UPGRADE ENERGY (PTY) LTD

Proposed Expansion of the Leeumax Solar Photovoltaic (PV) Energy Facility and Associated Infrastructure near Leeudoringstad in the North West Province

Draft Environmental Management Programme (EMPr)

Issue Date: November 2022
Revision no.: 1.0
Project No. 17420
DEDECT Ref No.: TBA

Date:	November 2022
Document Title:	Proposed Expansion of the Leeumax Solar Photovoltaic (PV) Energy Facility (SEF) and associated Infrastructure near Leeudoringstad in the North West Province: Draft Basic Assessment Report (DBAR)
Revision Number:	1.0
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Confidentiality Statement

UPGRADE ENERGY (PTY) LTD

LEEUMAX SOLAR PV ENERGY FACILITY

DRAFT ENVIRONMENTAL MANAGEMENT PROGRAMME (EMPR)

TABLE OF CONTENTS

APPENDICES

LIST OF FIGURES

LIST OF TABLES

UPGRADE ENERGY (PTY) LTD

LEEUMAX PV SOLAR ENERGY FACILITY

DRAFT ENVIRONMENTAL MANAGEMENT PROGRAMME (EMPR)

1. INTRODUCTION

Upgrade Energy (Pty) Ltd received authorisation for the following projects on a site located approximately 6km north-east of the town of Leeudoringstad in the Maquassi Hills Local Municipality, within the Dr Kenneth Kaunda District Municipality in the North West Province (**Figure 1**):

- 9.9MW Leeuwbosch 1 Solar PV Plant - **Reference Number:** NWP/EIA/42/2021
- 9.9MW Leeuwbosch 2 Solar PV Plant - **Reference Number:** NWP/EIA/45/2021
- 132/11kV Leeudoringstad Solar Plant Substation - **Reference Number:** NWP/EIA/43/2021

Application for a Part 1 Amendment is currently in process to combine Leeuwbosch 1 Solar PV Plant and Leeubosch 2 Solar PV Plants and rename the facility to be known as 'Leeumax Solar PV Plant'.

The applicant, Upgrade Energy (Pty Ltd), is further proposing to expand their already approved solar Photovoltaic (PV) facilities at Leeubosch with a further generation capacity of approximately 15MWac on both the existing approved footprints as well as in the southwestern portion of the property.

SiVEST Environmental Division has subsequently been appointed as the independent Environmental Assessment Practitioner (EAP) to undertake the required Draft Environmental Management Programme (EMPr) (in line with the National Environmental Management Act, 1998 (Act 107 of 1998)) for the proposed expansion of the Leeumax SEF and associated grid infrastructure.

The proposed expansion will comprise several arrays of PV panels, and associated infrastructure. The associated infrastructure would include, but not be limited to, additional internal access roads, one (1) additional switching substation, one (1) additional permanent guard house and one (1) additional temporary building zone. The total capacity of the Solar PV plant will have a contracted capacity of up to 35MWac and will be known as the Leeumax Solar PV Facility.

This EMPr provides a set of guidelines for the environmental management of all works executed by the Developer, Engineer, Contractor and Sub-contractor/s to have a minimum impact on the environment in accordance with all relevant legislation, policies and standards. In this context, it should be viewed as a dynamic or "living" document which may require updating or revision during the life-cycle of the development to address new circumstances as the need arises. It is essentially, a written plan of how the environment is to be managed in practical and achievable terms. The EMPr shall be deemed to have contractual standing on the developer and contractors onsite.

The effectiveness of the EMPr is limited by the level of adherence to the conditions set forth in this report by the Developer and the Contractor and Sub-contractors. It is further assumed that compliance

with the EMPr will be monitored and audited on a regular basis as set out in the EMPr and contractual clauses.

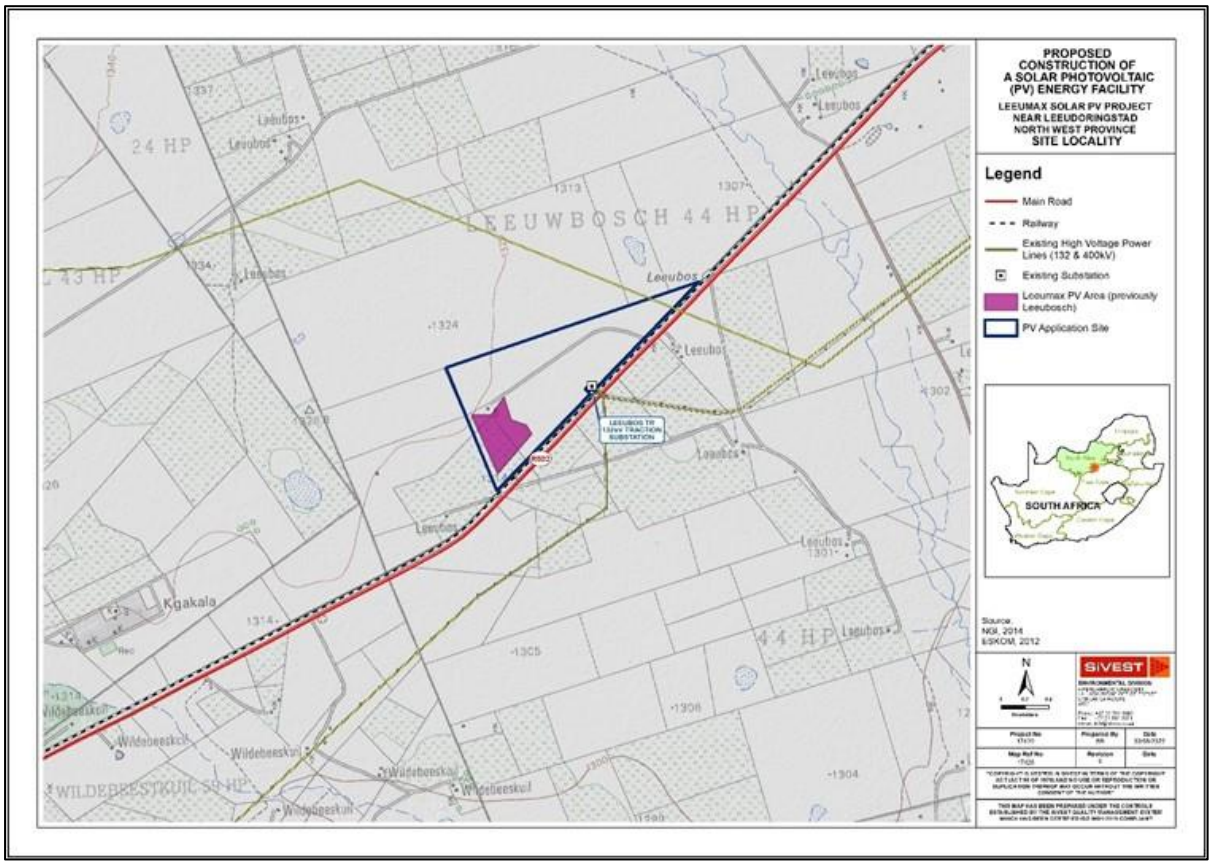


Figure 1: Site Locality

1.1 Content Requirements for an Environmental Management Programme (EMPr)

The content requirements for an EMPr (as provided in Appendix 4 of the EIA Regulations 2014, as amended), as well as details of which section of the report fulfils these requirements, are shown in **Table 1** below.

Table 1: Content requirements for a EMPr

2014 EIA Regulations, as amended.	Requirements for an EMPr	Location in this EMPr
Appendix 4, Section 1. (1)	An EMPr must comply with section 24N of the Act and include -	Refer to relevant sections below:
Appendix 4, Section 1 (a)	Details of –	-
	(i) The EAP who prepared the EMPr; and	Section 3.1 Section 3.2
	(ii) The expertise of that EAP to prepare an EMPr, including a curriculum vitae.	Section 3.2

2014 EIA Regulations, as amended.	Requirements for an EMPr	Location in this EMPr
Appendix 1, Section 3 (b)	a detailed description of the aspects of the activity that are covered by the EMPr as identified by the project description;	Section 4.1
Appendix 4, Section 1 (c)	a map at an appropriate scale which superimposes the proposed activity, its associated structures, and infrastructure on the environmental sensitivities of the preferred site, indicating any areas that should be avoided, including buffers;	Figure 1 and Figure 5
Appendix 4, Section 1 (d)	a description of the impact management outcomes, including management statements, identifying the impacts and risks that need to be avoided, managed and mitigated as identified through the environmental impact assessment process for all phases of the development including— (i) planning and design; (ii) pre-construction activities; (iii) construction activities; (iv) rehabilitation of the environment after construction and where applicable post closure; and (v) where relevant, operation activities;	Section 9
Appendix 4, Section 3 (f)	a description of proposed impact management actions, identifying the manner in which the impact management outcomes contemplated in paragraph (d) will be achieved, and must, where applicable, include actions to — (i) avoid, modify, remedy, control or stop any action, activity or process which causes pollution or environmental degradation; (ii) comply with any prescribed environmental management standards or practices; (iii) comply with any applicable provisions of the Act regarding closure, where applicable; and (iv) comply with any provisions of the Act regarding financial provision for rehabilitation, where applicable;	Section 9
Appendix 4, Section 3 (g)	the method of monitoring the implementation of the impact management actions contemplated in paragraph (f);	Section 9
Appendix 4, Section 3 (h)	the frequency of monitoring the implementation of the impact management actions contemplated in paragraph (f);	Section 9
Appendix 4, Section 3 (i)	an indication of the persons who will be responsible for the implementation of the impact management actions;	Section 8 Section 9
Appendix 4, Section 3 (j)	the time periods within which the impact management actions contemplated in paragraph (f) must be implemented;	Section 9
Appendix 4, Section 3 (k)	the mechanism for monitoring compliance with the impact management actions contemplated in paragraph (f);	Section 9
Appendix 4, Section 3 (l)	a program for reporting on compliance, taking into account the requirements as prescribed by the Regulations;	Section 9
Appendix 4, Section 3 (m)	an environmental awareness plan describing the manner in which— (i) the applicant intends to inform his or her employees of any environmental risk which may result from their work; and (ii) risks must be dealt with in order to avoid pollution or the degradation of the environment; and	Section 11
Appendix 4, Section 3 (n)	any specific information that may be required by the competent authority.	Section 7.3 Section 10

2014 EIA Regulations, as amended.	Requirements for an EMPr	Location in this EMPr
Appendix 4 Section 2	Where a government notice gazetted by the Minister provides for a generic EMPr, such generic EMPr as indicated in such notice will apply.	Generic EMPr has been compiled and included.

2. DETAILS OF APPLICANT

2.1 Name and contact details of the Applicant

Name and contact details of Applicant:

Table 2: Name and contact details of the applicant

Business Name of Applicant	Upgrade Energy (Pty) Ltd
Physical Address	8 Farm Road, Fisherhaven, Western Cape, 7200
Postal Address	P.O. Box 1171, Umhlanga Rocks
Postal Code	4320
Telephone	083 465 9825
Fax	086 600 8622
Email	emil@megatrade.co.za

3. DETAILS AND EXPERTISE OF THE EAP

3.1 Name and contact details of the Environmental Assessment Practitioner (EAP)

The table below provides the name and contact details of the Lead EAP for the project:

Table 3: Name and contact details of the Environmental Consultant who prepared the report

Business Name of EAP	SiVEST SA (PTY) Ltd
Name of Lead EAP	Michelle Nevette
Physical Address	4 Pencarrow Crescent, La Lucia Ridge Office Estate
Postal Address	PO Box 1899, Umhlanga Rocks
Postal Code	4320
Telephone	031 581 1500
Fax	031 566 2371
Email	michellen@sivest.co.za

3.2 Names and expertise of the EAPs

The table below provides the names of the people who prepared this report and their expertise:

Table 4: Names and details of the expertise of the EAP's involved in the preparation of this report

Name of representative of the EAP	Educational Qualifications	Professional Affiliations	Experience (years)
Michelle Nevette *(Cert.Sci.Nat.)*	MEnvMgt. (Environmental Management)	SACNASP Registration No. 120356 EAPASA Registration No. 2019/1560 IAIAsa	19
Luvanya Naidoo *(Pr.Sci.Nat)*	BSc Hons Environmental Monitoring & Modelling	SACNASP Registration No. 126107 EAPASA Registration No. 2019/1404 IAIA	12

CV's of SiVEST personnel and EAP declaration are attached in **Appendix A.**

3.3 Names and expertise of the specialists

Specialist studies have been conducted in terms of the Procedures for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes in terms of Sections 24(5)(A) and (H) And 44 of the NEMA when applying for EA, as well as the EIA Regulations, 2014 (as amended). The table below provides the names of the specialists involved in the project:

Table 5: Names of specialists involved in the project

Company	Name of representative of the specialist	Specialist	Educational Qualifications	Experience (years)
SLR Consulting (South Africa) (Pty) Ltd	Kerry Schwartz	Visual Impact Assessment	BA (Geography) GTc GISc 1187	25
Johann Lanz Consulting	Johann Lanz	Agriculture and Soils Assessment	M.Sc. (Environmental Geochemistry)	24
Chris Van Rooyen Consulting	Chris van Rooyen	Avifaunal Impact Assessment	BA LLB	22
	Albert Froneman		MSc Conservation	22
Banzai Environmental (Pty) Ltd	Elize Butler	Palaeontological Impact Assessment	MSc (cum laude) Zoology specialising in Palaeontology Palaeontological Society of South Africa	25
PGS Heritage (Pty) Ltd	Wouter Fourie	Heritage Impact Assessment	Professional Archaeologist registered ASAPA,CRM accreditation (ASAPA)	21

Company	Name of representative of the specialist	Specialist	Educational Qualifications	Experience (years)
			Professional Heritage Practitioner (APHP-Western Cape).	
Eco Assist Environmental Consulting	Wayne Jackson	Wetland Assessment	BSc Soil Science & Hydrology South African Council for Natural Scientific Professionals (SACNASP) reg No. 119037	13
Urban-Econ Development Economist	Ruan Oberholzer	Socio-Economic Impact Assessment	BTRP (Hons); MSc (Real Estate)	16
	Nthabiseng Makhoali		BCom Hons (Transport Economics), BCom (Economics & International Trade	3
JG Afrika (Pty) Ltd	Keval Sigh	Desktop Geotechnical Assessment	MSc (Engineering Geology)	10
SiVEST SA (Pty) Ltd	Ntuthuko Hlanguza (Pr. Eng)	Stormwater Management Plan	BSc.Eng (Civil) Engineering Council of South Africa Reg No. 202202263	8

4. ACTIVITY INFORMATION

4.1 Project Description

The site area to be expanded is approximately 15 ha in extent. It is anticipated that the expanded Solar PV energy facility will include PV fields (arrays) comprising of multiple PV panels. In summary, the proposed SEF expansion development will include the following components:

- The proposed solar PV plant will include PV fields (arrays) comprising multiple PV modules;
- PV panels will be single axis tracking mounting, and the modules will be either crystalline silicon or thin film technology;
- Each PV module will be approximately 2274mm (≈2.3m) long and 1134mm (≈1.1m) wide and mounted on supporting structures above ground;
- The foundations will most likely be either concrete or rammed piles;
- Generation capacity of up to 35MWac, broken down as follows:
  - PV 1 - up to 10MWac (to be expanded by 0.1 MWac on existing footprint)
  - PV 2 - up to 10MWac (to be expanded by 0.1 MWac on existing footprint)

- PV expansion area – new area, to be expanded by up to 15MWac
- One (1) new 33/132kV on-site substation (facility substation) occupying an area of up to approximately 0.2003ha (2 003m^2);
- One (1) guard house approximately 0.0876 ha (876m^2) in size;
- One (1) temporary building zone 0.2944 ha (2 944m^2);
- Site and internal access roads, up to 4m wide, will provide access to the PV arrays. Existing site roads will be used wherever possible, although new site roads will be constructed where necessary;
- Galvanized steel fencing with electrification approximately 2.1m in height;
- Existing boreholes will be used where possible. Water will potentially be stored in water storage tanks;

The proposed layout is reflected below in **Figure 2**.

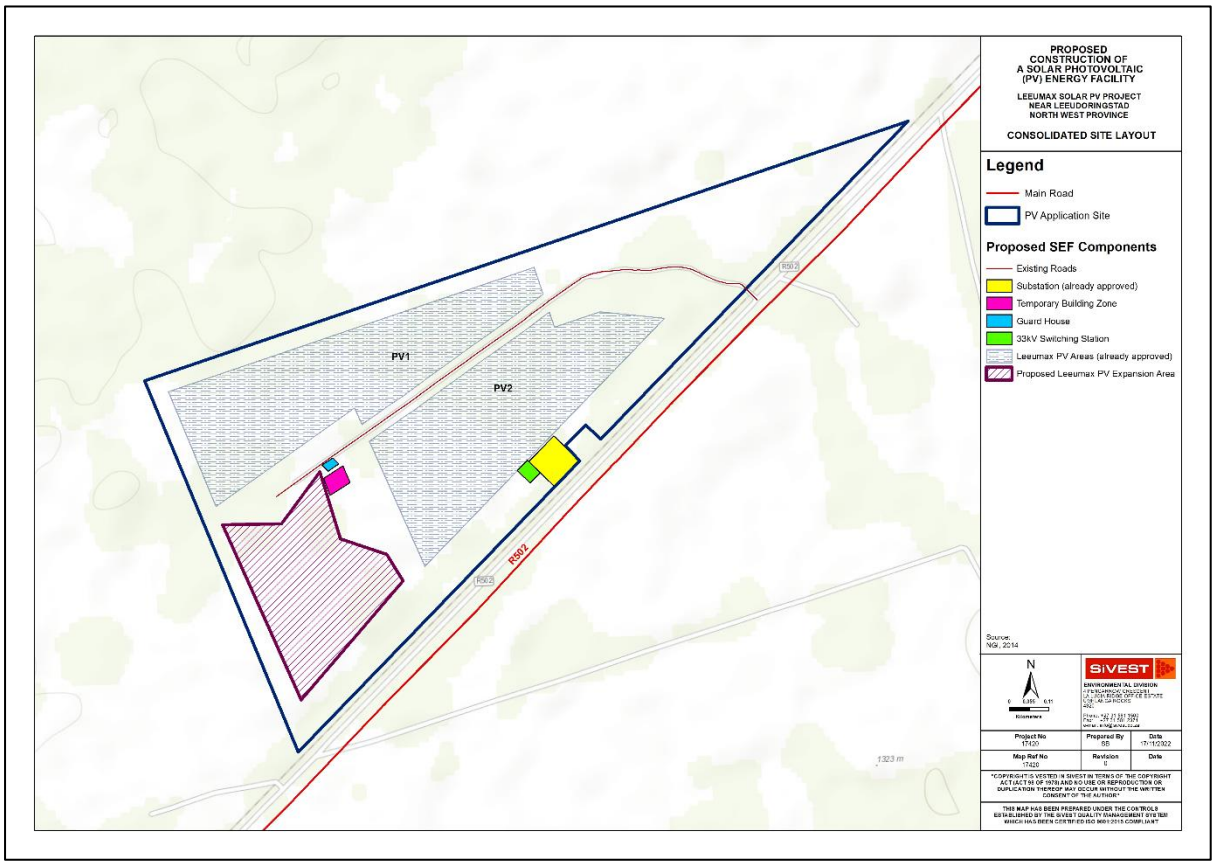


Figure 2: Proposed layout

A summary of the project technical details is provided in **Table 6** below.

Table 6: Technical Detail Summary

Component	Description / Dimensions
Location of site (centre point)	Latitude: 27°12'24.03" S Longitude: 26°18'2.64" E
Expansion site area	Approximately 15 ha

Component	Description / Dimensions
Technology	• The proposed expanded solar PV plant will include PV fields (arrays) comprising multiple PV modules. • PV panel mountings. PV panels will be single axis tracking mounting, and the modules will be either crystalline silicon or thin film technology. • Each PV module will be approximately 2274mm (≈2.3 m) long and 1134 mm (≈1.1 m) wide and mounted on supporting structures above ground. At this stage it is anticipated that the structures will be mono-facial modules. The final design details will become available during the detailed design phase of the proposed development, prior to the start of construction. • The foundations will most likely be either concrete or rammed piles. The final foundation design will be determined at the detailed design phase of the proposed development.
SG codes	T0HP00000000004400037
Generation Capacity of Expanded Solar PV Plant	Maximum of up to ± 35MW ac ○ PV 1 - up to 10MWac (to be expanded by 0.1 MWac on existing footprint) ○ PV 2 - up to 10MWac (to be expanded by 0.1 MWac on existing footprint) ○ PV expansion area – new area, to be expanded by up to 15MWac
Capacity of Additional Switching Substation	More than 33 kV but less than 275 kV. Exact capacity of the proposed on-site switching substation will be determined and confirmed at a later stage.
Dimensions of PV Panels	• Width: up to ± 2274mm (≈2.3m) • Length: up to ± 1134mm (≈1.1m)
Additional On-site Switching Substation	• One (1) new on-site switching substation with a capacity of more than 33 but less than 275 kV. • Total footprint: up to ± 0.2003 ha (2 003 m^2). • To contain transformers for voltage, step up from medium voltage to high voltage. DC power from the PV modules will be converted into AC power in the inverters and the voltage will be stepped up to medium voltage in the inverter transformers.
Additional Guard House	One (1) permanent guard house of ± 0.0876ha (876 m^2).
Additional Temporary Building Zone	One (1) temporary building zone of ± 0.2944ha (2 944 m^2).
Area Occupied by Buildings	Up to ± 1.3807 ha (13 807 m^2)
Width of Existing Internal Gravel Roads	• Up to ± 4 m; • Existing internal gravel site roads will be used wherever possible. However, where required, new internal gravel roads may be constructed.
Length of existing internal roads (to be potentially upgraded)	Up to ± 1.57 km
Site Access	Access to the proposed development will be via an existing gravel road which connects to the tarred R502 road.

Component	Description / Dimensions
Proximity to grid connection	• Grid connection is to the 132/11kV Leeudoringstad Solar Plant Substation, which has been authorised as part of a separate BA process; and • The 132/11kV Leeudoringstad Solar Plant Substation is located within the proposed Leumax Solar PV Plant application site (namely Portion 37 of the Farm Leeuwbosch No. 44). • Medium voltage cabling (anticipated to be ± 0.8m x 0.6m wide at this stage) will link the various PV arrays to the switching substation, as well as the Leeudoringstad Solar Plant Substation. These cables will be laid underground, wherever technically feasible.
Height of fencing	• ± 2.1 m high • Fencing will surround the entire proposed solar PV plant.
Type of fencing	Galvanised steel with electrification on top.
Area covered by fencing	Up to approximately 18 ha
Boreholes and storage tanks	• At this stage it is anticipated that existing boreholes will be utilised; • Water will potentially be stored in temporary water storage tanks.

4.2 NEMA Listed Activities

The amended EIA Regulations promulgated under Section 24(5) of the National Environmental Management Act, Act 107 of 1998 and published in Government Notice No. R. 326 list activities which may not commence without environmental authorization from the Competent Authority. The proposed activity is identified in terms of Government Notice No. R. 327, 325 and 324 for activities which must follow a full Environmental Impact Assessment Process. The project will trigger the following listed activities:

Table 7: Listed activities in terms of NEMA: EIA Regulations 2014 (as amended in 2017), applicable to the proposed project

Activity No(s):	Relevant activities as set out in Listing Notices 1, 2 and 3 of the EIA Regulations, 2014 as amended	Describe the portion of the proposed project to which the applicable listed activity relates.
Relevant Basic Assessment Activities as set out in Listing Notice 1		
11 (i)	**GN R. 327 Item 11:** The development of facilities or infrastructure for the transmission and distribution of electricity—	The application involves the construction of an on-site IPP substation within the proposed application site which will be located outside an urban area. The proposed switching substation will have a capacity of more than 33 but less than 275 kilovolts (kV).

Activity No(s):	Relevant activities as set out in Listing Notices 1, 2 and 3 of the EIA Regulations, 2014 as amended	Describe the portion of the proposed project to which the applicable listed activity relates.
	(i) outside urban areas or industrial complexes with a capacity of more than 33 but less than 275 kilovolts.	The proposed application also involves the construction of medium voltage cabling to link the various PV arrays to the proposed switching substation, as well as the Leeudoringstad Solar Plant Substation.
27	**GN R. 327 Item 27:** The clearance of an area of 1 hectares or more, but less than 20 hectares of indigenous vegetation, except where such clearance of indigenous vegetation is required for— (i) the undertaking of a linear activity; or (ii) maintenance purposes undertaken in accordance with a maintenance management plan.	The proposed application will include the clearance of an area of 1ha or more, but less than 20ha of indigenous vegetation within the proposed application site. The extent of the clearance is approximately 15ha.
28 (ii)	**GN R. 327 Item 28:** Residential, mixed, retail, commercial, industrial or institutional developments where such land was used for agriculture, game farming, equestrian purposes or afforestation on or after 01 April 1998 and where such development: (ii) will occur outside an urban area, where the total land to be developed is bigger than 1 hectare;	The proposed site is currently used and zoned for agricultural purposes. The proposed development will result in an area of agricultural land greater than 1ha being transformed to industrial / commercial use for the proposed facility. Consent has however been received from DALRRD and the Maquassi Hills Local Municipality to establish a solar panel farm on the property.
36	**GN R. 327 Item:** The expansion of facilities or structures for the generation of electricity from a renewable resource where – (i) the electricity output will be increased by 10 megawatts or more, excluding where such expansion take place on the original development footprint; or (ii) regardless the increased output of the facility, the facility, the development footprint will be expanded by 1 hectare or more; excluding where such expansion of facilities or structures is for photovoltaic installations and occurs – (a) within an urban area; or (b) on existing infrastructure	Generation of electricity from a renewable resource will be expanded as follows: The electricity output will be increased by approximately 15 megawatts, as follows: ○ PV 1 - up to 10MWac (to be expanded by 0.1 MWac on existing footprint) ○ PV 2 - up to 10MWac (to be expanded by 0.1 MWac on existing footprint) ○ PV 3 – new area, to be expanded by up to 15MWac The area to be expanded for the generation of electricity from a renewable

Activity No(s):	Relevant activities as set out in Listing Notices 1, 2 and 3 of the EIA Regulations, 2014 as amended	Describe the portion of the proposed project to which the applicable listed activity relates.
		energy will be expanded by approximately 15ha outside of an urban area.

5. LOCATION OF THE ACTIVITY

5.1 Regional Locality

The proposed development is located approximately 6 km north east of the town of Leeudoringstad in the Maquassi Hills Local Municipality, within the Dr Kenneth Kaunda District Municipality in the North West Province (**Figure 3**).

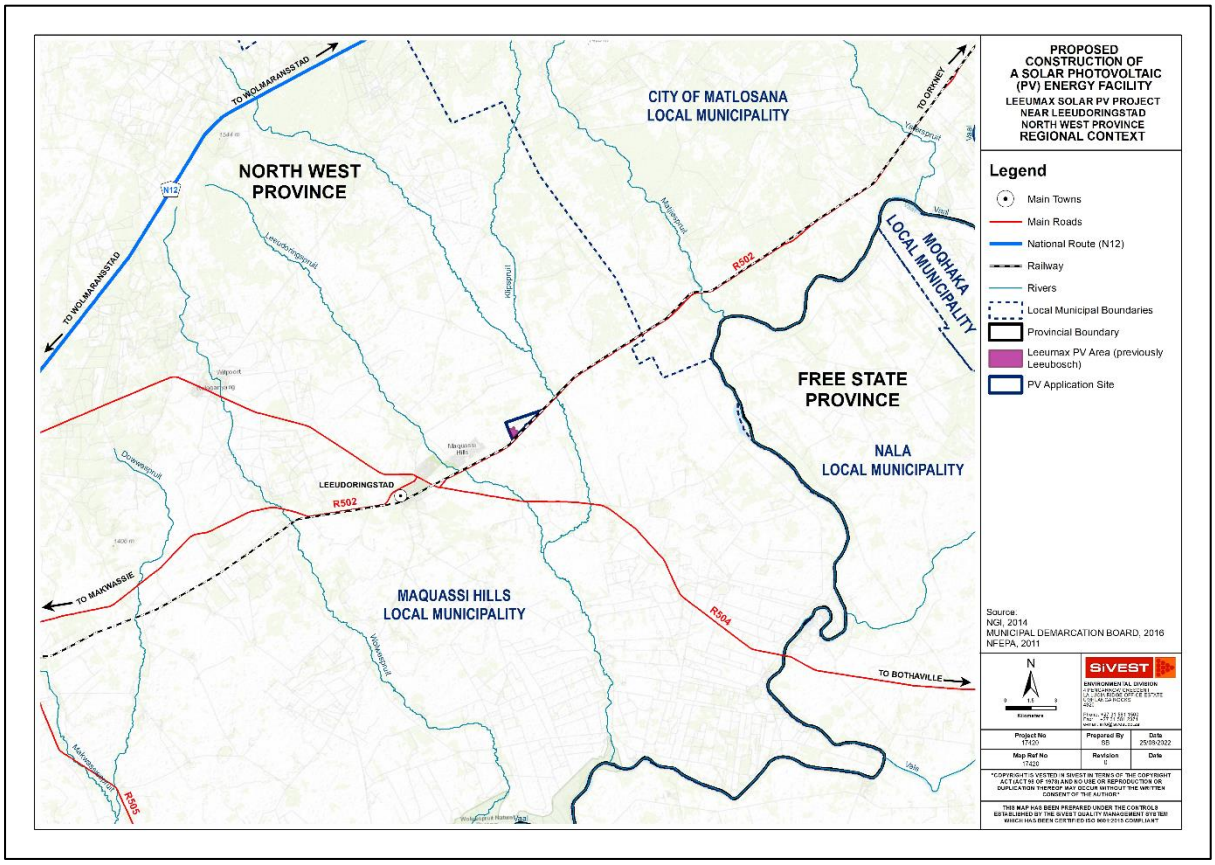


Figure 3: Regional Context

5.2 Summary of affected properties (including SG codes and Farm Names)

Table 8: Summary of affected properties (including SG Codes and Farm Names)

21-DIGIT SURVEYOR GENERAL (SG) CODE	FARM DESCRIPTION
T0HP00000000004400037	Portion 37 of the Farm Leeuwbosch No. 44

5.3 Coordinates of the site

Table 9: SEF Coordinates – Application site

LEEUMAX SEF: APPLICATION SITE		
COORDINATES AT CORNER POINTS (DD MM SS.sss)		
POINT	SOUTH	EAST
1	27°12'18.76"S	26°17'51.68"E
2	27°12'18.87"S	26°17'57.62"E
3	27°12'14.32"S	26°18'1.71"E
4	27°12'20.43"S	26°18'3.57"E
5	27°12'22.00"S	26°18'8.17"E
6	27°12'24.45"S	26°18'9.71"E
7	27°12'34.83"S	26°17'58.96"E
COORDINATES AT CENTRE POINT (DD MM SS.sss)		
POINT	SOUTH	EAST
8	27°12'24.91"S	26°18'1.14"E

LEEUMAX SEF: SUBSTATION AND ASSOCIATED INFRASTRUCTURE LOCATION		
COORDINATES AT CENTRE POINTS (DD MM SS.sss)		
POINT	SOUTH	EAST
33kV Switching Station	27°12'15.08"S	26°18'22.83"E
Temporary Building Zone	27°12'15.19"S	26°18'3.43"E
Guard House	27°12'13.71"S	26°18'2.79"E
Substation (already approved)	27°12'14.18"S	26°18'25.58"E

5.4 Study Area Description

According to the South African National Land Cover dataset (GeoTerra Image 2018), much of the assessment area is characterised by natural vegetation which is dominated by natural grassland. There are however significant patches of land classified as 'cultivated land' throughout the study area, although much of this land appears to be fallow grasslands. Hence livestock farming is the dominant agricultural activity in the study area, although livestock densities appear to be relatively low.

Farm properties in the study area tend to be relatively large resulting in a low density of rural settlement. Built form is largely characterised by scattered farmsteads and ancillary farm buildings, gravel access roads, telephone lines, fences and the remnants of disused workers' dwellings. Other human influence is visible in the area in the form of road, rail and electricity infrastructure. This includes the R502 regional road adjacent to the site (along the southern boundary of the application site) and the R504 regional road which traverses the south-western. In addition, an operational railway line runs directly adjacent

to the R502 and several high voltage power lines feed into the Leeubosh TR 132kV Traction Substation situated on the boundary of the application site. The tall steel structures of the Traction Substation, as well as the tall steel towers of the power lines are visible in the landscape.

A summary of the specialist findings and recommendations is attached in **Appendix D**.

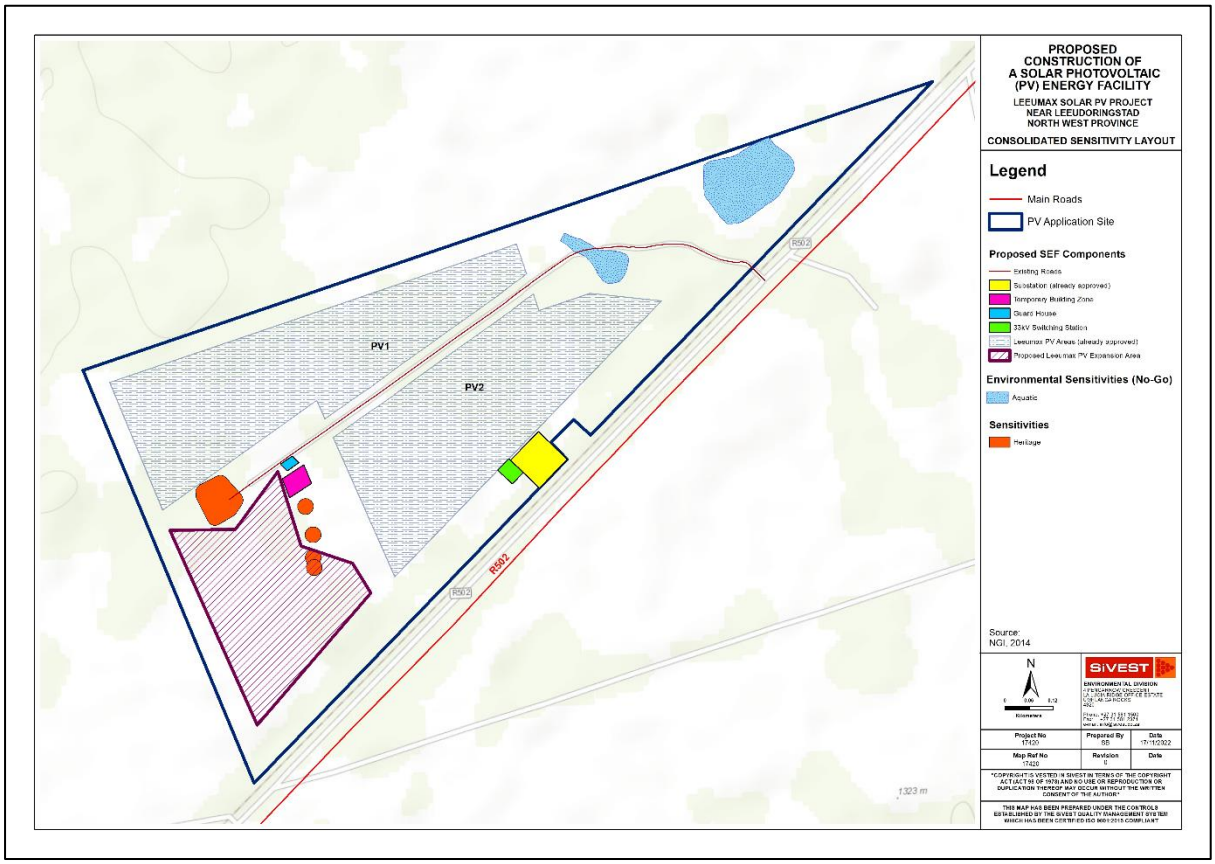


Figure 4: Proposed Layout with Sensitivity Overlay

6. ENVIRONMENTAL MANAGEMENT PROGRAMME

6.1 Introduction

The Environmental Management Programme (EMPr) has been prepared in order to comply with the requirements as stipulated in the National Environmental Management Act (No. 107 of 1998).

This EMPr includes:

- Details and expertise of the EAP who prepared the EMPr including curriculum vitae;
- Project Description;
- Facility Illustration Plans;
- Mitigation measures as contained in the Impact Assessment Report;
- Recommendations and conclusions emanating from the specialist studies;
- Impact Management Objectives and Actions; and
- A copy of the EA (if granted).

6.2 Aim and Objectives of the EMPr

The aim of the EMPr is to:

- Identify those construction activities identified for the proposed development that may have a negative impact on the environment;
- Outline the mitigation measures that will need to be taken and the steps necessary for their implementation;
- Describe the reporting system to be undertaken during construction.

The objectives of the EMP are to:

- Identify a range of mitigation measures which could reduce and mitigate the potential adverse impacts to minimal or insignificant levels.
- Provide a pro-active, feasible and practical working tool to enable the measurement and monitoring of environmental performance on site.
- Provide management structures that address the comments raised by I&APs pertaining to the development.
- Ensure that the environmental specifications are identified, effective and contractually binding so as to enable compliance on site.

6.3 Layout of the EMPr

The EMPr identifies the four phases of development as:

- Preconstruction Planning Phase Activities (Section 9.1)
- Construction Phase Activities (Section 9.2)
- Operation Phase Activities (Section 9.3)
- Decommissioning Phase Activities (Section 9.4)

The generic and specific provisions are included together under each phase for each environmental consideration. The generic provisions are the general environmental issues, procedures and controls that can be applied to the project and site as a whole. The specific provisions are those environmental issues, procedures and controls that are relevant to a particular section of the site. It should be understood that the EMP is considered an evolving document and may be amended at any time by the relevant authorities (DEDECT, DWS etc.).

7. LEGAL AND OTHER REQURIEMENTS

7.1 Compliance with Applicable Laws

The supreme law of the land is "The Constitution of the Republic of South Africa", which states: "*Every person shall have the right to an environment which is not detrimental to his or her health or wellbeing*". Laws applicable to the protection of the environment in terms of Environmental Management (and relating to construction activities) include but are not restricted to:

- Animals Protection Act, Act No. 71 of 1962
- Astronomy Geographic Advantage (Act No. 21 of 2007)
- Civil Aviation Act (Act No.13 of 2009)
- Conservation of Agricultural Resources Act, Act No. 43 of 1983
- Development Facilitation Act No. 67 of 1995
- Environment Conservation Act, Act No. 73 of 1989
- Environmental Planning Act, Act No. 88 of 1967
- Hazardous Substances Act, Act No. 15 of 1973
- Land Survey Act, Act No. 9 of 1921
- Minerals Act, Act No. 50 of 1991
- National Environmental Management: Air Quality Act, Act No. 39 of 2004);
- National Environmental Management: Biodiversity Act, Act No. 10 of 2004, as amended)
- National Environmental Management Act, Act No.107 of 1998
- NEMA EIA Regulations, 2014 (as amended)
- National Environmental Management: Protected Areas Act (NEM: PAA) (Act No. 57 of 2003, as amended)
- National Environmental Management: Waste Act, Act No. 59 of 2008
- National Forests Act (NFA) (Act No. 84 of 1998)
- The National Heritage Resources Act, Act No. 25 of 1999
- National Water Act, Act No. 36 of 1998
- National Dust Control Regulations (GN No. R. 827 of 1 November 2013
- National Road Traffic (Act No. 93 of 1996, as amended)
- Occupational Health and Safety Act, Act No. 85 of 1993
- Provincial and Local Government Ordinances and Bylaws
- Soil Conservation Act, Act No. 76 of 1969
- Subdivision of Agricultural Land (Act No. 70 of 1970, as amended)
- Water Services Act, Act No. 108 of 1997

Several regulations will be applicable to the construction phase of the project. These guidelines are mentioned in the EMPr tables. The EMPr forms part of the Contract Documentation and is thus is a legally binding document.

7.2 Compliance with the Environmental Management Programme

A copy of the EMPr must be kept on site during the construction period at all times. The EMPr will be made binding on all contractors operating on the site and will be included within the Contractual Clauses. Non-compliance with, or any deviation from, the conditions set out in this document constitutes a failure in compliance with the Environmental Authorisation (EA) issued by DEDECT.

It should be noted that in terms of Section 28 of the National Environmental Management Act (NEMA) Act No. 107 of 1998, those responsible for Environmental Damage must pay the repair costs both to the environment and human health and the preventative measures to reduce or prevent further pollution and/or environmental damage. (The polluter pays principle).

In terms of the EA, non-compliance of the EA may result in invalidation of the EA, criminal prosecution or other actions provided for in the NEMA (as amended) and associated regulations. Any non-compliance must result in an immediate stop to works being issued. The contractor and developer will be held liable for any damage and consequent rehabilitation to environmentally sensitive areas outside the site boundary. In the event of any dispute concerning the significance of a particular impact, the opinion of DEDECT in respect of its significance will prevail.

National government, provincial government, local authorities or committees appointed in terms of the conditions of the EA or any other public authority shall not be held responsible for any damages or losses suffered by the authorisation holder or successor in title in any instance where construction or operation subsequent to construction is temporarily or permanently stopped for reasons of non-compliance by the authorisation holder with the conditions of authorisation as set out in this document or any subsequent document emanating from these conditions of authorisation.

7.3 Specific Conditions Pertaining to Authorisations

Should the North West Department of Economic Development , Environment, Conservation and Tourism (DEDECT) issue an Environmental Authorisation (EA), this EMPr will be updated to include any additional pre-construction, construction, operation and decommissioning conditions stipulated in the EA not already included below.

A water use license will be applied for and may become applicable to the proposed project at a later stage.

Specific conditions pertaining to regulatory processes, or Licensee / Holder of the Authorisation requirements, have not been included within the EMPr and will only be included on finalization of the EMPr (pending decision). These conditions are to be undertaken by the Licensee / Holder of the Authorisation prior to the commencement of construction.

8. PROJECT RESPONSIBILITIES

8.1 Responsible Parties and associated roles

As described above, **Table 10** below provides a summary of the responsible parties and the auditing process to be carried out.

Table 10: Responsible Parties and Auditing Process

TITLE	PARTY	ROLE DURING CONSTRUCTION	ROLE DURING OPERATION
Project Developer (Proponent)	Upgrade Energy (Pty) Ltd	Assume ultimate responsibility	Assume ultimate responsibility
Project Manager	To be appointed by proponent	Project management	N/A
Contractor's Project Manager	Balance of Plant Contractor	Construction management	N/A
Main Contractor/s	There will be multiple contracts placed for the construction phase. These will cover civil earthworks and concrete, structural mechanical and electrical / instrumentation. There could also be the construction camp management contract. These may be managed by the Contractor's Project Manager (or other).	Main Contractor will undertake day to day construction activities covering aspects such as civil earthworks and concrete, structural mechanical and electrical / instrumentation.	N/A
Environmental Officer	To be appointed by Main Contractors	Day to day environmental responsibility, point of contact for ECO	N/A
Environmental Control Officer	To be appointed by Project developer	Monthly audits	Annual audits
Competent Authority	North West Department of Economic Development , Environment, Conservation and Tourism (DEDECT)	Conduct site visits when necessary.	Conduct site visits when necessary

The above may be updated based on the outcome of the Environmental process should additional responsibilities be identified.

9. IMPACT MANAGEMENT ACTIONS AND OUTCOMES

9.1 Pre-construction Phase

9.1.1 Site preparation

This section deals with the issues relative to site preparation during the pre-construction phase.

Table 11: Site preparation

ASPECT/ IMPACT	IMPACT MANAGEMENT ACTIONS	RESPONSIBILITY	METHOD	IMPACT MANAGEMENT OUTCOMES	TIMEFRAMES
Appointment of ECO	• Appoint an Environmental Control Officer.	Holder of the EA	Undertake regular audits	Avoid construction delays. Ensure the EMPr is adhered to.	Continuous
Site demarcation	• Before construction begins, all areas to be developed must be clearly demarcated with fencing or orange construction barrier where applicable. • All Construction Camps are to be fenced off in such a manner that unlawful entry is prevented and access is controlled. All access points to the Construction Camp should be controlled by a guard or otherwise monitored, to prevent unlawful access.	Contractor	Undertake regular audits	Prevent unauthorized impact on the environment. Ensure safety of the workers, public and prevent loss/ damage to equipment Ensure the conditions of the EA are adhered to	Continuous

ASPECT/ IMPACT	IMPACT MANAGEMENT ACTIONS	RESPONSIBILITY	METHOD	IMPACT MANAGEMENT OUTCOMES	TIMEFRAMES
				Compliance to all legislative requirements	
Site clearing	• Site clearing must take place in a phased manner, as and when required. • Areas which are not to be constructed on within two months must not be cleared to reduce erosion risks. • The area to be cleared must be clearly demarcated and this footprint strictly maintained. • Spoil that is removed from the site must be removed to an approved spoil site or a licensed landfill site. • The necessary silt fences and erosion control measures must be implemented in areas where these risks are more prevalent. • Storm water must be managed in such a manner as to disperse runoff and to prevent the concentration of storm water flow.	Holder of the EA/Contractor	Undertake regular audits	Site establishment undertaken responsibly Sensitive areas identified and avoided Erosion management plan implemented and hydrological measures in place. Appropriate stormwater structures as informed by the Storm Water Management Plan (Refer to **Appendix D**)	Once off
Construction Camp	• Site establishment shall take place in an orderly manner and all required amenities shall be installed at camp sites before the main workforce move onto site. • All construction equipment must be stored within the construction camp. • All associated oil changes etc. (no servicing) must take place within the camp over a sealed surface such as a concrete slab. • An area for the storage of hazardous materials must be established that conforms to the relevant safety	Contractor	Undertake regular audits	Prevent unauthorized impact on the environment. Ensure safety of the public and prevent loss/ damage equipment	Continuous

ASPECT/ IMPACT	IMPACT MANAGEMENT ACTIONS	RESPONSIBILITY	METHOD	IMPACT MANAGEMENT OUTCOMES	TIMEFRAMES
	requirements and that provides for spillage prevention and containment • All Construction Camps shall be provided with portable fire extinguishing equipment, in accordance with all relevant legislation and must be readily accessible. • The Contractor must provide sufficient ablution facilities, in the form of portable / VIP toilets, at the Construction Camps, and shall conform to all relevant health and safety standards and codes. No pit latrines, French drain systems or soak away systems shall be allowed and toilets may not be situated within 100 meters of any surface water body or 1:100-year flood line. • The Contractor shall inform all site staff to make use of supplied ablution facilities and under no circumstances shall indiscriminate sanitary activities be allowed. • No fires will be allowed and the Contractor must make alternative arrangements for heating. LP Gas may be used, provided that all required safety measures are in place. The Contractor shall take specific measures to prevent the spread of fires, caused by activities at the campsites. These measures may include appropriate instruction of employees about fire risks and the construction of firebreaks around the site perimeter.			Ensure EMP is adhered to Compliance to all legislative requirements	
Training of site staff	• Environmental awareness training for construction staff, concerning at a minimum the general environmental awareness, conservation of fauna and flora, the prevention of accidental spillage of hazardous chemicals and oil; pollution of water resources (both	Contractor	Undertake regular audits	All staff members are aware of the EMPr requirements relevant to them	Continuous

ASPECT/ IMPACT	IMPACT MANAGEMENT ACTIONS	RESPONSIBILITY	METHOD	IMPACT MANAGEMENT OUTCOMES	TIMEFRAMES
	surface and groundwater), air pollution and litter control and identification of archaeological artefacts. • Staff operating equipment (such as loaders, etc.) shall be adequately trained and sensitised to any potential hazards associated with their tasks. • No operator shall be permitted to operate critical items of mechanical equipment without having been trained by the Contractor and certified competent by the Project Manager. • Staff should be educated as to the need to refrain from indiscriminate waste disposal and/or pollution of local soil and water resources and receive the necessary safety training. • Staff must be trained in the hazards and required precautionary measures for dealing with these substances • Spillage packs must be available at construction areas.			All waste managed according to approved the Method Statement compiled by the contractor and approved by the engineer and reviewed by ECO	

9.1.2 Consultation

This section deals with the issues relative to consultation during the pre-construction phase.

Table 12: Consultation

ASPECT/ IMPACT	IMPACT MANAGEMENT ACTIONS	RESPONSIBILITY	IMPACT MANAGEMENT OUTCOMES	TIMEFRAMES
Consultation	• Provide a mechanism through which information could be exchanged between the project proponent and stakeholders.	Holder of the EA/ Contractor	Clear communication channels established	Continuous

ASPECT/ IMPACT	IMPACT MANAGEMENT ACTIONS	RESPONSIBILITY	IMPACT MANAGEMENT OUTCOMES	TIMEFRAMES
	• Identify relevant stakeholders and engage them at applicable stages of the process. • Inform the public about the proposed construction process. • Surrounding communities must be kept informed, through the identified and agreed consultation channels, of the commencement of construction. • Work on site to be restricted to work hours. • An agreement/contract should be formalised between the landowner and the applicant, that will ensure that the rehabilitation does not leave any liability to future landowners.			

9.1.3 Socio-economic

This section deals with the issues relative to Socio-economic during the pre-construction phase.

Table 13: Socio-economic

ASPECT/ IMPACT	IMPACT MANAGEMENT ACTIONS	RESPONSIBILITY	METHOD	IMPACT MANAGEMENT OUTCOMES	TIMEFRAMES/ FREQUENCY
Socio-economic: Availability of sufficient local construction materials for the PV Plant	• Source unavailable materials from abroad (import)	Project developer	Holder of the EA	Clear communication channels. Compliance to all legislative requirements. Ensure the EMPr is adhered to.	Continuous

9.2 Construction Phase

9.2.1 Construction Camp

This section deals with the issues relative to the construction camp during the construction phase.

Table 14: Construction Camp

ASPECT/ IMPACT	IMPACT MANAGEMENT ACTIONS	RESPONSIBILITY	IMPACT MANAGEMENT OUTCOMES	TIMEFRAME
Construction Camp: Site of construction camp	• The size of the construction camp must be aligned to the approved laydown area. • Adequate parking must be provided for site staff and visitors. The Contractor must attend to drainage of the camp site to avoid standing water and / or sheet erosion. • Suitable control measures over the Contractor's yard, plant and material storage to mitigate any visual impact of the construction activity must be implemented. • No construction should occur in an area of high or unique agricultural value, or in an area under cultivation.	Holder of the EA/Contractor	Ensure the conditions of the EA are adhered to. Compliance to all legislative requirements. Impacts avoided or managed as per specialist recommendations.	Once-off
Construction Camp: Storage of materials (including hazardous materials)	• Choice of location for storage areas must take into account prevailing winds, distances to water bodies, general onsite topography and water erosion potential of the soil. Impervious surfaces must be provided where necessary. • Storage areas must be designated, demarcated and fenced if necessary. • Storage areas should be secure so as to minimize the risk of crime. They should also be safe from access by unauthorised persons i.e. children / animals etc. • Fire prevention facilities must be present at all storage facilities.	Holder of the EA/Contractor	Choice of storage areas carefully considered to avoid impact to environment Correct handling, storage and/or disposal and/or cleanup of all	Continuous

ASPECT/ IMPACT	IMPACT MANAGEMENT ACTIONS	RESPONSIBILITY	IMPACT MANAGEMENT OUTCOMES	TIMEFRAME
	• Storage areas containing chemical substances / materials must be clearly sign posted. • Proper storage facilities for the storage of oils, paints, grease, fuels, chemicals and any hazardous materials to be used must be provided to prevent the migration of spillage into the ground and groundwater regime around the temporary storage area(s). These pollution prevention measures for storage must include a bund wall high enough to contain at least 110% of any stored volume, and this must be sited away from drainage lines in a site with the approval of the Project Manager. The bund wall must be high enough to contain 110% of the total volume of the stored hazardous material with an additional allocation for potential stormwater events. • These storage facilities (including any tanks) must be on an impermeable surface that is protected from the ingress of storm water from surrounding areas and that will not infiltrate into the ground in order to ensure that accidental spillage does not pollute local soil or water resources. • All fuel storage areas must be roofed to avoid creation of dirty stormwater • Material Safety Data Sheets (MSDSs) shall be readily available on site for all chemicals to be used on site. Where possible the available, MSDS's must additionally include information on ecological impacts and measures to minimise negative environmental impacts during accidental releases or escapes. • Staff dealing with these materials / substances must be aware of their potential impacts and follow the appropriate safety measures. • An approved waste disposal contractor must be employed to remove and recycle waste oil, if practical. The contractor must ensure that its staff is made aware of the health risks associated with any hazardous substances used and has been provided with the appropriate protective		materials to prevent impact to environment All hazardous substances managed according to approved Method Statement.	

ASPECT/ IMPACT	IMPACT MANAGEMENT ACTIONS	RESPONSIBILITY	IMPACT MANAGEMENT OUTCOMES	TIMEFRAME
	clothing/equipment in case of spillages or accidents and have received the necessary training. • All excess cement and concrete mixes are to be contained on the construction site prior to disposal off site. • All major spills as specified in the contractor emergency response procedure of any materials, chemicals, fuels or other potentially hazardous or pollutant substances must be cleaned immediately and the cause of the spill investigated. Preventative measures must be identified and submitted to the MC and ECO for information. Emergency response procedures to be followed and implemented.			
Construction Camp: Drainage of construction camp	• Surface drainage measures must be established in the Construction Camps so as to prevent – Ponding of water; – Erosion as a result of accelerated runoff; and, – Uncontrolled discharge of polluted runoff.	Holder of the EA/Contractor	Appropriate stormwater structures as informed by the Storm Water Management Plan (Refer to **Appendix D**) Storm Water Management Plan implemented Erosion plan implemented and hydrological measures in place.	Continuous

9.2.2 Environmental Education and Training

This section deals with the issues relative to environmental education and training during the construction phase.

Table 15: Environmental Education and Training

ASPECT/ IMPACT	IMPACT MANAGEMENT ACTIONS	RESPONSIBILITY	IMPACT MANAGEMENT OUTCOMES	TIMEFRAMES
Environmental Education and Training: Environmental Training	• Ensure that all site personnel have a basic level of environmental awareness training. The Contractor must submit a proposal for this training to the ECO for approval. Translators are to be used where necessary. Topics covered should include: – What is meant by "Environment" – Why the environment needs to be protected and conserved – How construction activities can impact on the environment – What can be done to mitigate against such impacts – Awareness of emergency and spills response provisions – Social responsibility during construction e.g. being considerate to local residents • It is the Contractor's responsibility to provide the site foreman with adequate environmental training and to ensure that the foreman has sufficient understanding to pass this information onto the construction staff. • Training should be provided to the staff members in the use of the appropriate fire-fighting equipment. • The need for a "clean site" policy also needs to be explained to the workers. • Staff operating equipment (such as loaders, etc.) shall be adequately trained and sensitized to any potential hazards associated with their tasks.	Contractor	Thorough induction to site.	Continuous

ASPECT/ IMPACT	IMPACT MANAGEMENT ACTIONS	RESPONSIBILITY	IMPACT MANAGEMENT OUTCOMES	TIMEFRAMES
Environmental Education and Training: Monitoring of environmental training	• The Contractor must monitor the performance of construction workers to ensure that the points relayed during their introduction have been properly understood and are being followed. If necessary, the ECO and / or a translator should be called to the site to further explain aspects of environmental or social behaviour that are unclear. Toolbox talks are recommended.	Contractor	Thorough induction to site.	Continuous

9.2.3 Waste Management

This section deals with the issues relative to waste management during the construction phase.

Table 16: Waste Management

IMPACT	IMPACT MANAGEMENT ACTIONS	RESPONSIBILITY	IMPACT MANAGEMENT OUTCOMES	TIMEFRAMES
Waste Management: Litter management/general waste	• The Contractor shall provide a method statement with regard to waste management. • Refuse bins must be placed at strategic positions to ensure that litter does not accumulate within the construction site. • The Contractor shall supply waste collection bins and all solid waste collected shall be disposed of at registered/licensed landfill. • A certificate of disposal shall be obtained by the Contractor and kept on file, if relevant. • A housekeeping team should be appointed to regularly maintain the litter and rubble situation on the construction site. • If possible and feasible, all waste generated on site must be separated into glass, plastic, paper, metal and wood and recycled. An independent contractor can be appointed to conduct this recycling.	Contractor The ECO shall monitor the neatness of the work sites as well as the Contractor campsite.	All waste managed according to approved Method Statement	Continuous

IMPACT	IMPACT MANAGEMENT ACTIONS	RESPONSIBILITY	IMPACT MANAGEMENT OUTCOMES	TIMEFRAMES
	• Where vegetation is cleared and is suitable, chipping and/or mulching can be considered. • Littering by the employees of the Contractor shall not be allowed under any circumstances. • Skip waste containers should be maintained on site. These should be kept covered and arrangements made for them to be collected regularly. • Any putrescible waste must be stored in containers that can keep out scavengers such as baboons and birds to prevent the spread of litter. • Storm water must be managed in such a manner as to disperse runoff and to prevent the concentration of storm water flow. • Under no circumstances may solid waste be burnt on site.			
Waste Management: Hazardous waste	• All waste hazardous materials, if present, must be carefully and appropriately stored, and then disposed of off-site at a licensed landfill site, where practical. • Contaminants to be stored safely to avoid spillage. • Machinery must be properly maintained to keep oil leaks in check • All necessary precaution measures shall be taken to prevent soil or surface water pollution from hazardous materials used during construction and any spills shall immediately be cleaned up and all affected areas rehabilitated.	Contractor	All waste managed according to approved Method Statement	Continuous
Waste Management: Sanitation	• The Contractor shall install mobile chemical toilets on the site. • The construction of “Long Drop” toilets are forbidden. Rather, portable toilets are to be used. • Staff shall be sensitised to the fact that they should use these facilities at all times. No indiscriminate sanitary activities on site shall be allowed. Under no circumstances may open areas, neighbours fences or the surrounding bush be used as a toilet facility. • Ablution facilities shall be within proximity from workplaces and not closer than 100m from any natural water bodies or boreholes. There should be	Contractor	Staff members aware of EMPr requirements and ablutions used and maintained accordingly	Continuous

IMPACT	IMPACT MANAGEMENT ACTIONS	RESPONSIBILITY	IMPACT MANAGEMENT OUTCOMES	TIMEFRAMES
	enough toilets available to accommodate the workforce (minimum requirement 1: 15 workers). Male and females must be accommodated separately where possible. • Toilets shall be serviced regularly (with proof) • Potable water must be provided for all construction staff.			
Waste Management: Remedial Actions	• In the event of an accidental spill or leakage of hazardous substances, such incident(s) must be reported to all relevant authorities, including the Directorate: Pollution and Chemicals Management, in accordance with section 30(5) of the NEMA, 1998 pertaining to the control of incidents. • Depending on the nature and extent of the spill, contaminated soil must be either excavated or treated on-site. • Excavation of contaminated soil must involve careful removal of soil using appropriate tools/machinery to storage containers until treated or disposed of at a licensed hazardous landfill site. • The precise method of treatment for polluted soil must be identified by a suitable specialist. This could involve the application of soil absorbent materials as well as oil-digestive powders to the contaminated soil. • If a spill occurs on an impermeable surface such as cement or concrete, the surface spill must be contained using oil absorbent material. • If necessary, oil absorbent sheets or pads must be attached to leaky machinery or infrastructure. • Materials used for the remediation of petrochemical spills must be used according to product specifications and guidance for use. • Contaminated remediation materials must be carefully removed from the area of the spill so as to prevent further release of petrochemicals to the environment and stored in adequate containers until appropriate disposal.	Contractor	All waste managed according to approved Method Statement	Continuous

9.2.4 Heritage

This section deals with the issues relative to heritage during the construction phase.

Table 17: Heritage

ASPECT/ IMPACT	IMPACT MANAGEMENT ACTIONS	RESPONSIBILITY	METHOD	IMPACT MANAGEMENT OUTCOMES	TIMEFRAMES/ FREQUENCY
Heritage: Site clearance and vegetation stripping	• Implement a chance finds procedures handle any heritage resources discovered during construction.	Construction Manager or Contractor	Monitoring of surface clearance relative to approved layout	Minimise landscape scarring	Ongoing basis
		ECO			Whenever on site (at least weekly)

9.2.5 Agriculture and Soils

This section deals with the issues relative to Agriculture and Soils during the construction phase.

Table 18: Agriculture and Soils

ASPECT/ IMPACT	IMPACT MANAGEMENT ACTIONS	RESPONSIBILITY	METHOD	IMPACT MANAGEMENT OUTCOMES	TIMEFRAMES/ FREQUENCY
Loss of agricultural land and	• Avoid any cultivated and especially irrigated areas, if possible.	• Project management • EPC • Engineer/Contractor	Undertake a periodic site inspection to record the occurrence of and re-vegetation progress of all areas that require re-vegetation.	That disturbance and existence of hard surfaces causes no erosion on or downstream of the site. That vegetation clearing does not pose a high erosion risk.	Ongoing basis
Soil erosion (wind or water) caused by surface disturbance	• Avoid extensive vegetation removal; re-vegetate as soon as possible and maintain cover (irrigate if necessary)				

9.2.6 Socio-Economic

This section deals with the issues relative to socio-economic during the construction phase.

Table 19: Socio-Economic

ASPECT/ IMPACT	IMPACT MANAGEMENT ACTIONS	RESPONSIBILITY	IMPACT MANAGEMENT OUTCOMES	TIMEFRAMES/ FREQUENCY
Socio-economic: Increase in production of the national and local economies due to project capital expenditure.	Procure inputs from local and domestic suppliers Employ local contractors where possible	Holder of EA Contractor ECO	Clear communication channels. Compliance to all legislative requirements. Ensure the EMPr is adhered to.	Continuous
Socio-economic: The creation of new direct and indirect opportunities related to the construction and operation of the proposed solar plant and facilities	• Employ labour-intensive methods • Employ local residents and communities • Sub-contract to local construction companies • Utilise local suppliers	Holder of EA Contractor ECO	Clear communication channels. Compliance to all legislative requirements. Ensure the EMPr is adhered to.	Continuous

9.2.7 Geotechnical

This section deals with the issues relative to geotechnical during the construction phase.

Table 20: Geotechnical

ASPECT/ IMPACT	IMPACT MANAGEMENT ACTIONS	RESPONSIBILITY	IMPACT MANAGEMENT OUTCOMES	TIMEFRAMES/FREQUENCY
Geotechnical: Displacement of natural earth material and overlying vegetation. • Increase in soil and wind erosion due to • clearing of vegetation. • Construction and earthmoving • vehicles may displace soil during operations. • Creation • of drainage paths along access tracks. • Potential oil • spillages from heavy plant. • Excessive dust.	• Identify protected areas prior to construction. • Construction of temporary berms and drainage channels to divert surface water. • Minimize earthworks and fills. • Use existing road network and access tracks. • Rehabilitation of affected areas (such as regrassing, mechanical stabilization). • Correct engineering design and construction of gravel roads and water crossings. • Correct construction methods for foundation installations. • Control stormwater flow • Dust suppression	Holder of EA Contractor ECO	Clear communication channels. Compliance to all legislative requirements. Ensure the EMPr is adhered to.	Continuous

9.2.8 Aquatic/ Freshwater

This section deals with the issues relative to aquatic during the construction phase.

Table 21: Aquatic/ Freshwater

ASPECT/ IMPACT	IMPACT MANAGEMENT ACTIONS	RESPONSIBILITY	METHOD	IMPACT MANAGEMENT OUTCOMES	TIMEFRAMES/ FREQUENCY
Aquatic: Loss of wetland areas through direct impact or indirect impacts of erosion or sedimentation).	During site clearing the vegetation and topsoil is removed, increasing the runoff and erosion potential of flowing water. to mitigate these impacts the following measures must be followed: • Minimise the area of soil disturbance to reduce the impact of sedimentation into waterbodies. • Clearing and grading must occur only where necessary to build and provide access to structures and infrastructure. Clearing must be done immediately before construction, rather than leaving soils exposed for months or years. • Where possible, plants should be cut down to ground level instead of being removed completely to stabilise the soil during land-clearing operations. • The proposed limits of land disturbance must be physically marked off to ensure that only the land area required for the development is cleared.	Holder of EA Contractor ECO	Construction monitoring and audit reports	Impacts avoided or managed. Ensure the conditions of the EA are adhered to.	Continuous

ASPECT/ IMPACT	IMPACT MANAGEMENT ACTIONS	RESPONSIBILITY	METHOD	IMPACT MANAGEMENT OUTCOMES	TIMEFRAMES/ FREQUENCY
	• When excavated areas are backfilled the surface must be level with the surrounding land surface, to minimise soil erosion from the areas when the excavation is complete. • The most efficient approach to control erosion is to minimise the area of land disturbed as well as the duration for which it is exposed. • Once surfaces have been exposed, they must immediately be protected from erosion, so limiting the source of the sediment. • During the excavation of pits, roads, construction sites etc. the removed topsoil must be stored and appropriately protected so that it does not wash into waterbodies, causing sedimentation and nutrient loading. This is then used to backfill the area so that it can be effectively rehabilitated. • Topsoil that is removed during excavation must NEVER be buried or rendered unusable in any way (such as mixing it with spoils or being compacted by machinery). • During excavation soil must be excavated one layer at a time and stored in separate stockpiles so they can be returned in their natural order when the area is backfilled.				

ASPECT/ IMPACT	IMPACT MANAGEMENT ACTIONS	RESPONSIBILITY	METHOD	IMPACT MANAGEMENT OUTCOMES	TIMEFRAMES/ FREQUENCY
	This improves soil functions and improves the template for plant growth. • To ensure that it reaches most people signs must be written in the languages of the area (NOT just English). This ensures that non-English speakers can understand and will hopefully cooperate in reducing water pollution by the measures indicated on the sign. • Within a construction site, vehicle access must be strictly controlled (i.e., there must be set parking, turning areas, set routes and no access to undisturbed areas.) This minimises soil disturbance and compaction and pollution from fluids leaking onto the ground as well as the disturbance of aquatic organisms.				
Aquatic: Hydrocarbon spills and compaction within wetland zones. **Aquatic:** Sewerage spills within wetlands or drainage lines feeding wetlands	• Areas (away from surface water bodies and outside of the riparian zone) must be designated for the storage of materials and mixing of materials (such as concrete or chemicals). This reduces contamination of water resources from these materials/ activities. • Portable toilets must be provided where work is being done and must be located a	Holder of EA	Construction monitoring and audit reports	Impacts avoided or managed. Ensure the conditions of the EA are adhered to.	Continuous

ASPECT/ IMPACT	IMPACT MANAGEMENT ACTIONS	RESPONSIBILITY	METHOD	IMPACT MANAGEMENT OUTCOMES	TIMEFRAMES/ FREQUENCY
Aquatic: Spills of stored hazardous material into wetlands or drainage lines feeding wetlands	considerable distance away from water resources and riparian areas. • If soil contamination occurs (such as due to a spill) the soil must be removed from the site and disposed of appropriately. • Prevention of spills eliminates or minimizes the discharge of pollutants to water bodies. • Handle hazardous and non-hazardous materials, such as concrete, solvents, asphalt, sealants, and fuels, as infrequently as possible and observe all national and local regulations when using, handling, or disposing of these materials. • An effective response plan must be in place and personnel must be ready to mobilise in the event of a spillage to reduce the environmental effects of an oil or chemical spill. • Spill control devices such as absorbent snakes and mats must be placed around chemical storage areas, and they can be used in an emergency to contain a spill. • Implement preventative maintenance system to ensure that work vehicles are maintained in an acceptable condition. This would involve routinely checking vehicles for leaks before construction begins; and not allowing vehicles with significant leaks to operate or be repaired within the				

ASPECT/ IMPACT	IMPACT MANAGEMENT ACTIONS	RESPONSIBILITY	METHOD	IMPACT MANAGEMENT OUTCOMES	TIMEFRAMES/ FREQUENCY
	construction site. Ideally, vehicle maintenance and washing occurs in garages and wash facilities, not on active construction sites. • Before an operation occurs near a waterbody, vehicles must be checked for leaks, to reduce soil and water contamination from vehicle fluids. • Old engine oil must NOT be thrown on the ground or down a stormwater drains but rather collected in containers and recycled. • Ensure that appropriate solid waste disposal facilities are provided, and adequate signage is provided for all solid, liquid, and hazardous waste types. These must contain waste products in a weatherproof manner and to prevent any airborne litter, access to scavengers or loss of food residues that may be washed into surface or ground waters. Collected waste needs to be disposed of at a registered landfill site/hazardous waste facility. • Re-fuelling areas for vehicles must be bunded and located away from water resources and sensitive environments to prevent any accidental spillage contaminating soil or seeping into groundwater aquifers. All servicing area run-off must be directed towards a fully				

ASPECT/ IMPACT	IMPACT MANAGEMENT ACTIONS	RESPONSIBILITY	METHOD	IMPACT MANAGEMENT OUTCOMES	TIMEFRAMES/ FREQUENCY
	contained collection sump for recovery and appropriate disposal. • There must be no standing water at a stockpile site, to reduce erosion as well as the contamination of the water by nutrients/ toxics. • Water resources must be well fenced and sign-posted, to keep machinery, people, and livestock away from the water body as well as vegetated areas to reduce the soil disturbance, soil compaction and vegetation destruction, which thus reduces the amount of erosion and habitat loss.				
Aquatic: The introduction of alien vegetation into disturbed areas disrupting natural wetland vegetation composition or alteration of water transpiration from soils.	• Alien and invasive vegetation have several detrimental effects on water quality, from nutrient enrichment to increased erosion and excessive water use, which is especially relevant in dry areas or in important catchments. Invasive species are highly likely to colonise disturbed areas, even after rehabilitation and follow-up clearing must be done until healthy vegetation returns to the site	Holder of EA Contractor ECO	Construction monitoring and audit reports	Impacts avoided or managed. Ensure the conditions of the EA are adhered to.	Continuous
Aquatic: The change in flow dynamics to and through wetlands potentially altering wetland types or potentially causing	• Runoff from disturbed areas (such as landing/depot areas, extraction routes, gravel pits, temporary and unpaved roads) must be directed to silt traps (silt fences, sandbags, etc) to remove sediment and				

ASPECT/ IMPACT	IMPACT MANAGEMENT ACTIONS	RESPONSIBILITY	METHOD	IMPACT MANAGEMENT OUTCOMES	TIMEFRAMES/ FREQUENCY
erosion from increased surface runoff.	reduce the sedimentation of the water bodies. • Check dams are small, temporary dams constructed across a swale or channel. They can be constructed using gravel, rock, gabions, or straw bales. They are used to reduce the velocity of concentrated flow and, therefore, to reduce erosion in a swale or channel.				

9.2.9 Avifaunal

This section deals with the issues relative to avifaunal during the construction phase.

Table 22: Avifaunal

ASPECT/ IMPACT	IMPACT MANAGEMENT ACTIONS	RESPONSIBILITY	METHOD	IMPACT MANAGEMENT OUTCOMES	TIMEFRAMES/FREQUENCY
Avifauna: Displacement of priority species due to disturbance associated with construction of the PV plant and associated infrastructure	• Construction activity should be restricted to the immediate footprint of the infrastructure • Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of priority species. • Measures to control noise and dust should be applied according to current best practice in the industry.	Contractor and ECO	1. Implementation of the CEMPr. Oversee activities to ensure that the CEMPr is implemented and enforced via site audits and inspections.	Prevent unnecessary displacement of avifauna by ensuring that contractors are aware of the requirements of the Construction Environmental Management	Monthly

ASPECT/ IMPACT	IMPACT MANAGEMENT ACTIONS	RESPONSIBILITY	METHOD	IMPACT MANAGEMENT OUTCOMES	TIMEFRAMES/FREQUENCY
	• Maximum used should be made of existing access roads and the construction of new roads should be kept to a minimum.		Report and record any non-compliance. 2. Ensure that construction personnel are made aware of the impacts relating to off-road driving. 3. Construction access roads must be demarcated clearly. Undertake site inspections to verify. 4. Monitor the implementation of noise control mechanisms via site inspections and record and report non-compliance. 5. Ensure that the construction area is demarcated	Programme (CEMPr.)	

ASPECT/ IMPACT	IMPACT MANAGEMENT ACTIONS	RESPONSIBILITY	METHOD	IMPACT MANAGEMENT OUTCOMES	TIMEFRAMES/FREQUENCY
			clearly and that construction personnel are made aware of these demarcations. Monitor via site inspections and report non-compliance.		

9.2.10 Terrestrial Biodiversity

This section deals with the issues relative to biodiversity during the construction phase.

Table 23: Terrestrial Biodiversity

ASPECT/ IMPACT	IMPACT MANAGEMENT ACTIONS	RESPONSIBILITY	METHOD	IMPACT MANAGEMENT OUTCOMES	TIMEFRAMES
Loss, degradation or fragmentation of vegetation through direct clearing	• Use existing road infrastructure for access roads. • Avoid construction of infrastructure within sensitive habitats. Minimise vegetation clearing and disturbance to footprint areas only. • Compile a rehabilitation programme and rehabilitate disturbed areas. • Compile and implement Alien Invasive Management Plan. Limit access to sensitive areas during construction.	Holder of EA Contractor ECO	Construction monitoring and audit reports	Impacts avoided or managed. Ensure the conditions of the EA are adhered to.	Continuous

ASPECT/ IMPACT	IMPACT MANAGEMENT ACTIONS	RESPONSIBILITY	METHOD	IMPACT MANAGEMENT OUTCOMES	TIMEFRAMES
	• Undertake monitoring to evaluate whether further measures are required.				

9.2.11 Visual

This section deals with the issues relative to visual during the construction phase.

Table 24: Visual

IMPACT/ ASPECT	MITIGATION/MANAGEMENT ACTIONS	RESPONSIBILITY	METHODOLOGY	MITIGATION/ MANAGEMENT OBJECTIVES AND OUTCOMES	FREQUENCY
Visual: Large construction vehicles and equipment will alter the natural character of the study area and expose visual receptors to impacts associated with construction. • Construction activities may be perceived as an unwelcome visual intrusion,	• Carefully plan to mimimise the construction period and avoid construction delays. • Inform receptors within 500m of the site of the construction programme and schedules. • Minimise vegetation clearing and rehabilitate cleared areas as soon as possible. • Vegetation clearing should take place in a phased manner. • Where possible, re-vegetate all reinstated cable trenches with the same vegetation that existed prior to the cable being laid.	Project management and EPC	As defined by the rehabilitation specialist.	• The surrounding landscape remains rural and agricultural in landscape and land use • Dust generated on site as well as on the access road to the site, is well managed and does not become a nuisance factor for the workers or the surrounding farmsteads.	• Commencement of construction

IMPACT/ ASPECT	MITIGATION/MANAGEMENT ACTIONS	RESPONSIBILITY	METHODOLOGY	MITIGATION/ MANAGEMENT OBJECTIVES AND OUTCOMES	FREQUENCY
particularly in more natural undisturbed settings. • Dust emissions and dust plumes from increased traffic on the gravel roads serving the construction site may evoke negative sentiments from surrounding viewers. • Surface disturbance during construction would expose bare soil (scarring) which could visually contrast with the surrounding environment.	• Establish erosion control measures on areas which will be exposed for long periods of time. This is to reduce the potential impact heavy rains may have on the bare soil. • Suitable buffers of intact natural vegetation should be provided along the perimeter of the development area. • Maintain a neat construction site by removing rubble and waste materials regularly. • Make use of existing gravel access roads where possible. • Limit the number of vehicles and trucks travelling to and from the construction site, where possible. • Ensure that dust suppression techniques are implemented: • on all access roads; • in all areas where vegetation clearing has taken place; • on all soil stockpiles. • Restrict construction activities to daylight hours in order to negate or reduce the visual				

IMPACT/ ASPECT	MITIGATION/MANAGEMENT ACTIONS	RESPONSIBILITY	METHODOLOGY	MITIGATION/ MANAGEMENT OBJECTIVES AND OUTCOMES	FREQUENCY
• Temporary stockpiling of soil during construction may alter the flat landscape. Wind blowing over these disturbed areas could result in dust which would have a visual impact.	impacts associated with lighting.				

9.3 Operation Operation Phase

9.3.1 Construction Site Decommissioning

This section deals with the issues relative to construction site decommissioning during the operation phase.

Table 25: Construction Site Decommissioning

ASPECT/ IMPACT	IMPACT MANAGEMENT ACTIONS	RESPONSIBILITY	IMPACT MANAGEMENT OUTCOMES	TIMEFRAMES
Construction Site Decommissioning: Removal of equipment	• All structures comprising the construction camp are to be removed from site.	Holder of EA/Contractor	Compliance to all legislative requirements.	Following construction

ASPECT/ IMPACT	IMPACT MANAGEMENT ACTIONS	RESPONSIBILITY	IMPACT MANAGEMENT OUTCOMES	TIMEFRAMES
	• The area that previously housed the construction camp is to be checked for spills of substances such as oil, paint, etc., and these shall be cleaned up. • All hardened surfaces within the construction camp area should be ripped, all imported materials removed, and the area shall be top soiled and regressed using the guidelines set out in the re-vegetation that forms part of this document.		Ensure the EMPr is adhered to.	
Construction Site Decommissioning: Temporary services	• The Contractor must arrange the cancellation of all temporary services. • Temporary roads must be closed and access across these, blocked. • All areas where temporary services were installed are to be rehabilitated to the satisfaction of the ECO.	Holder of EA/Contractor	Compliance to all legislative requirements. Ensure the EMPr is adhered to.	Following construction
Construction Site Decommissioning: Associated infrastructure	• Surfaces are to be checked for waste products from activities such as concreting or asphalting and cleared in a manner approved by the Engineer. • All surfaces hardened due to construction activities are to be ripped and imported material thereon removed. • All rubble is to be removed from the site to an approved disposal site as approved by the Engineer. Burying of rubble on site is prohibited. • The site is to be cleared of all litter. • The Contractor is to check that all watercourses are free from building rubble, spoil materials and waste materials. • Fences, barriers and demarcations associated with the construction phase are to be removed from the site unless stipulated otherwise by the Engineer.	Holder of EA/Contractor	All waste managed according to approved Method Statement	Following construction

ASPECT/ IMPACT	IMPACT MANAGEMENT ACTIONS	RESPONSIBILITY	IMPACT MANAGEMENT OUTCOMES	TIMEFRAMES
	• All residual stockpiles must be removed to spoil or spread on site as directed by the Engineer. • All leftover building materials must be returned to the depot or removed from the site. • The Contractor must repair any damage that the construction works has caused to neighbouring properties, specifically, but not limited to, damage caused by poor storm water management.			
Construction Site Decommissioning: Rehabilitation plan	• Rehabilitate and re-vegetate cleared areas with indigenous plant species.	Holder of EA/Contractor	Alien Plant Management Plan Plant Rehabilitation implemented	Following construction

9.3.2 Operation and Maintenance

This section deals with the issues relative to operation and maintenance during the operation phase.

Table 26: Operation and Maintenance

ASPECT/ IMPACT	IMPACT MANAGEMENT ACTIONS	RESPONSIBILITY	IMPACT MANAGEMENT OUTCOMES	TIMEFRAMES
Operation and Maintenance: Maintenance	• All applicable standards, legislation, policies and procedures must be adhered to during operation. • Regular ground inspection of the plants must take place to monitor their status. • Provide for suitable emergency and safety signage on site, and demarcation of any areas which may pose a safety risk (including hazardous substances). Emergency numbers for the local police,	Holder of the EA	Ensure the conditions of the EA are adhered to. Compliance to all legislative requirements	During operation

ASPECT/ IMPACT	IMPACT MANAGEMENT ACTIONS	RESPONSIBILITY	IMPACT MANAGEMENT OUTCOMES	TIMEFRAMES
	fire department and Eskom must be placed in a prominent clearly visible area on-site			
Operation and Maintenance: Public awareness	• The emergency preparedness plan must be ready for implementation at all times should an emergency situation arise.	Holder of the EA	Adhere to Emergency Evacuation Plan	During operation

9.3.3 Waste Management

This section deals with the issues relative to waste management during the operation phase.

Table 27: Waste Management

ASPECT/ IMPACT	IMPACT MANAGEMENT ACTIONS	RESPONSIBILITY	IMPACT MANAGEMENT OUTCOMES	TIME FRAME
Waste Management: Recycling and litter management	• The site should be kept clear of litter at all times. • Solid waste separation and recycling should take place for the duration of the operational phase for the development at the administration block. • Where vegetation is cleared and is suitable, chipping and/or mulching can be considered. • Any putrescible waste must be stored in containers that can keep out scavengers such as baboons and birds to prevent the spread of litter. • All waste must be removed promptly to ensure that it does not attract vermin or produce odours. • Solid waste should be collected on a regular basis • Waste needs to be collected and disposed of at a registered municipal site during and after construction, and written agreement	Holder of EA	All waste managed according to approved Method Statement Compliance to all legislative requirements.	Continuous

ASPECT/ IMPACT	IMPACT MANAGEMENT ACTIONS	RESPONSIBILITY	IMPACT MANAGEMENT OUTCOMES	TIME FRAME
	should be provided to the Northern Cape region Department of Water and Sanitation.			

9.3.4 Socio-Economic

This section deals with the issues relative to socio-economic during the operation phase.

Table 28: Socio-Economic

ASPECT/ IMPACT	IMPACT MANAGEMENT ACTIONS	RESPONSIBILITY	IMPACT MANAGEMENT OUTCOMES	TIMEFRAMES/ FREQUENCY
Socio-economic: The plant will increase the size of the local utility sector and stimulate economic production through multiplier effects.	• Procure goods and services required for the operation of the plant from the local economy.	Holder of the EA	Clear communication channels maintained	Continuous
Socio-economic: Creation of jobs to support the operation and maintenance of the plant	• Aim to fill all the positions with labour from the local community	Holder of the EA	Clear communication channels maintained	Continuous
Socio-economic: The generated electricity will improve the security of electricity in the local municipality and increase the government's revenue and service delivery	• No mitigation measures proposed	N/A	N/A	N/A

9.3.5 Geotechnical

This section deals with the issues relative to geotechnical during the operation phase.

Table 29: Geotechnical

ASPECT/ IMPACT	IMPACT MANAGEMENT ACTIONS	RESPONSIBILITY	IMPACT MANAGEMENT OUTCOMES	TIMEFRAMES/FREQUENCY
Geotechnical: Displacement of natural earth material. • Increase in soil erosion due to concentrated flow received off hardstand areas. • Potential oil spillages from maintenance vehicles. • Sedimentation of non-perennial features caused by soil erosion.	• Use of existing roads and tracks. • Rehabilitation of affected areas (such as erosion control mats). • Correct engineering design and construction of roads, water crossings and hardstand areas. • Vehicle repairs to be undertaken in designated areas • Design of and maintenance of stormwater system.	Holder of EA	Clear communication channels. Compliance to all legislative requirements. Ensure the EMPr is adhered to.	Continuous

9.3.6 Aquatic/ Freshwater

This section deals with the issues relative to aquatic freshwater during the operation phase.

Table 30: Aquatic/ Freshwater

ASPECT/ IMPACT	IMPACT MANAGEMENT ACTIONS	RESPONSIBILITY	IMPACT MANAGEMENT OUTCOMES	TIMEFRAMES/ FREQUENCY
Aquatic: The change in flow dynamics to and through wetlands potentially altering wetland types or potentially causing erosion from increased surface runoff.	• Runoff from disturbed areas (such as landing/depot areas, extraction routes, gravel pits, temporary and unpaved roads) must be directed to silt traps (silt fences, sandbags, etc) to remove sediment and reduce the sedimentation of the water bodies. • Check dams are small, temporary dams constructed across a swale or channel. They can be constructed using gravel, rock, gabions, or straw bales. They are used to reduce the velocity of concentrated flow and, therefore, to reduce erosion in a swale or channel.	Holder of EA	All staff members are aware of the EMPr. Ensure EMPr is adhered to.	Continuous
Aquatic: Hydrocarbon spills and compaction within wetland zones.	• Areas (away from surface water bodies and outside of the riparian zone) must be designated for the storage of materials and mixing of materials (such as concrete or chemicals). This reduces contamination of water resources from these materials/ activities. • Portable toilets must be provided where work is being done and must be located a considerable distance away from water resources and riparian areas. • If soil contamination occurs (such as due to a spill) the soil must be removed from the site and disposed of appropriately.	Holder of EA	All staff members are aware of the EMPr. Ensure EMPr is adhered to.	Continuous

ASPECT/ IMPACT	IMPACT MANAGEMENT ACTIONS	RESPONSIBILITY	IMPACT MANAGEMENT OUTCOMES	TIMEFRAMES/ FREQUENCY
	• Prevention of spills eliminates or minimizes the discharge of pollutants to water bodies. • Handle hazardous and non-hazardous materials, such as concrete, solvents, asphalt, sealants, and fuels, as infrequently as possible and observe all national and local regulations when using, handling, or disposing of these materials. • An effective response plan must be in place and personnel must be ready to mobilise in the event of a spillage to reduce the environmental effects of an oil or chemical spill. • Spill control devices such as absorbent snakes and mats must be placed around chemical storage areas, and they can be used in an emergency to contain a spill. • Implement preventative maintenance system to ensure that work vehicles are maintained in an acceptable condition. This would involve routinely checking vehicles for leaks before construction begins; and not allowing vehicles with significant leaks to operate or be repaired within the construction site. Ideally, vehicle maintenance and washing occurs in garages and wash facilities, not on active construction sites. • Before an operation occurs near a waterbody, vehicles must be checked for leaks, to reduce soil and water contamination from vehicle fluids.			

ASPECT/ IMPACT	IMPACT MANAGEMENT ACTIONS	RESPONSIBILITY	IMPACT MANAGEMENT OUTCOMES	TIMEFRAMES/ FREQUENCY
	• Old engine oil must NOT be thrown on the ground or down a stormwater drains but rather collected in containers and recycled. • Ensure that appropriate solid waste disposal facilities are provided, and adequate signage is provided for all solid, liquid, and hazardous waste types. These must contain waste products in a weatherproof manner and to prevent any airborne litter, access to scavengers or loss of food residues that may be washed into surface or ground waters. Collected waste needs to be disposed of at a registered landfill site/hazardous waste facility. • Re-fuelling areas for vehicles must be bunded and located away from water resources and sensitive environments to prevent any accidental spillage contaminating soil or seeping into groundwater aquifers. All servicing area run-off must be directed towards a fully contained collection sump for recovery and appropriate disposal. • There must be no standing water at a stockpile site, to reduce erosion as well as the contamination of the water by nutrients/ toxics. Water resources must be well fenced and sign-posted, to keep machinery, people, and livestock away from the water body as well as vegetated areas to reduce the soil disturbance, soil compaction and vegetation destruction, which thus reduces the amount of erosion and habitat loss.			

ASPECT/ IMPACT	IMPACT MANAGEMENT ACTIONS	RESPONSIBILITY	IMPACT MANAGEMENT OUTCOMES	TIMEFRAMES/ FREQUENCY
Aquatic: Loss of wetland areas through direct impact or indirect impacts of erosion or sedimentation.	During site clearing the vegetation and topsoil is removed, increasing the runoff and erosion potential of flowing water. to mitigate these impacts the following measures must be followed: • Minimise the area of soil disturbance to reduce the impact of sedimentation into waterbodies. • Clearing and grading must occur only where necessary to build and provide access to structures and infrastructure. Clearing must be done immediately before construction, rather than leaving soils exposed for months or years. • Where possible, plants should be cut down to ground level instead of being removed completely to stabilise the soil during land-clearing operations. • The proposed limits of land disturbance must be physically marked off to ensure that only the land area required for the development is cleared. • When excavated areas are backfilled the surface must be level with the surrounding land surface, to minimise soil erosion from the areas when the excavation is complete. • The most efficient approach to control erosion is to minimise the area of land disturbed as well as the duration for which it is exposed. • Once surfaces have been exposed, they must immediately be protected from erosion, so limiting the source of the sediment.	Holder of EA	All staff members are aware of the EMPr. Ensure EMPr is adhered to.	Continuous

ASPECT/ IMPACT	IMPACT MANAGEMENT ACTIONS	RESPONSIBILITY	IMPACT MANAGEMENT OUTCOMES	TIMEFRAMES/ FREQUENCY
	• During the excavation of pits, roads, construction sites etc. the removed topsoil must be stored and appropriately protected so that it does not wash into waterbodies, causing sedimentation and nutrient loading. This is then used to backfill the area so that it can be effectively rehabilitated. • Topsoil that is removed during excavation must NEVER be buried or rendered unusable in any way (such as mixing it with spoils or being compacted by machinery). • During excavation soil must be excavated one layer at a time and stored in separate stockpiles so they can be returned in their natural order when the area is backfilled. This improves soil functions and improves the template for plant growth. • To ensure that it reaches most people signs must be written in the languages of the area (NOT just English). This ensures that non-English speakers can understand and will hopefully cooperate in reducing water pollution by the measures indicated on the sign. • Within a construction site, vehicle access must be strictly controlled (i.e., there must be set parking, turning areas, set routes and no access to undisturbed areas.) This minimises soil disturbance and compaction and pollution from fluids leaking onto the ground as well as the disturbance of aquatic organisms.			

9.3.7 Avifaunal

This section deals with the issues relative to avifaunal during the operation phase.

Table 31: Avifaunal

ASPECT/ IMPACT	IMPACT MANAGEMENT ACTIONS	RESPONSIBILITY	METHOD	IMPACT MANAGEMENT OUTCOMES	TIMEFRAMES/ FREQUENCY
A**vifauna:** Displacement of priority species due to habitat transformation associated with construction of the PV plant and associated infrastructure	• Construction activity should be restricted to the immediate footprint of the infrastructure. • Access to the remainder of the site should be strictly controlled to prevent unnecessary degradation of habitat. • Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum. • The mitigation measures proposed by the vegetation specialist must be strictly enforced.	1. Project Developer 2. Facility Environmental Manager 3. Project Developer and Facility Operational Manager	1. Appointment of rehabilitation specialist to develop HRP. 2. Site inspections to monitor progress of HRP. 3. Adaptive management to ensure HRP goals are met.	Prevent unnecessary displacement of avifauna by ensuring that the rehabilitation of transformed areas is implemented by an appropriately qualified rehabilitation specialist, according to the recommendations of the botanical specialist study.	1. Once-off 2. Once a year 3. As and when required
A**vifauna:** Entrapment of large-bodied birds in the double perimeter fence	• It is recommended that a single perimeter fence is used				

9.3.8 Terrestrial Biodiversity

This section deals with the issues relative to biodiversity during the operational phase.

Table 32: Terrestrial Biodiversity

ASPECT/ IMPACT	IMPACT MANAGEMENT ACTIONS	RESPONSIBILITY	METHOD	IMPACT MANAGEMENT OUTCOMES	TIMEFRAMES
Establishment and spread of alien invasive plant species due to the presence of migration corridors and disturbance vectors	• Compile and implement Alien Invasive Management Plan. Rehabilitate disturbed areas.	Holder of EA Operator	Operational monitoring and audit reports	Impacts avoided or managed. Ensure the conditions of the EA are adhered to.	Continuous

9.3.9 Agriculture and Soils

This section deals with the issues relative to Agriculture and Soils during the operation phase.

Table 33: Agriculture and Soils

ASPECT/ IMPACT	IMPACT MANAGEMENT ACTIONS	RESPONSIBILITY	METHOD	IMPACT MANAGEMENT OUTCOMES	TIMEFRAMES
Agriculture and Soils: Loss of agricultural land	Avoid any cultivated and especially irrigated areas, if possible.	Facility Environmental Manager	Undertake a periodic site inspection to verify and inspect the effectiveness and integrity of the storm water run-off control system and to	That existence of hard surfaces causes no erosion on or downstream of the site. That denuded areas are re-vegetated to	Ongoing basis
Agriculture and Soils: Soil erosion (wind or water) caused by surface disturbance	Avoid extensive vegetation removal; re-vegetate as soon as possible and maintain cover (irrigate if necessary)				

ASPECT/ IMPACT	IMPACT MANAGEMENT ACTIONS	RESPONSIBILITY	METHOD	IMPACT MANAGEMENT OUTCOMES	TIMEFRAMES
			specifically record the occurrence of any erosion on site or downstream. Corrective action must be implemented to the run-off control system in the event of any erosion occurring. Undertake a periodic site inspection to record the progress of all areas that require re-vegetation.	stabilise soil against erosion	

9.3.10 Visual

This section deals with the issues relative to visual during the operation phase.

Table 34: Visual

IMPACT/ ASPECT	MITIGATION/MANAGEMENT ACTIONS	RESPONSIBILITY	METHODOLOGY	MITIGATION/MANAGEMENT OBJECTIVES AND OUTCOMES	FREQUENCY
Visual: • The PV arrays may be perceived as an	• Restrict vegetation clearance on the site to that which is required for the correct operation of the facility.	Project management and EPC	• Set up a clear management plan with clear accountability	• Dust generated on site as well as on the access road to the site, is well managed and does not become a nuisance	On completion of construction phase. On-going

IMPACT/ ASPECT	MITIGATION/MANAGEMENT ACTIONS	RESPONSIBILITY	METHODOLOGY	MITIGATION/MANAGEMENT OBJECTIVES AND OUTCOMES	FREQUENCY
unwelcome visual intrusion, particularly in more natural undisturbed settings. • The proposed solar PV facility will alter the visual character of the surrounding area and expose potentially sensitive visual receptor locations to visual impacts. • Dust emissions and dust plumes from maintenance vehicles accessing the site via gravel roads may evoke negative sentiments from surrounding viewers. • The night time visual environment will be altered as a result of	• Ensure that the PV arrays are not located within 500m of any farmhouses in order to minimise visual impacts on these dwellings. • As far as possible, limit the number of maintenance vehicles which are allowed to access the site. • Ensure that dust suppression techniques are implemented on all gravel access roads. • Only clear vegetation on site and adjacent to the site which is required to be cleared for the correct operation of the facility. • As far as possible, limit the amount of security and operational lighting present on site. • Light fittings for security at night should reflect the light toward the ground and prevent light spill. • If possible, light sources should be shielded by physical barriers (walls,		structures with set thresholds for triggering of mitigations. • A review of the security lights at night is undertaken by the EPC to check that undue light spillage is not taking place without loss of security.	factor for the workers or the surrounding farmsteads. • Lights contrast generated from the buildings as seen from the roads is low and does not attract the attention of the casual observer.	

IMPACT/ ASPECT	MITIGATION/MANAGEMENT ACTIONS	RESPONSIBILITY	METHODOLOGY	MITIGATION/MANAGEMENT OBJECTIVES AND OUTCOMES	FREQUENCY
operational and security lighting at the proposed PV facility.	vegetation, or the structure itself); • Lighting fixtures should make use of minimum lumen or wattage. • Mounting heights of lighting fixtures should be limited, or alternatively, foot-light or bollard level lights should be used. • If economically and technically feasible, make use of motion detectors on security lighting. Care should be taken with the layout of the security lights to prevent motorists on the R502 from being blinded by lights.				

9.4 Decommissioning Phase

9.4.1 On-going Stakeholder involvement

This is the process that is recommended when the proposed Facility is decommissioned.

Table 35: On-going Stakeholder involvement

IMPACT	IMPACT MANAGEMENT ACTIONS	RESPONSIBILITY	IMPACT MANAGEMENT ACTIONS	TIME FRAME
Ongoing Stakeholder Involvement	• Community to be notified, as culturally appropriate, timeously of the planned decommissioning, e.g.: – Proposed decommissioning start date; and – Process to be followed. • Recommend that a meeting with community leader(s) be held before decommissioning commence to inform them: – What activities will take place during the decommissioning phase. – How these activities will impact upon the communities and/or their properties. – Regarding the timeframes of scheduled activities • Regular interaction between the client and community leader(s) during the decommissioning phase. • A reporting office/ channel to be established should community members experience problems with contractors/ sub-contractors during the decommissioning phase. • A register to be kept of problems reported by community members and the steps taken to address / resolve it.	Holder of the EA	Clear communication channels maintained	During decommissioning

9.4.2 Waste Management

This section deals with the issues relative to waste management during the decommissioning phase.

Table 36: Waste Management

IMPACT	IMPACT MANAGEMENT ACTIONS	RESPONSIBILITY	IMPACT MANAGEMENT ACTIONS	TIME FRAME
Waste Management	• All decommissioned equipment must be removed from site and disposed of at a registered land fill. Records of disposal must be kept. • Any putrescible waste must be stored in containers that can keep out scavengers such as baboons and birds to prevent the spread of litter. • PV installations must be returned to the manufacturer or relevant recycling agent to be recycled.	Holder of the EA	All waste managed according to approved Method Statement	During decommissioning

9.4.3 Socio-Economic

This section deals with the issues relative to socio-economic during the decommissioning phase.

Table 37: Socio-Economic

ASPECT/ IMPACT	IMPACT MANAGEMENT ACTIONS	RESPONSIBILITY	IMPACT MANAGEMENT OUTCOMES	TIMEFRAMES/ FREQUENCY
Socio-economic: Land demarcated for the solar PV plant will be sterilized and all current activities taking place on said land will be discontinued.	Rehabilitation of land should take place at the end of the project's life to allow for the land to be used for commercial livestock farming after the project's closure.	Holder of EA /Contractor	Clear communication channels. Compliance to all legislative requirements. Ensure the EMPr is adhered to.	Continuous

9.4.4 Avifaunal

This section deals with the issues relative to avifaunal during the decommissioning phase.

Table 38: Avifaunal

ASPECT/ IMPACT	IMPACT MANAGEMENT ACTIONS	RESPONSIBILITY	METHOD	IMPACT MANAGEMENT OUTCOMES	TIMEFRAMES/ FREQUENCY
Avifauna: Displacement of priority species due to disturbance associated with decommissioning of the PV plant and associated infrastructure	• De-commissioning activity should be restricted to the immediate footprint of the infrastructure. • Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of priority species. • Measures to control noise and dust should be applied according to current best practice in the industry. • Maximum used should be made of existing access roads and the construction of new roads should be kept to a minimum. • The mitigation measures proposed by the vegetation specialist must be strictly enforced	Holder of EA	Construction monitoring and audit reports	Impacts avoided or managed. Ensure the conditions of the EA are adhered to.	Continuous
Avifauna: Entrapment of large-bodied birds in the double perimeter fence	• It is recommended that a single perimeter fence is used	Holder of EA	Construction monitoring and audit reports	Impacts avoided or managed. Ensure the conditions of the EA are adhered to.	Continuous

9.4.5 Terrestrial Biodiversity

This section deals with the issues relative to biodiversity during the decommissioning phase.

Table 39: Terrestrial Biodiversity

ASPECT/ IMPACT	IMPACT MANAGEMENT ACTIONS	RESPONSIBILITY	METHOD	IMPACT MANAGEMENT OUTCOMES	TIMEFRAMES
Loss and disturbance of natural vegetation due to the removal of infrastructure and need for working sites	• No additional clearing of vegetation should take place without a proper assessment of the environmental impacts and authorization from relevant authorities. • If any additional infrastructure needs to be constructed, for example overhead powerlines, communication cables, etc., then these must be located next to existing infrastructure, and clustered to avoid dispersed impacts. • No driving of vehicles off-road. Implement Alien Plant Management Plan, including monitoring, to ensure minimal impacts on surrounding areas. • Access to sensitive areas outside of development footprint should not be permitted during operation. • Surface runoff and erosion must be properly controlled and any issues addressed as quickly as possible	Holder of EA Contractor ECO	Construction monitoring and audit reports	Impacts avoided or managed. Ensure the conditions of the EA are adhered to.	Continuous
Continued establishment and spread of alien invasive plant species due to the presence of	• Implement an alien management plan, which highlights control priorities and areas and provides a programme for long-term control.	Holder of EA Contractor ECO	Construction monitoring and audit reports	Impacts avoided or managed.	Continuous

ASPECT/ IMPACT	IMPACT MANAGEMENT ACTIONS	RESPONSIBILITY	METHOD	IMPACT MANAGEMENT OUTCOMES	TIMEFRAMES
migration corridors and disturbance vectors	• Undertake regular monitoring to detect alien invasions early so that they can be controlled. • Post-decommissioning monitoring should continue for an appropriate length of time to ensure that future problems are avoided. • Do NOT use any alien plants during any rehabilitation that may be required.			Ensure the conditions of the EA are adhered to.	

9.4.6 Agriculture and Soils

This section deals with the issues relative to agriculture and soils during the decommissioning phase.

Table 40: Agriculture and Soils

IMPACT/ ASPECT	MITIGATION/MANAGEMENT ACTIONS	RESPONSIBILITY	METHODOLOGY	MITIGATION/MANAGEMENT OBJECTIVES AND OUTCOMES	FREQUENCY
Agriculture and Soils: Loss of agricultural land	• Avoid any cultivated and especially irrigated areas, if possible	Engineer /Contractor	• Undertake a periodic site inspection to verify and inspect the effectiveness and integrity of the storm water run-off control system and to specifically record the occurrence of any erosion on site or downstream. Corrective action must be implemented to the	• That disturbance and existence of hard surfaces causes no erosion on or downstream of the site. • That vegetation clearing does not pose a high erosion risk.	Every 2 months during the decommissioning phase, and then every 6 months after completion of decommissioning, until final sign-off is achieved.
Agriculture and Soils: Soil erosion (wind or water) caused by surface disturbance	• Avoid extensive vegetation removal; re-vegetate as soon as possible and maintain cover (irrigate if necessary)				

			• run-off control system in the event of any erosion occurring. • Undertake a periodic site inspection to record the occurrence of and re-vegetation progress of all areas that require re-vegetation.		

9.4.7 Visual

This section deals with the issues relative to visual during the decommissioning phase.

Table 41: Visual

IMPACT/ ASPECT	MITIGATION/MANAGEMENT ACTIONS	RESPONSIBILITY	METHODOLOGY	MITIGATION/MANAGEMENT OBJECTIVES AND OUTCOMES	FREQUENCY
Visual: Vehicles and equipment required for decommissioning will alter the natural character of the study area and expose visual receptors to visual impacts. • Decommissioning activities may be perceived as an unwelcome visual intrusion. • Dust emissions and dust plumes from increased traffic on the	• All infrastructure that is not required for post-decommissioning use should be removed. • Carefully plan to minimize the decommissioning period and avoid delays. • Maintain a neat decommissioning site by removing rubble and waste materials regularly. • Ensure that dust suppression procedures are maintained on all	Project management and EPC with inputs from rehabilitation specialist.	As defined by the rehabilitation specialist.	Soil sterilization does not take place and large degraded areas do not occur, with overall landscape integrity maintained.	Within 1 year of closure.

gravel roads serving the decommissioning site may evoke negative sentiments from surrounding viewers. • Surface disturbance during decommissioning would expose bare soil (scarring) which could visually surrounding environment. • Temporary stockpiling of soil during decommissioning may alter the flat landscape. Wind blowing over these disturbed areas could result in dust which would have a visual impact.	gravel access roads throughout the decommissioning phase. • All cleared areas should be rehabilitated as soon as possible Rehabilitated areas should be monitored post-decommissioning and remedial actions implemented as required.				

9.4.8 Geotechnical

This section deals with the issues relative to Geotechnical during the decommissioning phase.

Table 42: Geotechnical

ASPECT/ IMPACT	IMPACT MANAGEMENT ACTIONS	RESPONSIBILITY	IMPACT MANAGEMENT OUTCOMES	TIMEFRAMES/FREQUENCY
Geotech: Decommissioning of the structure will disturb the geological environmental. 1) Increase in soil and wind erosion due to clearance of structures 2) Construction and earthmoving vehicles will displace the soil. 3) Creation of drainage paths 4) Potential oil spillages from vehicles 5) Excessive sediments in non-perennial features	• Use of existing roads and tracks. • Use of temporary berms and drainage channels to divert surface water during flooding. • Minimize earthworks and demolish footprints. • Use of existing roads and tracks. • Rehabilitation of affected areas (such as regrassing). • Develop a chemical spill response plan. • Develop dust and demolitation fly supression plan. • Reinstate channelized drainage features.	Holder of EA	Clear communication channels. Compliance to all legislative requirements. Ensure the EMPr is adhered to.	Continuous

10. AMENDMENTS TO THE EMPR

The Environmental Control Officer (ECO) has the right to request (in writing) a method statement to be compiled by the contractor in cases where the Construction EMPr may not adequately address the issue or nature of the activity/site warrants the need thereof. The method statement must be approved in writing by the ECO prior to carrying out the activity.

Any major issues not covered in the EMPr as submitted as well as any layout changes, will be addressed as an addendum to the EMPr and must be submitted for approval prior to implementation.

Authorised officials of the Department reserve the right to review the approved EMPr during the construction and operational phases of the above-mentioned activity and amend/add any condition as it is deemed necessary. Authorised officials also reserve the right to inspect the project during both construction and operational phase of development.

11. ENVIRONMENTAL AWARENESS PLAN

Appendix 4 of GN R326 EIA Regulations 2014 (as amended) requires that and Environmental Awareness Plan describes the manner in which "*the applicant intends to inform his or her employees of any environmental risk which may result from their work; and risks must be dealt with in order to avoid pollution or the degradation of the environment*". In recognition of the need to protect our environment, environmental management should not only be seen as a legal obligation but also as a moral obligation.

This Environmental Awareness Plan is intended to create the required awareness and culture with personnel and contractor's / service providers on environmental safety and health issues associated with the development activities.

11.1 Policy on Environmental Awareness

This Environmental Awareness Plan must serve as the basis for the induction of all new employees (as well as contractors depending on the nature of their work on site) on matters as described herein and read in conjunction with the EMPr. The Plan will also be used to hone awareness of all employees on a continuous basis.

Specific environmental awareness performance criteria will also form part of the job descriptions of employees, to ensure diligence and full responsibility at all levels of the organisational work force.

11.2 Implementation of Environmental Awareness

General environmental awareness will be fostered among the project's workforce to encourage the implementation of environmentally sound practices throughout the project's duration. This will ensure that environmental accidents are minimised and environmental compliance maximised.

Environmental awareness will be fostered in the following manner:

- Induction course for all workers on site, before commencing work on site;

- Refresher courses as and when required;
- Daily toolbox talks with all workers on the site at the start of each day, where workers can be alerted to particular environmental concerns associated with their tasks for that day or the area/habitat in which they are working; and
- Displaying of information posters and other environmental awareness material at the general assembly points.

11.3 Training and awareness

The main contractor is to take responsibility for the management of their staff and subcontractors on the project site during the construction phase and supervise them closely at all times. The onus is on the contractor to make sure that all their staff and subcontractors fully comprehend the contents of the EMPr. The contractor must organise environmental awareness training programmes, which should be targeted at the two levels of employee: management and labour.

11.4 Training of construction workers

All construction staff must receive basic training in environmental awareness, including the storage and handling of hazardous substances, minimisation of disturbance to sensitive areas, management of waste, and prevention of water pollution. They must be informed of how to recognise historical / archaeological artefacts that may be uncovered. They must also be apprised of the EMPr's requirements. Environmental awareness training programmes need to be formulated for these employee levels and must comprise:

- A record of all names, positions and duties of staff to be trained;
- A framework for the training programmes;
- A summarised version of the training course(s); and
- An agenda for the delivery of the training courses.

Such programmes will set out the training requirements, which need to be conducted prior to any construction works occurring and will include:

- Acceptable behaviour with regard to flora and fauna;
- Management and minimising of waste, including waste separation;
- Maintenance of equipment to prevent the accidental discharge or spill of fuel, oil, lubricants, cement, mortar and other chemicals;
- Responsible handling of chemicals and spills;
- Environmental emergency procedures and incident reporting; and
- General code of conduct towards I&APs.

12. CONCLUSION

The environmental and social impacts of the project were identified through the four project phases (pre-construction, construction, operation and decommissioning). The following section briefly describes some of the major impacts and proposed mitigation measures within each of the project phases.

12.1 Pre-Construction Phase

The first site activities before mobilization of equipment will be a survey, required for final design of foundations. There will be negative impacts on land associated with the construction of camps (temporary loss) and storage of construction materials, and foundations for the buildings (permanent loss) and PV installations. Expectations of improvement in livelihood among locals should be addressed through public participation. Construction contracts will include environmental monitoring and management procedures and requirements. These must be in place prior to the commencement of any construction activities. Once the layouts plans have been finalised a detailed geotechnical investigation should be undertaken.

12.2 Construction Phase

This phase of the activity will have both positive and negative impacts. The positive impacts are employment opportunities offered to the construction workers and any other labourer who will be hired to provide their services during the construction phase. The negative impacts would include wastes generated, accidents, air, dust and noise pollution, vegetation clearance, soil erosion, socio-environmental issues, loss of vegetation, and compaction of soil. Most of the negative impacts are minor and temporary and the significance of the impacts can be greatly reduced by the implementation of mitigation measures, which are outlined in this EMPr. The contractor shall ensure that all staff have adequate protective clothing and are adequately trained.

12.3 Operational Phase

The proposed project will have minimal negative effects which mainly relates to loss of aesthetic value and habitat. Most of the negative impacts are minor and the significance of the impacts can be greatly reduced by the implementation of mitigation measures, which are outlined in this EMPr.

12.4 Decommissioning Phase

As with any project, the facilities used in this project will have a lifetime after which they may no longer be cost effective to continue with operation. At that time, the project would be decommissioned, and the existing equipment removed.

Potential environmental impacts caused during decommissioning are those, which will be mitigated as provided by the Environmental Management Programme. These include: noise and emissions to the surrounding environment, removal of hazardous waste and substances, fire, oil spills, wastes and public safety.

The disposal of materials from the decommissioned plant is not viewed as high risk. Much of the material would be recyclable (steel structures and turbine engines etc.) or inert (concrete foundations, etc.). These materials would however, need to be disposed of at a formal waste disposal or recycling centre.

Based on the above information, it is unlikely that the Project will have significant adverse social and environmental impacts. Most impacts will be of a temporary nature during the construction phase and can be managed to acceptable levels with implementation of the recommended mitigation measures for the Project such that the overall benefits from the Project will greatly outweigh the few negative impacts.

All the negative impacts could be easily mitigated and will either be moderate or less in rating. Generally, the proposed PV facility and associated infrastructure will result in appreciable benefits to the people in the project area of influence and bring opportunities for development to the country.

Appendix A:

Curriculum Vitae

Appendix B:

Environmental Incidents

LOG Environmental Incident Log

ENVIRONMENTAL INCIDENT LOG				
Date	Env. Condition	Comments *(Include any possible explanations for current condition and possible responsible parties. Include photographs, records etc. if available)*	Corrective Action Taken (*Give details and attach documentation as far as possible)*	*Signature*

Appendix C:

Complaints Record Sheet

Complaints Record Sheet

COMPLAINTS RECORD SHEET	File Ref: Page …. of ….	DATE: ……
COMPLAINT RAISED BY:		
CAPACITY OF COMPLAINANT:		
COMPLAINT RECORDED BY:		
COMPLAINT:		
PROPOSED REMEDIAL ACTION:		
EO: _____ Date: _____		
NOTES BY ECO:		
EO: _____ Date: _____ Site Manager: _____ Date: _____		

Appendix D:

Summary of Specialist Findings and Recommendations

SUMMARY OF SPECIALIST FINDINGS AND RECOMMENDATIONS

Specialist Study	Findings	Recommendations
Agricultural and Soils	Soil information was obtained for the solar PV plant and associated infrastructure proposed on Portion 37 of the Farm Leeuwbosch No. 44 near the town of Leeudoringstad in the North West Province. The data source was existing 1:250 000 scale land type information and indicates that the soils are mostly shallow, with much rock. The construction of the solar PV plant and associated infrastructure at the chosen site will have minimal impact on the loss of agricultural land, due to the small percentage of high potential agricultural land indicated by the Land Type survey information. The potential impact on the loss of agricultural land will be low, and there is not expected to be any significant soil erosion hazard, if standard mitigation measures are followed. Cumulative soil-related impacts are also expected to be low.	As far as the soils are concerned, as long as the proposed mitigation measures are adhered to, there should not be any significant cumulative impacts occurring, as any impact on agricultural potential will be contained to the specific site itself.
Geotechnical	The study area is underlain by the Allanridge Formation part of the Ventersdorp Supergroup, which comprises amygaloidal lava. The Ventersdorp Supergroup is predominantly an accumulation of andesitic to basaltic lavas with related pyroclastic rocks.. The desktop study indicates no fatal flaws from a preliminary and geological and geotechnical assessment. The impact of the development from a geotechnical perspective will be restricted to the removal and displacement of soil, boulders and bedrock.	No fatal flaws from a geotechnical perspective were identified. The impact of the Solar PV Facility was found to be “Negative low impact”. The anticipated impact will have negligible negative effects and will require little to no mitigation. The site from a desktop level geotechnical study is considered suitable for the proposed PV Plant. It recommended that a detailed geotechnical investigation be undertaken during the detailed design phase of the project. The detailed geotechnical investigation must entail the following: • Profiling and sampling exploratory trial pits to determine founding conditions for the PV modules, substation and

Specialist Study	Findings	Recommendations
		pylons. Also to determine the subgrade conditions for internal roads and a materials investigation (if required); • Thermal resistivity and electrical resistivity geophysical testing for electrical design and ground earthing requirements. • Groundwater sampling of existing boreholes to establish a baseline of the groundwater quality for construction purposes; • Dynamic Probe Super Heavy (DPSH) tests and rotary core drilling may be required depending on the soil profiles and imposed loads of the structures.
Avifaunal	The proposed SEF will have several potential impacts on priority avifauna. These impacts are the following: • Displacement of priority species due to disturbance associated with the construction and de-commissioning of the PV plant and associated infrastructure. • Displacement of priority species due to habitat transformation associated with the PV plant and associated infrastructure. • Mortality of priority species due to electrocution on the medium voltage internal reticulation network. • Entrapment of large-bodied birds in the double perimeter fence. • Displacement of priority species due to disturbance associated with de-commissioning of the PV plant and associated infrastructure. • Cumulative impact of displacement due to construction and habitat transformation, collisions with solar panels and entrapment in fences	The proposed Leeumax Solar PV Plant will have a medium pre-mitigation negative impact on priority avifauna, which in most instances, can be reduced to low with appropriate mitigation. The development is supported provided the mitigation measures listed in this report is strictly implemented. No fatal flaws were discovered in the course of the investigations. The cumulative impact of the facility on priority avifauna within a 35km radius around the proposed development (considering all current impacts on avifauna) is assessed to be low post mitigation, mainly due to the small size of the proposed development.
Heritage – Archaeological	The overall impact of the Leeumax facility, on the heritage resources identified during this report, is seen as acceptably low after the recommendations have been implemented and	The following is recommended: • For sites LD07, LD09, LD10, LD11 LD12:

Specialist Study	Findings	Recommendations
	therefore, impacts can be mitigated to acceptable levels allowing for the development to be authorised.	○ It is recommended that further consultation with local communities on the previous inhabitants of these areas be initiated to determine the possibility of infant burials. In the event that such burial is confirmed a grave relocation process must be initiated. • It is further recommended that an archaeologist monitor the earth moving activities during construction. • Site LD13 if any changes to the structures for the establishment of the watering point is envisaged permission under section 34 of the NHRA from the Provincial Heritage Authority must be obtained. This application for alteration or destruction must be accompanied by site sketches and photographs as compiled by a heritage specialist. In the event that heritage resources are discovered during site clearance, construction activities must stop in the vicinity, and a qualified archaeologist must be appointed to evaluate and make recommendations on mitigation measures. The overall impact of the Leeumax facility, on the heritage resources identified during this report, is seen as acceptably low after the recommendations have been implemented and therefore, impacts can be mitigated to acceptable levels allowing for the development to be authorised.
Heritage – Paleontological	The proposed development is underlain by the Allanridge Formation (Ventersdorp Supergroup). According to the PalaeoMap on the South African Heritage Resources Information System (SAHRIS) database, the Palaeontological Sensitivity of the Allanridge Formation is LOW (Almond and Pether 2008, SAHRIS website).	If fossil remains are discovered during any phase of construction, either on the surface or exposed by excavations the Chance Find Protocol must be implemented by the Environmental Control Officer (ECO) in charge of these developments. These discoveries ought to be protected (if possible, in situ) and the ECO must report to SAHRA (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za) so that

Specialist Study	Findings	Recommendations
	It is therefore considered that the proposed development is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological heritage of the area. Hence, the construction of the development may be authorised in its whole extent, as the development footprint is not considered sensitive in terms of palaeontological resources	correct mitigation (recording and collection) can be carry out by a paleontologist. No mitigation measures are required.
Social	The proposed construction of the Leeumax PV will be associated with multiple capital expenditures. Such expenses typically include the transportation and construction of PV modules, the connection of electricity and grids, foundations, civil engineering, and the construction of supporting structures. If goods and services are procured locally, that is, within South Africa, this will increase the production of the respective industries. This will in turn have a positive impact on the national economy and the economies of the municipalities where inputs are procured. It is anticipated that the proposed development will include an approximate R130 million in investments. Some of this is expected to be spent in South Africa, which will resultantly stimulate the national economy, although for a temporary period of about twelve months during the construction of the Solar PV. The construction of the proposed solar PV plant and associated infrastructure will require the temporary employment of construction workers, foremen, and engineers on site. It is anticipated that approximately 25 employment opportunities will be created during the construction phase. Considering the current skills profile of the local municipality, a good portion of these jobs are likely to be filled by people from the local communities. This project will thus contribute to increasing employment opportunities in the local municipality for a temporary period. Employment of the individuals, albeit	Regarding the impacts which will arise from the proposed development, it is anticipated that there will be no major direct or indirect concerns. The proposed solar PV plant will sterilise approximately 20ha of agricultural land currently used for commercial livestock farming,. Due to the nature of the activities taking place on the farms adjacent to the planned development, it is not expected to cause major disruptions during both construction and operational phase on the farms and their respective farmhouses. Furthermore, all potential impacts considered had no fatal flaws identified across all potential impacts considered.

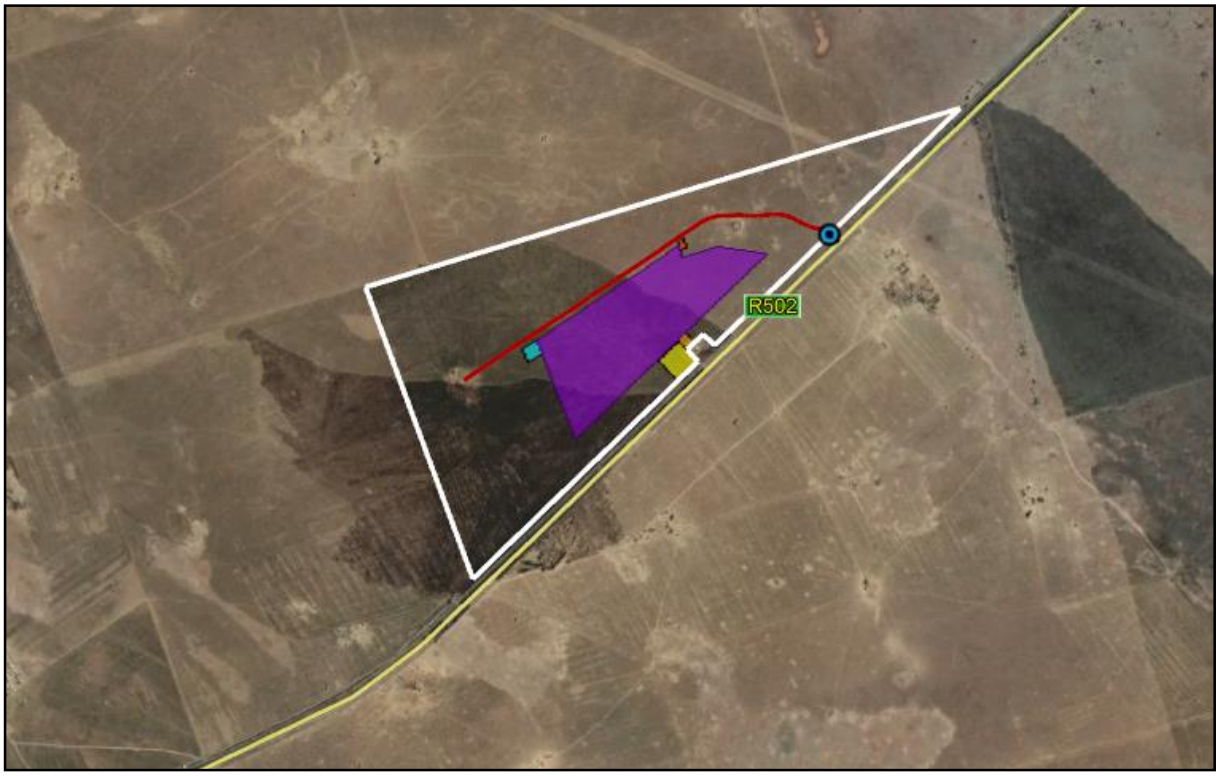
Specialist Study	Findings	Recommendations
	temporary, will increase their household income, improve their standard of living, and benefit their families. The nature of the activities taking place on the farms adjacent to the proposed facilities is also not expected to be sensitive to the proposed project's construction or operation. Therefore, the visual or noise effects that may result from the development of the PV system are not expected to adversely affect the farming activities and their respective farmhouses observed in the region.	
Wetland	The Leeumax site project does not show wetlands within the boundary of the proposed footprint; however, one (1) wetland (HGM 3) was found within the 500m regulated area. The wetland was located south of the project area approximately 185m away. The wetland is also buffered by the main road. The impact assessment concluded that the wetland will not be impacted by the proposed project and that the impact was rated as Low or no perceived impact.	It is recommended that an alien invasive management programme is implemented It is the opinion of the Specialist that the proposed development may proceed and that a GA will be sufficient, this is based on the above findings and recommendations.
Visual	No visually sensitive receptors were identified within the study area. This is most likely due to the fact that the study area is not typically valued or utilised for its tourism significance. Additionally, the R502 and R504 regional roads, which traverse the visual assessment zone, are used almost exclusively as local access roads and do not form part of any scenic tourist routes and are not specifically valued or utilised for their scenic or tourism potential. A total of thirty-two (32) potentially sensitive receptors were however identified, all of which appear to be existing farmsteads. These farmsteads are regarded as potentially sensitive visual receptors as they are located within a mostly rural setting and the proposed development will likely alter natural vistas experienced from these locations, although the	It is the specialist's opinion that the visual impacts associated with the proposed Leeumax SEF and associated infrastructure are of moderate significance. Given the relative absence of sensitive receptors and the significant degree of human transformation and landscape degradation in areas close to the Leeuwbosch 3 SPEF application site, the project is deemed acceptable from a visual impact perspective and the EA should be granted for the BA application. The specialist is of the opinion that the visual impacts associated with the construction, operation and decommissioning phases of the project can be mitigated to acceptable levels provided the recommended mitigation measures are implemented.

Specialist Study	Findings	Recommendations
	residents' sentiments toward the proposed development are unknown. The receptor impact rating conducted in respect of these potentially sensitive receptors found that none of these potentially sensitive receptors are expected to experience high levels of visual impact from the proposed SPEFs. Twenty-six (26) receptors are however expected to experience moderate levels of visual impact, while the remaining six (6) receptors are only expected to experience low levels of impact from the proposed SPEF. The overall impact rating revealed that the Leeuwbosch 3 SPEF is expected to have a (negative) low visual impact rating during both construction and decommissioning phases. From a visual perspective therefore, the proposed Leeuwbosch 3 SPEF is deemed acceptable and the Environmental Authorization (EA) should be granted. SLR is of the opinion that the visual impacts associated with the construction, operation and decommissioning phases can be mitigated to acceptable levels provided the recommended mitigation measures are implemented	
Terrestrial	In general, the site is considered to have potentially high sensitivity or biodiversity value, based on the location of the site within a listed ecosystem as well as being within an Ecological Support Area. The project study area consists of natural grassland habitat, and degraded areas associated with previous cultivation. The site is within an area where the remaining natural habitat has been assessed as having high conservation value. Existing impacts on natural habitat are related to possible previous cultivation on site. The extent of previous cultivation can be determined from	Use existing road infrastructure for access roads. Avoid construction of infrastructure within sensitive habitats. Minimise vegetation clearing and disturbance to footprint areas only. Compile a rehabilitation programme and rehabilitate disturbed areas. Compile and implement Alien Invasive Management Plan. Limit access to sensitive areas during construction. Undertake monitoring to evaluate whether further measures are required. No additional clearing of vegetation should take place without a proper assessment of the environmental impacts and authorization from relevant authorities. If any additional infrastructure needs to

Specialist Study	Findings	Recommendations
	the combination of local species composition and patterns from aerial imagery. The proposed project will therefore have some effects on areas of natural habitat that may possibly have important biodiversity value. The vegetation on site is part of a threatened ecosystem and has been assessed as being of high conservation value due to rates of transformation. The regional vegetation type that occurs on site, Vaal-Vet Sandy Grassland, is listed as Endangered in the National Ecosystem List, is part of an area earmarked for future National Park expansion and is part of a Provincial Ecological Support Area. Any remaining natural habitat on site therefore has high terrestrial biodiversity value. The most significant impact associated with the project is due to clearing of indigenous natural vegetation. This impact was evaluated as having a significance of MEDIUM after mitigation. All other assessed impacts had a significance of LOW after mitigation. One potential impact with the most significant risk in the absence of any management is due to the potential spread and growth of alien invasive plant species, which is facilitated by disturbance. On the basis of the relatively limited extent that will be disturbed, and the general absence of any species of concern, the proposed development can be authorised.	be constructed, for example overhead powerlines, communication cables, etc., then these must be located next to existing infrastructure, and clustered to avoid dispersed impacts. No driving of vehicles off-road. Implement Alien Plant Management Plan, including monitoring, to ensure minimal impacts on surrounding areas. Access to sensitive areas outside of development footprint should not be permitted during operation. Surface runoff and erosion must be properly controlled and any issues addressed as quickly as possible. Implement an alien management plan, which highlights control priorities and areas and provides a programme for long-term control. Undertake regular monitoring to detect alien invasions early so that they can be controlled. Post-decommissioning monitoring should continue for an appropriate length of time to ensure that future problems are avoided. Do NOT use any alien plants during any rehabilitation that may be required.

Appendix D:

Stormwater Management Plan

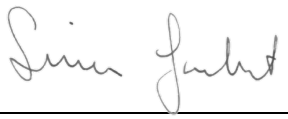


UPGRADE ENERGY (PTY) LTD

Leeuwbosch PV3 SWMP

Stormwater Management Plan

Issue Date: 17 November 2022
Revision No: 0
Project No: 17420
Document No: 17420-LEEUBOSCH_PV3-SWMP-NH-REV0

Date:	17 November 2022
Document Title:	17420 – Leeuwbosch PV3 SWMP
Revision Number	0
Author	Ntuthuko Hlanguza
Checked By:	Simon Joubert
Approved By:	Simon Joubert
Signature:	
Client:	Upgrade Energy (Pty) Ltd

Confidentiality Statement

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

UPGRADE ENERGY (PTY) LTD

LEEUWBOSCH PV3 SWMP

1. INTRODUCTION & BACKGROUND

Upgrade Energy (Pty) Ltd propose to construct four 15MWac Photovoltaic (PV) facilities and associated infrastructure on Farm Wildebeestkuil 59 and Farm Leeuwbosch 44, approximately 6-8km east of Leeudoringstad in the North West Province. The proposed sites are located within the Maquassi Hills Local Municipality which falls within the Dr Kenneth Kaunda District Municipality.

SiVEST SA (Pty) Ltd (SiVEST) were appointed to undertake the Basic Assessment Process which requires various specialist studies. SiVEST's Civil Engineering Division was appointed as the specialist consultant to develop a conceptual stormwater management plan (SWMP) for each of the proposed sites.

This SWMP focuses on the Leeuwbosch PV3 site which is located on Farm Leeuwbosch 44 (Portion 37). This report serves to provide a broad guideline for the developers, owners and professional teams to manage the stormwater and comply with the necessary rules and regulations of the relevant authorities and should not be viewed as a detailed design report.

2. OBJECTIVES & SCOPE OF WORK

The main objective of the study is to develop a conceptual stormwater management plan for Site PV3. The scope of works comprises the following:

- Data collection;
- Liaison with the client;
- Site inspection to confirm topographical conditions;
- Hydrological assessment of the site;
- Development of conceptual drawings and design guidelines; and Compilation of the SWMP in the form of report.

3. DATA COLLECTION

The following data was collected and used to undertake this study:

- 5m contour data from Planet GIS;
- Technical project information and proposed development footprint from SiVEST Environmental;
- Climate information from South African Weather Services;
- Design Rainfall data (JC Smithers & RE Schulze);
- Aerial Imagery from Google Earth and ESRI online base maps.

4. PROJECT DESCRIPTION

It is anticipated that the proposed Solar PV energy facility will include PV fields (arrays) comprising of multiple PV panels. In summary, the proposed SEF development will include the following components:

- The proposed solar PV plant will include PV fields (arrays) comprising multiple PV modules;
- PV panels will be single axis tracking mounting, and the modules will be either crystalline silicon or thin film technology;
- Each PV module will be approximately 2274mm (≈2.3m) long and 1134mm (≈1.1m) wide and mounted on supporting structures above ground;
- The foundations will most likely be either concrete or rammed piles;
- Generation capacity of up to 15MWac;
- The dimension of the PV panels will be approximately 2.3 m wide by 1.1 m long;
- One (1) new 33/132kV on-site substation (facility substation) occupying an area of up to approximately 0.2003ha (2 003m^2);
- Site and internal access roads, up to 4m wide, will provide access to the PV arrays. Existing site roads will be used wherever possible, although new site roads will be constructed where necessary;
- One (1) guard house approximately 0.0876 ha (876m^2) in size;
- One (1) temporary building zone 0.2944 ha (2 944m^2);
- Galvanized steel fencing with electrification approximately 2.1m in height;
- Existing boreholes will be used where possible. Water will potentially be stored in water storage tanks;

The project locality and proposed layout are depicted in Figure 4-1 and Figure 4-2 below.

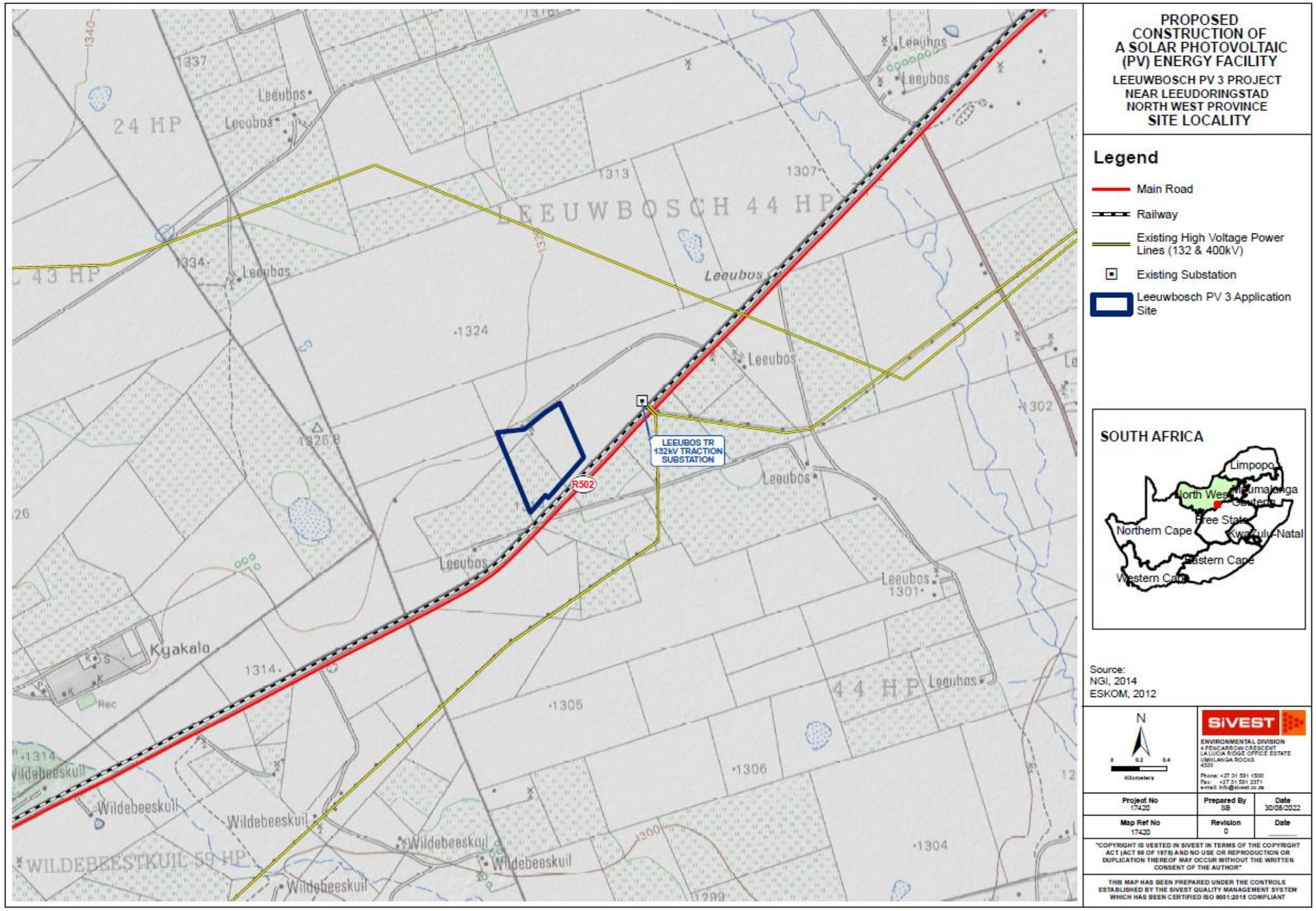


Figure 4-1: Site Locality

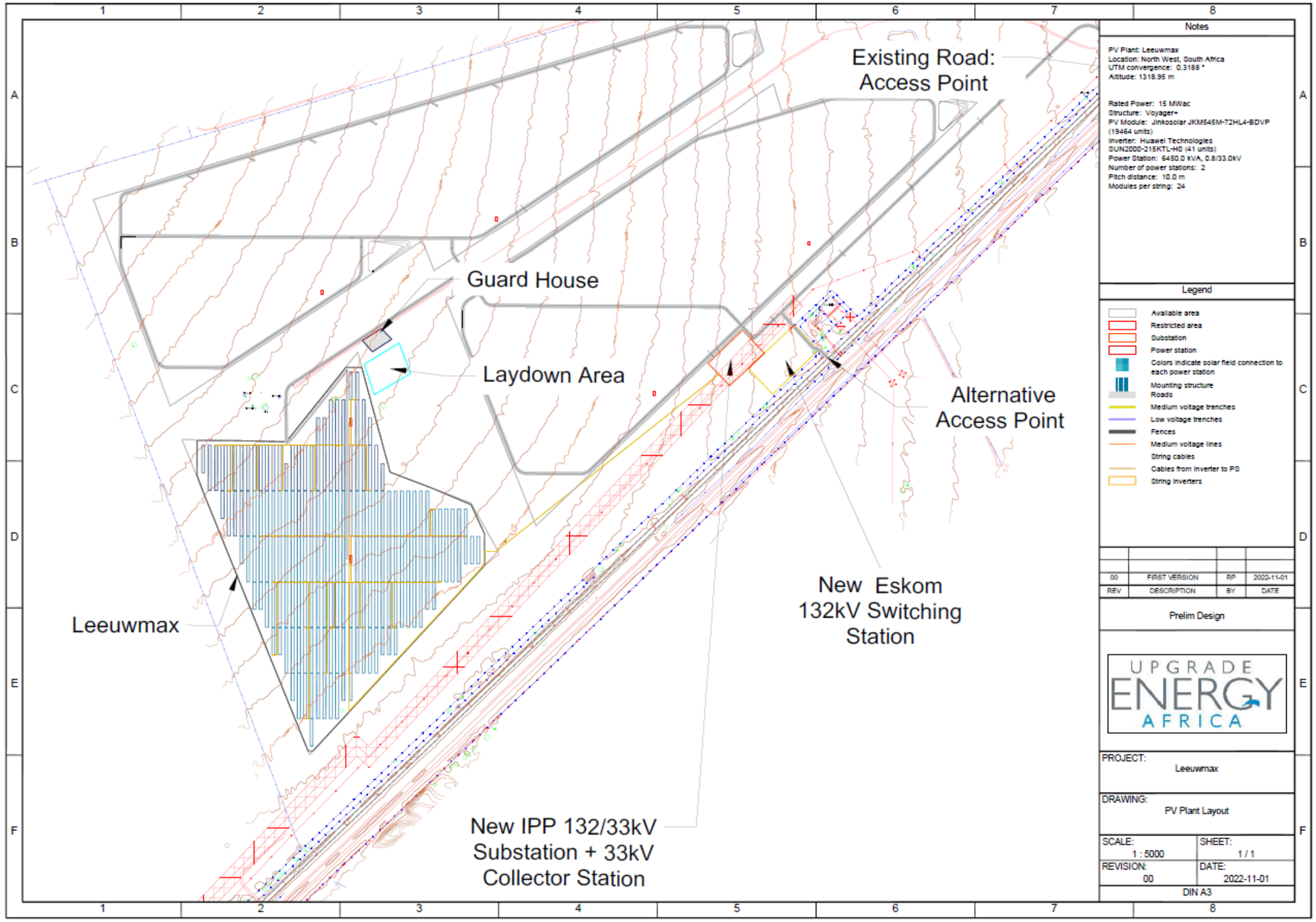


Figure 4-2: Leeuwbosch PV3 Site Layout

5. STORMWATER MANAGEMENT PHILOSOPHY

Development is a process of change or growth that usually involves the construction of buildings, roads and infrastructure which leads to a change in the hydraulic properties of an area. Permeable layers become less permeable or impermeable resulting in increased surface runoff and flood volumes. Conduits are constructed to drain runoff more efficiently resulting in shorter catchment response times and increased peak flows. Natural vegetation is often removed, reducing interception and transpiration and exposing soil to the impact of rain which may lead to increased erosion.

In order to lessen the negative impacts and enhance the positive impacts on the environment as a result of development, responsible management of stormwater is required. This can be achieved through the implementation of various mitigation measures in accordance with drainage requirements and guidelines as set out by the local authority.

Stormwater Management policies require that, for storms of similar recurrence intervals, the post-development runoff from an area may not exceed the runoff generated under the pre-development condition. The study area falls within The Maquassi Hills Local Municipality and, in the absence of site specific design guidelines, the stormwater drainage system should be designed in accordance with the criteria given in the "Red Book" [1] as well as the Drainage Manual[2]. This drainage system can be divided into minor and major stormwater systems.

The minor stormwater system comprises elements that aid in conveying stormwater runoff from within the development and road reserves to the major stormwater system. These elements include catch pits inlet structures, gutters, berms, canals, road verges, pipes and culverts.

The major stormwater system comprises elements of the minor system, road surfaces, natural low points, streams, rivers, wetlands, dams and flood attenuation structures necessary to control and drain stormwater or larger storms without damage and loss of life.

Stormwater runoff shall not be concentrated to an extent that would result in any damage to the downstream riverine ecology and/or built environment during storms with a recurrence interval exceeding 1:10 years and would result in only minor, repairable damage during storms with a recurrence interval exceeding 1:50 years.

To this end, the minor and major stormwater systems shall be designed to convey and withstand the 1:10 and 1:50 year flood events respectively. This is a guideline and the onus is on the design engineer to determine the risks associated with a storm with a specific recurrence interval. For areas where the risk of loss is unacceptably high, a higher recurrence interval and a higher level of service may need to be considered. For larger structures such as bridges and major culverts, the Department of Transport's specific requirements shall be considered.

Drainage systems must be maintained in a clean state, free of any rubbish, debris and matter likely to restrict the flow of stormwater or pose a pollution threat regulated by the departments of Water Affairs & Forestry, Environmental Affairs & Tourism and Health.

The Stormwater Management Philosophy for the development encourages the developer, the professional teams and contractors to do the following:

- Maintain adequate ground cover in all areas at all times to reduce the risk or erosion by wind, water and all forms of traffic;
- Prevent concentration of stormwater flow at any point where the ground is susceptible to erosion. Where unavoidable, adequate protection of the ground must be provided;

[1] *Guidelines for Human Settlement Planning and Design compiled by CSIR Building and Construction Technology*
[2] *Drainage Manual 6th Edition, Published by The South African National Roads Agency SOC Ltd, 2013*

- Reduce stormwater flows as much as possible by providing effective attenuation measures;
- Ensure that development does not increase the rate of stormwater flow above that which the natural ground can safely accommodate at any point;
- Ensure that all stormwater control works are constructed in a safe and aesthetic manner in keeping with the overall development;
- Prevent pollution of waterways and water features;
- Contain soil erosion by constructing protective works to trap sediment at appropriate locations. This applies particularly during construction; and
- Avoid situations where natural or artificial slopes may become saturated and unstable, both during and after the construction process.

The main stormwater management objectives and criteria that are considered to be relevant to the design and planning of stormwater drainage systems include:

- Minimising the threat of flooding;
- Minimising public inconvenience caused by frequent storms;
- Protecting the public and preventing the loss of life due to severe storms and/or malfunctioning drainage systems;
- Preventing erosion and siltation;
- Protection of receiving water bodies;
- Minimising costs;
- Sustainability of stormwater management systems; and
- Environmental and water pollution considerations.

6. HYDROLOGICAL ASSESSMENT

The methods described in the Drainage Manual were used to carry out hydrological assessments of the catchments and site.

6.1. CATCHMENT DESCRIPTION

The catchment is small (1.09 km²) and flat (<3%) and falls within the C25A quaternary catchment. It has the shape of a fairly proportioned polygon and has no evidence of clearly defined watercourses. Overland sheet flow occurs in a south-easterly direction through the site to meet the railway adjacent to the main road (R502). The catchment runoff eventually discharges into the Klipspruit.

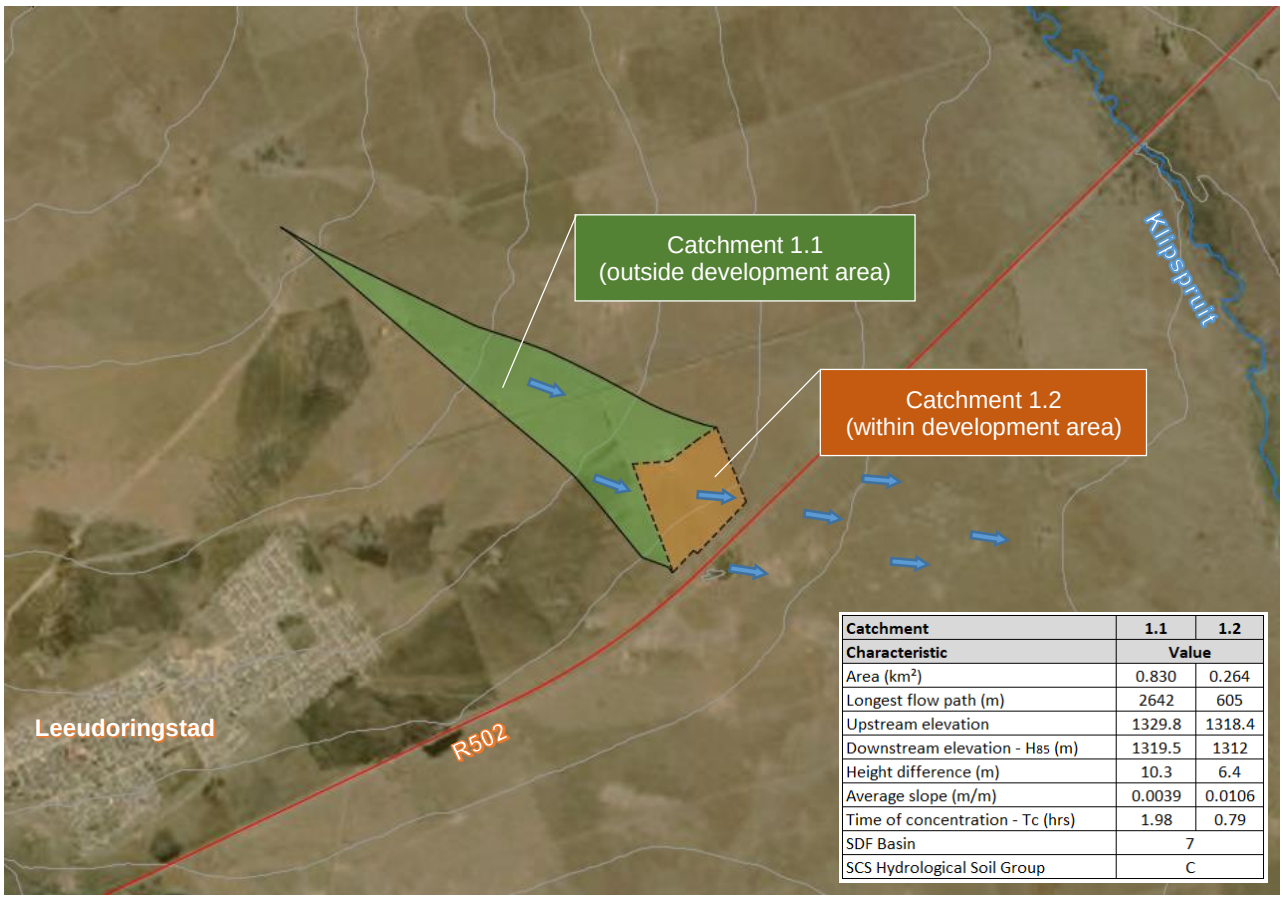
The landuse is predominantly rural grasslands. Soils were classed under the SCS hydrological soil group C, which have a moderately high stormflow potential (slow infiltration rates, shallow soil depths and restricted permeability).

The catchment was subdivided to separate the application site from the upper catchment. This would help determine the runoff entering and leaving the site which may be used in the design of mitigation measures if/where needed.

The site is located approximately 2.8 km away from the nearest river edge and will therefore not impact on or be impacted by a flood line.

6.2. CATCHMENT CHARACTERISTICS

The contributing catchments and their characteristics were determined using the existing 5m contours and aerial imagery. The catchment characteristics and delineations are illustrated in Figure 6-1 below.



Catchment	1.1	1.2
Characteristic	Value	
Area (km²)	0.830	0.264
Longest flow path (m)	2642	605
Upstream elevation	1329.8	1318.4
Downstream elevation - H85 (m)	1319.5	1312
Height difference (m)	10.3	6.4
Average slope (m/m)	0.0039	0.0106
Time of concentration - Tc (hrs)	1.98	0.79
SDF Basin	7	
SCS Hydrological Soil Group	C	

Figure 6-1: Catchments

6.3. CLIMATE

According to the Köppen-Geiger map updated by the CSIR to quantify the current South African climatic conditions, the site is given a BSk classification. This is indicative of a semi-arid climate, with cool, dry winters and warm to hot summers.

December and January are the hottest months of the year with an average temperature of approximately 30°C. June and July are the coldest months of the year with an average temperature of approximately 17°C.

The mean annual precipitation is approximately 550mm with most rainfall occurring during summer. The Design Rainfall Estimation[3] software was used to obtain the rainfall data (tabulated below) required for the runoff calculations.

[3] *Design Rainfall Estimation in South Africa Version 3 developed by MJ Gorven, JC Smithers and RE Schulze*

Table 6-1: Design Rainfall

Return Period		2yr	5yr	10yr	20yr	50yr	100yr	200yr
Duration		Rainfall Depth (mm)						
5	m	9.40	12.70	14.90	17.20	20.30	22.70	25.10
10	m	13.90	18.80	22.20	25.55	30.10	33.70	37.30
15	m	17.55	23.70	28.00	32.20	37.95	42.45	47.05
30	m	22.20	30.00	35.40	40.80	48.05	53.75	59.55
45	m	25.50	34.45	40.65	46.80	55.15	61.70	68.35
60	m	28.10	38.00	44.85	51.65	60.85	68.05	75.40
90	m	32.30	43.60	51.45	59.30	69.85	78.10	86.55
120	m	35.60	48.10	56.75	65.40	77.05	86.15	95.45
240	m	41.65	56.25	66.40	76.45	90.15	100.75	111.65
360	m	45.65	61.65	72.75	83.85	98.75	110.45	122.40
480	m	48.70	65.85	77.65	89.45	105.40	117.85	130.65
600	m	51.25	69.25	81.65	94.10	110.85	123.95	137.40
720	m	53.40	72.15	85.15	98.05	115.55	129.15	143.20
960	m	57.00	76.95	90.85	104.65	123.30	137.80	152.80
1200	m	59.95	80.95	95.55	110.05	129.70	145.00	160.70
1440	m	62.45	84.35	99.55	114.70	135.10	151.10	167.50
1	d	51.95	70.15	82.80	95.40	112.40	125.60	139.30
2	d	63.85	86.35	101.85	117.35	138.20	154.55	171.30
3	d	72.15	97.45	115.00	132.45	156.05	174.45	193.40
4	d	78.25	105.70	124.80	143.70	169.35	189.30	209.85
5	d	83.40	112.65	132.90	153.10	180.45	201.65	223.60
6	d	87.80	118.60	140.00	161.25	190.05	212.40	235.50
7	d	91.75	123.90	146.25	168.50	198.55	221.90	246.00

6.4. PEAK RUNOFF FLOWS

The runoff peak values were calculated using the widely-used Rational Method, which is considered appropriate for catchments less than 15km2. The Rational Method is based on a simplified representation of the law of conservation of mass and the hypothesis that the flow rate is directly proportional to the size of the contributing area and the rainfall intensity, with the latter a function of the return period. It is a method of estimating the runoff in a drainage basin at a specific point in time by means of the rational formula,

$$Q = \frac{CIA}{3.6},$$

where *C* is a runoff coefficient based on the type of surface,
I is the rainfall intensity in mm per hour, and
A is the area in km^2.

Three phases of the project were considered and assessed. These included the pre-development, construction and post-development scenarios.

6.4.1. Pre-Development

The pre-development catchment is considered predominantly flat (<3%), semi-permeable, and covered with grasslands and light bush.

The adopted pre-development peak flows are tabulated below with the detailed calculations included in Appendix A

Table 6-2: Adopted Pre-Development Peak Runoff Flows

Return Period	1:2	1:5	1:10	1:20	1:50	1:100
Catchment	**Peak Runoff (m^3/s)**					
1.1	1.03	1.48	1.86	2.27	2.82	3.31
1.2	0.36	0.53	0.68	0.88	1.28	1.72

Peak flows for sub-catchment 1.1 will remain the same for all phases since all development considered in this study fall entirely within sub-catchment 1.2. Sub-catchment 1.1 is therefore not included in the assessment of the construction phase and post-development phase. It is recommended that the runoff from sub-catchment 1.1 be controlled separately through the use of berms or similar measures in order not to compound the stormwater management requirements of sub-catchment 2 during and after construction.

6.4.2. Construction Phase

During construction the site will be highly susceptible to erosion and other stormwater-related impacts. Activities such as site clearance, topsoil removal, excavation and compaction of soils due to plant and vehicular traffic all contribute towards reducing infiltration and permeability and increasing stormwater runoff. The construction site will be deemed highly impermeable during this phase.

The adopted peak flows for the construction phase are tabulated below with the detailed calculations included in Appendix A

Table 6-3: Adopted Construction Phase Peak Runoff Flows

Return Period	1:2	1:5	1:10	1:20	1:50	1:100
Catchment	**Peak Runoff (m^3/s)**					
1.2	1.20	1.64	1.94	2.25	2.67	3.00

6.4.3. Post-Development

The proposed layout as well as research on similar facilities were used to make reasonable assumptions regarding the design of the PV facility. The final detailed design will influence the layout and arrangement of the PV arrays and therefore its footprint. It is understood that the 15MW solar PV Facility will occupy approximately 18 Ha. The estimated portion of land each component will typically occupy is summarised below.

Table 6-4: Typical Landuse Proportions for PV Facility

Component	% of footprint	Area (Ha)	% of Farm (125Ha)
Total Facility Area	100%	18	14.4%
PV Arrays	90%	16.2	13.0%
Buildings Substations Transformers	5%	0.9	0.7%
Internal and Access Roads	5%	0.9	0.7%

The actual runoff distribution patterns can only be determined once the final layout of the PV facility and associated infrastructure is available.

Whilst the PV panels are impervious and occupy the majority of the site area, they will not significantly impact on the runoff volume. They will be mounted on a structure (typically a modular frame or vertical poles) which will keep them elevated above and off the ground. The structure will either be pile driven or require concrete strip footings depending on the soil conditions. The impact of these mounting structures on the effective pervious area is deemed to be negligible. The critical factor therefore is the ultimate finished condition of the ground surface underneath the PV panels. Two finished-ground options are considered: re-vegetation to the original state; and bare ground or hardstand.

Option 1: Re-vegetation

Re-vegetating the ground is the ideal option from a stormwater management perspective as it significantly reduces the impact of the development on stormwater runoff. However, it cannot be guaranteed that pre-development vegetation can re-establish itself under the shading of PV panels, therefore the input of a vegetation specialist would be required. Furthermore, an appropriate maintenance regime would be required since overgrowth might hinder the performance of the panels and undergrowth might negate the envisaged runoff mitigation.

Option 2: Bare Ground or Hard Stand

It is common for solar PV facilities to maintain bare ground under the panels through soil poisoning, or to construct hard-stands under the panels. This simplifies the maintenance of the ground surface and avoids the operational hazard of overgrown vegetation. This option, however, results in higher stormwater runoff.

Notwithstanding the finished-ground options discussed above, other hardened (impervious) areas amount to 2.6 Ha (see Table 5-4), which is just over 10% of the facility.

The adopted peak flows for the post-development phase are tabulated below with the detailed calculations included in Appendix A.

Table 6-5: Adopted Post-Development Peak Runoff Flows

Return Period	1:2	1:5	1:10	1:20	1:50	1:100
Catchment	**Peak Runoff (m^3/s)**					
1.2 – Option 1	0.70	0.95	1.12	1.29	1.52	1.70
1.2 – Option 2	1.65	2.24	2.64	3.04	3.59	4.00

6.4.4. Attenuation

For attenuation of stormwater runoff to pre-development flows, the required attenuation volume for each phase is estimated using approximate hydrographs of the corresponding phase storm and the pre-development storm, as depicted in Figure X.

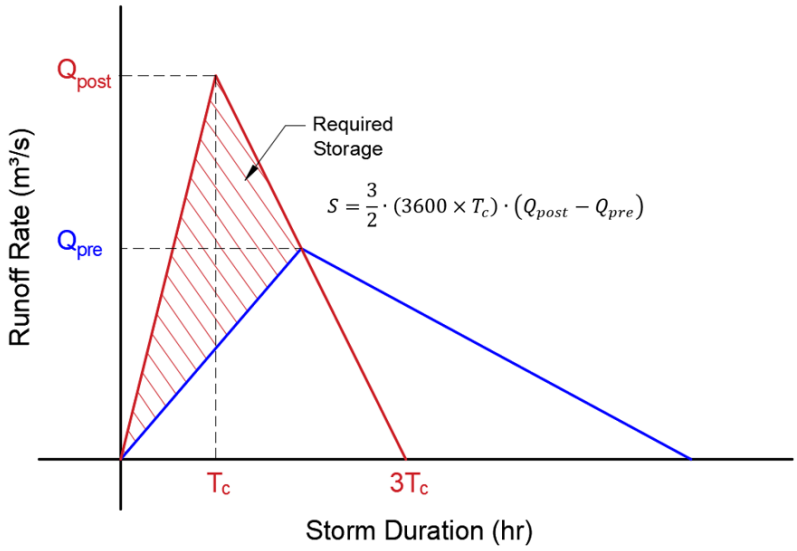


Figure 6-2: Required attenuation volume

A summary of the adopted peak flows for each phase together with the estimated attenuation volumes are tabulated below. These values are subject to refinement at the detail design stage.

Table 5-6: Attenuation volumes

Aspect	Tc	1:2	1:5	1:10	1:20	1:50
Pre-development flow (m³/s)	0.79	0.53	0.77	0.97	1.18	1.47
Construction phase flow (m³/s)	0.47	1.20	1.64	1.94	2.25	2.67
Post-development Opt 1 flow (m³/s)	0.47	0.70	0.95	1.12	1.29	1.52
Post-development Opt 2 flow (m³/s)	0.79	1.65	2.24	2.64	3.04	3.59
Development storage (m³)		1 705	2 205	2 487	2 737	3 069
Post-development Option 1 storage (m³)		717	764	660	481	239
Post-development Option 2 storage (m³)		2 851	3 730	4 257	4 744	5 396

7. STORMWATER MANGEMENT POLICY

The following rules are to be observed by the owner, developer, professional team, contractors and sub-contractors:

- Development designs must include measures for attenuating the concentration of and, increase in stormwater runoff. The post-development peak flows are to be attenuated back to pre-development conditions;
- Before the commencement of any construction activities, a plan must be agreed upon which details the measures to be implemented to control and prevent erosion during and after construction;
- On-site stormwater control systems, such as swales, berms and attenuation ponds are to be constructed before any other construction commences. These systems are to be monitored and appropriately adjusted as construction progresses to ensure complete stormwater, erosion and pollution control at all times;
- All embankments to be formed must be adequately stabilized;
- Stormwater must not be allowed to pond in close proximity to building foundations;
- An approved landscaping and re-vegetation plan must be implemented immediately after building works have reached a stage where newly established ground cover is not at risk from the construction works;
- No work is to commence without an approved Stormwater Control Plan (SCP). The SCP must describe what stormwater control measures are to be implemented before, during and after construction. Plans must indicate all persons responsible for the design and on-site monitoring during each stage of the implementation of the control measures;
- The SCP must show that all the provisions, regulations and guidelines contained in this document have been considered;
- In the event of a failure to adequately implement the approved SCP, the contractor shall be responsible for making good all consequential damage at his own cost. The developer is therefore advised to ensure that all members of the professional team and contractors are competent to undertake the development work and are adequately insured;
- The management of stormwater run-off during construction will be controlled by the Environmental Management Plan (EMP) as produced by the Environmental Control Officer (ECO). All construction activities within the development must comply with the EMP. This document is supplementary to the EMP and the control measures set out herein are not to be considered all-encompassing as the contractor will also have to adapt his control measures to the varying onsite conditions;
- All elements of the minor stormwater system shall be designed to safely accommodate and convey the 1:10 year storm event to the major stormwater system elements, which will be designed to accommodate the 1:50 year storm event. Exceptions to these capacities are to be made by the design engineer after assessing the risks;
- Attenuation/Detention facilities will be located at appropriately selected sites based on geotechnical, environmental and topographical conditions, including wetland conservation;
- Where conditions permit, open ditches, drains and channels will be used instead of pipes. On steeper slopes, where high flow velocities are anticipated, appropriate linings for all channels must be provided to withstand erosion. Such linings will vary from vegetated earthen to stone pitching and reinforced concrete;
- Flow velocities must be reduced wherever possible to reduce the erosion potential in channels, natural ground and points of flow concentration (typically at outlets);
- Silt, trash and oil traps must be strategically provided to ensure water quality is not compromised and to prevent blockages in the drainage systems;
- Areas within the proposed development that bound on stormwater attenuation areas, near road crossings, watercourse confluences and water features might be subject to flooding. In these situations, all development should take place above the outfall levels with an appropriate freeboard allowance;

- For areas flowing into the development area, potential future development in these sub-catchments should be considered and any stormwater attenuation requirements should be identified. Likewise, consideration must be given to the stormwater flowing out of the development which may impact on the downstream areas and watercourses. Appropriate measures must be taken to ensure any upstream development does not result in an increased flood damage risk downstream; and
- All natural and unlined channels should be inspected for adequate binding of soil by sustainable ground cover. Stone pitching should be used to reinforce channel inverts on steep slopes. Existing wetlands and stormwater attenuation areas should be protected from encroachment by the development.

8. GUIDELINES FOR OWNERS AND DEVELOPERS

The buildings/structures within the development will be required to control stormwater runoff in accordance with the stormwater management philosophy and policies of the local authority / municipality. The following guidelines are intended to assist in the design of the major and minor stormwater systems infrastructure, and to ensure that the objectives of this SWMP are met during the planning, design, construction and operational phases of all developments.

8.1. BUILDINGS

Any building will inevitably result in some degree of flow concentration, or deflection of flow around the building. The developer/owner shall ensure that all stormwater flow paths are protected against erosion. Discharge from the site must be attenuated back to the pre-development state.

Any inlet to a piped system shall be fitted with a screen, or grating to prevent debris and refuse from entering the stormwater system. This must be installed immediately on installation of the infrastructure.

No building works, earthworks, walls or fences may obstruct or encroach on a watercourse inside or outside the site without approved plans that do not compromise the objectives of the Stormwater Management Plan.

8.2. ROOF DRAINAGE

Building designs must ensure that rainfall runoff from roofing and other areas, not subjected to excessive pollution, be efficiently captured for re-use where possible for on-site irrigation and non-potable water uses.

Where storage for re-use and where ground conditions permit, rainwater runoff should be connected to detention areas to maximize groundwater recharge. These detention areas must be designed to contain at least the first hour of a minor storm's runoff without before overflowing.

8.3. PARKING AND PAVED AREAS

Parking or paved areas should be designed to attenuate stormwater runoff to an acceptable degree by allowing ponding or infiltration. Stormwater from such areas must be discharged in a controlled manner either as overland sheet flow or to larger attenuation facilities.

8.4. ROADS

Roads should be designed and graded to avoid concentration of flow along and off the road. Where flow concentration is unavoidable, measures to incorporate the road into the major stormwater system should be taken, with the provision of attenuation storage facilities at suitable points.

Culverts must be designed to ensure that the capacity of the culvert does not exceed the pre-development stormwater flow at that point and attenuation storage should be provided on the upstream side of the road crossing.

Outlet and culvert discharge points into the natural watercourse must be designed to dissipate flow energy and any unlined downstream channel must be adequately protected against soil erosion.

8.5. SUBSURFACE DISPOSAL OF STORMWATER

Any construction providing for the subsurface disposal of stormwater should be designed to ensure that such disposal does not cause slope instability, or areas of concentrated saturation or inundation. Infiltration structures should be integrated into the terrain so as to be unobtrusive and in keeping with the natural surroundings.

8.6. CHANNELS

Channels may be constructed to convey stormwater directly to a natural watercourse where deemed necessary and unavoidable. The channels must be suitably lined to prevent erosion and scour and provide maximum possible energy dissipation of the flow. Such linings will vary from vegetated earthen to stone pitching and reinforced concrete.

8.7. ENERGY DISSIPATION

Measures should be taken to dissipate flow energy wherever concentrated stormwater flow is discharged down an embankment or erodible slope.

8.8. OPEN TRENCHES

Open trenches should not be left open and unprotected for extended periods and should be progressively backfilled as construction proceeds. Excavated material to be used as backfill must be placed close to the trench on the upstream side to avoid loose material from washing away.

8.9. STOCKPILES

Material is to be stockpiled away from drainage paths. Loose material such as stone, sand or gravel must be covered or kept damp to minimise dust. Temporary silt screens are to be positioned immediately downstream of stockpiles to intercept loose material which may be washed away.

8.10. PHOTOVOLTAIC PANELS

Orientation of panels shall be considered with respect to drainage pattern, flow concentration, drainage area and velocity. Rows perpendicular to the contours may result in higher runoff concentrations, therefore the configuration should be designed and constructed such that the runoff remains as sheet flow across the entire site.

The panels shall be designed and constructed in such a manner as to allow vegetative growth and maintenance beneath and between panels. If the lowest vertical clearance of the panels above the ground is greater than 3m, non-vegetative control measures will be required to prevent/control erosion and scour along the drip line or otherwise provide energy dissipation from the water running off the panels.

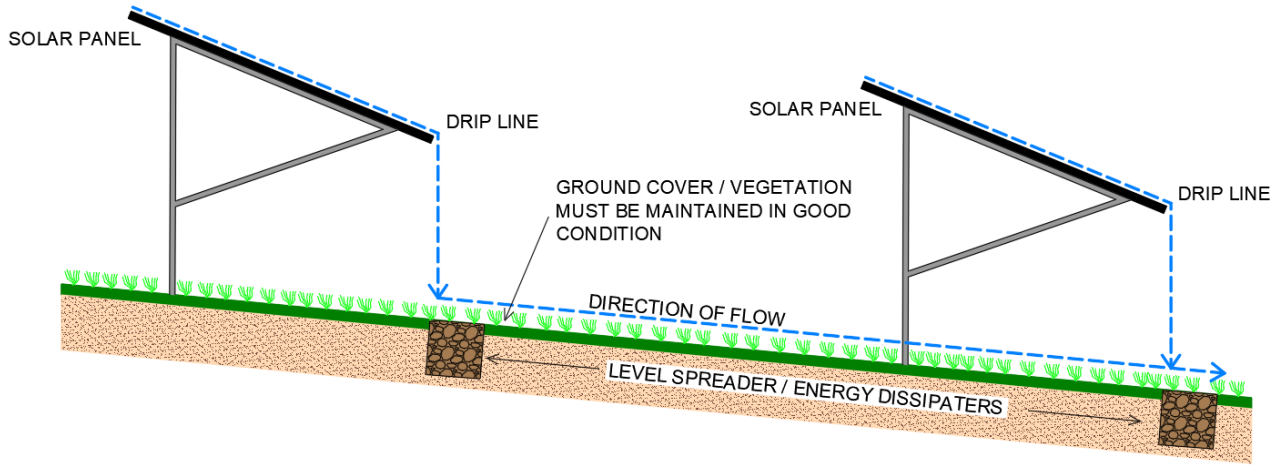


Figure 8-1: Stormwater control of PV panel runoff

8.11. STORMWATER POLLUTION CONTROL

The stormwater systems should be free from any materials that could have a detrimental effect on the fauna, flora and aquatic life in the water systems.

Sites which generate “dirty” (Grey or Black) water must have measures in place that separates the clean and “dirty” water. Depending on the nature of the “dirty” water, this must either be discharged into the wastewater system or contained on site for treatment or packaging before being re-used or disposed of. It is important that the wastewater system does not flood and overflow into the stormwater systems and designers must ensure there is sufficient capacity for the wastewater system to receive this “dirty” water.

Any site that is required to store substances that could be regarded as hazardous in terms of water pollution must take measures to ensure spillages of such substances can be adequately contained and prevent contamination of the water resources within the development area.

9. COMPLIANCE WITH STORMWATER MANGEMENT POLICY

This document should be read in conjunction with the EMP. The developer, owner and professional team, shall be responsible for ensuring that the requirements and conditions as set out in the EMP are to be adhered to.

The developer, owner and the professional team shall be responsible for the performance of all stormwater control measures implemented on the site and the impact such works may have on downstream or

neighbouring properties. Approval of any plan or document shall not be construed as absolving the developer, owner, and professional teams of this responsibility.

10. CONCLUSIONS & RECOMMENDATIONS

The following may be concluded:

- The hydrological assessment (Section 5) reveals that the proposed development/infrastructure will have a moderate impact on the stormwater quality and quantities post-development (operational phase). This impact can be successfully mitigated on site through re-vegetation and/or attenuation.
- The highest impact will occur during the construction phase and it is important that these impacts are strictly managed under the advisement of the guidelines set out in this document.
- The need for formal stormwater interventions can be minimised if the development is designed to maintain the existing drainage patterns. Overland flow via poorly-defined drainage paths will be the primary form of conveyance.
- A detailed stormwater management plan describing and illustrating the proposed stormwater and erosion control measures must be prepared by the Civil Engineers during the detailed design phase.

It is recommended that:

- The proposed development be approved in respect of its stormwater impacts;
- The policy described in Section 6 be implemented;
- The guidelines described in Section 7 be incorporated into the detailed design of the development.

Annexure A:

Calculations

Pre-Development Runoff Calculations

Catchment 1.1

Return Period	Tc (hrs)	Rainfall (mm)	Intensity (mm/hr)	A (Km^2)	C	Q (m^3/s)
1:2yr	1.98	35.6	18.0	2.47	0.35	3.31
1:5yr	1.98	48.1	20.1	2.47	0.35	4.47
1:10yr	1.98	56.8	21.96	2.47	0.35	5.27
1:20yr	1.98	65.4	25.27	2.47	0.35	6.07
1:50yr	1.98	77.1	29.82	2.47	0.35	7.16
1:100yr	1.98	86.1	33.31	2.47	0.35	8.00

Catchment 1.2

Return Period	Tc (hrs)	Rainfall (mm)	Intensity (mm/hr)	A (Km^2)	C	Q (m^3/s)
1:2yr	1.39	31.3	22.52	1.26	0.35	2.76
1:5yr	1.39	42.3	30.43	1.26	0.35	3.73
1:10yr	1.39	49.9	35.90	1.26	0.35	4.40
1:20yr	1.39	57.5	41.37	1.26	0.35	5.07
1:50yr	1.39	67.8	48.78	1.26	0.35	5.98
1:100yr	1.39	75.8	54.53	1.26	0.35	6.68

Construction Phase Runoff Calculations

Catchment 1.1

Return Period	Tc (hrs)	Rainfall (mm)	Intensity (mm/hr)	A (Km^2)	C	Q (m^3/s)
1:2yr	2.75	37.9	13.78	2.47	0.35	3.31
1:5yr	2.75	51.2	18.62	2.47	0.35	4.47
1:10yr	2.75	60.4	21.96	2.47	0.35	5.27
1:20yr	2.75	69.5	25.27	2.47	0.35	6.07
1:50yr	2.75	82	29.82	2.47	0.35	7.16
1:100yr	2.75	91.6	33.31	2.47	0.35	8.00

Catchment 1.2

Return Period	Tc (hrs)	Rainfall (mm)	Intensity (mm/hr)	A (Km^2)	C	Q (m^3/s)
1:2yr	1.39	31.3	22.52	1.26	0.48	3.78
1:5yr	1.39	42.3	30.43	1.26	0.48	5.11
1:10yr	1.39	49.9	35.90	1.26	0.48	6.03
1:20yr	1.39	57.5	41.37	1.26	0.48	6.95
1:50yr	1.39	67.8	48.78	1.26	0.48	8.19
1:100yr	1.39	75.8	54.53	1.26	0.48	9.16

Catchment 1 (Combined Catchment)

Return Period	Tc (hrs)	Rainfall (mm)	Intensity (mm/hr)	A (Km^2)	C	Q (m^3/s)
1:2yr	3.07	38.8	12.64	3.73	0.39	5.11
1:5yr	3.07	52.5	17.10	3.73	0.39	6.91
1:10yr	3.07	62	20.20	3.73	0.39	8.16
1:20yr	3.07	71.3	23.22	3.73	0.39	9.38
1:50yr	3.07	84	27.36	3.73	0.39	11.06
1:100yr	3.07	93.9	30.59	3.73	0.39	12.36

Post-Development Runoff Calculations

Catchment 1.1

Return Period	Tc (hrs)	Rainfall (mm)	Intensity (mm/hr)	A (Km^2)	C	Q (m^3/s)
1:2yr	2.75	37.9	13.78	2.47	0.35	3.31
1:5yr	2.75	51.2	18.62	2.47	0.35	4.47
1:10yr	2.75	60.4	21.96	2.47	0.35	5.27
1:20yr	2.75	69.5	25.27	2.47	0.35	6.07
1:50yr	2.75	82	29.82	2.47	0.35	7.16
1:100yr	2.75	91.6	33.31	2.47	0.35	8.00

Catchment 1.2

Return Period	Tc (hrs)	Rainfall (mm)	Intensity (mm/hr)	A (Km^2)	C	Q (m^3/s)
1:2yr	1.39	31.3	22.52	1.26	0.35	2.76
1:5yr	1.39	42.3	30.43	1.26	0.35	3.73
1:10yr	1.39	49.9	35.90	1.26	0.35	4.40
1:20yr	1.39	57.5	41.37	1.26	0.35	5.07
1:50yr	1.39	67.8	48.78	1.26	0.35	5.98
1:100yr	1.39	75.8	54.53	1.26	0.35	6.68

Catchment 1 (Combined Catchment)

Return Period	Tc (hrs)	Rainfall (mm)	Intensity (mm/hr)	A (Km^2)	C	Q (m^3/s)
1:2yr	3.07	38.8	12.64	3.73	0.35	4.58
1:5yr	3.07	52.5	17.10	3.73	0.35	6.20
1:10yr	3.07	62	20.20	3.73	0.35	7.32
1:20yr	3.07	71.3	23.22	3.73	0.35	8.42
1:50yr	3.07	84	27.36	3.73	0.35	9.92
1:100yr	3.07	93.9	30.59	3.73	0.35	11.09

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