgraded if damaged due to construction activities.	2	2	2	2	1	2	18	-	Low

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Disruption of services supplies and infrastructure	Disruptions of community facilities and infrastructure due to construction activities and an influx of workers.	2	3	2	2	1	2	20	-	Low	Regularly monitor the effect that the construction activities is having on public infrastructure and immediately report any damage to infrastructure to the appropriate authority.	2	2	2	2	1	2	18	-	Low
Job creation and skills development	The creation of job opportunities and the development of skills amongst the workforce.	3	3	2	2	1	2	22	+	Low	Wherever feasible, local residents should be recruited to fill semi and unskilled jobs. Women should be given equal employment opportunities and encouraged to apply for positions. A skills transfer plan should be put in place at an early stage and workers should be given the opportunity to develop skills which they can use to secure jobs elsewhere post-construction. A procurement policy promoting the use of local business should, where possible, be put in place to be applied throughout the construction phase.	3	3	2	2	2	2	24	+	Medium
Socio-economic development	Potential for positive socio-economic opportunities for the region associated with downstream business opportunities and corporate social responsibility initiatives.	3	3	2	2	2	2	24	+	Medium	A procurement policy promoting the use of local business should, where possible, be put in place to be applied throughout the construction phase.	3	3	2	2	3	2	26	+	Medium

Table 8: Paarde Valley Solar PV Facility and associated grid connection infrastructure – Construction phase

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Annoyance, dust and noise	Annoyance, dust and noise generated through construction activities.	1	3	1	2	1	2	16	-	Low	Apply appropriate dust suppressant to gravel roads on a regular basis Ensure that vehicles used to transport sand and building materials are fitted with tarpaulins or covers. Ensure all vehicles are roadworthy and drivers are qualified and made aware of the potential noise and dust issues. Appoint a community liaison officer to deal with complaints and grievances from the public.	1	3	1	2	1	1	8	-	Low
Increase in crime	An increase in crime associated with the construction phase of the project.	2	3	2	2	2	3	33	-	Medium	All workers should carry identification cards and wear identifiable clothing. Fence off the construction site and control access to the site. Appoint an independent security company to monitor the site. Appoint a community liaison officer. Encourage local people to report any suspicious activity associated with the construction site to the community liaison officer. A grievance mechanism must be prepared and communicated to surrounding landowners and local communities, to ensure that the project proponent, EPC contractor and sub-contractors remain responsible and accountable. This will also facilitate the	2	3	2	2	2	2	22	-	Low

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
											identification and implementation of additional mitigation measures if required. Prevent loitering within the vicinity of the construction camp as well as construction sites by recruiting off site via an offsite recruiting office/agent, whatever is most appropriate.									
Increased risk of HIV and AIDS	Increased risk of HIV and AIDS due to the influx of workers, job seekers and deliveries and availability of disposable income.	3	3	3	3	4	3	48	-	High	Ensure that an onsite HIV and AIDS policy is in place and that construction workers are exposed to a health and HIV/AIDS awareness educational programme within the first month of construction. Provide voluntary and free counselling, free testing and condom distribution services to the workforce. Where feasible extend the HIV/AIDS programme into the community with specific focus on schools and youth clubs.	3	3	3	3	4	2	32	-	Medium
Influx of construction workers and job seekers	Influx of construction workers and job seekers resulting in a temporary change in demographics	2	3	2	2	2	2	22	-	Low	Communicate, through Community Leaders and Ward Councillors, the limitation of opportunities created by the project to prevent an influx of job seekers. Develop and implement a local procurement policy which prioritises “locals first” to prevent the movement of people into the area in search of work. Draw up a recruitment policy in conjunction with Community Leaders	2	2	2	2	2	2	20	-	Low

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
											and Ward Councillors and ensure compliance with this policy.									
Hazard exposure	Exposure to hazards associated with construction activities and the delivery of heavy machinery and equipment to site.	2	3	2	2	1	2	20	-	Low	Ensure all construction equipment and vehicles are properly maintained at all times. Ensure that operators and drivers are properly trained and make them aware, through regular toolbox talks, of any risk they may pose to the community. Place specific emphasis on the vulnerable sector of the population such as children and the elderly. Ensure that fires lit by construction staff are only ignited in designated areas and that the appropriate safety precautions, such as not lighting fires in strong winds and completely extinguishing fires before leaving them unattended, are strictly adhered to. Make staff aware of the dangers of fire during regular tool box talks. A grievance mechanism must be prepared and communicated to surrounding landowners and local communities, to ensure that the project proponent, EPC contractor, and sub-contractors remain responsible and accountable and to facilitate the identification and implementation of	2	2	2	2	1	2	18	-	Low

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
											additional mitigation measures if required. Where necessary training should be provided on the implementation of the grievance mechanism to ensure that those who are most likely to be affected by the project are suitably equipped in the mechanism of raising concerns and having these addressed. Compile and implement a Fire Management and Emergency Preparedness Response Plan.									
Disruption of daily living patterns	Disruption of daily living patterns due to construction activities and deliveries of machinery and heavy equipment to site.	2	3	2	2	1	2	20	-	Low	Ensure that, at all times, people have access to their properties as well as to social facilities. All vehicles must be road worthy and drivers must be qualified, obey traffic rules, follow speed limits and be made aware of the potential road safety issues. Heavy vehicles should be inspected regularly to ensure their road safety worthiness. The developer and EPC Contractor must ensure that the roads utilised for construction activities are either maintained in the present condition or upgraded if damaged due to construction activities.	2	2	2	2	1	2	18	-	Low

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Disruption of services supplies and infrastructure	Disruptions of community facilities and infrastructure due to construction activities and an influx of workers.	2	3	2	2	1	2	20	-	Low	Regularly monitor the effect that the construction activities is having on public infrastructure and immediately report any damage to infrastructure to the appropriate authority.	2	2	2	2	1	2	18	-	Low
Job creation and skills development	The creation of job opportunities and the development of skills amongst the workforce.	3	3	2	2	1	2	22	+	Low	Wherever feasible, local residents should be recruited to fill semi and unskilled jobs. Women should be given equal employment opportunities and encouraged to apply for positions. A skills transfer plan should be put in place at an early stage and workers should be given the opportunity to develop skills which they can use to secure jobs elsewhere post-construction. A procurement policy promoting the use of local business should, where possible, be put in place to be applied throughout the construction phase.	3	3	2	2	2	2	24	+	Medium
Socio-economic development	Potential for positive socio-economic opportunities for the region associated with downstream business opportunities.	3	3	2	2	2	2	24	+	Medium	A procurement policy promoting the use of local business should, where possible, be put in place to be applied throughout the construction phase.	3	3	2	2	3	2	26	+	Medium

6.3. OPERATIONAL PHASE

The social impacts that apply to the operational phase of the project are:

- Transformation of the sense of place and
- Economic
  - Job creation and skills development
  - Socio-economic stimulation

In this respect the operational phase of each of the three solar PV facilities including the associated grid infrastructure is separately assessed with suggested mitigation and optimisation measures being presented in the following tables:

- Mooi Plaats Solar PV Facility and associated grid connection infrastructure – **Table 9**
- Wonderheuvel Solar PV Facility and associated grid connection infrastructure – **Table 10**
- Paarde Valley Solar PV Facility and associated grid connection infrastructure – **Table 11**.

Table 9: Assessment of the Mooi Plaats Solar PV Facility and associated grid connection infrastructure – Operational phase

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Transformation of the sense of place	Transformation of the sense of place due to the nature of the project.	2	4	4	3	4	3	51	-	High	Apply the mitigation measures suggested in the Visual Impact Assessment Report. Ensure that all affected landowners and tourist associations are regularly consulted. A Grievance Mechanism should be put in place and all grievances should be dealt with in a transparent manner. The mitigation measures recommended in the Heritage Impact Assessment should be followed.	2	4	4	3	4	2	34	-	Medium
Job creation and skills development	The creation of job opportunities and the development of skills amongst the workforce.	2	3	2	2	3	2	24	+	Medium	Implement a training and skills development programme for locals. Work closely with the appropriate municipal structures in regard to establishing a social responsibility programme.	2	3	2	2	3	2	24	+	Medium
Socio-economic stimulation	Potential for positive socio-economic opportunities for the region associated with downstream business opportunities and corporate social responsibility initiatives.	3	3	2	3	3	2	28	+	Medium	Ensure that the procurement policy supports local enterprises. Establish a social responsibility programme either in line with the REIPPP BID guidelines or equivalent. Work closely with the appropriate municipal structures in regard to establishing a social responsibility programme. Ensure that any trusts or funds are strictly managed in respect of outcomes and funds.	3	3	2	3	3	3	42	+	Medium

Table 10: Assessment of the Wonderheuvel Solar PV Facility and associated grid connection infrastructure – Operational phase

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Transformation of the sense of place	Transformation of the sense of place due to the nature of the project.	2	4	4	3	4	3	51	-	High	Apply the mitigation measures suggested in the Visual Impact Assessment Report. Ensure that all affected landowners and tourist associations are regularly consulted. A Grievance Mechanism should be put in place and all grievances should be dealt with in a transparent manner. The mitigation measures recommended in the Heritage Impact Assessment should be followed.	2	4	4	3	4	2	34	-	Medium
Job creation and skills development	The creation of job opportunities and the development of skills amongst the workforce.	2	3	2	2	3	2	24	+	Medium	Implement a training and skills development programme for locals. Work closely with the appropriate municipal structures in regard to establishing a social responsibility programme.	2	3	2	2	3	2	24	+	Medium
Socio-economic stimulation	Potential for positive socio-economic opportunities for the region associated with downstream business opportunities and corporate social responsibility initiatives.	3	3	2	3	3	2	28	+	Medium	Ensure that the procurement policy supports local enterprises. Establish a social responsibility programme either in line with the REIPPP BID guidelines or equivalent. Work closely with the appropriate municipal structures in regard to establishing a social responsibility programme. Ensure that any trusts or funds are strictly managed in respect of outcomes and funds.	3	3	2	3	3	3	42	+	Medium

Table 11: Assessment of the Paarde Valley Solar PV Facility and associated grid connection infrastructure – Operational phase

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Transformation of the sense of place	Transformation of the sense of place due to the nature of the project.	2	4	4	3	4	3	51	-	High	Apply the mitigation measures suggested in the Visual Impact Assessment Report. Ensure that all affected landowners and tourist associations are regularly consulted. A Grievance Mechanism should be put in place and all grievances should be dealt with in a transparent manner. The mitigation measures recommended in the Heritage Impact Assessment should be followed.	2	4	4	3	4	2	34	-	Medium
Job creation and skills development	The creation of job opportunities and the development of skills amongst the workforce.	2	3	2	2	3	2	24	+	Medium	Implement a training and skills development programme for locals. Work closely with the appropriate municipal structures in regard to establishing a social responsibility programme.	2	3	2	2	3	2	24	+	Medium
Socio-economic stimulation	Potential for positive socio-economic opportunities for the region associated with downstream business opportunities and corporate social responsibility initiatives.	3	3	2	3	3	2	28	+	Medium	Ensure that the procurement policy supports local enterprises. Establish a social responsibility programme either in line with the REIPPP BID guidelines or equivalent. Work closely with the appropriate municipal structures in regard to establishing a social responsibility programme. Ensure that any trusts or funds are strictly managed in respect of outcomes and funds.	3	3	2	3	3	3	42	+	Medium

6.4. DECOMMISSIONING PHASE

If the project was to be completely decommissioned the major social impacts likely to be associated with this would be the loss of jobs and revenue stream that stimulated the local economy and flowed into the municipal coffers. It is estimated that the project has a lifespan of approximately 20 years and there is the possibility that after this period the solar facility could be replaced with more up-to-date technology that would extend the life of the facilities. Although the loss of a job is significant and can be devastating on an individual and family level, the total number of jobs under threat could be insignificant as the operational staff complement is estimated at a total of 48 across all three facilities and many of these employees will be skilled and could find alternative employment.

Decommissioning will result in a limited number of jobs being created over a short period of time as components are dismantled and the site is cleared. Although positive, this will be a rather insignificant benefit considering the size of the facilities and the time period attached to decommissioning.

Considering the time period to decommissioning, the uncertainty of what would exactly occur, and the significance of the impact in isolation it would be rather meaningless to attach assessment criteria to decommissioning at this point. However, prior to decommissioning the following mitigation measures are suggested.

Decommissioning mitigation measures

- Ensure that a retrenchment package is in place.
- Ensure that staff have been trained in a manner that would provide them with saleable skills within the job market.
- Ensure that the site is cleared responsibly and left in a safe condition.

7. ASSESSMENT OF 'NO GO' ALTERNATIVE

The 'no go' option would mean that the social environment is not affected as the status quo would remain. On a negative front it would also mean that all the positive aspects associated with the project would not materialise. Consequently, there would be no job creation, no revenue streams into the local economy and municipal coffers and a lost opportunity to enhance the national grid with a renewable source of energy. Considering that Eskom's coal fired power stations are a huge contributor to carbon emissions the loss of a chance to supplement the National Grid through renewable energy would be significant at a national, if not at a global level. The Intergovernmental Panel on Climate Change (6 October 2018, p. 15) has warned that that Co^2 emissions need to be reduce by 45% from 2010 levels by 2030 and to zero by 2050 which basically means that coal must go. The no-project alternative is assed in **Table 12** with regard to all three solar PV facilities and associated infrastructure. The no go alternative is identical in respect of each of the solar PV facilities and to avoid unnecessary repetition is present in one table.

Table 12: No go alterative in respect of all three solar PV facilities

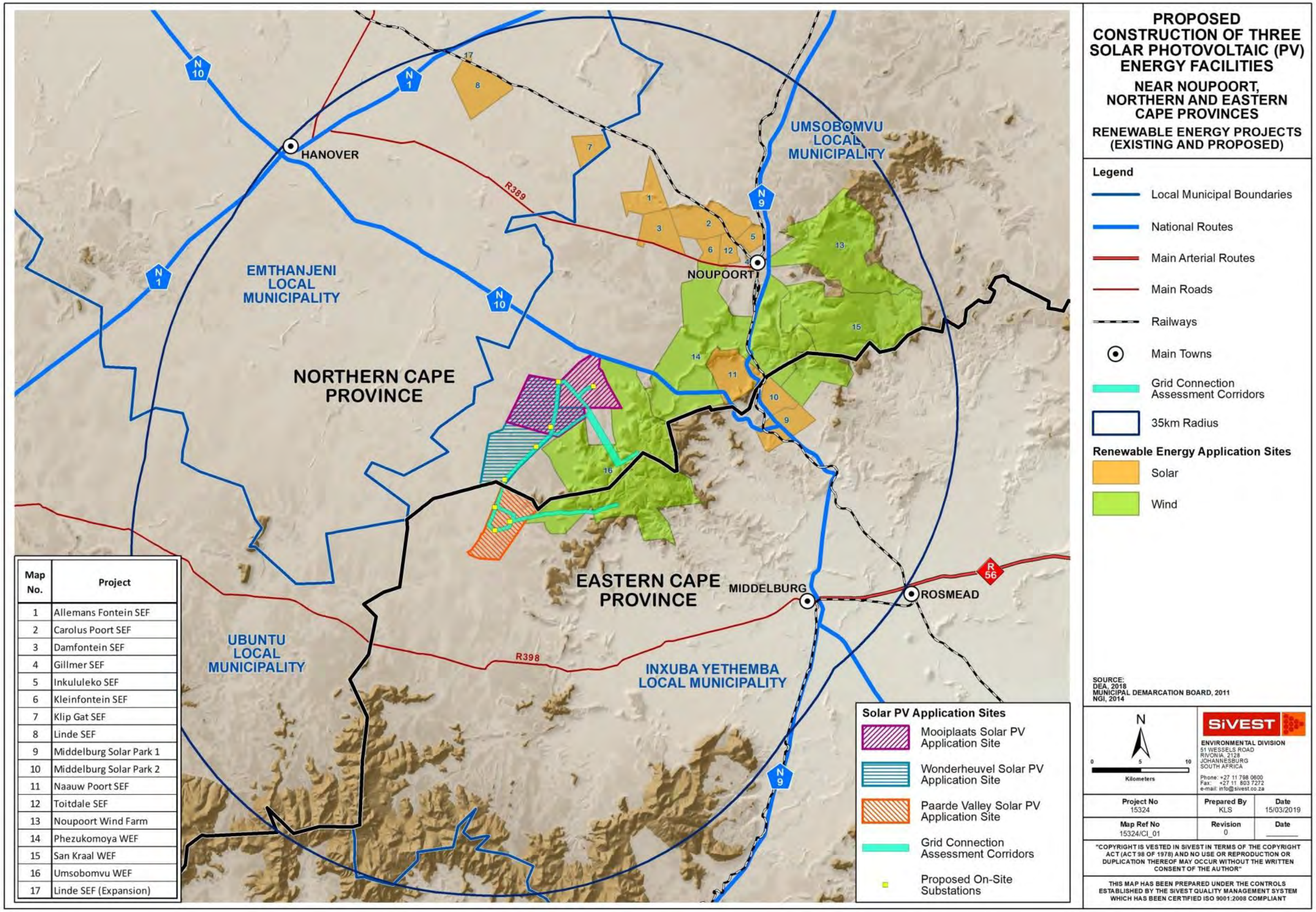
Environmental Significance	
Environmental Parameter	No project
Issue/Impact/Environmental Effect/Nature	Status quo
Extent	4
Probability	4
Reversibility	3
Loss of resources	3
Duration	3
Intensity/magnitude	3
Total	51
Status (+ or -)	-
Status	High

8. Cumulative Impacts

Renewable energy facilities require specific climatic conditions that provide high levels of solar radiation and wind energy. This has resulted in a tendency for these facilities to be clustered in specific areas, such as the Karoo, that provide these ideal conditions. Consequently, this grouping of facilities in specific areas has in turn led to cumulative impacts. In this regard the following projects, illustrated in the map in **Figure 13,** have been identified within a 35 km radius of the proposed Umsobomvu Solar PV Energy Facility:

- Allemans Fontein SEF
- Carolus Poort SEF
- Damfontein SEF
- Gillmer SEF
- Inkululeko SEF
- Kleinfontein SEF
- Klip Gat SEF
- Linde SEF
- Middelburg Solar Park 1

- Middelburg Solar Park 2
- Naauw Poort SEF
- Toitdale SEF
- Noupoort Wind Farm
- Phezukomoya WEF
- San Kraal WEF
- Umsobomvu WEF, and
- Linde SEF (Expansion).



Map No.	Project
1	Allemans Fontein SEF
2	Carolus Poort SEF
3	Damfontein SEF
4	Gillmer SEF
5	Inkululeko SEF
6	Kleinfontein SEF
7	Klip Gat SEF
8	Linde SEF
9	Middelburg Solar Park 1
10	Middelburg Solar Park 2
11	Naauw Poort SEF
12	Toitdale SEF
13	Noupoort Wind Farm
14	Phezukomoya WEF
15	San Kraal WEF
16	Umsobomvu WEF
17	Linde SEF (Expansion)

Source: SiVEST Environmental Division

Figure 13: Proposed renewable energy developments ~35 km radius from site

8.1. REVIEW OF SPECIALIST REPORTS FOR REFS IN THE AREA

The following more specific social issues have been raised in the specialist reports pertaining to the various renewable energy initiatives identified above.

- **Positive impacts**
  - Job creation; Impacts associated with the construction phase are generally short-term
  - Establishment of local community trust
  - Establishment of renewable energy infrastructure
- **Negative impacts**
  - Sense of place
  - Influx of construction workers
  - Impact on family and community relations – STDs and HIV
  - Risk of stock theft, poaching and damage to farm infrastructure
  - Risk of veld fires
  - Impact of heavy vehicles, damage to roads, safety, noise and dust
  - Loss of agricultural land
  - Impact on tourism
- **Indirect impacts**
  - After construction locals may not find future employment
  - Skills and development – increased employability
- **Cumulative impacts**
  - Development of additional renewable energy facilities – increased potential for job creation
  - Impact on family and community relations – STDs and HIV
  - Sense of place
  - Pressure on municipal and social services
- **No-Go option**
  - Loss of renewable energy infrastructure
  - High carbon emissions
  - Unsustainable way to produce electricity
  - Overall social impact
  - Predominantly low significance (positive impact)
  - In respect of climate change – a positive social benefit for society as a whole.

The details of the reports from which these impacts have been sourced are provided in **Table 13**.

Table 13: List of EIA reports for projects within a 35 km radius

Date	Title of report	DEA Ref number	Consultant responsible for report	Page numbers
July 2011	Establishment of Photovoltaic (Solar Power) Farms in the Northern Cape	12/12/20/2258	Sustainable Development Projects cc	4-5, 37-39, 51
February 2012	Environmental Basic Impact Assessment Process Draft Basic Assessment Report, Proposed Toitdale Solar Energy Facility Northern Cape Province	12/12/20/2653	Savannah Environmental (Pty) Ltd	47, 58, 61-62
March 2012	Social Impact Assessment Aced Middleburg Photovoltaic Solar Energy Facility Eastern Cape Province	Specialist report	Tony Barbour Environmental Consulting and Research	Entire report
March 2012	Environmental Basic Impact Assessment Process Draft Basic Assessment Report, Proposed Middelburg Solar Park 1 Eastern Cape Province	12/12/20/2465/2	Savannah Environmental (Pty) Ltd	54-63, 71-73
13 April 2012	Mainstream Renewable Power South Africa Noupoort (Pty) Ltd. Proposed Construction of a Wind Farm near Noupoort, Northern Cape Province, South Africa. Final Environmental Impact Report	12/12/20/2319	SiVEST Environmental Division	156-177, 221-228, 232-234
May 2012	Environmental Basic Impact Assessment Process Draft Basic Assessment Report, Proposed Tollie Solar Energy Installation on a site near Noupoort, Northern Cape Province	14/12/16/3/3/1/528	Savannah Environmental (Pty) Ltd	54-59, 65-68
September 2012	Environmental Impact Assessment Process Final Basic Assessment Report, Proposed Klip Gat Solar Energy Facility (75MW) near Noupoort, Northern Cape Province	14/12/16/3/3/2/354	Savannah Environmental (Pty) Ltd	61-62, 71-72, 79
September 2012	Environmental Impact Assessment Process Final Basic Assessment Report, Proposed Naauw Poort Solar Energy Facility (75MW) near Noupoort, Northern Cape Province	14/12/16/3/3/2/355	Savannah Environmental (Pty) Ltd	84-86, 95-96, 101, 101-111
November 2012	Social Impact Assessment Klipgat Solar Energy Facility Northern Cape Province (Draft Report)	Specialist report	Tony Barbour Environmental Consulting and Research	Entire report
December 2012	Environmental Impact Assessment Process Final Basic Assessment Report, Proposed Damfontein Solar Energy Facility near Noupoort, Northern Cape Province	14/12/16/3/3/1/728	Savannah Environmental (Pty) Ltd	70-72 & 79-81
January 2013	Environmental Impact Assessment Process Final Basic assessment Report, Allemans Fontein Solar Energy Facility near Noupoort, Northern Cape Province	14/12/16/3/3/1/730	Savannah Environmental (Pty) Ltd	66-67 & 80-81

Date	Report title	DEA Ref number	Responsible consultant	Page numbers
January 2013	Environmental Impact Assessment Process Final Basic Assessment Report, Proposed Carolus Poort Solar Energy Facility near Noupoort, Northern Cape Province	14/12/16/3/3/1/729	Savannah Environmental (Pty) Ltd	73-74
January 2013	Environmental Impact Assessment Process Final Basic Assessment Report, Proposed Gillmer Solar Energy Facility near Noupoort, Northern Cape Province	14/12/16/3/3/1/735	Savannah Environmental (Pty) Ltd	74-75 & 78-79, 82-83
January 2013	Environmental Impact Assessment Process Final Basic Assessment Report, Proposed Inkululeko Solar Energy Facility near Noupoort, Northern Cape Province	14/12/16/3/3/1/553	Savannah Environmental (Pty) Ltd	63, 66 & 68
January 2013	Environmental Impact Assessment Process Final Basic Assessment Report, Proposed Kleinfontein Solar Energy Facility near Noupoort, Northern Cape Province	12/12/20/3//2654	Savannah Environmental (Pty) Ltd	45-46, 59, 61
April 2016	Proposed Umsobomvu Wind Energy Facility, Northern Cape & Eastern Cape Provinces	14/12/16/3/3/2/730	Savannah Environmental (Pty) Ltd	117-121, 127, 147
December 2017	Social Impact Assessment Phezukomoya Wind Energy Facility Northern Cape and Eastern Cape Province	Specialist report	Tony Barbour Environmental Consultant and Researcher	Entire report
December 2017	Social Impact Assessment San Kraal Wind Energy Facility Northern and Eastern Cape Province	Specialist report	Tony Barbour Environmental Consultant and Researcher	Entire report
March 2018	Environmental Impact Assessment Report for the Proposed 315 MW Phezukomoya Wind Energy Facility and Grid Connection, Northern and Eastern Cape Provinces	14/12/16/3/3/2/1028	Arcus Consultancy Services South Africa (Pty) Limited	ix, 329-338, 350
March 2018	Environmental Impact Assessment Report for the Proposed 390 MW San Kraal Wind Energy Facility and Grid Connection, Northern and Eastern Cape Provinces	14/12/16/3/3/2/1029	Arcus Consultancy Services South Africa (Pty) Limited	vii-viii, 328-337, 350

Recommendation

Recommendations of the reports reviewed indicate that, on an overall basis, the social benefits of renewable energy projects in the area outweigh the negative benefits and that the negative social impacts can be mitigated.

In this regard the following cumulative impacts are addressed below:

- Risk of HIV
- Sense of place
- Service supplies and infrastructure, and
- The economic benefit.

8.2. Risk of HIV infections[2]

With an HIV prevalence rate of 17.5%, the Northern Cape Province has the lowest HIV prevalence rate of all provinces across South African with the Eastern Cape having the third highest rate at 31.4%. At a district level the Pixley ka Seme District Municipality has the 5th lowest HIV prevalence rate across all district municipalities in South Africa at 15.1%. In comparison, the Chris Hani district has the 14th highest HIV prevalence rate across all district municipalities with a rate of 34.5%. It is most likely that this higher prevalence rates in the Chris Hani district will be associated with more densely populated urban areas and along transport routes, considering that the Chris Hani district serves as a linking node to all regions in the Eastern Cape.

With most projects falling within what is a sparsely populated region of the Northern Cape and along the sparsely populated Northern and Eastern Cape boarder, it is likely that HIV prevalence rates will be low within the immediate vicinity of these projects. Consequently, it is important to consider the risk of the spread of HIV associated with these projects, particularly where the workforce is recruited from areas that are likely to have relatively high levels of HIV such as Middelburg and other urban areas further afield. This is important as it is well documented on both an international and local basis that the construction industry carries with it a high risk of HIV (Meintjes, Bowen, & Root, 2007; Bowen, Dorrington, Distiller, Lake, & Besesar, 2008; Wasie, et al., 2015; Bowen P. , Govender, Edwards, & Cattell, 2016; Kikwasi & Lukwale, 2017; Bowen P. , Govender, Edwards, & Lake, 2018) which can be spread amongst the local communities, particularly through an increase in prostitution that follows the

[2] HIV prevalence rates are at 2013 figures based on The 2013 National Antenatal Sentinel HIV Prevalence Survey, South Africa.

availability of disposable income. It is also well documented, on both an international and local level, that HIV is also spread by truck drivers (Singh & Malaviya, 1994; Ramjee & Gouws, 2002; Strauss, et al., 2018) and there is likely to be an increase in truck drivers in the area as equipment and material is delivered to the various construction sites.

These issues, associated with the area being extremely poor and the associated disposable income that will follow the construction workers and truck drivers to the area, will heighten the risk of the spread of HIV infections across what is a rather remote region. In this regard The World Bank (2009, pp. 367-368) had indicated a strong link between infrastructure projects and health as:

> "*Transport, mobility, and gender inequality increase the spread of HIV and AIDS, which along with other infectious diseases, follow transport and construction workers on transport networks and other infrastructure into rural areas, causing serious economic impacts.*"

8.3. TRANSFORMATION OF SENSE OF PLACE

There is also a concern amongst various interest groups that the proliferation of renewable energy facilities in the Karoo will have a significant and negative cumulative social impact on the area's isolated, tranquil and pristine environment[3]. In this regard issues such as the aesthetic appearance associated with highly visible solar parks and wind farms; the noise from turbine blades; the loss of bird and bat life and its effect on tourism; as well as the disruption of social networks have all been cited amongst these concerns.

This is, however, a complex issue as there are varying opinions in respect of the aesthetic appearance of renewable energy facilities with some regarding them in a far more positive light than others (Firestone, Bidwell, Gardner, & Knapp, 2018; Schneider, Mudra, & Kozumplíková, 2018). In a study of public attitudes towards onshore windfarms in south-west Scotland it was found that many regarded the visual impact of these developments in a positive light. It must, however, be noted that this was linked with community ownership having a positive impact on public attitudes towards windfarm developments in Scotland (Warren & McFadyen, 2010). A further and important consideration in this regard is of an ethical nature

[3] Amongst others see for instance:
1. Heritage South Africa's Karoo News Group http://heritagesa.org/wp/2222-2/
2. Alternative sources of energy for South Africa in various shades of green (Smit, 2011)
3. Social media sites such as the Facebook Karoo Energy Debate https://www.facebook.com/TheKarooEnergyDebate/
4. Why the Karoo. (Research Chair in the Sociology of Land, Environment and Sustainable Development. Department of Sociology and Social Anthropology, Stellenbosch University, 2016).

associated with community acceptance and energy justice and raises the question of the incorporation of public acceptance, particularly that of the underrepresented, into energy policy (Roddisa, Carvera, Dallimerb, Normana, & Ziva, 2018, pp. 362-363).

8.4. SERVICES, SUPPLIES AND INFRASTRUCTURE

With the increase in renewable energy facilities in the area it is quite likely that the local authorities, currently hard pressed to deliver services, will find it difficult to keep up with these developments. The influx of construction workers is likely to place pressure on accommodation and the need for both services and supplies. Noupoort, Hanover and Middelburg, being within a 35 km radius of these projects, are likely to bear the brunt of the demand for accommodation, services and supplies. On this basis market demands could inflate costs which may have a negative effect on local communities, particularly the poor, who may be forced to pay higher prices for essential supplies resulting in an escalation in the cost of living in the area.

Social services such as medical and educational facilities could also be placed under pressure due to increased demand. Although this may reach its peak during the construction phase it should be mitigated somewhat by the fact that the construction of the various project will be spread across different timelines, with some project commencing while others reach completion. Employing local people across the various projects and project phases will help in reducing the stress placed on services, supplies and infrastructure in the area.

During the operational phases it is likely that these demands will continue as operational staff take up more long-term residency in the area and are supported by service and maintenance personnel who may spend some time on site on a contractual basis. An influx of temporary maintenance and service workers is likely to last over the operational phase of the projects but is likely to settle within the medium term as the economy adjusts and the municipal authorities are able to respond to this growth.

8.5. ECONOMIC BENEFIT

The cumulative economic impact of the project will be both positive and negative. The negative economic impacts, associated with a possible rise in living costs driven by market demand, are considered under the section above. Under this section the positive economic impacts will be addressed.

From a positive perspective the proliferation of renewable energy facilities within the region is likely to result in significant and positive cumulative impacts in the area associated with both direct and indirect job creation, skills development, training opportunities, and the creation of business opportunities for local businesses. The district and local municipalities within the area have identified renewable energy as a strategic economic opportunity in a region that previously had few such opportunities. This is indicated in the various IDPs and LEDs pertaining to the affected municipalities.

8.6. ASSESSMENT OF CUMULATIVE IMPACTS

The cumulative impacts discussed above are assessed below in **Table 14**. It must, however, be noted that this assessment is at a superficial level as any in-depth investigation of the cumulative effects of the various developments being planned for the region are beyond the scope of this study as they would require a broad based investigation on a far larger scale.

Table 14: Assessment of cumulative impacts

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Risk of HIV infection	Risk associated with the influx of workers in the area.	3	3	4	3	4	3	51	-	High	Mitigation can only be implemented on a regional basis and are not project specific. Ensure that all companies coming into the area have and are implementing an effective HIV/AIDS policy. Introduce HIV/ADS awareness programs to schools and youth institutions. Carefully monitor and report on the HIV status of citizens in the region. Be proactive in dealing with any increase in the HIV prevalence rate in the area.	3	2	4	3	4	2	32	-	Medium
Sense of place	The transformation of the sense of place of the region.	2	4	4	3	4	3	51	-	High	Mitigation measures can only be implemented on a regional basis and are not project specific. Consider undertaking a cumulative impact assessment to evaluate the changes taking place across the area on a broader scale. Form a regional work group tasked with addressing the effect of changes to the sense of place of the region. Establish grievance mechanisms to deal with complaints associated with changes to the area. Enlighten the public about the need and benefits of renewable energy. Engage with the tourism businesses and authorities in the region to identify any areas of cooperation that could exist.	2	4	4	3	4	2	34	-	Medium

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Services, supplies and infrastructure	The influx of construction workers is likely to place pressure on accommodation and the need for both services and supplies.	2	3	2	2	2	2	22	-	Low	<u>Mitigation measures can only be implemented on a regional basis and are not project specific.</u> Engage with the municipal authorities to ensure that they are aware of the expansion planned for the area and the possible consequences of this expansion. Ensure that local labour is recruited in respect of these developments in the area.	2	2	2	2	2	2	20	-	Low
Economic	A proliferation of renewable energy facilities across the region is likely to result in significant and positive impacts in the area in terms of job creation, skills development, training opportunities and the creation of business opportunities for local businesses.	3	3	2	2	2	3	36	+	Medium	<u>Optimisation measures can only be implemented on a regional basis and are not project specific.</u> Implement a training and skills development programme for locals. Ensure that the procurement policy supports local enterprises. Work closely with the appropriate municipal structures in regard to establishing a social responsibility programme. Ensure that any trusts or funds are strictly managed in respect of outcomes and funds allocated.	3	3	2	2	2	4	48	+	High

The assessment of the cumulative impacts takes into consideration the impacts associated with all renewable energy facilities within a 35 km circumference of the Umsobomvu Solar PV Facilities. On this basis no fatal flaws associated with the cumulative impacts are evident at a social level. The findings support the recommendations of the reports listed in **Table 13** that, on an overall basis, the social benefits of renewable energy projects in the area outweigh the negative benefits and that the negative social impacts can be mitigated.

The impacts as assessed in respect of the construction and operational phases as well as the 'no-go' alternative and cumulative impacts are summarised for all three solar PV facilities and respective grid connection infrastructure in **Table 15** with a pre and post mitigation comparison being presented. This summery is in respect of all three solar PV facilities and associated grid connection infrastructure as there are no significant differences in respect of the social impacts associated with these facilities. To present three different comparative tables for each project would be repetitive and superfluous as the impacts associated with all three facilities are identical.

Table 15: Impact summary for all three solar PV energy facilities and associated grid infrastructure

Construction Phase					
Environmental parameter	**Issues**	**Rating prior to mitigation**	**Average**	**Rating post mitigation**	**Average**
Health & social wellbeing	Annoyance, dust and noise	-16 low	**Health & social wellbeing -27 medium**	-8 low	**Health & social wellbeing -20 low**
	Increase in crime	-33 medium		-22 low	
	Increased risk of HIV infections	-48 high		-32 medium	
	Influx of construction workers and job seekers	-22 low		-20 low	
	Hazard exposure.	-20 low		-18 low	
Quality of the living environment	Disruption of daily living patterns	-20 low	**Quality of the living environment -20 low**	-18 low	**Quality of the living environment-18 low**
	Disruptions to social and community infrastructure	-20 low		-18 low	
Economic	Job creation and skills development	+22 low	**Economic +23 low**	+24 medium	**Economic +25 medium**
	Socio-economic stimulation	+24 medium		+24 medium	
Operational Phase					
Quality of the living environment	Transformation of the sense of place	-51 high	**Quality of the living environment -51 high**	-34 medium	**Quality of the living environment -34 medium**
Economic	Job creation and skills development	+24 medium	**Economic +26 medium**	+24 medium	**Economic +33 medium**
	Socio-economic stimulation	+28 medium		+42 medium	
No Project Alternative					
No project	Status quo will remain	-51 high	**-51 high**	No mitigation measures	
Cumulative Impacts					
Health & social wellbeing	Risk of HIV	-51 high	**Health & social wellbeing -51 high**	-32 medium	**Health & social wellbeing -32 medium**
Quality of the living environment	Transformation of sense of place	-51 high	**Quality of the living environment -36.5 medium**	-34 medium	**Quality of the living environment -27 medium**
	Services, supplies & infrastructure	-22 low		-20 low	
Economic	Job creation, skills development and socio-economic stimulation	+36 medium	**Economic +36 medium**	+48 high	**Economic +48 high**

9. COMPARATIVE ASSESSMENT OF LAYOUT ALTERNATIVES

As no social preference emerged in respect of any of the grid connection options, the other specialist reports were perused to establish if there was any preference that would have an influence on the social aspect. The results of this analysis are as follows:

Agricultural Report (Lanz, 2019, p. 24)

No preference was found in respect of all three solar PV facilities due to "*Low agricultural impacts and the agricultural uniformity of the site*".

Avifauna Report (Chris van Rooyen Consulting, 2019, pp. 80-81)

"**Mooi Plaats Solar PV Facility:**

Grid Connection Option 1 Preferred Mostly avoids no-go areas

Grid Connection Option 2 Least preferred Traverses at least two no-go areas

Wonderheuvel Solar PV Facility:

Grid Connection Option 1 Least preferred Traverses several no-go areas

Grid Connection Option 2 Preferred Avoids all no-go areas

Paarde Valley Solar PV Facility:

Grid Connection Option 1 Least preferred Traverses several no-go areas

Grid Connection Option 2 Preferred Mostly avoids no-go areas, except one."

Ecology Scoping Assessment (David Hoare Consulting (Pty) Ltd, 2019, p. 72)

"*At the site-specific scale, some sensitivities have been identified, primarily related to natural habitat, but also to some individual species. However, it is possible that these can be minimised or avoided with the application of appropriate mitigation or management measures. There will be residual impacts, primarily on natural habitat.* ***The amount of habitat that will be lost to the project is insignificant compared to the area in hectares of the regional vegetation type that occurs on site but may be significant in terms of local patterns and diversity that could be affected****. It is therefore important that the infrastructure be located to minimize impacts on sensitive receptors. From this perspective it is unlikely that*

> *the proposed project will have an unacceptable impact on the natural environment. The preliminary view is that it should be authorised.*"

Heritage Assessment (PGS Heritage (Pty) Ltd, 2019, pp. 35-37)

At this stage no preferences have emerged but it is recommended that; "*further field trothing through an archaeological walk down and palaeontological study covering the site*" be undertaken.

Surface Water Assessment (SiVEST SA (Pty) Ltd, 2019a, pp. 85-86)

- Mooi Plaats Solar PV Facility Grid Connection Option 1
- Wonderheuvel Solar PV Facility: Grid Connection Option 2
- Paarde Valley Solar PV Facility Grid Connection Option 2.

Transportation Impact Assessment (SiVEST SA (Pty) Ltd, 2019c, pp. 21-22)

- Mooi Plaats Solar PV Facility Grid Connection Option – No preference emerged
- Wonderheuvel Solar PV Facility: Grid Connection Option – No preference emerged
- Paarde Valley Solar PV Facility Grid Connection Option – No preference emerged.

Visual Impact Assessment (SiVEST SA (Pty) Ltd, 2019b, pp. 109-117)

The results of the visual assessment indicate that:

> "*No fatal flaws were identified for any of the grid connection infrastructure alternatives and the preferred alternatives for each of the projects are listed below:*
>
> - *Mooi Plaats grid connection infrastructure: Option 1*
> - *Wonderheuvel grid connection infrastructure: Option 2*
> - *Paarde Valley grid connection infrastructure: Option 1.*"

The socially preferred grid connection infrastructure options that emerged from this analysis, for all three solar PV facilities, follows the preferences stated in the visual impact assessment based on the premise that, the visual has a significant influence on the sense of place. However, there could also be a similar influence in respect of avifauna and surface water and therefor, in respect of the Paarde Valley facility, it is quite acceptable on a social level that the motivations provided in the avifauna and surface water studies override those of the visual study. On the basis of this the socially preferred options are presented in **Table 16**.

Table 16: Comparative assessment of alternative grid connection infrastructure

Key	
Preferred	The alternative will result in a low impact / reduce the impact
Favourable	The impact will be relatively insignificant
Least preferred	The alternative will result in a high impact / increase the impact
No preference	The alternative will result in equal impacts

Grid Connection Infrastructure Alternatives (Power Line Corridors and Associated Substations)	Preference	Reasons (incl. potential issues)
MOOI PLAATS SOLAR PV FACILITY:		
Grid Connection Option 1	Preferred	Due to the visual preference and reasons provided in the Visual Impact Assessment. This is based on the potential to change the visual character of the area which is quite likely to have an influence on the sense of place of the area. Also preferred avifauna and surface water options.
Grid Connection Option 2	Favourable	Due to the visual preference and reasons provided in the Visual Impact Assessment. This is based on the potential to change the visual character of the area which is quite likely to have an influence on the sense of place of the area.
WONDERHEUVEL SOLAR PV FACILITY:		
Grid Connection Option 1	Favourable	Due to the visual preference and reasons provided in the Visual Impact Assessment. This is based on the potential to change the visual character of the area which is quite likely to have an influence on the sense of place of the area.

Grid Connection Option 2	Preferred	Due to the visual preference and reasons provided in the Visual Impact Assessment. This is based on the potential to change the visual character of the area which is quite likely to have an influence on the sense of place of the area. Also preferred avifauna and surface water options.
PAARDE VALLEY SOLAR PV FACILITY:		
Grid Connection Option 1	Preferred	Due to the visual preference and reasons provided in the Visual Impact Assessment. This is based on the potential to change the visual character of the area which is quite likely to have an influence on the sense of place of the area.
Grid Connection Option 2	Favourable	Due to the visual preference and reasons provided in the Visual Impact Assessment. This is based on the potential to change the visual character of the area which is quite likely to have an influence on the sense of place of the area. Preferred avifauna option as it mostly avoids no-go areas except one and preferred surface water option. For these reasons this option is acceptable from a social perspective.

10. CONCLUSION AND RECOMMENDATIONS

In assessing the social impact of the Umsobomvu Solar PV Facilities, it was found that in respect of the energy needs of the country and South Africa's need to reduce its carbon emissions that the project fits with national, provincial and municipal policy.

Regarding the social impacts associated with the project it was found that most apply over the short term to the construction phase of the project. Of these impacts all can be mitigated to within acceptable ranges and there are no fatal flaws associated with the construction or operation of the project.

On a cumulative basis it is evident that the cumulative impacts associated with changes to the social environment of the region are more significant than those attached to the project in isolation. On a negative front there are two issues associated with developments in the region that are of most concern. The first of these issues is the change to the sense of place of an area that was once considered a pristine region of South Africa. The second is the potential, through an influx of labour and an increase in transportation to constructions sites, of the risk for the prevalence of HIV to rise in an area that has a relatively low HIV prevalence rate. In this regard it is important that the relevant authorities recognise these issues and find ways of mitigating them to ensure that they do not undermine the benefit that renewable energy projects bring, both to the region as well as to the country as a whole. These issues are beyond a project specific basis and as such will need to be addressed at a higher level.

10.1. IMPACT STATEMENT

The project site and surrounding areas are sparsely populated with the agricultural potential of the area being low. Accordingly, the negative social impacts associated with the proposed Mooi Plaats, Wonderheuvel and Paarde Valley solar PV facilities and associated grid connection infrastructure are of low to moderate significance with most occurring over the short term construction phase. The project has a positive element which outweighs the negative in that it will contribute towards the supply of renewable energy into a grid system heavily reliant on coal powered energy generation. In this sense the projects form part of a national effort to reduce South Africa's carbon emissions and thus carries with it a significant social benefit and is thus supported and should proceed.

10.2. EIA PHASE

As the area is sparsely populated and the negative social impacts associated with all three solar PV facilities and associated grid infrastructure of moderate significance it is most unlikely that any further social study will be necessary. This will, however, be dependent on the outcome of the public participation process which may result in a need to update the current report by incorporating the comments recorded and updating the social impacts accordingly.

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Appendix 1:- Environmental impact assessment methodology

1. ENVIRONMENTAL IMPACT ASSESSMENT (EIA) METHODOLOGY

The Environmental Impact Assessment (EIA) Methodology assists in evaluating the overall effect of a proposed activity on the environment. Determining of the significance of an environmental impact on an environmental parameter is determined through a systematic analysis.

1.1. Determination of Significance of Impacts

Significance is determined through a synthesis of impact characteristics which include context and intensity of an impact. Context refers to the geographical scale (i.e. site, local, national or global), whereas intensity is defined by the severity of the impact e.g. the magnitude of deviation from background conditions, the size of the area affected, the duration of the impact and the overall probability of occurrence. Significance is calculated as shown in **Table 1**.

Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The total number of points scored for each impact indicates the level of significance of the impact.

1.2. Impact Rating System

The impact assessment must take account of the nature, scale and duration of effects on the environment and whether such effects are positive (beneficial) or negative (detrimental). Each issue / impact is also assessed according to the various project stages, as follows:

- Planning;
- Construction;
- Operation; and
- Decommissioning.

Where necessary, the proposal for mitigation or optimisation of an impact should be detailed. A brief discussion of the impact and the rationale behind the assessment of its significance has also been included.

The significance of Cumulative Impacts should also be rated (As per the Excel Spreadsheet Template).

1.2.1. *Rating System Used to Classify Impacts*

The rating system is applied to the potential impact on the receiving environment and includes an objective evaluation of the possible mitigation of the impact. Impacts have been consolidated into one (1) rating. In assessing the significance of each issue the following criteria (including an allocated point system) is used:

Table 1: Rating of impacts criteria

ENVIRONMENTAL PARAMETER		
A brief description of the environmental aspect likely to be affected by the proposed activity (e.g. Surface Water).		
ISSUE / IMPACT / ENVIRONMENTAL EFFECT / NATURE		
Include a brief description of the impact of environmental parameter being assessed in the context of the project. This criterion includes a brief written statement of the environmental aspect being impacted upon by a particular action or activity (e.g. oil spill in surface water).		
EXTENT (E)		
This is defined as the area over which the impact will be expressed. Typically, the severity and significance of an impact have different scales and as such bracketing ranges are often required. This is often useful during the detailed assessment of a project in terms of further defining the determined.		
1	Site	The impact will only affect the site
2	Local/district	Will affect the local area or district
3	Province/region	Will affect the entire province or region
4	International and National	Will affect the entire country
PROBABILITY (P)		
This describes the chance of occurrence of an impact		
1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
2	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).
3	Probable	The impact will likely occur (Between a 50% to 75% chance of occurrence).
4	Definite	Impact will certainly occur (Greater than a 75% chance of occurrence).

REVERSIBILITY (R)		
This describes the degree to which an impact on an environmental parameter can be successfully reversed upon completion of the proposed activity.		
1	Completely reversible	The impact is reversible with implementation of minor mitigation measures
2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible and no mitigation measures exist.
IRREPLACEABLE LOSS OF RESOURCES (L)		
This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.		
1	No loss of resource.	The impact will not result in the loss of any resources.
2	Marginal loss of resource	The impact will result in marginal loss of resources.
3	Significant loss of resources	The impact will result in significant loss of resources.
4	Complete loss of resources	The impact is result in a complete loss of all resources.
DURATION (D)		
This describes the duration of the impacts on the environmental parameter. Duration indicates the lifetime of the impact as a result of the proposed activity.		
1	Short term	The impact and its effects will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase (0 – 1 years), or the impact and its effects will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	Medium term	The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
3	Long term	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 50 years).
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered transient (Indefinite).

INTENSITY / MAGNITUDE (I / M)		
Describes the severity of an impact (i.e. whether the impact has the ability to alter the functionality or quality of a system permanently or temporarily).		
1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
2	Medium	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).
3	High	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.
4	Very high	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired (system collapse). Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.

SIGNIFICANCE (S)		
Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. This describes the significance of the impact on the environmental parameter. The calculation of the significance of an impact uses the following formula: **Significance = (Extent + probability + reversibility + irreplaceability + duration) x magnitude/intensity.** The summation of the different criteria will produce a non-weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.		
Points	**Impact Significance Rating**	**Description**
5 to 23	Negative Low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
5 to 23	Positive Low impact	The anticipated impact will have minor positive effects.
24 to 42	Negative Medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
24 to 42	Positive Medium impact	The anticipated impact will have moderate positive effects.
43 to 61	Negative High impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
43 to 61	Positive High impact	The anticipated impact will have significant positive effects.
62 to 80	Negative Very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
62 to 80	Positive Very high impact	The anticipated impact will have highly significant positive effects.

The table below is to be represented in the Impact Assessment section of the report. The excel spreadsheet template can be used to complete the Impact Assessment.

Table 2: Rating of impacts template and example

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Construction Phase																				
Vegetation and protected plant species	Vegetation clearing for access roads, turbines and their service areas and other infrastructure will impact on vegetation and protected plant species.	2	4	2	2	3	3	39	-	Medium	**Outline/explain the mitigation measures to be undertaken to ameliorate the impacts that are likely to arise from the proposed activity. These measures will be detailed in the EMPr.**	2	4	2	1	3	2	24	-	Low

Operational Phase																			
Fauna	Fauna will be negatively affected by the operation of the wind farm due to the human disturbance, the presence of vehicles on the site and possibly by noise generated by the wind turbines as well.	2	3	2	1	4	3	36	-	Medium	**Outline/explain the mitigation measures to be undertaken to ameliorate the impacts that are likely to arise from the proposed activity. These measures will be detailed in the EMPr.**	2	2	2	1	4	2	22	-	Low
Decommissioning Phase																			
Fauna	Fauna will be negatively affected by the decommissioning of the wind farm due to the human disturbance, the presence and operation of vehicles and heavy machinery on the site and the noise generated.	2	3	2	1	2	3	30	-	Medium	**Outline/explain the mitigation measures to be undertaken to ameliorate the impacts that are likely to arise from the proposed activity. These measures will be detailed in the EMPr.**	2	2	2	1	2	2	18	-	Low

Cumulative																				
Broad-scale ecological processes	Transformation and presence of the facility will contribute to cumulative habitat loss and impacts on broad-scale ecological processes such as fragmentation.	2	4	2	2	3	2	26	-	Medium	**Outline/explain the mitigation measures to be undertaken to ameliorate the impacts that are likely to arise from the proposed activity. These measures will be detailed in the EMPr.**	2	3	2	1	3	2	22	-	Low

SiVEST

Appendix 6G

Surface Water Assessment

MOOI PLAATS SOLAR POWER (PTY) LTD / WONDERHEUVEL SOLAR POWER (PTY) LTD / PAARDE VALLEY SOLAR POWER (PTY) LTD

PROPOSED CONSTRUCTION OF THE UMSOBOMVU SOLAR PV ENERGY FACILITIES, IN THE EASTERN CAPE AND NORTHERN CAPE PROVINCES

Surface Water Impact Assessment Report

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Author:	Stephen Burton *Pr. Sci. Nat.* (Registration Number: 117474)
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Approved:	Andrea Gibb
Signature:	
For:	Mooi Plaats Solar Power (Pty) Ltd / Wonderheuvel Solar Power (Pty) Ltd / Paarde Valley Solar Power (Pty) Ltd

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

Proposed Construction of the Mooi Plaats, Wonderheuvel and Paarde Valley Solar PV Energy Facilities and Associated Grid Connection Infrastructure, near Noupoort in the Northern and Eastern Cape Provinces.

Specialist:	SiVEST South Africa (Pty) Ltd		
Contact person:	Stephen Burton		
Postal address:	P O Box 707, Msunduzi		
Postal code:	3231	Cell:	083 795 2804
Telephone:	033 347 1600	Fax:	033 347 5762
E-mail:	stephenb@sivest.co.za		
Professional affiliation(s) (if any)	Pr. Sci. Nat. (Registration Number: 117474)		

Project Consultant:	SiVEST South Africa (Pty) Ltd		
Contact person:	Andrea Gibb		
Postal address:	P O Box 2921, Rivonia		
Postal code:	2128	Cell:	072 587 6525
Telephone:	011 798 0638	Fax:	011 803 7272
E-mail:	AndreaG@sivest.co.za		

4.2 The specialist appointed in terms of the Regulations_

I, Stephen Burton ______________________, 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:

SiVEST South Africa (Pty) Ltd

Name of company (if applicable):

02nd May 2019

Date:

National Environmental Management Act, 1998 (Act No. 107 of 1998) and Environmental Impact Regulations (2017) Requirements for Specialist Reports (Appendix 6)

Section in EIA Regulations (2014), as amended		Clause	Section in Report
Appendix 6 – Section 1	(1)	A specialist report prepared in terms of these Regulations must contain —	N/a
	(a)	details of –	N/a
		(i) the specialist who prepared the report; and	Section 1.3 & Appendix A
		(ii) the expertise of that specialist to compile a specialist report including a curriculum vitae.	Section 1.3 & Appendix A
	(b)	A declaration that the person is independent in a form as may be specified by the competent authority;	Appendix A
	(c)	An indication of the scope of, and the purpose for which, the report was prepared;	Section 1.1
	(cA)	An indication of the quality and age of base data used for the specialist report;	Section 3.1
	(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 1.2
	(e)	A description of the methodology adopted in preparing the report or carrying out the specialised process; inclusive of equipment and modelling used;	Section 3
	(f)	Details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 6
	(g)	An indication of any areas to be avoided, including buffers;	Section 5.5
	(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 16
	(i)	A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 1.2
	(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 or activities;	Section 6
	(k)	Any mitigation measures for inclusion in the EMPr;	Section 6

	(l)	Any conditions for inclusion in the environmental authorization;	Section 8
	(m)	Any monitoring requirements for inclusion in the EMPr or environmental authorization;	Section 6
	(n)	A reasoned opinion –	
		(i) as to whether the proposed activity, activities or portions thereof should be authorized;	Section 9
		(iA) regarding the acceptability of the proposed activity or activities; and	Section 9
		(ii) if the opinion is that the proposed activity, activities or portions thereof should be authorized, 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 authority.	N/A
	(2)	Where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	N/A

MOOI PLAATS SOLAR POWER (PTY) LTD / WONDERHEUVEL SOLAR POWER (PTY) LTD / PAARDE VALLEY SOLAR POWER (PTY) LTD

PROPOSED CONSTRUCTION OF THE UMSOBOMVU SOLAR PV ENERGY FACILITIES, IN THE EASTERN CAPE AND NORTHERN CAPE PROVINCES

SURFACE WATER IMPACT ASSESSMENT REPORT

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PROPOSED CONSTRUCTION OF THE UMSOBOMVU SOLAR PV ENERGY FACILITIES, IN THE EASTERN CAPE AND NORTHERN CAPE PROVINCES

SURFACE WATER IMPACT ASSESSMENT REPORT

1 INTRODUCTION

Mooi Plaats Solar Power (Pty) Ltd, Wonderheuvel Solar Power (Pty) Ltd and Paarde Valley Solar Power (Pty) Ltd are proposing the construction of three (3) Solar PV Energy Facilities including associated infrastructure in the Eastern Cape and Northern Cape Provinces (hereafter referred to as, “the proposed development”). In order to inform the environmental management programme, assess the best alternative for substation and laydown areas (as part of the Environmental Impact Assessment process being undertaken) and to identify whether any water use authorisation may be required for the development, the potential impacts on any freshwater resources need to be determined. As such, SiVEST Environmental Consultants have been appointed as the independent specialist to identify, delineate and assess the potential impacts on any surface water resources on the proposed study sites.

1.1 Terms of Reference

The terms of reference for this surface water resources delineation and impact assessment are as follows:

- Desktop assessment of current and available database to determine if there are any surface water resources (including wetland and riparian habitats) within the proposed development site and / or within a 500m radius;
- A review of the relevant legislation as pertaining to surface water resources (including wetland and riparian habitats), under the auspices of the proposed development;
- The study area is to include a 500m radius around the proposed development;
- All identified surface water resources (including wetlands and riparian habitat) identified on the ground will require delineation as per the **DWAF (2005)** guidelines, “A practical field procedure for the identification and delineation of wetlands and riparian areas”;
- Wetland Present Ecological Status (PES) determinations as per **Macfarlane *et al.* (2009)** methodology (if present);
- Vegetation Response Assessment Index (VEGRAI) using the **Kleyhans *et al.* (2007)** methodology;

- Wetland ecosystem services assessment to be undertaken in accordance with the WET-EcoServices (**Kotze *et al*., 2007**) methodology (if present);
- Riparian ecosystem services assessment to be undertaken qualitatively as no currently applicable or accepted methodology;
- Ecological Importance and Sensitivity Categorisation (EISC) in line with **Department of Water Affairs and Forestry (DWAF) (1999)** method;
- The determination of surface water resources (including wetlands and riparian habitat) buffer zones as developed by **Macfarlane *et al.* (2014)**;
- Potential impacts assessment using SiVEST methodology (**Appendix B**) or client's preferred methodology;
- Risk assessment in terms of **Government Notice 509 of August 2016 (Notice No. 40229)**;
- Meeting the minimum information requirements for wetland delineation reports as per **Government Notice 267 Regulations regarding the Procedural Requirements for Water Use License Applications and Appeals 24th March 2017** (if wetlands are identified);
- Assessment of alternative layouts; and
- Specialist recommendations are to be provided to inform the layout of the proposed development considering surface water resources (including wetland(s) and / or riparian habitat) identified on the study site.

1.2 Assumptions and Limitations

Where present, the investigation of both wetlands and riparian habitat were initially identified and delineated at a desktop level. These were then ground-truthed using a Global Positioning System (GPS) device and verified in the field work phase. The GPS used is expected to be accurate from 5m up to 15m depending on meteorological conditions. The initial delineations undertaken at a desktop level were refined following findings made in the field work phase and points recorded in the field.

The site visit was undertaken from the 05th to the 07th of February 2019. Due to seasonal wetland and riparian vegetation growth preferences, vegetation species can grow at different times / seasons of the year. As such, some hydrophytic wetland vegetation species may not have been present at the time of the assessment. Seasonal vegetation identification limitations therefore apply to this assessment given the short term once-off nature of the fieldwork component. The assessment should therefore not be undertaken to be a fully comprehensive study on wetland and riparian vegetation species occurrence.

This study has focused on the possible identification and delineation of wetlands and riparian habitat (as defined herein) that are to be affected by the layout of the proposed development on the study site. Identification and delineation of potential wetlands and riparian habitat in the wider area outside of the proposed development area was only undertaken for possible wetlands within 500m radius of the study site to make provision for **Government Notice 509 of 2016 (No. 40229)**. A comprehensive study of wetlands and riparian habitat in the wider area was not undertaken.

This study is limited to providing a surface water resources delineation, wetland and riparian zone ecological state (wetland Present Ecological State (PES) and Vegetation Response Assessment Index (VEGRAI) Ecological Condition (EC)) determination, wetland and riparian zone ecosystem services assessment, wetland and riparian habitat environmental importance and sensitivity classifications, an impact assessment and risk assessment in terms of **Government Notice 509 of 2016 (No. 40229)**, where each of these assessments are applicable. No other assessments were undertaken or formed part of this study. As such, aquatic studies including fish, invertebrates and amphibians have not been included in this report. Nor have water quality, hydrological, floodline or groundwater studies been included. These will be undertaken separately and where necessary for the project

Use of database information for the desktop assessment included the National Freshwater Ecosystem Priority Areas **(NFEPA, 2011)** database. This database is a national level database and some smaller surface water resources may not be contained in the database. Additionally, mainly permanently saturated wetlands are included in the database. Therefore, wetlands with seasonal and temporary saturation cycles may not be included. The fieldwork component was included in the assessment to verify the desktop database information in order to address these shortcomings should wetlands have been identified.

The risk assessment matrix as per **Government Notice 509 of 2016 (No. 40229)** was completed based on the current available layout plan. The risk assessment assumes a worst case scenario approach in which the current layout is implemented but which also takes into consideration the recommended control measures.

SiVEST undertook every effort to obtain the information (including specialist studies, BA / EIA / Scoping and EMPr Reports) for the surrounding developments. However, many of the documents are not currently publically available to download. The information that could be obtained for the surrounding planned renewable energy developments was taken into account as part of the cumulative impact assessment.

1.3 Specialist Credentials

This surface water resources delineation and impact assessment study has been undertaken by Stephen Burton from SiVEST. Stephen Burton has a Master's (MSc) Qualification. Stephen has undertaken numerous wetland and riparian delineations, present ecological state determinations, wetland ecosystem service assessment as well as ecological importance and sensitivity classifications for projects countrywide as well as a number of short training courses. A full CV and *Pr. Sci. Nat.* certificate is attached as **Appendix A**.

1.4 Aims and Objectives

The aim of the surface water resources assessment was to identify, delineate and classify any possible wetland(s) and / or riparian habitat that may be impacted on by the proposed development. This was initially undertaken from a desktop perspective. The information was then taken into the field for groundtruthing, verification, delineation and classification. A secondary aim was to determine the ecological state, ecosystem services and ecological importance and sensitivity of the wetland(s) and / or riparian habitat. Suitable buffer zones for the identified wetland(s) and / or riparian habitat were applied based on fieldwork findings and the results of the functional assessments.

The main objective was to determine the degree of potential impact on any identified wetlands and / or riparian habitat, taking into consideration the health and environmental importance and sensitivity of the identified features. The impact assessment was undertaken to determine the degree and significance of potential impacts as a result of the proposed development. Where identified, mitigation measures were stipulated in order to avoid or minimise potential impacts.

The second objective was to determine the risk of the proposed development to identified wetland(s) and / or riparian habitat in accordance with **Government Notice 509 of 2016 (No. 40229)**.

The tertiary objective was to evaluate the legislative implications of the proposed development affecting the wetland(s) and / or riparian habitat.

1.5 Legislative Context

1.5.1 National Water Act, 1998 (Act No. 36 of 1998)

The **National Water Act, 1998 (Act No. 36 of 1998)** (NWA) was created in order to ensure the protection and sustainable use of water resources (including wetlands) in South Africa. The NWA recognises that the ultimate aim of water resource management is to achieve the sustainable use of water for the benefit of all users. Bearing these principles in mind, there are a number of stipulations within the NWA that are relevant to the potential impacts on rivers, streams and wetlands that may be associated with the proposed development. These stipulations are explored below and are discussed in the context of the proposed development.

Firstly, it is important to discuss the type of water resources protected under the NWA. Under the NWA, a 'water resource' includes a watercourse, surface water, estuary, or aquifer. Specifically, a watercourse is defined as (*inter alia*):

- A river or spring;
- A natural channel in which water flows regularly or intermittently; and
- A wetland, lake or dam into which, or from which, water flows.

In this context, it is important to note that reference to a watercourse includes, where relevant, the bed and banks. The extent of a water resource, is therefore, a critical aspect considering the NWA. For wetlands, determining the full extent usually includes up to the outer edge of a wetland that is delineated according to **DWAF (2005/2008)** delineation guidelines. For the extent of rivers or streams, either the 1:100 year floodline or the outer edge of the riparian habitat (whichever is greatest) is taken as the full extent of a river, stream or drainage line. Where wetlands are found to be associated with rivers or streams (for example, floodplain wetlands), whichever extends further is taken as the full extent of the river or stream. For example, where the 1:100 year floodline extends further than the floodplain wetland associated with a river, the edge of the 1:100 year floodline is taken as the full extent of the water resource. Importantly, direct impacts to a watercourse triggers a full water use license application process that will need to be undertaken in order to obtain a license. However, **Government Notice 509 of 2016 (No. 40229)** makes provision for activities and / or impacts within the outer edge of the 1:100 year floodline and / or delineated riparian habitat (whichever is greatest), in the absence of the 1:100 year floodline or riparian area the area within 100m from the edge of a watercourses - where the edge of the watercourse is the first identifiable annual bank fill flood bench and lastly, within a 500m radius from the delineated boundary of any wetland or pan. Importantly, where it is assessed that activities and / or impacts result in a LOW risk activity and this is accepted by the Department of Water and Sanitation (DWS), the activity will fall within the ambit of a General Authorisation (GA) and not a full water use license. If impacts are MODERATE (and cannot be motivated to a LOW level) or HIGH, a full water use license application process will need to be followed.

It must be noted that water resources, including wetlands, are protected under the NWA. 'Protection' of a water resource, as defined in the NWA entails the:

- Maintenance of the quality and the quantity of the water resource to the extent that the water use may be used in a sustainable way;
- Prevention of degradation of the water resource; and
- Rehabilitation of the water resource.

The definition of pollution and pollution prevention contained within the NWA is relevant. 'Pollution', as described by the NWA, is the direct or indirect alteration of the physical, chemical or biological properties of a water resource, so as to make it (*inter alia*):

- Less fit for any beneficial purpose for which it may reasonably be expected to be used; or
- Harmful or potentially harmful to the welfare or human beings, to any aquatic or non-aquatic organisms, or to the resource quality.

The inclusion of physical properties of a water resource within the definition of pollution entails that any physical alterations to a water body (for example, the excavation of a wetland or changes to the morphology of a water body) can be considered to be pollution. Activities which cause alteration of the biological properties of a watercourse, i.e. the fauna and flora contained within that watercourse, are also considered pollution.

In terms of **Section 19** of the NWA, owners / managers / people occupying land on which any activity or process undertaken which causes, or is likely to cause pollution of a water resource must take all reasonable measures to prevent any such pollution from occurring, continuing or recurring. These measures may include measures to (*inter alia*):

- Cease, modify, or control any act or process causing the pollution;
- Comply with any prescribed waste standard or management practice;
- Contain or prevent the movement of pollutants;
- Remedy the effects of the pollution; and
- Remedy the effects of any disturbance to the bed and banks of a watercourse.

From a licensing perspective, according to the NWA, the following are considered "water uses" and will require a water use license application:

a) Taking water from a water resource;
b) Storing water;
c) Impeding or diverting the flow of water in a watercourse;
d) Engaging in stream flow reduction activity contemplated in **Section 36** of the NWA;
e) Engaging in a controlled activity identified as such in **Section 37 (1)** or declared under **Section 38(1)** of the NWA;
f) Discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit;
g) Disposing of waste in a manner which may detrimentally impact on a water resource;
h) Disposing of waste in a manner of water which contains waste from, or which has been heated in any industrial or power generation process;
i) Altering the bed, banks, course or characteristics of a watercourse;
j) Removing, discharging or disposing of water found underground if it is necessary for efficient continuation of an activity or for the safety of people; and
k) Using water for recreational purposes.

1.5.2 National Environmental Management Act, 1998 (Act No. 107 of 1998)

The **National Environmental Management, 1998 (Act No. 107 of 1998)** (NEMA) was created essentially to establish:

- Principles for decision-making on matters affecting the environment;
- Institutions that will promote co-operative governance; and
- Procedures for coordinating environmental functions exercised by organs of the state to provide for the prohibition, restriction or control of activities which are likely to have a detrimental effect on the environment.

It is stipulated in NEMA *inter alia* that everyone has the right to an environment that is not harmful to his or her health or well-being. Moreover, everyone has the right to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that prevent pollution and ecological degradation, promote conservation and secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

Accordingly, several of the principles of NEMA contained in **Chapter 1 Section 2**, as applicable to wetlands, stipulate that:

- Development must be socially, environmentally and economically sustainable;
- Sustainable development requires the consideration of all relevant factors including the following:
    - That the disturbance of ecosystems and loss of biological diversity are avoided, or, where they cannot be altogether avoided, are minimised and remedied;
    - That pollution and degradation of the environment are avoided, or, where they cannot be altogether avoided, are minimised and remedied; and
    - That negative impacts on the environment and on people's environmental rights be anticipated and prevented, and where they cannot be altogether prevented, are minimised and remedied.
- The costs of remedying pollution, environmental degradation and consequent adverse health effects and of preventing, controlling or minimising further pollution, environmental damage or adverse health effects must be paid for by those responsible for harming the environment; and
- Sensitive, vulnerable, highly dynamic or stressed ecosystems, such as coastal shores, estuaries, wetlands, and similar systems require specific attention in management and planning procedures, especially where they are subject to significant human resource usage and development pressure.

In line with the above, **Chapter 7** further elaborates on the application of appropriate environmental management tools in order to ensure the integrated environmental management of activities. In other words, this chapter of NEMA addresses the tools that must be utilised for effective environmental management and practice. Under these auspices, the Environmental Impact Regulations (2006, 2010, and 2014 as amended) were promulgated in order to give effect to the objectives set out in NEMA. Subsequently, activities were defined in a series of listing notices for various development activities. Should any of these activities be triggered, an application for Environmental Authorisation subject to a Basic Assessment (BA) or Environmental Impact Assessment (EIA) process is to be applied for. Fundamentally, applications are to be applied for (if required) so that any potential impacts on the environment in terms of the listed activities are considered, investigated, assessed and reported on to the competent authority charged with granting the relevant environmental authorisation.

The above stipulations of the NWA and NEMA have implications for the proposed development in the context of surface water resources. Accordingly, the potential impacts / issues and legislative implications of the proposed development on potentially affected wetlands are addressed later in this report (**Section 6 & 7**).

1.6 Definition of Water Resources as Assessed in this Study

The definition of water resources, as assessed in this study, will be taken in line with the definition of a watercourse under the NWA. Watercourses are defined as follows:

“a river, a spring, a natural channel in which water flows regularly or intermittently, a wetland, lake or dam into which, or from which, water flows” (**NWA, 1998**).

Watercourses may be perennial or non-perennial in nature. Moreover, non-perennial watercourses can encompass seasonal or ephemeral watercourses (including drainage lines) depending on the climate and other environmental constraints.

Going into finer detail however, wetlands and riparian habitats can be defined separately and more specifically. These definitions are provided in the sub-sections below.

1.6.1 Wetlands

The lawfully accepted definition of a wetland in South Africa is that within the NWA. Accordingly, the NWA defines a wetland as:

“*land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil*”.

Moreover, wetlands are accepted as land on which the period of soil saturation is sufficient to allow for the development of hydric soils, which in normal circumstances would support hydrophytic vegetation (i.e. vegetation adapted to grow in saturated and anaerobic conditions).

Inland wetlands can be categorised into hydrogeomorphic (HGM) units. **Ollis *et al.* (2013)** have described several different wetland hydrogeomorphic forms which include the following:

- Channel (river, including the banks): a linear landform with clearly discernible bed and banks, which permanently or periodically carries a concentrated flow of water. A river is taken to include both the active channel and the riparian zone as a unit;
- Channelled valley-bottom wetland: a valley-bottom wetland with a river channel running through it. Channelled valley-bottom wetlands must be considered as wetland ecosystems that are distinct from, but sometimes associated with, the adjacent river channel itself, which must be classified as a “river”;
- Unchannelled valley-bottom wetland: a valley-bottom wetland without a river channel running through it;
- Floodplain wetland: a wetland area on the mostly flat or gently-sloping land adjacent to and formed by an alluvial river channel, under its present climate and sediment load, which is subject to periodic inundation by over-topping of the channel bank. Floodplain wetlands must be considered as wetland ecosystems that are distinct from but associated with the adjacent river channel itself, which must be classified as a “river”;

- Depression: a wetland or aquatic ecosystem with closed (or near-closed) elevation contours, which increases in depth from the perimeter to a central area of greatest depth and within which water typically accumulates;
- Flat: a level or near-level wetland area that is not fed by water from a river channel, and which is typically situated on a plain or a bench, closed elevation contours are not evident around the edge of a wetland flat; and
- Hillslope seep: a wetland area located on gently to steeply sloping land and dominated by colluvial (i.e. gravity-driven), unidirectional movement of water and material down-slope.

1.6.2 Riparian Habitat

Riparian habitats (also known as riparian areas or zones) include plant communities usually adjacent to or along natural channels that are affected by surface and subsurface flows (**DWAF, 2005**). Riparian habitats can be found on the edges of lakes, or drainage lines but are more commonly associated with channelled flowing systems like streams and rivers. Riparian habitats can also be associated with wetlands that are similarly associated with streams and rivers. These are defined as riparian wetlands.

The above mentioned wetland, riparian habitat and watercourse forms occurring within the study area will be classified in accordance with the Classification System for Wetlands and other Aquatic Ecosystems in South Africa (**Ollis *et al*., 2013**). This is addressed later in the report (**Section 5.3**).

2 PROJECT TECHNICAL DESCRIPTION

2.1 Technical Details

It is proposed that three (3) Solar Photovoltaic (PV) Energy Facilities, with associated grid connection infrastructure, will be developed, these being:

- ***Mooi Plaats Solar PV Facility***, on an application site of approximately 5303ha, comprising the following farm portions:
    - Portion 1 of Leuwe Kop No 120
    - Remainder of Mooi Plaats No 121

- ***Wonderheuvel Solar PV Facility***, on an application site of approximately 5652ha, comprising the following farm portions:
    - Remainder of Mooi Plaats No 121
    - Portion 3 of Wonder Heuvel No 140
    - Portion 5 of Holle Fountain No 133

- ***Paarde Valley Solar PV Facility***, on an application site of approximately 2631ha, comprising the following farm portion:
  - Portion 2 of Paarde Valley No 62

The proposed Mooi Plaats and Wonderheuvel Solar PV facilities are located near the town of Noupoort within the Umsobomvu Local Municipality, in the Pixley ka Seme District Municipality of the Northern Cape Province. The proposed Paarde Valley Solar PV facility is located near the town of Middelburg within the Inxuba Yethemba Local Municipality, in the Chris Hani District Municipality of the Eastern Cape Province.

The study sites are shown in **Figure 1-3**.

2.2 Solar PV Components

The three (3) Solar PV facilities will include the following components:

- PV fields (arrays) comprising multiple PV panels. The number of panels, the generation capacity of each facility and the layout of the arrays will be dependent on the outcome of the specialist studies conducted during the EIA process.
- PV panels will be either fixed tilt mounting or single axis tracking mounting, and the modules will be either crystalline silicon or thin film technology. Each panel will be approximately 2m wide and between 1m and 4m in height, depending on the mounting type.
- Internal roads, between 4m and 10m wide, will provide access to the PV arrays. Existing site roads will be used wherever possible, although new site roads will be constructed where necessary.
- Each PV facility will include up to two (2) temporary construction laydown/staging areas of approximately 10ha each.
- Operation and maintenance (O&M) buildings will be provided for each PV field, occupying a site of approximately 2 500m^2 (50m x 50m).
- Medium voltage cabling will link the PV plant to the grid connection infrastructure. These cables will be laid underground wherever technically feasible.

2.3 Grid Connection Infrastructure

The proposed grid connection infrastructure for each PV facility is being assessed as part of a separate BA application. The grid connections will include the following components:

- New on-site substations and collector substations to serve each PV facility, each occupying an area of up to 4ha.
- A new 132kV overhead power line connecting the on-site substations or collector substations to either Hydra D Main Transmission Substation (MTS) or the proposed Coleskop Wind Energy Facility (WEF) substation from where the electricity will be fed into the national grid. The type of power line towers being considered at this stage to include both lattice and monopole towers which will be up to 25m in height.

Two (2) grid connection infrastructure alternatives have been provided for each PV project. These alternatives essentially provide for two (2) different route alignments with associated substations contained within an assessment corridor of approximately 400m wide. These alternatives are as follows:

- ***Mooi Plaats Solar PV Grid Connection***
  - Corridor Option 1 is approximately 13kms in length, linking Substations 1 and 2 to Hydra D MTS.
  - Corridor Option 2 is approximately 27kms in length, linking Substations 1 and 2 to Hydra D MTS via the proposed Central Collector substation located on the Wonderheuvel PV project application site.

- ***Wonderheuvel Solar PV Grid Connection***
  - Corridor Option 1 involves two separate grid connections to serve the northern and southern sectors of the application site. The northern connection is approximately 18kms in length, linking the proposed on-site Substation 3 to Hydra D MTS via the Northern Collector substation. The southern connection is approximately 17kms in length, linking Substation 4 to the proposed Coleskop WEF substation via the Southern Collector substation located on the Paarde Valley PV project application site.
  - Corridor Option 2 is approximately 20kms in length, linking Substations 3 and 4 to Hydra D MTS via the proposed Central Collector substation located on the Wonderheuvel PV project application site.

- **Paarde Valley Solar PV Grid Connection**
  - Corridor Option 1 is approximately 14kms in length, linking Substation 6 to the proposed Coleskop WEF substation via the Southern Collector substation.
  - Corridor Option 2 is approximately 26kms in length, linking Substations 5 and 6 to Hydra D MTS via the proposed Central Collector substation located on the Wonderheuvel PV project application site.

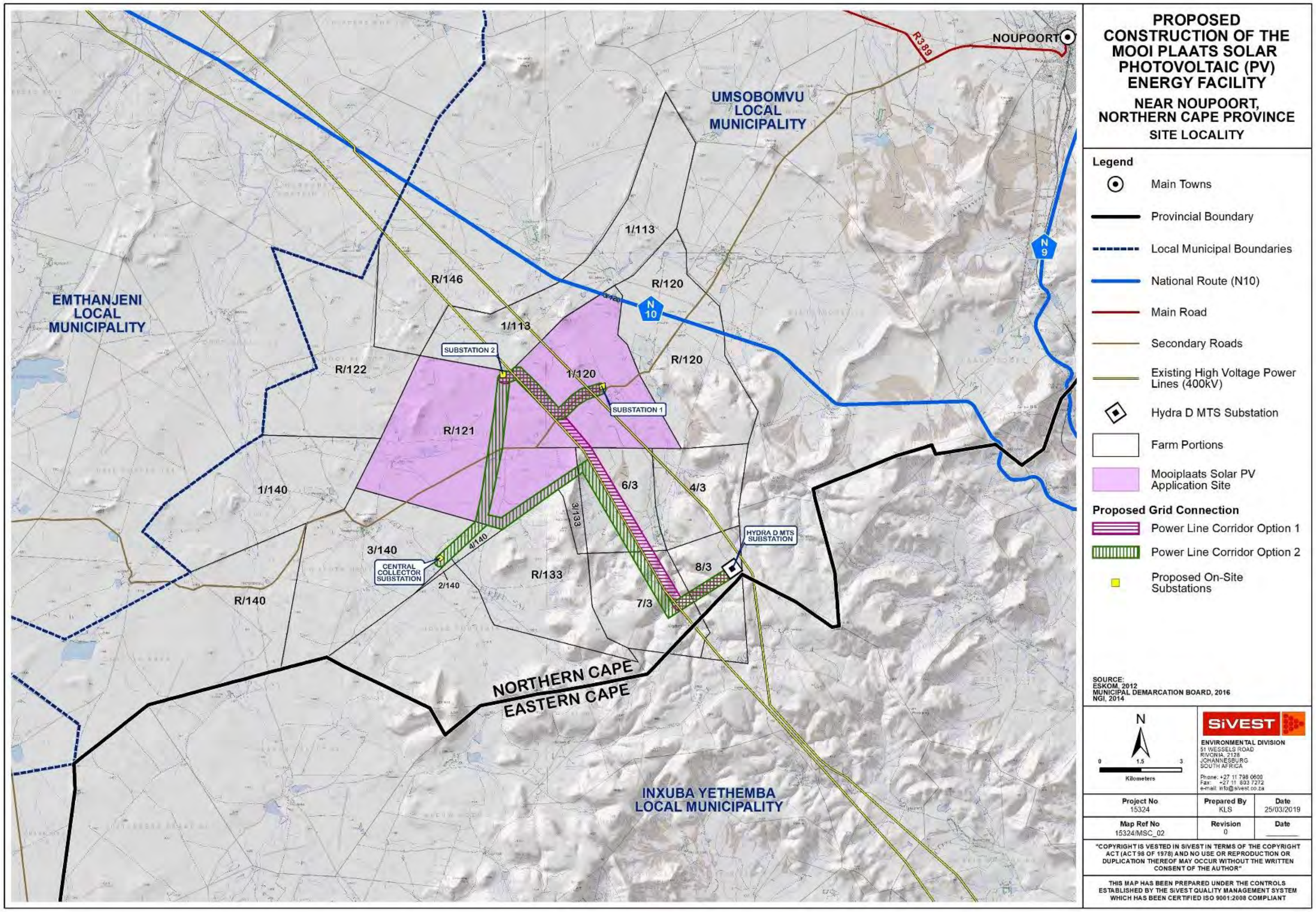

Figure 1. Mooi Plaats Solar PV Facility

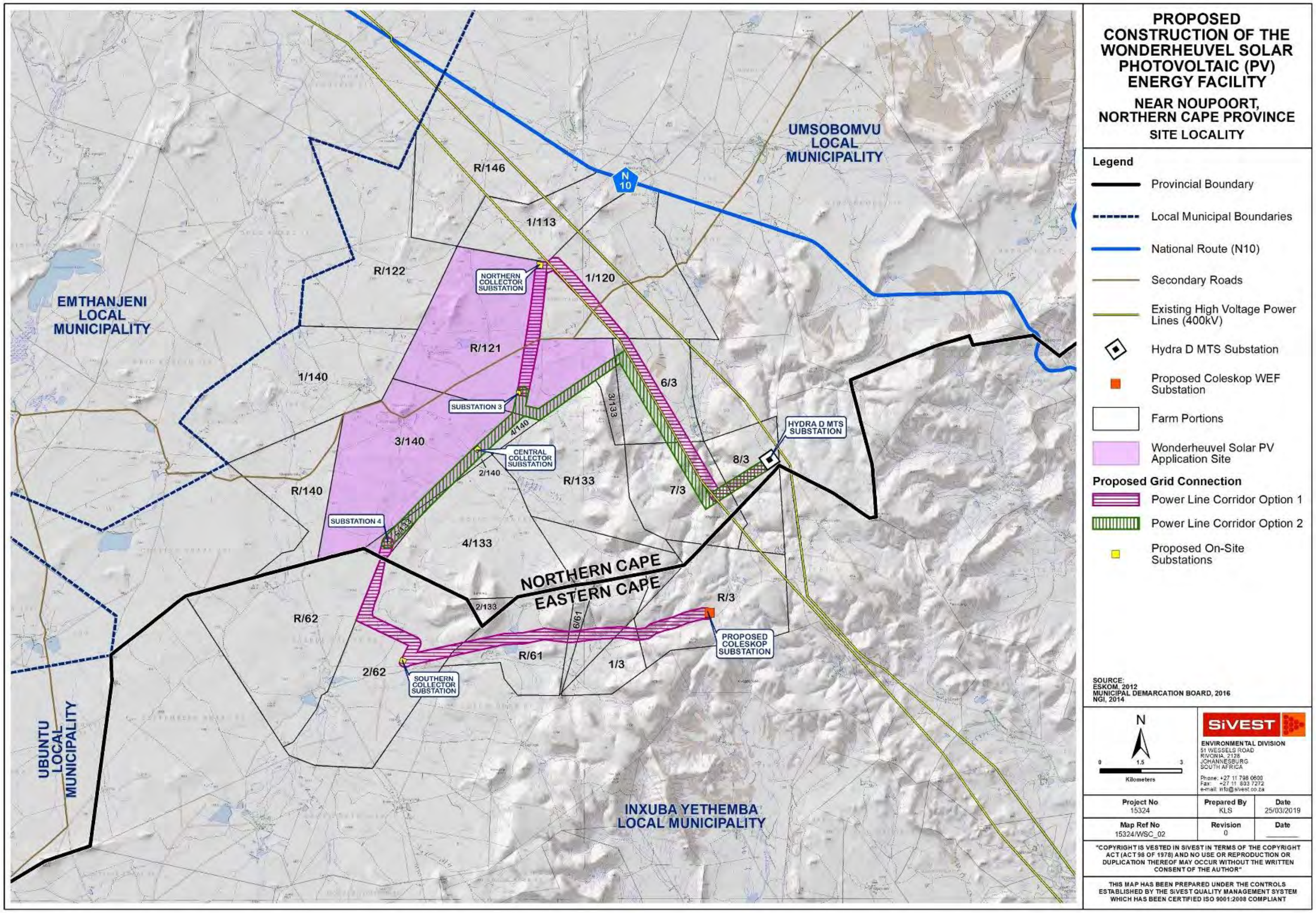

Figure 2. Wonderheuvel Solar PV Facility

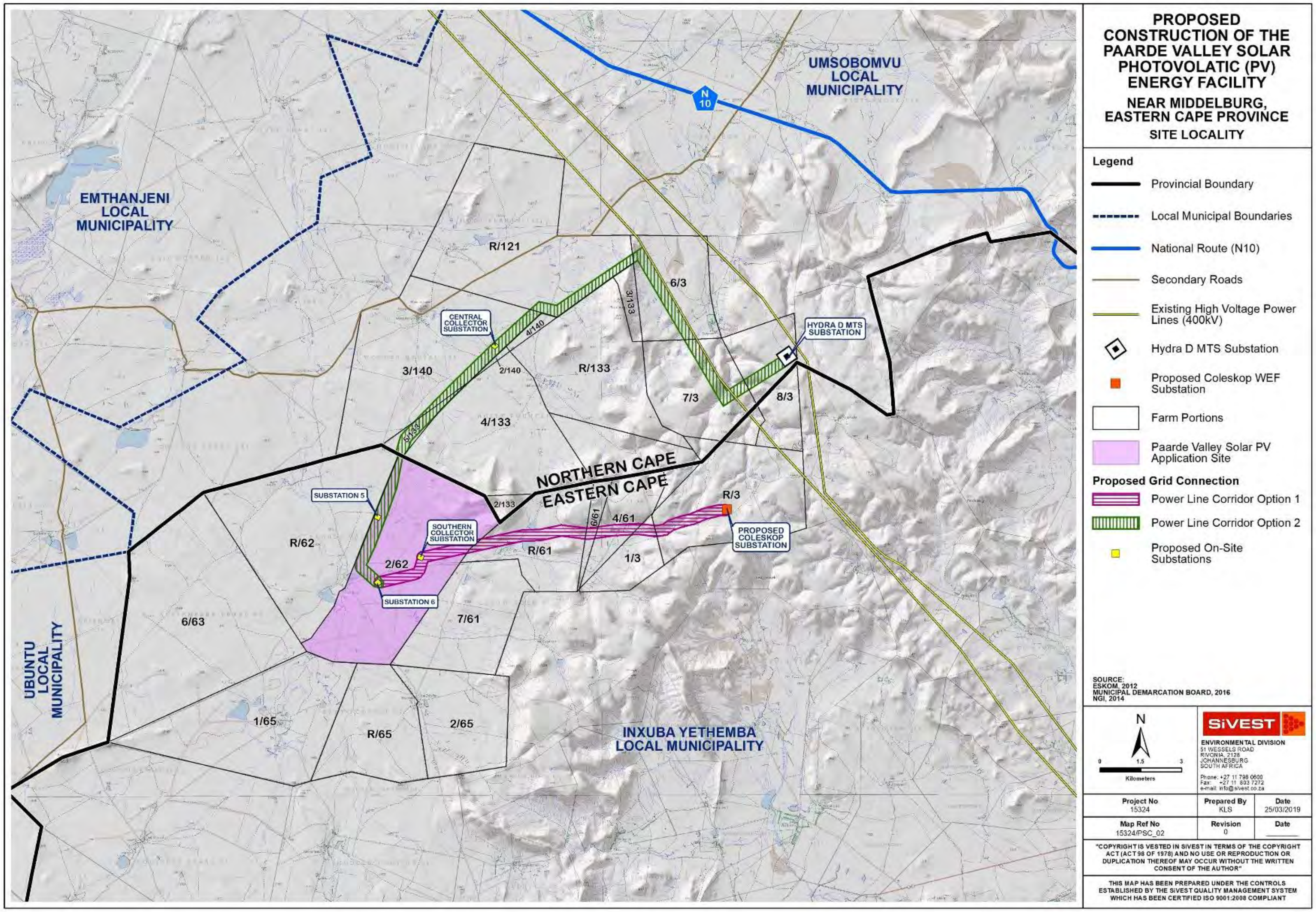

Figure 3. Paarde Valley Solar PV Energy Facility

3 METHODS

3.1 Desktop Delineation of Possible Wetlands and Riparian Habitat

The first step in the assessment was to identify all potential wetlands, drainage lines and associated riparian habitat on and within a 500m radius of the proposed development. This was undertaken using Geographic Information System (GIS) software. The software ArcView developed by ESRI was used. The collection of data source information encompassed (but is not limited to) 1:50 000 topographical maps, the National Freshwater Ecosystem Priority Areas **(NFEPA, 2011)** database, the National Environmental Potential Atlas **(ENPAT, 2000 & 2002)** database as well as the National Biodiversity Assessment **(SANBI, 2012)** database. The use of Google Earth™ imagery supplemented these data sources.

Utilising these resources, wetlands, drainage lines and associated riparian habitat that were identified were mapped and highlighted for the in-field phase of the assessment. The supplementary use of satellite imagery (**Google Earth™**) allowed for other potentially overlooked wetlands, drainage lines and riparian habitat not contained within the above mentioned databases, to be identified and ground-truthed in the field work phase.

3.2 Field-based Surface Water Resources Delineation Techniques

3.2.1 Wetlands

Wetland delineations are based primarily on soil characteristics or soil "wetness" indicators. For an area to be considered a wetland, redoximorphic features must be present within the top 50cm of the soil profile **(Collins, 2005)**. Redoximorphic features are the result of the reduction, translocation and oxidation (precipitation) of Fe (iron) and Mn (manganese) oxides that occur when soils alternate between aerobic (oxygenated) and anaerobic (oxygen depleted) conditions. Only once soils within 50cm of the surface display these redoximorphic features, can the soils be considered 'hydric soils'. Hydric soils, which are soils that are found within wetlands, are defined by the U.S. Department of Agriculture Natural Resources Conservation Service **(NRCS)** as being, "soils that formed under conditions of saturation, flooding or ponding long enough during the growing season to develop anaerobic conditions in the upper part". These anaerobic conditions would typically support the growth of hydromorphic vegetation (vegetation adapted to grow in soils that are saturated and starved of oxygen) and are typified by the presence of redoximorphic features. Redoximorphic features typically occur in three (3) types **(Collins, 2005)**:

- A reduced matrix - i.e. an *in situ* low chroma (soil colour), resulting from the absence of Fe^{3+} ions which are characterised by "grey" colours of the soil matrix;

- Redox depletions - the “grey” (low chroma) bodies within the soil where Fe-Mn oxides have been stripped out, or where both Fe-Mn oxides and clay have been stripped. Iron depletions and clay depletions can occur;
- Redox concentrations - Accumulation of iron and manganese oxides (also called mottles). These can occur as:
  - Concretions - harder, regular shaped bodies;
  - Mottles - soft bodies of varying size, mostly within the matrix, with variable shape appearing as blotches or spots of high chroma colours; and
  - Pore linings - zones of accumulation that may be either coatings on a pore surface, or impregnations of the matrix adjacent to the pore. They are recognized as high chroma colours that follow the route of plant roots, and are also referred to as oxidised rhizospheres.

The potential occurrence / non-occurrence of wetlands and wetland (hydric) soils on the study site were assessed mainly according to the **DWAF (2005)** guidelines, “A practical field procedure for the identification and delineation of wetlands and riparian areas”. The draft **DWAF (2008)** guidelines, “Update Manual for the Identification and Delineation of Wetlands and Riparian Areas” was also consulted as a supplementary guideline. This document was only used as a supplementary guideline as it is currently not finalised.

According to the **DWAF (2005)** guidelines, soil wetness indicators (i.e. identification of redoximorphic features) are the most important indicator of wetland occurrence. This is mainly due to the fact that soil wetness indicators remain in wetland soils, even if they are degraded or desiccated. It is important to note that the presence or absence of redoximorphic features within the upper 50cm of the soil profile alone is sufficient to identify the soil as being hydric or non-hydric (non-wetland soil) **(Collins, 2005)**. Three (3) other indicators (vegetation, soil form and terrain unit) are typically used in combination with soil wetness indicators to supplement findings. Where soil wetness and/or soil form could not be identified, information and personal professional judgment was exercised using the other indicators to determine what area would represent the outer edge of the wetland.

Importantly, it must be recognised that there can be up to three (3) saturation zones to every wetland including a permanent zone, seasonal zone and the temporary zone. Each zone is differentiated based on the degree and duration of soil saturation. The permanent zone usually reflects soils that indicate saturation cycles that last more or less throughout the year, whilst the seasonal zone may only reflect soils that indicate saturation cycles for a significant period during the rainy season. Lastly, the temporary zone reflects soils that indicate the shortest period(s) of saturation that are long enough, under normal circumstances, for the formation of hydromorphic soils and the growth of wetland vegetation **(DWAF, 2005)**. It must be noted that not all wetlands will have all three (3) saturation zones. In arid and semi-arid regions, wetlands are often only associated with temporary saturation zones or temporary and seasonal saturation zones, thereby lacking the permanent zone.

Vegetation identification was based on identifying general plant species within the wetland boundaries focusing on the occurrence of hydrophytic (water loving) wetland vegetation. In identifying hydrophytic vegetation, it is important to distinguish between plant species that are **(DWAF, 2005)**:

- Obligate wetland species (ow): always grows in wetland - >99% chance of occurrence;
- Facultative wetland species (fw): usually grow in wetlands – 67-99% chance of occurrence;
- Facultative species (f): are equally likely to grow in wetlands and non-wetland areas – 34-66% chance of occurrence;
- Facultative dry-land species (fd): usually grow in non-wetland areas but sometimes grow in wetland = 1-34% chance of occurrence.

The actual delineation process essentially entailed drawing soil samples, at depths between 0-50 cm in the soil profile, using a soil augur. This is done in order to determine the location of the outer edge (mainly temporary zone) of the wetland(s). The outer edge of the temporary zone will usually constitute the full extent of the wetland, thereby encompassing any other inner lying zones that are saturated for longer periods. Where the appropriate wetland soil form is of interest, soil samples are drawn up to a depth of 1.2 metres (where possible).

Where a wetland was identified, a conventional handheld Global Positioning System (GPS) was used to record the points taken in the field. The GPS points were then imported into a GIS system for mapping purposes. A GIS shapefile was created to represent the boundaries of the delineated wetlands or other surface water resources.

3.2.2 Riparian Habitat (Including Drainage Lines)

In terms of watercourses (including drainage lines) and riparian habitats as required by the **DWAF (2005 & 2008)** guidelines, the assessment for riparian habitats requires the following aspects to be taken into account:

- topography associated with the watercourse;
- vegetation; and
- alluvial soils and deposited material.

The topography associated with a watercourse can (but not always limited to) comprise the macro channel bank. This is a rough indicator of the outer edge of the riparian habitat.

The riparian habitat relies primarily on vegetation indicators. The outer edge of the riparian habitat can be delineated where there is a distinctive change in the species composition to the adjacent terrestrial area or where there is a difference in the physical structure (robustness or growth forms – size, structure, health, compactness, crowding, number of individual plants) of the species from the adjacent terrestrial area (**DWAF, 2005**).

Riparian habitats are usually associated with alluvial soils (relatively recent deposits of sand, mud or any type of soil sediment) (**DWAF, 2005**). This indicator is not commonly viewed as the primary indicator but rather as a supplementary indicator to confirm either topographical or vegetation indicators, or both.

Where riparian habitats occur, the above mentioned indicators were used to identify the outer edge. A GPS was used to record the points taken in the field.

Where watercourses with associated riparian habitat are present, it is possible to determine the hydrological regime which provides information on the functionality of the systems. **Ollis *et al.,* (2013)** maintain that the hydrological regime can be characterised by the frequency and duration of flow (i.e. perenniality), classified as follows:

- Perennial – flows continuously throughout the year in most years;
- Non-perennial – does not flow continuously throughout the year, although pools may persist. Can be subdivided as follows:
  - Seasonal – with water flowing for extended periods during the wet season/s (generally between 3 to 9 months duration) but not during the rest of the year;
  - Intermittent – water flows for a relatively short time of less than one season's duration (i.e. less than approximately 3 months), at intervals varying from less than a year to several years;
  - Unknown – for rivers where it is not known whether a non-perennial system is seasonal or intermittent.; and
- Unknown – for rivers where the flow type is not known.

Additionally, once identified, it is possible to classify watercourses into three (3) channel types. The channel types are based on the changing frequency of saturation of the soils in the riparian zone which can be classified *inter alia* as follows **(DWAF, 2005)**:

- A Section – Least sensitive watercourses in terms of impacts on water yield from the catchment. They are situated in the unsaturated zone and do not have riparian habitats or wetlands. Not as hydrologically sensitive as B and C Sections;
- B Section – In the zone of the fluctuating water table and only have base flow at any point in the channel when the saturated zone is in contact with the channel bed. Base flow is intermittent in this section, with flow at any point in the channel dependent on the current height of the water table. The gradient of the channel bed is flat enough for deposition of material to take place and initial signs of flood plain development may be observed; and
- C Section – Always in contact with the zone of saturation and therefore always have base flow. These are perennial streams with flow all year round, except perhaps in times of extreme droughts. Channel gradients in these sections are very flat and a flood plain is usually present.

3.3 Wetland and River Classification Methods

For the purposes of this assessment, the classification of the wetland and rivers (drainage lines) were undertaken applying the Classification System for Wetlands and other Aquatic Ecosystems in South Africa (**Ollis *et al*., 2013**). This classification system applies to inland systems which are defined as, “an aquatic ecosystem with no existing connection to the ocean”. There are three (3) broad types of inland systems that are dealt with by the classification system including the following:

- Rivers, which are ‘lotic’ aquatic ecosystems with flowing water concentrated within a distinct channel, either permanently or periodically;
- Open waterbodies, which are permanently inundated ‘lentic’ aquatic ecosystems where standing water is the principal medium within which the dominant biota live. In the Classification System, open waterbodies with a maximum depth greater than 2 m are called limnetic (lake-like) systems; and
- Wetlands, which are transitional between aquatic and terrestrial systems, and are generally characterised by (permanently to temporarily) saturated soils and hydrophytic vegetation. These areas are, in some cases, periodically covered by shallow water and / or may lack vegetation.

The inland system classification works on a six-tiered structure (**Table 1**). The tiered structure progresses from Systems (Marine vs. Estuarine vs. Inland) at the broadest spatial scale (Level 1), through Regional Setting (Level 2) and Landscape Units (Level 3), to HGM Units at the finest spatial scale (Level 4). At Level 5, Inland Systems are distinguished from each other based on the hydrological regime and, in the case of open waterbodies, the inundation depth class. At Level 6, six ‘descriptors’ have been incorporated into the Classification System. These descriptors allow you to distinguish between aquatic ecosystems with different structural, chemical, and/or biological characteristics. For the purposes of this assessment only a Level 4 classification was undertaken. The Level 4 classification can be further elaborated on and is shown in **Table 2** below.

Table 1. Inland System Classification (adapted from Ollis *et al*., 2013)

Distinguishing between Marine, Estuarine and Inland Systems	Wetland/Aquatic Ecosystem Context		Functional Unit		Wetland/Aquatic Ecosystem Characteristics
Level 1: Type of System	**Level 2: Regional Setting**	**Level 3: Landscape Unit**	**Level 4: Hydrogeomorphic (HGM) Unit**	**Level 5: Hydrological Regime**	**Level 6: Descriptors**
▪ Marine ▪ Estuarine ▪ Inland System	▪ Department of Water Affairs (DWA) Ecoregions ▪ NFEPA WetVeg Groups ▪ Other Spatial Framework	▪ Valley Floor ▪ Slope ▪ Plain ▪ Bench	River Floodplain Wetland Channelled Valley Bottom Wetland Depression Seep Wetland Flat	Perenniality ▪ Period and Depth of Inundation ▪ Period of Saturation	▪ Natural vs Artificial ▪ Salinity ▪ pH ▪ Substratum Type ▪ Vegetation Cover Type ▪ Geology

Table 2. Hydrogeomorphic Units for Inland Systems

Level 4: Hydrogeomorphic (HGM) Unit		
HGM Type	**Longitudinal Zonation/Landform/Outflow Drainage**	**Landform/Inflow Drainage**
A	**B**	**C**
River	Mountain Headwater Stream	Active Channel
		Riparian Zone
	Mountain Stream	Active Channel
		Riparian Zone
	Transitional	Active Channel
		Riparian Zone
	Upper Foothills	Active Channel
		Riparian Zone
	Lower Foothills	Active Channel
		Riparian Zone
	Lowland River	Active Channel
		Riparian Zone
	Rejuvenated Bedrock Fall	Active Channel
		Riparian Zone
	Rejuvenated Foothills	Active Channel
		Riparian Zone
	Upland Floodplain	Active Channel
		Riparian Zone
Channelled Valley Bottom Wetland	Not Applicable	Not Applicable
	Not Applicable	Not Applicable
Unchannelled Valley Bottom Wetland	Not Applicable	Not Applicable
	Not Applicable	Not Applicable
Floodplain Wetland	Floodplain Depression	Not Applicable
	Floodplain Flat	Not Applicable
Depression	Exorheic	With Channelled Flow
		Without Channelled Flow
	Endorheic	With Channelled Flow
		Without Channelled Flow
	Dammed	With Channelled Flow
		Without Channelled Flow
Seep	With Channelled Flow	Not Applicable
	Without Channelled Flow	Not Applicable
Wetland Flat	Not Applicable	Not Applicable

For a Level 4 inland system classification, the HGM unit (as described in Section 1.2) is identified for a Level 4A classification. Going into finer detail for a Level 4B classification, the longitudinal zonation / landform / outflow drainage type is defined. Finally, the Level 4C classification goes a step further in defining the landform / inflow drainage type. A level 4C classification was undertaken in this assessment.

3.4 Wetland Present Ecological Status

To assess wetland health, it is essential to understand how the current hydrological, geomorphological and ecological functioning of the wetland deviates from the reference condition (i.e. how have the hydrological processes and components changed from natural reference condition). In this sense, the Present Ecological Status (PES) can be determined which provides information on the integrity/health/state of a wetland. WET-Health is a tool that is designed to provide a rapid assessment on the PES of a wetland and examines the deviation from the natural reference condition by analysing the hydrological, geomorphological and vegetation components of a wetland in terms of the extent, intensity and magnitude of an impact (**Macfarlane *et al*., 2007**). This is done by assigning a score on a scale of 1 to 10 which is translated into one of six health classes ranging from A to F, with A representing completely unmodified (natural) and F representing modifications that have reached a critical level (**Macfarlane *et al*., 2007**). This is provided in **Table 3** below.

Table 3. Impact Scores and Categories of Present Ecological State used by WET-Health for describing the integrity of Wetlands

Impact Category	Description	Impact Score Range	Present State Category
None	Unmodified, natural.	0-0.9	A
Small	Largely natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.	1-1.9	B
Moderate	Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact.	2-3.9	C
Large	Largely modified. A large change in ecosystem processes and loss of natural habitat and biota and has occurred.	4-5.9	D
Serious	The change in ecosystem processes and loss of natural habitat and biota is great but some	6-7.9	E

Impact Category	Description	Impact Score Range	Present State Category
	remaining natural habitat features are still recognizable.		
Critical	Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8-10	F

Using a combination of threat and/or vulnerability, an assessment is also made for each component (hydrological, geomorphological and vegetation) on the likely Trajectory of Change within the wetland (**Macfarlane *et al*., 2007**). The five categories of likely change are: large improvement, slight improvement, remains the same, slight decline and rapid decline (**Macfarlane *et al*., 2007**). Overall health of the wetland is then presented for each module by jointly representing the Present State and likely Trajectory of Change (**Macfarlane *et al*., 2007**).

For this study, the Level 2 methodology was used to determine the PES for any wetlands identified directly on the study site.

3.5 Riparian Habitat Ecological Condition Determination

The riparian Vegetation Response Assessment Index (VEGRAI) is designed for a qualitative assessment of the response of riparian vegetation to impacts in such a way that qualitative ratings translate into quantitative and defensible results (**Kleyhans *et al*., 2007**). As **Kleynhans *et al.* (2007)** explains, the VEGRAI model firstly describes the status of riparian vegetation in both the current and reference states and secondly, compares differences between the two states as a measure of vegetation response to an impact regime. Essentially, the identified riparian vegetation zones (Marginal, Lower and Upper zones) are used as the metric groups which are then rated, weighted and an Ecological Category (A-F) can then be determined (see **Table 4** below). There are two levels that can be applied to the index assessment including a Level 3 and Level 4 assessment. The Level 3 index is aimed at general aquatic ecologists, whilst a Level 4 assessment is aimed at specialist riparian vegetation ecologists. A Level 3 assessment was applied to this study. The metric groups, for a Level 3 assessment, include the following:

- Woody
  - Cover
  - Abundance
  - Species Composition
- Non-woody
  - Cover

- Abundance
- Species Composition

Table 4. VEGRAI Ecological Category Classification (as taken from Kleynhans *et al* (2007))

Ecological Category	Description	Score (% of Total)
A	Unmodified, natural.	90-100
B	Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.	80-89
C	Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.	60-79
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	40-59
E	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.	20-39
F	Critically modified. Modifications have reached a critical level and the lotic system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances, the basic ecosystem functions have been destroyed and the changes are irreversible.	0-19

Through application of the above VEGRAI assessment, the ecological condition (state) of the riparian habitats were determined.

3.6 Wetland Ecosystem Services Assessment

Individual wetlands differ as per the respective hydro-geomorphic characteristics and the ecosystem services that are potentially supplied to society **(Kotze *et al*., 2007)**. The ecosystem services that were assessed through the WET-EcoServices **(Kotze *et al*., 2007)** tool are listed in **Table 5** below. The overall goal of the WET-EcoServices assessment is to assist decision makers, government officials, planners, consultant and educators in undertaking quick assessments of wetlands to reveal the potential ecosystem services that they supply **(Kotze *et al*., 2007)**. This ultimately provides an indication of the importance of the wetland unit. The WET-EcoServices tool applies only to palustrine (non-tidal, inland) wetlands.

Table 5. Ecosystems Services included in WET-EcoServices (Kotze *et al*., 2007)

Ecosystem services supplied by wetlands	Indirect benefits	Hydro-geochemical benefits	Flood attenuation	
			Streamflow regulation	
			Water quality enhancement benefits	Sediment trapping
				Phosphate assimilation
				Nitrate assimilation
				Toxicant assimilation
				Erosion control
			Carbon storage	
		Biodiversity maintenance		
	Direct benefits	*Provision of water for human use*		
		Provision of harvestable resources[2]		
		Provision of cultivated foods		
		Cultural significance		
		Tourism and recreation		
		Education and research		

Each HGM wetland unit delineated within the study site was assessed using the WET-EcoServices tool. Each HGM unit was labelled according to the HGM wetland unit it was classified as (for example, Channelled Valley Bottom Wetland).

Finally, an output diagram indicating the degree of which each ecosystem service is potentially offered by a wetland was included and labelled according to the HGM unit as described above.

3.7 Riparian Habitat Ecosystem Services

To assess the importance of the riparian habitat and the ecosystem services supplied to society, the following functions of the riparian habitat were considered:

- Sediment Trapping;
- Nutrient Trapping;
- Bank Stabilisation and Bank Maintenance;
- Flood Attenuation;
- Maintenance of Biotic Diversity;
- Primary Production;
- Erosion Control; and
- Ecological Corridor for Migration.

As no currently applicable methodology is available for the assessment of riparian zone ecosystem services, a qualitative assessment was undertaken.

3.8 Surface Water Resources Ecological Importance and Sensitivity

The ecological importance of a water resource is an expression of the importance of the system to the maintenance of ecological diversity and functioning on local and wider scales (**DWAF, 1999**). The ecological sensitivity refers to a system's ability to resist disturbance and its capability to recover from disturbance once it has occurred (**DWAF, 1999**). The ecological importance and sensitivity (EIS) can be calculated according to the determinants listed in **Table 6** below and attributing a suitable [1]score to each determinant. Information, where relevant, was taken from the Wetland and Riparian Ecosystem Services assessment (i.e. biodiversity maintenance information) as mentioned previously and applied to this section. Additionally, information on the conservation planning importance of a wetland and rivers were used. Wetlands and rivers are important in contributing to biodiversity targets. Wetland and rivers as biodiversity targets can be informed by the ecosystem threat status and protection level, the level of priority as assessed through the National Freshwater Ecosystem Priority Areas project (**Nel *et al*., 2011**), fine-scale biodiversity plans as well as bioregional plans (**Macfarlane *et al*., 2014**). As such, this information was used to inform scoring.

Once calculated the EIS category (EISC) can be determined (**Table 7**). The category can range from A to D with A being Very High and D being Low / Marginal.

Table 6. Environmental Importance and Sensitivity Biotic and Habitat Determinants

Determinant	Score	Confidence
Primary Determinants		
1. Rare & Endangered Species		
2. Populations of Unique Species		
3. Species/taxon Richness		
4. Diversity of Habitat Types or Features		
5. Migration route/breeding and feeding site for wetland and riparian species		
6. Sensitivity to Changes in the Natural Hydrological Regime		
7. Sensitivity to Water Quality Changes		

[1]Score guideline Very high = 4; High = 3, Moderate = 2; Marginal/Low = 1; None = 0

Confidence rating - Very high confidence = 4; High confidence = 3; Moderate confidence = 2; Marginal/low confidence = 1

Determinant	Score	Confidence
8. Flood Storage, Energy Dissipation & Particulate/Element Removal		
Modifying Determinants		
9. Protected Status		
10. Ecological Integrity		
TOTAL		
MEDIAN		
OVERALL ECOLOGICAL SENSITIVITY AND IMPORTANCE		

Table 7. Environmental Importance and Sensitivity Categories for Biotic and Habitat Determinants

Ecological Importance and Sensitivity Category (EIS)	Range of Median	Recommended Ecological Management Class
Very high Wetlands and riparian habitat that are considered ecologically important and sensitive on a national or even international level.	>3 and <=4	A
High Wetlands and riparian habitat that are considered to be ecologically important and sensitive.	>2 and <=3	B
Moderate Wetlands and riparian habitat that are considered to be ecologically important and sensitive on a provincial or local scale.	>1 and <=2	C
Low/marginal Wetlands and riparian habitat that are not ecologically important and sensitive at any scale.	>0 and <=1	D

3.9 Surface Water Resources Buffer Zones

An ecological resource buffer zone is typically an area of vegetated, un-developed land surrounding a resource that is maintained to protect, support and screen flora and fauna associated with a resource from the disturbances associated with neighbouring land uses and / or a proposed development. As wetlands and riparian habitats are regarded as inherently ecologically sensitive habitat units, the designation of conservation buffers allows for the protection of these habitat units that could potentially emanate from terrestrial-based activities. Ultimately, buffer zones are typically required to protect and minimise the edge impacts to the identified surface water resources.

The compilation of preliminary guidelines for the determination of wetland and watercourse buffer zones was developed by **Macfarlane *et al.* (2014)**. The current method according to **Macfarlane *et al.* (2014)** proposes highly conservative buffer widths based on generic relationships for broad-scale assessments, but also allows buffers to be modified based on more detailed site-level information. The conceptual framework utilises the following keys decisions in the design criteria **Macfarlane *et al.* (2014)**:

- Levels of user expertise;
- Precautionary principle;
- Predictability and administration;
- Data collection and assessment; and
- Buffer widths tailored according to risk.

The assessment procedure that was undertaken is an eight step process which is shown in **Figure 4** below.

Figure 4. Buffer determination assessment procedure according to Macfarlane *et al.* (2014)

The method was applied at a site specific level for the impact assessment. Furthermore, it was based on grounded scientific principles. Accordingly, this method was applied herein.

3.10 Risk Assessment

In terms **Government Notice 509 of 2016 (No. 40229),** an assessment of activities and / or potential impacts within 500m of a wetland is to be undertaken to determine the risk of the proposed development, as well as the applicability of a general authorisation or water use license application to be undertaken with the Department of Water and Sanitation (DWS). Although the development is located more than 500m away from the closest wetland and outside of the delineated extent of the watercourse on site, the Risk Assessment has never-the-less been completed as best practise as part of the current report. The assessment is undertaken in accordance with the Risk Assessment Protocol methodology. The Risk Assessment Protocol considers the phase (construction, operation, decommissioning) of the proposed development, aspect and impacts. A scoring system is then applied to a spreadsheet matrix is applied to the following metrics with provides the final risk rating:

- Severity;
- Spatial Scale;
- Duration;
- Frequency of Activity;
- Frequency of Impact;
- Legal Issues;
- Detection;
- Likelihood; and
- Significance.

The severity of the potential impact is evaluated against the following drivers of the wetland:

- Flow Regime;
- Physico-chemical (Water Quality);
- Habitat (Geomorphology & Vegetation); and
- Biota.

The risk assessment also considers the PES and EIS of the water resource.

The keys that are applicable when assessing the above mentioned metrics, in the risk assessment protocol, are shown in **Table 8** to **Table 15** below.

Table 8. Severity

Insignificant / non-harmful	1
Small / potentially harmful	2
Significant / slightly harmful	3
Great/ harmful	4
Disastrous / extremely harmful and / or wetland(s) are invovled	5

Where "or wetland(s) are involved" it means that the activity is located within the delineated boundary of any wetland. The score of 5 is only compulsory for the significance rating.	

Table 9. Spatial Scale

Area specific (at impact site)	1
Whole site (entire surface)	2
Regional / neighbouring areas (downstream within quaternary catchment)	3
National (impacting beyond secondary catchment or provinces)	4
Global (impacting beyond South Africa boundary)	5

Table 10. Duration

One day to one month, PES, EIS and / or REC not impacted	1
One month to one year, PES, EIS and / or REC impacted but no change in status	2
One year to ten years, PES, EIS and / or REC impacted to a lower status but can be improved over this period through mitigation	3
Life of the activity, PES, EIS and / or REC permanently lowered	4
More than life of the organisation / facility, PES and EIS scores, E or F	5
PES and EIS (sensitivity must be considered)	

Table 11. Frequency of the Activity

Annually or less	1
Six monthly	2
Monthly	3
Weekly	4
Daily	5

Table 12. Frequency of the Incident / Impact

Almost never / almost impossible / > 20%	1
Very seldom / highly unlikely / > 40%	2
Infrequent / unlikely / seldom / > 60%	3
Often / regularly / likely / possible / >80%	4
Daily / highly likely / definitely / >100%	5

Table 13. Legal Issues

No legislation	1
Fully covered by legislation (wetlands are legally governed)	5
Located within the regulated areas	

Table 14. Detection

Immediately	1

Without much effort	2
Need some effort	3
Remote and difficult to observe	4
Covered	5

Table 15. Rating Classes

Rating	Class	Management Description
1 – 55	(L) Low Risk	Acceptable as is or consider requirement for mitigation. Impact to watercourse(s) and resource quality small and easily managed.
56 – 169	(M) Moderate Risk	Risk and impact on watercourse(s) are notable and require mitigation measures on a higher level, which costs more and require specialist input. License required.
170 – 300	(H) High Risk	Watercourse(s) impacts by the activity are such that they impose a long term threat on a large scale and lowering of the Reserve. License required.

Where it is assessed that activities and / or potential impacts result in a LOW risk activity, the activity may fall within the ambit of a General Authorisation (GA). Where risks are assessed as borderline Low / Moderate, risk scores can be manually adapted downwards in class subject to listing additional mitigation measures listed. Where activities and / or potential impacts are MODERATE / HIGH, a water use license application will need to be submitted to the DWS.

The risk assessment provided in this report is based on a detailed construction and operational method statement and the final layout plan shown in Figure 1.

3.11 Impact Assessment Method

Current and potential impacts will be identified based on the proposed project and potential impacts that may result from the proposed project. The identified potential impacts will be evaluated using the SiVEST impact rating method **(Appendix B)**. This is addressed in **Section 6**.

4 GENERAL STUDY AREA

The proposed Solar PV Energy Facilities are located on adjoining farms lying south-west of Noupoort in the Northern Cape Province (**Figure 5**).

Mooi Plaats Solar PV project is located in the Umsobomvu Local Municipality, within the Pixley ka Seme District of the Northern Cape Province. The application site lies immediately south of the N10 national route, some 23kms from Noupoort, and comprises the following farm portions:

- Portion 1 of Leuwe Kop No 120
- Remainder of Mooi Plaats No 121

Wonderheuvel Solar PV project is also located in the Umsobomvu Local Municipality, within the Pixley ka Seme District of the Northern Cape Province. The application site lies between the Mooi Plaats Solar PV application site and the Paarde Valley Solar PV application site, some 30kms from Noupoort, and comprises the following farm portions:

- Remainder of Mooi Plaats No 121
- Portion 3 of Wonder Heuvel No 140
- Portion 5 of Holle Fountain No 133

Paarde Valley Solar PV project is located in the Inxuba Yethemba Local Municipality, within the Chris Hani District District of the Eastern Cape Province. The application site is located on the southern boundary of the Wonderheuvel Solar PV application site, some 38kms from Noupoort, and 32kms from Middelburg. The application site comprises the following farm portion:

- Portion 2 of Paarde Valley No 62

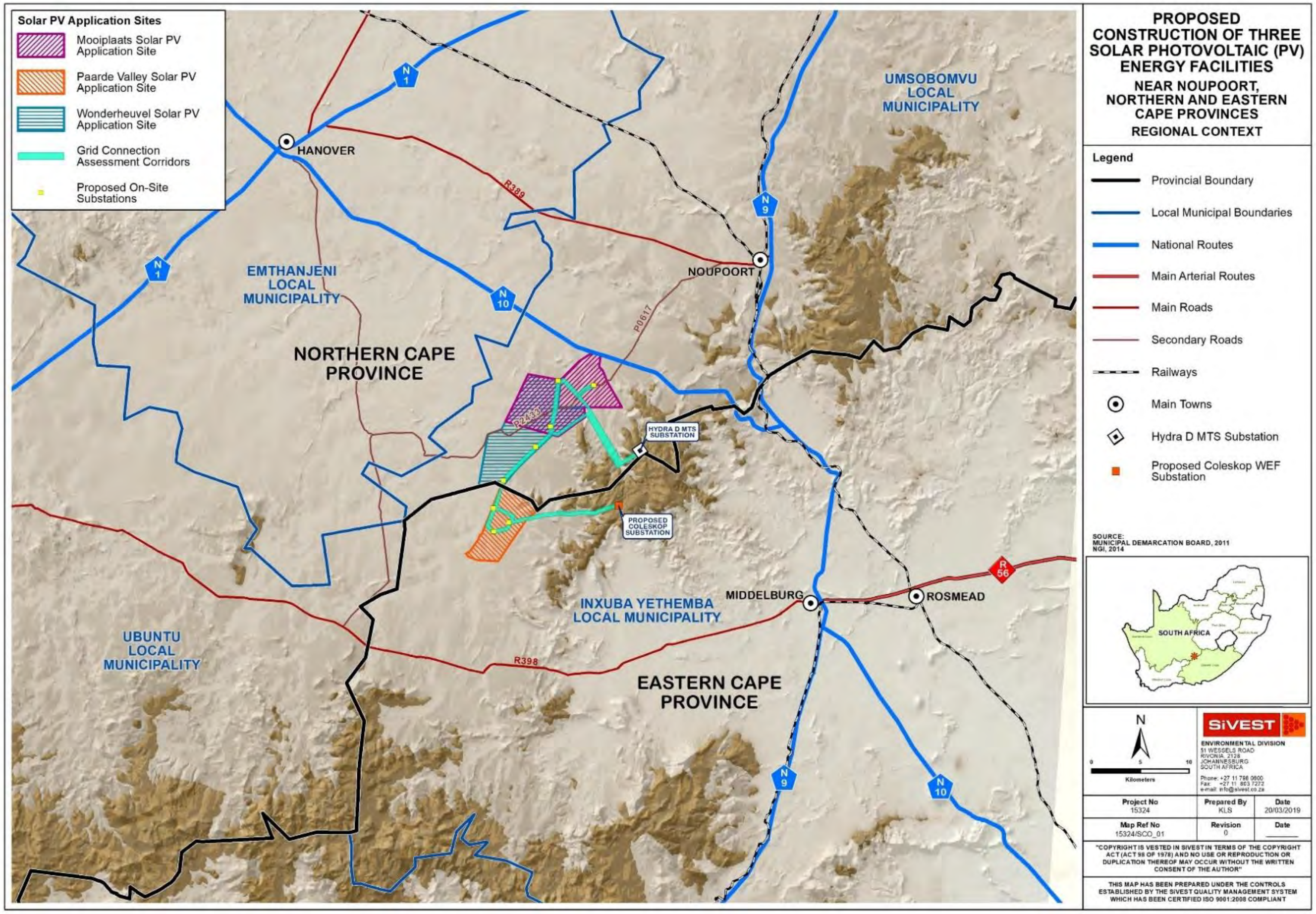

Figure 5. Regional Context Map

According to Mucina and Rutherford (2012), the areas are characterised by flatter Karoo plains which are largely covered by the Eastern Upper Karoo vegetation type, while the hillier areas in the east of the study area are characterised by Besem Karee Koppies shrubland. The aridity of the area has restricted the vegetation to low shrubs distributed uniformly across the landscape, except in areas of hillier terrain which tend to be more densely vegetated with more tree species in evidence.

Additional tree species are also present in the study area, particularly where exotic tree species and other typical garden vegetation has been established around farmsteads.

Much of the study area however is still characterised by natural low shrubland with transformation limited to patches of cultivation and a few isolated areas where pastoral activities such as livestock rearing are taking place.

5 FINDINGS OF THE WETLAND ASSESSMENT

5.1 Desktop Findings

In terms of the **ENPAT (2002)** national database, from a catchment perspective, the study site is located within the Orange Primary Catchment (**Figure 6**). More specifically, the study area is situated within the quaternary catchments D32C and D32B. The study site falls within the newly defined Water Management Areas (WMAs) of South Africa, as stated in Government Notice No. 1056 (16th of September 2016), within the Upper Orange WMA.

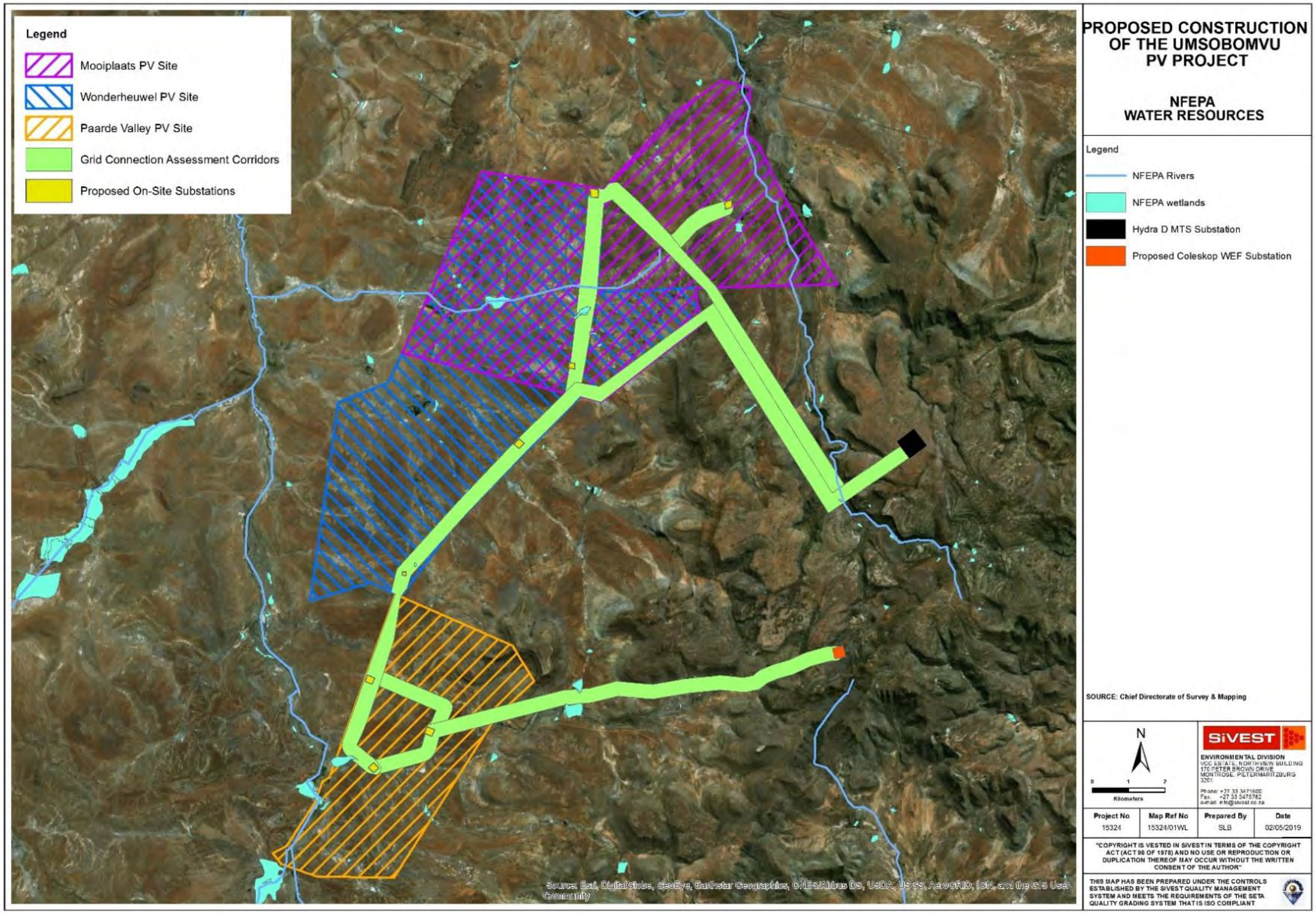

Figure 6: Database Surface Water Resources Occurrence Map

Three (3) rivers are shown within the study site according to the **NFEPA (2011)** database, while a number of small wetlands are shown to occur at points associated with farm dams. The closest main river, the Klein-Seekoei River, as contained in the **NFEPA (2011)** database, crosses the western boundary of the Paarde Valley PV site, is approximately 1 500m west of the Wonderheuwel PV study site, and is approximately 3 700m west of the Mooi Plaats PV study site. The sites all drain towards the Klein-Seekoei River to the West of the sites. The topography of the site indicates the potential presence of watercourses running east to west, and north to south, across the site. Two perennial rivers are present on the site. Both perennial rivers are tributaries of the Klein-Seekoei River, and both have a class C rating, meaning they are moderately modified. No other conservation sensitive areas were identified on the study site.

5.2 In-field Findings and Delineations

The in-field wetland delineation assessment took place between the 05th and 07th of February 2019. Conditions were hot and sunny with partial cloud cover. The study site has historically been used for grazing by sheep, and most of the palatable plants have been selectively grazed out, with many of the remaining plants being poisonous for livestock. It was noted that the first decent rain (50mm) in a number of years had fallen just prior to the site visit, and as such, a number of water bodies were present that would normally be dry.

The fieldwork ground-truthing, verification and delineation assessment was undertaken to scrutinise the results of the desktop assessment, as well as to identify any potentially overlooked wetlands and / or riparian habitat in the field within the study site. The delineation results are displayed in **Figure 7**.

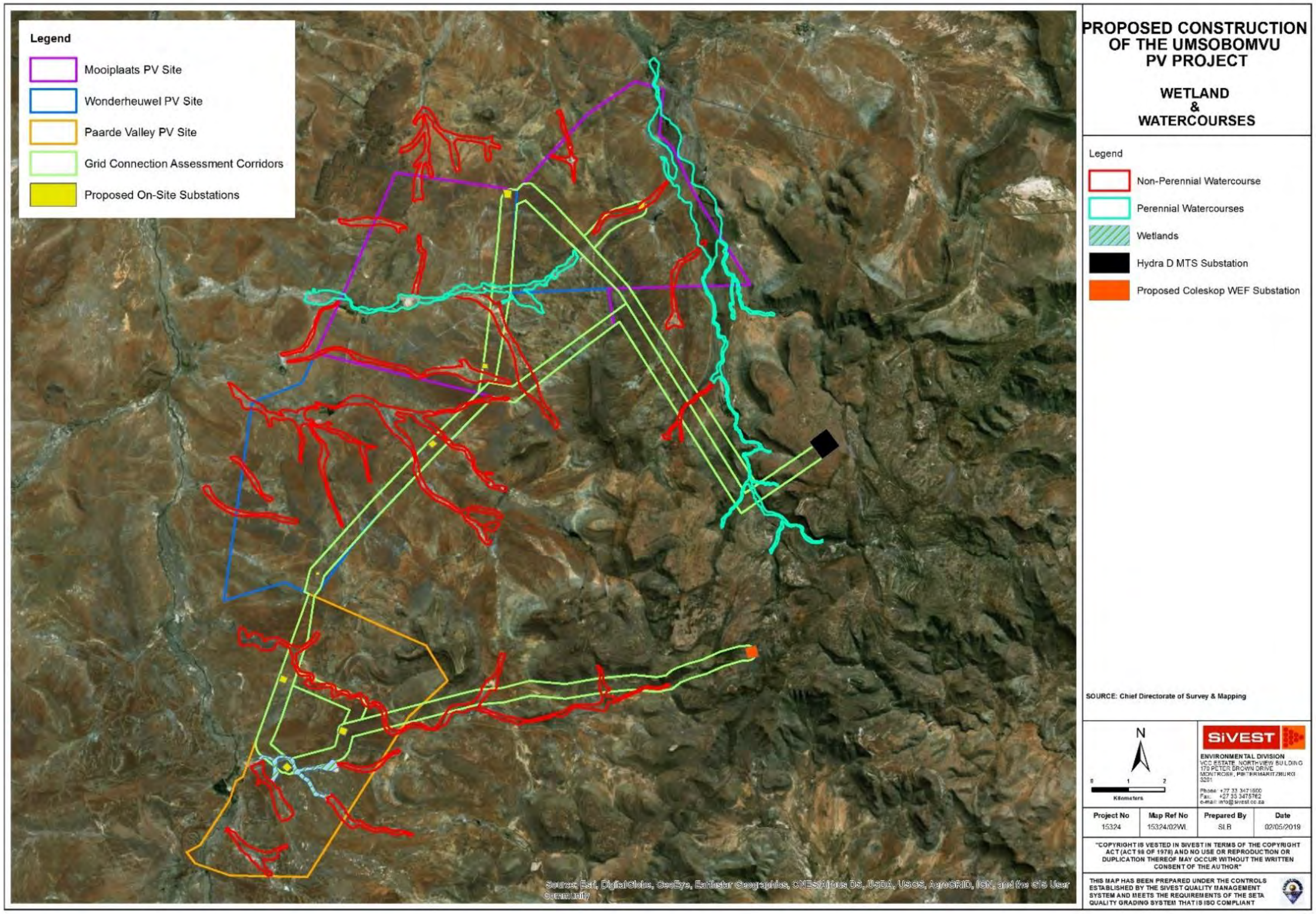

Figure 7: Drainage Line and Wetland Delineation Map

The fieldwork investigation confirmed that there are a number of non-perennial drainage channels which can be found flowing through the study site in an east to west direction, and south to north direction. In addition, a number of tributaries of the Klein-Seekoei River flows from within the sites to the actual Klein-Seekoei River, which runs adjacent to the western boundary of the study areas. A channelled valley bottom wetland system was noted within the Paarde Valley PV site.

Aside from the non-perennial watercourses, a number of man-made farm dams are present on the property, but many of these appear to have been dry for an extended period.

One wetland was identified on the Paarde Valley PV study site.

Overall from the above, the following water resources were identified in the field on the study site:

- A number of non-perennial watercourses without associated Riparian Habitat.
- A number of perennial watercourses with associated Riparian Habitat.
- One Channelled Valley Bottom Wetland System.

The biophysical characteristics and indicators of the above mentioned water resources are provided in the Sub-sections below.

5.2.1 Non-Perennial Watercourses without Riparian Habitat

5.2.1.1 Topography Associated with a Watercourse

The watercourses are shaped by a poorly to moderately developed channel which varies along the length of the watercourses within the study site. Some parts of the channel are better defined than other areas where the channel becomes more diffuse. For example, some of the mid-sections of watercourse are well defined, whereas the lower reaches of the watercourses are much more diffuse. Overall, a macro-channel is present with a smaller defined active (when in flow) channel within (**Figure 8**). The width of the macro-channel therefore varies. The macro-channel can be as little as 15m at the narrowest areas and up to 250m at the widest point on the study site.

Figure 8: Photo of the typical Channel Structure. Broad Macro-channel Section of the Watercourses are evident, but may have a number of smaller channels and flow paths within the macro-channel.

In terms of flow, as previously mentioned, the watercourses are non-perennial and flow from an east to west direction, or a south to north direction. The watercourse can be classified as an A-Section watercourse. The watercourse is above the zone of saturation, although relatively minimal soil depth (ranging from approximately 50mm to 600mm) along some sections of the active channel means that during the wet season, storm water run-off / overland flow can be expected for a relatively brief period (hours to days). This is especially so where bedrock can be found extruding from the watercourses in the channel, as well as in eroded areas.

5.2.1.2 Alluvial Soils and Deposited Materials

Deposited alluvial soils were clearly evident within the active channel as well as within the greater macro-channel bank (**Figure 9**). Sediments were sandy in texture ranging from fine to sandy sized grains. Detrital deposits were also observed in the form of leaves and small twigs.

Soil samples were taken where possible to determine whether soil wetness or wetland soil forms could be identified. Most areas were subject to soil augur restrictions due to the presence of exposed and / or deposited bedrock. Soils that have been deposited via wind or run-off from the surrounding area have however provided some substrate for which vegetation has established.

Soil samples that were taken showed no signs of mottling (which are typically associated with wetlands). The soils did not indicate hydromorphism which typically takes place in wetlands indicating that soil conditions are not favourable to wetland conditions.

Figure 9: Alluvial Sand Deposits within the Active Channel of the Watercourses

5.2.1.3 Vegetation

There are no riparian vegetation zones along any of the watercourses across the site (**Figure 10**). Of the vegetation species identified, none can be described as specifically hydrophytic. Presumably, this is a consequence of the semi-arid climate and other environmental constraints (including soil type and depth) limiting the study site.

Figure 10: There is no riparian vegetation associated with the Watercourses

5.2.2 Perennial Watercourses with Riparian Habitat

5.2.2.1 Topography Associated with a Watercourse

The perennial watercourses are shaped by a well-developed channel which varies along the length of the watercourses within the study site. Most parts of the channel are well defined, with only a few areas where the channel becomes more diffuse (**Figure 11**).

Figure 11: The Perennial Watercourses have well defined channels.

5.2.2.2 Vegetation

There is a distinct riparian vegetation zone along the perennial watercourses on site (**Figure 12**). Of the vegetation species identified, many can be described as specifically hydrophytic.

Figure 12: The Perennial Watercourses have distinct riparian vegetation.

5.2.3 Channelled Valley Bottom Wetland Systemt

5.2.3.1 Topography Associated with the Wetland

The channelled valley bottom wetland system on the Paarde Valley study site is characterised by a well-developed channel which varies from shallow to deep along the length of the wetland (**Figure 13**). Most parts of the channel are well defined, with only a few areas where the channel becomes more diffuse

Figure 13: The wetland system has a well-developed channel along much of its length.

5.2.3.2 Soils and Deposited Materials

In general, the soils within the wetland were only slightly mottled (**Figure 14**), which indicates that the wetland is only wet for perhaps a single season of the year. In general, there is evidence of alluvial material overlaying the wetland clay deposits, and this indicates that over surface flow is probably occurring during rainfall events.

Figure 14: The soils within the wetland show slight mottling, which indicates a seasonal wetland that is not inundated for extended periods.

5.2.3.3 Vegetation

There is a distinct wetland vegetation zone along the wetland channel on site (**Figure 15**). Of the vegetation species identified, many can be described as specifically hydrophytic.

Figure 15: Wetland obligate sedge and grass species are present along the channelled wetland system.

5.3 Ecological Condition

5.3.1 Non-Perennial Watercourses without Riparian Habitat

Since no riparian or wetland habitat is present along the watercourses over most of the site, it is difficult to apply a quantitative assessment of the present ecological state of the systems. As such, the assessment is qualitative in nature, and appropriate reference conditions have been estimated from the level of disturbance that was obvious on the site.

5.3.1.1 Present Ecological Condition

The results of the Present Ecological State assessment for the watercourses are as follows:

- Watercourse Ecological Condition – C Moderately Modified.

From the above, existing impacts are moderately affecting the current state of the watercourses. The factors affecting the various systems are explained below.

The area is semi-arid to arid, and the vegetation on site should be dominated by a range of drought tolerant succulent species, with a limited graminoid component. Minimal encroachment of alien species was noted. Overgrazing impacts were extremely apparent along with associated onset of erosion due to animal movement and vegetation removal. Overall, cover was not high and the habitat could be described as open scrubland.

Overall the impacts identified to be affecting vegetation cover, abundance and composition includes overgrazing due to sheep, erosion due to sheep trampling and the excavation of the dams. Water quantity impacts are mainly indirect because of run-off impacts due to infrastructure (dirt roads, tar roads, rail etc.) and decreased vegetation cover due to overgrazing. Water quality impacts affecting the watercourse mainly relate to sedimentation originating from run-off from the surrounding areas and roads. In general, however, the sedimentation impacts are a relatively moderate factor affecting water quality (and geomorphology) which in turn contributes to the current perceived change in state.

5.3.2 Perennial Watercourses with Riparian Habitat

In order to apply the VEGRAI index, it is essential to qualify the reference conditions (Kleynhans et al., 2007). The reference conditions are essentially a determination of the state of the riparian habitat that is completely natural and unmodified / affected by existing impacts. When assessing the state of the riparian habitat, the habitat can be broken down into two components including, the marginal zone and non-marginal zone. The marginal zone includes the area from the water level at low flow, if present, to those features that are hydrologically activated for the greater part of the year (Kleynhans et al., 2007). The non-marginal zone collectively includes the lower and upper zone. The lower zone which extends from the marginal zone usually ends where a marked increase occurs in lateral elevation, whilst the upper zone extends from the end of the lower zone to the end of the riparian corridor which is usually characterised by steeper slopes and the presence of both riparian and terrestrial vegetation species (Kleynhans et al., 2007).

5.3.2.1 Present Ecological Condition

The results of the VEGRAI assessment for the Klein-Seekoei River, and its tributaries, riparian habitat are as follows:

- Klein-Seekoei River, and tributaries, Riparian Habitat Ecological Condition – C Moderately Modified (67.5% of the reference condition).

From the above, existing impacts are moderately affecting the current state of the riparian habitats on site. The factors affecting the various systems are explained below.

Currently the marginal zone appears to be in a graminoid dominated state. Few tree species were present in this zone. This contrasts with what the reference state would be. The reference state should ideally be tree dominated. Nonetheless, graminoid cover was estimated at approximately 50%, whilst few sub-adult tree species were also observed making up approximately 30% of the vegetation cover. The remaining area directly in the channel was bare owing to scouring effect from flows. Extensive overgrazing, and recent frosts affected the percentage of cover observed during the assessment. Otherwise, minimal encroachment of alien species was noted. Overgrazing impacts were also apparent along with associated onset of erosion due to animal movement and vegetation removal. Overall, cover was not high and the habitat could be described as open grassland to open woodland.

The non-marginal zone generally contains a mixture of tree, shrub and graminoid species. The overall state of the non-marginal zone appears to be in transition to a graminoid dominated state. Like the marginal zone, the reference state should be tree dominated. As such, the degree of vegetation cover is somewhat reduced with less vegetation cover from tree species. Removal for firewood is also likely to contribute to decreased tree occurrence. Finally, overgrazing by cattle is similarly affecting general vegetation cover. In general, it is estimated that tree cover percentage is approximately 30%, whilst herbaceous cover is approximately 20% and graminoid cover is approximately 45%. The remaining is bare soils. Abundance of vegetation in the general non-marginal zone was higher in number of species, compared to adjacent areas. The moderately higher abundance owes mostly to the increased occurrence of tree and shrub species. Despite the increased tree and shrub occurrence, the current state differs from what should be a tree dominated state.

Overall the impacts identified to be affecting vegetation cover, abundance and composition includes overgrazing due to sheep and cattle, removal of vegetation of firewood, and erosion due to animal trampling. Water quantity impacts are mainly indirect because of run-off impacts due to infrastructure (dirt roads) and decreased vegetation cover due to overgrazing. Water quality impacts affecting the watercourse mainly relate to sedimentation originating from run-off from the surrounding areas and roads. In general, however, the sedimentation impacts are a relatively moderate factor affecting water quality (and geomorphology) which in turn contributes to the current perceived change in state from a tree dominated reference state to a graminoid dominated current state.

5.3.3 Channelled Valley Bottom Wetland

A single Channelled Valley Bottom wetland system is present on the Paarde Valley PV site, and it shows slight mottling that indicates that it is a seasonal wetland. The relatively short inundation period that the wetland soils are prone to has led to a vegetation community that is hydrophilic, but also capable of surviving dry conditions. The wetland has been impacted upon by overgrazing, which has allowed some alien invasive plant species to enter the system. In addition, the high foot traffic of animals within the channel, has caused some changes to the geomorphology of the system through trampling of vegetation, and subsequent erosion.

5.3.3.1 Present Ecological Condition

The formal health assessment of the wetland unit indicates that the wetland unit is Largely Modified resulting from past and current land uses and activities. A summary of the Present Ecological Status (PES) based on results from the WET-Health Tool is provided in **Table 16** below.

Table 16: WET-Health Score

	MODULE				
Unit	**Hydrology Impact Score and Class**	**Geomorphology Impact Score and Class**	**Vegetation Impact Score and Class**	**Combined Impact Score**	**PES Category**
1	3.7 (C)	3.5 (C)	3.1 (C)	3.47	C (Moderately Modified)

5.4 Ecological Importance and Sensitivity Categorisation

The environmental importance and sensitivity of the watercourses was assessed. A detailed description and reasons for the scoring of the EISC results are displayed in **Table 17** below.

Considering conditions on-site, a fair amount of disturbance has affected the study site. Despite this disturbance avi-faunal species of conservation concern (Blue Cranes) were observed within the watercourses, riparian zones and wetland system. The disturbance caused by sheep grazing may influence the potential occurrence of sensitive species. Nonetheless, this does not preclude the occurrence of protected species that were noted on site, and other species of conservation significance may occur during other times of the year as seasonal fluctuations may also have a bearing on the potential occurrence.

Table 17: Environmental Importance and Sensitivity Category for the Biotic and Habitat Determinants associated with the Identified Watercourses, riparian zones and wetland.

Determinant	Score	Confidence	Reason
Primary Determinants			
1. Rare & Endangered Species	3	2	No specific red data flora species of conservation importance associated with the watercourses were noted during the field assessment. There is a possibility that red data species may grow in the study area at different times of the year and were simply not noticed however during the field assessment. The area surrounding the study site is known to provide habitat for the endangered riverine rabbit *Bunolagus monticularis*.
2. Populations of Unique Species	3	2	No populations of unique species were observed during the site visit. However, again, the endangered riverine rabbit *Bunolagus monticularis* is likely to occur within the study site. This elevates the importance and sensitivity of the watercourses.
3. Species/taxon Richness	2	2	Species and taxon richness was moderate in terms of vegetation species. Disturbance due to sheep grazing is an important factor deterring the possible occurrence of indigenous faunal species.
4. Diversity of Habitat Types or Features	2	3	The diversity of habitat types is relatively homogenous.
5. Migration route/breeding and feeding site for water dependent species	3	3	The watercourses have small crossing points for access, which should therefore not act as barriers for species using the watercourses as migration route/breeding and feeding sites. In addition, the watercourses potentially act as a link between the Adamskraal River system and the Karee River system.
6. Sensitivity to Changes in the Natural Hydrological Regime	2	3	The watercourses are highly sensitive to changes in the natural hydrological regime as little or no vegetation is present within the watercourses and they are sand based, thus leading to increased risk of erosion.

7. Sensitivity to Water Quality Changes	2	3	The watercourses are moderately sensitive to water quality changes, this is evident due to current sedimentation impacts within the affected watercourse.
8. Flood Storage, Energy Dissipation & Particulate/Element Removal	2	3	One of the main potential watercourse ecosystem services / functions provided is the ability to provide flood attenuation. The watercourses are therefore regarded as relatively significant in terms of the role it performs in the greater landscape.
Modifying Determinants			
9. Protected Status	3	4	According to the Cape Winelands District Management Area database, the entire study site is located within an Ecological Support Zone.
10. Ecological Integrity	2	4	The overall EC of the watercourses are classified as C Moderately Modified.
TOTAL	24	29	
MEDIAN	2,4	2,9	
OVERALL ECOLOGICAL SENSITIVITY AND IMPORTANCE	**B**		

Given the presence of Blue Cranes within numerous watercourses, the wetland, and the riparian zones, the importance and sensitivity of the watercourse habitat is elevated.

Whilst the condition of the vegetation surrounding the watercourses identified on the study site is somewhat disturbed, the habitat is moderately intact and does not contain any highly sensitive species. The sensitivity is therefore reduced to a limited extent in this regard. However, the potential presence of conservation worthy species within the watercourses across the site leads to an increase in sensitivity.

Taking the above into account, as well as the EC and ecosystem services results, the EISC for the Watercourses, riparian zones and wetland was categorised as a Class B (High).

5.5 Ecological Buffer Zones

An adequate buffer zone is required that is suitable for the type of construction to be undertaken for the proposed development in provision of anticipated impacts. In consideration of this, limited clearance of vegetation will take place in the footprint of the internal roads, operation and maintenance building, lay-down area and under the actual PV panels. Shallow excavations can also be expected for underground cabling and other services that will be required.

Potential impacts to be expected include construction disturbance, habitat edge effects, indirect increased run-off and consequent sedimentation and erosion impacts. These are identified as the main threats to the watercourse, and wetland drivers (flow, water quality, geomorphology).

From an operation phase perspective, increased surface area characterised by hard impermeable structures (i.e. foundations, road infrastructure etc.) are expected to contribute to increased run-off rates. For the operation phase, a critical factor is the duration of potential impacts that may take place for the lifecycle of the proposed development. A consideration that was accordingly factored into the assessment. Accelerated flow resulting in increased run-off may pose an erosion and sedimentation risk to the watercourses and wetland given the shallow soil profile and characteristics of the study site. The increased flow rates are also likely to have flow alteration effects on the watercourses and wetland if not managed properly. Therefore, adequate protection of the watercourses and wetland will assist in minimising potential impacts downstream. With the implementation of mitigation measures, the identified potential impacts can be minimised.

It must be noted that the buffer zone has been determined bearing in mind that a number of mitigation measures have been proposed in **Section 6** below to reduce the potential impact to the delineated watercourses and wetland. The buffer zones that were determined include the following:

- All Watercourses, rivers and the wetland Aquatic Buffer
    - Construction Phase Buffer: 15m

- Operation Phase Buffer: 15m

5.6 Risk Assessment

A risk assessment undertaken as per **Government Notice 509 of 2016 (No. 40229)** needs to consider the "regulated area of a watercourse". The outer edge of the delineated riparian habitat in addition to the 1:100 year flood line delineation (whichever is greatest) have therefore been taken as the full "extent of the watercourses".

Importantly, the regulated area of the watercourse has been regarded as an exclusion zone for the PV foundations, building components of the plant (operation and maintenance buildings etc.) and underground cabling infrastructure given the sensitivity of the features. The only component that will be within the extent of the watercourse will be the proposed access roads that will make use of existing crossing points to minimise potential increased disturbance.

Given the above, as it is assumed that the proposed development will not directly encroach on the extent of the watercourse, the completion of the risk assessment protocol matrix in terms of **Government Notice 509 of 2016 (No. 40229)** has been undertaken to show the extremely low risk values and to ascertain the applicability of a general authorisation process, if required.

A map illustrating the above-mentioned regulated area and buffer zones are shown in **Figure 16** below. The detailed results of the risk protocol assessment are provided in **Appendix D**.

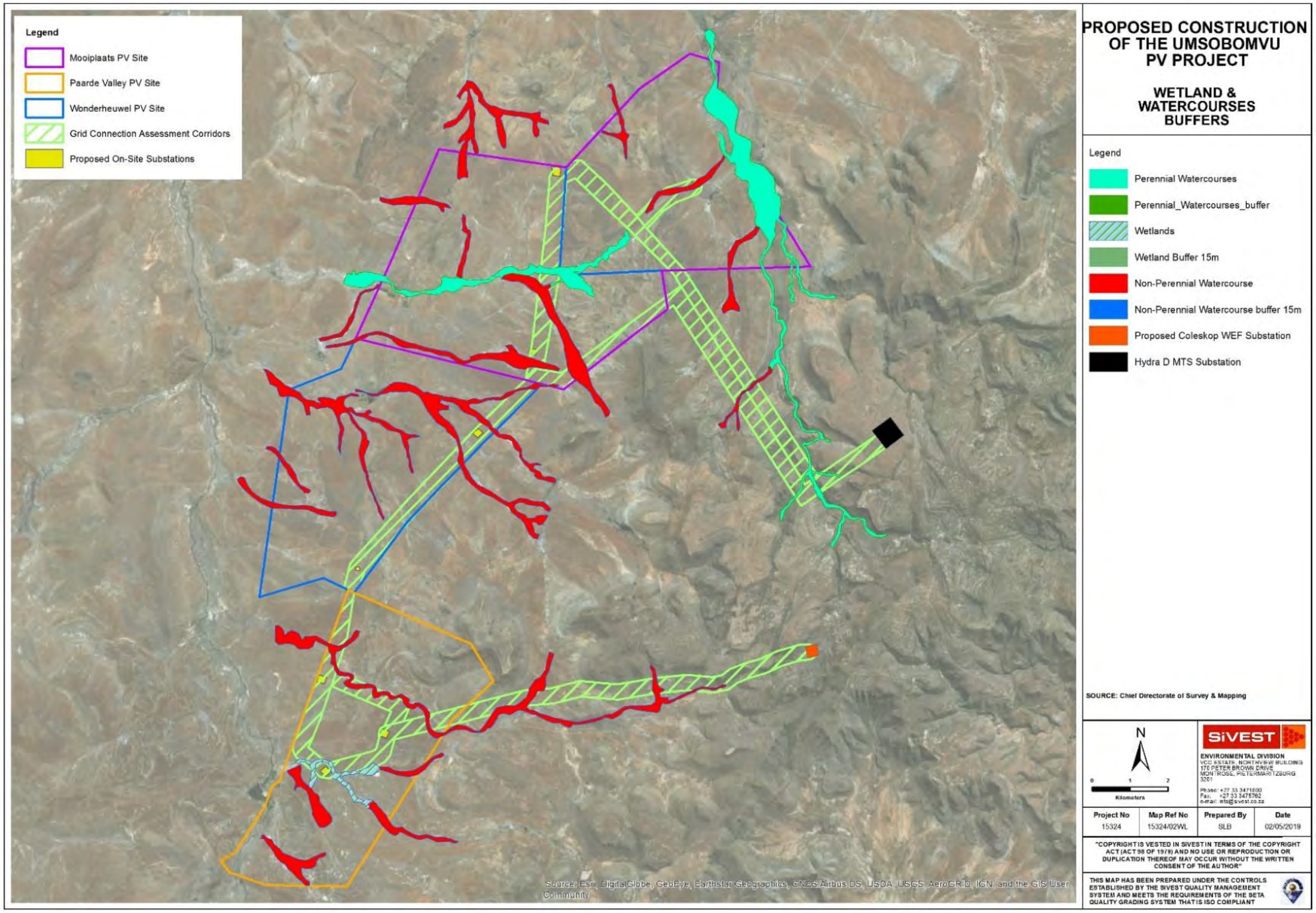

Figure 16: Risk Assessment Map

Overall, the above findings show that the risk of potential impacts on the watercourse was assessed to be in the LOW risk class. Where risks were identified, a number of control measures have been stipulated which will assist in decreasing the level of risk to an even lower level. In accordance with the implementation of control measures, all potential risks are classed as LOW. Importantly, no direct impact will take place on the identified watercourses, but rather within the surrounding catchment. Therefore, registration for General Authorisation can be undertaken, where required and agreed with the DWS.

6 NATURE OF THE POTENTIAL IMPACTS ASSOCIATED WITH THE PROPOSED DEVELOPMENT

From a watercourse perspective, this section will identify and contextualise the potential impacts within the context of the proposed development and the identified watercourses and wetland. This section will rate the impacts according to an impact rating system (see **Appendix B** for a full methodology and description of the impact rating system), determine the effect of the environmental impact, and provide recommendations towards mitigating the anticipated impact. The identification and rating of impacts will be undertaken (where applicable) for the construction and operation phases of the proposed development. It must be noted that the impact assessment determines a pre-mitigation rating (impacts based on current layout as is) and post-mitigation impact rating (impacts based on implementation of mitigation measures). Therefore, the impact assessment assumes automatic implementation of mitigation measures for the post-mitigation ratings.

The three (3) PV projects are identified and assessed individually below, as well as their respective grid connection alternatives.

6.1 Mooi Plaats PV Site Impact Assessment

6.1.1 Construction Phase Potential Impacts

6.1.1.1 Impacts to the Watercourses

During the construction phase, watercourses may be disturbed due to nearby construction. Note that no direct clearance of watercourses will take place, as the development footprint has been positioned outside of the extent of the delineated watercourse. Limited clearance of vegetation in the terrestrial area will be undertaken where the PV panel and power lines, operation and maintenance building, underground cable trenching and internal roads are to be constructed. It is expected that vegetation clearance will only take place potentially up to the edge of the watercourses. Edge effects afford opportunities to alien vegetation to colonise the Watercourses. Additionally, the disturbance may result in temporary displacement of the biota inhabiting the watercourses during construction. However, these biota may well return following the construction phase.

Assessment of the above potential negative impacts and mitigation measures thereto are provided in **Table 18** on **page 58** below.

6.1.1.2 Impacts to the Hydrology of the Watercourse

With the clearance of vegetation and increased run-off potential, the alteration of the hydrology of the watercourses can be expected. Increased flood peaks during and following rainfall events are likely whilst surfaces remain exposed following clearance and compaction during construction. However, it must be noted that the region is semi-arid and the watercourses are non-perennial systems. Hence, flows are fairly infrequent and the impacts to the hydrology will be temporary / short lived. Should adequate measures be implemented, the potential impacts can be successfully mitigated.

Assessment of the above potential negative impacts and mitigation measures thereto are provided in **Table 18** on **page 58** below.

6.1.1.3 Impacts to Water Quality

During the construction process, potential contamination impacts can be expected as a result of stored oils, fuels, and other hazardous substances or materials being transported *via* storm water run-off and / or direct leaks from construction vehicles and machinery. Should this occur, contamination impacts are likely to occur.

Water quality impacts can also result from workers using the watercourses for various purposes (such as for sanitation). Usage of sanitary substances (for example, soap) in the watercourses can alter the chemical balance or water quality thereby causing pollution to these hydrological systems. Additionally, usage of watercourses for urine and faecal waste is another potential negative water quality impact. Use of water for building purposes can also lead to impaired water quality.

Mixing cement and cleaning construction tools in the watercourses can furthermore affect the water quality. Impacts to the water quality may affect any organisms or vegetation inhabiting these systems *via* contamination impacts.

Lastly, water quality can be impaired as a result of sedimentation. Additional sediment loads emanating from construction areas that are contained in run-off entering watercourses can be regarded as pollution in accordance with the NWA, and therefore requires mitigation.

Assessment of the above potential negative impacts and mitigation measures thereto are provided in **Table 18** on **page 58** below.

6.1.2 Operation Phase Potential Impacts

6.1.2.1 Impacts to the Hydrology of the Watercourse

Once the proposed development is in operation, increased run-off, associated erosion and sedimentation impacts from storm water is a possibility. The impact of storm water run-off is primarily related to the types of structures and surfaces that will need to be established for the proposed development. Hard impermeable surfaces will be associated with the internal access roads, and maintenance and operation buildings. In general, flat and hard surfaces aid with the generation and acceleration of run-off which can impact on the watercourses through the alteration of floodpeaks as well as other knock-on effects including onset of erosion and increased sedimentation.

Assessment of the above potential negative impacts and mitigation measures thereto are provided in **Table 18** on **page 58** below.

6.1.3 Decommissioning Phase Potential Impacts

6.1.3.1 Decommissioning Impacts

Should the proposed development need to be decommissioned, the same impacts as identified for the construction phase of the proposed development can be anticipated. Similar potential impacts can therefore be expected to occur and the stipulated mitigation measures (where relevant) must be employed as appropriate to minimise impacts.

Assessment of the potential negative impacts associated with the decommissioning phase and mitigation measures thereto are provided in Table 18 on **page 58** below.

Table 18: Rating of Surface Water Impacts for Mooi Plaats PV Site (all phases)

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Construction Phase																				
Watercourses – Impacts to the Watercourses	Impacts associated with disturbance and edge effects to watercourses	1	3	2	2	2	2	20	-	Low	**Avoiding Direct Impacts to the Watercourses** – No vegetation trimming and / or pruning must take place along the existing access roads running through the extent of the watercourse. However, where nearby vegetation trimming and / or pruning is required outside the extent of the watercourse, this must take place accordance with recommendations of the vegetation specialist. **Preventing Temporary Increased Run-off Impacting on Watercourses** – Vegetation clearing must take place in a phased manner, only clearing areas where construction will take place and not in areas where construction will only take place in the future.	1	3	1	1	2	1	8	-	Low

											Preventing Littering of Watercourses – Provide sufficient facilities for litter disposal. Regular clean-ups are required to keep the construction area and adjacent watercourses clean. **Alien Eradication Programme** - An Alien Eradication and Removal Programme is to be compiled prior to construction and implemented for the duration of the proposed development										
Watercourse – Impacts to the Hydrology of the Watercourse	Impacts associated with accelerated run-off and associated increased flood peaks to the watercourse	2	3	2	2	1	2	20	-	Low	**Preventing Increased Run-off and associated Erosion Impacting on Watercourses** – Adequate structures, where necessary, must be put into place (temporary or permanent where necessary in extreme cases) to deal with increased/accelerated run-off and potential erosion. The use of silt fencing and potentially sandbags or hessian "sausage" nets or other appropriate measures along the boundaries of the PV panel and power line foundations and maintenance and operation buildings can be used where required to slow run-off entering the watercourses and the associated buffer zones, thereby preventing increase in flood peaks, run-off volumes and also the likelihood of erosion. An appropriate construction storm water management plan formulated by a suitably qualified professional must	1	2	2	2	2	1	9	-	Low

										accompany the proposed development to deal with increased run-off and associated sedimentation and erosion. An Environmental Control Officer (ECO) must be appointed during the construction phase to oversee construction activities undertaken by contractors. The ECO must also monitor increased run-off and associated erosion impacts. Where additional mitigation measures are stipulated by the ECO in order to control increased run-off and erosion, this is to be undertaken accordingly.									
Watercourse – Impacts to Water Quality	Potential impacts associated with the leakage / spillage of oils, fuels and other potentially hazardous substances from construction vehicles / machinery entering run-off and flowing into the watercourse. Pollution from workers using the watercourse for sanitation and cleaning purposes; as well as sedimentation via	2	3	2	3	3	3	39	-	Medium	**<u>Storage of Oils, Fuels and Hazardous Substances / Liquids</u>** – All oils, fuels and hazardous substances or liquids must not be stored within 100m from the full extent of the watercourse and the associated buffer zone, unless such storage is unavoidable and is approved by the ECO. Where these items are stored, the storage area must be adequately bunded to contain any spillage from containers. Emergency spill kits must be available to clean up and remove spills. **<u>Preventing Soil and Surface Water Contamination</u>** – All vehicles and machinery operating on the study site are to be checked for oil, fuel or any other fluid leaks before entering the	1	1	2	2	3	1	9	-	Low

	run-off polluting the watercourse.										construction areas. All vehicles and machinery must be regularly serviced and maintained before being allowed to enter the construction areas. No fuelling, re-fuelling, vehicle and machinery servicing or maintenance is to take place within 100m of the watercourse and the associated buffer zone. The study site is to contain sufficient safety measures throughout the construction process. Safety measures include (but are not limited) oil spill kits and the availability of fire extinguishers. Additionally, fuel, oil or hazardous substances storage areas must be bunded to 110% capacity to prevent oil or fuel contamination of the ground and / or nearby watercourses and the associated buffer zones. No cement mixing is to take place in the watercourse or the associated buffer zone. In general, any cement mixing should take place over a bin lined (impermeable) surface or alternatively in the load bin of a vehicle to prevent the mixing of cement with the ground. Cement / concrete can also be trucked in ready-mix vehicles. Importantly, no mixing of cement or concrete directly within the watercourse and associated buffer zone.									

											No “long drop” toilets are allowed on the study site. Suitable temporary chemical sanitation facilities are to be provided. Temporary chemical sanitation facilities must be placed at least 100 meters from the watercourse and the associated buffer zone where required. Temporary chemical sanitation facilities must be checked regularly for maintenance purposes and cleaned often to prevent spills. **Preventing Sedimentation Impacting on Surface Water Resources** – Adequate structures, where required, must be put into place (temporary or permanent where necessary in extreme cases) to deal with sedimentation. The use of silt fencing and potentially sandbags or hessian “sausage” nets or other appropriate measures along the boundaries of the PV panel and power line foundations, and maintenance and operation buildings can be used where required to prevent and / or reduce sediments entering the watercourse and the associated buffer zone. An appropriate construction storm water management plan formulated by a suitably qualified professional must accompany the proposed development to deal with sedimentation.									

											An ECO must be appointed during the construction phase to oversee construction activities undertaken by contractors. The ECO must also monitor sedimentation impacts. Where additional mitigation measures are stipulated by the ECO in order to control sedimentation, this is to be undertaken accordingly.									
Operational Phase																				
Watercourse - Impacts to the Hydrology of the Watercourse	Increased run-off as well as associated erosion and sedimentation impacts	2	3	2	2	3	3	36	-	Medium	**<u>Minimising Storm Water Impacts to Watercourses</u>** – The access roads, and maintenance and operation buildings must have energy dissipating structures where required to prevent increased run-off and sediments contained in the run-off entering adjacent areas or surface water resources. This will assist in erosion prevention as well. Structures can be in the form of hard concrete structures or soft engineering structures (such as grass blocks for example). Alternatively, a suitable operational storm water management design or plan can be compiled and implemented that accounts for the use of appropriate alternative structures or devices that will prevent increased run-off and sediment entering the watercourses thereby, also preventing erosion.	1	2	2	1	3	2	18	-	Low

											ECO monitoring is to take place during the post-construction rehabilitation phase. Monitoring is to take place for erosion as well as re-establishment of vegetation where trenching has taken place.									
Decommissioning Phase																				
Watercourses – Impacts to the Watercourses	Impacts associated with disturbance and edge effects to watercourses	1	3	2	2	2	2	20	-	Low	**Avoiding Direct Impacts to the Watercourses** – No vegetation trimming and / or pruning must take place along the existing access roads running through the extent of the watercourse. However, where nearby vegetation trimming and / or pruning is required outside the extent of the watercourse, this must take place accordance with recommendations of the vegetation specialist. **Preventing Temporary Increased Run-off Impacting on Watercourses** – Vegetation clearing must take place in a phased manner, only clearing areas where construction will take place and not in areas where construction will only take place in the future. **Preventing Littering of Watercourses** – Provide sufficient facilities for litter disposal. Regular clean-ups are required to keep the construction area and adjacent watercourses clean.	1	3	1	1	2	1	8	-	Low

										<u>Alien Eradication Programme</u> - An Alien Eradication and Removal Programme is to be compiled prior to construction and implemented for the duration of the proposed development									
Watercourse – Impacts to the Hydrology of the Watercourse	Impacts associated with accelerated run-off and associated increased flood peaks to the watercourse	2	3	2	2	1	2	20	-	Low	**<u>Preventing Increased Run-off and associated Erosion Impacting on Watercourses</u>** – Adequate structures, where necessary, must be put into place (temporary or permanent where necessary in extreme cases) to deal with increased/accelerated run-off and potential erosion. The use of silt fencing and potentially sandbags or hessian "sausage" nets or other appropriate measures along the boundaries of the PV panel and power line foundations and maintenance and operation buildings can be used where required to slow run-off entering the watercourses and the associated buffer zones, thereby preventing increase in flood peaks, run-off volumes and also the likelihood of erosion. An appropriate construction storm water management plan formulated by a suitably qualified professional must accompany the proposed development to deal with increased run-off and associated sedimentation and erosion. An Environmental Control Officer (ECO) must be appointed during the	1	2	2	2	2	1	9	-	Low

		2	3	2	3	3	3	39	-	Medium	construction phase to oversee construction activities undertaken by contractors. The ECO must also monitor increased run-off and associated erosion impacts. Where additional mitigation measures are stipulated by the ECO in order to control increased run-off and erosion, this is to be undertaken accordingly.									
Watercourse – Impacts to Water Quality	Potential impacts associated with the leakage / spillage of oils, fuels and other potentially hazardous substances from construction vehicles / machinery entering run-off and flowing into the watercourse. Pollution from workers using the watercourse for sanitation and cleaning purposes; as well as sedimentation via run-off polluting the watercourse.	2	3	2	3	3	3	39	-	Medium	**Storage of Oils, Fuels and Hazardous Substances / Liquids** – All oils, fuels and hazardous substances or liquids must not be stored within 100m from the full extent of the watercourse and the associated buffer zone, unless such storage is unavoidable and is approved by the ECO. Where these items are stored, the storage area must be adequately bunded to contain any spillage from containers. Emergency spill kits must be available to clean up and remove spills. **Preventing Soil and Surface Water Contamination** – All vehicles and machinery operating on the study site are to be checked for oil, fuel or any other fluid leaks before entering the construction areas. All vehicles and machinery must be regularly serviced and maintained before being allowed to enter the construction areas. No fuelling, refuelling, vehicle and machinery servicing or maintenance is to take place within 100m of the	1	1	2	2	3	1	9	-	Low

											watercourse and the associated buffer zone. The study site is to contain sufficient safety measures throughout the construction process. Safety measures include (but are not limited) oil spill kits and the availability of fire extinguishers. Additionally, fuel, oil or hazardous substances storage areas must be bunded to 110% capacity to prevent oil or fuel contamination of the ground and / or nearby watercourses and the associated buffer zones. No cement mixing is to take place in the watercourse or the associated buffer zone. In general, any cement mixing should take place over a bin lined (impermeable) surface or alternatively in the load bin of a vehicle to prevent the mixing of cement with the ground. Cement / concrete can also be trucked in ready-mix vehicles. Importantly, no mixing of cement or concrete directly within the watercourse and associated buffer zone. No "long drop" toilets are allowed on the study site. Suitable temporary chemical sanitation facilities are to be provided. Temporary chemical sanitation facilities must be placed at least 100 meters from the watercourse and the associated buffer zone where									

											required. Temporary chemical sanitation facilities must be checked regularly for maintenance purposes and cleaned often to prevent spills. **<u>Preventing Sedimentation Impacting on Surface Water Resources</u>** – Adequate structures, where required, must be put into place (temporary or permanent where necessary in extreme cases) to deal with sedimentation. The use of silt fencing and potentially sandbags or hessian “sausage” nets or other appropriate measures along the boundaries of the PV panel and power line foundations, and maintenance and operation buildings can be used where required to prevent and / or reduce sediments entering the watercourse and the associated buffer zone. An appropriate construction storm water management plan formulated by a suitably qualified professional must accompany the proposed development to deal with sedimentation. An ECO must be appointed during the construction phase to oversee construction activities undertaken by contractors. The ECO must also monitor sedimentation impacts. Where additional mitigation measures are stipulated by the ECO in order to									

											control sedimentation, this is to be undertaken accordingly.									

6.2 Wonderheuwel PV Site Impact Assessment

6.2.1 Construction Phase Potential Impacts

6.2.1.1 Impacts to the Watercourses

During the construction phase, watercourses may be disturbed due to nearby construction. Note that no direct clearance of watercourses will take place, as the development footprint has been positioned outside of the extent of the delineated watercourse. Limited clearance of vegetation in the terrestrial area will be undertaken where the PV panel and power lines, operation and maintenance building, underground cable trenching and internal roads are to be constructed. It is expected that vegetation clearance will only take place potentially up to the edge of the watercourses. Edge effects afford opportunities to alien vegetation to colonise the Watercourses. Additionally, the disturbance may result in temporary displacement of the biota inhabiting the watercourses during construction. However, these biota may well return following the construction phase.

Assessment of the above potential negative impacts and mitigation measures thereto are provided in Table 19 on **page 73** below.

6.2.1.2 Impacts to the Hydrology of the Watercourse

With the clearance of vegetation and increased run-off potential, the alteration of the hydrology of the watercourses can be expected. Increased flood peaks during and following rainfall events are likely whilst surfaces remain exposed following clearance and compaction during construction. However, it must be noted that the region is semi-arid and the watercourses are non-perennial systems. Hence, flows are fairly infrequent and the impacts to the hydrology will be temporary / short lived. Should adequate measures be implemented, the potential impacts can be successfully mitigated.

Assessment of the above potential negative impacts and mitigation measures thereto are provided in **Table 19** on **page 73** below.

6.2.1.3 Impacts to Water Quality

During the construction process, potential contamination impacts can be expected as a result of stored oils, fuels, and other hazardous substances or materials being transported *via* storm water run-off and / or direct leaks from construction vehicles and machinery. Should this occur, contamination impacts are likely to occur.

Water quality impacts can also result from workers using the watercourses for various purposes (such as for sanitation). Usage of sanitary substances (for example, soap) in the watercourses can alter the chemical balance or water quality thereby causing pollution to these hydrological systems. Additionally, usage of watercourses for urine and faecal waste is another potential negative water quality impact. Use of water for building purposes can also lead to impaired water quality.

Mixing cement and cleaning construction tools in the watercourses can furthermore affect the water quality. Impacts to the water quality may affect any organisms or vegetation inhabiting these systems *via* contamination impacts.

Lastly, water quality can be impaired as a result of sedimentation. Additional sediment loads emanating from construction areas that are contained in run-off entering watercourses can be regarded as pollution in accordance with the NWA, and therefore requires mitigation.

Assessment of the above potential negative impacts and mitigation measures thereto are provided in **Table 19** on **page 73** below.

6.2.2 Operation Phase Potential Impacts

6.2.2.1 Impacts to the Hydrology of the Watercourse

Once the proposed development is in operation, increased run-off, associated erosion and sedimentation impacts from storm water is a possibility. The impact of storm water run-off is primarily related to the types of structures and surfaces that will need to be established for the proposed development. Hard impermeable surfaces will be associated with the internal access roads, and maintenance and operation buildings. In general, flat and hard surfaces aid with the generation and acceleration of run-off which can impact on the watercourses through the alteration of floodpeaks as well as other knock-on effects including onset of erosion and increased sedimentation.

Assessment of the above potential negative impacts and mitigation measures thereto are provided in **Table 19** on **page 73** below.

6.2.3 Decommissioning Phase Potential Impacts

6.2.3.1 Decommissioning Impacts

Should the proposed development need to be decommissioned, the same impacts as identified for the construction phase of the proposed development can be anticipated. Similar potential impacts can therefore be expected to occur and the stipulated mitigation measures (where relevant) must be employed as appropriate to minimise impacts.

Assessment of the potential negative impacts associated with the decommissioning phase and mitigation measures thereto are provided in Table 19 on **page 73** below.

Table 19: Rating of Surface Water Impacts for Wonderheuvel PV Site (all phases)

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Construction Phase																				
Watercourses – Impacts to the Watercourses	Impacts associated with disturbance and edge effects to watercourses	1	3	2	2	2	2	20	-	Low	**Avoiding Direct Impacts to the Watercourses** – No vegetation trimming and / or pruning must take place along the existing access roads running through the extent of the watercourse. However, where nearby vegetation trimming and / or pruning is required outside the extent of the watercourse, this must take place accordance with recommendations of the vegetation specialist. **Preventing Temporary Increased Run-off Impacting on Watercourses** – Vegetation clearing must take place in a phased manner, only clearing areas where construction will take place and not in areas where construction will only take place in the future.	1	3	1	1	2	1	8	-	Low

											<u>Preventing Littering of Watercourses</u> – Provide sufficient facilities for litter disposal. Regular clean-ups are required to keep the construction area and adjacent watercourses clean. **<u>Alien Eradication Programme</u>** - An Alien Eradication and Removal Programme is to be compiled prior to construction and implemented for the duration of the proposed development									
Watercourse – Impacts to the Hydrology of the Watercourse	Impacts associated with accelerated run-off and associated increased flood peaks to the watercourse	2	3	2	2	1	2	20	-	Low	**<u>Preventing Increased Run-off and associated Erosion Impacting on Watercourses</u>** – Adequate structures, where necessary, must be put into place (temporary or permanent where necessary in extreme cases) to deal with increased/accelerated run-off and potential erosion. The use of silt fencing and potentially sandbags or hessian "sausage" nets or other appropriate measures along the boundaries of the PV panel and power line foundations and maintenance and operation buildings can be used where required to slow run-off entering the watercourses and the associated buffer zones, thereby preventing increase in flood peaks, run-off volumes and also the likelihood of erosion. An appropriate construction storm water management plan formulated by a suitably qualified professional must	1	2	2	2	2	1	9	-	Low

										accompany the proposed development to deal with increased run-off and associated sedimentation and erosion. An Environmental Control Officer (ECO) must be appointed during the construction phase to oversee construction activities undertaken by contractors. The ECO must also monitor increased run-off and associated erosion impacts. Where additional mitigation measures are stipulated by the ECO in order to control increased run-off and erosion, this is to be undertaken accordingly.									
Watercourse – Impacts to Water Quality	Potential impacts associated with the leakage / spillage of oils, fuels and other potentially hazardous substances from construction vehicles / machinery entering run-off and flowing into the watercourse. Pollution from workers using the watercourse for sanitation and cleaning purposes; as well as sedimentation via	2	3	2	3	3	3	39	-	Medium	**<u>Storage of Oils, Fuels and Hazardous Substances / Liquids</u>** – All oils, fuels and hazardous substances or liquids must not be stored within 100m from the full extent of the watercourse and the associated buffer zone, unless such storage is unavoidable and is approved by the ECO. Where these items are stored, the storage area must be adequately bunded to contain any spillage from containers. Emergency spill kits must be available to clean up and remove spills. **<u>Preventing Soil and Surface Water Contamination</u>** – All vehicles and machinery operating on the study site are to be checked for oil, fuel or any other fluid leaks before entering the	1	1	2	2	3	1	9	-	Low

	run-off polluting the watercourse.										construction areas. All vehicles and machinery must be regularly serviced and maintained before being allowed to enter the construction areas. No fuelling, re-fuelling, vehicle and machinery servicing or maintenance is to take place within 100m of the watercourse and the associated buffer zone. The study site is to contain sufficient safety measures throughout the construction process. Safety measures include (but are not limited) oil spill kits and the availability of fire extinguishers. Additionally, fuel, oil or hazardous substances storage areas must be bunded to 110% capacity to prevent oil or fuel contamination of the ground and / or nearby watercourses and the associated buffer zones. No cement mixing is to take place in the watercourse or the associated buffer zone. In general, any cement mixing should take place over a bin lined (impermeable) surface or alternatively in the load bin of a vehicle to prevent the mixing of cement with the ground. Cement / concrete can also be trucked in ready-mix vehicles. Importantly, no mixing of cement or concrete directly within the watercourse and associated buffer zone.									

											No “long drop” toilets are allowed on the study site. Suitable temporary chemical sanitation facilities are to be provided. Temporary chemical sanitation facilities must be placed at least 100 meters from the watercourse and the associated buffer zone where required. Temporary chemical sanitation facilities must be checked regularly for maintenance purposes and cleaned often to prevent spills. **<u>Preventing Sedimentation Impacting on Surface Water Resources</u>** – Adequate structures, where required, must be put into place (temporary or permanent where necessary in extreme cases) to deal with sedimentation. The use of silt fencing and potentially sandbags or hessian “sausage” nets or other appropriate measures along the boundaries of the PV panel and power line foundations, and maintenance and operation buildings can be used where required to prevent and / or reduce sediments entering the watercourse and the associated buffer zone. An appropriate construction storm water management plan formulated by a suitably qualified professional must accompany the proposed development to deal with sedimentation.									

											An ECO must be appointed during the construction phase to oversee construction activities undertaken by contractors. The ECO must also monitor sedimentation impacts. Where additional mitigation measures are stipulated by the ECO in order to control sedimentation, this is to be undertaken accordingly.										
Operational Phase																					
Watercourse - Impacts to the Hydrology of the Watercourse	Increased run-off as well as associated erosion and sedimentation impacts	2	3	2	2	3	3	36	-	Medium	**<u>Minimising Storm Water Impacts to Watercourses</u>** – The access roads, and maintenance and operation buildings must have energy dissipating structures where required to prevent increased run-off and sediments contained in the run-off entering adjacent areas or surface water resources. This will assist in erosion prevention as well. Structures can be in the form of hard concrete structures or soft engineering structures (such as grass blocks for example). Alternatively, a suitable operational storm water management design or plan can be compiled and implemented that accounts for the use of appropriate alternative structures or devices that will prevent increased run-off and sediment entering the watercourses thereby, also preventing erosion.	1	2	2	1	3	2	18	-	Low	

											ECO monitoring is to take place during the post-construction rehabilitation phase. Monitoring is to take place for erosion as well as re-establishment of vegetation where trenching has taken place.									
Decommissioning Phase																				
Watercourses – Impacts to the Watercourses	Impacts associated with disturbance and edge effects to watercourses	1	3	2	2	2	2	20	-	Low	**Avoiding Direct Impacts to the Watercourses** – No vegetation trimming and / or pruning must take place along the existing access roads running through the extent of the watercourse. However, where nearby vegetation trimming and / or pruning is required outside the extent of the watercourse, this must take place accordance with recommendations of the vegetation specialist. **Preventing Temporary Increased Run-off Impacting on Watercourses** – Vegetation clearing must take place in a phased manner, only clearing areas where construction will take place and not in areas where construction will only take place in the future. **Preventing Littering of Watercourses** – Provide sufficient facilities for litter disposal. Regular clean-ups are required to keep the construction area and adjacent watercourses clean.	1	3	1	1	2	1	8	-	Low

											Alien Eradication Programme - An Alien Eradication and Removal Programme is to be compiled prior to construction and implemented for the duration of the proposed development									
Watercourse – Impacts to the Hydrology of the Watercourse	Impacts associated with accelerated run-off and associated increased flood peaks to the watercourse	2	3	2	2	1	2	20	-	Low	**Preventing Increased Run-off and associated Erosion Impacting on Watercourses** – Adequate structures, where necessary, must be put into place (temporary or permanent where necessary in extreme cases) to deal with increased/accelerated run-off and potential erosion. The use of silt fencing and potentially sandbags or hessian "sausage" nets or other appropriate measures along the boundaries of the PV panel and power line foundations and maintenance and operation buildings can be used where required to slow run-off entering the watercourses and the associated buffer zones, thereby preventing increase in flood peaks, run-off volumes and also the likelihood of erosion. An appropriate construction storm water management plan formulated by a suitably qualified professional must accompany the proposed development to deal with increased run-off and associated sedimentation and erosion. An Environmental Control Officer (ECO) must be appointed during the	1	2	2	2	2	1	9	-	Low

											construction phase to oversee construction activities undertaken by contractors. The ECO must also monitor increased run-off and associated erosion impacts. Where additional mitigation measures are stipulated by the ECO in order to control increased run-off and erosion, this is to be undertaken accordingly.									
Watercourse – Impacts to Water Quality	Potential impacts associated with the leakage / spillage of oils, fuels and other potentially hazardous substances from construction vehicles / machinery entering run-off and flowing into the watercourse. Pollution from workers using the watercourse for sanitation and cleaning purposes; as well as sedimentation via run-off polluting the watercourse.	2	3	2	3	3	3	39	-	Medium	**Storage of Oils, Fuels and Hazardous Substances / Liquids** – All oils, fuels and hazardous substances or liquids must not be stored within 100m from the full extent of the watercourse and the associated buffer zone, unless such storage is unavoidable and is approved by the ECO. Where these items are stored, the storage area must be adequately bunded to contain any spillage from containers. Emergency spill kits must be available to clean up and remove spills. **Preventing Soil and Surface Water Contamination** – All vehicles and machinery operating on the study site are to be checked for oil, fuel or any other fluid leaks before entering the construction areas. All vehicles and machinery must be regularly serviced and maintained before being allowed to enter the construction areas. No fuelling, refuelling, vehicle and machinery servicing or maintenance is to take place within 100m of the	1	1	2	2	3	1	9	-	Low

											watercourse and the associated buffer zone. The study site is to contain sufficient safety measures throughout the construction process. Safety measures include (but are not limited) oil spill kits and the availability of fire extinguishers. Additionally, fuel, oil or hazardous substances storage areas must be bunded to 110% capacity to prevent oil or fuel contamination of the ground and / or nearby watercourses and the associated buffer zones. No cement mixing is to take place in the watercourse or the associated buffer zone. In general, any cement mixing should take place over a bin lined (impermeable) surface or alternatively in the load bin of a vehicle to prevent the mixing of cement with the ground. Cement / concrete can also be trucked in ready-mix vehicles. Importantly, no mixing of cement or concrete directly within the watercourse and associated buffer zone. No "long drop" toilets are allowed on the study site. Suitable temporary chemical sanitation facilities are to be provided. Temporary chemical sanitation facilities must be placed at least 100 meters from the watercourse and the associated buffer zone where									

											required. Temporary chemical sanitation facilities must be checked regularly for maintenance purposes and cleaned often to prevent spills. **Preventing Sedimentation Impacting on Surface Water Resources** – Adequate structures, where required, must be put into place (temporary or permanent where necessary in extreme cases) to deal with sedimentation. The use of silt fencing and potentially sandbags or hessian “sausage” nets or other appropriate measures along the boundaries of the PV panel and power line foundations, and maintenance and operation buildings can be used where required to prevent and / or reduce sediments entering the watercourse and the associated buffer zone. An appropriate construction storm water management plan formulated by a suitably qualified professional must accompany the proposed development to deal with sedimentation. An ECO must be appointed during the construction phase to oversee construction activities undertaken by contractors. The ECO must also monitor sedimentation impacts. Where additional mitigation measures are stipulated by the ECO in order to									

											control sedimentation, this is to be undertaken accordingly.									

6.3 Paarde Valley PV Site Impact Assessment

6.3.1 Construction Phase Potential Impacts

6.3.1.1 Impacts to the Watercourses

During the construction phase, watercourses may be disturbed due to nearby construction. Note that no direct clearance of watercourses will take place, as the development footprint has been positioned outside of the extent of the delineated watercourse. Limited clearance of vegetation in the terrestrial area will be undertaken where the PV panel and power lines, operation and maintenance building, underground cable trenching and internal roads are to be constructed. It is expected that vegetation clearance will only take place potentially up to the edge of the watercourses. Edge effects afford opportunities to alien vegetation to colonise the Watercourses. Additionally, the disturbance may result in temporary displacement of the biota inhabiting the watercourses during construction. However, these biota may well return following the construction phase.

Assessment of the above potential negative impacts and mitigation measures thereto are provided in Table 20 on **page 88** below.

6.3.1.2 Impacts to the Hydrology of the Watercourse

With the clearance of vegetation and increased run-off potential, the alteration of the hydrology of the watercourses can be expected. Increased flood peaks during and following rainfall events are likely whilst surfaces remain exposed following clearance and compaction during construction. However, it must be noted that the region is semi-arid and the watercourses are non-perennial systems. Hence, flows are fairly infrequent and the impacts to the hydrology will be temporary / short lived. Should adequate measures be implemented, the potential impacts can be successfully mitigated.

Assessment of the above potential negative impacts and mitigation measures thereto are provided in **Table 20** on **page 88** below.

6.3.1.3 Impacts to Water Quality

During the construction process, potential contamination impacts can be expected as a result of stored oils, fuels, and other hazardous substances or materials being transported *via* storm water run-off and / or direct leaks from construction vehicles and machinery. Should this occur, contamination impacts are likely to occur.

Water quality impacts can also result from workers using the watercourses for various purposes (such as for sanitation). Usage of sanitary substances (for example, soap) in the watercourses can alter the chemical balance or water quality thereby causing pollution to these hydrological systems. Additionally, usage of watercourses for urine and faecal waste is another potential negative water quality impact. Use of water for building purposes can also lead to impaired water quality.

Mixing cement and cleaning construction tools in the watercourses can furthermore affect the water quality. Impacts to the water quality may affect any organisms or vegetation inhabiting these systems *via* contamination impacts.

Lastly, water quality can be impaired as a result of sedimentation. Additional sediment loads emanating from construction areas that are contained in run-off entering watercourses can be regarded as pollution in accordance with the NWA, and therefore requires mitigation.

Assessment of the above potential negative impacts and mitigation measures thereto are provided in Table 20 on **page 88** below.

6.3.2 Operation Phase Potential Impacts

6.3.2.1 Impacts to the Hydrology of the Watercourse

Once the proposed development is in operation, increased run-off, associated erosion and sedimentation impacts from storm water is a possibility. The impact of storm water run-off is primarily related to the types of structures and surfaces that will need to be established for the proposed development. Hard impermeable surfaces will be associated with the internal access roads, and maintenance and operation buildings. In general, flat and hard surfaces aid with the generation and acceleration of run-off which can impact on the watercourses through the alteration of floodpeaks as well as other knock-on effects including onset of erosion and increased sedimentation.

Assessment of the above potential negative impacts and mitigation measures thereto are provided in **Table 20** on **page 88** below.

6.3.3 Decommissioning Phase Potential Impacts

6.3.3.1 Decommissioning Impacts

Should the proposed development need to be decommissioned, the same impacts as identified for the construction phase of the proposed development can be anticipated. Similar potential impacts can therefore be expected to occur and the stipulated mitigation measures (where relevant) must be employed as appropriate to minimise impacts.

Assessment of the potential negative impacts associated with the decommissioning phase and mitigation measures thereto are provided in **Table 20** on **page 88** below.

Table 20: Rating of Surface Water Impacts for Paarde Valley PV Site (all phases)

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Construction Phase																				
Watercourses – Impacts to the Watercourses	Impacts associated with disturbance and edge effects to watercourses	1	3	2	2	2	2	20	-	Low	**Avoiding Direct Impacts to the Watercourses** – No vegetation trimming and / or pruning must take place along the existing access roads running through the extent of the watercourse. However, where nearby vegetation trimming and / or pruning is required outside the extent of the watercourse, this must take place accordance with recommendations of the vegetation specialist. **Preventing Temporary Increased Run-off Impacting on Watercourses** – Vegetation clearing must take place in a phased manner, only clearing areas where construction will take place and not in areas where construction will only take place in the future.	1	3	1	1	2	1	8	-	Low

											Preventing Littering of Watercourses – Provide sufficient facilities for litter disposal. Regular clean-ups are required to keep the construction area and adjacent watercourses clean. **Alien Eradication Programme** - An Alien Eradication and Removal Programme is to be compiled prior to construction and implemented for the duration of the proposed development									
Watercourse – Impacts to the Hydrology of the Watercourse	Impacts associated with accelerated run-off and associated increased flood peaks to the watercourse	2	3	2	2	1	2	20	-	Low	**Preventing Increased Run-off and associated Erosion Impacting on Watercourses** – Adequate structures, where necessary, must be put into place (temporary or permanent where necessary in extreme cases) to deal with increased/accelerated run-off and potential erosion. The use of silt fencing and potentially sandbags or hessian "sausage" nets or other appropriate measures along the boundaries of the PV panel and power line foundations and maintenance and operation buildings can be used where required to slow run-off entering the watercourses and the associated buffer zones, thereby preventing increase in flood peaks, run-off volumes and also the likelihood of erosion. An appropriate construction storm water management plan formulated by a suitably qualified professional must	1	2	2	2	2	1	9	-	Low

										accompany the proposed development to deal with increased run-off and associated sedimentation and erosion. An Environmental Control Officer (ECO) must be appointed during the construction phase to oversee construction activities undertaken by contractors. The ECO must also monitor increased run-off and associated erosion impacts. Where additional mitigation measures are stipulated by the ECO in order to control increased run-off and erosion, this is to be undertaken accordingly.									
Watercourse – Impacts to Water Quality	Potential impacts associated with the leakage / spillage of oils, fuels and other potentially hazardous substances from construction vehicles / machinery entering run-off and flowing into the watercourse. Pollution from workers using the watercourse for sanitation and cleaning purposes; as well as sedimentation via	2	3	2	3	3	3	39	-	Medium	**<u>Storage of Oils, Fuels and Hazardous Substances / Liquids</u>** – All oils, fuels and hazardous substances or liquids must not be stored within 100m from the full extent of the watercourse and the associated buffer zone, unless such storage is unavoidable and is approved by the ECO. Where these items are stored, the storage area must be adequately bunded to contain any spillage from containers. Emergency spill kits must be available to clean up and remove spills. **<u>Preventing Soil and Surface Water Contamination</u>** – All vehicles and machinery operating on the study site are to be checked for oil, fuel or any other fluid leaks before entering the	1	1	2	2	3	1	9	-	Low

	run-off polluting the watercourse.										construction areas. All vehicles and machinery must be regularly serviced and maintained before being allowed to enter the construction areas. No fuelling, re-fuelling, vehicle and machinery servicing or maintenance is to take place within 100m of the watercourse and the associated buffer zone. The study site is to contain sufficient safety measures throughout the construction process. Safety measures include (but are not limited) oil spill kits and the availability of fire extinguishers. Additionally, fuel, oil or hazardous substances storage areas must be bunded to 110% capacity to prevent oil or fuel contamination of the ground and / or nearby watercourses and the associated buffer zones. No cement mixing is to take place in the watercourse or the associated buffer zone. In general, any cement mixing should take place over a bin lined (impermeable) surface or alternatively in the load bin of a vehicle to prevent the mixing of cement with the ground. Cement / concrete can also be trucked in ready-mix vehicles. Importantly, no mixing of cement or concrete directly within the watercourse and associated buffer zone.									

											No “long drop” toilets are allowed on the study site. Suitable temporary chemical sanitation facilities are to be provided. Temporary chemical sanitation facilities must be placed at least 100 meters from the watercourse and the associated buffer zone where required. Temporary chemical sanitation facilities must be checked regularly for maintenance purposes and cleaned often to prevent spills. **<u>Preventing Sedimentation Impacting on Surface Water Resources</u>** – Adequate structures, where required, must be put into place (temporary or permanent where necessary in extreme cases) to deal with sedimentation. The use of silt fencing and potentially sandbags or hessian “sausage” nets or other appropriate measures along the boundaries of the PV panel and power line foundations, and maintenance and operation buildings can be used where required to prevent and / or reduce sediments entering the watercourse and the associated buffer zone. An appropriate construction storm water management plan formulated by a suitably qualified professional must accompany the proposed development to deal with sedimentation.									

											An ECO must be appointed during the construction phase to oversee construction activities undertaken by contractors. The ECO must also monitor sedimentation impacts. Where additional mitigation measures are stipulated by the ECO in order to control sedimentation, this is to be undertaken accordingly.									
Operational Phase																				
Watercourse - Impacts to the Hydrology of the Watercourse	Increased run-off as well as associated erosion and sedimentation impacts	2	3	2	2	3	3	36	-	Medium	**<u>Minimising Storm Water Impacts to Watercourses</u>** – The access roads, and maintenance and operation buildings must have energy dissipating structures where required to prevent increased run-off and sediments contained in the run-off entering adjacent areas or surface water resources. This will assist in erosion prevention as well. Structures can be in the form of hard concrete structures or soft engineering structures (such as grass blocks for example). Alternatively, a suitable operational storm water management design or plan can be compiled and implemented that accounts for the use of appropriate alternative structures or devices that will prevent increased run-off and sediment entering the watercourses thereby, also preventing erosion.	1	2	2	1	3	2	18	-	Low

										ECO monitoring is to take place during the post-construction rehabilitation phase. Monitoring is to take place for erosion as well as re-establishment of vegetation where trenching has taken place.									
Decommissioning Phase																				
Watercourses – Impacts to the Watercourses	Impacts associated with disturbance and edge effects to watercourses	1	3	2	2	2	2	20	-	Low	**Avoiding Direct Impacts to the Watercourses** – No vegetation trimming and / or pruning must take place along the existing access roads running through the extent of the watercourse. However, where nearby vegetation trimming and / or pruning is required outside the extent of the watercourse, this must take place accordance with recommendations of the vegetation specialist. **Preventing Temporary Increased Run-off Impacting on Watercourses** – Vegetation clearing must take place in a phased manner, only clearing areas where construction will take place and not in areas where construction will only take place in the future. **Preventing Littering of Watercourses** – Provide sufficient facilities for litter disposal. Regular clean-ups are required to keep the construction area and adjacent watercourses clean.	1	3	1	1	2	1	8	-	Low

											Alien Eradication Programme - An Alien Eradication and Removal Programme is to be compiled prior to construction and implemented for the duration of the proposed development									
Watercourse – Impacts to the Hydrology of the Watercourse	Impacts associated with accelerated run-off and associated increased flood peaks to the watercourse	2	3	2	2	1	2	20	-	Low	**Preventing Increased Run-off and associated Erosion Impacting on Watercourses** – Adequate structures, where necessary, must be put into place (temporary or permanent where necessary in extreme cases) to deal with increased/accelerated run-off and potential erosion. The use of silt fencing and potentially sandbags or hessian "sausage" nets or other appropriate measures along the boundaries of the PV panel and power line foundations and maintenance and operation buildings can be used where required to slow run-off entering the watercourses and the associated buffer zones, thereby preventing increase in flood peaks, run-off volumes and also the likelihood of erosion. An appropriate construction storm water management plan formulated by a suitably qualified professional must accompany the proposed development to deal with increased run-off and associated sedimentation and erosion. An Environmental Control Officer (ECO) must be appointed during the	1	2	2	2	2	1	9	-	Low

											construction phase to oversee construction activities undertaken by contractors. The ECO must also monitor increased run-off and associated erosion impacts. Where additional mitigation measures are stipulated by the ECO in order to control increased run-off and erosion, this is to be undertaken accordingly.									
Watercourse – Impacts to Water Quality	Potential impacts associated with the leakage / spillage of oils, fuels and other potentially hazardous substances from construction vehicles / machinery entering run-off and flowing into the watercourse. Pollution from workers using the watercourse for sanitation and cleaning purposes; as well as sedimentation via run-off polluting the watercourse.	2	3	2	3	3	3	39	-	Medium	**Storage of Oils, Fuels and Hazardous Substances / Liquids** – All oils, fuels and hazardous substances or liquids must not be stored within 100m from the full extent of the watercourse and the associated buffer zone, unless such storage is unavoidable and is approved by the ECO. Where these items are stored, the storage area must be adequately bunded to contain any spillage from containers. Emergency spill kits must be available to clean up and remove spills. **Preventing Soil and Surface Water Contamination** – All vehicles and machinery operating on the study site are to be checked for oil, fuel or any other fluid leaks before entering the construction areas. All vehicles and machinery must be regularly serviced and maintained before being allowed to enter the construction areas. No fuelling, refuelling, vehicle and machinery servicing or maintenance is to take place within 100m of the	1	1	2	2	3	1	9	-	Low

											watercourse and the associated buffer zone. The study site is to contain sufficient safety measures throughout the construction process. Safety measures include (but are not limited) oil spill kits and the availability of fire extinguishers. Additionally, fuel, oil or hazardous substances storage areas must be bunded to 110% capacity to prevent oil or fuel contamination of the ground and / or nearby watercourses and the associated buffer zones. No cement mixing is to take place in the watercourse or the associated buffer zone. In general, any cement mixing should take place over a bin lined (impermeable) surface or alternatively in the load bin of a vehicle to prevent the mixing of cement with the ground. Cement / concrete can also be trucked in ready-mix vehicles. Importantly, no mixing of cement or concrete directly within the watercourse and associated buffer zone. No "long drop" toilets are allowed on the study site. Suitable temporary chemical sanitation facilities are to be provided. Temporary chemical sanitation facilities must be placed at least 100 meters from the watercourse and the associated buffer zone where									

											required. Temporary chemical sanitation facilities must be checked regularly for maintenance purposes and cleaned often to prevent spills. **<u>Preventing Sedimentation Impacting on Surface Water Resources</u>** – Adequate structures, where required, must be put into place (temporary or permanent where necessary in extreme cases) to deal with sedimentation. The use of silt fencing and potentially sandbags or hessian "sausage" nets or other appropriate measures along the boundaries of the PV panel and power line foundations, and maintenance and operation buildings can be used where required to prevent and / or reduce sediments entering the watercourse and the associated buffer zone. An appropriate construction storm water management plan formulated by a suitably qualified professional must accompany the proposed development to deal with sedimentation. An ECO must be appointed during the construction phase to oversee construction activities undertaken by contractors. The ECO must also monitor sedimentation impacts. Where additional mitigation measures are stipulated by the ECO in order to									

											control sedimentation, this is to be undertaken accordingly.									

6.4 Cumulative Impacts

Cumulative impacts are hard to predict even with knowledge of other sites in the general area that are also going to be developed (**Figure 17**). A single solar energy farm has little impact beyond the borders of the site, however, when several solar energy facilities are developed in an area, there is potentially a large cumulative impact. Negative impacts of roads are frequently cited as one of the major effects of renewable energy developments on watercourses and water resources. These impacts include increased hardened surfaces, erosion, and direct loss of watercourse habitat. However, given the semi-arid to arid system that the project will impact upon it is unlikely that large scale impacts will be imparted by the construction of the solar energy farm on the site, and the cumulative impact of the other developments in the area on water resources is likely to still pose a low risk to these systems if correct mitigation measures are implemented. The majority of the drainage of the site does not join that found on the sites to the south of the study area, and thus the effects of the neighbouring land parcels being developed will have little impact on the study area drainage. There are however, a few developments to the east and north of the site that also drain towards the Klein-Seekoei River but correct use of mitigation measures within the Umsobomvu sites will ensure that the cumulative impact will have minimal impact on the other sites in the area. Thus no immediate cumulative impact to the drainage patterns of the site are predicted.

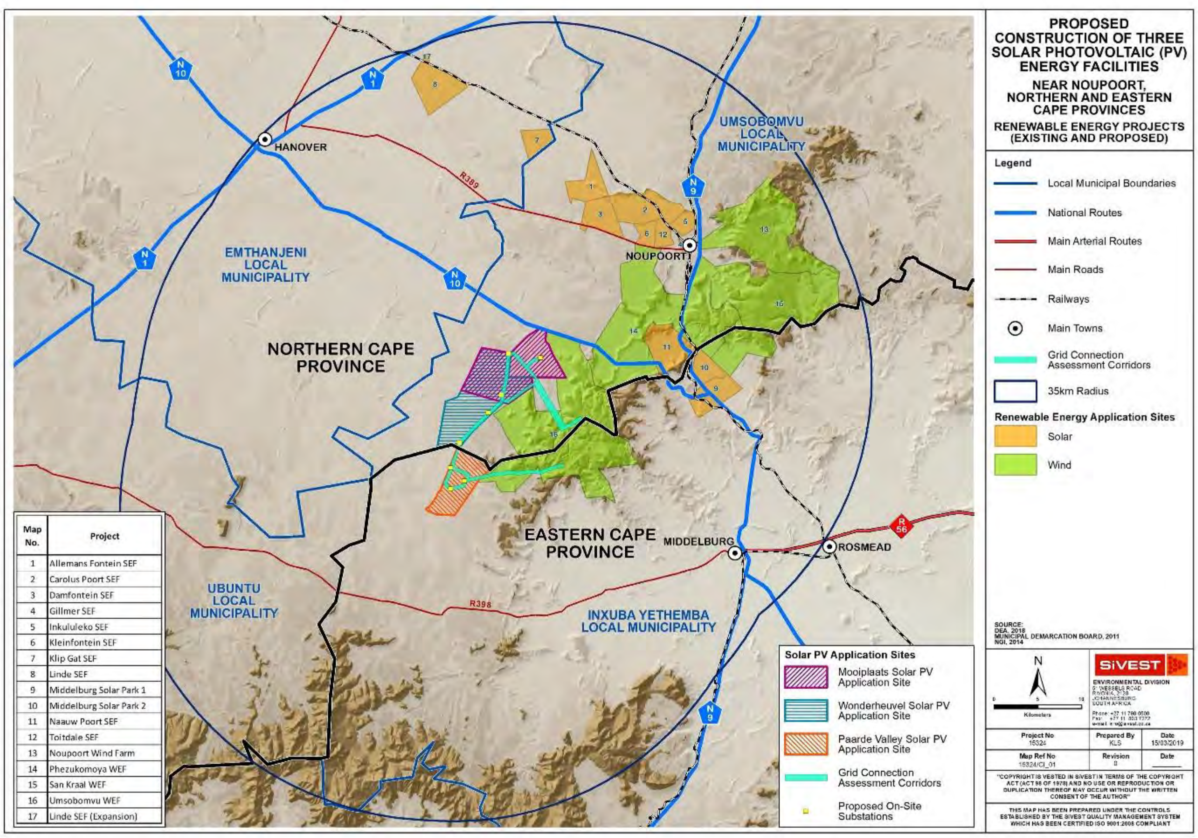

Figure 17: Other Proposed Renewable Energy Developments Within the Region

On a larger scale, all the drainage of the sites enters the Klein-Seekoei River which flows into the Orange River away from site. Thus, if the sites to the north cause a hydrological impact, and the Umsobomvu sites causes a hydrological impact, these impacts (increased run-off as well as associated erosion and sedimentation impacts) will eventually meet in the Seekoei River, and exacerbate each other. However, the risk of either site causing a significant impact is small if all appropriate mitigation (as contained in **Table 21** below) that has been proposed for all sites is implemented.

Table 21: Impact Rating for Cumulative Impacts to the Hydrology of the Region

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Cumulative																				
Watercourse - Cumulative Impacts to Hydrology of Region	Increased run-off as well as associated erosion and sedimentation impacts	2	3	2	2	3	3	36	-	Medium	**Minimising Storm Water Impacts to Watercourses** – The substation, access road, and maintenance and operation buildings must have energy dissipating structures where required to prevent increased run-off and sediments contained in the run-off entering adjacent areas or surface water resources. This will assist in erosion prevention as well. Structures can be in the form of hard concrete structures or soft engineering structures (such as grass blocks for example). Alternatively, a suitable operational storm water management design or plan can be compiled and implemented that accounts for the use of appropriate alternative structures or devices that will prevent increased run-off and sediment entering the	2	2	2	1	3	2	20	-	Low

											watercourses thereby, also preventing erosion. ECO monitoring is to take place during the post-construction rehabilitation phase. Monitoring is to take place for erosion as well as re-establishment of vegetation where trenching for cabling has taken place.									

SiVEST undertook every effort to obtain the information (including specialist studies, BA / EIA / Scoping and EMPr Reports) for the surrounding developments. However, many of the documents are not currently publically available to download. The information that could be obtained for the surrounding planned renewable energy developments was taken into account as part of the cumulative impact assessment.

6.5 Assessment of alternatives

The construction of the PV sites has been proposed with a number of substation and Power line route alternatives available. The comparative assessment of the alternatives, in terms of preference, is detailed below.

Table 22. Substation and Grid Connection Alternatives

GRID CONNECTION INFRASTRUCTURE ALTERNATIVES (POWER LINE CORRIDORS AND ASSOCIATED SUBSTATIONS)	Preference	Reasons (incl. potential issues)
MOOI PLAATS SOLAR PV FACILITY:		
Grid Connection Option 1	**PREFERRED**	The alternative will result in a low impact since a relatively short line is required to evacuate power to Hydra D Substation, and thus pylon number is minimised.
Grid Connection Option 2	**FAVOURABLE**	The impact will be relatively insignificant but the line distance will be longer.
WONDERHEUVEL SOLAR PV FACILITY:		
Grid Connection Option 1	**LEAST PREFERRED**	The alternative will result in a high impact on the watercourses than the other options.
Grid Connection Option 2	**PREFERRED**	The alternative will result in a low impact since a relatively short line is required to evacuate power to Hydra D Substation, and thus pylon number is minimised.
PAARDE VALLEY SOLAR PV FACILITY:		

GRID CONNECTION INFRASTRUCTURE ALTERNATIVES (POWER LINE CORRIDORS AND ASSOCIATED SUBSTATIONS)	Preference	Reasons (incl. potential issues)
Grid Connection Option 1	**LEAST PREFERRED**	The alternative will result in a high impact on the watercourses than the other options.
Grid Connection Option 2	**PREFERRED**	The alternative will result in a low impact since a relatively short line is required to evacuate power to Hydra D Substation, and thus pylon number is minimised.

7 LEGISLATIVE IMPLICATIONS

In the context of the proposed development and potential impacts affecting the watercourse, the environmental and water legislation implications from a surface water perspective are included in the sub-sections below.

7.1 National Environmental Management Act, 1998 (No. 107 of 1998) & Environmental Impact Assessment Regulations (2014), as Amended

Note that the definition of the watercourse in accordance with NEMA is in line with that provided in the NWA and is as follows (**NWA, 1998**),

"a river, a spring, a natural channel in which water flows regularly or intermittently, a wetland, lake or dam into which, or from which, water flows".

From the above, it is important to note that the edge of the watercourse as per NEMA is defined by the channel which *inter alia* includes the bed and banks. This differs from the extent of the watercourse as defined by the NWA which includes the 1:100 floodline and / or the edge of the riparian habitat (whichever is greater. As such, the macro-channel bank was delineated along with a 32m NEMA threshold. This is shown in **Figure 16**. From the map, it can be seen that although the various components are along the boundary of the 32m threshold, only the access roads are directly within the 32m threshold and therefore trigger activities in terms of the EIA Regulations (2014, as amended).

7.2 National Water Act, 1998 (Act No. 36 of 1998)

In the context of the NWA (1998) and the proposed development, a "water use" is required where construction activities will impact directly or indirectly (within the regulated area as per **Government Notice 509 of 2016 (No. 40229)**) on a water resource. As previously mentioned, the regulated area of a watercourse in the assessment is that taken as per **Government Notice 509 of 2016 (No. 40229)**, defined as follows:

- Activities within the outer edge of the 1:100 year flood line and / or riparian habitat (whichever is greatest).

With the above in mind, "water use" is defined *inter alia* as follows:

a) Taking water from a water resource;
b) Storing water;
c) Impeding or diverting the flow of water in a watercourse;
d) Engaging in stream flow reduction activity contemplated in **Section 36** of the NWA;
e) Engaging in a controlled activity identified as such in **Section 37 (1)** or declared under **Section 38(1)** of the NWA;
f) Discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit;
g) Disposing of waste in a manner which may detrimentally impact on a water resource;
h) Disposing of waste in a manner of water which contains waste from, or which has been heated in any industrial or power generation process;
i) Altering the bed, banks, course or characteristics of a watercourse;
j) Removing, discharging or disposing of water found underground if it is necessary for efficient continuation of an activity or for the safety of people; and
k) Using water for recreational purposes.

From the above, water uses c) and i) are potentially applicable since the access roads will need to cross the watercourses at various points. In terms of the risk assessment undertaken in **Section 5.8** as per **Government Notice 509 of 2016 (No. 40229)**, the findings show that the risk of potential impacts on the watercourses were assessed to be in the LOW risk class. Additionally, a number of control measures have been stipulated that will assist in decreasing the level of risk to the watercourse to an even lower level. Should this be undertaken, all risks are classed as LOW and registration for General Authorisation can be undertaken, where required and agreed with the DWS.

The decision on whether the proposed development is to proceed will rest on environmental and water governmental departments whom will need to make a trade-off between meeting the conservation targets of the province or meeting the energy demands of the country. However, it is the opinion of the specialist that the proposed development may proceed where the relevant control measures and mitigation measures stipulated above are implemented.

8 SPECIALIST RECOMMENDATIONS

There are a number of recommendations to be implemented for the proposed development. These include the following:

- Storm water management plan for all phases of the proposed development is required to be compiled prior to construction and implemented which accounts for control of increased run-off, erosion and sedimentation; and
- An Alien Eradication and Removal Programme is to be compiled prior to construction and implemented for the duration of the proposed development.

9 CONCLUSIONS

A surface water resources delineation and impact assessment is provided in this report for the proposed development. Findings were based on the method for delineating wetlands and riparian habitats as per the **DWAF (2005 & 2008)** guidelines. At a broad level, the study site is located within the Orange Catchment. More specifically, the study area is situated within the quaternary catchments D32B & D32C. In terms of fieldwork findings, it was found that there is one wetland on the Paarde Valley study site. However, a number of watercourses, both perennial and non-perennial, were identified.

In terms of the Ecological Condition of the watercourses, Ecological Condition was assessed to be a class C – Moderately Modified systems.

The Environmental Importance and Sensitivity Class for the watercourses was determined. The results showed that the EISC for the watercourses and wetland were categorised as a Class B (High). The classification of high EISC was primarily due to the condition of the watercourses assessed, as well as the presence of Endangered species.

The buffer zone determination findings for the watercourses took into account the type of the proposed development, potential impacts, condition of the habitat as well as other characteristics of the watercourse. As a result, the following buffer zones were assessed and are to be implemented as far as possible:

  - Construction Phase Buffer: 15m
  - Operation Phase Buffer: 15m

Foreseen potential negative impacts in terms of the proposed development were identified and assessed. The potential construction related impacts included impacts to watercourses (-20 low pre- and -8 low post-mitigation impact rating), hydrology of the watercourses (-20 low pre- and -9 low post-mitigation impact rating) and water quality impacts (-39 medium pre- and -9 low post-mitigation impact rating). The operational impacts identified included impacts to the hydrology of the watercourse (-36 medium pre- and -18 low post-mitigation impact rating). Overall, all impacts were assessed to be low, post implementation of mitigation measures.

In terms of potentially applicable environmental and water related legislation, listed activities were identified to be triggered in terms of NEMA (1998) and the EIA Regulations (2014, as amended) from a surface water perspective. With respect to the NWA (1998), water uses (c) and (i) were identified as being potentially applicable. However, the application of the risk assessment matrix protocol as per **Government Notice 509 of 2016 (No. 40229)** was undertaken, the findings show that the risk of potential impacts on the watercourse was assessed to be in the LOW risk class. Where risks were identified, a number of control measures have been stipulated which will assist in decreasing the level of risk to an even lower level. In accordance with the implementation of control measures, all potential risks are classed as LOW. Therefore, registration for General Authorisation can be undertaken where required and agreed with the DWS.

The decision on whether the proposed development is to proceed will rest on environmental and water governmental departments whom will need to make a trade-off between meeting the conservation targets of the province or meeting the energy demands of the country. However, it is the opinion of the specialist that the proposed development may proceed where the relevant control measures and mitigation measures stipulated above are implemented.

There are a number of recommendations to be implemented for the proposed development. These include the following:

- Storm water management plan for all phases of the proposed development is required to be compiled and implemented which accounts for control of increased run-off, erosion and sedimentation; and
- An Alien Eradication and Removal Programme is to be compiled and implemented for the duration of the proposed development.

Based on the findings above, with the implementation of the control and mitigation measures stipulated herein, it is the opinion of the specialist that the proposed development may proceed.

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Appendix A:
Specialist Credentials

Appendix B:
Impact Rating Methodology

1. ENVIRONMENTAL IMPACT ASSESSMENT (EIA) METHODOLOGY

The Environmental Impact Assessment (EIA) Methodology assists in evaluating the overall effect of a proposed activity on the environment. Determining of the significance of an environmental impact on an environmental parameter is determined through a systematic analysis.

1.1 Determination of Significance of Impacts

Significance is determined through a synthesis of impact characteristics which include context and intensity of an impact. Context refers to the geographical scale (i.e. site, local, national or global), whereas intensity is defined by the severity of the impact e.g. the magnitude of deviation from background conditions, the size of the area affected, the duration of the impact and the overall probability of occurrence. Significance is calculated as shown in **Table 23** below.

Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The total number of points scored for each impact indicates the level of significance of the impact.

1.2 Impact Rating System

The impact assessment must take account of the nature, scale and duration of effects on the environment and whether such effects are positive (beneficial) or negative (detrimental). Each issue / impact is also assessed according to the various project stages, as follows:

- planning
- construction
- operation
- decommissioning

Where necessary, the proposal for mitigation or optimisation of an impact should be detailed. A brief discussion of the impact and the rationale behind the assessment of its significance has also been included.

The significance of Cumulative Impacts should also be rated.

1.2.1 Rating System Used to Classify Impacts

The rating system is applied to the potential impact on the receiving environment and includes an objective evaluation of the possible mitigation of the impact. Impacts have been consolidated into one (1) rating. In assessing the significance of each issue the following criteria (including an allocated point system) is used:

Table 23: Rating of Impacts Criteria

ENVIRONMENTAL PARAMETER		
A brief description of the environmental aspect likely to be affected by the proposed activity (e.g. Surface Water).		
ISSUE / IMPACT / ENVIRONMENTAL EFFECT / NATURE		
Include a brief description of the impact of environmental parameter being assessed in the context of the project. This criterion includes a brief written statement of the environmental aspect being impacted upon by a particular action or activity (e.g. oil spill in surface water).		
EXTENT (E)		
This is defined as the area over which the impact will be expressed. Typically, the severity and significance of an impact have different scales and as such bracketing ranges are often required. This is often useful during the detailed assessment of a project in terms of further defining the determined.		
1	Site	The impact will only affect the site
2	Local/district	Will affect the local area or district
3	Province/region	Will affect the entire province or region
4	International and National	Will affect the entire country
PROBABILITY (P)		
This describes the chance of occurrence of an impact		
1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
2	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).
3	Probable	The impact will likely occur (Between a 50% to 75% chance of occurrence).
4	Definite	Impact will certainly occur (Greater than a 75% chance of occurrence).
REVERSIBILITY (R)		
This describes the degree to which an impact on an environmental parameter can be successfully reversed upon completion of the proposed activity.		
1	Completely reversible	The impact is reversible with implementation of minor mitigation measures

2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible and no mitigation measures exist.
IRREPLACEABLE LOSS OF RESOURCES (L)		
This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.		
1	No loss of resource.	The impact will not result in the loss of any resources.
2	Marginal loss of resource	The impact will result in marginal loss of resources.
3	Significant loss of resources	The impact will result in significant loss of resources.
4	Complete loss of resources	The impact is result in a complete loss of all resources.
DURATION (D)		
This describes the duration of the impacts on the environmental parameter. Duration indicates the lifetime of the impact as a result of the proposed activity.		
1	Short term	The impact and its effects will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase (0 – 1 years), or the impact and its effects will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	Medium term	The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
3	Long term	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 50 years).
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered transient (Indefinite).
INTENSITY / MAGNITUDE (I / M)		
Describes the severity of an impact (i.e. whether the impact has the ability to alter the functionality or quality of a system permanently or temporarily).		
1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
2	Medium	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).

3	High	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.
4	Very high	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired (system collapse). Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.

SIGNIFICANCE (S)

Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. This describes the significance of the impact on the environmental parameter. The calculation of the significance of an impact uses the following formula:

Significance = (Extent + probability + reversibility + irreplaceability + duration) x magnitude/intensity.

The summation of the different criteria will produce a non-weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.

Points	Impact Significance Rating	Description
5 to 23	Negative Low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
5 to 23	Positive Low impact	The anticipated impact will have minor positive effects.
24 to 42	Negative Medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
24 to 42	Positive Medium impact	The anticipated impact will have moderate positive effects.
43 to 61	Negative High impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
43 to 61	Positive High impact	The anticipated impact will have significant positive effects.
62 to 80	Negative Very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
62 to 80	Positive Very high impact	The anticipated impact will have highly significant positive effects.

The table below is to be represented in the Impact Assessment section of the report.

Table 24: Rating of impacts template and example

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Construction Phase																				
Vegetation and protected plant species	Vegetation clearing for access roads, turbines and their service areas and other infrastructure will impact on vegetation and protected plant species.	2	4	2	2	3	3	39	-	Medium	**Outline/explain the mitigation measures to be undertaken to ameliorate the impacts that are likely to arise from the proposed activity. These measures will be detailed in the EMPr.**	2	4	2	1	3	2	24	-	Low
Operational Phase																				
Fauna	Fauna will be negatively affected by the operation of the wind farm due to the human disturbance, the presence of vehicles on the site and possibly by noise	2	3	2	1	4	3	36	-	Medium	**Outline/explain the mitigation measures to be undertaken to ameliorate the impacts that are likely to arise from the proposed activity. These**	2	2	2	1	4	2	22	-	Low

	generated by the wind turbines as well.										**measures will be detailed in the EMPr.**									
Decommissioning Phase																				
Fauna	Fauna will be negatively affected by the decommissioning of the wind farm due to the human disturbance, the presence and operation of vehicles and heavy machinery on the site and the noise generated.	2	3	2	1	2	3	30	-	Medium	**Outline/explain the mitigation measures to be undertaken to ameliorate the impacts that are likely to arise from the proposed activity. These measures will be detailed in the EMPr.**	2	2	2	1	2	2	18	-	Low
Cumulative																				
Broad-scale ecological processes	Transformation and presence of the facility will contribute to cumulative habitat loss and impacts on broad-scale ecological processes such as fragmentation.	2	4	2	2	3	2	26	-	Medium	**Outline/explain the mitigation measures to be undertaken to ameliorate the impacts that are likely to arise from the proposed activity. These measures will be detailed in the EMPr.**	2	3	2	1	3	2	22	-	Low

Appendix C:

Risk Assessment Protocol Matrix Results

SiVEST Environmental Division
Northview Building, Bush Shrike Close, Victoria Country Club Office Estate, 170 Peter Brown Drive
Montrose, Pietermaritzburg 3201. South Africa
PO Box707, Msunduzi.3231. South Africa

Tel + 27 33 347 1600
Fax +27 33 347 5762
Email info@sivest.co.za
www.sivest.co.za

Contact Person: Stephen Burton
Cell No.: +27 83 795 2804
Email: stephenb@sivest.co.za