Avifaunal Basic Assessment for the proposed Roos Solar Energy Facilities and Grid Infrastructure, Mpumalanga Province

July 2023

For

SiVEST

Natalie Pullen / Phumela Madubela

NatalieP@sivest.com / PhumelaM@sivest.com

Enviro-Insight CC

Sam Laurence *(Pr. Sci. Nat*.)

AE van Wyk (*Cand. Sci. Nat.*)

Lindsay Mandy

info@enviro-insight.co.za

Professional Team

The technical team responsible for the pre-construction monitoring surveys and impact assessment reporting:

Author	Qualification	SACNASP	Role in project
Sam Laurence	MSc Zoology Cand.	*Pr. Sci. Nat.* – 400450/13	Lead avifauna specialist, Field observer, Report compilation
AE Van Wyk	BSc Hons Zoology	*Cand. Sci. Nat. – 125266*	Field technician
Lindsay Mandy	Masters of Arts		Field Technician
Lucas Namanye	*Dip Ed.*	-	Field technician

Specialist Declaration

I, Sam Laurence *Pr. Sci. Nat.,* declare that the work presented in this report is our own and has not been influenced in any way by the developer or the EAP. At no point has the developer asked us as specialists to manipulate the results in order to make it more favourable for the proposed development. We consider ourselves bound to the rules and ethics of the South African Council for Natural Scientific Professions (SACNASP) and the EIA Regulations (2014, as amended). I have the necessary qualifications and expertise (*Pr. Sci. Nat. Zoological Science)* in developing this specialist report.

Sam Laurence *Pr. Sci. Nat.*

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GLOSSARY AND ACRONYMS

BA	Basic Assessment
BARESG	Bird and Renewable Energy Specialist Group
CITES	Convention on International Trade in Endangered Species
Cumulative impact	Impacts on a species, ecosystem or resource as a result of the sum of actions in the past, present and foreseeable future, from multiple WEFs or a WEF in combination with other developments.
CWAC	Coordinated Waterbird Counts, a programme of bird censuses at a number of South African wetlands. See http://cwac.adu.org.za for more information.
DT	Drive Transect
ESKOM	Electricity Supply Commission (ESCOM), established in 1923.
Environmental Impact	The process of identifying environmental impacts due to activities and assessing and reporting these

Assessment (EIA)	impacts
GIS	Geographic Information Systems
GN	General Notice
IBA	Important Bird and Biodiversity Area. Part of a global network of sites that are critical for the long-term viability of bird populations. Now known as Important Bird and Biodiversity Areas.
IBA	Important Bird Area
IUCN	International Union for Conservation of Nature
NFEPA	National Freshwater Ecosystem Priority Areas
PA	Project Area (denotes infrastructure footprint)
PAOI	Project Area of Influence
Preconstruction Phase	The period prior to the construction of a solar energy facility
REF	Renewable Energy Facility (Wind and/or Solar)
Solar Energy related Priority species	Threatened or rare birds (in particular those unique to the region and especially those which are possibly susceptible to solar energy impacts), which occur in the given development area at relatively high densities or have high levels of activity in the area. These species should be the primary (but not the sole) focus of all subsequent monitoring and assessment.
SABAP	The Southern African Bird Atlas Project. A project in which data on bird distribution and relative abundance are collected by volunteers. There have been two SABAP projects; i.e. SABAP1 (completed in 1991) and SABAP2 (started in 2007 and on-going). See http://sabap2.adu.org.za for more information.
SACNASP	South African Council for Natural Scientific Professions
SANBI	South African National Biodiversity Institute
SCC	Species of Conservation Concern
SEA	Strategic Environmental Assessment
SEF	Solar energy facility. A power plant that uses solar radiation to generate electricity, also colloquially known as a solar farm

STC	Strategic Transmission Corridors
TOPS	Threatened or Protected Species Regulations
REDZ	Renewable Energy Development Zones
WT	Walking Transects

1 INTRODUCTION AND PROJECT BACKGROUND

The study area for the proposed Roos Solar PV development located on located on various land parcels in the western part of Mpumalanga, in the Emakhazeni Local Municipality. The total extent of the study area is approximately 324 ha while the development footprint is 271 ha.

The intention is to develop (through one BA process) a 50 MW solar PV facility and associated infrastructure on the property, depending on site sensitivities. The PV and grid infrastructure will be authorized through a single application for Environmental Authorisation (EA).The distinct components are as follows:

- Roos Solar PV Energy Facility
- Roos Electrical Grid Infrastructure

The associated infrastructure would include a BESS, site camp, substation and OHL, and O&M building. Refer to the table below for the key project information. The PV will consist of the following:

Table 1-1: Technical details for the proposed solar cluster to be known as Roos.

PV panels	▪ Mounting: Fixed-tilt PV, single-axis tracking PV or double-axis tracking PV. ▪ Module type: mono- or bi-facial ▪ up to approx. 3.5m PV panels
Access roads	▪ Main site access: Up to 8m, during construction and operation ▪ Internal roads: Approx. 4 - 5m, during construction and operation ▪ Existing roads will be utilised as far as reasonably possible and upgraded where necessary. Upgraded width: Up to 8m.
On-site Substation	▪ Substation will generally be stepping up from 22kV or 33kV to 88kV or 132kV. ▪ Maximum height of on-site substations: up to 10 m ▪ The proposed project will include one on-site substation hub incorporating the facility substation, switchyard, collector infrastructure, battery energy storage system (BESS) and associated O&M buildings.). ▪ Onsite substation size: Up to 4ha (for on-site substation hub)
Construction camp	▪ No construction camps would be developed, and labour would be sourced from nearby areas, as per relevant procurement requirements.
Temporary construction laydown / staging	▪ Temporary Laydown Area: up to approximately 7 ha. ▪ Locations: TBC

area	
Operation and Maintenance (O&M) buildings	▪ All Auxiliary buildings to be developed include, but are not limited to: O&M building, site office, staff lockers, bathrooms, warehouses, etc. ▪ Footprint up to 0.5 ha (i.e., 5000 m^2) Height (m): Up to 10 m
On-site IPP Electrical infrastructure	▪ *"Cables will be laid underground wherever technically feasible, with overhead 33kV lines grouping PV areas to crossing valleys and ridges to get to the on-site substation."* ▪ The proposed project will include one on-site substation hub incorporating the facility substation, switchyard, collector infrastructure, battery energy storage system (BESS) and associated O&M buildings.). ▪ Internal underground lines of up to 33 kV (22kV or 33kV). ▪ Substation will generally be stepping up from 22kV or 33kV to 88kV or 132kV. ▪ Depth (m): Up to 1.5 m
Fencing	▪ Height: Up to 3m ▪ The entire perimeter of the proposed facility will be secured. ▪ Length: TBC ▪ Type: Could be Palisade or mesh or fully electrified.
Boreholes and storage tanks (if applicable)	▪ If required, a 10,000l storage tank may be located on site for water storage.
Battery Energy Storage Systems	▪ Capacity in MWh: Up to 500MW/ 500MWh ▪ Size in hectare - A BESS would be developed within the substation/electrical infrastructure hub footprint, if required. ▪ Height: Up to 8 m ▪ Technology type (i.e.: Li-Ion solid state/Redox flow) Electrochemical Batteries including: a. Lead Acid and Advanced Lead Acid b. Lithium ion, NiCd, NiMH-based Batteries c. High Temperature (NaS, Na-NiCl2, Mg/PB-Sb)

	d. Flow Batteries (VRFB, Zn-Fe, Zn-Br) The BESS would therefore comprise the selected batteries together with chargers, inverters and related equipment.
Estimated number of employment opportunities generated by each PV project	▪ Construction phase: 100 (skills split would be in line with applicable procurement requirements but would be roughly 60% low-skilled, 25% semi-skilled and 15% skilled) ▪ Operational phase: 10 (skills split would be in line with applicable procurement requirements but would be roughly 70% low skilled, 25% semi-skilled and 5% skilled ▪ Decommissioning phase: unknown
Construction: Methodology	▪ The facility would be constructed in the following sequence: 1) Final design and micro-siting of the infrastructure based on topographical conditions and environmental sensitivities, and following obtaining required environmental permits. 2) Vegetation clearance and construction of access roads (where required) 3) Construction of foundations 4) Assembly and erection of infrastructure on site 5) Stringing of inverters 6) Rehabilitation of disturbed areas 7) Continued maintenance
Construction: Duration and start date	Up to 12-18 months, start date is dependent upon award of a bid. Construction activities could take place concurrently.

1.1 SCOPE OF WORK

The main objective is to fully understand and successfully mitigate the possible negative impacts of solar energy production (and associated infrastructure) on the avifauna within the Roos Cluster Project Area of Influence/s (PAOI). This report will provide baseline information to assess avifauna habitat use in a pre-construction (impact) scenario and evaluate the potential impact of the Project SEFs on avifauna (such as collision mortality, displacement due to disturbance, barrier effects and habitat loss).

1.2 STUDY AREA

As the data collection was conducted concurrently for both the proposed Roos SEF and WEF, the study area is described for both of the Renewable Energy Facilities (REFs). The project will be located on various land parcels located in the western part

of Mpumalanga, in the Emakhazeni Local Municipality.

The land parcels for the solar PV facility are listed below:

- Portion 8 of the Farm Wintershoek No 390
- Portion 14 of the Farm Generaalsdraai No 423

The site is located within the Emalahleni Renewable Energy Development Zone (REDZ) but outside the Power Corridor. The PV cluster will be located in the west of the area with an overall 270Ha of the PV development area which should be authorised. The associated infrastructure would include a BESS, site camp, substation and OHL, and O&M Building and a 132kV OHL route.

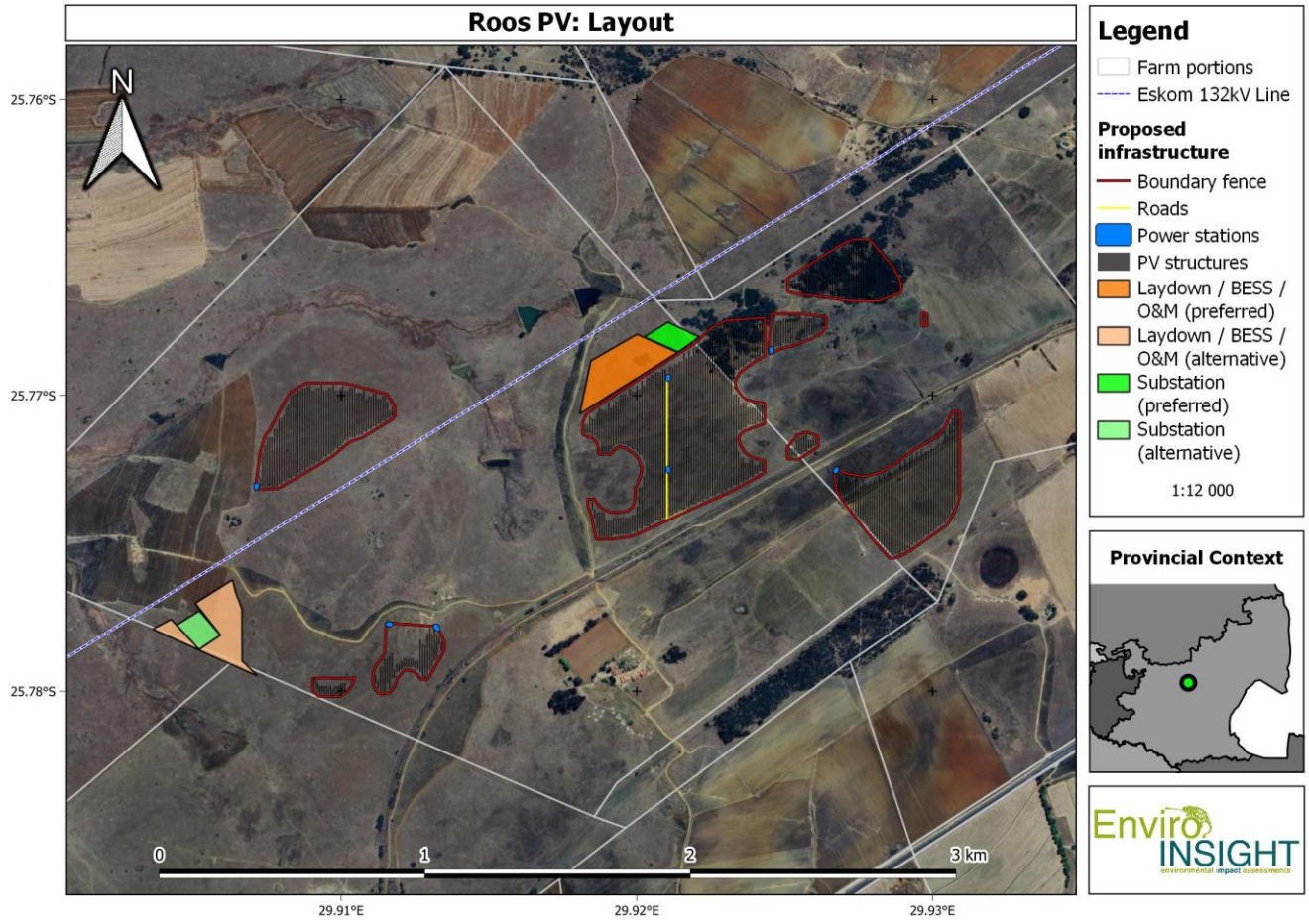

Figure 1-1: Location of the proposed Roos Cluster solar panel array

1.3 STUDY LIMITATIONS & CONSIDERATIONS

- It is assumed that all third-party information acquired is correct (e.g., GIS data, existing facility fatality data and the prescribed scope of work).
- There is still limited information available on the environmental effects of Solar Energy Facilities (SEFs) in South Africa.

- While sampling effort was conducted as recommended in the guidelines, to achieve statistically powerful results it would need to be increased beyond practical possibilities. The data was therefore interpreted using a precautionary approach.
- Walk Transects (WTs), Drive Transects (DTs) and Vantage Point (VP) surveys (carried out for the concurrent WEF but utilising a cross pollination of data) are only conducted during daylight. Therefore, any bird movement occurring at night was recorded under *ad hoc* conditions. Some waterbirds and night migrants are known to make regular flights and migration movements at night.

2 LEGISLATIVE FRAMEWORK

2.1 NATIONAL ENVIRONMENTAL SCREENING TOOL AND ENVIRONMENTAL THEME PROTOCOLS

2.1.1 Screening Report

The Minister of Environment, Forestry and Fisheries, gave notice that the submission of a report generated from the national web-based environmental screening tool[1], as contemplated in Regulation 16(1)(b)(v) of the Environmental Impact Assessment Regulations, 2014, published under Government Notice No. R982 in Government Gazette No. 38282 of 4 December 2014, as amended, will be compulsory from 4 October 2019 when submitting an application for environmental authorisation in terms of regulation 19 and regulation 21 of the Environmental Impact Assessment Regulations, 2014.

In addition, a set of protocols that an applicant needs to adhere to in the Environmental Authorisation (EA) process were developed and on 20 March 2020 the Minister of Forestry, Fisheries and the Environment gazetted the Protocols for national implementation purposes. The gazette '*Procedures to be followed for the Assessment and Minimum Criteria for Reporting of Identified Environmental Themes in terms of Section 24(5)(a) and (h) of the National Environmental Management Act (1998) when Applying for Environmental Authorisation*', has protocols that have been developed for environmental themes which include agriculture, avifauna, biodiversity (Terrestrial and Aquatic Biodiversity), noise, defence and civil aviation.

The protocols set requirements for the assessment and reporting of environmental impacts of activities requiring EA. The higher the sensitivity rating of the features on the proposed site as identified by the screening tool report, the more rigorous the assessment and reporting requirements. bird species sensitive to solar energy developments.

Based on the environmental screening tool reports generated for the report, (Figure 2-1,Figure 2-2), the Animal Combined Sensitivity Theme is indicated as a combination of Medium and **High** sensitivity in areas that are said to contain the following Sensitivity Feature(s).

- High Aves-*Geronticus calvus* (Southern Bald Ibis)
- High Aves-*Balearica regulorum* (Southern Grey Crowned Crane)
- High Aves- *Sagittarius serpentarius* (Secretary Bird)
- Medium Aves-*Eupodotis senegalensis* (White-bellied Bustard)
- Medium Aves-*Sagittarius serpentarius* (Secretary Bird)

[1] https://screening.environment.gov.za/screeningtool/#/pages/welcome

- Medium Aves- *Balearica regulorum* (Southern Grey Crowned Crane)

Due to the error in outputs (related specifically to SEF developments) and the coarse spatial scale of the tool as well as the presence of other Species of Conservation Concern (SCC), the overall theme was treated as High Sensitivity. The Screening Report clearly ignored the consistent and seemingly high (regional) density of Martial Eagles and wetland associates such as African Marsh Harrier, Southern Grey Crowned Crane, Blue Crane, Greater and Lesser Flamingo and various stork species (Yellow-billed, White and Black Storks).

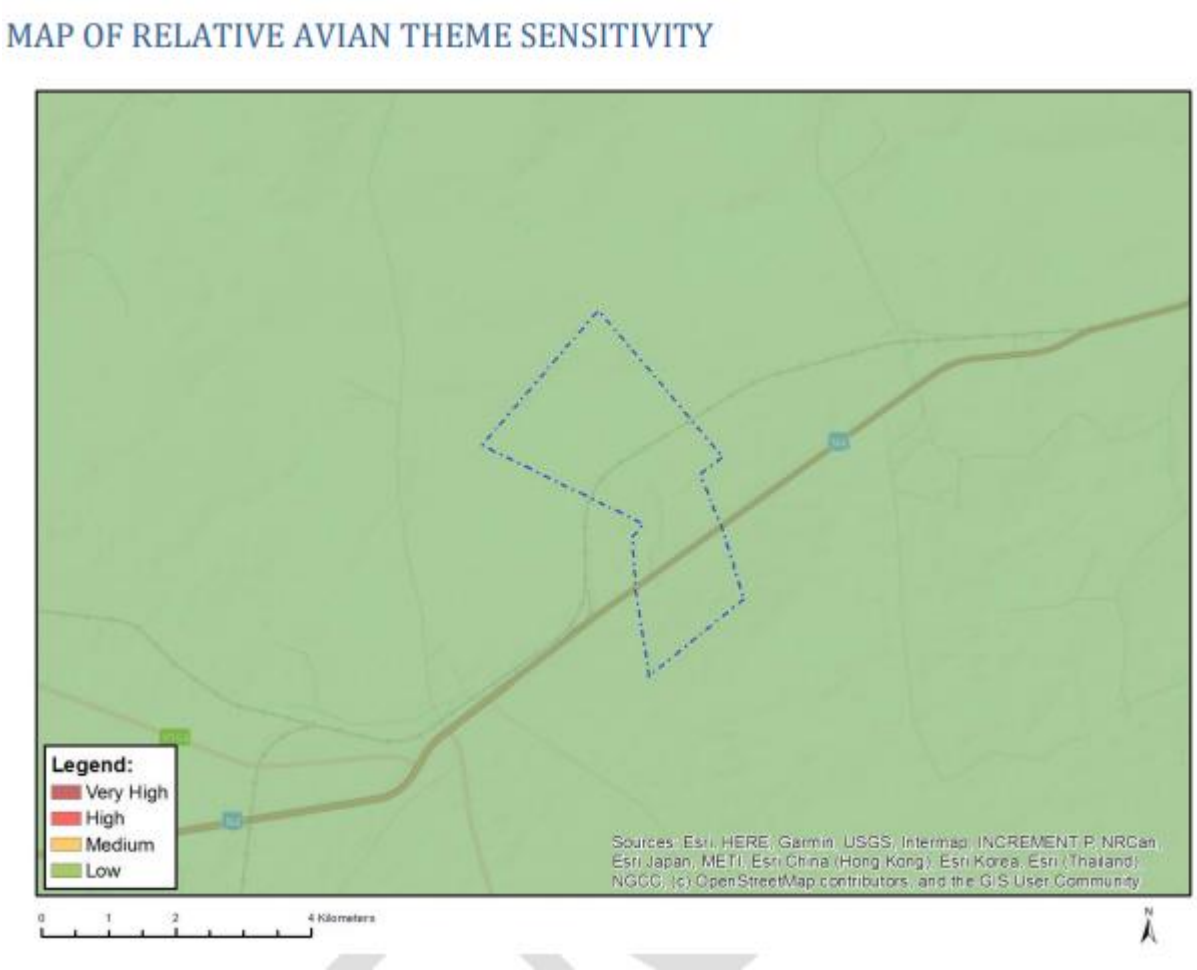

Figure 2-1: Environmental Screening Tool avifaunal sensitivity theme map the proposed Roos SEF Clusters.

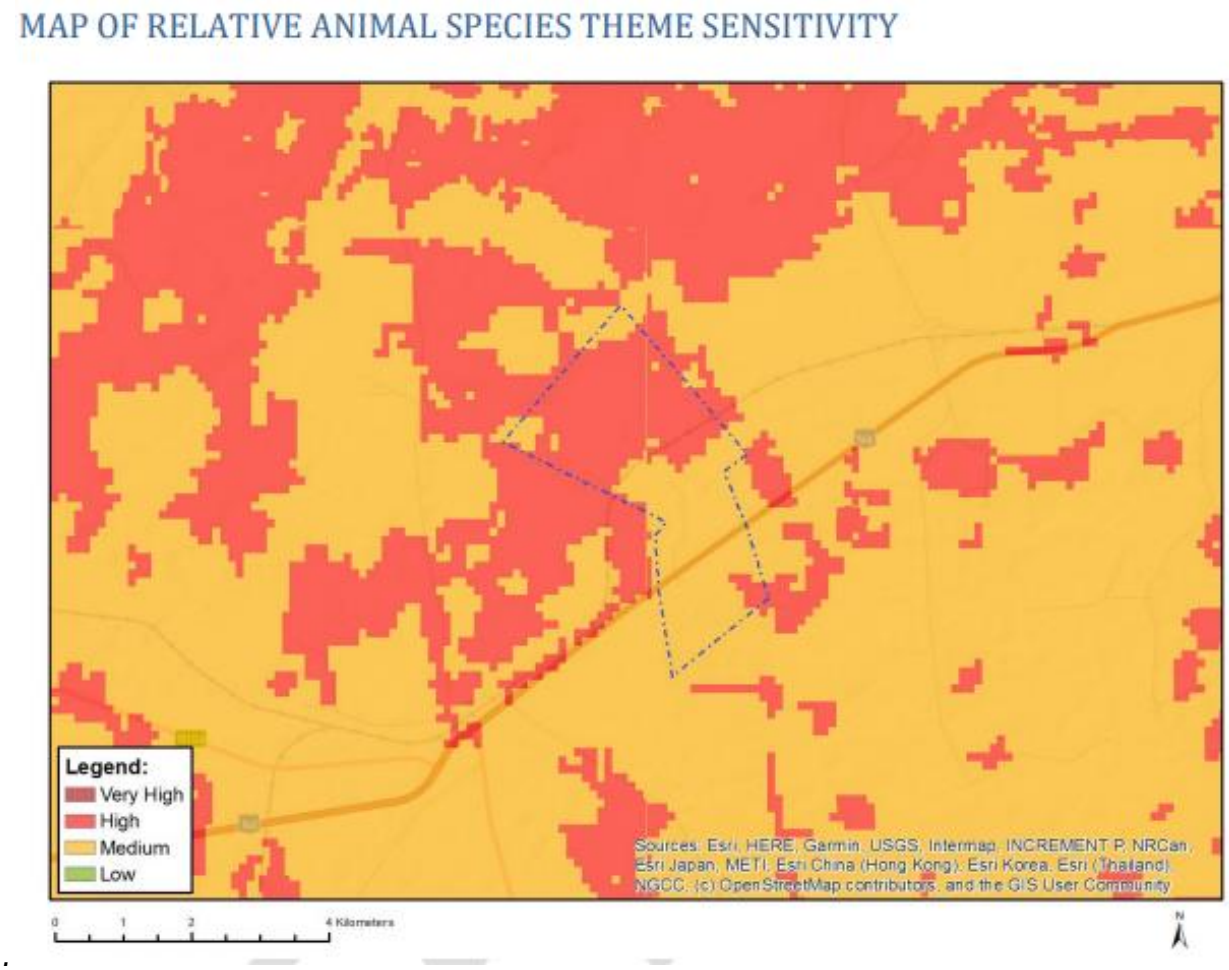

Figure 2-2: Environmental Screening Tool animal sensitivity theme map the proposed Roos SEF Clusters.

2.2 RENEWABLE ENERGY DEVELOPMENT ZONE

On 17 February 2016, Cabinet approved the Renewable Energy Development Zones (REDZs) for large scale solar and associated Strategic Transmission Corridors (STC) which support areas where long term electricity grid will be developed. The procedure to be followed in applying for EA for a large-scale project in a REDZ or in a Power Corridor was formally gazetted on 16 February 2018 in GN113 and GN114. On 17 July 2020, Minister Barbara Dallas Creecy, published Government Gazette 43528, Notice 786 for consultation with the intention to identify three additional Renewable Energy Development Zones to the eight Renewable Energy Development Zones published under Government Notice No. 114 in Government Gazette No. 41445 of 16 February 2018. REDZs are also aligned with the powerline corridors that were identified in the Electricity Grid Infrastructure SEA completed in 2016 and gazetted as powerline corridors in February 2018. In this way, the combination of the REDZs and power corridors provides strategic guidance to ESKOM on where to prioritise investment in grid infrastructure. The project is located within Renewable Energy Development Zones (REDZ) and accordingly, a Basic Assessment (BA) process was followed.

2.3 BIRDS AND SOLAR ENERGY BEST-PRACTICE GUIDELINES (2017)

The "*Best-Practice Guidelines for assessing and monitoring the impact of solar energy facilities on birds in southern Africa*" (Jenkins *et al*., 2017) are followed in order to fulfil the outlined requirements (steps in red represent the correct steps due to the location of the project within a REDZ).

As per Appendix 2 - *Minimum requirements for avifaunal impact assessment*, an avifaunal impact assessment for a SEF should follow a two-tier process:

1. **Scoping report**- process to identify issues that are likely to be important in the impact assessment process and to define the scope of work required in the assessment (e.g. timing, spatial extent and data collection methodologies). Largely based on desktop analysis of available data, but preferably also informed by a brief site visit.
2. **Preliminary assessment** – This is part of the planning for the EIA application, giving an overview on the biological context, likely impacts and potential red flags to the development, identifying alternatives and determining the appropriate assessment regime.
3. **In-depth Study** – Could including structured and repeated data collection on which to base the impact assessment report and provide a baseline against which post-construction monitoring can be compared.
4. **Impact assessment** - Informed by the data collected during the preliminary assessment.

3 METHODS

3.1 GIS

Existing data layers were incorporated into a GIS to establish how the proposed SEF layout and associated activities interact with important terrestrial entities. Emphasis was placed on the following spatial datasets:

- Vegetation Map of South Africa, Lesotho and Swaziland (SANBI, 2018);
- NFEPA wetlands and rivers (CSIR 2011);
- Technical Report for the Mpumalanga Biodiversity Sector Plan (MBSP 2015);
- Important Bird Areas (IBAs) (Marnewick *et al.*, 2015); and
- GIS layers provided by the client.

All mapping was performed using open-source GIS software (QGIS[2]).

3.2 DESKTOP AND LITERATURE SURVEY

Prior to the initiation of field surveys, a desktop survey was conducted to consider the best information available, in order to provide a better evaluation of all conditions present within the study area. An initial literature review was undertaken to assess which bird species could potentially occur in the vicinity of the proposed SEF using data from the second South African Bird Atlas Project (SABAP 2[3]; [SABAP2, 2021]). SABAP 2 records were developed based on records per pentad (i.e., 5' X 5'). A list of species potentially occurring was developed from SABAP 2 data for the pentads within which the study area falls (2540_2945, 2540_2950, 2540_2955, 2540_3000, 2545_2945, 2545_2950, 2545_2955, 2545_3000, 2550_2945, 2550_2950,2550_2955, 2550_3000, (Figure 3-1). The expected species list (Appendix 1) is therefore based on an area larger than the actual study area and was therefore subsequently refined. This approach was adopted to ensure that all species potentially occurring within the study area, whether resident, nomadic, or migratory, are identified. Species were considered sensitive because of their abundance, flight characteristics, ecological role, population trend and conservation status. A preliminary list of focal species impacts for this study area was compiled based on existing Avifaunal Environmental Impact Assessment and post-construction fatality monitoring reports for similar projects in the region the area and supplemented with sensitive species identified in the previous steps.

The following main literature sources have been consulted for the avifauna study:

- Information relating to avifauna species of conservation concern (SCC) was obtained from Taylor *et al.* (2015) and the IUCN Red List of threatened species (IUCN, 2022);
- del Hoyo *et al.* (1992) and Hockey *et al.* (2005) were consulted for general information on the life history attributes of relevant bird species;

[2] http://qgis.osgeo.org/en/site/
[3] http://sabap2.birdmap.africa/

- Distributional data (apart from those obtained during the surveys) was sourced from the Southern Africa Bird Atlas Project (SABAP 2, 2021), del Hoyo *et al.* (1992) and Sinclair & Ryan (2010); and
- Nomenclature and taxonomy followed the IOC World Bird Names unless otherwise specified (see www.worldbirdnames.org; Gill & Donsker, 2019).

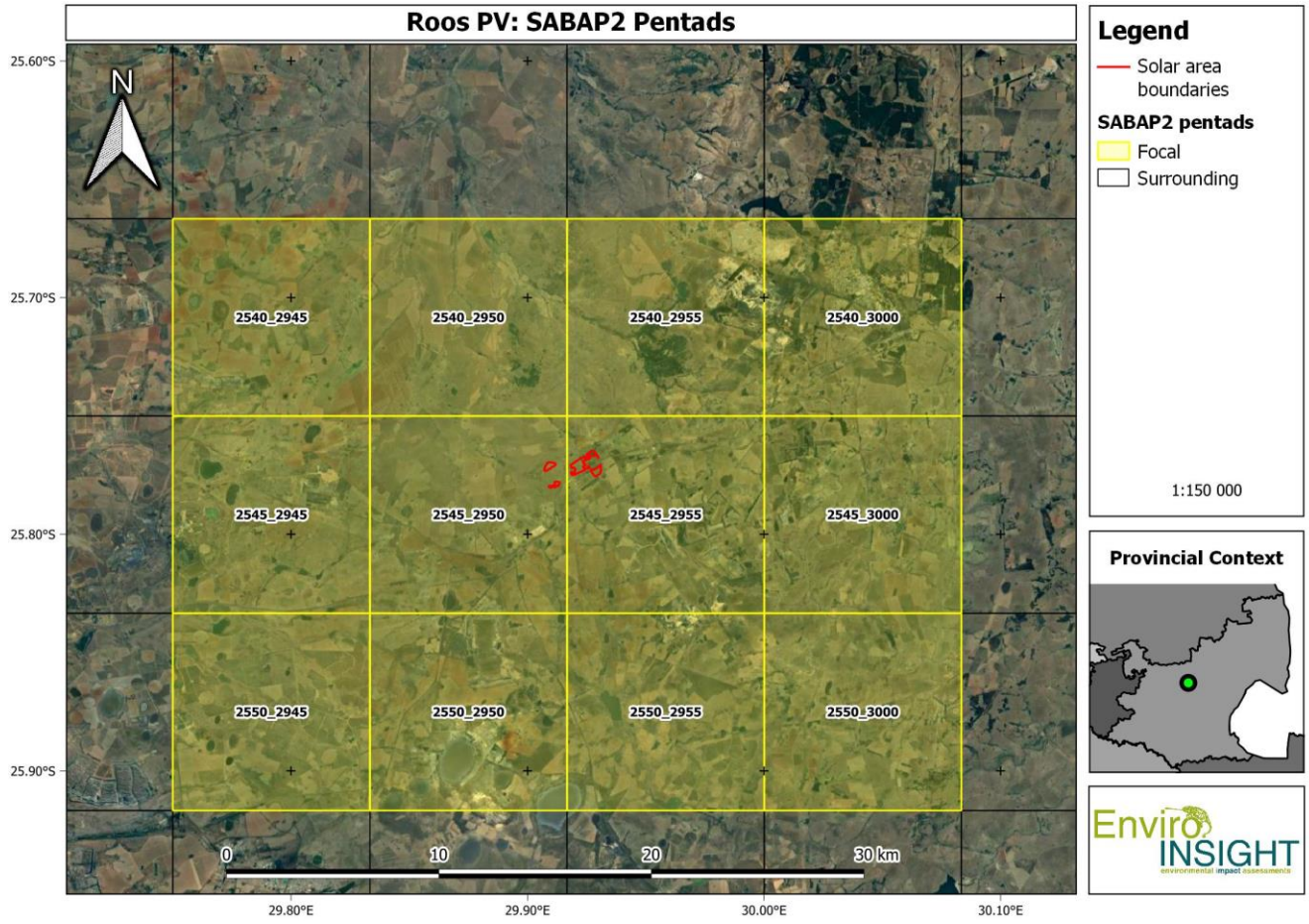

Figure 3-1: The proposed Roos Cluster SEFs in relation to the SABAP2 pentads.

3.3 PRECONSTRUCTION BIRD MONITORING SURVEY DESIGN

They proposed study area is classified as a Regime 2 based on the size of the study area (>150 ha), some high (animal) avifaunal sensitivity and type of technology that will be used for the proposed project. The avifaunal sensitivity was determined based on the number of priority species occurring, or potentially present, within or around the study area, the regional or globally threat status of these species, avifaunal habitat found in the area, population of priority species, bird movement corridor and proximity to Important Bird and Critical Biodiversity Areas. The field surveys were arranged so that the study area and control sites were surveyed for a total of 6 months (covering two seasons and supplementary surveys) and were completed in June 2023. This complies with the requirements of the Best Practice Guidelines available at the time (Jenkins *et al.* 2015). The preconstruction monitoring programme has included a total of two visits to the PA, with a further survey within an immediately

adjoining survey area for another application, resulting in three (3) surveys undertaken within the PAOI, covering the study area through a six-month period that included the summer, autumn and winter seasons of the (non-calendar) year. For the purposes of this report, the data used was from the surveys conducted as per the minimum requirements per season/ dates are summarised in Table 3-1 below.

Table 3-1: Avifauna monitoring sampling period for the proposed Roos SEF Clusters.

Date	Season	Methodology applied
6-9 March 2023	Summer- Autumn	DT, WT, WB, NE
9-12 June 2023	Autumn-Winter	VDT, WT, WB, NE
March 2023	Summer -	Supplementary data collection from a concurrent survey

*** WT – Walked transects; DT – Drive transects; NE – Nest searches, inspection and monitoring; WB – Water body inspections.**

3.3.1 Walked Transects

This method is utilised to monitor all birds, especially less obvious smaller bird species within the major habitat types within a study area. Transects were positioned at varying distances away from the proposed panel arrays (see Figure 3-2) to maximise the comparative value of the data which will be compared with the surveys from the post-construction phase results.

Four linear transects ranging from 500 m to 1.2 km in length (3.3 km total), were walked in order to characterize the passerine and small bird communities (Table 3-2). These transects are representative of the biotopes present within the study area. To avoid pseudo-replication, transects were located at a minimum distance of 400 m apart from one another (Sutherland, 2006). Each transect was conducted by one expert bird observer at a time (more than one observer for all transects were used), who recorded all bird contacts (both seen and heard) by walking slowly along the predetermined transect. Observations were made on both the left and right side of the predetermined transect. Birds were only recorded (seen or heard) within a fixed maximum width of between 150 to 100 m on either side if the transect line. The same transects were repeated in every season. Surveys started after sunrise and were performed throughout the day to account for temporal variation in bird activity.

As a general rule, transects were not walked in adverse conditions, such as heavy rain, strong winds or thick mist. During the surveys, no adverse conditions were recorded that precluded successful analysis. The combined (across season) Index of Kilometric Abundance (IKA = birds/km) was calculated for each priority species observed.

Table 3-2: Walk transect lengths and total length.

Name	length (m)
WT1	1173
WT2	734
WT3	523
WT4	796
Total	3226

Driven Transect

Large terrestrial birds (e.g., cranes, storks, Secretarybirds. korhaans, bustards) and most raptors cannot be adequately surveyed using walked transects. Populations of such birds should be estimated on each visit to the PA by means of road counts (vehicle-based sampling; best applied for relatively large proposed SEFs, especially those with good networks of roads and tracks).

Road counts of large terrestrial birds and raptors require that one or a number of driven transects be executed (depending on site size, terrain and infrastructure), comprising one or a number of set routes, limited by the existing roadways but as far as possible directed to include a representative cross section of habitats within the PAOI.

These transects were driven at a constant and slow speed (± 15 km/h), and all sightings of large terrestrial birds and raptors were recorded in terms of the same data-capture protocols used for walked transects (above), and in general compliance with the road-count protocols described for large terrestrial species (Young *et al.*, 2003) and raptors (Malan, 2009). Seven drive transects were identified in the PA and one drive transect in the control area with a combined total length of 6.6 km (Figure 3-2; Table 3-3). One observer travelling slowly in a vehicle recorded all species on both sides of the drive transect. The observer stopped at regular intervals (every 100 m) to scan the surrounding environment with binoculars. The combined (across season) Index of Kilometric Abundance (IKA = birds/km) was calculated for each priority species observed.

Table 3-3: Drive transects lengths and total length.

Name	length (m)
DT1	2628
DT2	3955
Total	6583

3.3.2 Wetlands

Prior to the initiation of the preconstruction monitoring campaign, the main water bodies (including wetlands) present within the PA were identified on a Geographical Information System (GIS) by using 1:50 000 topographic maps and aerial photos. Several significant water bodies were identified on and surrounding the PA. These identified and mapped water bodies were surveyed to determine their level of utilisation by water birds and water associated Priority Species.

3.3.3 Specialist Nest Survey

Any habitats within the PAOI of the proposed SEF, or equivalent habitats around the PA, deemed likely to support nest sites of key raptor and other species of conservation concern (SCC), including power lines, stands of large trees, marshes and drainage lines, were surveyed. All potential breeding sites, once identified fully, were mapped, and checked during each survey to confirm occupancy, and all evidence of breeding and the outcomes of such activity, where possible, recorded.

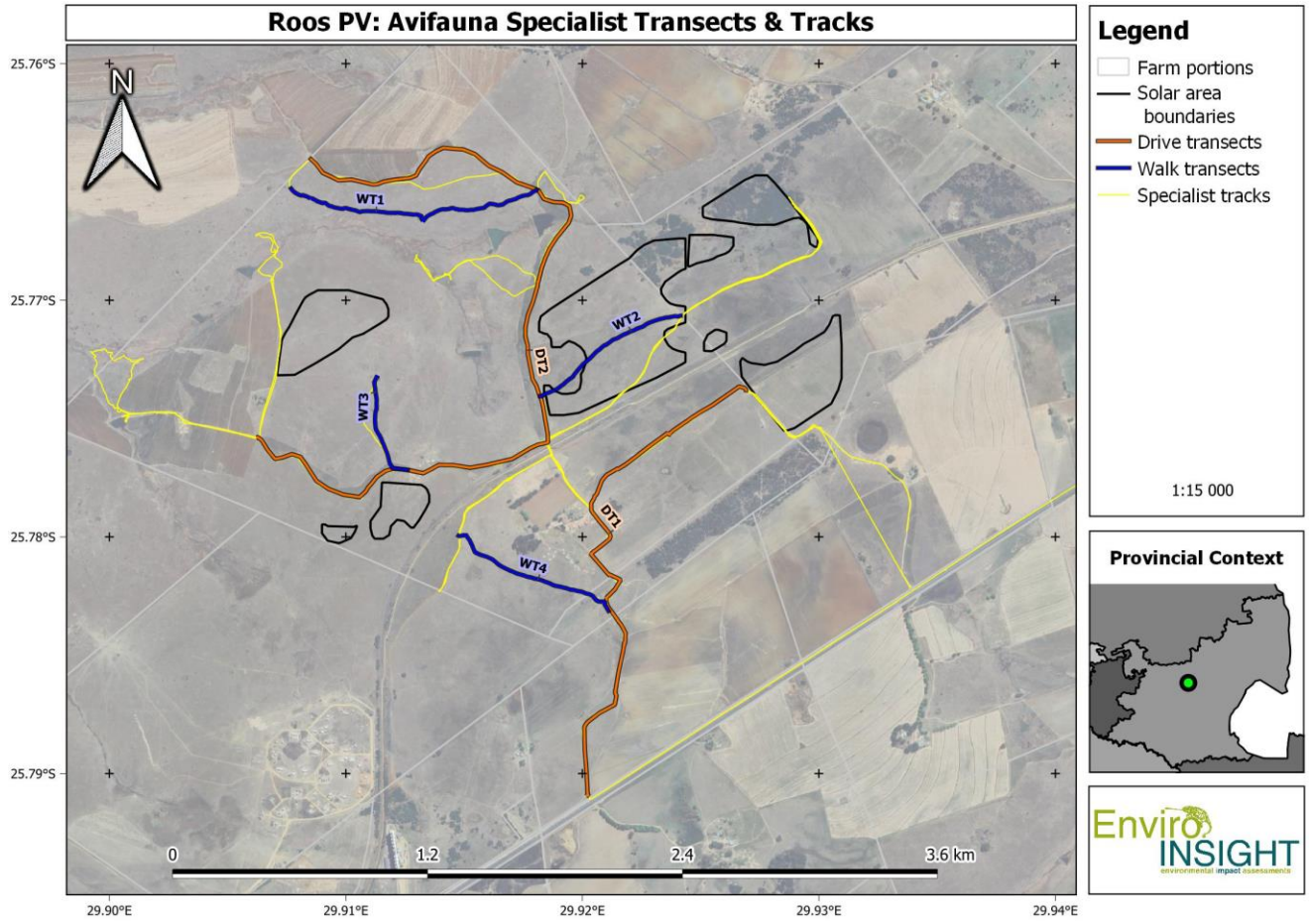

Figure 3-2: Avifauna survey sites and specialist coverage (GPS tracks as well as field of view) for the proposed Roos SEF Cluster.

3.3.4 Incidental Observations of Priority Species

All other sightings of priority species (and particularly those suggestive of breeding or important feeding or roosting sites or flight paths) in the PA and control site as well as within the PAOI were recorded, along with additional relevant information such as habitat type, abundance, habits and weather data. These observations were used as complementary data to characterise the bird community and its utilisation of the PA, as recommended by the Best Practice Guidelines (Jenkins *et al.*, 2015).

3.4 SPECIES OF CONSERVATION CONCERN

The Red List of threatened species generated by the IUCN (http://www.iucnredlist.org/) provided the global conservation status of avifauna. However, Taylor *et al.* (2015) produced a regional conservation status assessment following the IUCN criteria which was used for this report. The first three categories i.e., Critically Endangered, Endangered and Vulnerable, are collectively called 'threatened' species or Species of Conservation Concern (SCC).

The conservation status categories defined by the IUCN, which are considered here to represent SCC, are defined as follows:

- **Critically Endangered (CR)** - Critically Endangered refers to species facing immediate threat of extinction in the wild.
- **Endangered (EN)** - Endangered species are those facing a very high risk of extinction in the wild within the foreseeable future.
- **Vulnerable (VU)** - Vulnerable species are those facing a high risk of extinction in the wild in the medium-term.
- **Near Threatened (NT)** - any indigenous species which does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.

The National Environmental Management: Biodiversity Act (Act 10 of 2004) (NEMBA) provides for listing threatened or protected ecosystems, in one of four categories: critically endangered (CR), endangered (EN), vulnerable (VU) or protected. NEMBA also deals with endangered, threatened and otherwise controlled species, under the Threatened or Protected Species Regulations (ToPS). A ToPS permit is required for any activities involving the removal or destruction of any ToPS-listed species.

Protected species: any species which is of such high conservation value or national importance that it requires national protection. Species listed in this category include, among others, species listed in terms of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

3.4.1 Flagship species for the region

Flagship species are defined as species that may be highly conspicuous, readily identifiable, of high conservation value (SCC), of high tourism value or are endemic to the region. The Mpumalanga Province hosts significant populations of grassland, wetland and synanthropic-adapted large terrestrial birds which have been recorded (and are expected) within the PAOI such as Black Stork, White Stork, African Marsh Harrier, Denham's Bustard, White Bellied Bustard, Blue Crane, Southern Grey Crowned Crane, and Blue Korhaan. Additional "flagship" bird species include Martial Eagle, Tawny Eagle, Lanner Falcon, Bald Ibis, Verreaux's Eagle, Secretary Bird, with increasingly frequent incursions within the PAOI from species such as Cape Vulture (regional and adjacent sightings).

3.5 SENSITIVE HABITAT DELINEATION & SEI

3.5.1 Determination of Significance of Impacts

Significance is determined through a synthesis of impact characteristics which include context and intensity of an impact. Context refers to the geographical scale (i.e., site, local, national or global), whereas intensity is defined by the severity of the impact e.g., the magnitude of deviation from background conditions, the size of the area affected, the duration of the impact and the overall probability of occurrence. Significance is calculated as shown in Table 3-4.

Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The total number of points scored for each impact indicates the level of significance of the impact.

3.5.2 Impact Rating System

The impact assessment must take account of the nature, scale and duration of effects on the environment and whether such

effects are positive (beneficial) or negative (detrimental). Each issue / impact is also assessed according to the various project stages, as follows:

- Planning;
- Construction;
- Operation; and
- Decommissioning.

Where necessary, the proposal for mitigation or optimisation of an impact should be detailed. A brief discussion of the impact and the rationale behind the assessment of its significance has also been included.

3.5.3 Rating System Used to Classify Impacts

The rating system is applied to the potential impact on the receiving environment and includes an objective evaluation of the possible mitigation of the impact. Impacts have been consolidated into one (1) rating. In assessing the significance of each issue the criteria (including an allocated point system) as indicated in Table 3-4 is used.

Table 3-4: Rating of impacts criteria.

ENVIRONMENTAL PARAMETER		
A brief description of the environmental aspect likely to be affected by the proposed activity (e.g. Vegetation cover).		
ISSUE / IMPACT / ENVIRONMENTAL EFFECT / NATURE		
Include a brief description of the impact of environmental parameter being assessed in the context of the project. This criterion includes a brief written statement of the environmental aspect being impacted upon by a particular action or activity (e.g. oil spill in surface water).		
EXTENT (E)		
This is defined as the area over which the impact will be expressed. Typically, the severity and significance of an impact have different scales and as such bracketing ranges are often required. This is often useful during the detailed assessment of a project in terms of further defining the determined.		
1	Site	The impact will only affect the site
2	Local/district	Will affect the local area or district
3	Province/region	Will affect the entire province or region
4	International and National	Will affect the entire country
PROBABILITY (P)		
This describes the chance of occurrence of an impact		
1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
2	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).
3	Probable	The impact will likely occur (Between a 50% to 75% chance of occurrence).
4	Definite	Impact will certainly occur (Greater than a 75% chance of occurrence).
REVERSIBILITY (R)		
This describes the degree to which an impact on an environmental parameter can be successfully reversed upon completion of the proposed activity.		
1	Completely reversible	The impact is reversible with implementation of minor mitigation measures
2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible and no mitigation measures exist.
IRREPLACEABLE LOSS OF RESOURCES (L)		
This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.		

1	No loss of resource.	The impact will not result in the loss of any resources.
2	Marginal loss of resource	The impact will result in marginal loss of resources.
3	Significant loss of resources	The impact will result in significant loss of resources.
4	Complete loss of resources	The impact is result in a complete loss of all resources.

DURATION (D)

This describes the duration of the impacts on the environmental parameter. Duration indicates the lifetime of the impact as a result of the proposed activity.

The summation of the different criteria will produce a non-weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.

Points	Impact Significance Rating	Description
5 to 23	Negative Low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
5 to 23	Positive Low impact	The anticipated impact will have minor positive effects.
24 to 42	Negative Medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
24 to 42	Positive Medium impact	The anticipated impact will have moderate positive effects.
43 to 61	Negative High impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
43 to 61	Positive High impact	The anticipated impact will have significant positive effects.
62 to 80	Negative Very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
62 to 80	Positive Very high impact	The anticipated impact will have highly significant positive effects.

3.6 SITE ECOLOGICAL IMPORTANCE (SEI)

The Terrestrial Plant Species Protocol requires specialists to identify:

- the nature and the extent of the potential impact of the proposed development on SCC occurring on the proposed development site;
- the potential impact of the proposed development on the habitat of the SCC; and
- any alternative development footprints within the preferred development site which would be of 'low' sensitivity as identified by the screening tool and verified through the site sensitivity verification.

While most of the features that will be included in the conservation importance (CI) will be provided by the screening tool, it is important to note that CI is evaluated at a **much finer spatial scale** and based on fieldwork data collection and comprehensive desktop analyses performed by the specialist during the Environmental Authorisation (EA) process.

SEI is a function of the biodiversity importance (BI) of the receptor (e.g., SCC, the vegetation/fauna community or habitat type present on the site) and its resilience to impacts (receptor resilience [RR]) as follows: SEI = BI + RR

BI in turn is a function of CI and the functional integrity (FI) of the receptor as follows: BI = CI + FI

As BI is a function of CI and the FI of a receptor, BI can be derived from a simple matrix of CI and FI as follows:

Biodiversity importance		Conservation importance				
		Very high	High	Medium	Low	Very low
Functional integrity	Very high	Very high	Very high	High	Medium	Low
	High	Very high	High	Medium	Medium	Low
	Medium	High	Medium	Medium	Low	Very low
	Low	Medium	Medium	Low	Low	Very low
	Very low	Medium	Low	Very low	Very low	Very low

From the successful evaluation of both BI and RR as described above, it is possible to evaluate SEI from the final matrix as follows:

Site ecological importance		Biodiversity importance				
		Very high	High	Medium	Low	Very low
Receptor resilience	Very low	Very high	Very high	High	Medium	Low
	Low	Very high	Very high	High	Medium	Very low
	Medium	Very high	High	Medium	Low	Very low
	High	High	Medium	Low	Very low	Very low
	Very high	Medium	Low	Very low	Very low	Very low

The SEI in relation to proposed development activities can be interpreted as follows:

- **Very High:** Avoidance mitigation – no destructive development activities should be considered. Offset mitigation not acceptable/not possible (i.e. last remaining populations of species, last remaining good condition patches of ecosystems/ unique species assemblages). Destructive impacts for species/ecosystems where persistence target remains.
- **High:** Avoidance mitigation wherever possible. Minimisation mitigation – changes to project infrastructure design to limit the amount of habitat impacted; limited development activities of low impact acceptable. Offset mitigation may be required for high impact activities.
- **Medium:** Minimisation and restoration mitigation – development activities of medium impact acceptable followed by appropriate restoration activities.
- **Low:** Minimisation and restoration mitigation – development activities of medium to high impact acceptable followed by appropriate restoration activities.
- **Very Low:** Minimisation mitigation – development activities of medium to high impact acceptable and restoration activities may not be required.

For a full breakdown of the SEI methodology please refer to SANBI V3.1 (2020).

4 RESULTS

4.1 REGIONAL VEGETATION

The study area is located in the Steenkampsberg Montane Grassland Gm30 and Endangered Eastern Highveld Grassland Gm12 (Mucina & Rutherford, 2006 – as amended) (**Error! Reference source not found.**).

Steenkampsberg Montane Grassland (Gm30)

Distribution: Occurring along the Steenkampsberg escarpment that extends from the headwaters of the Waterval River in mountains north-west of Lydenburg, extending southwards through Dullstroom towards Belfast, then eastwards through Machadodorp to Bambi and Elandshoogte.

Vegetation & Landscape features: The landscape is mountainous, with plateau grasslands, mountain slopes and shallow valleys. Grasslands are short with high forb diversity. The highest point in Mpumalanga (2330 m) occurs just north of the Steenkampsberg Pass.

Climate: Climate is a seasonally arid temperate region with hot summers and cool and dry winters. Frost is common during the winter months. Mist is infrequent during summer. Compared to the Long Tom Pass Montane Grasslands, the Steenkampsberg experiences lower winter temperatures due to its overall higher altitude, as well its more inland position, more distant from the buffering effects of the warmer climate of the eastern subtropical Lowveld. It also receives significantly less mist during summer than does the Long Tom Pass Montane Grassland.

Geology & soils: The geology broadly forms part of the Pretoria Group, with the Dullstroom, Steenkampsberg, Lakenvlei, Vermont, Magaliesberg, Silverton, Strubenkop, Daspoort, Hekpoort, and Timeball Hill Formations running from the west through to the east. The Pretoria Group is commonly intersected by the intrusive Transvaal Diabase in the form of dykes and sills. The resulting rocks are predominantly comprised of quartzite, shale, dolerite, diabase and basalt.

Soils are shallow to deep, well-drained; either dystrophic and/or mesotrophic, depending on geology. Soil derived from quartzite results in sandy, white dystrophic soils with high humus content.

Conservation: Much of this unit is still natural (74.7%), although some parts have been afforested (14%) or cultivated (4%) with crops such as maise and, to a lesser extent, peach orchards. As much as 6% of this is comprised of old abandoned cultivated lands. Mining is a threat (0.25%) as this unit overlies considerable mineral wealth. This unit is poorly protected as only 12.4% of its national target of 27% is formally protected.

Remarks: A floristic analysis of the vegetation along the Mpumalanga escarpment supports the recognition of a new centre of plant endemism (Lydenburg Centre) with the proposal of two subcentres of plant endemism, namely the Long Tom Pass Subcentre and the Steenkampsberg subcentre. The Steenkampsberg subcentre has at least 15 endemic taxa.

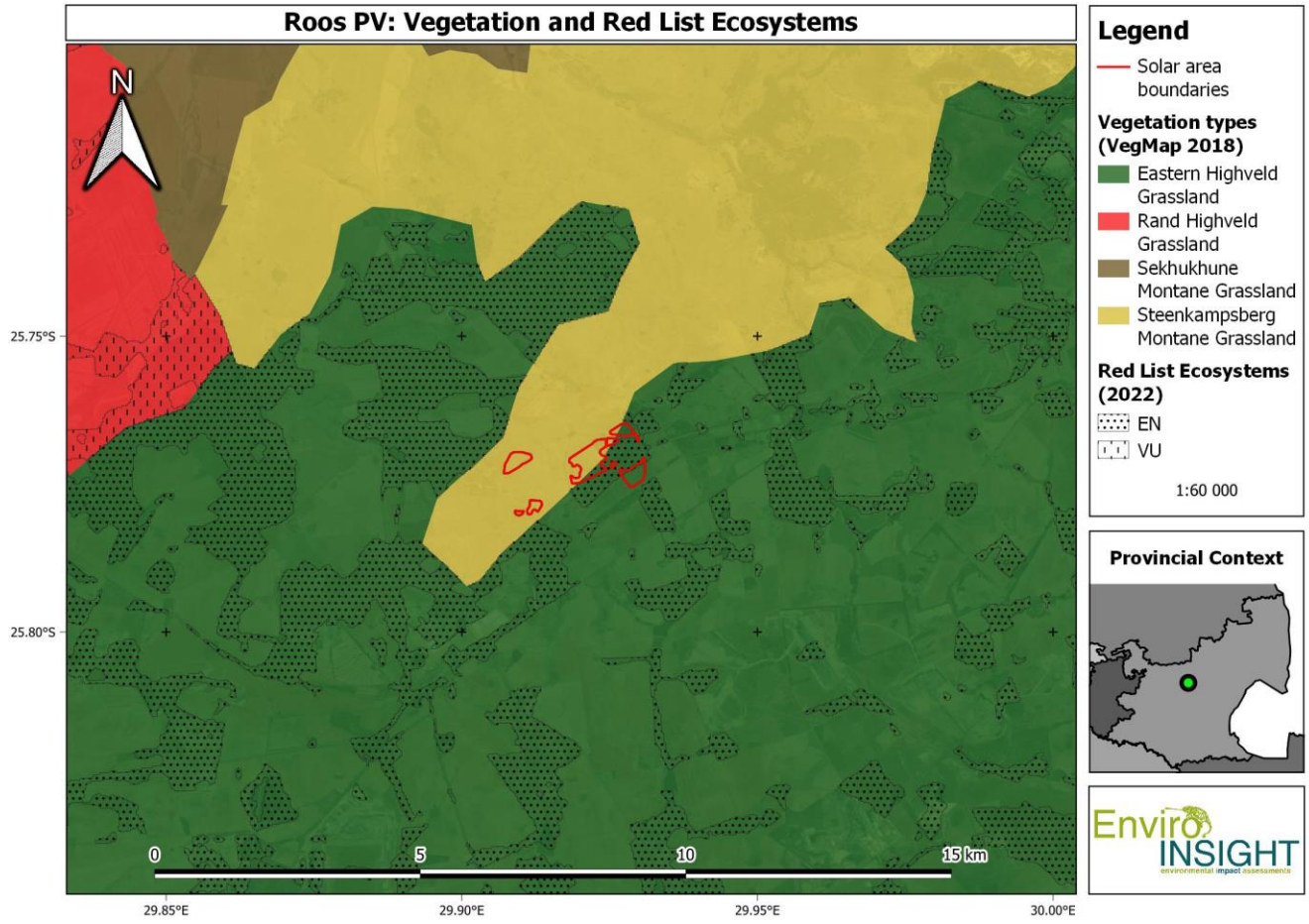

Figure 4-1: The proposed Roos Energy Facility Cluster (SEF boundary) in relation to major vegetation types (SANBI, 2018) and aquatic habitats.

Eastern Highveld Grassland (Gm12)

National land cover data show that Eastern Highveld Grassland has experienced extensive spatial declines of approximately 70% since 1750. It accordingly has a threat status of Endangered and A3 listing criterion based on the 2021 Revised National List of Ecosystems that are Threatened or in need of Protection.

Distribution: The Eastern Highveld Grassland is recorded on the plains between Belfast in the east and the eastern side of Johannesburg in the west, extending southwards to Bethal, Ermelo and west of Piet Retief within the Mpumalanga and Gauteng Provinces of South Africa (Mucina & Rutherford; 2006). The altitude varies between 1 520 and 1 780m, but also as low as 1 300m.

Vegetation & Landscape features: The Eastern Highveld Grassland is found on slightly to moderately undulating plains, including some low hills and pan depressions and consist of short, dense grassland, dominated by the usual Highveld grass composition (*Aristida, Digitaria, Eragrostis, Themeda, Tristachya*, etc.) with small, scattered rocky outcrops with wiry, sour grasses and some woody species (Mucina & Rutherford; 2006). Woody species include *Senegalia caffra, Celtis africana, Diospyros lycioides subsp. lycioides, Parinari capensis, Protea caffra and Searsia magalismontana*.

Geology & Soils: The area is characterised by red to yellow sandy soils of Ba and Bb land types found on shales and sandstones of Madzaringwe formation (Karoo Super group), which are prominent throughout the *Eastern Highveld Grassland* (Mucina & Rutherford, 2006).

The soils of this Eastern Highveld Grassland consist of yellow sandy soils of the Ba (30%) and Bb (65%) land types found on shale and sandstone of the Karroo Supergroup.

Climate: Eastern Highveld Grassland is characterised by strongly seasonal summer rainfall, with very dry winters. The Mean Annual Precipitation (MAP) is between 650-900 mm (overall average: 726 mm), MAP is relatively uniform across most of this unit, but increases significantly in the extreme southeast. The coefficient of variation in MAP is 25% across most of the unit, but drops to 21% in the east and southeast. Incidences of frost form (13-42 days) have been recorded, but increase at higher elevations (Mucina & Rutherford, 2006).

The Mean Annual Soil Moisture Stress (MASMS) value for the region is 73%. These values, when compared to the MAT and MAPE averages of 14.7°C and 1,926mm, respectively, show the region to be a relatively water-stressed area. Conservation of surface (and ground) water resources is therefore imperative to biodiversity conservation within the region.

Conservation: The Eastern Highveld grassland is classified as an endangered vegetation type (Rouget et al., 2004; Mucina & Rutherford, 2012, Ferrar & Lötter, 2007) due to mining activities within the provinces, with a conservation target of 24% (NSBA, 2018). Approximately 44% of the Gm12 has been transformed, primarily by cultivation, plantations, mining, urbanization and building of dams (Mucina & Rutherford; 2006). Erosion is very low, and no serious alien infestation is reported, although species such as *Acacia mearnsii* can become dominant in disturbed places.

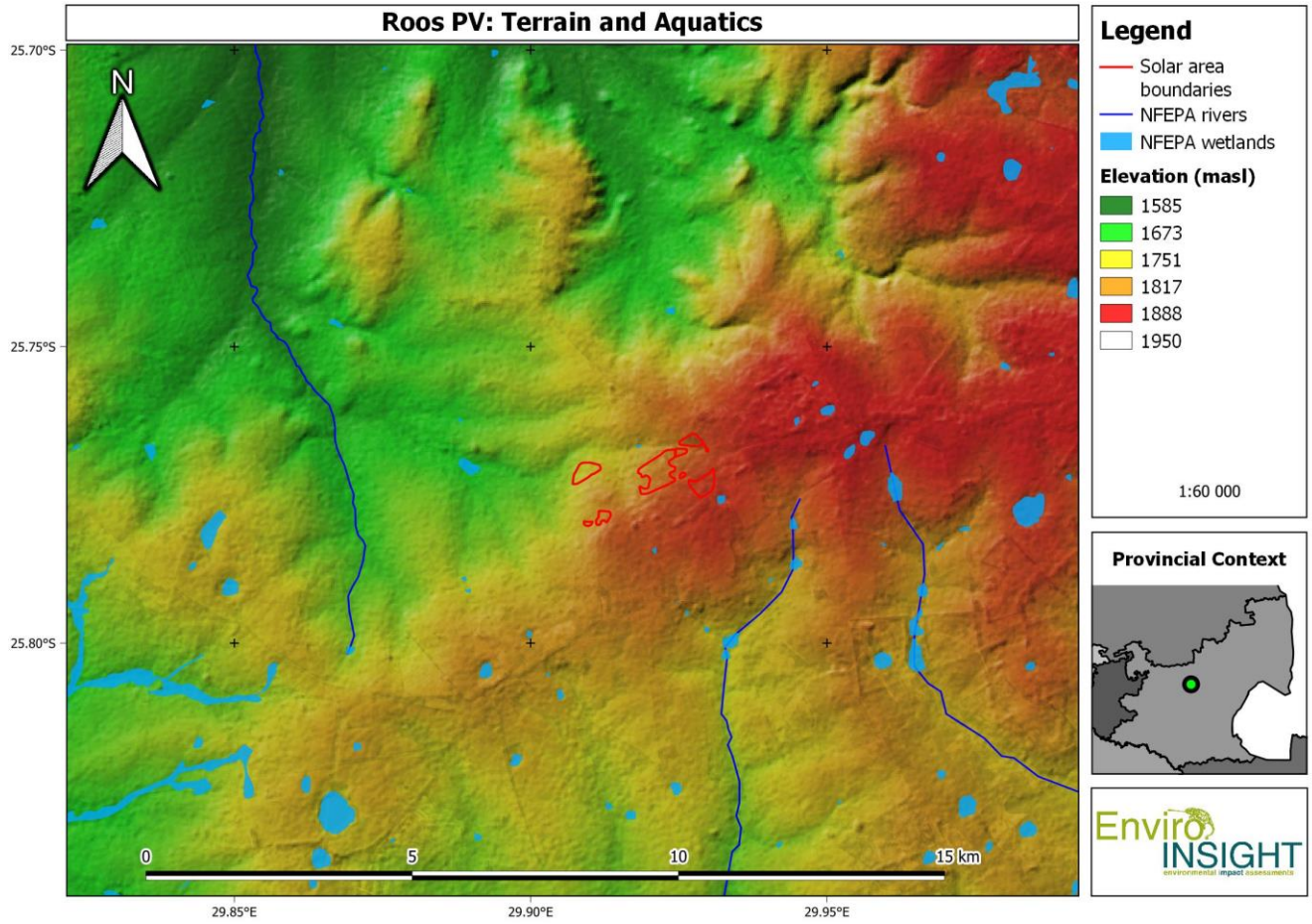

Figure 4-2: The proposed Roos SEF in relation to the terrain elevation and aquatic habitats.

4.2 PROTECTED AREAS AND IMPORTANT BIRD AREAS

4.3 THE PROTECTED AREAS AND IMPORTANT BIRD AREAS

The proposed Roos SEF is not located in an Important Bird Area (IBA) or protected area but borders the expansive Steenkampsberg IBA. There are many protected areas located within 30 km of the Roos project areas, including the Cecilia Private Nature Reserve, Nooitgedacht Dam Nature Reserve, Greater Lakenvlei Protected Environment, Middelpunt Nature Reserve, Langkloof Private Nature Reserve, Ermelo Private Nature Reserve, and Nederwelt Private Nature Reserve.

- The Steenkampsberg IBA encompasses 87 private farms within the Dullstroom and Belfast region. The Middelpunt Nature Reserve, Langkloof Private Nature Reserve, Greater Lakenvlei Protected Environment, and Cecilia Private Nature Reserve all fall within the IBA. The IBA is located on the central South African plateau which primarily consists of high-altitude grassland and rocky outcrops (1,700 – 2,100 m). There are two important wetland systems which include Lakensvleispruit and Verloren Valei. The critically important Middelpunt portion of Lakensvleispruit is dominated by *Phragmites* reed on permanently saturated ground. Verloren Valei consists largely of scattered wetlands characterised by short sedges, forbs and grasses. Outside of the wetlands, the IBA consists of sandy highveld grassland and mountain grassland. These habitats hold a variety of endemic forbs and ferns. The wetlands in the IBA are one of the world's few breeding grounds for the Critically Endangered White-winged Flufftail, while several breeding pairs of the Critically Endangered Wattled Crane are also present in the grasslands. As a result, this IBA is considered as critically important and severely threatened (BirdLife International, 2023).
- The Steenkampsberg IBA, as well as the surrounding protected areas (Nooitgedacht Dam Nature Reserve, Ermelo Private Nature Reserve, and Nederwelt Private Nature Reserve encompassing similar habitats), have recorded (or are likely to have) numerous SCCs. These notably include Striped Flufftail (VU), White-winged Flufftail (CR), Wattled Crane (CR), Blue Crane (NT), Southern Bald Ibis (VU), Ground Woodpecker (LC), Lesser Kestrel (VU), Rudd's Lark (EN), Buff-streaked Chat (LC), Gurney's Sugarbird (LC), Yellow-breasted Pipit (VU).

IBA conservation status assessments carried out in 2013 identified multiple ongoing threats to the Steenkampsberg IBA and surrounds. These threats included:

- Agricultural expansion: from timber crops, livestock ranching and aquaculture resulting in the afforestation of natural grasslands and wetlands, and human encroachment.
- Energy production and mining: oil and gas drilling, mining, quarrying, and power production, resulting in air, water, light and noise pollution, destruction of habitat, and human encroachment.
- Human intrusions and disturbance: both recreational and work-related activities such as fishing, solid waste removal, sewerage, development of dams and deliberate fire creations or suppressions, and above-mentioned activities, resulting in the depletion of natural habitats, SCC food sources, and breeding opportunities.
- Residential and commercial development: housing, tourism, roads and railways, resulting in the destruction of natural habitat and displacement of SCCs.

The location of the IBAs in relation to the PA is shown in Figure 4-3.

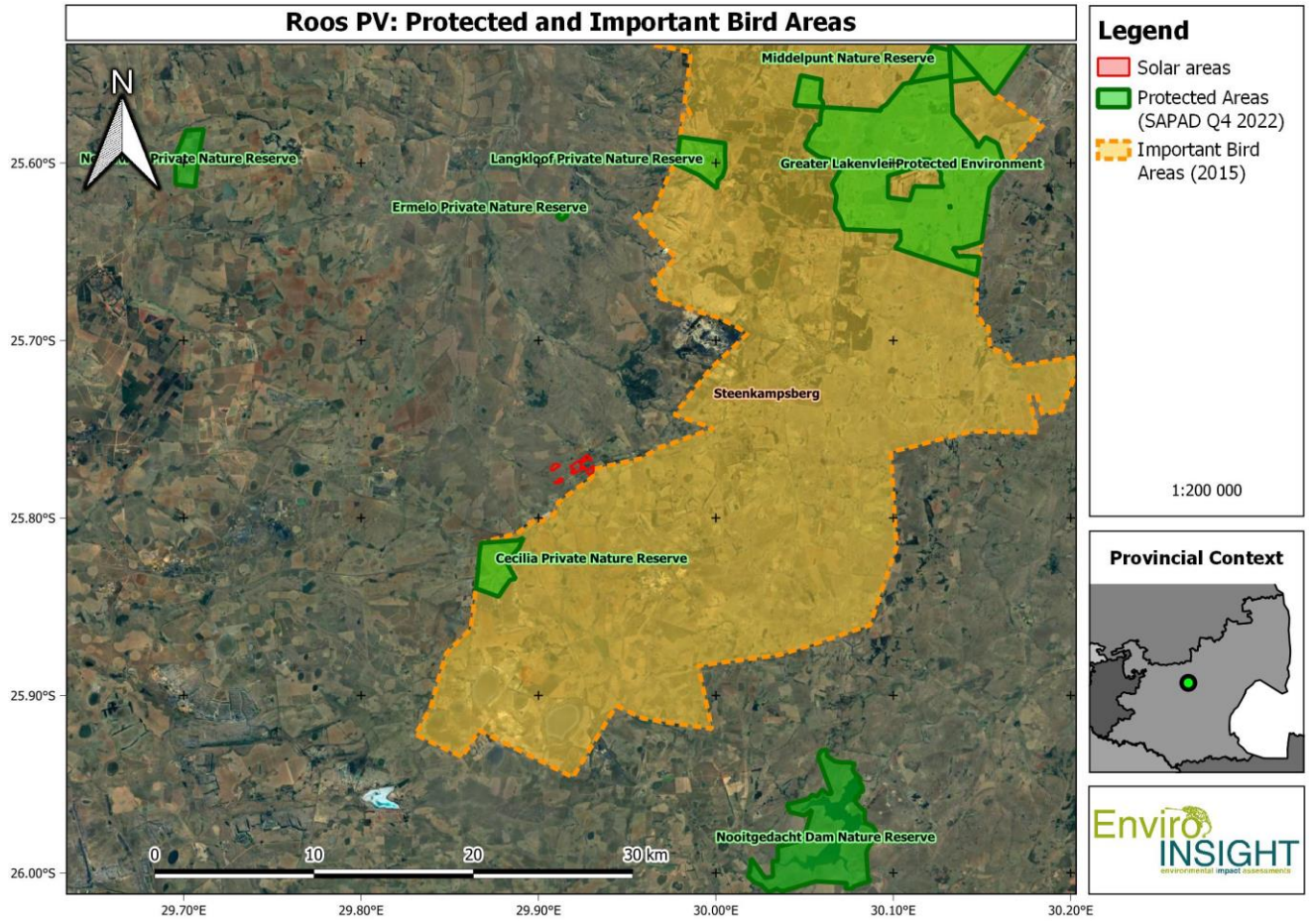

Figure 4-3: The proposed Roos SEF in relation to the adjacent Protected Areas and Important Bird Areas (IBAs).

4.4 CRITICAL BIODIVERSITY AREAS (CBA)

The following CBA information has been extracted and mapped Verbatim from the Enviro-Insight Terrestrial Biodiversity survey conducted as part of the application process.

CBA's and ESA's are terrestrial and aquatic features in the landscape that are critical for retaining biodiversity and supporting continued ecosystem functioning and services. The primary purpose of CBA's is to inform land-use planning in order to promote sustainable development and protection of important natural habitat and landscapes. Biodiversity priority areas are described as follows:

- **CBA's** are areas of the landscape that need to be maintained in a natural or near-natural state in order to ensure the continued existence and functioning of species and ecosystems and the delivery of ecosystem services. In other words, if these areas are not maintained in a natural or near-natural state then biodiversity conservation targets cannot be met. Maintaining an area in a natural state can include a variety of biodiversity-compatible land uses and resource uses. For CBA's the impact on biodiversity of a change in land-use that results in a change from the desired ecological state is most significant locally at the point of impact through the direct loss of a biodiversity feature (e.g. loss of a populations or habitat). All FEPA prioritized wetlands and rivers have a minimum category of CBA1, while all FEPA prioritised wetland clusters have a minimum category of CBA2.
- **ESA's** are areas that are not essential for meeting biodiversity representation targets/thresholds but which nevertheless play an important role in supporting the ecological functioning of critical biodiversity areas and/or in delivering ecosystem services that support socio-economic development, such as water provision, flood mitigation or carbon sequestration. The degree of restriction on land use and resource use in these areas may be lower than that recommended for critical biodiversity areas. For ESA's a change from the desired ecological state is most significant elsewhere in the landscape through the indirect loss of biodiversity due to a breakdown, interruption or loss of an ecological process pathway (e.g., removing a corridor result in a population going extinct elsewhere). All natural non-FEPA wetlands and larger rivers have a minimum category of ESA.

A map of the study area in relation to the 2014 Mpumalanga CBA's is presented in Figure 4-4 indicating that the study area is located primarily in CBA Optimal, Other Natural Areas, Heavily Modified, and a small section in CBA Irreplaceable and Moderately Modified. Areas of high biodiversity value including CBA Irreplaceable and Optimal should be avoided as far as possible concerning transformation of land cover.

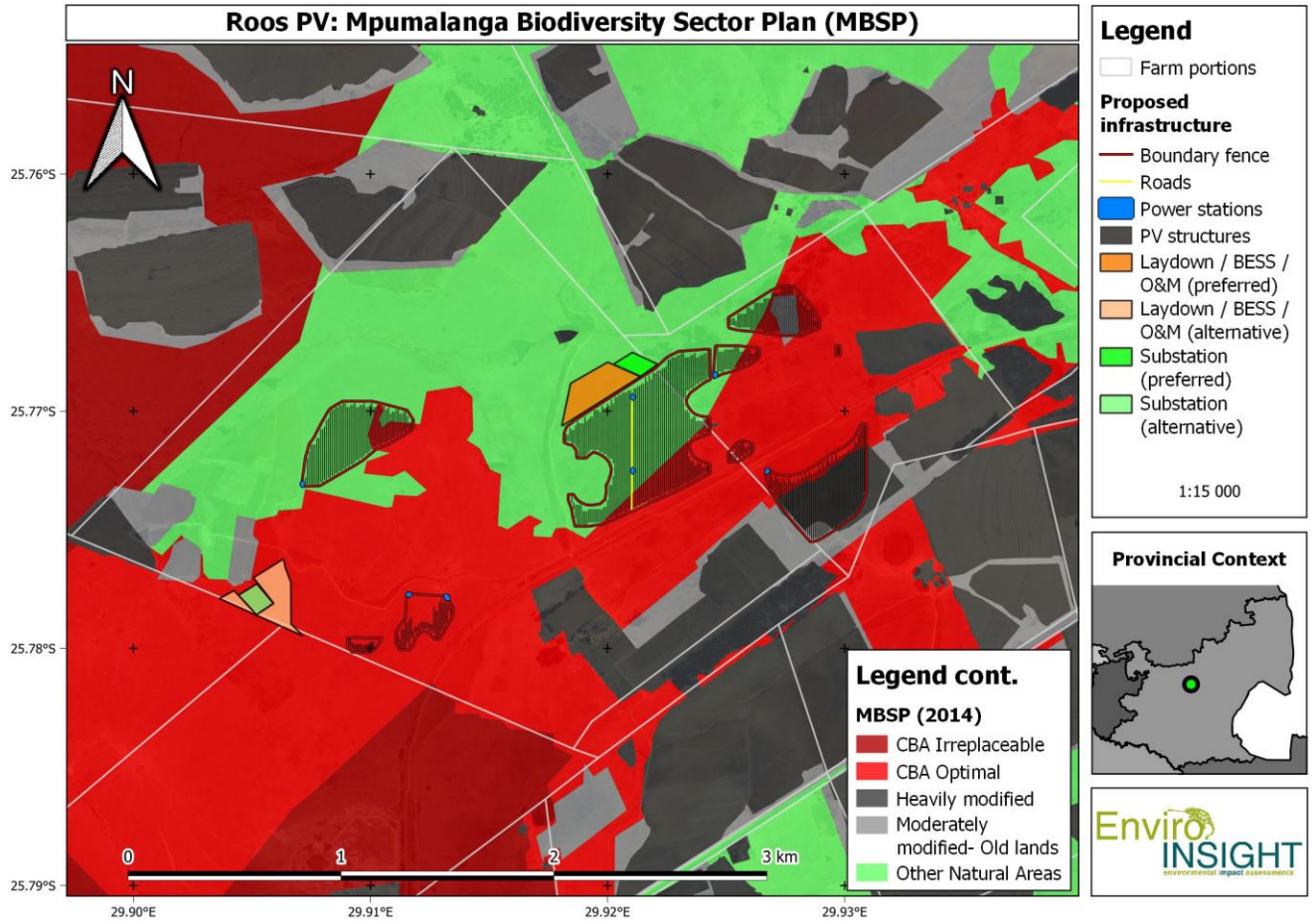

Figure 4-4: The proposed Roos SEF in relation to the Mpumalanga Critical Biodiversity Areas (2014).

4.5 DESCRIPTION OF MAJOR BIRD HABITATS

The primary avifaunal habitats are described in tabular formats below with accompanying representative photographs. It must be noted that the habitats have been delineated (Figure 4-5 and Figure 4-6) in accordance with the ecology of the prevailing avifaunal assemblages which may merge botanically divergent habitats and subsequently converted to sensitivity mapping. *In situ* habitat delineation can be viewed in the accompanying terrestrial ecology report while the designated avifaunal habitat sizes are shown as Table 4-1.The sensitivity of these habitat types was evaluated according to "avifaunal value" which relates to species diversity, endemism and the presence of topographical features or primary habitat units with the intrinsic ability to sustain certain avifaunal assemblages (with specific reference to SCC), their food supply and breeding habits, with specific relation to solar energy infrastructure and activities. It is apparent throughout the PA that most of the habitats are capable of supporting a wide range of general avifaunal species and Red-Listed / SCC although some habitats are more generic in nature and therefore the presence/ absence of SCC is less easily predicted. Due to the high diversity and density of the below-mentioned SCC recorded during the survey, (including regionally and globally listed Endangered and Vulnerable birds), the PAOI as a whole is an area of avifaunal importance, and the impact assessment that follows prioritises avoidance mitigation and the monitoring of avifaunal SCC.

Table 4-1: Avifaunal Habitats and Area within the proposed Roos SEF.

Habitat	Sensitivity	SEI	Area (ha)	Proportion	Percentage
Wetland	High	Very High	12.81	0.06	5.80
Disturbed habitat	Medium	Low	56.04	0.25	25.38
Natural grassland	High	Very High	128.57	0.58	58.22
Cropland	Medium	Low	13.76	0.06	6.23
Alien trees	Low	Very Low	9.56	0.04	4.33
Dam	High	Medium	0.08	0.00	0.04

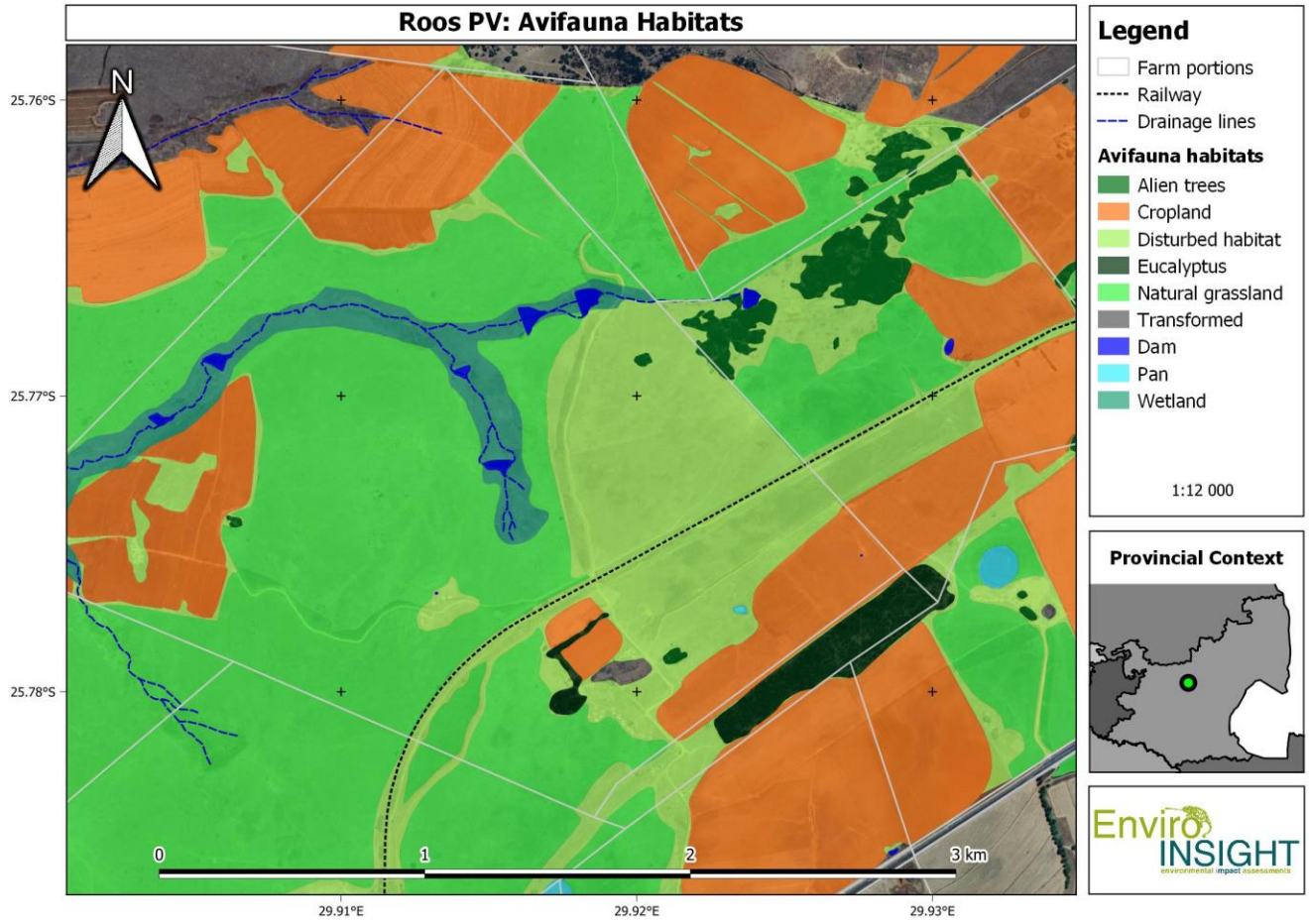

Figure 4-5: Avifaunal Habitats for Roos SEF

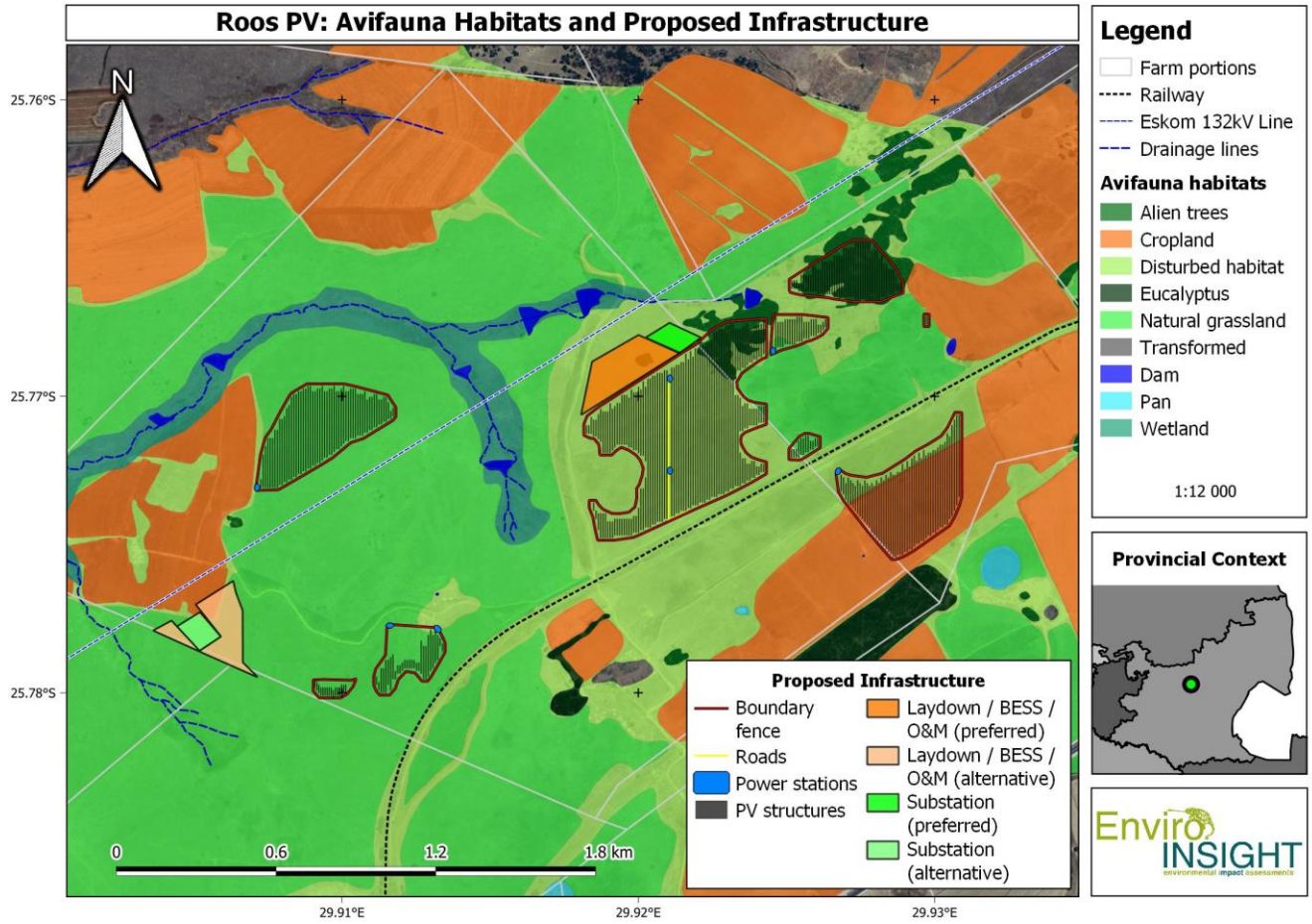

Figure 4-6: Avifaunal Habitats for the Roos SEF with Infrastructure Overlay.

4.5.1 Aquatic Features

Photographs	Description
  	**Classification:** Ephemeral and endorheic drainage lines and impoundments **Hydrology:** With avoidance, limited major hydrological impacts are expected from the development. **Geomorphology:** Channels varying in width and depth from large multi-channelled vegetated gullies to shallow narrow channels with seasonally inundated pans with large surface areas and permanent waterbodies. **Vegetation:** Vegetation varies depending on current levels of disturbance (especially livestock impacts and biosphere effects around pans), channel width and depth, where larger deep-rooted grasslands and larger channels with lower reed layers characterising smaller drainage line systems. **Avifaunal Characteristics:** Avifaunal assemblages differed depending on the classification of the impoundments and drainage line systems as well as the season. Most of the drainage line systems are seasonally ephemeral or permanent while the impoundments are mostly permanently inundated. Thus, most of the bird associations are linked to the prevailing vegetation and soil types within the delineated drainage line habitats or standing water. In summary, drainage lines with vegetative layers showed a much higher diversity of avifauna. SCC such as Cranes and Marsh Harriers can occur in varying but potentially great densities depending on the prevailing ecological conditions. The seasonal drainage lines and accompanying riparian shrubs act as linear dispersal corridors for terrestrial bird species. Much greater species diversity (as well as a unique composition) was observed in this habitat and therefore, these systems are classified to be of high avifaunal importance. The drainage lines, especially in association with ridges act as important flight corridors for cranes, passerines and raptors between foraging and roosting sites. *Notes: drainage may permanently be wet. They attract passerines such as widowbirds, bishops, waxbills and weavers, especially where these drainage lines run adjacent to crops. Ephemeral grasses run the risk of attracting breeding cranes and African Grass Owl (also Marsh Owl). The impoundments attracted typical large water-associated species, such as Egyptian Goose, Yellow-billed duck, Reed Cormorant, and Grey Heron.*

Photographs	Description
	The pan east of site had a Yellow-billed Egret foraging during the second season.

4.5.1 Natural Grassland

Photographs	Description
 	**Classification:** Natural grassland **Hydrology:** No major hydrological impacts are expected from the development **Geomorphology:** Undulating primary grassland habitat with large extents of flat terrain merging into wetlands. **Vegetation:** Vegetation varies depending on soil quality but is mostly comprised of grassland interspersed with shrub and forb patches **Avifaunal Characteristics:** These habitats exhibit high population density of reptiles, small mammals and ground birds, hares and korhaans which provide a sound prey base for larger at-risk priority bird species. Within the PAOI as well as the regional linkage to the drainage line habitats. Natural grassland habitats provide structural complexity allowing for a higher species diversity and often showed higher densities of avifauna due to the aforementioned abundance of specific prey species that are found within. The natural grassland habitats show an increased structural complexity and vegetation which provides for a more specific species diversity albeit often at high densities of individuals. *Notes: grassland appears to be subject to burning. All SCCs and raptors observed utilised grassland during seasonal observations. Other ground-dwelling species such as Cranes, Francolins, and White-bellied Bustards are likely to occur here. When burnt, areas attract greater pipit and lark numbers.*

4.5.2 Alien Vegetation: Wattles and Eucalyptus Groves

Photographs	Description
 	**Classification:** Alien Trees **Hydrology:** No major hydrological impacts are expected from the development although some ridges are associated with non-perennial watercourses and facultative wetlands. **Geomorphology:** Undulating vegetated habitat with large extents of connected and isolated ridges. **Vegetation:** Vegetation varies depending on soil quality but is mostly comprised of *Eucalyptus* and *Acacia mearnsii* (Black Wattle) stands. **Avifaunal Characteristics:** The localised low population densities of small mammals such as rodents and hares within the habitat and poor understory vegetation, reduces the overall ecological importance of this habitat for avifauna. The habitats provide structural complexity which often showed lower diversity and densities of avifauna due to the lack of abundance of prey species that are found in this habitat. *Notes: no nests were found, but larger alien trees may attract nesting and roosting raptors. There appears to be a wattle-clearing operation going on. Large birds such as Hadada Ibis frequently perched in Eucalyptus groves.*

4.5.3 Agricultural Activities: Cropland and Disturbed Grassland

Photographs	Description
	**Classification:** Maize crops and overgrazed grassland **Hydrology:** No major hydrological impacts are expected from the development although some ridges are associated with non-perennial watercourses and facultative wetlands. **Geomorphology:** Undulating habitat with large extents of connected and isolated crop stands. **Vegetation:** Vegetation varies depending on soil quality but is mostly comprised of crops (mostly maize) interspersed with grassy patches **Avifaunal Characteristics:** The localised high population densities of small mammals such as rodents, within the habitat type as well as the local linkage to the grassland habitats, elevates the overall ecological importance of this habitat for avifauna. The crop provide structural complexity which often showed lower diversity but high densities of avifauna due to the abundance of forage and prey species that are found in this habitat. *Notes: croplands were frequented by large birds such as Helmeted Guineafowl, Red-winged Francolin, Swainson's Spurfowl, and Crowned Lapwing. Smaller birds included widowbirds, whydahs, weavers and waxbills (unique species being Orange-breasted Waxbill). Where ploughed, areas attracted larks and foraging spurfowls. Overgrazed areas as a result of cattle grazing attracted Ant-eating Chats, Capped Wheatears, African Pipit, Red-capped Lark, African Stonechat, Cape Longclaw, and many Black-winged Kites. The photograph of the hay bales has been added to show that grass may be harvested.*

4.5.4 Powerline and Railway Infrastructure

Photographs	Description
 	**Classification:** Powerline and Railway Infrastructure **Hydrology:** No major hydrological impacts are expected from the development **Geomorphology:** The large powerline pylons have been placed on undulating vegetated habitat with large extents of flat terrain. **Vegetation:** Vegetation varies depending on soil quality but is mostly comprised of grassland and alien shrub. **Avifaunal Characteristics:** The Powerlines have proven to be important habitat for large raptors, especially Martial Eagle and Snake Eagles, which nest frequently on the powerline pylon infrastructure and utilise the pylons to launch hunts from. *Powerline Notes: the powerline running through the site had no evidence of nests, but the pylons and lines were utilised by perching Black-winged Kites. Powerlines permanently run the risk of collisions with larger birds, such as Cape Vulture, various eagles, cranes, bustards and Secretarybird. No carcasses were found during walks underneath sections of the powerlines.* *Railway Notes: the railway running through the site appears to attract raptors, as the rocky banks have been occupied by Rock Hyrax colonies, and likely attract reptiles. The railways was frequented by Martial Eagle during the winter visit (not common in the area) and Verreaux's Eagle (certainly not common) specifically targeting hyrax. Snake Eagles were also observed foraging along the railway, presumably for basking reptiles.*

4.5.5 Rocky Hillsides

Photographs	Description
	**Classification:** Rocky Hillsides **Hydrology:** No major hydrological impacts are expected from the development **Geomorphology:** The large powerline pylons have been placed on undulating vegetated habitat with large extents of flat terrain. **Vegetation:** Vegetation varies depending on soil quality but is mostly comprised of sandy grassland and rocky shrub. **Avifaunal Characteristics:** The Rocky Hillsides have proven to be important habitat for large raptors, especially Martial Eagle and White-backed Vultures, which hunt frequently within the habitat. *Notes: This refers to the northern hillside on the property containing natural grassland, acacias and scattered rocks. Not sure if this would be a classification. Certainly not worth being called a koppie or ridge. The area attracted many passerines flying between the area and the adjacent drainage line. Francolins were observed, as well as hunting raptors (African Harrier-Hawk, Black-winged Kite, Brown Snake Eagle, etc.). Due to its close proximity to the drainage line, the acacias and similar thorny shrubs on the hill may attract nesting Secretarybirds. No nests were found during the two site visits.*

4.6 OBSERVED AND EXPECTED AVIFAUNA

4.6.1 Total species composition and abundance

The PA supports a medium to high diversity and abundance of avifauna, which is to be expected in an area with a high habitat diversity such as the Mpumalanga Highveld Grassland region. A total of 81 species were observed during the surveys, as shown in Appendix 1. This medium to high diversity is predominantly due to a number of factors including:

- High seasonal aridity which shows a high temporal variability (turnover) in species diversity between seasons;
- Diverse habitat types (with some highly sensitive habitat such as drainage lines and temporary pans within the PAOI);
- Powerline infrastructure bisecting the PA (raptor nesting habitat).

4.6.2 Priority species

A total of 15 priority species are expected to occur on and surrounding the PA, of which five (5) were recorded during the surveys (including four SCC). It is clear from

Table 4-2: Priority avifauna species list for the Project Area of Influence (PAOI)

that numerous priority avifauna species occur within the PAOI and can be expected to interact with the proposed development. It is vital to consider the context within which these species were observed in the current study, as congregatory behaviour, nesting behaviour and foraging behaviour may differ from that at the PAOI habitats as opposed to the PA. In addition, Van Rooyen (2020) suggests that displacement effects of a WEF/ SEF can be more significant than direct fatality for certain species, especially for habitat specific species such as water associates (Marsh Harrier) and powerline nesting species such as Martial Eagle. Consequently, all applicable data of Priority Species observed across monitoring seasons allowed for careful evaluation of potential impacts and application of suitable mitigation measures to reduce these impacts where possible. According to the literature, 14 IUCN threatened, and near-threatened species are known to occur in the region with four species highly likely and four species confirmed during the completed surveys (Table 4-3), representing a low success rate given the study period. All relevant SCC are described in brief (Table 4-3). A number of selected relevant species that are possibly susceptible to the proposed development were discussed below in greater detail, which include specific (Guideline-based) recommendations for monitoring and mitigation. Photographic evidence of SCC and Priority Species observed during the current study is provided in Figure 4-7 and Figure 4-8.

Table 4-2: Priority avifauna species list for the Project Area of Influence (PAOI)

	Scientific Name	Common Name	Conservation Status	
			Regional	IUCN
Predicted	*Aquila rapax*	Tawny Eagle	EN	VU
Recorded	*Polemaetus bellicosus*	Martial Eagle	EN	EN
Known	*Balearica regulorum*	Grey Crowned Crane	EN	EN
Known	*Eupodotis senegalensis*	White-bellied Bustard	VU	LC
Known	*Falco biarmicus*	Lanner Falcon	VU	LC
Recorded	*Geronticus calvus*	Bald Ibis	VU	VU
Predicted	*Neotis denhami*	Denham's Bustard	VU	NT
Recorded	*Sagittarius serpentarius*	Secretarybird	VU	EN
Recorded	*Circus ranivorus*	African Marsh Harrier	EN	LC
Recorded	*Circonia circonia*	White Stork	LC	LC
Predicted	*Ciconia nigra*	Black Stork	VU	LC
Predicted	*Phoenicopterus roseus*	Greater Flamingo	LC	LC
Predicted	*Phoeniconaias minor*	Lesser Flamingo	NT	LC
Predicted	*Mycteria ibis*	Yellow-billed Stork	EN	LC
Predicted	*Gyps coprotheres*	Cape Vulture	EN	EN

Figure 4-7: SCC Martial Eagles and Secretarybirds observed within the proposed Roos SEF PAOI.

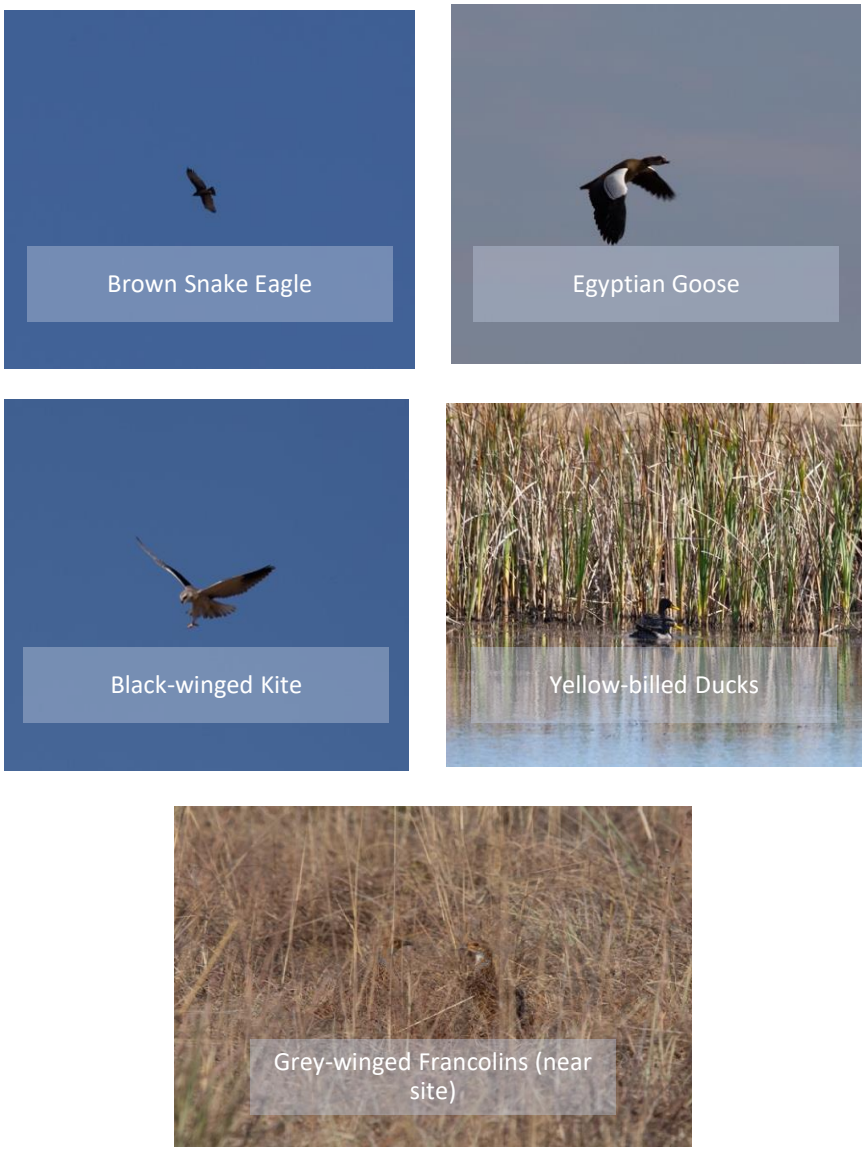

Figure 4-8: Other priority species observed within the proposed Roos SEF PAOI.

Table 4-3: Summary of avifauna species of conservation concern of known distribution (SABAP2, 2021), previously recorded in or adjacent to the Project Area.

Species	Global Conservation Status[1]	National Conservation Status[2]	Preferred Habitat	Potential likelihood of occurrence on study area and potential risk from the proposed De Rust SEF
Geronticus calvus (Southern Bald Ibis)	Vulnerable	Vulnerable	Grassland habitats, cliffs, livestock agricultural areas (due to foraging in dung)	**Confirmed**: Low densities throughout the region and not locally common in the PA The species is a breeding resident within or adjacent to the PA. A localised low flying large species, it is susceptible to SEF development activities due to its low foraging flights.
Aquila verreauxii (Verreaux's' Eagle)	Vulnerable	Vulnerable	Mountainous areas or areas with prominent outcrops with a high prey density (e.g. hyrax).	**Confirmed, sighted flying above PA**: Frequent foraging resident throughout the PAOI but far less frequent within the PAs due to the large distances to the preferred mountainous habitats and a general lack of localised abundant prey. However, localised areas exhibiting high abundance of hyraxes and rock rabbits, such as the railway lines, should be considered as potential foraging habitat for this species. The species is susceptible to poisoning events and SEF facilities, with a low risk from the proposed activities.

Polemaetus bellicosus (Martial Eagle)	Endangered	Endangered	Grasslands, open bushveld, desert savannah and karoo with adequate roosting and foraging potential.	**Confirmed:** A breeding resident adjacent to the PA and regular foraging visitor dependent on adequate food supply and roosts. No breeding pair nesting within the proposed SEF PA was recorded, but frequent sightings in terms of foraging activity on the PA, with breeding taking place within the PAOI. At the end of the survey period, one of the resident eagles was killed and a new pair of young eagles have moved into the greater PAOI and may colonise areas in association with the adjacent powerline infrastructure. Typically, the species is at a Moderate to High risk from SEF developments.
Falco biarmicus(Lanner Falcon)	-	Vulnerable	Varied, but prefers to breed in mountainous areas.	**Moderate:** A fairly common foraging and breeding resident recorded in the current study and expected periodically to breed in the PA. Not highly vulnerable to the proposed SEF activities.
Neotis denhami(Denham's Bustard)	Near Threatened	Near Threatened	Primary upland grassland, desert savannah and karoo with foraging and roosting particularly on rocky/ hilly terrain.	**Moderate:** Low densities throughout the PAOI and unconfirmed on the PA. The species is unlikely to be a breeding resident within or adjacent to the PA. A large bodied species, it is highly susceptible to indirect SEF development activities as shown by collision fatalities with the existing powerlines in the region.

Sagittarius serpentarius (Secretarybird)	Endangered	Vulnerable	Prefers open grassland or lightly wooded habitat although forages extensively in open karroid savannah.	**Confirmed:** Irregular low-density resident which is most likely at lower risk from the proposed development activities given its ground foraging habitats. Very limited nesting opportunities in the PA further reduces potential risk to this species from the proposed SEF.
Eupodotis senegalensis (White-bellied Korhaan)	Near threatened	Near threatened	Large patches of taller grassland	**Highly Likely:** Common resident occurring near areas with tall grasslands. drainage lines (including ephemeral) and open areas. Individually susceptible to SEF development activities but as a species is considered at low risk.
Eupodotis caerulescens (*Blue Korhaan*)	Near threatened	Near threatened	Large patches of taller grassland	**Highly Likely:** Common resident in the PAOI without being confirmed in the PA occurring near areas with drainage lines (including ephemeral) and open areas. Individually susceptible to SEF development activities but as a species is considered at low risk.
Ciconia nigra (Black Stork)	Least Concern	Vulnerable	Widespread species prefers open grassland or lightly wooded habitat although forages extensively in open grasslands and savannah.	**Highly likely intermittent foraging resident:** Common resident occurring near areas with drainage lines (including ephemeral) and open areas. Individually susceptible to SEF development activities but as a species is considered at low risk.

Mycteria ibis (*Yellow-billed Stork*)	Least Concern	Endangered	Savanna river associated species	**Unlikely:** Highly uncommon species for the PAOI resident occurring near areas with drainage lines (including ephemeral) and open areas. Individually susceptible to SEF development activities but as a species is considered at low risk.
Phoenicopterus roseus (Greater Flamingo)	Least Concern	Near threatened	Grassland habitats, large saline pans and shallow impoundments.	**Unlikely:** Common resident in the PAOI (not occurring in the PA) occurring near areas with drainage lines (including ephemeral) and open areas. Individually susceptible to SEF development activities but as a species is considered at low risk.
Phoeniconaias minor Lesser Flamingo	Near threatened	Near threatened	Grassland habitats, large saline pans and shallow impoundments.	**Unlikely:** Common resident in the PAOI (not occurring in the PA) occurring near areas with drainage lines (including ephemeral) and open areas. Individually susceptible to SEF development activities but as a species is considered at low risk.
*Gyps coprotheres (*Cape Vulture*)*	Endangered	Endangered	Cliff nesting widespread foraging species	**Unlikely**: Low densities throughout the region and locally uncommon in the PA The species is a non breeding resident within or adjacent to the PA. It may forage within the PAOI but with no breeding habitat (large cliffs) within 30 km, the species is not considered to be at risk from the SEF development.

1[1] IUCN 2022

1[2] Taylor et al. 2015

4.6.3 Nest Survey

Nest sites were searched for during the surveys on all suitable sites which included windmills, trees, pylons, bridges and masts, representing the most potential roost and nesting sites for raptors. Alien species tree stands, water bodies and drainage lines showed potential for roost and nesting sites for multiple species. During the survey and above average rainfall conditions was representative of optimal breeding habitat for water associated species. Power line pylons were examined for raptor nesting sites to be discussed for Martial Eagles below.

4.7 PRECONSTRUCTION MONITORING MAIN RESULTS

4.7.1 Walked and Driven Transect Counts

During the walked transects, the total number of individual birds (per species) were recorded regardless of their priority status. Notable Priority Species recorded during walked transects included Southern Bald Ibis, Black-chested Snake Eagle, Various Heron and Lapwing Species and Verreaux's Eagle. The main focus of drive transects were the recording of large birds and raptors. White Storks, various egret species, Grey, Black-headed and Purple Herons as well as Egyptian Goose.

For the walked transects, a total of 463 individual bird contacts were recorded of which 71 individuals were priority and 392 were nonpriority individuals. For driven transects, a total of 429 individual bird contacts were recorded of which 176 were priority and 253 were nonpriority. **In total, 1653 (1203 nonpriority and 450 priority) contacts were made, including incidental contacts outside of the prescribed methodology.**

The summary data for priority species observations made from these transects are provided in **Error! Reference source not found.**. Detailed data for priority species observations made from these transects are provided in Table 4-5.

The combined priority and non-priority (1653 contacts over 9.1 km) calculated Index of Kilometric Abundance (IKA = birds/km) IKA is 181.6 birds/km which is relatively high and reflects the high abundance of synanthropic species occupying the forage rich habitats of the PAOI which can be affected through seasonal ecological changes caused by events such as drought or high rainfall events. It must again be stressed that although the IKA is considered high, when applied to Priority Species (49.4 IKA) or SCC (0.88 IKA), **the risk is considered to be low, especially in the context of a SEF.**

4.7.2 Focal Sites

The drainage line and primary grassland systems scattered throughout much of the PA contained a relatively high density (and higher diversity) of passerines and water associates. All pylon infrastructure warranted special attention regarding foraging and breeding of priority species. Due to the fact that focal sites yielded data related to SCC, they are discussed specifically under Species Specific Risk Analysis and Recommendations.

Table 4-4: Per season priority species recorded during Walked Transects (WT)

		Season		
English IOC Name	**Scientific Name**	**Summer**	**Winter**	**Grand Total**
African Snipe	*Gallinago nigripennis*		1	1
Common Moorhen	*Gallinula chloropus*	2		2
Common Reed Warbler	*Acrocephalus scirpaceus*	8		8
Common Sandpiper	*Actitis hypoleucos*	2		2
Common Waxbill	*Estrilda astrild*	4	23	27
Egyptian Goose	*Alopochen aegyptiaca*	9	6	15
Grey Heron	*Ardea cinerea*	5		5
Intermediate Egret	*Ardea intermedia*		1	1
Levaillant's Cisticola	*Cisticola tinniens*		14	14
Little Egret	*Egretta garzetta*	1		1
Purple Heron	*Ardea purpurea*	1		1
Red-collared Widowbird	*Euplectes ardens*	4		4
Reed Cormorant	*Microcarbo africanus*	4	1	5
Southern Red Bishop	*Euplectes orix*	81	126	207
White-backed Duck	*Thalassornis leuconotus*	4		4
Yellow-billed Duck	*Anas undulata*		5	5
Yellow-crowned Bishop	*Euplectes afer*	1	1	2
Zitting Cisticola	*Cisticola juncidis*	14	1	15
Grand Total	**18**	**140**	**179**	**319**

4.7.3 Combined Species Summary

Using the prescribed methodology, priority species were recorded on 450 occasions divided into 39 species. The overwhelming majority of the species were not classified as SCC and were considered to be common associates within the habitats delineated in the PA. These species are highly fecund and endure (without population declines) normal anthropogenic impacts such as crop agriculture, livestock agriculture, human settlements, roads, railway lines and powerlines. The establishment of SEF infrastructure is unlikely to affect the population dynamics of these species.

There are however some SCC that were observed, albeit in lower densities (Table 4-6). Southern Bald Ibis were recorded on three occasions, Martial Eagles and Secretarybirds were recorded on two occasions each respectively with Verreaux's Eagle being recorded on a single occasion. Although these SCC are high profile and sensitive to WEF developments, they are less susceptible to SEF developments. In addition, the frequency of occurrence suggested transient foraging behaviour rather than breeding residents. The one possible concern was the numerous observations were recorded in association with the existing pylon infrastructure, especially given the potential for colonisation and nest establishment by priority species (especially raptors). Given the absence of an active nest within the PA, most priority species are considered to be a low density (foraging flights only) and the species is of lesser concern than for other developments in close proximity to an active nest. The sensitivity implications are discussed in detail within the sections below.

Somewhat surprisingly from an ecological point of view, the winter survey yielded a higher density count than the summer survey. However, this may be explained by the prevailing level of disturbance within the PA which sees a higher concentration of anthropogenic passerines around water points and agricultural feed points. Once again, this seems to suggest a prevailing resilience among the avifaunal assemblages in the PA.

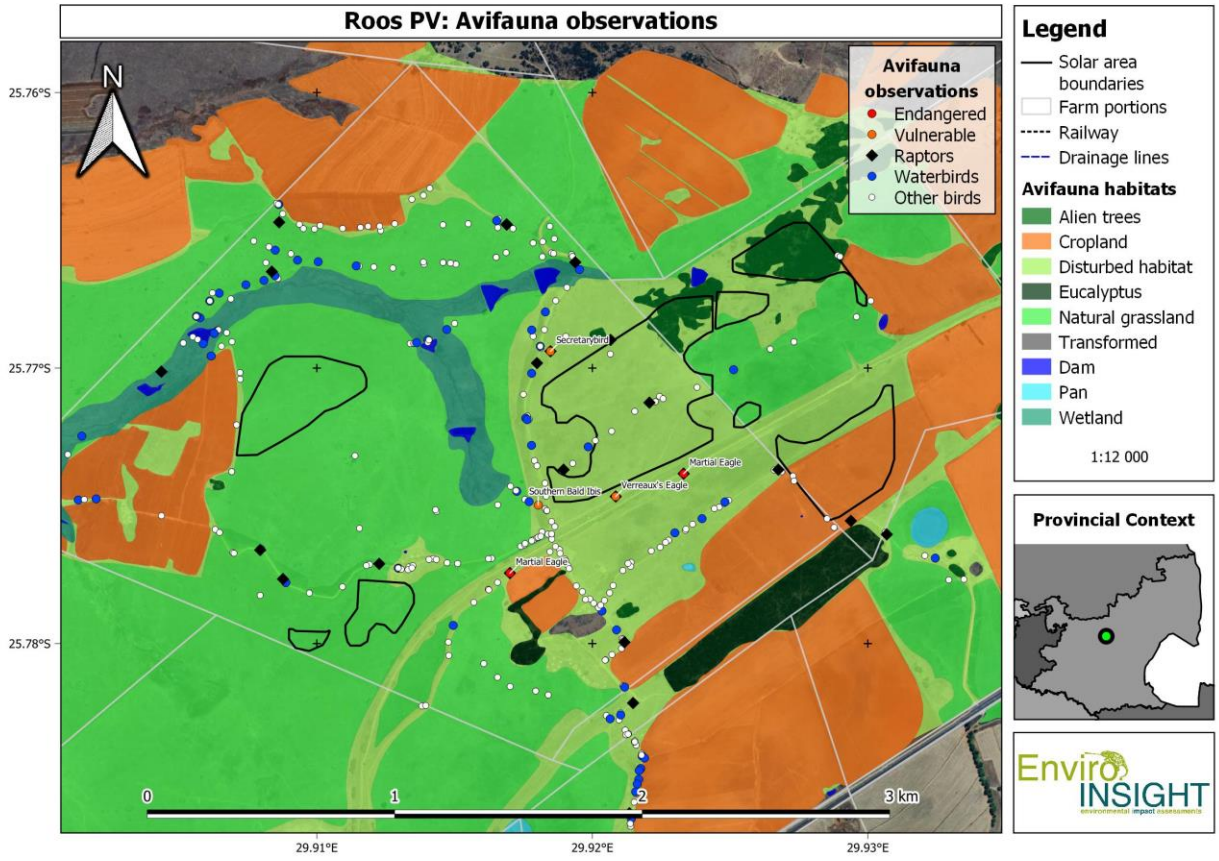

Figure 4-9: Locations of all avifaunal observations within the Roos

Table 4-5: Per season priority species recorded during Drive Transects (DT) and Walked Transects (WT).

			Drive Transects		Walk Transects				Incidental Records		
Season	English IOC Name	Scientific Name	DT1	DT2	WT1	WT2	WT3	WT4	Incidental (SEF)	Incidental (Greater)	Total
Summer	Black-chested Snake Eagle	*Circaetus pectoralis*		1		1					2
	Black-winged Kite	*Elanus caeruleus*			1				1	1	3
	Common Buzzard	*Buteo buteo*							1		1
	Common Moorhen	*Gallinula chloropus*							2		2
	Common Reed Warbler	*Acrocephalus scirpaceus*		4	2				2		8
	Common Sandpiper	*Actitis hypoleucos*							2		2
	Common Waxbill	*Estrilda astrild*							4		4
	Crowned Lapwing	*Vanellus coronatus*					4				4
	Egyptian Goose	*Alopochen aegyptiaca*	5							4	9
	Grey Heron	*Ardea cinerea*	2		1		1	1			5
	Jackal Buzzard	*Buteo rufofuscus*				1					1
	Little Egret	*Egretta garzetta*			1						1
	Long-crested Eagle	*Lophaetus occipitalis*							1		1
	Purple Heron	*Ardea purpurea*	1								1
	Red-collared Widowbird	*Euplectes ardens*			2				2		4
	Reed Cormorant	*Microcarbo africanus*			1				3		4
	Southern Bald Ibis	*Geronticus calvus*					3				3
	Southern Red Bishop	*Euplectes orix*	70		11						81

	Spotted Thick-knee	*Burhinus capensis*					2					2
	White Stork	*Ciconia ciconia*	8									8
	White-backed Duck	*Thalassornis leuconotus*							2		2	4
	Yellow-crowned Bishop	*Euplectes afer*			1							1
	Zitting Cisticola	*Cisticola juncidis*	2	2	2	1	2		5			14
	Summer Total	**23**	**88**	**7**	**22**	**3**	**12**	**1**	**25**		**7**	**165**
	African Harrier-Hawk	*Polyboroides typus*							2			2
	African Snipe	*Gallinago nigripennis*							1			1
	Black-headed Heron	*Ardea melanocephala*		1					1			2
	Black-winged Kite	*Elanus caeruleus*	2						11			13
	Brown Snake Eagle	*Circaetus cinereus*							1			1
	Common Waxbill	*Estrilda astrild*	1		8				14			23
	Crowned Lapwing	*Vanellus coronatus*							9			9
	Egyptian Goose	*Alopochen aegyptiaca*		2					4			6
Winter	Helmeted Guineafowl	*Numida meleagris*							6			6
	Intermediate Egret	*Ardea intermedia*							1			1
	Levaillant's Cisticola	*Cisticola tinniens*	1	2	1				10			14
	Martial Eagle	*Polemaetus bellicosus*	1						1			2
	Pied Crow	*Corvus albus*							2			2
	Red-eyed Dove	*Streptopelia semitorquata*	18						23			41
	Red-winged Francolin	*Scleroptila levaillantii*		2	2				2			6
	Reed Cormorant	*Microcarbo africanus*							1			1

Secretarybird	*Sagittarius serpentarius*								2		2
Southern Red Bishop	*Euplectes orix*	51		1			18	56			126
Speckled Pigeon	*Columba guinea*	10					2	4			16
Swainson's Spurfowl	*Pternistis swainsonii*							3			3
Verreaux's Eagle	*Aquila verreauxii*				1						1
Yellow-billed Duck	*Anas undulata*							5			5
Yellow-crowned Bishop	*Euplectes afer*							1			1
Zitting Cisticola	*Cisticola juncidis*							1			1
Winter Total		**24**	**84**	**7**	**12**	**1**		**20**	**161**		**285**
Grand Total		**39**	**172**	**14**	**34**	**4**	**12**	**21**	**186**	**7**	**450**

Table 4-6: Species of Conservation Concern (SCC) recorded during the survey period.

		Season		
English IOC Name	**Scientific Name**	**Summer**	**Winter**	**Grand Total**
Martial Eagle	*Polemaetus bellicosus*		2	2
Secretarybird	*Sagittarius serpentarius*		2	2
Southern Bald Ibis	*Geronticus calvus*	3		3
Verreaux's Eagle	*Aquila verreauxii*		1	1
	Grand Total	**3**	**5**	**8**

4.8 AVIFAUNA SENSITIVITY

4.8.1 General

Delineated habitats and other important features for avifauna (e.g., powerline infrastructure) were evaluated in relation to the risk to priority species occurring in these habitats/features from the placement of SEF infrastructure (Figure 4-10). There is a presence of a number (mainly four) SCC and fifteen priority species in the PA (examples including Martial Eagle, Verreaux's Eagle, Secretarybird and Southern Bald Ibis), recorded and occurring relatively widespread through the proposed SEF area. In addition, there are several raptors utilising the PAOI, some of them priority species and/or of conservation concern, such as the Long-crested Eagle, Brown Snake Eagle, Black-chested Snake Eagle, Jackal Buzzard, African Harrier Hawk, Pale-chanting Goshawk and Black-winged Kite.

The placement of infrastructure on primary grasslands/ grassland ridges and near impoundments/ drainage lines, which are vital to maintaining populations of habitat obligate sensitive species would result usually in a high probability of displacement for such SCC. However, these species are fairly ubiquitous in the region with the exception of primary grassland species which is an extremely threatened biome within South Africa. Consequently, avoidance mitigation is required for such habitats when siting panels. A 50 m buffer was applied around these habitat features and must be considered NO-GO where no panels and associated infrastructure may be located. A 200 m buffer was also applied around seasonally inundated watercourses in the PAOI, as these features function as flyways and attract birds under certain conditions and could be the only locations were certain sensitive species such as ducks, herons, storks and water birds are likely to occur. The sensitivity analysis is representative of unmitigated infrastructure placement and buffered high sensitivity areas must be, where possible, avoided by the developer where no panels and associated infrastructure should be located (Figure 4-10).

Several of the proposed panel positions and associated infrastructure coincide with areas currently demarcated as High (not No Go) and Medium sensitive features and consequently were subjected to the mitigation hierarchy. The layout was carefully re-evaluated in order to firstly avoid and secondly minimise negative interaction between SEF infrastructure and priority species. Finally, the presence of the Distribution line is a highly significant attractant for SCC and other priority species, with particular concern for the Martial Eagles which may establish nests within the powerline infrastructure. The presence of this species warrants detailed discussion below.

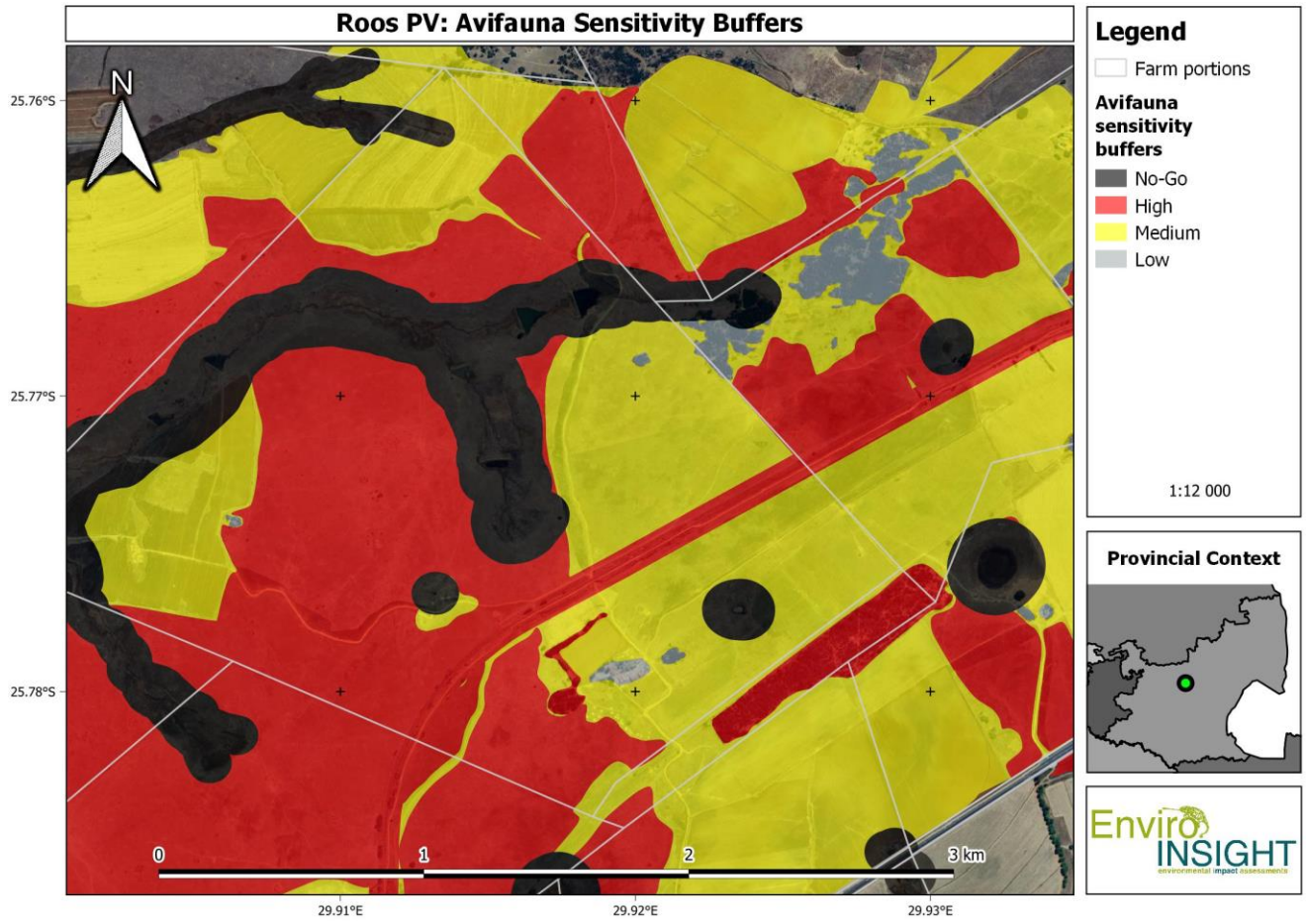

Figure 4-10: Avifauna Sensitivity Buffers with preferred solar infrastructure placement for the proposed Roos SEF.

4.8.2 Raptor (especially Martial Eagle) Nest Sites

Utilising the interpretations stipulated above and in the absence of any mitigation measures, a preliminary buffer of 1 km is recommended as an exclusion area around any known Martial Eagle, Secretarybird or Verreaux's Eagle nests. There is currently no species-specific guideline for the Martial Eagle, and buffer areas around nest sites remains a scientifically contentious topic of discussion in the industry without rigorous scientific studies providing necessary guidance (for example, Murgatroyd *et al.*, 2021). The only published recommended buffer to implement around eagle nests in South Africa is for the Verreauxs' Eagle (Ralston-Paton, 2017), which dictates that a precautionary buffer of 3 km is recommended for wind farms and may be reduced or increased based on the results of rigorous avifaunal surveys, but nest buffers should never be less than 1.5 km.

A recent paper from Murgatroyd *et al.* (2021) indicated that by using predictive models to account for habitat use instead of simple buffers around a nest, a greater area of land can be made available for renewable energy development without increased fatality risk to raptors. Even though this is designed to be used more for WEFs, accordingly, this tool can be used to provide robust guidance on solar panel infrastructure placement in a way which minimises the conflict between raptor species and the

development of SEFs in South Africa as well as provide the basis for rigorous monitoring programs to be applied. It must be noted that the study species for this research was Verreaux's Eagle which was tracked at only four locations (not including the current habitat or region), and accordingly the interpretation of the results needs to be considered as species- and site-specific, even though the same principle can be extrapolated to other raptor species in various regions. The study recommended that nest buffers should never be <3.7 km radius, but also indicated that additional site-specific specialist input or mitigation methods might allow a limited amount of development for high-risk developments. **Fortunately, no nests were confirmed to be present after the completion of the 6-month pre-construction monitoring (Figure 4-10). Any establishment of nests that arise during or post construction will be subject to mitigation measures referring to the above guidelines described as well as the mitigation measures characterised in the Impact Analysis below.**

As a general rule, all nesting raptors should be protected within the study area. Seen frequently, Brown Snake Eagles, African Harrier Hawks, Black-winged kites, Jackal Buzzard and Long-crested Eagle are most likely classified as a breeding resident within the PA and a regular coloniser of powerline infrastructure and alien species (especially *Eucalyptus* stands). Local populations of large to medium raptors are under constant pressure from development due to modifications and alterations of their preferred foraging habitat and dispersal networks. It must be stated that although large raptors rely on more ecologically "generic" habitats and are not bound by the ridge systems that define the presence and foraging of Verreaux's Eagle and Cape Vultures, the presence of the distribution line as an attractant severely alters the current ecology due to its function as a nesting substrate, vantage point for hunting and infrastructure for roosting. Overall, the impacts of the development will be less severe than for SEFs, especially because nests were not located within the project area of influence.

Nest Specific Mitigations

Not relevant for the PA.

4.8.3 Secretarybirds

Secretarybirds are less predictable in their ecology and habits due to the fact that they are a low-density species although very widespread and with very generalist habitat requirements. The arrival of multiple individuals within the project footprint may represent the establishment of long-term residents although currently, no nesting behaviour or habitats have been observed. The primary impacts of a SEF relate to loss of foraging habitat and potential collision with new powerline infrastructure which requires detailed discussion.

Although the overall findings data reveal several risks in regard to the current study. Increased regional stress to obtain food as well as prevailing climate change will almost certainly modify the species' behaviour within the national population. Like with larger species such as Verreaux's Eagles, breeding adults become less successful in their reproductive success leading to increased post-hatchling mortalities (Anon 2012) and population stress. This is especially relevant in regard to the loss of habitat for the cumulative effects due to much reduced available prey as well as the increased disturbance levels. In regards to WEFs, proposed future development can likely threaten the long-term viability of Secretarybird populations due to the risk of collisions. However, the effect on populations by SEFs is less certain and are likely of lower significance.

Nest Specific Mitigations

Not relevant for the PA.

4.9 SITE ECOLOGICAL IMPORTANCE (SEI)

As described in the species protocol guidelines (SANBI 2020), Site Ecological Importance (SEI) is a "standardised metric for identifying site-based ecological importance for species, in relation to a proposed project with a specific footprint and suite of anticipated activities". SEI allows for rapid spatial inspection and evaluation of impacts of a proposed development within the context of on-site habitats and SCC, and also facilitates integration of inputs from different specialist studies. SEI depends on the careful spatial delineation of habitat types and an understanding of their utilisation by SCC. The evaluation of SEI is presented in Table 4-7 with the guidelines for interpreting SEI shown in Figure 4-11

The final expression of the SEI delineation for the PA is shown in Figure 4-12.

Three habitats with High SEI are present in the PA where avoidance mitigation is recommended. Minimisation and restoration mitigation will be required for the Medium SEI habitats. It must be stated that Figure 4-12 can be interpreted alongside the Figure 4-10 sensitivity map. Ultimately, the exact delineation of Low, Medium, High and No Go areas will require on-the-ground micro-siting and mitigation. Ultimately, although some of the habitat and infrastructure is of High SEI, the PA is not fatally flawed.

Table 4-7: Evaluation of Site Ecological Importance (SEI) of avifauna habitats in the project area. BI = Biodiversity Importance.

Site ecological importance	Interpretation in relation to proposed development activities
Very high	Avoidance mitigation – no destructive development activities should be considered. Offset mitigation not acceptable/not possible (i.e. last remaining populations of species, last remaining good condition patches of ecosystems/ unique species assemblages). Destructive impacts for species/ecosystems where persistence target remains.
High	Avoidance mitigation wherever possible. Minimisation mitigation – changes to project infrastructure design to limit the amount of habitat impacted; limited development activities of low impact acceptable. Offset mitigation may be required for high impact activities.
Medium	Minimisation and restoration mitigation – development activities of medium impact acceptable followed by appropriate restoration activities.
Low	Minimisation and restoration mitigation – development activities of medium to high impact acceptable followed by appropriate restoration activities.
Very low	Minimisation mitigation – development activities of medium to high impact acceptable and restoration activities may not be required.

Figure 4-11: Guidelines for interpreting SEI in the context of the proposed development activities, reproduced from SANBI (2020).

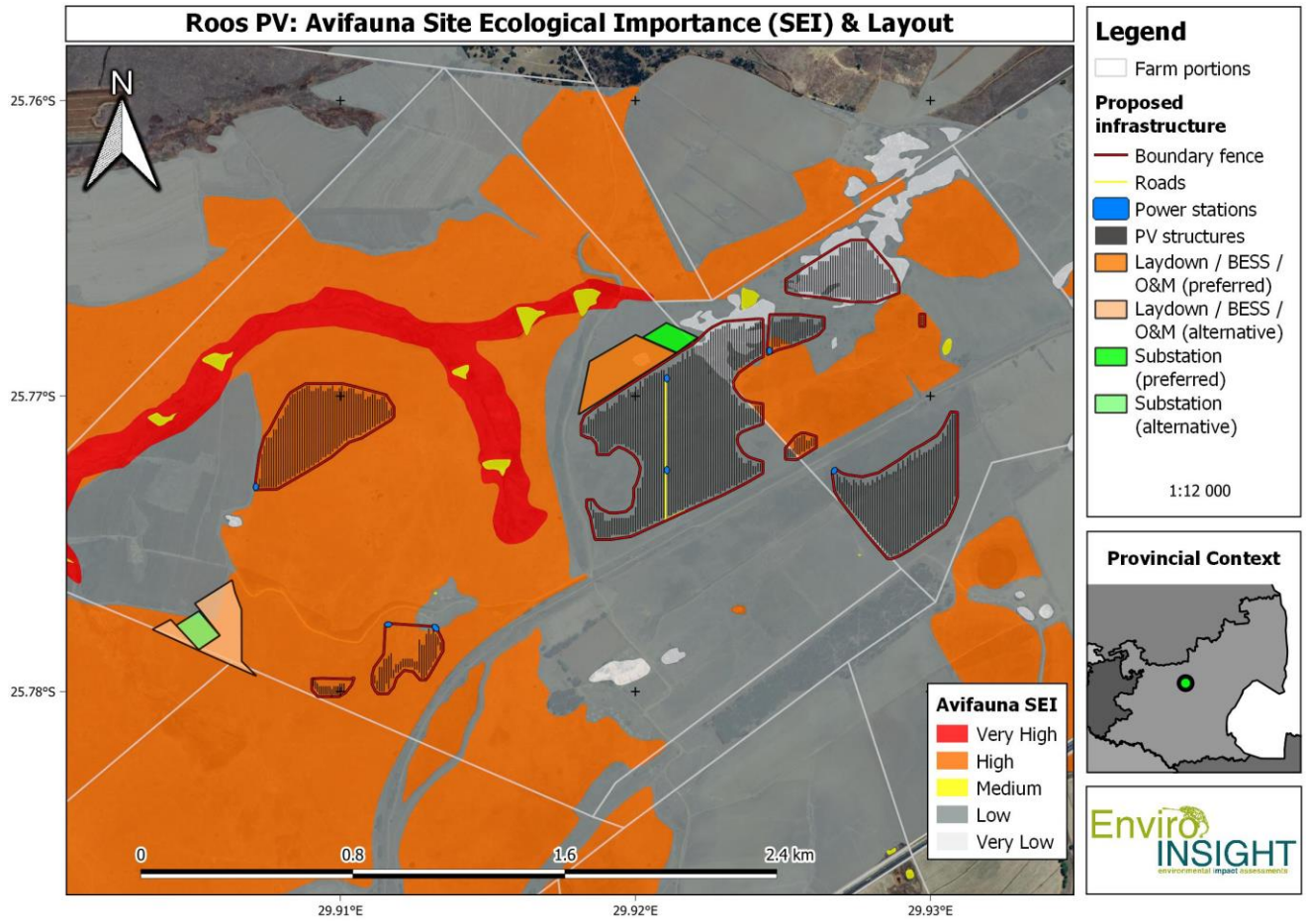

Figure 4-12: The Roos SEF Combined Project Area Site Ecological Importance (SEI).

Habitat	Conservation Importance (CI)	Functional Integrity (FI)	Receptor Resilience (RR)	Site Ecological Importance (SEI)	SEF Site Sensitivity
Alien Trees	**Very Low** – Very few confirmed or highly likely populations of SCC and where SCC of IUCN Vulnerable or Endangered are not relatively dependent on the habitat for foraging and breeding (e.g. breeding leks for Ludwig's bustard).	**Low** – Cumulatively lower area for any conservation status of SCC and as a foraging and breeding habitat (although some roosting may occur), the ecosystem type is insignificant with currently maximuml current negative ecological impacts (such as antibosis from *Eucalyptus* trees).	**Very Low** – Associated vegetation will recover slowly (~ more than 10 years) to restore > 75% of the original species composition and functionality. Alteration to the physical rock structure cannot recover.	**VERY LOW** **(BI = Very Low)**	**LOW**

Wetlands	**High** – Multiple confirmed or highly likely populations of SCC and where SCC of IUCN Near Threatened, Vulnerable or Endangered are relatively dependent on the habitat for migration. foraging and possibly breeding (e.g. Marsh Harrier).	**High** – Cumulatively medium (>100 ha) intact area for any conservation status of SCC. Currently only minimal negative ecological impacts.	**High** – Will recover slowly (~ more than 10 years) to restore > 75% of the original species composition and functionality.	**HIGH** **(BI = High)**	**HIGH**
Natural Grasslands	**High** – Confirmed or highly likely populations of SCC and where SCC of IUCN Near Threatened, Vulnerable or Endangered are relatively dependent on the habitat for migration. foraging and possibly breeding. .	**High** – Connected and classified as natural although not unmodified with relatively moderate level of current negative ecological impacts.	**High** – Will recover relatively slowly (if at all), even with "resting" and some minor ecological rehabilitation (~ more than 10 years) to restore > 75% of the original species composition and functionality.	**HIGH** **(BI = High)**	**HIGH**
Powerline Infrastructure (300 metre corridor either side)	**High** – Multiple confirmed or highly likely populations of SCC and where SCC of IUCN Near Threatened, Vulnerable or Endangered are relatively dependent on the habitat for breeding.	**High** – The linear transect traverses multiple habitat types and assuming a "corridor" or 100 metres either side of the powerlines, can be considered of high functional integrity as a breeding site for raptors. Although the pylon structure itself is considered to be artificial, the breeding habitat is highly functional and the line srves as foraging habitat for Verreaux's and Martial Eagle.	**Medium** – Does not apply to the actual powerline infrastructure. Assuming a neutral evaluation.	**HIGH** **(BI = High)**	**HIGH**

Disturbed Grassland, Agricultural Fields,	**Low** – Few confirmed or highly likely populations of SCC and where SCC of IUCN Near Threatened, Vulnerable or Endangered are relatively dependent on the habitat for breeding.	**Low** – Fragmented or poorly connected and classified as disturbed to transformed with relatively moderate to high level of current negative ecological impacts.	**Medium** – Variable recovery time equals a raised average. Will recover relatively slowly (if at all), even with "resting" and some minor ecological rehabilitation (~ more than 10 years) to restore > 75% of the original species composition and functionality.	**Low**	**Medium**
				(BI = Low)	

4.9.1 SEI Discussion

Avifaunal importance relates to species diversity, endemism and the presence of topographical features or primary habitat units with the intrinsic ability to sustain avifaunal assemblages, their food supply as well as the density and diversity of SCC. Throughout the PA, much of the habitat is generic in their ability to support a high diversity of general avifaunal species, Red-Listed species and SCC. However, unique geographical or topographical features exist in significant proportions which would cause the areas targeted for development to be classified as a "No Go" development in regard to avifauna. Due to the high diversity of the above mentioned, Red-Listed species recorded during the survey, (including regionally and globally listed Endangered and Vulnerable birds), the region as a whole is considered to be an area of high avifaunal importance and activities should be managed in a holistic manner, prioritising mitigation and monitoring of avifauna SCC.

4.9.2 High SEI

Habitats with high avifauna sensitivities include the natural grasslands, drainage lines and water sources:

- The drainage lines and accompanying vegetation are linear dispersal corridors for terrestrial and wetland associated bird species. A significantly high species diversity (as well as a unique composition) was observed in this habitat and therefore, these systems are assigned high avifaunal importance. The drainage lines act as important flight corridors for water associate, passerines and raptors between foraging and roosting sites. Grey crowned cranes **may** utilise the habitat on the upslopes of drainage lines for foraging.
- The surface water habitats (artificial dams) are vital in the landscape, primarily due to the connection with both grasslands and drainage lines and their presence as water associated breeding habitat. Avifaunal species depend on an interconnected system of water features (artificial or otherwise) and, based on seasonality and prevailing climatic conditions, it is anticipated that these systems experience a frequent turnover of species over time (seasonally and long term). They often provide essential breeding habitat, foraging habitat and water resources for avifaunal species including large, bodied SCC such as herons, ducks and storks.

- The natural grasslands as foraging habitat for diurnal birds of prey. It also provides potential hunting habitat for all SCC eagles (especially Martial) which hunt prey common in these habitats.
- The powerline corridor due to the plethora of SCC persisting and depending on the habitat and buffer within the PAOI.

4.9.3 Low and Medium SEI

Areas with medium avifaunal sensitivities include the disturbed grasslands and agricultural fields as well as alien tree stands:

- Most of these habitats are currently disturbed and non-sensitive, replete with synanthropic species.
- The trees can provide roosting habitats for raptors.
- The habitats are resilient despite current disturbance and recovery is likely with adequate management and avoidance.

5 IMPACT ASSESSMENT

5.1 BACKGROUND TO INTERACTIONS BETWEEN SOLAR ENERGY FACILITIES, POWER LINES AND BIRDS

The effects of a solar farm on birds are highly variable and depend on a wide range of factors including the design and specification of the development, the topography of the surrounding land, the habitats affected, and the number and species of birds present.

Typical potential impacts include (but are not necessarily limited to):

- Habitat loss (including foraging and breeding) and fragmentation due to displacement (avoidance of disturbance). Habitat loss has the tendency to not only destroy existing habitat but also displace bird species from large areas of natural habitat. This specifically has a greater impact on bird species restricted to a specific habitat and its requirements.
- Collision and electrocution with above-ground power transmission lines (to be assessed in separate application). In some cases, collision can be associated with combustion (streamers) from polarised light pollution and waterbird species mistaking large PV panels areas as wetlands or other waterbodies, a case known as the "lake effect" (as per Jenkins *et al*. 2017). The mitigation of these impacts are addressed in this final EIA report with operational phase monitoring designed in the EMPr.
- Disturbance due to noise, such as machinery movements and maintenance operations during the construction and operational phase of the proposed PV solar farm.
- The attraction of some novel bird species due to the development of a solar farm with associated infrastructure, such as perches, nest and shade opportunities
- Chemical pollution: Chemicals being used to keep the PV panels clean from dust (suppressants), etc.

New mitigation measures range from simple (e.g., buffering of habitats) to complex (retrofitting of panels to avoid Lake Effect Impacts). However, by far, the best mitigation option remains the first step of the mitigation hierarchy which is "avoidance". Consequently, all attempts must be made to avoid potential impacts arising from the proposed development through the application of necessary buffers for sensitive areas, where placement of panel infrastructure may not occur. Additional remaining impacts must be minimised through the application of known and previously tested mitigation measures.

Potential mitigation measures:

- Impacts associated with the loss of bird foraging habitat due to construction activity cannot be mitigated in relation to the majority of the habitats but can be mitigated by avoiding avifauna-specific highly sensitive areas and their associated buffers;
- Impact can be mitigated by timing construction in order to avoid breeding periods of species;
- Set-back areas or buffer zones are allocated to sensitive or important habitat features to alleviate the effect of foraging and nesting/ roosting habitat in particular;
- Impacts due to bird mortalities during the operational phase are practically unavoidable for any large facility, but with the appropriate mitigation measures these impacts can be minimised. It is likely that most of the avifaunal populations

will be largely displaced from the majority of the project infrastructure, although significant risks are associated with the likelihood of project vehicles flushing birds into fencing infrastructure as well as collisions of large bodied species with powerlines;

- All powerline infrastructure must be fitted with approved bird diverters in order to provide visibility for large-bodied birds while all fences must be set back from every service road in order to allow for vulnerable species such as cranes and korhaans to obtain adequate height after being flushed by vehicle traffic;
- Migratory pathways of birds cannot be changed and the resulting impacts are unavoidable. However, severity of the impacts can be reduced with appropriate mitigation measures;
- All habitat attractants should be eliminated so that avifaunal populations will not embed themselves within the infrastructure over time. This includes bird diverters, perch deterrents and the application of Non-polarising white tape can be used around and/or across panels to minimise reflection which can attract aquatic birds and insects (food) as panels mimic reflective surfaces of waterbodies;
- The application of strict chemical control protocols which are not detrimental to avifauna.

Table 5-1: Impacts Associated with the SEF

Roos SEF Clusters																				
ENVIRONMENTAL PARAMETER	**ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE**	**ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION**									**RECOMMENDED MITIGATION MEASURES**	**ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION**								
		E	**P**	**R**	**L**	**D**	**I / M**	**TOTAL**	**STATUS (+ OR -)**	**S**		**E**	**P**	**R**	**L**	**D**	**I / M**	**TOTAL**	**STATUS (+ OR -)**	**S**
Construction Phase																				
Habitat destruction	Significant habitat loss (including foraging and breeding) and fragmentation due to displacement (avoidance of disturbance) because of infrastructure installation (panels, powerlines, roads,	3	4	3	4	2	3	48	-	High	Impacts associated with the loss of bird foraging habitat due to construction activity cannot be mitigated in relation to the majority of the habitats but can be mitigated by avoiding avifaunal specific highly sensitive areas and their associated buffers, such as the local drainage lines, impoundments, smaller watercourses, high value sandy dunes, pans and rocky koppies. The overall severity of the impact can be reduced to being insignificant if avoidance	2	2	2	2	4	2	24	-	Med

	fences and sub surface cables) and associated dust effects. Habitat loss has the tendency to not only destroy existing habitat but also displace bird species from large areas of natural habitat. This specifically has a greater impact on bird species restricted to a specific habitat and its requirements.										mitigation is applied related to the positioning of the panels and supporting infrastructure and minimisation mitigation is applied. Finally, and for all panel infrastructure, **commencement** of construction should be, if possible, limited to the months of December, January, February, March, April, May, September, October, November (latest) to minimise dust effects and subsequent destruction of the avifaunal habitats, especially during foraging and breeding season. **For detailed wetland specific mitigation measures, refer to Section 5.3 below.**									
Disturbance of bird roosts and breeding sites	The destruction or disturbance of bird roosts during the construction phase	3	4	3	4	2	3	48	-	High	As with other impacts, this impact can be mitigated by preferably timing construction to May, June, July and August in order to avoid breeding periods of species within the sensitive drainage lines, wetlands and the general region. If construction takes place outside of May, June, July and August, all noise generated by machinery and maintenance operations must be kept to a minimum.	2	3	2	2	2	2	22	-	Low

Disturbance due to noise such as, machinery movements and maintenance operations	Disturbance (including of nesting SCC) due to noise such as, machinery movements and maintenance operations during the construction phase the proposed PV solar farm causing loss of offspring for a generation.	3	3	1	2	3	3	36	-	Med	As with other impacts, this impact can be mitigated by preferably timing construction to May, June, July and August in order to avoid breeding periods of species within the sensitive drainage lines, wetlands and the general region. If construction takes place outside of May, June, July and August, all noise generated by machinery and maintenance operations must be kept to a minimum.	3	2	1	2	3	2	22	-	Low
Operational Phase																				
Disturbance due to noise such as, machinery movements and maintenance operations	Disturbance (including of nesting SCC) due to noise such as, machinery movements and maintenance operations during the construction phase the proposed PV solar farm causing loss of offspring for a generation.	3	3	1	2	1	2	20	-	Low	No Mitigation Required	3	3	1	2	1	2	20	-	Low

Bird mortalities	Bird mortalities during the operational phase due to vehicle collisions, collisions with infrastructure and/or combustion.	3	4	3	4	2	3	48	-	High	Impacts due to bird mortalities during the operational phase are practically unavoidable for any large facility, but with the appropriate mitigation measures these impacts can be minimised. It is likely that most of the avifaunal populations will be largely displaced from the majority of the project infrastructure, although significant risks are associated with the likelihood of project vehicles flushing birds into fencing infrastructure as well as collisions of large bodied species with powerlines. Although the current overall bird activity qualifies the proposed solar development boundary as a high-density area, there are certain times of the year (and day) when it appears that large flocks of birds (such as bustards and large birds of prey) are far more prevalent. All powerline infrastructure must be fitted with approved bird diverters in order to provide visibility for large-bodied birds. In all areas where service road intersects with semi natural or natural habitat, all fences that are constructed (if any) must be set back at least (strictly) 75 metres from the edge of every service road in order to allow for	2	2	2	2	4	3	36	-	Med

											vulnerable species such as coursers, cranes and korhaans to obtain adequate height after being flushed by vehicle traffic. An Alternative mitigation measure and where a 75 metre buffer is not possible, new fences must be set back no more than 2 metres (directly adjacent) from the edge of service roads. Through the essential elimination of habitat, this will limit any chance of vulnerable species foraging on verge side vegetation and causing subsequent fence collisions. Finally, reflective diverters should be attached to new fencing alongside regular maintenance roads every 50 metres.									
Loss of Bird Foraging Habitat	Loss of Bird Foraging Habitat	3	3	3	3	3	3	45	-	High	Impacts associated with the loss of bird foraging habitat due to operations can be mitigated by avoiding avifaunal specific sensitive areas and their associated buffers, such as the local drainage lines, impoundments, smaller watercourses, sandy dunes, pans and koppies. A green buffer should be maintained around all habitats designated as High Sensitivity or above.	3	2	2	2	2	2	22	-	Low

Disruption of bird migratory pathways	Disruption of bird migratory pathways during the operational phase	2	2	2	2	4	3	36	-	Med	Migratory pathways of birds cannot be changed and the resulting impacts are unavoidable. However, severity of the impacts can be reduced with appropriate mitigation measures. Some significant discernible migratory flight pathways were able to be established which could be explained by large areas of generic habitats punctuated by some distinguishing geographic features in the landscape, such as large ridges, large impoundments, wetlands and drainage lines. The linear Drainage line habitats must be buffered by a minimum of 50 metres from the edge of the demarcated wetland.	3	2	2	2	2	2	22	-	Low
The attraction of some novel bird species due to the development of a solar farm with associated infrastructure such as lake effect, perches, nest	The attraction of some novel bird species due to the development of a solar farm with associated infrastructure such as lake effect perches, nest and shade opportunities may cause both damage to the	2	2	2	2	4	3	36	-	Med	Essentially, all habitat attractants should be eliminated so that avifaunal populations will not embedded themselves within the infrastructure over time. This includes bird diverters, perch deterrents and the application of non-polarising white tape can be used around and/or across panels to minimise reflection which can attract aquatic birds and insects (food) as panels mimic reflective surfaces of waterbodies. An ECO can advise on the mitigations	3	2	2	2	3	2	24	-	Med

and shade opportunities	infrastructure through acidic defecation by certain species but also draw birds closer to infrastructure and cause significant direct mortality risks.										during operations.									
Chemical pollution spills	Chemicals being used to keep the PV panels clean from dust (suppressants) etc.	3	3	2	2	4	3	42	-	High	Application of strict chemical control procedures as per the EMPr. Zero spills should be targeted and full clean up kits available in the event of any chemical spill. Soil testing subject to EMPr.	1	2	2	2	3	2	20	-	Low
Decommissioning Phase																				
Disruption of bird migratory pathways	Disruption of bird migratory pathways during the decommissioning phase	3	2	2	2	3	2	24	-	Med	Decommissioning of panels must not commence during the peak wet season months on November, December and January.	3	2	2	2	2	2	22		Low
Habitat destruction post decommissioning	Destruction of habitats and scarring	3	3	2	2	4	3	42	-	High	• A rehabilitation plan must be commissioned before construction commences. • All topsoil harvesting must	3	2	2	2	3	2	24	-	Med

											take place in the dry season (late dry season). • Returning the wetlands to their original grade must take place as minor differences in the final surface elevation can produce significant impacts on the type of vegetation that re-establishes itself (alien invasive species). • When topsoil is salvaged and returned, it is anticipated without reseeding that dense vegetative communities of native species can regenerate within two growing seasons. • As emergent wetlands will recover more quickly than others, artificial seeding is not advised as it creates competition for reestablishment of native facultative and obligate wetland vegetation.									

Table 5-2: Cumulative Impact Assessment

Cumulative: There are a number of existing renewable energy projects (currently only solar Energy Facilities (WEFs)) that already have quantified negative impacts on the avifauna community in the region. Therefore, any impacts anticipated from the proposed solar facility will add to these existing impacts and require assessment under a Cumulative Impacts assessment. Results obtained during this preconstruction survey and from the subsequent impact analysis should be considered in conjunction with the impacts created by the proposed development. The current developments within the region raise the possibility of significant cumulative impacts, especially concerning collision risk, habitat loss and fragmentation and loss of suitable habitat for threatened species.																				
Construction and Operational Phases																				
Habitat loss	Regional Saturation of SEF facilities causing habitat loss	3	4	3	3	4	4	68	-	Very High	Not able to be mitigated quantitatively. Mitigation measures are similar to SEF facility. Where possible, apply necessary buffers for roost sites and other sensitive bird habitat features, avoiding the construction of panels and access roads in these areas. Roads must utilise or upgrade existing farm roads as far as possible. All underground cables bisecting sensitive habitats must be placed below the subsurface flow of the ephemeral wetlands with the linear construction pits subjected to full rehabilitation in order to maintain normal subsurface slow. All roads and crossings must be engineered not to impede surface or subsurface flow in any way.									N/A

Collison mortality (vehicle)	Increased roadkill due to higher traffic volumes	3	3	3	3	4	3	48		High	Strict enforcement of speed limits in the PAOI as well saturation of fence infrastructure with reflective diverters and maintaining fence set aside distances (75/ 5 metres).	3	2	1	1	2	2	18		Low
Collison mortality (infrastructure)	Increased mortalities due to collisions with SEF infrastructure, especially powerlines and fences	3	3	3	3	4	3	48		High	Impacts due to bird mortalities during the operational phase are practically unavoidable for any large facility, but with the appropriate mitigation measures these impacts can be minimised. All powerline infrastructure must be fitted with approved bird diverters in order to provide visibility for large-bodied birds. Positive Cumulative Mitigation will be the **retrofitting of existing powerline infrastructure (in consultation with Eskom)** which currently does not have diverter infrastructure in place.	2	2	2	2	4	3	36	-	Med
Decommissioning Phase																				
Cumulative: Powerlines are ubiquitous throughout the South African rural landscape and ever-increasing connectivity combined with current developments within the region raise the possibility of significant cumulative impacts, especially concerning collision risk.																				
Collison mortality (powerlines)	Increased collision related mortalities due to increased	3	3	3	3	4	3	48		High	Saturation of powerline infrastructure with approved bird diverters	3	2	2	2	3	4	48		High

	powerlines																			

5.1.1.1 Post Construction Rehabilitation

- A rehabilitation plan must be commissioned before construction commences, especially for sandy dunes, drainage lines and wetlands.
- All topsoil harvesting must take place in the dry season (late dry season).
- Returning the wetlands to their original grade must take place as minor differences in the final surface elevation can produce significant impacts on the type of vegetation that re-establishes itself (alien invasive species).
- When topsoil is salvaged and returned, it is anticipated without reseeding that dense vegetative communities of native species can regenerate within two growing seasons.
- As emergent wetlands will recover more quickly than others, artificial seeding is not advised as it creates competition for reestablishment of native facultative and obligate wetland vegetation.

5.2 GENERAL MITIGATION OF IMPACTS

Due to the global demand for renewable energy, a strong research emphasis has been placed on describing and defining mitigation measures to negate or minimise the negative impacts associated with such facilities. In particular, much research is focused on bird impacts prevention/minimisation at solar facilities (see TBC 2021). New mitigation measures range from simple (e.g. buffering of habitats) to complex (retrofitting of panels to avoid Lake Effect Impacts). However, by far the best mitigation option remains the first step of the mitigation hierarchy which is “avoidance”. Consequently, all attempts will be made to avoid potential impacts arising from the proposed development through the application of necessary buffers for sensitive areas, where placement of panel infrastructure may not occur. Additional remaining impacts will be minimised through the application of known and previously tested mitigation measures.

Alternative additional mitigation measures may include change of the current land use to minimise attraction for priority species. Since development and construction go hand in hand with high ambient and stochastic noise levels (machinery) and habitat loss, it is possible for bird species and bird individuals to be displaced from the surrounding environment. It is essentially true for large species that require extensive home ranges, and those species that are inherently shy or unobtrusive by nature (e.g., raptors). Displacement will be the response of raptors to the disturbance activity, for example when a bird changes its behaviour or takes flight by aborting its activity prior to the disturbance or being unsuccessful in completing its current activity (Ruddock & Whitfield 2007). Reactions are likely to differ between species and between individuals of the same species (Rogers & Smith 1995; Rogers & Schwikert 2002). Reactions are also positively correlated to the magnitude and frequency of a particular disturbance event. For the proposed solar facilities as well as the cumulative impacts, it cannot be predicted to a 100% confidence to what degree these activities will affect the Priority Species, but it must be stated that many bird species will become accustomed, or have the ability to learn and adapt, to constant occurring disturbance events of low magnitude (e.g. vehicle noise) unless they are directly affected (e.g. their physical habitat is affected). Collision with powerlines is the most significant impact for the species in the region.

Set-back areas or buffer zones are allocated to sensitive or important habitat features to alleviate the potential effect of foraging and nesting/ roosting habitat in particular and these are built in to the sensitivity mapping. The choice of an appropriate set-back

distance is complex since different species and even different taxon groups demand different habitat types or home ranges to maintain a viable population in the long term. Given that the study area has not been confirmed as a foraging site and breeding site for Secretary Birds and Vultures but is a foraging site for other raptor species, the mitigation recommendations that are proposed in order to preserve the basic existing High sensitivity ecological function of the raptor habitats, minimising collisions and to maintain foraging corridors for large SCC raptor species in the form of a set-back area of natural vegetation are considered non-negotiable.

5.3 SUMMARY OF PROPOSED MITIGATION MEASURES

It is deemed possible, through the application of appropriate mitigation measures, to restrict the impact of on the local and regional avifaunal population to a low level of significance. The following mitigation summary is provided:

Habitat destruction: Where possible**,** apply necessary buffers for roost sites and other sensitive bird habitat features, avoiding the construction of panels and access roads in these areas. Roads must utilise or upgrade existing farm roads as far as possible. All underground cables bisecting sensitive habitats must be placed below the subsurface flow of the ephemeral wetlands with the linear construction pits subjected to full rehabilitation in order to maintain normal subsurface slow. All roads and crossings must be engineered not to impede surface or subsurface flow in any way.

Bird mortality: Avoid placement of panels near sensitive bird breeding and roosting habitats. The application of adaptive mitigation measures (e.g., retrofitting non-polarising white tape can be used around and/or across panels to minimise reflection), according to post-construction monitoring results (counted collisions of threatened species) must be informed by environmental correlates of avifaunal activity and/or collisions (EMPr).In addition, the addition of grazing sheep to the footprint may attract raptor SCC who may scavenge on dead lambs/ adult sheep or prey upon livestock. Strict carcass retrieval must be incorporated into the EMP where carcasses are removed and correctly disposed of within the same day of death. This will require constant monitoring of all sheep herds in the footprint.

Impacts due to bird mortalities during the operational phase are practically unavoidable for any large facility, but with the appropriate mitigation measures these impacts can be minimised. It is likely that most of the avifaunal populations will be largely displaced from the majority of the project infrastructure, although significant risks are associated with the likelihood of project vehicles flushing birds into fencing infrastructure as well as collisions of large bodied species with powerlines. Although the current overall bird activity qualifies the proposed solar development boundary as a high-density area, there are certain times of the year (and day) when it appears that large flocks of birds (such as cranes bustards and large birds of prey) are far more prevalent. All powerline infrastructure must be fitted with approved bird diverters in order to provide visibility for large-bodied birds. In all areas where service road intersects with semi natural or natural habitat, all fences must be set back at least (strictly) 75 metres from the edge of every service road in order to allow for vulnerable species such as cranes and korhaans to obtain adequate height after being flushed by vehicle traffic. Alternative 2 and where a 75-metre buffer is not possible, **new** fences must be set back no more than 5 metres (directly adjacent) from the edge of service roads. Through the essential elimination of habitat, this will limit any chance of vulnerable species foraging on verge side vegetation and causing subsequent fence collisions.

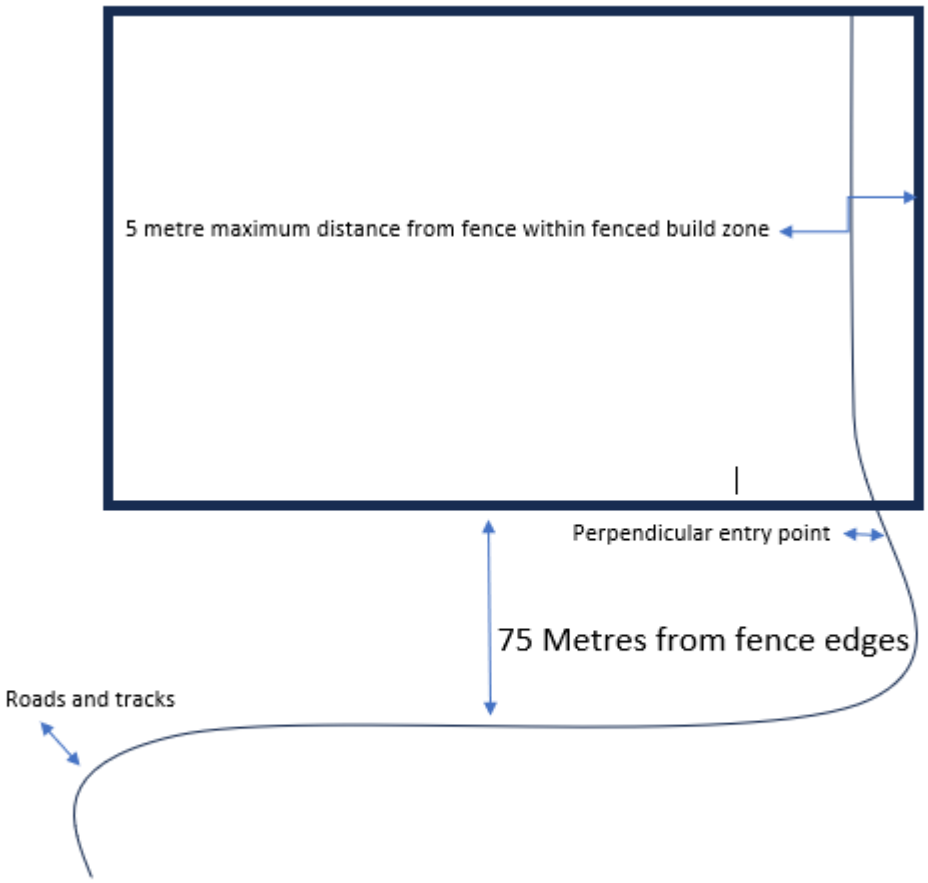

Figure 5-1: Diagrammatic representation of road alignment with fencing infrastructure

Bird collisions with panels and powerlines: Use of parabolic (curved) mirrors is preferred instead of flat heliostats to reduce the likelihood of skyward reflection to minimise potential bird collisions. However the use of flat panels does not represent a fatal flaw. All powerlines must be flapped with appropriate diverters and no elevated powerlines are to cross drainage line habitats.

Habitat Destruction: It is recommended that limited development takes place in High sensitivity areas. Minimise impacts to natural and artificial wetlands and water bodies by implementing the appropriate buffer areas where no development may take place. This includes a 50 m proposed no-go buffer proposed around small artificial water points as they serve as focal points for bird activity and 50 metres around drainage lines/ wetlands. All large impoundments require a buffer from any infrastructure activity. The buffering is displayed on the sensitivity mapping although significant infrastructure is far more than the required minimum buffering.

Impacts on foraging and breeding habitats: Impacts associated with the loss of bird foraging and breeding habitat due to construction activity cannot be mitigated in relation to the majority of the habitats but can be mitigated by avoiding avifaunal specific highly sensitive areas and their associated buffers, such as the local drainage lines, impoundments, smaller watercourses, pans and rocky koppies. The overall severity of the impact can be reduced to being insignificant if avoidance mitigation is applied related to the positioning of the panels and supporting infrastructure and minimisation mitigation is applied.
Disruption of breeding and foraging behaviour: As with other impacts, this impact can be mitigated by preferably timing construction to May, June, July and August in order to avoid breeding periods of species within the sensitive drainage lines, wetlands and the general region. If construction takes place outside of May, June, July and August, all noise generated by machinery and maintenance operations must be kept to a minimum.

5.4 SPECIFIC MITIGATIONS FOR WETLAND AND WATERBODY CROSSINGS

The Site Development Plan (SDP) provided clearly shows potential interaction between infrastructure and designated High Sensitivity avifaunal features. Methods used for constructing linear infrastructure (such as buried powerlines, pipelines, raised powerlines, roads) across wetlands or drainage lines will vary, depending on the nature of wetland hydrology and soils. Thus, the following specific prescribed mitigations as well as guiding principles and "best practice" are described below.

1. An ECO should be appointed in order to consult with the engineers regarding the technical requirements of the following mitigations. Changes may be allowed as per the ECOs discretion.
2. Horizontal directional drilling is preferred for the crossing of wetlands,
3. If as is more typical, an open trench is dug, mitigations should be implemented to reduce impacts to wetland hydrology and soil structure.
4. All pipeline corridors (affected areas) should be implemented to a maximum 10 metres wide through wetlands during construction.
5. During construction, laydown areas must be located in uplands a minimum of 35 metres from the wetland edge.
6. Construction equipment used while working in wetlands is limited to only those pieces that are essential and non-essential equipment is allowed to travel through wetlands only once during deployment and once during extraction.
7. During vegetation clearing, sediment barriers such as silt fences must be installed and maintained adjacent to wetlands.
8. The method of pipeline construction used in wetlands depends on the stability of the soils. Overall, topsoil is first removed and stored separately from the subsoil. Where wetland soils are saturated, segregating topsoil is not possible. Large timber mats placed ahead of the construction equipment can provide a stable working platform and protect wetland soils by spreading the weight of the construction equipment over a broad area.
9. Generally, the preferred method for crossing an actively flowing waterbody with a pipeline is horizontal directional drilling as compared to open-cut trenching. With this method, a hole is dug below the stream crossing and pulling a prefabricated section of pipe through the hole. The goal is for zero interruption to flow.
10. Open-cut crossings involve cutting a trench across the waterbody while water flows through the trenching area. Where the water is shallow enough, it may be diverted by flumes and pumps. A flume pipe may be placed to divert the water around the trenching area. Pumps in combination with dams may also be used to divert the water during open-cut trenching.

11. Where possible, pipelines can be installed using the push-pull technique-- stringing and welding the pipeline outside of the wetland and excavating and backfilling the trench using a backhoe supported by equipment mats or timber riprap. The prefabricated pipeline is installed in the wetland by pushing or pulling it across the trench. After the pipeline is floated into place, the floats are removed and the pipeline sinks into place. The trench is backfilled to the proper grade to maintain wetland hydrology and grades are restored to the original elevation.
12. If topsoil is segregated from subsoil, then subsoil is backfilled first.

5.4.1.1 Best Practice for Wetland Crossings

1. Avoidance. Avoid the construction of a crossing or staging area by either choosing an alternative route or by using aerial or overhead equipment;

2. Minimization. Limit the number of crossings and the number of equipment trips to as few as possible. Limit the number of equipment staging areas and spoil storage areas.

3. Use of Previously disturbed Areas. Use existing access roads, or staging areas.

4. Selection of Crossing Location. Consider criteria when locating crossing sites to minimize disturbance, such as shortest crossing point, avoiding unstable or steep banks, avoiding highly erodible soils, avoid unstable portions of stream channels.

5. Scheduling. Schedule construction during the season least damaging to the stream or wetland system (i.e. dry season).

5.4.1.2 Powerline Crossing of Wetlands

Presented below are design objectives, considerations and examples of construction techniques of best practices. Variables of avifaunal sensitivity include such factors as wetland quality, topography, congregatory avian populations, prey populations, line configuration, adjacent wetlands, and historical bird use areas, all of which have been assessed as part of the pre-construction monitoring. The following mitigation measures are suggested;

- Avoid siting lines in areas where birds concentrate;
- In all raised powerline crossings, powerlines must install bird diverters to enhance visibility of lines;
- Where possible, construction should involve the burying of lines underground.
- In order to reduce avian mortalities related to bird collisions or nests, perch guards should be installed on all infrastructure (such as poles and platforms).

5.4.1.3 Wetland Road Design and Construction Practices

- All road construction should preferably take place in the dry season.
- A temporary road in a wetland needs to provide adequate crossroad drainage at all natural drainageways. Temporary drainage structures include culverts, bridges, and porous material.
- Prior to construction, areas of infrastructure placement must be graded flat so as not to cause vegetation root mat loss or restriction to sub surface flow. Topsoil storage must be enacted. Construction of roads must occur at natural ground level (not below) to minimize to restricting water flow.
- Limit or restrict the construction of fill roads. All fill roads must use a permeable fill material (such as gravel or crushed

rock) for at least the first layer of fill in order to maintain the natural flow regimes of subsurface water.

- It is preferable to eliminate fill roads and utilise raised bridges and culverts with adequate sizing and spacing of water crossing structures, proper choice of the type of crossing structure, and installation of drainage structures at a depth adequate to pass subsurface flow.

5.5 GENERAL MITIGATION MEASURES

- Formal post construction monitoring must be applied once the development have been activated, as per the most recent edition of the best practice guidelines (Jenkins et al. 2017). The exact scope and nature of the post-construction monitoring will be informed on an ongoing basis by the result of the monitoring through a process of an establishment of available new technology and adaptive management. The purpose of this would be to establish if and to what extent displacement of priority species has occurred through the altering of breeding and foraging behaviour post-construction, and to search for and identify carcasses near panels and newly erected powerlines (mortality).
- Post-construction monitoring should be undertaken as per the EMPr and Section 6 of this report. The exact scope, nature and frequency of the post-construction monitoring will be informed on an ongoing basis by the results of the monitoring through a process of adaptive management.

5.6 CUMULATIVE IMPACT ASSESSMENT DISCUSSION

The cumulative effects of regional solar farm developments on birds are highly variable and depend on a wide range of factors including the density, designs and layouts of the infrastructure. This was evaluated within the framework of this final EIA report. The map of regional WEF and SEFs in relation to the Roos SEF is shown as Figure 5-2 with the surface area calculations shown as ***Table 5-3***.

Table 5-3: Cumulative Impact Calculations for the Roos SEF Clusters

Type	Area (m)	Area (ha)	Percentage of 30 km buffer
ROOS PV	673153.21	67.32	0.02
Wind	6496903.53	649.69	0.21
PV	9261194.39	926.12	0.31
PV+Roos PV	9934347.60	993.43	0.33
ALL+Roos PV	16431251.13	1643.13	0.54
30 km	3024739682.33	302473.97	100.0

There are a number of existing renewable energy projects (both solar and WEFs) that already have quantified negative impacts on the avifauna community in the region. Therefore, any impacts anticipated from the proposed solar facility will add to these existing impacts and require assessment under a Cumulative Impacts assessment. Results obtained during this preconstruction survey and from the subsequent impact analysis should be considered in conjunction with the impacts created by the proposed development. The current developments within the region raise the possibility of significant cumulative impacts, especially concerning collision risk, habitat loss and fragmentation and loss of suitable habitat for threatened species.

The following current impacts will be exacerbated through increased solar developments regionally;

- Habitat loss: The destruction of highly sensitive habitat (for example sandy dune habitats for Red Lark) will potentially increase. Many SCC exist within a narrow ecological and distributional belt and loss of its ecologically specific habitat may be highly significant.
- Road-kills: Many birds are commonly killed on roads and flushed into fences associated with the facility (e.g., Karoo Korhaan and Ludwig's Bustard).
- Regional saturation of solar facilities: This has implications for several priority species, both in terms of lake effect, collision mortality from additional powerline infrastructure (see below) for some species, especially Bustards and Raptors, and displacement due to transformation of habitats.
- Powerlines: Numerous existing and new power lines are significant threats to large terrestrial priority species in the region as powerlines may kill significant numbers of all large terrestrial bird species.

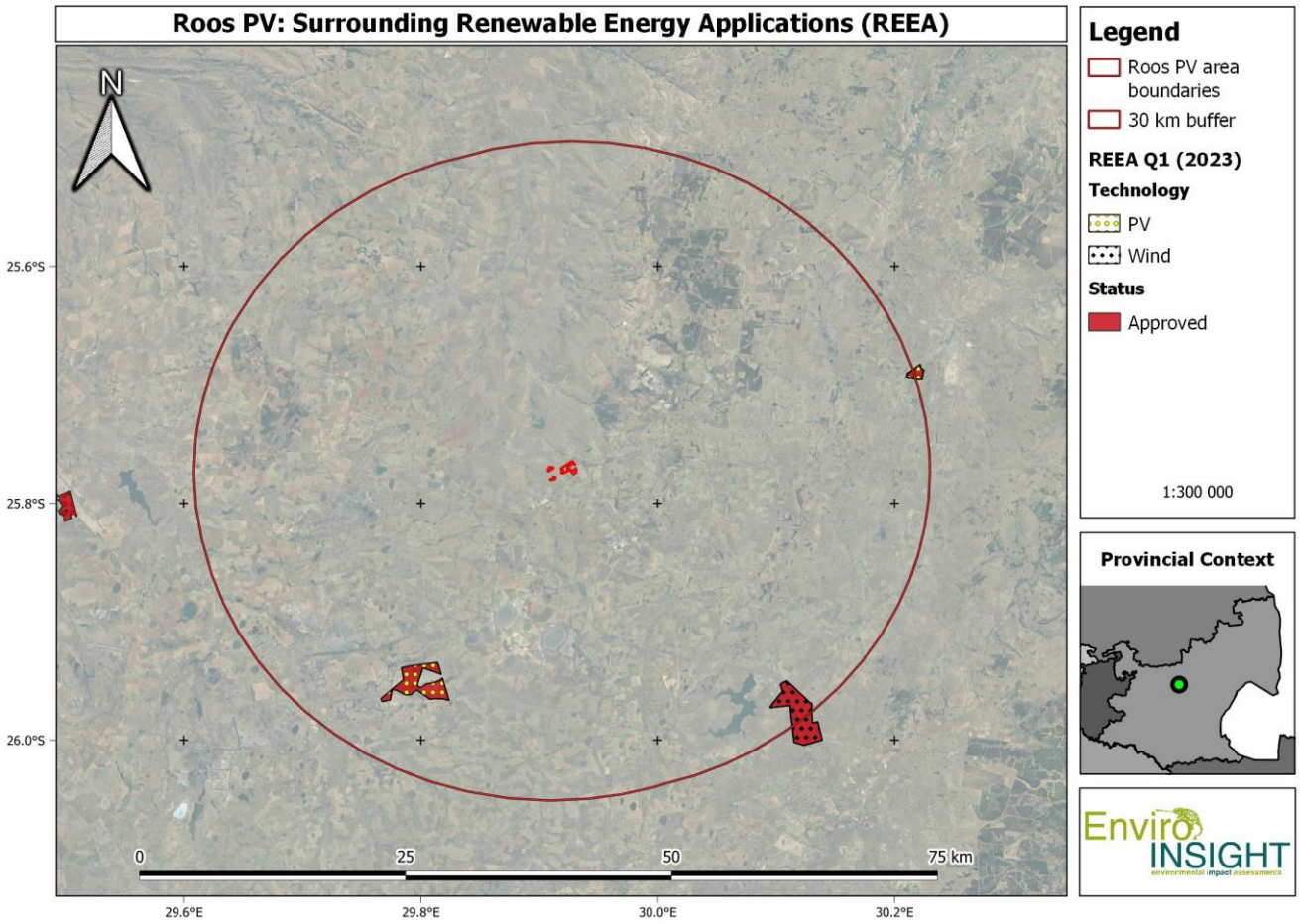

Figure 5-2: The map of regional SEFs in relation to the Roos

5.7 SPECIES SPECIFIC RISK ANALYSIS AND RECOMMENDED MITIGATIONS

Ultimately, it is suggested that the morphological and behavioural; characteristics of a given bird species traits of birds, especially those related to size, wing beat, manoeuvrability, flight pattern and hunting/ foraging behaviour, are known to influence the relative collision risk with structures such as power lines and solar panels. Larger bird species often need to use thermal and updrafts to gain altitude, particularly for long distance flights. Thermal updrafts (thermals) and orographic lift (slope updraft) will affect the relative risk per species. The relatively flat nature of the survey area dictates that the overall topography related risks are low, However, some higher risk species have been identified and described below.

5.7.1 Southern Grey Crowned Crane

Grey Crowned Cranes are globally and regionally listed as Endangered (BirdLife International 2012b and Taylor, *et. al.* 2015) which is cause for a significant evaluation of the species in relation to the proposed development. Extensive searches were carried out during the pre-construction monitoring process and the monitoring data suggest that no permanent population persist for prolonged periods within the PA. Multiple and frequent sightings were recorded in surrounding surveys (PAOI) by the specialist with no evidence on the PA. The species is highly migratory and localised development may not represent a fatal flaw.

Within the PAOI, this species is almost certainly resident and at risk to the creation of large, panels in combination with non-marked powerlines may cause collision of birds which could significantly reduce local and regional populations. In addition, large-scale increases in fencing combined with a high volume of large maintenance trucks and other vehicles may cause drastic declines in crane numbers due to flushing displacements, collisions and entanglements. The presence of this species must form a significant focal point of the mitigation measures.

On a final note, concerning monitoring of the species (and possible mitigations), it is vital to highlight that fact that as an Endangered species, Southern Grey Crowned Cranes demands higher degrees of auditing and monitoring attention than other Red-Listed birds (a fact supported by multiple publications including Visser *et. al.* 2018 and Scott *et. al.* 2012). It is also vital to highlight that presence or absence over time for a nomadic species is difficult to predict and spatial/ temporal population reductions may or may not be development-induced. For example, a prolonged drought may cause local colonisation which will be immediately reversed with the onset of more unusual heavy rains. Although it is highly feasible that the development may be directly responsible for local population reductions this is deemed unlikely given the lack of records in the PA and the suboptimal habitat.

5.7.2 Large and Medium Raptors

This group includes Eagles (Brown Snake, Black-Chested Snake and Martial Eagles), falcons (including IUCN VU Lanner Falcon), Kestrels and Kites. As a rule, all nesting raptors should be protected within the PA as many species represent Priority Species and if not, their nests are often colonised by Priority Species. Many raptor species are under constant pressure from development due to modifications and alterations of their preferred foraging and breeding habitats. This includes direct fatality as well as to the disruption of a foraging, breeding or roosting bird caused by SEF activities. Collision-caused fatalities of birds at SEFs create a 'green versus green' conflict between wildlife conservation and renewable energy. This conflict can be mitigated

through several interventions, including informed application of diverter infrastructure (flappers, diverters) when birds are considered at increased risk of collision.

6 MONITORING REQUIREMENTS

The following outlines a general monitoring plan (EMP) structure.

	Title: SCC community monitoring
Stressor	Project Activities, Climatic Changes
Receptor(s)	Avifauna SCC diversity and densities in each habitat type
Variables	Presence/absence of bird species of conservation concern, including observed breeding behaviour, proportion of SCC species present per sample site, species richness and densities.
Sampling Method	• Vantage Point counts – 2 x Three hour counts (morning and evening) to be conducted at each monitoring plot • Drive Transects (species lists) – all species seen to be recorded along set transects to be driven during dawn till pre 10 am; and • Walked Transects (species lists) – all species heard and seen to be recorded along set transects to be walked at dawn chorus
Sampling Frequency	• Annual wet and dry season surveys; and • Continuous observations by ECO.
Sampling Site(s)	As provided in EMPr.
Change and Action Thresholds	Loss/decrease in any SCC parameter, unnatural decline (cannot be explained by stochastic weather changes) in species densities and/or richness. Similarly, positive changes (e,g, unusual presence in high densities of nomadic species such as Ludwig's Bustard or establishment of SCC breeding population such as Secretary Bird) in species densities and/or richness that indicate disturbance. Rapid surveys of greater surrounding area should be conducted to attempt to determine cause of change detected.
Data Analysis	All variables acquired should be statistically and graphically compared to the available data and the original targeted baseline data. Photographs should be taken of as many SCC observed in the field.
Reporting requirements	Annual reporting presenting data analysis results and mapping indicating locations of change. Specific reporting on negative change detection not directly attributable to Project activities and their cause. All reporting to be accompanied by GIS shapefiles and any original photographs.

	TITLE: Collision monitoring
Stressor(s)	Avifauna-powerline and infrastructure collisions (incidents)
Receptor(s)	Avifauna community composition, density and distribution
Variables	Species, geographical location and date of every avifaunal mortality
Sampling Method	• For powerlines: Weekly surveys before dawn (prior to scavenger activity) by driving slowly along the servitudes and documenting each collision kill location and species (a georeferenced photograph as evidence is required).
Sampling Frequency	Weekly for powerlines
Sampling Site(s)	Along the entire powerline network on the PAOI.
Collision Action Thresholds	Collision frequency and intensity (#kills per species per unit time) will need to be assessed per species by specialist. However, any non-specific collision concentrations (> 10 kills per month clustering in a stretch of powerline) must initiate investigation and corrective measures (additional mitigation infrastructure).
Data Analysis	Geospatial analysis of density and dispersion of avifaunal mortalities highlighting the core areas of mortalities so that corrective measures can be implemented. Time-series and trend analysis to accompany evaluation to inform on temporal fluctuations (e.g. seasonality) and steer adaptive management. Cumulative species-specific summary statistics to be calculated.
Reporting requirements	• Bi-annual reporting of faunal avifaunal mortalities associated with collision data highlighting locations where corrective measures are to be taken (if necessary).

Table 5-4: EMP Table Summary for Roos SEF

Roos SEF					
Impact/Aspect	**Mitigation/Management Actions**	**Responsibility**	**Methodology**	**Mitigation/Management Objectives and Outcomes**	**Frequency**
Design					
Construction					
Disturbance of bird roosts	• As with other impacts, this impact can be mitigated by timing of any panel construction to not commence in November, December and January in order to avoid breeding periods of species within the sensitive drainage lines, wetlands and the general region.	• Client Appointed ECO.	• Drive Transects (species lists) – all species seen to be recorded along set transects to be driven during dawn till pre 10 am; and • Walked Transects (species lists) – all species heard and seen to be recorded along set transects to be walked at dawn chorus. • All variables acquired should be statistically and graphically compared to the available data and the original targeted baseline data. Photographs	• Loss/ decrease in any SCC parameter, unnatural decline (cannot be explained by stochastic weather changes) in species densities and/or richness. Similarly, positive changes (e,g, unusual presence in high densities of nomadic species such as Bustards or establishment of SCC breeding populations (not yet sighted), Large SCC Raptors and Secretary Bird) in species densities and/or richness that indicate disturbance. Rapid surveys of greater surrounding area should be conducted to attempt to	• Twice weekly during construction.

			should be taken of as many SCC observed in the field. • Quarterly reporting presenting data analysis results and mapping indicating locations of change. Specific reporting on negative change detection not directly attributable to Project activities (Solar Facility Operation) and their cause. All reporting to be accompanied by GIS shapefiles and any original photographs.	determine cause of change detected.	
Disturbance due to noise such as, machinery movements and maintenance operations	As with "Disturbance of bird roosts"	As with "Disturbance of bird roosts"	As with "Disturbance of bird roosts"	As with "Disturbance of bird roosts"	As with "Disturbance of bird roosts"
Operation					
Bird mortalities	• Impacts due to bird mortalities during the operational phase are practically unavoidable for	• Company Appointed ECO, trained by SACNASP	• For panel location sites: weekly inspection on foot of cleared areas for	• Collision frequency and intensity (# kills per species per unit time) will need to be	• Weekly for panels between November and March.

	any large facility, but with the appropriate mitigation measures these impacts can be minimised. It is likely that most of the avifaunal populations will be largely displaced from the majority of the project infrastructure, although significant risks are associated with the likelihood of project vehicles flushing birds into fencing infrastructure as well as collisions of large bodied species with powerlines. Although the current overall bird activity qualifies the proposed solar development boundary as a high-density area, there are certain times of the year (and day) when it appears that large flocks of birds (such as cranes, bustards and large birds of prey) are far more prevalent. All powerline infrastructure must be fitted with approved bird diverters in order to provide visibility for large-bodied birds. In all areas where service road intersects with semi natural or natural habitat, all fences must be set back at least (strictly) 75 metres from the edge of every service road in order to allow for	registered Zoologist.	birds killed during the operation process. Location and species must be recorded (a georeferenced photograph as evidence is also required). • Monthly reporting presenting data analysis results and mapping indicating locations of change. Specific reporting on negative change detection not directly attributable to Project activities (Solar Facility Operation) and their cause. All reporting to be accompanied by GIS shapefiles and any original photographs.	assessed per species by specialist. However, any non-specific collision concentrations (> 10 kills per month clustering in a stretch of powerline) must initiate investigation and corrective measures (including retrofitting of mitigation measures).	

	vulnerable species such as bustards, raptors and korhaans to obtain adequate height after being flushed by vehicle traffic. An Alternative mitigation measure and where a 75-metre buffer is not possible, new fences must be set back no more than 5 metres (directly adjacent) from the edge of service roads. Through the essential elimination of habitat, this will limit any chance of vulnerable species foraging on verge side vegetation and causing subsequent fence collisions.				
• ***Disruption of bird migratory pathways*** • ***The attraction of some novel bird species due to the development of a solar farm with associated infrastructure such as lake effect, perches, nest and shade opportunities.*** • ***Disturbance due to noise such as, machinery movements and maintenance***	• Migratory pathways of birds cannot be changed, and the resulting impacts are unavoidable. However, severity of the impacts can be reduced with appropriate mitigation measures. Some significant discernible migratory flight pathways were able to be established which could be explained by large areas of generic habitats punctuated by some distinguishing geographic features in the landscape, such as large ridges, large impoundments, wetlands	• Company Appointed ECO, trained by a SACNASP registered Zoologist.	• For panel location sites: Monthly inspection using Drive and Walking Transects. • CWAC counts	• Species inventories and passage rate data collection.	• Monthly SCC and species inventories during November, December, January and February

operations.	and drainage lines. The linear drainage line habitats must be buffered in accordance with the EIA sensitivity mapping. • Essentially, all habitat attractants should be eliminated so that avifaunal populations will not embedded themselves within the infrastructure over time. This includes bird diverters, perch deterrents and the application of Non-polarising white tape can be used around and/or across panels to minimise reflection which can attract aquatic birds and insects (food) as panels mimic reflective surfaces of waterbodies.				
Chemical pollution	• The application of strict chemical control protocols as per the EMPr.	• Company appointed ECO.	• For panel location sites: weekly inspection on foot • Yearly soil analysis sent to accredited lab	• Spill Records • Yearly chemical analysis results matched to prescribed thresholds	• Weekly spill detection for panels

7 SENSITIVITY ANALYSIS

The study area mostly consists of grassland, agricultural and drainage line habitats in the proposed project footprint. The natural vegetation within the PA provides potential foraging habitat for bird species such as cranes, storks, korhaan, and possibly includes foraging habitat for species such as Martial Eagle and Secretarybird and other larger raptors. Accordingly, final sensitivities have been shown in **Error! Reference source not found.**. The figure indicates that the entire central-western area, as well as smaller pockets to the south and east, are "high sensitivity" areas, with some "no-go" areas. The drainage line running across the site has also been marked as a "no-go".

Nest Specific Mitigations

None

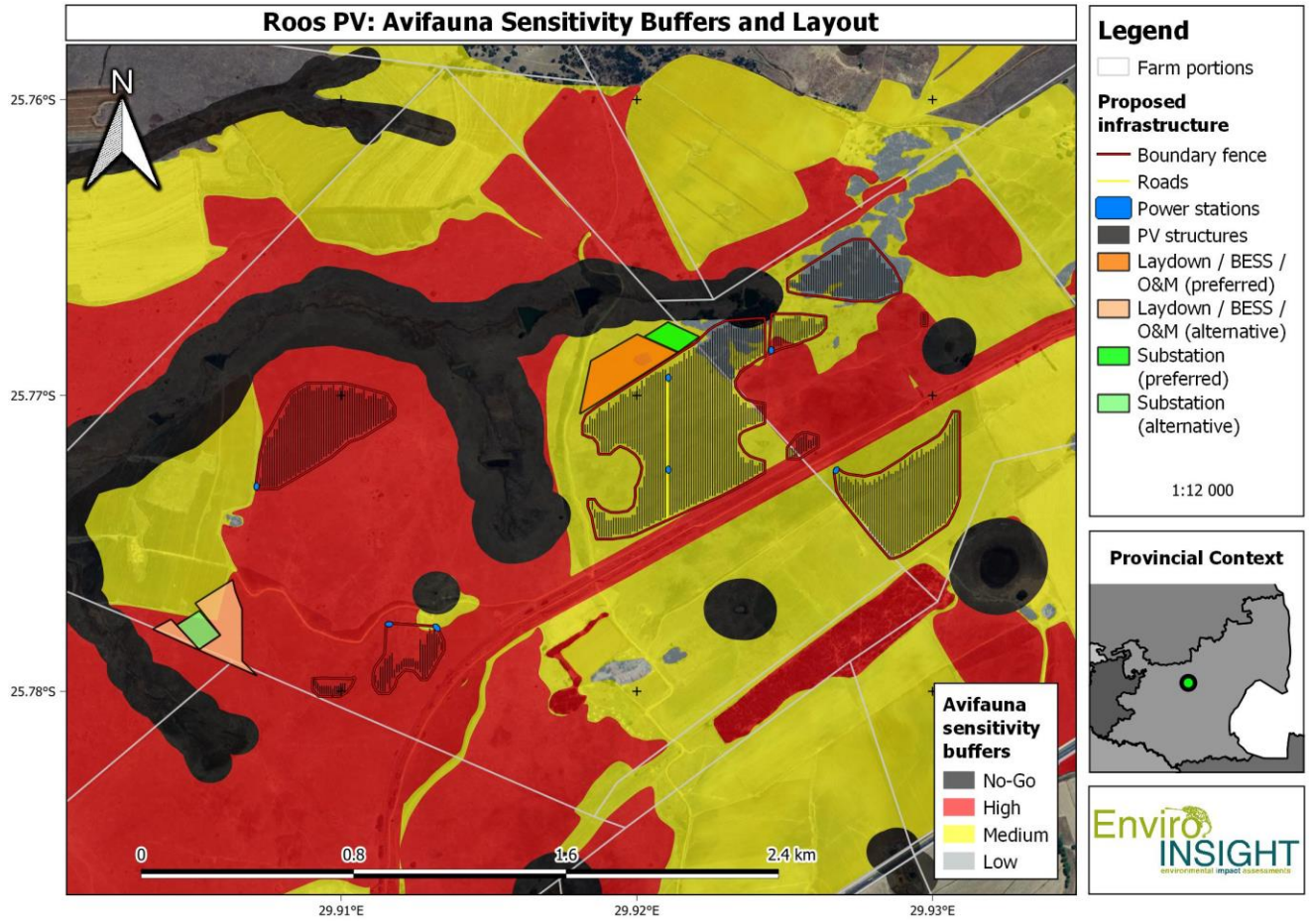

Figure 7.3: Avifauna Sensitivity Buffers with preferred solar infrastructure placement for the proposed Roos SEF.

8 PROFESSIONAL OPINION

The PA is located in a region dominated by natural grassland, drainage lines, disturbed grassland, cropland and stands of alien invasive trees. Several drainage lines and small farm dams can be found scattered across the PA with most being mostly permanent with some seasonal flow/ inundation. The powerline infrastructure that traverses the PAOI is a significant habitat for Martial Eagles and other raptors. Fifteen (15) priority species were predicted during the initial surveys, including Secretarybirds, Martial Eagles, Black-chested Snake Eagle, Southern Bald Ibis and White Storks Of these, the Secretarybirds and Martial Eagle were the most concerning large bird species. At the commencement of the survey, the PAOI was characterised by an extreme rainfall event (wet season) may have atypically transformed the PAOI where it is possible that increased densities (and perhaps diversity) of avifaunal assemblages may have been recorded due to an abundance of high forage value habitat. However, although the density and diversity of Priority Species was high, most of these species were common and widespread and largely synanthropic (water and natural grassland associates excluded) and the density and diversity of SCC was very low.

A final Professional Opinion is provided below.

8.1.1 Project Footprint Summary

- The addition of the proposed Roos SEF does indicate some (relatively few) potentially significant impacts (without mitigation) to the receiving environment via the risk to Priority Species (such as Secretary Bird, Martial Eagle, and Denham's Bustard and Southern Bald Ibis) and need to be considered with provision made within the EMPr for this development.
- Although previous impact assessments and monitoring programs for existing local SREFs indicated that not all impacts can be mitigated to acceptable levels, medium significance post-mitigation should be interpreted that more can be done to avoid critically important species-specific (especially Martial Eagle and Secretary Bird impacts as is the case for the impacts discussed within this statement). This is mainly because impact assessments regarding solar energy developments have been poorly understood since their inception and the impacts (especially cumulative impacts) of solar developments may have significant consequences if mitigation and monitoring is not implemented correctly.
- Overall, it is still the opinion of the consultants that the impacts associated with SEF projects are far preferable (from an environmental impact perspective) to extractive and/ or non-renewable alternatives or even Wind Energy Facilities (WEF). It must be related that this report must be considered in context with the greater EIA process which factors in economic desirability etc.
- In addition, while striving to maintain the highest standards of mitigation and monitoring as well as the commissioning of a highly detailed pre-construction micro siting assessment, developments such as the Roos SEF should be encouraged within designated areas.
- The roosting of Martial Eagles and the foraging of Secretarybirds is of some concern.
- Avoidance mitigation must be implemented in conjunction with the aforementioned micro siting as well as technological applications such as perch diverters, flappers and possibly taping over solar panels in the case of Lake Effect impacts. Thus, the author will look to support Environmental Authorisation (EA) based upon the following conditions:
    - All recommended No-Go buffering must be strictly adhered to;

- Micro siting of panel placement must occur prior to construction and should be supervised by a specialist zoologist in order to mitigate habitat loss and collision risks for species;
- All recommended mitigation measures described above must be applied;
- The EMPr must be updated every three years in order to reevaluate the potential distributional population changes of species such as Martial Eagles and Southern Crowned Cranes Thus, technological mitigations such as monitoring, flapper and diverter technology may have to be re-positioned, re-calibrated and updated.

8.1.2 Cumulative Impact Summary

Since the immediate area comprising approved or pending SEFs are expected to cumulatively result in a Moderate impact significance to avifauna after the application of the recommended mitigation measures, and since the combined area will likely contribute moderately to the total land area in the region transformed by renewable energy projects, it is recommended that the development may proceed on condition that:

- All mitigation measures stipulated above are adhered to and captured in an Environmental Management Plan (EMP);
- The EMP must include the necessity for post-construction avifauna monitoring as stipulated in Jenkins *et al*., (2015);
- All updated mitigation recommendations issued post-construction (informed by monitoring) must be adhered to.

Ultimately, the specialist recommends that the project be given a positive authorisation based upon the avifaunal baseline and Environmental Impact Assessment.

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10 APPENDIX

10.1 APPENDIX 1: EXPECTED AVIFAUNA SPECIES LIST

Avifauna recorded and predicted to potentially occur within the PA according to SABAP2.

English IOC Name	Scientific Name	Observed in SABAP2 Data	Observed on Site
Bokmakierie	*Telophorus zeylonus*	YES	YES
Hamerkop	*Scopus umbretta*	YES	NO
Mallard	*Anas platyrhynchos*	YES	NO
Neddicky	*Cisticola fulvicapilla*	YES	NO
Quailfinch	*Ortygospiza atricollis*	YES	YES
Ruff	*Calidris pugnax*	YES	NO
Secretarybird	*Sagittarius serpentarius*	YES	YES
Bar-throated Apalis	*Apalis thoracica*	YES	NO
Pied Avocet	*Recurvirostra avosetta*	YES	NO
Arrow-marked Babbler	*Turdoides jardineii*	YES	NO
Black-collared Barbet	*Lybius torquatus*	YES	NO
Crested Barbet	*Trachyphonus vaillantii*	YES	NO
Chinspot Batis	*Batis molitor*	YES	NO
European Bee-eater	*Merops apiaster*	YES	NO
White-fronted Bee-eater	*Merops bullockoides*	YES	NO
Southern Red Bishop	*Euplectes orix*	YES	YES
Yellow Bishop	*Euplectes capensis*	YES	NO
Yellow-crowned Bishop	*Euplectes afer*	YES	YES
Southern Boubou	*Laniarius ferrugineus*	YES	NO
Dark-capped Bulbul	*Pycnonotus tricolor*	YES	YES
Cape Bunting	*Emberiza capensis*	YES	NO
Cinnamon-breasted Bunting	*Emberiza tahapisi*	YES	NO
Golden-breasted Bunting	*Emberiza flaviventris*	YES	NO
Grey-headed Bushshrike	*Malaconotus blanchoti*	YES	NO
White-bellied Bustard	*Eupodotis senegalensis*	YES	NO
Common Buttonquail	*Turnix sylvaticus*	YES	NO
Common Buzzard	*Buteo buteo*	YES	YES
Jackal Buzzard	*Buteo rufofuscus*	YES	YES
Black-throated Canary	*Crithagra atrogularis*	YES	YES
Cape Canary	*Serinus canicollis*	YES	YES
Yellow Canary	*Crithagra flaviventris*	YES	NO
Yellow-fronted Canary	*Crithagra mozambica*	YES	YES

Ant-eating Chat	*Myrmecocichla formicivora*	YES	YES
Buff-streaked Chat	*Campicoloides bifasciatus*	YES	NO
Familiar Chat	*Oenanthe familiaris*	YES	NO
Mocking Cliff Chat	*Thamnolaea cinnamomeiventris*	YES	NO
Cloud Cisticola	*Cisticola textrix*	YES	NO
Lazy Cisticola	*Cisticola aberrans*	YES	NO
Levaillant's Cisticola	*Cisticola tinniens*	YES	YES
Pale-crowned Cisticola	*Cisticola cinnamomeus*	YES	NO
Rattling Cisticola	*Cisticola chiniana*	YES	YES
Wailing Cisticola	*Cisticola lais*	YES	NO
Wing-snapping Cisticola	*Cisticola ayresii*	YES	YES
Zitting Cisticola	*Cisticola juncidis*	YES	YES
Red-knobbed Coot	*Fulica cristata*	YES	NO
Reed Cormorant	*Microcarbo africanus*	YES	YES
White-breasted Cormorant	*Phalacrocorax lucidus*	YES	NO
Burchell's Coucal	*Centropus burchellii*	YES	NO
Black Crake	*Zapornia flavirostra*	YES	NO
Blue Crane	*Grus paradisea*	YES	NO
Grey Crowned Crane	*Balearica regulorum*	YES	NO
Long-billed Crombec	*Sylvietta rufescens*	YES	NO
Cape Crow	*Corvus capensis*	YES	NO
Pied Crow	*Corvus albus*	YES	YES
Black Cuckoo	*Cuculus clamosus*	YES	NO
Diederik Cuckoo	*Chrysococcyx caprius*	YES	NO
Klaas's Cuckoo	*Chrysococcyx klaas*	YES	NO
Red-chested Cuckoo	*Cuculus solitarius*	YES	NO
African Darter	*Anhinga rufa*	YES	NO
Cape Turtle Dove	*Streptopelia capicola*	YES	YES
Emerald-spotted Wood Dove	*Turtur chalcospilos*	YES	NO
Laughing Dove	*Spilopelia senegalensis*	YES	YES
Namaqua Dove	*Oena capensis*	YES	YES
Red-eyed Dove	*Streptopelia semitorquata*	YES	YES
Rock Dove	*Columba livia*	YES	NO
Fork-tailed Drongo	*Dicrurus adsimilis*	YES	NO
African Black Duck	*Anas sparsa*	YES	NO
Fulvous Whistling Duck	*Dendrocygna bicolor*	YES	NO
Knob-billed Duck	*Sarkidiornis melanotos*	YES	NO
Maccoa Duck	*Oxyura maccoa*	YES	NO

White-backed Duck	*Thalassornis leuconotus*	YES	YES
White-faced Whistling Duck	*Dendrocygna viduata*	YES	NO
Yellow-billed Duck	*Anas undulata*	YES	YES
African Fish Eagle	*Haliaeetus vocifer*	YES	NO
Black-chested Snake Eagle	*Circaetus pectoralis*	YES	YES
Brown Snake Eagle	*Circaetus cinereus*	YES	YES
Long-crested Eagle	*Lophaetus occipitalis*	YES	YES
Martial Eagle	*Polemaetus bellicosus*	NO	NO
Verreaux's Eagle	*Aquila verreauxii*	NO	NO
Spotted Eagle-Owl	*Bubo africanus*	YES	NO
Great Egret	*Ardea alba*	YES	NO
Intermediate Egret	*Ardea intermedia*	YES	YES
Little Egret	*Egretta garzetta*	YES	YES
Western Cattle Egret	*Bubulcus ibis*	YES	NO
Amur Falcon	*Falco amurensis*	YES	NO
Lanner Falcon	*Falco biarmicus*	YES	NO
Peregrine Falcon	*Falco peregrinus*	YES	NO
Cuckoo Finch	*Anomalospiza imberbis*	YES	NO
Red-headed Finch	*Amadina erythrocephala*	YES	NO
Red-billed Firefinch	*Lagonosticta senegala*	YES	NO
Southern Fiscal	*Lanius collaris*	YES	YES
Greater Flamingo	*Phoenicopterus roseus*	YES	NO
Lesser Flamingo	*Phoeniconaias minor*	YES	NO
Red-chested Flufftail	*Sarothrura rufa*	YES	NO
African Paradise Flycatcher	*Terpsiphone viridis*	YES	NO
Fiscal Flycatcher	*Melaenornis silens*	YES	YES
Spotted Flycatcher	*Muscicapa striata*	YES	NO
Coqui Francolin	*Peliperdix coqui*	YES	NO
Grey-winged Francolin	*Scleroptila afra*	YES	NO
Red-winged Francolin	*Scleroptila levaillantii*	YES	YES
Domestic Goose	*Anser anser*	YES	NO
Egyptian Goose	*Alopochen aegyptiaca*	YES	YES
Spur-winged Goose	*Plectropterus gambensis*	YES	NO
African Goshawk	*Accipiter tachiro*	YES	NO
Cape Grassbird	*Sphenoeacus afer*	YES	NO
Black-necked Grebe	*Podiceps nigricollis*	YES	NO
Great Crested Grebe	*Podiceps cristatus*	YES	NO
Little Grebe	*Tachybaptus ruficollis*	YES	NO
Common Greenshank	*Tringa nebularia*	YES	NO

Helmeted Guineafowl	*Numida meleagris*	YES	YES
Grey-headed Gull	*Chroicocephalus cirrocephalus*	YES	NO
African Marsh Harrier	*Circus ranivorus*	YES	NO
Montagu's Harrier	*Circus pygargus*	YES	NO
African Harrier-Hawk	*Polyboroides typus*	YES	YES
Black Heron	*Egretta ardesiaca*	YES	NO
Black-crowned Night Heron	*Nycticorax nycticorax*	YES	NO
Black-headed Heron	*Ardea melanocephala*	YES	YES
Goliath Heron	*Ardea goliath*	YES	NO
Grey Heron	*Ardea cinerea*	YES	YES
Purple Heron	*Ardea purpurea*	YES	YES
Squacco Heron	*Ardeola ralloides*	YES	NO
Brown-backed Honeybird	*Prodotiscus regulus*	YES	NO
Greater Honeyguide	*Indicator indicator*	YES	NO
African Hoopoe	*Upupa africana*	YES	NO
African Sacred Ibis	*Threskiornis aethiopicus*	YES	NO
Glossy Ibis	*Plegadis falcinellus*	YES	NO
Hadada Ibis	*Bostrychia hagedash*	YES	NO
Southern Bald Ibis	*Geronticus calvus*	YES	YES
African Jacana	*Actophilornis africanus*	YES	NO
Greater Kestrel	*Falco rupicoloides*	YES	NO
Lesser Kestrel	*Falco naumanni*	YES	NO
Rock Kestrel	*Falco rupicolus*	YES	NO
African Pygmy Kingfisher	*Ispidina picta*	YES	NO
Brown-hooded Kingfisher	*Halcyon albiventris*	YES	YES
Giant Kingfisher	*Megaceryle maxima*	YES	NO
Malachite Kingfisher	*Corythornis cristatus*	YES	NO
Pied Kingfisher	*Ceryle rudis*	YES	NO
Black-winged Kite	*Elanus caeruleus*	YES	YES
Yellow-billed Kite	*Milvus aegyptius*	YES	NO
Blue Korhaan	*Eupodotis caerulescens*	YES	NO
Northern Black Korhaan	*Afrotis afraoides*	YES	NO
African Wattled Lapwing	*Vanellus senegallus*	YES	NO
Black-winged Lapwing	*Vanellus melanopterus*	YES	NO
Blacksmith Lapwing	*Vanellus armatus*	YES	NO
Crowned Lapwing	*Vanellus coronatus*	YES	YES
Eastern Clapper Lark	*Mirafra fasciolata*	YES	NO
Eastern Long-billed Lark	*Certhilauda semitorquata*	YES	NO
Red-capped Lark	*Calandrella cinerea*	YES	YES

Rufous-naped Lark	*Mirafra africana*	YES	YES
Sabota Lark	*Calendulauda sabota*	YES	NO
Spike-heeled Lark	*Chersomanes albofasciata*	YES	YES
Cape Longclaw	*Macronyx capensis*	YES	YES
Bronze Mannikin	*Spermestes cucullata*	YES	NO
Banded Martin	*Riparia cincta*	YES	NO
Brown-throated Martin	*Riparia paludicola*	YES	YES
Common House Martin	*Delichon urbicum*	YES	YES
Rock Martin	*Ptyonoprogne fuligula*	YES	YES
Common Moorhen	*Gallinula chloropus*	YES	YES
Red-faced Mousebird	*Urocolius indicus*	YES	NO
Speckled Mousebird	*Colius striatus*	YES	YES
Common Myna	*Acridotheres tristis*	YES	NO
Fiery-necked Nightjar	*Caprimulgus pectoralis*	YES	NO
Freckled Nightjar	*Caprimulgus tristigma*	YES	NO
Rufous-cheeked Nightjar	*Caprimulgus rufigena*	YES	NO
Black-headed Oriole	*Oriolus larvatus*	YES	NO
Common Ostrich	*Struthio camelus*	YES	NO
Marsh Owl	*Asio capensis*	YES	NO
Western Barn Owl	*Tyto alba*	YES	NO
Red Phalarope	*Phalaropus fulicarius*	YES	NO
African Olive Pigeon	*Columba arquatrix*	YES	NO
Speckled Pigeon	*Columba guinea*	YES	YES
African Pipit	*Anthus cinnamomeus*	YES	YES
Buffy Pipit	*Anthus vaalensis*	YES	NO
Nicholson's Pipit	*Anthus nicholsoni*	YES	NO
Plain-backed Pipit	*Anthus leucophrys*	YES	NO
Common Ringed Plover	*Charadrius hiaticula*	YES	NO
Kittlitz's Plover	*Charadrius pecuarius*	YES	NO
Three-banded Plover	*Charadrius tricollaris*	YES	NO
Southern Pochard	*Netta erythrophthalma*	YES	NO
Black-chested Prinia	*Prinia flavicans*	YES	YES
Drakensberg Prinia	*Prinia hypoxantha*	YES	NO
Tawny-flanked Prinia	*Prinia subflava*	YES	YES
Black-backed Puffback	*Dryoscopus cubla*	YES	NO
Common Quail	*Coturnix coturnix*	YES	NO
Red-billed Quelea	*Quelea quelea*	YES	YES
African Rail	*Rallus caerulescens*	YES	NO
Cape Robin-Chat	*Cossypha caffra*	YES	NO

European Roller	*Coracias garrulus*	YES	NO
Lilac-breasted Roller	*Coracias caudatus*	YES	NO
Common Sandpiper	*Actitis hypoleucos*	YES	YES
Curlew Sandpiper	*Calidris ferruginea*	YES	NO
Marsh Sandpiper	*Tringa stagnatilis*	YES	NO
Wood Sandpiper	*Tringa glareola*	YES	NO
Black (Southern Africa) Saw-wing	*Psalidoprocne pristoptera holomelas*	YES	NO
Streaky-headed Seedeater	*Crithagra gularis*	YES	NO
South African Shelduck	*Tadorna cana*	YES	NO
Cape Shoveler	*Spatula smithii*	YES	NO
Lesser Grey Shrike	*Lanius minor*	YES	NO
Red-backed Shrike	*Lanius collurio*	YES	NO
African Snipe	*Gallinago nigripennis*	YES	YES
Cape Sparrow	*Passer melanurus*	YES	YES
House Sparrow	*Passer domesticus*	YES	NO
Southern Grey-headed Sparrow	*Passer diffusus*	YES	YES
White-browed Sparrow-Weaver	*Plocepasser mahali*	YES	YES
Black Sparrowhawk	*Accipiter melanoleucus*	YES	NO
Rufous-breasted Sparrowhawk	*Accipiter rufiventris*	YES	NO
African Spoonbill	*Platalea alba*	YES	NO
Natal Spurfowl	*Pternistis natalensis*	YES	NO
Swainson's Spurfowl	*Pternistis swainsonii*	YES	YES
Cape Starling	*Lamprotornis nitens*	YES	NO
Pied Starling	*Lamprotornis bicolor*	YES	YES
Red-winged Starling	*Onychognathus morio*	YES	NO
Violet-backed Starling	*Cinnyricinclus leucogaster*	YES	NO
Wattled Starling	*Creatophora cinerea*	YES	NO
Black-winged Stilt	*Himantopus himantopus*	YES	NO
Little Stint	*Calidris minuta*	YES	NO
African Stonechat	*Saxicola torquatus*	YES	YES
Abdim's Stork	*Ciconia abdimii*	YES	NO
Black Stork	*Ciconia nigra*	YES	NO
White Stork	*Ciconia ciconia*	YES	YES
Yellow-billed Stork	*Mycteria ibis*	YES	NO
Amethyst Sunbird	*Chalcomitra amethystina*	YES	NO
Greater Double-collared Sunbird	*Cinnyris afer*	YES	NO
Malachite Sunbird	*Nectarinia famosa*	YES	NO
White-bellied Sunbird	*Cinnyris talatala*	YES	NO

Barn Swallow	*Hirundo rustica*	YES	YES
Greater Striped Swallow	*Cecropis cucullata*	YES	YES
Lesser Striped Swallow	*Cecropis abyssinica*	YES	YES
Pearl-breasted Swallow	*Hirundo dimidiata*	YES	NO
Red-breasted Swallow	*Cecropis semirufa*	YES	NO
South African Cliff Swallow	*Petrochelidon spilodera*	YES	NO
White-throated Swallow	*Hirundo albigularis*	YES	NO
African Swamphen	*Porphyrio madagascariensis*	YES	NO
African Black Swift	*Apus barbatus*	YES	NO
African Palm Swift	*Cypsiurus parvus*	YES	YES
Alpine Swift	*Tachymarptis melba*	YES	NO
Common Swift	*Apus apus*	YES	YES
Horus Swift	*Apus horus*	YES	NO
Little Swift	*Apus affinis*	YES	YES
White-rumped Swift	*Apus caffer*	YES	YES
Black-crowned Tchagra	*Tchagra senegalus*	YES	NO
Blue-billed Teal	*Spatula hottentota*	YES	NO
Cape Teal	*Anas capensis*	YES	NO
Red-billed Teal	*Anas erythrorhyncha*	YES	NO
Whiskered Tern	*Chlidonias hybrida*	YES	NO
White-winged Tern	*Chlidonias leucopterus*	YES	NO
Spotted Thick-knee	*Burhinus capensis*	YES	YES
Cape Rock Thrush	*Monticola rupestris*	YES	NO
Groundscraper Thrush	*Turdus litsitsirupa*	YES	NO
Karoo Thrush	*Turdus smithi*	YES	NO
Kurrichane Thrush	*Turdus libonyana*	YES	NO
Olive Thrush	*Turdus olivaceus*	YES	NO
Southern Black Tit	*Melaniparus niger*	YES	NO
Cape Vulture	*Gyps coprotheres*	YES	NO
African Pied Wagtail	*Motacilla aguimp*	YES	NO
Cape Wagtail	*Motacilla capensis*	YES	YES
African Reed (Old, Use Common Reed Warbler) Warbler	*Acrocephalus baeticatus*	YES	NO
African Yellow Warbler	*Iduna natalensis*	YES	NO
Great Reed Warbler	*Acrocephalus arundinaceus*	YES	NO
Lesser Swamp Warbler	*Acrocephalus gracilirostris*	YES	NO
Little Rush Warbler	*Bradypterus baboecala*	YES	NO
Willow Warbler	*Phylloscopus trochilus*	YES	NO
Blue Waxbill	*Uraeginthus angolensis*	YES	NO

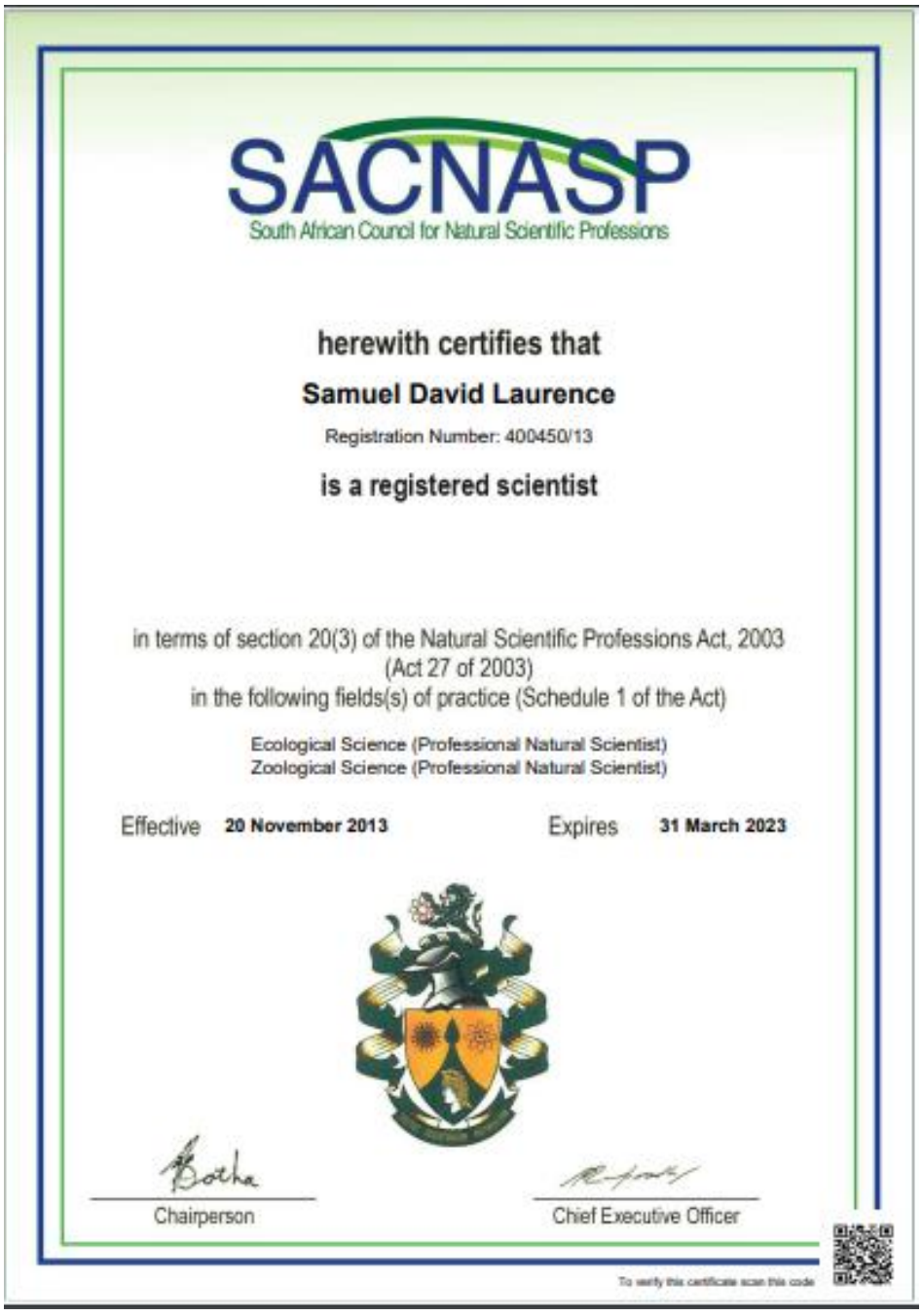
Common Waxbill	*Estrilda astrild*	YES	YES
Orange-breasted Waxbill	*Amandava subflava*	YES	YES
Swee Waxbill	*Coccopygia melanotis*	YES	NO
Cape Weaver	*Ploceus capensis*	YES	NO
Southern Masked Weaver	*Ploceus velatus*	YES	YES
Thick-billed Weaver	*Amblyospiza albifrons*	YES	NO
Village Weaver	*Ploceus cucullatus*	YES	NO
Capped Wheatear	*Oenanthe pileata*	YES	YES
Mountain Wheatear	*Myrmecocichla monticola*	YES	NO
Cape White-eye	*Zosterops virens*	YES	NO
Long-tailed Paradise Whydah	*Vidua paradisaea*	YES	NO
Pin-tailed Whydah	*Vidua macroura*	YES	YES
Fan-tailed Widowbird	*Euplectes axillaris*	YES	NO
Long-tailed Widowbird	*Euplectes progne*	YES	YES
Red-collared Widowbird	*Euplectes ardens*	YES	YES
White-winged Widowbird	*Euplectes albonotatus*	YES	YES
Green Wood Hoopoe	*Phoeniculus purpureus*	YES	NO
Cardinal Woodpecker	*Dendropicos fuscescens*	YES	NO
Red-throated Wryneck	*Jynx ruficollis*	YES	YES

10.2 APPENDIX 2: NON-PRIORITY SPECIES CONTACT DATA PER SEASON

		Season		
English IOC Name	Scientific Name	Summer	Winter	Grand Total
African Palm Swift	*Cypsiurus parvus*	2		2
African Pipit	*Anthus cinnamomeus*	21	2	23
African Stonechat	*Saxicola torquatus*	4	49	53
Ant-eating Chat	*Myrmecocichla formicivora*	17	34	51
Barn Swallow	*Hirundo rustica*	15		15
Black-chested Prinia	*Prinia flavicans*		4	4
Black-throated Canary	*Crithagra atrogularis*		5	5
Bokmakierie	*Telophorus zeylonus*	2	8	10
Bronze Mannikin	*Lonchura cucullata*	25		25
Brown-hooded Kingfisher	*Halcyon albiventris*	1		1
Brown-throated Martin	*Riparia paludicola*	30		30
Cape Canary	*Serinus canicollis*		16	16
Cape Longclaw	*Macronyx capensis*	21	68	89
Cape Sparrow	*Passer melanurus*		12	12
Cape Wagtail	*Motacilla capensis*		6	6
Capped Wheatear	*Oenanthe pileata*		3	3
Common House Martin	*Delichon urbicum*	15		15
Common Swift	*Apus apus*	172		172
Dark-capped Bulbul	*Pycnonotus tricolor*		7	7
Fiscal Flycatcher	*Melaenornis silens*		2	2
Greater Striped Swallow	*Cecropis cucullata*	33		33
Laughing Dove	*Spilopelia senegalensis*	19		19
Lesser Striped Swallow	*Cecropis abyssinica*	50		50
Little Swift	*Apus affinis*	25		25
Long-tailed Widowbird	*Euplectes progne*	51	25	76
Monotonous Lark	*Mirafra passerina*	3		3
Namaqua Dove	*Oena capensis*		1	1
Orange-breasted Waxbill	*Amandava subflava*		18	18
Pied Starling	*Lamprotornis bicolor*	10	1	11
Pin-tailed Whydah	*Vidua macroura*	1		1
Quailfinch	*Ortygospiza atricollis*		1	1
Rattling Cisticola	*Cisticola chiniana*	4		4
Red-billed Quelea	*Quelea quelea*		220	220
Red-capped Lark	*Calandrella cinerea*		8	8
Red-throated Wryneck	*Jynx ruficollis*		1	1
Ring-necked Dove	*Streptopelia capicola*	26	15	41
Rock Martin	*Ptyonoprogne fuligula*		2	2
Rufous-naped Lark	*Mirafra africana*	3		3
Southern Fiscal	*Lanius collaris*	2	34	36
Southern Grey-headed Sparrow	*Passer diffusus*		4	4
Southern Masked Weaver	*Ploceus velatus*		23	23
Speckled Mousebird	*Colius striatus*		10	10
Spike-heeled Lark	*Chersomanes albofasciata*		4	4

Tawny-flanked Prinia	*Prinia subflava*	4	4	8
White-browed Sparrow-Weaver	*Plocepasser mahali*		2	2
White-rumped Swift	*Apus caffer*	15		15
White-winged Widowbird	*Euplectes albonotatus*	2	8	10
Wing-snapping Cisticola	*Cisticola ayresii*		5	5
Yellow-fronted Canary	*Crithagra mozambica*	24	4	28
Grand Total	**49**	**597**	**606**	**1203**

10.3 APPENDIX 4: SACNASP QUALIFICATION



SACNASP
South African Council for Natural Scientific Professions

herewith certifies that

Samuel David Laurence

Registration Number: 400450/13

is a registered scientist

in terms of section 20(3) of the Natural Scientific Professions Act, 2003
(Act 27 of 2003)
in the following fields(s) of practice (Schedule 1 of the Act)

Ecological Science (Professional Natural Scientist)
Zoological Science (Professional Natural Scientist)

Effective **20 November 2013** Expires **31 March 2023**

Chairperson

Chief Executive Officer

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