Pofadder Wind Facility 3 (Pty) Ltd

PROPOSED CONSTRUCTION OF THE POFADDER WIND ENERGY FACILITY 3 AND ASSOCIATED INFRASTRUCTURE, NEAR POFADDER, NORTHERN CAPE PROVINCE, SOUTH AFRICA

Avifaunal Specialist Assessment Report

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AVIFAUNAL SPECIALIST ASSESSMENT

EXECUTIVE SUMMARY

1. INTRODUCTION

The applicant Pofadder Wind Facility 3 (Pty) Ltd is proposing the development of a 31-turbine commercial Wind Energy Facility (WEF) and its associated infrastructure on a site located approximately 20km south-east of Pofadder within the Kai! Garib Local Municipality and the Z F Mgcawu District Municipality in the Northern Cape Province.

Two additional WEF's are concurrently being considered on the same properties (Farm Ganna-Poort 202, Farm Lovedale 201, and Portion 3 of the Farm Sand Gat 150) and are assessed by way of separate impact assessment processes contained in the 2014 Environmental Impact Assessment Regulations (GN No. R982, as amended) for listed activities contained Listing Notices 1, 2 and 3 (GN R983, R984 and R985, as amended). These projects are known as Pofadder Wind Energy Facility 1 and Pofadder Wind Energy Facility 3.

This avifaunal impact assessment report concerns the Pofadder Wind Energy Facility 3.

2. AVIFAUNA

The SABAP 2 data indicates that a total of 96 bird species could potentially occur within the broader area – Appendix 1 provides a comprehensive list of all the species. Of these, 18 species are classified as wind energy priority species and 11 of these are South African Red List species. Based on the SABAP 2 reporting rates of the species, the habitat at the development area and the species recorded at the site during the surveys, we estimate that 15 of the priority species occurring in the broader area, have a medium to high chance of occurring regularly in the development area.

3. CONCLUSION AND SUMMARY

The proposed Pofadder WEF 3 will have several potential impacts on priority avifauna. These impacts are the following:

- Displacement of priority species due to disturbance linked to construction activities in the construction phase.

- Displacement due to habitat transformation in the construction phase.
- Collision mortality caused by the wind turbines in the operational phase.
- Electrocution on the 33kV MV overhead lines (if any) in the operational phase.
- Collisions with the 33kV MV overhead lines (if any) in the operational phase.
- Displacement of priority species due to disturbance linked to dismantling activities in the decommissioning phase.

3.1 Displacement of priority species due to disturbance linked to construction activities in the construction phase.

It is inevitable that a measure of displacement will take place for all priority species during the construction phase, due to the disturbance factor associated with the construction activities. This is likely to affect ground nesting species the most, as this could temporarily disrupt their reproductive cycle. Relative to this assessment, species which fall in this category are Ludwig's Bustard, Kori Bustard, Karoo Korhaan, Northern Black Korhaan, Burchell's Courser, Double-banded Courser, Spotted Eagle-Owl, Sclater's Lark and Red Lark. Some raptors might also be affected, e.g. Greater Kestrel which often breeds on crow nests which have been constructed on wind pumps. Some species might be able to recolonise the area after the completion of the construction phase, but for some species this might only be partially the case, resulting in lower densities than before once the WEF is operational, due to the disturbance factor of the operational turbines. The impact is rated as **medium** but could be mitigated to **low** levels.

3.2 Displacement due to habitat transformation in the construction phase.

The network of roads is likely to result in significant habitat fragmentation, and it could have an effect on the density of several species, particularly larger terrestrial species such as Ludwig's Bustard, Kori Bustard, Northern Black Korhaan and Karoo Korhaan. Red Lark and Sclater's Lark could also potentially be impacted. However, given the expected density of the proposed turbine layout and associated road infra-structure, it is not expected that any priority species will be permanently displaced from the development site. The building infrastructure and substations will all be situated in the same habitat, i.e., Karoo scrub. The habitat is not particularly sensitive, as far as avifauna is concerned, therefore the impact of the habitat transformation will be low given the extent of available habitat and the small size of the physical footprint. In summary, the following species are likely to be most affected by habitat transformation: Karoo Korhaan, Northern Black Korhaan, Kori Bustard, Ludwig's Bustard, Sclater's Lark, Red Lark and possibly raptors such as Pale Chanting Goshawk and Martial Eagle. The impact is rated as **low** both pre- and post-mitigation.

3.3 Collision mortality caused by the wind turbines in the operational phase.

The proposed WEF will pose a potential collision risk to several priority species which could occur regularly at the site. Species exposed to this risk are large terrestrial species i.e. Ludwig's Bustard, Kori Bustard, Karoo Korhaan and Northern Black Korhaan. Soaring priority species, i.e. species such as Martial Eagle, Pale Chanting Goshawk, Booted Eagle, Verreaux's Eagle, Greater Kestrel, White-backed Vulture and Lappet-faced Vulture. The high voltage powerline to the south of the project site is a focal point for vulture flight activity. No vultures were recorded during surveys in June and October 2021, all the flight activity was recorded during the third and fourth surveys in February and March 2022. Indications are that this could a regular pattern, based on experiences at other proposed wind farms in the Northern Cape. The passage rate over the combined WEF areas during the February 2022 survey was 0.3 birds/hour, or just under 4 birds per day. By March 2022, the passage rate had dropped to 0.03 birds/hour, or one bird every 2.5 days. This points to a regular occurrence of vultures, but only during a specific time period, namely the non-breeding season from January to May, with an expected peak in February and tapering off towards May when the breeding starts. The majority of the flight activity (14 out of 16 flights or 87.5%) was recorded within 2.8km of the powerline roost. Red Larks could also potentially be at risk during display flights. In summary, the following priority species could be at risk of collisions with the turbines: Greater Kestrel, Karoo Korhaan, Ludwig's Bustard, Kori Bustard, Martial Eagle, Northern Black Korhaan, Pale Chanting Goshawk, Spotted Eagle-Owl, Verreaux's Eagle, White-backed Vulture, Lappet-faced Vulture, Burchell's Courser, Double-banded Courser, Red Lark and Sclater's Lark. The impact is rated as **medium** pre-mitigation and **low** post-mitigation.

3.4 Electrocution on the 33kV MV overhead lines (if any) in the operational phase.

The majority of medium voltage cables will be buried, but there may be sections where overhead lines may be used due to technical reasons. Raptors and vultures could use these poles as perches. As far as the medium voltage powerlines are concerned, the potential electrocution risk to raptors could be eliminated by using a bird-friendly pole design. Species most at risk of electrocution on the medium voltage network are Greater Kestrel, Martial Eagle, Pale Chanting Goshawk, Spotted Eagle-Owl, Verreaux's Eagle, Lappet-faced Vulture and White-backed Vulture. The impact is rated as **medium** pre-mitigation and **low** post-mitigation.

3.5 Collisions with the 33kV MV overhead lines (if any) in the operational phase.

While the intention is to place the 33kV reticulation network underground where possible, there are areas where the lines might have to run above ground, for technical reasons. In these instances, the line could potentially pose a collision risk to various species, particularly large terrestrial species including Red Data species such as Ludwig's Bustard, Blue Crane, Karoo Korhaan and Secretarybird and various waterbirds when the dams are full, and the drainage lines contain water. The impact is rated as **medium** pre-mitigation and **low** post-mitigation.

3.6 Displacement of priority species due to disturbance linked to dismantling activities in the decommissioning phase.

The impact is likely to be similar to the construction phase.

3.7 Cumulative impacts

Nine proposed renewable energy projects (six wind and three solar) were considered within a 35km radius of the proposed development. The maximum number of wind turbines which are currently proposed for the six other wind farms which are located within a 35km radius in similar habitat around the project site, is 285. None of these have been constructed to date, and each of the planned projects must still be subject to a competitive bidding process where only the most competitive projects will obtain a power purchase agreement required for the project to proceed to construction. It is therefore unlikely that a total of 285 turbines will actually be constructed, but due to the possibility that it could happen, the precautionary principle must be applied, and it must be assumed that it will be the case. The Pofadder WEF 2 will consist of up to 31 turbines, which brings the total number of potential turbines within the 35km radius to 317. The 31 turbines of Pofadder WEF 3 constitutes approximately 10% of the total number of planned turbines. As such, its contribution to the total number of turbines, and by implication the cumulative impact of all the planned turbines, is relatively minor. The density of planned turbines in the 35km radius equates to 1 turbine per 2 073 ha, which is low, therefore the cumulative impact of all the planned turbines within the 35km radius is also considered to be low at this stage, as far as potential mortality of avifauna due to turbine collisions are concerned.

The total affected land parcel area where turbines and solar panels are planned, including the Pofadder WEF 3, adds up to approximately 60 135 ha, which constitutes about 9% of the total area (approximately 655,131 ha) of similar habitat available to birds in the 35km radius around the project. The potential cumulative displacement impact due to habitat transformation, of the planned renewable energy projects at the time of writing, is therefore still relatively moderate within the area contained in the 35km radius. The affected land parcel area of the proposed Pofadder WEF 3 amounts to about 3% of the total habitat available in the 35km radius. The contribution of the Pofadder WEF 3 to the cumulative impact of all the renewable energy facilities is therefore low as far as potential displacement of priority species due to habitat transformation is concerned.

The cumulative impact of all the planned renewable energy facilities in this area is assessed to be **low** pre-mitigation and post-mitigation.

3.8 The identification of environmental sensitivities: Wind Energy facility

The following environmental sensitivities were identified from an avifaunal perspective for the proposed wind energy facility:

3.8.1 Very High Sensitivity Zones

The very high sensitivity zones are listed below. The construction of <u>all infrastructure</u> in these zones should be avoided completely:

- 500m buffer zone around water troughs to prevent the displacement of Sclater's Larks due to disturbance and habitat transformation, and to reduce the risk of turbine collisions for priority species using the water troughs for drinking and bathing. Alternatively, water troughs could be relocated to maintain a minimum distance of 500m from the closest turbine.
- All identified breeding areas for Sclater's Lark.

3.8.2 High Sensitivity Zones

The high sensitivity zones are listed below. The construction of turbines in these zones should be avoided to eliminate the risk of turbine collisions. Other infrastructure is permitted:

- 2.8km turbine exclusion zone around the vulture roost on the Aries – Aggeneys 400kV powerline.

3.8.3 Medium Sensitivity Zones

The medium sensitivity zones are listed below. The construction of turbines in these zones should be restricted to a minimum to reduce the risk of turbine collisions. If restriction is not possible, additional mitigation measures will be required, e.g., increasing cut in speeds or shutdown on demand:

- Highly suitable Red Lark habitat: Placement of turbines in highly suitable Red Lark habitat to be avoided where possible. If avoidance is not possible, turbine cut in-speeds should be increased to 3m/s (measured at ground level) during daylight hours when a rainfall event of 10mm or higher is recorded at the site, for turbines located in areas of highly suitable Red Lark habitat, as determined by the avifaunal specialist. The increased cut-in speeds to be maintained for a period of six weeks after the rainfall event.
- The whole of the project site beyond the 2.8km High sensitivity zone is medium sensitivity, primarily due to the potential presence of White-backed Vultures and Lappet-faced Vultures during certain times of the year, but also due to the potential occurrence of other collision prone Red List species, namely Martial Eagle, Verreaux's Eagle, and Lanner Falcon. It is therefore recommended that shutdown on demand (SDoD) is implemented on all turbines for the above species, coupled with a carcass removal programme, to limit the risk of collisions with the turbines. SDoD has been successfully implemented at a wind farm in the Western Cape and has now been operative for a period of 21 months without any vulture mortalities recorded, despite high passage rates of vultures through the site. The reasons for the influx of the birds in vicinity of the Pofadder sites are not known, but it may be both seasonal and short term, as is the case with other recorded powerline roosts of White-backed Vultures and Lappet-faced Vultures in the Northern Cape where the roosts are seasonal i.e. limited to the period outside the breeding season. It is therefore recommended that the SDoD is implemented for the first two years of the operational phase to assess the dynamics of the situation, whereafter a decision whether to continue will be taken, based on the frequency of shutdown events. This programme must consist of a suitably qualified, trained, dedicated and resourced team of observers present on site for all daylight hours throughout the year. It is absolutely essential that passionate, hardworking staff are hired for this role. This team must be stationed at observation points with full visible coverage of all turbine locations. The observers must detect incoming priority bird species, track their flights, judge when they enter a turbine proximity threshold, and alert the control room to shut down the relevant turbine until the risk has reduced. A full detailed method statement must be designed by an ornithologist prior to the commercial operations date (COD) and must be in place by the time that the wind farm start operating.

Figure (i) below is an avifaunal sensitivity map for the Pofadder WEF 3 development area.

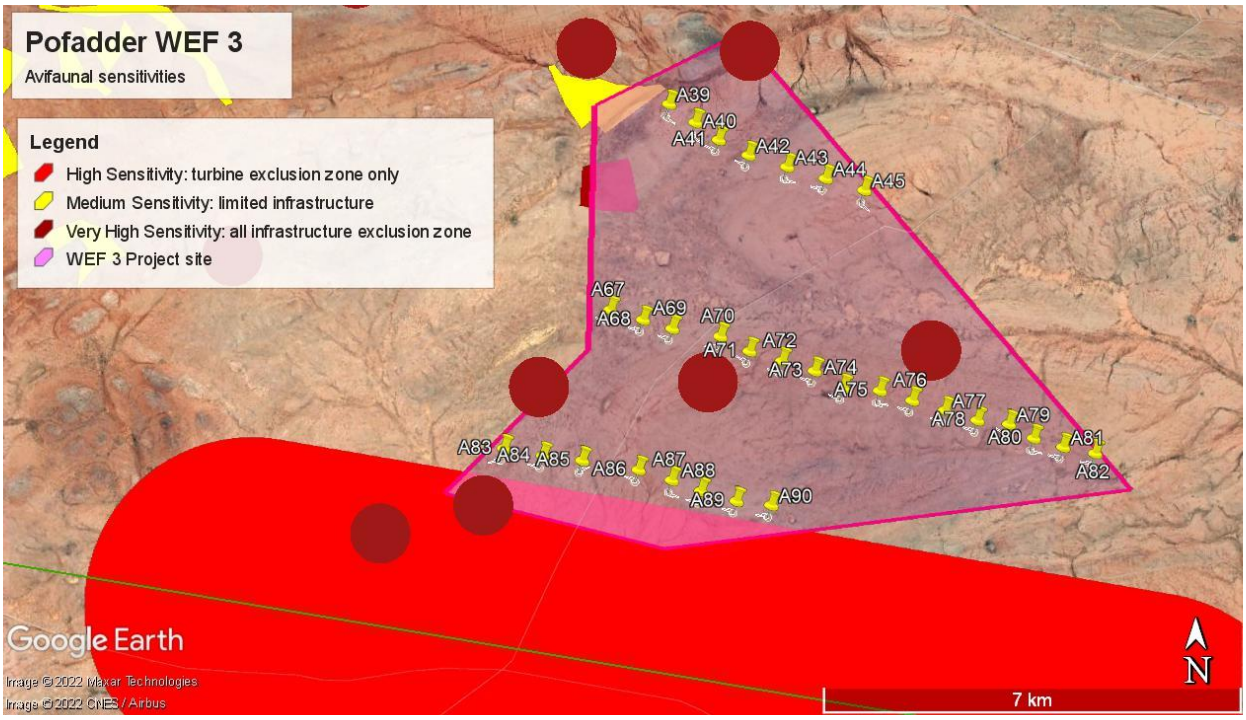

Figure (i): Avifaunal sensitivities within the Pofadder WEF 3 development area.

Table 1: Overall Impact Significance for the WEF (Pre- and Post-Mitigation)

Nature of impact and Phase	Overall Impact Significance (Pre - Mitigation)	Proposed mitigation	Overall Impact Significance (Post - Mitigation)
Construction: Displacement due to disturbance	Medium	• Very high sensitivity: All surface water (water troughs) should be buffered by 500m (all infrastructure) to prevent displacement of Sclater's Lark breeding population due to disturbance. Alternatively, water troughs could be relocated to maintain a minimum distance of 500m from the closest turbine. • Additional Sclater's Lark breeding areas as identified during the pre-construction monitoring must be designated an all-infrastructure No-Go zone. • Construction activity should be restricted to the immediate footprint of the infrastructure as far as possible. • 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. • Placement of turbines in highly suitable Red Lark habitat to be avoided where possible.	Low
Construction: Displacement due to habitat transformation	Low	• Very high sensitivity: All surface water (water troughs) should be buffered by 500m (all infrastructure) to prevent displacement of Sclater's Lark breeding population due to habitat transformation. Alternatively, water troughs could be relocated to maintain a minimum distance of 500m from the closest turbine. • Additional Sclater's Lark breeding areas as identified during the pre-construction monitoring must be designated an all-infrastructure No-Go zone. • 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 biodiversity specialist, including rehabilitation, must be strictly implemented. • Placement of turbines in highly suitable Red Lark habitat to be avoided where possible	Low
Operational: Collisions with the turbines	Medium	• A procedure for the prompt location and removal of carcasses within the development area must be implemented to prevent vultures from being attracted to the area where they could be at risk of collision with the turbines. • Based on the results of the pre-construction monitoring, a 2.8km turbine exclusion zone must be implemented around the vulture roost on the Aries – Aggeneys 1 400kV high voltage line. • All infilling for road construction should be compacted and all lose rock piles at the base or periphery of such infilling should be covered and	Low

Nature of impact and Phase	Overall Impact Significance (Pre - Mitigation)	Proposed mitigation	Overall Impact Significance (Post - Mitigation)
		packed down so as to eliminate all potential crevices and shelter for small mammals such as Rock Hyraxes (the primary source of food for the Verreaux's Eagles). • Live-bird monitoring and carcass searches should be implemented in the operational phase, as per the most recent edition of the Best Practice Guidelines at the time (Jenkins *et al.* 2015) to assess collision rates. • If an Endangered or Critically Endangered species mortality is recorded during the first year of operational monitoring, additional mitigation measures must be implemented which could include shut down on demand, or other proven mitigation measures as recommended by the avifaunal specialist. • Placement of turbines in highly suitable Red Lark habitat to be avoided where possible. If avoidance is not possible, turbine cut in-speeds should be increased to 3m/s (measured at ground level) during daylight hours when a rainfall event of 10mm or higher is recorded at the site, for turbines located in areas of highly suitable Red Lark habitat, as determined by the avifaunal specialist. The increased cut-in speeds to be maintained for a period of six weeks after the rainfall event. • The whole of the project site beyond the 2.8km High sensitivity zone is medium sensitivity, primarily due to the potential presence of White-backed Vultures and Lappet-faced Vultures during certain times of the year, but also due to the potential occurrence of other collision prone Red List species, namely Martial Eagle, Verreaux's Eagle, and Lanner Falcon. It is therefore recommended that shutdown on demand (SDoD) is implemented on all turbines for the above species, coupled with a carcass removal programme, to limit the risk of collisions with the turbines. SDoD has been successfully implemented at a wind farm in the Western Cape and has now been operative for a period of 21 months without any vulture mortalities recorded, despite high passage rates of vultures through the site. The reasons for the influx of the birds in vicinity of the Pofadder sites are not known, but it may be both seasonal and short term, as is the case with other recorded powerline roosts of White-backed Vultures and Lappet-faced Vultures in the Northern Cape where the roosts are seasonal i.e. limited to the period outside the breeding season. It is therefore recommended that the SDoD is implemented for the first two years of the operational phase to assess the dynamics of the situation, whereafter a decision whether to continue will be taken, based on the frequency of shutdown events. This programme must consist of a suitably qualified, trained, dedicated and resourced team of observers present on site for all daylight hours throughout the year. It is absolutely essential that passionate, hardworking staff are hired for this role. This team must be stationed at observation points with full visible	

Nature of impact and Phase	Overall Impact Significance (Pre - Mitigation)	Proposed mitigation	Overall Impact Significance (Post - Mitigation)
		coverage of all turbine locations. The observers must detect incoming priority bird species, track their flights, judge when they enter a turbine proximity threshold, and alert the control room to shut down the relevant turbine until the risk has reduced. A full detailed method statement must be designed by an ornithologist prior to the commercial operations date (COD) and must be in place by the time that the wind farm start operating.	
Operational: Mortality of priority species due to electrocution on the medium voltage internal reticulation network	Medium	• A raptor-friendly pole design must be used, and the pole design must be approved by the avifaunal specialist. • No avifaunal exclusion zones were determined necessary for the mitigation of this anticipated impact.	Low
Operational: Collisions with the 33kV MV network	Medium	• All medium voltage lines must be marked with Eskom approved Bird Flight Diverters according to the Eskom standard.	Low
Decommissioning: Displacement due to disturbance	Medium	• Decommissioning activity should be restricted to the immediate footprint of the infrastructure as far as possible. • 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.	Low
Cumulative impacts: 1. Mortality due to collisions with the wind turbines 2. Displacement due to disturbance during construction and operation of the wind farm 3. Displacement due to habitat change and loss at the wind farm 4. Mortality due to electrocution on the electrical infrastructure	Low	• All the mitigation measures listed in the various bird specialist studies compiled for the nine renewable energy facilities within a 35km radius around the project.	Low

3.9 Conclusion and Impact Statement

Based on the pre-construction monitoring, it is envisaged that the proposed 248MW Pofadder WEF 3 could potentially have a range of pre-mitigation negative impacts on priority avifauna ranging from low to medium, all of which could be reduced to acceptable levels with appropriate mitigation. No fatal flaws were discovered during the investigations.

NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998 (ACT NO. 107 OF 1998) AND ENVIRONMENTAL IMPACT REGULATIONS, 2014 (AS AMENDED) - REQUIREMENTS FOR SPECIALIST REPORTS (APPENDIX 6)

Regulation GNR 326 of 4 December 2014, as amended 7 April 2017, Appendix 6	Section of Report
1. (1) A specialist report prepared in terms of these Regulations must contain- a) details of- i. the specialist who prepared the report; and ii. the expertise of that specialist to compile a specialist report including a curriculum vitae;	Appendix 2
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Page 10
c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 2
(cA) an indication of the quality and age of base data used for the specialist report;	Section 2
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 7
d) the date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Appendix 3, 9
e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 1, 2
f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 6
g) an identification of any areas to be avoided, including buffers;	Sections 5, 6
h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Section 6
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 2
j) a description of the findings and potential implications of such findings on the impact of the proposed activity, (including identified alternatives on the environment) or activities;	Section 6
k) any mitigation measures for inclusion in the EMPr;	Appendix 7 and Appendix 8

l) any conditions for inclusion in the environmental authorisation;	Appendix 7 and Appendix 8
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Appendix 7 and Appendix 8
n) a reasoned opinion- i. (as to) whether the proposed activity, activities or portions thereof should be authorised; (iA) regarding the acceptability of the proposed activity or activities; and ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	Section 8
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	Not applicable
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	Not applicable
q) any other information requested by the competent authority.	Not applicable
2) Where a government notice *gazetted* by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	All sections

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List of Abbreviations

BA	Basic Assessment
BGIS	Biodiversity Geographic Information System
BLSA	Birdlife South Africa
DFFE	Department of Forestry, Fisheries and the Environment
EGI	Electricity Grid Infrastructure
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
HV	High voltage
IBA	Important Bird Area
IKA	Index of Kilometric Abundance
IUCN	International Union for Conservation of Nature
kV	Kilovolt
MV	Medium voltage
NEMA	National Environmental Management Act (Act 107 of 1998, as amended)
OHL	Overhead line
PV	Photovoltaic
REDZ	Renewable Energy Development Zone
SABAP 1	South African Bird Atlas 1
SABAP 2	South African Bird Atlas 2
SACNASP	South African Council for Natural and Scientific Professions
SANBI	South African Biodiversity Institute
SAPAD	South Africa Protected Areas Database
SDoD	Shutdown on Demand
WEF	Wind Energy Facility

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1. INTRODUCTION

The applicant Pofadder Wind Facility 3 (Pty) Ltd is proposing the development of a 31-turbine commercial Wind Energy Facility (WEF) and its associated infrastructure on a site located approximately 20km south-east of Pofadder within the Kai! Garib Local Municipality and the Z F Mgcawu District Municipality in the Northern Cape Province.

Two additional WEF's are concurrently being considered on the same properties (Farm Ganna-Poort 202, Farm Lovedale 201, and Portion 3 of the Farm Sand Gat 150) and are assessed by way of separate impact assessment processes contained in the 2014 Environmental Impact Assessment Regulations (GN No. R982, as amended) for listed activities contained Listing Notices 1, 2 and 3 (GN R983, R984 and R985, as amended). These projects are known as Pofadder Wind Energy Facility 1 and Pofadder Wind Energy Facility 2.

This report concerns the Pofadder Wind Energy Facility 3.

1.1 Terms of Reference

The terms of reference for this report are the following:

- Describe the affected environment from an avifaunal perspective
- Discuss gaps in baseline data and other limitations
- List and describe the expected impacts
- Assess and evaluate the potential impacts
- Give a considered opinion whether the project is fatally flawed from an avifaunal perspective
- If not fatally flawed, recommend mitigation measures to reduce the expected impacts.

For the general Terms of Reference for all specialist report, please see Appendix 1

1.2 Specialist Credentials

Please see Appendix 2 for Specialist CVs

1.3 Assessment Methodology

The following methods and sources were used to compile this report:

- Bird distribution data from the Southern African Bird Atlas Project 2 (SABAP 2) was obtained (http://SABAP 2.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. To get a more representative impression of the birdlife, a consolidated data set was obtained for a total of 17 pentads some of which intersect and others that are near the development area, henceforth referred to as "the broader area". The decision to include multiple pentads around the development area was influenced by the fact that many of the pentads in the area have few completed full protocol surveys. The additional pentads and their data augment the bird distribution data. The 17 pentad grid cells are the following: 2910_1935, 2910_1940, 2910_1945, 2915_1915, 2915_1920, 2915_1925, 2915_1930, 2915_1935, 2915_1940, 2915_1945, 2920_1915, 2920_1920, 2920_1925, 2920_1930, 2920_1935, 2920_1940 and 2920_1945 (Figure 3). A total of 29 full protocol lists (i.e., bird listing surveys lasting a minimum of two hours each) and 39 ad hoc protocol lists (surveys lasting less than two hours but still yielding valuable data) have been completed to date for the 17 pentads where the development area is located. The SABAP 2 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 on-site surveys conducted between 20-25 June 2020, and four pre-construction monitoring surveys conducted between 10-17 June 2021, 15-19 October 2021, 6-10 February 2022, and 21-25 March 2022 respectively, in addition to general knowledge of the area.
- A classification of the vegetation types in the development area was obtained from the Atlas of Southern African Birds 1 (SABAP1) and the National Vegetation Map compiled by the South African National Biodiversity Institute (Mucina & Rutherford 2006).
- Priority species for wind development were identified from the most recent (November 2014) list of priority species for wind farms compiled for the Avian Wind Farm Sensitivity Map (Retief *et al.* 2012).
- 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 (2021.3) 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 wind energy facilities on avifauna.
- Satellite imagery (Google Earth © 2022) was used 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 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:
  - Protocol for the specialist assessment and minimum report content requirements for environmental impacts on avifaunal species by onshore wind energy generation facilities where the electricity output is 20MW or more (Government Gazette No. 43110 – 20 March 2020).

- Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa. Endangered Wildlife Trust and Birdlife South Africa (Jenkins *et al*. 2015).

- The main source of information on the avifaunal diversity and abundance at the project site and development area is an integrated pre-construction monitoring programme which has been completed at the project site, covering the three proposed WEF projects (Appendix 3).

2. ASSUMPTIONS AND LIMITATIONS

This study made the basic assumption that the sources of information used are reliable and accurate. The following must be noted:

- The SABAP 2 dataset provides a reasonably accurate snapshot of the avifauna which could occur in the broader areas and at the proposed development area. Little data is available for the pentads within which the development area is located, therefore a broader area was chosen. Because of the relative uniformity of the habitat within the project site and broader area, this approach should still provide accurate estimates of the avifauna within the development area itself. The SABAP2 data was supplemented with personal observations made during the initial site survey in June 2020, previous field surveys in the broader area, the results of the four pre-construction monitoring surveys (June 2021, October 2021, February 2022, and March 2022), as well as general knowledge of the area.
- Conclusions in this impact assessment report are based on experience of these and similar species at wind farm developments in different parts of South Africa. However, bird behaviour can never be predicted with absolute certainty.
- To date, only one peer-reviewed scientific paper has been published on the impacts wind farms have on birds in South Africa (Perold *et al*. 2020). The precautionary principle was therefore applied throughout. The World Charter for Nature, which was adopted by the UN General Assembly in 1982, was the first international endorsement of the precautionary principle. Principle 15 of the 1992 Rio Declaration states that: "in order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall be not used as a reason for postponing cost-effective measures to prevent environmental degradation."
- The development area is the identified area (located within the project site) where the Pofadder WEF 3 is planned to be located. This area has been selected as a practicable option for the facility, considering technical preference and constraints. The project site is 5,060 ha in extent.
- While every reasonable effort is made to assess all relevant high-risk features of the development area, the possibility of additional high-risk features being discovered during the construction phase of the project, cannot be ruled out.

3. TECHNICAL DESCRIPTION

3.1 Project Location

The applicant Pofadder Wind Facility 3 (Pty) Ltd is proposing the development of a commercial Wind Energy Facility (WEF) and its associated infrastructure on a site located approximately 20km south-east of Pofadder within the Kai! Garib Local Municipality and the Z F Mgcawu District Municipality in the Northern Cape Province (**Figure 1**).

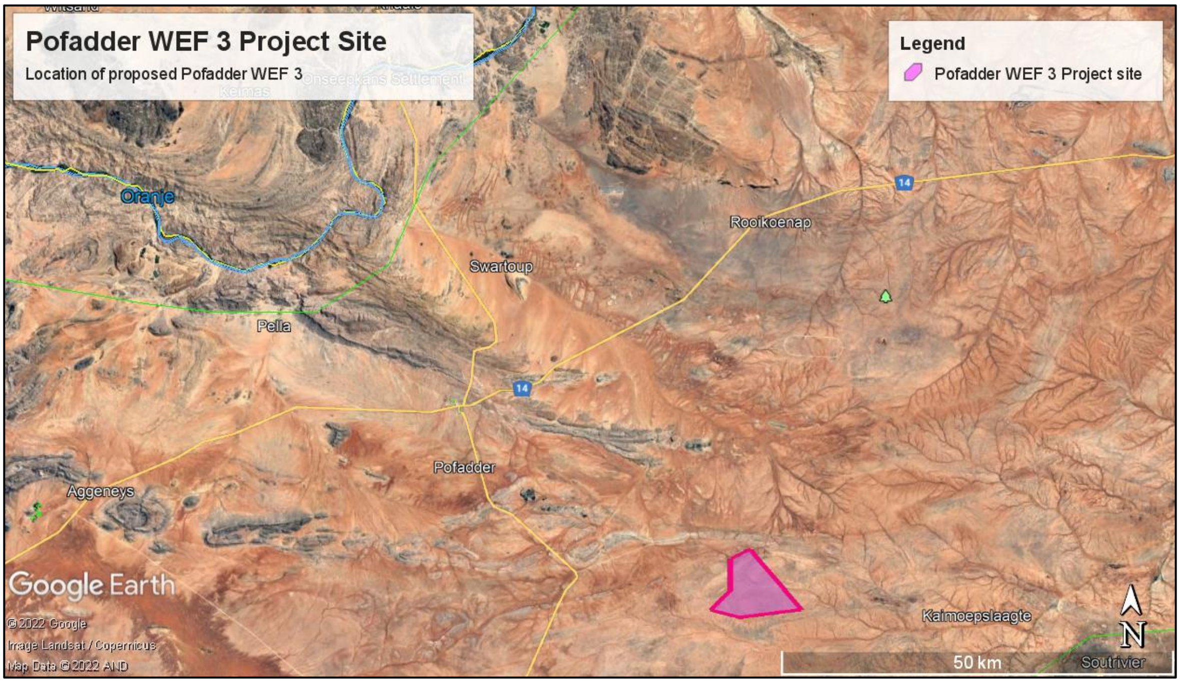


Figure 1: Regional Context Map

A preferred project site with an extent of approximately 5,060ha has been identified as a technically suitable area for the development of the Pofadder WEF 3 (**Figure 2**), which will comprise of up to 31 turbines with a combined contracted capacity of up to 248MW. The project site is located on the following properties:

- The Farm Ganna-Poort 202
- The Farm Lovedale 201; and
- Portion 3 of the Farm Sand Gat 150

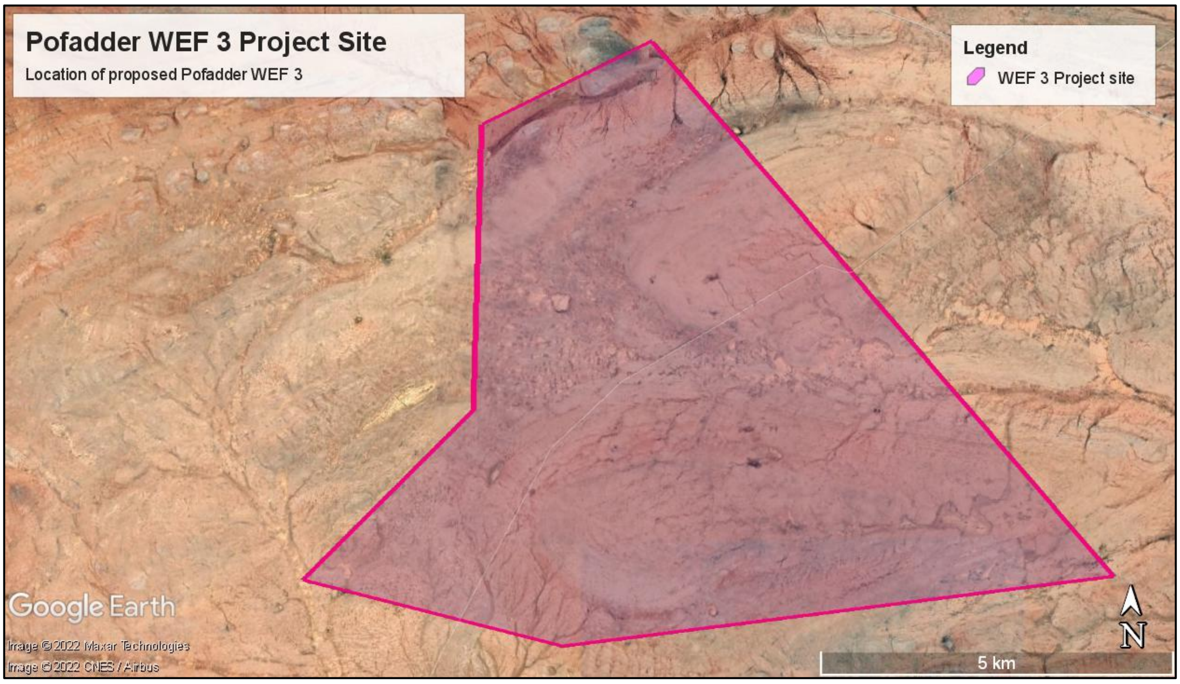


Figure 2: Pofadder WEF 3 Site Locality.

3.2 Project Description

At this stage it is anticipated that the proposed Pofadder WEF 3 will comprise of up to thirty-one (31) wind turbines with a maximum total energy generation capacity of up to 248MW The proposed Pofadder WEF 3 development will include the following components:

- Up to 31 wind turbines, each with a maximum of 8 MW output per turbine, with a maximum export capacity of approximately 248MW. This will be subject to allowable limits in terms of the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP). The final number of turbines and layout of the WEF will, however, be dependent on the outcome of the Specialist Studies conducted during the EIA process.
- Each wind turbine will have a maximum hub height and rotor diameter of up to approximately 200 m.
- Concrete turbine foundations and turbine hardstands
- Each turbine will have a circular foundation with a diameter of up to 32 m and this will be placed alongside the 45 m wide hardstand resulting in an area of about 45 m x 32 m that will be permanently disturbed for the turbine foundation. The combined permanent footprint for the turbines will be approximately 4.4 ha.
- Each turbine will have a crane hardstand of approximately 70 m x 45 m. The permanent footprint for turbine crane hardstands will be approximately 9.5 ha.
- Each turbine will have a blade hardstand of approximately 80 m x 45 m (3,600 m^2). The combined permanent footprint for blade hardstands will be approximately 10.8 ha.
- One (1) new 33/132 kV on-site substation occupying an area of approximately 1.6 ha.
- The wind turbines will be connected to the proposed on-site substation via medium voltage (33 kV) underground cables, which will mainly run alongside the access roads. Where burying of cables is not

possible due to technical, geological, environmental, or topographical constraints, cables will be overhead via 33 kV monopoles.

- The main access road will be between 8 – 12 m wide (to allow vehicles to pass).
- Internal roads with a width of between 6 – 8 m will provide access to each wind turbine. Existing farm roads will be upgraded and used wherever possible, although new site roads will be constructed where necessary.
- A 12 m wide corridor may be temporarily impacted during construction and rehabilitated to 6 m wide corridor after construction. The internal gravel roads will have an approximate 6 – 8 m wide surface and there will be up to 12m wide impacted during the construction phase, with additional space required for cut and fill, side drains and other stormwater control measures, turning areas and vertical and horizontal turning radii to ensure safe delivery of the turbine components.
- Pofadder WEF 3 will have a total road network of approximately 50 km.
- One (1) construction laydown / staging area of up to approximately 7 ha (to be rehabilitated following construction). It should be noted that no on-site labour camps will be required in order to house workers overnight as all workers will be accommodated in the nearby towns, and transported daily to site (by bus);
- The gate house and security house will occupy an area of up to 0.5 ha.
- Battery Energy Storage System (BESS) of approx. 3.6ha
- One (1) permanent Operation and Maintenance (O&M) building (including offices, warehouses, workshops, canteen, visitors centre and staff lockers) occupying an area of up to 1 ha
- A temporary site camp establishment and concrete batching plant occupying an area of up to 1.6 ha.
- Galvanized palisade fencing to be used at the substations with the maximum height of the fencing to be up to 3.5 m

To evacuate the energy generated by the WEF's to supplement the national grid, Pofadder Grid (Pty) Ltd is proposing two grid connection alternatives which will be assessed in a separate Integrated Grid Basic Assessment Reports (BARs):

- Alternative 1: A ~ 47 km new 400/132 kV OH powerline within a 300 m assessment corridor (150 m on either side) from the Switching Station on site to the proposed Korana MTS.
- Alternative 2: A ~ 7 km 132 kV OH powerline within a 300 m assessment corridor (150 m on either side) from the Switching Station on site to a proposed new 400/132 kV MTS located south of the WEF and adjacent to the Aggeneis – Aries 400 kV line. This MTS could serve as a back-up to the planned Korana MTS, in the event that Eskom encounters delays or development issues with that project.

The EA applications for the three wind farm projects and gridline are being undertaken in parallel as they are co-dependent, i.e., one will not be developed without the other.

3.2.1 No-go Alternative

The 'no-go' alternative is the option of not undertaking the proposed WEF and associated infrastructure. Hence, if the 'no-go' option is implemented, there would be no development. This alternative would result in no environmental impacts from the proposed project on the site or surrounding local area. It provides the baseline against which other alternatives are compared and will be considered throughout the report.

4. LEGAL REQUIREMENT AND GUIDELINES

Table 2 below lists agreements and conventions which South Africa is party to and which is directly relevant to the conservation of avifauna (BirdLife International 2020).

Table 2: Agreements and conventions which South Africa is party to and which is relevant to the conservation of avifauna.

Convention name	Description	Geographic scope
African-Eurasian Waterbird Agreement (AEWA)	The Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA) is an intergovernmental treaty dedicated to the conservation of migratory waterbirds and their habitats across Africa, Europe, the Middle East, Central Asia, Greenland and the Canadian Archipelago. Developed under the framework of the Convention on Migratory Species (CMS) and administered by the United Nations Environment Programme (UNEP), AEWA brings together countries and the wider international conservation community in an effort to establish coordinated conservation and management of migratory waterbirds throughout their entire migratory range.	Regional
Convention on Biological Diversity (CBD), Nairobi, 1992	The Convention on Biological Diversity (CBD) entered into force on 29 December 1993. It has 3 main objectives: The conservation of biological diversity The sustainable use of the components of biological diversity The fair and equitable sharing of the benefits arising out of the utilization of genetic resources.	Global
Convention on the Conservation of Migratory Species of Wild Animals, (CMS), Bonn, 1979	As an environmental treaty under the aegis of the United Nations Environment Programme, CMS provides a global platform for the conservation and sustainable use of migratory animals and their habitats. CMS brings together the	Global

Convention name	Description	Geographic scope
	States through which migratory animals pass, the Range States, and lays the legal foundation for internationally coordinated conservation measures throughout a migratory range.	
Convention on the International Trade in Endangered Species of Wild Flora and Fauna, (CITES), Washington DC, 1973	CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) is an international agreement between governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival.	Global
Ramsar Convention on Wetlands of International Importance, Ramsar, 1971	The Convention on Wetlands, called the Ramsar Convention, is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.	Global
Memorandum of Understanding on the Conservation of Migratory Birds of Prey in Africa and Eurasia	The Signatories will aim to take co-ordinated measures to achieve and maintain the favourable conservation status of birds of prey throughout their range and to reverse their decline when and where appropriate.	Regional

4.1 National legislation

4.1.1 Constitution of the Republic of South Africa, 1996

The Constitution of the Republic of South Africa provides in the Bill of Rights that: Everyone has the right –

(a) to an environment that is not harmful to their health or well-being; and

(b) to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that –

(i) prevent pollution and ecological degradation

(ii) promote conservation; and

(iii) secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

4.1.2 The National Environmental Management Act (Act No. 107 of 1998) (NEMA)

The National Environmental Management Act (Act No. 107 of 1998) (NEMA) as amended creates the legislative framework for environmental protection in South Africa and is aimed at giving effect to the environmental right in the Constitution. It sets out several guiding principles that apply to the actions of all organs of state that may significantly affect the environment. Sustainable development (socially, environmentally, and economically) is one of the key principles, and internationally accepted principles of environmental management, such as the precautionary principle and the polluter pays principle, are also incorporated.

NEMA also provides that a wide variety of listed developmental activities, which may significantly affect the environment, may be performed only after an environmental impact assessment has been done and authorization has been obtained from the relevant authority. Many of these listed activities can potentially have negative impacts on bird populations in a variety of ways. The clearance of natural vegetation, for instance, can lead to a loss of habitat and may depress prey populations, while erecting structures needed for generating and distributing energy, communication, and so forth can cause mortalities by collision or electrocution.

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 powerline developments. **In the case of wind energy developments, the Protocol for the specialist assessment and minimum report content requirements for environmental impacts on avifaunal species where the output is 20MW or more (Government Gazette No 43110, 20 March 2020) is applicable.**

4.1.3 The National Environmental Management: Biodiversity Act 10 of 2004 (NEMBA) and the Threatened or Protected Species Regulations, February 2007 (TOPS Regulations)

The most prominent statute containing provisions directly aimed at the conservation of birds is the National Environmental Management: Biodiversity Act 10 of 2004 read with the Threatened or Protected Species Regulations, February 2007 (TOPS Regulations). Chapter 1 sets out the objectives of the Act, and they are aligned with the objectives of the Convention on Biological Diversity, which are the conservation of biodiversity, the sustainable use of its components, and the fair and equitable sharing of the benefits of the use of genetic resources. The Act also gives effect to CITES, the Ramsar Convention, and the Bonn Convention on Migratory Species of Wild Animals. The State is endowed with the trusteeship of biodiversity and has the responsibility to manage, conserve and sustain the biodiversity of South Africa.

4.2 Provincial legislation

4.2.1 Northern Cape Nature Conservation Act No 9 of 2009

The current legislation applicable to the conservation of fauna and flora in the Northern Cape is the Northern Cape Nature Conservation Act No 9 of 2009. It provides for the sustainable utilisation of wild animals, aquatic biota and plants; the implementation of the Convention on International Trade in Endangered Species of Wild Fauna and Flora; describes offences and penalties for contravention of the Act; provides for the appointment of nature conservators to implement the provisions of the Act; provides for the issuing of permits and other authorisations; and provides for matters connected therewith

4.3 Best Practice Guidelines

The South African "Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa" (Jenkins, A.R., Van Rooyen, C.S., Smallie, J.J., Anderson, M.D., & A.H. Smit. 2011) are followed for this study. This document was published by the Endangered Wildlife Trust (EWT) and Birdlife South Africa (BLSA) in March 2011, and subsequently revised in 2011, 2012 and 2015.

5. DESCRIPTION OF THE RECEIVING ENVIRONMENT

5.1 Natural Environment

The habitat in the project site is highly homogenous and consists of extensive sandy and gravel plains with low shrub and grass. Mucina & Rutherford (2006) classify the vegetation as Bushmanland Arid Grassland, which occurs on extensive to irregular plains on a slightly sloping plateau, sparsely vegetated by grassland which are dominated by white grasses (*Stipagrostis* species) giving this vegetation type the character of semidesert 'steppe'. In places low shrubs of Salsola change the vegetation structure. In years of abundant rainfall rich displays of annual herbs can be expected (Mucina & Rutherford 2006). The project site constitutes a mixture of gravel and sandy plains. There are also bare patches in places, which are devoid of vegetation. The land is used for sheep farming.

SABAP1 recognises six primary vegetation divisions within South Africa, namely (1) Fynbos (2) Succulent Karoo (3) Nama Karoo (4) Grassland (5) Savanna and (6) Forest (Harrison *et al.* 1997). The criteria used by the authors to amalgamate botanically defined vegetation units, or to keep them separate were (1) the existence of clear differences in vegetation structure, likely to be relevant to birds, and (2) the results of published community studies on bird/vegetation associations. It is important to note that no new vegetation unit boundaries were created, with use being made only of previously published data. Using this classification system, the natural vegetation in the project site is classified as Nama Karoo. Nama Karoo is dominated by low shrubs and grasses; peak rainfall occurs in summer from December to May. Trees, e.g., *Vachellia karroo* are mainly restricted to ephemeral watercourses, but in the project site, due to the extreme aridity, the ephemeral watercourses contain mostly small, stunted trees and shrubs (Harrison *et al.* 1997).

The Pofadder area is extremely arid with cold winters and hot summers, with temperatures ranging between 33˚C in January (summer) and 2˚C in July (winter), and average rainfall happens mostly between December and April and averages about 120mm per year.

Whilst the distribution and abundance of the bird species in the project site are typical of the broad vegetation type, it is also necessary to examine bird habitats in more detail as it may influence the distribution and behaviour of priority species. The project site is situated on a wide plain. The only permanent surface water at the project site consists of boreholes with reservoirs. Drainage lines flow only briefly after good rains, and there are one or two small dams located in drainage lines. These habitats are discussed in more detail below.

5.2 Bird Habitat

- **Nama Karoo:** The vegetation at the project site consists of Karoo shrub vegetation. Although not remarkably rich in species or endemism, the flora and fauna of the region are remarkably adapted to the region's climatic extremes.

- **Surface Water:** Surface water is of specific importance to avifauna in this arid study area. The project site contains several boreholes. Boreholes with open water troughs are important sources of surface water, as they are the only permanent source of drinking water for birds at the project site.

- **Alien Trees:** The project site is generally devoid of trees, except for isolated clumps of trees at boreholes, where a mixture of alien and indigenous trees is growing. The trees could attract a variety of bird species for purposes of nesting and roosting.

- **High Voltage Lines:** High voltage lines are an important potential roosting and breeding substrate for large raptors in the broader area. The Aries – Aggeneys 1 400kV high voltage line, built on self-supporting lattice structures, runs approximately 2.8km south of closest planned turbine position. There are three Martial Eagle nests on the afore-mentioned line in the broader area, but none on the project site. The nearest nest is approximately 30km from the closest planned turbine.

Appendix 4 provides a photographic record of habitat features in the development area and immediate surroundings.

5.3 Important Bird Areas (IBAs)

An Important Bird Area (IBA), the Mattheus-Gat Conservation Area SA034 (Barnes 1998, Marnewick *et al.* 2015) (Figure 3) is situated approximately 15,5km north of the of the closest turbine location. This IBA is one of a few sites protecting both the globally threatened Red Lark, which inhabits the red sand dunes and sandy plains with a mixed grassy dwarf shrub cover, and the near-threatened Sclater's Lark, which occurs erratically on gravel plains. A Verreaux's Eagle nest is located just inside the border of the IBA, approximately 12km from the closest planned turbine. The proposed wind energy facility is not expected to impact on the avifauna in the Mattheus-Gat Conservation Area due to the distance from the nearest planned turbines.

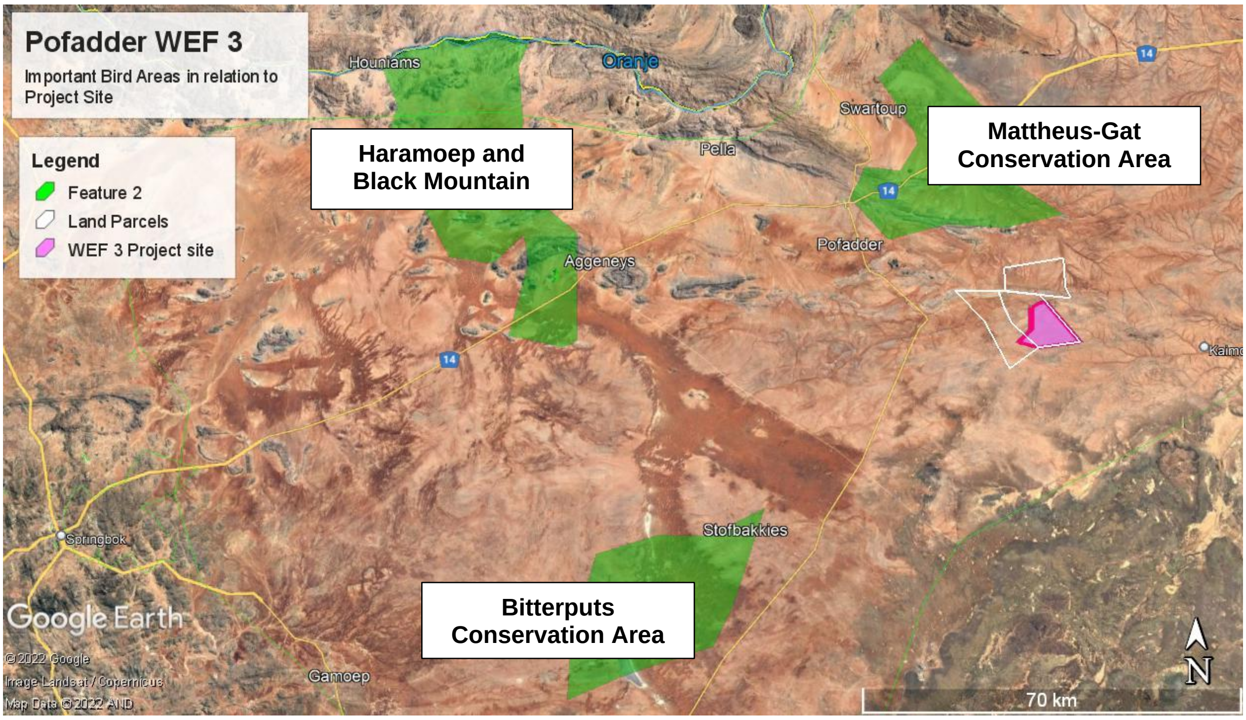


Figure 3: Regional map detailing the location of the proposed Pofadder WEF 3 in relation to Important Bird Areas (in green).

5.4 The DFFE National Screening Tool

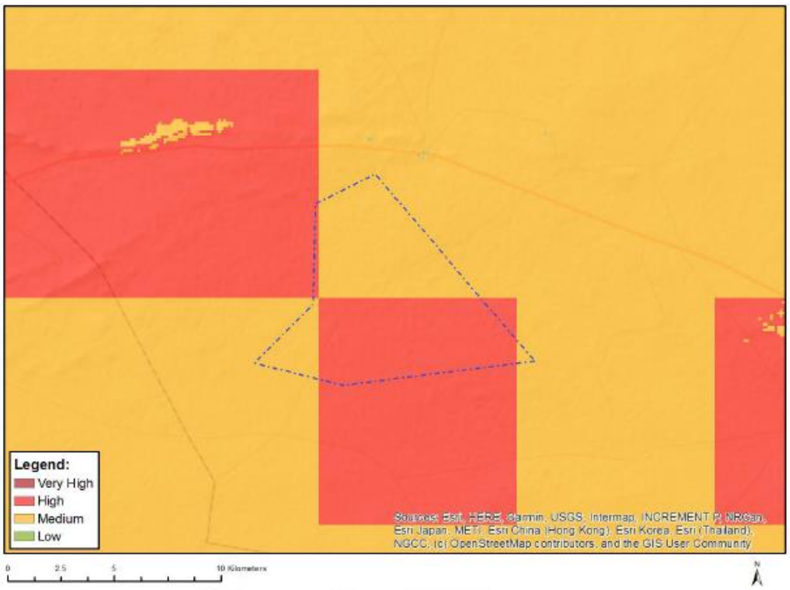
The Project Site and immediate environment is classified as **Medium** and **High** sensitivity for terrestrial animals according to the Terrestrial Animal Species Theme (Figure 4)[1]. The High and Medium sensitivity classifications are linked to Burchell's Courser *Cursorius rufus*, Ludwig's Bustard *Neotis ludwigii* and Secretarybird *Sagittarius serpentarius*. The Project Site contains confirmed habitat for species of conservation concern (SCC) as defined in 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). The classification of high sensitivity is confirmed based on the presence of species of conservation concern (SCC) recorded during onsite surveys and pre-construction monitoring at the project site, namely Verreaux's Eagle *Aquila verreauxii* (SA status: Vulnerable), Lanner Falcon *Falco biarmicus* (SA status: Vulnerable), Ludwig's Bustard (SA status: Endangered), Lappet-faced Vulture *Torgos tracheliotis* (SA status: Endangered), Karoo Korhaan *Eupodotis vigorsii* (SA status: Near-threatened) and Sclater's Lark *Spizocorys sclater* (SA status: Near-threatened). Furthermore, the development area contains habitat for other SCCs which could potentially occur, namely Martial Eagle *Polemaetus bellicosus* (SA status: Endangered), White-backed Vulture *Gyps africanus* (SA status: Endangered) and Burchell's Courser *Cursorius rufus* (SA status: Vulnerable).

Based on the available SABAP2 data, the Site Sensitivity Verification survey conducted in June 2020, and the four pre-construction monitoring surveys conducted in 2021 - 2022, the classification of **High** sensitivity for avifauna in the screening tool is confirmed for the Project Site and Development Area.

[1] The Wind Theme is only applicable to sites within a Renewable Energy Development Zone (REDZ).

See Appendix 10 for the site sensitivity verification report.

MAP OF RELATIVE ANIMAL SPECIES THEME SENSITIVITY



Where only a sensitive plant unique number or sensitive animal unique number is provided in the screening report and an assessment is required, the environmental assessment practitioner (EAP) or specialist is required to email SANBI at eiadatarequests@sanbi.org.za listing all sensitive species with their unique identifiers for which information is required. The name has been withheld as the species may be prone to illegal harvesting and must be protected. SANBI will release the actual species name after the details of the EAP or specialist have been documented.

Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
	X		

Sensitivity Features:

Sensitivity	Feature(s)
High	Aves-Cursorius rufus
Low	Subject to confirmation
Medium	Aves-Neotis ludwigii
Medium	Aves-Sagittarius serpentarius

Figure 4: The National Web-Based Environmental Screening Tool map of the Project Site, indicating sensitivities for the Terrestrial Animal Species theme. The High and Medium sensitivity classifications are linked to Burchell's Courser *Cursorius rufus*, Ludwig's Bustard *Neotis ludwigii* and Secretarybird *Sagittarius serpentarius.*

5.5 National Protected Areas

The project site and proposed development area do not fall within a formally protected area. The proposed wind energy facility is not expected to impact on the avifauna in the closest protected area, namely the Gamsberg Nature Reserve due to the distance (47km) from the nearest planned turbines.

5.6 Avifauna in the study area

The SABAP 2 data indicates that a total of 96 bird species could potentially occur within the broader area – Appendix 1 provides a comprehensive list of all the species. Of these, 18 species are classified as priority species (see definition of priority species in section 1.3) and 11 of these are South African Red List species. Based on the SABAP 2 reporting rates of the species, the habitat at the development area and the species recorded at the site during the surveys, we estimate that 15 of the priority species occurring in the broader area, have a medium to high chance of occurring regularly in the development area (**Table 2**).

Table 2 below lists all the priority species that are likely to occur regularly and the possible impact on the respective species by the proposed wind farm.

LC = Least Concern	H = High
NT = Near threatened	M = Medium
VU = Vulnerable	L = Low
EN = Endangered	

Table 3: Wind energy priority species recorded in the broader area.

Species	Taxonomic name	SABAP 2 reporting rates		Status				Habitat						Potential impact				
		SABAP 2 Reporting rate full protocol	SABAP 2 Reporting rate ad hoc protocol	Red Data Global (IUCN 2021.3)	Red Data Regional Taylor *et al.* 2015)	Probability of regular occurrence	Recorded during monitoring	Arid grassland and shrub on sand	Arid grassland on gravel plains	Surface water: water troughs	Ridges	Alien trees	High voltage lines	Collisions: Turbines	Displacement: Disturbance	Displacement: Habitat transformation	Collisions: MV Powerlines	Electrocutions: MV Powerlines
Black Stork	*Ciconia nigra*	2.86	0.00	LC	VU	Low				x	x	x		x			x	
Black-chested Snake-eagle	*Circaetus pectoralis*	2.86	0.00			Low		x	x	x		x	x	x				
Greater Kestrel	*Falco rupicoloides*	40.00	3.23			High	x	x	x			x	x	x	x			x
Jackal Buzzard	*Buteo rufofuscus*	2.86	0.00			Low	x			x	x	x	x	x				x
Karoo Korhaan	*Eupodotis vigorsii*	68.57	22.58	LC	NT	High	x	x	x					x	x	x	x	
Ludwig's Bustard	*Neotis ludwigii*	48.57	12.90	EN	EN	High	x	x	x					x	x	x	x	
Kori Bustard	*Ardeotis kori*	5.71	0.00	NT	NT	Medium	x	x	x					x	x		x	
Martial Eagle	*Polemaetus bellicosus*	11.43	0.00	VU	EN	Medium		x	x	x	x	x	x	x	x			x
Northern Black Korhaan	*Afrotis afraoides*	45.71	0.00			High	x	x	x					x	x	x	x	
Red Lark	*Calendulauda burra*	42.86	0.00	VU	VU	High	x	x						x	x	x		
Sclater's Lark	*Spizocorys sclateri*	51.43	19.35	NT	NT	High	x		x	x				x	x	x		
Pale Chanting Goshawk	*Melierax canorus*	68.57	9.68			High	x	x	x	x		x	x	x	x			x
Spotted Eagle-owl	*Bubo africanus*	20.00	9.68			High	x	x	x		x	x		x	x		x	x
Verreaux's Eagle	*Aquila verreauxii*	5.71	3.23	LC	VU	Low	x			x	x		x	x	x			x
White-backed Vulture	*Gyps africanus*	2.86	0.00	CR	CR	Medium	x	x	x	x	x	x	x	x	x		x	x

Species	Taxonomic name	SABAP 2 reporting rates		Status				Habitat						Potential impact				
		SABAP 2 Reporting rate full protocol	SABAP 2 Reporting rate ad hoc protocol	Red Data Global (IUCN 2021.3)	Red Data Regional Taylor *et al.* 2015)	Probability of regular occurrence	Recorded during monitoring	Arid grassland and shrub on sand	Arid grassland on gravel plains	Surface water: water troughs	Ridges	Alien trees	High voltage lines	Collisions: Turbines	Displacement: Disturbance	Displacement: Habitat transformation	Collisions: MV Powerlines	Electrocutions: MV Powerlines
Burchell's Courser	*Cursorius rufus*	11.43	3.23	LC	VU	High		x	x	x	x	x	x	x				
Double-banded Courser	*Rhinoptilus africanus*	42.86	9.68			High	x				x			x	x			
Lappet-faced Vulture	*Torgos tracheliotis*	0	0	EN	EN	Medium	x	x	x	x	x	x	x	x	x		x	x

5.7 Results of pre-construction bird monitoring

Table 3 and Figures 6 and 7 below present the results of the pre-construction monitoring conducted at the combined Project Sites for Pofadder WEF 1, 2 and 3 and control area. Figure 5 illustrates where monitoring was conducted.

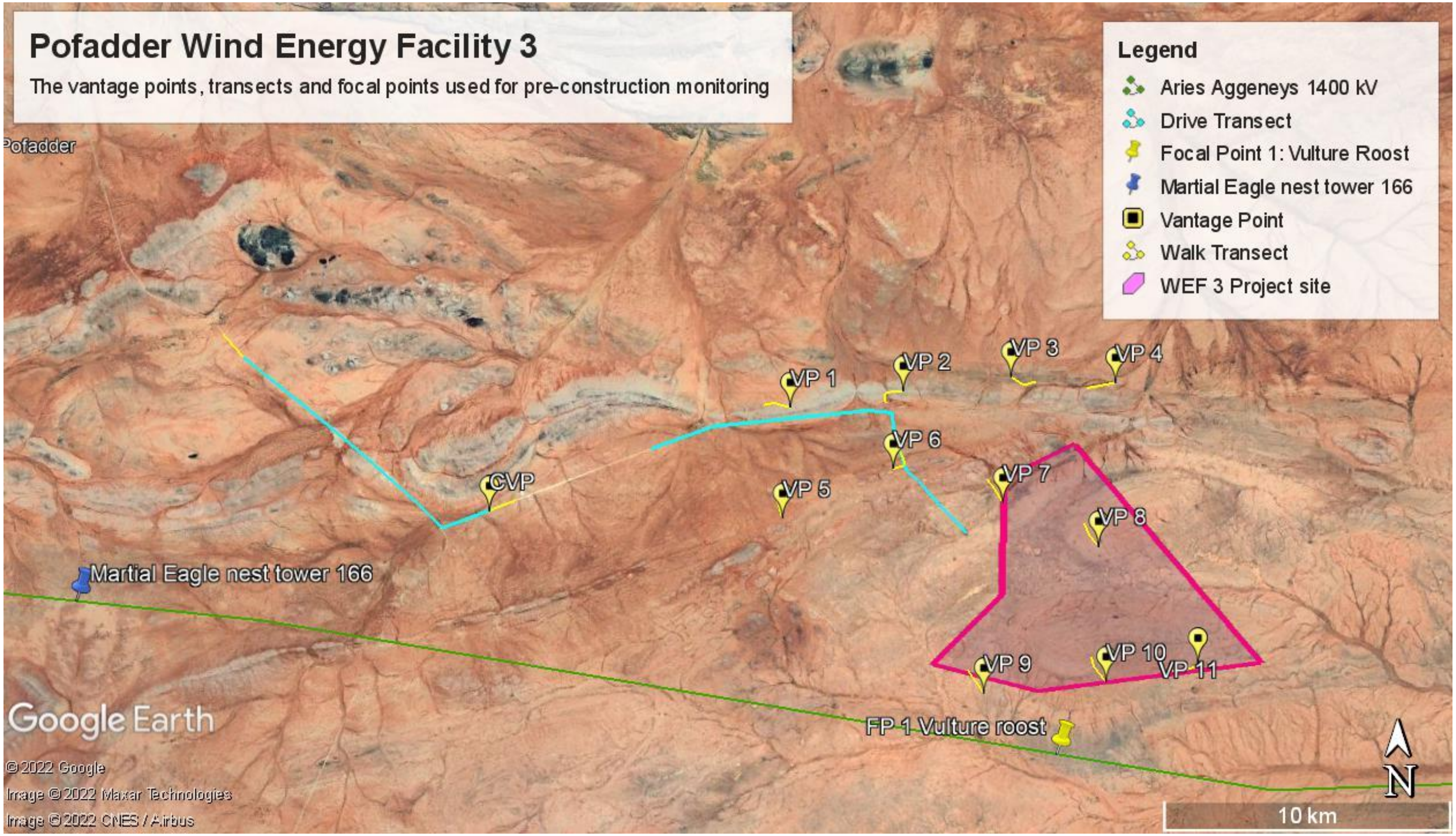


Figure 5: Area where monitoring took place, with the position of Vantage Points (VPs), drive transects, walk transects and focal points. The control area (CVP) is to the west of the Project Site.

5.7.1 Transects

Results from the drive transects and walk transects are captured in Table 3.

Table 4: Results of the drive and walk transects

WEF SITE		
Species composition count		
All Species	86	
Priority Species	12	14%
Non-Priority Species	74	
Total count		
Drive transects	2187	
Walk transects	5775	
Combined Total	7962	
CONTROL SITE		
Species composition count		
All Species	77	
Priority Species	7	9%
Non-Priority Species	70	
Total count		
Drive transects	3013	
Walk transects	957	
Combined Total	3970	

An Index of Kilometric Abundance (IKA = birds/km) was calculated for each priority species recorded during transects over all four seasons and the combined sites (Figures 6 and 7).

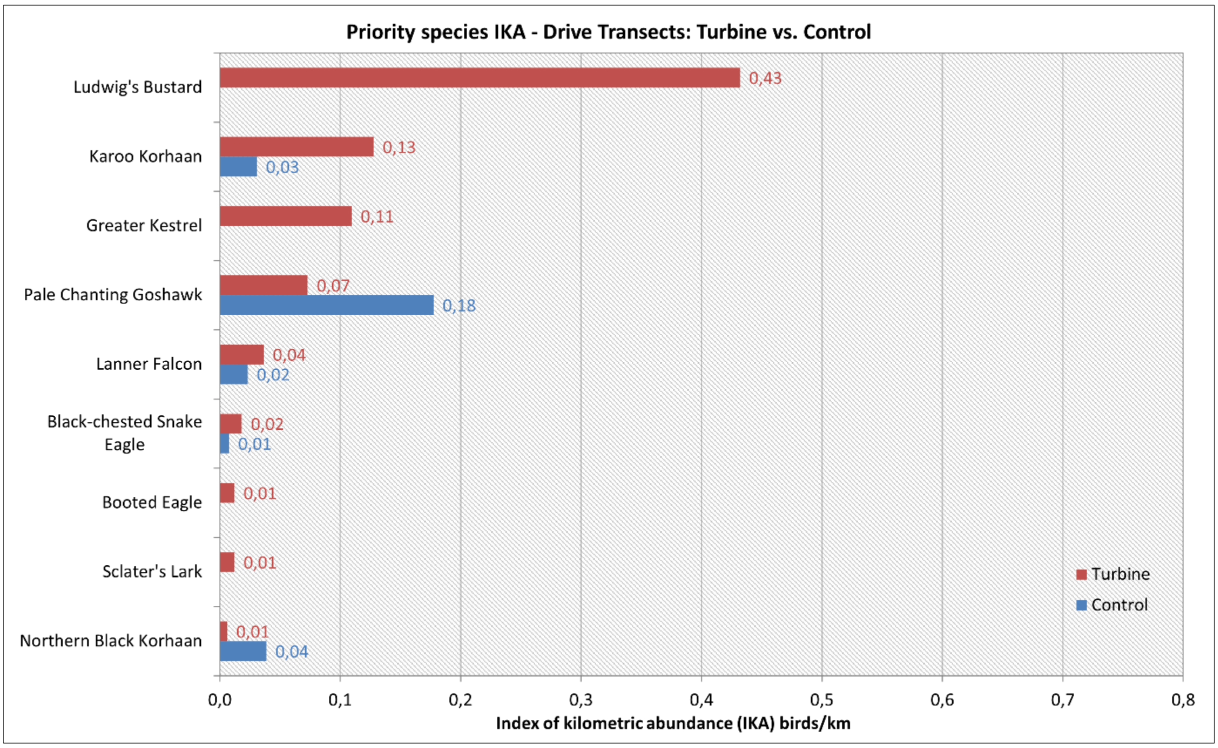


Figure 6: Drive transect survey index of kilometric abundance of priority species recorded at Pofadder WEF 1, 2 and 3 and the control sites across all four seasons.

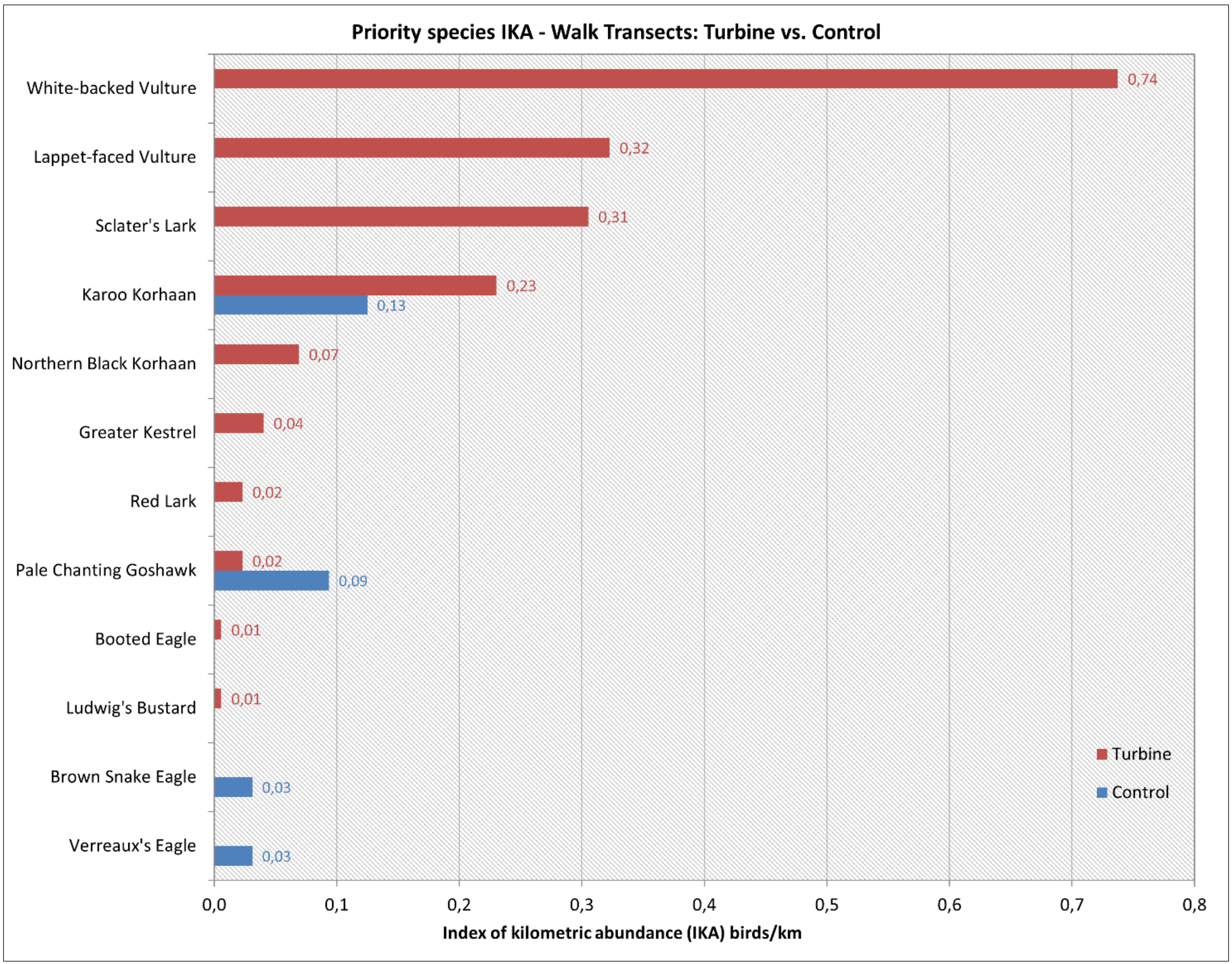


Figure 7: Walk transect survey index of kilometric abundance of priority species recorded at Pofadder WEF 1, 2 and 3 and the control sites across all four seasons.

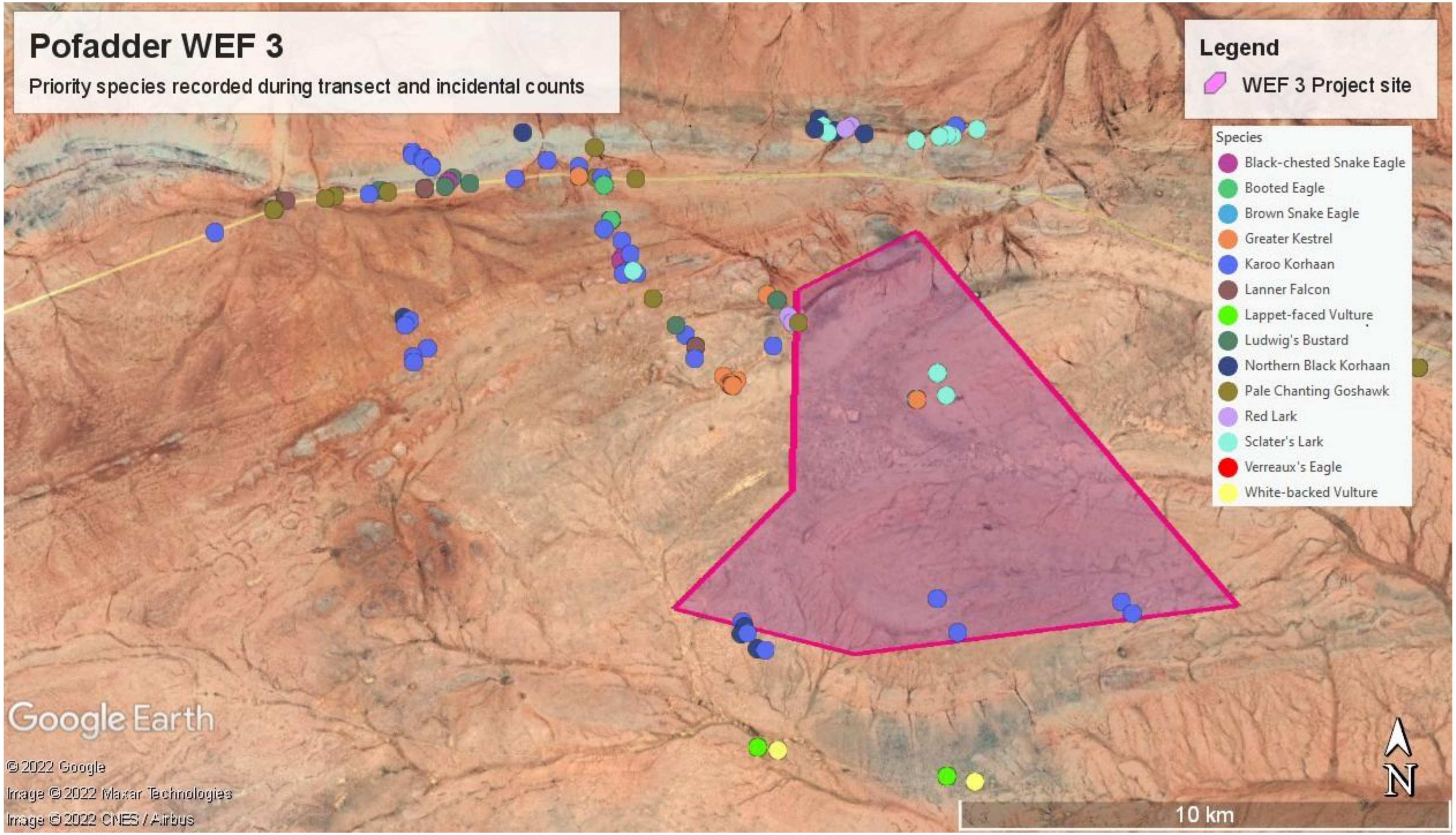


Figure 8: The locations of priority species recorded at the proposed WEF during transect counts and incidental sightings.

5.7.2 Focal points

No focal points of bird activity were identified during the first two surveys. The closest Martial Eagle nest is located on Tower 166 of the Aggeneis – Aries 1 400kV line (Figure 5), approximately 30 km west from the closest planned turbine position. The closest Verreaux's Eagle nest is located approximately 13km north of the closest planned turbine position. However, during the third survey, a total of 24 White-backed Vulture and 22 Lappet-faced Vultures were recorded roosting on the Aggeneys – Aries 1 400kV transmission line to the south of the development areas. This area was identified as a focal point and was monitored during subsequent surveys.

5.7.3 Incidental counts

Table 4 provides an overview of the incidental sightings of priority species during the four seasonal surveys at the combined Pofadder WEF 1, 2 and 3 project sites.

Table 5: Incidental sightings of priority species made during the seasonal surveys

Seasonal survey	Priority species recorded	Number recorded
Winter 2021	Greater Kestrel	14
	Karoo Korhaan	27
	Ludwig's Bustard	4
	Northern Black Korhaan	2
	Pale Chanting Goshawk	13
	Red Lark	1
	Sclater's Lark	47
	Spotted Eagle Owl	2
Spring 2021	Greater Kestrel	5
	Karoo Korhaan	14
	Northern Black Korhaan	1
	Pale Chanting Goshawk	1
	Red Lark	1
	Sclater's Lark	37
	Spotted Eagle Owl	6
Summer 2022	Black-chested Snake Eagle	5
	Booted Eagle	5
	Greater Kestrel	10
	Karoo Korhaan	7
	Lanner Falcon	3
	Lappet-faced Vulture	22
	Lesser Kestrel	1
	Ludwig's Bustard	3
	Northern Black Korhaan	8
	Pale Chanting Goshawk	8
	Spotted Eagle-Owl	5
	White-backed Vulture	24

Seasonal survey	Priority species recorded	Number recorded
Autumn 2022	Booted Eagle Greater Kestrel Lanner Falcon Lappet-faced Vulture Ludwig's Bustard Martial Eagle Northern Black Korhaan Pale Chanting Goshawk Red Lark Spotted Eagle-Owl	2 11 7 9 45 1 12 9 1 4

See Appendix 5 for a list of all species recorded during the pre-construction monitoring.

5.7.4 Vantage point observations

In total, the flight patterns of priority species amounted to 528 hours (12 hours per VP) at 11 vantage points at the turbine site development area in three height bands (high = above rotor altitude; medium = at rotor altitude; low = below rotor altitude). Approximate flight altitude was visually judged by an observer with the aid of binoculars. After four surveys, priority species were observed for 7 hours 46 minutes and 15 seconds during the combined observation periods. The passage rate for priority species was 0.53 birds /hour or approximately 7 birds per day[2]. Figure 9 presents the data gathered during vantage point watches at the turbine site development area.

[2] Assuming 13 hours of daylight averaged over all seasons.

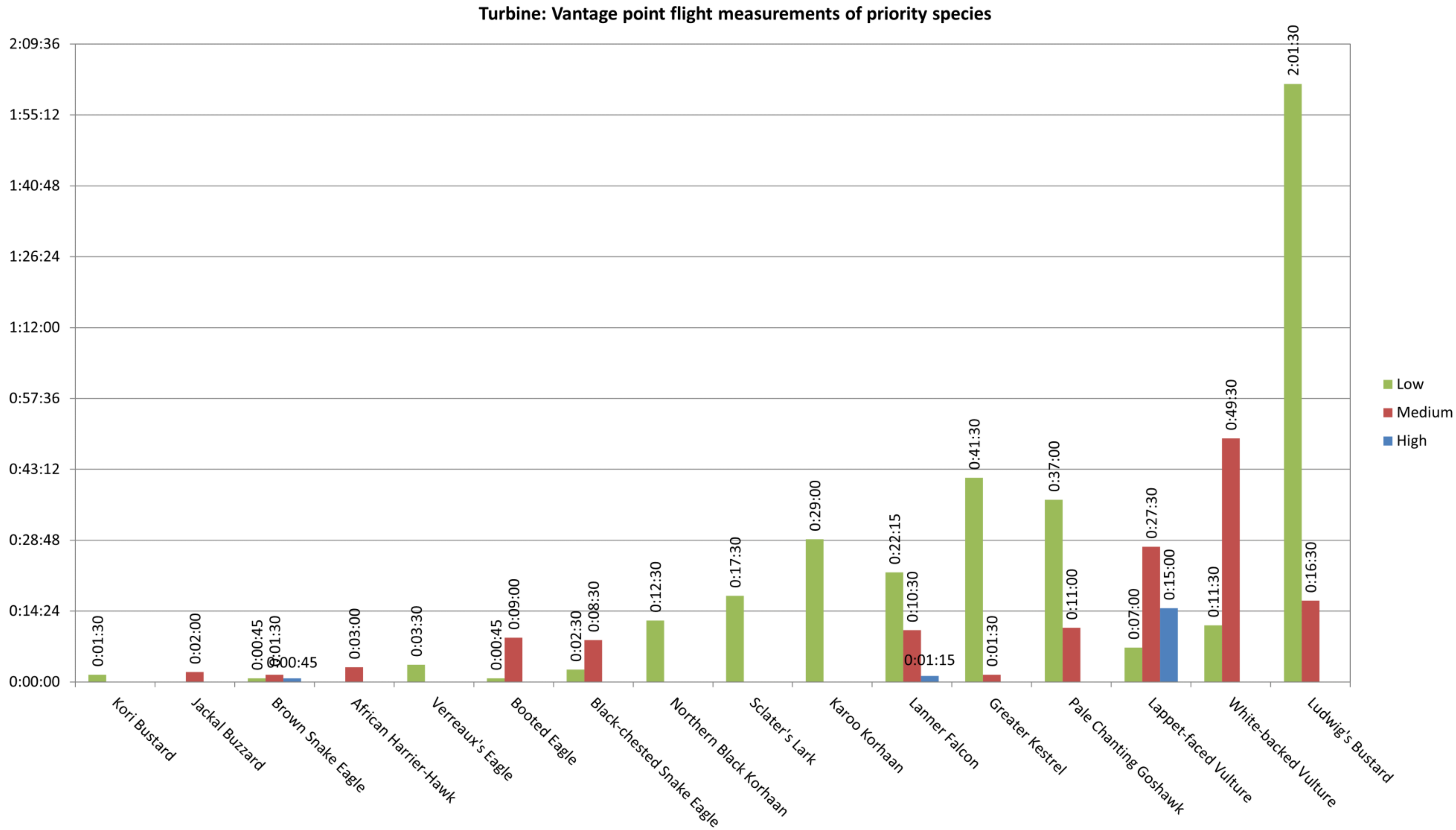


Figure 9: Recorded flight times and altitude (low, medium, high) for priority species. Time is indicated in hours: minutes: seconds.

5.7.5 Site specific collision risk rating

A site-specific collision risk rating for each priority species recorded during VP watches was calculated to give an indication of the likelihood of an individual of the specific species to collide with the turbines at these sites. This was calculated while considering the following factors:

- The duration of rotor altitude flights
- The susceptibility to collisions, based on morphology (size) and behaviour (soaring, predatory, ranging behaviour, flocking behaviour, night flying, aerial display, and habitat preference) using the ratings for priority species in the Avian Wind Farm Sensitivity Map of South Africa (Retief *et al*. 2012); and
- The number of turbines

This was done in order to gain a better understanding of which species are likely to be most at risk of collision. The formula used is as follows[3]:

Duration of rotor altitude flights (in decimal hours) x collision ratings in the Avian Wind Farm Sensitivity Map x number of turbines ÷100.

The results are presented in **Table 5** and **Figure 10** below.

[3] It is important to note that the formula does not incorporate avoidance behaviour. This may differ between species and may have a significant impact on the size of the risk associated with a specific species. It is generally assumed that 95-98% of bird flights will successfully avoid the turbines (SNH 2010).

Table 6: Site-specific collision risk rating

Species	**Duration of medium height flights (hr)**	**Collision rating: Avian Wind Farm Sensitivity Map (Retief *et al*. 2012)**	**Site specific collision risk rating**
Sclater's Lark	0.000	50	0.00
Karoo Korhaan	0.000	65	0.00
Kori Bustard	0.000	75	0.00
Verreaux's Eagle	0.000	115	0.00
Northern Black Korhaan	0.000	60	0.00
Greater Kestrel	0.001	57	0.02
Brown Snake Eagle	0.001	80	0.03
Jackal Buzzard	0.001	95	0.04
African Harrier-Hawk	0.002	65	0.04
Black-chested Snake Eagle	0.006	85	0.15
Booted Eagle	0.006	85	0.16
Pale Chanting Goshawk	0.008	70	0.16
Lanner Falcon	0.007	85	0.19
Ludwig's Bustard	0.011	85	0.29
Lappet-faced Vulture	0.019	100	0.57
White-backed Vulture	0.034	95	0.98
Average	**0.006**	**79.18**	**0.16**

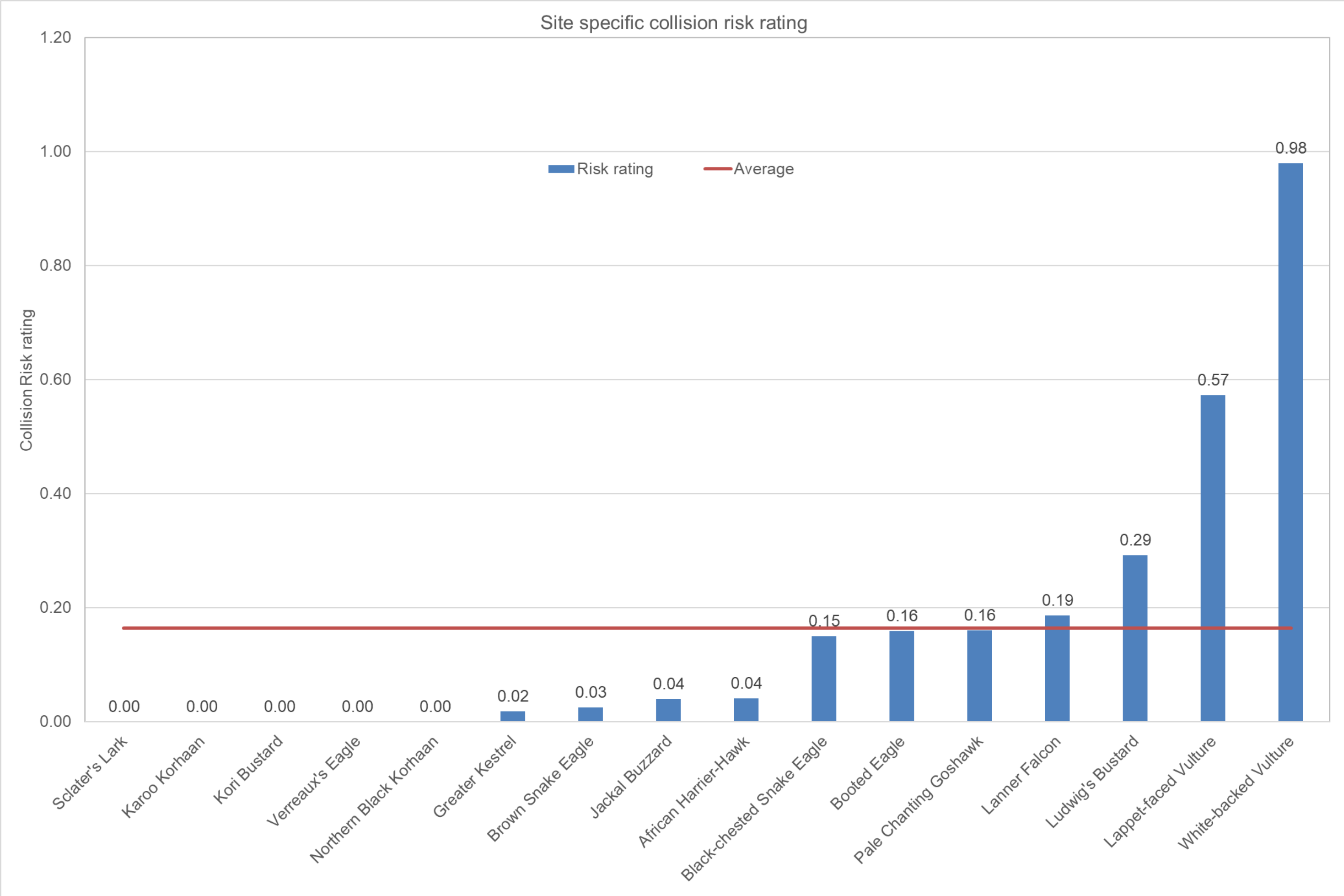


Figure 10: Site specific collision risk rating for priority species. The red line indicates the average collision risk rating for priority species at the application site, based on recorded flight behaviour in four seasonal surveys.

5.7.6 Spatial distribution of flights over the turbine area

Flight maps were prepared for the species with higher-than-average collision risk indices, indicating the spatial distribution of flights observed over the Pofadder WEF 3 site. This was done by overlaying a 100m x 100m grid over the survey area. Each grid cell was then given a weighting score (Very High; High; Medium; Low) taking into account the flight intensity i.e. the duration and distance of individual flight lines through a grid cell and the number of individual birds associated with each flight crossing the grid cell, in order to give an indication where the observed flight activity was most concentrated (see **Figure 11, Figure** 12**, and 13**).

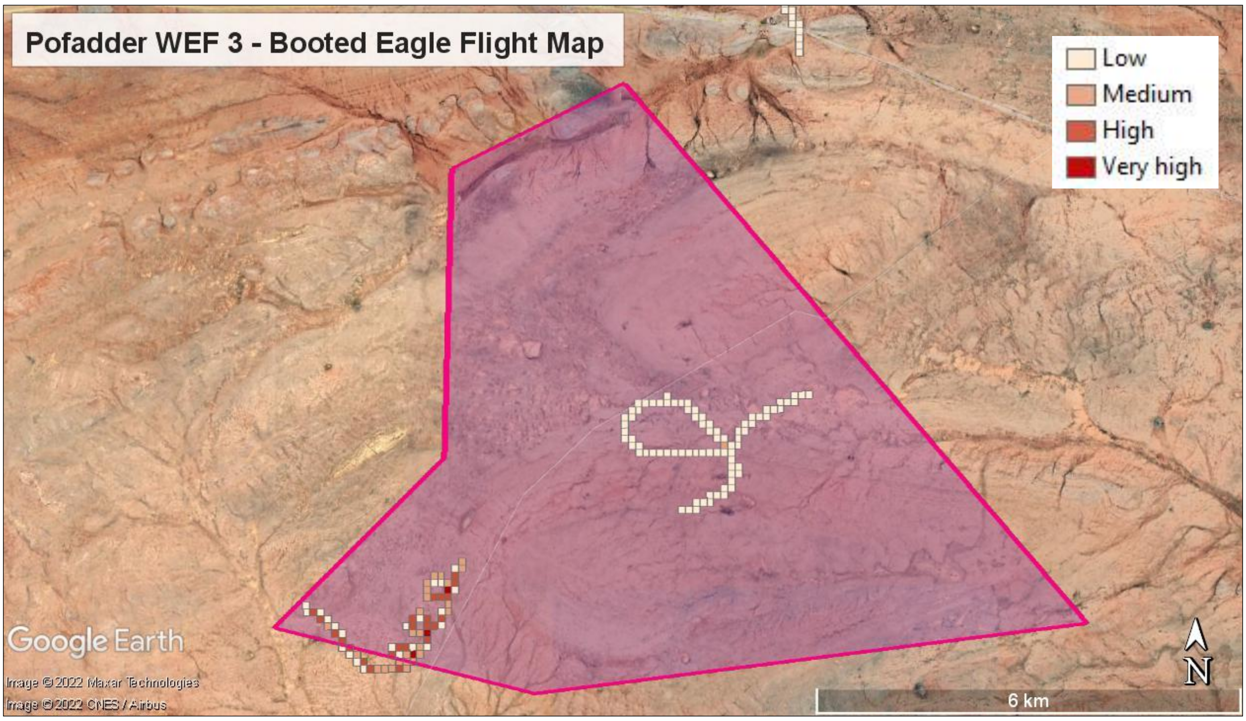


Figure 11: Intensity of flight activity of Booted Eagle over four seasons of monitoring

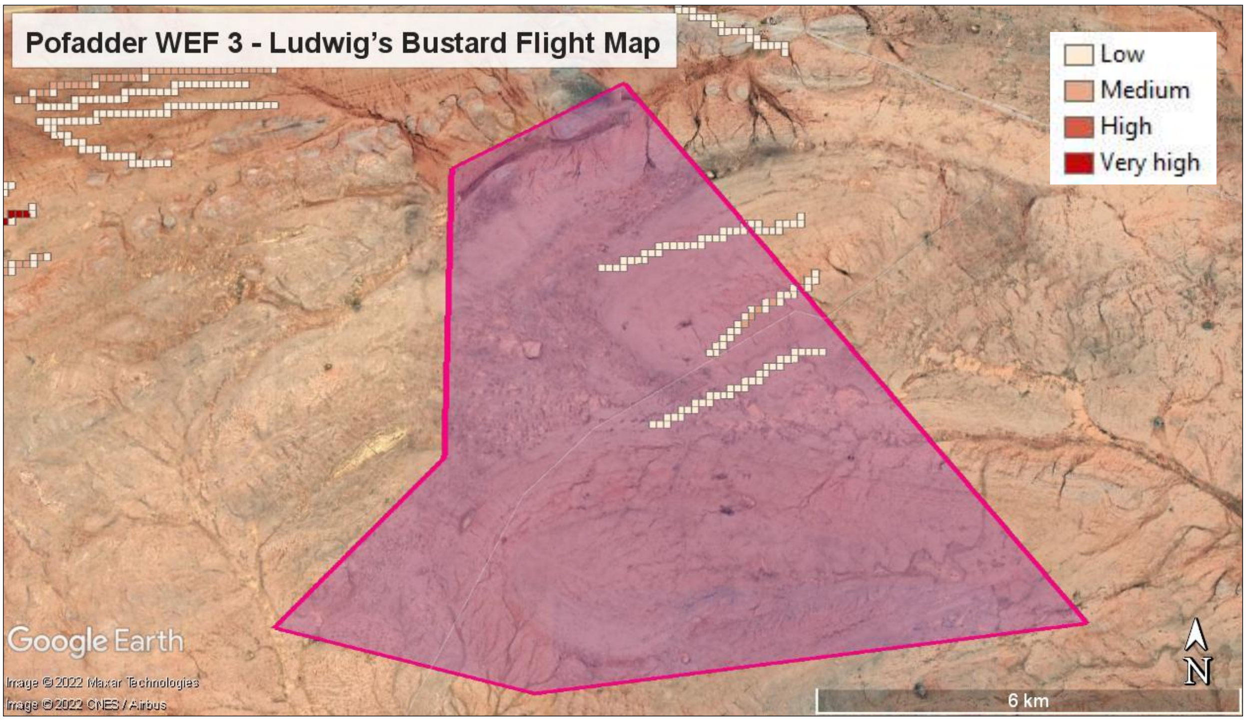


Figure 12: Intensity of flight activity of Ludwig's Bustard over four seasons of monitoring

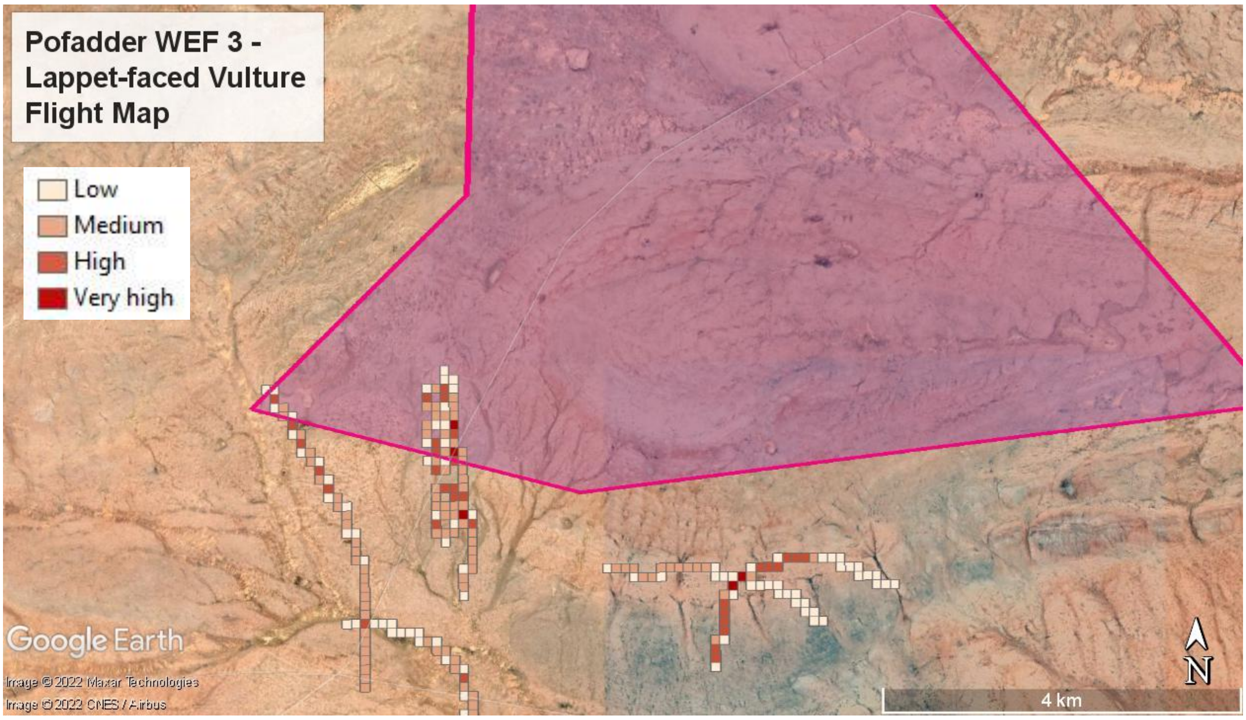


Figure 13: Intensity of flight activity of Lappet-faced Vulture over four seasons of monitoring

6. SPECIALIST FINDINGS AND ASSESSMENT OF IMPACTS

6.1 Wind Energy Facility (WEF)

The effects of a wind farm on birds are highly variable and depend on a wide range of factors including the specification of the development, the topography of the surrounding land, the habitats affected and the number and species of birds present. With so many variables involved, the impacts of each wind farm must be assessed individually. The principal areas of concern with regard to effects on birds are listed below. Each of these potential effects can interact with each other, either increasing the overall impact on birds or, in some cases, reducing a particular impact (for example where habitat loss or displacement causes a reduction in birds using an area which might then reduce the risk of collision):

- Mortality due to collisions with the wind turbines
- Displacement due to disturbance during construction and operation of the wind farm
- Displacement due to habitat change and loss at the wind farm
- Mortality due to electrocution on the electrical infrastructure

It should be noted that the assessment is made on the *status quo* as it is currently on site. The possible change in land use in the broader development site is not taken into account because the extent and nature of future developments (not only wind energy development) are unknown at this stage. It is however highly unlikely that the land use will change in the foreseeable future due to climatic limitations.

6.1.1 *Collision mortality on wind turbines*[4]

Wind energy generation has experienced rapid worldwide development over recent decades as its environmental impacts are considered to be relatively lower than those caused by traditional energy sources, with reduced environmental pollution and water consumption (Saidur *et al.*, 2011). However, bird fatalities due to collisions with wind turbines have been consistently identified as a main ecological drawback to wind energy (Drewitt and Langston, 2006).

Collisions with wind turbines appear to kill fewer birds than collisions with other man-made infrastructures, such as power lines, buildings or even traffic (Calvert *et al.* 2013; Erickson *et al.* 2005). Nevertheless, estimates of bird deaths from collisions with wind turbines worldwide range from 0 to almost 40 deaths per turbine per year (Sovacool, 2009). The number of birds killed varies greatly between sites, with some sites posing a higher collision risk than others, and with some species being more vulnerable (e.g. Hull *et al.* 2013; May *et al.* 2012a). These numbers may not reflect the true magnitude of the problem, as some studies do not account for detectability biases such as those caused by scavenging, searching efficiency and search radius (Bernardino *et al.* 2013; Erickson *et al.* 2005; Huso and Dalthorp 2014). Additionally, even for low fatality rates, collisions with wind turbines may have a disproportionate effect on some species. For long-lived species with low productivity and slow maturation rates (e.g. raptors), even low mortality rates can have a significant impact at the population level(e.g. Carrete *et al.* 2009; De Lucas *et al.* 2012a; Drewitt and Langston, 2006). The situation is even more critical for species of conservation concern, which sometimes are most at risk (e.g. Osborn *et al.* 1998).

High bird fatality rates at several wind farms have raised concerns among the industry and scientific community. High profile examples include the Altamont Pass Wind Resource Area (APWRA) in California because of high fatality of Golden eagles (*Aquila chrysaetos*), Tarifa in Southern Spain for Griffon vultures (*Gyps fulvus*), Smøla in Norway for White-tailed eagles (*Haliaatus albicilla*), and the port of Zeebrugge in Belgium for gulls (*Larus* sp.) and terns (*Sterna* sp.) (Barrios and Rodríguez, 2004; Drewitt and Langston, 2006; Everaert and Stienen, 2008; May *et al.* 2012a; Thelander *et al.* 2003). Due to their specific features and location, and characteristics of their bird communities, these wind farms have been responsible for a large number of fatalities that culminated in the deployment of additional measures to minimize or compensate for bird collisions. However, currently, no simple formula can be applied to all sites; in fact, mitigation measures must inevitably be defined according to the characteristics of each wind farm and the diversity of species occurring there (Hull *et al.* 2013; May *et al.* 2012b). An understanding of the factors that explain bird collision risk and how they interact with one another is therefore crucial to proposing and implementing valid mitigation measures.

Species-specific factors

- Morphological features

Certain morphological traits of birds, especially those related to size, are known to influence collision risk with structures such as power lines and wind turbines. Janss (2000) identified weight, wing length, tail length and total bird length as being collision risk determinant. Wing loading (ratio of body weight to wing area) and

[4] This section is based largely on a (2014) review paper by Ana Teresa Marques, Helena Batalha, Sandra Rodrigues, Hugo Costa, Maria João Ramos Pereira,Carlos Fonseca, Miguel Mascarenhas, Joana Bernardino. *Understanding bird collisions at wind farms: An updated review on the causes and possible mitigation strategies*. Biological Conservation 179 (2014) 40– 52.

aspect ratio (ratio of wing span squared to wing area) are particularly relevant, as they influence flight type and thus collision risk (Bevanger, 1994; De Lucas *et al.* 2008; Herrera-Alsina *et al.* 2013; Janss, 2000). Birds with high wing loading, such as the Griffon Vulture (*Gyps fulvus*), seem to collide more frequently with wind turbines at the same sites than birds with lower wing loadings, such as Common Buzzards (*Buteo buteo*) and Short-toed Eagles (*Circaetus gallicus*), and this pattern is not related with their local abundance (Barrios and Rodríguez, 2004; De Lucas *et al.* 2008). High wing-loading is associated with low flight manoeuvrability (De Lucas *et al.* 2008), which determines whether a bird can escape an encountered object fast enough to avoid collision.

Information on the wing loading of the priority species potentially occurring regularly at the Pofadder WEF 3 was not available at the time of writing. However, based on general observations, and research on related species, it can be confidently assumed that regularly occurring priority species that could potentially be vulnerable to wind turbine collisions due to morphological features (high wing loading) are Ludwig's Bustard, Kori Bustard, Karoo Korhaan, Northern Black Korhaan, Lappet-faced Vulture and White-backed Vulture, making them less manoeuvrable (Keskin *et al.* 2019).

- Sensorial perception

Birds are assumed to have excellent visual acuity, but this assumption is contradicted by the large numbers of birds killed by collisions with man-made structures (Drewitt and Langston, 2008; Erickson *et al.* 2005). A common explanation is that birds collide more often with these structures in conditions of low visibility, but recent studies have shown that this is not always the case (Krijgsveld *et al.* 2009). The visual acuity of birds seems to be slightly superior to that of other vertebrates (Martin, 2011; McIsaac, 2001). Unlike humans, who have a broad horizontal binocular field of 120°, some birds have two high acuity areas that overlap in a very narrow horizontal binocular field (Martin, 2011). Relatively small frontal binocular fields have been described for several species that are particularly vulnerable to power line collisions, such as vultures (Gyps sp.) cranes and bustards (Martin and Katzir, 1999; Martin et.al, 2010; Martin, 2012, 2011; O'Rourke *et al.* 2010). Furthermore, for some species, their high resolution vision areas are often found in the lateral fields of view, rather than frontally (e.g. Martin et.al, 2010; Martin, 2012, 2011; O'Rourke *et al.* 2010). Finally, some birds tend to look downwards when in flight, searching for conspecifics or food, which puts the direction of flight completely inside the blind zone of some species (Martin et.al, 2010; Martin, 2011).

Some of the potentially regularly occurring priority species at the proposed Pofadder WEF 3 have high resolution vision areas found in the lateral fields of view, rather than frontally, i.e., Ludwig's Bustard and Karoo Korhaan. The exceptions to this are the priority raptors and vultures which all have wider binocular fields, although as pointed out by Martin (2011, 2012), this does not necessarily result in these species being able to avoid obstacles better.

- Phenology

Recent studies have shown that, within a wind farm, raptor collision risk and fatalities are higher for resident than for migrating birds of the same species. An explanation for this may be that resident birds generally use the wind farm area several times while a migrant bird crosses it just once (Krijgsveld *et al.* 2009). However, other factors like bird behaviour are certainly relevant. Katzner *et al.* (2012) showed that Golden Eagles performing local movements fly at lower altitudes, putting them at a greater risk of collision than migratory eagles. Resident eagles flew more frequently over cliffs and steep slopes, using low altitude slope updrafts, while migratory eagles flew more frequently over flat areas and gentle slopes where thermals are generated, enabling the birds to use them to gain lift and fly at higher altitudes.

South Africa is at the end of the migration path for summer migrants; therefore, the phenomenon of migratory flyways where birds are concentrated in large numbers for a limited period, e.g., the African Rift Valley or Mediterranean Red Sea flyways, is not a feature of the landscape. To date few migratory priority species have been recorded within the project site and Pofadder WEF 3 development area, however Booted Eagle does occur and will behave much the same as the resident birds once they arrive in the area. The same is valid for local nomads such as the Ludwig's Bustard, Lappet-faced Vulture and White-backed Vulture, which are likely only present during certain months of the year, i.e., between January and May in the non-breeding season. According to several landowners, vultures have recently (2020) been observed at carcasses for the first time in several decades, with numbers ranging from a few birds to over a hundred. During the third survey in February 2022, 42 White-backed Vultures and Lappet-faced Vultures were recorded roosting on the Aries – Aggeneys 400kV line approximately 2.8km south of the closest planned turbine location. During the fourth survey in March 2022, 9 Lappet-faced Vultures were recorded at the roost, but no White-backed Vultures. Flight activity of Lappet-faced Vultures over the development area itself was also recorded. It is expected that, for the period when they are present, these species will be exposed to the same risks as resident species.

- Bird behaviour

Flight type seems to play an important role in collision risk, especially when associated with hunting and foraging strategies. Kiting flight (hanging in the wind with almost motionless wings), which is used in strong winds and occurs in rotor swept zones, has been highlighted as a factor explaining the high collision rate of Red-tailed Hawks *Buteo jamaicensis* at APWRA (Hoover and Morrison, 2005), and could also be a factor in contributing to the high collision rate for Jackal Buzzards in South Africa (Ralston-Paton & Camagu 2019). The hovering behaviour exhibited by Common Kestrels *Falco tinnunculus* when hunting may also explain the fatality levels of this species at wind farms in the Strait of Gibraltar (Barrios and Rodríguez, 2004). This may also explain the high mortality rate of Rock Kestrels *Falco rupicolus* at wind farms in South Africa (Ralston-Paton & Camagu 2019). Kiting and hovering are associated with strong winds, which often produce unpredictable gusts that may suddenly change a bird's position (Hoover and Morrison, 2005). Additionally, while birds are hunting and focused on prey, they might lose track of wind turbine positions (Krijgsveld *et al.* 2009; Smallwood *et al.* 2009). In the case of raptors, aggressive interactions may play an important role in turbine fatalities, in that birds involved in these interactions are momentarily distracted, putting them at risk. At least one eye-witness account of a Martial Eagle getting killed by a turbine in South Africa in this fashion is on record (Simmons & Martins 2016)

Social behaviour may also result in a greater collision risk with wind turbines due to a decreased awareness of the surroundings. Several authors have reported that flocking behaviour increases collision risk with power lines as opposed to solitary flights (e.g. Janss, 2000). However, caution must be exercised when comparing the particularities of wind farms with power lines, as some species appear to be vulnerable to collisions with power lines but not with wind turbines, e.g. indications are that bustards, which are highly vulnerable to power line collisions, are not prone to wind turbine collisions – a Spanish database of over 7000 recorded turbine collisions contains no Great Bustards *Otis tarda* (A. Camiña 2012a). Similarly, in South Africa, only two bustard collisions with wind turbines have been reported to date, both Ludwig's Bustards (Ralston-Paton & Camagu 2019). No Denham's Bustards *Neotis denhami* turbine fatalities have been reported to date, despite the species occurring at several wind farm sites.

The priority species which could occur with some regularity at the proposed Pofadder WEF 3 can be classified as either terrestrial species, soaring species or occasional long-distance fliers. Terrestrial species spend most of the time foraging on the ground. They do not fly often and when they do, they generally fly for short distances at low to medium altitude. At the project site, Ludwig Bustard, Kori Bustard, Karoo Korhaan and Northern Black Korhaan are included in this category. Occasional long-distance fliers generally behave as terrestrial species but can and do undertake long distance flights on occasion (Shaw 2013). Species in this category are Ludwig's Bustard. Soaring species spend a significant time on the wing in a variety of flight modes including soaring, kiting, hovering, and gliding at medium to high altitudes. At the project site, these include all the raptors and vultures. Based on the time spent potentially flying at rotor height, soaring species are likely to be at greater risk of collision. Specific behaviour of some species might put them at risk of collision, e.g. display flights of Red Lark and Northern Black Korhaan may place them within the rotor swept zone, resulting in mortalities (Ralston-Paton & Camagu 2019). Lappet-faced Vultures and White-backed Vultures taking off and arriving at carcasses could also be at risk of turbine collisions.

- Avoidance behaviours

Two types of avoidance have been described (Furness *et al.*, 2013): 'macro-avoidance' whereby birds alter their flight path to keep clear of the entire wind farm (e.g. Desholm and Kahlert, 2005; Plonczkier and Simms, 2012; Villegas-Patraca *et al.* 2014), and 'micro-avoidance' whereby birds enter the wind farm but take evasive actions to avoid individual wind turbines (Band *et al.* 2007). This may differ between species and may have a significant impact on the size of the risk associated with a specific species. It is generally assumed that 95-98% of birds will successfully avoid the turbines (SNH 2010).

It is anticipated that most birds at the proposed Pofadder WEF 3 will avoid the wind turbines, as is generally the case at all wind farms (SNH 2010). Exceptions already mentioned are raptors that engage in hunting which might serve to distract them and place them at risk of collision, birds engaged in display behaviour or inter- and intraspecific aggressive interaction. White-backed Vultures and Lappet-faced Vulture. Vultures descending to carcasses may also be at risk as they will be concentrating on the carcass and not the turbines. Complete macro-avoidance of the wind farm is unlikely for any of the priority species likely to occur within the project site.

- Bird abundance

Some authors suggest that fatality rates are related to bird abundance, density or utilization rates (Carrete *et al.* 2012; Kitano and Shiraki, 2013; Smallwood and Karas, 2009), whereas others point out that, as birds use their territories in a non-random way, fatality rates do not depend on bird abundance alone (e.g. Ferrer *et al.* 2012; Hull *et al.* 2013). Instead, fatality rates depend on other factors such as differential use of specific areas within a wind farm (De Lucas *et al.* 2008). For example, at Smøla, White-tailed Eagle flight activity is correlated with collision fatalities (Dahl *et al.* 2013). In the APWRA, Golden Eagles, Red-tailed Hawks and American Kestrels (*Falco spaverius*) have higher collision fatality rates than Turkey Vultures (*Cathartes aura*) and Common Raven (*Corvus corax*), even though the latter are more abundant in the area (Smallwood *et al.* 2009), indicating that fatalities are more influenced by each species' flight behaviour and turbine perception. Also, in southern Spain, bird fatality was higher in the winter, even though bird abundance was higher during the pre-breeding season (De Lucas *et al.* 2008).

The abundance of priority species within the proposed Pofadder WEF 3 development area will fluctuate depending on the season of the year, and possibly in response to rainfall e.g. Ludwig's Bustard. White-backed and Lappet-faced Vulture are probably only present at the project site in numbers between January and May, when collision with the turbines may occur. However, it is not clear at this stage whether the occurrence of White-backed Vultures and Lappet-faced Vultures in the first and second quarters (Lappet-faced Vultures only) of 2022 (during the third and fourth preconstruction monitoring surveys) is an extraordinary event, or whether it signals the start of a regular pattern in the non-breeding season. However, anecdotal evidence is accumulating that vultures are expanding deeper into the Northern Cape and roosting on high voltage lines.

Site-specific factors

- Landscape features

Susceptibility to collision can also heavily depend on landscape features at a wind farm site, particularly for soaring birds that predominantly rely on wind updrafts to fly. Some landforms such as ridges, steep slopes and valleys may be more frequently used by some birds, for example for hunting or during migration (Barrios and Rodríguez, 2004; Drewitt and Langston, 2008; Katzner *et al.* 2012; Thelander *et al.* 2003). In APWRA, Red-tailed Hawk fatalities occur more frequently than expected by chance at wind turbines located on ridge tops and swales, whereas Golden Eagle fatalities are higher at wind turbines located on slopes (Thelander *et al.* 2003). Other birds may follow other landscape features, such as peninsulas and shorelines, during dispersal and migration periods. Kitano and Shiraki (2013) found that the collision rate of White-tailed Eagles along a coastal cliff was extremely high, suggesting an effect of these landscape features on fatality rates.

The combined project sites area does not contain many landscape features as it is situated on a vast, slightly undulating plain. The most significant landscape features from a turbine collision risk perspective are the Aries – Aggeneys 400kV high voltage line, and the multitude of drinking troughs. The powerline might serve as a regular roosting substrate for White-backed Vulture and Lappet-faced Vulture as well as a roosting substrate for large raptors, including Martial Eagle. However, the powerline is situated 9.6km from the closest planned turbine, which reduces the risk to some extent. The water troughs will attract many birds, including Red List species such as Martial Eagle, Verreaux's Eagle, White-backed Vulture, Lappet-faced Vulture and Sclater's Lark.

- Flight paths

For territorial raptors like Golden Eagles (and Verreaux's Eagles – see Ralston-Patton 2017)), foraging areas are preferably located near to the nest, when compared to the rest of their home range. For example, in Scotland 98% of Golden Eagle movements were registered at ranges less than 6 km from the nest, and the core areas were located within a 2 - 3 km radius (McGrady *et al.* 2002). These results, combined with the terrain features selected by Golden Eagles to forage such as areas close to ridges, can be used to predict the areas used by the species to forage (McLeod *et al.* 2002), and therefore provide a sensitivity map and guidance to the development of new wind farms (Bright *et al.* 2006).

The potential areas of high flight activity that have been identified are the low ridges to the north of the project site (not present in the Pofadder WEF 3 development area), and the vulture roost on the Aries – Aggeneys 400kV powerline. The pair of Verreaux's Eagles which are breeding in Mattheus-Gat IBA might forage along the ridges, as they most likely fall within the core range of the pair, and a juvenile Verreaux's Eagle was also recorded perched on a ridge. However, it is unlikely that the species will regularly forage in the development area where the turbines are planned, due to the absence of ridges.

The high voltage powerline to the south of the project site is a focal point for vulture flight activity. No vultures were recorded during surveys in June and October 2021, all the flight activity was recorded during the third and fourth surveys in February and March 2022. Indications are that this could a regular pattern, based on experiences at other proposed wind farms in the Northern Cape. The passage rate over the combined WEF areas during the February 2022 survey was 0.3 birds/hour, or just under 4 birds per day. By March 2022, the passage rate had dropped to 0.03 birds/hour, or one bird every 2.5 days. This points to a regular occurrence of vultures, but only during a specific time period, namely the non-breeding season from January to May, with an expected peak in February and tapering off towards May when the breeding starts. The majority of the flight activity (14 out of 16 flights or 87.5%) was recorded within 2.8km of the powerline roost outside of the Pofadder WEF development area.

- Food availability

Factors that increase the use of a certain area or that attract birds, like food availability; also play a role in collision risk. For example, the high density of raptors at the APWRA and the high collision fatality due to collision with turbines is thought to result, at least in part, from high prey availability in certain areas (Hoover and Morrison, 2005; Smallwood *et al.* 2001). This may be particularly relevant for birds that are less aware of obstructions such as wind turbines while foraging (Krijgsveld *et al.* 2009; Smallwood *et al.* 2009). It is thought that the mortality of three Verreaux's Eagles in 2015 at a wind farm site in South Africa may have been linked to the availability of food (Smallie 2015).

The reason for the influx of Lappet-faced Vultures and White-backed Vultures into the broader area during the first two quarters of 2020 (as reported by landowners) and during the third and fourth pre-construction monitoring surveys at the project site in 2022, is not immediately clear, but it might be related to the availability of food. Rock Hyrax were observed on the ridges north of the project site, which could attract Verreaux's Eagle, including non-breeding floaters and juveniles, but these are not located near the WEF 3 development area.

- Summary

The proposed Pofadder WEF 3 could potentially pose a collision risk to several priority species which could occur regularly at the project site. Species exposed to this risk are large terrestrial species i.e. Ludwig's Bustard, Kori Bustard, Karoo Korhaan and Northern Black Korhaan - although bustards generally seem to be not as vulnerable to turbine collisions as was originally anticipated (Ralston-Paton & Camagu 2019). Soaring priority species, i.e. species such as Martial Eagle, Pale Chanting Goshawk, Verreaux's Eagle, Greater Kestrel, Lappet-faced Vulture and White-backed Vulture are most at risk of all the priority species likely to occur regularly at the project site.

In summary, the following regularly occurring priority species could be at risk of collisions with the turbines: Greater Kestrel, Karoo Korhaan, Ludwig's Bustard, Kori Bustard, Martial Eagle, Northern Black Korhaan, Pale Chanting Goshawk, Spotted Eagle-Owl, Verreaux's Eagle, White-backed Vulture (non-breeding season), Lappet-faced Vulture (non-breeding season) Burchell's Courser, Double-banded Courser, Red Lark and Sclater's Lark.

6.1.2 Displacement due to disturbance

The displacement of birds from areas within and surrounding wind farms due to visual intrusion and disturbance in effect can amount to habitat loss. Displacement may occur during both the construction and operation phases of wind farms, and may be caused by the presence of the turbines themselves through visual, noise and vibration impacts, or as a result of vehicle and personnel movements related to site maintenance. The scale and degree of disturbance will vary according to site- and species-specific factors and must be assessed on a site-by-site basis (Drewitt & Langston 2006).

Unfortunately, few studies of displacement due to disturbance are conclusive, often because of the lack of before- and-after and control-impact (BACI) assessments. Indications are that Great Bustard *Otis tarda* could be displaced by wind farms up to one kilometre from the facility (Langgemach 2008). An Austrian study found displacement for Great Bustards up to 600m (Wurm & Kollar as quoted by Raab *et al.* 2009). However, there is also evidence to the contrary; information on Great Bustard received from Spain points to the possibility of continued use of leks at operational wind farms (Camiña 2012b). The same situation seems to prevail at wind farms in the Eastern Cape where Denham's Bustard are still using wind farm sites as leks.[5] Research on small grassland species in North America indicates that permanent displacement is uncommon and very species specific (e.g. see Stevens et.al 2013, Hale et.al 2014). There also seems to be little evidence for a persistent decline in passerine populations at wind farm sites in the UK (despite some evidence of turbine avoidance), with some species, including Skylark, showing increased populations after wind farm construction (see Pierce-Higgins et. al 2012). Populations of Thekla Lark *Galerida theklae* were found to be unaffected by wind farm developments in Southern Spain (see Farfan *et al*. 2009).

The consequences of displacement for breeding productivity and survival are crucial to whether or not there is likely to be a significant impact on population size. However, studies of the impact of wind farms on breeding birds are also largely inconclusive or suggest lower disturbance distances, though this apparent lack of effect may be due to the high site fidelity and long life-span of the breeding species studied. This might mean that the true impacts of disturbance on breeding birds will only be evident in the longer term, when new recruits replace existing breeding birds. Few studies have considered the possibility of displacement for short-lived passerines (such as larks), although Leddy *et al.* (1999) found increased densities of breeding grassland passerines with increased distance from wind turbines, and higher densities in the reference area than within 80m of the turbines. A review of minimum avoidance distances of 11 breeding passerines were found to be generally <100m from a wind turbine ranging from 14 – 93m (Hötker *et al.* 2006). A comparative study of nine wind farms in Scotland (Pearce-Higgens *et al.* 2009) found unequivocal evidence of displacement: Seven of the 12 species studied exhibited significantly lower frequencies of occurrence close to the turbines, after accounting for habitat variation, with equivocal evidence of turbine avoidance in a further two. No species were more likely to occur close to the turbines. Levels of turbine avoidance suggest breeding bird densities may be reduced within a 500m buffer of the turbines by 15– 53%, with Common Buzzard *Buteo buteo*, Hen Harrier *Circus cyaneus*, Golden Plover *Pluvialis apricaria*, Snipe *Gallinago gallinago*, Curlew *Numenius arquata* and Wheatear *Oenanthe oenanthe* most affected. In a follow-up study, monitoring data from wind farms located on unenclosed upland habitats in the United Kingdom were collated to test whether breeding densities of upland birds were reduced as a result of wind farm construction or during wind farm operation. Red Grouse *Lagopus lagopus scoticus*, Snipe *Gallinago gallinago* and Curlew *Numenius arquata* breeding densities all

[5] Personal communication by Wessel Rossouw, bird monitor based in Jeffreys Bay, from on personal observations in the Kouga municipal area.

declined on wind farms during construction. Red Grouse breeding densities recovered after construction, but Snipe and Curlew densities did not. Post-construction Curlew breeding densities on wind farms were also significantly lower than reference sites. Conversely, breeding densities of Skylark *Alauda arvensis* and Stonechat *Saxicola torquata* increased on wind farms during construction. Overall, there was little evidence for consistent post-construction population declines in any species, suggesting that wind farm construction can have greater impacts upon birds than wind farm operation (Pierce-Higgens *et al.* 2012).

It is inevitable that a measure of displacement will take place for all priority species during the construction phase, due to the disturbance factor associated with the construction activities. Species that are likely to be most impacted are ground-nesting species and some species of raptors. If any priority nests are discovered habitat during pre-construction monitoring, it will have to be buffered appropriately to prevent displacement of the breeding birds. Based on likely occurrence in the development area, priority species that could be temporary displaced, either partially or completely, due to disturbance during the construction phase are Greater Kestrel, Karoo Korhaan, Ludwig's Bustard, Kori Bustard, Northern Black Korhaan, Pale Chanting Goshawk, Spotted Eagle-Owl, Burchell's Courser, Double-banded Courser, Red Lark and Sclater's Lark.

6.1.3 Displacement due to habitat loss

The scale of permanent habitat loss resulting from the construction of a wind farm and associated infrastructure depends on the size of the project but, in general, it is likely to be small per turbine base. Typically, actual habitat loss amounts to 2–5% of the total development site (Fox *et al.* 2006 as cited by Drewitt & Langston 2006), though effects could be more widespread where developments interfere with hydrological patterns or flows on wetland or peatland sites (unpublished data). Some changes could also be beneficial. For example, habitat changes following the development of the Altamont Pass wind farm in California led to increased mammal prey availability for some species of raptor (for example through greater availability of burrows for Pocket Gophers *Thomomys bottae* around turbine bases), though this may also have increased collision risk (Thelander *et al.* 2003 as cited by Drewitt & Langston 2006).

However, the results of habitat transformation may be more subtle, whereas the actual footprint of the wind farm may be small in absolute terms, the effects of the habitat fragmentation brought about by the associated infrastructure (e.g. power lines and roads) may be more significant. Sometimes Great Bustard can be seen close to or under power lines, but a study done in Spain (Lane *et al.* 2001 as cited by Raab *et al.* 2009) indicates that the total observation of Great Bustard flocks was significantly higher further from power lines than at control points. Shaw (2013) found that Ludwig's Bustard generally avoid the immediate proximity of roads within a 500m buffer. Bidwell (2004) found that Blue Cranes select nesting sites away from roads. This means that power lines and roads also cause loss and fragmentation of the habitat used by the population in addition to the potential direct mortality. The physical encroachment increases the disturbance and barrier effects that contribute to the overall habitat fragmentation effect of the infrastructure (Raab *et al.* 2010). It has been shown that fragmentation of natural grassland in Mpumalanga (in that case by afforestation) has had a detrimental impact on the densities and diversity of grassland species (Alan *et al.* 1997).

Marques *et al.* (2021) reviewed 71 peer-reviewed studies on displacement and compiled: (1) information on the geographical areas, type of wind farm, study design and bird groups studied; and (2) the evidence of displacement effects on different bird groups. They found that most studies have been conducted in Europe and North America, particularly in agricultural areas. About half of the studies did not find any effects, for wind farms both on land and at sea, while many studies (40.6%) found displacement effects, and a small proportion (7.7%) detected attraction, i.e., an increased abundance of birds around the wind farms. Relevant to this project, they found that raptors were significantly affected.

The network of roads is likely to result in some habitat fragmentation, and it could have an effect on the density of several species, particularly larger terrestrial species such as Ludwig's Bustard, Kori Bustard, Karoo Korhaan, Northern Black Korhaan, raptors such as Pale Chanting Goshawk and Martial Eagle, and possibly also on smaller passerines such as the Red Listed Sclater's Lark or Red Lark. The extent of this potential impact will depend on the density of the proposed turbine lay-out and associated road infrastructure, although it is not expected that any priority species will be permanently displaced from the development area.

6.1.4 Electrocution on the 33kV medium voltage network

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.

While the intention is to place the 33kV reticulation network underground where possible, there are areas where the lines might have to run above ground, for technical reasons. In these instances, the poles could potentially pose an electrocution risk to raptors.

The majority of medium voltage cables will be buried, but there may be sections where overhead lines may be used due to technical reasons. Raptors and vultures could use these poles as perches. As far as the medium voltage powerlines are concerned, the potential electrocution risk to raptors could be eliminated by using a bird-friendly pole design. Species most at risk of electrocution on the medium voltage network are Greater Kestrel, Martial Eagle, Pale Chanting Goshawk, Spotted Eagle-Owl, Verreaux's Eagle, Lappet-faced Vulture and White-backed Vulture.

6.1.5 Collisions with the 33kV medium voltage network

While the intention is to place the 33kV reticulation network underground where possible, there are areas where the lines might have to run above ground, for technical reasons. In these instances, the line could potentially pose a collision risk to various species. In summary, the following priority species could be vulnerable to collisions with the 33kV medium voltage lines:

Likely priority species candidates for collision mortality on the proposed medium voltage internal overhead powerlines are Ludwig's Bustard, Kori Bustard, Karoo Korhaan, Northern Black Korhaan and to a lesser extent White-backed Vulture and Lappet-faced Vulture.

6.2 The identification and assessment of potential impacts

The potential impacts on avifauna identified in the course of the study are listed and assessed in the tables below. The impact criteria are explained in Appendix 6.

6.2.1 Construction Phase

- Displacement of priority species due to disturbance associated with the construction of the wind turbines and associated infrastructure.
- Displacement of priority species due to habitat transformation associated with the construction of the wind turbines and associated infrastructure.

Table 7: Rating of impacts: Construction Phase

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
CONSTRUCTION PHASE																				
Avifauna	Displacement due to disturbance associated with the construction of the wind turbines and associated infrastructure.	1	4	2	3	1	3	33	1	Medium	1. Construction activity should be restricted to the immediate footprint of the infrastructure as far as possible. 2. Access to the remainder of the area should be strictly controlled to prevent unnecessary disturbance of priority species. 3. Measures to control noise and dust should be applied according to current best practice in the industry.	1	4	2	3	1	2	22		Low
Avifauna	Displacement due to habitat transformation associated with the construction of the wind turbines and associated infrastructure.	1	3	2	2	3	2	22		Low	1. Removal of vegetation must be restricted to a minimum and must be rehabilitated to its former state where possible after construction.	1	2	2	2	3	2	20		Low

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
											2. Construction of new roads should only be considered if existing roads cannot be upgraded. 3. The recommendations of the ecological and botanical specialist studies must be strictly implemented, especially as far as limitation of the activity footprint is concerned.									

6.2.2 Operational Phase

- Mortality due to collisions with the wind turbines.
- Mortality due to electrocutions on the overhead sections of the internal 33kV cables.
- Mortality due to collisions with the overhead sections of the internal 33kV cables.

Table 8: Rating of impacts: Operational Phase

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
OPERATION PHASE																				
Avifauna	Mortality of priority species due to collisions with the wind turbines.	2	3	1	3	3	3	36	-	Medium	1. A procedure for the prompt removal of carcasses within the development area must be implemented to prevent vultures from being attracted to the area where they could be at risk of collision with the turbines. 2. Based on the results of the pre-construction monitoring, a 2.8kmturbine exclusion zone must be implemented around the vulture roost on the Aries – Aggeneys 1 400kV high voltage line. 3. All infilling for road construction should be compacted and all lose rock piles at the base or periphery of such infilling should be covered and packed down so as to eliminate all potential crevices and shelter for small mammals such as Rock Hyraxes (the primary source of food	2	2	1	2	3	2	20	-	Low

											for the Verreaux's Eagles). 4. Live-bird monitoring and carcass searches should be implemented in the operational phase, as per the most recent edition of the Best Practice Guidelines at the time (Jenkins *et al.* 2015) to assess collision rates. 5. Shutdown on demand (SDoD) must be implemented on all turbines for White-backed Vulture, Lappet-faced Vulture, Martial Eagle, Verreaux's Eagle and Lanner Falcon, coupled with a carcass removal programme, to limit the risk of collisions with the turbines. The SDoD must be implemented for the first two years of the operational phase to assess the dynamics of the situation whereafter a decision whether to continue must be taken, based on the frequency of shutdown events. 6. Placement of turbines in highly suitable Red Lark habitat to be avoided where possible. If avoidance is not possible, turbine									

											cut in-speeds should be increased to 3m/s (measured at ground level) during daylight hours when a rainfall event of 10mm or higher is recorded at the site, for turbines located in areas of highly suitable Red Lark habitat, as determined by the avifaunal specialist. The increased cut-in speeds to be maintained for a period of six weeks after the rainfall event.									
Avifauna	Mortality of priority species due to electrocutions on the overhead sections of the internal 33kV cables.	2	3	1	3	3	2	24		Medium	1. Underground cabling should be used as much as practically possible. 2. If the use of overhead lines is unavoidable due to technical reasons, the Avifaunal Specialist must be consulted timeously to ensure that a raptor friendly pole design is used, and that appropriate mitigation is implemented pro-actively for complicated pole structures e.g., insulation of live components to prevent electrocutions on terminal structures and pole transformers. 3. Bi-monthly inspections of the overhead	2	2	1	2	3	1	10		Low

											sections of the internal reticulation network must be conducted during the operational phase to look for carcasses, as per the most recent edition of the Best Practice Guidelines at the time (Jenkins *et al.* 2015).									
Avifauna	Mortality due to collisions with the overhead sections of the internal 33kV cables.	2	3	2	3	3	2	26		Medium	1. Bird flight diverters should be installed on all the overhead line sections for the full span length according to the applicable Eskom Engineering Instruction (Eskom Unique Identifier 240 – 93563150: The utilisation of Bird Flight Diverters on Eskom Overhead Lines). These devices must be installed as soon as the conductors are strung.	2	1	1	2	3	1	9		Low

6.2.3 Decommissioning Phase

- Displacement due to disturbance associated with the decommissioning (dismantling) of the wind turbines and associated infrastructure.

Table 9: Rating of impacts: Decommissioning Phase

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
DECOMMISSIONING PHASE																				
Avifauna	Displacement due to disturbance associated with the dismantling of the wind turbines and associated infrastructure.	1	4	1	2	1	2	18		Low	1. Dismantling activity should be restricted to the immediate footprint of the infrastructure as far as possible. 2. Access to the remainder of the area should be strictly controlled to prevent unnecessary disturbance of priority species. 3. Measures to control noise and dust should be applied according to current best practice in the industry.	1	3	1	2	1	2	16		Low

6.3 The identification of environmental sensitivities: Wind Energy facility

The following environmental sensitivities were identified from an avifaunal perspective for the proposed wind energy facility:

6.3.1 Very High Sensitivity Zones

The very high sensitivity zones are listed below. The construction of all infrastructure in these zones should be avoided completely:

- 500m buffer zone around water troughs to prevent the displacement of Sclater's Larks due to disturbance and habitat transformation, and to reduce the risk of turbine collisions for priority species using the water troughs for drinking and bathing. Alternatively, water troughs could be relocated to maintain a minimum distance of 500m from the closest turbine.
- Newly identified breeding areas for Sclater's Lark.

6.3.2 High Sensitivity Zones

The high sensitivity zones are listed below. The construction of turbines in these zones should be avoided to eliminate the risk of turbine collisions. Other infrastructure is permitted:

- 2.8km turbine exclusion zone around the vulture roost on the Aries – Aggeneys 400kV powerline outside of the Pofadder WEF 3 development area.

6.3.3 Medium Sensitivity Zones

The medium sensitivity zones are listed below. The construction of turbines in these zones should be restricted to a minimum to reduce the risk of turbine collisions. If restriction is not possible, additional mitigation measures will be required, e.g., increasing cut in speeds or shutdown on demand:

- Highly suitable Red Lark habitat: Placement of turbines in highly suitable Red Lark habitat to be avoided where possible. If avoidance is not possible, turbine cut in-speeds should be increased to 3m/s (measured at ground level) during daylight hours when a rainfall event of 10mm or higher is recorded at the site, for turbines located in areas of highly suitable Red Lark habitat, as determined by the avifaunal specialist. The increased cut-in speeds to be maintained for a period of six weeks after the rainfall event.
- The whole of the project site beyond the 2.8km High sensitivity zone is medium sensitivity, primarily due to the potential presence of White-backed Vultures and Lappet-faced Vultures during certain times of the year, but also due to the potential occurrence of other collision prone Red List species, namely Martial Eagle, Verreaux's Eagle, and Lanner Falcon. It is therefore recommended that shutdown on demand (SDoD) is implemented on all turbines for the above species, coupled with a carcass removal programme, to limit the risk of collisions with the turbines. SDoD has been successfully implemented at a wind farm in the Western Cape and has now been operative for a period of 21 months without any vulture mortalities recorded, despite high passage rates of vultures through the site. The reasons for the influx of the birds in vicinity of the Pofadder sites are not known, but it may be both seasonal and short

term, as is the case with other recorded powerline roosts of White-backed Vultures and Lappet-faced Vultures in the Northern Cape where the roosts are seasonal i.e. limited to the period outside the breeding season. It is therefore recommended that the SDoD is implemented for the first two years of the operational phase to assess the dynamics of the situation, whereafter a decision whether to continue will be taken, based on the frequency of shutdown events. This programme must consist of a suitably qualified, trained, dedicated and resourced team of observers present on site for all daylight hours throughout the year. It is absolutely essential that passionate, hardworking staff are hired for this role. This team must be stationed at observation points with full visible coverage of all turbine locations. The observers must detect incoming priority bird species, track their flights, judge when they enter a turbine proximity threshold, and alert the control room to shut down the relevant turbine until the risk has reduced. A full detailed method statement must be designed by an ornithologist prior to the commercial operations date (COD) and must be in place by the time that the wind farm start operating.

Figure 14 below is an avifaunal sensitivity map for the Pofadder WEF 3 development area.

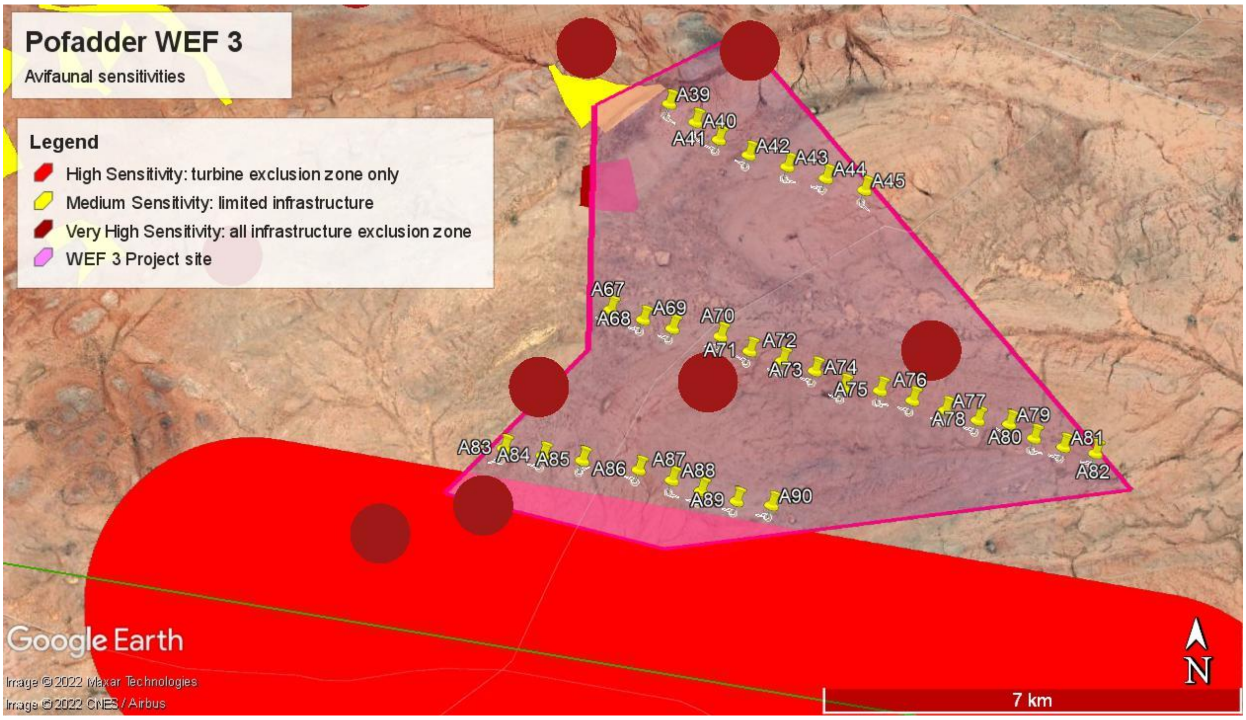


Figure 14: Avifaunal sensitivities within the Pofadder WEF 3 development area.

6.4 Cumulative impacts

"Cumulative Impact", in relation to an activity, means the past, current and reasonably foreseeable future impact of an activity, considered together with the impact of activities associated with that activity, that in itself may not be significant, but may become significant when added to existing and reasonably foreseeable impacts eventuating from similar or diverse activities. The assessment of cumulative effects therefore needs to consider all planned (both authorised and in process) renewable energy facilities (REFs) within a 35km radius of the proposed site.

Figure 15 shows the location of all planned renewable energy projects within a 35km radius around the proposed Pofadder WEF 3.

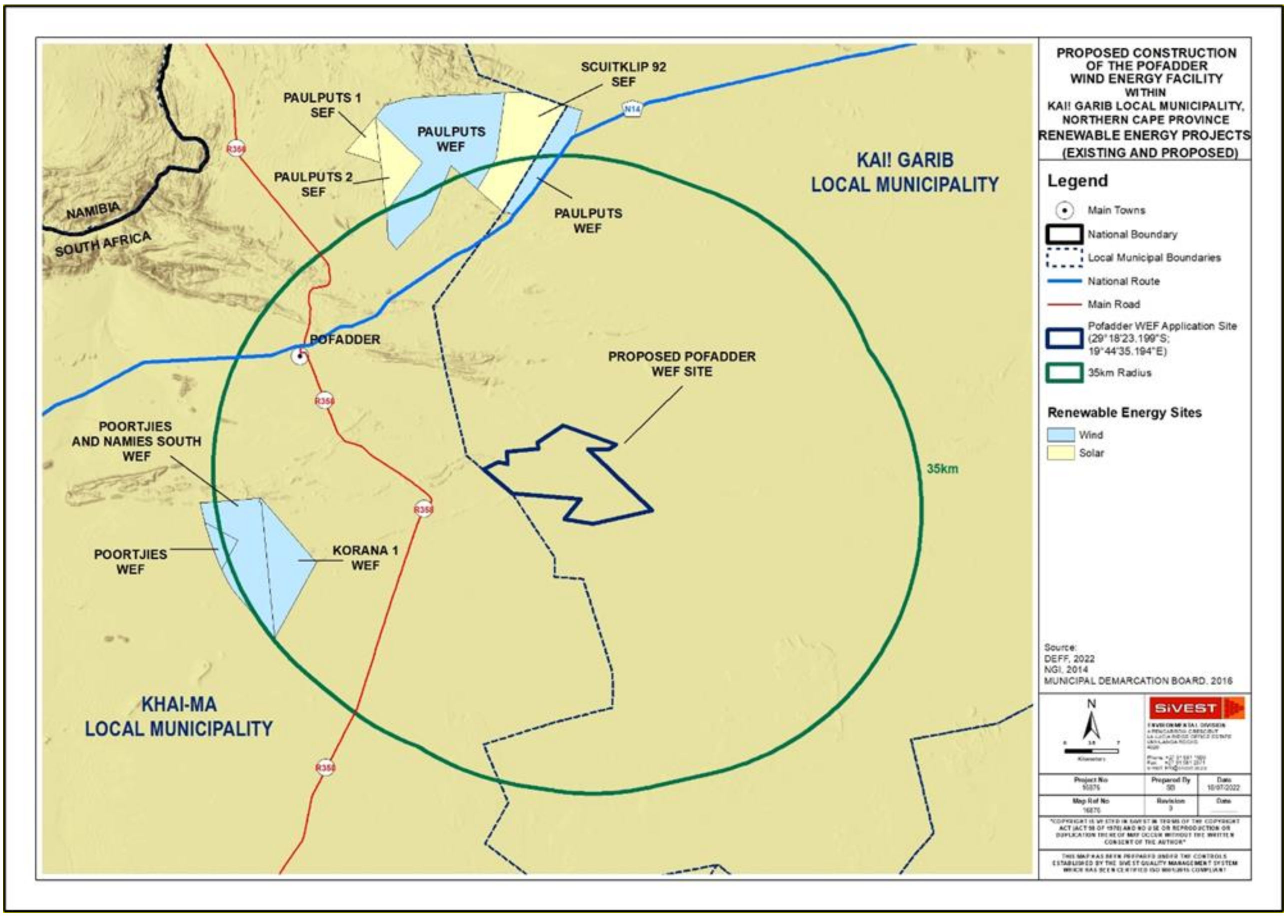


Figure 15: Proposed renewable energy projects within a 35km radius around the proposed Pofadder WEF 3.

Nine proposed renewable energy projects (six wind and three solar) were considered within a 35km radius of the proposed development:

Project Name	Number of turbines	Land parcel area
Paulputs Wind Energy Facility	75	Scuitklip & Lucasvlei Farms 11 813 ha
Korana Wind Energy Facility	70	Poortjies & Nama South Farms 17 393 ha
Khai-Ma Wind Energy facility	42	
Poortjies Wind Energy Facility	24	
Pofadder 1 Wind Energy Facility	28	Gannapoort, Lovedale & Sandgat Farms 22 992 ha
Pofadder 2 Wind Energy Facility	31	
Paulputs PV 1 Solar Energy Facility	n/a	Konkoonsies Farm 1 285 ha
Paulputs PV 2 Solar Energy Facility	n/a	Konkoonsies Farm 3 326 ha
Paulputs PV 3 Solar Energy Facility	n/a	Konkoonsies Farm 3 326 ha

In the case of the proposed Korana WEF, Khai-Ma WEF and Poortjies WEFs, the authors did the 12-months pre-construction monitoring and are therefore well acquainted with the sites and the proposed mitigation measures. No operational renewable energy facilities were identified. The projects were identified using the Renewable Energy EIA Application Database for SA from the Department of Fisheries, Forestry and Environment (DFFE), in conjunction with available information on the internet in the public domain. It should be noted that this list is based on information available at the time of writing this report and as such there may be other renewable energy projects proposed within the study area which may have gone undetected.

The maximum number of wind turbines which are currently proposed for the six other wind farms which are located within a 35km radius in similar habitat around the project site, is 285. None of these have been constructed to date, and each of the planned projects must still be subject to a competitive bidding process where only the most competitive projects will obtain a power purchase agreement required for the project to proceed to construction. It is therefore unlikely that a total of 285 turbines will actually be constructed, but due to the possibility that it could happen, the precautionary principle must be applied, and it must be assumed that it will be the case. The Pofadder WEF 2 will consist of up to 31 turbines, which brings the total number of potential turbines within the 35km radius to 316. The 31 turbines of Pofadder WEF 3 constitute approximnately 10% of the total number of planned turbines. As such, its contribution to the total number of turbines, and by implication the cumulative impact of all the planned turbines, is relatively minor. The density of planned turbines in the 35km radius equates to 1 turbine per 2 073 ha, which is low, therefore the cumulative impact of all the planned turbines within the 35km radius is also considered to be low at this stage, as far as potential mortality of avifauna due to turbine collisions are concerned.

The total affected land parcel area where turbines and solar panels are planned, including the Pofadder WEF 3, adds up to approximately 60 135 ha, which constitutes about 9% of the total area (approximately 655 131 ha) of similar habitat available to birds in the 35km radius around the project. The potential cumulative displacement impact due to habitat transformation, of the planned renewable energy projects at the time of writing, is therefore still relatively moderate within the area contained in the 35km radius. The affected land parcel area of the proposed Pofadder WEF 3 amounts to about 3% of the total habitat available in the 35km radius. The contribution of the Pofadder WEF 3 to the cumulative impact of all the renewable energy facilities is therefore low as far as potential displacement of priority species due to habitat transformation is concerned.

The cumulative impact of all the planned renewable energy facilities in this area is assessed to be **low** pre-mitigation and post-mitigation (see **Table 10** below).

Table 10: Rating of cumulative impacts: WEF

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
CUMULATIVE IMPACTS																				
Avifauna	1. Mortality due to collisions with the wind turbines 2. Displacement due to disturbance during construction and operation of the wind farm 3. Displacement due to habitat change and loss at the wind farm 4. Mortality due to electrocution on the electrical infrastructure	2	3	1	2	3	2	22	-	Low	All the mitigation measures listed in the various bird specialist studies compiled for the nine renewable energy facilities within a 35km radius around the project.	2	2	1	2	3	2	20	-	Low

6.5 Conditions for inclusion in the EMPr: WEF

Please see Appendix 8 for the monitoring requirements to be included in the EMPr for the WEF.

7. COMPARATIVE ASSESSMENT OF ALTERNATIVES

Site layout alternatives have not been comparatively assessed, but rather a single layout has been refined as additional information became available throughout the EIA process (e.g. specialist input, additional site surveys, and ongoing stakeholder engagement). The final layout has been amended based on specialist input and wind data and is being assessed during the EIR phase.

The development area presented in the draft EIA Scoping Report has been selected as a practicable option for the Pofadder WEF 3 considering technical preference and constraints, as well as No-Go layers informed by the relevant specialist during the initial screening studies.

7.1 No-Go Alternative

The no-go alternative will result in the current *status quo* being maintained as far as the avifauna is concerned. The low human population in the area is definitely advantageous to sensitive avifauna, especially Red Data species. The no-go option would eliminate any additional impact on the ecological integrity of the proposed development site as far as avifauna is concerned.

8. CONCLUSION AND SUMMARY

The proposed Pofadder WEF 3 will have several potential impacts on priority avifauna. These impacts are the following:

- Displacement of priority species due to disturbance linked to construction activities in the construction phase.
- Displacement due to habitat transformation in the construction phase.
- Collision mortality caused by the wind turbines in the operational phase.
- Electrocution on the 33kV MV overhead lines (if any) in the operational phase.
- Collisions with the 33kV MV overhead lines (if any) in the operational phase.
- Displacement of priority species due to disturbance linked to dismantling activities in the decommissioning phase.

8.1 Displacement of priority species due to disturbance linked to construction activities in the construction phase.

It is inevitable that a measure of displacement will take place for all priority species during the construction phase, due to the disturbance factor associated with the construction activities. This is likely to affect ground nesting species the most, as this could temporarily disrupt their reproductive cycle. Relative to this assessment, species which fall in this category are Ludwig's Bustard, Kori Bustard, Karoo Korhaan, Northern Black Korhaan, Burchell's Courser, Double-banded Courser, Spotted Eagle-Owl, Sclater's Lark and Red Lark. Some raptors might also be affected, e.g. Greater Kestrel which often breeds on crow nests which have been constructed on wind pumps. Some species might be able to recolonise the area after the completion of the construction phase, but for some species this might only be partially the case, resulting in lower densities than before once the WEF is operational, due to the disturbance factor of the operational turbines. The impact is rated as **medium** but could be mitigated to **low** levels.

8.2 Displacement due to habitat transformation in the construction phase.

The network of roads is likely to result in significant habitat fragmentation, and it could have an effect on the density of several species, particularly larger terrestrial species such as Ludwig's Bustard, Kori Bustard, Northern Black Korhaan and Karoo Korhaan. Red Lark and Sclater's Lark could also potentially be impacted. However, given the expected density of the proposed turbine layout and associated road infra-structure, it is not expected that any priority species will be permanently displaced from the development site. The building infrastructure and substations will all be situated in the same habitat, i.e., Karoo scrub. The habitat is not particularly sensitive, as far as avifauna is concerned, therefore the impact of the habitat transformation will be low given the extent of available habitat and the small size of the physical footprint. In summary, the following species are likely to be most affected by habitat transformation: Karoo Korhaan, Northern Black Korhaan, Kori Bustard, Ludwig's Bustard, Sclater's Lark, Red Lark and possibly raptors such as Pale Chanting Goshawk and Martial Eagle. The impact is rated as **low** both pre- and post-mitigation.

8.3 Collision mortality caused by the wind turbines in the operational phase.

The proposed WEF will pose a potential collision risk to several priority species which could occur regularly at the site. Species exposed to this risk are large terrestrial species i.e. Ludwig's Bustard, Kori Bustard, Karoo Korhaan and Northern Black Korhaan. Soaring priority species, i.e. species such as Martial Eagle, Pale Chanting Goshawk, Booted Eagle, Verreaux's Eagle, Greater Kestrel, White-backed Vulture and Lappet-faced Vulture. The high voltage powerline to the south of the project site is a focal point for vulture flight activity. No vultures were recorded during surveys in June and October 2021, all the flight activity was recorded during the third and fourth surveys in February and March 2022. Indications are that this could a regular pattern, based on experiences at other proposed wind farms in the Northern Cape. The passage rate over the combined WEF areas during the February 2022 survey was 0.3 birds/hour, or just under 4 birds per day. By March 2022, the passage rate had dropped to 0.03 birds/hour, or one bird every 2.5 days. This points to a regular occurrence of vultures, but only during a specific time period, namely the non-breeding season from January to May, with an expected peak in February and tapering off towards May when the breeding starts. The majority of the flight activity (14 out of 16 flights or 87.5%) was recorded within 2.8km of the powerline roost. Red Larks could also potentially be at risk during display flights. In summary, the following priority species could be at risk of collisions with the turbines: Greater Kestrel, Karoo Korhaan, Ludwig's Bustard, Kori Bustard, Martial Eagle, Northern Black Korhaan, Pale Chanting Goshawk, Spotted Eagle-Owl, Verreaux's Eagle, White-backed Vulture, Lappet-faced Vulture, Burchell’s Courser, Double-banded Courser, Red Lark and Sclater’s Lark. The impact is rated as **medium** pre-mitigation and **low** post-mitigation.

8.4 Electrocution on the 33kV MV overhead lines (if any) in the operational phase.

The majority of medium voltage cables will be buried, but there may be sections where overhead lines may be used due to technical reasons. Raptors and vultures could use these poles as perches. As far as the medium voltage powerlines are concerned, the potential electrocution risk to raptors could be eliminated by using a bird-friendly pole design. Species most at risk of electrocution on the medium voltage network are Greater Kestrel, Martial Eagle, Pale Chanting Goshawk, Spotted Eagle-Owl, Verreaux's Eagle, Lappet-faced Vulture and White-backed Vulture. The impact is rated as **medium** pre-mitigation and **low** post-mitigation.

8.5 Collisions with the 33kV MV overhead lines (if any) in the operational phase.

While the intention is to place the 33kV reticulation network underground where possible, there are areas where the lines might have to run above ground, for technical reasons. In these instances, the line could potentially pose a collision risk to various species, particularly large terrestrial species including Red Data species such as Ludwig’s Bustard, Blue Crane, Karoo Korhaan and Secretarybird and various waterbirds when the dams are full, and the drainage lines contain water. The impact is rated as **medium** pre-mitigation and **low** post-mitigation.

8.6 Displacement of priority species due to disturbance linked to dismantling activities in the decommissioning phase.

The impact is likely to be similar to the construction phase.

8.7 Cumulative impacts

Nine proposed renewable energy projects (six wind and three solar) were considered within a 35km radius of the proposed development. The maximum number of wind turbines which are currently proposed for the six other wind farms which are located within a 35km radius in similar habitat around the project site, is 285. None of these have been constructed to date, and each of the planned projects must still be subject to a competitive bidding process where only the most competitive projects will obtain a power purchase agreement required for the project to proceed to construction. It is therefore unlikely that a total of 285 turbines will actually be constructed, but due to the possibility that it could happen, the precautionary principle must be applied, and it must be assumed that it will be the case. The Pofadder WEF 3 will consist of up to 31 turbines, which brings the total number of potential turbines within the 35km radius to 316. The 31 turbines of Pofadder WEF 3 constitute approximately 10% of the total number of planned turbines. As such, its contribution to the total number of turbines, and by implication the cumulative impact of all the planned turbines, is relatively minor. The density of planned turbines in the 35km radius equates to 1 turbine per 2 073 ha, which is low, therefore the cumulative impact of all the planned turbines within the 35km radius is also considered to be low at this stage, as far as potential mortality of avifauna due to turbine collisions are concerned.

The total affected land parcel area where turbines and solar panels are planned, including the Pofadder WEF 3, adds up to approximately 60 135 ha, which constitutes about 9% of the total area (approximately 655 131 ha) of similar habitat available to birds in the 35km radius around the project. The potential cumulative displacement impact due to habitat transformation, of the planned renewable energy projects at the time of writing, is therefore still relatively moderate within the area contained in the 35km radius. The affected land parcel area of the proposed Pofadder WEF 3 amounts to about 3% of the total habitat available in the 35km radius. The contribution of the Pofadder WEF 3 to the cumulative impact of all the renewable energy facilities is therefore low as far as potential displacement of priority species due to habitat transformation is concerned.

The cumulative impact of all the planned renewable energy facilities in this area is assessed to be **low** pre-mitigation and post-mitigation.

Table 11: Overall Impact Significance for the WEF (Pre- and Post-Mitigation)

Nature of impact and Phase	Overall Impact Significance (Pre - Mitigation)	Proposed mitigation	Overall Impact Significance (Post - Mitigation)
Construction: Displacement due to disturbance	Medium	• Very high sensitivity: All surface water (water troughs) should be buffered by 500m (all infrastructure) to prevent displacement of Sclater's Lark breeding population due to disturbance. Alternatively, water troughs could be relocated to maintain a minimum distance of 500m from the closest turbine. • Additional Sclater's Lark breeding areas as identified during the pre-construction monitoring must be designated an all-infrastructure No-Go zone. • Construction activity should be restricted to the immediate footprint of the infrastructure as far as possible. • 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. • Placement of turbines in highly suitable Red Lark habitat to be avoided where possible.	Low
Construction: Displacement due to habitat transformation	Low	• Very high sensitivity: All surface water (water troughs) should be buffered by 500m (all infrastructure) to prevent displacement of Sclater's Lark breeding population due to habitat transformation. Alternatively, water troughs could be relocated to maintain a minimum distance of 500m from the closest turbine. • Additional Sclater's Lark breeding areas as identified during the pre-construction monitoring must be designated an all-infrastructure No-Go zone. • 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 biodiversity specialist, including rehabilitation, must be strictly implemented. • Placement of turbines in highly suitable Red Lark habitat to be avoided where possible	Low
Operational: Collisions with the turbines	Medium	• A procedure for the prompt location and removal of carcasses within the development area must be implemented to prevent vultures from being attracted to the area where they could be at risk of collision with the turbines. • Based on the results of the pre-construction monitoring, a 2.8km turbine exclusion zone must be implemented around the vulture roost on the	Low

Nature of impact and Phase	Overall Impact Significance (Pre - Mitigation)	Proposed mitigation	Overall Impact Significance (Post - Mitigation)
		Aries – Aggeneys 1 400kV high voltage line outside of the Pofadder WEF development area. • All infilling for road construction should be compacted and all lose rock piles at the base or periphery of such infilling should be covered and packed down so as to eliminate all potential crevices and shelter for small mammals such as Rock Hyraxes (the primary source of food for the Verreaux's Eagles). • Live-bird monitoring and carcass searches should be implemented in the operational phase, as per the most recent edition of the Best Practice Guidelines at the time (Jenkins *et al.* 2015) to assess collision rates. • If an Endangered or Critically Endangered species mortality is recorded during the first year of operational monitoring, additional mitigation measures must be implemented which could include shut down on demand, or other proven mitigation measures as recommended by the avifaunal specialist. • Placement of turbines in highly suitable Red Lark habitat to be avoided where possible. If avoidance is not possible, turbine cut in-speeds should be increased to 3m/s (measured at ground level) during daylight hours when a rainfall event of 10mm or higher is recorded at the site, for turbines located in areas of highly suitable Red Lark habitat, as determined by the avifaunal specialist. The increased cut-in speeds to be maintained for a period of six weeks after the rainfall event. • The whole of the project site beyond the 2.8km High sensitivity zone is medium sensitivity, primarily due to the potential presence of White-backed Vultures and Lappet-faced Vultures during certain times of the year, but also due to the potential occurrence of other collision prone Red List species, namely Martial Eagle, Verreaux's Eagle, and Lanner Falcon. It is therefore recommended that shutdown on demand (SDoD) is implemented on all turbines for the above species, coupled with a carcass removal programme, to limit the risk of collisions with the turbines. SDoD has been successfully implemented at a wind farm in the Western Cape and has now been operative for a period of 21 months without any vulture mortalities recorded, despite high passage rates of vultures through the site. The reasons for the influx of the birds in vicinity of the Pofadder sites are not known, but it may be both seasonal and short term, as is the case with other recorded powerline roosts of White-backed Vultures and Lappet-faced Vultures in the Northern Cape where the roosts are seasonal i.e. limited to the period outside the breeding season. It is therefore recommended that the SDoD is implemented for the first two years of the operational phase to assess the dynamics of	

Nature of impact and Phase	Overall Impact Significance (Pre - Mitigation)	Proposed mitigation	Overall Impact Significance (Post - Mitigation)
		the situation, whereafter a decision whether to continue will be taken, based on the frequency of shutdown events. This programme must consist of a suitably qualified, trained, dedicated and resourced team of observers present on site for all daylight hours throughout the year. It is absolutely essential that passionate, hardworking staff are hired for this role. This team must be stationed at observation points with full visible coverage of all turbine locations. The observers must detect incoming priority bird species, track their flights, judge when they enter a turbine proximity threshold, and alert the control room to shut down the relevant turbine until the risk has reduced. A full detailed method statement must be designed by an ornithologist prior to the commercial operations date (COD) and must be in place by the time that the wind farm start operating.	
Operational: Mortality of priority species due to electrocution on the medium voltage internal reticulation network	Medium	• A raptor-friendly pole design must be used, and the pole design must be approved by the avifaunal specialist. • No avifaunal exclusion zones were determined necessary for the mitigation of this anticipated impact.	Low
Operational: Collisions with the 33kV MV network	Medium	• All medium voltage lines must be marked with Eskom approved Bird Flight Diverters according to the Eskom standard.	Low
Decommissioning: Displacement due to disturbance	Medium	• Decommissioning activity should be restricted to the immediate footprint of the infrastructure as far as possible. • 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.	Low
Cumulative impacts: 5. Mortality due to collisions with the wind turbines 6. Displacement due to disturbance during construction and operation of the wind farm 7. Displacement due to habitat change and loss at the wind farm	Low	• All the mitigation measures listed in the various bird specialist studies compiled for the nine renewable energy facilities within a 35km radius around the project.	Low

Nature of impact and Phase	Overall Impact Significance (Pre - Mitigation)	Proposed mitigation	Overall Impact Significance (Post - Mitigation)
8. Mortality due to electrocution on the electrical infrastructure			

8.8 Conclusion and Impact Statement

Based on the pre-construction monitoring, it is envisaged that the proposed 248MW Pofadder WEF 3 could potentially have a range of pre-mitigation negative impacts on priority avifauna ranging from low to medium, all of which could be reduced to acceptable levels with appropriate mitigation. No fatal flaws were discovered during the investigations.

9. POST CONSTRUCTION PROGRAMME

The new procedures and minimum criteria for reporting on identified environmental themes in terms of Sections 24(5)(a) and (h) and 44 of NEMA came into force in March 2020. According to these regulations, a detailed post-construction monitoring programme must be included as part of the bird specialist study. See Appendix 9 for a proposed programme.

10. REFERENCES

- Barrios, L. & Rodríguez, A. 2004. Behavioural and environmental correlates of soaring-bird mortality at on-shore wind turbines. Journal of Applied Ecology. Volume 41. Issue 1. pp72-81.
- Carette, M., Zapata-Sanchez, J.A., Benitez, R.J., Lobon, M. & Donazar, J.A. (In press) Large scale risk-assessment of wind farms on population viability of a globally endangered long-lived raptor. Biol. Cons. (2009), doi: 10.1016/j.biocon.2009.07.027.
- De Lucas, M., Janss, G.F.E., Whitfield, D.P. & Ferrer, M. 2008. Collision fatality of raptors in wind farms does not depend on raptor abundance. Journal of Applied Ecology 45, 1695 – 1703.
- Drewitt, A.L. & Langston, R.H.W. 2006. Assessing the impacts of wind farms on birds. Ibis 148, 29-42.
- Endangered Wildlife Trust. 2014. Central incident register for powerline incidents. Unpublished data.
- Erickson, W. P., G. D. Johnson, and D. P. Young, Jr. 2005. A summary and comparison of bird mortality form anthropogenic causes with an emphasis on collisions. U.S. Department of Agriculture Forest Service General Technical Report PSW-GTR-191, Albany, California, USA.
- Erickson, W. P., G. D. Johnson, M. D. Strickland, D. P. Young, Jr., K. J. Sernka, and R. E. Good. 2001. Avian collisions with wind turbines: a summary of existing studies and comparisons to other sources of avian collision mortality in the United States. National Wind Coordinating Committee, c/o RESOLVE, Washington, D.C., USA.
- Everaert, J., Devos, K. & Kuijken, E. 2001. Windturbines en vogels in Vlaanderen: Voorlopige Onderzoeksresultaten En Buitenlandse Bevindingen [Wind Turbines and Birds in Flanders (Belgium): Preliminary Study Results in a European Context]. Instituut Voor Natuurbehoud. Report R.2002.03. Brussels B.76pp. Brussels, Belgium: Institut voor Natuurbehoud.
- EWEA 2003. Wind Energy – The Facts. Volume 4: Environment. The European Wind Energy Association (EWEA), and the European Commission's Directorate General for Transport and Energy (DG TREN). pp182-184. (www.ewea.org/documents/)

- Farfán M.A., Vargas J.M., Duarte J. and Real R. (2009). What is the impact of wind farms on birds? A case study in southern Spain. Biodiversity Conservation. 18:3743-3758.
- Ferrer, M., De Lucas, M., Janss, G.F.E., Casado, E., Munoz, A.R., Bechard, M.J., Calabuig,C.P. 2012. Weak relationship between risk assessment studies and recorded mortality on wind farms. Journal of Applied Ecology. 49. p38-46.
- Fox, A.D., Desholm, M., Kahlert, J., Christensen, T.K. & Krag Petersen, I.B. 2006. Information needs to support environmental impact assessments of the effects of European marine offshore wind farms on birds. In Wind, Fire and Water: Renewable Energy and Birds. Ibis 148 (Suppl. 1): 129–144.
- Harrison, J.A., Allan, D.G., Underhill, L.G., Herremans, M., Tree, A.J., Parker, V & Brown, C.J. (eds). 1997. The atlas of southern African birds. Vol 1 & 2. BirdLife South Africa, Johannesburg.
- Hockey, P.A.R., Dean, W.R.J, and Ryan, P.G. 2005. Robert's Birds of Southern Africa, seventh edition. Trustees of the John Voelcker Bird Book Fund, Cape Town.
- Hötker, H., Thomsen, K.-M. & H. Jeromin. 2006. Impacts on biodiversity of exploitation of renewable energy sources: the example of birds and bats - facts, gaps in knowledge, demands for further research, and ornithological guidelines for the development of renewable energy exploitation. Michael-Otto-Institut im NABU, Bergenhusen.
- Howell, J.A. & DiDonato, J.E. 1991. Assessment of avian use and mortality related to wind turbine operations: Altamont Pass, Alameda and Contra Costa Counties, California, September 1988 Through August 1989. Final report prepared for Kenentech Windpower.
- Hunt, W.G. 2001. Continuing studies of golden eagles at Altamont Pass. Proceedings of the National Avian-Wind Power Planning Meeting IV.
- Hunt, W.G., Jackman, R.E., Hunt, T.L., Driscoll, D.E. & Culp, L. 1999. A Population Study of Golden Eagles in the Altamont Pass Wind Resource Area: Population Trend Analysis 1994–97. Report to National Renewable Energy Laboratory, Subcontract XAT-6-16459–01. Santa Cruz: University of California.
- Jenkins A R; Van Rooyen C S; Smallie J J; Anderson M D & Smit H A. 2015. Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa. Endangered Wildlife Trust and Birdlife South Africa.
- Johnson, G.D., Strickland, M.D., Erickson, W.P. & Young, D.P. 2007. Use of data to develop mitigation measures for wind power impact on birds. In: De Lucas, M., Janss, G.F.E., & Ferrer, M eds: Birds and Wind Farms Risk Assessment and Mitigation. Quercus, Madrid.
- Johnson, G.D., Strickland, M.D., Erickson, W.P., Sheperd, M.F. & Sheperd D. A. 2000. Avian Monitoring Studies at the Buffalo Ridge, Minnesota Wind Resource Area: Results of a four-year study. Technical Report prepared for Northern States Power Company, Minneapolis, MN 262pp.
- Keskin, G., Durmus, S., Őzelmas, Ű and Karakaya, M. 2019. Effects of wing loading on take-off and turning performance which is a decisive factor in the selection of resting location of the Great Bustard (*Otis tarda*). Biological Diversity and Conservation 12(3):28-32. DOI: 10.5505/biodicon.2019.69875
- Langgemach, T. 2008. Memorandum of Understanding for the Middle-European population of the Great Bustard, German National Report 2008. Landesumweltamt Brandenburg (Brandenburg State Office for Environment).
- Langston, R.H.W. & Pullan, J.D. 2003. Wind farms and birds: an analysis of the effects of wind farms on birds, and guidance on environmental assessment criteria and site selection issues.

Report written by Birdlife International on behalf of the Bern Convention. Council Europe Report T-PVS/Inf

- Larsen, J.K. & Madsen, J. 2000. Effects of wind turbines and other physical elements on field utilization by pink-footed geese (*Anser brachyrhynchus*): A landscape perspective. Landscape Ecol. 15: 755–764.
- Leddy, K.L., Higgins, K.F., Naugle, D.E., 1999. Effects of wind turbines on upland nesting birds in conservation reserve program grasslands. Wilson Bulletin 11, 100–104.
- Madders, M & Whitfield, D.P. Upland raptors and the assessment of wind farm impacts. 2006. Ibis. Volume 148, Issue Supplement s1. pp 43-56.
- Marnewick M.S., Retief, E.F., Theron, N.T., Wright, D.R., & Anderson, T.A. 2015. Important Bird and Biodiversity Areas of South Africa. Johannesburg: BirdLife South Africa.
- Marques, A.T.; Batalha, H.; Bernardino, J. Bird Displacement by Wind Turbines: Assessing Current Knowledge and Recommendations for Future Studies. Birds 2021, 2, 460–475. https://doi.org/10.3390/birds2040034
- Mucina. L. & Rutherford, M.C. (Eds) 2006. The vegetation of South Africa, Lesotho and Swaziland. *Strelitzia* 19. South African National Biodiversity Institute, Pretoria.
- Orloff, S. & Flannery, A. 1992. Wind turbine effects on avian activity, habitat use and mortality in Altamont Pass and Solano County Wind Resource Areas, 1989–91. California. Energy Commission.
- Pearce-Higgins J.W, Stephen L, Langston R.H.W, Bainbridge, I.P.& R Bullman. The distribution of breeding birds around upland wind farms. Journal of Applied Ecology 2009, 46, 1323–1331
- Pearce-Higgins, J.W., Stephen, L., Douse, A., & Langston, R.H.W. Greater impacts on bird populations during construction than subsequent operation: result of multi-site and multi-species analysis. Journal of Applied Ecology 2012, 49, 396-394.
- Pedersen, M.B. & Poulsen, E. 1991. Impact of a 90 m/2MW wind turbine on birds. Avian responses to the implementation of the Tjaereborg wind turbine at the Danish Wadden Sea. Danske Vildtunderogelser Haefte 47. Rønde, Denmark: Danmarks Miljøundersøgelser.
- Perold V, Ralston-Paton S & Ryan P (2020): On a collision course? The large diversity of birds killed by wind turbines in South Africa, Ostrich, DOI: 10.2989/00306525.2020.1770889
- Raab, R., Julius, E., Spakovszky, P. & Nagy, S. 2009. Guidelines for best practice on mitigating impacts of infrastructure development and afforestation on the Great Bustard. Prepared for the Memorandum of Understanding on the conservation and management of the Middle-European population of the Great Bustard under the Convention on Migratory species (CMS). Birdlife International. European Dvision.
- Ralston-Patton, M & Camagu, N. 2019. Birds & Renewable Energy Update for 2019. Birds and Renewable Energy Forum, 10 October 2019. BirdLife South Africa.
- Retief E.F., Diamond M, Anderson M.D., Smit, H.A., Jenkins, A & M. Brooks. 2012. Avian Wind Farm Sensitivity Map. Birdlife South Africa http://www.birdlife.org.za/conservation/birds-and-wind-energy/windmap.
- Scottish Natural Heritage (2005, revised 2010) Survey methods for use in assessing the impacts of onshore windfarms on bird communities. SNH Guidance. SNH, Battleby.
- Scottish Natural Heritage. 2010. Use of Avoidance Rates in the SNH Wind Farm Collision Risk Model. SNH Avoidance Rate Information & Guidance Note.

- Smallwood, K. S. (2013), Comparing bird and bat fatality-rate estimates among North American wind-energy projects. Wildlife Society Bulletin, 37: 19–33. doi: 10.1002/wsb.260.
- South African Bird Atlas Project 2. http://sabap2.adu.org.za.
- Stewart, G.B., Coles, C.F. & Pullin, A.S. 2004. Effects of Wind Turbines on Bird Abundance. Systematic Review no. 4. Birmingham, UK: Centre for Evidence-based Conservation.
- Stewart, G.B., Pullin, A.S. & Coles, C.F. 2007. Poor evidence-base for assessment of windfarm impacts on birds. Environmental Conservation. 34, 1-11.
- Taylor, M.R., Peacock F, & Wanless R.W (eds.) 2015. The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland. BirdLife South Africa, Johannesburg, South Africa.
- Thelander, C.G., Smallwood, K.S. & Rugge, L. 2003. Bird Risk Behaviours and Fatalities at the Altamont Pass Wind Resource Area. Report to the National Renewable Energy Laboratory, Colorado.
- Ugoretz, S. 2001. Avian mortalities at tall structures. In: Proceedings of the National Avian Wind Power Planning Meeting IV pp. 165-166. National Wind Coordinating Committee. Washington DC.
- Van Rooyen, C.S. 2004. The Management of Wildlife Interactions with overhead lines. In: The fundamentals and practice of Overhead Line Maintenance (132kV and above), pp217-245. Eskom Technology, Services International, Johannesburg.

APPENDIX 1: TERMS OF REFERENCE

1. SPECIALIST REPORT REQUIREMENTS

1.1 Site Sensitivity Verification and Reporting

The requirements for Specialist Studies being undertaken in support of applications for Environmental Authorisation are specified in **Appendix 6** of the 2014 NEMA EIA Regulations (as amended), as well as the Assessment Protocols that were published on 20 March 2020, in Government Gazette 43110, GN 320. These protocols stipulate the 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 the NEMA, when applying for EA.

The Assessment Protocols as per GN320 are as follows:

- **PART A:** This relates to the Site Sensitivity Verification (SSV) and Reporting requirements where a Specialist Assessment is required but no specific Assessment Protocol has been prescribed. In this instance, specialist assessment must comply with **Appendix 6** of the 2014 NEMA EIA Regulations (as amended). However, the current use of the land and the environmental sensitivity of the site under consideration as identified by the DFFE Screening Tool must be verified and confirmed and an SSV report must be compiled and included as an appendix to the Specialist Assessment. Where there are no sensitivity layers on the Screening Tool for a particular Specialist Assessment, then this must be stated in the actual Specialist Assessment and in the accompanying SSV report.
- **PART B:** This relates to the Site Sensitivity Verification (SSV) and Reporting requirements where a Specialist Assessment is required and a specific Assessment Protocol has been prescribed. The following Assessment Protocols are relevant to the proposed project:
    - Agriculture
    - Terrestrial Biodiversity
    - Aquatic Biodiversity
    - Avifauna
    - Civil Aviation
    - Defence
    - Noise Assessment
    - Terrestrial Plant Species
    - Terrestrial Animal Species

1.2 Specialist Assessment Reports / Compliance Statements

Specialists are requested to provide ***one (1)*** scoping phase report and / or compliance statement that provides an assessment of the proposed Pofadder WEF 3 ***and*** the associated grid connection infrastructure (132kV overhead power line on-site switching / collector substation). The report should however include separate assessment and impact rating chapters/sections for the WEF and the grid connection proposals respectively.

During the EIA phase, specialists will be required to update the scoping phase specialist report to provide a review of their findings in accordance with revised site layouts and to address any comments or concerns arising from the public participation process.

The specialist assessment reports and / or compliance statements should include the following sections:

1.2.1 Project Description

The specialist report must include the project description as provided above.

1.2.2 Terms of Reference

The specialist report must include an explanation of the terms of reference (TOR) applicable to the specialist study. Where relevant, a table must be provided at the beginning of the specialist report, listing the requirements for specialist reports in accordance with Appendix 6 of the EIA Regulations, 2014 (as amended) and cross referencing these requirements with the relevant sections in the report. An MS Word version of this table will be provided by Pofadder Wind Energy Facility 1 (Pty) Ltd.

1.2.3 Legal Requirements and Guidelines

The specialist report must include a thorough overview of all applicable best practice guidelines, relevant legislation, prescribed Assessment Protocols and authority requirements.

1.2.4 Methodology

The report must include a description of the methodology applied in carrying out the specialist assessment.

1.2.5 Specialist Findings / Identification of Impacts

The report must present the findings of the specialist studies and explain the implications of these findings for the proposed development (e.g. permits, licenses etc.). This section of the report should also identify any sensitive and/or ‘no-go’ areas on the development site or within the power line assessment corridors. These areas must be mapped clearly with a supporting explanation provided.

This section of the report should also specify if any further assessment will be required.

1.2.6 Environmental Impact Assessment

The impacts (both direct and indirect) of the proposed WEF and the proposed grid connection infrastructure (during the Construction, Operation and Decommissioning phases) are to be assessed and rated *separately* according to the methodology developed by Pofadder Wind Energy Facility 1 (Pty) Ltd. Specialists will be required to make use of the impact rating matrix provided (in Excel format) for this purpose, and *separate tables* must be provided for the WEF and for the grid connection infrastructure respectively. **Please note that the significance of Cumulative Impacts should also be rated in this section.** Both the methodology and the rating matrix will be provided by Pofadder Wind Energy Facility 1 (Pty) Ltd.

Please be advised that this section must include mitigation measures aimed at minimising the impact of the proposed development.

1.2.7 Input to The Environmental Management Programme (EMPr)

The report must include a description of the key monitoring recommendations for each applicable mitigation measure identified for each phase of the project for inclusion in the Environmental Management Programme (EMPr) or Environmental Authorisation (EA).

Please make use of the Impact Rating Table (in Excel format) for each of the phases i.e. Design, Construction, Operation and Decommissioning.

1.2.8 Cumulative Impact Assessment

Cumulative impact assessments must be undertaken for the proposed WEF and associated grid connection infrastructure to determine the cumulative impact that will materialise if other Renewable Energy Facilities (REFs) and large scale industrial developments are constructed within 35kms of the proposed development.

The cumulative impact assessment must contain the following:

- A cumulative environmental impact statement noting whether the overall impact is acceptable; and
- A review of the specialist reports undertaken for other REFs and an indication of how the recommendations, mitigation measures and conclusion of the studies have been considered.

In order to assist the specialists in this regard, Pofadder Wind Energy Facility 1 (Pty) Ltd will provide the following documentation/data:

- A summary table listing all REFs identified within 35kms of the proposed WEF;
- A map showing the location of the identified REFs; and
- KML files.

It should be noted that it is the specialist's responsibility to source the relevant EIA / BA reports that are available in the public domain. Pofadder Wind Energy Facility 1 (Pty) Ltd will assist, where possible.

1.2.9 No Go Alternative

Consideration must be given to the “no-go” option in the EIA process. The “no-go” option assumes that the site remains in its current state, i.e. there is no construction of a WEF and associated infrastructure in the proposed project area and the status quo would be preserved.

1.2.10 Comparative Assessment Of Alternatives

As mentioned, alternatives for the Substation location, construction / laydown area and power line route alignment have been identified. These alternatives are being considered as part of the EIA / BA processes and as such specialists are required to undertake a comparative assessment of the alternatives mentioned above as per the latest table provided by Pofadder Wind Energy Facility 1 (Pty) Ltd.

1.2.11 Conclusion / Impact Statement

The conclusion section of the specialist report must include an Impact Statement, indicating whether any fatal flaws have been identified and ultimately whether the proposed development can be authorised or not (i.e. whether EA should be granted / issued or not).

1.2.12 Executive Summary

Specialists must provide an Executive Summary summarising the findings of their report to allow for easy inclusion in the EIA / BA reports.

1.2.13 Specialist Declaration of Independence

A copy of the Specialist Declaration of Interest (DoI) form, containing original signatures, must be appended to all Draft and Final Reports. This form will be provided to the specialists. *Please note that the undertaking / affirmation under oath section of the report must be signed by a Commissioner* of Oaths.

APPENDIX 2: SPECIALIST CV

Curriculum vitae: Chris van Rooyen

Profession/Specialisation	:	Avifaunal Specialist
Highest Qualification	:	BA LLB
Nationality	:	South African
Years of experience	:	22 years

Key Experience

Chris van Rooyen has twenty-two years' experience in the assessment of avifaunal interactions with industrial infrastructure. He was employed by the Endangered Wildlife Trust as head of the Eskom-EWT Strategic Partnership from 1996 to 2007, which has received international acclaim as a model of co-operative management between industry and natural resource conservation. He is an acknowledged global expert in this field and has consulted in South Africa, Namibia, Botswana, Lesotho, New Zealand, Texas, New Mexico and Florida. He also has extensive project management experience and he has received several management awards from Eskom for his work in the Eskom-EWT Strategic Partnership. He is the author and/or co-author of 17 conference papers, co-author of two book chapters, several research reports and the current best practice guidelines for avifaunal monitoring at wind farm sites. He has completed around 130 power line assessments; and has to date been employed as specialist avifaunal consultant on more than 50 renewable energy generation projects. He has also conducted numerous risk assessments on existing power lines infrastructure. He also works outside the electricity industry and he has done a wide range of bird impact assessment studies associated with various residential and industrial developments. He serves on the Birds and Wind Energy Specialist Group which was formed in 2011 to serve as a liaison body between the ornithological community and the wind industry.

Key Project Experience

Bird Impact Assessment Studies and avifaunal monitoring for wind-powered generation facilities:

1. Eskom Klipheuwel Experimental Wind Power Facility, Western Cape
2. Mainstream Wind Facility Jeffreys Bay, Eastern Cape (EIA and monitoring)
3. Biotherm, Swellendam, (Excelsior), Western Cape (EIA and monitoring)
4. Biotherm, Napier, (Matjieskloof), Western Cape (pre-feasibility)
5. Windcurrent SA, Jeffreys Bay, Eastern Cape (2 sites) (EIA and monitoring)
6. Caledon Wind, Caledon, Western Cape (EIA)
7. Innowind (4 sites), Western Cape (EIA)
8. Renewable Energy Systems (RES) Oyster Bay, Eastern Cape (EIA and monitoring)
9. Oelsner Group (Kerriefontein), Western Cape (EIA)
10. Oelsner Group (Langefontein), Western Cape (EIA)
11. InCa Energy, Vredendal Wind Energy Facility Western Cape (EIA)
12. Mainstream Loeriesfontein Wind Energy Facility (EIA and monitoring)
13. Mainstream Noupoort Wind Energy Facility (EIA and monitoring)
14. Biotherm Port Nolloth Wind Energy Facility (Monitoring)
15. Biotherm Laingsburg Wind Energy Facility (EIA and monitoring)
16. Langhoogte Wind Energy Facility (EIA)
17. Vleesbaai Wind Energy Facility (EIA and monitoring)
18. St. Helena Bay Wind Energy Facility (EIA and monitoring)
19. Electrawind, St Helena Bay Wind Energy Facility (EIA and monitoring)
20. Electrawind, Vredendal Wind Energy Facility (EIA)
21. SAGIT, Langhoogte and Wolseley Wind Energy facilities

22. Renosterberg Wind Energy Project – 12-month preconstruction avifaunal monitoring project
23. De Aar – North (Mulilo) Wind Energy Project – 12-month preconstruction avifaunal monitoring project
24. De Aar – South (Mulilo) Wind Energy Project – 12-month bird monitoring
25. Namies – Aggenys Wind Energy Project – 12-month bird monitoring
26. Pofadder - Wind Energy Project – 12-month bird monitoring
27. Dwarsrug Loeriesfontein - Wind Energy Project – 12-month bird monitoring
28. Waaihoek – Utrecht Wind Energy Project – 12-month bird monitoring
29. Amathole – Butterworth Utrecht Wind Energy Project – 12-month bird monitoring & EIA specialist
30. Phezukomoya and San Kraal Wind Energy Projects 12-month bird monitoring & EIA specialist study (Innowind)
31. Beaufort West Wind Energy Facility 12-month bird monitoring & EIA specialist study (Mainstream)
32. Leeuwdraai Wind Energy Facility 12-month bird monitoring & EIA specialist study (Mainstream)
33. Sutherland Wind Energy Facility 12-month bird monitoring (Mainstream)
34. Maralla Wind Energy Facility 12-month bird monitoring & EIA specialist study (Biotherm)
35. Esizayo Wind Energy Facility 12-month bird monitoring & EIA specialist study (Biotherm)
36. Humansdorp Wind Energy Facility 12-month bird monitoring & EIA specialist study (Cennergi)
37. Aletta Wind Energy Facility 12-month bird monitoring & EIA specialist study (Biotherm)
38. Eureka Wind Energy Facility 12-month bird monitoring & EIA specialist study (Biotherm)
39. Makambako Wind Energy Faclity (Tanzania) 12-month bird monitoring & EIA specialist study (Windlab)
40. R355 Wind Energy Facility 12-month bird monitoring (Mainstream)
41. Groenekloof Wind Energy Facility 12-month bird monitoring & EIA specialist study (Mulilo)
42. Tsitsikamma Wind Energy Facility 24-months post-construction monitoring (Cennergi)
43. Noupoort Wind Energy Facility 24-months post-construction monitoring (Mainstream)
44. Kokerboom Wind Energy Facility 12-month bird monitoring & EIA specialist study (Business Venture Investments)
45. Kuruman Wind Energy Facility 12-month bird monitoring & EIA specialist study (Mulilo)
46. Dassieklip Wind Energy Facility 3 years post-construction monitoring (Biotherm)
47. Loeriesfontein 2 Wind Energy Facility 2 years post-construction monitoring (Mainstream)
48. Khobab Wind Energy Facility 2 years post-construction monitoring (Mainstream)
49. Excelsior Wind Energy Facility 18 months construction phase monitoring (Biotherm)
50. Boesmansberg Wind Energy Facility 12-months pre-construction bird monitoring (juwi)
51. Mañhica Wind Energy Facility, Mozambique, 12-months pre-construction monitoring (Windlab)
52. Kwagga Wind Energy Facility, Beaufort West, 12-months pre-construction monitoring (ABO)
53. Pienaarspoort Wind Energy Facility, Touws River, Western Cape, 12-months pre-construction monitoring (ABO).
54. Pofadder WEF 1 and 2 Wind Energy Facilities, Beaufort West, Western Cape, 12 months pre-construction monitoring (Genesis Eco-energy)
55. Duiker Wind Energy Facility, Vredendal, Western Cape 12 months pre-construction monitoring (ABO)
56. Perdekraal East Wind Energy Facility, Touws River, Western Cape, 18 months construction phase monitoring (Mainstream).
57. Swellendam Wind Energy Facility, Western Cape, 12-month pre-construction monitoring (Veld Renewables)
58. Lombardskraal Wind Energy Facility, Western Cape, 12-month pre-construction monitoring (Enertrag SA)
59. Mainstream Kolkies & Heuweltjies Wind Energy Facilities, Western Cape, 12-month pre-construction monitoring (Mainstream)
60. Great Karoo Wind Energy Facility, Northern Cape, 12-month pre-construction monitoring (African Green Ventures).
61. Mpumalanga & Gauteng Wind and Hybrid Energy Facilities (6x), pre-construction monitoring (Enertrag SA)

62. Dordrecht Wind Energy Facilities, Eastern Cape, Screening Report (Enertrag SA)
63. Dordrecht Wind Energy Facilities, Eastern Cape, Screening Report (ACED)
64. Nanibees North & South Wind Energy Facilities, Northern Cape, Screening Report (juwi)
65. Sutherland Wind Energy Facilities, Northern Cape, Screening Report (WKN Windcurrent)
66. Pofadder Wind Energy Facility, Northren Cape, Screening Report (Atlantic Energy)
67. Haga Haga Wind Energy Facility, Eastern Cape, Amendment Report (WKN Windcurrent)
68. Banken Wind Energy Facility, Northern Cape, Screening Report (Atlantic Energy)
69. Hartebeest Wind Energy Facility, Western Cape, 12-month pre-construction monitoring (juwi).

Bird Impact Assessment Studies for Solar Energy Plants:

1. Concentrated Solar Power Plant, Upington, Northern Cape.
2. Globeleq De Aar and Droogfontein Solar PV Pre- and Post-construction avifaunal monitoring
3. JUWI Kronos PV project, Copperton, Northern Cape
4. Sand Draai CSP project, Groblershoop, Northern Cape
5. Biotherm Helena PV Project, Copperton, Northern Cape
6. Biotherm Letsiao CSP Project, Aggeneys, Northern Cape
7. Biotherm Enamandla PV Project, Aggeneys, Northern Cape
8. Biotherm Sendawo PV Project, Vryburg, North-West
9. Biotherm Tlisitseng PV Project, Lichtenburg, North-West
10. JUWI Hotazel Solar Park Project, Hotazel, Northern Cape
11. Namakwa Solar Project, Aggeneys, Northern Cape
12. Brypaal Solar Power Project, Kakamas, Northern Cape
13. ABO Vryburg 1,2,3 Solar PV Project, Vryburg, North-West
14. NamPower CSP Facility near Arandis, Namibia
15. Dayson Klip PV Facility near Upington, Northern Cape
16. Geelkop PV Facility near Upington, Northern Cape
17. Oya PV Facility, Ceres, Western Cape
18. Vrede and Rondawel PV Facilities, Free State
19. Kolkies & Sadawa PV Facilities, Western Cape
20. Leeuwbosch PV1 and 2 and Wildebeeskuil PV1 and 2 Facilities, North-West
21. Kenhardt PV 3,4 and 5, Northern Cape
22. Wittewal PV, Grootfontein PV and Hoekdoornen PV Facilities, Touws River, Western Cape

Bird Impact Assessment Studies for the following overhead line projects:

1. Chobe 33kV Distribution line
2. Athene - Umfolozi 400kV
3. Beta-Delphi 400kV
4. Cape Strengthening Scheme 765kV
5. Flurian-Louis-Trichardt 132kV
6. Ghanzi 132kV (Botswana)
7. Ikaros 400kV
8. Matimba-Witkop 400kV
9. Naboomspruit 132kV
10. Tabor-Flurian 132kV
11. Windhoek - Walvisbaai 220 kV (Namibia)
12. Witkop-Overyssel 132kV
13. Breyten 88kV
14. Adis-Phoebus 400kV
15. Dhuva-Janus 400kV
16. Perseus-Mercury 400kV
17. Gravelotte 132kV
18. Ikaros 400 kV
19. Khanye 132kV (Botswana)

20. Moropule – Thamaga 220 kV (Botswana)
21. Parys 132kV
22. Simplon –Everest 132kV
23. Tutuka-Alpha 400kV
24. Simplon-Der Brochen 132kV
25. Big Tree 132kV
26. Mercury-Ferrum-Garona 400kV
27. Zeus-Perseus 765kV
28. Matimba B Integration Project
29. Caprivi 350kV DC (Namibia)
30. Gerus-Mururani Gate 350kV DC (Namibia)
31. Mmamabula 220kV (Botswana)
32. Steenberg-Der Brochen 132kV
33. Venetia-Paradise T 132kV
34. Burgersfort 132kV
35. Majuba-Umfolozi 765kV
36. Delta 765kV Substation
37. Braamhoek 22kV
38. Steelpoort Merensky 400kV
39. Mmamabula Delta 400kV
40. Delta Epsilon 765kV
41. Gerus-Zambezi 350kV DC Interconnector: Review of proposed avian mitigation measures for the Okavango and Kwando River crossings
42. Giyani 22kV Distribution line
43. Liqhobong-Kao 132/11kV distribution power line, Lesotho
44. 132kV Leslie – Wildebeest distribution line
45. A proposed new 50 kV Spoornet feeder line between Sishen and Saldanha
46. Cairns 132kv substation extension and associated power lines
47. Pimlico 132kv substation extension and associated power lines
48. Gyani 22kV
49. Matafin 132kV
50. Nkomazi_Fig Tree 132kV
51. Pebble Rock 132kV
52. Reddersburg 132kV
53. Thaba Combine 132kV
54. Nkomati 132kV
55. Louis Trichardt – Musina 132kV
56. Endicot 44kV
57. Apollo Lepini 400kV
58. Tarlton-Spring Farms 132kV
59. Kuschke 132kV substation
60. Bendstore 66kV Substation and associated lines
61. Kuiseb 400kV (Namibia)
62. Gyani-Malamulele 132kV
63. Watershed 132kV
64. Bakone 132kV substation
65. Eerstegoud 132kV LILO lines
66. Kumba Iron Ore: SWEP - Relocation of Infrastructure
67. Kudu Gas Power Station: Associated power lines
68. Steenberg Booysendal 132kV
69. Toulon Pumps 33kV
70. Thabatshipi 132kV
71. Witkop-Silica 132kV
72. Bakubung 132kV
73. Nelsriver 132kV
74. Rethabiseng 132kV
75. Tilburg 132kV
76. GaKgapane 66kV

77. Knobel Gilead 132kV
78. Bochum Knobel 132kV
79. Madibeng 132kV
80. Witbank Railway Line and associated infrastructure
81. Spencer NDP phase 2 (5 lines)
82. Akanani 132kV
83. Hermes-Dominion Reefs 132kV
84. Cape Pensinsula Strengthening Project 400kV
85. Magalakwena 132kV
86. Benficosa 132kV
87. Dithabaneng 132kV
88. Taunus Diepkloof 132kV
89. Taunus Doornkop 132kV
90. Tweedracht 132kV
91. Jane Furse 132kV
92. Majeje Sub 132kV
93. Tabor Louis Trichardt 132kV
94. Riversong 88kV
95. Mamatsekele 132kV
96. Kabokweni 132kV
97. MDPP 400kV Botswana
98. Marble Hall NDP 132kV
99. Bokmakiere 132kV Substation and LILO lines
100. Styldrift 132kV
101. Taunus – Diepkloof 132kV
102. Bighorn NDP 132kV
103. Waterkloof 88kV
104. Camden – Theta 765kV
105. Dhuva – Minerva 400kV Diversion
106. Lesedi –Grootpan 132kV
107. Waterberg NDP
108. Bulgerivier – Dorset 132kV
109. Bulgerivier – Toulon 132kV
110. Nokeng-Fluorspar 132kV
111. Mantsole 132kV
112. Tshilamba 132kV
113. Thabamoopo - Tshebela – Nhlovuko 132kV
114. Arthurseat 132kV
115. Borutho 132kV MTS
116. Volspruit - Potgietersrus 132kV
117. Neotel Optic Fibre Cable Installation Project: Western Cape
118. Matla-Glockner 400kV
119. Delmas North 44kV
120. Houwhoek 11kV Refurbishment
121. Clau-Clau 132kV
122. Ngwedi-Silwerkrans 134kV
123. Nieuwehoop 400kV walk-through
124. Booysendal 132kV Switching Station
125. Tarlton 132kV
126. Medupi - Witkop 400kV walk-through
127. Germiston Industries Substation
128. Sekgame 132kV
129. Botswana – South Africa 400kV Transfrontier Interconnector
130. Syferkuil – Rampheri 132kV
131. Queens Substation and associated 132kV powerlines
132. Oranjemond 400kV Transmission line
133. Aries – Helios – Juno walk-down
134. Kuruman Phase 1 and 2 Wind Energy facilities 132kV Grid connection

135. Transnet Thaba 132kV

Bird Impact Assessment Studies for the following residential and industrial developments:

1. Lizard Point Golf Estate
2. Lever Creek Estates
3. Leloko Lifestyle Estates
4. Vaaloewers Residential Development
5. Clearwater Estates Grass Owl Impact Study
6. Somerset Ext. Grass Owl Study
7. Proposed Three Diamonds Trading Mining Project (Portion 9 and 15 of the Farm Blesbokfontein)
8. N17 Section: Springs To Leandra –"Borrow Pit 12 And Access Road On (Section 9, 6 And 28 Of The Farm Winterhoek 314 Ir)
9. South African Police Services Gauteng Radio Communication System: Portion 136 Of The Farm 528 Jq, Lindley.
10. Report for the proposed upgrade and extension of the Zeekoegat Wastewater Treatment Works, Gauteng.
11. Bird Impact Assessment for Portion 265 (a portion of Portion 163) of the farm Rietfontein 189-JR, Gauteng.
12. Bird Impact Assessment Study for Portions 54 and 55 of the Farm Zwartkop 525 JQ, Gauteng.
13. Bird Impact Assessment Study Portions 8 and 36 of the Farm Nooitgedacht 534 JQ, Gauteng.
14. Shumba's Rest Bird Impact Assessment Study
15. Randfontein Golf Estate Bird Impact Assessment Study
16. Zilkaatsnek Wildlife Estate
17. Regenstein Communications Tower (Namibia)
18. Avifaunal Input into Richards Bay Comparative Risk Assessment Study
19. Maquasa West Open Cast Coal Mine
20. Glen Erasmia Residential Development, Kempton Park, Gauteng
21. Bird Impact Assessment Study, Weltevreden Mine, Mpumalanga
22. Bird Impact Assessment Study, Olifantsvlei Cemetery, Johannesburg
23. Camden Ash Disposal Facility, Mpumalanga
24. Lindley Estate, Lanseria, Gauteng
25. Proposed open cast iron ore mine on the farm Lylyveld 545, Northern Cape
26. Avifaunal monitoring for the Sishen Mine in the Northern Cape as part of the EMPr requirements
27. Steelpoort CNC Bird Impact Assessment Study

Professional affiliations

I work under the supervision of and in association with Albert Froneman (MSc Conservation Biology) (SACNASP Zoological Science Registration number 400177/09) as stipulated by the Natural Scientific Professions Act 27 of 2003.

Curriculum vitae: Albert Froneman

Profession/Specialisation	:	Avifaunal Specialist
Highest Qualification	:	MSc (Conservation
Biology) Nationality	:	South African
Years of experience	:	22 years

Key Qualifications

Albert Froneman (*Pr.Sci.Nat*) has more than 22 years' experience in the management of avifaunal interactions with industrial infrastructure. He holds a M.Sc. degree in Conservation Biology from the University of Cape Town. He managed the Airports Company South Africa (ACSA) – Endangered Wildlife Trust Strategic Partnership from 1999 to 2008 which has been internationally recognized for its achievements in addressing airport wildlife hazards in an environmentally sensitive manner at ACSA's airports across South Africa. Albert is recognized worldwide as an expert in the field of bird hazard management on airports and has worked in South Africa, Swaziland, Botswana, Namibia, Kenya, Israel, and the USA. He has served as the vice chairman of the International Bird Strike Committee and has presented various papers at international conferences and workshops. At present he is consulting to ACSA with wildlife hazard management on all their airports. He also an accomplished specialist ornithological consultant outside the aviation industry and has completed a wide range of bird impact assessment studies. He has co-authored many avifaunal specialist studies and pre-construction monitoring reports for proposed renewable energy developments across South Africa. He also has vast experience in using Geographic Information Systems to analyse and interpret avifaunal data spatially and derive meaningful conclusions. Since 2009 Albert has been a registered Professional Natural Scientist (reg. nr 400177/09) with The South African Council for Natural Scientific Professions, specialising in Zoological Science.

KEY PROJECT EXPERIENCE

Renewable Energy Facilities – avifaunal monitoring projects in association with Chris van Rooyen Consulting

1. Jeffrey's Bay Wind Farm – 12-months preconstruction avifaunal monitoring project
2. Oysterbay Wind Energy Project – 12-months preconstruction avifaunal monitoring project
3. Ubuntu Wind Energy Project near Jeffrey's Bay – 12-months preconstruction avifaunal monitoring project
4. Bana-ba-Pifu Wind Energy Project near Humansdorp – 12-months preconstruction avifaunal monitoring project
5. Excelsior Wind Energy Project near Caledon – 12-months preconstruction avifaunal monitoring project
6. Laingsburg Spitskopvlakte Wind Energy Project – 12-months preconstruction avifaunal monitoring project
7. Loeriesfontein Wind Energy Project Phase 1, 2 & 3 – 12-months preconstruction avifaunal monitoring project
8. Noupoort Wind Energy Project – 12-months preconstruction avifaunal monitoring project
9. Vleesbaai Wind Energy Project – 12-months preconstruction avifaunal monitoring project
10. Port Nolloth Wind Energy Project – 12-months preconstruction avifaunal monitoring project
11. Langhoogte Caledon Wind Energy Project – 12-months preconstruction avifaunal monitoring project
12. Lunsklip – Stilbaai Wind Energy Project – 12-months preconstruction avifaunal monitoring project
13. Indwe Wind Energy Project – 12-months preconstruction avifaunal monitoring project
14. Zeeland St Helena bay Wind Energy Project – 12-months preconstruction avifaunal

monitoring project

15. Wolseley Wind Energy Project – 12-months preconstruction avifaunal monitoring project
16. Renosterberg Wind Energy Project – 12-months preconstruction avifaunal monitoring project
17. De Aar – North (Mulilo) Wind Energy Project – 12-months preconstruction avifaunal monitoring project (2014)
18. De Aar – South (Mulilo) Wind Energy Project – 12-months bird monitoring
19. Namies – Aggenys Wind Energy Project – 12-months bird monitoring
20. Pofadder - Wind Energy Project – 12-months bird monitoring
21. Dwarsrug Loeriesfontein - Wind Energy Project – 12-months bird monitoring
22. Waaihoek – Utrecht Wind Energy Project – 12-months bird monitoring
23. Amathole – Butterworth Wind Energy Project – 12-months bird monitoring & EIA specialist study
24. De Aar and Droogfontein Solar PV Pre- and Post-construction avifaunal monitoring
25. Makambako Wind Energy Faclity (Tanzania) 12-month bird monitoring & EIA specialist study (Windlab)
26. R355 Wind Energy Facility 12-month bird monitoring (Mainstream)
27. Aletta Wind Energy Facility 12-month bird monitoring (Biotherm)
28. Maralla Wind Energy Facility 12-month bird monitoring (Biotherm)
29. Groenekloof Wind Energy Facility 12-month bird monitoring & EIA specialist study (Mulilo)
30. Tsitsikamma Wind Energy Facility 24-months post-construction monitoring (Cennergi)
31. Noupoort Wind Energy Facility 24-months post-construction monitoring (Mainstream)
32. Kokerboom Wind Energy Facility 12-month bird monitoring & EIA specialist study (Business Venture Investments)
33. KurumanWind Energy Facility 12-month bird monitoring & EIA specialist study (Mulilo)
34. Mañhica Wind Energy Facility 12-month bird monitoring & EIA specialist study (Windlab)
35. Klipheuwel-Dassiefontein Wind Energy Facility, Caledon, Western Cape – Operational phase bird monitoring – Year 5 (Klipheuwel-Dassiefontein Wind Energy Facility)
36. Kwagga Wind Energy Facility, Beaufort West, 12-months pre-construction monitoring (ABO)
37. Pienaarspoort Wind Energy Facility, Touws River, Western Cape, 12-months pre-construction monitoring (ABO). Pofadder WEF 1 and 2 Wind Energy Facilities, Beaufort West, Western Cape, 12 months pre-construction monitoring (Genesis Eco-energy)
38. Duiker Wind Energy Facility, Vredendal, Western Cape 12 months pre-construction monitoring (ABO)
39. Perdekraal East Wind Energy Facility, Touws River, Western Cape, 18 months construction phase monitoring (Mainstream).
40. Swellendam Wind Energy Facility, Western Cape, 12-month pre-construction monitoring (Veld Renewables)
41. Lombardskraal Wind Energy Facility, Western Cape, 12-month pre-construction monitoring (Enertrag SA)
42. Mainstream Kolkies & Heuweltjies Wind Energy Facilities, Western Cape, 12-month pre- construction monitoring (Mainstream)
43. Great Karoo Wind Energy Facility, Northern Cape, 12-month pre-construction monitoring (African Green Ventures).
44. Mpumalanga & Gauteng Wind and Hybrid Energy Facilities (6x), pre-construction monitoring (Enertrag SA)
45. Dordrecht Wind Energy Facilities, Eastern Cape, Screening Report (Enertrag SA)
46. Dordrecht Wind Energy Facilities, Eastern Cape, Screening Report (ACED)
47. Nanibees North & South Wind Energy Facilities, Northern Cape, Screening Report (juwi)
48. Kappa Solar PV facility, Touwsrivier, Western Cape, pre-construction monitoring (Veroniva)
49. Sutherland Wind Energy Facilities, Northern Cape, Screening Report (WKN Windcurrent)

50. Pofadder Wind Energy Facility, Northren Cape, Screening Report (Atlantic Energy)
51. Haga Haga Wind Energy Facility, Eastern Cape, Amendment Report (WKN Windcurrent)
52. Banken Wind Energy Facility, Northern Cape, Screening Report (Atlantic Energy)
53. Hartebeest Wind Energy Facility, Western Cape, 12-month pre-construction monitoring (juwi).
54. Iphiko Wind Energy facilities, Laingsburg, Western Cape, screening and pre- construction monitoring (G7 Energies)
55. Kangnas Wind Energy Facility, Northern Cape, Operational Phase 2 years avifaunal monitoring (Mainstream)
56. Perdekraal East Wind Energy Facility, Northern Cape, Operational Phase 2 years avifaunal monitoring (Mainstream)
57. Aberdeen 1, 2 & Aberdeen Kudu (3&4) Wind Energy Facilities, Eastern Cape, 12- month pre-construction monitoring (Atlantic Renewable Energy Partners)
58. Loxton / Beaufort West Wind Energy Facilities, Northern Cape, 12-month pre- construction monitoring (Genesis Eco-Energy Developments)
59. Ermelo & Volksrust Wind Energy Facilities, Northern Cape, Screening Report (WKN Windcurrent)
60. Aardvark Solar PV facility, Copperton, Northern Cape, 12-month pre-construction monitoring (ABO)
61. Bestwood Solar PV facility, Kathu, Northern Cape, pre-construction monitoring (AMDA)
62. Boundary Solar PV facility, Kimberley, Northern Cape, Site sensitivity verification (Atlantic Renewable Energy Partners)
63. Excelsior Wind Energy Facility, Swellendam, Western Cape, Operational Phase 2 years avifaunal monitoring & implementation of Shut Down on Demand (SDOD) pro-active mitigation strategy (Biotherm)
64. De Aar cluster Solar PV facilities, De Aar, Western Cape, Site sensitivity verification (Atlantic Renewable Energy Partners)
65. Rinkhals Solar PV facilities, Kimberley, Northern Cape, Pre-construction monitoring (ABO)
66. Kolkies Sadawa Solar PV facilities, Touwsrivier, Western Cape, pre-construction monitoring (Mainstream)
67. Leeudoringstad Solar PV facilities, Leeudoringstad, North West, Pre-construction monitoring (Upgrade Energy)
68. Noupoort Umsobomvu Solar PV facilities, Noupoort, Northern Cape, Pre-construction monitoring (EDF Renewables)
69. Oya Solar PV facilities, Matjiesfontein, Western Cape, pre-construction monitoring (G7 Energies)
70. Scafell Solar PV facilities, Sasolburg, Free state, pre-construction monitoring (Mainstream)
71. Vrede & Rondawel Solar PV facilities, Kroonstad, Free state, pre-construction monitoring (Mainstream)
72. Gunstfontein Wind Energy Facilities, Sutherland, Northern Cape, additional pre- construction monitoring (ACED)
73. Ezelsjacht Wind Energy Facility, De Doorns, Western Cape, pre-construction monitoring (Mainstream)
74. Klipkraal Wind Energy Facility, Fraserburg, Northern Cape, avifaunal screening (Klipkraal WEF)
75. Pofadder Wind Energy Facility, Pofadder, Northern Cape, pre-construction monitoring (Atlantic Renewable Energy Partners)

Bird Impact Assessment studies and / or GIS analysis:

1. Aviation Bird Hazard Assessment Study for the proposed Madiba Bay Leisure Park adjacent to Port Elizabeth Airport.
2. Extension of Runway and Provision of Parallel Taxiway at Sir Seretse Khama Airport, Botswana Bird / Wildlife Hazard Management Specialist Study
3. Maun Airport Improvements Bird / Wildlife Hazard Management Specialist Study
4. Bird Impact Assesment Study - Bird Helicopter Interaction – The Bitou River, Western Cape Province South Africa
5. Proposed La Mercy Airport – Bird Aircraft interaction specialists study using bird detection radar to assess swallow flocking behaviour
6. KwaZulu Natal Power Line Vulture Mitigation Project – GIS analysis
7. Perseus-Zeus Powerline EIA – GIS Analysis
8. Southern Region Pro-active GIS Blue Crane Collision Project.
9. Specialist advisor ~ Implementation of a bird detection radar system and development of an airport wildlife hazard management and operational environmental management plan for the King Shaka International Airport
10. Matsapha International Airport – bird hazard assessment study with management recommendations
11. Evaluation of aviation bird strike risk at candidate solid waste disposal sites in the Ekurhuleni Metropolitan Municipality
12. Gateway Airport Authority Limited – Gateway International Airport, Polokwane: Bird hazard assessment; Compile a bird hazard management plan for the airport
13. Bird Specialist Study - Evaluation of aviation bird strike risk at the Mwakirunge Landfill site near Mombasa Kenya
14. Bird Impact Assessment Study - Proposed Weltevreden Open Cast Coal Mine Belfast, Mpumalanga
15. Avian biodiversity assessment for the Mafube Colliery Coal mine near Middelburg Mpumalanga
16. Avifaunal Specialist Study - SRVM Volspruit Mining project – Mokopane Limpopo Province
17. Avifaunal Impact Assessment Study (with specific reference to African Grass Owls and other Red List species) Stone Rivers Arch
18. Airport bird and wildlife hazard management plan and training to Swaziland Civil Aviation Authority (SWACAA) for Matsapha and Sikhupe International Airports.Bird Impact Assessment Study - Proposed 60 year Ash Disposal Facility near to the Kusile Power Station
19. Avifaunal pre-feasibility assessment for the proposed Montrose dam, Mpumalanga
20. Bird Impact Assessment Study – Proposed ESKOM Phantom Substation near Knysna, Western Cape
21. Habitat sensitivity map for Denham’s Bustard, Blue Crane and White-bellied Korhaan in the Kouga Municipal area of the Eastern Cape Province
22. Swaziland Civil Aviation Authority – Sikhuphe International Airport – Bird hazard management assessment
23. Avifaunal monitoring – extension of Specialist Study - SRVM Volspruit Mining project – Mokopane Limpopo Province
24. Avifaunal Specialist Study – Meerkat Hydro Electric Dam – Hope Town, Northern Cape
25. The Stewards Pan Reclamation Project – Bird Impact Assessment study
26. Airports Company South Africa – Avifaunal Specialist Consultant – Airport Bird and Wildlife Hazard Mitigation
27. Strategic Environmental Assessment For Gas Pipeline Development, CSIR
28. Avifaunal Specialist Assessment - Proposed monopole telecommunications mast – Roodekrans, Roodepoort, Gauteng (Enviroworks)
29. Gromis-Nama-Aggeneis 400kv Ipp Integration: Environmental Screening - Avifaunal Specialist Desktop Study
30. Melkspruit - Rouxville 132kV Distribution Line - Avifaunal Amendment and Walk-through

Report

31. Gamma - Kappa 2nd 765kV transmission line – Avifaunal impact assessment GIS analysis

Geographic Information System analysis & maps:

1. ESKOM Power line Makgalakwena EIA – GIS specialist & map production
2. ESKOM Power line Benficosa EIA – GIS specialist & map production
3. ESKOM Power line Riversong EIA – GIS specialist & map production
4. ESKOM Power line Waterberg NDP EIA – GIS specialist & map production
5. ESKOM Power line Bulge Toulon EIA – GIS specialist & map production
6. ESKOM Power line Bulge DORSET EIA – GIS specialist & map production
7. ESKOM Power lines Marblehall EIA – GIS specialist & map production
8. ESKOM Power line Grootpan Lesedi EIA – GIS specialist & map production
9. ESKOM Power line Tanga EIA – GIS specialist & map production
10. ESKOM Power line Bokmakierie EIA – GIS specialist & map production
11. ESKOM Power line Rietfontein EIA – GIS specialist & map production
12. Power line Anglo Coal EIA – GIS specialist & map production
13. ESKOM Power line Camcoll Jericho EIA – GIS specialist & map production
14. Hartbeespoort Residential Development – GIS specialist & map production
15. ESKOM Power line Mantsole EIA – GIS specialist & map production
16. ESKOM Power line Nokeng Flourspar EIA – GIS specialist & map production
17. ESKOM Power line Greenview EIA – GIS specialist & map production
18. Derdepoort Residential Development – GIS specialist & map production
19. ESKOM Power line Boynton EIA – GIS specialist & map production
20. ESKOM Power line United EIA – GIS specialist & map production
21. ESKOM Power line Gutshwa & Malelane EIA – GIS specialist & map production
22. ESKOM Power line Origstad EIA – GIS specialist & map production
23. Zilkaatsnek Development Public Participation –map production
24. Belfast – Paarde Power line - GIS specialist & map production
25. Solar Park Solar Park Integration Project Bird Impact Assessment Study – avifaunal GIS analysis.
26. Kappa-Omega-Aurora 765kV Bird Impact Assessment Report – Avifaunal GIS analysis.
27. Gamma – Kappa 2nd 765kV – Bird Impact Assessment Report – Avifaunal GIS analysis.
28. ESKOM Power line Kudu-Dorstfontein Amendment EIA – GIS specialist & map production.
29. Proposed Heilbron filling station EIA – GIS specialist & map production
30. ESKOM Lebatlhane EIA – GIS specialist & map production
31. ESKOM Pienaars River CNC EIA – GIS specialist & map production
32. ESKOM Lemara Phiring Ohrigstad EIA – GIS specialist & map production
33. ESKOM Pelly-Warmbad EIA – GIS specialist & map production
34. ESKOM Rosco-Bracken EIA –GIS specialist & map production
35. ESKOM Ermelo-Uitkoms EIA – GIS specialist & map production
36. ESKOM Wisani bridge EIA – GIS specialist & map productionCity of Tswane – New bulkfeeder pipeline projects x3Map production
37. ESKOM Lebohang Substation and 132kV Distribution Power Line Project Amendment GIS specialist & map production
38. ESKOM Geluk Rural Powerline GIS & Mapping
39. Eskom Kimberley Strengthening Phase 4 Project GIS & Mapping
40. ESKOM Kwaggafontein - Amandla Amendment Project GIS & Mapping
41. ESKOM Lephalale CNC – GIS Specialist & Mapping
42. ESKOM Marken CNC – GIS Specialist & Mapping
43. ESKOM Lethabong substation and powerlines – GIS Specialist & Mapping
44. ESKOM Magopela- Pitsong 132kV line and new substation – GIS Specialist & Mapping
45. Vlakfontein Filling Station – GIS Specialist & Mapping - EIA

46. Prieska – Hoekplaas Solar PV & BESS - GIS Specialist & Mapping – EIA
47. Mulilo Total Hydra Storage (MTHS) De Aar - GIS Specialist & Mapping – EIA
48. Merensky Uchoba Powerline, Steelpoort - GIS Specialist & Mapping – EIA
49. Douglas Solar Part 2 Amendment – grid connection - GIS Specialist & Mapping – EIA

Professional affiliations

- South African Council for Natural Scientific Professions (SACNASP) registered Professional Natural Scientist (reg. nr 400177/09) – specialist field: Zoological Science. Registered since 2009.
- Southern African Wildlife Management Association - Member
- Zoological Society of South Africa - Member

APPENDIX 3: PRE-CONSTRUCTION MONITORING PROTOCOL

Objectives

The objective of the pre-construction monitoring at the proposed Pofadder Wind Energy Facility 1, 2 and 3 Wind Energy Facilities was to gather baseline data over a period of four seasons on the following aspects pertaining to avifauna:

- The abundance and diversity of birds at the wind farm sites and a suitable control site to measure the potential displacement effect of the wind farm.
- Flight patterns of priority species at the wind farm sites to assess the potential collision risk with the turbines.

Methods

The monitoring protocol for the site was designed according to the latest version (2015) *of Jenkins A R; Van Rooyen C S; Smallie J J; Anderson M D & Smit H A. 2011. Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa. Endangered Wildlife Trust and Birdlife South Africa.*

The four monitoring surveys were conducted between:

- 10-17 June 2021
- 15-19 October 2021
- 6-10 February 2022
- 21-25 March 2022

Monitoring was conducted in the following manner:

- One drive transect was identified totalling 13.7km on the combined project sites and one drive transect in the control site with a total length of 10.8km.
- Two monitors travelling slowly (± 10km/h) in a vehicle recorded all birds on both sides of the transect. The observers stopped at regular intervals (every 500m) to scan the environment with binoculars. Drive transects were counted three times per sampling session.
- In addition, 11 walk transects of 1km each were identified on the development site and 2 transects of on the control site. The PV transects were counted 4 times per sampling season. All birds were recorded during walk transects.
- The following variables were recorded:
    - Species
    - Number of birds
    - Date
    - Start time and end time
    - Estimated distance from transect
    - Wind direction
    - Wind strength (estimated Beaufort scale)
    - Weather (sunny; cloudy; partly cloudy; rain; mist)
    - Temperature (cold; mild; warm; hot)

  - Behaviour (flushed; flying-display; perched; perched-calling; perched-hunting; flying-foraging; flying-commute; foraging on the ground) and
  - Co-ordinates (priority species only)

The aim with drive transects was primarily to record large priority species (i.e. raptors and large terrestrial species), while walk transects were primarily aimed at recording small passerines. The objective of the transect monitoring was to gather baseline data on the use of the site by birds in order to measure potential displacement by the wind farm activities.

- Eleven vantage points (VPs) were identified from which the majority of the proposed turbine area at the combined sites could be observed, to record the flight altitude and patterns of priority species. One VP was also identified on the control site. The following variables were recorded for each flight:
  - Species
  - Number of birds
  - Date
  - Start time and end time
  - Wind direction
  - Wind strength (estimated Beaufort scale 1-7)
  - Weather (sunny; cloudy; partly cloudy; rain; mist)
  - Temperature (cold; mild; warm; hot)
  - Flight altitude (high i.e. above rotor height; medium i.e. rotor height; low i.e. below rotor height)
  - Flight mode (soar; flap; glide; kite; hover) and
  - Flight time (in 15 second intervals).

The objective of vantage point counts was to measure the potential collision risk with the turbines. Priority species were identified using the latest (November 2014) BirdLife SA (BLSA) list of priority species for wind farms.

The presence of White-backed Vultures and Lappet-faced Vultures on the Aries – Aggeneys 400kV line was designated as a focal point and monitored as a roost site.

Figure 1 below indicates the location of the transects, vantage points and focal points where monitoring was taking place.

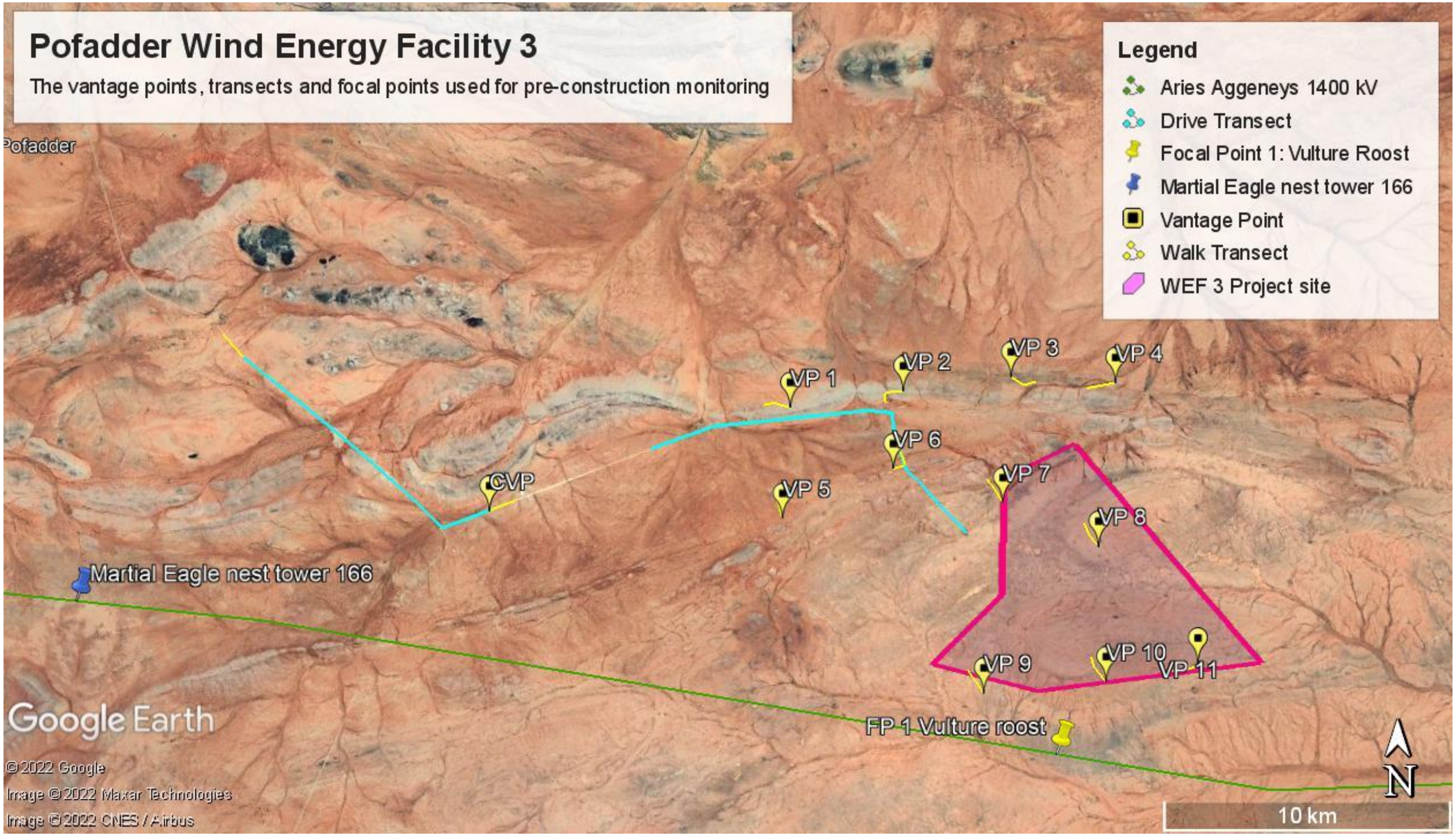


Figure 1: Pre-construction monitoring map indicating VP's, drive transects, walking transects in Project Site and Control

APPENDIX 4: BIRD HABITAT

Figure 1: Arid grassland and scrub on sandy plains in the development area.

Figure 2: Arid grassland on gravel plains in the development area.


Figure 3: A typical water trough in the project site.

APPENDIX 5: SPECIES LIST FOR THE BROADER AREA

Species name	Taxonomic name	SABAP2 Full protocol reporting rate	SABAP2 Ad hoc protocol reporting rate	Global status	Regional status	Wind priority species	Recorded during monitoring
Acacia Pied Barbet	*Tricholaema leucomelas*	51.43	16.13	-	-		x
African Pipit	*Anthus cinnamomeus*	2.86	0.00	-	-		
African Red-eyed Bulbul	*Pycnonotus nigricans*	17.14	3.23	-	-		x
Ant-eating Chat	*Myrmecocichla formicivora*	57.14	16.13	-	-		x
Ashy Tit	*Melaniparus cinerascens*	2.86	0.00	-	-		
Barn Swallow	*Hirundo rustica*	14.29	0.00	-	-		
Black Stork	*Ciconia nigra*	2.86	0.00	-	VU	x	
Black-chested Prinia	*Prinia flavicans*	40.00	9.68	-	-		x
Black-chested Snake Eagle	*Circaetus pectoralis*	2.86	0.00	-	-	x	
Black-eared Sparrow-Lark	*Eremopterix australis*	20.00	9.68	-	-		
Black-headed Canary	*Serinus alario*	17.14	3.23	-	-		x
Blacksmith Lapwing	*Vanellus armatus*	8.57	3.23	-	-		
Black-winged Stilt	*Himantopus himantopus*	2.86	6.45	-	-		
Bokmakierie	*Telophorus zeylonus*	31.43	3.23	-	-		x
Burchell's Courser	*Cursorius rufus*	11.43	3.23	-	VU	x	x
Cape Bunting	*Emberiza capensis*	20.00	0.00	-	-		x
Cape Penduline Tit	*Anthoscopus minutus*	11.43	6.45	-	-		
Cape Robin-Chat	*Cossypha caffra*	2.86	0.00	-	-		
Cape Sparrow	*Passer melanurus*	68.57	16.13	-	-		x
Cape Turtle Dove	*Streptopelia capicola*	37.14	6.45	-	-		x
Cape Wagtail	*Motacilla capensis*	5.71	0.00	-	-		
Capped Wheatear	*Oenanthe pileata*	20.00	9.68	-	-		x
Chat Flycatcher	*Melaenornis infuscatus*	65.71	16.13	-	-		x
Chestnut-vented Warbler	*Curruca subcoerulea*	5.71	0.00	-	-		x
Common Greenshank	*Tringa nebularia*	2.86	0.00	-	-		
Desert Cisticola	*Cisticola aridulus*	2.86	0.00	-	-		
Double-banded Courser	*Rhinoptilus africanus*	42.86	9.68	-	-	x	x
Dusky Sunbird	*Cinnyris fuscus*	45.71	9.68	-	-		x
Egyptian Goose	*Alopochen aegyptiaca*	2.86	6.45	-	-		
Fairy Flycatcher	*Stenostira scita*	5.71	0.00	-	-		x
Familiar Chat	*Oenanthe familiaris*	28.57	3.23	-	-		x
Fawn-coloured Lark	*Calendulauda africanoides*	8.57	0.00	-	-		
Greater Kestrel	*Falco rupicoloides*	40.00	3.23	-	-	x	x
Greater Striped Swallow	*Cecropis cucullata*	2.86	0.00	-	-		
Grey Tit	*Melaniparus afer*	2.86	0.00	-	-		x
Grey-backed Cisticola	*Cisticola subruficapilla*	28.57	9.68	-	-		x
Grey-backed Sparrow-Lark	*Eremopterix verticalis*	37.14	6.45	-	-		x
House Sparrow	*Passer domesticus*	17.14	0.00	-	-		

Species name	Taxonomic name	SABAP2 Full protocol reporting rate	SABAP2 Ad hoc protocol reporting rate	Global status	Regional status	Wind priority species	Recorded during monitoring
Jackal Buzzard	*Buteo rufofuscus*	2.86	0.00	-	-	x	x
Karoo Chat	*Emarginata schlegelii*	57.14	22.58	-	-		x
Karoo Eremomela	*Eremomela gregalis*	2.86	0.00	-	-		
Karoo Korhaan	*Eupodotis vigorsii*	68.57	22.58	-	NT	x	x
Karoo Long-billed Lark	*Certhilauda subcoronata*	60.00	12.90	-	-		x
Karoo Scrub Robin	*Cercotrichas coryphoeus*	42.86	6.45	-	-		x
Karoo Thrush	*Turdus smithi*	14.29	0.00	-	-		
Kori Bustard	*Ardeotis kori*	5.71	0.00	NT	NT	x	x
Lappet-faced Vulture	*Totgos tracheliotis*	0.00	0.00	EN	EN	x	x
Large-billed Lark	*Galerida magnirostris*	25.71	3.23	-	-		x
Lark-like Bunting	*Emberiza impetuani*	74.29	16.13	-	-		x
Laughing Dove	*Spilopelia senegalensis*	22.86	0.00	-	-		x
Layard's Warbler	*Curruca layardi*	5.71	3.23	-	-		x
Little Grebe	*Tachybaptus ruficollis*	0.00	3.23	-	-		
Little Swift	*Apus affinis*	8.57	0.00	-	-		
Long-billed Crombec	*Sylvietta rufescens*	20.00	0.00	-	-		x
Ludwig's Bustard	*Neotis ludwigii*	48.57	12.90	EN	EN	x	x
Martial Eagle	*Polemaetus bellicosus*	11.43	0.00	EN	EN	x	
Mountain Wheatear	*Myrmecocichla monticola*	20.00	6.45	-	-		x
Namaqua Dove	*Oena capensis*	48.57	9.68	-	-		x
Namaqua Sandgrouse	*Pterocles namaqua*	74.29	19.35	-	-		x
Northern Black Korhaan	*Afrotis afraoides*	45.71	0.00	-	-	x	x
Pale Chanting Goshawk	*Melierax canorus*	68.57	9.68	-	-	x	x
Pale-winged Starling	*Onychognathus nabouroup*	22.86	6.45	-	-		
Pied Avocet	*Recurvirostra avosetta*	2.86	3.23	-	-		
Pied Crow	*Corvus albus*	65.71	16.13	-	-		x
Pririt Batis	*Batis pririt*	5.71	0.00	-	-		x
Pygmy Falcon	*Polihierax semitorquatus*	5.71	3.23	-	-		
Red Lark	*Calendulauda burra*	42.86	0.00	VU	VU	x	x
Red-capped Lark	*Calandrella cinerea*	20.00	0.00	-	-		
Red-faced Mousebird	*Urocolius indicus*	17.14	3.23	-	-		
Red-headed Finch	*Amadina erythrocephala*	2.86	0.00	-	-		x
Rock Kestrel	*Falco rupicolus*	11.43	0.00	-	-		
Rock Martin	*Ptyonoprogne fuligula*	60.00	9.68	-	-		x
Rufous-eared Warbler	*Malcorus pectoralis*	65.71	16.13	-	-		x
Sabota Lark	*Calendulauda sabota*	34.29	12.90	-	-		x
Scaly-feathered Weaver	*Sporopipes squamifrons*	5.71	6.45	-	-		
Sclater's Lark	*Spizocorys sclateri*	51.43	19.35	NT	NT	x	x
Sociable Weaver	*Philetairus socius*	60.00	12.90	-	-		x
South African Shelduck	*Tadorna cana*	0.00	3.23	-	-		

Species name	Taxonomic name	SABAP2 Full protocol reporting rate	SABAP2 Ad hoc protocol reporting rate	Global status	Regional status	Wind priority species	Recorded during monitoring
Southern Fiscal	*Lanius collaris*	45.71	0.00	-	-		x
Southern Grey-headed Sparrow	*Passer diffusus*	2.86	0.00	-	-		
Southern Masked Weaver	*Ploceus velatus*	22.86	0.00	-	-		x
Speckled Pigeon	*Columba guinea*	65.71	19.35	-	-		x
Spike-heeled Lark	*Chersomanes albofasciata*	85.71	38.71	-	-		x
Spotted Eagle-Owl	*Bubo africanus*	20.00	9.68	-	-	x	x
Spotted Thick-knee	*Burhinus capensis*	11.43	0.00	-	-		
Stark's Lark	*Spizocorys starki*	42.86	29.03	-	-		x
Three-banded Plover	*Charadrius tricollaris*	0.00	6.45	-	-		
Tractrac Chat	*Emarginata tractrac*	51.43	16.13	-	-		x
Verreaux's Eagle	*Aquila verreauxii*	5.71	3.23	-	VU	x	x
White-backed Mousebird	*Colius colius*	17.14	3.23	-	-		
White-backed Vulture	*Gyps africanus*	2.86	0.00	CR	CR	x	
White-browed Sparrow-Weaver	*Plocepasser mahali*	2.86	0.00	-	-		
White-rumped Swift	*Apus caffer*	2.86	0.00	-	-		
White-throated Canary	*Crithagra albogularis*	45.71	9.68	-	-		x
Yellow Canary	*Crithagra flaviventris*	48.57	9.68	-	-		x
Yellow-bellied Eremomela	*Eremomela icteropygialis*	37.14	9.68	-	-		x

APPENDIX 6: ASSESSMENT CRITERIA

1 ENVIRONMENTAL IMPACT ASSESSMENT (EIA) METHODOLOGY

The Environmental Impact Assessment (EIA) Methodology assists in evaluating the overall effect of a proposed activity on the environment. Determining of the significance of an environmental impact on an environmental parameter is determined through a systematic analysis.

1.1 Determination of Significance of Impacts

Significance is determined through a synthesis of impact characteristics which include context and intensity of an impact. Context refers to the geographical scale (i.e., site, local, national or global), whereas intensity is defined by the severity of the impact e.g., the magnitude of deviation from background conditions, the size of the area affected, the duration of the impact and the overall probability of occurrence. Significance is calculated as shown in **Table 1**.

Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The total number of points scored for each impact indicates the level of significance of the impact.

1.2 Impact Rating System

The impact assessment must take account of the nature, scale and duration of effects on the environment and whether such effects are positive (beneficial) or negative (detrimental). Each issue / impact is also assessed according to the various project stages, as follows:

- Planning
- Construction
- Operation; and
- Decommissioning

Where necessary, the proposal for mitigation or optimisation of an impact should be detailed. A brief discussion of the impact and the rationale behind the assessment of its significance has also been included.

1.2.1 Rating System Used to Classify Impacts

The rating system is applied to the potential impact on the receiving environment and includes an objective evaluation of the possible mitigation of the impact. Impacts have been consolidated into one (1) rating. In assessing the significance of each issue, the following criteria (including an allocated point system) is used:

Table 1: Rating of impacts criteria

ENVIRONMENTAL PARAMETER		
A brief description of the environmental aspect likely to be affected by the proposed activity (e.g. Surface Water).		
ISSUE / IMPACT / ENVIRONMENTAL EFFECT / NATURE		
Include a brief description of the impact of environmental parameter being assessed in the context of the project. This criterion includes a brief written statement of the environmental aspect being impacted upon by a particular action or activity (e.g. oil spill in surface water).		
EXTENT (E)		
This is defined as the area over which the impact will be expressed. Typically, the severity and significance of an impact have different scales and as such bracketing ranges are often required. This is often useful during the detailed assessment of a project in terms of further defining the determined.		
1	Site	The impact will only affect the site
2	Local/district	Will affect the local area or district
3	Province/region	Will affect the entire province or region
4	International and National	Will affect the entire country
PROBABILITY (P)		
This describes the chance of occurrence of an impact		
1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
2	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).
3	Probable	The impact will likely occur (Between a 50% to 75% chance of occurrence).
4	Definite	Impact will certainly occur (Greater than a 75% chance of occurrence).
REVERSIBILITY (R)		
This describes the degree to which an impact on an environmental parameter can be successfully reversed upon completion of the proposed activity.		
1	Completely reversible	The impact is reversible with implementation of minor mitigation measures
2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible, and no mitigation measures exist.
IRREPLACEABLE LOSS OF RESOURCES (L)		

This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.		
1	No loss of resource.	The impact will not result in the loss of any resources.
2	Marginal loss of resource	The impact will result in marginal loss of resources.
3	Significant loss of resources	The impact will result in significant loss of resources.
4	Complete loss of resources	The impact is result in a complete loss of all resources.
DURATION (D)		
This describes the duration of the impacts on the environmental parameter. Duration indicates the lifetime of the impact as a result of the proposed activity.		
1	Short term	The impact and its effects will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase (0 – 1 years), or the impact and its effects will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	Medium term	The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
3	Long term	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 50 years).
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered transient (Indefinite).
INTENSITY / MAGNITUDE (I / M)		
Describes the severity of an impact (i.e. whether the impact has the ability to alter the functionality or quality of a system permanently or temporarily).		
1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
2	Medium	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).

3	High	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.
4	Very high	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired (system collapse). Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.

SIGNIFICANCE (S)

Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. This describes the significance of the impact on the environmental parameter. The calculation of the significance of an impact uses the following formula:

Significance = (Extent + probability + reversibility + irreplaceability + duration) x magnitude/intensity.

The summation of the different criteria will produce a non-weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.

Points	Impact Significance Rating	Description
5 to 23	Negative Low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
5 to 23	Positive Low impact	The anticipated impact will have minor positive effects.
24 to 42	Negative Medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
24 to 42	Positive Medium impact	The anticipated impact will have moderate positive effects.

43 to 61	Negative High impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
43 to 61	Positive High impact	The anticipated impact will have significant positive effects.
62 to 80	Negative Very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
62 to 80	Positive Very high impact	The anticipated impact will have highly significant positive effects.

APPENDIX 7: ENVIRONMENTAL MANAGEMENT PLAN FOR THE WEF

Environmental Management Programme: WEF

Management Plan for the Planning and Design Phase

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
AVIFAUNA: DISPLACEMENT DUE TO DISTIURBANCE AND HABITAT TRANSFORMATION					
Displacement of priority avifauna due to disturbance and habitat transformation	Prevent mortality of priority avifauna	1. All surface water (water troughs) should be buffered by 500m (all infrastructure) to prevent displacement of Sclater's Lark breeding population due to disturbance. Alternatively, water troughs could be relocated to maintain a minimum distance of 500m from the closest turbine. 2. Additional Sclater's Lark breeding areas as identified during the pre-construction monitoring must be designated an all-infrastructure No-Go zone. 3. Placement of turbines in highly suitable Red Lark habitat to be avoided where possible.	Design lay-out around the proposed buffer zones	Once-off during the planning phase.	Project Developer
AVIFAUNA: MORTALITY DUE TO COLLISIONS WITH THE TURBINES					
Mortality of priority avifauna due to collisions with the wind turbines	Prevent mortality of priority avifauna	1. Based on the results of the pre-construction monitoring, a 2.8km turbine exclusion zone	1. Design lay-out around the	1. Once-off during the	1. Project Developer

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
		must be implemented around the vulture roost on the Aries – Aggeneys 1 400kV high voltage line.	proposed buffer zones	planning phase. 2. As soon as the first turbines start turning.	
AVIFAUNA: MORTALITY DUE TO ELECTROCUTION					
Electrocution of raptors on the internal 33kV poles	Prevent mortality of priority avifauna	1. A raptor-friendly pole design must be used, and the pole design must be approved by the avifaunal specialist.	Design engineers to consult with avifaunal specialist on the final design of the poles.	Once-off during the planning phase.	Project Developer

Management Plan for the Construction Phase (Including pre- and post-construction activities)

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	*Frequency*	*Responsibility*
AVIFAUNA: DISPLACEMENT DUE TO DISTURBANCE					
The noise and movement associated with the construction activities at the development footprint will be a source of disturbance which would lead to the displacement of avifauna from the area	Prevent unnecessary displacement of priority avifauna by ensuring that contractors are aware of the requirements of the Construction Environmental Management Programme (CEMPr.)	A site-specific CEMPr must be implemented, which gives appropriate and detailed description of how construction activities must be conducted. All contractors are to adhere to the CEMPr and should apply good environmental practice during construction. The CEMPr must specifically include the following: 1. No off-road driving. 2. Maximum use of existing roads. 3. Measures to control noise and dust according to latest best practice. 4. Restricted access to the rest of the property. 5. Strict application of all recommendations in the botanical specialist report pertaining to the limitation and	1. Implementation of the CEMPr. Oversee activities to ensure that the CEMPr is implemented and enforced via site audits and inspections. Report and record any non-compliance. 2. Ensure that construction personnel are made aware of the impacts relating to off-road driving. 3. Construction access roads must be demarcated clearly. Undertake site inspections to verify. 4. Monitor the implementation of noise control mechanisms via site inspections and record and report non-compliance.	1. On a daily basis 2. Monthly 3. Monthly 4. Monthly 5. Monthly	1. Contractor and ECO 2. Contractor and ECO 3. Contractor and ECO 4. Contractor and ECO 5. Contractor and ECO

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	*Frequency*	*Responsibility*
		rehabilitation of the footprint.	5. Ensure that the construction area is demarcated clearly and that construction personnel are made aware of these demarcations. Monitor via site inspections and report non-compliance.		
AVIFAUNA: DISPLACEMENT DUE TO HABITAT TRANSFORMATION					
Total or partial displacement of avifauna due to habitat transformation associated with the vegetation clearance and the presence of the wind turbines and associated infrastructure.	Prevent unnecessary displacement of avifauna by ensuring that the rehabilitation of transformed areas is implemented according to the recommendations of the biodiversity/vegetation specialist.	1. Ensure that all the recommendations for mitigation from the biodiversity/vegetation specialist, including rehabilitation of disturbed areas, are strictly implemented.	1. Appointment of specialist to coordinate and monitor the rehabilitation of the vegetation.	1. Once-off	1. Wind farm operator

Management Plan for the Operational Phase

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	*Frequency*	*Responsibility*
AVIFAUNA: MORTALITY DUE TO COLLISIONS WITH THE WIND TURBINES					
Bird collisions with the wind turbines	Prevention of priority species collision mortality on the wind turbines.	1. Formal live-bird monitoring and carcass searches should be implemented at the start of the operational phase, as per the most recent edition of the Best Practice Guidelines at the time (Jenkins *et al*. 2015) to assess collision rates. The exact time when operational monitoring should commence, will depend on the construction schedule, and should commence when the first turbines start operating. The Best Practice Guidelines require that, as an absolute minimum, operational monitoring should be undertaken for the first two (preferably three) years of operation, and then repeated again in	1. Appoint Avifaunal Specialist to compile operational monitoring plan, including live bird monitoring and carcass searches. 2. Implement operational monitoring plan. 3. Engage with the landowner to design and implement an effective system to locate a carcass promptly and ensure the immediate removal of the carcass before it can attract vultures. 4. Appoint a team of suitably qualified, trained, dedicated and resourced team of observers	1. Once-off 2. Years 1,2, 5 and every five years after that for the duration of the operational lifetime of the facility. 3. Before the first turbines start turning. 4. As and when required, within six months of threshold having been exceeded. 5. Quarterly and annually	1. Wind farm operator 2. Wind farm operator 3. Wind farm operator 4. Wind farm operator/avifaunal specialist 5. Wind farm operator/avifaunal specialist

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
		year 5, and again every five years thereafter for the operational lifetime of the facility. 2. A procedure for the immediate removal of carcasses within the development area must be implemented to prevent vultures from being attracted to the area where they could be at risk of collision with the turbines. 3. Shutdown on demand (SDoD) must be implemented on all turbines for White-backed Vulture, Lappet-faced Vulture, Martial Eagle, Verreaux's Eagle and Lanner Falcon, coupled with a carcass removal programme, to limit the risk of collisions with the turbines. The SDoD must be implemented for the first two years of the operational phase to assess the dynamics of the situation,	to be present on site for all daylight hours throughout the year. It is absolutely essential that passionate, hardworking staff are hired for this role. This team must be stationed at observation points with full visible coverage of all turbine locations. The observers must detect incoming priority bird species, track their flights, judge when they enter a turbine proximity threshold, and alert the control room to shut down the relevant turbine until the risk has reduced. 5. A full detailed method statement must be designed		

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
		whereafter a decision whether to continue must be taken, based on the frequency of shutdown events.	by an avifaunal specialist prior to the commercial operations date (COD) and must be in place by the time that the wind farm starts operating. 6. Compile quarterly and annual progress reports detailing the results of the operational monitoring and progress with any recommended mitigation measures.		

AVIFAUNA: MORTALITY DUE TO COLLISIONS AND ELECTROCUTIONS ON THE 33KV NETWORK					
Bird electrocutions on the overhead sections of the internal 33kV cables	Prevention of electrocution mortality on the overhead sections of the 33kV internal cable network.	1. Conduct regular inspections of the overhead sections of the internal reticulation network to look for carcasses.	1. Carcass searchers under the supervision of the Avifaunal Specialist. 2. Design and implement mitigation measures if mortality thresholds are exceeded. 3. Compile quarterly and annual progress reports detailing the results of the operational monitoring and progress with any recommended mitigation measures.	1. At least once every two months. 2. As and when required, within six months of threshold having been exceeded. 3. Quarterly and annually	1. Operations Manager/Avifaunal specialist 2. Wind farm operator/Avifaunal specialist 3. Wind farm operator/Avifaunal specialist

Management Plan for the Decommissioning Phase

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	*Frequency*	*Responsibility*
AVIFAUNA: DISPLACEMENT DUE TO DISTURBANCE ASSOCIATED WITH THE DISMANTLING ACTIVITIES					
The noise and movement associated with the de-commissioning activities at the WEF footprint will be a source of disturbance which would lead to the displacement of avifauna from the area	Prevent unnecessary displacement of avifauna by ensuring that contractors are aware of the requirements of the EMPr.	A site-specific EMPr must be implemented, which gives appropriate and detailed description of how construction activities must be conducted. All contractors are to adhere to the EMPr and should apply good environmental practice during construction. The EMPr must specifically include the following: 1. No off-road driving. 2. Maximum use of existing roads. 3. Measures to control noise and dust according to latest best practice. 4. Restricted access to the rest of the property. 5. Strict application of all recommendations in the biodiversity/vegetation	1. Implementation of the EMPr. Oversee activities to ensure that the EMPr is implemented and enforced via site audits and inspections. Report and record any non-compliance. 2. Ensure that construction personnel are made aware of the impacts relating to off-road driving. 3. Access roads must be demarcated clearly. Undertake site inspections to verify.	1. On a daily basis 2. Monthly 3. Monthly 4. Monthly 5. Monthly	1. Contractor and ECO 2. Contractor and ECO 3. Contractor and ECO 4. Contractor and ECO 5. Contractor and ECO 6. Contractor and ECO

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	*Frequency*	*Responsibility*
		specialist report pertaining to the limitation of the footprint.	4. Monitor the implementation of noise control mechanisms via site inspections and record and report non-compliance. 5. Ensure that the footprint area is demarcated and that construction personnel are made aware of these demarcations. 6. Monitor via site inspections and report non-compliance.		

APPENDIX 8: OPERATIONAL MONITORING PLAN – WEF

1 INTRODUCTION

The avifaunal post-construction monitoring at the proposed WEF must be conducted in accordance with the latest version (2015) of the *Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa* (Jenkins *et al*. 2015)[6].

2 AIM OF POST-CONSTRUCTION MONITORING

The avifaunal post construction monitoring aims to assess the impact of the WEF by comparing pre- and post-construction monitoring data and to measure the extent of bird fatalities caused by the WEF. Post-construction monitoring is therefore necessary to:

- Confirm as far as possible what the actual impacts of the WEF are on avifauna; and
- Determine what mitigation is required if need be (adaptive management).

The proposed post-construction monitoring can be divided into three categories:

- Habitat classification
- Quantifying bird numbers and movements (replicating baseline pre-construction monitoring)
- Quantifying bird mortalities.

Post-construction monitoring will aim to answer the following questions:

- How has the habitat available to birds in and around the WEF changed?
- How has the number of birds and species composition changed?
- How have the movements of priority species changed?
- How has the WEF affected priority species' breeding success?
- How many birds collide with the turbines? And are there any patterns to this?
- What mitigation is necessary to reduce the impacts on avifauna?

3 TIMING

Post-construction monitoring should commence as soon as possible after the first turbines become operational to ensure that the immediate effects of the facility on resident and passing birds are recorded,

[6] Jenkins, A.R., Van Rooyen, C.S., Smallie, J.J., Anderson, M.D., & A.H. Smit. 2015. Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa. Produced by the Wildlife & Energy Programme of the Endangered Wildlife Trust & BirdLife South Africa.

before they have time to adjust or habituate to the development. However, it should be borne in mind that it is also important to obtain an understanding of the impacts of the facility as they would be over the lifespan of the facility. Over time the habitat within the WEF may change, birds may become habituated to, or learn to avoid the facility. It is therefore necessary to monitor over a longer period than just an initial one year.

4 DURATION

Monitoring should take place in Year 1 and 2 of the operational phase, and then repeated in Year 5 and every five years after that. After the first year of monitoring, the programme should be reviewed in order to incorporate significant findings that have emerged. This may entail the revision of the number of turbines to be searched, and the size of the search plots, depending on the outcome of the first year of monitoring. If significant impacts are observed, i.e. exceeding predetermined thresholds, and mitigation is required, the matter should be taken up with the operator to discuss potential mitigation. In such instances the scope of monitoring could be reduced to focus only on the impacts of concern.

5 HABITAT CLASSIFICATION

Any observed changes in bird numbers and movements at a WEF may be linked to changes in the available habitat. The avian habitats available must be mapped at least once a year (at the same time every year), using the same methods which were used during pre-construction.

6 BIRD NUMBERS AND MOVEMENTS

In order to determine if there are any impacts relating to displacement and/or disturbance, all methods used to estimate bird numbers and movements during baseline monitoring must be applied as far as is practically possible in the same way to post-construction work in order to ensure maximum comparability of these two data sets. This includes sample counts of small terrestrial species, counts of large terrestrial species and raptors, focal site surveys and vantage point surveys according to the current best practice.

7 COLLISIONS

The collision monitoring must have three components:

- Experimental assessment of search efficiency and scavenging rates of bird carcasses on the site.
- Weekly searches in the immediate vicinity of the wind farm turbines for collision casualties.
- Estimation of collision rates.

8 SEARCHER EFFICIENCY AND SCAVENGER REMOVAL

The value of surveying the area for collision victims is only valid if some measure of the accuracy of the survey method is developed. The probability of a carcass being detected and the rate of removal/decay of the carcass must be accounted for when estimating collision rates and when designing the monitoring protocol. This must be done in the form of searcher and scavenger trails at least twice a year.

9 COLLISION VICTIM SURVEYS

9.1 Aligning search protocols

The search protocol must be agreed upon between the bat and bird specialists to constitute an acceptable compromise between the current best practice guidelines for bird and bat monitoring.

Searches must begin as early in the mornings as possible to reduce carcass removal by scavengers. A carcass searcher must walk in straight line transects, 6 m apart, covering 3 m on each side. A team of searchers and one supervisor must be trained to implement the carcass searches. The searchers must have a vehicle available for transport per site. The supervisor must assist with the collation of the data at each site and to provide the data to the specialist in electronic format on a weekly basis. The specialists must ensure that the supervisor is completely familiar with all the procedures concerning the management of the data. The following must be loaded on a cloud server on a weekly basis for the avifaunal specialist to access:

- Carcass fatality data (hardcopy and scans as well as data entered into Excel spreadsheets);
- Pictures of any carcasses, properly labelled
- GPS tracks of the search plots walked; and
- Turbine search interval spreadsheets.

When a carcass is found, it must be bagged, labelled and kept refrigerated for species confirmation when the specialist visits the site.

9.2 Estimation of collision rates

Observed mortality rates need to be adjusted to account for searcher efficiency and scavenger removal. There have been many different formulas proposed to estimate mortality rates. The available methodologies must be investigated, and an appropriate method will be applied. The current method which is used widely is the GenEst method.

10 DELIVERABLES

10.1 Annual report

An operational monitoring report must be completed at the end of each year of operational monitoring. As a minimum, the report must attempt to answer the following questions:

- How has the habitat available to birds in and around the WEF changed?
- How has the number birds and species composition changed?

- How have the movements of priority species changed?
- How has the WEF affected priority species' breeding success?
- What are the likely drivers of any changes observed?
- How many, and which species of birds collided with the turbines and
- associated infrastructure? And are there any patterns to this?
- What is the significance of any impacts observed?
- What mitigation measures are required to reduce the impacts?

10.2 Quarterly reports

Concise quarterly reports must be provided with basic statistics and any issues that need to be addressed.

APPENDIX 9: SITE SENSITIVITY VERIFICATION - WEF

RECOINASSANCE REPORT (IN TERMS OF PART B OF THE ASSESSMENT PROTOCOLS PUBLISHED IN GN 320 ON 20 MARCH 2020

Introduction

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 reconnaissance visit has been 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).

Site Sensitivity Verification

The following methods and sources were used to compile this report:

- Bird distribution data from the Southern African Bird Atlas Project 2 (SABAP 2) was obtained (http://SABAP 2.adu.org.za/), in order 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. To get a more representative impression of the birdlife, a consolidated data set was obtained for a total of 17 pentads some of which intersect and others that are near the development area, henceforth referred to as “the broader area”. The decision to include multiple pentads around the development area was influenced by the fact that many of the pentads in the area have few completed full protocol surveys. The additional pentads and their data augment the bird distribution data. The 17 pentad grid cells are the following: 2910_1935, 2910_1940, 2910_1945, 2915_1915, 2915_1920, 2915_1925, 2915_1930, 2915_1935, 2915_1940, 2915_1945, 2920_1915, 2920_1920, 2920_1925, 2920_1930, 2920_1935, 2920_1940 and 2920_1945 (Figure 3). A total of 29 full protocol lists (i.e. bird listing surveys lasting a minimum of two hours each) and 39 ad hoc protocol lists (surveys lasting less than two hours but still yielding valuable data) have been completed to date for the 17 pentads where the development area is located. The SABAP 2 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 on-site surveys conducted between 20-25 June 2020.
- A classification of the vegetation types in the development area was obtained from the Atlas of Southern African Birds 1 (SABAP1) and the National Vegetation Map compiled by the South African National Biodiversity Institute (Mucina & Rutherford 2006).
- Priority species for wind development were identified from the most recent (November 2014) list of priority species for wind farms compiled for the Avian Wind Farm Sensitivity Map (Retief *et al.* 2012).

- 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 (2021.3) 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).
- 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 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:
  - Protocol for the specialist assessment and minimum report content requirements for environmental impacts om avifaunal species by onshore wind energy generation facilities where the electricity output is 20MW or more (Government Gazette No. 43110 – 20 March 2020).
  - Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa. Endangered Wildlife Trust and Birdlife South Africa (Jenkins *et al*. 2015).
- The main source of information on the avifaunal diversity and abundance at the project site and development area is an integrated pre-construction monitoring programme which was implemented at the project site, covering all three proposed Pofadder WEF projects.
- Priority species for wind development were identified from the updated list of priority species for wind farms compiled for the Avian Wind Farm Sensitivity Map (Retief *et al*. 2012).

Outcome Of Site Reconnaissance

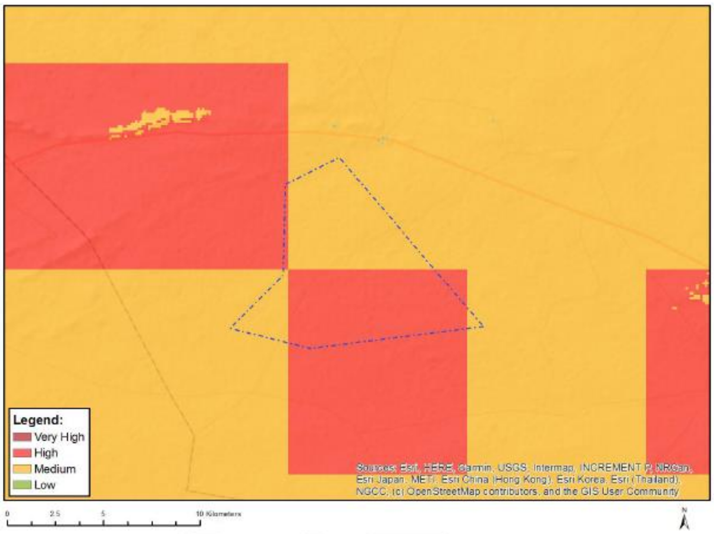
The Project Site and immediate environment is classified as **Medium** and **High** sensitivity for terrestrial animals according to the Terrestrial Animal Species Theme (Figure 4)[7]. The High and Medium sensitivity classifications are linked to Burchell's Courser *Cursorius rufus*, Ludwig's Bustard *Neotis ludwigii* and Secretarybird *Sagittarius serpentarius*. The Project Site contains confirmed habitat for species of conservation concern (SCC) as defined in 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). The classification of high sensitivity is confirmed based on the presence of species of conservation concern (SCC) recorded during onsite surveys and pre-construction monitoring at the project site, namely Verreaux's Eagle *Aquila verreauxii* (SA status: Vulnerable), Lanner Falcon *Falco biarmicus* (SA

[7] The Wind Theme is only applicable to sites within a Renewable Energy Development Zone (REDZ).

status: Vulnerable), Ludwig's Bustard (SA status: Endangered), Lappet-faced Vulture *Torgos tracheliotis* (SA status: Endangered), Karoo Korhaan *Eupodotis vigorsii* (SA status: Near-threatened) and Sclater's Lark *Spizocorys sclater* (SA status: Near-threatened). Furthermore, the development area contains habitat for other SCCs which could potentially occur, namely Martial Eagle *Polemaetus bellicosus* (SA status: Endangered), White-backed Vulture *Gyps africanus* (SA status: Endangered) and Burchell's Courser *Cursorius rufus* (SA status: Vulnerable).

Based on the available SABAP2 data, the Site Sensitivity Verification survey conducted in June 2020, and the four pre-construction monitoring surveys conducted in 2021 - 2022, the classification of **High** sensitivity for avifauna in the screening tool is confirmed for the Project Site and Development Area.

MAP OF RELATIVE ANIMAL SPECIES THEME SENSITIVITY



Where only a sensitive plant unique number or sensitive animal unique number is provided in the screening report and an assessment is required, the environmental assessment practitioner (EAP) or specialist is required to email SANBI at eiadatarequests@sanbi.org.za listing all sensitive species with their unique identifiers for which information is required. The name has been withheld as the species may be prone to illegal harvesting and must be protected. SANBI will release the actual species name after the details of the EAP or specialist have been documented.

Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
	X		

Sensitivity Features:

Sensitivity	Feature(s)
High	Aves-Cursorius rufus
Low	Subject to confirmation
Medium	Aves-Neotis ludwigii
Medium	Aves-Sagittarius serpentarius

Figure 1: The National Web-Based Environmental Screening Tool map of the Project Site, indicating sensitivities for the Terrestrial Animal Species theme. The High and Medium sensitivity classifications are linked to Burchell's Courser *Cursorius rufus*, Ludwig's Bustard *Neotis ludwigii* and Secretarybird *Sagittarius serpentarius.*

Conclusion

Based on the available SABAP2 data, the Site Sensitivity Verification survey conducted in June 2020, and the four pre-construction monitoring surveys conducted in 2021 - 2022, the classification of **High** sensitivity for avifauna in the screening tool is confirmed for the Project Site and Development Area.