# D4: Avifaunal Impact Assessment

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# AVIFAUNAL ASSESSMENT:

# ENVIRONMENTAL IMPACT ASSESSMENT REPORT

# FOR

# THE PROPOSED CARPE DIEM SOLAR PV FACILITY

# located on Portion 5 of Farm Varkenslaagte No. 119 and Portion 27 of Farm Doornfontein No. 118, Gauteng Province

**June 2025**

**For**

**Legacy EMC**

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## 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 Env. Management. | *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 |

### 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 Assessment (EIA)** | The process of identifying environmental impacts due to activities and assessing and reporting these 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) |

| | |
|---|---|
| **RR** | Receptor Resilience |
| **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

Enviro-Insight was requested to conduct the Avifaunal Preconstruction assessment for the proposed Carpe Diem Solar PV Facility located on Portion 5 of Farm Varkenslaagte No. 119 and Portion 27 of Farm Doornfontein No. 118. All properties are located within the Merafong City Municipality, Gauteng Province, within proximity of the Carmel Distribution Centre (DC) (Eskom Power). The associated infrastructure would include a BESS, site camp, substation and OHL, and O&M building with the general location shown as Figure 1-1 and Figure 1-2 with the final layout shown as Figure 1-3.

## 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 Carpe Diem Project Area of Influence/s (PAOI) and specifically, the Project Footprint (referred to herewith as the Project Area or PA). This report will provide baseline information (EIA Level) 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).

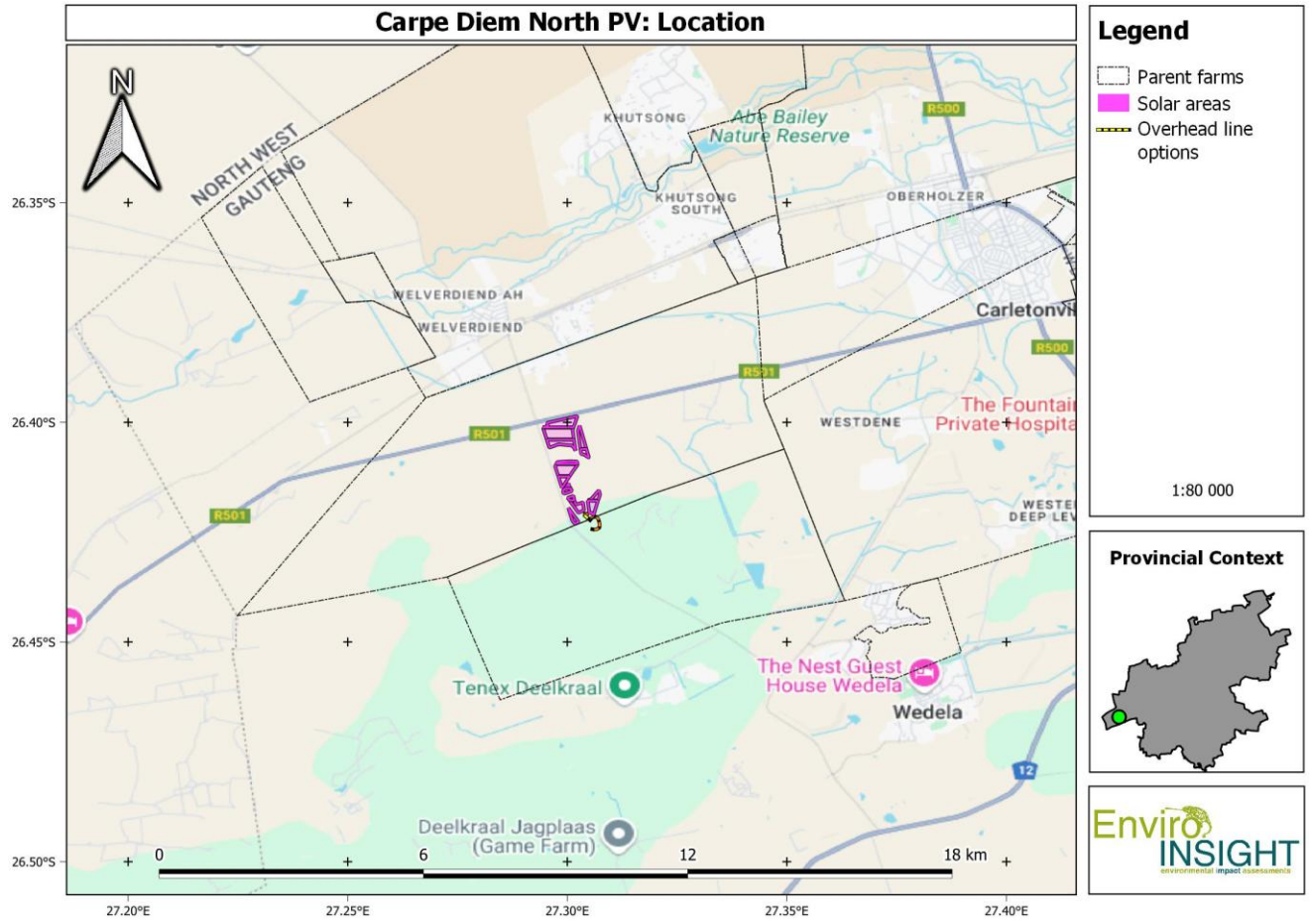


*Figure 1-1: Location of the proposed Carpe Diem North PV solar panel array*

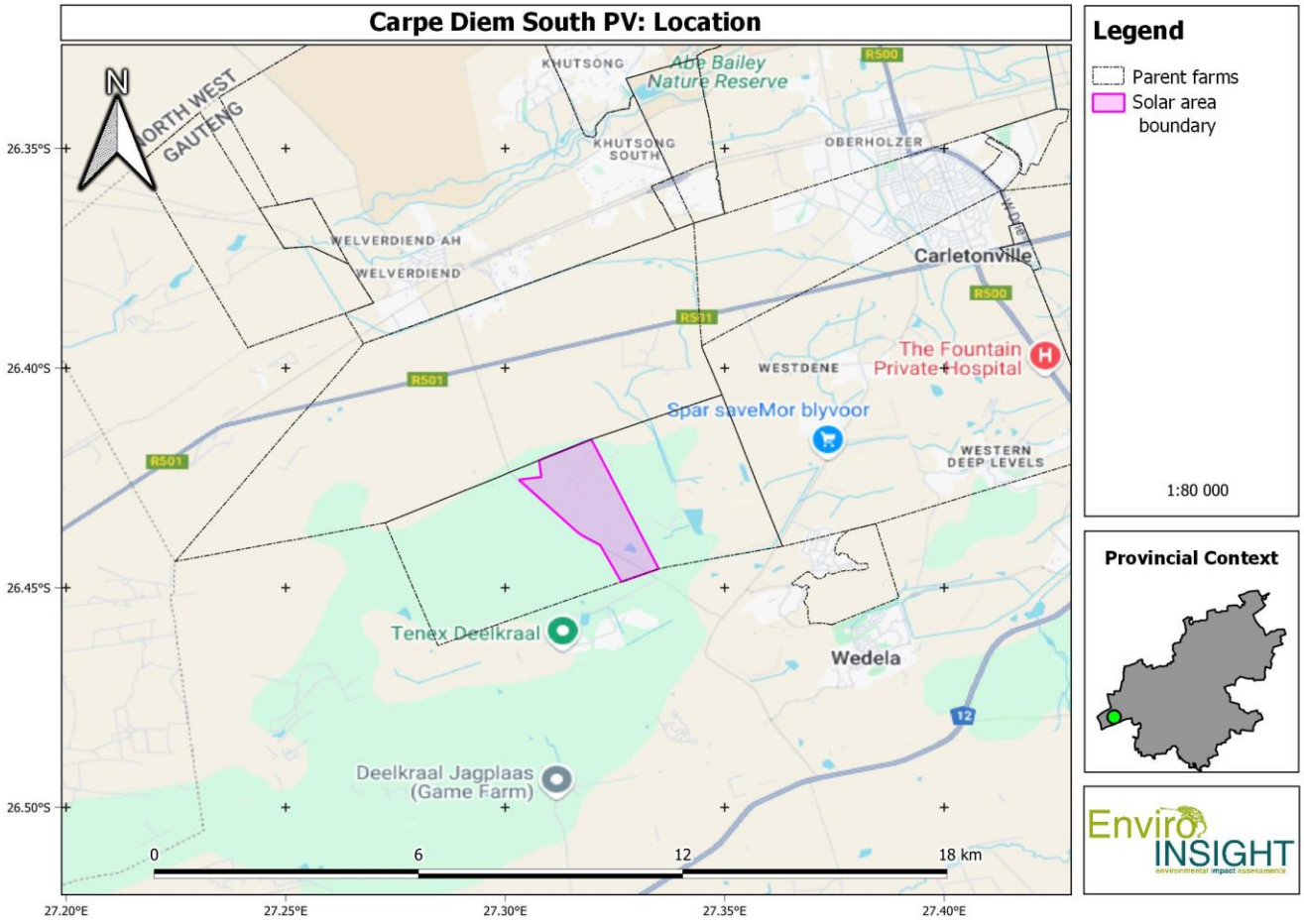


*Figure 1-2: Location of the proposed Carpe Diem South PV solar panel array*

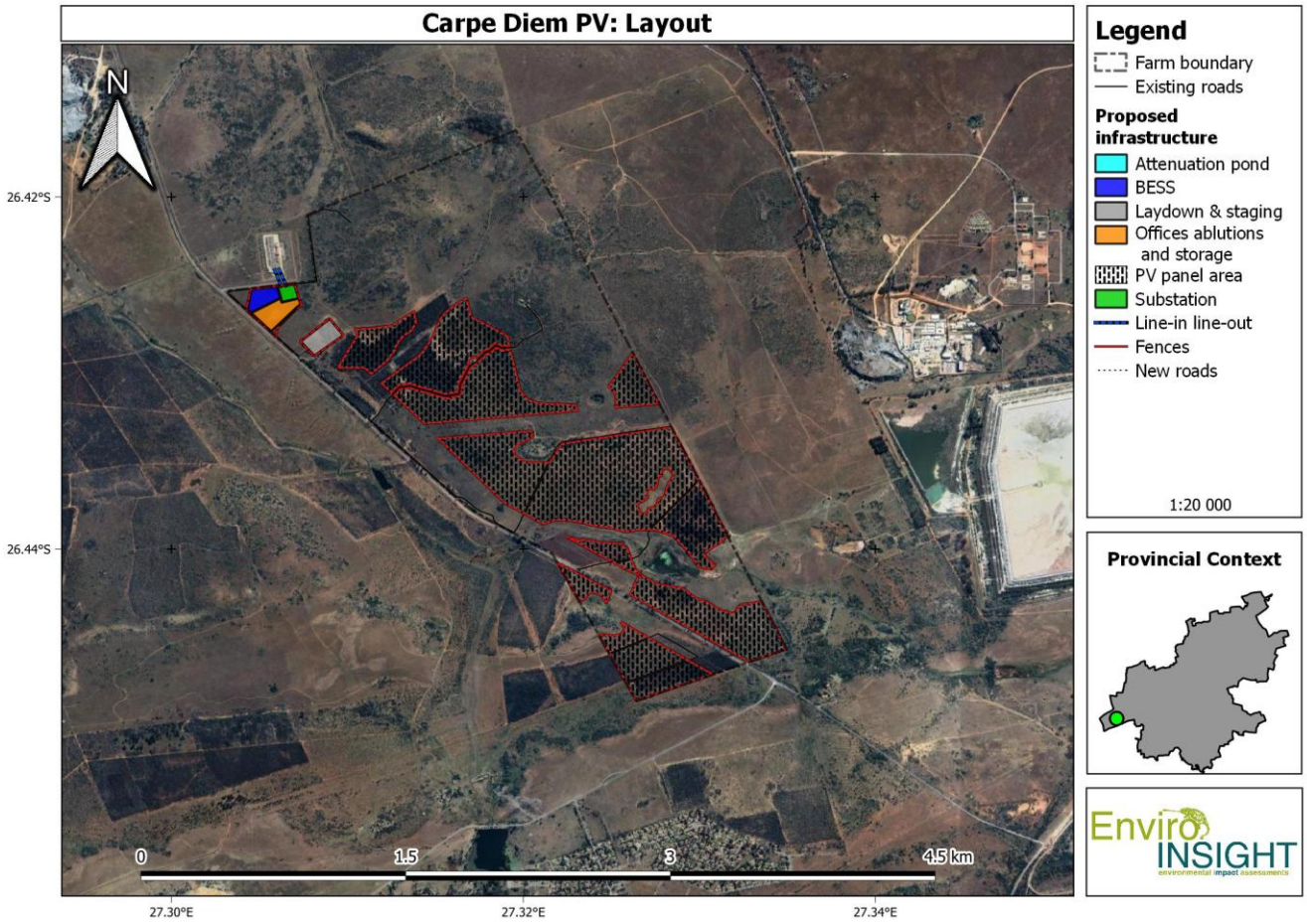


*Figure 1-3: Layout of Carpe Diem PV solar panel array*

## 1.2 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.
- The BESS footprint was not provided until after the primary SEF project was conducted and thus a follow up survey in August 2024 took place to supplement the data and generate a separate BESS sensitivity delineation.

# 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,**Error! Reference source not found.**), the Animal Combined Sensitivity Theme is indicated as a combination of Low and **High** sensitivity in areas that are said to contain the following Sensitivity Feature(s).

- High Aves-*Circus ranivorus* (African Marsh Harrier)
- Medium Aves-*Tyto capensis* (African Grass Owl)
- Medium Aves- *Hydroprogne caspia*

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

- Medium Aves-*Eupodotis senegalensis* (White-bellied Bustard)

Due to 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 a mosaic of High and Medium Sensitivity for the entire Project Area of Influence (PAOI) but Medium for the Project Area/ (PA)/ Footprint. The Screening Report did not consider **the supposed proximity to Cape Vulture roosting habitat which was activated in the adjacent development of Carletonville**.

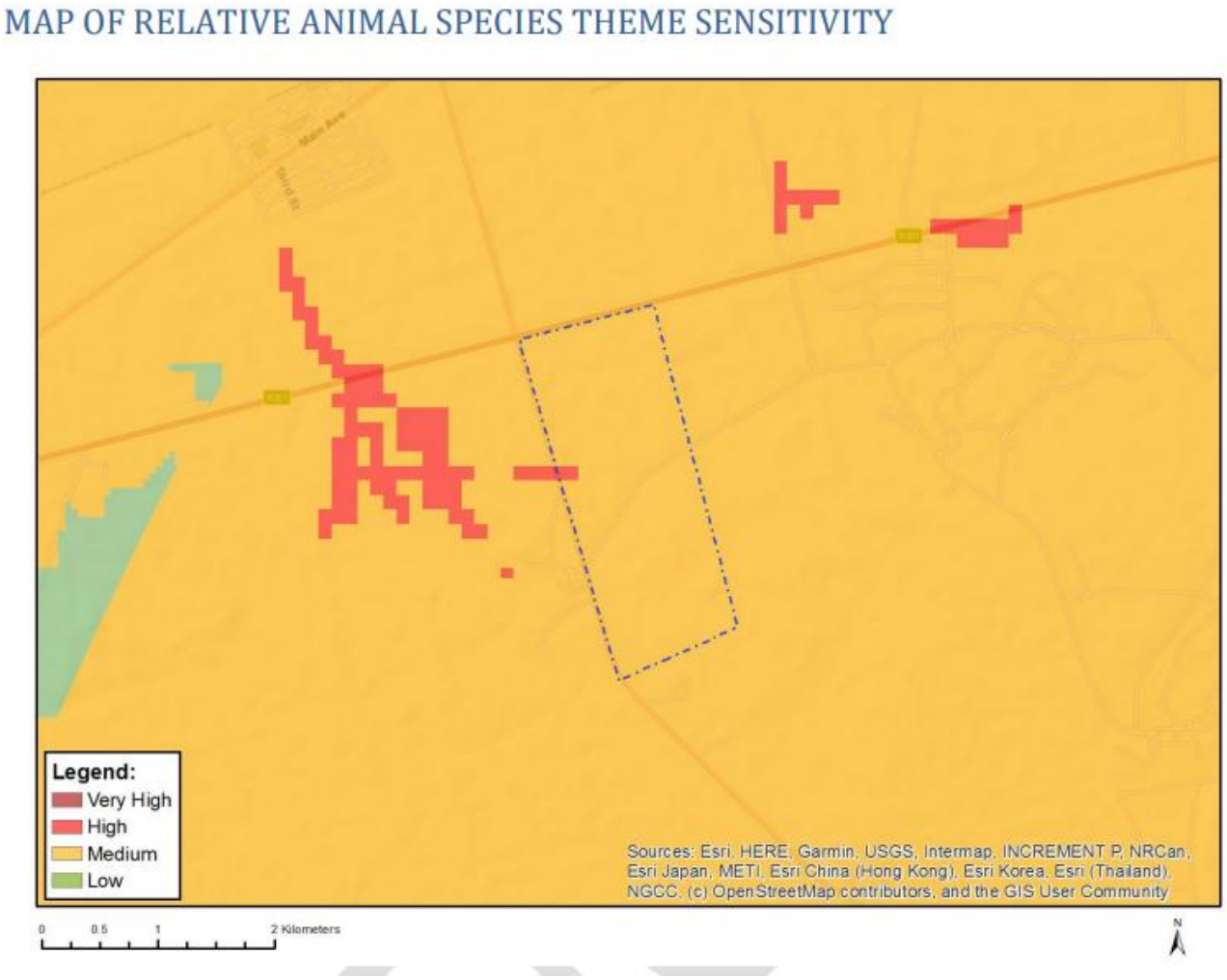


***Figure 2-1: Environmental Screening Tool animal sensitivity theme map the proposed* Carpe Diem North *SEF.***

MAP OF RELATIVE ANIMAL SPECIES THEME SENSITIVITY

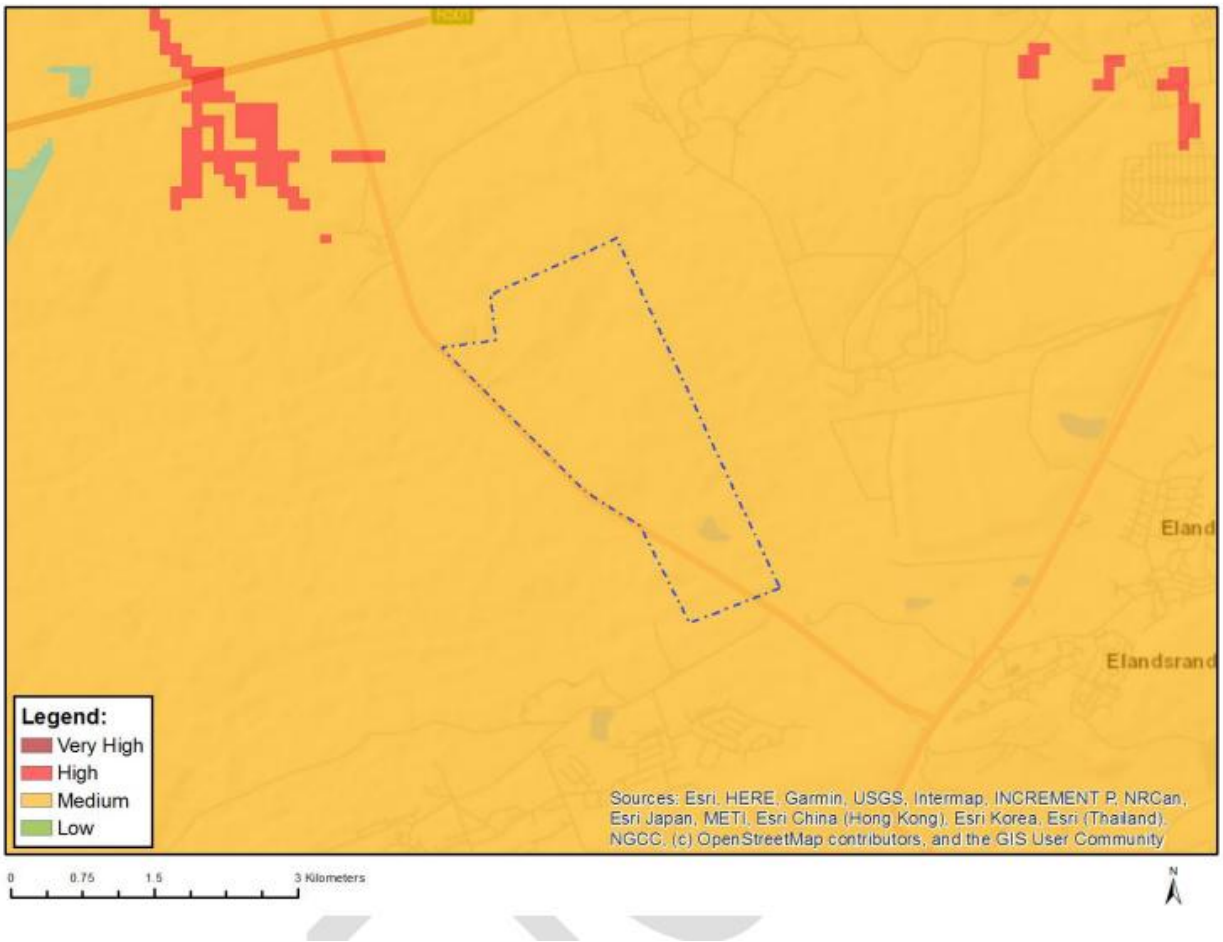


*Figure 2-2: Environmental Screening Tool animal sensitivity theme map the proposed* **Carpe Diem South** *SEF.*

| Sensitivity | Feature(s) |
|---|---|
| Medium | Aves-Tyto capensis |
| Medium | Aves-Hydroprogne caspia |
| Medium | Aves-Eupodotis senegalensis |
| Medium | Insecta-Lepidochrysops praeterita |
| Medium | Insecta-Lepidochrysops procera |
| Medium | Mammalia-Crocidura maquassiensis |
| Medium | Mammalia-Hydrictis maculicollis |
| Medium | Invertebrate-Clonia uvarovi |

## 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 not located within Renewable Energy Development Zones (REDZ) and accordingly, the study must fulfil a Scoping & EIA process.

## 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 outside of a REDZ).

As per Appendix 2 - *Minimum requirements for avifaunal impact assessment*, an avifaunal impact assessment for a SEF should follow a four-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. **Environmental 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);
- Gauteng Conservation Plan Version 3.3 (Gauteng C-Plan 2014);

- 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 (2615_2710, 2615_2715, 2615_2720, 2615_2725, 2620_2710, 2620_2715, 2620_2720, 2620_2725, 2625_2710, 2625_2715,2625_2725, 2630_2710, 2630_2715, 2630_2720, 2630_2725, (Figure 3-1). The expected species lists (including species of conservation concern or SCC) are 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 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, 2023);
- del Hoyo *et al.* (1992) and Hockey *et al.* (2005) were consulted for general information on the life history attributes of relevant bird species;
- 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).

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

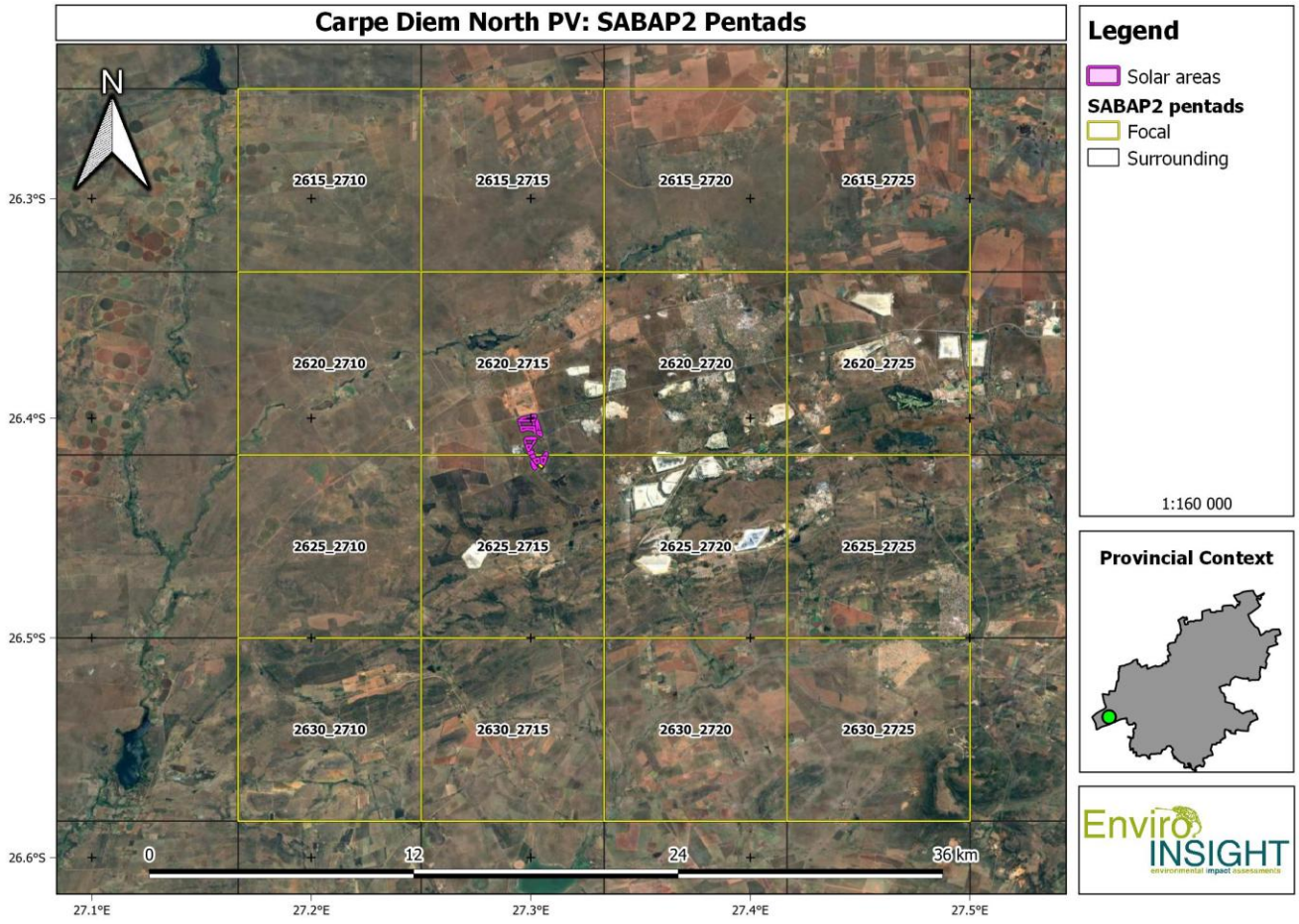


*Figure 3-1: The proposed Carpe Diem North SEF in relation to the SABAP2 pentads.*

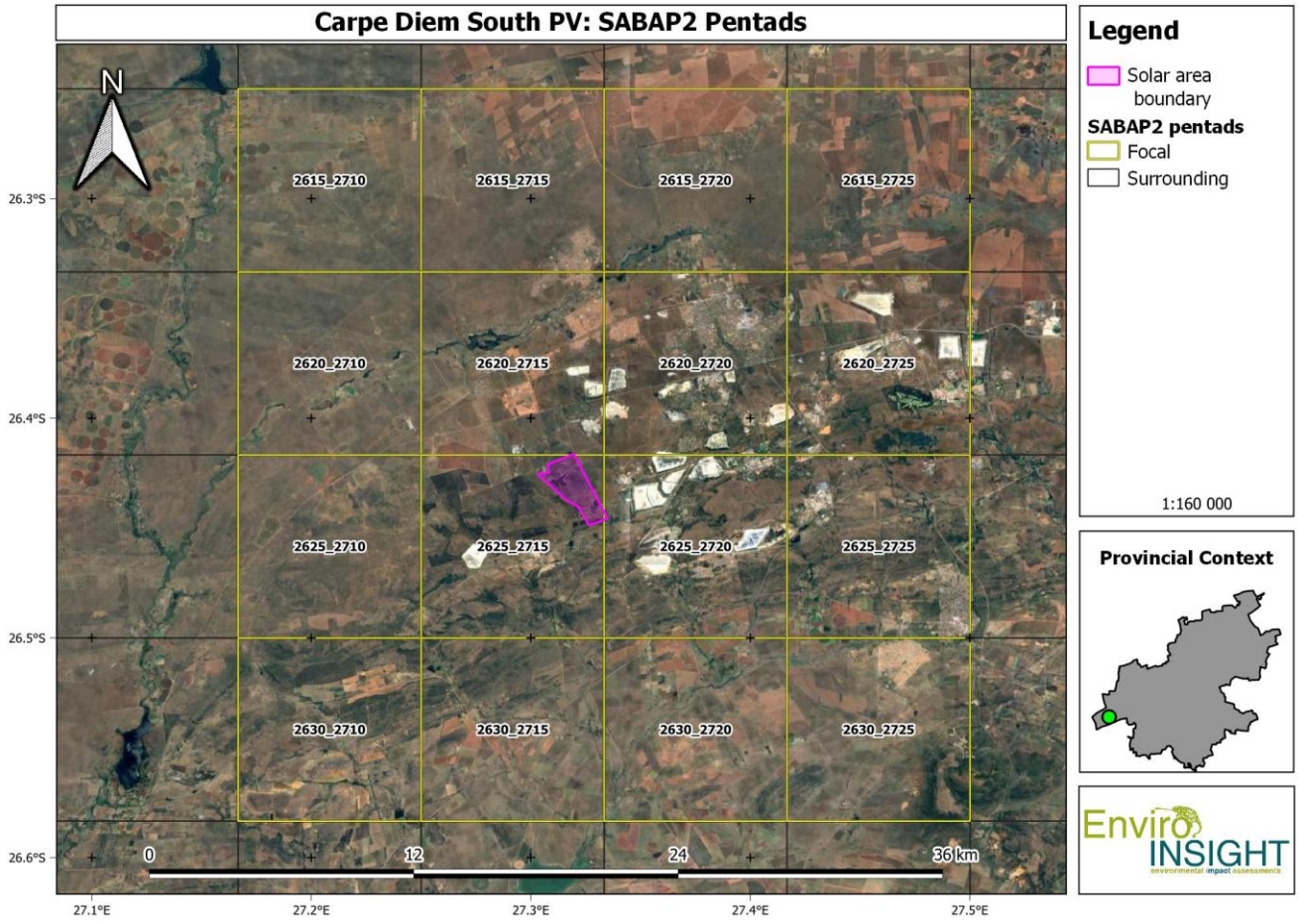


*Figure 3-2: The proposed Carpe Diem South SEF in relation to the SABAP2 pentads.*

## 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 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. All distances for WT and DT are shown as Table 3-2

***Table 3-1: Avifauna monitoring sampling period for the proposed Carpe Diem SEF.***

| Date | Season | Methodology applied |
|---|---|---|
| 27 Oct 2022 | Spring | Reconnaissance |
| 20-22 Feb 2023 | Summer | WT, DT, NE, WB |
| 14-16 June 2023 | Winter | WT, DT, NE, WB |

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

***Table 3-2: Drive and walk transects lengths and total length.***

| Site | Method | Distance |
|---|---|---|
| CD | DT1 | 2645 |
| CD | DT2 | 1796 |
| CD | DT3 | 2119 |
| CD | WT1 | 518 |
| CD | WT2 | 882 |
| CD | WT3 | 604 |
| **DT** | | 6560 |
| **WT** | | 2004 |
| **Total** | | **8564** |

### 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 3-3) to maximise the comparative value of the data which will be compared with the surveys from the post-construction phase results.

Three linear transects ranging from 518 m to 882 m in length (2.04 km total), were walked in order to characterise the passerine and small bird communities (Figure 3-3). 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) is to be calculated for each priority species observed and inserted in the final EIA.

### 3.3.2 Driven Transects

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). Three driven transects was identified in the PA with a total length of 6560 m. 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) is calculated for each priority species observed and to be inserted into the final EIA.

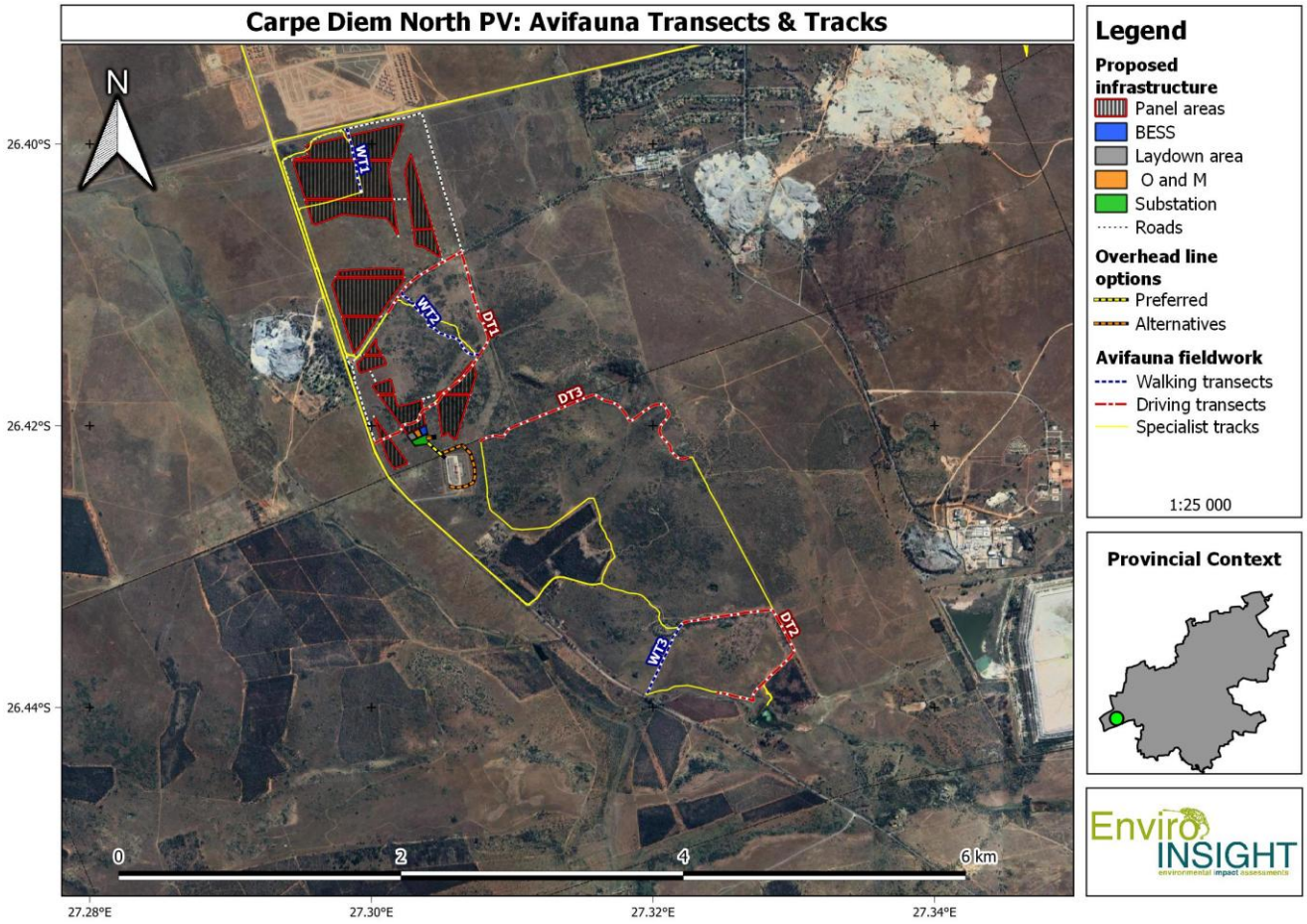


*Figure 3-3: Avifauna survey sites and specialist coverage (GPS tracks as well as field of view) for the proposed Carpe Diem North SEF.*

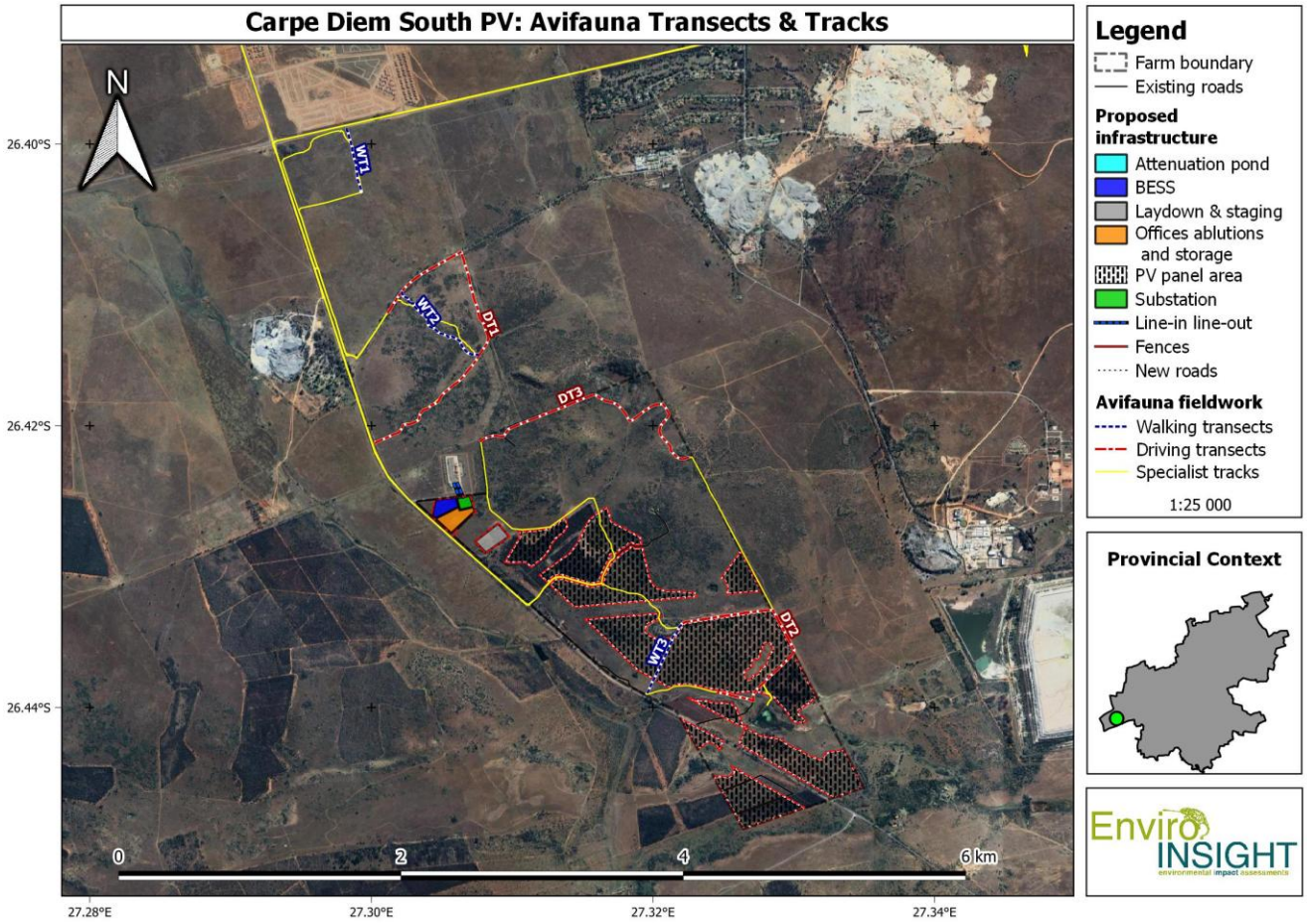


***Figure 3-4: Avifauna survey sites and specialist coverage (GPS tracks as well as field of view) for the proposed Carpe Diem South SEF.***

### 3.3.3 Wetlands/ Dams and Drainage Lines

Prior to the initiation of the preconstruction monitoring campaign, the main water bodies (including wetlands) present within the PA were searched for on a Geographical Information System (GIS) by using 1:50 000 topographic maps and aerial photos. No significant water bodies were identified on and surrounding the PA although a large canal was identified and surveyed. This was surveyed to determine their level of utilisation by water birds and water associated Priority Species.

### 3.3.4 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.

### 3.3.5 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** are 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 Gauteng 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 Caspian Tern, Black Stork, White Stork, African Marsh Harrier, White Bellied Bustard, Blue Crane and African Grass Owl. Additional "flagship" bird species include Martial Eagle, Tawny Eagle, Lanner Falcon, Verreaux's Eagle, Secretary Bird, with increasingly frequent incursions within the PAOI from species such as Cape Vulture (regional and adjacent sightings).The expected Priority Species according to SABAP2 is shown in Table 3-3.

***Table 3-3: Priority Species according to SABAP2***

| English IOC Name | Scientific Name |
|---|---|
| Abdim's Stork | *Ciconia abdimii* |
| African Grass Owl | *Tyto capensis* |
| African Marsh Harrier | *Circus ranivorus* |
| Black Harrier | *Circus maurus* |
| Black Stork | *Ciconia nigra* |
| Black-winged Pratincole | *Glareola nordmanni* |
| Blue Crane | *Grus paradisea* |
| Cape Vulture | *Gyps coprotheres* |
| Caspian Tern | *Hydroprogne caspia* |
| Curlew Sandpiper | *Calidris ferruginea* |
| European Roller | *Coracias garrulus* |
| Greater Flamingo | *Phoenicopterus roseus* |
| Greater Painted-snipe | *Rostratula benghalensis* |
| Half-collared Kingfisher | *Alcedo semitorquata* |
| Lanner Falcon | *Falco biarmicus* |
| Lesser Flamingo | *Phoeniconaias minor* |

| | |
|---|---|
| Maccoa Duck | *Oxyura maccoa* |
| Marabou Stork | *Leptoptilos crumenifer* |
| Martial Eagle | *Polemaetus bellicosus* |
| Pallid Harrier | *Circus macrourus* |
| Red-footed Falcon | *Falco vespertinus* |
| Secretarybird | *Sagittarius serpentarius* |
| Verreaux's Eagle | *Aquila verreauxii* |
| White-backed Vulture | *Gyps africanus* |
| Yellow-billed Stork | *Mycteria ibis* |

## 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 assessment of the potential environmental and social impacts was based on the project team's professional judgement, field observations and desk-top analysis..

The standard Legacy EMC impact/risk rating method has been adopted to enable the author to determine the overall impact of the proposed activities by collating the information at hand into a uniform rating matrix.

The following methodology has been applied to the prediction and assessment of impacts. Potential impacts have been rated in terms of the direct, indirect and cumulative nature of the impact:

- **Direct** impacts – are impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity. These impacts are usually associated with the construction, operation or maintenance of an activity and are generally obvious and quantifiable;
- **Indirect** impacts – of an activity are indirect or induced changes that may occur as a result of the activity. These types of impacts include all the potential impacts that do not manifest immediately when the activity is undertaken, or which occur at a different place as a result of the activity;
- **Cumulative** impacts – are impacts that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities. Cumulative impacts can occur from the collective impacts of individual minor actions over a period of time and can include both direct and indirect impacts.

The significance of each potential impact, with and without the implementation of the proposed mitigation measures, will be assessed based on the following variables (evaluation components):

- Spatial extent – The size of the area that will be affected by the impact;
- Intensity – The anticipated severity of the impact;
- Duration – The timeframe during which the impact will be experienced;
- Probability – The probability of the impact occurring;
- Reversibility – The "reversibility" of the environmental impacts of the proposed development after project cessation or decommissioning; and
- Irreplaceability – The "irreplaceability" of natural characteristics in the area that may be impacted upon by the proposed development.

Using the criteria above, the impacts will further be assessed with the use of quantifiable values as described below:

*Table 3-4: Evaluation of criteria by means of quantitative ratings and descriptions.*

| Criteria | Description | Quantitative Rating |
|---|---|---|
| **Duration** | Temporary (less than a year) | 1 |
| | Short term (1 to 6 years) | 2 |
| | Medium term (6 to 15 years) | 3 |
| | Long term (the impact will cease after the operational life of the activity) | 4 |
| | Permanent (mitigation will not occur in such a way or in such a time span than the impact can be considered transient) | 5 |
| **Spatial extent** | Site specific | 1 |
| | Local (less than 2 km from the site); | 2 |
| | Regional (within 30 km of the site) | 3 |
| | National (beyond Provincial boundaries and within National boundaries) | 4 |
| | International / Transboundary (Beyond National boundaries) | 5 |
| **Intensity / Magnitude Applicable to Negative Impacts (at indicated spatial extent)** | None (Biophysical and/or social functions and/or processes will remain unaltered) | 0 |
| | Very Low (Biophysical and/or social functions and/or processes might be negligibly altered) | 2 |
| | Low (Biophysical and/or social functions and/or processes might be slightly altered) | 4 |
| | Medium (Biophysical and/or social functions and/or processes might be notably altered) | 6 |
| | High (Biophysical and/or social functions and/or processes might be considerably altered) | 8 |
| | Very High (Biophysical and/or social functions and/or processes might be severely altered) | 10 |
| **Intensity / Magnitude Applicable to Positive Impacts** | None (Biophysical and/or social functions and/or processes will remain unaltered) | 0 |
| | Very Low (Biophysical and/or social functions and/or processes might be negligibly enhanced) | 2 |

| Criteria | Description | Quantitative Rating |
|---|---|---|
| **(at indicated spatial extent)** | Low (Biophysical and/or social functions and/or processes might be slightly enhanced) | 4 |
| | Medium (Biophysical and/or social functions and/or processes might be notably enhanced) | 6 |
| | High (Biophysical and/or social functions and/or processes might be considerably enhanced) | 8 |
| | Very High (Biophysical and/or social functions and/or processes might be substantially enhanced) | 10 |
| **Probability** | Improbable (5% to no chance of occurring) | 1 |
| | Probable (5% - 25% chance of occurring) | 2 |
| | Medium Probability (25% - 75% chance of occurring) | 3 |
| | Highly probable (75% - 95% chance of occurring) | 4 |
| | Definite (greater than 95% chance of occurring) | 5 |
| **Reversibility** | No impact | 0 |
| | Impact will be reversible | 1 |
| | High potential that impact might be reversed | 2 |
| | Moderate potential that impact might be reversed | 3 |
| | Low potential that impact might be reversed | 4 |
| | Impact cannot be reversed | 5 |
| **Irreplaceability** | None | 0 |
| | Very low potential for loss of irreplaceable resources | 1 |
| | Low potential for loss of irreplaceable resources | 2 |
| | Moderate potential for loss of irreplaceable resources | 3 |
| | High potential for loss of irreplaceable resources. | 4 |
| | Definite loss of irreplaceable resources | 5 |
| **CUMULATIVE impact** | **High**: The activity is one of several similar pasts, present or future activities in the same geographical area, and might contribute to a very significant combined impact on the natural, cultural, and/or socio-economic resources of local, regional or national concern. | |
| | **Medium**: The activity is one of a few similar pasts, present or future activities in the same geographical area, and might have a combined impact of moderate significance on the natural, cultural, and/or socio-economic resources of local, regional or national concern. | |

| Criteria | Description | Quantitative Rating |
|---|---|---|
| | **Low**: The activity is localised and might have a negligible cumulative impact. | |
| | **None**: No cumulative impact on the environment. | |

Once the evaluation components have been ranked for each impact, the significance of the potential impact is assessed (or calculated) using the following formula:

SP (significance points) = (intensity + duration + spatial extent + irreplaceable + reversibility) x probability

The maximum value is 150 SP (significance points). The unmitigated and mitigated scenarios for each environmental impact should be rated as per the table below (***Table 3-5***).

***Table 3-5: Definition of significance ratings (positive and negative)***

| Significance Points | Environmental Significance | Description |
|---|---|---|
| **125 – 150** | Very high (VH) | An impact of high or very high significance could influence a decision about whether or not to proceed with the proposed Project, regardless of available mitigation options.<br>**Cumulative Impacts:**<br>The activity is one of several similar pasts, present or future activities in the same geographical area, and might contribute to a very significant combined impact on the natural, cultural, and/or socio-economic resources of local, regional or national concern. |
| **100 – 124** | High (H) | |
| **75 – 99** | Moderate-High (MH) | If left unmanaged, an impact of moderate-high significance could influence a decision about whether or not to proceed with the proposed Project. Mitigation options should be re-evaluated. |
| **40 – 74** | Moderate (M) | If left unmanaged, an impact of moderate significance could influence a decision about whether or not to proceed with the proposed Project.<br>**Cumulative Impacts:**<br>The activity is one of a few similar pasts, present or future activities in the same geographical area, and might have a combined impact of moderate significance on the natural, cultural, and/or socio-economic resources of local, regional or national concern. |
| **<40** | Low (L) | An impact of low significance is likely to contribute to positive decisions about whether or not to proceed with the proposed |

| Significance Points | Environmental Significance | Description |
|---|---|---|
| | | Project. It will have little real effect and is unlikely to have an influence on project design or alternative motivation.<br>**Cumulative Impacts:**<br>The activity is localised and might have a negligible cumulative impact. |
| + | Positive impact (+) | A positive impact is likely to result in a positive consequence/effect and is likely to contribute to positive decisions about whether or not to proceed with the proposed Project. |

## 3.6 SITE ECOLOGICAL IMPORTANCE (SEI)

The Animal Species Protocol and SEA Guideline (SANBI 2020) 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 site is mainly situated within the Carletonville Dolomite Grassland, and a small section towards the southwest in the Gauteng Shale Mountain Bushveld (Mucina & Rutherford, 2006 – as amended (Figure 4-1).

***Carletonville Dolomite Grassland (Gh 15)***

**Distribution:** Carpe Diem Dolomite Grasslands are predominantly found in the Gauteng Province, in the regions round Potchefstroom, Ventersdorp and Carpe Diem.

**Vegetation & Landscape features**: Carletonville Dolomite Grassland is characterised by slightly undulating plains dissected by prominent rocky chert ridges. Species-rich grasslands forming a complex mosaic pattern dominated by many species but is mainly characterised by important taxa such as *Aristida congesta*, *Heteropogon contortus*, *Crabbea angustifolia*, and *Elephantorrhiza elephantina.* The geology is mostly dolomite and chert of the Malmani Subgroup.

**Important Plant Taxa**

- **Grasses**: *Aristida congesta, Brachiaria serrata, Cynodon dactylon, Digitaria tricholaenoides, Diheteropogon amplectens, Eragrostis chloromelas, E. racemosa, Heteropogon contortus, Loudetia simplex, Schizachyrium sanguineum, Setaria sphacelata, Themeda triandra* and *Alloteropsis semialata*.
- **Herbs**: *Acalypha angusta, Barleria macrostegia, Chamaecrista mimosoides, Chamaesyce inaequilatera, Crabbea angustifolia, Dianthus mooiensis, Dicoma anomala, Helichrysum caespititium, H. miconiifolium, H. nudifolium, Ipomoea ommaneyi, Kyphocarpa angustifolia* and *Senecio coronatus*.
- **Shrubs**: *Anthospermum rigidum, Indigofera comosa, Pygmaeothamnus zeyheri, Englerophytum magalismontana, Tylosema esculentum* and *Ziziphus zeyheriana*

**Conservation:** Only a small extent conserved in statutory reserves (Sterkfontein Caves—part of the Cradle of Humankind World Heritage Site, Oog Van Malmanie, Abe Bailey, Boskop Dam, Schoonspruit, Krugersdorp, Olifantsvlei, Groenkloof) and in at least six private conservation areas. Almost a quarter already transformed for cultivation, by urban sprawl. Erosion very low (84%) and low (15%).

***Gauteng Shale Mountain Bushveld (SVcb 10)***

**Distribution:** Gauteng Shale Mountain Bushveld occurs in a narrow band along a series of ridges from Carpe Diem-Westonaria-Lenasia.

**Vegetation and Landscape Features:** Gauteng Shale Mountain Bushveld occurs on low, rocky ridges of varying steepness. Vegetation is characterised by short, semi-open thicket consisting of a variety of fine- and broad-leaf woody species. The field layer is normally dominated by grasses (Mucina and Rutherford, 2006). The underlying geology comprises shale with some coarser clastic sediments and andesite from the Pretoria Group. Soils are shallow to deep Mispah.

**Important Plant Taxa**

Based on Mucina and Rutherford (2006) vegetation classification, important plant taxa are those species that have a high abundance, a frequent occurrence (not being particularly abundant) or are prominent in the landscape within a particular vegetation type. They recognise the following species as important taxa in Gauteng Shale Mountain Bushveld:

- **Trees**: *Dombeya rotundifolia, Celtis africana, Combretum molle, Cussonia spicata, Englerophytum magalismontanum, Protea caffra, Rhus leptodictya, Vangueria infausta, Vachellia caffra, V. karroo, Zanthoxylum capense* and *Ziziphus mucronata.*
- **Shrubs**: *Asparagus laricinus, Canthium gilfillanii, Chrysanthemoides monilifera, Dichrostachys cinerea, Diospyros austro-africana, Diospyros lycioides* subsp*. lycioides, Ehretia rigida* subsp*. rigida, Grewia occidentalis, Gymnosporia polyacantha* and *Olea europaea*.
- **Grasses**: *Hyparrhenia dregeana, Cymbopogon caesius, Digitaria eriantha* and *Eragrostis curvula*.
- **Herbs**: *Dicoma zeyheri, Helichrysum nudifolium, H. rugulosum, Hermannia lancifolia, Selaginella dregei, Senecio venosus, Vernonia natalensis, Vernonia oligocephala, Cheilanthes hirta, Pellaea calomelanos* and *Scadoxus puniceus*.

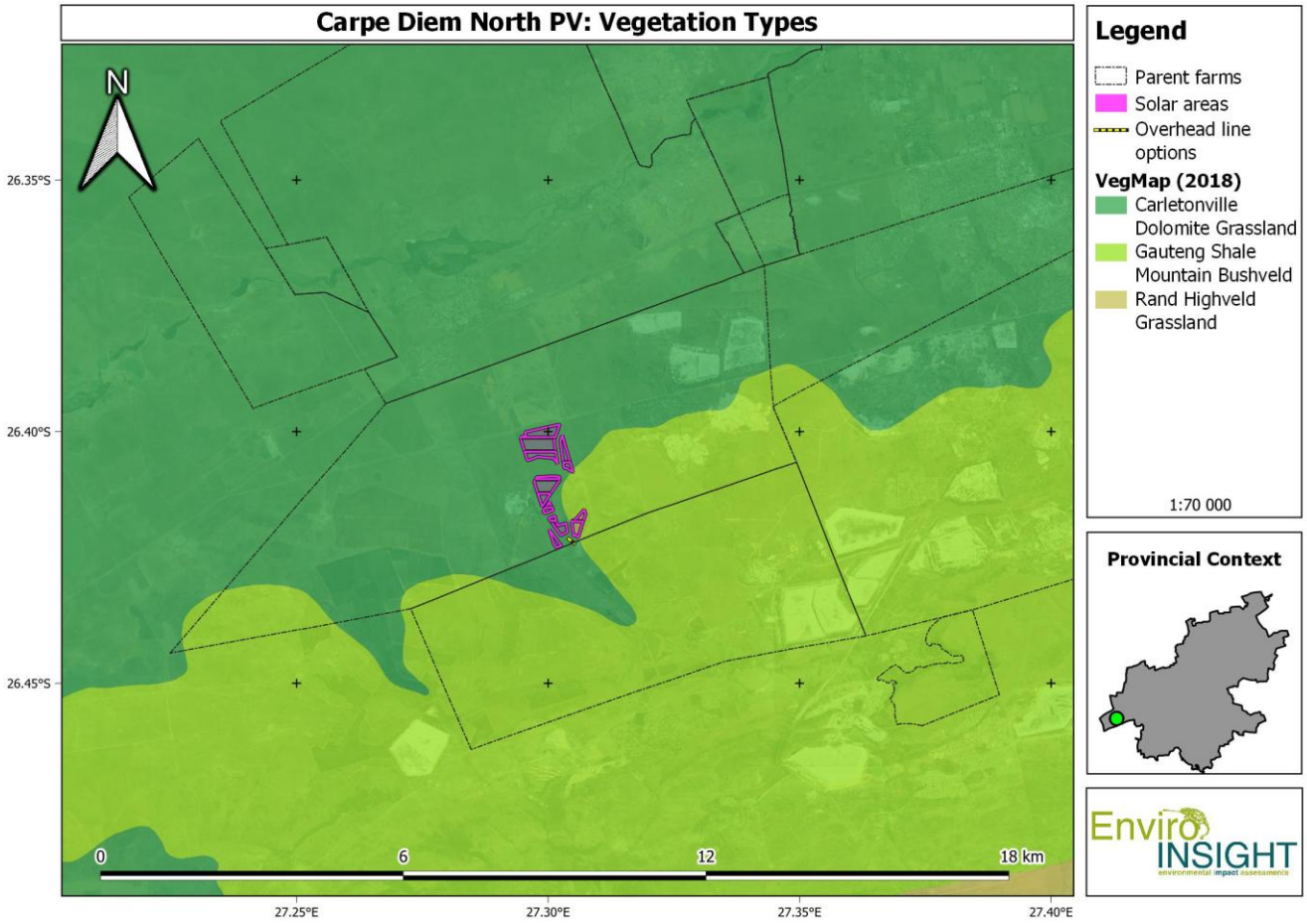


*Figure 4-1: The proposed Carpe Diem North SEF in relation to major vegetation types (SANBI, 2018).*

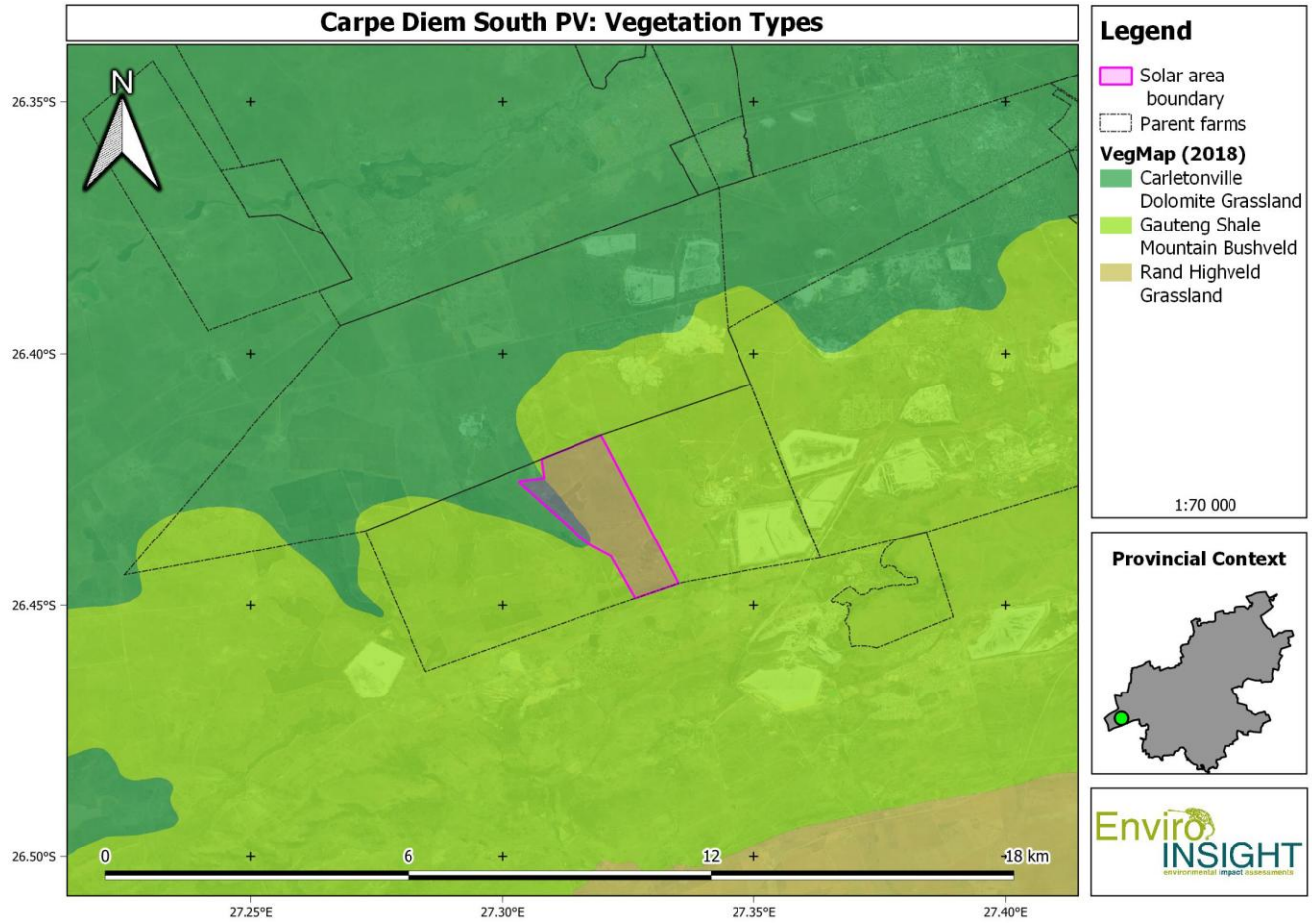


*Figure 4-2: The proposed Carpe Diem South SEF in relation to major vegetation types (SANBI, 2018).*

## 4.2 THE PROTECTED AREAS AND IMPORTANT BIRD AREAS

The proposed Carpe Diem SEF is not located in an Important Bird Area (IBA) or protected area but borders the expansive Abe Bailey Nature Reserve. The Abe Bailey Nature Reserve comprises wetlands, bushveld and grassy savannahs. Each of these provides a different habitat for a unique combination of birds, and other flora and fauna.

Avifaunal species present include barbets (black-collared, pied and crested), bulbuls, African fish eagles, mousebirds (speckled, red-faced and white-backed), goliath herons, paradise flycatchers, yellow-billed storks, Diedericks cuckoos, blue waxbills, black-throated canaries, Black-chested Prinia, little bitterns and black crakes. During the winter months (June to August), fairy flycatchers may also be seen. Although Figure 4-3 shows some proximity to protected areas and IBAs, the PA shows no ecological linkage to these habitats. The impacts that preclude this ecological linkage includes Figure 4-3;

- 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.

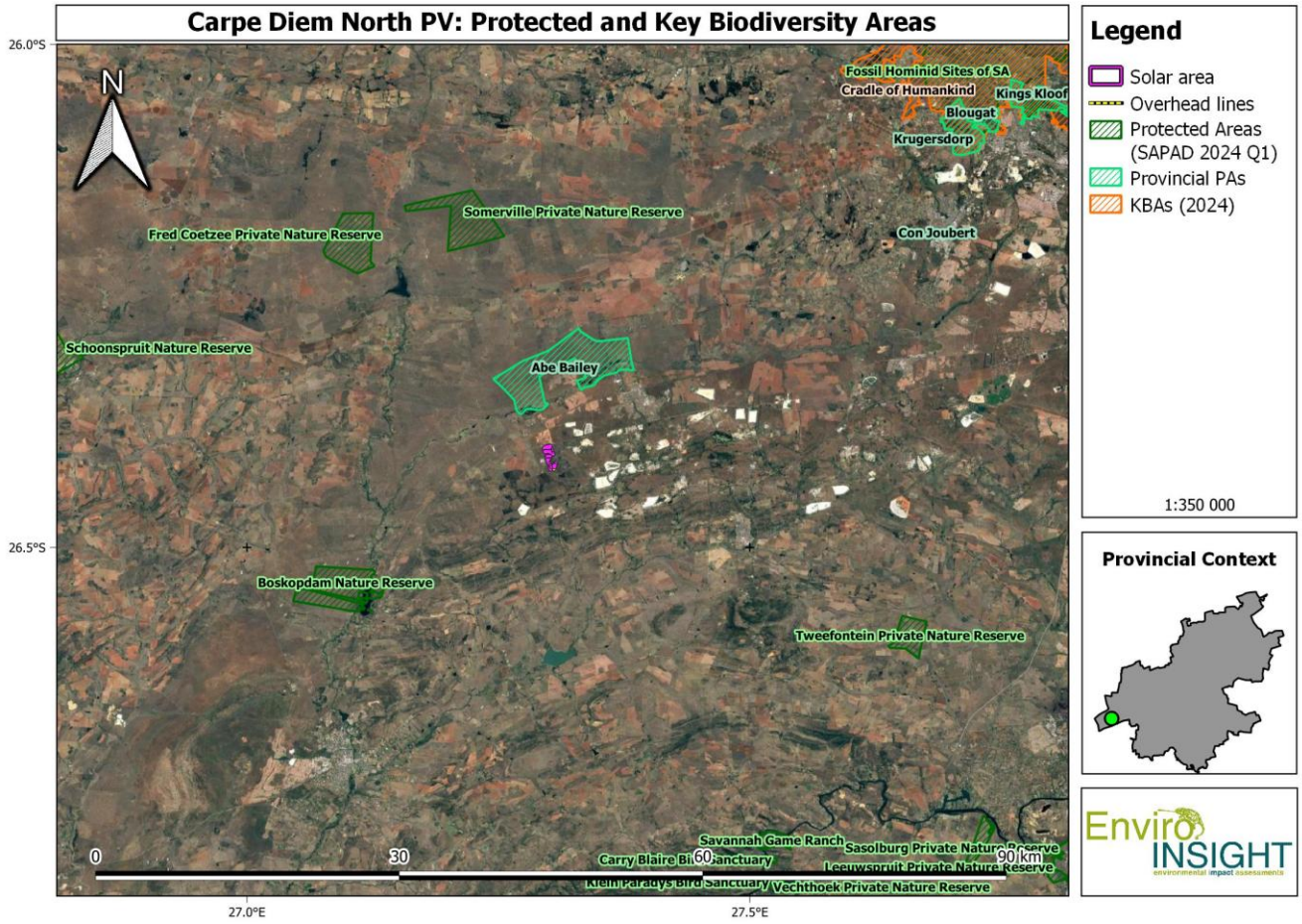


*Figure 4-3: The Carpe Diem SEF in relation to Protected Areas and IBAs.*

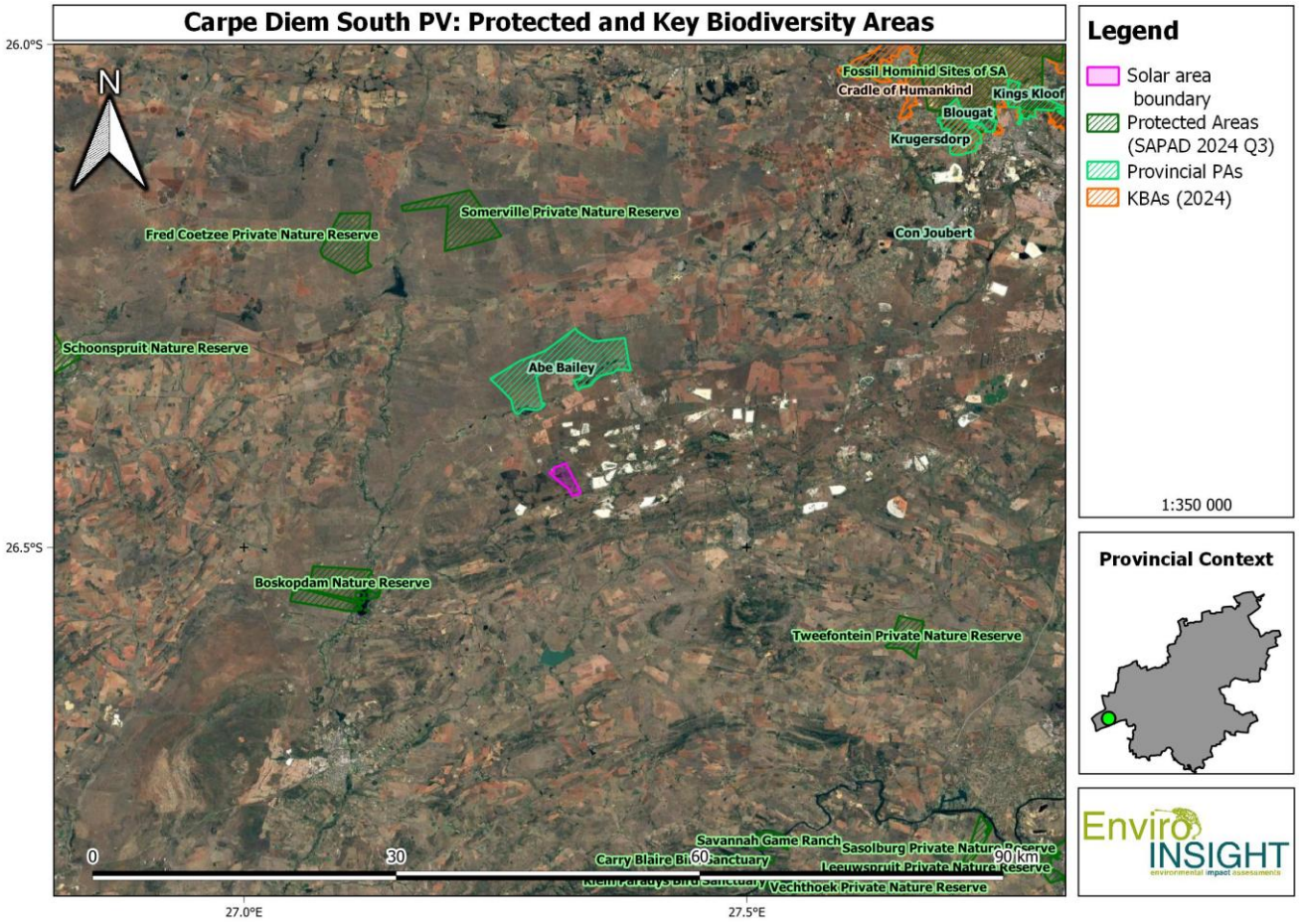


*Figure 4-4: The Carpe Diem SEF in relation to Protected Areas and IBAs.*

## 4.3 2011 GAUTENG CONSERVATION PLAN 3.3 (C-PLAN 3.3)

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).
- **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 in relation to the Gauteng CBA's is presented in Figure 4-5. indicating that the study area is located primarily in a CBA2 (Important) and ESA. CBA2 are indicated based on Primary Grassland, Red Listed Bird habitat and potential Orange list plant species. A small portion of the Carpediem North SEF intersects with the delineated CBA2.

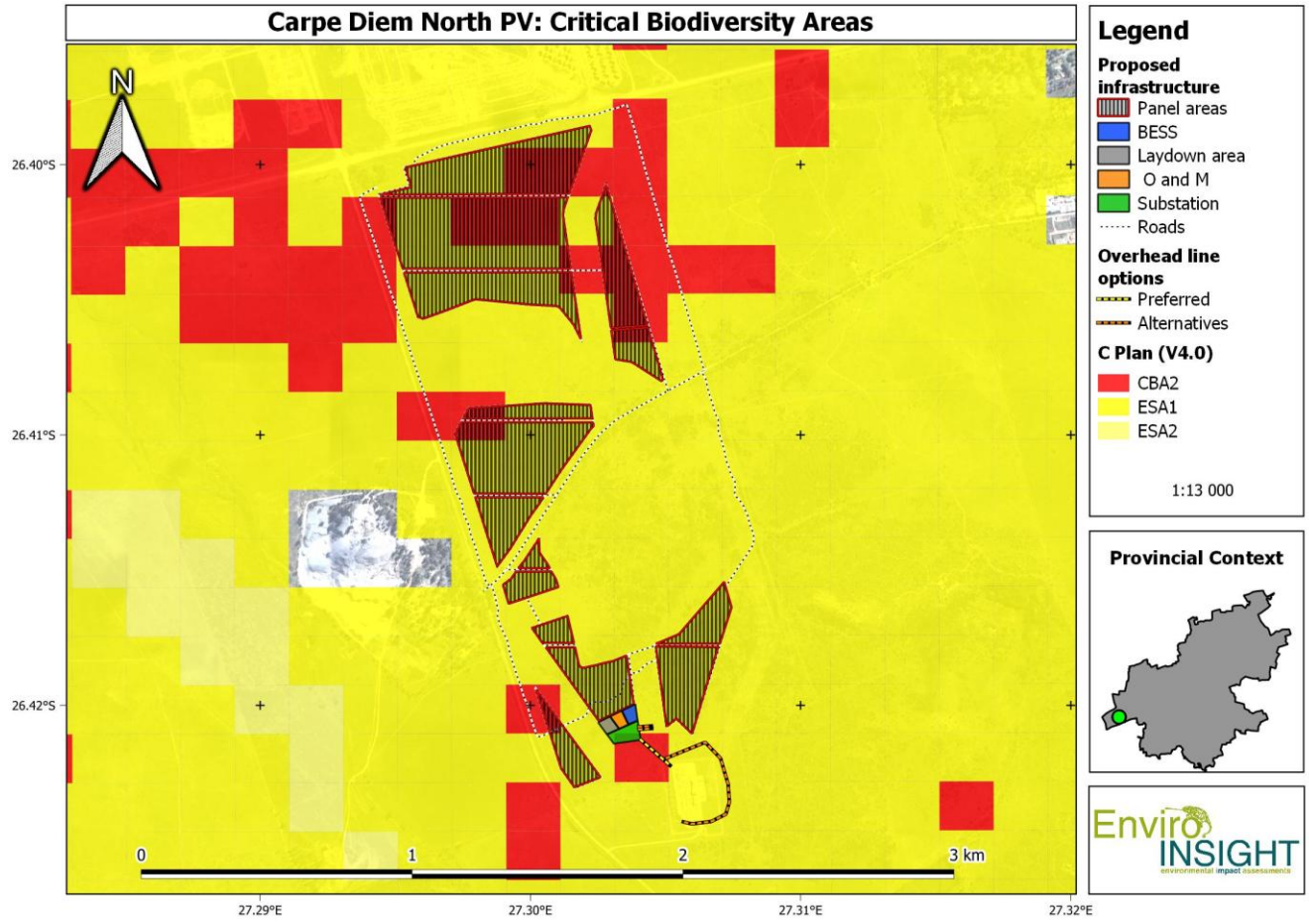


*Figure 4-5: The proposed Carpe Diem North SEF in relation to the C Plan V4.0*

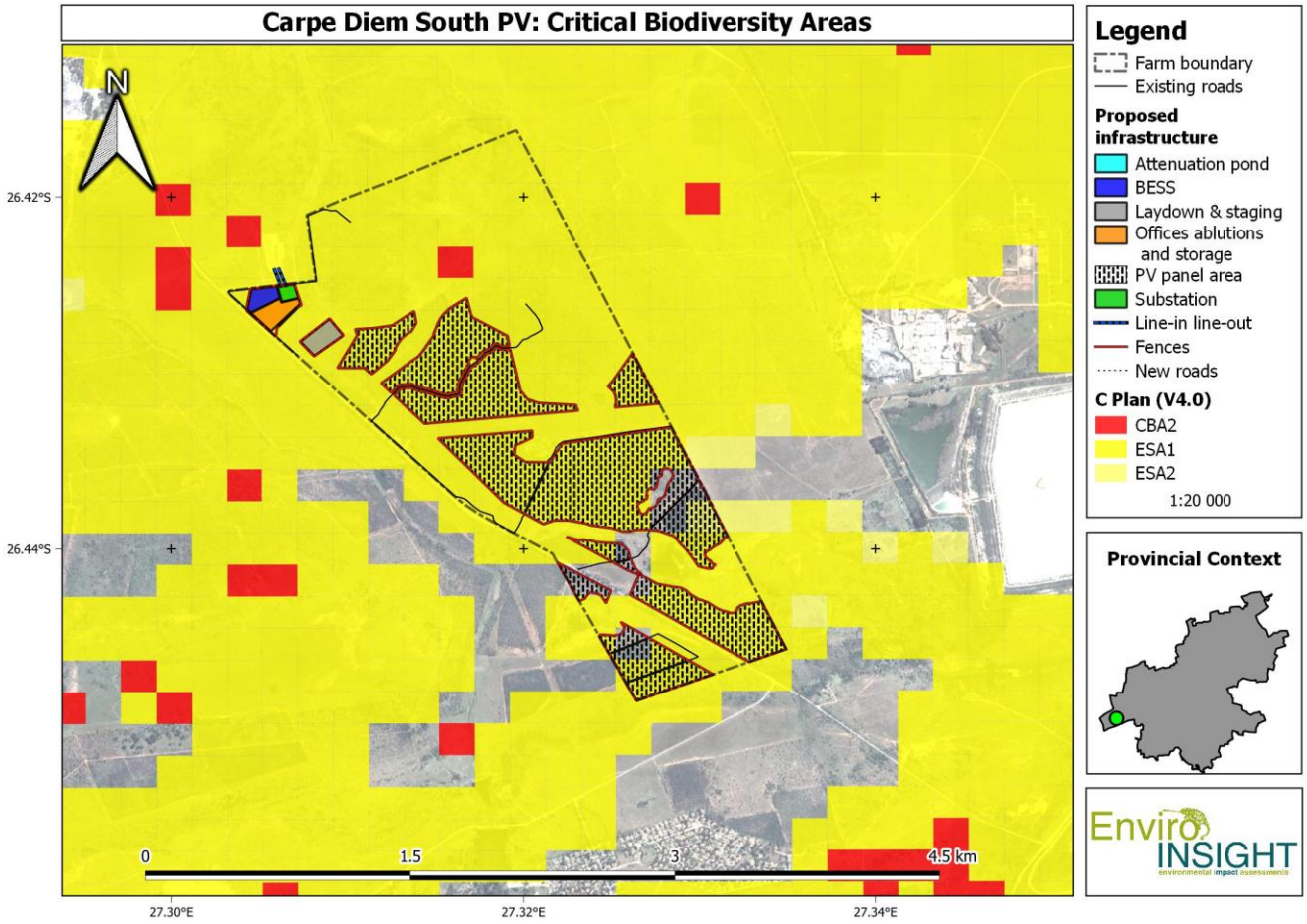


*Figure 4-6: The proposed Carpe Diem SEF in relation to the C Plan V4.0*

## 4.4 DESCRIPTION OF MAJOR BIRD HABITATS

Within the overall Project Area of Influence (PAOI), five main avifaunal habitats were identified based on species composition and structure as well as transformed areas where no or limited vegetation remains. The five habitats include: Grassland, Disturbed Grassland, and Bushveld/Rocky Grassland Mosaic, Watercourse and Dam, Alien Invasive Species Stands. 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 4-7) in accordance with the ecology of the prevailing avifaunal assemblages which may merge botanically divergent habitats and subsequently converted to sensitivity mapping. The infrastructure overlay is expressed as Figure 4-9. *In situ* habitat delineation can be viewed in the accompanying terrestrial ecology report. 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 very few of the habitats are capable of supporting a wide range of general avifaunal species and Red-Listed / SCC and some habitats are more generic in nature and therefore the presence/ absence of SCC is more easily predicted.

**Due to the moderate diversity and density of the below-mentioned SCC recorded during the survey, (including regionally and globally listed Endangered and Vulnerable birds), the PAOI is not considered an area of Critical avifaunal importance, although the impact assessment must follow avoidance mitigation due to regional high avifaunal sensitivity.**

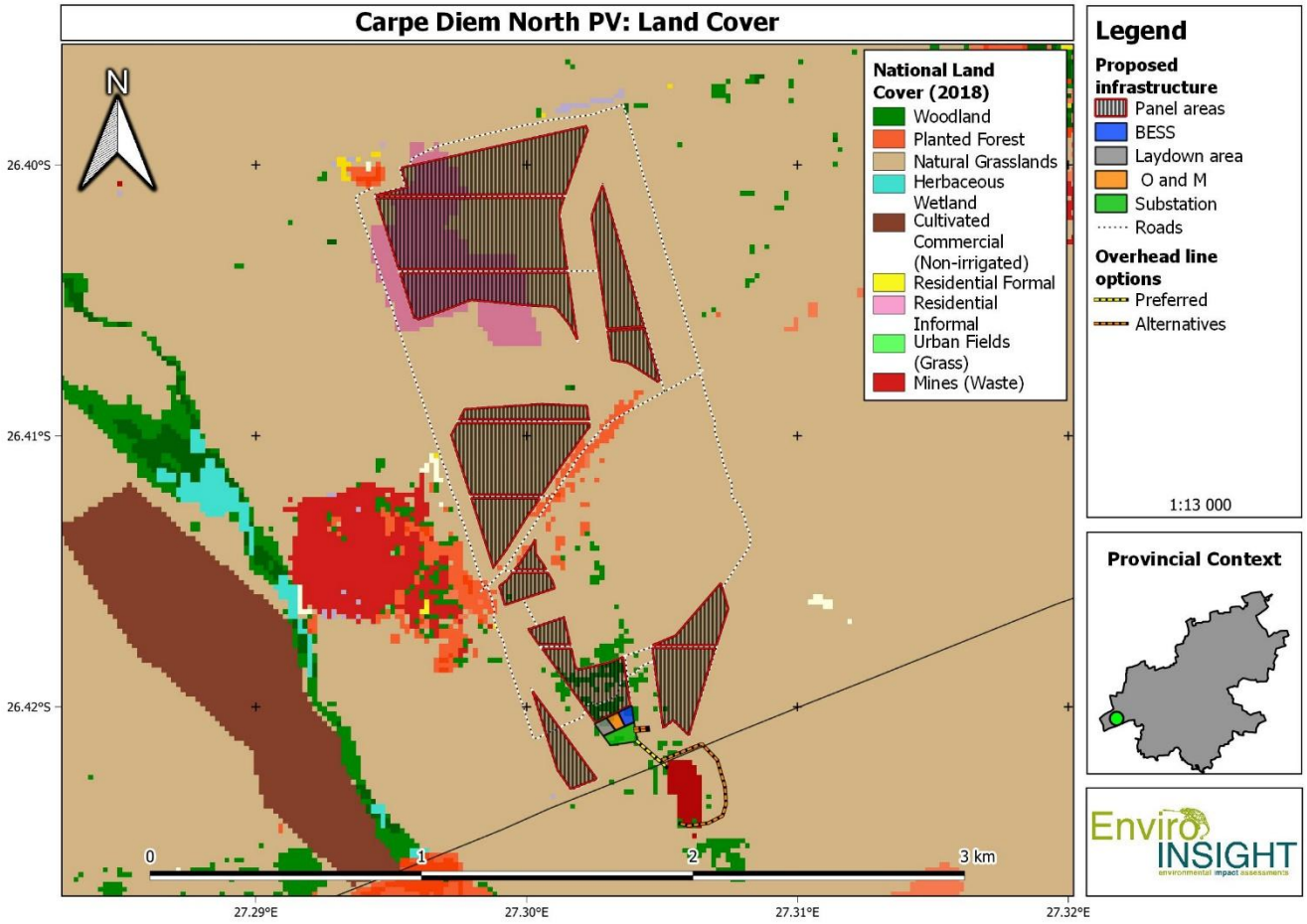


*Figure 4-7: Avifaunal Habitats (Landcover) for the Carpe Diem North SEF.*

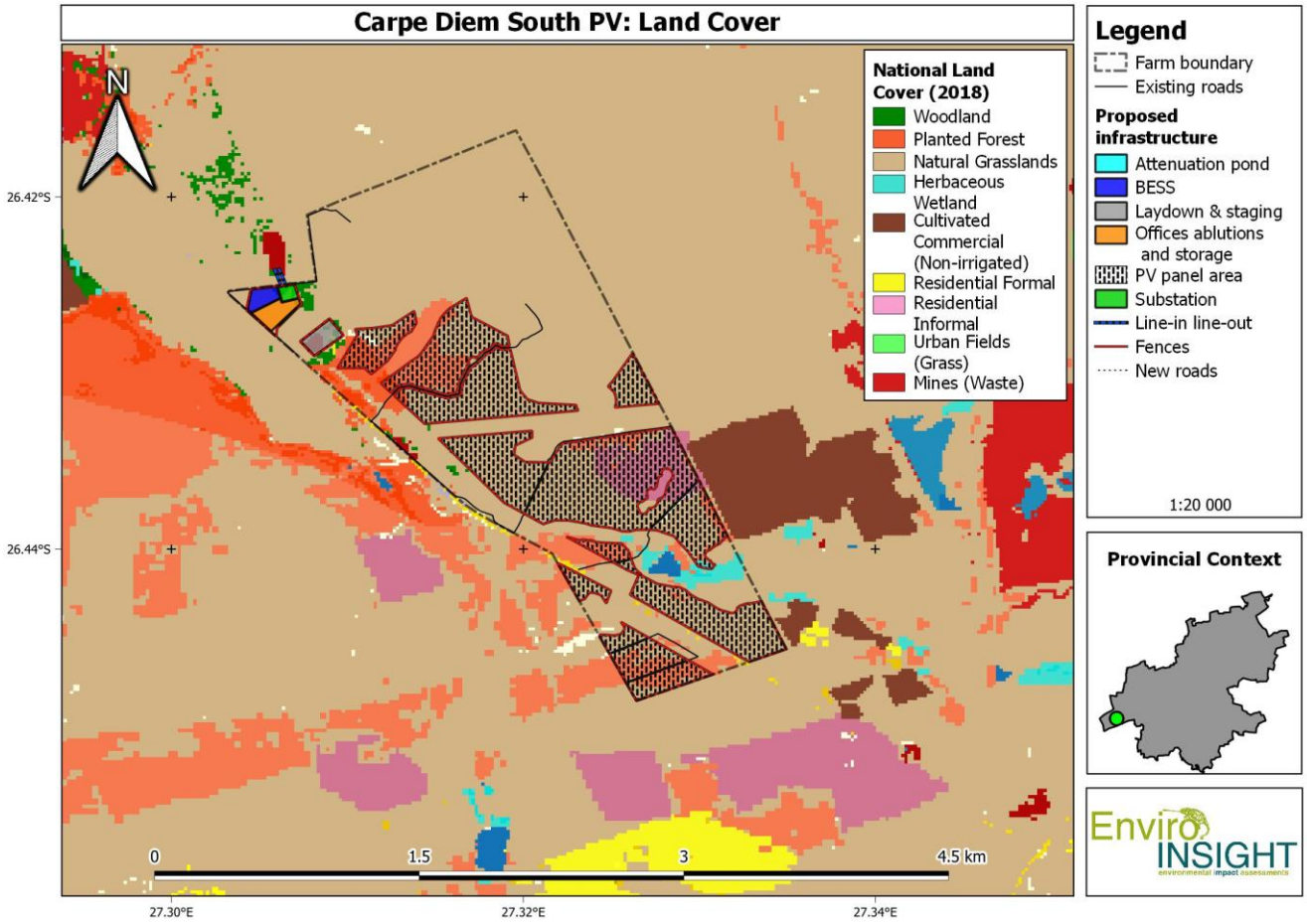


*Figure 4-8: Avifaunal Habitats (Landcover) for the Carpe Diem South SEF.*

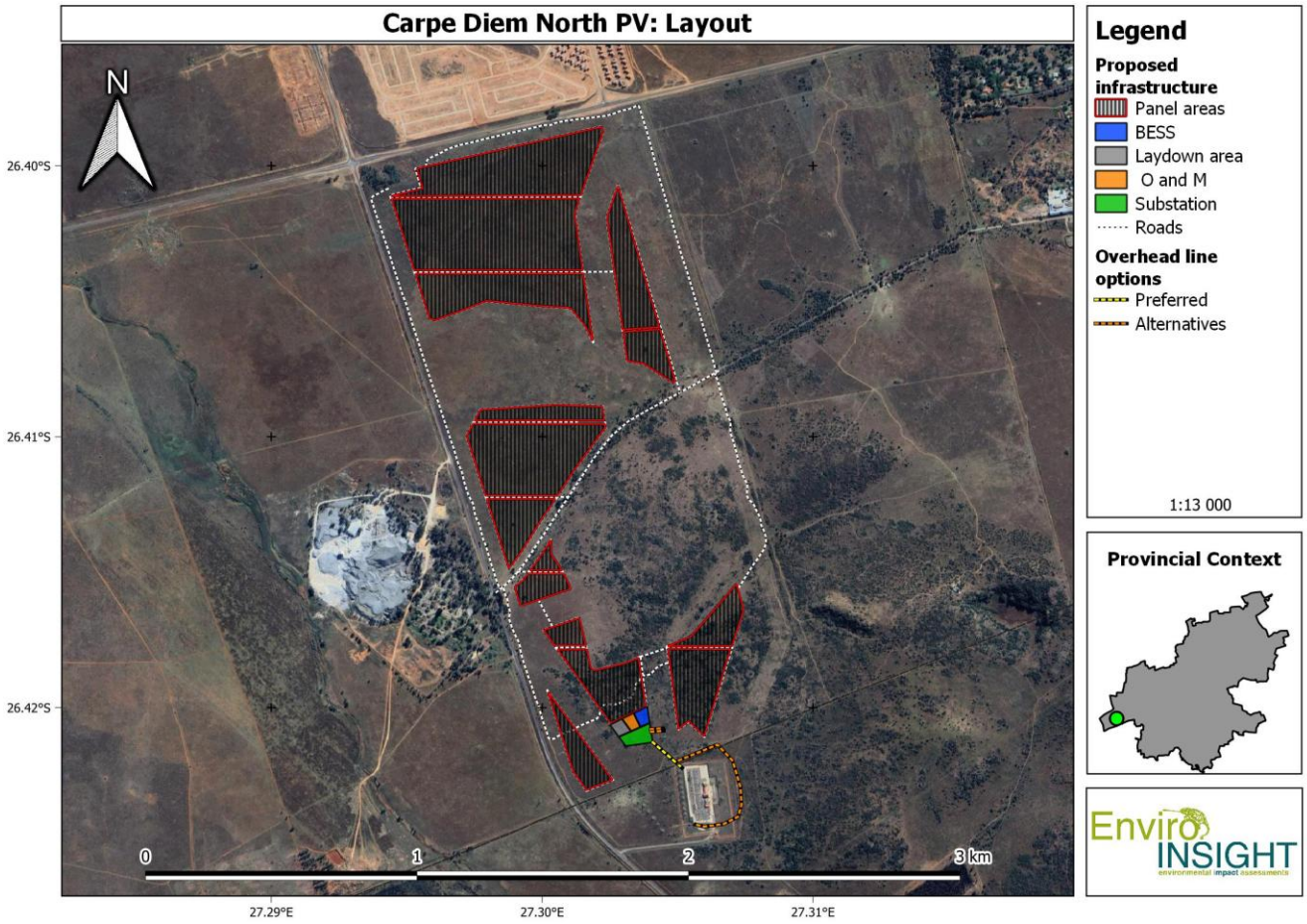


*Figure 4-9: Carpe Diem North Infrastructure Overlay.*

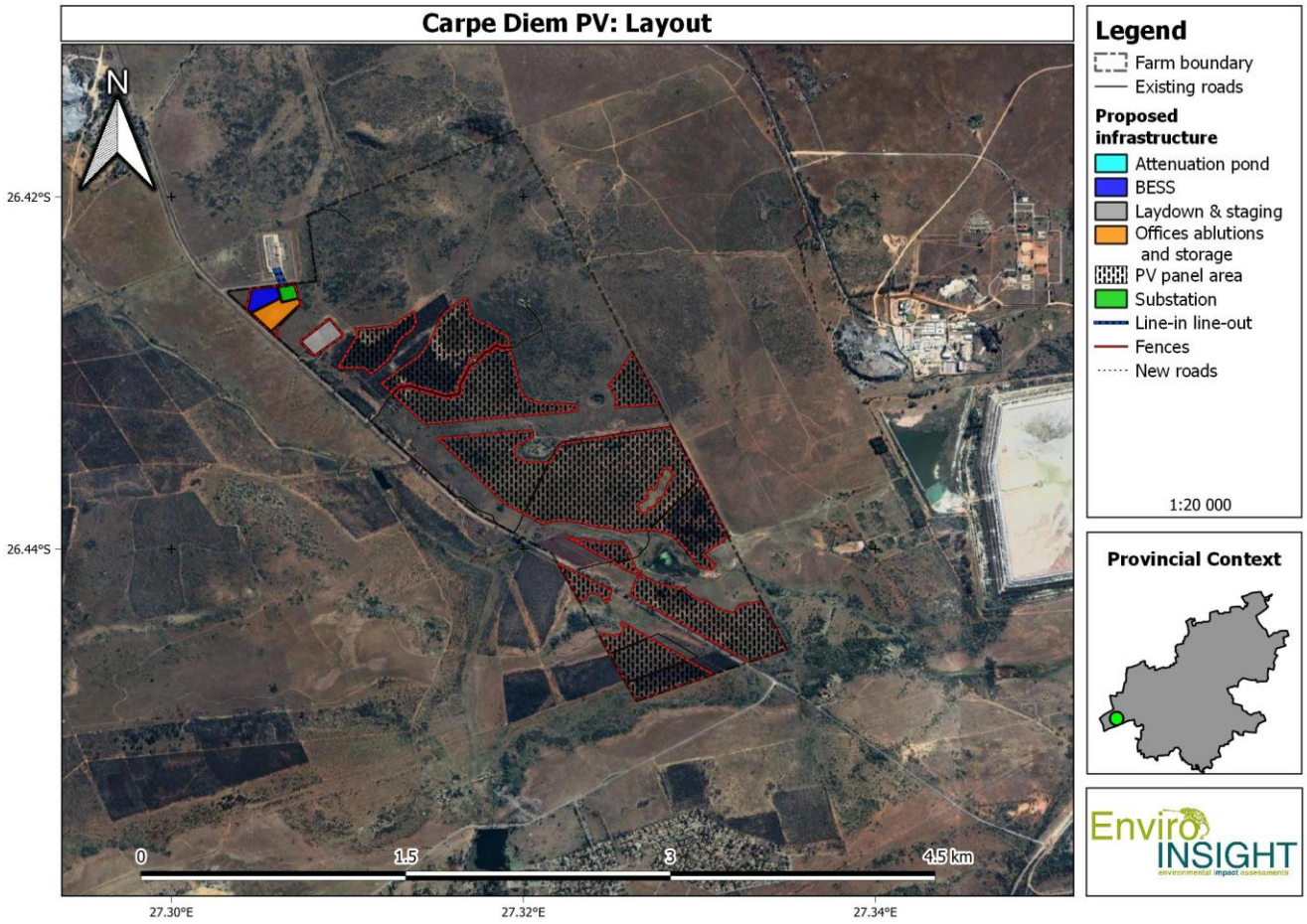


*Figure 4-10: Carpe Diem South Infrastructure Overlay.*

### 4.4.1 Natural Grassland

| Photographs | Description |
|---|---|
|  | **Classification:** Natural grassland<br>**Hydrology:** No major hydrological impacts are expected from the development<br>**Geomorphology:** Undulating primary grassland habitat with large extents of flat terrain merging into wetlands.<br>**Vegetation:** Vegetation varies depending on soil quality but is mostly comprised of grassland interspersed with shrub and forb patches<br><br>**Avifaunal Characteristics:**<br>These habitats exhibit low population density of reptiles, small mammals and ground birds, hares and korhaans which may provide a sound prey base for larger at-risk priority bird species such as larger raptors. 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 raptors observed (such as Amur Falcon, Black-winged Kite, Common Buzzard), utilised grassland during seasonal observations. Other ground-dwelling species such as, Francolins, and White-bellied Bustards are unlikely to occur here. When burnt, areas attract greater pipit and lark numbers.* |

### 4.4.2 Disturbed Grassland

| Photographs | Description |
|---|---|
|  | **Classification:** Disturbed and overgrazed grassland<br>**Hydrology:** No major hydrological impacts are expected from the development although some ridges are associated with non-perennial watercourses and facultative wetlands.<br>**Geomorphology:** Undulating habitat with large extents of connected and isolated crop stands.<br>**Vegetation:** Vegetation varies depending on soil quality but is mostly comprised of disturbed grassy patches<br><br>**Avifaunal Characteristics:**<br>The high levels of disturbance reduces the overall ecological importance of this habitat for avifauna. The poor structural complexity which often showed lower diversity but high densities of avifauna due to the lack of abundance of forage and prey species that are found in this habitat. *Notes: Disturbed areas were frequented by large birds such as Helmeted Guineafowl, Swainson's Spurfowl, and Crowned Lapwing. Smaller birds included Levaillant's and Zitting Cisticola, larks weavers and waxbills. 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. Notes: no nests were found, but larger alien trees may attract nesting and roosting raptors.* |

### 4.4.3 Rocky Bushveld Grassland Mosaic

| Photographs | Description |
|---|---|
|  | **Classification:** Bushveld and Rocky Grassland Mosaic<br>**Hydrology:** No major hydrological impacts are expected from the development<br>**Geomorphology:** Undulating rocky and vegetated habitat with large extents of flat terrain.<br>**Vegetation:** Vegetation varies depending on soil quality but is mostly comprised of bushveld vegetation, grassland and rocky shrub.<br><br>**Avifaunal Characteristics:**<br>The Bushveld and Rocky Grassland Mosaic have not proven to be important habitat for large raptors,<br><br>*Notes: This refers to grasslands on the PA containing some natural grassland, bushveld and scattered rocks. The area attracted many passerines flying between the area. Francolins were observed, as well as hunting raptors Black Sparrowhawk, Amur Falcon, African Harrier-Hawk, Black-winged Kite, etc.). No significant nests and roosts were found during the two site visits.* |

### 4.4.4 Rocky Grassland

| Photographs | Description |
|---|---|
|  | **Classification:** Rocky Grassland<br>**Hydrology:** No major hydrological impacts are expected from the development<br>**Geomorphology:** The large powerline pylons have been placed on undulating vegetated habitat with large extents of flat terrain.<br>**Vegetation:** Vegetation varies depending on soil quality but is mostly comprised of grassland and rocky shrub.<br><br>**Avifaunal Characteristics:**<br>The Rocky Grasslands have not proven to be important habitat for large raptors. *Notes: This refers to grasslands on the PA containing some natural grassland, acacias and scattered rocks. The area attracted many passerines flying between the area and the adjacent canal line. Francolins were observed, as well as hunting raptors (Amur Falcon, Black-winged Kite, etc.). No nests were found during the two site visits.* |

### 4.4.5 Drainage lines

| Photographs | Watercourses and Drainage Lines |
|---|---|
|  | **Classification:** Ephemeral and endorheic drainage lines and impoundments.<br>**Hydrology:** No major hydrological impacts are expected from the development.<br>**Geomorphology:** Channels varying in width and depth from large multi-channeled gullies to shallow narrow channels. The impoundments are well vegetated and even artificial waterbodies show significant avifaunal habitat.<br>**Vegetation:** Vegetation varies depending on channel width and depth, where larger deep-rooted trees line larger channels with lower shrub layers characterising smaller drainage line systems.<br><br>**Avifaunal Characteristics:**<br>The seasonal drainage lines and accompanying riparian trees are linear dispersal corridors for terrestrial bird species. Much higher 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 act as important flight corridors for passerines and raptors between foraging and roosting sites.<br>Avifaunal assemblages differed depending on the classification of the drainage line system as well as the season. Most of the drainage line systems are seasonally ephemeral or dry. Thus, most of the bird associations are linked to the prevailing vegetation and soil types within the delineated drainage line habitats. In summary, drainage lines with taller shrub and tree layers showed a much higher diversity of passerine species as well as sand-associates and ground-dwelling birds such as coursers and thick-knees. Water associated species (Moorhens, Ducks, Warblers, Hamerkops, Crakes, Herons and Lapwings). |

### 4.4.6 Alien Invasive Tree Stands

| Photographs | Description |
|---|---|
|  | **Classification:** *Eucalyptus* tree stands<br>**Hydrology:** No major hydrological impacts are expected from the development although some ridges are associated with non-perennial watercourses and facultative wetlands.<br>**Geomorphology:** Undulating habitat with large extents of connected alien invasive species. Understories are limited due to toxic antibiosis leaking from Eucalyptus trees.<br>**Vegetation:** Vegetation varies depending on soil quality but is mostly comprised of disturbed grassy patches<br><br>**Avifaunal Characteristics:**<br>The high level of disturbance reduces the overall ecological importance of this habitat for avifauna. The poor structural complexity which often showed lower diversity but high densities of avifauna due to the lack of abundance of forage and prey species that are found in this habitat. *Notes: Disturbed areas were frequented by large birds such as Helmeted Guineafowl, Swainson's Spurfowl, and Crowned Lapwing. Smaller birds included larks, weavers and waxbills. There appears to be some tree-clearing operations occurring. Large birds such as Hadada Ibis frequently perched in Eucalyptus groves and no large-scale roosting behaviours from species such as Amur Falcon was recorded.* |

## 4.5 OBSERVED AND EXPECTED AVIFAUNA

### 4.5.1 iNaturalist Findings

Since the fieldwork for this assessment took place in the first six months of 2023, new information has come to light for the larger area, specifically with regards to avifauna SCC (Figure 4-11). Nine out of a total of 15 SCC observations were made between August 2023 and August 2024. Within a 10 km radius from the study area, seven avifauna SCC have been recorded (Figure 4-12). One species is listed as Endangered, three are Vulnerable and the last three are Near Threatened. **Error! Reference source not found.** provides a contextual Probability of Occurrence and risk evaluation for the priority species which directly influence the mitigation measures required.

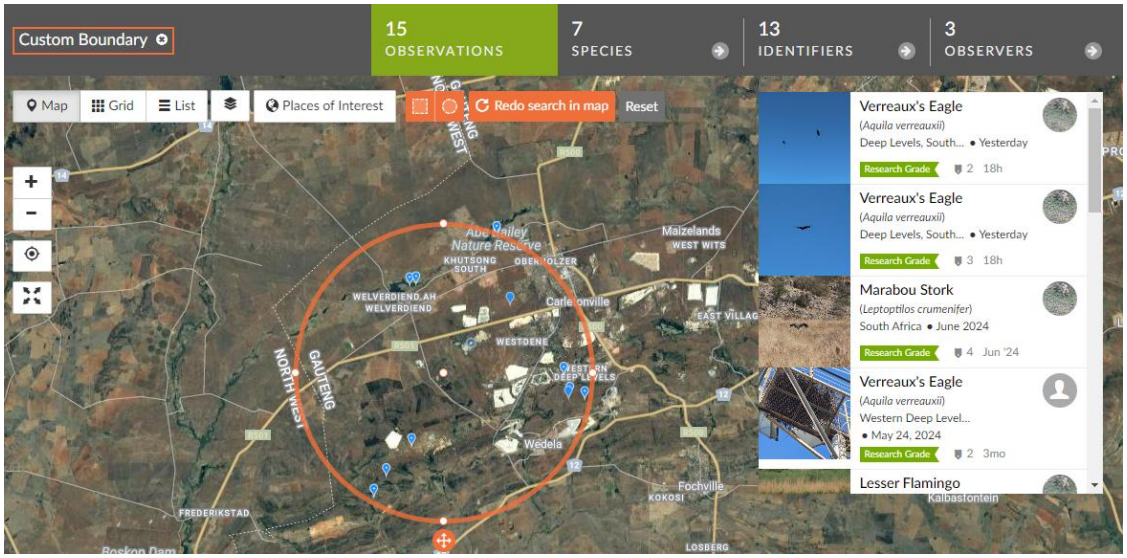


*Figure 4-11: Observations of Threatened Avifauna Species within a 10km radius of the proposed Carpe Diem SEF (Source: iNaturalist).*

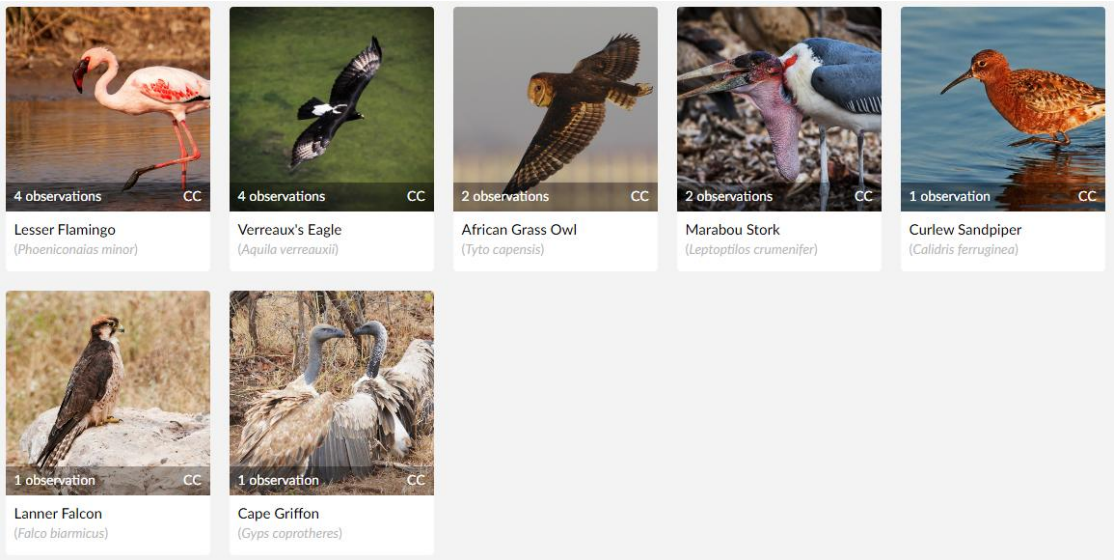


***Figure 4-12: Seven avifauna SCC recorded within a 10 km radius from the study area (Source: iNaturalist).***

### 4.5.2 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 **regionally** high habitat diversity such as the Gauteng Highveld Grassland region. A total of 106 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:

- Moderate seasonal aridity which shows a high temporal variability (turnover) in species diversity between seasons;
- Moderate diversity of habitat types; and
- Moderate levels of disturbance.

**1170 contacts** were made in total of all species which represents a high density, although many species are small synanthropic or agricultural/ disturbance adapted birds.

### 4.5.3 Priority species

A total of 9 SCC species are expected to occur with the PAOI. Overall, 39 priority species were recording on and surrounding the PA (the PAOI), of which no SCC were recorded. It is clear from Table 4-1, that not only do very few SCC avifauna species occur within the PAOI but a low number species can be expected to interact with the proposed development. However, 353 contacts of Priority Species were made during the survey as shown in Table 4-2 and 274 waterfowl contacts were made as shown in Table 4-3. This elevates the sensitivity of the PA and influences mitigation measure requirements. Photographic evidence of some representative Species observed during the current study is provided in Figure 4-16.

*Table 4-1: SCC avifauna species list for the Project Area of Influence (PAOI) (as per SABAP).*

| | Scientific Name | Common Name | Conservation Status | |
|---|---|---|---|---|
| | | | Regional | IUCN |
| **Predicted** | *Aquila rapax* | Tawny Eagle | EN | VU |
| **Predicted** | *Eupodotis senegalensis* | White-bellied Bustard | VU | LC |
| **Predicted** | *Sterna caspia* | Caspian Tern | VU | LC |
| **Predicted** | *Falco biarmicus* | Lanner Falcon | VU | LC |
| **Predicted** | *Sagittarius serpentarius* | Secretarybird | VU | EN |
| **Predicted** | *Circus ranivorus* | African Marsh Harrier | EN | LC |
| **Predicted** | *Ciconia nigra* | Black Stork | VU | LC |
| **Predicted** | *Gyps coprotheres* | Cape Vulture | EN | EN |
| **Predicted** | *Tyto capensis* | African Grass Owl | VU | VU |

### 4.5.4 Combined Species Summary

Updated as shown in Table 4-2

*Table 4-2: Recorded priority avifauna species list for the Project Area (PA).*

**Total number of priority species individuals observed per season**

Note: IF Priority = Large Bird (>30cm) or Red Listed or Raptor or Waterbird

| | | Season | | |
|---|---|---|---|---|
| **English IOC Name** | **Scientific Name** | **Summer** | **Winter** | **Total** |
| Amur Falcon | *Falco amurensis* | 5 | | 5 |
| Black Crake | *Zaporina flavirostra* | | 2 | 2 |
| Black Sparrowhawk | *Accipiter melanoleucus* | 1 | | 1 |
| Black-headed Heron | *Ardea melanocephala* | 2 | 1 | 3 |
| Black-winged Kite | *Elanus caeruleus* | 2 | 1 | 3 |
| Blacksmith Lapwing | *Vanellus armatus* | 2 | 1 | 3 |
| Blue-billed Teal | *Anas hottentota* | 3 | 4 | 7 |
| Common Buzzard | *Buteo buteo* | 2 | | 2 |
| Common Cuckoo | *Cuculus canorus* | 1 | | 1 |
| Common Moorhen | *Gallinula chloropus* | 14 | 11 | 25 |
| Common Reed Warbler | *Acrocephalus scirpaceus* | 1 | | 1 |
| Common Waxbill | *Estrilda astrild* | | 12 | 12 |
| Crowned Lapwing | *Vanellus coronatus* | 1 | 2 | 3 |
| Egyptian Goose | *Alopochen aegyptiaca* | 3 | 4 | 7 |

| | | | | |
|---|---|---|---|---|
| Glossy Ibis | *Plegadis falcinellus* | 2 | | 2 |
| Grey Heron | *Ardea cinerea* | 2 | | 2 |
| Hadada Ibis | *Bostrychia hagedash* | 4 | 2 | 6 |
| Hamerkop | *Scopus umbretta* | 2 | | 2 |
| Helmeted Guineafowl | *Numida meleagris* | 25 | | 25 |
| Jackal Buzzard | *Buteo rufofuscus* | 1 | | 1 |
| Lesser Swamp Warbler | *Acrocephalus gracilirostris* | 2 | | 2 |
| Levaillant's Cisticola | *Cisticola tinniens* | 10 | 3 | 13 |
| Pied Crow | *Corvus albus* | 8 | 2 | 10 |
| Red-billed Teal | *Anas erythrorhyncha* | 3 | | 3 |
| Red-collared Widowbird | *Euplectes ardens* | 11 | | 11 |
| Red-eyed Dove | *Streptopelia semitorquata* | 5 | 3 | 8 |
| Red-knobbed Coot | *Fulica cristata* | 47 | 18 | 65 |
| Reed Cormorant | *Microcarbo africanus* | 8 | | 8 |
| South African Shelduck | *Tadorna cana* | 10 | 10 | 20 |
| Southern Red Bishop | *Euplectes orix* | 3 | 10 | 13 |
| Speckled Pigeon | *Columba guinea* | 7 | | 7 |
| Spur-winged Goose | *Plectropterus gambensis* | 6 | | 6 |
| Swainson's Spurfowl | *Pternistis swainsonii* | 1 | | 1 |
| Three-banded Plover | *Charadrius tricollaris* | 2 | 6 | 8 |
| Western Cattle Egret | *Bubulcus ibis* | 3 | | 3 |
| White-breasted Cormorant | *Phalacrocorax lucidus* | 12 | 1 | 13 |
| Yellow-billed Duck | *Anas undulata* | 7 | 6 | 13 |
| Yellow-crowned Bishop | *Euplectes afer* | 1 | | 1 |
| Zitting Cisticola | *Cisticola juncidis* | 35 | | 35 |
| **Grand Total** | | **39** | **254** | **99** | **353** |

*Table 4-3: Recorded water associated avifauna species list for the Project Area (PA).*

| | | Season | | |
|---|---|---|---|---|
| **English IOC Name** | **Scientific Name** | **Summer** | **Winter** | **Total** |
| Black Crake | *Zaporina flavirostra* | | 2 | 2 |
| Blacksmith Lapwing | *Vanellus armatus* | 2 | 1 | 3 |
| Blue-billed Teal | *Anas hottentota* | 3 | 4 | 7 |
| Common Moorhen | *Gallinula chloropus* | 14 | 11 | 25 |
| Common Reed Warbler | *Acrocephalus scirpaceus* | 1 | | 1 |
| Common Waxbill | *Estrilda astrild* | | 12 | 12 |
| Egyptian Goose | *Alopochen aegyptiaca* | 3 | 4 | 7 |
| Glossy Ibis | *Plegadis falcinellus* | 2 | | 2 |
| Grey Heron | *Ardea cinerea* | 2 | | 2 |
| Hamerkop | *Scopus umbretta* | 2 | | 2 |
| Lesser Swamp Warbler | *Acrocephalus gracilirostris* | 2 | | 2 |
| Levaillant's Cisticola | *Cisticola tinniens* | 10 | 3 | 13 |
| Red-billed Teal | *Anas erythrorhyncha* | 3 | | 3 |
| Red-collared Widowbird | *Euplectes ardens* | 11 | | 11 |
| Red-knobbed Coot | *Fulica cristata* | 47 | 18 | 65 |
| Reed Cormorant | *Microcarbo africanus* | 8 | | 8 |
| South African Shelduck | *Tadorna cana* | 10 | 10 | 20 |
| Southern Red Bishop | *Euplectes orix* | 3 | 10 | 13 |
| Spur-winged Goose | *Plectropterus gambensis* | 6 | | 6 |
| Three-banded Plover | *Charadrius tricollaris* | 2 | 6 | 8 |
| White-breasted Cormorant | *Phalacrocorax lucidus* | 12 | 1 | 13 |
| Yellow-billed Duck | *Anas undulata* | 7 | 6 | 13 |
| Yellow-crowned Bishop | *Euplectes afer* | 1 | | 1 |
| Zitting Cisticola | *Cisticola juncidis* | 35 | | 35 |
| **Grand Total** | **24** | **186** | **88** | **274** |

*Figure 4-13: African Shellduck (Priority Species).*

*Figure 4-14: Black Sparrowhawk (Priority Species).*

*Figure 4-15: White-breasted Cormorant (Priority Species).*

*Figure 4-16: Common Buzzard (Priority Species).*

### 4.5.5 Nest Survey

Nest sites were searched for during the surveys on all suitable sites which included trees and pylons 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. **No nests were recorded on site.**

## 4.6 SPECIES SPECIFIC RISK ANALYSIS AND RECOMMENDED MITIGATIONS

The relevant SCC predicted to interact with the development are described below.

### 4.6.1 Endangered species

- Martial Eagle (*Polemaetus bellicosus*) occur widely across South Africa and are not habitat-specific but require tall trees (or man-made structures) for breeding purposes. This species is adept at exploiting man-made structures for breeding. Direct persecution, habitat loss and habitat transformation are the major threats to this species (Taylor 2015a). It is expected to be a irregular visitor to the area although and is thus considered a lower risk species. Given this species' ability to exploit man-made structures, it is probable that individuals will perch, and even breed, on structures associated with the Facility, particularly electricity pylons. As a rule, all nesting raptors should be protected within the study area as they represent Priority Species but solar facilities represent a far lower risk than wind facilities for the species. Many raptor species are under constant pressure from development due to modifications and alterations of their preferred foraging habitat and dispersal networks. Disturbance applies to direct mortality as well as to the disruption of a foraging, breeding or roosting bird caused by SEF activities).
- Marsh Harrier (*Circus ranivorus*) was sighted just outside the PAOI as the project footprint is not considered to be optimal habitat. The same risks to all other large raptors (see Martial Eagle) apply to the species.
- Cape Vulture (*Gyps coprotheres*) has a relatively wide geographic distribution, with frequent roosting in the PAOI albeit no recorded breeding. This species is likely to be an infrequent visitor to the area, where it is likely to forage in the greater landscape and/or bathe in the ephemeral pans although not within the actual project footprint. The major threat to this species is poisoning, although direct persecution, electrocution on powerlines and collisions with powerlines are also threats (Allan 2015) as are turbine collisions.
- Secretarybird (*Sagittarius serpentarius*) is listed as Endangered globally and Vulnerable regionally (Taylor et al., 2015; BirdLife International 2020). Secretarybirds favour open habitats for terrestrial foraging and seek out flat-top Acacia (now Vachellia) trees or other thorny trees for nesting. This species has an extremely wide distribution across Africa but occurs at very low densities. It is prone to collision with powerlines and fences (from being flushed), while habitat loss and alteration are also major regional threats (Retief 2015). Individuals have been observed during the surveys albeit just outside of the PAOI, and this species is expected to be an infrequent but regular visitor to the project site subject to standard collision mitigations.

### 4.6.2 Vulnerable species

- Lanner Falcon (*Falco biarmicus*) occurs widely across South Africa in nearly all open habitat types. Major threats include habitat loss and collisions with powerlines (Taylor 2015b). This species is adept at using man-made structures such as transmission pylons as perches, sites to hunt from, and nesting sites.
- Verreaux's Eagle (*Aquila verreauxii*) is quite widely distributed in South Africa, showing a preference for rocky ridges and mountains on which it breeds (Davies and Allan 1997). The main threats facing this species in South Africa are direct persecution, drowning in farm dams, and collisions with and electrocutions on electricity transmission lines (Taylor 2015c). Collisions with wind turbines is a growing threat. This species may occasionally forage over the site and is subject to normal collision-based mitigations.
- White-bellied Bustard (*Eupodotis senegalensis*) prefers open savannah and grassland. The main threats to this species are habitat destruction (especially conversion to agriculture) and collision with overhead powerlines. This species is expected to be an infrequent visitor to the site with higher frequency expected in the surrounding PAOI regions.
- No Grass Owl (*Tyto capensis*) habitat existed within the PA.

### 4.6.3 Near-Threatened species

- Lesser Flamingo (*Phoeniconaias minor*) is a nomadic waterbird that is likely to be seen flying over the study site or making temporary use of the ephemeral pans within the PAOI and has been recorded by iNaturalist within 10km of the PA. Large numbers of individuals could be attracted to the ephemeral pans during high rainfall events, when conditions are favourable. The largest local threat is collisions with overhead powerlines and turbines. The species migrates between habitats (especially at night where there are highly susceptible to collisions). Thus, and in combination with other nocturnal migrants, mitigation measures such as light emitting markers are warranted for new OHPL infrastructure.

## 4.7 PRECONSTRUCTION FOCAL SITE MAIN RESULTS

### 4.7.1 Focal Sites

24 species were recorded within the focal sites which represents a high diversity and translates to significant buffering of the water associated habitats (Table 4-4).

***Table 4-4: Species recorded in the focal sites***

| English IOC Name | Scientific Name |
|---|---|
| Black Crake | *Zaporina flavirostra* |
| Blacksmith Lapwing | *Vanellus armatus* |
| Blue-billed Teal | *Anas hottentota* |
| Common Moorhen | *Gallinula chloropus* |
| Common Reed Warbler | *Acrocephalus scirpaceus* |
| Common Waxbill | *Estrilda astrild* |
| Egyptian Goose | *Alopochen aegyptiaca* |
| Glossy Ibis | *Plegadis falcinellus* |
| Grey Heron | *Ardea cinerea* |
| Hamerkop | *Scopus umbretta* |
| Lesser Swamp Warbler | *Acrocephalus gracilirostris* |
| Levaillant's Cisticola | *Cisticola tinniens* |
| Red-billed Teal | *Anas erythrorhyncha* |
| Red-collared Widowbird | *Euplectes ardens* |
| Red-knobbed Coot | *Fulica cristata* |
| Reed Cormorant | *Microcarbo africanus* |
| South African Shelduck | *Tadorna cana* |
| Southern Red Bishop | *Euplectes orix* |
| Spur-winged Goose | *Plectropterus gambensis* |
| Three-banded Plover | *Charadrius tricollaris* |
| White-breasted Cormorant | *Phalacrocorax lucidus* |
| Yellow-billed Duck | *Anas undulata* |
| Yellow-crowned Bishop | *Euplectes afer* |
| Zitting Cisticola | *Cisticola juncidis* |
| **Grand Total** | **24** |

### 4.7.2 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. There is no highly likely **permanent** predicted **resident breeding** presence of SCC in the PA which does not apply to the 39 priority species recorded in the PA, most of which are widespread through the region. Several raptors utilise habitats within the region and the PAOI, some of them priority species and/or of conservation concern, such as the Cape Vulture, Verreaux's Eagle, Long-crested Eagle, Brown Snake Eagle, Marsh Harrier, Black-chested Snake Eagle, Jackal Buzzard, African Harrier Hawk 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. Due to the preliminary layout, some buffering was applied around these habitat features although most habitats are not classified as NO-GO where no panels and associated infrastructure may be located.

Some of the southern proposed panel positions and associated infrastructure coincide with areas currently demarcated as High (No Go) which will require avoidance and the Medium sensitive features and consequently were subjected to the mitigation hierarchy.

### 4.7.3 Raptor 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. Up to 30 km buffer is recommended for Cape Vulture nest sites. 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. 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. The presence of Cape Vultures within the PAOI has no bearing on the site layout for the Carpe Diem SEF.**

As a general rule, all nesting raptors should be protected within the study area. Amur falcons are present in significant numbers within the PA while Black-winged kites and Jackal Buzzard and Long-crested Eagle (seen infrequently) are most likely classified as a foraging resident within the PA and an irregular 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 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. 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.

## 4.8 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 4-5 with the guidelines for interpreting SEI shown in Figure 4-17

Zero habitats with Very High SEI are present in the PA where avoidance mitigation is required, although the waterbodies habitat shows a definite HIGH SEI value. Minimisation and restoration mitigation will be required for the Medium SEI habitats. Ultimately, although some of the habitat and infrastructure is of Medium, SEI, the PA is not fatally flawed.

| 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 4-17: Guidelines for interpreting SEI in the context of the proposed development activities, reproduced from SANBI (2020).***

*Table 4-5: Evaluation of Site Ecological Importance (SEI) of avifauna habitats in the project area. BI = Biodiversity Importance.*

| Habitat | Conservation Importance (CI) | Functional Integrity (FI) | Receptor Resilience (RR) | Site Ecological Importance (SEI) |
|---|---|---|---|---|
| **Natural Grassland** | **Medium** – Multiple confirmed or highly likely populations of SCC albeit relatively generic and where SCC of IUCN Vulnerable or Endangered are dependent on the habitat. | **Medium** – Despite large area, this habitat has a sustained moderate level of current negative ecological impacts. Recovery potential is high. | **Low** – Habitat that is unlikely to be able to recover fully after a relatively long period: > 15 years required to restore | **MEDIUM**<br>**(BI = Medium)** |
| **Bushveld/ Rocky Grassland Mosaic** | **Medium** – Multiple confirmed or highly likely populations of SCC and where SCC of IUCN Vulnerable or Endangered are relatively dependent on the habitat for foraging and possibly breeding. | **Medium** – Cumulatively small (<100 ha) intact area for any conservation status of SCC although ecosystem type is Least Concern. Habitat type crucial for SCC foraging, roosting and breeding with currently only minimal current negative ecological impacts. | **Medium** – Will recover slowly (~ more than 10 years) to restore > 75% of the original species composition and functionality. | **MEDIUM**<br>**(BI = Medium)** |
| **Wetland and Drainage line/ Impoundments** | **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. | **High** – Cumulatively large (>100 ha) intact area for any conservation status of SCC. Habitat type crucial for SCC foraging, roosting and breeding with currently only minimal current negative ecological impacts. | **Medium** – Will recover slowly (~ more than 10 years) to restore > 75% of the original species composition and functionality. | **HIGH**<br>**(BI = HIGH)** |
| **Disturbed Grasslands** | **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 | **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 maximum current negative ecological impacts (such as antibiosis from *Eucalyptus* trees). | **Medium** – 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. | **LOW** |
| **Alien Invasive 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 | **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 maximum current negative ecological impacts | **High** – 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** |

### 4.8.1 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 without supporting populations of Priority Species and SCC. No 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.

### 4.8.2 High SEI

- Watercourses – specifically for Carpe Diem South

### 4.8.3 Low and Medium SEI

Areas with medium avifaunal sensitivities include the disturbed and rocky grasslands 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 the 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 farms.
- 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 Proposed Carpe Diem North and South SEF as well as the Carpe Diem North BESS.*

| ENVIRONMENTAL PARAMETER | ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE | ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION | | | | | | | | | RECOMMENDED MITIGATION MEASURES | ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | I | D | SE | IR | R | P | TOTAL | STATUS (+ OR -) | S | | I | D | SE | IR | R | P | TOTAL | STATUS (+ OR -) | S |
| CONSTRUCTION PHASE | | | | | | | | | | | | | | | | | | | | |
| ***Habitat destruction*** | Significant habitat loss (105 Ha total and 10 Ha for the BESS) (including foraging and breeding) and fragmentation due to displacement (avoidance of disturbance) because of infrastructure installation (panels, powerlines, roads, fences and sub | 6 | 4 | 2 | 3 | 3 | 5 | 90 | - | Mod-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, pans. 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. | 4 | 3 | 2 | 2 | 2 | 4 | 52 | - | Mod |

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| | 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. | | | | | | | | | | | | | | | | | | | |
| ***Disturbance of bird roosts and breeding sites*** | The destruction or disturbance of bird roosts during the construction phase | 8 | 2 | 3 | 3 | 4 | 5 | 100 | - | High | As with other impacts, this impact can be mitigated by preferably timing high impact construction (including 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. | 4 | 2 | 2 | 2 | 2 | 3 | 36 | | Low |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***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. | 8 | 2 | 3 | 4 | 4 | 5 | 105 | - | 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. | 4 | 2 | 2 | 2 | 2 | 3 | 36 | | Low |
| OPERATIONS 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 | 2 | 2 | 2 | 3 | 2 | 24 | - | Med | No Mitigation Required other than avoidance during design | 3 | 3 | 1 | 2 | 1 | 2 | 20 | - | Low |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Bird mortalities*** | Bird mortalities during the operational phase due to vehicle collisions, collisions with infrastructure and/or combustion. | 8 | 2 | 3 | 3 | 4 | 5 | 100 | - | 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 and smaller migratory birds of prey) are far more prevalent. All powerline infrastructure must be fitted with approved bird diverters (including light reflecting/ emitting markers for nocturnal migrants) 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 | 4 | 2 | 2 | 3 | 3 | 3 | 40 | - | Mod |

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| | | | | | | | | | | | least (strictly) 75 metres from the edge of every service road in order to allow for vulnerable species such as coursers, francolins 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 preferably 2 m and 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. Finally, reflective diverters should be attached to new fencing alongside regular maintenance roads every 50 metres. Finally, Mitigation may have to include the **retrofitting of existing powerline infrastructure within the Project Footprint (in consultation with Eskom)** which currently does not have diverter infrastructure in place. Retrofitting of diverters will be based on carefully considered if in fact new infrastructure radically influences flight paths of birds which will avoid the new infrastructure and fly into the old | | | | | | | | | |

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| | | | | | | | | | | | unmitigated. infrastructure in which case this will have to be addressed. A suggested standard is 1500 metres either side of high-density collision points registered as part of the monitoring during the operations phase using retrofitting techniques approved by the EWT and Birdlife. | | | | | | | | | |
| ***Loss of Bird Foraging Habitat*** | Loss of Bird Foraging Habitat | 4 | 2 | 2 | 2 | 2 | 2 | 24 | - | Low | 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, pans and. A green buffer should be maintained around all habitats designated as High Sensitivity or above. | 2 | 2 | 2 | 2 | 2 | 2 | 20 | - | Low |
| ***Disruption of bird migratory pathways*** | Disruption of bird migratory pathways during the operational phase | 6 | 3 | 3 | 3 | 4 | 4 | 76 | - | Mod-High | 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 are predicted, especially flamingos moving through the areas which could be explained by large areas of generic habitats punctuated by some distinguishing geographic features in the | 4 | 2 | 2 | 3 | 3 | 3 | 42 | - | Mod |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | 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. | | | | | | | | | |
| ***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*** | 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 infrastructure through acidic defecation by certain species but also draw birds closer to | 8 | 2 | 3 | 3 | 4 | 4 | 80 | - | Mod-High | 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 during operations. | 6 | 2 | 2 | 2 | 3 | 3 | 45 | - | Mod |

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| | infrastructure and cause significant direct mortality risks. | | | | | | | | | | | | | | | | | | | |
| ***Chemical pollution spills*** | Chemicals being used to keep the PV panels clean from dust (suppressants) etc. | 8 | 2 | 2 | 2 | 4 | 4 | 72 | - | Mod 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. | 4 | 2 | 2 | 2 | 2 | 2 | 24 | - | Low |

***Table 5-2: Cumulative Impact Assessment***

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Cumulative:** There are a number of existing renewable energy projects (such as the proposed Carpe Diem SEFs) 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 | 6 | 4 | 3 | 3 | 4 | 4 | 80 | - | Mod-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 | 4 | 2 | 2 | 2 | 4 | 3 | 42 | | Mod |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | 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. | | | | | | | | | |
| ***Collison mortality (vehicle)*** | Increased roadkill due to higher traffic volumes | 6 | 4 | 4 | 4 | 4 | 3 | 66 | - | Mod | Strict enforcement of speed limits in the PAOI as well saturation of fence infrastructure with reflective diverters and maintaining fence set aside distances (75/2- 5 metres). | 6 | 3 | 3 | 3 | 3 | 2 | 36 | | Low |
| ***Collison mortality (infrastructure)*** | Increased mortalities due to collisions with SEF infrastructure, especially powerlines and fences | 6 | 4 | 3 | 3 | 4 | 4 | 80 | - | Mod<br>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 new powerline infrastructure must be fitted with approved bird diverters in order to provide visibility for large-bodied birds. However, unmitigated (flapped/marked) powerline infrastructure should be | 6 | 4 | 4 | 4 | 4 | 3 | 66 | - | Mod |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | subject to retrofitting if collision mortality thresholds of SCC are met during the Operations Phase. As stated above, Positive and/ or rectification Cumulative Mitigation will be the **retrofitting of existing powerline infrastructure (in consultation with Eskom)** which currently does not have diverter infrastructure in place. Retrofitting of diverters will be based on carefully considered if in fact new infrastructure radically influences flight paths of birds which will avoid the new infrastructure and fly into the old unmitigated. infrastructure in which case this will have to be addressed. A suggested standard is 1500 metres either side of high-density collision points registered as part of the EMPR monitoring during the operations phase using retrofitting techniques approved by the EWT and Birdlife. | | | | | | | | | |

### 5.1.1 Post Construction Rehabilitation

- A rehabilitation plan must be commissioned before construction commences, especially for drainage lines and wetlands.
- All topsoil harvesting must take place in the dry season (late dry season).
- When topsoil is salvaged and returned, it is anticipated without reseeding that dense vegetative communities of native species can regenerate within two growing seasons.

## 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 into the final 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 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. The 10 Ha of habitat loss for the BESS should be minimised within the 40 HA footprint and place as far away from the associated ridge habitat as possible.

**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). 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 korhaans 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.

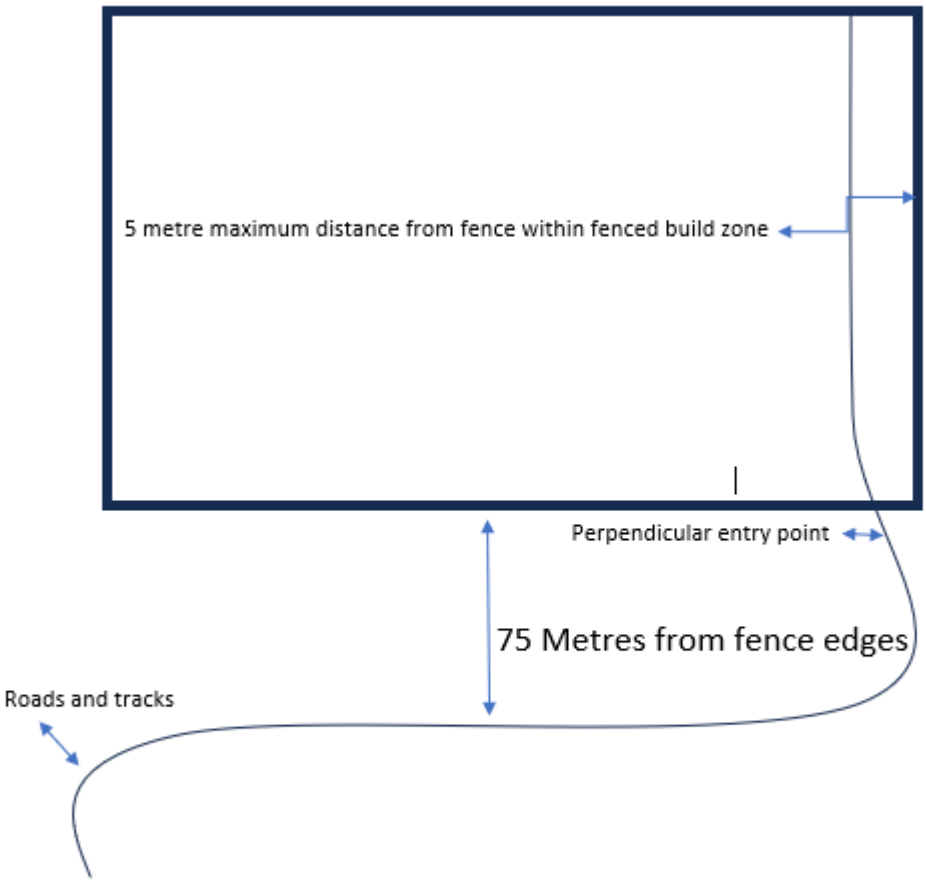


*Figure 5-1: Diagrammatic representation of road alignment with fencing infrastructure*

**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, August, September and October, all noise generated by machinery and maintenance operations must be kept to a minimum.

## 5.4 GENERAL MITIGATION MEASURES

- Formal post construction monitoring must be applied once the development has 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.

## 5.5 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 will be evaluated within the framework of the final EIA report.

There are a number of proposed renewable energy projects that may have quantifiable 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 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., owls and storks).
- 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.

The map of regional Renewable Energy Facilities (REFs) in relation to the Carpe Diem SEF is shown as Figure 5-2. There are numerous renewable energy project that already have quantified negative impacts on the avifauna community in the region in close proximity to the proposed Carpe Diem SEF. Therefore, any impacts anticipated from the proposed solar facility will add to these existing impacts and require assessment under a Cumulative Impacts assessment.

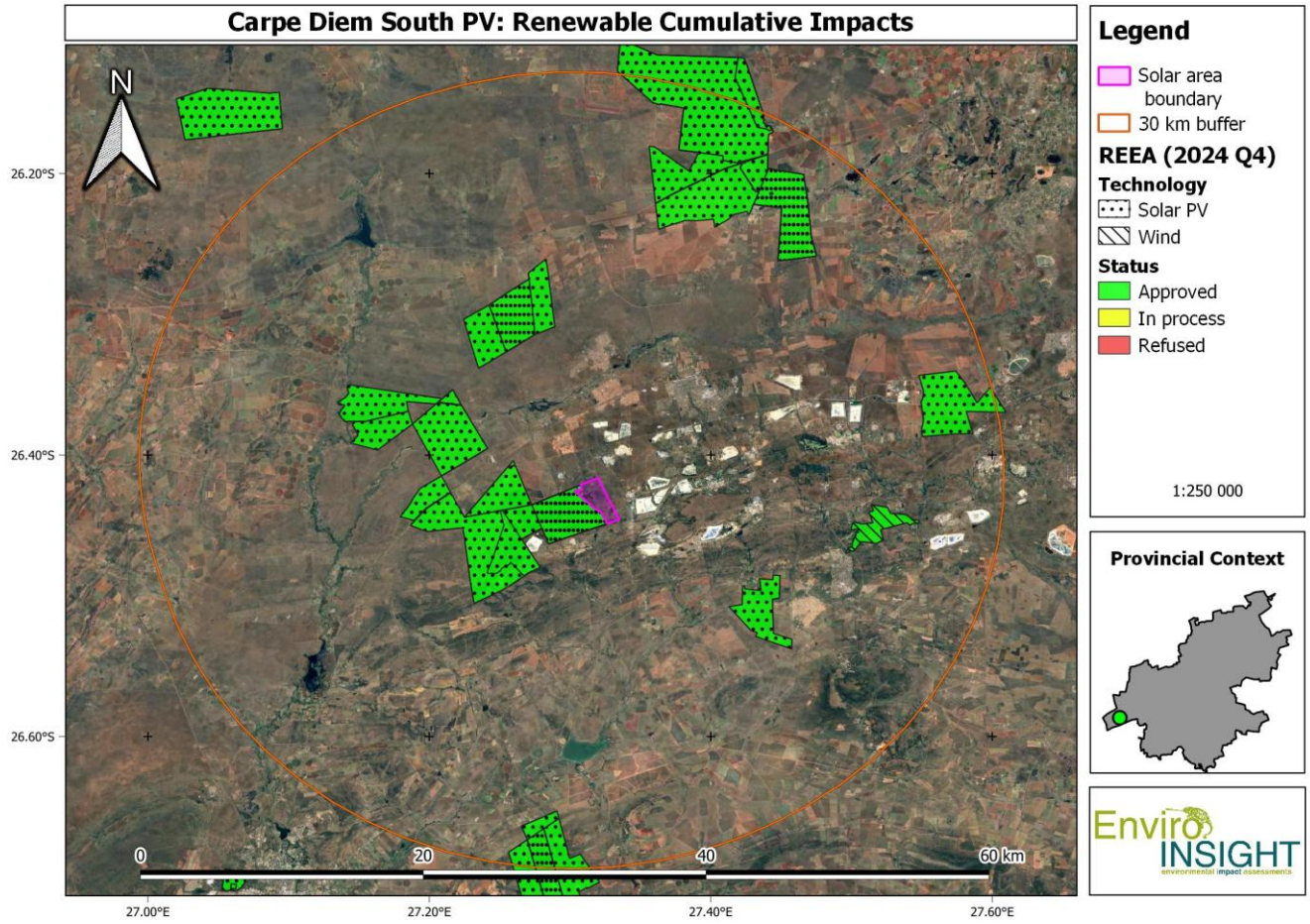


*Figure 5-2: The map of regional SEFs in relation to the proposed SEF applications.*

## 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** | • Drive Transects (species lists) – all species seen to be recorded along set transects to be driven during dawn till pre 10 am; and<br>• 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<br>• 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 Bustards/ Korhaans/SCC Raptors 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 powerline infrastructure |
| **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 of SCC per month clustering in a stretch of powerline) must initiate investigation and corrective measures (additional mitigation of powerline infrastructure involving retrofitting of lines with diverters and markers). |
| **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 5-3: EMP Table Summary for the* Carpe Diem *SEF*

| Carpe Diem SEF EMP SUMMARY | | | | | |
|---|---|---|---|---|---|
| **Impact/Aspect** | **Mitigation/Management Actions** | **Responsibility** | **Methodology** | **Mitigation/Management Objectives and Outcomes** | **Frequency** |
| **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<br>• Walked Transects (species lists) – all species heard and seen to be recorded along set transects to be walked at dawn chorus.<br>• 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 | • 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 raptors or establishment of SCC breeding populations (not yet sighted), Large SCC Raptors 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. | • Twice weekly during construction. |

| | | | | | |
|---|---|---|---|---|---|
| | | | field.<br>• 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. | | |
| ***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 any large facility, but with | • Company Appointed ECO, trained by SACNASP registered | • For panel location sites: weekly inspection on foot of cleared areas for birds killed during | • Collision frequency and intensity (# kills per species per unit time) will need to be assessed per species | • Weekly for panels between November and March. |

| | | | | | |
|---|---|---|---|---|---|
| | 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 | Zoologist. | the operation process. Location and species must be recorded (a georeferenced photograph as evidence is also required).<br>• 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. | 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).<br>R**etrofitting of existing powerline infrastructure (in consultation with Eskom)** which currently does not have diverter infrastructure in place will be based on carefully considered if in fact new infrastructure radically influences flight paths of birds which will avoid the new infrastructure and fly into the old unmitigated. infrastructure in which case this will have to be addressed. A suggested standard is 1500 metres either side of high-density collision points registered as part of the monitoring during the operations phase using retrofitting techniques approved | |

| | | | | | |
|---|---|---|---|---|---|
| | service road in order to allow for vulnerable species such as,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. | | | by the EWT and Birdlife. | |
| • ***Disruption of bird migratory pathways***<br>• ***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.***<br>• ***Disturbance due to noise such as, machinery*** | • 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, | • Company Appointed ECO, trained by a SACNASP registered Zoologist. | • For panel location sites: Monthly inspection using Drive and Walking Transects.<br>• CWAC counts | • Species inventories and passage rate data collection. | • Monthly SCC and species inventories during November, December, January and February |

| | | | | | |
|---|---|---|---|---|---|
| ***movements and maintenance operations.*** | such as large ridges, large impoundments, wetlands and drainage lines. The linear drainage line habitats must be buffered in accordance with the EIA sensitivity mapping.<br>• Essentially, 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.. Retrofitting will only apply if mortality thresholds are exceeded and thus the Lake Effect is recognised as an Impact as per the EMP. | | | | |
| ***Chemical pollution*** | • The application of strict chemical control protocols as per the EMPr. | • Company appointed ECO. | • For panel location sites: weekly inspection on foot<br>• Yearly soil analysis sent to accredited lab | • Spill Records<br>• Yearly chemical analysis results matched to prescribed thresholds | • Weekly spill detection for panels |

# 7 SENSITIVITY ANALYSIS

## 7.1 BESS SENSITIVITY

The BESS Sensitivity was analysed as a separate footprint given the unique impacts specific to the infrastructure type as well as the fact that no BESS footprint was available at the time of the initial analysis. The sensitivity is shown as combined with the infrastructure as per the figures below. The BESS laydown area should be moved away from the ridge habitat if possible and the BESS footprint itself should also be moved as far away from the ridge as possible.

## 7.2 SEF SENSITIVITY

The study area mostly consists of grassland and disturbed habitat in the proposed project footprint. The natural vegetation within the PA provides potential foraging habitat for bird species such as, storks, korhaan, and possibly includes foraging habitat for species such as larger raptors. Accordingly, sensitivities have been shown in Figure 7-1 and Figure 7-2. The figures indicate that the entire PA is of mostly moderate sensitivity with small sections of High/ No Go delineations (mostly on South) where buffering is required.

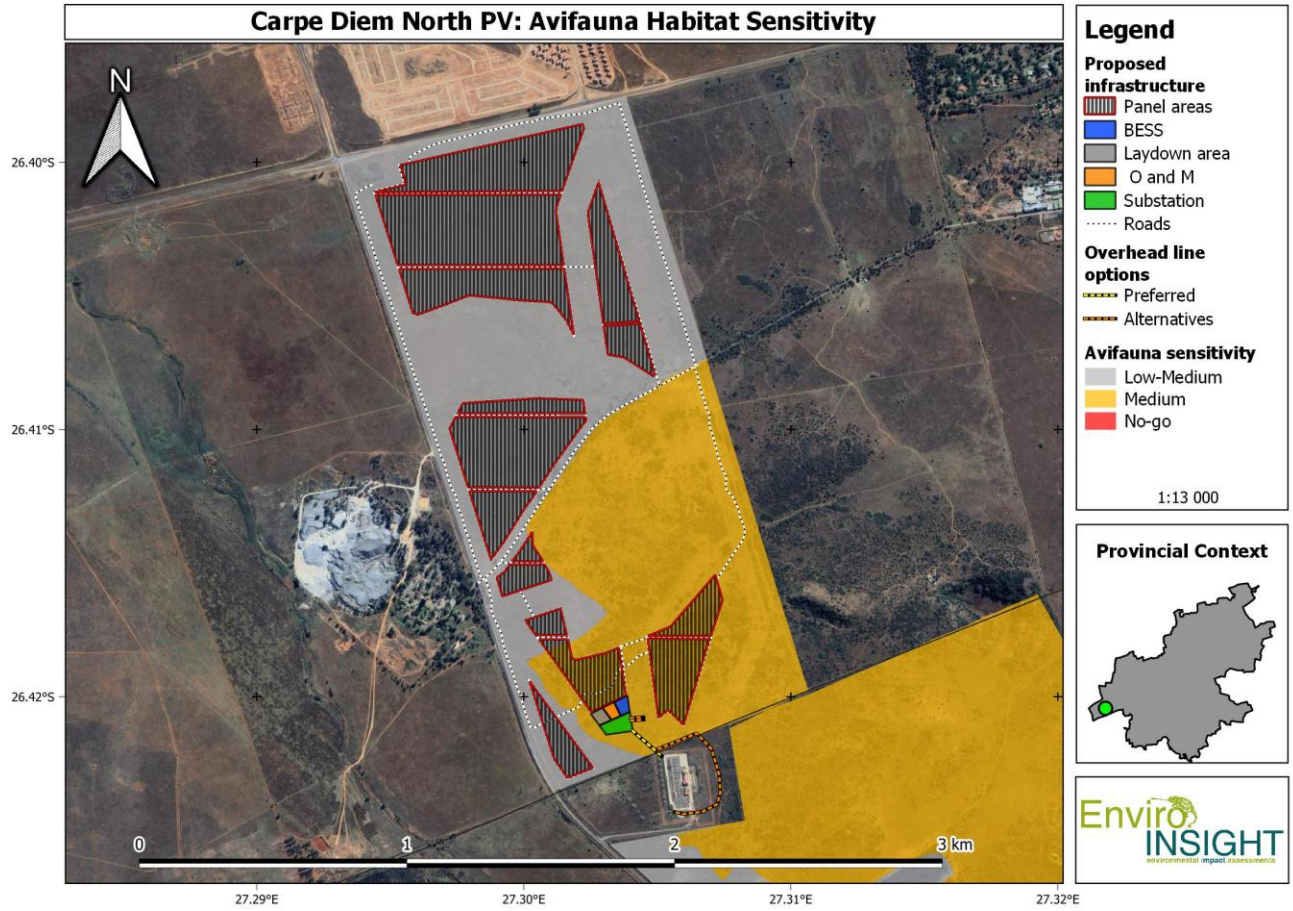


*Figure 7-1: Avifauna Sensitivity Buffers with preferred solar infrastructure placement for the proposed Carpe Diem North SEF.*

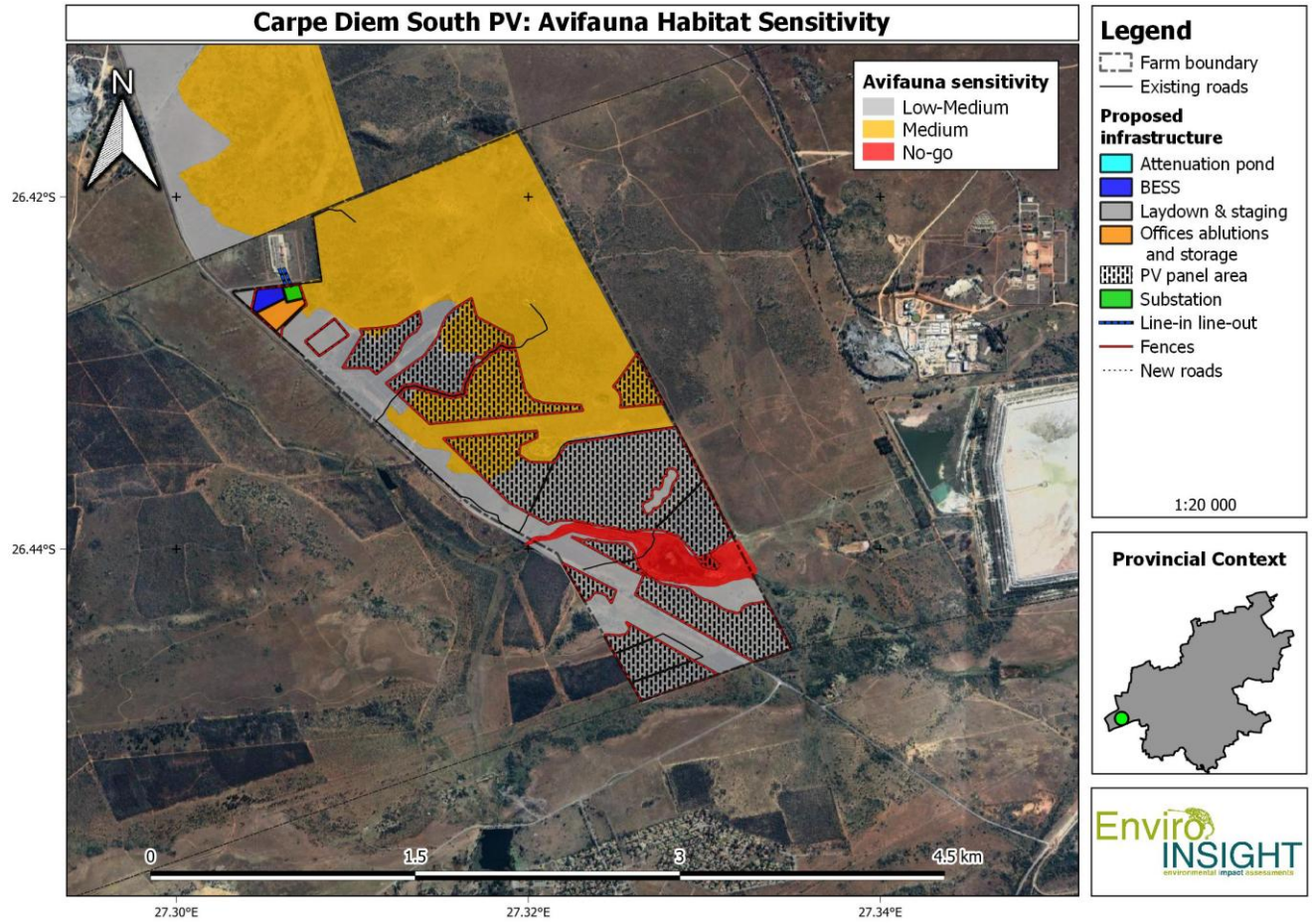


*Figure 7-2: Avifauna Sensitivity Buffers with preferred solar infrastructure placement for the proposed Carpe Diem South SEF.*

# 8 PROFESSIONAL OPINION

The PA is located in a region dominated by some natural but mostly disturbed grasslands and stands of alien invasive trees. The density and diversity of Priority Species was low and 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.

The proposed PV project is situated within an area dominated by anthropogenic activities including mining, industrial structures and residential development. The landscape is thus highly modified and fragmented, with only patches of remaining natural grassland. Habitats recorded within the proposed development footprint include grassland, rocky grassland and disturbed grassland. The study area is located in the Carpe Diem Dolomite Grassland, and a small section towards the southwest in the Gauteng Shale Mountain Bushveld. Neither are considered threatened.

A Professional Opinion is provided below.

## 8.1 PROFESSIONAL OPINION

- There are two developments considered within this Professional Opinion, namely Carpe Diem North SEF and Carpe Diem South SEF.
- The addition of the proposed Carpe Diem SEF does indicate some potentially significant impacts (without mitigation) to the receiving environment via the risk to Priority Species (such as raptors) and need to be considered with provision made within the EMPr for this development.
- The **stand-alone** BESS footprint will not require all of the designated footprint. The Laydown area should be moved away from the ridge as a priority and the **stand-alone** BESS footprint itself must be shifted within the footprint as far away from the ridge habitat as possible.
- Drainage lines and impoundments affected by activities (inc. construction) are considered to be of High Sensitivity and require buffering.
- The impact assessment and monitoring programs indicated that the impacts can be mitigated to acceptable levels.
- 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 developments such as the Carpe Diem SEF should be encouraged within designated areas.
- Avoidance mitigation must be applied alongside technological applications such as perch diverters, flappers, light reflecting markers and possibly taping over solar panels in the case of Lake Effect impacts (if fatality thresholds are reached as a result of the EMPr monitoring).
- Powerline flappers should include light reflecting markers to mitigate against nighttime collisions of nocturnal birds.
    - 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 large raptors. Thus, technological mitigations such as monitoring, flapper and diverter technology may have to be re-positioned, re-calibrated and updated.

- It appears that the current layout aligns with the proposed mitigations and recommendations.
- No offsets are recommended.
- No further avifaunal surveys outside of a prescribed monitoring program is recommended.
- Given the small project footprint, monitoring points within the designated EMPr must be geospatially representative and compliant with best practice recommendations.
- The specialist recommends that from an avifaunal perspective, the project authorisation be granted.

## 9 REFERENCES

BirdLife International. 2020. *Polemaetus bellicosus*. *The IUCN Red List of Threatened Species* 2020: e.T22696116A172287822. https://dx.doi.org/10.2305/IUCN.UK.2020-3.RLTS.T22696116A172287822.en.

BirdLife International (2021[a]) Important Bird Areas factsheet: Bitterputs Conservation Area. Downloaded from http://www.birdlife.org.

BirdLife International (2021[b]) Species factsheet: *Calendulauda burra*. Downloaded from http://www.birdlife.org.

BirdLife International (2021[c]) Species factsheet: *Polemaetus bellicosus*. Downloaded from http://www.birdlife.org

Del Hoyo, J., Elliott, A. AND Sargatal, J. 1992. Handbook of the birds of the world. 1992 – 2011 editions, Lynx Editions, Barcelona.

Drewitt, A.L. and Langston, R.H., 2006. Assessing the impacts of wind farms on birds. Ibis, 148, pp.29-42.

Gartman, V., Bulling, L., Dahmen, M., Geißler, G., & Köppel, J. (2016a). Mitigation measures for wildlife in wind energy development, consolidating the state of knowledge—part 1: planning and siting, construction. *Journal of Environmental Assessment Policy and Management*, 18(03), 1650013.

Gill, F. & Donsker, D. (Eds). 2019. IOC World Bird List (v9.2). doi: 10.14344/IOC.ML.9.2.

Harebottle, D.M, and Harrison, J.A. 1999. Coordinated Waterbird Counts (CWAC): Guidelines for the completion of the Site Data Collection Form. http://cwac.birdmap.africa/forms.php

Harrison, J.A., Allan, D.G., Underhill, L.G., Herremans, M., Tree, A.J., Parker, V., & Brown, C.J. (eds). (1997) *The Atlas of Southern African Birds*. BirdLife South Africa, Johannesburg.

Hockey P., Dean, W., Ryan, P., Maree S. & Brickman, B. (2005). *Roberts - Birds of Southern Africa* 7th ed. Trustees of the John Voelcker Bird Book Fun/ Africa Geographic Books. 1296 p.

Holness, S. & Oosthuysen, E. 2016. Critical Biodiversity Areas of the Northern Cape: Technical Report. DENC, Springbok.

IUCN. (2022) The IUCN Red List of Threatened Species. http://www.iucnredlist.org.

Jenkins, A.R., van Rooyen, C.S., Smallie, J.J., Harrison, J.A., Diamond, M., Smit-Robinson, H.A. & Ralston, S. (2015) *Best-Practice Guidelines for Assessing and Monitoring the Impact of Wind-Energy Facilities on Birds in Southern Africa*.

Malan, G. (2009) *Raptor Survey and Monitoring – a Field Guide for African Birds of Prey*. Briza Publications, Pretoria, South Africa.

Marnewick, M., Retief, E., Theron, N., Wright, D., & Anderson, T. (2015). Important Bird and Biodiversity Areas of South Africa. BirdLife South Africa. Johannesburg.

Mucina, L. & Rutherford, M.C. (eds). (2006, as amended). *The Vegetation of South Africa, Lesotho and Swaziland*. South African National Biodiversity Institute, Pretoria.

Ralston-Paton, S. (2017). Verreauxs' Eagle and Wind Farms: Guidelines for impact assessment, monitoring, and mitigation.

BirdLife South Africa Occasional papers, Johannesburg.

Ralston-Paton, S., Smallie J., Pearson A., and Ramalho R. (2017). Wind energy's impacts on birds in South Africa: A preliminary review of the results of operational monitoring at the first wind farms of the Renewable Energy Independent Power Producer Procurement Programme in South Africa. BirdLife South Africa Occasional Report Series No. 2. BirdLife South Africa, Johannesburg, South Africa.

Retief, E.F., Diamond, M., Anderson, M.D., Smit, H.A., Jenkins, A., Brooks, M. & Simmons, R. (2012). *Avian Wind Farm Sensitivity Map for South Africa.*

SABAP2 (South African Bird Atlas Project) (2021). Visited April 2021. http://vmus.adu.org.za/

Sinclair, I. & Ryan, P. 2010. Birds of Africa south of the Sahara: a comprehensive illustrative field guide. 2nd Ed. Struik Publishers. Cape Town.

South African National Biodiversity Institute. (2018) Beta Vegetation Map of South Africa, Lesotho and Swaziland (File Geodatabase) [File geodatabase] 2018. Available from the Biodiversity GIS website (http://bgis.sanbi.org/SpatialDataset/Detail/670).

Sutherland, W.J. 2006 Ecological Census Techniques: A Handbook. Cambridge University Press, New Jork.

Szurlej-Kielanska A, Pilacka LA (2022) Sustainable development of green energy-automated bird protection at wind farms. Glob J Zool 7(1): 019-023. DOI: https://dx.doi.org/10.17352/gjz.000024

Taylor, M.R., Peacock, F. & Wanless, R.M. (eds). (2015). *The 2015 Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland*. BirdLife South Africa, Johannesburg, South Africa.

Van Rooyen, C.(2020). Avifaunal operational monitoring at the Khobab Wind Farm: Year 1& 2. Chris Van Rooyen Consulting.

Young, D.J., Harrison, J.., Navarro, R.A., Anderson, M.A. & Colahan, B.D. (eds). (2003) Big Birds on Farms: Mazda CAR Report 1993-2001. Avian Demography Unit, Cape Town. Young, D.J., Harrison, J.., Navarro, R.A., Anderson, M.A. & Colahan, B.D. (eds). (2003) Big Birds on Farms: Mazda CAR Report 1993-2001. Avian Demography Unit, Cape Town.

# 10 APPENDIX

## 10.1 APPENDIX 1: RECORDED AVIFAUNA SPECIES LIST

Avifauna recorded within the PAOI according to Seasonal Observations and SABAP2

| | | Season | | |
|---|---|---|---|---|
| **English IOC Name** | **Scientific Name** | **Summer** | **Winter** | **Total** |
| Acacia Pied Barbet | *Tricholaema leucomelas* | 17 | 1 | 18 |
| African Paradise Flycatcher | *Terpsiphone viridis* | 5 | | 5 |
| African Pipit | *Anthus cinnamomeus* | 2 | 2 | 4 |
| African Red-eyed Bulbul | *Pycnonotus nigricans* | 32 | | 32 |
| African Stonechat | *Saxicola torquatus* | 14 | 4 | 18 |
| Amur Falcon | *Falco amurensis* | 5 | | 5 |
| Ashy Tit | *Melaniparus cinerascens* | 3 | | 3 |
| Bar-throated Apalis | *Apalis thoracica* | 3 | | 3 |
| Barn Swallow | *Hirundo rustica* | 175 | | 175 |
| Black Crake | *Zaporina flavirostra* | | 2 | 2 |
| Black Sparrowhawk | *Accipiter melanoleucus* | 1 | | 1 |
| Black-chested Prinia | *Prinia flavicans* | 14 | | 14 |
| Black-collared Barbet | *Lybius torquatus* | 12 | 2 | 14 |
| Black-faced Waxbill | *Brunhilda erythronotos* | 3 | | 3 |
| Black-headed Heron | *Ardea melanocephala* | 2 | 1 | 3 |
| Black-throated Canary | *Crithagra atrogularis* | 1 | | 1 |
| Black-winged Kite | *Elanus caeruleus* | 2 | 1 | 3 |
| Blacksmith Lapwing | *Vanellus armatus* | 2 | 1 | 3 |
| Blue Waxbill | *Uraeginthus angolensis* | 2 | | 2 |
| Blue-billed Teal | *Anas hottentota* | 3 | 4 | 7 |
| Bokmakierie | *Telophorus zeylonus* | 12 | | 12 |
| Brown-crowned Tchagra | *Tchagra australis* | 4 | | 4 |
| Brown-throated Martin | *Riparia paludicola* | | 2 | 2 |
| Brubru | *Nilaus afer* | 7 | | 7 |
| Buffy Pipit | *Anthus vaalensis* | 2 | | 2 |
| Cape Bunting | *Emberiza capensis* | 1 | | 1 |
| Cape Longclaw | *Macronyx capensis* | 14 | 7 | 21 |
| Cape Robin-Chat | *Cossypha caffra* | 1 | | 1 |
| Cape Sparrow | *Passer melanurus* | 1 | 2 | 3 |
| Cape Wagtail | *Motacilla capensis* | | 4 | 4 |
| Cape White-eye | *Zosterops virens* | 20 | 3 | 23 |
| Chestnut-vented Warbler | *Curruca subcoerulea* | 1 | | 1 |

| | | | | |
|---|---|---|---|---|
| Chinspot Batis | *Batis molitor* | 4 | | 4 |
| Cinnamon-breasted Bunting | *Emberiza tahapisi* | 3 | | 3 |
| Cloud Cisticola | *Cisticola textrix* | 9 | | 9 |
| Common Buzzard | *Buteo buteo* | 2 | | 2 |
| Common Cuckoo | *Cuculus canorus* | 1 | | 1 |
| Common Moorhen | *Gallinula chloropus* | 14 | 11 | 25 |
| Common Reed Warbler | *Acrocephalus scirpaceus* | 1 | | 1 |
| Common Scimitarbill | *Rhinopomastus cyanomelas* | 1 | | 1 |
| Common Waxbill | *Estrilda astrild* | | 12 | 12 |
| Crested Barbet | *Trachyphonus vaillantii* | 4 | | 4 |
| Crimson-breasted Shrike | *Laniarius atrococcineus* | 7 | | 7 |
| Crowned Lapwing | *Vanellus coronatus* | 1 | 2 | 3 |
| Dark-capped Bulbul | *Pycnonotus tricolor* | | 7 | 7 |
| Desert Cisticola | *Cisticola aridulus* | 2 | 2 | 4 |
| Diederik Cuckoo | *Chrysococcyx caprius* | 2 | | 2 |
| Eastern Clapper Lark | *Mirafra fasciolata* | 2 | | 2 |
| Egyptian Goose | *Alopochen aegyptiaca* | 3 | 4 | 7 |
| European Bee-eater | *Merops apiaster* | 11 | | 11 |
| Fiscal Flycatcher | *Melaenornis silens* | 3 | 2 | 5 |
| Glossy Ibis | *Plegadis falcinellus* | 2 | | 2 |
| Greater Double-collared Sunbird | *Cinnyris afer* | | 2 | 2 |
| Greater Striped Swallow | *Cecropis cucullata* | 9 | | 9 |
| Grey Heron | *Ardea cinerea* | 2 | | 2 |
| Hadada Ibis | *Bostrychia hagedash* | 4 | 2 | 6 |
| Hamerkop | *Scopus umbretta* | 2 | | 2 |
| Helmeted Guineafowl | *Numida meleagris* | 25 | | 25 |
| Jackal Buzzard | *Buteo rufofuscus* | 1 | | 1 |
| Kalahari Scrub Robin | *Cercotrichas paena* | 1 | | 1 |
| Karoo Thrush | *Turdus smithi* | | 1 | 1 |
| Lesser Grey Shrike | *Lanius minor* | 1 | | 1 |
| Lesser Swamp Warbler | *Acrocephalus gracilirostris* | 2 | | 2 |
| Levaillant's Cisticola | *Cisticola tinniens* | 10 | 3 | 13 |
| Little Bee-eater | *Merops pusillus* | 4 | | 4 |
| Little Swift | *Apus affinis* | 8 | | 8 |
| Long-tailed Widowbird | *Euplectes progne* | 1 | | 1 |
| Neddicky | *Cisticola fulvicapilla* | 56 | | 56 |
| Pied Crow | *Corvus albus* | 8 | 2 | 10 |
| Pin-tailed Whydah | *Vidua macroura* | 8 | | 8 |
| Red-billed Quelea | *Quelea quelea* | 23 | | 23 |

| | | | | |
|---|---|---|---|---|
| Red-billed Teal | *Anas erythrorhyncha* | 3 | | 3 |
| Red-collared Widowbird | *Euplectes ardens* | 11 | | 11 |
| Red-eyed Dove | *Streptopelia semitorquata* | 5 | 3 | 8 |
| Red-faced Mousebird | *Urocolius indicus* | 7 | | 7 |
| Red-knobbed Coot | *Fulica cristata* | 47 | 18 | 65 |
| Red-throated Wryneck | *Jynx ruficollis* | 2 | | 2 |
| Reed Cormorant | *Microcarbo africanus* | 8 | | 8 |
| Ring-necked Dove | *Streptopelia capicola* | 10 | 9 | 19 |
| Rufous-naped Lark | *Mirafra africana* | 49 | 3 | 52 |
| South African Shelduck | *Tadorna cana* | 10 | 10 | 20 |
| Southern Boubou | *Laniarius ferrugineus* | 1 | | 1 |
| Southern Fiscal | *Lanius collaris* | 18 | 4 | 22 |
| Southern Grey-headed Sparrow | *Passer diffusus* | 4 | | 4 |
| Southern Masked Weaver | *Ploceus velatus* | 35 | 1 | 36 |
| Southern Red Bishop | *Euplectes orix* | 3 | 10 | 13 |
| Speckled Mousebird | *Colius striatus* | 18 | | 18 |
| Speckled Pigeon | *Columba guinea* | 7 | | 7 |
| Spike-heeled Lark | *Chersomanes albofasciata* | 5 | 1 | 6 |
| Spotted Flycatcher | *Muscicapa striata* | 4 | | 4 |
| Spur-winged Goose | *Plectropterus gambensis* | 6 | | 6 |
| Swainson's Spurfowl | *Pternistis swainsonii* | 1 | | 1 |
| Tawny-flanked Prinia | *Prinia subflava* | 12 | | 12 |
| Three-banded Plover | *Charadrius tricollaris* | 2 | 6 | 8 |
| Wattled Starling | *Creatophora cinerea* | 11 | | 11 |
| Western Cattle Egret | *Bubulcus ibis* | 3 | | 3 |
| White-bellied Sunbird | *Cinnyris talatala* | 2 | 1 | 3 |
| White-breasted Cormorant | *Phalacrocorax lucidus* | 12 | 1 | 13 |
| White-browed Scrub Robin | *Cercotrichas leucophrys* | 1 | | 1 |
| White-browed Sparrow-Weaver | *Plocepasser mahali* | 10 | 3 | 13 |
| White-rumped Swift | *Apus caffer* | 43 | | 43 |
| White-throated Swallow | *Hirundo albigularis* | 16 | | 16 |
| Willow Warbler | *Phylloscopus trochilus* | 1 | | 1 |
| Yellow-billed Duck | *Anas undulata* | 7 | 6 | 13 |
| Yellow-crowned Bishop | *Euplectes afer* | 1 | | 1 |
| Zitting Cisticola | *Cisticola juncidis* | 35 | | 35 |
| **Grand Total** | | **106** | **1008** | **162** | **1170** |

## 10.2 APPENDIX 2: 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 field(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 2024**

Chairperson

Chief Executive Officer

To verify this certificate scan this code