Non-Priority Species	66

Number of birds counted	
Drive transects	2472

Figure 7 and Figure 8 below present the spatial distribution of the priority species recorded during transect counts and incidental sightings during the two field monitoring surveys.

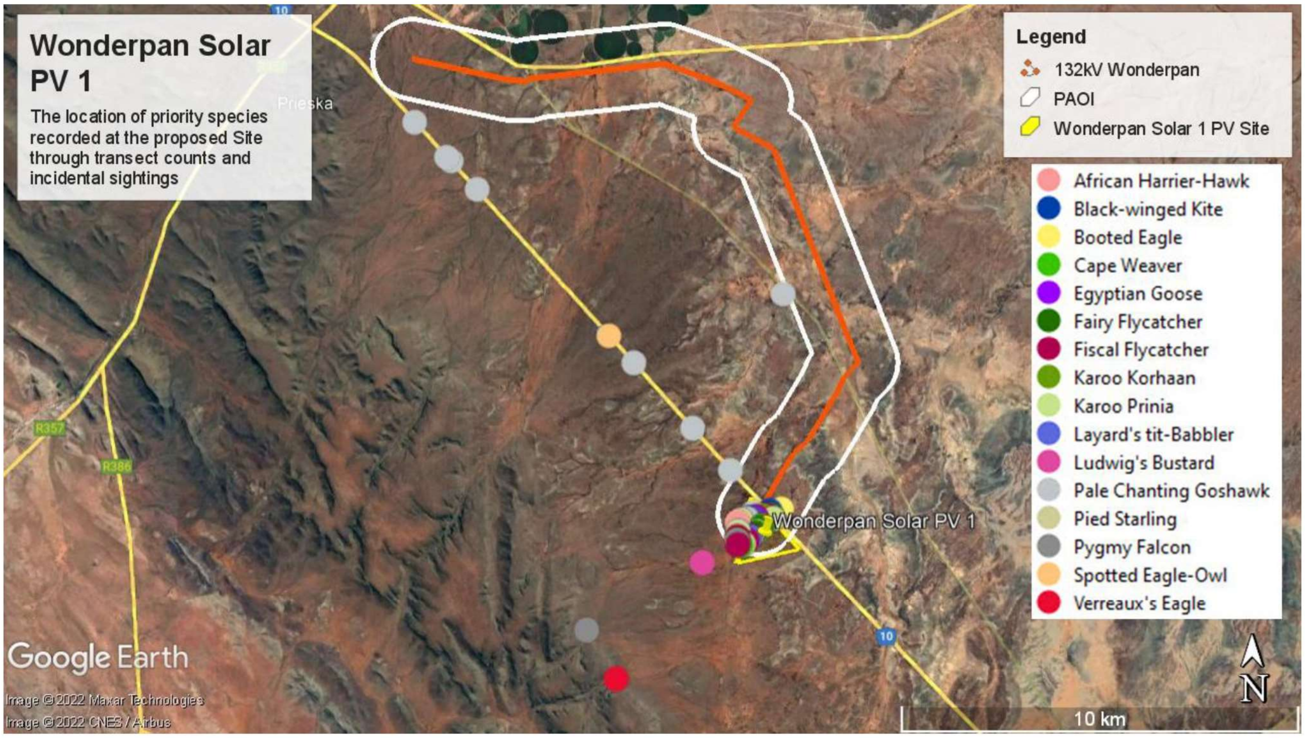

Figure 7: The location of priority species recorded at and near the PAOI through transect counts and incidental sightings.

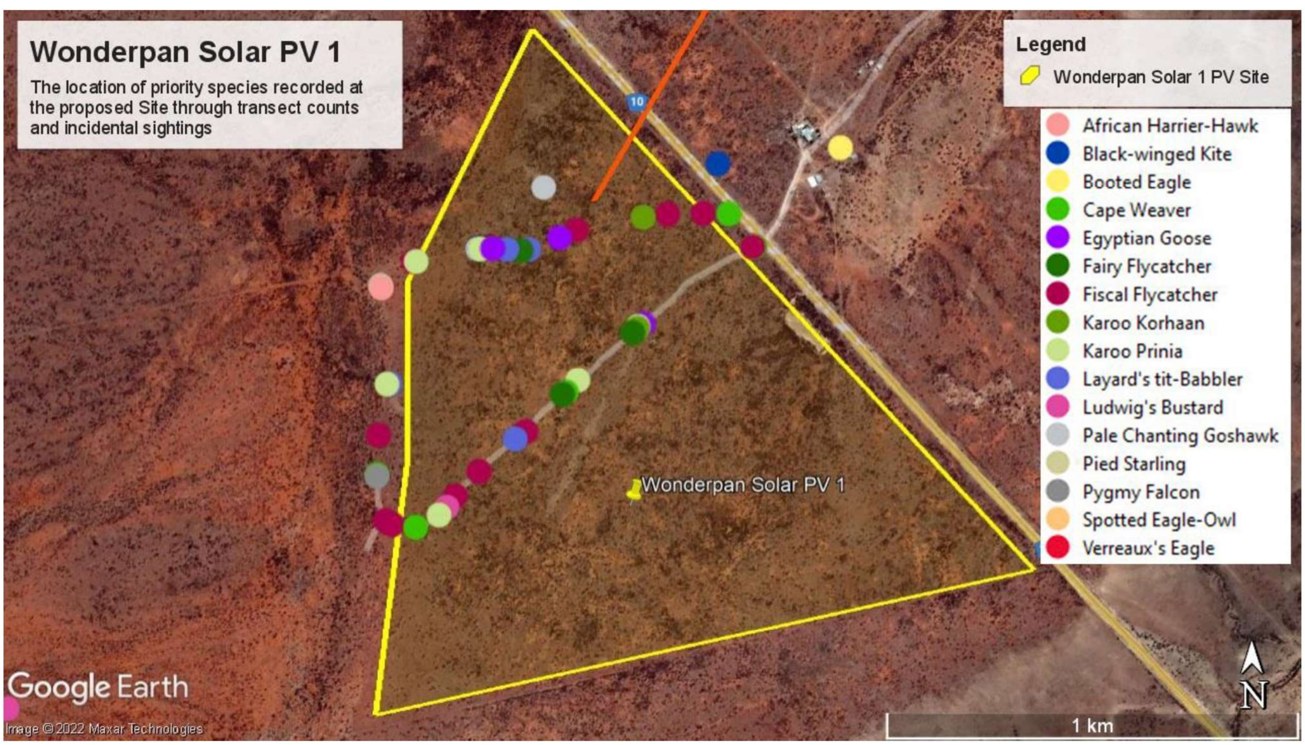

Figure 8: The location of priority species recorded at the proposed Wonderpan Solar 1 PV development area through transect counts and incidental sightings.

8 IMPACT ASSESSMENT

A literature review reveals a scarcity of published, scientifically examined information regarding large-scale PV plants and birds. The reason for this is mainly that large-scale PV plants is a relatively recent phenomenon. The main source of information for these types of impacts are from compliance reports and a few government-sponsored studies relating to recently constructed solar plants in the south-western United States. In South Africa, only two published scientific studies been conducted on the environmental impacts of PV plants in a South African context (Rudman *et al.*, 2017; Visser *et al.*, 2019). A related scientific study has also been conducted upon the effects of concentrated solar power facilities on wildlife in South Africa (Jeal *et al.*, 2019).

In summary, the main impacts of PV plants on avifauna which have emerged so far include the following:

- Displacement due to disturbance associated with the construction of the solar PV plant and associated infrastructure.
- Displacement due to habitat transformation associated with the construction of the solar PV plant and associated infrastructure.
- Collisions with the solar panels.
- Entrapment in perimeter fences.
- Electrocutions, collisions, and disturbance associated with the construction and operation of the associated electricity infrastructure.

8.1 Introduction

Anthropogenic climate change poses a global conservation concern, and is predicted to drive rapid redistribution of plant and animal species (National Audubon Society, 2015). Such redistribution events include large-scale population displacements alongside species range reductions and fragmentation, alongside population displacements (Ehrlén & Morris, 2015; Pecl *et al.*, 2017), and changes to the timing interactions (Kharouba *et al.*, 2018). Collectively, these anthropogenically-induced changes pose the risk of extinction events occurring at unprecedented rates compared to natural long-term climate (Urban, 2015) – which is itself a fundamental driver behind species distributions. In 2006, WWF Australia produced a report on the envisaged impact of climate change on birds worldwide (Wormworth & Mallon, 2006). The report found that:

- Anthropogenic Climate change now affects bird species' behaviour, ranges and population dynamics;
- Some bird species are already experiencing strong negative impacts from climate change;
- In future, subject to greenhouse gas emissions levels and climatic response, climate change will put large numbers of bird species at risk of extinction, with estimates of extinction rates varying from 2 to 72%, depending on the region, climate scenario and potential for birds to shift to new habitat.

Using statistical models based on the North American Breeding Bird Survey and Audubon Christmas Bird Count datasets, the National Audubon Society assessed geographic range shifts through the end of the century for 588 North American bird species during both the summer and winter seasons under a range of future climate change scenarios (National Audubon Society, 2015). Their analysis showed the following:

- 314 of 588 species modelled (53%) lose more than half of their current geographic range in all three modelled scenarios.
- For 126 species, range loss is predicted to occur without accompanying range expansion.
- For 188 species, predicted range loss is coupled with the potential to colonize new areas.

Climate sensitivity is an important piece of information to incorporate into conservation planning and adaptive management strategies. The persistence of many birds will depend on their ability to colonize climatically suitable areas outside of current ranges and management actions that target climate change adaptation.

South Africa is among the world's top 10 developing countries required to significantly reduce their carbon emissions (Seymore *et al.*, 2014), and the introduction of low carbon-emitting technologies into the country's compliment of power generation will greatly facilitate achieving this important objective (Walwyn & Brent, 2015). Given that South Africa receives among the highest levels of solar radiation on earth (Fluri, 2009; Munzhedzi & Sebitosi, 2009), it is clear that solar power generation should feature prominently in future national efforts to convert to a more sustainable energy suite of energy productions to combat human-induced climate change.

From an avifaunal perspective, solar power generation undoubtedly presents a long-term benefit to species viability, given that solar power generation is anticipated to mitigate the environmental threats posed by anthropogenic climate change (i.e., rapid species redistribution and broad-scale habitat transformation). However, renewable energy facilities – including solar PV facilities – themselves can impede the viability of bird species populations. The environmental risks associated with solar PV facilities need to be recognised and addressed to minimise the negate impacts such facilities may have of bird species populations.

8.2 Impacts associated with PV plant

8.2.1 Impact trauma (collisions)

This impact refers to collision-related fatality i.e., fatality resulting from the direct contact of the bird with a project structure(s). This type of fatality has been occasionally documented at solar projects of all technology types (McCrary *et al.* 1986; Hernandez *et al.* 2014; Kagan *et al.* 2014). In some instances, the bird is not killed outright by the collision impact, but succumbs to predation later, as it cannot avoid predators due to its injured state.

Sheet glass used in commercial and residential buildings has been well established as a hazard for birds. When the sky is reflected in the sheet glass, birds fail to see the building as an obstacle and attempt to fly through the glass, mistaking it for empty space (Loss *et al.* 2014). Although very few cases have been reported it is possible that the reflective surfaces of solar panels could constitute a similar risk to avifauna.

An extremely rare but potentially related problem is the so-called "lake effect" i.e. it seems possible that reflections from solar facilities' infrastructure, particularly large sheets of dark blue photovoltaic panels, may attract birds in flight across the open desert, who mistake the broad reflective surfaces for water (Kagan *et al.* 2014)[4]. The unusually high percentage of waterbird mortalities at the Desert Sunlight PV facility (44%) may support the "lake effect" hypothesis (West 2014). Although in the case of Desert Sunlight, the proximity of evaporation ponds may act as an additional risk increasing factor, in that birds are both attracted to the water feature and habituated to the presence of an accessible aquatic environment in the area. This may translate into the misinterpretation of diffusely reflected sky or horizontal polarised light source as a body of water. However, due to limited data it would be premature to make any general conclusions about the influence of the lake effect or other factors that contribute to fatality of water-dependent birds. The activity and abundance of water-dependent species near solar facilities may depend on other site-specific or regional factors, such as the surrounding landscape (Walston *et al.* 2015). Koskiuch *et al.* (2020) found that water-obligate birds, which rely on water for take-off and landing, occurred at 90% (9/10) of site-years at 7 sites in the Sonoran and Mojave Deserts Bird Conservation Region in the USA from January 2013 to September 2018. However, they stressed that their statements should not be interpreted as evidence there will be water-obligate bird mortality at PV

[4] This could either result in birds colliding directly with the solar panels or getting stranded and unable to take off again because many aquatic bird species find it very difficult and sometimes impossible to take off from dry land e.g., grebes and cormorants. This exposes them to predation, even if they do not get injured through direct collisions with the panels.

facilities developed in areas with concentrations of migrating or overwintering water obligates because the causal mechanism for fatality risk is unknown. Until such time that enough scientific evidence has been collected to discount the “lake effect” hypothesis, it must be considered as a potential source of impacts.

Weekly mortality searches at 20% coverage were conducted at the 250MW, 1300ha California Valley Solar Ranch PV site (Harvey & Associates 2014a and 2014b). According to the information that could be sourced from the internet (two quarterly reports), 152 avian mortalities were reported for the period 16 November 2013 – 15 February 2014, and 54 for the period 16 February 2014 – 15 May 2014, of which approximately 90% were based on feather spots which precluded a finding on the cause of death. These figures give an estimated unadjusted 1 030 mortalities per year, which is obviously an underestimate as it does not include adjustments for carcasses removed by scavengers and missed by searchers. The authors stated clearly that these quarterly reports do not include the results of searcher efficiency trials, carcass removal trials, or data analyses, nor does it include detailed discussions.

In a report by the National Fish and Wildlife Forensic Laboratory (Kagan *et al.* 2014), the cause of avian mortalities was estimated based on opportunistic avian carcass collections at several solar facilities, including the 550MW, 1 600ha Desert Sunlight PV plant. Impact trauma emerged as the highest identifiable cause of avian mortality, but most mortality could not be traced to an identifiable cause.

Walston *et al.* (2015) conducted a comprehensive review of avian fatality data from large scale solar facilities (all technology types) in the USA. Collision as cause of death (19 birds) ranked second at Desert Sunlight PV plant and California Valley Solar Ranch (CVSR) PV plant, after unknown causes. Cause of death could not be determined for over 50% of the fatality observations and many carcasses included in these analyses consisted only of feather spots (feathers concentrated together in a small area) or partial carcasses, thus making determination of cause of death difficult. It is anticipated that some unknown fatalities were caused by predation or some other factor unrelated to the solar project. However, they found that the lack of systematic data collection and standardization was a major impediment in establishing the actual extent and causes of fatalities across all projects.

The only scientific investigation of potential avifaunal impacts that has been performed at a South African PV facility was completed in 2016 at the 96MW Jasper PV solar facility (28°17′53″S, 23°21′56″E) which is located on the Humansrus Farm, approximately 4 km south-east of Groenwater and 30km east of Postmasburg in the Northern Cape Province (Visser *et al.* 2019). The Jasper PV facility contains 325 360 solar panels over a footprint of 180 hectares with the capacity to deliver 180 000 MWh of renewable electricity annually. The solar panels face north at a fixed 20° angle, reaching a height of approximately 1.86 m relative to ground level with a distance of 3.11 m between successive rows of panels. Mortality surveys were conducted from the 14th of September 2015 until the 6th of December 2015, with a total of seven mortalities recorded among the solar panels which gives an average rate of 0.003 birds per hectare surveyed per month. All fatalities were inferred from feather spots. Extrapolated bird mortality within the solar field at the Jasper PV facility was 435 birds/yr (95% CI 133 - 805). The broad confidence intervals result from the small number of birds detected. The mortality estimate is likely conservative because detection probabilities were based on intact birds, and probably decrease for older carcasses and feather spots. The study concluded inter alia that the short study period, and lack of comparable results from other sources made it difficult to provide a meaningful assessment of avian mortality at PV facilities. It further stated that despite these limitations, the few bird fatalities that were recorded might suggest that there is no significant collision-related mortality at the study site. The conclusion was that to fully understand the risk of solar energy development on birds, further collation and analysis of data from solar energy facilities across spatial and temporal scales, based on scientifically rigorous research designs, is required (Visser *et al.* 2018).

The results of the available literature lack compelling evidence of collisions as a cause of large-scale mortality among birds at PV facilities. Kosciuch *et al.* (2020) synthesized results from fatality monitoring studies at 10 photovoltaic solar facilities across 13 site years in California and Nevada in the USA. Annual fatality rates never exceeded 2.99 fatalities/MW/year (1.03 fatalities/hectare/year), and 3 of the four top species detected were ground-dwelling species.

It is clear from this limited literature survey that the lack of systematic and standardised data collection is a major problem in the assessment of the causes and extent of avian mortality at all types of solar facilities, regardless of the technology employed. Until statistically tested results emerge from existing compliance programmes and more dedicated scientific research, conclusions will inevitably be largely speculative and based on professional opinion.

Based on the lack of evidence to the contrary, it is not foreseen that collisions with the solar panels at the PV facility will be a significant impact. The priority species which would most likely be potentially affected by this impact are mostly small, ground-dwelling birds which forage between the solar panels, and possibly raptors which prey on them.

Based on the lack of evidence to the contrary, it is not foreseen that collisions with the solar panels at the PV facility will be a significant impact. The priority species which would most likely be potentially affected by this impact are mostly small, ground-dwelling birds which forage between the solar panels, and possibly raptors which prey on them. Due to the absence of large permanent waterbodies at or close to the development area, it is unlikely that waterbirds will be attracted to the solar arrays due to the "lake effect".

Priority species with a high to medium chance of occurring in the PAOI, which could potentially be impacted due to collisions with the solar panels, are the following: Black-winged Kite, Common Buzzard, Karoo Korhaan, Lanner Falcon, Pale Chanting Goshawk, Pygmy Falcon, Rock Kestrel, Spotted Eagle-Owl, Western Barn Owl, Yellow-billed Kite, Fiscal Flycatcher, Karoo Prinia, Karoo Thrush, Namaqua Warbler, and Pearl-spotted Owlet.

8.2.2 Entrapment in perimeter fences

Visser *et al.* (2019) recorded a fence-line fatality (Orange River Francolin *Scleroptila gutturalis*) resulting from the bird being trapped between the inner and outer perimeter fence of the facility. This was further supported by observations of large-bodied birds unable to escape from between the two fences (e.g. Red-crested Korhaan *Lophotis ruficrista*) (Visser *et al.* 2019). Considering that one would expect the birds to be able to take off in the lengthwise direction (parallel to the fences), it seems possible that the birds panicked when they were approached by observers and thus flew into the fence. This risk remains low, however, with Visser *et al.* (2019) tentatively presenting a fatality rate of 0.002 birds per km per month from this risk factor, although qualifying that the single documented fatality was inadequate for robust extrapolations. Owls are also prone to getting entangled in barbed wire fences (personal observation).

It is not foreseen that entrapment of priority species in perimeter fences will be a significant impact at the PV facility. The priority species which could potentially be affected by this impact are most likely medium to large terrestrial species, and possibly large owls.

Priority species, with a medium to high chance of occurring in the PAOI, which could potentially be impacted due entrapment are the following: Abdim's Stork, Black-headed Heron, Karoo Korhaan, Kori Bustard, Ludwig's Bustard, Spotted Eagle-Owl, and Western Barn Owl.

8.2.3 Displacement due to habitat transformation associated with the construction of the solar PV facility

Ground-disturbing activities affect a variety of processes in arid areas, including soil density, water infiltration rate, vulnerability to erosion, secondary plant succession, invasion by exotic plant species, and stability of cryptobiotic soil crusts. These processes have the ability – individually and together – to alter habitat quality, often to the detriment of wildlife, including avifauna. Any disturbance and alteration to the desert landscape, including the construction and decommissioning of utility-scale solar energy facilities, has the potential to increase soil erosion. Erosion can physically and physiologically affect plant species and can thus adversely influence primary production and food availability for wildlife (Lovich & Ennen 2011).

Solar energy facilities require substantial site preparation (including the removal of vegetation) that alters topography and, thus, drainage patterns to divert the surface flow associated with rainfall away from facility infrastructure. Channelling runoff away from plant communities can have dramatic negative effects on water availability and habitat quality in arid areas. Areas deprived of runoff from sheet flow support less biomass of perennial and annual plants relative to adjacent areas with uninterrupted water-flow patterns (Lovich & Ennen 2011).

The activities listed below are typically associated with the construction and operation of solar facilities and could have direct impacts on avifauna through the transformation of habitat (County of Merced 2014):

- Preparation of solar panel areas for installation, including vegetation clearing, grading, cut and fill;
- Excavation/trenching for water pipelines, cables, fibre-optic lines, and the septic system;
- Construction of piers and building foundations;
- Construction of new dirt or gravel roads and improvement of existing roads;
- Temporary stockpiling and side-casting of soil, construction materials, or other construction wastes;
- Soil compaction, dust, and water runoff from construction sites;
- Degradation of water quality in drainages and other water bodies resulting from project runoff;
- Maintenance of fire breaks and roads; and
- Weed removal, brush clearing, and similar land management activities related to the ongoing operation of the project.

These activities could have an impact on birds breeding, foraging and roosting in or in close proximity through transformation of habitat, which could result in temporary or permanent displacement.

In a study comparing the avifaunal habitat use in PV arrays with adjoining managed grassland at airports in the USA, DeVault *et al.* (2014) found that species diversity in PV arrays was reduced compared to the grasslands (37 vs 46), supporting the view that solar development is generally detrimental to wildlife on a local scale.

In order to identify functional and structural changes in bird communities in and around the development footprint, Visser *et al.* (2018) gathered bird transect data at the 180 hectares, 96MW Jasper PV solar facility in the Northern Cape, representing the solar development, boundary, and untransformed landscape. The study found both bird density and diversity per unit area was higher in the boundary and untransformed landscape, however, the extent therefore was not considered to be statistically significant. This indicates that the PV facility matrix is permeable to most species. However, key environmental features, including available habitat and vegetation quality are most likely the overriding factors influencing species' occurrence and their relative density within the development footprint. Her most significant finding was that the distribution of birds in the landscape changed, from a shrubland to open country and grassland bird community, in response to changes in the distribution and abundance of habitat resources such as food, water and nesting sites. These changes in resource availability patterns were detrimental to some bird species and beneficial to others. Shrubland specialists appeared to be negatively affected by the presence of the PV facility. In contrast, open country/grassland and generalist species, were favoured by its development (Visser *et al.* 2019).

As far as displacement, either completely or partially (reduced densities) due to habitat loss is concerned, it is highly likely that the same pattern of reduced avifaunal densities will manifest itself at the proposed PV facility. In addition, ground nesting species and some raptors and vultures are also likely to be impacted by the habitat transformation, as it will result in reduced food availability and accessibility.

Priority species, with a medium to high chance of occurring in the PAOI, that could be negatively affected by displacement due to habitat loss are the following: Abdim's Stork, Black-headed Heron, Black-winged Kite, Common Buzzard, Jackal Buzzard, Karoo Korhaan, Kori Bustard, Lanner Falcon, Ludwig's Bustard, Pale Chanting Goshawk, Pygmy Falcon, Rock Kestrel, Spotted Eagle-Owl, Verreaux's Eagle, Western Barn Owl, Western Cattle Egret, Yellow-

billed Kite, Blacksmith Lapwing, Fairy Flycatcher, Fiscal Flycatcher, Karoo Prinia, Karoo Thrush, Namaqua Warbler, Pearl-spotted Owlet, Lappet-faced Vulture, and White-backed Vulture.

8.2.4 Displacement due to disturbance associated with the construction of the solar PV facility

As far as disturbance is concerned, it is likely that all the avifauna, including all the priority species, will be temporarily displaced in the footprint area, either completely or more likely partially (reduced densities) during the construction phase, due to the disturbance associated with the construction activities e.g. increased vehicle traffic, and short-term construction-related noise (from equipment) and visual disturbance.

At the PV facility, the priority species which would be most severely affected by disturbance would be ground nesting species, and those that utilise low shrubs and trees for nesting.

Priority species, with a medium to high chance of occurring in the PAOI, that could be negatively affected by displacement due to disturbance are the following: Black-headed Heron, Black-winged Kite, Common Buzzard, Jackal Buzzard, Karoo Korhaan, Kori Bustard, Lanner Falcon, Ludwig's Bustard, Pale Chanting Goshawk, Pygmy Falcon, Rock Kestrel, Spotted Eagle-Owl, Verreaux's Eagle, Western Barn Owl, Western Cattle Egret, Yellow-billed Kite, Blacksmith Lapwing, Cape Weaver, Fairy Flycatcher, Fiscal Flycatcher, Karoo Prinia, Karoo Thrush, Namaqua Warbler, and Pearl-spotted Owlet.

8.3 Impacts associated with the associated electricity infrastructure

8.3.1 Electrocution of priority species in the on-site and combiner substations.

Electrocution refers to the scenario where a bird is perched or attempts to perch on the electrical structure and causes an electrical short circuit by physically bridging the air gap between live components and/or live and earthed components (van Rooyen 2000). The electrocution risk is largely determined by the design of the electrical hardware. Electrocutions within the proposed substations are possible, however the likelihood of this impact on the more sensitive Red List priority species is remote, as these species are unlikely to regularly utilise the infrastructure within the substation yard for perching or roosting.

Species that are most vulnerable to this impact are raptors, vultures, crows, owls and certain species of waterbirds. The priority species with a medium to high likelihood of occurrence in the PAOI, which are potentially vulnerable to electrocution in substations are the following: Black-headed Heron, Black-winged Kite, Booted Eagle, Common Buzzard, Egyptian Goose, Hadada Ibis, Helmeted Guineafowl, Jackal Buzzard, Lanner Falcon, Lappet-faced Vulture, Pale Chanting Goshawk, Pied Crow, Pygmy Falcon, Rock Kestrel, Spotted Eagle-Owl, Verreaux's Eagle, Western Barn Owl, Western Cattle Egret and White-backed Vulture.

8.3.2 Electrocution of priority species on the 132kV overhead lines.

The electrocution risk is largely determined by the pole/tower design, and the size of the bird.

The only priority species capable of bridging the clearance distances of the proposed 132kV power line infrastructure are White-backed Vultures and Lappet-faced Vultures, due to their size and gregarious nature. There is an established White-backed Vulture and Lappet-faced Vulture roost using the existing Burchell - Cuprum 132kV overhead powerline that lies within close proximity to the PAOI (>100 birds).

Based on interviews with landowners and personal observations, it seems that the numbers of White-backed Vultures and Lappet-faced Vultures are on the increase south of the Orange River in the Northern Cape during the non-breeding season (December to May). These birds establish temporary roosts on power lines, and it is

entirely possible that the birds could on occasion roost on the proposed 132kV powerlines. Depending on the proposed pole design, this could place them at risk of electrocution.

8.3.3 Collisions with the 132kV overhead line

Collisions may well be the biggest threat posed by high voltage lines to birds in southern Africa (Van Rooyen 2004). Most heavily impacted upon are bustards, storks, cranes, and various species of waterbirds, and to a lesser extent, vultures. These species are mostly heavy-bodied birds with limited manoeuvrability, which makes it difficult for them to take the necessary evasive action to avoid colliding with transmission lines (Van Rooyen 2004, Anderson 2001).

From incidental record keeping by the Endangered Wildlife Trust, it is possible to give a measure of what species are generally susceptible to power line collisions in South Africa (Figure 5).

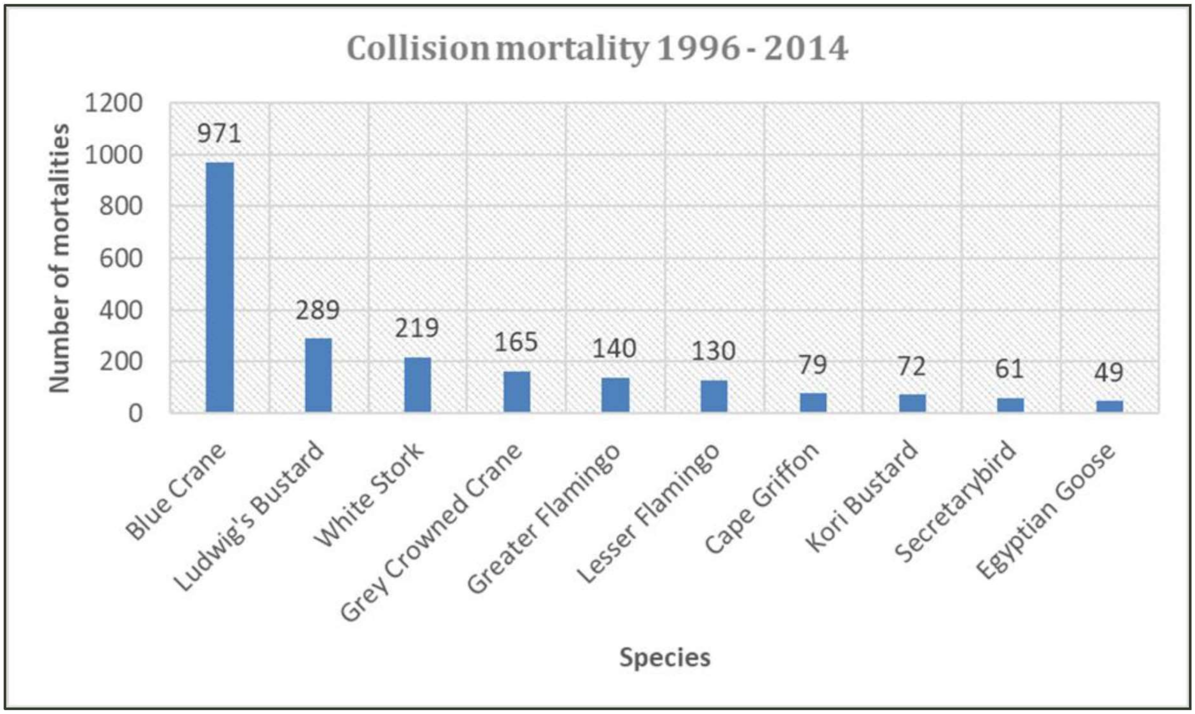

Figure 9: The top 10 collision prone bird species in South Africa, in terms of reported incidents contained in the Eskom/Endangered Wildlife Trust Strategic Partnership central incident register 1996 - 2014 (EWT unpublished data)

Power line collisions are generally accepted as a key threat to bustards (Raab *et al*. 2009; Raab *et al*. 2010; Jenkins & Smallie 2009; Barrientos *et al*. 2012, Shaw 2013). In one study, carcass surveys were performed under high voltage transmission lines in the Karoo for two years, and low voltage distribution lines for one year (Shaw 2013). Ludwig's Bustard was the most common collision victim (69% of carcasses), with bustards generally comprising 87% of mortalities recovered. Total annual mortality was estimated at 41% of the Ludwig's Bustard population, with Kori Bustards *Ardeotis kori* also dying in large numbers (at least 14% of the South African population killed in the Karoo alone). Karoo Korhaan was also recorded, but to a much lesser extent than Ludwig's Bustard. The reasons for the relatively low collision risk of this species probably include their smaller size (and hence greater agility in flight) as well as their more sedentary lifestyles, as local birds are familiar with their territory and are less likely to collide with power lines (Shaw 2013).

Using a controlled experiment spanning a period of nearly eight years (2008 to 2016), the Endangered Wildlife Trust (EWT) and Eskom tested the effectiveness of two types of line markers in reducing power line collision mortalities of large birds on three 400kV transmission lines near Hydra substation in the Karoo. Marking was highly effective for Blue Cranes, with a 92% reduction in mortality, and large birds in general with a 56% reduction in mortality, but not for bustards, including the endangered Ludwig's Bustard. The two different marking devices were approximately equally effective, namely spirals and bird flappers, they found no evidence supporting the preferential use of one type of marker over the other (Shaw *et al*. 2017).

There are several collision prone priority species with a medium to high likelihood of occurrence in the PAOI. Priority species which most at risk of collisions with the proposed overhead lines are the following: Abdim's Stork, Black-headed Heron, Common Buzzard, Egyptian Goose, Jackal Buzzard, Karoo Korhaan, Kori Bustard, Ludwig's Bustard, Spotted Eagle-Owl, Verreaux's Eagle, Western Barn Owl, Hadada Ibis, Helmeted Guineafowl, Northern Black Korhaan, Red-crested Korhaan, White-backed Vulture and Lappet-faced Vulture.

8.3.3 Displacement of priority species due to disturbance associated with the construction of the proposed overhead powerline

The construction of the proposed 132kV overhead line and its associated infrastructure may cause the temporary displacement of priority species using the existing Burchell - Cuprum 132kV line for roosting and nesting purposes, due to disturbance associated with the construction activities.

Priority species with a medium to high chance of occurring in the PAOI, which could potentially be impacted by disturbance during the construction of the power lines are the following: Abdim's Stork, Black-headed Heron, Black-winged Kite, Common Buzzard, Jackal Buzzard, Karoo Korhaan, Kori Bustard, Lanner Falcon, Ludwig's Bustard, Pale Chanting Goshawk, Pygmy Falcon, Rock Kestrel, Spotted Eagle-Owl, Verreaux's Eagle, Western Barn Owl, Yellow-billed Kite, Northern Black Korhaan, Red-crested Korhaan, Lappet-faced Vulture and White-backed Vulture

9 IMPACT RATING

9.1 Determination of Significance of Impacts

Direct, indirect, and cumulative impacts of the issues identified through the EIA process were assessed in terms of the following criteria:

- The nature, which includes a description of what causes the effect, what will be affected and how it will be affected.

- The extent, wherein it is indicated whether the impact will be
  - 1 = site only
  - 2 = local
  - 3 = regional
  - 4 = national
  - 5 = international

- The duration, wherein is indicated whether:
  - 1 = the lifetime of the impact will be of a very short duration (0–1 years)
  - 2 = the lifetime of the impact will be of a short duration (2-5 years)
  - 3 = medium-term (5–15 years)
  - 4 = long term (> 15 years)
  - 5 = permanent

- The consequences (magnitude), quantified on a scale from 0-10, where:

- 0 = small and will have no effect on the environment
- 2 = minor and will not result in an impact on processes
- 4 = low and will cause a slight impact on processes
- 6 = moderate and will result in processes continuing but in a modified way
- 8 = high (processes are altered to the extent that they temporarily cease)
- 10 = very high and results in complete destruction of patterns and permanent cessation of processes.

- The probability of occurrence, which describes the likelihood of the impact actually occurring. Probability is estimated on a scale of 1–5, where:
  - 1 = very improbable (probably will not happen)
  - 2 = improbable (some possibility, but low likelihood)
  - 3 = probable (distinct possibility)
  - 4 = highly probable (most likely)
  - 5 is definite (impact will occur regardless of any prevention measures)

- The significance, which is determined through a synthesis of the characteristics described above and is assessed as low, medium, or high

- The status, which is described as either positive, negative, or neutral.

- The degree to which the impact can be reversed.

- The degree to which the impact may cause irreplaceable loss of resources.

- The degree to which the impact can be mitigated.

The significance is calculated by combining the criteria in the following formula:

S = (E+D+M)P

S = Significance weighting

E = Extent

D = Duration

M = Magnitude

P = Probability

The significance weightings for each potential impact are as follows:

- < 30 points: Low (i.e. where this impact would not have a direct influence on the decision to develop in the area),
- 30-60 points: Medium (i.e. where the impact could influence the decision to develop in the area unless it is effectively mitigated),
- 60 points: High (i.e. where the impact must have an influence on the decision process to develop in the area).

9.2 Impact Assessment

The impact assessments are summarised in the tables below.

9.2.1 Construction Phase

Nature: *Displacement of priority species due to disturbance associated with construction of the PV plant and associated substations.*		
	Without mitigation	**With mitigation**
Extent	2 local	2 local
Duration	1 very short	1 very short
Magnitude	8 high	6 moderate
Probability	5 definite	5 definite
Significance	**55 MEDIUM**	**45 MEDIUM**
Status (positive or negative)	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes, but to a limited extent	

Mitigation:

- Activity should as far as possible be restricted to the footprint of the infrastructure.
- Measures to control noise and dust should be applied according to current best practice in the industry.
- Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum as far as practical.
- Access to the rest of the property must be restricted.
- The recommendations of the ecological and botanical specialist studies must be strictly implemented, especially as far as limitation of the construction footprint is concerned.
- Measures to control noise and dust should be applied according to current best practice in the industry

Residual Risks: The residual risk of displacement will be reduced but remain at a medium level after mitigation, if the proposed mitigation is implemented.

Nature: *Displacement of priority species due to habitat transformation associated with construction of the PV plant and associated substations.*		
	Without mitigation	**With mitigation**
Extent	1 site only	1 site only
Duration	4 long term	4 long term
Magnitude	8 high	6 moderate
Probability	5 definite	4 improbable
Significance	**65 HIGH**	**44 MEDIUM**
Status (positive or negative)	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	To a limited extent	
Mitigation: • Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum. • The mitigation measures proposed by the vegetation specialist must be strictly implemented.		
Residual Risks: The residual risk of displacement will be reduced after mitigation but will remain for some species due to the change in habitat.		

Nature: *Displacement of priority species due to disturbance associated with construction of the 132kV overhead power line.*		
	Without mitigation	**With mitigation**
Extent	2 local	2 local
Duration	1 very short	1 very short
Magnitude	8 high	6 moderate
Probability	4 highly probable	2 improbable
Significance	**44 MEDIUM**	**18 LOW**
Status (positive or negative)	Negative	Negative
Reversibility	Medium	High
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	

Mitigation:

- Conduct a pre-construction inspection (avifaunal walk-through) to record the status of nests of SCC on the existing Burchell – Cuprum 132kV high voltage line. If a nest is occupied, the avifaunal specialist must consult with the contractor to find ways of minimising the potential disturbance to the breeding pair of birds during the construction period.
- Construction activity should be restricted to the immediate footprint of the infrastructure.
- Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of priority species.
- Measures to control noise and dust should be applied according to current best practice in the industry.
- Maximum used should be made of existing access roads and the construction of new roads should be kept to a minimum.

Residual Risks: The residual risk of displacement will be reduced to a low level after mitigation, if the proposed mitigation is implemented.

9.2.2 Operational Phase

Nature: *Mortality of priority species due to collisions with solar panels.*		
	Without mitigation	**With mitigation**
Extent	1 local	1 local
Duration	4 long term	4 long term
Magnitude	4 low	4 low
Probability	2 improbable	2 improbable
Significance	**18 LOW**	**18 LOW**
Status (positive or negative)	Negative	Negative
Reversibility	High	High

Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	No mitigation required	
Mitigation: • No mitigation is required due to the low significance.		
Residual Risks: Not applicable		

Nature: *Entrapment of large-bodied birds in the double perimeter fence.*		
	Without mitigation	**With mitigation**
Extent	2 local	2 local
Duration	4 long term	4 long term
Magnitude	6 moderate	4 low
Probability	3 possible	2 improbable
Significance	**36 MEDIUM**	**20 LOW**
Status (positive or negative)	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	
Mitigation: • Increasing the spacing between at least the top two wires (to a minimum of 30cm) and ensuring they are correctly tensioned will reduce the snaring risk for owls. • If possible, a single perimeter fence should be used.		
Residual Risks: The residual risk of electrocution will be low once mitigation is implemented.		

Nature: *Mortality of priority species due to electrocution in the substations*		
	Without mitigation	**With mitigation**
Extent	2 local	2 local
Duration	4 long term	4 long term
Magnitude	6 medium	4 low
Probability	3 possible	1 very improbable
Significance	**36 MEDIUM**	**10 LOW**
Status (positive or negative)	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	

Mitigation: • The hardware within the proposed central collector substation yard is too complex to warrant any mitigation for electrocution at this stage. It is recommended that if on-going impacts are recorded once operational, site-specific mitigation (insulation) be applied reactively. This is an acceptable approach because Red List priority species are unlikely to frequent the switching station and substation and be electrocuted.
Residual Risks: The residual risk of electrocution will be low once mitigation is implemented.

Nature: *Mortality of priority species due to collisions with the 132kV high voltage line*		
	Without mitigation	**With mitigation**
Extent	2 local	2 local
Duration	4 long term	4 long term
Magnitude	6 medium	4 low
Probability	3 possible	2 improbable
Significance	**36 MEDIUM**	**20 LOW**
Status (positive or negative)	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
Mitigation: • Eskom approved bird flight diverters should be installed on the 132kV overhead line according to the applicable Eskom Engineering Instruction. These devices must be installed as soon as the conductors are strung.		
Residual Risks: The residual risk of collision will still be present for Ludwig's Bustard, but significantly reduced for other species.		

Nature: *Mortality of priority species due to electrocution on the 132kV high voltage line*		
	Without mitigation	**With mitigation**
Extent	3 regional	3 regional
Duration	4 long term	4 long term
Magnitude	8 high	4 low
Probability	4 highly probable	1 very improbable
Significance	**60 HIGH**	**10 LOW**
Status (positive or negative)	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	
Mitigation:		

• Construction of the power line using an approved bird friendly pole/tower design in accordance with the Eskom Distribution Technical Bulletin relating to bird friendly structures. The avifaunal specialist must sign off on the final design.
Residual Risks: The residual risk of electrocution will be low once mitigation is implemented.

9.2.3 Decommissioning Phase

Nature: *Displacement of priority species due to disturbance associated with decommissioning of the PV plant and associated infrastructure.*		
	Without mitigation	**With mitigation**
Extent	2 local	2 local
Duration	1 very short	1 very short
Magnitude	8 high	6 moderate
Probability	5 definite	5 definite
Significance	**55 MEDIUM**	**45 MEDIUM**
Status (positive or negative)	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes, but to a limited extent	
Mitigation: • Activity should as far as possible be restricted to the footprint of the infrastructure. • Measures to control noise and dust should be applied according to current best practice in the industry. • Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum as far as practical. • Access to the rest of the property must be restricted. • The recommendations of the ecological and botanical specialist studies must be strictly implemented, especially as far as limitation of the construction footprint is concerned. • Measures to control noise and dust should be applied according to current best practice in the industry		
Residual Risks: The residual risk of displacement will be reduced but remain at a medium level after mitigation, if the proposed mitigation is implemented.		

The impacts are summarized, and a comparison made between pre-and post-mitigation phases as shown in Table 5 below. The rating of environmental issues associated with different parameters prior to, and post mitigation of a proposed activity was averaged.

10 CUMULATIVE IMPACTS

According to the DFFE national database of renewable energy applications, there are currently six renewable energy projects (all solar) within a 30km radius around the proposed Wonderpan Solar 1 PV facility (Table 4 and Figure 10).

The total affected land parcel area taken up by authorised and planned renewable energy projects within a 30 km radius around the proposed Wonderpan Solar 1 PV facility is approximately 271 km². The total affected land parcel area affected by the proposed Wonderpan Solar 1 PV facility equates to approximately 1.37km². The combined land parcel area affected by authorised renewable energy developments within the 30 km radius around the proposed Wonderpan Solar 1 PV facility, including the latter, thus equals approximately 272.37 km². Of this, the proposed Wonderpan Solar 1 PV facility land parcel areas constitute 0.5 %. The cumulative impact of the proposed Wonderpan Solar 1 PV facility is thus anticipated to be **low** after mitigation.

The total area within the 30km radius around the proposed projects equates to about 2976 km² of similar habitat (excluding urban areas). The total combined size of the land parcels potentially affected by renewable energy projects will equate to 9.1% of the available habitat in the 30km radius. Assuming that all the projects are actually constructed, the cumulative impact of all the proposed renewable energy projects is estimated to be **medium**. However, the actual physical footprint of the renewable energy facilities will be much smaller than the land parcel areas themselves. Furthermore, several of these projects must still be subject to a competitive bidding process where only the most competitive projects will win a power purchase agreement required for the project to proceed to construction. If all mitigation measures are strictly implemented the cumulative impact could be reduced to **low**.

The cumulative impact of all the planned renewable energy facilities in this area is rated as **medium** pre-mitigation, and **low** post-mitigation, **provided all the proposed mitigation measures are strictly applied**.

As far as the proposed 132kV grid connection is concerned, the grid connection will add approximately 21km to the existing high voltage grid (approximately 61km) in the 30km radius around the proposed facility, of which approximately 6km will run parallel to existing high voltage lines[5]. This amounts to an increase of approximately 24% in the length of new high voltage lines within this area, if the length of line running next to existing lines is discounted. The cumulative impact of the proposed 132kV grid, is thus anticipated to be **medium** before mitigation, but it should be reduced to **low** with mitigation**.**

Table 4: Planned renewable energy facilities within 30km from the proposed Wonderpan 1 PV facility

Name	DFFE registration number	Status
115 MW Camel Thorn Photovoltaic Solar Energy Facility on the Remaining Extent of Portion 2 of the Farm Karabee 50 east of Prieska within the Siyathemba Local Municipality	DEA/EIA/000374/2016	Approved
The Proposed Construction Of A 75mw Photovoltaic Power Plant And Its Associated Infrastructure On A Portion Of The Remaining Extent Of Erf 1 Prieska Within The Siyathemba Local Municipality, Northern Cape Province	14/12/16/3/3/2/345	Approved
Proposed 75MW IPMS Solar power plant in Prieska, Northern Cape Province	14/12/16/3/3/1/981	Approved
The proposed 2MW Mahoebe solar energy facility and associated infrastructure on portion 19 of the farm De Hoek 32, Northern Cape Province	14/12/16/3/3/1/1475	Approved
The proposed 1GW Siyathemba solar park, Northern Cape Province	14/12/16/3/3/2/521	In process
Construction of the 75MW Prieska Solar Energy facility on protion 3 of the Farm Holsloot 47,Northern Cape Province	14/12/16/3/3/2/313	In process

[5] No information could be sourced on the length of the grid lines for the other planned PV facilities.

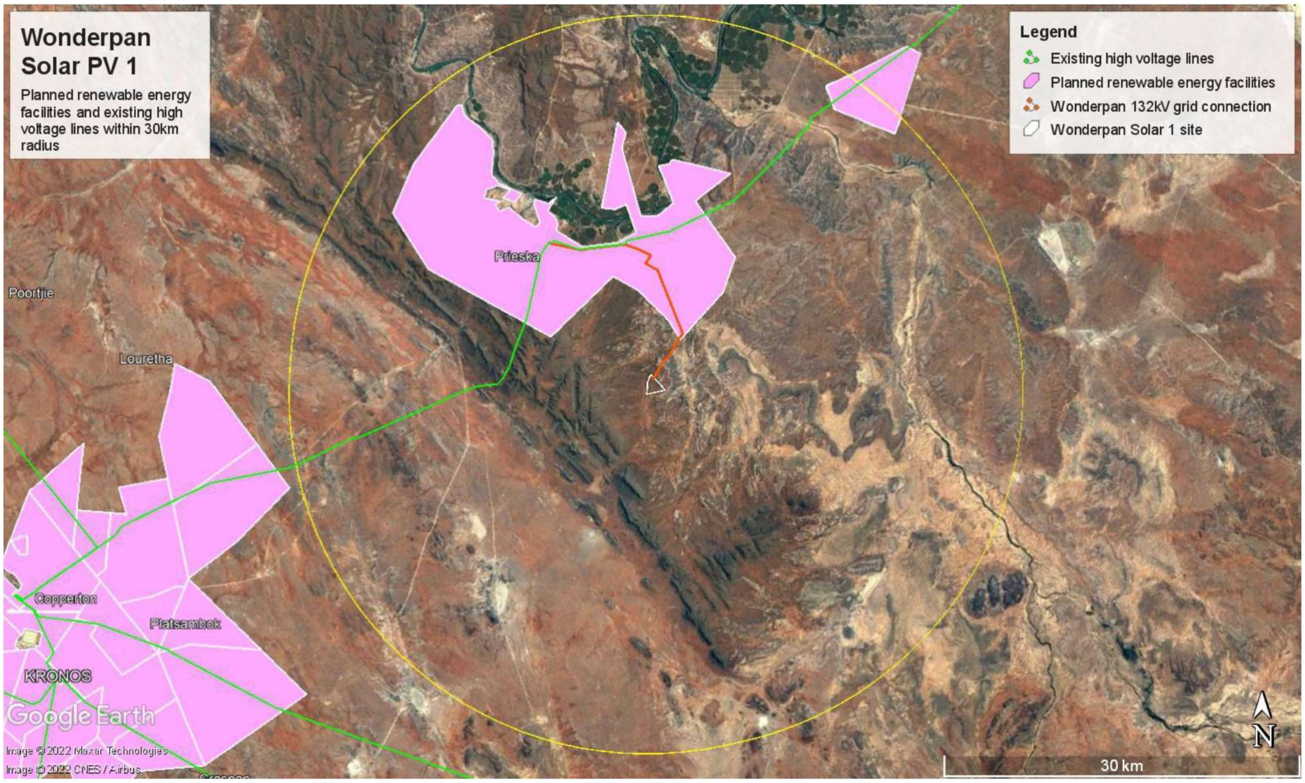

Figure 10: Planned renewable energy facilities within a 30km radius around the proposed Wonderpan PV 1 facility.

Table 5: Comparison of summarised impacts on environmental parameters

Environmental Parameter	Nature of the Impact	Rating prior to mitigation	Rating post mitigation
Avifauna	Displacement of priority species due to disturbance associated with construction of the PV plant and associated infrastructure.	55 MEDIUM	45 MEDIUM
	Displacement of priority species due to habitat transformation associated with construction of the PV plant and associated infrastructure.	65 HIGH	44 MEDIUM
	Mortality of priority species due to collisions with solar panels.	18 LOW	18 LOW
	Entrapment of large-bodied birds in the double perimeter fence.	36 MEDIUM	20 LOW
	Mortality of priority species due to electrocution in the substations	36 MEDIUM	10 LOW
	Mortality of priority species due to collisions with the 132kV powerline	36 MEDIUM	20 LOW

Environmental Parameter	Nature of the Impact	Rating prior to mitigation	Rating post mitigation
	Mortality of priority species due to electrocution on the 33kV and 132kV powerlines	60 HIGH	10 LOW
	Displacement of priority species due to disturbance associated with decommissioning of the PV plant and associated infrastructure.	55 MEDIUM	45 MEDIUM
	Displacement of priority species due to disturbance associated with construction of the 132kV overhead power line.	44 MEDIUM	18 LOW
	AVERAGE SIGNIFICANCE RATING	**45 MEDIUM**	**25 LOW**

11 ENVIRONMENTAL SENSITIVITIES

For the Wonderpan Solar 1 PV development area (i.e., PAOI) no avifaunal environmental sensitivities were identified. However, it should be noted that nesting sites of Verreaux's Eagles were recorded about 4km from the development area. Due to the distance of the nests from the PAOI, no buffer zone is required at this stage (Figure 10).

It should also be noted that there is an established White-backed Vulture and Lappet-faced Vulture roost (>100 birds) using the existing Burchell - Cuprum 132kV overhead powerline which is within close proximity of the PAOI. Based on interviews with landowners and personal observations, it seems that the numbers of White-backed Vultures and Lappet-faced Vultures are on the increase south of the Orange River in the Northern Cape during the non-breeding season (December to May). These birds establish temporary roosts on power lines, and it is entirely possible that the birds could on occasion roost on the proposed Wonderpan 132kV powerline. Depending on the proposed pole design, this could place them at risk of electrocution.

Avifaunal sensitivities in the general area of the proposed Wonderpan Solar PV 1 Facility fall outside of the PAOI and therefore do not require a buffer zone (Figure 11).

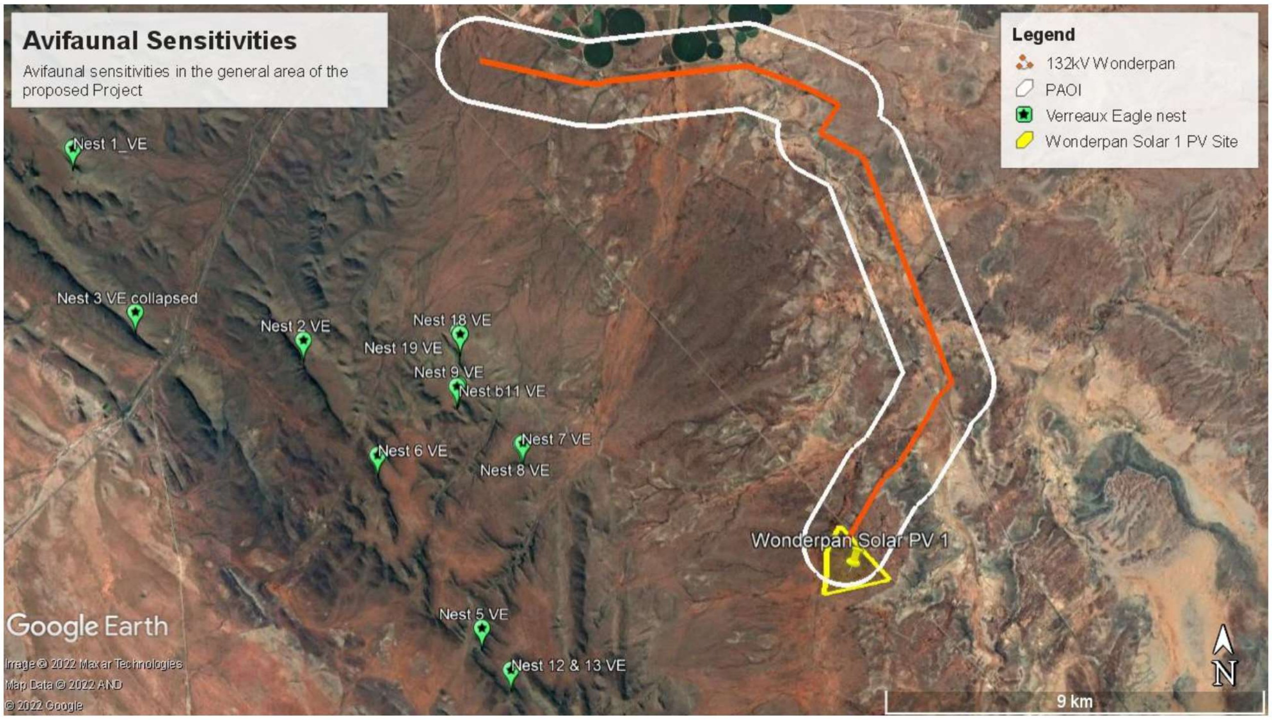

Figure 11: Avifaunal sensitivities in the general area of the proposed Wonderpan Solar PV 1 Facility. These sensitivities fall outside of the PAOI and therefore do not require a buffer zone.

12 ENVIRONMENTAL MANAGEMENT PROGRAMME

For each anticipated impact, management recommendations for the design, construction, and operational phase of the solar PV facility and the overhead powerline (where appropriate) will be included in the project EMPr of the Bird Specialist Study (see Appendix 4).

13 CONCLUSIONS

The proposed Wonderpan Solar 1 PV Facility could have a range of potential pre-mitigation impacts on priority avifauna ranging from low to high, which is expected to be reduced to medium and low with appropriate mitigation measures. No fatal flaws were discovered during the investigations. The proposed Project is supported provided that all mitigation measures are adhered to.

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APPENDIX 1: SABAP 2 SPECIES LIST FOR THE BROADER AREA

Species name	Scientific name	SABAP2 Reporting Rate		Global Red List Status	Regional Red List Status
		Full protocol	Ad hoc protocol		
Abdim's Stork	*Ciconia abdimii*	9,76	4,00	-	NT
African Black Duck	*Anas sparsa*	2,44	0,00	-	-
African Darter	*Anhinga rufa*	4,88	0,00	-	-
African Fish Eagle	*Haliaeetus vocifer*	19,51	2,00	-	-
African Sacred Ibis	*Threskiornis aethiopicus*	21,95	0,00	-	-
Black-headed Heron	*Ardea melanocephala*	9,76	0,00	-	-
Black-winged Kite	*Elanus caeruleus*	12,20	0,00	-	-
Booted Eagle	*Hieraaetus pennatus*	4,88	2,00	-	-
Cape Shoveler	*Spatula smithii*	7,32	0,00	-	-
Cape Teal	*Anas capensis*	7,32	2,00	-	-
Common Buzzard	*Buteo buteo*	9,76	2,00	-	-
Egyptian Goose	*Alopochen aegyptiaca*	53,66	4,00	-	-
Glossy Ibis	*Plegadis falcinellus*	2,44	0,00	-	-
Goliath Heron	*Ardea goliath*	4,88	0,00	-	-
Grey Heron	*Ardea cinerea*	19,51	0,00	-	-
Hamerkop	*Scopus umbretta*	4,88	0,00	-	-
Jackal Buzzard	*Buteo rufofuscus*	4,88	6,00	-	-
Karoo Korhaan	*Eupodotis vigorsii*	7,32	2,00	-	NT
Kori Bustard	*Ardeotis kori*	4,88	2,00	NT	NT
Lanner Falcon	*Falco biarmicus*	7,32	4,00	-	VU
Little Egret	*Egretta garzetta*	2,44	0,00	-	-
Little Grebe	*Tachybaptus ruficollis*	14,63	0,00	-	-
Ludwig's Bustard	*Neotis ludwigii*	7,32	0,00	EN	EN
Pale Chanting Goshawk	*Melierax canorus*	34,15	18,00	-	-
Pygmy Falcon	*Polihierax semitorquatus*	21,95	8,00	-	-
Red-billed Teal	*Anas erythrorhyncha*	4,88	0,00	-	-
Red-knobbed Coot	*Fulica cristata*	12,20	0,00	-	-
Red-necked Falcon	*Falco chicquera*	2,44	0,00	-	-
Reed Cormorant	*Microcarbo africanus*	21,95	2,00	-	-
Rock Kestrel	*Falco rupicolus*	12,20	0,00	-	-
South African Shelduck	*Tadorna cana*	26,83	2,00	-	-
Southern Pochard	*Netta erythrophthalma*	4,88	0,00	-	-
Spotted Eagle-Owl	*Bubo africanus*	9,76	0,00	-	-
Spur-winged Goose	*Plectropterus gambensis*	17,07	2,00	-	-
Striated Heron	*Butorides striata*	2,44	0,00	-	-
Verreaux's Eagle	*Aquila verreauxii*	7,32	2,00	-	VU
Western Barn Owl	*Tyto alba*	9,76	0,00	-	-
Western Cattle Egret	*Bubulcus ibis*	9,76	0,00	-	-
White-breasted Cormorant	*Phalacrocorax lucidus*	17,07	4,00	-	-
White-faced Whistling Duck	*Dendrocygna viduata*	24,39	2,00	-	-
Yellow-billed Duck	*Anas undulata*	12,20	0,00	-	-
Yellow-billed Kite	*Milvus aegyptius*	4,88	8,00	-	-
Hadada Ibis	*Bostrychia hagedash*	48,78	4,00	-	-
Helmeted Guineafowl	*Numida meleagris*	29,27	8,00	-	-

Northern Black Korhaan	*Afrotis afraoides*	31,71	10,00	-	-
Pied Crow	*Corvus albus*	60,98	18,00	-	-
Red-crested Korhaan	*Lophotis ruficrista*	21,95	2,00	-	-
White-necked Raven	*Corvus albicollis*	2,44	0,00	-	-
African Rock Pipit	*Anthus crenatus*	2,44	2,00	NT	NT
Blacksmith Lapwing	*Vanellus armatus*	34,15	4,00	-	-
Black-winged Stilt	*Himantopus himantopus*	9,76	0,00	-	-
Cape Weaver	*Ploceus capensis*	4,88	0,00	-	-
Cape White-eye	*Zosterops virens*	2,44	0,00	-	-
Common Sandpiper	*Actitis hypoleucos*	2,44	0,00	-	-
Fairy Flycatcher	*Stenostira scita*	4,88	0,00	-	-
Fiscal Flycatcher	*Melaenornis silens*	43,90	2,00	-	-
Giant Kingfisher	*Megaceryle maxima*	7,32	0,00	-	-
Karoo Prinia	*Prinia maculosa*	4,88	0,00	-	-
Karoo Thrush	*Turdus smithi*	43,90	0,00	-	-
Layard's Warbler	*Curruca layardi*	2,44	2,00	-	-
Namaqua Warbler	*Phragmacia substriata*	21,95	2,00	-	-
Pearl-spotted Owlet	*Glaucidium perlatum*	9,76	0,00	-	-
Pied Kingfisher	*Ceryle rudis*	9,76	2,00	-	-
Pied Starling	*Lamprotornis bicolor*	2,44	0,00	-	-
Sickle-winged Chat	*Emarginata sinuata*	2,44	0,00	-	-
Three-banded Plover	*Charadrius tricollaris*	17,07	2,00	-	-
Acacia Pied Barbet	*Tricholaema leucomelas*	78,05	14,00	-	-
African Hoopoe	*Upupa africana*	9,76	2,00	-	-
African Palm Swift	*Cypsiurus parvus*	14,63	0,00	-	-
African Pipit	*Anthus cinnamomeus*	14,63	2,00	-	-
African Red-eyed Bulbul	*Pycnonotus nigricans*	58,54	8,00	-	-
African Reed Warbler	*Acrocephalus baeticatus*	26,83	0,00	-	-
African Stonechat	*Saxicola torquatus*	7,32	0,00	-	-
Alpine Swift	*Tachymarptis melba*	7,32	2,00	-	-
Ant-eating Chat	*Myrmecocichla formicivora*	19,51	6,00	-	-
Ashy Tit	*Melaniparus cinerascens*	17,07	0,00	-	-
Barn Swallow	*Hirundo rustica*	31,71	4,00	-	-
Black-chested Prinia	*Prinia flavicans*	75,61	14,00	-	-
Black-faced Waxbill	*Brunhilda erythronotos*	4,88	0,00	-	-
Black-throated Canary	*Crithagra atrogularis*	24,39	2,00	-	-
Bokmakierie	*Telophorus zeylonus*	36,59	4,00	-	-
Bradfield's Swift	*Apus bradfieldi*	2,44	0,00	-	-
Brown-crowned Tchagra	*Tchagra australis*	4,88	0,00	-	-
Brown-hooded Kingfisher	*Halcyon albiventris*	29,27	2,00	-	-
Brown-throated Martin	*Riparia paludicola*	34,15	6,00	-	-
Brubru	*Nilaus afer*	9,76	2,00	-	-
Burchell's Coucal	*Centropus burchellii*	9,76	0,00	-	-
Cape Bunting	*Emberiza capensis*	7,32	2,00	-	-
Cape Robin-Chat	*Cossypha caffra*	43,90	2,00	-	-
Cape Sparrow	*Passer melanurus*	63,41	6,00	-	-
Cape Starling	*Lamprotornis nitens*	48,78	10,00	-	-
Cape Turtle Dove	*Streptopelia capicola*	41,46	14,00	-	-
Cape Wagtail	*Motacilla capensis*	41,46	2,00	-	-
Capped Wheatear	*Oenanthe pileata*	2,44	2,00	-	-
Cardinal Woodpecker	*Dendropicos fuscescens*	9,76	0,00	-	-
Chat Flycatcher	*Melaenornis infuscatus*	9,76	8,00	-	-
Chestnut-vented Warbler	*Curruca subcoerulea*	51,22	8,00	-	-
Common Buttonquail	*Turnix sylvaticus*	9,76	0,00	-	-

Common House Martin	*Delichon urbicum*	2,44	2,00	-	-
Common Myna	*Acridotheres tristis*	2,44	2,00	-	-
Common Quail	*Coturnix coturnix*	7,32	2,00	-	-
Common Scimitarbill	*Rhinopomastus cyanomelas*	9,76	2,00	-	-
Common Starling	*Sturnus vulgaris*	2,44	0,00	-	-
Common Waxbill	*Estrilda astrild*	17,07	0,00	-	-
Crested Barbet	*Trachyphonus vaillantii*	36,59	8,00	-	-
Crowned Lapwing	*Vanellus coronatus*	26,83	0,00	-	-
Desert Cisticola	*Cisticola aridulus*	17,07	4,00	-	-
Diederik Cuckoo	*Chrysococcyx caprius*	4,88	0,00	-	-
Double-banded Courser	*Rhinoptilus africanus*	9,76	0,00	-	-
Dusky Sunbird	*Cinnyris fuscus*	53,66	8,00	-	-
Eastern Clapper Lark	*Mirafra fasciolata*	14,63	0,00	-	-
European Bee-eater	*Merops apiaster*	12,20	2,00	-	-
Familiar Chat	*Oenanthe familiaris*	51,22	6,00	-	-
Fawn-colored Lark	*Calendulauda africanoides*	12,20	4,00	-	-
Golden-tailed Woodpecker	*Campethera abingoni*	2,44	0,00	-	-
Greater Striped Swallow	*Cecropis cucullata*	46,34	2,00	-	-
Grey-backed Cisticola	*Cisticola subruficapilla*	21,95	0,00	-	-
House Sparrow	*Passer domesticus*	43,90	10,00	-	-
Kalahari Scrub Robin	*Cercotrichas paena*	39,02	6,00	-	-
Karoo Chat	*Emarginata schlegelii*	4,88	4,00	-	-
Karoo Long-billed Lark	*Certhilauda subcoronata*	12,20	2,00	-	-
Karoo Scrub Robin	*Cercotrichas coryphoeus*	48,78	8,00	-	-
Lark-like Bunting	*Emberiza impetuani*	29,27	4,00	-	-
Laughing Dove	*Spilopelia senegalensis*	85,37	28,00	-	-
Lesser Grey Shrike	*Lanius minor*	12,20	4,00	-	-
Lesser Honeyguide	*Indicator minor*	2,44	2,00	-	-
Lesser Swamp Warbler	*Acrocephalus gracilirostris*	21,95	2,00	-	-
Levaillant's Cisticola	*Cisticola tinniens*	12,20	0,00	-	-
Little Swift	*Apus affinis*	31,71	8,00	-	-
Long-billed Crombec	*Sylvietta rufescens*	31,71	2,00	-	-
Marico Sunbird	*Cinnyris mariquensis*	2,44	2,00	-	-
Marsh Warbler	*Acrocephalus palustris*	2,44	0,00	-	-
Mountain Wheatear	*Myrmecocichla monticola*	9,76	6,00	-	-
Namaqua Dove	*Oena capensis*	48,78	6,00	-	-
Namaqua Sandgrouse	*Pterocles namaqua*	14,63	4,00	-	-
Neddicky	*Cisticola fulvicapilla*	14,63	0,00	-	-
Orange River White-eye	*Zosterops pallidus*	48,78	4,00	-	-
Pale-winged Starling	*Onychognathus nabouroup*	24,39	10,00	-	-
Pearl-breasted Swallow	*Hirundo dimidiata*	2,44	0,00	-	-
Pin-tailed Whydah	*Vidua macroura*	14,63	0,00	-	-
Pririt Batis	*Batis pririt*	31,71	4,00	-	-
Quailfinch	*Ortygospiza atricollis*	4,88	0,00	-	-
Red-backed Shrike	*Lanius collurio*	2,44	0,00	-	-
Red-billed Firefinch	*Lagonosticta senegala*	7,32	0,00	-	-
Red-billed Quelea	*Quelea quelea*	41,46	0,00	-	-
Red-capped Lark	*Calandrella cinerea*	4,88	0,00	-	-
Red-eyed Dove	*Streptopelia semitorquata*	56,10	8,00	-	-
Red-faced Mousebird	*Urocolius indicus*	41,46	4,00	-	-
Red-headed Finch	*Amadina erythrocephala*	7,32	0,00	-	-
Rock Dove	*Columba livia*	12,20	2,00	-	-
Rock Martin	*Ptyonoprogne fuligula*	51,22	4,00	-	-
Rufous-eared Warbler	*Malcorus pectoralis*	21,95	6,00	-	-

Sabota Lark	*Calendulauda sabota*	36,59	12,00	-	-
Sand Martin	*Riparia riparia*	2,44	0,00	-	-
Scaly-feathered Weaver	*Sporopipes squamifrons*	29,27	4,00	-	-
Short-toed Rock Thrush	*Monticola brevipes*	2,44	8,00	-	-
Sociable Weaver	*Philetairus socius*	68,29	44,00	-	-
Southern Fiscal	*Lanius collaris*	65,85	10,00	-	-
Southern Grey-headed Sparrow	*Passer diffusus*	26,83	2,00	-	-
Southern Masked Weaver	*Ploceus velatus*	70,73	16,00	-	-
Southern Red Bishop	*Euplectes orix*	41,46	4,00	-	-
Speckled Pigeon	*Columba guinea*	46,34	6,00	-	-
Spike-heeled Lark	*Chersomanes albofasciata*	17,07	6,00	-	-
Spotted Flycatcher	*Muscicapa striata*	2,44	0,00	-	-
Spotted Thick-knee	*Burhinus capensis*	4,88	0,00	-	-
Stark's Lark	*Spizocorys starki*	2,44	0,00	-	-
Swallow-tailed Bee-eater	*Merops hirundineus*	26,83	2,00	-	-
Wattled Starling	*Creatophora cinerea*	24,39	2,00	-	-
White-backed Mousebird	*Colius colius*	60,98	4,00	-	-
White-browed Sparrow-Weaver	*Plocepasser mahali*	63,41	20,00	-	-
White-fronted Bee-eater	*Merops bullockoides*	17,07	0,00	-	-
White-rumped Swift	*Apus caffer*	34,15	6,00	-	-
White-throated Canary	*Crithagra albogularis*	24,39	0,00	-	-
White-throated Swallow	*Hirundo albigularis*	19,51	0,00	-	-
Yellow Canary	*Crithagra flaviventris*	36,59	2,00	-	-
Yellow-bellied Eremomela	*Eremomela icteropygialis*	31,71	2,00	-	-
Zitting Cisticola	*Cisticola juncidis*	17,07	2,00	-	-
Lappet-faced Vulture	*Torgos tracheliotos*	0,00	0,00	EN	EN
White-backed Vulture	*Gyps africanus*	0,00	0,00	CR	CR

APPENDIX 2: HABITAT FEATURES AT THE DEVELOPMENT AREAS

Figure 1: Grassland interspersed with shrubs/small trees in the PAOI.

Figure 2: Agricultural fields in the PAOI.

Figure 3: Woodland habitat in the PAOI.

Figure 4: Grassy shrubland in the PAOI.

APPENDIX 3: SITE SENSITIVITY VERIFICATION

Prior to commencing with the specialist assessment in accordance with Appendix 6 of the National Environmental Management Act (Act 107 of 1998, as amended) (NEMA) Environmental Impact Assessment (EIA) Regulations of 2014, a site sensitivity verification was undertaken in order to confirm the current land use and environmental sensitivity of the proposed project area as identified by the National Web-Based Environmental Screening Tool (Screening Tool). NEMA makes provision for the prescription of procedures for the assessment and minimum criteria for reporting on identified environmental themes (Sections 24(5)(a) and (h) and 44) when applying for environmental authorisation. The Protocol for the specialist assessment and minimum report content requirements for environmental impacts on terrestrial animal species (Government Gazette No 43855, 30 October 2020) is applicable in the case of solar PV developments.

The details of the site sensitivity verification (SSV) are noted below:

Date of Site Visit	May 2022
Supervising Specialist Name	Albert Froneman
Professional Registration Number	MSc Conservation Biology (SACNASP Zoological Science Registration number 400177/09)
Specialist Affiliation / Company	Chris van Rooyen Consulting

METHODOLOGY

The following methods were used to compile the SSV report:

- The project area of impact (PAOI) was defined as the total PV development site and a 1km buffer around the proposed 132kV grid connection.
- The PV development site was defined as the 137-ha area where the solar panels and associated infrastructure will be constructed.
- Bird distribution data from the Southern African Bird Atlas Project 2 (SABAP 2) was obtained (http://sabap2.adu.org.za/) to ascertain which species occur in the pentads where the proposed development is located. A pentad grid cell covers 5 minutes of latitude by 5 minutes of longitude (5' × 5'). Each pentad is approximately 8 × 7.6 km. **A consolidated data set was obtained for a total of 6 pentads which overlaps with the PAOI, henceforth referred to as the <u>broader area</u>. The PAOI was defined as an aggregate area comprising of the proposed PV development area and a 1km radius around the proposed 132kV powerline**. The 6 pentad grid cells are the following: 2940_2240, 2940_2245, 2940_2250, 2945_2240, 2945_2245 and 2945_2250 (Figure 33). A total of 41 full protocol lists (i.e., bird listing surveys lasting at least a minimum of two hours each) and 50 ad hoc protocol lists (surveys lasting less than two hours but still yielding valuable data) have been completed to date for the 6 pentads where the PAOI is located. The SABAP2 data was therefore regarded as a reliable reflection of the avifauna which occurs in the area, but the data was also supplemented by data collected during dedicated site surveys and previous work done for renewable energy projects in the area.
- A classification of the vegetation types in the development area was obtained from the Atlas of Southern African Birds 1 (SABAP1), the National Vegetation Map compiled by the South African National Biodiversity Institute (Mucina & Rutherford 2006) and the scoping report compiled by Dr. D.J. van Niekerk (2021).
- The national threatened status of all priority species was determined with the use of the most recent edition of the Red List Book of Birds of South Africa, Lesotho, and Swaziland (Taylor *et al.* 2015), and the latest authoritative summary of southern African bird biology (Hockey *et al.* 2005).
- The global threatened status of all priority species was determined by consulting the latest (2022) IUCN Red List of Threatened Species (http://www.iucnredlist.org/).
- The Important Bird and Biodiversity Areas of South Africa (Marnewick *et al.* 2015; http://www.birdlife.org.za/conservation/important-bird-areas) was consulted for information on potentially relevant Important Bird Areas (IBAs).
- An intensive internet search was conducted to source information on the impacts of solar facilities on avifauna.

- Satellite imagery (Google Earth © 2021) was used in order to view the broader area on a landscape level and to help identify bird habitat on the ground.
- The South African National Biodiversity BGIS map viewer was used to determine the locality of the development area relative to National Protected Areas.
- The DFFE National Screening Tool (https://screening.environment.gov.za/) was used to determine the assigned avian sensitivity of the development area.
- The following sources were consulted to determine the investigation protocol that is required for the site:
  - Procedures for the Assessment and Minimum criteria for reporting on identified environmental themes in terms of sections 24(5)(a) and (h) and 44 of NEMA when applying for Environmental Authorisation (Gazetted October 2020)
  - Guidelines for the Implementation of the Terrestrial Flora (3c) & Terrestrial Fauna (3d) Species Protocols for EIAs in South Africa produced by the South African National Biodiversity Institute on behalf of the Department of Environment, Forestry and Fisheries (2020).
  - The BirdLife South Africa (BLSA) Guidelines for assessing and monitoring the impact of solar power generating facilities on birds in southern Africa. BirdLife South Africa by Jenkins, A.R., Ralston-Patton, Smit- Robinson, A.H. 2017 (hereafter referred to as the Solar Guidelines) were consulted to determine the level of survey effort that is required.
- Site visits were conducted in May and September 2022 during which time data was collected by means of transect and incidental counts.

NATURAL ENVIRONMENT AND HABITAT TYPES

- **Grassland/Shrubland**

The PAOI falls within the Nama Karoo Biome (Mucina & Rutherford 2006), but the vegetation on site is an ecotone between Karoo and Savanna. The vegetation in the PAOI can be described as shrubland dominated by *Rhigozum trichotomum* (Driedoring) and a well-developed grassy layer. *Senegalia mellifera* (Swarthaak) dominates along drainage lines and forms large shrubs and small trees. The topography in the PAOI is flat, but mountainous terrain is present towards the west and south of the PAOI. The average annual rainfall in the Prieska area is ~200 mm with most rain falling from February to April (Mucina & Rutherford 2006). Temperatures range from an average daytime high of about 35° Celsius in January to about 19° Celsius in June/July (https://www.meteoblue.com/). See Figures 1 and 2.