DEVELOPMENT OF SAN SOLAR PV FACILITY AND ASSOCIATED INFRASTRUCTURE, NORTHERN CAPE PROVINCE

Avifauna Scoping Report

January 2022

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EXECUTIVE SUMMARY

Pachnoda Consulting cc was requested by Savannah Environmental (Pty) Ltd on behalf of San Solar Energy Facility (Pty) Ltd to compile an avifauna scoping report for a solar facility and associated infrastructure with a contracted capacity of up to 100MW located on a site approximately 16km north west of Kathu in the Northern Cape 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 (excluding transformed habitat units), ranging from Kathu Bushveld on deep red sands to open Kathu Bushveld and ephemeral pans and artificial livestock watering points. Approximately 145 bird species have been recorded within the development area and surrounding landscape, although the number of conservation important species were low (c. three IUCN Red listed species). However, the respective habitat types provided habitat for at least 50 % of the regional endemic bird composition as well as six collision-prone waterbird species (when the ephemeral pans are inundated).

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).

A total of 28 collision-prone bird species have been recorded from the development (*sensu* atlas data), of which 12 species were birds of prey and six species were waterbird species.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

DECLARATION OF INDEPENDENCE

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

- I act as the independent specialist in this application to Savannah Environmental (Pty) Ltd and San Solar Energy Facility (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)
14 January 2022

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

1. INTRODUCTION

1.1 Project Description

Pachnoda Consulting cc was requested by Savannah Environmental (Pty) Ltd on behalf of San Solar Energy Facility (Pty) Ltd to compile an avifauna scoping report for a solar facility and associated infrastructure with a contracted capacity of up to 100MW located on a site approximately 16km north west of Kathu in the Northern Cape Province. The study area[1] is situated within the Gamagara Local Municipality within the John Taolo Gaetsewe District Municipality. The site is accessible via the R380 provincial route which branches off the N14 National Road, approximately 3km south of Kathu.

A facility development area[2], which will include the PV facility, BESS and a 132kV facility substation to be connected via a Loop-in-Loop out (LILO) connection to the Umtu 132kV overhead power line will be identified within the study area considered in the Scoping phase. The infrastructure associated with this 100MW PV facility includes:

- PV modules and mounting structures
- Inverters and transformers
- Cabling between the panels, to be laid underground where practical.
- Battery Energy Storage System (BESS)
- Site and internal access roads (up to 8m wide)
- Laydown area
- Operation and Maintenance buildings including a gate and security building, control centre, offices, warehouse, and workshop areas for maintenance and storage.
- Grid connection solution including a 132kV facility substation to be connected via a Loop-in-Loop out (LILO) connection to the Umtu 132kV overhead power line (located ~5km east of the site).

The development area will be larger than the area needed for the construction of a 100MW PV facility and will provide the opportunity for the optimal placement of the infrastructure, ensuring avoidance of major identified environmental sensitivities by the development footprint[3]. To avoid areas of potential sensitivity and to ensure that potential detrimental environmental impacts are minimised as far as possible, the development footprint within which the infrastructure of San Solar PV facility and its associated infrastructure will be located will be fully assessed during the EIA Phase.

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[1] The study area is defined as the Remaining extent of the Farm Wincanton 472, which has the extent of ~ 1000ha.

[2] The development area is that identified area (located within the study area) where the San Solar PV facility would be located.

[3] The development footprint is the defined area (located within the development area) where the PV panel array and other associated infrastructure for San Solar PV will be planned to be constructed. This will be the actual footprint of the facility, and the area which would be disturbed. The extent of the development footprint will be determined in the EIA Phase.

1.2 Terms of Reference

The main aim of this scoping exercise was to investigate the avifaunal attributes at the proposed PV facility by means of a desktop analysis of GIS based information and third-party datasets.

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

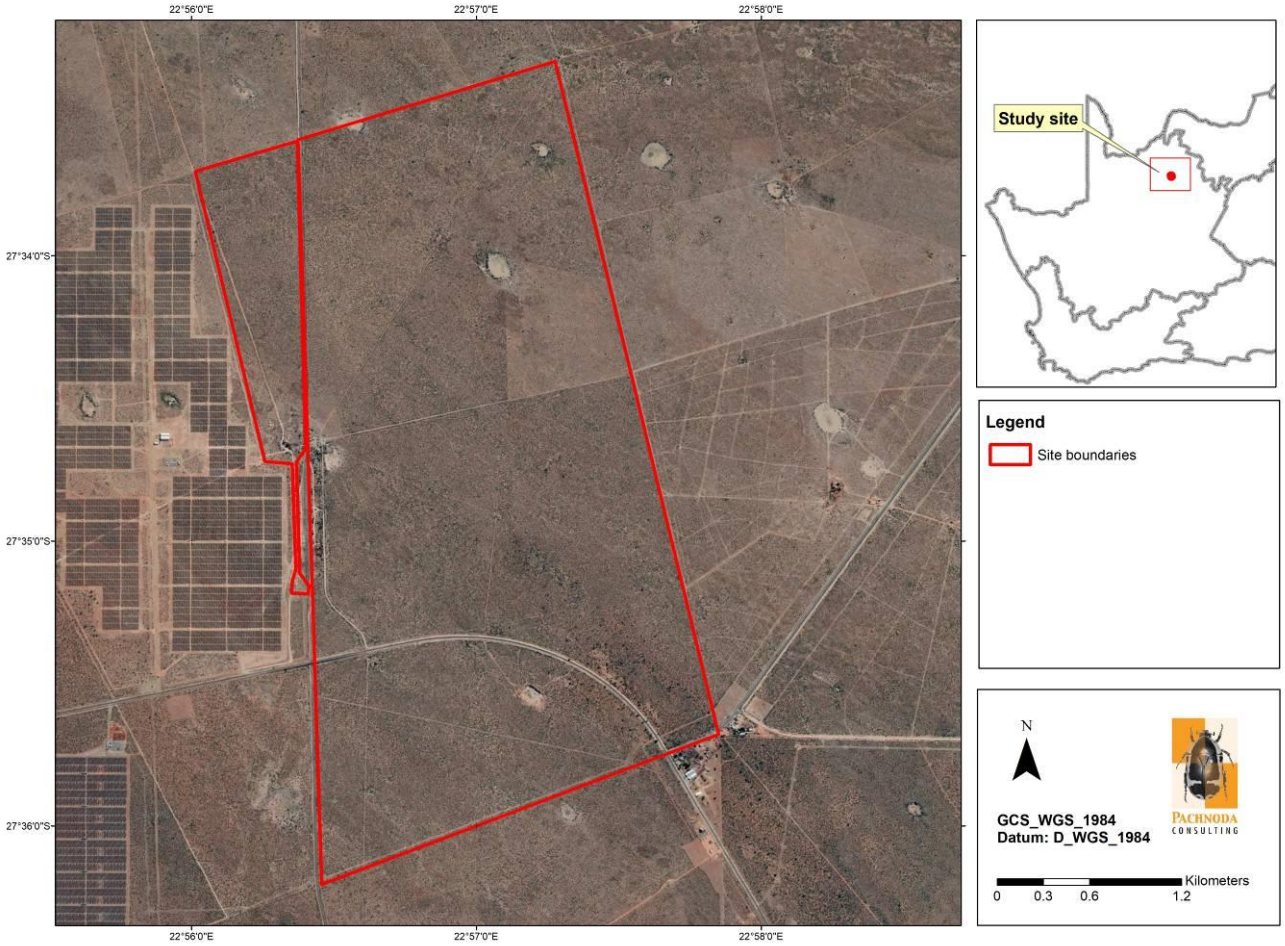


Figure 1: A satellite image illustrating the geographic position of the proposed San solar PV development area.

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 development area, thereby aiming to describe the preliminary conservation significance of the ecosystems in the area. Therefore, the occurrence of certain bird species and their relative abundances (to be determined during the EIA although herewith deduced from reporting rates) could determine the outcome of the ecological sensitivity of the area and the subsequent layout of the proposed solar facility infrastructure.

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

- relevant literature – see section below;
- personal observations from similar habitat types in proximity to the study area, with emphasis on an assessment conducted by Pachnoda Consulting (2017).

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 the quarter-degree grid cell (QDGC) 2722DB (Dibeng). The information was then modified according to the prevalent habitat types present on the development 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 2730_2255 and 2735_2255 (although all eight pentad grids surrounding grid 2730_2255 were also scrutinised) (Figure 2).
- The choice of scientific nomenclature, taxonomy and common names were recommended by the International Ornithological Committee (the IOC World Bird List v. 11.2), unless otherwise specified (see www.worldbirdnames.org as specified by Gill et al, 2021). Colloquial (common) names were used according to Hockey *et. al.* (2005) to avoid confusion;
- The 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).

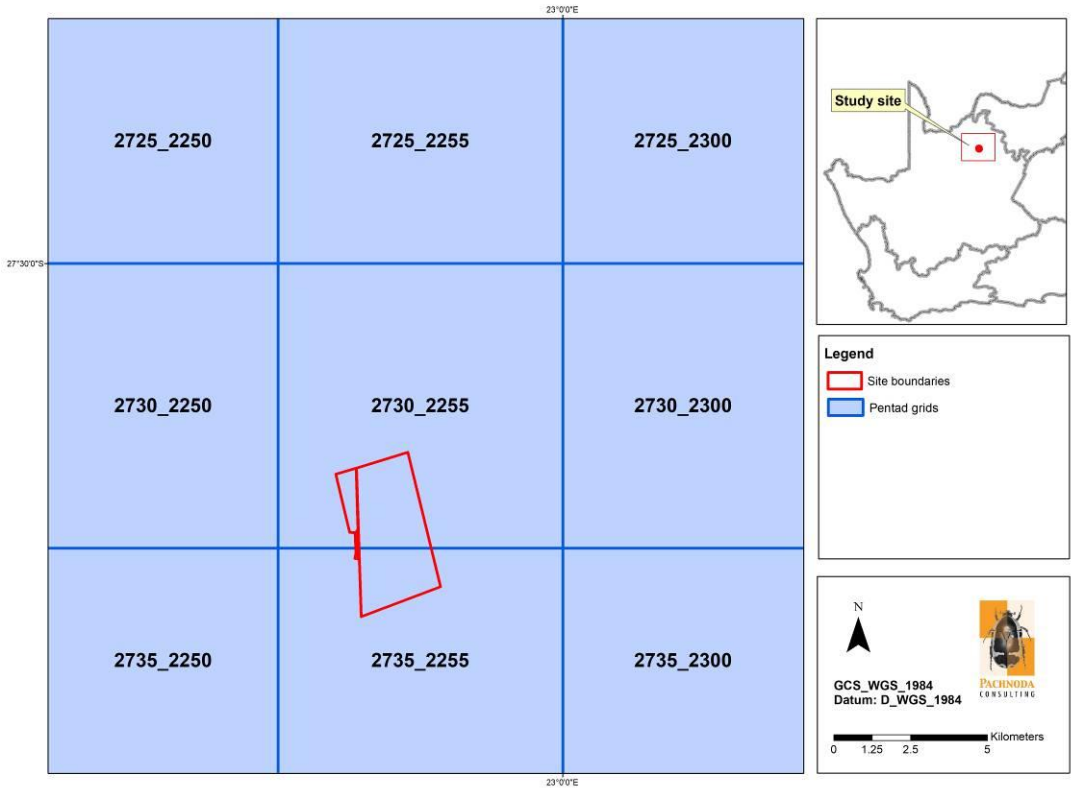


Figure 2: A map illustrating the pentad grids that were investigated for this project.

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 development 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 third-party datasets.

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.

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. 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 development 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.

3. PRELIMINARY RESULTS AND DESCRIPTION OF THE AFFECTED ENVIRONMENT

3.1 Locality

The development area is located 16km north west of Kathu in the Northern Cape Province and east of Dibeng. The development area is also located on the Remaining extent of the Farm Wincanton 472 (Figure 1).

3.2 Regional Vegetation Description

The proposed PV facility corresponds to the Savanna Biome and more particularly to the Eastern Kalahari Bushveld Bioregion as defined by Mucina & Rutherford (2006). It comprehends an ecological type known as Kathu Bushveld (Mucina & Rutherford, 2006) (Figure 3).

Kathu Bushveld is entirely confined to the Northern Cape and occurs from Kathu and Dibeng in the south, and northwards to the Botswana border near Van Zylsrus. It consists of a medium tree layer of *Vachellia (=Acacia) erioloba* and a shrub layer dominated by *Senegalia (=Acacia) mellifera, Diospyros lycioides* and *Lycium hirsutum.*

Kathu Bushveld is least threatened with none conserved in statutory conservation areas. More than 1 % is transformed, mainly due to iron ore mining near Sishen.

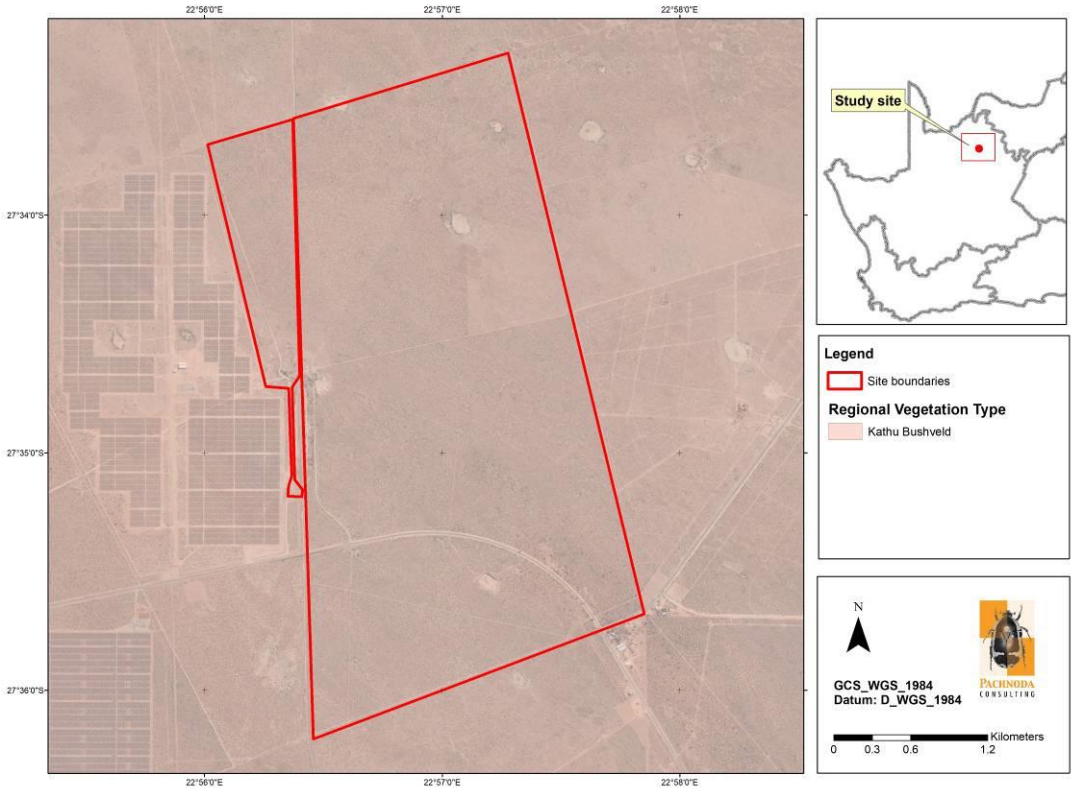


Figure 3: A satellite image illustrating the regional vegetation type corresponding to the development area. Vegetation type categories were defined by Mucina & Rutherford (2006).

3.3 Land cover, land use and existing infrastructure.

According to the South African National dataset of 2013-2014 (Geoterrainimage, 2015) the study site comprehends the following land cover categories (Figure 4):

Natural areas:

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

Transformed areas:

- Mines and quarries.

From the land cover dataset it is evident that most of the development area is covered by natural grassland and low shrubland. The development area is primarily vacant. Existing infrastructure includes roads and what appear to be small quarries. The grassland was probably erroneously digitised since this unit should be placed in the low shrubland which is part of the Kathu Bushveld.

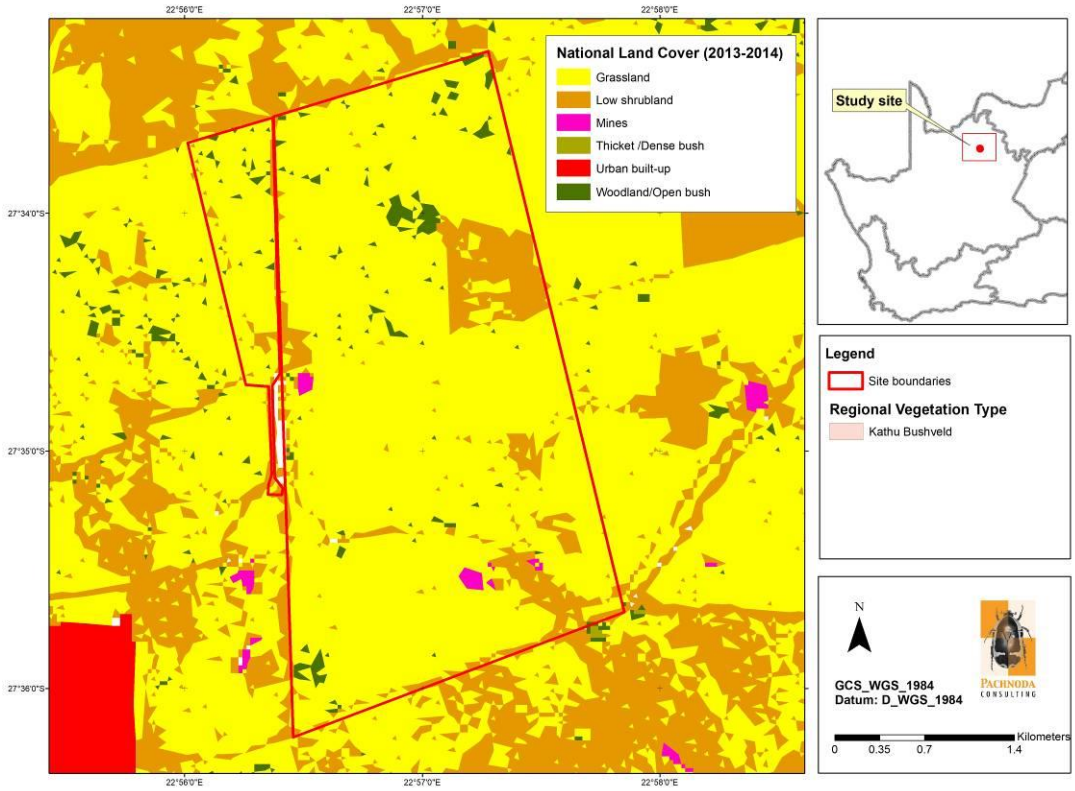


Figure 4: A map illustrating the land cover classes (Geoterrainimage, 2015) corresponding to the proposed development area.

3.4 Conservation Areas, Protected Areas and Important Bird Areas

There are no formal protected or conservation areas or any Important Bird and Biodiversity Areas in close proximity to the development area.

3.5 Avifaunal microhabitat types

Apart from the regional vegetation type, the local composition and distribution of the vegetation associations on the development area are a consequence of a combination of factors simulated by soil texture, geology and historical disturbance regimes which have culminated in a number of habitat types that deserve further discussion[4] (Figure 5):

1. *Kathu Bushveld:* This unit is prominent on the study site and covers a significant extent in surface area of the proposed development area. It is represented by two discrete floristic variations which also provide habitat for two discrete avifaunal associations. The first floristic variation consists of open short shrubland dominated by open short *Senegalia mellifera* - *Tarchonanthus camphoratus* shrubland with a fairly well developed graminoid

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

layer. It is expected to provide habitat for small passerine granivores and leaf-gleaning insectivores, most notably that of Scaly-feathered Weaver (*Sporopipes squamifrons*), Black-chested Prinia (*Prinia flavicans*) and Chestnut-vented Warbler (*Curruca subcoerulea*). Birds of prey are expected to be rare and mainly occurs overhead during hunting bouts. Large-terrestrial species are expected to occur at low densities and will consist of the Red-crested Korhaan (*Lophotis ruficrista*) and Northern Black Korhaan (*Afrotis afraoides*). The average bird density on this habitat type is expected to approximate 10.51 birds.ha^{-1} with a richness of approximately 20 - 25 species (according to Pachnoda Consulting, 2017). The second variation is compositionally similar to the aforementioned habitat types, but it also includes a tree layer consisting of scattered *Vachellia erioloba* trees. The increase in vertical heterogeneity is expected to be positively correlated with species richness. Expected typical species will include Tinkling Cisticola (*Cisticola rufilatus*), Spotted Flycatcher (*Muscicapa striata*) and Southern Masked Weavers (*Ploceus velatus*) which are normally uncommon from the adjacent shrubland. The *V. erioloba* trees also provide perching and potential nesting sites for small to medium-sized birds of prey. The expected average bird density on this variation approximates 12.53 birds.ha^{-1} and the expected richness is 30 - 40 species (according to Pachnoda Consulting, 2017).

2. *Kathu Bushveld on deep red sands:* This unit is prominent on the eastern part of the development area. It is represented by dense *Senegalia mellifera - Tarchonanthus camphoratus* shrubland on deep red sands. The floristic variation is compositionally similar to the aforementioned habitat type, although the shrub layer is marginally taller and denser. The expected bird density is higher, although richness remained constant when compared to the open Kathu Bushveld. The expected average bird density on this habitat type approximates 13.69 birds.ha^{-1} and the expected richness is 20 - 30 species (according to Pachnoda Consulting, 2017).

3. *Ephemeral pans*: These include a number of small basins which tend to hold surface water for a short duration after precipitation events. Surface water is a scarce commodity in arid environments and expected to attract many bird species, both passerines and non-passerines. Therefore, when inundated, the pans may provide ephemeral foraging habitat for a number of nomadic waterbirds and shorebirds which under normal environmental conditions, are absent from the study area (e.g. South African Shelduck *Tadorna cana* and Hadeda Ibis *Bostrychia hagedash*). In most instances the pans are expected to be bordered by dense woody vegetation dominated by *Ziziphus mucronata* and *Vachellia karroo*, thereby providing refuge and perching opportunities for a variety of bird species. The expected average bird density on this habitat type approximates 8.67 birds.ha^{-1} and the expected richness is 25-35 species.

4. *Open Kathu Bushveld*: These are represented by areas that were historically cleared or were intensively grazed or may represent open bushveld on deep

sand (the status of this unit will be evaluated during the detailed surveys). The open woody cover provides foraging opportunities for a variety of large terrestrial bird species, many being threatened of near threatened such as the Secretarybird (*Sagittarius serpentarius*) and Kori Bustard (*Ardeotis kori*).

5. *Artificial livestock watering points*: These are represented by artificial water troughs and reservoirs with the purpose to provide drinking water to livestock. However, they act as focal congregation areas for many granivore passerine species. This habitat feature often sustains high bird richness and also provides foraging habitat for bird of prey.

6. *Transformed areas (including quarries)*: These areas are represented by roads, old homesteads and quarries. These often provide habitat for generalist/unspecialised bird species.

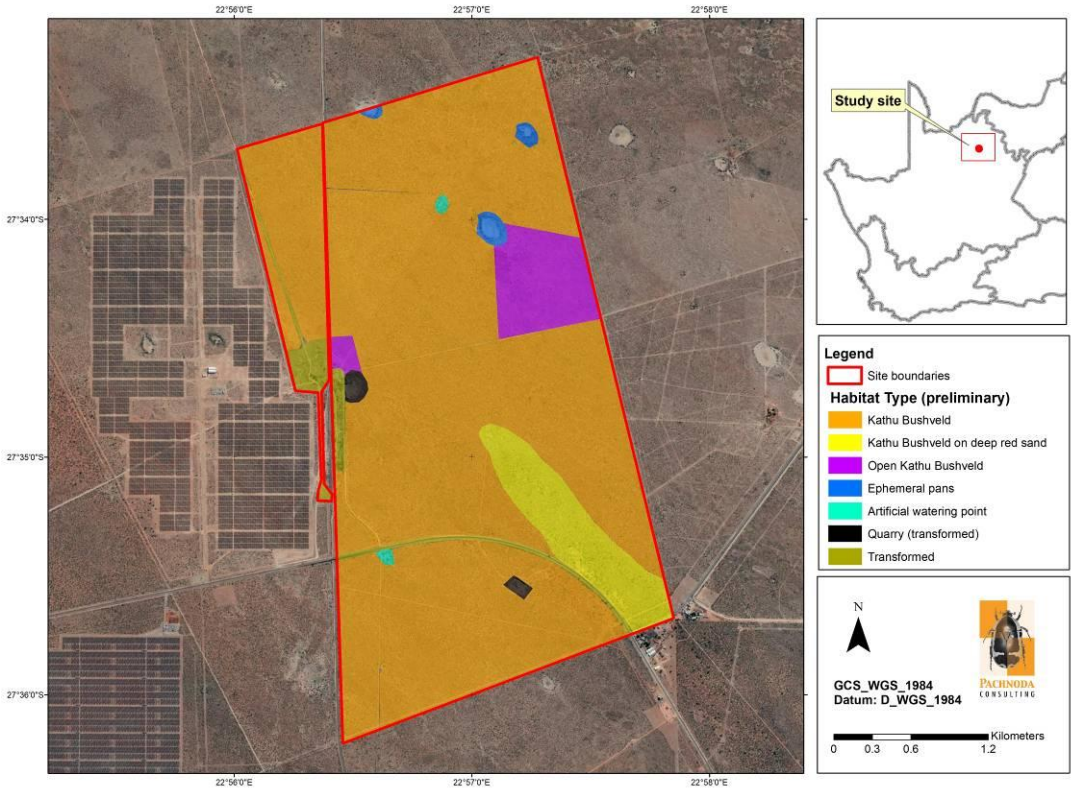


Figure 5: A preliminary habitat map illustrating the avifaunal habitat types on the development area (the habitat types are subject to change pending the outcome of detailed surveys).

3.6 Species Richness and Predicted summary statistics

Approximately ~145 bird species[5] are expected to occur on the study area and immediate surroundings (refer to Appendix 1 & Table 1). The expected richness was inferred from the South African Bird Atlas Project (SABAP1 & SABAP2) (Harrison et al., 1997; www.sabap2.birdmap.africa) and the presence of suitable habitat on the development area. The expected richness is also strongly correlated with favourable environmental conditions (e.g. during good rains when the pans are filled with surface water) and seasonality (e.g. when migratory species are present during the austral summer). This equates to 15 % of the approximate 985[6] species listed for the southern African subregion[7] (and approximately 17 % of the 857 species recorded within South Africa[8]). However, the species richness obtained from the pentad grids 2730_2255 and 2735_2255 corresponding to the development area is lower than the expected number of species for the study area with an average of 47.5 species recorded. The average number of species for each full protocol card submitted (for observation of two hours or more) is 30.8 species (range = 28 - 40 species).

According to Table 1, the development area is poorly represented by biome-restricted[9] (see Table 2) and local endemic bird species. However, the expected number of regional near-endemic species is high with *ca*. 50 % of the near-endemic species being present. In addition, the number of expected threatened and near threatened species is low.

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* SABAP1 and SABAP2) to occur in the development area and immediate surroundings.

Description	Expected Richness Value***
Total number of species*	145 (17 %)
Number of Red Listed species*	3 (2 %)
Number of biome-restricted species – Zambezian, Namib-Karoo and Kalahari-Highveld Biomes)*	5 (15 %)
Number of local endemics (BirdLife SA, 2018)*	0 (0 %)
Number of local near-endemics (BirdLife SA, 2018)*	4 (13 %)
Number of regional endemics (Hockey *et al.,* 2005)**	12 (11 %)
Number of regional near-endemics (Hockey *et al.,* 2005)**	31 (51 %)

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

5 According to pentad grid 2730_2255 and eight surrounding pentad grids (50 submitted cards, 35 being full protocol cards and 15 being ad hoc cards).

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

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

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

9 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, 2018).

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

Species	Kalahari-Highveld	Namib-Karoo	Zambezian	Expected Frequency of occurrence
Kalahari Scrub-robin (*Cercotrichas paena)*	X			Common
Barred Wren-Warbler (*Calamonastes fasciolatus*)	X			Fairly Common
Burchell's Sandgrouse (*Pterocles burchelli*)	X			Uncommon
Layard's Warbler (*Curruca layardi*)		X		Uncommon to Rare
White-bellied Sunbird (*Cinnyris talatala*)			X	Common

3.7 Bird species of conservation concern

Table 3 provides an overview of bird species of conservation concern that could occur on the development area based on their historical distribution ranges and the presence of suitable habitat. According to Table 3, only three species could occur on which includes one globally threatened species (Martial Eagle *Polemaetus bellicosus*), one globally near threatened species (Kori Bustard *Ardeotis kori*) and one regionally threatened species (Lanner Falcon *Falco biarmicus*).

It is evident from Table 3 that these species occur at low reporting rates (< 5% for full protocol cards and <10 % for ad hoc cards submitted), which suggests that these species are irregular visitors to the development area. However, the Kori Bustard (*Ardeotis kori*) may be under-recorded in the area (due to the low number of citizen scientists) that have visited the area for which suitable habitat is provided by the open Kathu Bushveld units.

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

Species	Global Conservation Status*	National Conservation Status**	Mean Reporting rate: SABAP2 (n=50)	Preferred Habitat	Potential Likelihood of Occurrence
Falco biarmicus (Lanner Falcon)	-	Vulnerable	2.63 (singe observation)	Varied, but prefers to breed in mountainous areas.	An irregular foraging visitor to the study area. Most recent record obtained during June 2009

Species	Global Conservation Status*	National Conservation Status**	Mean Reporting rate: SABAP2 (n=50)	Preferred Habitat	Potential Likelihood of Occurrence
					(sensu SABAP2).
Polemaetus bellicosus (Martial Eagle)	Endangered	Endangered	8.33 (singe ad hoc observation)	Varied, from open karroid shrub to lowland savanna.	An irregular foraging visitor. It was last recorded on 18 August 2020 on the study area.
Ardeotis kori (Kori Bustard)	Near threatened	Near threatened	2.63	Open savannoid grassland and open secondary shrubland	An uncommon foraging and breeding resident. It was last recorded during October 2021from the study area.

3.8 Preliminary avifaunal sensitivity

A preliminary sensitivity map was compiled, illustrating habitat units comprising of potential sensitive elements based on the following arguments (Figure 6):

Areas of high sensitivity

The open Kathu Bushveld, ephemeral pans and artificial watering points are considered to be of high avifaunal sensitivity. The open Kathu Bushveld provides potential foraging habitat for large terrestrial bird species such as the Kori Bustard (*Ardeotis kori*), many which are also prone towards collisions with powerlines.

The ephemeral pans provide ephemeral foraging opportunities for waterbirds and shorebird taxa, which are rare or absent in the area when these are dry. Many of these species are highly nomadic in the area and may become disorientated by the "lake effect" caused by the PV panels which may result in bird colliding with the panels (and also powerlines). The pans are also important from a functional and dynamic perspective at the landscape level since these form part of an "inter-connected" system or "stepping stones" of pans within the regional context, meaning that environmental conditions at these pans (e.g. water levels, salinity, food availability) are constantly changing depending on precipitation and evaporation. Therefore, none of the pans are exactly similar to each, thereby providing a continuous supply of resources for waterbirds when inundated.

The artificial livestock watering points often attract large numbers of granivore passerine and non-passerine bird species, of which many need to drink water on a

daily basis. The placement of electrical infrastructure in close proximity to these areas could increase potential avian collisions with the infrastructure. These areas are therefore of artificial origin, but could be relocated to other areas.

Areas of medium sensitivity

It includes the Kathu Bushveld (including Kathu Bushveld on deep red sands) which are prominent in the region and provides potential suitable foraging habitat for some collision-prone bird species, including the Northern Black Korhaan (*Afrotis afraoides*) and Red-crested Korhaan (*Lophotis ruficrista*) with the potential to interact (e.g. collide) with the proposed electrical infrastructure. In addition, reporting rates for threatened and near threatened bird species are anticipated to be relatively low in this unit, thereby suggesting a medium sensitivity rating instead of a high sensitivity even though the majority of the habitat is natural. In addition, Kathu Bushveld is widespread in the region.

The Kathu Bushveld on deep red sands is expected to sustain a higher number of bird species when compared to the other units.

Areas of low sensitivity

These habitat units are represented by transformed types and roads, homesteads and quarries.

There is a probability that the conservation status of some of the aforementioned 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 6 pending the outcome of a detailed survey.

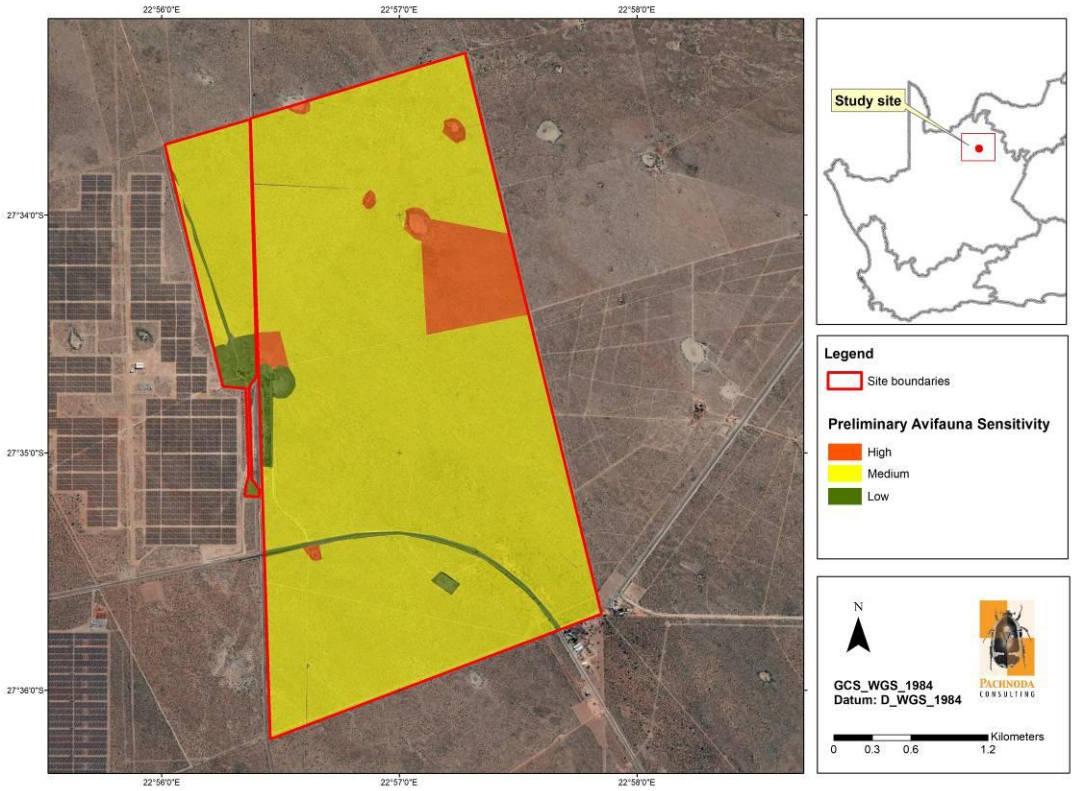


Figure 6: A map illustrating the preliminary avifaunal sensitivity of the area based on habitat types supporting bird taxa of conservation concern and important ecological function.

3.9 Overview of Avian Impacts at Solar Facilities

3.9.1 Background to solar facilities and their impact on birds

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

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

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

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

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

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

3.9.2 Potential impacts of PV solar facilities on birds

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

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

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

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

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

3.10 Potential Impacts associated with the San Solar PV Solar Energy Facilities

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

3.10.1 Loss of habitat and displacement of birds

Most of the development area will cleared of vegetation and habitat to accommodate the panel arrays and associated infrastructure. Clearing of vegetation will inevitably result in the loss of habitat and displacement of bird species. From the preliminary results it is evident that large-bodied species are more likely to become displaced as

opposed to small passerine species. It is particularly regional endemics and conservation important species that are likely to become displaced. These include mainly passerine and smaller non-passerine species inhabiting the Kathu Bushveld and large terrestrial birds inhabiting the open Kathu Bushveld units.

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 detailed surveys of the proposed PV facilities. From a preliminary analysis, the following bird species are most likely to be impacted by the loss of habitat due to their habitat requirements, fecundity and conservation status (although not limited to) due to the proposed development:

- Black-chested Snake Eagle (*Circaetus pectoralis*);
- Barred Wren-Warbler (*Calamonastes fasciolatus*);
- Burchell's Sandgrouse (*Pterocles burchelli*);
- Fawn-colored Lark (*Calendulauda africanoides*);
- Kori Bustard (*Ardeotis kori*);
- Layard's Warbler (*Curruca layardi*);
- Pale Chanting Goshawk (*Melierax canorus*);
- Red-billed Spurfowl (*Pternistis adspersus*);
- Red-crested Korhaan (*Lophotis ruficrista*);
- Northern Black Korhaan (*Afrotis afraoides*);
- Tinkling Cisticola (*Cisticola rufilatus*);
- Kalahari Scrub Robin (*Cercotrichas paena*);
- Orange River Francolin (*Scleroptila gutturalis*).

3.10.2 Interaction with overhead powerlines and reticulation

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

- *Electrocution*

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

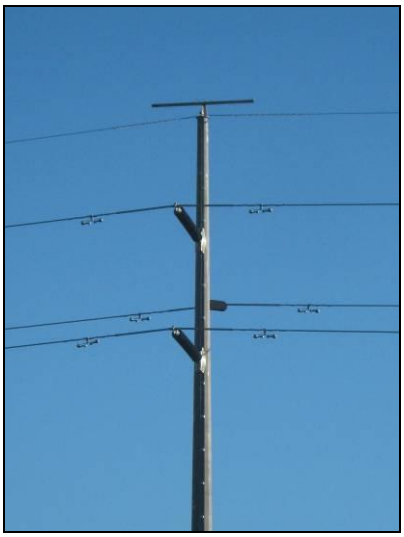
in the area. Other types of electrocutions happen by means of so-called “bird-streamers”. This happens when a bird, especially when taking off, excretes and thereby causes a short-circuit through the fluidity excreta (Van Rooyen & Taylor, 1999).

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

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

It is therefore recommended that the pylon design incorporates "features as illustrated by Figure 7[10].

From Figure 7 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).



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

Figure 7: 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.

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

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

The open Kathu Bushveld also deserve special consideration as they often attract large terrestrial bird species. Construction activities in close proximity to these features could possibly displace these individuals from the area or increase the risk of collision.

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

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

Issue 2	**Nature of Impact**	**Extent**	**No-Go Areas**
Impact: Avian collision impacts related to the PV facility during the operational phase (collision with the PV panels).			
Potential collision of birds with the PV panel structures	Negative, especially for waterbirds.	Regional	All pans
Description of expected significance of impact: The impact will be of a long duration (prior to mitigation) and is highly probable with a high significance, but may be reduced to a medium significance as per recommended mitigation measures (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 distribution	Negative, especially for vultures	Regional	Pans
Description of expected significance of impact: The impact will be of a long duration (prior to mitigation) and probable with a hihg 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 wet season survey is proposed to determine occurrence of collision prone bird species.			

3.11 Collision-prone bird species

A total of 28 collision-prone bird species have been recorded from the development area, of which 12 species are birds of prey and six species are facultative waterbird taxa (Table 5).

Collision-prone species with the highest probability to occur along the power-line servitude includes the Helmeted Guineafowl (*Numida meleagris*), Pale-chanting Goshawk (*Melierax canorus*), Speckled Pigeon (*Columba guinea*), Hadeda Ibis (*Bostrychia hagedash*), Pied Crow (*Corvus albus*), Namagua Sandgrouse (*Pterocles namaqua*), Red-crested Korhaan (L*ophotis ruficrista*) and Northern Black Korhaan (*Afrotis afraoides*). Three of the 28 species are regionally threatened and include the endangered Martial Eagle (*Polemaetus bellicosus*), vulnerable Lanner Falcon (*Falco biarmicus*) and near threatened Kori Bustard (*Ardeotis kori*) (sensu Taylor et al., 2015).

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

Species name	Taxonomic name	National conservation status (*sensu* Taylor *et al.* (2015)	Mean SABAP2 Reporting Rate (%)
Helmeted Guineafowl	*Numida meleagris*		68.42
Pale Chanting Goshawk	*Melierax canorus*		36.84
Speckled Pigeon	*Columba guinea*		36.84
Hadeda Ibis	*Bostrychia hagedash*		23.68
Pied Crow	*Corvus albus*		23.68
Namaqua Sandgrouse	*Pterocles namaqua*		18.42
Northern Black Korhaan	*Afrotis afraoides*		18.42
Red-crested Korhaan	*Lophotis ruficrista*		18.42
Red-billed Spurfowl	*Pternistis adspersus*		15.79
Western Barn Owl	*Tyto alba*		15.79
Gabar Goshawk	*Micronisus gabar*		13.16
Black-chested Snake Eagle	*Circaetus pectoralis*		10.53
Burchell's Sandgrouse	*Pterocles burchelli*		7.89
South African Shelduck	*Tadorna cana*		7.89
Cape Teal	*Anas capensis*		5.26
Egyptian Goose	*Alopochen aegyptiaca*		5.26
Black-winged Kite	*Elanus caeruleus*		2.63
Common (Steppe) Buzzard	*Buteo buteo vulpinus*		2.63
Greater Kestrel	*Falco rupicoloides*		2.63
Jackal Buzzard	*Buteo rufofuscus*		2.63
Kori Bustard	*Ardeotis kori*	Near Threatened	2.63

Lanner Falcon	*Falco biarmicus*	Vulnerable	2.63
Orange River Francolin	*Scleroptila gutturalis*		2.63
Red-billed Teal	*Anas erythrorhyncha*		2.63
Rock Kestrel	*Falco rupicolus*		2.63
Spotted Eagle-Owl	*Bubo africanus*		2.63
Western Cattle Egret	*Bubulcus ibis*		2.63
Martial Eagle	*Polemaetus bellicosus*	Endangered	0.00

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. However, it is anticipated that the anticipated impacts on the avifaunal community will be of a low significance.

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.

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www.sabap2.birdmap.africa

Appendix 1: A shortlist of bird species expected to be present on the development area and immediate surroundings. 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
432	Acacia Pied Barbet	*Tricholaema leucomelas*	81.58	31.00	16.67	2.00
341	African Cuckoo	*Cuculus gularis*	2.63	1.00	0.00	0.00
424	African Grey Hornbill	*Lophoceros nasutus*	52.63	20.00	16.67	2.00
418	African Hoopoe	*Upupa africana*	39.47	15.00	0.00	0.00
387	African Palm Swift	*Cypsiurus parvus*	26.32	10.00	0.00	0.00
692	African Pipit	*Anthus cinnamomeus*	5.26	2.00	0.00	0.00
544	African Red-eyed Bulbul	*Pycnonotus nigricans*	92.11	35.00	16.67	2.00
386	Alpine Swift	*Tachymarptis melba*	5.26	2.00	0.00	0.00
575	Ant-eating Chat	*Myrmecocichla formicivora*	18.42	7.00	0.00	0.00
514	Ashy Tit	*Melaniparus cinerascens*	42.11	16.00	0.00	0.00
493	Barn Swallow	*Hirundo rustica*	23.68	9.00	0.00	0.00
614	Barred Wren-Warbler	*Calamonastes fasciolatus*	5.26	2.00	0.00	0.00
344	Black Cuckoo	*Cuculus clamosus*	10.53	4.00	0.00	0.00
650	Black-chested Prinia	*Prinia flavicans*	86.84	33.00	25.00	3.00
146	Black-chested Snake Eagle	*Circaetus pectoralis*	10.53	4.00	8.33	1.00
841	Black-faced Waxbill	*Brunhilda erythronotos*	31.58	12.00	0.00	0.00
245	Blacksmith Lapwing	*Vanellus armatus*	23.68	9.00	8.33	1.00
860	Black-throated Canary	*Crithagra atrogularis*	10.53	4.00	0.00	0.00
130	Black-winged Kite	*Elanus caeruleus*	2.63	1.00	0.00	0.00
270	Black-winged Stilt	*Himantopus himantopus*	5.26	2.00	0.00	0.00
722	Bokmakierie	*Telophorus zeylonus*	2.63	1.00	0.00	0.00
381	Bradfield's Swift	*Apus bradfieldi*	7.89	3.00	0.00	0.00
714	Brown-crowned Tchagra	*Tchagra australis*	23.68	9.00	8.33	1.00
731	Brubru	*Nilaus afer*	36.84	14.00	0.00	0.00
695	Buffy Pipit	*Anthus vaalensis*	2.63	1.00	0.00	0.00
308	Burchell's Sandgrouse	*Pterocles burchelli*	7.89	3.00	0.00	0.00
531	Cape Penduline Tit	*Anthoscopus minutus*	10.53	4.00	0.00	0.00
581	Cape Robin-Chat	*Cossypha caffra*	15.79	6.00	8.33	1.00
786	Cape Sparrow	*Passer melanurus*	81.58	31.00	0.00	0.00
737	Cape Starling	*Lamprotornis nitens*	89.47	34.00	16.67	2.00
98	Cape Teal	*Anas capensis*	5.26	2.00	0.00	0.00
686	Cape Wagtail	*Motacilla capensis*	52.63	20.00	8.33	1.00
450	Cardinal Woodpecker	*Dendropicos fuscescens*	10.53	4.00	8.33	1.00
663	Chat Flycatcher	*Melaenornis infuscatus*	2.63	1.00	0.00	0.00
658	Chestnut-vented Warbler	*Curruca subcoerulea*	89.47	34.00	16.67	2.00
154	Common (Steppe) Buzzard	*Buteo buteo vulpinus*	2.63	1.00	0.00	0.00
734	Common Myna	*Acridotheres tristis*	13.16	5.00	0.00	0.00
1	Common Ostrich	*Struthio camelus*	10.53	4.00	0.00	0.00
421	Common Scimitarbill	*Rhinopomastus cyanomelas*	34.21	13.00	0.00	0.00

#	Common Name	Scientific Name	SABAP2 Reporting Rate			
			Full Protocol (%)	Number of cards	Ad Hoc Protocol (%)	Number of cards
378	Common Swift	*Apus apus*	2.63	1.00	0.00	0.00
439	Crested Barbet	*Trachyphonus vaillantii*	50.00	19.00	8.33	1.00
711	Crimson-breasted Shrike	*Laniarius atrococcineus*	76.32	29.00	16.67	2.00
242	Crowned Lapwing	*Vanellus coronatus*	55.26	21.00	8.33	1.00
630	Desert Cisticola	*Cisticola aridulus*	7.89	3.00	0.00	0.00
352	Diederik Cuckoo	*Chrysococcyx caprius*	13.16	5.00	8.33	1.00
764	Dusky Sunbird	*Cinnyris fuscus*	13.16	5.00	0.00	0.00
1183	Eastern Clapper Lark	*Mirafra fasciolata*	10.53	4.00	0.00	0.00
89	Egyptian Goose	*Alopochen aegyptiaca*	5.26	2.00	0.00	0.00
404	European Bee-eater	*Merops apiaster*	31.58	12.00	8.33	1.00
570	Familiar Chat	*Oenanthe familiaris*	18.42	7.00	0.00	0.00
459	Fawn-colored Lark	*Calendulauda africanoides*	28.95	11.00	0.00	0.00
665	Fiscal Flycatcher	*Melaenornis silens*	52.63	20.00	0.00	0.00
517	Fork-tailed Drongo	*Dicrurus adsimilis*	68.42	26.00	8.33	1.00
162	Gabar Goshawk	*Micronisus gabar*	13.16	5.00	0.00	0.00
874	Golden-breasted Bunting	*Emberiza flaviventris*	36.84	14.00	0.00	0.00
447	Golden-tailed Woodpecker	*Campethera abingoni*	44.74	17.00	8.33	1.00
440	Greater Honeyguide	*Indicator indicator*	2.63	1.00	0.00	0.00
122	Greater Kestrel	*Falco rupicoloides*	2.63	1.00	0.00	0.00
502	Greater Striped Swallow	*Cecropis cucullata*	10.53	4.00	8.33	1.00
419	Green Wood Hoopoe	*Phoeniculus purpureus*	2.63	1.00	0.00	0.00
830	Green-winged Pytilia	*Pytilia melba*	26.32	10.00	0.00	0.00
339	Grey Go-away-bird	*Crinifer concolor*	0.00	0.00	8.33	1.00
485	Grey-backed Sparrow-Lark	*Eremopterix verticalis*	7.89	3.00	0.00	0.00
557	Groundscraper Thrush	*Turdus litsitsirupa*	39.47	15.00	0.00	0.00
84	Hadeda Ibis	*Bostrychia hagedash*	23.68	9.00	0.00	0.00
192	Helmeted Guineafowl	*Numida meleagris*	68.42	26.00	8.33	1.00
784	House Sparrow	*Passer domesticus*	21.05	8.00	0.00	0.00
152	Jackal Buzzard	*Buteo rufofuscus*	2.63	1.00	0.00	0.00
348	Jacobin Cuckoo	*Clamator jacobinus*	10.53	4.00	0.00	0.00
586	Kalahari Scrub Robin	*Cercotrichas paena*	73.68	28.00	25.00	3.00
583	Karoo Scrub Robin	*Cercotrichas coryphoeus*	5.26	2.00	0.00	0.00
1104	Karoo Thrush	*Turdus smithi*	34.21	13.00	0.00	0.00
217	Kori Bustard	*Ardeotis kori*	2.63	1.00	8.33	1.00
114	Lanner Falcon	*Falco biarmicus*	2.63	1.00	0.00	0.00
871	Lark-like Bunting	*Emberiza impetuani*	10.53	4.00	0.00	0.00
317	Laughing Dove	*Spilopelia senegalensis*	73.68	28.00	25.00	3.00
659	Layard's Warbler	*Curruca layardi*	2.63	1.00	0.00	0.00
706	Lesser Grey Shrike	*Lanius minor*	23.68	9.00	0.00	0.00
442	Lesser Honeyguide	*Indicator minor*	2.63	1.00	0.00	0.00
413	Lilac-breasted Roller	*Coracias caudatus*	23.68	9.00	25.00	3.00
6	Little Grebe	*Tachybaptus ruficollis*	5.26	2.00	0.00	0.00

#	Common Name	Scientific Name	SABAP2 Reporting Rate			
			Full Protocol (%)	Number of cards	Ad Hoc Protocol (%)	Number of cards
385	Little Swift	*Apus affinis*	42.11	16.00	8.33	1.00
621	Long-billed Crombec	*Sylvietta rufescens*	34.21	13.00	0.00	0.00
852	Long-tailed Paradise Whydah	*Vidua paradisaea*	7.89	3.00	0.00	0.00
1016	Mallard	*Anas platyrhynchos*	2.63	1.00	0.00	0.00
661	Marico Flycatcher	*Melaenornis mariquensis*	42.11	16.00	8.33	1.00
755	Marico Sunbird	*Cinnyris mariquensis*	42.11	16.00	8.33	1.00
142	Martial Eagle	*Polemaetus bellicosus*	0.00	0.00	8.33	1.00
318	Namaqua Dove	*Oena capensis*	50.00	19.00	16.67	2.00
307	Namaqua Sandgrouse	*Pterocles namaqua*	18.42	7.00	0.00	0.00
637	Neddicky	*Cisticola fulvicapilla*	5.26	2.00	0.00	0.00
1035	Northern Black Korhaan	*Afrotis afraoides*	18.42	7.00	0.00	0.00
179	Orange River Francolin	*Scleroptila gutturalis*	2.63	1.00	0.00	0.00
1171	Orange River White-eye	*Zosterops pallidus*	26.32	10.00	8.33	1.00
165	Pale Chanting Goshawk	*Melierax canorus*	36.84	14.00	0.00	0.00
365	Pearl-spotted Owlet	*Glaucidium perlatum*	52.63	20.00	8.33	1.00
522	Pied Crow	*Corvus albus*	23.68	9.00	33.33	4.00
674	Pririt Batis	*Batis pririt*	44.74	17.00	0.00	0.00
415	Purple Roller	*Coracias naevius*	7.89	3.00	0.00	0.00
844	Quailfinch	*Ortygospiza atricollis*	2.63	1.00	0.00	0.00
708	Red-backed Shrike	*Lanius collurio*	15.79	6.00	0.00	0.00
779	Red-billed Buffalo Weaver	*Bubalornis niger*	10.53	4.00	0.00	0.00
837	Red-billed Firefinch	*Lagonosticta senegala*	5.26	2.00	0.00	0.00
805	Red-billed Quelea	*Quelea quelea*	18.42	7.00	0.00	0.00
182	Red-billed Spurfowl	*Pternistis adspersus*	15.79	6.00	0.00	0.00
97	Red-billed Teal	*Anas erythrorhyncha*	2.63	1.00	0.00	0.00
224	Red-crested Korhaan	*Lophotis ruficrista*	18.42	7.00	0.00	0.00
314	Red-eyed Dove	*Streptopelia semitorquata*	55.26	21.00	8.33	1.00
392	Red-faced Mousebird	*Urocolius indicus*	68.42	26.00	8.33	1.00
820	Red-headed Finch	*Amadina erythrocephala*	21.05	8.00	8.33	1.00
316	Ring-necked Dove	*Streptopelia capicola*	89.47	34.00	25.00	3.00
123	Rock Kestrel	*Falco rupicolus*	2.63	1.00	0.00	0.00
506	Rock Martin	*Ptyonoprogne fuligula*	71.05	27.00	8.33	1.00
372	Rufous-cheeked Nightjar	*Caprimulgus rufigena*	2.63	1.00	0.00	0.00
619	Rufous-eared Warbler	*Malcorus pectoralis*	7.89	3.00	0.00	0.00
460	Sabota Lark	*Calendulauda sabota*	15.79	6.00	0.00	0.00
789	Scaly-feathered Weaver	*Sporopipes squamifrons*	65.79	25.00	16.67	2.00
847	Shaft-tailed Whydah	*Vidua regia*	31.58	12.00	8.33	1.00
561	Short-toed Rock Thrush	*Monticola brevipes*	7.89	3.00	0.00	0.00
90	South African Shelduck	*Tadorna cana*	7.89	3.00	0.00	0.00
707	Southern Fiscal	*Lanius collaris*	28.95	11.00	0.00	0.00
4142	Southern Grey-headed Sparrow	*Passer diffusus*	21.05	8.00	0.00	0.00
803	Southern Masked Weaver	*Ploceus velatus*	65.79	25.00	0.00	0.00

#	Common Name	Scientific Name	SABAP2 Reporting Rate			
			Full Protocol (%)	Number of cards	Ad Hoc Protocol (%)	Number of cards
536	Southern Pied Babbler	*Turdoides bicolor*	34.21	13.00	0.00	0.00
426	Southern Yellow-billed Hornbill	*Tockus leucomelas*	55.26	21.00	0.00	0.00
311	Speckled Pigeon	*Columba guinea*	36.84	14.00	0.00	0.00
368	Spotted Eagle-Owl	*Bubo africanus*	2.63	1.00	0.00	0.00
654	Spotted Flycatcher	*Muscicapa striata*	15.79	6.00	0.00	0.00
275	Spotted Thick-knee	*Burhinus capensis*	18.42	7.00	0.00	0.00
411	Swallow-tailed Bee-eater	*Merops hirundineus*	18.42	7.00	0.00	0.00
238	Three-banded Plover	*Charadrius tricollaris*	5.26	2.00	0.00	0.00
641	Tinkling Cisticola	*Cisticola rufilatus*	5.26	2.00	0.00	0.00
840	Violet-eared Waxbill	*Granatina granatina*	57.89	22.00	8.33	1.00
735	Wattled Starling	*Creatophora cinerea*	15.79	6.00	0.00	0.00
359	Western Barn Owl	*Tyto alba*	15.79	6.00	0.00	0.00
61	Western Cattle Egret	*Bubulcus ibis*	2.63	1.00	0.00	0.00
391	White-backed Mousebird	*Colius colius*	57.89	22.00	0.00	0.00
763	White-bellied Sunbird	*Cinnyris talatala*	7.89	3.00	0.00	0.00
780	White-browed Sparrow-Weaver	*Plocepasser mahali*	71.05	27.00	8.33	1.00
383	White-rumped Swift	*Apus caffer*	10.53	4.00	0.00	0.00
865	White-throated Canary	*Crithagra albogularis*	10.53	4.00	0.00	0.00
495	White-throated Swallow	*Hirundo albigularis*	2.63	1.00	0.00	0.00
599	Willow Warbler	*Phylloscopus trochilus*	2.63	1.00	0.00	0.00
866	Yellow Canary	*Crithagra flaviventris*	84.21	32.00	16.67	2.00
600	Yellow-bellied Eremomela	*Eremomela icteropygialis*	28.95	11.00	0.00	0.00