# DEVELOPMENT OF THE HARMONY ONE PLANT SOLAR PV FACILITY NEAR VIRGINIA, FREE STATE PROVINCE

**Avifauna Scoping Report**

**July 2022**


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## EXECUTIVE SUMMARY

Pachnoda Consulting cc was requested by Savannah Environmental (Pty) Ltd on behalf of Freegold Harmony (Pty) Ltd to compile an avifauna scoping report for the proposed Harmony One Plant Solar PV facility and associated infrastructure with a contracted capacity of up to 30MW located in the town of Welkom and 14km north west of the town of Virginia, Free State Province.

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

Five avifaunal habitat types were identified on the study site and surroundings, ranging from moist mixed and secondary grassland, grassy depressions and inundated quarries to transformed and landscape/manicured areas. The study site was also surrounded by a number of pans and the Witpan Dam, which provide habitat for a large number of waterbird taxa. A total of 178 bird species have been recorded within the study area, including 11 Red listed species (threatened and near threatened species).

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

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

In addition, a total of 80 collision-prone bird species have been recorded from the study area (*sensu* atlas data), of which 62 species were waterbird and shorebird taxa and another 10 species were birds of prey. These also included the near threatened Greater Flamingo (*Phoenicopterus roseus*) and Lesser Flamingo (Pho*eniconaias minor*) which were both regular foraging visitors to the nearby Witpan Dam and the many smaller pans in the area.

The study site was located in close proximity to many prominent wetland systems or pans, and therefore the risk of waterbird colliding with the proposed infrastructure was considered to be high. In addition, a high frequency of waterbirds was expected commuting over the site on a daily basis. Therefore, it is important that the layout of the proposed PV facility, especially the placement of the PV arrays coincides with areas where the frequency of passing waterbirds was low in order to minimise potential bird collisions.

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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 Savannah Environmental (Pty) Ltd and Freegold Harmony (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)
25 July 2022

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 Savannah Environmental (Pty) Ltd on behalf of Freegold Harmony (Pty) Ltd to compile an avifauna scoping report for the proposed Harmony One Plant Solar PV facility and associated infrastructure with a contracted capacity of up to 30MW. The Harmony One Plant Solar PV facility is based near Harmony 1 Gold Plant operations located in the town of Welkom and ~14km north west of the town of Virginia within the Matjhabeng Local Municipality respectively, and within the Lejweleputswa District Municipality, Free State Province.

The solar facility will be located on a 75ha development area, which will include the PV arrays, associated infrastructure and grid connection infrastructure (Figure 2). The infrastructure associated PV facility includes:

- Solar PV arrays comprising of bifacial PV modules and mounting structures, using single axis tracking technology. Once installed, it will stand up to 5m above ground level.
- Inverters and transformers, a SCADA room, and maintenance room.
- Cabling between the project components.
- Balance of Plant:
    - Existing spare switchgear panels, upgraded switchgear circuit breakers or additional switchgear panels.
    - EK self-build works as defined in the CEL.
- On-site facility substation to facilitate the connection between the solar PV facilities and Eskom electricity grid. The Size and Capacity of the on-site stations will be 40MW.
- An onsite Medium voltage (MV) switching station forming part of the collector substation.
- Temporary laydown areas.
- Access roads, internal roads and fencing around the development area.
- Up to 132kV Overhead Power Lines (OHPL) with a maximum of 30m height with a 30m servitude width.
- Underground LV cabling will be used on the PV sites.

The PV facility will be located on the following farm portions:

| Farm Name | Portion Number |
|---|---|
| STUIRMANSPAN 92 | RE/90 |
| STUURMANSPAN 157 | RE/157 |
| MARMAGELI 20 | RE/20 |
| WELKOM 80 | RE/80 |

The facility will tie-in to the Brand gold (6.6/132 kV) substation. The grid line will have a connection capacity of up to 132kV. The line connecting the PV facility to the respective substation will be up to 44kV.

To avoid areas of potential sensitivity and to ensure that potential detrimental environmental impacts are minimised as far as possible, the developer will identify a suitable development footprint within which the infrastructure of Harmony One Plant Solar PV facility and its associated infrastructure is proposed to be located and fully assessed during the EIA Phase.

### 1.2 Terms of Reference

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

The terms of reference for this scoping report are to:

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

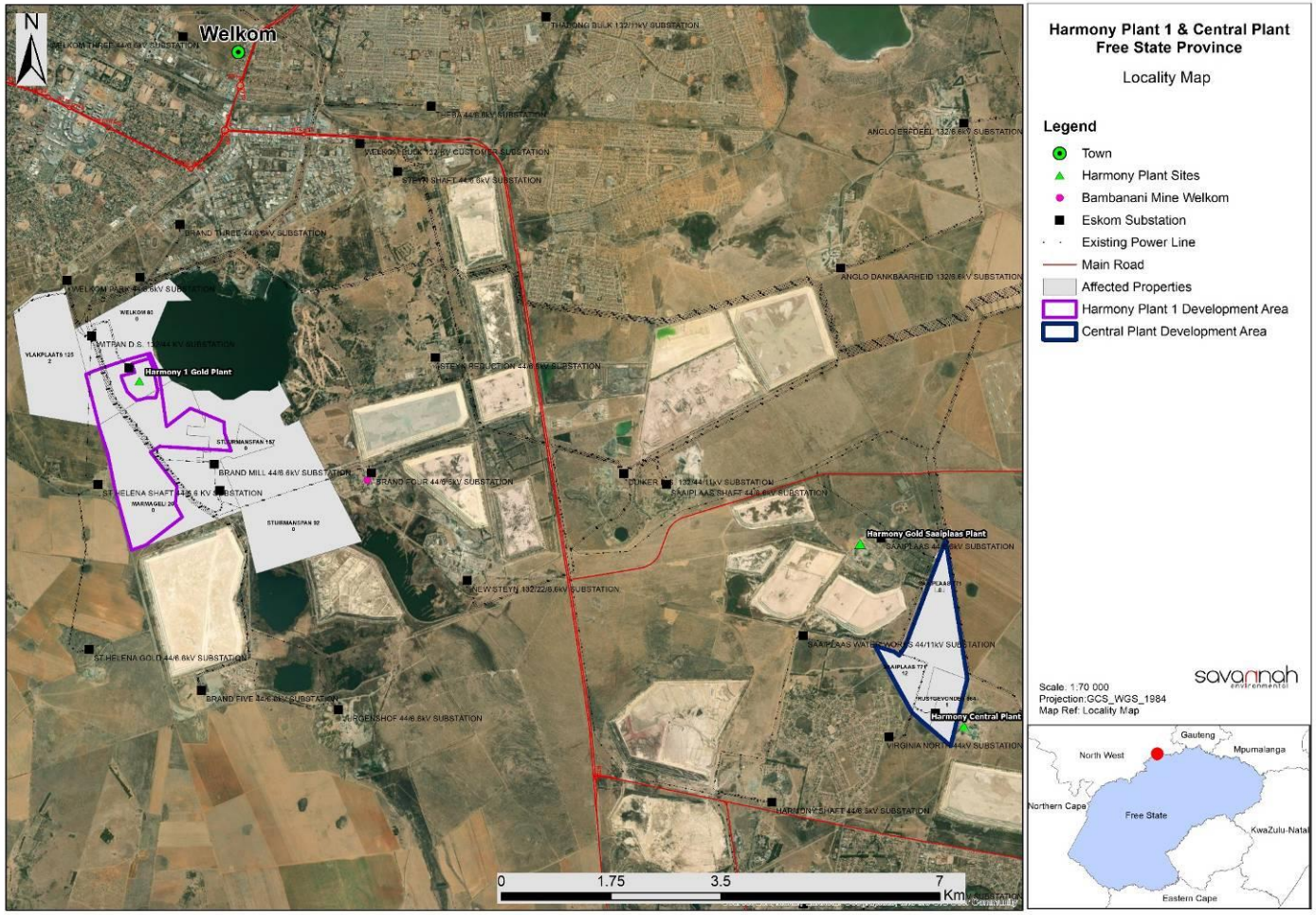



**Figure 1:** A map illustrating the geographic position of the proposed Harmony One Plant solar PV facility. The map also shows the proposed location of another PV facility known as Harmony Central Plant Solar PV.

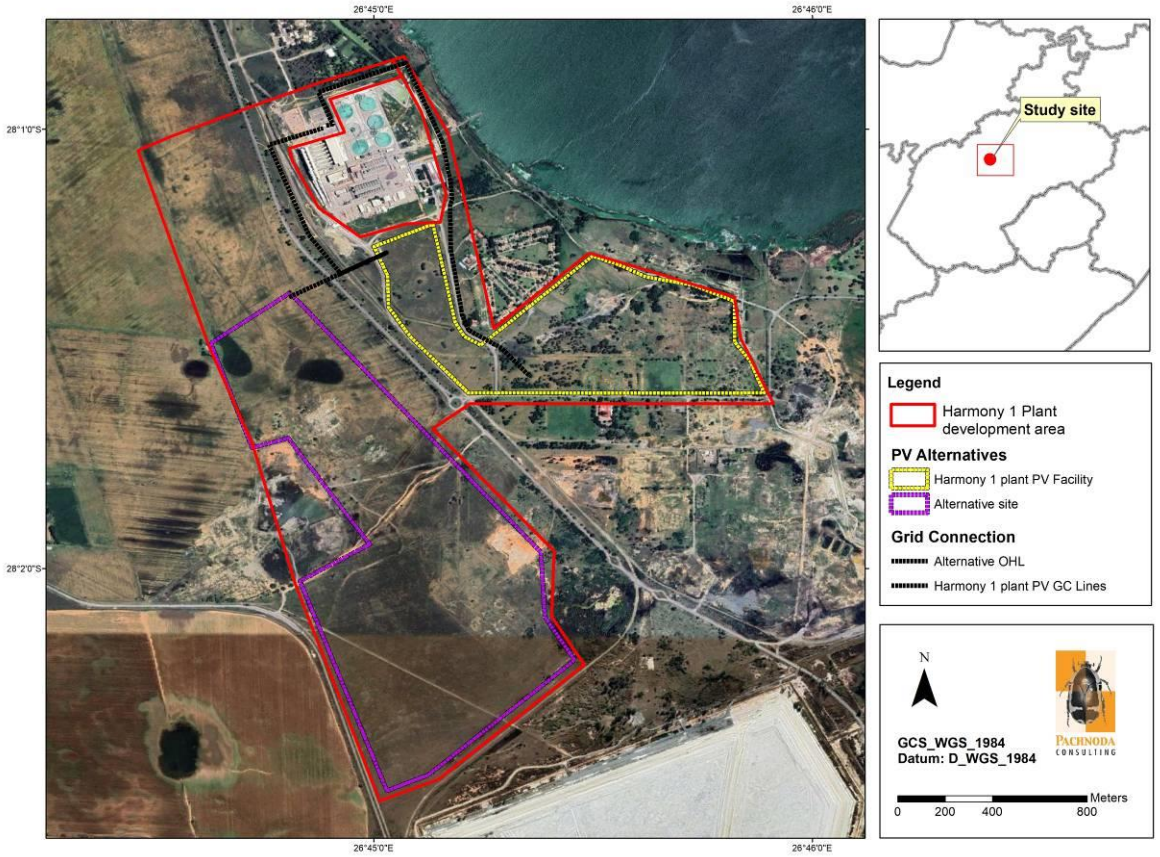



**Figure 2:** A satellite image illustrating the geographic position of the proposed Harmony One Plant Solar PV facility and proposed alternatives.

# 2. METHODS & APPROACH

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

Also take note that the current report put emphasis on the avifaunal community as a key indicator group on the proposed study site 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 (to be determined during the EIA although herewith deduced from reporting rates) could determine the outcome of the ecological sensitivity of the area and the subsequent layout of the proposed solar facility infrastructure.

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

- relevant literature – see section below;
- observations made during a site visit (06 - 09 June 2022); and
- personal observations from similar habitat types in close proximity to the study area, with emphasis on assessments conducted by Pachnoda Consulting (2020).

## 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, 2022) 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 cells (QDGCs) 2826BA (Bloudrif) and 2826BB (Virginia) (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 2800_2640 and 2800_2645 (although all eight pentad grids surrounding grid 2800_2640 were also scrutinised; Figure 4).
- The choice of scientific nomenclature, taxonomy and common names were recommended by the International Ornithological Committee (the IOC World Bird List v. 12.1), unless otherwise specified (see www.worldbirdnames.org as specified by Gill et al, 2022). Colloquial (common) names were used according to Hockey *et. al.* (2005) to avoid confusion;
- 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.

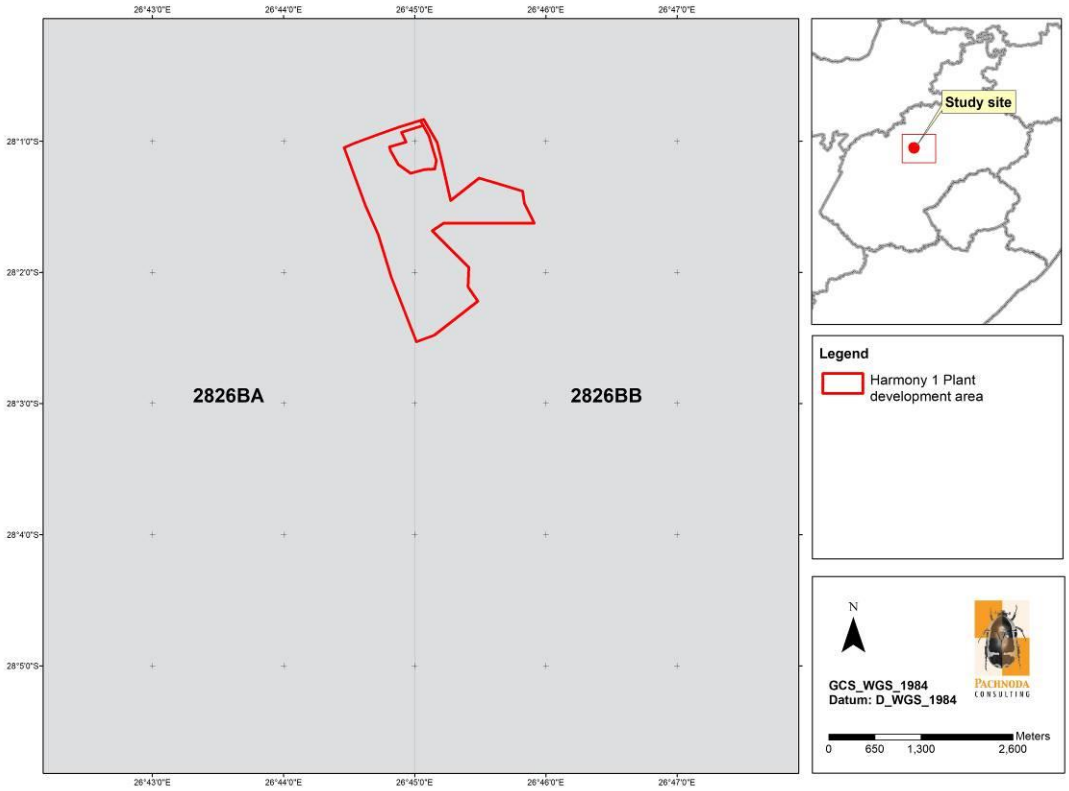



**Figure 3:** A map illustrating the quarter-degree grid cells that were investigated for this project.

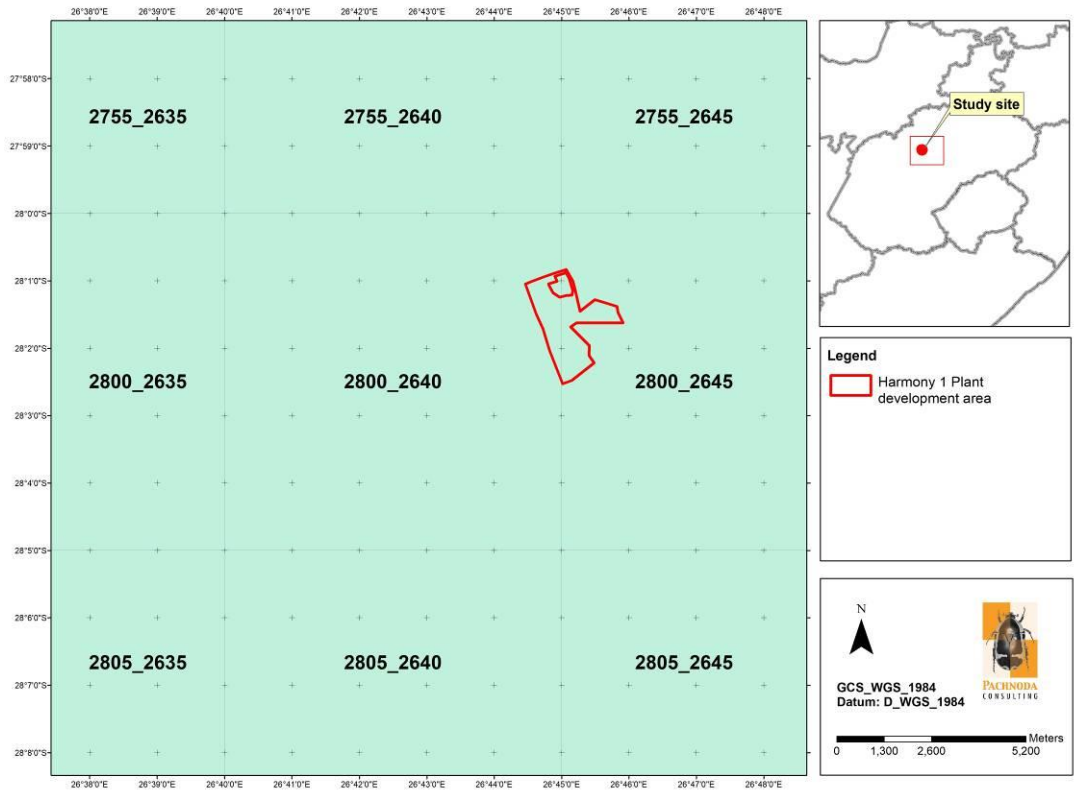



**Figure 4:** A map illustrating the pentad grids that were investigated for this project.

## 2.2 Preliminary Sensitivity Analysis

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

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

### *2.3.1 Ecological Function*

Ecological function relates to the degree of ecological connectivity between systems within a landscape matrix. Therefore, systems with a high degree of landscape connectivity amongst one another are perceived to be more sensitive and will be those contributing to ecosystem service (e.g. wetlands) or the overall preservation of biodiversity.

### *2.3.2 Avifaunal Importance*

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

### *2.3.3 Sensitivity Scale*

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

## 2.3 Limitations

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

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

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

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

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

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

# 3. PRELIMINARY RESULTS AND DESCRIPTION OF THE AFFECTED ENVIRONMENT

## 3.1 Locality

The proposed PV facility will be located near Harmony Gold Central Plant operations located ~6km north east of the town of Virginia and ~11km south east of the town of Welkom, Free State Province (Figure 1).

## 3.2 Regional Vegetation Description

The proposed PV facility corresponds to the Grassland Biome and more particularly to the Dry Highveld Grassland Bioregion as defined by Mucina & Rutherford (2006). It comprehends an ecological type known as Vaal-Vet Sandy Grassland (Mucina & Rutherford, 2006) (Figure 5).

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.

The Vaal-Vet Sandy Grassland occurs in the Free State and North-West Provinces, where it extends from Lichtenburg and Ventersdorp southwards to Klerksdorp, Leeudoringstad, Bothaville and the Brandfort area north of Bloemfontein. It occurs at an altitude of 1 220-1 560 m and is mainly confined to aeolian and colluvial sand overlying shales and mudstones. The floristic structure of the Vaal-Vet Sandy Grassland is mainly a low tussocky grassland with many karroid elements. In its untransformed condition, *Themeda triandra* is an important dominant graminoid, while intense grazing and erratic rainfall is responsible for an increase of *Elionurus muticus, Cymbopogon pospischilii* and *Aristida congesta*.

The Vaal-Vet Sandy Grassland is a threatened (**Endangered** ) ecosystem with only a few remaining patches of untransformed grassland being statutorily conserved (c. 0.3 % at Bloemhof Dam, Schoonspruit, Sandveld, Faan Meintjies, Wolwespruit and Soetdoring Nature Reserves). In addition, the Vaal-Vet Sandy Grassland is a Critically Endangered Ecosystem (as per Section 52 of National Environmental Management Biodiversity Act, (Act No. 10 of 2004)) and a Critical Biodiversity Area

as per the Free State Conservation Plan (DESTEA, 2015). More than 63 % of this grassland type is already transformed by cultivation, and intense livestock grazing.

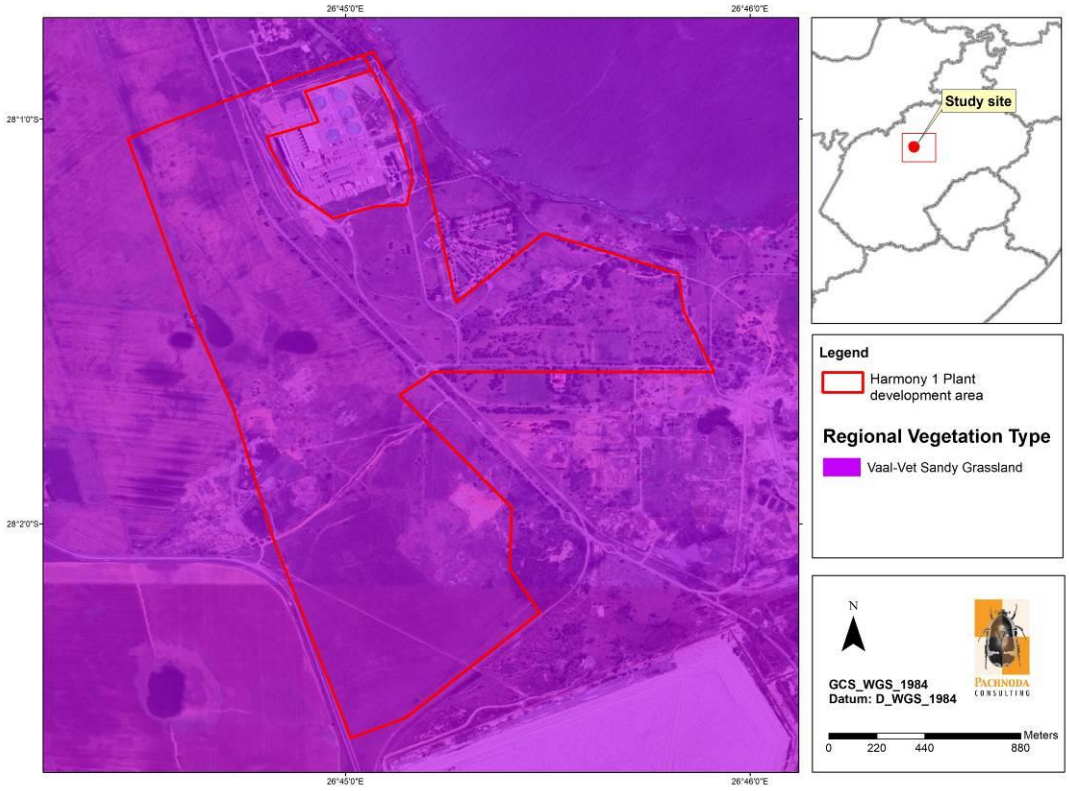



**Figure 5:** A satellite image illustrating the regional vegetation type corresponding to the study site and immediate surroundings. Vegetation type categories were defined by Mucina & Rutherford (2006; updated 2012).

### 3.3 Land cover, land use and existing infrastructure.

According to the South African National dataset of 2013-2014 (Geoterrainimage, 2015) the study site comprehends the following land cover categories (Figure 7):

Natural areas:

- Grassland;
- Low shrubland; and
- Wetlands;

Transformed areas:

- Mines and quarries; and
- Build-up areas.

From the land cover dataset it is evident that most of the study site is covered by natural grassland and low shrubland. However, quarries and build-up areas is also respectively prevalent on the western and eastern parts of the study site (the latter includes manicured and landscaped habitat consisting of exotic tree species. The majority of the study site (consisting of natural grassland) is primarily vacant with the exception of the eastern section which consists of homesteads and build-up land.

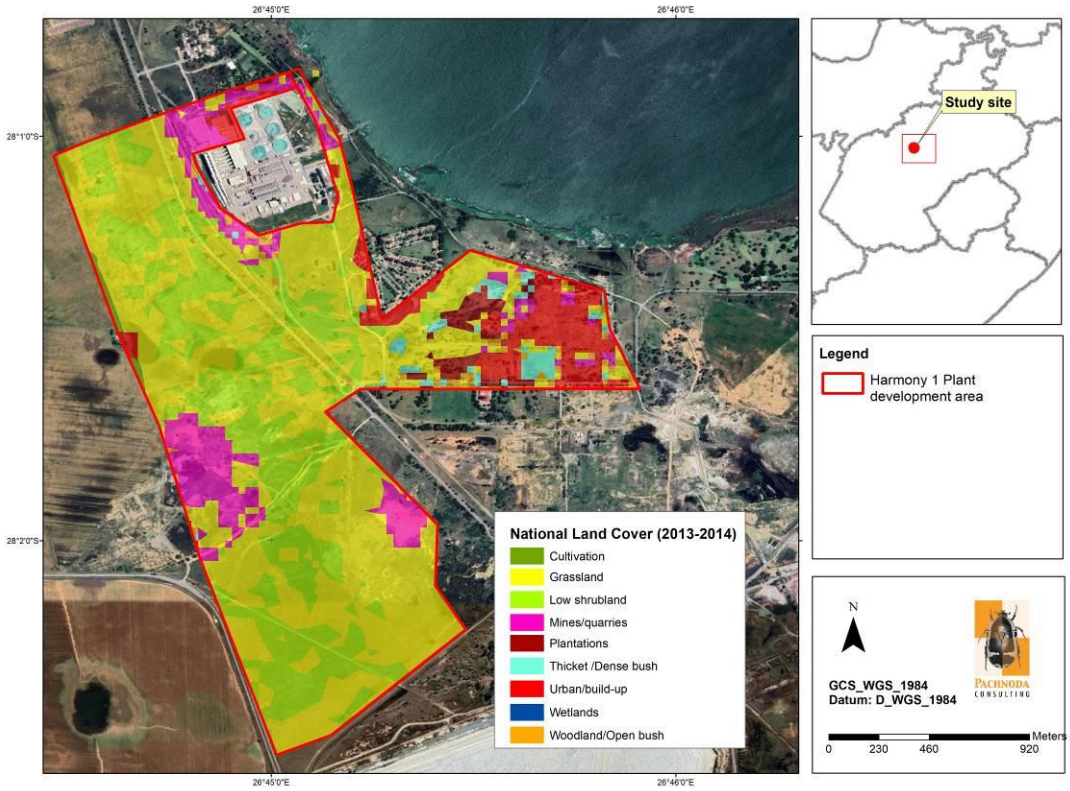



**Figure 6:** A map illustrating the land cover classes (Geoterrainimage, 2015) corresponding to the proposed study site and immediate surroundings.

### 3.4 Conservation Areas, Protected Areas and Important Bird Areas

The study site does not coincide with any conservation area or Important Bird and Biodiversity Area (IBA). The nearest conservation area to the proposed study site is the Willem Pretorius Game Reserve, which is located 45 km south-east of the study site. The Willem Pretorius Game Reserve is also a recognised IBA (SA044).

### 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 study site and immediate surroundings hold a **medium** sensitivity with respect to the relative animal species protocol (Figure 7) (report generated 25/04/2022):

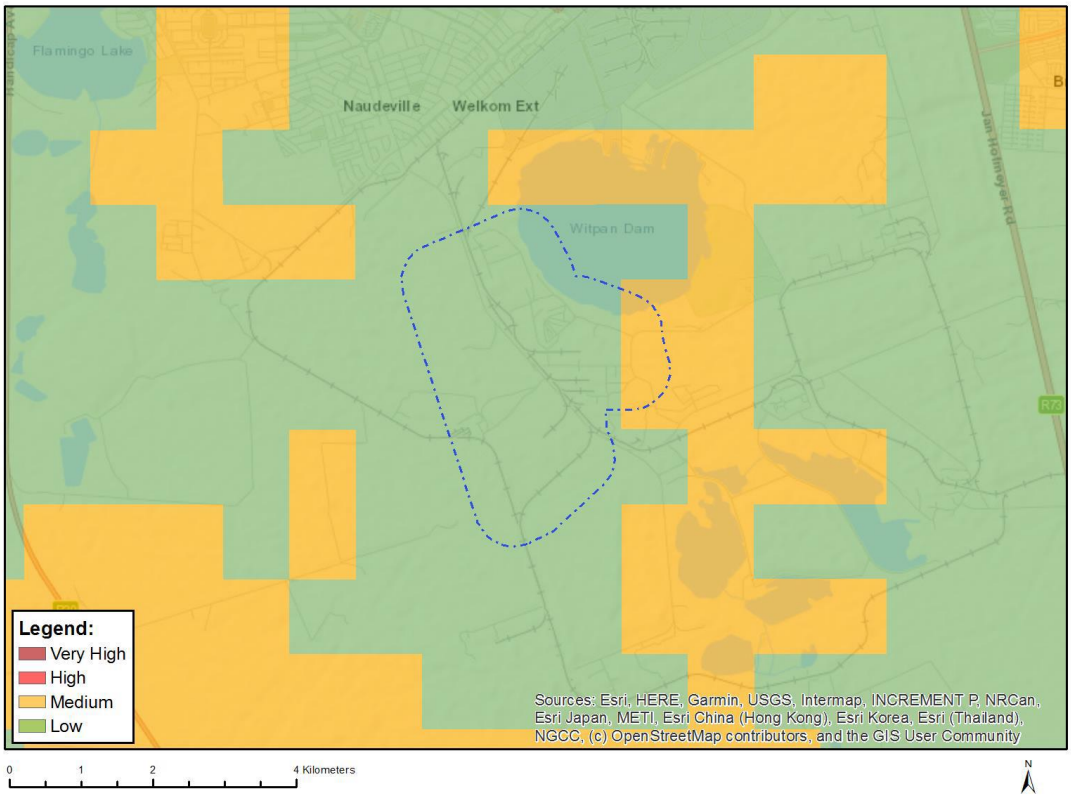



**Figure 7**: The animal species sensitivity of the study site and immediate surroundings according to the Screening Tool.

Sensitive features include the following:

| Sensitivity | Feature(s) |
|---|---|
| Low | Low sensitivity |
| Low | Reptilia-*Smaug giganteus* |
| Low | Mammalia-*Ourebia ourebi ourebi* |

According to the results of the screening tool, a low probability of occurrence is evident for threatened bird species although the eastern section holds a medium sensitivity for a threatened lizard and mammal species.

It is evident that the study site and immediate surroundings correspond to a **low** avian theme sensitivity (see Figure 8).

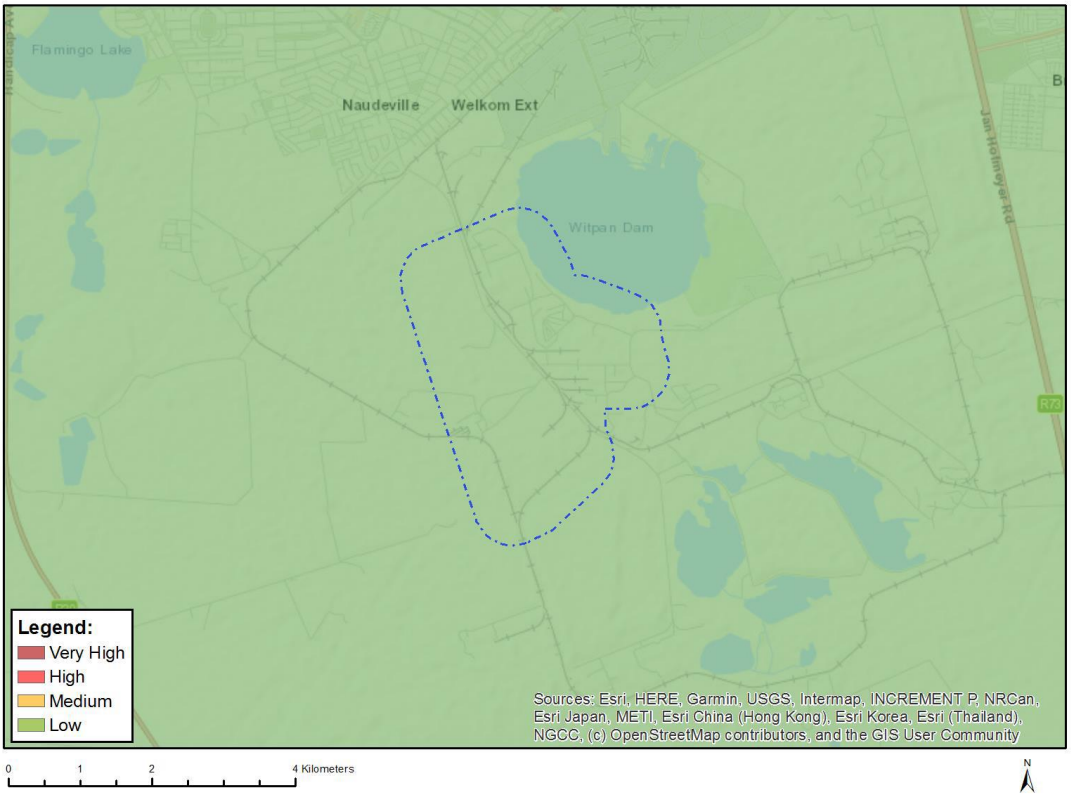



**Figure 8**: The relative avian sensitivity of the study site and immediate surroundings according to the Screening Tool.

Sensitive features include the following:

| Sensitivity | Feature(s) |
|---|---|
| Low | Low sensitivity |

However, the study site and immediate surroundings hold a **very high** sensitivity with respect to the relative terrestrial biodiversity theme (Figure 9):

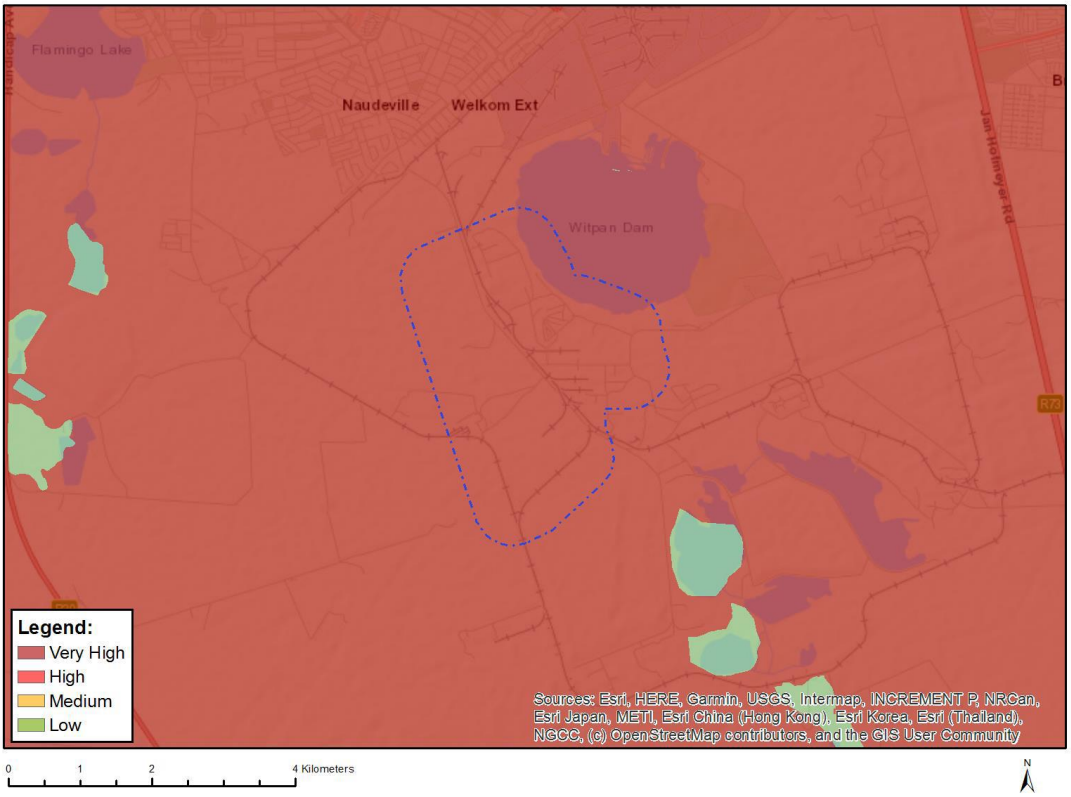



**Figure 9**: The relative terrestrial biodiversity sensitivity of the study site and immediate surroundings according to the Screening Tool.

Sensitive features include the following:

| Sensitivity | Feature(s) |
|---|---|
| Very High | Critical Biodiversity Area 1 |
| Very High | Endangered Ecosystem |

It is evident from the results of the Screening Tool report that part of the entire study area coincides with a Critical Biodiversity Area 1 (CBA 1) as per the Free State Biodiversity Plan (DESTEA, 2015). In addition, the study site also coincides with an Endangered ecosystem which is represented by the Vaal-Vet Sandy Grassland.

### 3.6 Preliminary avifaunal habitat types

Apart from the regional vegetation type, the local composition and distribution of the vegetation associations on the study site and immediate surroundings are a consequence of a combination of factors simulated by geomorphology, presence of inundated wetland features and past land use practice which have culminated in a number of habitat types that deserve further discussion[1] (Figure 11):

1. *Secondary grassland:* This unit is prominent on the study site and covers a significant surface area on the western part of the proposed PV facility which was probably utilised as cultivation in the past. It represents a grassland sere

[1] The habitat types are subject to change pending on the outcome of a detailed baseline surveys.

with a secondary albeit monotonous composition that is dominated by *Cynodon dactylon* and graminoid species of the genus *Eragrostis*. The expected bird composition is represented by widespread cryptic grassland species of which the richness is low. Typical bird species expected to be present include a variety of cisticolas (Cloud Cisticola *Cisticola textrix*, Desert Cisticola *C. aridulus* and Zitting Cisticola *C. juncidis*), Cape Longclaw (*Macronyx capense*), Rufous-naped Lark (*Mirafra africana*) and Long-tailed Widowbird (*Euplectes progne*). It also provides ephemeral foraging habitat for collision-prone species such as the Northern Black Korhaan (*Afrotis afraoides*).

2. *Moist mixed grassland:* This unit is located on the southern part of the study site as well as at the western boundary adjacent to the Witpan Dam shoreline. The graminoid structure and composition is essentially similar to that of the secondary grassland unit, although the graminoid composition appears to be higher and more diverse and it is located on soils with a high moisture content (probably due to seepage from the nearby slimes dams and pans). The bird composition is also similar to that of the secondary grassland although it provides habitat for high numbers of foraging passerine birds, especially when burned (caused by veld fires). Large numbers of foraging granivores and insectivores colonise this grassland sere during the dry season which include prominent species such as Red-billed Quelea (*Quelea quelea*), Pied Starling (*Lamprotornis bicolor*), Red-capped Lark (*Calandrella cinerea*), Southern Red Bishop (*Euplectes orix*) and Long-tailed Widowbird (*E. progne*). The endemic Melodious Lark (*Mirafra cheniana*) is a regular foraging and potential breeding resident (pers. obs.).

*3.* *Depressions*: This habitat occurs on the western part of the study site and is represented by a series of small grassy depressions of which the basins are colonised by members of the Cyperaceae, especially species of the genus *Eleocharis, Kyllinga* and *Cyperus*. The edges are often dominated by *Eragrostis gummiflua*. This habitat provides habitat for a unique bird composition represented by many smaller wetland-associated passerine species, although larger non-passerines such as waterfowl were absent since the presence of open water and lentic conditions were uncommon, which will discourage waterfowl and shorebirds from utilising the habitat. Expected typical bird species include Zitting Cisticola (*C. juncidis*), Levaillant's Cisticola (*C. tinniens*) and Quailfinch (*Ortygospiza atricollis*).

*4.* *Artificial dam and inundated quarries*: These are represented by mined quarries which have become inundated during precipitation events and groundwater infiltration. Although artificial of origin, these often provide ephemeral foraging habitat for widespread waterfowl and shorebird such as Egyptian Goose (*Alopochen aegyptiacus*), Little Grebe (*Tachybaptus ruficollis*), Red-knobbed Coot (*Fulica cristata*) and Three-banded Plover (*Charadrius tricollaris*).

5. *Transformed and landscaped (manicured) areas*: These areas are represented by build-up land and landscaped areas of which the tree cover is predominantly composed of exotic species. These features are invariably also artificial although colonised by a high number of bird species which favours the vertical heterogeneity provided by the tree canopy. However, the bird composition is expected to be represented by a "bushveld" composition which is often present in urban landscaped (manicured) gardens and parks (c. Ring-necked Dove *Streptopelia capicola*, White-browed Sparrow-weaver *Plocepasser mahali*, Red-eyed Dove *S. semitorquata*, Common Myna *Acridotheres tristis*, Crested Barbet *Trachyphonus vaillantii* and Cape Starling *Lamprotornis nitens*).

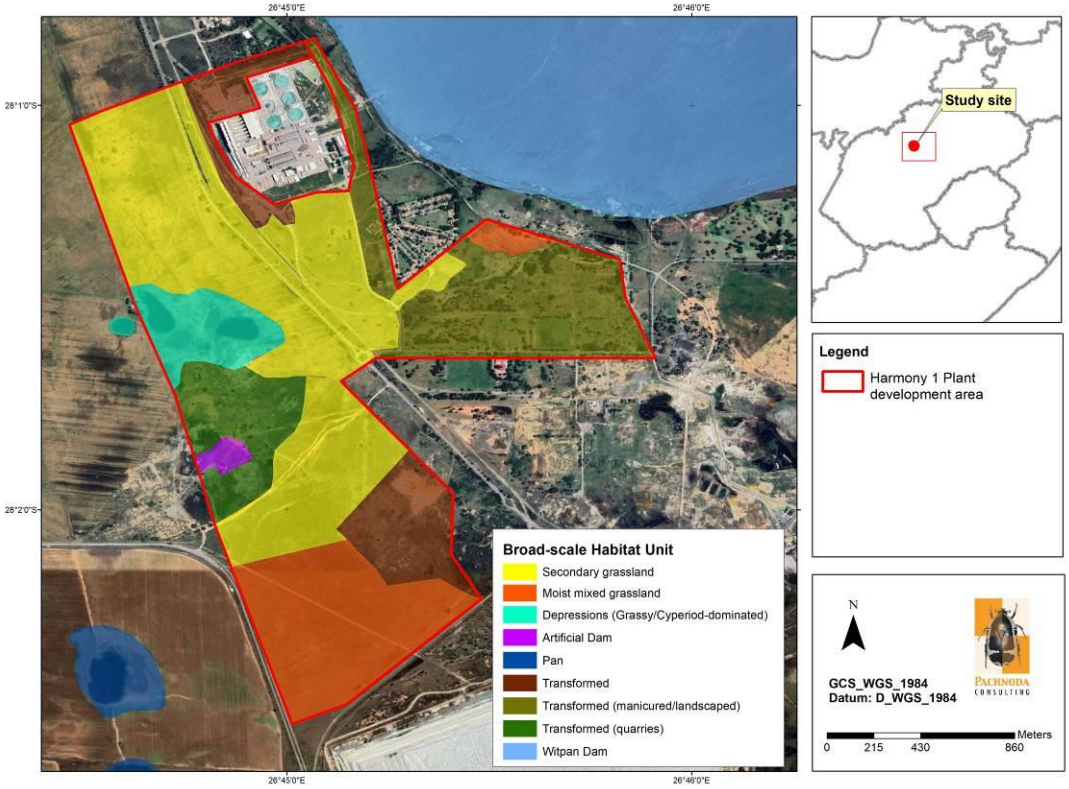



**Figure 10:** A preliminary habitat map illustrating the avifaunal habitat types on the study site and immediate surroundings (the habitat types are subject to change pending the outcome of a detailed baseline surveys).

### 3.7 Species Richness and Predicted summary statistics

Approximately ~178 bird species have been recorded within the study area refer to (Appendix 1 & Table 1), although it is more likely that between 80 - 100 bird species could occur within the physical boundaries of the study site (according to the habitat types and the ecological condition thereof). The richness was inferred from the South African Bird Atlas Project (SABAP2)[2] (Harrison et al., 1997; www.sabap2.birdmap.africa) and the presence of suitable habitat in the study area. This equates to 18 % of the approximate 987[3] species listed for the southern African subregion[4] (and approximately 20 % of the 871 species recorded within South Africa[5]). However, the species richness obtained from the pentad grids corresponding to the study area (c. 2800_2640 and 2800_2645) range between 123 and 148 species (which include a number of large pans and dams which were not present within the physical boundaries of the study site), with an average number of 70 species for each full protocol card submitted (for observation of two hours or more; range= 35-101 species).

According to Table 1, the study area is poorly represented by biome-restricted[6] (see Table 2) and local endemic and near-endemic bird species. It supports *ca*. 21 % of the near -endemic species present in the subregion. However, a large percentage of the species recorded in the study area is represented by waterbirds and shorebird taxa (ca. 37% of the total number of recorded bird species, sensu SABAP2).

**Table 1:** A summary table of the total number of species, Red listed species (according to Taylor et al., 2015 and the IUCN, 2022), endemics and biome-restricted species (Marnewick et al., 2015) expected (*sensu* SABAP2) to occur in the study site and immediate surroundings.

| Description | Expected Richness Value |
|---|---|
| Total number of species* | 178 (20 %) |
| Number of Red Listed species* | 11 (8 %) |
| Number of biome-restricted species – Zambezian and Kalahari-Highveld Biomes)* | 2 (14 %) |
| | |
| Number of local endemics (BirdLife SA, 2022)* | 3 (8 %) |
| Number of local near-endemics (BirdLife SA, 2022)* | 6 (20 %) |
| Number of regional endemics (Hockey *et al.,* 2005)** | 16 (15 %) |
| Number of regional near-endemics (Hockey *et al.,* 2005)** | 13 (21 %) |

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

[2] The expected richness statistic was derived from pentad grids 2800_2640 and 2800_2645 totalling 177 bird species (based on 39 full protocol cards).

3 *sensu* www.zestforbirds.co.za (Hardaker, 2020), including four recently confirmed bird species (vagrants.

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

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

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

** 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, 2022).

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

| Species | Kalahari-Highveld | Zambezian | Expected Frequency of occurrence |
|---|---|---|---|
| Kalahari Scrub-robin (*Cercotrichas paena)* | X | | Uncommon |
| White-bellied Sunbird (*Cinnyris talatala*) | | X | Uncommon |

### 3.8 Bird species of conservation concern

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

It is evident from Table 3 that the highest reporting rates (>10%) were observed for the globally endangered Maccoa Duck (*Oxyura maccoa*), the regionally endangered Yellow-billed Stork (*Mycteria ibis*), the globally near threatened Lesser Flamingo (*Phoeniconaias minor*) and Curlew Sandpiper (*Calidris ferruginea*) and the regionally near threatened Greater Flamingo (*Phoenicopterus roseus*). These species are regarded as regular foraging visitors to the pans and the Witpan Dam which occur adjacent to the study site. However, these species are probably absent on the physical study site due to the absence of any suitable habitat on the study site. *Nevertheless, birds dispersing or commuting between the nearby pans and Witpan Dam will have to fly over the study site and could potentially interact (collide) with the PV panels and associated electrical infrastructure*.

The regionally vulnerable Lanner Falcon (*Falco biarmicus*) appears to be resident on the study site, where it as observed hunting pigeons and doves between the Harmony one plant and the onsite substation. This species was previously overlooked since it was last recorded during 2014 in the study area (sensu SABAP2).

The remaining species have low reporting rates (<10%) and are regarded as irregular foraging visitors with low probabilities of occurrence. The low probability of occurrence for these species is due to absence of suitable habitat (mainly foraging habitat) on the study site and the historical displacement of these species owing to increased anthropogenic disturbances (e.g. agriculture, mining activities and pedestrians).

**Table 3:** Bird species of conservation concern that could utilise the study site based on their historical distribution range and the presence of suitable habitat. Red list categories according to the IUCN (2022)* and Taylor et al. (2015)**.

| Species | Global Conservation Status* | National Conservation Status** | SABAP2 reporting rate | Preferred Habitat | Potential Likelihood of Occurrence |
|---|---|---|---|---|---|
| *Calidris ferruginea* (Curlew Sandpiper) | Near-threatened | - | 12.82 | Generally confined to muddy fringes of inland pans and large impoundments, lagoons and estuaries. | Regular summer non-breeding visitor to the shoreline habitat of nearby pans and large impoundments.<br><br>Probably absent on the physical study site due to the absence of suitable habitat. Birds dispersing between pans could potentially fly over the site and may interact with the PV panels. |
| *Ciconia abdimii* (Abdim's Stork) | - | Near-threatened | 2.56 | A non-breeding summer visitor to open grassland and recently tilled agricultural land. | Probably highly irregular foraging visitor in summer. Highly seasonal and often absent in some years.<br><br>It has not been recently observed on the study area (it was lass recorded during 2010; *sensu* SABAP2). |
| *Charadrius pallidus* (Chestnut-banded Plover) | - | Near-threatened | 7.69 | Partial to the shoreline of saline pans and also saltworks. | An uncommon visitor to the shoreline habitat of nearby pans.<br><br>Probably absent on the physical study site due to the absence of suitable habitat. Birds dispersing between pans could potentially |

| Species | Global Conservation Status* | National Conservation Status** | SABAP2 reporting rate | Preferred Habitat | Potential Likelihood of Occurrence |
|---|---|---|---|---|---|
| | | | | | fly over the site and may interact with the PV panels. |
| *Eupodotis caerulescens* (Blue Korhaan) | Near-threatened | (delisted) | 2.56 | Prefers extensive open short grassland and cultivated land. | Vagrant, probably absent and historically displaced due to anthropogenic activities.<br><br>It has not been recently observed on the study area (it was last recorded during 2012; *sensu* SABAP2). |
| *Falco biarmicus* (Lanner Falcon) | - | Vulnerable | 2.56 | Varied, but prefers to breed in mountainous areas although also using old disused mine voids. | It appears to be resident on the study site where it was frequently observed hunting pigeons and doves between the main Harmony One plant and the on-site substation (pers. obs.).<br><br>This individual was probably overlooked since it was previously recorded during 2014 on the study site. |
| *Oxyura maccoa* (Maccoa Duck) | Endangered | Vulnerable | 58.97 | Large saline pans and shallow impoundments. | A regular foraging visitor and possibly also breeding visitor to the pans and impounds adjacent to the study site.<br><br>Probably absent on the physical study site due to the absence of suitable habitat. Birds dispersing between pans |

| Species | Global Conservation Status* | National Conservation Status** | SABAP2 reporting rate | Preferred Habitat | Potential Likelihood of Occurrence |
|---|---|---|---|---|---|
| | | | | | could potentially fly over the site and may interact with the PV panels en electrical infrastructure. |
| *Mycteria ibis* (Yellow-billed Stork) | - | Endangered | 17.95 | Wetlands, pans and flooded grassland. | A regular foraging visitor to the pans and impounds adjacent to the study site.<br><br>Probably absent on the physical study site due to the absence of suitable habitat. Birds dispersing between pans could potentially fly over the site and may interact with the PV panels en electrical infrastructure. |
| *Phoeniconaias minor* (Lesser Flamingo) | Near-threatened | Near-threatened | 64.10 | Restricted to large saline pans and other inland water bodies containing cyanobacteria. | A regular foraging visitor to the shallow margins of Witpan Dam (pers. obs.) and probably also the nearby smaller pans.<br><br>Probably absent on the physical study site due to the absence of suitable habitat. Birds dispersing between the pans and dams in the area could potentially fly over the site and may interact with the PV panels en electrical infrastructure. |
| *Phoenicopterus roseus* (Greater Flamingo) | - | Near-threatened | 69.23 | Restricted to large saline pans and other inland water bodies. | A highly regular foraging visitor to the shallow margins of |

| Species | Global Conservation Status* | National Conservation Status** | SABAP2 reporting rate | Preferred Habitat | Potential Likelihood of Occurrence |
|---|---|---|---|---|---|
| | | | | | Witpan Dam (pers. obs.) and probably also the nearby smaller pans.<br><br>Probably absent on the physical study site due to the absence of suitable habitat. Birds dispersing between the pans and dams in the area could potentially fly over the site and may interact with the PV panels en electrical infrastructure. |
| *Rostratula benghalensis* (Greater Painted-snipe) | - | Near-threatened | 2.56 | Prefers well-vegetated seasonally inundated depressions and pans, especially in the Savanna Biome. | A highly irregular foraging visitor and probably absent on the study site.<br><br>It has not been recently observed on the study area (it was last recorded during 2012; *sensu* SABAP2). |
| *Sagittarius serpentarius* (Secretarybird) | Endangered | Endangered | 2.56 | Prefers open grassland or lightly wooded habitat. | A highly irregular foraging visitor and probably absent on the study site. Historically displaced due to anthropogenic activities.<br><br>It has not been recently observed on the study area (it was last recorded during 2009; *sensu* SABAP2). |

## 3.9 Preliminary avifaunal sensitivity

A preliminary sensitivity map was compiled, illustrating habitat units comprising of potential sensitive elements based on the following arguments (Figure 12):

*Areas of high sensitivity*

It includes the grassy depressions, all adjacent pans and the buffer zones.

The grassy depressions have the potential to attract passerine bird species with high affinities for wetland-associated habitat units. It thereby contributed towards the local avian richness in supporting bird species that are otherwise absent from the surrounding terrestrial "dryland" grassland units.

More importantly, the nearby pans and the Witpan Dam support large congregations of waterfowl and shorebirds taxa, including globally and regionally threatened and near threatened species (e.g. flamingo taxa). These pans are also important from a functional and dynamic perspective at the landscape level since it forms part of an "inter-connected" system or "stepping stones" within the regional catchment, meaning that environmental conditions at these pans (e.g. water levels, salinity, food availability, availability of shoreline habitat) are constantly changing. Therefore, none of the pans within catchment are similar to each, thereby providing a continuous supply of resources for waterbirds which tend to commute on a daily basis over the study site and along the edges of the slimes dams (which are often inundated). The placement of electrical infrastructure and PV panels in close proximity to these areas as well as on areas where the frequency of fly-overs by waterbirds are high could increase potential avian collisions with the infrastructure. Nevertheless, the inundaed quarries are of artificial origin, and could be removed.

*Areas of medium sensitivity*

It includes the moist mixed grassland and the artificial impoundment/quarry. The grassland provide potential suitable foraging habitat for a high number of bird species and bird individuals when compared to the other units. However, reporting rates for threatened and near threatened bird species are anticipated to be relatively low, thereby suggesting a medium sensitivity rating instead of a high sensitivity even though the majority of the habitat is natural. In addition, the inundated quarry attracts small numbers of waterfowl and shorebirds which feed and roost along the margins, especially Spur-winged Goose (*Plectropterus gambiensis*), Egyptian Goose (*Alopochen aegyptiacus*), South African Shelduck (*Tadorna cana*) and Three-banded Plover (*Charadrius tricollaris*).

*Areas of low sensitivity*

These habitat units are represented by transformed types and include the secondary grasslands, a build-up land and landscaped/manicured areas.

*The preliminary sensitivity map shows a large surface area that is earmarked with low sensitivity. There is a probability that some of these units or part thereof could have higher (or lower) sensitivity ratings. It is therefore expected that some of the units or part thereof could represent different sensitivity ratings to those displayed in Figure 121pending the outcome of a detailed baseline survey.*

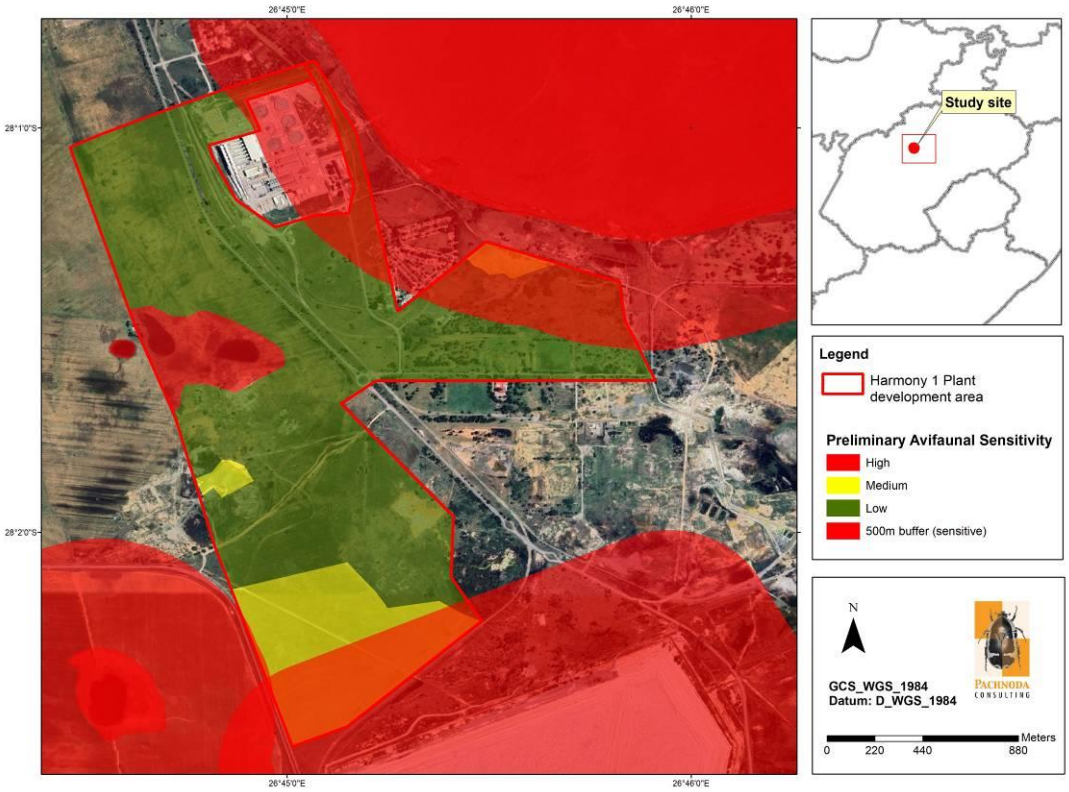



**Figure 11**: A map illustrating the preliminary avifaunal sensitivity of the area based on habitat types supporting bird taxa of conservation concern and important ecological function.

### 3.10 Overview of Avian Impacts at Solar Facilities

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

### *3.10.1 Background to solar facilities and their impact on birds*

Birds are mobile, and are therefore also more readily affected by solar facilities than other taxonomic groups (e.g. mobile mammals that could move away from the facilities due to displacement). In fact, birds are also vulnerable to impacts caused by other types of energy facilities such as overhead power lines and wind farms. Little information is available on the impacts of solar energy facilities on birds although Gunerhan *et al.* (2009), McCrary *et al.* (1986), Tsoutsos *et al.* (2005) and the recent investigation reports on bird fatalities in the USA by Kagen *et al*. (2014) and Walston *et al*. (2016) provide discussions thereof. These studies have shown that avian fatalities vary greatly between the geographic positions of the solar facilities and also depend on the type of solar facility. In addition, very few of the large solar facilities in operation undertake systematic monitoring of avian fatalities, which explains the lack of detailed information of avian impacts. According to these studies conducted at both Concentrated Solar Power (CSP) and PV facilities, avian incidental fatalities range from 14 to over 180 birds which were summarised over a survey period conducted during one to three years. According to the Walston *et al.* (2016) assessment, the average annual mortality rate for known utility-scale solar facilities (the annual number of estimated bird deaths per megawatt of electrical capacity) is 2.7, and 9.9 for known and unknown fatalities (which include carcasses found on the project site of which the death is not known). McCrary *et al.* (1986) found an average rate of mortality of 1.9-2.2 birds per week affecting 0.6-0.7 % of the local bird population. However, most of the avian fatalities at these solar facilities are also probably underestimated since 10-30 % of dead birds are removed by scavengers before being noted.. From these analyses and assessments it was evident that:

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

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

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

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

### *3.10.2 Potential impacts of PV solar facilities on birds*

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

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

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

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

- The loss of habitat and subsequent displacement of bird species due to the ecological footprint required during construction;
- Disturbances caused to birds during construction and operation;

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

## 3.11 Potential Impacts associated with the proposed PV Solar Facility

### *3.11.1 Loss of habitat and displacement of birds*

Most of the study site will cleared of vegetation and habitat to accommodate the panel arrays and associated infrastructure. Clearing of vegetation will inevitably result in the loss of habitat and displacement of bird species. From the preliminary results it is evident that smaller passerine species are likely more likely to become displaced as opposed to small passerine species. It is particularly endemic species that are likely to become displaced, as well as habitat specialists (e.g. grassland specialists) which will disappear from the area.

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

- Melodious Lark (Mirafra cheniana);
- Cloud Cisticola (Cisticola textrix); and to a lesser extend also
- Kalahari Scrub Robin (*Cercotrichas paena*);
- Northern Black Korhaan (*Afrotis afraoides*).

### *3.11.2 Collision trauma caused by photovoltaic panels (the "lake-effect")*

The presence of pans, inundated quarries and the Witpan Dam in close proximity to the study site increase the risk of waterbirds and shorebird taxa interacting with the PV panels. A number of species were observed with a high frequency of occurrence which traversed the study site in on a daily basis (bird dispersing between the pans) which could interact with the PV panels.

Placement of the proposed PV panels will be critical and should preferably correspond to the northern part of the study site and as well as the appropriate application of bird deterrent devices such as a combination of rotating

flashers/reflectors, including diverters which emit light during nigh time to increase the visibility of the infrastructure for birds such as flamingos which tend to disperse during the night. Post construction monitoring to quantify mortalities will be important during to early operational phase in order to determine "hotspot" areas which may require additional mitigation measures.

Desktop results and site observations show that the following species could interact with the panel infrastructure:

- South African Shelduck (*Tadorna cana*);
- Egyptian Goose (*Alopochen aegyptiaca*);
- Spur-winged Goose (*Plectropterus gambiensis*);
- Yellow-billed Duck (*Anas undulata*);
- White-faced Duck (*Dendrocygna viduata*);
- Red-billed Teal (*Anas erythrorhynchus*);
- Cape Teal (*Anas capensis*);
- Cape Shoveller (*Anas smithii*);
- Glossy Ibis (*Plegadis falcinellus*);
- Black-winged Stilt (*Himantopus himantopus*);
- Three-banded Plover (*Charadrius tricollaris*); and potentially also
- Greater Flamingo (*Phoenicopterus roseus*);
- Lesser Flamingo (*Phoeniconaias minor*);
- Maccoa Duck (*Oxyura maccoa*);
- White-breasted Cormorant (*Phalacrocorax lucidus*)
- Reed Cormorant (*Microcarbo africanus*);
- African Sacred Ibis (*Threskiornis aethiopicus*) and potentially also
- Little Grebe (*Tachybaptus ruficollis*);
- Black-headed Heron (*Ardea melanocephala*);
- Red-knobbed Coot (*Fulica cristata*);
- Grey Heron (*Ardea cinerea*);
- Little Egret (*Egretta garzetta*);
- Great Egret (*Ardea alba*);
- African Darter (*Anhinga rufa*);
- Common Moorhen (*Gallinula chloropus*) and
- African Swamphen (*Porphyrio madagascariensis*).

### *3.11.3 Interaction with overhead powerlines and reticulation*

A 132kV overhead powerline is proposed to tie-in to the Brand gold (6.6/132 kV) substation. Birds are impacted in three ways by means of overhead powerlines (described below). It is however a common rule that large and heavy-bodied terrestrial bird species are more at risk of being affected in a negative way when interacting with powerlines in general. These include the following:

- *Electrocution*

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

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

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

It is therefore recommended that the pylon design incorporates "features as illustrated by Figure 13[7].

From Figure 13 it is clear that perching of birds is discouraged by the addition of diagonal crossbars or by doing away with the crossbars that holds the conductors in place. Bird "streamers" are also eliminated by fitting the poles with bird guards/spikes above the conductors. However, safe perching is facilitated by the fitment of a horizontal bar on top of the pole structure without the risk of electrocution (due to the perpendicular orientation of the bar relative to the conductors).

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

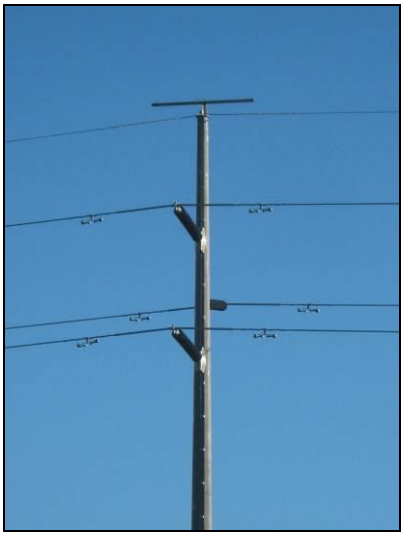
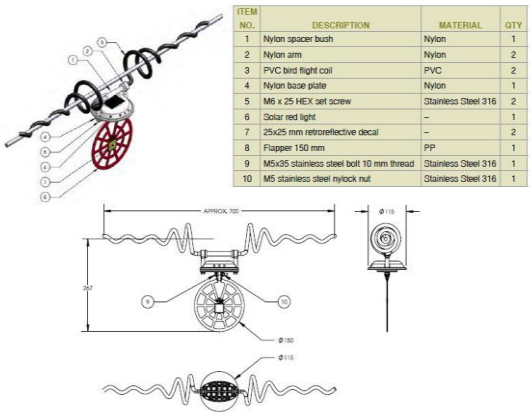


**Figure 12:** Two bird-friendly tower designs to be used for the current project.

- *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) also considers the fitment of dynamic devices such as the "Viper live bird flapper" and nocturnal LED solar-charged bird diverters owing to the potential nocturnal flyovers by flamingo taxa (see figure 13).



| ITEM NO. | DESCRIPTION | MATERIAL | QTY |
|---|---|---|---|
| 1 | Nylon spacer bush | Nylon | 1 |
| 2 | Nylon arm | Nylon | 2 |
| 3 | PVC bird flight coil | PVC | 2 |
| 4 | Nylon base plate | Nylon | 1 |
| 5 | M6 x 25 HEX set screw | Stainless Steel 316 | 2 |
| 6 | Solar red light | – | 1 |
| 7 | 25x25 mm retroreflective decal | – | 2 |
| 8 | Flapper 150 mm | PP | 1 |
| 9 | M5x35 stainless steel bolt 10 mm thread | Stainless Steel 316 | 1 |
| 10 | M5 stainless steel nylock nut | Stainless Steel 316 | 1 |


**Figure 13:** Examples of bird flight diverters to be used on the power lines: Nocturnal LED solar-charged bird diverter (left) and Viper live bird flapper (right).

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

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

| Issue 2 | Nature of Impact | Extent | No-Go Areas |
|---|---|---|---|
| **Impact:** Avian collision impacts related to the PV facility during the operational phase (collision with the PV panels). | | | |
| Potential collision of birds with the PV panel structures | Negative, especially for waterbirds and shorebird taxa | Local and immediate surrounding area | Potentially the southern part of the study area where a high frequency of passing birds is expected on a daily basis. |
| **Description of expected significance of impact:** The impact will be of a long duration (prior to mitigation) and is probable with a high significance, but may be reduced to a medium significance according to placement of PV arrays and appropriate mitigation and monitoring protocols (to be assessed during the EIA phase). | | | |
| **Gaps in knowledge and recommendations for further study:** A wet season survey is proposed to determine occurrence of waterbird species. | | | |

| Issue 3 | Nature of Impact | Extent | No-Go Areas |
|---|---|---|---|
| **Impact:** Avian collision impacts related to the powerline reticulation and new distribution lines during operation. | | | |
| Potential collision due to electrical overhead distribution lines | Negative, especially for large-bodied species and potentially also storks and flamingo taxa | Site and immediate surroundings | Potentially the southern part of the study area where a high frequency of passing birds is expected on a daily basis. |
| **Description of expected significance of impact:** The impact will be of a long duration (prior to mitigation) and probable with a medium significance, but may be reduced to a moderate or even low significance as per recommended mitigation measures (to be assessed during the EIA phase). | | | |
| **Gaps in knowledge and recommendations for further study:** A baseline survey is proposed to determine occurrence of collision prone bird species. | | | |

### 3.12 Collision-prone bird species

A total of 80 collision-prone bird species have been recorded from the study area, of which 62 species are waterbirds and 10 species are birds of prey (Table 5). According to Table 5, it is evident that the number of potential collision-prone species that could occur in the study area is high (c. 45% of the total number of bird species recorded in the area).

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

| Common Name | Scientific Name | SABAP2 Reporting Rate | | | |
|---|---|---|---|---|---|
| | | Full Protocol (%) | Number of cards | Ad Hoc Protocol (%) | Number of cards |
| Abdim's Stork | *Ciconia abdimii* | 2.56 | 1 | 6.25 | 1 |
| African Darter | *Anhinga rufa* | 41.03 | 16 | 6.25 | 1 |
| African Fish Eagle | *Haliaeetus vocifer* | 15.38 | 6 | 0.00 | 0 |
| African Rail | *Rallus caerulescens* | 7.69 | 3 | 0.00 | 0 |
| African Sacred Ibis | *Threskiornis aethiopicus* | 43.59 | 17 | 0.00 | 0 |
| African Snipe | *Gallinago nigripennis* | 33.33 | 13 | 6.25 | 1 |
| African Spoonbill | *Platalea alba* | 33.33 | 13 | 0.00 | 0 |
| African Swamphen | *Porphyrio madagascariensis* | 79.49 | 31 | 6.25 | 1 |
| Amur Falcon | *Falco amurensis* | 2.56 | 1 | 0.00 | 0 |
| Black Crake | *Zapornia flavirostra* | 20.51 | 8 | 0.00 | 0 |
| Black Heron | *Egretta ardesiaca* | 25.64 | 10 | 6.25 | 1 |
| Black Sparrowhawk | *Accipiter melanoleucus* | 5.13 | 2 | 0.00 | 0 |
| Black-crowned Night Heron | *Nycticorax nycticorax* | 10.26 | 4 | 0.00 | 0 |
| Black-headed Heron | *Ardea melanocephala* | 38.46 | 15 | 0.00 | 0 |
| Black-necked Grebe | *Podiceps nigricollis* | 71.79 | 28 | 0.00 | 0 |
| Black-winged Kite | *Elanus caeruleus* | 53.85 | 21 | 12.50 | 2 |
| Black-winged Stilt | *Himantopus himantopus* | 84.62 | 33 | 18.75 | 3 |
| Blue Korhaan | *Eupodotis caerulescens* | 2.56 | 1 | 6.25 | 1 |
| Blue-billed Teal | *Spatula hottentota* | 74.36 | 29 | 6.25 | 1 |
| Cape Shoveler | *Spatula smithii* | 79.49 | 31 | 12.50 | 2 |
| Cape Teal | *Anas capensis* | 79.49 | 31 | 12.50 | 2 |
| Chestnut-banded Plover | *Charadrius pallidus* | 7.69 | 3 | 0.00 | 0 |
| Common Buzzard | *Buteo buteo* | 7.69 | 3 | 6.25 | 1 |
| Common Greenshank | *Tringa nebularia* | 28.21 | 11 | 0.00 | 0 |
| Common Moorhen | *Gallinula chloropus* | 87.18 | 34 | 0.00 | 0 |
| Common Ringed Plover | *Charadrius hiaticula* | 12.82 | 5 | 0.00 | 0 |
| Common Sandpiper | *Actitis hypoleucos* | 25.64 | 10 | 6.25 | 1 |
| Curlew Sandpiper | *Calidris ferruginea* | 12.82 | 5 | 0.00 | 0 |
| Egyptian Goose | *Alopochen aegyptiaca* | 79.49 | 31 | 18.75 | 3 |

| Common Name | Scientific Name | SABAP2 Reporting Rate | | | |
|---|---|---|---|---|---|
| | | Full Protocol (%) | Number of cards | Ad Hoc Protocol (%) | Number of cards |
| Fulvous Whistling Duck | *Dendrocygna bicolor* | 25.64 | 10 | 0.00 | 0 |
| Giant Kingfisher | *Megaceryle maxima* | 5.13 | 2 | 0.00 | 0 |
| Glossy Ibis | *Plegadis falcinellus* | 79.49 | 31 | 12.50 | 2 |
| Goliath Heron | *Ardea goliath* | 53.85 | 21 | 6.25 | 1 |
| Great Crested Grebe | *Podiceps cristatus* | 28.21 | 11 | 0.00 | 0 |
| Great Egret | *Ardea alba* | 2.56 | 1 | 0.00 | 0 |
| Greater Flamingo | *Phoenicopterus roseus* | 69.23 | 27 | 37.50 | 6 |
| Greater Painted-snipe | *Rostratula benghalensis* | 2.56 | 1 | 0.00 | 0 |
| Grey Heron | *Ardea cinerea* | 33.33 | 13 | 12.50 | 2 |
| Grey Plover | *Pluvialis squatarola* | 2.56 | 1 | 0.00 | 0 |
| Grey-headed Gull | *Chroicocephalus cirrocephalus* | 69.23 | 27 | 6.25 | 1 |
| Helmeted Guineafowl | *Numida meleagris* | 76.92 | 30 | 6.25 | 1 |
| Intermediate Egret | *Ardea intermedia* | 20.51 | 8 | 0.00 | 0 |
| Kelp Gull | *Larus dominicanus* | 2.56 | 1 | 0.00 | 0 |
| Kittlitz's Plover | *Charadrius pecuarius* | 25.64 | 10 | 6.25 | 1 |
| Lanner Falcon | *Falco biarmicus* | 2.56 | 1 | 0.00 | 0 |
| Lesser Flamingo | *Phoeniconaias minor* | 64.10 | 25 | 25.00 | 4 |
| Lesser Kestrel | *Falco naumanni* | 7.69 | 3 | 0.00 | 0 |
| Little Bittern | *Ixobrychus minutus* | 5.13 | 2 | 0.00 | 0 |
| Little Egret | *Egretta garzetta* | 33.33 | 13 | 0.00 | 0 |
| Little Grebe | *Tachybaptus ruficollis* | 79.49 | 31 | 12.50 | 2 |
| Maccoa Duck | *Oxyura maccoa* | 58.97 | 23 | 12.50 | 2 |
| Marsh Owl | *Asio capensis* | 2.56 | 1 | 0.00 | 0 |
| Marsh Sandpiper | *Tringa stagnatilis* | 23.08 | 9 | 0.00 | 0 |
| Northern Black Korhaan | *Afrotis afraoides* | 82.05 | 32 | 12.50 | 2 |
| Orange River Francolin | *Scleroptila gutturalis* | 15.38 | 6 | 0.00 | 0 |
| Pied Avocet | *Recurvirostra avosetta* | 66.67 | 26 | 6.25 | 1 |
| Pied Kingfisher | *Ceryle rudis* | 10.26 | 4 | 6.25 | 1 |
| Purple Heron | *Ardea purpurea* | 41.03 | 16 | 0.00 | 0 |
| Red-billed Teal | *Anas erythrorhyncha* | 82.05 | 32 | 0.00 | 0 |
| Red-knobbed Coot | *Fulica cristata* | 92.31 | 36 | 25.00 | 4 |
| Reed Cormorant | *Microcarbo africanus* | 79.49 | 31 | 6.25 | 1 |
| Ruff | *Calidris pugnax* | 64.10 | 25 | 6.25 | 1 |
| Secretarybird | *Sagittarius serpentarius* | 2.56 | 1 | 0.00 | 0 |
| South African Shelduck | *Tadorna cana* | 61.54 | 24 | 6.25 | 1 |
| Southern Pochard | *Netta erythrophthalma* | 66.67 | 26 | 12.50 | 2 |
| Speckled Pigeon | *Columba guinea* | 92.31 | 36 | 6.25 | 1 |
| Spotted Eagle-Owl | *Bubo africanus* | 23.08 | 9 | 0.00 | 0 |
| Spur-winged Goose | *Plectropterus gambensis* | 71.79 | 28 | 12.50 | 2 |
| Squacco Heron | *Ardeola ralloides* | 64.10 | 25 | 6.25 | 1 |
| Swainson's Spurfowl | *Pternistis swainsonii* | 74.36 | 29 | 18.75 | 3 |

| Common Name | Scientific Name | SABAP2 Reporting Rate | | | |
|---|---|---|---|---|---|
| | | Full Protocol (%) | Number of cards | Ad Hoc Protocol (%) | Number of cards |
| Three-banded Plover | *Charadrius tricollaris* | 84.62 | 33 | 6.25 | 1 |
| Western Cattle Egret | *Bubulcus ibis* | 79.49 | 31 | 18.75 | 3 |
| Whiskered Tern | *Chlidonias hybrida* | 48.72 | 19 | 0.00 | 0 |
| White-backed Duck | *Thalassornis leuconotus* | 12.82 | 5 | 0.00 | 0 |
| White-breasted Cormorant | *Phalacrocorax lucidus* | 48.72 | 19 | 6.25 | 1 |
| White-faced Whistling Duck | *Dendrocygna viduata* | 84.62 | 33 | 6.25 | 1 |
| White-winged Tern | *Chlidonias leucopterus* | 35.90 | 14 | 12.50 | 2 |
| Wood Sandpiper | *Tringa glareola* | 23.08 | 9 | 0.00 | 0 |
| Yellow-billed Duck | *Anas undulata* | 82.05 | 32 | 6.25 | 1 |
| Yellow-billed Stork | *Mycteria ibis* | 17.95 | 7 | 0.00 | 0 |

# 4. PLAN OF STUDY FOR THE EIA PHASE

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

## 4.1 Proposed approach and methods

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

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

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www.sabap2.birdmap.africa

**Appendix 1:** A shortlist of bird species recorded on the study area. The list provides an indication of the species occurrence according to SABAP2 reporting rates.

| # | Common Name | Scientific Name | SABAP2 Reporting Rate | | | |
|---|---|---|---|---|---|---|
| | | | Full Protocol (%) | Number of cards | Ad Hoc Protocol (%) | Number of cards |
| 78 | Abdim's Stork | *Ciconia abdimii* | 2.56 | 1 | 6.25 | 1 |
| 432 | Acacia Pied Barbet | *Tricholaema leucomelas* | 33.33 | 13 | 0.00 | 0 |
| 52 | African Darter | *Anhinga rufa* | 41.03 | 16 | 6.25 | 1 |
| 149 | African Fish Eagle | *Haliaeetus vocifer* | 15.38 | 6 | 0.00 | 0 |
| 418 | African Hoopoe | *Upupa africana* | 17.95 | 7 | 0.00 | 0 |
| 228 | African Jacana | *Actophilornis africanus* | 2.56 | 1 | 0.00 | 0 |
| 387 | African Palm Swift | *Cypsiurus parvus* | 58.97 | 23 | 0.00 | 0 |
| 692 | African Pipit | *Anthus cinnamomeus* | 76.92 | 30 | 18.75 | 3 |
| 197 | African Rail | *Rallus caerulescens* | 7.69 | 3 | 0.00 | 0 |
| 544 | African Red-eyed Bulbul | *Pycnonotus nigricans* | 30.77 | 12 | 6.25 | 1 |
| 606 | African Reed Warbler | *Acrocephalus baeticatus* | 41.03 | 16 | 0.00 | 0 |
| 81 | African Sacred Ibis | *Threskiornis aethiopicus* | 43.59 | 17 | 0.00 | 0 |
| 250 | African Snipe | *Gallinago nigripennis* | 33.33 | 13 | 6.25 | 1 |
| 85 | African Spoonbill | *Platalea alba* | 33.33 | 13 | 0.00 | 0 |
| 576 | African Stonechat | *Saxicola torquatus* | 79.49 | 31 | 12.50 | 2 |
| 208 | African Swamphen | *Porphyrio madagascariensis* | 79.49 | 31 | 6.25 | 1 |
| 119 | Amur Falcon | *Falco amurensis* | 2.56 | 1 | 0.00 | 0 |
| 575 | Ant-eating Chat | *Myrmecocichla formicivora* | 56.41 | 22 | 18.75 | 3 |
| 493 | Barn Swallow | *Hirundo rustica* | 43.59 | 17 | 12.50 | 2 |
| 203 | Black Crake | *Zapornia flavirostra* | 20.51 | 8 | 0.00 | 0 |
| 64 | Black Heron | *Egretta ardesiaca* | 25.64 | 10 | 6.25 | 1 |

| # | Common Name | Scientific Name | SABAP2 Reporting Rate | | | |
|---|---|---|---|---|---|---|
| | | | Full Protocol (%) | Number of cards | Ad Hoc Protocol (%) | Number of cards |
| 159 | Black Sparrowhawk | *Accipiter melanoleucus* | 5.13 | 2 | 0.00 | 0 |
| 650 | Black-chested Prinia | *Prinia flavicans* | 94.87 | 37 | 12.50 | 2 |
| 431 | Black-collared Barbet | *Lybius torquatus* | 5.13 | 2 | 0.00 | 0 |
| 69 | Black-crowned Night Heron | *Nycticorax nycticorax* | 10.26 | 4 | 0.00 | 0 |
| 55 | Black-headed Heron | *Ardea melanocephala* | 38.46 | 15 | 0.00 | 0 |
| 5 | Black-necked Grebe | *Podiceps nigricollis* | 71.79 | 28 | 0.00 | 0 |
| 245 | Blacksmith Lapwing | *Vanellus armatus* | 92.31 | 36 | 31.25 | 5 |
| 860 | Black-throated Canary | *Crithagra atrogularis* | 79.49 | 31 | 6.25 | 1 |
| 130 | Black-winged Kite | *Elanus caeruleus* | 53.85 | 21 | 12.50 | 2 |
| 270 | Black-winged Stilt | *Himantopus himantopus* | 84.62 | 33 | 18.75 | 3 |
| 223 | Blue Korhaan | *Eupodotis caerulescens* | 2.56 | 1 | 6.25 | 1 |
| 839 | Blue Waxbill | *Uraeginthus angolensis* | 2.56 | 1 | 0.00 | 0 |
| 99 | Blue-billed Teal | *Spatula hottentota* | 74.36 | 29 | 6.25 | 1 |
| 722 | Bokmakierie | *Telophorus zeylonus* | 15.38 | 6 | 0.00 | 0 |
| 714 | Brown-crowned Tchagra | *Tchagra australis* | 2.56 | 1 | 0.00 | 0 |
| 509 | Brown-throated Martin | *Riparia paludicola* | 71.79 | 28 | 6.25 | 1 |
| 703 | Cape Longclaw | *Macronyx capensis* | 74.36 | 29 | 12.50 | 2 |
| 581 | Cape Robin-Chat | *Cossypha caffra* | 15.38 | 6 | 0.00 | 0 |
| 94 | Cape Shoveler | *Spatula smithii* | 79.49 | 31 | 12.50 | 2 |
| 786 | Cape Sparrow | *Passer melanurus* | 92.31 | 36 | 25.00 | 4 |
| 737 | Cape Starling | *Lamprotornis nitens* | 23.08 | 9 | 0.00 | 0 |
| 98 | Cape Teal | *Anas capensis* | 79.49 | 31 | 12.50 | 2 |
| 316 | Ring-necked Dove | *Streptopelia capicola* | 97.44 | 38 | 18.75 | 3 |
| 686 | Cape Wagtail | *Motacilla capensis* | 92.31 | 36 | 6.25 | 1 |

| # | Common Name | Scientific Name | SABAP2 Reporting Rate | | | |
|---|---|---|---|---|---|---|
| | | | Full Protocol (%) | Number of cards | Ad Hoc Protocol (%) | Number of cards |
| 450 | Cardinal Woodpecker | *Dendropicos fuscescens* | 7.69 | 3 | 0.00 | 0 |
| 484 | Chestnut-backed Sparrow-Lark | *Eremopterix leucotis* | 2.56 | 1 | 0.00 | 0 |
| 236 | Chestnut-banded Plover | *Charadrius pallidus* | 7.69 | 3 | 0.00 | 0 |
| 658 | Chestnut-vented Warbler | *Curruca subcoerulea* | 15.38 | 6 | 6.25 | 1 |
| 631 | Cloud Cisticola | *Cisticola textrix* | 33.33 | 13 | 6.25 | 1 |
| 154 | Common Buzzard | *Buteo buteo* | 7.69 | 3 | 6.25 | 1 |
| 263 | Common Greenshank | *Tringa nebularia* | 28.21 | 11 | 0.00 | 0 |
| 210 | Common Moorhen | *Gallinula chloropus* | 87.18 | 34 | 0.00 | 0 |
| 734 | Common Myna | *Acridotheres tristis* | 66.67 | 26 | 0.00 | 0 |
| 189 | Common Quail | *Coturnix coturnix* | 5.13 | 2 | 0.00 | 0 |
| 233 | Common Ringed Plover | *Charadrius hiaticula* | 12.82 | 5 | 0.00 | 0 |
| 258 | Common Sandpiper | *Actitis hypoleucos* | 25.64 | 10 | 6.25 | 1 |
| 733 | Common Starling | *Sturnus vulgaris* | 2.56 | 1 | 0.00 | 0 |
| 378 | Common Swift | *Apus apus* | 2.56 | 1 | 0.00 | 0 |
| 843 | Common Waxbill | *Estrilda astrild* | 28.21 | 11 | 0.00 | 0 |
| 439 | Crested Barbet | *Trachyphonus vaillantii* | 41.03 | 16 | 0.00 | 0 |
| 242 | Crowned Lapwing | *Vanellus coronatus* | 92.31 | 36 | 12.50 | 2 |
| 251 | Curlew Sandpiper | *Calidris ferruginea* | 12.82 | 5 | 0.00 | 0 |
| 630 | Desert Cisticola | *Cisticola aridulus* | 53.85 | 21 | 0.00 | 0 |
| 352 | Diederik Cuckoo | *Chrysococcyx caprius* | 30.77 | 12 | 0.00 | 0 |
| 278 | Double-banded Courser | *Rhinoptilus africanus* | 20.51 | 8 | 6.25 | 1 |
| 89 | Egyptian Goose | *Alopochen aegyptiaca* | 79.49 | 31 | 18.75 | 3 |
| 404 | European Bee-eater | *Merops apiaster* | 28.21 | 11 | 0.00 | 0 |
| 678 | Fairy Flycatcher | *Stenostira scita* | 7.69 | 3 | 0.00 | 0 |

| # | Common Name | Scientific Name | SABAP2 Reporting Rate | | | |
|---|---|---|---|---|---|---|
| | | | Full Protocol (%) | Number of cards | Ad Hoc Protocol (%) | Number of cards |
| 570 | Familiar Chat | *Oenanthe familiaris* | 2.56 | 1 | 0.00 | 0 |
| 665 | Fiscal Flycatcher | *Melaenornis silens* | 5.13 | 2 | 6.25 | 1 |
| 101 | Fulvous Whistling Duck | *Dendrocygna bicolor* | 25.64 | 10 | 0.00 | 0 |
| 395 | Giant Kingfisher | *Megaceryle maxima* | 5.13 | 2 | 0.00 | 0 |
| 83 | Glossy Ibis | *Plegadis falcinellus* | 79.49 | 31 | 12.50 | 2 |
| 56 | Goliath Heron | *Ardea goliath* | 53.85 | 21 | 6.25 | 1 |
| 4 | Great Crested Grebe | *Podiceps cristatus* | 28.21 | 11 | 0.00 | 0 |
| 58 | Great Egret | *Ardea alba* | 2.56 | 1 | 0.00 | 0 |
| 603 | Great Reed Warbler | *Acrocephalus arundinaceus* | 7.69 | 3 | 0.00 | 0 |
| 86 | Greater Flamingo | *Phoenicopterus roseus* | 69.23 | 27 | 37.50 | 6 |
| 230 | Greater Painted-snipe | *Rostratula benghalensis* | 2.56 | 1 | 0.00 | 0 |
| 502 | Greater Striped Swallow | *Cecropis cucullata* | 41.03 | 16 | 0.00 | 0 |
| 419 | Green Wood Hoopoe | *Phoeniculus purpureus* | 5.13 | 2 | 0.00 | 0 |
| 54 | Grey Heron | *Ardea cinerea* | 33.33 | 13 | 12.50 | 2 |
| 241 | Grey Plover | *Pluvialis squatarola* | 2.56 | 1 | 0.00 | 0 |
| 288 | Grey-headed Gull | *Chroicocephalus cirrocephalus* | 69.23 | 27 | 6.25 | 1 |
| 84 | Hadada Ibis | *Bostrychia hagedash* | 82.05 | 32 | 0.00 | 0 |
| 192 | Helmeted Guineafowl | *Numida meleagris* | 76.92 | 30 | 6.25 | 1 |
| 784 | House Sparrow | *Passer domesticus* | 7.69 | 3 | 0.00 | 0 |
| 60 | Intermediate Egret | *Ardea intermedia* | 20.51 | 8 | 0.00 | 0 |
| 586 | Kalahari Scrub Robin | *Cercotrichas paena* | 2.56 | 1 | 6.25 | 1 |
| 583 | Karoo Scrub Robin | *Cercotrichas coryphoeus* | 2.56 | 1 | 6.25 | 1 |
| 1104 | Karoo Thrush | *Turdus smithi* | 10.26 | 4 | 0.00 | 0 |
| 287 | Kelp Gull | *Larus dominicanus* | 2.56 | 1 | 0.00 | 0 |

| # | Common Name | Scientific Name | SABAP2 Reporting Rate | | | |
|---|---|---|---|---|---|---|
| | | | Full Protocol (%) | Number of cards | Ad Hoc Protocol (%) | Number of cards |
| 237 | Kittlitz's Plover | *Charadrius pecuarius* | 25.64 | 10 | 6.25 | 1 |
| 114 | Lanner Falcon | *Falco biarmicus* | 2.56 | 1 | 0.00 | 0 |
| 317 | Laughing Dove | *Spilopelia senegalensis* | 84.62 | 33 | 25.00 | 4 |
| 87 | Lesser Flamingo | *Phoeniconaias minor* | 64.10 | 25 | 25.00 | 4 |
| 125 | Lesser Kestrel | *Falco naumanni* | 7.69 | 3 | 0.00 | 0 |
| 604 | Lesser Swamp Warbler | *Acrocephalus gracilirostris* | 82.05 | 32 | 0.00 | 0 |
| 646 | Levaillant's Cisticola | *Cisticola tinniens* | 92.31 | 36 | 0.00 | 0 |
| 67 | Little Bittern | *Ixobrychus minutus* | 5.13 | 2 | 0.00 | 0 |
| 59 | Little Egret | *Egretta garzetta* | 33.33 | 13 | 0.00 | 0 |
| 6 | Little Grebe | *Tachybaptus ruficollis* | 79.49 | 31 | 12.50 | 2 |
| 253 | Little Stint | *Calidris minuta* | 56.41 | 22 | 0.00 | 0 |
| 385 | Little Swift | *Apus affinis* | 61.54 | 24 | 0.00 | 0 |
| 852 | Long-tailed Paradise Whydah | *Vidua paradisaea* | 2.56 | 1 | 0.00 | 0 |
| 818 | Long-tailed Widowbird | *Euplectes progne* | 64.10 | 25 | 18.75 | 3 |
| 103 | Maccoa Duck | *Oxyura maccoa* | 58.97 | 23 | 12.50 | 2 |
| 397 | Malachite Kingfisher | *Corythornis cristatus* | 17.95 | 7 | 0.00 | 0 |
| 361 | Marsh Owl | *Asio capensis* | 2.56 | 1 | 0.00 | 0 |
| 262 | Marsh Sandpiper | *Tringa stagnatilis* | 23.08 | 9 | 0.00 | 0 |
| | Melodious Lark | *Mirafra cheniana* | n/a | | | |
| 564 | Mountain Wheatear | *Myrmecocichla monticola* | 2.56 | 1 | 6.25 | 1 |
| 318 | Namaqua Dove | *Oena capensis* | 28.21 | 11 | 0.00 | 0 |
| 637 | Neddicky | *Cisticola fulvicapilla* | 41.03 | 16 | 12.50 | 2 |
| 1035 | Northern Black Korhaan | *Afrotis afraoides* | 82.05 | 32 | 12.50 | 2 |
| 179 | Orange River Francolin | *Scleroptila gutturalis* | 15.38 | 6 | 0.00 | 0 |

| # | Common Name | Scientific Name | SABAP2 Reporting Rate | | | |
|---|---|---|---|---|---|---|
| | | | Full Protocol (%) | Number of cards | Ad Hoc Protocol (%) | Number of cards |
| 1171 | Orange River White-eye | *Zosterops pallidus* | 23.08 | 9 | 0.00 | 0 |
| 838 | Orange-breasted Waxbill | *Amandava subflava* | 51.28 | 20 | 0.00 | 0 |
| 269 | Pied Avocet | *Recurvirostra avosetta* | 66.67 | 26 | 6.25 | 1 |
| 394 | Pied Kingfisher | *Ceryle rudis* | 10.26 | 4 | 6.25 | 1 |
| 746 | Pied Starling | *Lamprotornis bicolor* | 64.10 | 25 | 6.25 | 1 |
| 846 | Pin-tailed Whydah | *Vidua macroura* | 35.90 | 14 | 6.25 | 1 |
| 57 | Purple Heron | *Ardea purpurea* | 41.03 | 16 | 0.00 | 0 |
| 844 | Quailfinch | *Ortygospiza atricollis* | 61.54 | 24 | 6.25 | 1 |
| 708 | Red-backed Shrike | *Lanius collurio* | 2.56 | 1 | 0.00 | 0 |
| 837 | Red-billed Firefinch | *Lagonosticta senegala* | 20.51 | 8 | 0.00 | 0 |
| 805 | Red-billed Quelea | *Quelea quelea* | 61.54 | 24 | 12.50 | 2 |
| 97 | Red-billed Teal | *Anas erythrorhyncha* | 82.05 | 32 | 0.00 | 0 |
| 488 | Red-capped Lark | *Calandrella cinerea* | 35.90 | 14 | 6.25 | 1 |
| 314 | Red-eyed Dove | *Streptopelia semitorquata* | 84.62 | 33 | 6.25 | 1 |
| 392 | Red-faced Mousebird | *Urocolius indicus* | 43.59 | 17 | 0.00 | 0 |
| 820 | Red-headed Finch | *Amadina erythrocephala* | 25.64 | 10 | 0.00 | 0 |
| 212 | Red-knobbed Coot | *Fulica cristata* | 92.31 | 36 | 25.00 | 4 |
| 453 | Red-throated Wryneck | *Jynx ruficollis* | 5.13 | 2 | 0.00 | 0 |
| 50 | Reed Cormorant | *Microcarbo africanus* | 79.49 | 31 | 6.25 | 1 |
| 940 | Rock Dove | *Columba livia* | 12.82 | 5 | 0.00 | 0 |
| 256 | Ruff | *Calidris pugnax* | 64.10 | 25 | 6.25 | 1 |
| 458 | Rufous-naped Lark | *Mirafra africana* | 41.03 | 16 | 6.25 | 1 |
| 789 | Scaly-feathered Weaver | *Sporopipes squamifrons* | 2.56 | 1 | 6.25 | 1 |
| 105 | Secretarybird | *Sagittarius serpentarius* | 2.56 | 1 | 0.00 | 0 |

| # | Common Name | Scientific Name | SABAP2 Reporting Rate | | | |
|---|---|---|---|---|---|---|
| | | | Full Protocol (%) | Number of cards | Ad Hoc Protocol (%) | Number of cards |
| 504 | South African Cliff Swallow | *Petrochelidon spilodera* | 20.51 | 8 | 0.00 | 0 |
| 90 | South African Shelduck | *Tadorna cana* | 61.54 | 24 | 6.25 | 1 |
| 707 | Southern Fiscal | *Lanius collaris* | 89.74 | 35 | 25.00 | 4 |
| 4142 | Southern Grey-headed Sparrow | *Passer diffusus* | 23.08 | 9 | 0.00 | 0 |
| 803 | Southern Masked Weaver | *Ploceus velatus* | 97.44 | 38 | 18.75 | 3 |
| 102 | Southern Pochard | *Netta erythrophthalma* | 66.67 | 26 | 12.50 | 2 |
| 808 | Southern Red Bishop | *Euplectes orix* | 84.62 | 33 | 18.75 | 3 |
| 390 | Speckled Mousebird | *Colius striatus* | 10.26 | 4 | 0.00 | 0 |
| 311 | Speckled Pigeon | *Columba guinea* | 92.31 | 36 | 6.25 | 1 |
| 474 | Spike-heeled Lark | *Chersomanes albofasciata* | 46.15 | 18 | 0.00 | 0 |
| 368 | Spotted Eagle-Owl | *Bubo africanus* | 23.08 | 9 | 0.00 | 0 |
| 275 | Spotted Thick-knee | *Burhinus capensis* | 2.56 | 1 | 0.00 | 0 |
| 88 | Spur-winged Goose | *Plectropterus gambensis* | 71.79 | 28 | 12.50 | 2 |
| 62 | Squacco Heron | *Ardeola ralloides* | 64.10 | 25 | 6.25 | 1 |
| 185 | Swainson's Spurfowl | *Pternistis swainsonii* | 74.36 | 29 | 18.75 | 3 |
| 238 | Three-banded Plover | *Charadrius tricollaris* | 84.62 | 33 | 6.25 | 1 |
| 851 | Village Indigobird | *Vidua chalybeata* | 7.69 | 3 | 0.00 | 0 |
| 735 | Wattled Starling | *Creatophora cinerea* | 41.03 | 16 | 6.25 | 1 |
| 61 | Western Cattle Egret | *Bubulcus ibis* | 79.49 | 31 | 18.75 | 3 |
| 305 | Whiskered Tern | *Chlidonias hybrida* | 48.72 | 19 | 0.00 | 0 |
| 104 | White-backed Duck | *Thalassornis leuconotus* | 12.82 | 5 | 0.00 | 0 |
| 391 | White-backed Mousebird | *Colius colius* | 15.38 | 6 | 0.00 | 0 |
| 763 | White-bellied Sunbird | *Cinnyris talatala* | 2.56 | 1 | 0.00 | 0 |
| 47 | White-breasted Cormorant | *Phalacrocorax lucidus* | 48.72 | 19 | 6.25 | 1 |

| # | Common Name | Scientific Name | SABAP2 Reporting Rate | | | |
|---|---|---|---|---|---|---|
| | | | Full Protocol (%) | Number of cards | Ad Hoc Protocol (%) | Number of cards |
| 780 | White-browed Sparrow-Weaver | *Plocepasser mahali* | 94.87 | 37 | 12.50 | 2 |
| 100 | White-faced Whistling Duck | *Dendrocygna viduata* | 84.62 | 33 | 6.25 | 1 |
| 383 | White-rumped Swift | *Apus caffer* | 25.64 | 10 | 0.00 | 0 |
| 495 | White-throated Swallow | *Hirundo albigularis* | 53.85 | 21 | 12.50 | 2 |
| 304 | White-winged Tern | *Chlidonias leucopterus* | 35.90 | 14 | 12.50 | 2 |
| 814 | White-winged Widowbird | *Euplectes albonotatus* | 2.56 | 1 | 0.00 | 0 |
| 599 | Willow Warbler | *Phylloscopus trochilus* | 17.95 | 7 | 0.00 | 0 |
| 264 | Wood Sandpiper | *Tringa glareola* | 23.08 | 9 | 0.00 | 0 |
| 866 | Yellow Canary | *Crithagra flaviventris* | 33.33 | 13 | 0.00 | 0 |
| 96 | Yellow-billed Duck | *Anas undulata* | 82.05 | 32 | 6.25 | 1 |
| 76 | Yellow-billed Stork | *Mycteria ibis* | 17.95 | 7 | 0.00 | 0 |
| 812 | Yellow-crowned Bishop | *Euplectes afer* | 30.77 | 12 | 6.25 | 1 |
| 629 | Zitting Cisticola | *Cisticola juncidis* | 46.15 | 18 | 0.00 | 0 |