DEVELOPMENT OF THE KAREERAND BATTERY STORAGE ENERGY FACILITY AND ASSOCIATED INFRASTRUCTURE NEAR KLERKSDORP, NORTH WEST PROVINCE

Avifauna Baseline Report

February 2024

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Prepared for:
Kareerand BESS (Pty) Ltd

EXECUTIVE SUMMARY

Pachnoda Consulting cc was requested by Kareerand BESS (Pty) Ltd to compile an avifauna baseline report for the proposed construction of the Kareerand Battery Energy Storage (BESS) Facility, consisting of a BESS and solar photovoltaic (PV) infrastructure. The Kareerand BESS facility will be located approximately 22 km east of Klerksdorp within the North West Province.

The objectives of the avifaunal study were to: (a) describe the avifauna associations in the project area according to species composition and richness prior to construction activities; (b) provide an inventory of bird species occurring in the project area including species prone towards collisions with the proposed infrastructure; (c) provide an impact assessment; and (d) provide an indication of the occurrence of species of concern (e.g. threatened and near threatened species).

Baseline avian data was obtained from point count and ad hoc sampling techniques during the months of August/September 2023, November/December 2023 and January 2024.

Seven avifaunal habitat types were identified on the study area and surroundings, consisting of open grassland with bush clumps (ranging from open savannoid grassland to rocky grassland), wetlands and floodplains, secondary grassland and *Vachellia* dominated bushveld. The wetlands and floodplains (e.g. Koekemoerspruit) provided foraging, roosting and breeding habitat for many waterbird and wading bird taxa, although the occurrence of such taxa on the BESS facility was considered to be low. Approximately 286 bird species were expected to occur in the wider study area, of which 210 species were observed in the area. The expected richness included 12 threatened or near threatened bird species. However, the occurrence of threatened and near threatened bird species was predicted to be low, apart from the regionally vulnerable Lanner Falcon (*Falco biarmicus*) which was regarded as a regular foraging visitor to the area. In addition, large sections of open grassland east of the Koekemoerspruit (along the proposed grid connection) provided suitable foraging habitat for Secretarybirds (*Sagittarius serpentarius*), although this species was regarded as uncommon in the area (sensu SABAP Reporting rates). Approximately,17 southern African endemics and 23 near-endemic species were expected to be present.

The main potential impacts associated with the facility and grid connection corridor 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 powerline (mainly overhead powerlines).

An evaluation of potential and likely impacts on the avifauna revealed that the impact significance was moderate to low after mitigation (depending on the type of impact). No fatal-flaws were identified during the assessment, although it was recommended that the proposed mitigation measures a be implemented during the construction and operational phase of the project.

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DECLARATION OF INDEPENDENCE

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

- I act as the independent specialist in this application to Kareerand BESS (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)
10 February 2024

Lukas Niemand is registered with The South African Council for Natural Scientific Professionals (400095/06) with more than 20 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 Kareerand BESS (Pty) Ltd to compile an avifauna baseline report for the proposed construction of the Kareerand Battery Energy Storage (BESS) Facility, consisting of a BESS and solar photovoltaic (PV) infrastructure. The Kareerand BESS facility will be located approximately 22 km east of Klerksdorp within the North West Province (Figure 1).

The Kareerand BESS facility will have a total development footprint of up to approximately 25 ha and will have a maximum export capacity of up to 77 MW. The development area is situated within the City of Matlosana Local Municipality and the JB Marks Local Municipality. The site is accessible via existing tarred and gravel roads to the north-east of the site. These existing gravel roads will be ugraded to a maximum width of 8m.

The proposed Kareerand BESS facility will include the following infrastructure:

- PV modules and mounting structures (up to 10 ha).
- Inverters and transformers.
- Solid State Battery Energy Storage System (BESS) (up to 10 ha).
- Site and internal access roads (up to 8m wide).
- Operation and Maintenance buildings including a gate house and security building, control centre, offices, warehouses and workshops for storage and maintenance (up to 1 ha).
- Laydown areas (3 ha temporary and 1 ha permanent).
- A 132 kV facility substation (up to 1 ha).

The Kareerand BESS facility will be located on Portion 3 of the Farm Kareerand No. 444. In addition, the existing access road on Portion 3 of the Farm Kareerand No. 444, Portion 4 of the Farm Kareerand 444, Portion 16 of the Farm Kromdraai 420, Portion 17 of the Farm Kromdraai 420, Farm Umfula No. 575, Portion 20 of Farm Umfula No. 567 and Portion 56 of the Farm Kromdraai 420 will also be upgraded.

The project will also include Grid connection infrastructure consisting of:

- A 132 kV Eskom Switching Station (up to 1 ha).
- 132 kV powerline (up to 11.5 km long) connecting the Eskom switching station to the Hermes Main Transmission Substation (a grid connection corridor of 100m wide will be assessed to allow for environmental sensitivities and/or micro-siting).

The Grid connection infrastructure, although assessed cumulatively with the BESS, will be subject to a separate environmental application process administered by the provincial authority. The grid connection infrastructure will be located on Portion 3 of the Farm Kareerand No. 444, Portion 15 of the Farm Kromdraai 443, Remainder of

Portion 5 of Farm no. 422, Portion 6 of the Farm Buffelsfontein 443, Portion 3 of the Farm Kareerand 444, Portion 2 of the Farm Buffelsfontein 443, Portion 103 of the Farm Hartebeestfontein 422, Portion 38 of the Farm Hartebeestfontein 422, Portion 79 of the Farm Hartebeestfontein 422, Portion 8 of the Farm Hartebeestfontein 422, Portion 2 of the Farm Mapaiskraal No. 441, Portion 41 of the Farm Hartebeestfontein 422 and Portion 4 of the Farm Mapaiskraal 441.

1.2 Objectives and Terms of Reference

The main objectives of the avifaunal study were to: (a) describe the avifauna associations in the study area and along the grid corridor according to species composition and richness prior to construction activities; (b) provide an inventory of bird species occurring in the study area including species prone towards collisions with the proposed infrastructure; (c) provide an impact assessment; and (d) provide an indication of the occurrence of species of concern (e.g. threatened and near threatened species; sensu IUCN, 2023; Taylor et al., 2015; Marnewick et al., 2015).

A bird assessment is required as part of the Environmental Impact Assessment process to investigate the impacts of the proposed solar facility on the avian attributes at the study site and its immediate surroundings. The avifaunal attributes at the proposed PV facility will be determined by means of a desktop analysis of GIS based information, third-party datasets and a baseline survey. It also provides the results from two independent surveys during the austral wet season and the austral dry season as per the best practice guidelines of Jenkins *et al.* (2017).

The terms of reference are to:

- conduct a baseline bird assessment based on available information pertinent to the ecological and avifaunal attributes on the project area and habitat units;
- conduct an assessment of all information on an EIA level in order to present the following results:
    - typify the regional and site-specific avifaunal macro-habitat parameters that will be affected by the proposed project;
    - provide a shortlist of bird species present as well as highlighting dominant species and compositions;
    - 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 area;
    - highlight areas of concern or "hotspot" areas;
    - identify and describe impacts that are considered pertinent to the proposed development; and
    - highlight gaps of information in terms of the avifaunal environment.

1.3 Scope of Work

The following aspects form part of the Scope of Work:

- A desktop study of bird species expected to occur (e.g. species that could potentially be present), as well as species recorded in the past (e.g. SABAP1 and SABAP2);
- A baseline survey of observed bird species according to ad hoc and point count observations during the austral wet season (summer) and during the austral dry season (winter);
- A list of bird species historically recorded within the relevant quarter degree grid in which the study site occurs (SABAP1);
- Any protected or threatened bird species recorded in the past within the relevant quarter degree grid, their scientific names and colloquial names, and protected status according to IUCN red data lists; and
- The potential of these protected or threatened species to persist within the study area.

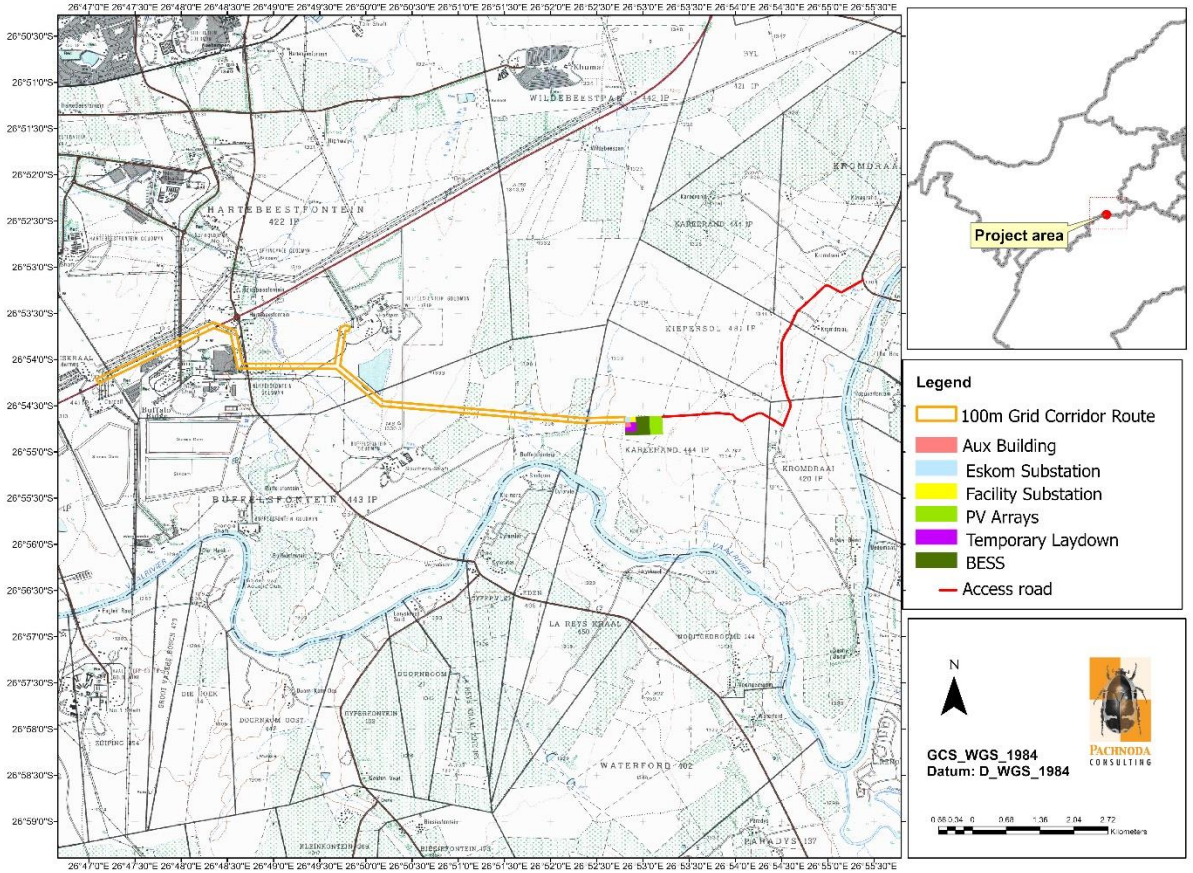


Figure 1: A topocadastral map illustrating the geographic position of the proposed Kareerand BESS facility and grid connection corridor.

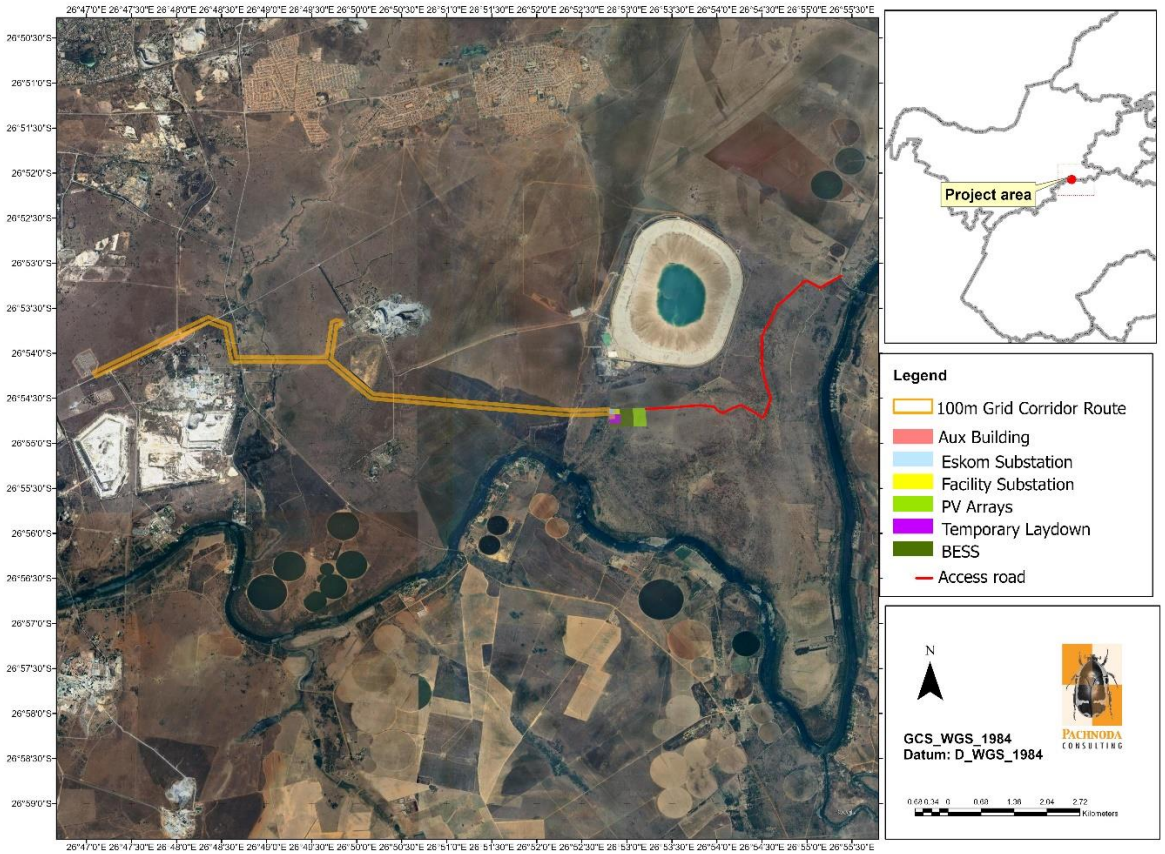


Figure 2: A satellite image illustrating spatial position of the proposed Kareerand BESS facility and grid connection corridor.

2. METHODS & APPROACH

The objectives 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 place emphasis on the avifaunal community as a key indicator group on the proposed development area and immediate surroundings, 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 will 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 the austral dry and wet season (30 August to 01 September 2023, 29 November - 01 December 2023 and 07 January 2024); and
- personal observations from similar habitat types in close proximity to the project area.

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, 2023) 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 quarter-degree grid cell (QDGC) 2626DD (Stilfontein) (Figure 3). 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 grids relevant to the current project are 2650_2645, 2650_2650, 2655_2645 and 2655_2550 (Figure 4).
- The choice of scientific nomenclature, taxonomy and common names were recommended by the International Ornithological Committee (the IOC World Bird List v. 14.1), unless otherwise specified (see www.worldbirdnames.org as specified by Gill et al, 2024).
- 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.

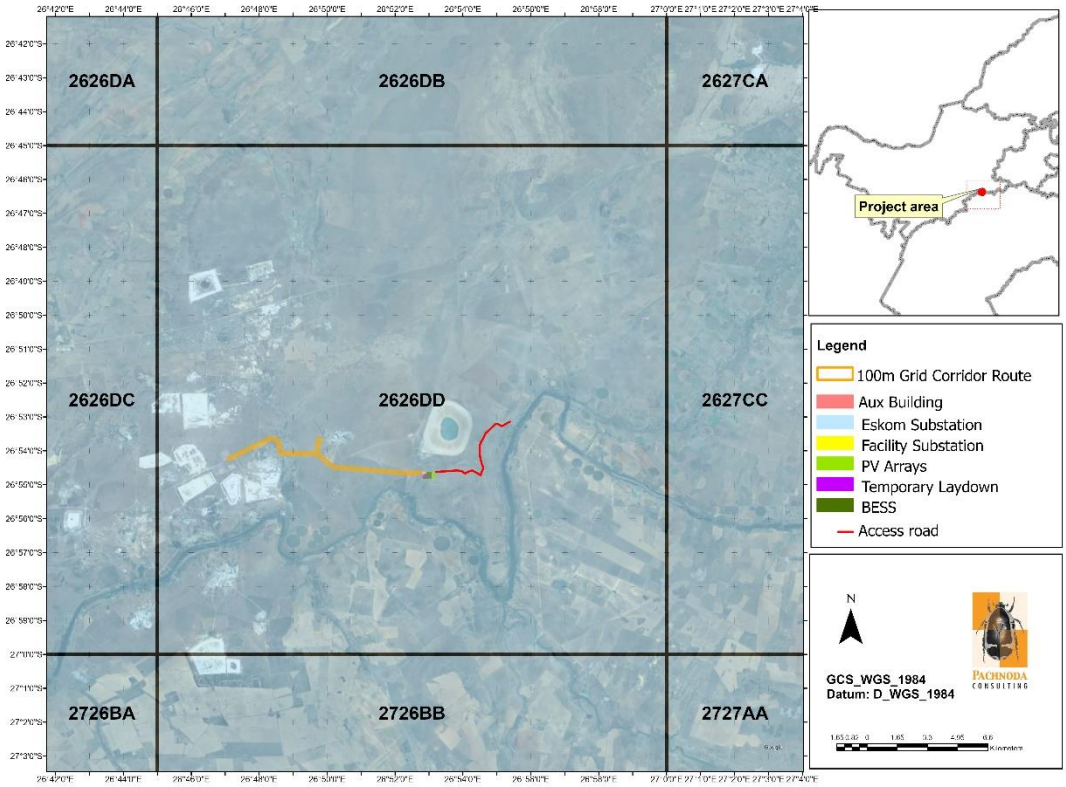


Figure 3: A map illustrating the quarter-degree grid cells that were investigated for this project.

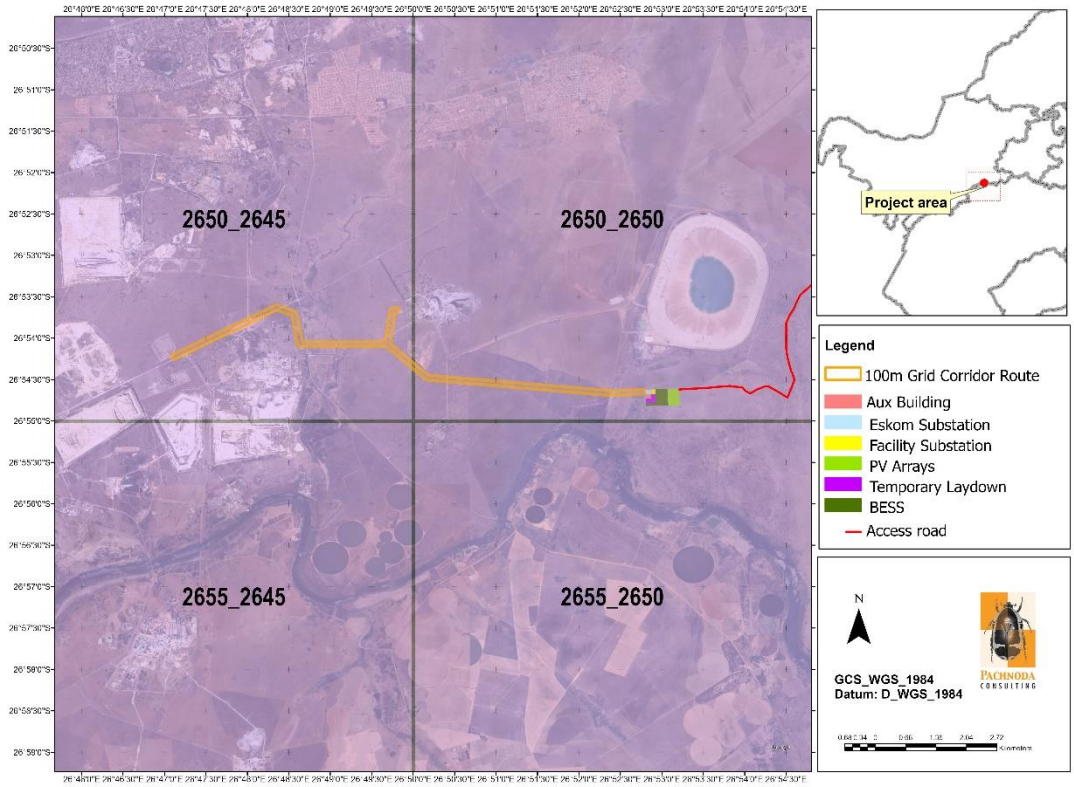


Figure 4: A map illustrating the pentad grids that were investigated for this project.

2.2 Field Methods

The avifauna of the study area was surveyed during the austral dry season (August/September 2023) and the austral wet season (November/December 2023 and January 2024).

The baseline avifaunal survey was conducted by means of the following survey techniques:

2.2.1 Point Counts

Bird data was collected by means of 72 point counts (as per Buckland et al. 1993) from natural and untransformed habitat (not active agricultural land) representing two survey sessions (36 counts during the August 2023 survey and 36 counts during the November 2023 survey). Data from the point counts has been analysed to determine dominant and indicator bird species (so-called discriminant species), relative densities and to delineate the different bird associations present.

The use of point counts is advantageous since it is the preferred method to use for skulking or elusive species. In addition, it is the preferred method to line transect counts where access is problematic, or when the terrain appears to be complex (e.g. mountainous). It is considered to be a good method to use, and very efficient for

gathering a large amount of data in a short period of time (Sutherland, 2006). The spatial position of each point count is illustrated in Figure 5. The spatial placement of the point counts was determined through a stratified random design which ensures coverage of each habitat type and/or macro-habitat (Sutherland et al., 2004).

The sampling approach was adapted so that all the bird species seen within approximately 50 m from the centre of the point were recorded (resulting in an area of 0.78 ha) along with their respective abundance values (a laser rangefinder was used to delineate the area to be surveyed at each point). Each point count lasted approximately 15-20 minutes, while the area within the 50 m radius of homogenous habitat was slowly traversed to ensure that all bird species were detected and or flushed (as proposed by Watson, 2003). To ensure the independence of observations, points were positioned at least 200 m apart. Observations were not truncated, and in order to standardise data collection, the following assumptions were conformed to (according to Buckland *et al.*, 1994):

- All birds on the point must be seen and correctly identified. This assumption is in practice very difficult to meet in the field as some birds in the nearby vicinity may be overlooked due to low visibility or were obscured by vegetation (e.g. graminoid cover). Therefore, it is assumed that the portion of birds seen on the point count represents the total assemblage on the point.
- All birds must be recorded at their initial location. All movements of the birds are random and therefore natural in relation to the movements of the observer. None of the birds moved in response to the presence of the observer, and birds flying past without landing were omitted from the analysis.
- In other words, no bird is recorded more than once.

2.2.2 Field Equipment Used

The following equipment was used during the respective surveys:

- For bird identification and observation:
    - *Swarovski 10x42 NL Pure* binoculars; and
    - *Swarovski 25-70x90 ATX* Spotting Scope mounted on a tripod (for identification of distant objects).
- For photographing bird species of conservation concern: *Canon EOS R6* mirrorless body with *Canon RF 800mm F11 IS STM* telephoto lens.
- For measuring distance during point counts (50m radius): *Bushnell Scout 1000 ARC* Rangefinder.
- Recording of nocturnal bird vocalisations: *Wildlife Acoustics Songmeter SM4* (passive acoustic recorded).
- For navigation and capturing waypoint data: *Garmin Montana 380* and a *Garmin Montana 700i* handheld GPS.
- For capturing data to spreadsheet format: *Samsung Galaxy Tab A.*
- For capturing digital information on habitat features: *Canon S120* compact camera.

2.2.3 Random (ad hoc) surveys

To obtain an inventory of bird species present (apart from those observed during the point counts), all bird species observed/detected while moving between point counts were identified and noted. Particular attention was devoted to suitable roosting, foraging and nesting habitat for species of conservation concern (e.g. threatened or near threatened species). In addition, the fly patterns of large non-passerine and birds of prey were recorded, as well as the locality of collision-prone birds.

An additional 11 point sites located along the grid connection corridor was also inspected to obtain information regarding the dominant habitat types along the grid corridor and the potential for threatened or near threatened bird species to occur (Figure 5).

2.2.4 Analyses

Data generated from the point counts was 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. Hierarchical Agglomerative Clustering (a cluster analysis-based group-average linkages; Clarke & Warwick 1994) was performed on calculated Bray-Curtis coefficients derived from the data. A cluster analysis is used to assign "species associations" between samples with the aim to objectively delineate groups or assemblages. Therefore, sampling entities that group together (being more similar) are believed to have similar compositions.

The species richness and diversity of each bird association was analysed by means of richness measures (such as the total number of species recorded (S) and Shannon Wiener Index) were calculated to compare the associations with each other.

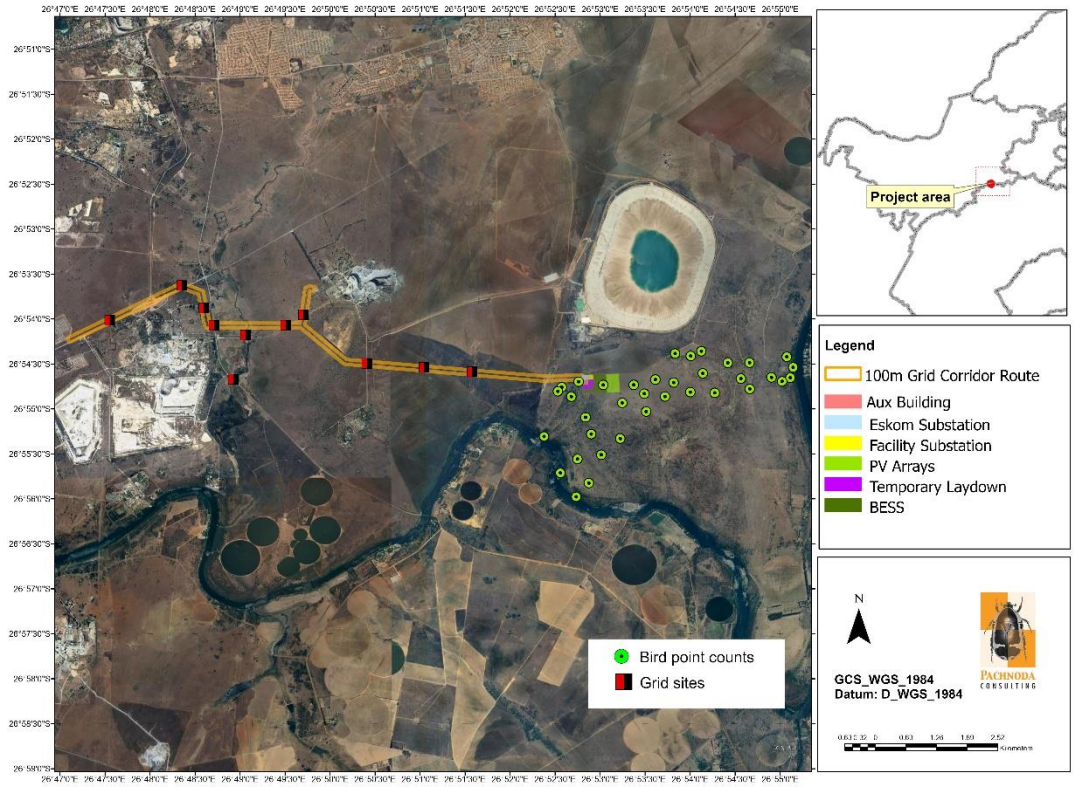


Figure 5: A map illustrating the spatial position of bird point counts located within the study area as well as the locality of a passive acoustics recorder.

2.3 Sensitivity Analysis

A 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).

2.4 Limitations

- 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 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. artificial livestock watering points). In addition, these datasets encompass surface areas larger than the study area, which could include habitat types and species that are not present on the study site. Therefore the potential to overestimate species richness is highly likely while it is also possible that certain cryptic or specialist species could have been be overlooked in the past.
- Some of the datasets (e.g. SABAP2) managed by the Animal Demography Unit of the University of Cape Town were recently initiated and therefore incomplete.
- 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.

3. DESCRIPTION OF THE AFFECTED ENVIRONMENT

3.1 Locality

The proposed BESS facility will be located approximately 22 km east of the town of Klerksdorp and will be located on Portion 3 of the Farm Kareerand No. 444 in the North West Province (Figure 1). The site coordinates of the centre of the proposed facility are S26° 54' 37.6" E26° 52' 48.3".

3.2 Regional Vegetation Description

The proposed BESS facility and grid connection corridor correspond to the Grassland Biome and more particularly to the Dry and Mesic Highveld Grassland Bioregion as defined by Mucina & Rutherford (2006). It comprehends two ecological types known as Vaal Reefs Dolomite Sinkhole Woodland (Mucina & Rutherford, 2006) and Rand Highveld Grassland (Figure 6).

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.

Vaal Reefs Dolomite Sinkhole Woodland is confined to a small area associated with dolomite sinkholes in the Stilfontein and Orkney areas corresponding to the North West and Free State Provinces. It is located on the western part of the study site and more particularly to the proposed grid connection. It occurs on slightly undulating landscapes dissected by prominent chert ridges, thereby supporting a grassland-woodland floristic mosaic. A prominent floristic structure of this vegetation type is woodland formations in the form of bush clumps around sinkholes and dolomite outcrops.

The Vaal Reefs Dolomite Sinkhole Woodland is a threatened (Vulnerable) ecosystem with only a small patch in the statutorily conservation area of the Sterkfontein Caves (part of the Cradle of Humankind World Heritage Site. Approximately 25% of this vegetation type has been transformed due to mining activities and cultivation, and it corresponds to an area with the highest concentration of mines when compared to other vegetation types.

The Highveld Alluvial Vegetation is confined to the Free State, North West, Mpumalanga and Gauteng Provinces, where it is located along major alluvial drainage systems and floodplains that are embedded in the Grassland Biome, and herewith associated with the middle Vaal River and its tributaries. It occurs on a relatively flat topography supporting riparian thickets dominated by *Vachellia karroo* and seasonally flooded grassland. Noteworthy plant species include *V. karroo, Salix mucronata, Ziziphus mucronata, Gymnosporia buxifolia, Cynodon dactylon* and *Asparagus laricinus*.

The Alluvial Highveld Vegetation is a Least Concern ecosystem with approximately 10 % conserved in the Barberspan, Bloemhof Dam, Schoonspruit, Faan Meintjies, Wolwespruit and Soetdoring Nature Reserves. In addition, more than 25 % of this vegetation type has been transformed by cultivation and the construction of dams. It is also, due to its high nutrient content, prone towards invasion by alien plant species such as *Melia azedarach, Morus alba* and *Populus x canescens*.

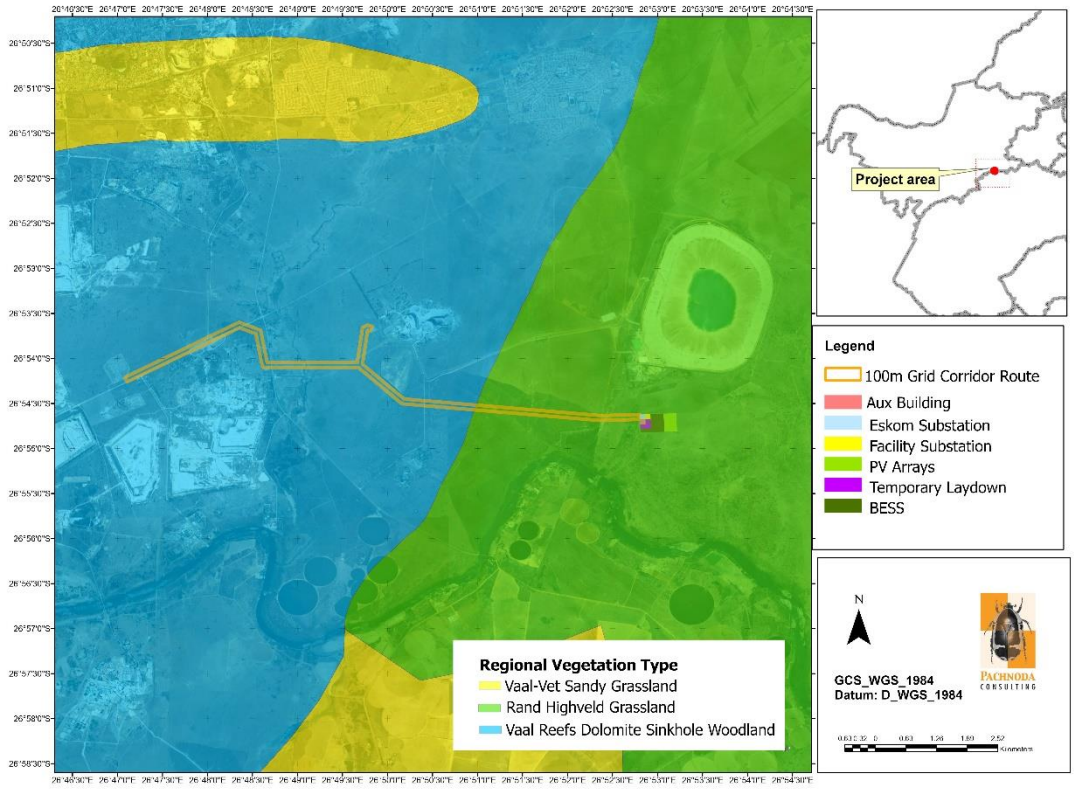


Figure 6: A satellite image illustrating the regional vegetation type corresponding to the development area and immediate surroundings. Vegetation type categories were defined by Mucina & Rutherford (2006; updated 2012).

3.3 Land cover, land use and existing infrastructure.

According to the South African National dataset of 2018-2020 (Geoterrainimage, 2020) the study area comprehends the following land cover categories (Figure 7):

Natural areas:

- Natural Grassland;
- Open woodland and
- Herbaceous wetlands

Transformed areas:

- Mine infrastructure and build-up land; and
- Cultivation and pastures.

From the land cover dataset it is evident that the proposed facility and most of the grid corridor are predominantly occupied by natural grassland, while part of the grid connection is also occupied by open woodland (mainly Vachellia tree species) and herbaceous wetlands. The latter include the Koekemoerspruit and a wetland system near the facility which include effluent emanating from the nearby slimes dam. Most of the surrounding land use include gold mining activities and livestock grazing.

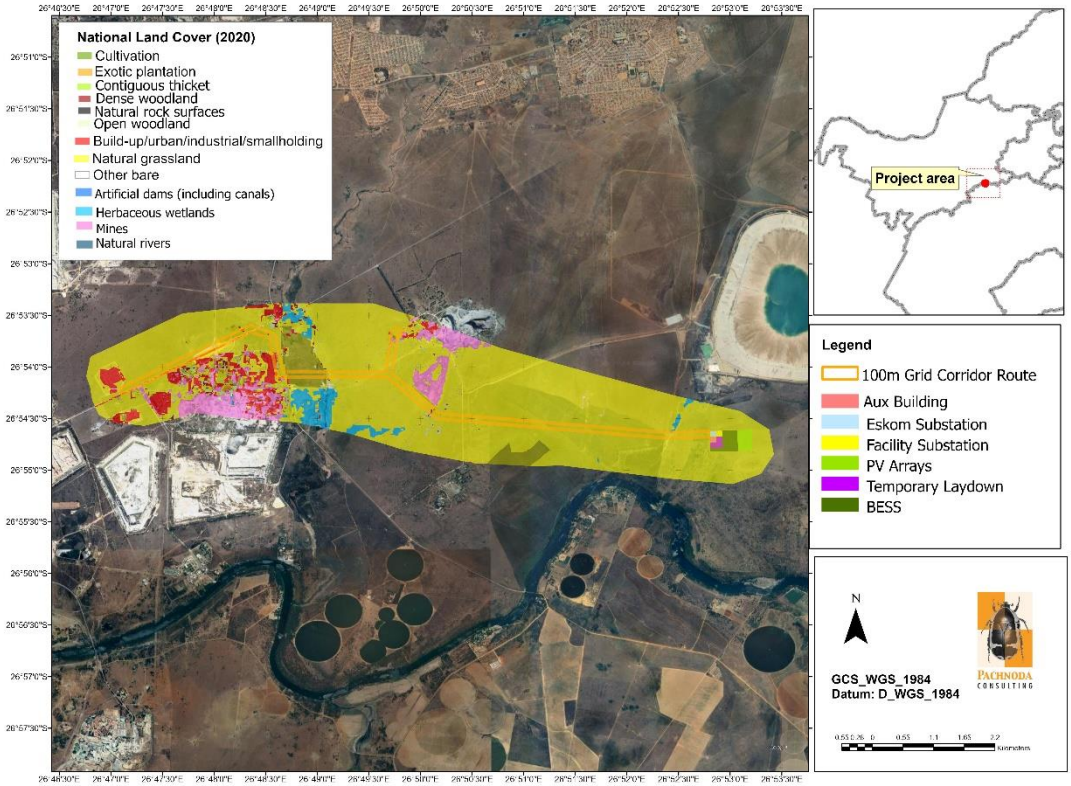


Figure 7: A map illustrating the land cover classes (Geoterrainimage, 2020) corresponding to the proposed study area.

3.4 Conservation Areas, Protected Areas and Important Bird Areas

The proposed facility coincides with the Bushybend Private Nature Reserve, while the Mispah Game Farm is located approximately 11 km south-west of the study area (see Figure 8). The project area is not located in close proximity to any Important bird area.

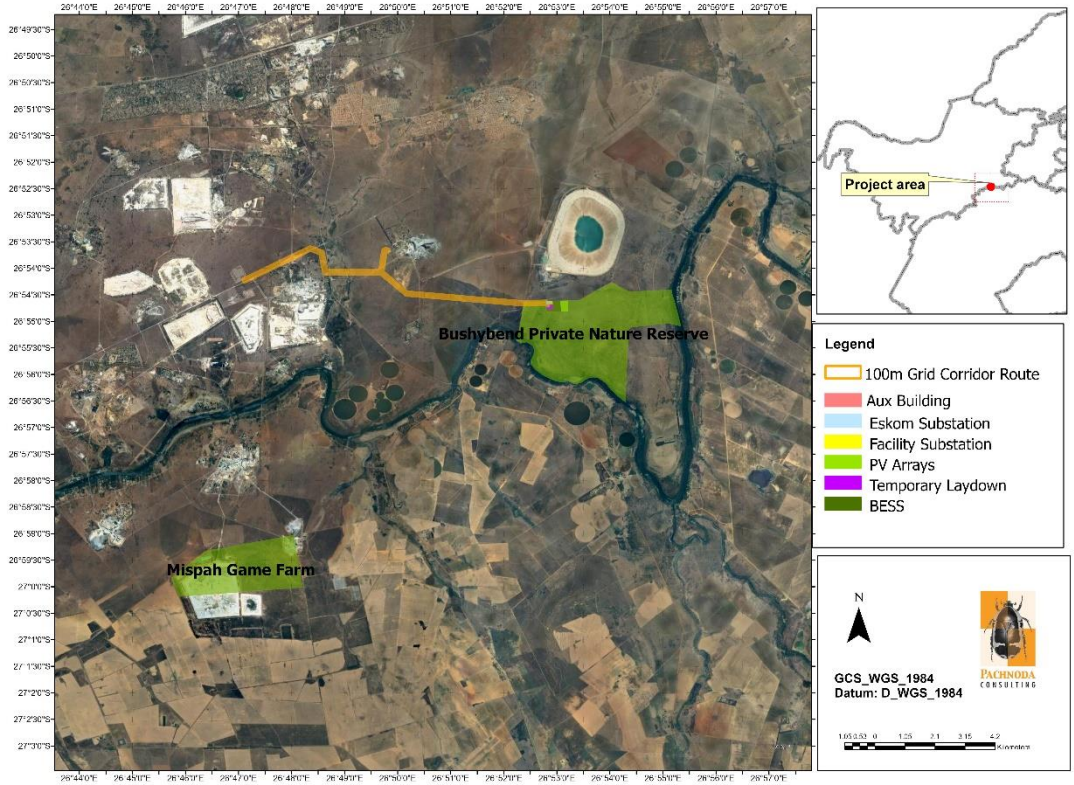


Figure 8: A map illustrating the spatial locality of nearby conservation areas to the study area.

3.5 Annotations on the National Web-Based Environmental Screening Tool

Regulation 16(1)(v) of the Environmental Impact Assessment Regulations, 20145 (EIA Regulations) provides that an applicant for Environmental Authorisation is required to submit a report generated by the Screening Tool as part of its application. On 5 July 2019, the Minister of Environmental Affairs, Forestry and Fisheries published a notice in the Government Gazette giving notice that the use of the Screening Tool is compulsory for all applicants to submit a report generated by the Screening Tool from 90 days of the date of publication of that notice.

The Screening Tool is intended to allow for pre-screening of sensitivities in the landscape to be assessed within the EA process. This assists with implementing the mitigation hierarchy by allowing developers to adjust their proposed development footprint to avoid sensitive areas. The Screening Tool report will indicate the

(preliminary) environmental sensitivities that intersect with the proposed development footprint as defined by the applicant as well as the relevant Protocols.

As the Screening Tool contains datasets that are mapped at a national scale, there may be areas where the Screening Tool erroneously assigns, or misses, environmental sensitivities because of mapping resolution and a high paucity of available and accurate data. Broad-scale site investigations will provide for an augmented and site-specific evaluation of the accuracy and 'infilling' of obvious and large-scale inaccuracies. Information extracted from the National Web-based Environmental Screening Tool (Department of Environmental Affairs, 2020), indicated that the development area and grid connection hold a **medium to low** sensitivity with respect to the relative animal species protocol (Figure 9) (report generated 10/01/2024):

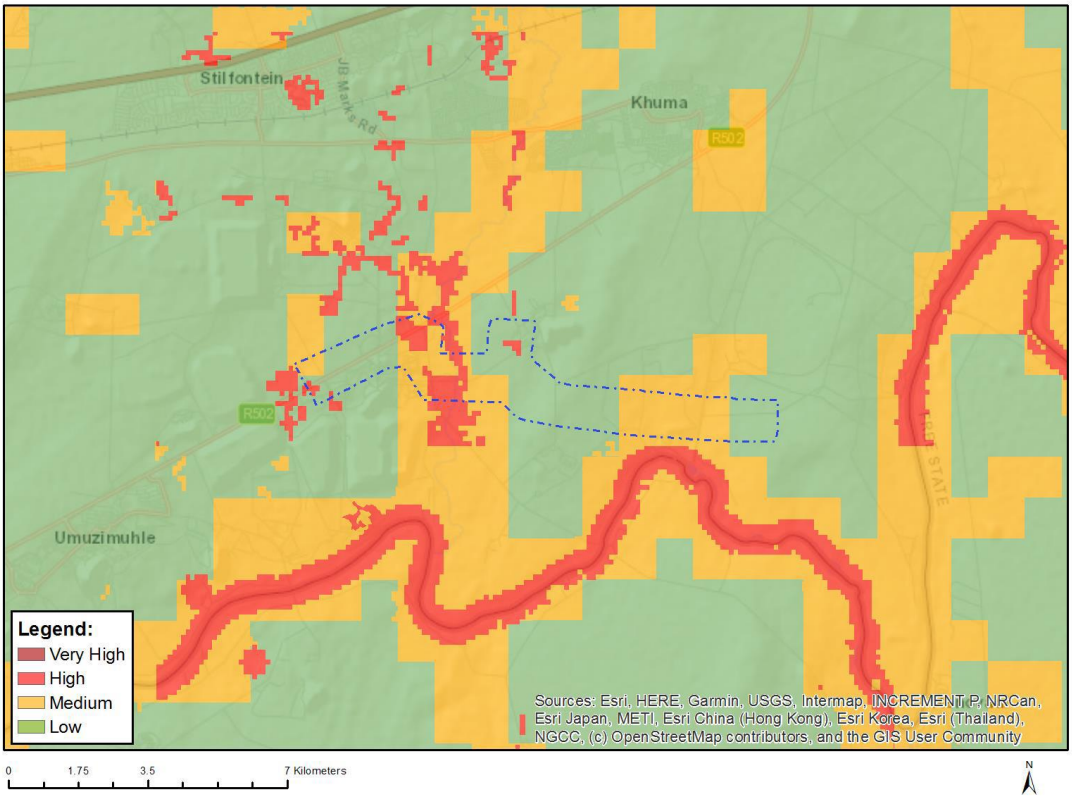


Figure 9: The animal species sensitivity of the proposed BESS facility and grid corridor according to the Screening Tool.

Sensitive features include the following:

Sensitivity	Feature(s)
High	Aves – *Circus ranivorus*
Medium	Aves – *Circus ranivorus*
Low	Subject to confirmation

Part of the overhead grid connection corridor traverses across habitat with a medium to high probability for the occurrence of the regionally endangered African Marsh

Harrier (*Circus ranivorus*). Habitat with a high sensitivity according the Screening Tool was mainly confined to the Koekemoerspruit.

It is evident that the BESS facility and grid connection correspond to a **low** avian theme sensitivity (see Figure 10).

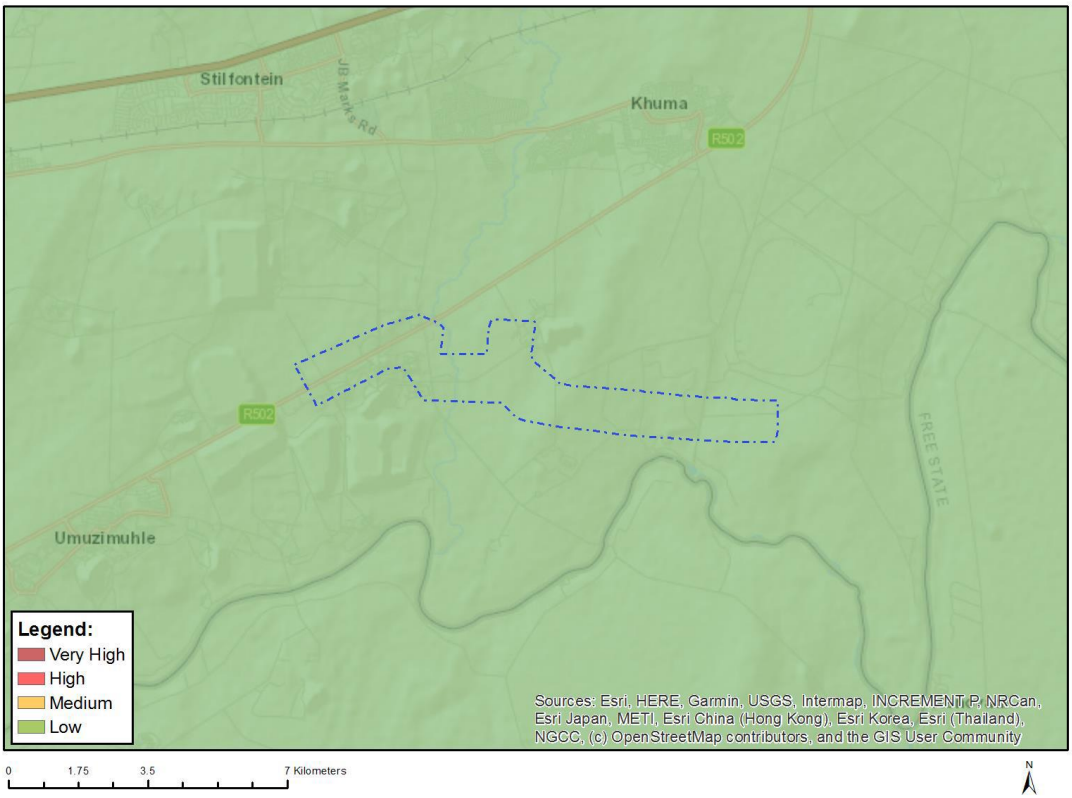


Figure 10: The relative avian sensitivity of the development area and immediate surroundings according to the Screening Tool.

4. RESULTS AND DISCUSSION

4.1 Avifaunal habitat types

Apart from the regional vegetation types, the local composition and distribution of the vegetation associations on the facility and grid connection are a consequence of a combination of factors simulated by grazing intensity, past disturbance regimes (past land use practice), soil texture and hydrological regimes which have culminated in a number of habitat types that deserve further discussion (Figures 11 - 15):

1. *Open savannoid grassland with bush clump mosaics:* This unit is dominant on the western section of the proposed grid connection corridor. It is represented by two discrete floristic variations which also provide habitat for two discrete avifaunal associations. The first floristic variation is predominantly represented by both untransformed and grazed grassland, depending on grazing intensity, and dominated by "late-successional" graminoids such a *Themeda triandra,*

Cymbopogon caesius, C. pospischilii, Trachypogon spicatus, Schizachyrium sanguineum and *Diheteropogon amplectens*. It is occupied by a typical grassland bird composition dominated by insectivorous and granivore passerine bird species such as Desert Cisticola (*Cisticola aridulus*), Cloud Cisticola (*C. textrix*), Rufous-naped Lark (*Mirafra africana*), Eastern Clapper Lark (*Mirafra fasciolata*) and Red-billed Quelea (*Quelea quelea*). When the grass is burned, large numbers of Capped Wheatear (*Oenanthe pileata*) occur. 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 Helmeted Guineafowl (*Numida meleagris*).

The bush clumps form a prominent mosaic characterised by the dominance of a woody layer of *Searsia lancea, Celtis africana, Asparagus laricinus, Vachellia erioloba* and *V. karoo* 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 and frugivore passerines such as Black-chested Prinia (*Prinia flavicans*), Chestnut-vented Warbler (*Curruca subcoerulea*), African Red-eyed Bulbul (*Pycnonotus nigricans*), Kalahari Scrub-robin (*Cercotrichas paena*) as well as granivores such as Southern Masked Weaver (*Ploceus velatus*). Non-passerine bird taxa are represented by Ring-necked Dove (*Streptopelia capicola*), Acacia Pied Barbet (*Tricholaema leucomelas*) and Red-faced Mousebird (*Urocolius indicus*).

2. *Rocky grassland with bush clump mosaics:* This unit is dominant on the eastern section of the proposed grid connection corridor as well as the proposed BESS facility and consists of a floristic composition that is reminiscent of Rand Highveld Grassland. It is characterised by the occurrence of many shallow ridges and outcrops located within a graminoid matrix. It provides habitat for a bird composition that is similar to that of the open savannoid grassland which include cryptic Highveld bird species such as Desert Cisticola (*Cisticola aridulus*), Cloud Cisticola (*C. textrix*), Rufous-naped Lark (*Mirafra africana*), Eastern Clapper Lark (*Mirafra fasciolata*) and pipit taxa (in particular Nicholson’s Pipit *Anthus nicholsonii*). It also provides foraging habitat for larger terrestrial bird species such as the Northern Black Korhaan (*Afrotis afroides*).

3. *Dense microphyllous bushveld:* This unit is confined to dense *Vachellia karoo* dominated bushveld and located immediately to the west of the proposed BESS facility. The high vertical heterogeneity of the tree layer is colonised by a bird composition that is essentially similar to the bush clump habitat, although the dense cover abundance allows for shy and skulking species to occur such as Cape Robin-chat (*Cossypha caffra*), White-throated Robin-chat (*C. humeralis*) and granivore taxa such as Green-winged Pytilia (*Pytilia melba*) and Violet-eared Waxbill (*Granatina granatina*). Other noteworthy bird species include Willow Warbler (*Phylloscopus trochilus*), Spotted Flycatcher

(*Muscicapa striata*), Fiscal Flycatcher (*Malaenornis silens*), Fairy Flycatcher (*Stenostira scita*) and Cardinal Woodpecker (*Dendropicos fuscescens*).

4. *Vachellia erioloba bushveld:* This unit is confined to fragmented patches of *Vachellia erioloba* dominated bushveld oon the central section of the proposed grid connection corridor. Although supporting many grassland and bushveld bid species with high similarities to the previous units, the open graminoid structure and flat-topped appearance of many of the *V. erioloba* trees will render this unit as suitable breeding habitat for Secretarybirds (*Sagittarius serpentarius*).

5. *Secondary/regenerating grassland:* This unit is confined to old agricultural lands which are left fallow. The floristic composition is dominated by many secondary grasses and weed species, which is subsequently colonised by generalist bird species (mainly granivores) and grassland insectivores (e.g. Desert Cisticola *C. aridulus*).

6. *Wetlands and floodplains: Koekemoerspruit:* This unit is represented by a channelled valley-bottom wetland and associated floodplain of the Koekemoerspruit (a tributary of the Vaal River) which is located on the western section of the proposed grid connection corridor. It is earmarked by a well-defined meandering channel and floodplain that is located on clay soils with dense stands of *Phragmites australis* and *Typha capensis* reedbeds. It provides important foraging, roosting and potentially also breeding habitat for waterfowl and a variety of waterbird taxa such as Yellow-billed Duck (*Anas undulata*), Red-billed Teal (*A. erythrorhyncha*), Egyptian Goose (*Alopochen aegyptiacus*), South African Shelduck (*Tadorna cana*), Reed Cormorant (*Microcarbo africanus*), Glossy Ibis (*Plegadis falcinellus*) and Hamerkop (*Scopus umbretta*). The moist and/or inundated grassland of the associated floodplain is colonised by facultative grassland species such as Levaillant's Cisticola (*Cisticola tinniens*), African Stonechat (*Saxicola torquatus*) and Southern Red Bishop (*Euplectes orix*). Certain parts of the system tend to retain surface water for extended periods of time during the austral dry season which tend to provide foraging habitat for waterbirds over long periods of time.

7. *Wetlands and floodplains: Slimes dam seep:* This unit is represented by effluent seeping from a nearby slimes dam. It is represented by a shallow seep dominated by *Typha capensis*, although during the respective site visits the floristic structure was heavily trampled by livestock. It was poorly represented by bird species.

6. *Transformed areas (roads and build-up land)*: These areas are represented by roads and build-up land. These features are invariably artificial with a bird composition that is often of low richness and composed of generalist taxa.

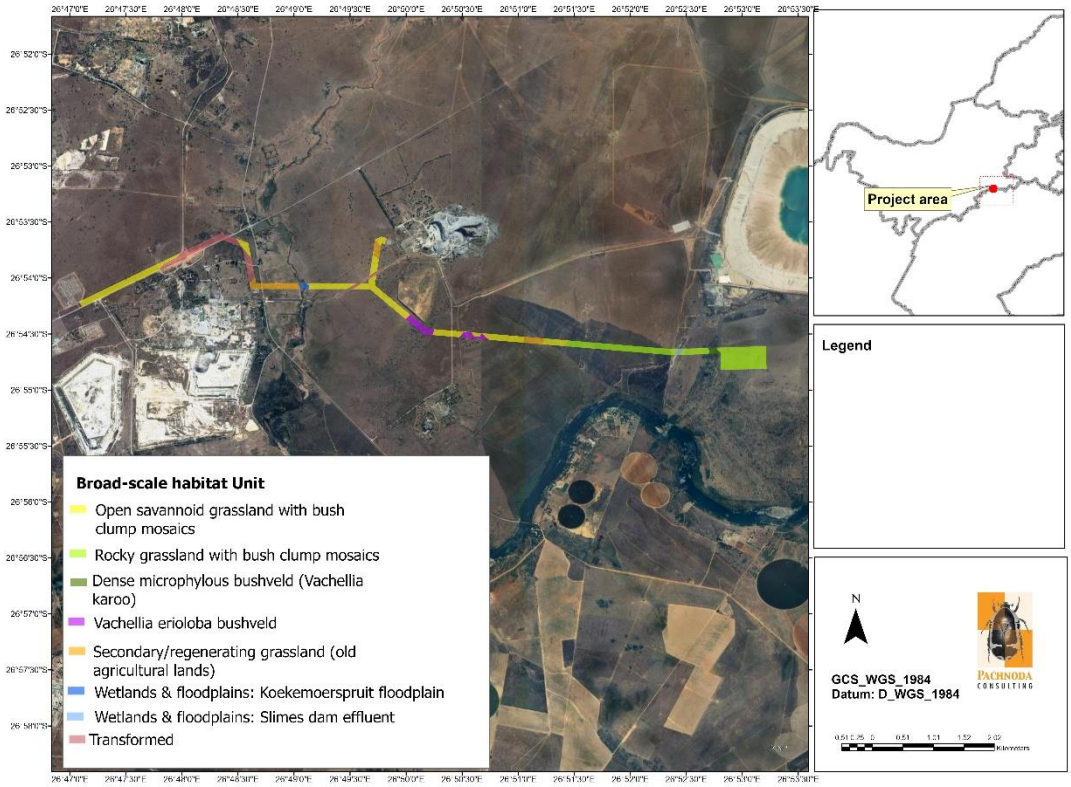


Figure 11: A habitat map illustrating the avifaunal habitat types on the project area (BESS facility and grid corridor).

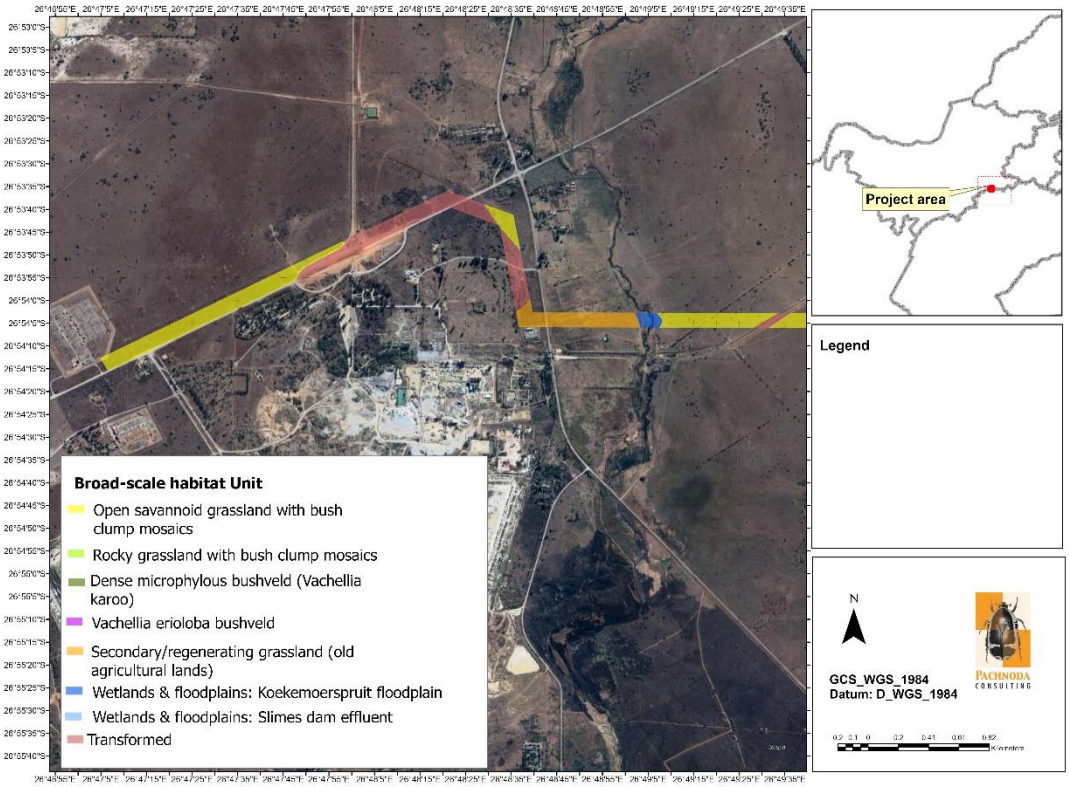


Figure 12: A habitat map illustrating the avifaunal habitat types along the proposed grid connection corridor – western area.

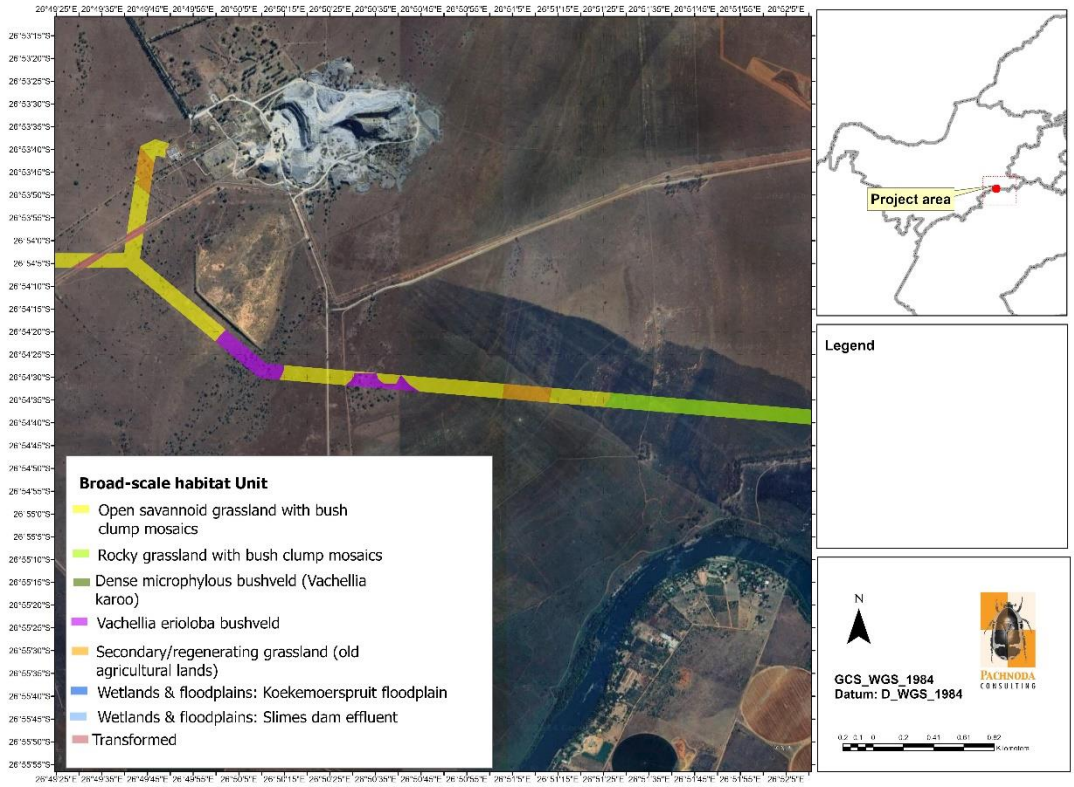


Figure 13: A habitat map illustrating the avifaunal habitat types along the proposed grid connection corridor – central area.

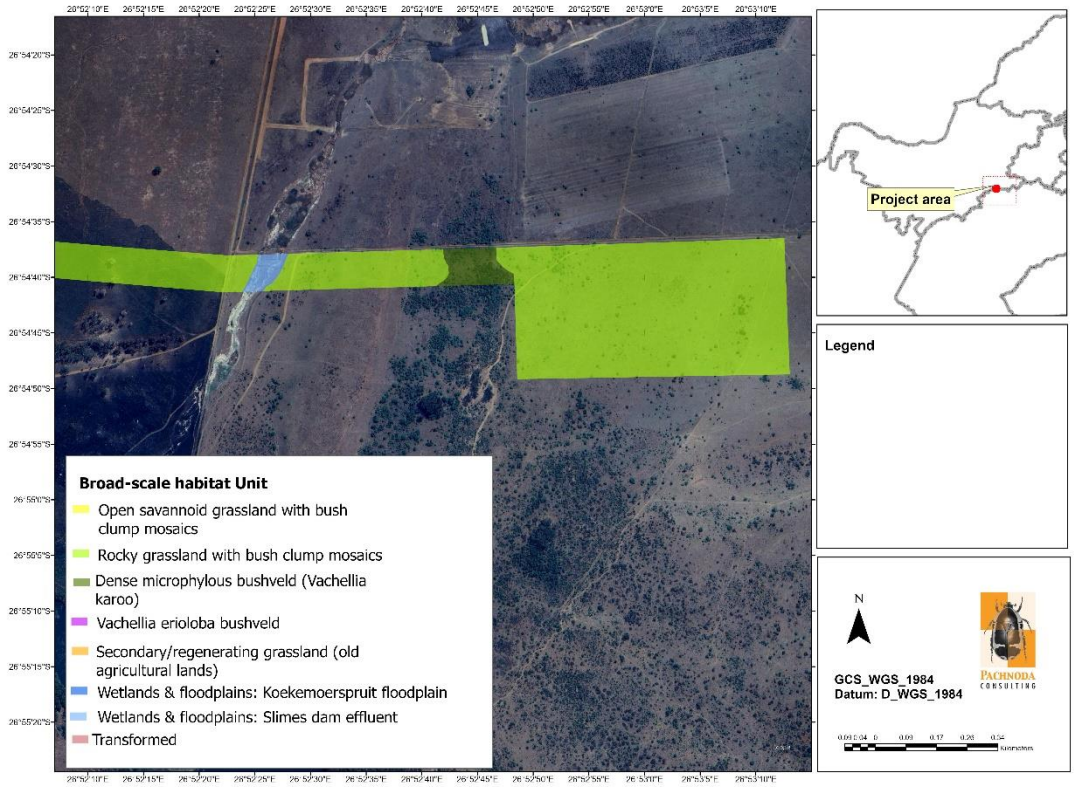
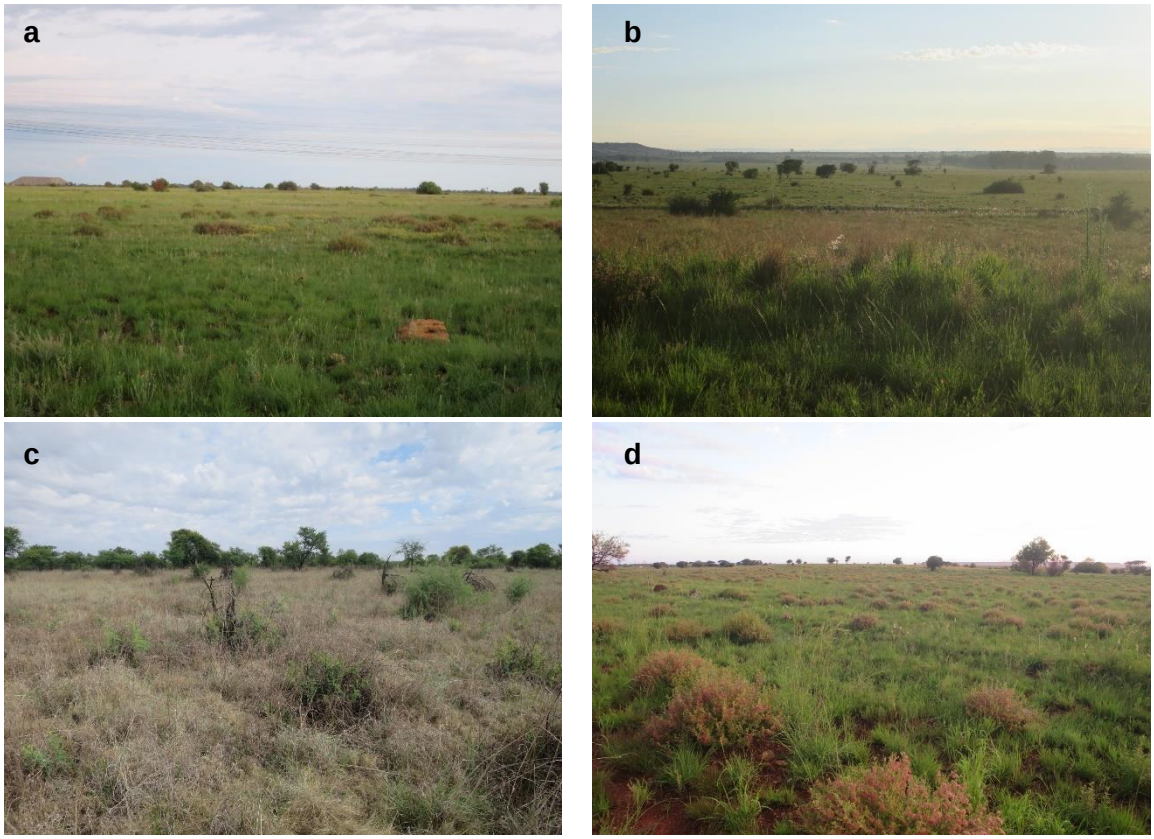


Figure 14: A habitat map illustrating the avifaunal habitat types at the proposed BESS facility and immediate surroundings.

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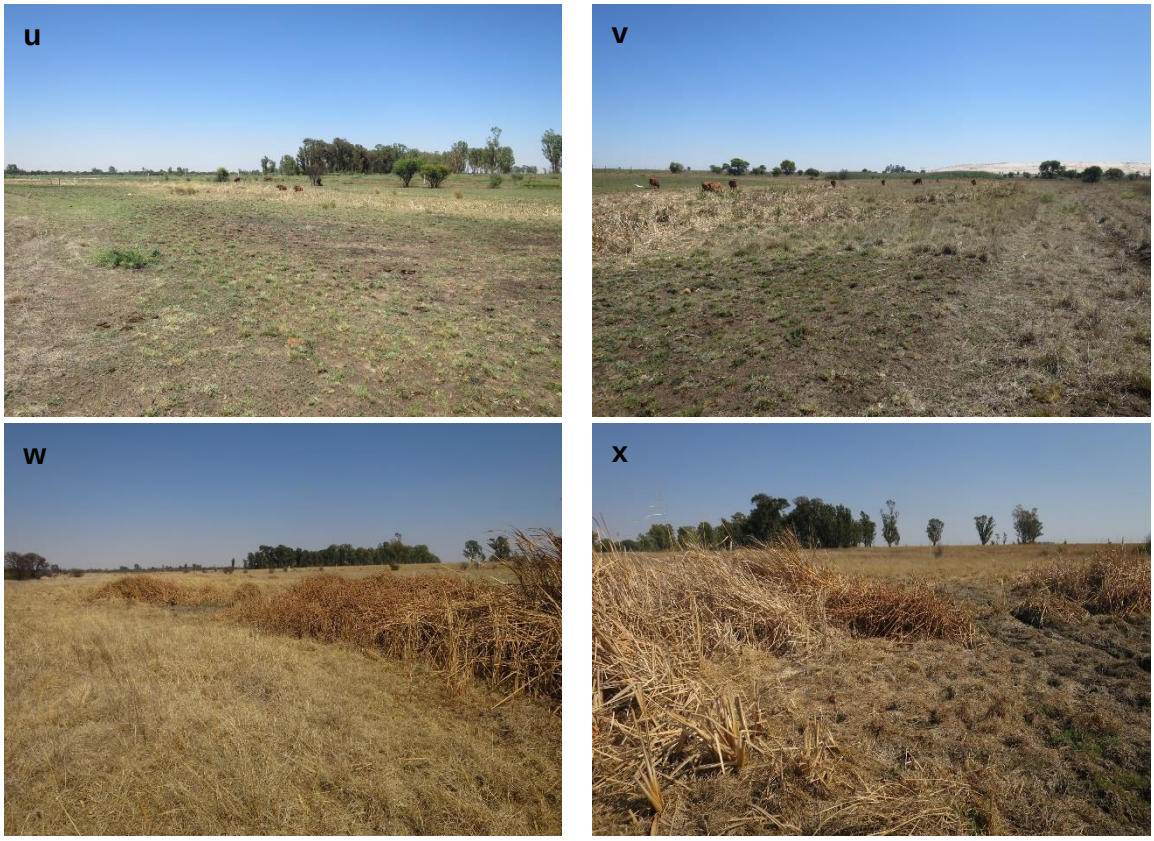

Figure 15: A collage of images illustrating examples of avifaunal habitat types observed on the proposed study area: (a - d) open savannoid grassland with bush clump mosaics, (e - h) rocky grassland with bush clump mosaics, (i - l) dense microphyllous bushveld dominated by *Vachellia karoo*, (m - n) *Vachellia erioloba* bushveld, (o – p) secondary/regenerating grassland (mainly confined to old agricultural land), (q – t) wetlands and floodplains confined to the Koekemoerspruit and (u - x) wetlands and floodplains confined to a seep emanating from a slimes dam.

4.2 Species Richness and Predicted summary statistics

The study area is known to support approximately ~286 bird species (Appendix 1 & Table 1). However, it is more likely that between 200 - 220 bird species could occur on the study area and immediate surroundings (according to the habitat types and the ecological condition thereof). The expected richness was inferred from the South African Bird Atlas Project (SABAP2)[1] (Harrison et al., 1997; www.sabap2.birdmap.africa) and the presence of suitable habitat on the development area. This equates to 28 % of the approximate 994[2] species listed for the southern African subregion[3] (and approximately 33 % of the 871 species recorded within South Africa[4]). However, the average species richness obtained from the pentad grids

1 The expected richness statistic was derived from pentad grids 2650_2645, 2650_2650, 2655_2645 and 2655_2550 totalling 308 bird species (based on 520 full protocol cards).

2 *sensu* www.zestforbirds.co.za (Hardaker, 2022), including recently confirmed bird species (vagrants).

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

4 With reference to South Africa (including Lesotho and eSwatini (BirdLife South Africa, 2022).

corresponding to the study area (c. for pentad grids 2650_2645, 2650_2650, 2655_2645 and 2655_2550) is 61.5 species for each full protocol card submitted (for observation of two hours or more; range= 13-132 species).

According to Table 1, the study area is poorly represented by biome-restricted[5] (see Table 2), local endemic species and local near-endemic bird species. It supports *ca*. 33 % of the near-endemic species present in the subregion. In addition, although the wider study area (outside the ambit of the BESS facility) supports a large diversity of waterbird species (due to the nearby Vaal River), the poor representation of aquatic-associated habitat within the physical boundaries of the BESS facility resulted in a poor richness of waterbird species (mainly represented by large waterfowl such as Egyptian Goose *Alopochen aegyptiaca* and South African Shelduck *Tadorna cana*).

Approximately 12 threatened or near threatened bird species are known to be present in the wider study area, of which two species (c. Lanner Falcon *Falco biarmicus* and Caspian Tern *Hydroprogne caspia*) were observed, although not within the physical boundaries of the BESS facility and the grid corridor. Furthermore, 13 southern African endemics and 16 near-endemic species were confirmed on the study area and the immediate surroundings (Table 3).

According to Table 3 it is evident that 60.78% of species of conservation concern (including endemics) were observed within the study area, of which the 33.33% are prone to collide with overhead powerlines, and 74.51% could become displaced by the infrastructure during construction activities (if the footprint coincides with suitable habitat).

Table 1: A summary table of the total number of species, Red listed species (according to Taylor *et al*., 2015 and the IUCN, 2023), endemics and biome-restricted species (Marnewick *et al*., 2015) expected (*sensu* SABAP1 and SABAP2) to occur in the study area and immediate surroundings.

Description	Expected Richness Value (study area and surroundings) ***	Observed Richness Value (study area) ****
Total number of species*	286 (33%)	210 (73 %)
Number of Red Listed species**	12 (9%)	1 (78 %)
Number of biome-restricted species – Zambezian and Kalahari-Highveld Biomes*	4 (22 %)	4 (100 %)
Number of local endemics (BirdLife SA, 2022)*	2 (5 %)	2 (100 %)
Number of local near-endemics (BirdLife SA, 2022)*	6 (20%)	5 (83 %)

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

Description	Expected Richness Value (study area and surroundings) ***	Observed Richness Value (study area) ****
Number of regional endemics (Hockey *et al.,* 2005)**	17 (16 %)	13 (76 %)
Number of regional near-endemics (Hockey *et al.,* 2005)**	23 (38 %)	16 (70 %)

* only species in the geographic boundaries of South Africa (including Lesotho and eSwatini) 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, 2022a).
**** Percentage values in brackets refer to totals compared against the expected number of species in the project area.
# Includes taxa recorded from pentad grids adjacent to 2655_2645.

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

Species	Kalahari-Highveld	Zambezian	Expected Frequency of occurrence
Kalahari Scrub-robin (*Cercotrichas paena)*	X		Common
Barred Wren-warbler (*Calamonastes fasciolatus*)	X		Fairly Common in tall *Vachellia karroo* bushveld
White-throated Robin-chat (*Cossypha humeralis*)		X	Fairly common
White-bellied Sunbird (*Cinnyris talatala*)		X	Common

Table 3: Bird species of conservation concern occurring in the broader study area which could collide and/ or become displaced by the proposed PV and grid infrastructure.

Common Name	Scientific name	Regional Status	Global Status	Observed	Collision with power lines	Collision with PV panels	Displacement (disturbance & loss of habitat)
Cape Vulture	*Gyps coprotheres*	EN, End	VU		1		
White-backed Vulture	*Gyps africanus*	CR	CR		1		
Caspian Tern	*Hydroprogne caspia*	VU		1	1	1	
Martial Eagle	*Polemaetus bellicosus*	EN	EN		1		
Secretarybird	*Sagittarius serpentarius*	EN	EN		1		
South African Shelduck	*Tadorna cana*	End			1	1	
Cape Shoveler	*Anas smithii*	End			1	1	
Northern Black Korhaan	*Afrotis afraoides*	End		1	1		1
White-backed Mousebird	*Colius colius*	End		1			1
Karoo Thrush	*Turdus smithi*	End		1			1

Common Name	Scientific name	Regional Status	Global Status	Observed	Collision with power lines	Collision with PV panels	Displacement (disturbance & loss of habitat)
White-throated Robin-chat	*Cossypha humeralis*	End		1			1
Ant-eating Chat	*Myrmecocichla formicivora*	End		1			1
Fairy Flycatcher	*Stenostira scita*	End		1			1
Fiscal Flycatcher	*Melaenornis silens*	End		1			1
Melodious Lark	*Mirafra cheniana*	End		1			1
Cape Longclaw	*Macronyx capensis*	End		1			1
Pied Starling	*Lamprotornis bicolor*	End		1			1
Cape White-eye	*Zosterops virens*	End		1			1
Orange River White-eye	*Zosterops pallidus*	End		1			1
South African Cliff Swallow	*Petrochelidon spilodera*	End		1			1
Cape Weaver	*Ploceus capensis*	End					1
Orange River Francolin	*Scleroptila gutturalis*	N-end		1	1		1
Pale-chanting Goshawk	*Melierax canorus*	N-end		1	1		
Natal Spurfowl	*Pternistis natalensis*	N-end		1			1
Acacia Pied Barbet	*Tricholaema leucomelas*	N-end		1			1
Cape Penduline Tit	*Anthoscopus minutus*	N-end					1
Eastern Clapper Lark	*Mirafra fasciolata*	N-end		1			1
Cloud Cisticola	*Cisticola textrix*	N-end		1			1
Ashy Tit	*Parus cinerascens*	N-end		1			1
African Red-eyed Bulbul	*Pycnonotus nigricans*	N-end		1			1
Kalahari Scrub Robin	*Cercotrichas paena*	N-end		1			1
Pririt Batis	*Batis pririt*	N-end					1
Chestnut-vented Warbler	*Curruca subcoerulea*	N-end		1			1
Crimson-breasted Shrike	*Laniarius atrococcineus*	N-end		1			1
Barred Wren-warbler	*Calamonastes fasciolatus*	N-end		1			1
Mountain Wheatear	*Oenanthe monticola*	N-end					1
Bokmakierie	*Telophorus zeylonus*	N-end		1			1
Marico Flycatcher	*Bradornis mariquensis*	N-end					1
Cape Sparrow	*Passer melanurus*	N-end		1			1

Common Name	Scientific name	Regional Status	Global Status	Observed	Collision with power lines	Collision with PV panels	Displacement (disturbance & loss of habitat)
Scaly-feathered Weaver	*Sporopipes squamifrons*	N-end		1			1
Pink-billed Lark	*Spizocorys conirostris*	N-end					1
Red-headed Finch	*Amadina erythrocephala*	N-end					1
Shaft-tailed Whydah	*Vidua regia*	N-end					1
Yellow Canary	*Crithagra flaviventris*	N-end		1			1
Black-winged Pratincole	*Glareola nordmanni*	NT	NT		1		
African Marsh Harrier	*Circus ranivorus*	EN			1		1
African Grass-owl	*Tyto capensis*	VU			1		1
Abdim's Stork	*Ciconia abdimii*	NT			1		
Greater Flamingo	*Phoenicopterus roseus*	NT			1	1	
Lanner Falcon	*Falco biarmicus*	VU		1	1		
Yellow-billed Stork	*Mycteria ibis*	EN			1		
	Totals:	**51**	**5**	**31**	**17**	**4**	**38**

Threatened and near threatened species are indicated in red

CR - Critically endangered, EN - endangered, VU - vulnerable, NT - near threatened.

End - southern African endemic

N-end - southern African near-endemic

4.3 Bird species of conservation concern

Table 4 provides an overview of bird species of conservation concern that could occur on the development area and immediate surroundings based on their historical distribution ranges and the presence of suitable habitat. According to Table 4, a total of 12 species have been observed in the wider study area, which include four globally threatened species, five regionally threatened species, one globally near threatened species and two regionally near threatened species.

It is evident from Table 4 that most of the expected threatened and near threatened bird species have low reporting rates (<1%), implying that most of these species are irregular visitors to the study area. Due to the absence of suitable habitat on the study area, many of the threatened and near-threatened species that were recorded from the wider study area are also unlikely to be present within the physical boundaries of the development area (e.g. Greater Flamingo *Phoenicopterus roseus* and the Caspian Tern *Hydroprogne caspia*).

However, the regionally vulnerable Lanner Falcon (*Falco biarmicus*) is the only species with a high probability to be present as regular foraging visitors. A single adult bird was observed hunting approximately 2.3km southeast of the proposed BESS facility.

In addition, the Caspian Tern (*Hydroprogne caspia*) is regarded as a regular passage visitor along the nearby Vaal River located approximately 1.4km southwest of the

proposed BESS facility. It utilises the Vaal River during dispersal between breeding and roosting sites (Vaal Dam and Bloemhof Dam). In addition, the wetland and floodplain habitat along the Koekemoerspruit were the only suitable foraging and potential breeding habitat for endangered African Marsh-harrier (*Circus ranivorus*). According to SABAP2 data, it is only known from a single observation in the study area, which suggest that this species is uncommon to rare in the study area.

The proposed BESS facility and grid corridor, especially the open grassland habitat along the eastern section of the grid corridor and the *Vachellia erioloba* bushveld provided potential foraging and even breeding habitat for the endangered Secretarybird (*Sagittarius serpentarius*). However, Secretarybirds have not been recently observed in the study area (*sensu* SABAP2 and personal observations), suggesting that this species could be an irregular visitor to the area, or may have been displaced due to mining and livestock grazing activities in the area. It is possible that the low reporting rates for Secretarybirds reflect the poor coverage of certain parts of the study area (e.g. the eastern section of the proposed grid corridor) by citizen scientists (e.g. birdwatchers), and this species could occur in higher numbers due to being overlooked.

Table 4: 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 (2023)* and Taylor et al. (2015)**.

Species	Global Conservation Status*	National Conservation Status**	Mean Reporting rate: SABAP2	Preferred Habitat	Potential Likelihood of Occurrence
Ciconia abdimii (Abdim's Stork)	-	Near threatened	0.58 (three observations)	Open stunted grassland, fallow land and agricultural fields.	An uncommon summer foraging visitor to areas consisting of open grassland or arable land.
Circus ranivorus (African Marsh Harrier)	-	Endangered	0.19 (one observation)	Restricted to permanent wetlands with extensive reedbeds.	The extensive reedbeds along the Koekemoerspruit provide suitable habitat for this species to occur. It is unlikely to be present on any of the other habitat types (apart from the Koekemoerspruit). Only known from a single observation, during 2017. (sensu SABAP2).

Species	Global Conservation Status*	National Conservation Status**	Mean Reporting rate: SABAP2	Preferred Habitat	Potential Likelihood of Occurrence
Falco biarmicus (Lanner Falcon)	-	Vulnerable	4.83 (23 observations)	Varied, but prefers to breed in mountainous areas.	A regular foraging visitor to the study area. An adult bird was observed hunting approximately 2.3km southeast of the proposed BESS facility.
Glareola nordmanni (Black-winged Pratincole)	Near threatened	Near threatened	0.58 (three observations)	Varied, but forages over open short grassland, pastures and agricultural lands (especially when being tilled).	An irregular foraging visitor to the study area.
Gyps coprotheres (Cape Vulture)	Endangered	Endangered	0.58 (three observations)	Mainly confined to mountain ranges, especially near breeding sites. Ventures far afield in search of food.	An irregular foraging/scavenging visitor to the study area pending the presence of food (e.g. livestock/game carcasses).
Hydroprogne caspia (Caspian Tern)	-	Vulnerable	4.44 (23 observations)	Large impoundments and large perennial rivers, and large pans, also estuaries.	Unlikely to occur on BESS facility and grid connection owing to an absence of suitable habitat. A regular passage visitor along the nearby Vaal River (pers. obs.) . This species has a high reporting rate for the wider study area, which is owing to birds observed dispersing along the Vaal River (a major flyway for this species between Bloemhof Dam and the Vaal Dam; it regularly breeds at these sites). It is

Species	Global Conservation Status*	National Conservation Status**	Mean Reporting rate: SABAP2	Preferred Habitat	Potential Likelihood of Occurrence
					unlikely to occur on the development area.
Phoenicopterus roseus (Greater Flamingo)	-	Near threatened	0.77 (four observations)	Restricted to large saline pans and other inland water bodies.	Unlikely to occur on the BESS facility and grid corridor owing to an absence of suitable habitat.
Gyps africanus (White-backed Vulture)	Critically Endangered	Critically Endangered	0.58 (three observations)	Breed on tall, flat-topped trees. Mainly restricted to large rural or game farming areas.	An irregular foraging/scavenging visitor to the study area pending the presence of food (e.g. livestock/game carcasses).
Polemaetus bellicosus (Martial Eagle)	Endangered	Endangered	0.19 (single observation)	Varied, from open karroid shrub to lowland savanna.	A highly irregular foraging visitor. It has not been observed on the study area since 2010.
Mycteria ibis (Yellow-billed Stork)	-	Endangered	0.77 (known from four records)	Wetlands, pans and flooded grassland.	Probably an irregular foraging visitor to the Koekemoerspruit
Sagittarius serpentarius (Secretarybird)	Endangered	Endangered	0.19 (single observation)	Prefers open grassland or lightly wooded habitat.	Probably an irregular foraging visitor to the study area even though optimal foraging and breeding habitat occurs. It was last observed during 2016 on the study area.
Tyto capensis (African Grass-owl)	-	Vulnerable	0.19 (single observation)	Prefers open grassland for foraging and dense rank and moist grassland for roosting and breeding adjacent to vleis and marshland (especially	Probably uncommon on the study area although it could be present along the floodplain habitat along the Koekemoerspruit.

Species	Global Conservation Status*	National Conservation Status**	Mean Reporting rate: SABAP2	Preferred Habitat	Potential Likelihood of Occurrence
				rank *Imperata cylindrica*).	

4.4 Species accumulation curve

Prior to further analyses where species richness values are considered, it is imperative to determine if all bird species present were sufficiently sampled. Species accumulation curves (SAC) provide a means to examine data and sampling efficacy. For this project the species accumulation curves (SAC) for the point count data were generated using the software program Estimates S (version 9) with 100 randomizations (as recommended in Colwell, 2013). Curves were generated for the full data set (all point counts). Sampling sufficiency was determined by establishing whether a point had been reached where a line representing one new sample adding one new species was tangent to the curve (Brewer & McCann, 1982). The Michaelis-Menten equation (Soberôn & Llorente 1993) was fitted to the predicted number of species using Estimates S (Raaijmakers, 1987). A satisfactory level of sampling was achieved if between 80-90 % of the bird species were detected, and hence predicted by the model (Moreno & Halffter, 2000).

The species accumulation curve (SAC) reached an asymptote at approximately 24 point counts (Figure 16). The sampling captured approximately 73.84% of the number of species predicted by the Michaelis-Menten model at 24 point counts. Approximately 88.77% of the expected species was captured by 72 counts. Sampling effort was considered sufficient and recorded most of the species present on the study area and immediate surroundings during the respective survey sessions.

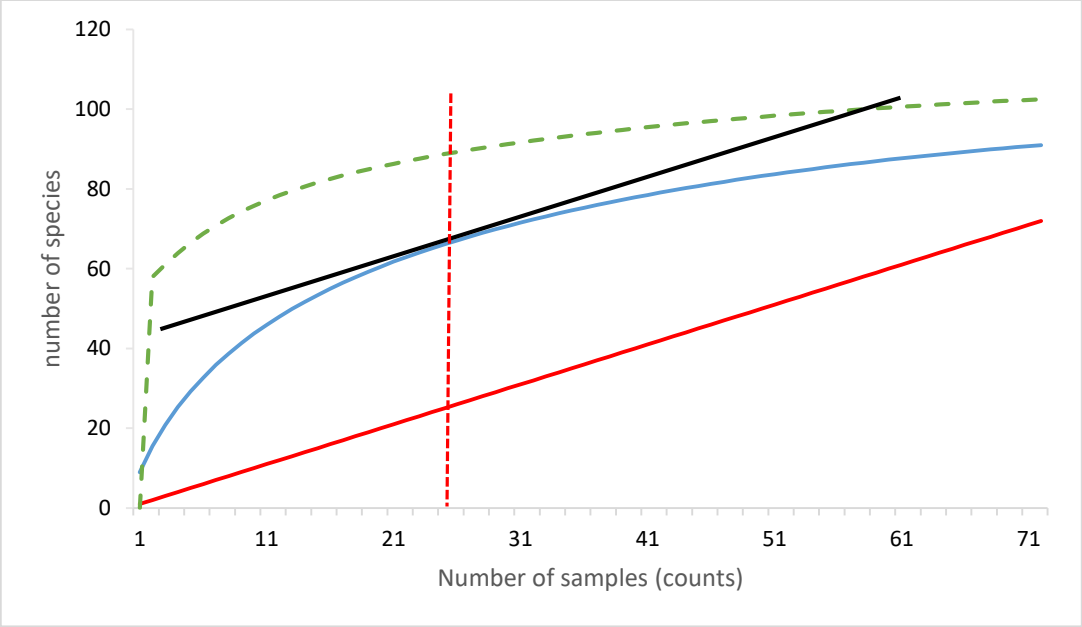

Figure 16: The species accumulation curve (SAC) (red line) for bird points sampled during the survey sessions. The blue line represents an accumulation of one species for every additional point count. The black line is parallel to the blue one and is tangent to the SAC approximately after 24 counts (as represented by the vertical red stippled line). The green stippled line represents the Michaelis-Menten curve.

4.5 Bird Assemblage Structure and Composition

4.5.1 Summary of point counts

A total of 91 bird species and an average abundance of 879.5 individuals were recorded from the bird point counts (representing surveys conducted during the dry and wet season) located on the BESS facility and surroundings. A mean of 13.25 species and 24.4 individuals were recorded per point count. The highest number of species and individuals recorded from a point count was respectively 30 species (and 85 individuals (from tall riparian woodland located along the edge of the nearby Vaal River). The lowest number of species and individuals was respectively one species and a single individual (from rocky grassland in close proximity to the BESS facility). The mean number of species corresponding to the proposed BESS facility is 8.6 species (range=5 – 19 species) and with an average of 13.6 individuals (range= 6-31.5 individuals) per point count. The mean frequency of occurrence of a bird species in the study area was 14.56 % and the median was 8.33 %, while the most common value (mode) was 2.78 %. The latter represents those species that were encountered in only one point count. Six bird species occurred in 50 % or more of the counts (Table 5), of which the Black-chested Prinia (*Prinia flavicans*) occurred in >80% of all the counts (Table 5).

Table 5: Bird species with a frequency of occurrence greater than 50 % observed on the study site and immediate surroundings.

Species	Frequency (%)	Species	Frequency (%)
Black-chested Prinia (*Prinia flavicans*)	80.56	Southern Masked Weaver (*Ploceus velatus*)	66.67
African Red-eyed Bulbul (*Pycnonotus nigricans*)	77.78	Neddicky (*Cisticola fulvicapilla*)	50.00
Chestnut-vented Warbler (*Curruca subcoerulea*)	69.44	Willow Warbler (*Phylloscopus trochilus*)	50.00

4.5.2 Dominance and typical bird species

The “typical” species (species with a high frequency of occurrence) on the study area are presented in Table 6. Only those species that cumulatively contributed to more than 90% to the overall similarity between the point counts are presented.

The three most typical bird species on the study area include the Black-chested Prinia (*Prinia flavicans*), African Red-eyed Bulbul (Pycnonotus nigricans) and Chestnut-vented Warbler (*Curruca subcoerulea*). These species are considered widespread species in the broader study area and occur in most of the habitat types that area present. It is also evident from Table 6 that the typical bird assemblage is primarily represented by insectivores (insect-eating) and by small-bodied granivores (seed-eating taxa. It includes both species that with high affinities for grassland habitat (e.g. Desert Cisticola *Cisticola aridulus*) and dense microphyllous bushveld (e.g. Green-winged Pytilia *Pytilia melba* and Cape Robin-chat *Cossypha caffra*).

Table 6: Bird species with a high frequency of occurrence (“typical bird species”) on the study area.

Species	Av. Abundance	Consistency (Sim/SD)	Contribution (%)	Primary Trophic Guild
Black-chested Prinia (*Prinia flavicans*)	1.65	1.05	18.03	Insectivore: upper canopy foliage gleaner
African Red-eyed Bulbul (*Pycnonotus nigricans*)	1.43	1.06	14.98	Frugivore and Insectivore: upper canopy gleaner
Chestnut-vented Warbler (*Curruca subcoerulea*)	1.51	0.84	13.00	Insectivore: upper canopy foliage gleaner
Southern Masked Weaver (*Ploceus velatus*)	1.61	0.82	10.04	Granivore: lower canopy to ground gleaner
Desert Cisticola (*Cisticola aridulus*)	0.33	0.29	5.84	Insectivore: upper canopy foliage gleaner
Neddicky (*Cisticola fulvicapilla*)	0.58	0.53	5.42	Insectivore: upper canopy foliage gleaner
Willow Warbler (*Phylloscopus trochilus*)	0.64	0.55	4.31	Insectivore: upper canopy foliage gleaner
Brown-crowned Tchagra (*Tchagra australis*)	0.64	0.40	2.78	Insectivore: upper canopy foliage gleaner
Green-winged Pytilia (*Pytilia melba*)	0.72	0.34	2.19	Granivore: lower canopy to ground gleaner

Species	Av. Abundance	Consistency (Sim/SD)	Contribution (%)	Primary Trophic Guild
Cape Robin-chat (*Cossypha caffra*)	0.57	0.34	1.93	Insectivore: lower canopy foliage gleaner

4.5.3 Composition and diversity

Multidimensional scaling and hierarchical agglomerative clustering ordination of bird abundance values obtained from the point counts on the project area differentiate between four discrete bird associations (Global R= 0.269, p=0.006; Figure 17), with statistically strong differences between canopy height, bush clump habitat and grassland habitat due to differences in floristic vertical heterogeneity (e.g. tree/shrub height). The typical bird association on the study area include four bird associations: (1) an association pertaining to floodplain habitat and riparian woodland (mainly confined to the Koekemoerspruit and nearby Vaal River), (2) an association confined to microphyllous (*Vachellia*) bushveld, (3) an association confined to rocky grassland with bush clump mosaics and (4) an association confined to open savannoid grassland with bush clump mosaics.

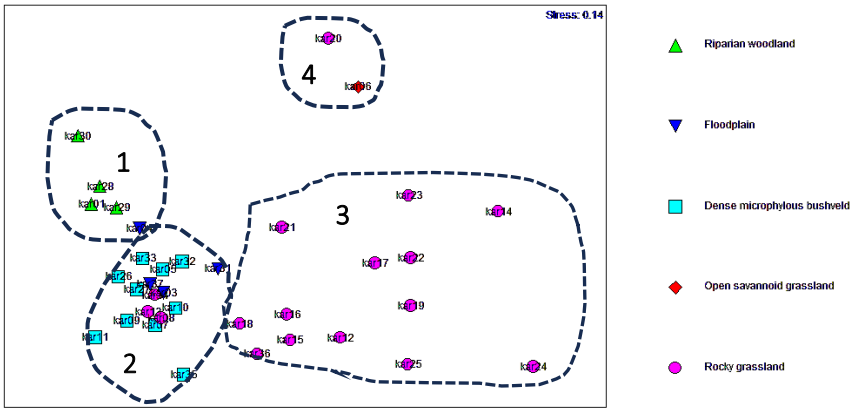

Figure 17: A two-dimensional non-metric multidimensional scaling ordination (stress=0.14) of the relative abundances of bird species based on Bray-Curtis similarities obtained from point counts on the project area. It differentiates between four bird associations: (1) an association pertaining to floodplain habitat and riparian woodland (mainly confined to the Koekemoerspruit and nearby Vaal River), (2) an association confined to microphyllous (*Vachellia*) bushveld, (3) an association confined to rocky grassland with bush clump mosaics and (4) an association confined to open savannoid grassland with bush clump mosaics.

The following bird associations are relevant to the study area and immediate surroundings:

1. Association on floodplain and riparian woodland

This association is confined to the floodplain of the Koekemoerspruit and the tall riparian woodland located along the shore of the nearby Vaal River.

Dominant species: Black-chested Prinia (*Prinia flavicans*), African Red-eyed Bulbul (*Pycnonotus nigricans*), Orange River White-eye (*Zosterops pallidus*), Natal Spurfowl (*Pternistis natalensis*), Bar-throated Apalis (*Apalis thoracica*), Karoo Thrush (*Turdus smithii*), African Darter (*Anhinga rufa*), Reed Cormorant (*Microcarbo africanus*), Southern Red Bishop (*Euplectes orix*), Egyptian Goose (*Alopochen aegyptiacus*) and South African Shelduck (*Tadorna cana*) are prominent.

Indicator species[6]: African Darter (*Anhinga rufa*), Reed Cormorant (*Microcarbo africanus*), White-breasted Cormorant (*Phalacrocorax lucidus*), Lesser Swamp Warbler (*Acrocephalus gracilirostris*), Little Rush Warbler (*Bradypterus baboecala*), Common Reed Warbler (*Acrocephalus scirpaceus*), Yellow-crowned Bishop (*Euplectes afer*), Yellow-billed Duck (*Anas undulata*), African Black Duck (*Anas sparsa*), Giant Kingfisher (*Megaceryle maxima*), Pied Kingfisher (*Ceryle rudis*) and Levaillant's Cisticola (*Cisticola tinniens*).

2. Association pertaining to microphyllous bushveld

This association is confined to *Vachellia karoo* and *V. erioloba* bush clumps located within a matrix of open savannoid and rocky grassland habitat.

Dominant species: Black-chested Prinia (*Prinia flavicans*), Chestnut-vented Warbler (*Curruca subcoerulea*), African red-eyed Bulbul (*Pycnonotus nigricans*), Southern Masked Weaver (*Ploceus velatus*), Brown-crowned Tchagra (*Tchagra australis*), Neddicky (*Cisticola fulvicapilla*), Willow Warbler (*Phylloscopus trochilus*), Cardinal Woodpecker (*Dendropicos fuscescens*), Green-winged Pytilia (*Pytilia melba*), Laughing Dove (*Spilopelia sengalensis*), Spotted Flycatcher (*Muscicapa striata*), Kalahari Scrub Robin (*Cercotrichas paena*), Acacia Pied Barbet (*Tricholaema leucomelas*) and White-throated Robin-chat (*Cossypha humeralis*).

Indicator species: Cardinal Woodpecker (*Dendropicos fuscescens*), White-browed Scrub Robin (*Cercotrichas leucophrys*), Barred Wren Warbler (*Calamonastes fasciolatus*), Violet-eared Waxbill (*Granatina granatina*), Black-faced Waxbill (*Brunhilda erythronotos*) and Crimson-breasted Shrike (*Laniarius atrococcineus*).

[6] Indicator species refers to a species with high numbers that is restricted to a particular habitat.

3. Association confined to rocky grassland with bush clump mosaics

This association is confined to the open grassland with exposed ridges, and was mainly distributed along the eastern section of the proposed grid corridor and the BESS facility.

Dominant species: Desert Cisticola (*Cisticola aridulus*), Black-chested Prinia (*Prinia flavicans*), Chestnut-vented Warbler (*Curruca subcoerulea*), Southern Fiscal (*Lanius collaris*), Cloud Cisticola (*C. textrix*) and Rufous-naped Lark (*Mirafra africana*) are prominent.

Indicator species: Nicholson's Pipit (*Anthus nicholsonii*) and Plain-backed Pipit *(A. leucophrys*).

4. Association confined to open savannoid grassland with bush clump mosaics

This association is confined to the open grassland habitat located on the western section of the proposed grid corridor.

Dominant species: Desert Cisticola (*Cisticola* aridulus), Cloud Cisticola (*C. textrix*), Eastern Clapper Lark (*Mirafra faciolata*) and Cape Longclaw (*Macronyx capensis*) are prominent.

Indicator species: High numbers of African Pipit (*Anthus cinnamomeus*) and Spike-heeled Lark (*Chersomanes albofasciata*).

The highest number of bird species on the project area was observed from floodplain habitat and riparian woodland, followed by an association confined to dense Vachellia bushveld (Table 7). The latter two habitat types also support the highest number of bird individuals. The lowest number of bird species was recorded from the open savannoid grassland on the western parts of the study area.

Table 7: A summary of the observed species richness and number of bird individuals confined to the bird associations on the project area.

Bird Association	Number of species	Number of Individuals	Shannon Wiener Index H'(log_e)
1. Floodplain and riparian woodland	57	41.24	3.65
2. Dense microphyllous bushveld	57	33.75	3.63
3. Rocky grassland with bush clumps	52	12.05	3.54
4. Open savannoid grassland with bush clumps	4	7.00	1.27

4.6 Passerine bird densities

Fifty-six passerine bird species were recorded from the point counts on the study site and immediate surroundings. The study site and immediate surroundings comprise of a mean of 12.82 species.ha^{-1} (Appendix 2). The average density per hectare is 21.94 birds.ha^{-1} and ranges between 1.28 birds.ha^{-1} to 46.79 birds.ha^{-1}.

4.7 Movements/dispersal of Priority Collision-prone birds

Daily dispersal of waterbird taxa (Figure 24) was confined to large-bodied waterfowl (mainly Egyptian Goose *Alopochen aegyptiacus* and Spur-winged Goose *Plectropterus gambiensis*) which commute between foraging habitat either between the many of the livestock watering points in the area, the slimes dam to the north and the Vaal River in the south, which appeared to be frequent (regular). The nearby Vaal River and Koekemoerspruit is also regarded as an important dispersal corridors for waterbird species in the region.

The home ranges of approximately 2-3 Northern Black Korhaan pairs correspond to the proposed BESS facility and immediate surroundings (Figure 18), which will become displaced during the construction of the facility. Many Western Cattle Egret (*Bubulcus ibis*) also use the study area as foraging habitat, although their occurrence is primarily associated with the presence of grazing livestock.

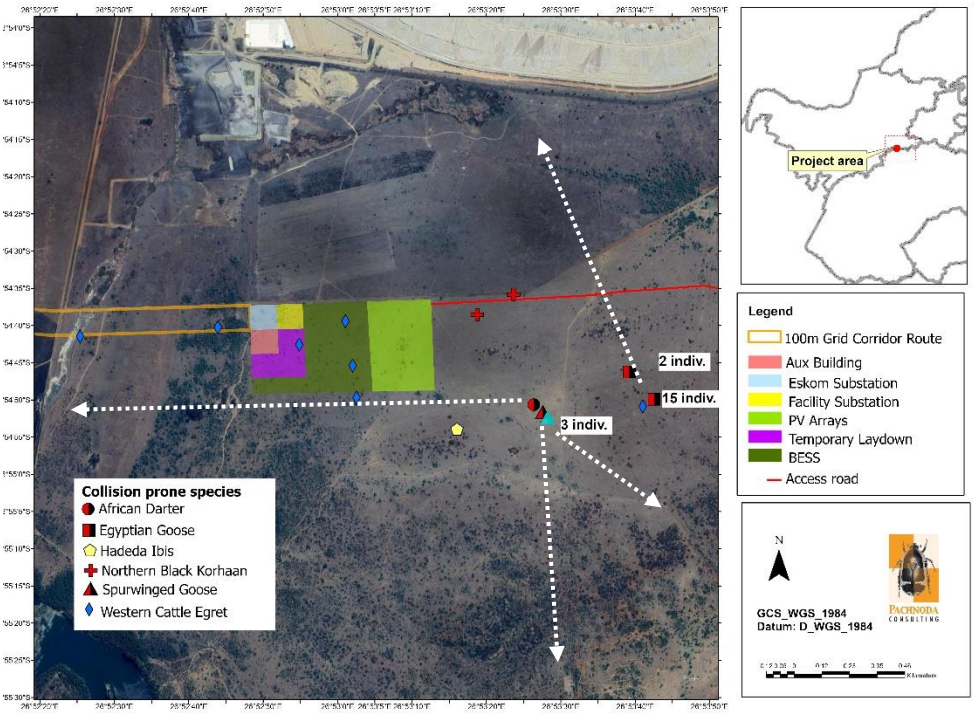

Figure 18: A map of the study site illustrating the occurrence and movements of priority collision-prone species.

4.8 Avifaunal sensitivity

A sensitivity map was compiled, illustrating habitat units comprising of potential sensitive elements based on the following arguments (Figures 19 - 22):

Areas of high sensitivity

It includes the Koekemoerspruit and its floodplain, which is regarded as an important flyway for waterbirds, thereby also facilitating the dispersal of birds towards the Vaal River. Therefore, overhead powerline infrastructure spanning these avian flyways may result in increased bird collisions with waterbirds. The floodplain habitat also provided foraging habitat for the endangered African Marsh-harrier (*Circus ranivorus*).

Areas of medium sensitivity

These include open savannoid grassland, rocky grassland and bush clump mosaics which 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.

Areas of low sensitivity

These habitat units are represented by transformed types and include the secondary/regenerating grassland, roads and build-up areas.

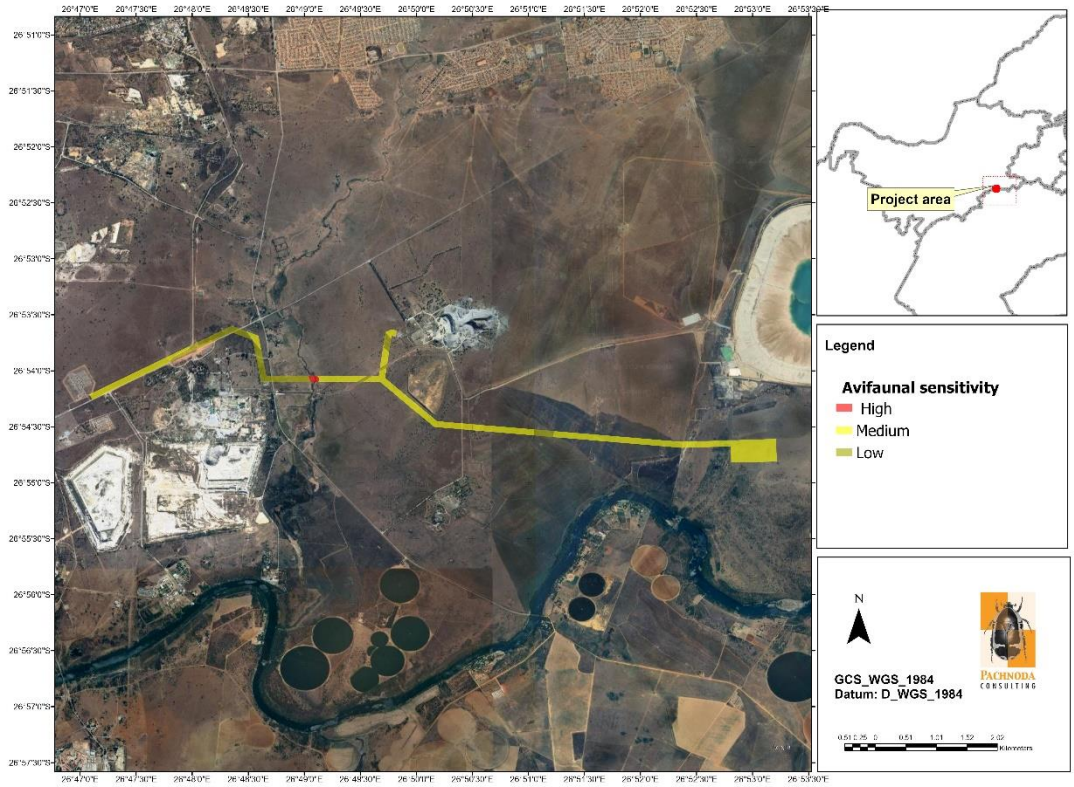

Figure 19: A map illustrating the avifaunal sensitivity of the study area based on habitat types supporting bird taxa of conservation concern and important ecological function.

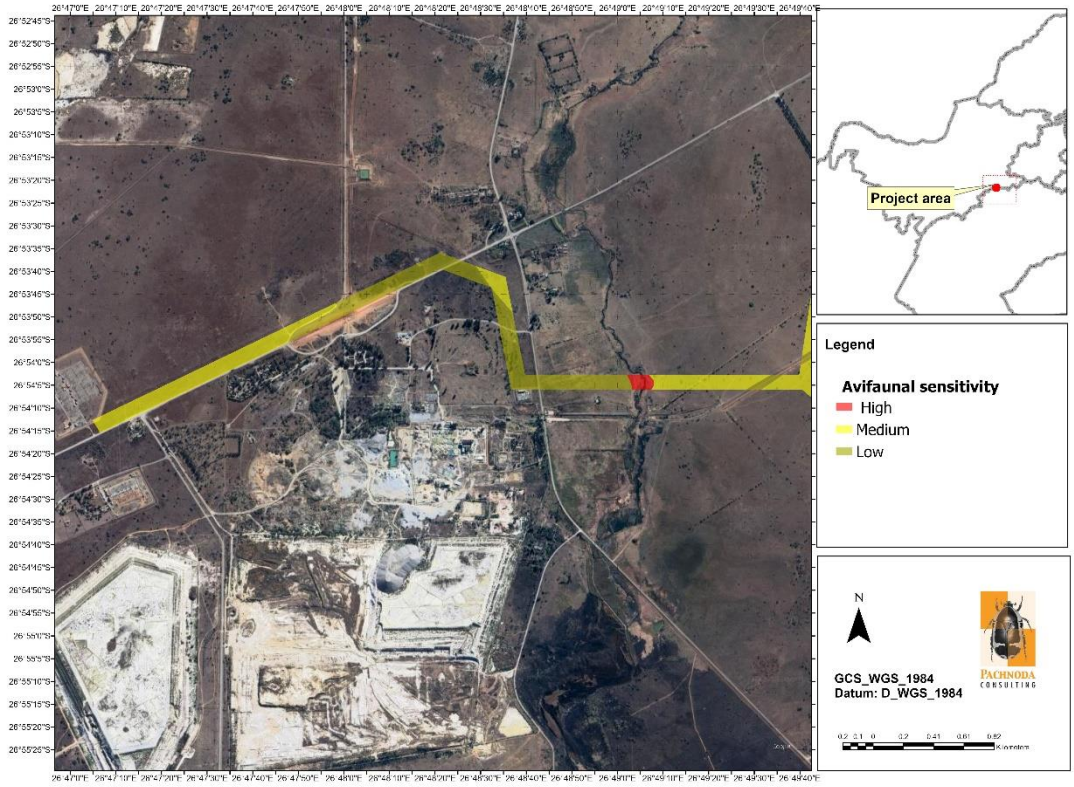

Figure 20: A map illustrating the avifaunal sensitivity of the western section of the grid connection based on habitat types supporting bird taxa of conservation concern and important ecological function.

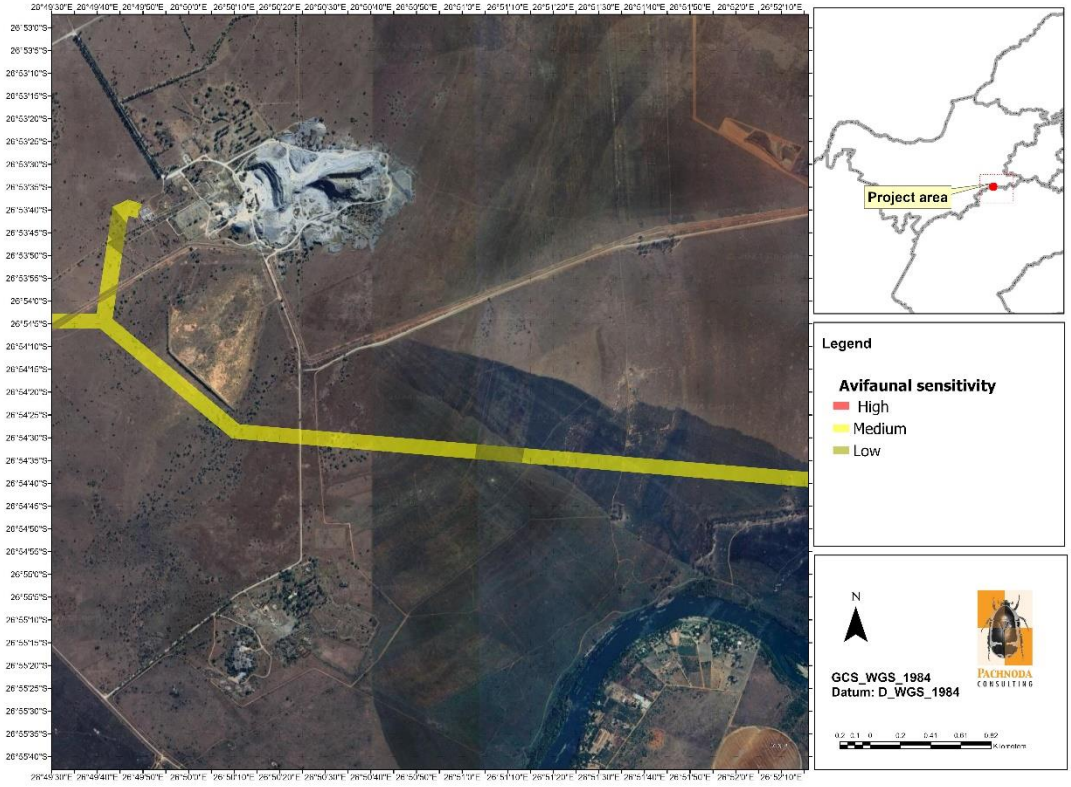

Figure 21: A map illustrating the avifaunal sensitivity of the central section of the grid connection based on habitat types supporting bird taxa of conservation concern and important ecological function.

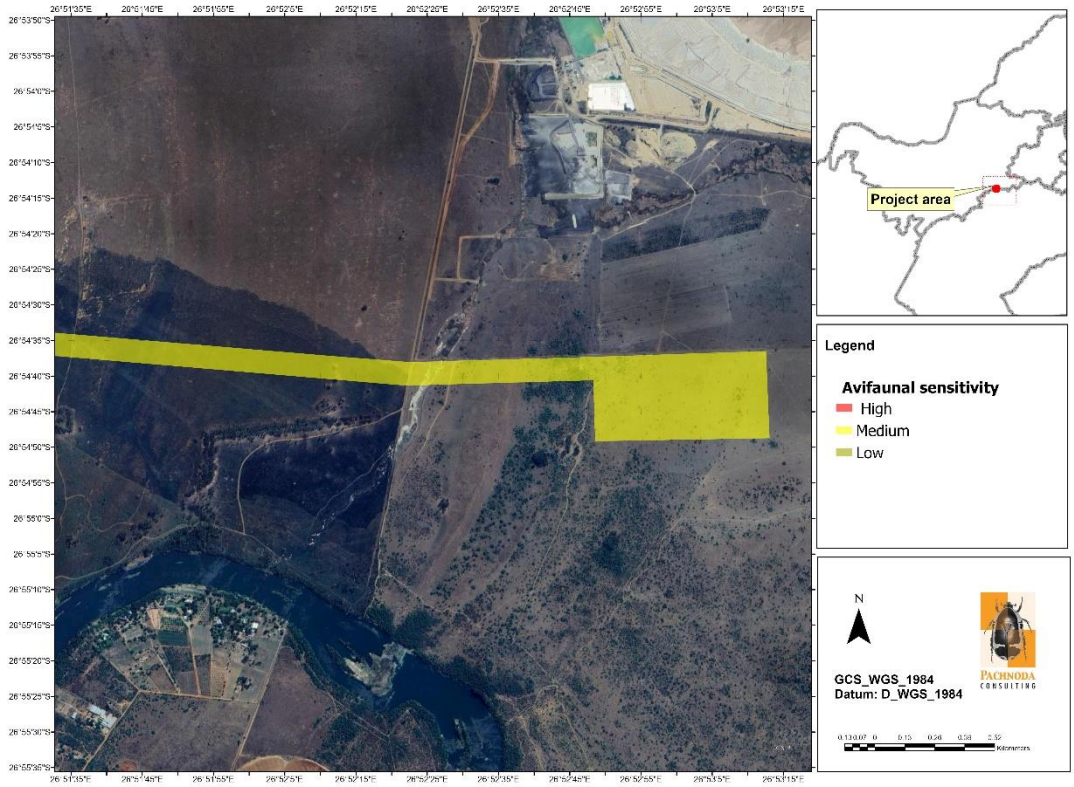

Figure 22: A map illustrating the avifaunal sensitivity of the eastern section of the grid connection and the BESS facility based on habitat types supporting bird taxa of conservation concern and important ecological function.

4.9 Potential Impacts associated with the proposed BESS Facility

Table 8 provides a summary of the anticipated impacts.

The main impacts associated with the proposed facility and grid corridor include the following:

- 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 and electrocution with overhead powerlines;
- 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.

4.9.1 Loss of habitat and displacement of birds at the BESS facility

It is anticipated that up to 25 ha will be required during the construction of the BESS facility and associated infrastructure. Construction of the facility will entail the clearing of vegetation and natural habitat to accommodate the BESS, panel arrays and associated infrastructure. Clearing of vegetation will inevitably result in the loss of habitat and displacement of bird species, which is primarily confined to habitat of medium avifaunal sensitivity. From the results, approximately 12.82 species.ha^{-1} and 21.94 birds.ha^{-1} will become displaced should the activity occur across all the habitat types on the study site (as per Jenkins et al., 2017). Displacement will mainly affect endemic passerine and smaller non-passerine species inhabiting the rocky grassland and associated bush clump mosaics of medium avifaunal sensitivity, with at least two to three pairs of Northern Black Korhaan that may become displace.

In addition, the upgrade of the access road will also involve clearing of vegetation, although the clearing is likely to be limited since the proposed road coincides with an existing gravel road.

The following bird species are most likely to be impacted by the loss of habitat due to their habitat requirements, endemism and conservation status (although not limited to) due to the proposed development:

- Northern Black Korhaan (*Afrotis afraoides*);
- Barred Wren-warbler (*Calamonastes fasciolatus*);
- Kalahari Scrub Robin (*Cercotrichas paena*);
- Orange River Francolin (*Scleroptila gutturalis*); and
- Melodious Lark (*Mirafra cheniana*).

4.9.2. Creation of "new" avian habitat and bird pollution

It is possible that the infrastructure (during operation) could inadvertently attract bird species which may occupy the site or interact with the local (native) bird assemblages in the wider region. These include alien and cosmopolitan species, as well as aggressive omnivorous passerines which could displace other bird species from the area:

- House Sparrow (*Passer domesticus*);
- Common Myna (*Acridotheres tristis*);
- Pied Crow (*Corvus albus*); and
- Speckled Pigeon (*Columba guinea*).

The infrastructure may attract large numbers of roosting columbid taxa, especially Speckled Pigeons (*Columba guinea*), which may result in avian "pollution" through excreta, thereby fouling the panel surfaces.

4.9.3 Collision trauma caused by photovoltaic panels (the "lake-effect")

The BESS facility does not overlap with any major flyway and major wetland-associated, which explain the low occurrence of waterbird taxa at the BESS site, apart from the daily occurrence of passing Egyptian Goose (*Alopochen aegyptiacus*), Spurwinged Goose (*Plectropterus gambiensis*) and Hadeda Ibis (*Bostrychia hagedash*).

However, it is recommended that appropriate bird deterrent devices should be installed at strategic localities (e.g. at the corners of the PV facility), and these should include a combination of rotating flashers/reflectors to increase the visibility of the infrastructure..

Site observations show that the following species could potentially interact with the panel infrastructure:

- South African Shelduck (*Tadorna cana*);
- Egyptian Goose (*Alopochen aegyptiaca*);
- Yellow-billed Duck (*Anas undulata*);
- Red-billed Teal (*Anas erythrorhynchus*);
- Reed Cormorant (*Microcarbo capensis*);
- African Sacred Ibis (*Threskiornis aethiopicus*), and potentially also
- Glossy Ibis (*Plegadis falcinellus*);
- Red-knobbed Coot (*Fulica cristata*);
- Black-headed Heron (*Ardea melanocephala*);
- Cape Shoveler (*Anas smithii*);
- White-faced Whistling Duck (Dendrocygna viduata); and
- Spur-winged Goose (*Plectropterus gambiensis*).

4.9.4 Interaction with overhead powerlines and reticulation

Energy will be evacuated via the Eskom switching station at the BESS facility to the Hermes Main Transmission substation via a 132 kV overhead powerline of up to 11.5 km long. 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.

- *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. For the current project it is proposed that the overhead powerlines (including existing lines) consider the fitment of dynamic devices such as the "Viper live bird flapper" (see section below dealing with mitigation measures), especially spans crossing the Koekemoerspruit and its floodplain. In addition, it is also recommended that the earth wires spanning sections of open grassland east of the Koekemoerspruit be fitted with bird flight diverters since this area provide suitable foraging habitat for large terrestrial bird species, for example Secretarybirds (*Sagittarius serpentarius*) and White Storks (*Ciconia ciconia*).

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

It is anticipated that part of the powerline 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.

Table 8: The quantification of impacts associated with the proposed PV facility and its infrastructure.

1. Nature: 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.		
BESS and PV Layout (and associated infrastructure, including access road)	**Without mitigation**	**With mitigation**
Extent	Local (2)	Site (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	Moderate (6)	Low (4)
Probability	Definite (5)	Highly Probable (4)
Significance	**Medium (60)**	**Medium (36)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes, to some extent	Yes, to some extent
Mitigation: It is difficult to mitigate against the loss of habitat since clearing of vegetation (or habitat) will be required for the infrastructure associated with the project. The BESS facility and associated infrastructure occur predominantly on habitat types of medium sensitivity. The best practicable mitigation will be to consolidate and to avoid areas of high sensitivity.		
Residual: Decreased bird species richness, low evenness values and subsequent loss of avian diversity on a local scale. The impact will also result in fragmentation of habitat.		

2. Nature: The creation of novel or new avian habitat for commensal bird species or superior competitive species. This is expected to occur during the operation phase of the facility.		
BESS and PV Layout	**Without mitigation**	**With mitigation**
Extent	Footprint (1)	Footprint (1)
Duration	Medium-term (3)	Medium-term (3)
Magnitude	Minor (2)	Minor (2)
Probability	Probable (3)	Improbable (2)
Significance	**Low (18)**	**Low (12)**
Status (positive or negative)	Negative	Negative
Reversibility	Moderate	Moderate
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes, with experimentation	Yes
Mitigation: Apply bird deterrent devices and remove nest structures constructed on infrastructure associated with the BESS and PV infrastructure under the guidance of the ECO.		
Residual: Secondary displacement by completive bird species such as crows and increased fecundity rate for commensal bird species that are adapted to anthropogenic activities. The impact is regarded as low.		

3. Nature: Avian collision impacts related to the PV arrays during the operation phase (collision with the PV panels).		
PV arrays	**Without mitigation**	**With mitigation**
Extent	Site and immediate surroundings (4)	Site (2)
Duration	Long-term (4)	Medium-term (3)
Magnitude	Moderate (6)	Low (4)
Probability	Probable (3)	Probable (3)
Significance	**Medium (42)**	**Low (27)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes, potential loss of waterfowl species.	Yes, potential loss of some waterfowl species.
Can impacts be mitigated?	Yes, with experimentation	Yes, with experimentation
Mitigation: Apply bird deterrent devices such as rotating flashers/reflectors to the panels for birds that may mistake the panels for open water and to prevent them from landing on the panels - Document bird mortalities and conduct direct observations and carcass searches on a regular and systematic basis – apply deterrent devices at areas where mortalities are prevalent.		
Residual: Direct mortality is possible and may still occur irrespective of applied mitigation measures. Regular and systematic monitoring is proposed to assess the efficacy of applied mitigation and further research and testing is suggested to improve mitigation measures (e.g. bird deterrent devices). The residual impact is regarded as moderate.		

4. Nature: Avian collision impacts related to overhead power lines during operation.		
Overhead powerline corridor	**Without mitigation**	**With mitigation**
Extent	Local (2)	Local (2)
Duration	Long-term (4)	Long-term (4)
Magnitude	High (8)	Moderate (6)
Probability	Highly Probable (4)	Highly Probable (4)
Significance	**Medium (56)**	**Medium (48)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes (to some extent), owing to the potential collision by terrestrial birds, waterbird species and certain bird of prey species.	Yes (to some extent), owing to the potential collision by terrestrial birds, waterbird species and certain bird of prey species.
Can impacts be mitigated?	Yes	Yes
Mitigation: Apply bird deterrent devices to the power lines and make use of "bird-friendly" pylon structures. To aid post-construction monitoring and/or monitoring of bird mortality rates, it is advised to conduct direct observations and carcass searches on a regular and systematic basis.		
Residual: Direct mortality is possible and may still happen irrespective of applied mitigation measures. The residual impact will be low.		

5. Nature: Avian electrocution related to the new distribution lines during operation.		
Overhead powerline corridors (both options)	**Without mitigation**	**With mitigation**
Extent	Local (2)	Site (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	High (8)	Moderate (6)
Probability	Highly Probable (4)	Probable (3)
Significance	**Medium (56)**	**Low -Medium (33)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes (to some extent), owing to the potential collision by terrestrial birds, waterbird species and certain bird of prey species.	Yes (to some extent), owing to the potential collision by terrestrial birds, waterbird species and certain bird of prey species.
Can impacts be mitigated?	Yes, to some extent	Yes, to some extent
Mitigation: Make use of bird-friendly pylons and bird guards as recommended by EWT.		

4.10 Collision-prone bird species

A total of 70 collision-prone bird species have been recorded from the wider project area, and could potentially collide with the overhead powerline (Table 9). In addition, approximately 38 species of these species have been confirmed along the grid corridor and immediate surroundings. According to SABAP Reporting Rates, species with full protocol reporting rates >20% have a higher probability to interact with the proposed overhead powerline.

Table 9: Powerline collision-prone bird species known to be present on the study area and immediate surroundings inferred from the South African Atlas Project (SABAP2).

Common Name	Scientific Name	Observed	SABAP2 Reporting Rates			
			Full Protocol (%)	Number of cards	Ad hoc Protocol (%)	Number of cards
Hadada Ibis	*Bostrychia hagedash*	1	85.49	442.00	25.96	27.00
Speckled Pigeon	*Columba guinea*	1	82.40	426.00	22.12	23.00
Western Cattle Egret	*Bubulcus ibis*	1	73.69	381.00	32.69	34.00
Egyptian Goose	*Alopochen aegyptiaca*	1	69.25	358.00	20.19	21.00
Yellow-billed Duck	*Anas undulata*	1	66.92	346.00	17.31	18.00
Reed Cormorant	*Microcarbo africanus*	1	63.64	329.00	16.35	17.00
Helmeted Guineafowl	*Numida meleagris*	1	62.86	325.00	17.31	18.00
Black-winged Kite	*Elanus caeruleus*	1	45.26	234.00	15.38	16.00
Northern Black Korhaan	*Afrotis afraoides*	1	44.68	231.00	16.35	17.00
African Darter	*Anhinga rufa*	1	38.49	199.00	12.50	13.00
African Sacred Ibis	*Threskiornis aethiopicus*	1	37.33	193.00	14.42	15.00
Red-billed Teal	*Anas erythrorhyncha*	1	33.27	172.00	4.81	5.00
Black-headed Heron	*Ardea melanocephala*	1	32.88	170.00	8.65	9.00
White-faced Whistling Duck	*Dendrocygna viduata*	1	31.91	165.00	6.73	7.00
South African Shelduck	*Tadorna cana*	1	31.72	164.00	13.46	14.00
Spur-winged Goose	*Plectropterus gambensis*	1	30.95	160.00	9.62	10.00
Grey Heron	*Ardea cinerea*	1	27.08	140.00	8.65	9.00
Glossy Ibis	*Plegadis falcinellus*	1	21.66	112.00	4.81	5.00
White-breasted Cormorant	*Phalacrocorax lucidus*	1	20.89	108.00	5.77	6.00
Gabar Goshawk	*Micronisus gabar*	1	20.70	107.00	7.69	8.00
Black-crowned Night Heron	*Nycticorax nycticorax*		17.41	90.00	2.88	3.00

Common Name	Scientific Name	Observed	SABAP2 Reporting Rates			
			Full Protocol (%)	Number of cards	Ad hoc Protocol (%)	Number of cards
Little Egret	*Egretta garzetta*	1	17.41	90.00	2.88	3.00
African Spoonbill	*Platalea alba*	1	15.09	78.00	2.88	3.00
Purple Heron	*Ardea purpurea*	1	13.93	72.00	0.00	0.00
African Fish Eagle	*Haliaeetus vocifer*	1	10.83	56.00	3.85	4.00
Squacco Heron	*Ardeola ralloides*		10.44	54.00	0.96	1.00
Striated Heron	*Butorides striata*	1	10.44	54.00	2.88	3.00
African Black Duck	*Anas sparsa*	1	9.48	49.00	2.88	3.00
Orange River Francolin	*Scleroptila gutturalis*	1	9.09	47.00	2.88	3.00
Fulvous Whistling Duck	*Dendrocygna bicolor*		8.12	42.00	3.85	4.00
Cape Shoveler	*Spatula smithii*		7.93	41.00	6.73	7.00
Common Buzzard	*Buteo buteo*	1	7.93	41.00	1.92	2.00
Greater Kestrel	*Falco rupicoloides*		6.96	36.00	6.73	7.00
Amur Falcon	*Falco amurensis*		6.58	34.00	3.85	4.00
Hamerkop	*Scopus umbretta*	1	6.19	32.00	0.00	0.00
Black Heron	*Egretta ardesiaca*		6.00	31.00	1.92	2.00
Lesser Kestrel	*Falco naumanni*	1	5.03	26.00	2.88	3.00
Peregrine Falcon	*Falco peregrinus*		5.03	26.00	0.96	1.00
Lanner Falcon	*Falco biarmicus*	1	4.84	25.00	2.88	3.00
Goliath Heron	*Ardea goliath*		4.26	22.00	0.00	0.00
Black Sparrowhawk	*Accipiter melanoleucus*	1	4.06	21.00	1.92	2.00
European Honey-buzzard	*Pernis apivorus*		3.87	20.00	0.96	1.00
Yellow-billed Egret	*Ardea brachyrhyncha*		3.68	19.00	1.92	2.00
Western Barn Owl	*Tyto alba*	1	3.48	18.00	0.96	1.00
African Harrier-Hawk	*Polyboroides typus*		3.29	17.00	0.96	1.00
Southern Pochard	*Netta erythrophthalma*		2.90	15.00	1.92	2.00

Common Name	Scientific Name	Observed	SABAP2 Reporting Rates			
			Full Protocol (%)	Number of cards	Ad hoc Protocol (%)	Number of cards
Great Egret	*Ardea alba*		2.32	12.00	0.96	1.00
Spotted Eagle-Owl	*Bubo africanus*	1	2.32	12.00	0.96	1.00
Ovambo Sparrowhawk	*Accipiter ovampensis*	1	2.13	11.00	0.96	1.00
Blue-billed Teal	*Spatula hottentota*		1.93	10.00	1.92	2.00
Cape Teal	*Anas capensis*		1.74	9.00	0.00	0.00
Marsh Owl	*Asio capensis*	1	1.74	9.00	1.92	2.00
Rock Kestrel	*Falco rupicolus*		1.74	9.00	0.96	1.00
Pale Chanting Goshawk	*Melierax canorus*	1	1.16	6.00	0.96	1.00
Long-crested Eagle	*Lophaetus occipitalis*		0.97	5.00	0.00	0.00
Yellow-billed Kite	*Milvus aegyptius*		0.97	5.00	0.96	1.00
Black-chested Snake Eagle	*Circaetus pectoralis*		0.77	4.00	0.00	0.00
Greater Flamingo	*Phoenicopterus roseus*		0.77	4.00	0.96	1.00
White Stork	*Ciconia ciconia*		0.77	4.00	0.96	1.00
Yellow-billed Stork	*Mycteria ibis*		0.77	4.00	0.00	0.00
Abdim's Stork	*Ciconia abdimii*		0.58	3.00	0.00	0.00
Black-winged Pratincole	*Glareola nordmanni*		0.58	3.00	0.96	1.00
Cape Vulture	*Gyps coprotheres*		0.58	3.00	0.96	1.00
White-backed Vulture	*Gyps africanus*		0.58	3.00	0.96	1.00
Cape Crow	*Corvus capensis*		0.39	2.00	0.00	0.00
Knob-billed Duck	*Sarkidiornis melanotos*		0.39	2.00	0.00	0.00
African Marsh Harrier	*Circus ranivorus*		0.19	1.00	0.00	0.00
Martial Eagle	*Polemaetus bellicosus*		0.19	1.00	0.00	0.00
Secretarybird	*Sagittarius serpentarius*		0.19	1.00	0.00	0.00
Brown Snake Eagle	*Circaetus cinereus*		0.00	0.00	0.96	1.00

4.11 Cumulative Impacts

Cumulative impacts are defined as impacts that result from additional or incremental activities caused by past or present actions together with the current project. Therefore, cumulative impacts are those that will affect the general avifaunal community on the study area due to other planned solar farm projects and electrical infrastructure in the region.

There are at least 26 solar PV facilities (all approved) within 30 km of the proposed BESS facility and grid corridor which may have a cumulative impact (Table 10).

Table 10: Solar PV developments with an approved Environmental Authorisation within 30 km of the proposed study area.

No	EIA Reference No	Classification	Status of application	Distance from proposed area (km)
1	12/12/20/2513/2/AM1	Solar PV	Approved	4.3
2	14/12/16/3/3/1/2739	Solar PV	Approved	10.7
3	14/12/16/3/3/1/2668	Solar PV	Approved	28.5
4	14/12/16/3/3/1/2743	Solar PV	Approved	9.6
5	14/12/16/3/3/1/2475	Solar PV	Approved	10.6
6	14/12/16/3/3/1/2748	Solar PV	Approved	9.5
7	14/12/16/3/3/1/2548	Solar PV	Approved	24.6
8	14/12/16/3/3/1/2476	Solar PV	Approved	3.8
9	14/12/16/3/3/2/777/AM2	Solar PV	Approved	0
10	14/12/16/3/3/1/2691	Solar PV	Approved	21
11	12/12/20/2513/4	Solar PV	Approved	4.3
12	14/12/16/3/3/1/2365	Solar PV	Approved	11.7
13	14/12/16/3/3/1/2667	Solar PV	Approved	29.8
14	14/12/16/3/3/1/2747	Solar PV	Approved	14.8
15	12/12/20/2513/2	Solar PV	Approved	8.1
16	14/12/16/3/3/1/2669	Solar PV	Approved	28.6
17	14/12/16/3/3/2/954	Solar PV	Approved	27.2
18	14/12/16/3/3/1/2744	Solar PV	Approved	10.6
19	14/12/16/3/3/2/1/2369	Solar PV	Approved	9.2
20	14/12/16/3/3/1/2546	Solar PV	Approved	21
21	14/12/16/3/3/1/2533	Solar PV	Approved	3.8
22	12/12/20/2513/3/AM6	Solar PV	Approved	4.3
23	14/12/16/3/3/2/777	Solar PV	Approved	0
24	14/12/16/3/3/1/2730	Solar PV	Approved	16.1
25	12/12/20/2513/3/AM2	Solar PV	Approved	4.3
26	14/12/16/3/3/1/2742	Solar PV	Approved	10.6

The cumulative impacts are likely to increase the displacement and loss of habitat at a regional scale of which the grid connection (via overhead powerlines) of these facilities could also potentially contribute towards a higher frequency of bird strikes with earth wires resulting in avian mortalities.

A summary of the cumulative impacts is provided in Table 11.

Table 11: A summary of the cumulative impacts.

1. Nature: Regional losses of natural habitat and subsequent displacement of birds.		
	Overall impact of the proposed project considered in isolation	**Cumulative impact of the project and other projects in the area**
Extent	Site (1)	Local and immediate surroundings (3)
Duration	Long-term (4)	Long-term (4)
Magnitude	Low (4)	Moderate (6)
Probability	Highly Probable (4)	Highly Probable (4)
Significance	**Medium (36)**	**Medium (52)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes, to some extent	To some extent
Confidence in findings: High.		
Mitigation: It is difficult to mitigate against the loss of habitat without considering alternative sites. The best practicable mitigation will be to consolidate infrastructure (e.g. proposed powerline) to areas where existing impacts occur (e.g. placing the proposed powerline alongside existing powerlines), where possible and to concentrate infrastructure on land with a low biodiversity conservation value.		
2. Nature: Avian collision impacts related to the PV arrays during the operational phase (collision with the PV panels).		
	Overall impact of the proposed project considered in isolation	**Cumulative impact of the project and other projects in the area**
Extent	Site (2)	Local and immediate surroundings (3)
Duration	Medium-term (3)	Long-term (4)
Magnitude	Low (4)	Moderate (6)
Probability	Probable (3)	Probable (4)
Significance	**Low (27)**	**Medium (52)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes, potential loss of waterfowl	Yes, potential loss of waterfowl
Can impacts be mitigated?	Yes, to some extent	Yes, to some extent
Confidence in findings: Low.		
Mitigation: Apply bird deterrent devices to the panels for birds that may mistake the panels for open water and to prevent them from landing on the panels. Conduct direct observations and carcass searches on a regular and systematic basis. Apply appropriate buffer zones to nearby water features and wetlands.		
3. Nature: Avian collision impacts related to the powerline reticulation and new distribution lines during operation.		
	Overall impact of the proposed project considered in isolation	**Cumulative impact of the project and other projects in the area**
Extent	Local (2)	Local and immediate surroundings (3)
Duration	Long-term (4)	Long-term (4)

Magnitude	Moderate (6)	Moderate (6)
Probability	Highly Probable (4)	Highly Probable (4)
Significance	**Medium (48)**	**Medium (52)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes (to some extent), owing to the potential collision by terrestrial birds, waterbird species and certain bird of prey species.	Yes (to some extent), owing to the potential collision by terrestrial birds, waterbird species and certain bird of prey species.
Can impacts be mitigated?	Yes, to some extent	Yes, to some extent
Confidence in findings: High.		
Mitigation: Apply bird deterrent devices to the power line and make use of "bird-friendly" pylon structures. **Allow for construction of new powerlines parallel to existing lines**. To aid post-construction monitoring and/or monitoring of bird mortality rates, it is advised to conduct direct observations and carcass searches on a regular and systematic basis.		
4. Nature: Avian electrocution related to the powerline reticulation and new distribution lines during operation***.***		
	Without mitigation	**With mitigation**
Extent	Site (1)	Local (2)
Duration	Long-term (4)	Long-term (4)
Magnitude	Moderate (6)	Moderate (6)
Probability	Probable (3)	Highly Probable (4)
Significance	**Low -Medium (33)**	**Medium (48)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes (to some extent), owing to the potential collision by terrestrial birds, waterbird species and certain bird of prey species.	Yes (to some extent), owing to the potential collision by terrestrial birds, waterbird species and certain bird of prey species.
Can impacts be mitigated?	Yes, to some extent	Yes, to some extent
Confidence in findings: Moderate.		
Mitigation: Apply bird deterrent devices to the power line and make use of "bird-friendly" pylon structures. Make use of bird-friendly pylons and bird guards. **Position electrical infrastructure in close proximity to existing infrastructure**.		

4.12 Recommended mitigation

4.12.1 Loss of habitat and displacement bird taxa

- Concentrate all surface infrastructure on habitat of medium and low avifaunal sensitivity. The development footprint of the various individual facilities must be kept as small as possible and sensitive habitats must be avoided. Avoid habitat with high avifaunal sensitivity (e.g. avoid the placement of pylons within the floodplain of the Koekemoerspruit).

- Prevent an overspill of construction activities into areas that are not part of the proposed construction site.
- Use indigenous plant species native to the study area during landscaping and rehabilitation.
- The development footprint of the pylon structures must be kept as small as possible.
- Make use of existing access roads and tracks (where possible) during the construction and stringing of the powerline.

4.12.2 Creation of "new" avian habitat and bird pollution

The following mitigation measures are proposed:

- Apply bird deterrent devices at selective areas (for example at the corners and middle part of the facility) to the PV arrays to discourage birds from colonising the infrastructure or to discourage birds from constructing nests. These could include visual or bio-acoustic deterrents such as highly reflective rotating devices, anti-perching devices such as bird guards, scaring or chasing activities involving the use of trained dogs or raptors and/or netting. Nests should be removed when nest-building attempts are noticed under the guidance of the ECO.
- Reduce or minimise the use of outdoor lighting to avoid attracting birds to the lights or to reduce potential disorientation to migrating birds.
- Use indigenous plant species native to the study area during landscaping and rehabilitation.

4.12.3 Collision trauma caused by photovoltaic panels (the "lake-effect")

The following mitigation measures are proposed:

- Apply bird deterrent devices to the panels at selective areas (for example at the corners and middle part of the facility) to discourage birds from potentially colonising/colliding with the infrastructure. Bird deterrent devices should be placed at the corners and middle part of the PV arrays. These could include visual or bio-acoustic deterrents such as highly reflective rotating devices, flashers, anti-perching devices such as bird guards, scaring or chasing activities involving the use of trained dogs or raptors and/or netting. An option is to employ video cameras at selected areas to document bird mortalities.
- Apply systematic reflective/dynamic markers to the boundary fence to increase the visibility of the fence for approaching birds (e.g. korhaan/bustard taxa) and to avoid potential bird collisions with the fence structure.
- Reduce or minimise the use of outdoor lighting to avoid attracting birds to the lights or to reduce potential disorientation to migrating/disperding birds.

4.12.4 Power line interaction: collision and electrocution with power lines

The following mitigation measures are proposed:

- A “walk-through” of the powerline corridor must be conducted prior to the construction phase. The ”walk-through” will aim to identify areas where marking of earth wires by means of “bird flight devices” is considered to be beneficial or compulsory.
- In general, the proposed pylon design must incorporate the following design parameters:
  - The clearances between the live components should be as wide as possible within the design limitations/capabilities of the power line.
  - 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. In addition, conductors should be strung below the pole to avoid bridging the air gap by perching birds of prey.

It is therefore recommended that the pylon design incorporates "features as illustrated in Figure 23[7].

From Figure 23 it is clear that perching by 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 23: Two bird-friendly tower designs to be considered for the current project.

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

- Where possible make use of the Viper Live bird flapper as an appropriate bird flight diverter for the powerline (Figure 24). Dynamic devices (e.g. Viper live bird flapper), should be applied to earth wires while alternating between different colours (e.g. between black and yellow or black and red) and should be fitted to the middle 60 % of the span (corresponding to the lower part of the span). All devices should be spaced at 5 m intervals from each other.
- Where wetlands and floodplains are spanned (e.g. the Koekemoerspruit), it is recommended that the actual crossover span as well as one span on either side of the wetland/ floodplain be marked with diverters.
- The spanning of wetland and floodplain crossings should be perpendicular to the natural channel of the wetland/floodplain.

Figure 24: An example of a bird flight diverter to be used on the powerline: Viper live bird flapper.

4.12.5 General mitigation measures

- All construction sites/areas must be demarcated on site layout plans (preferably), and no construction personnel or vehicles may leave the demarcated area except those authorised to do so. Those areas surrounding the construction sites that are not part of the demarcated development area should be considered as “no-go” areas for employees, machinery or even visitors.
- All road networks must be planned with care to minimise dissection or fragmentation of important avifaunal habitat type. Where possible, the use of existing roads is encouraged.
- Open fires are strictly prohibited and only allowed at designated areas.
- Killing or poaching of any bird species should be avoided by means of awareness programs presented to the labour force. The labour force should be made aware of the conservation issues pertaining to the bird taxa occurring on

the study site. Any person found deliberately harassing any bird species in any way should face disciplinary measures, following the possible dismissal from the site.

- Checks must be carried out at regular intervals to identify areas where erosion is occurring. Appropriate remedial action, including the rehabilitation of eroded areas should be undertaken.

4.13 Opinion regarding the feasibility of the project

Pachnoda Consulting cc was requested by Kareerand BESS (Pty) Ltd to compile an avifauna baseline report for the proposed construction of the Kareerand Battery Energy Storage (BESS) Facility, consisting of a BESS and solar photovoltaic (PV) infrastructure. The Kareerand BESS facility will be located approximately 22 km east of Klerksdorp within the North West Province.

Seven avifaunal habitat types were identified on the study area and surroundings, consisting of open grassland with bush clumps (ranging from open savannoid grassland to rocky grassland), wetlands and floodplains, secondary grassland and *Vachellia* dominated bushveld. The wetlands and floodplains (e.g. Koekemoerspruit) provided foraging, roosting and breeding habitat for many waterbird and wading bird taxa, although the occurrence of such taxa on the BESS facility was considered to be low. Approximately 286 bird species were expected to occur in the wider study area, of which 210 species were observed in the area. The expected richness included 12 threatened or near threatened bird species. However, the occurrence of threatened and near threatened bird species was predicted to be low, apart from the regionally vulnerable Lanner Falcon (*Falco biarmicus*) which was regarded as a regular foraging visitor to the area. In addition, large sections of open grassland east of the Koekemoerspruit (along the proposed grid connection) provided suitable foraging habitat for Secretarybirds (*Sagittarius serpentarius*), although this species was regarded as uncommon in the area (sensu SABAP Reporting rates). Approximately,17 southern African endemics and 23 near-endemic species were expected to be present.

An evaluation of potential and likely impacts on the avifauna revealed that the impact significance was moderate to low after mitigation (depending on the type of impact). No fatal-flaws were identified during the assessment, although it was recommended that the proposed mitigation measures a be implemented during the construction and operational phase of the project.

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Appendix 1: A shortlist of bird species expected to be present on the study area and immediate surrounding. The list provides an indication of the species occurrence according to SABAP2 reporting rates. The list was derived (and modified) from species observed in pentad grids 2650_2645, 2650_2650, 2655_2645 and 2655_2550 and from personal observations. The reporting rates include submissions made during the August/September and November/December 2023 surveys.

#	Common Name	Scientific Name	Observed (Aug, Nov 2023 & Jan 2024)	SABAP2 Reporting Rates			
				Full Protocol (%)	Number of cards	Ad hoc Protocol (%)	Number of cards
78	Abdim's Stork	*Ciconia abdimii*		0.58	3.00	0.00	0.00
432	Acacia Pied Barbet	*Tricholaema leucomelas*	1	57.45	297.00	15.38	16.00
95	African Black Duck	*Anas sparsa*	1	9.48	49.00	2.88	3.00
380	African Black Swift	*Apus barbatus*		0.77	4.00	0.00	0.00
199	African Crake	*Crecopsis egregia*		0.39	2.00	0.00	0.00
127	African Cuckoo-Hawk	*Aviceda cuculoides*		0.77	4.00	0.00	0.00
52	African Darter	*Anhinga rufa*	1	38.49	199.00	12.50	13.00
149	African Fish Eagle	*Haliaeetus vocifer*	1	10.83	56.00	3.85	4.00
360	African Grass Owl	*Tyto capensis*		0.19	1.00	0.00	0.00
171	African Harrier-Hawk	*Polyboroides typus*		3.29	17.00	0.96	1.00
418	African Hoopoe	*Upupa africana*	1	54.74	283.00	8.65	9.00
167	African Marsh Harrier	*Circus ranivorus*		0.19	1.00	0.00	0.00
387	African Palm Swift	*Cypsiurus parvus*	1	59.57	308.00	17.31	18.00
682	African Paradise Flycatcher	*Terpsiphone viridis*	1	15.67	81.00	2.88	3.00
685	African Pied Wagtail	*Motacilla aguimp*	1	11.22	58.00	0.00	0.00
692	African Pipit	*Anthus cinnamomeus*	1	35.40	183.00	9.62	10.00
197	African Rail	*Rallus caerulescens*	1	12.19	63.00	0.00	0.00
544	African Red-eyed Bulbul	*Pycnonotus nigricans*	1	94.39	488.00	20.19	21.00
606	Common Reed Warbler	*Acrocephalus scirpaceus*	1	23.79	123.00	3.85	4.00
81	African Sacred Ibis	*Threskiornis aethiopicus*	1	37.33	193.00	14.42	15.00

#	Common Name	Scientific Name	Observed (Aug, Nov 2023 & Jan 2024)	SABAP2 Reporting Rates			
				Full Protocol (%)	Number of cards	Ad hoc Protocol (%)	Number of cards
250	African Snipe	*Gallinago nigripennis*	1	8.32	43.00	1.92	2.00
85	African Spoonbill	*Platalea alba*	1	15.09	78.00	2.88	3.00
576	African Stonechat	*Saxicola torquatus*	1	61.90	320.00	14.42	15.00
208	African Swamphen	*Porphyrio madagascariensis*	1	18.57	96.00	2.88	3.00
247	African Wattled Lapwing	*Vanellus senegallus*	1	9.86	51.00	0.00	0.00
772	Amethyst Sunbird	*Chalcomitra amethystina*	1	24.37	126.00	9.62	10.00
119	Amur Falcon	*Falco amurensis*		6.58	34.00	3.85	4.00
575	Ant-eating Chat	*Myrmecocichla formicivora*	1	21.47	111.00	2.88	3.00
	Arrow-marked Babbler	*Turdoides jardineii*	1	0.19	1.00	0.00	0.00
514	Ashy Tit	*Melaniparus cinerascens*	1	4.45	23.00	1.92	2.00
202	Baillon's Crake	*Zapornia pusilla*		0.19	1.00	0.00	0.00
510	Banded Martin	*Riparia cincta*	1	4.06	21.00	1.92	2.00
493	Barn Swallow	*Hirundo rustica*	1	29.98	155.00	12.50	13.00
614	Barred Wren-Warbler	*Calamonastes fasciolatus*	1	0.58	3.00	0.00	0.00
622	Bar-throated Apalis	*Apalis thoracica*	1	9.09	47.00	0.96	1.00
	Black Cuckoo	*Cuculus clamosus*	1	0.39	2.00	0.00	0.00
203	Black Crake	*Zapornia flavirostra*	1	32.69	169.00	1.92	2.00
64	Black Heron	*Egretta ardesiaca*		6.00	31.00	1.92	2.00
159	Black Sparrowhawk	*Accipiter melanoleucus*	1	4.06	21.00	1.92	2.00
712	Black-backed Puffback	*Dryoscopus cubla*		0.97	5.00	0.00	0.00
650	Black-chested Prinia	*Prinia flavicans*	1	89.17	461.00	22.12	23.00
146	Black-chested Snake Eagle	*Circaetus pectoralis*		0.77	4.00	0.00	0.00
431	Black-collared Barbet	*Lybius torquatus*	1	48.94	253.00	12.50	13.00
69	Black-crowned Night Heron	*Nycticorax nycticorax*		17.41	90.00	2.88	3.00
841	Black-faced Waxbill	*Brunhilda erythronotos*	1	6.00	31.00	0.96	1.00

#	Common Name	Scientific Name	Observed (Aug, Nov 2023 & Jan 2024)	SABAP2 Reporting Rates			
				Full Protocol (%)	Number of cards	Ad hoc Protocol (%)	Number of cards
55	Black-headed Heron	*Ardea melanocephala*	1	32.88	170.00	8.65	9.00
245	Blacksmith Lapwing	*Vanellus armatus*	1	87.81	454.00	26.92	28.00
860	Black-throated Canary	*Crithagra atrogularis*	1	68.47	354.00	19.23	20.00
130	Black-winged Kite	*Elanus caeruleus*	1	45.26	234.00	15.38	16.00
	Black-headed Oriole	*Oriolus larvatus*	1	0.19	1.00	0.00	0.00
282	Black-winged Pratincole	*Glareola nordmanni*		0.58	3.00	0.96	1.00
270	Black-winged Stilt	*Himantopus himantopus*	1	17.21	89.00	0.96	1.00
839	Blue Waxbill	*Uraeginthus angolensis*	1	66.92	346.00	11.54	12.00
99	Blue-billed Teal	*Spatula hottentota*		1.93	10.00	1.92	2.00
405	Blue-cheeked Bee-eater	*Merops persicus*		0.39	2.00	0.00	0.00
722	Bokmakierie	*Telophorus zeylonus*	1	13.35	69.00	3.85	4.00
823	Bronze Mannikin	*Spermestes cucullata*		7.93	41.00	0.96	1.00
145	Brown Snake Eagle	*Circaetus cinereus*		0.00	0.00	0.96	1.00
443	Brown-backed Honeybird	*Prodotiscus regulus*	1	3.29	17.00	0.00	0.00
714	Brown-crowned Tchagra	*Tchagra australis*	1	23.60	122.00	5.77	6.00
402	Brown-hooded Kingfisher	*Halcyon albiventris*	1	34.24	177.00	4.81	5.00
509	Brown-throated Martin	*Riparia paludicola*	1	41.97	217.00	1.92	2.00
731	Brubru	*Nilaus afer*	1	4.26	22.00	0.96	1.00
695	Buffy Pipit	*Anthus vaalensis*	1	3.68	19.00	0.96	1.00
4131	Burchell's Coucal	*Centropus burchellii*	1	23.60	122.00	1.92	2.00
	Burnt-necked Eremomela	*Eremomela usticollis*	1	0.39	2.00	0.00	0.00
523	Cape Crow	*Corvus capensis*		0.39	2.00	0.00	0.00
703	Cape Longclaw	*Macronyx capensis*	1	34.43	178.00	8.65	9.00
531	Cape Penduline Tit	*Anthoscopus minutus*		1.16	6.00	0.00	0.00
581	Cape Robin-Chat	*Cossypha caffra*	1	66.54	344.00	13.46	14.00

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94	Cape Shoveler	*Spatula smithii*		7.93	41.00	6.73	7.00
786	Cape Sparrow	*Passer melanurus*	1	85.49	442.00	16.35	17.00
737	Cape Starling	*Lamprotornis nitens*	1	69.83	361.00	19.23	20.00
98	Cape Teal	*Anas capensis*		1.74	9.00	0.00	0.00
316	Ring-necked Dove	*Streptopelia capicola*	1	82.01	424.00	20.19	21.00
106	Cape Vulture	*Gyps coprotheres*		0.58	3.00	0.96	1.00
686	Cape Wagtail	*Motacilla capensis*	1	53.97	279.00	8.65	9.00
799	Cape Weaver	*Ploceus capensis*		0.58	3.00	0.00	0.00
1172	Cape White-eye	*Zosterops virens*	1	11.80	61.00	5.77	6.00
568	Capped Wheatear	*Oenanthe pileata*	1	11.03	57.00	2.88	3.00
450	Cardinal Woodpecker	*Dendropicos fuscescens*	1	12.96	67.00	2.88	3.00
290	Caspian Tern	*Hydroprogne caspia*	1	4.45	23.00	0.96	1.00
484	Chestnut-backed Sparrow-Lark	*Eremopterix leucotis*		1.93	10.00	0.96	1.00
658	Chestnut-vented Warbler	*Curruca subcoerulea*	1	75.44	390.00	9.62	10.00
673	Chinspot Batis	*Batis molitor*	1	8.51	44.00	1.92	2.00
872	Cinnamon-breasted Bunting	*Emberiza tahapisi*	1	17.21	89.00	2.88	3.00
631	Cloud Cisticola	*Cisticola textrix*	1	14.70	76.00	4.81	5.00
154	Common Buzzard	*Buteo buteo*	1	7.93	41.00	1.92	2.00
263	Common Greenshank	*Tringa nebularia*	1	3.68	19.00	0.00	0.00
507	Common House Martin	*Delichon urbicum*	1	0.39	2.00	0.00	0.00
210	Common Moorhen	*Gallinula chloropus*	1	58.03	300.00	5.77	6.00
734	Common Myna	*Acridotheres tristis*	1	84.33	436.00	21.15	22.00
189	Common Quail	*Coturnix coturnix*		0.58	3.00	0.00	0.00
258	Common Sandpiper	*Actitis hypoleucos*	1	3.87	20.00	0.00	0.00

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421	Common Scimitarbill	*Rhinopomastus cyanomelas*	1	8.90	46.00	0.96	1.00
378	Common Swift	*Apus apus*	1	0.39	2.00	0.00	0.00
843	Common Waxbill	*Estrilda astrild*	1	14.31	74.00	3.85	4.00
594	Common Whitethroat	*Curruca communis*	1	1.93	10.00	0.00	0.00
439	Crested Barbet	*Trachyphonus vaillantii*	1	80.85	418.00	13.46	14.00
711	Crimson-breasted Shrike	*Laniarius atrococcineus*	1	4.26	22.00	0.96	1.00
242	Crowned Lapwing	*Vanellus coronatus*	1	79.11	409.00	22.12	23.00
821	Cut-throat Finch	*Amadina fasciata*		5.42	28.00	0.00	0.00
	Dark-capped Bulbul	*Pycnonotus tricolor*	1	0.19	1.00	0.00	0.00
630	Desert Cisticola	*Cisticola aridulus*	1	32.50	168.00	10.58	11.00
352	Diederik Cuckoo	*Chrysococcyx caprius*	1	39.65	205.00	7.69	8.00
849	Dusky Indigobird	*Vidua funerea*		1.74	9.00	0.00	0.00
1183	Eastern Clapper Lark	*Mirafra fasciolata*	1	22.82	118.00	5.77	6.00
89	Egyptian Goose	*Alopochen aegyptiaca*	1	69.25	358.00	20.19	21.00
404	European Bee-eater	*Merops apiaster*	1	32.69	169.00	7.69	8.00
132	European Honey-buzzard	*Pernis apivorus*		3.87	20.00	0.96	1.00
412	European Roller	*Coracias garrulus*		0.58	3.00	0.96	1.00
678	Fairy Flycatcher	*Stenostira scita*	1	2.90	15.00	0.96	1.00
570	Familiar Chat	*Oenanthe familiaris*		17.80	92.00	0.00	0.00
665	Fiscal Flycatcher	*Melaenornis silens*	1	48.74	252.00	3.85	4.00
	Fork-tailed Drongo	*Dicrurus adsimilis*	1	0.19	1.00	0.00	0.00
101	Fulvous Whistling Duck	*Dendrocygna bicolor*		8.12	42.00	3.85	4.00
162	Gabar Goshawk	*Micronisus gabar*	1	20.70	107.00	7.69	8.00
595	Garden Warbler	*Sylvia borin*		0.97	5.00	0.96	1.00
395	Giant Kingfisher	*Megaceryle maxima*	1	7.93	41.00	0.96	1.00

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83	Glossy Ibis	*Plegadis falcinellus*	1	21.66	112.00	4.81	5.00
874	Golden-breasted Bunting	*Emberiza flaviventris*	1	1.16	6.00	0.00	0.00
447	Golden-tailed Woodpecker	*Campethera abingoni*	1	2.90	15.00	0.96	1.00
56	Goliath Heron	*Ardea goliath*		4.26	22.00	0.00	0.00
58	Great Egret	*Ardea alba*		2.32	12.00	0.96	1.00
603	Great Reed Warbler	*Acrocephalus arundinaceus*		6.77	35.00	0.00	0.00
86	Greater Flamingo	*Phoenicopterus roseus*		0.77	4.00	0.96	1.00
440	Greater Honeyguide	*Indicator indicator*	1	5.03	26.00	0.96	1.00
122	Greater Kestrel	*Falco rupicoloides*		6.96	36.00	6.73	7.00
502	Greater Striped Swallow	*Cecropis cucullata*	1	44.29	229.00	9.62	10.00
419	Green Wood Hoopoe	*Phoeniculus purpureus*	1	29.79	154.00	10.58	11.00
830	Green-winged Pytilia	*Pytilia melba*	1	12.19	63.00	3.85	4.00
339	Grey Go-away-bird	*Crinifer concolor*		1.93	10.00	0.00	0.00
54	Grey Heron	*Ardea cinerea*	1	27.08	140.00	8.65	9.00
288	Grey-headed Gull	*Chroicocephalus cirrocephalus*	1	5.03	26.00	0.96	1.00
557	Groundscraper Thrush	*Turdus litsitsirupa*	1	11.41	59.00	2.88	3.00
84	Hadada Ibis	*Bostrychia hagedash*	1	85.49	442.00	25.96	27.00
72	Hamerkop	*Scopus umbretta*	1	6.19	32.00	0.00	0.00
192	Helmeted Guineafowl	*Numida meleagris*	1	62.86	325.00	17.31	18.00
384	Horus Swift	*Apus horus*	1	1.16	6.00	0.96	1.00
784	House Sparrow	*Passer domesticus*	1	64.22	332.00	12.50	13.00
596	Icterine Warbler	*Hippolais icterina*		0.97	5.00	0.00	0.00
60	Yellow-billed Egret	*Ardea brachyrhyncha*		3.68	19.00	1.92	2.00
348	Jacobin Cuckoo	*Clamator jacobinus*	1	1.35	7.00	0.00	0.00
835	Jameson's Firefinch	*Lagonosticta rhodopareia*	1	12.57	65.00	0.00	0.00

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586	Kalahari Scrub Robin	*Cercotrichas paena*	1	38.68	200.00	6.73	7.00
1104	Karoo Thrush	*Turdus smithi*	1	58.03	300.00	13.46	14.00
237	Kittlitz's Plover	*Charadrius pecuarius*		2.51	13.00	0.00	0.00
351	Klaas's Cuckoo	*Chrysococcyx klaas*	1	0.77	4.00	0.00	0.00
91	Knob-billed Duck	*Sarkidiornis melanotos*		0.39	2.00	0.00	0.00
114	Lanner Falcon	*Falco biarmicus*	1	4.84	25.00	2.88	3.00
317	Laughing Dove	*Spilopelia senegalensis*	1	96.13	497.00	34.62	36.00
706	Lesser Grey Shrike	*Lanius minor*	1	5.22	27.00	3.85	4.00
442	Lesser Honeyguide	*Indicator minor*	1	10.44	54.00	1.92	2.00
125	Lesser Kestrel	*Falco naumanni*	1	5.03	26.00	2.88	3.00
604	Lesser Swamp Warbler	*Acrocephalus gracilirostris*	1	55.51	287.00	7.69	8.00
646	Levaillant's Cisticola	*Cisticola tinniens*	1	63.83	330.00	10.58	11.00
413	Lilac-breasted Roller	*Coracias caudatus*		0.39	2.00	0.96	1.00
410	Little Bee-eater	*Merops pusillus*	1	16.05	83.00	3.85	4.00
67	Little Bittern	*Ixobrychus minutus*	1	3.29	17.00	0.96	1.00
59	Little Egret	*Egretta garzetta*	1	17.41	90.00	2.88	3.00
6	Little Grebe	*Tachybaptus ruficollis*	1	44.29	229.00	4.81	5.00
609	Little Rush Warbler	*Bradypterus baboecala*	1	25.34	131.00	3.85	4.00
158	Little Sparrowhawk	*Accipiter minullus*		8.51	44.00	5.77	6.00
253	Little Stint	*Calidris minuta*		8.90	46.00	0.00	0.00
385	Little Swift	*Apus affinis*	1	40.23	208.00	15.38	16.00
621	Long-billed Crombec	*Sylvietta rufescens*	1	4.45	23.00	1.92	2.00
138	Long-crested Eagle	*Lophaetus occipitalis*		0.97	5.00	0.00	0.00
852	Long-tailed Paradise Whydah	*Vidua paradisaea*	1	12.96	67.00	9.62	10.00

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818	Long-tailed Widowbird	*Euplectes progne*	1	34.04	176.00	5.77	6.00
397	Malachite Kingfisher	*Corythornis cristatus*	1	19.15	99.00	4.81	5.00
661	Marico Flycatcher	*Melaenornis mariquensis*		0.58	3.00	0.00	0.00
361	Marsh Owl	*Asio capensis*	1	1.74	9.00	1.92	2.00
262	Marsh Sandpiper	*Tringa stagnatilis*		4.26	22.00	0.00	0.00
607	Marsh Warbler	*Acrocephalus palustris*	1	2.90	15.00	0.96	1.00
142	Martial Eagle	*Polemaetus bellicosus*		0.19	1.00	0.00	0.00
456	Melodious Lark	*Mirafra cheniana*	1	2.51	13.00	1.92	2.00
564	Mountain Wheatear	*Myrmecocichla monticola*		5.42	28.00	3.85	4.00
318	Namaqua Dove	*Oena capensis*	1	20.89	108.00	11.54	12.00
183	Natal Spurfowl	*Pternistis natalensis*	1	12.96	67.00	2.88	3.00
637	Neddicky	*Cisticola fulvicapilla*	1	62.48	323.00	4.81	5.00
10877	Nicholson's Pipit	*Anthus nicholsoni*	1	0.97	5.00	0.00	0.00
1035	Northern Black Korhaan	*Afrotis afraoides*	1	44.68	231.00	16.35	17.00
179	Orange River Francolin	*Scleroptila gutturalis*	1	9.09	47.00	2.88	3.00
1171	Orange River White-eye	*Zosterops pallidus*	1	71.57	370.00	11.54	12.00
838	Orange-breasted Waxbill	*Amandava subflava*	1	3.09	16.00	0.96	1.00
157	Ovambo Sparrowhawk	*Accipiter ovampensis*	1	2.13	11.00	0.96	1.00
165	Pale Chanting Goshawk	*Melierax canorus*	1	1.16	6.00	0.96	1.00
498	Pearl-breasted Swallow	*Hirundo dimidiata*	1	0.77	4.00	0.96	1.00
113	Peregrine Falcon	*Falco peregrinus*		5.03	26.00	0.96	1.00
269	Pied Avocet	*Recurvirostra avosetta*		6.38	33.00	0.96	1.00
522	Pied Crow	*Corvus albus*	1	76.98	398.00	32.69	34.00
394	Pied Kingfisher	*Ceryle rudis*	1	13.73	71.00	1.92	2.00
746	Pied Starling	*Lamprotornis bicolor*	1	32.11	166.00	11.54	12.00

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490	Pink-billed Lark	*Spizocorys conirostris*		2.32	12.00	0.96	1.00
846	Pin-tailed Whydah	*Vidua macroura*	1	33.85	175.00	8.65	9.00
694	Plain-backed Pipit	*Anthus leucophrys*	1	3.09	16.00	1.92	2.00
674	Pririt Batis	*Batis pririt*		10.64	55.00	0.00	0.00
57	Purple Heron	*Ardea purpurea*	1	13.93	72.00	0.00	0.00
850	Purple Indigobird	*Vidua purpurascens*		1.16	6.00	0.96	1.00
844	Quailfinch	*Ortygospiza atricollis*	1	21.66	112.00	7.69	8.00
642	Rattling Cisticola	*Cisticola chiniana*	1	27.66	143.00	7.69	8.00
708	Red-backed Shrike	*Lanius collurio*	1	19.92	103.00	15.38	16.00
837	Red-billed Firefinch	*Lagonosticta senegala*	1	36.94	191.00	8.65	9.00
805	Red-billed Quelea	*Quelea quelea*	1	64.80	335.00	19.23	20.00
97	Red-billed Teal	*Anas erythrorhyncha*	1	33.27	172.00	4.81	5.00
501	Red-breasted Swallow	*Cecropis semirufa*	1	3.87	20.00	0.96	1.00
488	Red-capped Lark	*Calandrella cinerea*	1	6.00	31.00	0.96	1.00
343	Red-chested Cuckoo	*Cuculus solitarius*	1	7.93	41.00	0.00	0.00
205	Red-chested Flufftail	*Sarothrura rufa*	1	2.51	13.00	0.00	0.00
813	Red-collared Widowbird	*Euplectes ardens*		9.09	47.00	0.00	0.00
314	Red-eyed Dove	*Streptopelia semitorquata*	1	90.52	468.00	24.04	25.00
392	Red-faced Mousebird	*Urocolius indicus*	1	68.47	354.00	15.38	16.00
820	Red-headed Finch	*Amadina erythrocephala*		36.75	190.00	15.38	16.00
212	Red-knobbed Coot	*Fulica cristata*	1	58.22	301.00	9.62	10.00
453	Red-throated Wryneck	*Jynx ruficollis*	1	1.55	8.00	1.92	2.00
50	Reed Cormorant	*Microcarbo africanus*	1	63.64	329.00	16.35	17.00
940	Rock Dove	*Columba livia*	1	46.42	240.00	10.58	11.00
123	Rock Kestrel	*Falco rupicolus*		1.74	9.00	0.96	1.00

#	Common Name	Scientific Name	Observed (Aug, Nov 2023 & Jan 2024)	SABAP2 Reporting Rates			
				Full Protocol (%)	Number of cards	Ad hoc Protocol (%)	Number of cards
506	Rock Martin	*Ptyonoprogne fuligula*		1.74	9.00	0.00	0.00
256	Ruff	*Calidris pugnax*	1	7.16	37.00	2.88	3.00
372	Rufous-cheeked Nightjar	*Caprimulgus rufigena*	1	0.19	1.00	0.96	1.00
458	Rufous-naped Lark	*Mirafra africana*	1	50.87	263.00	16.35	17.00
460	Sabota Lark	*Calendulauda sabota*	1	8.70	45.00	3.85	4.00
789	Scaly-feathered Weaver	*Sporopipes squamifrons*	1	38.30	198.00	12.50	13.00
105	Secretarybird	*Sagittarius serpentarius*		0.19	1.00	0.00	0.00
608	Sedge Warbler	*Acrocephalus schoenobaenus*	1	1.16	6.00	0.00	0.00
847	Shaft-tailed Whydah	*Vidua regia*		6.00	31.00	0.96	1.00
504	South African Cliff Swallow	*Petrochelidon spilodera*	1	25.34	131.00	11.54	12.00
90	South African Shelduck	*Tadorna cana*	1	31.72	164.00	13.46	14.00
707	Southern Fiscal	*Lanius collaris*	1	59.19	306.00	22.12	23.00
4142	Southern Grey-headed Sparrow	*Passer diffusus*	1	67.89	351.00	17.31	18.00
803	Southern Masked Weaver	*Ploceus velatus*	1	97.68	505.00	31.73	33.00
102	Southern Pochard	*Netta erythrophthalma*		2.90	15.00	1.92	2.00
808	Southern Red Bishop	*Euplectes orix*	1	83.17	430.00	27.88	29.00
390	Speckled Mousebird	*Colius striatus*	1	38.10	197.00	12.50	13.00
311	Speckled Pigeon	*Columba guinea*	1	82.40	426.00	22.12	23.00
474	Spike-heeled Lark	*Chersomanes albofasciata*	1	4.06	21.00	5.77	6.00
368	Spotted Eagle-Owl	*Bubo africanus*	1	2.32	12.00	0.96	1.00
654	Spotted Flycatcher	*Muscicapa striata*	1	12.19	63.00	0.96	1.00
275	Spotted Thick-knee	*Burhinus capensis*	1	10.64	55.00	2.88	3.00
88	Spur-winged Goose	*Plectropterus gambensis*	1	30.95	160.00	9.62	10.00
62	Squacco Heron	*Ardeola ralloides*		10.44	54.00	0.96	1.00

#	Common Name	Scientific Name	Observed (Aug, Nov 2023 & Jan 2024)	SABAP2 Reporting Rates			
				Full Protocol (%)	Number of cards	Ad hoc Protocol (%)	Number of cards
867	Streaky-headed Seedeater	*Crithagra gularis*		0.77	4.00	0.00	0.00
63	Striated Heron	*Butorides striata*	1	10.44	54.00	2.88	3.00
185	Swainson's Spurfowl	*Pternistis swainsonii*	1	52.22	270.00	8.65	9.00
411	Swallow-tailed Bee-eater	*Merops hirundineus*	1	1.16	6.00	0.00	0.00
649	Tawny-flanked Prinia	*Prinia subflava*	1	12.19	63.00	0.96	1.00
277	Temminck's Courser	*Cursorius temminckii*		0.19	1.00	0.00	0.00
804	Thick-billed Weaver	*Amblyospiza albifrons*		29.21	151.00	4.81	5.00
	Tinkling Cisticola	*Cisticola rufilatus*	1	0.19	1.00	0.00	0.00
238	Three-banded Plover	*Charadrius tricollaris*	1	32.30	167.00	2.88	3.00
851	Village Indigobird	*Vidua chalybeata*	1	16.63	86.00	1.92	2.00
797	Village Weaver	*Ploceus cucullatus*	1	0.19	1.00	0.96	1.00
736	Violet-backed Starling	*Cinnyricinclus leucogaster*	1	0.58	3.00	0.96	1.00
840	Violet-eared Waxbill	*Granatina granatina*	1	4.45	23.00	3.85	4.00
639	Wailing Cisticola	*Cisticola lais*		0.39	2.00	0.00	0.00
735	Wattled Starling	*Creatophora cinerea*	1	42.94	222.00	11.54	12.00
359	Western Barn Owl	*Tyto alba*	1	3.48	18.00	0.96	1.00
61	Western Cattle Egret	*Bubulcus ibis*	1	73.69	381.00	32.69	34.00
305	Whiskered Tern	*Chlidonias hybrida*	1	5.22	27.00	1.92	2.00
80	White Stork	*Ciconia ciconia*		0.77	4.00	0.96	1.00
391	White-backed Mousebird	*Colius colius*	1	26.50	137.00	1.92	2.00
107	White-backed Vulture	*Gyps africanus*		0.58	3.00	0.96	1.00
763	White-bellied Sunbird	*Cinnyris talatala*	1	25.92	134.00	5.77	6.00
47	White-breasted Cormorant	*Phalacrocorax lucidus*	1	20.89	108.00	5.77	6.00
780	White-browed Sparrow-Weaver	*Plocepasser mahali*	1	84.33	436.00	24.04	25.00

#	Common Name	Scientific Name	Observed (Aug, Nov 2023 & Jan 2024)	SABAP2 Reporting Rates			
				Full Protocol (%)	Number of cards	Ad hoc Protocol (%)	Number of cards
588	White-browed Scrub Robin	*Cercotrichas leucophrys*	1	1.35	7.00	0.96	1.00
100	White-faced Whistling Duck	*Dendrocygna viduata*	1	31.91	165.00	6.73	7.00
409	White-fronted Bee-eater	*Merops bullockoides*		26.31	136.00	9.62	10.00
383	White-rumped Swift	*Apus caffer*	1	23.02	119.00	5.77	6.00
582	White-throated Robin-Chat	*Cossypha humeralis*	1	2.71	14.00	0.00	0.00
495	White-throated Swallow	*Hirundo albigularis*	1	33.08	171.00	4.81	5.00
304	White-winged Tern	*Chlidonias leucopterus*		1.93	10.00	0.00	0.00
814	White-winged Widowbird	*Euplectes albonotatus*	1	13.15	68.00	2.88	3.00
599	Willow Warbler	*Phylloscopus trochilus*	1	8.70	45.00	1.92	2.00
634	Wing-snapping Cisticola	*Cisticola ayresii*		2.71	14.00	0.96	1.00
264	Wood Sandpiper	*Tringa glareola*	1	12.38	64.00	3.85	4.00
866	Yellow Canary	*Crithagra flaviventris*	1	33.85	175.00	5.77	6.00
96	Yellow-billed Duck	*Anas undulata*	1	66.92	346.00	17.31	18.00
	Yellow-fronted Tinkerbird	*Pogoniulus chrysoconus*	1	0.19	1.00	0.96	1.00
129	Yellow-billed Kite	*Milvus aegyptius*		0.97	5.00	0.96	1.00
76	Yellow-billed Stork	*Mycteria ibis*		0.77	4.00	0.00	0.00
812	Yellow-crowned Bishop	*Euplectes afer*	1	15.86	82.00	1.92	2.00
859	Yellow-fronted Canary	*Crithagra mozambica*		1.55	8.00	0.00	0.00
788	Yellow-throated Bush Sparrow	*Gymnoris superciliaris*	1	3.29	17.00	0.00	0.00
629	Zitting Cisticola	*Cisticola juncidis*	1	21.28	110.00	17.31	18.00

Appendix 2: Preliminary density estimates of passerine birds recorded from the study site and immediate surroundings during August/September 2023 and November/December 2023.

Species	kar01	kar03	kar04	kar05	kar06	kar07	kar08	kar09	kar10	kar11	kar12	kar13	kar33	kar14	kar15	kar16	kar17	kar18	kar19	kar20
African Paradise Flycatcher	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
African Pipit	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3.5
African Red-eyed Bulbul	1.5	2	2	2	0	2	1.5	2	1.5	2	0	2	2	0	2	1	1	2	0	0
African Stonechat	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0
Ashy Tit	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Barred Wren-warbler	0	0	0	0	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Bar-throated Apalis	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Black-chested Prinia	2	2	3	2	0	2	2	2	2	2	1.5	2	2	0	2	2	0	2	2	0
Black-faced Waxbill	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0
Blue Waxbill	0	2	0	0	0	0	2	4	0	2	0	0	0	0	0	0	0	0	0	0
Bokmakierie	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brown-crowned Tchagra	0	1	2	2	0	2	2	1	1	2	0	0	1	0	0	0	0	0	0	0
Buffy Pipit	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Cape Longclaw	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cape Robin-chat	1.5	0	1.5	2	0	0	0	0	0	0	0	1	1.5	0	0	0	0	0	0	0
Cape White-eye	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chestnut-vented Warbler	2	2	2	3	0	4	3	3	2	2	2	2	2	0	2	1	0	2	0	0
Chinspot Batis	0	0	0	0	0	2	2	2	0	0	0	2	0	0	0	0	0	0	0	0
Cloud Cisticola	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Desert Cisticola	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1	1	0	2	0
Fairy Flycatcher	0	0	0	0	0	1	0	1	0	1	0	1	0	0	0	0	0	0	0	0
Fiscal Flycatcher	0	1	0	0	0	0	0	1.5	2	2	0	2	1	0	0	0	0	0	0	0
Green-winged Pytilia	0	4	0	0	0	2	2	2	2	2	0	2	0	0	0	0	0	0	0	0

Species	kar01	kar03	kar04	kar05	kar06	kar07	kar08	kar09	kar10	kar11	kar12	kar13	kar33	kar14	kar15	kar16	kar17	kar18	kar19	kar20
Groundscraper Thrush	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
Jameson's Firefinch	0	2	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
Kalahari Scrub-robin	0	0	0	1	0	1	2	1	1	1	0	1	0	0	0	0	0	0	0	0
Karoo Thrush	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Lesser Grey Shrike	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Long-billed Crombec	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2	0	0	0	0	0
Melodious Lark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Neddicky	0	1	2	1	0	2	1	1.5	1	1	0	1	1	0	0	1	1	1	0	0
Nicholson's Pipit	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1.5	0	0
Orange River White-eye	3	0	2	0	0	0	0	2	0	0	0	0	2	0	0	0	0	0	0	0
Pin-tailed Whydah	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Plain-backed Pipit	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Quailfinch	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
Rattling Cisticola	2	2	2	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Red-backed Shrike	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0
Red-billed Quelea	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Red-capped Lark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	4
Rufous-naped Lark	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	1	0	0	0	0
Sabota Lark	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Southern Fiscal	0	1	0	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	1	2
Southern Grey-headed Sparrow	2	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
Southern Masked Weaver	2	9	2	2	3	5	2	2	2	4	0	2	2	0	0	0	0	1	0	1
Spotted Flycatcher	1	1	0	1	0	1	0	0	0	1	0	1	0	0	0	0	0	0	0	0
Tawny-flanked Prinia	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Violet-backed Starling	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
White-bellied Sunbird	1	0	0	0	0	1.5	0	1	1	1.5	0	1	0	0	1	0	0	2	0	0

Species	kar01	kar03	kar04	kar05	kar06	kar07	kar08	kar09	kar10	kar11	kar12	kar13	kar33	kar14	kar15	kar16	kar17	kar18	kar19	kar20
White-browed Scrub-robin	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
White-browed Sparrow-weaver	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
White-throated Robin-chat	1	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0
White-winged Widowbird	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Willow Warbler	0	1	0	1	0	2	1	1	1	1	0	1	1	0	0	0	0	0	0	0
Yellow Canary	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Zitting Cisticola	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Number of individuals	23	31	21.5	27	7	33.5	21.5	36	16.5	36.5	5.5	21	17.5	7	10	7	6	12.5	6	14.5
Number of species	14	14	11	14	4	17	12	22	11	21	4	14	12	6	6	6	5	8	4	7
Number of birds/ha	**29.49**	**39.74**	**27.56**	**34.62**	**8.97**	**42.95**	**27.56**	**46.15**	**21.15**	**46.79**	**7.05**	**26.92**	**22.44**	**8.97**	**12.82**	**8.97**	**7.69**	**16.03**	**7.69**	**18.59**
Number of species/ha	**17.95**	**17.95**	**14.10**	**17.95**	**5.13**	**21.79**	**15.38**	**28.21**	**14.10**	**26.92**	**5.13**	**17.95**	**15.38**	**7.69**	**7.69**	**7.69**	**6.41**	**10.26**	**5.13**	**8.97**
Density																				
Average number of birds/ha	**21.94**																			
Average number of species/ha	**12.82**																			

Species	kar21	kar22	kar23	kar24	kar25	kar26	kar27	kar28	kar29	kar30	kar31	kar32	kar34	kar35	kar36	kar37	Mean Bird/ha
African Paradise Flycatcher	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	**0.071**
African Pipit	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.160**
African Red-eyed Bulbul	3	0	1	0	0	1	2	1	2	1.5	1.5	4	3	1	1	3	**1.834**
African Stonechat	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.071**
Ashy Tit	0	0	0	0	0	2	0	0	0	2	2	0	2	0	0	2	**0.356**
Barred Wren-warbler	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.107**
Bar-throated Apalis	0	0	0	0	0	0	0	2	2	2	0	0	0	0	0	0	**0.285**
Black-chested Prinia	2	0	0	0	1	2	2	2	2	2	2	2	3	2	2	3	**2.119**
Black-faced Waxbill	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.107**
Blue Waxbill	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	**0.427**
Bokmakierie	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.071**
Brown-crowned Tchagra	0	0	0	0	0	2	1	0	2	0	0	2	0	0	0	2	**0.819**
Buffy Pipit	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.071**
Cape Longclaw	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.214**
Cape Robin-chat	0	0	0	0	0	2	2	2	2	2	0	0	1	0	0	2	**0.730**
Cape White-eye	0	0	0	0	0	0	2	0	0	0	0	0	0	1	0	0	**0.142**
Chestnut-vented Warbler	0	1	0	0	0	2	3	2	0	0	2	2	3	2	1.5	2	**1.941**
Chinspot Batis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	**0.356**
Cloud Cisticola	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.107**
Desert Cisticola	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	**0.427**
Fairy Flycatcher	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	**0.214**
Fiscal Flycatcher	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	**0.374**
Green-winged Pytilia	2	0	0	0	0	2	2	0	0	0	0	0	2	0	0	2	**0.926**
Groundscraper Thrush	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.071**
Jameson's Firefinch	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	**0.214**

Species	kar21	kar22	kar23	kar24	kar25	kar26	kar27	kar28	kar29	kar30	kar31	kar32	kar34	kar35	kar36	kar37	Mean Bird/ha
Kalahari Scrub-robin	0	0	0	0	0	0	1	0	0	0	0	0	1.5	0	0	1	**0.410**
Karoo Thrush	0	0	0	0	0	0	0	1	1	2	0	0	0	0	0	0	**0.214**
Lesser Grey Shrike	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.036**
Long-billed Crombec	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	**0.214**
Melodious Lark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.036**
Neddicky	0	0	0	0	0	0	1	0	0	0	0	1.5	1	1	1	0	**0.748**
Nicholson's Pipit	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.125**
Orange River White-eye	0	0	0	0	0	2	0	2	4	4	0	0	2	0	0	0	**0.819**
Pin-tailed Whydah	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	**0.071**
Plain-backed Pipit	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.036**
Quialfinch	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.071**
Rattling Cisticola	0	0	0	0	0	0	0	0	0	0	1	2	0	2	0	0	**0.499**
Red-backed Shrike	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.071**
Red-billed Quelea	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	**0.499**
Red-capped Lark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.214**
Rufous-naped Lark	1	0	1	0	0	0	0	0	0	0	2	1	0	0	0	0	**0.285**
Sabota Lark	1	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	**0.249**
Southern Fiscal	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.285**
Southern Grey-headed Sparrow	0	0	0	0	0	2	0	0	0	0	0	2	0	0	0	0	**0.285**
Southern Masked Weaver	1	0	0	0	0	2	2	1	2	2	3	3	1	0	0	2	**2.066**
Spotted Flycatcher	0	0	0	0	0	2	1	0	0	0	0	1	1	0	0	0	**0.392**
Tawny-flanked Prinia	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	**0.142**
Violet-backed Starling	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.036**
White-bellied Sunbird	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.356**
White-browed Scrub-robin	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	**0.107**
White-browed Sparrow-weaver	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.071**

Species	kar21	kar22	kar23	kar24	kar25	kar26	kar27	kar28	kar29	kar30	kar31	kar32	kar34	kar35	kar36	kar37	Mean Bird/ha
White-throated Robin-chat	0	0	0	0	0	1	1	0	1	1	0	0	0	1	0	1	**0.321**
White-winged Widowbird	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.071**
Willow Warbler	0	0	0	0	0	2	1	2	1	1	2	1	1	0	0	2	**0.819**
Yellow Canary	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	**0.107**
Zitting Cisticola	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	**0.071**
Number of individuals	15	5	7	1	3	26	22	18	19	19.5	15.5	30.5	26.5	13	5.5	29	
Number of species	10	4	6	1	3	15	14	11	10	10	8	13	15	9	4	15	
Number of birds/ha	**19.23**	**6.41**	**8.97**	**1.28**	**3.85**	**33.33**	**28.21**	**23.08**	**24.36**	**25.00**	**19.87**	**39.10**	**33.97**	**16.67**	**7.05**	**37.18**	
Number of species/ha	**12.82**	**5.13**	**7.69**	**1.28**	**3.85**	**19.23**	**17.95**	**14.10**	**12.82**	**12.82**	**10.26**	**16.67**	**19.23**	**11.54**	**5.13**	**19.23**	
Density																	
Average number of birds/ha	**21.94**																
Average number of species/ha	**12.82**																