AVIFAUNAL IMPACT ASSESSMENT REPORT AND AVIFAUNAL COMPLIANCE STATEMENT

Mercury Solar PV Cluster (Southern PV farms) near Viljoenskroon, Free State

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EXECUTIVE SUMMARY

Landscape Dynamics was appointed by Mulilo Renewable Power (Pty) Ltd to manage the Environmental Impact Assessment (EIA) process for the proposed Mercury Photovoltaic (PV) Solar Energy Cluster and associated grid connections. The assessment area for the proposed PV Solar farms and grid connections is situated north and south of the R76 close to the town of Viljoenskroon in the Free State Province. It falls within the jurisdiction of the Moqhaka Local Municipality in the Fezile Dabi District Municipality. The cluster will consist of the following facilities:

Project	**Project Area**	**Authorisation**
	ha	**MW**
Hormah Solar PV1	227	Up to 120
Kleinfontein Solar PV1	354	Up to 120
Vlakfontein Solar PV1	211	Up to 100
Zaaiplaats Solar PV1	356	Up to 120
Ratpan Solar PV1	291	Up to 80

This report serves as the Compliance Statement for the Southern PV farms:

- Hormah PV 1
- Ratpan PV 1

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A total of 246 species could potentially occur within the broader area where the total assessment area is located (see Appendix B). Of these, 91 are classified as priority species. Of the 91 priority species, 51 have a medium to high probability of occurring in the total assessment area. Of the 51 priority species with a medium to high probability of occurrence, 22 were recorded during site surveys. **No species of conservation concern (SCC) were recorded 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.

Decommissioning Phase

- Displacement due to disturbance associated with the decommissioning of the solar PV facility 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 from the DFFE Screening Tool (see Figure 6). The medium sensitivity classification is not linked to avifauna. The total assessment area 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.

The following avifaunal sensitivities were identified at the total assessment area:

- Wetlands and pans: The total assessment area contains two drainage lines with associated wetlands, and a pan. Wetlands are important refuges for a number of priority species, including the Marsh Owl that often breeds in the tall rank grassland around wetlands. The wetlands and the pan must be buffered with a 50m solar panel exclusion zone to prevent the disturbance of wetland birds during the construction period, and to allow free access to the wetland for birds commuting to and from the wetland.

IMPACT RATINGS

Horma PV1			
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.*	Moderate	Low
	Mortality of priority species due to collisions with solar panels	Low	Low
	Entrapment of birds in the perimeter fence	Moderate	Low
	Displacement of priority species due to disturbance associated with decommissioning of the PV plant and associated infrastructure.	Moderate	Low
	Mortality of priority species due to collisions with solar panels	Low	Low
	Entrapment of birds in the perimeter fence	Moderate	Low
	Displacement of priority species due to disturbance associated with decommissioning of the PV plant and associated infrastructure.	Moderate	Low
Ratpan PV1			
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	Moderate
	Mortality of priority species due to collisions with solar panels	Low	Low
	Entrapment of birds in the perimeter fence	Moderate	Low
	Displacement of priority species due to disturbance associated with decommissioning of the PV plant and associated infrastructure.	Moderate	Low

MANAGEMENT ACTIONS

The following management actions have been proposed in this assessment for the Southern PV farms:

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.
- Ratpan PV 1: A 50m buffer zone must be maintained around the pan at -27.061595° 26.839521°

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.
- If possible, a single fence should be used.

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 total assessment 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 total assessment area 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 at any of the proposed PV sites.

IMPACT STATEMENT

It is recommended that the Ratpan PV 1and Hormah PV 1 solar facilities are authorised, on condition that the proposed mitigation measures as detailed in the Impact Tables (Appendix D 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 Mercury PV Suite.

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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

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List of Abbreviations

BA	Basic Assessment
BGIS	Biodiversity Geographic Information System
BLSA	BirdLife South Africa
DFFE	Department of Environment, Forestry and Fisheries
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	
Total assessment area	The total assessment area is the area covering all the PV sites in the cluster as shown in Figure 1.
Broader area	A consolidated data set for the four pentads where the total assessment area is located.
PV site	An individual PV site where a development will be located
Priority species	• South African Red Data species. • South African endemics and near-endemics. • Raptors • Waterbirds

1. Introduction

Landscape Dynamics was appointed by Mulilo Renewable Power (Pty) Ltd to manage the Environmental Impact Assessment (EIA) process for the proposed Mercury Photovoltaic (PV) Solar Energy Cluster and associated grid connections. The assessment area for the proposed PV Solar farms and grid connections is situated north and south of the R76 close to the town of Viljoenskroon in the Free State Province. It falls within the jurisdiction of the Moqhaka Local Municipality in the Fezile Dabi District Municipality. The cluster will consist of the following facilities:

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Ratpan Solar PV1	291	Up to 80

The total assessment area is located within the Klerksdorp Renewable Development Zone 10 (REDZ 10), and 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:

- Mercury – Perseus 1 765 kV Power Line;
- Hermes-Mercury 400kV Power Line;
- Mercury – Mookodi 1 400 kV Power Line
- Mercury – Zeus 765kV Power Line
- Mercury -Midas 1 400kV

All of the above-mentioned power lines connect to the Mercury Main Transmission Substation (MTS), located on northern border of the total assessment area. The grid connection infrastructure associated with the proposed project will be a direct connection into Mercury 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 Landscape Dynamics to conduct an Avifaunal Impact Assessment and to compile a Compliance Statement for each PV project as part of the EIA process.

This report serves as the Compliance Statement for the Southern PV farms:

- Hormah PV1
- Ratpan PV1

Each PV facility will consist of the following components:

- Solar PV Farm
- On site IPP substation
- Battery Energy Storage Systems (BESS)
- Diesel storage facility of less than 500m3
- 132kV Grid Connections with switching station for each PV facility (separate BA process)
- Laydown area for the construction period
- Operational & Maintenance Buildings

- Additional infrastructure (Access Roads - new and/or upgrade; stormwater; water pipelines, perimeter fencing etc.)

See Figure 1 for a map of the Mercury PV Solar Energy Cluster.

1.1 Scope, Purpose and Objectives of this Compliance Statement

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

1.2 Terms of Reference

The terms of reference for the Compliance Statement for each PV facility 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.

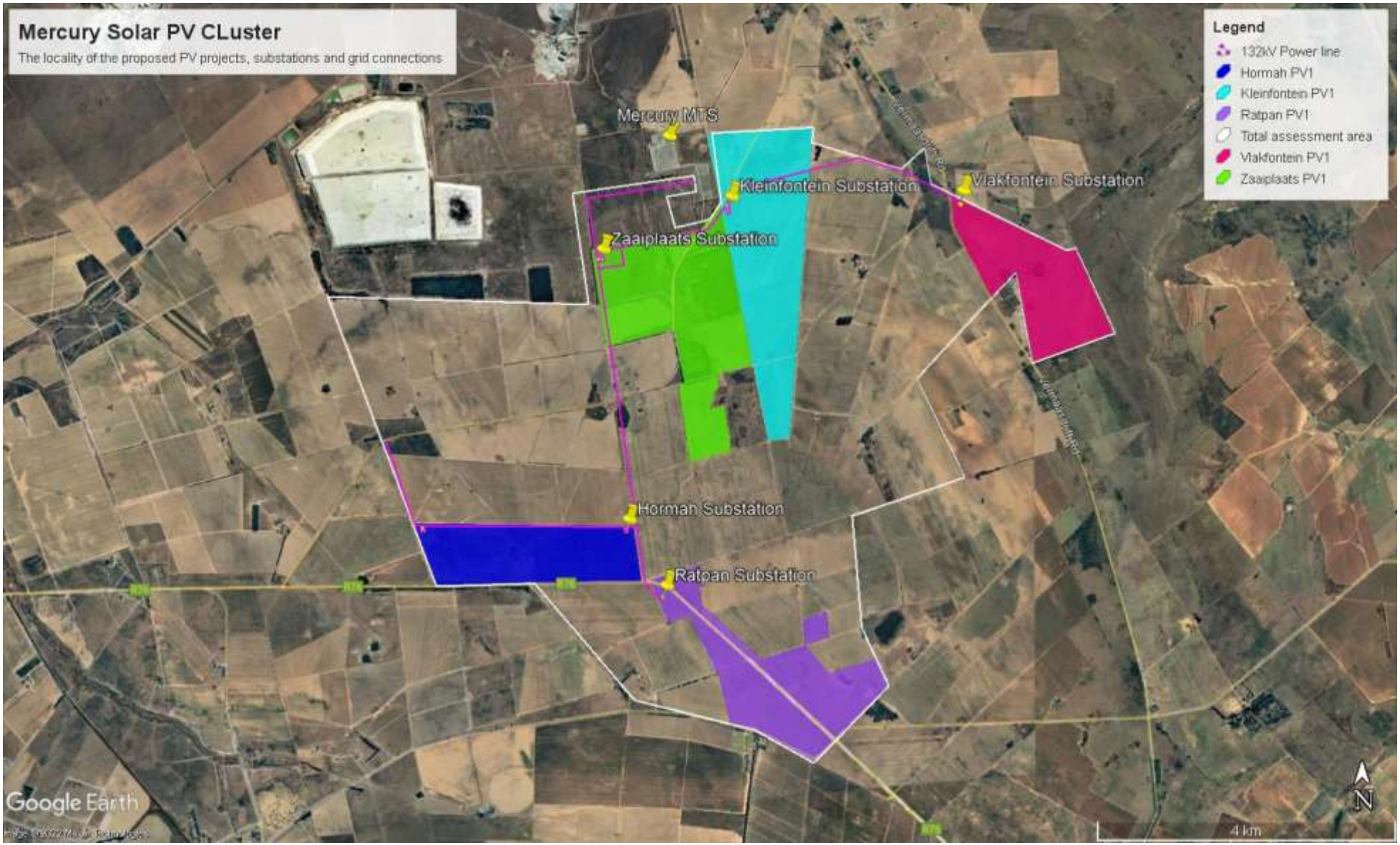


Figure 1: Map of the proposed Mercury Solar PV Cluster. The Southern PV farms are Hormah PV1 and Ratpan PV1.

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 119 SABAP2 full protocol lists had been completed for the four pentads (broader area) where the proposed project is located (i.e. bird listing surveys lasting a minimum of two hours each). In addition, 28 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 (2021.3) 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 08 – 10 January 2022 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 5.38 km, 2.77 km and 6.34 km respectively were identified in the study area and counted four times over a period of 3 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 SABAP2 pentads (broader area = green squares).

See Figure 3 for the location of drive transects.

Figure 3: The location of the drive transects and focal points relative to the Mercury PV total assessment area (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 Forestry, Fisheries, and the Environment (DFFE)	2021, Q3	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 2022	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. 3	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 for bird conservation, identified nationally through multi-stakeholder processes using globally standardised, quantitative and scientifically agreed criteria.
Strategic Environmental Assessment	Department of Environmental Affairs, 2015. Strategic Environmental Assessment for wind and solar	2015	SEA	The SEA identifies areas where large scale wind and solar PV energy facilities can

Data / Information	Source	Date	Type	Description
for wind and solar photovoltaic energy in South Africa	photovoltaic energy in South Africa. CSIR Report Number: CSIR/CAS/EMS/ER/2015/0001/B. Stellenbosch.			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).
Phase 2 Strategic Environmental Assessment for wind and solar photovoltaic energy in South Africa	Department of Environment, Forestry and Fisheries, 2019. Phase 2 Strategic Environmental Assessment for wind and solar PV energy in South Africa. CSIR Report Number: CSIR/SPLA/SECO/ER/2019/0085 Stellenbosch, Western Cape.	2019	SEA	The SEA identifies additional 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). These are referred to as FA9 eMalahleni (solar PV), FA10 Klerksdorp and. (solar PV) and FA11 Beaufort West (wind). The numbers are a continuation from the already gazetted eight REDZs from the Phase 1 wind and solar PV SEA.
The National Screening Tool	Department of Environment, Forestry and Fisheries	April 2022	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 119 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, 28 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 total assessment 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 *et al.* 2019) 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 total assessment 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 pentads where the projects are located (see Figure 2 above). The **total assessment area** is defined as the area covering all the PV sites in the cluster as shown in Figure 1. The **PV site** refers to an individual PV site where a development will be located.

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 1: 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 name	Description	Geographic scope
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), Washington DC, 1973	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
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. Baseline Environmental Description

4.1 General Description

5.1.1 Important Bird Areas (IBAs)

The Suikerbosrand Nature Reserve IBA SA022 is the closest IBA and is located approximately 123km 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 officially protected area is the Mispah Game Farm which is located approximately 1.1km away from the closest PV facility. No information could be sourced on the Mispah Game Farm, but from Google Earth imagery it is obvious that the property is highly transformed with a large slime dam present on the property. The proposed development is not expected to have any impact on the avifauna in this nature reserve due to the highly degraded nature of the habitat.

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

The site falls within the Klerksdorp 10 Renewable Energy Zone (REDZ).

5.1.4 Bird Habitat

The total assessment area falls within the Grassland Biome, within the Dry Highveld Grassland Bioregion (Mucina & Rutherford). The dominant vegetation type at the total assessment area is Vaal Vet Sandy 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, agriculture and powerlines. The habitat in the total assessment area is highly transformed and very little natural grassland remains. The following bird habitats were recorded at, or in the immediate vicinity of the total assessment area:

- Disturbed grassland
- Wetlands, drainage lines and pans
- High voltage lines
- Agriculture (crops and cultivated grazing)
- Alien trees

Table 2 shows the habitat types present on each PV site.

Table 2: Habitat present at the respective PV sites

PV site	Disturbed grassland	Wetlands, drainage lines and pans	High voltage lines	Agriculture	Alien trees
Hormah PV 1	x				x
Ratpan PV 1	x	x			x

5.1.4.1 Grassland

The following priority species with a medium to high likelihood of occurrence could potentially use the grassland in the total assessment area:

Species name	Taxonomic name	Full protocol	Ad hoc protocol	Recorded during monitoring	Likelihood of regular occurrence
Amur Falcon	*Falco amurensis*	10.08	0.00		M
Black-headed Heron	*Ardea melanocephala*	33.61	10.71	x	H
Blacksmith Lapwing	*Vanellus armatus*	89.92	21.43	x	H
Black-winged Kite	*Elanus caeruleus*	49.58	14.29	x	H
Cloud Cisticola	*Cisticola textrix*	10.92	0.00	x	M
Common Buzzard	*Buteo buteo*	12.61	0.00	x	M
Egyptian Goose	*Alopochen aegyptiaca*	68.91	14.29	x	H
Greater Kestrel	*Falco rupicoloides*	6.72	3.57	x	M
Marsh Owl	*Asio capensis*	2.52	7.14		M
Pied Starling	*Lamprotornis bicolor*	17.65	7.14		H
South African Cliff Swallow	*Petrochelidon spilodera*	40.34	7.14	x	H
Spotted Eagle-Owl	*Bubo africanus*	2.52	7.14		M
Spur-winged Goose	*Plectropterus gambensis*	35.29	14.29	x	H

5.1.4.2 High voltage lines

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

Species name	Taxonomic name	Full protocol	Ad hoc protocol	Recorded during monitoring	Likelihood of regular occurrence
Amur Falcon	*Falco amurensis*	10.08	0.00		M
Black-headed Heron	*Ardea melanocephala*	33.61	10.71	x	H
Black-winged Kite	*Elanus caeruleus*	49.58	14.29	x	H
Common Buzzard	*Buteo buteo*	12.61	0.00	x	M
Egyptian Goose	*Alopochen aegyptiaca*	68.91	14.29	x	H
Greater Kestrel	*Falco rupicoloides*	6.72	3.57	x	M
Spotted Eagle-Owl	*Bubo africanus*	2.52	7.14		M
Spur-winged Goose	*Plectropterus gambensis*	35.29	14.29	x	H

5.1.4.3 Agriculture

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

Species name	Taxonomic name	Full protocol	Ad hoc protocol	Recorded during monitoring	Likelihood of regular occurrence
African Sacred Ibis	*Threskiornis aethiopicus*	30.25	3.57		H
Amur Falcon	*Falco amurensis*	10.08	0.00		M
Black-headed Heron	*Ardea melanocephala*	33.61	10.71	x	H
Black-winged Kite	*Elanus caeruleus*	49.58	14.29	x	H
Common Buzzard	*Buteo buteo*	12.61	0.00	x	M
Egyptian Goose	*Alopochen aegyptiaca*	68.91	14.29	x	H
Greater Kestrel	*Falco rupicoloides*	6.72	3.57	x	M
Pied Starling	*Lamprotornis bicolor*	17.65	7.14		H
South African Cliff Swallow	*Petrochelidon spilodera*	40.34	7.14	x	H
Spur-winged Goose	*Plectropterus gambensis*	35.29	14.29	x	H

5.1.4.4 Alien trees

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

Species name	Taxonomic name	Full protocol	Ad hoc protocol	Recorded during monitoring	Likelihood of regular occurrence
African Sacred Ibis	*Threskiornis aethiopicus*	30.25	3.57		H
Amur Falcon	*Falco amurensis*	10.08	0.00		M
Black-headed Heron	*Ardea melanocephala*	33.61	10.71	x	H
Black-winged Kite	*Elanus caeruleus*	49.58	14.29	x	H
Cape White-eye	*Zosterops virens*	13.45	0.00	x	M
Common Buzzard	*Buteo buteo*	12.61	0.00	x	M
Egyptian Goose	*Alopochen aegyptiaca*	68.91	14.29	x	H
Fiscal Flycatcher	*Melaenornis silens*	67.23	3.57	x	H
Giant Kingfisher	*Megaceryle maxima*	12.61	3.57		M
Greater Kestrel	*Falco rupicoloides*	6.72	3.57	x	M
Grey Heron	*Ardea cinerea*	37.82	17.86	x	H
Hamerkop	*Scopus umbretta*	3.36	0.00		M
Karoo Thrush	*Turdus smithi*	31.93	3.57		M
Pied Starling	*Lamprotornis bicolor*	17.65	7.14		H
Spotted Eagle-Owl	*Bubo africanus*	2.52	7.14		M
Spur-winged Goose	*Plectropterus gambensis*	35.29	14.29	x	H
Western Cattle Egret	*Bubulcus ibis*	58.82	14.29		H

5.1.4.5 Drainage lines, wetlands and pans

Species name	Taxonomic name	Full protocol	Ad hoc protocol	Recorded during monitoring	Likelihood of regular occurrence
African Black Duck	*Anas sparsa*	19.33	7.14		H
African Darter	*Anhinga rufa*	62.18	10.71	x	H
African Pied Wagtail	*Motacilla aguimp*	33.61	0.00		H
African Sacred Ibis	*Threskiornis aethiopicus*	30.25	3.57		H
African Snipe	*Gallinago nigripennis*	5.04	0.00		M
African Spoonbill	*Platalea alba*	5.88	0.00		M
African Swamphen	*Porphyrio madagascariensis*	10.08	0.00		M
Black Crake	*Zapornia flavirostra*	27.73	0.00		H
Black-headed Heron	*Ardea melanocephala*	33.61	10.71	x	H
Blacksmith Lapwing	*Vanellus armatus*	89.92	21.43	x	H
Black-winged Stilt	*Himantopus himantopus*	10.08	0.00		M
Cape Shoveler	*Spatula smithii*	8.40	10.71	x	M
Common Moorhen	*Gallinula chloropus*	58.82	0.00	x	H
Common Sandpiper	*Actitis hypoleucos*	5.88	0.00		M
Egyptian Goose	*Alopochen aegyptiaca*	68.91	14.29	x	H
Giant Kingfisher	*Megaceryle maxima*	12.61	3.57		M
Glossy Ibis	*Plegadis falcinellus*	9.24	10.71	x	M
Great Egret	*Ardea alba*	5.04	0.00		M

Grey Heron	*Ardea cinerea*	37.82	17.86	x	H
Grey-headed Gull	*Chroicocephalus cirrocephalus*	5.88	0.00		M
Hamerkop	*Scopus umbretta*	3.36	0.00		M
Little Egret	*Egretta garzetta*	17.65	0.00		M
Little Grebe	*Tachybaptus ruficollis*	52.10	3.57	x	H
Little Stint	*Calidris minuta*	6.72	0.00		M
Malachite Kingfisher	*Corythornis cristatus*	15.97	0.00		M
Marsh Owl	*Asio capensis*	2.52	7.14		M
Purple Heron	*Ardea purpurea*	9.24	0.00		M
Red-billed Teal	*Anas erythrorhyncha*	21.85	3.57	x	H
Red-knobbed Coot	*Fulica cristata*	59.66	14.29	x	H
Reed Cormorant	*Microcarbo africanus*	71.43	21.43		H
Ruff	*Calidris pugnax*	4.20	0.00		M
South African Shelduck	*Tadorna cana*	36.13	21.43	x	H
Spotted Eagle-Owl	*Bubo africanus*	2.52	7.14		M
Spur-winged Goose	*Plectropterus gambensis*	35.29	14.29	x	H
Squacco Heron	*Ardeola ralloides*	10.08	0.00		M
Three-banded Plover	*Charadrius tricollaris*	26.05	0.00		H
Western Cattle Egret	*Bubulcus ibis*	58.82	14.29		H
Whiskered Tern	*Chlidonias hybrida*	8.40	0.00		M
White-breasted Cormorant	*Phalacrocorax lucidus*	42.86	3.57		H
White-faced Whistling Duck	*Dendrocygna viduata*	15.13	7.14	x	M
Wood Sandpiper	*Tringa glareola*	8.40	0.00		M
Yellow-billed Duck	*Anas undulata*	83.19	10.71	x	H

5.1.5 Avifauna

- **Southern African Bird Atlas 2**

A total of 246 species could potentially occur within the broader area where the total assessment area is located (see Appendix B). Of these, 91 are classified as priority species. Of the 91 priority species, 51 have a medium to high probability of occurring in the total assessment area. Of the 51 priority species with a medium to high probability of occurrence, 22 were recorded during site surveys. **No species of conservation concern (SCC) were recorded during site surveys**.

The probability of a priority species occurring regularly in the study area is indicated in Table 3.

Table 3 below lists all the priority species and the possible impact on the respective species by the proposed PV facility and associated infrastructure.

- VU = Vulnerable, L= Low, M = Medium, H = High

Table 3: Priority species occurring in the broader area, with a medium to high likelihood of occurrence at the total assessment area. Potential impacts are also indicated.

Species name	Taxonomic name	SABAP2 reporting rate		Status				Status					Potential impacts			
		Full protocol	Ad hoc protocol	Global status	SA status	Recorded during monitoring	Likelihood of regular occurrence	Grassland	Agriculture	Pans and wetlands	Alien trees	HV lines	Solar - Collisions with solar panels	Solar - Displacement: Disturbance	Solar - Displacement: Habitat transformation	Solar - Entanglement in fences
African Black Duck	*Anas sparsa*	19.33	7.14	-	-		H			x			x			
African Darter	*Anhinga rufa*	62.18	10.71	-	-	x	H			x			x			
African Pied Wagtail	*Motacilla aguimp*	33.61	0.00	-	-		H			x			x			
African Sacred Ibis	*Threskiornis aethiopicus*	30.25	3.57	-	-		H		x	x	x		x		x	
African Snipe	*Gallinago nigripennis*	5.04	0.00	-	-		M			x			x		x	
African Spoonbill	*Platalea alba*	5.88	0.00	-	-		M			x			x			
African Swamphen	*Porphyrio madagascariensis*	10.08	0.00	-	-		M			x			x			
Black Crake	*Zapornia flavirostra*	27.73	0.00	-	-		H			x			x			
Black-headed Heron	*Ardea melanocephala*	33.61	10.71	-	-	x	H	x	x	x	x	x	x	x	x	x
Blacksmith Lapwing	*Vanellus armatus*	89.92	21.43	-	-	x	H	x		x			x		x	
Black-winged Stilt	*Himantopus himantopus*	10.08	0.00	-	-		M			x			x			
Cape Shoveler	*Spatula smithii*	8.40	10.71	-	-	x	M			x			x			
Common Moorhen	*Gallinula chloropus*	58.82	0.00	-	-	x	H			x			x			
Common Sandpiper	*Actitis hypoleucos*	5.88	0.00	-	-		M			x			x			
Egyptian Goose	*Alopochen aegyptiaca*	68.91	14.29	-	-	x	H	x	x	x	x	x	x	x	x	
Giant Kingfisher	*Megaceryle maxima*	12.61	3.57	-	-		M			x	x		x			
Glossy Ibis	*Plegadis falcinellus*	9.24	10.71	-	-	x	M			x			x			
Grey Heron	*Ardea cinerea*	37.82	17.86	-	-	x	H			x	x		x			
Grey-headed Gull	*Chroicocephalus cirrocephalus*	5.88	0.00	-	-		M			x			x			

Species name	Taxonomic name	SABAP2 reporting rate		Status				Status					Potential impacts			
		Full protocol	Ad hoc protocol	Global status	SA status	Recorded during monitoring	Likelihood of regular occurrence	Grassland	Agriculture	Pans and wetlands	Alien trees	HV lines	Solar - Collisions with solar panels	Solar - Displacement: Disturbance	Solar - Displacement: Habitat transformation	Solar - Entanglement in fences
Hamerkop	*Scopus umbretta*	3.36	0.00	-	-		M			x	x		x			
Little Egret	*Egretta garzetta*	17.65	0.00	-	-		M			x			x			
Little Grebe	*Tachybaptus ruficollis*	52.10	3.57	-	-	x	H			x			x			
Little Stint	*Calidris minuta*	6.72	0.00	-	-		M			x			x			
Marsh Owl	*Asio capensis*	2.52	7.14	-	-		M	x		x			x	x	x	x
Purple Heron	*Ardea purpurea*	9.24	0.00	-	-		M			x			x			
Red-billed Teal	*Anas erythrorhyncha*	21.85	3.57	-	-	x	H			x			x			
Red-knobbed Coot	*Fulica cristata*	59.66	14.29	-	-	x	H			x			x			
Reed Cormorant	*Microcarbo africanus*	71.43	21.43	-	-		H			x			x			
Ruff	*Calidris pugnax*	4.20	0.00	-	-		M			x			x			
South African Shelduck	*Tadorna cana*	36.13	21.43	-	-	x	H			x			x			
Spotted Eagle-Owl	*Bubo africanus*	2.52	7.14	-	-		M	x		x	x	x	x	x	x	x
Spur-winged Goose	*Plectropterus gambensis*	35.29	14.29	-	-	x	H	x	x	x	x	x	x		x	
Squacco Heron	*Ardeola ralloides*	10.08	0.00	-	-		M			x			x			
Three-banded Plover	*Charadrius tricollaris*	26.05	0.00	-	-		H			x			x			
Western Cattle Egret	*Bubulcus ibis*	58.82	14.29	-	-		H			x	x		x		x	
Whiskered Tern	*Chlidonias hybrida*	8.40	0.00	-	-		M			x			x			
White-breasted Cormorant	*Phalacrocorax lucidus*	42.86	3.57	-	-		H			x			x			
White-faced Whistling Duck	*Dendrocygna viduata*	15.13	7.14	-	-	x	M			x			x			
Wood Sandpiper	*Tringa glareola*	8.40	0.00	-	-		M			x			x			
Yellow-billed Duck	*Anas undulata*	83.19	10.71	-	-	x	H			x			x			

- Pre-construction surveys

As noted above, on-site surveys were conducted at the total assessment area from 08 – 10 January 2022 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).[1] A total of 84 species were recorded, of which 13 (15%) were priority species. A total of 2 445 birds were recorded.

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.

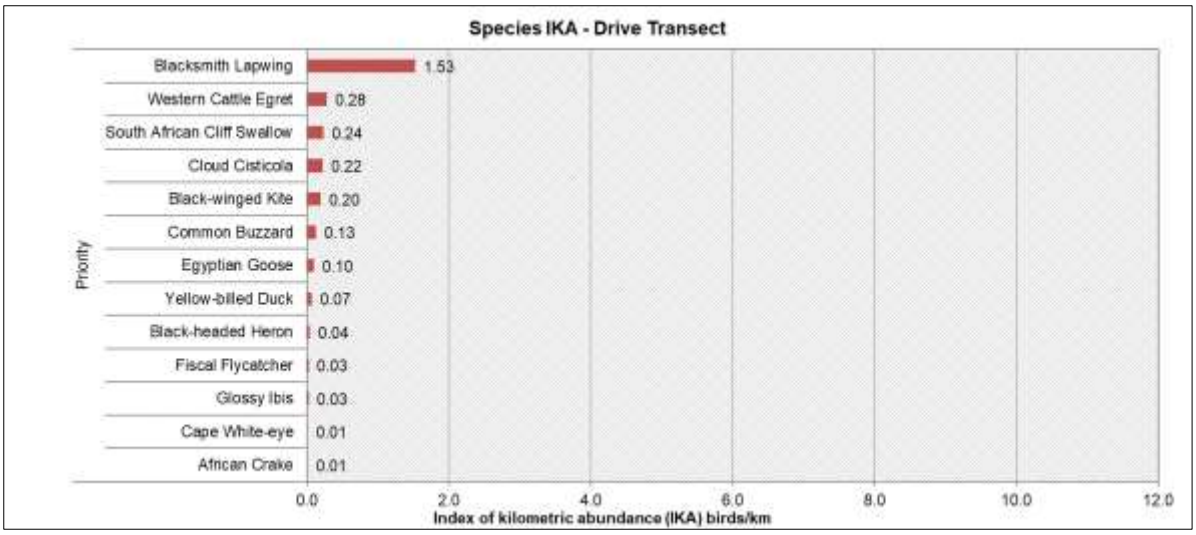


Figure 4: The abundance of priority species recorded during transect counts.

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

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

Species names	Sci name	Survey 1	Grand total
Black-winged Kite	*Elanus caeruleus*	15	**15**
Greater Kestrel	*Falco rupicoloides*	7	**7**
Yellow-billed Duck	*Anas undulata*	2	**2**
Red-knobbed Coot	*Fulica cristata*	2	**2**
Fiscal Flycatcher	*Melaenornis silens*	2	**2**
South African Shelduck	*Tadorna cana*	2	**2**
Amur Falcon	*Falco amurensis*	1	**1**
White-faced Whistling Duck	*Dendrocygna viduata*	1	**1**
Blacksmith Lapwing	*Vanellus armatus*	1	**1**
Cape Shoveler	*Spatula smithii*	1	**1**
Egyptian Goose	*Alopochen aegyptiaca*	1	**1**
African Darter	*Anhinga rufa*	1	**1**
Spur-winged Goose	*Plectropterus gambensis*	1	**1**
Red-billed Teal	*Anas erythrorhyncha*	1	**1**
Black-headed Heron	*Ardea melanocephala*	1	**1**

[1] 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.

Grey Heron	*Ardea cinerea*	1	**1**
Common Buzzard	*Buteo buteo*	1	**1**

The overall abundance of priority species at the total assessment area and immediate environment was moderate, with an average of 2.9 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.

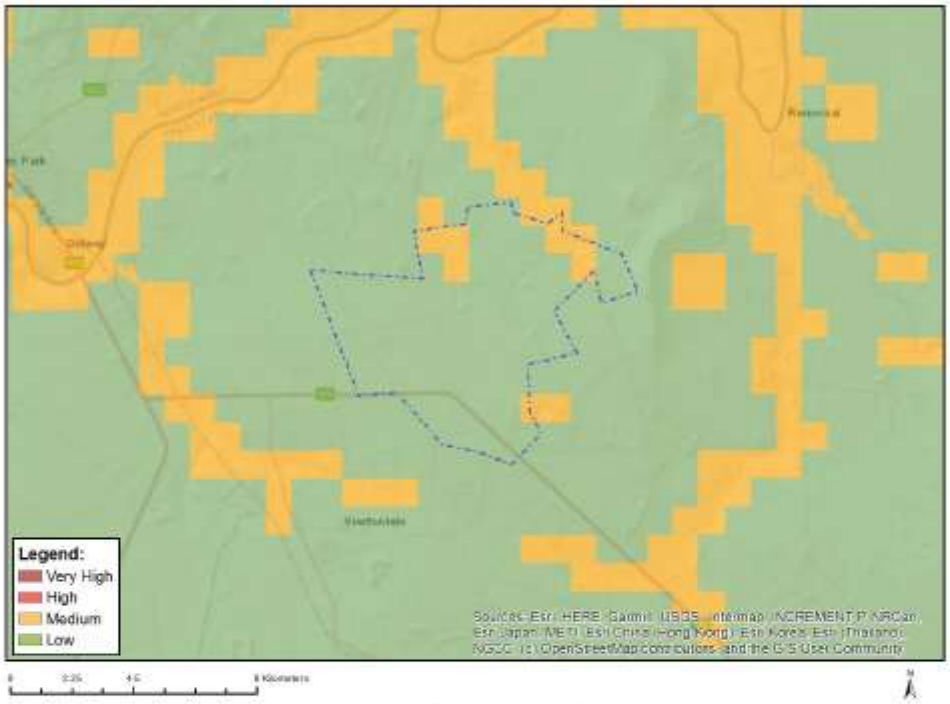
5.2. Identification of Environmental Sensitivities

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[2] (see Figure 6). The medium sensitivity classification is not linked to avifauna. The total assessment area contains only marginal 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.

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

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	Mammalia-Hydrictis maculicollis

Figure 6: The National Web-Based Environmental Screening Tool map of the Mercury PV Cluster 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

The following avifaunal sensitivities were identified at the total assessment area:

- Wetlands and pans: The total assessment area contains two drainage lines with associated wetlands, and a pan. Wetlands and pans are important refuges for a number of priority species, including the Marsh Owl that often breeds in the tall rank grassland around wetlands. The wetlands and the pan must be buffered with a 50m solar panel exclusion zone to prevent the disturbance of wetland birds during the construction period, and to allow free access to the wetland for birds commuting to and from the wetland.

See Figure Table 5 and Figures 7-8 for a description of the sensitivity zones in each PV site.

PV site	Pans	Wetlands, drainage lines and pans
Hormah PV 1	-	-
75MW Ratpan Solar PV 1	A pan and wetland is present in the southern section of the PV area.	-

Figure 7: Avifaunal no-go buffer zones at Ratpan PV1 site

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

6.1.3 Decommissioning Phase

- Displacement due to disturbance associated with the decommissioning of the solar PV plant 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*. 2019).

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)[3]. 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 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). Kosciuch *et al.* (2020) analysed the results from fatality monitoring studies at 10 photovoltaic solar facilities across 13 site years in the Sonoran and Mojave Deserts Bird Conservation Region in California and Nevada in the USA. They found no evidence of mass mortality related to the lake effect despite the occurrence of water water-obligate birds, which rely on water for take-off and landing, occurring at 90% (9/10) of site-years in the Sonoran and Mojave Deserts Bird Conservation Region. However, until such time that enough scientific evidence has been collected to discount the “lake effect” hypothesis completely, 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

[3] 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.

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.* 2019). 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.* 2019).

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 (Kosciuch *et al.* 2020). Until statistically tested results emerge from existing compliance programmes and more dedicated scientific research, conclusions will inevitably be largely 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, ground-dwelling birds which forage between the solar panels, and a variety of waterbirds which may be potentially at risk due to the “lake effect”.

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

7.2.2 Entrapment in perimeter fences

Visser *et al.* 2019 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.* 2019). 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.

See Table 2 for list of priority 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.* (2019) 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.* (2019) 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. This is likely to affect breeding residents most.

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, perhaps more so for shrubland species than grassland species, as explained above, will manifest itself at the proposed project. In addition, raptors and terrestrial species could also be impacted.

See Table 2 for list of priority 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 and the total assessment area is already highly transformed, which makes it of limited value for avifauna.

8 Impact rating methodology

Impacts for each PV site are evaluated and assessed in terms of the following criteria:

Extent of impact	**Explanation of extent**
Site	Impacts limited to construction site and direct surrounding area
Local	Impacts affecting environmental elements within the local area / district
Regional	Impacts affecting environmental elements within the province
National	Impacts affecting environmental elements on a national level
Duration of impact	**Explanation of duration**
Short term	0 - 5 years. The impact is reversible in less than 5 years.
Medium term	5 - 15 years. The impact is reversible in less than 15 years.
Long term	>15 years, but where the impacts will cease if the project is decommissioned

Permanent	The impact will continue indefinitely and is irreversible.
Probability of impact	**Explanation of Probability**
Unlikely	The chance of the impact occurring is extremely low
Possible	The impact may occur
Probable	The impact will very likely occur
Definite	Impact will certainly occur
Reversibility of impact	**Explanation of Reversibility Ratings**
Low	The affected environment will not be able to recover from the impact - permanently modified
Medium	The affected environment will only recover from the impact with significant intervention
High	The affected environmental will be able to recover from the impact
Significance of impact	**Explanation of Significance**
None	There is no impact at all
Low	Impact is negligible or is of a low order and is likely to have little real effect
Moderate	Impact is real but not substantial
High	Impact is substantial
Very high	Impact is very high and can therefore influence the viability of the project

9 Impact Assessments

See Appendix D for tables summarising the potential impacts on avifauna of the individual PV sites.

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

Table 5: Comparison of impacts on environmental parameters pre- and post-mitigation for each PV site

Horma PV1			
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.*	Moderate	Low
	Mortality of priority species due to collisions with solar panels	Low	Low
	Entrapment of birds in the perimeter fence	Moderate	Low
	Displacement of priority species due to disturbance associated with decommissioning of the PV plant and associated infrastructure.	Moderate	Low
Ratpan PV1			
Environmental parameter	Issues	Significance rating prior to mitigation	Significance rating post mitigation
	Displacement of priority species due to disturbance and habitat destruction associated with construction of the PV facility and associated infrastructure.	Moderate	Low
	Mortality of priority species due to collisions with solar panels	Low	Low

Avifauna	*Entrapment of birds in the perimeter fence*	Moderate	Low
	Displacement of priority species due to disturbance associated with decommissioning of the PV plant and associated infrastructure.	Moderate	Low

Ratpan PV2			
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	Moderate
	Mortality of priority species due to collisions with solar panels	Low	Low
	Entrapment of birds in the perimeter fence	Moderate	Low
	Displacement of priority species due to disturbance associated with decommissioning of the PV plant and associated infrastructure.	Moderate	Low

10 Environmental Management Programme Inputs

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

11 Final Specialist Statement and Authorisation Recommendation

11.1 Statement and Reasoned Opinion

The total assessment 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 total assessment area 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 recommended that the Hormah PV 1 and Ratpan PV 1 solar facilities are authorised, on condition that the proposed mitigation measures as detailed in the Impact Tables (Appendix D of the report) and the EMPr (Appendix C) are strictly implemented.

12 References

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Appendices

Appendix A: Specialist Expertise
Appendix B: Species List
Appendix C: Environmental Management Plans
Appendix D: Impact Ratings

APPENDIX A - SPECIALIST EXPERTISE

Curriculum vitae: Chris van Rooyen

Profession/Specialisation	:	Avifaunal Specialist
Highest Qualification	:	BA LLB
Nationality	:	South African
Years of experience	:	25 years

Key Experience

Chris van Rooyen has twenty-five 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).
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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	:	22 years

Key Qualifications

Albert Froneman **(**Pr.Sci.Nat) has more than 22 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 Mercury & 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 LISTS

SABAP2 BROADER AREA Species name	Taxonomic name	Full protocol	Ad hoc protocol	Global status	SA status
Acacia Pied Barbet	*Tricholaema leucomelas*	61.345	0	-	-
African Black Duck	*Anas sparsa*	19.33	7.14	-	-
African Black Swift	*Apus barbatus*	1.6807	0	-	-
African Crake	*Crecopsis egregia*	1.68	0.00	-	-
African Darter	*Anhinga rufa*	62.18	10.71	-	-
African Firefinch	*Lagonosticta rubricata*	3.3613	0	-	-
African Fish Eagle	*Haliaeetus vocifer*	26.05	3.57	-	-
African Hoopoe	*Upupa africana*	26.891	3.5714	-	-
African Jacana	*Actophilornis africanus*	4.20	0.00	-	-
African Palm Swift	*Cypsiurus parvus*	36.135	3.5714	-	-
African Paradise Flycatcher	*Terpsiphone viridis*	5.042	0	-	-
African Pied Wagtail	*Motacilla aguimp*	33.61	0.00	-	-
African Pipit	*Anthus cinnamomeus*	31.092	7.1429	-	-
African Rail	*Rallus caerulescens*	0.84	0.00	-	-
African Red-eyed Bulbul	*Pycnonotus nigricans*	94.118	0	-	-
African Reed Warbler	*Acrocephalus baeticatus*	36.135	7.1429	-	-
African Sacred Ibis	*Threskiornis aethiopicus*	30.25	3.57	-	-
African Snipe	*Gallinago nigripennis*	5.04	0.00	-	-
African Spoonbill	*Platalea alba*	5.88	0.00	-	-
African Stonechat	*Saxicola torquatus*	84.034	17.8571	-	-
African Swamphen	*Porphyrio madagascariensis*	10.08	0.00	-	-
African Wattled Lapwing	*Vanellus senegallus*	20.168	0	-	-
Amethyst Sunbird	*Chalcomitra amethystina*	1.6807	0	-	-
Amur Falcon	*Falco amurensis*	10.08	0.00	-	-
Ant-eating Chat	*Myrmecocichla formicivora*	50.42	7.1429	-	-
Ashy Tit	*Melaniparus cinerascens*	4.2017	0	-	-
Banded Martin	*Riparia cincta*	7.563	0	-	-
Barn Swallow	*Hirundo rustica*	36.135	14.2857	-	-
Barred Wren-Warbler	*Calamonastes fasciolatus*	0.8403	0	-	-
Bar-throated Apalis	*Apalis thoracica*	10.084	3.5714	-	-
Black Crake	*Zapornia flavirostra*	27.73	0.00	-	-
Black Heron	*Egretta ardesiaca*	4.20	0.00	-	-
Black-chested Prinia	*Prinia flavicans*	95.798	10.7143	-	-
Black-collared Barbet	*Lybius torquatus*	42.857	0	-	-
Black-crowned Night Heron	*Nycticorax nycticorax*	2.52	0.00	-	-
Black-faced Waxbill	*Brunhilda erythronotos*	3.3613	0	-	-
Black-headed Heron	*Ardea melanocephala*	33.61	10.71	-	-
Black-necked Grebe	*Podiceps nigricollis*	0.84	0.00	-	-
Blacksmith Lapwing	*Vanellus armatus*	89.92	21.43	-	-
Black-throated Canary	*Crithagra atrogularis*	68.067	3.5714	-	-
Black-winged Kite	*Elanus caeruleus*	49.58	14.29	-	-
Black-winged Stilt	*Himantopus himantopus*	10.08	0.00	-	-
Blue Waxbill	*Uraeginthus angolensis*	56.303	0	-	-
Blue-billed Teal	*Spatula hottentota*	3.36	0.00	-	-
Bokmakierie	*Telophorus zeylonus*	7.563	3.5714	-	-
Bronze Mannikin	*Spermestes cucullata*	0.8403	0	-	-
Brown-backed Honeybird	*Prodotiscus regulus*	6.7227	0	-	-
Brown-crowned Tchagra	*Tchagra australis*	35.294	0	-	-
Brown-hooded Kingfisher	*Halcyon albiventris*	29.412	3.5714	-	-

Species name	Taxonomic name	Full protocol	Ad hoc protocol	Global status	SA status
Brown-throated Martin	*Riparia paludicola*	65.546	7.1429	-	-
Brubru	*Nilaus afer*	5.042	0	-	-
Buffy Pipit	*Anthus vaalensis*	5.042	0	-	-
Burchell's Coucal	*Centropus burchellii*	17.647	0	-	-
Cape Longclaw	*Macronyx capensis*	36.975	3.5714	-	-
Cape Robin-Chat	*Cossypha caffra*	71.429	7.1429	-	-
Cape Shoveler	*Spatula smithii*	8.40	10.71	-	-
Cape Sparrow	*Passer melanurus*	73.109	10.7143	-	-
Cape Starling	*Lamprotornis nitens*	56.303	3.5714	-	-
Cape Turtle Dove	*Streptopelia capicola*	90.756	10.7143	-	-
Cape Wagtail	*Motacilla capensis*	62.185	10.7143	-	-
Cape White-eye	*Zosterops virens*	13.45	0.00	-	-
Capped Wheatear	*Oenanthe pileata*	6.7227	0	-	-
Cardinal Woodpecker	*Dendropicos fuscescens*	12.605	0	-	-
Caspian Tern	*Hydroprogne caspia*	13.45	3.57	-	VU
Chestnut-backed Sparrow-Lark	*Eremopterix leucotis*	1.6807	0	-	-
Chestnut-vented Warbler	*Curruca subcoerulea*	83.193	3.5714	-	-
Chinspot Batis	*Batis molitor*	10.924	0	-	-
Cinnamon-breasted Bunting	*Emberiza tahapisi*	17.647	0	-	-
Cloud Cisticola	*Cisticola textrix*	10.92	0.00	-	-
Common Buzzard	*Buteo buteo*	12.61	0.00	-	-
Common Greenshank	*Tringa nebularia*	0.84	0.00	-	-
Common Moorhen	*Gallinula chloropus*	58.82	0.00	-	-
Common Myna	*Acridotheres tristis*	67.227	7.1429	-	-
Common Ostrich	*Struthio camelus*	29.412	10.7143	-	-
Common Quail	*Coturnix coturnix*	0.8403	0	-	-
Common Sandpiper	*Actitis hypoleucos*	5.88	0.00	-	-
Common Scimitarbill	*Rhinopomastus cyanomelas*	8.4034	0	-	-
Common Waxbill	*Estrilda astrild*	15.126	3.5714	-	-
Common Whitethroat	*Curruca communis*	5.8824	0	-	-
Crested Barbet	*Trachyphonus vaillantii*	76.471	0	-	-
Crimson-breasted Shrike	*Laniarius atrococcineus*	6.7227	0	-	-
Crowned Lapwing	*Vanellus coronatus*	71.429	3.5714	-	-
Curlew Sandpiper	*Calidris ferruginea*	0.84	0.00	NT	LC
Desert Cisticola	*Cisticola aridulus*	31.092	7.1429	-	-
Diederik Cuckoo	*Chrysococcyx caprius*	42.017	3.5714	-	-
Domestic Goose	*Anser anser domesticus*	19.328	0	-	-
Dusky Indigobird	*Vidua funerea*	2.521	0	-	-
Eastern Clapper Lark	*Mirafra fasciolata*	11.765	0	-	-
Eastern Long-billed Lark	*Certhilauda semitorquata*	0.84	0.00	-	-
Egyptian Goose	*Alopochen aegyptiaca*	68.91	14.29	-	-
European Bee-eater	*Merops apiaster*	22.689	10.7143	-	-
European Roller	*Coracias garrulus*	1.68	0.00	-	NT
Familiar Chat	*Oenanthe familiaris*	4.2017	0	-	-
Fiscal Flycatcher	*Melaenornis silens*	67.23	3.57	-	-
Fulvous Whistling Duck	*Dendrocygna bicolor*	2.52	0.00	-	-
Gabar Goshawk	*Micronisus gabar*	4.20	0.00	-	-
Garden Warbler	*Sylvia borin*	1.6807	0	-	-
Giant Kingfisher	*Megaceryle maxima*	12.61	3.57	-	-
Glossy Ibis	*Plegadis falcinellus*	9.24	10.71	-	-
Golden-tailed Woodpecker	*Campethera abingoni*	7.563	0	-	-

Species name	Taxonomic name	Full protocol	Ad hoc protocol	Global status	SA status
Goliath Heron	*Ardea goliath*	8.40	0.00	-	-
Hadada Ibis	*Bostrychia hagedash*	80.672	17.8571	-	-
Great Crested Grebe	*Podiceps cristatus*	1.68	0.00	-	-
Great Reed Warbler	*Acrocephalus arundinaceus*	8.4034	0	-	-
Greater Honeyguide	*Indicator indicator*	0.8403	0	-	-
Great Egret	*Ardea alba*	5.04	0.00	-	-
Greater Striped Swallow	*Cecropis cucullata*	25.21	0	-	-
Green Wood Hoopoe	*Phoeniculus purpureus*	10.084	0	-	-
Green-winged Pytilia	*Pytilia melba*	14.286	3.5714	-	-
Greater Kestrel	*Falco rupicoloides*	6.72	3.57	-	-
Grey Heron	*Ardea cinerea*	37.82	17.86	-	-
Helmeted Guineafowl	*Numida meleagris*	79.832	3.5714	-	-
Grey-headed Gull	*Chroicocephalus cirrocephalus*	5.88	0.00	-	-
Hamerkop	*Scopus umbretta*	3.36	0.00	-	-
Horus Swift	*Apus horus*	1.6807	0	-	-
House Sparrow	*Passer domesticus*	21.849	0	-	-
Icterine Warbler	*Hippolais icterina*	3.3613	0	-	-
Intermediate Egret	*Ardea intermedia*	1.68	3.57	-	-
Jameson's Firefinch	*Lagonosticta rhodopareia*	16.807	0	-	-
Kalahari Scrub Robin	*Cercotrichas paena*	44.538	3.5714	-	-
Karoo Thrush	*Turdus smithi*	31.93	3.57	-	-
Kittlitz's Plover	*Charadrius pecuarius*	1.68	0.00	-	-
Lanner Falcon	*Falco biarmicus*	3.36	0.00	-	VU
Laughing Dove	*Spilopelia senegalensis*	93.277	17.8571	-	-
Lesser Grey Shrike	*Lanius minor*	10.924	0	-	-
Lesser Honeyguide	*Indicator minor*	4.2017	0	-	-
Lesser Kestrel	*Falco naumanni*	2.52	0.00	-	-
Lesser Swamp Warbler	*Acrocephalus gracilirostris*	68.067	7.1429	-	-
Levaillant's Cisticola	*Cisticola tinniens*	78.992	14.2857	-	-
Little Bee-eater	*Merops pusillus*	9.2437	0	-	-
Little Bittern	*Ixobrychus minutus*	1.68	0.00	-	-
Little Egret	*Egretta garzetta*	17.65	0.00	-	-
Little Grebe	*Tachybaptus ruficollis*	52.10	3.57	-	-
Little Rush Warbler	*Bradypterus baboecala*	15.126	0	-	-
Little Sparrowhawk	*Accipiter minullus*	0.84	0.00	-	-
Little Stint	*Calidris minuta*	6.72	0.00	-	-
Little Swift	*Apus affinis*	41.177	3.5714	-	-
Long-billed Crombec	*Sylvietta rufescens*	5.8824	0	-	-
Long-crested Eagle	*Lophaetus occipitalis*	0.84	0.00	-	-
Long-tailed Paradise Whydah	*Vidua paradisaea*	10.084	0	-	-
Long-tailed Widowbird	*Euplectes progne*	32.773	3.5714	-	-
Maccoa Duck	*Oxyura maccoa*	1.68	0.00	VU	NT
Malachite Kingfisher	*Corythornis cristatus*	15.97	0.00	-	-
Malachite Sunbird	*Nectarinia famosa*	0.8403	0	-	-
Marsh Owl	*Asio capensis*	2.52	7.14	-	-
Marsh Sandpiper	*Tringa stagnatilis*	4.20	0.00	-	-
Marsh Warbler	*Acrocephalus palustris*	6.7227	3.5714	-	-
Martial Eagle	*Polemaetus bellicosus*	0.84	0.00	EN	EN
Mountain Wheatear	*Myrmecocichla monticola*	2.521	0	-	-
Namaqua Dove	*Oena capensis*	23.529	0	-	-
Natal Spurfowl	*Pternistis natalensis*	38.656	3.5714	-	-

Species name	Taxonomic name	Full protocol	Ad hoc protocol	Global status	SA status
Neddicky	*Cisticola fulvicapilla*	65.546	0	-	-
Northern Black Korhaan	*Afrotis afraoides*	52.101	7.1429	-	-
Orange River Francolin	*Scleroptila gutturalis*	4.2017	0	-	-
Orange River White-eye	*Zosterops pallidus*	66.387	0	-	-
Orange-breasted Waxbill	*Amandava subflava*	2.521	3.5714	-	-
Pearl-breasted Swallow	*Hirundo dimidiata*	0.8403	0	-	-
Peregrine Falcon	*Falco peregrinus*	0.84	0.00	-	-
Pied Avocet	*Recurvirostra avosetta*	0.84	0.00	-	-
Pied Crow	*Corvus albus*	63.866	17.8571	-	-
Pied Kingfisher	*Ceryle rudis*	15.97	0.00	-	-
Pied Starling	*Lamprotornis bicolor*	17.65	7.14	-	-
Pink-billed Lark	*Spizocorys conirostris*	1.6807	0	-	-
Pin-tailed Whydah	*Vidua macroura*	30.252	3.5714	-	-
Pririt Batis	*Batis pririt*	24.37	0	-	-
Purple Heron	*Ardea purpurea*	9.24	0.00	-	-
Purple Indigobird	*Vidua purpurascens*	3.3613	3.5714	-	-
Quailfinch	*Ortygospiza atricollis*	22.689	3.5714	-	-
Rattling Cisticola	*Cisticola chiniana*	52.101	7.1429	-	-
Red-backed Shrike	*Lanius collurio*	27.731	14.2857	-	-
Red-billed Firefinch	*Lagonosticta senegala*	21.849	7.1429	-	-
Red-billed Quelea	*Quelea quelea*	65.546	10.7143	-	-
Red-billed Teal	*Anas erythrorhyncha*	21.85	3.57	-	-
Red-capped Lark	*Calandrella cinerea*	10.924	7.1429	-	-
Red-chested Cuckoo	*Cuculus solitarius*	12.605	0	-	-
Red-chested Flufftail	*Sarothrura rufa*	1.68	0.00	-	-
Red-collared Widowbird	*Euplectes ardens*	14.286	0	-	-
Red-eyed Dove	*Streptopelia semitorquata*	94.118	17.8571	-	-
Red-faced Mousebird	*Urocolius indicus*	63.025	3.5714	-	-
Red-headed Finch	*Amadina erythrocephala*	2.521	0	-	-
Red-knobbed Coot	*Fulica cristata*	59.66	14.29	-	-
Red-throated Wryneck	*Jynx ruficollis*	1.6807	0	-	-
Reed Cormorant	*Microcarbo africanus*	71.43	21.43	-	-
Rock Dove	*Columba livia*	9.2437	0	-	-
Rock Kestrel	*Falco rupicolus*	2.52	0.00	-	-
Rock Martin	*Ptyonoprogne fuligula*	2.521	0	-	-
Ruff	*Calidris pugnax*	4.20	0.00	-	-
Rufous-naped Lark	*Mirafra africana*	46.219	3.5714	-	-
Sabota Lark	*Calendulauda sabota*	5.042	0	-	-
Scaly-feathered Weaver	*Sporopipes squamifrons*	57.143	3.5714	-	-
Sedge Warbler	*Acrocephalus schoenobaenus*	0.8403	0	-	-
Shaft-tailed Whydah	*Vidua regia*	4.2017	0	-	-
South African Cliff Swallow	*Petrochelidon spilodera*	40.34	7.14	-	-
South African Shelduck	*Tadorna cana*	36.13	21.43	-	-
Southern Fiscal	*Lanius collaris*	69.748	14.2857	-	-
Southern Grey-headed Sparrow	*Passer diffusus*	66.387	3.5714	-	-
Southern Masked Weaver	*Ploceus velatus*	97.479	17.8571	-	-
Southern Pochard	*Netta erythrophthalma*	3.36	0.00	-	-
Southern Red Bishop	*Euplectes orix*	76.471	25	-	-
Southern Yellow-billed Hornbill	*Tockus leucomelas*	0.8403	0	-	-
Speckled Mousebird	*Colius striatus*	26.891	0	-	-

Species name	Taxonomic name	Full protocol	Ad hoc protocol	Global status	SA status
Speckled Pigeon	*Columba guinea*	73.109	10.7143	-	-
Spike-heeled Lark	*Chersomanes albofasciata*	1.6807	0	-	-
Spotted Eagle-Owl	*Bubo africanus*	2.52	7.14	-	-
Spotted Flycatcher	*Muscicapa striata*	11.765	0	-	-
Spotted Thick-knee	*Burhinus capensis*	2.521	0	-	-
Spur-winged Goose	*Plectropterus gambensis*	35.29	14.29	-	-
Squacco Heron	*Ardeola ralloides*	10.08	0.00	-	-
Striated Heron	*Butorides striata*	4.20	0.00	-	-
Swainson's Spurfowl	*Pternistis swainsonii*	63.025	7.1429	-	-
Swallow-tailed Bee-eater	*Merops hirundineus*	1.6807	0	-	-
Tawny-flanked Prinia	*Prinia subflava*	21.008	0	-	-
Temminck's Courser	*Cursorius temminckii*	0	3.5714	-	-
Thick-billed Weaver	*Amblyospiza albifrons*	15.966	0	-	-
Three-banded Plover	*Charadrius tricollaris*	26.05	0.00	-	-
Village Indigobird	*Vidua chalybeata*	15.126	3.5714	-	-
Village Weaver	*Ploceus cucullatus*	0	3.5714	-	-
Violet-eared Waxbill	*Granatina granatina*	3.3613	0	-	-
Wattled Starling	*Creatophora cinerea*	32.773	0	-	-
Western Barn Owl	*Tyto alba*	0.84	0.00	-	-
Western Cattle Egret	*Bubulcus ibis*	58.82	14.29	-	-
Whiskered Tern	*Chlidonias hybrida*	8.40	0.00	-	-
White Stork	*Ciconia ciconia*	0.84	0.00	-	-
White-backed Duck	*Thalassornis leuconotus*	1.68	0.00	-	-
White-backed Mousebird	*Colius colius*	42.017	0	-	-
White-bellied Sunbird	*Cinnyris talatala*	7.563	0	-	-
White-breasted Cormorant	*Phalacrocorax lucidus*	42.86	3.57	-	-
White-browed Scrub Robin	*Cercotrichas leucophrys*	0.8403	0	-	-
White-browed Sparrow-Weaver	*Plocepasser mahali*	81.513	17.8571	-	-
White-faced Whistling Duck	*Dendrocygna viduata*	15.13	7.14	-	-
White-fronted Bee-eater	*Merops bullockoides*	28.571	10.7143	-	-
White-rumped Swift	*Apus caffer*	18.487	3.5714	-	-
White-throated Robin-Chat	*Cossypha humeralis*	1.6807	0	-	-
White-throated Swallow	*Hirundo albigularis*	38.656	3.5714	-	-
White-winged Tern	*Chlidonias leucopterus*	2.52	0.00	-	-
White-winged Widowbird	*Euplectes albonotatus*	24.37	3.5714	-	-
Willow Warbler	*Phylloscopus trochilus*	12.605	3.5714	-	-
Wing-snapping Cisticola	*Cisticola ayresii*	2.521	0	-	-
Wood Sandpiper	*Tringa glareola*	8.40	0.00	-	-
Yellow Canary	*Crithagra flaviventris*	37.815	0	-	-
Yellow-billed Duck	*Anas undulata*	83.19	10.71	-	-
Yellow-billed Stork	*Mycteria ibis*	0.84	0.00	-	EN
Yellow-crowned Bishop	*Euplectes afer*	15.966	0	-	-
Yellow-fronted Canary	*Crithagra mozambica*	2.521	0	-	-
Yellow-throated Bush Sparrow	*Gymnoris superciliaris*	3.3613	0	-	-
Zitting Cisticola	*Cisticola juncidis*	12.605	7.1429	-	-

Pre-construction surveys Priority species	Taxonomic name	Transects	Incidental	Focal Point
African Crake	*Crex egregia*	*		
African Darter	*Anhinga rufa*		*	
Amur Falcon	*Falco amurensis*		*	
Black-headed Heron	*Ardea melanocephala*	*	*	
Blacksmith Lapwing	*Vanellus armatus*	*	*	
Black-winged Kite	*Elanus caeruleus*	*	*	
Cape Shoveler	*Spatula smithii*		*	
Cape White-eye	*Zosterops virens*	*		
Cloud Cisticola	*Cisticola textrix*	*		
Common Buzzard	*Buteo buteo*	*	*	
Common Moorhen	*Gallinula chloropus*			*
Egyptian Goose	*Alopochen aegyptiaca*	*	*	
Fiscal Flycatcher	*Melaenornis silens*	*	*	
Glossy Ibis	*Plegadis falcinellus*	*		
Greater Kestrel	*Falco rupicoloides*		*	
Grey Heron	*Ardea cinerea*		*	
Little Grebe	*Tachybaptus ruficollis*			*
Red-billed Teal	*Anas erythrorhyncha*		*	
Red-knobbed Coot	*Fulica cristata*		*	*
South African Cliff Swallow	*Petrochelidon spilodera*	*		
South African Shelduck	*Tadorna cana*		*	
Spur-winged Goose	*Plectropterus gambensis*		*	
Western Cattle Egret	*Bubulcus ibis*	*		*
White-faced Whistling Duck	*Dendrocygna viduata*		*	
Yellow-billed Duck	*Anas undulata*	*	*	
25		**13**	**17**	**4**
Non-Priority Species		**Transects**	**Incidental**	**Focal point**
African quail-finch	*Ortygospiza atricollis*	*		
African Red-eyed Bulbul	*Pycnonotus nigricans*	*		
African Stonechat	*Saxicola torquatus*	*		
Ant-eating Chat	*Myrmecocichla formicivora*	*		
Banded Martin	*Riparia cincta*	*		
Barn Swallow	*Hirundo rustica*	*		
Black-chested Prinia	*Prinia flavicans*	*		*
Black-throated Canary	*Crithagra atrogularis*	*		
Blue Waxbill	*Uraeginthus angolensis*	*		
Bokmakierie	*Telophorus zeylonus*	*		
Brown-throated Martin	*Riparia paludicola*	*		

Non-Priority Species cont.		Transects	Incidental	Focal point
Cape glossy starling	*Lamprotornis nitens*	*		
Cape Longclaw	*Macronyx capensis*	*		*
Cape Robin-Chat	*Cossypha caffra*	*		
Cape Sparrow	*Passer melanurus*	*		*
Cape turtle dove	*Streptopelia capicola*	*		
Cape Wagtail	*Motacilla capensis*	*		
Chestnut-vented tit-babbler	*Sylvia subcoerulea*	*		
Common House Martin	*Delichon urbicum*	*		
Common Waxbill	*Estrilda astrild*	*		
Crested Barbet	*Trachyphonus vaillantii*	*		
Crowned Lapwing	*Vanellus coronatus*	*		
Desert Cisticola	*Cisticola aridulus*	*		
Diederik Cuckoo	*Chrysococcyx caprius*	*		
Eastern Clapper Lark	*Mirafra fasciolata*	*		*
European Bee-eater	*Merops apiaster*	*		
Great Reed Warbler	*Acrocephalus arundinaceus*	*		
Greater Striped Swallow	*Cecropis cucullata*	*		
Green Wood Hoopoe	*Phoeniculus purpureus*	*		
Hadeda Ibis	*Bostrychia hagedash*	*		
Helmeted Guineafowl	*Numida meleagris*	*		
House Sparrow	*Passer domesticus*	*		
Jameson's Firefinch	*Lagonosticta rhodopareia*	*		
Laughing Dove	*Spilopelia senegalensis*	*		*
Levaillant's Cisticola	*Cisticola tinniens*	*		*
Little Bee-eater	*Merops pusillus*	*		
Little Swift	*Apus affinis*	*		
Long-tailed Widowbird	*Euplectes progne*	*		
Namaqua Dove	*Oena capensis*	*		
Neddicky	*Cisticola fulvicapilla*	*		
Northern Black Korhaan	*Afrotis afraoides*		*	
Orange River White-eye	*Zosterops pallidus*	*		
Orange-breasted Waxbill	*Amandava subflava*	*		
Pied Crow	*Corvus albus*	*		
Pin-tailed Whydah	*Vidua macroura*	*		
Purple Indigobird	*Vidua purpurascens*	*		
Rattling Cisticola	*Cisticola chiniana*	*		
Red-backed Shrike	*Lanius collurio*	*		
Red-billed Firefinch	*Lagonosticta senegala*	*		
Red-billed Quelea	*Quelea quelea*	*		
Red-capped Lark	*Calandrella cinerea*	*		
Red-eyed Dove	*Streptopelia semitorquata*	*		
Rock Dove	*Columba livia*	*		

Non-Priority Species cont.		Transects	Incidental	Focal point
Rufous-naped Lark	*Mirafra africana*	*		
Scaly-feathered finch	*Sporopipes squamifrons*	*		
Shaft-tailed Whydah	*Vidua regia*	*		
Southern Fiscal	*Lanius collaris*	*		
Southern Grey-headed Sparrow	*Passer diffusus*	*		
Southern Masked Weaver	*Ploceus velatus*	*		
Southern Red Bishop	*Euplectes orix*	*		*
Speckled Mousebird	*Colius striatus*	*		
Speckled Pigeon	*Columba guinea*	*		*
Spotted Flycatcher	*Muscicapa striata*	*		
Swainson's Spurfowl	*Pternistis swainsonii*	*		*
Village Indigobird	*Vidua chalybeata*	*		
White-backed Mousebird	*Colius colius*	*		
White-browed Sparrow-Weaver	*Plocepasser mahali*	*		
White-rumped Swift	*Apus caffer*	*		
White-winged Widowbird	*Euplectes albonotatus*	*		
Yellow Canary	*Crithagra flaviventris*	*		
Yellow-crowned Bishop	*Euplectes afer*	*		*
Zitting Cisticola	*Cisticola juncidis*	*		*
72	Subtotal	71	1	11
	Grand total	**84**	**18**	**15**

APPENDIX C: ENVIRONMENTAL MANAGEMENT PROGRAMMES

HORMAH PV 1

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. 2. Use a single perimeter fence if possible.	Design the facility with a single bird-friendly perimeter fence.	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 these demarcations. Monitor via site	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***
			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: 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 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	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	1. Implementation of the DEMPr. Oversee activities to ensure tha the DEMPr is implemented and enforced via site audits and inspections. Report and record any non-compliance. Ensure that	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***
disturbance which would lead to the displacement of avifauna from the area		during decommissioning. The 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;	decommissioning 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.		

RATPAN PV 1

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. 2. Use a single perimeter fence if possible.	Design the facility with a single bird-friendly perimeter fence.	Once-off during the planning phase.	Project Developer
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 facility and associated infrastructure.	Prevent unnecessary displacement of avifauna by ensuring that sensitive habitat is protected.	Maintain 50m solar panel exclusion buffer zone around pan and wetland at -27.061595° 26.839521°	Design the facility with a 50m solar panel exclusion buffer zone around wetlands and pans.	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	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***
			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 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: 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 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 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 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 DEMPr must specifically include the following: 5. No off-road driving; 6. 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; 7. Measures to control noise and dust according to latest best practice; 8. Restricted access to the rest of the property;	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 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.	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

APPENDIX D: IMPACT RATINGS TABLES

HORMAH PV 1

1 DESIGN AND PRE-CONSTRUCTION PHASE

No impacts are expected

2 CONSTRUCTION PHASE

Impact Description

Displacement of priority species due to disturbance associated with construction of the PV plant and associated infrastructure.

Cumulative impact description

There are currently three approved renewable energy projects within a 30km radius around the proposed Mercury Solar Cluster, namely the 75MW Buffels Solar PV 1 Solar Energy Project, the 100MW Orkney PV Solar Energy Project and 132kV powerline, and the Kabi Vaalkop Photovoltaic Facility, Substation and Powerlines. Displacement due to disturbance associated with the construction of the PV dacilities is a possibility at all the planned renewable energy facilities. However, the cumulative impact on species of conservation concern is expected to be low, given the highly transformed habitat and location of all the projects.

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 use should be made of existing access roads and the construction of new roads should be kept to a minimum.
- The mitigation measures proposed by the vegetation specialist must be strictly enforced.

Impact Assessment

Name of Impact	Extent	Duration	Probability	Reversibility of impact	Significance without mitigation	Significance after mitigation
Displacement of priority species due to disturbance	Site	Short term	Probable	High	Moderate	Low

Impact on Irreplaceable Resources (*after* mitigation) If yes, please explain	NO. The resources are not irreplaceable. There are no species of conservation concern at the PV site.

Cumulative impact rating (*after* mitigation)	Low. The PV site is highly transformed, which makes it generally unsuitable for species of

If high, please explain	conservation concern.

Impact Description

Displacement of priority species due to habitat transformation (vegetation clearance and the presence of the solar panels) associated with construction of the PV plant and associated infrastructure.

Cumulative impact description

There are currently three approved renewable energy projects within a 30km radius around the proposed Mercury Solar Cluster, namely the 75MW Buffels Solar PV 1 Solar Energy Project, the 100MW Orkney PV Solar Energy Project and 132kV powerline, and the Kabi Vaalkop Photovoltaic Facility, Substation and Powerlines. Displacement due to habitat transformation associated with the construction of the grid connection and substations is a possibility at all the planned renewable energy facilities. However, the cumulative impact on species of conservation concern is expected to be low, given the highly transformed habitat and location of all the projects.

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 use should be made of existing access roads and the construction of new roads should be kept to a minimum.
- The mitigation measures proposed by the vegetation specialist must be strictly enforced.
- Rehabilitation of vegetation must take place under the guidance of a vegetation specialist after the conclusion of the construction phase.

Impact Assessment

Name of Impact	Extent	Duration	Probability	Reversibility of impact	Significance without mitigation	Significance after mitigation
Displacement of priority species due to habitat transformation	Site	Short term	Probable	High	Moderate	Low

Impact on Irreplaceable Resources (*after* mitigation) If yes, please explain	NO. The resources are not irreplaceable. There are no species of conservation concern at the PV site.

Cumulative impact rating (*after* mitigation) If high, please explain	Low. The PV site is highly transformed, which makes it generally unsuitable for species of conservation concern.

3 OPERATIONAL PHASE

Impact Description

Mortality of priority species due to collisions with the solar panels.

Cumulative impact description

There are currently three approved renewable energy projects within a 30km radius around the proposed Mercury Solar Cluster, namely the 75MW Buffels Solar PV 1 Solar Energy Project, the 100MW Orkney PV Solar Energy Project and 132kV powerline, and the Kabi Vaalkop Photovoltaic Facility, Substation and Powerlines. Mortality due to collisions with the solar panels is a possibility at all the planned renewable energy facilities. However, the cumulative impact on species of conservation concern is expected to be low, given the highly transformed habitat and location of all the projects.

Mitigation

No mitigation is required.

Impact Assessment

Name of Impact	Extent	Duration	Probability	Reversibility of impact	Significance without mitigation	Significance after mitigation
Mortality of priority species due to collisions with the solar panels.	Site	Long term	Possible	High	Low	n/a

Impact on Irreplaceable Resources (*after* mitigation) If yes, please explain	NO. The resources are not irreplaceable. There are no species of conservation concern at the PV site.

Cumulative impact rating (*after* mitigation) If high, please explain	Low. The PV site is highly transformed, which makes it generally unsuitable for species of conservation concern. The impact is likely to be insignificant to start with.

Impact Description

Entrapment of birds in the perimeter fence

Cumulative impact description

There are currently three approved renewable energy projects within a 30km radius around the proposed Mercury Solar Cluster, namely the 75MW Buffels Solar PV 1 Solar Energy Project, the 100MW Orkney PV Solar Energy Project and 132kV powerline, and the Kabi Vaalkop Photovoltaic Facility, Substation and Powerlines. Mortality due to entrapment in perimeter fences is a possibility at all the planned renewable energy facilities. However, the cumulative impact on species of conservation concern is expected to be low, given the highly transformed habitat and location of all the projects.

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.
- Use a single perimeter fence if possible, to prevent birds from getting trapped between fences.

Impact Assessment

Name of Impact	Extent	Duration	Probability	Reversibility of impact	Significance without mitigation	Significance after mitigation
Mortality of priority species due to entrapment in the perimeter fences	Site	Long term	Possible	High	Moderate	Low

Impact on Irreplaceable Resources (*after* mitigation) If yes, please explain	NO. The resources are not irreplaceable. There are no species of conservation concern at the PV site.

Cumulative impact rating (*after* mitigation) If high, please explain	Low. The PV site is highly transformed, which makes it generally unsuitable for species of conservation concern.

4 DECOMMISSIONING PHASE

Impact Description

Displacement of priority species due to disturbance associated with decommissioning of the PV facility and associated infrastructure.

Cumulative impact description

There are currently three approved renewable energy projects within a 30km radius around the proposed Mercury Solar Cluster, namely the 75MW Buffels Solar PV 1 Solar Energy Project, the 100MW Orkney PV

Solar Energy Project and 132kV powerline, and the Kabi Vaalkop Photovoltaic Facility, Substation and Powerlines. Displacement due to disturbance associated with the dismantling of the PV facility and associated infrastructure is a possibility at all the planned renewable energy facilities. However, the cumulative impact on species of conservation concern is expected to be low, given the highly transformed habitat and location of all the projects.

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.
- Measures to control noise and dust should be applied according to current best practice in the industry.

Impact Assessment

Name of Impact	Extent	Duration	Probability	Reversibility of impact	Significance without mitigation	Significance after mitigation
Displacement of priority species due to disturbance associated with decommissioning of the PV facility and associated infrastructure.	Site	Short term	Probable	High	Moderate	Low

Impact on Irreplaceable Resources (*after* mitigation) If yes, please explain	NO. The resources are not irreplaceable. There are no species of conservation concern at the PV site.

Cumulative impact rating (*after* mitigation) If high, please explain	Low. The PV site is highly transformed, which makes it generally unsuitable for species of conservation concern.

RATPAN PV 1

1 DESIGN AND PRE-CONSTRUCTION PHASE

No impacts are expected

2 CONSTRUCTION PHASE

Impact Description

Displacement of priority species due to disturbance associated with construction of the PV plant and associated infrastructure.

Cumulative impact description

There are currently three approved renewable energy projects within a 30km radius around the proposed Mercury Solar Cluster, namely the 75MW Buffels Solar PV 1 Solar Energy Project, the 100MW Orkney PV Solar Energy Project and 132kV powerline, and the Kabi Vaalkop Photovoltaic Facility, Substation and Powerlines. Displacement due to disturbance associated with the construction of the PV dacilities is a possibility at all the planned renewable energy facilities. However, the cumulative impact on species of conservation concern is expected to be low, given the highly transformed habitat and location of all the projects.

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 use should be made of existing access roads and the construction of new roads should be kept to a minimum.
- The mitigation measures proposed by the vegetation specialist must be strictly enforced.
- A 50m buffer zone must be maintained around the pan at -27.061595° 26.839521°

Impact Assessment

Name of Impact	Extent	Duration	Probability	Reversibility of impact	Significance without mitigation	Significance after mitigation
Displacement of priority species due to disturbance	Site	Short term	Probable	High	High	Moderate

Impact on Irreplaceable Resources (*after* mitigation) If yes, please explain	NO. The resources are not irreplaceable. There are no species of conservation concern at the PV site.

Cumulative impact rating (*after* mitigation) If high, please explain	Low. The PV site is highly transformed, which makes it generally unsuitable for species of conservation concern.

Impact Description

Displacement of priority species due to habitat transformation (vegetation clearance and the presence of the solar panels) associated with construction of the PV plant and associated infrastructure.

Cumulative impact description

There are currently three approved renewable energy projects within a 30km radius around the proposed Mercury Solar Cluster, namely the 75MW Buffels Solar PV 1 Solar Energy Project, the 100MW Orkney PV Solar Energy Project and 132kV powerline, and the Kabi Vaalkop Photovoltaic Facility, Substation and Powerlines. Displacement due to habitat transformation associated with the construction of the grid connection and substations is a possibility at all the planned renewable energy facilities. However, the cumulative impact on species of conservation concern is expected to be low, given the highly transformed habitat and location of all the projects.

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 use should be made of existing access roads and the construction of new roads should be kept to a minimum.
- The mitigation measures proposed by the vegetation specialist must be strictly enforced.
- A 50m buffer zone must be maintained around the pan at -27.061595° 26.839521°
- Rehabilitation of vegetation must take place under the guidance of a vegetation specialist after the conclusion of the construction phase.

Impact Assessment

Name of Impact	Extent	Duration	Probability	Reversibility of impact	Significance without mitigation	Significance after mitigation
Displacement of priority species due to habitat transformation	Site	Short term	Probable	High	High	Moderate

Impact on Irreplaceable Resources (*after* mitigation) If yes, please explain	NO. The resources are not irreplaceable. There are no species of conservation concern at the PV site.

Cumulative impact rating (*after* mitigation) If high, please explain	Low. The PV site is highly transformed, which makes it generally unsuitable for species of conservation concern.

3 OPERATIONAL PHASE

Impact Description

Mortality of priority species due to collisions with the solar panels.

Cumulative impact description

There are currently three approved renewable energy projects within a 30km radius around the proposed Mercury Solar Cluster, namely the 75MW Buffels Solar PV 1 Solar Energy Project, the 100MW Orkney PV Solar Energy Project and 132kV powerline, and the Kabi Vaalkop Photovoltaic Facility, Substation and Powerlines. Mortality due to collisions with the solar panels is a possibility at all the planned renewable energy facilities. However, the cumulative impact on species of conservation concern is expected to be low, given the highly transformed habitat and location of all the projects.

Mitigation

No mitigation is required.

Impact Assessment

Name of Impact	Extent	Duration	Probability	Reversibility of impact	Significance without mitigation	Significance after mitigation
Mortality of priority species due to collisions with the solar panels.	Site	Long term	Possible	High	Low	n/a

Impact on Irreplaceable Resources (*after* mitigation) If yes, please explain	NO. The resources are not irreplaceable. There are no species of conservation concern at the PV site.

Cumulative impact rating (*after* mitigation) If high, please explain	Low. The PV site is highly transformed, which makes it generally unsuitable for species of conservation concern. The impact is likely to be insignificant to start with.

Impact Description

Entrapment of birds in the perimeter fence

Cumulative impact description

There are currently three approved renewable energy projects within a 30km radius around the proposed Mercury Solar Cluster, namely the 75MW Buffels Solar PV 1 Solar Energy Project, the 100MW Orkney PV Solar Energy Project and 132kV powerline, and the Kabi Vaalkop Photovoltaic Facility, Substation and Powerlines. Mortality due to entrapment in perimeter fences is a possibility at all the planned renewable energy facilities. However, the cumulative impact on species of conservation concern is expected to be low, given the highly transformed habitat and location of all the projects.

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.
- Use a single perimeter fence if possible, to prevent birds from getting trapped between fences.

Impact Assessment

Name of Impact	Extent	Duration	Probability	Reversibility of impact	Significance without mitigation	Significance after mitigation
Mortality of priority species due to entrapment in the perimeter fences	Site	Long term	Possible	High	Moderate	Low

Impact on Irreplaceable Resources (*after* mitigation) If yes, please explain	NO. The resources are not irreplaceable. There are no species of conservation concern at the PV site.

Cumulative impact rating (*after* mitigation) If high, please explain	Low. The PV site is highly transformed, which makes it generally unsuitable for species of conservation concern.

4 DECOMMISSIONING PHASE

Impact Description

Displacement of priority species due to disturbance associated with decommissioning of the PV facility and associated infrastructure.

Cumulative impact description

There are currently three approved renewable energy projects within a 30km radius around the proposed Mercury Solar Cluster, namely the 75MW Buffels Solar PV 1 Solar Energy Project, the 100MW Orkney PV Solar Energy Project and 132kV powerline, and the Kabi Vaalkop Photovoltaic Facility, Substation and Powerlines. Displacement due to disturbance associated with the dismantling of the PV facility and associated infrastructure is a possibility at all the planned renewable energy facilities. However, the cumulative impact on species of conservation concern is expected to be low, given the highly transformed habitat and location of all the projects.

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.
- Measures to control noise and dust should be applied according to current best practice in the industry.

Impact Assessment

Name of Impact	Extent	Duration	Probability	Reversibility of impact	Significance without mitigation	Significance after mitigation
Displacement of priority species due to disturbance associated with decommissioning of the PV facility and associated infrastructure.	Site	Short term	Probable	High	Moderate	Low

Impact on Irreplaceable Resources (*after* mitigation) If yes, please explain	NO. The resources are not irreplaceable. There are no species of conservation concern at the PV site.

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