Draft Environmental Impact Report

Proposed 90 MW Drennan Photovoltaic (PV) Power Facility, Eastern Cape

Solaire Direct Southern Africa (Pty) Ltd

DEA Ref: 14/12/16/3/3/2/359

September 2013

www.erm.com

Delivering sustainable solutions in a more competitive world

Solaire Direct Southern Africa (Pty) Ltd

Draft Environmental Impact Report:

Proposed 90 MW Drennan Photovoltaic (PV) Power Facility, Eastern Cape

September 2013

www.erm.com

ERM Reference: 0166587

Prepared by: Dean Alborough and Mischa Minné

For and on behalf of
Environmental Resources Management

Approved by: Brett Lawson

Signed:

Position: Partner

Date: September 2013

.

As per the requirement of the Department of Environmental Affairs Acceptance of the Application for Environmental Authorisation for the proposed 90MW Drennan Photovoltaic (PV) Power Facility dated 20 June 2012, this *Section* details the General Site Information for the proposed Project.

DESCRIPTION OF THE AFFECTED FARM PORTION

The Project Site (hereafter referred to as the Site) for the proposed PV power facility is located in Inxuba Yethemba Local Municipality, Eastern Cape (see *Figure 1.1*). The Site is located on Portion 15, of Portion 1, of the Farm Waai Plaats (no. 550) at Drennan. The Site is located 28 km south of Cradock, approximately 5.5 km west off the N10 and is accessible via the R390 (gravel road). The Site is designated for agricultural use, with current agricultural practices including grazing for livestock (cattle, sheep). There is an existing railway line traversing the Site in a north south direction. An existing gravel road network exists on the Site, which crosses the railway line. The existing 132 kV Drennan Traction Substation is located within the northern section of the Site, and an existing 132 kV power line traverses the northeastern section of the Site from the Drennan Traction Substation in a northwest/southeast direction, exiting the northern boundary of the Site.

21 DIGIT SURVEYOR GENERAL CODE

C02200000000055000015

SOLAR PV POWER FACILITY DESIGN SPECIFICATIONS

PV Power Facility Design Specifications

Item	Specification
Type of technology	Fixed PV solar panel SD 1-0610 or SD 610 models. Inverters and Transformers. 4000m^2 Substation and 2500m^2 Loop-in loop-out Substation to existing 330 kV Eskom powerline.
Structure height	PV Array will be 3.33m in height.
Surface area to be covered (including associated infrastructure such as roads)	110ha
Structure orientation	The PV arrays will face north in order to capture maximum sunlight.
Laydown area dimensions (construction period and thereafter)	5000m^2
Generation capacity	Each PV panel will produce 305W
Generation capacity of the facility as a whole at delivery points	Total generating capacity of the PV Power Facility will be 90MW.

COPY OF TITLE DEED OF AFFECTED FARM PORTION

See overleaf for copy of Title Deed.

14 (4)

VANDERBIJLPARK
BC 013530710

GEKANSELLEER
CANCELLED

REGISTRATEUR/REGISTRAAR

25 MAR 2010

DATA / VERIFY
07 SEP 2004
DE VILLIERS A

Opgestel deur my
TRANSPORTBESORGER
JJ MOOLMAN

Landbank

ARTIKEL 40(5)(a) WET 47 VAN 1937 SECTION ACT 47 OF 1937

VERBIND MORTGAGED

B 31564/2001

VIR FOR R 400 000 00

(5) BC 000059197/2004

16 AUG 2004

REGISTRATEUR/REGISTRAR

FOOI FEE R 95 00

SERTIFIKAAT VAN VERENIGDE TITEL

[Uitgereik kragtens die bepalings van Artikel veertig van die Registrasie van Aktes Wet, 1937 (47 van 1937.)]

NADEMAAL

Die Trustees indertyd van die
WATERVAL TRUST
NR IT 1395/96

T 000079744/2004

aansoek gedoen het om die uitreiking aan hom van 'n Sertifikaat van Verenigde Titel kragtens die bepalings van Artikel 40 van die Registrasie van Aktes Wet, Nr 47 van 1937; en

NADEMAAL Waterval Trust die geregistreerde eienaar is van

1. GEDEELTE 14, 'n gedeelte van Gedeelte 1 (DRENNAN) van die Plaas WAAI PLAATS NR 550, geleë in die INXUBA YETHEMBA MUNISIPALITEIT, Afdeling van CRADOCK, Provinsie Oos-Kaap

GEHOU kragtens Transportakte T 000079743/2004

(1)

EASTERN CAPE DEEDS OFFICE
03 SEP 2004
LARNEY F.

2/...

FOR FURTHER ENDORSEMENTS SEE
VIR VERDERE ENDOSSEMENTE SIEN (5)

~~This bond ranks prior to B 286~~

WOP

ARTIKEL 40(5) a WET 47 VAN 1937 SECTION ACT 47 OF 1937

VERBIND MORTGAGED

B 28689 /2002

VIR FOR R 480 0000

Preference waived i.f.o.

BC 0059198 /2004

BC 013533 /10 18 AUG 2004

REGISTRATEUR/REGISTRAR

GEKANSELLEER
CANCELLED

REGISTRATEUR/REGISTRAR

25 MAR 2010

BC 013531/10

GEKANSELLEER
CANCELLED

REGISTRATEUR/REGISTRAR

25 MAR 2010

Landbank

WOP

VERBIND MORTGAGED

VIR FOR R 1 139 200,00

Preference ~~waived~~ i.f.o B

This bond ranks prior to B28689/2002

B 000064559 /2004

18 AUG 2004

REGISTRATEUR/REGISTRAR

Meegande

WOP

VERBIND MORTGAGED

VIR FOR R 480 000,00

Preference waived i.f.o. B.

B 000064560 /2004

18 AUG 2004

REGISTRATEUR/REGISTRAR

BC 013534/10

GEKANSELLEER
CANCELLED

REGISTRATEUR/REGISTRAR

25 MAR 2010

VIR ENDOSSEMENTE KYK BLADSY . 6
FOR ENDORSEMENTS SEE PAGE 6

en

2. DIE RESTANT van Gedeelte 2 (WAAI PLAATS) van die Plaas WAAI PLAATS NR 550, geleë in die INXUBA YETHEMBA MUNISIPALITEIT, Afdeling van CRADOCK, Provinsie Oos-Kaap

GEHOU deur Waterval Trust kragtens Transportakte Nr. T45636/2001

en welke eiendomme verenig is tot die grond hieronder beskryf;

So is dit dat ingevolge die bepalings van genoemde Wet, ek, die Registrateur van Aktes te Kaapstad hierby sertifiseer dat voornoemde

Trustees indertyd van die
WATERVAL TRUST
NR IT1395/96

die se administrateurs of regverkrygendes, die geregistreerde eienaar is van

GEDEELTE 15 van die Plaas WAAI PLAATS NR 550, geleë in die INXUBA YETHEMBA MUNISIPALITEIT, Afdeling van CRADOCK, Provinsie Oos-Kaap

GROOT: 1497,1664 (Een Duisend Vier Honderd Sewe en Negentig Komma Een Ses Ses Vier) Hektaar

EN SOOS meer volledig blyk uit Kaart Nr LG 2379/2002 hierby aangeheg.

WAT betref die gehele eiendom :

A. ONDERHEWIG in terme van Notariële Akte Nr. 145/1972 is die reg aan ESKOM verleen om elektrisiteit te gelei oor die eiendom wat hiermee oorgedra word, tesame met sekere verdere bykomende regte, en onderhewig aan sekere voorwaardes soos meer volledig sal blyk uit die gemelde Notariële Akte en waarna verwys word in die endossement gedateer 23 Maart 1972 op Transportakte Nr. T6813/1968.

3/...

(6)

BC 013532/10
GEKANSELLEER
CANCELLED
REGISTRATEUR/REGISTRAR
25 MAR 2010

W.O.P.

VERBIND MORTGAGED
VIR FOR R 1 600 000,00

B 000036174/2007
2007-04-24
REGISTRATEUR/REGISTRAR

This bond ranks prior
B28689/2000
B64560/2004

(1)

VERBIND MORTGAGED
VIR FOR R 7 000 000,00

B 8299/2010
25 MAR 2010
REGISTRATEUR/REGISTRAR

W.O.P.

BC 000016090/2012 (2)
GEKANSELLEER
CANCELLED
REGISTRATEUR/REGISTRAR
19 APR 2012

VERBIND MORTGAGED
VIR FOR R 3 000 000,00

B 012227/11
3 MAY 2011
REGISTRATEUR/REGISTRAR

W.O.P.

BC 000016091/2012 (3)
GEKANSELLEER
CANCELLED
REGISTRATEUR/REGISTRAR
19 APR 2012

VERBIND MORTGAGED
VIR FOR R 3000 000,00

B 000035369/2012
13 DEC 2012
REGISTRATEUR/REGISTRAR

B. ONDERHEWIG VERDER in terme van Notariële Akte Nr. K37/1983S is die hieringemelde eiendom onderhewig aan 'n reg ten gunste van ESKOM om elektrisiteit te gelei oor die eiendom, tesame met sekere verdere bykomende regte, en onderhewig aan sekere voorwaardes soos meer volledig sal blyk uit verwysing na die genoemde Notariële Akte en na verwys in die endossement gedateer 18 Januarie 1983 op Transportakte Nr. T6813/1968.

I. WAT BETREF die figuur A B C D E F G H J K L M N P Q d c b a:

C. ONDERHEWIG VERDER aan die voorwaardes waarna verwys word in Transportakte Nr. T 4226 gedateer 6 Julie 1909

D. ONDERHEWIG VERDER aan die terme van die volgende endossement gedateer 23 Junie 1956 op Transportakte Nr. T15647/1951, naamlik:

"Endorsement in terms of Section 11(1)(b) Act 37/1955.

A portion of the herein mentioned property, under para 2, being portion of the Remainder approx. 3.6387 mgn has by virtue of Section 3(1) of Act 37 of 1955, been expropriated by the Railway Administration As will more fully appear from Notice of Expropriation No. C.74/56 dd. 21.5.56 Diag. No. P.E. 128 A.234, and application dd. 12.6.1956 for noting of expropriation in terms of Sect. 11 of Act No. 37 of 1955 filed with counterpart."

E. ONDERHEWIG VERDER in terme van Artikel 11(1)(b) van Wet 37/1955 die hierinvermelde eiendom groot 5225 vierkante meter onteien is deur die Spoorweg Administrasie in terme van Artikel 3(1) van Wet Nr. 37 van 1955 (vide Kennisgewing van Onteiening Nr. 430/1973) aansoek gedateer 18.04.1973 en na verwys in die endossement gedateer 14/09/1973 op Transportakte Nr. T6813/1968.

II. WAT BETREF die figuur a b c d R S T U e middel van ou spoor V W X Y Z:

F. ONDERHEWIG VERDER aan die voorwaardes na verwys in Transportakte Nr. T9694 gedateer 27 September 1918.

4/...

EN DAT, kragtens hierdie sertifikaat, genoemde

Trustees indertyd van die
WATERVAL TRUST
NR IT1395/96

die se administrateurs of regsverkrygendes, nou en voortaan daartoe geregtig is ooreenkomstig plaaslike gebruik, maar behoudens die regte van die Staat.

TEN BEWYSE waarvan ek, voornoemde Registrateur, hierdie Akte onderteken en met die ampseël bekragtig het.

ALDUS GEDOEN en GETEKEN te die kantoor van die Registrateur van Aktes te KAAPSTAD op hede die 18de dag van augustus 2004

Registrateur van Aktes

River with Associated Waterways

Source: Steven Stead, 2013.

Agricultural Fields

Source: Steven Stead, 2013.

Farmsteads and Outbuildings

Source: Steven Stead, 2013.

View of the Area as seen from the R390 Road

Source: Steven Stead, 2013.

Overhead Transmission Lines and Drennan substation at the Site

Source: Steven Stead, 2013.

Mountains, Hills and Steep Slopes to the South of the Site

Source: Steven Stead, 2013.

Drainage Lines and Gullies

Source: Steven Stead, 2013.

View of Mountains to the West of the Site

Source: Steven Stead, 2013.

View of Mountains to the East of the Site

Source: Steven Stead, 2013.

View of Valley Landscape with River and Scattered Wetlands

Source: Steven Stead, 2013.

Agricultural Activities Surrounding the Site

Source: Steven Stead, 2013.

View from the N10 as a Tourist Corridor

Source: Steven Stead, 2013.

1 NON-TECHNICAL SUMMARY

1.1 INTRODUCTION

Solaire Direct Southern Africa (Pty) Ltd, hereafter referred to as Solaire Direct, appointed *Environmental Resources Management Southern Africa (Pty) Ltd*, hereafter referred to as ERM, as independent environmental consultants to undertake the Environmental Impact Assessment (EIA) process for the proposed photovoltaic (PV) power facility for the generation of solar energy in the Eastern Cape. The proposed development includes the installation and operation of solar PV panels (connected to each other in PV arrays) with a projected output of up to 90 megawatts (MW). It is intended that the electricity generated by the proposed facility will feed into the national power grid network.

1.2 PURPOSE OF THIS REPORT

This report is the non-technical summary of the Environmental Impact Report (EIR) for the proposed Drennan PV Power Facility. The EIR has been compiled as part of the EIA process in accordance with regulatory requirements stipulated in the EIA Regulations (Government Notices R543, R544 and R546 of 18 June 2010) promulgated in terms of Section 24(5) of the National Environmental Management Act (NEMA) (Act No. 107 of 1998), as amended.

The non-technical summary provides a summary of the proposed project activities, alternatives considered, the EIA methodology, and impacts identified and assessed.

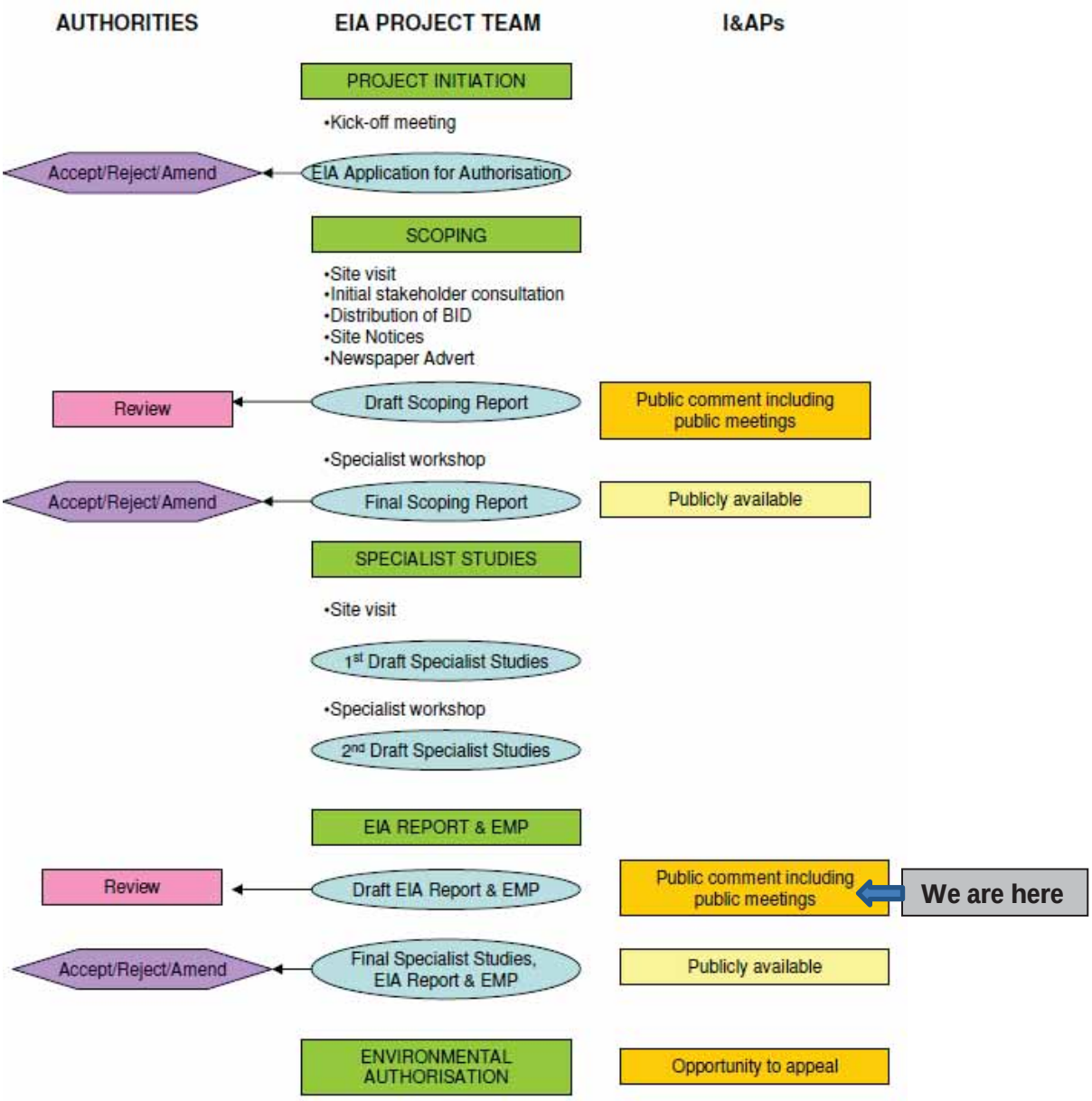
1.3 EIA PROCESS, APPROACH AND METHODOLOGY

Environmental Impact Assessment (EIA) is a systematic process that identifies and evaluates the potential impacts (positive and negative) that a proposed project may have on the biophysical and socio-economic environment. It identifies mitigation measures that need to be implemented in order to avoid, minimise or reduce the negative impacts, and also identifies measures to enhance positive impacts. The overall EIA process required for development proposals in South Africa is shown schematically in *Figure 1.1.* The EIA is not fully a linear process, but one where several stages are carried out in parallel and where the assumptions and conclusions are revisited and modified as the project progresses. The following sections provide additional detail regarding the key stages in this EIA process. These stages are:

- Scoping Phase;
- Specialist Study Phase; and
- Integration and Assessment Phase.

Figure 1.1 below provides an outline of the EIA process and indicates where you can be involved as an interested and affected (I&AP). All steps are described in more detail in the EIR.

Figure.1 *EIA Process Flow Diagram*



1.4 *OPPORTUNITY TO COMMENT ON THE FINAL SCOPING REPORT*

Interested and Affected Parties (I&APs) and authorities have been provided with an opportunity to comment on any aspect of the proposed activity and

the Draft EIR. A hardcopy of the Draft EIR has been made available at the Cradock Public Library and electronically at:

http://www.erm.com/solairedirect-drennan

A notification letter has been sent to all registered and identified I&APs, in order to inform them of the release of the Draft EIR and the details of where the report may be viewed.

I&APs were requested to forward comments to ERM at the address, tel. / fax numbers or e-mail address shown below. The deadline by which comments are to reach ERM is 11 November 2013.

Attention: Tougheeda Aspeling
Solaire Direct Drennan PV Power Facility
DEA Ref: 14/12/16/3/3/2/359
ERM Ref: 0166587
ERM Southern Africa (Pty) Ltd
Postnet Suite 90,
Private Bag X12
Tokai, Cape Town,
7966
Tel: (021) 681 5400; Fax: (021) 686 0736
E-mail: drennan.solar@erm.com

1.5 PROJECT JUSTIFICATION

Solaire Direct's intentions of establishing the PV power facility include developing solar resources to generate electricity and reduce the dependence on non-renewable fossil fuel resources. Emergency load shedding in 2007 and 2008 highlighted the challenges facing South Africa in terms of security of electricity supply. The National Energy Response Plan (NERP), drafted at the time, acknowledged the role that independent power producers (IPPs) could play in ensuring sustainable electricity generation.

1.5.1 *Project Motivation*

- Reduce South Africa's dependence on fossil fuel resources
- Improve reliability and range of electrical services
- Meet demand for diversified energy sources
- Ensure the future of sustainable energy use
- Reduce CO_2 emissions and the nation's carbon footprint
- Contribute to targets for emission reduction as outlined in IRP 2010
- Promote environmental, social and economically sustainable development
- Contribute to reaching South Africa's goal of 10,000 GWh of renewable energy by 2013
- Contribute to meeting the NERP goal of 30 percent of all new energy from IPPs

1.6 PROJECT DESCRIPTION

The Site for the proposed PV power facility is located in Inxuba Yethemba Local Municipality, Eastern Cape Province (see *Figure 4.1*). The area being considered for development of the proposed facility and associated infrastructure is located on Portion 15 of Portion 1, of the Farm Waai Plaats (no. 550) at Drennan. The Site is 28 km south of Cradock, approximately 3 km west off the N10 and is accessible via the R390

The Site is designated for agricultural use, with current agricultural practices including grazing for livestock (cattle, sheep). Limited cultivation is undertaken within the proposed Site, with a single crop circle typical of pivot agriculture located around 2km to the north of the PV Footprint. Land use in the surrounding area includes further sheep and cattle farming. Substantial cultivation is conducted on the east banks of the Great-Fish River which is located less than 1 km to the east of the Site. Drainage lines occur throughout the Site. These include two significant lines that run in a westerly to easterly direction, directly to the south of the PV footprint. There are six small dams that are located at points along the drainage lines within the Site, the nearest of which is located 35m to the south of the PV footprint.

There is an existing railway line traversing the Site in a north / south direction. An existing gravel road network exists on the Site, which crosses the railway line. The existing 132 kV Drennan Traction Substation is located within the northern section of the Site, and an existing 132 kV power line traverses the northeastern section of the Site from the Drennan Traction Substation in a northwest / southeast direction, exiting the northern boundary of the Site.

- PV solar panels / modules (arranged in arrays);
- PV module mountings;
- DC-AC current inverters and transformers;
- New grid connection substation;
- Underground cabling / overhead power lines;
- On-site buildings (including an operational control centre, office, ablutions and a guard house);
- Access roads and internal road network; and
- Ancillary infrastructure.

The proposed development will include PV panels that will occupy approximately 110 ha (1.1 km^2) of the site area in total. The collective term for a series of PV panels in rows is a PV array. The PV panels will be 1660 mm in length, 990 mm in width and 45 mm in height with each producing an output of 305 W. The PV panels will be mounted on aluminium fixed-frame structures approximately 3.33 m in height from the ground. The aluminium structures will be mounted on steel screw piles or concrete foundations 1500 mm deep, depending on soil conditions. The distance or spacing between rows will be approximately 6.2 m. The PV arrays will face north in order to capture maximum sunlight.

The inverter / transformer enclosures convert the direct current (DC) produced by the PV panels to alternating current (AC). The inverter / transformer enclosures also contain transformers that transform Low Voltage AC (350V) from the inverter to Medium Voltage AC (22kV).

The inverter / transformer enclosures will connect via underground cabling to a new 'loop-in loop-out' substation. The new 'loop-in loop-out' substation will be a brick building containing Medium Voltage (22 kV) circuit breakers that will combine the power generated by each inverter / transformer enclosure. This combined power will then be transformed from Medium Voltage (22kV) up to High Voltage (132 kV) for connection to the existing Eskom overhead transmission line via additional power lines of approximately 250 m in length, which will be constructed from the new 'loop-in loop-out' substation.

The Site will be accessed from the R390 gravel road on the eastern perimeter of the Site (32^{0}26'26.66"S 25^{0}43'50.39" E), which links to the N10 national road. The existing gravel road will be upgraded to approximately 6 m in width and this road will provide access to the proposed PV footprint. Internal tracks will be created to enable access within the PV power facility.

Additional infrastructure that will be required for the project includes the following:

- Site perimeter fencing (electrified palisade fencing of approximately 2.8 m in height) including access gates;
- lighting at the main entrance only;
- temporary construction camp (see Annex L with a typical design to house 35 personnel);
- an office for project supervision;
- a meeting room;
- an office for the caretaker of the Site;
- two cloakrooms;
- two temporary chemical toilets, due to the fact that there is no water on the Site; and
- a lay-down area for the temporary storage of materials during the construction activities of approximately 14, 400 m^2.

At this stage it is unknown (but unlikely) whether a borrow pit for rock or soil material will be required for the construction of Project infrastructure. A soil stockpile of approximately 18, 000 m^2 will be required.

During the construction phase, the primary water use requirement will be for dust control. However, water may also be required to moisture condition the soils for proper compaction at roads and foundations. It is estimated that for dust control and compaction, approximately 4, 800, 000 litres of water will be required. Water will also be required for the concrete mixing for the foundations. It is estimated that 575, 586 litres of water will be required for the concrete foundations. The estimated construction-related water requirement is 5,4 million litres with a daily usage of 60, 000 litres over 18-24 months. Water requirements for the construction phase of the PV power facility will be supplied by the Local Water Users' Association. Alternatively, additional water will be provided via a rainwater tank. During the operational phase, it is estimated that PV panel cleaning will require a total of approximately 750, 000 litres / year.

The total investment cost of the project is estimated to be approximately R1 350 million. During the construction phase, the following employment opportunities will be created:

- Site management: 25 employees;
- Civil works: 54 employees;
- Frames & foundations: 27 employees;
- PV modules: 125 employees; and
- Electrical system & components: 60 employees.

Of the PV power facility's employees during construction, 174 employees are estimated to be skilled.

During the operations phase the following employment opportunities will be created:

- General administration and maintenance: 30 employees;
- Compliance related activities: 3 employees;
- Performance monitoring of the PV power facility: 2 employee; and
- Security: 24 employees.

Of the PV power facility's employees during operation, 21 employees are estimated to be skilled.

The labour cost during construction is estimated to be R 3 million, of which local labour is expected to receive 75% (approximately R2.25 million). This estimate excludes the value of manufacturing labour costs. The estimate of the local manufacturing portion of the EPC contract is approximately R 18 million.

Solaire Direct intends to contribute a portion of the gross profit (before tax and depending on the project stage) to a local community trust that has been set up specifically for this project. The value of this contribution will be

determined on finalisation of the tariff as part of the Power Purchase Agreement (PPA).

The project life-cycle can be divided into three key stages as follows:

- site preparation and construction;
- operation (including maintenance and repair); and
- decommissioning.

Prior to construction, site preparation would include the following activities:

- vegetation clearance – removal or cutting of any tall vegetation if present (bush cutting);

- levelling and grading of areas where the arrays will be sited, to remove steep slopes and undulations normally occurring, but this is not deemed necessary given the flat nature of the terrain on the site ;

- levelling of hard-standing areas, e.g. for temporary laydown and storage areas;

- erection of site fencing;

- construction of a temporary construction camp; and

- upgrading of farm tracks/ construction of on-site access roads.

Once the site has been prepared, prior to the installation of the PV components, the following construction activities will take place:

- the installation of fixed aluminium structures to support the PV modules;

- the construction of the new grid connection substation;

- the construction of electrical and control room;

- the construction of site office and storage facilities, including security and ablution facilities and associated septic tanks;

- the construction of array enclosure and inverter/transformer foundations and housing; and

- the installation of cables.

Installation of the full 90 MW could take up to 9 months or more to complete. Once each phase of the facility is complete and operational, it is expected that it will have a lifespan of at least 20 years. Day to day facility operations will involve both regular on-site preventive and corrective maintenance tasks, in

order to keep the PV power plant in optimal working order throughout the operational period. The PV power facility will be decommissioned after 20 to 30 years. Alternatively, it will be upgraded and an application submitted to obtain a new license for the upgraded facility. Solaire Direct intend for the salvage value to cover the cost of decommissioning. Should the plant be decommissioned, the site will be rehabilitated to its original state.

1.7 CONSIDERATION OF ALTERNATIVES

As part of the Site selection process a number of potential Sites were investigated in the Eastern Cape through a desk-top analysis and intrusive studies. The Drennan Site was identified based on a number of criteria, including:

- Solar resource;
- Site extent;
- Eskom grid access;
- Land suitability;
- Landowner consent;
- Environmental and socio-economic impacts; and
- Workforce availability.

The PV power facility layout and Project component design was subjected to a number of iterations, based on technical aspects of the project. These included aspects such as detailed site-specific solar data and construction conditions, as well as specialist input and sensitivity ratings for the site that were explored during the EIA process.

Technical criteria and buffer zones considered in deriving the final site layout (Final PV Footprint, see *Figure 1* below) included:

- Where possible, avoiding areas which are very rocky or uneven, in order to minimise earthworks and thus real and potential environmental impact;
- Buffer around dry pans of 50 m;
- National road buffer of 150m;
- Local district road buffer of 100 m;
- Railway buffer of 100 m;
- External farm boundary buffer of 50 m; and
- Buffer along existing Eskom grid infrastructure of 50 m.

The following different solar energy technologies were considered as technology alternatives:

- Fixed PV plants;
- Tracking PV plants (with solar panels that rotate to follow the sun's movement);
- Concentrated Solar Power (CSP) plants; and
- Concentrated PV Plants.

The options of connecting the PV power facility to Eskom's national grid are subject to on-going discussions between Solaire Direct and Eskom. The most efficient and practical option which is considered viable for the Site is connection into the existing Eskom overhead transmission lines.

The Draft Scoping Report indicated that an additional power line would be required from the new substation to the existing Eskom Drennan Traction Substation. However, due to land parcel ownership and the additional impacts this power line would have, this alternative is not deemed feasible. Instead, the alternative of using the new 'loop-in loop-out' grid connection substation is the alternative deemed most feasible.

Legend

- Place Names
- Contour (20m)
- Perennial Rivers
- Non Perennial Rivers
- Railway Line
- Eskom Power Line
- Dams
- Access Roads
- "Loop-in-Loop-out" Connection
- Substation
- Laydown Camp Site and Assembly Area for Construction
- Substation and Guard House
- PV Footprint
- River (50m Buffer)
- Railway Line (100m Buffer)
- Transmission Line (50m Buffer)
- Heritage Sites (10m Buffer)

Ecology Sensitivity

- Very High
- High
- Medium-High
- Medium
- Low

- Drennan Photovoltaic (PV) Power Facility

SCALE:
0 200 400 600 800 1 000
Metres

TITLE:
Figure 2:
Final PV Footprint on Constraints Map

CLIENT:

DATE: Sept 2013	CHECKED: DA	PROJECT: 0166587
DRAWN: AB	APPROVED: BL	SCALE: 1 : 32 000

DRAWING: Fig 4.11_Final PV Footprint on Constraints Map.mxd
REV: 0

ERM
Great Westerford Building
240 Main Road
Rondebosch, 7725
Cape Town, SOUTH AFRICA
Tel: +27 21 681 5400
Fax +27 21 686 073

Projection: Transverse Mercator, CM 25, Datum: WGS 84
Source: NGI: Chief Directorate National Geo-Spatial Information, 3225BC & 8D_2005_ED4_GEO.TIF
Inset: ESRI Data and Maps

SIZE: A3

T:\Gis Projects\0166587_Drennan Solar Park\Mapping\MXD\ERM\Fig 4.11_Final PV Footprint on Constraints Map.mxd

1.8 BIO-PHYSICAL AND SOCIO-ECONOMIC BASELINE

1.8.1 *Bio-physical Baseline*

The Site is zoned as agricultural land and contains vast grazing land for sheep, cattle and game. Beyond the northern boundary of the Site there is a small area of irrigated land where pivot agriculture has been undertaken. Crops under irrigation in the surrounding area include maize and potato. More intensive agricultural activities are located on either side of the Great Fish River, which runs roughly 2 km to the east of the PV Footprint.

The Study Area has a continental climate with a late summer rainfall regime i.e. most of the rainfall is confined to summer and autumn. The region typically experiences hot days with an average mid-day temperature of 29 °C in summer, while average night time temperatures drop to around 2 °C during winter.[1]

The topography of the Study Area is a mix of open plains, riparian areas and steeper slopes. In most cases sloping land is more difficult to cultivate and usually less productive than flatland, and is subject to higher rates of water runoff and soil erosion. Around 70 percent of the Site is dominated by steeper slopes and rocky outcrops. Away from these rocky areas the land is generally flat with an average gradient of less than 10 percent, these flatter areas are associated with a higher potential for grazing. The flat topography of the eastern portion of the Site makes this area ideal for the proposed development, as minimal earthworks will be required to prepare the Site for the installation of PV arrays

The Beaufort Group is world-renowned for its rich fossil record. The geology of the Study Area contains Late Permian rocks, which are between 255 and 252 million years old and belong to the Balfour Formation of the Beaufort Group, Karoo Supergroup. The Site is underlain by mudstone and Dolerite, mudstone in particular can be characterised as possessing a very fine grain size and is mostly devoid of vegetative cover.

The steeper slopes, in the southern and western portions of the Site, are associated with shallow, rocky soils which is a limiting factor in terms of sustainable crop production. The central portion and eastern area are dominated by Glenrosa and Mispah soil forms. These forms are also associated with shallow soils and have an inherently low agricultural potential due to a prohibitive rooting depth and lower water holding capacity. These soil forms also exhibit moderately high soil erosion hazard ratings.

The Site is dominated by unimproved grassland and scattered trees. The influenced farm portions are currently used as extensive grazing land for free range sheep and beef production.

[1] http://www.saexplorer.co.za/south-africa/climate/cradock_climate.asp [Accessed 15 March 2013]

Approximately 70 percent of the Site is dominated by steeper slopes and rocky outcrops, the remaining 30 percent of the area consists of gently sloping grazing land, interspersed with seasonal stream beds and stock watering impoundments.

The Site is located away from the more fertile flood plain of the Great Fish River. The Site does not have abstraction or water rights. Even if irrigation water could be secured it is not agriculturally or economically feasible to irrigate this Site. Due to the high abstraction demand on the Great Fish River the successful procurement of such water use licences would likely be doubtful.

Taking the above into consideration the majority of the Site is classified as having a low potential for crop production. The Site is considered to be of low value in terms of grazing land which is its current use.

A major ecological feature at the Site is a large drainage system which traverses the area and is considered ecologically sensitive and unsuitable for development. The proposed development, although located outside of the drainage system, presents a risk to sensitivity receptors, particularly with regards to soil debris or waste run-off into the catchment area's surrounding drainage lines.

According to the ecological baseline study undertaken by Simon Todd Consulting (2012), the Site is largely dominated by Eastern Upper Karoo vegetation type, with the drainage areas corresponding to the Southern Karoo Riviere vegetation type. The Eastern Upper Karoo vegetation type is the most extensive vegetation type in South Africa and is classified as least threatened. The Final PV Footprint lies entirely within this vegetation type. The Southern Karoo Riviere vegetation type is also classified as least threatened. However, since this vegetation type is associated with rivers and drainage lines, it should be considered sensitive and development of these areas should be avoided. The vegetation within the proposed development area consists of a low mixed grassy shrubland with occasional trees or bush clumps. There are also a number of succulents and aloe species present. The Site was found to be relatively free of alien species.

According to the South African National Biodiversity Institute (SANBI) Integrated Biodiversity Information System (SIBIS) database, 23 red-data listed plant species are known from the broader area and of these four were confirmed as being present at the site. The abundance of these protected species was generally quite low. In addition to the red-data listed species a number of protected species were also confirmed as being present at the Site however the abundance of these protected species was also quite low.

The Site lies within the planning domain of the Eastern Cape Biodiversity Conservation Plan. This biodiversity assessment identifies Critical Biodiversity Areas (CBA's) which represent biodiversity priority areas which should be maintained in a natural to near natural state. The Site falls within

an extensive Tier 2 CBA which is intended to provide a corridor to maintain the connectivity of the landscape and enable fauna and flora to respond to global change. The major issue with regards to the development as it pertains to the CBA is the extent to which the development is likely to threaten or disrupt the connectivity of the landscape and hence compromise the ecological functioning of the CBA. From north to south the development is less than 1 km across, compared to the CBA which is about 25 km. Therefore the extent of the development is small in comparison to the CBA and it is highly unlikely that the development would pose a significant direct threat to the ecological functioning of the CBA.

According to the ecological baseline the site falls within the distribution range of as many as 59 terrestrial mammals, indicating the mammalian diversity at the site is potentially high. Of these, five are listed species, these are the Brown Hyaena *Hyaena brunnea* (Near Threatened), Black-footed cat *Felis nigripes* (Vulnerable), White-tailed Mouse *Mystromys albicaudatus* (Endangered), Ratel or Honey Badger *Mellivora capensis* (Endangered) and Leopard *Panthera pardus* (Near Threatened). Of these species only the Leopard and Brown Hyaena are unlikely to be found within the area due to the nature of the habitat and agricultural activity that takes place in the region.

The site lies in or near the distribution range of 35 reptile species, indicating that the reptile diversity at the site is likely to be quite low. This is expected given the fact that the diversity of reptile habitats at the site is limited. No listed reptile species are known from the area. The site lies within the distribution range of 11 amphibian species. Amphibian abundance at the site is likely to be high within the drainage and floodplain areas, while only those species which forage away from water are likely to regularly occur within the preferred development area. Only the Giant Bullfrog *Pyxicephalus adspersus* is of conservation concern and is listed as Near Threatened.

At least 238 bird species occur within the vicinity of the Site, including 12 listed species (see *Table 5.1*). Although most of the listed species are uncommon in the area and not likely to occur at the Site on a regular basis, there are a number of the species that are common residents or regular visitors to the area and thus would be likely to occur at the Site, these include the Martial Eagle, Blue Crane, Secretarybird, and Lesser Kestrel. Furthermore, most of the listed species are large raptors, cranes and bustards, which are all vulnerable to collisions with power line infrastructure.

1.8.2 Socio-economic Baseline

The project is located within Ward 6 of the Inxuba Yethemba Local Municipality (IYLM), which falls within the Chris Hani District Municipality (CHDM), in the Eastern Cape. Within this administrative structure, the provincial government is responsible for providing a strategic vision and framework for the province, as well as ensuring cooperation between municipalities and ensuring each municipality performs their respective functions.

The Eastern Cape faces the challenge of high unemployment rates and low income levels. The Chris Hani District Municipality is considered largely rural, and like the Eastern Cape Province as a whole the Chris Hani District Municipality also faces high poverty rates. The Inxuba Yethemba Local Municipality (IYLM), in which the project is located, is one of the eight local municipalities within the Chris Hani District Municipality, with its administrative centre located in Cradock.

Data from the 2011 National Census shows that the population of the IYLM has increased slightly from the time of the last Census (2001). This may be attributed to less out-migration of job seekers from the IYLM, as compared to the CHDM and Eastern Cape, to other provinces and urban areas. The largest increase in the IYLM population was experienced by the African population group.

In general, education levels are low within the IYLM, although in 2011 Cradock was the best performing educational district in the province. Almost two thirds (64.7 percent) of those with a higher education are White, while 35.2 percent are African or Coloured. These indicators demonstrate that the education levels in the IYLM are highly polarised. A key challenge for the IYLM is that education facilities are not distributed evenly around the Municipality. As such, access to these facilities is limited.

The economically active population (aged 15 – 64 years) of the IYLM was estimated to be 42, 341people in 2011, making up 64.6 percent of the total population. The unemployment rate in the IYLM is lower than that of the Province (29.8 percent), and in line with the National unemployment rate of 24.9 percent. At a Ward level, unemployment is seen as a major concern despite the relatively low levels of unemployment (which as of 2011 was 8.87 percent). Unemployment is very low among the White population group and the Indian / Asian group, although the population size of the latter in the IYLM is very small.

Residents in the IYLM in the have adequate access to water (97 percent of the population have access to tap water inside their homes, with others accessing water from points on or in close proximity to their properties). The majority of residents have access to electricity, with only a small proportion relying on alternative sources of fuel, such as wood or paraffin, for cooking and heating. The majority of the population in IYLM live in formal housing, with only one per cent occupying informal or traditional dwellings. There are two hospitals and eight clinics in the region.

Four archaeological sites were found within the area. One of these was a very well preserved Koekhoen stone kraal / alignment (circa 1000 – 1400 AD) while the others included a historical Kraal and two potential pre-colonial graves (stone cairns). Fortunately all of these sites are limited in size and potentially avoidable in terms of project development. The Site falls within a geological zone known to contain the fossilized remains of fauna including fish,

amphibians, reptiles and numerous species of therapsids (the ancient ancestors of mammals). Thus, foundations excavated into rocks and sediments on the Site may intersect fossil-bearing deposits. If so, there is the potential to provide opportunities for observations not otherwise accessible to researchers.

1.9 *IMPACTS IDENTIFIED AND ASSESSED*

The bio-physical and socio-economic impacts during the construction phase that have been identified and assessed in the EIR include the following:

Table 1. Summary of Pre-mitigation Significance during Construction Phase for the Layout of the Final PV Footprint

	Section	Impact	Pre-mitigation Significance	Residual Impact Significance *(Based on mitigation)*
Soils	7.1	Loss of Topsoil, Soil Compaction and Soil Erosion	MODERATE (-VE)	MINOR (-VE)
Water	7.2	Impact on Surface and Groundwater	MINOR (-VE)	MINOR (-VE)
Agriculture	8.1	Impact on Agriculture	NEGLIGIBLE	NEGLIGIBLE
Flora	9.1	Destruction and Loss of Natural Vegetation and Sensitive Plant Communities	MODERATE (-VE)	MODRATE-MINOR (-VE)
	9.2	Alien Plant Invasion	MODERATE (-VE)	MINOR (-VE)
	9.3	Increased Erosion Risk	MODERATE (-VE)	MINOR (-VE)
Fauna	9.4	Impacts from Habitat Loss and Disturbance	MODERATE (-VE)	MODERATE (-VE)
Avifauna	9.5	Avifaunal Disturbance	MODERATE (-VE)	MODERATE-MINOR (-VE)
Critical Biodiversity Areas (CBAs)	9.6	Impact On Critical Biodiversity Area	MODERATE (-VE)	MODERATE-MINOR (-VE)
Visual	10.3	Visual Impacts	MINOR(-VE)	NEGLIGIBLE
Palaeontology	11.1	Damage or Destruction to Paleontological Resources	MINOR (-VE)	MINOR (-VE)
Archaeology	11.2	Damage or Destruction to Archaeological Resources: If grave and kraal sites completely avoided and left in-situ with no preservation or documentation.	MAJOR/CRITICAL (-VE)	NEGLIGIBLE
Cultural Heritage	11.3	Destruction or Disturbance of Cultural Heritage	MINOR (-VE)	MINOR (-VE)
Socio-economic	12.2	Direct Employment and Training	MINOR - MODERATE (+VE)	MODERATE (+VE)
	12.2	Procurement and Indirect Employment	MINOR - MODERATE (+VE)	MINOR - MODERATE (+VE)
	12.2	Induced Economic Benefits	MINOR (+VE)	MINOR (+VE)
	12.2	Increased Community Investment	MODERATE (+VE)	MODERATE-MAJOR (+VE)
	12.2	Inflation and Increased Cost of Living	MINOR (-VE)	MINOR (-VE)
	12.3	Social Disturbance Factors	MINOR (-VE)	NEGLIGIBLE
	12.4	Impact on Agricultural Activities	MINOR (-VE)	NEGLIGIBLE
	12.5	Impact on Tourism	NEGLIGIBLE	NEGLIGIBLE
Traffic	13.1	Impact from Increased Traffic	MODERATE-MINOR (-VE)	MINOR (-VE)
Waste	13.2	Impact from Waste and Effluent	MODERATE (-VE)	MINOR (-VE)
Air Quality	13.3	Dust and Emissions	MINOR (-VE)	NEGLIGIBLE

The major mitigation / enhancement measures to address the more significant impacts for the construction phase include the following (for a comprehensive list of mitigation measures please refer to the EIR report and EMP):

- Protect disturbed surfaces against erosion, and disturbed areas will be rehabilitated as soon as possible to prevent erosion.
- Fuel, oil and used oil storage areas will be contained in bunds of 110 percent capacity of the stored material.
- Site clearing activities will be kept to the minimum required (PV arrays and road footprint).
- Sensitive areas as demarcated on the ecological sensitivity map in the EIR will be avoided as far as possible, and where these areas must be traversed by roads or infrastructure, specific precautions should be taken to ensure that impacts are minimized.
- Ecologically sensitive areas near the construction areas will be clearly demarcated as no-go areas.
- Any fauna directly threatened by the construction activities will be removed to a safe location by the Environmental Control Officer (ECO) or suitably qualified ecologist.
- In order to reduce collisions of vehicles with fauna, a 30 km / hr speed limit will apply to all roads and vehicles using the site. Animals will have right of way.
- The collection, hunting or harvesting of any animals at the site will be strictly forbidden throughout all phases of the project. Solaire Direct will develop and implement a disciplinary procedure for staff who are caught conducting such activities.
- All new power lines will be marked with bird flight diverters.
- All new power line infrastructure will be bird-friendly in configuration and adequately insulated.
- Visual buffer zones from the N10, district roads, the rail line and farm boundaries have been recommended in the EIR, and applied to the layout.
- The layout of the proposed facility should avoid the railway line and the sensitive ecological areas on the project site. The Final PV Footprint avoids these areas.
- If any human remains are uncovered during the construction of the site, development should cease and SAHRA and HNC should be notified. SAHRA or HNC will investigate and propose a way forward.
- Solaire Direct will initiate training and skills development programmes prior to the commencement of construction, as a means of ensuring that members of the local workforce are up-skilled and can be employed on the project.
- Solaire Direct will build the capacity of employees through development plans, technical, health and safety training and provide them with relevant training certificates.
- Solaire Direct will develop and implement a grievance procedure that is easily accessible to local communities, through which complaints related to contractor or employee behaviour can be lodged and responded to.

- Solaire Direct and its appointed contractors will develop an induction programme, including a Code of Conduct, for all workers (including contractors and their workers). A copy of the Code of Conduct will be presented to all workers and signed by each person.
- A Waste Management Plan (WMP) for the proposed project will be developed. This will follow the principles of waste minimisation at source, segregation for reuse, recycling, treatment or disposal.

Table 2. Summary of Pre-mitigation Significance during Operational Phase for the Layout of the Final PV Footprint

	Section	Impact	Pre-mitigation Significance	Residual Impact Significance
Soils	7.1	Loss of Topsoil, Soil Compaction and Soil Erosion	**MODERATE (-VE)**	**MINOR (-VE)**
Water	7.2	Impact on Surface and Groundwater	**MODERATE-MINOR (-VE)**	**MINOR (-VE)**
Agriculture	8.1	Loss of Agricultural Land and/or Production	**MINOR (-VE)**	**MINOR (-VE)**
Flora	9.1	Impacts of Maintenance Activities on Vegetation	**MODERATE-MINOR (-VE)**	**MINOR (-VE)**
	9.2	Alien Plant Invasion	**MODERATE (-VE)**	**MINOR (-VE)**
	9.3	Increased Erosion Risk	**MINOR (-VE)**	**MINOR (-VE)**
Fauna	9.4	Impacts from Habitat Loss and Disturbance	**MINOR (-VE)**	**MINOR (-VE)**
Avifauna	9.5	Avifaunal Disturbance	**MINOR (-VE)**	**MINOR (-VE)**
	9.5	Avifaunal Mortality	**MODERATE (-VE)**	**MODERATE-MINOR(-VE)**
Critical Biodiversity Areas (CBAs)	9.6	Impact on Critical Biodiversity Area	**MODERATE-MINOR (-VE)**	**MINOR (-VE)**
Visual	10.3	Visual Impacts	**MODERATE(-VE)**	**MINOR(-VE)**
Cultural Heritage	11.3	Impact on Sense of Place	**MINOR (-VE)**	**MINOR (-VE)**
Socio-economic	12.2	Direct Employment and Training	**MINOR (+VE)**	**MINOR (+VE)**
	12.2	Procurement and Indirect Employment	**MINOR (+VE)**	**MINOR (+VE)**
	12.2	Induced Economic Benefits	**NEGLIGIBLE**	**NEGLIGIBLE**
	12.2	Increased Community Investment	**MODERATE (+VE)**	**MODERATE-MAJOR (+VE)**
	12.2	Inflation and Increased Cost of Living	**NEGLIGIBLE**	**NEGLIGIBLE**
	12.3	Social Disturbance Factors	**NEGLIGIBLE**	**NEGLIGIBLE**
	12.4	Impact on Agricultural Activities	**MINOR (-VE)**	**NEGLIGIBLE**
	12.5	Impact on Tourism	**NEGLIGIBLE**	**NEGLIGIBLE**
Traffic	13.1	Impact of Increased Traffic	**NEGLIGIBLE**	**NEGLIGIBLE**
Waste	13.2	Impact from Waste and Effluent	**MINOR (-VE)**	**MINOR (-VE)**
Air Quality	13.3	Dust and Emissions	**NEGLIGIBLE**	**NEGLIGIBLE**

The major mitigation / enhancement measures to address the more significant impacts for the operational phase include the following (for a comprehensive list of mitigation measures please refer to the EIR report and EMP):

- Allow periodic grazing within the PV fields (sheep and wildlife). This mitigation will minimise the loss of grazing land and allow agricultural production to remain relatively unaffected.
- Vegetation that needs to be reduced in height will be mowed or brush-cut to an acceptable height, and not to ground level, except where necessary.
- Monitor alien plant abundance within the development areas, as well as in the surrounding area on at least a bi-annual basis.
- Document erosion problems and the control measures implemented.
- Any electrocution and collision events that occur will be recorded, including the species affected and the date.
- The footprint of the operations and maintenance facilities, as well as parking and vehicular circulation, should be clearly defined, and not be allowed to spill over into other areas of the site.
- Solaire Direct will calculate their contribution towards the Community Trust and establish the Trust in accordance with the relevant laws and guidelines.
- Projects will be identified in collaboration with the local Municipality and community representatives to ensure alignment with the key needs identified through the Integrated Development Planning process.

The available information gathered during the EIA process was considered adequate to assess all of the impacts identified with a sufficient degree of certainty. A systematic assessment of all the potential impacts, in terms of pre-mitigation impact significance and residual impact significance, showed these to range from negligible to medium-major ratings. The reduction in most residual impacts relative to the pre-mitigation assessment is based on Solaire Direct's commitment to the implementation of mitigation measures and rehabilitation outlined in the EIR and EMP.

Cumulative effects and benefits on various environmental and social receptors will occur to varying degrees with the development of several renewable energy facilities in South Africa. The degree of significance of these cumulative effects is difficult to predict without detailed studies based on more comprehensive data / information on each of the receptors and the site specific developments. The scale at which the cumulative effects are assessed is important. At this stage it is not feasible to examine solar farm developments at a national scale and for practical purposes a sub-regional scale has been selected.

There are four known proposed solar power plants in addition to the Drennan PV Power Facility, all of which are located more than 85 km from the Site. There is uncertainty as to whether all the above-mentioned developments will proceed to construction. Furthermore, the facilities described are sufficiently distanced from the Project area such that their development can reasonably be expected to add insignificantly to the potential direct impacts of the Project. It

is thus difficult to quantitatively assess potential cumulative impacts, although it is possible to assess them qualitatively, which is necessary in order to meet legislative requirements. It is also instructive in terms of providing a better understanding of potential cumulative impacts and the mitigation actions that need to be applied in this case.

In the context of the proposed Drennan PV Power Facility, the loss of agricultural land, habitat loss, visual impact and cultural heritage, are not significantly high negative impacts when viewed in isolation. However, should other developments in the area (such as residential, industrial, or other solar power farms) lead to similar impacts the respective cumulative negative effects could become significant.

It is possible that the traditional exporting of labour to other provinces would be reduced if a local PV industry were to develop in the Eastern Cape, which could carry both negative and positive socio-economic implications. If the influx of individuals into the province was not properly planned for by local government and power producing companies, there is a chance that a range of socio-economic issues may be compounded over the long term. However with adequate influx management which is regionally focused and initiated at an early stage, there are possibilities to develop the capacity of local authorities and create positive impacts for local communities through *inter alia* increasing their connectivity to the mainstream economy, improved infrastructure and services, and improved economic opportunities.

The economic benefits of renewable energy developments at a local, regional and national level have the potential to be significant. However, there is a lack of understanding of the cumulative effects on other environmental and social receptors, such as the ecology, visual amenity and landscape character of the affected areas. As these cumulative effects are explored in more detail, the trade-offs between promoting renewable energy (and the associated benefits in terms of reduction in CO_2 emissions) versus the local and regional environmental and social impacts and benefits (i.e. impacts on landscape, tourism, flora, employment, etc.) will become evident. It is only when these trade-offs are fully understood, that the true benefits of renewable energy can be assessed. There is a need for strategic planning and cooperation to better understand the cumulative effects that may result from promoting renewable energy.

1.10 RECOMMENDATIONS

ERM is confident that every effort has been made by Solaire Direct to accommodate the mitigation measures recommended during the EIA process to the extent that is practically possible, without compromising the economic viability of the proposed PV power facility. The implementation of the mitigation measures detailed in *Chapters 7* to *14* and listed in the Environmental Management Programme (EMPr), including monitoring, will provide a basis for ensuring that the potential positive and negative impacts

associated with the establishment of the development are enhanced and mitigated to a level which is deemed adequate for the development to proceed.

In summary, based on the findings of this assessment, ERM finds no reason why the 90 MW PV power facility proposed for the Drennan Site should not be authorised, contingent on the mitigations and monitoring for potential environmental and socio-economic impacts as outlined in the EIR and EMPr being implemented.

CONTENTS

ACRONYMS		1-1
ABBREVIATIONS		1-2
1	INTRODUCTION	1-1
1.1	OVERVIEW	1-1
1.2	PURPOSE OF THE REPORT	1-3
1.3	THE PROJECT APPLICANT	1-3
1.4	DETAILS OF ENVIRONMENTAL ASSESSMENT PRACTITIONER	1-4
1.4.1	ERM Southern Africa	1-4
1.4.2	Project Team	1-5
1.5	REPORT STRUCTURE	1-7
1.6	OPPORTUNITY TO COMMENT ON THE DRAFT ENVIRONMENTAL IMPACT REPORT	1-8
2	ADMINISTRATIVE FRAMEWORK	2-1
2.1	APPLICABLE LEGISLATION	2-1
2.1.1	National Environmental Management Act (NEMA)	2-1
2.1.2	EIA Regulations	2-2
2.2	REGIONAL PLANNING CONTEXT	2-3
3	APPROACH AND METHODOLOGY	3-1
3.1	THE EIA PROCESS	3-1
3.2	SCOPING PHASE	3-3
3.2.1	Initial Site Visit and Project Initiation	3-3
3.2.2	Public Participation	3-3
3.2.3	Authority Consultation	3-3
3.3	SPECIALIST STUDIES PHASE	3-4
3.4	INTEGRATION AND ASSESSMENT PHASE	3-5
3.5	IMPACT ASSESSMENT METHODOLOGY	3-5
3.5.1	Impact Assessment Process	3-5
3.5.2	Impact Assessment Methodology	3-6
3.6	IDENTIFICATION OF MITIGATION MEASURES	3-10
3.7	SPECIALIST STUDY METHODOLOGY	3-11
3.7.1	Botany and Terrestrial Ecology	3-11
3.7.2	Archaeology, Heritage and Palaeontology	3-11
3.7.3	Landscape and Visual	3-12
3.7.4	Agriculture	3-12
3.7.5	Socio-economic	3-13

3.8	ASSUMPTIONS AND LIMITATIONS	3-13
3.8.1	Gaps and Uncertainties	3-14
4	PROJECT DESCRIPTION	4-1
4.1	MOTIVATION	4-1
4.2	PROJECT LOCATION AND EXISTING LAND USE	4-3
4.3	PV PLANTS AND POWER GENERATION	4-5
4.4	PROJECT COMPONENTS	4-5
4.4.1	PV Arrays and Mountings	4-8
4.4.2	Electrical Connections and Controls	4-9
4.4.3	Grid Connection	4-12
4.4.4	Auxiliary Electrical Equipment	4-13
4.4.5	Access Roads and Internal Paths	4-13
4.4.6	Additional Infrastructure	4-14
4.5	TRANSPORT, EQUIPMENT AND MACHINERY REQUIREMENTS	4-14
4.6	WATER REQUIREMENTS	4-15
4.7	WASTE MANAGEMENT	4-16
4.7.1	Waste Types and Quantities Generated	4-16
4.7.2	Hazardous Materials and Hazardous Wastes	4-17
4.7.3	Non-hazardous Wastes	4-18
4.8	SOCIO-ECONOMIC ASPECTS	4-18
4.9	PROJECT STAGES AND ACTIVITIES	4-19
4.9.1	Site Preparation and Construction	4-20
4.9.2	Operation	4-21
4.9.3	Decommissioning	4-21
4.10	CONSIDERATION OF ALTERNATIVES	4-22
4.10.1	Site Location Alternatives	4-22
4.10.2	Site Layout Alternatives	4-23
4.10.3	Technological Alternatives	4-27
4.10.4	Grid Connection Alternatives	4-28
4.10.5	No-go Alternatives	4-29
5	BIOPHYSICAL BASELINE	5-1
5.1	PHYSICAL BASELINE	5-1
5.1.1	Site Setting	5-1
5.1.2	Climate	5-1
5.1.3	Landscape and Topography	5-2
5.1.4	Geology	5-2
5.1.5	Paleontology	5-5
5.1.6	Soils	5-6
5.1.7	Hydrology – Ground and Surface Water	5-18
5.2	BIOLOGICAL BASELINE	5-18
5.2.1	Flora	5-18

5.2.2	Fauna	5-22
5.2.3	Avifauna	5-23
5.2.4	Critical Biodiversity Area and Ecological Processes	5-23
5.2.5	Ecological Sensitivity of the Site	5-25
5.2.6	Protected and Conservation Areas	5-26
6	SOCIO-ECONOMIC BASELINE DESCRIPTION	6-1
6.1	INTRODUCTION	6-1
6.2	ADMINISTRATIVE STRUCTURE	6-1
6.3	PROVINCIAL CONTEXT	6-2
6.4	THE CHRIS HANI DISTRICT MUNICIPALITY	6-3
6.5	THE INXUBA YETHEMBA LOCAL MUNICIPALITY	6-4
6.5.1	Local Economy	6-6
6.5.2	Population Demographics	6-6
6.5.3	Education	6-7
6.5.4	Employment and Livelihoods	6-8
6.5.5	Surrounding Landuse	6-13
6.5.6	Health	6-15
6.5.7	General Infrastructure and Services	6-15
6.5.8	Crime	6-19
6.6	ARCHAEOLOGY AND CULTURAL HERITAGE	6-19
6.6.1	Archaeology	6-19
7	IMPACTS ON SOILS, HYDROLOGY AND HYDROGEOLOGY	7-1
7.1	LOSS OF TOPSOIL, SOIL COMPACTION AND EROSION	7-2
7.1.1	Construction Phase Impacts	7-2
7.1.2	Operational Phase Impacts	7-3
7.1.3	Mitigation	7-4
7.1.4	Residual	7-5
7.2	IMPACT ON SURFACE AND GROUNDWATER	7-6
7.2.1	Construction Phase Impacts	7-6
7.2.2	Operational Phase Impacts	7-7
7.2.3	Mitigation	7-8
7.2.4	Residual	7-9
8	AGRICULTURAL IMPACTS	8-1
8.1.1	Construction Phase Impacts	8-1
8.1.2	Operational Phase Impacts	8-2
8.1.3	Mitigation	8-6
8.1.4	Residual	8-7

9	FLORA AND FAUNA IMPACTS	9-1
9.1	DESTRUCTION AND LOSS OF NATURAL VEGETATION	9-3
9.1.1	Construction Phase Impacts	9-4
9.1.2	Operational Phase Impacts	9-5
9.1.3	Mitigation	9-6
9.1.4	Residual Significance	9-7
9.2	ALIEN PLANT INVASION	9-7
9.2.1	Construction Phase Impacts	9-8
9.2.2	Operational Phase Impacts	9-9
9.2.3	Mitigation	9-9
9.2.4	Residual Significance	9-10
9.3	INCREASED EROSION RISK	9-10
9.3.1	Construction Phase Impacts	9-11
9.3.2	Operational Phase Impacts	9-11
9.3.3	Mitigation	9-11
9.3.4	Residual Significance	9-12
9.4	IMPACTS ON FAUNA	9-12
9.4.1	Construction Phase Impacts	9-12
9.4.2	Operational Phase Impacts	9-14
9.4.3	Mitigation	9-15
9.4.4	Residual	9-17
9.5	IMPACTS ON AVIFAUNA	9-17
9.5.2	Construction Phase Impacts	9-20
9.5.3	Operational Phase Impacts	9-20
9.5.4	Mitigation	9-21
9.5.5	Residual	9-24
9.6	IMPACTS ON CRITICAL BIODIVERSITY AREAS (CBAS)	9-25
9.6.1	Construction Phase Impacts	9-26
9.6.2	Operational Phase Impacts	9-26
9.6.3	Mitigation	9-26
9.6.4	Residual	9-27
10	VISUAL IMPACTS	10-1
10.1	STUDY AREA LANDSCAPE CHARACTER	10-1
10.1.1	Western and Eastern Mountains	10-2
10.1.2	Valley Landscape with River and Scattered Wetlands	10-3
10.1.3	Agriculture	10-3
10.1.4	N10 as Tourist Corridor	10-4
10.1.5	Infrastructure	10-4
10.2	LANDSCAPE CHARACTER AT THE SITE	10-5
10.2.1	River with Associated Waterways and Water Bodies (Dams)	10-5
10.2.2	Agricultural Fields and Activities	10-6
10.2.3	Farmsteads and Outbuildings	10-6
10.2.4	R390 Road	10-7

10.2.5	Infrastructure	10-7
10.2.6	Mountain, Hills and Steep Slopes	10-8
10.2.7	Drainage Lines and Gullies	10-9
10.3	IMPACT ASSESSMENT	10-10
10.3.1	Construction Phase Impacts	10-15
10.3.2	Operational Phase Impact	10-16
10.3.3	Mitigation	10-17
10.3.4	Residual	10-18
11	PALAEONTOLOGY, ARCHAEOLOGY AND CULTURAL HERITAGE IMPACTS	11-1
11.1	PALAEONTOLOGY	11-2
11.1.1	Construction Phase Impacts	11-2
11.1.2	Mitigation	11-3
11.1.3	Residual	11-4
11.2	ARCHAEOLOGY	11-4
11.2.1	Construction Phase Impacts	11-4
11.2.2	Mitigation	11-5
11.2.3	Residual	11-7
11.3	CULTURAL HERITAGE	11-8
11.3.1	Construction Phase Impacts	11-8
11.3.2	Operation Phase Impacts	11-8
11.3.3	Mitigation	11-9
11.3.4	Residual	11-9
12	SOCIO-ECONOMIC IMPACTS	12-1
12.1	INTRODUCTION	12-1
12.2	IMPACTS ON THE ECONOMY	12-1
12.2.1	Direct Employment and Training	12-2
12.2.2	Procurement and Indirect Employment	12-6
12.2.3	Induced Economic Benefits	12-9
12.2.4	Increased Community Investment	12-11
12.2.5	Inflation and Increased Cost of Living	12-13
12.3	INCREASED SOCIAL DISTURBANCE FACTORS	12-15
12.3.1	Construction Phase Impacts	12-16
12.3.2	Operation Phase Impacts	12-17
12.3.3	Mitigation	12-18
12.3.4	Residual Impact	12-19
12.4	IMPACT ON AGRICULTURAL ACTIVITIES	12-20
12.4.1	Construction and Operation Phase Impact	12-21
12.4.2	Mitigation	12-22
12.4.3	Residual Impact	12-23
12.5	IMPACT ON TOURISM	12-23

12.5.1	Construction and Operation Phase Impact	12-24
12.5.2	Mitigation	12-25
12.5.3	Residual Impact	12-25
12.6	DISCUSSION	12-25
12.6.1	Unmet Stakeholder Expectations	12-25
13	OTHER IMPACTS	13-1
13.1	TRAFFIC	13-1
13.1.1	Construction Phase Impacts	13-1
13.1.2	Operation Phase Impacts	13-2
13.1.3	Mitigation	13-3
13.1.4	Residual	13-3
13.2	WASTE AND EFFLUENT	13-3
13.2.1	Construction Phase Impacts	13-4
13.2.2	Operation Phase Impacts	13-6
13.2.3	Mitigation	13-7
13.2.4	Residual	13-9
13.3	AIR QUALITY	13-9
13.3.1	Construction Phase Impacts	13-10
13.3.2	Operation Phase Impacts	13-11
13.3.3	Mitigation	13-11
13.3.4	Residual	13-11
14	CUMULATIVE EFFECTS	14-1
14.1	INTRODUCTION	14-1
14.2	SOILS AND SURFACE AND GROUNDWATER	14-3
14.3	ECOLOGY	14-3
14.4	BIRDS	14-4
14.5	LANDSCAPE AND VISUAL IMPACT	14-4
14.6	SOCIO-ECONOMIC IMPACTS	14-4
14.7	CONCLUSIONS	14-6
15	DECOMMISSIONING IMPACTS	15-1
16	CONCLUSIONS AND RECOMMENDATIONS	16-1
16.1	INTRODUCTION	16-1
16.2	SUMMARY OF IMPACTS IDENTIFIED AND ASSESSED	16-4
16.2.1	Construction Phase Impacts	16-4
16.2.2	Operational Phase Impacts	16-7
16.3	RECOMMENDATIONS	16-10

ACRONYMS

BID	Background Information Document
DEA	Department of Environmental Affairs
DEDEAT	Eastern Cape Department of Economic Development Environmental Affairs and Tourism
ECPHRA	Eastern Cape Provincial Heritage Resources Authority
EHS	Environmental, Health and Safety
EIA	Environmental Impact Assessment
EIR	Environmental Impact Assessment Report
EMPr	Environmental Management Programme
ERM	Environmental Resources Management
GN	Government Notice
I&APs	Interested & Affected Parties
IPP	Independent Power Producer
NEMA	National Environmental Management Act
NERSA	National Energy Regulator of South Africa
SAHRA	South African Heritage Resources Agency
ToR	Terms of Reference

%	Percent
cm	Centimetres
CO_2	Carbon Dioxide
GWh	Giga Watt Hour
kg	Kilograms
km	Kilometres
km^2	Square kilometres
kV	Kilovolt
m	Metres
MW	Mega Watts
m^2	Square meters
R	South African Rand

1 INTRODUCTION

1.1 OVERVIEW

Solaire Direct Southern Africa (Pty) Ltd, hereafter referred to as Solaire Direct, appointed *Environmental Resources Management Southern Africa (Pty) Ltd*, hereafter referred to as ERM, as independent environmental consultants to undertake the Environmental Impact Assessment (EIA) process for the proposed Drennan Photovoltaic (PV) Power Facility "The Project".

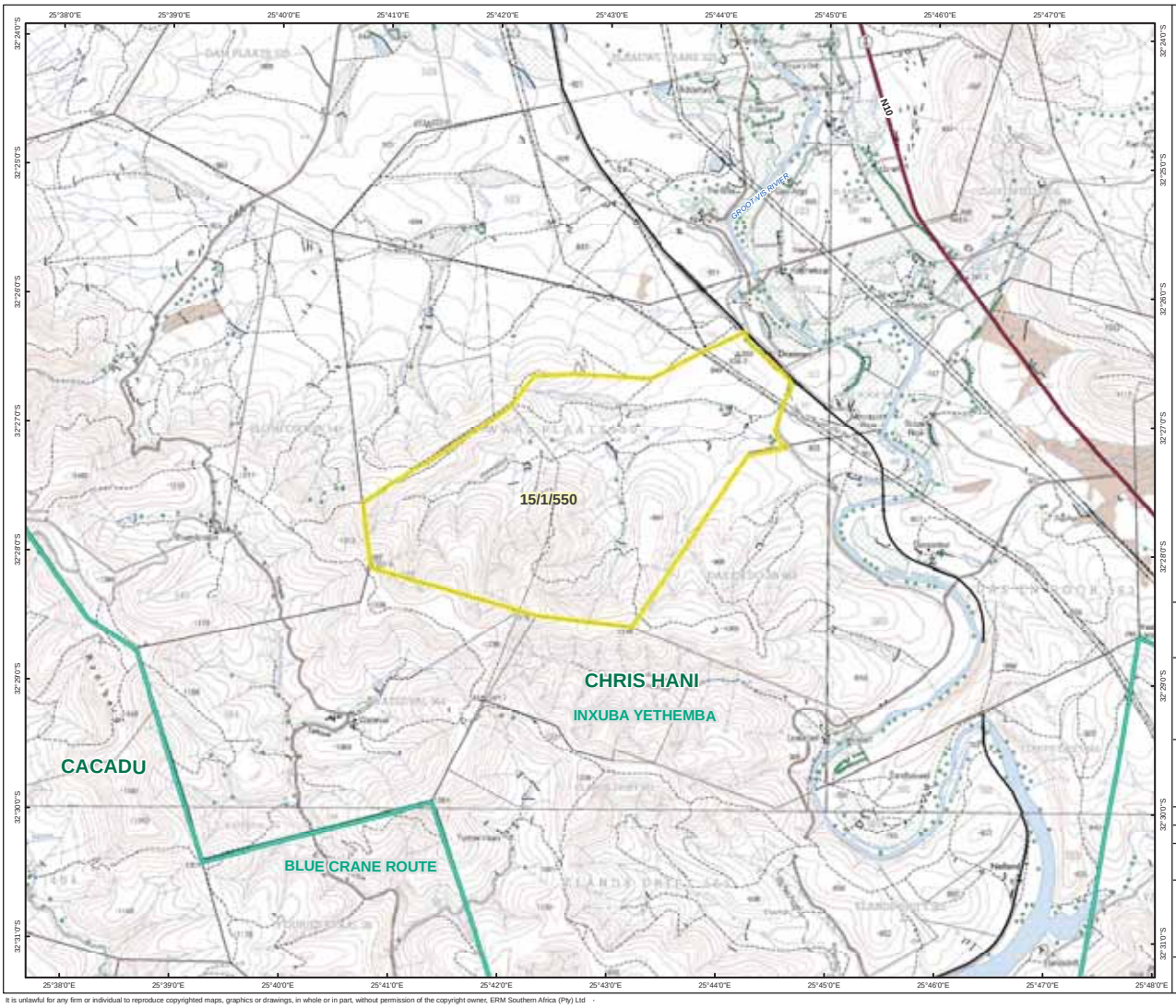
The Project Site (hereafter referred to as the Site) for the proposed PV power facility is located in Inxuba Yethemba Local Municipality, Eastern Cape (see *Figure 1.1*). The Site is located on Portion 15, of Portion 1, of the Farm Waai Plaats (no. 550) at Drennan. The Site is located 28 km south of Cradock, approximately 5.5 km west off the N10 and is accessible via the R390 (gravel road).

The Project will consist of the following key components:

- PV panels / modules (arranged in arrays);
- PV module mountings;
- DC-AC current inverters;
- New 'loop-in loop-out' substation;
- Underground cabling / overhead power lines;
- On-site buildings (including an operational control centre, office, ablutions and a guard house);
- Access roads and internal road network; and
- Ancillary infrastructure

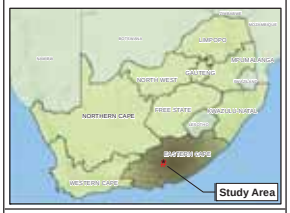
Additional infrastructure will be required such as a temporary construction camp and a permanent meteorological building.

This Draft Environmental Impact Report (EIR) has been compiled as part of the EIA process in accordance with regulatory requirements stipulated in the EIA Regulations (Government Notices R543, R544 and R546 of 18 June 2010) promulgated in terms of Section 24(5) of the National Environmental Management Act (NEMA) (Act No. 107 of 1998), as amended.



Legend

- Contours
- Perennial River
- Non-perennial River
- Arterial Route
- Secondary Roads
- Other Roads
- Track and Hiking Trail
- Railway
- Power Line
- Cadastral Farm
- Erosion; Sand
- Cultivated Lands
- Dry Watercourse
- Water Bodies
- DistrictMunicipalities
- Local Municipalities
- Drennan Photovoltaic (PV) Power Facility



SCALE:

0 1 2 3

Kilometres

TITLE:

Figure 1.1:
Locality Map

CLIENT:

solairedirect

DATE: Sept 2013	CHECKED: DA	PROJECT: 0166587
DRAWN: AB	APPROVED: BL	SCALE: 1 : 50 000

DRAWING: Fig 1.1_Locality Map_Rev3.mxd | REV: 3

ERM
Great Westerford Building
240 Main Road
Rondebosch, 7725
Cape Town, SOUTH AFRICA
Tel: +27 21 681 5400
Fax +27 21 686 073

Projection: Transverse Mercator, CM 25, Datum: WGS 84
Source: NGI: Chief Directorate National Geo-Spatial Information, 3225BC & BD_2005_ED4_GEO.TIF
Inset: ESRI Data and Maps

SIZE: A3

T:\Gis Projects\0166587_Drennan\Solar Park\Mapping\MXD\ERF\Fig 1.1_Locality Map_Rev3.mxd

1.2 PURPOSE OF THE REPORT

The information contained in the EIR along with comments and inputs received from stakeholders and commenting authorities will assist the competent authority, the National Department of Environmental Affairs (DEA), in deciding whether or not to grant environmental authorisation for the proposed development, and to inform the conditions associated with such authorisation.

Environmental assessment involves the identification, prediction and evaluation of the actual and potential environmental consequences of an activity and the options for mitigation of negative impacts and enhancement of positive impacts. It is often possible to introduce measures to avoid, mitigate or compensate for many of the negative environmental impacts of a particular development, provided that these potential impacts are identified early in the planning process. At the same time, it is important to also look at opportunities for enhancement of positive impacts or benefits.

The objectives of this document are to:

- Communicate the results of the EIA process for the proposed development and alternatives considered;
- Ensure that the impacts identified during the EIA process are adequately addressed;
- Show the Applicant's response to the environmental concerns raised, and efforts taken by the Applicant towards mitigating/ enhancing the impacts/ benefits;
- Provide a record of comments and responses received from Interested and Affected Parties (I&APs) during the process; and
- Facilitate an informed, transparent and accountable decision-making process by the relevant authorities.

1.3 THE PROJECT APPLICANT

Solaire Direct Southern Africa (Pty) Ltd is a subsidiary of the Solaire Direct Group, the largest privately owned solar power developer in France. Solaire Direct Southern Africa operates as an independent power producer (IPP) in Southern African Development Community (SADC) countries.

Founded in France in 2006, the Solaire Direct Group has successfully developed, financed and completed 14 solar projects with a total installed capacity of 120 MW. The Solaire Direct Group has power generation subsidiaries around the globe including Southern Africa, Northern Africa, India and South America. Furthermore, Solaire Direct has a PV module

manufacturing subsidiary, Solaire Direct Technologies, located in South Africa.

1.4 DETAILS OF ENVIRONMENTAL ASSESSMENT PRACTITIONER

1.4.1 ERM Southern Africa

ERM was appointed by Solaire Direct to undertake the EIA for the proposed 90 MW PV power facility in question. ERM and specialists appointed by ERM during the course of this EIA have no financial ties to, nor are they a subsidiary, legally or financially, of Solaire Direct. Remuneration for the services by the Applicant (Solaire Direct) in relation to this EIA is not linked to approval by any decision-making authority and ERM has no secondary or downstream interest in the development.

ERM is a global environmental consulting organisation employing over 4,000 people with 140 offices in 40 countries worldwide. Founded in 1971, ERM has built an organisation based on the supply of a full range of environmental and social policy, scientific, technical, and regulatory expertise. ERM's primary focus is to provide quality work and service to our clients in these areas.

From a regional perspective, ERM has been involved in numerous projects in Africa over the past 30 years and in 2003 established a permanent presence in Southern Africa to meet the growing needs of our clients. The Southern African ERM offices are based in Cape Town, Johannesburg, Pretoria and Durban. ERM Southern Africa has a staff complement of 180 comprising dedicated environmental professionals offering expert skills in EIA, EMP, EMS, risk assessment, EHS management and auditing, corporate social responsibility and socio-economic impact assessment, climate change services, specialist groundwater services as well as contaminated site management. ERM Southern Africa has recently undertaken a number of EIAs for PV power facilities locally, specifically in the Northern Cape, Western Cape and Free State provinces.

1.4.2 Project Team

The project team includes ERM consultants, support staff and external specialists. Details of the external specialists that form part of the team are provided in *Section 3.3.* Details of ERM's core project team are provided below.

Table 1.1 ERM Core Project Team

Partner in Charge	**Brett Lawson** MA Environ & Geog Sciences, University of Cape Town. Certified EAPSA Practitioner, Pr Sci Nat.
Principal Project Manager	**Tania Swanepoel** BSc Hons (Engineering & Environmental Geology) University of Pretoria &BSc Hons (Geology and Geohydrology), University of the Western Cape. Pr Sci Nat.
Project Manager	**Dean Alborough** Bsc Hons (Zoology and Environmental Science) & MSc Environmental Science, University of Cape Town.
Project Consultant	**Mischa Minné** MPhil, Distinction (Climate Change & Sustainable Development), University of Cape Town.

The Partner in Charge, Brett Lawson, has considerable multi-disciplinary experience across the range of developmental and environmental sciences in a variety of geographies, including particular expertise in the environmental implications of energy generation and transmission. A summary of power-related EIAs, EMPs and environmental reviews undertaken by Brett to date comprise eight coal-fired power stations, five wind energy facilities, three solar (PV) facilities, three hydropower plants, two gas turbine facilities, 19 distribution and transmission lines, two substations and the environmental auditing of two coal-fired power stations, four transmission substations and two transmission lines.

The Principal Project Manager, Tania Swanepoel, has over thirteen years of broad-based environmental and consulting experience in South Africa and has worked on a variety of EIA projects including renewable energy facilities, infrastructure developments and oil and gas projects.

The Project Manager, Dean Alborough, has more than four years of relevant experience in Integrated Environmental Management, and more than six years in environmental science. Dean's experience includes larger environmental and social impact assessments (ESIAs), management plans, public participation, environmental site investigations, monitoring, auditing and risk assessments. Dean has been involved in a number of EIAs in the renewables (wind and solar) and in the oil and gas sectors.

The Project Consultant, Mischa Minné, has been involved on a number of social and biophysical impact assessments for the mining and renewable energy sectors in Africa and South Africa since joining ERM a year and a half ago. This has included stakeholder engagement and database compilation, the research of socio-economic baseline information, and the undertaking of scoping and environmental impact assessments. Mischa has also been involved in research and consultation on climate sustainability and risk projects, as well as climate related policy and strategy development.

1.5 REPORT STRUCTURE

The structure of this Draft EIR is as follows:

Table 1.2 Report Structure

Section	Contents
Chapter 1 Introduction	Contains a brief description of the proposed activity and an outline of the report structure.
Chapter 2 Regulatory Framework	Outlines the legislative, policy and administrative requirements applicable to the proposed development.
Chapter 3 Approach and Methodology	Outlines the approach to the EIA study and summarises the process undertaken for the project to date.
Chapter 4 Project Description	Includes a detailed description of the proposed project activities and the alternatives.
Chapter 5 Biophysical Baseline	Describes the receiving biophysical baseline environment.
Chapter 6 Socio-economic Baseline	Describes the receiving socio-economic baseline environment.
Chapter 7 Soils, Hydrology and Hydrogeology Impacts	Describes and assesses the potential impacts of the proposed development on soils, surface and groundwater. Mitigation measures are also recommended.
Chapter 8 Agricultural Impacts	Describes and assesses the potential impacts of the proposed development on the agricultural potential of the proposed Site.
Chapter 9 Flora and Fauna Impacts (including Avifauna Impacts)	Describes and assesses the potential impacts of the proposed development on flora and fauna. Mitigation measures are also recommended.
Chapter 10 Visual Impacts	Describes and assesses the potential visual impacts of the proposed development and describes relevant mitigation measures.
Chapter 11 Palaeontology, Archaeology and Cultural Heritage Impacts	Describes and assesses the potential impacts of the proposed development on palaeontology, archaeology and cultural heritage aspects and describes relevant mitigation measures.
Chapter 12 Socio-economic Impacts	Describes and assesses the potential socio-economic impacts of the proposed development and describes relevant mitigation measures.
Chapter 13 Other Impacts	Describes and assesses other potential impacts of the proposed development and describes relevant mitigation measures.
Chapter 14 Cumulative Effects	Qualitatively assesses potential cumulative effects.
Chapter 15 Decommissioning	Indicates that decommissioning impacts would be similar to construction impacts.
Chapter 16 Conclusions and Recommendations	Summarises the key findings of the EIA and provides recommendations for the mitigation of potential impacts and the management of the proposed project.
Chapter 17 References	Contains a list of references used in compiling the report.

In addition, the report includes the following annexures:

Annex A: Legislative Framework
Annex B: Photographs
Annex C: Public Participation Documentation
Annex D: Comments and Responses Report
Annex E: Authority Communications
Annex F: Ecology and Biodiversity Specialist Report
Annex G: Paleontological, Archaeological and Cultural Heritage Specialist Report
Annex H: Landscape and Visual Specialist Report
Annex I Agricultural Specialist Report
Annex J Social Specialist Declaration of Independence
Annex K Framework Environmental Management Programme
Annex L Project Specifications

Appendix A: Alien Invasive Management Sub-Plan
Appendix B: Plant Rescue and Protection Sub-Plan
Appendix C: Re-vegetation and Rehabilitation Sub-Plan
Appendix D: Erosion Management Sub-Plan
Appendix E: Storm Water Management Sub-Plan
Appendix F: Storage and Handling of Hazardous Substances Sub-Plan
Appendix G: Traffic and Transport Management Sub-Plan
Appendix H: Open Space Management Sub-Plan

1.6 OPPORTUNITY TO COMMENT ON THE DRAFT ENVIRONMENTAL IMPACT REPORT

Interested and Affected Parties (I&APs) and authorities have been provided with an opportunity to comment on any aspect of the proposed activity and the Draft EIR. A hardcopy of the Draft EIR has been made available at the Cradock Public Library and electronically at:

http://www.erm.com/solairedirect-drennan

A notification letter has been sent to all registered and identified I&APs, in order to inform them of the release of the Draft EIR and the details of where the report may be viewed.

I&APs were requested to forward comments to ERM at the address, tel. / fax numbers or e-mail address shown below. The deadline by which comments are to reach ERM is 11 November 2013.

Attention: Tougheeda Aspeling
Solaire Direct Drennan PV Power Facility
DEA Ref: 14/12/16/3/3/2/359
ERM Ref: 0166587
ERM Southern Africa (Pty) Ltd
Postnet Suite 90,
Private Bag X12
Tokai, Cape Town,
7966
Tel: (021) 681 5400; Fax: (021) 686 0736
E-mail: drennan.solar@erm.com

2 ADMINISTRATIVE FRAMEWORK

2.1 APPLICABLE LEGISLATION

The proposed activity is subject to legislative and policy requirements at a national and provincial level. A detailed description of relevant legislation pertaining to the EIA process for the Project and the permitting thereof, is contained in *Annex A*. This legislation includes the following:

- National Environmental Management Act (Act No. 107 of 1998), as amended, and associated EIA Regulations (GN R543, R544, R545 and R546 of June 2010);
- National Environmental Management: Protected Areas Act (Act No. 57 of 2003);
- National Water Act (Act No. 36 of 1998);
- National Environmental Management: Biodiversity Act (Act No. 10 of 2004);
- National Forests Act (Act No. 84 of 1998);
- The National Environmental Management: Waste Act (59 of 2008);
- National Heritage Resources Act (Act No. 25 of 1999);
- Electricity Regulation Act (Act No. 4 of 2006);
- Occupational Health and Safety Act (Act No. 85 of 1993);
- Hazardous Substances Act (Act No. 15 of 1973);
- Conservation of Agricultural Resources Act (Act 43 of 1983);
- Subdivision of Agricultural Land Act (Act No. 70 of 1970);
- Eastern Cape Parks and Tourism Agency Act (Act No. 2 of 2010); and
- Nature and Environmental Conservation Ordinance 19 of 1974.

The primary relevant legislation pertaining to the Environmental Authorisation for development is the National Environmental Management Act (NEMA) (No. 107 of 1998) as amended and the Environmental Impact Assessment (EIA) Regulations of 2010 promulgated under NEMA. The relevance of this legislation is summarised below.

2.1.1 *National Environmental Management Act (NEMA)*

NEMA requires that certain listed activities be investigated that may have a potential impact on the environment, socio-economic conditions, and cultural heritage. The results of such investigation must be reported to the relevant authority, who are tasked with the authorisation of such activities before they may commence. Procedures for the investigation and communication of the potential impact of activities are contained in Section 24 (7) of the Act.

Section 24(C) of the Act defines the competent decision-making authority which in this case is the national environmental department, the Department of Environmental Affairs (DEA).

2.1.2 *EIA Regulations*

The EIA Regulations of June 2010 (Government Notice R544, R545 and R546) identify activities which may have a detrimental effect on the environment and the listed activities which may be triggered by the Project. These include:

GN 544:

Activity 10 (i): *'The construction of facilities or infrastructure for the transmission and distribution of electricity - (i) outside urban areas or industrial complexes with a capacity of more than 33 but less than 275 kilovolts…'*

Activity 11 (xi): 'The construction of infrastructure or structures covering 50 square metres or more where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line.'

Activity 13: 'The construction of facilities or infrastructure for the storage, or for the storage and handling, of a dangerous good, where such storage occurs in containers with a combined capacity of 80 m^3 but not exceeding 500 m^3.'

Activity 22 (ii): 'The construction of a road outside urban areas where no reserve exists where the road is wider than 8 metres.'

GN 545:

Activity 1: 'The construction of facilities or infrastructure for the generation of electricity where the electricity output is 20 megawatts or more.'

Activity 8: 'The construction of facilities or infrastructure for the transmission and distribution of electricity with a capacity of 275 kilovolts or more, outside an urban area or industrial complex.'

Activity 15: 'Physical alteration of undeveloped, vacant or derelict land for residential, retail, commercial, recreational, industrial or institutional use where the total area to be transformed is 20 hectares or more; except where such physical alteration takes place for: (i) linear development activities; or (ii) agriculture or afforestation where activity 16 in this Schedule will apply.'

GN 546:

Activity 14: 'The clearing of an area of 5 hectares or more of vegetation where 75% or more of the vegetation cover constitutes indigenous vegetation.'

Government Notice R543 sets out the procedures and documentation for Scoping and EIA that need to be complied with.

2.2 REGIONAL PLANNING CONTEXT

Certain activities related to the Project may, in addition to national legislation, be subject to control by municipal by-laws for aspects such as planning, dust, noise and roads, as well as any stipulations in the Chris Hani District Municipality Integrated Development Plans (IDPs). Relevant legislation, policies and plans have been identified as part of the various specialist studies during the EIA Phase and further information is provided in *Annex A*.

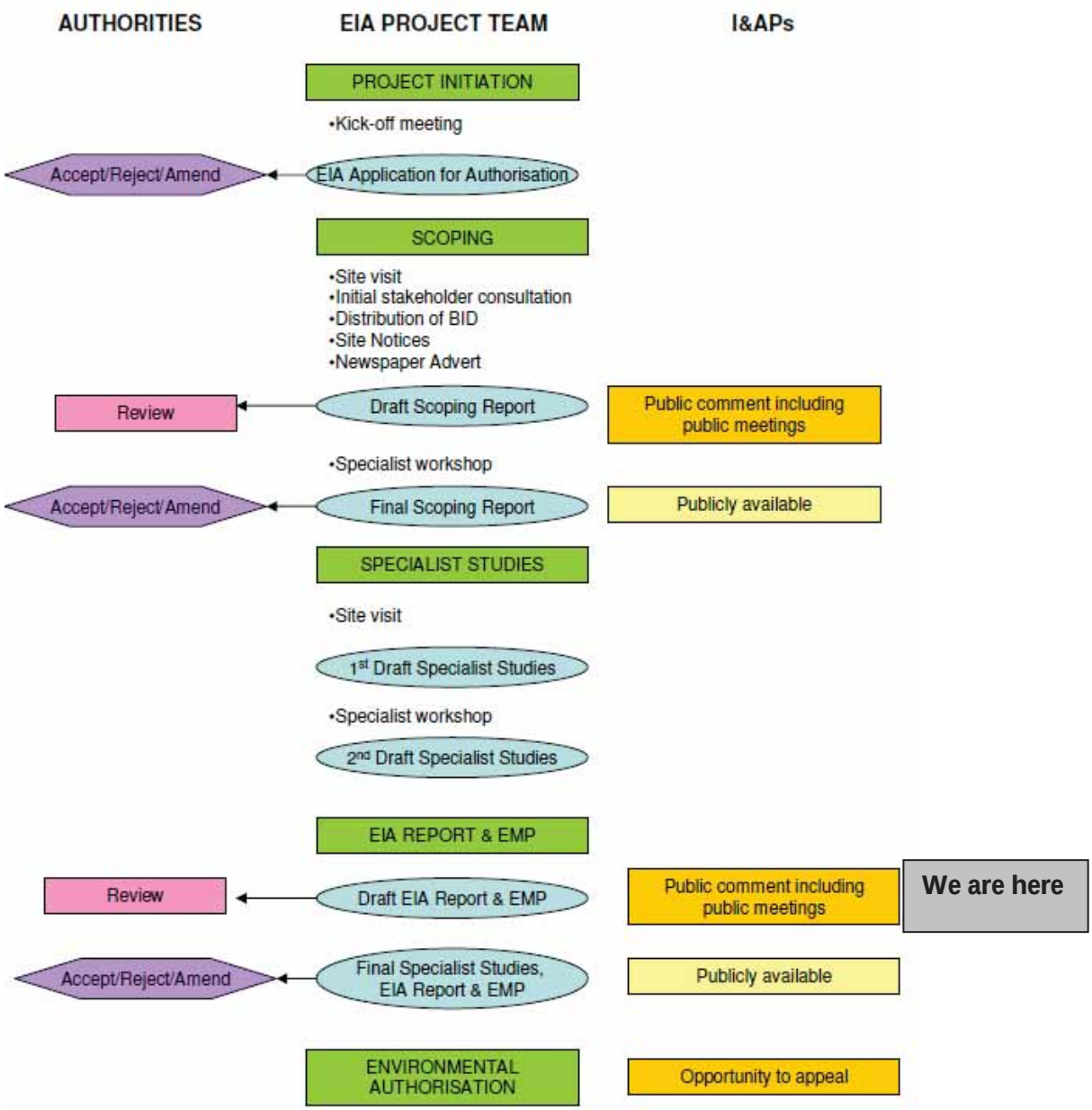
3 APPROACH AND METHODOLOGY

3.1 THE EIA PROCESS

Environmental Impact Assessment (EIA) is a systematic process that identifies and evaluates the potential impacts (positive and negative) that a Project may have on the biophysical and socio-economic environment, and identifies mitigation measures that need to be implemented in order to avoid, minimise or reduce the negative impacts and also identifies measures to enhance positive impacts. The overall EIA process required for developments in South Africa is shown schematically in *Figure 3.1.* The EIA is not fully a linear process, but one where several stages are carried out in parallel and where the assumptions and conclusions are revisited and modified as the project progresses. The following sections provide additional detail regarding the key stages in this EIA process. These stages are:

- Scoping Phase;
- Specialist Study Phase; and
- Integration and Assessment Phase.

Figure 3.1 EIA Process Flow Diagram



3.2 SCOPING PHASE

The first phase of the EIA process is a Scoping Study, with an emphasis on public involvement. The various tasks and consultation activities undertaken thus far by ERM are described and summarised below.

3.2.1 Initial Site Visit and Project Initiation

As part of the project initiation ERM carried out an initial site reconnaissance visit on 2 March 2012. The purpose of the site visit was to familiarise the project team with the project proposal and affected project area and to begin the environmental and social screening and scoping process.

3.2.2 Public Participation

Table 3.1 details the public participation tasks that were undertaken during the Scoping Phase.

Table 3.1 Public Participation Tasks: Scoping Phase

Activity	Description and Purpose
Preparation of a preliminary stakeholder database	A preliminary database has been compiled of authorities (local and provincial), Non-Governmental Organisations and other key stakeholders (refer to *Annex C*). This database of registered I&APs will continue to be expanded during the ongoing EIA process.
Erection of site notices	Two site notices (English and Afrikaans version) were placed at the N10/R310 intersection (the entrance to the site). Photographs showing the site notices are included in *Annex C*.
Distribution of BIDs	Background Information Documents (BIDs) were distributed to all I&APs.
Newspaper Advert	Adverts were placed in the *Cradock Courant*, and *The Herald* newspapers notifying the public of the Project and availability of the Draft Scoping Report for comment. Proof of these adverts are included in *Annex C.*
Public Meeting	A Public Meeting was held with the surrounding land owners on 6 December 2012. Stakeholders could voice their concerns about the project. Minutes of the meeting can be found in *Annex C.*
Distribution of Final Scoping Report	Notification of submission of the Final Scoping Report to DEA and a further opportunity for public comment was sent to all stakeholders on 27 March 2013.

3.2.3 Authority Consultation

Authority consultation and involvement in the EIA process thus far included:

- Submission of an EIA Application for Authorisation form to DEA on 6 June 2012. DEA's Acknowledgement of Receipt and approval to proceed with the Scoping Study was received on 20 June 2012, DEA Reference 14/12/16/3/3/2/359, see *Annex E*.

- Submission of Final Scoping Report to DEA on 27 March 2013. DEA's Acknowledgement of Receipt was received on 20 June 2012. DEA's acceptance of the Final Scoping Report and Plan of Study was received on 20 June 2012, and is attached in *Annex E*.

3.3 SPECIALIST STUDIES PHASE

During the Specialist Study phase, the appointed specialists gathered data relevant to identifying and assessing environmental impacts that might occur as a result of the Project. They assisted the project team in assessing potential impacts according to a predefined assessment methodology included in the Scoping Report. Specialists have also suggested ways in which negative impacts could be mitigated and benefits could be enhanced.

The independent specialists responsible for the specialist studies are listed in *Table 3.2.*

Table 3.2 Independent Specialist Studies and Appointed Specialists

Specialist Study	Specialists and Organisation	Qualifications
Archaeological and Heritage study	Tim Hart (ACO Associates *cc.*)	PhD Archaeology, University of Cape Town
	Liesbet Schietecatte	MA Catholic University of Leuven (Belgium), MSc. Archaeology University of Cape Town
Landscape and Visual	Steven Stead (VRM Africa)	BA Hons (Human Geography and Geographic Information Management Systems), University of Kwa-Zulu Natal
Botany and Terrestrial Ecology	Simon Todd	MSc, Cum Laude Conservation Biology University of Cape Town
Agriculture	Kurt Barichievy	MSc. (Hydrology) UKZN, Pietermaritzburg (2006 – 2009) Pr.Sci.Nat
Socio-economic	Lindsey Bungartz	BSocSci (Hons) Environmental Management
	Mischa Minné	Mphil, Distinction. Climate Change and Sustainable Development, University of Cape Town
Palaeontology study	Graham Avery	PhD Archaeology, University of Cape Town.
		MA Archaeology, University of Cape Town.

The specialist reports and declarations of independence are included in *Annex F* to *Annex J* with the exception of the socio-economic study undertaken by ERM's social specialists Lindsey Bungartz and Mischa Minné, which is presented in Chapters 6 and 12 of this EIR. Please note that the social specialists are employed with and form part of the ERM team and therefore act as independent environmental / social practitioners.

3.4 INTEGRATION AND ASSESSMENT PHASE

The final phase of the EIA is the Integration and Assessment Phase. The assessment of impacts proceeds through an iterative process considering three key elements:

a) **Prediction of the significance** of impacts that are the consequence of the Project on the natural and social environment.
b) **Development of mitigation measures** to avoid, reduce or manage the impacts.
c) **Assessment of residual significant impacts** after the application of mitigation measures.

A synthesis of the specialist studies, which addresses the key issues identified during the Scoping Phase, is documented in this EIR. Relevant technical and specialist studies are included as appendices to this EIR.

This Draft EIR has been made available to I&APs for a public comment period and registered and identified I&APs have been notified of the release of the Draft EIR and where the report can be reviewed.

Comments received on the Draft EIR will be assimilated and the EIA project team will provide appropriate responses to all comments. A Comments and Responses Report will be appended to the Final EIR, which will be submitted to DEA for decision-making.

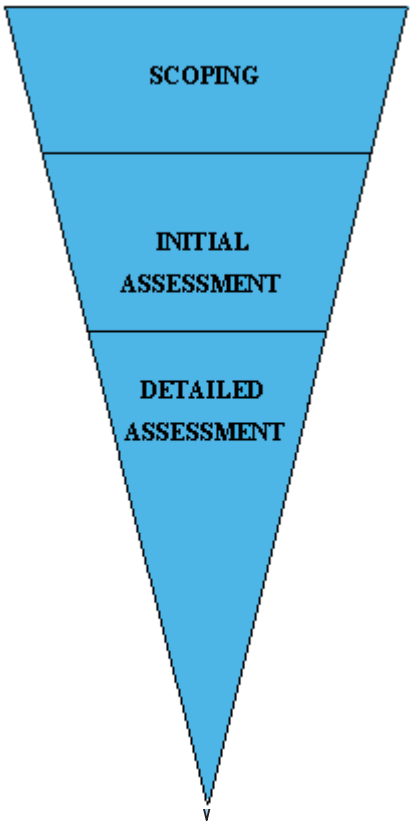
All registered I&APs will be notified when an Environmental Authorisation has been issued by DEA. A 40-day appeal period will follow the issuing of the Environmental Authorisation.

3.5 IMPACT ASSESSMENT METHODOLOGY

3.5.1 *Impact Assessment Process*

The following diagram (*Figure 3.2*) describes the impact identification and assessment process through scoping, screening and detailed impact assessment. The methodology for detailed impact assessment is outlined in *Section 3.5.2* below.

Figure 3.2 Impact Assessment Process



Interactions between project activities and environmental and social receptors are identified for further assessment. Areas where interactions are not expected to occur are 'scoped out' of the assessment.

Potential interactions are further evaluated against site-specific conditions using information gathered through baseline studies. Interactions are 'screened out' if the potential for impact does not exist or is negligible.

Interactions with potential for impact are assessed in detail to determine the nature and characteristics. Mitigations are applied and the residual impact is re-assessed. The significance of the residual impact is then reported.

3.5.2 Impact Assessment Methodology

The purpose of impact assessment and mitigation is to identify and evaluate the significance of potential impacts on identified receptors and resources according to defined assessment criteria and to develop and describe measures that will be taken to avoid or minimise any potential adverse effects and to enhance potential benefits.

Definition of Key Terminology

- **Project** - The features and activities that are a necessary part of the Project Proponent's development, including all associated facilities without which the Project cannot proceed. The Project is also the collection of features and activities for which authorization is being sought.

- **Project Site** - The (future) primary operational area for the Project activities. Private transport corridors (ie, those dedicated for use solely by Project operational activities) are included as part of the Project Site.

- **Project Footprint** - The area that may reasonably be expected to be physically touched by Project activities, across all phases. The Project

Footprint includes land used on a temporary basis such as construction lay down areas or construction haul roads, as well as disturbed areas in transport corridors, both public and private. Note that for the purposes of this Project the Project Footprint will be referred to as the PV Footprint.

Impact Types and Definitions

An impact is any change to a resource or receptor brought about by the presence of a project component or by the execution of a project related activity. The evaluation of baseline data provides crucial information for the process of evaluating and describing how the project could affect the bio-physical and socio-economic environment.

Impacts are described according to their nature or type, as summarised in *Table 3.3*.

Table 3.3 Impact Nature and Type

Nature or Type	Definition
Positive	An impact that is considered to represent an improvement on the baseline or introduces a positive change.
Negative	An impact that is considered to represent an adverse change from the baseline, or introduces a new undesirable factor.
Direct impact	Impacts that result from a direct interaction between a planned project activity and the receiving environment / receptors (e.g. between occupation of a site and the pre-existing habitats or between an effluent discharge and receiving water quality).
Indirect impact	Impacts that result from other activities that are encouraged to happen as a consequence of the Project (e.g. in-migration for employment placing a demand on resources).
Cumulative impact	Impacts that act together with other impacts (including those from concurrent or planned future third party activities) to affect the same resources and / or receptors as the Project.

Assessing Significance

Impacts are described in terms of 'significance'. Significance is a function of the **magnitude** of the impact and the **likelihood** of the impact occurring. Impact magnitude (sometimes termed severity) is a function of the **extent, duration and intensity** of the impact. The criteria used to determine significance are summarised in *Table 3.4*. Once an assessment is made of the magnitude and likelihood, the impact significance is rated through a matrix process as shown in *Table 3.5* and *Table 3.6*.

Significance of an impact is qualified through a statement of the **degree of confidence**. Confidence in the prediction is a function of uncertainties, for example, where information is insufficient to assess the impact. Degree of confidence is expressed as low, medium or high.

Table 3.4 Significance Criteria

Impact Magnitude	
Extent	**On-site** – impacts that are limited to the boundaries of the development site. **Local** – impacts that affect an area in a radius of 20km around the development site. **Regional** – impacts that affect regionally important environmental resources or are experienced at a regional scale as determined by administrative boundaries, habitat type / ecosystem. **National** – impacts that affect nationally important environmental resources or affect an area that is nationally important / or have macro-economic consequences.
Duration	**Temporary** – impacts are predicted to be of short duration and intermittent / occasional. **Short-term** – impacts that are predicted to last only for the duration of the construction period. **Long-term** – impacts that will continue for the life of the Project, but ceases when the project stops operating. **Permanent** – impacts that cause a permanent change in the affected receptor or resource (e.g. removal or destruction of ecological habitat) that endures substantially beyond the project lifetime.
Intensity	BIOPHYSICAL ENVIRONMENT: *Intensity can be considered in terms of the sensitivity of the biodiversity receptor (i.e. habitats, species or communities).* **Negligible** – the impact on the environment is not detectable. **Low** – the impact affects the environment in such a way that natural functions and processes are not affected. **Medium** – where the affected environment is altered but natural functions and processes continue, albeit in a modified way. **High** – where natural functions or processes are altered to the extent that they will temporarily or permanently cease. *Where appropriate, national and/or international standards are to be used as a measure of the impact.*

	Specialist studies should attempt to quantify the magnitude of impacts and outline the rationale used. SOCIO-ECONOMIC ENVIRONMENT: *Intensity can be considered in terms of the ability of people/communities affected by the Project to adapt to changes brought about by the Project.* **Negligible** – there is no perceptible change to people's livelihood. **Low** - people / communities are able to adapt with relative ease and maintain pre-impact livelihoods. **Medium** – people / communities are able to adapt with some difficulty and maintain pre-impact livelihoods but only with a degree of support. **High** - affected people / communities will not be able to adapt to changes or continue to maintain-pre impact livelihoods.
Likelihood - the likelihood that an impact will occur	
Unlikely	The impact is unlikely to occur.
Likely	The impact is likely to occur under most conditions.
Definite	The impact will occur.

Once a rating is determined for magnitude and likelihood, the following matrix can be used to determine the impact significance.

Table 3.5 Significance Rating Matrix

SIGNIFICANCE				
		LIKELIHOOD		
MAGNITUDE		**Unlikely**	**Likely**	**Definite**
	Negligible	Negligible	Negligible	Minor
	Low	Negligible	Minor	Minor
	Medium	Minor	Moderate	Moderate
	High	Moderate	Major	Major

Table 3.6 Significance Colour Scale

Negative ratings	**Positive ratings**
Negligible	Negligible
Minor	Minor
Moderate	Moderate
Major	Major

Table 3.7 Significance Definitions

Significance definitions	
Negligible significance	An impact of negligible significance (or an insignificant impact) is where a resource or receptor (including people) will not be affected in any way by a particular activity, or the predicted effect is deemed to be 'negligible' or 'imperceptible' or is indistinguishable from natural background variations.
Minor significance	An impact of minor significance is one where an effect will be experienced, but the impact magnitude is sufficiently small (with and without mitigation) and well within accepted standards, and / or the receptor is of low sensitivity / value.
Moderate significance	An impact of moderate significance is one within accepted limits and standards. The emphasis for moderate impacts is on demonstrating that the impact has been reduced to a level that is as low as reasonably practicable (ALARP). This does not necessarily mean that 'moderate' impacts have to be reduced to 'minor' impacts, but that moderate impacts are being managed effectively and efficiently.
Major significance	An impact of major significance is one where an accepted limit or standard may be exceeded, or large magnitude impacts occur to highly valued / sensitive resource / receptors. A goal of the EIA process is to get to a position where the Project does not have any major residual impacts, certainly not ones that would endure into the long term or extend over a large area. However, for some aspects there may be major residual impacts after all practicable mitigation options have been exhausted (i.e. ALARP has been applied). An example might be the visual impact of a development. It is then the function of regulators and stakeholders to weigh such negative factors against the positive factors such as employment, in coming to a decision on the Project.

Once the significance of the impact has been determined, it is important to qualify the **degree of confidence** in the assessment. Confidence in the prediction is associated with any uncertainties, for example, where information is insufficient to assess the impact. Degree of confidence can be expressed as low, medium or high.

Mitigation Measures and Residual Impacts

For activities with significant impacts, the EIA process is required to identify suitable and practical mitigation measures that can be implemented. The implementation of the mitigations is ensured through compliance with the Framework Environmental Management Programme (EMPr). After first assigning significance in the absence of mitigation, each impact is re-evaluated

assuming the appropriate mitigation measure(s) is/are effectively applied, and this results in a significance rating for the residual impact.

3.6 IDENTIFICATION OF MITIGATION MEASURES

For the identified significant impacts, the project team, with the input of the client, has identified suitable and practical mitigation measures that are implementable. Mitigation that can be incorporated into the project design, in order to avoid or reduce the negative impacts or enhance the positive impacts, have been defined and require final agreement with the client as these are likely to form the basis for any conditions of approval by DEA.

3.7 SPECIALIST STUDY METHODOLOGY

3.7.1 *Botany and Terrestrial Ecology*

A botany and terrestrial ecological specialist study was undertaken by Simon Todd of Simon Todd Consulting (see *Annex F*). As part of this study, a desktop study was carried out of publicly available scientific publications to investigate the ecology and biodiversity of the affected project area. A site visit was undertaken where the different biodiversity features, habitat, vegetation and landscape units present at the site were identified and mapped in the field. This included generating a fine-scale vegetation map for the site which identified and mapped the different plant communities present. Walk-through-surveys were conducted across the site and all plant and animal species observed were recorded. Searches for listed and protected plant species at the site were conducted and the location of all listed plant species observed was recorded using a GPS. Active searches for reptiles and amphibians were also conducted within habitats likely to harbour or be important for such species. The presence of sensitive habitats such as wetlands or pans and unique edaphic environments such as rocky outcrops or quartz patches were noted in the field if present, recorded on a GPS and mapped onto satellite imagery of the site. The impact assessment phase involved the determination of the nature of likely impacts of the development and recommendations on mitigation.

3.7.2 *Archaeology, Heritage and Palaeontology*

A palaeontological, archaeological and cultural heritage specialist study, as described below, was undertaken by Tim Hart and Liesbet Schietecatte of ACO Associates and Graham Avery (see *Annex G*).

Palaeontology

A desktop palaeontological study was undertaken for the Site. The 1:250 00 Geological Series 3318 Cape Town map was consulted for background information. The focus was to illustrate the potential of sub-surface sediments through the geological context and observations in the general vicinity. The

impact assessment phase involved the determination of the nature of likely impacts of the development and recommendations on mitigation.

Archaeology

A desktop study was carried out of publicly available scientific publications to determine the archaeological history of the affected project area. In addition, an archaeological field survey was undertaken of the affected project area. Archaeological materials and structures were inventoried, with GPS positions, with approximate age and descriptions recorded as necessary. No archaeological material was removed from the project area, but recorded and photographed *in situ*. The impact assessment phase involved the determination of the nature of likely impacts of the development and recommendations on mitigation.

Heritage

Publications of the history of the affected project area were investigated and informed the specialist study. A heritage field survey was undertaken in order to identify existing heritage structures in the affected project area. These heritage structures were inventoried, with their GPS positions, age and descriptions recorded. The impact assessment phase involved the determination of the nature of likely impacts of the development and recommendations on mitigation.

3.7.3 Landscape and Visual

A landscape and visual impact assessment study was undertaken by Stephen Stead of VRM Africa (see *Annex H*). A site visit was undertaken where visual features and the landscape setting of the site were recorded. An assessment was also made as to what degree people who make use of these locations (e.g. a nearby holiday resort) would be sensitive to change(s) in their views, brought about by the Project. These receptors were then identified, as well as Key Observation Points (KOPs) (those sensitive receptors who had views of the Project) particularly those relating to intersections of major roads, arterial and scenic routes, as well as urban areas, settlements and farmsteads.

The landscape character was then surveyed in terms of scenic quality (landscape significance) and receptor sensitivity to landscape change (of the site) in order to define the visual objective for the project site. Photomontages using panoramic photographs were used to determine the degree of visibility of the Project and change in views of the surrounding landscape. The impact assessment phase involved the determination of the nature of likely impacts of the development and recommendations on mitigation.

3.7.4 Agriculture

An agriculture impact assessment study was undertaken by Kurt Barichievy of SiVest engineering (see *Annex I*). A detailed desktop assessment was undertaken for the Drennan Site and surrounds land. The objective of this

study was to broadly evaluate the soil and land use of the sites and receiving environment by interrogating relevant climate, topographic, land-use and soil datasets. By utilising the available data resources the relevant specialist was able to broadly assess the current soil, agricultural and land use characteristics and provide a basis for a more detailed and spatially relevant assessment.

Furthermore a detailed soil survey was conducted for the Drennan Site. At each sample point a hand auger was used to identify and describe the diagnostic horizons to form and family level according to the Soil Classification Working Group (1991). The soil characteristics such as depth, texture and limiting layers were also noted. At each auger point the relevant soil and land use data was recorded and the location of the auger point captured using a handheld GPS. This information was combined to produce detailed soil polygon and soil depth maps.

The agricultural potential of the site was also determined. The soil information gained from the survey along with the land use assessment was combined with climate, water resource, crop information and topographic data in order to provide a spatial classification of the land based on its agricultural potential. A study of local agricultural practices was also carried out.

Finally the impact assessment utilised the findings of the soil survey and agricultural potential assessment in order to determine reference conditions of the soil and agricultural resources. Potential soil and agricultural impacts, as a result of the proposed activities, were described and any major impacts / fatal flaws identified for consideration by the pertinent authorities.

3.7.5 Socio-economic

The socio-economic specialist study was undertaken by ERM social specialists, Lindsey Bungartz and Mischa Minné (see *Annex J* for the Social Specialist Declaration of Independence). The study began with the compilation of a baseline description. The baseline description was derived from a range of secondary data (including but not limited to census data, existing reports, development plans and other strategic planning documents) and primary data collection. The primary data used for the baseline is based on information provided by the directly-affected landowners and issues raised through the public consultation process.

The impact assessment phase incorporated the identification and assessment of socio-economic impacts (direct, indirect and cumulative) that may result from the construction and operation phases of the project. Mitigation measures that address the local context and needs were recommended as the final phase of the study.

3.8 ASSUMPTIONS AND LIMITATIONS

Environmental Impact Assessment is a process that aims to identify and anticipate possible impacts based on past and present baseline information. As the EIR deals with the future there is, inevitably, always some uncertainty about what will actually happen in reality. Impact predictions have been made based on field surveys and with the best data, methods and scientific knowledge available at this time. However, some uncertainties could not be entirely resolved. Where significant uncertainty remains in the impact assessment, this is acknowledged and the level of uncertainty is provided.

In line with best practice, this EIR has adopted a precautionary approach to the identification and assessment of impacts. Where it has not been possible to make direct predictions of the likely level of impact, limits on the maximum likely impact have been reported and the design and implementation of the project (including the use of appropriate mitigation measures) will ensure that these are not exceeded. Where the magnitude of impacts cannot be predicted with certainty, the team of specialists have used professional experience and available scientific research from solar facilities worldwide to judge whether a significant impact is likely to occur or not. Throughout the assessment, this conservative approach has been adopted to the allocation of significance.

3.8.1 *Gaps and Uncertainties*

Inevitably knowledge gaps remain. For instance, there is an incomplete understanding of cumulative impacts as it is not known how many of the proposed solar power facilities in the vicinity of the Site will be granted authorisation and selected as projects in the IPP procurement process.

Gaps in Project Description

- Regarding the location of solar arrays, the assessment is based on a preferred and refined layout derived from revisions of earlier layouts, to accommodate environmental sensitivities. Although the final layout has been confirmed, the precise locations of the solar arrays may be subjected to fine-scale siting that would allow for more detailed geotechnical studies. This will also seek to ensure that all locations remain in areas of low sensitivity as defined by this study and that the specialists will sign off the revised positions.
- At this stage it is unknown, although unlikely, whether a borrow pit for rock or soil material will be required for the construction of project infrastructure.

Gaps in Baseline Information

- Ecological limitations; a limitation associated with the sampling approach was the narrow temporal window of sampling. Ideally, a site should be visited several times during all the different annual seasons to ensure that the full complement of plant and animal species present are captured. However, this is rarely possible due to time and cost constraints and

therefore, the data captured is representative of the species at the site. The vegetation at the time of the site was in a reasonable condition for sampling. Although a full plant species list was compiled for the site from the site visit, this was complemented by a list of any listed species which are known from other studies to occur in the broad vicinity of the site. The lists of amphibians, reptiles and mammals for the site are based on those observed at the site as well as those likely to occur in the area based on their distribution and habitat preferences. This represents a sufficiently conservative and cautious approach which takes account of the study limitations.

Gaps in Understanding of Impacts

- It should be noted that as large scale solar power facilities are new to South Africa, the impacts associated with them have not been scientifically researched in the context of their occurrence in this country, and therefore the specialists have used the precautionary principal where necessary in undertaking their respective impact assessments.

4 PROJECT DESCRIPTION

This Chapter provides an overview of the Project. Project activities and requirements for the construction, operation and decommissioning of the facility are discussed in this section, as well as the motivation for the project and the alternatives considered.

4.1 MOTIVATION

Global dependence on fossil fuels, rising fossil fuel prices and concern regarding the impacts of climate change has resulted in increasing international pressure on countries around the world to increase their share of energy derived from renewable sources. Targets for the promotion of renewable energy now exist in more than 58 countries around the world and solar energy is emerging as an important component of the energy market in a number of countries.

The South African government has developed a policy framework (the White Paper on Renewable Energy, 2003) and set a target of sourcing 10,000 GWh from renewable energy projects by 2013. This amounts to approximately 4 percent of South Africa's total estimated energy demand by 2013. At the Copenhagen Conference in December 2009, South Africa's president also set a target for the reduction of CO_2 emissions, as laid out in the Integrated Resource Plan (IRP 2010), which sets a target reduction of CO_2 emissions by 34 percent by 2020. The utilisation of renewable energy will play a major role in achieving this goal. South Africa's commitment to achieving this goal was reiterated by Minister Edna Molewa at the December 2010 Climate Change Conference in Cancun, Mexico. At present, approximately 77 percent of the power consumed in South Africa is generated from coal and as a country South Africa is among the largest emitters of CO_2 globally.

In addition, PV power facilities are more effective where there is a high level of solar radiation. South Africa and more specifically the Eastern Cape Province experience some of the highest levels of solar radiation in the world. As such, the development of renewable energy projects such as this presents an opportunity for contributing to sustainable development and growth of the province and the country at large.

The intentions of Solaire Direct in establishing a PV power facility include reducing South Africa's dependence on non-renewable fossil fuel resources, contributing towards the reduced emissions targets and goals the South African government has set out, and contributing to climate change mitigation.

The Renewable Energy Independent Power Producer Procurement Programme (IPP Procurement Programme) has been designed for the following reasons:

- To allow the private sector to contribute to the generation of renewable energy (and the target set by government);
- To contribute towards socio-economic and environmentally sustainable growth; and
- To enhance the renewable energy sector in South Africa.

The programme allows for Applicants to submit proposals for the finance, construction, operation and maintenance of renewable energy facilities.

In terms of future national energy trends, South Africa's policy-adjusted IRP (Department of Energy, 2011) estimates that additional energy capacity by 2030 will include 17.8 GW from renewable sources, with solar PV and wind energy receiving an equal share of the overall energy allocation from renewable sources, with a small portion (1 GW), allocated to concentrated solar power. The IRP stipulates that by 2030 energy from renewable sources will constitute 9 percent of South Africa's overall energy budget. Against this background, the cumulative impact of this 90 MW development as well as the numerous other proposed solar power facilities in the area may prove significant.

Beyond the positive climate impact however, solar energy is very well placed to rapidly come on line and contribute to alleviating the power gap in South Africa. Emergency load shedding in South Africa during 2007 and 2008 highlighted the challenges facing the country in terms of electricity generation, transmission and distribution. The National Energy Resource Plan (NERP), drafted at the time, acknowledged the role that independent power producers (IPPs) (including those harnessing renewable energy resources) can play in ensuring sustainable electricity generation, and sets a goal that 30 percent of all new power generation will be derived from IPPs .

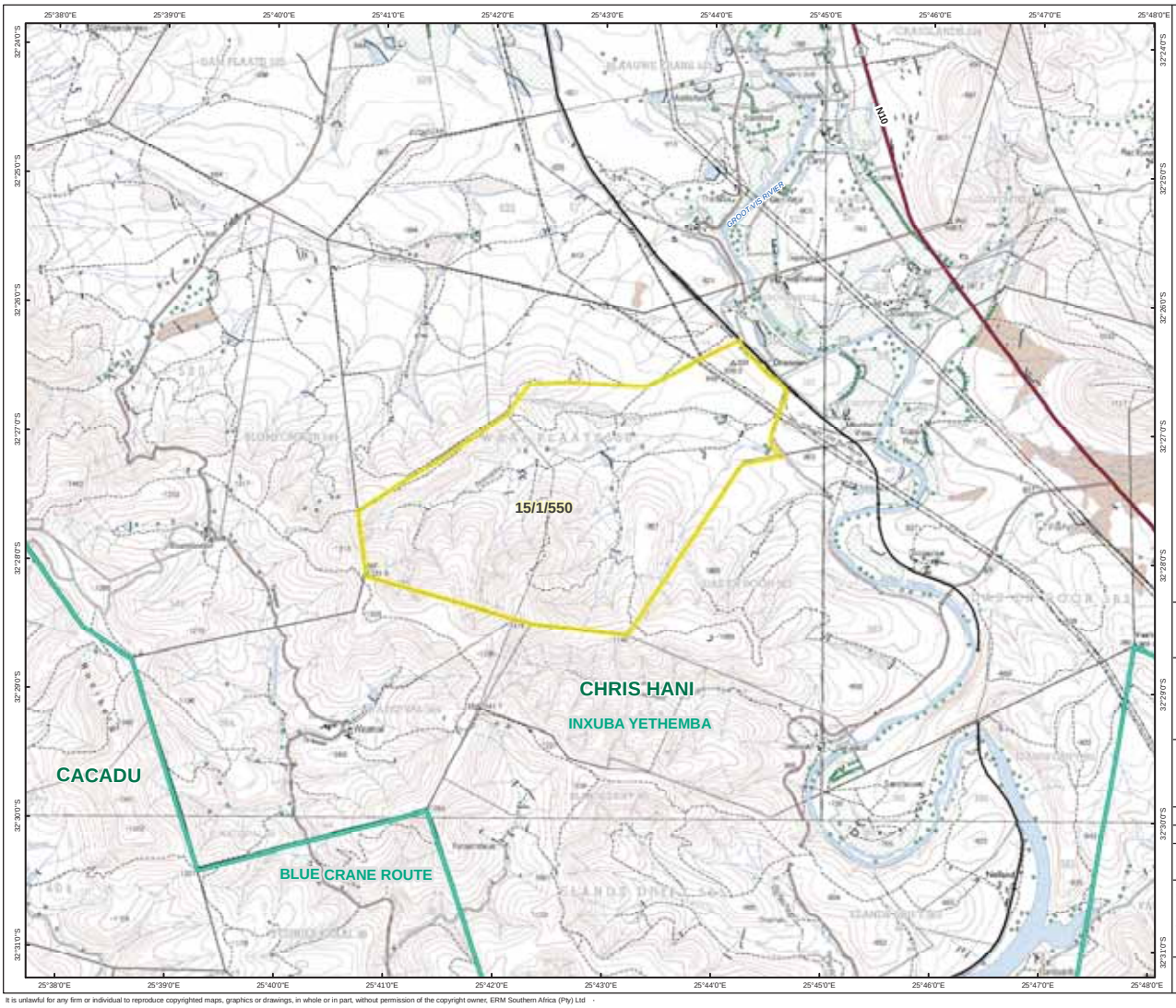
The development of solar energy in the Eastern Cape offers the opportunity for a new industry in the province. Existing levels of employment are low within the province and wider Site locality. Employment is considered to be the single biggest opportunity outside of the advantages expressed above, associated with the project. Training provided to employees will provide individuals with a skill set that will be highly desirable throughout the industry sector in South Africa, as the renewable energy industry and specifically, the solar energy sector rapidly develops, increasing potential opportunities available to such individuals.

4.2 PROJECT LOCATION AND EXISTING LAND USE

The Site for the Project is located in Inxuba Yethemba Local Municipality, Eastern Cape Province (see *Figure 4.1*). The area being considered for development of the Project and associated infrastructure is located on Portion 15 of Portion 1, of the Farm Waai Plaats (no. 550) at Drennan. The Site is 28 km south of Cradock, approximately 3 km west off the N10 and is accessible via the R390.

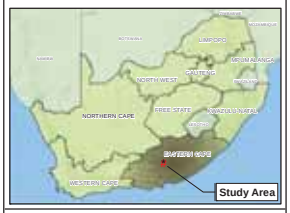
The Site is designated for agricultural use, with current agricultural practices including grazing for livestock (cattle, sheep). Limited cultivation is undertaken within the Site, with a single crop circle typical of pivot agriculture located around 2km to the north of the PV Footprint. Land use in the surrounding area includes further sheep and cattle farming. Substantial cultivation is conducted on the east banks of the Great-Fish River which is located less than 1 km to the east of the Site. Drainage lines occur throughout the Site. These include two significant lines that run in a westerly to easterly direction, directly to the south of the PV footprint. There are six small dams that are located at points along the drainage lines within the Site, the nearest of which is located 35m to the south of the PV footprint.

There is an existing railway line traversing the Site in a north / south direction. An existing gravel road network exists on the Site, which crosses the railway line. The existing 132 kV Drennan Traction Substation is located within the northern section of the Site, and an existing 132 kV power line traverses the northeastern section of the Site from the Drennan Traction Substation in a northwest / southeast direction, exiting the northern boundary of the Site.



Legend

- Contours
- Perennial River
- Non-perennial River
- Arterial Route
- Secondary Roads
- Other Roads
- Track and Hiking Trail
- Railway
- Power Line
- Cadastral Farms
- Erosion; Sand
- Cultivated Lands
- Dry Watercourse
- Water Bodies
- DistrictMunicipalities
- Local Municipalities
- Drennan Photovoltaic (PV) Power Facility



SCALE:

0 1 2 3

Kilometres

TITLE:

Figure 4.1:
Locality Map

CLIENT:

solairedirect

DATE: Sept 2013	CHECKED: DA	PROJECT: 0166587
DRAWN: AB	APPROVED: BL	SCALE: 1 : 50 000

DRAWING: Fig 4.1_Locality Map_Rev3.mxd

REV: 3

ERM
Great Westerford Building
240 Main Road
Rondebosch, 7725
Cape Town, SOUTH AFRICA
Tel: +27 21 681 5400
Fax +27 21 686 073

Projection: Transverse Mercator, CM 25, Datum: WGS 84
Source: NGI: Chief Directorate National Geo-Spatial Information, 3225BC & BD_2005_ED4_GEO.TIF
Inset: ESRI Data and Maps

SIZE: A3

T:\Gis Projects\0166587_Drennan\Solar Park\Mapping\MXD\EIR\Fig 4.1_Locality Map_Rev3.mxd

4.3 PV PLANTS AND POWER GENERATION

Solar energy systems produce energy by converting solar irradiation into electricity or heat. For the Project, Solaire Direct will utilise photovoltaic (PV) technology to generate electricity. PV technology consists of the following components:

- **PV cell;** a basic photovoltaic device, which generates electricity when exposed to solar radiation. The absorbed solar energy excites electrons inside the cells and produces electrical energy. The PV cells are commonly constructed from polycrystalline silicon. All photovoltaic cells produce direct current (DC).

- **PV module or panel;** the smallest complete assembly of interconnected photovoltaic cells. In the case of crystalline silicon cells, following testing and sorting to match the current and voltage, the cells are interconnected and encapsulated between a transparent front (usually glass) and a backing material. The module is then typically mounted in an aluminium frame.

- **PV array;** a mechanically integrated assembly of modules and panels together with support structures, to form a direct current power producing unit. The Project will consist of antireflective modules arranged in numerous arrays. The feeding of electricity into the grid requires the transformation of DC from the PV array into alternating current (AC) by means of an inverter.

4.4 PROJECT COMPONENTS

It is anticipated that the project will feed a total of 90 MW into the national grid (see *Annex L* for detailed schematics of project components). The key components of the Project are discussed in detail below:

- PV solar panels / modules (arranged in arrays);

- PV module mountings;

- DC-AC current inverters and transformers;

- New 2 500 m^2 'loop-in loop-out' substation facilitating connection to the national electricity grid (see *Figure 4.10*);

- New 4 000 m^2 substation located within the PV footprint (see *Figure 4.10*);

- Underground cabling / overhead power lines;

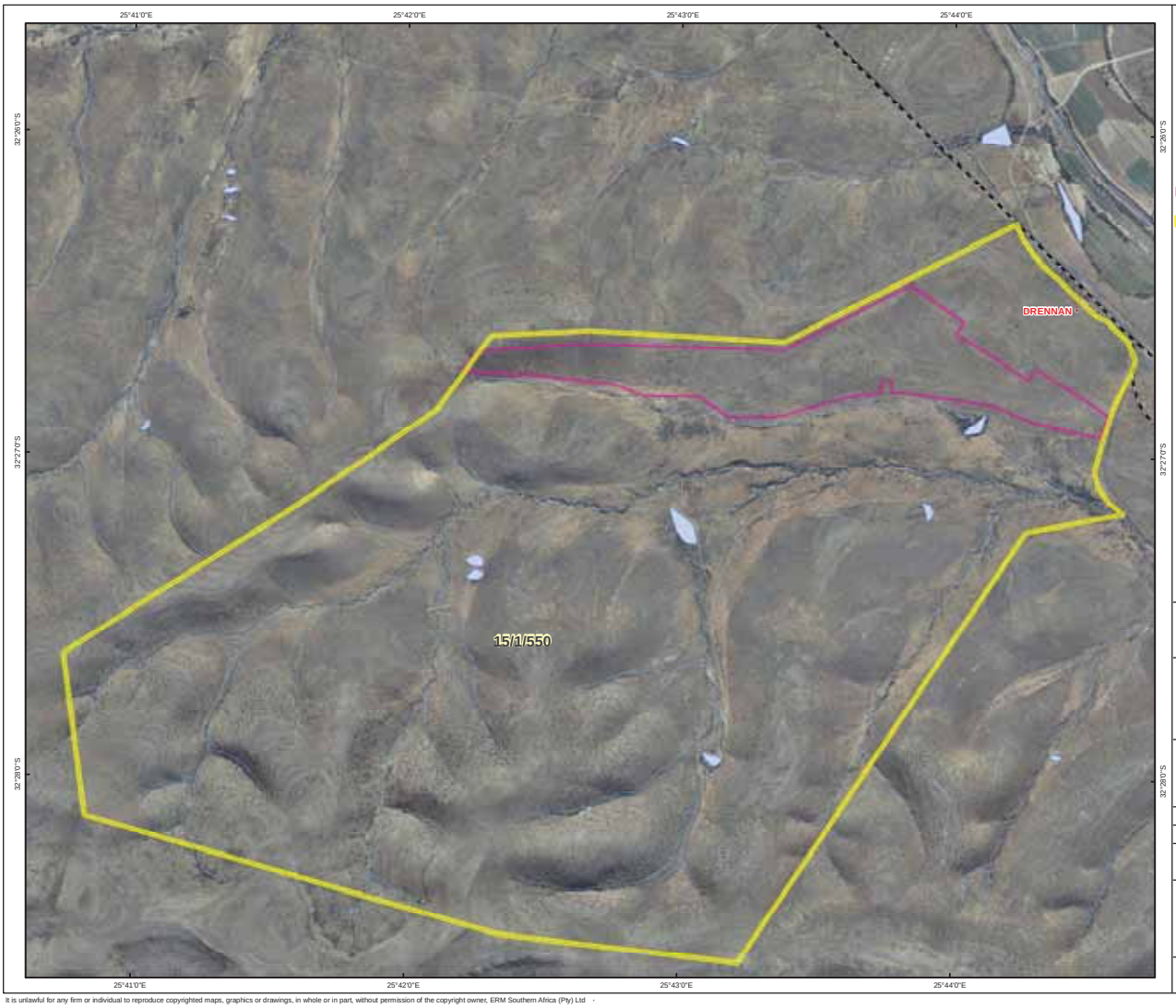
- On-Site buildings (including an operational control centre, office, ablutions and a guard house);

- Access roads and internal road network; and
- Ancillary infrastructure.

The 'final PV footprint' *Figure 4.2* is considered a feasible option for a development of this nature and thus an assessment of this Site will be carried out in further stages of the EIA process. In this regard, it is important to note that the PV footprint selection process was based on various environmental and technical constraints and is subject to change throughout the EIA process. Refer to *Section 4.10.2* below for further detail on the manner in which potential development footprint Sites are chosen. *Table 4.1* gives the co-ordinates of the proposed powerline and PV footprint.

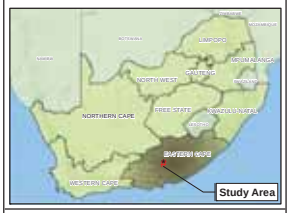
Table 4.1 Coordinates of Powerline and PV Footprint

Component	X Co-ordinate	Y Co-ordinate
Loop-in loop-out Substation	32°25'26.20"S	25°43'14.69"E
New 400m² Substation	32°26'27.97"S	25°43'52.14"E
Powerline Start Point	32°26'27.44"S	25°43'52.40"E
Powerline End Point	32°26'28.66"S	25°43'54.62"E
PV Footprint	32°26'27.85"S	25°43'52.16"E
	32°26'51.80"S	25°44'35.11"E
	32°26'56.61"S	25°44'32.97"E
	32°26'56.22"S	25°44'15.58"E
	32°26'51.98"S	25°44'8.10"E
	32°26'49.00"S	25°43'48.71"E
	32°26'54.52"S	25°43'14.77"E
	32°26'49.37"S	25°42'59.05"E
	32°26'48.51"S	25°42'42.43"E
	32°26'40.55"S	25°42'42.39"E
	32°26'40.04"S	25°43'23.35"E



Legend

- Place Names
- Contour (20m)
- Perennial Rivers
- Non Perennial Rivers
- Railway Line
- Dams
- PV Footprint
- Drennan Photovoltaic (PV) Power Facility



SCALE:
0 200 400 600 800 1 000
Metres

TITLE:

Figure 4.2:
Final PV Footprint

CLIENT:

DATE: Sept 2013	CHECKED: DA	PROJECT: 0166587
DRAWN: AB	APPROVED: BL	SCALE: 1 : 32 000

DRAWING: Fig 4.2_Locality Map Image.mxd | REV: 0

ERM
Great Westerford Building
240 Main Road
Rondebosch, 7725
Cape Town, SOUTH AFRICA
Tel: +27 21 681 5400
Fax +27 21 686 073

Projection: Transverse Mercator, CM 25, Datum: WGS 84
Source: NGI: Chief Directorate National Geo-Spatial Information, 3225BC & BD_2005_ED4_GEO.TIF
Inset: ESRI Data and Maps

SIZE: A3

T:\Gis Projects\0166587_Drennan Solar Park\Mapping\MXD\EIR\Fig 4.11_Site Fig 4.2_Locality Map Image.mxd

4.4.1 *PV Arrays and Mountings*

With respect to the 'Final PV Footprint' option (refer to *Section 4.4* above), the Project will include PV panels that will occupy approximately 110 ha (1.1 km^2) of the Site area in total. The PV panels will be 1660 mm in length, 990 mm in width and 45 mm in height with each producing an output of 305W. Each PV panel will weigh approximately 19 kg. Within each PV panel there will be 60 polycrystalline cells (each 156 mm x 156 mm). These polycrystalline cells will be encapsulated in Ethylene Vinyle Acetate (EVA). The front substrate of the PV panel will be 3.2 mm of antireflection glass, while the back substrate will be Tedlar or APA composite sheeting. Each PV panel will be placed in a black or raw anodized aluminium frame 45 mm in width and equipped with drainage holes. PV panels will be connected in arrays to form units with a total power of 1MW each (around 280 000 PV panels will be installed on a 90 MW project). See *Annex F* for further technical specifications of the PV panels.

The PV panels will be mounted on aluminium fixed frame structures approximately 3.33 m in height from the ground (see *Figure 4.3*). The aluminium structures will be mounted on steel screw piles or concrete foundations 1 500 mm deep, depending on soil conditions. The distance or spacing between rows will be approximately 6.2 m. The PV arrays will face north in order to capture maximum sunlight. *Figure 4.4* shows a typical array of PV panels.

Figure 4.3 Typical Anodized Aluminium Frame

Source: Solaire Direct, 2012

Figure 4.4 Typical PV Array

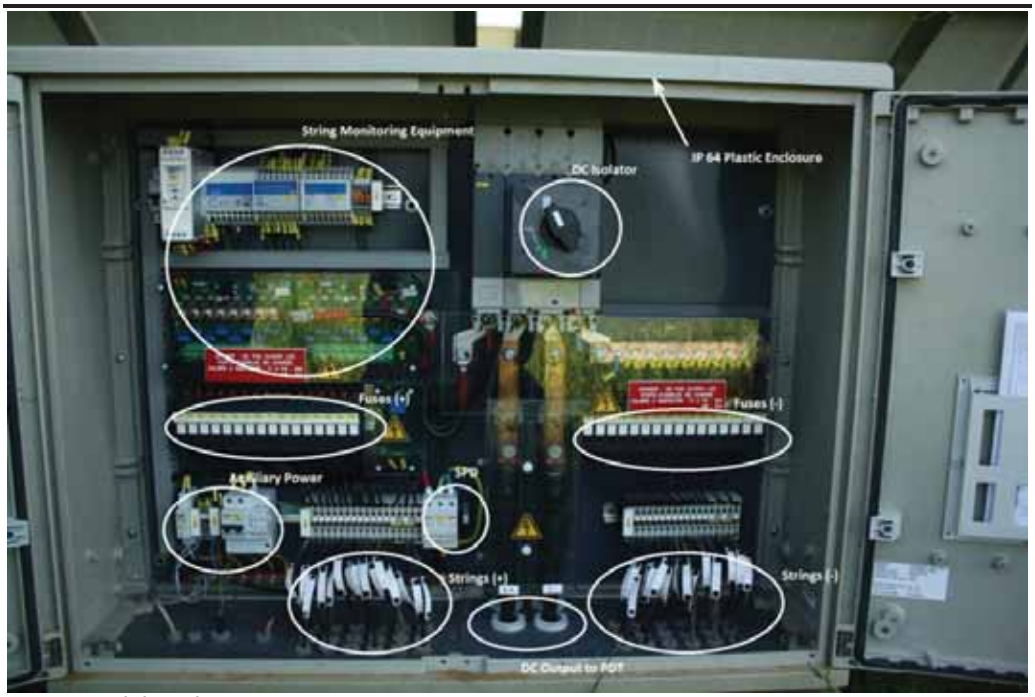
4.4.2 *Electrical Connections and Controls*

The PV panel arrays will be connected via underground cables (800 mm depth) to array enclosures (see *Figure 4.5* and *Figure 4.6*). Array enclosures combine the power generated by many PV panels and transmit that power via two underground DC cables (the array enclosures will be mounted underneath the PV module mounting structures and each array enclosure will occupy an area of approximately 1 m^2) to an inverter / transformer enclosure.

Figure 4.5 Typical Array Enclosure

Source: Solaire Direct, 2012

Figure 4.6 Array Enclosure Components



Source: Solaire Direct, 2012

The inverter / transformer enclosures convert the direct current (DC) produced by the PV panels to alternating current (AC) (see *Figure 4.7*). The inverter / transformer enclosures also contain transformers that transform Low Voltage AC (350V) from the inverter to Medium Voltage AC (22kV). The rated power of each central inverter is 630kW at peak output. Two central

inverters, along with a Low Voltage AC to Medium Voltage AC step-up transformer is placed inside a pre-fabricated concrete container. The container size is approximately 7 m x 3 m x 3.5 m (length x width x height). Between 57 and 60 inverter / transformer enclosures will be required. The inverter / transformer enclosures will connect via underground cabling (depth 800 mm) to a new 'loop-in loop-out' substation of approximately 2500 m^2. The new 'loop-in loop-out' substation will be a brick building containing Medium Voltage (22 kV) circuit breakers that will combine the power generated by each inverter / transformer enclosure. This combined power will then be transformed from Medium Voltage (22kV) up to High Voltage (132 kV) for connection to the existing Eskom overhead transmission line via additional power lines of approximately 250 m in length, which will be constructed from the new 'loop-in loop-out' substation. The power transformer units will be two 40 MW power transformers or three 25 MW power transformers. The power transformers and associated protection equipment (e.g. circuit breakers) will be installed in the new 'loop-in loop-out' substation yard, constructed to Eskom specifications (see *Figure 4.8* and *Figure 4.9*).

Figure 4.7 *Typical Inverter/Transformer Enclosures*

Source: Solaire Direct, 2012

Figure 4.8 Power Transformer

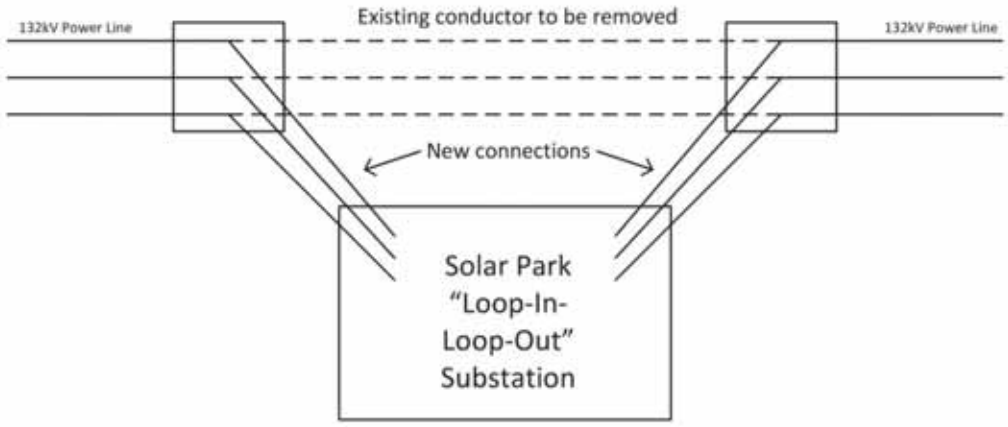
Source: Solaire Direct, 2012

A new on-site substation of approximately 4 000 m² will be constructed. The construction of the substation would include the foundations, erection and installation of equipment (including the transformer) and connection of the necessary conductors.

4.4.3 Grid Connection

The 132 kV power supply from the new 'loop-in loop-out' substation will be connected to the existing 132 kV Transmission Line, which feeds the Eskom Drennan Traction Substation, located to the north of the Site on the east side of the railway line. This connection shall be achieved by installing a T-off from the existing 132 kV line that then connects two overhead power lines of approximately 250 m in length to the new 'loop-in loop-out' substation of the PV power facility (see *Figure 4.9*). Both power lines will be installed on the same steel lattice structure, according to Eskom specifications.

Figure 4.9 New Loop-in Loop-out Substation



Source: Solaire Direct, 2013.

4.4.4 *Auxiliary Electrical Equipment*

The following additional electrical equipment will be required for the project:

- A 200 kVA (10 MW) diesel generator will supply power to security and monitoring systems in the event of a grid failure;
- Security system, electrical fence and 24 hour on Site security access control;
- Fire detection system;
- Weather monitoring equipment (rainfall, wind speed / direction, solar irradiation, air moisture) will be located inside or in close proximity to the guard house;
- PV power facility monitoring equipment and associated telecommunication links will be located inside the guard house; and
- Air-conditioning equipment inside inverter / transformer enclosures which will regulate the operating temperature of the inverters.

4.4.5 *Access Roads and Internal Paths*

The Site will be accessed from the R390 gravel road on the eastern perimeter of the Site (32^{0}26'26.66"S 25^{0}43'50.39" E), which links to the N10 national road. The existing gravel road will be upgraded to approximately 6 m in width and this road will provide access to the proposed PV footprint. Internal tracks will be created to enable access within the PV power facility.

Within the PV arrays, a minimum spacing of 6 m is required between each row to avoid shadowing of the panels by adjacent rows. These spaces will not be gravelled or paved. PV power facility maintenance will consist mainly of PV panel replacement, PV panel cleaning and other minor mechanical and

electrical infrastructure repairs. Access will be needed primarily for light service vehicles entering the Site for maintenance, inspection and PV panel cleaning purposes. During the operational phase, traffic impacts will be less, with vehicles only required to transport infrastructure during routine maintenance and upgrading phases.

4.4.6 *Additional Infrastructure*

Additional infrastructure that will be required for the project includes the following:

- Site perimeter fencing (electrified palisade fencing of approximately 2.8 m in height) including access gates;
- lighting at the main entrance only;
- temporary construction camp (see Annex L with a typical design to house 35 personnel);
- an office for project supervision;
- a meeting room;
- an office for the caretaker of the Site;
- two cloakrooms;
- two temporary chemical toilets, due to the fact that there is no water on the Site; and
- a lay-down area for the temporary storage of materials during the construction activities of approximately 14 400 m².

At this stage it is unknown (but unlikely) whether a borrow pit for rock or soil material will be required for the construction of Project infrastructure. A soil stockpile of approximately 18 000 m² will be required.

4.5 *TRANSPORT, EQUIPMENT AND MACHINERY REQUIREMENTS*

During the construction phase, it is expected that potential traffic impacts will be higher than normal as trucks will be required to transport materials and equipment such as PV panels and frames to the Site. Infrastructure required for the Project, including support structures, PV modules, frames, as well as machinery will be transported to and from the Site from various locations in the region.

It is anticipated that the following number of trips would be required:

- Delivery of panels: 200 loads consisting of 18.9 tons each on 12 m long trailers.

- Delivery of electrical equipment and components: 28 loads of 20 tons each.

- Delivery of frames: 21 loads of 20 tons each.

- Earthworks: potentially 1 400 loads of 10 m^3 each to the identified Local Authority Landfill Site, over the entire construction phase (time period of approximately 9 months).

During the operational phase, it is expected that potential traffic impacts will be less, with vehicles only required to transport infrastructure during routine maintenance and upgrading phases.

4.6 WATER REQUIREMENTS

During the construction phase the primary water use requirement will be for dust control. However, water may also be required to moisture condition the soils for proper compaction at roads and foundations. It is estimated that for dust control and compaction approximately 4 800 000 litres of water will be required (an average of three truck loads per day for the first 60 days of construction and one truck load per day for the following 60 days of construction, with each truck carrying approximately 20 000 litres). Water will also be required for the concrete foundations. It is estimated that 575 586 litres of water will be required for the concrete foundations (with a total of 209 litres / m^3 X 2,754 m^3). The estimated construction-related water requirement is 5.4 million litres with a daily usage of 60 000 litres. Temporary ablution facilities will be required during construction (i.e. portable toilets). Water requirements for the construction phase of the PV power facility will be supplied by the Landowner (see *Annex E* for landowner confirmation of water supply), alternatively the Inxuba Yethemba Local Municipality, Eastern Cape Province.

During the operational phase it is estimated that PV panel cleaning will require a total of approximately 750 000 litres / year (10 000 litres / MW / year). The PV panels will be cleaned manually with a window washer type device (covered with a specialized cloth material), soft brush, window squeegee or soft cloth. A composting toilet will be installed in the guard house requiring no water. During the operational phase, drinking water and process water will also be supplied by existing boreholes and may require treatment for domestic use.

During the operational phase, it is the intention of Solaire Direct to source the required water from an existing reticulation system, either from the Inxuba Yethemba Local Municipality or the Landowner. If this is not feasible, alternative options would be to tanker in the required water and / or amend

the existing Landowner's water use license to include the activity of the required water use.

During decommissioning and Site restoration, dust control will be required, and it is anticipated that similar volumes of water as the construction phase will be required. Similar temporary ablution facilities as in the construction phase will be required during the decommissioning phase.

4.7 WASTE MANAGEMENT

All project generated wastes will need to be managed and disposed of in a manner to prevent potential impacts on the environment and risks to human health. A Waste Management Plan (WMP) for the Project will be developed. This will follow the principles of waste minimisation at source, segregation for reuse, recycling, treatment or disposal.

All wastes produced from the project activities on Site will be temporarily stored in designated waste storage areas. Waste streams will be generated from logistical activities associated with project activities and accommodating personnel.

4.7.1 *Waste Types and Quantities Generated*

All wastes generated from the project will be categorised as either *non-hazardous* or *hazardous* following an assessment of the hazard potentials of the material, in line with South African requirements. The main sources of waste will result from the temporary construction camp and construction and decommissioning activities. One of the main sources of non-hazardous wastes will be the domestic type solid waste from the approximately 35 personnel at the temporary construction camp. These wastes will be produced daily and comprise of the following:

- Domestic type waste, such as mixed waste from kitchens / canteen or living quarters;
    - o residual packaging and food wastes
    - o metal cans (from food and drinks)
    - o plastics drinks bottles
    - o glass jars and bottles

- Wooden pallets and cartons;
- Scrap metal;
- Concrete waste;
- Paper and cardboard;
- Grey water - from showers; and
- Food wastes.

The following hazardous wastes will also be produced from construction activities.

- Batteries (including large lead acid type);
- Medical / clinical wastes - from camp clinic;
- Oily rags and absorbents;
- Used oil and oil filters - from generators or vehicle maintenance;
- Contaminated water - slops and oily water from drip trays; and
- Sewage from toilets.

All wastes produced from project activities on Site will be transferred to designated temporary storage areas and where possible into secure containers. Solid wastes will be segregated to facilitate reuse and recycling of specific materials. All wastes that cannot be reused or recycled will be collected by approved waste contractors and transferred to an appropriately licensed waste management facility for treatment and disposal.

4.7.2 Hazardous Materials and Hazardous Wastes

The construction and decommissioning phases will require the use of hazardous materials such as fuels and greases to fuel equipment and vehicles and maintain equipment. These substances will be stored on Site in temporary aboveground storage tanks. Fuels on Site will be stored in a locked container within a fenced and secure temporary staging area. Trucks and construction vehicles will be serviced off Site. The use, storage, transport and disposal of hazardous materials used for the project will be carried out in accordance with all applicable South African regulations. Material Safety Data Sheets for all applicable materials present on Site will be readily available to on-Site personnel. It is proposed that the construction contracting company supply the required temporary ablution facilities and be responsible for the removal and treatment thereof. Solaire Direct will be responsible to ensure that the contracting company is accredited and has the necessary permits to remove the sewage. The sewage will be treated in accordance with the municipal sewage works policies and guidelines.

Operations and maintenance of the PV power plant is not expected to require hazardous materials to be present and used on Site or to generate hazardous waste. PV panels, array enclosures and inverter / transformer enclosures will not produce waste during operation.

A new septic tank will be constructed on Site (see *Annex L* for a detailed plan), with no additional sewage services infrastructure required on the property, e.g. sewage treatment. With respect to this, a composting toilet will be used in the guardhouse, which makes use of an aerobic process to treat human waste material. The composting toilet requires no water and produces compost-like, odourless, de-hydrated material that could be either disposed of via municipal waste services or be used in the production of compost. Sewerage will be regularly collected and transported to appropriate municipal sewerage treatment facilities.

4.7.3 *Non-hazardous Wastes*

Construction waste will most likely consist of concrete rubble (if concrete foundations are utilised to support mounting structures) and scrap metal. All concrete mixing will be undertaken on impermeable plastic linings to prevent contamination of the soils and surrounding areas. Construction solid waste will be managed by an Environmental Management Programme (EMPr) and will incorporate reduction, recycling and re-use principles.

All waste that cannot be reused or recycled will be appropriately disposed of. All construction debris will be placed in appropriate on-Site storage containers and periodically disposed of by a licensed waste contractor in accordance with applicable South African regulations. The construction contractor will remove refuse collected from the designated waste storage areas at the Site at least once a week. It is estimated that approximately 222 m^3 of construction debris will be produced per month, while it is estimated that approximately 0.2 m^3 of solid waste will be generated per month during the 20 to 30 year period of operation.

4.8 *SOCIO-ECONOMIC ASPECTS*

The total investment cost of the project is estimated to be approximately R1 350 million.

During the construction phase, the following employment opportunities will be created:

- Site management: 25 employees;
- Civil works: 54 employees;
- Frames & foundations: 27 employees;
- PV modules: 125 employees; and
- Electrical system & components: 60 employees.

Of the PV power facility's employees during construction, 174 employees are estimated to be skilled.

During the operations phase the following employment opportunities will be created:

- General administration and maintenance: 30 employees;
- Compliance related activities: 3 employees;
- Performance monitoring of the PV power facility: 2 employee; and
- Security: 24 employees.

Of the PV power facility's employees during operation, 21 employees are estimated to be skilled.

Certain aspects of the project will provide better opportunities for local employment and economic development than others. The conditions of contract between Solaire Direct and the subcontractor will include requirements for local Enterprise Development addressing the following identified opportunities:

- Electrical system: there will be a requirement for the electrical contractor to make use of local electrical companies for certain elements of the installation of the electrical system. The requirement will be for a minimum of 5% of the subcontract value to be spent on local enterprises.

- Security: there will be a contractual requirement for the security service contractor to subcontract the provision of local security staff to a local company. If such a company does not exist, then the requirement will be for the security service contractor to establish such a subcontractor. The requirement will be for a minimum of 25% of the subcontract value to be spent on local enterprises.

The labour contract between Solaire Direct and contractors who are appointed to provide services during the construction phase of the development will specify local labour employment criteria, e.g. percentage of total workforce.

The labour cost during construction is estimated to be R 3 million, of which local labour is expected to receive 75% (approximately R2.25 million). This estimate excludes the value of manufacturing labour costs. The estimate of the local manufacturing portion of the EPC contract is approximately R 18 million.

Numerous local employment opportunities will be created in the manufacturing process of the PV panels, steel frames, etc. During the operation phase, the PV power plant is expected to generate approximately 8-24 security and 35 operation and maintenance employment opportunities (totalling an estimated R 59 million per year during the first 10 years of operation).

All financial benefits will accrue to beneficiaries, including equity partners, according to Solaire Direct's company structure. Solaire Direct also intends to contribute a portion of the gross profit (before tax and depending on the project stage) to a local community trust that will be specifically set up for this project. The value of this contribution will be determined on finalisation of the tariff as part of the Power Purchase Agreement (PPA).

4.9 PROJECT STAGES AND ACTIVITIES

The project life-cycle can be divided into three key stages as follows:

- Site preparation and construction;
- operation (including maintenance and repair); and

- decommissioning.

Each of these stages is outlined in the sections below.

4.9.1 Site Preparation and Construction

Prior to construction of the PV power plant, the Site will be prepared. Depending on the topography of the proposed layout, Site preparation will generally include the following activities:

- vegetation clearance – removal or cutting of any tall vegetation if present (bush cutting);
- levelling and grading of areas where the array will be sited would normally occur, but this is not deemed necessary given the flat nature of the terrain on the Site;
- levelling of hard-standing areas, e.g. for temporary laydown and storage areas;
- erection of Site fencing;
- construction of a temporary construction camp; and
- upgrading of farm tracks / construction of on-Site access roads.

Once the Site has been prepared, prior to the installation of the PV components, the following construction activities will take place:

- the installation of fixed aluminium structures to support the PV modules;
- the construction of the new 2 500 m^2 'loop-in loop-out' substation;
- the construction of the new 4 000 m^2 substation;
- the construction of electrical and control room;
- the construction of Site office and storage facilities, including security and ablution facilities (i.e. composting toilet);
- the construction of array enclosures and inverter / transformer foundations and housing; and
- the installation of cables.

The PV, electrical and structural equipment will be procured in South Africa where available, or from an international manufacturer when sourcing from within the country is not possible. It is expected that these components will be delivered to Site via road in small trucks. Once the PV components have

arrived on Site, technicians will supervise the assembly of the panels and test the facility. The PV panels will be installed on the fixed aluminium structures anchored to the ground through poles which will be screwed or piled into the ground.

Phased Approach to Construction

The development will be constructed in a phased approach. The exact size of each phase will be dependent on the various consents and authorisations to be obtained for the project, primarily the Power Purchase Agreement. The interconnection technical constraints will also need to be discussed and agreed with Eskom via the Interconnection Agreement. Installation of the full 90 MW could take up to 9 months or more to complete.

During the Site preparation period, the workforce required for Site security, manual labour, civil works, transportation of goods and other similar services will most likely be drawn from the local labour pool. During the first phase of construction, a highly-skilled team of solar energy technicians (the majority of which would likely be from overseas as a workforce with the required skills is not currently available in the South African market) will train a number of the potential employees, preferably from the province, where available. Up to 291 personnel will be required to construct the full 90 MW PV power facility. However, any accurate employment number is dependent on how the phasing of the project is undertaken. For the purposes of the impact assessment, we have assumed that the development will take place in consecutive phases rather than simultaneously.

4.9.2 Operation

Once each phase of the facility is complete and operational it is expected that it will have a lifespan of at least 20 years. Measuring the performance of the PV power plant will be done remotely, through the use of telemetric monitoring. Day to day facility operations will involve both regular on Site preventive and corrective maintenance tasks in order to keep the PV power plant in optimal working order throughout the operational period. Maintenance will consist mostly of panel replacement and other mechanical and electrical infrastructure repairs. Intermittent cleaning of the panels will be carried out as necessary which is anticipated to be once or twice a year. Faulty components will be replaced as soon as problems are identified.

4.9.3 Decommissioning

The PV power facility will be decommissioned after 20-30 years. Alternatively the facility will be upgraded. Solaire Direct intend for the salvage value to cover the cost of decommissioning. Should the plant be decommissioned, the Site will be rehabilitated to its original state by applying the following actions:

- PV panels will be removed from the fixed aluminium frames.

- Fixed aluminium frame structures will be removed.

- PV panels will be transported to special recycling facilities (alternatively used at other operational Sites).

- Electrical equipment (transformers) will either be re-used on other developments / projects or sold.

- Underground cable runs (where applicable) will be removed.

- Gravel / chipstone on the access roads, on-Site service roads, guardhouse foundations will be removed.

- Buildings, such as the guardhouse can be taken over by the landowner for operational purposes; alternately all the reusable material can be removed, the structures demolished and the rubble transported to a municipal waste Site.

- Disturbed land areas will be rehabilitated, and replanted with indigenous vegetation if required.

4.10 CONSIDERATION OF ALTERNATIVES

In terms of the EIA Regulations, Section 28(1)(c) and NEMA, Section 24(4), feasible and reasonable alternatives are required to be considered in the EIA process. '*"Alternatives", in relation to a proposed activity, means different ways of meeting the general purposes 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 (No Go)'.

This section outlines the alternatives considered in for the Drennan PV power facility.

4.10.1 Site Location Alternatives

As part of the Site selection process a number of potential Sites were investigated in the Eastern Cape through a desk-top analysis and intrusive studies. The Drennan Site was identified based on a number of criteria, including:

- **Solar resource:** Analysis of available data from existing weather stations suggests that the Site has sufficient solar resource to make a solar energy

facility viable. The Site is located in one of the most irradiated areas of the country.

- **Site extent:** Sufficient land was purchased to enable sufficient power supply and to allow for a minimum number of PV panels to make the project feasible.

- **Grid access:** Access to the grid and adequate transmission lines were key considerations for Site location, i.e. proximity to Eskom's Drennan Traction Substation.

- **Land suitability:** Sites that facilitate easy construction conditions (relatively flat land with deep soft soil and few rock outcrops or waterbodies) were favoured during Site selection.

- **Landowner consent:** The selection of Sites where the land owners are supportive of the development of renewable energy is essential for ensuring the success of the project.

- **Environmental and socio-economic impacts:** Consideration was given to identifying a Site with low agricultural potential, level of biodiversity value and potential visual impacts during Site selection.

- **Workforce:** The availability of a potential work force in the surrounding area was taken into consideration.

4.10.2 Site Layout Alternatives

The PV power facility layout and project component design was subjected to a number of iterations, based on technical aspects of the project. These included aspects such as detailed Site-specific solar data, construction conditions, as well as specialist input and sensitivity ratings for the Site that were explored during the EIA process.

From a technical perspective, the final PV plant layout depends on a number of factors, including:

- Site-specific topographical conditions;

- Geotechnical features of the Site;

- Drainage analysis;

- Final available interconnection capabilities to the Eskom grid;

- Final dimensions and sizing of structures to be done by specialized engineers to insure that all built equipment will be suitable for the local weather conditions; and

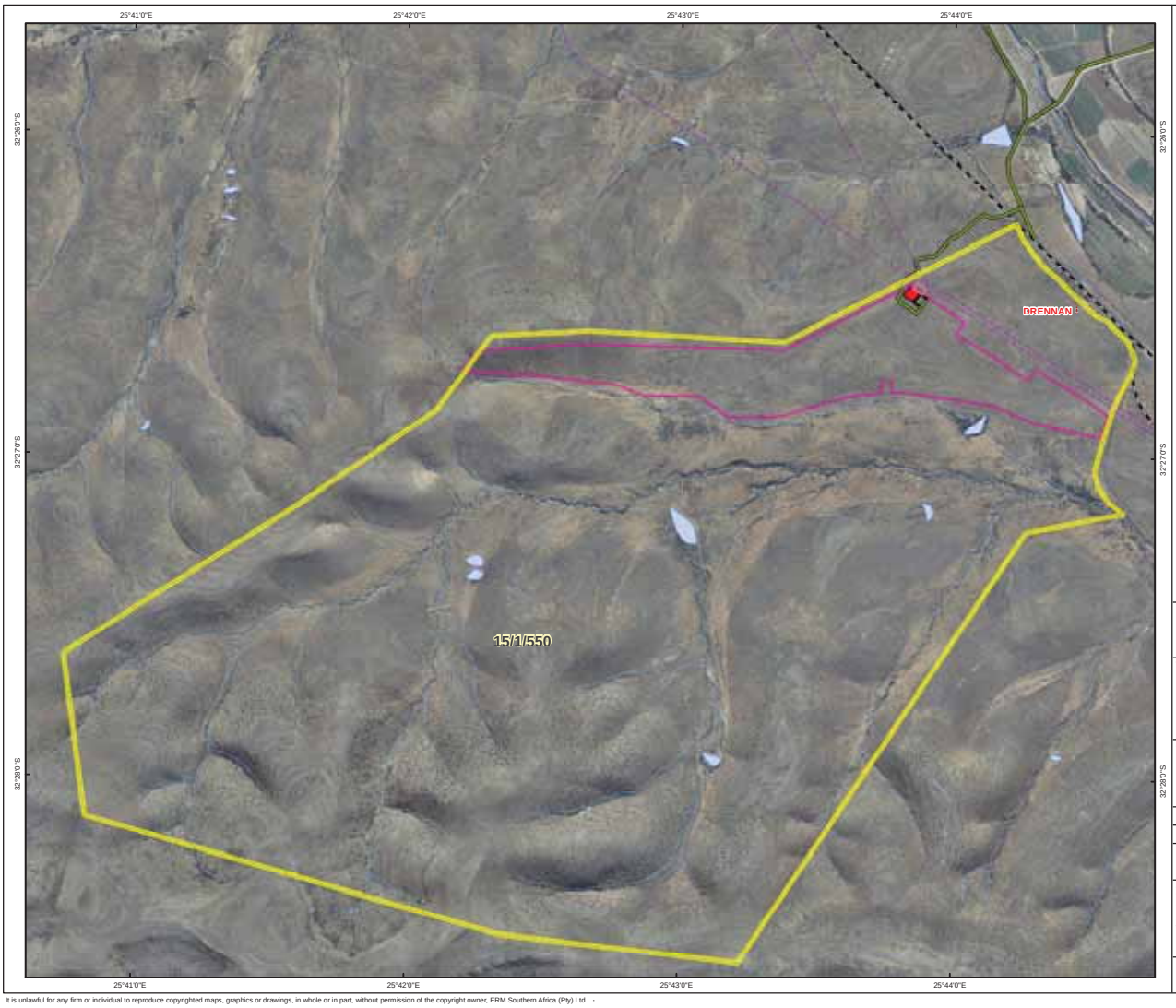
- Any additional inputs, obstacles, or constraints identified during the EIA and Site survey process, as discussed below.

The final PV Footprint was determined through an initial screening process of the Site (*Figure 4.11*) undertaken by Solaire Direct. The screening process, which involved input from environmental specialists, guided decision making with respect to the layout of the PV Footprint. Areas within Site considered unsuitable by the environmental specialists were excluded, based on potential impacts to vegetation, fauna, agriculture, cultural heritage and visual considerations (this included areas immediately to the south and west within the Site, which are dominated by drainage lines and steeper slopes). As such the final PV Footprint (*Figure 4.12*) was selected as the most feasible Site layout alternative. *Figure 4.12* indicates the final PV footprint on the constraints map, indicating the 'buildable areas' based on various environmental and social constraints, as well as additional technical constraints.

Technical criteria and buffer zones considered in deriving the final PV footprint included:

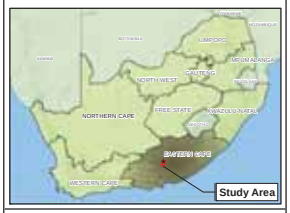
- Where possible, avoiding areas which are very rocky or uneven, in order to minimise earthworks and thus real and potential environmental impact;
- Ecologically sensitive areas;
- Buffer around drainage lines of 50 m;
- Buffer around heritage sites of 10m;
- National road buffer of 150m;
- Local district road buffer of 100 m;
- Railway buffer of 100 m;
- External farm boundary buffer of 30 m; and
- Buffer along existing Eskom grid infrastructure of 50 m.

The aim of considering layout alternatives was to balance the technical and financial objectives of maximising the output of the Project with the other critical environmental and socio-economic constraints, including visual, botanical, faunal, heritage, archaeology, and palaeontology.



Legend

- Place Names
- Contour (20m)
- Perennial Rivers
- Non Perennial Rivers
- Railway Line
- Eskom Power Line
- Dams
- Access Roads
- "Loop-in-Loop-out" Connection Substation
- Laydown Camp Site and Assembly Area for Construction
- Substation and Guard House
- PV Footprint
- Drennan Photovoltaic (PV) Power Facility



SCALE:
0 200 400 600 800 1 000
Metres

TITLE:
Figure 4.10:
Layout of the Project Site

CLIENT:
solairedirect

DATE: Sept 2013	CHECKED: DA	PROJECT: 0166587
DRAWN: AB	APPROVED: BL	SCALE: 1 : 32 000

DRAWING: Fig 4.10_Project Infrastructure.mxd
REV: 0

ERM
Great Westerford Building
240 Main Road
Rondebosch, 7725
Cape Town, SOUTH AFRICA
Tel: +27 21 681 5400
Fax +27 21 686 073

Projection: Transverse Mercator, CM 25, Datum: WGS 84
Source: NGI: Chief Directorate National Geo-Spatial Information, 3225BC & BD_2005_ED4_GEO.TIF
Inset: ESRI Data and Maps

SIZE: A3

T:\Gis Projects\0166587_Drennan\Solar Park\Mapping\MXD\ERM\Fig 4.10_Project Infrastructure.mxd

Legend

- Place Names
- Contour (20m)
- Perennial Rivers
- Non Perennial Rivers
- Railway Line
- Eskom Power Line
- Dams
- Access Roads
- "Loop-in-Loop-out" Connection Substation
- Laydown Camp Site and Assembly Area for Construction
- Substation and Guard House
- PV Footprint
- River (50m Buffer)
- Railway Line (100m Buffer)
- Transmission Line (50m Buffer)
- Heritage Sites (10m Buffer)

Ecology Sensitivity

- Very High
- High
- Medium-High
- Medium
- Low
- Drennan Photovoltaic (PV) Power Facility

SCALE:
0 200 400 600 800 1 000
Metres

TITLE:
Figure 4.11:
Final PV Footprint on Constraints Map

CLIENT:
solairedirect

DATE: Sept 2013	CHECKED: DA	PROJECT: 0166587
DRAWN: AB	APPROVED: BL	SCALE: 1 : 32 000

DRAWING:
Fig 4.11_Final PV Footprint on Constraints Map.mxd
REV: 0

ERM
Great Westerford Building
240 Main Road
Rondebosch, 7725
Cape Town, SOUTH AFRICA
Tel: +27 21 681 5400
Fax +27 21 686 073

Projection: Transverse Mercator, CM 25, Datum: WGS 84
Source: NGI: Chief Directorate National Geo-Spatial Information, 3225BC & BD_2005_ED4_GEO.TIF
Inset: ESRI Data and Maps

SIZE: A3

T:\Gis Projects\0166587_Drennan\Solar Park\Mapping\MXD\EIR\Fig 4.11_Final PV Footprint on Constraints Map.mxd

4.10.3 *Technological Alternatives*

Solar energy is considered to be the most suitable renewable energy technology for this Site, based on the Site location, ambient conditions and energy resource availability. There are a number of different solar energy technologies that include:

- Fixed PV plants;
- Tracking PV plants (with solar panels that rotate on a dual- or single-axis to follow the sun's movement);
- Concentrated Solar Power (CSP) plants; and
- Concentrated PV Plants.

Financial, technical and environmental factors were taken into account when choosing the type of solar power technology for the Site, including the local solar resource and its likely generation output, the economics of the Project and availability of government feed-in tariffs and energy production licenses, and the requirement for other development inputs such as water resource requirements. PV is the most environmentally sensitive technology for the preferred Site as large volumes of water are not needed for power generation purposes compared to the CSP option. CSP requires large volumes of water for cooling purposes. PV is also preferred when compared to CSP technology because of the lower visual profile.

The remaining types of technologies were evaluated and the preferred configuration was selected based primarily on the operating environment. The suitability of different types of PV solar panels was assessed including thin film and polycrystalline panels. Based on performance in high temperature environments similar to those typical of the Eastern Cape, thin film panels were selected as the preferred option. The Drennan PV power facility will install fixed structures rather than tracking systems as they require less repair work and maintenance during the operational life of the project. This decision is based on the benefits demonstrated by fixed structures with a longer track record in other markets, showing their high reliance during long periods of time. High capacity inverters (typically 1 MW) are considered more robust than smaller inverters and thus were selected as part of the preferred configuration.

Fixed Mounted PV System (Preferred Alternative)

In a fixed mounted PV system, PV panels are installed at a pre-determined angle from which they will not move during the lifetime of the plant's operation. The limitations imposed on this system due to its static placement are offset by the fact that the PV panels are able to absorb incident radiation reflected from surrounding objects. In addition the misalignment of the angle of PV panels has been shown to only marginally affect the efficiency of energy

collection. There are further advantages which are gained from fixed mounted systems, including;

- The maintenance and installation costs of a fixed mounted PV system are lower than that of a 'tracking' system which is mechanically more complex given that these PV mountings include moving parts.

- Fixed mounted PV systems are an established technology with a proven track record in terms of reliable functioning. In addition replacement parts are able to be sourced more economically and with greater ease than with alternative systems.

- Fixed mounted systems are robustly designed and able to withstand greater exposure to winds than tracking systems.

Dual Axis Tracking System

In a dual axis tracking system PV panels are fixed to mountings which track the sun's movement. There are various tracking systems. A 'single axis tracker' will track the sun from east to west, while a dual axis tracker will in addition be equipped to account for the seasonal waning of the sun. These systems utilise moving parts and complex technology including solar irradiation sensors to optimise the exposure of PV panels to sunlight.

Tracking systems are a new technology and as such are less suitable to operations in South Africa. This is because:

- A high degree of maintenance is required due to the nature of the machinery used in the system, which consists of numerous components and moving parts. A qualified technician is required to carry out regular servicing of these parts, which places a question on the feasibility of this system given the remote location of the Site.

- The costs of the system are necessarily higher than a fixed mounted arrangement due to the maintenance required for its upkeep and its complex design.

- A larger Site is required for this system given that the separate mountings need to be placed a distance apart to account for their tracking movement.

- A power source is needed to activate the tracking system and this offsets a certain portion of the net energy produced by the plant.

4.10.4 Grid Connection Alternatives

The options of connecting the PV power facility to Eskom's national grid are subject to on-going discussions between Solaire Direct and Eskom. The most efficient and practical option which is considered viable for the Site is connection into the existing Eskom overhead transmission lines which

traverse the north eastern boundary of the current PV footprint. One new 'loop-in loop-out' substation will be built (5 000 m^2 in size) containing Medium Voltage (22 kV) circuit breakers that will combine the power generated by each inverter / transformer enclosure. This combined power will then be transformed from Medium Voltage (22 kV) up to high voltage (132 kV) for connection to the existing 132 kV Eskom overhead transmission lines.

The Draft Scoping Report indicated that an additional power line would be required from the new substation to the existing Eskom Drennan Traction Substation. However, due to land parcel ownership and the additional impacts this power line would have, this alternative is not deemed feasible. Instead, the alternative of using the new 'loop-in loop-out' grid connection substation is the alternative deemed most feasible.

4.10.5 No-go Alternatives

The no-go alternative is the option of not implementing the activity or executing the Project. Assuming that the solar power plant would not be developed at the Site, the Site would remain in its current state. However, the agricultural potential (although limited for this Site) would not be lost due to the establishment of the facility on agricultural land. Similarly, there would be no positive impacts if the power plant is not executed; there will be no increase in electricity generation, no CO_2 offsets associated with the Project, no economic benefit to the landowners associated with the potential income generated through the operation of the facility, and there would be no contribution to meeting South Africa's targets for renewable energy generation.

The direct benefits associated with the both the construction and operational phases of the solar power plant such as increased employment opportunities and associated economic benefits would also not occur should the development not go ahead.

5 BIOPHYSICAL BASELINE

The environment consists of interacting physical, biological, social, economic and cultural factors. It is essential that the baseline conditions of an environment are characterised in order to be in a position to accurately predict the potential effects a development may have on that environment. This Chapter describes the existing physical and biological baseline conditions of the Site and surrounding area.

5.1 PHYSICAL BASELINE

5.1.1 Site Setting

The Project is located on Portions 15 of Portion 1, of Farm Waai Plaats (no. 550) at Drennan, situated in the Inxuba Yethemba Local Municipality in the Eastern Cape Province (see *Figure 1.1*). The Site is located approximately 28 km South of Cradock and is accessible from the N10 (tarred road).

The Site is zoned as agricultural land and contains vast grazing land for sheep, cattle and game. Beyond the northern boundary of the Site there is a small area of irrigated land where pivot agriculture has been undertaken. Crops under irrigation in the surrounding area include maize and potato. More intensive agricultural activities are located on either side of the Great Fish River, which runs roughly 2 km to the east of the PV Footprint.

Although the Site is remote, there are existing man-made features present in the immediate landscape. There is an existing railway line 500 m to the east of the PV Footprint, which runs adjacent to the eastern boundary of the Site in a north south direction. An existing gravel road network exists on the Site, which crosses the railway line. Existing 400kV overhead transmission lines run along the north eastern boundary of the PV Footprint, which link to the existing 132kV Drennan Traction Substation located 2 km to the north. Housing infrastructure is located along the railway line located around 500m to the immediate north east of the PV Footprint.

5.1.2 Climate

The climate in the Eastern Cape is highly varied. The Study Area has a continental climate with a late summer rainfall regime i.e. most of the rainfall is confined to summer and autumn. Cradock normally receives about 248 mm of rain per year, with most rainfall occurring during autumn. The Eastern Cape receives the lowest rainfall (4 mm) in August and the highest (46 mm) in March. The Mean Annual Precipitation (MAP) for the Study Area is 379 mm (SA Rainfall Atlas, 2012). The average midday temperatures for Cradock range from 16.8 °C in June to 29.5 °C in January. A MAP of 379 mm is deemed low, as 500 mm is considered the minimum amount of rain required for sustainable dry land farming (Smith, 2006). The region typically experiences

hot days with an average mid-day temperature of 29 °C in summer, while average night time temperatures drop to around 2 °C during winter.[1] Frost, which can damage certain crops, is common during the winter months.

5.1.3 *Landscape and Topography*

The topography of the Study Area is a mix of open plains, riparian areas and steeper slopes. Slope, or terrain, is used to describe the lie of the land. Terrain influences climate and soils characteristics, and thus plays a dominant role in determining whether land is suitable for agriculture. In most cases sloping land is more difficult to cultivate and usually less productive than flatland, and is subject to higher rates of water runoff and soil erosion (FAO, 2007). Around 70 percent of the Site is dominated by steeper slopes and rocky outcrops. Away from these rocky areas the land is generally flat with an average gradient of less than 10 percent, these flatter areas are associated with a higher potential for grazing. The flat topography of the eastern portion of the Site makes this area ideal for the Project, as minimal earthworks will be required to prepare the Site for the installation of PV arrays (see *Figure 5.1*).

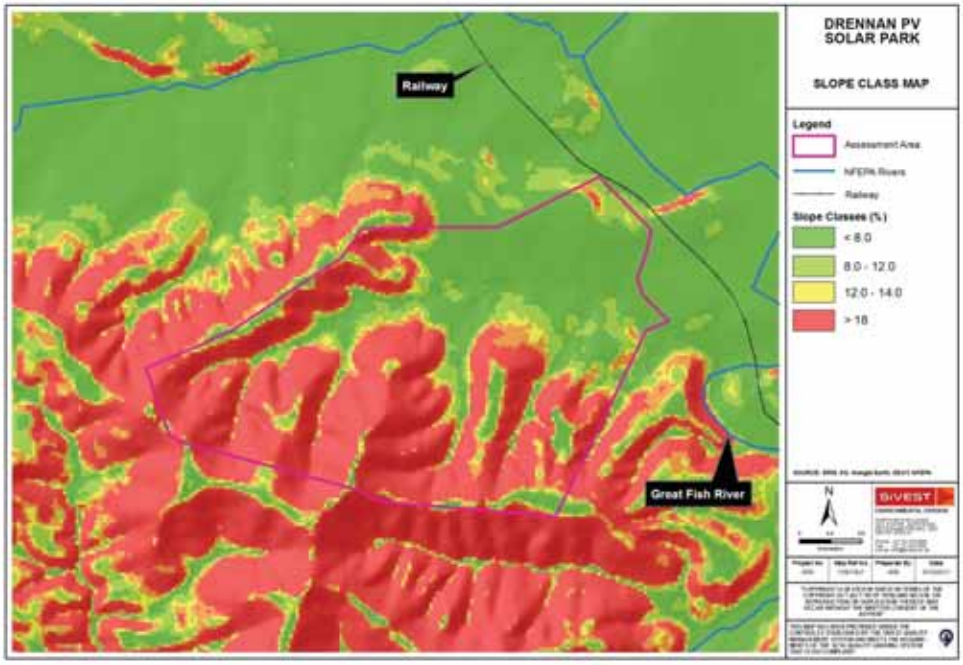
5.1.4 *Geology*

The geology of the Study Area contains Late Permian rocks, which are between 255 and 252 million years old and belong to the Balfour Formation of the Beaufort Group, Karoo Supergroup. These rocks consist mostly of mudstones and siltstones. The Beaufort Group is world-renowned for its rich fossil record. They contain some of the most significant evidence for the origins of dinosaurs, mammals and turtles. The rocks of the Beaufort Group are sub-divided into assemblage zones according to the various vertebrate fossils found in each zone. Drennan falls within the *Dicynodon* Assemblage Zone, named after the most common dicynodont therapsid fossil found in the zone. The Dicynodon Assemblage Zone fauna include fish, amphibians, reptiles and numerous species of therapsids which are the ancient ancestors of mammals (Hart, 2012).

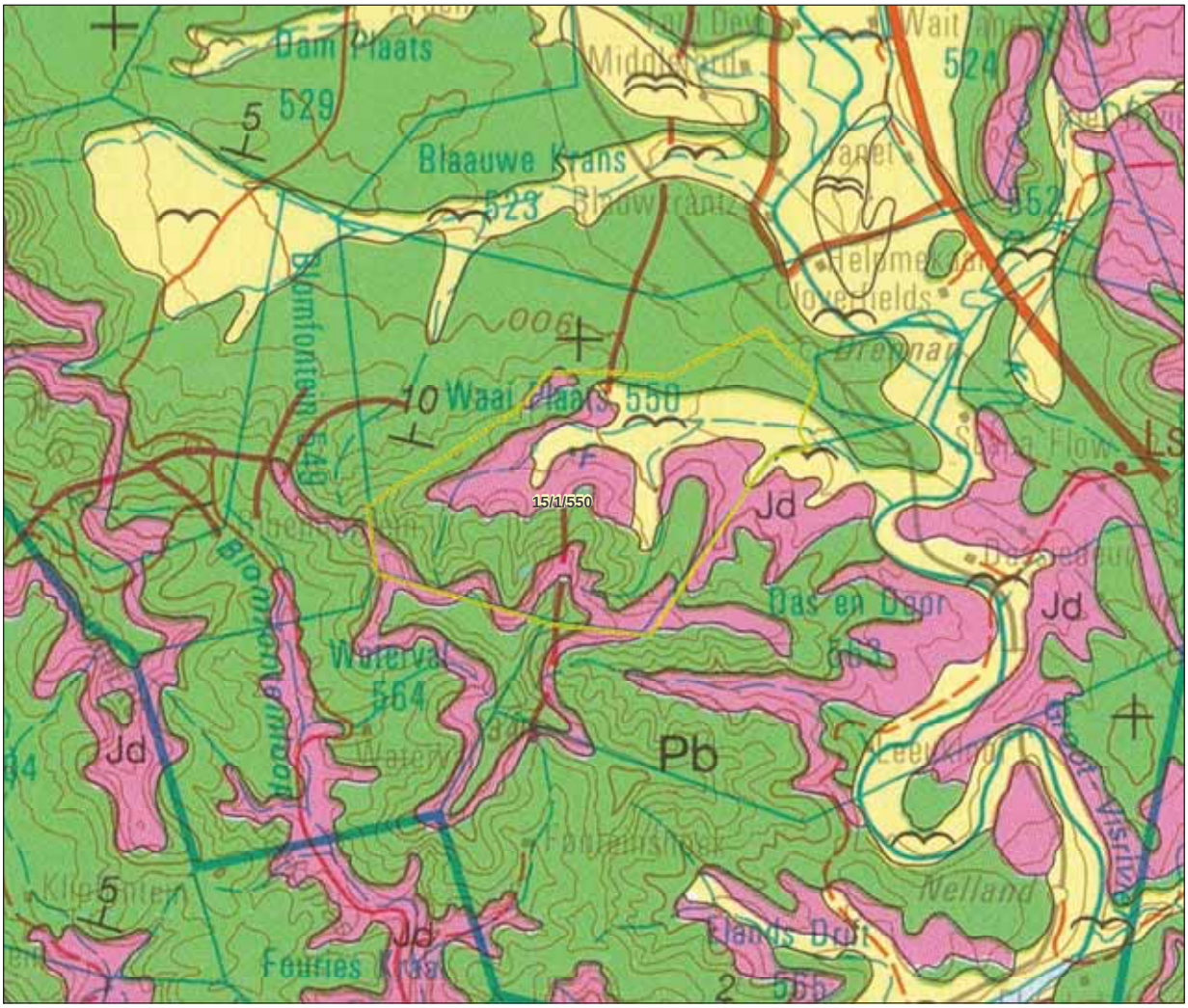
The Site is underlain by mudstone and Dolerite (*Figure 5.2*). Mudstone is a clastic sedimentary rock which is formed from the lithification of deposited mud and clay. Mudstone consists of a very fine grain size of less than 0.005 mm and is mostly devoid of bedding. Dolerite geological materials underlie the central areas as well as the southern boundary of the Site (Barichievy, 2013).

[1] http://www.saexplorer.co.za/south-africa/climate/cradock_climate.asp [Accessed 15 March 2013]

Figure 5.1 Slope Map

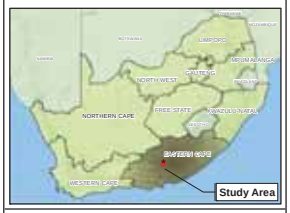


Source: Kurt Barichievy, 2012



Legend

- Drennan Photovoltaic (PV) Power Facility
- Terrace Gravel; Calcrete
- Jd Dolorite
- Pb Mudstone



SCALE:

0 1 2 3

Kilometers

TITLE:

Figure 5.2:
Geology Map

CLIENT:

solairedirect

DATE: Sept 2013	CHECKED: DA	PROJECT: 0166587
DRAWN: AB	APPROVED: BL	SCALE: 1 : 50 000

DRAWING: Fig 5.2_Geology Map_Rev2.mxd | REV: 2

ERM
Great Westerford Building
240 Main Road
Rondebosch, 7725
Cape Town, SOUTH AFRICA
Tel: +27 21 681 5400
Fax +27 21 686 073

Projection: Transverse Mercator, CM 25, Datum: WGS 84
Source: Geosciences Council, 3224 1:250 000 Geology Map
Inset: ESRI Data and Maps

SIZE: A3

T:\Gis Projects\0166587_Drennan\SolarPark\Mapping\MXD\EIR\Fig 5.2_Geology Map_Rev2.mxd

5.1.5 *Paleontology*

The Site is situated in a palaeontologically sensitive and important area of the ancient Karoo Basin (Johnson, et al. 2009; Rubidge, et al. 1995; Smith 1990).

"*The Karoo Supergroup covers almost two thirds of the present land surface of southern Africa. Its strata record an almost continuous sequence of continental sedimentation that began in the Permo-Carboniferous (280 Ma) and terminated in the early Jurassic 100 million years later. The glacio-marine to terrestrial sequences accumulated in a variety of tectonically controlled depositories under progressively more arid climatic conditions. Numerous vertebrate fossils are preserved in these rocks, including fish, amphibians, primitive aquatic reptiles, primitive land reptiles, more advanced mammal-like reptiles, dinosaurs and even the earliest mammals*" (Smith 1990).

As such the Great Karoo is one of the world's most important repositories of paleontological information about the evolution on both marine and terrestrial plants and animals. As mentioned Drennan is underlain by rocks which form part of the Beaufort Group, which contains some of the most significant evidence for the origins of dinosaurs, mammals and turtles. The rocks of the Beaufort Group are sub-divided into assemblage zones according to the various vertebrate fossils found in each zone. Drennan falls within the Dicynodon Assemblage Zone, named after the most common dicynodont therapsid fossil found in the zone. The Dicynodon Assemblage Zone fauna include fish, amphibians, reptiles and numerous species of therapsids (the ancient ancestors of mammals).

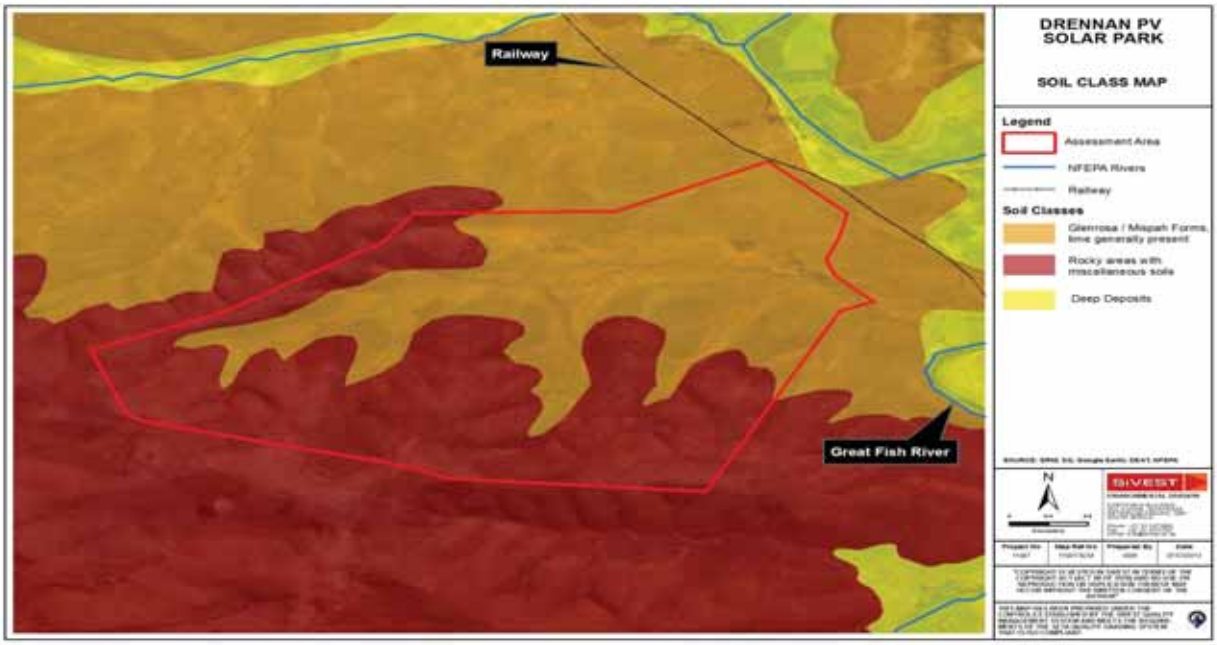
Excavations into sediments not normally accessible to palaeontologists should be seen as providing opportunities to recover potentially-important fossil material that enable observations otherwise impossible to be made.
No reference to surface palaeontological material specifically on the Site was found, although fossils have been recorded in the Cradock area. Since the Site has been disturbed, the surface potential of the Site may be minimal, although it is not possible to exclude the possibility that fossils do occur there. It is possible that fossils or sub-fossils of interest could be encountered during any excavation that cuts into underlying older hard rock and alluvial sediments.

In addition to the potential within the Balfour Formation rocks, small pockets of bone can occur, for instance, where bone accumulators such as hyaenas, Jackals or porcupines used holes / burrows dug by aardvarks; older and younger sediments may also contain ancient wetland deposits and / or more-recent fossils. In addition to fossil bones and molluscs, there is the potential for encountering macro-plant remains and pollens of considerable age in wetland deposits. Thus, foundations excavated into rocks and sediments on the Site may intersect fossil-bearing deposits. If so, there is the potential to provide opportunities for observations not otherwise accessible to researchers.

5.1.6 Soils

According to the Environmental Potential Atlas (ENPAT) database, the Site is underlain by two soil groups (*Figure 5.3*). The steeper slopes, in the southern and western portions of the Site, are associated with shallow, rocky soils with an effective soil depth (depth to which roots can penetrate the soil) of less than 0.45 m, which is a limiting factor in terms of sustainable crop production. The central portion and eastern area are dominated by Glenrosa and Mispah soil forms. These forms are also associated with shallow soils, where parent rock is found close to the land surface. These soils have an inherently low agricultural potential due to a prohibitive rooting depth and lower water holding capacity. These soil forms also exhibit moderately high soil erosion hazard ratings. The riparian zones to the east of the Site are associated with deeper soils and rich alluvial deposits (*Figure 5.3*). These areas are characterised by moderate soil depths of between 0.45 and 0.75 m (Barichievy, 2013).

Figure 5.3 Soil Class Map



Source: Kurt Barichievy, 2012

The major soil forms identified during the field survey include the Mispah, Glenrosa, Swartland, and Coega. Other soils encountered during the field survey, which were recorded very sparsely across the Site and therefore not fully described below, include the Mayo (Melanic A, Lithocutanic B).

Mispah Form

Soil Family: Mostly 1100 (Non bleached, Non Calcareous), limited bleaching
Diagnostic Horizons and Materials:
A-Horizon: Orthic
B-Horizon: Hard Rock

The Mispah soil form falls within the lithic soil group. Lithic soils are associated with shallow soils where parent rock is found close to the soil surface. The A-horizon varied from bleached brown to dark brown in colour and was generally 10-20 cm deep, directly overlying various hard rock materials. The Mispah soil form dominates large areas of the Site. Surface rocks were also a common sight (*Figure 5.4*). Some portions of the Site contain non-contiguous bands of shallow rock and Lithocutanic B horizons which lead to these areas being classified as a Mispah and Glenrosa complex.

The Mispah form soil has low agricultural potential due to the distinct lack of rooting depth and as such these soils are generally utilised for grazing land. If ripped and cultivated, precise irrigation scheduling is a requirement. These soils can also exhibit high soil erosion hazard ratings.

Figure 5.4 Shallow, Rocky Soils of the Mispah Form

Source: Kurt Barichievy, 2012.

Glenrosa Form

Soil Family: Mostly 1211 (A-horizon not bleached, B1 Hard, no signs of wetness and non-calcareous)
Diagnostic Horizons and Materials:
A-Horizon: Orthic
B-Horizon: Lithocutanic

The Glenrosa form also falls within the lithic soil group. This soil form is found throughout the surveyed areas of the Site where bands of weathering rock are found close to the soil surface. The Orthic A-Horizon is mostly approximately 10-30 cm deep depending on topographic position.
The shallow Orthic A-Horizon overlies a Lithocutanic B-Horizon, which contains a high proportion (over 70 percent) of weathered rocks (see *Figure 5.5*). The lower B-Horizon is generally limiting to plant roots but gaps between the weathering rock fragments can be opened by larger roots, therefore the agricultural land use potential of this soil can be higher than expected. The Lithocutanic B-Horizon merges into solid rock layers generally found between 20 and 40 cm below the soil surface. These solid rock layers are generally limiting to plant growth. Surface rocks were often evident where this soil form was found. Portions of the Site contain non-contiguous bands of Lithocutanic B-Horizons and hard rock which lead to these areas being classified as a Mispah and Glenrosa complex.

Without careful management or preparation this soil form has low agricultural potential, as the effective soil depth is approximately 30 cm. Due to the low agricultural potential these soils are usually used as grazing land. If these soils are cultivated, careful irrigation scheduling is essential. This soil form also exhibits high soil erosion hazard ratings.

Figure 5.5 Sample of a Glenrosa Soil Form

Source: Kurt Barichievy, 2012.

Swartland Form

Soil Family: 1211 (Mostly Non-Bleached A, Non-Calcareous B); Limited bleaching and / or Calcarous
Diagnostic Horizons and Materials:
A-Horizon: Orthic
B-Horizon: Pedocutanic
C-Horizon: Saprolite

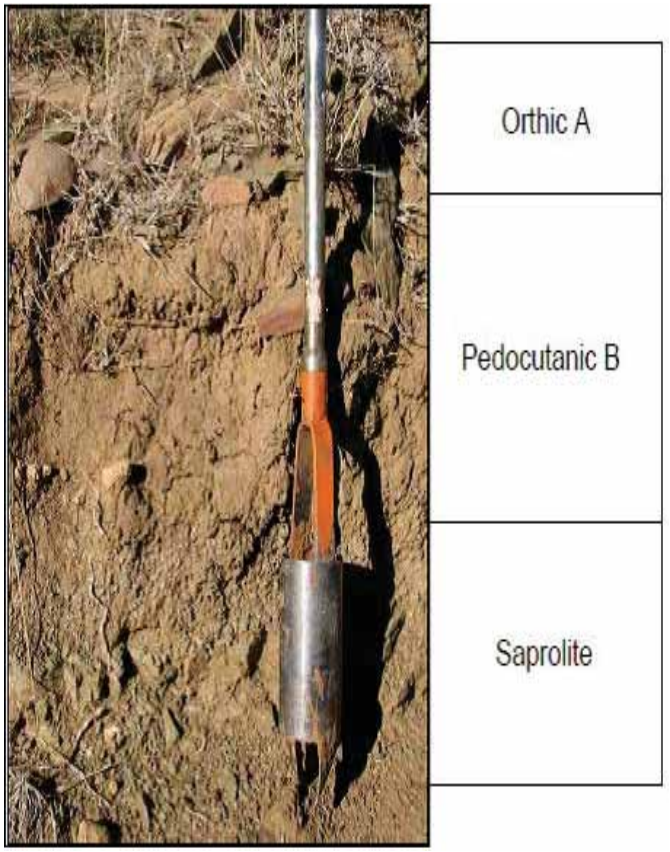
The Swartland soil form falls within the duplex soil group whose defining characteristic is the enrichment of clay within the soil profile. Duplex soils are mostly found in the drier parts of South Africa and have in common the development of strong structure in the B-Horizon and a marked increase in clay compared to the overlying horizon (Fey, 2010). This form dominates the flatter plain on either side of the riparian drainage corridor, and was commonly found in between rocky outcrops, providing slightly deeper rooting than the adjacent rocky outcrops.

The Orthic A-Horizon identified on the Site was generally brown in colour and moderately structured. The Orthic A-Horizon overlies a well-structured B-Horizon. The B-Horizon contains a high proportion of clay due to illuviation. The B-Horizon has a cutanic character and medium course texture

(see *Figure 5.6*). This soil can be classified as duplex in nature and in certain instances the B-Horizon was considered an impediment to root growth and water movement. The pedocutanic layer of the B-Horizon merged into weathering rock.

Duplex soils occur widely in South Africa and present a variety of management challenges to farmers and engineers. This soil form, in the context of this assessment, has a low agricultural potential owing to the well-structured Pedocutanic B, shallow effective soil depth and duplex character of the B-Horizon, which curtails root growth and water movement. The effective depth of this soil was often identified as less than 0.3 m. This soil form also exhibits high soil erosion hazard ratings. The main cause of erosion is clay dispersion, which gives rise to surface sealing and intensifies surface runoff.

Figure 5.6 Sample of Swartland Soil Form



Source: Kurt Barichievy, 2012.

CoegaForm

Soil Family: 1000 (Calcareous A Horizon)
Diagnostic Horizons and Materials:
A-Horizon: Orthic
B-Horizon: Hardpan Carbonate

The Coega form is characterised by calcic soils, whose profile contains at least one carbonate-rich horizon. Carbonate retention in the soil profile is a result

of an arid climate where evaporation far exceeds rainfall. The Hardpan Carbonate horizon was often found on the surface. The effective soil depth was generally less than 0.2 m (see *Figure 5.7*).

Calcic soils are associated with arid regions and thus the use of these carbonate rich soils in South Africa is limited. Limitations in terms of sustainable agricultural use include shallow rooting depth, high pH, high salinity and low plant Phosphorus availability (Fey, 2010). Such limitations restrict calcic soils to extensive grazing unless irrigation is available. These soils also exhibit high soil erosion hazard ratings.

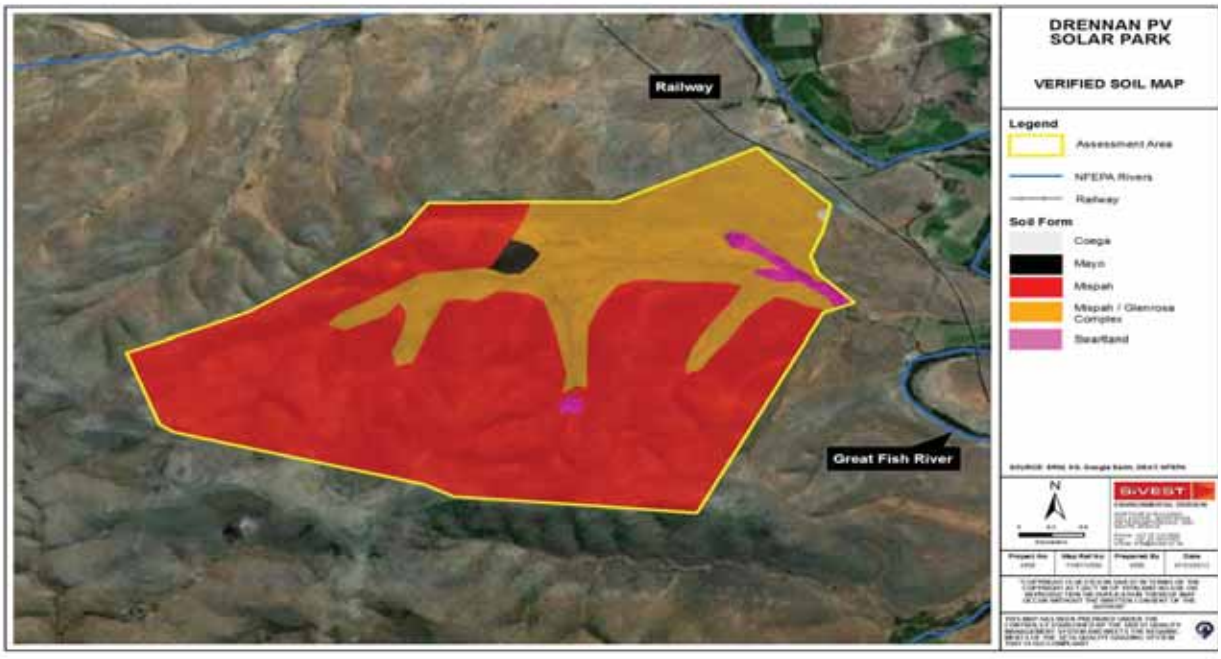
Figure 5.7 Sample of a Coega Soil Form (Surface hardpan carbonate)

Source: Kurt Barichievy, 2012.

Overall the soils identified are predominantly shallow with a low agricultural potential. Rocky and duplex soils (Mispah, Glenrosa and Swartland Form) cover approximately 98 percent of the surveyed area (see *Figure 5.8*). All the soils encountered on the Site contained at least one layer that was limiting to plant growth and these layers included Lithocutanic, hard rock, saprolite and hard pan carbonate.

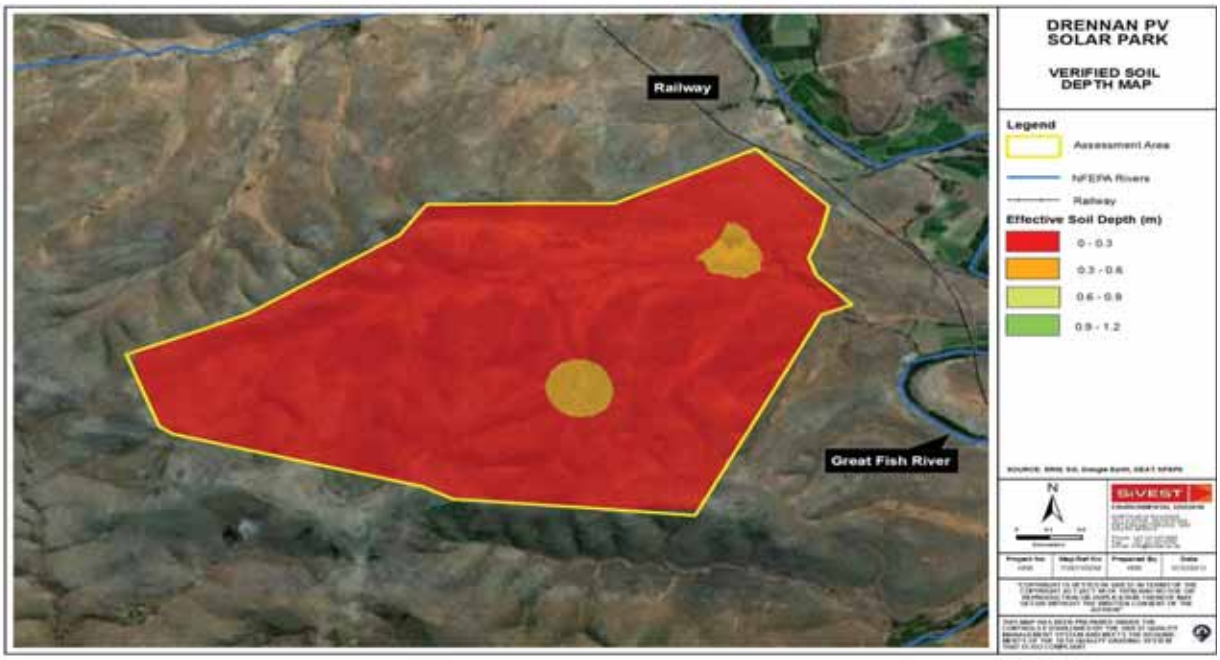
A verified soil map showing homogeneous soil bodies and a verified soil depth map have been developed (see *Figure 5.8* and *Figure 5.9*). Soils with an effective depth of greater than 30 cm were rarely observed during the soil survey, with most soils exhibiting an effective soil depth of less than 20 cm.

Figure 5.8 Verified Soil Map



Source: Kurt Barichievy, 2012.

Figure 5.9 Verified Soil Depth Map



Source: Kurt Barichievy, 2012.

Agricultural Potential

The Site is dominated by unimproved grassland and scattered trees. The influenced farm portions are currently used as extensive grazing land for free range sheep and beef production. Stocking rates are estimated at around 1 SSU (small stock unit) per 3 hectares and 1 LSU (large stock unit) per 15 hectares. Approximately 70 percent of the Site is dominated by steeper slopes and rocky outcrops. These areas are limiting to arable agriculture and due to the steep topography and associated engineering constraints these areas are excluded from the preliminary development layouts. The remaining 30 percent of the area consists of gently sloping grazing land, interspersed with ephemeral stream beds and excavated stock watering impoundments.

Other than topography, water is the major limiting factor to local agricultural enterprises. The Site is located away from the more fertile flood plain of the Great Fish River. The Site does not have abstraction or water rights. Even if irrigation water could be secured it is not agriculturally or economically feasible to irrigate this Site. Due to the high abstraction demand on the Great Fish River the successful procurement of such water use licences is also in doubt. The Site does not accommodate any centre pivots, irrigation schemes or active agricultural fields.

Taking the above into consideration the majority of the Site is classified as having a low potential for crop production (see *Figure 5.10*). Furthermore, the Farm Waai Plaats is not classified as having a high agricultural potential and is also not a unique dry land agricultural resource. The Site is considered to have a moderate to moderately low value when utilised as grazing land, its current use.

Figure 5.10 Agricultural Potential Map

Source: Kurt Barichievy, 2012.

5.1.7 *Hydrology – Ground and Surface Water*

The aquifer type for the Site is classified as fractured and would likely have a borehole yield of 0.5 to 2.0l/s (1:500,000 Hydrogeological Map Sheet 3122, Beaufort West). The subsurface lithology is likely to be predominantly argillaceous rock including shale, carbonaceous shale and siltstone resulting in a groundwater quality of 0 – 70 mS/m (1).

A major ecological feature at the Site is a large drainage system which traverses the area and is considered ecologically sensitive and unsuitable for development. The Project, although located outside of the drainage system, presents a risk to sensitivity receptors, particularly with regards to soil debris or waste run-off into the catchment area's surrounding drainage lines.

5.2 *BIOLOGICAL BASELINE*

This section describes the existing biological environment within and around the Site.

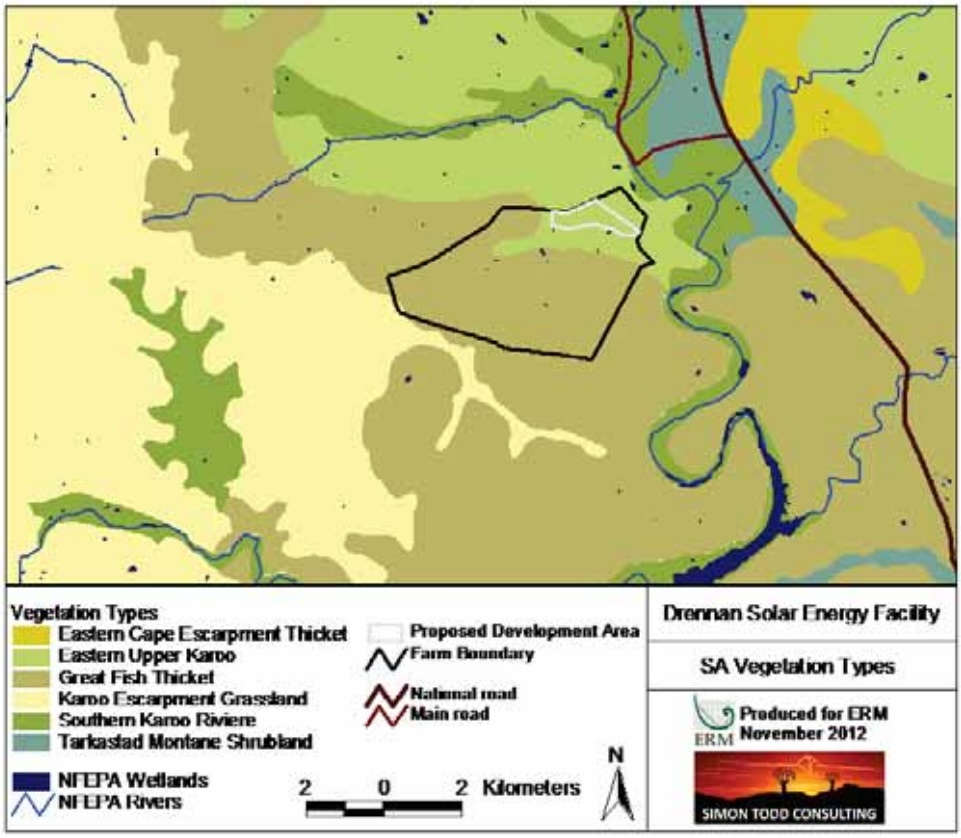
5.2.1 *Flora*

Broad Vegetation Patterns

The national vegetation map (Mucina and Rutherford, 2006) indicates that the Site is largely dominated by Eastern Upper Karoo vegetation type, with the drainage areas corresponding to the Southern Karoo Riviere vegetation type. The Project Area lies entirely within the Eastern Upper Karoo vegetation type. The Eastern Upper Karoo vegetation type is the most extensive vegetation type in South Africa and forms a large proportion of the central and eastern Nama Karoo Biome. This vegetation type is classified as Least Threatened, and about 2 percent of the original extent has been transformed largely for intensive agriculture. However, the vegetation type is poorly protected. Less than one percent of the 21 percent target has been formally conserved. The Southern Karoo Riviere vegetation type is also classified as Least Threatened. However, since this vegetation type is associated with rivers and drainage lines, those areas classified under this vegetation type should be considered sensitive and should be avoided by the development. The southern boundary of the Final PV Footprint is defined by a drainage line, but there are no drainage lines or other wetland ecosystems within the Final PV Footprint itself. *Figure 5.11* shows the broad scale vegetation patterns at the Site (2).

(1) mS/m refers to a multiple of siemens (one thousandth of a siemens per meter). Siemens are a unit of electric conductivity.
(2) The vegetation map is an extract of the national vegetation map as produced by Mucina & Rutherford (2006), and also includes rivers and wetlands delineated by the National Freshwater Ecosystem Priority Areas Assessment (Nel et al. 2011).

Figure 5.11 Broad Scale Vegetation Patterns



Source: Simon Todd, 2012.

Fine Scale Vegetation Patterns

There are two main vegetation units on the Site, the first associated with the drainage line and adjacent floodplain, and the second associated with higher-lying slopes to the south and west of the Site which also contain a greater bush cover as they consist of Great Fish Thicket. These vegetation units correspond to the national vegetation map depicted in *Figure 5.11*. Within the Project Area itself, the vegetation is however fairly homogenous and it was not possible to differentiate different plant communities within this area. The vegetation within the Project Area consists of a low mixed grassy shrubland with occasional trees or bush clumps.

The dominant species within the shrub layer include *Pentzia incana,Rosenia glandulosa*, *Senecio acutifolius*, *Walafrida geniculate*. Common and dominant grasses include *Enneapogon scoparius*, *Digitaria eriantha*, *Themeda triandra* and *Aristida congesta .* Taller shrubs include *Rhigozum obovatum* and *Lycium oxycarpum,* while species associated with the bush clumps include *Carissa haematocarpa, Azimia tetracantha, Ehretia rigida, Mayteus heterophylla* and *Haemanthus albiflos.* Trees include *Boscia oleiodes, Acacia karoo, Diospyros lycoides and Euclea undulata.* There are also a number of succulents and aloe species present such as *Aloe ferox, Aloe striata,*

and *Haworthia.* The drainage lines are dominated by species such as *Acacia karoo, Diospyros lycoides* and *Lycium oxycarpum.* Although there are no large rocky outcrops within the Site, there are some low rocky ledges and areas of exposed bedrock present.

Figure 5.12 Two Views of the Plains Habitat

Source: Simon Todd, 2012

Alien Species

The Site was found to be relatively free of alien species. There were some alien plants identified around the watering points and other disturbed areas. However, the veld was generally free of aliens. Alien species which did occur at the Site include *Opuntia ficus-indica* which occurred as scattered individuals and *Opuntica aurantica* which was common throughout the Site but is less visible on account of its low stature. *Opuntia aurantica* is a concern as the species has sharp spines which catch onto anything which brushes the plant and spreads by means of the cladodes (succulent leaves) which easily break off when the plant is touched (see *Figure 5.13*). Other alien species which were observed at the Site at low density or restricted to disturbed areas include *Argemone ochroleuca*, *Conyza bonariensis*, *Salsola kali*, *Xanthium spinosum*, *Bidens pilosa*, *Cirsium vulgare* and *Tagetes minuta*.

Figure 5.13 Opuntia aurantica species common at the Site

Source: Simon Todd, 2012

Species of Conservation Concern

According to the South African National Biodiversity Institute (SANBI) Integrated Biodiversity Information System (SIBIS) database, 23 red-data listed species are known from the broader area (see *Annex F*). Of these, four were confirmed as being present, namely; *Aloe longistyla*, *Boophone disticha*, *Drimia altissima*, and *Euphorbia globosa*. *Euphorbia globosa* has not been recorded from the area before. Of the listed species *Aloe longistyla* was not common and the individuals observed were not within the PV Footprint. *Boophone disticha* was also not common but occurred scattered across the northern parts of the Site where shallow rocky soils were present. Few individuals of this species would be impacted. *Drimia altissima* was fairly common along the ridge which defines the north-eastern boundary of the Site. Affected individuals could potentially be translocated. This species is still widespread and common in many areas.

The presence of *Euphorbia globosa* at the Site is potentially significant as this species has not been recorded from the area before. In addition it is known from only five remaining locations and is threatened by coastal development (SANBI, 2012). The species does however extend well beyond the Project Area and occurs in greater abundance in those areas.

In addition to the red-data listed species a number of protected species were also confirmed as being present; including *Ammocharis coranica,* as well as several aloe species such as *Aloe maculata A.striata* subsp*. striata*, *A.tenuior* and *A.variegata*. The abundance of these protected species was generally quite low except for *Aloe tenuior* which occurred commonly across the Site and thus thousands of individuals would be impacted by the development.

5.2.2 Fauna

Mammals

The Site falls within the distribution range of about 59 terrestrial mammal species, indicating that mammalian diversity at the Site is potentially high (see *Appendix F* for a full list of species). Of these, there are five listed species, namely the Brown Hyaena *Hyaena brunnea* (Near Threatened), Black-footed Cat *Felis nigripes* (Vulnerable), White-tailed Mouse *Mystromys albicaudatus* (Endangered), Ratel or Honey Badger *Mellivora capensis* (Endangered) and Leopard *Panthera pardus* (Near Threatened). It is unlikely that the Leopard and Brown Hyaena occur within the Site given the open nature of the habitat and agricultural activity that takes place in the area. The habitat is however suitable for the Black-footed Cat, which favours a mix of open and densely vegetated habitat. This species is however widely distributed across the arid and semi-arid areas of South Africa, and the development would not amount to a significant amount of habitat loss for this species. The White-tailed Mouse is not likely to occur at the Site, as suitable refuges such as cracks in the soil to shelter down in were not observed. This species is relatively widely distributed and there is little to suggest that the Site would represent an area of above average significance for this species. It is likely that the Honey Badger occurs at the Site. However, the Project is not likely to have a significant impact on local populations of this species as they are wide-ranging and the development area is not within optimal habitat for this species. Mammals observed at the Site include Bat-eared Fox *Otocyon megalotis*, Greater Kudu *Tragelaphus strepsiceros*, Springbok *Antidorcas marsupialis*, Steenbok *Raphicerus campestris*, South African Ground Squirrel *Xerus inauris*, Aardvark *Orycteropus afer*, Cape Porcupine *Hystrix africaeaustralis*, Yellow Mongoose *Cynictis penicillata* and Vervet Monkey *Cercopithecus mitis.*

The Site falls within the distribution range of Schreibers' long-fingered bat *Miniopterus schreibersii* which is listed as Near Threatened. However, this species requires caves for roosting and the nearest potential cave sites would be along the escarpment 20-30 km to the north of the Site. Therefore, the Site is unlikely to be an important area for this bat species.

Reptiles

The Site lies in or near the distribution range of about 35 reptile species (see *Appendix F* for a full list of species), indicating that the reptile diversity at the Site is likely to be low. The diversity of habitats at the Site is low, and there are no large rocky outcrops at the Site which would be important reptile habitat. Based on distribution maps and habitat requirements, the composition of the reptile fauna is likely to comprise one terrapin, one tortoise, 17 snakes, eight lizards and skinks, seven geckos and one chameleon. There are no listed reptile species known from the area. Species observed at the Site include include the Spotted Skaapsteker *Psammophylax rhombeatus*, Cape Skink *Mabuya capensis*, Spotted Sand Lizard *Pedioplanis lineoocellata* and Rock Monitor *Varanus albigularis*.

Amphibians

The Site lies within the distribution range of 11 amphibian species (see *Appendix F* for a full list of species). Amphibian abundance at the Site is likely to be high within the drainage and floodplain habitats. Only those species which forage away from water are likely to regularly occur within the development area. Only the Giant Bullfrog *Pyxicephalus adspersus* is of conservation concern and is listed as Near Threatened. Should this species occur at the Site, it would be associated with pans or the floodplain environment. Given that the development area is not near to the drainage areas, the potential impacts on this species would be low as would impacts on the majority of other amphibians. Given the overall lack of specialized natural amphibian habitats present within the development area, amphibians are not likely to be highly sensitive to the development.

5.2.3 *Avifauna*

At least 238 bird species occur within the vicinity of the Site, including 12 listed species (see *Table 5.1*). Although most of the listed species are uncommon in the area and not likely to occur at the Site on a regular basis, there are a number of the species that are common residents or regular visitors to the area and thus would be likely to occur at the Site. Furthermore, most of the listed species are large raptors, cranes and bustards, which are all vulnerable to collisions with power line infrastructure. The evaluation of the frequency of avifaunal activity in the area (*Table 5.1*) is based on their reporting rate within South African Bird Atlas Project (SABAP).

Table 5.1 Listed Bird Species Known from the Vicinity of the Site

Species	Status	Frequency
Black Stork	Near threatened (NT)	Very Rare
Secretarybird	NT	Occasional
Cape Vulture (Griffon)	Vulnerable (VU)	Very Rare
Tawny Eagle	VU	Very Rare
Martial Eagle	VU	Occasional
Black Harrier	NT	Rare
Lanner Falcon	NT	Very Rare
Lesser Kestrel	VU	Regular
Blue Crane	VU	Regular
Denham's (Stanley's) Bustard	VU	Rare
Ludwig's Bustard	VU	Rare
Melodious (Latakoo) Lark	NT	Very Rare

Source: Simon Todd, 2013

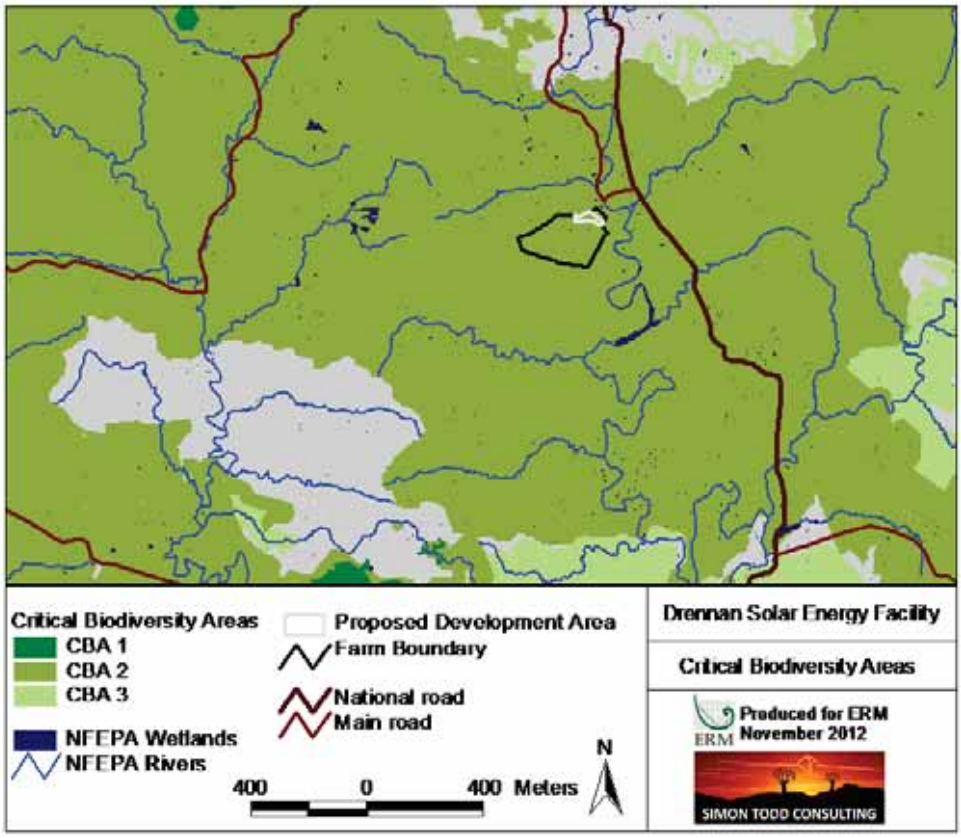
5.2.4 *Critical Biodiversity Area and Ecological Processes*

The Site lies within the planning domain of the Eastern Cape Biodiversity Conservation Plan (Berliner and Desment, 2007). This biodiversity assessment identifies Critical Biodiversity Areas (CBAs) which represent biodiversity priority areas which should be maintained in a natural to near natural state.

The CBA maps indicate the most efficient selection and classification of land portions requiring safeguarding in order to maintain ecosystem functioning and meet national biodiversity objectives. The Site falls within an extensive Tier 2 CBA which is intended to provide a corridor to maintain the connectivity of the landscape and enable fauna and flora to respond to global change (see *Figure 5.14*).

As such it is important to note that the Site does not fall within an area that has been identified as being a hotspot of biodiversity for any fauna or flora. Therefore, the major issue with regards to the development as it pertains to the CBA is the extent to which the development is likely to threaten or disrupt the connectivity of the landscape and hence compromise the ecological functioning of the CBA. From north to south the development is less than 1 km across, compared to the CBA which is about 25 km. Therefore the extent of the development is small in comparison to the CBA and it is highly unlikely that the development would pose a significant direct threat to the ecological functioning of the CBA. In addition, there are no specific attributes of the Site which suggest that it would be especially important as a corridor for fauna or flora movement and migration. Therefore, the development would have a local impact on the CBA, but would not be likely to compromise the broad-scale ecological functioning of the CBA. The development of the Site would however contribute to cumulative habitat loss and fragmentation in the area, with intensive agriculture being the primary source of habitat loss and transformation in the area.

Figure 5.14 Critical Biodiversity Area Map

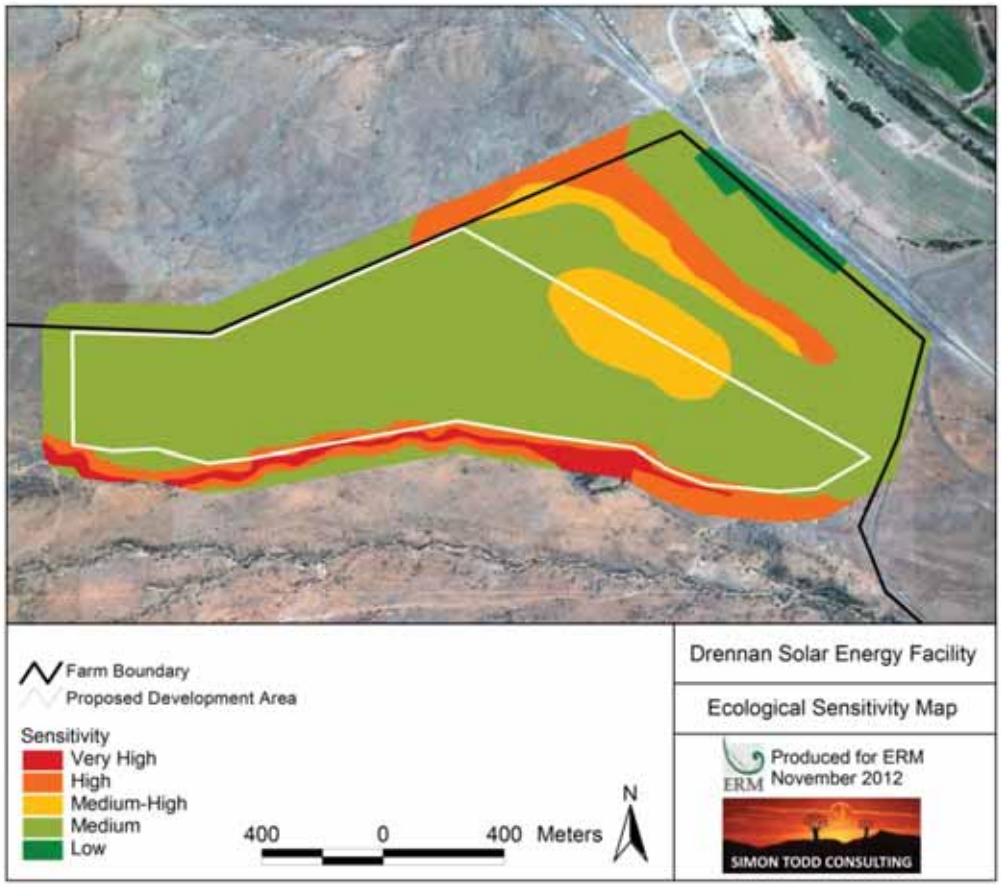


Source: Simon Todd, 2012

5.2.5 *Ecological Sensitivity of the Site*

The Final PV Footprint area is relatively homogenous and there are no specific features within it that would need to be avoided. The upper part of the Final PV Footprint area towards the crest of the ridge is classified as having a higher sensitivity than the rest of it, on account of the greater plant species richness of this area and the greater abundance of red-listed plant species such as *Drimia altissima* and *Euphorbia globosa*. The southern boundary of the Final PV Footprint area is formed by a drainage line and this feature should be appropriately delineated and buffered from the development. Although the regulations stipulate that development should not take place within 32 m of drainage lines without a permit, 50 m would be a more appropriate buffer under the current circumstances. The presence of a relatively large number of red-listed and protected species at the Site is the major characteristic feature of the Site. Although the development will inevitably result in some loss of habitat for such species, the loss of individuals can to some extent be mitigated by translocating affected plants outside of the development footprint. This would however not be practical for some species such as *Euphorbia globosa* which are small and numerous and, as some *Euphorbia* species do not transplant well, survival may be very low if this was attempted.

Figure 5.15 Ecological Sensitivity Map



Source: Simon Todd, 2012.

5.2.6 *Protected and Conservation Areas*

The closest section of the Mountain Zebra National Park (MZNP) lies approximately 27 km to the north west of the Drennan Site, adjacent to the R337 road.

6 SOCIO-ECONOMIC BASELINE DESCRIPTION

6.1 INTRODUCTION

The purpose of this section is to describe the socio-economic environment within which the Project is located. The Project will have benefits on a national level in terms of increasing electricity supply to the national grid. However, the majority of socio-economic impacts will be experienced at the local level. A brief description of the Province and District Municipality is given below, but the socio-economic baseline description is focused on the local level, i.e. the Inxuba Yethemba Local Municipality.

The description provided in this section is based on the most up to date publically available secondary information, as well as primary data collected for this project. It should be noted that in a few instances the latest data for certain socio-economic indicators were not yet available from the most recent census (Census, 2011), and in these cases data from the Statistics South Africa (StatsSA) Community Survey 2007 were used.

6.2 ADMINISTRATIVE STRUCTURE

The Site is located within Ward Six of the Inxuba Yethemba Local Municipality, which falls within the Chris Hani District Municipality, in the Eastern Cape Province (see *Figure 6.1* and *Figure 6.2*). Within this administrative structure, the provincial government is responsible for providing a strategic vision and framework for the province, as well as ensuring cooperation between municipalities and ensuring each municipality performs their respective functions. The district and local municipalities are each responsible for the provision of services and infrastructure within their municipal boundaries. This is facilitated through the development and implementation of Integrated Development Plans (IDPs), Spatial Development Frameworks (SDFs) and Local Economic Development (LED) Plans.

Figure 6.1 Administrative Structure

6.3 PROVINCIAL CONTEXT

The Eastern Cape Province, in which the Site is located, is the second largest province in South Africa, measuring 169,580 km^2. There are two primary metropolitan areas within the Eastern Cape, namely, Port Elizabeth and East London. The town of Bisho is the provincial capital and smaller district towns include Grahamstown, King Williams Town, Queenstown, and Mthatha. In addition there are a number of small towns scattered throughout the Province.

The Eastern Cape is the third most populous province in South Africa (with a population of 6,562,049), comprising approximately 12.7 percent of the national population (Statistics South Africa [StatsSA], 2011). However in the period since the 2001 census was undertaken, the Eastern Cape's population has grown at a rate of 4.5 percent, which is the second lowest growth rate of all provinces in the country. A factor which may underpin this trend is that the Eastern Cape tends to experience an out-migration of inhabitants who leave to live and work in other provinces (Eastern Cape Socio-Economic Consultative Council [ECSECC], 2012a)[1]. In this regard the StatsSA mid-year population estimate for 2013 noted that 264, 449 people in the Eastern Cape migrated from the province for the period 2006 to 2011 (StatsSA, 2013a).

The Eastern Cape faces the challenge of high unemployment rates and low income levels. The unemployment rate in the Province as of the fourth quarter 2012 stood at 30.2 percent, the second highest in the country after the Free State (31.6 percent) and also higher than the national average of 25.2 percent. Employment increases in the Eastern Cape between the fourth quarter 2012 and the first quarter of 2013 amount to 51, 000 new jobs.

1To illustrate this point, as of 2011 around 2 million of those born in the Eastern Cape were living in other provinces in the country.

However the unemployment rate in the province increased from 29.8 percent as of the fourth quarter 2012 to 30.2 percent in the first quarter of 2013 (StatsSA, 2013b). This occurrence is most likely the result of the entry into the labour market of recent school leavers who were not part of the economically active labour pool in 2012.

As indicated in *Table 6.1* the economic sectors which are pertinent to an industrial development such as the PV project under consideration, namely trade, transport and construction, all underwent a contraction in employee numbers between the first and second quarters of 2012, with the transport sector losing 6,000, trade 3,000 and construction 2,000 employees respectively. Employment in manufacturing and utilities remained static over the same period (ECSECC, 2012a).

Table 6.1 Employment per sector

Sector	Fourth Quarter 2012	First Quarter 2013	Quarter to Quarter Change
Transport	65,000	64, 000	-1.5%
Trade	284,000	275, 000	-3.2%
Construction	131,000	128, 000	-2.3%

Source: StatsSA, Quarterly Labour Force Survey: Quarter 1, 2013.

6.4 THE CHRIS HANI DISTRICT MUNICIPALITY

The Chris Hani District Municipality (CHDM) is one of seven District Municipalities in the Eastern Cape. It is located inland, roughly in the centre of the Province and is approximately 36,561 km^2 in size. There are eight Local Municipalities (LM) within the District Municipality, namely, Emalahleni LM, Engcobo LM, Inkwanca LM, Intsika Yethu LM, Inxuba Yethemba LM, Lukhanji LM, Tsolwana LM, and Sakhisizwe LM.

According to the 2011 Census, the population of the CHDM is approximately 795,461, accounting for 12 percent of the total population in the Eastern Cape. A large portion of the population (40 percent) within the District is between the age of five and 24 (StatsSA, 2011). The occurrence of a young population is a Province-wide trend and may be linked to the fact that the Eastern Cape has historically been a labour sending area.

The CHDM is largely rural, with small to medium-sized urban centers, such as Queenstown, Middelburg, Lady Frere and Cradock. Like the Eastern Cape Province as a whole, the CHDM also experiences high levels of poverty, with a poverty rate of 53 percent and 10 percent unemployment amongst the population of working age (ECSECC, 2012b). [1] There are 58,945 people (7.4 percent) in the district who are without any level of schooling.

1 Typically the population of working age refers to those individuals between the ages of 15 and 65.

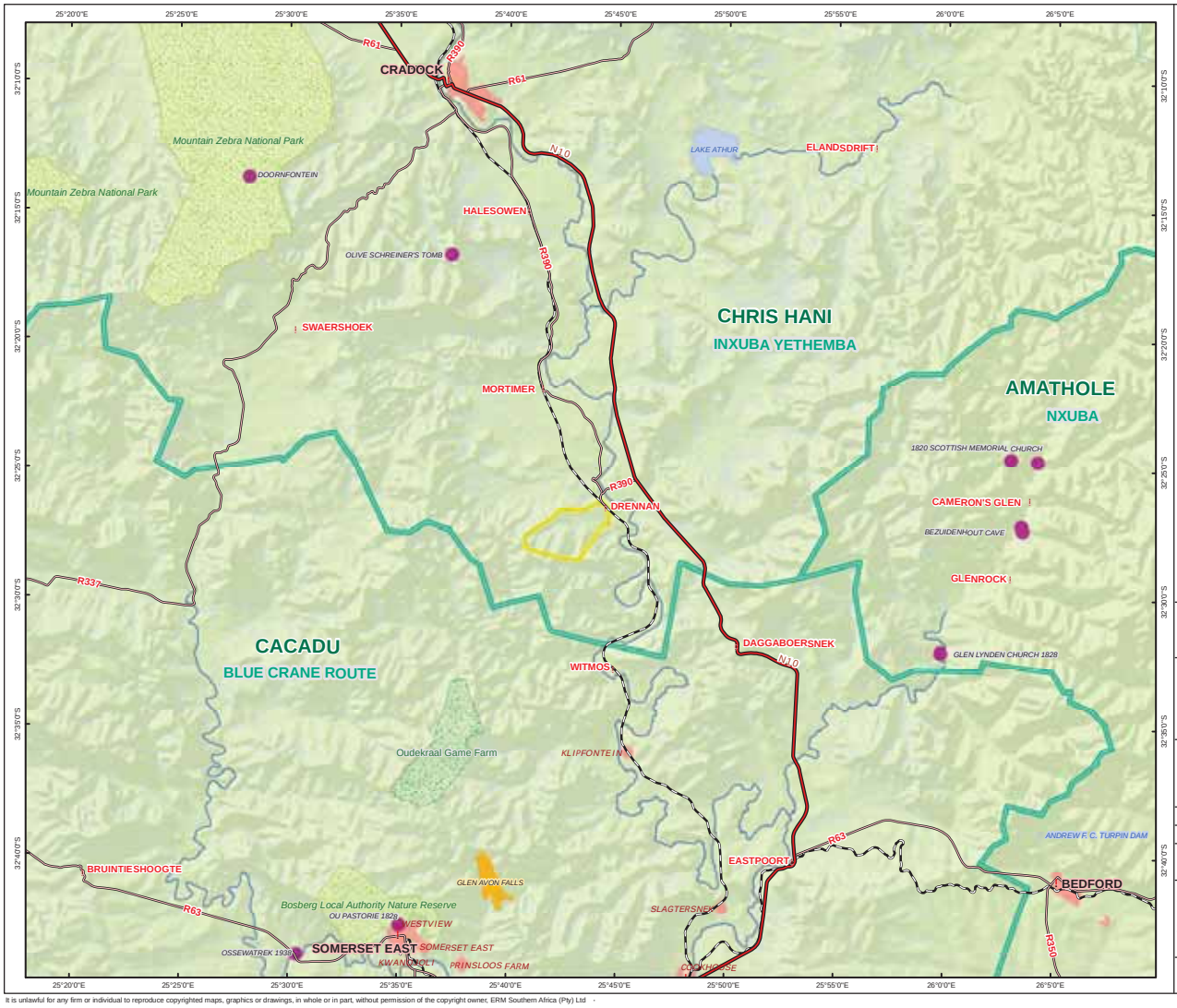
The development of a special economic zone, with one aim to develop primary value adding capabilities (beneficiation) within the surrounding local municipalities, is part of the CHDM's development agenda. The sectors to be targeted include crop production, livestock improvement, forestry, tourism, coal mining, and of significance for this Project, alternative energy (ECSECC. 2012b).

6.5 THE INXUBA YETHEMBA LOCAL MUNICIPALITY

The Site is located within a rural setting off the N10 approximately 28 km south of the town of Cradock on Portions 15 of Portion 1 of the Farm Waai Plaats (no. 550) near Drennan, situated in the Inxuba Yethemba Local Municipality (IYLM) (see *Figure 6.2*). The town of Cradock has one residential extension located on either side of the N10 upon entering the town from the south west, which is known as Lingelihle.

The IYLM comprises an area of 11,592 km^2. The administrative centre of the IYLM is Cradock. There are nine Wards within the Municipality and the Site is located in Ward 6. The Great-Fish River runs through the IYLM and is a vital water source for the irrigation of farm lands. The N10 national road bisects the Municipality from north to south.

The sections below provide a description of the socio-economic conditions pertaining to the IYLM, and, where relevant, to Ward 6.



Legend

- MainTown
- Place Names
- Communities
- Perennial Rivers
- Non Perennial Rivers
- Dams
- National Roads
- Secondary Roads
- Railway Line
- Local Municipalities
- DistrictMunicipalities
- National Parks
- Informal Protected Areas
- Cultural Sites
- Heritage Site
- Drennan Photovoltaic (PV) Power Facility

SCALE:

0 5 10 15

Kilometres

TITLE:

Figure 6.2:
Map showing Municipal Boundaries

CLIENT:

solairedirect

DATE: Sept 2013	CHECKED: DA	PROJECT: 0166587
DRAWN: AB	APPROVED: BL	SCALE: 1 : 250 000

DRAWING: Fig 6.2_Municipal Boundaries Map.mxd

REV: 0

ERM
Great Westerford Building
240 Main Road
Rondebosch, 7725
Cape Town, SOUTH AFRICA
Tel: +27 21 681 5400
Fax +27 21 686 073

Projection: Transverse Mercator, CM 25, Datum: WGS 84
Source: NGI: Chief Directorate National Geo-Spatial Information, SANBI, EnPAT, Demarcation Board (2012)
Inset: ESRI Data and Maps

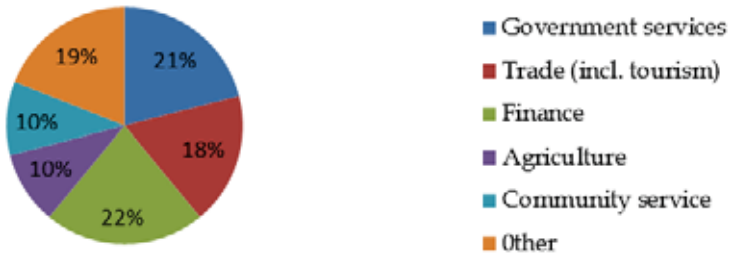
SIZE: A3

T:\Gis Projects\0166587_Drennan\Solar Park\Mapping\MXD\ERF\Fig 6.2_Municipal Boundaries Map.mxd

6.5.1 *Local Economy*

According to the IYLM Integrated Development Plan (IDP) 2010, the most significant contributors to the municipal Gross Geographic Product [(1)] (GGP) are finance (22 percent), general government services (21 percent), trade (18 percent) and agriculture (10 percent) see *Figure 6.3*. The IYLM contribution to the National Gross Domestic Product[(2)] (GDP) was approximately 0.1 percent (R1,7 Billion) in 2007. According to the IDP, the contribution of agriculture to the GGP declined from 20 percent in 1995 to 10 percent in 2007, showing negative growth in this sector. According to the ECSECC (2011) the decline can be attributed to drought, climate change and deregulation of the agricultural industry. Agriculture, however, remains an important employer within the Municipality. Tourism has been identified as a potential growth sector within the IYLM, this is discussed in more detail in *Section 6.5.5.*

Figure 6.3 Economic Indicators (highest sector contributors)



Source: IYLM IDP 2010

6.5.2 *Population Demographics*

The population in the IYLM was an estimated 65,560 at the time of the 2011 census. This shows a slight increase since the 2001 census, when the population size was 60,364 (StatsSA, 2011). This increase is counter to the slight decrease of 0.1 percent which the CHDM experienced in the same period. This may be attributed to less out-migration of job seekers from the IYLM, as compared to the CHDM and Eastern Cape, to other provinces and urban areas. The largest increase in the IYLM population was experienced by the African population group, as shown in *Figure 6.4*.

Census 2011 data indicates that females represent 52 percent of the population within the IYLM, while males account for 48 percent, which is almost identical to the 51.8 to 48.2 percent split recorded in the 2001 census. In addition according to the IYLM IDP 2010, within Ward 6, the gender split differs, with

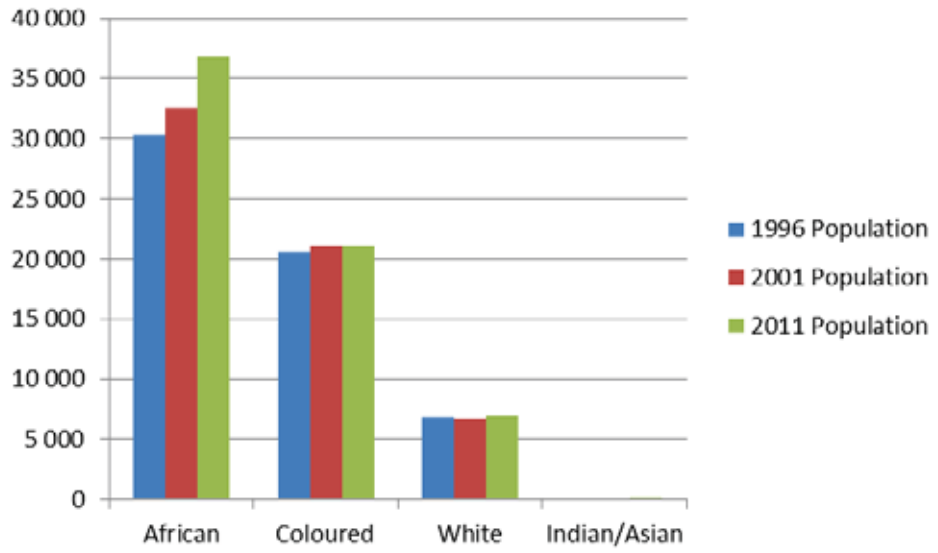
(1) The gross geographic product (GGP) of a particular area amounts to the total income or payment received by the production factors – (land, labour, capital, and entrepreneurship) – for their participation in the production within that area.

(2) The market value of all the finished goods and services produced within a country's borders in a specific time period:

a greater percentage (55.9 percent) of the population being male (StatsSA, 2011).

The racial composition of the IYLM comprises of 56.2 percent African, 32.1 percent Coloured and 10.5 percent White people. Whilst in Ward 6 the racial composition is 55.1 percent African, 34 percent Coloured, 8.8 percent White and less than one percent Indian / Asian people (StatsSA, 2011).

Figure 6.4 *Population change between 1996, 2001 and 2011, by population group*



Source: Statistics South Africa: Census Data, 2011

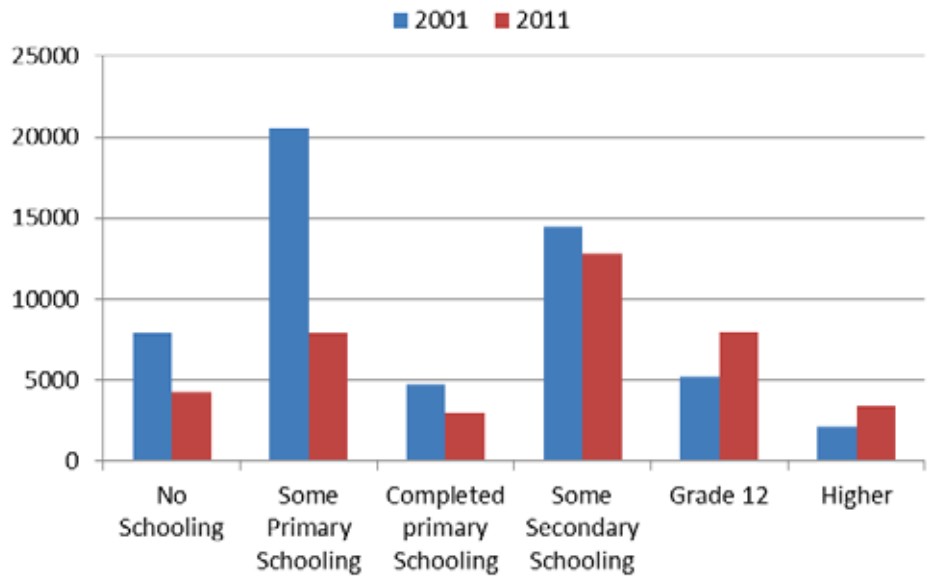
6.5.3 Education

The IYLM falls under the Cradock educational district. In general, education levels are low within the IYLM (see *Figure 6.5*), although in 2011 Cradock was the best performing educational district in the province, with a pass rate of 73.8 percent for the 814 learners who wrote the national senior certificate examinations (Eastern Cape Education Department, 2012). These indicators demonstrate that the education levels in the IYLM are highly polarised.

An estimated 11 percent of the population over 20 years of age have not received any form of schooling. It is estimated that 36 percent of the population over 20 years have completed some secondary schooling, followed by 20 percent who have completed grade 12 and nine percent who have attained a higher education qualification (StatsSA, 2011).

Almost two thirds (64.7 percent) of those with a higher education are White, while 35.2 percent are African or Coloured. A slightly higher percentage of females (51.7 percent) have completed grade 12, which is in line with the 52 percent female – 48 percent male gender split within the IYLM, as mentioned in *Section 6.5.2* above.

Figure 6.5 Education levels of those aged 20 and older in 2001 & 2011



Source: Statistics South Africa: Census Data, 2011

The IYLM IDP 2010 indicates there were 23 crèches and 20 primary schools within the Municipality, and only two pre-primary schools and seven secondary schools. There are only two tertiary educational facilities within the Municipality. Within Ward 6 there are four primary schools and one crèche. Samephore Primary School is located around 10km to the north of the Site on a rural road which links the N10 to the R337/R390. The number of learners attending the school was noted as 50 as of a survey conducted by the Department of Water Affairs in 2000(1).

A key challenge for the IYLM is that education facilities are not distributed evenly around the Municipality. As such, access to these facilities is limited. A further challenge is that many crèches and pre-primary schools have been established in inadequate structures.

6.5.4 *Employment and Livelihoods*

The economically active population (aged 15 – 64 years) of the IYLM was estimated to be 42, 341people in 2011, making up 64.6 percent of the total population.

Of that total, 25.5 percent are employed, while 10 percent are unemployed. A further 25.7 percent are considered economically inactive(2). The

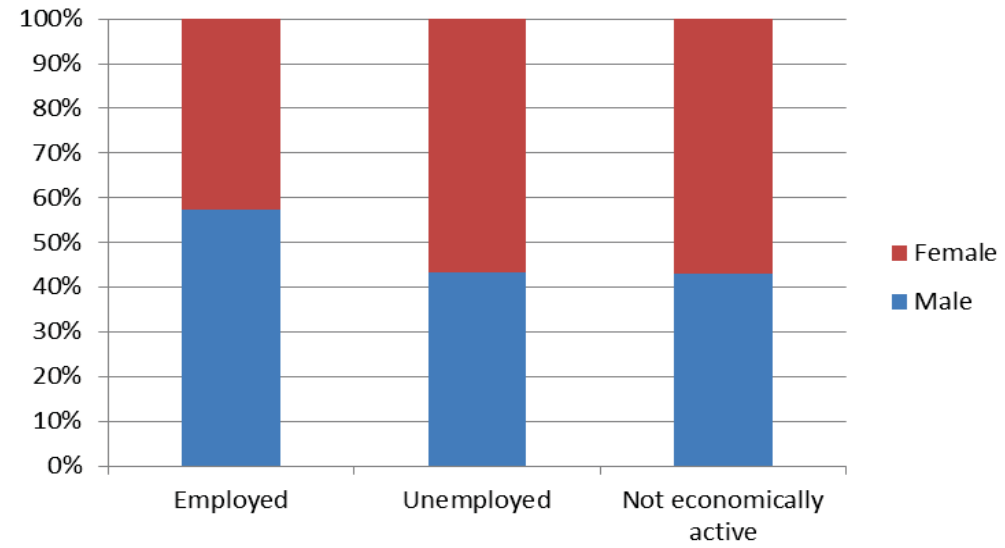
(1) For further details see http://www.dwa.gov.za/dir_ws/wsnis/default.asp?nStn=pg_reports&cid=3&SAID=&SASID=&Prov=EC&cursecAuthorityCode=&curLinkID=&curYear=10&curEntityID=EC600732&curReportID=26&curParams=@SchoolId&curlevelid=4 [Accessed: 7 May, 2013]

(2) Economically inactive population refers to students, elderly, sick, differently-abled persons and people who choose not to work.

unemployment rate in the IYLM is lower than that of the Province (29.8 percent), and in line with the National unemployment rate of 24.9 percent. At a Ward level, unemployment is seen as a major concern, despite the relatively low levels of unemployment (which as of 2011 was 8.87 percent). It was reported that alcohol consumption is high amongst unemployed people, which could explain the increase in crime and other social nuisance factors in the area(1).

There is a difference in the employment rate between males and females, with 43 percent of males unemployed in the IYLM as compared to 57 percent females, see *Figure 6.6.* Females also make up a larger portion of the economically inactive population, as shown in *Figure 6.6* below. *Figure 6.7* shows that the unemployed population in both the IYLM and Ward 6 consists largely of previously disadvantaged South Africans, i.e. African and Coloured groups. In contrast, unemployment is very low among the White population group and the Indian / Asian group, although the population size of the latter in the IYLM is very small.

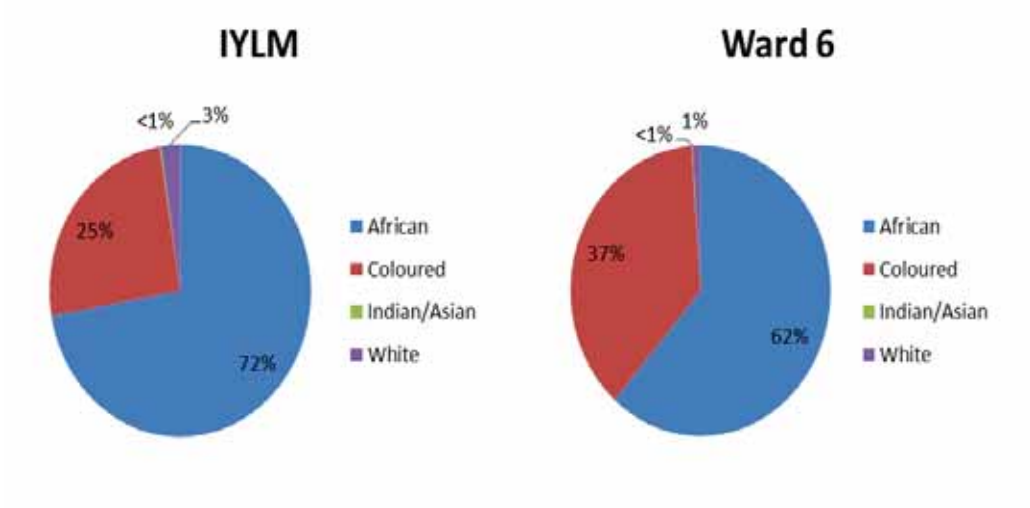
Figure 6.6 *Employment by Gender in 2007*



Source: Statistics South Africa: Census Data, 2011

(1) Personal Communication: Ward Councillor

Figure 6.7 Unemployment Levels by Race in 2011 in the IYLM and in Ward 6

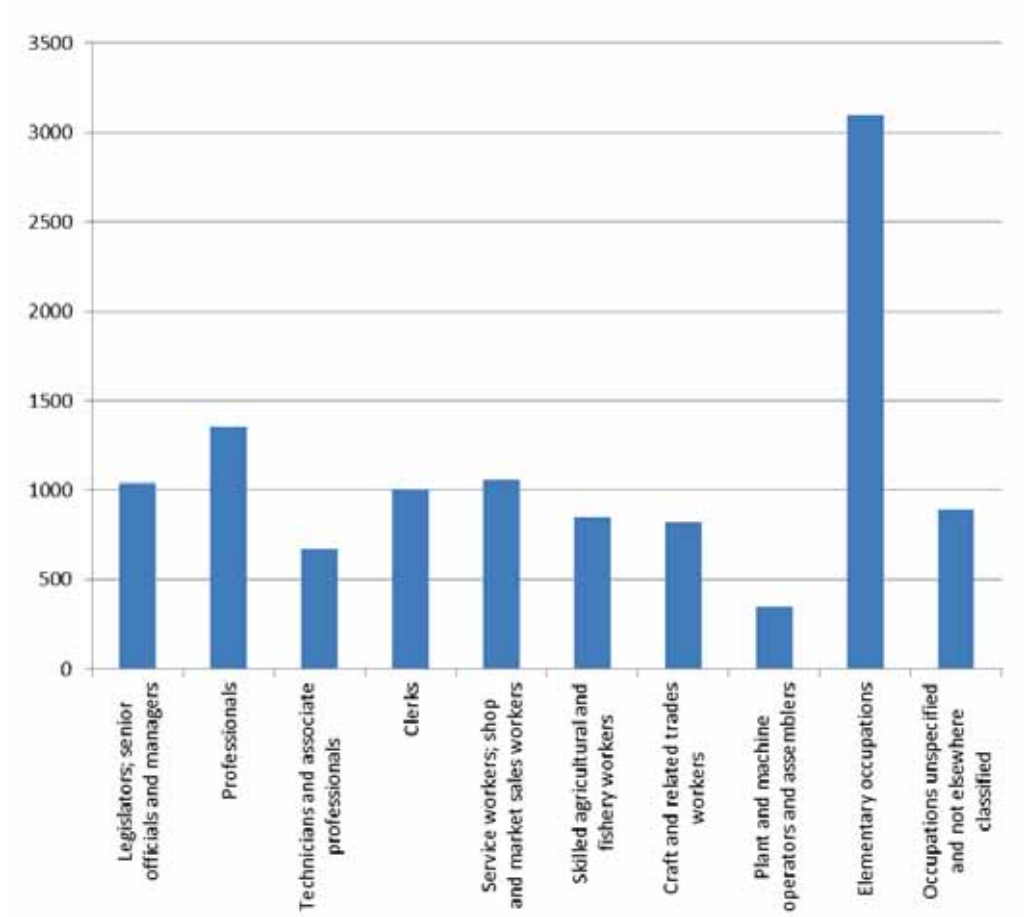


Source: Statistics South Africa: Census, 2011

The main occupations undertaken by those living in IYLM are shown in *Figure 6.8*. The StatsSA Community Survey 2007 indicated that elementary occupations i.e. occupations which require unskilled labour, were the dominant occupation at 29 percent in 2007 (StatsSA, 2007). Twelve percent of the IYLM were indicated as undertaking professional occupations, followed by clerks, legislators and senior officials, and service workers, shop and market sales workers, who each comprised approximately nine percent of the occupations undertaken within the IYLM. Skilled agricultural workers made up eight percent of the occupations within the IYLM. The high percentage of people with elementary occupations reflected the lack of specialised skills training and completion of higher education in the IYLM. The lack of specialised skills within the labour force and the lack of skills training available has also been highlighted as a concern at Ward level(1). The low numbers of people with professional occupations may be influenced by the lack of availability of such jobs and the limited opportunities for training.

(1) Personal Communication: Ward Councillor

Figure 6.8 Primary Occupations within the Local Municipality



Source: Community Survey, 2007

According to the StatsSA Community Survey 2007, the primary employment sector within the IYLM was community; social and personal services, employing approximately 23 percent of the working population (see *Table 6.2*). The next most dominant sector was agriculture, hunting, forestry and fishing, employing 17 percent of the working population, followed by wholesale and retail trade, employing 13 percent(1). As shown in *Table 6.2* other sectors such as manufacturing, construction and transport, each employed less than ten percent of the population.

Table 6.2 The Main Employment Sectors in 2007

Sector	Percentage
Community; social and personal services	23%
Agriculture; hunting; forestry and fishing	17%
Wholesale and retail trade	13%
Manufacturing	10%
Financial; insurance; real estate and business services	7%
Construction	6%

(1) Statistics South Africa: Community Survey, 2007

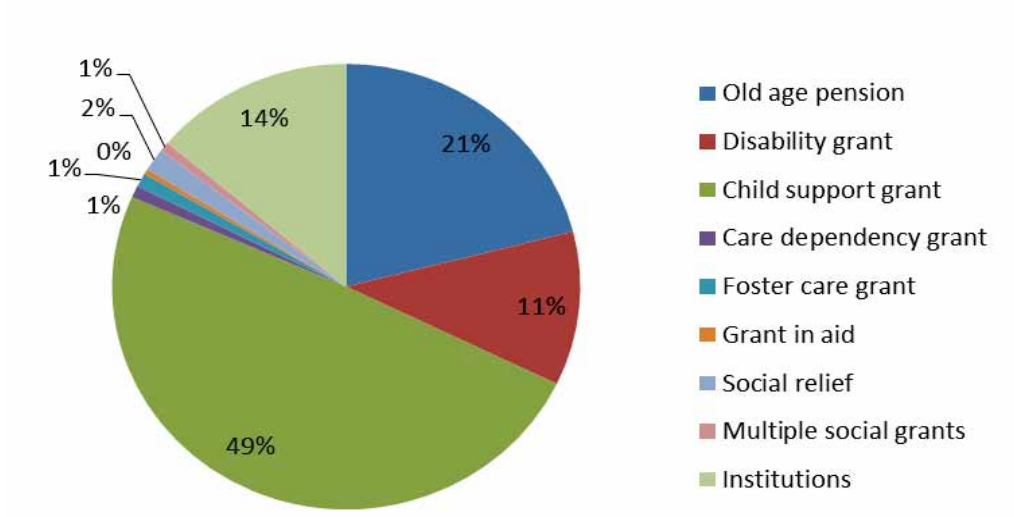
Sector	Percentage
Transport; storage and communication	4%
Undetermined, unspecified	20%

Source: Community Survey, 2007

Within the IYLM, 32.5 percent of the economically active population reported that they had no income in the 2011 Census, while 40 percent reportedly earn a low income of below R1,600 per month. A smaller number, 12.1 percent, earn between R1,601 and R12,800 per month. Only 2.7 percent earn between R12,801 and R52,200 per month, and 0.4 percent reported earning above R51,200 per month(StatsSA, 2011). The high percentage of people who earn low to no incomes can be attributed to the high unemployment rate and dominance of elementary (unskilled / low skilled) occupations in the IYLM.

In addition to low income levels a significant portion of the IYLM population has historically been dependent on social grants from the Government, specifically 28 percent in 2007 (StatsSA, 2007). As shown in *Figure 6.9* the main social grants received at that time were child support grants (58 percent), followed by old age pensions (24 percent) and disability grants (13 percent).

Figure 6.9 *Social Grant Recipients in 2007*



Source: Statistics South Africa: Community Survey, 2007

The comparative indications of household income between the 2001 and 2011 censuses (indicated in *Table 6.3* below) shows that the IYLM is substantially better positioned than both the CHDM and the Eastern Cape. The national average household income per annum underscores the relative poverty currently experienced within the Eastern Cape Province.

Table 6.3 Distribution of annual average household income– 2001 and 2011

	2001 (R)	2011 (R)
Inxuba Yethemba	33, 405	81, 892
Chris Hani	19, 689	48, 183
Eastern Cape	29, 334	64, 539
SA Average	48, 385	103, 204

Source: StatsSA Census 2011

6.5.5 Surrounding Landuse

The Site is located in a rural setting and the surrounding landuse is dominated by commercial agriculture undertaken along the Great-Fish River. Other activities in proximity to the Site include tourism and small businesses. These are discussed in more detail below.

Agriculture

Despite the fact that the contribution of agriculture to the GGP within the IYLM has been steadily declining, it remains an important sector in the Municipality. The IYLM IDP indicates that there are around 350 to 400 commercial farmers in the Cradock area, practicing two primary types of farming activities, namely dryland farming and intense irrigation farming (IYLM IDP, 2010). The irrigation farming takes place along the Fish and Tarka Rivers, where water from the rivers can be used to irrigate lucerne, wheat, oats, maize and vegetables. The irrigated fields also facilitate dairy farming. The dryland farming in the area consists of stock farming, (sheep, cattle, goats, ostrich) and game ranching.

The farming activities surrounding the Site are commercial, large-scale undertakings. The Site does not contain any large water bodies and there does not appear to have been any significant irrigation of the land undertaken within the Site. The eastern boundary of the Site is, however, around one kilometre away from the Fish River where intensive agriculture is being undertaken.

There are some emerging farmers in the IYLM, with two groups in the Middelburg area and 12 groups in the Cradock area. According to the IYLM IDP 2010, the emerging farmers mostly farm the same piece of land in groups and these commonages are rented from the municipality. The IDP notes that the challenges faced by emerging farmers include a lack of appropriate skills amongst them, little support from government and limited access to agricultural finance. There are however opportunities to access training in that there are two agricultural institutions, one of which is located in Cradock (Marlow agricultural high school), and another in Middelburg (Grootfontein College).

Tourism

The Site is located along the N10 National Road, which connects the coastal city of Port Elizabeth to the inland towns of Bloemfontein and Kimberley. Middelburg, Cradock and the surrounding areas are convenient stopover locations along the N10, therefore, much of the domestic tourism in the area consists of people passing through the area and overnight stays. The IYLM IDP notes that there is opportunity to grow the tourism sector. However there are a number of constraints, primarily the lack of cohesion amongst operators, the long distances between tourist attractions and lack of support from government, whose focus is primarily on coastal towns.

The Mountain Zebra National Park is located 36km north west of the Site. There are no other statutory nature reserves or national parks within a 50km radius of the Site. There are a number of private game reserves in the Eastern Cape; however, none appear to be located close to the Drennan Site. Other attractions in the area include historical buildings in Cradock and Middelburg, rock art, agri-tourism and natural Karoo landscapes.

The Karoo Calata Route is a tourist route designed to take visitors to the above mentioned attractions in the area. It forms a loop between Middelburg, Cradock and Queenstown and passes through Tarkastad, Sterkstroom, Molteno and Rosmead before returning to Middelburg. It does not appear to be well established or widely advertised as a tourist route.

Local Businesses

The Site is located in a rural setting and the local businesses are largely located in the nearby town of Cradock. Cradock has a number of local accommodation options. A number of eateries, grocery stores and speciality stores such as florists can be found in Cradock, and other amenities include filling stations, liquor stores, hardware stores and clothing stores.

Existing infrastructure surrounding the Site

There is an existing railway line 500m to the east of the PV footprint, which traverses the Site in a north south direction. An existing gravel road network exists on the Site, which crosses the railway line and runs 500m to the north east of the PV Footprint in a south-east to north-west direction (see *Figure 6.10*). Existing 132kV overhead transmission lines run along the north eastern boundary of the PV footprint, which link to the existing 132kV Drennan Traction Substation located two kilometers to the north of the Site. Two kilometers beyond the northern boundary of the Site there is an area of irrigated land where pivot agriculture has been undertaken. Housing infrastructure is scattered along the portion of railway line located around 500m to the immediate north east of the PV Footprint.

Figure 6.10 View of the Project Site showing existing railway line

Source: Stephen Stead, 2012

6.5.6 Health

There are two hospitals and eight clinics located in the IYLM, including one in the Lingelihle extension adjacent to Cradock. In the rural areas, access to health care facilities is somewhat limited (IYLM IDP, 2010); people living in the rural areas travel long distances to access medical facilities. The IYLM 2012 IDP identified the need for mobile clinics within the IYLM to address this problem and by 2012 there were three mobile clinics operating out of Cradock (Education Managament Information System [EMIS], 2012). Other health challenges within the IYLM include clinics with insufficient medicine supplies and staff. The percentage of the population in the IYLM infected with HIV / AIDS increased from 5.7 percent in 2001, to 7.6 percent in 2010, although it should be noted that this was a decrease from 2007 when this number was 8.8 percent (ECSECC, 2013).

6.5.7 General Infrastructure and Services

Housing

The IYLM IDP notes that there is an average of six people per household in the municipality (IYLM IDP, 2010). As of 2011 the majority (97 percent) of the population of IYLM lived in formal dwellings, while two percent resided in informal dwellings. Only one percent of the population lived in traditional dwellings (StatsSA, 2011). The housing in Lingelihle is predominantly of the Reconstruction and Development Plan (RDP) type (see *Figure 6.11*).

Table 6.4 Distribution of Households in the IYLM by Dwelling Type

Census	Formal dwellings	Informal dwellings	Traditional dwellings
2001	15 531	247	216
2011	17 903	381	67

Source: StatsSA, Census 2011

Figure 6.11 Typical Housing

Energy

The StatsSA Community Survey 2007 showed that the majority of the households within the IYLM (94 percent) had access to electricity, which was used primarily for lighting, heating and cooking, as shown in *Figure 6.12*. Households that did not have access to electricity for cooking made use of other fuel sources. For example, paraffin was used for cooking by 14 percent of the households in the IYLM, and for heating by 33.5 percent of the households. Wood was used for heating by 17 percent of households (StatsSA, 2007).

By 2011, as indicated in *Table 6.5,* the IYLM had experienced a steady increase in the proportion of households that utilised electricity for lighting, heating and cooking. Of particular significance were the greater number of households which prepared food with electricity as opposed to other energy sources mentioned above, which are commonly associated with health risks and environmental pollution.

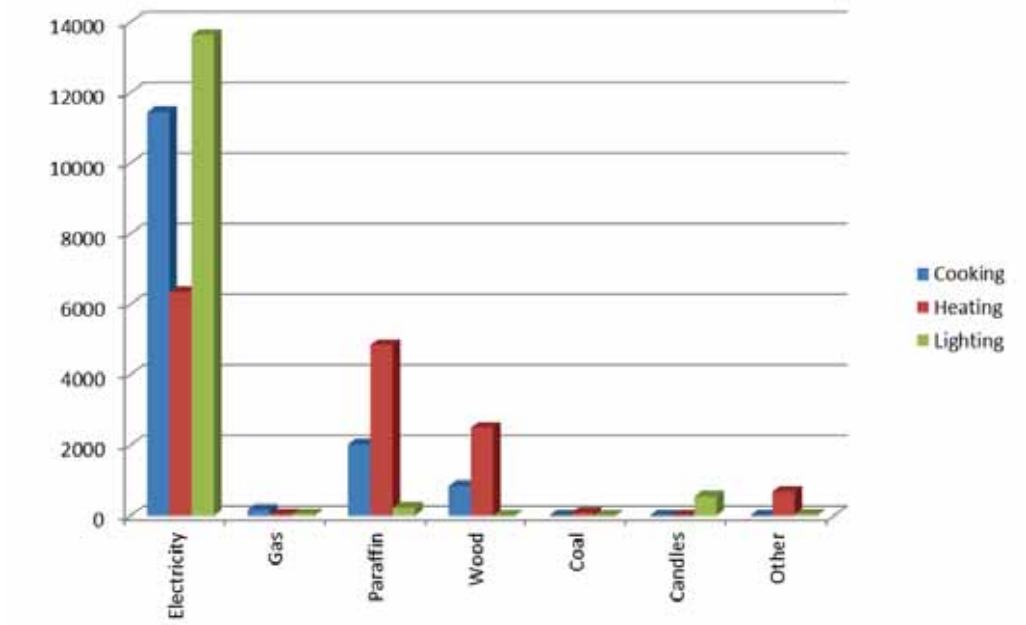
In Ward 6 specifically the IYLM IDP 2010 indicated that 90 percent of the Ward had access to electricity, and 99 percent to street lights (IYLM IDP, 2010).

Table 6.5 Percentage of households use of electricity in the IYLM

Inxuba Yethemba	Census 2011	CS 2007	Census 2011
Electricity used for lighting	82.5	94.1	95.6
Electricity used for heating	44.3	43.7	56.8
Electricity used for cooking	52.8	79	90.2

Source: StatsSA Community Survey 2007 / Census 2011

Figure 6.12 Household energy sources and their uses in the IYLM in 2007



Source: Statistics South Africa: Community Survey, 2007

Water and Sanitation

According to the StatsSA 2007 Community Survey, an estimated 52 percent of households in the IYLM had access to tap water inside their homes, while 39 percent had access to water outside their homes (within their yard). Three percent of households have access to piped water from an access point outside of their yard and six percent do not have access to piped water and obtain water from boreholes. The 2011Census indicated that 97 percent of households in the IYLM had access to piped water inside their yard or dwelling, and there were less than one percent of households without access to piped tap water (see *Table 6.6*). The percentage of households with connection to flush toilets in the IYLM (87 percent) compares far more favourably that the percentage in the CHDM (31 percent).

Table 6.6 Household Access to Piped Water in the IYLM, 2001 and 2011

Inxuba Yethemba	**2001**	**2011**
Piped (tap) water inside yard / dwelling	85%	97%
Piped (tap) water on a communal stand	12%	3%
No access to piped (tap) water	3%	<1%

Source: StatsSA Census 2011

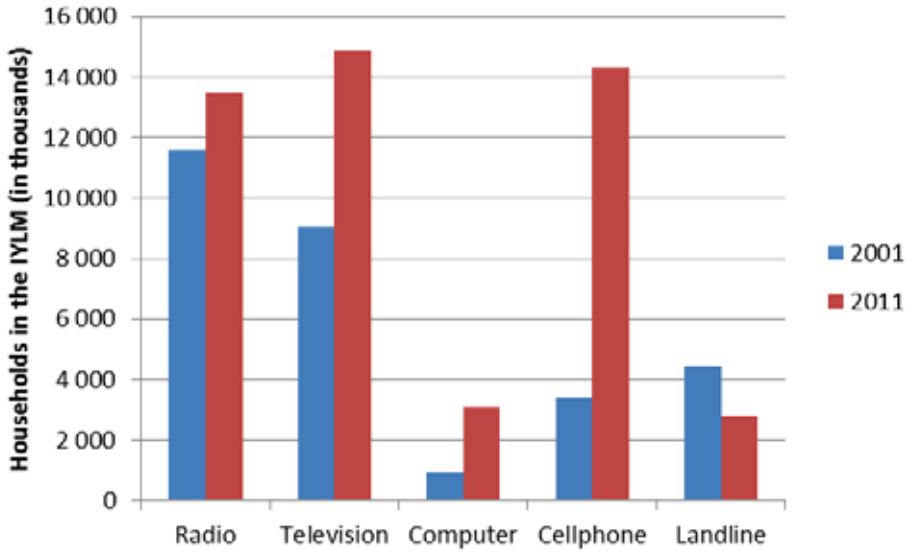
Roads and Access

Long sections of the N10 are currently being upgraded and re-surfaced, and as a result the N10 is in good condition. Most roads are paved in the older parts of Cradock, while some roads in the extension of Lingelihle are unpaved. The R390 by which the Site can be accessed is a graded gravel road and there are additional dirt tracks which occur within the Site. The proposed access road would be 900m in length and 6m wide, entering at the north of the PV Footprint.

Access to technology

The results from the 2011 Census (*Figure 6.13*) indicate that there has been a considerable increase in television, computer and cell phone possession between 2001 and 2011. During this time, television access amongst households in the IYLM increased from 56 to 80 percent, computer access from 5.6 to nearly 16.7 percent, and cell phone use increase from 21 to 77.5 percent. The number of households with landlines decreased by 37.5 percent between 2001 and 2011 which reflects the significant shift towards cell phone use in the IYLM. According to the StatsSA Community Survey 2007, only four percent of households within the IYLM had access to the internet. This has increased to 26 percent in 2011 (StatsSA, 2011).

Figure 6.13 Distribution of households with access to various forms of technology



Source: StatsSA Census 2011

6.5.8 *Crime*

Stock theft is a problem in the rural areas of South Africa, especially on farms located close to main roads or towns. There are regular police patrols in the IYLM to try and combat this problem(1). It was noted that small solar panels used for road signage, communication towers and PV panels located on farms have been stolen and damaged in the past(2).

6.6 *ARCHAEOLOGY AND CULTURAL HERITAGE*

6.6.1 *Archaeology*

Many archaeological collections were received from the Cradock area, where freshwater mussel middens containing stone implements and pottery were recorded from the banks of the Great-Fish River.

It is therefore anticipated that the study area will contain artefactual material dating to the Early and Middle Stone Age of the Pleistocene epoch (3 million – 20,000 years ago). This material is often noted in eroded areas, or on terraces in river valleys.

It can be predicted, with confidence, that there will be Later Stone Age sites within the study area. These are attributed to the ancestors of the San people and Khoekhoen pastoralists (after 2,000 years ago). The legacy of the San includes numerous open sites while traces of their presence can also be found

(1) Personal Communication: Ward Councilor
(2) Personal Communication: Neighbouring Landowner

in most large rock shelters, often in the form of rock art. They frequently settled a short distance from permanent water sources (springs or waterholes) and made use of natural shelters such as rock outcrops or large boulders. In the Great Karoo natural elevated features such as dolerite dykes and ridges played a significant role in San settlement patterns.

The introduction of pastoralism (sheep and goats, later cattle) roughly 2,000 years ago, along with the arrival of the Khoekhoen, was a significant event that broke the ancient tradition of hunting and gathering. According to the historic records, the Khoekhoen herders were divided into large tribal communities, distributed along the coastal plains and up as far as Graaff Reinet. These communities in transition (herding cattle and sheep) may have utilized the grazing opportunities of the Karoo on a seasonal basis but information on this is sketchy.

The San appear to have retreated to the Great Karoo with the arrival of the first Dutch Trekboers in the mid-18th century. Here they managed to eke out an existence which includes hunting, gathering and raiding the livestock of the Trekboers, resulting in the "Bushman War" which continued for almost 60 years. Eventually the kommandos which were dispatched from regional centres such as Graaff Reinet prevailed, and the "wild bushman" of the Karoo were rendered extinct by the early 19th century.

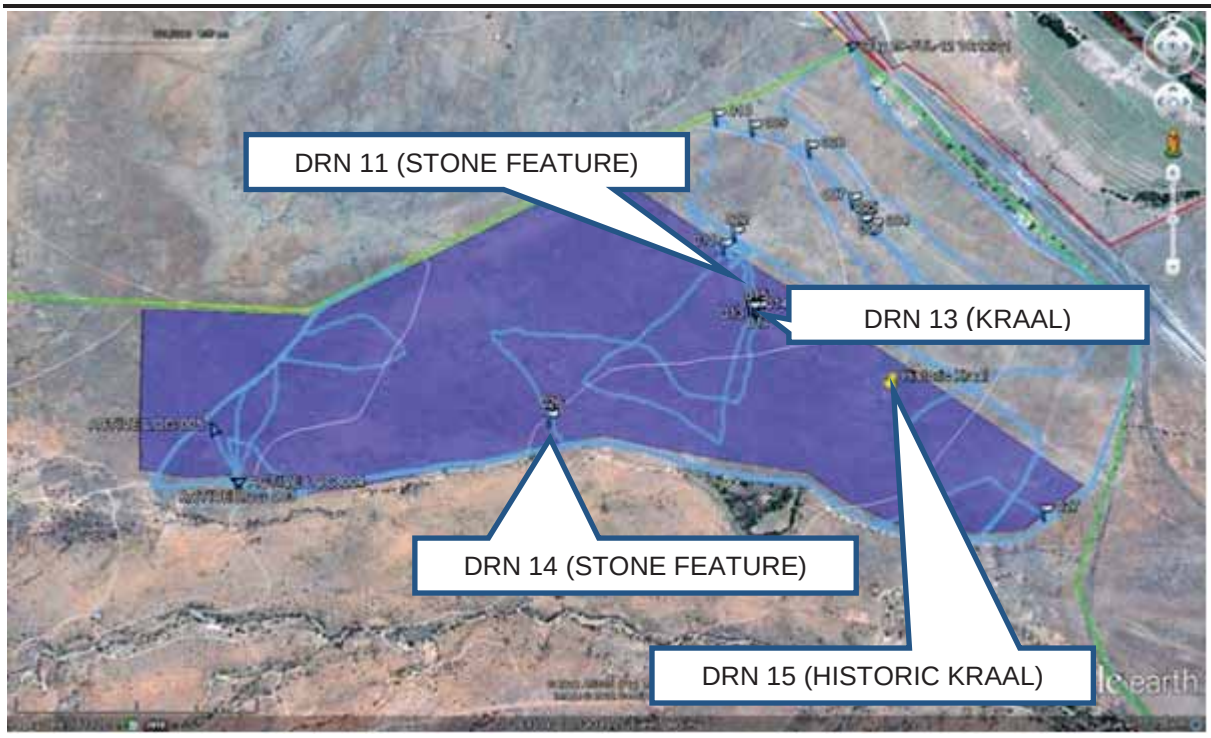
Field Survey Results

Four archaeological sites were found within the area (see *Figure 6.14*). One of these was a very well preserved Koekhoen stone kraal / alignment (circa 1000 – 1400 AD) while the others included a historical Kraal (see *Figure 6.15*) and two potential pre-colonial graves (stone cairns, see *Figure 6.16*). Fortunately all of these sites are limited in size and avoidable in terms of project development.

The Koekhoen stone kraal (DRN 13) is best conserved in-situ due to its completeness with a 10m buffer zone. However if this is not possible, its destruction can only be undertaken under a permit issued by the Eastern Cape Provincial Heritage Resources Authority. For this to happen it will need to be recorded and documented first by an archaeologist. The same applies to the historical kraal (DRN 15), which is well represented in the Karoo and protected under the NHRA.

The two possible graves (DRN 11 and DRN 14), both of which lie close to the edge of the PV Footprint, are best left in-situ in a small 10m buffer zone as the process of exhumation is time consuming, costly and requires its own public process in terms of section 36 of the National Heritage Resources Act 25 of 1999.

Figure 6.14 Key Archaeological Sites



Source: Tim Hart, 2013

Figure 6.15 A Piled Stone Kraal Typical of the Central Karoo

Source: Tim Hart, 2013

Figure 6.16 A Possible Burial Cairn at the Site

Source: Tim Hart, 2013

The Site is situated in a palaeontologically sensitive and important area of the ancient Karoo Basin (Johnson, et al. 2009; Rubidge, et al. 1995; Smith 1990). Fossilized plant remains are common in parts. Iziko South African Museum's Karoo Palaeontology section holds Balfour and Katberg Formation vertebrate and plant fossils from the Cradock area in its collection (pers. Comm, S. Kaal, Iziko Museums of South Africa). Thus, excavations into sediments not normally accessible to palaeontologists should be seen as providing opportunities to recover potentially important fossil material that enable observations otherwise impossible to be made.

The rocks of the hills to the north of the Site belong to the Balfour Formation of the Beaufort Group which is world-renowned for its rich fossil record and contain some of the most significant evidence for the origins of dinosaurs, mammals and turtles. Fossils from this area could potentially be of great significance. However, the presence of dolerite extrusions and dykes as well as indurated rock means that well preserved fossils are an unlikely occurrence on the surface. Fossils are potentially present on exposures to the south-west of the Site, an area which will be unaffected by construction, but from where fossils may roll down slopes into the PV Footprint when they weather out.

In addition to the potential within the Balfour Formation rocks, small pockets of bone can occur, for instance, where bone accumulators like hyaenas, jackals or porcupines used holes/burrows dug by aardvarks; older and younger younger sediments, too, may contain ancient wetland deposits and/or more-recent fossils. In addition to fossil bones and molluscs, there is the potential

for encountering macro-plant remains and pollens of considerable age in wetland deposits. Thus, foundations excavated into rocks and sediments on the Site may intersect fossil-bearing deposits. If so, there is the potential to provide opportunities for observations not otherwise accessible to researchers.

This chapter identifies and assesses the potential impacts the proposed Drennan PV power facility may have on soils, and surface- and groundwater. These potential impacts are summarised in *Table 7.1*. There are six small dams that are located at points along the drainage lines within the Site, the nearest of which is located 35m to the south of the PV footprint (see *Chapter 4*).

The major ecological feature at the Site is a large drainage system which traverses the area and is considered ecologically sensitive and unsuitable for development. The proposed development, although located outside of the drainage system, presents a risk to sensitive receptors, specifically with regards to the potential for the run- off of soil debris or waste into the catchment areas surrounding drainage lines.

The specialist reports highlight that the entire Site is underlain by strongly structured duplex type soils (see *Chapter 5*). The defining characteristic of duplex soils is the enrichment of clay within the soil profile. This strong structure can be considered an impediment to root growth and water movement. Duplex soils present a variety of management challenges to farmers and engineers alike. The major concern relates to high erosion hazards that these soils exhibit. The main cause of erosion is clay dispersion, which gives rise to surface sealing and intensifies surface runoff.

Table 7.1 Impact characteristics: Impacts on soils, surface water and groundwater

	Construction	**Operation**
Project Aspect / activity	(i) Soil compaction, removal of topsoil and erosion associated with clearance and preparation in the PV footprint, construction of compacted gravel tracks, laydown area etc. (ii) Impact on surface water and groundwater resulting from fuel, oils or cement spills.	(i) Soil erosion around cleared areas, roads and at the foot of PV panels. (ii) Impact on surface water and groundwater resulting from fuel and oil spills. (iii) Reduction of groundwater recharge due to sealed surfaces and PV panels.
Impact Type	Direct	Direct
Receptors Affected	(i) Soils at the Site underlying construction areas, PV Footprint, roads etc. (ii) Surface and groundwater quality at or near the Site.	(i) Soils in the vicinity of cleared areas or roads and PV Footprint. (ii) Surface and groundwater quality at or near the Site.

7.1 LOSS OF TOPSOIL, SOIL COMPACTION AND EROSION

7.1.1 Construction Phase Impacts

Preparation of the site for the establishment of PV arrays, underground cables, access road(s), temporary laydown area and buildings (control and accommodation) during the construction phase will require vegetation clearance, some site levelling and grading and soil compaction.

The area required for the PV array locations, buildings and access tracks linking infrastructure (PV Footprint) will be considerable. The total PV Footprint of the Drennan facility will be approximately 110 ha.

Construction at the Site could lead to increased erosion by concentrating water flows and removing the natural erosion protection (vegetation cover), as well as increasing run-off from the Site, thus reducing infiltration and groundwater recharge. This risk is compounded by the duplex soil type present at the site. The vegetation, surficial gravel layer and soil duricrust that is present on the Site all act as protection against erosion by water and wind. Removal of these by excavation, grading or clearing will encourage erosion. The vegetation cover is the most important physical factor influencing soil erosion. An intact cover reduces physical impact from rain-drops on the soil, slows down surface run-off, filters sediment and binds the soil together for more stability. The intensity of potential erosion is also influenced by precipitation which is generally low in this semi-arid region. The Mean Annual Precipitation (MAP) for the Study Area is 379 mm.

Run-off within the Site occurs over the entire area in the form of sheetwash(1). Compaction of soils from increased levelling and grading of areas of the Site will result in lower permeability and therefore decrease infiltration and increased runoff. Without appropriate measures, runoff from PV panels, compacted areas and hardstanding areas in addition to erosion by wind may increase erosion and increase the sediment load in run-off. Potential impacts to surface water are assessed further in *Section 7.2.*

In addition, the permanent removal of the topsoil horizon changes the soil profile which may inhibit rehabilitation which may, in turn, increase the erosion potential of the soil.

Furthermore, soil may undergo chemical degradation as a result of spills or leaks of fuels, oils and lubricants from construction vehicles. These impacts are dependent on the size of the spill and the speed with which it is remediated. The likelihood of a spill is also associated with the volume of product that may be stored onsite. Typically for a development of this nature,

(1) Sheetwash refers to gradual erosion whereby a thin film of water transports soil particles over the land surface, without resulting in the formation of gullies or channels (definition adapted from the Oxford Dictionary of Geography).

above ground storage tanks for diesel and varying amounts of hydraulic oils, transformer oil and used oils will be required onsite during the construction phase.

Box 7.1 Construction Impact: Loss of Topsoil, Soil Compaction and Soil Erosion

Nature: The loss of topsoil, changes in the soil profile through compaction, potential soil erosion and contamination will have a **negative direct** impact on the soils of the Site.

Impact Magnitude –Medium

- **Extent:** The extent of the impact is **local.** Although the impacts are predominantly limited to the boundaries of the Site, there is a chance they may extend beyond the Site.
- **Duration:** The duration would be **long-term** since although removal of topsoil and compaction in areas of the Site will occur largely during the construction phase, the effect may continue through the Project lifecycle.
- **Intensity:** The intensity is **medium** since although topsoil removal and soil compaction may be limited to specific areas of the Site, potential erosion may affect a larger area.

Likelihood – It is **likely** that this impact will occur.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MODERATE (-VE)

Degree of Confidence: The degree of confidence is **medium**.

7.1.2 Operational Phase Impacts

Soil erosion caused by stormwater or surface water runoff may occur during the operational phase as a result of additional impervious surfaces onsite, such as the gravel compacted roads, and the laydown and storage areas used for the construction phase, resulting in increased runoff. In addition, although the disturbance associated with the construction phase will have ended, unless mitigation measures are undertaken, loss of topsoil may continue during the operational phase of the Project. No topsoil clearing is anticipated during routine operation and maintenance of the facility, although effects of wind could exacerbate erosion where vegetation cover has been removed.

Obstructions such as poles supporting the PV structures, building foundations and compacted gravel tracks on the Site may concentrate water flows into catchment areas feeding surrounding drainage lines. Surface water flows diverted along tracks and infilled trenches could also result in in the formation of eroded gullies or dongas.

Box 7.2 Operational Impact: Loss of Topsoil, Soil Compaction and Soil Erosion

Nature: Routine operational and maintenance activities may result in a **negative direct** impact on the soils at the Site, whereas PV panels acting as wind breaks result in a **positive direct** impact on soils located in the vicinity of the PV Footprint.

Impact Magnitude –Medium

- **Extent:** The extent of the impact is **local;** the impacts are predominantly limited to the Site boundaries but may extend to the immediate surrounds of the Site.
- **Duration:** The duration would be **long-term** as the soils may be affected at least throughout the operational phase of the Project.
- **Intensity:** The intensity is **medium** since the source of the impact will be limited to areas inside the infrastructure footprint, however, significant loss of soil can result from erosion caused by excessive runoff if not mitigated adequately.

Likelihood – It is **likely** that these impacts will occur.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MODERATE (-VE)

Degree of Confidence: The degree of confidence is **medium**.

7.1.3 Mitigation

Design Phase

- Clearing activities will be kept to a minimum and will only be undertaken during agreed working times as permitted by suitable weather conditions. If heavy rains or severe winds are expected, clearing activities will be put on hold. In this regard, the developer and contractor will be cognisant of regional weather forecasts and the seasonal climate characteristics of the Study Area.

Construction Phase

- Drainage lines or hydraulic corridors identified traversing the Site, especially immediately below the culvert outlets (at the railway), will be kept open. Should the drainage lines not be avoided, adequate breadth and width below panels and supports will be maintained so as not to trap debris.

Following the clearing of an area, the surfaces of all exposed slopes will be roughened to retain water and increase infiltration (especially important during the wet season). Any steep or large embankments that are expected to be exposed during the rainy months will either be armoured with fascine like structures or vegetated(1).

- Regular diversion berms will be built on gravel compacted roads.

(1) A fascine structure usually consists of a natural wood material and is used for the strengthening of earthen structures or embankments.

- The removal of vegetation and soil cover will be restricted to only those areas necessary for the development. In particular, the unnecessary removal of groundcover vegetation from slopes will be prevented, especially on steep slopes.

- Soil conservation measures will be implemented such as stockpiling topsoil or gravel for the remediation of disturbed areas.

- Stockpiles will be vegetated or appropriately covered to reduce soil loss as a result of wind or water erosion.

- Disturbed areas will be rehabilitated as soon as possible to prevent erosion.

- Work areas will be clearly defined and where necessary demarcated to avoid unnecessary disturbance of areas outside the development footprint.

- Fuel, oil and used oil storage areas will be contained in bunds of 110 percent capacity of the stored material.

- Spill containment and clean up kits will be available onsite and clean-up from any spill will be appropriately contained and disposed of.

- Construction vehicles and equipment will be serviced regularly and off site.

- Construction vehicles will remain on designated and prepared compacted gravel roads. The additional creation of access roads will be kept to a minimum. Where roads need to be created, a dual tyre track road will be used rather than clearing the entire road width.

Operational Phase

- Laydown or infrastructure assembly areas not required during the operational phase of the PV power facility will be re-vegetated with indigenous vegetation to prevent erosion immediately after these areas are no longer required for construction.

- Bi-annual monitoring of erosion in the vicinity of roads, PV arrays and other hard-standing surfaces will be conducted before and after the rainy season to ensure erosion sites can be identified early and remedied.

7.1.4 Residual Impacts

Assuming the above stipulated mitigation measures are implemented, the residual impact significances for the construction and operational phases are reduced to *Minor* negative.

Table 7.2 *Pre- and Post-Mitigation Significance: Loss of Topsoil, Soil Compaction and Erosion*

Phase	Significance (Pre-mitigation)	Residual Significance (Post-mitigation)
Construction	**MODERATE(-VE)**	**MINOR(-VE)**
Operation	**MODERATE(-VE)**	**MINOR (-VE)**

7.2 IMPACT ON SURFACE AND GROUNDWATER

7.2.1 Construction Phase Impacts

As mentioned in *Section 7.1,* soil compaction and vegetation clearance may increase the intensity and volume of surface water runoff as a result of a decrease in water infiltration recharging the groundwater. This may impact drainage lines within the Site by exacerbating erosion features, and increasing the sediment load of the water entering these channels when they are flowing. Increased run off from hard standing areas could result in the creation of drainage lines and damage to solar infrastructure and installation equipment by debris, and the deepening and lateral erosion of channels and loss of infiltration.

The major surface water feature is the drainage system present on the Site. The PV Footprint avoids the drainage lines, and therefore has no direct impact on them.

Groundwater may be impacted as a result of infiltration of contaminants associated with spills or leaks of fuels, oils and lubricants from construction vehicles or storage tanks. The likelihood of a spill is associated with the volume of product that may be stored onsite. These impacts are dependent on the size of the spill and the speed with which it is remediated, as well as the vulnerability and susceptibility of the aquifer(1). Given the low level of vulnerability and susceptibility of the aquifer, the potential impacts due to spills are likely to be of a lower significance.

(1)Vulnerability in this instance refers to the tendency or likelihood for contaminants to reach a specified position in the groundwater system after introduction at some location above the uppermost aquifer. Susceptibility refers to a qualitative measure of the relative ease with which a groundwater body can be potentially contaminated by anthropogenic activities and includes both aquifer vulnerability and the relative importance of the aquifer in terms of its classification.

Box 7.3 Construction Impact: Impact on Surface and Groundwater

Nature: Surface and groundwater impacts resulting from soil compaction, increased sediment load or through leaks or spills would result in a **negative direct** impact.

Impact Magnitude – Low

- **Extent:** The extent of the impact is **local** since the impacts are limited predominantly to the boundaries of the Site or in the vicinity of the Site.
- **Duration:** The duration for impacts to the creation of new drainage channels would be **permanent** since the Site's natural pattern of runoff would be permanently altered. Impacts to water quality from spills would be **short- term** depending on the size or nature of the spill.
- **Intensity:** The intensity is **medium** since runoff is expected to be of a low to medium level of intensity, in addition to the fact that the quantity of dangerous goods stored onsite will be relatively small.

Likelihood – It is **likely** that this impact will occur.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MINOR (-VE)

Degree of Confidence: The degree of confidence is **medium**.

7.2.2 Operational Phase Impacts

Soil erosion caused by storm water or surface water runoff may occur during the operational phase and result in an increase in the sediment load of onsite runoff. Obstructions such as foundations and roadways may concentrate water flows into catchment areas feeding surrounding drainage lines. Similarly, flows diverted along tracks and infilled trenches may also result in soil erosion, creating new gullies or dongas. These impacts will last the duration of the operational phase.

Surface water and groundwater impacts associated with leaks and spills are reduced during the operation phase since on-site storage of hydrocarbons and site activities will be considerably reduced.

Due to proposed hard standing areas (lay down areas, building foundations, compacted gravels roads), compacted soil (rows between arrays) and PV panels covering large parts of the Site (covering approximately 110 ha), recharge to groundwater from rainfall is expected to be reduced on the Site.

Box 7.4 Operational Impact: Impact on Surface- and Groundwater

Nature: Increased sediment loads in runoff, spills and leaks during routine operational and maintenance activities and reduced groundwater recharge may result in a **negative direct** impact on surface- and groundwater.

Impact Magnitude –Medium-Low

- **Extent:** The extent of the impact is **local** since the impacts are limited predominantly to the boundaries of the Site or in the vicinity of the Site.
- **Duration:** The duration for contamination would be **short to long-term** depending on the size of the spill. The duration for increased sediment loads and reduced groundwater recharge would be **long-term**.
- **Intensity:** The intensity is **low** since the size of a spill is likely to be small given the limited volume of product to be stored onsite. Intensity for change in flow during the operation phase and increased sediment load will be **medium** and for reduced groundwater recharge **low** since the natural groundwater recharge from rainfall in the area is low.

Likelihood – It is **likely** that this impact will occur.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MODERATE-MINOR (-VE)

Degree of Confidence: The degree of confidence is **medium**.

7.2.3 Mitigation

Design Phase

- Appropriate contractors who will be responsible for removing spillage residue from the Site will be appointed. Handling, storage and disposal of excess or containers of potentially hazardous materials will be in accordance with the requirements of the relevant legislation (see *Chapter 2*).

Construction Phase

- Drainage lines or hydraulic corridors identified traversing the Site will be kept open, especially immediately below the culvert outlets (at the railway on the eastern boundary of the Site).

- Fuel, oil and used oil storage areas will be contained in bunds of 110 percent capacity of the stored material.

- Spill containment and clean up kits will be available onsite and clean-up from any spill will be appropriately contained and disposed of at a registered landfill site.

- Project staff will not be permitted to utilise any water sources (stream, river, or other water bodies) for the purposes of bathing, washing of clothing or for any other construction or related activities.

- Construction vehicles and equipment will be serviced regularly.
- Construction vehicles and equipment will be serviced off site.

Operational Phase

- Fuel, oil and used oil storage areas will be contained in bunds of 110 capacity of the stored material.

7.2.4 *Residual*

The PV Footprint avoids the drainage lines which occur at the Project Site. Assuming the above stipulated mitigation is implemented, the residual impact significances on surface and groundwater is reduced to *Minor* negative in the construction and operational phases (*Table 7.3*).

Table 7.3 Pre- and Post-Mitigation Significance: Impacts on Surface and Groundwater

Phase	Significance (Pre-mitigation)	Residual Significance (Post-mitigation)
Construction	**MINOR (-VE)**	**MINOR(-VE)**
Operation	**MODERATE-MINOR (-VE)**	**MINOR (-VE)**

This Chapter discusses the agricultural potential and the impact the Project may have on agriculture at the Site. Potential impacts on agriculture are assessed and mitigation measures to reduce these impacts are outlined below. ERM appointed Kurt Barichievy of SiVEST to undertake an agricultural field survey and assessment of the Site to establish the current agricultural potential and agricultural baseline, and assess the potential impacts of the development on the agriculture potential of the Site. The full findings of this study are included in *Annex I* and are summarised in this Chapter.

Table 8.1 Impact Characteristics: Impacts on Agriculture

	Construction	**Operation**
Project Aspect / activity	(i) Loss of agricultural land as a result of the PV power facility development footprint. (ii) Potential of disturbance to agricultural practices as a result of construction activities. (iii) Erosion and clearing of topsoil.	(i) Loss of agricultural land as a result of the PV power facility development footprint. (ii) Erosion of topsoil.
Impact Type	Direct	Direct
Receptors Affected	(i) Grazing lands. (ii) Cultivated lands. (iii) Agricultural livestock.	(i) Grazing lands. (ii) Cultivated lands. (iii) Agricultural livestock.

8.1.1 Construction Phase Impacts

During the construction phase of the Project there may be certain direct impacts to agriculture at the Site. These impacts may include potential disturbance to agricultural practices as a result of construction activities, and the potential erosion of topsoil due to clearing activities. These impacts would occur over a relatively short timeframe with a relatively low intensity due to the low agricultural potential of the Site, and the low percentage of land extent required for the Project. Due to the relatively small extent of the Site, short timeframe and low intensity, the pre-mitigation significance is rated as *Negligible*

The loss of agricultural land within the PV Footprint is an impact which has greater importance in the operational phase of the Project, and therefore this impact has been assessed in the operational phase

Box 8.1 Construction Impact: Impact on Agriculture

Nature: The PV power facility will require activities of clearing of vegetation for construction of access roads, PV arrays, buildings and laydown areas, which may result in a direct negative impact on agricultural activities and potential erosion of topsoil.

Impact Magnitude –Low

- **Extent**: The extent of the impact is **on-Site** as the impacts will be limited to the boundaries of the Site.
- **Duration**: The duration would be short**-term** as the agricultural resources will only be affected for the duration of the construction phase of the project.
- **Intensity**: The intensity is **low** given the low agricultural potential of the Site, the understanding that there is currently no agricultural practices on the Site and the low percentage of land extent required for the project.

Likelihood – The impact is **likely** to occur.

IMPACT SIGNIFICANCE (PRE-MITIGATION) –NEGLIGIBLE

Degree of Confidence: The degree of confidence is **high**.

8.1.2 Operational Phase Impacts

The loss of high value farm land and / or the associated food security production loss as a result of developments is of particular concern in South Africa. South Africa has a scarcity of high potential agricultural land, with less than 14 percent of its land being suitable for dry land crop production (Smith, 2006). Therefore, areas which can sustainably accommodate dry land production need to be protected from non-agricultural land uses.

The primary impact on agricultural activities at the Site will be the loss of agricultural land, resulting from the construction and operation of the PV arrays and associated infrastructure. Although the initial impact will occur in the construction phase, the impact on agriculture will occur throughout the duration of the PV power facility's operation, and therefore the potential impact on agriculture from the loss of agricultural land is assessed in the operational phase of the Project. The construction of the PV power facility will entail the clearing of vegetation and levelling of the Site. Unless grazing is allowed between the PV arrays, their installation will eliminate the development footprint's agricultural potential for the duration of the PV power facility's operation.

The affected Project area has a semi-arid to arid continental climate with a late summer rainfall regime (i.e. most of the rainfall is confined to summer and early autumn). The mean annual precipitation (MAP) is approximately 379 mm per year. The combination of low rainfall and high moisture deficit means that sustainable arable agriculture cannot take place on the Drennan Farm without some form of irrigation. The affected Project area is approximately 650 m from the Great Fish River, a reliable irrigation resource. However, the impacted farm portions have no water rights to this resource.

Even if irrigation water could be secured it is not agriculturally and economically feasible to irrigate these farm portions.

Of the assessment area, around 70 percent of it is dominated by steeper slopes and rocky outcrops. Away from these rocky areas the land is generally flat with an average gradient of less than 10 percent. These flatter areas are associated with a higher potential for grazing. The flat topography makes this eastern area ideal for the Project, as minimal earthworks will be required to prepare the Site for the installation of PV arrays. The soils identified on the Site are shallow, being predominantly rocky and/or duplex with a low agricultural potential. Rocky and shallow duplex soils (Mispah, Glenrosa and Swartland Form) cover 98 percent of the surveyed area. Most of soils encountered on Site contained at least one layer that was limiting to plant growth and these layers included Lithocutanic, hard rock, strongly structured cutanic B-Horizons and saprolite. Deeper, well-structured duplex soils dominate the riparian corridor and areas under irrigated pasture production.

The majority of the Study Area is unsuitable for sustainable crop production and is dominated by unimproved grazing land. The riparian areas are an exception to this pattern, where deeper alluvial soils are highly suitable for cultivation. These areas generally correspond to irrigation infrastructure and high value agricultural enterprises. However, the Site is located outside of the riparian corridor of the Great-Fish River.

The entire Site is classified as having a low potential for crop production, due to the arid climate and the presence of highly restrictive soil characteristics (see *Chapter 5*). Furthermore, the farm Waai Plaats at Drennan is not classified as having a high agricultural potential nor is it a unique dry land agricultural resource. The Site is considered to have a moderate value when utilised as grazing land, which is its current land use.

The construction of the 90 MW PV power facility and associated infrastructure will only influence a small portion of the total farm area (approximately 110 ha). The remaining land will continue to function as it did prior to the development (approximately 1387 ha or 93 percent). As the riparian corridor and actively cultivated fields are precluded from the development layout, the overall impact of the PV power facility on the Site's agricultural potential and production will be low, due to the remaining area's low inherent agricultural potential and value. The proposed linking power lines, from the PV arrays to the Eskom overhead transmission lines, will be facilitated by a new 'loop-in, loop-out' substation and additional transmission lines of around 22m in length (the construction of additional transmission line towers is not required). Owing to this, the new grid connection infrastructure will have an insignificant impact on agricultural production.

A map showing the "no go"agricultural exclusion areas has been developed for the Site, and is shown in *Figure 8.1*. As can be seen from the map, the proposed PV Footprint, and the entire Site, is considered suitable for development from an agricultural perspective.

Figure 8.1 Agricultural Exclusion Map

Source: Kurt Barichievy, 2012.

Box 8.2 Operational Impact: Impact on Agriculture

Nature: The PV power facility will require clearing of vegetation for construction of access roads, PV arrays, buildings and laydown areas, resulting in a direct negative impact on the soil and land use resources on the Site.

Impact Magnitude –Low

- **Extent**: The extent of the impact is **on-Site** as the impacts will be limited to the boundaries of the Site.
- **Duration**: The duration would be **long-term** as the agricultural resources will be affected for the duration of the operational phase of the Project.
- **Intensity**: The intensity is **low** given the low agricultural potential of the Site, and the low percentage of land extent required for the project.

Likelihood – The impact has a **definite** likelihood of occurring.

IMPACT SIGNIFICANCE (PRE-MITIGATION) –MINOR (-VE)

Degree of Confidence: The degree of confidence is **high**.

8.1.3 Mitigation

Construction and Operation

- Preclude riparian areas, stock watering dams and active cultivated fields from the development layout.

- Allow periodic grazing within the PV Footprint (sheep and wildlife). This mitigation will minimise the loss of grazing land and allow agricultural production to remain virtually unaffected.

Due to the overarching characteristics of the Site, and the nature of the Project, the remainder of the viable mitigation measures are limited to erosion control:

- Clearing activities will be kept to a minimum (PV panel and road footprint).

- If heavy rains are expected, activities will be put on hold to reduce the risk of erosion.

- If additional earthworks are required, any steep or large embankments that are expected to be exposed during the rainy months will be armoured with fascine like structures (unlikely scenario), storm water control and wind screening will also be undertaken to prevent soil loss from the Site.

8.1.4 *Residual*

Assuming the above mitigation measures are implemented, the residual impact significance for the construction phase is reduced to *Negligible* and the impact significance for the operational phase will remain as *Minor*.

Table 8.2 Residual Impact Significance: Impact on Agriculture

Impact	Significance (Pre-mitigation)	Residual Significance (Post-mitigation)
Construction: Disturbance of Agricultural Activities and/or Soil Erosion	**NEGLIGIBLE**	**NEGLIGIBLE**
Operation: Loss of Agricultural Land and/or Production	**MINOR (-VE)**	**MINOR (-VE)**

9 FLORA AND FAUNA IMPACTS

The impacts that the Project may have on flora and fauna are discussed in this chapter. The potential impacts are assessed and mitigation measures to reduce the impacts are outlined below. ERM appointed Simon Todd Consulting to undertake an ecological and biodiversity field survey and assessment of the Site to establish the current ecological baseline and assess the potential impacts of the development on terrestrial vertebrate fauna and flora. The full findings of this study are included in *Annex F* and are summarised in this chapter.

The layout of the Final PV Footprint in relation to the ecological sensitivity of the Site is depicted in *Figure 5.15*. The very high sensitivity areas at the Site consist of the drainage lines and the riparian corridors. These areas do not however constitute a large proportion of the Site, and are limited to the southern boundary of the PV Footprint. Thus the final layout of the PV Footprint avoids the ecologically sensitive areas at the Site and would not have a significant direct impact on the ecologically important parts of the Site.

Table 9.1 Impact Characteristics: Impacts on Flora and Fauna

	Construction	Operation
Project Aspect / activity	(i) Loss of vegetation and avian habitat associated with Site clearance, road construction, building and PV array support construction etc. (ii) Potential of disturbance resulting in invasion of alien species. (iii) Erosion and clearing of topsoil (loss of habitat and habitat fragmentation). (iv) Disturbance of fauna associated with Site clearance, road construction, building and PV array support construction etc. (v) Disturbance of drainage areas. (vi) Disturbance / displacement of avifauna associated with noise and movement of construction equipment and personnel.	(i) Damage to natural vegetation through movement of vehicles and maintenance activities. (ii) Disturbance to fauna associated with the operation of the PV power facility and movement of vehicles. (iii) Collision and / or electrocution of avifauna with project infrastructure. (iv) Loss of avifauna habitat to space occupied by PV panels and associated infrastructure, and disturbance / displacement associated with routine maintenance work. (v) Avifauna mortality in collisions with PV panels and / or power lines, or by electrocution on new power infrastructure.
Impact Type	Direct	Direct
Receptors Affected	(i) Fauna and flora on Site including mammals, amphibians, reptiles and Karoo endemics. (ii) All avifauna on Site; key species: Blue Crane, Lesser Kestrel, Secretarybird,	(i) On-Site vegetation. (ii) Fauna on Site. (iii) Avifauna on Site; key species: Blue Crane, Lesser Kestrel, Secretarybird, Karoo endemics. (iv) Large terrestrial species, large raptors, overflying wetland birds.

9.1 *DESTRUCTION AND LOSS OF NATURAL VEGETATION*

According to the national vegetation map (Mucina & Rutherford 2006), the Site falls within the Eastern Upper Karoo vegetation type. There are a number of other vegetation types in the area, such as Southern Karoo Riviere and Great Fish Thicket, but these are associated with the riverine areas and

adjacent hills respectively and do not occur within the Study Area. The Project areas lie entirely within the Eastern Upper Karoo vegetation type. The Eastern Upper Karoo vegetation type is the most extensive vegetation type in South Africa and forms a large proportion of the central and eastern Nama Karoo Biome. This vegetation type is classified as Least Threatened, and about two percent of the original extent has been transformed largely for intensive agriculture. However, the vegetation type is poorly protected. Less than one percent of the 21 percent target has been formally conserved. Although, the southern boundary of the Site is defined by a drainage line, there are no drainage lines or other wetland ecosystems within the Site itself.

At a broad scale, there are differences in vegetation structure and composition related to aspect, slope, soil depth and rock cover at the Site. The most conspicuous differences are the drainage lines which are well wooded compared to the adjacent plains and the higher-lying slopes to the south and west of the Site which also contain a greater bush cover as they consist of Great Fish Thicket. Within the Project Area itself, the vegetation is however fairly homogenous and it was not possible to differentiate different plant communities within this area.

A total of 174 plant species were observed at the Site. This is a relatively high total given the limited extent of the Site and reflects the high diversity of the area. According to the SANBI SIBIS database, 23 red-data listed species are known from the area (see *Annex F*). Of these, three were confirmed as being present and a fourth red-data listed species, *Euphorbia globosa* which has not been recorded from the area before was also confirmed as being present.

In terms of the abundance and significance of the red-data species present, *Aloe longistyla* was not common and the individuals observed were not within the PV Footprint. *Boophone disticha* was also not common but occurred scattered across the northern parts of the Site where shallow rocky soils were present. Not many individuals of this species would be impacted and as this species is still very common across large parts of its range the potential loss of some individuals of this species would not have broader significance. *Drimia altissima* was fairly common along the ridge which defines the north-eastern boundary of the Site. Affected individuals could potentially be translocated and as this species is still widespread and common in many areas, the impact on this species is not considered highly significant. The presence of *Euphorbia globosa* at the Site is potentially significant as this species has not been recorded from the area before and was observed to be abundant within the Study Area, especially on the hills to the north of the Site. However the population extends well beyond the PV Footprint, with the species occurring most abundantly beyond the Site. Moreover as this species also occurs on rocky slopes at the Site, there do not appear to be any other major threats to this species and the local population is not in any immediate threat.

In addition to the red-data listed species a number of protected species were also confirmed as being present (see *Annex F*). Although the abundance of

protected species was generally quite low except for *Aloe tenuior* which is a common species across most of the Site and thousands of individuals would be impacted by the development.

9.1.1 Construction Phase Impacts

Clearance of vegetation will be undertaken through brush cutting, which is required for the establishment of the PV power facility's infrastructure including for the PV arrays, buildings (including an operational control centre, office, ablutions and a guard house), fencing, access roads and internal road network and storage and lay-down areas, resulting in permanent loss of vegetation within the Site. Necessary space is also required to be kept between rows to avoid shadow effects from one row to the next. These rows will remain free from any construction although vegetation in these areas will be cut back to allow movement of vehicles during the construction phase. Although not all the vegetation between the arrays will be cleared or cut back, significant disturbance and loss is nevertheless likely to occur. The total area of the PV Footprint will be approximately 110 ha.

The construction of the Project will result in a high level of disturbance at the Site, in particular of the vegetation located within the PV Footprint. This impact will be long-term, as it would persist for as long as the facility is in operation. Recovery of vegetation under the PV panels and in other places that do not need to remain cleared should be encouraged. Although there will be a direct clearing of natural vegetation through brush cutting, the overall intensity of this impact is rated as *medium*, as the impact is not likely to be of wider significance given the paucity of species of conservation concern in the area, as well as the overwhelmingly intact nature of the surrounding landscape.

The very high sensitivity areas at the Site consist of the drainage lines and the riparian corridors. The final PV Footprint avoids the ecologically sensitive areas at the Site and thus would not have a significant direct impact on the ecologically important parts of the Site.

Box 9.1 *Construction Impact: Destruction and Loss of Natural Vegetation and Sensitive Plant Communities*

Nature: The construction phase will require clearing of vegetation for construction of access roads, PV arrays, buildings and laydown areas, resulting in a direct negative impact on the natural vegetation of the 110ha Site. The loss of some red-listed plant species from the Site cannot be fully mitigated as the habitat loss is permanent and it is not likely that all the individuals of listed species can be translocated.

Impact Magnitude –**Medium**

- **Extent**: The extent of the impact is **on-Site** as the impacts will be limited to the boundaries of the Site.
- **Duration**: The duration would be **long-term** as the natural vegetation of the Site would be affected at least until the Project decommissioning.
- **Intensity**: The intensity is **high** given the high level of disturbance that is likely to accompany the construction activities.

Likelihood – The impact has a **definite** likelihood of occurring.

IMPACT SIGNIFICANCE (PRE-MITIGATION) –MODERATE (-VE)

Degree of Confidence: The degree of confidence is **high**.

9.1.2 Operational Phase Impacts

The impacts on natural vegetation and sensitive plant communities are largely restricted to the construction phase. Operational phase impacts are likely to be restricted to maintenance activities within the Site such as vegetation clearing through brush cutting from under PV arrays and from the internal road network. As such these impacts are considered to have a low intensity, and an overall *Moderate-Minor* significance. This significance rating is based on vegetation clearance without the use of herbicides, which is not recommended.

Box 9.2 *Operations Impact: Impacts of Maintenance Activities on Vegetation*

Nature: The operational phase will require clearing of some vegetation for maintenance of the PV power facility such as from under PV arrays and away from access roads.

Impact Magnitude –Medium-**Low**

- **Extent**: The extent of the impact is **on-Site** as the impacts will be limited to the boundaries of the Site.
- **Duration**: The duration would be **long-term** as the natural vegetation of the Site would be affected at least until Project decommissioning..
- **Intensity**: The intensity is **low** given that the density of the vegetation at the Site is low, and there would only be a need for occasional vegetation clearance for maintenance.

Likelihood – The impact is **likely** to occur.

IMPACT SIGNIFICANCE (PRE-MITIGATION) –MODERATE-MINOR (-VE)

Degree of Confidence: The degree of confidence is **high**.

9.1.3 *Mitigation*

Design Phase

- Sensitive areas as demarcated on the ecological sensitivity map in *Figure 5.15* will be avoided as far as possible, and where these areas must be traversed (eg upgrade of access road), specific precautions will be taken to ensure that impacts are minimized.

Construction Phase

- Prior to commencement of construction, the final development area will be surveyed by a suitably qualified botanist for species suitable for search and rescue .

- The drainage line along the southern boundary of the Site will be clearly demarcated as a no-go area prior to any heavy vehicles moving onto the site.

- Vegetation clearing will be kept to a minimum through brush cutting. The vegetation of the Site is largely low and open and therefore whole-sale vegetation clearing will only be applied if necessary and within the PV Footprint.

- All no-go areas will be clearly demarcated.

- Erosion control measures will be implemented in areas where slopes have been disturbed. Document erosion problems and the control measures implemented.

- Revegetation of cleared areas will be undertaken to ensure that recovery is taking place.

- Cleared areas which are not being used will be revegetated using plants or seed of locally occurring species.

- Document pre- and post- construction vegetation cover and recovery of the ground layer.

Operational Phase

- Vegetation clearing through brush cutting for maintenance activities will be done manually wherever possible. The use of herbicides will be avoided.

- Any cleared areas which do not have some vegetation cover to protect the soil will be revegetated with locally occurring species and monitored to ensure recovery is taking place.

- Vegetation that needs to be reduced in height will be mowed or brush-cut to an acceptable height, and not to ground level except where necessary.

- Collection or harvesting of any plants on the Site is be strictly forbidden throughout all phases of the project. Solaire Direct will develop and implement a disciplinary procedure for personnel who are caught conducting such activities.

9.1.4 Residual Significance

Assuming the above-mentioned mitigation measures are implemented, the construction phase impact significance is reduced to *Moderate-Minor* and the operational phase impact significance is reduced to *Minor*.

Table 9.2 Residual Impact Significance: Destruction and Loss of Natural Vegetation

Impact	Significance (Pre-mitigation)	Residual Significance (Post-mitigation)
Construction: Destruction and Loss of Natural Vegetation and Sensitive Plant Communities	**MODERATE (-VE)**	**MODERATE-MINOR (-VE)**
Operation: Impacts of Maintenance Activities on Vegetation	**MODERATE-MINOR (-VE)**	**MINOR (-VE)**

9.2 ALIEN PLANT INVASION

Due to the increased levels of human activity at the Site and the relatively large amount of disturbance and bare soil associated with the construction phase of the Project, ideal conditions for the invasion of alien plants will be created. This will leave the Site vulnerable to alien plant invasion post construction, during the operation phase. The introduction of alien plants may prevent the natural recovery of the natural vegetation on the Site, reducing plant and animal diversity at the Site as well as resulting in various other negative ecosystem consequences. Furthermore, the Conservation of Agricultural Resources Act, (Act No. 43 of 1983) requires that listed alien species are controlled in accordance with the Act.

It is likely that alien species will colonise the bare soils created during the construction phase and it will be difficult to keep alien plants out of the disturbed areas. A high abundance of alien species within the Site would have a negative impact on the ecological value of the affected vegetation. The high seed output would impact adjacent areas of intact vegetation and contribute to degradation of the surrounding landscape.

9.2.1 Construction Phase Impacts

Box 9.3 Construction Impact: Alien Plant Invasion

Nature: The construction phase will require clearing of vegetation resulting in natural vegetation disturbance which could lead to alien plant invasion.

Impact Magnitude –Medium

- **Extent**: The extent of the impact is **local** as although the immediate impacts will be limited to within the boundaries of the Site, alien plant invasion if uncontrolled could spread beyond the Site boundaries.
- **Duration**: The duration would be **long-term** as the natural vegetation of the Site would be affected at least until Project decommissioning.
- **Intensity**: The intensity is **medium** given the high level of disturbance that is likely to accompany the construction activities.

Likelihood – The impact has a **definite** likelihood of occurring.

IMPACT SIGNIFICANCE (PRE-MITIGATION) –MODERATE (-VE)

Degree of Confidence: The degree of confidence is **high**.

9.2.2 Operational Phase Impacts

Box 9.4 Operations Impact: Alien Plant Invasion

Nature: Alien plant species are likely to invade and dominate the disturbed areas of the Site unless properly controlled.

Impact Magnitude –Medium

- **Extent**: The extent of the impact is **local** as although the impacts will be limited to the Site and immediate surroundings, alien plant invasion if uncontrolled could spread beyond the Site boundaries.
- **Duration**: The duration would be **long-term** as alien plant species clearing will probably be required at least until Project decommissioning.
- **Intensity**: The intensity is **medium** as it is likely that some alien plant invasion will occur, but given the low rainfall and shallow soils in the area, invasion is not likely to become severe.

Likelihood – The impact is **likely** to occur.

IMPACT SIGNIFICANCE (PRE-MITIGATION) –MODERATE (-VE)

Degree of Confidence: The degree of confidence is **high**.

9.2.3 Mitigation

Construction Phase

- Soil disturbance and vegetation clearing will be kept to minimum.

- All construction equipment is to be cleaned (mud and soil removed) at source before being brought to site so as to minimise the introduction of alien species.

- If sand or other natural materials for building are required and brought onto Site, the stored heaps will be monitored for the growth and germination and alien species and will be regularly cleared during construction.

- Regular monitoring will be undertaken (at least every 6 months) to ensure that alien plants are not increasing as a result of the disturbance that has taken place.

Operational Phase

- Regular monitoring for alien plants within the PV Footprint will be undertaken (at least every 6 months).

- Regular alien clearing will be conducted using good-practice methods for the species concerned. The use of herbicides will be avoided as far as possible.

- Bare soil will be kept to a minimum, and at least some grass or low shrub cover will be encouraged under the PV panels.

9.2.4 Residual Significance

Assuming the above mentioned mitigation measures are implemented there will be a low residual impact from alien species presence and the construction and operational phase impact significances are thus reduced to *Minor*.

Table 9.3 Residual Impact Significance: Alien Plant Invasion

Impact	Significance (Pre-mitigation)	Residual Significance (Post-mitigation)
Construction: Alien Plant Invasion	**MODERATE (-VE)**	**MINOR (-VE)**
Operation: Alien Plant Invasion	**MODERATE (-VE)**	**MINOR (-VE)**

9.3 INCREASED EROSION RISK

The potential for soil erosion at the Site, due to relatively erodible soils, will be increased by the development, but could be effectively mitigated. Development within areas of natural or previously transformed land, where the impacts are likely to be largely local and the risk of secondary impact such as erosion low, could proceed with relatively little ecological impact provided that appropriate mitigation measures are taken. The Project Area largely

avoids the higher sensitivity areas which have been identified, ie the drainage lines which are vulnerable to soil erosion, as it is located in the least sensitive, stony parts of the Site, where the risks of secondary ecological impacts are lowest.

Cumulative impacts relating to soil erosion would only occur if erosion is not controlled effectively and would result in soil movement, siltation of dams and drainage lines and degradation of the affected areas and aquatic ecosystems.

9.3.1 Construction Phase Impacts

Box 9.5 Construction Impact: Increased Erosion Risk

Nature: The construction phase will require clearing of vegetation and soil disturbance, potentially resulting in a direct negative impact from an increased erosion risk.

Impact Magnitude –Medium

- **Extent**: The extent of the impact is **local** as although the impacts will be mostly limited to the boundaries of the Site, but impacts could go beyond Site boundaries.
- **Duration**: The duration would be **long-term** as the natural vegetation of the Site and eroded areas would be affected at least until Project decommissioning.
- **Intensity**: The intensity is **medium** given the high level of disturbance that is likely to accompany the construction activities.

Likelihood – The impact has a **definite** likelihood of occurring.

IMPACT SIGNIFICANCE (PRE-MITIGATION) –MODERATE (-VE)

Degree of Confidence: The degree of confidence is **high**.

9.3.2 Operational Phase Impacts

Box 9.6 Operations Impact: Increased Erosion Risk

Nature: The operations phase may require clearing of vegetation and soil disturbance for maintenance, potentially resulting in a direct negative impact from an increased erosion risk.

Impact Magnitude –Medium

- **Extent**: The extent of the impact is **local** as the impacts will mostly be limited to the Site, but the immediate surroundings may be impacted.
- **Duration**: The duration would be **long-term** as the natural vegetation of the Site and the eroded areas will be affected at least until the Project stops operating.
- **Intensity**: The intensity is **low** given the almost negligible level of soil disturbance during maintenance activities.

Likelihood – The impact is **unlikely** to occur.

IMPACT SIGNIFICANCE (PRE-MITIGATION) –MINOR (-VE)

Degree of Confidence: The degree of confidence is **high**.

9.3.3 *Mitigation*

Construction Phase

- Wherever possible, access roads and tracks will be constructed so as to run along the contour.
- All access roads and tracks running down the slope must have water diversion structures present.
- Any extensive cleared areas that are no longer or not required for construction activities will be re-seeded with locally-sourced seed of suitable species. Bare areas can also be packed with brush removed from other parts of the Site to encourage natural vegetation regeneration and limit erosion.
- No construction vehicles will be allowed to drive around the veld. All construction vehicles will remain on properly demarcated roads.

Operational Phase

- Regular monitoring for erosion to ensure that no erosion problems are occurring at the Site as a result of the roads and other infrastructure will be undertaken. All erosion problems observed will be rectified as soon as possible.
- All maintenance vehicles will remain on the demarcated access roads.

9.3.4 *Residual Significance*

Assuming the above mentioned mitigation measures are implemented, there will be little or no residual impact from erosion and thus the construction and operational phase impact significances are reduced to *Minor*.

Table 9.4 Residual Impact Significance: Increased Erosion Risk

Impact	Significance (Pre-mitigation)	Residual Significance (Post-mitigation)
Construction: Increased Erosion Risk	**MODERATE (-VE)**	**MINOR (-VE)**
Operation: Increased Erosion Risk	**MINOR (-VE)**	**MINOR (-VE)**

9.4 *IMPACTS ON FAUNA*

9.4.1 *Construction Phase Impacts*

The potential impacts associated with vegetation loss are closely linked to potential impacts on fauna, since a key determinant of faunal abundance is

generally habitat quality. Fauna such as small mammals, reptiles and amphibians are likely to occur at various habitats throughout the Site. The national vegetation map (Mucina & Rutherford, 2006) indicates that the Site is largely dominated by Eastern Upper Karoo, with the drainage areas corresponding to the Southern Karoo Riviere vegetation type. The Project areas lie entirely within the Eastern Upper Karoo vegetation type. The drainage areas are considered to be ecologically sensitive. Construction phase activities that will impact on animal life in the area include:

- Increased human activity and associated noise.
- Possible increase in hunting due to increased numbers of people in the area.
- Increased traffic of trucks and heavy machinery and associated noise.
- Increased noise levels due to construction activities.
- Increased dust levels due to construction activities.
- Stripping of vegetation and soil to clear and level areas for infrastructure.
- Increased potential of soil erosion and contamination of soil, which will impact directly on vegetation and soil-dwelling organisms, and indirectly on other animals.

Shy mammals will move away from the noise and disturbance during the construction phase. Some mammals and reptiles will be vulnerable to illegal poaching and collecting during the construction phase due to the presence of personnel on Site.

The Site falls within the distribution range of as many as 59 terrestrial mammal species, indicating that mammalian diversity at the Site is potentially high (see *Appendix F* for a full list of species). Of these, there are five listed species, namely the Brown Hyaena *Hyaena brunnea* (Near Threatened), Black-footed Cat *Felis nigripes* (Vulnerable), White-tailed Mouse *Mystromys albicaudatus* (Endangered), Ratel or Honey Badger *Mellivora capensis* (Endangered) and Leopard *Panthera pardus* (Near Threatened). It is unlikely that the Leopard and Brown Hyaena occur within the Site given the open nature of the habitat and agricultural activity that takes place in the area.

The Site falls within the distribution range of Schreibers' long-fingered bat *Miniopterus schreibersii* which is listed as Near Threatened. However, this species requires caves for roosting and the nearest potential cave Sites would be along the escarpment 20-30 km to the north of the Site. Therefore, the Site is unlikely to be an important area for this bat species.

The Site lies in or near the distribution range of at least 35 reptile species (see *Appendix F* for a full list of species), indicating that the reptile diversity at the Site is likely to be low. The diversity of habitats at the Site is low, and there are no large rocky outcrops at the Site which would be important reptile habitat. There are no listed reptile species known from the area. Species observed at the Site include the Spotted Skaapsteker *Psammophylax rhombeatus*, Cape Skink *Mabuya capensis*, Spotted Sand Lizard *Pedioplanis lineoocellata* and Rock Monitor *Varanus albigularis*.

The Site lies within the distribution range of 11 amphibian species (see *Appendix F* for a full list of species). Amphibian abundance at the Site is likely to be high within the drainage and floodplain habitats. Only those species which forage away from water are likely to regularly occur within the Site. Only the Giant Bullfrog *Pyxicephalus adspersus* is of conservation concern and is listed as Near Threatened. Should this species occur at the Site, it would be associated with pans or the floodplain environment. Given that the development areas are not near to the drainage areas, the potential impacts on this species would be low as would impacts on the majority of other amphibians. Given the overall lack of specialized natural amphibian habitats present within the development areas, amphibians are not likely to be highly sensitive to the development.

Box 9.7 *Construction Impact: Impacts on Fauna*

Nature: Noise, pollution, possible poaching and disturbance caused by construction activities will have a **direct negative** impact on fauna.

Impact Magnitude –Medium

- **Extent**: The extent of the impact is **on-Site** as the impacts will be limited to the Site.
- **Duration**: The duration would be **short-term** as the disturbance would persist for the duration of the construction phase.
- **Intensity**: The intensity is **high** given the high level of disturbance to accompany the construction activities.

Likelihood – The impact is **definite** to occur.

IMPACT SIGNIFICANCE (PRE-MITIGATION) –MODERATE (-VE)

Degree of Confidence: The degree of confidence is **high**.

9.4.2 Operational Phase Impacts

The presence of the PV power facility will result in habitat loss for resident species. Shy fauna are likely to avoid the area due to the human activity. There may also be a shift in small mammal and reptile community structure within the area affected by the PV arrays. The nature of this shift will depend on the management of the vegetation in this area. If this area is kept largely clear of vegetation, this will favour species adapted to open areas and nocturnal species. If the vegetation cover is allowed to increase, then diurnal and species associated with cover will increase. The presence of the PV panels

will shield the soil from avian predators which will result in changes in species density and composition. Small mammals and reptiles will not necessarily increase as small predators such as mongoose and polecat will probably increase in response to any long-term increases in their prey abundance.

A potential impact on bats' food species would however result from lighting the Site at night, which would attract insects and potentially bat species as well.

The erection of fencing which prevents the movement of animals is a potential concern regarding the development of the Site. However, the Site occurs adjacent to the N10 as well as the railway line which are both already fenced on either side by restrictive mesh fencing. The fencing of the Site is therefore not likely to contribute significantly to a reduction the connectivity of the landscape, which has already been impacted to some degree.

Apart from a relatively small direct loss of habitat, the shading of the soil by the solar panels is likely to impact reptile composition in these areas, as the shading is likely to alter soil temperatures which has direct implications for cold-blooded animals. Most reptiles are also sensitive to the amount of plant cover which is also likely to be affected by the arrays. The presence of the arrays and electrical infrastructure would however create additional habitat for species which utilise such structures such as tubercled geckos (*Chondrodactylus* spp) and agamas (*Agama* spp).

Box 9.8 *Operation Impact: Impacts on Fauna*

Nature: The habitat alteration will have a **direct negative** impact on fauna.

Impact Magnitude –Low

- **Extent**: The extent of the impact is **local** as the impacts will be limited to the Site and the surrounding area.
- **Duration**: The duration would be **long-term** as the disturbance would persist for at least as long as the PV power facility is operational.
- **Intensity**: The intensity is **low** given that most of the disturbance will be associated with the construction phase of the project, and there are few listed fauna species likely to be impacted by the presence of the PV power facility.

Likelihood – The impact is **definite** to occur.

IMPACT SIGNIFICANCE (PRE-MITIGATION) –MINOR (-VE)

Degree of Confidence: The degree of confidence is **high**.

9.4.3 *Mitigation*

Construction Phase

- Any fauna directly threatened by the construction activities will be removed to a safe location by the Environmental Control Officer (ECO), or other suitably qualified ecologist.

- Fires will only be allowed within fire-safe demarcated areas.

- No fuelwood collection will be allowed on Site.

- No dogs will be allowed on Site.

- All hazardous materials will be stored in the appropriate manner to prevent contamination of the Site. All fuels and oils will be stored in bunds of 110 percent of tank capacity. Any accidental chemical, fuel and oil spills that occur at the Site will be cleaned up in a manner appropriate to the nature of the spill.

- Should the Site need to be fenced, the fencing will be constructed in manner which allows for the passage of small and medium sized mammals, at least at strategic places, such as along drainage lines or other areas of dense vegetation.

- If electrified strands are to be use, there will be no strands within 30 cm of the ground because tortoises retreat into their shells when electrocuted and eventually succumb from repeated shocks.

- Should the development require night-lighting, these should be of the low-UV emitting types, such as most LEDs, which attract significantly less insects.

- All construction and construction related activity will be restricted to demarcated areas.

- No unauthorized persons will be allowed onto the Site.

- In order to reduce collisions of vehicles with fauna, a 30 km/hr speed limit will apply to all roads and vehicles using the Site.

- Animals will have right of way.

- Personnel present during the operational phase will receive environmental education so as to ensure that that no hunting, killing or harvesting of plants and animals occurs at any stage during the Project. Solaire Direct will develop and implement a disciplinary procedure for staff who are caught conducting such activities.

Operational Phase

- If the Site must be lit at night for security purposes, this will be done with low-UV type lights (such as most LEDs), which do not attract insects.
- No fires will be allowed on-Site.
- No fuelwood collection will be allowed on-Site.
- No unauthorized persons will be allowed onto the Site.
- In order to reduce collisions of vehicles with fauna, a 30 km/hr speed limit will apply to all roads and vehicles using the Site.
- Animals will have right of way.

9.4.4 Residual

The PV power facility will result in some habitat loss, but this would not be of high significance given the extensive tracts of similar intact habitat in the area, therefore there will be a residual impact which cannot be mitigated. Although the above mentioned mitigation is important and required, it is not enough to reduce the overall significance ratings and the construction phase residual significance rating remains *Moderate*, while the operational phase remains *Minor*.

Table 9.5 Residual Impact Significance: Impacts on Fauna

Impact	Significance (Pre-mitigation)	Residual Significance (Post-mitigation)
Construction: Impacts from Habitat Loss and Disturbance	**MODERATE (-VE)**	**MODERATE (-VE)**
Operation: Impacts from Habitat Loss and Disturbance	**MINOR (-VE)**	**MINOR (-VE)**

9.5 IMPACTS ON AVIFAUNA

At least 238 bird species occur within the vicinity of the Site, including 12 listed species (see *Table 5.1*). Although most of the listed species are uncommon in the area and not likely to occur at the Site on a regular basis, there are a number of the species that are common residents or regular visitors to the area and thus would be likely to occur at the Site. Furthermore, most of the listed species are large raptors, cranes and bustards, which are all vulnerable to collisions with power line infrastructure. The evaluation of the frequency of avifaunal activity in the area (*Table 5.1*) is based on their reporting rate within South African Bird Atlas Project (SABAP).

Table 5.6 Listed Bird Species Known from the Vicinity of the Site

Species	Status	Frequency
Black Stork	Near threatened (NT)	Very Rare
Secretarybird	NT	Occasional
Cape Vulture (Griffon)	Vulnerable (VU)	Very Rare
Tawny Eagle	VU	Very Rare
Martial Eagle	VU	Occasional
Black Harrier	NT	Rare
Lanner Falcon	NT	Very Rare
Lesser Kestrel	VU	Regular
Blue Crane	VU	Regular
Denham's (Stanley's) Bustard	VU	Rare
Ludwig's Bustard	VU	Rare
Melodious (Latakoo) Lark	NT	Very Rare

Source: Simon Todd, 2013

9.5.1 Habitat Loss – Destruction, Disturbance and Displacement

The most significant potential impact on birds of any solar energy facility is the displacement or exclusion of threatened, rare, endemic or range-restricted species from critical areas of habitat. Given the considerable space requirements of commercially viable solar facilities (greater than 100 ha), this effect could be significant in some instances. To a lesser extent, construction, ongoing maintenance activities are likely to cause the disturbance of birds in the general surrounds of a PV power facility, and especially of shy and/or ground-nesting species resident in the area. Mitigation of such effects requires that good practice principles be rigorously applied - sites are selected to avoid the destruction of key habitats, and construction and final footprints, as well as sources of disturbance of key species, must be kept to an absolute minimum.

9.5.2 Other Impacts

Impacts of Associated Infrastructure

Solar power facilities generally feature large areas of reflective panelling. It is possible that nearby or overflying birds may be disorientated by light reflected off the PV panels, and consequently be displaced from an area more extensive than just the developed footprint of the facility. Conversely, certain bird species may be attracted to the PV arrays, 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 arrays, other animals attracted to the PV power facility). Such scenarios might be associated with fouling of critical components of the solar infrastructure, bringing local bird populations into conflict with the facility operators. Under these circumstances, specialist advice should be sought in devising effective avian deterrents to minimise associated damage.

Infrastructure commonly associated with PV power facilities may also have detrimental effects on birds. The construction and maintenance of power lines, servitudes and roadways causes both temporary and permanent habitat destruction and disturbance, and overhead power lines pose a collision and possibly an electrocution threat to certain species (Van Rooyen 2004a, Lehman et al. 2007, Jenkins et al. 2010).

Construction and Maintenance of Power Lines

Some habitat destruction and alteration inevitably takes place during the construction of power lines and associated roadways. Additionally, power line service roads or servitudes have to be cleared of excess vegetation at regular intervals in order to allow access to the line for maintenance, and to prevent vegetation from intruding into the legally prescribed clearance gaps between the ground and the conductors. These activities have an impact on birds breeding, foraging and roosting in or in close proximity to the servitude, and retention of cleared servitudes can have the effect of altering bird community structure along the length of any given power line (e.g. King & Byers 2002).

Electrocution on 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 (van Rooyen 2004b, Lehman et al. 2007). 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 energized components. Mitigation of electrocution risk involves the use of bird-safe structures (ideally with critical air gaps greater than two metres), the physical exclusion of birds from high risk areas of live infrastructure, and comprehensive insulation of such areas (van Rooyen 2004b, Lehman et al. 2007).

There will be some (limited) loss of habitat for the conservation important Blue Crane and Sectretarybird, and other threatened large terrestrial birds (eg Ludwig's Bustard). For a full avifauna species list see *Table 5.1.*

9.5.3 Construction Phase Impacts

Box 9.9 Construction Impact: Avifaunal Disturbance

Nature: All construction activities would result in a **negative direct** impact on the avifauna at the Site; disturbance associated with noise and movement of construction equipment and personnel at the Site may deter many bird species from the area and disrupt the breeding of sensitive species or those breeding within the development area, especially large terrestrial and raptor species

Impact Magnitude –Medium

- **Extent**: The extent of the impact is **local** as the impacts would be beyond the Site boundaries.
- **Duration**: The duration would be **short-term** as the disturbance would last for the construction phase.
- **Intensity**: Local populations of priority species will be disturbed, however this will be for a limited period of time. The extent of the habitat disturbed is small when compared to the surrounding available habitat, so the effect on processes will be **medium**.

Likelihood – The impact is **definite** to occur.

IMPACT SIGNIFICANCE (PRE-MITIGATION) –MODERATE (-VE)

Degree of Confidence: The degree of confidence is **high**.

9.5.4 Operational Phase Impacts

Box 9.10 Operational Impact: Avifaunal Disturbance

Nature: Operational activities would result in a **negative direct** impact on the avifauna at the Site; disturbance or displacement of large terrestrial species and raptors by routine maintenance activities.

Impact Magnitude –Medium

- **Extent**: The extent of the impact is **local** as impacts would be beyond the Site boundaries.
- **Duration**: The duration would be **long-term** as the disturbance would last for the duration of the operational phase.
- **Intensity**: Some priority species may be displaced for the duration of the project however these species are likely to adapt due to the availability of similar habitat, therefore the magnitude of the change will be **low**.

Likelihood – The impact is **likely** to occur.

IMPACT SIGNIFICANCE (PRE-MITIGATION) –MINOR (-VE)

Degree of Confidence: The degree of confidence is **moderate-high**.

Box 9.11 Operational Impact: Avifaunal Mortality

Nature: Operational activities would result in a **negative direct** impact on the avifauna at the Site. Mortality of large terrestrial species and raptors, as well as overflying wetland birds, may result from collisions with power lines or by electrocution on new power infrastructure. The risks of increased incidence of collisions are however minimal given the nominal length of the new power lines required to connect the Project to the Eskom 400kV line.

Impact Magnitude –Medium

- **Extent**: The extent of the impact is **regional** given that bird ranges may extend well beyond the Study Area.
- **Duration**: The duration would be **long-term** as the ecology of the area would be impacted for the duration of the operational phase.
- **Intensity**: Individuals of threatened species may be killed in collision/electrocution incidents, so the intensity of change will be **medium-high**.

Likelihood – The impact is un**likely** to occur.

IMPACT SIGNIFICANCE (PRE-MITIGATION) –MODERATE (-VE)

Degree of Confidence: The degree of confidence is **moderate**.

9.5.5 Mitigation

Design Phase

- A Site survey will be undertaken immediately before the start of construction by an appropriately qualified ornithologist to determine if and where any priority species are roosting or nesting in close proximity to the inclusive development area.

- Solaire Direct will ensure that no development is planned for any areas known to contain breeding or roosting Sites or priority species, and ensure that all the wetland and vlei areas are buffered against any development or disturbance as per the ecologically sensitive no-go areas (see *Figure 5.15).*

- The local avifauna should be carefully monitored by an appropriately qualified ornithologist pre- and post-construction (see below), and appropriate additional mitigation will be implemented as and when significant changes are recorded in the number, distribution or breeding behaviour of any of the priority species listed in this report, or when collision or electrocution mortalities are recorded.

Construction Phase

- Ensure that all new power lines of the new 'loop-in loop-out' substation are marked with bird flight diverters – either static or dynamic markers, generally fitted to the upper, earth wire in most power line configurations

(Jenkins et al., 2010), and that all new power infrastructure is adequately insulated and bird friendly in configuration (Lehman et al., 2007).

- The results of pre-construction monitoring should be applied to project-specific impact mitigation in a way that allows for the potential direct impacts and cumulative effects on the local / regional avifauna affected by the Project are reduced.

Operational Phase

- Minimising the disturbance impacts associated with the operation of the facility by scheduling maintenance activities to avoid disturbances at sensitive times (eg, Blue Crane – October to January, and Secretarybird – August to November pre-breeding, incubation and small nestling seasons) or in sensitive areas as mapped in this report.

- Ensure that any maintenance on the transmission infrastructure of the Site retains the bird-friendly design features.

- Any electrocution and collision events that occur should be recorded, including the species affected and the date. If repeated collisions occur, then further mitigation and avoidance measures may need to be implemented.

Monitoring:

The primary aims of monitoring work would be to:

(i) Determine the densities of birds resident within the impact area of the PV power facility before construction of the plant, and afterwards, once the plant, or phases of the plant, become operational.
(ii) Document patterns of bird activity and movements in the vicinity of the Project before construction, and afterwards, once the plant is operational.
(iii) Register and as far as possible document the circumstances surrounding all avian mortalities associated with the PV power facility and its ancillary infrastructure for at least a full calendar year after the PV power facility becomes operational.
(iv) Register and as far as possible document the circumstances surrounding all other avian interactions with the PV arrays of the PV power facility for at least a full calendar year after the PV power facility becomes operational.

Bird density and activity monitoring should focus on rare and / or endemic, potentially disturbance or collision prone species, which occur with some regularity in the area. Ultimately, the study should provide much needed quantitative information on the effects of the PV power facility on the distribution and abundance of birds, and the actual risk it poses to the local

avifauna, and serve to inform and improve mitigation measures to reduce this risk.

Avian Densities Before and After

A set of at least eight walk-transect routes, each of at least 500 m in length, should be established in areas representative of all the avian habitats present within a two kilometres radius of centre of the Site. Each of these should be walked at least once every two months over the six months preceding construction, and at least once every two months over the same calendar period, at least six months after the PV power facility is commissioned. The transects should be walked after 06h00 and before 09h00, and the species, number and perpendicular distance from the transect line of all birds seen should be recorded for subsequent analysis and comparison.

Bird Activity Monitoring

Monitoring of bird activity in the vicinity of the PV power facility should be done over a single day at least every two months for the six months preceding construction, and at least once per quarter for a full calendar year starting at least six months after the PV power facility is commissioned. Each monitoring period should involve full-day counts of all species flying over or past the PV power facility impact area.

Monitoring of Avian Collisions

Collision monitoring should have two components:

(i) Experimental assessment of search efficiency and scavenging rates of bird carcasses on the Site.

(ii) Regular searches of the vicinity of the PV power facility for collision casualties.

The value of surveying the area for collision victims only holds if some measure of the accuracy of the survey method is developed (Morrison, 2002). To do this, a sample of suitable bird carcasses (of similar size and colour to the priority species – e.g. Egyptian Goose *Alopochen aegyptiacus*, domestic waterfowl and pigeons) should be obtained and distributed randomly around the Site without the knowledge of the surveyor, some time before the Site is surveyed. This process should be repeated opportunistically (as and when suitable bird carcasses become available) for the first two months of the monitoring period, with the total number of carcasses not less than 10. The proportion of the carcasses located in surveys will indicate the relative efficiency of the survey method.

The area within a radius of at least 20 m of each PV panel, the area on and under the PV panel itself, and the area within 5 m on either side of any new

lengths of power line, should be checked regularly for bird casualties (Anderson et al. 1999, Morrison 2002). The frequency of these surveys should be informed by assessments of scavenge and decomposition rates conducted in the initial stages of the monitoring period, but they should be done at least weekly for the first two months of the study. All suspected mortality incidents should be comprehensively documented, detailing the apparent cause of death, precise location (preferably a GPS reading), date and time at which the evidence was found, and the Site of the find should be photographed with all the evidence in situ. These surveys should also include detailing (location, extent, size, number) of all bird products (e.g. faeces, pellets, nest structures etc) found on the PV panels.

9.5.6 *Residual*

Provided that the above mentioned mitigation, and any further mitigation requirements identified by on Site monitoring work are applied wherever possible post-construction, this development should have a limited impact on avifauna.. Therefore, provided that mitigation is effectively applied, it is not likely that the development of the Site would generate significant long-term impact on the listed avifauna present.

The overall significance ratings for the construction phase residual significance are reduced to *Moderate-Minor*. The operational phase residual significance rating for disturbance to avifauna is reduced to *Minor*, and operational avifaunal mortality residual significance rating is reduced to *Moderate-Minor*.

Table 9.7 Residual Impact Significance: Impacts on Avifauna

Impact	Significance (Pre-mitigation)	Residual Significance (Post-mitigation)
Construction: Disturbance	**MODERATE (-VE)**	**MODERATE-MINOR (-VE)**
Operation: Disturbance	**MINOR(-VE)**	**MINOR (-VE)**
Operation: Avifaunal Mortality	**MODERATE (-VE)**	**MODERATE-MINOR (-VE)**

9.6 *IMPACTS ON CRITICAL BIODIVERSITY AREAS (CBAS)*

The Site lies within the planning domain of the Eastern Cape Biodiversity Conservation Plan (Berliner and Desment, 2007). This biodiversity assessment identifies Critical Biodiversity Areas (CBAs) which represent biodiversity priority areas which should be maintained in a natural to near natural state. The CBA maps indicate the most efficient selection and classification of land portions requiring safeguarding in order to maintain ecosystem functioning and meet national biodiversity objectives.

The Site falls within an extensive Tier 2 CBA which is intended to provide a corridor to maintain the connectivity of the landscape and enable fauna and flora to respond to global change. As such it is important to note that the Site does not fall within a site that has been identified as being a hotspot of biodiversity for any fauna or flora. Therefore, the major issue with regards to the development as it pertains to the CBA is the extent to which the development is likely to threaten or disrupt the connectivity of the landscape and hence compromise the ecological functioning of the CBA. From north to south the development is less than 1 km across, compared to the CBA which is about 25km. Therefore the extent of the development is small in comparison to the CBA and is highly unlikely that the development would pose a significant direct threat to the ecological functioning of the CBA.

In addition, there are no specific attributes of the Site which suggest that it would be especially important as a corridor for fauna or flora movement and migration. Therefore, the development would have a local impact on the CBA, but would not be likely to compromise the broad-scale ecological functioning of the CBA. The development of the Site would however contribute to cumulative habitat loss and fragmentation in the area, with intensive agriculture being the primary source of habitat loss and transformation in the area.

9.6.1 Construction Phase Impacts

Box 9.12 Construction Impact: Impacts on Critical Biodiversity Area

Nature: The vegetation clearance, noise, pollution, possible poaching and disturbance caused by construction activities may have a **direct negative** impact on the CBA.

Impact Magnitude –Medium

- **Extent**: The extent of the impact is **local** as the impacts will be limited to the extent of the CBA.
- **Duration**: The duration would be **short-term** as the disturbance would persist for the duration of the construction phase.
- **Intensity**: The intensity is **high** given the high level of disturbance to accompany the construction activities.

Likelihood – The impact is **definite** to occur.

IMPACT SIGNIFICANCE (PRE-MITIGATION) –MODERATE (-VE)

Degree of Confidence: The degree of confidence is **high**.

9.6.2 Operational Phase Impacts

Box 9.13 Operation Impact: Impacts on Critical Biodiversity Area

Nature: The habitat alteration will have a **direct negative** impact on the CBA; the presence of the facility and the alterations to the habitat will disrupt the connectivity of the landscape for some fauna which will avoid passing through the area as well as impact the ecological functioning of the CBA.

Impact Magnitude –Low

- **Extent**: The extent of the impact is **local** as the impacts will be limited to the extent of the CBA.
- **Duration**: The duration would be **long-term** as the disturbance would persist for at least as long as the PV power facility is operational.
- **Intensity**: The intensity is **low** given that most of the disturbance will be associated with the construction phase of the project.

Likelihood – The impact is **definite** to occur.

IMPACT SIGNIFICANCE (PRE-MITIGATION) –MODERATE-MINOR (-VE)

Degree of Confidence: The degree of confidence is **high**.

9.6.3 Mitigation

Design Phase

- Preconstruction surveys by an appropriately qualified ecologist in order to delineate any sensitive areas near the construction Site.
- Preconstruction surveys by an appropriately qualified ecologist to locate any listed plant species within the development footprint for translocation.

Construction Phase

- The drainage line will be demarcated prior to construction and will be buffered by at least 50m from the edge of the demarcated area.
- The development footprint will be kept as small as possible and natural strips of vegetation will be allowed to persist between the rows of arrays.
- Approaching, engaging or disturbing fauna outside the construction area will be prohibited.
- If the Site must be lit at night, this will be done with low-UV type lights (such as most LEDs), which do not attract insects.

The above mitigation measures pertaining specifically to flora, fauna and avifauna will aid in mitigating impacts on the CBA.

9.6.4 *Residual*

The construction phase of the facility will result in some residual impact on the connectivity of the landscape as fauna are likely to avoid the area regardless on account of the large amount of noise and activity that will be associated with this phase of the development. During operation the disruption of landscape connectivity can only be partly mitigated and some fauna will avoid the area on account of the presence of the facility. However, the extent of the Site is relatively limited and species which avoid the facility are also likely to be those large enough to move around it.

Assuming that the above mitigation for the impacts on flora, fauna, avifauna and the CBA is implemented the overall significance ratings for the construction phase residual significance rating is reduced to *Moderate-Minor*, while the operational phase residual significance rating is reduced to *Minor*.

Table 9.8 Residual Impact Significance: Impacts on Fauna

Impact	Significance (Pre-mitigation)	Residual Significance (Post-mitigation)
Construction: Impacts from Habitat Loss and Disturbance	**MODERATE (-VE)**	**MODERATE-MINOR (-VE)**
Operation: Impacts from Habitat Loss and Disturbance	**MODERATE-MINOR (-VE)**	**MINOR (-VE)**

10 VISUAL IMPACTS

This Chapter discusses the potential visual impacts the Project may have on the landscape of the Site, surrounding area, its characteristic features and on the people who view it. ERM appointed Stephen Stead of Visual Resource Management Africa cc (VRM) to undertake the required visual specialist study for the Project, whose report is appended as *Annex H*. The potential impacts are assessed and mitigation measures to reduce the impacts are outlined below.

10.1 STUDY AREA LANDSCAPE CHARACTER

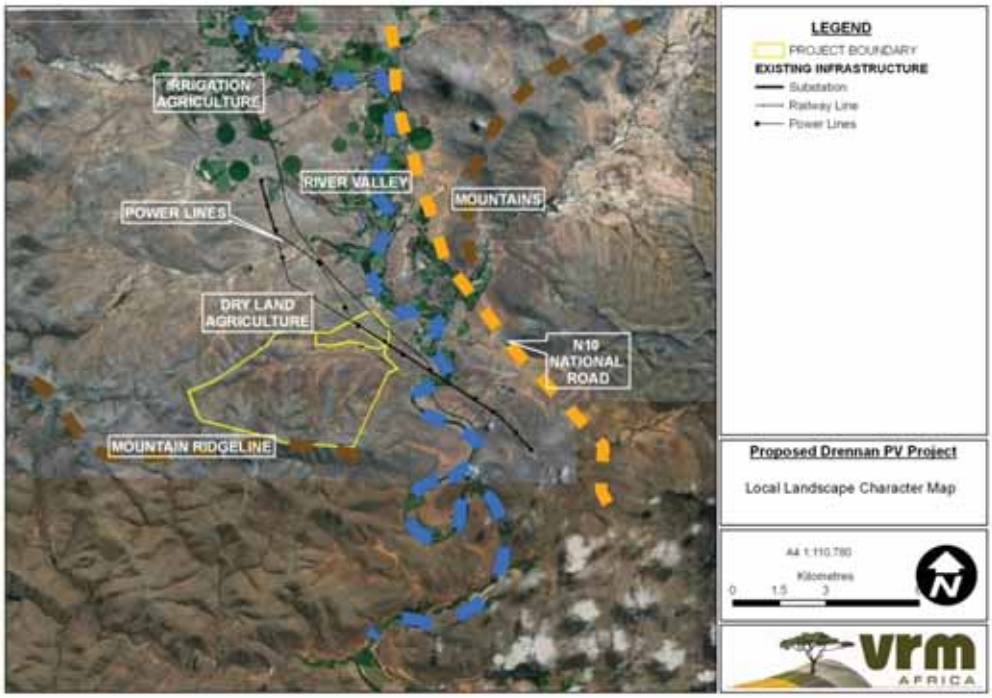
The landscape in the Study Area is dominated by a series of parallel mountain ranges, running east to west, that have a profound effect on the natural vegetation and subsequent biome diversity. The Winterberg Mountain range and the fertile Fish River Valley are the dominate landscape features of the area.

Cradock is on the eastern edge of the Karoo, near the headwaters of the Great Fish River (Nxuba River), and it is a dry and barren area, dominated by flat-topped hills and wind-swept plains.

The significant surrounding landscape features identified during the field survey are listed and mapped below (see *Figure 10.1*).

- Western mountains
- Eastern mountains
- Valley landscape with associated river and scattered wetlands
- Agriculture
- Farmsteads and outbuildings
- N10 as a tourism corridor
- Infrastructure, including railway line, Drennan substation and associated power lines

Figure 10.1 Significant Landscape Features



10.1.1 Western and Eastern Mountains

The western and eastern mountains are dominant landforms in the landscape and interesting within the setting, but are fairly common within the region (see *Figure 10.2* and *Figure 10.3*). The mountain vegetation is limited to only a few major types, and colours are generally subtle and in muted tones. With regard to general receptors in the area, the mountains are also not landscape features that are extensively 'used' and as a result public interest (1) in alterations to these landscape features is not likely to be high.

Figure 10.2 View of Mountains to the West

Source: Steven Stead, 2013.

(1) Public interest refers to the level of public concern for the area, which is commonly indicated by the degree of attention a given change to an area may elicit in the public domain (public meetings, media reports, letters etc).

Figure 10.3 View of Mountains to the East

Source: Steven Stead, 2013.

10.1.2 Valley Landscape with River and Scattered Wetlands

This landscape is characterised by flat valley depressions, with flowing water captured in moderately deep eroded river banks. The water, however, is not visible unless one is very near to it due to its recessed setting within the base of the valley. The R390 road runs mostly parallel to the river, and other minor roads also cross it.

Figure 10.4 View of Valley Landscape with River and Scattered Wetlands

Source: Steven Stead, 2013.

10.1.3 Agriculture

Agricultural activities in the study area include crop production, grazing and ostrich farming. There are few topographically interesting features relating to agricultural activities, as even though agricultural activities are associated with seasonally rich colours, vegetation usually consists of mono species.

Irrigation systems are minor discordant elements in the landscape. The agricultural landscape features at the Site are common within the region.

Figure 10.5 Agricultural Activities

Source: Steven Stead, 2013.

10.1.4 N10 as Tourist Corridor

The scenery adjacent to the N10 enhances the visual quality of the N10 as a tourist corridor. The N10 is not only a major tourist route, but also a major transportation link. There is likely to be a range of concern and interest from the public with regards to the visual quality of this feature, depending on the different types of users. The project would appear at a range of distances to receptors from the N10 (*Figure 10.15*).

Figure 10.6 View of the Scenery as Viewed from the N10

Source: Steven Stead, 2013.

10.1.5 Infrastructure

Infrastructural elements are perceived as discordant elements within a scenic landscape. The adjacent scenery would enhance the visual quality, even though there is little variation in vegetation and colour. Infrastructure elements are also common within the region.

Figure 10.7 View of Infrastructure including Railway Line, Drennan substation and associated Powerlines

Source: Steven Stead, 2013.

10.2 LANDSCAPE CHARACTER AT THE SITE

10.2.1 River with Associated Waterways and Water Bodies (Dams)

The rivers and associated waterways are an important component of the Site. The Great Fish River runs more or less north-south, adjacent to the east of the Site. The waterway has cut deeply into the landscape and the river is mostly screened by topography, unless when driving alongside it, or at the river crossing. A dry run traverses the Site approximately through the centre, in an east-west direction. This feature too is recessed into the landscape setting. A few farm dams are located in other waterways, but these are also not prominent in the landscape.

Figure 10.8 River with Associated Waterways

Source: Steven Stead, 2013.

10.2.2 Agricultural Fields and Activities

Even though agricultural fields have little or no interesting features, they do possess a richness and intensity in colour which comes to its fullest when it is the season to plant and grow crops. As a landscape feature, the topography is flat, water is present in the form of irrigation during growing season and there is no variation in vegetation. The adjacent scenery enhances the overall visual quality of this feature, which is quite common in the region. Cultural modifications include irrigation systems, mostly in the form of pivot systems or sprinklers during growing season.

Receptors generally have a moderate concern for the visual quality of agricultural fields, which are fairly common in the surrounds. However, because of the topography associated with this feature, the vegetation height and the lack of variation in vegetation, the agricultural fields are not easily absorbed into their surroundings and thus modifications to these areas may result in the creation of visual contrasts as seen by receptors in the area. Visual receptors are only likely to have moderate concern for the visual quality of agricultural fields.

Figure 10.9 Agricultural Fields

Source: Steven Stead, 2013.

10.2.3 Farmsteads and Outbuildings

Vegetation associated with farmsteads is characterised by interesting forms, textures, patterns and richness in colour. The adjacent scenery enhances the overall visual quality and, even though the farmstead and outbuildings are distinctive in the immediate surroundings, they are similar to other farmsteads in the region. Farmsteads and associated outbuildings are seen as cultural modifications, adding variety, but discordant elements to the scenic value of the area. Farmsteads should be treated as sensitive receptors and an effort should be made to avoid, or minimise, the impact on these features.

Figure 10.10 Farmsteads and Outbuildings

Source: Steven Stead, 2013.

10.2.4 R390 Road

The R390 road is a junction off the N10 road in a westerly direction, crossing the main river; thereafter it turns north, traversing the Site in a north-south direction along the central eastern outskirts. Leaving the Site, it continues in a north-south direction towards Cradock. The road has a moderate to high level of use and users would have a moderate concern for the visual quality of the surrounding area. The concern of the general public would be low, since it is not a private road but used for the transport of crops and livestock. The maintenance of the visual quality of the adjacent land would be moderately important.

Figure 10.11 View of the Area as seen from the R390 Road

Source: Steven Stead, 2013.

10.2.5 Infrastructure

The landscape forms associated with these infrastructural elements are mostly flat, but there are some interesting characteristics where infrastructure cuts through the topography and where some variety in vegetation occurs, which is mostly associated with the substation and cluster development where colour is evident. The adjacent scenery definitely enhances the visual quality,

even though the setting is fairly common within the region. Public interest would be low as most users are likely to have a low concern for infrastructural features.

Figure 10.12 Overhead transmission lines and Drennan substation at the Site

Source: Steven Stead, 2013.

10.2.6 Mountain, Hills and Steep Slopes

The land form of the surrounding low hills and steep slopes dominates the landscape and is fairly common within the region. The mountain vegetation is limited to only a few major types, and colours are generally subtle and in muted tones. In terms of the Western Cape DEA&DP Guideline for the Management of Development on Mountains, Hills and Ridges of the Western Cape, a degree of development constraint is required. These features would have a high biodiversity value due to their remoteness, and would be important for existing and future eco-tourism activities in this area. In order to protect the visual resources of this mountain landscape it is recommended that visual receptors in the area are subjected to low levels of visual intrusion through landscape modification.

Figure 10.13 Mountains, Hills and Steep Slopes to the South of the Site

Source: Steven Stead, 2013.

10.2.7 Drainage Lines and Gullies

The area to the south of the Site consists of a shallow valley and the Site is screened from areas in the north, west and south by the surrounding elevated topography. Adjacent scenery of the low hills to the south and east and the shallow valley to the south moderately enhances the overall visual quality. Man-made modifications include two small dams as well as much induced erosion as indicated in *Figure 10.13*, which degrade the landscape.

The area is in close proximity to surrounding hills and river washes. The degree of 'use' of this landscape feature is low given that the types of users are mainly those undertaking local agriculture activities.

Figure 10.14 Drainage Lines and Gullies

Source: Steven Stead, 2013.

10.3 IMPACT ASSESSMENT

The visual impact will be largely limited to the operation phase. However, large machinery will be visible on Site as soon as Site preparation begins and aspects of the PV power facility will be visible during the construction phase.

The visual impacts will be perceived by two types of receptors, namely:

- receptors located at a fixed point, i.e. dwellings on the Site and surrounding areas; and
- receptors who will temporarily come into contact with the PV power facility, such as passing motorists and tourists in the area.

The potential visual impacts are summarised in *Table 10.1.*

Table 10.1 Impact Characteristics: Visual Impacts

	Construction	**Operation**
Project Aspect/ activity	Construction of the PV power facility	Operation of the PV power facility
Impact Type	Direct negative	Direct negative
Stakeholders/ Receptors Affected	Fixed receptors, affected landowners, neighbouring land owners, road users, visitors to the area.	Fixed receptors, affected landowners, neighbouring land owners, road users, visitors to the area.

A terrain model was generated for the Study Area from points located on the flatter agricultural lands more suited to the Project. The viewshed map (*Figure 10.15)*, shows that the visibility would be local and contained to the valley area, and that key receptors located on the N10 national road would be outside the two kilometre high exposure distance zone. *Figure 10.16* shows a photomontage of the PV arrays as viewed from the N10.

Table 10.2 below describes the visual assessment criteria in relation to the Drennan PV Power Facility.

Table 10.2 Criteria used to Assess Visual Impacts

Criteria	Description	Comment
Viewpoint	Viewpoints were selected based on potentially prominent or sensitive viewing positions in the area, from where views of the Project may be obtained.	The Project will be visible from the N10, the rail line and the R390. (See *Figure 10.15)*
Visibility and Visual Exposure	Determined by the viewshed or view catchment, being the geographic area within which the Project would be visible. The viewshed boundary tends to follow ridgelines and high points in the landscape.	Due to topographic undulation, the viewshed is constrained to the valley area, mainly within the six kilometre foreground / middle ground, but would also extend further to the east on the raised terrain of the eastern mountains. The undulating terrain further afield would reduce the clarity of the views, as seen from mobile receptors. See viewshed in *Figure 10.15.*
Visual Sensitivity	Determined by topographic features, steep slopes, protected areas, rivers or scenic routes.	The low mountains, hills and steep slopes in the area are landscape features of importance. The Great Fish River is nearby, and river washes and sensitive drainage lines and gullies occur on the Site. The N10 (km to the east of the Site) is an important National Road and view corridor through the scenic countryside.
Landscape Integrity	Visual quality is enhanced by intactness of the landscape, and lack of other visual intrusions.	The Site has a number of visual intrusions in the area, including a rail line, transmission lines and associated infrastructure. The project would further add to the industrialisation of the rural landscape, but over a fairly limited area within a 2km radius.

Criteria	Description	Comment
Visual Absorption Capacity	This is the potential for the landscape to screen or absorb the PV power facility.	The landscape is visually exposed to receptors in the north east, but given the modest height of the solar arrays (3.3m), some screening by the topography and vegetation is likely to occur.
Cumulative impacts	This is the accumulation of visual impacts in the area, particularly in relation to other existing or proposed power facilities and other industrial-type facilities.	There are no other known energy facilities, existing or proposed, within proximity to the Site. The Project will contribute only minimal additions to the existing rail and power line infrastructure.

Figure 10.15 Viewshed of the Drennan Site

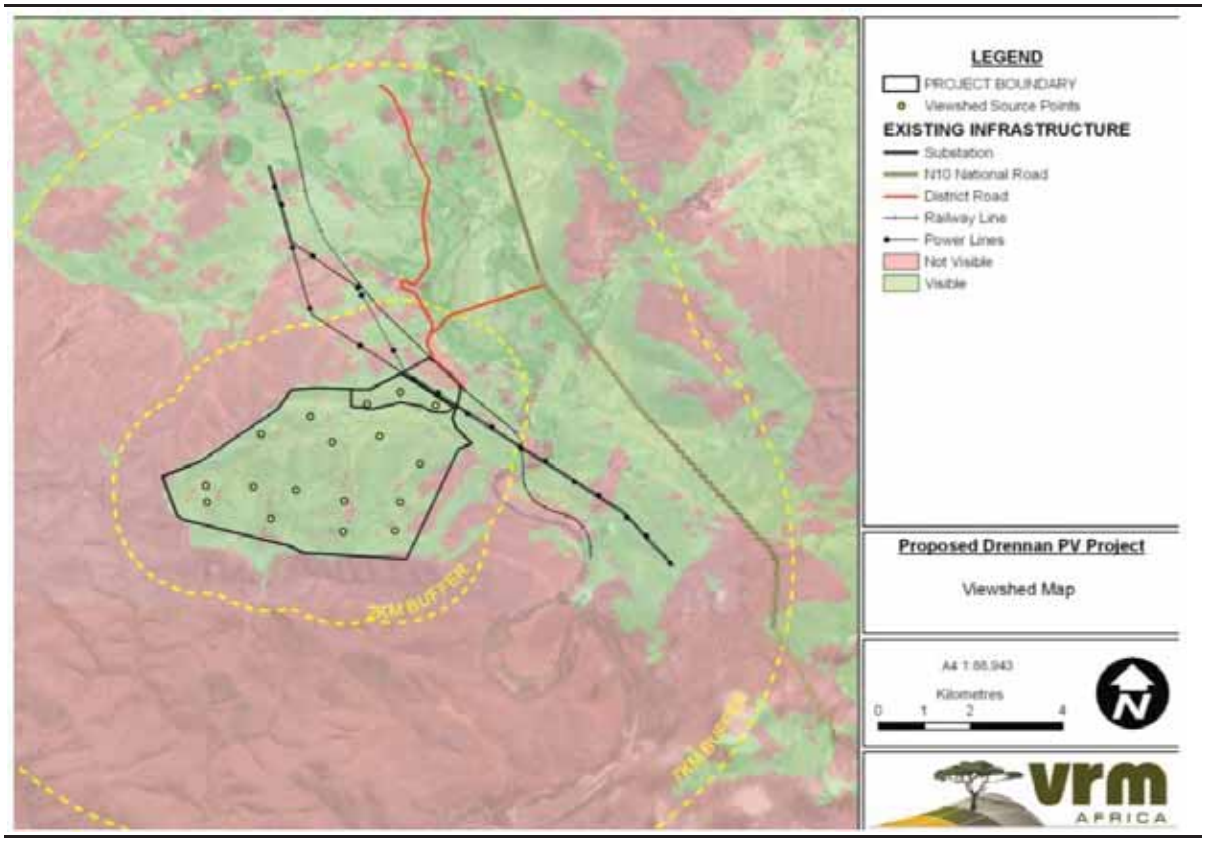
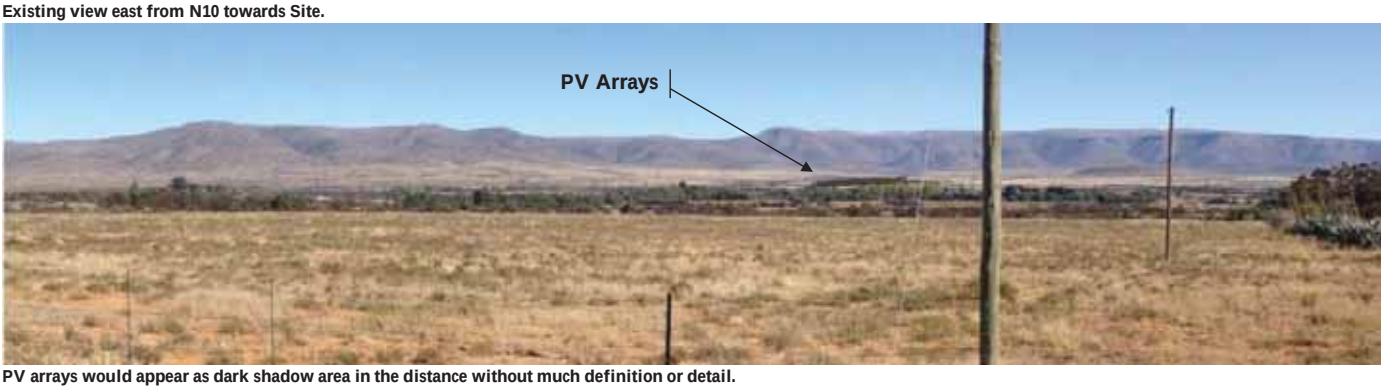


Figure 10.16 Photomontage of Drennan PV Power Facility

Existing view east from N10 towards Site.



PV arrays would appear as dark shadow area in the distance without much definition or detail.

Source: Steven Stead, 2013.

The following community points would be exposed to the Project and are the most critical locations surrounding the landscape modification, where receptors would make consistent use of the views associated with the site, and their modification would have the greatest impact on the areas sense of place:

- The N10 road;
- The R390 road; and
- The Drennan farming communities to the north and east of the site, mainly making use of the Witmos – Mortimer rural road (R390).

The power lines, substation and railway line sections of the Site present existing high levels of visual contrast to receptors in the area, which do detract from the scenic quality. It is recommended that higher visual contrast-generating landscape modifications be located in closer proximity to these areas. The final PV Footprint is suitably located in this regard.

Given that there are no important scenic or tourist resources, that the area is sparsely populated, that there is already a substation and railway line in close proximity to the Site, and that there are already Eskom power lines which traverse the Site, it is not believed that the Project would constitute a fatal flaw in terms of visual and landscape considerations, provided that the recommended mitigation measures which will be detailed in the sections below are adopted.

Cumulative visual impacts are not considered to be significant as no other energy facilities are proposed in the general area, and no future expansion of the Drennan PV Power Facility is planned at this stage. However, the addition of an inverter, a substations and an additional transmission line would result in some cumulative visual impacts. The construction of the PV power facility at Drennan may alter the visual character of the landscape, as these features are in contrast to the rural surrounding landscape.

10.3.1 Construction Phase Impacts

The construction phase impacts are associated with the following aspects:

- Large machinery will be visible on Site as soon as Site preparation begins;
- Construction activity involves Site works (which will create dust);
- Stockpiles of materials on Site; and
- Aspects of the PV power facility will be visible during the construction phase.

Box 10.1 Construction Impact: Visual

Nature: Construction would result in a **negative direct** impact on the visual landscape in the area surrounding the Site.

Impact Magnitude: Medium-Low

- **Extent:** The extent of the impact is **local**, as the construction activities will be hardly visible beyond a 7 km radius. In addition the Site is screened by steep terrain occurring to the south, west and north.
- **Duration:** The duration would be **short-term** since it will occur during the construction phase.
- **Intensity:** The intensity will be **medium,** as the activities will be marginally or moderately visible from the railway, and the N10 and R390 roads.

Likelihood – It is **likely** that this impact will occur.

IMPACT SIGNIFICANCE (PRE-MITIGATION) MINOR (-VE)

Degree of Confidence: The degree of confidence is **high**.

10.3.2 Operational Phase Impact

The visibility of the PV power facility influences the intensity and therefore significance of the visual impact associated with the Project.

Disturbance of the landscape features in close proximity to the river at the Site should be avoided, and a buffer zone should be retained around the main rivers, as well as the smaller streams, gullies and washes and dams located within the Site. It is recommended that these areas are not utilised for development as they are an important components of the landscape and define the scenery of the area as seen from receptors travelling on the N10 and R390. Given the location of the final PV Footprint it is not anticipated that changes to these landscape features will occur.

Box 10.2 Operational Impact: Visual

Nature: Operational activities would result in a **negative direct** impact on the visual landscape in the area surrounding the Site.

Impact Magnitude: Medium

- **Extent:** The extent of the impact is **local**, as the facility will be hardly visible beyond 10 km from the Site.
- **Duration:** The duration would be **long-term** since it will persist for as long at the facility remains operational.
- **Intensity:** The intensity will be **medium,** as the PV solar facility will be marginally or moderately visible from the railway and the N10 and R390 roads.

Likelihood – It is **likely** that this impact will occur.

IMPACT SIGNIFICANCE (PRE-MITIGATION) - MODERATE (-VE)

Degree of Confidence: The degree of confidence is **high**.

10.3.3 Mitigation

Design Phase

- All cables and power lines will be located underground as far as possible.
- The substations, gatehouses and maintenance and storage buildings will be grouped as far as possible to avoid the scatter of buildings in the open landscape.
- The design of the buildings will be compatible in scale and form with rural buildings, such as farm barns, in the surrounding area.
- All yards and storage areas to be enclosed by masonry walls or screens.
- The colour of the solar array structures, such as the supports and the rear of the panels, will be carefully selected, and to be in the dark grey or green range, to minimise visibility and avoid reflectivity.
- External lighting will be confined to the substations and maintenance areas. Lights will be low-level and fitted with reflectors to avoid light spillage.
- Signage related to the enterprise are to be discrete and confined to the entrance gates. No other corporate or advertising signage, particularly billboards or flags, to be permitted.

Construction Phase

- Access roads will be kept clean, and measures taken to minimise dust from construction traffic on gravel roads.
- As the lay-down area(s) will be visible from the N10, it will be screened with shade cloth.
- Site offices and structures will be limited to single storey and sited carefully to reduce visual intrusion. Colours will reflect hues of the surrounding vegetation and/or the ground. Roofs will be grey and non-reflective. Door and window frame colour will reference either the roof or wall colours.
- Road construction and management will take run-off into consideration in order to prevent soil erosion.
- The developer will be required to ensure that the footprint areas of all impact sites utilised in construction and not in operation are rehabilitated and restored to previous natural vegetation.

- The fencing will be grey in colour and located as much as possible around the PV Footprint.

- Substations will be set into the ground as much as possible and the structures will be painted a grey green colour.

Operation Phase

- All lighting will 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, will be used.

- No naked light sources will be directly visible from a distance. Only reflected light will be visible from outside the Site.

- External lighting will use 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 will also be shielded so that no light falls outside the area needing to be lit. Unnecessarily tall light poles are to be avoided.

- Retain the agricultural usage of the area for grazing of livestock as much as possible.

10.3.4 Residual

The Project is of a large scale and the project viewshed, although contained to the local valley area, does include the N10 national route as well as the agricultural areas located adjacent to the Fish River which do have scenic value and potential for agri-tourism activities. However with the application of the mitigation measures detailed in *Section 10.5.3* the residual impact significance for the construction phase remains *Moderate*, and the impact significance remains *Moderate* for the operational phase as the major mitigation measures would have already been taken into consideration prior to the pre-mitigation assessment rating.

Table 10.3 Pre- and Post-Mitigation Significance: Visual

Phase	Significance (Pre-mitigation)	Residual Significance (Post-mitigation)
Construction	**MINOR (-VE)**	**NEGLIGIBLE**
Operation	**MODERATE (-VE)**	**MINOR (-VE)**

11 PALAEONTOLOGY, ARCHAEOLOGY AND CULTURAL HERITAGE IMPACTS

This chapter discusses the potential impacts on palaeontology, archaeology and cultural heritage resources resulting from the establishment of the PV power facility on the Site. ERM appointed Tim Hart & Liesbet Schietecatte of ACO Associates cc to conduct a heritage impact assessment, as part of the EIA process for the Project. The findings of this study are detailed in *Annex G* and summarised in this chapter.

During Site preparation works a number of project activities are likely to interfere to varying extents with paleontological, archaeological and cultural heritage resources present within the Site boundary. These activities include levelling and grading of areas where the PV arrays will be erected, although the extent of levelling is likely to be minimal given the flat nature of the terrain on the Site. Additional Site levelling is required in preparation for vehicle parking, temporary laydown, and storage areas. In addition, trenching activities required for drainage and cable routes and the installation of array structures into the ground have the potential to impact features of paleontological, archaeological and cultural heritage interest.

The features of interest at the Site include a stone alignment or kraal thought to be of pre-colonial age, along with two stone cairns, which are possibly pre-colonial burial cairns. In addition there was an abandoned historical square stone kraal found within the Site (see *Figure 6.14*). The PV Footprint avoids the kraal complex, which is situated just back from the low ridge which overlooks the Drennan train station and housing. The section below assesses the potential impacts of this development on paleontological, archaeological and cultural heritage and outlines mitigation measures to reduce the impact significance.

Table 11.1 Impact Characteristics: Impacts on Archaeology, Palaeontology and Cultural Heritage

Summary	Construction	Operation
Project Aspect / activity	(i) Disturbance of, or damage to, archaeological, cultural heritage Sites or palaeontology resources associated with Site preparation and construction activities.	(i) Disturbance to sense of place associated with surrounding areas.
Impact Type	Direct	Direct

Summary	Construction	Operation
Receptors Affected	(i) Archaeological, palaeontological and cultural heritage interests within Site clearance areas. (ii) On-Site fossils.	(i) Cultural heritage aspects in neighbouring areas.

11.1 PALAEONTOLOGY

11.1.1 Construction Phase Impacts

The rocks of the hills to the north of the Project belong to the Balfour Formation of the Beaufort Group which is world-renowned for its rich fossil record and contain some of the most significant evidence for the origins of dinosaurs, mammals and turtles. Fossils from this area could potentially be of great significance. However, the presence of dolerite extrusions and dykes as well as indurated rock means that well preserved fossils are an unlikely occurrence on the surface. Excavations that involve excavation into or exposure of bedrock are likely to impact fossil material. However, excavation into bedrock is unlikely to occur in this Project. Fossils are potentially present on exposures to the south-west of the Site, an area which will be unaffected by construction, but from where fossils may role down slopes into the PV Footprint when they weather out. It is however unlikely that the shallow excavations required for the Project during construction, including drilling or screwing of the solar frames into place, will have a significant impact on paleontological material. Thus the impact on paleontological material is considered *Minor* in view of the unlikely event that project construction will disturb fossil-bearing sediments at the Site.

No impacts on paleontological resources are expected to occur during operation, as no excavation, earthworks or manipulation of the infrastructure is expected.

Box 11.1 Construction Impact: Damage or Destruction to Paleontological Resources

Nature: Construction activities such as drilling and screwing of PV panels into the ground have the potential to have a **direct negative** impact on the paleontological resources.

Impact Magnitude – Medium

- **Extent:** The extent of the impact is **local,** as paleontological resources are of local importance and the extent of their disturbance would be on-site.
- **Duration:** The duration would be **permanent,** as paleontological resources are irreplaceable and any loss would be permanent.
- **Intensity:** The intensity is **high** considering the potential significance of any fossils present.

Likelihood – It is **unlikely** that this impact will occur due to the shallow earthworks of project construction activities.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MINOR (-VE)

Degree of Confidence: The degree of confidence is **medium.**

11.1.2 Mitigation

Construction

- During construction the Environmental Control Officer (ECO) should remain aware that all sedimentary deposits have the potential to contain fossils and he / she will monitor all substantial excavations. If any significant fossils are found (e.g. vertebrate teeth, bones, burrows, petrified wood), construction activities will stop and South African Heritage Resources Agency (SAHRA) will be notified immediately.

- The site should be inspected by a palaeontologist before disturbance, thereafter bulk earth works and excavation for foundations / infrastructure should be monitored by a palaeontologist. The frequency of this to be worked out a priori with the contractor to minimize time spent on site.

- If possible, geotechnical information together with the proposed locations and depths of excavations for foundations and / or infrastructure should be provided prior to the commencement of construction. This may enable a better estimation of the time(s) when monitoring would be necessary.

- Protocols for dealing with palaeontological / palynological (fossil pollens) monitoring and possible further mitigation must be included within the brief of the appointed palaeontologist.

- Any material recovered will be lodged in the collections of Iziko South African Museum or a regional museum with suitable curatorial capacity.

11.1.3 *Residual*

If the above mentioned mitigation is adhered to, the residual impact significance on any paleontological resources is considered to be *Minor*.

Table 11.1 Pre- and Post-Mitigation Significance: Damage or Destruction to Paleontological Resources

Phase	Significance (Pre-mitigation)	Residual Impact Significance (Post-mitigation)
Construction: Palaeontology	**MINOR (-VE)**	**MINOR (-VE)**

11.2 *ARCHAEOLOGY*

11.2.1 *Construction Phase Impacts*

Four archaeological sites were found within the area (see *Figure 6.14*). One of these was a very well preserved Koekhoen stone kraal / alignment (circa 1000 – 1400 AD) while the others included a historical Kraal and two potential pre-colonial graves (stone cairns). Fortunately all of these sites are limited in size and avoidable in terms of project development.

The Koekhoen stone kraal (DRN 13) will be left in-situ due to its completeness with a 10m buffer zone.

The two possible graves (DRN 11 and DRN 14), both of which lie close to the edge of the PV Footprint, will be left in-situ in a small 10m buffer zone.

The archaeological remains occurring in and around the Site may be negatively affected by construction activities associated with the Project, however, with the exception of the Koekhoen stone kraal, their archaeological significance is considered to be low given their common occurrence in the region. In terms of the spatial extent of possible impacts to these remains during the construction phase of the Project, the impacts are considered to be contained within the Site. The operational phase is not expected to impact on the archaeological resources of the Site, as no excavation will take place, and therefore no operational impacts are considered here.

Box 11.2 Construction Impact: Destruction or Disturbance to Archaeological Resources

Nature: Construction activities would result in **direct negative** impacts to archaeological resources should no mitigation be implemented. Site preparation activities associated with the development which apply appropriate buffers around the existing archaeological sites have the potential to have a **direct positive** impact on archaeological resources on the Site, including the preservation of a rare Koekhoen stone kraal.

Impact Magnitude – Medium

- **Extent:** The extent of the impact is **local**, given the importance of the archaeological resources on the Site.
- **Duration:** The duration would be **permanent,** as archaeological resources are irreplaceable and any loss would be permanent.
- **Intensity:** The intensity is **high** considering the rarity and protection status of the archaeological resources under the NHRA.

Likelihood – It is **likely** that this impact will occur if the mitigation is not implemented.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MAJOR/CRITICAL (-VE)

Degree of Confidence: The degree of confidence is **high.**

11.2.2 Mitigation

The objective of mitigation is to minimise impacts on identified archaeological resources and ensure opportunities to identify further resources are maximised.

Design Phase

- Stone cairns DRN 11 and DRN 14:

  The two possible graves automatically get a high significance rating in heritage terms as they are covered by legislation at national level. The graves will be avoided with a 10m buffer zone implemented around each grave and left undisturbed.

- Pre-colonial kraal DRN 13:

  The pre-colonial stone kraal is good example of its kind and should be considered to be worthy of a grade IIIA rating (which means of high local significance) on account of its complete and original condition. The kraal will be avoided and left in-situ within a 10m radius buffer zone of exclusion from the perimeter of the kraal. This yields a *Negligible* residual impact significance.

- Historic kraal DRN 15:

The historic kraal is of a form which is well represented in the Karoo and not considered especially important.

The kraal will be avoided and left in-situ within a 10m radius buffer zone of exclusion from the perimeter of the kraal. This yields a *Negligible* residual impact significance.

- It is recommended that once the Project planning is finalised, a walk-through is undertaken by an archaeologist to document in-loco a selection of representative surface archaeological material.

- An archaeologist will conduct a second site visit prior to the start of construction to mark out the areas of sensitivity with coloured flags so that these can be avoided during construction activities

- The Fish River facing slope is archaeologically sensitive as there are numerous stone features that appear to make up a complex of pre-colonial kraals and thus this areas will be considered a no go area for access roads, fences or other project interventions.

Construction Phase

- Should any archaeological materials (artefacts; cultural material such as historic glass, ceramics, etc; sub-surface structures, etc) be uncovered or exposed during earthworks or excavations, they will immediately be reported to the South African Heritage Resources Agency (SAHRA). After assessment, and if appropriate, a permit will be obtained from SAHRA or the Eastern Cape Provincial Heritage Resources Authority (ECPHRA) to remove such remains.

11.2.3 Residual

Should the mitigation measures of avoiding and applying a 10m buffer zone to the existing sites of archaeological resources be undertaken then the residual impacts will be considered *negligible*. However these impacts may also be *positive* if any additional finds (structures, artefacts etc) are reported to the South African Heritage Resources Agency (SAHRA), as the Project would thus be contributing towards existing research in this field.

Table 11.1 Pre- and Post-Mitigation Significance: Damage or Destruction to Archaeological Resources

Phase	Significance (Pre-mitigation)	Residual Impact Significance (Post-mitigation)
Construction: If grave and kraal sites completely avoided and left in-situ with no preservation or documentation.	**MAJOR/CRITICAL (-VE)**	**NEGLIGIBLE**

11.3 CULTURAL HERITAGE

11.3.1 Construction Phase Impacts

There are no buildings apart from the station buildings at Drennan which are typical railway buildings built after the mid-twentieth century. These are mostly in very poor condition, some occupied by farm workers, others vandalised and stripped.

Box 11.3 Construction Impact: Destruction or Disturbance of Cultural Heritage

Nature: Construction of the Project has the potential to have a **negative** impact on the cultural heritage of the Project area.

Impact Magnitude – Medium

- **Extent:** The extent of the impact would be **local,** as heritage buildings would have a local importance.
- **Duration:** The duration would be **permanent** if heritage buildings were impacted as heritage resources are irreplaceable.
- **Intensity:** The intensity is **low** considering there are no buildings located in the construction footprint.

Likelihood – It is **unlikely** that this impact will occur.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MINOR (-VE)

Degree of Confidence: The degree of confidence is **high.**

11.3.2 Operation Phase Impacts

While the Fish River Valley contains a mosaic of cultivated land in and along the river flood plain, the Study Area is at a higher elevation and well above the cultivated land. Thus the cultural landscape consists of natural veld used as pastures for livestock and game. The Site is also located away from places of significant heritage interest, thus the cultural landscape of the area is not considered to be valued as highly significant (see *Chapter 10* Visual Impact). . It is likely that given the Site's location that the PV power facility will be visible from the N10 (see *Figure 10.14*)..

Box 11.4 Operation Phase Impact: Sense of Place

Nature: Visual presence of the Project has the potential to have a **direct negative** impact on the landscape and sense of place of the Site and the surrounding area.

Impact Magnitude – Medium

- **Extent:** The extent of the impact is **local** as the Project may impact on the sense of place over an area in a radius that extends some kilometres from the Site.
- **Duration:** The duration would be **long-term** as the sense of place would only be resorted on the decommissioning of the facility.
- **Intensity:** The intensity is **low** considering the extent of the Project and the fact that there are no structures of cultural significance in the vicinity of the Site, and that the area is characterised by natural veld.

Likelihood – It is **unlikely** that this impact will occur.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MINOR (-VE)

Degree of Confidence: The degree of confidence is **medium.**

11.3.3 Mitigation

The mitigation measures to reduce the visual impact of the facility on the motorists travelling along the N10 are not described here in detail as they are developed in *Chapter 10.*

Construction Phase

- The remains of an abandoned car (circa 1920 vintage) lie to the southern side of the site. While not of major significance it is protected under the NHRA and should be left in-situ.

11.3.4 Residual

It is likely that given the Site's location that the PV power facility will be visible from the N10. Thus there could be some impact on the general sense of place of the area and therefore the residual impact significance remains *Minor***.**

Table 11.1 Pre- and Post-Mitigation Significance: Damage or Destruction to Cultural Heritage

Phase	Significance (Pre-mitigation)	Residual Impact Significance (Post-mitigation)
Construction: Cultural Heritage (disturbance / destruction)	**MINOR (-VE)**	**MINOR (-VE)**
Operation: Cultural Heritage (sense of place)	**MINOR (-VE)**	**MINOR (-VE)**

12 SOCIO-ECONOMIC IMPACTS

12.1 INTRODUCTION

The purpose of this section is to present the assessment of potential socio-economic impacts associated with the Project. The assessment considers the ways in which the current socio-economic conditions will be impacted by the presence of the Project activities. It assesses the predicted impacts in terms of magnitude and with respect to the sensitivity of the identified receptors and resources affected, presents the results of the assessment in terms of the significance of the impacts. The ESIA process is outlined in *Chapter 3.*

Although the Project will have some benefits on a national level in terms of enhancing electricity supply to the national grid, the potential socio-economic impacts resulting from the Project will primarily be experienced at the local level. These are described below.

12.2 IMPACTS ON THE ECONOMY

The development of the Project will have a positive impact on the South African economy during both the construction and operation phases. The Department of Energy (DoE) have, through the Request for Proposal (RFP) Bid process, set a target for project developers to focus on enhancing local content (use of local labour and local procurement of goods and services) in order to boost benefits to the local and national economies. The RFP defines local content as the total costs attributed to the project that will be spent on South Africans and South African products. To date, the local content target has been 20 percent, however, it is possible that this will increase.

The positive benefits to the economy will range from the local level (ie Local and District Municipalities) to the national level (ie South Africa), and will be direct, indirect or induced in nature. The potential impacts on the economy are discussed in more detail in *Sections 12.2.1* to *12.2.5. Table 12.1* below provides a summary of the characteristics of the impacts on the economy.

Table 12.1 Impact Characteristics

Summary	**Construction**	**Operation**
Project Aspect / Activity	Employment and procurement of local workers and contractors. Lease agreements with directly affected farmers. Increased community investment through the establishment of a community trust. Increased inflation linked to increased demand for accommodation, goods and services (and the possible lack of supply).	
Impact Type	Direct, indirect and induced positive impacts and negative impacts.	

Summary	Construction	Operation
Stakeholders / Receptors Affected	Local communities, local municipality, local / provincial and national suppliers, and directly and indirectly affected landowners.	

12.2.1 *Direct Employment and Training*

The capital investment in a solar project of this scale is estimated to be R1,350 million. The construction and operation of the Drennan PV Power Facility will create direct employment opportunities across different skills levels, from unskilled to highly skilled labour. The DoE has stipulated that Independent Power Producers should create employment opportunities for South Africans living within the local area (1). At present, a target of 20 percent local employment on renewable energy projects has been set through the RFP Bid Process.

As mentioned in *Chapter 6* above, *elementary occupations* i.e. occupations which require unskilled labour, were the dominant occupation (29 percent) in the Inxuba Yethemba Local Municipality (IYLM) in 2007 (2). While there are other planned PV facilities in the IYLM, none are currently in the construction phase, so there are no existing projects which skills would have been attained. As such, it is likely that there will be a low skills base in the IYLM, which, together with low education levels, may limit the employment opportunities for local residents.

The potential benefits associated with direct employment and training during the construction and operation phases are discussed in further detail below.

Construction Phase Impacts

The construction of a 90 MW PV facility typically takes between 18 and 24 months. Construction will occur in phases and the duration of each phase will depend on various agreements and consents written into the Power Purchase Agreement, as well as potential technical and supply constraints (such as the availability of specialised components). During the construction phase, approximately 290 employment opportunities will be created. Given the phased approach to construction, the availability and duration of jobs will depend on the job function and construction schedule. Not all the jobs will be available at the same time and they will not be available for the entire duration of the construction phase. The limited duration of the some job opportunities will reduce the significance of employment creation in the local area. Employment opportunities that will be available during the construction, and the duration thereof, are listed in *Table 12.2.*

(1) The 'local area' has been defined by DoE as being a 50 km radius around the Project Site.
(2) Statistics South Africa: Community Survey, 2007

Table 12.2 Employment Opportunities and Duration

Job Description	Number of Opportunities	Duration
Site management	25	18 – 24 months
Civil works	54	8 months
Frames and foundations	27	4 months
PV modules	125	2 months
Electrical system and components	60	3 months

Approximately 40 percent of the jobs available during construction will be undertaken by semi-skilled and unskilled labour, while 60 percent of the construction jobs will require skilled labour.

The labour cost estimate during construction (excluding manufacturing labour costs) is estimated to be R 67.5 million, of which local labour (from within the IYLM) is expected to receive 75 percent (approximately R 50 million). Given the skills base in the IYLM, as discussed above, local labour will occupy the unskilled and semi-skilled positions available during construction. The specialised and technical jobs will more than likely be sourced from elsewhere in the Eastern Cape or South Africa.

An additional direct benefit during the construction phase is the opportunity for 'on-the-job' training for local people. The highly skilled solar energy technicians can provide training to local employees, increasing their skills level so that they will be employable on other solar projects. The potential impact on direct employment and training during the construction phase is described in *Box* 12.1.

Box 12.1 Construction Impact: Direct Employment and Training

Nature: The creation of direct employment and training opportunities will be a **direct** and **positive** benefit to those employed and to the local economy.

Impact Magnitude – Low - Medium

- **Extent:** Employment will be created for South Africans at a **local, provincial and national** level depending on skills and capacity availability.
- **Duration:** Employment generated during the construction phase will take place over an 18 to 24 month period and will therefore be **short-term**.
- **Intensity:** The intensity will be **low to medium** as approximately 290 jobs will be created, however, some of the jobs will last less than six months. Solaire Direct intend to spend 75 percent of labour costs on local labour.

Likelihood – It is **definite** that this impact will occur.

IMPACT SIGNIFICANCE (PRE-ENHANCEMENT) – MINOR - MODERATE POSITIVE

Degree of Confidence: The degree of confidence is **medium** given that actual employment figures are not yet available due to the early stage of this project.

Operation Phase Impacts

The estimated operational life of the Drennan PV Power Facility is 25 years; however, this can be extended by refurbishing and / or installing new technology. During the operation phase, the day to day activities of the PV Power Facility will be largely automated, however, there will be 59 permanent employment opportunities including the following:

- general administration and maintenance: 30 employees;
- compliance related activities: 3 employees;
- performance monitoring of the PV power facility: 2 employees; and
- security: 24 employees.

It is estimated that 40 percent of the above mentioned jobs will require semi-skilled workers, who could be sourced locally. It is likely that the personnel required to fill highly skilled jobs (such as performance monitoring) will be recruited from outside the IYLM. During the course of the operation phase, however, skills development programmes and 'on-the-job' training could increase the employment and advancement opportunities for local employment. The potential impact of direct employment opportunities and training during the construction phase is described in *Box 12.2.*

Box 12.2 Operation Impact: Direct Employment and Training

Nature: The creation of employment and training opportunities will be a **direct and positive** benefit to those employed and the local economy.

Impact Magnitude – Low

- **Extent:** Employment will be created for South Africans at a **local, provincial and national** level depending on skills and capacity availability.
- **Duration:** Employment generated during the operation phase will take place over the life of the Project, approximately 25 years and will therefore be **long-term**.
- **Intensity:** The intensity will be **low** as 59 jobs will be created, of which a maximum of 40 percent will be local.

Likelihood – It is **definite** that this impact will occur.

IMPACT SIGNIFICANCE (PRE-ENHANCEMENT) – MINOR POSITIVE

Degree of Confidence: The degree of confidence is **medium** given that actual figures are not yet available due to the early stage of this project.

Enhancement Measures

The objective of enhancement measures is to optimise the opportunity for direct employment and training for the work force at a local, provincial or national level. It is recognised that due to the nature of the project, and given that the technology is still relatively new in South Africa, some specialised skills will be sourced from outside South Africa.

The following measures will be implemented to ensure that direct employment and training opportunities are maximised:

- Solaire Direct will establish a recruitment policy which will set reasonable targets for the employment of local residents (from the IYLM). The policy will be aligned with the requirements of the DoE as stipulated in the RFP Documents and, where possible, Solaire Direct will strive to exceed these requirements.

- The policy will also promote the employment of women to ensure that gender equality is attained as defined in the Employment Equity Act No 55 of 1998.

- Solaire Direct will work closely with the relevant local authorities, community representatives and NGOs to ensure that the use of local labour is maximised. This should include:

    - sourcing and using available skills/ employment databases that the local authorities may have;

    - where no database is available, Solaire Direct to establish a database in consultation with the IYLM, community representatives and NGOs; this database will be shared with contractors; and

    - advertising employment opportunities through the Local Municipality and using local media.

- Solaire Direct will notify identified representatives of the Local Municipality of the specific jobs and the skills required for the project, prior to the commencement of construction. This will give the local population time prior to enable them to attain the relevant skills/qualifications to be employable on the Project.

- Solaire Direct will initiate training and skills development programmes prior to the commencement of construction, as a means of ensuring that members of the local workforce are up-skilled and can be employed on the project.

- The conditions of the contract between Solaire Direct and the subcontractor will include requirements for local Enterprise Development addressing a contractual requirement for the security service contractor to subcontract the provision of local security staff to a local company. If such a company does not exist, then the requirement will be for the security service contractor to establish such a subcontractor. The requirement will be for a minimum of 25 percent of the subcontract value to be spent on local enterprises.

- Solaire Direct will build the capacity of employees through development plans, technical, health and safety training and provide them with relevant training certificates.

Residual Impact

The implementation of the above enhancement measures should ensure that the direct employment and training benefits would increase to *Moderate* positive significance during the construction phase and remain of *Minor* positive significance during the operation phase. The pre- and post-mitigation impacts are compared in *Table 12.3.*

Table 12.3 Pre- and Post- Mitigation Significance: Direct Employment and Training

Phase	Significance (Pre-mitigation)	Residual Impact Significance
Construction	**MINOR - MODERATE (+VE)**	**MODERATE (+VE)**
Operation	**MINOR (+VE)**	**MINOR (+VE)**

12.2.2 Procurement and Indirect Employment

The construction and operation of Drennan PV Power Facility will create opportunities for the supply of goods and services to the Project and in turn, indirect employment will be created in the supply chain. Although construction companies will obtain specialised components from suppliers outside the local area, it is likely that everyday supplies will be obtained from local stores. The manufacturing, hospitality and service industries are likely to be the largest beneficiaries within the supply chain.

Construction Phase Impacts

The highly specialised nature of the project will mean that the majority of the technical components will only be available from specialist suppliers. Solaire Direct have a PV Manufacturing Facility in Cape Town, which will supply the PV panels to the project. The Facility currently employs 110 people and a second phase is planned to increase production (and therefore employment) as the demand for PV panels increases. The development of the Project, together with other proposed Solaire Direct PV Projects, will lead to this increase in demand for PV panels and will result in further job opportunities at the PV Manufacturing Facility.

During the construction phase the personnel will need to be housed close to the site (1). There will be business opportunities for the local hospitality industry (e.g. accommodation facilities, restaurants) and a potential opportunity for income generation from short-term rental accommodation. The Drennan site is located approximately 30 km south of the town of Cradock. The town, although small, has a well established hospitality industry, offering a selection of accommodation and dining options.

(1) At this stage it is not clear where construction personnel from outside the local area will be housed.

There may be further opportunities for local companies to provide catering to construction teams on site during the day. Other potential opportunities exist through activities such as waste / recycling collection and landscaping. These business opportunities for the local economy will be primarily linked to the construction phase. The potential benefit of procurement and indirect employment opportunities during the construction phase are described in *Box 12.3.*

Box 12.3 Construction Impact: Procurement and Indirect Employment

Nature: The indirect employment and procurement opportunities will have a **direct** and **positive** benefit.

Impact Magnitude – Low – Medium

- **Extent:** There will be opportunities for businesses to provide services to the project at a **local, provincial and national** level depending on services offered and capacity availability.
- **Duration:** Business generated during the construction phase will take place over an 18 to 24 month period and will therefore be **short-term**.
- **Intensity:** The intensity will be **low - medium** as it will create a steady flow of business opportunities for a limited time only.

Likelihood – It is **definite** that this impact will occur.

IMPACT SIGNIFICANCE (PRE-ENHANCEMENT) – MINOR - MODERATE POSITIVE

Degree of Confidence: The degree of confidence is **medium** given that actual figures are not yet available due to the early stage of this project.

Operation Phase Impacts

During the operation phase, procurement opportunities will be limited to maintenance work for balance of plant facilities and cleaning of PV panels. Accommodation needs will be limited to a relatively small number of employees from outside the area who will commute to site or rent houses in Cradock; the local workers will not require accommodation. The demand for solar panels for the Drennan PV Power Facility will be limited to panels for the replacement of damaged or faulty panels. The potential impact of the indirect employment and local procurement during the operation phase is described in *Box* 12.4 below.

Box 12.4 Operation Impact: Procurement and Indirect Employment

Nature: The procurement and indirect employment opportunities will have a **direct positive** benefit.

Impact Magnitude – Low

- **Extent:** There will be opportunities for businesses to provide services to the project at a **local, provincial and national** level depending on services offered and capacity availability.
- **Duration:** Business generated during the operation phase will take place over the life span of the Project, approximately 25 years and will therefore be **long-term**.
- **Intensity:** The intensity will be **low** as there will be limited operation during the operation phase.

Likelihood – It is **likely** that this impact will occur.

IMPACT SIGNIFICANCE (PRE-ENHANCEMENT) – MINOR POSITIVE

Degree of Confidence: The degree of confidence is **medium** given that actual figures are not yet available due to the early stage of this project.

Enhancement Measures

The objective of the enhancement measures is to optimise the opportunities within the supply chain at local, provincial and national level. The following enhancement measures will be implemented to ensure that business opportunities emanating from the Project are maximised.

The conditions of the contract between Solaire Direct and the subcontractor will include requirements for local Enterprise Development addressing the electrical system; there will be a requirement for the electrical contractor to make use of local electrical companies for certain elements of the installation of the electrical system. The requirement will be for a minimum of 5 percent of the subcontract value to be spent on local enterprises.

- Solaire Direct will include requirements for local employment in the contracts that they establish with subcontractors and require that all contractors recruit in accordance with the Solaire Direct recruitment policy and RFP documents.

- Solaire Direct will work with the Local Municipality, community representatives and NGO's to conduct an assessment of capacity within the Local Municipality and South Africa to supply goods and services over the operational lifetime of the project (specifically BBBEE companies).

- Solaire Direct will offer assistance to local companies to ensure that barriers to entry are reduced, for example by assisting companies to complete the required tender documents.

- Solaire Direct will work closely with the suppliers to provide the requisite training to the workers. The training provided will focus on development of local skills.

- Ensure that the appointed project contractors and suppliers have access to Health, Safety, Environmental and Quality training as required by the project. This will help to ensure that they have future opportunities to provide goods and services to the sector.

Residual Impact

The implementation of the above enhancement measures should ensure that the construction phase impact remains one of *Minor - Moderate* positive significance, and the operation phase impact remains one of *Minor* positive negative significance. The pre- and post-mitigation impacts are compared in *Table* 12.4.

Table 12.4 Pre- and Post- Mitigation Significance: Procurement and Indirect Employment

Phase	Significance (Pre-mitigation)	Residual Impact Significance
Construction	**MINOR - MODERATE (+VE)**	**MINOR - MODERATE (+VE)**
Operation	**MINOR (+VE)**	**MINOR (+VE)**

12.2.3 Induced Economic Benefits

Construction Phase Impacts

Employment and procurement (discussed in *Section 12.2.1 and 12.2.2*) will be most significant during the construction phase of the project, bringing additional income into households. The increase in disposable income (via the project workers) will result in increased demand for goods and services, and greater spending within the local community. *Box* 12.5 describes the construction phase impact of induced economic benefits.

Box 12.5 Construction Impact: Induced Economic Benefits

Nature: The induced economic benefits will have a **direct** and **positive** benefit.

Impact Magnitude – Low

- **Extent:** There will be increased spending at a **local** level resulting from increased levels of disposable income and a greater demand for goods and services.
- **Duration:** The construction phase will take place over an 18 to 24 month period and will therefore be **short-term**.
- **Intensity:** The intensity will be **medium** as it will create a relatively small, *albeit* steady flow of spending in the local area, but for a limited time only.

Likelihood – It is **likely** that this impact will occur.

IMPACT SIGNIFICANCE (PRE-ENHANCEMENT) – MINOR POSITIVE

Degree of Confidence: The degree of confidence is **medium** given that actual figures are not yet available due to the early stage of this project.

Operation Phase Impact

Fewer job opportunities exist during the operation phase, and for those gainfully employed during this phase, they will continue spending within the local community. It is estimated that the lifespan of the PV Power Facility is 25 years, however, this lifespan can be increased through on-going maintenance and refurbishment.

The directly affected landowner will receive payments from Solaire Direct for the use of the land for the life of the Project, in addition, the value of the directly affected farms are likely to increase as a result of the added income stream (1).

Box 12.6 describes the construction phase impact of benefits of induced economic benefits.

(1) The impacts on the individual landowners have not been assessed. The landowners have formal contracts with the Project Proponent that result in economic gains that are limited in extent to the landowner. Assessing this positive impact would bias the findings of this report.

Box 12.6 Operation Impact: Induced Economic Benefits

Nature: The induced economic benefits will be a **direct** and **positive** benefit.

Impact Magnitude – Low

- **Extent:** There will be increased spending at a **local** level resulting from increased levels of disposable income and a greater demand for goods and services.
- **Duration:** The operation phase will take place over a 25 year period and will therefore be **long-term**.
- **Intensity:** The intensity will be **low** as there will be limited induced economic benefits during the operation phase due to a very small number of employees. The landowner will benefit from income earned through the lease agreement with Solaire Direct.

Likelihood – It is **likely** that this impact will occur.

IMPACT SIGNIFICANCE (PRE-ENHANCEMENT) – MINOR POSITIVE

Degree of Confidence: The degree of confidence is **medium** given that actual figures are not yet available due to the early stage of this project.

Enhancement Measures

The induced benefits brought about by the Project can be enhanced through maximising local employment and procurement. Refer to the enhancement measures for maximising local content given in Section *12.2.1* and *12.2.2* above.

Residual Impact

The implementation of the above enhancement measures should ensure that the construction and operation phase impacts remain unchanged at *Minor* and *Negligible* positive significance, respectively. The pre- and post-mitigation impacts are compared in *Table 12.5.*

Table 12.5 Pre- and Post- Mitigation Significance: Induced benefits

Phase	Significance (Pre-mitigation)	Residual Impact Significance
Construction	**MINOR (+VE)**	**MINOR (+VE)**
Operation	**NEGLIGIBLE**	**NEGLIGIBLE**

12.2.4 Increased Community Investment

Construction and Operation Impact

The DoE, through the RFP document, requires that all renewable energy bidders must illustrate how the Project will benefit the local community. At present, the DoE is stipulating that one percent of revenue generated by the project must be contributed towards socio-economic development. In accordance with the relevant BBBEE legislation and guidelines, up to four percent of profit after tax could be used for community development over and

above that associated with expenditure in the area. The BBBEE Scorecard specifies the following contributions (totalling four percent):

- enterprise development – maximum of 15 points awarded for the contribution of three percent of profit after tax, or more; and

- socio-economic development – maximum of five points awarded for the contribution of one percent of profit after tax, or more.

Benefits to local communities are required to be real and tangible. Solaire Direct intend to achieve this through the establishment of a community trust. According to Solaire Direct, the final percentage contribution to the Trust will be calculated upon finalisation of the feed-in tariff as part of the Power Purchase Agreement (1). The trust will be administered by a board that will be comprised of a range of representatives including representatives from the local community.

The structure and operational objectives of the Community Trust have yet to be determined. It is envisaged that the development objectives / projects identified and supported by the Trust will be identified in collaboration with the Local Municipality and community representatives. Projects will be aligned with key needs as identified in the IYLM Integrated Development Plan (IDP). *Box* 12.7 describes the Project level benefits associated with the increased community investment.

Box 12.7 Construction and Operation Impact: Increased Community Investment

Nature: Increased community investment will be a **direct** and **positive** benefit to the local community.

Impact Magnitude – Medium

- **Extent:** The community trust is intended to benefit the local community, therefore, the impact will be **local.**
- **Duration:** The trust will be in place for the life of the Project, approximately 25 years and will therefore be **long-term**. The intention of such initiatives is to ensure that the structure is sustainable and generates benefits beyond the life of the Project (permanent).
- **Intensity:** The intensity will be **medium** as there are a broad range of development needs (including service delivery backlogs) within the area.

Likelihood – It is **definite** that this impact will occur.

IMPACT SIGNIFICANCE (PRE-ENHANCEMENT) – MODERATE POSITIVE

Degree of Confidence: The degree of confidence is **medium** as the actual percent that will be contributed towards the trust is not yet known.

(1) The feed-in-tariff has not yet been determined and still needs to be negotiated through the Power Purchase Agreement. The final price will allow Solaire Direct to accurately calculate the contribution to the Community Trust.

Enhancement Measures

The objective of these enhancement measures is to optimise the benefits to the local community through the development and operation of a Community Trust. Solaire Direct's financial contribution towards a community trust will be linked to the finalisation of the tariff as part of the Power Purchase Agreement (PPA). The following enhancement measures should be implemented to enhance the benefit to the local community.

- Solaire Direct will calculate their contribution towards the Community Trust and establish the Trust in accordance with the relevant laws and guidelines.
- Suitable reporting and governance mechanisms will be established and integrated into the Trust set-up and operation.
- Projects will be identified in collaboration with the local Municipality and community representatives to ensure alignment with the key needs identified through the Integrated Development Planning process.
- Projects will be identified in collaboration with the land owners as well as other local stakeholders to improve general living conditions and access to better living standards in the broader area.
- Projects will be implemented in partnership with the Local Municipality and community representatives to ensure the maximisation of benefits within the local community.
- All projects will be aligned with Solaire Direct's policies.
- Solaire Direct will have a clear exit strategy from Community Trust and the associated Projects, this strategy will, as far as possible, ensure that the projects are sustainable and have the organisational capacity to operate without the support of Solaire Direct.

Residual Impact

The implementation of the above enhancement measures should ensure that the benefit of increased community investment will increase to one of *Moderate–Major* significance. The pre- and post-mitigation impacts are compared in *Table* 12.6.

Table 12.6 Pre- and Post- Mitigation Significance: Increased Community Investment

Phase	Significance (Pre-mitigation)	Residual Impact Significance
Operation	MODERATE (+VE)	MODERATE MAJOR (+VE)

12.2.5 Inflation and Increased Cost of Living

Construction Phase Impact

During the construction phase approximately 290 jobs will be available, and while Solaire Direct intend to employ local residents as far as possible, some of the labour force will be brought in from outside the local area. An influx of workers, job seekers and potentially their families will increase competition for housing in the local area. An increased demand for housing is likely to drive up the cost of rental accommodation and potentially property value. Other sectors may also be impacted by increased demand leading to an increase in the cost of goods and services. It is not, however, anticipated that the construction of the PV Power Facility will attract a large number of job seekers given the relatively short construction period and limited job opportunities. The majority of those who do travel to the area in anticipation of work are most likely going to return to their place of origin once it is clear that there are not many employment opportunities associated with this type of project. *Box* 12.8 describes the construction phase impact of increased inflation.

Box 12.8 Construction Impact: Inflation and Increased Cost of Living

Nature: An increase in inflation and cost of living will be an **indirect** and **negative** impact.

Impact Magnitude – Low

- **Extent:** People living in the project area will be impacted by increased costs, therefore the impact would be **local.**
- **Duration:** The construction phase will take place over an 18 to 24 month period and will therefore be **short-term**.
- **Intensity:** The intensity will be **low** as it is anticipated that there will be a limited influx of workers and job seekers.

Likelihood – It is **likely** that this impact will occur.

IMPACT SIGNIFICANCE (PRE-ENHANCEMENT) – MINOR NEGATIVE

Degree of Confidence: The degree of confidence is **medium** given that the extent of the influx is unknown at this stage.

Operation Phase Impacts

It is not anticipated that there will be an influx of workers and job seekers during the operation phase given the limited employment opportunities. *Box 12.9* describes the construction phase impact of increased inflation.

Box 12.9 Operation Impact: Inflation and Increased Cost of Living

Nature: An increase in inflation and cost of living that may arise as a result of the Project will be an **indirect** and **negative** impact to those living in the local area.

Impact Magnitude – **Negligible**

- **Extent:** People living in the project area will be impacted by increased costs, therefore the impact would be **local**.
- **Duration:** Those people employed to work on the Project will remain for the life of the Project; therefore the impact will be **long-term**.
- **Intensity:** The intensity will be **negligible** as there are limited job opportunities during operation and it is likely that job seekers will leave the area if no employment is available.

Likelihood – It is **likely** that this impact will occur.

IMPACT SIGNIFICANCE (PRE-ENHANCEMENT) – NEGLIGIBLE NEGATIVE

Degree of Confidence: The degree of confidence is **medium** given that the extent of the influx is unknown at this stage.

Mitigation

The objectives of mitigation are to limit the possible impacts of inflation brought about by the construction and operation of the PV Power Facility.

- Mitigation measures proposed in Section *12.2.1* regarding the employment procedures and communication of opportunities will serve to reduce the influx of job-seekers.

- Solaire Direct will develop and implement a grievance procedure that is easily accessible to local communities, through which complaints related to contractor or employee behaviour can be lodged and responded to. Solaire Direct must respond directly to such complaints. Key steps of the grievance mechanism include:

    - circulation of contact details of 'grievance officer' or other key Solaire Direct contacts;

    - awareness raising among local communities (including all directly affected and neighbouring farmers) regarding the grievance procedure and how it works; and

    - establishment of a grievance register to be updated by Solaire Direct, this should include all responses and response times.

- Solaire Direct will conduct a census of local accommodation options in Cradock to ensure that the accommodation requirements can be met. Solaire Direct should work with the Local Municipality to address accommodation shortages should these arise.

Residual Impact

The implementation of the above mitigation measures should ensure that the construction and operation impacts remain of *Minor* and *Negligible* significance, respectively. The pre- and post-mitigation impacts are compared in *Table* 12.7.

Table 12.7 Pre- and Post- Mitigation Significance: Inflation and Increased Cost of Living

Phase	Significance (Pre-mitigation)	Residual Impact Significance
Construction	**MINOR (-VE)**	**MINOR (-VE)**
Operation	**NEGLIGIBLE**	**NEGLIGIBLE**

12.2.6 Discussion Around Unmet Stakeholder Expectations

Based on previous experience with renewable energy projects, there is often high expectation around economic benefits (employment and procurement) and community development associated with the Project. Many of the stakeholder expectations will be met through routine project related activities (e.g. contract employment, procurement and skills development). Other expectations will be met through the activities associated with the Community Trust. *Sections 12.2.1 to 12.2.4* provide more information about these benefits. It is however possible that the expectations may exceed the benefits delivered, this may be especially true with the regard to the expectation for employment opportunities.

There is likely to be disappointment within the local community, potential anger and resentment towards Solaire Direct if these expectations are not met. Unmet expectations that are not actively managed by Solaire Direct could have a negative impact on stakeholder relations and the perceptions of Solaire Direct as a company. As a worst case scenario, the residents in the surrounding areas may attempt to disrupt construction activities and become aggressive towards Solaire Direct. As such, it is important that Solaire Direct maximise local employment and procurement as outlined in *Section 12.2.1* and *12.2.2* and address all grievances raised appropriately as outlined in *Section 12.3.3.* On-going engagement with the IYLM and other key community members and associations during the construction and operation phases will also help to manage stakeholder expectation.

12.3 INCREASED SOCIAL DISTURBANCE FACTORS

The Project area is located in a predominantly rural setting, between Cradock and Cookhouse. The population density of the immediate area is low and the majority of the surrounding land is farmland. While Cradock and Cookhouse have a higher population density, they are still considered to be small towns.

The introduction of construction activity into remote, rural environments can induce social change. This change is typically linked to the influx of unskilled

workers (directly related to the project) as well as job-seekers into an area. Influx to an area can increase levels of crime, drug and alcohol abuse, in some cases increase the incidence of sex workers and place additional pressure on the existing infrastructure and services. It is, however, unlikely that there will be large-scale influx into Cradock and the surrounding areas given the relatively short construction period and the limited number of employment opportunities. Solaire Direct intend to maximise the employment of local people, specifically into unskilled labour positions, further limiting the influx of unskilled labour.

The presence of construction workers (local or not) on the Drennan site and job-seekers in the surrounding area (*albeit* limited) may lead to and increase petty crime and stock theft.

Solaire Direct has limited control over the behaviour of job-seekers, and can only enforce its policies on those employed by the project. *Table 12.8* below provides a summary of the characteristics of the potential impacts linked to influx of workers and job-seekers.

Table 12.8 Impact Characteristics: Social Disturbance Factors

Summary	Construction	Operation
Project Aspect / activity	Construction staff and potential influx of job-seekers.	Operation staff.
Impact Type	Direct and indirect, negative impact.	Direct, negative impact.
Stakeholders / Receptors Affected	Local residents of the area, most specifically landowners of directly affected farms and neighbouring farms.	Local residents of the area, most specifically landowners of directly affected farms and neighbouring farms.

12.3.1 Construction Phase Impacts

Solaire Direct has estimated that there will be approximately 290 people employed during the height of the construction phase. The construction phase will take up to two years, although it is not anticipated that there will be 290 construction workers on site for the full duration of the period. It is intended that the majority of unskilled positions will be filled with residents from the local area, thus limiting the influx of construction workers from outside the area. No construction workers will be housed on the Drennan site, as such, the potential for adverse impacts caused by workers on the surrounding area will be limited. Other potential concerns are described in more detail below.

- **Livestock Theft:** Theft of livestock has been identified as a problem on farms located close to towns, main roads and in areas where construction work is taking place. The presence of construction workers may increase the risk of stock theft and it is likely that stock theft will possibly increase during the construction phase.

- **Petty Crimes:** There is a chance that petty crimes (e.g. theft of tools, household items and farm materials) may occur on the Drennan site and neighbouring farms. With the movement of different construction teams on and off the site, it may be more difficult for farm owners and / or workers to differentiate between construction workers and unwanted intruders on the site.

Further to the above, an increase in disposable income within the project area (among workers) could result in an increase in alcohol and drug abuse, increased incidences of prostitution and casual sexual relations. These sexual relations could lead to increased incidents of HIV / AIDS infections and an increased number of unwanted pregnancies. *Box* 12.10 describes the construction phase impact as related to an increase in social disturbance factors.

Box 12.10 Construction Impact: Social Disturbance Factors

Nature: Increased social disturbance would be regarded as a **direct** (as related to workers) and an **indirect** (as related to job-seekers), **negative** impact.

Impact Magnitude – Low

- **Extent:** It is anticipated that the potential impacts of increased social disturbance factors will have impacts at the **local** level.
- **Duration:** The impacts identified are expected to be linked to the construction period and therefore **short-term**.
- **Intensity:** The intensity will be **low** given the influx into the area of workers and job-seekers is expected to be limited.

Likelihood – It is **likely** that this impact will occur during the construction phase.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MINOR NEGATIVE

Degree of Confidence: The degree of confidence is **medium** given that the extent of the influx of job-seekers is unknown.

12.3.2 Operation Phase Impacts

During the operation phase, there will be fewer permanent workers onsite (up to 59 permanent staff). As such, it is likely that the social disturbance factors above will not be experienced to the same extent during the operation phase. Given the limited job opportunities in Cradock and the surrounding area, it is not likely that people will stay in the area following the end of the construction phase.

Theft or vandalism of the PV panels or associated infrastructure may be of some concern during the operation phase. PV panels used on the farms and telecommunications towers in the area are already regarded as high risk for theft; many are reported stolen. *Box 12.11* describes the construction phase impact of increased social disturbance factors.

Box 12.11 Operational Impact: Social Disturbance Factors

Nature: Increased social disturbance would be regarded as a **direct** (as related to workers) and an **indirect** (as related to job-seekers), **negative** impact.

Impact Magnitude – Negligible

- **Extent:** It is anticipated that the potential impacts of increased social disturbance factors will have impacts at the **local** level.
- **Duration:** The impacts identified are expected to be **long-term** as they will persist for the life of the project.
- **Intensity:** The intensity will be **negligible** given the small workforce.

Likelihood – It is **likely** that this impact will occur during the operation phase.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – NEGLIGIBLE

Degree of Confidence: The degree of confidence is **medium**.

12.3.3 Mitigation

The objectives of mitigation are to limit, where possible, social disturbance factors brought about by the construction and operation of the PV Power Facility. Furthermore, mitigation should ensure that contractors manage their workers in such a way that the impacts are limited.

Specific measures include:

- Solaire Direct and its appointed contractors will develop an induction programme, including a Code of Conduct, for all workers (including contractors and their workers). A copy of the Code of Conduct to be presented to all workers and signed by each person.
- The Code of Conduct will address the following aspects:
    - respect for local residents;
    - respect for farm infrastructure and agricultural activities;
    - no hunting or unauthorised taking of products or livestock;
    - zero tolerance of illegal activities by construction personnel including: unlicensed prostitution; illegal sale or purchase of alcohol; sale, purchase or consumption of drugs; illegal gambling or fighting;
    - compliance with the Traffic Management Plan and all road regulations; and
    - description of disciplinary measures for infringement of the Code of Conduct and company rules.

- If workers are found to be in contravention of the Code of Conduct, which they will be required to sign at the commencement of their contract, they will face disciplinary procedures that could result in dismissal. Stock theft should be noted as a dismissible offence.

- Solaire Direct must develop and implement a grievance procedure that is easily accessible to local communities, through which complaints related to contractor or employee behaviour can be lodged and responded to. Solaire Direct must respond directly to such complaints. Key steps of the grievance mechanism include:

    - circulation of contact details of 'grievance officer' or other key Solaire Direct contacts.

    - awareness raising among local communities (including all directly affected and neighbouring farmers) regarding the grievance procedure and how it works.

    - establishment of a grievance register to be updated by Solaire Direct, this should include all responses and response times.

- Solaire Direct, together with the appointed contractors must develop a means of monitoring access to the site, prohibiting unauthorised access to the site and ensuring that all visitors report to the site office.

- No employment will take place at the entrance to the site. Only formal channels for employment will be used.

- Solaire Direct will award a contract to an appropriate security company, to provide 24hr security at the site. The security company will comply with the above mentioned Code of Conduct.

- Solaire Direct must develop and implement an HIV / AIDS policy and information document for all workers directly related to the project. All contractors must implement this policy. The information document will address factual health issues as well as behaviour change issues around the transmission and infection of HIV / AIDS. Solaire Direct will make condoms available to employees and all contractor workers.

- The construction workers (from outside the area) should be allowed to return home over the weekends or on a regular basis to visit their families; the contractor should make the necessary arrangement to facilitate these visits.

12.3.4 Residual Impact

The implementation of the above mitigation measures should reduce the construction impacts from one of *Minor* to *Negligible* significance, and the

operation impact will be remain of *Negligible* significance. The pre- and post-mitigation impacts are compared in *Table 12.9.*

Table 12.9 Pre- and Post- Mitigation Significance: Social Disturbance Factors

Phase	Significance (Pre-mitigation)	Residual Impact Significance
Construction	**MINOR (-VE)**	**NEGLIGIBLE**
Operation	**NEGLIGIBLE**	**NEGLIGIBLE**

12.4 IMPACT ON AGRICULTURAL ACTIVITIES

The Drennan site is currently zoned for agricultural use and will have to be rezoned before the Project can commence. At present, there are three relevant pieces of legislation that apply to the change of land use; namely:

- Land Use and Planning Ordinance (1) (Ordinance 15 of 1985) (LUPO);
- Eastern Cape Planning and Development Act (currently in progress); and
- Subdivision of Agricultural Land Act No 70 of 1970.

The Western Cape Department of Environmental Affairs and Development Planning (DEA&DP) have published amendments to LUPO, which are applicable in the Eastern Cape. The proposed amendments make allowance for a consent use in Agriculture Zone 1 so that these properties can facilitate renewable energy structures. Further development parameters for renewable energy structures are included in the proposed amendments, making provision for height, setback, finishing and colour, lighting, advertising, noise and associated noise pollution (2). The proposed amendments must be read with environmental legislation, including any laws relating to the rehabilitation of land, land clearing, soil erosion and habitat impact and provide for the restoration of land during the decommissioning process.

In addition to the amendments to LUPO, an intergovernmental meeting was held in October 2010 by the Department of Energy and National Department of Agriculture Forestry and Fisheries (DAFF) and the South African Wind Energy Association to discuss guidelines for the regulation of renewable energy facilities' uptake of agricultural land (3). The new draft guidelines state that no renewable energy facility structures, footprint, service area, supporting infrastructure or access routes in any form or for any purpose will be allowed:

- On high potential or unique agricultural land as has been determined or identified by DAFF or the relevant provincial Department of Agriculture.

- On areas currently being cultivated (cultivated fields / production areas) or on fields that have been cultivated in the last ten years. This is relevant

(1) LUPO is used by three provinces Western Cape Northern Cape and Eastern Cape on Local Municipal level. On May 21 an updated Ordinance was published in the Western Cape Provincial Gazette for public comment.
(2) http://www.legalbrief.co.za/article.php?story=20110726104904758.
(3) Comments received from Department of Agriculture, Western Cape, 2010, on a related renewable energy project.

to cultivated land utilised for dryland production and land under any form of irrigation.

- To intervene with or impact negatively on existing or planned production areas (including grazing land) as well as agricultural infrastructure (e.g. silos, irrigation lines, pivot points, channels, feeding structures, dip tanks, grazing camps, animal housing, farm roads).

- To result in a degradation of the natural resource base of the farm or surrounding areas. This includes, but is not limited to, the limit of soil degradation or soil loss through erosion or any manner of soil degradation, the degradation of water resources (both quality and quantity) and the degradation of vegetation (composition and condition of both natural or established vegetation).

The development of the Drennan PV Power Facility takes cognisance of these guidelines, and the potential impacts on agricultural land are described below. *Table* 12.10 provides a summary of the description of impact.

Table 12.10 Impact Characteristics: Impact on Agricultural Activities

Summary	**Construction and Operation**
Project Aspect / activity	Land-take for the construction of the facility. Potential risk of fires caused by construction activities.
Impact Type	Direct and indirect, negative impact
Stakeholders / Receptors Affected	Directly affected landowners, and Local, Provincial and National Government.

12.4.1 Construction and Operation Phase Impact

Loss of Grazing Land

The Project, including PV panels and associated infrastructure will occupy approximately 110 ha (1.1 km^2) of the total site. The landowner has worked closely with Solaire Direct to ensure that the foot print of the PV area does not restrict access to other areas of the farm or potential areas where irrigation would be viable. It is not anticipated therefore that the loss of grazing land will have a negative impact on the extent of the current grazing activities.

Loss of Farm Labour

Farm labourers working on the site and surrounding farms may be tempted to leave their current positions in pursuit of improved wages (real or perceived) on the Project. This is a concern to farmers who have indicated that they have spent time and money training their existing staff. The implications of losing staff to the Project would mean that they would have to source reliable replacements and more than likely provide training.

Damage to Farm Infrastructure

The movement of workers and vehicles on the site could cause damage to farm infrastructure (e.g. fencing, irrigation systems, and gates), during construction and operation phases there is also a risk of stock loss due to farm gates being left open, or not being closed properly by construction and operation teams.

Risk of Veld Fires

Construction and maintenance activities on site, such as welding and cutting, may increase the potential for veld fires. This could be potentially detrimental as the spread of a wild fire would lead to the loss of grazing and irrigated land, impacting on the livelihoods of the affected landowners. A wild fire would also pose a threat to livestock, game and wildlife in the area and damage or destroy farm houses and infrastructure.

Box 12.12 describes the construction and operation phase impact of loss or damage of agricultural land.

Box 12.12 Construction and Operation Impact: Impact on Agricultural Activities

Nature: The impact on agricultural activities could be experienced as a **direct** or **indirect, negative** impact.

Impact Magnitude – **Low**

- **Extent:** The impact on livelihoods resulting from construction and operation activities will occur at the **local** level.
- **Duration:** This impact will occur for the duration of the construction and operation phases and will therefore be **long-term**.
- **Intensity:** The intensity will be **low** as limited agricultural land will be lost.

Likelihood – It is **likely** that this impact will occur.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MINOR NEGATIVE

Degree of Confidence: The degree of confidence is **high**.

12.4.2 Mitigation

The objectives of mitigation are to limit, where possible, loss or damage to agricultural land brought about by the construction and operation of the PV Power Facility. By restricting the movement of construction workers, clearly defining the development footprint and adhering to the measures given below, this impact can be mitigated. Specific measures are outlined below.

- Solaire Direct must minimise the damage to farmland caused by construction activities by ensuring strict compliance with construction plans to minimise the development footprint and to implement a 'Code of Conduct' governing workers.

- Solaire Direct must design the infrastructure layout in a manner that limits the footprint of the facility and all associated infrastructure.

- Solaire Direct must not actively seek to employ workers already employed on the Drennan site, or surrounding farms.

- Solaire Direct must assist farmers in explaining to their staff that employment on the Project would be temporary, and should not be seen as an alternative to existing long term employment.

- Solaire Direct must ensure that wages paid on the project are the equivalent to those paid in the area for work of a similar nature.

- Any damage to vegetation would be rehabilitated in accordance with mitigation proposed for the rehabilitation of natural vegetation in *Chapter 9*.

- A designated area must be established for welding, cutting and any other "hot-work" and such work must be limited (as far as possible) to this area.

- An Emergency Response Procedure must be developed and communicated to all surrounding landowners, workers and other relevant stakeholders. All appropriate equipment for managing fires and other emergencies will be stored on site and maintained.

- The contractor must ensure that a contact list for all neighbouring landowners is available on site so that all neighbours can be contacted in the event of a fire.

- A firebreak must be established around the PV site prior to the commencement of construction and must be maintained throughout the operation phase of the PV Power Facility.

12.4.3 Residual Impact

The implementation of the above mitigation measures should ensure that the construction and operation impacts will be reduced from *Minor* to *Negligible* significance. The pre- and post-mitigation impacts are compared in *Table* 12.11.

Table 12.11 Pre- and Post- Mitigation Significance: Impact on Agricultural Activities

Phase	Significance (Pre-mitigation)	Residual Impact Significance
Construction and Operation	**MINOR (-VE)**	**NEGLIGIBLE**

12.5 IMPACT ON TOURISM

The Project will be located along the N10 in a rural area. The N10 is a main thoroughfare running from the coastal city of Port Elizabeth to key inland

roads such as the N1 and N12 and the towns of Bloemfontein and Kimberley. The N10 itself is seen as a tourist route because of the scenery through which it traverses. There are, however, no major tourist attractions within the immediate vicinity of the Drennan PV Power Facility. The Mountain Zebra National Park is located 35 km north west of the site and the Project will not be visible from the Park. People are attracted to the area for the natural Karoo landscapes, historical buildings in Cradock, rock art, and agri-tourism. The IYLM IDP notes that there is opportunity to grow the tourism sector. *Table 12.12* below provides a summary of the description of impact.

Table 12.12 Impact Characteristics: Impact on Tourism

Summary	**Construction and Operation**
Project Aspect / activity	Construction and operation of the Solar Power Farm.
Impact Type	Direct, negative impact (for some receptors).
Stakeholders / Receptors Affected	Directly affected landowner, neighbouring landowners, road users (particularly passing tourists), and interested people.

12.5.1 Construction and Operation Phase Impact

There is very little available research reflecting the specific impacts on tourism by Solar Power Facilities in South Africa. Based on an understanding of the Project and the area, the construction of the Solar Power Farm will result in some visual and traffic disturbances that may, in turn, impact on the general sense of place in the area (see *Chapter 10 – Visual Impacts* and *Chapter 11 – Cultural Heritage*). These factors are unlikely to have a significant impact on tourism due to the limited duration of the construction activities as well as the limited amount of tourism activities in the immediate vicinity of the Project Site.

Operation of the PV Power Facility is not likely to have a negative impact on tourism-related activities in the area; this is, however, subjective and will be dependent on each individuals particular set of values. Although the facility will be intermittently visible from the N10 and from some locations on the neighbouring land, it is unlikely that this is going to significantly affect the tourist's experience of the area.

It is unlikely that the PV Power Facility will attract people to the area given that there are several other facilities planned for the Eastern Cape, and the rest of the country, reducing the 'novelty value' of the facility. *Box 12.13* describes the construction and operation phase impact on tourism.

Box 12.13 Construction and Operation Impact: Impact on Tourism

Nature: The impact on tourism activities could be experienced as a **direct, negative** impact by some receptors who will not value the change to the area.

Impact Magnitude – **Negligible**

- **Extent:** The impacts on tourism linked to the construction and operation activities will occur at the **local** level.
- **Duration:** This impact will occur for the duration of the construction and operation phases and will therefore be **long-term**.
- **Intensity:** The intensity will be **negligible** as those who are directly affected will be able to adapt with relative ease given the intermittent visual intrusion. The facility will not be visible from surrounding tourist attractions.

Likelihood – It is **likely** that this impact will occur.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – NEGLIGIBLE

Degree of Confidence: The degree of confidence is **high**.

12.5.2 Mitigation

The objective of mitigation is to minimise the negative impacts of the PV Power Facility on tourism activities in the area. This can be achieved by applying all mitigation measures to reduce the visual impacts as presented in *Chapter 10* of this EIR.

12.5.3 Residual Impact

The implementation of the above mitigation measures given in *Chapter 10* and *Chapter 11* should ensure that the construction and operation impacts will reduce from *Minor* to *Negligible* significance. The pre- and post-mitigation impacts are compared in *Table 12.13.*

Table 12.13 Pre- and Post- Mitigation Significance: Impact on Tourism

Phase	Significance (Pre-mitigation)	Residual Impact Significance
Construction and Operation	**NEGLIGIBLE**	**NEGLIGIBLE**

12.6 DISCUSSION

12.6.1 Unmet Stakeholder Expectations

During stakeholder consultation it was clear that there are high expectations around economic benefits (employment and procurement), community development and local electricity provision associated with the Project. Many of the stakeholder expectations will be met through routine project related activities (e.g. contract employment, procurement and skills development). Other expectations will be met through the activities associated with the Community Trust. *Sections 12.2.1 to 12.2.4* provide more information about these benefits. It is however possible that the expectations may exceed the

benefits delivered, this may be especially true with the regard to the expectation for employment opportunities.

With regards to the provision of cheaper electricity to the project area, it is unlikely that Solaire Direct will be able to directly meet this demand. Solaire Direct is an independent power producer and is only allowed to sign a power purchase agreement with Eskom. The electricity produced at the facility will therefore be fed directly into the national electricity grid for distribution by Eskom. The presence of the PV Power Facility and the sub-station would, however, make the possibility of electricity distribution in the area more accessible given the construction of the lower voltage transmission lines.

There is likely to be disappointment within the local community, potential anger and resentment towards Solaire Direct if these expectations are not met. Unmet expectations that are not actively managed by Solaire Direct could have a negative impact on stakeholder relations and the perceptions of Solaire Direct as a company. As a worst case scenario, the residents in the surrounding areas may attempt to disrupt construction activities and become aggressive towards Solaire Direct. As such, it is important that Solaire Direct maximise local employment and procurement as outlined in *Section 12.2.1* and *12.2.2* and address all grievances raised appropriately as outlined in *Section 12.3.3.*

13 OTHER IMPACTS

13.1 TRAFFIC

This section considers the impacts to traffic and road users during the construction and operation of the Drennan PV power facility.

Table 13.1 Impact Characteristics: Traffic

	Construction	**Operation**
Project Aspect / activity	Delivery of PV components and construction equipment. Delivery of concrete. Construction personnel commuting to and from Site.	Operational personnel commuting to and from Site. Delivery of replacement PV components.
Impact Type	Direct negative	Direct negative
Stakeholders / Receptors Affected	Road users. Affected landowners.	Road users. Affected landowners.

13.1.1 Construction Phase Impacts

During the construction phase of the PV power facility, there will be an increase in vehicle movement to and from the Site. This has the potential to impact on traffic along the final transport route and on the Site.

The increase in traffic could create noise, dust (1) and safety impacts for other road users and people living or working within close proximity to the roads on the selected transport route. In addition, the increased volume of traffic along the transport route will increase the wear and tear on these roads and possibly lead to deterioration in road conditions. Photovoltaic components, electrical and structure equipment will be procured in South Africa where available, or from an international manufacturer when sourcing from within the country is not possible. It is expected that these components will be delivered to Site via road in small trucks (2). However, the final route to be taken to transport these components to the Site will be dependent on the chosen manufacturer.

The following use of transport for construction is expected:

- Delivery of panels: 200 loads consisting of 18.9 tons each on 12m long trailers;
- Delivery of electrical equipment and components: 28 loads of 20 tons each;
- Delivery of aluminium frames: 21 loads of 20 tons each;

(1) Impacts of dust are assessed separately below.

(2) Should abnormal loads be required, the relevant permits will be sought prior to transportation.

- Earthworks: potentially 1400 loads of 10 m^3 each to the identified Local Authority Landfill Site; and

- Water requirements: average of three truck loads per day for the first 60 days of construction and one truck load per day for the following 60 days of construction, with each truck carrying approximately 20,000 litres.

Construction of the project will take place in a phased approach, and as mentioned in *Chapter 4,* the approach is dependent on various factors. Installation of the full 90 MW project could take 9 months or more to complete, with solar components arriving throughout the period.

As a railway line passes through the Site, Solaire Direct will liaise with Transnet to ensure the Project does not disrupt railway shcedules.

Box 13.1 Construction Impact: Increased Traffic

Nature: Construction activities that increase traffic would result in a **negative direct** impact on people who use the roads along the final transport route.

Impact Magnitude – Medium

- **Extent**: The extent of the impact is **regional** as the potential impact will extend along the selected transport route.
- **Duration**: The duration will be **short-term** for the duration of construction.
- **Intensity:** The intensity is likely to be **medium,** as the increase in traffic could create a nuisance and impact on the safety of other road users. However the increase in traffic will be temporary, and the frequency of Project related vehicles operating on the roads during construction will generally be low.

Likelihood – There is a **definite** likelihood of increased traffic.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MODERATE-MINOR (-VE)

Degree of Confidence: The degree of confidence is **medium**.

13.1.2 Operation Phase Impacts

A limited number of people will be employed permanently at the Site during the operation phase of the PV power facility and these employees will reside in on-site accommodation. Infrequent deliveries of replacement parts may be made during the lifespan of the PV power facility. Traffic impacts associated with the operation of the facility will be minimal and therefore traffic impacts associated with operation are not considered any further.

Similarly during the operational phase, any disturbance or impacts to the railway will be mitigated to avoid impacts to the railway line.

13.1.3 *Mitigation*

Construction

- During construction, arrangements and routes for abnormal loads (if required) will be agreed in advanced with the relevant authorities and the appropriate permit will be obtained for the use of public roads.
- A grievance procedure will be established whereby any complaints by neighbours or affected parties are recorded and responded to.
- Liaison will take place with Transnet to mitigate or minimise disturbance or impacts to the railway line.

Operation

- During operation, if abnormal loads are required for maintenance, the appropriate arrangements will be made to obtain the necessary transportation permits and the route agreed with the relevant authorities to minimise the impact of other road users.
- Liaison will take place with Transnet to mitigate or minimise disturbance or impacts to the railway line.

13.1.4 *Residual*

If the above stipulated mitigation measures are implemented, the residual impact significance will be reduced to *Minor* negative for construction, while impacts are considered *Negligible* for the operational phase.

Table 13.2 Pre- and Post- Mitigation Significance: Traffic

Phase	Significance (Pre-mitigation)	Residual Significance (Post-mitigation)
Construction	**MODERATE-MINOR (-VE)**	**MINOR (-VE)**
Operation	**NEGLIGIBLE**	**NEGLIGIBLE**

13.2 *WASTE AND EFFLUENT*

Waste and effluent will be generated during the construction and operational phases of the Drennan PV power facility. The key types of waste generated and / or activities these arise from, are set out below.

All wastes generated from the project will be categorised as either *non-hazardous* or *hazardous* following an assessment of the hazard potentials of the material in line with South African legislative requirements.

Table 13.3 Impact Characteristics: Waste and Effluent

	Construction	Operation

	Construction	Operation
Project Aspect / activity	Construction activities including excavation / trenching, unpacking of solar components, accommodation facilities on Site and ablution facilities.	Maintenance activities, personnel and general office facilities.
Impact Type	Direct negative	Direct negative
Stakeholders / Receptors Affected	Affect land owner. Surrounding habitat.	Affect land owner. Surrounding habitat.

13.2.1 Construction Phase Impacts

The construction of the PV power facility will produce a variety of waste products. The initial solid waste generated on Site will be the cleared vegetation and soil overburden from levelling and grading of areas of the Site. Some building rubble will be produced throughout the construction phase from activities such as the construction of buildings and concrete pouring. Packaging material will be accumulated from unpacking of solar components. The main sources of waste will result from the temporary construction camp and construction and decommissioning activities. One of the main sources of non-hazardous wastes will be the domestic type solid waste from the approximately 59 personnel at the temporary construction camp. These wastes will be produced daily and comprise of the following:

- Domestic type waste, such as mixed waste from kitchens / canteen or living quarters;
    - o residual packaging and food wastes
    - o metal cans (from food and drinks)
    - o plastics drinks bottles
    - o glass jars and bottles
- Wooden pallets and cartons;
- Scrap metal;
- Concrete waste;
- Paper and cardboard;
- Grey water - from ablutions; and
- Food wastes.

The following hazardous wastes will also be produced from construction activities.

- Batteries (including large lead acid type);
- Medical / clinical wastes - from camp clinic;
- Oily rags and absorbents;
- Used oil and oil filters - from generators or vehicle maintenance;
- Contaminated water - slops and oily water from drip trays; and
- Sewage from toilets.

All wastes produced from project activities on Site will be transferred to designated temporary storage areas and where necessary into secure

containers. Solid wastes will be segregated to facilitate reuse and recycling of specific materials. All wastes that cannot be reused or recycled will be collected by approved waste contractors and transferred to an appropriately licensed waste management facility for treatment and disposal, likely located in Cradock.

Hazardous Wastes

The construction phase will require the use of hazardous materials such as fuels and greases to fuel equipment and vehicles and maintain equipment. These substances will be stored on-Site in temporary aboveground storage tanks. All fuels storage tanks will be locked, and fuels on Site in drums will be stored in a locked container within a fenced and secure temporary staging area. Trucks and construction vehicles will be serviced off-Site. The use, storage, transport and disposal of hazardous materials used for the project will be carried out in accordance with all applicable South African regulations. Material Safety Data Sheets for all applicable materials present on Site will be readily available to on-Site personnel. It is proposed that the construction contracting company supply the required temporary ablution facilities and be responsible for the removal and treatment thereof. Solaire Direct will be responsible to ensure that the contracting company is accredited and has the necessary permits to remove the sewage. The sewage will be treated in accordance with the municipal sewage works policies and guidelines.

There is potential for waste, effluent and sewerage stored on Site to leach into the soil and / or groundwater, causing harm to the natural environment and potentially contaminating the soil and / or groundwater.

Non-hazardous Wastes

Construction waste will most likely consist of concrete (if concrete foundations are utilised to support mounting structures) and scrap metal. All concrete mixing will be undertaken on impermeable plastic lining to prevent contamination of the soils and surrounding areas. The management of construction solid waste is detailed in the Environmental Management Programme (EMPr) and will incorporate reduction, recycling and re-use principles.

All waste that cannot be reused or recycled will be appropriately disposed of. All construction debris will be placed in appropriate on-Site skips and periodically disposed of by a licensed waste contractor in accordance with applicable South African regulations. The construction contractor will remove refuse collected from the designated waste storage areas at the Site at least once a week. All rubble generated during the construction phase will be removed from the Site regularly to a licensed landfill Site, likely located in Cradock. It is estimated that approximately 222 m^3 of construction debris will be produced per month.

Box 13.2 Construction Impact: Waste and Effluent

Nature: Construction activities that produce waste would result in a **negative direct** impact on the Site.

Impact Magnitude – Medium

- **Extent**: The extent of the impact is **local** as impacts may be just beyond the Site boundaries.
- **Duration**: The duration would be **short-term** as impacts may last just beyond the construction of the PV power facility.
- **Intensity:** The intensity is likely to be **medium** as levels of waste volumes generated will be high based on the large workforce required on-Site.

Likelihood – It is **likely** that waste and effluent generated on Site if unmitigated will impact on the soil and / or groundwater and other Site users.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MODERATE (-VE)

Degree of Confidence: The degree of confidence is **high.**

13.2.2 Operation Phase Impacts

Operations and maintenance of the PV power plant is not expected to require hazardous materials to be present and used on Site or to generate hazardous waste. PV panels, array enclosures and inverter / transformer enclosures will not produce waste during operation. The PV panels contain micron-sized amounts of cadmium telluride (CdTe) which is classified as hazardous waste. Once the PV panels have reached the end of their life cycle, the manufacturer of the PV panels will collect and recycle the PV panels and recover any hazardous substances in the PV modules. This provision forms part of the supply agreement between Solaire Direct and the selected PV panel manufacturer. This reduces the risk of the CdTe impacting on human health or the environment. It is estimated that approximately 0.2 m^3 of solid waste will be generated per annum during the estimated 20 year operational phase.

The composting toilet to be used in the guardhouse makes use of an aerobic process to treat human waste material. The composting toilet requires no water and produces compost-like, odourless, dehydrated material that could be either disposed of via municipal waste services or be used in the production of compost.

The PV panels will possibly be cleaned once or twice a year to remove dust accumulated on the surfaces of the modules during the operational phase of the project. The water used for cleaning will not contain any harmful chemicals or additives and will not be heated. Therefore the water is not regarded as wastewater and the water will be allowed to percolate into the soil.

Box 13.3 Operation Impact: Waste and Effluent

Nature: Operation activities that produce will result in a **negative direct** impact on the Site.

Impact Magnitude – Low

- **Extent**: The extent of the impact is **local** as impacts may move just beyond the Site boundaries.
- **Duration**: The duration would be **long-term**, potentially lasting the duration of the operation of the PV power facility.
- **Intensity:** The intensity is likely to be **low** owing to the small number of personnel present on Site during the operation phase and few waste generating activities.

Likelihood – It is **likely** that waste and effluent generated on Site if unmitigated will impact on the soil and / or groundwater and other Site users.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MINOR (-VE)

Degree of Confidence: The degree of confidence is **high.**

13.2.3 Mitigation

The potential impacts associated with the generation of waste and effluent can be minimised through careful mitigation measures.

Design

- A suitable area for the temporary waste storage areas and secure waste skips must be selected, away from drainage lines, and included in the final Site layout plan with approval by the Environmental Control Officer (ECO).

- A Waste Management Plan (WMP) for the Project will be developed. This will follow the principles of waste minimisation at source, segregation for reuse, recycling, treatment or disposal.

Construction

- Construction waste management will be governed by an EMPr and will incorporate reduction, recycling and re-use principles.

- Material Safety Data Sheets for all applicable materials present on Site will be readily available to on-Site personnel.

- All wastes produced from project activities on Site will be transferred to designated temporary storage areas and where possible into secure containers.

- Solid wastes will be segregated to facilitate reuse and recycling of specific materials.

- All wastes that cannot be reused or recycled will be collected by approved waste contractors and transferred to an appropriately licensed waste management facility for treatment and disposal.

- Indigenous vegetative material will be kept on Site and mulched after construction to be spread over the disturbed areas to enhance rehabilitation of the natural vegetation.

- Effluent from the washing-down of concrete mixing and handling equipment will be contained within a bunded area of 110 percent capacity of the stored material. This effluent will then be treated as hazardous waste and disposed of by a licensed contractor.

- All hazardous and liquid waste materials e.g. fuel for generators, including any contaminated soils will be stored in a bunded area of 110 percent of the stored material's capacity and disposed of by a licensed contractor.

- Fuels on Site in drums will be stored in a locked container within a fenced and secure temporary staging area.

- Trucks and construction vehicles will be serviced off-Site.

- Effluent and stormwater run-off will be discharged away from any identified drainage lines.

- All concrete mixing be undertaken on impermeable plastic lining to prevent contamination of the soils and surrounding areas.

- All construction debris will be placed in appropriate on-Site storage containers and periodically disposed of by a licensed waste contractor in accordance with applicable South African regulations.

- The construction contractor will remove refuse collected from the designated waste storage areas at the Site at least once a week.

- All rubble generated during the construction phase will be removed from the Site regularly to a licensed landfill Site.

Operation

- Operation waste management will be governed by an EMPr and will incorporate reduction, recycling and re-use principles.

- Material Safety Data Sheets for all applicable materials present on Site will be readily available to on-Site personnel.

- All wastes produced from project activities on Site will be transferred to designated temporary storage areas and where possible into secure containers.

- Solid wastes will be segregated to facilitate reuse and recycling of specific materials.

- All wastes that cannot be reused or recycled will be collected by approved waste contractors and transferred to an appropriately licensed waste management facility for treatment and disposal.

13.2.4 Residual

If the mitigation measures stipulated above are implemented, the residual impact significance will be reduced to *Minor* during the construction phase and remain *Minor* during the operational phase.

Table 13.4 Pre- and Post- Mitigation Significance: Waste and Effluent

Phase	Significance (Pre-mitigation)	Residual Significance (Post-mitigation)
Construction	**MODERATE (-VE)**	**MINOR (-VE)**
Operation	**MINOR (-VE)**	**MINOR (-VE)**

13.3 AIR QUALITY

The two primary areas of interest are:

- Dust generated during clearing of vegetation and earthmoving activities, and by vehicles on Site travelling along unpaved roads; and

- Emissions from the exhaust of vehicles during construction.

Table 13.5 Impact Characteristics: Air Quality

	Construction
Project Aspect / activity	Soil disturbance and excavating. Vehicle movement on gravel roads. Emissions from construction vehicles and equipment.
Impact Type	Direct negative
Stakeholders / Receptors Affected	Affected landowners. Road users. Construction personnel.

13.3.1 Construction Phase Impacts

The presence of dust can be a nuisance to Site users, including construction workers and other nearby receptors. Across the Site there are large areas of sparse vegetation and exposed soil. The levels of dust at the Site are expected to be variable and dependent on the time of year, the intensity of the activity

and the prevailing winds. During the construction phase, dust will be generated from increased vehicle movements from trucks driving on gravel roads and from activities that cause disturbance of the soil.

Dust becomes airborne due to the action of winds on material stockpiles and other dusty surfaces, or when thrown up by mechanical action, for example the movement of tyres on a dusty road or activities such as excavating. The quantity of dust released during construction depends on a number of factors, including:

- the type of construction activities occurring;
- the area of exposed materials;
- the moisture and silt content of the materials;
- distances travelled on unpaved surfaces; and
- the mitigation measures employed.

The key construction activities likely to result in increased dust levels are movement of trucks transporting solar infrastructure to and from the Site, movement of construction vehicles along dusty roads, clearance of vegetation, trenching, burial of cables and screwing/ piling support poles of structures into the ground. Dust emissions are exacerbated by dry weather and high wind speeds. The impact of dust also depends on the wind direction and the relative locations of dust sources and receptors.

In addition to dust generation, construction vehicles and other construction equipment will generate exhaust emissions. It is not anticipated that large volumes of exhaust emissions will be generated during the construction phase of the PV power facility.

Box 13.4 Construction Impact: Dust and Emissions

Nature: Construction activities that generate dust and emissions will result in a **negative direct** impact on receptors in the area.

Impact Magnitude – Low

- **Extent**: The extent of the impact is **local,** limited to within 200 m of construction activities.
- **Duration**: The duration will be **short-term** lasting for the duration of construction phase.
- **Intensity:** The Site is very remote and dust generated or emissions released are therefore unlikely to impact any sensitive receptors, the intensity can be considered **low.**

Likelihood – There is a **definite** likelihood of dust and emissions generation.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MINOR (-VE)

Degree of Confidence: The degree of confidence is **high**.

13.3.2 Operation Phase Impacts

Minimal dust generation is expected to occur during the operational phase of the project by maintenance vehicles along the gravel access roads, which will be infrequent. Furthermore, minimal emissions are expected from vehicles

and equipment during the operational phase. Therefore, impact of dust and emissions generated during the operation phase is not considered any further.

13.3.3 Mitigation

Given that the Site is located in a water-scarce area, wetting of surfaces to minimise dust is not recommended.

Construction Phase

- Vehicles travelling on gravel roads will not exceed a speed of 30 km / hr.
- Stockpiles of dusty materials will be enclosed or covered by suitable shade cloth or netting to prevent escape of dust during loading and transfer from Site.
- Vehicles will be kept in good working order and serviced regularly to minimise emissions.
- Any directly affected individuals including neighbouring farmers will be able to lodge grievances with Solaire Direct using the grievance procedure (included in the EMPr) regarding dust emissions that could be linked to the project.

Operation Phase

- Vehicles travelling on gravel roads should not exceed a speed of 30 km / hr.

13.3.4 Residual

If the above stipulated mitigation measures are implemented, the residual impact significance will be reduced to *Negligible* for the construction and operational phases.

Table 13.6 Pre- and Post- Mitigation Significance: Dust and Emissions

Phase	Significance (Pre-mitigation)	Residual Significance (Post-mitigation)
Construction	**MINOR (-VE)**	**NEGLIGIBLE**
Operation	**NEGLIGIBLE**	**NEGLIGIBLE**

14 CUMULATIVE EFFECTS

14.1 INTRODUCTION

Cumulative effects are a result of effects that act together (including those from concurrent or planned future third party activities) to affect the same resources and / or receptors as the project under consideration (e.g. the combined effect of other similar projects in the general area). An effect to a resource in itself may not be considered significant, but may become significant when added to the existing and potential effects eventuating from similar or diverse developments in the area.

Cumulative effects have been defined as "*changes to the environment that are caused by an action in combination with other past, present and future human actions*" (Hegmann *et al* 1999).

There has been a substantial increase in renewable energy developments recently in South Africa, and legislation is evolving to facilitate the introduction of Independent Power Producers (IPPs) and renewable energy into South African electricity generation. Solar energy developments have largely been focused in the Northern Cape, with the focus in the Eastern Cape largely directed towards wind energy projects. It should however be noted that because of the following reasons not all renewable energy developments presently under consideration in the Eastern Cape will become operational, partly due to the following:

- There are limitations to the capacity of the existing Eskom grid;
- Not all applications will receive positive environmental authorisation from the Department of Environmental Affairs (DEA);
- There are stringent requirements to be met by applicants in the competitive bidding process; and
- Not all solar power plants will be successful in securing financial support.

The preceding impact assessment chapters have assessed the impacts associated with the Project largely in isolation. As part of legislated requirement, it is important to consider cumulative effects associated with a proposed development. This chapter examines whether the Project's potential impacts become more significant when considered in combination with the additional existing and proposed infrastructure, including solar power projects, within the area.

All reasonable effort has been made to review the currently proposed position of the Project, in relation to other existing or proposed solar power plants, wind farms and major infrastructure in the surrounding area. There are currently no existing commercial solar power plants or wind farms in

operation in close proximity to the Site. These developments are listed in *Table 14.1* below.

Table 14.1 Planned Solar Power Plants in the vicinity of the Project

Solar Power Plant	MW output	Distance (km)
Solar Energy Facility North of Middelburg	75MW	143km
Solar Energy Facility South West of the Project	20MW	137km
Solar Energy Facility North East of Middelburg	5MW	141km
Solar Energy Facility 55km North of Cradock	90MW	85km

As evident in *Table 14.1* there are four known proposed solar power plants in addition to the Project, all of which are located more than 85 km from the Site. There is uncertainty as to whether all the above-mentioned developments will proceed to construction. This is in part due to the fact that the operation of solar energy projects in the region will feed increased wattage into the national grid. Given that there is a physical capacity to the grid system (substations, transmission lines), and limits to the amount of electricity the Department of Energy will purchase from renewable resources, the possibility exists for competition between operators for grid capacity. This underscores the difficulty in terms of making assertions as to future developments in the renewable energy sector.

Furthermore, the facilities described are sufficiently distanced from the Project area such that their development can reasonably be expected to add insignificantly to the potential direct impacts of the Project. It is thus difficult to quantitatively assess potential cumulative impacts, although it is possible to assess them qualitatively, which is necessary in order to meet legislative requirements. It is also instructive in terms of providing a better understanding of potential cumulative impacts and the mitigation actions that need to be applied in this case.

The assessment and implementation of mitigation measures should be led by Government in collaboration with the renewable energy sector and relevant NGOs. As these cumulative impacts are explored in more detail, the trade-offs between promoting renewable energy (and the associated benefits in terms of reduction in CO_2 emissions) versus the local and regional environmental and social impacts and benefits (i.e. impacts on bird populations, landscape, tourism, flora, employment, etc.) will become evident. It is only when these trade-offs are fully understood that the true benefits of renewable energy can be assessed.

In the sections below the potential cumulative impacts are explored in terms of a scenario in which additional solar energy developments or other industrial developments are constructed within close proximity to the Project. This scenario represents the least positive future prediction for the Project, but this forecast is necessary to facilitate the consideration of cumulative impacts. The discussion and associated conclusions must be understood in the context

of the uncertainty associated with the proposed and known developments and the qualitative nature of the assessment.

14.2 SOILS AND SURFACE AND GROUNDWATER

When preparing Sites for PV panels, some developers clear the entire Site of vegetation, often leveling and grading the whole extent of the Site. This may result in soil compaction, soil disturbance and erosion. As PV solar plants occupy large areas, potential cumulative effects could be significant if not managed properly. The proposed Project is located on a flat Site, with a system of drainage channels occurring to the south of the Site, outside the boundary of the PV Footprint. Activities such as leveling and grading during construction have the potential to increase the sedimentation of rivers and tributaries in the area. This impact will be compounded if more than one facility were to be constructed and operated within close proximity, leading to increased run-off of soil and other particles into the same catchment areas. Should the stipulated mitigation measures to avoid disturbance to the soils and surface and groundwater be implemented, the cumulative effects associated with PV power facilities in this regard are expected to be minimal.

14.3 ECOLOGY

The national vegetation map that the Site is largely dominated by Eastern Upper Karoo, with the drainage areas corresponding to the Southern Karoo Riviere vegetation type. The Project areas lie entirely within the Eastern Upper Karoo vegetation type. The Eastern Upper Karoo vegetation type is the most extensive vegetation type in South Africa and forms a large proportion of the central and eastern Nama Karoo Biome. This vegetation type is classified as Least Threatened, and about two percent of the original extent has been transformed largely for intensive agriculture. However, the vegetation type is poorly protected. Less than one percent of the 21 percent target has been formally conserved. The Southern Karoo Riviere vegetation type is also classified as Least Threatened. However, since this vegetation type is associated with rivers and drainage lines, those areas classified under this vegetation type should be considered sensitive and should be avoided by the development.

It can be expected that proposed PV power facilities, if constructed within the vicinity of the Drennan Site, will fall within the above-mentioned vegetation types, thereby contributing towards the cumulative effects pertaining to them. Considering the vegetation types found on the Site are all classified as Least Threatened (the receiving Eastern Upper Karoo vegetation type is the most extensive vegetation type in the country), the cumulative effects of PV power facility development within the area on these vegetation types is likely to be considered as low.

Furthermore, specialist studies have shown that the wider area has low topographic diversity and as a result, broad-scale ecological processes are likely to operate in a diffuse manner with Sites in the area therefore not likely to function as part of a movement or migration corridor for fauna and flora. The larger fauna which occurs in the area is typical of arid and semi-arid areas and constitutes species which are able to avoid human contact through mobility or their unobtrusive behaviour. Such species will be able to persist within the developed areas, or will be able to avoid them. In addition, the area is already relatively impacted due to the presence of the existing railway line as well as Eskom's Drennan Traction Substation and associated transmission lines. The overall impact on the connectivity of the landscape and the further disruption of ecosystem processes by additional developments would thus be reduced by the proximity to these existing developments.

14.4 BIRDS

The most significant potential impact on bird life by solar PV facilities relates to the displacement or exclusion of threatened, rare, endemic or range-restricted species from critical areas of habitat. Given the considerable space requirements of commercially viable PV facilities (>50-100 ha), this effect could be regarded as significant in some instances when taking into consideration the possibility of various proposed solar power plants being constructed around the Project and elsewhere in the Eastern Cape. However, as discussed it is unlikely that all the proposed solar power plants will become operational (see *Section 14.1*). Regional planning should consider the above potential cumulative impacts in solar park development.

14.5 LANDSCAPE AND VISUAL IMPACT

Should many more of these types of PV power facilities be installed in close proximity to each other in the affected project area, there is a possibility that the agricultural sense of place of the area will be undermined. This could be the result should the landscape characteristic come to be defined by the solar energy facilities or other industrial developments. However, due to the limited visual resources in the area and the limited number of receptors, the potential cumulative impact is likely to be marginal. It should also be noted that the typical design characteristics of PV power facilities (the fact that they are constructed in close proximity to the ground), determines that they are not easily discernible from a distance and would impact marginally on receptors in the surrounding area (road users, visitors to the Karoo). Regional planning should consider the above potential cumulative impacts in solar park development

Benefits to the local, regional and national economy through employment and procurement of services could be substantial should a number of renewable energy facilities be constructed in the Province. This benefit will increase significantly should critical mass be reached that allows local companies to develop the necessary skills to support construction and maintenance activities and that allows for components of the PV power facilities to be manufactured in South Africa. Over time, as businesses develop locally to meet the needs of the solar energy sector, it is likely that levels of local procurement would increase.

The potential for the proposed Project and other future projects to result in greater impacts on the local and national economy as a whole is primarily dependent on economies of scale. Initially, import content will be high. However, if the sector grows in size it should provide opportunities for growth of the local supply chain and the additional benefits that would flow from this. The introduction of large numbers of PV power facilities could provide local economic opportunities for component manufacture, and with an appropriate industrial policy it would be possible to leverage South Africa's relatively cheap steel resources. The distance from other international manufacturers will also present a competitive advantage, especially for less-specialised large-scale components such as PV array support structures.

As the Eastern Cape is traditionally a labour sending area, the creation of new local industry around PV power facilities could result in changes occurring with respect to socio-economic conditions in the province. It is possible that the traditional exporting of labour to other provinces would be reduced if a local PV industry were to develop, which could carry both negative and positive socio-economic implications. If the influx of individuals into the province was not properly planned for by local government and power producing companies, there is a chance that a range of socio-economic issues may be compounded over the long term. However with adequate influx management which is regionally focused and initiated at an early stage, there are possibilities to develop the capacity of local authorities and create positive impacts for local communities through *inter alia* increasing their connectivity to the mainstream economy, improved infrastructure and services, and improved economic opportunities(1).

From the environmental standpoint the cumulative impact in terms of loss of agricultural land could potentially be extensive due to the large land take required for PV power facilities. However, the agricultural potential of the land at the Site and in the surrounding area is classified as low for crop production and moderate for grazing (see *Chapter 8*) and therefore these impacts are not likely to result in significant cumulative impacts.

(1) These issues are addressed in detail by the International Finance Corporation (IFC) Handbook for Addressing Project-Induced In-Migration. Available:
http://www1.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/ifc+sustainability/publ

14.7 CONCLUSIONS

Cumulative effects and benefits on various environmental and social receptors would occur to varying degrees with the development of additional PV power facilities in the Eastern Cape. The alignment of renewable energy developments with South Africa's National Energy Response Plan and the global drive to move away from the reliance on non-renewable energy resources is undoubtedly a positive development. It is also a crucial if South Africa is to reduce its carbon emissions to the levels stipulated in the Government's Long Term Mitigation Scenarios. The economic benefits of renewable energy developments at a local, regional and national level have the potential to be significant. Should impacts be managed and appropriate monitoring implemented, the cumulative effects to environmental receptors as a result of the construction of the Project is not considered as significant. Furthermore the construction of additional PV power facilities within the same region would also not be expected to contribute significantly towards cumulative impacts.

As mentioned in *Chapter 4*, the Project would have a minimum lifespan of at least 20 years. Once the facility reaches the end of its lifespan the PV arrays may be refurbished or replaced to continue operating as a power generating facility or the facility could be closed and decommissioned. If decommissioned, all components would be removed and the Site rehabilitated. The PV panels would be recycled as appropriate. The decommissioning and reinstatement of the Site will involve many activities that may have some environmental and socio-economic impacts.

It is anticipated that the impacts associated with decommissioning will be similar to those encountered during construction. The generation of waste through the decommissioning activity is anticipated to be high although the choice of the preferred supplier was made to mitigate this impact since the supplier has an existing programme which would maximise the reuse and recycling of the PV panels therefore significantly decreasing the waste generation during decommissioning. The PV panels are piled or screwed into the ground and therefore the need to excavate PV panel foundations during decommissioning is avoided thus limiting the disturbance of vegetation.

The comprehensive decommissioning plan should be developed prior to the decommissioning of the facility to minimise potential negative impacts and enhance positive impacts associated with decommissioning.

16.1 INTRODUCTION

The aim of the EIA for the Project is to provide information to inform decision-making that will contribute to sustainable development. This report is submitted to the Department of Environmental Affairs (DEA) to provide information and an independent assessment, thus enabling the DEA to make an informed decision regarding whether or not to grant an environmental authorisation for the Project in terms of NEMA. If granted, this report will also assist the DEA to define under what conditions the development should go ahead. In considering the development of renewable energy projects, it is inevitable that there will be some negative environmental impacts. However, there is also the need to encourage renewable energy in South Africa in order to move toward more sustainable energy practices and meet targets set by the government of sourcing 10,000 GWh from renewable energy projects by 2013 (1).

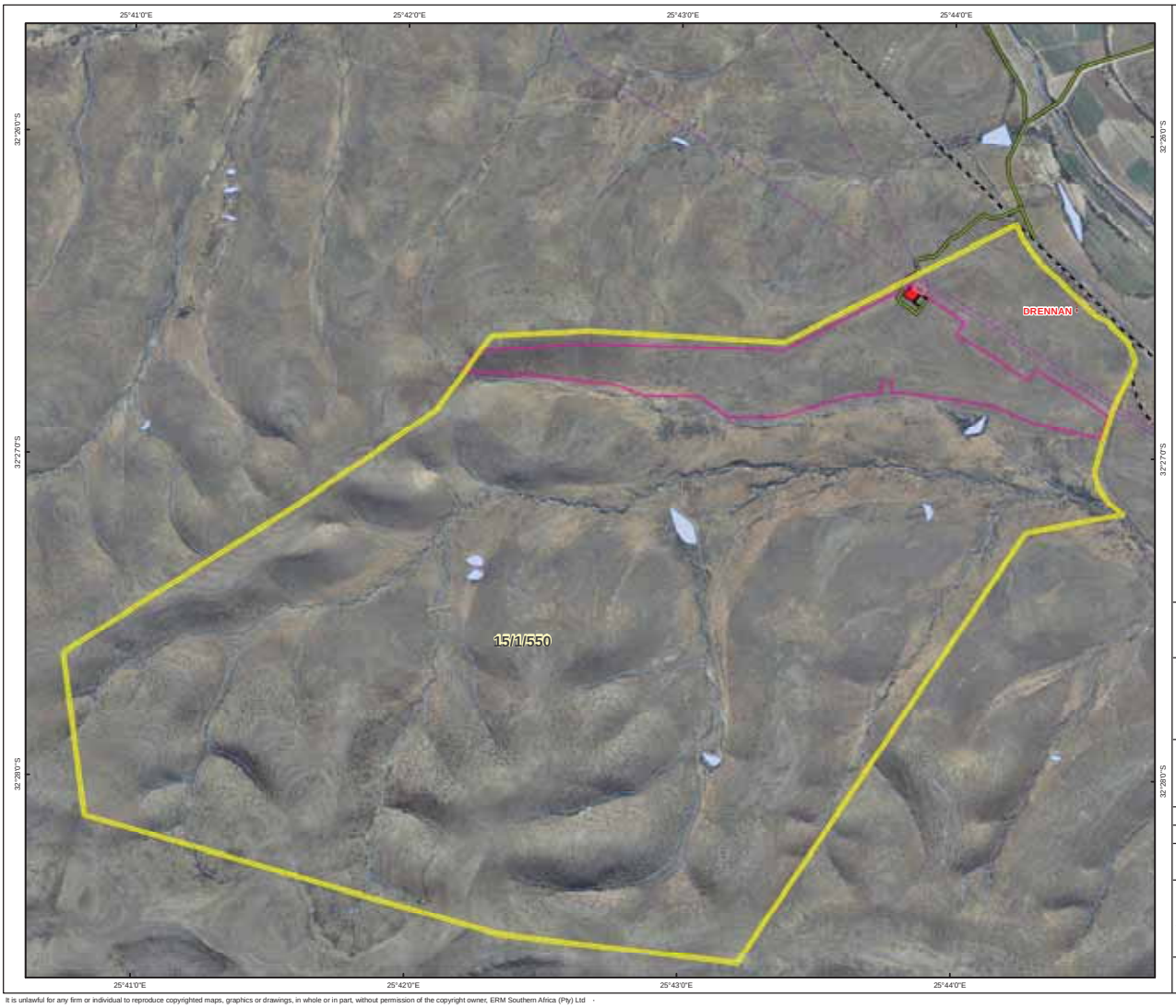
Through the EIA process which included various stakeholder and specialist input, ERM has identified and assessed a number of potential impacts relating to the development. This chapter provides an overview of the EIA findings and makes recommendations regarding key mitigation measures for the final PV Footprint.

The final PV Footprint has been designed based on the sensitivity constraints of the Site as established both prior to, and during, the EIA process. *Figure 16.1* and *Figure 16.2* show the Site and Final PV Footprint layout, and illustrate how the layout of the Final PV Footprint was located based on specialist feedback during the process.

The final layout of the PV arrays is based on the best currently available information but may require some minor alterations as a consequence of more detailed geo-technical studies. Any revisions of the design will, however, be within the allowable zones limited by the environmental constraints prescribed by this Environmental Impact Report (EIR)(see *Figure 4.11*) and any amendments to the final layout will be submitted to DEA before construction, with an indication of the extent of change and associated changes in significance ratings of impacts, if applicable.

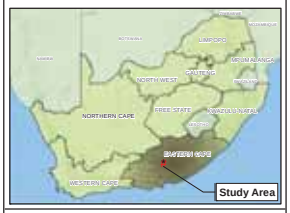
The potential impacts associated with the development are summarised below and should be considered both in the context of the project rationale and the discussion of cumulative impacts in the previous chapter.

(1) National Energy Regulator of South Africa, South Africa Renewable Energy Feed-In Tariff (2009), NERSA Publications.



Legend

- Place Names
- Contour (20m)
- Perennial Rivers
- Non Perennial Rivers
- Railway Line
- Eskom Power Line
- Dams
- Access Roads
- "Loop-in-Loop-out" Connection
- Substation
- Laydown Camp Site and Assembly Area for Construction
- Substation and Guard House
- PV Footprint
- Drennan Photovoltaic (PV) Power Facility



SCALE:
0 200 400 600 800 1 000
Metres

TITLE:
Figure 16.1:
Layout of the Project Site

CLIENT:
solairedirect

DATE: Sept 2013	CHECKED: DA	PROJECT: 0166587
DRAWN: AB	APPROVED: BL	SCALE: 1 : 32 000

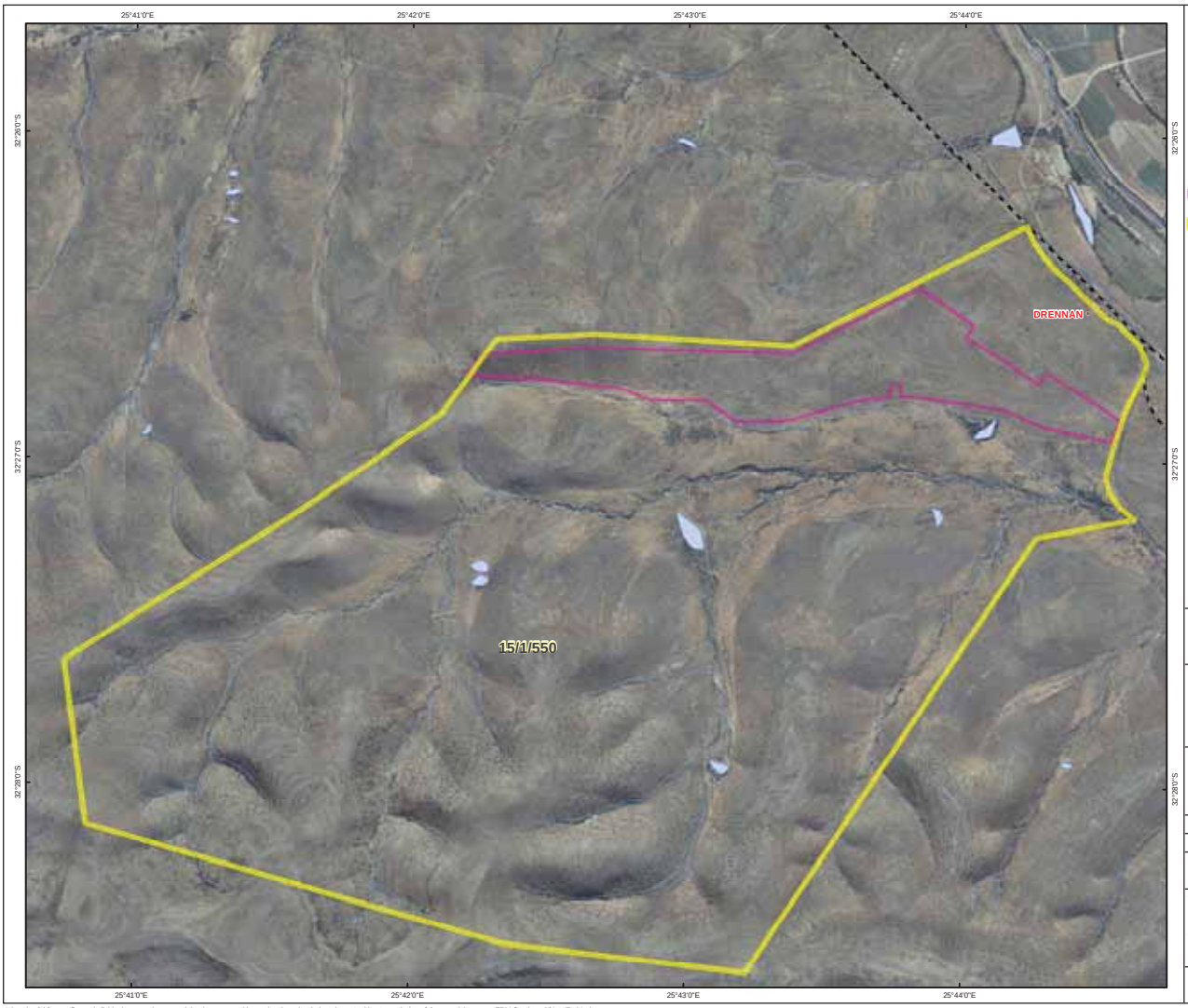
DRAWING: Fig 16.1_Project Infrastructure.mxd
REV: 0

ERM
Great Westerford Building
240 Main Road
Rondebosch, 7725
Cape Town, SOUTH AFRICA
Tel: +27 21 681 5400
Fax +27 21 686 073

Projection: Transverse Mercator, CM 25, Datum: WGS 84
Source: NGI: Chief Directorate National Geo-Spatial Information, 3225BC & BD_2005_ED4_GEO.TIF
Inset: ESRI Data and Maps

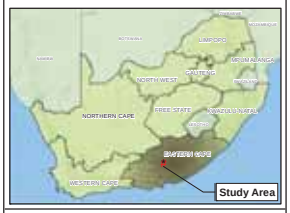
SIZE: A3

T:\Gis Projects\0166587_Drennan\Solar Park\Mapping\MXD\ERM\Fig 16.1_Project Infrastructure.mxd



Legend

- Place Names
- Contour (20m)
- Perennial Rivers
- Non Perennial Rivers
- Railway Line
- Dams
- PV Footprint
- Drennan Photovoltaic (PV) Power Facility



SCALE:
0 200 400 600 800 1 000
Metres

TITLE:

Figure 16.2:
Final PV Footprint

CLIENT:

DATE: Sept 2013	CHECKED: DA	PROJECT: 0166587
DRAWN: AB	APPROVED: BL	SCALE: 1 : 32 000

DRAWING: Fig 4.2_Locality Map Image.mxd | REV: 0

ERM
Great Westerford Building
240 Main Road
Rondebosch, 7725
Cape Town, SOUTH AFRICA
Tel: +27 21 681 5400
Fax +27 21 686 073

Projection: Transverse Mercator, CM 25, Datum: WGS 84
Source: NGI: Chief Directorate National Geo-Spatial Information, 3225BC & BD_2005_ED4_GEO.TIF
Inset: ESRI Data and Maps

SIZE: A3

T:\Gis Projects\0166587_Drennan Solar Park\Mapping\MXD\ERF\Fig 4.11_Site Fig 4.2_Locality Map Image.mxd

16.2 SUMMARY OF IMPACTS IDENTIFIED AND ASSESSED

16.2.1 Construction Phase Impacts

The Site includes numerous ecologically sensitive drainage lines, and therefore there would be a significant impact were the PV Footprint (buildable area) to be located in these areas. The Very High sensitivity areas at the Site (drainage lines and the riparian corridors) constitute a large proportion of the southern portion of the Site, and consequently place some constraints on the possible location of PV infrastructure. However, the 90 MW Final PV Footprint avoids these ecologically sensitive areas and thus a significant direct impact on the ecology at the Site is avoided.

The potential impact from the loss of topsoil, soil compaction and erosion is primarily due to the preparation of the Site for the establishment of PV arrays, underground cables, access road(s), temporary laydown area and buildings (control and accommodation) requiring vegetation clearance, some Site levelling and grading and soil compaction. This negative impact is considered to be of *Minor* residual significance.

The negative impact on surface and groundwater due to a change in drainage network on the Site and potential spills of contaminants is of *Minor* residual significance.

The destruction and loss of natural vegetation as a result of the vegetation clearance for the installation of the PV arrays is considered to have a residual significance of a *Minor-Moderate* nature.

The negative impacts on fauna due to noise, pollution, potential poaching and disturbance caused by construction activities will be of *Minor-Moderate* residual significance.

Potential negative avifaunal impacts resulting from noise, pollution, possible poaching and disturbance caused by construction activities is considered to have a *Minor-Moderate* residual significance.

It is not expected that a negative visual impact will occur during construction, and this impact is considered to be of *Negligible* residual significance.

The potential damage or destruction to paleontological resources as a result of construction activities such as drilling and screwing of the PV arrays supports into the ground is considered to have a *Minor* residual significance.

The potential impacts on archaeological resources due to construction activities is considered to be of a *Negligible* residual significance if grave and kraal sites are completely avoided and left in-situ with a buffer. The potential negative impact on cultural heritage as a result of damage or destruction is considered to be of *Minor* residual significance. This is due to the fact that no

buildings or other infrastructure of cultural importance occur in close proximity to the Site.

The positive impact through the creation of direct employment and training opportunities will be of *Moderate* residual significance. The positive impact of indirect employment and procurement for the local economy will be of *Minor-Moderate* residual significance. The positive impact from induced economic benefits as a result of an increase in disposable income in the local economy will be of *Minor* residual significance. The positive impact from community investment through the Community Trust to be established is considered to be of *Moderate-Major* residual significance.

During construction, the negative impact from inflation and an increased cost of living as a result of increased demand for goods, services and accommodation will be of *Minor* residual significance. The possible negative impact due to social nuisances, such as increased levels of crime, drug and alcohol abuse, increased incidences of sex workers, domestic violence, and the additional pressure on the existing infrastructure and services as a result of an influx of workers is considered to be *Negligible*. The potential negative impact on the socio-economic aspects of agricultural activities is considered to be of *Negligible* residual significance. Any potential impact on tourism is considered to be *Negligible*.

A summary of the bio-physical and socio-economic impacts associated with the construction phase of the Project, including their pre-mitigation and residual impacts, are given in *Table 16.1* below. All negative impacts associated with the Project have been mitigated to a level which is deemed appropriate for the construction phase to proceed.

Table 16.1 Summary of Pre-mitigation Significance during Construction Phase for the Layout of the Final PV Footprint

	Section	Impact	Pre-mitigation Significance	Residual Impact Significance *(Based on mitigation)*
Soils	7.1	Loss of Topsoil, Soil Compaction and Soil Erosion	MODERATE (-VE)	MINOR (-VE)
Water	7.2	Impact on Surface and Groundwater	MINOR (-VE)	MINOR (-VE)
Agriculture	8.1	Impact on Agriculture	NEGLIGIBLE	NEGLIGIBLE
Flora	9.1	Destruction and Loss of Natural Vegetation and Sensitive Plant Communities	MODERATE (-VE)	MODRATE-MINOR (-VE)
	9.2	Alien Plant Invasion	MODERATE (-VE)	MINOR (-VE)
	9.3	Increased Erosion Risk	MODERATE (-VE)	MINOR (-VE)
Fauna	9.4	Impacts from Habitat Loss and Disturbance	MODERATE (-VE)	MODERATE (-VE)
Avifauna	9.5	Avifaunal Disturbance	MODERATE (-VE)	MODERATE-MINOR (-VE)
Critical Biodiversity Areas (CBAs)	9.6	Impact On Critical Biodiversity Area	MODERATE (-VE)	MODERATE-MINOR (-VE)
Visual	10.3	Visual Impacts	MINOR(-VE)	NEGLIGIBLE
Palaeontology	11.1	Damage or Destruction to Paleontological Resources	MINOR (-VE)	MINOR (-VE)
Archaeology	11.2	Damage or Destruction to Archaeological Resources: If grave and kraal sites completely avoided and left in-situ with no preservation or documentation.	MAJOR/CRITICAL (-VE)	NEGLIGIBLE
Cultural Heritage	11.3	Destruction or Disturbance of Cultural Heritage	MINOR (-VE)	MINOR (-VE)
Socio-economic	12.2	Direct Employment and Training	MINOR - MODERATE (+VE)	MODERATE (+VE)
	12.2	Procurement and Indirect Employment	MINOR - MODERATE (+VE)	MINOR - MODERATE (+VE)
	12.2	Induced Economic Benefits	MINOR (+VE)	MINOR (+VE)
	12.2	Increased Community Investment	MODERATE (+VE)	MODERATE-MAJOR (+VE)
	12.2	Inflation and Increased Cost of Living	MINOR (-VE)	MINOR (-VE)
	12.3	Social Disturbance Factors	MINOR (-VE)	NEGLIGIBLE
	12.4	Impact on Agricultural Activities	MINOR (-VE)	NEGLIGIBLE
	12.5	Impact on Tourism	NEGLIGIBLE	NEGLIGIBLE
Traffic	13.1	Impact from Increased Traffic	MODERATE-MINOR (-VE)	MINOR (-VE)
Waste	13.2	Impact from Waste and Effluent	MODERATE (-VE)	MINOR (-VE)
Air Quality	13.3	Dust and Emissions	MINOR (-VE)	NEGLIGIBLE

16.2.2 Operational Phase Impacts

The negative impact on loss of topsoil, soil compaction and erosion due to Site maintenance activities and potential drainage network changes on the Site is considered to be of *Minor* residual significance.

The negative impact on surface and groundwater from potential increased sediment loading in Site runoff and potential spills of contaminants is considered to be of *Minor* residual significance.

The potential impact on the agricultural potential of the Site due to the installation of the PV arrays and loss of land for agricultural purposes is considered to be of *Minor* residual significance, primarily as a result of the low rated existing agricultural potential of the Site.

The destruction and loss of natural vegetation due to vegetation clearance for maintenance purposes is considered to be of *Minor* negative residual significance. The potential for alien plant invasions due to the disturbance of the Site's established natural vegetation is considered to be of *Minor* negative residual significance.

The negative impacts on fauna due to disruption of landscape connectivity and habitat alteration is considered to be of *Minor* residual significance.

Potential negative avifaunal impacts, primarily due to the presence of new powerlines on the Site, which pose a threat to large avifauna through collisions and electrocution is considered to be of *Minor* residual significance.

The negative visual impact of the PV power facility on the landscape is considered to be of *Minor* residual significance.

The negative cultural heritage impact on the landscape and sense of place due to the presence of the PV power facility in a currently rural and remote area is considered to be of *Minor* residual significance.

The positive impact from the creation of direct employment and training, and for indirect employment and procurement for the local economy during operations is considered to be of *Minor* residual significance owing to the relatively lower number of job opportunities compared to the construction phase. The positive impact from induced economic benefits as a result of an increase in disposable income is considered to be of *Negligible* residual significance, due to relatively fewer jobs during the operational phase. The *Moderate-Major* residual significance for the positive impact from community investment derived from the establishment of a Community Trust will continue through the operational phase.

The negative impact from inflation and an increased cost of living as a result of increased demand in the local economy for goods, services and accommodation is considered to be of *Negligible* residual significance. The

possible negative impact of social nuisances, such as increased levels of crime, drug and alcohol abuse, increased incidences of sex workers, domestic violence, and the additional pressure on the existing infrastructure and services as a result of an influx of workers is considered to be *Negligible*. Any potential negative impact on the socio-economic aspects of a loss of agricultural activities during operations is considered to be *Negligible*. There will be a *Negligible* impact on tourism in the area and a *Negligible* residual impact from increased traffic.

A summary of the bio-physical and socio-economic impacts associated with the operational phase of the Project, including their pre-mitigation and residual impacts, are given in *Table 16.2* below.

All negative impacts associated with the Project have been mitigated to a level which is deemed appropriate for the operational phase of the PV power facility to be sustainable.

Table 16.2 Summary of Pre-mitigation Significance during Operational Phase for the Layout of the Final PV Footprint

	Section	Impact	Pre-mitigation Significance	Residual Impact Significance
Soils	7.1	Loss of Topsoil, Soil Compaction and Soil Erosion	MODERATE (-VE)	MINOR (-VE)
Water	7.2	Impact on Surface and Groundwater	MODERATE-MINOR (-VE)	MINOR (-VE)
Agriculture	8.1	Loss of Agricultural Land and / or Production	MINOR (-VE)	MINOR (-VE)
Flora	9.1	Impacts of Maintenance Activities on Vegetation	MODERATE-MINOR (-VE)	MINOR (-VE)
	9.2	Alien Plant Invasion	MODERATE (-VE)	MINOR (-VE)
	9.3	Increased Erosion Risk	MINOR (-VE)	MINOR (-VE)
Fauna	9.4	Impacts from Habitat Loss and Disturbance	MINOR (-VE)	MINOR (-VE)
Avifauna	9.5	Avifaunal Disturbance	MINOR (-VE)	MINOR (-VE)
	9.5	Avifaunal Mortality	MODERATE (-VE)	MODERATE-MINOR(-VE)
Critical Biodiversity Areas (CBAs)	9.6	Impact on Critical Biodiversity Area	MODERATE-MINOR (-VE)	MINOR (-VE)
Visual	10.3	Visual Impacts	MODERATE(-VE)	MINOR(-VE)
Cultural Heritage	11.3	Impact on Sense of Place	MINOR (-VE)	MINOR (-VE)
Socio-economic	12.2	Direct Employment and Training	MINOR (+VE)	MINOR (+VE)
	12.2	Procurement and Indirect Employment	MINOR (+VE)	MINOR (+VE)
	12.2	Induced Economic Benefits	NEGLIGIBLE	NEGLIGIBLE
	12.2	Increased Community Investment	MODERATE (+VE)	MODERATE-MAJOR (+VE)
	12.2	Inflation and Increased Cost of Living	NEGLIGIBLE	NEGLIGIBLE
	12.3	Social Disturbance Factors	NEGLIGIBLE	NEGLIGIBLE
	12.4	Impact on Agricultural Activities	MINOR (-VE)	NEGLIGIBLE
	12.5	Impact on Tourism	NEGLIGIBLE	NEGLIGIBLE
Traffic	13.1	Impact of Increased Traffic	NEGLIGIBLE	NEGLIGIBLE
Waste	13.2	Impact from Waste and Effluent	MINOR (-VE)	MINOR (-VE)
Air Quality	13.3	Dust and Emissions	NEGLIGIBLE	NEGLIGIBLE

16.3 RECOMMENDATIONS

ERM is confident that every effort has been made by Solaire Direct to accommodate the mitigation measures recommended during the EIA process to the extent that is practically possible, without compromising the economic viability of the Project. The implementation of the mitigation measures detailed in *Chapters 7* to *14* and listed in the Environmental Management Programme (EMPr), including monitoring, will provide a basis for ensuring that the potential positive and negative impacts associated with the establishment of the development are enhanced and mitigated to a level which is deemed adequate for the development to proceed.

In summary, based on the findings of this assessment, ERM finds no reason why the 90 MW PV power facility proposed for the Site should not be authorised, contingent on the mitigations and monitoring for potential environmental and socio-economic impacts as outlined in the EIR and EMPr being implemented.

AGIS Database 2012. Accessed: *http://www.agis.agric.za/agisweb/agis.html*

Alexander, G. & Marais, J. 2007. *A Guide to the Reptiles of Southern Africa*. Struik Nature, Cape Town.

ASTER GDEM. METI and NASA, Accessed: https://lpdaac.usgs.gov

Berliner D. & Desmet P. (2007) *Eastern Cape Biodiversity Conservation Plan: Technical Report*.

Brady, N.C., and Weil, R.R. 2004. Elements of The Nature and Properties of Soils, 2nd edn. Upper Saddle, NJ: Prentice-Hall.

Branch W.R. 1998. *Field guide to snakes and other reptiles of southern Africa*. Struik, Cape Town.

Brownlie, S. 2005. Guideline for Involving Biodiversity Specialists in EIA Processes: Edition 1. CSIR Report

Bureau of Land Management, U.S. Department of Interior. 2004. Visual Resource Management Manual 8400

De Villiers CC, Driver A, Clark B, Euston-Brown DIW, Day EG, Job N, Helme NA, Holmes PM, Brownlie S, and Rebelo AB (2005) *Fynbos Forum Ecosystem Guidelines for Environmental Assessment in the Western Cape.* Fynbos Forum and Botanical Society of South Africa, Kirstenbosch.

Department of Environmental Affairs and Tourism, 2007. National Environmental Management:Biodiversity Act, 2004 (Act 10 of 2004): Publication of lists of Critically Endangered, Endangered, Vulnerable and Protected Species. Government Gazette, Republic of South Africa.

Department of Environmental Affairs and Tourism. 2001. *Environmental Potential Atlas for South Africa.*

Department of Water Affairs and Forestry Project No 2005-012, Pretoria. 1 August 2007

Du Preez, L. & Carruthers, V. 2009. *A Complete Guide to the Frogs of Southern Africa*. Struik Nature.,Cape Town.

Eastern Cape Education Department. 2012. *Province of the Eastern cape education department. 2012. Analysis of past performance 2008-2011*. Accessed: http://www.ecdoe.gov.za/files/documents/analysis_past_performance.pdf

ECSECC, 2011. *Growth and Employment Fourth Quarter, March 2011*. Accessed: http://www.ecsecc.org/files/library/documents/4Q2010_2.pdf

ECSECC. 2012a. *Eastern Cape socio economic consultative forum summary of census 2011*. Accessed: http://www.ecsecc.org/files/library/documents/ECSECCCensus2011_1.pdf

ECSECC. 2012b. *Chris Hani District Municipality facts sheet*. Accessed: http://www.ecsecc.org/files/library/documents/CHDM_factsheet.pdf [2013, April 19]

Environmental Resources Management (ERM). 2013. Final Scoping Report: Proposed 90 MW Drennan Photovoltaic (PV) Power Facility. Eastern Cape. March 2013. Solaire Direct Southern Africa (Pty) Ltd. ERM Reference: 0166587.

ERM. 2012. Drennan Draft Scoping Report.

FAO. (2007). Mapping biophysical factors that influence agricultural production and rural vulnerability. Accessed: *www.fao.org/docrep/010/a1075e/a1075e00.HTM*

Fey, M. (2010). Soils of South Africa. Cambridge University Press.

Hendey, Q.B. 1981. *Palaeoecology of the Late Tertiary fossil occurrence in 'E' Quarry, Langebaanweg, South Africa, and a reinterpretation of their geological context*. Annals of the South African Museum 84(1):1-104.

Hull, R.B. and Bishop, I.E. (1988), Scenic Impacts of Electricity Transmission Mine: The Influence of Landscape Type and Observer Distance. *Journal of Environmental Management.*1988 (27) Pg 99-108.

IUCN 2012. IUCN Red List of Threatened Species. Version 2010.2. <www.iucnredlist.org>. Downloaded on 19 January 2012.

Johnson, M.R., et al. 2009. Sedimentary Rocks of the Karoo Supergroup. In *Geology of South Africa*. M.R. Johnson, C.R. Anhaeusser, and R.J. Thomas, eds. Pp. 461-499. Cape Town: Geological Society of South Africa & Council for Geoscience.

Klein, R.G. 1975. *Paleoanthropological implications of the nonarchaeological bone assemblage from Swartklip I, South-Western Cape Province, South Africa*. Quaternary Research 5:275-288.

Lange, E. 1994: Integration of computerized visual Simulation and visual Assessment in environmental Planning. Landscape and Urban Planning.

Lehman, R.N., Kennedy, P.L. & Savidge, J.A. 2007. The state of the art in raptor electrocution research: a global review. *Biological Conservation* 136: 159-174.

Mucina L. & Rutherford M.C. (eds) 2006. *The Vegetation of South Africa, Lesotho and Swaziland*.

Nel, J.L., Murray, K.M., Maherry, A.M., Petersen, C.P., Roux, D.J., Driver, A., Hill, L., Van Deventer, H., Funke, N., Swartz, E.R., Smith-Adao, L.B., Mbona, N., Downsborough, L. and Nienaber, S. (2011).*Technical Report for the National Freshwater Ecosystem Priority Areas project*. WRC Report No. K5/1801.

No ENV-S-C 2005 053 C. Provincial Government of the Western Cape, Department of Environmental Affairs & Development Planning, Cape Town. 63 pp.

Oberholzer, B. 2005. Guideline for involving visual and aesthetic specialists in EIA processes: Edition 1. CSIR Report No ENV-S-C 2005 053 F. Republic of South Africa, Provincial Government of the Western Cape, Department of Environmental Affairs and Development Planning, Cape Town.

Pers comm. 2013. S. Kaal, Iziko Museums of South Africa.

Rubidge, B.S., et al. 1995. *An introduction to the biozonation of the Beaufort Group*. Biostratigraphy Series for the South African Committee for Stratigraphy 1: 1-2.

SA Explorer. Accessed: *http://www.saexplorer.co.za*

SA Rainfall Atlas. Accessed: *http://134.76.173.220/rainfall/index.html*

Sheppard, S.R.J. 2005. Validity, reliability, and ethics in visualization. In: Bishop, I. & Lange, E. (Eds.) *Visualization in Landscape and Environmental Planning: Technology and Applications*. Taylor and Francis, London. Chapter 5, pp. 79-97. Accessed: www.calp.forestry.ubc.ca/Coe of Ethics_July03.pdf

Skinner, J.D. & Chimimba, C.T. 2005. The mammals of the Southern African Subregion. Cambridge University Press, Cambridge.

Smit, H.A. 2012. *Guidelines to minimise the impact on birds of Solar Facilities and Associated Infrastructure in South Africa.* Birdlife South Africa. Accessed: http://www.birdlife.org.za/conservation/birds-and-wind-energy

Smith, B. 2006. The Farming Handbook. University of KwaZulu-Natal Press.

Smith, R.M.H. 1990. *A review of stratigraphy and sedimentary environments of the Karoo Basin of South Africa*. Journal of African Earth Sciences 10:117-137.

Soil Classification Working Group. 1991. Soil Classification: a taxonomic system for South Africa. ARC-Institute for Soil, Climate and Water, Pretoria.

StatsSA. 2013a. *StatsSA Mid-year population estimates 2013*. Accessed: http://www.statssa.gov.za/Publications/P0302/P03022013.pdf [2013, May 14].

StatsSA. 2013b. *Statistics South Africa Quarterly labour force survey. First Quarter 2013*. Accessed: http://www.statssa.gov.za/Publications/statsdownload.asp?PPN=P0211&SCH=5518

Strelitzia 19. South African National Biodiversity Institute, Pretoria.

U.K Institute of Environmental Management and Assessment (IEMA). 'Guidelines for Landscape and Visual Impact Assessment' Second Edition, Spon Press, 2002. p 44.

Van Lyden, G.W.J. and Oldeman, L.R.(1997) The Assessment of the Status of Human-Induced Soil Degradation in South and Southeast Asia. International Soil Reference and Information Centre.

World map of the status of human-induced soil degradation: an explanatory note. (1990) Oldeman, L.R., Hakkeling, R.T.A, and Sombroek, W.G. International Soil Reference and Information Centre; Nairobi: United Nations Environment Programme. -I11.