DEVELOPMENT OF THREE PV SOLAR ENERGY FACILITIES (BARLERIA, DICOMA & SETARIA) AND ASSOCIATED INFRASTRUCTURE NEAR LICHTENBURG, NORTH WEST PROVINCE

Avifauna Scoping Report

October 2021

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EXECUTIVE SUMMARY

Pachnoda Consulting cc was requested by Savannah Environmental (Pty) Ltd on behalf of Dicoma PV (Pty) Ltd, Barleria PV (Pty) Ltd and Setaria PV (Pty) Ltd to compile an avifauna scoping report for three proposed solar facilities (herewith referred to as the Dicoma PV, Barleria PV and Setaria PV facilities) and associated infrastructure with a contracted capacity of up to 75MW located on a site approximately 5km north west of the town of Lichtenburg in the North West Province.

The objectives of this phase of the project were to obtain a basic overview of the variation and general status of the avifaunal habitat types and expected bird species likely to be affected by the proposed project.

Four avifaunal habitat types were identified, ranging from open mixed dolomite grassland with bush clump mosaics, mixed open woodland, artificial livestock watering points and transformed areas. A total of 200 bird species have been recorded within the study area, including 11 Red listed species (threatened and near threatened species).

The main potential impacts associated with the proposed PV solar facility are expected to be the following:

- The loss of habitat and subsequent displacement of bird species due to the ecological footprint required during construction.
- Direct interaction (collision trauma) by birds with the surface infrastructure (photovoltaic panels) caused by polarised light pollution and/or waterbirds colliding with the panels (as they are mistaken for waterbodies).
- Collision with associated infrastructure (mainly overhead powerlines and reticulation).

The endangered Cape Vulture (*Gyps coprotheres*), critically endangered White-backed Vulture (*Gyps africanus*) and Lappet-faced Vulture (*Torgos tracheliotos*) could occur as regular foraging visitors on the study sites (according to reporting rates obtained from the atlas project - SABAP2). These species are highly prone to powerline collisions, whereby the proposed distribution powerline could pose a collision risk to vultures. The risk of collision is considered high when vultures feed on a carcass in close proximity to a powerline. The risk may be mitigated by locating the proposed powerline parallel to the existing Eskom powerline servitudes.

In addition, a total of 43 collision-prone bird species have been recorded from the study area (*sensu* atlas data), of which 20 species were birds of prey. The study sites are not located near any prominent wetland system or impoundment, and therefore the risk of waterbird collisions with the proposed infrastructure is considered to be low.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

DECLARATION OF INDEPENDENCE

I, Lukas Niemand (Pachnoda Consulting CC) declare that:

- I act as the independent specialist in this application to Savannah Environmental (Pty) Ltd, Dicoma PV (Pty) Ltd, Barleria PV (Pty) Ltd and Setaria PV (Pty) Ltd;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have no vested financial, personal or any other interest in the application;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority; and
- All the particulars furnished by me in this form are true and correct.

Lukas Niemand (Pr.Sci.Nat)
28 September 2021

Lukas Niemand is registered with The South African Council for Natural Scientific Professionals (400095/06) with more than 15 years of experience in ecological-related assessments and more than 15 years in the field of bird interactions with electrical and renewable energy infrastructure. He has conducted numerous ecological and avifaunal impact assessments including Eskom Transmission projects, hydro-electric schemes, solar farms and other activities in South Africa and other African countries.

1. INTRODUCTION

1.1 Project Description

Pachnoda Consulting cc was requested by Savannah Environmental (Pty) Ltd on behalf of Dicoma PV (Pty) Ltd, Barleria PV (Pty) Ltd and Setaria PV (Pty) Ltd to compile an avifauna scoping report for three proposed solar facilities (herewith referred to as the Dicoma PV, Barleria PV and Setaria PV facilities) and associated infrastructure with a contracted capacity of up to 75MW located on a site approximately 5km north west of the town of Lichtenburg in the North West Province. The development area is situated within the Ditsobotla Local Municipality within the Ngaka Modiri Molema District Municipality. The site is accessible via an existing gravel road which provides access to the development area off the R505, located east of the development area.

The infrastructure of each proposed facility will consists of the following components:

- PV modules and mounting structures
- Inverters and transformers
- Battery Energy Storage System (BESS)
- Site and internal access roads (up to 8m wide)
- Site offices and maintenance buildings, including workshop areas for maintenance and storage.
- Temporary and permanent laydown area
- Grid connection solution (with two alternative locations assessed) within a 100m wide corridor, including:
    - 33kV cabling between the project components and the facility substation
    - A 132kV facility substation
    - A 132kV Eskom switching station
    - A Loop-in-Loop out (LILO) overhead 132kV power line between the Eskom switching station and the existing Delareyville Munic–Watershed 1 88kV power line.1

1.1.1 Dicoma PV Facility

The development area for the Dicoma PV facility and associated infrastructure will be located on the following properties:

- Portion 1 of the Farm Houthaalboomen 31

[1] The LILO corridor intersects with several existing parallel Eskom power lines(Watershed-Sephaku 1 132kV, Dudfield–Watershed 2 88kV, Dudfield-Watershed 1 88kV, and Watershed-Klerksdorp North 1 132kV). Therefore, should the connection to the Delareyville Munic–Watershed 1 88kV not be technically feasible, connection to the above mentioned power lines would still be within the assessed LILO corridor and considered feasible through the construction of a shorter LILO connection.

- Portion 9 of the Farm Houthaalboomen 31
- Portion 10 of the Farm Houthaalboomen 31
- Portion 0 of Farm Talene 25
- Portion 7 of Farm Elandsfontein 34

The development area of the Dicoma PV facility is approximately 180 ha, and will include two alternative grid connection solutions (within a 100m wide corridor).

1.1.2 Barleria PV Facility

The development area for the Barleria PV facility and associated infrastructure will be located on the following properties:

- Portion 1 of the Farm Houthaalboomen 31
- Portion 9 of the Farm Houthaalboomen 31
- Portion 10 of the Farm Houthaalboomen 31
- Portion 0 of Farm Talene 25
- Portion 7 of Farm Elandsfontein 34

The development area of the Barleria PV facility is approximately 176 ha, and will include two alternative grid connection solutions (within a 100m wide corridor).

1.1.3 Setaria PV Facility

The development area for the Setaria PV facility and associated infrastructure will be located on the following properties:

- Portion 1 of the Farm Houthaalboomen 31
- Portion 9 of the Farm Houthaalboomen 31
- Portion 10 of the Farm Houthaalboomen 31
- Portion 0 of Farm Talene 25
- Portion 7 of Farm Elandsfontein 34

The development area of the Setaria PV facility is approximately 186 ha, and will include two alternative grid connection solutions (within a 100m wide corridor).

1.1.4 Grid Connection Alternatives

Two gird connection alternatives are proposed:

Grid Connection Alternative 1: 33kV MV cabling will connect the PV solar arrays of each facility to a 132kV facility substation. The 132kV Eskom switching station is located directly adjacent to the development footprint of each facility substation. The substation and Eskom switching station of the Barleria PV facility are located 2.2km east the facility, while the substation and Eskom switching station of the Dicoma PV

facility are located within the south eastern corner of the PV development footprint. The substation and Eskom switching station of the Setaria PV facility are located within the south western corner of the PV development footprint. A 132kV Loop-in-Loop Out power line from the Eskom switching station will connect into the Delareyville Munic–Watershed 1 88kV[1]. The grid connection infrastructure is located within an assessment corridor of 100m wide.

Grid Connection Alternative 2: 33kV MV cabling will connect the PV solar arrays of each facility to a 132kV facility substation. The 132kV Eskom switching station is located directly adjacent to the development footprint of each facility substation. The substation and Eskom switching station of the Barleria PV facility are located 2.3 km east the facility, while the substation and Eskom switching station of the Dicoma PV facility are located 1.3 km of the development footprint. The substation and Eskom switching station of the Setaria PV facility are located within the south eastern corner of the PV development footprint. A 132kV Loop-in-Loop Out power line from the Eskom switching station will connect into the Delareyville Munic–Watershed 1 88kV[1]. The grid connection infrastructure is located within an assessment corridor of 100m wide.

1.2 Terms of Reference

The main aim of this scoping exercise was to investigate the avifaunal attributes of the proposed PV facilities by means of a desktop analysis of GIS based information and third-party datasets and included a brief site visit which constituted the austral winter season sampling survey.

Since the three proposed PV facilities are spatially autocorrelated (located within the same broad-scale habitat types, topography and climatic conditions), a combined scoping report was compiled which aims to provide an overview of the avifaunal attributes on the following properties ("herewith referred to as the "study site"):

- Portion 1 of the Farm Houthaalboomen 31
- Portion 9 of the Farm Houthaalboomen 31
- Portion 10 of the Farm Houthaalboomen 31
- Portion 0 of Farm Talene 25
- Portion 7 of Farm Elandsfontein 34

However, a separate avifaunal impact report will be compiled for each facility (three reports) during the EIA phase of the project.

The terms of reference for this scoping report are to:

- conduct an assessment on a screening level based on available information pertinent to the ecological and avifaunal attributes on the study site;
- conduct an assessment of all information on a screening level in order to present the following results:

- typify the regional vegetation and avifaunal macro-habitat parameters that will be affected by the proposed project;
- provide an indication on the occurrence of threatened, near-threatened, endemic and conservation important bird species likely to be affected by the proposed project;
- provide an indication of sensitive areas or bird habitat types corresponding to the study site;
- highlight areas of concern or "hotspot" areas;
- identify potential impacts that are considered pertinent to the proposed development;
- highlight gaps of information in terms of the avifaunal environment; and
- recommend further studies to be conducted as part of the Environmental Impact Assessment (EIA) phase.

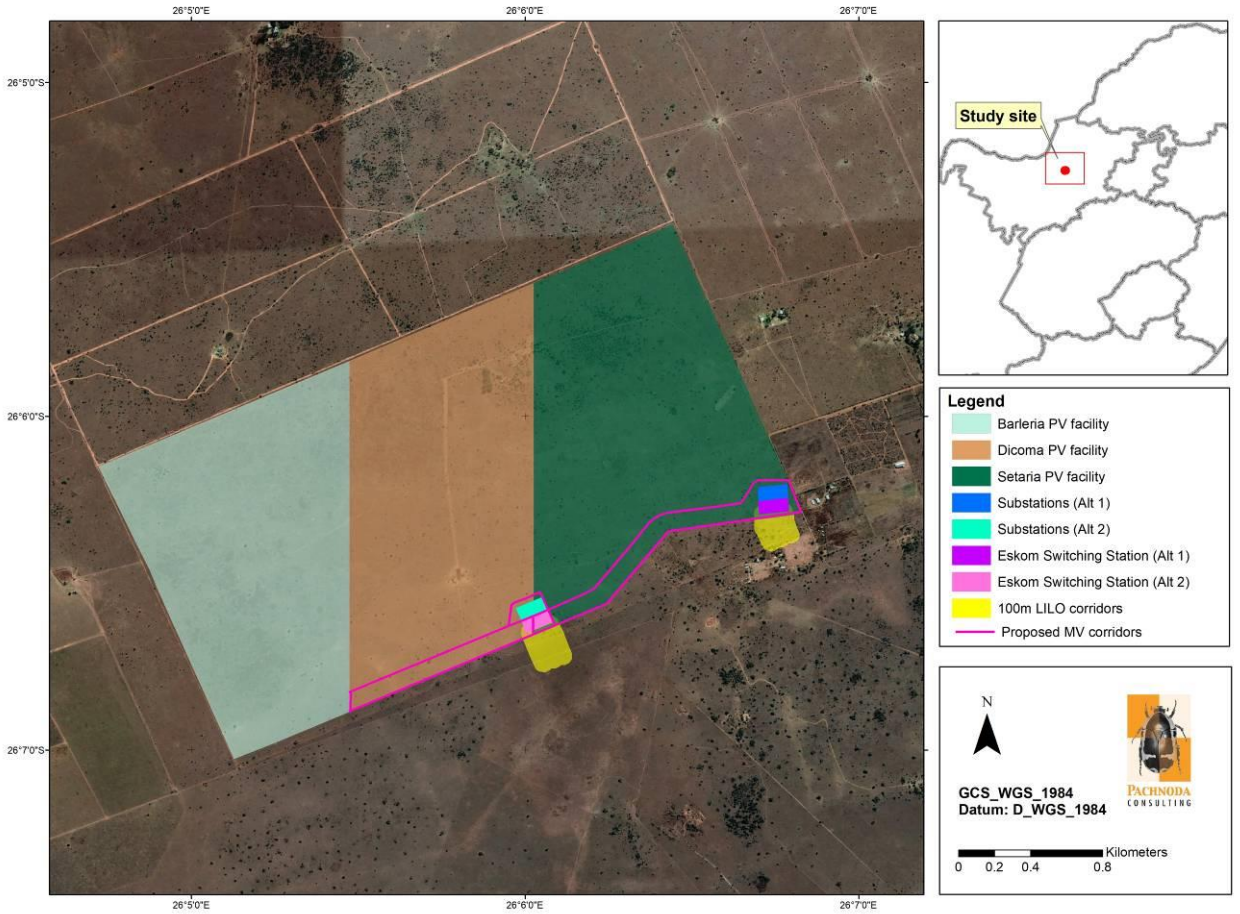

Figure 1: A satellite image illustrating the geographic position of the proposed PV facilities and grid connections.

2. METHODS & APPROACH

The objectives of this phase of the project were to obtain a basic overview of the variation and general status of the avifaunal habitat types and expected bird species likely to be affected by the proposed project.

Also take note that the current report put emphasis on the avifaunal community as a key indicator group on the proposed study area, thereby aiming to describe the preliminary conservation significance of the ecosystems in the area. Therefore, the occurrence of certain bird species and their relative abundances (to be determined during the EIA although herewith deduced from reporting rates) could determine the outcome of the ecological sensitivity of the area and the subsequent layout of the proposed solar facility infrastructure.

The information provided in this report was principally sourced from the following sources/observations:

- relevant literature – see section below;
- observations made during a site visit (04 - 06 August 2021); and
- personal observations from similar habitat types in proximity to the study area, with emphasis on assessments conducted by Pachnoda Consulting (2018) of where an avifauna study was conducted by the author.

2.1 Literature survey and Database acquisition

A desktop and literature review of the area under investigation was commissioned to collate as much information as possible prior to the detailed baseline survey. Literature consulted primarily makes use of small-scale datasets that were collected by citizen scientists and are located at various governmental and academic institutions (e.g. Animal Demography Unit & SANBI). These include (although are not limited to) the following:

- Hockey *et al*. (2005) for general information on bird identification and life history attributes.
- Marnewick *et al.* (2015) was consulted for information regarding the biogeographic affinities of selected bird species that could be present on the study area.
- The conservation status of bird species was categorised according to the global IUCN Red List of threatened species (IUCN, 2021) and the regional conservation assessment of Taylor *et al.* (2015).
- Distributional data was sourced from the South African Bird Atlas Project (SABAP1) and verified against Harrison et al. (1997) for species corresponding to the quarter-degree grid cell (QDGC) 2626AA (Lichtenburg). The information was then modified according to the prevalent habitat types present on the study area. The SABAP1 data provides a “snapshot” of the abundance and composition of species recorded within a quarter degree grid

cell (QDGC) which was the sampling unit chosen (corresponding to an area of approximately 15 min latitude x 15 min longitude). It should be noted that the atlas data makes use of reporting rates that were calculated from observer cards submitted by the public as well as citizen scientists. It therefore provides an indication of the thoroughness of which the QDGCs were surveyed between 1987 and 1991;

- Additional distributional data was also sourced from the SABAP2 database (http://www.sabap2.birdmap.africa). The information was then modified according to the prevalent habitat types present on the study area. Since bird distributions are dynamic (based on landscape changes such as fragmentation and climate change), SABAP2 was born (and launched in 2007) from SABAP1 with the main difference being that all sampling is done at a finer scale known as pentad grids (5 min latitude x 5 min longitude, equating to 9 pentads within a QDGC). Therefore, the data is more site-specific, recent and more comparable with observations made during the site visit (due to increased standardisation of data collection). The pentad grid relevant to the current project is 2605_2605 (although all eight surrounding pentad grid information was also scrutinised).
- The choice of scientific nomenclature, taxonomy and common names were recommended by the International Ornithological Committee (the IOC World Bird List v. 11.2), unless otherwise specified (see www.worldbirdnames.org as specified by Gill et al, 2021). Colloquial (common) names were used according to Hockey *et. al.* (2005) to avoid confusion;
- The incidental occurrence records for large birds of prey and vulture tracking data were included (only for 2018).
- Data on power line derived bird mortalities were requested from the electrical infrastructure mortality incident register (the dataset was provided by EWT).
- The best practice guidelines for assessing and monitoring the impact of solar power generating facilities on birds in southern Africa were also consulted (Jenkins *et al.,* 2017).
- Additional information regarding bird-power line interactions was provided by the author's own personal observations.

2.2 Preliminary Sensitivity Analysis

A preliminary sensitivity map was compiled based on the outcome of a desktop analysis.

The ecological sensitivity of any piece of land is based on its inherent ecosystem service (e.g. wetlands) and overall preservation of biodiversity.

2.3.1 Ecological Function

Ecological function relates to the degree of ecological connectivity between systems within a landscape matrix. Therefore, systems with a high degree of landscape

connectivity amongst one another are perceived to be more sensitive and will be those contributing to ecosystem service (e.g. wetlands) or the overall preservation of biodiversity.

2.3.2 Avifaunal Importance

Avifaunal importance relates to species diversity, endemism (unique species or unique processes) and the high occurrence of threatened and protected species or ecosystems protected by legislation.

2.3.3 Sensitivity Scale

- *High* – Sensitive ecosystems with either low inherent resistance or low resilience towards disturbance factors or highly dynamic systems considered important for the maintenance of ecosystem integrity. Most of these systems represent ecosystems with high connectivity with other important ecological systems OR with high species diversity and usually provide suitable habitat for a number of threatened or rare species. These areas should preferably be protected;
- *Medium* – These are slightly modified systems which occur along gradients of disturbances of low-medium intensity with some degree of connectivity with other ecological systems OR ecosystems with intermediate levels of species diversity but may include potential ephemeral habitat for threatened species; and
- *Low* – Degraded and highly disturbed/transformed systems with little ecological function and are generally very poor in species diversity (most species are usually exotic or weeds).

2.3 Limitations

To obtain a comprehensive understanding of the diversity and dynamics of avifaunal community on the study area, as well as the status of endemic, rare or threatened species in the area, detailed assessments should always consider investigations at different time scales (across seasons/years) and through replication. However, due to the fact that the findings in this report were based on a scoping/screening assessment, long-term studies were not feasible and inferred interpretations were mostly based on ad hoc observations.

It should also be realised that bird distribution patterns fluctuate widely in response to environmental conditions (e.g. local rainfall patterns, nomadism, migration patterns, seasonality), meaning that a composition noted at a particular moment in time will differ during another time period at the same locality. For this reason a dry season and wet season survey will be conducted.

Due to the scope of the work presented during a scoping assessment, a detailed investigation of the avifaunal community in the area were not possible and is not perceived as part of the Terms of Reference for a scoping/screening level exercise.

Furthermore, additional information may become known during a later stage of the process or development. This company, the consultants and/or specialist investigators do not accept any responsibility for conclusions, suggestions, limitations and recommendations made in good faith, based on the information presented to them, obtained from the surveys or requests made to them at the time of this report.

The following assumptions are relevant to the literature survey and database acquisition phase:

- It is assumed that third party information (obtained from government, academic/research institution, non-governmental organisations) is accurate and true;
- Some of the datasets are out of date and therefore extant distribution ranges may have shifted although these datasets could provide insight into historical distribution ranges of relevant species;
- The datasets are mainly small-scale and could not always consider azonal habitat types that may be present on the study area (e.g. small dams, pans and depressions). In addition, these datasets encompass surface areas larger than the study area that could include habitat types and species that is not present on the study area. Therefore, the potential to overestimate species richness is highly likely while it is also possible that certain cryptic or specialist species could have been overlooked in the past;
- Some of the datasets (e.g. SABAP2) managed by the Animal Demography Unit of the University of Cape Town were only recently initiated and therefore incomplete; and
- In addition, the study site is under private ownership and primarily inaccessible to the public. Since most of the species distribution ranges concerning the relevant datasets are subject to observations made by the public, it is likely that many bird species are overlooked or not formally catalogued for the area.

3. PRELIMINARY RESULTS AND DESCRIPTION OF THE AFFECTED ENVIRONMENT

3.1 Locality

The proposed PV facilities comprise of Portions 1, 9 and 10 of the Farm Houthaalboomen 31, Portion 0 of Farm Talene 25 and Portion 7 of Farm Elandsfontein 34, located approximately 5km north west of the town of Lichtenburg in the North West Province (Figure 1).

3.2 Regional Vegetation Description

The proposed PV facilities correspond to the Grassland Biome and more particularly to the Dry Highveld Grassland Bioregion as defined by Mucina & Rutherford (2006). It comprehends an ecological type known as Carletonville Dolomite Grassland (Mucina & Rutherford, 2006) (Figure 2).

From an avifaunal perspective it is evident that bird diversity is positively correlated with vegetation structure, and floristic richness is not often regarded to be a significant contributor of patterns in bird abundance and their spatial distributions. Although grasslands are generally poor in woody plant species, and subsequently support lower bird richness values, it is often considered as an important habitat for many terrestrial bird species such as larks, pipits, korhaans, cisticolas, widowbirds including large terrestrial birds such as Secretarybirds, cranes and storks. Many of these species are also endemic to South Africa and display particularly narrow distribution ranges. Due to the restricted spatial occurrence of the Grassland Biome and severe habitat transformation, many of the bird species that are restricted to the grasslands are also threatened or experiencing declining population sizes.

Carletonville Dolomite Grassland is confined to the dolomite plains that stretch from Lichtenburg in the North West Province to sections of rocky grassland in Gauteng, especially between altitudes of 1 350 m and 1 450 m. It occurs on slightly undulating plains dissected by prominent chert ridges, thereby containing a grassland composition rich in floristic species forming a complex mosaic dominated by many plant species.

Currently, only 2 % of the remaining 76 % of untransformed Carletonville Dolomite Grassland is formally protected within the Cradle of Humankind World Heritage Site and various nature reserves such as Abe Baily and Krugersdorp Nature Reserves.

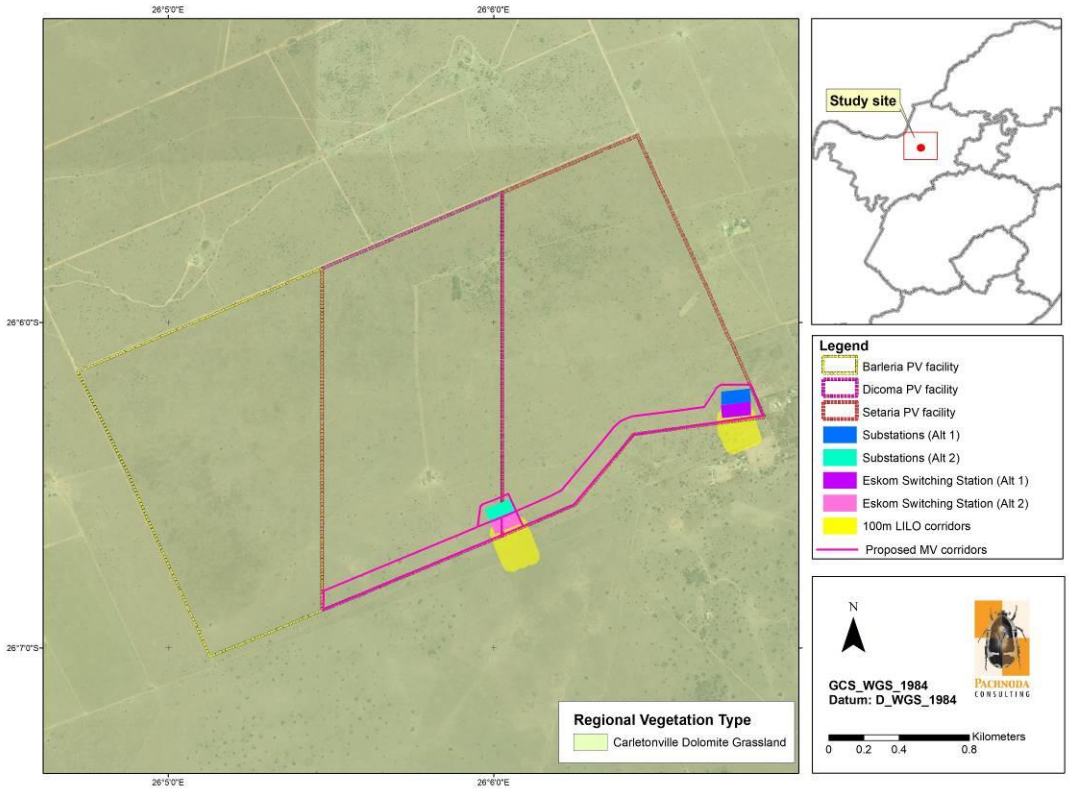

Figure 2: A satellite image illustrating the regional vegetation type corresponding to the study site. Vegetation type categories were defined by Mucina & Rutherford (2006).

3.3 Land cover, land use and existing infrastructure.

According to the South African National dataset of 2013-2014 (Geoterrainimage, 2015) the study site comprehends the following land cover categories (Figure 3):

Natural areas:

- Grassland;
- Low shrubland; and
- Woodland and open bush.

Transformed areas:

- Cultivation.

From the land cover dataset it is evident that most of the study site is covered by natural grassland, while the north eastern and south western parts consist of low shrubland. The study site is primarily used for livestock production and livestock grazing. Existing infrastructure includes a homestead and associated farm infrastructure, cattle feedlots and a number of powerline servitudes located on the southern boundary of the site.

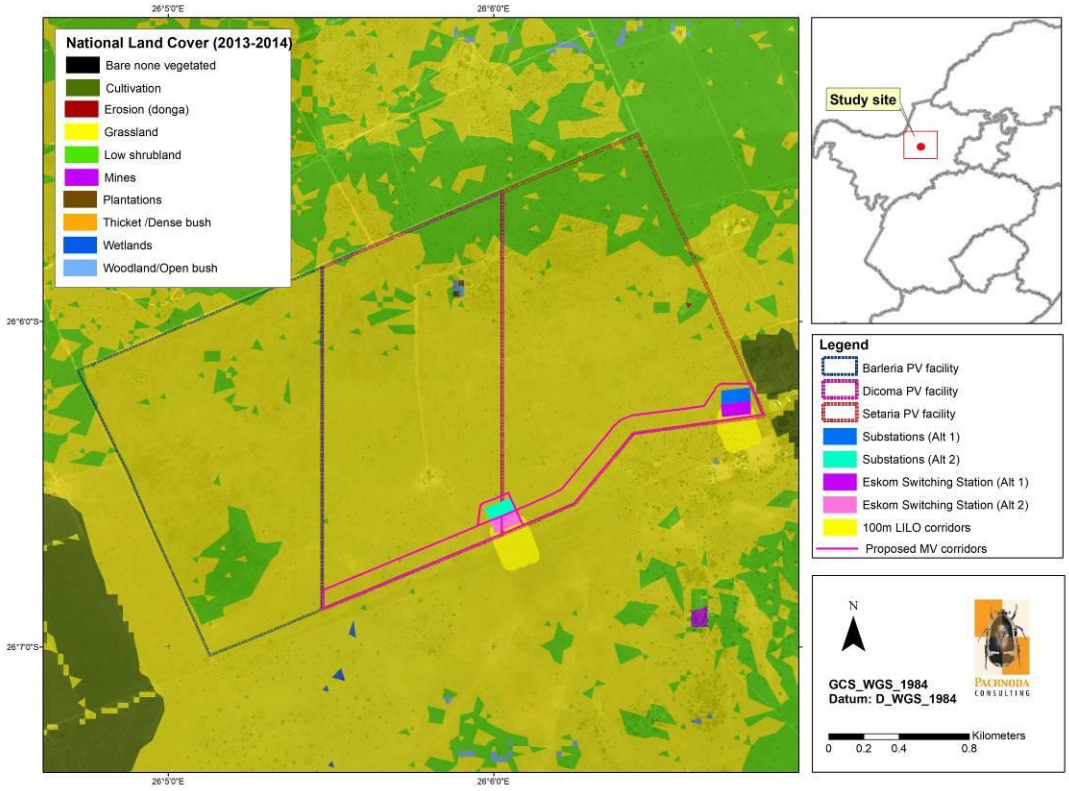

Figure 3: A map illustrating the land cover classes (Geoterrainimage, 2015) corresponding to the proposed study site.

3.4 Conservation Areas, Protected Areas and Important Bird Areas

The study site is located approximately 3km west of the Lichtenburg Game Breeding Centre (Figure 4). This conservation area contains a variety of game species, and the facility used to operate a vulture restaurant which attracts foraging vultures (c. three species) to the region. This area is currently under new management (by lease agreement with the municipality).

There are no other formal protected areas or any Important Bird and Biodiversity Areas in close proximity to the study site.

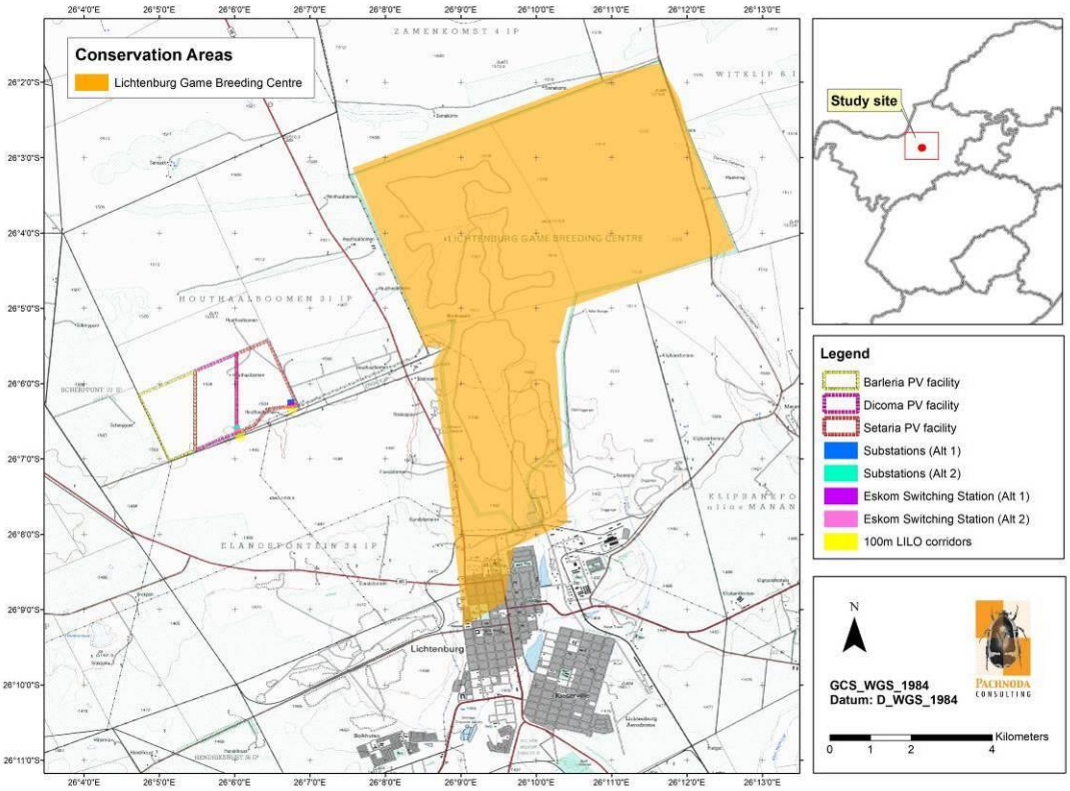

Figure 4: A map illustrating the locality of conservation areas in close proximity to the proposed study site.

3.5 Important avifaunal habitat types

Apart from the regional vegetation type, the local composition and distribution of the vegetation associations on the study site are a consequence of a combination of factors simulated by soil type, geology and grazing intensity (presence of livestock) which have culminated in a number of habitat types that deserve further discussion[2] (Figure 5 and Figure 6):

1. *Open mixed dolomite grassland with bush clump mosaics:* This unit is prominent on the study site and covers a significant extent in surface area of the proposed PV facilities. It is represented by two discrete floristic variations which also provide habitat for two discrete avifaunal associations. The first floristic variation consists of open untransformed to semi-transformed mixed dolomite grassland and bush clumps with an eminent woody layer. The grassland variation is represented by untransformed and grazed Carletonville Dolomite Grassland, depending on grazing intensity, and dominated by "late-successional" graminoids such a *Themeda triandra, Cymbopogon caesius, C. pospischilii, Trachypogon spicatus, Elionurus muticus* and *Andropogon schirensis*. It is occupied by a typical grassland bird composition dominated

[2] The habitat types are subject to change pending on the outcome of a detailed austral summer survey.

by insectivorous and granivore passerine bird species such as Desert Cisticola, (*Cisticola aridulus*), Eastern Clapper Lark (*Mirafra fasciolata*) Melodious Lark (*Mirafra cheniana*), Spike-heeled Lark (*Chersomanes albofasciata*), Cape Longclaw (*Macronyx capense*), Ant-eating Chat (*Myrmecocichla formicivora*) and African Pipit (*Anthus cinnamomeus*). Prominent non-passerine species include Orange River Francolin (*Scleroptila gutturalis*), Swainson's Spurfowl (*Pternistis swainsonii*), Northern Black Korhaan (*Afrotis afraoides*), Crowned Lapwing (*Vanellus coronatus*) and Black-winged Kite (*Elanus caeruleus*).

The bush clumps form a prominent mosaic characterised by the dominance of a woody layer of *Searsia lancea, S. pyroides, Ziziphus mucronata, Gymnosporia buxifolia* and *Asparagus laricinus*. *Celtis africana* and *Olea europaea subsp. africana* forms canopy constituents in some areas. The eminent increase in vertical heterogeneity provided by the woody layer is colonised by a "Bushveld" bird association consisting of insectivorous passerines such as Black-chested Prinia (*Prinia flavicans*), Chestnut-vented Warbler (*Sylvia subcoerulea*), Kalahari Scrub Robin (*Cercotrichas paena*), Fiscal Flycatcher (*Melaenornis silens*), Dark-capped Bulbul (*Pycnonotus tricolor*) as well as granivores such as Yellow Canary (*Crithagra flaviventris*) and Southern Masked Weaver (*Ploceus velatus*). Non-passerine bird taxa are represented by Laughing Dove (*Spilopelia senegalensis*), Cape Turtle Dove (*Streptopelia capicola*), Acacia Pied Barbet (*Tricholaema leucomelas*) and White-backed Mousebird (*Colius colius*).

2. *Mixed open woodland:* This unit is prominent on the northern parts of the proposed Dicoma and Setaria PV facilities. It is represented by tall microphyllous woodland dominated by *Senegalia cf. hereroensis* as well as other plant species that are similar in floristic composition to the bush clump mosaics. The tall vertical heterogeneity assists with the colonisation of a "Bushveld" bird association consisting of mainly insectivorous passerines. The latter composition is similar to the bird composition predicted for the bush clump mosaic habitat unit. Other noteworthy species include Crested Barbet (*Trachyphonus vaillantii*), Crimson-breasted Shrike (*Laniarius atrococcineus*) and Common Scimitarbill (*Rhinopomastus cyanomelas*).

3. *Artificial livestock watering points*: These are represented by artificial water troughs and reservoirs with the purpose to provide drinking water to livestock. However, they act as focal congregation areas for many granivore passerine and non-passerine species, including Cape Sparrow (*Passer melanurus*), Laughing Dove (*Spilopelia senegalensis*), Namaqua dove (*Oena capensis*), Scaly-feathered Weaver (*Sporopipes squamifrons*) and Wattled Starling (*Creatophora cinerea*).

4. *Transformed areas*: These are represented by an *Eucalyptus* sp. grove on the Dicoma PV facility and a small waster rock dump on the Setaria PV facility.

These are unimportant habitat for bird species, although the *Eucalyptus* grove could provide roosting habitat for certain non-passerine birds such as the Hadeda Ibis (*Bostrychia hagedash*).

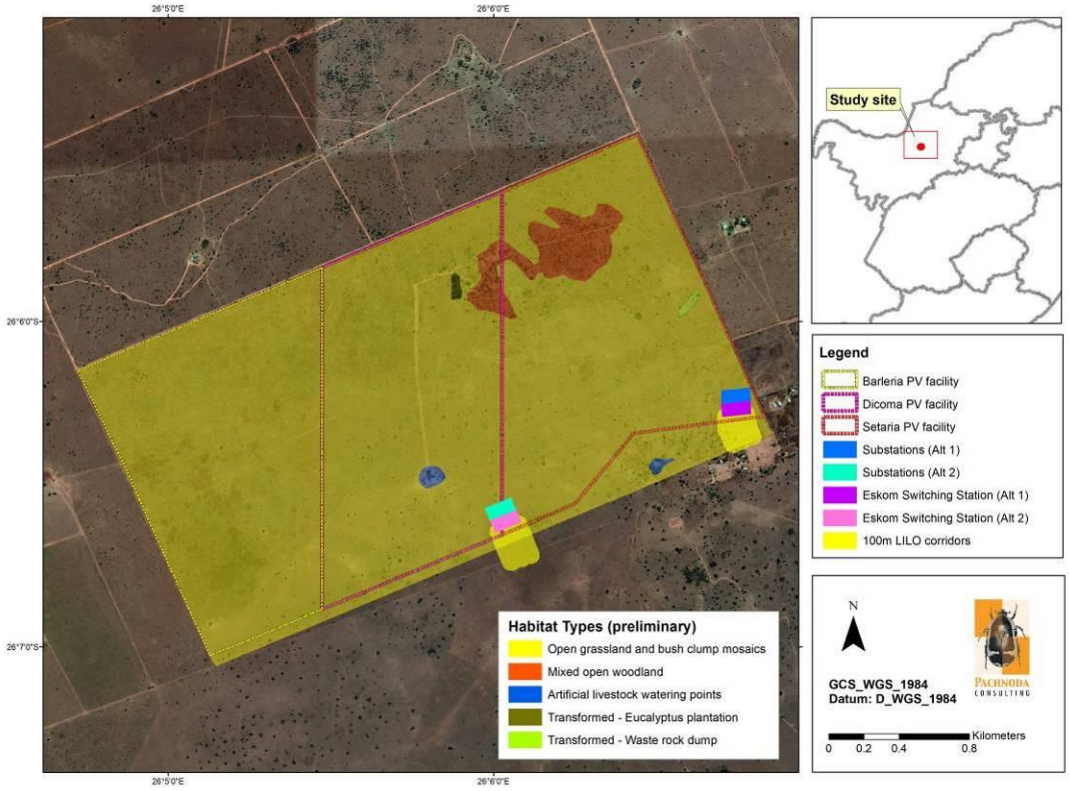

Figure 5: A preliminary habitat map illustrating the avifaunal habitat types on the study site (the habitat types are subject to change pending the outcome of a detailed austral summer survey).

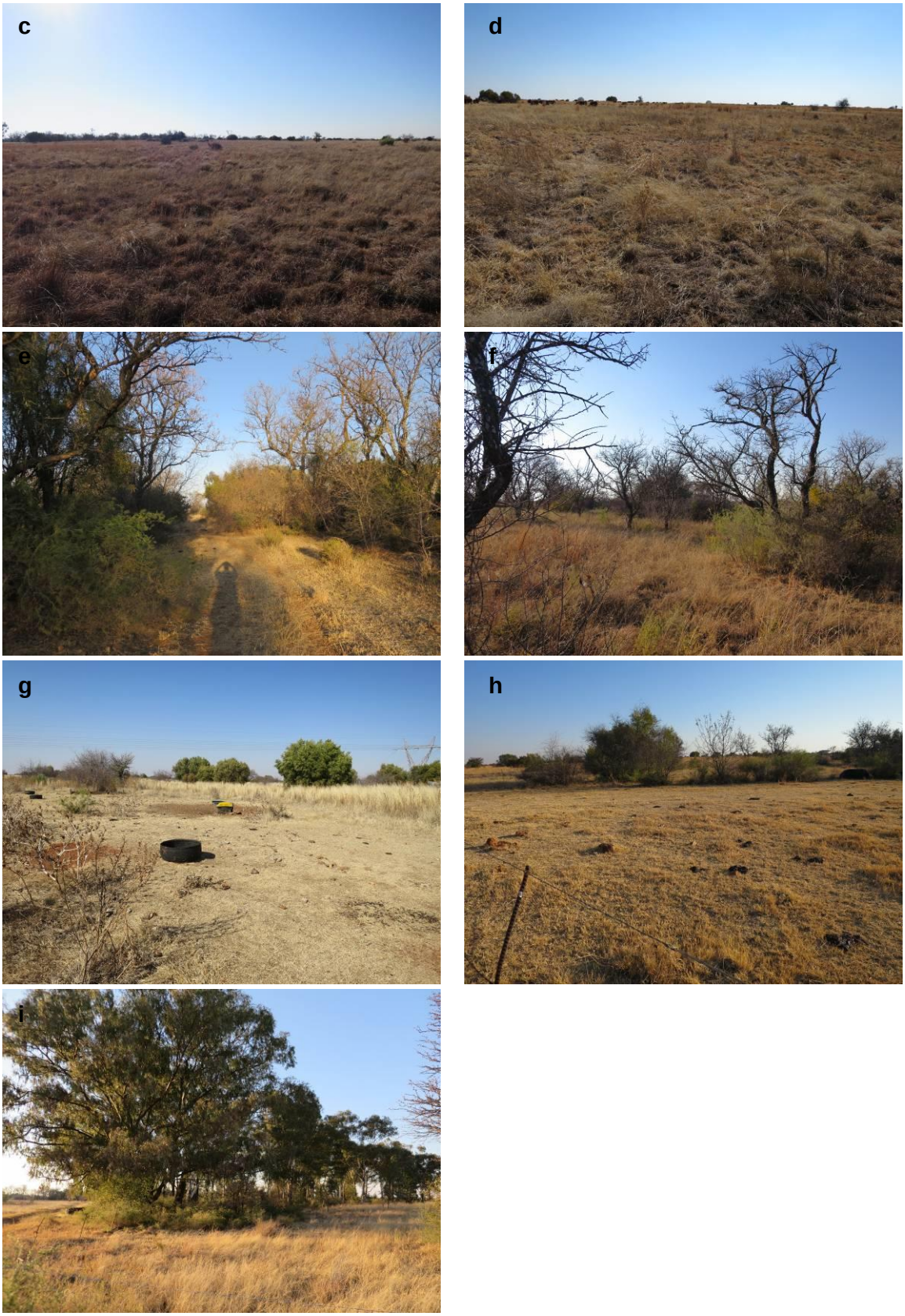

Figure 6: A collage of images illustrating examples of avifaunal habitat types on the study site observed during the austral winter season (August 2021): (a - d) open mixed dolomite grassland and bush clump mosaics, (e - f) mixed open woodland and (g - h) artificial livestock watering points and (i) an *Eucalyptus* sp. grove.

3.6 Species Richness and Predicted summary statistics

Approximately ~200 bird species are expected to occur on the study site and immediate surroundings (refer to Appendix 1 & Table 1). The expected richness was inferred from the South African Bird Atlas Project (SABAP1 & SABAP2) (Harrison et al., 1997; www.sabap2.birdmap.africa) and the presence of suitable habitat in the study area. The expected richness is also strongly correlated with favourable environmental conditions (e.g. during good rains) and seasonality (e.g. when migratory species are present). This equates to 20 % of the approximate 985[3] species listed for the southern African subregion[4] (and approximately 23 % of the 857 species recorded within South Africa[5]). However, the total species richness obtained from the pentad grid 2605_2605 corresponding to the study site contained 176 species, with an average number of 48 species for each full protocol card submitted (for observation of two hours or more). According to personal observations, the average number of species observed on the study site is *ca*. 70 species (obtained during the austral winter season of August 2021).

According to Table 1, the study site is poorly represented by biome-restricted[6] (see Table 2) and local endemic bird species. It does support *ca*. 30 % of the near - endemic species present in the subregion. Prominent wetland features and waterbodies are absent from the study site, thereby explaining the absence and low richness of waterfowl, wading birds and shorebird taxa.

Table 1: A summary table of the total number of species, Red listed species (according to Taylor et al., 2015 and the IUCN, 2021), endemics and biome-restricted species (Marnewick et al., 2015) expected (*sensu* SABAP1 and SABAP2) to occur in the study site.

Description	Expected Richness Value***
Total number of species*	198 (23 %)
Number of Red Listed species*	11 (8 %)
Number of biome-restricted species – Zambezian and Kalahari-Highveld Biomes)*	3 (21 %)
Number of local endemics (BirdLife SA, 2018)*	2 (5 %)
Number of local near-endemics (BirdLife SA, 2018)*	7 (23 %)
Number of regional endemics (Hockey *et al.,* 2005)**	16 (15 %)
Number of regional near-endemics (Hockey *et al.,* 2005)**	21 (34 %)

* only species in the geographic boundaries of South Africa (including Lesotho and Swaziland) were considered.

** only species in the geographic boundaries of southern Africa (including Namibia, Botswana, Zimbabwe and Mozambique south of the Zambezi River) were considered

*** Percentage values in brackets refer to totals compared against the South African avifauna (*sensu* BirdLife SA, 2018).

3 *sensu* www.zestforbirds.co.za (Hardaker, 2020)

4 A geographical area south of the Cunene and Zambezi Rivers (includes Namibia, Botswana, Zimbabwe, southern Mozambique, South Africa, Swaziland and Lesotho).

5 With reference to South Africa (including Lesotho and Swaziland (BirdLife South Africa, 2018).

6 A species with a breeding distribution confined to one biome. Many biome-restricted species are also endemic to southern Africa.

Table 2: Expected biome-restricted species (Marnewick *et al*, 2015) likely to occur on the study site.

Species	Kalahari-Highveld	Zambezian	Expected Frequency of occurrence
Kalahari Scrub-robin (*Cercotrichas paena)*	X		Common
White-throated Robin-chat (*Cossypha humeralis*)		X	Common
White-bellied Sunbird (*Cinnyris talatala*)		X	Common

3.7 Bird species of conservation concern

Table 3 provides an overview of bird species of conservation concern that could occur on the study site based on their historical distribution ranges and the presence of suitable habitat. According to Table 3, a total of 11 species could occur on the study site which includes six globally threatened species, one globally near threatened species, two regionally threatened species and two regionally near-threatened species.

It is evident from Table 3 that the highest reporting rates (>5%) were observed for the globally endangered Cape Vulture (*Gyps coprotheres*) and the globally critically endangered White-backed Vulture (*Gyps africanus*). These species have a high likelihood of occurrence pending the presence of suitable food (livestock carcasses).

The regionally vulnerable Lanner Falcon (*Falco biarmicus*), globally endangered Lappet-faced Vulture (*Torgos tracheliotos*) and globally near threatened Red-footed Falcon (*Falco vespertinus*) show reporting rates between 2% and 5 %. These species have a moderate probability of occurrence and are regarded as occasional foraging visitors to the area.

The remaining species have low reporting rates (<2%) and are regarded as irregular foraging visitors with low probabilities of occurrence. However, during the brief scoping site visit it was noticed that extensive areas of suitable foraging habitat persists for some of these species (e.g. Secretarybird *Sagittarius serpentarius*) despite being ominously absent from the area. It is possible that the low reporting rates reflect the poor coverage of the study area by citizen scientists (e.g. birdwatchers), and some of these species could occur in higher numbers due to being overlooked. As an example, Red-footed Falcons (*F. vespertinus*) often occur in flocks of the similar-looking Amur Falcon (*F. amurensis*), which based on reporting rates appear to be a common summer visitor to the area. Therefore, it is highly possible that Red-footed Falcons were previously overlooked or misidentified.

Table 3: Bird species of conservation concern that could utilise the study site based on their historical distribution range and the presence of suitable habitat. Red list categories according to the IUCN (2021)* and Taylor et al. (2015)**.

Species	Global Conservation Status*	National Conservation Status**	Mean Reporting rate: SABAP1 (n=142)	Mean Reporting rate: SABAP2 (n=64)	Preferred Habitat	Potential Likelihood of Occurrence
Anthropoides paradiseus (Blue Crane)	Vulnerable	Near threatened	47.18	-	Prefers open grasslands. Also forages in wetlands, pastures and agricultural land.	Potential vagrant or highly irregular foraging visitor.
Aquila rapax (Tawny Eagle)	Endangered-	Endangered	2.11	-	Lowveld and Kalahari savannas, especially game farming areas and reserves	An irregular visitor or vagrant to the study site.
Ciconia abdimii (Abdim's Stork)	-	Near threatened	7.75	-	Open stunted grassland, fallow land and agricultural fields.	An uncommon summer foraging visitor to areas consisting of secondary grassland or arable land.
Falco vespertinus (Red-footed Falcon)	Near threatened	Near threatened	2.11	3.13	Varied, prefers to hunt open arid grassland and savannoid woodland, often in company with Amur Falcons (*F. amurensis*).	An occasional summer foraging visitor to the area.
Falco biarmicus (Lanner Falcon)	-	Vulnerable	2.82	9.1 (for pentad 2605_2605)	Varied, but prefers to breed in mountainous areas.	An occasional foraging visitor to the study area.
Gyps coprotheres (Cape Vulture)	Endangered	Endangered	17.16	9.1 (for pentad 2605_2605)	Mainly confined to mountain ranges, especially near breeding	A regular foraging/scavenging visitor to the study site pending the presence of food (e.g. livestock

Species	Global Conservation Status*	National Conservation Status**	Mean Reporting rate: SABAP1 (n=142)	Mean Reporting rate: SABAP2 (n=64)	Preferred Habitat	Potential Likelihood of Occurrence
					site. Ventures far afield in search of food.	carcasses).
Gyps africanus (White-backed Vulture)	Critically Endangered	Critically Endangered	16.18	4.5 (for pentad 2605_2605)	Breed on tall, flat-topped trees. Mainly restricted to large rural or game farming areas.	A regular foraging/scavenging visitor to the study site pending the presence of food (e.g. livestock carcasses).
Leptoptilos crumeniferus (Marabou Stork	-	Near threatened	0.70	1.56	Varied, from savanna to wetlands, pans and floodplains – dependant of game farming areas	An irregular scavenging visitor to the area.
Polemaetus bellicosus (Martial Eagle)	Endangered	Endangered	-	4.5 (for pentad 2605_2605)	Varied, from open karroid shrub to lowland savanna.	An irregular foraging visitor. It was last recorded from pentad 2605_2605 south of the study site on 28 Jan 2012.
Sagittarius serpentarius (Secretarybird)	Endangered	Vulnerable	2.45	1.56	Prefers open grassland or lightly wooded habitat.	Regarded as an irregular foraging visitor to the study site despite the widespread presence of suitable foraging habitat.
Torgos tracheliotos (Lapped-faced Vulture)	Endangered	Endangered	5.63	4.69	Lowveld and Kalahari savanna; mainly on game farms and reserves	A regular foraging/scavenging visitor to the study site pending the presence of food (e.g. livestock carcasses).

3.8 Preliminary avifaunal sensitivity

A preliminary sensitivity map was compiled, illustrating habitat units comprising of potential sensitive elements based on the following arguments (Figure 7):

Areas of medium sensitivity

It includes open mixed woodland, artificial livestock watering points and extensive open grassland and bush clump mosaics. The mixed woodland was often used as roosting platforms for vultures (observed during the dry season survey in August 2021) and supported areas where a higher number of bird species are anticipated to occur.

The artificial livestock watering points attracted large numbers of granivore passerine and non-passerine bird species, of which many need to drink water on a daily basis. The placement of electrical infrastructure in close proximity to these areas could increase potential avian collisions with the infrastructure. These areas are therefore of artificial origin, but could be relocated to other areas.

The extensive open grassland and bush clump mosaics provide potential suitable foraging habitat for some collision-prone bird species, including the Northern Black Korhaan (*Afrotis afraoides*) with the potential to interact (e.g. collide) with the proposed electrical infrastructure. However, reporting rates for threatened and near threatened bird species are anticipated to be relatively low, thereby suggesting a medium sensitivity rating instead of a high sensitivity even though the majority of the habitat is natural. In addition, the open grassland and bush clump mosaics are widespread in the region.

Areas of low sensitivity

These habitat units are represented by transformed types and include a waste rock dump and a *Eucalyptus* plantation.

The preliminary sensitivity map shows a large surface area that is earmarked with medium sensitivity. There is a probability that some of these units or part thereof could have higher (or lower) sensitivity ratings. It is therefore expected that some of the units or part thereof could represent different sensitivity ratings to those displayed in Figure 8 pending the outcome of a detailed austral summer season survey.

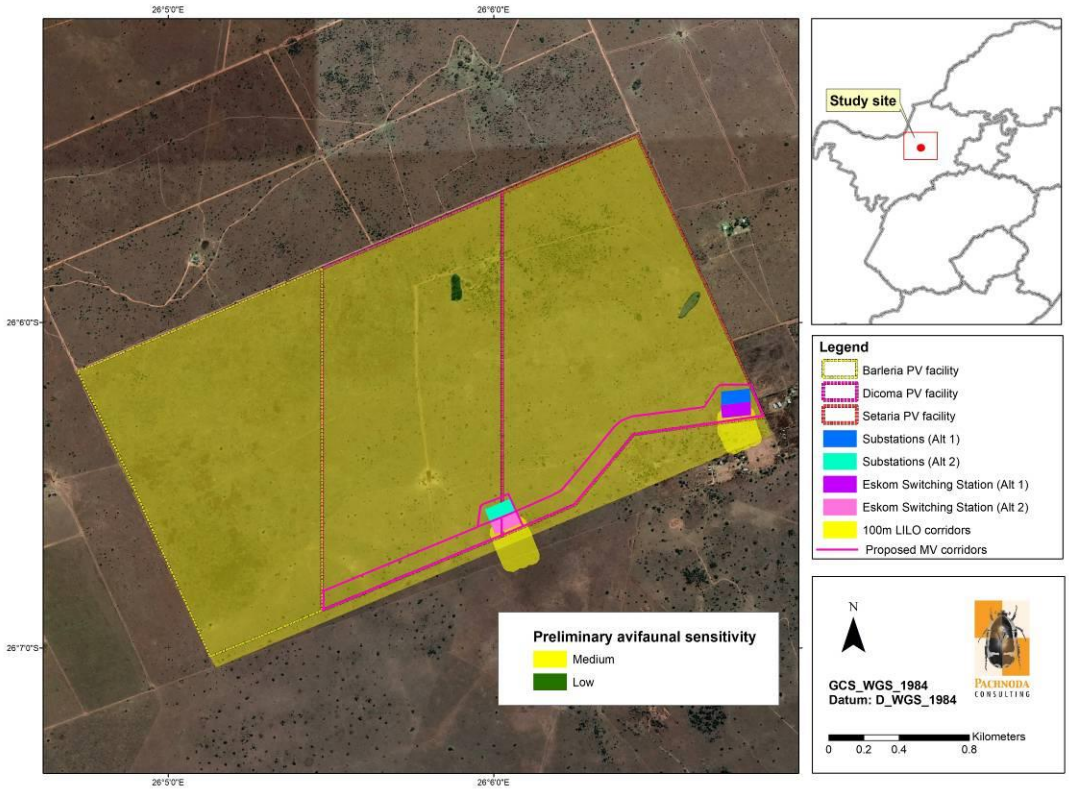

Figure 7: A map illustrating the preliminary avifaunal sensitivity of the area based on habitat types supporting bird taxa of conservation concern and important ecological function.

3.9 Overview of Avian Impacts at Solar Facilities

3.9.1 Background to solar facilities and their impact on birds

Birds are mobile, and are therefore also more readily affected by solar facilities than other taxonomic groups (e.g. mobile mammals that could move away from the facilities due to displacement). In fact, birds are also vulnerable to impacts caused by other types of energy facilities such as overhead power lines and wind farms. Little information is available on the impacts of solar energy facilities on birds although Gunerhan *et al.* (2009), McCrary *et al.* (1986), Tsoutsos *et al.* (2005) and the recent investigation reports on bird fatalities in the USA by Kagen *et al*. (2014) and Walston *et al*. (2016) provide discussions thereof. These studies have shown that avian fatalities vary greatly between the geographic positions of the solar facilities and also depend on the type of solar facility. In addition, very few of the large solar facilities in operation undertake systematic monitoring of avian fatalities, which explains the lack of detailed information of avian impacts. According to these studies conducted at both Concentrated Solar Power (CSP) and PV facilities, avian incidental fatalities range from 14 to over 180 birds which were summarised over a survey period conducted during one to three years. According to the Walston *et al.* (2016) assessment, the average annual mortality rate for known utility-scale solar facilities

(the annual number of estimated bird deaths per megawatt of electrical capacity) is 2.7, and 9.9 for known and unknown fatalities (which include carcasses found on the project site of which the death is not known). McCrary *et al.* (1986) found an average rate of mortality of 1.9-2.2 birds per week affecting 0.6-0.7 % of the local bird population. However, most of the avian fatalities at these solar facilities are also probably underestimated since 10-30 % of dead birds are removed by scavengers before being noted.. From these analyses and assessments it was evident that:

- Medium levels of bird fatalities occur at PV sites when compared to CSP sites (when taking powerline collisions into account).
- Approximately 81 % of all avian mortalities were caused by collisions, including collisions with electrical distribution lines.
- Most of the mortalities were small passerines (especially swallows).
- Fatalities at these solar facilities also include waterbirds (e.g. grebes, herons and gulls) which were probably attracted by the apparent "lake effect" caused by the reflective surface of the PV panels.
- Approximately 10-11 % of the fatalities consists of waterbirds, but could be as high as 49 % at certain facilities.
- It is unclear if the "lake effect" caused by the panels (at PV facilities) or mirrors (at CSP facilities) are the main cause of birds colliding or interacting with the infrastructure (since both waterbirds and other passerines are colliding with the infrastructure).
- Most of the fatalities are of resident birds as opposed to migratory species.

In a review report by Harrison *et al.* (2016), an attempt was made to provide evidence of the impacts caused by solar PV facilities alone (not combined with CSP facilities) on birds in the UK. These authors reviewed approximately 420 scientific documents, including 37 so-called "grey" literature from non-government and government organisations for any evidence relating to the ecological impacts of solar PV facilities. Their main findings were as follows:

- The majority of the documents were not relevant and peer-reviewed documents of experimental scientific evidence on avian fatalities were non-existent.
- Results based on carcass searches suggest that the bird collision risk at PV developments are low, although these studies did not take collision by overhead power lines into account.
- Many of the documents recommended that PV developments in close proximity to protected areas should be avoided.
- The PV panels reflect polarised light, which can attract polarotactic insects with potential impact to their reproductive biology. In addition, the polarising effect of the PV panels may also induce drinking behaviour in some birds, which may mistake the panels for water.

They conclude that impact assessment reports should consider taxon-specific requirements of birds and their guilds.

3.9.2 Potential impacts of PV solar facilities on birds

The magnitude and significance of impacts to birds caused by solar facilities will depend on the following factors:

- The geographic locality of the planned solar facility;
- The size or surface extent of the solar facility;
- The type of solar facility (according to the technologies applied, e.g. PV or Concentrated Solar Power (CSP)); and
- The occurrence of collision-prone bird species (which are often closely related to the locality of the solar facility).

Any planned solar facility corresponding to an area with many threatened, range-restricted or collision-prone species will have a higher impact on these birds. In addition, any planned solar facility located in close proximity to important flyways, wetland systems or roosting/nesting sites used by the aforementioned species will have a higher impact.

The main impacts associated with PV solar facilities include (Jenkins *et al*., 2017):

- The loss of habitat and subsequent displacement of bird species due to the ecological footprint required during construction;
- Disturbances caused to birds during construction and operation;
- Direct interaction (collision trauma) by birds with the surface infrastructure (photovoltaic panels) caused by polarised light pollution and/or waterbirds colliding with the panels (as they are mistaken for waterbodies);
- Collision with associated infrastructure (mainly overhead powerlines and reticulation);
- Attracting novel species to the area (owing to the artificial provision of new habitat such as perches and shade) which could compete with the residing bird population.

3.10 Potential Impacts associated with the Dicoma, Barleria and Setaria PV Solar Energy Facilities

Table 4 provides a preliminary summary of the impacts anticipated and a preliminary quantification thereof.

3.10.1 Loss of habitat and displacement of birds

Most of the study site will cleared of vegetation and habitat to accommodate the panel arrays and associated infrastructure. Clearing of vegetation will inevitably result in the loss of habitat and displacement of bird species. From the preliminary results it is evident that large-bodied species are more likely to become displaced as opposed to small passerine species. It is particularly biome-restricted, endemic and conservation important species that are likely to become displaced, as well as habitat

specialists (e.g. grassland specialists) which will disappear from the area. These include mainly passerine and smaller non-passerine species inhabiting the untransformed dolomite grasslands and bush clump mosaics.

To quantify the impact it is necessary to calculate the number of birds (density) lost or displaced by the activity, including estimated density values of important species per unit area of habitat. This will be conducted during an austral summer season survey of the proposed PV facilities. From a preliminary analysis, the following bird species are most likely to be impacted by the loss of habitat due to their habitat requirements, fecundity and conservation status (although not limited to) due to the proposed development:

- Northern Black Korhaan (*Afrotis afraoides*);
- Melodious Lark (*Mirafra cheniana*);
- Kalahari Scrub Robin (*Cercotrichas paena*);
- White-browed Scrub-robin (*Cossypha humeralis*); and
- Orange River Francolin (*Scleroptila gutturalis*).

3.10.2 Interaction with overhead powerlines and reticulation

An overhead powerline is proposed in parallel to Eskom's existing powerlines. Birds are impacted in three ways by means of overhead powerlines (described below). It is however a common rule that large and heavy-bodied terrestrial bird species are more at risk of being affected in a negative way when interacting with powerlines in general. These include the following:

- *Electrocution*

Electrocution happens when a bird bridges the gap between the live components or a combination of a live and earth component of a power line, thereby creating a short circuit. This happens when a bird, mainly a species with a fairly large wingspan attempts to perch on a tower or attempts to fly-off a tower. Many of these species include vultures (of the genera *Gyps* and *Torgos*) as well as other large birds of prey such as the Martial Eagle (*Polemaetus bellicosus*) (Ledger & Annegarn, 1981; Kruger, 1999; Van Rooyen, 2000). These species will attempt to roost and even breed on the tower structures if available nesting platforms are a scarce commodity in the area. Other types of electrocutions happen by means of so-called "bird-streamers". This happens when a bird, especially when taking off, excretes and thereby causes a short-circuit through the fluidity excreta (Van Rooyen & Taylor, 1999).

Large transmission lines (from 220 kV to 765 kV) are seldom a risk of electrocution, although smaller distribution lines (88 – 132kV) pose a higher risk. However, for this project, the design of the pylon is an important consideration in preventing bird

electrocutions. **The proposed pylon design must incorporate the following design parameters**:

- The clearances between the live components should exceed the wingspan of any bird species;
- The height of the tower should allow for unrestricted movement of terrestrial birds between successive pylons;
- The live components should be "bundled" to increase the visibility for approaching birds;
- "Bird streamers" should be eliminated by discouraging birds from perching above the conductors.

It is therefore recommended that the pylon design incorporates "features as illustrated by Figure 8[7].

From Figure 8 it is clear that perching of birds is discouraged by the addition of diagonal crossbars or by doing away with the crossbars that holds the conductors in place. Bird "streamers" are also eliminated by fitting the poles with bird guards/spikes above the conductors. However, safe perching is facilitated by the fitment of a horizontal bar on top of the pole structure without the risk of electrocution (due to the perpendicular orientation of the bar relative to the conductors).

Figure 8: Two bird-friendly tower designs to be used for the current project.

[7] Please note that these are examples of recommended pylon designs. These are taken from steel monopole pylons.

- *Collision*

Collisions with earth wires have probably accounted for most bird-powerline interactions in South Africa. In general, the earth wires are much thinner in diameter when compared to the live components, and therefore less visible to approaching birds. Many of the species likely to be affected include heavy, large-bodied terrestrial species such as bustards, korhaans and a variety of waterbirds that are not very agile or manoeuvrable once airborne. These species, especially those with the habit of flying with outstretched necks (e.g. most species of storks) find it difficult to make a sudden change in direction while flying – resulting in the bird flying into the earth wires.

Areas where bird collisions are likely to be high could be ameliorated by marking the lines with appropriate bird deterrent devices such as “bird diverters” and “flappers” to increase the visibility of the lines.

- *Physical disturbances and habitat destruction caused during construction and maintenance*

It is anticipated that part of the power line servitude will be cleared of vegetation. In addition, construction activities go hand in hand with high ambient noise levels. Although construction is considered temporary, many species will vacate the area during the construction phase and will become temporarily displaced.

The artificial livestock watering points also deserve special consideration since these features are often overlooked or neglected during the construction of power lines as they often attract large numbers of small passerine birds and birds of prey (the latter often include falconiform taxa which hunt small passerines). Construction activities in close proximity to these features could possibly displace these individuals from the area or increase the risk of collision. Nevertheless, these features could easily be removed or relocated to other areas.

Table 4: A preliminary summery of impacts associated with the proposed PV facility and its infrastructure.

Issue 1	**Nature of Impact**	**Extent**	**No-Go Areas**
Impact: Losses of natural habitat and displacement of birds through physical transformation, modifications, removals and land clearance. This impact is mainly restricted to the construction phase and is permanent.			
Habitat destruction and disturbance and/or displacement of birds	Negative, especially for large or terrestrial bird species.	Local	N/a
Description of expected significance of impact: The impact will be of a long duration, (prior to mitigation). The impact is expected to have a medium significance after proposed mitigation suggestions and if the sensitivity map is considered.			
Gaps in knowledge and recommendations for further study: A wet season survey is proposed to determine relative bird densities and distribution ranges.			

Issue 2	**Nature of Impact**	**Extent**	**No-Go Areas**
Impact: Avian collision impacts related to the PV facility during the operational phase (collision with the PV panels).			
Potential collision of birds with the PV panel structures	Negative, especially for waterbirds.	Local	N/a
Description of expected significance of impact: The impact will be of a long duration (prior to mitigation). The impact i expected to have a low significance during recommended mitigation recommendations			
Gaps in knowledge and recommendations for further study: A wet season survey is proposed to determine occurrence of waterbird species.			

Issue 3	**Nature of Impact**	**Extent**	**No-Go Areas**
Impact: Avian collision impacts related to the powerline reticulation and new distribution lines during operation.			
Potential collision due to electrical distribution	Negative, especially for vultures	Regional	N/a
Description of expected significance of impact: The impact will be of a long duration (prior to mitigation). and highly probable with a high significance, but may be reduced to a medium significance as per recommended mitigation measures (top be assessed during the EIA phase).			
Gaps in knowledge and recommendations for further study: A wet season survey is proposed to determine occurrence of collision prone bird species.			

3.11 Collision-prone bird species

A total of 43 collision-prone bird species have been recorded from the study area, of which 20 species are birds of prey (Table 5). Three of these species are vulture species (Cape Vulture *Gyps coprotheres*, White-backed Vulture *Gyps africanus* and Lappet-faced Vulture *Torgos tracheliotos*). Those species with mean reporting rates higher than 10% are regarded to be regular on the site and includes the highly collision-prone and critically endangered White-backed Vulture (*Gyps africanus*).

Table 5: Collision-prone bird species and Red listed species (in red) expected to be present on the study site inferred from the South African Atlas Project (SABAP1 & SABAP2).

Species name	Taxonomic name	National conservation status (*sensu* Taylor *et al.* (2015)	Mean SABAP2 Reporting Rate (%)	Mean SABAP1 Reporting Rate (%)
Pigeon, Speckled	*Columba guinea*		62.50	69.12
Ibis, Hadeda	*Bostrychia hagedash*		56.25	81.86
Egret, Western Cattle	*Bubulcus ibis*		45.31	78.92
Spurfowl, Swainson's	*Pternistis swainsonii*		42.19	36.27
Guineafowl, Helmeted	*Numida meleagris*		40.63	59.80
Crow, Pied	*Corvus albus*		40.63	85.78
Duck, Yellow-billed	*Anas undulata*		35.94	63.73
Korhaan, Northern Black	*Afrotis afraoides*		31.25	52.94
Kite, Black-winged	*Elanus caeruleus*		31.25	59.80
Ibis, Glossy	*Plegadis falcinellus*		20.31	14.71
Heron, Black-headed	*Ardea melanocephala*		17.19	47.06
Goose, Egyptian	*Alopochen aegyptiacus*		17.19	60.78
Francolin, Orange River	*Scleroptila gutturalis*		15.63	15.20
Dove, Rock	*Columba livia*		14.06	7.84
Kite, Yellow-billed	*Milvus aegyptius*		12.50	7.84
Vulture, White-backed	*Gyps africanus*	Critically Endangered	10.94	16.18
Ibis, African Sacred	*Threskiornis aethiopicus*		10.94	60.29
Vulture, Cape	*Gyps coprotheres*	Endangered	7.81	17.16
Goose, Spur-winged	*Plectropterus gambensis*		6.25	43.14
Hamerkop, Hamerkop	*Scopus umbretta*		4.69	12.75
Falcon, Lanner	*Falco biarmicus*	Vulnerable	4.69	2.82
Vulture, Lappet-faced	*Torgos tracheliotos*	Endangered	4.69	5.63
Harrier-Hawk, African	*Polyboroides typus*		3.13	0.00
Eagle-owl, Spotted	*Bubo africanus*		3.13	1.47
Snake-eagle, Black-chested	*Circaetus pectoralis*		3.13	1.47
Buzzard, Common (Steppe)	*Buteo buteo vulpinus*		3.13	10.29
Falcon, Red-footed	*Falco vespertinus*	Near threatened	3.13	2.11

Gull, Grey-headed	*Chroicocephalus cirrocephalus*		3.13	2.11
Francolin, Coqui	*Peliperdix coqui*		3.13	2.45
Kestrel, Greater	*Falco rupicoloides*		3.13	27.94
Eagle, Martial	*Polemaetus bellicosus*	Endangered	1.56	0.00
Snake-eagle, Brown	*Circaetus cinereus*		1.56	0.00
Kite, Black	*Milvus migrans*		1.56	0.70
Stork, Marabou	*Leptoptilos crumeniferus*	Near threatened	1.56	0.70
Secretarybird	*Sagittarius serpentarius*	Vulnerable	1.56	2.45
Crow, Cape	*Corvus capensis*		1.56	20.59
Owl, Western Barn	*Tyto alba*		1.56	6.37
Goshawk, Southern Pale Chanting	*Melierax canorus*		-	0.70
Eagle, Tawny	*Aquila rapax*	Endangered	-	2.11
Crane, Blue	*Anthropoides paradiseus*	Near threatened	-	47.18
Owl, Marsh	*Asio capensis*		-	5.63
Stork, White	*Ciconia ciconia*		-	6.34
Stork, Abdim's	*Ciconia abdimii*	Near threatened	-	7.75

The study site does not coincide with any prominent wetland system or impoundment which could increase the risk of waterbird collisions with the proposed electrical infrastructure.

3.11.1 Vultures

Three species of vulture occur in the study area, which are prone towards electrocution and collision with powerlines. These include the globally critically endangered White-backed Vulture (*Gyps africanus*), the globally endangered Cape Vulture (*G. coprotheres*) and the globally endangered Lapped-faced Vulture (*Torgos tracheliotos*). These species are of international significance and any mortality of adult individuals could have a negative effect on its species' population recruitment. Most of these suffer from a shortage of food supplies which is responsible for low reproductive rates, especially for Cape Vultures (Taylor *et al*., 2015). In addition, most of these species also tend to congregate at mammalian carcasses, where they feed in large groups, especially in terms of Cape Vultures. In addition, Cape Vultures also typically search for food in groups. It is such congregations which increase the risk of mortalities whenever these individuals forage or roost in close proximity to powerlines. For example, the proposed study area coincides with the foraging rangeland of Cape Vultures as evidenced by dispersal data obtained from vulture individuals fitted with satellite tracking devices and the movements of this species should be considered during the EIA phase of the assessment (Figure 9).

The highest number of mortalities due to electrocution and collision recorded in the study region pertains to Cape Vultures (*Gyps coprotheres*) and White-backed Vultures (*Gyps africanus*) (according to the electrical infrastructure mortality incident register) (Figure 10). Most of the mortalities were caused during electrocution from

smaller distribution lines in the area, although a significant number of Cape Vulture mortalities (*c*. 30 %) were also caused by collisions with transmission lines (Figure 11). There is a definite correlation between the size (in terms of voltage) of the powerline and the type of mortality, whereby electrocution incidents were prominent from distribution lines, while collisions were caused by transmission lines. Therefore, it is postulated that risk of collision mortalities in vulture species in the area will remain when considering the proposed powerline will be placed alongside existing powerlines. Most of the powerline interactions also occurred in the Ventersdorp and Lichtenburg area (Figure 12), with a single mass mortality involving 10 Cape Vultures and eight White-backed Vultures on 09 March 2009 **It clearly shows that when these species congregate (for example when feeding from a carcass in close proximity to a powerline or when roosting on pylons or nearby structures in close proximity to powerlines), the risk of mortality due to both electrocution and collision is greatly increased**.

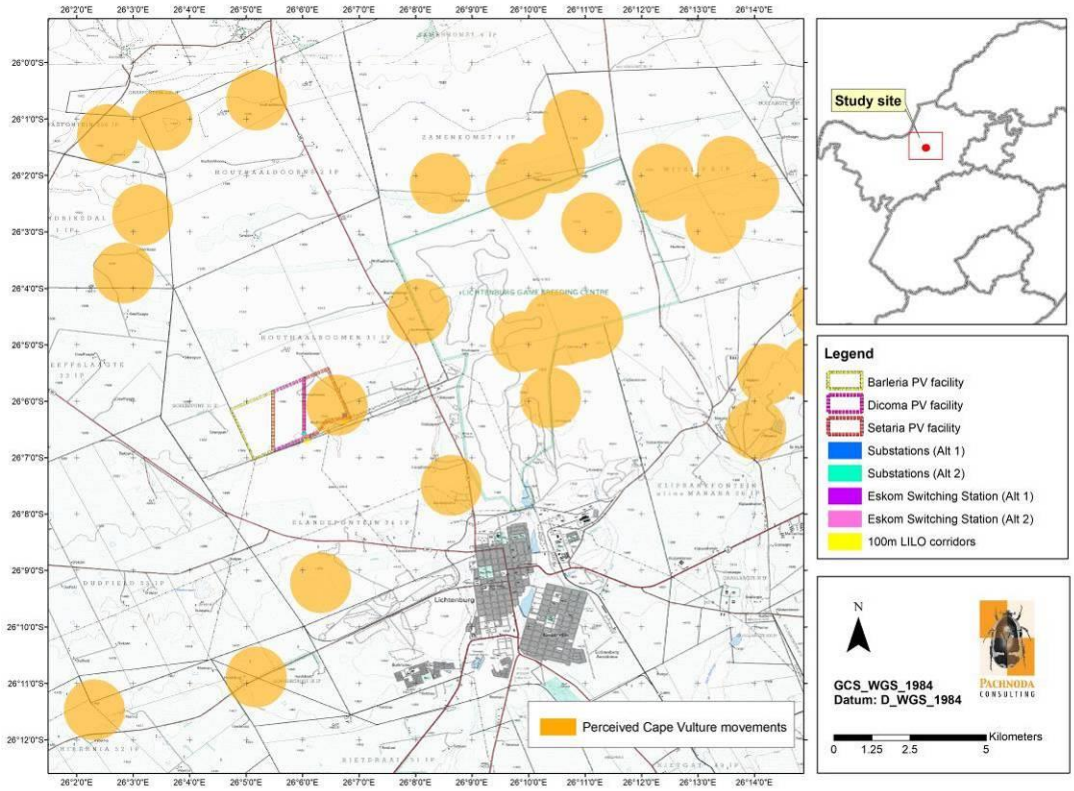

Figure 9: The occurrence of Cape Vultures (*Gyps coprotheres*) within the study region fitted with satellite trackers.

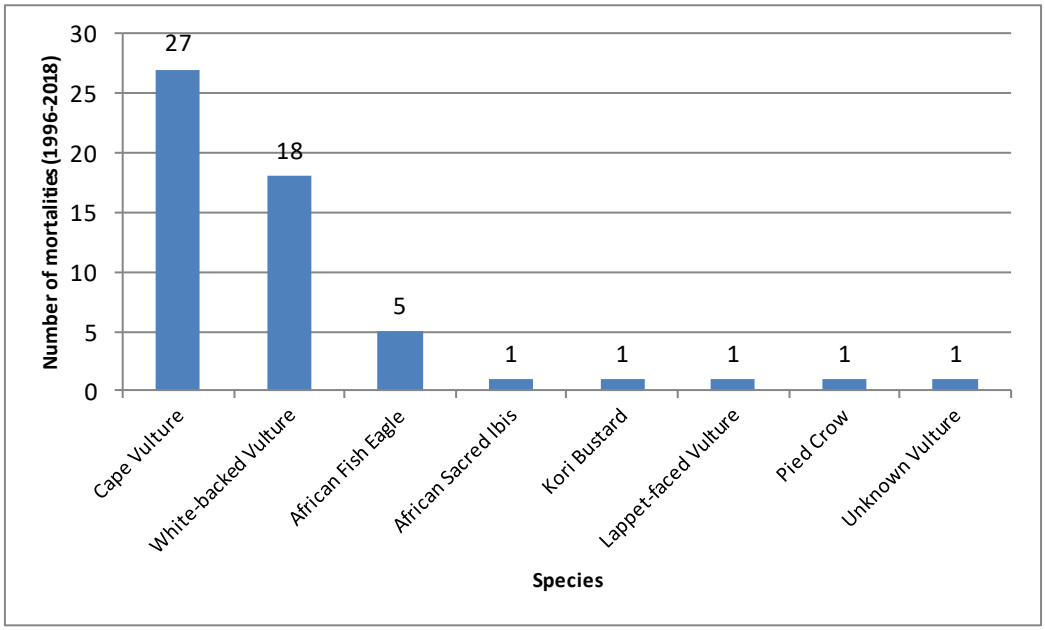

Figure 10: The number of mortalities (electrocutions and collisions) per bird species due to transmission and distribution lines in the study area (1996-2018).

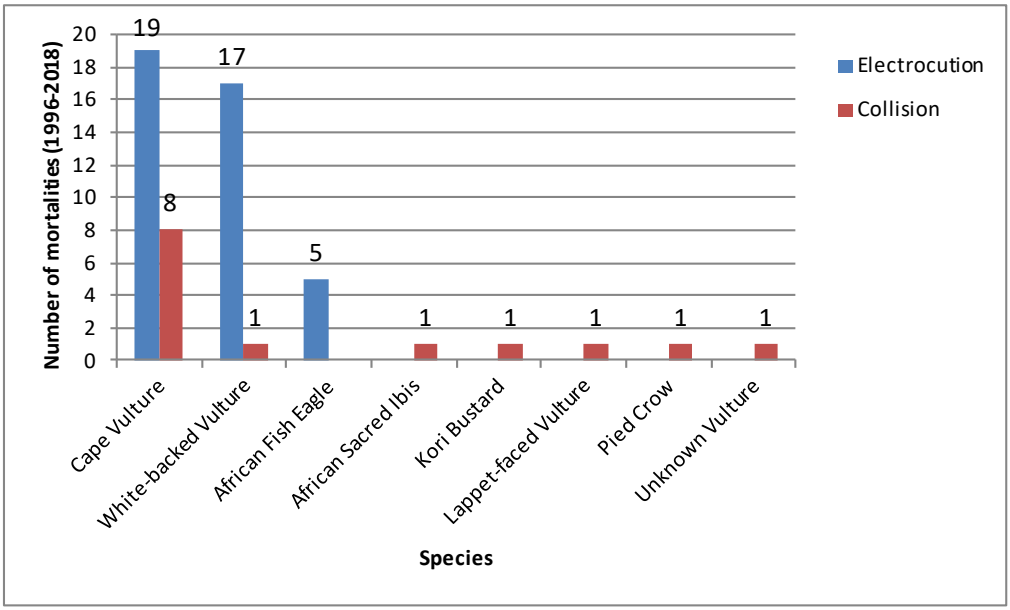

Figure 11: The number of mortalities per bird species caused by electrocutions (distribution lines) and collisions (transmission lines) (1996-2018).

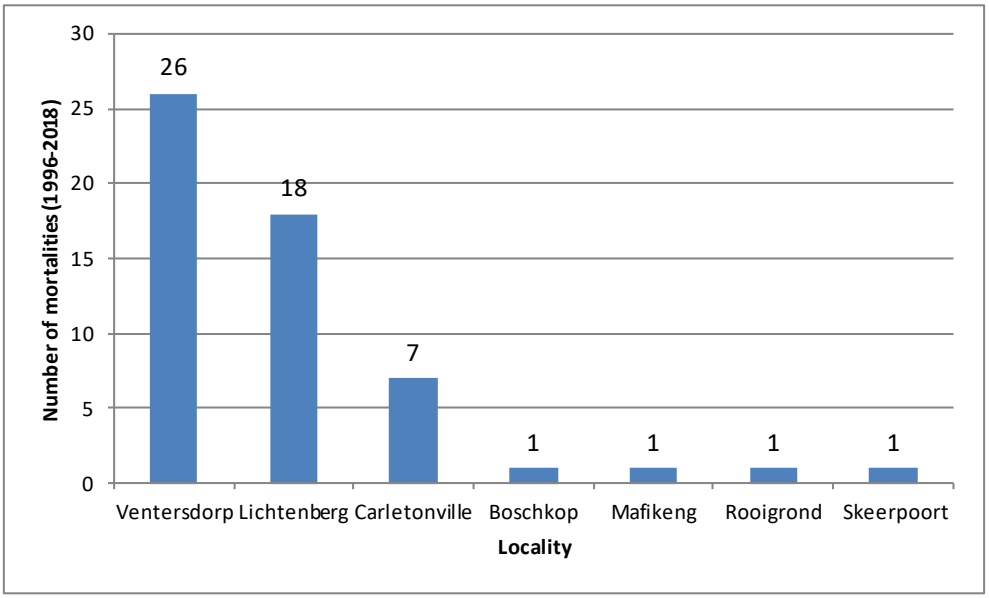

Figure 12: The number of bird mortalities caused by power lines per geographic locality (1996-2018), including the Lichtenburg area.

4. PLAN OF STUDY FOR THE EIA PHASE

Due to the limited level of detail that is normally implemented during a scoping assessment, it is imperative that detailed avifaunal investigations be conducted on the study area at an appropriate season.

4.1 Proposed approach and methods

The following methods are proposed during an austral summer season survey:

- Active searching and the compilation of a bird inventory while traversing much of the available habitat types;
- The determination of the occurrence of Red Data species and collision-prone bird species;
- The identification and mapping of suitable habitat for species of conservation concern while focussing on structural and topographical cues;
- A landscape analysis of important flyways or daily flight paths corresponding to important landscape features; and
- Density estimates will be collected by means of point counts to evaluate the dominant/typical species and their respective relative densities at each site. At each point the number of bird species seen will be recorded, as well as their respective abundances and distance from the observer (by means of a rangefinder). The data generated from the point counts will be analysed according to Clarke & Warwick (1994) based on the computed percentage contribution (%) of each species including the consistency (calculated as the similarity coefficient/standard deviation) of its contribution to the each habitat type.

5. REFERENCES

Birdlife South Africa. 2018. *BirdLife South Africa Checklist of Birds in South Africa*, 2018.

Clarke, K.R. & Warwick, R.M. 1994. *Changes in marine communities: An approach to statistical analysis and interpretation*. Natural Environmental Research Council, United Kingdom.

Convention on Biological Diversity. Signed 1993 and ratified 2 November 1995.

Geoterrainimage. 2015. *The South African National Land cover Dataset*. Version 05.

Gill, F, D Donsker, & P Rasmussen (Eds). 2021. IOC World Bird List (v 11.2). Doi 10.14344/IOC.ML.10.2. http://www.worldbirdnames.org/.

Gunerhan, H., Hepbasli, A. & Giresunlu, U. 2009. Environmental impacts from the solar energy systems. Energy Sources, Part A: *Recovery, Utilization and Environmental Effects* 31: 131-138.

Hardaker, T. 2018. Southern African Bird List - Version 08 - 11 March 2018.

Harrison, C., Lloyd, H. & Field, C. 2016. *Evidence review of the impact of solar farms on birds, bats and general ecology*. NEER012 report, Manchester Metropolitan University, UK.

Harrison, J.A., Allan, D.G., Underhill, L.G., Herremans, M., Tree, A.J., Parker, V. & Brown, C.J. (eds.). 1997. *The Atlas of Southern African Birds. Vol. 1 & 2*. BirdLife South Africa, Johannesburg.

Hockey, P.A.R., Dean, W.R.J. & Ryan, P.G. (eds.) 2005. *Roberts – Birds of Southern Africa*, VIIth ed. The Trustees of the John Voelker Bird Book Fund, Cape Town.

IUCN Red List of Threatened Species. Version 2021. http://www.iucnredlist.org/.

Jenkins, A.R, Ralston-Paton, S & Smit-Robinson, H.A. 2017. Best practice guidelines: Birds and Solar Energy. Guidelines for assessing and monitoring the impact of solar power generating facilities on birds in southern Africa. BirdLife South Africa.

Kagen, R.A., Verner, T.C., Trail, PW & Espinoza, E.O. 2014. Avian mortality at solar energy facilities in southern California: A preliminary analysis. Unpublished report by the National Fish and Wildlife Forensics Laboratory, USA.

Kruger, R. 1999. *Towards solving raptor electrocutions on Eskom Distribution Structures in South Africa.* M. Phil. Mini-thesis. University of the Orange Free State. Bloemfontein. South Africa.

Ledger, J. & Annegarn, H.J. 1981. Electrocution Hazards to the Cape Vulture (*Gyps coprotheres*) in South Africa. *Biological Conservation* 20: 15-24.

Marnewick, M.D., Retief, E.F., Theron, N.T., Wright, D.R. And Anderson, T.A. 2015. *Important Bird and Biodiversity Areas of South Africa*. Johannesburg: BirdLife South Africa.

McCrary, M.D., McKernan, R.L., Schreiber, R.W., Wagner, W.D. & Sciarotta, T.C. 1986. Avian mortality at a solar energy power plant. *Journal of Field Ornithology* 57: 135-141.

Mucina, L. & Rutherford, M.C. (eds.). 2006. The vegetation of South Africa, Lesotho and Swaziland. *Strelitzia 19*. South African National Biodiversity Institute, Pretoria.

National Environmental Management Biodiversity Act, 2004 (Act No. 10 of 2004).

Pachnoda Consulting. 2018. Development of the Lichtenburg 3 PV solar energy facility and associated infrastructure on a site near Lichtenburg, North West Province. A report compiled for Savanna Environmental.

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

Tsoutsos, T., Frantzeskaki, N. & Gekas, V. 2005. Environmental impacts from solar energy technologies. *Energy Policy* 33: 289-296.

Van Rooyen, C.S. 2000. An overview of Vulture Electrocutions in South Africa. *Vulture News* 43: 5-22.

Van Rooyen, C.S. & Taylor, P.V. 1999. *Bird streamers as probable cause of electrocutions in South Africa*. EPRI Workshop on Avian Interactions with Utility Structures, Charleston, South Carolina.

Vosloo, H. 2003. Birds and power lines. *ESI Africa* 3: 38.

Walston Jr. L.J., Rollins, K.E., LaGory, K.E., Smith, K.P. & Meyers, S.A. 2016. A preliminary assessment of avian mortality at utility-scale solar energy facilities in the United States. *Renewable Energy* 92 (2016) 405-414.

www.sabap2.birdmap.africa

Appendix 1: A shortlist of bird species expected to be present on the study area. The list provides an indication of the species occurrence according to SABAP1 and SABAP2 reporting rates.

Ref	Species name	Taxonomic name	SABAP2 Reporting Rate (%)			SABAP1 Reporting Rate (%)
			Full protocol	Adhoc protocol	Incidentals	
533	Babbler, Arrow-marked	*Turdoides jardineii*	3.13			27.45
432	Barbet, Acacia Pied	*Tricholaema leucomelas*	37.50			56.37
431	Barbet, Black-collared	*Lybius torquatus*	29.69			58.33
439	Barbet, Crested	*Trachyphonus vaillantii*	64.06			76.96
673	Batis, Chinspot	*Batis molitor*				38.71
404	Bee-eater, European	*Merops apiaster*	26.56			16.67
410	Bee-eater, Little	*Merops pusillus*	4.69			11.27
411	Bee-eater, Swallow-tailed	*Merops hirundineus*	1.56			3.52
409	Bee-eater, White-fronted	*Merops bullockoides*	12.50			4.90
808	Bishop, Southern Red	*Euplectes orix*	59.38			40.20
812	Bishop, Yellow-crowned	*Euplectes afer*	4.69			6.37
722	Bokmakierie, Bokmakierie	*Telophorus zeylonus*	45.31			50.49
709	Boubou, Southern	*Laniarius ferrugineus*	3.13			25.49
731	Brubru, Brubru	*Nilaus afer*	1.56			1.41
544	Bulbul, African Red-eyed	*Pycnonotus nigricans*	43.75			63.73
545	Bulbul, Dark-capped	*Pycnonotus tricolor*	35.94			46.57
872	Bunting, Cinnamon-breasted	*Emberiza tahapisi*	14.06			10.29
874	Bunting, Golden-breasted	*Emberiza flaviventris*				7.35
871	Bunting, Lark-like	*Emberiza impetuani*	1.56			0.70
723	Bush-shrike, Grey-headed	*Malaconotus blanchoti*	1.56			0.00
196	Buttonquail, Kurrichane	*Turnix sylvaticus*				0.70
154	Buzzard, Common (Steppe)	*Buteo buteo vulpinus*	3.13	16.67		10.29
860	Canary, Black-throated	*Crithagra atrogularis*	40.63			41.18
866	Canary, Yellow	*Crithagra flaviventris*	60.94			37.25
859	Canary, Yellow-fronted	*Crithagra mozambicus*				8.82
575	Chat, Anteating	*Myrmecocichla formicivora*	43.75	33.33		63.73
570	Chat, Familiar	*Oenanthe familiaris*	4.69			2.94
631	Cisticola, Cloud	*Cisticola textrix*	18.75			2.45
630	Cisticola, Desert	*Cisticola aridulus*	15.63			3.43
646	Cisticola, Levaillant's	*Cisticola tinniens*	40.63			16.18
642	Cisticola, Rattling	*Cisticola chiniana*	10.94			1.47
629	Cisticola, Zitting	*Cisticola juncidis*	37.50			4.90
504	Cliff-swallow, South African	*Petrochelidon spilodera*	29.69			34.80
4131	Coucal, Burchell's	*Centropus burchellii*	20.31			46.08
278	Courser, Double-banded	*Rhinoptilus africanus*				2.82
277	Courser, Temminck's	*Cursorius temminckii*				2.94
216	Crane, Blue	*Anthropoides paradiseus*				47.18

Ref	Species name	Taxonomic name	SABAP2 Reporting Rate (%)			SABAP1 Reporting Rate (%)
			Full protocol	Adhoc protocol	Incidentals	
621	Crombec, Long-billed	*Sylvietta rufescens*	3.13			0.70
523	Crow, Cape	*Corvus capensis*	1.56			20.59
522	Crow, Pied	*Corvus albus*	40.63			85.78
344	Cuckoo, Black	*Cuculus clamosus*				1.61
352	Cuckoo, Diderick	*Chrysococcyx caprius*	32.81			32.35
346	Cuckoo, Great Spotted	*Clamator glandarius*				0.70
348	Cuckoo, Jacobin	*Clamator jacobinus*				4.84
351	Cuckoo, Klaas's	*Chrysococcyx klaas*				2.45
347	Cuckoo, Levaillant's	*Clamator levaillantii*				1.61
343	Cuckoo, Red-chested	*Cuculus solitarius*				24.19
317	Dove, Laughing	*Spilopelia senegalensis*	93.75	16.67	1	90.69
318	Dove, Namaqua	*Oena capensis*	9.38	16.67		33.82
314	Dove, Red-eyed	*Streptopelia semitorquata*	71.88	16.67	1	78.92
940	Dove, Rock	*Columba livia*	14.06			7.84
517	Drongo, Fork-tailed	*Dicrurus adsimilis*	1.56	16.67		77.42
96	Duck, Yellow-billed	*Anas undulata*	35.94			63.73
142	Eagle, Martial	*Polemaetus bellicosus*	1.56			0.00
134	Eagle, Tawny	*Aquila rapax*				2.11
368	Eagle-owl, Spotted	*Bubo africanus*	3.13			1.47
61	Egret, Western Cattle	*Bubulcus ibis*	45.31			78.92
600	Eremomela, Yellow-bellied	*Eremomela icteropygialis*				0.70
119	Falcon, Amur	*Falco amurensis*	21.88			13.38
114	Falcon, Lanner	*Falco biarmicus*	4.69			2.82
120	Falcon, Red-footed	*Falco vespertinus*	3.13			2.11
820	Finch, Red-headed	*Amadina erythrocephala*	28.13			61.97
789	Weaver (=Finch), Scaly-feathered	*Sporopipes squamifrons*	20.31			6.37
837	Firefinch, Red-billed	*Lagonosticta senegala*	17.19			7.84
707	Fiscal, Southern	*Lanius collaris*	70.31	16.67		87.75
678	Flycatcher, Fairy	*Stenostira scita*				3.92
665	Flycatcher, Fiscal	*Melaenornis silens*	43.75			58.82
661	Flycatcher, Marico	*Melaenornis mariquensis*	6.25			5.88
654	Flycatcher, Spotted	*Muscicapa striata*	17.19			11.76
173	Francolin, Coqui	*Peliperdix coqui*	3.13			2.45
179	Francolin, Orange River	*Scleroptila gutturalis*	15.63			15.20
339	Go-away-bird, Grey	*Corythaixoides concolor*	18.75	16.67		41.18
89	Goose, Egyptian	*Alopochen aegyptiacus*	17.19			60.78
88	Goose, Spur-winged	*Plectropterus gambensis*	6.25			43.14
165	Goshawk, Southern Pale Chanting	*Melierax canorus*				0.70
192	Guineafowl, Helmeted	*Numida meleagris*	40.63	16.67		59.80
288	Gull, Grey-headed	*Chroicocephalus cirrocephalus*	3.13			2.11

Ref	Species name	Taxonomic name	SABAP2 Reporting Rate (%)			SABAP1 Reporting Rate (%)
			Full protocol	Adhoc protocol	Incidentals	
72	Hamerkop, Hamerkop	*Scopus umbretta*	4.69			12.75
171	Harrier-Hawk, African	*Polyboroides typus*	3.13			0.00
55	Heron, Black-headed	*Ardea melanocephala*	17.19			47.06
440	Honeyguide, Greater	*Indicator indicator*	4.69			2.45
442	Honeyguide, Lesser	*Indicator minor*	3.13			0.98
418	Hoopoe, African	*Upupa africana*	42.19	16.67		77.45
424	Hornbill, African Grey	*Lophoceros nasutus*				12.75
81	Ibis, African Sacred	*Threskiornis aethiopicus*	10.94			60.29
83	Ibis, Glossy	*Plegadis falcinellus*	20.31			14.71
84	Ibis, Hadeda	*Bostrychia hagedash*	56.25			81.86
851	Indigobird, Village	*Vidua chalybeata*				4.90
122	Kestrel, Greater	*Falco rupicoloides*	3.13			27.94
125	Kestrel, Lesser	*Falco naumanni*	17.19			14.22
402	Kingfisher, Brown-hooded	*Halcyon albiventris*				18.63
128	Kite, Black	*Milvus migrans*	1.56			0.70
130	Kite, Black-winged	*Elanus caeruleus*	31.25	50.00	1	59.80
129	Kite, Yellow-billed	*Milvus aegyptius*	12.50	16.67		7.84
1035	Korhaan, Northern Black	*Afrotis afraoides*	31.25			52.94
247	Lapwing, African Wattled	*Vanellus senegallus*	1.56			3.43
245	Lapwing, Blacksmith	*Vanellus armatus*	68.75			73.53
242	Lapwing, Crowned	*Vanellus coronatus*	64.06			72.06
1183	Lark, Eastern Clapper	*Mirafra fasciolata*	15.63			24.02
488	Lark, Red-capped	*Calandrella cinerea*	1.56			6.34
456	Lark, Melodious	*Mirafra cheniana*	0.00			0.00
458	Lark, Rufous-naped	*Mirafra africana*	29.69			33.33
460	Lark, Sabota	*Calendulauda sabota*	3.13			4.93
474	Lark, Spike-heeled	*Chersomanes albofasciata*	20.31			25.98
703	Longclaw, Cape	*Macronyx capensis*	25.00			36.27
510	Martin, Banded	*Riparia cincta*	10.94			4.41
803	Masked-weaver, Southern	*Ploceus velatus*	76.56			69.12
392	Mousebird, Red-faced	*Urocolius indicus*	50.00	16.67		51.47
390	Mousebird, Speckled	*Colius striatus*	12.50			14.71
391	Mousebird, White-backed	*Colius colius*	48.44			54.90
734	Myna, Common	*Acridotheres tristis*	67.19	16.67		0.00
637	Neddicky	*Cisticola fulvicapilla*	15.63			12.75
371	Nightjar, European	*Caprimulgus europaeus*				0.70
372	Nightjar, Rufous-cheeked	*Caprimulgus rufigena*				4.84
521	Oriole, Black-headed	*Oriolus larvatus*	4.69			25.98
359	Owl, Western Barn	*Tyto alba*	1.56			6.37
361	Owl, Marsh	*Asio capensis*				5.63
365	Owlet, Pearl-spotted	*Glaucidium perlatum*				2.94

Ref	Species name	Taxonomic name	SABAP2 Reporting Rate (%)			SABAP1 Reporting Rate (%)
			Full protocol	Adhoc protocol	Incidentals	
387	Palm-swift, African	*Cypsiurus parvus*	39.06			21.08
682	Paradise-flycatcher, African	*Terpsiphone viridis*	9.38			11.76
852	Paradise-whydah, Long-tailed	*Vidua paradisaea*	1.56			2.11
531	Penduline-tit, Cape	*Anthoscopus minutus*	1.56			0.00
311	Pigeon, Speckled	*Columba guinea*	62.50	16.67		69.12
692	Pipit, African	*Anthus cinnamomeus*	35.94			21.57
695	Pipit, Buffy	*Anthus vaalensis*				2.11
238	Plover, Three-banded	*Charadrius tricollaris*	32.81			25.98
282	Pratincole, Black-winged	*Glareola nordmanni*				0.70
650	Prinia, Black-chested	*Prinia flavicans*	65.63			31.37
649	Prinia, Tawny-flanked	*Prinia subflava*	7.81			3.92
830	Pytilia, Green-winged	*Pytilia melba*	1.56			2.82
189	Quail, Common	*Coturnix coturnix*				0.98
844	Quailfinch	*Ortygospiza atricollis*	9.38			4.90
805	Quelea, Red-billed	*Quelea quelea*	40.63			29.90
606	Reed-warbler, African	*Acrocephalus baeticatus*	18.75			1.96
581	Robin-chat, Cape	*Cossypha caffra*	18.75			61.27
582	Robin-chat, Whitethroated	*Cossypha humeralis*	-	-	-	-
412	Roller, European	*Coracias garrulus*	1.56			1.96
514	Tit, Ashy	*Melaniparus cinerascens*	-	-	-	-
413	Roller, Lilac-breasted	*Coracias caudatus*	1.56			14.08
421	Scimitarbill, Common	*Rhinopomastus cyanomelas*	14.06			20.97
586	Scrub-robin, Kalahari	*Cercotrichas paena*	29.69			18.14
588	Scrub-robin, White-browed	*Cercotrichas leucophrys*	1.56			1.47
105	Secretarybird	*Sagittarius serpentarius*	1.56			2.45
711	Shrike, Crimson-breasted	*Laniarius atrococcineus*	14.06	16.67		28.92
706	Shrike, Lesser Grey	*Lanius minor*	17.19			7.35
708	Shrike, Red-backed	*Lanius collurio*	26.56			16.67
146	Snake-eagle, Black-chested	*Circaetus pectoralis*	3.13			1.47
145	Snake-eagle, Brown	*Circaetus cinereus*	1.56			0.00
786	Sparrow, Cape	*Passer melanurus*	71.88	16.67		71.57
784	Sparrow, House	*Passer domesticus*	51.56	16.67		51.47
4142	Sparrow, Southern Grey-headed	*Passer diffusus*	17.19			6.86
780	Sparrow-weaver, White-browed	*Plocepasser mahali*	68.75			60.78
484	Sparrowlark, Chestnut-backed	*Eremopterix leucotis*	1.56			9.15
485	Sparrowlark, Grey-backed	*Eremopterix verticalis*				5.63
185	Spurfowl, Swainson's	*Pternistis swainsonii*	42.19		1	36.27
737	Starling, Cape Glossy	*Lamprotornis nitens*	28.13			82.35
746	Starling, Pied	*Lamprotornis bicolor*	7.81			39.22
735	Starling, Wattled	*Creatophora cinerea*	42.19			51.96
576	Stonechat, African	*Saxicola torquatus*	40.63			57.84

Ref	Species name	Taxonomic name	SABAP2 Reporting Rate (%)			SABAP1 Reporting Rate (%)
			Full protocol	Adhoc protocol	Incidentals	
78	Stork, Abdim's	*Ciconia abdimii*				7.75
73	Stork, Marabou	*Leptoptilos crumeniferus*	1.56			0.70
80	Stork, White	*Ciconia ciconia*				6.34
772	Sunbird, Amethyst	*Chalcomitra amethystina*	6.25			18.63
755	Sunbird, Marico	*Cinnyris mariquensis*	1.56			0.00
763	Sunbird, White-bellied	*Cinnyris talatala*	9.38			35.29
493	Swallow, Barn	*Hirundo rustica*	31.25			35.78
502	Swallow, Greater Striped	*Crecopis cucullata*	48.44			36.76
498	Swallow, Pearl-breasted	*Hirundo dimidiata*				0.70
501	Swallow, Red-breasted	*Crecopis semirufa*	3.13	16.67		3.92
384	Swift, Horus	*Apus horus*				2.11
385	Swift, Little	*Apus affinis*	32.81			31.86
383	Swift, White-rumped	*Apus caffer*	28.13			18.63
714	Tchagra, Brown-crowned	*Tchagra australis*	7.81			6.86
275	Thick-knee, Spotted	*Burhinus capensis*	3.13			19.12
557	Thrush, Groundscraper	*Turdus litsipsirupa*	7.81			24.02
1104	Thrush, Karoo	*Turdus smithi*	57.81			66.18
658	Warbler, Chestnut-vented	*Sylvia subcaerulea*	40.63			30.88
316	Turtle-dove, Cape	*Streptopelia capicola*	17.19	16.67		58.82
106	Vulture, Cape	*Gyps coprotheres*	7.81			17.16
108	Vulture, Lappet-faced	*Torgos tracheliotos*	4.69			5.63
107	Vulture, White-backed	*Gyps africanus*	10.94			16.18
686	Wagtail, Cape	*Motacilla capensis*	57.81			86.27
607	Warbler, Marsh	*Acrocephalus palustris*	3.13			0.00
599	Warbler, Willow	*Phylloscopus trochilus*	9.38			5.39
839	Waxbill, Blue	*Uraeginthus angolensis*	20.31			4.41
843	Waxbill, Common	*Estrilda astrild*	17.19			6.37
838	Waxbill, Orange-breasted	*Amandava subflava*	3.13			1.96
840	Waxbill, Violet-eared	*Granatina granatina*	1.56			6.34
799	Weaver, Cape	*Ploceus capensis*	6.25			30.88
568	Wheatear, Capped	*Oenanthe pileata*	7.81			9.80
564	Wheatear, Mountain	*Oenanthe monticola*				11.76
1172	White-eye, Cape	*Zosterops virens*	25.00			66.18
594	Whitethroat, Common	*Sylvia communis*				0.70
846	Whydah, Pin-tailed	*Vidua macroura*	28.13			22.55
847	Whydah, Shaft-tailed	*Vidua regia*				0.70
818	Widowbird, Long-tailed	*Euplectes progne*	35.94	16.67		56.37
813	Widowbird, Red-collared	*Euplectes ardens*	3.13			2.11
814	Widowbird, White-winged	*Euplectes albonotatus*	20.31			4.41
419	Wood-hoopoe, Green	*Phoeniculus purpureus*	12.50			16.18
450	Woodpecker, Cardinal	*Dendropicos fuscescens*				8.06