DRAFT ENVIRONMENTAL IMPACT ASSESSMENT REPORT

APPLICATION FOR ENVIRONMENTAL AUTHORIZATION
GOVERNMENT NOTICE REGULATIONS
GNR 543, GNR 544, GNR 545 AND GNR 546
NATIONAL ENVIRONMENT MANAGEMENT ACT 1998

for

A 75MW PHOTOVOLTAIC ELECTRICITY GENERATION FACILITY
and
A SUBSTATION AND 132 KV POWERLINE OF APPROXIMATELY 1KM TO FEED THE ELECTRICITY GENERATED INTO THE EXISTING ARIES SUBSTATION

on

PORTION 12 OF FARM 187 OLYVENKOLK, KENHARDT DISTRICT

Prepared for: Wine Estate Capital Management
P.O. Box 204
Wellington
7654
Tel: 021 873 6682
Fax: 086 605 3006
michael.stoeltzing@greencontinent.com

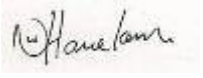
Prepared by: Eco Impact Legal Consulting (Pty) Ltd
P.O. Box 45070
Claremont
South Africa
7735
Tel: 021 671 1660;
Fax: 088 021 671 1660
Email: admin@ecoimpact.co.za

DEA REFERENCE NUMBER: 14/12/16/3/3/2/343
NEAS REFERNCE NUMBER: DEA/EIA0001219/2012

DECEMBER 2012

PROJECT DETAILS

Title: Wine Estate Capital Management Draft Environmental Impact Assessment Report.		
Eco Impact No: 1 - 122012	**Date:** December 2012	**Report Status:** Draft
Carried Out By: Eco Impact Legal Consulting (Pty) Ltd P.O. Box 45070 Claremont 7735 Tel: 021 671 1660; Fax: 088 021 67 11660 E-mail: admin@ecoimpact.co.za	**Commissioned By:** Mr Michael Stoeltzing P.O. Box 204 Wellington 7654 Tel: 021 873 6682 Fax: 086 605 3006 E-mail: michael.stoeltzing@green-continent.com	**Client:** Wine Estate Capital Management P.O. Box 204 Wellington 7654 Tel: 021 873 6682 Fax: 086 605 3006 E-mail: michael.stoeltzing@green-continent.com
Author: Nicolaas Hanekom	**Client Contact Person:** Mr Michael Stoeltzing	
© COPYRIGHT: Eco Impact Legal Consulting (Pty) Ltd		

Verification	Capacity	Name	Signature	Date
Author	Principle EAP	Nicolaas Hanekom		7 December 2012
Authorized By:	Director	Mark Duckitt		7 December 2012

APPENDICES

GLOSSARY OF TERMS

“Alluvial” Resulting from the action of rivers, whereby sedimentary deposits are laid down in river channels, floodplains, lakes, depressions etc

“Alternating Current (AC)” type of electrical current, the direction of which is reversed at regular intervals or cycles. Electricity transmission networks use AC because voltage can be controlled with relative ease.

"Activity" means an activity identified in Government Notice Numbers. R. 544, 545 and 546 of 2010 as a listed activity.

"Alternatives", in relation to a proposed activity, means different means of meeting the general purpose and requirements of the activity, which may include alternatives to property, activity, design or technology.

"Applicant" means a person who has submitted or intends to submit an application;

"Application" means an application for an environmental authorization in terms of Chapter 3 of the Environmental Impact Assessment Regulations, 2010.

"Associated Infrastructure" means any building or infrastructure that is necessary for the functioning of a facility or activity or that is used for an ancillary service or use from the facility.

“Biodiversity” The variety of life in an area, including the number of different species, the genetic wealth within each species, and the natural areas where they are found.

“Borehole” Includes a well, excavation or any artificially constructed or improved underground cavity which can be used for the purpose of:

- intercepting, collecting or storing water in or removing water from an aquifer;
- observing and collecting data and information on water in an aquifer; or
- recharging an aquifer.

“Climate Change” Climate change means a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.

“Cultural significance” This means aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance.

"Cumulative impact" in relation to an activity, means the impact of an activity that in itself may not be significant but may become significant when added to the existing and potential impacts eventuating from similar or diverse activities or undertakings in the area.

"Environmental impact assessment' in relation to an application to which scoping must be applied, means the process of collecting, organizing, analyzing, interpreting and communicating information that is relevant to the consideration of that application.

“Direct Current” A type of electricity transmission and distribution by which electricity flows in one direction through the conductor, usually associated with relatively low voltage and high current.

“Distribution” The electricity network infrastructure operating at nominal voltage of 132 kV or below.

“Environment” The environment has been defined as “The external circumstances, conditions and objects that affect the existence and development of an individual, organism or group”. These circumstances include biophysical, social, economic, historical, cultural and political aspects.

“Environmental Assessment Practitioner” Person or company, independent of the applicant (developer), that manages the environmental assessment process of a proposed project on behalf of the applicant.

“Environmental Impact Report” In-depth assessment of impacts associated with a proposed development. This forms the second phase of an Environmental Impact Assessment and follows on from the Scoping Report.

"Environmental management plan" means an environmental management plan in relation to identified or specified activities envisaged in Chapter 5 of the National Environmental Management Act and described in regulation 34;

“Heritage resources” This means any place or object of cultural significance. It also includes archaeological resources.

“Hydromorphic / hydric soil” Soil that in its undrained condition is saturated or flooded long enough during the growing season to develop anaerobic conditions favouring growth and regeneration of hydrophytic vegetation. These soils are found in and associated with wetlands.

“Independent Power Producer” Any undertaking by any person or entity, in which the government of South Africa does not hold a controlling ownership interest (direct or indirect), of new energy generation capacity at a generating facility following a determination made by the Minister in terms of section 34(1) of the Electricity Regulation Act (4 of 2006).

"Interested and Affected Party" means an interested and affected party contemplated in section 24(4) (d) of the Act, and which in terms of that section includes -
(a) any person, group of persons or organization interested in or affected by an activity; and
(b) any organ of state that may have jurisdiction over any aspect of the activity;

“Kilovolt (kV)” a unit of electric potential equal to a thousand volts (a volt being the standard unit of electric potential. It is defined as the amount of electrical potential between two points on a conductor carrying a current of one ampere while one watt of power is dissipated between the two points).

“Photovoltaic Module” The smallest environmentally protected, essentially planar assembly of solar cells and ancillary parts, such as interconnections, terminals intended to generate DC power under unconcentrated sunlight.

“Photovoltaic cell” The smallest semiconductor element within a PV module to perform the immediate conversion of light into electrical energy.

"Public Participation Process" means a process in which potential interested and affected parties are given an opportunity to comment on, or raise issues relevant to, specific matters; *"Registered Interested and Affected Party", in relation to an application, means an interested and affected party whose name is recorded in the register opened for that application in terms of regulation 57.*

“Red Data species” All those species included in the categories of endangered, vulnerable or rare, as defined by the International Union for the Conservation of Nature and Natural Resources.

“Renewable Feed-In Tariff” A tariff approved by NERSA for a renewable energy generator or cogeneration.

“Riparian” The area of land adjacent to a stream or river that is influenced by stream induced or related processes.

“Scoping Report” An “issues-based” report which forms the first phase of an Environmental Impact Assessment process.

“Study corridor” The corridors identified after initial investigation of technical and environmental attributes of the total study area which will then be assessed in more detail to identify a route corridor.

"Significant impact" means an impact that by its magnitude, duration, intensity or probability of occurrence may have a notable effect on one or more aspects of the environment;

“Substation” A collection of equipment for the purpose of raising, lowering and regulating the voltage of electricity.

"The Act" means the National Environmental Management Act, 1998 (Act No.107 of 1998).

“Transmission” The electricity network infrastructure operating at nominal voltage of 275 kV, 400kV or 765kV or below.

ABBREVIATIONS

BID: Background Information Document
DME: Department of Minerals and Energy
DEA: Department of Environmental Affairs
DWA: Department of Water Affairs
EAP : Environmental Assessment Practitioner
ECO: Environmental Control Officer
EMP: Environmental Management Programme
ENPAT: Environmental Potential Atlas
EIA: Environmental Impact Assessment
EIR: Environmental Impact Report
FSR: Final Scoping Report
NCBCP: Northern Cape Biodiversity Conservation Plan
NCDEANC: Northern Cape Department of Environmental Affairs and Nature Conservation
GDP: Gross Domestic product
GHG: Greenhouse Gases
GIS: Geographic Information System
GPS: Global Positioning System
HIA: Heritage Impact Assessment
I&APs: Interested and Affected Parties
IDP: Integrated Development Plan
IEP: Integrated Energy Plan
IPP: Independent Power Producer
IRP: Integrated Resource Plan
ISEP: Integrated Strategic Electricity Planning
Kwh: Kilowatt hour
MAR: Mean annual rainfall
MW: Megawatt
MWp: Megawatt peak
NEMA: National Environmental Management Act
NEMBA: National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004)
NEM:WA: National Environmental Management: Waste Act
NEM:AQA: National Environmental Management: Air Quality Act
NERSA: National Energy Regulator of South Africa
NERP: National Energy Response Plan
NHRA: National Heritage Resources Act
NIRP: National Integrated Resource Plan
NSBA: National Spatial Biodiversity Assessment
NWA: National Water Act, 1998 (Act No. 36 of 1998)
PPA: Power Purchase Agreement
PPP: Public Participation Process
PV: Photovoltaic
PHRA: Provincial Heritage Resources Agency
REFIT: Renewable Energy Feed-In Tariff
SACNASP: South African Council for Natural Scientific Professions
SANBI: South African National Biodiversity Institute
SDF: Spatial development Framework
SG: Surveyor General
SIA: Social Impact Assessment
ToR: Terms of Reference
NER: National Electricity Regulator
VIA: Visual Impact Assessment

EXECUTIVE SUMMARY

Wine Estate Capital Management is proposing the establishment of commercial solar electricity generating facilities and associated infrastructure on Portion 12 of Farm 187 Olyvenkolk, Kenhardt District. The solar facility intends to accommodate a photovoltaic component and associated infrastructure on the proposed site. The proposed site for the Wine Estate Capital Management Photovoltaic Electricity Generation Facility was identified through an extensive site selection process which took several conditions such as climatic conditions, topography and grid connection into consideration.

The proposed facility will consist of several arrays of photovoltaic (PV) panels using Polycrystalline and thin-film solar cell technology with a generating capacity of approximately 75 MW and associated infrastructure. These units comprise blocks of photovoltaic arrays, mounted on pedestals, with a converter unit and supported by associated infrastructure, permanent and temporary. Each converter unit has its own step-up transformer. These transformers will be fed to a central point of connection consisting of switch gear and protection infrastructure. Electricity is fed to the ESKOM 132 kV network via this point of connection, which will be situated on the southern edge of the electricity generation facility.

The panels will be mounted on the ground using a ground screw. A concrete foot piece secured to a steel pen driven into the ground will be used where it is not feasible to use ground screws. The geo-technical assessment tests indicate that screws up to a depth of 1.8m can be installed. A small substation with infrastructure will feed the electricity generated into the Aries substation. A portion of the ground mounted solar panels will be equipped with so called sun-trackers. This means that the solar panels will follow the sun in order to increase the efficiency of the panel.

A 5m management road surrounds each block totalling ±8km of gravel road. These single track management roads will be used as access to service and maintain structures and to serve as fire breaks. The facility and associated infrastructure will be accessed on a 6m wide gravel road with direct access off the Kenhardt to Pofadder gravel road. Services infrastructure will be as follows:

The proposed Wine Estate Capital Management Photovoltaic Electricity Generation Facility comprises of:

- Solar panels arranged in units with a generating capacity of approximately 75 MW with a total footprint of approx. 244.99ha;
- A substation with a approximate footprint of 3000 m^2 and 132 Kv powerline of approximately 1km to feed the electricity generated into the existing Aries substation.

In the case of the proposed Wine Estate Capital Management solar energy facility on Farm 187/12 near Kenhardt in the Northern Cape, it is expected that archaeological impacts will be limited to the important quarry site (260) on the high point overlooking the floodplain. Larger numbers of tools, including Site 393, tend to concentrate or cluster around the drainage lines, but these remains mostly occur within the 32 m buffer and will not be directly impacted by the proposed development.

Archaeological remains occur over the remainder of the footprint area, but the density of remains is overall quite low, and the form and types of tools are fairly homogenous across a vast expanse of space that is not only limited to the site of the proposed solar energy facility.

Indications are that the proposed development of a 75 MW solar energy farm on the Farm Olyvenkolk 187/12 near Kenhardt will have a limited impact on the archaeological heritage, and that potentially significant impacts on Site 260 and Site 393 can be easily mitigated.

The overall impact on **soil and agricultural potential (inclusive of land reform)** during the construction and operation is likely to be of **low significance** given the implementation of the recommended mitigation measures. The site is dominated by quaternary to recent sands and sandy soil of the Gordonia Formation (Kalahari Group) and Mbizane Formation (Permo-Carboniferous Dwyka Group, Karoo Supergroup) which is stony/rocky. The agricultural sector in the area is the main economic sector with the largest potential for economic growth. The area is also ideal for small stock farming and the area around Kenhardt is known as the capital of Dorper sheep farming. The area has a carrying capacity to the order of 1 small stock unit per 6ha. The farmer currently stocks 118 ewes on this cadastre. The sterilization of the area will allow the farmer to stock fewer ewes on this section of the farm. The solar electricity generation facility will impact on a 280ha camp. The proposed facility site is situated in the southern corner of the cadastre and farm. The camp fence will have to be realigned.

The overall impact on **ecology** is likely to be of a **low significance** given the implementation of mitigation measures. The habitats, such as drainage lines and rare endangered species (species protected in terms of the Treatened or Protected Species regulations) are being regarded as of high importance in terms of ecological sensitivity. The proposed facility will not impact on any of these high ecologically sensitive areas, including the set buffer area.

The overall **social and socio-economic** impact in terms of positive and negative impacts is likely to be of a **low significance** during both the construction and operational phases with the implementation of enhanced/mitigation measures. The potential negative impacts associated with the construction phase are typical of construction related projects and are expected to respond to the mitigation measures proposed. The possible job creation and skills development aspects are regarded as a **significant positive** injection into the area. The project will result in significant positive economic spin-offs for the local area and region primarily because of the labour intensive operational practices that will be associated with it.

The facility will be partly visible from an intermediate area. The greatest visual impact is restricted to relative short distance of ±5km along the bypassing public road, by and large only apparent to motorists approaching the facility from an eastern direction. The landscape can visually absorb only small to medium size changes. Facility is occasionally visually noticeable by viewer. No existing tourism facilities exist in the region. Potential tourists attracted to the area by the accommodation facilities to be developed on land to the south, will have a positive attitude and low sensitivity to the visual impact of the proposal. Facility is partly recognisable by viewer. The proposed facility maintains a very low profile and follows the natural lay of the land. Facility fits only partially into surroundings. The Aries substation and associated transmission lines, as well as other similar facilities authorized in the direct vicinity of the proposal, sets a precedent for the development of similar activities in the area. The significance of the visual impact can be classified as **moderate** inclined to **low** on condition that the mitigation measures as specified are implemented. This conclusion is reached as a result of the positive effect mitigation has on all VIAC (visual impact assessment criteria).

The establishment of the facility will have positive benefits as the integration of an additional 75 MW may alleviate the pressure on the local and national grid to a small extent and would contribute (albeit small) to the national target of renewable energy. Therefore, based on the

findings of the studies undertaken, in terms of environmental constraints identified through the initial Environmental Assessment process, **no environmental fatal flaws** were identified with the establishment of the proposed PV plant and it is recommended that the project should be authorised. However, a number of issues requiring mitigation have been highlighted.

1. INTRODUCTION

This report has been prepared in compliance with the requirements of Regulations contained in Government Notices No's GNR 543, GNR 544, GNR 545 and GNR 546 as promulgated in terms of the National Environmental Management Act 107 of 1998, known as the Environmental Impact Assessment **(EIAA)** Regulations.

The purpose of these Regulations is to regulate procedures and set criteria as contemplated in Chapter 5 of the Act to enable the submission, processing, consideration and decision making regarding applications for environmental authorization of activities and matters pertaining thereto.

1.1 Background and Purpose of the Environmental Impact Report

Wine Estate Capital Management is proposing the establishment of commercial solar electricity generating facilities and associated infrastructure on Portions 12 of Farm 187, Kenhardt, Northern Cape.

The solar facility intends to accommodate a Photovoltaic component and associated infrastructure on the proposed site. The proposed site for the Wine Estate Capital Management Photovoltaic Electricity Generation Facility was identified through an extensive site selection process which took several conditions such as climatic conditions, topography and grid connection into consideration.

Eco Impact Legal Consulting Pty Ltd (Eco Impact) have been appointed by Wine Estate Capital Management as the independent environmental assessment practitioner **(EAP)** for this project as required in terms of the regulations. Eco Impact will be managing the application for authorization, having already submitted an Application form to the Department of Environmental Affairs **(DEA)**, and will be preparing an EIA process application for submission to DEA.

The EIA will be evaluated by DEA who will either issue an Environmental Authorization (usually with conditions), or alternatively, refuse the application for authorization.

Wine Estate Capital Management propose the establishment of a 75 MW Photovoltaic plant to generate electricity to feed into the national grid. The project is also in line with the government's commitment to provide renewable energy as an alternative energy source to those currently utilized and in line with the Integrated Resource Plan (IRP) 2010 as amended.

1.2. Environmental Assessment Practitioner

This section of the report is included in compliance with Regulations 17 of R543.

This report has been rprepared by Nicolaas Hanekom of Eco Impact.

Mr Nicolaas Hanekom is a registered Professional Natural Scientist in the ecological science field with the South African Council for Natural Scientific Professions ("SACNASP") and a qualified EAP who holds a Masters Technologiae, Nature Conservation ("Vegetation Ecology and Biodiversity Assessment") degree from the Cape Peninsula University of Technology.

He further qualified in Environmental Management Systems ISO 14001:2004, at the Centre for Environmental Management, North-West University, as well as Environmental Management Systems ISO 14001:2004 Audit: Internal Auditors Course to ISO 19011:2003 level, from the Centre for Environmental Management, North-West University qualifying him to audit to ISO/SANS environmental compliance and EMS standards.

He has also completed the suite of Greener Governance courses with certificates in:

An Overview of Environmental Management at the Local Government Level, Centre for Environmental Management, North-West University;
Greener Governance for Local Authorities, Centre for Environmental Management, North-West University;
Tools for Integrated Environmental Management and Governance, Centre for Environmental Management, North-West University.

Mr Hanekom attended and obtained a certificate on Integrated Protected Area Planning at the Centre for Environmental Development, University of KwaZulu Natal and a certificate in Project Management (Theory and Practical), through CS Holdings. He has presented lectures in two subjects at the Cape Peninsula University of Technology. He has 14 years of environmental planning experience, working for Free State and Western Cape Departments of Environmental Affairs, where he reviewed and commented on development (EIA) applications in the West Coast Region.

Mr Hanekom has been responsible for many environmental impact assessments and several EIA applications, waste licence and atmospheric emission licence applications as well as being involved in the implementation of several environmental management systems.

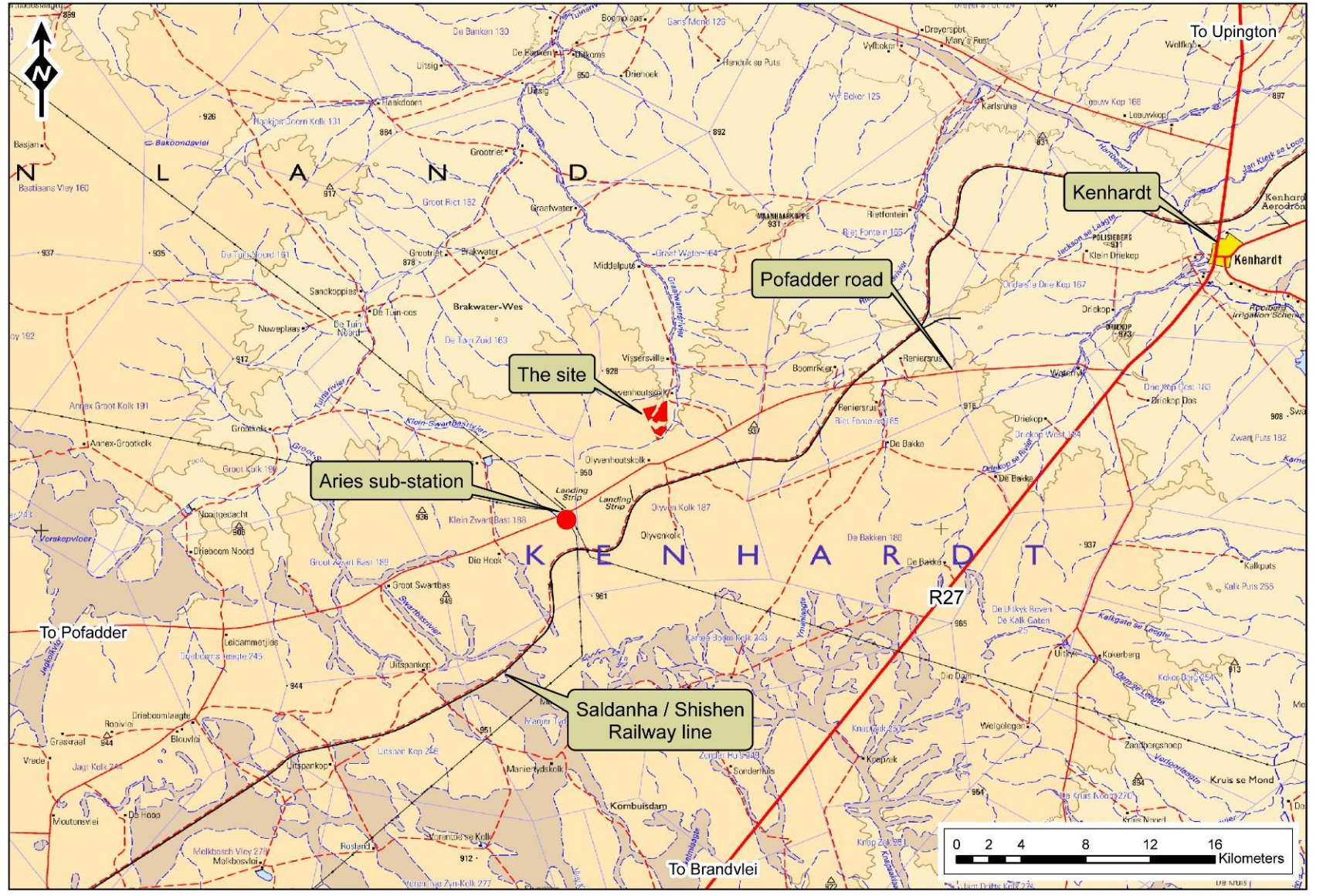


Figure 1: Locality Map

1.3. The EIA Process to Date

The current EIA process for the proposed development application was initiated by Eco Impact in July 2012. As required by the Regulation under NEMA, this initially consisted of a Scoping phase during which members of the public were notified of the process, and invited to submit comments and raise any issues and concerns. The purpose of the Scoping process was to identify the environmental impacts and range of feasible alternatives requiring more detailed investigation in the EIA. The Scoping process culminated in the compilation of a Scoping Report (Eco Impact 2012) containing the following information:

- A detailed background to the project;
- An overview of the legal requirements for the proposed activities;
- The terms of reference for the EIA, and overview of the approach to and scope of the environmental investigation;
- A description of the public participation process undertaken for the project;
- A detailed description of the proposed activities and the full range of identified project alternatives;
- An overview of the affected environment; and
- A summary of the potential environmental impacts identified by the public, literature review and professional inputs.

The Scoping Report outlined the full range of potential environmental impacts and feasible project alternatives and how these were derived. Moreover, included with the Scoping Report was a Plan of Study for EIA, which outlined in detail the proposed approach to the subsequent and final phase of the EIA process, *viz.* the (EIR) phase. The aforementioned documents were submitted to DEA and accepted.

We are now in the Environmental Impact Report (EIR) Phase of the EIA process, and the sequence of documents produced thus far are as follows:

- The Department of Environmental Affairs (DEA) Application Form, providing the formal application for the projects (As per GN R 543 under NEMA).
- The Draft and Final Scoping Reports, outlining the findings of the Scoping Process and reflecting public comment in this regard (As per GN R 354 under NEMA);
- The Plan of Study for EIA, describing the proposed approach to the Environmental Impact Report phase (As per GN R 543 under NEMA); and
- The Draft Environmental Impact Report (this report), which is being released for review by Interested and Affected Parties (I&APs), (As per GN R 543 under NEMA).

1.4. Structure and Scope of this Report

As outlined above, the EIA process undertaken to date has culminated in the production of a comprehensive Scoping Report which provides detailed information relevant to the project. However, for the sake of being succinct, information contained within the Scoping Report is not repeated within this EIR unless it has direct bearing on the issues under discussion. **Accordingly, to ensure a holistic understanding of the project, the nature of the activities and the substance of the environmental process, it is critical that this EIR is read in conjunction with the Final Scoping Report** (Eco Impact 2012*).*

The structure of this EIR has been informed by the Department of Environmental Affairs (DEA) EIR guidelines (DEAT, 2006a, and NEMA GNR 543, R31,(2), and the need for a clear and succinct document to facilitate informed decision-making by the applicant and environmental authorities in compliance with Regulations 31(2) of R543.
This section of the report is included in compliance with Regulations 31(2) of R543.

The EIR contains the following information:

- Details of the EAP who compiled the report and the expertise of the EAP to carry out an environmental impact assessment
- A detailed description of the proposed activity
- A description of the property on which the activity is to be undertaken and the location of the activity on the property
- A description of the environment that may be affected by the activity and the manner in which the physical, biological, social, economic and cultural aspects of the environment may be affected by the proposed activity
- Details of the public participation process conducted
- A description of the need and desirability of the proposed activity
- A description of identified potential alternatives to the proposed activity, including advantages and disadvantages that the proposed activity or alternatives may have on the environment and the community that may be affected by the activity
- An indication of the methodology used in determining the significance of potential environmental impacts
- A description and comparative assessment of all alternatives identified during the environmental impact assessment process
- A summary of the findings and recommendations of any specialist report or report on a specialised process
- A description of all environmental issues that were identified during the environmental impact assessment process, an assessment of the significance of each issue and an indication of the extent to which the issue could be addressed by the adoption of mitigation measures
- An assessment of each identified potentially significant impact, including cumulative impacts, the nature of the impact, the extent and duration of the impact, the probability of the impact occurring, the degree to which the impact can be reversed, the degree to which the impact may cause irreplaceable loss of resources, and the degree to which the impact can be mitigated
- A description of any assumptions, uncertainties and gaps in knowledge
- A reasoned opinion as to whether the activity should or should not be authorised, and if the opinion is that it should be authorised, any conditions that should be made in respect of that authorisation
- An environmental impact statement which contains a summary of the key findings of the environmental impact assessment, and a comparative assessment of the positive and negative implications of the proposed activity and identified alternatives
- A draft environmental management programme
- Copies of any specialist reports and reports on specialized processes
- Any specific information that may be required by the competent authority

FULL EIA PROCESS				
		NEMA REGULATIONS Department of Environmental Affairs and Development Planning	LAND USE PLANNING ORDINANCE SWARTLAND MUNICIPALITY & WEST COAST DISTRICT MUNICIPALITY	Date
Scoping Phase	Stage 1	SETUP PROJECT		
	Stage 2	Preliminary Scoping with Authorities and Key Stakeholders • Review existing information • Identify issues/concerns • Identify key Stakeholders • Meet Authorities as necessary	Site Analysis and Assessment Specialist Analysis and Assessment	
	Stage 3	PREPARE DETAILED CONCEPTUAL DEVELOPMENT FRAMEWORK		
		Prepare BID Advertise in terms of NEMA Regulations		
		AMEND CONCEPTUAL DEVELOPMENT FRAMEWORK		
		Prepare Draft Scoping Report Advertise in terms of NEMA Regulations.		
		Finalise Scoping Report and Submit to DEA&DP		
Environmental Impact Assessment Phase	Stage 4	PREPARE DETAIL DESIGN AND LAYOUT PROPOSALS		
		Prepare Draft EIA Report	Prepare LUPO Application	
	Stage 5		Submit LUPO Application To Swartland Municipality	
		ADVERTISE IN TERMS OF NEMA REGS, NHRA & LUPO		
	Stage 6	AMEND DETAIL DESIGN AND LAYOUT PROPOSALS		
		Finalise EIA Report and submit to DEA&DP	Submit Comment and Objections and Amended Layout	
Authorization Phase	Stage 7	Authorization with conditions		
			Decision with Conditions	

Table 1: EIA Process Flow

1.5. Approach to the Project

1.5.1. The EIR phase

As outlined in the Scoping Report, there are three distinct phases in the EIA process, as required in terms of the NEMA, namely the Initial Application, the Scoping Report and the EIR phases (refer to Table 1.1 for an overview of these phases). This Report covers the final phase, *viz.* the EIR phase. The Initial Application phase entailed the submission of the Application Form, whilst the Scoping Report phase entailed the compilation and submission of the Scoping Report and Plan of Study for EIA.

The purpose of the EIR is to describe and assess the range of feasible alternatives identified during the Scoping process in terms of the potential environmental impacts identified. The ultimate purpose of the EIR is to provide a basis for informed decision-making, firstly by the applicant with respect to the option they wish to pursue, and secondly by the environmental authority regarding the environmental acceptability of the applicant's preferred option.

The approach to the EIR phase entailed the following:

- Undertaking a further review of relevant literature;
- Appointing various specialists to undertake the specialist studies identified during the Scoping Report phase:
- Nicolaas Hanekom - Eco Impact - Environmental Assessment Practitioners as EAP, Biodiversity and Ecological Specialist, Agricultural Specialist and Water Use License

Applications.

- Dr John Almond - NATURA VIVA cc - Palaeontological Impact Assessments & Heritage Management, Natural History Education, Tourism, Research
- Johann Strauss – Electrical Engineer – Stellenbosch University – Grid Connections.
- Anelia Coetzee and Evelynn Oppelt - Leap Sustainable Development and E& E Resources – Socio- Economic Study
- Jonathan Kaplan – Agency for Cultural Resource Management – Archaeological Impact Assessment.
- Martin Langenhoven and Dr Piet Groenewald – Visual Impact Assessment
- SKCM Consulting Engineers – Geo-Technical Assessment and Flood Line Determination

Consultation with the public forms an integral component of this investigation and enables I&APs *e.g.* landowners, local authorities, businesses, informal traders, environmental groups, civic associations and communities, to comment on the potential environmental impacts associated with the feasible alternatives and to identify additional issues which they feel have not been adequately addressed in the EIR. A detailed summary of the public participation process, and the comments submitted by I&APs, is provided in Section 5.

1.5.2. Authority involvement

In accordance with the requirements of Regulation 543, a Scoping Report and a Plan of Study for EIA for the proposed project were compiled and submitted to the competent authorities.

1.5.3 Decision making

Once the Final EIR has been completed and all I&AP comments have been incorporated into the report, the EIR will be submitted to the client for their review. Based on the findings of the EIR, as well as other financial and technical considerations the applicant will decide which options they would like to pursue for the proposed activities. The EIR, together with the applicant's motivating for their preferred options, will be submitted to DEA for their review and decision.

Once they have reviewed the document and are satisfied that it contains sufficient information to make an informed decision, DEA will determine the environmental acceptability of the applicant's preferred options. Thereafter DEA will issue an Environmental Authorization outlining their decision. Following the issuing of the Environmental Authorization, DEA's decision will be communicated by means of letters to all identified I&APs and there will be a 20-day appeal period within which I&APs will have an opportunity to appeal against the decision to the Minister of the Department of Environmental Affairs in terms of the NEMA.

1.6 Assumptions and Limitations

In undertaking this investigation and compiling the Scoping Report and EIR, the following has been assumed:

- The information provided by the client, engineers and specialists is accurate and unbiased.
- The scope of this investigation is limited to assessing the environmental impacts associated with the development.
- Should the proposed project be authorised, the applicant will incorporate the

recommendations and mitigation measures outlined in the EIR into the detailed design and construction contract specifications and operational management system for the proposed project.

2. The Legal Framework For Renewable Energy In South Africa

Allocation of applicable environmental legislation as at 28 February 2011

Environmental Legislation	Description of Activity
Kai !Garib Municipality: Antenna By-law	Erection of antennae or satellite dishes
Kai !Garib Municipality: Construction of Buildings By-law	The construction of buildings
Kai !Garib Municipality: Fire Service By-law	Storage of combustible materials and gas filled devices
Kai !Garib Municipality: Electricity By-law	Electricity generation and consumption
Kai !Garib Municipality: Removal of Waste By-law	Generation, transportation, removal and disposal of waste
Kai !Garib Municipality: Advertising By-law	Commercial advertising which may have an environmental impact
ATMOSPHERIC POLLUTION PREVENTION ACT, 45 OF 1965 Regulations only	Activities that result in emissions of dust, vehicle emissions and noxious or offensive gasses.
CONSERVATION OF AGRICULTURAL RESOURCES ACT, 43 OF 1983	Weeds and the tolerance thereof, which applies in both urban and other areas.
FERTILIZERS, FARM FEEDS, AGRICULTURAL REMEDIES AND STOCK REMEDIES ACT, 36 OF 1947 and relevant regulations	Activities associated with pest control and the use of agricultural remedies.
HEALTH ACT, 63 OF 1977	Littering and causing a nuisance
HAZARDOUS SUBSTANCES ACT, 15 OF 1973 and relevant Regulations	The storage and/or use of substances which may cause injury or ill-health to or death of human beings by reason of their toxic, corrosive, irritant, strongly sensitizing or flammable nature or the generation of pressure thereby in certain circumstances, and for the control of certain electronic products and radioactive material.
NATIONAL BUILDING REGULATIONS AND BUILDING STANDARDS ACT, 103 OF 1977 and relevant regulations	The erection of new buildings.
NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 107 OF 1998 and relevant regulations	Various general activities, too numerous to list, including but not limited to the control of emergency incidents and the care and remediation of environmental damage. Listed activities that trigger the requirement for an environmental authorization
NATIONAL ROAD TRAFFIC ACT, 93 OF 1996 and relevant regulations	Driving on public roads and in particular, the transportation of certain dangerous goods.

NATIONAL WATER ACT, 36 OF 1998 and relevant regulations	The use of water, including any water purification and effluent treatment facilities, dams and irrigation systems.
NATIONAL ENVIRONMENTAL MANAGEMENT: AIR QUALITY ACT, 39 OF 2004 and relevant regulations	Activities that may affect the air quality on site and the environment surrounding it.
WATER SERVICES ACT, 108 OF 1997 and relevant regulations	The use of water and sanitation services of a water services provider.
NATIONAL ENVIRONMENTAL MANAGEMENT: BIODIVERSITY ACT, 10 OF 2004 Threatened or Protected Species Regulations.	Threatened or Protected Species and vegetation types identified under National Spatial Biodiversity Assessment.

2.1 Policy and Planning Context for Solar Energy in South Africa

2.1.1 White Paper and the Renewable Energy Policy of the Republic of South Africa, 1998

The White Paper on Renewable Energy pledges *"Government support for the development, demonstration and implementation of renewable energy sources for both small and large-scale applications"*. Its sets out the policy principles, goals and objectives to achieve:
An energy economy in which modern renewable energy increases its share of energy consumed and provides affordable access to energy throughout South Africa, thus contributing to sustainable development and environmental conservation.

An energy economy in which modern renewable energy increases its share of energy consumed and provides affordable access to energy throughout South Africa, thus contributing to sustainable development and environmental conservation. South Africa currently relies heavily on coal to meet its energy needs. It is a relatively low-cost means of supplying electricity to many residential, commercial and institutional consumers. However, conscious of the concerns around the use of fossil fuels and global warming, the need to utilise renewable energy resources more has been recognised. The Department of Minerals and Energy (DME) has thus embarked on an Integrated Energy Plan (IEP) to develop the renewable energy resources, while taking safety, health and the environment into consideration.

The government has set the target of:
10 000 GWh (0.8 Mtoe) renewable energy contribution to final energy consumption by 2013, to be produced mainly from biomass, wind, solar and small-scale hydro. The renewable energy is to be utilised for power generation and non-electric technologies such as solar water eating and bio-fuels. The first round of preferred bidders has been finalized and contracts signed that will result in the construction of renewable electricity generation facilities that will feed into the ESKOM grid by June 2014.

Relevance to the Project
The White Paper is in support of renewable energy as indicated above and acknowledges that Projects such as this one could contribute to sustainable economic growth and development.

2.1.2 Integrated Resource Plan for Electricity, 2010-2030

The Integrated Resource Plan (IRP) is a long-term electricity capacity plan, which defines the need for new generation and transmission capacity for the country. The objective of the IRP is to develop a sustainable electricity investment strategy for generation capacity and transmission infrastructure for South Africa over the next twenty years.

The IRP is intended to:

- Improve the long term reliability of electricity supply through meeting adequacy criteria over and above keeping pace with economic growth and development;
- Ascertain South Africa's capacity investment needs for the medium term business planning environment;
- Consider environmental and other externality impacts and the effect of renewable energy technologies;

Relevance to the Project

The IRP 2010-2030 recognises renewable energy as a critical component of the energy mix going forward. There has however been criticism that the build up to renewable energy is slower than anticipated and that there is reliance on nuclear and coal for base load scenarios (Creamer, 2010). The Project has the potential to contribute 150 MW of solar-generated energy towards the national renewable energy targets.

2.1.3 Renewable Energy Feed-In Tariff (REFIT)

The NERSA Renewable Energy Feed-In Tariff (REFIT) Guidelines published in 2009 under the Electricity Regulation Act (Act 4 of 2006) guarantees attractive rates of payment for renewable energy sold back to the grid, thereby encouraging investment in the various sub-sectors of renewable energy and supporting the national renewable energy targets for 2013. The REFIT Phase I tariffs include quotas for wind, small hydro, landfill gas and concentrated solar power (CSP) and following public commentary was expanded to include additional technologies under REFIT Phase II. The REFIT Phase II tariffs include quotas for CSP: solar trough without storage and central tower, and photovoltaic systems: large ground or roof based and concentrating photovoltaic (CPV), biomass solid, and biogas. Recently, NERSA has published "Rules on Selection Criteria for Renewable Energy Projects under the REFIT Programme" which sets out criteria which renewable energy or cogeneration Independent Power producers (IPPs) must comply with to qualify for licences.

Relevance to the Project

REFIT provides incentives to renewable energy developers, renders the developments economically feasible, and will enable the achievement of national renewable energy targets. It is understood that the Project would be able to generate power for sale under the R3.94/kWh tariff for large solar grid-connected photovoltaic projects.

2.2 Energy Statutes

2.2.1 National Energy Act (34 of 2008)

This Act aims to ensure that diverse energy resources are available, in sustainable quantities and at affordable prices, to the South African economy in support of economic growth and poverty alleviation.

Relevance to the Project
The Act recognises that environmental management requirements are taken into account in planning and that increased generation of renewable energies is required.

2.2.2 Electricity Act, 41 of 1987
The objective of the Electricity Act, 41 of 1987, is to provide for the continued existence of the National Electricity Regulator and the control of the generation and supply of electricity and related matters. As such it takes over the functions of the previous Electricity Control Board and has as its objects, "…*to exercise control over the electricity supply industry so as to ensure order in the generation and sufficient supply of electricity*…". The functions of the Regulator include the issuing of licenses, determination of process, settling disputes, collecting information and related matters.

Relevance to the Project
The proposed development requires a generation licence from NERSA.

2.3 Environmental Statutes

2.3.1 Constitution of the Republic of South Africa (No. 108 of 1996)
The legal foundation for environmental law in South Africa originates in the Constitution of the Republic of South Africa, Act 108 of 1996. All environmental aspects should be interpreted within the context of the Constitution. The Constitution has enhanced the status of the environment by virtue of the fact that environmental rights have been established (Section 24) and because other rights created in the Bill of Rights may impact on environmental management.

Relevance to the Project
The Constitution is applicable in respect of all actions of the citizens of South Africa.

2.3.2 National Environmental Management Act (No. 107 of 1998) as amended
NEMA (107 of 1998) is the key legislation setting out the framework for environmental management in South Africa. The Act promotes cooperative environmental governance and establishes principles for decision-making on matters affecting the environment. NEMA is the primary legislation influencing the Scoping and EIA. Specifically, Chapter 5 deals with Integrated Environmental Management and promotes the application of appropriate tools. The "EIA Regulations" published in GN R543 of 18 Jume 2010 in terms of Section 24(5), 24M and 44 of NEMA require that certain activities listed in GN R544 and 546 of 18 June 2010 will require a "Basic Assessment", and those in GN R545 of 18 June 2010 will require a "Scoping and EIA" respectively before they can proceed.

Relevance to the Project
This project includes a number of listed activities which collectively form part of the proposal. Those activities falling under GN R545 trigger the requirement for a Scoping and EIA whilst those falling under GN R544 and 546 trigger a Basic Assessment.

Listed Activities associated with the proposed development for which Environmental Authorization is applied for.

Indicate the number and date of the relevant notice:	Activity No (s) (in terms of the relevant notice) :	Describe each listed activity as per project description[1]:
544, 18 June 2010	10 (i)	Electricity line connections to Aries Substation
544, 18 June 2010	11 (xi)	Solar panels within 32 m of watercourses.
544, 18 June 2010	18 (i)	Existing access roads upgrade and underground power cable connections through drainage lines.
544, 18 June 2010	38	Extensions at the ESKOM grid to feed electricity generated into network.
545, 18 June 2010	1	Photovoltaic Panels electricity generation in access of 20MW
545, 18 June 2010	15	Photovoltaic Panels electricity generation covering an area bigger than 20 ha
546, 18 June 2010	14	Clearing of natural vegetation to construct facility

2.3.3 National Heritage Resource Act (No. 25 of 1999)

Provincial Heritage Resources Agency (PHRAG) is tasked with protecting heritage resources of national significance. Under Section 38 of the National Heritage Resources Act, all new developments which will change the character of a site and which exceed an area of 5 000 m², must at the very preliminary stages of initiating such a development, notify the responsible heritage resources authority and furnish it with details regarding the location, nature and extent of the proposed development. The Heritage Impact Assessment (HIA) may be carried out as part of the EIA, and must be carried out by a person or persons approved by the responsible heritage resources authority. The authorities must ensure that the EIA fulfils the Provincial Heritage Resources Agency (PHRAG) requirements, and that any comments and recommendations from PHRAG have been taken into account prior to the granting of the consent by the relevant authority. PHRAG is thus able to restrict and/or regulate development within a heritage environment.

Relevance to the Project

Section 38 of the NHRA states that Heritage Impact Assessments (HIAs) are required for certain kinds of development such as rezoning of land greater than 10 000 m^2 in extent or exceeding 3 or more sub-divisions, or for any activity that would alter the character or landscape of a site greater than 5,000 m^2. “Standalone HIAs” are not required where an EIA is carried out as long as the EIA contains an adequate HIA component that fulfils Section 38 provisions.

2.3.4 The National Water Act (No. 36 of 1998)

The National Water Act (Act 36 of 1998) is the fundamental law for managing South Africa’s water resources. The purpose of the Act is to ensure that water resources of the nation are protected, used, developed, conserved and controlled. It is concerned with the allocation of equitable access and the conservation of water resources within South Africa. The National Water Act (Act 36 of 1998) repeals many of the powers and functions of the Water Act (Act 54 of 1956). The proposed development is located an area with rivers and drainage lines. Under the National Water Act (No.36 of 1998), drainage lines and rivers are classified as water

[1] Please note that this description should not be a verbatim repetition of the listed activity as contained in the relevant Government Notice, but should be a brief description of activities to be undertaken as per the project description

resources, and as such are protected and should not be subjected to any pollution or damage. Thus, the proposed development should in no way disturb damage and alter the characteristics of wetlands on the site.

Relevance to the Project
Section 19 refers to pollution prevention and places responsibility on the person who owns controls or uses the land to take all reasonable measures to prevent pollution of a water resource from occurring, continuing to occur or recurring as a result of activities on land. Prescribed waste standard or management practices require compliance. Section 21 classifies "water use" in respect of requiring a license and these include (a) taking water from a water source; (i) altering the bed, banks, course or characteristics of a watercourse and (j) removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people. As the project may require the abstraction of water through boreholes on site, the relevant licensing or registration procedures may apply as set out in Sections 40-42.

2.3.5 The National Environmental Management: Biodiversity Act (No. 10 of 2004)
South Africa has ratified the International Convention on Biological Diversity, which commits the country to follow a strategy for the conservation, sustainable use and equitable sharing of the benefits of diversity, making this Act applicable to all proposed development applications. The National Environmental Management: Biodiversity Act (Act 10 of 2004**)** or NEMBA provides for the management and conservation of South Africa"s biodiversity within the framework of NEMA. This Act allows for the protection of species and ecosystems that warrant national protection, the sustainable use of indigenous biological resources, the fair and equitable sharing of benefits arising from bio-prospecting involving indigenous biological resources and the establishment and functions of the South African National Biodiversity Institute. Key elements of the Act are:

- The identification, protection and management of species of high conservation value;
- The identification, protection and management of ecosystems and areas of high biodiversity value;
- Alien invasive species control of which the management responsibility is directed to the landowner; and
- Section 53 of the Act identifies that any process or activity that is regarded as a threatening process in terms of a threatened ecosystem, requires environmental authorization via a full Environmental Impact Assessment.

Relevance to the Project
Chapter 4 in particular relates to threatened and protected ecosystems and species and related threatening processes and restricted activities. The EIA has taken into consideration those indigenous species listed as threatened or protected species in terms of Section 56(1) of the Act. In order to work within the framework of this Act, specialist ecological studies have been conducted for the study area. The specialist studies included:

- Vegetation
- red data species
- rivers

The results of these assessments influence the layout of the PV plant.

2.3.6 Conservation of Agricultural Resources Act (No. 43 of 1983) (CARA)
As part of a National strategy towards gaining control of invasive alien plant species and weeds, the Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983), as amended,

stipulates that landowners are legally responsible for the control of invasive alien plants on their properties. Alien plants are rendering agricultural land uses and therefore if weeds or invader plants occur contrary to the provisions of these regulations, the land user must control them by means of any of the control methods that are appropriate for the species concerned (Regulation 15). Any action taken to control weeds or invader plants must be executed with caution and in a manner that will have minimal environmental impact. The Act also deals with run-off control of surface water and control measures against erosion.

Relevance to the Project
Section 5 relates to the prohibition of the spreading of weeds and invader plants and Regulation 15 makes provision for these types of plants.

2.3.7 National Veld and Forest Fire Act (101 of 1998)

This Act serves a dual purpose being firstly established to prevent and combat veld, forest and mountain fires throughout South Africa. Secondly, the Act provides for a variety of institutions, methods and practices for achieving this purpose. It has numerous implications for fire prevention and fire fighting.

Every landowner on whose land a fire may start or burn or from where a fire may spread must prepare and maintain a firebreak on his/her side of the border between his/her land and all the neighbours. Therefore, there is a need for appropriate emergency response plans to be in place to respond to and combat fires associated with the proposed PV plant and its associated infrastructure. Appropriate fire breaks will be in place and be maintained.

Relevance to the Project
Section 12(1) relates to the duty of the landowner to prevent fire from spreading to adjoining properties. Although the veld on site is not prone to veld fires, fire prevention procedures have been set out in the Draft EMP to reduce the risk of fire and to respond accordingly during both construction and operational phases.

2.3.8 National Environmental Management: Waste Act (No 59 of 2008)

The National Environmental Management: Waste Act, No 59 of 2008 came into effect on 1 July 2009. The main objectives of the Waste Act are as follows:

- Promote an integrated approach in dealing with waste which focuses on prevention, minimization and responsible disposal of waste.
- Ensure that waste is properly managed in order to minimise its potential to cause damage to the socio-economic and bio-physical environments.

On 3 July 2009, a list of waste management activities that no person may commence with, unless a waste management license is issued in respect of that activity was published. The Waste Act states that, any person who wished to commence, undertake or conduct:

- an activity listed under Category A, must conduct a Basic Assessment process
- an activity listed under Category B, must conduct a Scoping and EIA process.

A waste license will not be required for this proposed development; however, all other principles of this Act must be complied with.

Relevance to the Project
Chapter 4 sets out waste management measures. In particular, Part 3 (reduction, re-use, recycling and recovery of waste) and Part 5 (storage, collection and transportation of waste) are of relevance to the construction phase of the Project and are referred to in the Draft EMP.

2.3.9 National Environmental Management: Air Quality Act (No. 39 of 2004)
The National Environmental Management: Air Quality Act (No 39 of 2004), Section 21 states that The Minister, or the MEC may by notice in the Gazette publish a list of activities which result in atmospheric emissions and which the Minister or MEC reasonable believes have or may have a significant detrimental effect on the environment, including health, social conditions, economic conditions, ecological conditions or cultural heritage. No listed emissions are anticipated from the proposed construction of a PV plant; however, the provisions of this Act must be considered.

Relevance to the Project
Section 32 and 34 set out measures relating to the control of dust and noise which would be applicable to the construction phase of the Project.

2.3.10 Occupational Health and Safety Act (85 of 1993)
This Act provides the legal framework for the health and safety of persons at work and for those in connection with the use of plant and machinery. According to the Act, the "health and safety standard" is defined as any standard, irrespective of whether or not the force of the law, which if applied for the purpose of this act will in the opinion of the Minister promote the attainment of an object of this Act.

Relevance to the Project
The Act is primarily aimed at ensuring the health and safety of persons at work and visitors and specifies the basic systems that need to be in place and measures that need to be taken. Section 9(1) in particular relates to the responsibility of the employers to provide and maintain as far as reasonably realistic a safe working environment that is not detrimental to the health of the employees and this would be applicable throughout the lifespan of the Project.

2.4 Guidelines

2.4.1 Guidelines published under NEMA
While compiling this Report the following Guidelines have been considered:
- DEAT (2002) Scoping, Integrated Environmental Management, Information Series 2, Department of Environmental Affairs and Tourism (DEAT), Pretoria.
- DEAT (2005) Guideline 3: General Guide to the Environmental Impact Assessment Regulations, 2005, Integrated Environmental Management Guideline Series, Department of Environmental Affairs and Tourism (DEAT), Pretoria.
- Guideline on Environmental Impact Assessments for Facilities to be Included in the Electricity Response Plan (NERP)
- Guideline on Public Participation
- Guidelines on Alternatives
- Guideline for Determining the Scope of Specialist Involvement in EIA Processes
- Guideline for Involving Biodiversity Specialists in EIA Processes
- Guideline for the Review of Specialist Input in EIA Processes
- Guideline for Involving Heritage Specialists in EIA Processes
- Guideline for Environmental Management Plans (EMP's)

- South African National Standards (SANS) 10328, Methods for environmental noise impact assessments in term of NEMA

2.4.2. Policies

National Spatial Development Framework

3. DESCRIPTION OF THE PROPERTY AND PROPOSED ACTIVITY

A description of the property and the proposed activity

The facility will be constructed next to the Aries ESKOM Substation southwest of the town Kenhardt, Northern Cape (See Figure 1) on a portion of Farm Olyvenkolk 187/12. The property where the facility is proposed covers a total area of approximately 245ha, the extent of which is larger than the space required for the facility's developmental footprint. The site falls within the quarter degree grid 2920BD. GPS readings as per Google - 29° 26‘ 29“S and 20° 50‘ 42“E.

The study site is situated approximately 37km southwest of Kenhardt, east of the Aries Eskom substation. The study area is north of the gravel road from Kenhardt to Pofadder. The gravel road turns west off the R27 south of the town Kenhardt. The Sishen Saldanha railway line runs over the southern portion of the study site. Existing infrastructure on the study area include a gravel landing strip, the farmyard houses and stores and the partly decommissioned Sishen Saldanha construction yard.

The proposed Wine Estate Capital Management Photovoltaic Electricity Generation Facility comprises of:

- Solar panels arranged in units with a generating capacity of approximately 75MW with a total footprint of approx. 245 ha;
- A substation with a approximate footprint of 3000 m^2 and 132 Kv powerline of approximately 1km to feed the electricity generated into the existing Aries substation.

Electricity Generated distribution to ESKOM Grid:

The Wine Estate Capital Management PV plant consists of several smaller PV blocks. At each of these blocks the DC input voltage from the PV panels is converted to AC by means of inverters. The AC output voltage from the inverter is then stepped up with a 400 V to 22 kV step-up transformer at each block. The electrical power is then transported via underground cables to a central point close to the Aries substation. At this central point the underground cables connect to a central busbar above ground through the relevant protection switch gear, isolators and measurement devices.

The Wine Estate Capital Management plant will be connected ESKOM grid via a 132 kV overhead transmission line.

The proposed facility is to consist of several arrays of photovoltaic (PV) panels using Polycrystalline and thin-film solar cell technology with a generating capacity of approximately 75 MW and associated infrastructure. These units comprise two blocks of photovoltaic arrays, mounted on pedestals, with a converter unit and supported by associated infrastructure, permanent and temporary. Each converter unit has its own step-up transformer. These transformers will be fed to a central point of connection consisting of switch gear and protection infrastructure. Electricity is fed to the ESKOM 132 kV network via this point of connection which

will be situated on the southern edge of the electricity generation facility. Two possible routes were considered. The preferred route is approximately 1km long and will run south in a straight line to connect to the ESKOM 132 Kv line to the south of the property. The alternative route will run west for approximately 1km and then south for another 1km to connect to the ESKOM 132 Kv line next to the Aries substation. The alternative route is not preferred as it will impact on a larger area and will double the length of the preferred electricity connection line.

The panels will be mounted on the ground using a ground screw. A concrete foot piece secured to a steel pen driven into the ground will be used where it is not fesible to use ground screws. The geo-technical assessment tests indicate that screws up to a depth of 1.8m can be installed. A small substation with infrastructure will feed the electricity generated into the Aries substation. A portion of the ground mounted solar panels will be equipped with so called sun-trackers. This means that the solar panels will follow the sun in order to increase the efficiency of the panel.

A 5m management road surrounds each block totalling ±9km of gravel road. These single track management roads will be used as access to service and maintain structures and to serve as fire breaks. The facility and associated infrastructure will be accessed on a 6m wide gravel road with direct access off the Kenhardt to Pofadder gravel road.

Services will be obtained as follows:

- Water will be sourced from existing boreholes that will be registered under the National Water Act for water use.
- Electricity will be obtained from ESKOM.

Electrical Infrastructure

The Wine Estate Capital Management PV plant consists of several smaller PV blocks. At each of these blocks the DC input voltage from the PV panels is converted to AC by means of inverters. The AC output voltage from the inverter is then stepped up with a 400 V to 22 kV step-up transformer at each block. The electrical power is then transported via underground cables to a central point close to the Aries substation. At this central point the underground cables connect to a central busbar above ground through the relevant protection switch gear, isolators and measurement devices.

The Wine Estate Capital Management plant plant will be connected to the Aries substation via a 132 kV overhead transmission line through the appropriate protection switch gear, ext. via an overhead transmission line.

The transmission line will entail a configuration very similar to the 11 kV and 22 kV transmission lines found throughout South Africa to electrify rural parts of the country, i.e. wooden poles with the three conductors spaced in a triangular arrangement. The only possible difference is slightly thicker conductors than what is normally seen.

Roads

The existing farm access on the Kenhardt-Pofadder Road (P2986) will be maintained. The internal roads may have a dust free surface. A combination of paving and treated gravel is being investigated. It is proposed that the roads be 6m wide. The roads linking the solar panel areas will be gravel roads. Initial DCP test results indicate that the in situ material has a CBR of at least 15, which is an adequate bearing capacity to be used as sub grade material in the roads. The vertical alignment of the roads will be designed to enable natural storm water run-off

from the roads. Due to the low rainfall in the area all storm water will be managed above ground.

Fencing
For health & safety and security reasons, the plant will have to be fenced off from the surrounding farm.

Construction phase
a) Conduct surveys
Prior to construction, surveys such as, but not limited to, geotechnical, site surveys and confirmation of PV array micro-siting, road servitudes, etc. must be conducted.

b) Establish access roads
Access to site is via the Pofadder gravel road. Within the site itself, access will be required from the existing roads to the individual facility components for construction purposes (and later limited access for maintenance).

c) Site preparation
This will include clearance of vegetation at all the roads and infratsructure. These activities will require the stripping of topsoil which will need to be stockpiled, backfilled and/or spread on site.

d) Establishment of laydown areas
Laydown and storage areas will be required for the construction equipment required on site.

e) Establishment of ancillary infrastructure
The establishment of these facilities/buildings will require the clearing of vegetation and levelling of the development site and the excavation of foundations prior to construction. A laydown area for building materials and equipment associated with these buildings will also be required.

f) Contouring
Natural contouring must be used when constructing the facility. This enables limited artificial contouring to be used.

g) Construction of infrastructure foundations
The geo-technical assessment tests indicate that screws up to a depth of 1.8m can be installed. Screw-on foundations will be constructed for the “feet” of the PV panels. This statistically tested technology saves money and is environmentally friendly as no digging or concreting is necessary.

Picture of Ground Screw

h) Transport of components and equipment to site
Trucks will be used to transport all components (e.g. trucks, graders, compaction equipment, and panels) to site. The equipment will be transported to the site using appropriate National and Provincial routes and the dedicated access road to the site itself.

i) Establishment of PV panels
PV panels are transported in containers. The steel structures will be assembled on site. The supports for the panels are made of steel structures directly driven into the ground or mounted on a steel pen driven into the soil with a concrete footpiece. The panels are arranged in a binary structure. The height of the supports has been determined so that the maximum height of the panel in operation is approximately 4.80 m. This choice is motivated by the need to avoid production losses due to fouling of the panels and the absorption of sunlight by clouds to the ground during the cold season. The minimum height is greater than 0.8m from the ground level to allow freedom and enjoyment of the land for agricultural or pastoral purposes where required.

j) Connection of PV panels to the substation
The PV plant consists of several smaller PV blocks. At each of these blocks the DC input voltage from the PV panels is converted to AC by means of inverters. The AC output voltage from the inverter is then stepped up with a 400 V to 22 kV step-up transformer at each block. The electrical power is then transported via underground cables to a central point south of the facility. At this central point the underground cables connect to a central busbar above ground through the relevant protection switch gear, isolators and measurement devices.

k) Connect substation to the grid
The plant will be connected to the ESKOM grid via a 132 kV overhead transmission line through the appropriate protection switch gear, ext. via an overhead transmission line.

The transmission line will entail a configuration very similar to the 66 kV transmission lines found throughout South Africa to electrify rural parts of the country, i.e. concrete poles with the three conductors spaced in a triangular arrangement. The only possible difference is slightly thicker conductors than what is normally seen.

l) Undertake site remediation
Once construction is completed and all construction equipment is removed, the site must be rehabilitated where practical and reasonable. On full commissioning of the facility, any access points to the site which are not required during the operational phase must be closed and rehabilitated.

Operation phase
The electricity that is generated from the PV modules will be stepped up through the onsite transformers. Thereafter the power will be fed to the ESKOM grid via an existing 132 kV overhead power line. It is anticipated that a full-time security, maintenance and control room staff will be required on site. Each component within the solar energy facility will be operational except under circumstances of mechanical breakdown, unfavourable weather conditions or maintenance activities. Maintenance will consist mostly of panel replacement and other mechanical and electrical infrastructure repairs. Cleaning would be undertaken using wet cloth as required. New self-cleaning technology is also investigated and will be implemented if feasible. Water usage is minimal. An onsite maintenance facility will be used as a repair base and storage of maintenance equipment. Grounds will be maintained. All waste generated will be transported weekly or when required to the Kenhardt waste managing facilities.

Decommissioning phase
The PV is expected to have a lifespan of approximately 30 years (with maintenance). The infrastructure will only be decommissioned once it has reached the end of its economic life. If economically feasible, the decommissioning activities will comprise the disassembly and replacement of the individual components with more appropriate technology/infrastructure available at the time. However, if not deemed so, then the facility will be completely decommissioned which will include the following decommissioning activities.

(a) Site preparation
Activities will include confirming the integrity of the access to the site to accommodate the required equipment and the mobilisation of decommissioning equipment.

(b) Disassemble and replace existing components
The components will be disassembled and reused and recycled or disposed of in accordance with regulatory requirements.

4. DESCRIPTION OF THE RECEIVING ENVIRONMENT

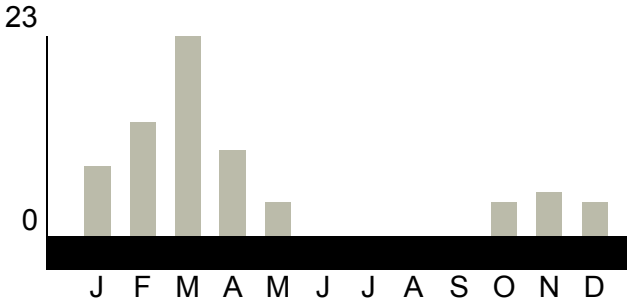
Picture. View in western direction from roadside. Distance to site approximately 2 km.

Activities on adjacent properties to the site comprise agricultural activities. The site is currently being used for agricultural activities (sheep grazing).

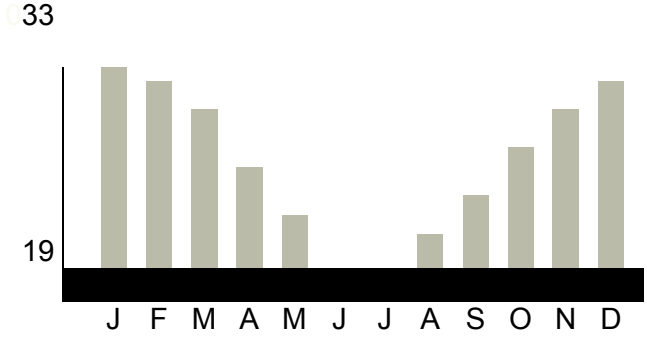
4.1 Climate

The study area is characterised by an arid climate. Kenhardt normally receives about 127mm of rain per year, with most rainfall occurring mainly during autumn. The chart below shows the average rainfall values for Kenhardt per month. It receives the lowest rainfall (0mm) in June and the highest (23mm) in March. The monthly distribution of average daily maximum temperatures shows that the average midday temperatures for Kenhardt range from 19°C in June to 33°C in January. The region is the coldest during July when the mercury drops to 2.6°C on average during the night. Consult the chart below for an indication of the monthly variation of average minimum daily temperatures.

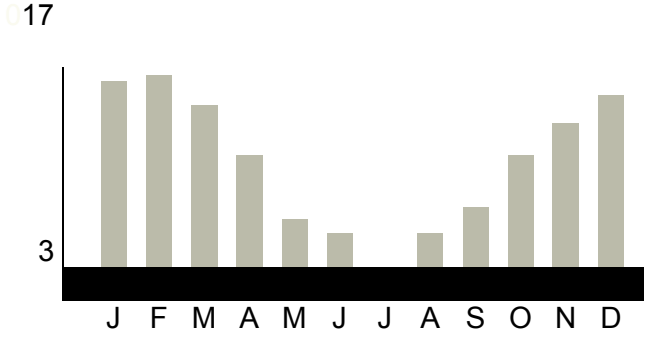
Average rainfall (mm)



Average midday temperature (°C)



Average night-time temperature (°C)



4.2 Topography

The study site is located mostly on flat plains which slope gently (20m drop in 2 km) towards the east. This landscape is typical of the broader region within which the study area is located and the pattern repeats itself up 30km in any direction. The plains are situated at an elevation of 960m. The highest point on the plains within the study site is at the western side of the site and it drains down to a flat area in the east. The site is situated in a very arid part of South Africa. Several drainage lines drain the water collected on the site towards the east, which eventually feed into the upper catchment of the Graafwatersrivier, a non-perennial river east of the study area.

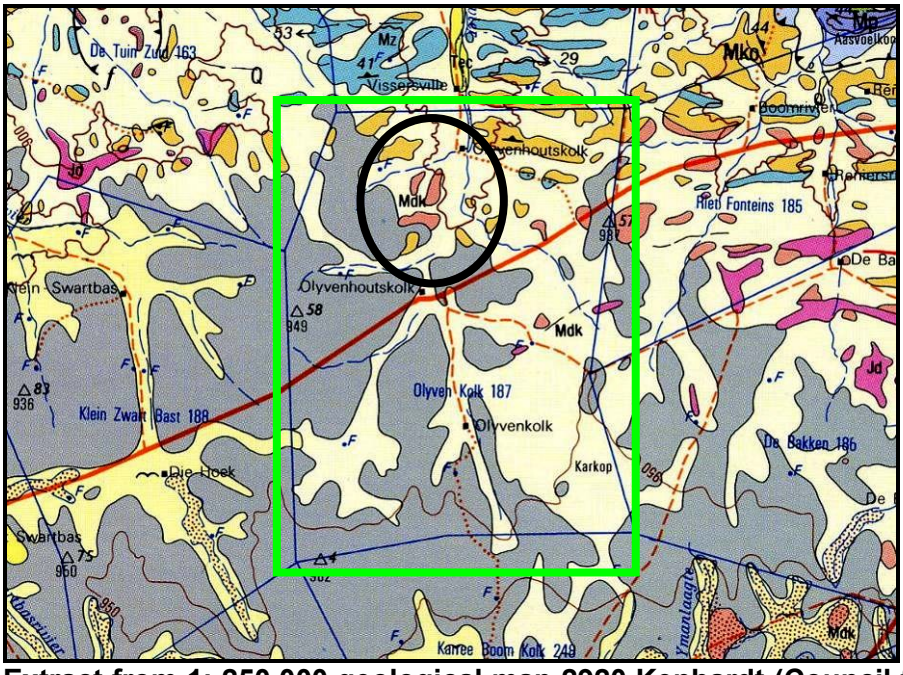
4.3 Geology and Soil

The geology of the study area is outlined on the 1: 250 000 geology map 2920 Kenhardt (Council for Geoscience, Pretoria; Fig. 3 herein). An explanation to the Kenhardt geological map has been published by Slabbert *et al.* (1999). Several of the relevant rock units are also treated in the explanations for the adjacent 1: 250 000 sheets such as the Britstown sheet to the southeast (Prinsloo 1989), the Pofadder sheet to the west (Agenbacht 2007) and the Sakrivier sheet to the south (Siebrits 1989).

According to the Kenhardt 1: 250 000 geology map (Fig. 3) the construction site of the proposed Wine Estate Capital Management PV power station is underlain by the Permocarboniferous **Dwyka Group** (Karoo Supergroup, **C-Pd**). Dwyka sediments underlie most of the western portion of farm Olyven Kolk 187, with Quaternary alluvium lining the major water courses. Both these rock units are present in the vicinity of the Olyvenhoutskolk farmstead (black circle in Fig. 3) where most of the proposed construction will take place. Small exposures of Mokolian (Mid Proterozoic) basement rocks of the **Namaqua-Natal Province** (De Bakken Granite, **Mdk**, and the Kokerberg Formation, **Mko**) occur in the northeastern portion of farm Olyven Kolk 187. These two billion year old granitoid intrusions and highly metamorphosed sediments (*cf* Cornell *et al.* 2006) are largely mantled by Quaternary wind-blown sands and associated fluvial sediments and pedocretes of the **Gordonia Formation** (Kalahari Group, **Q**). Since the Mokolian basement rocks are unfossiliferous and will not be directly affected by the proposed development, they will not be considered further here. Satellite images (Fig. 2) show that the landscape in the study area is extensively dissected by distal tributaries of the Orange River, notably the Graafwatersriver that flows northwards into the Hartbeesrivier and thence into the Orange.

Dwyka Group

Permocarboniferous glacially-related sediments of the **Dwyka Group** (**C-Pd** in Fig. 3) underlie the thin, superficial cover of Gordonia sands, calcrete and Late Caenozoic alluvium both north and south of the Orange River and crop out at surface within the study area southwest of Kenhardt. The geology of the Dwyka Group has been summarized by Visser (1989), Visser *et al.* (1990) and Johnson *et al.* (2006), among others. The geology of the Dwyka Group along the north-western margin of the Main Karoo Basin as far east as Prieska has been reviewed by Visser (1985). Other studies on the Dwyka in or near the Prieska Basin include those by Visser *et al.* (1977-78; summarized by Zawada 1992) and Visser (1982). Fairly detailed observations by Prinsloo (1989) on the Dwyka beds on the northern edge of the Britstown 1: 250 000 geology sheet are in part relevant to the more proximal (near-source) outcrops at Kenhardt. Massive tillites at the base of the Dwyka succession (**Elandsvlei Formation**) were deposited by dry-based ice sheets in deeper basement valleys. Later climatic amelioration led to melting, marine transgression and the retreat of the icesheets onto the continental highlands in the north. The valleys were then occupied by marine inlets within which drifting glaciers deposited dropstones onto the muddy sea bed ("boulder shales"). The upper Dwyka beds (**Mbizane Formation**) are typically heterolithic, with shales, siltstones and fine-grained sandstones of deltaic and / or turbiditic origin. These upper successions are typically upwards-coarsening and show extensive soft-sediment deformation (loading and slumping). Varved (rhythmically laminated) mudrocks with gritty to fine gravely dropstones indicate the onset of highly seasonal climates, with warmer intervals leading occasionally even to limestone precipitation.



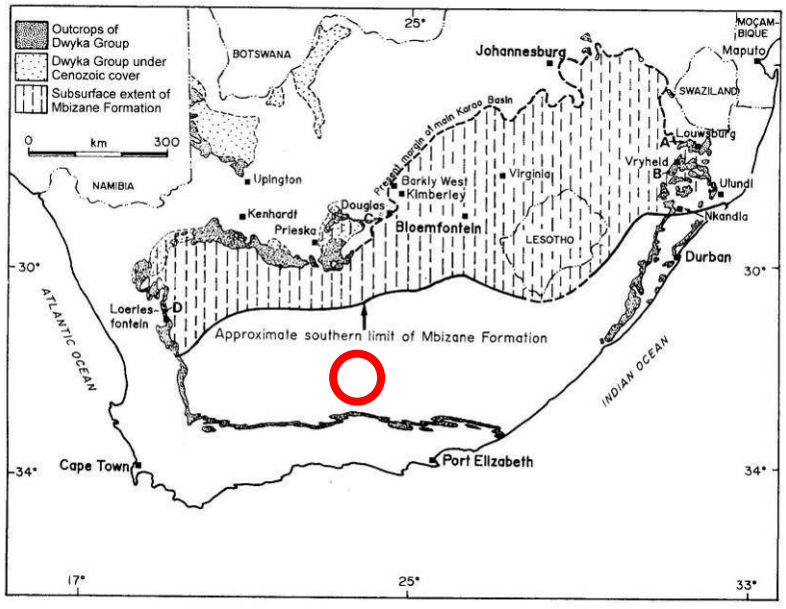
Extract from 1: 250 000 geological map 2920 Kenhardt (Council for Geoscience, Pretoria) showing the approximate location of proposed Wine Estate Capital Management study area on the northern part of farm Olyven Kolk 187 (Green rectangle). Construction will largely take place in the vicinity of the Olyvenhoutskolk farmstead (small black ellipse), in an area that is underlain by Quaternary alluvium (pale yellow) and Dwyka glacial deposits at depth (grey).

MAIN GEOLOGICAL UNITS:
Orange (Mdk) = De Bakken Granite (Mokolian Basement, De Kruis Fragment)
Dark yellow (Mko) = Kokerberg Formation (De Kruis Group, De Kruis Fragment of Mokolian Basement)
Grey (C-Pd) = Mbizane Formation (Permo-Carboniferous Dwyka Group, Karoo Supergroup)
Pale yellow (Q) = Quaternary to Recent sands and sandy soil of the Gordonia Formation (Kalahari Group).

According to maps in Visser *et al.* (1990) and Von Brunn and Visser (1999; Fig. 4 herein) the Dwyka rocks in the Kenhardt area close to the northern edge of the Main Karoo Basin belong to the **Mbizane Formation**. This is equivalent to the "Northern (valley and inlet) Facies" of Visser *et al*. (1990). The Mbizane Formation, up to 190m thick, is recognized across the entire northern margin of the Main Karoo Basin where it may variously form the whole or only the *upper* part of the Dwyka succession. It is characterized by its extremely heterolithic nature, with marked vertical and horizontal facies variation (Von Brunn & Visser 1999). The proportion of diamictite and mudrock is often low, the former often confined to basement depressions. Orange-tinted sandstones (often structureless or displaying extensive soft-sediment deformation, amalgamation and mass flow processes) may dominate the succession. The Mbizane-type heterolithic successions characterize the thicker Dwyka of the ancient palaeovalleys cutting back into the northern basement rocks. The key Reference Stratotype C section for the valley fill facies of the Mbizane Formation is located a few kilometres west of Douglas on the northern side of the Vaal River (Von Brunn & Visser 1999). The composite section, which overlies glacially-striated Precambrian bedrock, is some 25-30m thick. The lower part of the section consists of massive diamictites with subordinate conglomerates and siltstones. The upper half is

dominated by laminated mudrocks with thin diamictites, lonestones (dropstones) and calcareous concretions. The section is conformably overlain by mudrocks of the Prince Albert Formation (Ecca Group) which is not represented in the study area.

For details of the Dwyka Group rocks in the Kenhardt area the reader is referred to the accounts of Visser (1985) and Slabbert *et al.* (1999). The study area *c*. 35km southwest of Kenhardt lies close to the eastern edge of the Sout River palaeovalley identified by Visser (1985, fig. 12 therein). The Dwyka succession in this area comprises both massive, muddy diamictites ("boulder shales") as well as heterolithic intervals dominated by interbedded reddish-brown, pebbly sandstones, conglomerates, and diamictite (ibid., figs. 2, 4). Slabbert *et al.* (1999, p. 107) report that the uppermost Dwyka beds contain stromatolites, oolites and calcareous concretions.



Outcrop map of the Dwyka Group within the Main Karoo Basin of South Africa. Exposures in the study area southwest of Kenhardt (red circle) are assigned to the outcrop area of the Mbizane Formation (From Von Brunn & Visser 1999).

Superficial deposits: Kalahari Group sands, calcretes, alluvial gravels

Unconsolidated, reddish-brown aeolian (*i.e.* wind-blown) sands of the Quaternary **Gordonia Formation** (**Kalahari Group**) (**Q** in Fig. 3) blanket large areas of the landscape in the Kenhardt area (Slabbert *et al.* 1999). The geology of the Late Cretaceous to Recent Kalahari Group is reviewed by Thomas (1981), Dingle *et al.* (1983), Thomas *et al.* (1988), Thomas & Shaw 1991, Haddon (2000) and Partridge *et al.* (2006). The Gordonia dune sands are considered to range in age from the Late Pliocene / Early Pleistocene to Recent, dated in part from enclosed Middle to Later Stone Age stone tools (Dingle *et al*., 1983, p. 291). Note that the recent extension of the Pliocene - Pleistocene boundary from 1.8Ma back to 2.588 Ma would place the Gordonia Formation almost entirely within the Pleistocene Epoch.

According to Slabbert *et al.* (1999, p. 109) Gordonia wind-blown sands in the Kenhardt area, far to the south of the main Kalahari Basin, are thin, rarely preserve longitudinal dune bedforms (these are seen along the Hartbeesrivier near Kenhardt but not further west), and are probably of Holocene age. In the study area the thin superficial blanket of sandy sediments is admixed

with local weathering products of the Karoo and other bedrocks. According to these geological survey authors, the sands capping the plains west of the Hartbeesrivier might not in fact be correlated with the Gordonia Formation proper, although they are at least in part derived from the Kalahari Basin.

Late Caenozoic **alluvial deposits** of the Hartbeesrivier tributaries are not described or discussed in detail by Slabbert *et al.* (1999). In addition to finer-grained silts and sands, in the study area they probably include an admixture of coarser gravels derived from weathering of the Karoo rocks (*e.g.* polymict, bouldery erratics and pebbles from diamictites and conglomerates of the Dwyka Group). De Wit (1999) discusses the post-Gondwana evolution of the drainage systems in the Bushmanland region, including pans between Kenhardt and Brandvlei that fed floodwaters from the region *via* the Sakrivier and Hartbees Rivers into the Orange from at least the Plio-Pleistocene times (Ibid., fig. 13. See also De Wit *et al.* 2000).

Approximately 4m deep quarry south of the study area

4.4 Historical and Archaeological Characteristics

The site of the proposed Kenhardt Solar PV power station site is directly underlain by Permocarboniferous glacial-related sediments of the Dwyka Group (Mzibane Formation) that are generally of low palaeontological sensitivity. Quaternary aeolian sediments of the Gordonia Formation (Kalahari Group) as well as alluvial gravels and calcretes, both of low palaeontological sensitivity, may also be encountered near-surface in the study area.

The archaeology of the Northern Cape is rich and varied covering long spans of human history. Work done by Kiberd (2002, 2006) near Copperton (in eastern Bushmanland) recovered archaeological material that included large numbers of Later Stone Age tools, Middle Stone Age lithics with fauna and Early Stone Age tools and fauna in a stratigraphic context, including a possible hearth, which may be older than 300 000 years.

Refer to the specialist reports in Appendix A

4.5 Biophysical Elements

The study area lies within the Orange River Broken Veld vegetation type of the Northern Cape. The site is not isolated as it forms part of an extended natural veld area used as extensive grazing for sheep and cattle farming. There are an estimated 5400 plant species in the Northern Cape Province. These plants occur in six large vegetation units known as biomes. Each biome is a broad ecological unit that represents major life zones of large natural areas, defined mainly by vegetation structure and climate. There are six biomes in the Northern Cape, namely the Savanna Biome, Nama Karoo Biome, Succulent Karoo Biome, Fynbos Biome, Grassland Biome & Desert. The proposed site falls within the Nama Karoo biome. Each biome is subdivided into vegetation types, which are groups of plant communities that share similar ecosystem processes, and have similar climatic and geological requirements. There are many vegetation types in the Northern Cape. The Orange River Nama Karoo is an example of one of these vegetation types, within the Nama Karoo Biome. It is found along most of the Orange River from its confluence with the Vaal River near Kimberley to the Richtersveld in the far northwestern corner of the Northern Cape. A common plant of this vegetation type is the Quiver Tree (Kokerboom) *Aloe dichotoma* that grows on the broken, rocky terrain.

The study area has been impacted upon to some degree by livestock farming, although the vegetation is in relatively good condition and mostly natural. The vegetation of the study area is dominated by *Salsola tuberculata*, *Eriocephalus ericoides*, *Rhigozum trichotomum*, etc.

The property lies in the general area that supports Bushmanland Basin Shrubland, according to the new vegetation map of South Africa (Mucina & Rutherford 2003). This vegetation type is listed as Not Threatened in the South African National Spatial Biodiversity Assessment (Rouget et al 2004). Some of the vegetation species identified on site during the survey included *Prosopis sp, Acacia karoo, Agave rigida var. sisalana, Eriocepthalus ericoides* (kappokbos), *Chrysocoma ciliata, Rhigozum trichotumum, Pterthrix spinescens, Aloe dichotoma* (Quiver Tree), *Phaeoptilum sponsum, Zygophyllum gilfillanii, Salsola tuberculata, Limeum aethipicum, Thesium lineatum, Cenchurs ciliaris, Schmidtia kalihariensis, Stipagrostis ciliate var. capensis, Stipagrostis obtuse, Stipgrostis uniplumis var. uniplumis, Fingerhthia africana, Eragrostis curvula* and *Pelargonium sp.*

Several mammal species are supported in the Nama Karoo. The big mammal species however were replaced with sheep. Springbok is the largest mammal occurring on the property. Some 36 species are known to occur in the bigger area (Smithers 1983). Some of the species identified on site during the survey included *Proteles cristatus* (Aardwolf spoor), *Ictonys strtiatus* (Striped polecat), *Xerus inauris* (Ground squirrel), *Hystrix africaeaustralis* (Porcupine), *Otocyon megalotis* (Bat Eared Fox) and *Raphicerus campestris* (Steenbok).
As reported in Branch (1988) 26 reptile species are likely to inhabit the area. Some of the species identified on site during the survey included *Agama hispida* (Spiny agama), *Chondrodactylus turneri, Mabaya capensis* (Cape Skink) and *Stigmachelys pardalis* (Leopard Tortoise). No Red Listed amphibian or reptiles species are known to occur in the area of the development site.

As reported in (Hockey et al 2006) 62 avifauna species are known to occur in the bigger area. Some of the species identified on site during the survey included *Alopochen aegyptiaca, Bubo africanus, Coluba guinea, Neotis ludwigii, Eupodotis vigorsii, Pterolcles namqua, Charadrius tricollaris, Melicras canorus, Polemaetus bellicousus, Falco biarmicus, Telophorus zeylonus, Corvus albus, Lanius collaris, Hirundo fuligula, Prinia maculosa, Chersomanus albosfasciata*

var. garrula, Chrthilauda sub coronate, Erythoropygia coryphaeus, Myrmecochchla formicrivora, Philetarious socius and *Motacilla capensis.*

Aloe dichotoma is the only Threatened or Protected species recorded during the site survey. No *Aloe dichotoma* are present on the development area and will therefore not be impacted upon. No permit is therefore required in therms of the Threatened or Protected species regulations.

Environmental gradients (e.g. upland-lowland), biome boundaries, soil interfaces or sand movement corridors on the site or in its vicinity are not present on site. The ecology of the area is not a fire driven system, e.g. fire is not require to maintain ecological functioning. The likelihood of any fire occurring on site is also almost zero.

The proposed development site and its associated infrastructure will not impact on any tree species or any threatened or protected species as per the TOPS regulations.

4.6 Noise

The study area has a rural character in terms of background noise levels. The only potential receptors are located at the existing farmyards and houses, which are situated far from the site. The only noise associated with this activity will be during construction and decommissioning of the facilities and vehicles during the operational phase. The electricity generation facility does not have moveable parts which can generate noise.

4.7 Socio-Economic Elements

The demographics and municipal services of the Kai !Garib Municipality can be summarized as follows.
Employability:

- Kai !Garib has a relatively young population with a 2:1 employable dependent ratio.
- The unemployment rate in the Kai !Garib is 15%; The unemployment rate in Kenhardt is 59%.
- The majority (96%) of the workforce is employed in unskilled and semi-skilled positions.
- The population has a low level of education with 28% having had 9 years of schooling. Fifty seven percent (57%) of the population has a qualification equal to matric or higher.
- The majority of people work in agriculture, fishing and forestry, followed by community services.
- Proper construction/building/transport and tourism related skills are limited.

Demographics:

- There are 5 360 people living in Kenhardt constituting ten percent (9.6%) of the population of the Kai !Garib.
- 55% of the Kenhardt population is male whilst 45% of the population is female.
- 69% of the Kai !Garib population is coloured, 23% African and 8% white.
- More than 80% of the Kai !Garib population is Afrikaans speaking.
- 70% of the Kai !Garib population had < 12 years of schooling, of which 15% has no schooling and 15% had 12 and more years of schooling.
- 4% of the employable Kai !Garib population is highly skilled, whilst 57% is unskilled and thirty nine percent 39 % are semi-skilled i.e. tradesmen and crafts.
- 67% of the Kai ! Garib population is of employable age whilst ± 28% can be defined as children and youth at school. 5% is retired. 57% of the Kenhardt population is employable.

Economics:

- Northern Cape contributes 2 % of the national GDP.
- The economy of the Kai !Garib is dominated by Mining and quarrying (23.7%) followed by Finance, real estate and business services (13.7%) and Transport, storage, communications (12.8%), Wholesale, retail, trade (11%), Community Service (8.2%) and Agriculture (7.3%).
- The highest number of persons (28.4%, 2001) are employed in Agriculture, Forestry and Fishing (ranked as the sixth biggest economic contributor in the Kai !Garib) followed by 19.8% (2001) in Community Services (ranked as the fifth biggest economic contributor in Kai !Garib), 12.7% in Whole Sale and Retail (ranked as the fourth biggest economic contributor in Kai !Garib) and 11.4% Private Households.
    - 88% of the all households earn R 3 500 or less.
    - The rate of job creation grows proportionally slower at 1.4% whilst the unemployment rate grows by 3.5% in the Kai !Garib.
    - 36% of the population travel on foot, 10% by car and 1% by public transport.

Housing and Infrastructure:

- Kai !Garib has an estimated backlog of 2 640 houses according to the IDP.
- 87% of the inhabitants of the Kai !Garib live in formal structures.
- 48% of the households in Kai !Garib have piped water.
- 64% of the households have flush toilets (Census 2001).
- 69% of the households have access to electricity or gas.
- 24% of the households have access to telephone or cell-phone.
- 41% of households' refuse are removed weekly.

4.8 Sensitive Landscapes

No natural or cultural sensitive landscape occurs in close proximity to the study area.

4.9 Visual Impact Elements

The "viewshed" refers to the theoretical outer-most extent or area from which a site can be seen. It must, however, be remembered that visibility may be obscured in reality by objects within the viewshed such as existing buildings, trees, lower ridges, outcrops and other geographical or natural features, and also by distance where an object can visually blend into its background or be completely lost to sight.

The facility will be partly visible from an intermediate area. The greatest visual impact is restricted to relative short distance of ±5km along the bypassing public road, by and large only apparent to motorists approaching the facility from an eastern direction. The landscape can visually absorb only small to medium size changes. Facility is occasionally visually noticeable by viewer. No existing tourism facilities exist in the region. Potential tourists attracted to the area by the accommodation facilities to be developed on land to the south, will have a positive attitude and low sensitivity to the visual impact of the proposal. Facility is partly recognisable by viewer. The proposed facility maintains a very low profile and follows the natural lay of the land. Facility fits only partially into surroundings. The Aries substation and associated transmission lines, as well as other similar facilities authorized in the direct vicinity of the proposal, sets a precedent for the development of similar activities in the area. The significance of the visual impact can be classified as **moderate** inclined to **low** on condition that the mitigation measures as specified are implemented. This conclusion is reached as a result of the positive effect mitigation has on all VIAC (visual impact assessment criteria).

4.10 Water Features

Several drainage lines drain the water collected on the site towards the east, which eventually feed into the upper catchment of the Graafwatersrivier, a non-perennial river north of the study area. The solar electricity generation panels and their entire associated infrastructure will not be impact on the identified drainage lines, except for the access road that will cross a drainage line. A water use license application is being applied for this activity.

Water Table
No seepage water or water table was observed during trial pitting.

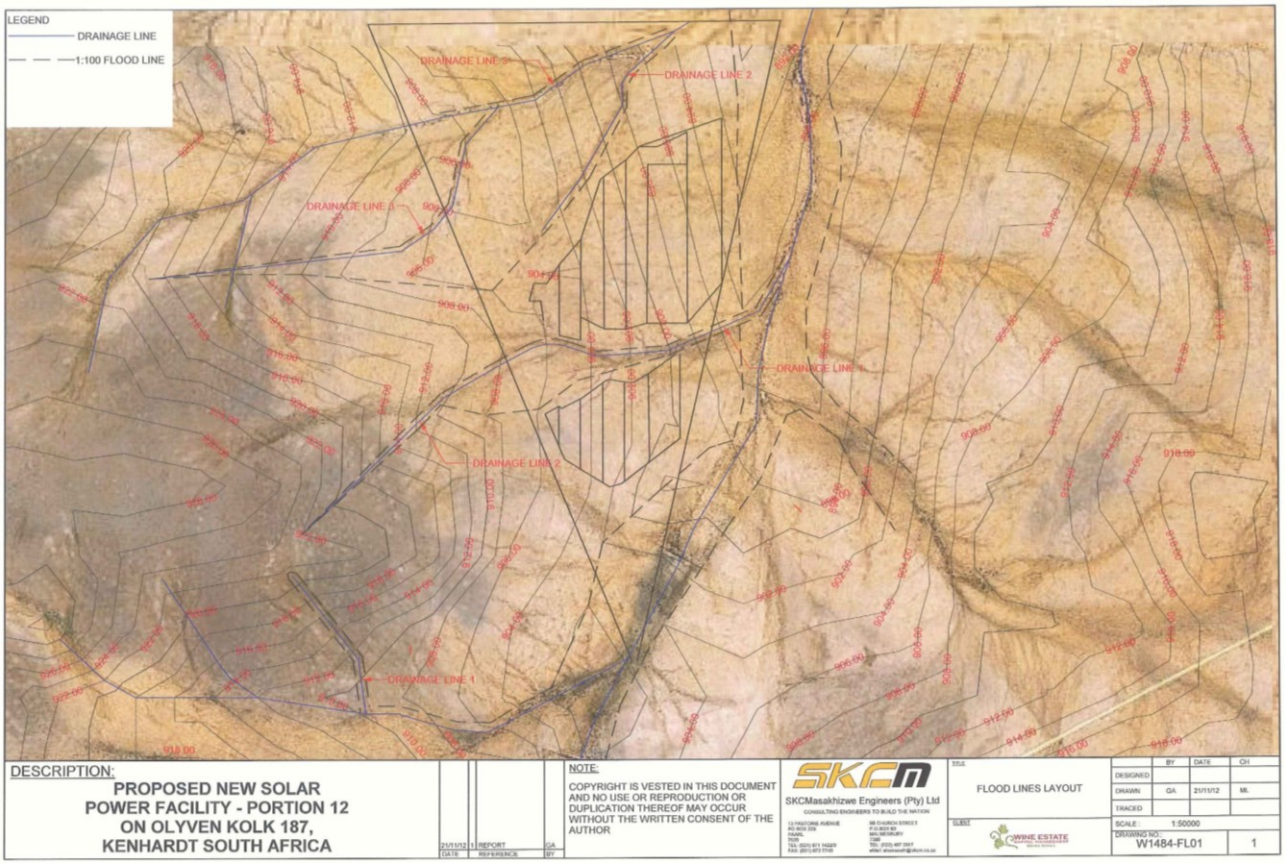
Flood Hydrology

The study area is situated in an arid region with a very low annual rainfall of 127mm and annual evaporation of between 2600mm and 2800mm per annum. Average temperatures vary between approximately 20°C in July and 36° in January.

The site is situated to the west of a relatively small watercourse as can be seen in Fig. 2. This water course flows in a north easterly direction. There are two water courses of the property. The slope on the site can be classified as flat (<3.5%). The vegetation is mostly sparse grass and light thorn shrub growing in the watercourses. The uppermost soils of the site are very permeable, with the harder layers below being described as impermeable. The watercourses are partially overgrown with thorn shrub and in general fairly straight with constant gradients with no natural or manmade ponds or dams.

The photovoltaic panels are generally situated above and well away from the 1:100 year flood line areas. There is a general flat area between drainage lines 2&3. This area could be prone to sheet flooding during abnormal high rainfall.

The panels are mounted on a frame structure anchored in the ground with ground screws. This type of construction will allow the free flow of surface water underneath the panels. The natural slope of the site is very gentle and rapid surface water flow is not expected. The risk of flooding and associated damage in the areas indicated for the panel installation is therefore low.



Flood Line Deleniation line figure

As can be seen from the figure above the proposed photovoltaic panels and infratsructure are located above the 1:100 year floodlines.

4.11 Ground Water Use

Groundwater on the farm is the only water source. The borehole water on site is used for livestock and farming operations. A water yield and strength study was conducted on the boreholes by Agri Solar on 6 September 2011. Borehole 4 will be registered for use. The results of this study are as follow:

Borehole No1.

Water Level	10m
Depth of hole	25m
Pump depth	23m
Deliver	3500 litres per hour

Borehole No2.

Water Level	14m
Depth of hole	30m
Pump depth	27m
Deliver	2200 litres per hour

Borehole No3.

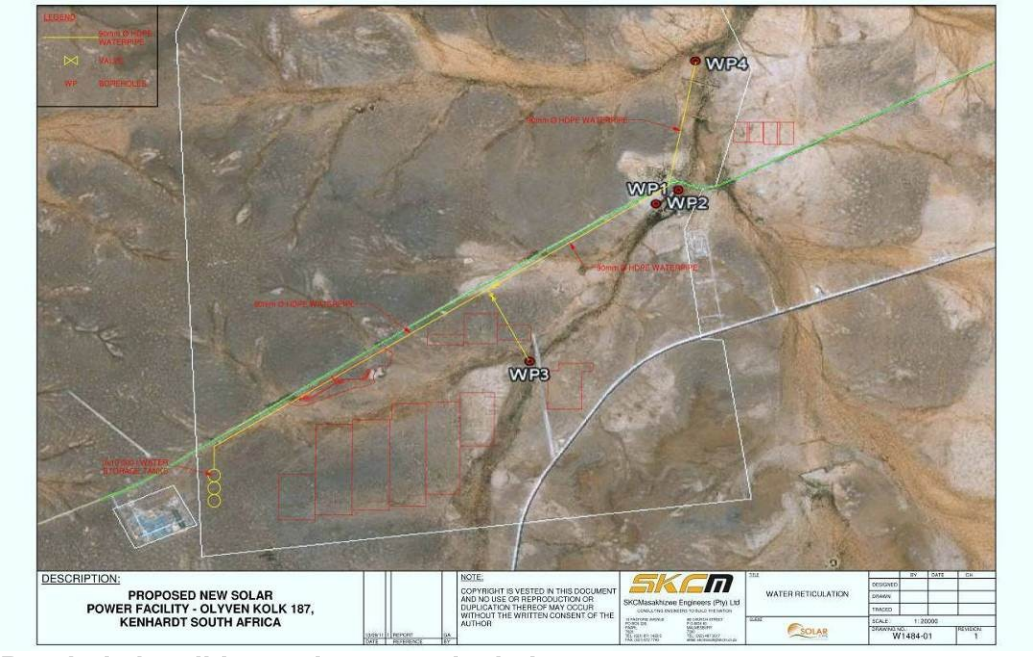
Water Level	8m
Depth of hole	35m
Pump depth	28m
Deliver	400 litres per hour

Borehole No4.

Water Level	8m
Depth of hole	35m
Pump depth	30m
Deliver	1600 litres per hour

Borehole Put.

Water Level	8m
Depth of hole	12m
Pump depth	10m
Deliver	3200 litres per hour



Borehole localities and water reticulation system.

4.12 Agricultural Potential

The agricultural sector in the area is the main economic sector with the largest potential for economic growth. The area is also ideal for small stock farming and the area around Kenhardt is known as the capital of Dorper sheep farming. The area has a carrying capacity to the order of 1 small stock unit per 6ha.

The study area has been impacted upon to some degree by livestock farming, although the natural vegetation is in relatively good condition. The drought of recent months is visible in the veld. The veld is open with sparse grass cover. Grass seedlings are visible in some areas of the study site after the recent rains. The vegetation of the study area is dominated by *Salsola*

tuberculata, Eriocephalus ericoides and *Rhigozum trichotomum*. Dominant grasses include *Stipagrostis ciliata* var. *capensis, Stipagrostis obtusa, Stipagrostis uniplumis* var. *uniplumis*, and *Eragrostis curvula.*

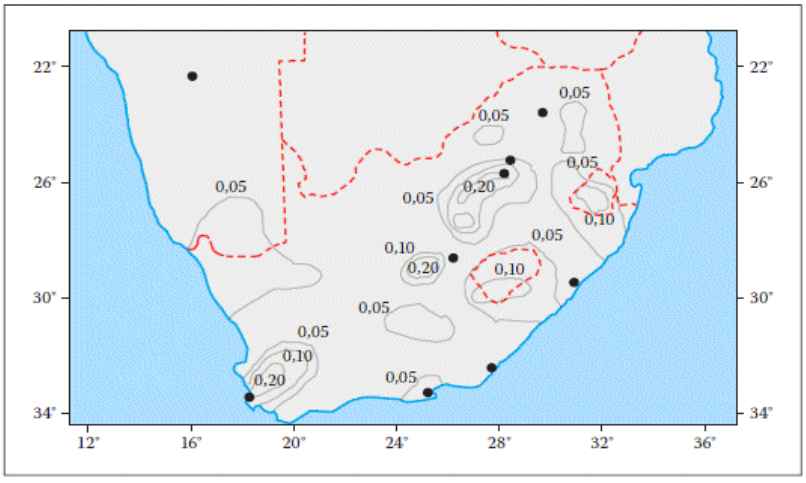
- *Salsola tuberculata* grows in plains, depressions and brackish veld. It is palatable and highly resistant to grazing and drought.
- *Eriocephalus ericoides* grows almost everywhere though the palatability varies greatly in the different regions, habitats and seasons.
- *Rhigozum trichotomum* grows on hills, apron veld and plains, but it prefers sandy soils. It is unpalatable but the flowers and pods can be grazed. It displaces more valuable plants and sometimes forms impenetrable thickets.
- *Stipagrostis ciliata* var. *capensis* grows in the gravel on plains and sandy areas, especially in river beds. Palatable and valuable grass. Is drought resistant with a high grazing value.
- *Stipagrostis obtusa* grows mostly in dry sandy soils. It is a palatable and valuable grass. Is drought resistant with a high grazing value.
- *Stipagrostis uniplumis* var. *uniplumis* grows on undisturbed sandy soils and flood plains. It is palatable with a medium grazing value.
- *Eragrostis curvula* grows mostly on disturbed areas. It is palatable with a medium grazing value.

Rain water will run off the solar panels and naturally drain eastwards towards the drainage lines in between the solar panels. In essence none to minimal concentrated water runoff will be evident.

The full farming unit consists of 6 cadastral units with a total of 7011ha. The current farmer stocks 600 ewes on the 7011 ha. This is a small stock carrying capacity of 12ha per small stock unit.

4.13. Geo-Technical

According to the seismic hazard map contained in SABS 0160-1993, (reproduced as Figure below), the proposed sites are located in an area where the peak ground acceleration will not exceed 0.05g (gravity acceleration) or approximately 50cm/s², with a 10% probability of exceedance in 50 years.



Seismic hazard map from SABS 0160-1993

According to a map produced by the United Nations Office for the Coordination of Humanitarian affairs depicting earthquake intensity zones in Africa, the proposed sites are located in a area where earthquake magnitude may vary from instrumental to fairly strong. (Earthquake intensity degree I –V according to the Modified Mercalli scale of 1956.) No incidences of widely perceived seismic activity have been recorded in the area. No special foundation measures are therefore required due to possible seismic activity.

The soils of the study area are slightly corrosive. Conventional galvanising of critical elements in contact with the soil will provide adequate long term corrosion protection to all metal elements. The material specification for unsurfaced rural roads contained in section 3.5 of TRH 20, the in-situ material of the study area will be suitable for use as sub base layers. When used as wearing coarse layers the material will be prone to the development of corrugations and may become slippery when wet. Gravel loss and associated dust generation will also be high. It is therefore recommended that gravel be transported from a registered borrow pit in the vicinity of the site where suitable material for use as a wearing coarse may be found.

Field assessment indicated that the undisturbed in situ soils will have excellent load bearing capacity. Building foundations must however be placed on the calcareous layer underlying the loose topsoil layer to prevent settlement of buildings. Initial assessments indicate that the proposed ground screw founding method is feasible on the site. Vertical and horizontal load bearing capacity of the soil will be sufficient to transmit vertical compression and horizontal loads applied to the screws. Pull out resistance of the screws should be sufficient if the screws are placed deep enough into the calcareous pedogenic material below the sand layers, since minimal wind loads is expected on the screws due to the elevation of the Photovoltaic panels.

5. PUBLIC PARTICIPATION PROCESS

5.1. Introduction

As outlined previously, public participation forms an integral component of the EIA process. The public participation process for the project initiation and Scoping Report phase was outlined in detail in the Scoping Report, and that for the EIR was summarised in the Plan of Study for EIA. The purpose of this chapter is to provide a brief summary of the public consultation process undertaken to date and provide a more detailed overview of the public participation envisaged for the EIR phase.

5.2. Summary of Public Participation to Date

The public participation process to date has entailed the following key components

Potential I&AP's were notified about the project by:

- Fixing notice boards at the boundary of the property
- Giving written notice to adjacent property owners and dwellers, the municipal councillor of the ward within which the site is located, the local municipality and organs of state having jurisdiction in respect of any aspect of the project
- Placing an advertisement in the local newspaper
- Additionally, the Scoping and Environmental Impact Reports was prepared and made available to any I&AP upon request, as advised on the notice boards, notices and advertisements.

The Scoping Report was included for statutory comment with the written notice as sent to the commenting organs of state. List of Potentially Interested and Affected Parties was compiled. Each I&AP received a written notice inviting them to register and give comments on the proposed development. List of Registered Interested and Affected Parties was compiled. A summary of issues raised by Interested and Affected Parties was compiled. The draft EIR will be sent to all key departments and registered Interested and Affected Parties for a 40 day commenting period.

5.3. Authority Involvement

Liaison with the relevant authorities plays a crucial role in the successful completion of any EIA process. In addition to the interaction with DEA, the key departments on the registered list were provided with the relevant project documentation and invited to submit comment.

5.4. Comments on the Draft Environmental Impact Report

The next stage of the public participation process involves submitting this EIR to the registered I&AP's and Key Departments to discuss the findings of the report.

5.5. Decision and Appeal Period

Once the Final EIR has been completed and all I&AP comments have been incorporated into the report, it will be submitted to the applicant for their review. On the basis of the findings of the EIR as well as other financial and technical considerations, the applicant will decide whether they would like to proceed with the project and if so which of the alternatives they would like to seek authorisation for. At this point, the final EIR together with a letter from the applicant motivating their preferred options and indicating which mitigation measures they are prepared to commit to, would be submitted to DEA for their review and decision.

Once they have reviewed the document and are satisfied that it contains sufficient information to make an informed decision, DEA will use the information contained within the EIR to determine the environmental acceptability of the applicant's preferred options. Thereafter DEA will issue an Environmental Authorization outlining the nature of their decision and the Conditions of Approval attached to any authorisation should the proposed activity be approved.

Following the issuing of the Environmental Authorization, I&APS will be notified of DEA's decision by means of letters and there will be a 20-day appeal period during which I&AP's will have an opportunity to appeal against the decision to the Minister of the Department of Environmental Affairs and Development Planning in terms of the NEMA.

Public Participation information attached as Addendums 1 - 6

6. NEED & DESIRABILITY OF THE ACTIVITY

South Africa currently faces an electricity shortage due to population growth and the resulting increase in electricity demand. South Africa relies heavily on coal to meet its energy needs and has developed an efficient, large scale, coal-based power generation system that provides low-cost electricity. However, South Africa has recognised that the emissions of greenhouse gases from the use of fossil fuels, such as coal and petroleum products, has led to increasing concerns about climate change in the country. The energy industry in South Africa is the biggest contributor to Greenhouse Gas emissions (GHGs). This has led the country to be rated amongst the top 20 emitters in the world. The utilisation of alternative energy sources is becoming a great opportunity in an effort to utilise renewable energy resources that have less adverse impacts on the environment. South Africa is well endowed with renewable sources; however, they have remained largely untapped. South Africa is one of the areas in the world with the highest count of sunny days per year, therefore making it also one of the most appropriate places in the world to use solar power energy.
The installation of a photovoltaic plant will:
Reduce electricity demand on Eskom generation;
Results in less non-renewable resources being used and less CO^2 being produced;
Produce no pollution during operation;
Improve the health of the nation (health benefits realised through reduced atmospheric pollution and improved living conditions).

Moreover, the South African Government has recognized the country‟s potential for renewable energy and has developed a White Paper on Renewable Energy (November, 2003) which has set a target of 10 000 GWh renewable energy contributions to final consumption by 2013. This is equivalent to 4% or 1667MW of the total estimated electricity demand which amounts to 41 539MW by 2013.

The proposed project will be beneficial for the following reasons:-

Electricity supply
Over the last few years, South Africa has been adversely impacted by interruptions in the supply of electricity. The creation of a 'decentralised' power generation facility (i.e. not located in the traditionally centralised power producing regions of the Republic of South Africa) next to Aries Eskom Substation with it proposes to supply and strengthen the Northern Cape and National electricity grid, will secure a supplementary energy source for South Africa.

Green energy
Growing concerns such as climate change and the on going exploitation of non-renewable resources have prompted increased international pressure on countries to increase their share of renewable energy generation. The South African government has recognized the country's high level of renewable energy potential and has placed targets of 10 000 GWh of renewable energy by 2013.

The electricity generated by the photovoltaic facility will displace some fossil fuel based forms of electricity generation. The photovoltaic facility, over its lifetime, will therefore avoid the production of a sizeable amount of CO^2, SO^2 and NO^2 that would otherwise be emitted to the atmosphere.

1. Is the activity permitted in terms of the property's existing land use rights?		NO	Please explain
Currently zone Agriculture 1 where the facility is proposed. A special zoning application will submitted under LUPO to the Local Authority for a decision as part of this application process.			
2. Will the activity be in line with the following?			
(a) Provincial Spatial Development Framework (PSDF)	YES		Please explain
The proposed activity is in line with the NSDP. All three spheres of government have common objectives in so far as the achievement of economic growth and poverty alleviation through social development are concerned. It follows that all infrastructure and development spending programmes should therefore support the attainment of these objectives. The **NSDP** proposes that decisions by the different spheres of government on infrastructure and development spending should be guided by the following set of normative principles: • Economic growth is a prerequisite for the achievement of other policy objectives, key among which would be poverty alleviation; • Government spending on fixed investment, beyond the constitutional obligation to provide basic services to all citizens, should therefore be focused on localities of economic growth or economic potential in order to attract private sector investment, stimulate sustainable economic activities and create long-term employment opportunities; • Efforts to address past and current social inequalities should focus on people not places. In localities where there are both high levels of poverty and development potential this could include fixed capital investment beyond basic services to exploit the potential of those localities. In localities with low development potential, government spending, beyond basic services, should focus on providing social transfers, human resource development and labour market intelligence. This will enable people to become more mobile and migrate, if they choose to, to localities that are more likely to provide sustainable employment of other economic opportunities; and • In order to overcome the spatial distortions of apartheid, future settlement and economic development opportunities should be channelled into corridors and nodes that are adjacent to or link the main economic growth centres. Infrastructure investment and development spending should primarily support localities that will become major growth nodes in South Africa. Furthermore, the Land-Use Management Bill referred to above propose a set of Directive Principles that should guide the formulation, determination, development and implementation of all policies and legislation regulating spatial planning. These are: equality; efficiency; integration; sustainability; and fair and good governance.			
(b) Urban edge / Edge of Built environment for the area	YES		Please explain
The proposed development will not affect the urban edge of Kenhardt. Situated far away from the urban area.			
(c) Integrated Development Plan and Spatial Development Framework of the Local Municipality (e.g. would the approval of this application compromise the integrity of the existing approved and credible municipal IDP and SDF?).	YES		Please explain
The proposed land use is in line with the Existing Spatial Development Framework, and IDP. Activity will promoted job creation.			
(d) Approved Structure Plan of the Municipality	YES		Please explain
Will create much needed jobs and a local economy.			
(e) An Environmental Management Framework (EMF) adopted by the Department (e.g. Would the approval of this application	YES		Please explain

compromise the integrity of the existing environmental management priorities for the area and if so, can it be justified in terms of sustainability considerations?)			
No EMF conducted for area.			
(f) Any other Plans (e.g. Guide Plan)	YES	■	Please explain
Within approved Guide plan.			
3. Is the land use (associated with the activity being applied for) considered within the timeframe intended by the existing approved Spatial Development Framework (SDF) agreed to by the relevant environmental authority (i.e. is the proposed development in line with the projects and programmes identified as priorities within the credible IDP)?	■	NO	Please explain
The new development will make a positive contribution to the area and will give practical effect to planning guidelines and plans in the area.			
4. Should development, or if applicable, expansion of the town/area concerned in terms of this land use (associated with the activity being applied for) occur here at this point in time?	YES	■	Please explain
The problem regarding the South African network in the Northern Cape is that the 132 kV lines are long lines. As a rule of thumb, when lines are longer than about 80 km (and this is a rough estimate), it is not the thermal limit of the line, i.e. the maximum current capability, that determines the maximum power transfer capability anymore, but rather the phase shift between the sending end and receiving end of line (known as the power angle) that reaches a certain maximum. From here on, the longer the line, the less power can be transferred when that limit is reached. Aries Eskom substation is a strategic substation and a good location for a solar power plant. The necessary infrastructure is in place to connect the electricity generating facility to the ESKOM grid. In fact, connection to the grid will be fairly straight forward. A 132 kV line will feed into the substation and are capable of transmitting power of the order of 75 MW and even more due to its close proximity. The facility will strengthen transmission capacity in the Northern Cape.			
5. Does the community/area need the activity and the associated land use concerned (is it a societal priority)? (This refers to the strategic as well as local level (e.g. development is a national priority, but within a specific local context it could be inappropriate.)	YES	■	Please explain
This is not a societal priority. However it will create much needed jobs and help to create the so called renewable electricity generation through solar economy of the Northern Cape. Within the REFIT program.			
6. Are the necessary services with adequate capacity currently available (at the time of application), or must additional capacity be created to cater for the development	YES	■	Please explain
In close proximity to Aries substation. Connecting to the substation will be fairly easy.			
7. Is this development provided for in the infrastructure planning of the municipality, and if not what will the implication be on the infrastructure planning of the municipality (priority and placement of services and opportunity costs	YES	■	Please explain
No municipal services needed.			
8. Is this project part of a national programme to address an	YES	■	Please

issue of national concern or importance?			explain
Both principles of energy security and diversification can only be possible if we bring on board Independent Power Producers (IPPs) to contribute to the energy balance. This commitment is enshrined in our White Paper on Renewable Energy Policy which is under review and the Integrated Resources Plan. The Northern Cape has been selected for this project after a careful consideration and the realization that the province meets many of the key criteria as confirmed by independent analysis. Some of the findings include: • excellent and consistent sun, • flat and sparsely-populated land, • the ability to connect to the electricity grid at multiple points,			
9. Do location factors favour this land use (associated with the activity applied for) at this place? (This relates to the contextualisation of the proposed land use on this site within its broader context.)	YES	■	Please explain
Can fairly easily be connected to the Aries Eskom Substation. Refer to Scoping report for all criteria considered which further motivate why the location factors favours this activity on this site in this time and place.			
10. How will the activity or the land use associated with the activity applied for, impact on sensitive natural and cultural areas (built and rural/natural environment)?	Please explain		
The sensitive natural and cultural land uses were identified and respected during the EIA process and the development layout is designed according to such parameters. None of these sites occur on the site.			
11. How will the development impact on people's health and wellbeing (e.g. in terms of noise, odours, visual character and sense of place, etc)?	Please explain		
Solar electricity health risks from PV panels are very slight once the panels are produced and installed. This type of solar electricity is known for reliability and low maintenance. The facility has no movable part. The noise impact is therefore limited to operation, e.g. mainly vehicles.			
12. Will the proposed activity or the land use associated with the activity applied for, result in unacceptable opportunity costs?	YES	■	Please explain
The construction of such a facility is expensive. The cost of this development will be for the applicant or outside investors. The REFIT tariff (price of electricity sold to ESKOM) enables a reasonable return on investment. This tariff is the same for all solar electricity generation facilities and is controlled by National Government within their legal and policy frameworks.			
13. What will the cumulative impacts (positive and negative) of the proposed land use associated with the activity applied for, be?	Please explain		
Refer to scoping report for more detail.			
14. Is the development the best practicable environmental option for this land/site?	YES	■	Please explain
Generation of renewable electricity. All environmental factors have been identified in this report and will be assessed in the EIR report in the second phase.			
15. What will the benefits be to society in general and to the local communities?			Please explain
Electricity generation making use of renewable sources. Job creation. Refer to Socio-Economic study for more details. Will be assessed in more detail in the EIR phase.			
16. Any other need and desirability considerations related to the proposed			Please

activity?	explain
N/A	

7. IDENTIFIED POTENTIAL ALTERNATIVES

Introduction

As outlined previously, the purpose of the Scoping Report phase is to identify the range of feasible alternatives and potential environmental impacts requiring more detailed investigation and assessment in the EIR.

A detailed description of the proposed activities as well as the full range of project alternatives was provided in Chapter 2 of the Scoping Report. The potential biophysical and social impacts associated with the project alternatives were outlined in Chapter 5 of the Scoping Report. These included potential impacts that may arise during the operational phase, as well as the potential construction related impacts (i.e. short-term impacts). Some of these impacts were screened out during the Scoping Phase, while others were identified as requiring more detailed assessment during this EIR phase.

This chapter provides a brief review of the feasible alternatives and potential environmental impacts, for the proposed project, identified for further assessment during the EIR phase. It should be noted that some of the alternatives have been revisited and revised in light of new information that has become available since the publication of the Scoping Report.

The following alternatives as per the guideline exists

Site Alternatives
Portion 12 of Farm 187, Kenhardt, Northern Cape were identified for consideration within an Environmental Impact Assessment process during the site identification process. The area was chosen as the region is among the best “solar insolation” areas in South Africa and the capacity of the grid and the Aries substation will allow the electricity generated to be fed into the national grid. No other site alternatives were proposed for this project as the site is dependent on several factors including climatic conditions, site extent and topography.
The main determining factors for selecting the proposed location were:-

- Solar availability;
- Proximity to a grid connection point;
- Available land.

The site was chosen as the preferred site due to the following characteristics:

Climatic conditions
The proposed site is among the best “solar insolation” in South Africa. This is the most important factor used in selecting a site to build a photovoltaic power plant. The energy output of a photovoltaic system is directly proportional to the insolation input. Other climatic and environmental factors such as temperature extremes, precipitation, wind and land topography, will limit and constrain a PV plant. These factors are all secondary when compared with the availability of insolation.

Size of the site
The site is approximately 245ha in extent, which will be sufficient for the installation of a 75MW photovoltaic power plant. The area has lots of surplus land to accommodate project sensitive areas buffer zones.

Grid Connection
Eskom owns and operates a high voltage transmission and distribution network within the area. Various electrical connection points to the Aries Substation bordering the site were negotiated with Eskom for the proposed PV plant.

Site Access
The site can be accessed via the Kenhardt to Pofadder gravel road.

Topography
The site has a relatively flat area which is required for the construction of PV plant.

Preliminary investigations have identified that the proposed project site meets these specific criteria and so different locations for the current project will not be reasonable. The connectivity to the grid is a critical factor to the overall feasibility of the project; therefore alternative locations will not be assessed.

Site location alternatives on the property were considered. The layout was changed to accommodate heritage features identified during the heritage impact assessment. An area of 25 m by 25 m inside the PV facility was excluded to accommodate these heritage features. Refer to Perferred layout attached. The area on the southern boundary of the property was assessed and found feasible for the development of the PV facility. Ecological, heritage and infrastructure features were assessed and considered and the preferred layout accommodates all limitations. The preferred site location is the most feasible and reasonable alternative as it is close to the ESKOM grid connections and will result in shorter line access routes. All ecological and heritage features were identified and the preferred alternative accommodates these features and does not impact on them.

Activity Alternatives
The core business area of the project proponent, Wine Estate Capital Management, is photovoltaic development for the generation of electricity. As such, the fundamental alternative of a development other than to construct and operate a solar energy facility is therefore not viable in this case, and will not be considered further in the EIA.

Design or layout alternatives
Environmental sensitive features were mapped and used to determine the development layout. Several assessments, i.e. heritage, biodiversity, flood lines, visual, etc., was conducted to ensure that environmental and social sensitive areas were avoided. During the Scoping Phase, site-specific specialist studies are used to identified potentially environmental sensitive areas (which should be avoided by the proposed development as far as possible) for consideration in detail during the EIA phase. The information from the studies in the EIR phase informed the layout alternatives for the proposed development site and provides recommendations regarding the preferred layout alternative. Specific design alternatives included the layout of the PV panels, as well as the connections to the ESKOM grid and access roads. The aim of this planning process was to avoid environmentally sensitive area as far as possible.

Technology alternatives (e.g. to reduce resource demand and resource use efficiency)

There are three general families of photovoltaic (PV) modules (solar panels) on the market today. They are monocrystalline silicon also known as single-crystal silicon, polycrystalline silicon, and thin film Monocrystalline and Polycrystalline Solar panels represent the "traditional" technologies. They can be grouped into the category "crystalline silicon." Monocrystalline is the original PV technology invented in 1955, and never known to wear out. Polycrystalline entered the market in 1981. It is similar in performance and reliability. Monocrystalline modules are composed of cells cut from a piece of continuous crystal. The material forms a cylinder which is sliced into thin circular wafers. To minimize waste, the cells may be fully round or they may be trimmed into other shapes, retaining more or less of the original circle. Because each cell is cut from a single crystal, it has a uniform color which is dark blue.

Polycrystalline cells are made from similar silicon material except that instead of being grown into a single crystal, it is melted and poured into a mold. This forms a square block that can be cut into square wafers with less waste of space or material than round single-crystal or monocrystalline wafers. As the material cools it crystallizes in an imperfect manner, forming random crystal boundaries. The efficiency of energy conversion is slightly lower. This merely means that the size of the finished module is slightly greater per watt than most Monocrystalline modules. The cells look different from Monocrystalline cells. The polycrystalline surface has a jumbled look with many variations of blue color. In fact, they are quite beautiful like sheets of gemstone.

In addition to the above processes, some companies have developed alternatives such as ribbon growth and growth of crystalline film on glass. Most crystalline silicon technologies yield similar results, with high durability. Twenty-year warranties are common for crystalline silicon modules. Monocrystalline tends to be slightly smaller in size per watt of power output, and slightly more expensive than polycrystalline.

The silicon used to produce crystalline solar modules is derived from sand. It is the second most common element on Earth, so why is it so expensive? The answer is that in order to produce the photovoltaic effect, it must be purified to an extremely high degree. Such pure "semiconductor grade" silicon is very expensive to produce. It is also in high demand in the electronics industry because it is the base material for computer chips and other devices. Crystalline solar cells are about the thickness of a human fingernail. They use a relatively large amount of silicon.

Thin-Film or Amorphous Solar Panels
Imagine if a PV cell was made with a microscopically thin deposit of silicon, instead of a thick wafer. It would use very little of the precious material. Now, imagine if it was deposited on a sheet of metal or glass, without the wasteful work of slicing wafers with a saw. Imagine the individual cells deposited next to each other, instead of being mechanically assembled. That is the idea behind thin film technology. (It is also called amorphous, meaning "not crystalline.") The active material may be silicon, or it may be a more exotic material such as cadmium telluride.

Thin-film panels can be made flexible and lightweight by using plastic glazing. Some flexible panels can tolerate a bullet hole without failing. Some of them perform slightly better than crystalline modules under low light conditions. They are also less susceptible to power loss from partial shading of a module.

The disadvantages of thin-film technology are lower efficiency and uncertain durability. Lower efficiency means that more space and mounting hardware are required to produce the same power output. Thin film materials tend to be less stable than crystalline, causing degradation over time. PV experts generally agree that crystalline silicon will remain the "premium" technology for critical applications in remote areas. Thin film will be strong in the "consumer" market where price is a critical factor.

A portion of the ground mounted solar panels will be equipped with so called sun-trackers. This means that the Solar panels will follow the sun in order to increase the efficiency of the panel.

Benefit of a tracking system
Even though a fixed flat-panel can be set to collect a high proportion of available noon-time energy, significant power is also available in the early mornings and late afternoons when the misalignment with a fixed panel becomes excessive to collect a reasonable proportion of the available energy. For example, even when the Sun is only 10° above the horizon the available energy can already be around half the noon-time energy levels (or even greater depending on latitude, season, and atmospheric conditions). Thus the primary benefit of a tracking system is to collect solar energy for the longest period of the day, and with the most accurate alignment as the Sun's position shifts with the seasons.

Several competing systems are available to support the sun-tracking technology. All systems are simple electrical mechanical devices that rotate the panel in a desired direction. Compared to complete fixed mounted panels, there is no different environmental impact other than:

- use of self generated electricity which is over compensated by the improved efficiency of the solar panel
- some higher maintenance cost which will lead to higher employment

The three above technologies alternatives were considered. A combination of Polycrystalline panels and First Solar using cadmium based Thin-film solar cell technology will be preferred in the layout.

Grid Connection Alternatives
The Wine Estate Capital ManagementPV plant consists of several smaller PV blocks. At each of these blocks the DC input voltage from the PV panels is converted to AC by means of inverters. The AC output voltage from the inverter is then stepped up with a 400 V to 22 kV step-up transformer at each block. The electrical power is then transported via underground cables to a central point. At this central point the underground cables connect to a central busbar above ground through the relevant protection switch gear, isolators and measurement devices.

The Wine Estate Capital Managementplant will be connected to the ESKOM grid via a 132 kV overhead transmission line through the appropriate protection switch gear, ext. via an overhead transmission line.

Operational Alternatives

Operational alternatives were not considered as it is not feasible or reasonable. Eskom have specific requirements when electricity generated is connected to the national grid.

The option of not implementing the activity (the No-Go Option)
The No-Go option will result in the site remaining as it is presently, e.g. sheep farming activities.

8. IMPACT ASSESSMENT

8.1. Assessment Methodology

Introduction
Below is the assessment methodology utilized in determining the significance of the construction, operational and decommission impacts of the proposed activities, and where applicable the possible alternatives, on the biophysical and socio-economic environment. The methodology is broadly consistent to that described in DEA's Guideline Document on the EIA Regulations (1998).

ASSESSMENT METHODOLOGY
This section outlines the methodology used to assess the significance of the potential environmental impacts. For each impact, the EXTENT (spatial scale), MAGNITUDE (size or degree scale) and DURATION (time scale) are used to ascertain the SIGNIFICANCE of the impact, firstly in the case of no mitigation and then with the most effective mitigation measure(s) in place. The mitigation described in the document represents the full range of plausible and pragmatic measures *but does not necessarily imply that they should or will all be implemented*. The decision as to which mitigation measures to implement lies with the applicant and ultimately with DEADP. The tables on the following pages show the scale used to assess these variables, and defines each of the rating categories.

Assessment criteria for the evaluation of impacts

CRITERIA	CATEGORY	DESCRIPTION
Extent or spatial influence of impact	**Regional**	Beyond a 20 km radius of the site
	Local	Within a 20 km radius of the centre of the site
	Site specific	On site or within 100 m of the site
Magnitude of impact (at the indicated spatial scale)	**High**	Natural and/ or social functions and/ or processes are *severely* altered
	Medium	Natural and/ or social functions and/ or processes are *notably* altered
	Low	Natural and/ or social functions and/ or processes are *slightly* altered
	Very Low	Natural and/ or social functions and/ or processes are *negligibly* altered
	Zero	Natural and/ or social functions and/ or processes remain *unaltered*
Duration of impact	**Construction period Medium Term**	Up to 60 months Up to 10 years after construction
	Long Term	More than 10 years after construction

The SIGNIFICANCE of an impact is derived by taking into account the temporal and spatial scales and magnitude. The means of arriving at the different significance ratings is explained in the following table.

Definition of significance ratings

SIGNIFICANCE RATINGS	LEVEL OF CRITERIA REQUIRED
High	• High magnitude with a regional extent and long term duration • High magnitude with either a regional extent and medium term duration or a local extent and long term duration • Medium magnitude with a regional extent and long term duration
Medium	• High magnitude with a local extent and medium term duration • High magnitude with a regional extent and construction period or a site specific extent and long term duration • High magnitude with either a local extent and construction period duration or a site specific extent and medium term duration • Medium magnitude with any combination of extent and duration except site specific and construction period or regional and long term • Low magnitude with a regional extent and long term duration
Low	• High magnitude with a site specific extent and construction period duration • Medium magnitude with a site specific extent and construction period duration • Low magnitude with any combination of extent and duration except site specific and construction period or regional and long term • Very low magnitude with a regional extent and long term duration
Very low	• Low magnitude with a site specific extent and construction period duration • Very low magnitude with any combination of extent and duration except regional and long term
Neutral	• Zero magnitude with any combination of extent and duration

Once the significance of an impact has been determined, the PROBABILITY of this impact occurring as well as the CONFIDENCE in the assessment of the impact would be determined using the rating systems outlined in below respectively. It is important to note that the significance of an impact should always be considered in concert with the probability of that impact occurring.

Probability ratings	Criteria
Definite	>95% chance of impact occurring.
Probable	5 – 95% chance of impact occurring.
Unlikely	<5% chance of impact occurring.

Confidence ratings	Criteria
Certain	Wealth of information on and sound understanding of the environmental factors potentially influencing the impact.
Sure	Reasonable amount of useful information on and relatively sound understanding of the environmental factors potentially influencing the impact.
Unsure	Limited useful information on and understanding of the environmental factors potentially influencing this impact.

8.2. Summary of Findings and Recommendations of specialist

8.2.1. Agricultural Impacts

This report has identified a number of issues of importance many of which, if effectively mitigated, are however unlikely to result in significant agricultural and environmental impacts. The actual infrastructure is unlikely to have any significant impact on the viable agricultural activities in the area with the majority of impacts being related to the management of the activity. In order to effectively deal with potential impacts, the management plan must deal with the mitigation measures described in this report. The most critical issue with respect to potential impact is the non-removal and rehabilitation of the infrastructure at the decommissioning phase. It can be concluded that the proposed solar electricity generation facility will not have significant impact on agriculture and that no further specialist agricultural assessment will be required. The facility will not impact or be constructed in any vlei land, marsh, water sponge or water course. All infrastructures are outside of any flood line. The property will be subdivided and rezoned. An application is being drafted and will be submitted shortly.

8.2.2. Heritage Impact Assessments

Indications are that the proposed development of a 75 MW solar energy farm on the Farm Olyvenkolk 187/12 near Kenhardt will have a limited impact on the archaeological heritage, and that potentially significant impacts on Site 260 and Site 393 can be easily **mitigated.**

A 2-day survey of the proposed site was undertaken by J. Kaplan in which the following observations were made:

- 341 archaeological occurrences (numbering more than 1500 stone implements) were documented in the proposed footprint area. Most of the remains are spread unevenly and randomly over the surrounding landscape, but larger numbers of tools tend to cluster alongside/around drainage lines that intersect the site.
- The majority of the finds are assigned to the Middle Stone Age (MSA), which are dominated by triangular shaped flakes, flaked chunks, chunky blade tools, round, flat, and irregular cores. Many of the flakes and blades are utilized, and/or retouched on one or both sides. Seven convex and end scrapers, and six unifacial/bifacial flakes and points, were also recorded.
- With regard to raw material frequencies more than 90% of the lithics are made in quartzite, with smaller numbers in indurated shale. A few implements in exotic chalcedony, silcrete and banded ironstone were also found.
- Early Stone Age (ESA) tools were documented across the site but the numbers are overall quite small. Twelve bifaces/handaxes were counted. Relatively large numbers of large, weathered, retouched flakes in hornfels/indurated shale were also encountered, which appear to be widespread over the surrounding area.
- Later Stone Age (LSA) flakes in chalcedony and opaline were documented, but the numbers are very small. No LSA formal tools were found.

In archaeological terms, no fatal flaws have been identified and the project is deemed to be viable. With regard to the proposed development of the Wine Estate Capital Management 75 MW solar energy facility on Farm 187/12 near Kenhardt, in the Northern Cape, the following recommendations however made:

- The MSA quarry site (260) must be mapped in detail and the material collected for analysis. Alternatively (and perhaps more realistically), a buffer of at least 25 m must be established around this important site and declared a `No-Go' development area. The site must be fenced off and fencing must be done in consultation with, and under the supervision of the archaeologist. A gate must also be provided in case any future research is undertaken at the site. In order to make up for lost `panel' space, the area east of the gravel road can be included in the application area as this area is not considered to be archaeologically sensitive.
- Care should be taken to ensure that the LSA site (393) inside the 32 m drainage line buffer is not harmed or disturbed in any way during the construction phase of the proposed project. The site must be secured and no personnel must be allowed in the area. The area of demarcation must be done in consultation with and under the supervision of the archaeologist. No plant equipment or any temporary facilities must be stored or established close to the site.

The site of the proposed Kenhardt Solar PV power station site is directly underlain by Permocarboniferous glacial-related sediments of the Dwyka Group (Mzibane Formation) that are generally of low palaeontological sensitivity. Quaternary aeolian sediments of the Gordonia Formation (Kalahari Group) as well as alluvial gravels and calcretes, both of low palaeontological sensitivity, may also be encountered near-surface in the study area. Since the palaeontological sensitivity of the rock units within the study area is generally low, the development footprint is fairly small, and extensive bedrock excavations are not envisaged, the impact significance of the proposed Wine Estate Capital ManagementPV facility as far as fossil heritage is concerned is likely to be very small. Therefore further specialist palaeontological mitigation of this project is not considered necessary. Should substantial fossil remains be exposed during construction, however, these should be recorded (GPS, photos), safeguarded if possible *in situ*, and SAHRA should be notified by the ECO so that appropriate mitigation can be considered.

8.2.3. Biodiversity and Ecological Impact Assessment

The report finds that the proposed development should not impact negatively on any listed species. No significant breeding, roosting or habitat on the site will be impacted upon. Most animals will move out of the area when construction starts and back when construction is finished. Eco Impact is of the opinion, and based on the survey and study done, that the development if designed according to the ecological sensitivity map will not impact significantly on the biodiversity or affect ecological functioning of the area. No additional survey or further assessment is recommended in our view.

Protected tree species such as *Acacia erioloba; Boscia albitrunca* and *Euclea pseudebenus* are known to occur in the area. The proposed development site and its associated infrastructure will not impact on any tree species, or any threatened or protected species as per the Treatened or Protected Species Regulations. No protected species occur on the proposed impacted site. Protected species under CITIES and NCEC, e.g. *Aloe dichotoma* and *Hoodia gordonii* were recorded during the survey. The proposed development will not impact on them and no permit would be required to damage or remove them. The *Prosopis sp* occur within the drainage line features. These areas will not be impacted upon. A detailed assessment will be done during the

operational environmental management program as part of the alien clearing program. The landowner will ensure that they identify all known aliens that need to be removed.

Picture: Flower of Prosopis sp

Picture: Prosopis sp left and Acacia Karoo right

Picture: Closeup of Prosopis sp thorns and leaves

The listed activity that includes the construction of solar panels closer than 32m from a water feature was included. The proposed development will however not be constructed closer than 32 meters from any water feature. The electricity cable connecting the panels to each other and the distribution network will however be laid underground through some of the drainage lines. The impact of these was assessed and a Water Use License application submitted. The proposed development is not close and definitively further than 100m from the Graafwatersrivier.

Eco Impact assessed and investigated the TOPS regulations and species listed therein. The proposed development will not impact on any of these species.

Further recommendations:

- The project implementation process should be fully subject to regular and up to requisite standard Environmental Management Programme prescripts and conditions, inclusive of regular competent ECO supervision.
- Rehabilitation under ECO supervision should be conducted after construction activities and disturbance of the river bank should be kept to a minimum.
- The site sensitivity map produced in this report must be adhered to.

8.2.4. Geo-Technical Assessments

The site is situated to the west of the Kenhardt Pofadder gravel road and approximately 4km northeast of the existing Eskom Aries substation.

The proposed sites have a low risk of flooding and seismic activity in the area is limited. Ground movement is less than approximately 50cm/s with a 10% probability of exceedance in 50 Years.

The agricultural potential of the sites is low and is suitable for limited grazing only, mainly due to the harsh climate, shallow soils and low annual rainfall.

The soil profile over the study area can be described as a loose to very loose sand in the upper layer and generally underlain by dense and to very dense calcareous pedogenic layers that disintegrate into coarse gravel during excavation. Only one of the four trial pits could be excavated down to 1 800mm by the digger loader. For the rest of the trial pits the depth to refusal varied from 700mm to 1400mm. I am of the opinion that an excavator will be able to excavate through this layer.

Although the founding method (foundation screws or steel piles) for the solar panels is still to be determined, the dense nature of the soil poses a question mark whether the anchors will be able to penetrate the very dense material. Rocky outcrops are visible on the terrain in the vicinity of Trial Pit F. This constraint will have to be taken into account in the layout of the panels. Although we are of the opinion that this founding method will be feasible, we propose that additional tests be conducted by the specialist contractor responsible for the design and installation of the anchors.

The soil PH ranges between 6.4 and 6.9. The soils are therefore slightly corrosive. Conventional galvanising should be sufficient to protect critical elements in contact with the ground from corrosion.

The study area is considered to be suitable from a geotechnical perspective for the proposed development of a solar power facility.

8.2.5. Service Requirements

All service requirements can be met. The whole facility can be serviced. Water will be supplied from boreholes on the farm. Water Test results revealed that the boreholes can supply the water needs of the facility. Refer to Water Quality Management Report and Application forms submitted under Specialist Report to DWA for registration of water use.

Roads

The existing farm access on the Kenhardt-Pofadder Road (P2986) will be upgraded and maintained.

Water Supply

The farm has a number of boreholes which is fitted with wind pumps. The delivery of 4 of the boreholes has been tested by Agri Solar in Uppington.

Borehole 4 of the boreholes will be used to supply water to the facility. The demand is 13 700l/day.The delivery of the one borehole is 1600l/hour. The boreholes will be fitted with a submersible pump. The water network will consist of HDPE Class 9 pipes with maximum diameter of 90mm. Three 10 000l tanks will be installed to supply a storage capacity equal to 57 hours of water usage.

8.2.6. Water Quality Management Report

In terms of section 21 of the National Water Act, two water uses were identified that needs registration. They include the registration of boreholes to supply the water needs of the development and the acces road crossing.

8.2.7. Visual Impact

The facility will be partly visible from an intermediate area. The greatest visual impact is restricted to relative short distance of ±5km along the bypassing public road, by and large only apparent to motorists approaching the facility from an eastern direction. The landscape can visually absorb only small to medium size changes. Facility is occasionally visually noticeable by

viewer. No existing tourism facilities exist in the region. Potential tourists attracted to the area by the accommodation facilities to be developed on land to the south, will have a positive attitude and low sensitivity to the visual impact of the proposal. Facility is partly recognisable by viewer. The proposed facility maintains a very low profile and follows the natural lay of the land. Facility fits only partially into surroundings. The Aries substation and associated transmission lines, as well as other similar facilities authorized in the direct vicinity of the proposal, sets a precedent for the development of similar activities in the area. The significance of the visual impact can be classified as **moderate** inclined to **low** on condition that the mitigation measures as specified are implemented. This conclusion is reached as a result of the positive effect mitigation has on all VIAC (visual impact assessment criteria).

8.3. Impacts that may result from the Planning, Design and Construction Phase

The construction phase is likely to result in a number of negative impacts on the biophysical and social environments. These impacts relate to the short-term impacts that occur during the construction phase. The significance of construction phase impacts is likely to be curtailed by their relatively short duration and the degraded nature of much of the receiving environment. Furthermore, many of the construction phase impacts can be mitigated by the implementation of an Environmental Management Plan and the appointment of an Environmental Control Officer.

The project will result in an increase of jobs. However, due to the lack of skills within the community (57% unskilled and 39% semi-skilled) others may be employed to do the work. During the construction phase of the plant and related infrastructure an average of fifty (50) job opportunities (<1%) will be created. Forty to forty five (40-45) of these jobs will fall in the unskilled and semi-skilled categories. These jobs include, but are not limited to site clearing, fencing, general construction work (brick laying, plastering etc), mounting panels, digging trenches, creation of fire breaks, operating the construction vehicle.

The impacts identified all have a low level of significance and significance stays low after mitigation. The few impacts that may occur for the No Go alternative are skills development, sales volume and GGP contribution.

The project will result in an increase of <1% jobs during the operation of the project. The energy generation side is not labour intensive and a total of five to ten (5-10) permanent jobs will be created. These jobs include security personnel, general workers (cleaners) and a project manager (electrician).

The general workers, security personnel and cleaning (unskilled labour) will be sourced from Kenhardt. The electrician and some of the teaching staff (skilled labour) will be sourced from the municipal area or the region. Should unskilled and semi-skilled employment opportunities be granted to locals the competition with “outsiders” to get the work done would be eliminated. The employment of locals would have a long term positive impact on the economic and material well being of the local community as opportunities to be trained will enhance their skill base and/or will enhance local SMMEs. However, should contract workers or outside job seekers be employed, it may have an impact on the community stability and safety. Conflict between locals and outsiders and addition pressure on housing will be experienced. Irrespective of local or “others” be employed, there is the fear that increased crime will be experienced on the farm area where the site is located: trespassing on the remainder the farm, an increase in crime and particularly in stealing livestock, increase in traffic, littering and informal vending may take place.

The perception that crime will increase provide criminals, not the locals or others employed, to increase their activities such as stealing livestock. However the plant and related infrastructure will be safe guarded 24 hours.

As job creation will affect less than <1% of the employable population before and after mitigation, its significance is low. However as skills levels are very low (57% of the population is unskilled), affording approximately 17 people the opportunity to get employed is viewed as significant in comparison with the No Go alternative. The youth (Kenhardt Youth Trust) and women's movement view the creation of jobs as highly significant.

It is highly likely that locals will be recruited to do the unskilled and semi-skilled work during the construction phase. Skilled labour (i.e. a project manager (an electrical engineer) and three electricians) may be sourced nationally or internationally and from local or nearby communities respectively. Should the semi-skilled employment opportunities be granted to locals the competition with "outsiders" to get the work done would be eliminated. The employment of locals would have a short term positive impact on the economic and material well being of the local community as opportunities to be trained will enhance their skill base and/or will enhance local SMMEs.

As the educational levels of the Kai !Garib Municipality is low (15% has grade 12 and higher qualifications) and the skills levels is low (39% semi-skilled and 59% unskilled), the implementation of capacity building and skills development training programmes will benefit the community in the long term. The proposed Photovoltaic Electricity Generation Facility will afford less than 1% people to improve their skills. However, as people get trained their income will increase and their economic and material well-being will improve. Decent employment will give meaning to their lives and will help to prohibit the abuse of drug, alcohol and the violent consequences there off. Obtaining skills will enable community members to find work at future construction projects in the area, municipality and the region. Future projects where employment can be obtained are the building of ±264 subsidized houses in Ward 5, the Upington solar park proposed by Eskom, two more solar facilities next to the Arries site and the establishment of Agri-villages, a government priority since 2011. More of these projects will be proposed and developed given the Northern Cape's Solar Irradiance and climate.

The creation of the opportunity to work and to receive training and skills development will cause more jobseekers to settle in the Kenhardt community. This may cause societal tension and instability particularly if locals do not find work and the spiral of poverty deepens. Such jobseekers settling in Kenhardt, will increase the pressure on the provision of housing and services.

Alternative (preferred alternative)

The potential impacts associated with the construction of the proposed PV facility are discussed below. Detailed specialist studies are included in Appendix A which detail the potential environmental impacts on heritage resources, soil erosion and agricultural potential, and ecological impacts on flora and fauna

Impact tables summarising the significance of impacts on Heritage Resources

Potential impacts on archaeological and paleontological heritage

The site of the proposed Kenhardt Solar PV power station site is directly underlain by Permocarboniferous glacial-related sediments of the Dwyka Group (Mzibane Formation) that are generally of low palaeontological sensitivity. Quaternary aeolian sediments of the Gordonia Formation (Kalahari Group) as well as alluvial gravels and calcretes, both of low palaeontological sensitivity, may also be encountered near-surface in the study area.

In archaeological terms, no fatal flaws have been identified and the project is deemed to be viable. With regard to the proposed development of the Wine Estate Capital Management 75 MW solar energy facility on Farm 187/12 near Kenhardt, in the Northern Cape, the following recommendations however made:

- The MSA quarry site (260) must be mapped in detail and the material collected for analysis. Alternatively (and perhaps more realistically), a buffer of at least 25 m must be established around this important site and declared a `No-Go' development area. The site must be fenced off and fencing must be done in consultation with, and under the supervision of the archaeologist. A gate must also be provided in case any future research is undertaken at the site. In order to make up for lost `panel' space, the area east of the gravel road can be included in the application area as this area is not considered to be archaeologically sensitive.
- Care should be taken to ensure that the LSA site (393) inside the 32 m drainage line buffer is not harmed or disturbed in any way during the construction phase of the proposed project. The site must be secured and no personnel must be allowed in the area. The area of demarcation must be done in consultation with and under the supervision of the archaeologist. No plant equipment or any temporary facilities must be stored or established close to the site.

The site of the proposed Kenhardt Solar PV power station site is directly underlain by Permocarboniferous glacial-related sediments of the Dwyka Group (Mzibane Formation) that are generally of low palaeontological sensitivity. Quaternary aeolian sediments of the Gordonia Formation (Kalahari Group) as well as alluvial gravels and calcretes, both of low palaeontological sensitivity, may also be encountered near-surface in the study area.

Since the palaeontological sensitivity of the rock units within the study area is generally low, the development footprint is fairly small, and extensive bedrock excavations are not envisaged, the impact significance of the proposed Wine Estate Capital ManagementPV facility as far as fossil heritage is concerned is likely to be very small. Therefore further specialist palaeontological mitigation of this project is not considered necessary. Should substantial fossil remains be exposed during construction, however, these should be recorded (GPS, photos), safeguarded if possible *in situ*, and SAHRA should be notified by the ECO so that appropriate mitigation can be considered. The proposed ESKOM 132 KV powerline route of 1 km will not impact on any heritage features.

Nature of impact: Destruction of archaeological heritage		
	Without Mitigation	With mitigation
Extent	Local (1)	Local (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	Low (4)	Low (4)
Probability	Probable (3)	Improbable (2)
Significance	30 (Medium)	20 (Low)
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low

Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	

Mitigation:
The site known as 260 is protected by a buffer of at least 25m around this important archaeological site and declared a `No-Go' development area. The area will be fenced and a access gate constructured for future research.

As these objects are surface material, they are out of primary context and area views to have a low significance. Therefore no mitigation measures are required. However, if a heritage object is found, work in that area must be stopped immediately, and appropriate specialist brought in to assess the site, notify the administering authority of the item/site, and undertake due/required processes. Should substantial fossil remains be exposed during construction, however, these should be recorded (GPS, photos), safeguarded if possible in situ, and SAHRA should be notified by the ECO so that appropriate mitigation can be considered.

Cumulative impacts:
No cumulative impacts are expected.

Residual impacts:
No residual impacts are expected.

Potential impacts on agriculture
The agricultural sector in the area is the main economic sector with the largest potential for economic growth. The area is also ideal for small stock farming and the area around Kenhardt is known as the capital of Dorper sheep farming. The area has a carrying capacity to the order of 1 small stock unit per 6 ha.
The study area has been impacted upon to some degree by livestock farming, although the vegetation is in relatively good condition and natural. The vegetation of the study area is dominated by Salsola tuberculata, Eriocephalus ericoides and Rhigozum trichotomum. Dominant grasses include Stipagrostis ciliata var. capensis, Stipagrostis obtusa, Stipagrostis uniplumis var. uniplumis, and Eragrostis curvula.

- Salsola tuberculata grows in plains, depressions and brackish veld. It is palatable and highly resistant to grazing and drought.
- Eriocephalus ericoides grows almost everywhere though the palatability varies greatly in the different regions, habitats and seasons.
- Rhigozum trichotomum grows on hills, apron veld and plains, but it prefers sandy soils. It is unpalatable but the flowers and pods can be grazed. It displaces more valuable plants and sometimes forms impenetrable thickets.
- Stipagrostis ciliata var. capensis grows in the gravel on plains and sandy areas, especially in river beds. Palatable and valuable grass. Is drought resistant with a high grazing value.
- Stipagrostis obtusa grows mostly in dry sandy soils. It is a palatable and valuable grass. Is drought resistant with a high grazing value.
- Stipagrostis uniplumis var. uniplumis grows on undisturbed sandy soils and flood plains. It is palatable with a medium grazing value.
- Eragrostis curvula grows mostly on disturbed areas. It is palatable with a medium grazing value.

Rain water will run off the solar panels and naturally drain eastwards towards the drainage lines

in between the solar panels. In essence none to minimal concentrated water runoff will be evident.

The full farming unit consists of 6 cadastral units with a total of 7011ha. The current farmer stocks 600 ewes on the 7011 ha. This is a small stock carrying capacity of 12ha per small stock unit.

Nature of impact: Livestock Theft		
	Without Mitigation	With mitigation
Extent	Local (1)	Local (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	Low (4)	Low (4)
Probability	Probable (3)	Improbable (2)
Significance	30 (Low)	20 (Low)
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: ECO and security control measures to be put in place.		
Cumulative impacts: No cumulative impacts are expected.		
Residual impacts: No residual impacts are expected.		
Discussion: Theft of livestock is possible during the construction and decommissioning phases. Likelihood of occurrence is improbable if mitigation measures are fully implemented. Fine structures in the EMP should reflect livestock value to ensure replacement value should theft occur. The proposed 132 Kv powerline will not impact on the agricultural activities and viability of the farm.		

Nature of impact: Erosion and Storm Water Management		
	Without Mitigation	With mitigation
Extent	Local and Surrounding Areas (1)	Local (1)
Duration	Short term (2)	Short term (2)
Magnitude	Moderate (6)	Low (4)
Probability	Probable (3)	Improbable (2)
Significance	27 (Low)	14 (Low)
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: Erosion monitoring and maintenance. Rehabilitate site after use		
Cumulative impacts: Siltation and blockage of water drainage systems and erosion.		

Residual impacts: No residual impacts are expected.
Discussion: The study site is located on a flat plain. North of the site the topography slope gently (20m drop in 2 km) towards the south east. This landscape is typical of the broader region within which the study area is located and the pattern repeats itself up 30 km in any direction. The plains are situated at an elevation of 960 m. The site is situated in a very arid part of South Africa. Several drainage lines drains the water collected on the bigger site towards the north, which eventually feed into the upper catchment of the Graafwatersrivier, a non-perennial river north of the study area. Water runoff from panels will penetrate soil and runoff will be reduced by the vegetation cover. Areas disturbed during construction must be re-vegetated as soon as possible. Natural vegetated buffer areas in between solar panels must be maintained to reduce water runoff and to prevent erosion. All roads need to be maintained and monitored and visible signs of possible erosion immediately rehabilitated. Erosion potential is low due to the nature of the soil being dominated by quaternary to recent sands and sandy soil of the Gordonia Formation (Kalahari Group) and Mbizane Formation (Permo-Carboniferous Dwyka Group, Karoo Supergroup) which is stony/rocky. The proposed 132 Kv powerline will not impact on any drainage lines or ecological features nor will in impact on any TOPS species.

Nature of impact: Uncontrolled fires may cause significant damage to agricultural areas and infrastructure and ecology.		
	Without Mitigation	With mitigation
Extent	Local (1)	Local (1)
Duration	Short term (2)	Short term (2)
Magnitude	Low (4)	Low (4)
Probability	Improbable (2)	Very Improbable (1)
Significance	14 (Low)	7 (Low)
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: Ensure proper fire control measures on site and during hot periods. Ensure staff is trained in fire drill.		
Cumulative impacts: Loss of habitat and grazing.		
Residual impacts: No residual impacts are expected.		
Discussion: Must ensure that the requirements of the National Veld and Forest Fire Act are met to ensure proper fire management and prevention. Especially veld fires that may spread from the property or enter and threaten infrastructure on site. This is however very unlikely and of very low significance since this is not a fire driven ecological system and no history of a veld fire on site has ever been recorded.		

Nature of impact: Land Reform.		
	Without Mitigation	With mitigation

Extent	Local (1)	Local (1)
Duration	Long term (4)	Long term (4)
Magnitude	High (8)	Low (4)
Probability	Probable (3)	Probable (3)
Significance	39 (Medium)	27 (Low)
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: None		
Cumulative impacts: Loss of agricultural land for land reform purposes.		
Residual impacts: No residual impacts are expected.		
Discussion: Land redistribution is about making land available for: • agricultural production • settlement and • non-agricultural enterprises During the first five years (1994-1999) the main emphasis of land redistribution was to provide the disadvantaged and the poor with land for housing and small scale farming purposes. 20% of this solar electricity generation project will be owned by BEE certified partners who will lead to the redistribution of non-agricultural land. The proposed property is not identified nor in process of a land reform project to meet the targets set by District Assessment Committees to achieve the required transfer of agricultural land to historically disadvantaged individuals. As far as Eco Impact knows, no land claim for the restoration of land rights is in process or has been submitted.		

Nature of impact: Removal of Waste and Rehabilitation		
	Without Mitigation	With mitigation
Extent	Local (1)	Local (1)
Duration	Short term (2)	Short term (2)
Magnitude	Low (4)	Low (4)
Probability	Improbable (2)	Very Improbable (1)
Significance	14 (Low)	7 (Low)
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: Removal, clearing and rehabilitation of infrastructure		
Cumulative impacts: Loss of agricultural land and impact on agricultural activities.		
Residual impacts: No residual impacts are expected.		
Discussion:		

Potential waste as contained in the panels could be glass and silicon. The silicon is however in a sealed unit and will not leach out and both must be removed and be recycled. All infrastructures must be removed and the site fully cleared and rehabilitated at the decommissioning phase.

Potential impacts on geographical and physical aspects:

Nature of impact: Impact of construction activities on Diesel or oil spillage.		
	Without Mitigation	With mitigation
Extent	Local (1)	Local (1)
Duration	Short term (2)	Short term (2)
Magnitude	Low (4)	Low (4)
Probability	Probable (3)	Improbable (2)
Significance	21 (Low)	14 (Low)
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: Mitigation measures outlined in the EMP, attached as Appendix B, shall be adhered to.		
Cumulative impacts: Diesel and oil spills affecting ground and water quality		
Residual impacts: No residual impacts are expected.		
Discussion: Ground water will manifest itself during the wet season as a perched water table overlying transported materials. Storm Water Management: The Best Management Practices (BMPs) for storm water management usually vary from site to site; however, the basic concepts that are aimed at protecting aquatic ecosystems are the same. The following storm water management will be implemented: • Prevent storm water impacts on the receiving freshwater ecosystem • Manage storm water as a resource • Sustain the hydrologic balance (quantity and quality) • Storm water management is integrated into the initial site design process • Will preserve and utilize natural systems (soil, vegetation, etc.) • Manage storm water as close to the source as possible • Slow storm water flows down • Inspect and maintain storm water systems In addition to the storm water management laid out above that would be applicable to management of storm water to minimise their impact on the receiving freshwater systems, the following mitigation measures relating to future storm water development adjacent to the stream are recommended: • Buffer zones must be maintained on either side of the stream as described in the previous section • The banks of the stream should be kept clear of invasive alien plants, and as far as		

possible the banks should be landscaped and vegetated with indigenous plants

- Habitat variability should be maintained and environmentally acceptable materials utilised. Design of the storm water systems should also allow for flow variability
- Litter and pollutants transported in the storm water systems must be prevented from entering the streams.

Nature of impact: Impact of dust on surrounding environment.		
	Without Mitigation	With mitigation
Extent	Local (1)	Local (1)
Duration	Very Short term (1)	Very Short term (1)
Magnitude	Low (4)	Low (4)
Probability	Definitive (5)	Probable (3)
Significance	30 (Medium)	18 (Low)
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: Mitigation measures outlined in the EMP, attached as Appendix B, shall be adhered to, including: Measures to ensure that material loads are properly covered during transportation. Minimisation of the areas disturbed at any one time and protection of exposed soil against wind erosion, e.g. by dampening with water. Location and treatment of material stockpiles shall take consideration of prevailing wind directions and dwellings as well as to prevent erosion and run off. Dust suppression measures in the form of dampening with water shall be used when particularly during dry periods of weather during the summer months. Adherence to provisions of the Occupational Health and Safety Act.		
Cumulative impacts: Dust impacts on surrounding environment and community.		
Residual impacts: No residual impacts are expected.		

Nature of impact: Impact of construction on planning environment.		
	Without Mitigation	With mitigation
Extent	Local (1)	Local (1)
Duration	Long term (4)	Long term (4)
Magnitude	Low (4)	Low (4)
Probability	Probable (3)	Improbable (2)
Significance	27 (Low)	18 (Low)
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: Whole development falls within planning policy and guideline requirements. New infrastructure is integrated with the existing farm operations. New development is situated		

next to the existing infrastructure and does not encroach onto high potential agricultural lands. Will not impact negatively on the surrounding farming activities.
Cumulative impacts: Impact on future planning, infrastructure and surrounding agricultural activities.
Residual impacts: No residual impacts are expected.

Potential impact on biological aspects:

Nature of impact: Impacts of construction activities on fresh water.		
	Without Mitigation	With mitigation
Extent	Local (1)	Local (1)
Duration	Very Short term (1)	Very Short term (1)
Magnitude	Low (4)	Low (4)
Probability	Probable (3)	Improbable (2)
Significance	18 (Low)	12 (Low)
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: Construction will not take place within the rivers buffer area. No infrastructure will be within the 1 in 100 year flood line area. Buffer area allowed for in the design. Control by ECO and EMP.		
Cumulative impacts: Loss of fresh water habitat		
Residual impacts: No residual impacts are expected.		

Nature of impact: Impacts of construction activities on fauna and flora.		
	Without Mitigation	With mitigation
Extent	Local (1)	Local (1)
Duration	Short term (2)	Short term (2)
Magnitude	Low (4)	Low (4)
Probability	Definitive (5)	Highly probable (4)
Significance	35 (Medium)	28 (Low)
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: The proposed development will not impact on conservation worthy or threatened and protected species, vegetation types or ecosystems. Will work only in defined areas as guided by EMP. The proposed powerline poles will be placed outside any drainage line or its 32m buffer areas.		
Cumulative impacts: Loss of threatened or protected and conservation worthy species and habitat		

Residual impacts:
No residual impacts are expected.

Discussion:
The study area has been impacted upon to some degree by livestock farming, although the vegetation is in relatively good condition and natural. The vegetation of the study area is dominated by Salsola tuberculata, Eriocephalus ericoides, Rhigozum trichotomum, etc. Dominant grasses include Stipagrostis ciliata var. capensis, Stipagrostis obtusa, Stipgrostis uniplumis var. Uniplumis, and Eragrostis curvula.

The property lies in the general area that supports Bushmanland Basin Shrubland, according to the new vegetation map of South Africa (Mucina & Rutherford 2003). This vegetation type is listed as Not Threatened in the South African National Spatial Biodiversity Assessment (Rouget et al 2004).
(Refer to Appendix A, Baseline Biodiversity Assessment).

Nature of impact: Introduction of alien plant species		
	Without Mitigation	With mitigation
Extent	Local (1)	Local (1)
Duration	Very Short term (1)	Very Short term (1)
Magnitude	Low (4)	Low (4)
Probability	Probable (3)	Probable (3)
Significance	18 (Low)	18 (Low)
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	

Mitigation:
Ensure building materials are free of alien seeds
Regular monitoring and clearing Will work only in defined areas as guided by EMP.

Cumulative impacts:
Loss of valuable biodiversity, ecosystems and agricultural land

Residual impacts:
No residual impacts are expected.

Discussion:
Declared Weeds may be transported onto the site and spread to surrounding agricultural properties which may have management and cost impacts on the surrounding properties. Introduction of alien plant species through building material and vehicular traffic is an important aspect that needs to be considered. Alien grass seeds for example may become attached to vehicles and be transported to site or be brought on to site in building materials such as sand to be used for roads. Without monitoring this could become problematic.

The following measures will assist in reducing the potential for the introduction of alien species into new areas and will help to prevent infestation of these areas should the introductions occur.

- Materials such as sand and stone should, wherever possible, be sourced from areas which are free of alien plants.
- Wherever possible rehabilitation of disturbed area should be done with seeds

collected in the area requiring rehabilitation.

- An important aspect of on-going maintenance is the monitoring of the rehabilitated sites and access road verges for alien plant species.
- Should alien species be identified then these should immediately be removed.

No amount of mitigation will prevent the introduction of alien plant species into the area. The mitigation measures mentioned above will however help reduce the risk of introductions and will ensure that should introductions occur they are controlled timeously.

Potential impacts on socio-economic aspects:

Nature of impact: Impact of construction workers on local community safety and security.		
	Without Mitigation	With mitigation
Extent	Local (1)	Local (1)
Duration	Short term (2)	Short term (2)
Magnitude	Low (4)	Low (4)
Probability	Improbable (2)	Improbable (2)
Significance	14 (Low)	14 (Low)
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: As a proclaimed work site the public is not entitled to legal access. Provision will be made for sign boards/ wire perimeter identification/ danger taping of sites. Public access will need to be overtly discouraged via some security presence. Control of personnel.		
Cumulative impacts: Theft of property of neighbouring communities		
Residual impacts: No residual impacts are expected.		

Nature of impact: Job creation		
Extent	Local (1)	
Duration	Short term (2)	
Magnitude	Low (4)	
Probability	Probable (3)	
Significance	21 (Low)	
Status (positive or negative)	Positive	
Reversibility	N/A	
Irreplaceable loss of resources?	N/A	
Can impacts be mitigated?	Yes	
Enhance measures: The use of local labour for low- semi skilled jobs should be maximised as far as possible.		

Potential noise impacts:

Nature of impact: Impact of noise on surrounding environment.

	Without Mitigation	With mitigation
Extent	Local (1)	Local (1)
Duration	Very Short term (1)	Very Short term (1)
Magnitude	Low (4)	Low (4)
Probability	Probable (3)	Probable (3)
Significance	18 (Low)	18 (Low)
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	

Mitigation:
Working hours will be restricted to normal working hours.
All noise and sounds generated by plant or machinery must adhere to SABS 0103 specifications for the maximum permissible noise levels.
All plant and machinery are to be fitted with adequate silencers.
No sound amplification equipment such as sirens, loud hailers or hooters may be used on site, after normal working hours, except in emergencies.
If work is to be undertaken outside of normal work hours, permission must be obtained from the Local Authority.
Prior to commencing any such activity the Contractor is also to advise the potentially affected neighbouring residents. Dates, times and the nature of the work to be undertaken are to be provided. Notification could include letter-drops.

Cumulative impacts:
Noise of construction activities may affect surrounding environment.

Residual impacts:
No residual impacts are expected.

Discussion:
Nuisance impacts could relate to the increase noise and disturbance associated with the proposed development, e.g. noise, traffic etc.

Construction activities and construction personnel on the sites, and construction vehicles moving to and from the sites would cause an increase in noise in the area, which may impact negatively upon the adjoining landowners. Impacts on noise generation during construction should be mitigated by ensuring that all regulations relating to noise generation are observed (in particular the requirements of SANS 10103) and by restricting work, especially outside work that would generate noise, to normal working hours and weekdays.

Alternative (alternative layout and ESKOM line route)

The potential impacts associated with the construction of the proposed PV facility are discussed below. Detailed specialist studies are included in Appendix A which detail the potential environmental impacts on heritage resources, soil erosion and agricultural potential, and ecological impacts on flora and fauna

Impact tables summarising the significance of impacts on Heritage Resources

Potential impacts on archaeological and paleontological heritage

The site of the proposed Kenhardt Solar PV power station site is directly underlain by Permocarboniferous glacial-related sediments of the Dwyka Group (Mzibane Formation) that are generally of low palaeontological sensitivity. Quaternary aeolian sediments of the Gordonia Formation (Kalahari Group) as well as alluvial gravels and calcretes, both of low palaeontological sensitivity, may also be encountered near-surface in the study area.

In archaeological terms, no fatal flaws have been identified and the project is deemed to be viable. With regard to the proposed development of the Wine Estate Capital Management 75 MW solar energy facility on Farm 187/12 near Kenhardt, in the Northern Cape, the following recommendations however made:

- The MSA quarry site (260) must be mapped in detail and the material collected for analysis. Alternatively (and perhaps more realistically), a buffer of at least 25 m must be established around this important site and declared a `No-Go' development area. The site must be fenced off and fencing must be done in consultation with, and under the supervision of the archaeologist. A gate must also be provided in case any future research is undertaken at the site. In order to make up for lost `panel' space, the area east of the gravel road can be included in the application area as this area is not considered to be archaeologically sensitive.
- Care should be taken to ensure that the LSA site (393) inside the 32 m drainage line buffer is not harmed or disturbed in any way during the construction phase of the proposed project. The site must be secured and no personnel must be allowed in the area. The area of demarcation must be done in consultation with and under the supervision of the archaeologist. No plant equipment or any temporary facilities must be stored or established close to the site.

The site of the proposed Kenhardt Solar PV power station site is directly underlain by Permocarboniferous glacial-related sediments of the Dwyka Group (Mzibane Formation) that are generally of low palaeontological sensitivity. Quaternary aeolian sediments of the Gordonia Formation (Kalahari Group) as well as alluvial gravels and calcretes, both of low palaeontological sensitivity, may also be encountered near-surface in the study area.

Since the palaeontological sensitivity of the rock units within the study area is generally low, the development footprint is fairly small, and extensive bedrock excavations are not envisaged, the impact significance of the proposed Wine Estate Capital ManagementPV facility as far as fossil heritage is concerned is likely to be very small. Therefore further specialist palaeontological mitigation of this project is not considered necessary. Should substantial fossil remains be exposed during construction, however, these should be recorded (GPS, photos), safeguarded if possible *in situ*, and SAHRA should be notified by the ECO so that appropriate mitigation can be considered.

Nature of impact: Destruction of archaeological heritage		
	Without Mitigation	With mitigation
Extent	Local (1)	Local (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	Low (4)	Low (4)
Probability	Probable (3)	Improbable (2)
Significance	30 (Medium)	20 (Low)
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low

Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	

Mitigation:
The site known as 260 will be impacted upon. The area will be further surveyed and research before construction on this site may occur.

As these objects are surface material, they are out of primary context and area views to have a low significance. Therefore no mitigation measures are required. However, if a heritage object is found, work in that area must be stopped immediately, and appropriate specialist brought in to assess the site, notify the administering authority of the item/site, and undertake due/required processes. Should substantial fossil remains be exposed during construction, however, these should be recorded (GPS, photos), safeguarded if possible in situ, and SAHRA should be notified by the ECO so that appropriate mitigation can be considered.

Cumulative impacts:
No cumulative impacts are expected.

Residual impacts:
No residual impacts are expected.

Potential impacts on agriculture
The agricultural sector in the area is the main economic sector with the largest potential for economic growth. The area is also ideal for small stock farming and the area around Kenhardt is known as the capital of Dorper sheep farming. The area has a carrying capacity to the order of 1 small stock unit per 6 ha.
The study area has been impacted upon to some degree by livestock farming, although the vegetation is in relatively good condition and natural. The vegetation of the study area is dominated by Salsola tuberculata, Eriocephalus ericoides and Rhigozum trichotomum. Dominant grasses include Stipagrostis ciliata var. capensis, Stipagrostis obtusa, Stipagrostis uniplumis var. uniplumis, and Eragrostis curvula.

- Salsola tuberculata grows in plains, depressions and brackish veld. It is palatable and highly resistant to grazing and drought.
- Eriocephalus ericoides grows almost everywhere though the palatability varies greatly in the different regions, habitats and seasons.
- Rhigozum trichotomum grows on hills, apron veld and plains, but it prefers sandy soils. It is unpalatable but the flowers and pods can be grazed. It displaces more valuable plants and sometimes forms impenetrable thickets.
- Stipagrostis ciliata var. capensis grows in the gravel on plains and sandy areas, especially in river beds. Palatable and valuable grass. Is drought resistant with a high grazing value.
- Stipagrostis obtusa grows mostly in dry sandy soils. It is a palatable and valuable grass. Is drought resistant with a high grazing value.
- Stipagrostis uniplumis var. uniplumis grows on undisturbed sandy soils and flood plains. It is palatable with a medium grazing value.
- Eragrostis curvula grows mostly on disturbed areas. It is palatable with a medium grazing value.

Rain water will run off the solar panels and naturally drain eastwards towards the drainage

lines in between the solar panels. In essence none to minimal concentrated water runoff will be evident.

The full farming unit consists of 6 cadastral units with a total of 7011ha. The current farmer stocks 600 ewes on the 7011 ha. This is a small stock carrying capacity of 12ha per small stock unit. The proposed132 Kv powerline will impact on the agricultural viability of the property.

Nature of impact: Livestock Theft		
	Without Mitigation	With mitigation
Extent	Local (1)	Local (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	Low (4)	Low (4)
Probability	Probable (3)	Improbable (2)
Significance	30 (Low)	20 (Low)
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: ECO and security control measures to be put in place.		
Cumulative impacts: No cumulative impacts are expected.		
Residual impacts: No residual impacts are expected.		
Discussion: Theft of livestock is possible during the construction and decommissioning phases. Likelihood of occurrence is improbable if mitigation measures are fully implemented. Fine structures in the EMP should reflect livestock value to ensure replacement value should theft occur.		

Nature of impact: Erosion and Storm Water Management		
	Without Mitigation	With mitigation
Extent	Local and Surrounding Areas (1)	Local (1)
Duration	Short term (2)	Short term (2)
Magnitude	Moderate (6)	Low (4)
Probability	Probable (3)	Improbable (2)
Significance	27 (Low)	14 (Low)
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: Erosion monitoring and maintenance. Rehabilitate site after use		
Cumulative impacts: Siltation and blockage of water drainage systems and erosion.		

Residual impacts: No residual impacts are expected.
Discussion: The study site is located on a flat plain. North of the site the topography slope gently (20m drop in 2 km) towards the south east. This landscape is typical of the broader region within which the study area is located and the pattern repeats itself up 30 km in any direction. The plains are situated at an elevation of 960 m. The site is situated in a very arid part of South Africa. Several drainage lines drains the water collected on the bigger site towards the north, which eventually feed into the upper catchment of the Graafwatersrivier, a non-perennial river north of the study area. Water runoff from panels will penetrate soil and runoff will be reduced by the vegetation cover. Areas disturbed during construction must be re-vegetated as soon as possible. Natural vegetated buffer areas in between solar panels must be maintained to reduce water runoff and to prevent erosion. All roads need to be maintained and monitored and visible signs of possible erosion immediately rehabilitated. Erosion potential is low due to the nature of the soil being dominated by quaternary to recent sands and sandy soil of the Gordonia Formation (Kalahari Group) and Mbizane Formation (Permo-Carboniferous Dwyka Group, Karoo Supergroup) which is stony/rocky. The 132 Kv powerline poles will be placed outside any drainage lines or its 32m buffer areas.

Nature of impact: Uncontrolled fires may cause significant damage to agricultural areas and infrastructure and ecology.		
	Without Mitigation	With mitigation
Extent	Local (1)	Local (1)
Duration	Short term (2)	Short term (2)
Magnitude	Low (4)	Low (4)
Probability	Improbable (2)	Very Improbable (1)
Significance	14 (Low)	7 (Low)
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: Ensure proper fire control measures on site and during hot periods. Ensure staff is trained in fire drill.		
Cumulative impacts: Loss of habitat and grazing.		
Residual impacts: No residual impacts are expected.		
Discussion: Must ensure that the requirements of the National Veld and Forest Fire Act are met to ensure proper fire management and prevention. Especially veld fires that may spread from the property or enter and threaten infrastructure on site. This is however very unlikely and of very low significance since this is not a fire driven ecological system and no history of a veld fire on site has ever been recorded.		

Nature of impact: Land Reform.		
	Without Mitigation	With mitigation

Extent	Local (1)	Local (1)
Duration	Long term (4)	Long term (4)
Magnitude	High (8)	Low (4)
Probability	Probable (3)	Probable (3)
Significance	39 (Medium)	27 (Low)
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: None		
Cumulative impacts: Loss of agricultural land for land reform purposes.		
Residual impacts: No residual impacts are expected.		
Discussion: Land redistribution is about making land available for: • agricultural production • settlement and • non-agricultural enterprises During the first five years (1994-1999) the main emphasis of land redistribution was to provide the disadvantaged and the poor with land for housing and small scale farming purposes. 20% of this solar electricity generation project will be owned by BEE certified partners who will lead to the redistribution of non-agricultural land. The proposed property is not identified nor in process of a land reform project to meet the targets set by District Assessment Committees to achieve the required transfer of agricultural land to historically disadvantaged individuals. As far as Eco Impact knows, no land claim for the restoration of land rights is in process or has been submitted.		

Nature of impact: Removal of Waste and Rehabilitation		
	Without Mitigation	With mitigation
Extent	Local (1)	Local (1)
Duration	Short term (2)	Short term (2)
Magnitude	Low (4)	Low (4)
Probability	Improbable (2)	Very Improbable (1)
Significance	14 (Low)	7 (Low)
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: Removal, clearing and rehabilitation of infrastructure		
Cumulative impacts: Loss of agricultural land and impact on agricultural activities.		
Residual impacts: No residual impacts are expected.		
Discussion:		

Potential waste as contained in the panels could be glass and silicon. The silicon is however in a sealed unit and will not leach out and both must be removed and be recycled. All infrastructures must be removed and the site fully cleared and rehabilitated at the decommissioning phase.

Potential impacts on geographical and physical aspects:

Nature of impact: Impact of construction activities on Diesel or oil spillage.		
	Without Mitigation	With mitigation
Extent	Local (1)	Local (1)
Duration	Short term (2)	Short term (2)
Magnitude	Low (4)	Low (4)
Probability	Probable (3)	Improbable (2)
Significance	21 (Low)	14 (Low)
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: Mitigation measures outlined in the EMP, attached as Appendix B, shall be adhered to.		
Cumulative impacts: Diesel and oil spills affecting ground and water quality		
Residual impacts: No residual impacts are expected.		
Discussion: Ground water will manifest itself during the wet season as a perched water table overlying transported materials. Storm Water Management: The Best Management Practices (BMPs) for storm water management usually vary from site to site; however, the basic concepts that are aimed at protecting aquatic ecosystems are the same. The following storm water management will be implemented: • Prevent storm water impacts on the receiving freshwater ecosystem • Manage storm water as a resource • Sustain the hydrologic balance (quantity and quality) • Storm water management is integrated into the initial site design process • Will preserve and utilize natural systems (soil, vegetation, etc.) • Manage storm water as close to the source as possible • Slow storm water flows down • Inspect and maintain storm water systems In addition to the storm water management laid out above that would be applicable to management of storm water to minimise their impact on the receiving freshwater systems, the following mitigation measures relating to future storm water development adjacent to the stream are recommended: • Buffer zones must be maintained on either side of the stream as described in the previous section • The banks of the stream should be kept clear of invasive alien plants, and as far as		

possible the banks should be landscaped and vegetated with indigenous plants

- Habitat variability should be maintained and environmentally acceptable materials utilised. Design of the storm water systems should also allow for flow variability
- Litter and pollutants transported in the storm water systems must be prevented from entering the streams.

Nature of impact: Impact of dust on surrounding environment.		
	Without Mitigation	With mitigation
Extent	Local (1)	Local (1)
Duration	Very Short term (1)	Very Short term (1)
Magnitude	Low (4)	Low (4)
Probability	Definitive (5)	Probable (3)
Significance	30 (Medium)	18 (Low)
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: Mitigation measures outlined in the EMP, attached as Appendix B, shall be adhered to, including: Measures to ensure that material loads are properly covered during transportation. Minimisation of the areas disturbed at any one time and protection of exposed soil against wind erosion, e.g. by dampening with water. Location and treatment of material stockpiles shall take consideration of prevailing wind directions and dwellings as well as to prevent erosion and run off. Dust suppression measures in the form of dampening with water shall be used when particularly during dry periods of weather during the summer months. Adherence to provisions of the Occupational Health and Safety Act.		
Cumulative impacts: Dust impacts on surrounding environment and community.		
Residual impacts: No residual impacts are expected.		

Nature of impact: Impact of construction on planning environment.		
	Without Mitigation	With mitigation
Extent	Local (1)	Local (1)
Duration	Long term (4)	Long term (4)
Magnitude	Low (4)	Low (4)
Probability	Probable (3)	Improbable (2)
Significance	27 (Low)	18 (Low)
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: Whole development falls within planning policy and guideline requirements. New infrastructure is integrated with the existing farm operations. New development is situated		

next to the existing infrastructure and does not encroach onto high potential agricultural lands. Will not impact negatively on the surrounding farming activities.
Cumulative impacts: Impact on future planning, infrastructure and surrounding agricultural activities.
Residual impacts: No residual impacts are expected.

Potential impact on biological aspects:

Nature of impact: Impacts of construction activities on fresh water.		
	Without Mitigation	With mitigation
Extent	Local (1)	Local (1)
Duration	Very Short term (1)	Very Short term (1)
Magnitude	Low (4)	Low (4)
Probability	Probable (3)	Improbable (2)
Significance	18 (Low)	12 (Low)
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: Construction will not take place within the rivers buffer area. No infrastructure will be within the 1 in 100 year flood line area. Buffer area allowed for in the design. Control by ECO and EMP.		
Cumulative impacts: Loss of fresh water habitat		
Residual impacts: No residual impacts are expected.		

Nature of impact: Impacts of construction activities on fauna and flora.		
	Without Mitigation	With mitigation
Extent	Local (1)	Local (1)
Duration	Short term (2)	Short term (2)
Magnitude	Low (4)	Low (4)
Probability	Definitive (5)	Highly probable (4)
Significance	35 (Medium)	28 (Low)
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: The proposed development will not impact on conservation worthy or threatened and protected species, vegetation types or ecosystems. Will work only in defined areas as guided by EMP.		
Cumulative impacts: Loss of threatened or protected and conservation worthy species and habitat		
Residual impacts:		

No residual impacts are expected.

Discussion:
The study area has been impacted upon to some degree by livestock farming, although the vegetation is in relatively good condition and natural. The vegetation of the study area is dominated by Salsola tuberculata, Eriocephalus ericoides, Rhigozum trichotomum, etc. Dominant grasses include Stipagrostis ciliata var. capensis, Stipagrostis obtusa, Stipgrostis uniplumis var. Uniplumis, and Eragrostis curvula.

The property lies in the general area that supports Bushmanland Basin Shrubland, according to the new vegetation map of South Africa (Mucina & Rutherford 2003). This vegetation type is listed as Not Threatened in the South African National Spatial Biodiversity Assessment (Rouget et al 2004).
(Refer to Appendix A, Baseline Biodiversity Assessment).

Nature of impact: Introduction of alien plant species		
	Without Mitigation	With mitigation
Extent	Local (1)	Local (1)
Duration	Very Short term (1)	Very Short term (1)
Magnitude	Low (4)	Low (4)
Probability	Probable (3)	Probable (3)
Significance	18 (Low)	18 (Low)
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	

Mitigation:
Ensure building materials are free of alien seeds
Regular monitoring and clearing Will work only in defined areas as guided by EMP.

Cumulative impacts:
Loss of valuable biodiversity, ecosystems and agricultural land

Residual impacts:
No residual impacts are expected.

Discussion:
Declared Weeds may be transported onto the site and spread to surrounding agricultural properties which may have management and cost impacts on the surrounding properties. Introduction of alien plant species through building material and vehicular traffic is an important aspect that needs to be considered. Alien grass seeds for example may become attached to vehicles and be transported to site or be brought on to site in building materials such as sand to be used for roads. Without monitoring this could become problematic.

The following measures will assist in reducing the potential for the introduction of alien species into new areas and will help to prevent infestation of these areas should the introductions occur.

- Materials such as sand and stone should, wherever possible, be sourced from areas which are free of alien plants.
- Wherever possible rehabilitation of disturbed area should be done with seeds collected in the area requiring rehabilitation.

- An important aspect of on-going maintenance is the monitoring of the rehabilitated sites and access road verges for alien plant species.
- Should alien species be identified then these should immediately be removed.

No amount of mitigation will prevent the introduction of alien plant species into the area. The mitigation measures mentioned above will however help reduce the risk of introductions and will ensure that should introductions occur they are controlled timeously.

Potential impacts on socio-economic aspects:

Nature of impact: Impact of construction workers on local community safety and security.		
	Without Mitigation	With mitigation
Extent	Local (1)	Local (1)
Duration	Short term (2)	Short term (2)
Magnitude	Low (4)	Low (4)
Probability	Improbable (2)	Improbable (2)
Significance	14 (Low)	14 (Low)
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: As a proclaimed work site the public is not entitled to legal access. Provision will be made for sign boards/ wire perimeter identification/ danger taping of sites. Public access will need to be overtly discouraged via some security presence. Control of personnel.		
Cumulative impacts: Theft of property of neighbouring communities		
Residual impacts: No residual impacts are expected.		

Nature of impact: Job creation		
Extent	Local (1)	
Duration	Short term (2)	
Magnitude	Low (4)	
Probability	Probable (3)	
Significance	21 (Low)	
Status (positive or negative)	Positive	
Reversibility	N/A	
Irreplaceable loss of resources?	N/A	
Can impacts be mitigated?	Yes	
Enhance measures: The use of local labour for low- semi skilled jobs should be maximised as far as possible.		

Potential noise impacts:

Nature of impact: Impact of noise on surrounding environment.		
	Without Mitigation	With mitigation

Extent	Local (1)	Local (1)
Duration	Very Short term (1)	Very Short term (1)
Magnitude	Low (4)	Low (4)
Probability	Probable (3)	Probable (3)
Significance	18 (Low)	18 (Low)
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	

Mitigation:
Working hours will be restricted to normal working hours.
All noise and sounds generated by plant or machinery must adhere to SABS 0103 specifications for the maximum permissible noise levels.
All plant and machinery are to be fitted with adequate silencers.
No sound amplification equipment such as sirens, loud hailers or hooters may be used on site, after normal working hours, except in emergencies.
If work is to be undertaken outside of normal work hours, permission must be obtained from the Local Authority.
Prior to commencing any such activity the Contractor is also to advise the potentially affected neighbouring residents. Dates, times and the nature of the work to be undertaken are to be provided. Notification could include letter-drops.

Cumulative impacts:
Noise of construction activities may affect surrounding environment.

Residual impacts:
No residual impacts are expected.

Discussion:
Nuisance impacts could relate to the increase noise and disturbance associated with the proposed development, e.g. noise, traffic etc.

Construction activities and construction personnel on the sites, and construction vehicles moving to and from the sites would cause an increase in noise in the area, which may impact negatively upon the adjoining landowners. Impacts on noise generation during construction should be mitigated by ensuring that all regulations relating to noise generation are observed (in particular the requirements of SANS 10103) and by restricting work, especially outside work that would generate noise, to normal working hours and weekdays.

No Go Alternative

The impact that will result from the no-go option will mean that the additional electricity generated from the solar electricity generation facility will not be evacuated into the ESKOM grid. In context of coal fire power stations, some of which generate in excess of 3 GW, the loss of the proposed electricity generation is not significant in the regional and national context. However, the integration of an additional 75 MW should alleviate the pressure on the local grid to a small extent and would contribute in a small way to meeting the government's targets for renewable energy.

8.4. Impacts That May Result From The Operational Phase

Potential impacts associated with the operation of the proposed PV facility are discussed below. Detailed specialist studies are included within Appendix A.

The potential impacts associated with the construction of the proposed PV facility are discussed below. Detailed specialist studies area included within Appendix A which detail the potential environmental impacts on heritage resources, soil erosion and agricultural potential, and ecological impacts on flora and fauna

Impact tables summarising the significance of impacts on Heritage Resources

Potential impacts on archaeological and paleontological heritage

The potential impacts associated with the construction of the proposed PV facility are discussed below. Detailed specialist studies area included within Appendix A which detail the potential environmental impacts on heritage resources, soil erosion and agricultural potential, and ecological impacts on flora and fauna

Impact tables summarising the significance of impacts on Heritage Resources

Potential impacts on archaeological and paleontological heritage
The site of the proposed Kenhardt Solar PV power station site is directly underlain by Permocarboniferous glacial-related sediments of the Dwyka Group (Mzibane Formation) that are generally of low palaeontological sensitivity. Quaternary aeolian sediments of the Gordonia Formation (Kalahari Group) as well as alluvial gravels and calcretes, both of low palaeontological sensitivity, may also be encountered near-surface in the study area.

In archaeological terms, no fatal flaws have been identified and the project is deemed to be viable. With regard to the proposed development of the Wine Estate Capital Management 75 MW solar energy facility on Farm 187/12 near Kenhardt, in the Northern Cape, the following recommendations however made:

- The MSA quarry site (260) must be mapped in detail and the material collected for analysis. Alternatively (and perhaps more realistically), a buffer of at least 25 m must be established around this important site and declared a `No-Go' development area. The site must be fenced off and fencing must be done in consultation with, and under the supervision of the archaeologist. A gate must also be provided in case any future research is undertaken at the site. In order to make up for lost `panel' space, the area east of the gravel road can be included in the application area as this area is not considered to be archaeologically sensitive.
- Care should be taken to ensure that the LSA site (393) inside the 32 m drainage line buffer is not harmed or disturbed in any way during the construction phase of the proposed project. The site must be secured and no personnel must be allowed in the area. The area of demarcation must be done in consultation with and under the supervision of the archaeologist. No plant equipment or any temporary facilities must be stored or established close to the site.

Nature of impact: Destruction of archaeological heritage		
	Without Mitigation	**With mitigation**
Extent	Local (1)	Local (1)

Duration	Permanent (5)	Permanent (5)
Magnitude	Low (4)	Low (4)
Probability	Probable (3)	Improbable (2)
Significance	**30 (Medium)**	**20 (Low)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: The site known as 260 and the buffer of at least 25 m must be declared a `No-Go' development area. The site will be used by scientist to do research.		
Cumulative impacts: No cumulative impacts are expected.		
Residual impacts: No residual impacts are expected.		

Potential impacts on agriculture

The agricultural sector in the area is the main economic sector with the largest potential for economic growth. The area is also ideal for small stock farming and the area around Kenhardt is known as the capital of Dorper sheep farming. The area has a carrying capacity to the order of 1 small stock unit per 6 ha.

The study area has been impacted upon to some degree by livestock farming, although the vegetation is in relatively good condition and natural. The vegetation of the study area is dominated by *Salsola tuberculata*, *Eriocephalus ericoides* and *Rhigozum trichotomum*. Dominant grasses include *Stipagrostis ciliata var. capensis, Stipagrostis obtusa, Stipagrostis uniplumis var. uniplumis,* and *Eragrostis curvula.*

- *Salsola tuberculata* grows in plains, depressions and brackish veld. It is palatable and highly resistant to grazing and drought.
- *Eriocephalus ericoides* grows almost everywhere though the palatability varies greatly in the different regions, habitats and seasons.
- *Rhigozum trichotomum* grows on hills, apron veld and plains, but it prefers sandy soils. It is unpalatable but the flowers and pods can be grazed. It displaces more valuable plants and sometimes forms impenetrable thickets.
- *Stipagrostis ciliata var. capensis* grows in the gravel on plains and sandy areas, especially in river beds. Palatable and valuable grass. Is drought resistant with a high grazing value.
- *Stipagrostis obtusa* grows mostly in dry sandy soils. It is a palatable and valuable grass. Is drought resistant with a high grazing value.
- *Stipagrostis uniplumis var. uniplumis* grows on undisturbed sandy soils and flood plains. It is palatable with a medium grazing value.
- *Eragrostis curvula* grows mostly on disturbed areas. It is palatable with a medium grazing value.

Rain water will run off the solar panels and naturally drain eastwards towards the drainage lines in between the solar panels. In essence none to minimal concentrated water runoff will be evident.

The full farming unit consists of 6 cadastral units with a total of 7011ha. The current farmer stocks 600 ewes on the 7011ha. This is a small stock carrying capacity of 12ha per small stock unit.

Nature of impact: Erosion and Storm Water Management		
	Without Mitigation	**With mitigation**
Extent	Local and Surrounding Areas (1)	Local (1)
Duration	Short term (2)	Short term (2)
Magnitude	Moderate (6)	Low (4)
Probability	Probable (3)	Improbable (2)
Significance	**27 (Low)**	**14 (Low)**
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: Erosion monitoring and maintenance. Rehabilitate site after use		
Cumulative impacts: Soil erosion might extend to areas outside the area of development, especially along the water course. This will lead to higher sediment and solute content of water leaving the area, thus lowering water quality and possibly influencing agricultural practices in the area and posing a threat to human health.		
Residual impacts: Soil erosion related impacts may influence surrounding areas.		
Discussion: The study site is located on a flat plain. North of the site the topography slope gently (20m drop in 2km) towards the east. This landscape is typical of the broader region within which the study area is located and the pattern repeats itself up 30 km in any direction. The plains are situated at an elevation of 960 m. The site is situated in a very arid part of South Africa. Several drainage lines drains the water collected on the bigger site towards the north, which eventually feed into the upper catchment of the Graafwatersrivier, a non-perennial river north of the study area. Water runoff from panels will penetrate soil and runoff will be reduced by the vegetation cover. Areas disturbed during construction must be re-vegetated as soon as possible. Natural vegetated buffer areas in between solar panels must be maintained to reduce water runoff and to prevent erosion. All roads need to be maintained and monitored and visible signs of possible erosion immediately rehabilitated. Erosion potential is low due to the nature of the soil being dominated by quaternary to recent sands and sandy soil of the Gordonia Formation (Kalahari Group) and Mbizane Formation (Permo-Carboniferous Dwyka Group, Karoo Supergroup) which is stony/rocky.		

Nature of impact: Uncontrolled fires may cause significant damage to agricultural areas and infrastructure and ecology.		
	Without Mitigation	**With mitigation**

Extent	Local (1)	Local (1)
Duration	Short term (2)	Short term (2)
Magnitude	Low (4)	Low (4)
Probability	Improbable (2)	Very Improbable (1)
Significance	**14 (Low)**	**7 (Low)**
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: Ensure proper fire control measures on site and during hot periods. Ensure staff are trained in fire drill.		
Cumulative impacts: Loss of habitat and grazing.		
Residual impacts: No residual impacts are expected.		
Discussion: Must ensure that the requirements of the National Veld and Forest Fire Act are met to ensure proper fire management and prevention. Especially veld fires that may spread from the property or enter and threaten infrastructure on site. This is however very unlikely and of very low significance since this is not a fire driven ecological system and no history of a veld fire on site has ever been recorded.		

Nature of impact: Effect of Zero Sunlight on panel area.		
	Without Mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Long term (4)	Long term (4)
Magnitude	Moderate (6)	Low (4)
Probability	Probable (3)	Probable (3)
Significance	**33 (Medium)**	**27 (Low)**
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: None		
Cumulative impacts: Loss of agricultural land due to the zero sunlight effect.		
Residual impacts: No residual impacts are expected.		
Discussion: The panels are fitted off the ground, approximately 1,8m above the ground. Sunlight will not be fully blocked out in the area. Areas under the panels will be in shade during		

periods of the day. The panels are fixed. Sunlight will be able to penetrate the shade areas during limited periods of the day. The blocking of sunlight will however not affect the productivity of the soil. An extreme example of the effect of zero sunlight on soil productivity and rehabilitation is the construction of a tar road. Some roads may be rehabilitated after 30 years. There is evidence recorded of tar roads which are rehabilitated and ploughed after years. These ploughed roads quickly recover and plant growth is evident at these areas. The area impacted upon by the solar panels will not be exposed to a zero sunlight effect, and they will quickly recover after the panels are removed.

Nature of impact: Impact of the solar panels on the existing and future surrounding agricultural activities.

	Without Mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Long term (4)	Long term (4)
Magnitude	Moderate (6)	Low (4)
Probability	Probable (3)	Probable (3)
Significance	**33 (Medium)**	**27 (Low)**
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: Communication procedures included in EMP		
Cumulative impacts: Loss of agricultural land due negative impacts.		
Residual impacts: Operation of activity negatively affects surround agricultural activities.		
Discussion: The proposed solar electricity facility will utilize less productive agricultural land and will not impact on the economic viability of the agricultural unit. Hence, it will have a positive impact. It will increase the economic viability of the property.		

Nature of impact: Impact of the solar panels on the existing and future surrounding agricultural activities as a result of electricity supply.

	Without Mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Long term (4)	Long term (4)
Magnitude	Minor (2)	Minor (2)
Probability	Improbable (2)	Very Improbable (1)
Significance	**14 (Low)**	**7 (Low)**
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Low
Irreplaceable loss of resources?	Yes	Yes

Can impacts be mitigated?	Yes	
Mitigation: Good communications. That the proposed development is aware of these possible impacts before approval.		
Cumulative impacts: Electricity outages affecting surrounding activities.		
Residual impacts: No residual impacts are expected.		
Discussion: The proposed solar electricity facility will feed directly into the ESKOM grid. Connection to the ESKOM network and maintenance will result in power outages. Must be communicated to the ESKOM network users.		

Nature of impact: Introduction of alien plant species		
	Without Mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Very Short term (1)	Very Short term (1)
Magnitude	Low (4)	Low (4)
Probability	Probable (3)	Probable (3)
Significance	**18 (Low)**	**18 (Low)**
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: Regular monitoring and clearing		
Cumulative impacts: Loss of valuable biodiversity, ecosystems and agricultural land		
Residual impacts: No residual impacts are expected.		
Discussion: Declared Weeds may be transported onto the site and spread to surrounding agricultural properties which may have management and cost impacts on the surrounding properties. Introduction of alien plant species through building material and vehicular traffic is an important aspect that needs to be considered. Alien grass seeds for example may become attached to vehicles and be transported to site or be brought on to site in building materials such as sand to be used for roads. Without monitoring this could become problematic. The following measures will assist in reducing the potential for the introduction of alien species into new areas and will help to prevent infestation of these areas should the introductions occur. • Materials such as sand and stone should, wherever possible, be sourced from areas which are free of alien plants. • Wherever possible rehabilitation of disturbed area should be done with seeds		

collected in the area requiring rehabilitation.

- An important aspect of on-going maintenance is the monitoring of the rehabilitated sites and access road verges for alien plant species.
- Should alien species be identified then these should immediately be removed.

No amount of mitigation will prevent the introduction of alien plant species into the area. The mitigation measures mentioned above will however help reduce the risk of introductions and will ensure that should introductions occur they are controlled timeously.

Potential impacts on socio-economic aspects:

Nature of impact: Job creation		
Extent	Local (1)	
Duration	Short term (2)	
Magnitude	Low (4)	
Probability	Probable (3)	
Significance	**21 (Low)**	
Status (positive or negative)	Positive	
Reversibility	N/A	
Irreplaceable loss of resources?	N/A	
Can impacts be mitigated?	Yes	
Enhance measures: The use of local labour for low- semi skilled jobs should be maximised as far as possible.		

Potential impacts on visual aspects:

Nature of impact: Visual Impact from Pofadder		
	Without Mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Long Term (4)	Long Term (4)
Magnitude	Minor (2)	Minor (2)
Probability	Probable (2)	Probable (2)
Significance	**14 (medium)**	**14 (Low)**
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Medium
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: • Signage related to the facility should be discrete and confined to the entrance gates. • No other corporate or advertising signs should be permitted. • All structures should be kept as small and low as possible. • All painted surfaces are to use earth tones chosen for its ability to blend into the		

background.

- Security fencing should be as transparent as possible and mimic agricultural fencing fond in the area.
- The fence should not be visually dominant over the solar arrays.
- The use of razor wire should be avoided.
- Screen planting in the form of tree lines should not be considered.
- Only in exceptional circumstances should vegetation screening be considered in clumps around structures to mimic farmsteads found in the region.
- Security lighting must be kept to the absolute minimum and be confined to only those sections of the facility that are necessary to be illuminated.
- No external up-lighting of any part of the facility must be allowed.
- External, inclusive of perimeter security lighting must be by means of shielded downlighters, minimizing light pollution beyond the extent of the area to be lit.
- Transmission lines to Aries substation should follow the path of the existing power line.
- Underground cabling should be installed where possible.

Cumulative impacts:

Renewable energy facilities tend to locate, due to economic factors, as close as possible to existing electricity infrastructure into which it feeds the power it generates. As Aries substation and the transmission lines that feed into it are mayor infrastructure connected to the national electricity grid, it can thus be expected that more renewable energy facilities will locate around it. The facility that is the subject to this report is one of 5 photovoltaic electricity generation projects in the immediate vicinity of Aries substation, known to the authors, of which 3 has already been authorised. If all 5 projects were to be implemented the intensity of the visual impact, from a local perspective would be higher as the visual character of a larger area will be affected. From a subregional perspective though, the 5 facilities impact on the same viewshed and will the visual impact not be significantly enlarged. These possible future activities will however, consist of the same structural components, with similar visual characteristics and therefore, with similar visual impacts as the present activity. The nature of this future cumulative visual impact will have a horizontal, rather than a vertical characteristic. From a visual perspective it would be preferable to locate all similar visual impacts within sight of the substation rather than affecting more distant areas within the landscape.

Residual impacts:

No residual impacts are expected.

Discussion:

The facility will be partly visible from an intermediate area. The greatest visual impact is restricted to relative short distance of ±5km along the bypassing public road, by and large only apparent to motorists approaching the facility from an eastern direction. The landscape can visually absorb only small to medium size changes. Facility is occasionally visually noticeable by viewer. No existing tourism facilities exist in the region. Potential tourists attracted to the area by the accommodation facilities to be developed on land to the south, will have a positive attitude and low sensitivity to the visual impact of the proposal. Facility is partly recognisable by viewer. The proposed facility maintains a very low profile and follows the natural lay of the land. Facility fits only partially into surroundings. The Aries substation and associated transmission lines, as well as other similar facilities authorized in the direct vicinity of the proposal, sets a precedent for the development of similar activities in the area. The significance of the

visual impact can be classified as **moderate** inclined to **low** on condition that the mitigation measures as specified are implemented. This conclusion is reached as a result of the positive effect mitigation has on all VIAC (visual impact assessment criteria).

Potential impacts on avifuana:

Nature of impact: Impacts on avifuana species		
	Without Mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Long Term (4)	Long Term (4)
Magnitude	Minor (2)	Minor (2)
Probability	Improbable (2)	Improbable (2)
Significance	**14 (Low)**	**14 (Low)**
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Medium
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: None		
Cumulative impacts: May affect birdlife flying in the area.		
Residual impacts: No residual impacts are expected.		

Discussion:

A study **"Development and Application of a Multi-Criteria Decision Analysis Software Tool for Renewable Energy Sources"**, conducted by several universities on behalf of the European Commission. This study highlights several potential effects on avifauna from other renewable technologies i.e. wind and related infrastructure, but clearly concludes that the solar pv installations do not affect avifauna in any negative way and the impact is considered as zero.

Photovoltaic solar panels are designed to absorb sunlight in order to convert solar energy into electricity. The more sunlight that is absorbed, the more energy can be produced. A mono-crystalline silicon solar cell, similar to those proposed at the site, absorbs two-thirds of the sunlight reaching the panel's surface. This means that only one-third of the sunlight reaching the surface of a solar panel can be reflected.

An anti-reflective coating or glass can reduce the sunlight that is reflected and increase the amount of sunlight that is absorbed. The solar panels proposed are designed with at least one anti-reflective layer. Such measures will further reduce reflectivity.

The potential reflectivity of a surface, or albedo, varies with the type of material used to cover it. Solar panels have a netto reflectivity of around 4%. The reflectivity of the current on site surface materials such as dry sand will have a reflectivity of around 45%, or grass-type vegetation with around 25% and broadleaf deciduous trees with around a 10% reflectivity index. The solar panels installation therefore does not noticeably alter

negatively the site's current reflected or indirect sunlight capacity.

A recent report assessing the impact of Solar PV installations close to some USA airports. The conclusion is that the reflectivity emanating from solar pv panels (@4%) is significantly less than the reflectivity from the windows of parked cars (@7%).

The index of refraction of the proposed solar pv panels is approx **1.4**. This is very similar to water which has an index of refraction of **1.33**. Open bodies of water thus reflect a similar per centage of light at around 4%.

With regard to the installation, the impact of the potential "glare" from the solar array will approximate that which would result from any open body of water i.e. dams or lakes of similar extent. Avifauna is not negatively affected by the numerous water surfaces that prevail in their normal habitat.

Due to the path of the sun, sunlight would reach the solar panels at varying angles to be absorbed or reflected over the course of any day. Based on the orientation of the north-facing the solar energy harvesting system and the known sun path, summertime at noon would present the highest potential for any impact onto the surrounding area.

Taking in consideration all of the above factors the proposed impact of potential glare from the solar panels on avi-fauna will be low or not significant.

- Glare from the proposed solar panels will not have a significant impact on any avi-fauna species of conservation significance.
- Potential glare will further also not affect the birds of prey hunting patterns.
- No bird flight paths will be affected.

Should there be any glare from the panels birds flying over the site will simply follow an alternative route until they are familiar with or used to the new site phenomena. The connection electricity lines between the facility and the eskom substation will not impact on avifuana. Birds will not fly into this line. The line will be approximately 1000m in length 30m high but is not on a bird flight parth area.

No Go Alternative

The impact that will result from the no-go option will mean that the additional electricity generated from the solar electricity generation facility will not be evacuated into the ESKOM grid. In context of coal fire power stations, some of which generate in excess of 3 GW, the loss of the proposed electricity generation is not significant in the regional and national context. However, the integration of an additional 75 MW should alleviate the pressure on the local grid to a small extent and would contribute in a small way to meeting the government's targets for renewable energy.

8.5. Impacts That May Result From The Decommissioning And Closure Phase

Alternative (preferred alternative)

The impacts during the decommissioning and closure phases will be similar to impacts of the construction phase as discussed above. All structures must be removed. Waste, where

possible must be recycled. All concrete must be removed off site to a licensed facility. As the basic landform will not be affected the visual impacts will be entirely reversible and the land can be returned to its original visual status. This is of course dependant on the prevention of any future activities on site that could have long-term negative visual implications.

No Go Alternative

The impact that will result from the no-go option will mean that the additional electricity generated from the solar electricity generation facility will not be evacuated into the ESKOM grid. In context of coal fire power stations, some of which generate in excess of 3 GW, the loss of the proposed electricity generation is not significant in the regional and national context. However, the integration of an additional 75 MW should alleviate the pressure on the local grid to a small extent and would contribute in a small way to meeting the government's targets for renewable energy.

8.6. Environmental Impact Statement

Taking the assessment of potential impacts into account, please provide an environmental impact statement that summarises the impact that the proposed activity and its alternatives may have on the environment after the management and mitigation of impacts have been taken into account, with specific reference to types of impact, duration of impacts, likelihood of potential impacts actually occurring and the significance of impacts.

Alternative A (preferred alternative)

This section provides a summary of the assessment conclusions for the proposed development site. In doing so, it draws on the information gathered as part of the Assessment process and the knowledge gained by the environmental assessment practitioner during the course of the process and presents an informed opinion of the environmental impacts associated with the proposed project.

The overall **heritage** impact is likely to be of **low significance** as no sites, features or objects of cultural heritage significance will be impacted upon. The site identified in the study area is excluded as a no go development area and will be protected with a buffer area.

The overall impact on **soil and agricultural potential (inclusive of land reform)** during the construction and operation is likely to be of **low significance** given the implementation of the recommended mitigation measures. The site is dominated by quaternary to recent sands and sandy soil of the Gordonia Formation (Kalahari Group) and Mbizane Formation (Permo-Carboniferous Dwyka Group, Karoo Supergroup) which is stony/rocky. The agricultural sector in the area is the main economic sector with the largest potential for economic growth. The area is also ideal for small stock farming and the area around Kenhardt is known as the capital of Dorper sheep farming. The area has a carrying capacity to the order of 1 small stock unit per 6ha. The farmer currently stocks 118 ewes on this cadastre. The sterilization of the area will allow the farmer to stock fewer ewes on this section of the farm. The proposed facility site is situated in the south western corner of the cadastre and farm. The camp fence will have to be realigned.

The overall impact on **ecology** is likely to be of a **low significance** given the implementation of mitigation measures. The habitats, such as drainage lines and rare endangered species

(species protected in terms of the Treatened or Protected Species regulations) are being regarded to be of high importance in terms of ecological sensitivity. The proposed facility will not impact on any of these high ecological sensitive areas, including their set buffer area.

The overall **social and socio-economic** impact in terms of positive and negative impacts is likely to be of a **low significance** during both the construction and operational phases with the implementation of enhance/mitigation measures. The potential negative impacts associated with the construction phase are typical of construction related projects and are expected to respond to the mitigation measures proposed. The possible job creation and skills development are regarded as a **significant positive** injection into the area. The project would result in significant positive economic spin-offs for the local area and region primarily because of the labour intensive operational practices that would be associated with it.

The facility will be partly visible from an intermediate area. The greatest visual impact is restricted to relative short distance of ±5km along the bypassing public road, by and large only apparent to motorists approaching the facility from an eastern direction. The landscape can visually absorb only small to medium size changes. Facility is occasionally visually noticeable by viewer. No existing tourism facilities exist in the region. Potential tourists attracted to the area by the accommodation facilities to be developed on land to the south, will have a positive attitude and low sensitivity to the visual impact of the proposal. Facility is partly recognisable by viewer. The proposed facility maintains a very low profile and follows the natural lay of the land. Facility fits only partially into surroundings. The Aries substation and associated transmission lines, as well as other similar facilities authorized in the direct vicinity of the proposal, sets a precedent for the development of similar activities in the area. The significance of the visual impact can be classified as **moderate** inclined to **low** on condition that the mitigation measures as specified are implemented. This conclusion is reached as a result of the positive effect mitigation has on all VIAC (visual impact assessment criteria).

The establishment of the facility will have positive benefits as the integration of an additional 75 MW may alleviate the pressure on the local and national grid to a small extent and would contribute (albeit small) to the national target of renewable energy.

Therefore, based on the findings of the studies undertaken, in terms of environmental constrains identified through the initial Environmental Assessment process, **no environmental fatal flaws** were identified with the establishment of the proposed PV plant and it is recommended that the project should be authorised. However, a number of issues requiring mitigation have been highlighted. Environmental specifications for the management of these issues / impacts are detailed within the draft Environmental Management Programme (EMP) included within Addendum B.

No-go alternative (compulsory)

The impact that will result from the no-go option will mean that the additional electricity generated from the solar electricity generation facility will not be evacuated into the ESKOM grid. In context of coal fire power stations, some of which generate in excess of 3 GW, the loss of the proposed electricity generation is not significant in the regional and national context. However, the integration of an additional 75 MW should alleviate the pressure on the local and national grid to a small extent and would contribute in a small way to meeting the government's targets for renewable energy.

IMPACT SUMMARY

The following impacts were identified by registered interested and affected parties and identified key departments during the public participation process in the Scoping phase:

Red Data Book Species and Protected Species under the Threatened or Protected Species Regulations
The Department of Agriculture Forestry and Fisheries' main concern is the possible impact on protected tree species (National Forest Act, Act 84 of 1998 as amended) and other protected flora. Protected tree species such as *Acacia erioloba; Boscia albitrunca* and *Euclea pseudebenus* are known to occur in the area, the latter usually being present in the riparian zone on the banks of the Orange River.

Other protected plant species may also occur onsite, species such as *Aloe dichotoma, Hoodia gordonii, Sutherlandia frutescens* and *Harpagophytum procumbens*. Care should be taken not to disturb or remove any such species listed as protected in terms of legislation such as the Northern Cape Nature Conservation Ordinances and the TOPS Regulations (NEM: Biodiversity Act) unless if a permit was applied for and issued by the Department of Environment and Nature Conservation (DENC).

The Department of Forestry is very curious about the *Prosopis sp* identified on site. This species is not listed in the South African National List of Introduced Trees. Although there are 44 species of the genus *Prosopis* only 6 are said to occur in South Africa. Poynton (2009) listed them as *P. glandulosa* (syn. *P. juliflora); P. pubscens, P. velutina, P. chilensis; P. tamarugo* and a hybrid. It is a well-known fact that the *Prosopis* spp occur in the Kenhardt District. The Department of Forestry is kindly requesting more information on the *P. Africana,* including photographs of the tree, flowers, pods, etc. This is to ensure that the specie is not mistakenly misidentified as an exotic whereas it might be the indigenous *Parkinsonia africana* which is known to occur along dry river beds in the area.

The Branch: Forestry suggests that the Department of Water Affairs be consulted in this regard. Flash floods are a common occurrence in the Northern Cape and can instantly turn a dry riverbed into a fast flowing river destroying everything in its path. It is therefore advisable also from an environmental perspective to have a buffer zone of at least 100m from any dry tributary such as the Graafwatersriver.

The proposed development is said to fall within the Bushmanland Basin shrubland (Mucina & Rutherford). Although this vegetation type is classified as least threatened it contains some bio-geographically important taxa and endemic species. The conservation target is 21% and at this stage none of it is formally conserved in statutory conservation areas. The Bushmandland Basin contains a number endorheic pans and extensive systems of intermittent river channels contributing to ecosystems functioning and the maintenance of biodiversity in this arid region.

The proposed development site and its associated infrastructure will not impact on any tree species, or any threatened or protected species as per the TOPS regulations. No protected species occur on the proposed impacted site. *Aloe dichotoma* and *Hoodia gordonii* were recorded on the bigger site.. No relocation of threatened or protected species will be required. The *Prosopis sp* occur within the drainage line features. These areas will not be impacted upon. A detailed assessment will be done during the operational environmental management program as part of the alien clearing program. The landowner will ensure that they identify all known aliens that need to be removed. The proposed

development is outside the 1 in 100 year flood line. The electricity cable connecting the panels to each other and the distribution network will however be laid underground through some of the drainage lines. This construction will not impact on the ecological function of the drainage lines. A small channel will be dugged, the cable laid and emediately covered with the to soil removed to rehabilitate.

The Department of Agriculture, Land Reform & Rural Development is guided by the Act 43 of 1983. With the development of the above mentioned activities the developer must take care of the following:

Article 7.(3)b of Regulation 9238: Conservation of Agricultural Resources Act (Act 43 of 1983) Utilisation and protection of vleilands, marshes, water sponges and water courses.
7.(1)"… no land user shall utilize the vegetation in a vlei, marsh or water sponge or within the flood are of a water course or within 10m horizontally outside such a flood area in a manner that causes or may cause the deterioration of damage to the natural agriculture resources.
(3)(b) "cultivate any land on his farm unit within the flood area of a water course or within 10m horizontally outside the flood area of a water course".

Rezonging will also be applicable because the land use will change from the current agricultural status. The Department foresees no problems in the development as mentioned above as long as the developer adheres to the articles in Act 43 of 1983.

The facility will not impact or be constructed in any vlei land, marsh, water sponge or water course. All infrastructures are outside of any flood line. The property will be subdivided and rezoned. An application is being drafted and submitted.

This section provides a summary of the assessment conclusions for the proposed development site. In doing so, it draws on the information gathered as part of the Assessment process and the knowledge gained by the environmental assessment practitioner during the course of the process and presents an informed opinion of the environmental impacts associated with the proposed project.

The overall **heritage** impact is likely to be of **low significance** as the sites, features or objects of cultural heritage significance were identified in the study area and excluded from the developable area.

The overall impact on **soil and agricultural potential (inclusive of land reform)** during the construction and operation is likely to be of **low significance** given the implementation of the recommended mitigation measures. The site is dominated by quaternary to recent sands and sandy soil of the Gordonia Formation (Kalahari Group) and Mbizane Formation (Permo-Carboniferous Dwyka Group, Karoo Supergroup) which is stony/rocky. The agricultural sector in the area is the main economic sector with the largest potential for economic growth. The area is also ideal for small stock farming and the area around Kenhardt is known as the capital of Dorper sheep farming. The camp fence will have to be realigned.

The overall impact on **ecology** is likely to be of a **low significance** given the implementation of mitigation measures. The habitats, such as drainage lines and rare endangered species are being regarded to be of high importance in terms of ecological sensitivity. The proposed facility will not impact on any of these high ecological sensitive areas, including their set buffer area.

The overall **social and socio-economic** impact in terms of positive and negative impacts is likely to be of a **low significance** during both the construction and operational phases with the implementation of enhance/mitigation measures. The potential negative impacts associated with the construction phase are typical of construction related projects and are expected to respond to the mitigation measures proposed. The possible job creation and skills development are regarded as a **significant positive** injection into the area. The project would result in significant positive economic spin-offs for the local area and region primarily because of the labour intensive operational practices that would be associated with it.

The facility will be partly visible from an intermediate area. The greatest visual impact is restricted to relative short distance of ±5km along the bypassing public road, by and large only apparent to motorists approaching the facility from an eastern direction. The landscape can visually absorb only small to medium size changes. Facility is occasionally visually noticeable by viewer. No existing tourism facilities exist in the region. Potential tourists attracted to the area by the accommodation facilities to be developed on land to the south, will have a positive attitude and low sensitivity to the visual impact of the proposal. Facility is partly recognisable by viewer. The proposed facility maintains a very low profile and follows the natural lay of the land. Facility fits only partially into surroundings. The Aries substation and associated transmission lines, as well as other similar facilities authorized in the direct vicinity of the proposal, sets a precedent for the development of similar activities in the area. The significance of the visual impact can be classified as **moderate** inclined to **low** on condition that the mitigation measures as specified are implemented. This conclusion is reached as a result of the positive effect mitigation has on all VIAC (visual impact assessment criteria).

The establishment of the facility will have positive benefits as the integration of an additional 75 MW may alleviate the pressure on the local grid to a small extent and would contribute (albeit small) to the national target of renewable energy.

Therefore, based on the findings of the studies undertaken, in terms of environmental constrains identified through the initial Environmental Assessment process, **no environmental fatal flaws** were identified with the establishment of the proposed PV plant and it is recommended that the project should be authorised. However, a number of issues requiring mitigation have been highlighted. Environmental specifications for the management of these issues / impacts are detailed within the draft Environmental Management Programme (EMP) included within Appendix B.

Additional Management, Mitigation and Monitoring Measures

Refer to Appendix B for more details in EMP.

Adequacy of the Assessment Methods Used

Based on the EAP's assessment, issues raised by I&AP's and the project team, specialist studies were undertaken to provide information to address the concerns and assess the impacts of the proposed development on the environment.

The various specialists have provided baseline information. This information has been used by the planning team to inform the current development proposals. The specialists are provided with set criteria for undertaking their assessments, to allow for comparative assessment of all issues. These criteria are detailed in the Terms of Reference to each specialist. These criteria are based on the EIA Regulations.

Gaps in Knowledge
The EAP has no detailed knowledge regarding the other specialist studies conducted. He is only familiar with the biodiversity, environmental and agricultural aspects.

Underlying Assumptions
Qualified Specialists were appointed and guided by the terms of reference for specialists and the EAP presumes that the information and assessment findings are correct and feasible.

Subjectivity In Assigning Significance
To facilitate informed decision-making, EIAs must endeavour to come to terms with the significance of the potential environmental impacts associated with particular development activities. Despite their attempts at providing a completely objective and impartial assessment of the environmental implications of development activities, EIA processes can never completely escape the subjectivity inherent in attempting to define significance. Recognising this, we have attempted to address potential subjectivity in the current process as follows:

- Being explicit about the difficulty of being completely objective in the determination of significance, as outlined above.
- Developing an explicit methodology for assigning significance to impacts and outlining this methodology in detail in the Plan of Study for EIA and in this EIR. Having an explicit methodology not only forces the assessor to come to terms with the various facets contributing toward determination of significance, thereby avoiding arbitrary assignment, but also provides the reader of the EIR with a clear summary of how the assessor derived the assigned significance.
- Wherever possible, differentiating between the likely significance of potential environmental impacts as experienced by the various affected parties.

Although these measures may not totally eliminate subjectivity, they provide an explicit context within which to review the assessment of impacts.

Consideration of Cumulative Impacts
Various cumulative impacts could be associated with the proposed Development, namely:
- Social impacts for the District;
- Increase in trafiic on road during construction
- Increase in renewable energy generation is South Africa

Uncertainties
None

9. CONCLUSIONS AND RECOMMENDATIONS

Conclusions
This EIR has provided a comprehensive assessment of the potential environmental impacts, identified by the EIA team and I&APs, associated with the development proposed.

The significance of the potential environmental (biophysical and social) impacts associated with the proposed project is summarised as follows:

Level of Confidence in Assessment
For all of the impacts assessed in this report, and for all of the proposed developments, the EIA team is confident in their assessment, with a confidence rating of either "sure" or "certain". Accordingly, the information contained within the Final Scoping Report and this EIR is deemed adequate to inform the applicant's decision regarding which options to pursue and DEA determination of the environmental acceptability of the chosen options.

Considerations in the Identification of the Preferred Option
Following the finalisation of the EIR the next step in the EIA process would be for the applicant to identify their preferred options, utilising this EIR together with the relevant technical and financial considerations to inform their decision. It should be noted that it is not the role of the EIR to recommend the preferred option, but to provide a comparison between the various options considered, specifically in terms of their potential environmental impacts. However, it is appropriate to guide the applicant in their identification of their preferred option by highlighting the following environmental implications of the various alternative options assessed in this investigation:

In terms of the the Development:

- None of the impacts are so significant or unmanageable as to suggest that the development should not proceed. Failure to implement the project would preclude the realisation of certain significant socio- economic benefits and renewable energy generation.

Recommendations
The EIR has outlined various mitigation measures, which, if implemented, could minimise the negative impacts, and enhance the positive effects associated with the proposed projects. Careful consideration must be given to the implementation of these measures, especially those relating to the design and layout of the proposed projects, and where appropriate, these, and any others identified by DEA must be enforced as Conditions of Approval in the Environmental Authorization. The most pertinent mitigation measures for each of the proposed developments are included in the EMP.

EA Conditions
The construction of the proposed facility should be implemented according to the EMP to adequately mitigate and manage potential impacts associated with construction activities. The construction activities and relevant rehabilitation of disturbed areas should be monitored against the approved EMP, the Environmental Authorization and all other relevant environmental legislation.

Relevant conditions to be adhered to include:

Design, Construction and Decommissioning Phase:

The following mitigation and management measures should be implemented during the construction phase in order to minimise potential environmental impacts:

- If a heritage object is found, work in that area must be stopped immediately, and appropriate specialist brought in to assess the site, notify the administering authority of the item/site, and undertake due/required processes.
- Mitigation measures outlined in the EMP, attached as Appendix B, shall be adhered to
- Measures to ensure that material loads are properly covered during transportation
- Minimisation of the areas disturbed at any one time and protection of exposed soil against wind erosion, e.g. by dampening with water. Location and treatment of material stockpiles shall take consideration of prevailing wind directions and dwellings as well as to prevent erosion and run off
- Dust suppression measures in the form of dampening with water shall be used when particularly during dry periods of weather during the summer months
- Adherence to provisions of the Occupational Health and Safety Act
- As a proclaimed work site the public is not entitled to legal access. Provision will be made for sign boards/ wire perimeter identification/ danger taping of sites. Public access will need to be overtly discouraged via some security presence. Control of personnel
- The use of local labour for low- semi skilled jobs should be maximised as far as possible
- All noise and sounds generated by plant or machinery must adhere to SABS 0103 specifications for the maximum permissible noise levels
- All plant and machinery are to be fitted with adequate silencers
- No sound amplification equipment such as sirens, loud hailers or hooters may be used on site, after normal working hours, except in emergencies
- If work is to be undertaken outside of normal work hours, permission must be obtained from the Local Authority
- Prior to commencing any such activity the Contractor is also to advise the potentially affected neighbouring residents. Dates, times and the nature of the work to be undertaken are to be provided. Notification could include letter-drops
- Ensure that the slope of the stockpiled material is such that surface runoff is minimal
- Additions of stabilizing agents such as organic material or vegetation cover for erosion control
- Building of swales or berms to decrease water runoff speed
- Appoint Environmental Control Officer (ECO)
- Demarcate all areas where no impacts will be allowed, clearly marking these areas with high visibility signs, inform all contractors and construction workers to refrain from entering / affecting these areas
- Prevent impacts on any surface water as a result of hazardous materials, contamination, unnecessary crossing by vehicles or personnel, extraction, drinking or other uses, construction and maintenance activities
- Implement a weed monitoring and control programme
- All declared aliens must be identified and managed in accordance with the Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983), the implementation of a monitoring programme in this regard is recommended
- The removal or picking of any protected or unprotected plant shall not be permitted and no horticultural specimens (even within demarcated working areas) shall be removed, damaged, or tampered with unless agreed to by the ECO

- No painting or marking of rocks or vegetation to identify locality or other information shall be allowed as it will disfigure the natural setting. Marking shall be done by steel stakes with tags, if required
- Make use of existing access roads, ensuring proper upgrade/ construction/ maintenance in order to limit erosion, proliferation of weeds
- Use of branches of trees and shrubs for fire making purposes is strictly prohibited
- Prevent open fire; provide demarcated fire-safe zones, facilities, and fire control measures
- Fire fighting equipment shall be made available on all vehicles and at various suitable points within the development site
- No animals may be hunted, trapped, or killed for any purpose whatsoever
- In the event that animals are present that may pose a risk to human safety, a suitable animal handler must be requested to remove the animal in an environmentally responsible manner. This specifically refers to snakes, spiders and scorpions
- Use only local indigenous species in the rehabilitation / re-vegetation process
- Should substantial fossil remains be exposed during construction, however, these should be recorded (GPS, photos), safeguarded if possible *in situ*, and SAHRA should be notified by the ECO so that appropriate mitigation can be considered.
- The archaeological important areas and its buffer area of 25m must be fenced and handled as a no go area and a gate must be provided for acess during research.

Operation Phase:
The following mitigation and management measures should be implemented during the operation phase in order to minimise potential environmental impacts:

- Ensure proper fire control measures on site and during hot periods. Ensure staff is trained in fire drill
- Implement a weed monitoring and control programme
- The use of local labour for low- semi skilled jobs should be maximised as far as possible.
- Maintenance of erosion control measures
- Maintenance of roads and fire breaks
- Maintenance of solar panels and electricity generation an connection infrastructure

The Way Forward
The next stage of the public participation process involves the submitting of this EIR to all key departments and registered I&APs

Cognisance will be taken of all comments when compiling the final report, and the comments, together with the study team and client's responses thereto, will be included as an annexure in the Final EIR. Where necessary, the report will be updated accordingly.

Once the Final EIR has been completed and all I&AP comments have been incorporated into the report, it will be submitted to the applicant for review. On the basis of the findings of the EIR as well as other financial and technical considerations, the applicant will decide whether they would like to proceed with the project and if so which of the alternatives they would like to seek authorisation for. At this point, the Final EIR together with a letter from the applicant motivating for their preferred options and indicating which mitigation measures they are prepared to commit to, would be submitted to DEA for their review and decision.

Once they have reviewed the document and are satisfied that it contains sufficient

information to make an informed decision, DEA will use the information contained within the EIR to determine the environmental acceptability of applicant's preferred options. Thereafter DEA will issue a Environmental Authorization outlining the nature of their decision and the Conditions of Approval attached to any authorisation should the proposed activity be approved.

Following the issuing of the Environmental Authorization, I&APS will be notified of DEA decision by means of letters and there will be a 20-day appeal period during which I&APs will have an opportunity to appeal against the decision to the Minister of Environmental Affairs and Tourism in terms of the National Environment Management Act.

10. REFERENCES

AGENBACHT, A.L.D. 2007. The geology of the Pofadder area. Explanation of 1: 250 000 geology sheet 2918. 89 pp. Council for Geoscience, Pretoria.

ALMOND, J.E. 2008a. Fossil record of the Loeriesfontein sheet area (1: 250 000 geological sheet 3018). Unpublished report for the Council for Geoscience, Pretoria, 32 pp.

ALMOND, J.E. 2008b. Palaeozoic fossil record of the Clanwilliam sheet area (1: 250 000 geological sheet 3218). Unpublished report for the Council for Geoscience, Pretoria, 49 pp. (To be published by the Council in 2009).

ALMOND, J.E. 2009. Contributions to the palaeontology and stratigraphy of the Alexander Bay sheet area (1: 250 000 geological sheet 2816), 117 pp. Unpublished technical report prepared for the Council for Geoscience by Natura Viva cc, Cape Town.

ALMOND, J.E. 2011. PALAEONTOLOGICAL IMPACT ASSESSMENT: DESKTOP STUDY

ALMOND, J.E. & PETHER, J. 2008. Palaeontological heritage of the Northern Cape. Interim SAHRA technical report, 124 pp. Natura Viva cc., Cape Town.

ANON: Potential Impacts - Reflection of Proposed Solar Panels. Proposed Solar Highway Site at West Linn, Oregon USA: Will the solar panels create glare or reflection impacts for Oregon City residents. Impact study report by the Good Company

Anon: EUROPEAN COMMISSION Development and Application of a Multi-Criteria Decision Analysis Software Tool for Renewable Energy Sources (MCDA-RES) Contract NNE5-2001-273. FIFTH FRAMEWORK PROGRAMME. EUROPEAN COMMISSION. July 2004.

Anon: Solar Panel Installations at Airports

ANDERSON, A.M. 1974. Arthropod trackways and other trace fossils from the Early Permian lower Karoo Beds of South Africa. Unpublished PhD thesis, University of Witwatersrand, Johannesburg, 172 pp.

ANDERSON, A.M. 1975. Turbidites and arthropod trackways in the Dwyka glacial deposits (Early Permian) of southern Africa. Transactions of the Geological Society of South Africa 78: 265-273.

ANDERSON, A.M. 1976. Fish trails from the Early Permian of South Africa. Palaeontology 19: 397-409, pl. 54.

ANDERSON, A.M. 1981. The *Umfolozia* arthropod trackways in the Permian Dwyka and Ecca Groups of South Africa. Journal of Paleontology 55: 84-108, pls. 1-4.

ANDERSON, A.M. & MCLACHLAN, I.R. 1976. The plant record in the Dwyka and Ecca Series (Permian) of the south-western half of the Great Karoo Basin, South Africa. Palaeontologia africana 19: 31-42.

ANDERSON, J.M. 1977. The biostratigraphy of the Permian and the Triassic. Part 3: A review of Gondwana Permian palynology with particular reference to the northern Karoo Basin, South Africa. Memoirs of the Botanical Survey of South Africa 45, 14-36.

ANDERSON, J.M. & ANDERSON, H.M. 1985. Palaeoflora of southern Africa. Prodromus of South African megafloras, Devonian to Lower Cretaceous, 423 pp, 226 pls. Botanical Research Institute, Pretoria & Balkema, Rotterdam.

BAMFORD, M.K. 2000. Fossil woods of Karoo age deposits in South Africa and Namibia as an aid to biostratigraphical correlation. Journal of African Earth Sciences 31, 119-132.

BAMFORD, M.K. 2004. Diversity of woody vegetation of Gondwanan South Africa. Gondwana Research 7, 153-164.

BAMFORD, M.K. & DE WIT, M.C.J. 1993. Taxonomic description of fossil wood from Cainozoic Sak River terraces, near Brandvlei, Bushmanland, South Africa. Palaeontologia africana 30: 71-80.

BANGERT, B., STOLLHOFEN, H., LORENTZ, V. & ARMSTRONG, R. 1999. The geochronology and significance of ash-fall tuffs in the glacigenic Carboniferous – Permian Dwyka Group of Namibia and South Africa. Journal of African Earth Sciences 29: 33-49.

BANGERT, B., STOLHOFEN, H., GEIGER, M. & LORENZ, V. 2000. Fossil record and high resolution tephrostratigraphy of Carboniferous glaciomarine mudstones, Dwyka Group, southern Namibia. Communications of the Geological Survey of Namibia 12, 235-245.

BANGERT, B. & BAMFORD, M. 2001. Carboniferous pycnoxylic woods from the Dwyka Group of southern Namibia. Palaeontologia africana 37, 13-23.

BUATOIS, L. & MANGANO, M.G. 1995. The paleoenvironmental and paleoecological significance of the lacustrine *Mermia* ichnofacies: an archetypal subaqueous nonmarine trace fossil assemblage. Ichnos 4: 151-161.

BUATOIS, L. & MANGANO, M.G. 2004. Animal-substrate interactions in freshwater environments: applications of ichnology in facies and sequence stratigraphic analysis of fluvio-lacustrine successions. In: McIlroy, D. (Ed.) The application of ichnology to palaeoenvironmental and stratigraphic analysis. Geological Society, London, Special Publications 228, pp 311-333.

BUTZER, K.W., HELGREN, D.M., FOCK, G. & STUCKENRATH, R. 1973. Alluvial terraces of the Lower Vaal River, South Africa: a re-appraisal and re-investigation. Journal of geololgy 81, 341-362.

COETZEE A AND OPPELT E - Leap Sustainable Development and E& E Resources – Socio-Economic Study (March 2011)

COOKE, H.B.S. 1949. Fossil mammals of the Vaal River deposits. Memoirs of the geological Survey of South Africa 35, 1-117.

COOPER, M.R. & OOSTHUIZEN, R. 1974. Archaeocyathid-bearing erratics from Dwyka Subgroup (Permo-Carboniferous) of South Africa, and their importance to continental drift. Nature 247, 396-398.

DE WIT, M.C.J. 1990. Palaeoenvironmental interpretation of Tertiary sediments at Bosluispan, Namaqualand. Palaeoecology of Africa and the surrounding islands 21: 101-118.

DE WIT, M.C.J. 1993. Cainozoic evolution of drainage systems in the north-western Cape. Unpublished PhD thesis, University of Cape Town, Cape Town, 371 pp.

DE WIT, M.C.J. 1999. Post-Gondwana drainage and the development of diamond placers in western South Africa. Economic Geology 94: 721-740.

DE WIT, M.C.J. & BAMFORD, M.K. 1993. Fossil wood from the Brandvlei area, Bushmanland as an indication of palaeoenvironmental changes during the Cainozoic. Palaeontologia africana 30: 81-89.

DE WIT, M.C.J., MARSHALL, T.R. & PARTRIDGE, T.C. 2000. Fluvial deposits and drainage evolution. In: Partridge, T.C. & Maud, R.R. (Eds.) The Cenozoic of southern Africa, pp.55-72. Oxford University Press, Oxford.

DICKENS, J.M. 1961. *Eurydesma* and *Peruvispira* from the Dwyka Beds of South Africa. Palaeontology 4: 138-148, pl. 18.

DICKENS, J.M. 1984. Late Palaeozoic glaciation. BMR Journal of Australian Geology and Geophysics 9: 163-169.

DINGLE, R.V., SIESSER, W.G. & NEWTON, A.R. 1983. Mesozoic and Tertiary geology of southern Africa. viii + 375 pp. Balkema, Rotterdam.

DU TOIT, A. 1954. The geology of South Africa. xii + 611pp, 41 pls. Oliver & Boyd, Edinburgh.

ERIKSSON, P.G., ALTERMANN, W. & HARTZER, F.J. 2006. The Transvaal Supergroup and its precursors. In: Johnson, M.R., Anhaeusser, C.R. & Thomas, R.J. (Eds.) The geology of South Africa, pp. 237-260. Geological Society of South Africa, Marshalltown.

EVANS, F.J.E. 2005. Taxonomy, palaeoecology and palaeobiogeography of some Palaeozoic fish of southern Gondwana. Unpublished PhD thesis, University of Stellenbosch, 628 pp.

GRILL, H. 1997. The Permo-Carboniferous glacial to marine Karoo record in southern Namibia: sedimentary facies and sequence stratigraphy. Beringeria 19: 3-98, 1 pl.

HADDON, I.G. 2000. Kalahari Group sediments. In: Partridge, T.C. & Maud, R.R. (Eds.) The Cenozoic of southern Africa, pp. 173-181. Oxford University Press, Oxford.

HELGREN, D.M. 1977. Geological context of the Vaal River faunas. South African Journal of Science 73, 303-307.

HERBERT, C.T. & COMPTON, J.S. 2007. Depositional environments of the lower Permian

Dwyka diamictite and Prince Albert shale inferred from the geochemistry of early diagenetic concretions, southwest Karoo Basin, South Africa. Sedimentary Geology 194: 263-277.

JOHNSON, M.R., VAN VUUREN, C.J., VISSER, J.N.J., COLE, D.I., De V. WICKENS, H., CHRISTIE, A.D.M., ROBERTS, D.L. & BRANDL, G. 2006. Sedimentary rocks of the Karoo Supergroup. In: Johnson, M.R., Anhaeusser, C.R. & Thomas, R.J. (Eds.) The geology of South Africa, pp. 461-499. Geological Society of South Africa, Marshalltown.

KLEIN, R.G. 1984. The large mammals of southern Africa: Late Pliocene to Recent. In: Klein, R.G. (Ed.) Southern African prehistory and paleoenvironments, pp 107-146. Balkema, Rotterdam.

MACRAE , C. 1999. Life etched in stone. Fossils of South Africa. 305 pp. The Geological Society of South Africa, Johannesburg.

MCLACHLAN, I.R. & ANDERSON, A. 1973. A review of the evidence for marine conditions in southern Africa during Dwyka times. Palaeontologia africana 15: 37-64.

MILLER, R.M. 2008. Karoo Supergroup, pp. 16-1 to 16-115 *in* Miller, R.G. The geology of Namibia. Volume 3. Upper Palaeozoic to Cenozoic. Geological Survey, Namibia.

OELOFSEN, B.W. 1986. A fossil shark neurocranium from the Permo-Carboniferous (lowermost Ecca Formation) of South Africa. In: Uyeno, T, Arai, R., Taniuchi, T & Matsuura, K. (Eds.) Indo-Pacific fish biology. Proceedings of the Second International Conference on Indo-Pacific Fishes. Ichthyological Society of Japan, Tokyo, pp 107-124.

PARTRIDGE, T.C., BOTHA, G.A. & HADDON, I.G. 2006. Cenozoic deposits of the interior. In: Johnson, M.R., Anhaeusser, C.R. & Thomas, R.J. (Eds.) The geology of South Africa, pp. 585-604. Geological Society of South Africa, Marshalltown.

PICKFORD, M. & SENUT, B. 2002. The fossil record of Namibia. 39 pp. The Geological Survey of Namibia.

PLUMSTEAD, E.P. 1969. Three thousand million years of plant life in Africa. Alex Du Toit Memorial Lectures No. 11. Transactions of the Geological Society of South Africa, Annexure to Volume 72, 72pp. 25 pls.

PRINSLOO, M.C. 1989. Die geologie van die gebied Britstown. Explanation to 1: 250000 geology Sheet 3022 Britstown, 40 pp. Council for Geoscience, Pretoria.

SAVAGE, N.M. 1970. A preliminary note on arthropod trace fossils from the Dwyka Series in Natal. IUGS Second Gondwana Symposium, South Africa, 1970, Proceedings and Papers, pp 627-635, pls. 1-5.

SAVAGE, N.M. 1971. A varvite ichnocoenosis from the Dwyka Series of Natal. Lethaia 4: 217-233.

SEILACHER, A. 2007. Trace fossil analysis, xiii + 226pp. Springer Verlag, Berlin.

SENUT, B., PICKFORD, M., WARD, J., DE WIT, M., SPAGGIARI, R. & MORALES, J. 1996.

Biochronology of the Cainozoic sediments at Bosluis Pan, Northern Cape Province, South Africa. South African Journal of Science 92: 249-251.

SIEBRITS, L.B. 1989. Die geologie van die gebied Sakrivier. Explanation of 1: 250 000 geology sheet 3020, 19 pp. Council for Geoscience, Pretoria.

SLABBERT, M.J., MOEN, H.F.G. & BOELEMA, R. 1999. Die geologie van die gebied Kenhardt. Explanation to 1: 250 000 geology Sheet 2920 Kenhardt, 123 pp. Council for Geoscience, Pretoria.

STAPLETON, R.P. 1977. Carboniferous unconformity in southern Africa. Nature 268, 222-223.

STEPHENSON, M.H. 2008. A review of the palynostratigraphy of Gondwanan Late Carboniferous to Early Permian glacigene successions. In: Fielding, C.R., Frank, T.D. & Isbell, J.L. (eds). Resolving the Late Paleozoic Ice Age in time and space. Geological Society of America Special Paper 441, 317-330.

STOLLHOFEN, H., STANISTREET, I.G., BANGERT, B. & GRILL, H. 2000. Tuffs, tectonism and glacially-related sea-level changes, Carboniferous-Permian, southern Namibia. Palaeogeography, Palaeoclimatology, Palaeoecology 161: 127-150.

STONE, P. & THOMSON, M.R.A. 2005. Archaeocyathan limestone blocks of likely Antarctic origin in Gondwanan tillite from the Falkland Islands. Geological Society, London, Special Publications 246, 347-357.

THOMAS, M.J. 1981. The geology of the Kalahari in the Northern Cape Province (Areas 2620 and 2720). Unpublished MSc thesis, University of the Orange Free State, Bloemfontein, 138 pp.

THOMAS, R.J., THOMAS, M.A. & MALHERBE, S.J. 1988. The geology of the Nossob and Twee Rivieren areas. Explanation for 1: 250 000 geology sheets 2520-2620. 17pp. Council for Geoscience, Pretoria.

THOMAS, D.S.G. & SHAW, P.A. 1991. The Kalahari environment, 284 pp. Cambridge University Press.

VAN DER STOK A. SEPTEMBER 2011. Visual Impact Statement

VEEVERS, J.J., COLE, D.I. & COWAN, E.J. 1994. Southern Africa: Karoo Basin and Cape Fold Belt. Geological Society of America, Memoir 184: 223-279.

VISSER, J.N.J. 1982. Upper Carboniferous glacial sedimentation in the Karoo Basin near Prieska, South Africa. Palaeogeography, Palaeoclimatology, Palaeoecology 38, 63-92.

VISSER, J.N.J. 1985. The Dwyka Formation along the north-western margin of the Karoo Basin in the Cape Province, South Africa. Transactions of the Geological Society of South Africa 88, 37-48.

VISSER, J.N.J. 1989. The Permo-Carboniferous Dwyka Formation of southern Africa: deposition by a predominantly subpolar marine ice sheet. Palaeogeography,

Palaeoclimatology, Palaeoecology 70, 377-391.

VISSER, J.N.J. 1997. Deglaciation sequences in the Permo-Carboniferous Karoo and Kalahari Basins of southern Africa: a tool in the analysis of cyclic glaciomarine basin fills. Sedimentology 44: 507-521.

VISSER, J.N.J. 2003. Lithostratigraphy of the Elandsvlei Formation (Dwyka Group). South African Committee for Stratigraphy, Lithostratigraphic Series No. 39, 11 pp. Council for Geoscience, Pretoria.

VISSER, J.N.J., LOOCK, J.C., VAN DER MERWE, J., JOUBERT, C.W., POTGIETER, C.D., MCLAREN, C.H., POTGIETER, G.J.A., VAN DER WESTHUIZEN, W.A., NEL, L. & LEMER, W.M. 1977-78. The Dwyka Formation and Ecca Group, Karoo Sequence, in the northern Karoo Basin, Kimberley-Britstown area. Annals of the Geological Survey of South Africa 12, 143-176.

VISSER, J.N.J., VON BRUNN, V. & JOHNSON, M.R. 1990. Dwyka Group. Catalogue of South African Lithostratigraphic Units 2, 15-17. Council for Geoscience, Pretoria.

VISSER, J.N.J., VAN NIEKERK, B.N. & VAN DER MERWE, S.W. 1997. Sediment transport of the Late Palaeozoic glacial Dwyka Group in the southwestern Karoo Basin. South African Journal of Geology 100: 223-236.

VON BRUNN, V. & VISSER, J.N.J. 1999. Lithostratigraphy of the Mbizane Formation (Dwyka group). South African Committee for Stratigraphy, Lithostratigraphic Series No. 32, 10 pp. Council for Geoscience, Pretoria.

WELLS, L.H. 1964. The Vaal River ‘Younger Gravels” faunal assemblage: a revised list. South African Journal of Science 60, 92-94.

ZAWADA, P.K. 1992. The geology of the Koffiefontein area. Explanation of 1: 250 000 geology sheet 2924 Koffiefontein, 30 pp. Council for Geoscience, Pretoria.