AVIFAUNAL COMPLIANCE STATEMENT

Damlaagte Solar PV Facility near Parys, Free State

June 2021

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

EXECUTIVE SUMMARY

SLR Consulting was appointed by Mainstream Renewable Power Developments (Pty) Ltd to manage the Environmental Impact Assessment (EIA) process for the proposed Scafell Photovoltaic (PV) Solar Energy Cluster. The project sites are located 19 km west of the town Sasolburg, in Ward 7 of the Ngwathe Local Municipality of the Free State Province. Access to the project sites is obtained via an unnamed tarred road to the north of the project site and routes above the N1 national road for 4 km in a westerly direction. This road connects to the Boundary Road at the Vaal Eden intersection. The Boundary Road can be reached via the R59 (located 6 km south of the project site) of the N1. The cluster will consist of the following projects:

- Damlaagte Solar PV Facility
- Scafell Solar PV Facility
- Vlakfontein Solar PV Facility
- Ilikwa Solar PV Facility

Chris van Rooyen Consulting was appointed by SLR Consulting to compile a Compliance Statement for each PV project as part of the EIA process. **This statement is specifically for the Damlaagte Solar PV Facility.**

A total of 194 species could potentially occur within the pentad where the project is located (see Appendix B). Of these, 62 are classified as priority species. Of the 62 priority species, 31 have a medium to high probability of occurring in the development site. Of the 31 priority species with a medium to high probability of occurrence, 19 were recorded during site surveys. **No species of conservation concern (SCC) were recorded by SABAP2 in this pentad or during site surveys**.

POTENTIAL IMPACTS

The following impacts have been identified relative to avifauna:

Construction Phase

- Displacement due to disturbance and habitat transformation associated with the construction of the solar PV facility and associated infrastructure.

Operational Phase

- Collisions with the solar panels.
- Entrapment in perimeter fences.
- Electrocutions in the onsite substations and on the 33kV overhead lines.

Decommissioning Phase

- Displacement due to disturbance associated with the decommissioning of the solar PV facilities and associated infrastructure.

ENVIRONMENTAL SENSITIVITIES

The study area and immediate environment is classified as **Low to Medium** sensitivity for terrestrial animals according to the Terrestrial Animal Species Theme[1] from the DFFE Screening Tool (see Figure 6). The medium sensitivity classification is not linked to avifauna. The development site contains no confirmed habitat for species of conservation concern (SCC) as defined in the Protocol for the specialist assessment and minimum report content requirements for environmental impacts on terrestrial animal species (Government Gazette No 43855, 30 October 2020, namely listed on the IUCN Red List of Threatened Species or South Africa's National

[1] Note that the Avian theme for PV in the Screening Tool is incorrect, as it displays the sensitivities for bats, and not birds.

Red List website as Critically Endangered, Endangered or Vulnerable. The absence of SCC was confirmed during the site surveys. Based on these criteria, the study area is correctly classified as **Low** sensitivity for avifauna.

No specific avifaunal sensitivities were identified at the application site which will require buffer zones.

Environmental parameter	Impact	Significance rating prior to mitigation	Significance rating post mitigation
Avifauna	*Displacement of priority species due to disturbance and habitat destruction associated with construction of the PV facility and associated infrastructure.*	High	High
	Mortality of priority species due to collisions with solar panels	Very low	Very low
	Entrapment of birds in the perimeter fence	Medium	Low
	Mortality of priority species due to electrocution in the onsite substations and the 33kV overhead lines	Medium	Low
	Displacement of priority species due to disturbance associated with decommissioning of the PV facility and associated infrastructure.	Medium	Medium

MANAGEMENT ACTIONS

The following management actions have been proposed in this assessment:

Construction phase

- Activity should as far as possible be restricted to the footprint of the infrastructure.
- Measures to control noise and dust should be applied according to current best practice in the industry.
- Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum as far as practical.
- Access to the rest of the property must be restricted.
- The recommendations of the ecological and botanical specialist studies must be strictly implemented, especially as far as limitation of the construction footprint is concerned.

Operational phase

- Perimeter fence: Increasing the spacing between at least the top two wires (to a minimum of 30cm) and ensuring they are correctly tensioned will reduce the snaring risk.
- Substation: Due to the complicated design of the substation hardware, pro-active mitigation is not a practical option. Instead, the situation must be monitored, and should electrocutions of priority species be recorded, reactive mitigation could be applied in the form of insulation of live components.
- 33kV network: The cables must be placed underground as much as practically possible. The final pole design must be developed in consultation with the avifaunal specialist to ensure that a bird friendly design is employed. The avifaunal specialist must sign off on the final pole design.

De-commissioning phase

- Decommissioning 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.

REASONED OPINION

The study area and immediate environment is classified as Low to Medium sensitivity for terrestrial animals according to the Terrestrial Animal Species Theme from the DFFE Screening Tool. The medium sensitivity classification is not linked to avifauna. The development site contains no confirmed habitat for species of conservation concern (SCC) as defined in the Protocol for the specialist assessment and minimum report content requirements for environmental impacts on terrestrial animal species (Government Gazette No 43855, 30 October 2020, namely listed on the IUCN Red List of Threatened Species or South Africa's National Red List website as Critically Endangered, Endangered or Vulnerable. The absence of SCC was confirmed during the site surveys undertaken from 18 – 23 January 2021. Based on these criteria, the study area is correctly classified as Low sensitivity for avifauna. No fatal flaws were discovered during the investigations.

IMPACT STATEMENT

It is recommended that the activity is authorised, on condition that the proposed mitigation measures as detailed in the Impact Tables (Section 9 of the report) and the EMPr (Appendix C) are strictly implemented.

DECLARATION OF INDEPENDENCE

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

_____

Full Name: Chris van Rooyen

Title / Position: Director

Minimum report requirements listed in the Protocol for the specialist assessment and minimum report content requirements for environmental impacts on terrestrial animal species (Government Gazette No 43855, 30 October 2020)	
Contact details and relevant experience as well as the SACNASP Registration number of the specialist preparing the assessment including a curriculum vitae;	Appendix A
A signed statement of independence by the specialist;	Page 6
A statement on the duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment;	Section 2
A description of the methodology used to undertake the site sensitivity verification, impact assessment and site inspection, including equipment and modelling used where relevant;	Section 2
A description of the mean density of observations/number of sample sites per unit area and the site inspection observations;	Section 5
A description of the assumptions made and any uncertainties or gaps in knowledge or data;	Section 2
The location of areas not suitable for development and to be avoided during construction where relevant;	Section 5
Impact management actions and impact management outcomes proposed by the specialist for inclusion in the Environmental Management Programme (EMPr);	Section 9 and Appendix C
A reasoned opinion, based on the findings of the specialist assessment, regarding the acceptability or not of the development and if the development should receive approval or not, related to the specific theme being considered, and any conditions to which the opinion is subjected if relevant; and	Section 11
A motivation must be provided if there were any development footprints identified as per paragraph 2.2.12 above that were identified as having “low” or “medium” terrestrial animal species sensitivity and were not considered. appropriate.	Section 5

Contents

List of Figures

List of Tables

List of Abbreviations

BA	Basic Assessment
BGIS	Biodiversity Geographic Information System
BLSA	BirdLife South Africa
DFFE	Department of Forestry, Fisheries and the Environment
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
IBA	Important Bird Area
IKA	Index of Kilometric Abundance
IUCN	International Union for Conservation of Nature
NEMA	National Environmental Management Act (Act 107 of 1998, as amended)
OHL	Overhead Line
PV	Photovoltaic
REDZs	Renewable Energy Development Zones
SABAP 1	South African Bird Atlas 1
SABAP 2	South African Bird Atlas 2
SACNASP	South African Council for Natural and Scientific Professions
SANBI	South African Biodiversity Institute
SAPAD	South Africa Protected Areas Database

Glossary

Definitions	
Study area	The area covered by the proposed application site.
Broader area	A consolidated data set for the 2645_2735 pentad where the study area is located.
PV footprint	The development footprint containing the PV solar arrays and associated infrastructure.
Priority species	• South African Red Data species. • South African endemics and near-endemics. • Raptors • Waterbirds

1. Introduction

SLR Consulting was appointed by Mainstream Renewable Power Developments (Pty) Ltd to manage the Environmental Impact Assessment (EIA) process for the proposed Scafell Photovoltaic (PV) Solar Energy Cluster. The project sites are located 19 km west of the town Sasolburg, in Ward 7 of the Ngwathe Local Municipality of the Free State Province. Access to the project sites is obtained via an unnamed tarred road to the north of the project site and routes above the N1 national road for 4 km in a westerly direction. This road connects to the Boundary Road at the Vaal Eden intersection. The Boundary Road can be reached via the R59 (located 6 km south of the project site) of the N1. The cluster will consist of the following projects:

- Damlaagte Solar PV Facility
- Scafell Solar PV Facility
- Vlakfontein Solar PV Facility
- Ilikwa Solar PV Facility

The project site is located within the Central Strategic Transmission Corridor – a node for the development and expansion of large-scale electricity / grid connection infrastructure, i.e. power lines and substations, etc. Existing grid connection infrastructure within the vicinity of the project site include the following:

- Scafell Main Transmission Substation;
- Mercury – Zeus 765 kV Power Line;
- Olympus – Scafell 1 275 kV Power Line,
- Scafell – Snowdon 1 275 kV Power Line; and
- Makalu – Scafell 1 275 kV Power Line.

All of the above-mentioned power lines connect to the Scafell Main Transmission Substation (MTS), located 2 km south – east of the project site. The grid connection infrastructure associated with the proposed project would either be a direct connection or loop in / loop out connection to the Scafell MTS. A separate Basic Assessment (BA) process is being undertaken for this proposed grid connection infrastructure.

See Figure 1 for a map of the proposed PV Cluster.

Chris van Rooyen Consulting was appointed by SLR Consulting to compile a Compliance Statement for each PV project as part of the EIA process. This statement is specifically for the Damlaagte Solar PV Facility.

See Table 1 for the technical description of the project.

Table 1: Technical description of the Damlaagte PV Facility

Component	Damlaagte Solar PV Facility
Farm name & portion number:	Damlaagte 229 Remaining Extent
Property size:	282.22 ha
Project Site size:	173 ha
Development footprint size:	166 ha
Centre coordinates of site:	26°47'29.47"S 27°37'43.58"E
Capacity	Up to 150 MW_{ac}
Mounting structures	Single Axis Tracking, Dual Axis Tracking or Fixed Axis Mounting System Technology
Inverters	Centralised or String Inverter Stations and Power Transformers
Installed PV panel height	Up to 3 m
Number of PV panels	Up to 304 452

Cabling	Underground and overhead transmission lines (up to 33kV)
IPP Substation capacity	Up to 33 / 132 kV
IPP Substation footprint	Up to 2.5 ha`
Grid Connection	▪ 132 kV power line from the 33 / 132 kV from the on-site substation to the Scafell MTS ▪ 132 kV power line from the 33 / 132 kV on-site substation via Loop-in / Loop-out connection into the existing Bernina – Leeudoring Shaft / Scafell 132 kV power lines.
Grid Connection Corridor Length & Width	Up to 5 km long and 150 m wide (and up to 500 m wide for the on-site substation)
BESS footprint	Up to 1 ha
BESS technology	Solid State or Redox Flow Batteries
Size of laydown area	Up to 3 ha
Internal access road	Gravel, 12 km long and 5 m wide
Main access road	Gravel, 12 km long and 8 m wide
Operation and maintenance buildings	▪ Operations and Control Centre ▪ Operation and Maintenance Area / Warehouse / Workshop / Control Centre and Office ▪ Ablution Facilities ▪ Substation Building ▪ Security and Guard House
Associated infrastructure	▪ Permanent Laydown Area ▪ Temporary Construction Camp and Laydown Area ▪ Fencing and Lighting ▪ Lightening Protection Infrastructure ▪ Telecommunication Infrastructure ▪ A 400 m^3 reservoir, water pipeline and stormwater channels

1.1 Project Alternatives

Various alternatives are being considered for the proposed Project. These include technology alternatives such as the type of battery energy storage system, monofacial and bifacial PV panel modules and PV panel mounting structure types. The alternatives considered for the proposed project are described below:

i. Photovoltaic Panels / Modules

Three types of photovoltaic panels / modules are being considered and would be utilised for the proposed project. These include the following:

- **Monocrystalline Modules** are made from pure silicon crystal ingots melted down and drawn out into a solid silicon crystal. The cells are then cut from the silicon crystal. The cells are rigid and mounted on a rigid frame. The modules are covered in glass to protect the cells from being damaged. The advantages and disadvantages of monocrystalline modules are made from pure silicon. The advantage of monocrystalline modules is that the modules are highly efficient. The disadvantage is that they are expensive to produce.
- **Polycrystalline Modules** are made with silicon along with added impurities. It is melted down and cut up into wafers which make up the blocks in a module. The cells are then cut from the silicon crystal with added impurities. The cells are rigid and mounted on a rigid frame. The modules are covered in glass to protect the cells from being damaged. The advantages of polycrystalline modules are that they are silicon-based, however, they contain impurities. The advantage of this is that the modules are cheaper to produce. The disadvantage is that they are not as efficient as monocrystalline modules.
- **Thin Film Modules** are cells manufactured from a chemical ink compound that has similar properties to that of silicon cells. The ink compound gets printed onto a sheet metal to form the base of the module. This sheet is heated to turn into a semiconductor (like silicon). A layer of glass is also added to cover the cell surface. This allows thin-film modules to match the lifespan

of silicon modules, allowing them to be competitive with silicon-based module technologies. The main advantage of thin-film modules is that, due to the manufacturing process of the modules, they are cheaper to produce and therefore cheaper to purchase compared to silicon-based modules. The disadvantage of thin-film modules is that they are slightly less efficient than silicon-based modules.

ii. Photovoltaic Panel-Type

Mainstream is considering the use of **Monofacial** and **Bifacial** PV panel modules for the proposed solar PV facilities. Monofacial PV panel modules generate electricity from one side of the module, whereas bifacial PV panel modules generate electricity from the front and rear side of the module thus providing more output. Bifacial PV panel modules are regarded as having a higher energy yield in comparison to monofacial PV panel modules. Thus, the utilisation of bifacial PV panel modules will require the placement of reflective material beneath the PV panel module such as concrete to enhance the albedo effect from the rear surface of the module.

iii. Mounting Structures

Mainstream is considering the use of either fixed tilt or dual tracking (single or dual axis) mounting structures for the proposed solar PV facilities. The mounting structures alternatives are described below:

- **Single-axis tracking** – this system has a single degree of flexibility that serves as an axis of rotation and is usually aligned along a North-South path. The advantages of this system are that it is cheaper, more reliable, and has a longer lifespan than dual-axis systems. The disadvantages are that the system has a lower energy output and fewer technological advancements.
- **Dual-axis tracking** – this system allows for two degrees of flexibility, offering a wider range of motion. The primary and secondary axes work together to allow these trackers to point the solar panels at specific points in the sky. The advantages of the dual axis include a higher degree of flexibility, allowing for a higher energy output and a higher degree of accuracy in directional pointing. The disadvantages of this system are that the system is mechanically complex making it more likely for something to go wrong, has a lower lifespan and reliability, and is unreliable during cloudy or overcast weather. Directions moves on a dual axis, meaning it can move in two different directions.
- **Fixed axis** – a fixed-tilt system positions the modules at a “fixed” tilt and orientation.

iv. Battery Energy Storage Systems

Mainstream is considering the use of either Solid State or Redox Flow Batteries for the Battery Energy Storage Systems (BESS) for each of the solar PV facilities. Each of the BESS-type technologies are described in detail below:

- **Solid State Batteries**
  Solid State Batteries are energy storage units that are associated with a range of containerised systems ranging from 500 kWh to 4 MWh. For a 150 MWac renewable energy facility, a total footprint area of up to 1 ha will be required for the placement of containerised solid-state batteries within each footprint of the proposed solar PV facilities. In general, solid-state batteries consist of numerous battery cells that collectively form modules. Each cell contains an anode, cathode, and an electrolyte. The modules will be assembled and packed inside shipping-size containers (i.e., 17 m long, 3.5 m wide and 4 m high) and delivered to the study area for placement within each of the solar PV facilities proposed for the Scafell Cluster Project. Each container will be placed on a raised concrete plinth of up to 30 cm and may be stacked on top of each other to a maximum height of approximately 15 m. Additional infrastructure associated with the modules include inverters and temperature control equipment which will be positioned inside the containers.

- **Redox Flow Batteries**
  Redox Flow Batteries (RFB) are also being considered as an alternative for the proposed solar PV facilities. For this technology, energy is stored as an electrolyte in the flow cells. Specific options include Sodium polysulfide / bromine (PSB) flow batteries, Vanadium Redox (VRB) flow batteries, and Zinc-Bromine (ZNBR) flow batteries which would be contained in small bunded areas. RFBs generally consist of two half-cells containing liquid electrolyte systems. Once supplied with electrical energy a reduction - oxidation (redox) reaction between ions of the two electrolytes, separated by a membrane, charge the electrodes (i.e., cathode and anode) with energy. Energy discharge from an RFB is achieved by a reversed redox reaction between ions resulting in the potential for electrical energy to be drawn from the electrodes. The footprint of a RFB system is approximately 150 x 100 m, with a height of 15 m. The system consists of two electrolyte storage tanks that are contained within a 2.5 m high berm wall which prevents leakage of the electrolyte chemical into the surrounding environment.

An assessment of the potential impacts anticipated from the alternatives considered for the proposed project is included in Chapter 7 of this Report.

1.2 Scope, Purpose and Objectives of this Compliance Statement

The purpose of the statement is to assess the potential impacts of the Damlaagte PV Solar Facility, as well as all associated infrastructure, on avifauna, and to recommend measures, if any, for the mitigation of identified impacts.

1.3 Terms of Reference

The terms of reference for the Compliance Statement are as follows:

- Describe the affected environment from an avifaunal perspective.
- Discuss gaps in baseline data and other limitations.
- Describe the methodology that was used for the field surveys.
- Compare the site sensitivity recorded in the field with the sensitivity classification in the DFFE National Screening Tool and adjust if necessary.
- Provide an overview of all applicable legislation.
- Provide an overview of assessment methodology.
- Identify and assess the potential impacts of the proposed development on avifauna.
- Provide sufficient mitigation measures to include in the Environmental Management Programme (EMPr).
- Conclude with an impact statement.

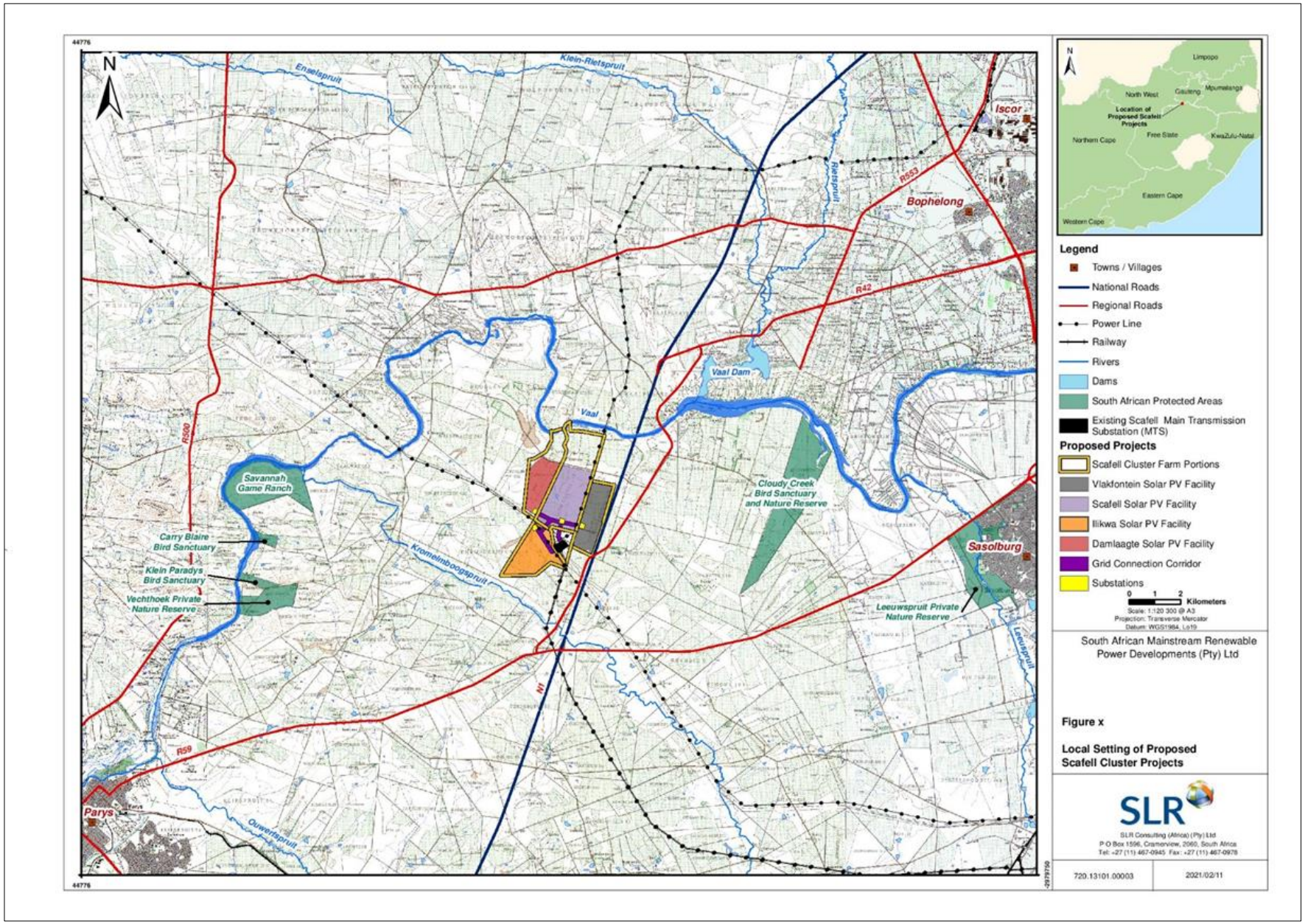


Figure 1: Map of the proposed Scafell PV Cluster.

2. Approach and Methodology

The below approach was followed to conduct this study:

- Bird distribution data from the Southern African Bird Atlas Project 2 (SABAP 2) was obtained (http://sabap2.adu.org.za/), in order to ascertain which species occur in the pentad where the proposed development area is located. A pentad grid cell covers 5 minutes of latitude by 5 minutes of longitude (5'× 5'). Each pentad is approximately 8 × 7.6 km. The SABAP2 data covers the period 2007 to 2020. The relevant pentad is 2645_2735 (henceforth referred to as the "broader area"). A total of 31 SABAP2 full protocol lists had been completed for the pentad where the proposed project is located (i.e. bird listing surveys lasting a minimum of two hours each). In addition, 36 ad hoc protocol lists (i.e. bird listing surveys lasting less than two hours but still giving useful data) were also recorded. The SABAP2 data was therefore regarded as an adequate indicator of the avifauna which could occur at the study area, and it was further supplemented by data collected during the on-site surveys.
- A classification of the vegetation types in the development area was obtained from the Atlas of Southern African Birds 1 (SABAP1) and the National Vegetation Map (2018) accessed via the South African National Biodiversity Institute (SANBI) Biodiversity Geographic Information System (BGIS) map viewer (SANBI 2020).
- The national threatened status of all priority species was determined with the use of the most recent edition of the Red Data Book of Birds of South Africa, Lesotho and Swaziland (Taylor *et al*. 2015).
- The global threatened status of all priority species was determined by consulting the latest (2021.1) International Union for Conservation of Nature (IUCN) Red List of Threatened Species.
- The Important Bird and Biodiversity Areas of South Africa (Marnewick *et al.* 2015) was consulted for information on potentially relevant Important Bird Areas (IBAs).
- The DFFE National Screening Tool was used to determine the assigned avian sensitivity of the study area.
- Satellite imagery was used to view the broader area on a landscape level and to help identify bird habitat on the ground.
- On-site surveys were conducted from 18 – 23 January 2021 based on the best practice guidelines for avifaunal impact studies for solar developments, compiled by BirdLife South Africa (BLSA) in 2017 (Jenkins *et al*. 2017). Monitoring was conducted in the following manner:
    - Three drive transects of 6.2 km, 6.75 km and 3.5 km respectively were identified in the study area and counted six times over a period of 7 days. One observer driving slowly recorded all birds on both sides of the transect. The observer stopped at regular intervals and moved a distance away from the vehicle to listen to bird calls and to scan the environment with binoculars.
    - The following variables were recorded:
        - Species;
        - Number of birds;
        - Date;
        - Start time and end time;
        - Estimated distance from transect (m);
        - Wind direction;
        - Wind strength (estimated Beaufort scale 1 - 7);
        - Weather (sunny; cloudy; partly cloudy; rain; mist);
        - Temperature (cold; mild; warm; hot);
        - Behaviour (flushed; flying-display; perched; perched-calling; perched-hunting; flying- foraging; flying-commute; foraging on the ground.
    - All incidental sightings of priority species were recorded.

See Figure 2 below for the extent of the broader area.

Figure 2: Area covered by the 2645_2735 SABAP 2 pentad (broader area = square).

See Figure 3 for the location of drive transects.

Figure 3: The location of the drive transects relative to the Damlaagte PV site (white polygon).

2.1 Information Sources

The following data sources were used to compile this report:

Data / Information	Source	Date	Type	Description
South African Protected Areas Database (SAPAD)	Department of Environment, Forestry and Fisheries (DEFF)[2]	2020, Q2	Spatial	Spatial delineation of protected areas in South Africa. Updated quarterly
Atlas of Southern African Birds 1 (SABAP1)	University of Cape Town	1987-1991	Spatial, reference	SABAP1, which took place from 1987-1991.
South African Bird Atlas Project 2 (SABAP2)	University of Cape Town	April 2021	Spatial, database	SABAP2 is the follow-up project to the SABAP1. The second bird atlas project started on 1 July 2007 and is still growing. The project aims to map the distribution and relative abundance of birds in southern Africa.
National Vegetation Map	South African National Biodiversity Institute (SANBI) (BGIS)	2018	Spatial	The National Vegetation Map Project (VEGMAP) is a large collaborative project established to classify, map and sample the vegetation of South Africa, Lesotho and Swaziland.
Red Data Book of Birds of South Africa, Lesotho and Swaziland	BirdLife South Africa	2015	Reference	The 2015 Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland is an updated and peer-reviewed conservation status assessment of the 854 bird species occurring in South Africa undertaken in collaboration between BirdLife South Africa, the Animal Demography Unit of the University of Cape Town, and the SANBI.
IUCN Red List of Threatened Species (2020.2)	IUCN	2021. 1	Online reference source	Established in 1964, the International Union for Conservation of Nature's Red List of Threatened Species is the world's most comprehensive information source on the global extinction risk status of animal, fungus and plant species.
Important Bird and Biodiversity Areas of South Africa	BirdLife South Africa	2015	Reference work	Important Bird and Biodiversity Areas (IBAs), as defined by BirdLife International, constitute a global network of over 13 500 sites, of which 112 sites are found in South Africa. IBAs are sites of global significance

[2] Now referred to as the Department of Forestry, Fisheries and the Environment (DFFE).

Data / Information	Source	Date	Type	Description
				for bird conservation, identified nationally through multi-stakeholder processes using globally standardised, quantitative and scientifically agreed criteria.
Strategic Environmental Assessment for wind and solar photovoltaic energy in South Africa	Department of Environmental Affairs, 2015. Strategic Environmental Assessment for wind and solar photovoltaic energy in South Africa. CSIR Report Number: CSIR/CAS/EMS/ER/2015/0001/B. Stellenbosch.	2015	SEA	The SEA identifies areas where large scale wind and solar PV energy facilities can be developed in terms of Strategic Infrastructure Project (SIP) 8 and in a manner that limits significant negative impacts on the natural environment, while yielding the highest possible socio-economic benefits to the country. These areas are referred to as Renewable Energy Development Zones (REDZs).
The National Screening Tool	Department of Forestry, Fisheries and the Environment	April 2021	Spatial	The National Web based Environmental Screening Tool is a geographically based web-enabled application which allows a proponent intending to submit an application for environmental authorisation in terms of the Environmental Impact Assessment (EIA) Regulations 2014, as amended to screen their proposed site for any environmental sensitivity.

2.2 Assumptions, Knowledge Gaps and Limitations

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

- A total of 31 SABAP2 full protocol lists had been completed for the broader area where the proposed project is located (i.e. bird listing surveys lasting a minimum of two hours each). In addition, 36 ad hoc protocol lists (i.e. bird listing surveys lasting less than two hours but still giving useful data) were also recorded. The SABAP2 data was therefore regarded as an adequate indicator of the avifauna which could occur at the study area, and it was further supplemented by data collected during the on-site surveys.
- The focus of the study was primarily on the potential impacts of the proposed solar PV facility on priority species.
- Priority species were defined as follows:
  - South African Red Data species.
  - South African endemics and near-endemics.
  - Raptors
  - Waterbirds
- Only one published scientific study on the impact of PV facilities on avifauna in South Africa (Visser 2018) currently exists. Some reliance was therefore placed on expert opinion and data from existing monitoring programmes at solar facilities in the USA where monitoring has been ongoing since 2013. The pre-cautionary principle was applied throughout as the full extent of impacts on avifauna at solar facilities is not presently known.
- The assessment of impacts is based on the baseline environment as it currently exists at the study area.

- Conclusions drawn in this study are based on experience of the specialist on the species found on site and similar species in different parts of South Africa. Bird behaviour can never be entirely reduced to formulas that will be valid under all circumstances.
- The **broader area** is defined as the area encompassed by the pentad where the project is located (see Figure 2 above). The **study area** is defined as the area covered by the application site. The **PV footprint** is the where the development will be located, i.e. the footprint containing the PV solar arrays and associated infrastructure.

3. Legislative and Permit Requirements

3.1 Legislative Framework

There is no legislation pertaining specifically to the impact of solar facilities and associated electrical grid infrastructure on avifauna. There are best practice guidelines available which were compiled under the auspices of BLSA i.e. Jenkins, A.R., Ralston-Patton, Smit- Robinson, A.H. 2017. *Guidelines for assessing and monitoring the impact of solar power generating facilities on birds in southern Africa*. This guideline has been considered in this assessment.

3.1.1 Agreements and conventions

International agreements and conventions are described in this section.

Table 2: International agreements and conventions which South Africa is party to and which is relevant to the conservation of avifauna.

Convention name	Description	Geographic scope
African-Eurasian Waterbird Agreement (AEWA)	The Agreement on the Conservation of AEWA is an intergovernmental treaty dedicated to the conservation of migratory waterbirds and their habitats across Africa, Europe, the Middle East, Central Asia, Greenland and the Canadian Archipelago. Developed under the framework of the Convention on Migratory Species (CMS) and administered by the United Nations Environment Programme (UNEP), AEWA brings together countries and the wider international conservation community in an effort to establish coordinated conservation and management of migratory waterbirds throughout their entire migratory range.	Regional
Convention on Biological Diversity (CBD), Nairobi, 1992	The Convention on Biological Diversity (CBD) entered into force on 29 December 1993. It has three main objectives: • The conservation of biological diversity; • The sustainable use of the components of biological diversity; and • The fair and equitable sharing of the benefits arising out of the utilization of genetic resources.	Global
Convention on the Conservation of Migratory Species of Wild Animals, (CMS), Bonn, 1979	As an environmental treaty under the aegis of the UNEP, CMS provides a global platform for the conservation and sustainable use of migratory animals and their habitats. CMS brings together the States through which migratory animals pass, the Range States, and lays the legal foundation for internationally coordinated conservation measures throughout a migratory range.	Global
Convention on the International Trade in Endangered Species of Wild Flora and Fauna,	CITES is an international agreement between governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival.	Global

Convention name	Description	Geographic scope
(CITES), Washington DC, 1973		
Ramsar Convention on Wetlands of International Importance, Ramsar, 1971	The Convention on Wetlands, called the Ramsar Convention, is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.	Global
Memorandum of Understanding on the Conservation of Migratory Birds of Prey in Africa and Eurasia	The Signatories will aim to take co-ordinated measures to achieve and maintain the favourable conservation status of birds of prey throughout their range and to reverse their decline when and where appropriate.	Regional

3.1.2 National legislation

3.1.2.1 Constitution of the Republic of South Africa, 1996

The Constitution of the Republic of South Africa provides in the Bill of Rights that: Everyone has the right –

(a) to an environment that is not harmful to their health or well-being; and
(b) to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that –
    (i) prevent pollution and ecological degradation;
    (ii) promote conservation; and
    (iii) secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

3.1.2.2 The National Environmental Management Act NEMA (Act 107 of 1998, as amended)

The NEMA creates the legislative framework for environmental protection in South Africa and is aimed at giving effect to the environmental right in the Constitution. It sets out a number of guiding principles that apply to the actions of all organs of state that may significantly affect the environment. Sustainable development (socially, environmentally and economically) is one of the key principles, and internationally accepted principles of environmental management, such as the precautionary principle and the polluter pays principle, are also incorporated.

NEMA also provides that a wide variety of listed developmental activities (via the promulgation of the EIA Regulations (2014, as amended), which may significantly affect the environment, may be performed only after an EIA or BA has been undertaken and environmental authorisation has been obtained from the relevant competent authority. Many of these listed activities can potentially have negative impacts on bird populations in a variety of ways. The clearance of natural vegetation, for instance, can lead to a loss of habitat and may depress prey populations, while erecting structures needed for generating and distributing energy, communication, and so forth can cause mortalities by collision or electrocution.

NEMA makes provision for the prescription of procedures for the assessment and minimum criteria for reporting on identified environmental themes (Sections 24(5)(a) and (h) and 44) when applying for environmental authorisation. The Protocol for the specialist assessment and minimum report content requirements for environmental impacts on terrestrial animal species (Government Gazette No 43855, 30 October 2020 is applicable in the case of solar PV developments.

3.1.2.3 The National Environmental Management: Biodiversity Act 10 of 2004 and the Threatened or Protected Species Regulations, February 2007

The most prominent statute containing provisions directly aimed at the conservation of birds is the National Environmental Management: Biodiversity Act (Act 10 of 2004, as amended) read with the Threatened or Protected Species Regulations, February 2007 (TOPS Regulations). Chapter 1 sets out the objectives of the Act, and they are aligned with the objectives of the Convention on Biological Diversity, which are the conservation of biodiversity, the sustainable use of its components, and the fair and equitable sharing of the benefits of the use of genetic resources. The Act also gives effect to CITES, the Ramsar Convention, and the Bonn Convention on Migratory Species of Wild Animals (as noted in Table 5 above). The State is endowed with the trusteeship of biodiversity and has the responsibility to manage, conserve and sustain the biodiversity of South Africa.

3.1.3 Provincial legislation

3.1.3.1 Free State Nature Conservation ordinance 8 of 1969

This statute provides for the conservation of fauna and flora and the hunting of animals causing damage and for matters incidental thereto.

4. Description of Project Aspects relevant to Avifauna

The facility will comprise of the following components which could potentially affect avifauna:

Component	Damlaagte Solar PV Facility
Development footprint size:	166 ha
Number of PV panels	Up to 304 452
Cabling	Underground and overhead transmission lines (up to 33kV)
IPP Substation capacity	Up to 33 / 132 kV (up to 2.5 ha)
Grid Connection[3]	▪ 132 kV power line from the 33 / 132 kV from the on-site substation to the Scafell MTS. ▪ 132 kV power line from the 33 / 132 kV on-site substation via Loop-in / Loop-out connection into the existing Bernina – Leeudoring Shaft / Scafell 132 kV power lines.
Grid Connection Corridor Length & Width	▪ Up to 5 km long and 150 m wide (and up to 500 m wide for the on-site substation)
BESS technology	Solid State or Redox Flow Batteries (up to 1 ha)
Laydown area	Up to 3 ha
Internal access road	Gravel, 12 km long and 5 m wide
Main access road	Gravel, 12 km long and 8 m wide
Operation and maintenance buildings	▪ Operations and Control Centre ▪ Operation and Maintenance Area / Warehouse / Workshop / Control Centre and Office ▪ Ablution Facilities ▪ Substation Building ▪ Security and Guard House
Associated infrastructure	▪ Permanent Laydown Area ▪ Temporary Construction Camp and Laydown Area ▪ Fencing and Lighting ▪ Lightening Protection Infrastructure ▪ Telecommunication Infrastructure ▪ A 400 m^3 reservoir, water pipeline and stormwater channels

[3] This is assessed as part of a separate BA

5. Baseline Environmental Description

5.1 General Description

5.1.1 Important Bird Areas (IBAs)

The Suikerbosrand Nature Reserve IBA SA022 is the closest IBA and is located approximately 60km north-east of the site. The proposed development is not expected to have any impact on the avifauna in this IBA due to the distance from the development.

5.1.2 Protected Areas

The site does not form part of a formally protected area. The closest protected area is the Cloudy Creek Bird Sanctuary and Nature Reserve which is located approximately 8km away at its closest point. The proposed development is not expected to have any impact on the avifauna in this nature reserve due to the distance from the development.

5.1.3 The Strategic Environmental Assessment for Wind and Solar Photovoltaic Energy in South Africa

The site does not fall within a Renewable Energy Zone (REDZ).

5.1.4 Bird Habitat

The application site falls within the Grassland Biome (Mucina & Rutherford). The dominant vegetation type at the development site is Soweto Highveld Grassland (Mucina & Rutherford 2006). However, vegetation structure, rather than the actual plant species, is more significant for bird species distribution and abundance (Harrison *et al.* 1997). Man-made modifications to the environment can also constitute a distinct avifaunal habitat class e.g. man-made dams and powerlines. The following bird habitats were recorded at, or in the immediate vicinity of the development site:

- Medium to tall grassland
- Wetlands, including drainage lines
- Clumps of natural woodland, mostly *Vachellia karroo.*
- High voltage lines
- Agriculture (cultivated grazing)
- Alien trees

5.1.4.1 Grassland

The following priority species with a medium to high likelihood of occurrence could potentially use the grassland in the development site:

Species	Taxonomic name	Full protocol reporting rate	Ad hoc protocol reporting rate	Possibility of regular occurrence	Recorded during surveys	Grassland
Black-headed Heron	*Ardea melanocephala*	58.06	8.33	H	x	x
Blacksmith Lapwing	*Vanellus armatus*	93.55	5.56	H	x	x
Black-winged Kite	*Elanus caeruleus*	77.42	22.22	H	x	x
Cloud Cisticola	*Cisticola textrix*	29.03	5.56	H	x	x
Common Buzzard	*Buteo vulpinus*	29.03	5.56	H	x	x
Greater Kestrel	*Falco rupicoloides*	3.23	0.00	M	x	x
South African Cliff-swallow	*Hirundo spilodera*	48.39	8.33	H	x	x
Western Cattle Egret	*Bubulcus ibis*	67.74	13.89	H	x	x
Amur Falcon	*Falco amurensis*	6.45	2.78	M		x
Lesser Kestrel	*Falco naumanni*	6.45	0.00	M		x
Long-crested Eagle	*Lophaetus occipitalis*	3.23	0.00	M		x
Marsh Owl	*Asio capensis*	3.23	2.78	M		x
Pied Starling	*Spreo bicolor*	48.39	0.00	H		x
Spotted Eagle-owl	*Bubo africanus*	3.23	0.00	M		x

5.1.4.2 Woodland

The following priority species with a medium to high likelihood of occurrence could potentially use the clumps of woodland in the development site:

Species	Taxonomic name	Full protocol reporting rate	Ad hoc protocol reporting rate	Possibility of regular occurrence
Black-winged Kite	*Elanus caeruleus*	77.42	22.22	H
Common Buzzard	*Buteo vulpinus*	29.03	5.56	H
Greater Kestrel	*Falco rupicoloides*	3.23	0.00	M
Long-crested Eagle	*Lophaetus occipitalis*	3.23	0.00	M
Pied Starling	*Spreo bicolor*	48.39	0.00	H
Spotted Eagle-owl	*Bubo africanus*	3.23	0.00	M
Cape White-eye	*Zosterops virens*	41.94	2.78	H
Fiscal Flycatcher	*Sigelus silens*	83.87	2.78	H
Karoo Thrush	*Turdus smithi*	54.84	2.78	H

5.1.4.3 High voltage lines

The following priority species with a medium to high likelihood of occurrence could potentially use the high voltage lines in the development site:

Species	Taxonomic name	Full protocol reporting rate	Ad hoc protocol reporting rate	Possibility of regular occurrence
Black-winged Kite	*Elanus caeruleus*	77.42	22.22	H
Common Buzzard	*Buteo vulpinus*	29.03	5.56	H
Greater Kestrel	*Falco rupicoloides*	3.23	0.00	M
Long-crested Eagle	*Lophaetus occipitalis*	3.23	0.00	M
Black-headed Heron	*Ardea melanocephala*	58.06	8.33	H
Amur Falcon	*Falco amurensis*	6.45	2.78	M
Lesser Kestrel	*Falco naumanni*	6.45	0.00	M

5.1.4.4 Agriculture

The following priority species with a medium to high likelihood of occurrence could potentially use the agricultural fields in the development site:

Species	Taxonomic name	Full protocol reporting rate	Ad hoc protocol reporting rate	Possibility of regular occurrence
Black-winged Kite	*Elanus caeruleus*	77.42	22.22	H
Common Buzzard	*Buteo vulpinus*	29.03	5.56	H
Long-crested Eagle	*Lophaetus occipitalis*	3.23	0.00	M
Black-headed Heron	*Ardea melanocephala*	58.06	8.33	H
Amur Falcon	*Falco amurensis*	6.45	2.78	M
Lesser Kestrel	*Falco naumanni*	6.45	0.00	M
Pied Starling	*Spreo bicolor*	48.39	0.00	H
Spotted Eagle-owl	*Bubo africanus*	3.23	0.00	M
Blacksmith Lapwing	*Vanellus armatus*	93.55	5.56	H
South African Cliff-swallow	*Hirundo spilodera*	48.39	8.33	H
Western Cattle Egret	*Bubulcus ibis*	67.74	13.89	H
Marsh Owl	*Asio capensis*	3.23	2.78	M
Egyptian Goose	*Alopochen aegyptiacus*	83.87	13.89	H
Spur-winged Goose	*Plectropterus gambensis*	64.52	11.11	H
African Sacred Ibis	*Threskiornis aethiopicus*	45.16	13.89	M

5.1.4.5 Alien trees

The following priority species with a medium to high likelihood of occurrence could potentially use the alien trees in the development site:

Species	Taxonomic name	Full protocol reporting rate	Ad hoc protocol reporting rate	Possibility of regular occurrence
Black-winged Kite	*Elanus caeruleus*	77.42	22.22	H
Common Buzzard	*Buteo vulpinus*	29.03	5.56	H
Long-crested Eagle	*Lophaetus occipitalis*	3.23	0.00	M
Black-headed Heron	*Ardea melanocephala*	58.06	8.33	H
Amur Falcon	*Falco amurensis*	6.45	2.78	M
Lesser Kestrel	*Falco naumanni*	6.45	0.00	M
Pied Starling	*Spreo bicolor*	48.39	0.00	H
Spotted Eagle-owl	*Bubo africanus*	3.23	0.00	M
Western Cattle Egret	*Bubulcus ibis*	67.74	13.89	H
African Sacred Ibis	*Threskiornis aethiopicus*	45.16	13.89	M
Greater Kestrel	*Falco rupicoloides*	3.23	0.00	M
African Fish-eagle	*Haliaeetus vocifer*	25.81	0.00	M

5.1.5 Avifauna

- **Southern African Bird Atlas 2**

A total of 194 species could potentially occur within the pentad where the project is located (see Appendix B). Of these, 62 are classified as priority species. Of the 62 priority species, 31 have a medium to high probability of occurring in the development site. Of the 31 priority species with a medium to high probability of occurrence, 19 were recorded during site surveys. **No species of conservation concern (SCC) were recorded by SABAP2 in this pentad or during site surveys**. The probability of a priority species occurring regularly in the study area is indicated in Table 2.

Table 2 below lists all the priority species and the possible impact on the respective species by the proposed PV facility and associated infrastructure.

- EN = Endangered, VU = Vulnerable, NT = Near threatened, LC = least concern, L= Low, M = Medium
- H = High

Table 3: Priority species occurring in the broader area. The likelihood of potential for occurrence in each habitat type as represented in the study area, is also indicated.

Species	Taxonomic name	Full protocol reporting rate	Ad hoc protocol reporting rate	Possibility of regular occurrence	Recorded during surveys	Grassland	Agriculture	Woodland	Wetland	HV lines	Alien trees	PV panel collisions	Displacement - disturbance	Displacement - habitat loss	Entrapment in fences	Electrocution : 33kV network and substations
African Black Duck	*Anas sparsa*	9.68	0.00	L					x			x				
African Darter	*Anhinga rufa*	41.94	8.33	L					x			x				
African Fish-eagle	*Haliaeetus vocifer*	25.81	0.00	M	x				x		x					
African Jacana	*Actophilornis africanus*	6.45	0.00	L					x			x				
African Purple Swamphen	*Porphyrio madagascariensis*	3.23	0.00	L					x			x				
African Sacred Ibis	*Threskiornis aethiopicus*	45.16	13.89	M			x		x		x	x		x		
African Spoonbill	*Platalea alba*	12.90	0.00	L					x			x				
Amur Falcon	*Falco amurensis*	6.45	2.78	M		x	x			x	x	x		x		x
Barn Owl	*Tyto alba*	3.23	0.00	L		x	x	x			x	x	x			x
Black Crake	*Amaurornis flavirostris*	3.23	0.00	L					x			x				
Black Sparrowhawk	*Accipiter melanoleucus*	3.23	0.00	L							x		x	x		
Black-headed Heron	*Ardea melanocephala*	58.06	8.33	H	x	x	x		x	x	x	x		x		x
Blacksmith Lapwing	*Vanellus armatus*	93.55	5.56	H	x	x	x		x			x	x	x		
Black-winged Kite	*Elanus caeruleus*	77.42	22.22	H	x	x	x	x		x	x	x		x		x
Black-winged Stilt	*Himantopus himantopus*	6.45	0.00	L					x			x				
Cape White-eye	*Zosterops virens*	41.94	2.78	H				x				x	x	x		
Cloud Cisticola	*Cisticola textrix*	29.03	5.56	H	x	x						x	x	x		
Common Buzzard	*Buteo vulpinus*	29.03	5.56	H	x	x	x	x		x	x		x	x		x
Common Moorhen	*Gallinula chloropus*	29.03	0.00	M	x				x			x				
Common Sandpiper	*Actitis hypoleucos*	3.23	0.00	L					x			x				
Egyptian Goose	*Alopochen aegyptiacus*	83.87	13.89	H	x		x		x			x				x
Fiscal Flycatcher	*Sigelus silens*	83.87	2.78	H				x				x	x	x		
Fulvous Whistling Duck	*Dendrocygna bicolor*	6.45	0.00	M	x				x			x				
Giant Kingfisher	*Megaceryle maximus*	12.90	2.78	L					x			x				
Glossy Ibis	*Plegadis falcinellus*	22.58	2.78	M	x				x			x				
Goliath Heron	*Ardea goliath*	9.68	0.00	L					x			x				
Great Egret	*Egretta alba*	6.45	0.00	L												
Greater Kestrel	*Falco rupicoloides*	3.23	0.00	M	x	x		x		x	x			x		x

Species	Taxonomic name	Full protocol reporting rate	Ad hoc protocol reporting rate	Possibility of regular occurrence	Recorded during surveys	Grassland	Agriculture	Woodland	Wetland	HV lines	Alien trees	PV panel collisions	Displacement - disturbance	Displacement - habitat loss	Entrapment in fences	Electrocution: 33kV network and substations
Grey Heron	*Ardea cinerea*	25.81	2.78	L					x			x				
Grey-headed Gull	*Larus cirrocephalus*	3.23	0.00	L					x			x				x
Hamerkop	*Scopus umbretta*	6.45	2.78	L					x			x				x
Karoo Thrush	*Turdus smithi*	54.84	2.78	H				x				x	x	x		
Lesser Kestrel	*Falco naumanni*	6.45	0.00	M		x	x			x	x	x	x	x		x
Little Egret	*Egretta garzetta*	16.13	0.00	L					x			x				
Little Grebe	*Tachybaptus ruficollis*	16.13	2.78	M	x				x			x				
Little Sparrowhawk	*Accipiter minullus*	3.23	0.00	L				x			x	x	x	x		
Long-crested Eagle	*Lophaetus occipitalis*	3.23	0.00	M		x	x	x	x	x	x	x		x		x
Malachite Kingfisher	*Alcedo cristata*	6.45	2.78	L					x			x				
Marsh Owl	*Asio capensis*	3.23	2.78	M		x	x		x			x	x	x	x	x
Osprey	*Pandion haliaetus*	0.00	2.78	L					x		x		x			
Peregrine Falcon	*Falco peregrinus*	3.23	0.00	L		x	x			x		x	x	x		x
Pied Kingfisher	*Ceryle rudis*	9.68	0.00	L					x			x				
Pied Starling	*Spreo bicolor*	48.39	0.00	H		x	x	x			x	x	x	x		
Purple Heron	*Ardea purpurea*	6.45	0.00	L					x			x				
Red-billed Teal	*Anas erythrorhyncha*	12.90	0.00	M	x				x			x				
Red-chested Flufftail	*Sarothrura rufa*	3.23	0.00	L					x			x				
Red-knobbed Coot	*Fulica cristata*	29.03	0.00	M	x				x			x				
Reed Cormorant	*Phalacrocorax africanus*	58.06	5.56	L												
South African Cliff-swallow	*Hirundo spilodera*	48.39	8.33	H	x	x	x					x	x	x		
South African Shelduck	*Tadorna cana*	16.13	0.00	M					x			x				
Spotted Eagle-owl	*Bubo africanus*	3.23	0.00	M		x	x	x			x		x	x		x
Spur-winged Goose	*Plectropterus gambensis*	64.52	11.11	H	x		x		x			x				
Squacco Heron	*Ardeola ralloides*	6.45	0.00	L					x			x				
Striated Heron	*Butorides striata*	3.23	0.00	L					x			x				
Western Cattle Egret	*Bubulcus ibis*	67.74	13.89	H	x	x	x				x		x	x		x
Whiskered Tern	*Chlidonias hybrida*	9.68	0.00	L					x			x				
White Stork	*Ciconia ciconia*	0.00	2.78	L		x	x							x		
White-breasted Cormorant	*Phalacrocorax carbo*	32.26	2.78	M	x				x			x				
White-faced Duck	*Dendrocygna viduata*	3.23	2.78	L					x			x				
Wood Sandpiper	*Tringa glareola*	3.23	0.00	L					x			x				
Yellow-billed Duck	*Anas undulata*	61.29	0.00	M	x				x			x				
Yellow-billed Egret	*Egretta intermedia*	6.45	0.00	L					x			x				

- Pre-construction surveys

As noted above, on-site surveys were conducted from 18 – 23 January 2021 during the high (wet) season. Surveys were conducted according to a Regime 1 site (low sensitivity) as defined in the best practice guidelines for avifaunal impact studies at solar developments, compiled by BLSA in 2017 (Jenkins *et al.* 2017).[4]

The abundance of priority species (Index of Kilometric Abundance i.e. birds/km = IKA) recorded during the drive and walk transects is displayed in Figure 4 below.

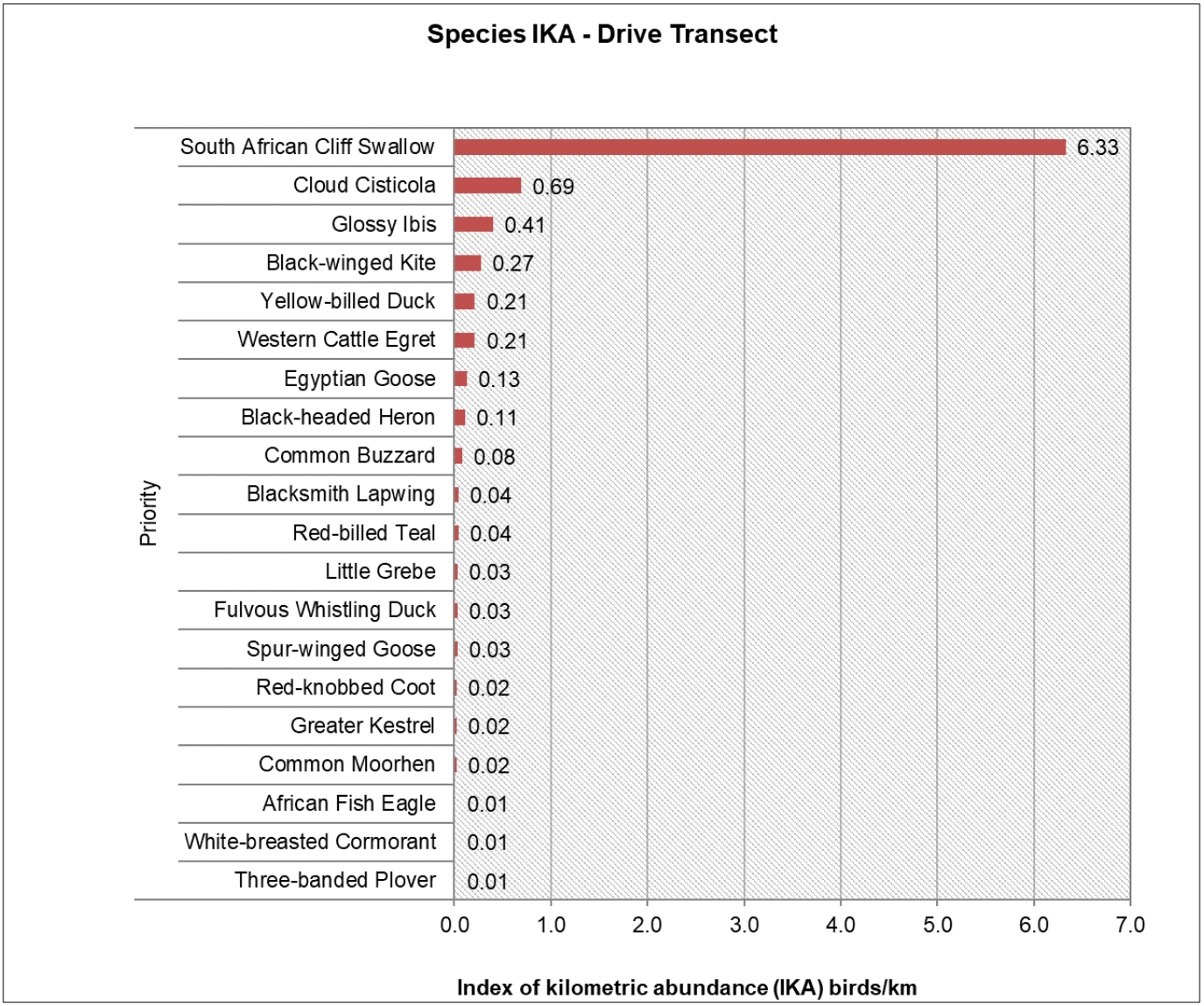


Figure 4: The abundance of priority species recorded during transect counts.

[4] It should be noted that the sensitivity criteria in the best practice guidelines for avifaunal impact studies for solar developments, compiled by BirdLife South Africa (BLSA) in 2017 (Jenkins *et al*. 2017) differs from the sensitivity criteria in Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Terrestrial Animal Species which was published in October 2020.

Table 4 lists the priority species which were recorded as incidental records.

Table 4: Priority species which were recorded as incidental records.

Species	Taxonomic name
Yellow-billed Duck	*Anas undulata*
Cloud Cisticola	*Cisticola textrix*
Common Buzzard	*Buteo buteo*

The overall abundance of priority species at the site and immediate environment was high, with an average of 8.71 birds/km recorded during drive transect counts. However, no species of conservation concern (SCC) were recorded during site surveys.

See Figure 5 for the location of priority species recorded during the surveys.

Figure 5: Priority species recorded during surveys.

5.2. Identification of Environmental Sensitivities

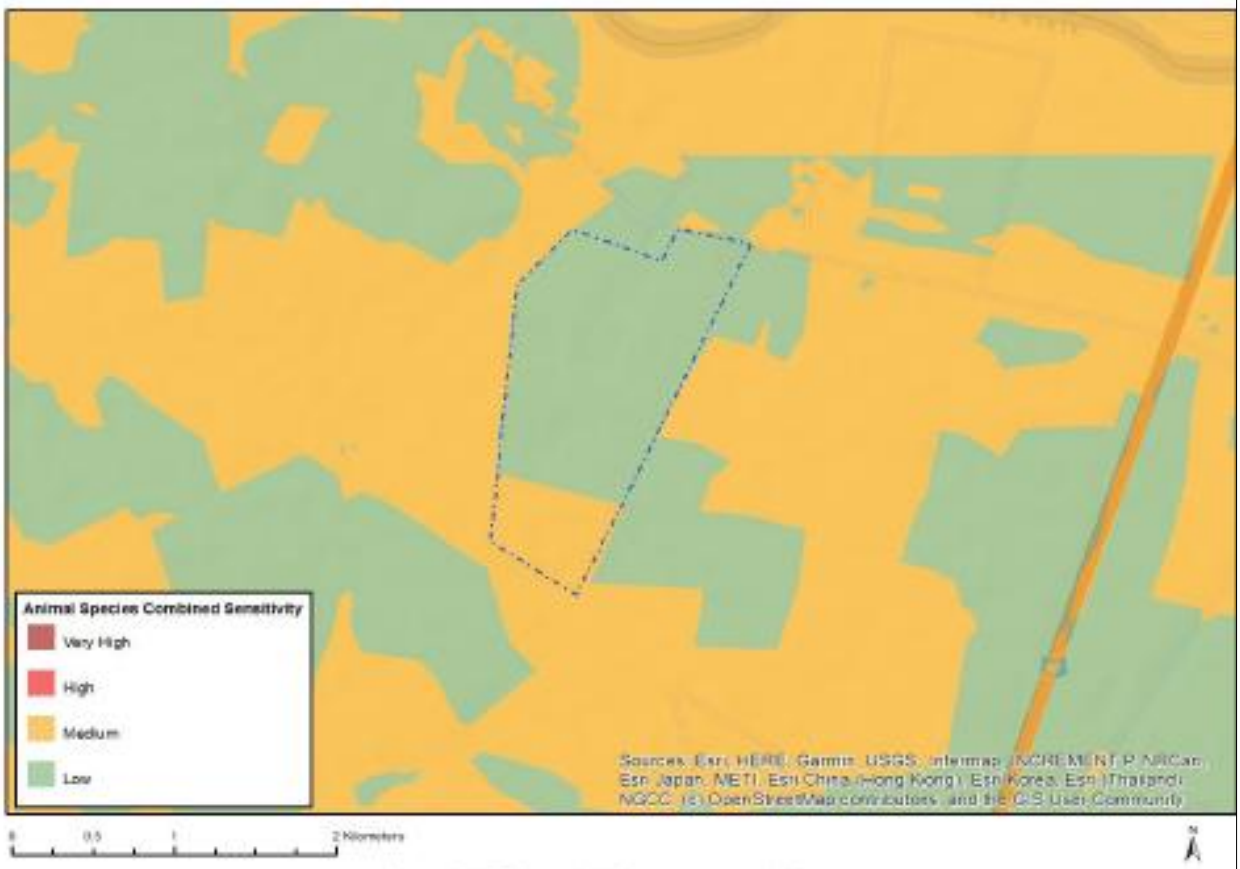
5.2.1 Sensitivities identified by the National Web-Based Environmental Screening Tool

The study area and immediate environment is classified as **Low to Medium** sensitivity for terrestrial animals according to the Terrestrial Animal Species Theme[5] from the DFFE Screening Tool (see Figure 6). The medium sensitivity classification is not linked to the occurrence of a species of insect. The development site contains no confirmed habitat for bird species of conservation concern (SCC) as defined in the Protocol for the specialist assessment and minimum report content requirements for environmental impacts on terrestrial animal species (Government Gazette No 43855, 30 October 2020, namely listed on the IUCN Red List of Threatened Species or South Africa's National Red List website as Critically Endangered, Endangered or Vulnerable. The absence of SCC was confirmed during the

[5] Note that the Avian theme for PV in the Screening Tool is incorrect, as it displays the sensitivities for bats, and not birds.

site surveys. Based on these criteria, the study area is correctly classified as **Low** sensitivity for avifauna.

MAP OF RELATIVE ANIMAL SPECIES THEME SENSITIVITY



Where only a sensitive plant unique number or sensitive animal unique number is provided in the screening report and an assessment is required, the environmental assessment practitioner (EAP) or specialist is required to email SANBI at eiadatarequests@sanbi.org.za listing all sensitive species with their unique identifiers for which information is required. The name has been withheld as the species may be prone to illegal harvesting and must be protected. SANBI will release the actual species name after the details of the EAP or specialist have been documented.

Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
		X	

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low sensitivity
Medium	Insecta-Lepidochrysops procera

Figure 6: The National Web-Based Environmental Screening Tool map of the Damlaagte PV site, indicating sensitivities for the Terrestrial Animal Species theme. The medium sensitivity classification is not linked to avifauna.

5.2.2 Specialist Sensitivity Analysis and Verification

No specific avifaunal sensitivities were identified at the application site which will require buffer zones.

6 Issues, Risks and Impacts

6.1 Identification of Potential Impacts/Risks

The potential impacts identified in the course of the study are:

6.1.1 Construction Phase

- Displacement due to disturbance and habitat transformation associated with the construction of the solar PV facility and associated infrastructure.

6.1.2 Operational Phase

- Collisions with the solar panels
- Entrapment in perimeter fences
- Electrocutions in the onsite substation and on the internal 33kV medium voltage overhead lines.

6.1.3 Decommissioning Phase

- Displacement due to disturbance associated with the decommissioning of the solar PV facility and associated infrastructure.

7 Impact Assessment

7.1 Introduction

Increasingly, human-induced climate change is recognized as a fundamental driver of biological processes and patterns. Historic climate change is known to have caused shifts in the geographic ranges of many plants and animals, and future climate change is expected to result in even greater redistributions of species (National Audubon Society 2015). In 2006, the World Wide Fund for Nature (WWF) Australia produced a report on the envisaged impact of climate change on birds worldwide (Wormworth & Mallon, 2006). The report found that:

- Climate change now affects bird species' behaviour, ranges and population dynamics;
- Some bird species are already experiencing strong negative impacts from climate change; and
- In future, subject to greenhouse gas emissions levels and climatic response, climate change will put large numbers of bird species at risk of extinction, with estimates of extinction rates varying from 2 to 72%, depending on the region, climate scenario and potential for birds to shift to new habitat.

Using statistical models based on the North American Breeding Bird Survey and Audubon Christmas Bird Count datasets, the National Audubon Society assessed geographic range shifts through the end of the century for 588 North American bird species during both the summer and winter seasons under a range of future climate change scenarios (National Audubon Society 2015). Their analysis showed the following:

- 314 of 588 species modelled (53%) lose more than half of their current geographic range in all three modelled scenarios.
- For 126 species, loss occurs without accompanying range expansion.
- For 188 species, loss is coupled with the potential to colonize new areas.

Climate sensitivity is an important piece of information to incorporate into conservation planning and adaptive management strategies. The persistence of many birds will depend on their ability to colonize climatically suitable areas outside of current ranges and management actions that target climate change adaptation.

South Africa is among the world's top 10 developing countries required to significantly reduce their carbon emissions (Seymore *et al.* 2014), and the introduction of low-carbon technologies into the country's compliment of power generation will greatly assist with achieving this important objective (Walwyn & Brent 2015). Given that South Africa receives among the highest levels of solar radiation on earth (Fluri 2009; Munzhedi & Sebitosi. 2009), it is clear that solar power generation should feature prominently in future efforts to convert to a more sustainable energy mix in order to combat climate change, also from an avifaunal impact perspective. However, while the expansion of solar power generation is undoubtedly a positive development for avifauna in the longer term in that it will help reduce the effect of climate change and thus habitat transformation, it must also be acknowledged that renewable energy facilities, including solar PV facilities, in themselves have some potential for negative impacts on avifauna.

A literature review reveals a scarcity of published, scientifically examined information regarding large-scale PV plants and birds. The reason for this is mainly that large-scale PV plants are a relatively recent phenomenon. The main source of information for these types of impacts are from compliance reports and a few government-sponsored studies relating to recently constructed solar plants in the south-west United States. In South Africa, only one published scientific study has been completed on the impacts of PV plants in a South African context (Visser *et al.* 2018).

7.2 Impacts associated with PV plants and associated infrastructure

7.2.1 Impact trauma (collisions)

This impact refers to collision-related fatality i.e. fatality resulting from the direct contact of the bird with a project structure(s). This type of fatality has been occasionally documented at solar projects of all technology types (McCrary *et al.* 1986; Hernandez *et al.* 2014; Kagan *et al.* 2014). In some instances, the bird is not killed outright by the collision impact, but succumbs to predation later, as it cannot avoid predators due to its injured state.

Sheet glass used in commercial and residential buildings has been well established as a hazard for birds. When the sky is reflected in the sheet glass, birds fail to see the building as an obstacle and attempt to fly through the glass, mistaking it for empty space (Loss *et al.* 2014). Although very few cases have been reported it is possible that the reflective surfaces of solar panels could constitute a similar risk to avifauna.

An extremely rare but potentially related problem is the so-called "lake effect" i.e. it seems possible that reflections from solar facilities' infrastructure, particularly large sheets of dark blue photovoltaic panels, may attract birds in flight across the open desert, who mistake the broad reflective surfaces for water (Kagan *et al.* 2014)[6]. The unusually high percentage of waterbird mortalities at the Desert Sunlight PV facility in California (44%) may support the "lake effect" hypothesis (West 2014). Although in the case of Desert Sunlight, the proximity of evaporation ponds may act as an additional risk increasing factor, in that birds are both attracted to the water feature and habituated to the presence of an accessible aquatic environment in the area. This may translate into the misinterpretation of diffusely reflected sky or horizontal polarised light source as a body of water. However, due to limited data it would be

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

premature to make any general conclusions about the influence of the lake effect or other factors that contribute to fatality of water-dependent birds. The activity and abundance of water-dependent species near solar facilities may depend on other site-specific or regional factors, such as the surrounding landscape (Walston *et al.* 2015). However, until such time that enough scientific evidence has been collected to discount the "lake effect" hypothesis, it must be considered as a potential source of impacts.

Weekly mortality searches at 20% coverage were conducted at the 250MW, 1300ha California Valley Solar Ranch PV site (Harvey & Associates 2014a and 2014b). According to the information that could be sourced from the internet (two quarterly reports), 152 avian mortalities were reported for the period 16 November 2013 – 15 February 2014, and 54 for the period 16 February 2014 – 15 May 2014, of which approximately 90% were based on feather spots which precluded a finding on the cause of death. These figures give an estimated unadjusted 1 030 mortalities per year, which is obviously an underestimate as it does not include adjustments for carcasses removed by scavengers and missed by searchers. The authors stated clearly that these quarterly reports do not include the results of searcher efficiency trials, carcass removal trials, or data analyses, nor does it include detailed discussions.

In a report by the National Fish and Wildlife Forensic Laboratory (Kagan *et al.* 2014), the cause of avian mortalities was estimated based on opportunistic avian carcass collections at several solar facilities, including the 550MW, 1 600ha Desert Sunlight PV plant. Impact trauma emerged as the highest identifiable cause of avian mortality, but most mortality could not be traced to an identifiable cause.

Walston *et al.* (2015) conducted a comprehensive review of avian fatality data from large scale solar facilities (all technology types) in the USA. Collision as cause of death (19 birds) ranked second at Desert Sunlight PV plant and California Valley Solar Ranch (CVSR) PV plant, after unknown causes. Cause of death could not be determined for over 50% of the fatality observations and many carcasses included in these analyses consisted only of feather spots (feathers concentrated together in a small area) or partial carcasses, thus making determination of cause of death difficult. It is anticipated that some unknown fatalities were caused by predation or some other factor unrelated to the solar project. However, they found that the lack of systematic data collection and standardization was a major impediment in establishing the actual extent and causes of fatalities across all projects.

The only scientific investigation of potential avifaunal impacts that has been performed at a South African PV facility was completed in 2016 at the 96MW Jasper PV solar facility (28°17′53″S, 23°21′56″E) which is located on the Humansrus Farm, approximately 4 km south-east of Groenwater and 30km east of Postmasburg in the Northern Cape Province (Visser *et al.* 2018). The Jasper PV facility contains 325 360 solar panels over a footprint of 180 hectares with the capacity to deliver 180 000 MWh of renewable electricity annually. The solar panels face north at a fixed 20° angle, reaching a height of approximately 1.86 m relative to ground level with a distance of 3.11 m between successive rows of panels. Mortality surveys were conducted from the 14th of September 2015 until the 6th of December 2015, with a total of seven mortalities recorded among the solar panels which gives an average rate of 0.003 birds per hectare surveyed per month. All fatalities were inferred from feather spots. Extrapolated bird mortality within the solar field at the Jasper PV facility was 435 birds/yr (95% CI 133 - 805). The broad confidence intervals result from the small number of birds detected. The mortality estimate is likely conservative because detection probabilities were based on intact birds, and probably decrease for older carcasses and feather spots. The study concluded inter alia that the short study period, and lack of comparable results from other sources made it difficult to provide a meaningful assessment of avian mortality at PV facilities. It further stated that despite these limitations, the few bird fatalities that were recorded might suggest that there is no significant collision-related mortality at the study site. The conclusion was that to fully understand the risk of solar energy development on birds, further collation and analysis of data from solar energy facilities across spatial and temporal scales, based on scientifically rigorous research designs, is required (Visser *et al.* 2018).

The results of the available literature lack compelling evidence of collisions as a cause of large-scale mortality among birds at PV facilities. However, it is clear from this limited literature survey that the lack

of systematic and standardised data collection is a major problem in the assessment of the causes and extent of avian mortality at all types of solar facilities, regardless of the technology employed. Until statistically tested results emerge from existing compliance programmes and more dedicated scientific research, conclusions will inevitably be largely speculative and based on professional opinion.

Based on the lack of evidence to the contrary, it is not foreseen that collisions with the solar panels at the PV facility will be a significant impact. The priority species which would most likely be potentially affected by this impact are mostly small birds which forage between the solar panels, raptors which prey on them, and a variety of waterbirds which may be at risk due to the “lake effect”.

See Table 2 for list of species which could potentially be affected by this impact.

7.2.2 Entrapment in perimeter fences

Visser *et al.* (2018) recorded a fence-line fatality (Orange River Francolin *Scleroptila gutturalis*) resulting from the bird being trapped between the inner and outer perimeter fence of the facility. This was further supported by observations of large-bodied birds unable to escape from between the two fences (e.g. Red-crested Korhaan *Lophotis ruficrista*) (Visser *et al.* 2018). Considering that one would expect the birds to be able to take off in the lengthwise direction (parallel to the fences), it seems possible that the birds panicked when they were approached by observers and thus flew into the fence. Another potential problem is birds, particularly owls, that get stuck between the strands of barbed wire fences.

It is not foreseen that entrapment in perimeter fences will be a significant impact for priority species at the PV facility. The only priority species which could potentially be affected by this impact is the Marsh Owl, that often gets entangled in fences (personal observation).

See Table 3 for list of species which could potentially be affected by this impact.

7.2.3 Displacement due to disturbance and habitat transformation associated with the construction and operation of the solar PV facilities.

Ground-disturbing activities affect a variety of processes in arid areas, including soil density, water infiltration rate, vulnerability to erosion, secondary plant succession, invasion by exotic plant species, and stability of cryptobiotic soil crusts. These processes have the ability – individually and together – to alter habitat quality, often to the detriment of wildlife, including avifauna. Any disturbance and alteration to the semi-desert landscape, including the construction and decommissioning of utility-scale solar energy facilities, has the potential to increase soil erosion. Erosion can physically and physiologically affect plant species and can thus adversely influence primary production and food availability for wildlife (Lovich & Ennen 2011).

Solar energy facilities require substantial site preparation (including the removal of vegetation) that alters topography and, thus, drainage patterns to divert the surface flow associated with rainfall away from facility infrastructure. Channelling runoff away from plant communities can have dramatic negative effects on water availability and habitat quality in arid areas. Areas deprived of runoff from sheet flow support less biomass of perennial and annual plants relative to adjacent areas with uninterrupted water-flow patterns (Lovich & Ennen 2011).

The activities listed below are *typically* associated with the construction and operation of solar facilities and could have direct impacts on avifauna (County of Merced 2014):

- Preparation of solar panel areas for installation, including vegetation clearing, grading, cut and fill;
- Excavation/trenching for water pipelines, cables, fibre-optic lines, and the septic system;
- Construction of piers and building foundations;
- Construction of new dirt or gravel roads and improvement of existing roads;

- Temporary stockpiling and side-casting of soil, construction materials, or other construction wastes;
- Soil compaction, dust, and water runoff from construction sites;
- Increased vehicle traffic;
- Short-term construction-related noise (from equipment) and visual disturbance;
- Degradation of water quality in drainages and other water bodies resulting from project runoff;
- Maintenance of fire breaks and roads; and
- Weed removal, brush clearing, and similar land management activities related to the ongoing operation of the project.

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

In a study comparing the avifaunal habitat use in PV arrays with adjoining managed grassland at airports in the USA, DeVault *et al.* (2014) found that species diversity in PV arrays was reduced compared to the grasslands (37 vs 46), supporting the view that solar development is generally detrimental to wildlife on a local scale.

In order to identify functional and structural changes in bird communities in and around the development footprint, Visser *et al.* (2018) gathered bird transect data at the 180 hectares, 96MW Jasper PV solar facility in the Northern Cape, representing the solar development, boundary, and untransformed landscape. The study found both bird density and diversity per unit area was higher in the boundary and untransformed landscape, however, the extent therefore was not considered to be statistically significant. This indicates that the PV facility matrix is permeable to most species. However, key environmental features, including available habitat and vegetation quality are most likely the overriding factors influencing species' occurrence and their relative density within the development footprint. The most significant finding of Visser *et al*. (2018) was that the distribution of birds in the landscape changed, from a shrubland to open country and grassland bird community, in response to changes in the distribution and abundance of habitat resources such as food, water and nesting sites. These changes in resource availability patterns were detrimental to some bird species and beneficial to others. Shrubland specialists appeared to be negatively affected by the presence of the PV facility. In contrast, open country/grassland and generalist species, were favoured by its development (Visser *et al.* 2019).

As far as disturbance is concerned, it is likely that all the avifauna, including all the priority species, will be temporarily displaced in the footprint area of the proposed project, either completely or more likely partially (reduced densities) during the construction phase, due to the disturbance associated with the construction activities.

As far as displacement, either completely or partially (reduced densities) due to habitat loss and transformation is concerned, it is highly likely that the same pattern of reduced avifaunal densities for shrubland species, as explained above, will manifest itself at the proposed project. In addition, raptors and terrestrial species could also be impacted.

See Table 3 for list of species which could potentially be affected by this impact.

7.2.4 Electrocutions

Electrocution refers to the scenario where a bird is perched or attempts to perch on the electrical structure and causes an electrical short circuit by physically bridging the air gap between live components and/or live and earthed components (van Rooyen 2004). The electrocution risk is largely determined by the design of the electrical hardware. There could be an electrocution risk to certain species, mostly raptors, but also some waterbirds, in the onsite substations, but it is unlikely to be a regular occurrence for any of the priority species. Depending on the pole design, the 33kV overhead

lines could also pose an electrocution risk to certain priority species, particularly raptors, which is a more significant risk than the substations.

See Table 3 for list of species which could potentially be affected by this impact.

7.3 No-go option

The no-go option will result in no additional impacts on avifauna and will result in the ecological status quo being maintained, which will be to the advantage of the avifauna. However, no fatal flaws were identified during the investigations.

7.4 Preferred alternative

From a bird impact perspective, the proposed alternative technologies for the infrastructure will not make a difference. The impacts will be the same for all the proposed technologies.

8 Impact rating methodology

See Appendix D for the explanation of the impact criteria.9

9 Impact Assessments

Then tables below summarise the potential impacts on avifauna of the proposed Damlaagte PV project.

9.1 Construction Phase

Displacement of priority species due to disturbance and habitat transformation associated with construction of the PV plant and associated infrastructure		
CRITERIA	WITHOUT MITIGATION	WITH MITIGATION
Intensity	High	High
Duration	Long term	Long term
Extent	Local	Local
Consequence	High	High
Probability	Definite	Probable
Significance	**High**	**High**
Status	Negative	Negative
Confidence	Medium	Medium
Degree to which impact can be reversed	Low	
Degree to which impact may cause irreplaceable loss of resources	High	
Degree to which impact can be mitigated	Very low	
PROPOSED MITIGATION		
• 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. • 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.		

9.2 Operational Phase

Mortality of priority species due to collisions with the solar panels		
CRITERIA	**WITHOUT MITIGATION**	**WITH MITIGATION**
Intensity	Low	Low
Duration	Long term	Long term
Extent	Local	Local
Consequence	Low	Low
Probability	Possible	Possible
Significance	**Very low**	**Very low**
Status	Negative	Negative
Confidence	Medium	Medium
Degree to which impact can be reversed	Low	
Degree to which impact may cause irreplaceable loss of resources	High	
Degree to which impact can be mitigated	Very low	
PROPOSED MITIGATION		
No mitigation is required due to the low significance of this impact.		

Entrapment of birds in the perimeter fence		
CRITERIA	**WITHOUT MITIGATION**	**WITH MITIGATION**
Intensity	Medium	Medium
Duration	Long term	Long term
Extent	Local	Local
Consequence	Medium	Medium
Probability	Probable	Improbable
Significance	**Medium**	**Low**
Status	Negative	Negative
Confidence	Medium	Medium
Degree to which impact can be reversed	Irreversible	
Degree to which impact may cause irreplaceable loss of resources	High	
Degree to which impact can be mitigated	Medium	
PROPOSED MITIGATION		
Increasing the spacing between at least the top two wires (to a minimum of 30cm) and ensuring they are correctly tensioned will reduce the snaring risk.		

Electrocution of priority species on the 33kV powerline network and in the site substations.		
CRITERIA	**WITHOUT MITIGATION**	**WITH MITIGATION**
Intensity	Medium	Medium
Duration	Long term	Long term
Extent	Local	Local
Consequence	Medium	Medium
Probability	Probable	Improbable
Significance	**Medium**	**Low**
Status	Negative	Negative
Confidence	High	High
Degree to which impact can be reversed	Irreversible	
Degree to which impact may cause irreplaceable loss of resources	High	
Degree to which impact can be mitigated	High	
PROPOSED MITIGATION		
The cables must be placed underground as much as practically possible. The final pole design must be developed in consultation with the avifaunal specialist to ensure that a bird friendly design is employed. The avifaunal specialist must sign off on the final pole design. The final pole design must be developed in consultation with the avifaunal specialist to ensure that a bird friendly design is employed. The avifaunal specialist must sign off on the final pole design. Due to the complicated design of the substation hardware, pro-active mitigation is not a practical option. Instead, the situation must be monitored, and should electrocutions of priority species be recorded, reactive mitigation could be applied in the form of insulation of live components.		

9.3 Decommissioning Phase

Displacement of priority species due to disturbance associated with decommissioning of the PV facility and associated infrastructure.		
CRITERIA	**WITHOUT MITIGATION**	**WITH MITIGATION**
Intensity	High	High
Duration	Short term	Short term
Extent	Local	Local
Consequence	Medium	Medium
Probability	Definite	Definite
Significance	**Medium**	**Medium**
Status	Negative	Negative
Confidence	High	High
Degree to which impact can be reversed	High	
Degree to which impact may cause irreplaceable loss of resources	Low	
Degree to which impact can be mitigated	Low	
PROPOSED MITIGATION		
• Decommissioning 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.		

Displacement of priority species due to disturbance associated with decommissioning of the PV facility and associated infrastructure.
• Measures to control noise and dust should be applied according to current best practice in the industry.

A comparison between pre-and post-mitigation phases is shown in Table 5 below.

Table 5: Comparison of impacts on environmental parameters pre- and post-mitigation

Environmental parameter	Issues	Significance rating prior to mitigation	Significance rating post mitigation
Avifauna	*Displacement of priority species due to disturbance and habitat destruction associated with construction of the PV facility and associated infrastructure.*	High	High
	Mortality of priority species due to collisions with solar panels	Very low	Very low
	Entrapment of birds in the perimeter fence	Medium	Low
	Mortality of priority species due to electrocution in the onsite substations and on the 33kV overhead lines	Medium	Low
	Displacement of priority species due to disturbance associated with decommissioning of the PV facility and associated infrastructure.	Medium	Medium

10 Environmental Management Programme Inputs

Refer to Appendix C for a description of the key mitigation and monitoring recommendations for each applicable mitigation measure identified for all phases of the project.

11 Final Specialist Statement and Authorisation Recommendation

11.1 Statement and Reasoned Opinion

The study area and immediate environment is classified as Low to Medium sensitivity for terrestrial animals according to the Terrestrial Animal Species Theme. The medium sensitivity classification is not linked to avifauna. The development site contains no confirmed habitat for species of conservation concern (SCC) as defined in the Protocol for the specialist assessment and minimum report content requirements for environmental impacts on terrestrial animal species (Government Gazette No 43855, 30 October 2020, namely listed on the IUCN Red List of Threatened Species or South Africa's National Red List website as Critically Endangered, Endangered or Vulnerable. The absence of SCC was confirmed during the site surveys. Based on these criteria, the study area is correctly classified as Low sensitivity for avifauna. No fatal flaws were discovered during the investigations. It is therefore recommended that the activity is authorised, on condition that the proposed mitigation measures as detailed in the Impact Tables (Section 9 of the report) and the EMPr (Appendix C) are strictly implemented.

12 References

- ANIMAL DEMOGRAPHY UNIT. 2021. The southern African Bird Atlas Project 2. University of Cape Town. http://sabap2.adu.org.za.
- BIRDLIFE INTERNATIONAL (202) Country profile: South Africa. Available from http://www.birdlife.org/datazone/country/south-africa.
- COUNTY OF MERCED. 2014. Draft Environmental Impact Report for the Wright Solar Park Conditional Use Permit Application CUP12-017. Public Draft. July. (ICF 00552.13.) Merced, CA. Prepared by ICF International, Sacramento, CA.
- DEVAULT, T. L., SEAMANS, T. W., SCHMIDT, J A., BELANT, J. L., BLACKWELL, B F., MOOERS, N., TYSON, L. A., & VANPELT, L. 2014. "Bird Use of Solar Photovoltaic Installations at US Airports: Implications for Aviation Safety". USDA National Wildlife Research Center - Staff Publications. 1418.https://digitalcommons.unl.edu/icwdm_usdanwrc/1418.
- FLURI, T.P. 2009. The potential of concentrating solar power in South Africa. Energy Policy 37: 5075-5080.
- H. T. HARVEY & ASSOCIATES. 2014a. California Valley Solar Ranch Project Avian and Bat Protection Plan Sixth Quarterly Post construction Fatality Report 16 November 2013 - 15 February 2014.
- H. T. HARVEY & ASSOCIATES. 2014b. California Valley Solar Ranch Project Avian and Bat Protection Plan Sixth Quarterly Post construction Fatality Report 16 February 2014 - 15 May 2014.
- HARRISON, J.A., ALLAN, D.G., UNDERHILL, L.G., HERREMANS, M., TREE, A.J., PARKER, V & BROWN, C.J. (eds). 1997. The atlas of southern African birds. Vol 1 & 2. BirdLife South Africa, Johannesburg.
- HERNANDEZ, R.R., et al., 2014, “Environmental Impacts of Utility-Scale Solar Energy,” Renewable and Sustainable Energy Reviews 29: 766–779.
- HOCKEY P.A.R., DEAN W.R.J., AND RYAN P.G. 2005. Robert’s Birds of Southern Africa, seventh edition. Trustees of the John Voelcker Bird Book Fund, Cape Town.
- JEAL. C. 2017. The impact of a ‘trough’ Concentrated Solar Power facility on birds and other animals in the Northern Cape, South Africa. Minor Dissertation presented in partial fulfilment of the requirements for the degree of Master of Science in Conservation Biology. University of Cape Town.
- JENKINS, A.R., RALSTON-PATTON, SMIT- ROBINSON, A.H. 2017. Guidelines for assessing and monitoring the impact of solar power generating facilities on birds in southern Africa. BirdLife South Africa.
- KAGAN, R. A., T. C. VINER, P. W. TRAIL, AND E. O. ESPINOZA. 2014. Avian Mortality at Solar Energy Facilities in Southern California: A Preliminary Analysis. National Fish and Wildlife Forensics Laboratory.
- LOSS, S.R., WILL, T., LOSS, S.S., & MARRA, P.P. 2014. Bird–building collisions in the United States: Estimates of annual mortality and species vulnerability. The Condor 116(1):8-23. 2014.
- LOVICH, J.E. and ENNEN, J.R. 2011, Wildlife Conservation and Solar Energy Development in the Desert Southwest, United States, BioScience 61:982–992.
- MARNEWICK, M.D., RETIEF E.F., THERON N.T., WRIGHT D.R., ANDERSON T.A. 2015. Important Bird and Biodiversity Areas of South Africa. Johannesburg: Birdlife South Africa.
- MCCRARY, M. D., R. L. MCKERNAN, R. W. SCHREIBER, W. D. WAGNER, AND T. C. SCIARROTTA. 1986. Avian mortality at a solar energy plant. J. Field Ornithology 57:135-141.
- MUCINA. L. & RUTHERFORD, M.C. (Eds) 2006. The vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19. South African National Biodiversity Institute, Pretoria.
- MUNZHEDI, R. & SEBITOSI, A.B. 2009. Re-drawing the solar map of South Africa for photovoltaic applications. Renewable Energy 34: 165-169.
- NATIONAL AUDUBON SOCIETY. 2015. Audubon’s Birds and Climate Change Report: A Primer for Practitioners. National Audubon Society, New York. Contributors: Gary Langham, Justin Schuetz, Candan Soykan, Chad Wilsey, Tom Auer, Geoff LeBaron, Connie Sanchez, Trish Distler. Version 1.3.
- SEYMORE, R., INGLESI-LOTZ, R. & BLIGNAUT, J. 2014. A greenhouse gas emissions inventory for South Africa: a comparative analysis. Renewable & Sustainable Energy Reviews 34: 371-379.

- TAYLOR, M.R., PEACOCK F, & WANLESS R.W (EDS.) 2015. The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland. BirdLife South Africa, Johannesburg, South Africa.
- VISSER, E., PEROLD, V., RALSTON-PATON, S., CARDENAL, A.C., RYAN, P.G. 2018. Assessing the impacts of a utility-scale photovoltaic solar energy facility on birds in the Northern Cape, South Africa. https://doi.org/10.1016/j.renene.2018.08.106 Renewable Energy 133 (2019) 1285 – 1294.
- WALSTON, L.J. ROLLINS, K.E. SMITH, K.P. LAGORY, K.E. SINCLAIR, K. TURCHI, C. WENDELIN, T. & SOUDER, H. A. 2015. Review of Avian Monitoring and Mitigation Information at Existing Utility-Scale Solar Facilities. U.S. Department of Energy, SunShot Initiative and Office of Energy Efficiency & Renewable Energy. April 2015.
- WALWYN, D.R., BRENT A.C. 2015. Renewable energy gathers steam in South Africa. Renewable and Sustainable Energy 41: 390-401.
- WEST (Western EcoSystems Technology, Inc.), 2014, Sources of Avian Mortality and Risk Factors Based on Empirical Data from Three Photovoltaic Solar Facilities, prepared by Western EcoSystems Technology, Inc., June 17.
- WORMWORTH, J. & MALLON, K. 2006. Bird Species and Climate Change. WWF – Australia. Sydney, NSW, Australia.

Appendices

Appendix A: Specialist Expertise
Appendix B: Species List
Appendix C: Environmental Management Plan
Appendix D: Impact Assessment Methodology

APPENDIX A - SPECIALIST EXPERTISE

Curriculum vitae: Chris van Rooyen

Profession/Specialisation	:	Avifaunal Specialist
Highest Qualification	:	BA LLB
Nationality	:	South African
Years of experience	:	22 years

Key Experience

Chris van Rooyen has twenty-two years' experience in the assessment of avifaunal interactions with industrial infrastructure. He was employed by the Endangered Wildlife Trust as head of the Eskom-EWT Strategic Partnership from 1996 to 2007, which has received international acclaim as a model of co-operative management between industry and natural resource conservation. He is an acknowledged global expert in this field and has consulted in South Africa, Namibia, Botswana, Lesotho, New Zealand, Texas, New Mexico and Florida. He also has extensive project management experience and he has received several management awards from Eskom for his work in the Eskom-EWT Strategic Partnership. He is the author and/or co-author of 17 conference papers, co-author of two book chapters, several research reports and the current best practice guidelines for avifaunal monitoring at wind farm sites. He has completed around 130 power line assessments; and has to date been employed as specialist avifaunal consultant on more than 50 renewable energy generation projects. He has also conducted numerous risk assessments on existing power lines infrastructure. He also works outside the electricity industry and he has done a wide range of bird impact assessment studies associated with various residential and industrial developments. He serves on the Birds and Wind Energy Specialist Group which was formed in 2011 to serve as a liaison body between the ornithological community and the wind industry.

Key Project Experience

Bird Impact Assessment Studies and avifaunal monitoring for wind-powered generation facilities:

1. Eskom Klipheuwel Experimental Wind Power Facility, Western Cape
2. Mainstream Wind Facility Jeffreys Bay, Eastern Cape (EIA and monitoring)
3. Biotherm, Swellendam, (Excelsior), Western Cape (EIA and monitoring)
4. Biotherm, Napier, (Matjieskloof), Western Cape (pre-feasibility)
5. Windcurrent SA, Jeffreys Bay, Eastern Cape (2 sites) (EIA and monitoring)
6. Caledon Wind, Caledon, Western Cape (EIA)
7. Innowind (4 sites), Western Cape (EIA)
8. Renewable Energy Systems (RES) Oyster Bay, Eastern Cape (EIA and monitoring)
9. Oelsner Group (Kerriefontein), Western Cape (EIA)
10. Oelsner Group (Langefontein), Western Cape (EIA)
11. InCa Energy, Vredendal Wind Energy Facility Western Cape (EIA)
12. Mainstream Loeriesfontein Wind Energy Facility (EIA and monitoring)
13. Mainstream Noupoort Wind Energy Facility (EIA and monitoring)
14. Biotherm Port Nolloth Wind Energy Facility (Monitoring)
15. Biotherm Laingsburg Wind Energy Facility (EIA and monitoring)
16. Langhoogte Wind Energy Facility (EIA)
17. Vleesbaai Wind Energy Facility (EIA and monitoring)
18. St. Helena Bay Wind Energy Facility (EIA and monitoring)
19. Electrawind, St Helena Bay Wind Energy Facility (EIA and monitoring)
20. Electrawind, Vredendal Wind Energy Facility (EIA)
21. SAGIT, Langhoogte and Wolseley Wind Energy facilities
22. Renosterberg Wind Energy Project – 12-month preconstruction avifaunal monitoring project
23. De Aar – North (Mulilo) Wind Energy Project – 12-month preconstruction avifaunal monitoring project
24. De Aar – South (Mulilo) Wind Energy Project – 12-month bird monitoring
25. Namies – Aggenys Wind Energy Project – 12-month bird monitoring
26. Pofadder - Wind Energy Project – 12-month bird monitoring
27. Dwarsrug Loeriesfontein - Wind Energy Project – 12-month bird monitoring
28. Waaihoek – Utrecht Wind Energy Project – 12-month bird monitoring
29. Amathole – Butterworth Utrecht Wind Energy Project – 12-month bird monitoring & EIA specialist
30. Phezukomoya and San Kraal Wind Energy Projects 12-month bird monitoring & EIA specialist study

(Innowind)

31. Beaufort West Wind Energy Facility 12-month bird monitoring & EIA specialist study (Mainstream)
32. Leeuwdraai Wind Energy Facility 12-month bird monitoring & EIA specialist study (Mainstream)
33. Sutherland Wind Energy Facility 12-month bird monitoring (Mainstream)
34. Maralla Wind Energy Facility 12-month bird monitoring & EIA specialist study (Biotherm)
35. Esizayo Wind Energy Facility 12-month bird monitoring & EIA specialist study (Biotherm)
36. Humansdorp Wind Energy Facility 12-month bird monitoring & EIA specialist study (Cennergi)
37. Aletta Wind Energy Facility 12-month bird monitoring & EIA specialist study (Biotherm)
38. Eureka Wind Energy Facility 12-month bird monitoring & EIA specialist study (Biotherm)
39. Makambako Wind Energy Facility (Tanzania) 12-month bird monitoring & EIA specialist study (Windlab)
40. R355 Wind Energy Facility 12-month bird monitoring (Mainstream)
41. Groenekloof Wind Energy Facility 12-month bird monitoring & EIA specialist study (Mulilo)
42. Tsitsikamma Wind Energy Facility 24-months post-construction monitoring (Cennergi)
43. Noupoort Wind Energy Facility 24-months post-construction monitoring (Mainstream)
44. Kokerboom Wind Energy Facility 12-month bird monitoring & EIA specialist study (Business Venture Investments)
45. Kuruman Wind Energy Facility 12-month bird monitoring & EIA specialist study (Mulilo)
46. Dassieklip Wind Energy Facility 3 years post-construction monitoring (Biotherm)
47. Loeriesfontein 2 Wind Energy Facility 2 years post-construction monitoring (Mainstream)
48. Khobab Wind Energy Facility 2 years post-construction monitoring (Mainstream)
49. Excelsior Wind Energy Facility 18 months construction phase monitoring (Biotherm)
50. Boesmansberg Wind Energy Facility 12-months pre-construction bird monitoring (juwi)
51. Mañhica Wind Energy Facility, Mozambique, 12-months pre-construction monitoring (Windlab)
52. Kwagga Wind Energy Facility, Beaufort West, 12-months pre-construction monitoring (ABO)
53. Pienaarspoort Wind Energy Facility, Touws River, Western Cape, 12-months pre-construction monitoring (ABO).
54. Koup 1 and 2 Wind Energy Facilities, Beaufort West, Western Cape, 12 months pre-construction monitoring (Genesis Eco-energy)
55. Duiker Wind Energy Facility, Vredendal, Western Cape 12 months pre-construction monitoring (ABO)
56. Perdekraal East Wind Energy Facility, Touws River, Western Cape, 18 months construction phase monitoring (Mainstream).
57. Swellendam Wind Energy Facility, Western Cape, 12-month pre-construction monitoring (Veld Renewables)
58. Lombardskraal Wind Energy Facility, Western Cape, 12-month pre-construction monitoring (Enertrag SA)
59. Mainstream Damlaagte & Heuweltjies Wind Energy Facilities, Western Cape, 12-month pre-construction monitoring (Mainstream)
60. Great Karoo Wind Energy Facility, Northern Cape, 12-month pre-construction monitoring (African Green Ventures).
61. Mpumalanga & Gauteng Wind and Hybrid Energy Facilities (6x), pre-construction monitoring (Enertrag SA)
62. Dordrecht Wind Energy Facilities, Eastern Cape, Screening Report (Enertrag SA)
63. Dordrecht Wind Energy Facilities, Eastern Cape, Screening Report (ACED)
64. Nanibees North & South Wind Energy Facilities, Northern Cape, Screening Report (juwi)
65. Sutherland Wind Energy Facilities, Northern Cape, Screening Report (WKN Windcurrent)
66. Pofadder Wind Energy Facility, Northern Cape, Screening Report (Atlantic Energy)
67. Haga Wind Energy Facility, Eastern Cape, Amendment Report (WKN Windcurrent)
68. Banken Wind Energy Facility, Northern Cape, Screening Report (Atlantic Energy)
69. Hartebeest Wind Energy Facility, Western Cape, 12-month pre-construction monitoring (juwi).

Bird Impact Assessment Studies for Solar Energy Plants:

1. Concentrated Solar Power Plant, Upington, Northern Cape.
2. Globeleq De Aar and Droogfontein Solar PV Pre- and Post-construction avifaunal monitoring
3. JUWI Kronos PV project, Copperton, Northern Cape
4. Sand Draai CSP project, Groblershoop, Northern Cape
5. Biotherm Helena PV Project, Copperton, Northern Cape
6. Biotherm Letsiao CSP Project, Aggeneys, Northern Cape
7. Biotherm Enamandla PV Project, Aggeneys, Northern Cape
8. Biotherm Sendawo PV Project, Vryburg, North-West

9. Biotherm Tlisitseng PV Project, Lichtenburg, North-West
10. JUWI Hotazel Solar Park Project, Hotazel, Northern Cape
11. Namakwa Solar Project, Aggeneys, Northern Cape
12. Brypaal Solar Power Project, Kakamas, Northern Cape
13. ABO Vryburg 1,2,3 Solar PV Project, Vryburg, North-West
14. Scatec Solar Kenhardt PV 4, PV 5 and PV6 Projects, Kenhardt, Northern Cape
15. NamPower CSP Facility near Arandis, Namibia
16. Dayson Klip PV Facility near Upington, Northern Cape
17. Geelkop PV Facility near Upington, Northern Cape
18. Oya PV Facility, Ceres, Western Cape
19. Vrede and Rondawel PV Facilities, Free State
20. Veroniva Ceres PV Facilities, Western Cape
21. Leeudoringstad PV Facility, North-West

Bird Impact Assessment Studies for the following overhead line projects:

1. Chobe 33kV Distribution line
2. Athene - Umfolozi 400kV
3. Beta-Delphi 400kV
4. Cape Strengthening Scheme 765kV
5. Flurian-Louis-Trichardt 132kV
6. Ghanzi 132kV (Botswana)
7. Ikaros 400kV
8. Matimba-Witkop 400kV
9. Naboomspruit 132kV
10. Tabor-Flurian 132kV
11. Windhoek - Walvisbaai 220 kV (Namibia)
12. Witkop-Overyssel 132kV
13. Breyten 88kV
14. Adis-Phoebus 400kV
15. Dhuva-Janus 400kV
16. Perseus-Mercury 400kV
17. Gravelotte 132kV
18. Ikaros 400 kV
19. Khanye 132kV (Botswana)
20. Moropule – Thamaga 220 kV (Botswana)
21. Parys 132kV
22. Simplon –Everest 132kV
23. Tutuka-Alpha 400kV
24. Simplon-Der Brochen 132kV
25. Big Tree 132kV
26. Mercury-Ferrum-Garona 400kV
27. Zeus-Perseus 765kV
28. Matimba B Integration Project
29. Caprivi 350kV DC (Namibia)
30. Gerus-Mururani Gate 350kV DC (Namibia)
31. Mmamabula 220kV (Botswana)
32. Steenberg-Der Brochen 132kV
33. Venetia-Paradise T 132kV
34. Burgersfort 132kV
35. Majuba-Umfolozi 765kV
36. Delta 765kV Substation
37. Braamhoek 22kV
38. Steelpoort Merensky 400kV
39. Mmamabula Delta 400kV
40. Delta Epsilon 765kV
41. Gerus-Zambezi 350kV DC Interconnector: Review of proposed avian mitigation measures for the Okavango and Kwando River crossings
42. Giyani 22kV Distribution line

43. Liqhobong-Kao 132/11kV distribution power line, Lesotho
44. 132kV Leslie – Wildebeest distribution line
45. A proposed new 50 kV Spoornet feeder line between Sishen and Saldanha
46. Cairns 132kv substation extension and associated power lines
47. Pimlico 132kv substation extension and associated power lines
48. Gyani 22kV
49. Matafin 132kV
50. Nkomazi_Fig Tree 132kV
51. Pebble Rock 132kV
52. Reddersburg 132kV
53. Thaba Combine 132kV
54. Nkomati 132kV
55. Louis Trichardt – Musina 132kV
56. Endicot 44kV
57. Apollo Lepini 400kV
58. Tarlton-Spring Farms 132kV
59. Kuschke 132kV substation
60. Bendstore 66kV Substation and associated lines
61. Kuiseb 400kV (Namibia)
62. Gyani-Malamulele 132kV
63. Watershed 132kV
64. Bakone 132kV substation
65. Eerstegoud 132kV LILO lines
66. Kumba Iron Ore: SWEP - Relocation of Infrastructure
67. Kudu Gas Power Station: Associated power lines
68. Steenberg Booysendal 132kV
69. Toulon Pumps 33kV
70. Thabatshipi 132kV
71. Witkop-Silica 132kV
72. Bakubung 132kV
73. Nelsriver 132kV
74. Rethabiseng 132kV
75. Tilburg 132kV
76. GaKgapane 66kV
77. Knobel Gilead 132kV
78. Bochum Knobel 132kV
79. Madibeng 132kV
80. Witbank Railway Line and associated infrastructure
81. Spencer NDP phase 2 (5 lines)
82. Akanani 132kV
83. Hermes-Dominion Reefs 132kV
84. Cape Pensinsula Strengthening Project 400kV
85. Magalakwena 132kV
86. Benficosa 132kV
87. Dithabaneng 132kV
88. Taunus Diepkloof 132kV
89. Taunus Doornkop 132kV
90. Tweedracht 132kV
91. Jane Furse 132kV
92. Majeje Sub 132kV
93. Tabor Louis Trichardt 132kV
94. Riversong 88kV
95. Mamatsekele 132kV
96. Kabokweni 132kV
97. MDPP 400kV Botswana
98. Marble Hall NDP 132kV
99. Bokmakiere 132kV Substation and LILO lines
100. Styldrift 132kV
101. Taunus – Diepkloof 132kV
102. Bighorn NDP 132kV

103. Waterkloof 88kV
104. Camden – Theta 765kV
105. Dhuva – Minerva 400kV Diversion
106. Lesedi –Grootpan 132kV
107. Waterberg NDP
108. Bulgerivier – Dorset 132kV
109. Bulgerivier – Toulon 132kV
110. Nokeng-Fluorspar 132kV
111. Mantsole 132kV
112. Tshilamba 132kV
113. Thabamoopo - Tshebela – Nhlovuko 132kV
114. Arthurseat 132kV
115. Borutho 132kV MTS
116. Volspruit - Potgietersrus 132kV
117. Neotel Optic Fibre Cable Installation Project: Western Cape
118. Matla-Glockner 400kV
119. Delmas North 44kV
120. Houwhoek 11kV Refurbishment
121. Clau-Clau 132kV
122. Ngwedi-Silwerkrans 134kV
123. Nieuwehoop 400kV walk-through
124. Booysendal 132kV Switching Station
125. Tarlton 132kV
126. Medupi - Witkop 400kV walk-through
127. Germiston Industries Substation
128. Sekgame 132kV
129. Botswana – South Africa 400kV Transfrontier Interconnector
130. Syferkuil – Rampheri 132kV
131. Queens Substation and associated 132kV powerlines
132. Oranjemond 400kV Transmission line
133. Aries – Helios – Juno walk-down
134. Kuruman Phase 1 and 2 Wind Energy facilities 132kV Grid connection
135. Transnet Thaba 132kV

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

1. Lizard Point Golf Estate
2. Lever Creek Estates
3. Leloko Lifestyle Estates
4. Vaaloewers Residential Development
5. Clearwater Estates Grass Owl Impact Study
6. Somerset Ext. Grass Owl Study
7. Proposed Three Diamonds Trading Mining Project (Portion 9 and 15 of the Farm Blesbokfontein)
8. N17 Section: Springs to Leandra – “Borrow Pit 12 And Access Road On (Section 9, 6 And 28 Of the Farm Winterhoek 314 Ir)
9. South African Police Services Gauteng Radio Communication System: Portion 136 Of the Farm 528 Jq, Lindley.
10. Report for the proposed upgrade and extension of the Zeekoegat Wastewater Treatment Works, Gauteng.
11. Bird Impact Assessment for Portion 265 (a portion of Portion 163) of the farm Rietfontein 189-JR, Gauteng.
12. Bird Impact Assessment Study for Portions 54 and 55 of the Farm Zwartkop 525 JQ, Gauteng.
13. Bird Impact Assessment Study Portions 8 and 36 of the Farm Nooitgedacht 534 JQ, Gauteng.
14. Shumba’s Rest Bird Impact Assessment Study
15. Randfontein Golf Estate Bird Impact Assessment Study
16. Zilkaatsnek Wildlife Estate
17. Regenstein Communications Tower (Namibia)
18. Avifaunal Input into Richards Bay Comparative Risk Assessment Study
19. Maquasa West Open Cast Coal Mine

20. Glen Erasmia Residential Development, Kempton Park, Gauteng
21. Bird Impact Assessment Study, Weltevreden Mine, Mpumalanga
22. Bird Impact Assessment Study, Olifantsvlei Cemetery, Johannesburg
23. Camden Ash Disposal Facility, Mpumalanga
24. Lindley Estate, Lanseria, Gauteng
25. Proposed open cast iron ore mine on the farm Lylyveld 545, Northern Cape
26. Avifaunal monitoring for the Sishen Mine in the Northern Cape as part of the EMPr requirements
27. Steelpoort CNC Bird Impact Assessment Study

Professional affiliations

I work under the supervision of and in association with Albert Froneman (MSc Conservation Biology) (SACNASP Zoological Science Registration number 400177/09) as stipulated by the Natural Scientific Professions Act 27 of 2003.

Curriculum vitae: Albert Froneman

Profession/Specialisation	:	Avifaunal Specialist
Highest Qualification	:	MSc (Conservation Biology)
Nationality	:	South African
Years of experience	:	20 years

Key Qualifications

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

Key Project Experience

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

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

Investments)

31. Kuruman Wind Energy Facility 12-month bird monitoring & EIA specialist study (Mulilo)
32. Mañhica Wind Energy Facility 12-month bird monitoring & EIA specialist study (Windlab)
33. Kwagga Wind Energy Facility, Beaufort West, 12-months pre-construction monitoring (ABO)
34. Pienaarspoort Wind Energy Facility, Touws River, Western Cape, 12-months pre-construction monitoring (ABO). Koup 1 and 2 Wind Energy Facilities, Beaufort West, Western Cape, 12 months pre-construction monitoring (Genesis Eco-energy)
35. Duiker Wind Energy Facility, Vredendal, Western Cape 12 months pre-construction monitoring (ABO)
36. Perdekraal East Wind Energy Facility, Touws River, Western Cape, 18 months construction phase monitoring (Mainstream).
37. Swellendam Wind Energy Facility, Western Cape, 12-month pre-construction monitoring (Veld Renewables)
38. Lombardskraal Wind Energy Facility, Western Cape, 12-month pre-construction monitoring (Enertrag SA)
39. Mainstream Damlaagte & Heuweltjies Wind Energy Facilities, Western Cape, 12-month pre-construction monitoring (Mainstream)
40. Great Karoo Wind Energy Facility, Northern Cape, 12-month pre-construction monitoring (African Green Ventures).
41. Mpumalanga & Gauteng Wind and Hybrid Energy Facilities (6x), pre-construction monitoring (Enertrag SA)
42. Dordrecht Wind Energy Facilities, Eastern Cape, Screening Report (Enertrag SA)
43. Dordrecht Wind Energy Facilities, Eastern Cape, Screening Report (ACED)
44. Nanibees North & South Wind Energy Facilities, Northern Cape, Screening Report (juwi)
45. Sutherland Wind Energy Facilities, Northern Cape, Screening Report (WKN Windcurrent)
46. Pofadder Wind Energy Facility, Northern Cape, Screening Report (Atlantic Energy)
47. Haga Haga Wind Energy Facility, Eastern Cape, Amendment Report (WKN Windcurrent)
48. Banken Wind Energy Facility, Northern Cape, Screening Report (Atlantic Energy)
49. Hartebeest Wind Energy Facility, Western Cape, 12-month pre-construction monitoring (juwi).

Bird Impact Assessment studies and / or GIS analysis:

1. Aviation Bird Hazard Assessment Study for the proposed Madiba Bay Leisure Park adjacent to Port Elizabeth Airport.
2. Extension of Runway and Provision of Parallel Taxiway at Sir Seretse Khama Airport, Botswana Bird / Wildlife Hazard Management Specialist Study
3. Maun Airport Improvements Bird / Wildlife Hazard Management Specialist Study
4. Bird Impact Assessment Study - Bird Helicopter Interaction – The Bitou River, Western Cape Province South Africa
5. Proposed La Mercy Airport – Bird Aircraft interaction specialists study using bird detection radar to assess swallow flocking behaviour
6. KwaZulu Natal Power Line Vulture Mitigation Project – GIS analysis
7. Perseus-Zeus Powerline EIA – GIS Analysis
8. Southern Region Pro-active GIS Blue Crane Collision Project.
9. Specialist advisor ~ Implementation of a bird detection radar system and development of an airport wildlife hazard management and operational environmental management plan for the King Shaka International Airport
10. Matsapha International Airport – bird hazard assessment study with management recommendations
11. Evaluation of aviation bird strike risk at candidate solid waste disposal sites in the Ekurhuleni Metropolitan Municipality
12. Gateway Airport Authority Limited – Gateway International Airport, Polokwane: Bird hazard assessment; Compile a bird hazard management plan for the airport
13. Bird Specialist Study - Evaluation of aviation bird strike risk at the Mwakirunge Landfill site near Mombasa Kenya
14. Bird Impact Assessment Study - Proposed Weltevreden Open Cast Coal Mine Belfast, Mpumalanga
15. Avian biodiversity assessment for the Mafube Colliery Coal mine near Middelburg Mpumalanga
16. Avifaunal Specialist Study - SRVM Volspruit Mining project – Mokopane Limpopo Province
17. Avifaunal Impact Assessment Study (with specific reference to African Grass Owls and other Red List species) Stone Rivers Arch
18. Airport bird and wildlife hazard management plan and training to Swaziland Civil Aviation Authority (SWACAA) for Matsapha and Sikhupe International Airports
19. Avifaunal Impact Scoping & EIA Study - Renosterberg Wind Farm and Solar PV site
20. Bird Impact Assessment Study - Proposed 60 year Ash Disposal Facility near to the Kusile Power Station

21. Avifaunal pre-feasibility assessment for the proposed Montrose dam, Mpumalanga
22. Bird Impact Assessment Study – Proposed ESKOM Phantom Substation near Knysna, Western Cape
23. Habitat sensitivity map for Denham's Bustard, Blue Crane and White-bellied Korhaan in the Kouga Municipal area of the Eastern Cape Province
24. Swaziland Civil Aviation Authority – Sikhuphe International Airport – Bird hazard management assessment
25. Avifaunal monitoring – extension of Specialist Study - SRVM Volspruit Mining project – Mokopane Limpopo Province
26. Avifaunal Specialist Study – Rooikat Hydro Electric Dam – Hope Town, Northern Cape
27. The Stewards Pan Reclamation Project – Bird Impact Assessment study
28. Airports Company South Africa – Avifaunal Specialist Consultant – Airport Bird and Wildlife Hazard Mitigation

Geographic Information System analysis & maps

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

Professional affiliations

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

APPENDIX B: SPECIES LIST FOR BROADER AREA

Species	Taxonomic name	Full protocol reporting rate	Ad hoc protocol reporting rate	Solar priority species	Recorded during surveys
Acacia Pied Barbet	*Tricholaema leucomelas*	54.84	0.00		x
African Black Duck	*Anas sparsa*	9.68	0.00	x	
African Black Swift	*Apus barbatus*	3.23	0.00		
African Darter	*Anhinga rufa*	41.94	8.33	x	
African Firefinch	*Lagonosticta rubricata*	3.23	0.00		
African Fish-eagle	*Haliaeetus vocifer*	25.81	0.00	x	x
African Hoopoe	*Upupa africana*	48.39	0.00		
African Jacana	*Actophilornis africanus*	6.45	0.00	x	
African Palm-swift	*Cypsiurus parvus*	45.16	2.78		x
African Paradise-flycatcher	*Terpsiphone viridis*	12.90	0.00		
African Pied Wagtail	*Motacilla aguimp*	0.00	2.78		
African Pipit	*Anthus cinnamomeus*	74.19	2.78		x
African Purple Swamphen	*Porphyrio madagascariensis*	3.23	0.00	x	
African Quailfinch	*Ortygospiza atricollis*	38.71	5.56		
African Red-eyed Bulbul	*Pycnonotus nigricans*	93.55	5.56		x
African Reed-warbler	*Acrocephalus baeticatus*	16.13	2.78		
African Sacred Ibis	*Threskiornis aethiopicus*	45.16	13.89	x	
African Snipe	*Gallinago nigripennis*	16.13	0.00		
African Spoonbill	*Platalea alba*	12.90	0.00	x	
African Stonechat	*Saxicola torquatus*	90.32	5.56		x
African Wattled Lapwing	*Vanellus senegallus*	25.81	0.00		
Amethyst Sunbird	*Chalcomitra amethystina*	9.68	0.00		
Amur Falcon	*Falco amurensis*	6.45	2.78	x	
Anteating Chat	*Myrmecocichla formicivora*	87.10	5.56		x
Ashy Tit	*Parus cinerascens*	3.23	0.00		
Banded Martin	*Riparia cincta*	6.45	2.78		x
Barn Owl	*Tyto alba*	3.23	0.00	x	
Barn Swallow	*Hirundo rustica*	38.71	19.44		x
Bar-throated Apalis	*Apalis thoracica*	25.81	5.56		
Black Crake	*Amaurornis flavirostris*	3.23	0.00	x	
Black Sparrowhawk	*Accipiter melanoleucus*	3.23	0.00	x	
Black-chested Prinia	*Prinia flavicans*	90.32	5.56		x
Black-collared Barbet	*Lybius torquatus*	32.26	2.78		
Black-headed Heron	*Ardea melanocephala*	58.06	8.33	x	x
Black-shouldered Kite	*Elanus caeruleus*	77.42	22.22	x	x
Blacksmith Lapwing	*Vanellus armatus*	93.55	5.56		x
Black-throated Canary	*Crithagra atrogularis*	80.65	8.33		x

Species cont.	Taxonomic name	Full protocol reporting rate	Ad hoc protocol reporting rate	Solar priority species	Recorded during surveys
Black-winged Stilt	*Himantopus himantopus*	6.45	0.00	x	
Blue Waxbill	*Uraeginthus angolensis*	83.87	2.78		
Bokmakierie	*Telophorus zeylonus*	45.16	0.00		x
Brown-crowned Tchagra	*Tchagra australis*	32.26	0.00		x
Brown-hooded Kingfisher	*Halcyon albiventris*	16.13	0.00		
Brown-throated Martin	*Riparia paludicola*	74.19	0.00		
Buffy Pipit	*Anthus vaalensis*	6.45	0.00		x
Burchell's Coucal	*Centropus burchellii*	9.68	0.00		
Cape Glossy Starling	*Lamprotornis nitens*	61.29	2.78		x
Cape Longclaw	*Macronyx capensis*	74.19	8.33		x
Cape Robin-chat	*Cossypha caffra*	77.42	2.78		x
Cape Sparrow	*Passer melanurus*	87.10	0.00		x
Cape Turtle-dove	*Streptopelia capicola*	93.55	27.78		
Cape Wagtail	*Motacilla capensis*	48.39	0.00		
Cape White-eye	*Zosterops virens*	41.94	2.78	x	
Capped Wheatear	*Oenanthe pileata*	6.45	2.78		
Cardinal Woodpecker	*Dendropicos fuscescens*	12.90	0.00		
Cattle Egret	*Bubulcus ibis*	67.74	13.89	x	
Chestnut-backed Sparrowlark	*Eremopterix leucotis*	3.23	0.00		
Chestnut-vented Tit-babbler	*Parisoma subcaeruleum*	83.87	5.56		x
Chinspot Batis	*Batis molitor*	22.58	0.00		
Cinnamon-breasted Bunting	*Emberiza tahapisi*	9.68	0.00		
Cloud Cisticola	*Cisticola textrix*	29.03	5.56	x	x
Common (Southern) Fiscal	*Lanius collaris*	100.00	8.33		x
Common Moorhen	*Gallinula chloropus*	29.03	0.00	x	x
Common Myna	*Acridotheres tristis*	80.65	2.78		x
Common Ostrich	*Struthio camelus*	41.94	0.00		
Common Quail	*Coturnix coturnix*	0.00	2.78		
Common Sandpiper	*Actitis hypoleucos*	3.23	0.00	x	
Common Scimitarbill	*Rhinopomastus cyanomelas*	6.45	0.00		
Common Starling	*Sturnus vulgaris*	3.23	0.00		
Common Waxbill	*Estrilda astrild*	35.48	2.78		x
Coqui Francolin	*Peliperdix coqui*	6.45	0.00		
Crested Barbet	*Trachyphonus vaillantii*	74.19	8.33		x
Crowned Lapwing	*Vanellus coronatus*	87.10	11.11		x
Dark-capped Bulbul	*Pycnonotus tricolor*	0.00	5.56		
Desert Cisticola	*Cisticola aridulus*	25.81	2.78		x
Diderick Cuckoo	*Chrysococcyx caprius*	32.26	0.00		x
Eastern Clapper Lark	*Mirafra fasciolata*	16.13	0.00		x

Species cont.	Taxonomic name	Full protocol reporting rate	Ad hoc protocol reporting rate	Solar priority species	Recorded during surveys
Egyptian Goose	*Alopochen aegyptiacus*	83.87	13.89	x	x
European Bee-eater	*Merops apiaster*	41.94	5.56		x
Familiar Chat	*Cercomela familiaris*	3.23	0.00		
Fiscal Flycatcher	*Sigelus silens*	83.87	2.78	x	
Fulvous Duck	*Dendrocygna bicolor*	6.45	0.00	x	x
Garden Warbler	*Sylvia borin*	3.23	0.00		
Giant Kingfisher	*Megaceryle maximus*	12.90	2.78	x	
Glossy Ibis	*Plegadis falcinellus*	22.58	2.78	x	x
Golden-tailed Woodpecker	*Campethera abingoni*	12.90	0.00		
Goliath Heron	*Ardea goliath*	9.68	0.00	x	
Great Egret	*Egretta alba*	6.45	0.00	x	
Greater Honeyguide	*Indicator indicator*	6.45	0.00		
Greater Kestrel	*Falco rupicoloides*	3.23	0.00	x	x
Greater Striped Swallow	*Hirundo cucullata*	48.39	2.78		x
Green Wood-hoopoe	*Phoeniculus purpureus*	19.35	2.78		
Green-backed Heron	*Butorides striata*	3.23	0.00	x	
Green-winged Pytilia	*Pytilia melba*	38.71	0.00		
Grey Heron	*Ardea cinerea*	25.81	2.78	x	
Grey-headed Gull	*Larus cirrocephalus*	3.23	0.00	x	
Hadeda Ibis	*Bostrychia hagedash*	93.55	8.33	x	x
Hamerkop	*Scopus umbretta*	6.45	2.78	x	
Helmeted Guineafowl	*Numida meleagris*	100.00	16.67		x
House Sparrow	*Passer domesticus*	48.39	0.00		
Jameson's Firefinch	*Lagonosticta rhodopareia*	3.23	0.00		
Kalahari Scrub-robin	*Cercotrichas paena*	70.97	5.56		
Karoo Thrush	*Turdus smithi*	54.84	2.78	x	
Laughing Dove	*Streptopelia senegalensis*	100.00	8.33		x
Lesser Grey Shrike	*Lanius minor*	3.23	2.78		
Lesser Honeyguide	*Indicator minor*	9.68	0.00		
Lesser Kestrel	*Falco naumanni*	6.45	0.00	x	
Lesser Swamp-warbler	*Acrocephalus gracilirostris*	12.90	0.00		
Levaillant's Cisticola	*Cisticola tinniens*	83.87	8.33		x
Little Egret	*Egretta garzetta*	16.13	0.00	x	
Little Grebe	*Tachybaptus ruficollis*	16.13	2.78	x	x
Little Sparrowhawk	*Accipiter minullus*	3.23	0.00	x	
Little Swift	*Apus affinis*	54.84	11.11		x
Long-crested Eagle	*Lophaetus occipitalis*	3.23	0.00	x	
Long-tailed Paradise-whydah	*Vidua paradisaea*	12.90	0.00		
Long-tailed Widowbird	*Euplectes progne*	87.10	13.89		x

Species cont.	Taxonomic name	Full protocol reporting rate	Ad hoc protocol reporting rate	Solar priority species	Recorded during surveys
Malachite Kingfisher	*Alcedo cristata*	6.45	2.78	x	
Marsh Owl	*Asio capensis*	3.23	2.78	x	
Namaqua Dove	*Oena capensis*	32.26	2.78		
Natal Spurfowl	*Pternistis natalensis*	12.90	2.78		x
Neddicky	*Cisticola fulvicapilla*	87.10	2.78		x
Northern Black Korhaan	*Afrotis afraoides*	90.32	5.56		x
Orange River Francolin	*Scleroptila levaillantoides*	25.81	2.78		x
Orange River White-eye	*Zosterops pallidus*	38.71	2.78		
Orange-breasted Waxbill	*Amandava subflava*	19.35	0.00		
Osprey	*Pandion haliaetus*	0.00	2.78	x	
Peregrine Falcon	*Falco peregrinus*	3.23	0.00	x	
Pied Avocet	*Recurvirostra avosetta*	6.45	0.00		
Pied Crow	*Corvus albus*	16.13	16.67		x
Pied Kingfisher	*Ceryle rudis*	9.68	0.00	x	
Pied Starling	*Spreo bicolor*	48.39	0.00	x	
Pink-billed Lark	*Spizocorys conirostris*	3.23	0.00		
Pin-tailed Whydah	*Vidua macroura*	45.16	2.78		x
Plain-backed Pipit	*Anthus leucophrys*	3.23	0.00		
Purple Heron	*Ardea purpurea*	6.45	0.00	x	
Rattling Cisticola	*Cisticola chiniana*	19.35	0.00		
Red-backed Shrike	*Lanius collurio*	3.23	0.00	x	
Red-billed Firefinch	*Lagonosticta senegala*	9.68	0.00		
Red-billed Quelea	*Quelea quelea*	48.39	5.56		
Red-billed Teal	*Anas erythrorhyncha*	12.90	0.00	x	x
Red-capped Lark	*Calandrella cinerea*	6.45	0.00		
Red-chested Cuckoo	*Cuculus solitarius*	22.58	2.78		x
Red-chested Flufftail	*Sarothrura rufa*	3.23	0.00	x	
Red-collared Widowbird	*Euplectes ardens*	45.16	0.00		
Red-eyed Dove	*Streptopelia semitorquata*	93.55	8.33		x
Red-faced Mousebird	*Urocolius indicus*	77.42	2.78		x
Red-headed Finch	*Amadina erythrocephala*	22.58	0.00		
Red-knobbed Coot	*Fulica cristata*	29.03	0.00	x	x
Red-throated Wryneck	*Jynx ruficollis*	12.90	0.00		x
Reed Cormorant	*Phalacrocorax africanus*	58.06	5.56	x	
Rock Dove	*Columba livia*	22.58	0.00		
Rock Martin	*Hirundo fuligula*	3.23	0.00		
Rufous-naped Lark	*Mirafra africana*	64.52	5.56		x
Scaly-feathered Finch	*Sporopipes squamifrons*	58.06	0.00		x
South African Cliff-swallow	*Hirundo spilodera*	48.39	8.33	x	x

Species cont.	Taxonomic name	Full protocol reporting rate	Ad hoc protocol reporting rate	Solar priority species	Recorded during surveys
South African Shelduck	*Tadorna cana*	16.13	0.00	x	
Southern Grey-headed Sparrow	*Passer diffusus*	90.32	2.78		x
Southern Masked-weaver	*Ploceus velatus*	100.00	19.44		x
Southern Red Bishop	*Euplectes orix*	96.77	8.33		x
Speckled Mousebird	*Colius striatus*	61.29	8.33		
Speckled Pigeon	*Columba guinea*	93.55	0.00		x
Spike-heeled Lark	*Chersomanes albofasciata*	16.13	0.00		x
Spotted Eagle-owl	*Bubo africanus*	3.23	0.00	x	
Spotted Flycatcher	*Muscicapa striata*	9.68	2.78		
Spotted Thick-knee	*Burhinus capensis*	16.13	0.00		x
Spur-winged Goose	*Plectropterus gambensis*	64.52	11.11	x	x
Squacco Heron	*Ardeola ralloides*	6.45	0.00	x	
Common Buzzard	*Buteo vulpinus*	29.03	5.56	x	x
Streaky-headed Seedeater	*Crithagra gularis*	12.90	0.00		
Swainson's Spurfowl	*Pternistis swainsonii*	70.97	8.33		x
Swallow-tailed Bee-eater	*Merops hirundineus*	16.13	0.00		
Tawny-flanked Prinia	*Prinia subflava*	32.26	5.56		x
Thick-billed Weaver	*Amblyospiza albifrons*	3.23	0.00		
Three-banded Plover	*Charadrius tricollaris*	22.58	0.00		
Wailing Cisticola	*Cisticola lais*	6.45	0.00		x
Wattled Starling	*Creatophora cinerea*	38.71	0.00		
Whiskered Tern	*Chlidonias hybrida*	9.68	0.00	x	
White Stork	*Ciconia ciconia*	0.00	2.78	x	
White-backed Mousebird	*Colius colius*	38.71	0.00		x
White-bellied Sunbird	*Cinnyris talatala*	38.71	2.78		
White-breasted Cormorant	*Phalacrocorax carbo*	32.26	2.78	x	x
White-browed Sparrow-weaver	*Plocepasser mahali*	100.00	11.11		
White-faced Duck	*Dendrocygna viduata*	3.23	2.78	x	
White-fronted Bee-eater	*Merops bullockoides*	9.68	0.00		
White-rumped Swift	*Apus caffer*	48.39	2.78		x
White-throated Swallow	*Hirundo albigularis*	41.94	0.00		x
White-winged Widowbird	*Euplectes albonotatus*	25.81	5.56		x
Willow Warbler	*Phylloscopus trochilus*	19.35	0.00		
Wing-snapping Cisticola	*Cisticola ayresii*	6.45	0.00		x
Wood Sandpiper	*Tringa glareola*	3.23	0.00	x	
Yellow Canary	*Crithagra flaviventris*	61.29	0.00		x
Yellow-billed Duck	*Anas undulata*	61.29	0.00	x	x
Yellow-billed Egret	*Egretta intermedia*	6.45	0.00	x	
Yellow-crowned Bishop	*Euplectes afer*	70.97	2.78		x
Zitting Cisticola	*Cisticola juncidis*	51.61	8.33		x

APPENDIX C: ENVIRONMENTAL MANAGEMENT PROGRAMME

Management Plan for the Planning and Design Phase

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
Avifauna: Entrapment					
Entrapment of birds in the perimeter fences, leading to mortality.	Prevent mortality of avifauna	1. Increase the spacing between at least the top two wires (to a minimum of 30cm) and ensure they are correctly tensioned.	Design the facility with a bird-friendly perimeter fence.	Once-off during the planning phase.	Project Developer
Avifauna: Electrocution					
Electrocution of priority species on the internal 33kV powerlines	Prevent mortality of avifauna	1. Pole design must be bird friendly.	Input must be obtained from the avifaunal specialist to ensure a bird-friendly design is used.	Once-off during the planning phase.	Project Developer

Management Plan for the Construction Phase

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
Avifauna: Disturbance					
The noise and movement associated with the construction activities at the development footprint will be a source of disturbance which would lead to the displacement of avifauna from the area	Prevent unnecessary displacement of avifauna by ensuring that contractors are aware of the requirements of the Construction Environmental Management Programme (CEMPr.)	A site-specific CEMPr must be implemented, which gives appropriate and detailed description of how construction activities must be conducted. All contractors are to adhere to the CEMPr and should apply good environmental practice during construction. The CEMPr must specifically include the following: 1. No off-road driving; 2. Maximum use of existing roads, where possible; 3. Measures to control noise and dust according to latest best practice; 4. Restricted access to the rest of the property;	1. Implementation of the CEMPr. Oversee activities to ensure that the CEMPr is implemented and enforced via site audits and inspections. Report and record any non-compliance. Ensure that construction personnel are made aware of the impacts relating to off-road driving. 2. Construction access roads must be demarcated clearly. Undertake site inspections to verify. 3. Monitor the implementation of noise control mechanisms via site inspections and record and report non-compliance. 4. Ensure that the construction area is demarcated clearly and that construction personnel are made aware of	1. On a daily basis 2. Weekly 3. Weekly 4. Weekly	1. Contractor and ECO 2. Contractor and ECO 3. Contractor and ECO 4. Contractor and ECO

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
			these demarcations. Monitor via site inspections and report non-compliance.		
Avifauna: Displacement due to habitat transformation					
Total or partial displacement of avifauna due to habitat transformation associated with the vegetation clearance and the presence of the solar PV plants and associated infrastructure.	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. Monitor rehabilitation via site audits and site inspections to ensure compliance. Record and report any non-compliance.	1. Appointment of rehabilitation specialist to develop habitat rehabilitation plan. 2. Site inspections to monitor progress of rehabilitation. 3. Adaptive management to ensure HRP goals are met.	1. Once-off 2. Once a year 3. As and when required	1. Project Developer 2. Facility Environmental Manager 3. Project Developer and Facility Operational Manager

Management Plan for the Operational Phase

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
Avifauna: Electrocution in the onsite substations					
Electrocution of priority species in the onsite substations	Prevent the mortality of Red Data species	Reactive mitigation of hardware if electrocutions of Red Data species are recorded.	Investigate the electrocution incident and implement appropriate mitigation by insulating the hardware	As and when required	Facility Operational Manager

Management Plan for the Decommissioning Phase

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
Avifauna: Displacement due to disturbance					
The noise and movement associated with the activities at the PV footprints will be a source of disturbance which would	Prevent unnecessary displacement of avifauna by ensuring that contractors are aware of the requirements of the Decommissioning EMPr.	A site-specific Decommissioning EMPr (DEMPr) must be implemented, which gives appropriate and detailed description of how construction activities must be conducted. All contractors are to adhere to the DEMPr and should apply good environmental practice during decommissioning. The	1. Implementation of the DEMPr. Oversee activities to ensure that the DEMPr is implemented and enforced via site audits and inspections. Report and record any non-compliance. Ensure that decommissioning	1. On a daily basis 2. Weekly 3. Weekly 4. Weekly	1. Contractor and ECO 2. Contractor and ECO 3. Contractor and ECO 4. Contractor and ECO

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
lead to the displacement of avifauna from the area		DEMPr must specifically include the following: 1. No off-road driving; 2. Maximum use of existing roads during the decommissioning phase and the construction of new roads should be kept to a minimum as far as practical; 3. Measures to control noise and dust according to latest best practice; 4. Restricted access to the rest of the property;	personnel are made aware of the impacts relating to off-road driving. 2. Access roads must be demarcated clearly. Undertake site inspections to verify. 3. Monitor the implementation of noise control mechanisms via site inspections and record and report non-compliance. 4. Ensure that the decommissioning area is demarcated clearly and that personnel are made aware of these demarcations. Monitor via site inspections and report non-compliance.		

APPENDIX D: IMPACT ASSESMENT METHODOLOGY

Method for Impact Identification and Evaluation

The identification and assessment of environmental impacts is a multi-faceted process, using a combination of quantitative and qualitative descriptions and evaluations. It involves applying scientific measurements and professional judgement to determine the significance of environmental impacts associated with the proposed project. The process involves consideration of, *inter alia*: the purpose and need for the project; views and concerns of interested and affected parties (I&APs); social and political norms, and general public interest.

Identification and Description of Impacts

Identified impacts are described in terms of the nature of the impact, compliance with legislation and accepted standards, receptor sensitivity and the significance of the predicted environmental change (before and after mitigation). Mitigation measures may be existing measures or additional measures that were identified through the impact assessment and associated specialist input. The impact rating system considers the confidence level that can be placed on the successful implementation of mitigation.

Evaluation of Impacts and Mitigation Measures

INTRODUCTION

Impacts are assessed using SLR's standard convention for assessing the significance of impacts, a summary of which is provided below.

In assigning significance ratings to potential impacts before and after mitigation the approach presented below is to be followed.

1. **Determine the impact consequence rating:** This is a function of the "intensity", "duration" and "extent" of the impact (see Section 0). The consequence ratings for combinations of these three criteria are given in Section 0.
2. **Determine impact significance rating:** The significance of an impact is a function of the consequence of the impact occurring and the probability of occurrence (see Section 0). Significance is determined using the table in Section 0.
3. **Modify significance rating (if necessary):** Significance ratings are based on largely professional judgement and transparent defined criteria. In some instances, therefore, whilst the significance rating of potential impacts might be "low", the importance of these impacts to local communities or individuals might be extremely high. The importance/value which interested and affected parties attach to impacts will be highlighted, and recommendations should be made as to ways of avoiding or minimising these perceived negative impacts through project design, selection of appropriate alternatives and / or management.
4. **Determine degree of confidence of the significance assessment:** Once the significance of the impact has been determined, the degree of confidence in the assessment will be qualified (see Section 0). Confidence in the prediction is associated with any uncertainties, for example, where information is insufficient to assess the impact.

CRITERIA FOR IMPACT ASSESSMENT

The criteria for impact assessment are provided below.

Criteria	Rating	Description
Criteria for ranking of the INTENSITY (SEVERITY) of environmental impacts	**ZERO TO VERY LOW**	Negligible change, disturbance or nuisance. The impact affects the environment in such a way that natural functions and processes are not affected. People / communities are able to adapt with relative ease and maintain pre-impact livelihoods.
	LOW	Minor (Slight) change, disturbance or nuisance. The impact on the environment is not detectable or there is no perceptible change to people's livelihood.
	MEDIUM	Moderate change, disturbance or discomfort. Where the affected environment is altered, but natural functions and processes continue, albeit in a modified way. People/communities are able to adapt with some difficulty and maintain pre-impact livelihoods but only with a degree of support.
	HIGH	Prominent change, disturbance or degradation. Where natural functions or processes are altered to the extent that they will temporarily or permanently cease. Affected people/communities will not be able to adapt to changes or continue to maintain-pre impact livelihoods.
Criteria for ranking the DURATION of impacts	**SHORT TERM**	< 5 years.
	MEDIUM TERM	5 to < 15 years.
	LONG TERM	> 15 years, but where the impact will eventually cease either because of natural processes or by human intervention.
	PERMANENT	Where mitigation either by natural processes or by human intervention will not occur in such a way or in such time span that the impact can be considered transient.
Criteria for ranking the EXTENT / SPATIAL SCALE of impacts	**LOCAL**	Impact is confined to project or study area or part thereof, e.g. limited to the area of interest and its immediate surroundings.
	REGIONAL	Impact is confined to the region, e.g. catchment, municipal region, etc.
	NATIONAL	Impact is confined to the country as a whole, e.g. South Africa, etc.
	INTERNATIONAL	Impact extends beyond the national scale.
Criteria for determining the PROBABILITY of impacts	**IMPROBABLE**	Where the possibility of the impact to materialise is very low either because of design or historic experience, i.e. ≤ 30% chance of occurring.
	POSSIBLE	Where there is a distinct possibility that the impact would occur, i.e. > 30 to ≤ 60% chance of occurring.
	PROBABLE	Where it is most likely that the impact would occur, i.e. > 60 to ≤ 80% chance of occurring.
	DEFINITE	Where the impact would occur regardless of any prevention measures, i.e. > 80% chance of occurring.
	LOW	≤ 35% sure of impact prediction.

Criteria	Rating	Description
Criteria for determining the DEGREE OF CONFIDENCE of the assessment	**MEDIUM**	> 35% and ≤ 70% sure of impact prediction.
	HIGH	> 70% sure of impact prediction.
Criteria for the DEGREE TO WHICH IMPACT CAN BE MITIGATED - the degree to which an impact can be reduced / enhanced	**NONE**	No change in impact after mitigation.
	VERY LOW	Where the significance rating stays the same, but where mitigation will reduce the intensity of the impact.
	LOW	Where the significance rating drops by one level, after mitigation.
	MEDIUM	Where the significance rating drops by two to three levels, after mitigation.
	HIGH	Where the significance rating drops by more than three levels, after mitigation.
Criteria for LOSS OF RESOURCES - the degree to which a resource is permanently affected by the activity, i.e. the degree to which a resource is irreplaceable	**LOW**	Where the activity results in a loss of a particular resource but where the natural, cultural and social functions and processes are not affected.
	MEDIUM	Where the loss of a resource occurs, but natural, cultural and social functions and processes continue, albeit in a modified way.
	HIGH	Where the activity results in an irreplaceable loss of a resource.
Criteria for REVERSIBILITY - the degree to which an impact can be reversed	**IRREVERSIBLE**	Where the impact is permanent.
	PARTIALLY REVERSIBLE	Where the impact can be partially reversed.
	FULLY REVERSIBLE	Where the impact can be completely reversed.

DETERMINING CONSEQUENCE

Consequence attempts to evaluate the importance of a particular impact, and in doing so incorporates extent, duration and intensity. The ratings and description for determining consequence are provided below.

Rating	Description *
VERY HIGH	Impacts could be EITHER: of ***high intensity*** at a ***regional level*** and endure in the ***long term***; OR of ***high intensity*** at a ***national level*** in the ***medium term***; OR of ***medium intensity*** at a ***national level*** in the ***long term.***
HIGH	Impacts could be EITHER: of ***high intensity*** at a ***regional level*** and endure in the ***medium term***; OR of ***high intensity*** at a ***national level*** in the ***short term***; OR of ***medium intensity*** at a ***national level*** in the ***medium term;*** OR of ***low intensity*** at a ***national level*** in the ***long term***; OR of ***high intensity*** at a ***local level*** in the ***long term***; OR of ***medium intensity*** at a ***regional level*** in the ***long term.***
MEDIUM	Impacts could be EITHER: of ***high intensity*** at a ***local level*** and endure in the ***medium term***;

Rating	Description *
	OR of ***medium intensity*** at a ***regional level*** in the ***medium term***; OR of ***high intensity*** at a ***regional level*** in the ***short term***; OR of ***medium intensity*** at a ***national level*** in the ***short term***; OR of ***medium intensity*** at a ***local level*** in the ***long term***; OR of ***low intensity*** at a ***national level*** in the ***medium term;*** OR of ***low intensity*** at a ***regional level*** in the ***long term.***
LOW	Impacts could be EITHER of ***low intensity*** at a ***regional level*** and endure in the ***medium term***; OR of ***low intensity*** at a ***national level*** in the ***short term***; OR of ***high intensity*** at a ***local level*** and endure in the ***short term***; OR of ***medium intensity*** at a ***regional level*** in the ***short term***; OR of ***low intensity*** at a ***local level*** in the ***long term***; OR of ***medium intensity*** at a ***local level*** and endure in the ***medium term.***
VERY LOW	Impacts could be EITHER of ***low intensity*** at a ***local level*** and endure in the ***medium term***; OR of ***low intensity*** at a ***regional level*** and endure in the ***short term***; OR of ***low to medium intensity*** at a ***local level*** and endure in the ***short term.*** OR **Zero to very low intensity** with any combination of extent and duration.

* Note: For any impact that is considered to be "Permanent" or "International" apply the "Long-Term" and "National" ratings, respectively.

DETERMINING SIGNIFICANCE

The consequence rating is considered together with the probability of occurrence in order to determine the overall significance using the table below.

		PROBABILITY			
		IMPROBABLE	**POSSIBLE**	**PROBABLE**	**DEFINITE**
CONSEQUENCE	**VERY LOW**	**INSIGNIFICANT**	**INSIGNIFICANT**	**VERY LOW**	**VERY LOW**
	LOW	**VERY LOW**	**VERY LOW**	**LOW**	**LOW**
	MEDIUM	**LOW**	**LOW**	**MEDIUM**	**MEDIUM**
	HIGH	**MEDIUM**	**MEDIUM**	**HIGH**	**HIGH**
	VERY HIGH	**HIGH**	**HIGH**	**VERY HIGH**	**VERY HIGH**

In certain cases it may not be possible to determine the significance of an impact. In these instances the significance is **UNKNOWN**.