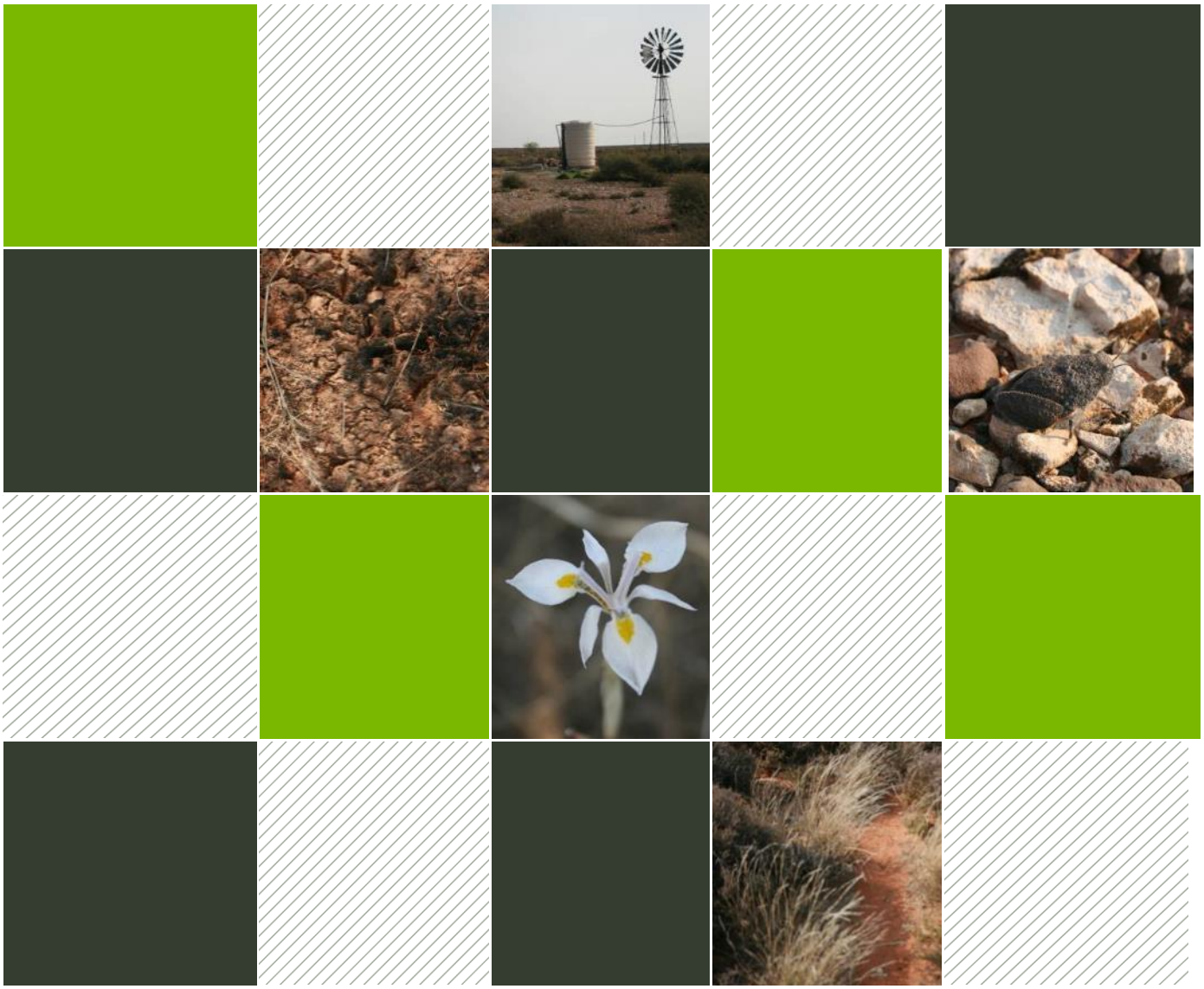

PROPOSED 75MW PV10 PHOTOVOLTAIC ENERGY PLANTS ON THE FARM HOEKPLAAS NEAR COPPERTON, NORTHERN CAPE

DEA REF. NO: 14/12/16/3/3/2/501 NEAS REF. NO: DEA/EIA/0001762/2013

REVISED FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT

23 MARCH 2015

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STRUCTURE OF THE ENVIRONMENTAL IMPACT ASSESSMENT REPORT

Table 1-1 presents the structure of the Environmental Impact Assessment Report (EIAR) as well as the applicable sections that address the required information in terms of the National Environmental Management Act (Act No. 107 of 1998) (NEMA). Specifically, Section 31 of the Environmental Impact Assessment (EIA) Regulations requires that the following information is provided:

Table 1-1 Information required by NEMA for inclusion in the EIA documentation

SECTION 31 OF REGULATION 543		CHAPTER OR SECTION
Section 31(2) of Regulation 543		
(a)	Details of: (i) the Environmental Assessment Practitioner (EAP) who prepared the report; and (ii) the expertise of the EAP to carry out an EIA;	Section 2.4 and **Annexure D**
(b)	a detailed description of the proposed activity;	Chapter 3
(c)	a description of the property on which the activity is to be undertaken and the location of the activity on the property, or if it is: (i) a linear activity, a description of the route of the activity; or (ii) an ocean-based activity, the coordinates where the activity is to be undertaken;	Chapter 3
(d)	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;	Chapter 5
(e)	details of the public participation process conducted in terms of subregulation (1), including- (i) steps undertaken in accordance with the plan of study; (ii) a list of persons, organisations and organs of state that were registered as interested and affected parties; (iii) a summary of comments received from, and a summary of issues raised by registered interested and affected parties, the date of receipt of these comments and the response of the EAP to those comments; and (iv) copies of any representations and comments received from registered interested and affected parties;	Section 2.1.4 and **Annexure B**
(f)	a description of the need and desirability of the proposed activity;	Chapter 4
(g)	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;	Chapter 3
(h)	an indication of the methodology used in determining the significance of potential environmental impacts;	**Annexure E**
(i)	a description and comparative assessment of all alternatives identified during the EIA process;	Chapter 5
(j)	a summary of the findings and recommendations of any specialist report or report on a specialised process;	Chapter 5
(k)	a description of all environmental issues that were identified during the EIA 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;	Chapter 4

SECTION 31 OF REGULATION 543		CHAPTER OR SECTION
(l)	an assessment of each identified potentially significant impact, including- (i) cumulative impacts; (ii) the nature of the impact; (iii) the extent and duration of the impact; (iv) the probability of the impact occurring; (v) the degree to which the impact can be reversed; (vi) the degree to which the impact may cause irreplaceable loss of resources; and (vii) the degree to which the impact can be mitigated;	Chapter 5
(m)	a description of any assumptions, uncertainties and gaps in knowledge;	Section 2.2
(n)	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;	Chapter 6
(o)	an environmental impact statement which contains- (i) a summary of the key findings of the environmental impact assessment; and (ii) a comparative assessment of the positive and negative implications of the proposed activity and identified alternatives;	Chapter 6 and Section 0
(p)	a draft environmental management programme containing the aspects contemplated in regulation 33;	**Annexure D**
(q)	copies of any specialist reports and reports on specialized processes complying with regulation 32;	**Annexure C**
(r)	any specific information that may be required by the competent authority; and	**Annexure F**
(s)	any other matters required in terms of sections 24(4)(a) and (b) of the Act.	
	Section 31(3) of Regulation 543	
	The EAP managing the application must provide the competent authority with detailed, written proof of an investigation as required by Section 24(4)(b)(i) of the Act and motivation if no reasonable or feasible alternatives, as contemplated in subregulation 31(2)(g), exist.	Chapter 3 and Section 3.2.7

IMPORTANT PROJECT INFORMATION

Table 1-2 Important information requested by the Department of Environmental Affairs

No.	Project aspect	Description
1	**Description of the activity**	Hoekplaas Solar PV10 (Pty) Ltd (Mulilo) proposes to construct a photovoltaic (PV) energy facility, referred to as Hoekplaas Solar PV10 (PV10), on The Farm Hoekplaas Number 146, near Copperton in the Northern Cape. The proposed PV facility would consist of the following: • **PV panels** and associated support infrastructure to generate up to 75MW through the PV effect. • **Facility substation:** An onsite 132kV, 6 bay substation. • **Transmission lines:** 132kV overhead double circuit transmission lines.
2	**Municipality**	SiyaThemba Local Municipality of the Pixley ka Seme District Municipality.
3	**Applicant**	Hoekplaas Solar PV10 (Pty) Ltd
4	**Size of the site**	5016ha
5	**Development footprint**	249ha
6	**Capacity of the facility (in MW)**	75
7	**Type of technology**	**Conventional photovoltaic**
8	**Structure height**	< 5m
9	**Grid connection (substation to which project will connect)**	132kV overhead double circuit transmission line (**Figure 3-3**) to connect the proposed Hoekplaas Solar PV10 facility to the newly constructed Hoekplaas Solar PV5 or connect to the existing Eskom substation which is situated offsite if the Hoekplaas Solar PV5 is not approved. (i.e. Kronos or Cuprum)
10	**Power line/s (e.g. number of overhead power line/s required, route/s, voltage, height, servitude width, etc.)**	One overhead 132kV double circuit transmission line of ~15m in height with a servitude width of 31m to connect the proposed facility to the newly constructed Hoekplaas Solar PV5 Substation or to Kronos.
11	**Other infrastructure (e.g. additional infrastructure, details of access roads, extent of areas required for laydown of materials and equipment, etc.)**	**Solar energy facility:** A photovoltaic component comprising of numerous arrays of PV panels and associated support infrastructure to generate up to 75MW per facility, through the PV effect (see **Annexure I**). **Transmission line:** 132kV Double Circuit overhead transmission line (Figure 3-3) to connect the facility to the newly constructed Hoekplaas Solar PV5 or an existing Eskom substation which is situated offsite (i.e. Kronos substation). • Hoekplaas Solar PV10 will connect to the grid via the A D C routing option should no other project be awarded an EA and Preferred Bidder Status. However should Hoekplaas PV5 be awarded an EA and Preferred Bidder Status the line would connect from A to D (**Figure** 3-4). A: 30° 1'54.31"S 22°22'55.07"E | D: 30° 1'2.08"S 22°22'16.60"E | C: 30° 1'26.78"S 22°20'16.94"E **Substation:** An onsite 132kV, 6 bay. **Roads:** Access and internal roads for servicing and maintenance of

		the facility would use routing XYQ if no other projects are awarded an EA and Preferred Bidder Status. If PV5 or PV7 are awarded an EA and Preferred Bidder Status, the connection route would be Y to Q. No access route would be required for PV10 if PV8 or PV9 were awarded an EA and Preferred Bidder Status.

X: 30° 1'7.58"S 22°20'27.66"E	Y: 30° 1'7.58"S 22°20'27.66"E	Q: 30° 1'53.89"S 22°23'42.46"E

Boundary fence: The facility would have an electrical or barbed wire fence for safety and security.
Buildings: Buildings would likely include an onsite substation, a connection building, operational and maintenance building, guard cabin, an electrical substation and solar resource measuring substation.

Multiple PV facilities are proposed for Farm Hoekplaas and shared infrastructure may occur if more than one project is awarded:
Stormwater infrastructure: Including, but not limited to, drainage spines, drainage channels, multiple apron outlets, detention areas and kinetic energy dissipaters.
Buildings: Buildings would likely include an onsite substation, a connection building, operational and maintenance building, guard cabin, an electrical substation and solar resource measuring substation.

The following infrastructure can also be shared among the proposed PV facilities and have received environmental authorisation under the PV1[1] and PV4[2] projects on farm Hoekplaas:
Water supply infrastructure: It is proposed that potable water would be obtained from the Alkantpan pipeline while negotiating sourcing of water from the local municipality.
Buildings: Buildings would likely include Operations and Maintenance Building, guard cabin, an electrical substation and solar resource measuring substation to monitor the performance of the plant compared to the solar radiation.[3]
Laydown areas: Two laydown areas have been identified and one of these would be used during the construction phases of the proposed PV facility. This laydown area has already received authorisation under the authorised PV1 and PV4 facility.

1 DEA Ref. No. 12/12/20/2501 & NEAS Ref. No. DEAT/EIA/0000611/2011
2 DEA Ref. No. 14/12/16/3/3/2/495 & NEAS Ref. No. DEA/EIA/0001756/2013
[3] Shared infrastructure may occur if more than one project is awarded but each facility will need to have the necessary infrastructure authorised should they need to operate individually.

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GLOSSARY OF TERMS

Environment	The surroundings (biophysical, social and economic) within which humans exist and that are made up of i. the land, water and atmosphere of the earth; ii. micro-organisms, plant and animal life; iii. any part or combination of (i) and (ii) and the interrelationships among and between them; and iv. the physical, chemical, aesthetic and cultural properties and conditions of the foregoing that influence human health and wellbeing;
Environmental Impact Assessment (EIA)	A study of the environmental consequences of a proposed course of action.
Environmental Impact Report Assessment (EIAR)	A report assessing the potential significant impacts as identified during the Scoping phase.
Environmental impact	An environmental change caused by some human act.
Environmental Management Programme (EMP)	A document that provides procedures for mitigating and monitoring environmental impacts, during the construction, operation and decommissioning phases.
Photovoltaic (PV)	Method to convert solar radiation into direct current electricity (Photovoltaics, 2013).
Public Participation Process	A process of involving the public in order to identify needs, address concerns, in order to contribute to more informed decision making relating to a proposed project, programme or development
Scoping	A procedure for determining the extent of and approach to an EIA, used to focus the EIA to ensure that only the significant issues and reasonable alternatives are examined in detail
Scoping Report	A report describing the issues identified
Wetland	"Land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is periodically covered with shallow water and which in normal circumstances supports or would support vegetation typically adapted to life in saturated soils." (SA Water Act of1998).

ABBREVIATIONS

AC	Alternating Current
AGIS	Agricultural Geo-Referenced Information System
BID	Background Information Document
CARA	Conservation of Agricultural Resources Act
CBD	Central Business District
CFC	Chlorofluorocarbon
CPV	Concentrated Photovoltaic
CISPR	The International Special Committee on Radio Interference
CRR	Comments and Response Report
DAFF	Department of Agriculture, Forestry and Fisheries
dB	Decibels
DEA	Department of Environmental Affairs (previously Department of Environmental Affairs and Tourism)
DEA&DP	Department of Environmental Affairs and Development Planning
DEANC	Department of Environmental Affairs and Nature Conservation
DEAT	Department of Environmental Affairs and Tourism
DM	District Municipality
DME	Department of Minerals and Energy
DoE	Department of Energy
DSR	Draft Scoping Report
DWS	Department of Water and Sanitation (previously Department of Water Affairs)
EAP	Environmental Assessment Practitioner
EAPSA	Environmental Assessment Practitioner of South Africa
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
ENPAT	Environmental Potential Atlas
EMC	Electromagnetic compatibility
EMF	Environmental Management Framework
EMP	Environmental Management Programme
ERA	Electricity Regulation Act
ESA	Early Stone Age
GHG	Greenhouse gasses
GN	Government Notice
GWh	Gigawatt Hours
Ha	Hectares
HIA	Heritage Impact Assessment
HIV/AIDS	Human Immunodeficiency Virus Infection / Acquired Immunodeficiency Syndrome
Hz	Hertz
I&APs	Interested and Affected Parties
ICASA	Independent Communications Authority of South Africa
IDP	Integrated Development Plans
IEA	International Energy Agency
IEC	International Electro-technical Commission
IEIM	Integrated Environmental Information Management
IEMP	Integrated Environmental Management Plan
IEP	Integrated Energy Plan
IGBT	Insulated Gate Bipolar Transistor

ISRIC	International Soil Reference and Information Centre
IPP	Independent Power Producer
IPPPP	Independent Power Producer Procurement Programme
IRP	Integrated Resource Plan
IUCN	International Union for Conservation of Nature
KCAA	Karoo Core Astronomy Advantage Area
KOP	Key Observation Point
kV	Kilovolt
LRdn	Day/Night Rating Level
LM	Local Municipality
LEMP	Life-cycle Environmental Management Plan
LSA	Late Stone Age
MAP	Mean Annual Precipitation
MSA	Middle Stone Age
MW	Megawatts
NEAS	National Environmental Authorisation System
NEMA	National Environmental Management Act (No. 107 of 1998) (as amended)
NERSA	National Energy Regulator of South Africa
NHRA	National Heritage Resources Act (No. 25 of 1999)
NIRP	National Integrated Resource Plan
NWA	National Water Act (No 36 of 1998)
PPA	Power Purchase Agreement
PV	Photovoltaic
REFIT	Renewable Energy Feed-In Tariffs
RFI	Radio Frequency Interference
SAHRA	South African Heritage Resources Agency
SACNSP	South African Council for Natural Scientific Professions
SANS	South African National Standards
SASPO	South African SKA Projects Office
SKA	Square Kilometre Array
SDF	Spatial Development Framework
TB	Tuberculosis
ToR	Terms of Reference
TSF	Tailings Storage Facility
TSP	Total Suspended Particulates
UNCBD	United Nations Convention on Biological Diversity
UNFCCC	United Nations Framework Convention on Climate Change
VIA	Visual Impact Assessment
WMA	Water Management Area

Revision of the Final EIA Report

The purpose of this report is to separate one of the proposed projects, namely PV10, from the initial Final Environmental Impact Assessment Report (FEIAR) as requested by DEA in their letter attached as **Annexure J** to this report.

1 INTRODUCTION AND BACKGROUND

The purpose of this Chapter is to introduce the project and describe the relevant legal framework within which the project takes place. Other applicable policies and guidelines are also discussed. The Terms of Reference, scope of and approach to the Environmental Impact Assessment are described and assumptions and limitations are stated.

1.1 Introduction

Hoekplaas Solar PV10 (PTY) LTD (Mulilo) intends to develop a 75MW Alternating Current (AC) photovoltaic (PV) solar energy facility, namely Hoekplaas Solar PV10 (PV10) on The Farm Hoekplaas No. 146, near Copperton in the Northern Cape. The Hoekplaas farm borders the Kronos substation and is located approximately 7.8km to the south of Copperton (**Figure 1-1**).

Note that Aurecon undertook an Environmental Impact Assessment (EIA process during 2012 on behalf of Mulilo for the authorisation of a 100MW PV facility on the same property[4] (i.e. The Farm Hoekplaas No. 146). An Environmental Authorisation (EA) was issued by the Department of Environmental Affairs (DEA) on 21 January 2013[5].

In February 2013, Mulilo appointed Aurecon South Africa (Pty) Ltd (Aurecon) to undertake an Environmental Impact Assessment (EIA), in terms of NEMA, for ten proposed PV facilities (PV2-PV11) on The Farm Hoekplaas No. 146, which would each have a maximum generation capacity of 75MW AC through PV technology. Each project was applied for separately, i.e. a separate EIA Application form was submitted to the Department of Environmental Affairs (DEA) for each project. As all the projects are to be located on the same farm, one EIA report was submitted detailing all ten projects.

However, this approach was rejected by DEA for various reasons contained in a letter dated 21 February 2014 (see Annexure J) who requested separate reports for each of the applications. Subsequent to DEA's decision, Mulilo identified three priority projects they wished to submit for the 18 August 2014 Independent Power Producer Procurement Programme (IPPPP) bidding window, of which one was Hoekplaas PV4[6]. These projects were then separated into individual reports and submitted to the Department on 9 April 2014. An Environmental Authorisation (EA) was granted for Hoekplaas PV4 on 9 July 2014 (see **Figure 1-2** for the location of the authorised projects). The remaining projects from the initial submission (PV2, PV3, PV5, PV8, and PV9) will be submitted to DEA for review and decision making once the applicable report has been completed.

It is important to note that during these EIA phases, various impacts were identified from the initial 18 projects that were assessed in the area (20km radius). In order to mitigate the specific and cumulative impacts, a total of five projects (Hoekplaas PV6, PV7 and PV11 and Klipgats PV2 and PV4) were removed completely from the development plan.

[4] DEA Ref. No. 12/12/20/2501 & NEAS Ref. No. DEAT/EIA/0000611/2011
[5] The authorised PV facility would hereafter be referred to as Hoekplaas PV1
[6] DEA Ref. No. 14/12/16/3/3/2/495 & NEAS Ref. No. DEA/EIA/0001756/2013

The purpose of this report is to present one of these projects, namely PV10, and to discuss the potential impacts that the project might pose and what mitigation measures should be applied where the impacts cannot be avoided altogether. It further aims to present the DEA with sufficient information to make an informed decision on whether or not to approve the proposed project.

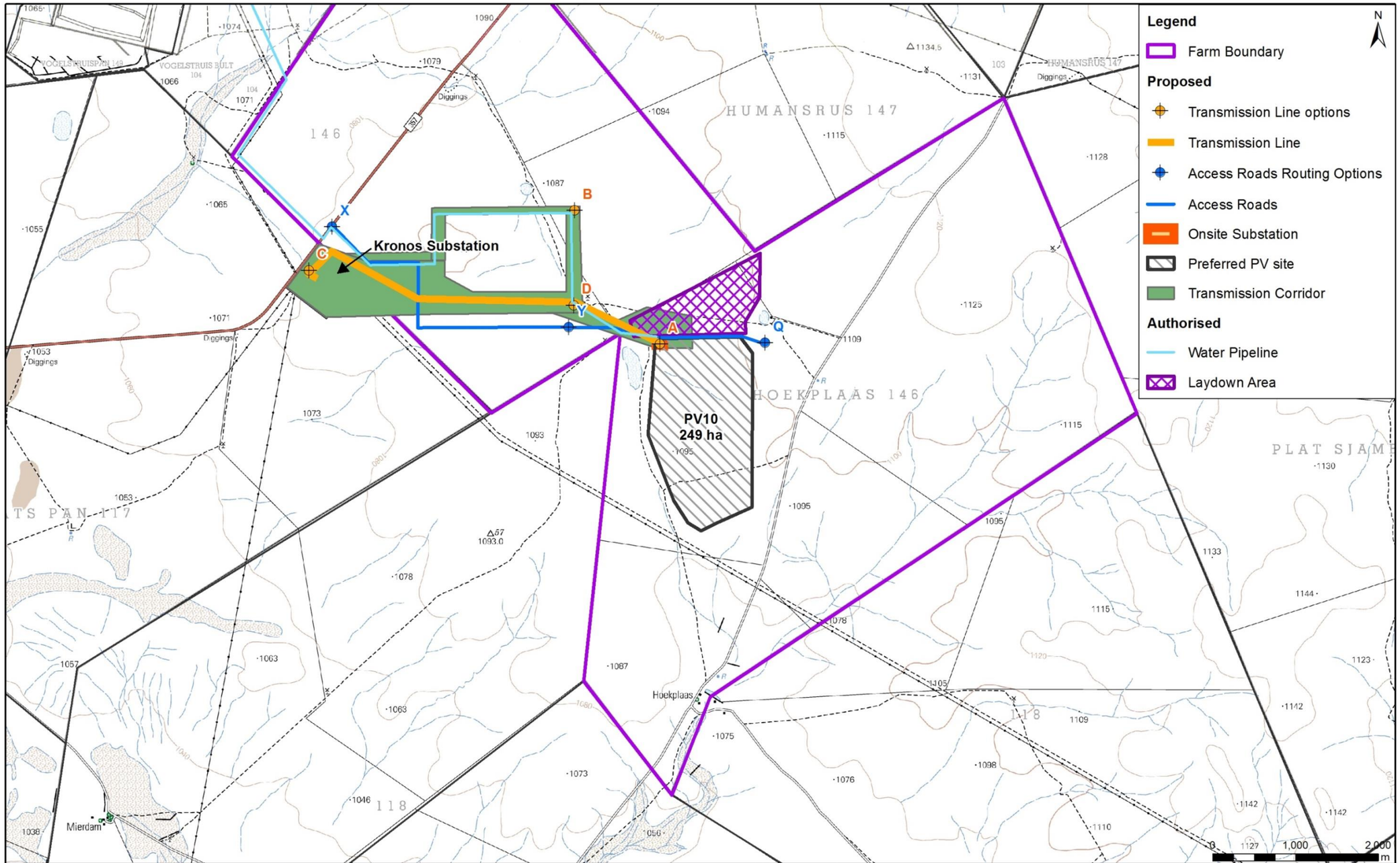
Ancillary infrastructure associated with the proposed PV10 facility would include an onsite 132kV double circuit overhead transmission line and substation, an electrical or barbed wire fence around the 75MW facility, onsite water supply infrastructure, and stormwater management infrastructure. In addition, a connection building, operational and maintenance building, guard cabin and a solar resource measuring substation would be established.

In terms of the NEMA, the proposed development triggers a suite of activities, which require authorisation from the competent environmental authority before they can be undertaken. Since the project is for the generation of energy, and energy projects are dealt with by the national authority, the competent authority is the national DEA. DEA's decision will be based on the outcome of this EIA process.

The EIA Phase is the last phase in the EIA process. Accordingly, this EIA Report (EIAR)[7] aims to collate, synthesise and analyse information from a range of sources to provide sufficient information for DEA to make an informed decision on whether or not the potential environmental impacts associated with the proposed project are acceptable from an environmental perspective (the EIA process and sequence of documents produced as a result of the process are illustrated in Section 2.1). Accordingly the EIAR:

- Outlines the legal and policy framework;
- Describes the Public Participation Process undertaken to date;
- Describes strategic and planning considerations;
- Describes the proposed project and its alternatives;
- Describes the assessment methodology used; and
- Assesses potential impacts and possible mitigation measures.

[7] Section 31 of EIA Regulation No. 543 of NEMA lists the content required in an EIAR.



aurecon www.aurecongroup.com	DRAWING TITLE *Preferred Layout*	PROJECT TITLE **PROPOSED PV10 PHOTOVOLTAIC ENERGY FACILITY ON FARM HOEKPLAAS NEAR COPPERTON, NORTHERN CAPE**	SCALE: 1:60,000 PAPER DESIGNED DRAWN D Ogier CHECKED APPROVAL	NOTES	1:60,000 Aurecon GIS FILE NAME Document Name: PreferedLayout DRAWING NUMBER XXXXXXXXXXXXXX

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Figure 1-1 Preferred layout for the PV10 facility on The Farm Hoekplaas No.146

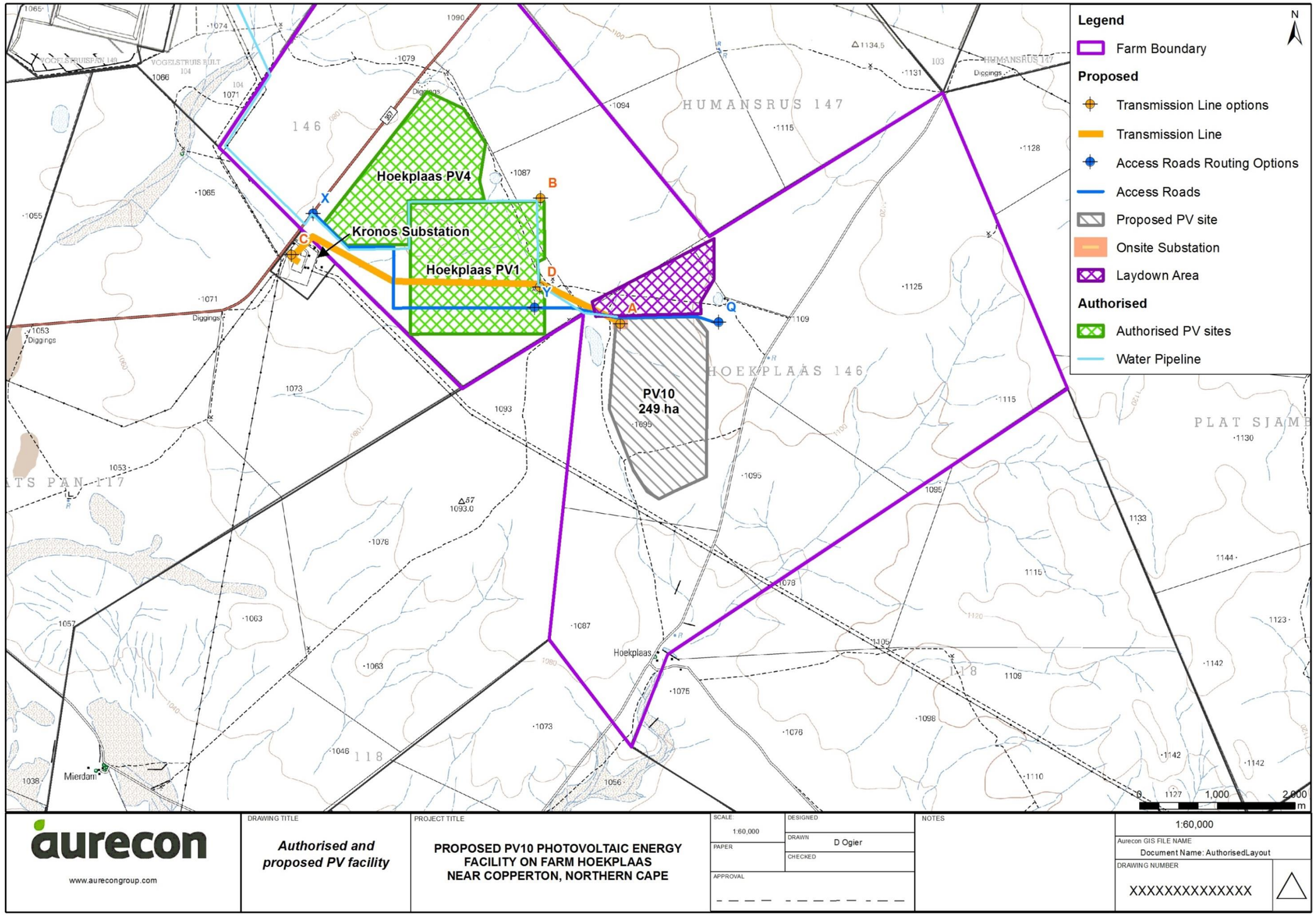

Figure 1-2 Previously authorised PV sites and infrastructure and the proposed PV10 facility on farm Hoekplaas

1.2 Legal requirements

There are a multitude of legal and policy documents and guidelines to consider when undertaking these types of projects. An overview of the legislation (**Table 1-1**), policies (**Table 1-2**), and guidelines (**Table 1-3**) relevant to the proposed project is provided, with more detailed information provided in **Annexure H**.

Table 1-1 Legislation considered in preparation of the EIA Report

LEGAL REQUIREMENTS		
Title of legislation, policy or guideline	**Applicability to the project**	**Administrating Authority**
The Republic of South Africa Constitution Act No. 108 of 1996 ("the Constitution"),	The environmental right contained in Section 24 of the Constitution provides that everyone is entitled to an environment that is not harmful to his or her well-being.	The Constitutional Court
National Environmental Management Act, No. 107 of 1998 (NEMA)	Several listed activities in terms of NEMA Government Notice (GN) No. 544, 545 and 546, 18 June 2010, have been triggered and need to be authorised for the proposed PV10 facility (also see Section 0).	DEA
National Water Act, No. 36 of 1998 (NWA)	The proposed PV10 facility may require an application for a water use licence; however this would fall outside of the scope of this EIA and would be addressed by Mulilo as part of their broader project planning. Comment would however be sought from the Department of Water and Sanitation (DWS) as part of the EIA process.	Department of Water and Sanitation (DWS)
National Heritage Resources Act, No. 25 of 1999 (NHRA)	The development will change the character of a site exceeding 5,000m^2 in extent and includes the construction of an access road and transmission line exceeding 300m in length. As such, the Act requires that a Heritage Impact Assessment (HIA) is undertaken for the proposed project.	South African Heritage Resources Agency (SAHRA)
Astronomy Geographic Advantage Act , No. 21 of 2007	The proposed PV10 facility falls outside of the Karoo Core Astronomy Advantage Area (KCAA), but inside the general astronomy advantage area. Comment would however be sought from relevant astronomical bodies.	Independent Communications Authority of South Africa (ICASA) Minister of Science and Technology Karoo Core Astronomy Advantage Area
Conservation of Agricultural Resources Act, No. 43 of 1983 (CARA)	The EIA process would ensure that measures are implemented to maintain the agricultural production of land, prevent soil erosion, and protect any water bodies and natural vegetation onsite through the control of any undesired aliens, declared weeds, and plant invaders listed in the regulation that may pose	Department of Agriculture, Forestry and Fisheries (DAFF).

LEGAL REQUIREMENTS		
Title of legislation, policy or guideline	**Applicability to the project**	**Administrating Authority**
	a problem as a result of the proposed PV10 facility.	
The National Energy Act, No. 34 of 2008	In terms of the New Generation Regulations, the Integrated Resource Plan (IRP) has been developed by the Department of Energy (DoE) and sets out the new generation capacity requirement per technology, taking energy efficiency and the demand-side management project into account. This required, new generation capacity must be met through the technologies and project listed in the IRP and all Independent Power Producer (IPP) procurement programmes will be undertaken in accordance with the specified capacities and technologies listed in the IRP. While the DEA may have already authorised a sufficient number of projects to meet the MW targets set by the DoE. The DoE requires a suite of viable Renewable Energy projects in order to make an informed choice based on criteria not necessarily considered by the DEA. Limiting the amount of projects authorised would be in conflict with the DoE's mandate by forcing them to select only those renewable energy projects already authorised by the DEA, as preferred bidders. The DoE would not have the option to select the preferred bidders based on other imperatives, such as their own policies, pricing considerations and economic development, as they would need to approve all projects to secure the MW targets set. In order to ensure that the preferred bidders can be selected based on the DoE's set criteria, the DEA needs to continue to authorise environmentally acceptable renewable energy projects.	DoE

Table 1-2 Policies considered in preparation of the EIA Report

RELEVANT POLICIES		
Policies considered	**Relevant Organ of State / authority**	**Aspect of Project**
Policies regarding greenhouse gas and carbon emissions		Electricity generation using carbon based fuels is responsible for a large proportion of carbon dioxide (CO_2) emissions worldwide. In Africa, the CO_2 emissions are primarily the result of fossil fuel burning and industrial processes, such coal fired power stations. South Africa accounted for some 40% of Africa's CO_2 emissions. The International Energy Agency (2008) "Renewables in global energy supply: An IEA facts sheet" estimates that nearly 50% of global electricity supplies will need to come from renewable energy sources in order to halve carbon dioxide emissions by 2050 and minimise significant, irreversible climate change impacts. The United Nations Framework Convention on Climate Change (UNFCCC) initiated the Kyoto Protocol which placed specific legal obligations in the form of GHG reduction targets on developed countries and countries with 'Economies in Transition'. South Africa's commitment is to reduce GHG emissions totalling by 34% by 2020 and 42% by 2025. South African policies are being informed by the Kyoto Protocol (which was valid until 2012) and its partial successor the Copenhagen Accord 2010 and associated sustainable development principles whereby emphasis is being placed on industries for 'cleaner' technology and production.
White Paper on the Energy Policy of the Republic of South Africa (1998)	Department of Minerals and Energy (DME)	The White Paper commits to government's focused support for the development, demonstration and implementation of renewable energy sources for both small and large-scale applications. With the aim of drawing on international best practice, specific emphasis is given to solar and wind energy sources, particularly for rural and often off-grid areas. It is with this outlook that the renewable energy, including solar energy, is seen as a viable, attractive and sustainable option to be promoted as part of South Africa's energy policy towards energy diversification.
White Paper on Renewable Energy (2003)	N/A	The White Paper sets out the vision, policy principles, strategic goals, and objectives in terms of renewable energy. At the outset the policy refers to the long term target of "10,000 Gigawatt Hours (GWh) (0.8Mtoe) renewable energy contribution to final energy demand by 2013." The aim of this 10-year plan is to meet this goal via the production of energy mainly from biomass, wind, solar, and small-scale hydro sources.
National Energy Act (No. 34 of 2008) and Electricity Regulation Act (ERA) (No. 4 of 2006)	DoE	South Africa has two acts that direct the planning and development of the country's electricity sector: (i) The National Energy Act (No. 34 of 2008); and (ii) The ERA. Electricity Regulations on New Generation Capacity under the ERA. The New Generation Regulations establish rules and guidelines that are applicable to the undertaking of an IPP Bid Programme and the procurement of an IPP for new generation capacity. They also facilitate the fair treatment and non-discrimination between IPPs and the buyer of the energy[8]. The IRP has been developed by the DoE and sets out the new generation capacity requirement per technology, taking energy efficiency and the demand-side management projects into account.

[8] Guide to Independent Power Producer (IPP) processes [online]. Eskom. Available at: http://www.eskom.co.za/c/73/ipp-processes/ (Accessed 15/09/2013)

RELEVANT POLICIES		
Policies considered	**Relevant Organ of State / authority**	**Aspect of Project**
		While the DEA may have already authorised a sufficient number of projects to meet the MW targets set by DoE, the DoE requires a suite of viable Renewable Energy projects in order to make an informed choice based on criteria not necessarily considered by the DEA. Limiting the amount of projects authorised would be in conflict with the DoE's mandate by forcing them to select only those renewable energy projects already authorised by the DEA, as preferred bidders. The DoE would not have the option to select the preferred bidders based on other imperatives such as their own policies, pricing considerations and economic development, as they would need to approve all projects to secure the MW targets set. In order to ensure that the preferred bidders can be selected based on the DoE's set criteria, the DEA needs to continue to authorise environmentally acceptable renewable energy projects. This will ensure that the DoE can fulfil their mandate to optimise energy efficiency through distribution and pricing factors, amongst others, by having a selection of projects from which to choose.
Integrated Energy Plan (IEP) for the Republic of South Africa (2003)	DME	Commissioned by DME in 2003, the IEP aims to provide a framework in which specific energy policies, development decisions and energy supply trade-offs can be made on a project-by-project basis. The framework is intended to create a balance in providing low cost electricity for social and economic developments, ensuring security of supply, and minimising the associated environmental impacts.
Integrated Resources Plan (IRP)	N/A	The IRP is a National Electricity Plan, which is a subset of the Integrated Energy Plan. The IRP is also not a short or medium-term operational plan, but a plan that directs the expansion of the electricity supply over the given period. The primary objective of the IRP 2010, as with its predecessors, is to determine the long-term electricity demand and detail how this demand should be met in terms of generating capacity, type, timing, and cost.

Table 1-3 Guidelines considered in preparation of the EIA Report

Relevant Guidelines
This EIA process is informed by the series of national Environmental Guidelines[9] where applicable and relevant: • Integrated Environmental Information Management (IEIM), Information Series 5: Companion to the NEMA EIA Regulations of 2010 (DEA, 2010). • Implementation Guidelines: Sector Guidelines for the EIA Regulations (draft) (DEA, 2010). • IEIM, Information Series 2: Scoping (Department of Environmental Affairs and Tourism (DEAT), 2002). • DEAT. 2002. IEIM, Information Series 3: Stakeholder Engagement (DEAT, 2002). • IEIM, Information Series 4: Specialist Studies (DEAT, 2002). • IEIM, Information Series 11: Criteria for determining Alternatives in EIA (DEAT, 2004). • IEIM, Information Series 12: Environmental Management Plans (DEAT, 2004). • Integrated Environmental Management Guideline Series, Guideline 4: Public Participation, in support of the EIA Regulations. Unpublished (DEAT, 2005). • Integrated Environmental Management Guideline Series, Guideline 7: Detailed Guide to Implementation of the Environmental Impact Assessment Regulations. Unpublished (DEAT, 2007). • Guideline for involving biodiversity specialists in EIA process (June 2005). • Guideline for involving heritage specialists in the EIR process (June 2005). • Guideline for involving visual and aesthetic specialists in the EIR process (June 2005). • Guideline for Environmental Management Plans (June 2005). • Guideline for determining the scope of specialist involvement in EIA Processes (June 2005). • Guideline for the review of specialist input into the EIA Process (June 2005). The following guidelines from the Department of Environmental Affairs and Development Planning (Western Cape) (DEA&DP) were also taken into consideration: • DEA&DP. 2013. Generic Terms of Reference for EAPs and Project Schedules. • DEA&DP. 2013. Guideline on Public Participation. • DEA&DP. 2013. Guideline on Alternatives. • DEA&DP. 2013. Guideline on Need and Desirability. • DEA&DP. 2013. Guideline on Exemption Applications. • DEA&DP. 2013. Guideline on Appeals.

[9] Note that these Guidelines have not yet been subjected to the requisite public consultation process as required by Section 74 of R385 of NEMA.

1.3 Listed Activities in terms of NEMA

In terms of the 2010 EIA regulations, certain activities are identified, which require authorisation from the competent environmental authority, in this case the DEA, before commencing. Listed activities in Government Notice (GN) No. 545 require Scoping and EIA, whilst those listed in GN No. 544 and GN No. 546 require a Basic Assessment (unless they are being assessed under an EIA process). Such activities are detailed in three listing notices, the activities applicable to the proposed project being described in **Table 1-4** below.

Table 1-4 Listed activities in terms of NEMA GN No. 544, 545 and 546, 18 June 2010, to be authorised for the proposed PV10 facility

NO	LISTED ACTIVITY	APPLICABILITY TO THE PROPOSED PROJECT
GN No. R544, 18 June 2010		
10	The construction of facilities or infrastructure for the transmission and distribution of electricity - • outside urban areas or industrial complexes with a capacity of more than 33, but less than 275 kilovolts;	The construction of a 132kV overhead transmission line located in a rural area, connected from the PV10 facility to the central onsite substation or an existing Eskom substation which is situated offsite (i.e. Kronos or Cuprum).
11	The construction of - (iv) dams; (x) buildings exceeding 50 square metres (m^2) in size; or (xi) infrastructure or structures covering 50m^2 or more where such construction occurs within a watercourse or within 32m of a watercourse, measured from the edge of a watercourse, excluding where such construction would occur behind the development setback line.	The construction of: • A PV facility with a footprint of approximately 249ha; • Storm water attenuation ponds; • On Site Substation; • Interconnection Building; • Interconnection Cabin; • Operation and Maintenance Building; • Inverter Cabins; • A 132kV double circuit transmission line; and • Access roads. All of which may be located within 32m of a watercourse such as drainage lines that are scattered across the proposed site. The combined footprint area of the proposed PV facility and associated infrastructure exceeds 50m^2 therefore this activity will be triggered.
18	The infilling or depositing of any material of more than 5 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 5 cubic metres from: (i) a watercourse	Attenuation ponds would be required to manage the onsite storm water and may require more than 5 cubic metres of material to be deposited and/or dredged within the affected watercourse/s.
GN No. R545, 18 June 2010		
1	The construction of facilities or infrastructure for the generation of electricity where the electricity output is 20MW or more.	The construction of a PV facility with an electricity output of approximately 75MW.
15	Physical alteration of undeveloped, vacant or derelict land for residential retail, commercial, recreational, industrial or institutional use where the total	The site is zoned for agricultural use but is considered undeveloped as it is used for pasture and not cultivation, as such more than 20ha of undeveloped land would be transformed.

NO	LISTED ACTIVITY	APPLICABILITY TO THE PROPOSED PROJECT
	area to be transformed is 20 hectares or more.	
GN No. R546, 18 June 2010		
14	The clearance of an area of 5 hectares or more of vegetation where 75% or more of the vegetation cover constitutes indigenous vegetation in the Northern Cape: ii.All areas outside urban areas.	A vegetated area greater than 5ha would need to be cleared for the proposed project, which is located in a rural area. The vegetation is comprised of 75% or more of indigenous vegetation.

1.4 2014 EIA Regulations (GN R982, R983, R984, and R985)

On 4 December 2014 new EIA Regulations were promulgated and came into effect on 8 December 2014. Section 53 (3) of the 2014 EIA Regulations reads: "*Where an application submitted in terms of the previous NEMA regulations, is pending in relation to an activity of which a component of the same activity was not identified under the previous NEMA notices, but is now identified in terms of section 24(2) of the Act, the competent authority must dispense of such application in terms of the previous NEMA regulations and may authorise the activity identified in terms of section 24(2) as if it was applied for, on condition that all impacts of the newly identified activity and requirements of these Regulations have also been considered and adequately assessed.*"

Based on the above, we would like to highlight Activity 28, as listed in GN R983, and Activity 15 of GN R984, which are not included in the Listing Notice 1 (GN R545) or Listing Notice 3 of the 2010 EIA regulations, but would be triggered by the proposed project. As it is a requirement in terms of Section 53 (3) of the 2014 EIA Regulations, these activities have therefore also been assessed.

Table 1-5 Applicable listed activities in terms of the new NEMA regulations inacted 8 December 2014:

Activity	GN No. 983, 8 December 2014	
28	Residential, mixed, retail, commercial, industrial or institutional developments where such land was used for agriculture or afforestation on or after 1 April 1998 and where such development: (ii) will occur outside an urban area, where the total land to be developed is bigger than 1 hectare.	The farm on which the proposed project would be constructed, is currently being used for grazing and was used for agriculture before 1 April 1998.
Activity	**GN No. 984, 8 December 2014**	
15	The clearance of an area of 20 hectares or more of indigenous vegetation, excluding where such clearance of indigenous vegetation is required for- (i) the undertaking of a linear activity; or (ii) maintenance purposes taken in accordance with a maintenance management plan.	During the construction phase 20% (i.e. 50ha) of the footprint area would be cleared while the vegetation on the remaining 80% (i.e. 199ha) would be brush cut to a height of 40-50cm.

2 APPROACH TO THE PROJECT

The purpose of this chapter is to provide the reader with an overview of the proposed EIA methodology. It also provides a description of the public participation to date as engagement with the public and stakeholders forms an integral component of the EIA process. This is followed by a description on the assumptions and limitations and the independence of the environmental assessment practitioners.

As outlined in **Figure 2-1**, there are three distinct phases in the EIA process, as required in terms of NEMA, namely the Initial Application Phase, the Scoping Phase and the EIA Phase. This report covers the third phase, *viz.* the EIA Report Phase. The DEA reference numbers are indicated in **Table 2-1**.

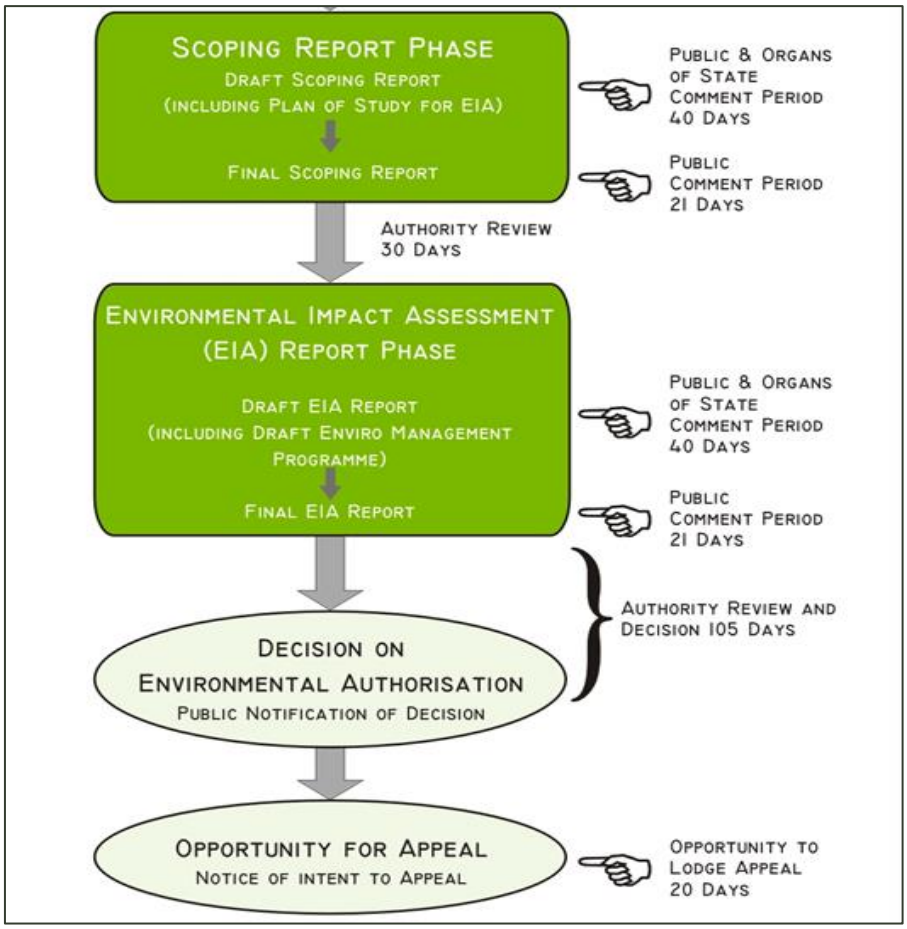

Figure 2-1 The EIA process

2.1 EIA phases

2.1.1 Initial application phase

The Initial Application Phase entailed the submission of an EIA Application Form in March 2013 to notify DEA of the proposed PV10 project. The acknowledgement of receipt of the EIA Application Form was received from DEA on 26 March 2013. The Application Form and DEA's letter of acknowledgement was included in the Scoping Report. However, as indicated earlier on in the report, only PV10 will be considered in this Final EIA Report (FEIAR) as requested by the

DEA in their letter of 21 February 2014 (see Annexure J). The DEA reference number for all five current projects and the two retracted projects are indicated in **Table 2-1**.

Table 2-1 DEA reference numbers for the proposed PV facilities and their current application status

Proposed PV Facility	DEA Ref. No.	NEAS Ref. No.	Application Status
PV1	12/12/20/2501	DEAT/EIA/0000611/2011	Authorised
PV2	14/12/16/3/3/2/493	DEA/EIA/0001754/2013	Final public review: 23 March – 16 April 2015
PV3	14/12/16/3/3/2/494	DEA/EIA/0001755/2013	Final public review: 23 March – 16 April 2015
PV4	14/12/16/3/3/2/495	DEA/EIA/0001756/2013	Authorised
PV5	14/12/16/3/3/2/496	DEA/EIA/0001757/2013	Final public review: 23 March – 16 April 2015
PV6	14/12/16/3/3/2/497	DEA/EIA/0001758/2013	Retracted
PV7	14/12/16/3/3/2/498	DEA/EIA/0001759/2013	Final public review: 23 March – 16 April 2015
PV8	14/12/16/3/3/2/499	DEA/EIA/0001760/2013	Final public review: 23 March – 16 April 2015
PV9	14/12/16/3/3/2/500	DEA/EIA/0001761/2013	Final public review: 23 March – 16 April 2015
PV10	**14/12/16/3/3/2/501**	**DEA/EIA/0001762/2013**	**Final public review: 23 March – 16 April 2015 (i.e. this report)**
PV11	14/12/16/3/3/2/502	DEA/EIA/0001763/2013	Retracted

2.1.2 The Scoping Phase

Scoping is defined as a procedure for determining the extent of, and approach to, the EIA Report Phase and involves the following key tasks:

- Involvement of relevant authorities and Interested and Affected Parties (I&APs);
- Identification and selection of feasible alternatives to be taken through to the EIA phase;
- Identification of significant issues/impacts associated with each alternative to be examined in the EIA Report; and
- Determination of specific terms of reference for any specialist studies required in the EIA Report (Plan of Study for the EIA Report).

To date the Scoping Phase has involved a desktop review of relevant literature, including a review of previous environmental studies in the area. These included, *inter alia*, the following:

- Proposed PV Energy Plant on Farm Hoekplaas near Copperton, Northern Cape: Final EIA Report (Aurecon, 2012);
- Pixley ka Seme Integrated Environmental Management Program (IEMP)(African EPA, 2007);
- Pixley ka Seme District Municipality Spatial Development Framework (SDF) (2007);
- SiyaThemba IEMP (African EPA, 2007);
- Vegetation Map of South Africa (Mucina & Rutherford, 2006);
- Proposed Solar Farm, Prieska. Draft Environmental Impact Assessment Report (EIA Report) (DJ Environmental Consultants, 2010);
- Proposed Construction of a Wind Farm and PV Plant near Prieska, Northern Cape Province of South Africa. Draft Scoping Report (SiVEST, 2011);
- Proposed Wind Energy Facility near Copperton, Northern Cape: Final Scoping Report. Report No. 5357A/ 106563 (Aurecon, 2011);
- Proposed Prieska Solar Energy Facility and Associated Infrastructure, Northern Cape (Savannah Environmental Pty (Ltd) January 2013); and
- Proposed Garob Wind Energy facility project, located near Copperton in the Northern Cape, (Savannah Environmental Pty (Ltd), December 2012).

Other tasks undertaken included:

- Advertisements were placed in a local newspaper, *the Gemsbok*, notifying the broader public of the initiation of the EIA and inviting them to register as I&APs on 26 April 2013.
- A site notice was placed at the entrance to Farm Hoekplaas on 25 April 2013 (see **Annexure B**).
- Lodging the Draft Scoping Report (DSR) at Prieska (Elizabeth Vermeulen) Public Library, Ietznietz Guest House in Copperton and on the Aurecon website from 30 April 2013 until 10 June 2013. All registered I&APs were notified of the availability of the DSR by means of a letter sent by fax, post and/or e-mail on 23 April 2013. The notification letters also included a copy of the Executive Summary of the DSR in English and Afrikaans.
- I&APs had 40 days, until 10 June 2013, to submit their written comments on the DSR.
- Cognisance was taken of all comments when compiling the final report, and the comments, together with the project team and proponent's responses thereto, were included in the Final Scoping Report (FSR).
- The FSR was made available to the public for review and comment until 12 August 2013 at the same locations as the DSR from 23 July 2013. Registered I&APs were informed of the FSR public comment period via a letter dated 15 July 2013 which was emailed or posted. An Executive summary together with an update page in English and/or Afrikaans was also emailed or posted to registered I&APs which highlighted the key changes made to the DSR as a result of the 40 day public comment period.
- The FSR outlined the full range of potential environmental impacts and feasible project alternatives and how these were derived. Moreover, it included a Plan of Study for EIA, which outlined the proposed approach to the current EIA Phase, including the requisite specialist investigations to be undertaken.
- The FSR and associated Plan of Study for EIA was submitted to DEA on 19 July 2013 and accepted on 2 September 2013 (see **Annexure A** for a copy of the acceptance letter). DEA requested specific information to be included in the EIA reports as indicated in **Annexure F**.

Due to Aurecon's involvement in the 2012 EIA process undertaken on the same site (i.e. The Farm Hoekplaas No.146), no fieldtrips were undertaken by the EAP for the current application. An inception field trip was held on 28 and 29 September 2011 during the initial 2012 EIA for Hoekplaas. The initial EIA has helped to gain an understanding of the key aspects such as:

- Biophysical aspects, including:
    - Terrestrial fauna and flora especially avifauna;
    - Surface water resources;
    - Ecological sensitive area; and
    - Vegetation types on site.
- Socio-economic aspects, including:
    - Heritage issues;
    - Land use, including agricultural potential;
    - Visual aesthetics including the location of the project in terms of roads, topography and proximity to houses;
    - Location of local communities;
    - Dust;
    - Employment opportunities; and
    - Tourism.

The information gathered during the site visit was used in refining the Plan of Study for the EIA process and Terms of Reference (ToR) for the specialist studies which were undertaken during the EIA Phase. DEA accepted the FSR on 2 September 2013. Please refer to **Annexure A** for a copy of the letter from DEA.

2.1.3 The EIA Phase

The Scoping Phase is followed by the EIA Phase, during which the specialist investigations are undertaken and a comprehensive EIAR documents the outcome of the impact assessments.

The following specialist investigations were undertaken in accordance to the Plan of Study for EIA as indicated in **Table 2-2**.

Table 2-2 Specialist studies undertaken as per Plan of Study for EIA

STUDY	CONSULTANT AND ORGANISATION
Botanical assessment	Dr Dave McDonald of Bergwind Botanical Tours and Surveys
Agriculture potential assessment	Mr Kurt Barichievy of SiVEST
Aquatic assessment	Mr James Mackenzie of Mackenzie Ecological & Development Services
Hydrology assessment / Stormwater	Dr Nick Walker of Aurecon
Avifauna assessment	Dr Andrew Jenkins of Avisense Consulting
Heritage assessment: **Archaeology / Cultural Palaeontology**	Dr Jayson Orton of ACO Associates Dr John Almond of Natura Viva
Visual assessment	Mr Steven Stead of VRM Africa cc

The findings of the specialist investigations are summarised in Section 5 and the full reports are included in Annexure C.

This report covers the third and final phase of the EIA process, namely the EIA Phase. The purpose of the EIAR 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 is to provide a basis for informed decision making, firstly by the applicant with respect to the option(s) they wish to pursue, and secondly by the environmental authority regarding the environmental acceptability of the applicant's preferred option.

The approach to the EIA Phase entailed undertaking further review of relevant literature and specialist studies. The information collected has been used to describe and assess the significance of the identified potential impacts associated with the proposed project. This EIAR synthesises the key issues arising out of the PPP to date, to provide a balanced view of the proposed activities and the implications for the environment.

2.1.4 The Public Participation Process

Consultation with the public forms an integral component of this investigation and enables I&APs (e.g. directly affected landowners, national, provincial and local authorities, environmental groups, civic associations and communities), to identify their issues and concerns, relating to the proposed activities, which they feel should be addressed in the EIA process.

To create a transparent process and to ensure that I&APs are well informed about the project, as much information as is available has been included upfront to afford I&APs numerous opportunities to review and comment on the proposed project. A summary of the public participation process is provided in **Annexure B**.

Currently there are 70 I&APs registered on the project database (see **Annexure B** for a list of current I&APs). The Comments and Response Reports are included in **Annexure B**.

2.1.5 Additional 21 day Public Participation Process on the revised EIA report

DEA rejected the Final EIA Report dated 21 February 2014 for Klipgats PV6 and Hoekplaas PV2 and requested separate reports for the proposed PV facilities on farm Hoekplaas as well as a 40 public day review period. A request was submitted to DEA on 17 February 2015 to reduce the public review period to 21 days. Approval was obtained on 25 February 2015 (see **Annexure B**).

Authorities and I&APs are therefore provided with 21-days from **23 March 2015 until 16 April 2015** to review the Revised FEIAR and are invited to submit comments in writing to the Aurecon team. All comments will be forwarded to DEA to inform their decision-making.

2.1.6 Authority involvement

Authority consultation represents the first stage of the public consultation process. An EIA Application Form was submitted to DEA to notify the Department of the proposed project. DEA acknowledged receipt of the EIA Application Form and issued a reference number for the proposed project in March 2013.

As indicated earlier, DEA will fulfil the role of the competent environmental authority for this project and will make a decision in light of the information presented in the final EIAR. However, given that the PV10 project is located in the Northern Cape Province, DEA will work closely with the Department of Environmental Affairs and Nature Conservation (DEA&NC) in the decision-making process.

Where the need arises, Focus Group meetings will be arranged with representatives from the relevant national and provincial departments and local authorities. The purpose of these meetings will be to ensure that the authorities have a thorough understanding of the need for the project and that Aurecon has a clear understanding of the authority requirements. It is anticipated that beyond providing key inputs into the EIA, this authority scoping process will ultimately expedite the process by ensuring that the final documentation satisfies the authority requirements and that the authorities are fully informed with respect to the nature and scope of the proposed solar energy facility.

There are other authorities who have a commenting role to play in the EIA process. Their comments on the EIA Report will help to inform DEA's decision making. These authorities include:

- SiyaThemba Local Municipality, (Mr Gert Bessies);
- Pixley ka Seme District Municipality, (Mr Sam Diokpala);
- South African Heritage Resources Agency, (Dr Mariagrazia Galimberti);
- Northern Cape Provincial Heritage, (Mr Andrew Timothy);
- Northern Cape DEA&NC, (Mr Chamuwari Ketano);

- Department of Energy (Northern Cape): Regional Energy Director, (Mrs SP Mohapi);
- Department of Agriculture (Northern Cape), (Ms Lucia Manong);
- Department of Agriculture, Forestry and Fisheries, (Ms Jacoline Mans);
- Department of Water Affairs, (Mr Shaun Cloete);
- Eskom, (Mr J Geeringh); and
- Square Kilometre Array (SKA) South Africa, (Mr Adrian Tiplady)

DEA accepted the FSR on 2 September 2013. Please refer to **Annexure A** for a copy of the letter from DEA.

2.1.7 Decision making

The original FEIAR, that included the original proposed 10 PV projects, was submitted to the DEA on 22 November 2013 and rejected on 21 February 2014 (**Annexure J**). Based on discussions with the DEA, the original FEIAR has been split into separate EIA reports specifically addressing each proposed PV project. The Revised FEIAR, together with all I&AP comments on the Draft and FEIARs, was submitted to DEA for their review and decision-making. DEA must within 14 days acknowledge receipt of the Revised FEIAR and then within 60 days do one of the following:

- Accept the report;
- Notify the applicant that the report has been referred for specialist review;
- Request amendments to the report; or
- Reject the report if it does not materially comply with regulations.

If the report is accepted, DEA must within 45 days:

- Grant authorisation in respect of all or part of the activity applied for; or
- Refuse authorisation in respect of all or part of the activity.

Once DEA issues their decision on the proposed project, all registered I&APs on the project database will be notified of the outcome of the decision within 12 calendar days of the Environmental Authorisation having been issued. Should anyone (a member of public, registered I&AP or the Applicant) wish to appeal DEA's decision, a Notice of Intention to Appeal in terms of Chapter 7 of the EIA Regulations (GN No. 543) in terms of NEMA must be lodged with the Minister of Water and Environmental Affairs within 20 calendar days of the decision being issued and the substantive Appeal must be lodged within 30 days of the Notice.

2.2 Assumptions and limitations

2.2.1 Assumptions

In undertaking this investigation and compiling the EIAR, the following has been assumed:

- The strategic level investigations undertaken by DoE regarding South Africa's proposed energy mix prior to the commencement of the EIA process are technologically acceptable and robust.
- The information provided by the applicant and specialists is accurate and unbiased.
- The scope of this investigation is limited to assessing the environmental impacts associated with the proposed PV facility and connections to the grid.

2.2.2 Gaps in knowledge

This EIA Report has identified the potential environmental impacts associated with the proposed activities. However, Mulilo is undertaking further work on the proposed project and

investigations in parallel with this EIA process from a technical feasibility perspective. As such the nature and significance of potential impacts presented in this report could change, should new information become available, or as the project description is refined. The purpose of this section is therefore to highlight gaps in knowledge when the EIA Phase of the project was undertaken, which included a lack of confirmation of service's capacity from the municipality.

The planning for the proposed facility is at a feasibility level and therefore some of the specific details are not available to the EIA process. This EIA process forms a part of the suite of feasibility studies, and as these studies progress, more information will become available. This will require the various authorities, and especially DEA, to issue their comments and ultimately their environmental decision to allow for the type of refinements that typically occur during these feasibility studies and detailed design phase of project. Undertaking the EIA process in parallel with the feasibility study does however have a number of benefits, such as integrating environmental aspects into the layout and design and therefore ultimately encouraging a more environmentally sensitive and sustainable project.

The gaps in knowledge that were evident during the Scoping Phase include:

- Confirmation of service's capacity from the municipality.
- Clarity regarding exact accommodation of construction workers.
- Commencement date of construction phase.

2.3 Independence

The requirement for independence of the environmental consultant is aimed at reducing the potential for bias in the environmental process. Neither Aurecon nor any of its sub-consultants are subsidiaries of Mulilo nor is Mulilo a subsidiary to Aurecon. Furthermore, all these parties do not have any interests in secondary or downstream developments that may arise out of the authorisation of the proposed project.

2.4 Details and expertise of the EAPS who compiled the EIAR

The Project Director, Mr Andries van der Merwe, Project Leader, Miss Franci Gresse, and the Project Staff, Mr Simon Clark and Mrs Kirsten Jones, are appropriately qualified and registered with the relevant professional bodies and/or are in the process of registering. Mr van der Merwe is a certified Professional Engineer of South Africa (Environmental Assessment Practitioner of South Africa). Miss Gresse has a BSc (Hons) degree in Conservation Ecology and has been involved in a number of renewable energy projects in the Western and Northern Cape provinces. The CV summaries of the key Aurecon staff are included in **Annexure D**.

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3 THE PROPOSED ACTIVITY

This chapter briefly outlines the nature of the proposed activities and describes the various project alternatives to focus the EIA Phase on the most feasible alternatives.

3.1 Description of the proposed activity

Mulilo propose to construct a PV facility (Hoekplaas Solar PV10) with a generation capacity of approximately 75MW and a footprint of approximately 249ha, on The Farm Hoekplaas No. 146 near Copperton in the Northern Cape. The layout was revised to incorporate specialist recommendations for buffers around sensitive features and areas (see **Figures 3-4** and **3-9**).

Table 3-1 Footprint, capacity and coordinates of the proposed PV10 facility (preferred alternative)

Facility	Footprint (ha)	Capacity (MW)	Coordinates (middle point)
PV10	249	75	30° 2'27.53"S 22°23'7.85"E

Alternatively one PV facility with generation capacity of 500MW (referred to as Alternative 2) is proposed. The total extent of the alternative PV4A facility would be approximately 2162ha (**Table 3-2**).

Table 3-2 Footprint, capacity and coordinates of the alternative PV4A facility

Facilities	Footprint (ha)	Capacity (MW)	Coordinates (middle point)
PV4A	2162	500	30° 2'19.54"S 22°24'9.45"E

3.1.1 Project components

It is proposed that Hoekplaas Solar PV10 would share associated infrastructure with PV facilities already authorised on the Hoekplaas farm. However this would be dependent on whether the authorised projects are awarded preferred bidder status and ultimately constructed. As such it is proposed that DEA authorise specific infrastructure and/or routing options for the Hoekplaas Solar PV10 facility in order to avoid duplicating authorisations. Therefore the following specific infrastructure and/or routing options for Hoekplaas Solar PV10 need to be considered for environmental authorisation:

- **Solar energy facility:** A photovoltaic component comprising of numerous arrays of PV panels and associated support infrastructure to generate up to 75MW per facility, through the PV effect (see **Annexure I**).
- **Transmission line:** 132kV Double Circuit overhead transmission line (Figure 3-3) to connect the facility to the newly constructed Hoekplaas Solar PV5 substation or an existing Eskom substation which is situated offsite (i.e. Kronos substation).
    - Hoekplaas Solar PV10 will connect to the grid via the A D C routing option should no other project be awarded an EA and Preferred Bidder Status. However, should Hoekplaas PV5 be awarded an EA and Preferred Bidder Status the line would connect from A to D (**Figure** 3-4).

- **Substation:** An onsite 132kV, 6 bay.
- **Roads:** Access and internal roads for servicing and maintenance of the facility would use routing XYQ if no other projects are awarded an EA and Preferred Bidder Status. If PV5 or PV7 are awarded an EA and Preferred Bidder Status, the connection route would be Y to Q. No access route would be required for PV10 in if PV8 or PV9 were awarded an EA and Preferred Bidder Status.
- **Boundary fence:** The facility would have an electrical or barbed wire fence for safety and security.
- **Buildings:** Buildings would likely include an onsite substation, a connection building, operational and maintenance building, guard cabin, an electrical substation and solar resource measuring substation.

Multiple PV facilities are proposed for Farm Hoekplaas and shared infrastructure may occur if more than one project is awarded:

- **Stormwater infrastructure:** Including, but not limited to, drainage spines, drainage channels, multiple apron outlets, detention areas and kinetic energy dissipaters.
- **Buildings:** Buildings would likely include an onsite substation, a connection building, operational and maintenance building, guard cabin, an electrical substation and solar resource measuring substation.

The following infrastructure can also be shared among the proposed PV facilities and received environmental authorisation in terms of the PV1[10] and PV4[11] projects on farm Hoekplaas:

- **Water supply infrastructure:** It is proposed that potable water would be obtained from the Alkantpan pipeline while negotiating sourcing of water from the local municipality.
- **Buildings:** Buildings would likely include Operations and Maintenance Building, guard cabin, an electrical substation and solar resource measuring substation to monitor the performance of the plant compared to the solar radiation.[12]
- **Laydown areas:** Two laydown areas have been identified and one of these would be used during the construction phases of the proposed PV facility. This laydown area has already received authorisation under the authorised PV1 and PV4 facility.

The relevant infrastructure and their footprint and/or dimensions are provided in **Table 3-3**.

Table 3-3 Infrastructure and relevant foot print and/or dimensions

Component	Description / dimension
Height of PV panels	< 5m
Area of PV array	249 ha
Number of inverters required	150
Area occupied by inverter / transformer stations / substations	10 000m²
Capacity of on-site substation	22/33/132kV, 6 bay, 200m x 100m
Length of Transmission Line	7000m
Area occupied by both permanent and construction laydown areas	50ha
Area occupied by buildings	1 200 m²
Length of internal roads	15km
Width of internal roads	8m

10 DEA Ref. No. 12/12/20/2501 & NEAS Ref. No. DEAT/EIA/0000611/2011

11 DEA Ref. No. 14/12/16/3/3/2/495 & NEAS Ref. No. DEA/EIA/0001756/2013

12 Shared infrastructure may occur if more than one project is awarded but each facility will need to have the necessary infrastructure authorised should they need to operate individually.

Proximity of grid connection	7000m
Height of fencing	3m
Type of fencing	Electrical or Barbed Wire

The projects main components are described in the sections below.

3.1.2 Single axis tracking PV technology

Photovoltaic solar energy technology use light energy from the sun to generate electricity through a process known as the PV effect (**Annexure I**). The PV cells absorb light energy which energises the electrons to produce electricity. **Figure 3-1** depicts a typical PV facility in a landscape similar to Copperton.

Figure 3-1 Example of a PV facility in a landscape similar to Copperton (image courtesy of Mulilo)

The proposed PV panels are approximately 2m wide and 1m long. These panels are arranged into modules that are durable and can last up to 25 years due to the sturdiness of the structure and few moving parts. The PV modules (which consist of PV panels) would be physically mounted to a galvanized steel rotation tube, single axis tracking system to ensure ground connection from the module frames to the structure. The PV modules, fixed to the tracking system, are arranged into tracker blocks as indicated in **Figure 3-2**. These tracker blocks would be uniformly aligned to facilitate efficient sun-tracking.The dimensions of a tracker block range between 88m and 113m in an east to west direction and 35m to 38m in a north south direction (Mulilo, 2013).

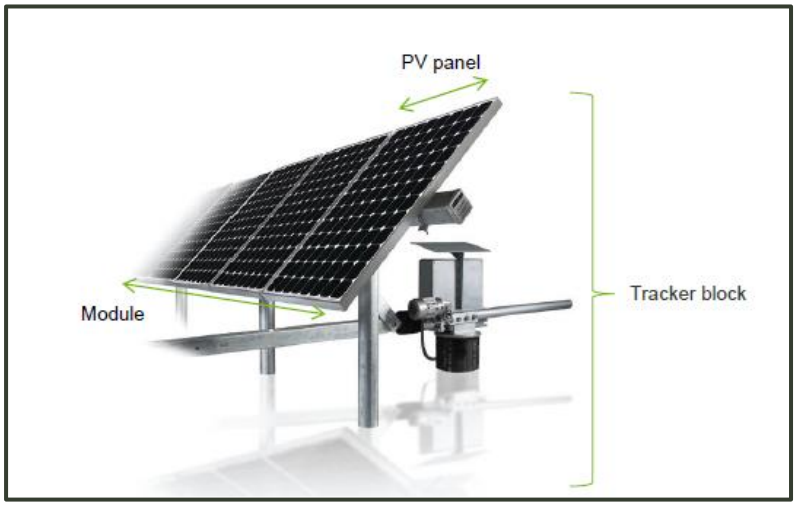

Figure 3-2 Single axis tracking system (image courtesy of Mulilo)

The supports of the frame would be fixed on top of the steel piles. Since there is existence of rock (dolerite and siltstone) at shallow depths, the steel piles would be embedded into a concrete pile. However, the final design of the foundations would depend on the geotechnical conditions of the site which would be determined at a later stage.

3.1.3 Transmission lines and substations

It is envisaged that the PV facility would require an onsite substation. The anticipated dimensions of the substations and buildings that would be required are indicated in **Table 3-4.**

Table 3-4 Anticipated dimensions of substations and buildings required for PV10

Substations	Dimensions	Proposed/ Authorised
Onsite Substation (x1)	~200m x 100m x 25m	Proposed
Interconnection (Substation) Building (x1)	~25m x 15m x 5m	Proposed
Interconnection Cabin (x1)	~15m x 4m x 5m	Proposed
Operation and Maintenance Building (x1)	~30m x 15m x 4m	Proposed
Inverter Cabins (x200)	~15m x 5m x 4m	Proposed
Solar Structures	~30m x 7m x 5m	Proposed

The substations would feed into Hoekplaas Solar PV5 or Kronos substations by means of 132kV overhead transmission lines (**Figure 3-3**). Since the PV proposed for farm Hoekplaas would share some of the infrastructure (some of which has already received environmental authorisation) the DEA will only be requested to authorise the transmission line sections and substations specific to each facility. Please refer to **Figure** 3-4 which shows the transmission line section and infrastructures specific to proposed PV10, as well as, shared infrastructure that has already received approval. Hoekplaas Solar PV10 will connect to the grid via the A D C routing option should no other project be awarded an EA and Preferred Bidder Status. However should Hoekplaas PV5 be awarded an EA and Preferred Bidder Status the line would connect from A to D. (**Table 3-5** and **Figure** 3-4).

Table 3-5 Co-ordinates of proposed transmission line for PV10

A	D	C
30° 1'54.31"S 22°22'55.07"E	30° 1'2.08"S 22°22'16.60"E	30° 1'26.78"S 22°20'16.94"E

Figure 3-3 Example of an existing 132 kV transmission line (taken 29/09/2011)

3.1.4 Additional infrastructures (road, buildings, stormwater, water pipeline)

An additional access road of 6m in width leading from the R357 would be required. Internal roads (gravel) would lead from the main access roads to connect the PV facility. These roads would coincide with the existing dirt tracks where possible (see in **Figure** 3-4). Access and internal roads for servicing and maintenance of the facility would use routing XYQ if no other projects are awarded an EA and Preferred Bidder Status. If PV5 or PV7 are awarded an EA and Preferred Bidder Status, the connection route would be Y to Q. No access route would be required for PV10 if PV8 or PV9 were awarded an EA and Preferred Bidder Status (**Table 3-6**).

Table 3-6 Co-ordinates of proposed access road for PV10

X	Y	Q
30° 1'7.58"S 22°20'27.66"E	30° 1'7.58"S 22°20'27.66"E	30° 1'53.89"S 22°23'42.46"E

Two laydown areas have been identified (**Figure** 3-4) and one of these would be used during the construction phases of the proposed PV facility. This laydown area has already received authorisation under the authorised PV1[13] and PV4[14] facility. Septic tanks would be constructed at the site offices and serviced by the municipality on a monthly basis.

The natural water flow of the site would be interrupted by the proposed roads, and therefore stormwater infrastructure would be required to facilitate surface water flow and to prevent erosion channels from developing.

It is anticipated that water requirements during the construction and operational phases would be met via the Alkantpan pipeline:

13 DEA Ref. No. 12/12/20/2501 & NEAS Ref. No. DEAT/EIA/0000611/2011
14 DEA Ref. No. 14/12/16/3/3/2/495 & NEAS Ref. No. DEA/EIA/0001756/2013

- **Construction Phase:** The 75MW facility would require roughly 1,400kℓ over a period of 12 to 24 months.
- **Operational Phase:** 508kℓ of water per year or 1.4kℓ per day.

However, the applicant is still in the process of confirming whether sufficient capacity is available from the municipality (also see **Section 3.1.5**) and can only finalise negotiations once the project is authorised.

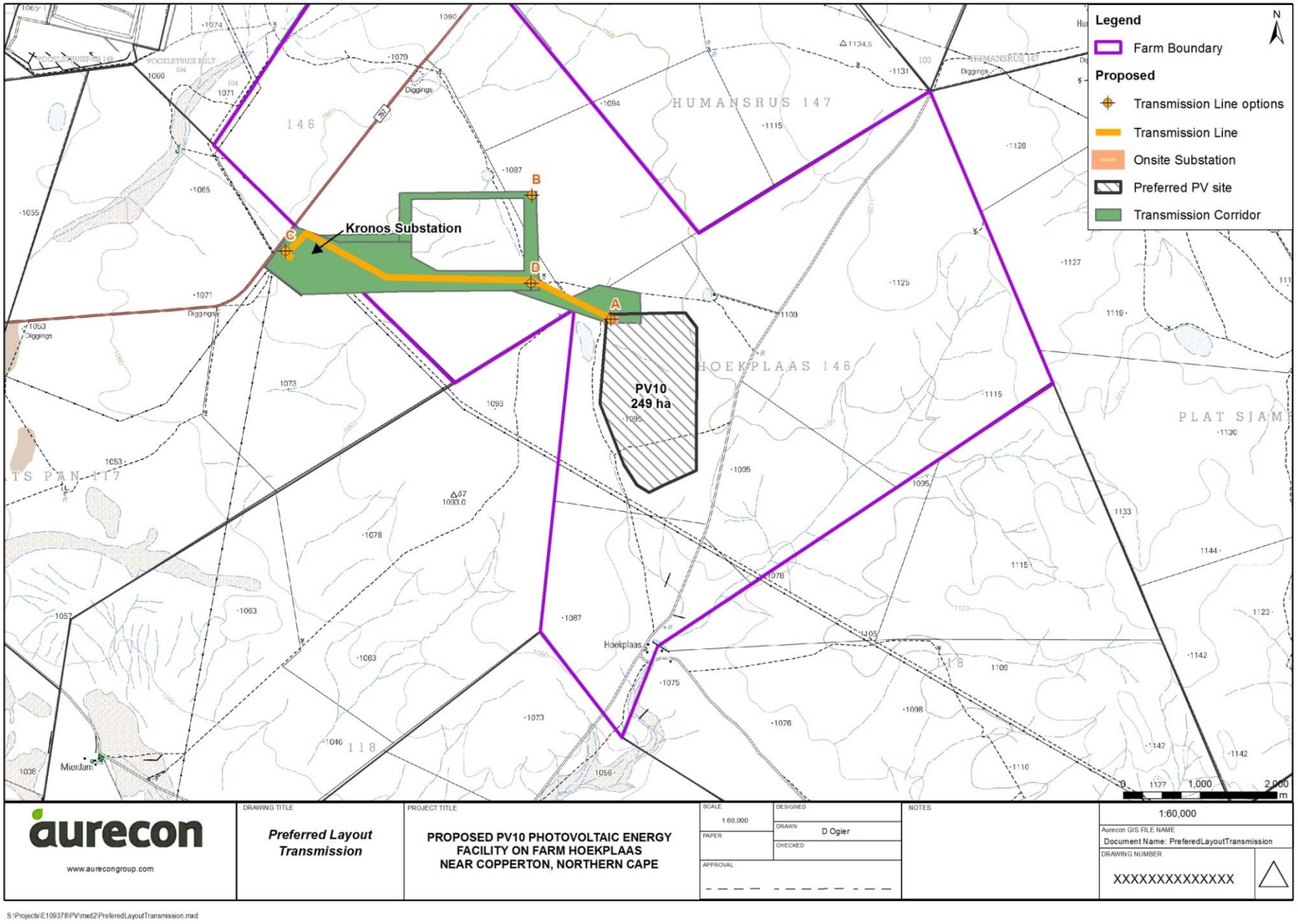

Figure 3-4 Proposed transmission line corridors

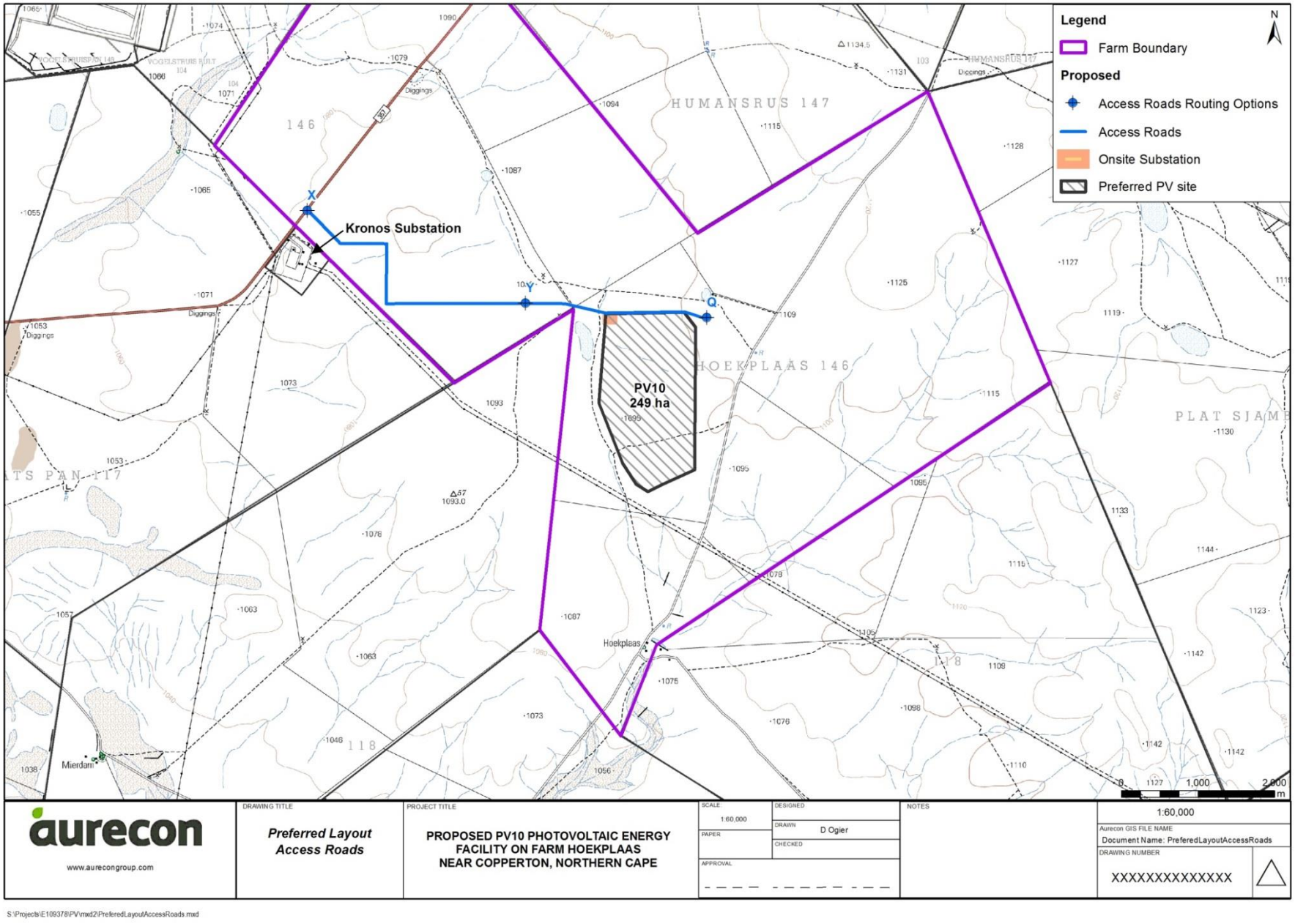

Figure 3-5 Propossed access roads

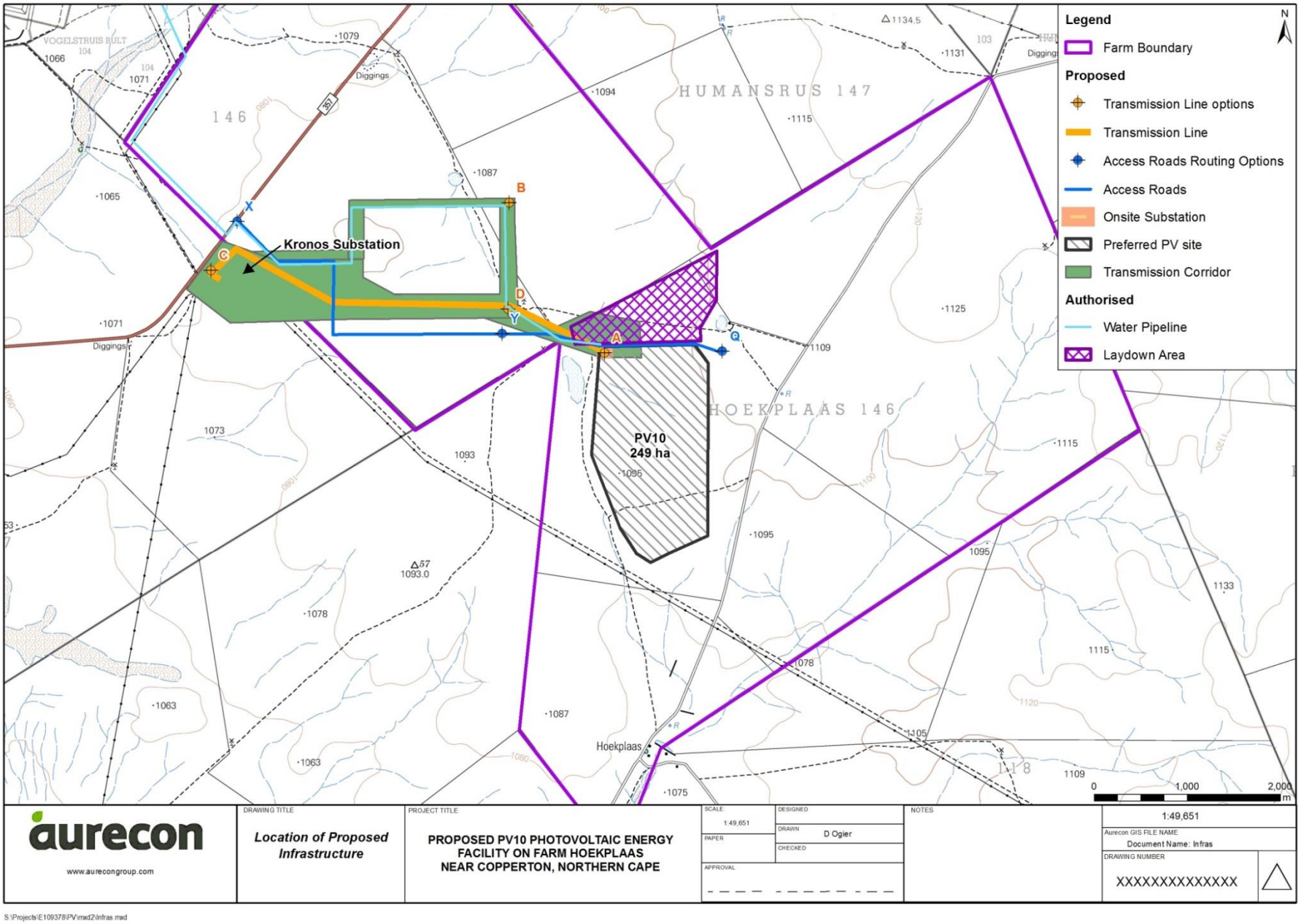

Figure 3-6 Additional infrastructure

Table 3-7 details components and infrastructure requirements of the proposed project which include the physical size, number, footprint and land requirements.

Table 3-7 Summary of proposed solar infrastructure components, size, footprints and land requirements

Component	Size (m)	Footprint (ha)	Land Requirement (ha)	Proposed/Authorised
PV Panels for 75MW	Panel dimensions: ~30m x 7m x 5m	~265	~265	Proposed
Access Roads	Width: 8 Length: ~4.4 km	~0.0264	~0.0264	Remaining 1.5km Proposed
Substation	200 x 100 x 25	~0.6	~0.6	Proposed
Operation and maintenance building	~30 x 15 x 4	~0.045	~0.045	Proposed
Construction camp and storage area	-	66.4	66.4	Authorised under PV1 and PV4 EA

3.1.5 Construction phase

The construction phase of the 75MW PV10 facility would last approximately 12 to 18 months. Employment opportunities created during the construction phases equates to approximately 2,800 man months of which 80% would be allocated to South African citizens. These employment opportunities can be divided into the following employment categories:

- 50% would be for black citizens.
- 15% would be skilled employees.
- 8% would be black skilled employees.
- 30% of the jobs created would be from the local community.

Accommodation would be provided through temporary construction camps onsite (i.e. the laydown areas) for non-locals. However, the project aims to employ at least 80% South African citizens and of that at least 30% (up to 60%) of the work force would be sourced from the surrounding communities for construction.

Approximately 1,400kℓ of water would be required for the duration of the construction phase. This water would be sourced via the Alkantpan pipeline from the local municipality. Mulilo has indicated that the water supply allocated to the authorised PV facility on Farms Hoekplaas, Klipgats Pan and Struisbult was originally over calculated. As such the over allocated water would be used during the construction and operational phases of the proposed PV facility and only a limited volume of additional water would be requested from Alkantpan and the local municipality.

Construction vehicles are likely to make use of the existing roads, including the R357 and N10, to transport equipment and material to the construction site. Approximately 450 truckloads transporting in total 900 x 40-foot containers would be required during the construction period. These deliveries would be distributed across the construction period. Internal gravel roads from the main access roads to the PV10 facility would be required (**Figure 3-7**). Where possible, the layout of these roads would coincide with the existing dirt tracks.

Figure 3-7 Example of a site access road being constructed (image courtesy of SunPower)

During the construction phase 20% of the footprint area would be cleared while the vegetation on the remaining 80% would be brush cut to a height of 40-50cm (**Figure 3-8**). Different types of control measures would be required to limit soil migration through the site. These mitigation measures are described in the Life-cycle Environmental Management Plan (LEMP) included in **Annexure D**. The disturbed areas would be rehabilitated to as a natural vegetative state as possible.

Figure 3-8 Example of a PV site being prepared for construction (image courtesy of SunPower)

3.1.6 Operational phase

It is anticipated that the proposed PV facility would last the full period of the Power Purchase Agreement (PPA) which is approximately 20 years. The remainder of the farm would continue to be used for grazing.

Employment opportunities to be created during the operational phase equates to approximately 35 man months of which 80% would be allocated to South African citizens. These employment opportunities can once again be divided into the following employment categories:

- 50% would be for black citizens.
- 45% would be skilled employees.
- 14% would be black skilled employees.
- 54% of the jobs created would be from the local community.

Approximately 500ℓ of fuel and 50ℓ of lubrication oil would be stored on site. The combined volume falls well below the thresholds listed in terms of NEMA. However, the necessary precautionary measures would be put in place and would be included in the LEMP.

Regular cleaning of the panels would be required to ensure that the PV panels operate at maximum electricity generation levels. Dust, dirt, pollen, and bird excretions can reduce the efficiency of PV panels. The frequency of panel cleaning would depend on the site conditions, but is anticipated to occur on a biannual basis. Panels would be washed manually with water with no cleaning agents added. Approximately 508kℓ of water per annum would be required.

3.1.7 Decommissioning phase

The PV10 site would potentially be decommissioned at the end of the PPA (20 years from the date of commissioning). The possibility of upgrading the proposed facility to more advantageous technologies would be investigated at the end of the PPA. Should decommissioning be considered to be the favourable option, it would potentially take between 6 to 12 months per 75MW PV facility. After disconnecting the PV infrastructure from the electricity network, the module components would be removed and recycled as far as possible. The structures would be dismantled and the concrete pile foundations would be removed. All underground cables would be excavated and removed. The buildings would be demolished and removed by an authorised and qualified company.

The rehabilitation of the disturbed areas would form part of the decommissioning phase. The aim would be to restore the land to its original substratum characteristics (or as near as possible). The restoration activities would include the following:

- Sub-soiling[15] of the disturbed soil layer to reduce the density thereof;
- Distribution of a layer of topsoil (30cm) over the disturbed areas;
- Improvement of soil composition and possible application of fertilizers; and
- Replanting with indigenous seed mix.

Annexure G provides an overview of the anticipated decommissioning phase.

[15] This involves drilling or removing material from this soil layer to a depth of 50 to 100cm in order to air it and enable the agricultural plant species situated above to take root.

3.2 Consideration of alternatives

NEMA requires the consideration of alternatives during the EIA process. An important function of the Scoping Phase is to screen alternatives to derive a list of feasible options for further detailed assessment during the EIA Phase. An alternative can be defined as a possible course of action, in place of another, that would meet the same purpose and need (DEAT, 2004).

"Alternatives", in relation to a proposed activity, means different ways of meeting the general purpose and requirements of the activity, which may include alternatives to -

a) the property on which or **location** where it is proposed to undertake the activity;
b) the type of **activity** to be undertaken;
c) the design or **layout** of the activity;
d) the **technology** to be used in the activity;
e) the **operational** aspects of the activity; and
f) the option of not implementing the activity.

In addition to the list above, the 2013 DEA&DP Guidelines on Alternatives also considers the following as alternatives:

- **Demand alternative:** Arises when a demand for a certain product or service can be met by some alternative means (e.g. the demand for electricity could be met by supplying more energy or using energy more efficiently by managing demand).
- **Input alternative:** Input alternatives are applicable to applications that may use different raw materials or energy sources in their process (e.g. Industry may consider using either high sulphur coal or natural gas as a fuel source).
- **Routing alternative:** Consideration of alternative routes generally applies to linear developments such as power line servitudes, transportation and pipeline routes.
- **Scheduling and timing alternative:** Where a number of measures might play a part in an overall programme, but the order in which they are scheduled would contribute to the overall effectiveness of the end result.
- **Scale and Magnitude alternative:** Activities that can be broken down into smaller units and can be undertaken on different scales (e.g. for a housing development there could be the option 10, 15 or 20 housing units. Each of these alternatives may have different impacts).

The Scoping Phase screened alternatives to derive a list of feasible alternatives assessed in detail in the current EIA Phase. The following types of alternatives were considered to be the most pertinent to the proposed project:

- **Location alternatives:** Alternative locations for the entire project proposal or for components of the project proposal.
- **Activity (type) alternatives:** Requires a change in the nature of the proposed activity.
- **Layout alternatives:** Site layout alternatives in terms of scale and magnitude.
- **Routing alternatives:** Transmission line route alternatives.
- **Technology alternatives:** Consideration of different types of technology used.
- **No-Go Alternative:** Consideration of not developing the project.

The alternative types pertinent to the PV10 project is described in the subsequent sections.

3.2.1 Location alternatives

Mulilo has considered the option to develop large scale PV power generation in South Africa over the last five years, given the good solar resource which is available over a large portion of the western part of the country (**Figure 3-9**). Aspects that were taken into consideration included, but were not limited to, irradiation levels, distance to the grid, site accessibility, founding conditions, topography, fire risk, and current land use. Mulilo have already received five approvals for PV facilities on farms in the Copperton area and is now applying for six proposed PV projects, including PV10, on the farm Hoekplaas and two proposed PV projects of 75MW each on the farm Klipgats. The locations of these sites are provided in **Figure 3-12.**

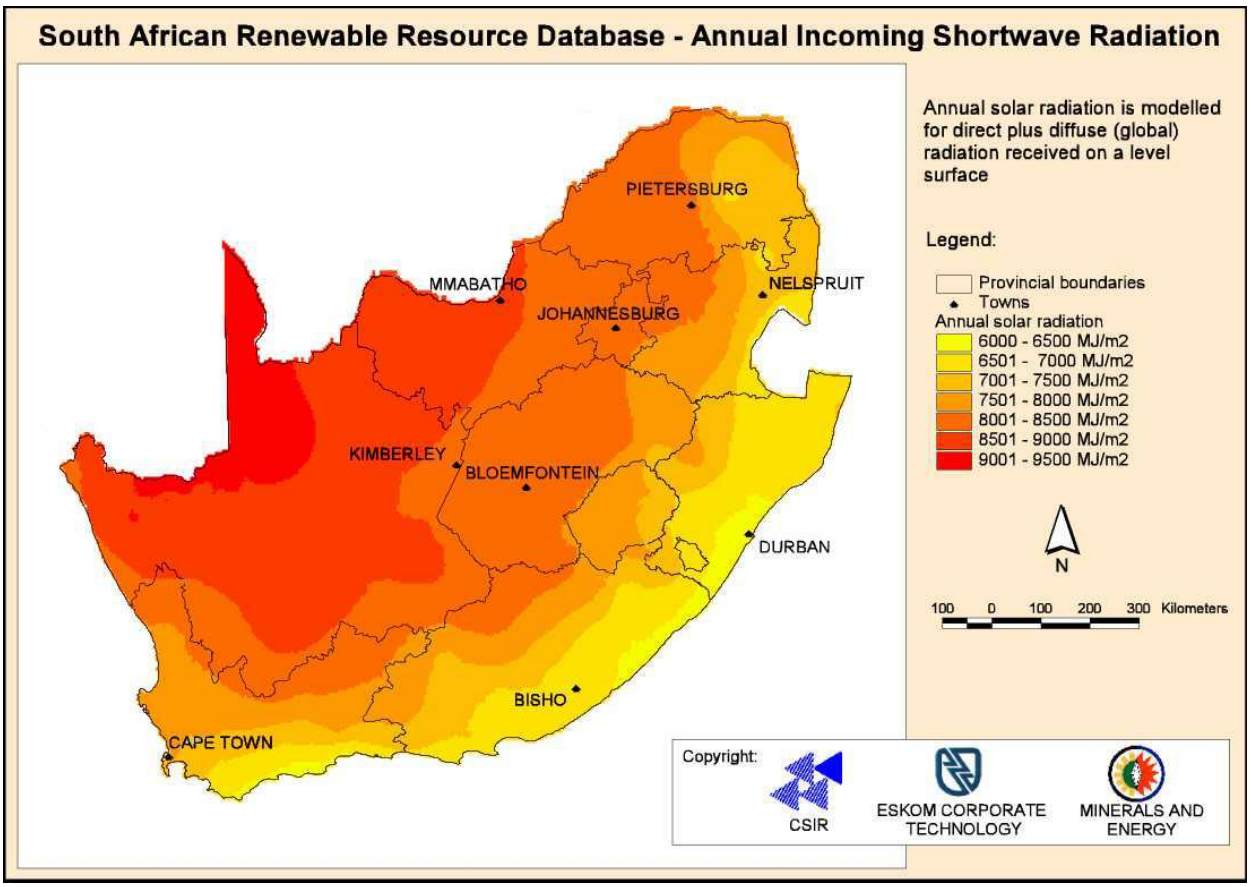

Figure 3-9 Annual solar radiation for South Africa (DME, 2003)

To summarise, the proposed site for PV10 was selected based on the following criteria:

- Solar radiation based on historic satellite data;
- Grid connectivity and close proximity to strong grid access points;
- Availability of flat, level and open land;
- Land use in terms of population numbers and non-arable / low potential agricultural land;
- Potential sensitive receptors and features, such as fauna, flora, heritage, visual and other technical aspects such as the SKA.

Furthermore, as explained in the Needs and Desirability Table (**Table 4-2**), the concentration of the proposed PV10 and the authorised PV1 and PV4 facilities on one farm would provide various positive benefits, such as:

- Sharing of supply infrastructure such as water, sewage and electricity;
- Reducing the impact on the environment by “concentrating” infrastructure and footprints to one farm portion;

- Reducing the cost of electricity as a result of reduced development, construction and operational costs due to the combined sharing of infrastructure, etc.;
- Utilizing shared laydown areas and construction camps, minimizing traffic and associated impacts with multiple camps;
- Allowing a phased approach to construction activities, thereby extending the construction period and employment opportunities; and
- Reducing the need for multiple electricity grid upgrades in the long term.

Therefore, only one location alternative has been considered for the proposed PV10 facility on Farm Hoekplaas.

3.2.2 Activity alternatives

As can be seen by the numerous policies and legislation described in **Section 1.2**, the need for additional energy generation in South Africa is well documented. Furthermore, these policies and legislation also indicate the mixture of renewable and non-renewable energy which South Africa wishes to pursue. These strategic documents provide the road map for the activity alternatives available to the country. Based on these requirements for renewable energy, Mulilo has identified a number of projects for solar energy generation.

Projects for wind generated electricity, (
Figure 3-13) are also located in the Copperton area. This indicates that the proposed site could also be suitable for wind power. However, the selection of the site was based on the requirements for solar energy. As such the only activity alternative, other than the no-go alternative, which would be investigated in this project specific EIA is solar energy.

Note: *The no-go alternative is the baseline against which all alternatives are assessed and includes PV1 and PV4. It consists of the status quo, and as such would not be explicitly assessed. Refer to Section 3.2.6 for further detail on the no-go alternative.*

3.2.3 Site layout alternatives

The DoE introduced a capacity limit of 75MW for solar facilities as part of the IPP bidding process. Mulilo are hopeful that the DoE would realise the benefits of having combined facilities, as discussed, and are therefore proposing two scale and magnitude alternatives. Therefore, the capacity (MW) of the proposed facility would determine the layout of the facility. The proposed alternatives, with relevant details, are listed in **Table 3-2.**

The preferred proposed layouts (**Figure 3-11**) have taken cognisance of the environmentally sensitive areas identified during the 2012 EIA process undertaken for PV1 (Aurecon, 2012). Based on these and recent specialist studies, buffers were allocated around sensitive points or areas and the layouts were revised to avoid these.

This report assesses the final layout i.e. the layout incorporating relevant buffers and recommendations of the specialists, while the specialist reports assessed the original focus areas. Comment was however sourced from the specialists on the revised layouts.

To summarise, the two alternative layouts considered are:

a) Layout Alternative 1 (preferred)

This alternative consists of the proposed 75MW PV10 facility and associated infrastructure. The layouts take cognisance of the 75MW DoE cap and the environmentally sensitive areas that were identified in the 2012 EIA process for The Farm Hoekplaas No.146, as well as the current EIA process (see **Figure 3-9**). Please refer to **Table 3-1** for more information on the footprint sizes, capacities and coordinates.

b) Layout Alternative 2

This alternative consists of a PV facility of 500MW (PV4A) (see **Figure 3-10**). The site layouts were developed by extending the proposed 75MW facility. This alternative is thus not limited to the DoE's 75MW cap per project. The benefit of developing larger facility relates to the reduction of associated development and construction costs which in turn reduces lending rates and essentially lowers the tariff of electricity sold.

3.2.4 Routing alternatives

Due to the large number of local renewable energy project that could potentially connect to the grid via the Kronos Substation (
Figure 3-13), two potential routing alternatives for transmission lines have been considered.

a) Routing Alternative 1 (preferred)

It is envisaged that the PV10 facility would have an onsite substation. The substation would feed into one central onsite multi-bay substation by means of onsite overhead 132kV transmission line before connecting to the Kronos Substation. The shortest routes were identified for the proposed transmission lines to limit the visual impact and area of disturbance, as well as reduce costs and illustrated as ADC in **Figure** 3-4.

b) Routing Alternative 2

Alternatively the transmission line could connect to the Cuprum Substation (transmission route corridor on **Figure 3-10**) should the Kronos Substation not have sufficient capacity. A corridor of approximately 6.3km in length (measured from the farm boundary) and 180m wide has therefore been identified for the transmission lines.

3.2.5 Technology alternatives

Technology alternatives in terms of solar panel type and mounting systems have been considered for the proposed PV10 facility.

a) Solar panel type

Three solar panel types were considered for the proposed PV10 facility: concentrated PV (CPV), concentrated solar power (CSP) and conventional PV solar cells. Information gathered through previous EIAs (Aurecon; 2012), as well as the recent technology advances informed this investigation.

CPV technology makes use of optics, such as lenses or curved mirrors, to concentrate sunlight onto a small area of solar PV cells to generate electricity. This technology type is considered to

be more cost effective than conventional PV solar cells in that it requires a smaller area of PV material. However, it does require active solar tracking[16] to be effective.

Figure 3-10 Photographs of CPV (left)[17], CSP (middle)[18] and conventional PV (right)[19] technology

Similar to CPV technology, **CSPs** use mirrors or lenses to concentrate sunlight onto a small area to generate electricity directly via a heat engine, e.g. a steam turbine.

Conventional PV technology on the other hand does not make use of any mirrors or lenses and generates electricity by converting solar radiation energy into a Direct Current (DC) which then needs to be converted to AC to connect to the grid.

The conventional PV and CPV technologies require less water (19ℓ/MWh of water) than the CSP system which needs approximately 3,420ℓ/MWh of water during the operational period. Due to the scarcity of water in the project area, and the large volume of water required for the CSP system, **only conventional PV (preferred) and CPV technologies have been considered** for the proposed PV10 solar facility.

[16] Solar tracker: Device that orients the PV panels towards the sun (Solar Tracker, 2013).
[17] Courtesy: Mulilo
[18] Concentrated Solar Power, 2013.
[19] Courtesy: Mulilo

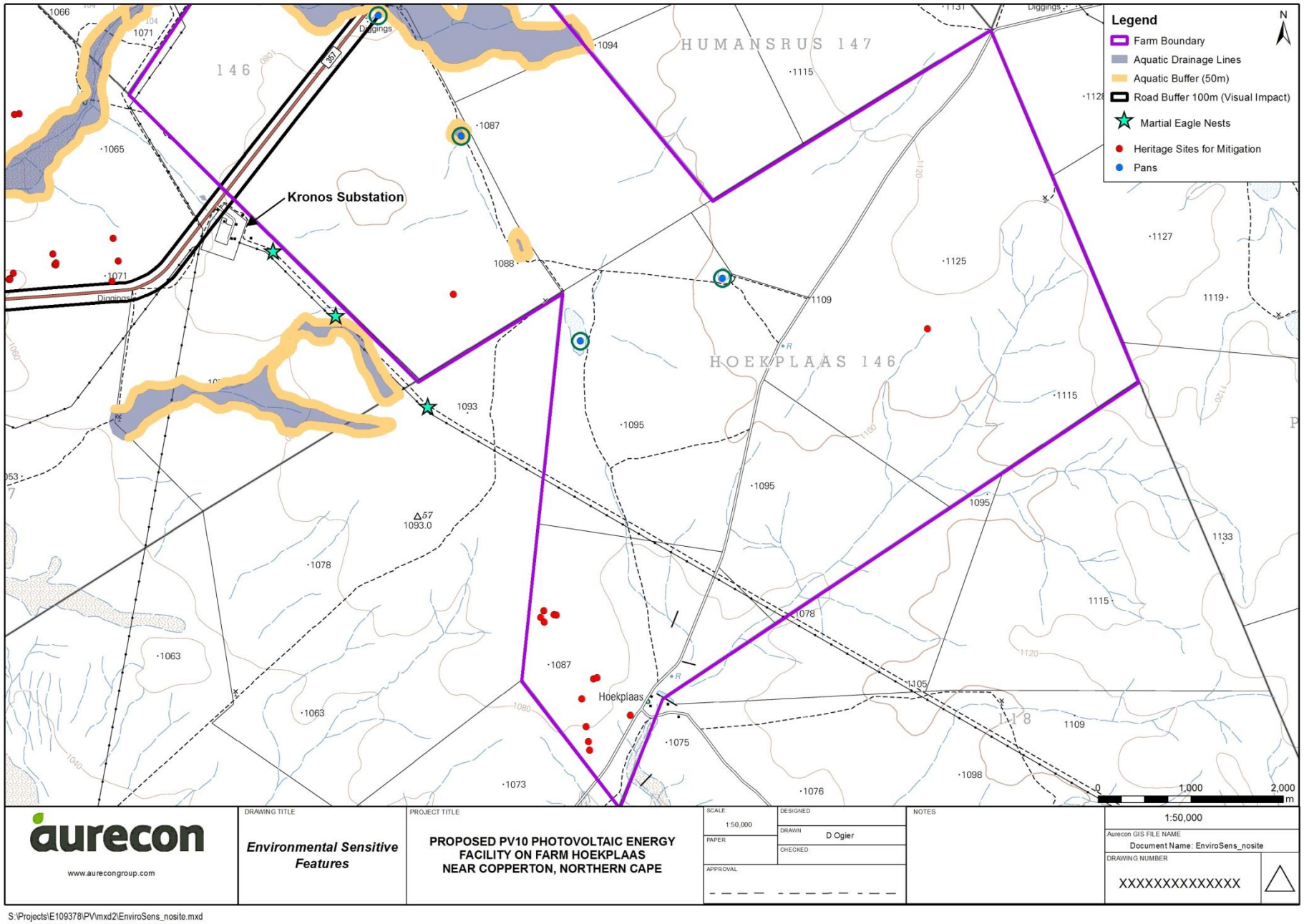

Figure 3-11 Sensitive features and areas as identified by specialists

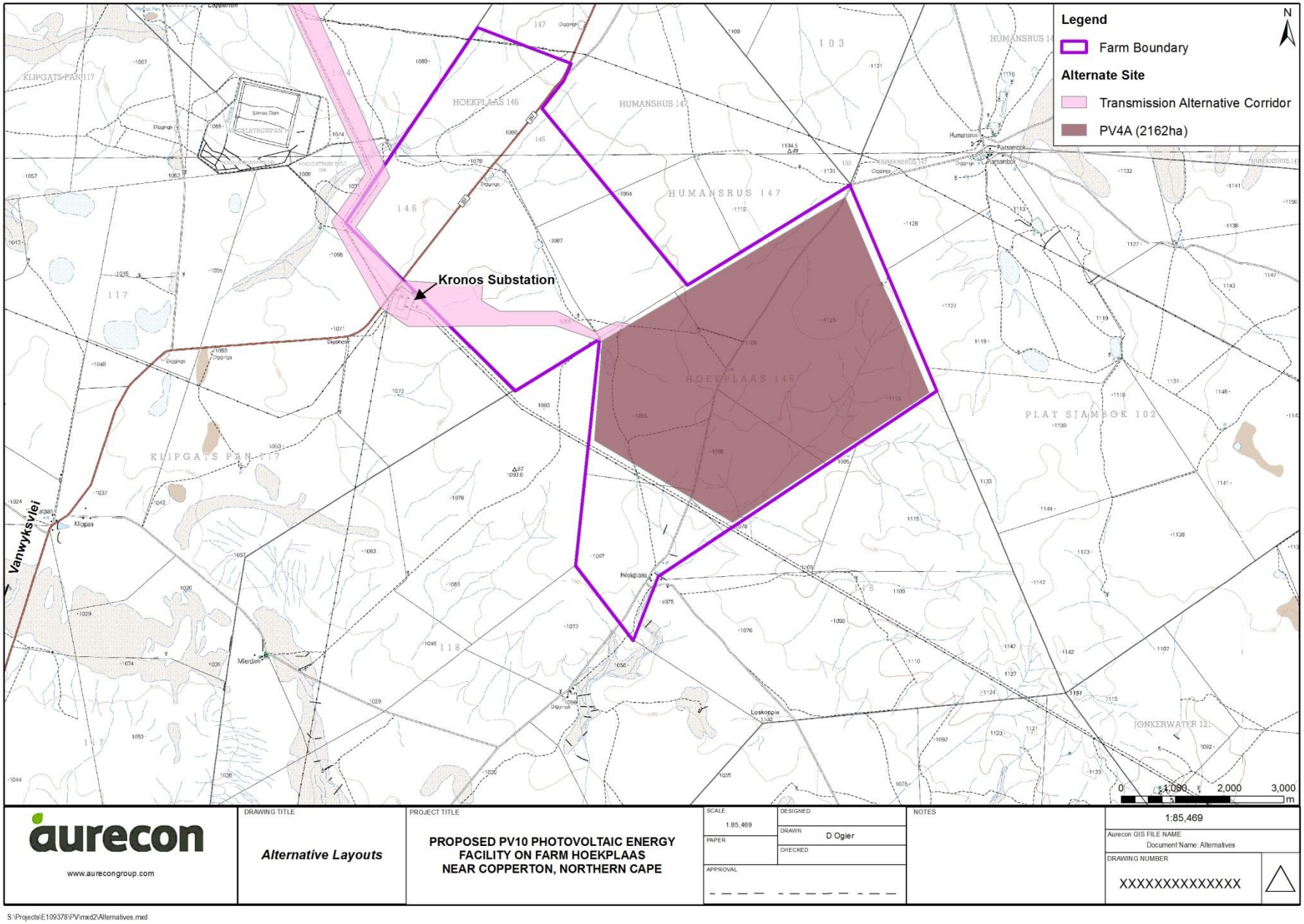

Figure 3-12 Alternative layout for the proposed PV10 facility on farm Hoekplaas

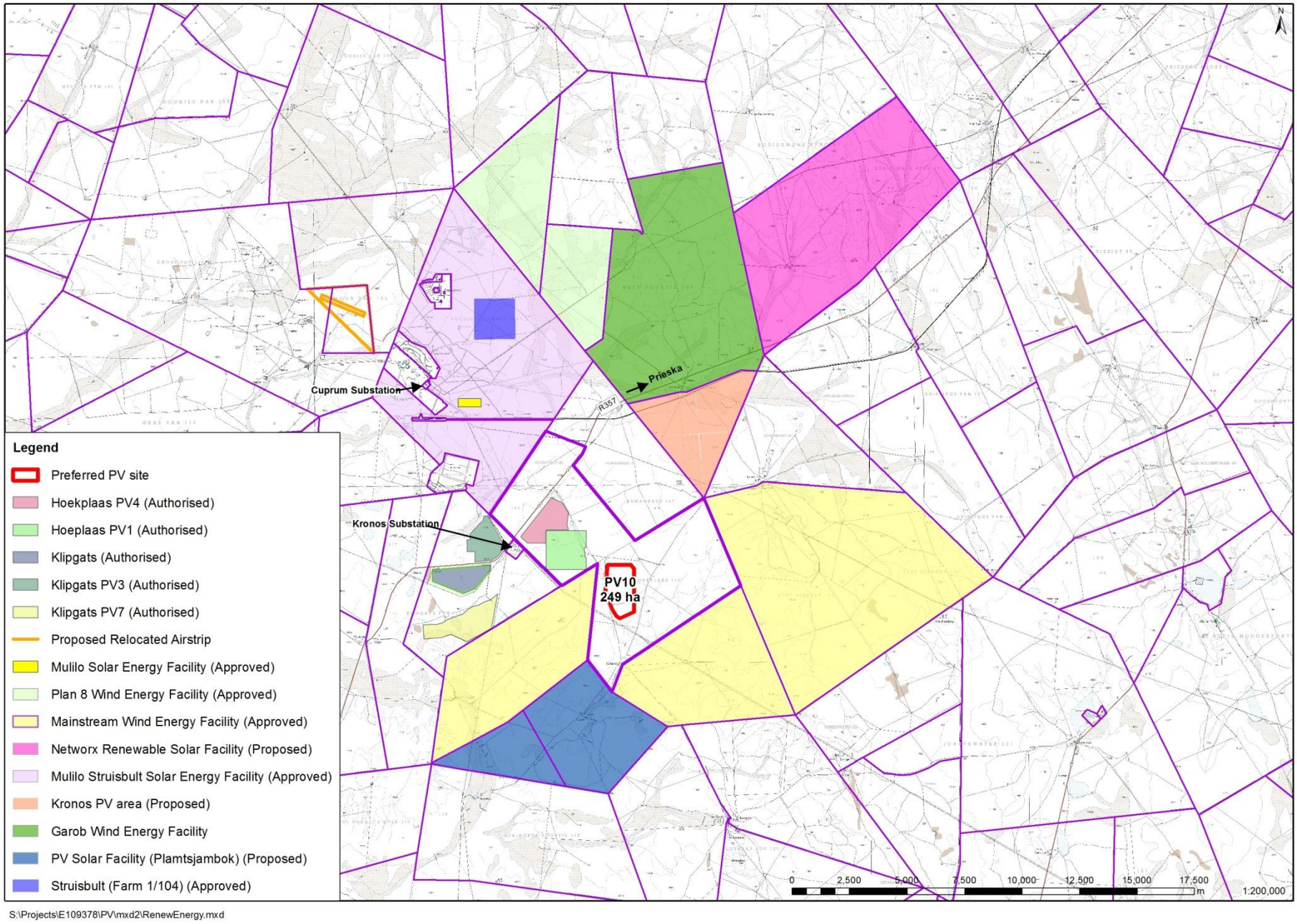

Figure 3-13 Other renewable energy projects (solar and wind) proposed for the Copperton area

b) Mounting system

Solar panels can be mounted in various ways to ensure maximum exposure of the PV panels to sunlight. Single axis tracking systems are considered along with fixed axis tracking systems. This decision will be made by the proponent closer to detail design phase after taking into consideration the economic viability, water requirements, land requirements, efficiency and potential environmental impacts of the proposed solar panel types.

In a fixed axis tracking system the PV panels are installed at a set tilt and cannot move, whereas in a single axis tracking system the panels follow the sun to ensure maximum exposure to sunlight as indicated in **Figure 3-14**.

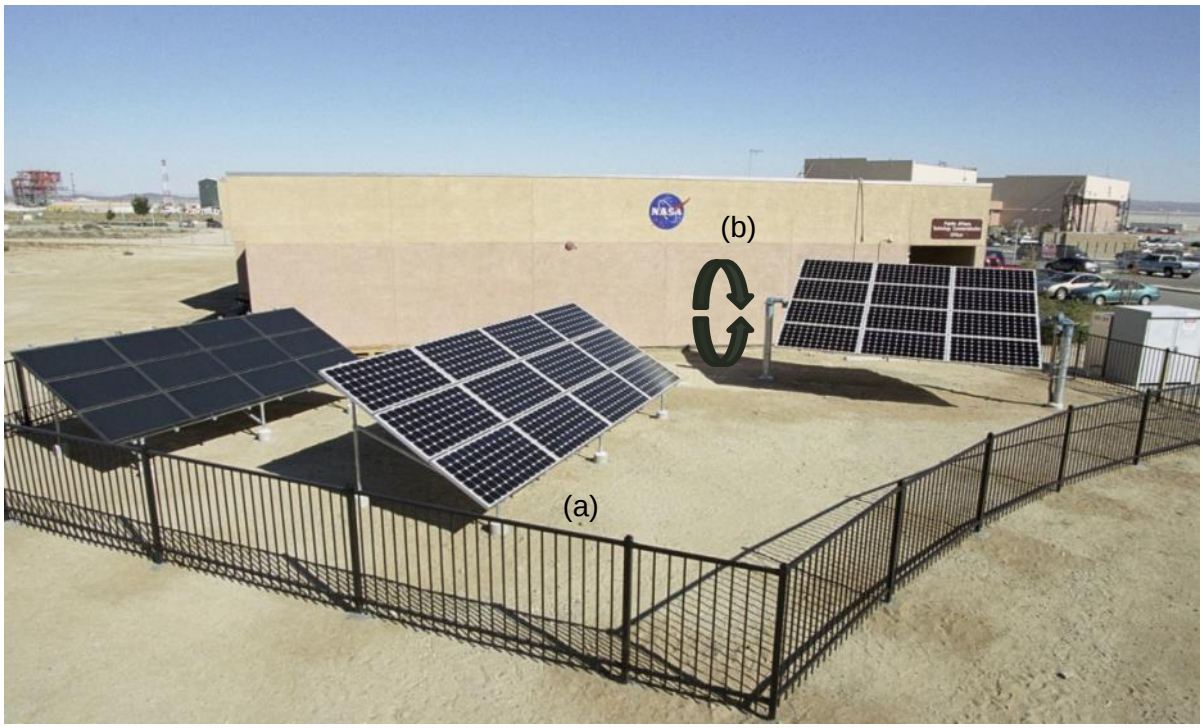

Figure 3-14 Fixed axis tracking system (a) and single axis tracking system (b) (courtesy Mulilo)

The photovoltaic single axis tracking technology has the following benefits:

- The panels are the highest efficiency panels with the highest efficiency inverter, maximizing the system output. Therefore, the installation costs are less as fewer panels are required.
- By minimising shading and grouping trackers closer together, this highly efficient technology produces the most energy per hectare of any tracking system. It requires up to 20% less land than conventional crystalline fixed tilt systems and up to 60% less than thin film technology. These highly efficient panels not only require less land, but also less concrete, steel and cabling per MW.
- The panel's anti-reflective glass and exceptional low-light performance characteristics enhances energy delivery.

The reflectivity of PV panels in relation to other surface areas is indicated in **Figure 3-15** below. The reflectivity of a PV panel is considered to be between that of asphalt and a forest. A Glint and Glare analysis report of the proposed PV technology is included in **Annexure I.**

The proposed PV panels would be approximately 2m wide and 1m long and are grouped into modules of which the frame supports are fixed on top of steel piles. Due to the occurrence of hardpan calcrete layers and cobbles/boulders on site at shallow depths, the steel piles would be embedded into a concrete pile. However, the final design of the foundations will depend on the geotechnical conditions of the site which will be determined at a later stage.

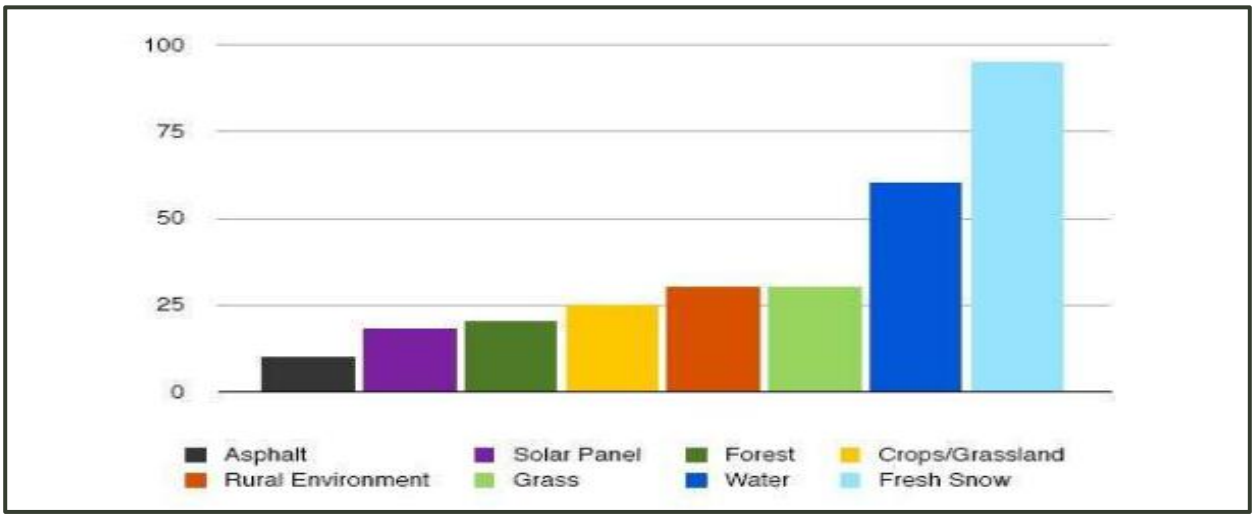

Figure 3-15 Reflectiveness of PV panels (Albedo reflectance)

3.2.6 No-Go alternative

The assessment of alternatives must at all times include the "no-go" option as a baseline against which all other alternatives must be measured. The option of not implementing the activity must always be assessed and to the same level of detail as the other feasible and reasonable alternatives. The "no-go" option is taken to be the existing rights on the property, which includes the authorised PV1 and PV4 facilities, and all the duty of care and other legal responsibilities that apply to the owner of the property.

3.2.7 Summary of alternatives

To summarise, the feasible alternatives which would be assessed in the EIA Report are indicated in **Table 3-8**.

Table 3-8 Feasible alternatives assessed in the EIAR

Alternative Type	Description
Location alternatives	• One location for the proposed PV facility, i.e. The Farm Hoekplaas No. 146
Activity alternatives	• Solar energy generation via a PV facility • No-go" alternative to solar energy production
Site layout alternatives	• One 75MW PV facility (Layout Alternative 1) • One PV facility with a generation capacity of 500MW, (Layout Alternative 2)
Technology alternatives	• Conventional PV vs. CPV technology • Single Axis vs. Fixed Axis PV tracking technology
Routing Alternative	• 132 kV transmission line connecting to the Hoekplaas Solar PV5 or Kronos Substation (Route Alternative 1, preferred) • 132 kV transmission line connecting to the Cuprum Substation (Route Alternative 2)

4 THE NEED FOR THE PROPOSED ACTIVITY

This section provides a motivation for the proposed project focussing on the availability of solar energy, the national targets for emissions, the ability to enhance the energy security and to create a sustainable economy.

The 2013 DEA&DP Guideline for Need and Desirability[20] highlights the obligation for all proposed activities which trigger the environmental regulations to be considered in light of (amongst others) the National Framework for Sustainable Development[21], the spatial planning context, broader societal needs and financial viability. This information allows the authorities to contemplate the strategic context of a decision on the proposed activity. This section seeks to provide the context within which the need and desirability of the proposed activity should be considered.

The need for renewable energy is well documented and reasons for the desirability of solar energy include:

- Utilising resources available to South Africa;
- Meeting nationally appropriate emission targets in line with global climate change commitments;
- Enhancing energy security by diversifying generation; and
- Creating a more sustainable economy.

4.1 Utilise resources available to South Africa

As illustrated in **Figure 3-7** South Africa is subject to some of the highest levels of solar radiation in the world with an average daily solar radiation that varies between 4.5 and 6.5kWh/m^2. This in comparison to the ± 3.6kWh/m^2 received by parts of the United States and ± 2.5kWh/m^2 for Europe and the United Kingdom (DME, 2003), indicates that South Africa has considerable solar resource potential which should be utilised.

South Africa generates most of its required electricity from coal of which there is a ready supply of at the local level. However, national government is on the verge of augmenting the existing generation capacity of thermal and nuclear power facility with renewable energy power generation, thereby creating a framework that will lead to an increase in the supply of clean energy for the nation.

The proposed PV facility is considered to be of national importance in anticipation of its contribution to electricity supply and reduced reliance on fossil energy sources. The IRP2010 allows for an additional 14,749MW of renewable energy in the electricity blend in South Africa by 2030. While there are a number of renewable energy options (including, *inter alia,* wind, solar, and hydropower) being pursued in South Africa, many more renewable energy projects are required to meet the targets set by the IRP2010. Consequently, based on this requirement for renewable energy, Mulilo has identified various projects for PV solar energy generation.

[20] DEA&DP, 2011.
[21] Republic of South Africa, 2008.

4.2 Meeting nationally appropriate emission targets in line with global climate change commitments

As can be seen by the numerous policies and legislation described in **Section 1.2**, the need for renewable energy is well documented. Due to concerns such as climate change, and the on-going exploitation of non-renewable resources, there is increasing international pressure on countries to increase their share of renewable energy generation. The proposed PV10 project is expected to contribute positively towards climate change mitigation.

Furthermore, renewable energy is recognized internationally as a major contributor in protecting the climate, nature and the environment, as well as providing a wide range of environmental, economic, and social benefits that can contribute towards long-term global sustainability.

Solar energy is also a source of "green" electricity as for every 1MWh of "green" electricity used instead of traditional coal generated electricity, one can:

- Save 1 500 litres of water;
- Avoid 8.22 kg of sulphur dioxide (SO_2) emissions;
- Avoid 1 000 kg of carbon dioxide (CO_2) emissions (including transmission losses);
- Avoid 142 kg of ash production; and
- Contribute to social upliftment.

4.3 Enhancing energy security by diversifying generation

The establishment of the proposed PV facility would strengthen the existing electricity grid for the area. Moreover, the project would contribute towards meeting the national energy target as set by the DoE. Should the proposed PV facility identified by Mulilo be acceptable, it is considered viable that long term benefits for the community and society in the Copperton / Prieska area would be realized as highlighted above.

The proposed project would also have international significance as it contributes to South Africa being able to meet some of its international obligations by aligning domestic policy with internationally agreed strategies and standards as set by the United Nations Framework Convention on Climate Change (UNFCCC), Kyoto Protocol, and United Nations Convention on Biological Diversity (UNCBD) all of which South Africa is a signatory too.

4.4 Creating a more sustainable economy

The Northern Cape has a semi-arid climate, and particularly the Copperton / Prieska area, has large tracts of open land which are sparsely inhabited. The towns are generally small with limited job opportunities. The need to improve the quality of life for all, and especially for the poor, through job creation is critical in South Africa. It is expected that the proposed project would contribute directly to the upliftment of the individuals and the societies in which they live. Skills development, and the transfer thereof, and local community involvement would be two of the priorities. Community involvement would either be through direct employment or indirectly through service industries. This would be enhanced as far as possible. It is anticipated that job opportunities amounting to approximately 2,800 man months would be created for the construction phase of the 75MW project depending on the procurement method and the primary contractor. In addition to local skills development and job creation, the following potential benefits could be realised:

- Reducing the demand on scarce resources, such as water as the generation of energy from PV facilities uses less water per MW/h than coal-fired facilities;

- Reducing pollution as the generation of energy from PV facilities produces far less pollution per MW/h than coal-fired facilities;
- Local economic development; and
- Local skills development.

Numerous studies and reports have attempted to quantify the employment creation potential of renewable energy per unit of power installed or generated. AGAMA Energy (2003) established that solar PV has the largest creation potential of all the renewable technologies as indicated in **Table 4-1.**

Table 4-1 Renewable energy employment potential in terms of the gross direct jobs created per GWh for the various technologies (Agama Energy, 2003)

Employment per GWh						
Technology	**Fuel**	**Manufacture**	**Installation**	**O&M**	**Other**	**Total**
Solar thermal	0	3	7	0.4	0	10.4
Solar PV	0	32.9	21.2	4.4	3.5	62
Wind	0	8.4	1.3	2.6	0.3	12.6
Bio-energy	0	3.55	3.55	7.2	0	14.3
Hydro	0	8.4	1.3	2.6	0.3	12.6

Table 4-2 Specific questions as detailed in the Need and Desirability Guideline

NEED (TIMING) Question	Response
1. Is the land use (associated with the activity being applied for) considered within the timeframe intended by the existing authorised 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 IDP?	The area proposed is currently zoned as Agricultural land. The farmer has signed a lease agreement with Mulilo for the site which has relatively low agricultural potential. Furthermore the additional income would safeguard the economic sustainability of the farm. Even though the IDP does not specifically allow for renewable energy projects, solar energy was identified as one of the local municipality's (LM) priorities for development. Other needs that were identified include sustainable developments (economically, socially and environmentally sustainable) and job creation. The proposed PV10 facility would create job opportunities for a wide range of skills. In addition, Mulilo has committed to developing a training strategy to train and employ people from the local community.
2. Should development, or if applicable, expansion of the town/ area concerned in terms if this land use (associated with the activity being applied for) occur at this point in time?	Yes. The activity is in line with the Pixley ka Seme District Spatial Development Framework which recognises the need for sustainable land management, job creation and the development of new skills.
3. Does the community/ area need the activity and the associated land use concerned (is it a societal priority)?	Yes. The proposed PV10 facility would not only be a source of income for the landowner, but it would create job opportunities for the local community as the construction and operation of the PV10 facility require a wide range of skill levels. Secondary economic impacts (as explained in Question 1 above) would include an increased demand on the service

NEED (TIMING) Question	Response
	industry through a demand for accommodation and other services.
4. Are there necessary services with appropriate capacity currently available (at the time of application), or must additional capacity be created to cater for the development?	It is anticipated that water requirements during the construction and operational phases would be met via the Alkantpan pipeline. However, the applicant still needs to confirm whether sufficient capacity is available. Estimated water requirements: • Construction Phase: The 75MW PV10 facility would require roughly 1,400kℓ over a period of 12 - 18 months • Operational Phase: 508kℓ of water per year or 1.4kℓ per day. Furthermore, the establishment of the proposed PV10 facility would strengthen the existing electricity grid for the area resulting in a positive impact on the available electrical services.
5. Is this development provided for in the infrastructure planning of the municipality, and if not, what would the implication be on the infrastructure planning of the municipality (priority and placements of services)?	No. It should be noted that once the proposed PV10 facility is operational, there would be a very limited requirement for municipal services in terms of water, waste and sewage services.
6. Is this project part of a national programme to address an issue of national concern or importance?	Yes. The establishment of the proposed facility would strengthen the existing electricity grid for the area. Moreover, the project would contribute towards meeting the national energy target as set by the DoE.
7. Is the development the best practicable environmental option (BPEO) for this land/ site?	The proposed development would provide additional income to the landowner which could be used for sustainable agricultural practices on his farm.
8. Would the approval of this application compromise the integrity of the existing authorised Municipal IDP and SDF as agreed to by the relevant authorities.	No. The activity is in line with the SiyaThemba IEMP and Pixley ka Seme District SDF which recognizes the need for: • Sustainable developments; • New skills development; and • Economic development. The proposed PV facility would not only be a source of income to the farmer, but would also create job opportunities for the local community as the construction and operation of the PV10 facility would require a wide range of skill levels.
9. Would the approval of this application compromise the integrity of the existing environmental management priorities for the area (e.g. as defined in EMFs), and if so, can it be justified from in terms of sustainability considerations?	No. According to the SiyaThemba IEMP land degradation, especially from overgrazing, is one of the key issues that need attention. The proposed development would provide additional income to the landowner which could be used for sustainable agricultural practices on his farm.
10. Do location factors favour this land use (associated with the activity applied for) at this place?	Yes. The site was selected based on the following criteria: • Solar resource potential based on historic satellite data; • Grid connectivity and close proximity to strong grid

NEED (TIMING) Question	Response
	access; • Close proximity to Eskom's existing transmission lines; • Flat, level, and open land; and • Unpopulated and non-arable or low arable potential land. In addition, specialist studies undertaken during 2012 on the farm found that it was suitable for the solar energy project. Furthermore, the benefit of combining the proposed PV10 facility on one farm along with the previously authorised PV1 and PV4, includes: • Sharing of supply infrastructure such as water, sewage and electricity; • Reducing the impact on the environment by "concentrating" infrastructure and footprints; • Reducing the cost of electricity as a result of reduced development, construction and operational costs due to the combined sharing of infrastructure, etc.; • Utilizing a single laydown area and construction camp, minimizing traffic and associated impacts with multiple camps; • Allowing a phased approach to construction activities, thereby extending the construction period and employment opportunities; and • Reducing the need for multiple electricity grid upgrades in the long term.
11. How would the activity or the land use associated with the activity applied for, impact on sensitive natural and cultural areas (built and rural/ natural environment)?	Potential impacts associated with the proposed PV10 facility are discussed in Chapter 5 of the EIAR.
12. How would the development impact on people's health and wellbeing (e.g. in terms of noise, odours, visual character and sense of place, etc.)?	Potential impacts associated with the proposed PV10 facility are discussed in Chapter 5 of the EIAR.
13. Would the proposed activity or the land use associated with the activity applied for, result in unacceptable opportunity costs?	Potential impacts associated with the proposed PV10 facility are discussed in Chapter 5 of the EIAR.
14. Would the proposed land use result in unacceptable cumulative impacts?	Potential impacts associated with the proposed PV10 facility are discussed in Chapter 5 of the EIAR.

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5 ASSESSMENT OF POTENTIAL IMPACTS AND POSSIBLE MITIGATION MEASURES

This Chapter forms the focus of the EIAR. It contains a detailed assessment of the operational (or long-term) impacts as well as the construction and decommissioning phase impacts on the biophysical and socio-economic environments. A summary table of the assessment of all the potential impacts is also provided.

5.1 Introduction

This Chapter describes the potential impacts on the biophysical and socio-economic environments, which may occur due to the proposed activities described in **Chapter 3**. These include potential impacts, which may arise during the operation of the proposed development (i.e. long-term impacts), as well as the potential construction and decommissioning related impacts (i.e. short to medium term) and cumulative impacts on a regional scale. The assessment of potential impacts will help to inform and confirm the selection of the preferred alternatives to be submitted to DEA for consideration. In turn, DEA's decision on the environmental acceptability of the proposed project and the setting of conditions of authorisation (should the project be authorised) will be informed by this chapter, amongst other information, contained in this EIAR.

The Scoping Phase identified various impacts on the biophysical and socio-economic environment which are anticipated to occur throughout the construction, operational and decommissioning phases. These impacts are described in the sections below in the following order:

- Impact on flora;
- Impact on avifauna;
- Impact on fauna;
- Impacts on surface water resources, including sedimentation and erosion;
- Impact on hydrology;
- Impacts on palaeontology and heritage resources;
- Social impacts (positive and negative) including impact on local economy (employment);
- Impact on traffic;
- Visual impacts;
- Impact on agricultural resources;
- Storage of hazardous substances on site;
- Noise pollution;
- Dust pollution;
- Impact on energy production;
- Impact on climate change; and
- Impact on surrounding land uses.

These impacts on the biophysical and socio-economic environment were assessed, in terms of the methodology outlined in the Plan of Study for EIA (for ease of reference the methodology is included in **Annexure E**). For each impact assessed, mitigation measures have been proposed to reduce and / or avoid negative impacts and enhance positive impacts. These mitigation

measures were also incorporated into the LEMP to ensure that they are implemented during the planning, construction, operational and decommissioning phases. The LEMP forms part of the EIA Report, as such its implementation will become a binding requirement should this project be authorised.

Cumulative effects assessments were undertaken and are discussed under each impact section set out below. In addition Section 5.16 provides a collective overview by considering the cumulative assessments from each of the impact sections. Cumulative effects are commonly understood to be impacts from different projects that combine to result in significant change, which could be larger than the sum of all the individual impacts. The assessment of cumulative effects therefore considered all renewable energy developments (wind and solar), and either constructed or proposed with an environmental authorisation from DEA within a 20km radius of the proposed site. The assessment also took into consideration the other PV facilities authorised and proposed for the same farm.

5.2 Impact on flora

The vegetation on Hoekplaas is moderately grazed and mostly intact. The potential therefore exists for the proposed solar energy facility to impact on the vegetation of Farm Hoekplaas. As such Dr Dave McDonald of Bergwind Botanical Surveys & Tours cc was appointed to undertake a Botanical Impact Assessment. A site visit was conducted by Dr McDonald on 24 and 25 November 2011 and again on 16 and 17 April 2013 in order to inform the assessment. The study considered locality, topography, geology, climate vegetation types and conservation status. The Botanical Impact Assessment and comment on the revised layout and technology alternatives is included in **Annexure C**. The summary below includes findings and recommendations of the specialist.

5.2.1 Description of the environment

The site falls within the Nama Karoo Biome which covers a large part of the Northern Cape Province. According to the national classification of the vegetation of South Africa (Mucina *et al.* 2006) the vegetation found at the study site is mainly Bushmanland Basin. Although there are few statutory conservation areas in this type, it forms agricultural rangelands and is conserved for its grazing potential. The National Spatial Biodiversity Assessment (Rouget *et al.* 2004) classifies this vegetation type as Least Threatened and it is not listed in the National List of Threatened Terrestrial Ecosystems (Government Gazette No. 24909. 2011).

Six vegetation communities occur across the preferred and alternative sites as described in the table below:

Table 5-1 Description of vegetation communities occuring at Hoekplaas

Vegetation Community	Description
Rhigozum trichotomum (granaatbos)	*Rhigozum trichotomum* is a tough woody shrub and is scattered throughout the study area but tends to be concentrated and dominant in areas where there is an accumulation of red sand and surface rocks. It has low botanical / ecological sensitivity.
Asteraceous Shrubland	The Asteraceous Shrubland is the most extensive vegetation type in the study area and it also has the greatest diversity of species. It may be described as “bossieveld” to distinguish it from areas of grassland. This vegetation occurs on shallow sandy-loam soils often with bedrock, mostly as hardpan calcrete and it is not ecologically sensitive (see Figure 5-1).

Vegetation Community	Description
Salsola spp. – Pentzia incana Shrubland	*Salsola* spp. – *Pentzia incana* Shrubland is a low shrubland that is found on red sandy soil and is ecotonal[22] between Asteraceous Shrubland and *Rhigozum trichotomum* Shrubland. It has few species and is not ecologically or botanically sensitive.
'Leegte' Shrubland	'Leegte' Shrubland is found in the shallow seasonal drainage lines on Hoekplaas. This vegetation community was previously highlighted as sensitive by McDonald (2012a). It is variable in stature and has a low stratum dominated by grasses but also with low shrubs. The *Rhigozum trichotomum* Shrubland is also found in drainage lines and grades into the 'Leegte' Shrubland in places.
Psilocaulon junceum – Lycium spp. Shrubland	*Psilocaulon junceum* – *Lycium* spp. Shrubland is characterized by *Psilocaulon junceum* which is a succulent shrub most often found in disturbed areas such as heuweltjies[23] and around stock watering points together with taller *Lycium* spp. This vegetation community is therefore considered to be characteristic of disturbed places and is not botanically or ecologically sensitive.
Endorheic pans	A few endorheic pans[24] are found at Hoekplaas (McDonald, 2012a). These are shallow basins that fill with water during rainy periods but then later dry out. At Hoekplaas the pans become vegetated with grasses, forbs and in some places clusters of shrubs (Figure **5-2**). They are an important landscape feature with assemblages of plant species peculiar to them. The pan vegetation communities are recognized as specific and important and therefore sensitive habitats that should be avoided and not disturbed.

Figure 5-1 Asteraceous Shrubland on red sandy clay loam with pebbles scattered on the surface (McDonald, 2012)

The plant communities on Hoekplaas do not form discreet units in the landscape, often being interlaced with each other in a mosaic depending on local micro-topography and variation in soil conditions and drainage. It is therefore equally not possible to assign discreet vegetation units to a PV layout area. McDonald (2013) has however summarized the sensitivity for the PV area and was individually identified as having low sensitivity, except for the 'Leegte' Shrubland which is considered to be sensitive (**Table 5-1**).

A well-defined and extensive seasonal drainage area / watercourse are located adjacent to PV10 in the area identified for Layout Alternative 2. The drainage system arises on Farms

[22] Ecotone: Transitional zone been two biomes / communities containing species characteristic to each of the biomes / communities (The Free Dictionary, 2013).
[23] Heuweltjies: Fossil termite mounds above or near the surface of the landscape (Heuweltjies, 2013).
[24] Endorheic pans: Permanent or seasonal closed drainage basin / pan that retains water and does not allow outflow to other external waterbodies such as rivers, streams, etc. (Endorheic basin, 2013).

Hoekplaas and Struisbult and runs westwards to the neighbouring farm, Klipgats Pan. The drainage system is vegetated principally with *Rhigozum trichotomum* Shrubland and is considered to be botanically sensitive, not specifically due to its species composition but rather due to the habitat created. Furthermore, a pan was identified in the footprint area of PV4A (i.e. Layout Alternative 2) and is considered to be very sensitive to disturbance. The preferred layout takes coginsance and avoids this pan.

Figure 5-2 An endorheic pan at Hoekplaas with the central part demarcated by a red boundary

5.2.2 Impact assessment

The assessments for Layout Alternative 1 and Layout Alternative 2 below include the impact of associated infrastructures including the transmission corridor, access roads and the water pipeline. The technology alternatives did not influence the assessment rating for the Layout Alternatives as indicated below.

The following impacts are deemed relevant to this project and were therefore assessed:

- Loss or fragmentation of indigenous natural vegetation (terrestrial);
- Loss of ecological processes; and
- Establishment and spread of declared weeds and alien invader plants.

a) Construction and operational phases

The potential impacts of the proposed project on the vegetation on Hoekplaas would include the loss of vegetation types (plant species) and habitats as well as the loss of ecological processes. If the proposed energy facility is constructed a large percentage of the vegetation cover (preferred alternative or alternative, respectively) would be lost. It is also likely that vegetation in the surrounding area may be impacted on due to trampling and movement of vehicles. Ecological processes are closely linked to vegetation and habitat and impacts could include a loss of small mammal activity due to the loss of heuweltjies, the promotion of a particular species that could benefit from the solar panels, as well as trampling and concentration of animals around the solar panels.

A *Boscia albitrunca* tree has been identified at waypoint HPL39 (**Figure 5-3**). This is a protected tree species and must be avoided. The tree is located at the north end of the farm, where PV10's and PV4A's site demarcation has taken cognisance of the tree and avoids it altogether.

It should be noted that individual *Boscia albitrunca* tree was encountered in the survey on Hoekplaas. However, a more intensive search could reveal more of these trees. Should more *Boscia albitrunca* trees be found, and if they are likely to be impacted by the proposed project, then these trees should be avoided where possible. If this is not possible, a permit would be required to remove and/or relocate them.

Furthermore, there is a possibility for *Aloe claviflora*, a protected species in the Northern Cape Province, to occur on Hoekplaas. However, no specimens were found during the site survey. If it is encountered during the construction phase the plants could be removed and relocated elsewhere in a similar habitat which would not be affected by construction. This would require a permit from provincial authorities.

Other impacts to flora could occur as a result of alien plant seeds that are introduced with construction material such as sand or other materials, with any disturbed areas being particularly vulnerable. The LEMP sets out suitable mitigation measures considered as best practice for managing alien plants during construction.

Loss of vegetation type and habitat

For Layout Alternative 1 (PV10) and Layout Alternative 2 (PV4A), the potential impact is considered to be of low magnitude, local extent (within the bioregional context) and long term and therefore of **low (-)** significance, without and with mitigation.

Loss of ecological processes

For Layout Alternative 1 (PV10) and 2 (PV4A), the potential impact is considered to be of low magnitude, local extent (within the bioregional context) and long term and therefore of **low (-)** significance, without and with mitigation.

b) Decommissioning

The decommissioning of the facility could potentially provide ideal habitat for alien vegetation to establish on site. For both alternatives the impact is deemed to be local in extent, medium magnitude, long term with a **medium (-)** significance without mitigation. The significance could be reduced to **very low (-)** through implementing mitigation measures.

c) No-go alternative

Assessment of the 'no-go' option is where the status quo (current activities) continues onsite. This includes mostly animal husbandry and the authorised PV1 and PV4 facility.

d) Cumulative impacts

It is noted that when applying the EIA methodology, scale is an important factor to consider. The local effect, should PV10, together with proposed PV2, PV3, PV5, PV8, and PV9, and authorized PV1 and PV4 projects on Hoekplaas receive environmental authorisation and preferred bidder status, would be identified as a **high (-)** impact as a considerable amount, but not all of the vegetation would be disturbed on Hoekplaas itself. However, taking into account the vegetation type as a whole, which covers a wide area in the Bushmanland Bioregion, the local impact becomes **low (-)** in the context of overall loss of the vegetation type. Scale is therefore an important factor when making the assessment and 'bioregional scale' is applied as opposed to the 'local scale'.

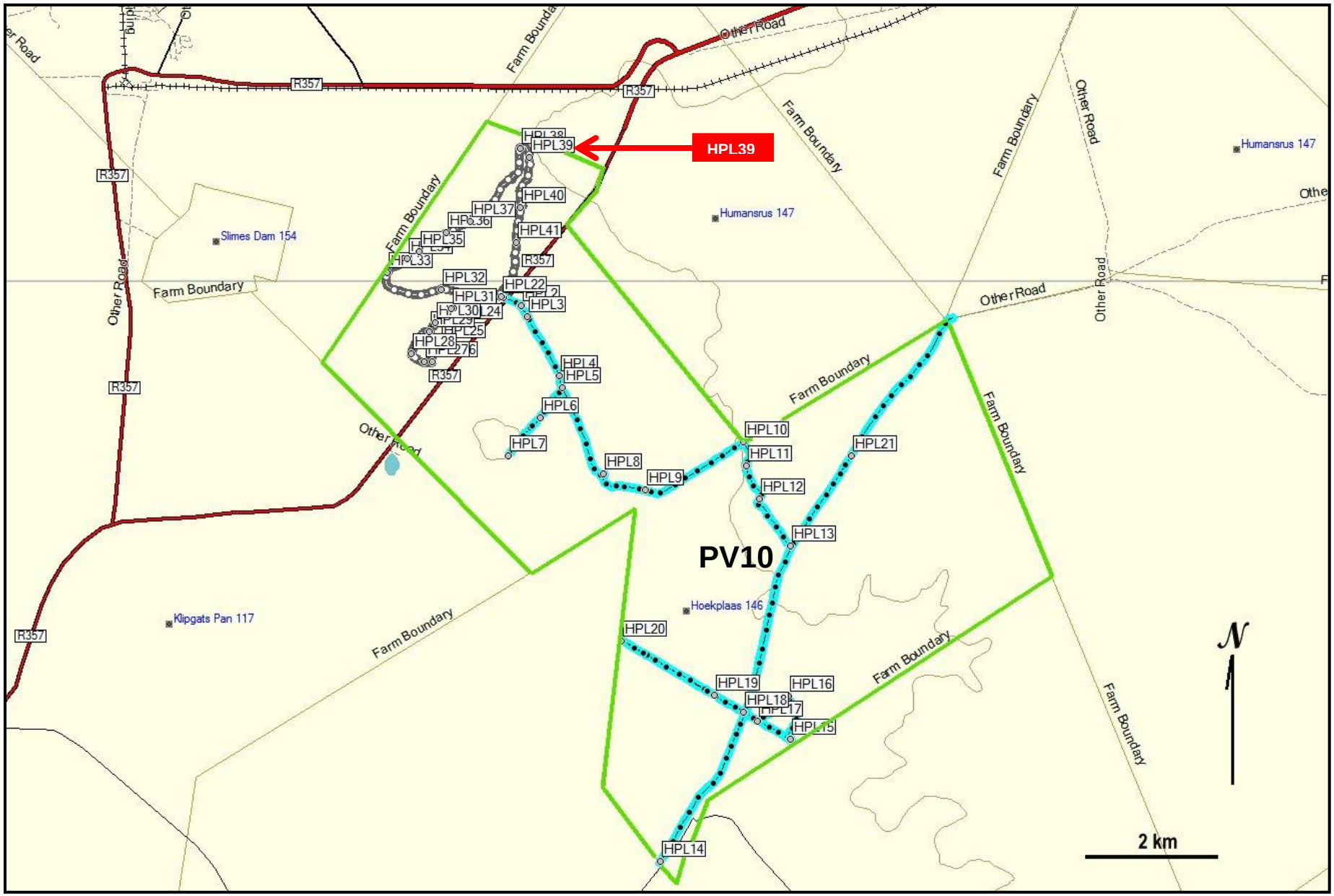

Figure 5-3 The Hoekplaas (RE/146) farm (green boundary) showing location of protected *Boscia albitrunca* tree at waypoint HPL39 (McDonald, 2012)

5.2.3 Mitigation measures

The following mitigation measures are recommended for the **construction phase of all project alternatives**:

1. All construction activities shall be contained within the PV facility footprints to minimize disturbance outside these areas.
2. Protected trees must be avoided or if that is not possible, permits must be obtained for removal and transportation. Any Aloe species, particularly *Aloe claviflora* shall be relocated if affected by the PV10 facility.

The following mitigation measures are recommended for the **operational phase of all project alternatives**:

3. A rehabilitation plan for the site shall be compiled and implemented with the aid of a rehabilitation specialist.
4. Shallow depressions, well defined pans and seasonal watercourses shall be avoided, with buffer zones of at least 30m around pans and from 'Leegte Shrubland'. Roads and transmission lines traversing such areas shall be avoided where possible and if not, physical impacts shall be limited as far as possible.

The following mitigation measures are recommended for the **decommissioning phase of all project alternatives**:

5. All construction activities shall be contained within the PV facility footprints to minimize disturbance outside these areas.
6. A rehabilitation plan for the site shall be compiled and implemented with the aid of a rehabilitation specialist.

5.2.4 Botanical impact table

Table 5-2 indicates the significance of the various ecological impacts and how these were derived.

5.2.5 Botanical conclusion

The construction of both Layout Alternatives for the proposed PV10 facility (including associated infrastructures) is botanically acceptable provided that the areas identified as sensitive are avoided.

In terms of impacts on vegetation and flora, the technology alternatives are not of great importance and are not emphasized in this report. It is accepted that CPV and conventional PV panels could be installed on a single-axis tracking system. Of more importance to the vegetation is the overall footprint of the PV10 facility, i.e. the location and layout alternatives.

Table 5-2 Summary of potential impacts on flora

Key impacts	Project (preferred / alternative)	Extent	Magnitude	Duration	SIGNIFICANCE (Without Mitigation)	SIGNIFICANCE (With Mitigation)	Probability	Confidence	Reversibility
Construction and Operational Phases									
Loss of natural vegetation	PV10 PV4A	Local	Low	Long term	Low (-)	Low (-)	Probable	High	Low
Loss of ecological processes	PV10 PV4A	Local	Low	Long term	Low (-)	Low (-)	Probable	High	Low
Decommissioning Phase									
Establishment of alien vegetation	PV10 PV4A	Local	Medium	Long term	Medium (-)	Very Low (-)	Probable	High	High
Cumulative Impacts									
Loss of natural vegetation and loss of ecological processes	PV10 PV4A	Regional	Low	Long term	Low (-)	Low (-)	Probable	High	High
No-Go									
Loss or fragmentation of indigenous natural vegetation	PV10 / PV4A	Local	Low	Long term	Low (-)	Low (-)	Probable	High	Low
Establishment and spread of declared weeds and alien invader plants	PV10 / PV4A	Local	Low	Long term	Low (-)	Very Low (-)	Probable	High	Low

5.3 Impact on avifauna

At least 215 bird species are likely to occur in the area, of which 68 are endemic or near endemic species, 18 red listed species and five species are red listed endemics. The expected impacts of solar energy facility on avifauna are related to footprint impacts associated with:

- Habitat destruction;
- Disturbance by construction and maintenance activities and possibly by the operation of the facility;
- Displacement or disturbance of sensitive species; and
- Mortality caused by collision with the associated power line network and electrocution of avifauna.

In addition, some birds may interfere with the efficient running of the proposed PV installation. As such an avifaunal study was undertaken by Dr Andrew Jenkins and Johan du Plessis of Avisense Consulting. A desktop review of relevant literature and a site visit on 7 January 2012 and again on 9 and 10 May 2013 informed the avifaunal study. The avifaunal study is included in **Annexure C**. The findings and recommendations of the avifauna study are summarised below.

5.3.1 Description of the environment

The broader impact zone of the proposed PV facility is contained within an extensive tract of undulating, remote, arid Bushmanland Karoo, while the immediate vicinity includes degraded natural veld with some anthropogenic influences. The broader area could support over 200 bird species, including up to 18 red-listed species, 68 endemics, and five red-listed endemics. The birds of greatest potential relevance and importance to the proposed PV facility are likely to be local populations of endemic, and possibly red-listed passerines (Sclater's Lark and possibly Red Lark), seasonal influxes of Ludwig's Bustard and Kori Bustard (*Ardeotis kori)*, and locally resident or passing raptors, especially red-listed species - Martial Eagle (*Polemaetus bellicosus)*, Tawny Eagle (*Aquila rapax)* and Lanner Falcon (*Falco biarmicus).* These species breed on the nearby Eskom transmission lines, as well as regional endemics such as the Jackal Buzzard (*Buteo rufofuscus)* and Pale Chanting Goshawk (*Melierax canorus)* (**Table 5-3***)*. Pigeons, crows, weavers, sparrows and some raptor species may perch, roost, forage or even nest on or around the facility and cause fouling problems. It should be noted that Hoekplaas is on the southern edge of a recent range expansion by Sociable Weaver (*Philetarius socius).* The huge communal grass nests built by this species may require active management if any are attached to critical infrastructure of the development.

The development area encroaches directly into a Martial Eagle breeding territory, which was occupied and possibly active during the site visit made to inform this report. Greater Kestrels have been found breeding in Pied Crow (*Corvus alba)* nests on 132kV power poles, and Southern Pale Chanting Goshawk (*Melierax canorus)* nests have been found in trees along drainage lines within / close to the proposed development area. Densities of regional endemics such as Northern Black Korhaan (*Afrotis afraoides)*, Karoo Korhaan (*Eupodotis vigorsii)*, Sabota Lark (*Calendulauda sabota)*, Eastern Clapper Lark (*Mirafra fasciolata)*, Spike-heeled Lark (*Chersomanes albofasciata)* and Rufous-eared Warbler (*Malcorus pectoralis)* may be particularly high in the area. Small numbers of Sclater's Lark (as well as Pink-billed Lark *Spizocorys conirostris*, Stark's Lark *Spizocorys starki*) were recorded in the north-western sector, as well as quite high densities of other regionally endemic passerines (e.g. Sabota Lark, Eastern Clapper Lark, Spike-heeled Lark and the Rufous-eared Warbler*)* across much of the development area. In addition one Kori Bustard was recorded in the south-eastern sector of the

development area and one Ludwig's Bustard (*Neotis ludwigii)* collision victim was found under a 132kV power line in the vicinity.

Table 5-3 List of priority bird species that could potentially occur on site (Avisense Consulting, 2012)

Common name	Scientific name	SA conservation status & Global conservation status	Regional endemism	Estimated importance of local population
Ludwig's Bustard	*Neotis ludwigii*	SA: Vulnerable Global: Endangered	Near-endemic	Moderate-High
Kori Bustard	*Ardeotis kori*	SA: Vulnerable	-	Moderate
Tawny Eagle	*Aquila rapax*	SA: Vulnerable	-	Low
Martial Eagle	*Polemaetus bellicosus*	SA: Vulnerable Global: Near-threatened	-	Moderate-High
Secretarybird	*Sagittarius serpentarius*	SA: Near-threatened Global: Vulnerable	-	Moderate
Lanner Falcon	*Falco biarmicus*	SA: Near-threatened	-	Moderate
Greater Flamingo	*Phoenicopterus ruber*	SA: Near-threatened	-	Low
Lesser Flamingo	*Phoenicopterus minor*	SA: Near-threatened	-	Low
Red Lark	*Calendulauda burra*	SA: Vulnerable Global: Vulnerable	Endemic	Low
Sclater's Lark	*Spizocorys sclateri*	SA: Near-threatened	Endemic	Moderate

With the notable exception of the Martial Eagle site on the Hydra-Kronos transmission line, and the possibility that significant numbers of Red and Sclater's Larks may occur in some areas at certain times (to be clarified by the monitoring project) the avifauna of the development site itself is largely replaceable, at best replicating that which occurs across huge areas of the Bushmanland.

5.3.2 Impact assessment

Specific impacts of the proposed site are most likely to be manifested in the following ways:

- Disturbance and displacement of resident/breeding raptors (especially Martial Eagle and possibly Lanner Falcon) from nesting and / or foraging areas and / or mortality of these species in collisions with new power lines or by electrocution when perched on power infrastructure.
- Disturbance and displacement of resident / breeding Karoo endemics (including Sclater's Lark and possibly even Red Lark).
- Disturbance and displacement of seasonal influxes of large terrestrial birds (especially Ludwig's Bustard and Kori Bustard) from nesting and / or foraging areas and / or mortality of these species in collisions with new power lines while commuting between resource areas.

The assessment of operational impacts indicates that Layout Alternative 1 and 2 would have a similar footprint and impacts of the same significance. Mitigation measures that can address the impacts are set out below. The assessments for Layout Alternative 1 and 2 below include the impact of associated infrastructures including transmission corridor, access roads and the water pipeline. The technology alternatives did not influence the assessment rating for the Layout Alternatives as indicated below.

a) Construction phase

Impacts to avifauna include disturbance / displacement associated with noise and movement of construction equipment and personnel. This would have a direct impact on Karoo endemics, raptors and large terrestrial species, especially shy and / or ground-nesting species resident in the area.

Habitat loss

All construction activities would result in a negative direct impact on the avifauna of the Hoekplaas site: loss of vegetation and habitat affecting Karoo endemics, raptors and large terrestrial species, through site clearance, road upgrade and establishment of the camp and assembly areas.

For Layout Alternative 1 (PV10) and associated infrastructures, the potential impact on birds, as a result of habitat loss, was considered to be low to medium magnitude, local extent and short term and therefore of **low-medium (-)** significance without mitigation. The significance of this impact could be reduced to **low (-)** with mitigation.

For Layout Alternative 2 (PV4A), the potential impact on birds as a result of habitat loss is considered to be of medium-high magnitude, local extent and short term and therefore of **medium (-)** significance without mitigation. The significance of this impact could be reduced to **low-medium (-)** with mitigation.

Disturbance

All construction activities would result in a negative direct impact on the avifauna of the Hoekplaas farm. Disturbance associated with noise and movement of construction equipment and personnel would affect Karoo endemics, raptors and large terrestrial species.

For Layout Alternative 1 (PV10) and associated infrastructures, the potential impact on birds, as a result of disturbance, was considered to be low to medium magnitude, local extent and short term and therefore of **medium-high (-)** significance without mitigation. The significance of this impact could be reduced to **low-medium (-)** with mitigation.

For Layout Alternative 2 (PV4A) and associated infrastructure, the potential impact on birds as a result of disturbance is considered to be of medium-high magnitude, local extent and short term and therefore of **medium-high (-)** significance with or without mitigation.

b) Operational phase

The potential impacts of the proposed project on birds include habitat loss, disturbance and displacement of sensitive species by maintenance activities and possible operation of the facility, collision with power lines and electrocution on the required power line and substation infrastructure.

Habitat loss and disturbance

The most significant potential impact on birds of any solar energy generation facility is the displacement or exclusion of threatened, rare, endemic or range-restricted species from critical areas of habitat. The effect could be significant in some instances, particularly given the possibility that the initial footprint of a successful facility may be expanded over time, and allowing for the possible cumulative effects of multiple facilities in one area.

Routine maintenance activities are likely to cause some disturbance of birds in the general surrounds of a solar facility, and especially of shy and / or ground-nesting species resident in the area. Furthermore, solar facilities generally feature large areas of reflective paneling. It is possible that nearby or overflying birds may be disorientated by the reflected light, and consequently be displaced from an area more extensive than just the developed footprint of the facility.

For Layout 1 (PV10) (including associated infrastructure) the potential impact on birds as a result of habitat loss and disturbance is considered to be of medium magnitude, local extent and long term and therefore of **medium (-)** significance with and without mitigation.

For Layout 2, (PV4A) (including associated infrastructure) the potential impact on birds as a result of habitat loss and disturbance is considered to be of medium-high magnitude, local extent and long term and therefore of **medium-high (-)** significance with and without mitigation.

Mortality

The solar panels and associated infrastructure could result in mortality of raptors, through collisions with solar panels and / or power lines, or by electrocution on new power infrastructure.

Avian electrocutions occur when a bird perches or attempts to perch on an electrical structure and causes an electrical short circuit by physically bridging the air gap between live components and / or live and earthed components. Electrocution risk is strongly influenced by the voltage and design of the power lines erected (generally occurring on lower voltage infrastructure where air gaps are relatively small), and mainly affects larger, perching species, such as vultures, eagles and storks, easily capable of spanning the spaces between energised components.

Vertical, reflective surfaces may confuse approaching birds with the result that birds are killed in collisions with such surfaces. Solar installations generally feature large areas of reflective paneling. It is possible that nearby or overflying birds may be disorientated by the reflected light, and consequently be displaced from an area more extensive than just the developed footprint of the facility.

Other species may seek to benefit from the installations, using the erected structures as prominent perches, sheltered roost sites or even nesting sites, and possibly foraging around the infrastructure in response to changes in the distribution of preferred foods (plants growing under the paneling, other animals attracted to the facility). Such scenarios might be associated with fouling of critical components in the solar array, bringing local bird populations into conflict with the facility operators. Under these circumstances, specialist advice should be sought in devising effective avian deterrents to minimize associated damage.

For Layout 1 (PV10) (including associated infrastructure) the potential impact on birds as a result of mortality is considered to be of medium-high magnitude, regional extent and long term and therefore of **medium-high (-)** significance which can be reduced to **low-medium (-)** with mitigation.

For Layout 2 (including associated infrastructure) the potential impact on birds as a result of mortality is considered to be of medium-high magnitude, regional extent and long term and therefore of **medium-high (-)** significance which can be reduced to **low-medium (-)** with mitigation.

In terms of avifauna impacts, technology alternatives and transmission line alternatives do not differ significantly and have not been assessed separately.

c) Decommissioning

Impacts to avifauna during decommissioning could arise from disturbance / displacement associated with noise and movement of decommissioning equipment and personnel. This could affect all birds on site, including key species such as the Martial Eagle, Tawny Eagle, Lanner Falcon, Ludwig's Bustard, Kori Bustard and Karoo endemics (especially Sclater's Lark).

For Layout 1 (PV10) (including associated infrastructure) the potential impact for this alternative is considered to be of medium magnitude, local extent and limited to the decommissioning phase and therefore of **medium (-)** significance, which can be reduced to **low-medium (-)** with mitigation.

For Layout 2 (including associated infrastructure) the potential impact for this alternative is considered to be of medium-high magnitude, regional extent and limited to the decommissioning phase and therefore of **medium-high (-)** significance, which can be reduced to **medium (-)** with mitigation.

d) No-go alternative

The no-go Alternative will have a neutral impact as the status quo will remain.

e) Cumulative impacts

On a local scale the significance ratings of potential impacts (as described in this section, i.e. Section 5.3) on avifauna remains the same for the individual proposed and authorised Hoekplaas PV facilities, as well as the combined Hoekplaas Pan PV facilities. However, it is highly likely that these impacts could be substantially amplified by multiple renewable energy projects in the area (i.e. within a 20km radius of the site) and could potentially result in the long-term evacuation of the more sensitive species in the local Copperton area and/or region, and is therefore of **high(-) significance**. However, with careful and responsible implementation of the mitigation measures identified by the avifauna specialist, the assessed construction and operational impacts should be reduced to tolerable and sustainable levels. It is also advised that an integrated mitigation approach be considered for all the proposed and authorised renewable energy projects in the Copperton area.

5.3.3 Mitigation measures

Over and above the application of generic best-practice principles, the following mitigation measures are recommended for the **construction phase of all project alternatives**:

1. Pre-construction monitoring shall be undertaken as part of the long term avifauna monitoring programme detailed in **Annexure C**.
2. The construction footprint shall be kept to the minimum size required for development.
3. Construction timeframes shall be reduced as much as possible.
4. The entire length of all new lines shall be marked with bird flight diverters to avoid additional cost should this be retro-fitted post-construction based on the findings of the monitoring programme.

The following mitigation measures are recommended for the **operational phase of all project alternatives**:

5. To protect the Martial Eagle nest site located on the western edge of Hoekpaas, it shall be necessary to relocate the nest site to a more distant, less disturbed area (e.g. Jenkins

et al. 2007, 2013). The extent and distribution of other renewable energy developments planned for the immediate vicinity probably precludes a short-range relocation, and a dedicated structure, strategically situated off the power line network aggregated around the Kronos substation, may be the best option. The requirements of such an undertaking shall be further investigated during future visits to the site as part of the pre-construction monitoring programme.

6. Development shall be excluded from areas / microhabitats identified during the bird monitoring programme as being of particular value to threatened / priority species (e.g. Red Lark, Sclater's Lark).
7. Noise and disturbances associated with maintenance activities at the plant shall be kept to the minimum once it becomes operational.
8. The length of all new power lines installed shall be kept to the minimum. Where possible transmission lines shall be buried. If lines cannot be buried, all new lines shall be marked with bird flight diverters (Jenkins et al. 2010) along their entire length.
9. All new transmission line infrastructure shall be adequately insulated and bird friendly in configuration (Lehman et al. 2007)[25].
10. The minimum area shall be used for fencing, given that these may present a collision risk for collision-prone birds.
11. A comprehensive impact monitoring programme shall be implemented of which the results shall be used to inform and refine a dynamic approach to mitigation. Details of this are set out in **Annexure D.**
12. Should the results from the monitoring programme show that the cumulative impacts from the multiple renewable energy projects in the Copperton area are causing high negative impacts on bird species on a local and regional scale (i.e. beyond a radius of 10km from Hoekplaas), DEA shall be contacted to discuss the implementation of an integrated mitigation approach by all renewable energy facilities contributing to the cumulative negative impact on avifauna.
13. Specialist advice shall be sought in devising effective avian deterrents to minimize associated damage should conflict arise with local bird populations due to fouling of critical components, etc.

The following mitigation measures are recommended for the **decommissioning phase of all project alternatives**:

14. Decommissioning timeframes shall be reduced as much as possible.
15. Noise and disturbances associated with decommissioning activities shall be kept to the minimum.

5.3.4 Avifauna impact table

Table 5-4 indicates how the significance ratings of the various impacts were derived.

5.3.5 Avifauna conclusion

Layout alternative 1 (PV10) is preferred as the alternative layout 2 is likely to have a greater impact on the local avifauna in all aspects of construction, operation and decommissioning due to its larger scale.

[25] Note that current understanding of power line collision risk in birds precludes any guarantee of successfully distinguishing high risk from medium or low risk sections of a new line (Jenkins et al. 2010). The relatively low cost of marking the entire length of a new line during construction, especially quite a short length of line in an area frequented by collision prone birds, more than offsets the risk of not marking the correct sections, causing unnecessary mortality of birds, and then incurring the much greater cost of retro-fitting the line post-construction. In situations where new lines run in parallel with existing, unmarked power lines, this approach has the added benefit of reducing the collision risk posed by the older line.

Table 5-4 Summary of potential impacts on avifauna

Key impacts	Project	Extent	Magnitude	Duration	SIGNIFICANCE (Without Mitigation)	SIGNIFICANCE (With Mitigation)	Probability	Confidence	Reversibility
Construction Phase									
Habitat Loss	**PV10**	Local	Medium	Short term	Low-Medium (-)	Low (-)	Definite	Certain	Reversible
	PV4A	Local	Medium-High	Short term	Medium (-)	Low-Medium (-)	Definite	Certain	Reversible
Disturbance	**PV10**	Local	Medium-High	Short term	Medium-High (-)	Low-Medium (-)	Definite	Certain	Reversible
	PV4A	Regional	Medium-High	Short term	Medium-High (-)	Medium (-)	Definite	Certain	Reversible
Operational Phase									
Habitat loss and disturbance	**PV10**	Local	Medium	Long term	Medium (-)	Medium (-)	Definite	Certain	Reversible
	PV4A	Local	Medium- High	Long term	Medium- High (-)	Medium- High (-)	Definite	Certain	Reversible
Mortality	**PV10**	Regional	Medium-High	Long term	Medium-High (-)	Low-Medium (-)	Probable	Unsure	Irreversible
	PV4A	Regional	Medium-High	Long term	Medium-High (-)	Low-Medium (-)	Probable	Unsure	Irreversible
Decommissioning Phase									
Disturbance	**PV10**	Local	Medium	Short term	Medium (-)	Low-Medium (-)	Definite	Certain	Reversible
	PV4A	Regional	Medium- High	Short term	Medium- High (-)	Medium (-)	Definite	Certain	Reversible
Cumulative impacts									
Habitat loss, disturbance and mortality	**PV10 PV4A**	Regional Extent	High	Long term	High (-)	Low-Medium (-)	Definite	Sure	Reversible
No-GO									
Habitat loss, disturbance and mortality	**PV10 / PV4A**	Neutral							

5.4 Impact on fauna

Animals likely to be found on site and the surrounding environment include small antelope, mongoose, Black-backed Jackals, Caracal, snakes, etc. Various faunal species, or evidence of these animals, were observed during a site visit by the EAP on 28 September 2011, namely Black Korhaan, Meerkat, Pied Crow, Steenbok and various pipits and larks. The farmer also indicated that Black-backed Jackal, Aardvark, Aardwolf, Brown Hyaena (*Parahyaena brunnea*) and Small Spotted Cat (*Felis nigripes*) (also called the Black-Footed Cat) occur in the area. The Small Spotted Cat is listed as Vulnerable on the IUCN Red List[26], whilst the Brown Hyaena is listed as Near Threatened[27].

The Small Spotted Cat is a specialist of open, short grass areas with an abundance of small rodents and ground-roosting birds, and hence is likely to breed and feed in the area. The Brown Hyena is more likely to be an occasional visitor to the area as its presence would have been noticed by local farmers due to its relatively large size and it is likely the local farmers would have tried to kill any hyena based on common negative perceptions of this animal.

Small Spotted cats are threatened primarily by habitat degradation by grazing and agriculture, as well as by poison and other indiscriminate methods of pest control (IUCN, 2011). Brown Hyena are often shot, poisoned, trapped and hunted with dogs in predator eradication or control programmes, or inadvertently killed in non-selective control programmes (IUCN, 2011). Agricultural developments (habitat degradation) and predator eradication or control programmes are considered to be the main threats to these species.

As the vegetation type is considered to be Least Threatened it is unlikely that the animals occurring within this vegetation type would be rare or endangered, as large areas of habitat remain.

5.4.1 Impact assessment

a) Construction phase

Any affected fauna would generally be largely mobile and would relocate during the construction phase and are likely to recolonise the area, once the construction phase has been completed and the disturbed areas rehabilitated.

Based on the above, the potential impact on flora, avifauna and fauna during construction as a result of disturbance, habit loss and displacement for both alternatives is considered to be of low to medium magnitude, local extent and short term and therefore **low- medium (-)** significance without mitigation. With the implementation of mitigation measures this is anticipated to reduce to **low (-)** significance. There would be no difference in significance as a result of the proposed alternatives.

b) Operational phase

The density of the proposed project would be high, with project components located close together. The entire footprint would potentially be cleared which would result in disturbance of animals or habitat. However due to the mobility of fauna the impact is likely to be limited. Operation and maintenance of the proposed project would entail very few or rare on site activities and as such disturbance of animals or habitat are likely to be very limited. Existing human activities in the area are likely to have habituated most animals to the presence of

[26] *Felis nigripes*, 2013.
[27] *Hyaena brunnea*, 2013.

humans and as such it is anticipated that any disturbance would result in animals leaving an area for a short period, if at all, and returning once the disturbance has passed. As such the potential impact of the proposed project on fauna is considered to be of low magnitude, local extent and long term (and therefore of **low (-)** significance), with or without mitigation. No difference in significance would result from the proposed alternative location, technology or transmission line routing.

c) Decommissioning

Any affected fauna would generally be largely mobile and would relocate during the decommissioning phase and are likely to recolonise the area, once the decommissioning phase has been completed and the disturbed areas rehabilitated.

Based on the above the potential impact on fauna during decommissioning due to disturbance, habit loss and displacement is considered to be of low to medium magnitude, local extent and short term and therefore **low (-)** significance without mitigation. With the implementation of mitigation measures this is anticipated to reduce to **very low (-)** significance. There would be no difference in significance as a result of the proposed alternatives.

d) No-go alternative

The No-Go Alternative will have a neutral impact as the status quo will remain.

e) Cumulative impacts

Although a number of renewable energy projects are proposed for the area, these are mostly spaced apart and are unlikely to result in cumulative impacts on animals. The remaining PV facilities proposed for Hoekplaas (PV2, PV3, PV5, PV8, PV9) and already authorised (PV1 and PV4) are not expected to result in significant cumulative impacts as the majority of the impacts would result during the construction phase, after which animals are expected to return to the area. Some localised habitat loss is expected but in the context of the wider area it is anticipated to be of a low significance.

5.4.2 Mitigation measures

The following mitigation measures are recommended for the **construction phase for all project alternatives**:

1. Compile and implement a vegetation rehabilitation plan with the aid of a rehabilitation specialist, for inclusion in the Construction EMP. The specialist is to recommend species to be used in rehabilitation as well as any special measures for rehabilitation such as shade-netting and alien vegetation removal.
2. Once construction is complete, disturbed areas shall be rehabilitated and maintained with appropriate local indigenous vegetation.
3. The construction phase shall be closely monitored by an Environmental Control Officer who shall identify any areas requiring rehabilitation in the post-construction phase. The restoration of those areas must follow the construction phase.
4. Demarcate no-go areas identified during pre-construction monitoring.
5. Low-lying depressions and watercourses shall be avoided wherever possible.
6. Shallow depressions and well defined pans shall be avoided and buffered by at least 30m.
7. All endorheic pans shall be avoided with no construction within 30m of the pan.
8. The site shall be cleared in sections as required for construction and not all at once.
9. The top 300mm of the soil layer shall be stockpiled for rehabilitation purposes.

10. Rehabilitation of completed sections with appropriate local indigenous vegetation shall start immediately and bare soil shall be covered by straw as protection against wind while vegetation re-establishes (or as required by the rehabilitation specialist).

The following mitigation measure is recommended for the **operational phase for all project alternatives**:

1. Small ground level openings, 20-30cm in height, shall be allowed for in the electrical or barbed wire fence to facilitate the movement of small mammals and reptiles through the site.

5.4.3 Fauna impact table

Table 5-5 indicates how the significance ratings of the various impacts were derived.

5.4.4 Fauna conclusion

The Layout Alternative 1 is preferred since a smaller area would be disturbed. In terms of transmission line routing, there is no significant variance in faunal characteristics within the corridors and as such, from a fauna perspective, both corridors are considered to be suitable to accommodate the proposed transmission line. There is no preference for the technology alternatives.

Table 5-5 Summary of potential impacts on fauna

Key impacts	Project (preferred / alternative)	Extent	Magnitude	Duration	SIGNIFICANCE (Without Mitigation)	SIGNIFICANCE (With Mitigation)	Probability	Confidence	Reversibility
Construction Phase									
Habitat disturbances	**PV10 PV4A**	Local	Low	Short term	Low-Medium (-)	Low (-)	Probable	Low	Reversible
Operational Phase									
Habitat disturbances	**PV10 PV4A**	Local	Low	Long term	Low (-)	Low (-)	Probable	Low	Reversible
Decommissioning Phase									
Habitat disturbances	**PV10 PV4A**	Local	Low	Short term	Low (-)	Very Low (-)	Probable	Low	Reversible
Cumulative impacts									
Habitat disturbances	**PV10 PV4A**	Regional Extent	Low	Long term	Low (-)	Low (-)	Probable	Low	Reversible
No-Go									
Habitat disturbances	**PV10 / PV4A**	Local	Low	Short term	Low-Medium (-)	Low (-)	Probable	Low	Reversible

5.5 Impact on surface water resources

The study area falls within the arid region of South Africa. Average annual rainfall is low (189mm) and as such it is expected that few rivers and low groundwater tables will be found in the area. The site is located within the D54D quaternary catchment of the Lower Orange River. With few rivers draining the area, apart from the Orange River 42km east of the site, endorheic (inward flowing) pans occur. Pans are an important wildlife habitat, particularly for birds (especially migratory birds), mammal species and invertebrates. A small number of pans are located on the site. Numerous small dry drainage lines cross the area.

The proposed project could disturb these pans and / or cause erosion to occur in sensitive areas such as these pans or drainage lines. This in turn could have an impact on the distribution of fauna and flora, as well as agricultural use. As such, MacKenzie Ecological and Development Services were appointed to undertake an Aquatic Ecology Impact Assessment. A site visit was conducted on 8 – 10 November 2011 and 22 – 24 April 2013. The study considered the aquatic ecology, delineation of riparian zones or wetlands, climate, geology and soils. The desktop Aquatic Ecology Impact Assessment for The Farm Hoekplaas is included in **Annexure C.** The summary below includes findings and recommendations of the specialist.

Nick Walker of Aurecon was also appointed to carry out a desktop study of the surface hydrology and provide a preliminary stormwater management plan (**Annexure C**).

5.5.1 Description of the environment

The local topography is generally flat to gently sloping, with drainage areas and pans being variously ephemeral. Some pans are not well defined although typically endorheic (inward flowing) (**Figure 5-4**).

Climate

Copperton area has an arid continental climate with a summer rainfall regime. Mean annual precipitation is approximately 176mm with peaks in late summer, usually March. The region typically experiences hot days and cold nights with an average summer temperature of approximately 33°C and winter night time temperatures of approximately 1°C. Most of the rainfall is confined to summer and early autumn.

Geology

Soils are generally base-rich, weakly structured and shallow. They drain freely, usually with less than 15% clay and have characteristic high levels of salt (Mucina and Rutherford, 2006).

Surface hydrology

The site falls within the 'Lower Vaal River' drainage catchment (Primary Catchment D) which covers a vast area extending between the Lesotho Highlands, Gauteng and the Karoo. The site is located in the north eastern quadrant of the D54D Quaternary Catchment which hosts one major river, the 'Carnarvonleegte River' situated in the south western quadrant of the catchment.

Figure 5-4 An endorheic pan, covered by inner small shrub layer (MEDS, 2011).

There are no prominent hills / high lying areas on the farm. Endorheic pans were identified at waypoints Hp 2, 3, 4 and 7. The farm is mainly located within one catchment referred to by the specialist as Catchment 1 (**Figure 5-5**), which is the catchment for the Hoekplaas Farm Dam. The dam wall is approximately 2.5m high and has been damaged by a previous flood event where the dam wall meets the spillway. Farm worker dwellings and the Hoekplaas farmhouse have been previously inundated with flood waters estimated at 0.5m deep. Catchment 1 has an area of 54.18km^2. Catchment 2 drains from the Hoekplaas Farm through the Klipgats Pan Farm and exits the farm boundary to supply several pans with water.

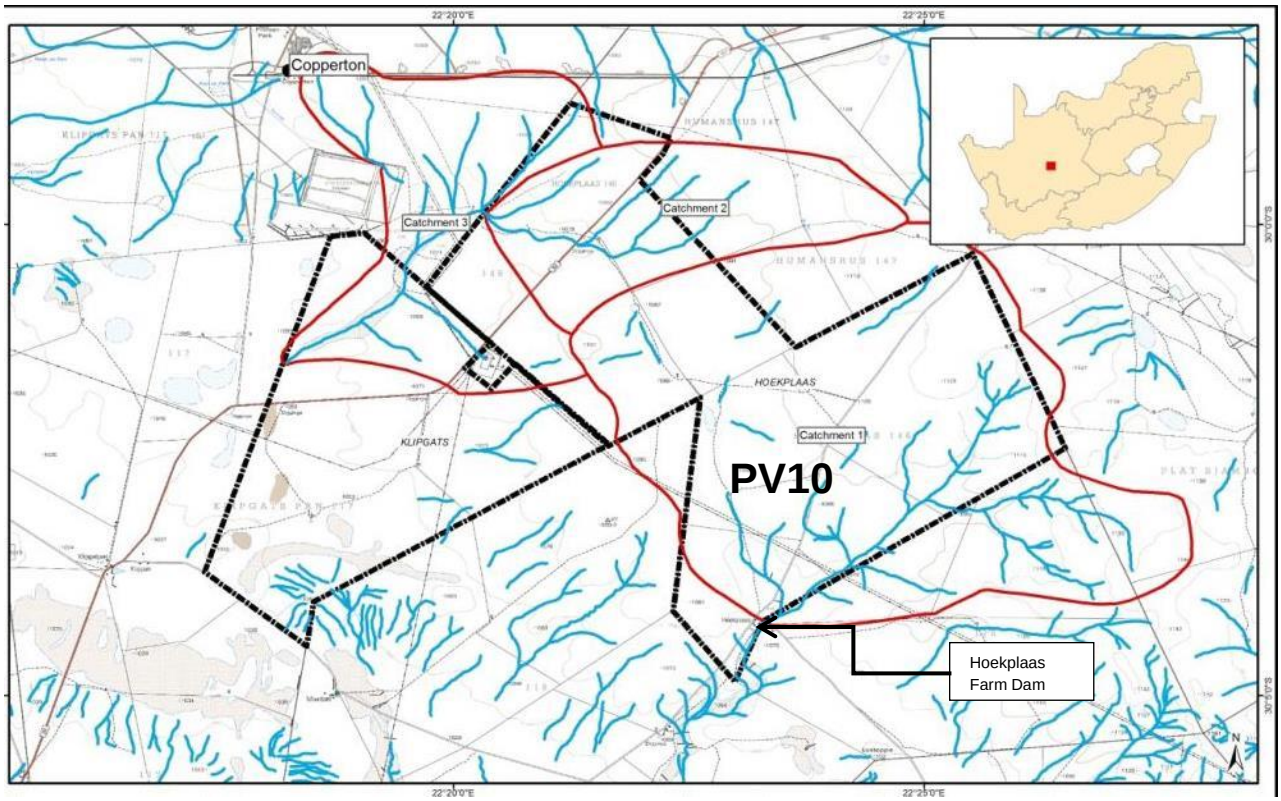

Figure 5-5 Three catchments that feature on Hoekplaas Dam Farm

5.5.2 Impact assessment

The following factors have been identified as having an impact on stormwater runoff:

- PV technology;
- Layout plan;
- Vegetation clearance; and
- Site topography.

a) Construction phase

Destruction (clearing and levelling) of no-go areas

Should the proposed PV facility be placed in such a way that it covers one or more (or section) of the drainage lines and pans (hereafter referred to as no-go areas) that have been delineated, wetland habitat (i.e. pans) would be lost as well as surface water drainage functionality (should drainage zones be cleared, levelled, traversed or disturbed). The same applies to the placement of offices or staff / construction worker accommodations, even if these are temporary, as well as access roads, power lines and pipelines. Layout Alternative 1 negates the possibility of this impact.

For Layout Alternative 2 (PV4A), the potential impact is considered to be of medium magnitude, site specific and permanent, and therefore of **high (-)** significance which can be reduced to **low (-)** with mitigation.

Formation of barriers to drainage areas

The diversion of water (intentional or unintentional) would result in the drainage of ecological sensitive pans and / or drainage lines, which in turn would result in the loss of biodiversity and functioning of these features.

For Layout Alternative 1 (PV10) (including associated infrastructure) and Layout Alternative 2 (PV4A) the potential impact is considered to be of medium magnitude, site specific and long term, and therefore of **medium (-)** significance which can be reduced to **low (-)** with mitigation.

Erosion and / or sediment inputs to no-go areas

The diversion of water and inappropriate management of surface water runoff would cause erosion problems onsite, resulting in the transportation of sediment to sensitive pans and / or drainage lines. This in turn would have an impact on these features ecological functioning and biodiversity.

For Layout Alternative 1 (PV10) (including associated infrastructure) and Layout Alternative 2 (PV4A) the potential impact is considered to be of medium magnitude, site specific and long term, and therefore of **medium (-)** significance which can be reduced to **low (-)** with mitigation.

Increased invasion by alien plant species, especially perennial aggressive species such as Prosopis glandulosa

P. glandulosa already exists on the farm and is associated with areas of elevated wetness and inundation, i.e. is preferentially associated with wetland (pans) and riparian areas. Disturbance of surface substrates such as construction activities would promote the colonisation of *P. glandulosa* since recruitment opportunities are created. However, the impacts for surface water are indirect in that *P. glandulosa* alters the species composition in its vicinity (by excluding

indigenous flora) and promotes open, more erodible, sub-canopy areas. Due to its provision of shade, these areas also tend to get highly trampled by sheep, which exacerbates potential erosion.

For Layout Alternative 1 (PV10) (including associated infrastructure) and Layout Alternative 2 (PV4A) the potential impact is considered to be of medium magnitude, site specific and long term, and therefore of **medium (-)** significance which can be reduced to **low (-)** with mitigation.

Waste reticulation and removal

This impact pertains to the production and handling of waste water which could pollute surface water features.

For Layout Alternative 1 (PV10) (including associated infrastructure) and Layout Alternative 2 (PV4A) the potential impact is considered to be of very low magnitude, site specific and short term, and therefore of **medium (-)** significance which can be reduced to **very low (-)** with mitigation.

b) Operational phase

The proposed facility has the potential to impact surface water quality and quantity and the various impacts are assessed separately below.

Stormwater run-off impacts

The type of solar technology and layout can impact stormwater run-off as a result of the clearance of vegetation to accommodate the trackers and the topography of the PV10 site. Design recommendations are set out to mitigate potential stormwater run-off impacts.

For Layout Alternative 1 (PV10) (including associated infrastructure) and Layout Alternative 2 (PV4A) the potential impact is considered to be of low magnitude, site specific and long term and therefore of **medium (-)** significance which can be reduced to **low (-)** with mitigation.

Increased surface water runoff from panel washing activities

This impact has the potential to change the water balance in the vicinity of its application since average annual rainfall is so low and panel washing activities would introduce additional water (which supersedes rainfall) to the runoff surface. Additional water to a cleared surface has to potential to erode surface substrates (presumably bare soil in this case), but would also illicit a vegetative response in that vegetation (including alien species) would readily colonise the area due to elevated and regular soil moisture availability.

For Layout Alternative 1 (PV10) (including associated infrastructure) and Layout Alternative 2 (PV4A) the potential impact is considered to be of low magnitude, site specific and long term and therefore of **medium (-)** significance which can be reduced to **very low (-)** with mitigation.

Increased flood peaks

It has been estimated that the 1:20 year flood peak for Alternative 1 would increase by 55% and for Alternative 2 with 51%. Both layouts are located in Catchments 1 that drains via a well-defined ephemeral watercourse through the southern section of the farm (**Figure 5-5**).

For Layout Alternative 1 (PV10) (including associated infrastructure) and Layout Alternative 2 the potential impact is considered to be of high magnitude, local impact and long term and therefore of **Medium-High (-)** significance which can be reduced to **Low (-)** with mitigation.

Increased invasion by alien plant species, especially perennial aggressive species such as Prosopis glandulosa

P. glandulosa already exists on the farm and is associated with areas of elevated wetness and inundation i.e. is preferentially associated with wetland and riparian areas. Operational activities (especially maintenance of cleared areas and elevated moisture availability from panel washing) would promote the colonisation of *P. glandulosa*, which is a deep-rooted tree that utilises groundwater. However, the impacts for surface water are indirect in that *P. glandulosa* alters the species composition in its vicinity (by excluding indigenous flora) and promotes open more erodible sub-canopy areas. Due to its provision of shade, these areas also tend to get highly trampled which exacerbates potential erosion.

For Layout Alternative 1 (PV10) (including associated infrastructure) and Layout Alternative 2 (PV4A) the potential impact is considered to be of medium magnitude, site specific and long term and therefore of **medium (-)** significance which can be reduced to **very low (-)** with mitigation.

Domestic waste reticulation and removal

This impact pertains to the production of and handling of domestic waste water i.e. ablution facilities at offices.

For Layout Alternative 1 (PV10) (including associated infrastructure) and Layout Alternative 2 (PV4A) the potential impact is considered to be of low magnitude, site specific and long term and therefore of **medium (-)** significance which can be reduced to **very low (-)** with mitigation. The No-Go Alternative will have a neutral impact as the status quo will remain.

c) Decommissioning

Increased surface erosion in denuded area

During decommissioning there are likely to be denuded areas with little or no vegetation cover. These areas would be vulnerable to soils erosion during rain events until such a time that vegetation is established.

For Layout Alternative 1 (PV10) (including associated infrastructure) and Layout Alternative 2 (PV4A) the potential impact is considered to be of medium magnitude, site specific extent and medium term and therefore of **medium (-)** significance, which can be reduced to **low (-)** with mitigation.

Remnants of vegetation with altered species composition

It is possible that at the time of decommissioning alien vegetation would be promoted to colonise open areas, especially species such as *P. glandulosa* due to soil disturbances.

For Layout Alternative 1 (PV10) (including associated infrastructure) and Layout Alternative 2 (PV4A) the potential impact is considered to be of medium magnitude, site specific extent and medium term and therefore of **medium (-)** significance, which can be reduced to **very low (-)** with mitigation.

d) No-go alternative

The current (status quo) landscape is used for livestock farming with little to no impacts on surface water or surface water features. As such this is the preferred alternative as far as impacts to surface water dynamics is concerned.

e) Cumulative impacts

A number of other renewable energy applications are proposed in the general area, including PV and wind energy projects. In addition, eight PV facilities are proposed on Hoekplaas of which two have received environmental authorisation. Catchment 1 on Hoekplaas farm watercourse feeds into a dam near the existing farmhouse that has been damaged by previous flooding. A large number of facilities would ultimately impact on this drainage system and potentially flood the farmhouse and other dwellings. The cumulative impact for each operational impact is assessed in **Table 5-6** below and range between **low (-)** and **very low (-)**.

Please note that the cumulative and individual impacts for the proposed and authorised PV facilities on Hoekplaas remain the same and is shown in **Table 5-6** below. The significance ratings of these impacts range between **low (-)** and **very low (-)**.

5.5.3 Mitigation measures

Potential stormwater mitigation measures in terms of the design of the system (as described in the preliminary Stormwater Management Plan included in **Annexure C**) must be considered and applied where applicable, including the following:

1. The increase in flood peak should be reduced to pre-development levels before the runoff leaves the PV10 facility which could be achieved by using attenuation ponds.
1. A detailed stormwater management plan to be developed to avoid flood risks on the farmsteads.
2. Stormwater management infrastructure should not concentrate flow from a large area (≥200ha) to one outlet as this would cause erosion and change the hydrology from overland flow to channelled flow.

The following mitigation measures are recommended for the **construction phase for all project alternatives**:

1. Should denudation be severe, rehabilitation of these areas shall be required and involve the establishment of vegetative cover comparable to surrounding indigenous vegetation. Planting grasses by means of seeds would likely be the easiest and quickest form of mitigation. It is critical that no alien species are used for re-vegetation.
2. The area shall be inspected at regular intervals (as determined by the rehabilitation specialist) for the presence of alien species and these removed.
3. Ephemeral drainage areas shall not be blocked such that the movement of water is impeded or diverted.
4. Denuded areas and stockpiles of aggregates or soil shall be protected in such a way that erosion or sediment inputs to no-go areas during rainfall events are prevented.
5. Straw barriers shall be installed in drainage paths to act as a check dam, i.e. to reduce velocity, and as a sediment trap during construction (**Figure 5-6**). These erosion barriers shall be placed at intervals of 25-50m apart in the drainage paths to intercept suspended solids from entering the natural drainage paths.
6. Packed stone (also known as rip-rap) shall be placed as liners for channel spines (in consultation with an appropriately qualified aquatic specialist). These comprise packed stones with an average diameter of 100mm, packed in the channels as lining material to control flow velocities and hence erosion.
7. Earth cut-off channels shall be provided at the boundaries of the facility to direct concentrated surface flow away from the site and reduce the possibility of flooding from runoff origination from outside the site (in consultation with an appropriately qualified aquatic specialist).

8. Erosion protection shall be provided at channel outfalls and positions of high flow concentration. These comprise packed stones with an average diameter of 200mm, packed in the drainage path to control flow velocities and hence erosion.
9. The sediment and erosion control measures shall remain in place until construction is complete and will require regular monitoring during construction and reinstatement as necessary.

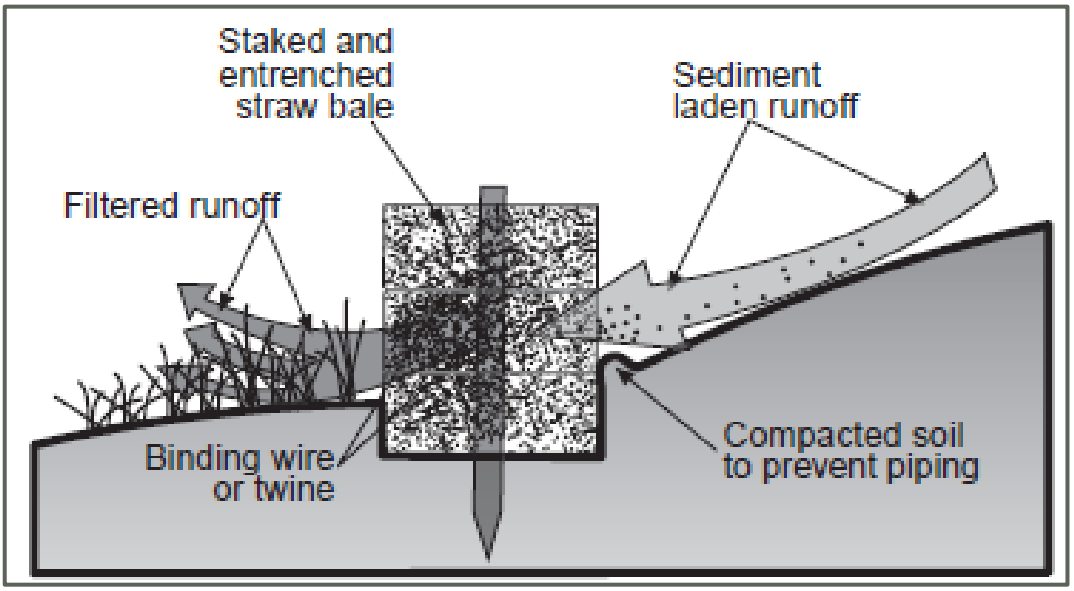

Figure 5-6 Cross-sectional view of an installed straw bale

The following mitigation measures are recommended for the **operational phase for all project alternatives:**

1. Design requirements as determined by the Stormwater Management Plan.

The following mitigation measures are recommended for the **decommissioning phase for all project alternatives:**

1. Vegetative cover comparable to surrounding indigenous vegetation shall be restored according to the rehabilitation plan developed by an appropriately qualified rehabilitation specialist. It is critical that no alien species are used for re-vegetation.
2. The area shall be inspected for the presence of alien species and these shall be removed. This shall occur on an annual basis (or as determined by the rehabilitation plan) for at least the first 3 years following decommissioning.

5.5.4 Surface water impact table

Table 5-6 indicates how the significance ratings of the various impacts were derived.

Table 5-6 Summary of potential impacts on surface water features and runoff

Key impacts	Project (preferred / alternative)	Extent	Magnitude	Duration	SIGNIFICANCE (Without Mitigation)	SIGNIFICANCE (With Mitigation)	Probability	Confidence	Reversibility
Construction Phase									
Destruction of no-go areas	PV10	Neutral							
	PV4A	Site	Medium	Permanent	High (-)	Low (-)	Probable	Sure	Irreversible for Pans
Formation of barriers to drainage areas	PV10 PV4A	Site	Low	Long term	Medium (-)	Low (-)	Unlikely	Sure	Reversible
Erosion and / or sediment inputs to no-go areas	PV10 PV4A	Site	Medium	Long term	Medium (-)	Low (-)	Probable	Sure	Reversible
Increased invasion by alien vegetation	PV10 PV4A	Site	Medium	Long term	Medium (-)	Low (-)	Probable	Sure	Reversible
Waste reticulation and removal	PV10 PV4A	Site	Very low	Short term	Medium (-)	Very Low (-)	Probable	Sure	Reversible
Operational Phase									
Increased surface water run-off	PV10 PV4A	Site	Low	Long term	Medium (-)	Low (-)	Probable	Sure	Reversible
Increased run-off from washing panels	PV10 PV4A	Site	Low	Long term	Medium (-)	Low (-)	Probable	Sure	Reversible
Increased flood peak	PV10 PV4A	Local	High	Long term	Medium High (-)	Low (-)	Probable	Unsure	Irreversible
Increased invasion by alien vegetation	PV10 PV4A	Site	Medium	Long term	Medium (-)	Very Low (-)	Probable	Sure	Reversible
Impact of domestic waste reticulation on no-go area	PV10 PV4A	Site	Low	Long term	Medium (-)	Very Low (-)	Probable	Sure	Reversible

Decommissioning Phase									
Increased surface erosion in denuded area	**PV10 PV4A**	Site	Medium	Medium term	Medium (-)	Low (-)	Probable	Sure	Reversible
Remnants of vegetation with altered species composition	**PV10 PV4A**	Site	Medium	Medium term	Medium (-)	Very Low (-)	Probable	Sure	Reversible
Cumulative impacts									
Increased surface water runoff from panel washing activities and stormwater runoff	**PV10 PV4A**	Regional Extent	Low	Long term	Low (-)	Low (-)	Probable	Sure	Reversible
Increased invasion by alien facility species, especially perennial aggressive species such as *Prosopis glandulosa*	**PV10 PV4A**	Regional Extent	Medium	Long term	Low (-)	Very Low (-)	Probable	Sure	Reversible
Domestic waste reticulation and removal	**PV10 PV4A**	Regional Extent	Low	Long term	Very Low (-)	Very Low (-)	Probable	Sure	Reversible
No-Go									
Increased surface water run-off	**PV10 / PV4A**	Neutral							

5.5.5 Surface water conclusion

In terms of surface water drainage and the associated features (i.e. dry river beds and pans) Layout Alternative 1 (i.e. PV10) is the preferred option. According to the project information given, Layout Alternative 1 is advantageous as it accounts for all known surface water features and is planned in such a way as to not cause direct disturbance to them.

Transmission Route 1 is also the preferred option since it negates the need for a 6.8km long corridor which traverses drainage lines on neighbouring farms. Nevertheless, while overhead 132kV transmission lines cannot easily be routed in such a way to avoid drainage lines, all care must be taken to avoid demarcated pans in the area.

Both technologies have similar water requirements for operation and maintenance and hence are equally preferable. Furthermore, two alternatives are considered to mount the panels, i.e. single axis and fixed axis tracking systems. However, since these alternatives have the same water use, both are considered to be equally acceptable in terms of this assessment. Both layout alternatives are equally preferred.

Cumulatively should all the PV facilities be constructed a detailed stormwater management plan would be required to avoid potential flooding risks to the Hoekplaas homesteads below the dam.

5.6 Impact on heritage resources (including palaeontology)

A Heritage Impact Assessment (HIA) was conducted by Dr Jayson Orton and Ms Lita Webley of the Archaeology Contracts Office (ACO) to assess the impacts of the proposed solar energy facility on the heritage resources in the project area. Information for the study was sourced from published and unpublished archaeological reports, as well as a physical survey by the specialists of the project area on 12 December 2011 and 3 May 2013. The HIA and comment on the revised layout and technology alternatives are included in **Annexure C**.

A Palaeontology Impact Assessment (PIA) was undertaken by Dr John Almond as the site is located in an area of the Main Karoo Basin of South Africa that is underlain by potentially fossiliferous sedimentary rocks of the Karoo Supergroup known for its value as potential source of palaeontology heritage. The study included a desktop review and field-based assessment on 26 January 2012 and 24 May 2013 of the paleontological aspects in the project area. The PIA and comment on the revised layout and technology alternatives are included in **Annexure C**. The findings and recommendations of the studies are summarised below.

5.6.1 Description of the environment

In general the Karoo and Bushmanland area is documented to contain abundant stone artefacts from the Early (ESA) and Middle Stone Age (MSA), while occasional Later Stone Age (LSA) is also present. These artefacts are generally very well weathered in the form of background scatter. Excavations at Bundu Pan 25-30km northwest of Copperton uncovered archaeological material regarded to be generally rare in South Africa and included findings of preserved Pleistocene faunal material, bones of wildebeest, warthog, extinct giant hartebeest, species of equid (horse/zebra), baboon, springbok and blesbok. Several LSA sites in the Bushmanland area to the northwest, west and southwest of Copperton have also been found to have hunter-gatherer assemblages including blades, scrapers, potsherds, ceramics and ostrich egg flasks. Rock art in the form of engravings are common to the area, dating back to the period when indigenous people or Bushman lived in the area. Stone Age circles are a further archaeological

feature of concern. More recent heritage includes typical flat-roofed Karoo-style houses commonly found in the small towns and war graves and a British fort at Prieska dating from the Anglo-Boer War.

Figure 5-7 and 5-8 show the distribution of archaeological resources recorded during the survey.Pink/brown areas depict the proposed PV footprints with the PV10 site labelled and yellow areas represent the proposed laydown areas. The blue lines indicate search paths and the dashed circle the location of a pan. Resources were widespread across the study area, with certain landscape features obviously attracting settlement, such as pans and hills, with resulting higher densities of finds.

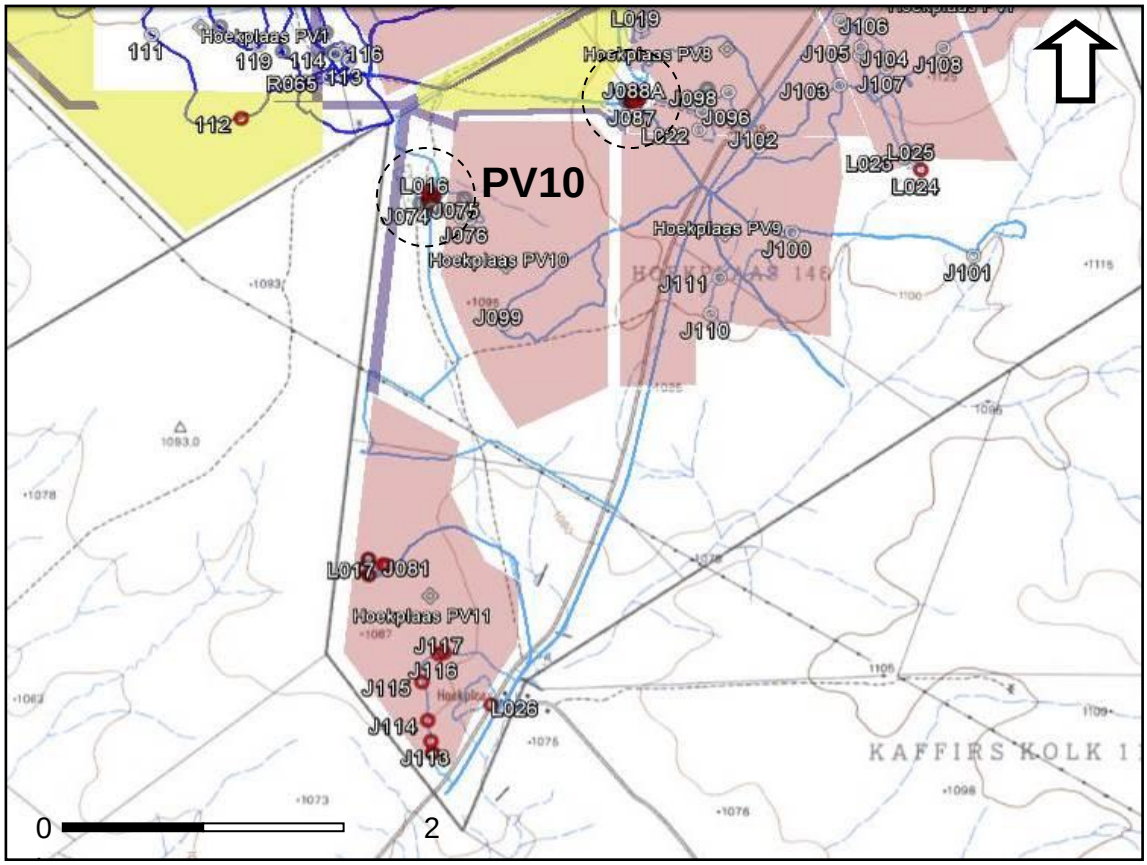

Figure 5-7 Map of the northern part of the study area (Layout Alternative 1) showing the locations of archaeological sites requiring mitigation (red symbols) (ACO, 2013)

Stone Age material included ‘background scatter’ as well as larger artefacts such as hand-axes found across the study area (**Figure 5-9**). Most of the ‘background scatter’ is expected to be of MSA origin and only one site was recorded near a borrow pit (originally a pan) along the main road and comprised a buried horizon of artefacts along with a fossilised equid (horse) tooth. Although this does not fall within layout areas, the extent of the site underground is not known. LSA artefacts were often found in clusters suggestive of actual occupation sites, many of which were found around pans. Within the site there were a number of quartzite outcrops that were used to obtain stone and could be of LSA in age (**Figure 5-10**). Ostrich eggshell flakes were common throughout the study area and one fragment included a flask mouth as evidenced by the nature of the hole. Historical artefacts were absent from the study area with one exception where a single fragment of European ceramic and one of glass was found.

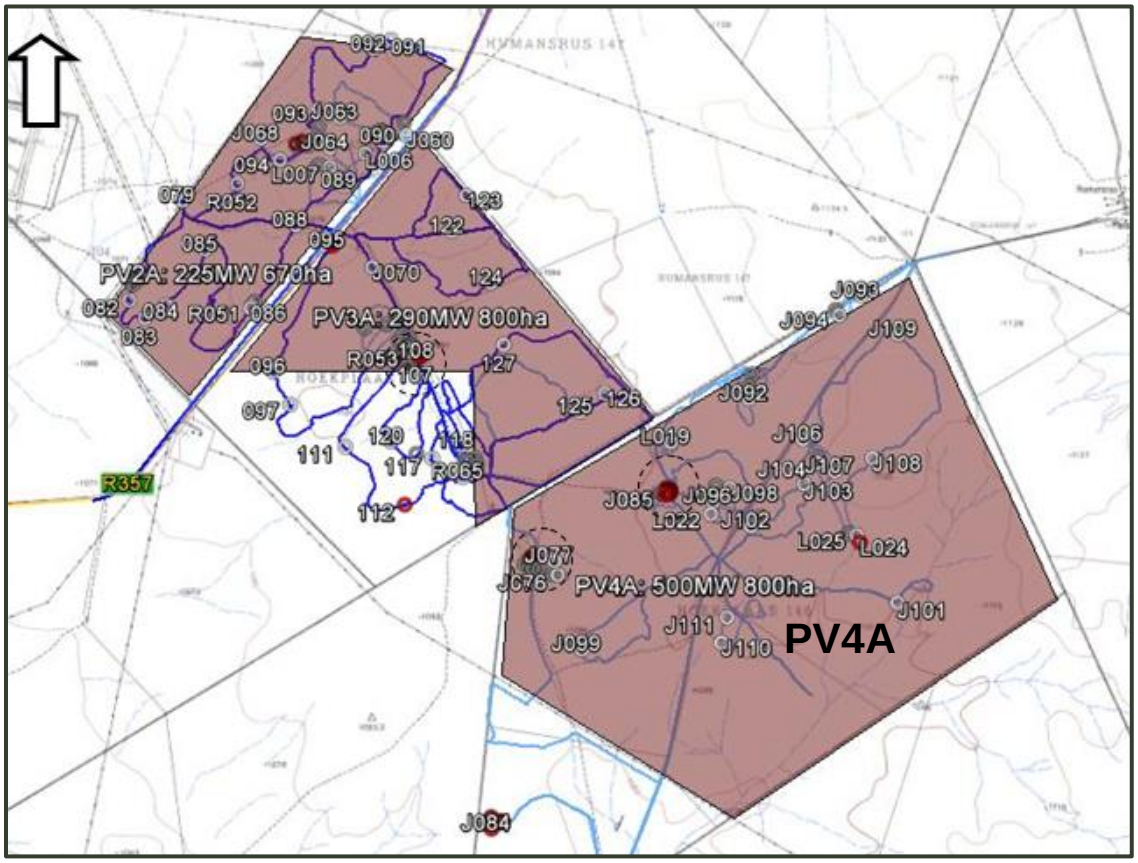

Figure 5-8 Map of the study area (Layout Alternative 2) showing the locations of archaeological sites requiring mitigation (red symbols) (ACO, 2013)

Figure 5-9 Selection of isolated artefacts from the background scatter on Hoekplaas showing the variability in materials and weathering states (ACO, 2012)

Figure 5-10 Quarried quartzite outcrop (ACO, 2013)

The site does not have any buildings or structures of heritage value, while the cultural landscape is composed of an ephemeral pan with gum trees, a windmill, water troughs and an old cement dam alongside it. The R357 connecting Prieska and Vanwyksvlei via Copperton, is a generally scenic route and contributes to the sense of place created by typical undeveloped Karoo open space.

The geology of the study area consists of Permo-Carboniferous glacial sediments of the Dwyka Group (Karoo Supergroup) that overlie granitoid Precambrian basement rocks of the Namaqua-Natal Metamorphic Province (**Figure 5-11**). These older bedrocks are widely covered by a range of superficial deposits of Pleistocene to Recent age, including alluvium, down wasted coarse gravels, calcrete hardpans, and sandy to silty soils and pan sediments.

Field assessment suggests that the poorly-exposed upper Dwyka Group bedrocks in the Hoekplaas study area do not contain rich trace fossil assemblages, petrified wood or other fossil material, and are therefore of low palaeontological sensitivity. The only fossils recorded from the Dwyka succession in this region are ice-transported erratic boulders of Precambrian limestone or dolomite that contain small stromatolites (microbial mounds or columns). The study area is mantled by Pleistocene to Recent superficial sediments (soils, alluvium, calcretes, gravels etc) that are likewise generally of low palaeontological sensitivity. However, important mammal fossil remains assigned to the Late Pleistocene Florisian Mammal Age have been recorded from pan sediments at Bundu Pan only 22km to the northwest of Copperton and somewhat younger fossil teeth have been reported from subsurface gravels on Hoekplaas. It is possible that comparable concentrations of Pleistocene vertebrate fossils are also preserved on buried palaeosurfaces and within alluvial gravels or pan sediments elsewhere on Hoekplaas. However, these occurrences are likely to be sparse and their distribution is largely unpredictable. Fossil heritage recorded within each of the main sedimentary rock units mapped at surface within the study area is summarised in **Table 5-7**.

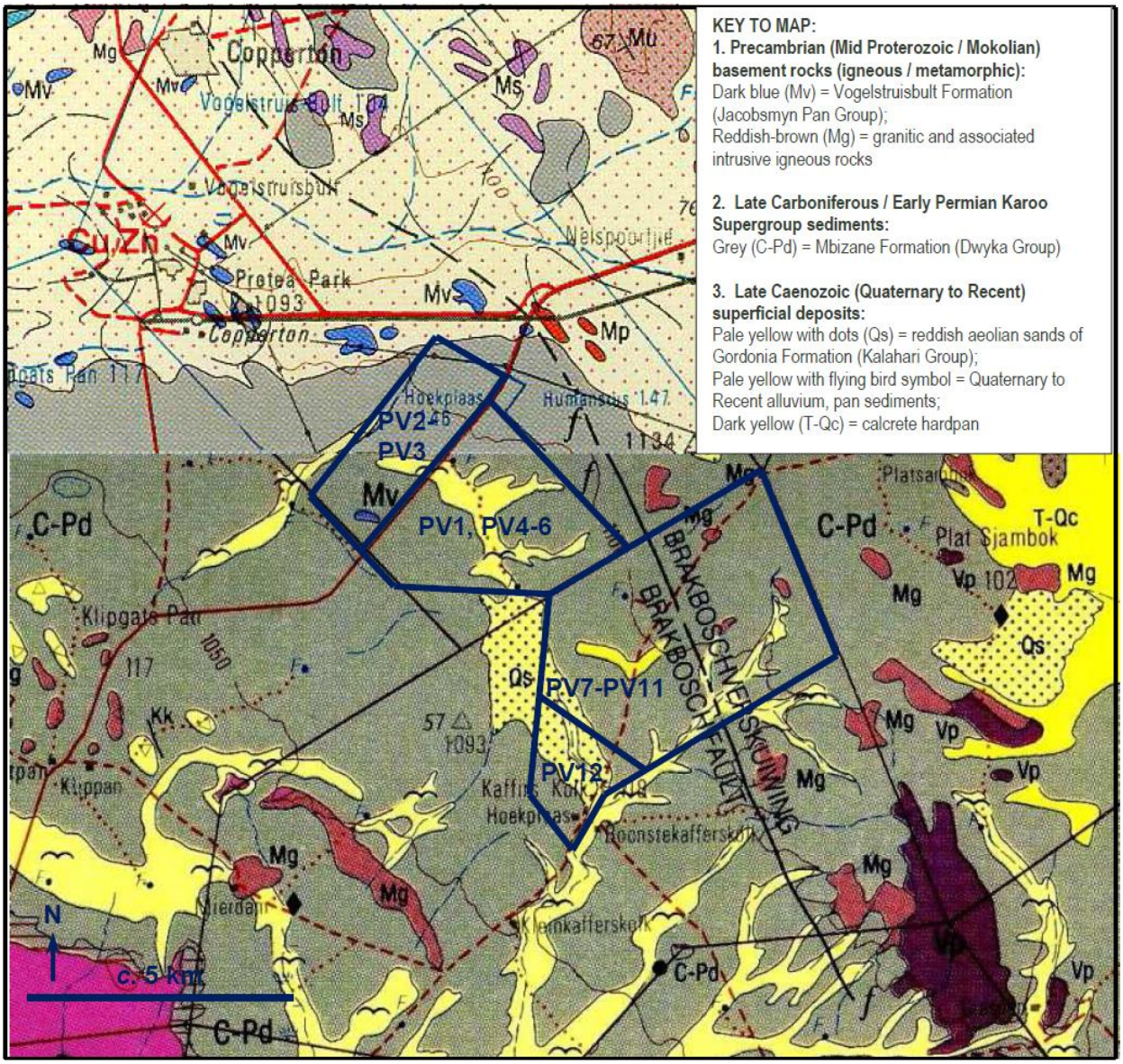

Figure 5-11 Extracts from 1: 250 000 geology maps 2922 Prieska (above) and 3022 Britstown (below) (Council for Geoscience, Pretoria) showing the approximate outline of the proposed solar energy facility study area near Copperton (blue polygons) (Almond, 2013)

Table 5-7 Fossil heritage in the Copperton area (Almond, 2013)

Geological unit	Rock types & age	Fossil heritage	Palaeontological Sensitivity
Unassigned superficial sediments (including possible equivalents of Kalahari Group)	Surface aeolian sands, sandy and silty soils, calcrete hardpans, downwasted gravels, *plus* fluvial gravels, alluvium, freshwater pan deposits Age: Mainly Pleistocene	Calcretised rhizoliths & termitaria, ostrich egg shells, land snail shells, rare mammalian and reptile (*e.g.* tortoise) bones & teeth, freshwater units associated with diatoms, molluscs, stromatolites *etc.*	Generally Low But Locally High (*e.g.* concentrations of mammalian fossils, molluscs in pan and fluvial sediments)
Kimberlite intrusions	Mica-rich kimberlite dykes Age: Cretaceous	None	Zero
Karoo Dolerite Suite	Dolerite sills & dykes Early Jurassic	None	Zero

Geological unit	Rock types & age	Fossil heritage	Palaeontological Sensitivity
Mbizane Formation **Dwyka Group**	Tillites, interglacial mudrocks, deltaic & turbiditic sandstones, minor thin limestones Age: Late Carbonifer-Ous – Early Permian	Sparse petrified wood & other facility remains, palynomorphs, trace fossils (*e.g.* arthropod trackways, fish trails, U-burrows) possible stromatolites in limestones, fossiliferous erratics (*e.g.* stromatolitic limestones / dolomites)	Low
Namaqua-Natal Metamorphic Province	Unnamed granitic and high grade metamorphic basement rocks Age: Mid Proterozoic	None	N/A

5.6.2 Impact assessment

a) Construction phase

The proposed PV10 facility has potential to produce a wide range of impacts that would affect the heritage qualities of an area. During the construction phase of the project, earthworks may cause the following impacts to heritage resources:

- Displacement or damage to archaeological material;
- Negative visual impact of solar energy generation facility on the cultural landscape, scenic quality and sense of place of the Karoo and Bushmanland; and
- Disturbance, damage or destruction of fossils preserved at or below the ground surface.

Archaeological resources

Archaeological resources are widespread but of generally limited significance. Those with the greatest research value tend to be located around pans. At present all well-defined pans are protected from development by at least 90m. One LSA site located in a laydown area requires mitigation.

For PV10 (Layout Alternative 1) the potential impact on archaeological resources is considered to be of low magnitude, site-specific in extent and permanent and therefore of **low (-)** significance which can be reduced to **very low (-)** with mitigation.

For PV4A (Layout Alternative 2) the potential impact on archaeological resources is considered to be of medium magnitude, site-specific in extent and permanent and therefore of **medium (-)** significance which can be reduced to **very low (-)** with mitigation.

Cultural landscape

While visual impacts to the local landscape will undoubtedly be the most significant heritage-related impacts that would be experienced through implementation of the proposed developments, the significance of this impact is to a large degree off-set by the other renewable energy facility being planned for the surrounding landscape and the existing copper mine to the north. Furthermore, the area is sparsely populated and does not see tourist traffic. Visual impacts are assessed in further detail in **Section 5.9**.

For Layout Alternative 1 (PV10) the potential impact on the cultural landscape is considered to

be of low magnitude, local in extent and long term and therefore of **low (-)** significance without mitigation. As no mitigation is possible, it remains of **low (-)** significance.

For Layout Alternative 2 (PV4A) impacts on the cultural landscape will not be any different from Layout Alternative 1 (PV10).

Palaeontological resources

The construction phase of the development would entail excavations into the superficial sediment cover (soils, alluvial gravels etc) and perhaps also into the underlying potentially fossiliferous bedrock. These notably include excavations for the PV panel support structures, buried cables, internal access roads, any new power line pylons and associated infrastructure. All these developments may adversely affect potential fossil heritage within the study area by destroying, disturbing or permanently sealing-in fossils that are then no longer available for scientific research or other public good.

Potential impacts on fossil heritage are confined to the development footprint. As far as fossil heritage is concerned, the impact significance of the proposed PV layout is considered to be low for the following reasons:

- The Karoo Supergroup bedrocks are deeply weathered, locally calcretised and baked, and at most sparsely fossiliferous;
- The development footprint for the proposed PV10 are small and largely underlain by superficial deposits of low palaeontological sensitivity;
- Significant fossil material (e.g. mammal remains) at or near surface level is most likely very sparsely distributed within the study area; and
- Extensive, deep bedrock excavations are not envisaged during the construction phase.

For Layout Alternatives 1 and 2 (PV10 and PV4A), including both alternatives for transmission line corridors, the potential impact on fossils is considered to be of very low magnitude, site specific in extent and long term and therefore of **low (-)** significance, without and with mitigation.

There is no preference on fossil heritage grounds for the Layout Alternatives or Technology Alternatives.

b) Operational phase and decommissioning

Impacts to archaeological heritage resources would primarily occur during the construction phase and thereafter remain unchanged through the operational and decommissioning phases.

With regards to the cultural landscape, potential impacts would be experienced during construction and operation but then, with rehabilitation (**Section 5.9.4**), would revert to the status quo (assessed as the No-Go alternative) after decommissioning.

c) No-go alternative

The no-go Alternative would result in maintenance of the status quo. Impacts to archaeological and palaeontological resources, as well as the cultural landscape, would remain entirely unchanged and experience neutral impacts.

d) Cumulative impacts

Cumulative impacts are difficult to assess, since archaeological resources, in particular, are point-specific. Each is unique and, while the general location of heritage sites can often be

predicted, there is no guarantee that a site would be found in an expected location. For this reason one cannot be sure how many sites could be lost relative to the number and type of sites occurring in the local and wider regions. A review of reports conducted for other renewable energy projects in the area suggests that the MSA and LSA material found on Hoekplaas is fairly typical of the area, although for its rarity and potentially very high research value, the MSA site at HKP2011/002 (located outside the PV10 development footprint) would be regarded as exceptional. Due to the uncertainties, the significance of impacts has thus been kept the same at all scales. The potential cumulative impact on archaeological resources at the farm, local and regional extents, is considered to be of medium magnitude and permanent and therefore of **low (-)** significance which can be reduced to **very low (-)** with mitigation.

The cultural landscape is of very limited value and it is extensive, stretching well beyond the immediate surroundings. The potential cumulative impact on the cultural landscape at the farm, local and regional extents, is considered to be of low magnitude and long term and therefore of **low (-)** significance without mitigation. As no mitigation is possible, it remains of **low (-)** significance.

Given the low overall palaeontological sensitivity of the Karoo bedrocks and Pleistocene to Recent superficial sediments of the region as a whole, the cumulative impact of this development on fossils at the Hoekplaas farm, local and regional scale is considered as being of very low magnitude, site specific in extent and long term and therefore of **low (-)** significance, without and with mitigation (**Table 5-7**).

This is due to the following reasons:

- The low palaeontological sensitivity of the bedrocks (Dwyka Group, Precambrian basement rocks) throughout the Copperton region;
- Weathering, calcretisation and local baking of the near-surface bedrocks, further decreasing their palaeontological sensitivity;
- The very sparse occurrence of fossils within the extensive mantle of superficial sediments (soils, gravels, calcretes etc) in the Copperton region; and
- The limited amount of substantial (deep, voluminous) bedrock excavations envisaged and comparatively small development footprints of the solar facility project.

5.6.3 Mitigation measures

The following mitigation measures are required for the **construction phase for all project alternatives**:

1. Buffer zones of 90m shall be applied to all pans.
2. All mitigation-worthy archaeological sites that are avoided by the development and are not mitigated shall be protected from incidental damage (for example from vehicles driving over them or through the establishment of power line access tracks).
3. The mitigation worthy archaeological site located within the most western laydown area shall be demarcated as a “no-go” area. Mitigation measures shall be implemented should it be found during construction that the site cannot be avoided.
4. The ECO responsible for the development shall be aware of the possibility of important fossils (e.g. mammalian bones, teeth) being present or unearthed on site and should monitor all substantial excavations into superficial sediments as well as fresh (i.e. unweathered) sedimentary bedrock for fossil remains.
5. In the case of any significant fossil finds (e.g. vertebrate teeth, bones, burrows, petrified wood) during construction, these should be safeguarded - preferably in situ - and

reported by the ECO as soon as possible to the relevant heritage management authority (SAHRA. Contact details: Mrs Colette Scheermeyer, P.O. Box 4637, Cape Town 8000. Tel: 021 462 4502. Email: cscheermeyer@sahra.org.za) so that any appropriate mitigation (i.e. fossil recording, sampling or collection) by a palaeontological specialist can be considered and implemented, at the developer's expense.

6. The palaeontologist concerned with mitigation work will need a valid fossil collection permit from SAHRA and any material collected would have to be curated in an authorised depository (e.g. museum or university collection). All palaeontological specialist work should conform to international best practice for palaeontological fieldwork and the study (e.g. data recording, fossil collection and curation, final report) should adhere as far as possible to the minimum standards for Phase 2 palaeontological studies recently developed by SAHRA (2013).
7. The heritage specialist shall examine the exact alignment of the linear components (e.g. transmission lines) once these have been finalised and possibly undertake a walk-down survey if deemed necessary.

The following mitigation measures are required for the **construction phase of Layout Alternative 1**:

8. All mitigation-worthy sites falling into areas to be impacted shall have archaeological mitigation in the form of excavation, sampling and analysis carried out. This only affects one area in the centre of the farm (located at a laydown area). Some sites fall within the corridors identified for linear infrastructure and, once the exact layouts have been decided upon, these shall be mitigated if required. An estimate on the amount of time required on site for each archaeological site is indicated in **Annexure D**. Note that avoiding and protecting these sites is always preferred when feasible, but they are not of such a nature that their protection should be required.

The following mitigation measures are required for the **construction phase of Layout Alternative 2**:

9. Test excavations shall be undertaken in the area around the pans located in PV4A.
10. All mitigation-worthy archaeological sites that are avoided by the development and are not mitigated shall be protected from incidental damage (for example from vehicles driving over them or through the establishment of power line access tracks).

5.6.4 Heritage impact table

Table 5-8 indicates how the significance ratings of the various impacts were derived.

5.6.5 Heritage conclusion

Layout Alternative 2 would have far greater archaeological impact than Layout Alternative 1 since the surrounding archaeological sites would also be directly impacted. Layout Alternative 1 is therefore preferred.

There is no preference in terms of technology alternatives. Also, due to the relatively narrow width of the proposed transmission corridor, the transmission lines would have the same level of impact no matter where in the corridors they are constructed. Archaeological impacts, too, would not differ since no sites requiring mitigation were identified in the corridors and the impact is therefore neutral.

Table 5-8 Summary of potential impacts on archaeology and palaeontological resources

Key impacts	Project (preferred / alternative)	Extent	Magnitude	Duration	SIGNIFICANCE (Without Mitigation)	SIGNIFICANCE (With Mitigation)	Probability	Confidence	Reversibility
Construction Phase – Layout Alternative 1									
Archaeological	**PV10**	Site Specific	Very Low	Permanent	Very Low (-)	Very Low (-)	Definite	Sure	Irreversible
Cultural Landscape	**PV10**	Local	Low	Long term	Low (-)	Low (-)	Definite	Sure	Reversible
Palaeontology	**PV10**	Site specific	Very low	Long term	Low (-)	Low (-)	Probable	Unsure	Irreversible
Construction Phase – Layout Alternative 2									
Archaeological	**PV4A**	Site specific	Low	Permanent	Low (-)	Very low (-)	Definite	Sure	Irreversible
Cultural Landscape	**PV4A**	Local	Low	Long term	Low (-)	Low (-)	Definite	Sure	Reversible
Palaeontology	**PV4A**	Site specific	Very low	Long term	Low (-)	Low (-)	Probable	Unsure	Irreversible
Cumulative Impacts									
Archaeology	**PV10/ PV4A**	Regional extent	Medium	Permanent	Medium (-)	Very low (-)	Definite	Sure	Irreversible
Cultural landscape	**PV10/ PV4A**	Regional extent	Low	Long term	Low (-)	Low (-)	Definite	Sure	Reversible
Palaeontology	**PV10/ PV4A**	Regional extent	Very low	Long term	Low (-)	Low (-)	Probable	Unsure	Irreversible
No-Go									
Archaeology, Cultural and Palaeontological resources	**PV10 / PV4A**	Neutral							

5.7 Impact on local economy (employment) and social conditions

The establishment of the proposed PV energy facility would provide a number of direct, indirect and induced jobs. Direct jobs are created during manufacturing, construction and installation, operation and maintenance. The proposed PV10 project would also result in a large amount of expenditure in South Africa, both to procure services (e.g. transportation services) and materials (e.g. road building materials).

5.7.1 Description of the environment

Demographics

Copperton falls within the SiyaThemba LM of the Pixley ka Seme District Municipality (DM) in the south eastern quadrant of the Northern Cape Province, the largest Province in South Africa. The LM covers 8,251km^2 and the DM is 102,766km^2 in extent. The LM is home to 21,591 people and the DM has a total population of 186,351 (Census, 2011). The area is very sparsely populated as is evident from the low population density measured in person per square kilometre which is one (1) for the LM, two (2) for the DM and three (3) for the province (in comparison the national average for South Africa is 42 people per square kilometre) (Census, 2011). The LM has a growth rate of 1.6 between 2001 and 2011 which is higher than the province at 1.4 (**Table 5-9**).

Table 5-9 Population density and growth rates

	Extent (km^3)	Population	Population Density	Growth Rate (2011)
SiyaThemba LM	8,251	21,591	1	1.6
Pixley ka Seme DM	102,766	186,351	2	1.1
Northern Cape Province	372,889	1,145,861	3	1.4

The LM is dominated by a coloured population (72%), with a smaller representation of black people (19%) and white people (9%) with very few Asians (0.5%). The demographic composition by age reflects a higher percentage of youth (15 to 25 years) at 33% of the population, with children (age 0-14 years) slightly lower at 31%, adults (36-64 years) at 30%, and the elderly (64 years and above) at 6%. This proportion of youth however is not as high as the average for the province (36%) and country as a whole and is therefore slightly more favourable in terms of welfare related implications.

Service Provision

The average household size in the LM is 3.6 people, similar to the DM and the province at 3.7 (Census, 2011). More than a third of households are headed by females (36%) which are slightly more favourable than the DM (37%) and the province (39%) (Census, 2011). Please refer to **Table 5-10** for more information.

Table 5-10 Household data

	People per Household	Female headed (%)
SiyaThemba LM	3.6	36
Pixley ka Seme DM	3.7	37
Northern Cape Province	3.7	39

As indicated in **Table 5-11**, 94% of households have access to piped water inside their dwelling or yard, with 4% having access within 200m, 1% having no access and the remainder having access further than 200m. This is less favourable than the provincial average (97%) and less so than the national average (91%) in terms of piped water inside dwellings. However, the Pixley ka Seme DM IDP (2011) highlights the importance of water provision and availability as a

constraint to economic activity in many of the towns. With respect to sanitation, 71% of households in the LM have flush toilets, 17% have pit toilets, 8% have no toilets, 4% have bucket toilets with the remainder having chemical toilets or other. This is also more favourable than the provincial average (66%) and the national average (57%) in terms of flushed toilets.

With respect to energy source for lighting, most households have access to electricity at 86%, with 11% only having candles, 2% having solar, and the remainder having either paraffin, gas, other or no energy for lighting. This is slightly more favourable than the provincial average and the national average (both 85%). The access to refuse removal in the LM is more favourable than the province as a whole with 77% of households having refuse removed by the council, compared to the provincial average (66%) and the national average (64%). Overall the service provision in the LM is favourable but there is still potential for improvement. The IDP notes that because of the sparsely distributed population, service provision is a challenge as long distances must be travelled (Pixley ka Seme DM, 2011).

Table 5-11 Access to services (per household)

	Piped Water (%)	Flush Toilets (%)	Electricity for Lighting (%)	Refuse Removal (%)
SiyaThemba LM	94	71	86	77
Northern Cape Province	97	66	85	66
South Africa	91	57	85	64

Copperton is a unique settlement whereby the mining town was sold to a private owner upon closure and is currently on a long term lease by the 'Request Trust' (SiyaThemba LM, 2012). Many houses were demolished but there are still some remaining and an agreement was reached between the Lessee and Alkantpan (Amscor) for the delivery of water, sanitation, and electricity services to the residents. Amscor also maintains one of the main roads.

Education

A critical factor affecting quality of life is the standard of education within a community. According to Census (2011), the population of the LM has a low level of education. As many as 12% of the population (aged 20 and older) have no schooling, 22% have some primary schooling, 8% have completed primary schooling and 35% have some secondary schooling. Only 18% have completed matric, with 5% completing some form of higher education. This is less favourable than the province which has 23% with a matric and 7% with a higher education, and the national average at 28% with a matric and 12% with a higher education.

Welfare

In 2010, the prevalence of HIV/AIDS within the population of the LM was 6% and 6.5% in the DM. Although these rates are not as critical as that of the province (7.6%) and the country as a whole (12.6%) the problem is significant and has been identified as priority for the Prieska area specifically. Furthermore, the prevalence of Tuberculosis (TB), which is significantly higher in the Northern Cape compared to the national average, is expected to rise with the increase in HIV/AIDS prevalence (Pixley ka Seme DM, 2011).

The Pixley ka Seme IDP indicates that social problems in the district include high levels of domestic violence, substance and alcohol abuse, a rise in teen pregnancy, as well as theft and illegal activities which are coupled with a lack of capacity of the police (Pixley ka Seme DM, 2011). The SiyaThemba LM IDP reports that in 2010, the most crimes in the LM were recorded at the Prieska Police Station with the most prevalent type of incident being assault with the

intent to inflict grievous bodily harm, followed by theft. Stock theft is recognised as a problem elsewhere in the LM (SiyaThemba LM, 2012).

Community services in Prieska include a hospital, a clinic and a mobile clinic however additional health services are identified as a prioritised need for the area. Other facilities in the town include four primary schools and two secondary schools, two libraries, three community halls and some recreational facilities (Pixley ka Seme DM, 2011).

Employment and Earnings

Lack of employment opportunities has been identified as a challenge within the DM. The unemployment rate in the LM is considered high at 24.5% which is lower than the DM at 28.3%. It is also lower than the provincial rate at 28.1% and the national rate at 39% (Census, 2011). The annual average household income is R71,007 which is lower than the DM at R75,237 and the province at R86,185 as well as the national average at over R100,000. Refer to **Table 5-12**.

Table 5-12 Employment and Earnings

	Unemployment Rate (%)	Household Income (R)
SiyaThemba LM	24.5	71,007
Pixley ka Seme DM	28.3	75,237
Northern Cape Province	28.1	86,185
South Africa	39	100,00+

Economy

According to the Pixley ka Seme DM IDP (2011), the economy of the District is founded on community services, agriculture, transport and tourism. The small towns function primarily as agricultural service centres, and the main economic activities are located in the main urban areas of De Aar, Colesberg, Victoria-West and Carnarvon. In SiyaThemba LM particularly, the labour force is highly concentrated in the Services sector (SiyaThemba LM, 2012). The SiyaThemba LM IDP (2012) highlights that local employment trends are not well-integrated with that of the wider region, with a reliance on specific sectors listed above, and associated employment vulnerability.

In terms of agriculture, wheat, maize and lucerne are key crops, and irrigation farming also supports the production of peanuts, grapes, dry beans, soya beans, potatoes, olives, pecan nuts, pistachio nuts and cotton (Pixley ka Seme DM, 2011). Small stock farming is widespread and mainly focusses on sheep and goats, with sheep farming producing mutton and wool. The IDP highlights that there are opportunities for benefaction of resources which are currently being lost as products are sent to other areas for processing (Pixley ka Seme DM, 2011).

According to the IDP, tourism is facilitated by a number of government projects, namely the Rolfontein outdoor Wilderness school, and the re-development of several resorts and facilities such as the Wildebeeest Kuilrock Art Centre, the Douglas Holiday Resort and Die Bos Resort in Prieska (Pixley ka Seme DM, 2011). While the town of Prieska is home to a few tourist attractions such as the fort, memorial garden and museum; the Khoi San rock art and game reserves are other assets contributing to the tourism component of the local economy (SiyaThemba LM, 2012).

The District has limited mineral resources, although in the past copper, asbestos and diamonds contributed towards the economy (Pixley ka Seme DM, 2011). Of relevance is the copper mine in Copperton which was closed as it was no longer viable and sold to a private owner and

currently on a long term lease by the 'Request Trust' as described above (SiyaThemba LM, 2012). Glen Ellen and Koegas asbestos mines were also closed due to health risks and the diamond mine at Franshek is apparently nearing closure due to the limited deposits (Pixley ka Seme DM, 2011). Recent information indicates that uranium and gas deposits are also found in the region.

The District is well connected and located along some of the major transport routes, which include the N1 from the Northern Province, Pretoria and Johannesburg to Cape Town; the N9 from Colesberg joining the N10 to Port Elizabeth and the Eastern Cape, the N12 from Johannesburg via Kimberley to Cape Town; and the N10 from Namibia via Upington linking Namibia to the Eastern Cape (Pixley ka Seme DM, 2011). Furthermore, the railway network around De Aar is well developed and one of the largest in South Africa.

In terms of the economy, the economic growth of the district was estimated at 0.6% in 2005, which is below the national average of 4% in 2007 (Pixley ka Seme DM, 2011). Key challenges include the following:

- lack of diversification of the district economy;
- lack of investment in the region;
- lack of employment; opportunities;
- lack of skills; lack of entrepreneurship;
- small number of SMME's active in the region;
- underutilization of the regions natural resources and economic opportunities; and
- lack of water for irrigation farming (Pixley ka Seme DM, 2011).

Specific opportunities identified for growth and development include manufacturing, agro-processing, mining and activities relating to the mining of semi-precious stones. It is also recognised that in order to attract investors to the district, the municipalities should focus on critical development activities that are taking place nationally and internationally (Pixley ka Seme DM, 2011). There is a recognition that sustainable projects must be identified that would enhance economic growth and long term job creation.

5.7.2 Impact assessment

a) Construction phase

Construction impacts are described below and summarised in **Table 5-13**.

Direct Employment and Skills Development

The construction of the proposed PV facility would require a workforce and therefore direct employment would be generated. Employment opportunities created by the construction phase equates to approximately 2,800 man months over a period of 12 to 18 months.

Of these opportunities, 80% would be allocated to South African citizens and 50% specifically for black citizens (Aurecon, 2013). In terms of skills, the project would create job opportunities for 15% skilled employees and 8% would be black skilled employees. In addition, 30% of the jobs created would be from the local community. Furthermore, skills in various engineering fields (e.g. civil, structures and electrical), Operational Health and Safety and project management would be required (Mulilo, 2013).

As indicated in the previous section, the population has a low level of education with only 18% having completed matric and this is linked to a limited skills base and high level of

unemployment (a rate of 24.5%). Of the skills required on-site, there would be potential opportunities for low skilled security staff and construction workers. Should these staff require training, the developer is committed to a training and skills development programme. The developer would need to specify that the contracting company recruits 30% of the jobs from the local community.

The positions requiring more highly skilled staff from outside the local area or region would have a positive impact on the economy. However this impact is more diluted due to the scale of the national environment and is considered in the assessment of cumulative impacts.

For Layout Alternative 1 (PV10) and Layout Alternative 2 (PV4A), including associated infrastructure, the potential impact is considered to be of low magnitude, local and regional extent and limited to the construction phase and therefore of **low (+)** significance which can be increased to **low-medium (+)** with mitigation.

Economic Multiplier Effects

The total capital expenditure for the 75MW PV10 project is approximately R1.7 billion of which between 55 and 70% would be local spend (Mulilo, 2013). The PV cells would be sourced abroad and therefore imported. However the modules and inverters would be assembled locally with benefits for the local economy.

At a LM and DM level, there are likely to be economic multiplier effects from the use of local goods and services which includes, but is not limited to, construction materials and equipment and workforce essentials such as food, clothing, safety equipment, and other goods. The 30% of the workforce that is local would most likely spend the majority of their salaries within the local area or region. Although on-site accommodation would be provided, the non-local staff (70% of the workforce) would visit towns during their free time and this additional spend would provide an indirect boost to the local economy. However, the extent to which these benefits can be achieved would also depend on the location of the contractor and the subcontractors and their preferred suppliers.

For Layout Alternative 1 (PV10) and Layout Alternative 2 (PV4A), including associated infrastructure, the potential impact is considered to be of low magnitude, local and regional extent and limited to the construction phase and therefore of **low (+)** significance which can be increased to **low-medium (+)** with mitigation.

Indirect effects of additional workers on site

Additional workers on the site during construction may have indirect impacts, such as increased security issues for neighbouring farms and damage to property, such as the risk of veld fire, stock theft and so forth. The site would accommodate 70% of the construction workforce overnight and is fairly large and isolated, which would indicate a potentially high risk. There is also an existing problem of stock theft in the district.

For Layout Alternative 1 (PV10) and Layout Alternative 2 (PV4A), including associated infrastructure, the potential impact is considered to be of low magnitude, local extent and limited to the construction phase and therefore of **low (-)** significance which can be reduced to **very low (-)** with mitigation.

Impacts of a non-local workforce on society

The introduction of a non-local workforce has the potential to result in social disruption both physical and emotional during construction. Such disruption could result in an increased demand on social infrastructure such as accommodation, health facilities, transport facilities and so forth. Social ills including the spread of diseases (such as HIV/AIDS), crime and social conflict are also a potential risk.

However, the degree to which society is disrupted largely depends on the level of local employment achievable. In the case of the proposed project 30% of the workforce is expected to be sourced locally and the outsiders would be accommodated on-site.

The infrastructure within Copperton and Prieska is likely to have the capacity to absorb the additional people. In terms of social ills, however, there is an existing substance and alcohol abuse problem in the area which is often linked to crime and this has the potential to be exacerbated by newcomers.

For Layout Alternative 1 (PV10) and Layout Alternative 2 (PV4A), including associated infrastructure, the potential impact is considered to be of low magnitude, local extent and limited to the construction phase and therefore of **low (-)** significance which can be reduced to **very low (-)** with mitigation.

Disruption or damage to adjacent properties

Construction activities would involve the following activities (Mulilo, 2013):

- Preparation including the removal of all vegetation;
- Excavations for the cable trenches, foundations, etc.;
- Pouring of foundations, drilling of holes for the structures to be built on, etc.;
- Construction of boundary fences around the facility; and
- Construction of substations and transmission lines.

As a result, disruption or damage to adjacent properties (including access arrangements) is a potential issue and may include a temporary increase in noise and dust, or the wear and tear on private farm roads for access to the site.

Adjacent access roads however would not be impacted as an additional access roads leading from the R357 would be constructed and would connect to the PV10 facility. These roads would coincide with existing dirt tracks where possible. Construction vehicles utilising these roads would include trucks to deliver containers, digger loaders for land clearing and trucks with cranes to assemble the facility. Dust arising from vehicles using the road as well as earthworks on the site would be worse in the dry winter months and could be managed through the EMP, which would include procedures for dealing with dust pollution events including watering of roads, etc. Potential noise impacts from typical construction equipment could impact avifauna or fauna (as assessed in **Section c**)) but would be restricted to the farm with very few human receptors being within range of these impacts.

For Layout Alternative 1 (PV10) and Layout Alternative 2 (PV4A), including associated infrastructure, the potential impact is considered to be of low magnitude, local extent and limited to the construction phase and therefore of **low (-)** significance which can be reduced to **neutral** with mitigation.

b) Operational phase

Operational impacts are described below and summarised in **Table 5-13**.

Direct Employment and Skills Development

Operational employment has been calculated as 35 man months per annum over the design life of a minimum of 20 years. Of these opportunities, 80% would be allocated to South African citizens and 50% specifically for black citizens (Mulilo, 2013). In terms of skills, the proposed PV10 facility would create job opportunities for a wide range of skills, 45% would be skilled employees and 14% would be black skilled employees. In addition, 54% of the jobs created would be from the local community and the developer is committed to developing a training strategy to train and employ people from the local community.

Maintenance would be carried out throughout the lifetime of the PV facility. Panel washing would likely occur twice to three times a year, while permanent security (consisting of two guards) would be required. Furthermore, technicians would be required to undertake maintenance activities on a monthly basis.

For Layout Alternative 1 (PV10) and Layout Alternative 2 (PV4A), including associated infrastructure, the potential impact is considered to be of low magnitude, local and regional extent and long term and therefore of **low (+)** significance which would remain **low (+)** with mitigation.

Economic Multiplier Effects

Economic multiplier effects generated from the supply of local goods and services to the proposed PV10 facility during operation would include maintenance tools, supplies and equipment which may be technology specific and therefore not necessarily available locally as the manufacturer is based abroad. Such specialist equipment would be sourced internationally, with other 'high tech' equipment sourced from large CBD's and only the 'low tech' sourced from the surrounding areas (Mulilo, 2013).

Furthermore the operational wage bill for the 75MW facility is estimated as R15,000 / month (highly-skilled), R8,000-15,000 / month (skilled) and R4,000 – 8,000 / month (non-skilled) over a period of 20 years (Mulilo, 2013). This could benefit the local economy through spend on items such as employee essentials, namely food, clothing, safety equipment, and other goods. There is a lower potential for leakage if employees are sourced locally as most of their salaries would be spent locally within the district or region.

For Layout Alternative 1 (PV10) and Layout Alternative 2 (PV4A), including associated infrastructure, the potential impact is considered to be of low magnitude, local and regional extent and long term and therefore of **low (+)** significance which would remain **low (+)** with mitigation.

Landowner revenue

The proposed PV10 facility would increase the profitability of the land leased from the landowner which could be used to reinvest in agricultural activities. This could have indirect benefits for the local economy, or it could enter the local economy through additional spend.

For Layout Alternative 1 (PV10) and Layout Alternative 2 (PV4A), including associated infrastructure, the potential impact is considered to be of low magnitude, local extent and long term and therefore of **low (+)** significance without mitigation. No mitigation is recommended.

Diversification of the local economy

Increasing the contribution of the renewable energy sector to the local economy could assist with diversification and provide greater stability. The economy of the Pixley ka Sempe DM is founded on community services, agriculture, transport and tourism, with the service sector supporting a large proportion of the labour force within SiyaThemba LM. It is recognised that diversification of the district economy is one of the key challenges that needs to be addressed in order to facilitate economic growth (Pixley ka Sempe DM, 2011). In SiyaThemba specifically, diversification of the economy would reduce the current levels of employment vulnerability in the LM (SiyaThemba LM, 2012).

The growth in the renewable energy sector could therefore contribute towards diversification and stability of the economy, reducing the employment vulnerability with positive impacts for the local economy and communities.

For Layout Alternative 1 (PV10) and Layout Alternative 2 (PV4A), including associated infrastructure, the potential impact is considered to be of low magnitude, local extent and long term and therefore of **low (+)** significance without mitigation. No mitigation is recommended.

Impact on local and regional tourism as a result of visual intrusion

Depending on the location, the visual impact of solar infrastructure could result in impacts to tourism at a local and regional level. The visual impact has been assessed in the VIA as **high (-)** for the PV layout (see **Section 5.9** and **Annexure C**). However, even though the landscape is valued for the wide open spaces and typical Karoo vistas, it is also associated with the existing Copperton Mine tailings storage facility (TSF), the Kronos substation and numerous Eskom power lines. Furthermore the area is not associated with any landscape-based tourism. During the 2012 EIA process undertaken for PV1, no comments or concerns were raised by I&APs to suggest tourism may be impacted by the presence of the facility. It is therefore unlikely to have an impact on local and regional tourism and is assessed as **neutral**.

c) Decommissioning

Decommissioning and restoration activities are likely to have similar impacts as those identified for the construction phase (**Table 5-13**). There are likely to be fewer skills and training opportunities available because at the end of the operational phase (after 20 years), skills would already be established.

The only major difference would be that the removal of infrastructure would have an overall positive visual impact and should some infrastructure remain, it would be a lasting visual impact. The recycling of infrastructure is also proposed however the socio-economic benefits are not likely to be significant.

d) No-go alternative

The no-go alternative will have a neutral impact as the status quo will remain.

5.7.3 Cumulative impacts

The sudden spate of renewable energy development proposals within the Northern Cape, and South Africa in general, has been driven by national government as part of a global environmental governance solution to the energy supply crisis and to mitigate climate change. An abundant solar resource in the Northern Cape has led to a high concentration of solar energy facility proposals in this area with associated concerns regarding the potential

cumulative impact on the environment. Of relevance to this project is the high number of renewal energy projects proposed in the Copperton area.

According to the DEAT Guidelines on 'Cumulative Effects Assessment' (2004, p: 3):
"*Cumulative effects are commonly understood as the impacts which combined from different projects and which result in significant change, which is larger than the sum of all the impacts*."
DEA's also defines a *"cumulative impact" as follows "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".*

Although the proposed PV facility would yield relatively minor benefits for the local economy, given the appropriate enabling environment and in combination with the projected capacity of renewable energy generation, the impacts could be significant. Of importance is the fact that the renewable energy sector would require a wide range of skills to implement the various technologies (Agama Energy, 2003). Based on a survey undertaken in the United States (US), the labour requirements for constructing, transporting, installing and servicing a PV system can be broken down as follows: professional, technical and management (36%), benchwork (15%), structural (14%), miscellaneous (12%), processing (11%), clerical and sales (7%) and machine trades (5%) (REPP, 2001, cited in Agama Energy, 2003). Industry projections for the European Union suggest that every 100MW of PV power would provide 1,020 full-time equivalent manufacturing jobs, 3,190 contracting and installation jobs, and 48 annual jobs in Operation and Maintenance (O&M) (EPIA, 2008 and BMU 2008 cited in Rutovitz and Atherton, 2009). This highlights the significant potential in the contracting and installation sectors, followed by the opportunity to harness further economic benefits through manufacture of the PV components locally (within South Africa).

The findings of the study undertaken by Agama Energy (2003: p.ii) shows that "*renewable energy technologies offer a quantifiable potential for creating and sustaining new and decentralised employment in South Africa, which can offset some of the employment attrition that is a current trend in the conventional energy sectors*". This has associated economic benefits as well as skills development and training opportunities.

Positive impacts would manifest during the construction phase in the form of employment, multiplier effect, etc. As such Layout Alternative 1 (PV10) and Layout Alternative 2 (PV4A), including associated infrastructure, would be the same and is considered to be of medium magnitude, local, regional and national in extent and for the construction phase and therefore of **high (+)** significance. No mitigation is recommended. Negative impact would also manifest during the construction phase in the form of impacts of additional non-local workers, disruption, or damage to surrounding properties and impact on tourism and is considered to be of medium magnitude, local and regional in extent for the construction phase and therefore of **medium (-)** significance.

For Layout Alternative 1 (PV10) and Layout Alternative 2 (PV4A), including associated infrastructure, would be the same and is considered to be of medium magnitude, local, regional and national in extent and long term to permanent and therefore of **medium-high (+)** significance. No mitigation is recommended.

5.7.4 Mitigation measures

The following mitigation measures are recommended for the **construction phase for all project alternatives:**

1. A local employment policy shall be developed, implemented and audited and shall be accompanied by a training programme.
2. Contractors shall be responsible for making available to sub-contractors the contact details for all the local businesses offering related goods and services.
3. A comprehensive employee induction programme shall address land access protocols, fire management, etc. as discussed in the LEMP.
4. The employee induction programme shall address issues such as HIV/AIDS and TB, as well as alcohol and substance abuse. The induction could also address a code of behaviour for employees that would align with community values.
5. Incidences and complaints regarding noise and dust control shall be reported in a log book.

The following mitigation measures are recommended for the **operational phase for all project alternatives:**

6. A local employment policy, as stated by the developer, shall be implemented and audited and accompanied by a training programme.
7. A local procurement policy shall be adopted to maximise benefits to the local economy and minimise leakage.

5.7.5 Socio-economic impact table

Table 5-13 indicates how the significance ratings of the various impacts were derived.

5.7.6 Social conclusions

From a social point of view, any proposed alternative can proceed as the specialist did not have a preference.

Table 5-13 Summary of potential impacts on the socio-economic environment

Key impacts	Project (preferred / alternative)	Extent	Magnitude	Duration	SIGNIFICANCE (Without Mitigation)	SIGNIFICANCE (With Mitigation)	Probability	Confidence	Reversibility
Construction phase									
Direct employment and skills development	PV10 PV4A	Local and Regional	Low	Construction phase	Low (+)	Low-Medium (+)	Probable	High	Reversible
Economic Multiplier Effects	PV10 PV4A	Local and Regional	Low	Construction phase	Low (+)	Low-Medium (+)	Probable	Low	Reversible
Indirect effects of additional workers on site	PV10 PV4A	Local	Low	Construction phase	Low (-)	Very Low (-)	Probable	Medium	Irreversible
Impacts of a non-local workforce on society	PV10 PV4A	Local	Low	Construction phase	Low (-)	Very Low (-)	Improbable	Medium	Irreversible
Disruption or damage to adjacent properties	PV10 PV4A	Local	Low	Construction phase	Low (-)	Neutral	Probable	Medium	Irreversible
Operational phase									
Direct Employment and Skills Development	PV10 PV4A	Local and Regional	Low	Long term	Low (+)	Low (+)	Probable	High	Reversible
Economic Multiplier Effects	PV10 PV4A	Local and Regional	Low	Long term	Low (+)	Low (+)	Probable	Low	Reversible
Landowner revenue	PV10 PV4A	Local and Regional	Low	Long term	Low (+)	Low (+)	Probable	Medium	Reversible
Diversification of the local economy	PV10 PV4A	Local and Regional	Low	Long term	Low (+)	Low (+)	Probable	Medium	Reversible
Impact on local and regional tourism as a result of visual intrusion	PV10 PV4A	Neutral							
Cumulative impacts									
Indirect effects of additional workers on site Impacts of a non-local workforce on society Disruption or damage to adjacent properties Impact on local and regional	PV10 PV4A	Local and Regional	Medium	Construction phase	Medium (-)	Medium (-)	Probable	Medium	Reversible

Key impacts	Project (preferred / alternative)	Extent	Magnitude	Duration	SIGNIFICANCE (Without Mitigation)	SIGNIFICANCE (With Mitigation)	Probability	Confidence	Reversibility
tourism as a result of visual intrusion									
Direct Employment and Skills Development **Economic Multiplier Effects** **Landowner revenue** **Diversification of the local economy**	**PV10** **PV4A**	Local and Regional	Medium	Construction phase	High (+)	High (+)	Probable	Medium	Reversible
Direct Employment and Skills Development **Economic Multiplier Effects** **Landowner revenue** **Diversification of the local economy**	**PV10** **PV4A**	Local, Regional and National	Medium	Long term	Medium-High (+)	Medium-High (+)	Probable	Medium	Reversible
No-Go									
Potential negative or positive effects	**PV10 / PV4A**	Neutral							

5.8 Impact on traffic

Construction vehicles are likely to make use of the existing roads to transport equipment and material to the construction site. These vehicles would include:

- 450 truckloads transporting 900 x 40-foot containers;
- Two to five digger loaders for land clearing; and
- Five to ten trucks with cranes to assemble the facility.

5.8.1 Description on the environment

The District is well connected and located along some of the major transport routes, which include the N1 from the Northern Province, Pretoria and Johannesburg to Cape Town; the N9 from Colesberg joining the N10 to Port Elizabeth and the Eastern Cape, the N12 from Johannesburg via Kimberley to Cape Town; and the N10 from Namibia via Upington linking Namibia to the Eastern Cape (Pixley ka Seme DM, 2011).

With regards to the proposed PV10 facility at Hoekplaas, the additional access roads of 6m in width leading from the R357 would be required. Internal roads (gravel) would lead from the main access roads to connect the PV10 facility. These roads would coincide with the existing dirt tracks where possible (see in **Figure 3 4**).

5.8.2 Impact assessment

a) Construction phase

Transporting components to site is likely to necessitate the upgrading of sections of road to ensure clearances and bends are negotiable by trucks. In addition, a new access road and internal gravel roads will be required.

The potential impact of the project on transport is considered to be of low magnitude, regional extent and short term and therefore of **very low (-)** significance, with or without mitigation.

b) Operational and Decommissioning phase

Decommissioning and restoration activities are likely to have similar impacts as those identified for the construction phase.

c) No-go alternative

The no-go alternative will have a neutral impact as the status quo will remain.

d) Cumulative impacts

The proposed PV facility would be constructed consecutively, thereby reducing the number of deliveries to Hoekplaas at a given time. However, a number of other renewable energy projects are also proposed for the Copperton area and could contribute to a general increase in delivery vehicles, etc. on the local and regional road network. This could potentially increase the risk of traffic accidents occurring, but can be mitigated through the implementation of appropriate mitigation measures.

Potential cumulative impacts are considered to be of medium magnitude, regional extent and short term and therefore of **medium (-)** significance, with or without mitigation. No difference in impact significance would result from the proposed alternatives.

5.8.3 Mitigation measures

The following mitigation measures are recommended throughout the project life-cycle for all project alternatives:

1. Ensure that road junctions have good sightlines;
2. Implement traffic control measures where necessary;
3. Transport components overnight as far as possible; and
4. Engage with the roads authorities prior to construction to ensure the necessary road upgrades, permits, traffic escorts, etc. are scheduled.

5.8.4 Traffic impact table

Table 5-14 indicates how the significance ratings of the various impacts were derived.

5.8.5 Traffic conclusion

Construction vehicles are likely to make use of the existing roads to transport equipment and material to the construction site. The number of other renewable energy projects also proposed for the Copperton area could contribute to a general increase in delivery vehicles. However, this is considered to be a temporary impact and should not result in significant impacts if the mitigation measures are implemented. There are no preferences in terms of technology or layout alternatives.

Table 5-14 Summary of potential impacts on traffic

Key impacts	Project (preferred / alternative)	Extent	Magnitude	Duration	SIGNIFICANCE (Without Mitigation)	SIGNIFICANCE (With Mitigation)	Probability	Confidence	Reversibility
Construction Phase									
Impact on transport	**PV10/ PV4A**	Regional	Low	Construction phase	Very Low (-)	Very Low (-)	Probable	Moderate	Reversible
Cumulative impacts									
Impact on transport	**PV10/ PV4A**	Regional	High	Short term	Medium (-)	Medium (-)	Possible	Moderate	Reversible
No-Go									
Impact on transport	**PV6 / PV10A**	Neutral							

5.9 Impact on visual aesthetics

The area surrounding the site is located at some 1,100m – 1,200m above mean sea level. The area is gently undulating to flat, with a very gradual slope east to west. The landscape is covered in shrubs with a few sparse trees. Any tall structures, such as existing power lines, are visible for many kilometres. The potential therefore exists that the proposed PV facility and associated infrastructure would be visible from many kilometres away. As such Mr Stephen Stead, of Visual Resource Management Africa cc and his team, were appointed to undertake a Visual Impact Assessment (VIA) to identify and assess potential visual impacts of the proposed PV facility. A regional landscape survey was undertaken in the field in 16th and 17th of April 2013. The VIA, and comment on the revised layout and technology alternatives, is contained in **Annexure C**.

5.9.1 Description of the environment

The site is situated in a sparsely populated, remote area of the Northern Cape where the dominant landscape feature is the open plains of the Karoo scrub and the Nama Karoo which is strongly associated with South African cultural heritage. Cultural modifications are typically Karoo farming and are limited to the occasional farmstead, which adds to the sense of open space. The dominant land use is agriculture with pasture mainly for sheep, goats and a few cattle. The surrounding farms are widely dispersed and sparsely inhabited and there are no farmsteads found within 5km of the site.

The topography consists of flat plains, with a few ridges sporadically seen within the landscape. These ridges are therefore extremely visually prominent and along with koppies should be conserved and not be transformed or developed in any way.

Copperton is the nearest settlement located at a distance of 6km. This town was originally established for the workers of Copperton Mine, which commenced in 1972 and closed in 1991 when the majority of the houses were demolished. Although there are some trees and shrubs present, the sense of place is one of a derelict, small settlement. The resident population is in the order of 70 people. The remaining built structures include the mineshaft, an adjacent concrete shed and large concrete storage tanks, as well as unused lighting pylons.

The disused copper mine is situated approximately 4km to the north of the proposed site and occupies about 4.5km². The remaining built structures consist of a tall mineshaft, a large, tall concrete shed, concrete storage tanks and unused lighting pylons.

Figure 5-12 View of existing mining infrastructure of Copperton Mine (VRM, 2013)

Alkantpan is situated 13km from the site, south west of Copperton and consists of a high security area with low concrete bunkers and low observation buildings. It does not have a residential component. A few scattered farmsteads are within 5km of the site, although not all are still regularly inhabited.

Existing vertical elements in the landscape are the lines of transmission pylons leading to and from existing substations, telegraph poles, the mine shaft and other tall and bulky remnant mine buildings (**Figure 5-13**). These bring some industrial character into this rural area.

Figure 5-13 View of existing Kronos substation (VRM, 2013)

The existing landscape character has been shaped historically by the uniform nature of the flat Nama Karoo plains, which is strongly associated with South African cultural heritage. Cultural modifications are typically Karoo farming and are limited to the occasional farmstead, which adds to the sense of open space. Receptor sensitivity to these landscapes would be moderate, as the wide open plains add value to the vista and are a core element in the area's sense of place. The landscape has agricultural and cultural value. However, the site does not have a specific sense of place. There are no landscape modifications and this ads value due to the open vista and remote scenic quality.

The flat uniformity of the local landscape results in a merging view with surrounding flat open areas. This is a completely uncluttered landscape. The landscape is of such a scale that the site barely forms a visual focus, even absorbing the clutter of the mine and of the Copperton settlement. The overall visual impression of the locality is one of an open, flat, rural, landscape with some industry, offering long expansive views.

As a result of the flat, horizontal landscape, any vertical structures such as power lines are visible for many kilometres. Key Observation Points (KOPs) surrounding the project site was used to evaluate the potential visual impacts associated with the proposed landscape modifications. They are defined as the people (receptors) located in strategic locations surrounding the property that make consistent use of the views associated with the site where the landscape modifications are proposed. The methodology has identified the R357 Regional Road and the Copperton Road as the two KOPs. Receptor views from these roads are provided in **Figure 5-14** and **Figure 5-15**.

Figure 5-14 Area visible to community: R357 westbound where the proposed panels would be visible on either side of the road (VRM, 2013)

Figure 5-15 Area visible to community: View west from Copperton towards proposed transmission lines (VRM, 2013)

It is anticipated that throughout the project lifecycle various activities would result in visual impacts as described and assessed below.

5.9.2 Impact assessment

a) Construction phase

Hauling and delivery of PV parts

For Layout Alternative 1 (PV10) and Layout Alternative 2 (PV4A), the potential visual impact is considered to be of high magnitude, regional in extent and limited to the construction phase and therefore of **high (-)** significance which can be reduced to **medium (-)** with mitigation.

Hauling and delivery of construction materials

For Layout Alternative 1 (PV10) and Layout Alternative 2 (PV4A), the potential visual impact is considered to be of high magnitude, sub-regional in extent and limited to the construction phase and therefore of **high (-)** significance which can be reduced to **medium (-)** with mitigation.

Location of access road

For Layout Alternative 1 (PV10) and Layout Alternative 2 (PV4A), the potential visual impact is considered to be of medium magnitude, local in extent and limited to the construction phase and therefore of **medium (-)** significance which can be reduced to **low (-)** with mitigation.

Visual disturbance of construction site and laydown area

For Layout Alternative 1 (PV10) and Layout Alternative 2 (PV4A), the potential visual impact is considered to be of high magnitude, local in extent and limited to the construction phase and therefore of **medium (-)** significance which can be reduced to **low (-)** with mitigation.

Movement of construction vehicles with lights

For Layout Alternative 1 (PV10) and Layout Alternative 2 (PV4A), the potential visual impact is considered to be of medium magnitude, local in extent and limited to the construction phase and therefore of **medium (-)** significance which can be reduced to **low (-)** with mitigation.

Construction of trenches for cables

For Layout Alternative 1 (PV10) and Layout Alternative 2 (PV4A), the potential visual impact is considered to be of medium magnitude, local in extent and limited to the construction phase and therefore of **medium (-)** significance which can be reduced to **low (-)** with mitigation.

Construction of PV facility and buildings

For Layout Alternative 1 (PV10) and Layout Alternative 2 (PV4A), the potential visual impact is considered to be of high magnitude, local in extent and limited to the construction phase and therefore of **high (-)** significance which can be reduced to **medium-high (-)** with mitigation.

Construction of transmission lines

For Layout Alternative 1 (PV10) and Layout Alternative 2 (PV4A), the potential visual impact is considered to be of medium magnitude, local in extent and limited to the construction phase and therefore of **medium (-)** significance without and with mitigation.

Completion of site works and fencing

For Layout Alternative 1 (PV10) and Layout Alternative 2 (PV4A), the potential visual impact is considered to be of medium magnitude, local in extent and limited to the construction phase and therefore of **medium (-)** significance which can be reduced to **low (-)** with mitigation.

b) Operational phase

According to VRM's methodology, Visual Management Classes were defined for the site to establish the relative value of the visual resources of an area. It was identified that the site would fall into a Class IV (least value). However, as they are agricultural, this would change to a Class III (moderate value). The Class III objective is to partially retain the existing character of the landscape, where the level of change to the characteristic landscape should be moderate. Management activities may attract attention, but should not dominate the view of the casual observer, and changes should repeat the basic elements found in the predominant natural features of the characteristic landscape.

The proposed landscape modification is large and would generate strong levels of visual contrast. The Class III visual objectives, to retain the existing rural landscape character, would not be met and a change in the landscape character would take place to the site and the immediate surrounds. Through application of impact assessment criteria, a significance rating was undertaken for the following visual aspects:

Maintenance visits using existing road access

For Layout Alternative 1 (PV10) and Layout Alternative 2 (PV4A), the potential impact is considered to be of low magnitude, local extent and long term and therefore of **medium (-)** significance, which can be reduced to **low (-)** with mitigation.

Visual impact of installation

For Layout Alternative 1 (PV10), the potential impact is considered to be of high magnitude, local extent and long term and therefore of **high (-)** significance, with and without mitigation.

For Layout Alternative 2 (PV4A), the potential impact is considered to be of medium magnitude, local extent and long term and therefore of **high (-)** significance, with and without mitigation.

Site buildings and perimeter fence

For Layout Alternative 1 (PV10) and Layout Alternative 2 (PV4A), the potential impact is considered to be of medium magnitude, local extent and long term and therefore of **medium (-)** significance, with and without mitigation.

Impact of transmission line

For Layout Alternative 1 (PV10) and Layout Alternative 2 (PV4A), the potential impact is considered to be of medium magnitude, local extent and long term and therefore of **medium (-)** significance, with and without mitigation. However, Transmission routing Alternative 1 would be the preferred option as it connects to the existing Kronos substation on the adjacent site.

c) Decommissioning

Potential visual impacts could arise during the removal of all PV structures, associated structures and fencing. Activities could include ripping of all internal roads and rehabilitation to natural state which would also result in visual impacts.

Removal of existing road access

For Layout Alternative 1 (PV10) and Layout Alternative 2 (PV4A), the potential impact is considered to be of low magnitude, local extent and long term and therefore of **medium (-)** significance, which can be reduced to **low (-)** with mitigation.

Removal of PV structures

For Layout Alternative 1 (PV10) and Layout Alternative 2 (PV4A), the potential impact is considered to be of medium magnitude, local extent and long term and therefore of **high (-)** significance, which can be reduced to **low (-)** with mitigation.

Removal of site buildings and perimeter fence

For Layout Alternative 1 (PV10) and Layout Alternative 2 (PV4A), the potential impact is considered to be of medium magnitude, local extent and long term and therefore of **medium (-)** significance, which can be reduced to **low (-)** with mitigation.

Removal of transmission line from site to adjacent Eskom line

For Layout Alternative 1 (PV10) and Layout Alternative 2 (PV4A), the potential impact is considered to be of medium magnitude, local extent and long term and therefore of **medium (-)** significance, which can be reduced to **low (-)** with mitigation.

d) No-go alternative

The no-go alternative will have a neutral impact as the status quo will remain.

e) Cumulative impact

The cumulative visual impact of this proposed development is assessed in the context of the other renewable energy projects within the Copperton area, some of which have already been granted environmental authorisation. It is therefore likely that the area will undergo a change to the current landscape character. As the area is strongly associated with the existing Copperton Mine TSF, the Kronos substation and numerous Eskom power lines, and is not associated with any landscape-based tourism, the suitability of using the site as a node for energy development increases. This impact was assessed as being of low magnitude with a local extent and long term and therefore of **medium (-)** significance. This can however be reduced to **low (-)** with mitigation. The main risk with the area as an energy node relates to the post closure phase in the instance where the energy projects are not properly de-constructed and rehabilitated. This scenario would result in significant landscape degradation. As the PV and wind energy projects utilise a renewable resource, it is unlikely that this scenario would take place. Furthermore, by implementing the proposed mitigation measures identified for the decommissioning phase of the proposed and authorised PV facilities on Hoekplaas, this impact can be mitigated on a local scale. **Figure 5-16** represents the viewshed of the existing TSF and the authorised Hoekplaas PV1 visibility. As indicated in the map, the bulk of the proposed project takes place in a shallow bowl and is contained.

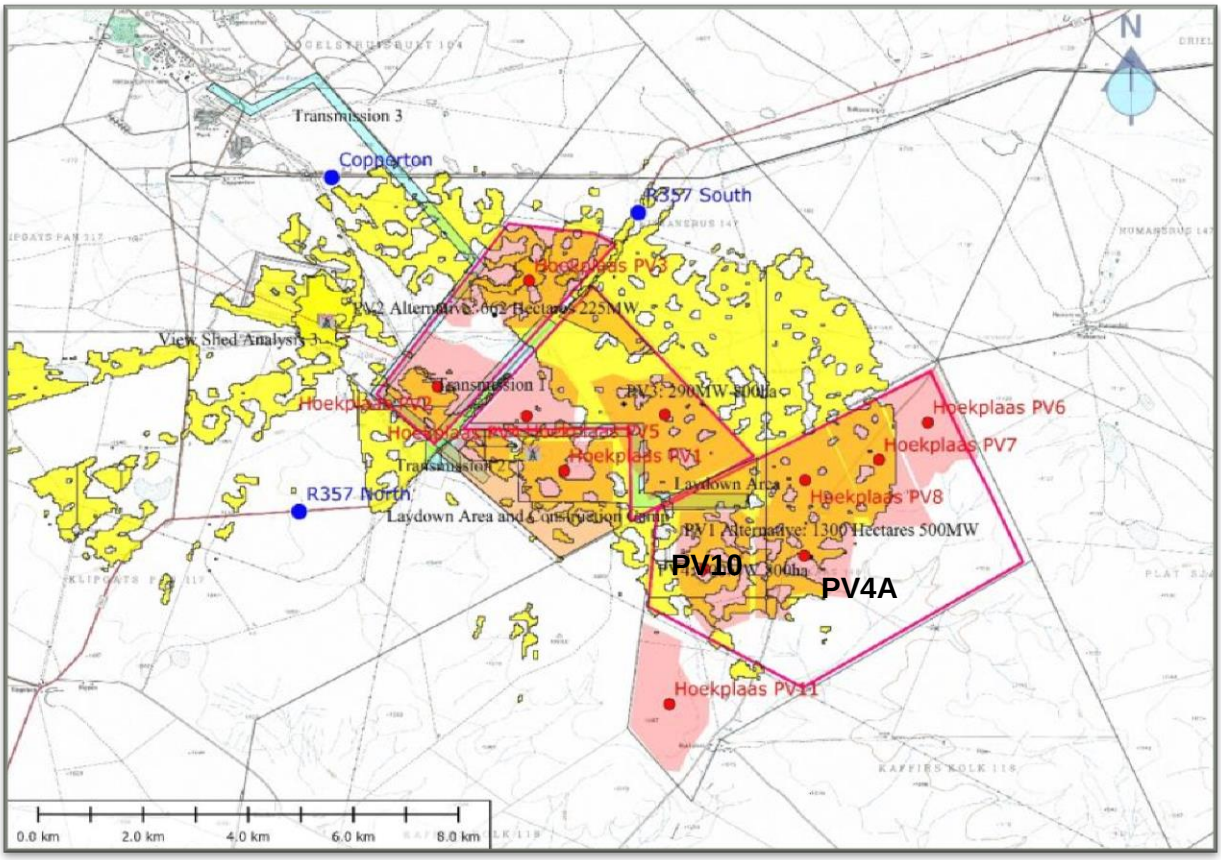

Figure 5-16 Existing TSF and DEA authorised PV viewshed overlaid onto project alternatives map (VRM, 2013)

5.9.3 Mitigation measures

It must be noted that there are a number of other energy-related projects proposed for the immediate surrounds which would significantly alter the surrounding landscape character.

The following mitigation measures are recommended for the **construction phase for all project alternatives:**

1. Good traffic management measures shall be implemented.
2. Local residents shall be kept informed of activities.
3. Access roads shall be kept clean, and measures shall be taken to minimise dust from construction traffic on gravel roads.
4. Surface material shall be scraped off, conserved and used for rehabilitation. The remainder could be used for site development, and any surplus shall be disposed of in a manner that appears natural.
5. If possible, lay-down area(s) should be located outside of direct view of the R357 and shall be screened with shade cloth.
6. Site offices and structures shall be limited to single storey and sited carefully to reduce visual intrusion. Colours shall reflect hues of the surrounding vegetation and / or the ground. Roofs shall be grey and non-reflective. Doors and window frame colour shall reference either the roof or wall colours.
7. Litter shall be regarded as a serious offence and no contaminants shall be allowed to enter the environment by any means.
8. Road construction and management shall take run-off into consideration in order to prevent soil erosion.

9. The top 300mm of naturally occurring substrate shall be separated and then spread over finished levels.
10. The developer shall be required to ensure that the footprint areas of all impact sites utilised in construction but not in operation, are rehabilitated and re-vegetated.
11. The fencing shall be grey in colour and located as close as possible around the PV site. If possible, natural water ways and drainage lines indicated as sensitive should not be fenced in.
12. All PV footprints shall maintain a 100m buffer from the R357. The fence shall not be within 50m of the R357.
13. No construction works shall to be undertaken at night or during weekends.

The visual recommendation that pylons should be constructed of wooden poles is not in line with Eskom's requirements. Construction from wooden poles would require additional supports and infrastructure to support the weight of the power lines when compared to steel structures. A wooden structure would require at least two main ground supports followed by an additional three structural members to construct the H-frame required. Eskom now prefer specifying a single steel monopole structure which is more cost effecting, required less ground footprint and is less of an environmental disturbance. Therefore it is recommended that this mitigation measure as proposed by the visual specialist should not be implemented.

The following mitigation measures are recommended for the **operational phase for all project alternatives:**

14. Good management practices and dust control measures shall be adhered to.
15. All lighting shall be kept to a minimum within the requirements of safety and efficiency.
16. Where such lighting is deemed necessary, low-level lighting, which is shielded to reduce light spillage and pollution, shall be used.
17. No naked light sources shall be directly visible from a distance. Only reflected light shall be visible from outside the site.
18. Necessary aircraft warning lights shall be installed as per the relevant authority requirements.
19. External lighting shall consist of down-lighters shielded in such a way as to minimise light spillage and pollution beyond the extent of the area that needs to be lit.
20. Security and perimeter lighting shall be shielded so that no light falls outside the area needing to be lit. Excessively tall light poles shall be avoided.
21. Repairs shall be carried out promptly and the site buildings and perimeter fence shall be kept tidy.

The following mitigation measures are recommended for the **decommissioning phase for all project alternatives:**

22. All PV structures, associated structures and fencing shall be removed and recycled.
23. Internal roads shall be ripped and then rehabilitated.
24. All impacted footprint areas shall be rehabilitated and re-vegetated.

5.9.4 Visual impact table

Table 5-15 indicates how the significance ratings of the various impacts were derived.

5.9.5 Visual conclusion

Due to the location of the site, and to the small number of potential receptors, it is recommended that, from a visual perspective, the preferred layout (i.e. Layout Alternative 1) proceed.

Transmission routing Alternative 1 would be the preferred option as it connects to the existing Kronos substation on the adjacent site. Due to the remoteness of the location where there are very few receptors, no preference of PV technology type or structure type is defined, and best performance criteria should be utilised to define the optimum PV technology and structure type.

Table 5-15 Summary of potential visual impacts

Key impacts	Project (preferred / alternative)	Extent	Magnitude	Duration	SIGNIFICANCE (Without Mitigation)	SIGNIFICANCE (With Mitigation)	Probability	Confidence	Reversibility
Construction Phase									
Hauling and delivery of PV parts	PV10 PV4A	Regional	High	Construction phase	High (-)	Medium (-)	Definite	Sure	Reversible
Hauling and delivery of construction materials	PV10 PV4A	Sub-regional	High	Construction phase	High (-)	Medium (-)	Definite	Sure	Reversible
Location of access road	PV10 PV4A	Local	Medium	Construction phase	Medium (-)	Low (-)	Definite	Sure	Irreversible
Visual disturbance of construction site and laydown area	PV10 PV4A	Local	High	Construction phase	Medium (-)	Low (-)	Definite	Certain	Reversible
Movement of construction vehicles with lights	PV10 PV4A	Local	Medium	Construction phase	Medium (-)	Low (-)	Definite	Sure	Reversible
Construction of trenches for cables	PV10 PV4A	Local	Medium	Construction phase	Medium (-)	Low (-)	Definite	Sure	Reversible
Construction of PV facility and buildings	PV10 PV4A	Local	High	Construction phase	High (-)	Medium-High (-)	Definite	Certain	Irreversible
Construction of transmission lines	PV10 PV4A	Local	Medium	Construction phase	Medium (-)	Medium (-)	Definite	Certain	Irreversible
Completion of site works and fencing	PV10 PV4A	Local	Medium	Construction phase	Medium (-)	Low (-)	Definite	Certain	Irreversible
Operational Phase									
Maintenance visits using existing road access	PV10	Local	Low	Long term	Medium (-)	Low (-)	Definite	Certain	Irreversible
	PV4A	Local	Low	Long term	Medium (-)	Low (-)	Definite	Certain	Irreversible
Visual impact of installation	PV10	Local	High	Long term	High (-)	High (-)	Definite	Certain	Irreversible
	PV4A	Local	Medium	Long term	High (-)	High (-)	Definite	Certain	Irreversible
Site buildings and perimeter fence	PV10	Local	Medium	Long term	Medium (-)	Medium (-)	Definite	Certain	Irreversible
	PV4A	Local	Medium	Long term	Medium (-)	Medium (-)	Definite	Certain	Irreversible
Impact of transmission line	PV10	Local	Medium	Long term	Medium (-)	Medium (-)	Definite	Certain	Irreversible
	PV4A	Local	Medium	Long term	Medium (-)	Medium (-)	Definite	Certain	Irreversible

Decommissioning Phase									
Removal of existing road access	**PV10 PV4A**	Local	Low	Long term	Medium (-)	Low (-)	Definite	Certain	Irreversible
Removal of PV structures	**PV10 PV4A**	Local	Medium	Long term	High (-)	Low (-)	Definite	Certain	Irreversible
Removal of site buildings and perimeter fence	**PV10 PV4A**	Local	Medium	Long term	Medium (-)	Low (-)	Definite	Certain	Irreversible
Removal of transmission line from site to adjacent Eskom line	**PV10 PV4A**	Local	Medium	Long term	Medium (-)	Low (-)	Definite	Certain	Irreversible
Cumulative visual impacts – Layout 1 and 2									
Visual impact of the PV facility	**PV10 PV4A**	Regional	Low	Long term	Medium (-)	Low (-)	Possible	Moderate	Reversible
No-Go									
Visual disturbance	**PV 6/ PV10A**	Neutral							

5.10 Impact on land capability and erosion potential

The proposed site, is located south-east of Copperton and is used as grazing land for livestock. The proposed PV10 facility would cover an area of approximately 249ha which is currently used for livestock grazing. Hence, the footprint of the proposed facility would reduce the area available for agriculture. Mr Kurt Barichievy of SiVEST (Pty) Ltd was therefore appointed to undertake a desktop Agricultural Impact Assessment. The study considered climate, geology, soils, terrain, land capability, current agricultural practices and agricultural potential. The 2013 desktop Agricultural Assessment and comment on the revised layout and technology alternatives for Hoekplaas Farm are available in **Annexure C**. The findings and recommendations of the study are summarised below.

5.10.1 Description of the environment

For the purpose of this study, agricultural potential is described as an area's suitability and capacity to sustainably accommodate an agricultural land use of the area. In most cases the agricultural potential is benchmarked against crop production.

Climate

Copperton has an arid continental climate with a summer rainfall regime. The region typically experiences hot days and cold nights with the average summer temperature of approximately 33°C and the average winter night time temperatures of approximately 1°C. Most of the rainfall is confined to summer and early autumn. According to the Daily Rainfall Extraction Utility (Lynch, 2003) the Mean Annual Precipitation (MAP) for the Copperton area is approximately 176mm per year with 62% of rainfall occurring between January and April. Considering that 500mm is the minimum amount of rain required for sustainable dry land farming, the MAP of 176mm is extremely low. Therefore without some form of supplementary irrigation, natural rainfall for the Copperton area is insufficient to produce sustainable harvests. This is reflected in the lack of dry land crop production within the area.

Slope

The topography for the proposed site is characterised by a flat and gently sloping landscape. The average gradient is less than 10%, making this area ideal for intensive agriculture, with high potential for large scale mechanisation. The topography is thus not a limiting factor for agriculture.

Land use

The dominant veld type for the area is classified as Bushmanland Basin Shrubland. The proposed site consists of a mix of natural veld and vacant land. Vast un-improved grazing land is interspersed by non-perennial stream beds. Stocking rates for the region are estimated at 1 small animal unit per 6ha and 1 large animal unit per 35ha. According to the land use data there are no signs of formal agricultural fields or cultivation on Hoekplaas Farm.

Soils

The Environmental Potential Atlas for South Africa (ENPAT) for the Northern Cape Province shows the majority of Hoekplaas Farm is dominated by a mix of both red and yellow apedal soil types (**Figure 5-17**). Apedal soils are weakly structured, tend to be freely drained and due to overriding climate conditions these soils will tend to be Eutropohic (high base status).The study area is classified as having an effective soil depth (depth to which roots can penetrate the soil) of less than 0.45m deep and therefore it is a limiting factor in terms of sustainable crop production. According to the Agricultural Geo-Referenced Information System (AGIS, 2012) the soils on Hoekplaas Farm are associated with saline soils with a low water holding capacity, high pH and low organic matter content.

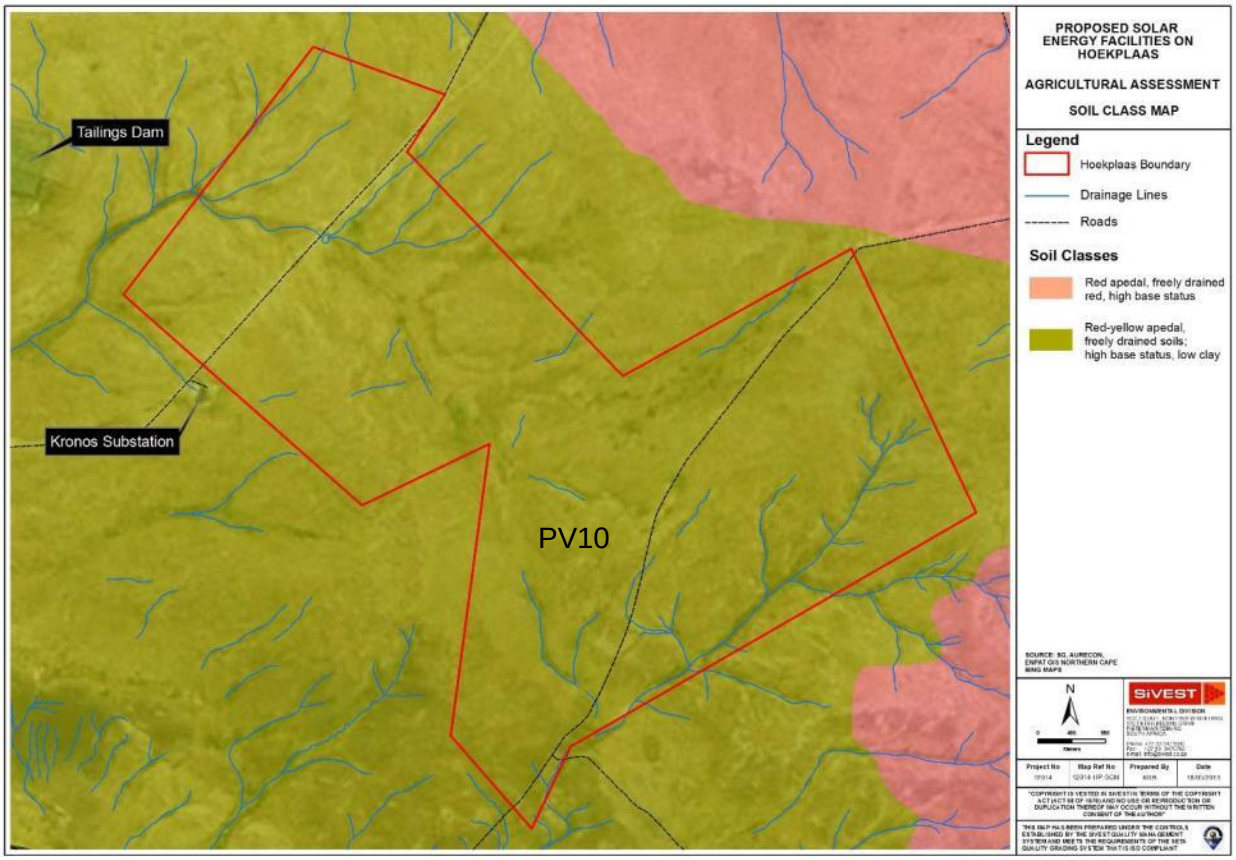

Figure 5-17 Soil Map (SiVEST, 2013)

Agricultural potential

Restrictive climate characteristics, due to the strong summer rainfall regime, moisture stress and low winter temperatures reduce the agricultural potential of Hoekplaas Farm. The ENPAT database provides an overview of the study area's agricultural potential based on its soil characteristics although it does not take prevailing climate into account. The database indicated the study area is dominated by soils which are not suited for arable agriculture, but which can still be used as grazing land (**Figure 5-18**)

Figure 5-18 Grazing land identified on Hoekplaas Farm (SiVEST, 2013)

By taking all the site characteristics (climate, geology, land use, slope and soils) into account the agricultural potential for the majority of the site is classified as being extremely low for crop production, while moderate to moderately low for grazing. This poor agricultural potential rating is

primarily due to restrictive climatic characteristics and soil depth limitations. The site is not classified as high potential nor is it a unique dry land agricultural resource.

5.10.2 Impact assessment

a) Construction phase

Construction activities could result in the loss of agricultural land and degradation of soil resources. Even though the areas directly affected by the proposed developments have low agricultural value and capability, the activities still have the potential to negatively impact the immediate and surrounding soil and land resources. The International Soil Reference and Information Centre (ISRIC), the producers of the World Map of Human-Induced Soil Degradation, recognises two categories of human-induced soil degradation processes. The first category deals with soil degradation by displacement of soil material mainly through water and wind erosion. Soil erosion causes land degradation through a reduction in agricultural potential in many parts of South Africa. The major issues surrounding soil erosion are the loss of the top soil layer required for facility growth, reduction of soil nutrients, siltation of aquatic systems as well as the general land and ecosystem degradation. The second category of soil degradation deals with in-situ soil physical, chemical and biological deterioration. In-situ soil degradation due to anthropogenic activities can be divided into various classes and subclasses:

- Physical Degradation (waterlogging, compaction, crusting, pore modification, etc.).
- Chemical Degradation (eutrophication, acidification, salinisation, heavy metal pollution, etc.).
- Biological Degradation (pathogen introduction, modification of microbial activity etc.).

A single or combination of the aforementioned degradations leads to a decrease in soil quality/health, which in turn influences land capability ratings (ISRIC, 1990). Due to the proposed activities a management plan is required which focuses primarily on soil erosion however also considers generic soil contamination mitigations.

For Layout Alternative 1 (PV10) (including associated infrastructure) and Layout Alternative 2 (PV4A), the potential agricultural impact is considered to be of medium magnitude, site specific in extent and limited to the construction phase and therefore of **low (-)** significance without and with mitigation.

For Transmission Corridor 1 and 2, the potential agricultural impact is considered to be of very low magnitude, local in extent and long term and therefore of **very low (-)** significance without and with mitigation.

b) Operational phase

Rehabilitation, which includes revegetating the PV10 site, would be required as soon as construction is completed. It is recommended that more palatable grass species are used for revegetation purposes to enable faster stocking initiation. It is unlikely that typical vegetation species (Karoo shrubs) would return to the PV site and there is also a possibility that additional shading and water (used for cleaning the panels) could influence the vegetation characteristics Unfortunately there is no local baseline facility to infer results from and thus long term monitoring would improve understanding of these variables. A possible positive impact would be the additional electrical fencing, which could result in a decrease in stock theft.

Layout Alternatives

From an agricultural perspective the post-mitigation impact scores are similar for both Layout Alternative 1 and 2. PV10 is preferred as it influences a smaller area, compared to the larger

coverage of the alternative (PV4A) layout. Layout Alternative1 would also allow normal agricultural activities to continue for longer and on greater portions of the remaining farm. This layout also precludes the major drainage lines and pans, which are associated with the highest grazing potential. The proposed phased approach would reduce cumulative impacts and should also allow for easier site management, rehabilitation and grazing scheduling.

For Layout Alternative 1 (PV10) (including associated infrastructure) and Layout Alternative 2 (PV4A), the potential impact is considered to be of medium magnitude, site specific in extent and long term and therefore of **medium (-)** significance, which can be reduced to **very low (-)** significance with mitigation.

Transmission Line Alternatives

According to spatial land use data and in-field verification, the two proposed route Alternatives routes are dominated by unimproved grazing land and natural veld. Owing to this, the crossing of this land by these power lines would have a very limited impact on agricultural production. Where the lines do cross farm land, normal grazing can still take place under the power lines. The only loss of agricultural land would be directly below the tower's footprint.

The land use data indicates that both Alternatives (Layout 1 and 2) share virtually identical agricultural potential and value, and are both suitable to accommodate the proposed transmission lines. However, Route Alternative 1 (preferred) via Kronos substation is recommended as it represents the shortest proposed power line route, which will minimise disturbance.

For both Transmission Corridor Alternatives, the potential impact is considered to be of very low magnitude, local in extent and long term and therefore of **very low (-)** significance, without and with mitigation.

In terms of agricultural impacts, technology alternatives do not differ significantly and have not been assessed.

c) Decommissioning

Significant loss of agricultural land and or production is not envisioned during this phase of the project for all alternatives. However, standard soil erosion mitigation measures were included in the LEMP to be implemented during decommissioning.

d) No-go Alternative

The no-go alternative will have a neutral impact as the status quo will remain.

e) Cumulative impacts

A number of solar and renewable energy projects have been proposed in the Copperton area, and thus, the cumulative impact of these developments on surrounding farms could become detrimental to local agricultural resources if the loss of usable grazing land is not taken into account when determining optimum herd size. A phased approach (refer to the LEMP included in Annexure D) in combination with erosion control and land rehabilitation, within each farm, will reduce this impact. The inherently low agricultural potential of the region also reduces the overall cumulative impact and thus is considered to be of **low (-)** significance.

5.10.3 Mitigation measures

The following generic mitigation measures are recommended for the **construction phase for all project alternatives:**

1. A planned phased approach shall be adopted.
2. Normal agricultural activities shall continue in unaffected areas.
3. Stocking rates shall be temporarily reduced during the construction phase in order to reduce the risk of overgrazing of the remaining land portions.
4. Land rehabilitation and re-vegetation shall commence immediately upon completion of construction.
5. The soil erosion monitoring and management plan included in the LEMP shall be implemented.

The following mitigation measures are recommended for the **operation phase for all project alternatives:**

1. Initiate land rehabilitation and re-vegetation as soon as possible and continue to monitor land for early signs of degradation and erosion.
2. It is recommended that more palatable species form part of the re-vegetation plan to enable faster stocking initiation.
3. Rotational grazing of small stock (sheep and goats) shall be permitted within the PV site, if feasible. The remaining, un-impacted land can continue to function as un-improved grazing land, its current use.

5.10.4 Agricultural Impact Table

Table 5-16 indicates how the significance ratings of the various impacts were derived.

5.10.5 Agriculture Conclusion

Layout Alternative 1 is considered to be more desirable due to its smaller total footprint. Furthermore, both Transmission Corridor Alternatives (1 and 2) share virtually identical agricultural potential and value, and are both suitable to accommodate the proposed transmission lines. However, Route 1 (preferred) is recommended as it represents the shortest proposed power line route, which would minimise disturbance.

Table 5-16 Summary of potential agricultural impacts

Key impacts	Project (preferred / alternative)	Extent	Magnitude	Duration	SIGNIFICANCE (Without Mitigation)	SIGNIFICANCE (With Mitigation)	Probability	Confidence	Reversibility
Construction Phase – Layout 1 and 2									
Loss of agricultural land & degradation of soil resources	**PV10 PV4A**	Site specific	Medium	Construction Phase	Low (-)	Low (-)	Definite	Sure	Irreversible
Construction Phase – Route 1 and 2									
Loss of agricultural land & degradation of soil resources	**PV10 P V2A**	Local	Very Low	Long Term	Very Low (-)	Very Low (-)	Definite	Certain	Reversible
Operational Phase – Layout 1 and 2									
Loss of agricultural land & degradation of soil resources	**PV10 PV4A**	Site specific	Medium	Long Term	Medium (-)	Very Low (-)	Definite	Sure	Irreversible
Operational Phase – Route 1 and 2									
Loss of agricultural land & degradation of soil resources	**PV10 PV4A**	Local	Very Low	Long Term	Very Low (-)	Very Low (-)	Definite	Certain	Reversible
Cumulative impacts									
Loss of agricultural land & degradation of soil resources	**PV10 PV4A**	Regional	Low	Long Term	Medium (-)	Low (-)	Probable	Unsure	Reversible
No-Go									
Loss of agricultural land & degradation of soil resources	**PV6 / PV10A**	Neutral							

5.11 Storage of hazardous substances on site

As at any construction site, various hazardous substances (less than $5m^3$) are likely to be used and stored on site. These substances may include amongst other things, diesel, curing compounds, shutter oil and cement. Utilisation of such substances in close proximity to aquatic environments such as pans is of greater concern than when used in a terrestrial environment.

5.11.1 Impact assessment

a) Construction phase impacts

The volume that would be stored onsite falls well below the triggers as listed activity in terms of NEMA. However, the necessary precaution measures would be in place and have been included in the LEMP.

The potential impact of spillages is considered to be of low intensity, site specific in extent and long term and therefore of **low (-)** significance, without mitigation. With the implementation of mitigation measures this would reduce to **very low (-)** significance. No difference in impact significance would result from the proposed alternatives.

Typical mitigation measures include storage of the material in a bunded area, with a volume of 110% of the largest single storage container or 25% of the total storage containers whichever is greater, refuelling of vehicles in designated areas that have a protective surface covering and utilisation of drip trays for stationary plant.

b) No-go alternative

The no-go alternative will have a neutral impact as the *status quo* will remain.

c) Cumulative impacts

Activities involving the use of hazardous substances can contaminate and reduce water quality. Topography, soil type and vegetation can affect the amount of contamination that occurs. Runoff from land can carry contaminants into streams, rivers, dams and aquifers. However given the topography, limited rainfall and absence of surface water most of the year it is unlikely that cumulative impacts would be significant. The inherently low risk is considered to be of **low (-)** significance without mitigation and reduced to **very low (-)** with mitigation.

5.11.2 Stored hazardous substances impact table

Table 5-17 indicates how the significance ratings of the various impacts were derived.

Table 5-17 Summary of potential impacts from stored hazardous substances

Key impacts	Project (preferred / alternative)	Extent	Magnitude	Duration	SIGNIFICANCE (Without Mitigation)	SIGNIFICANCE (With Mitigation)	Probability	Confidence	Reversibility
Construction, Operational and Decommissioning phases – All alternatives									
Pollution of aquatic and terrestrial habitats	**PV10/ PV4A**	Site specific	Low	All Phases	Low (-)	Very Low (-)	Probable	Sure	Reversible
Cumulative impacts									
Pollution of aquatic and terrestrial habitats	**All projects within 20km of PV10/ PV4A**	Regional	Low	Long Term	Low (-)	Very Low (-)	Probable	Unsure	Reversible
No-Go									
Pollution of aquatic and terrestrial habitats	**PV10/ PV4A**	Neutral							

5.12 Noise pollution

Noise is generally defined as unwanted sound transmitted through a compressible medium such as air. Noise is reported in decibels (dB). Sound in turn, is defined as any pressure variation that the ear can detect. The number of pressure variations per second is referred to as the frequency of sound and is measured in hertz (Hz).Human response to noise is complex and highly variable as it is subjective rather than objective. The hearing of a young, healthy person ranges between 20Hz and 20,000Hz.

In terms of sound pressure level, audible sound ranges from the threshold of hearing at 0dB to the pain threshold of 130dB and above. Even though an increase in sound pressure level of 6dB represents a doubling in sound pressure, an increase of 8dB to 10dB is required before the sound subjectively appears to be significantly louder. Similarly, the smallest perceptible change is about 1dB.

Many factors affect the propagation of noise from source to receiver. The most important of these are:

- The type of source and its sound power;
- The distance between the source and the receiver;
- The extent of atmospheric absorption (attenuation);
- Wind speed and direction;
- Temperature and temperature gradient;
- Obstacles such as barriers or buildings between the source and receiver;
- Ground absorption;
- Reflections;
- Humidity; and
- Precipitation

Noise will be generated during the construction operation and decommissioning phases of the proposed PV10 project. Construction and decommissioning activities are often similar. Potential sources of noise during the construction phase are increased traffic, operation of heavy machinery during the construction period and additional people in the area.

5.12.1 Description of the Environment

Noise sensitive community members include residences on surrounding farms. Baseline noise levels within the project area are considered ‘rural’ with day and night-time noise levels of 45dBA and 35dBA respectively.

5.12.2 Impact Assessment

a) Construction phase impacts

Construction related noise is mostly associated with the use of diesel mobile equipment, earthworks, concrete batching and building finishing operations. The level and character of the construction noise will be highly variable as different activities with different plant/equipment take place at different times, over different periods, in different combinations, in different sequences and on different parts of the construction site.

The construction phase is expected to have the most notable impact on environmental noise levels and may result in levels above the South African National Standards (SANS) guideline at the site boundaries. Noise impacts during construction would be local, low in magnitude and limited to the construction period. The significance is therefore **low (-)** without mitigation, but can be mitigated to **very low (-)**. With mitigation in place, these impacts could be brought into compliance.

b) Operational and decommissioning phase impacts

It is expected that noise will be generated from the following operational phase installations and activities:

- PV arrays and support structures;
- Power inverters and electrical substations;
- Corona noise from overhead power lines;
- Washing system to clean PV panels;
- Ancillary works; and
- Traffic.

Whereas the PV arrays' tracking motors would generate some noise during the day, other operations, such as the cleaning of the PV panels would occur during night-time. Transformers typically emit a predominant pure tone of 100Hz, which, although not loud in volume, has the potential to induce vibrations in nearby structures. It is expected that the slight increase in traffic would be immaterial in comparison with current traffic related noise. Noise during the operational phase would be long term, local and very low in magnitude. The significance of noise during operation is therefore considered **low (-)** but can be mitigated to **very low (-).**

c) Decommissioning phase impacts

The decommissioning phase would have similar impacts to that of the construction phase. This would however be site specific with a low magnitude and would be short term. The significance for both layout alternatives are therefore considered **low (-)** without mitigation, but can be mitigated to **very low (-)**.

d) No-go alternative

The no-go alternative will have a neutral impact as the *status quo* will remain.

e) Cumulative impacts

Industrial type noise sources are distant enough from the proposed PV facility that cumulative impacts are unlikely. Furthermore, as noted earlier the highest potential for noise to be generated is during the construction phase which will be managed via a number of strict mitigation measures to ensure compliance with the applicable SANS guidelines. The potential impact of noise is considered to be of low intensity, site specific in extent and short term and therefore of **low (-)** significance, without mitigation. With the implementation of mitigation measures this would reduce to **very low (-)** significance.

5.12.3 Mitigation Measures

The following generic mitigation measures are recommended for the **construction phase for all project alternatives:**

1. Construction site yards, workshops, concrete batching plants, and other noisy fixed facilities shall be located well away from noise sensitive areas.
2. Stationary noisy equipment such as compressors and pumps shall be encapsulated in acoustic covers, screens or sheds where possible. Portable acoustic shields shall be used in the case where noisy equipment is not stationary (i.e. angle grinders, chipping hammers).
3. Vehicles shall avoid unnecessary use of the reverse gear to minimise annoyance caused by reverse sirens. Consideration of alternative safety measures may be necessary when taking such a measure.
4. All diesel powered equipment shall be regularly maintained and kept at a high level of maintenance. This shall particularly include the regular inspection and, if necessary,

replacement of intake and exhaust silencers. Any change in the noise emission characteristics of equipment shall serve as trigger for withdrawing it for maintenance.

5. Truck traffic shall be routed away from noise sensitive areas, where possible.
6. Noisy operations shall be combined so that they occur where possible at the same time.
7. Instruction of employees on low-noise work methods, for example, the handling of structural steel and the use radiotelephony rather than shouting for communication.
8. Machines in intermittent use shall be shut down in the intervening periods between work or throttled down to a minimum.
9. Construction activities shall be contained to reasonable hours during the day and early evening.
10. Night-time activities near noise sensitive areas shall not be allowed. No construction shall be allowed on weekends.
11. With regard to unavoidable very noisy construction activities in the vicinity of noise sensitive areas, the contractor shall liaise with local residents and owners on how best to minimise impact, and the local population shall be kept informed of the nature and duration of intended activities.

The following generic mitigation measures are recommended for the **operational phase for all project alternatives:**

1. The design of all major plant components shall incorporate all the necessary acoustic design aspects required to ensure that the generated noise level from the proposed PV10 facility does not exceed the SANS 10103 maximum equivalent continuous day / night rating level (LRdn) of 70dBA for industrial areas at the project boundary.
2. The design shall also to take into account the maximum allowable equivalent continuous day and night rating levels of the potentially impacted sites outside the project boundary. Where the noise level at such an external site is presently lower than the maximum allowed, the maximum shall not be exceeded. Where the noise level at the external site is presently at or exceeds the maximum, the existing level shall not be increased by more than what is considered as acceptable in SANS 10103.
3. The design process is to consider, inter alia, the following aspects:
    - The position and orientation of buildings on the site.
    - The design of the buildings to minimise the transmission of noise from the inside to the outdoors.
    - The insulation of particularly noisy plant and equipment.
    - All plant, equipment and vehicles are to be kept in good repair.
    - Where possible, very noisy activities shall not take place at night.

5.12.4 Noise conclusions

There are no preferences for any alternative based on noise impacts.

5.12.5 Noise impact table

Table 5-18 indicates how the significance ratings of the various impacts were derived.

Table 5-18 Summary of noise impacts

Key impacts	Project (preferred / alternative)	Extent	Magnitude	Duration	SIGNIFICANCE (Without Mitigation)	SIGNIFICANCE (With Mitigation)	Probability	Confidence	Reversibility
Construction phases – All alternatives									
Disturbance of sensitive receptors	**PV10 / PV4A**	Site specific	Low	All Phases	Low (-)	Very Low (-)	Probable	Sure	Reversible
Operational phase – All alternatives									
Disturbance of sensitive receptors	**PV10 / PV4A**	Site specific	Low	All Phases	Low (-)	Very Low (-)	Probable	Sure	Reversible
Decommissioning phase – All alternatives									
Disturbance of sensitive receptors	**PV10 / PV4A**	Site specific	Low	All Phases	Low (-)	Very Low (-)	Probable	Sure	Reversible
Cumulative impacts									
Disturbance of sensitive receptors	**All projects within 20km of PV10 / PV4A**	Local	Low	Long Term	Low (-)	Very Low (-)	Probable	Unsure	Reversible
No-Go									
Disturbance of sensitive receptors	**PV10 / PV4A**	Neutral							

5.13 Dust impacts

Solar technologies results in negligible emissions since no fuels are combusted. However, air pollution in the form of dust emissions would occur during the construction phase.

5.13.1 Description of the Environment

Particulates represent the main pollutant of concern at the construction operations of the PV10 facility. Airborne particulate matter comprises a mixture of organic and inorganic substances, ranging in size, shape and density. These can be divided into Total Suspended Particulates (TSP), thoracic particles or PM10 (particulate matter with an aerodynamic diameter of less than 10 µm) and respirable particles or PM2.5 (particulate matter with an aerodynamic diameter of less than 2.5µm). PM10 and PM2.5 are associated with health impacts with TSP associated with dust fallout.

Gaseous emissions would derive from combustions sources such as construction equipment and vehicles. SO_2, carbon monoxide (CO), CO_2, oxides of nitrogen (NO_x) and hydrocarbons would derive from on-site trucks and heavy construction equipment. Delivery vehicles would also contribute to these gaseous emissions but it is expected that it is not a busy road and therefore the contribution is negligible.

Impact Assessment

Materials handling

The handling of topsoil and gravel for construction operations could be a potential significant source of dust generation at the various transfer points. The quantity of dust generated depends on various climatic parameters, such as wind speed and precipitation, in addition to non-climatic parameters such as the nature and volume of the material handled. Fine particulates are most readily disaggregated and released to the atmosphere during the material transfer process, as a result of exposure to strong winds. Increases in the moisture content of the material being transferred would decrease the potential for dust emission, since moisture promotes the aggregation and cementation of fines to the surfaces of larger particles.

Vehicle entrainment on paved and unpaved roads onsite

Vehicle-entrained dust emissions from paved and unpaved roads are significant sources of dust, especially where there are high traffic volumes on a road. The force of the wheels travelling on unpaved roads causes the pulverisation of surface material. Particles are lifted and dropped from the rotating wheels, and the road surface is exposed to strong air currents in turbulent shear with the surface. The turbulent wake behind the vehicle continues to act on the road surface after the vehicle has passed. The quantity of dust emissions from unpaved roads will vary linearly with the volume of traffic expected on that road.

Windblown dust from stockpiles

Wind erosion is a complex process, including three different phases of particle entrainment, transport and deposition. It is primarily influenced by atmospheric conditions (e.g. wind, precipitation and temperature), soil properties (e.g. soil texture, composition and aggregation), land-surface characteristics (e.g. topography, moisture, aerodynamic roughness length, vegetation and non-erodible elements) and land-use practice (e.g. farming, grazing and mining).

Windblown dust generates from natural and anthropogenic sources. For wind erosion to occur, the wind speed needs to exceed a certain threshold, called the threshold velocity. This relates to gravity and the inter-particle cohesion that resists removal. Surface properties such as soil texture, soil moisture and vegetation cover influence the removal potential. Conversely, the friction velocity or

wind shear at the surface is related to atmospheric flow conditions and surface aerodynamic properties. Thus, for particles to become airborne the wind shear at the surface must exceed the gravitational and cohesive forces acting upon them, called the threshold friction velocity (Shao, 2008).

The main sources of windblown dust are likely to be the proposed topsoil storage piles and cleared land that would be prone to wind-blown dust. Wind erosion would occur during strong wind conditions when wind speeds exceed the critical threshold required to lift and suspend the dust particles. This threshold is determined by the parameters that resist removal such as the particle size distribution of the bed material, moisture content and vegetation. A typical wind speed threshold is given as 5.4m/s for storage piles. Moisture would act as a binding agent and reduce wind erosion emission by around 50%, depending on the amount of water applied. Alternatives include vegetation of exposed surfaces that would not be constructed on.

a) Construction phase

There is a possibility for high off-site dust fallout and PM_{10} and $PM_{2.5}$ impacts due to the extent of the proposed PV10 facility. This could however be managed by maintaining vegetation cover at a minimum height of 40-50 cm to ensure foliage remains on the shrubs (D McDonald, pers. comm., 2013). The vegetation would assist with the infiltration and retention of water, while also reducing the rate at which soil moisture evaporates compared to bare soil. Furthermore, it is expected that only 20% of the construction footprint will be completely cleared of vegetation, while the remaining 80% will remain vegetated. With mitigation in place, primarily comprising of water sprays, these impacts could be mitigated. The potential impact of dust is considered to be of medium intensity, site specific in extent and long term and therefore of **medium (-)** significance (i.e. medium magnitude, local and limited to the construction period), without mitigation. With the implementation of mitigation measures this would reduce to **low (-)** significance.

b) Operational phase

Emissions to air associated with the operational phase would only result from maintenance vehicles. These are regarded as insignificant.

c) Decommissioning phase

The decommissioning phase would mainly include materials handling activities, wind erosion and to a lesser extent vehicle and equipment movement on-site and on the access road. The impacts would therefore be similar to that of the construction phase. The significance of these impacts during decommissioning is also considered to be **medium (-)** which can be mitigated to **low (-)**.

d) No-go alternative

The no-go alternative will have a neutral impact as the *status quo* will remain.

e) Cumulative impacts

Cumulative impacts as a result of dust are considered to be of temporary nature during the construction activities and negligible during the operational phase. The likelihood that construction activities will be localised on small areas at any given time, would reduce the potential for significant off-site cumulative impacts. Cumulative impacts are therefore considered to have a very low magnitude, will be experienced locally and would be long term and would have a significance rating of **very low (-)** with and without mitigation measures.

5.13.2 Mitigation measures

Based on the qualitative evaluation of the proposed PV10 facility and associated infrastructures (all alternatives), generic management objectives are provided to address potential dust generation throughout the project lifecycle.

1. During construction, 80% of the construction footprint shall remain vegetated and be brush cut to a height of 40-50 cm to ensure foliage are left on shrubs.
2. Water sprays shall be applied at the area to be cleared should significant amounts of dust be generated. Moist topsoil would reduce the potential for dust generation when tipped onto stockpiles.
3. Ensure travel distance between clearing area and topsoil piles to be at a minimum.
4. Ensure exposed areas remain moist through regular water spraying during dry, windy periods.
5. Reshape all disturbed areas to their natural contours.
6. Cover disturbed areas with previously collected topsoil and replant native species.

5.13.3 Dust conclusions

The temporary nature of the construction activities, and the likelihood that these activities will be localised and on small areas at any given time, would reduce the potential for significant off-site impacts. Any of the proposed alternatives may proceed.

5.13.4 Dust impact table

Table 5-19 indicates how the significance ratings of the various impacts were derived.

Table 5-19 Summary of dust impacts

Key impacts	Project (preferred / alternative)	Extent	Magnitude	Duration	SIGNIFICANCE (Without Mitigation)	SIGNIFICANCE (With Mitigation)	Probability	Confidence	Reversibility
Construction phases – All alternatives									
Disturbance on sensitive receptors	**PV6 / PV10A**	Site specific	Medium	All Phases	Medium (-)	Low (-)	Probable	Sure	Reversible
Operational phase – All alternatives									
Disturbance on sensitive receptors	**PV6 / PV10A**	Site specific	Medium	All Phases	Medium (-)	Low (-)	Probable	Sure	Reversible
Decommissioning phase – All alternatives									
Disturbance on sensitive receptors	**PV6 / PV10A**	Site specific	Medium	All Phases	Medium (-)	Low (-)	Probable	Sure	Reversible
Cumulative impacts									
Disturbance on sensitive receptors	**All projects within 20km of PV6 / PV10A**	Local	Low	Long Term	Very Low (-)	Very Low (-)	Probable	Unsure	Reversible
No-Go									
Disturbance on sensitive receptors	**PV6 / PV10A**	Neutral							

5.14 Impact on energy production

South Africa has experienced a shortfall in electricity supply in the past few years and continues to experience constrained electricity supply. The proposed project could impact on the ability of Eskom to provide electricity.

5.14.1 Description of the environment

Historical trends in electricity demand in South Africa have shown a consistent increase in demand. There are some years where the demand levels off or decreases but over the long term there is still an increase. Such a decrease in demand was seen in 2009 in line with the global recession, but demand growth has since resumed. As a result, the reserve margin still remains low and Eskom is still short of capacity, a situation that is expected to continue until new base load capacity can be brought online from 2012 onwards. The reserve margin will again be constrained after 2018 should no new base load power stations be constructed. The proposed wind energy facility would be able to provide power to assist in meeting the energy demand within South Africa.

The introduction of renewables such as PV facilities into the national grid would promote energy diversification. Energy diversification refers the use of multiple sources of energy to supply electricity thereby mitigating the risks of utilising specific non-renewable energy sources, such as coal and diesel which have an array of negative environmental and social impacts.

In Eskom's Medium Term Adequacy Report (Week 44 of 2011) it is anticipated that the reserve margin would vary between 6.8 % (2013) and 12.7 % (2011) of Eskom's capacity and it would be necessary to import 1,500MW of electricity annually up until 2014[28].

As noted in **Section 4.1** South Africa aims to procure 3,725MW capacity of renewable energy by 2016 (the first round of procurement). The proposed project could provide 75MW (preferred layout) or 500MW (PV4A) towards this figure.

5.14.2 Impact assessment

a) Operational phase

Given the urgent need for increased production capacity in South Africa, as well as the targeted renewable energy figure, the potential impact of the proposed project on energy production is considered to be of low magnitude, regional and long term and therefore of **low *(+)*** significance, without or with mitigation measures.

No difference in significance would result from the proposed alternatives.

b) No-go alternative

A large number of renewable energy projects are proposed across South Africa which will be submitted to the DoE for consideration during the next bidding round. Of these submissions, the DoE will be able to select the projects that meet their selection criteria to achieve the IRP objectives. The No-go alternative will therefore have a neutral impact should this project not be implemented.

c) Cumulative impacts

As shown in **Figure 3-11** there are eighteen other renewable energy projects proposed for the area, with a combined capacity of 1850-1900MW. This is in addition to the other PV facilities already

[28] Adequacy Report Week 44, 2011.

authorised (PV1 and PV4) and those proposed for Hoekplaas Farm (PV2, PV3, PV5, PV8, and PV9). The potential cumulative impact of these proposed projects on South Africa's energy production is of medium magnitude, regional extent and long term and therefore of **medium (+)** significance.

5.14.3 Mitigation measures

No mitigation measures are recommended.

5.14.4 Potential energy production impact table

Table 5-20 indicates how the significance ratings of the various impacts were derived.

Table 5-20 Summary of potential energy production impacts

Key impacts	Project (preferred / alternative)	Extent	Magnitude	Duration	SIGNIFICANCE (Without Mitigation)	SIGNIFICANCE (With Mitigation)	Probability	Confidence	Reversibility
Operational phase – All alternatives									
Electrcity diversification and contribution to the national grid	**PV10 / PV4A**	Site specific	Low	Operational	Low (+)	Low (+)	Probable	Sure	Reversible
Cumulative impacts									
Electrcity diversification and contribution to the national grid	**All projects within 20km of PV10 / PV4A**	Regional	Medium	Long Term	Medium (+)	Medium (+)	Probable	Sure	Reversible
No-Go									
Electrcity diversification and contribution to the national grid	**PV10 / PV4A**	Low (-)							

5.15 Impact on climate change

The establishment of a PV facility would reduce South Africa's future reliance on energy from coal-fired power stations which could in turn reduce the future volume of greenhouse gases emitted to the atmosphere, reducing the greenhouse effect on a regional, national and international scale.

5.15.1 Description of the environment

Gases which contribute to the greenhouse effect are known to include CO_2, methane (CH_4), water vapour, nitrous oxide, chloroflurocarbons (CFCs), halons and peroxyacylnitrate (PAN). All of these gases are transparent to shortwave radiation reaching the earth's surface, but trap long-wave radiation leaving the earth's surface, acting like a greenhouse. This action leads to a warming of the earth's lower atmosphere, with changes in the global and regional climates, rising sea levels and extended desertification. This is turn is expected to have severe ecological consequences and a suite of implications for humans. Total greenhouse gas emissions reported to be emitted within South Africa for the 2008 year was approximately 435 million metric tons of CO_2 equivalent (UN Statistical division, 2011).

5.15.2 Impact assessment

Greenhouse gases released from a new coal-fired power station are primarily CO_2 with minor amounts of nitrous oxide (N_2O). The Medupi Power Station (4 788MW), currently under construction near Lephalale in Limpopo, is expected to produce 29.9 million metric tons of CO_2 per annum. The emissions from Medupi Power Station would increase South Africa's CO_2 equivalent emissions (2008) by some 7%. This is a significant increase in greenhouse gas emissions, given the aims of the Kyoto Protocol, which are to reduce overall emission levels of the six major greenhouse gases to 5% below the 1990 levels, between 2008 and 2012 in developed countries. While South Africa, as a developing country, is not obliged to make such reductions, the increase in greenhouse gas emissions must be viewed in light of global trends to reduce these emissions significantly.

No greenhouse gases are produced by PV facilities during operation, as PV facilities use solar energy that generate the electricity. Although PV facilities would not completely replace coal-fired power stations within South Africa, since these would still be required to provide base-load, they would reduce South Africa's reliance on them. This would assist in reducing future volumes of greenhouse gas emissions.

A life-cycle analysis looks at the entire chain of activities needed for electricity production and distribution, such as fuel extraction and transport, processing and transformation, construction and installation of the facilities and equipment, waste disposal, as well as the eventual decommissioning. Every energy technology (solar, wind, hydro, coal, gas, etc) has its own very distinct fuel cycle. A comparative life-cycle analysis for the current energy technologies used in Europe was conducted by AUMA (2000). The study focused mainly on emissions from the various energy technologies. Although the results of the analysis are not necessarily entirely accurate in the South African context, they offer a good proxy for a comparative assessment of coal-fired and wind energy facilities in South Africa. The results of the analysis are illustrated graphically in **Figure 5-19** below.

a) Operational phase

It is evident from **Figure 5-19** that environmental impacts associated with renewables, as opposed to fossil fuels such as coal, are significantly less over the entire life-cycle.

While the proposed PV facility would not provide an equivalent amount of energy to a typical new coal-fired power station (75MW-500MW compared to 4,788MW), when considered with regards to climate change and given the spirit of the Kyoto Protocol and that of the Copenhagen Accord, the impact is deemed to be of regional extent, very low magnitude and long term and therefore of **low *(+)*** significance, without mitigation.

5.15.3 Cumulative impacts

As shown in **Figure 3-11** eight other renewable energy projects are proposed on the farm (of which two have received environmental authorisation, i.e. PV1 and PV4), with a combined capacity of 600MW-1015MW. Furthermore, many more PV facilities are proposed throughout South Africa. Given the number of PV facilities proposed across the country, the potential reduction in future greenhouse gas emissions is considered to be of regional extent, low magnitude and long term, and therefore of medium (+) significance.

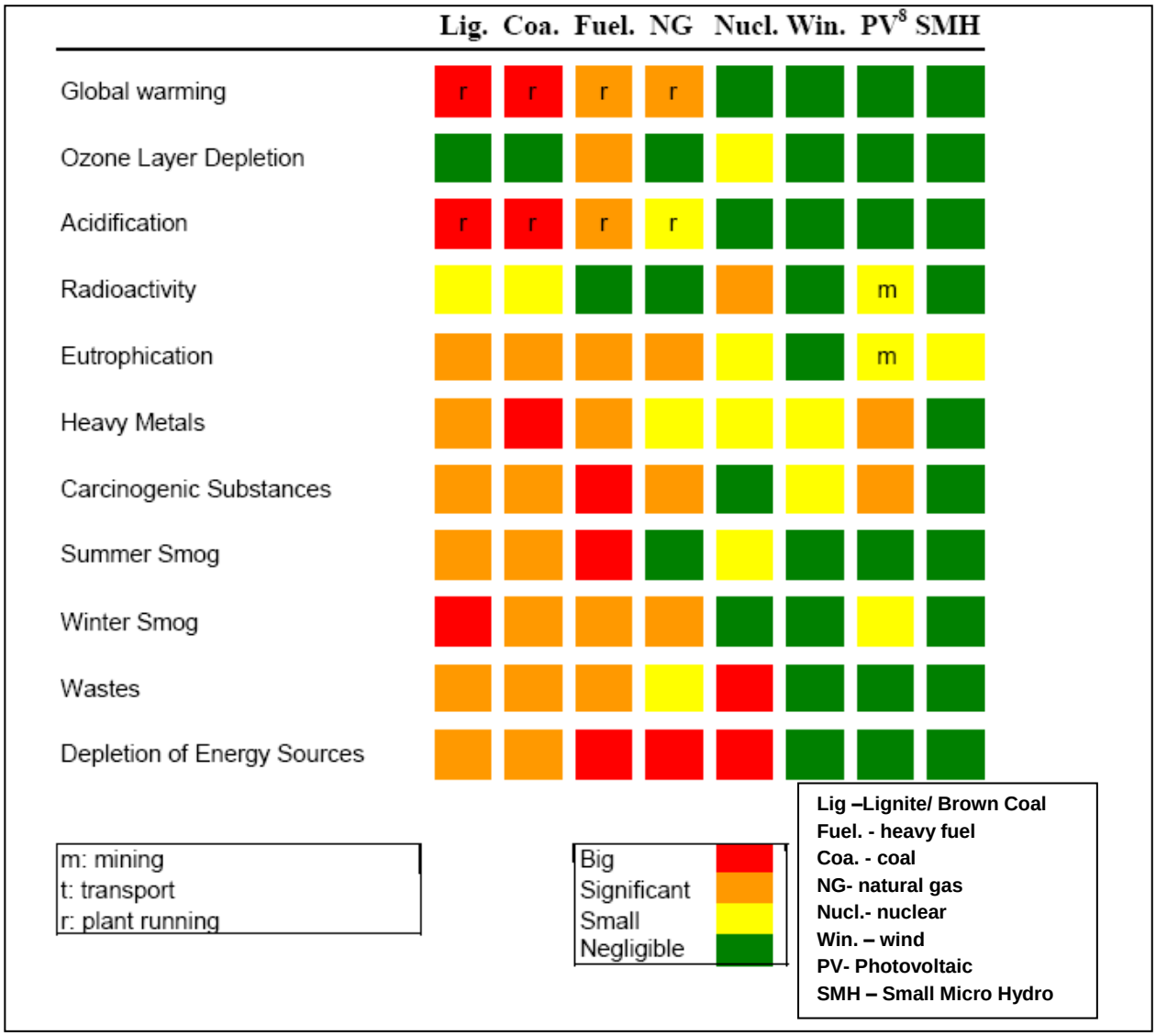

Figure 5-19 Matrix of environmental impacts by categories (AUMA, 2000)

b) No-go alternative

The no-go alternative will have a neutral impact as the *status quo* will remain.

5.15.4 Mitigation measures

No mitigation measures are recommended.

Table 5-21 Summary of potential climate change impacts

Key impacts	Project (preferred / alternative)	Extent	Magnitude	Duration	SIGNIFICANCE (Without Mitigation)	SIGNIFICANCE (With Mitigation)	Probability	Confidence	Reversibility
Operational phase – All alternatives									
Provision of electricity to the national grid reducing reliance on coal powered stations while strengthening the grid with additional capacity.	**PV10 / PV4A**	Site specific	Low	Operational	Low (+)	N/A	Probable	Sure	Reversible
Cumulative impacts									
Provision of electricity to the national grid reducing reliance on coal powered stations while strengthening the grid with additional capacity.	**All projects within 20km of PV10 / PV4A**	Regional	Medium	Long Term	Medium (+)	N/A	Probable	Sure	Reversible
No-Go									
Provision of electricity to the national grid reducing reliance on coal powered stations while strengthening the grid with additional capacity.	**PV10 / PV4A**	Neutral							

5.16 Impact on surrounding land uses

The predominant surrounding land use is agriculture. However a few other land uses exist and the proposed project could impact on these surrounding land uses.

5.16.1 Description of the environment

At the abandoned Copperton mine a PV power generation facility is proposed by Mulilo that recently received an Environmental Authorisation (DEA Ref. No. 12/12/20/1722). Hoekplaas has already received authorisation for PV1 (DEA Ref. No. 12/12/20/2501) and PV4 (DEA Ref. No. 14/12/16/3/3/2/495). Further west of the site is Alkantpan, a weapons testing range, used by many countries for weapons testing. Other proposed activities in the area include a wind energy facility to the east of the site, the proposed by Plan 8 (Pty) Ltd (DEA Ref. No. 12/12/20/2099), six PV facilities to the west and north of the site on farm Klipgats Pan (DEA Ref. No. 14/12/16/3/3/2/486-491) and Struisbult (DEA Ref. No.12/12/20/2502) and wind and solar energy facilities proposed by Mainstream Renewable Energy (Pty) Ltd (DEA Ref. No. 12/12/20/2320/1 and 12/12/20/2320/2) of which the one site (Farm 118/1) borders directly to Hoekplaas and the remaining two sites are approximately 5km (Farm 118/3) and 8km (Farm 102/RE) to the south. In addition, solar energy facilities have been proposed by Juwi Renewable Energy (Pty) Ltd (DEA Ref. No. 14/12/16/3/3/2/313) northwest of Hoekplaas. Four new 75 Megawatt PV facilities (PV1- DEA Ref no.:14/12/16/3/3/2/768; PV2- DEA Ref no.:14/12/16/3/3/2/769 PV3- DEA Ref no.:14/12/16/3/3/2/770 PV4- DEA Ref no.:14/12/16/3/3/2/771) have been proposed to the east of Klipgats Pan on the farm Nelpoortjie, Portion 6 of Farm No. 103 by juwi Renewable Energy (Pty) Ltd. Two transmissions lines (Trans 1-DEA Ref no.:14/12/16/3/3/1/1343 Trans 2- DEA Ref no.:14/12/16/3/3/1/1344) are also proposed to connect the facility at the Kronos substation.

Furthermore, a 1.7km airstrip is located to the west of the site and is used by a number of aeroclubs (e.g. Aeroclub SA). The airstrip would however need to be relocated to Alkantpan as a wind energy facility (by Plan 8 (Pty) Ltd (DEA Ref. No. 12/12/20/2099)) has received approval. The current world record for paragliding (502km) was set from Copperton. Copperton produces good thermal activity with minimal low level obstructions to facilitate safe launching and departures for paragliders and light aircraft.

As noted in **Figure 5-20** the proposed PV generation facility site falls within the general astronomy advantage area and is located approximately 13km north of a SKA station.

5.16.2 Impact assessment

a) Operational phase

Based on the distance to the nearest SKA station the proposed development could potentially impact on the SKA projects. There are two major mechanisms that would result in detrimental effects on radio astronomy observations by PV facilities. The first effect is as a result of the electromagnetic interference generated from the power generation equipment. This is broadband interference, and would result in a complete shutdown of radio astronomy observations. Mulilo has however investigated radio frequency interference (RFI) shielding of the primary switchgear and insulated gate bipolar transistor (IGBT) components. South African SKA Project Office (SASPO) is already involved with the final designs of the authorised PV1 project and will be closely consulted with for the proposed PV facility.

Furthermore a study of the electromagnetic characterisation of similar equipment being used at a PV facility near De Aar was undertaken by Mesa Solutions (Pty) Ltd (Mesa) on 24 April 2014

on behalf of the applicant. Measurements for both conducted and radiated electromagnetic characteristics were taken on cables, inverters, transformers and electric fencing and can be extrapolated to the equipment that will be used for the proposed PV10 facility. These measurements were taken at distances of 10m, 20m and 100m from the perimeter of the facility. The findings from radiated levels, particularly for horizontal polarisation exceeded the The International Special Committee on Radio Interference (CISPR) Class B reference limit at 10m for inverters and transformers by between 3dB and 9dB above 230MHz. It is therefore recommended that further propagation studies be undertaken in consultation with SASPO to determine the potential impact levels on the nearest SKA radio telescope. Potential mitigation measures such as Electromagnetic compatibility (EMC) hardening on inverters and transformer cabinets can be recommended if required. Furthermore, the earth cable of the electric fence was found to be below the 70MHz lower limit of the SKA. Please refer to Annexure D for the executive summary from the report[29].

SASPO has indicated that experience from other equipment that meets the various SANS standards in South Africa indicates that at least a 10km separation distance would be required for equipment at ground level. Based on this fact, Mulilo has selected the current location of the site and performed a view shed analysis (refer to **Figure 5-20**) on them to ensure no line of site impacts were evident.

At heights greater than 50m above ground, this separation distance would increase significantly due to the lack of potential topographical shielding. The second, and probably more significant mechanism, is that of the PV facility acting as secondary transmitters. That is, the solar panels would reflect distant radio signals from other transmitters onto the radio telescopes. This would result in detrimental effects to the radio astronomy facility. International practice suggests that energy facilities should not be in line-of site of any radio telescope receiver.

Based on the information available should the PV generation facility interfere with the SKA satellite station the potential impact is considered to be of low magnitude, regional extent and long term and therefore of **low (-)** significance, without mitigation for all alternatives. Note that the confidence in this impact is considered to be Unsure[30]. No difference in significance would result from the proposed alternatives. The confidence level of this impact would change once a detailed impact analysis is undertaken together with the SASPO.

As mitigation measures have not yet been determined it is not possible to ascertain the significance of the potential impact after mitigation at this point. However, it is anticipated that mitigation measures would be sufficient to reduce the significance of the potential impact to a level acceptable to SASPO. Should monitoring results during the operational phase show that the risk of interference from the proposed PV facility remain, further mitigation methods will be identified and implemented in consultation with SASPO. The significance of the potential impact would only be determined after the detailed impact analysis is complete.

a) No-go alternative

The no-go alternative will have a neutral impact as the *status quo* will remain.

[29] Please note that it was agreed with the DEA that this report will not be available to the public as it is a confidential report that contains proprietary information.

[30] Limited useful information on and understanding of the environmental factors potentially influencing this impact is available.

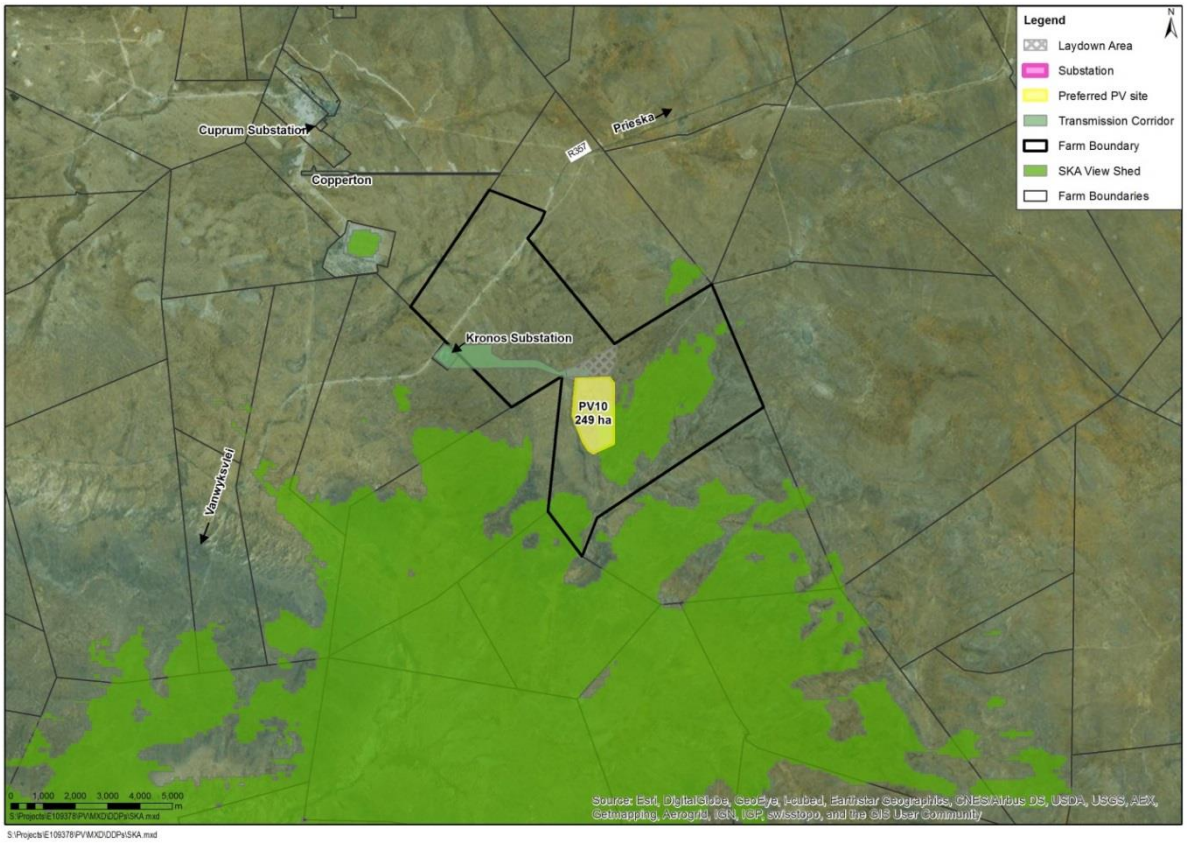

Figure 5-20 Results from a view shed analysis (areas indicated in green) and PV10 (indicated in yellow) undertaken by Mulilo to identify potential impacts on the nearest SKA station (Source Mulilo)

5.16.3 Cumulative impacts

According to the SKA Project Office's approved Electromagnetic Radio Frequency Interference specialist, Mesa (P. van der Merwe. Pers. Comm. 26 February 2015), it is not possible to assess the cumulative impact of multiple renewable energy facilities on the RFI within the Astronomy Geographic Area as the results depends on topographical and propagational complexities and variations in earthing characteristics. The impact of the renewable energy facilities would therefore have to be assessed individually on site at various distances in relation to the nearest SKA radio telescopes. It is however anticipated that the potential impact on SKA would be reduced to a level acceptable to SASPO. Furthermore, it is expected that any other PV energy facilities would need to reduce their potential impact (including cumulative impact) to a level acceptable to SASPO.

5.16.4 Mitigation measures

It is anticipated that mitigation measures would be identified after the detailed impact analysis (including appropriate Electromagnetic Interference studies) has taken place. All studies will be identified and completed in close consultation with the SASPO. Please refer to Appendix D which contains a letter from the applicant to confirm their commitment to implement all mitigation measures required by the SASPO (Annexure K).

5.16.5 Noise impact table

Table 5-22 indicates how the significance ratings of the various impacts were derived.

Table 5-22 Summary of potential land use impacts

Key impacts	Project (preferred / alternative)	Extent	Magnitude	Duration	SIGNIFICANCE (Without Mitigation)	SIGNIFICANCE (With Mitigation)	Probability	Confidence	Reversibility
Operational phase – All alternatives									
Radiated electromagnetic interference on nearest SKA station	**PV10 / PV4A**	Regional	Low	Operational	Low (-)	Low (-)	Probable	Sure	Reversible
Change from agricultural land use		Local	Low	Operational	Low (-)	Low (-)	Probable	Sure	Reversible
Cumulative impacts									
Radiated electromagnetic interference on nearest SKA station	**All projects within 20km of PV10 / PV4A**	Regional	Low	Long Term	Low (-)	Low (-)	Probable	Unsure	Reversible
Change from agricultural land use	**All projects within 20km of PV10 / PV4A**	Local	Low	Operational	Low (-)	Low (-)	Probable	Sure	Reversible
No-Go									
Radiated electromagnetic interference on nearest SKA station	**PV10 / PV4A**	Neutral							

5.17 Cumulative impacts

Cumulative impacts result from multiple actions on receptors and resources over time and are generally additive or interactive (synergistic) in nature. Cumulative impacts can also be considered as impacts resulting from incremental changes caused by other past, present or reasonably foreseeable actions together with the project (European Commission, 1999, cited in Highways Agency, 2008).

The assessment of cumulative impacts is globally recognised as a sub-field of integrated environmental management however there is no single globally accepted methodology. In defining the area of influence of a project, the International Finance Corporation (IFC) Performance Standards (PS) 1 states that the area of influence should include "*Cumulative impacts that result from the incremental impact, on areas or resources used or directly impacted by the project, from other existing, planned or reasonably defined developments at the time the risks and impacts identification process is conducted*" (IFC, 2007: 4), which corresponds with the DEA's definition of cumulative impacts (see Section 5.6.2(e)). The IFC handbook is a universally accepted guideline and the methodology that is based on the World Bank Equator Principles and was has therefore applied to this project.

5.17.1 Technical scope

To address these potential system wide consequences resulting from the combination of individual effects of multiple actions over time, the IFC has published a guideline to advice on the assessment and management of cumulative impacts, the *Good Practice Handbook Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets* (IFC, 2013). The methodology has focused on the current and future natural and social trends within the wider study area and the potential future baseline within this area that may result in cumulative impacts on identified Valued Environmental and Social Components (VECs).

5.17.2 Future development scenario

The IFC Handbook (2013: 10) defines these other projects more loosely as "*other existing and reasonably predictable projects and human activities that do/would affect the VECs*"; and "*where there is a significant potential for further development, but not specific development proposals in place, a scenario of potential development may be considered*."

The IFC Handbook (2013) recognises that a wide variety of methods have been used for cumulative impact assessment analysis and that they should be compatible with the information available. Therefore in this case, a development scenario has been assumed due to uncertainties.

5.17.3 Methodology

A table format has been used to identify the VECs, namely:

- the project activity causing the impacts;
- the impacts to the VEC; and
- the subsequent effect on the receptor.

The future baseline with respect to the specific VEC is also described, taking into account the future development scenario. This is undertaken as a qualitative exercise and has been

informed by specialist studies undertaken as part of this EIA as well as other available information.

The IFC Handbook (2013) states that in order to assess the significance of a cumulative impact on a VEC, it is necessary to establish whether the cumulative impact on VEC condition will approach, be near to, or exceed a threshold. The guideline notes that the analysis may reveal that significant cumulative impacts will exist without the project.

The following five categories were used to determine the significance of cumulative effects and have been aligned with the significance categories used in this assessment. The categories have been ascribed to the cumulative impact on each VEC. Refer to **Table 5-23** below.

Table 5-23 Framework for assessing significance of cumulative effects (source: Highways Agency, 2008)

Significance	Impact
Very High	Effects that the decision-maker must take into account as the receptor/resource is irretrievably compromised.
High	Effects that may become key decision-making issue.
Medium	Effects that are unlikely to become issues on whether the project design should be selected, but where future work may be needed to improve on current performance.
Low	Effects which are locally significant.
Neutral	Effects that are beyond the current forecasting ability or are within the ability of the resource to absorb such change.

The IFC Handbook (2013) requires that the methodology should include the identification, where necessary, of additional project mitigation (beyond that identified in the project EIA) to reduce an estimated unacceptable cumulative impact on a VEC to an acceptable level. For example, the study could identify the potential for other regional strategies that could maintain VECs at acceptable conditions.

However, in this case there was no certainty as the proposed renewable developments are subject to the IPP bidding process, meaning not all projects will ultimately receive preferred bidder status and be constructed.

5.17.4 Current and future growth scenario in the study area

The spatial scope of the cumulative impacts assessment has been identified as those areas within a 20km radius from the project site.

In terms of future developments, EU guidance (European Commission, 1999) suggests that, in general, beyond five years there is too much uncertainty associated with most development proposals. Although the design life of the facility is 20 years, a development scenario over the next five year period has been taken as the temporal scope for the cumulative impact assessment. The current trends in the study area are described in order to make assumptions about the type of growth and development that can be expected in the future, and the impacts of these on VECs.

Copperton has some of the highest renewable energy resource levels in the world, with good existing road infrastructure and accessibility to the national grid through Kronos and Cuprum substations. As a result a number of renewable energy facilities are proposed for the Copperton

area, with one PV facility already in operation. In addition, the applicant already has environmental authorisations for Hoekplaas PV1 and PV4 and is also proposing PV2, PV3,PV5 PV8, and PV9 on the same farm, each of which has its own inherent impact profile, contributing to the net aggregate impact of the entire proposed development. In order to determine the significance level of anticipated cumulative impacts the various specialists considered all other projects within 20km of the site. Cumulative impacts were assessed under each potential environmental aspect in Sections 5.1 to 5.15 and are summarised in **Table 5-24** below.

Table 5-24 Assessment of potential cumulative impacts

Receptor (VEC)	Project activity	Vector / Impact	Impact on receptor	Cumulative impact	Significance with mitigation
Flora	• Vegetation clearance • Earthworks • Stockpiles • Construction spills and leaks • Construction traffic	• Loss of natural vegetation • Loss of ecological processes • Fragmentation • Alien invasion	Habitat degradation or loss. This may diminish the ability to provide ecosystem services.	If development of renewable facilities continues to grow as planned in the Copperton area this would result in further loss of Bushmanland Basin Shrubland and relevant connections with biodiversity and ecosystem services.	**low (-)**
Avifauna	• Construction traffic • Operational traffic • Vegetation clearance	• Disturbance • Displacement • Habitat loss • Mortality	Terrestrial and aquatic biodiversity may suffer from habitat degradation or loss. This may diminish the ability to provide ecosystem services.	Resultant loss of biodiversity and ecosystem services.	**high (-)***
Fauna	• Construction traffic • Operational traffic • Vegetation clearance	• Disturbance • Displacement • Habitat loss • Mortality	Terrestrial and aquatic biodiversity may suffer from habitat degradation or loss. This may diminish the ability to provide ecosystem services.	Resultant loss of biodiversity and ecosystem services.	**low (-)**
Surface water and hydrology	• Design of drainage for access roads • Design of stormwater retention ponds • Design of PV panel technology	• Formation of barriers to drainage areas • Destruction (clearing and levelling) of no-go areas • Erosion and/or sediment inputs to no-go areas • Increased	Impacts on surface water quality in the study area; Modifications of the natural drainage characteristics and changes in drainage flows; risk of flooding.	Resultant widespread water pollution (sedimentation) and modification of the hydrological regime.	**low (-) to very low (-).**

Receptor (VEC)	Project activity	Vector / Impact	Impact on receptor	Cumulative impact	Significance with mitigation
		invasion by alien species, • Waste water reticulation and removal • Stormwater run-off impacts • Increased surface water runoff from panel washing activities • Increased flood peaks • Increased surface erosion in denuded area			
Palaeontology	• Construction activities • Earthworks	• Loss of Palaeontological resources	Impacts on Palaeontological resources in the study area.	Although there is low palaeontological sensitivity of the bedrocks (Dwyka Group, Precambrian basement rocks) throughout the Copperton region there is potential with the increased numbers of facilities.	**low (-)**
Heritage	• Construction activities • Earthworks	• Loss of Archaeological resources • Change in Cultural landscape	Impacts on archaeological and cultural resources in the study area.	Loss of any significant LSA sites would impact on knowledge of the wider region.	**very low (-)**
Social-economic	• Construction traffic • Construction activities • Construction workforce	• Indirect effects of additional workers on site • Impacts of a non-local workforce on society • Disruption or damage to adjacent properties • Impact on local and regional tourism as a result of visual intrusion	Impacts on socio-economic conditions at a regional and/or national scale.	Negative impacts of additional workers on site and non-local workforce in the local communities.	**medium-high (-)**
	• Construction activities and	• Direct Employment and		Significant potential in the contracting	**High (+)**

Receptor (VEC)	Project activity	Vector / Impact	Impact on receptor	Cumulative impact	Significance with mitigation
	• Operation of facility	Skills Development • Economic Multiplier Effects • Landowner revenue • Diversification of the local economy		and installation sectors, followed by the opportunity to harness further economic benefits through manufacture of the PV components locally (within South Africa).	**Medium – High (+)**
Traffic	• Construction traffic • Component Transport traffic	• Congestion • Delays • Incidents and accidents • Road damage	Drivers may be negatively impacted by the additional construction traffic using the network roads some of which are in poor condition. Associated air and noise impacts.	Future development is likely to result in additional construction traffic which could have additional negative impacts on the road condition and for vehicle drivers. Future growth would also bring more vehicles onto the existing road network.	**Medium (-)**
Visual	• Construction traffic • Component Transport • Construction activities • Operation of facility	• Hauling and delivery of PV parts and construction materials • Location of access road • Visual disturbance of construction site and laydown area • Movement of construction vehicles with lights • Construction of trenches for cables • Construction of PV facility and buildings • Construction of transmission lines • Completion of site works and fencing • Maintenance visits using existing road	Impact of similar renewable energy projects in the area resulting in possible landuse conflicts related to rapid and large scale landscape change.	Change in current landscape to a node for energy development increases.	**Low (-)**

Receptor (VEC)	Project activity	Vector / Impact	Impact on receptor	Cumulative impact	Significance with mitigation
		access • Visual impact of installation • Site buildings and perimeter fence • Impact of transmission line			
Agriculture	• Vegetation clearance • Earthworks • Stockpiles	• Loss of agricultural potential • Alien invasion • Loss of topsoil	Loss of agricultural potential.	Resultant loss of agricultural productivity, specifically grazing potential.	**Low (-)**
Soil and Groundwater	• Storage of hazardous materials during construction and operation	• Potential contamination of soil and groundwater	Soil and groundwater are important VEC's in the area given the scarcity of water and farming activities. Contamination of these VEC's will affect receptors as it will further reduce an already scarce resource.	Cumulative contamination of soil and groundwater.	**Very Low (-)**
Noise	• Construction and operation of the facility	• Noise during construction as a result of traffic, equipment, and plant • Noise generated by equipment during operation	The potential for cumulative noise impacts exist near major roads. Other industrial type noise sources are distant enough from the projects that cumulative impacts are unlikely.	Negative impact of construction and operational noise on receptors.	**Very Low (-)**
Dust Pollution	• Dust generated through construction activities	• Increase in dust	Air quality to be impacted by additional dust.	Dust generated during construction would impact on air quality. Dust could also result in a nuisance for nearby receptors.	**Very Low (-)**
Energy production	• Operation of facility	• Increased Energy diversification • Harnessing an area with high renewable resource potential	Current deficient electricity supply and increasing demands.	Provision of electricity to the national grid reducing reliance on coal powered stations while strengthening the grid with additional capacity.	**Medium (+)**
Surrounding	• Construction	• Change in	Loss of sense of	Change land use	**To be**

Receptor (VEC)	Project activity	Vector / Impact	Impact on receptor	Cumulative impact	Significance with mitigation
land uses	activities and Operation of facility	predominant land use.	place and impact on the SKA.	from agricultural to renewable hub. Interference with SKA where currently few EMF generators exist currently.	**determined through additional studies and consultation with SASPO**

* Careful and responsible implementation of the mitigation measures identified by the avifauna specialist, the assessed construction, and operational impacts should be reduced to tolerable and sustainable levels.

5.18 Impacts of the No-Go

Impacts of the No-Go were assessed and are summarised in **Table 5-25** below.

Table 5-25 Assessment of No-Go

	Project activity	Vector / Impact	Impact on receptor	Cumulative impact	Significance
No-Go	• None	• Reduced Energy diversification • Not harnessing an area with high renewable resource potential • Loss of economic benefits and job opportunities	Impact on the provision of electricity from renewable resources and resultant CO^2 from conventional fossil fuel based power facilities. Loss of job opportunities and economic development.	Through not developing alternative forms of energy (renewable energy facilities) South Africa maintains it reliance on the use of fossil fuel based power production which has a multitude of negative impacts on the natural and human environments.	**Medium (-)**

5.19 Mulilo's commitments

Mulilo recognises that by constructing a PV facility near Prieska constitutes a change in the predominant land-use and would result in impacts (both positive and negative) to the biophysical and social environment. Furthermore, as this is a long-term project Mulilo takes cognisance of the need to create a sustainable environment within the community. Part of the IPP bid application requirements to construct a renewable project requires a strict, comprehensive Economic Development Plan to be submitted. This plan would detail the various job creation, socio economic development, skills development, local content and ownership and bind Mulilo to the following initiatives as a minimum:

- Create a local community trust which has an equity share in the project life to benefit historically disadvantaged communities.
- Initiate a training strategy to facilitate employment from the local community.
- Give preference to local suppliers of components for the construction of the facility.
- Put in place a maintenance plan to ensure that broken panels or materials are recycled or are disposed of in an environmentally sound manner.
- Recycle the panels following the decommissioning of the site.

Rehabilitate the site to its original state prior to the construction of the PV facility, as far as possible.

6 CONCLUSIONS AND WAY FORWARD

The purpose of this Chapter is to briefly summarise and conclude the EIAR and describe the way forward.

6.1 Conclusions

A concise summary of the FEIAR is provided below:

6.1.1 Proposed development and location

Hoekplaas PV10 (Pty) Ltd propose to construct a PV facility (PV10) with a generation capacity of approximately 75MW and a footprint of approximately 249ha, on The Farm Hoekplaas No. 146 near Copperton in the Northern Cape.The proposed PV facility would consist of:

- **Transmission line:** 132kV Double Circuit overhead transmission line (Figure 3-3) to connect the facility to the newly constructed Hoekplaas Solar PV5 Substation or an existing Eskom substation which is situated offsite (i.e. Kronos substation).
- Hoekplaas Solar PV10 will connect to the grid via the A D C routing option should no other project be awarded an EA and Preferred Bidder Status. However, should Hoekplaas PV5 be awarded an EA and Preferred Bidder Status the line would connect from A to D (**Figure** 3-4).
- **Substation:** An onsite 132kV, 6 bay.
- **Roads:** Access and internal roads for servicing and maintenance of the facility would use routing XYQ if no other projects are awarded an EA and Preferred Bidder Status. If PV5 or PV7 are awarded an EA and Preferred Bidder Status, the connection route would be Y to Q. No access route would be required for PV10 if PV8 or PV9 were awarded an EA and Preferred Bidder Status (Figure 3-6**).**
- **Boundary fence:** The facility would have an electrical or barbed wire fence for safety and security.
- **Buildings:** Buildings would likely include an onsite substation, a connection building, operational and maintenance building, guard cabin, an electrical substation and solar resource measuring substation.

Multiple PV facilities are proposed for Farm Hoekplaas and shared infrastructure may occur if more than one project is awarded:

- **Stormwater infrastructure:** Including, but not limited to, drainage spines, drainage channels, multiple apron outlets, detention areas and kinetic energy dissipaters.
- **Buildings:** Buildings would likely include an onsite substation, a connection building, operational and maintenance building, guard cabin, an electrical substation and solar resource measuring substation.

The following infrastructure can also be shared among the proposed PV facilities and received environmental authorisation in terms of the PV1[31] and PV4[32] projects on farm Hoekplaas:

- **Water supply infrastructure:** It is proposed that potable water would be obtained from the Alkantpan pipeline while negotiating sourcing of water from the local municipality.

31 DEA Ref. No. 12/12/20/2501 & NEAS Ref. No. DEAT/EIA/0000611/2011
32 DEA Ref. No. 14/12/16/3/3/2/495 & NEAS Ref. No. DEA/EIA/0001756/2013

- **Buildings:** Buildings would likely include Operations and Maintenance Building, guard cabin, an electrical substation and solar resource measuring substation to monitor the performance of the plant compared to the solar radiation.[33]
- **Laydown areas:** Two laydown areas have been identified and one of these would be used during the construction phases of the proposed PV facility. This laydown area has already received authorisation under the authorised PV1 and PV4 facility.

6.1.2 Alternatives that were considered

An important part of an EIA is to consider alternatives to achieve the most environmentally and socially responsible development. A number of project related alternatives were considered in this EIA, as outlined in **Table 6.1**
Table 6-1 below.

Table 6-1 Alternative types and description

Alternative Type	Description
Location alternatives	• One location for the proposed PV10 facility, i.e. Hoekplaas
Activity alternatives	• Solar energy generation via a PV facility • No-go" alternative to solar energy production
Site layout alternatives	• One 75MW PV facility (Layout Alternative 1) (PV10) • One PV facility with a generation capacity of 500MW (Layout Alternative 2) (PV4A)
Technology alternatives	• Conventional PV vs. CPV technology • Single Axis vs. Fixed Axis PV tracking technology
Routing Alternative	• 132kV transmission line connecting to the Hoekplaas Solar PV5 or Kronos Substation (Route Alternative 1, preferred) • 132kV transmission line connecting to the Cuprum Substation (Route Alternative 2)

Furthermore, in terms of the legislation, the alternative of no development has also been considered.

[33] Shared infrastructure may occur if more than one project is awarded but each facility will need to have the necessary infrastructure authorised should they need to operate individually.

6.1.3 Need for the PV facility

South Africa currently generates the majority of its required electricity from coal. South Africa has always been heavily dependent on coal and is currently looking at ways to diversify its power-generating capacity. Concerns on climate change, the on-going exploitation of non-renewable resources and international pressure to increase renewable energy generation is motivation for diversification in power generation. Renewable energy is recognised internationally as a major contributor in reducing the effects of climate change, as well as providing a wide range of environmental, economic and social benefits that can contribute towards long-term global sustainability. South Africa is subject to some of the highest levels of solar radiation in the world which is why the proposed PV facility is expected to contribute positively towards climate change mitigation. The establishment of the proposed PV facility would strengthen the existing electricity grid. Moreover, the project would contribute towards meeting the national energy target as set by the DoE. The proposed project would also have international significance as they contribute to South Africa being able to meet some of its international obligations by aligning domestic policy with internationally agreed strategies and standards as set by the Kyoto Protocol and United Nations Convention on Biological Diversity, all of which South Africa is a signatory to.

Aurecon confirms that this Revised FEIAR provides a comprehensive assessment of the environmental issues associated with each of the feasible alternatives of the proposed project outlined in the FSR and the associated Plan of Study for EIA. These impacts and alternatives were derived in response to inputs from consultation with I&APs, provincial and local authorities, and the EIA project team. As per the requirements of NEMA, this EIR investigation has reviewed a range of project alternatives and contemplated the array of potential environmental impacts associated with the proposed projects activities.

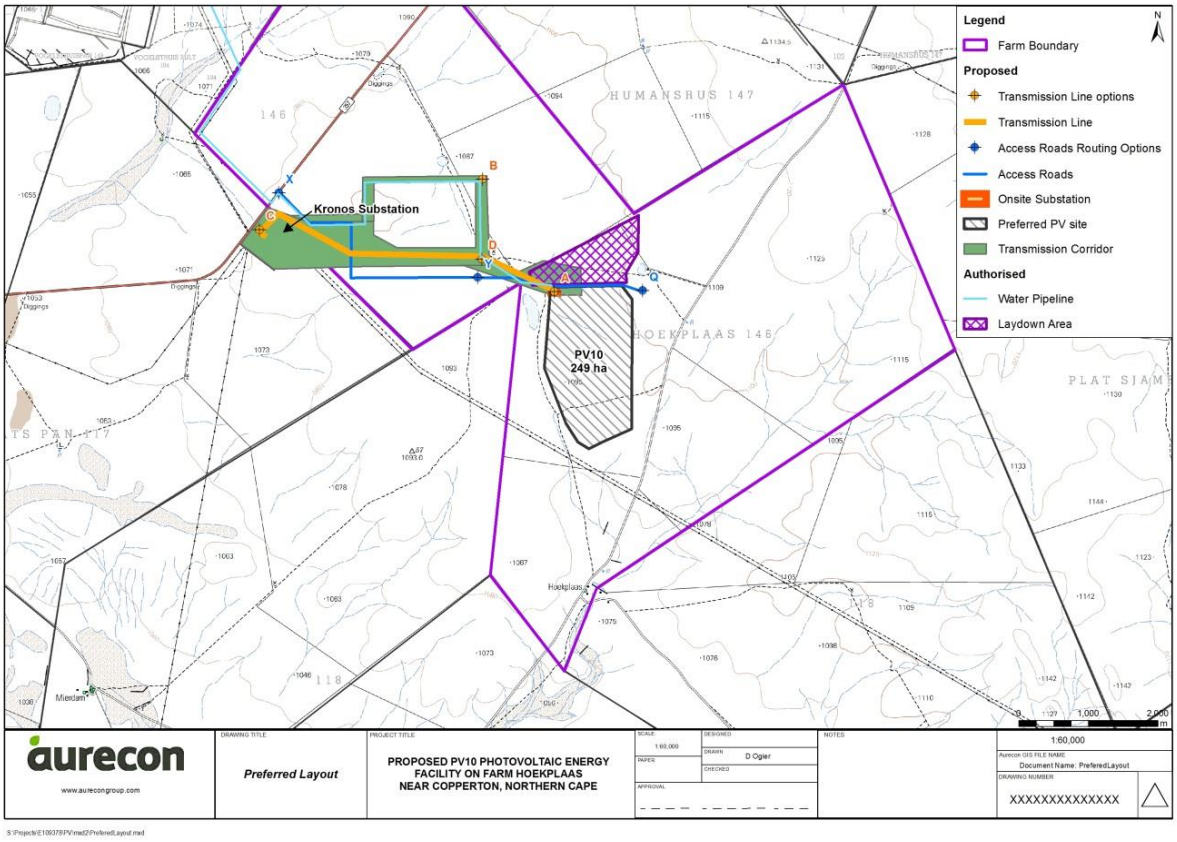

Figure 6-1 Layout Alterative 1 PV6 (preferred)

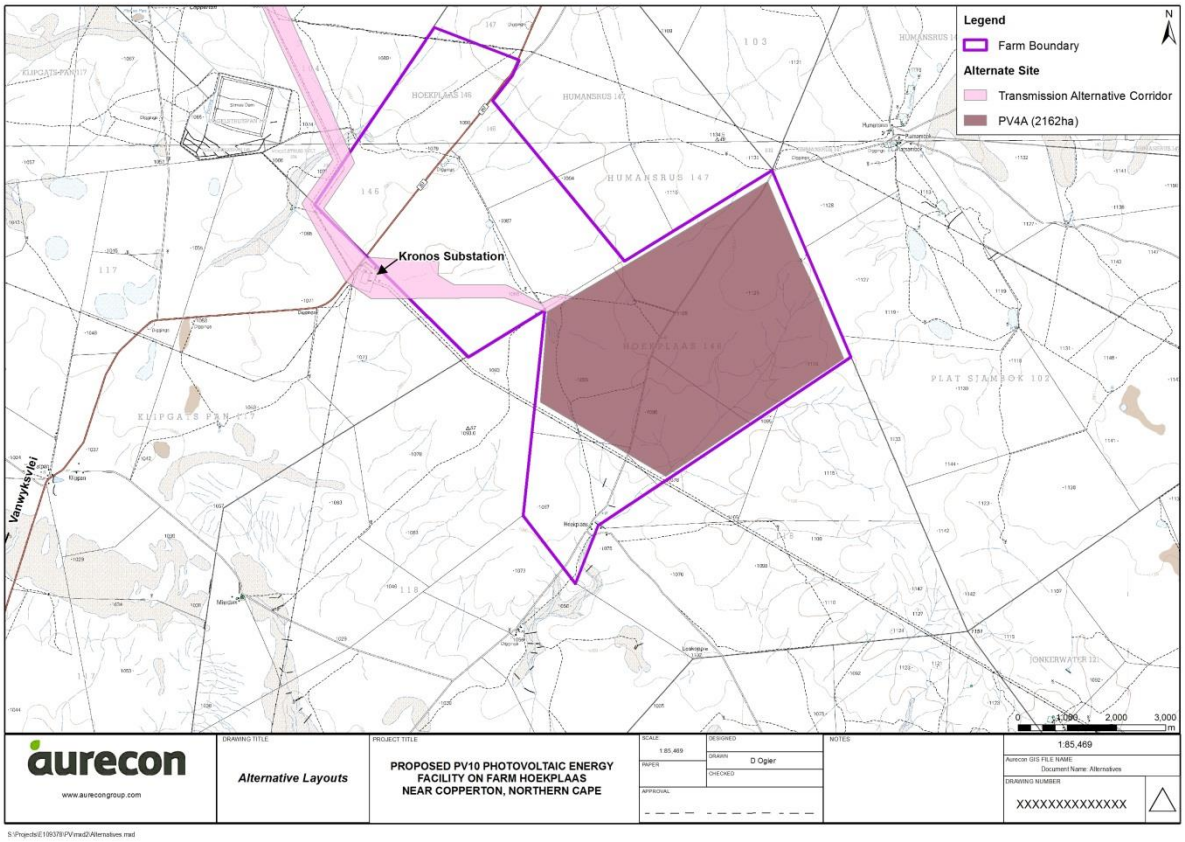

Figure 6-2 Layout Alternative 2

6.1.4 Potential impacts

The proposed PV facility and associated infrastructure could potentially result in a range of environmental and socio-economic impacts. The scoping phase identified the potential impacts that could be expected. Based on site specific characteristics, certain impacts would be more significant than others. The following potential impacts were identified:

- Impact on flora;
- Impact on avifauna;
- Impact on fauna;
- Impacts on surface water resources; including sedimentation and erosion;
- Impact on hydrology;
- Impacts on palaeontology and heritage resources;
- Social impacts (positive and negative) including impact on local economy (employment);
- Increased traffic;
- Visual impacts;
- Impact on agricultural resources;
- Storage of hazardous substances on site;
- Noise pollution;
- Dust pollution;
- Impact on energy production;
- Impact on climate change;
- Impact on surrounding land uses; and
- Cumulative impacts.

During the EIA, a team of specialists assessed the significance of the potential impacts of the alternatives identified. This is done by means of specific methodology developed for assessment of significance of impacts, based on the specific characteristics of the site and the proposed PV facility. The findings are presented in the EIA and briefly described below.

Please refer to **Table 6-17** for a summary of the significance of the environmental impacts associated with this proposed project as discussed below.

a) Impact on flora

The study area falls within the Nama Karoo Biome with Bushmanland Basin vegetation type mainly found on site. This vegetation type is considered to be Least Threatened. Potential impacts to the ecology of the study area and the significance thereof is indicated in **Table 6-2** below.

Table 6-2 Impact on flora

Layout Alternatives*	CONSTRUCTION		OPERATION		DECOMMISSIONING	
	No Mitigation	With Mitigation	No Mitigation	With Mitigation	No Mitigation	With Mitigation
Layout Alt.1 & 2	Low (-)	Low (-)	Medium (-)	Very Low (-)	Low (-)	Low (-)
Cumulative	Low (-)					

* All alternatives assessed includes associated infrastructure.

The following mitigation measures are recommended for the construction phase of all project alternatives:

- All construction activities shall be contained within the PV facility footprints to minimise disturbance outside these areas.

- Protected trees must be avoided or if that is not possible, permits must be obtained for removal and transportation. Any Aloe species, particularly Aloe claviflora shall be relocated if affected by the PV facility.

The following mitigation measures are recommended for the operational phase of all project alternatives:

- A rehabilitation plan for the site shall be compiled and implemented with the aid of a rehabilitation specialist.
- Shallow depressions, well defined pans and seasonal watercourses shall be avoided, with buffer zones of at least 30m around pans and from 'Leegte Shrubland'. Roads and transmission lines traversing such areas shall be avoided where possible and if not, physical impacts shall be limited as far as possible.

The following mitigation measures are recommended for the decommissioning phase of all project alternatives:

- All construction activities shall be contained within the PV facility footprint to minimise disturbance outside these areas.
- A rehabilitation plan for the site shall be compiled and implemented with the aid of a rehabilitation specialist.

b) Impact on avifauna

The broader impact zone of the proposed PV facility is contained within an extensive tract of undulating, remote, arid Bushmanland Karoo, while the immediate vicinity includes degraded natural veld with some anthropogenic influences. The broader area could support over 200 bird species, including up to 18 red-listed species, 68 endemics, and five red-listed endemics. The following impacts in **Table 6-3** are anticipated.

Table 6-3 Impact on avifauna

IMPACTS	CONSTRUCTION**		OPERATION		DECOMMISSIONING	
	No Mitigation	With Mitigation	No Mitigation	With Mitigation	No Mitigation	With Mitigation
Layout Alt.1 &2*	Medium-High (-)	Low-Medium (-)	Medium-High (-)	Medium-High (-)	Medium-High (-)	Medium (-)
Cumulative	High (-)**					

* All alternatives assessed includes associated infrastructure.

** Careful and responsible implementation of the mitigation measures identified by the avifauna specialist, the assessed construction, and operational impacts should be reduced to tolerable and sustainable levels.

Over and above the application of generic best-practice principles, the following mitigation measures are recommended for the construction phase of all project alternatives:

- Pre-construction monitoring shall be undertaken as part of the long term avifauna monitoring programme detailed in Annexure C of the Avifaunal Report.
- The construction footprint shall be kept to the minimum size required for development.
- Construction timeframes shall be reduced as much as possible.
- The entire length of all new lines shall be marked with bird flight diverters to avoid additional cost should this be retro-fitted post-construction based on the findings of the monitoring programme.

The following mitigation measures are recommended for the operational phase of all project alternatives:

- To protect the Martial Eagle nest site located on the western edge of Hoekplaas, it shall be necessary to relocate the nest site to a more distant, less disturbed area (e.g. Jenkins et al. 2007, 2013). The extent and distribution of other renewable energy developments planned for the immediate vicinity probably precludes a short-range relocation, and a dedicated structure, strategically situated off the power line network aggregated around the Kronos substation, may be the best option. The requirements of such an undertaking shall be further investigated during future visits to the site as part of the pre-construction monitoring programme.
- Development shall be excluded from areas/microhabitats identified during the bird monitoring programme as being of particular value to threatened/priority species (e.g. Red Lark, Sclater's Lark).
- Noise and disturbances associated with maintenance activities at the facility shall be kept to aminimum once it becomes operational.
- The length of all new power lines installed shall be kept to the minimum. Where possible transmission lines shall be buried. If lines cannot be buried, all new lines shall be marked with bird flight diverters (Jenkins et al. 2010) along their entire length.
- All new transmission line infrastructure shall be adequately insulated and bird friendly in configuration (Lehman et al. 2007).
- The minimum area shall be used for fencing, given that these may present a collision risk for collision-prone birds.
- A comprehensive impact monitoring programme shall be implemented of which the results shall be used to inform and refine a dynamic approach to mitigation. Details of this are set out in Annexure D.
- Should the results from the monitoring programme show that the cumulative impacts from the multiple renewable energy projects in the Copperton area are causing high negative impacts on bird species on a local and regional scale (i.e. beyond a radius of 10km from Hoekplaas), DEA shall be contacted to discuss the implementation of an integrated mitigation approach by all renewable energy facilities contributing to the cumulative negative impact on avifauna.
- Specialist advice shall be sought in devising effective avian deterrents to minimise associated damage should conflict arise with local bird populations due to fouling of critical components, etc.

The following mitigation measures are recommended for the decommissioning phase of all project alternatives:

- Decommissioning timeframes shall be reduced as much as possible.
- Noise and disturbances associated with decommissioning activities shall be kept to the minimum.

c) Impact on fauna

The removal of vegetation could potentially result in habitat loss. Although any affected fauna would generally be largely mobile and would be able to relocate, this impact was nonetheless assessed. The following impacts in **Table 6-4** are anticipated.

Table 6-4 Impact on fauna

IMPACTS	CONSTRUCTION		OPERATION		DECOMMISSIONING	
	No Mitigation	With Mitigation	No Mitigation	With Mitigation	No Mitigation	With Mitigation
Layout Alt.1 & 2*	Low-Medium (-)	Low (-)	Low (-)	Low (-)	Low (-)	Very Low (-)
Cumulative	Medium (-)					

* All alternatives assessed includes associated infrastructure.

The following mitigation measures are recommended for the construction phase for all project alternatives:

- Compile and implement a vegetation rehabilitation plan with the aid of a rehabilitation specialist, for inclusion in the Construction EMP. The specialist is to recommend species to be used in rehabilitation as well as any special measures for rehabilitation such as shade-netting and alien vegetation removal.
- Once construction is complete, disturbed areas shall be rehabilitated and maintained with appropriate local indigenous vegetation.
- The construction phase shall be closely monitored by an ECO who shall identify any areas requiring rehabilitation in the post-construction phase. The restoration of those areas must follow the construction phase.
- Demarcate no-go areas identified during pre-construction monitoring.
- Low-lying depressions and watercourses shall be avoided wherever possible.
- Shallow depressions and well defined pans shall be avoided and buffered by at least 30m.
- All endorheic pans shall be avoided with no construction within 30m of the pan.
- The site shall be cleared in sections as required for construction and not all at once.
- The top 300mm of the soil layer shall be stockpiled for rehabilitation purposes.
- Rehabilitation of completed sections with appropriate local indigenous vegetation shall start immediately and bare soil shall be covered by straw as protection against wind while vegetation re-establishes (or as required by the rehabilitation specialist).

The following mitigation measure is recommended for the operational phase for all project alternatives:

- Small ground level openings, 20-30cm in height, shall be allowed for in the electrical fence to facilitate the movement of small mammals and reptiles through the site.

d) Impact on surface water resources

The study area falls within the arid region of South Africa. Average annual rainfall is low (189mm) and as such it is expected that few rivers and low groundwater tables will be found in the area. With few rivers draining the area, apart from the Orange River 42km east of the site, endorheic (inward flowing) pans occur. Pans are an important wildlife habitat, particularly for birds (especially migratory birds), mammal species and invertebrates. A small number of pans are located on the site. Numerous small dry drainage lines cross the area. Furthermore, it has been estimated that the 1:20 year flood peak for Alternative 1 would increase by 24% and for Alternative 2 with 46%. The increased flood peaks would increase the risk of a second breach of a farm dam and inundation of the main farmhouse and farm worker dwellings. The following impacts in **Table 6-5** are anticipated.

Table 6-5 Impact surface water resources

IMPACTS	CONSTRUCTION		OPERATION		DECOMMISSIONING	
	No Mitigation	With Mitigation	No Mitigation	With Mitigation	No Mitigation	With Mitigation
Layout Alt.1*	Medium (-)	Low (-)	Medium-High (-)	Low (-)	Medium (-)	Low (-)
Layout Alt.2*	High (-)	Low (-)	Medium-High (-)	Low (-)	Medium (-)	Low (-)
Cumulative	Low (-) to Very Low (-)					

* All alternatives assessed includes associated infrastructure.

Potential stormwater mitigation measures in terms of the design of the system (as described in the preliminary Stormwater Management Plan included in **Annexure C**) must be considered and applied where applicable, including the following:

- The increase in flood peak should be reduced to pre-development levels before the runoff leaves the PV facility which could be achieved by using attenuation ponds.
- Discussions should be held with the landowner regarding flood risk implications pre- and post-development. Possible measures to manage flood risk which would require further investigation are:
  - the determination of a 1:100 year floodline for Hoekplaas farm house and other dwellings using a detailed survey;
  - improve the capacity of the spillway channel; and
  - protect the housing with a berm.

The following mitigation measures are recommended for the construction phase for all project alternatives:

- Should denudation be severe, rehabilitation of these areas shall be required and involve the establishment of vegetative cover comparable to surrounding indigenous vegetation. Planting grasses by means of seeds would likely be the easiest and quickest form of mitigation. It is critical that no alien species are used for re-vegetation.
- The area shall be inspected at regular intervals (as determined by the rehabilitation specialist) for the presence of alien species and these removed.
- Ephemeral drainage areas shall not be blocked such that the movement of water is impeded or diverted.
- Denuded areas and stockpiles of aggregates or soil shall be protected in such a way that erosion or sediment inputs to no-go areas during rainfall events are prevented.
- Straw barriers shall be installed in drainage paths to act as a check dam, i.e. to reduce velocity, and as a sediment trap during construction. These erosion barriers shall be placed at intervals of 25-50m apart in the drainage paths to intercept suspended solids from entering the natural drainage paths.
- Packed stone (also known as rip-rap) shall be placed as liners for channel spines (in consultation with an appropriately qualified aquatic specialist). These comprise packed stones with an average diameter of 100mm, packed in the channels as lining material to control flow velocities and hence erosion.
- Earth cut-off channels shall be provided at the boundaries of the facility to direct concentrated surface flow away from the site and reduce the possibility of flooding from runoff origination from outside the site (in consultation with an appropriately qualified aquatic specialist).
- Erosion protection shall be provided at channel outfalls and positions of high flow concentration. These comprise packed stones with an average diameter of 200mm, packed in the drainage path to control flow velocities and hence erosion.
- The sediment and erosion control measures shall remain in place until construction is complete and will require regular monitoring during construction and reinstatement as necessary.

The following mitigation measures are recommended for the operational phase for all project alternatives:

- Design requirements as determined by the Stormwater Management Plan.

The following mitigation measures are recommended for the decommissioning phase for all project alternatives:

- Vegetative cover comparable to surrounding indigenous vegetation shall be restored according to the rehabilitation plan developed by an appropriately qualified rehabilitation specialist. It is critical that no alien species are used for re-vegetation.
- The area shall be inspected for the presence of alien species and these shall be removed. This shall occur on an annual basis (or as determined by the rehabilitation plan) for at least the first three years following decommissioning.

e) Impact on heritage resources (including palaeontology)

In general the Karoo and Bushmanland area is documented to contain abundant stone artefacts from the Early (ESA) and Middle Stone Age (MSA), while occasional Later Stone Age (LSA) is also present. The site does not have any buildings or structures of heritage value, while the cultural landscape is composed of an ephemeral pan with gum trees, a windmill, water troughs and an old cement dam alongside it. The only fossils recorded from the Dwyka succession in this region are ice-transported erratic boulders of Precambrian limestone or dolomite that contain small stromatolites (microbial mounds or columns). The following impacts in **Table 6-6** are anticipated.

Table 6-6 Impact on heritage resources (including palaeontology)

IMPACTS	CONSTRUCTION		OPERATION		DECOMMISSIONING	
	No Mitigation	With Mitigation	No Mitigation	With Mitigation	No Mitigation	With Mitigation
Layout Alt.1* (PV10) Archaeology	Low (-)	Very Low (-)				
Layout Alt.2* (PV10A) Archaeology	Low (-)	Very Low (-)	-	-	-	-
Cumulative - Heritage	Very Low (-)					
Cumulative - Palaeontology	Low (-)					

* All alternatives assessed includes associated infrastructure.

The following mitigation measures are required for the construction phase for all project alternatives:

- Buffer zones of 90m shall be applied to all pans.
- All mitigation-worthy archaeological sites that are avoided by the development and are not mitigated shall be protected from incidental damage (for example from vehicles driving over them or through the establishment of power line access tracks).
- The ECO responsible for the development shall be aware of the possibility of important fossils (e.g. mammalian bones, teeth) being present or unearthed on site and should monitor all substantial excavations into superficial sediments as well as fresh (i.e. unweathered) sedimentary bedrock for fossil remains.
- The mitigation worthy archaeological site located within the most western laydown area shall be demarcated as a “no-go” area. Mitigation measures shall be implemented should it be found during construction that the site cannot be avoided.
- In the case of any significant fossil finds (e.g. vertebrate teeth, bones, burrows, petrified wood) during construction, these should be safeguarded - preferably in situ - and reported by the ECO as soon as possible to the relevant heritage management authority (SAHRA contact details: Mrs Colette Scheermeyer, P.O. Box 4637, Cape Town 8000. Tel: 021 462 4502. Email: cscheermeyer@sahra.org.za) so that any appropriate mitigation (i.e. fossil recording, sampling or collection) by a palaeontological specialist can be considered and implemented, at the developer’s expense.
- The palaeontologist concerned with mitigation work will need a valid fossil collection permit from SAHRA and any material collected would have to be curated in an authorised depository (e.g. museum or university collection). All palaeontological specialist work should conform to international best practice for palaeontological fieldwork and the study (e.g. data recording, fossil collection and curation, final report) should adhere as far as possible to the minimum standards for Phase 2 palaeontological studies recently developed by SAHRA (2013).
- Once the exact alignments of the linear components of the project have been decided on these shall be examined by a heritage specialist and possibly subjected to a walk-down survey.

The following mitigation measures are required for the construction phase of Layout Alternative 1:

- Test excavations shall be undertaken in the northernmost section of PV10 located closest to the MSA site (HKP2011/002) to ensure that no subsurface material will be impacted.
- All mitigation-worthy sites falling into areas to be impacted shall have archaeological mitigation in the form of excavation, sampling and analysis carried out. This only affects the centre of the farm (located at a laydown area). Some sites fall within the corridors identified for linear infrastructure and, once the exact layouts have been decided upon, these shall be mitigated if required. An estimate on the amount of time required on site for each archaeological site is indicated in Annexure D of the heritage report. Note that avoiding and protecting these sites is always preferred when feasible, but they are not of such a nature that their protection should be required.
- Test excavations shall be undertaken in the area of PV10 closest to the HKP2011/002 MSA. This site also lies within the identified transmission line corridor but, subject to the test excavations, this may not be a problem.

The following mitigation measures are required for the construction phase of Layout Alternative 2:

- Test excavations shall be undertaken in the area around the pans located in PV10A.
- All mitigation-worthy archaeological sites that are avoided by the development and are not mitigated shall be protected from incidental damage (for example from vehicles driving over them or through the establishment of power line access tracks).

f) Impact on local economy (employment) and social conditions

The proposed PV facility would impact on the socio-economic *status quo* through job creation, indirect effects of additional workers onsite, impact of a non-local workforce on society and disruption or damage to adjacent properties. The following impacts in **Table 6-7** are anticipated.

Table 6-7 Impact on local economy (employment) and social conditions

IMPACTS		CONSTRUCTION		OPERATION		DECOMMISSIONING	
		No Mitigation	With Mitigation	No Mitigation	With Mitigation	No Mitigation	With Mitigation
Layout Alt.1 & 2*		Low (-)	Low (-)	Low (+)	Low (+)	-	-
Layout Alt.1 & 2* (employment)		Low (+)	Low-Medium (+)	-	-	-	-
Cumulative	**Disruption or damage from non-local workforce**	Medium (-)					
Cumulative	**Direct Employment and Skills Development**	High (+)					
Cumulative	**Economic Multiplier Effects; Landowner revenue; Diversification of the local economy**			Medium-High (+)			

* All alternatives assessed includes associated infrastructure.

The following mitigation measures are recommended for the construction phase for all project alternatives:

- A local employment policy shall be developed, implemented and audited and shall be accompanied by a training programme.
- Contractors shall be responsible for making available to sub-contractors the contact details for all the local businesses offering related goods and services.
- A comprehensive employee induction programme shall address land access protocols, fire management, etc. as discussed in the Life-cycle Environmental Management Plan (LEMP).

- The employee induction programme shall address issues such as HIV/AIDS and TB, as well as alcohol and substance abuse. The induction could also address a code of behaviour for employees that would align with community values.
- Incidences and complaints regarding noise and dust control shall be reported in a log book.

The following mitigation measures are recommended for the operational phase for all project alternatives:

- A local employment policy, as stated by the developer, shall be implemented and audited and accompanied by a training programme.
- A local procurement policy shall be adopted to maximise benefits to the local economy and minimise leakage.

g) Impact on traffic

Construction vehicles are likely to make use of the existing roads to transport equipment and material to the construction site. These vehicles would include 450 truckloads transporting 900 by 40-foot containers, up to five digger loaders for land clearing and five to ten trucks with cranes to assemble the facility. The following impacts in **Table 6-8** are anticipated.

Table 6-8 Impact on traffic

IMPACTS	CONSTRUCTION		OPERATION		DECOMMISSIONING	
	No Mitigation	With Mitigation	No Mitigation	With Mitigation	No Mitigation	With Mitigation
Layout Alt.1 & 2*	Low (-)	Low (-)	Low (-)	Low (-)	-	-
Cumulative	Medium (-)					

* All alternatives assessed includes associated infrastructure.

The following mitigation measures are recommended throughout the project life-cycle for all project alternatives:

- Ensure that road junctions have good sightlines.
- Implement traffic control measures where necessary.
- Transport components overnight as far as possible.
- Engage with the roads authorities prior to construction to ensure the necessary road upgrades, permits, traffic escorts, etc. are scheduled.

h) Impact on visual aesthetics

The general topography of the Copperton area is gently undulating to flat, with a very gradual slope east to west. The landscape is covered in shrubs with a few sparse trees. Any tall structures, such as existing powerlines, are visible for many kilometres. The potential therefore exists that the proposed PV facility and associated infrastructure would be visible from many kilometres away. The following impacts in **Table 6-9** are anticipated.

Table 6-9 Impact on visual aesthetics

IMPACTS	CONSTRUCTION		OPERATION		DECOMMISSIONING	
	No Mitigation	With Mitigation	No Mitigation	With Mitigation	No Mitigation	With Mitigation
Layout Alt.1 & 2*	High (-)	Medium-High (-)	High (-)	High (-)	High (-)	Low (-)
Route Alt.1*	Medium (-)	Medium (-)	Medium (-)	Medium (-)	Medium (-)	Low (-)
Route Alt.2*	Medium (-)	Medium (-)	Medium (-)	Medium (-)	Medium (-)	Low (-)

IMPACTS	CONSTRUCTION		OPERATION		DECOMMISSIONING	
	No Mitigation	With Mitigation	No Mitigation	With Mitigation	No Mitigation	With Mitigation
Cumulative	Low (-)					

* All alternatives assessed includes associated infrastructure.

It must be noted that there are a number of other energy-related projects proposed for the immediate surrounds which would significantly alter the surrounding landscape character.

The following mitigation measures are recommended for the construction phase for all project alternatives:

- Good traffic management measures shall be implemented.
- Local residents shall be kept informed of activities.
- Access roads shall be kept clean, and measures shall be taken to minimise dust from construction traffic on gravel roads.
- Surface material shall be scraped off, conserved and used for rehabilitation. The remainder could be used for site development, and any surplus shall be disposed of in a manner that appears natural.
- If possible, lay-down area(s) should be located outside of direct view of the R357 and shall be screened with shade cloth.
- Site offices and structures shall be limited to single storey and sited carefully to reduce visual intrusion. Colours shall reflect hues of the surrounding vegetation and/or the ground. Roofs shall be grey and non-reflective. Doors and window frame colour shall reference either the roof or wall colours.
- Litter shall be regarded as a serious offence and no contaminants shall be allowed to enter the environment by any means.
- Road construction and management shall take run-off into consideration in order to prevent soil erosion.
- The top 300mm of naturally occurring substrate shall be separated and then spread over finished levels.
- The developer shall be required to ensure that the footprint areas of all impact sites utilised in construction but not in operation, are rehabilitated and re-vegetated.
- The fencing shall be grey in colour and located as close as possible around the PV site. If possible, natural water ways and drainage lines indicated as sensitive should not be fenced in.
- The PV footprint shall maintain a 100m buffer from the R357. The fence shall not be within 50m of the R357.
- No construction works shall to be undertaken at night or during weekends.

The following mitigation measures are recommended for the operational phase for all project alternatives:

- Good management practices and dust control measures shall be adhered to.
- All lighting shall be kept to a minimum within the requirements of safety and efficiency.
- Where such lighting is deemed necessary, low-level lighting, which is shielded to reduce light spillage and pollution, shall be used.
- No naked light sources shall be directly visible from a distance. Only reflected light shall be visible from outside the site.
- Necessary aircraft warning lights shall be installed as per the relevant authority requirements.
- External lighting shall consist of down-lighters shielded in such a way as to minimise light spillage and pollution beyond the extent of the area that needs to be lit.
- Security and perimeter lighting shall be shielded so that no light falls outside the area needing to be lit. Excessively tall light poles shall be avoided.

- Repairs shall be carried out promptly and the site buildings and perimeter fence shall be kept tidy.

The following mitigation measures are recommended for the decommissioning phase for all project alternatives:

- All PV structures, associated structures and fencing shall be removed and recycled.
- Internal roads shall be ripped and then rehabilitated.
- All impacted footprint areas shall be rehabilitated and re-vegetated.

i) Impact on land capability and erosion potential

The proposed PV facility could result in the loss of agricultural land and degradation of soil resources. Even though the areas directly affected by the proposed developments have low agricultural value and capability, the activities still have the potential to negatively impact the immediate and surrounding soil and land resources. The following impacts in **Table 6-10** are anticipated.

Table 6-10 Impact on land capability and erosion potential

IMPACTS	CONSTRUCTION		OPERATION		DECOMMISSIONING	
	No Mitigation	With Mitigation	No Mitigation	With Mitigation	No Mitigation	With Mitigation
Layout Alt.1 & 2*	Low (-)	Low (-)	Medium (-)	Very Low (-)	-	-
Route Alt.1 & 2* Transmission lines	Very Low (-)	Very Low (-)	Very Low (-)	Very Low (-)	-	-
Cumulative	Medium (-)					

* All alternatives assessed includes associated infrastructure.

The following generic mitigation measures are recommended for the construction phase for all project alternatives:

- A planned phased approach shall be adopted.
- Normal agricultural activities shall continue in unaffected areas.
- Stocking rates shall be temporarily reduced during the construction phase in order to reduce the risk of overgrazing of the remaining land portions.
- Land rehabilitation and re-vegetation shall commence immediately upon completion of construction.
- The soil erosion monitoring and management plan included in the LEMP shall be implemented.

The following mitigation measures are recommended for the operation phase for all project alternatives:

- Initiate land rehabilitation and re-vegetation as soon as possible and continue to monitor land for early signs of degradation and erosion.
- It is recommended that more palatable species form part of the re-vegetation plan to enable faster stocking initiation.
- Rotational grazing of small stock (sheep and goats) shall be permitted within the PV site. It is recommended that the PV site is used as rotational grazing camps. The remaining, un-impacted land can continue to function as un-improved grazing land, its current use.

j) Noise pollution

Noise will be generated during the construction operation and decommissioning phases of the proposed project. Construction and decommissioning activities are often similar. Potential

sources of noise during the construction phase are increased traffic, operation of heavy machinery during the construction period and additional people in the area.

The following generic mitigation measures are recommended for the construction phase for all project alternatives:

- Construction site yards, workshops, concrete batching plants, and other noisy fixed facilities shall be located well away from noise sensitive areas.
- Stationary noisy equipment such as compressors and pumps shall be encapsulated in acoustic covers, screens or sheds where possible. Portable acoustic shields shall be used in the case where noisy equipment is not stationary (i.e. angle grinders, chipping hammers).
- Vehicles shall avoid unnecessary use of the reverse gear to minimise annoyance caused by reverse sirens. Consideration of alternative safety measures may be necessary when taking such a measure.
- All diesel powered equipment shall be regularly maintained and kept at a high level of maintenance. This shall particularly include the regular inspection and, if necessary, replacement of intake and exhaust silencers. Any change in the noise emission characteristics of equipment shall serve as trigger for withdrawing it for maintenance.
- Truck traffic shall be routed away from noise sensitive areas, where possible.
- Noisy operations shall be combined so that they occur where possible at the same time.
- Instruction of employees on low-noise work methods, for example, the handling of structural steel and the use of radiotelephony rather than shouting for communication.
- Machines in intermittent use shall be shut down in the intervening periods between work or throttled down to a minimum.
- Construction activities shall be contained to reasonable hours during the day and early evening.
- Night-time activities near noise sensitive areas shall not be allowed. No construction shall be allowed on weekends.
- With regard to unavoidable very noisy construction activities in the vicinity of noise sensitive areas, the contractor shall liaise with local residents and owners on how best to minimise impact, and the local population shall be kept informed of the nature and duration of intended activities.

The following generic mitigation measures are recommended for the operational phase for all project alternatives:

- The design of all major plant components shall incorporate all the necessary acoustic design aspects required to ensure that the generated noise level from the proposed PV facility does not exceed the SANS 10103 maximum equivalent continuous day/night rating level (LRdn) of 70dBA for industrial areas at the project boundary.
- The design shall also to take into account the maximum allowable equivalent continuous day and night rating levels of the potentially impacted sites outside the project boundary. Where the noise level at such an external site is presently lower than the maximum allowed, the maximum shall not be exceeded. Where the noise level at the external site is presently at or exceeds the maximum, the existing level shall not be increased by more than what is considered as acceptable in SANS 10103.
- The design process is to consider, inter alia, the following aspects:
    - The position and orientation of buildings on the site.
    - The design of the buildings to minimise the transmission of noise from the inside to the outdoors.
    - The insulation of particularly noisy plant and equipment.
    - All plant, equipment and vehicles are to be kept in good repair.
    - Where possible, very noisy activities shall not take place at night.

Noise impacts are assessed in **Table 6-11** below.

Table 6-11 Impact on noise

IMPACTS	CONSTRUCTION		OPERATION		DECOMMISSIONING	
	No Mitigation	With Mitigation	No Mitigation	With Mitigation	No Mitigation	With Mitigation
Layout Alt.1 & 2*	Low (-)	Very Low (-)	Low (-)	Very Low (-)	Low (-)	Very Low (-)
Cumulative	Very Low (-)					

* All alternatives assessed includes associated infrastructure

k) Dust

Solar technologies results in negligible emissions since no fuels are combusted. However, air pollution in the form of dust emissions would occur during the construction phase. There is a possibility for high off-site dust fallout and PM_{10} and $PM_{2.5}$ impacts due to the extent of the proposed PV facility. With mitigation in place, primarily comprising of water sprays, these impacts could be mitigated.

The following mitigations are provided to address potential dust generation throughout the project lifecycle:

- During construction, 80% of the construction footprint shall remain vegetated and be brush cut to a height of 40-50cm to ensure foliage are left on shrubs.
- On site vegetation shall be brush cut to a height of 40-50cm to ensure foliage are left on shrubs.
- Water sprays shall be applied at the area to be cleared should significant amounts of dust be generated. Moist topsoil would reduce the potential for dust generation when tipped onto stockpiles.
- Ensure travel distance between clearing area and topsoil piles to be at a minimum.
- Ensure exposed areas remain moist through regular water spraying during dry, windy periods.
- Reshape all disturbed areas to their natural contours.
- Cover disturbed areas with previously collected topsoil and replant native species.

Dust impacts are assessed in **Table 6-12** below.

Table 6-12 Impact on dust

IMPACTS	CONSTRUCTION		OPERATION		DECOMMISSIONING	
	No Mitigation	With Mitigation	No Mitigation	With Mitigation	No Mitigation	With Mitigation
Layout Alt.1 & 2*	Medium (-)	Low (-)	Medium (-)	Low (-)	Medium (-)	Low (-)
Cumulative	Very Low (-)					

* All alternatives assessed includes associated infrastructure

l) Impact on energy production

The proposed PV facility would be able to provide power to assist in meeting the energy demand within South Africa. The potential impact of the proposed project on energy production is considered to be of low (+) significance, without or with mitigation measures, and therefore no mitigation measures are recommended.

Energy production impacts are assessed in **Table 6-13** below

Table 6-13 Impact on energy production

IMPACTS	CONSTRUCTION		OPERATION		DECOMMISSIONING	
	No Mitigation	With Mitigation	No Mitigation	With Mitigation	No Mitigation	With Mitigation
Layout Alt.1 & 2*	-	-	Low (+)	Low (+)	-	-
Cumulative	Low (+)					

* All alternatives assessed includes associated infrastructure

m) Storage of hazardous substances

Hazardous substances would be stored on site during the operational phase. These substances may include amongst other things, hydrocarbons (i.e. fuel), curing compounds, shutter oil, and cement. The use of hazardous substances at a site is controlled by various pieces of legislation. Approximately 500ℓ of fuel and 50ℓ of lubrication oil would be stored on site. This volume falls well below the triggers as listed activity in terms of NEMA.

The following mitigation measures are proposed in the LEMP:

- The management and protection of the environment would be achieved through the implementation of the LEMP, which *inter alia* specify the storage details of hazardous compounds and the emergency procedures to follow in the event of a spillage.
- Typical mitigation measures include storage of the material in a bunded area, with a volume of 110% of the largest single storage container or 25% of the total storage containers whichever is greater, refuelling of vehicles in designated areas that have a protective surface covering and utilisation of drip trays for stationary plant.

Hazardous substances impacts are assessed in **Table 6-11** below.

Table 6-14 Impact on hazardous substances

IMPACTS	CONSTRUCTION		OPERATION		DECOMMISSIONING	
	No Mitigation	With Mitigation	No Mitigation	With Mitigation	No Mitigation	With Mitigation
Layout Alt.1 & 2*	Low (-)	Very Low (-)	Low (-)	Very Low (-)	Low (-)	Very Low (-)
Cumulative	Low (-)					

* All alternatives assessed includes associated infrastructure

n) Impact on climate change

The establishment of a PV facility would reduce South Africa's future reliance on energy from coal-fired power stations which could in turn reduce the future volume of greenhouse gases emitted to the atmosphere, reducing the greenhouse effect on a regional, national and international scale. Given the number of PV facilities proposed across the country, the potential reduction in future greenhouse gas emissions is considered to be of regional extent, low magnitude and long term, and therefore of medium (+) significance (**Table 6-15**).

Table 6-15 Impact on climate change

IMPACTS	CONSTRUCTION		OPERATION		DECOMMISSIONING	
	No Mitigation	With Mitigation	No Mitigation	With Mitigation	No Mitigation	With Mitigation
Layout Alt.1 & 2*	-	-	Low (+)	Low (+)	-	-
Cumulative	Medium (+)					

* All alternatives assessed includes associated infrastructure

o) Impact on surrounding land uses

The predominant surrounding land use is agriculture. However, a few other land uses exist and the proposed project could impact on these surrounding land uses. Furthermore, Hoekplaas falls within the general astronomy advantage area and is located approximately 13km north of a SKA station. The proposed PV facility could thus potentially impact on the SKA projects. The two major mechanisms that would result in detrimental effects on radio astronomy observations by PV facilities are (1) electromagnetic interference generated from the power generation equipment and (2) broadband interference which would result in a complete shutdown of radio astronomy observations.

Based on the information available the potential impact is considered to be of low magnitude, regional extent and long term and therefore of low (-) significance, without mitigation for all alternatives (**Table 6-16**). Note that the confidence in this impact is considered to be unsure. No difference in significance would result from the proposed alternatives. The confidence level of this impact would change once a detailed impact analysis is undertaken together with the SASPO.

Table 6-16 Impact surrounding land uses

IMPACTS	CONSTRUCTION		OPERATION		DECOMMISSIONING	
	No Mitigation	With Mitigation	No Mitigation	With Mitigation	No Mitigation	With Mitigation
Layout Alt.1 & 2*	Low (-)	Low (-)	Low (-)	Low (-)	Low (-)	Low (-)
Cumulative	Additional studies and co-ordination with SASPO					

* All alternatives assessed includes associated infrastructure

Table 6-17 provides an overall summary of all potential impacts and their significance associated with the proposed development.

Key

H	High Significance	VL-L	Very Low to Low Significance
M-H	Medium to High Significance	N	Neutral Significance
M	Medium Significance	L-M+	Medium positive significance
L-M	Low to Medium Significance	L+	Low positive significance
L	Low Significance	M+	Medium positive significance
		H-M+	Medium-High positive significance

Table 6-17 Summary of significance of the potential impacts associated with the proposed development

IMPACTS	Layout alternatives of the PV facility and associated infrastructure	Construction		Operation		Decommissioning		Cumulative
		No Mitigation	With Mitigation	No Mitigation	With Mitigation	No Mitigation	With Mitigation	
Impact on flora	Layout Alt.1 and 2*	Low (-)	Low (-)	Medium (-)	Very low (-)	Low (-)	Low (-)	Low (-)
Impact on avifauna	Layout Alt.1 and 2*	Medium-High (-)	Low-Medium (-)	Medium-High (-)	Medium-High (-)	Medium-High (-)	Medium (-)	High (-)
Impact on fauna	Layout Alt.1 and 2*	Low-Medium (-)	Low (-)	Low (-)	Low (-)	Low (-)	Very Low (-)	Low (-)
Impact on Agriculture	Layout Alt.1 and 2	Low (-)	Low (-)	Medium (-)	Very low (-)	-		Low (-)
	Transmission Line Route Alt.1 and 2	Very Low (-)	Very Low (-)	Very low (-)	Very low (-)	-		
Surface water	Layout Alt.1	Medium (-)	Low (-)	Medium (-)	Low (-)	Medium (-)	Low (-)	Low (-) to very low (-)
	Layout Alt. 2*	High (-)	Low (-)	Medium-High (-)	Low (-)	Medium (-)	Low (-)	
Impact on Palaeontology	Layout Alt.1 and 2*	Low (-)	Low (-)	-				Low (-)
Impact on heritage	Layout Alt.1 PV2*	Low (-)	Very Low (-)	-				Very low (-)
	Layout Alt.2 PV4A*	Low (-)	Very Low (-)	-				
	Layout Alt.2 PV4A	Low (-)	Very Low (-)	-				
Visual impacts	Layout Alt.1 &2	High (-)	Medium-High (-)	High (-)	High (-)	High (-)	Low (-)	Low (-)
	Transmission Line Route Alt.1	Medium (-)	Medium (-)	Medium (-)	Medium (-)	Medium (-)	Low (-)	
	Transmission Line Route Alt.2	Medium (-)	Medium (-)	High (-)	High (-)	Medium (-)	Low (-)	
Social impacts	Layout Alt.1 and 2*	Low (-)	Low (-)	Low (+)	Low (+)	-		Medium (-)
	Layout Alt.1 and 2* (employment)	Low (+)	Low-Medium (+)	Low (+)	Low (+)	-		High (+) to Medium – High (+)
Impact on Energy production	Layout Alt.1 and 2*	-		Low (+)	Low (+)	-		Medium (+)
Storage of hazardous substances on site impacts	Layout Alt.1 and 2*	Low (-)	Very Low (-)	Low (-)	Very Low (-)	Low (-)	Very Low (-)	Very low (-)
Noise impacts	Layout Alt.1 and 2*	Low (-)	Very Low (-)	Low (-)	Very Low (-)	Low (-)	Very Low (-)	Very low (-)
Dust impacts	Layout Alt.1 and 2*	Medium (-)	Low (-)	Medium (-)	Low (-)	Medium (-)	Low (-)	Very low (-)
Impact on Climate Change	Layout Alt.1 and 2*	-		Low (+)	Low (+)	-		Medium (+)
Land use impacts	Layout Alt.1 and 2*	Low (-)	Low (-)	Low (-)	Low (-)	Low (-)	Low (-)	Additional studies and co-ordination with SASPO
Impact on traffic	Layout Alt.1 and 2*	Low (-)	Low (-)	Very Low (-)	Very Low (-)	Low (-)	Low (-)	Medium (-)
No-Go	Layout Alt.1 and 2*	Neutral						-

***Including Route and Technology Alternatives * With careful and responsible implementation of the mitigation measures identified by the avifauna specialist, the assessed construction and operational impacts should be reduced to tolerable and sustainable levels.**

6.2 Level of confidence in assessment

With reference to the information available at the feasibility stage of the project planning cycle, the confidence in the environmental assessment undertaken is regarded as being acceptable for the decision-making, specifically in terms of the environmental impacts and risks. The EAP believes that the information contained within the FSR and this EIAR is adequate to inform Mulilo's decision making regarding which alternatives to pursue and will allow DEA to be able to determine the environmental acceptability of the proposed alternatives.

It is acknowledged that the project details will evolve during the detailed design and construction phases to a limited extent. However, these are unlikely to change the overall environmental acceptability of the proposed project and any significant deviation from what was assessed in this EIAR should be subject to further assessment. If this was to occur, an amendment to the Environmental Authorisation may be required in which case the prescribed process would be followed.

6.3 Recommendations

Chapter 5 has outlined mitigation measures which, if implemented, could significantly reduce the negative impacts associated with the project. With regards to the SKA project, Mulilo will closely liaise with the SKA Project Office to ensure that appropriate studies are completed to ensure that the correct mitigation measures are identified and implemented[34]. Where appropriate, these and any others identified by DEA could be enforced as Conditions of Approval in the Environmental Authorisation, should DEA issue a positive Environmental Authorisation.

Considerations in identification of preferred alternative

In order to identify the preferred alternative, the EAP evaluated all the recommendations and impact assessments determined by the respective specialists. Based on the specialist findings, it was evident that Layout Alternative 1 was the preferred alternative as it has a smaller footprint which takes environmentally sensitive areas into consideration. Layout Alternative 1 was assessed on a worst case scenario in that the ratings provided are for the impacts associated with all the other proposed projects applied for by Mulilo. In other words, it is a cumulative assessment, hence if not all the projects in the area are authorised the actual impacts would be of lower significance than assessed in this report. Therefore, based on the ratings provided by the specialists, the project could be authorised since the impacts are of an acceptable level, even if all the other proposed projects applied for by Mulilo also receives approval. The positive impacts would remain at least low (+), regardless of the number of projects authorised.

The proposed project results in **low to medium (+)** significance impacts and **low to high (-)** significance impacts, without mitigation, on the environment. The negative impacts of the proposed project are considered to be environmentally acceptable, considering the positive impacts and considering that the significance of impacts would reduce to **medium-high to very low (-)** with the implementation of mitigation measures.

Route 1 for the transmission line was preferred by the specialists based on the fact it would be substantially shorter than the alternative and connect to the adjacent Kronos substation. There

[34] Mitigation measures can only be identified after the layout of the proposed PV facility has been finalised which will only be undertaken should the project be awarded preferred bidder status. Detailed impact analysis (including appropriate Electromagnetic Interference studies) will then be based on the final layout to ensure that the correct mitigation measures are in place.

were no environmental differences between single axis tracking system or fixed axis tracking system. Based on economic viability, single axis tracking system is preferred. Conventional PV was preferred from a visual perspective. In terms of differences in the significance of potential impacts of the feasible alternatives, the impacts associated with the preferred layout would be significant lower than the alternative layout. As such it is recommended that the preferred layout be authorised.

Opinion with respect to environmental authorisation

Regulation 32(2)(m) of the EIA Regulations requires that the EAP include an opinion as to whether the activity should be authorised or not.

The impacts associated with the proposed project would result in regional impacts (both biophysical and socio-economic) that would negatively affect the area. The significance of these impacts without mitigation is deemed to be of **medium or lower** (-) significance. However, with the implementation of the recommended mitigation measures the significance of the negative impacts would be minimized and would be **low or very low (-)**, for all but one impact that of visual which would reduce to **medium-high (-)**. However given the short duration of the construction period and localised extent the impact is deemed acceptable.

Associated with the proposed project are positive impacts on energy production and local economy (employment) and social conditions of **low to medium (+)** significance.

The cumulative impacts associated with the proposed project coupled with numerous other renewable energy facilities that have either been proposed , authorised or constructed would result in regional impacts (both biophysical and socio-economic) that would have both negative and positive impacts. The most significant of the negative impacts is on Avifauna deemed to be of **high (-)** significance. However, with careful and responsible implementation of the mitigation measures identified by the avifauna specialist, the assessed construction and operational impacts should be reduced to tolerable and sustainable levels. The next most significant of the negative impacts is social deemed to be of **medium-high (-)** significance with Traffic deemed to be of a **medium (-)** significance. The most significant positive cumulative impact would be on the socio-economic environment deemed as having a **high (+)** and **medium-high (+)** significance for construction and operation respectively. Further positive cumulative impacts will be experienced on production of energy and climate change both deemed to have a significance of **medium (+).**

Based on the above, the EAP is of the opinion that the proposed solar energy facility and associated infrastructure, including alternatives, being applied for be authorised as the benefits outweigh the negative environmental impacts. The design of the proposed PV10 facility takes cognisance of sensitive environmental features **(Figure 6-3).** The significance of negative impacts can be reduced with effective and appropriate mitigation through a LEMP, as described in this report. If authorised, the implementation of an LEMP should be included as a condition of approval.

Based on the outcome of this EIA, we are of the opinion that the following project alternatives, which are more favourable, should be authorised:

Table 6-18 Preferred alternatives

Alternative	Preferred Alternative	Reason for preference	Coordinates	Map
Location alternative:	Farm Hoekplaas Number 146	A 100 MW facility, referred to as PV1 (DEA Reference Number: 12/12/20/2501 & NEAS Ref. No. DEAT/EIA/0000611/2011) and PV4 were previously authorised on Farm Hoekplaas Number 146. It is economically feasible to group developments on a site that is already well studied to promote infrastructure sharing. This location alternative is preferred as it could result in the following benefits: • Sharing of supply infrastructure including water, sewage and electricity; • Reducing the impact on the environment due to combining infrastructure and footprints; • Utilising a single laydown area and construction camp minimising traffic and associated impacts with multiple camps; • Allowing a phased approach to construction activities thereby extending the construction period for employment and creating more long term employment jobs; • Reducing the need for multiple electricity grid connection points and transmission lines; and • Improved accuracy in terms of assessing cumulative impacts during the EIA phase.	Middle point of Farm Hoekplaas Number 146 Farm: 30° 1' 38.668" S 22° 23' 4.932" E	**Figure** 1-1
Layout alternative	Alternative 1 (PV10)	This alternative consists of the proposed 500MW PV facility and associated infrastructure. Layout Alternative 1 takes cognisance of the 75MW DoE cap and the environmentally sensitive areas as identified by Aurecon (2012). Therefore Layout Alternative 1 is the preferred layout alternative.	Middle point of PV10: 30° 2'27.53"S 22°23'7.85"E	**Figure 1-1**
Technology alternatives	Solar Panel alternative: Conventional PV	Photovoltaic Technology is preferred by the proponent as it is the most cost effective technology and less water intensive.	N/A	**Figure 3-1**
	Mounting Alternatives: single	The single axis tracking system is preferred for the following reasons: • The panels are the highest efficiency panels with the highest	N/A	**Figure 3-2**

Alternative	Preferred Alternative	Reason for preference	Coordinates	Map
	axis tracking system	efficiency inverter, maximising the system output. The installation costs are less as fewer panels are required. • By minimising shading and grouping trackers closer together, this highly efficient technology produces the most energy per hectare of any tracking system. It requires up to 20% less land than conventional crystalline fixed tilt systems and up to 60% less than thin film technology. These highly efficient panels will not only require less land, but also less concrete, steel and cabling per MW. • The panel's anti-reflective glass and exceptional low-light performance characteristics enhances energy delivery.		
Transmission line routing	Routing Alternative 1	This is the shortest route alternative that was identified for the proposed transmission line to limit the visual impact and area of disturbance, as well as reduce costs. This preference is supported by the findings of the specialist assessments. ○ Hoekplaas Solar PV10 will connect to the grid via the A D C routing option should no other project be awarded an EA and Preferred Bidder Status. However should Hoekplaas PV5 be awarded an EA and Preferred Bidder Status the line would connect from A to D (**Figure** 3-4). ○ An Alternative Routing to the Cuprum substation has been assessed in the situation that there is insufficient capacity at Kronos Substation	Start point (A): 30° 1'54.31"S 22°22'55.07"E Middle Point (D): 30° 1'2.08"S 22°22'16.60"E End point (C): 30° 1'26.78"S 22°20'16.94"E	**Figure 3-11**

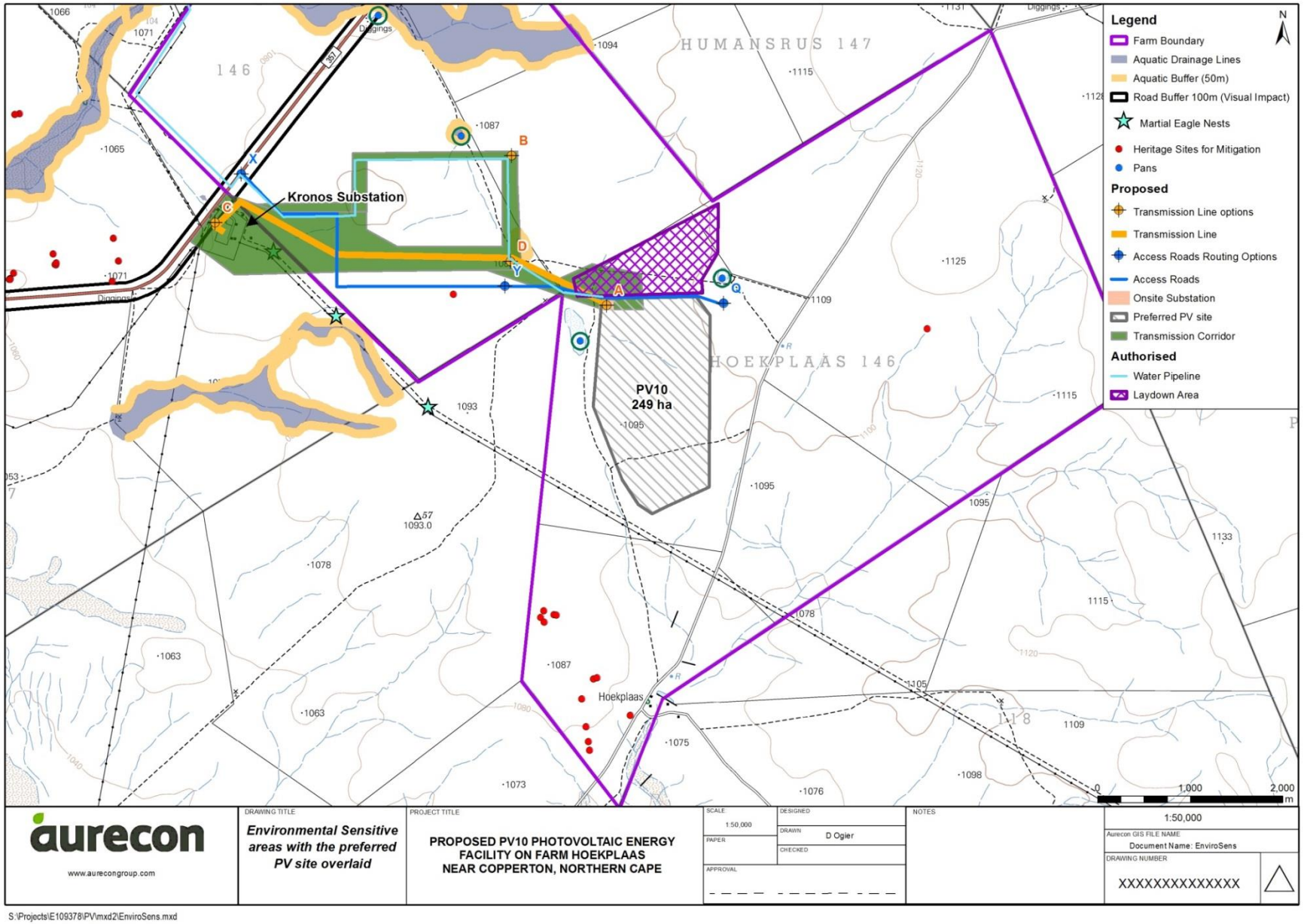

Figure 6-3 Sensitive features and areas as identified by specialists and how the design of PV6 takes cognisance of these features.

6.4 Way forward

The Final EIAR was lodged at the Prieska (Elizabeth Vermeulen) Public Library, Ietznietz in Copperton and on the Aurecon website (www.aurecongroup.com/)(change “Current Location” to “South Africa” and follow the Public Participation links) from 22 November 2013 to 12 December 2013. The approach to combine multiple applications in one Report was rejected by DEA for various reasons contained in a letter dated 21 February 2014 (see Annexure H), it was therefore agreed to re-submit this Report which focuses on the PV10 application. The revised Report has been lodged at the same locations as the previous Final EIA reports from 23 March 2015 to 16 April 2015. All registered I&APs were notified of the availability of the Final EIAR by means of a letter which includes a copy of the Final EIAR Update Page.

Comments received on the Revised Final EIAR was not be included in a Comments and Response Report but were instead be collated and forwarded directly to DEA (see Annexure B).

Once DEA has reviewed the Revised Final EIAR, they will need to ascertain whether the EIA process undertaken met the legal requirements and whether there is adequate information to make an informed decision. Should the above requirements be met, they will then need to decide on the environmental acceptability of the proposed project. Their decision will be documented in an Environmental Authorisation, which will detail the decision, the reasons therefore, and any related conditions. Following the issuing of the Environmental Authorisation, DEA’s decision will be communicated by means of a letter to all registered I&APs and the appeal process will commence, during which any party concerned will have the opportunity to appeal the decision to the Minister of Environmental Affairs in terms of NEMA.

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