Avifaunal Impact Assessment Report

FE Kudu Wind Energy Facility

Aberdeen, Eastern Cape Province

AfriAvian Environmental
Formerly Afrimage Photography t/a Chris van Rooyen Consulting and Albert Froneman Consulting
VAT#: 4580238113
email: albert.froneman@gmail.com
Tel: +27 (0)82 901 4016

August 2023

Albert Froneman (Pr.Sci.Nat)

Albert has a M. Sc. in Conservation Biology from the University of Cape Town and started his career in the natural sciences as a Geographic Information Systems (GIS) specialist at Council for Scientific and Industrial Research (CSIR). He is a registered Professional Natural Scientist in the field of zoological science with the South African Council of Natural Scientific Professionals (SACNASP). In 1998, he joined the Endangered Wildlife Trust where he headed up the Airports Company South Africa – EWT Strategic Partnership, a position he held until he resigned in 2008 to work as a private ornithological consultant. Albert's specialist field is the management of wildlife, especially bird related hazards at airports. His expertise is recognized internationally; in 2005 he was elected as Vice Chairman of the International Bird Strike Committee. Since 2010, Albert has worked closely with Chris van Rooyen in developing a protocol for pre-construction monitoring at wind energy facilities, and they are currently jointly coordinating pre-construction monitoring programmes at several wind farm facilities. Albert also works outside the electricity industry and had done a wide range of bird impact assessment studies associated with various residential and industrial developments.

Dr Megan Loftie-Eaton (Pr.Sci.Nat)

Megan is a registered Professional Natural Scientist with the South African Council of Natural Scientific Professionals (SACNASP) in the field of Ecology, and she is a member of the Zoological Society of Southern Africa (ZSSA). Megan is also a registered Environmental Assessment Practitioner and assists with Environmental Impact Assessments (EIA's), Basic Assessments (BA's) and provides specialist input within the avifaunal and ecological fields. She obtained her BSc in Environmental & Conservation Sciences with distinction through the University of Alberta in Edmonton, Canada. After moving back to South Africa in 2011 she went on to complete her MSc in Zoology (2014) at the University of Cape Town, and her PhD in Biological Sciences (2018), looking at the impacts of bush encroachment on bird distributions in the savanna biome of South Africa. Megan has conducted avifaunal field surveys and has good experience with conducting avifaunal impact assessments.

DECLARATION OF INDEPENDENCE

EXECUTIVE SUMMARY

FE Kudu (Pty) Ltd is proposing the development of a wind energy facility and associated infrastructure on a site located approximately 40km west of Aberdeen in the Eastern Cape Province. The project is located within the Dr Beyers Naudè Local Municipality and the greater Sarah Baartman District Municipality. The project site comprises a single affected property, Portion 2 of Farm Oorlogspoort 85. The project is known as the FE Kudu Wind Energy Facility. The project is planned as part of a cluster of renewable energy projects, which includes a second facility, FE Tango Wind Energy Facility, located approximately 20km to the east of the site.

The entire extent of the site falls within the Beaufort West Renewable Energy Development Zones (i.e. REDZ Focus Area 11). The undertaking of a basic assessment process for the project is in-line with the requirements stated in GNR 114 of 16 February 2018.

The FE Kudu Wind Energy Facility will have a contracted capacity of up to 600MW and comprise wind turbines with a capacity of up to 7.5MW each. The project has a preferred project site of approximately ~9 170ha. Access to the site will be via an existing road off of the nearby R61.

The FE Kudu Wind Energy Facility project site is proposed to accommodate the following infrastructure:

» Up to 80 wind turbines, turbine foundations and turbine hardstands
» An on-site substation hub incorporating:
  - A132kV on-site facility substation
  - Switchyard with collector infrastructure
  - Battery Energy Storage System (BESS)
  - Operation and Maintenance buildings
» A balance of plant area incorporating:
  - Temporary laydown areas
  - A construction camp laydown and temporary concrete batching plant
» Power lines internal to the wind farm, trenched and located adjacent to internal access roads, where feasible[1].
» Access roads to the site and between project components with a width up to 8m for primary access routes.

A technically viable development footprint was proposed by the developer and assessed as part of the studies.

The details of the project is as follows:

Project Name	FE Kudu Wind Energy Facility
Location	Portion 2 of Farm Oorlogspoort 85
Applicant	FE Kudu (Pty) Ltd
Contracted capacity	Up to 600MW (turbines up to 7.5MW in capacity)
Number of turbines	Up to 80 turbines[2]
Turbine hub height	Up to 164m

[1] The intention is for internal project cabling to follow the internal roads.

[2] 42 north turbines, and 41 south turbines

Turbine top tip height	Up to 250m
Rotor swept area	up to 21m^2
Capacity of on-site substation	132kV
Area occupied by the on-site substation	~ 2ha in extent
Underground cabling	Underground cabling, with a capacity of 33kV, will be installed to connect the turbines to the on-site facility substation.
Battery Energy Storage System (BESS)	Solid state battery technology (e.g. Lithium-ion technology) as a preferred technology. BESS will be housed in containers approximately 20m long, 3m wide, and 5m high with an approximate footprint of up to 5ha.
Operation and maintenance (O&M) buildings	~ 1ha in extent
Balance of plant area	Temporary laydown areas with an extent up to 6ha. Temporary warehouse of 1ha Temporary site camp establishment and concrete batching plants of 1ha.
Access and internal roads – Main road	Main access road to the site and between project components with a width up to 8m and a servitude of 13.5m.
Access and internal roads – internal network	Road network between project components with a width up to 8m
Turbine hardstand	~up to 7500m^2 per turbine
Turbine foundation	~ 1000m^2 per turbine

The project is intended to provide electricity to the national grid through the Department of Mineral Resource and Energy's (DMRE) Renewable Energy Independent Power Producer Procurement (REIPPP) Programme or other public or private off-taker programmes.

1 AVIFAUNA IN THE STUDY AREA

The SABAP2 data indicates that a total of 194 bird species could potentially occur within the Broader Area – **Appendix C** provides a comprehensive list of all the species. Of these, 28 species are classified as priority species for wind energy developments (see definition of priority species in Section 1.3) and 14 of these are South African Red List species. Of the 28 priority species, 17 are likely to occur regularly in the Project Site (**Table 2**).

2 SUMMARY OF FINDINGS

The proposed FE Kudu WEF will have several potential impacts on priority avifauna. The impacts are the following:

- Collision mortality with the wind turbines
- Displacement due to disturbance
- Displacement due to habitat transformation
- Electrocution on the 33kV MV overhead cables and in the substation yard.
- Mortality due to collisions with the 33kV overhead lines.

2.1 Displacement of priority species due to disturbance and habitat transformation

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. Species that fall in this category are Ludwig’s Bustard, Blue Crane, Karoo Korhaan, Southern Black Korhaan, and Spotted Eagle-Owl. Some raptors might also be affected, e.g., Greater Kestrel which often breeds on crow nests that have been constructed on wind pumps. Some species might be able to recolonise the area after the completion of the construction phase, but for other species this might only be partially the case, resulting in lower densities than before once the wind farm is operational, due to the disturbance factor of the operational turbines. In summary, the following species could be impacted by disturbance during the construction phase: African Harrier-Hawk, African Rock Pipit, Black Harrier, Black Stork, Black-winged Kite, Blue Crane, Booted Eagle, Brown Snake Eagle, Burchell's Courser, Double-banded Courser, Greater Kestrel, Grey-winged Francolin, Jackal Buzzard, Karoo Korhaan, Kori Bustard, Lanner Falcon, Ludwig's Bustard, Martial Eagle, Pale Chanting Goshawk, Sclater's Lark, Secretarybird, Southern Black Korhaan, Spotted Eagle-Owl, Verreaux's Eagle.

The identified turbine exclusion zones were shared with the applicant and most of these areas are avoided by the facility layout. An adjusted layout was designed in response to WTG N20 being located within an avifaunal turbine exclusion zone and this WTG was relocated as a mitigation strategy to reduce the impact on avifauna in the area.

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, Blue Crane, Southern Black Korhaan, and Karoo Korhaan. Given the expected density of the proposed turbine layout and associated road infrastructure, it is not expected that any priority species will be permanently displaced from the Project Site. The building infrastructure and substation 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 footprint. In summary, the following species are likely to be affected by habitat transformation: African Rock Pipit, Blue Crane, Burchell's Courser, Double-banded Courser, Grey-winged Francolin, Karoo Korhaan, Kori Bustard, Ludwig's Bustard, Sclater's Lark, Secretarybird, and Southern Black Korhaan.

2.2 Mortality of priority species due to collisions with the wind turbines

The proposed FE Kudu WEF will pose a collision risk to several priority species which could regularly occur at the site. Species exposed to this risk are large terrestrial species i.e., mostly bustards such as Karoo Korhaan, Southern Black Korhaan, Ludwig’s Bustard, Kori Bustard, and Blue Crane, although bustards and cranes 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, Lanner Falcon, Booted Eagle, Verreaux’s Eagle, Greater Kestrel, and Lesser Kestrel are most at risk of all the priority species that are likely to occur at the project site. In summary, the following priority species could be at risk of collisions with the turbines: African Harrier-Hawk, Amur Falcon, Black Harrier, Black Stork, Black-winged Kite, Blue Crane, Booted Eagle, Brown Snake Eagle, Burchell's Courser, Common Buzzard, Double-banded Courser, Greater Kestrel, Grey-winged Francolin, Jackal Buzzard, Karoo Korhaan, Kori Bustard, Lanner Falcon, Lesser Kestrel, Ludwig's Bustard, Martial Eagle, Pale Chanting Goshawk, Sclater's Lark, Secretarybird, Southern Black Korhaan, Spotted Eagle-Owl, Verreaux's Eagle, and White Stork.

The identified turbine exclusion zones were shared with the applicant and most of these areas are avoided by the facility layout. An adjusted layout was designed in response to WTG N20 being located within an avifaunal turbine exclusion zone and this WTG was relocated as a mitigation strategy to reduce the impact on avifauna in the area.

2.3 Mortality of priority species due to electrocutions on the 33kV MV reticulation network and in the substation yard

While the intention is to place the medium voltage 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. In summary, the following priority species could be vulnerable to electrocution: African Harrier-Hawk, Amur Falcon, Black Harrier, Black Stork, Black-winged Kite, Booted Eagle, Brown Snake Eagle, Common Buzzard, Greater Kestrel, Jackal Buzzard, Lanner Falcon, Lesser Kestrel, Martial Eagle, Pale Chanting Goshawk, Spotted Eagle-Owl, and Verreaux's Eagle. Electrocutions within the proposed substation yard are also possible, particularly smaller species such as Greater Kestrel and Spotted Eagle-Owl but should not affect the larger Red Data raptors such as Martial Eagle, as these species are unlikely to use the infrastructure within the substation yard for perching or roosting.

2.4 Mortality of priority species due to collisions with the 33kV overhead lines

While the intention is to place the majority of the medium voltage reticulation network underground at the wind farm, there are areas where the lines will run above ground. Priority species which are most at risk of collisions with the medium voltage powerlines are the following: Black Stork, Blue Crane, Karoo Korhaan, Kori Bustard, Ludwig's Bustard, Secretarybird, Southern Black Korhaan, Spotted Eagle-Owl, Verreaux's Eagle, and White Stork. In particular, large dams and agricultural fields are high-risk areas.

2.5 Conclusions

The investigations into the potential impacts on avifauna, including the avifaunal pre-construction monitoring by means of four surveys in the period January 2021 to January 2022, have not revealed any fatal flaws which stand in the way of the development of the proposed WEF. <u>However, this conclusion is subject to the implementation of the recommendations listed in this report.</u>

2.6 Cumulative Impacts

The total affected land parcel area taken up by other authorised renewable energy projects within a 30 km radius is approximately 145 km². The total land parcel area affected by the FE Kudu Wind Energy Facility equates to approximately 91.7 km². The combined land parcel area affected by authorised renewable energy developments within a 30 km radius of similar habitat around the proposed FE Kudu Wind Energy Facility, inclusive of the FE Kudu Wind Energy Facility, thus equals approximately 236.7 km². Of this, the proposed FE Kudu WEF project constitutes ~39% (91.7 km²). The cumulative impact of the proposed FE Kudu WEF is thus anticipated to be **low** to **moderate** <u>after mitigation</u>.

The total area within a 30km radius around the proposed projects equates to about 2827.4 km² of similar habitat. The total combined size of the land parcels potentially affected by renewable energy projects will equate to ~8.4% of the available untransformed habitat in a 30km radius. However, the actual physical footprint of the renewable energy facilities will be smaller than the land parcel areas themselves. Furthermore, each of these projects must still be subject to a competitive bidding process where only the most competitive projects will win a power purchase agreement required for the project to proceed to construction. The cumulative impact of all the proposed renewable energy projects is, therefore, estimated to be **moderate**.

3 CONCLUDING STATEMENT

The proposed FE Kudu WEF will have a medium impact on avifauna which, in most instances, could be reduced to a low impact through the appropriate mitigation measures. The current proposed 80-turbine layout assessed in this report avoids all the recommended avifaunal turbine exclusion zones (including rotor-swept areas) and is therefore deemed acceptable; turbine N20 has been micro-sited to avoid the recommended avifaunal sensitivity buffer. The development is supported, provided the mitigation measures listed in this report are strictly applied. See **Figure i** and **Appendix E** for a map of the exclusion areas.

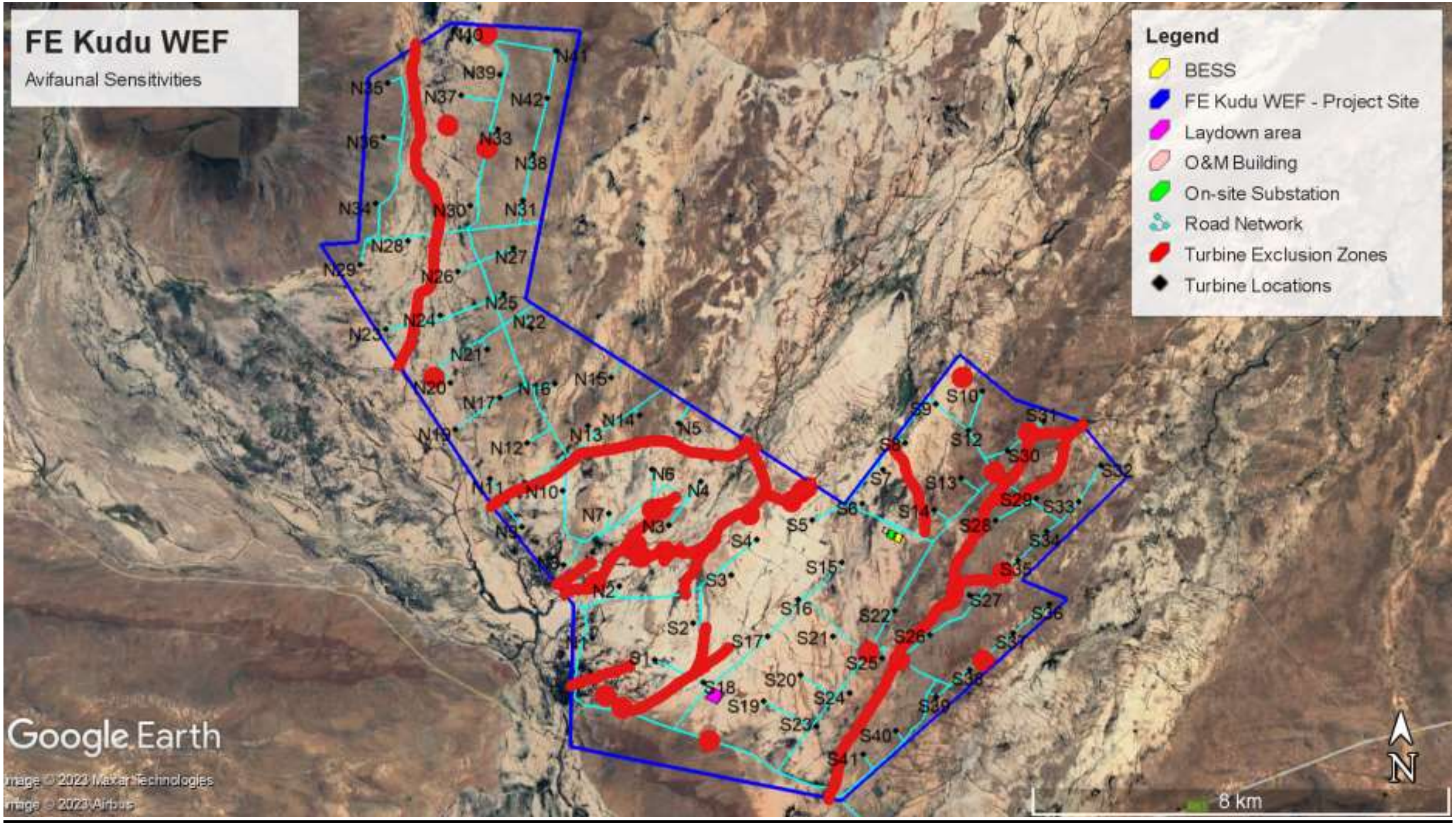


Figure i: Avifaunal sensitivities identified for the proposed FE Kudu WEF Project.

CONTENTS

1. INTRODUCTION

FE Kudu (Pty) Ltd is proposing the development of a wind energy facility and associated infrastructure on a site located approximately 40km west of Aberdeen in the Eastern Cape Province. The project is located within the Dr Beyers Naude Local Municipality and the greater Sarah Baartman District Municipality. The project site comprises a single affected property, Portion 2 of Farm Oorlogspoort 85. The project is known as the FE Kudu Wind Energy Facility. The project is planned as part of a cluster of renewable energy projects, which includes a second facility, FE Tango Wind Energy Facility, located approximately 20km to the east of the site.

The entire extent of the site falls within the Beaufort West Renewable Energy Development Zones (i.e. REDZ Focus Area 11). The undertaking of a basic assessment process for the project is in-line with the requirements stated in GNR 114 of 16 February 2018.

The FE Kudu Wind Energy Facility will have a contracted capacity of up to 600MW and comprise wind turbines with a capacity of up to 7.5MW each. The project has a preferred project site of approximately ~9 170ha. Access to the site will be via an existing road off of the nearby R61. The FE Kudu Wind Energy Facility project site is proposed to accommodate the following infrastructure:

» Up to 80 wind turbines, turbine foundations and turbine hardstands
» An on-site substation hub incorporating:
  - A132kV on-site facility substation
  - Switchyard with collector infrastructure
  - Battery Energy Storage System (BESS)
  - Operation and Maintenance buildings
» A balance of plant area incorporating:
  - Temporary laydown areas
  - A construction camp laydown and temporary concrete batching plant
» Power lines internal to the wind farm, trenched and located adjacent to internal access roads, where feasible[3].
» Access roads to the site and between project components with a width up to 8m for primary access routes.

A technically viable development footprint was proposed by the developer and assessed as part of the studies.

The details of the project is as follows:

Project Name	FE Kudu Wind Energy Facility
Location	Portion 2 of Farm Oorlogspoort 85
Applicant	FE Kudu (Pty) Ltd
Contracted capacity	Up to 600MW (turbines up to 7.5MW in capacity)
Number of turbines	Up to 80 turbines[4]
Turbine hub height	Up to 164m
Turbine top tip height	Up to 250m
Rotor swept area	up to 21 000m^2

[3] The intention is for internal project cabling to follow the internal roads.

[4] 42 north turbines, and 41 south turbines

Capacity of on-site substation	132kV
Area occupied by the on-site substation	~ 2ha in extent
Underground cabling	Underground cabling, with a capacity of 33kV, will be installed to connect the turbines to the on-site facility substation.
Battery Energy Storage System (BESS)	Solid state battery technology (e.g. Lithium-ion technology) as a preferred technology. BESS will be housed in containers approximately 20m long, 3m wide, and 5m high with an approximate footprint of up to 5ha.
Operation and maintenance (O&M) buildings	~ 1ha in extent
Balance of plant area	Temporary laydown areas with an extent up to 6ha. Temporary warehouse of 1ha Temporary site camp establishment and concrete batching plants of 1ha.
Access and internal roads – Main road	Main access road to the site and between project components with a width up to 8m and a servitude of 13.5m.
Access and internal roads – internal network	Road network between project components with a width up to 8m
Turbine hardstand	~up to 7500m^2 per turbine
Turbine foundation	~ 1000m^2 per turbine

The project is intended to provide electricity to the national grid through the Department of Mineral Resource and Energy's (DMRE) Renewable Energy Independent Power Producer Procurement (REIPPP) Programme or other public or private off-taker programmes.

See **Figure 1** for a map of the proposed layout of the WEF.

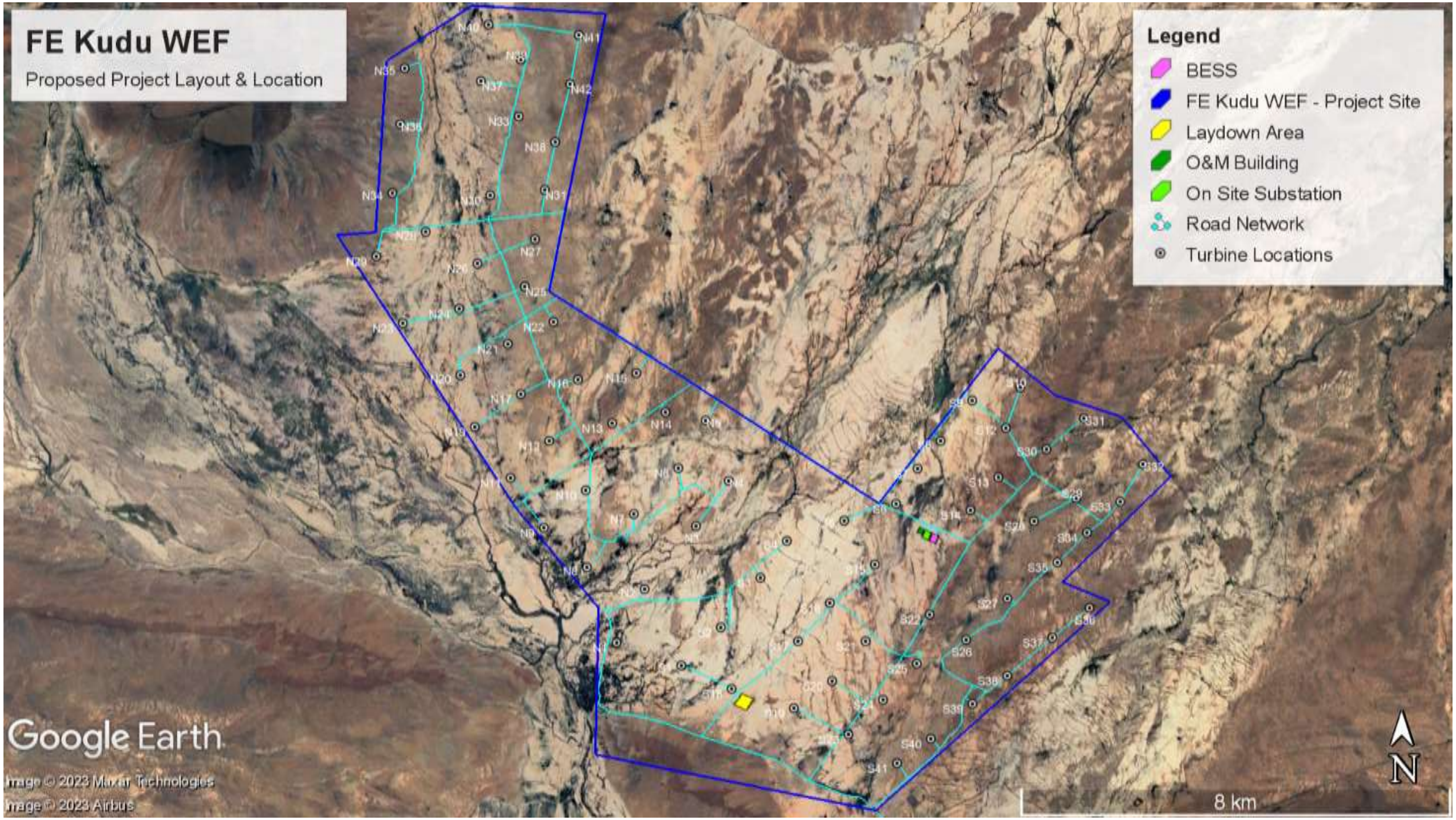


Figure 1: Layout of proposed FE Kudu WEF.

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 acceptable an avifaunal perspective; and
- If not acceptable recommend mitigation measures to reduce the expected impacts.

1.2 Sources of Information

The following information sources were consulted to conduct this study:

- Bird distribution data from the Second Southern African Bird Atlas Project (SABAP2) was obtained (https://sabap2.birdmap.africa/) to ascertain which species occur in the pentads where the proposed Project is located. A pentad grid cell covers 5 minutes of latitude by 5 minutes of longitude (5' × 5'). Each pentad is approximately 9 × 8 km in size. To get a representative impression of the bird species in the area a consolidated dataset was obtained for a total of nine (9) pentads some of which intersect and others that are near the Project Site, henceforth referred to as "the Broader Area" (**Figure 2**). The nine pentad grid cells are the following: 3220_2325, 3220_2330, 3220_2335, 3225_2325, 3225_2330, 3225_2335, 3230_2325, 3230_2330, and 3230_2335. A total of 118 full protocol lists (i.e. bird listing surveys lasting a minimum of two hours each) and 98 ad hoc protocol lists (surveys lasting less than two hours but still yielding valuable data) have been completed to date for the 6 pentads where the Project Site is located.
- The SABAP2 data was regarded as a reliable reflection of the avifauna which occurs in the Broader Area, but the data was also supplemented with data collected during the on-site surveys and with general knowledge of the area.
- A classification of the vegetation types in the Project Site was obtained from the First Atlas of Southern African Birds (SABAP1) and the National Vegetation Map (2018) compiled by the South African National Biodiversity Institute (Mucina & Rutherford 2006).
- The national threatened status of all priority species was determined with the use of the most recent edition of the Red List Book of Birds of South Africa, Lesotho and Swaziland (Taylor *et al.* 2015), and the latest authoritative summary of southern African bird biology (Hockey *et al.* 2005).
- The global threatened status of all priority species was determined by consulting the latest (2022.2) 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 © 2023) 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 Project Site relative to National Protected Areas.
- The DFFE National Screening Tool was used to determine the assigned avian sensitivity of the Project Site.
- The following sources were consulted to determine the investigation protocol that is required for the site:
    - Procedures for the Assessment and Minimum criteria for reporting on identified environmental themes in terms of sections 24(5)(a) and (h) and 44 of NEMA when applying for Environmental Authorisation (Gazetted October 2020)

- 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).
    - 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 Project Sites in southern Africa. Produced by the Wildlife & Energy Programme of the Endangered Wildlife Trust & BirdLife South Africa.
- The primary source of information on avifaunal diversity, abundance, and flight patterns at the site are the results of a pre-construction monitoring programme conducted over four seasons (between (January 2021 to January 2022) at the proposed FE Kudu WEF Project Site. The primary methods of data capturing were walk transect counts, drive transect counts, vantage point watches and incidental sightings (See **Appendix A**).

Figure 2: The Broader Area covered by the nine SABAP2 pentads.

1.3 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 SABAP2 dataset is a comprehensive dataset which provides a reasonably accurate snapshot of the avifauna which could occur at the proposed site. For purposes of completeness, the list of species that could be encountered was supplemented with personal observations, general knowledge of the area, and the results of the pre-construction monitoring conducted at the Project Site.
- Conclusions in this 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 of wind farms 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. The principle was implemented in an international treaty as early as the 1987 Montreal Protocol and, among other international treaties and declarations, is reflected in the 1992 Rio Declaration on Environment and Development. 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."
- According to the specifications received from the proponent, the 33kV medium-voltage lines will be buried where practically feasible. It was therefore assumed that there could be 33kV overhead lines which could pose an electrocution risk to priority species.
- The Development Area is area (located within the Project Site) where the FE Kudu WEF is planned to be located. This area has been selected as a practicable option for the facility, considering technical preference and constraints. The Development Area is ~9170 ha in extent.
- The broader area refers to the area covered by the six SABAP2 pentads (see Figure 3).
- Priority species for wind developments were identified from the updated list of priority species for wind farms compiled for the Avian Wind Farm Sensitivity Map (Retief *et al*. 2012).

2 LEGISLATIVE CONTEXT

2.1 Agreements and Conventions

Table 1 below lists agreements and conventions which South Africa is party to, and which is directly relevant to the conservation of avifauna (BirdLife International 2021).

Table 1: 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	Global

Convention Name	Description	Geographic Scope
	biological diversity The fair and equitable sharing of the benefits arising out of the utilization of genetic resources.	
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 States through which migratory animals pass, the Range States, and lays the legal foundation for internationally coordinated conservation measures throughout a migratory range.	Global
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

2.2 National Legislation

2.2.1 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.

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

The National Environmental Management Act (Act No. 107 of 1998) (NEMA) 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 of Environmental Impacts on Avifauna by Onshore Wind and/or Solar PV Energy Generation Facilities where the Electricity Output is 20 MW or more published on 20 March 2020 (GG 43110 / GNR 320, 20 March 2020). This protocol replaces the requirements of Appendix 6 of the 2014 NEMA EIA Regulations (as amended).

2.2.3 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.

2.3 Provincial Legislation

The current legislation applicable to the conservation of fauna and flora in the Eastern Cape is the Draft Eastern Cape Environmental Management Bill. The Draft Eastern Cape Environmental Management Bill, 2019 was published in the Eastern Cape Provincial Gazette for comment on 22 July 2019.

Its professed objectives are to rationalize, consolidate and reform the law regulating environmental management and to provide for the harmonisation of provincial legislation with national legislation regulating protected areas, biodiversity, waste management and air quality; and to provide for matters connected therewith.

It is proposed in the draft bill that the following Acts applying in the Eastern Cape are repealed:

- Nature and Environmental Conservation Ordinance, 1974
- Nature Conservation Act, 1987 (Ciskei)
- Environmental Conservation Decree, 1992 (Transkei)
- Mountain Catchment Areas Act, 1970

2.4 Best Practice Guidelines

The pre-construction monitoring was designed according to the following best practice guidelines (hereafter referred to as the wind guidelines):

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 Project Sites in southern Africa.* Produced by the Wildlife & Energy Programme of the Endangered Wildlife Trust & BirdLife South Africa.

No species of conservation concern that have specific guidelines that apply to them, were recorded on site, therefore species specific guidelines were not required.

3. DESCRIPTION OF THE AFFECTED ENVIRONMENT

3.1 Natural Environment

The Project Site falls within the Nama-Karoo Biome (Mucina & Rutherford 2006). The Nama-Karoo covers an extensive part of the south-central plateau of South Africa – an area of 248 284 km^2 (Mucina and Rutherford, 2006). The biome is characterized by low rainfall (70 to 500 mm per year) that falls mostly in late summer (Mucina & Rutherford 2006) resulting in a high summer aridity index (Rutherford & Westfall 1985). The biome is classified as arid (Mucina & Rutherford 2006). Summers are hot (maximum >30^oC), winters are cold (minimum close to 0^oC) and frost is common. The vegetation of the Nama-Karoo is dominated by chamaephytes (low-growing shrubs) and hemicryptophytes (graminoids) in a grassy, dwarf shrubland.

The main vegetation types within the Project Site are Southern Karoo Riviere (Inland Saline Vegetation Bioregion) and Eastern Lower Karoo (Lower Karoo Bioregion) (**Figure 3**). The Southern Karoo Riviere vegetation type occurs along the rivers of the semi-arid regions of the Nama-Karoo. It is dominated by *Vachellia karroo* trees and is tolerant of severe flooding. Associated species include *Diospyros dichrophylla*, *Lycium oxycarpum*, *Cenchrus ciliaris* and *Gymnosporia heterophylla*. The Eastern Lower Karoo is characterised by flat plains interrupted by some dolerite dykes, butts, and mesas (koppies). The dominant vegetation is low to middle-height microphyllous shrubland with drought-resistant 'white' grasses becoming abundant in places, especially on sandy and silty bottomlands. Leaf-succulent dwarf shrubs of the families Aizoaceae and Crassulaceae can also be encountered.

The Project Site also contains several non-perennial rivers (**Figure 4**) with their associated drainage line woody vegetation. These areas are of particular importance to avifauna for roosting, nesting, and foraging. Raptors may also use these areas to hunt other bird species.

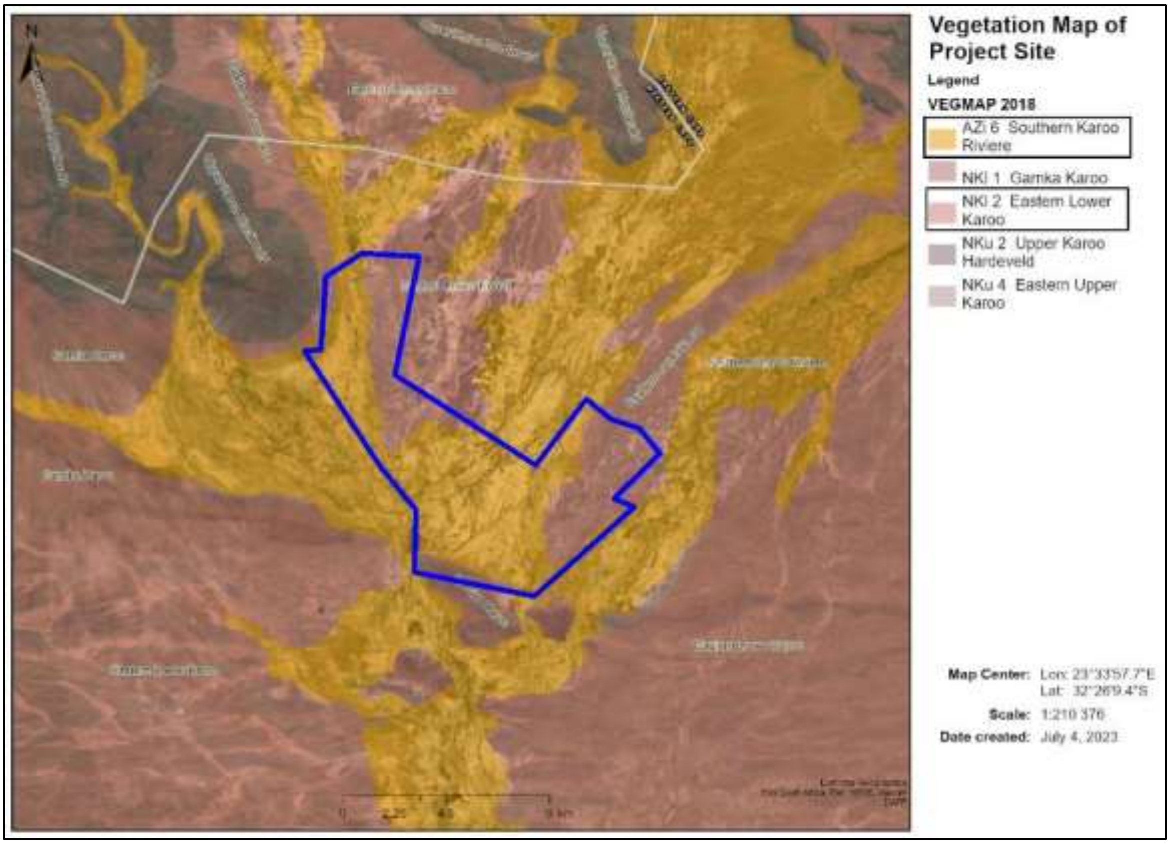


Figure 3: Vegetation types in and near the Project Site (outlined in blue).

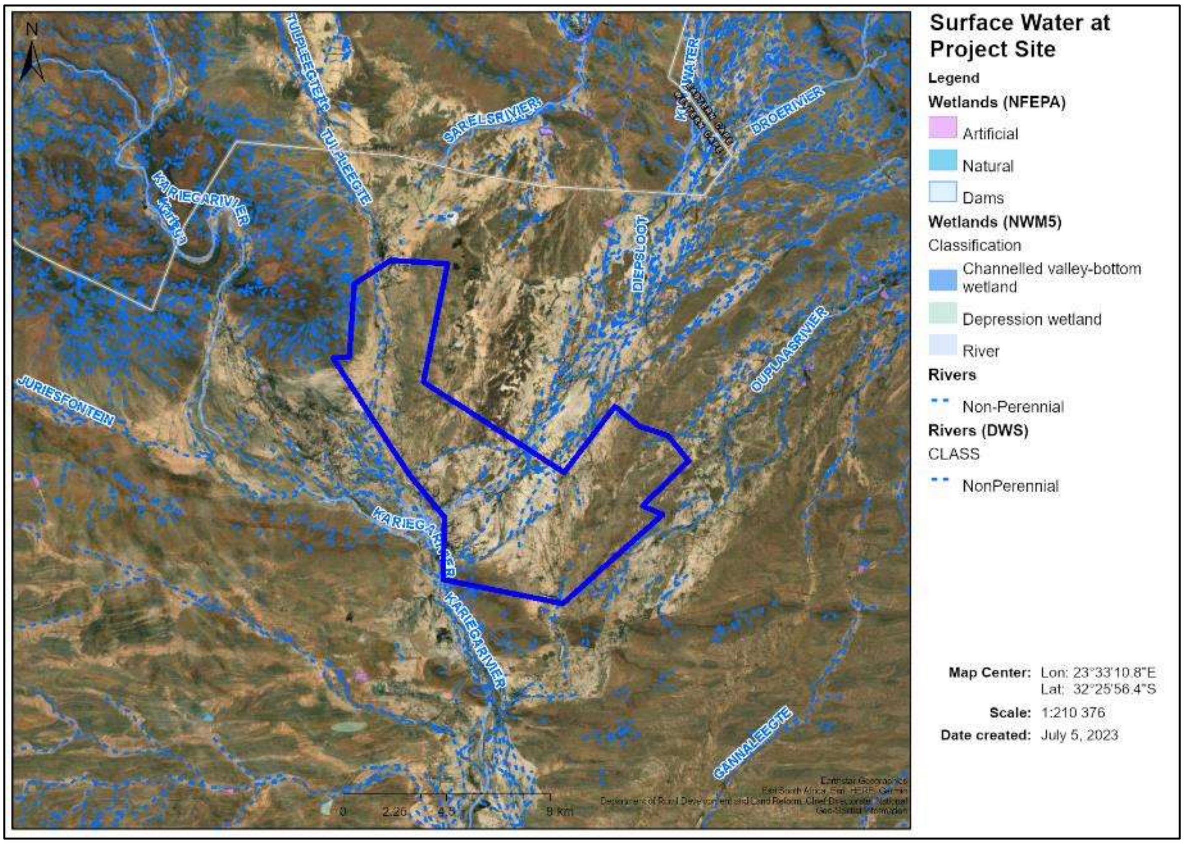


Figure 4: Surface water features in and near the Project Site (outlined in blue).

3.2 Modified Environment

Whilst the distribution and abundance of the bird species in and near the Project Site is mostly associated with natural vegetation, as this comprises virtually all the habitat, it is also necessary to examine some of the man-made modifications to the environment that have relevance for birds.

The following avifaunal-relevant anthropogenic habitat modifications were recorded within the Project Site:

- **Surface Water:** The Project Site contains sources of permanent surface water, namely, boreholes with water troughs, or cement dams. There are also several ground dams. The land use in the broader area is mostly small stock and game farming. The entire area is divided into large grazing camps, with associated boreholes and drinking troughs. In this arid environment, open water is a big drawcard for birds which use the open water troughs to bath and drink.
- **Alien Trees:** The Project Site is generally devoid of trees, except for isolated clumps of trees at homesteads and boreholes, where a mixture of alien and indigenous trees grow. The trees could attract a variety of bird species for the purposes of nesting and roosting.
- **Agriculture:** The land use in the broader area is mostly small stock (sheep) and game farming. The Project Site and nearby areas contain irrigated fields, usually lucerne, or planted grazing pasture for sheep. Birds could utilise these areas for foraging.

Appendix B provides a photographic record of the habitats in and near the Project Site.

3.3 Important Bird Areas (IBAs)

There are no Important Bird Areas (IBAs) within a 50km radius of the proposed FE Kudu WEF. The closest IBAs to the Project Site are the Karoo National Park IBA SA102, 83km west of the Project Site, and the Camdeboo National Park SA090, 85km east of the Project Site. It is therefore highly unlikely that the proposed development will have a negative impact on these IBAs due to the distance from the Project Site.

3.4 The DFFE National Screening Tool

The Project Site and immediate environment is classified as **HIGH** sensitivity for avifauna according to the Animal Species Theme (**Figure 5**). The sensitivity classification is linked to the possible occurrence of Ludwig's Bustard *Neotis ludwigii* (Globally and Regionally Endangered) and Southern Black Korhaan *Afrotis afra* (Globally and Regionally Vulnerable). The Project Site contains confirmed habitat for species of conservation concern (SCC) as defined in the Protocol for specialist assessments 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). SCCs are listed on the IUCN Red List of Threatened Species or South Africa's National Red List website as Critically Endangered, Endangered or Vulnerable.

The occurrence of SCC at the Project Site was confirmed during the 12-month pre-construction monitoring programme (January 2021 to January 2022) with observations of Ludwig's Bustard, Blue Crane *Grus paradisea* (Globally Vulnerable and Regionally Near-threatened), Karoo Korhaan *Eupodotis vigorsii* (Regionally Near-threatened), Kori Bustard *Ardeotis kori* (Globally and Regionally Near-threatened), Martial Eagle *Polemaetus bellicosus* (Globally and Regionally Endangered), Southern Black Korhaan, Sclater's Lark *Spizocorys sclateri* (Globally and Regionally Near-threatened), and Lanner Falcon *Falco biarmicus* (Regionally Vulnerable) recorded on-site. Based on the confirmed habitat and the field surveys, the classification of **HIGH** sensitivity for avifauna in the Screening Tool is therefore supported.

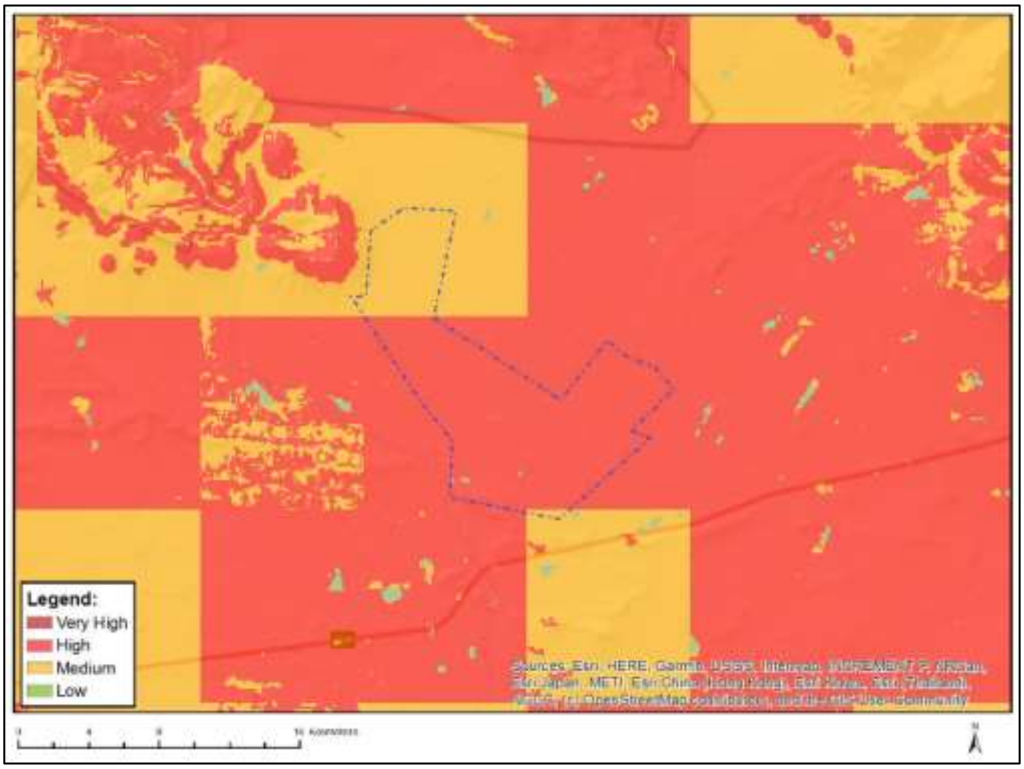


Figure 5: The classification of the FE Kudu WEF Project Site according to the animal species theme in the DFFE National Screening Tool. The High and Medium sensitivity classification is linked to the potential occurrence of Ludwig's Bustard (Globally and Regionally Endangered) and Southern Black Korhaan (Globally and Regionally Vulnerable).

4. AVIFAUNA IN THE STUDY AREA

The SABAP2 data indicates that a total of 194 bird species could potentially occur within the Broader Area – **Appendix C** provides a comprehensive list of all the species. Of these, 28 species are classified as priority species for wind energy developments (see definition of priority species in Section 1.3) and 14 of these are South African Red List species. Of the 28 priority species, 17 are likely to occur regularly in the Project Site (**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 WEF. The following abbreviations and acronyms are used:

Conservation Status: NT = Near Threatened, VU = Vulnerable, EN = Endangered
Probability of Occurrence: H = High, M = Medium, L = Low

Table 2: Priority species potentially occurring at the Project Site (Red List species are shaded yellow).

Species Name	Scientific Name	SABAP2 Reporting Rate %		Global Status	Regional Status	Recorded during monitoring	Likelihood of Regular Occurrence	Nama Karoo Shrubland	Drainage Line Woodland	Surface Water – Dams & Boreholes	Alien Trees	Agriculture	Wind - Collision with turbines	Wind - Displacement: habitat transformation	Wind - Displacement: disturbance	Powerline - Electrocution MV	Powerline - Collision
		Full Protocol	Ad hoc Protocol														
African Harrier-Hawk	*Polyboroides typus*	0,85	0,00	-	-		L		x		x		x		x	x	
African Rock Pipit	*Anthus crenatus*	3,39	0,00	NT	NT		L	x						x	x		
Amur Falcon	*Falco amurensis*	1,69	0,00	-	-		L	x		x	x	x	x			x	
Black Harrier	*Circus maurus*	2,54	0,00	EN	EN		L		x		x		x		x	x	
Black Stork	*Ciconia nigra*	0,85	0,00	-	VU		L			x			x		x	x	x
Black-winged Kite	*Elanus caeruleus*	0,85	3,06	-	-		L	x		x	x	x	x		x	x	
Blue Crane	*Grus paradisea*	17,80	15,31	VU	NT	x	H	x		x		x	x	x	x		x
Booted Eagle	*Hieraaetus pennatus*	5,08	0,00	-	-	x	M	x	x		x		x		x	x	
Brown Snake Eagle	*Circaetus cinereus*	0,00	0,00	-	-	x	M	x	x	x	x		x		x	x	
Burchell's Courser	*Cursorius rufus*	3,39	1,02	-	VU		L	x				x	x	x	x		
Common Buzzard	*Buteo buteo*	5,93	8,16	-	-	x	M	x		x	x	x	x			x	
Double-banded Courser	*Rhinoptilus africanus*	27,12	4,08	-	-	x	H	x				x	x	x	x		
Greater Kestrel	*Falco rupicoloides*	8,47	3,06	-	-	x	M	x			x	x	x		x	x	
Grey-winged Francolin	*Scleroptila afra*	0,85	0,00	-	-		L	x					x	x	x		
Jackal Buzzard	*Buteo rufofuscus*	2,54	0,00	-	-	x	M	x		x	x	x	x		x	x	
Karoo Korhaan	*Eupodotis vigorsii*	65,25	23,47	-	NT	x	H	x				x	x	x	x		x

Species Name	Scientific Name	SABAP2 Reporting Rate %		Global Status	Regional Status	Recorded during monitoring	Likelihood of Regular	Nama Karoo Shrubland	Drainage Line Woodland	Surface Water – Dams & Boreholes	Alien Trees	Agriculture	Wind - Collision with turbines	Displacement: habitat	Wind - Displacement:	Powerline - Electrocution MV	Powerline - Collision
Kori Bustard	*Ardeotis kori*	16,10	2,04	NT	NT	x	H	x				x	x	x	x		x
Lanner Falcon	*Falco biarmicus*	10,17	7,14	-	VU	x	M	x		x	x	x	x		x	x	
Lesser Kestrel	*Falco naumanni*	0,85	2,04	-	-		L	x		x		x	x			x	
Ludwig's Bustard	*Neotis ludwigii*	33,90	5,10	EN	EN	x	H	x				x	x	x	x		x
Martial Eagle	*Polemaetus bellicosus*	0,85	0,00	EN	EN	x	M	x		x	x		x		x	x	
Pale Chanting Goshawk	*Melierax canorus*	50,00	6,12	-	-	x	H	x		x	x	x	x		x	x	
Sclater's Lark	*Spizocorys sclateri*	6,78	3,06	NT	NT	x	L	x						x	x		
Secretarybird	*Sagittarius serpentarius*	6,78	1,02	EN	VU		M	x	x	x		x	x	x	x		x
Southern Black Korhaan	*Afrotis afra*	21,19	4,08	VU	VU	x	H	x				x	x	x	x		x
Spotted Eagle-Owl	*Bubo africanus*	13,56	5,10	-	-	x	H	x	x		x		x		x	x	x
Verreaux's Eagle	*Aquila verreauxii*	3,39	3,06	-	VU		L	x					x		x	x	x
White Stork	*Ciconia ciconia*	0,85	0,00	-	-		L			x		x	x				x

4.1 Results of Bird Monitoring

Table 3, Figures 6 and 7 below present the results of the pre-construction monitoring conducted at the Project Site and a Control Site. The monitoring surveys were conducted by two field monitors in the following time periods:

- Survey 1: 21 – 25 January 2021
- Survey 2: 24 – 30 April 2021
- Survey 3: 06 – 12 September 2021
- Survey 4: 21 – 30 November 2021, and 08 – 11 January 2022

4.1.1 Transects

The results of the transect counts in the Project Site are presented in **Table 3** below:

Table 3: The results of the transect counts.

TURBINE SITE	
Species Composition	
All Species	69
Priority Species (6%)	4
Non-Priority Species	65
Total Count	
Drive transects	1428
Walk transects	1040
	2468
CONTROL SITE	
Species Composition	
All Species	67
Priority Species (12%)	8
Non-Priority Species	59
Total Count	
Drive transects	1251
Walk transects	412
	1663

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

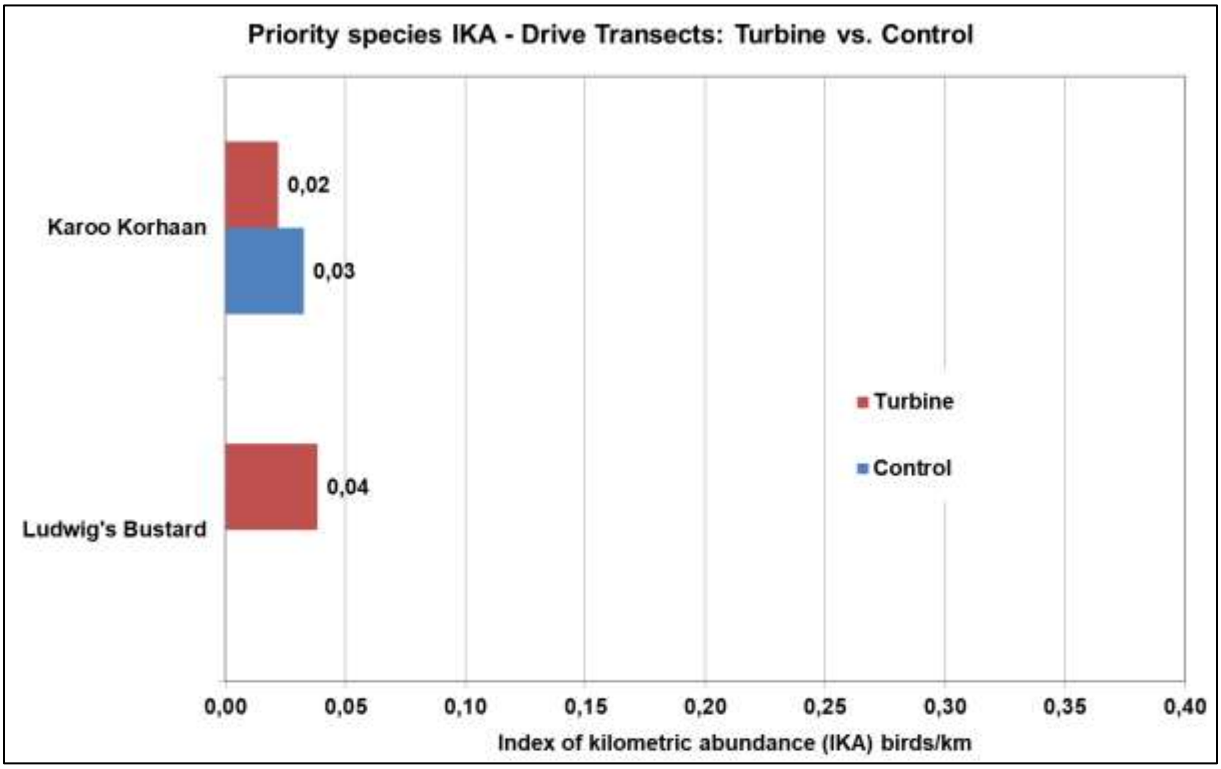


Figure 6: Index of kilometric abundance of priority species recorded at the WEF and control site during drive transect surveys across all four seasons.

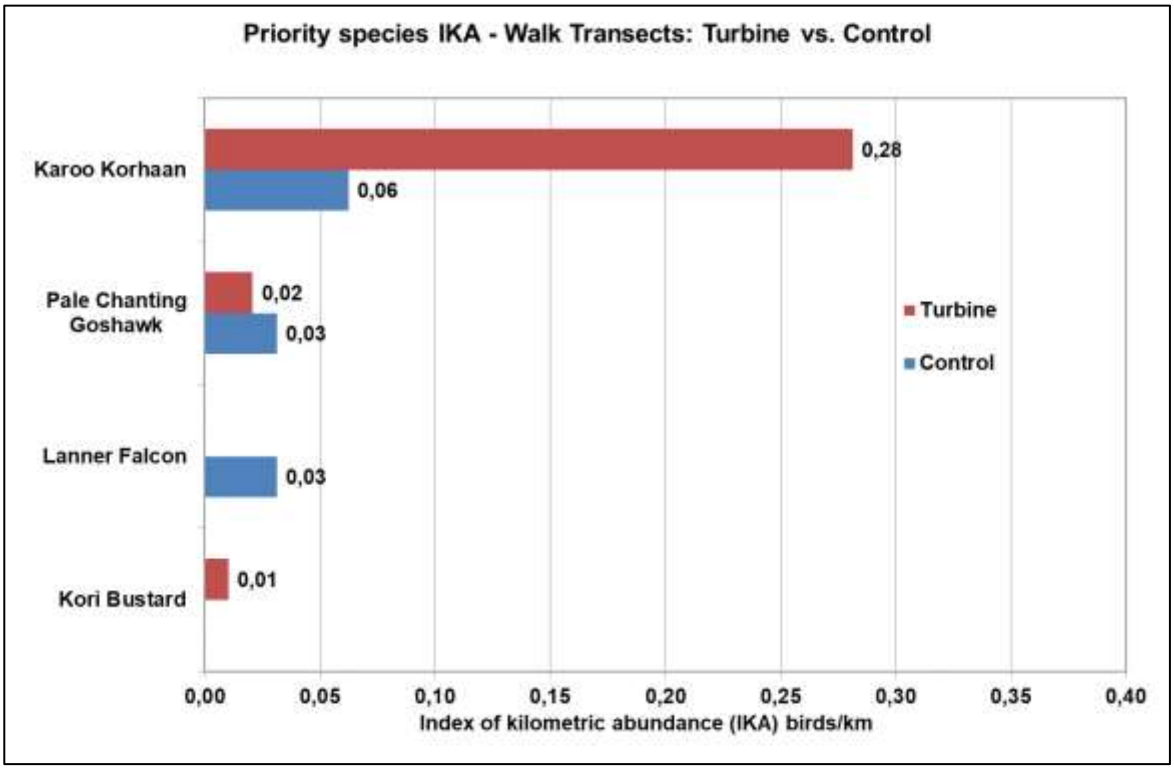


Figure 7: Index of kilometric abundance of priority species recorded at the WEF during walk transect surveys across all four seasons.

Figure 8 below shows the spatial distribution of the priority species recorded during transect counts and incidental sightings over all four seasons.

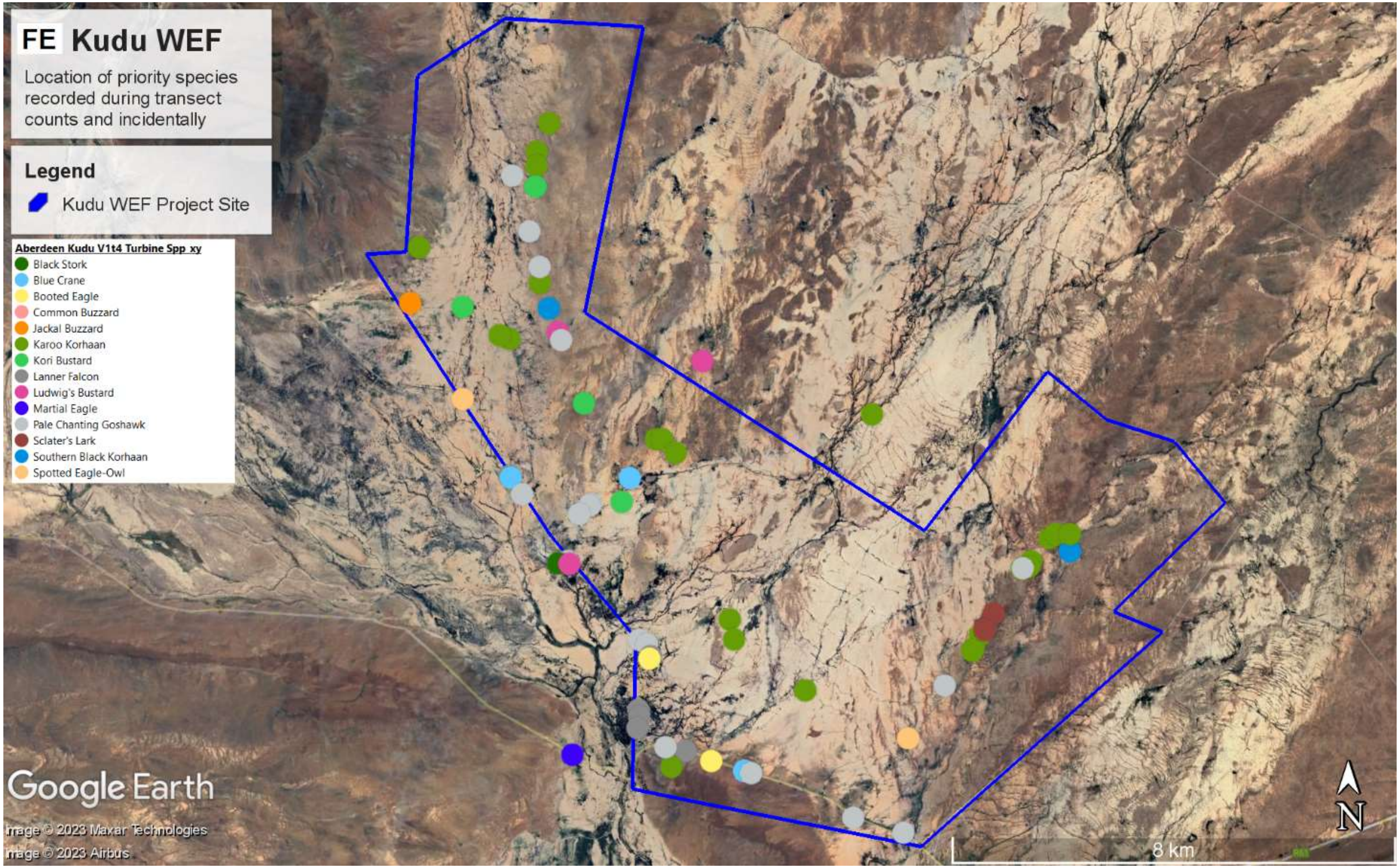


Figure 8: The location of priority species recorded at the proposed WEF during transect counts and incidentally.

4.1.2 Focal Points

No focal points of bird activity in or near the Project Site were identified during the pre-construction monitoring. Areas of potential Verreaux's Eagle habitat were inspected for nests, but none were found. However, access is restricted in some places and the owners do not necessarily reside on the farms.

4.1.3 Incidental Counts

Table 4 provides an overview of the incidental sightings of priority species recorded during the four surveys.

Table 5: Incidental sightings of Priority Species

Species Name	Scientific Name	Survey 1	Survey 2	Survey 3	Survey 4	Grand Total
Karoo Korhaan	*Eupodotis vigorsii*	2	3	2	2	**9**
Pale Chanting Goshawk	*Melierax canorus*	3	1	2	1	**7**
Kori Bustard	*Ardeotis kori*	1	1	1		**3**
Lanner Falcon	*Falco biarmicus*				3	**3**
Southern Black Korhaan	*Afrotis afra*	1	1			**2**
Spotted Eagle-Owl	*Bubo africanus*	1		1		**2**
Sclater's Lark	*Spizocorys sclateri*			2		**2**
Booted Eagle	*Hieraaetus pennatus*			1	1	**2**
Jackal Buzzard	*Buteo rufofuscus*	1				**1**
Blue Crane	*Grus paradisea*		1			**1**
Martial Eagle	*Polemaetus bellicosus*				1	**1**

See **Appendix C** for a list of all species recorded during the pre-construction monitoring at the project site.

4.1.4 Vantage Point Observations

A total of 288 hours of vantage point watches were completed at six vantage points to record flight patterns of priority species at the Project Site. During the four survey periods the duration of priority species flights amounted to 01 hour and 44 minutes. A total of 60 individual flights were recorded. The passage rate for priority species was 0.21 birds/hour[5]. This amounts to approximately 2 - 3 birds per day.[6] See **Figure 9** below for the duration and altitude of flights for each priority species[7].

[5] A distinction was drawn between passages and flights. A passage may consist of several flights e.g., every time an individual bird changes height or mode of flight; this was recorded as an individual flight, although it still forms part of the same passage.

[6] Assuming 13 hours daylight averaged over all four seasons.

[7] Flight duration was calculated by multiplying the flight time with the number of individuals in the flight e.g., if the flight time was 30 seconds and it contained two individuals, the flight duration was 30 seconds x 2 = 60 seconds.

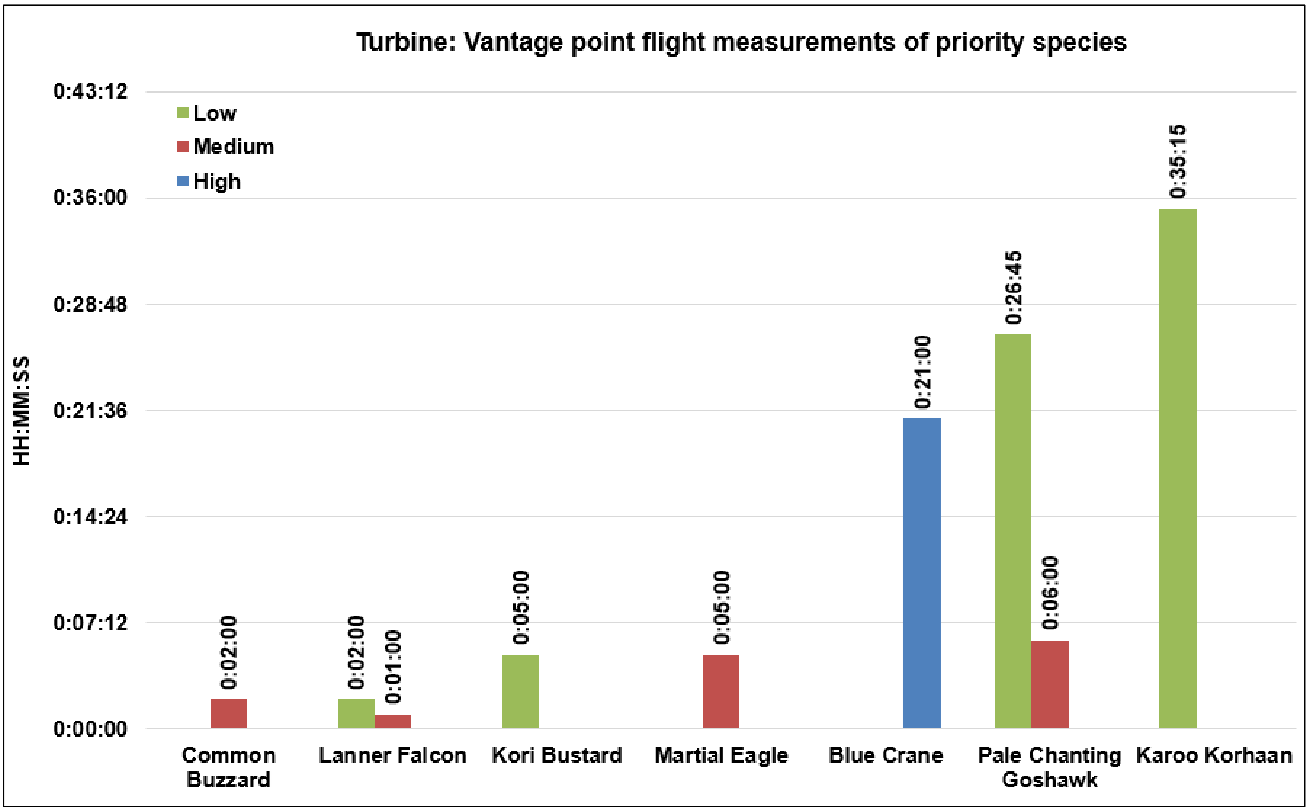


Figure 9: Flight durations and altitudes recorded for priority species at the Project Site after four surveys (288 hours of observation).

4.1.5 Site Specific Collision Risk Rating

A site-specific collision risk rating for each priority species recorded during VP watches at the project site was calculated to give an indication of the likelihood of an individual of a specific species to collide with the turbines at the site. This was calculated taking into account the following factors:

- The duration of rotor altitude flights (medium height 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 to gain some understanding of which species are likely to be most at risk of collision. The formula used is as follows[8]:

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 6**6** and **Figure** 10**10** below.

[8] 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

Priority Species	Duration of medium flights (hr)	Collision Rating	# turbines	Risk Rating	Average
Kori Bustard		75	80	0,00	0,09
Blue Crane		85	80	0,00	0,09
Karoo Korhaan		65	80	0,00	0,09
Lanner Falcon	0,000694444	85	80	0,05	0,09
Common Buzzard	0,001388889	75	80	0,09	0,09
Pale Chanting Goshawk	0,004166667	70	80	0,24	0,09
Martial Eagle	0,003472222	100	80	0,29	0,09

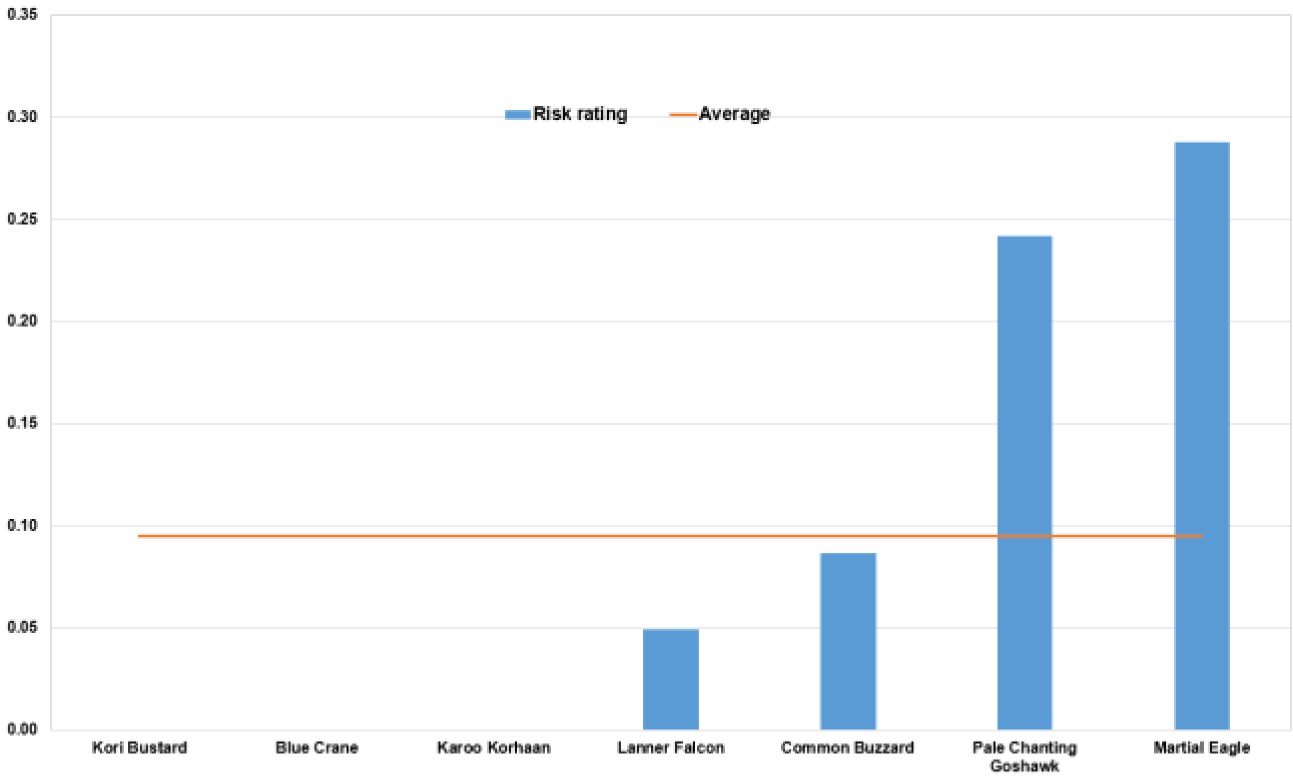


Figure 10: Site specific collision risk rating for priority species. The red line indicates the average collision risk rating for priority species at the project site, based on recorded flight behaviour after four surveys.

4.1.6 Flight Lines of Priority Species

Flight lines of priority species were recorded at the WEF site during Vantage Point watches for each of the four surveys. The recorded flight lines for priority species after four surveys are shown in **Figure 11**.

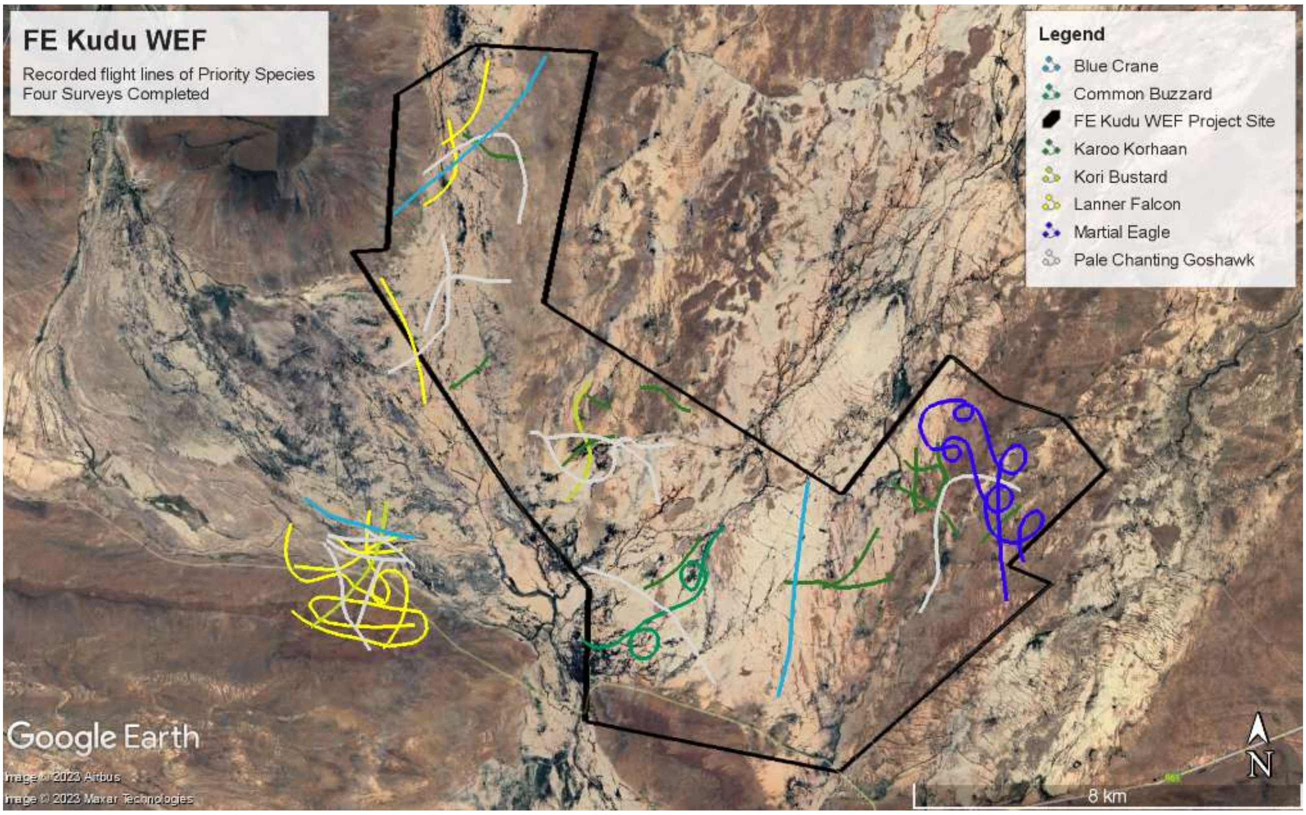


Figure 11: Recorded flight lines of Priority Species after four surveys.

5 DESCRIPTION OF EXPECTED IMPACTS

5.1 Wind Energy Facility

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
- Collisions with the 33kV overhead lines

It is important to note that the assessment is made on the *status quo* on site. The possible change in land use in the broader Project 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.

5.1.1 Collision Mortality on Wind Turbines[9]

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 aspect ratio (ratio of wingspan 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 Cape Vulture (*Gyps fulvus*), seem to collide more frequently with

[9] 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

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 FE Kudu WEF was not available at the time of writing. However, based on general observations, and research on related species, it can be confidently assumed that priority species that could potentially be vulnerable to wind turbine collisions due to morphological features (high wing loading) are bustards and vultures, because they are less manoeuvrable (Keskin et al. 2019).

- **Visual 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 regularly occurring priority species at the proposed FE Kudu WEF have high resolution vision areas found in the lateral fields of view, rather than frontally, e.g., bustards and cranes. The exceptions to this are the priority raptors 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 of time, e.g. the African Rift Valley or Mediterranean Red Sea flyways, is not a feature of the landscape. The migratory priority species which could occur at the proposed FE Kudu WEF with some regularity, e.g., Booted Eagle, Lesser Kestrel and Common Buzzard will behave much the same as the resident birds once they arrive in the area. The same is valid for local migrants such as the Ludwig's Bustard, Kori Bustard, and Blue Crane.

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 FE Kudu WEF can be classified as either terrestrial species, soaring species, or occasional long-distance fliers. Terrestrial species spend most of their 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's Bustard, Kori Bustard, Southern Black Korhaan, and Karoo 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. Species in this category are Ludwig's Bustard, Blue Crane, and Kori 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, vultures and storks which could occur i.e., Lanner Falcon, Booted Eagle, Martial Eagle, Greater Kestrel, Pale Chanting Goshawk, Jackal Buzzard, Verreaux's Eagle, Black Stork and Blue Crane (which soars on occasion). Based on the time spent potentially flying at rotor height, soaring species are likely to be at greater risk of collision.

- **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 FE Kudu WEF 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. Complete macro-avoidance of the WEF is unlikely for any of the priority species likely to occur at the proposed FE Kudu WEF.

- **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 at the proposed FE Kudu WEF will fluctuate depending on the season of the year, and especially in response to rainfall e.g., Ludwig's Bustard, Kori Bustard, Lesser Kestrel, Greater Kestrel, and Blue Crane.

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 Project Site does not contain many significant landscape features as it is situated on a vast, slightly undulating plain, but there are ridges which provide potential for slope soaring for raptors. The most significant landscape features from a collision risk perspective are the borehole dams, drinking troughs and the drainage lines (when flowing). *Surface water attracts many birds, including Red List species such as Martial Eagle, Secretarybird, Blue Crane, Black Stork, and Lanner Falcon.*

- **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 boreholes and water troughs are likely to act as a focal point for flight activity as birds fly towards and away from these surface waterpoints to forage, drink, or bathe. Raptors will also scan these areas for potential prey. Other distinctive potential flight paths identified at the Site are the drainage lines, which may serve as a flight path for waterbirds when they flow. However, they are dry most of the time.

- **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 speculated 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).

Food availability can fluctuate greatly depending on rainfall. Above average rainfall could result in better foraging conditions and therefore higher bird activity in the area.

- **Summary**

The proposed FE Kudu WEF will pose a collision risk to several priority species which could occur regularly at the site. Species exposed to this risk are large terrestrial species i.e., mostly bustards such as Karoo Korhaan, Southern Black Korhaan, Ludwig's Bustard, Kori Bustard, and Blue Crane, although bustards and cranes 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, Lanner Falcon, Booted Eagle, Verreaux's Eagle, Greater Kestrel and Lesser Kestrel are most at risk of all the priority species likely to occur at the project site. In summary, the following priority species could be at risk of collisions with the turbines: African Harrier-Hawk, Amur Falcon, Black Harrier, Black Stork, Black-winged Kite, Blue Crane, Booted Eagle, Brown Snake Eagle, Burchell's Courser, Common Buzzard, Double-banded Courser, Greater Kestrel, Grey-winged Francolin, Jackal Buzzard, Karoo Korhaan, Kori Bustard, Lanner Falcon, Lesser Kestrel, Ludwig's Bustard, Martial Eagle, Pale Chanting Goshawk, Sclater's Lark, Secretarybird, Southern Black Korhaan, Spotted Eagle-Owl, Verreaux's Eagle, and White Stork.

5.1.2 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 is still using wind farm sites as leks.[10] 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 lifespan 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 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. This is likely to affect ground nesting species the most, as this could temporarily disrupt their reproductive cycle. Species which fall in this category are Ludwig's Bustard, Blue Crane, Karoo Korhaan, Southern Black Korhaan and Spotted Eagle-Owl. Some raptors might also be affected, e.g, Greater Kestrel which often breeds on crow nests that have been

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

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 wind farm is operational, due to the disturbance factor of the operational turbines. In summary, the following species could be impacted by disturbance during the construction phase: African Harrier-Hawk, African Rock Pipit, Black Harrier, Black Stork, Black-winged Kite, Blue Crane, Booted Eagle, Brown Snake Eagle, Burchell's Courser, Double-banded Courser, Greater Kestrel, Grey-winged Francolin, Jackal Buzzard, Karoo Korhaan, Kori Bustard, Lanner Falcon, Ludwig's Bustard, Martial Eagle, Pale Chanting Goshawk, Sclater's Lark, Secretarybird, Southern Black Korhaan, Spotted Eagle-Owl, Verreaux's Eagle.

5.1.3 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 Project 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 avoids 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).

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, Blue Crane, Southern Black Korhaan and Karoo Korhaan. Given the expected density of the proposed turbine layout and associated road infrastructure, it is not expected that any priority species will be permanently displaced from the Project Site. The building infrastructure and substation 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 footprint. In summary, the following species are likely to be affected by habitat transformation: African Rock Pipit, Blue Crane, Burchell's Courser, Double-banded Courser, Grey-winged Francolin, Karoo Korhaan, Kori Bustard, Ludwig's Bustard, Sclater's Lark, Secretarybird, and Southern Black Korhaan.

5.2. Associated Infrastructure

5.2.1 Electrocution in the Substation and 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 medium voltage 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. In summary, the following priority species could be vulnerable to electrocution: African Harrier-Hawk, Amur Falcon, Black Harrier, Black Stork, Black-winged Kite, Booted Eagle, Brown Snake Eagle, Common Buzzard, Greater Kestrel, Jackal Buzzard, Lanner Falcon, Lesser Kestrel, Martial Eagle, Pale Chanting Goshawk, Spotted Eagle-Owl, Verreaux's Eagle. Electrocutions within the proposed substation yard are also possible, particularly smaller species such as Greater Kestrel and Spotted Eagle-Owl but should not affect the larger Red Data raptors such as Martial Eagle, as these species are unlikely to use the infrastructure within the substation yard for perching or roosting.

5.2.2 Collisions with the 33kV OHL

While the intention is to place the 33kV reticulation network underground where possible, there are areas were the lines might have to run above ground, for technical reasons. This includes an option to construct a 33kV OHL of approximately 10km to link the two Project Sites. This could pose a collision risk to several priority species.

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

From incidental record keeping by the Endangered Wildlife Trust, it is possible to give a measure of what species are generally susceptible to power line collisions in South Africa (**Figure 11**).

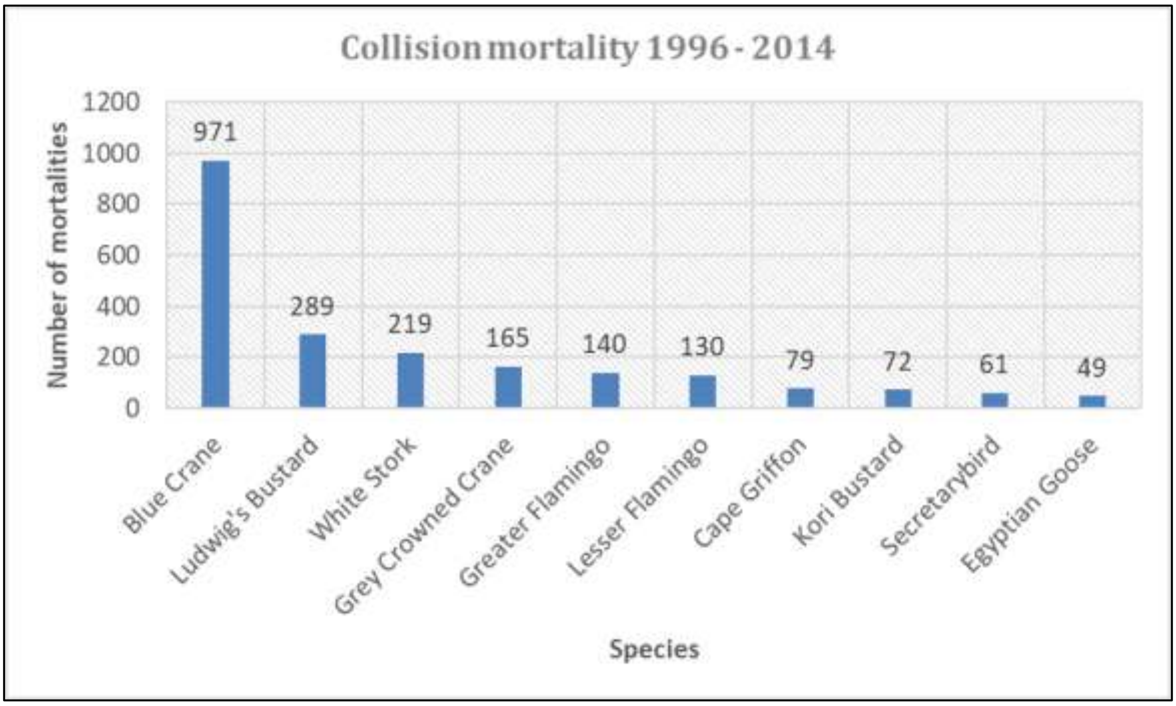


Figure 12: The top 10 collision prone bird species in South Africa, in terms of reported incidents contained in the Eskom/Endangered Wildlife Trust Strategic Partnership central incident register 1996 - 2014 (EWT unpublished data)

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

Using a controlled experiment spanning a period of nearly eight years (2008 to 2016), the Endangered Wildlife Trust (EWT) and Eskom tested the effectiveness of two types of line markers in reducing power line collision mortalities of large birds on three 400kV transmission lines near Hydra substation in the Karoo. Marking was highly effective for Blue Cranes, with a 92% reduction in mortality, and large birds in general with a 56% reduction in mortality, but not for bustards, including the endangered Ludwig's Bustard. The two different marking devices (spirals and flappers) were approximately equally effective (Shaw *et al*. 2017).

While the intention is to place the majority of the medium voltage reticulation network underground at the wind farm, there are areas where the lines will run above ground. Priority species which are most at risk of collisions with the medium voltage powerlines are the following: Black Stork, Blue Crane, Karoo Korhaan, Kori Bustard, Ludwig's Bustard, Secretarybird, Southern Black Korhaan, Spotted Eagle-Owl, Verreaux's Eagle, and White Stork. In particular, large dams and agricultural fields are high-risk areas.

6. ASSESSMENT OF IMPACTS ON AVIFAUNA

The assessment criteria used for the assessment of the impacts on avifauna is attached as **Appendix D**.

6.1 Impact Tables

6.1.1 Construction Phase

Nature: Displacement of priority species due to disturbance during construction phase		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Very short (1)	Very short (1)
Magnitude	High (8)	Moderate (6)
Probability	Definite (5)	Definite (5)
Significance	**Medium (50)**	**Medium (40)**
Status (positive or negative)	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	To some extent	
Mitigation: • Construction activity should be restricted to the immediate footprint of the infrastructure as far as possible, and in particular to the proposed road network. Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of priority species. • Removal of vegetation must be restricted to a minimum and must be rehabilitated to its former state where possible after construction. • Construction of new roads should only be considered if existing roads cannot be upgraded. • Vehicle and pedestrian access to the site should be controlled and restricted as much as possible		

to prevent unnecessary disturbance of priority species.
Residual Impacts: Due to the nature of the construction activities, it is inevitable that temporary displacement of priority species will happen as a result. While this can be mitigated to some extent, the significance of the residual impacts will remain at a medium level.

6.1.2 Operational Phase

Nature: Displacement of priority species due to habitat loss in the operation phase		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Long term (4)	Long term (4)
Magnitude	Moderate (6)	Low (4)
Probability	Probable (3)	Probable (3)
Significance	**Medium (33)**	**Low (27)**
Status (positive or negative)	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	To some extent	
Mitigation: • Once operational, vehicle and pedestrian access to the site should be controlled and restricted to prevent unnecessary destruction of vegetation. • Formal live-bird monitoring should be resumed once the turbines have been constructed, as per the most recent edition of the Best Practice Guidelines (Jenkins *et al*. 2015). The purpose of this would be to establish if displacement of priority species has occurred and to what extent. 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 year 5, and thereafter every five years for the operational lifetime of the facility. • The mitigation measures proposed by the botanical specialist, including rehabilitation, must be strictly implemented. • Excavated rocks should be removed, or 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 to eliminate all potential crevices and shelter for small mammals such as Rock Hyraxes (the primary food source for Verreaux's Eagles).		
Residual Impacts: Due to the nature of the infrastructure, it is highly likely that long term partial displacement of priority species will happen, particularly because of the habitat fragmentation caused by the associated road network. The habitat transformation can be limited to some extent through mitigation measures, to keep the significance of the residual impacts at a low level.		

Nature: Mortality of priority species due to collisions with the turbines in the operation phase		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Long term (4)	Long term (4)
Magnitude	Moderate (6)	Low (4)
Probability	Highly probable (4)	Probable (3)
Significance	**Medium (44)**	**Low (27)**
Status (positive or negative)	Negative	Negative

Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	

Mitigation:

- A 200m turbine (including the rotor-swept area) exclusion zone should be implemented around boreholes and dams and a 100m turbine (including the rotor-swept area) exclusion zone on either side of drainage lines (**Appendix E**) – a KMZ with coordinates of dams can be provided.
- Carcass searches must commence to establish mortality rates, as per the most recent edition of the Best Practice Guidelines (Jenkins *et al*. 2015). Operational monitoring should commence when the first turbines start operating, the exact timing will depend on the construction schedule. 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 year 5, and thereafter every five years for the operational lifetime of the facility.
- If annual estimated collision rates indicate unsustainable mortality levels of priority species, i.e. if natural background mortality together with the estimated mortality caused by turbine collisions exceeds a critical mortality threshold as determined by the avifaunal specialist in consultation with other experts e.g. BLSA, additional measures will have to be implemented which could include shutdown on demand. This must be undertaken in consultation with a qualified avifaunal specialist.

Residual Impacts:

It is not possible to completely eliminate the risk of turbine collisions, but through mitigation measures, it could be reduced to a low level.

Nature: Mortality of priority species due to electrocutions on the overhead MV network (where applicable) and in the substation yard.

	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Long term (4)	Long term (4)
Magnitude	High (8)	High (8)
Probability	Highly probable (4)	Improbable (1)
Significance	**Medium (52)**	**Low (13)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	

Mitigation:

- Overhead lines should be restricted to an absolute minimum and should only be allowed if underground cabling is unfeasible due to technical constraints.
- The final pole designs must be signed off by the bird specialist to ensure that a bird-friendly design is used, where relevant.
- Bi-monthly inspections of the overhead sections of the MV network must be conducted to look for carcasses under the poles, where relevant.
- With regards to the infrastructure within the substation yard, the hardware is too complex to warrant any mitigation for electrocution at this stage. It is rather recommended that if any impacts are recorded once operational, site-specific mitigation be applied reactively and in consultation with a qualified avifauna specialist.

Residual Impacts:

It is possible to almost completely eliminate the risk of electrocutions through the use of bird-friendly designs, although all structures carry some risk of electrocution.

Nature: Mortality of priority species due to collisions with the 33kV OHL		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Long term (4)	Long term (4)
Magnitude	High (8)	Moderate (6)
Probability	Highly probable (4)	Probable (3)
Significance	**Medium (52)**	**Medium (33)**
Status (positive or negative)	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	To a limited extent	To a limited extent
Mitigation: • Overhead lines should be restricted to an absolute minimum and should only be allowed if underground cabling is unfeasible due to technical constraints. • Bird flight diverters should be installed on all 33kV overhead lines on the full span length on the earthwire (according to Eskom guidelines - five metres apart). Light and dark colour devices must be alternated to provide contrast against both dark and light backgrounds respectively. These devices must be installed as soon as the conductors are strung.		
Residual Risks: There will be an ongoing residual risk of collisions with the OHL, but mitigation should reduce the risk by some extent.		

6.1.3 Decommissioning Phase

Nature: Displacement of priority species due to disturbance during the decommissioning phase		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Very short (1)	Very short (1)
Magnitude	High (8)	Moderate (6)
Probability	Definite (5)	Definite (5)
Significance	**Medium (50)**	**Medium (40)**
Status (positive or negative)	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	To some extent	
Mitigation: • Decommissioning activity should be restricted to the immediate footprint of the infrastructure as far as possible, and in particular to the proposed road network. Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of priority species. • Construction of new roads should only be considered if existing roads cannot be utilised / upgraded. • Vehicle and pedestrian access to the site should be controlled and restricted as much as possible to prevent unnecessary disturbance of priority species.		
Residual Impacts: Due to the nature of the decommissioning activities, it is inevitable that temporary displacement of priority species will happen as a result. While this can be mitigated to some extent, the significance of the residual impacts will remain at a medium level.		

6.2 Inputs into the Environmental Management Programme (EMPr)

Please see **Appendix G** for specialist inputs into the EMPr.

7 CUMULATIVE IMPACTS

Cumulative effects are commonly understood to be impacts from different projects that combine to result in significant change, which could be larger than the sum of all the individual impacts. The assessment of cumulative effects therefore needs to consider all renewable energy projects within a 30 km radius that have received an EA at the time of starting the environmental impact process, as well as the proposed FE Kudu WEF Project. There are currently four (4) renewable energy projects authorised within a 30 km radius of the proposed FE Kudu WEF. These projects were identified using the DFFE's Renewable Energy EIA Application Database for South Africa in conjunction with information provided by Independent Power Producers (IPPs) operating in the broader region. 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 30 km radius. The localities of renewable projects (affected properties) which are authorised are displayed in **Figure 12**.

7.1 The cumulative impact of the proposed FE Kudu WEF

The total affected land parcel area taken up by other authorised renewable energy projects within a 30 km radius is approximately 145 km². The total land parcel area affected by the FE Kudu Wind Energy Facility equates to approximately 91.7 km². The combined land parcel area affected by authorised renewable energy developments within a 30 km radius of similar habitat around the proposed FE Kudu Wind Energy Facility, inclusive of the FE Kudu Wind Energy Facility, thus equals approximately 236.7 km². Of this, the proposed FE Kudu WEF project constitutes ~39% (91.7 km²). The cumulative impact of the proposed FE Kudu WEF is thus anticipated to be **low** to **moderate** after mitigation.

The total area within a 30km radius around the proposed projects equates to about 2827.4 km² of similar habitat. The total combined size of the land parcels potentially affected by renewable energy projects will equate to ~8.4% of the available untransformed habitat in a 30km radius. However, the actual physical footprint of the renewable energy facilities will be smaller than the land parcel areas themselves. Furthermore, each of these projects must still be subject to a competitive bidding process where only the most competitive projects will win a power purchase agreement required for the project to proceed to construction. The cumulative impact of all the proposed renewable energy projects is estimated to be **moderate**.

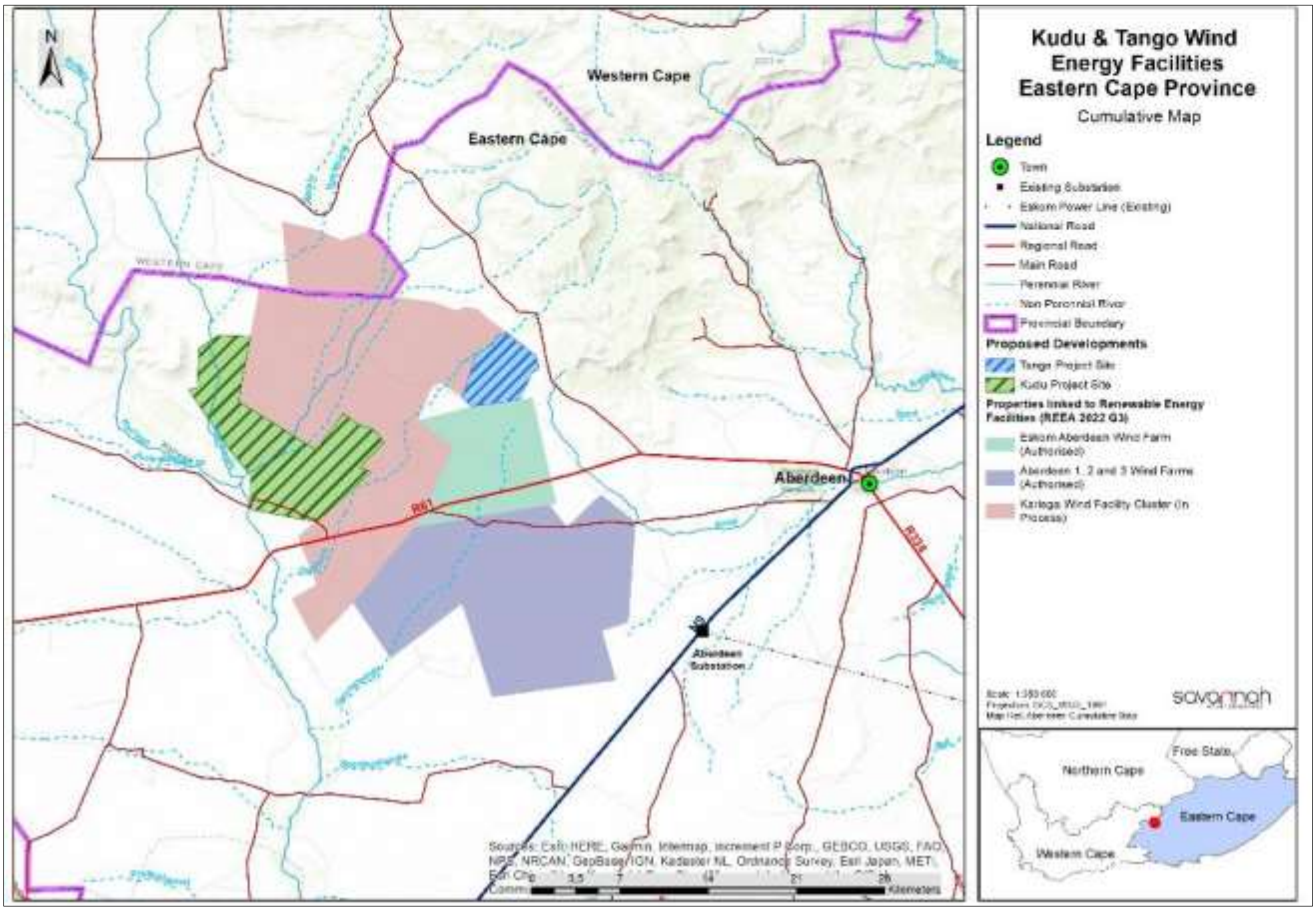


Figure 13: Regional EA applications for renewable energy projects located within a 30 km radius of the proposed FE Kudu WEF (Source: DFFE – Q1, 2023).

Nature: **Cumulative impacts in terms of:** • **Displacement of priority species due to disturbance during construction phase** • **Displacement of priority species due to habitat loss in the operation phase** • **Mortality of priority species due to collisions with the turbines in the operation phase** • **Mortality of priority species due to electrocutions on the overhead MV network and in the substation yard.** • **Mortality of priority species due to collisions with the 33kV medium voltage overhead lines in the operation phase**		
	Overall impact of the proposed project considered in isolation (post mitigation)	***Cumulative impact of the project and other projects in the area (post mitigation)***
Extent	Low (1)	High (3)
Duration	Long term (4)	Long term (4)
Magnitude	Low (4)	Moderate (6)
Probability	Probable (3)	Probable (3)
Significance	**Low (27)**	**Medium (39)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	Yes
Mitigation: All the mitigation measures which have been listed in the bird impact assessment reports for all the		

relevant wind energy projects must be applied to the relevant projects. These include the following: • Construction activity should be restricted to the immediate footprint of the infrastructure as far as possible. • Burying of internal MV cables. • Rehabilitation of disturbed vegetation. • Using bird-friendly structures for the MV poles. • Curtailment of turbines if mortality thresholds are exceeded. • Maximum use of existing roads. • Implementation of operational monitoring to assess mortality levels. • Avoidance of no-go buffers around sensitive areas, including raptor nests. • Marking of overhead lines with Bird Flight Diverters.
Residual Impacts: The implementation of the proposed mitigation measures will result in a reduction of the cumulative impacts, but it will still have a medium residual impact at a regional level.

8 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 avifauna. The no-go option would therefore eliminate any additional impact on the ecological integrity of the proposed Project Site as far as avifauna is concerned.

9 SUMMARY OF FINDINGS AND CONCLUDING STATEMENT

The proposed FE Kudu WEF will have several potential impacts on priority avifauna. The impacts are the following:

- Collision mortality on the wind turbines
- Displacement due to disturbance
- Displacement due to habitat transformation
- Electrocution on the 33kV MV overhead cables and in the substation yard.
- Mortality due to the collisions with the 33kV overhead lines.

9.1 Displacement of priority species due to disturbance and habitat transformation

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. Species which fall in this category are Ludwig’s Bustard, Blue Crane, Karoo Korhaan, Southern Black Korhaan and Spotted Eagle-Owl. Some raptors might also be affected, e.g., Greater Kestrel which often breeds on crow nests that 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 wind farm is operational, due to the disturbance factor of the operational turbines. In summary, the following species could be impacted by disturbance during the construction phase: African Harrier-Hawk, African Rock Pipit, Black Harrier, Black Stork, Black-winged Kite, Blue Crane, Booted Eagle, Brown Snake Eagle, Burchell's Courser, Double-banded Courser, Greater Kestrel, Grey-winged Francolin, Jackal Buzzard, Karoo Korhaan, Kori Bustard, Lanner Falcon, Ludwig's Bustard, Martial Eagle, Pale Chanting Goshawk, Sclater's Lark, Secretarybird, Southern Black Korhaan, Spotted Eagle-Owl, and Verreaux's Eagle.

The identified turbine exclusion zones were shared with the applicant and most of these areas are avoided by the facility layout. An adjusted layout was designed in response to WTG N20 being located within an avifaunal turbine exclusion zone and this WTG was relocated as a mitigation strategy to reduce the impact on avifauna in the area.

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, Blue Crane, Southern Black Korhaan, and Karoo Korhaan. 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 Project Site. The building infrastructure and substation 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 footprint. In summary, the following species are likely to be affected by habitat transformation: African Rock Pipit, Blue Crane, Burchell's Courser, Double-banded Courser, Grey-winged Francolin, Karoo Korhaan, Kori Bustard, Ludwig's Bustard, Sclater's Lark, Secretarybird, and Southern Black Korhaan.

9.2 Mortality of priority species due to collisions with the wind turbines

The proposed FE Kudu WEF will pose a collision risk to several priority species which could occur regularly at the site. Species exposed to this risk are large terrestrial species i.e., mostly bustards such as Karoo Korhaan, Southern Black Korhaan, Ludwig's Bustard, Kori Bustard, and Blue Crane, although bustards and cranes 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, Lanner Falcon, Booted Eagle, Verreaux's Eagle, Greater Kestrel and Lesser Kestrel are most at risk of all the priority species likely to occur at the project site. In summary, the following priority species could be at risk of collisions with the turbines: African Harrier-Hawk, Amur Falcon, Black Harrier, Black Stork, Black-winged Kite, Blue Crane, Booted Eagle, Brown Snake Eagle, Burchell's Courser, Common Buzzard, Double-banded Courser, Greater Kestrel, Grey-winged Francolin, Jackal Buzzard, Karoo Korhaan, Kori Bustard, Lanner Falcon, Lesser Kestrel, Ludwig's Bustard, Martial Eagle, Pale Chanting Goshawk, Sclater's Lark, Secretarybird, Southern Black Korhaan, Spotted Eagle-Owl, Verreaux's Eagle, and White Stork.

The identified turbine exclusion zones were shared with the applicant and most of these areas are avoided by the facility layout. An adjusted layout was designed in response to WTG N20 being located within an avifaunal turbine exclusion zone and this WTG was relocated as a mitigation strategy to reduce the impact on avifauna in the area.

9.3 Mortality of priority species due to electrocutions on the 33kV MV reticulation network and in the substation yard

While the intention is to place the medium voltage 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. In summary, the following priority species could be vulnerable to electrocution: African Harrier-Hawk, Amur Falcon, Black Harrier, Black Stork, Black-winged Kite, Booted Eagle, Brown Snake Eagle, Common Buzzard, Greater Kestrel, Jackal Buzzard, Lanner Falcon, Lesser Kestrel, Martial Eagle, Pale Chanting Goshawk, Spotted Eagle-Owl, and Verreaux's Eagle. Electrocutions within the proposed substation yard are also possible, particularly smaller species such as Greater Kestrel and Spotted Eagle-Owl but should not affect the larger Red Data raptors such as Martial Eagle, as these species are unlikely to use the infrastructure within the substation yard for perching or roosting.

9.4 Mortality of priority species due to collisions with the 33kV overhead lines

While the intention is to place the majority of the medium voltage reticulation network underground at the wind farm, there are areas where the lines will run above ground. Priority species which are most at risk of collisions with the medium voltage powerlines are the following: Black Stork, Blue Crane, Karoo Korhaan, Kori Bustard, Ludwig's Bustard, Secretarybird, Southern Black Korhaan, Spotted Eagle-Owl, Verreaux's Eagle, and White Stork. In particular, large dams and agricultural fields are high-risk areas.

9.5 Conclusions

The investigations into the potential impacts on avifauna, including the avifaunal pre-construction monitoring, by means of four surveys in the period January 2021 to January 2022, have not revealed any fatal flaws which stand in the way of the development of the proposed WEF. However, this conclusion is subject to the implementation of the recommendations listed in this report.

9.6 Cumulative Impacts

The total affected land parcel area taken up by other authorised renewable energy projects within a 30 km radius is approximately 145 km². The total land parcel area affected by the FE Kudu Wind Energy Facility equates to approximately 91.7 km². The combined land parcel area affected by authorised renewable energy developments within the 30 km radius of similar habitat around the proposed FE Kudu Wind Energy Facility, inclusive of the FE Kudu Wind Energy Facility, thus equals approximately 236.7 km². Of this, the proposed FE Kudu WEF project constitutes ~39% (91.7 km²). The cumulative impact of the proposed FE Kudu WEF is thus anticipated to be **low** to **moderate** after mitigation.

The total area within a 30km radius around the proposed projects equates to about 2827.4 km² of similar habitat. The total combined size of the land parcels potentially affected by renewable energy projects will equate to ~8.4% of the available untransformed habitat in a 30km radius. However, the actual physical footprint of the renewable energy facilities will be smaller than the land parcel areas themselves. Furthermore, each of these projects must still be subject to a competitive bidding process where only the most competitive projects will win a power purchase agreement required for the project to proceed to construction. The cumulative impact of all the proposed renewable energy projects is estimated to be **moderate**.

10 CONCLUDING STATEMENT

The proposed FE Kudu WEF will have a medium impact on avifauna which, in most instances, could be reduced to a low impact through the appropriate mitigation measures. The current proposed 80-turbine layout assessed in this report avoids all the recommended avifaunal turbine exclusion zones (including rotor-swept areas) and is therefore deemed acceptable; turbine N20 has been micro-sited to avoid the recommended avifaunal sensitivity buffer. The development is supported, provided the mitigation measures listed in this report are strictly applied. See **Figure i** and **Appendix E** for a map of the exclusion areas.

11 POST-CONSTRUCTION MONITORING PROGRAMME

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 F** for a proposed programme.

12 REFERENCES

- Altamont Pass Avian Monitoring Team. 2008. Bird Fatality Study at Altamont Pass Wind Resource Area October 2005 – September 2007. Draft Report prepared for the Almeda County Scientific Review Committee.
- Anderson, M. D. 2000. in Ludwig's Bustard *Neotis ludwigii*, Edited by Barnes, K N, BirdLife South Africa: 105-107.
- Avian Power Line Interaction Committee (Aplic). 2012. Mitigating Bird Collisions with Power Lines: The State of the Art in 2012. Edison Electric Institute. Washington D.C.
- Barrientos R, Ponce C, Palacin C, Martín Ca, Martín B, et al. 2012. Wire marking results in a small but significant reduction in avian mortality at power lines: A BACI Designed Study. PLoS ONE 7(3): e32569.
- Barrientos, R., Alonso, J.C., Ponce, C., Palacín, C. 2011. Meta-Analysis of the effectiveness of marked wire in reducing avian collisions with power lines. Conservation Biology 25: 893-903.
- Barrios, L. & Rodríguez, A. 2004. Behavioural and environmental correlates of soaring-bird mortality at on-shore wind turbines. Journal of Applied Ecology. 41: 72-81.
- Bio3 (2013). Kangnas wind energy facility – Bird community monitoring. Pre-construction phase. Final report.
- Carette, M., Zapata-Sanchez, J.A., Benitez, R.J., Lobon, M. & Donazar, J.A. (2009) Large scale risk-assessment of wind farms on population viability of a globally endangered long-lived raptor. Biological Conservation 142: 2954-2961.
- Civil Aviation Regulations. 1997. Part 139.01.33 of the civil aviation regulations, 1997, to the Aviation Act, 1962 (Act 74 of 1962).
- 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.
- 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: 38-46.
- 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.
- 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 Project Sites in southern Africa. Endangered Wildlife Trust and Birdlife South Africa.
- Jenkins, A. & Smallie, J. 2009. Terminal velocity: the end of the line for Ludwig's Bustard? Africa Birds and Birding. Vol 14, No 2.
- Jenkins, A.R., Smallie, J.J. & Diamond, M. 2010. Avian collisions with power lines: a global review of causes and mitigation with a South African perspective. Bird Conservation International 20: 263-278.
- 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 p262.
- 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
- Kruckenberg, H. & Jaene, J. 1999. Zum Einfluss eines Windparks auf die Verteilung weidender Bläßgänse im Rheiderland (Landkreis Leer, Niedersachsen). Natur und Landschaft. 74: 420–427.
- 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.
- Ledger, J. 1983. Guidelines for Dealing with Bird Problems of Transmission Lines and Towers. Eskom Test and Research Division. (Technical Note TRR/N83/005).
- Madders, M & Whitfield, D.P. Upland raptors and the assessment of wind farm impacts. 2006. Ibis. 148, Supplement s1: 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.
- Martin, G., Shaw, J., Smallie J. & Diamond, M. 2010. Bird's eye view – How birds see is key to avoiding power line collisions. Eskom Research Report. Report Nr: RES/RR/09/31613.
- 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. 2009. The distribution of breeding birds around upland wind farms. Journal of Applied Ecology 46: 1323–1331
- Pearce-Higgins, J.W., Stephen, L., Douse, A., & Langston, R.H.W. 2012. Greater impacts on bird populations during construction than subsequent operation: result of multi-site and multi-species analysis. Journal of Applied Ecology 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 91:228-239.
- 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 Division.
- Raab, R., Spakovszky, P., Julius, E., Schütz, C. & Schulze, C. 2010. Effects of powerlines on flight behaviour of the West-Pannonian Great Bustard *Otis tarda* population. Bird Conservation International. Birdlife International.
- Ralston-Patton S. 2017. Verreaux's Eagles and Wind Farms. Guidelines for impact assessment, monitoring and mitigation. BirdLife South Africa, March 2017
- 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.
- Shaw, J.M. 2013. Power line collisions in the Karoo: Conserving Ludwig's Bustard. Unpublished PhD thesis. Percy FitzPatrick Institute of African Ornithology, Department of Biological Sciences, Faculty of Science University of Cape Town May 2013.
- Shaw, J.M., Pretorius, M.D., Gibbons, B., Mohale, O., Visagie, R., Leeuwner, J.L. & Ryan, P.G. 2017. The effectiveness of line markers in reducing power line collisions of large terrestrial birds at De Aar, Northern Cape. Eskom Research, Testing and Development. Research Report. RES/RR/17/1939422.
- Simmons, R.E. 2018. Screening Analysis for the proposed FE Kudu WEF, Tankwa Karoo: Avian Assessment 2018. Unpublished report to ABO Wind renewable energies.
- Smallwood, K. S. (2013), Comparing bird and bat fatality-rate estimates among North American wind-energy projects. Wildlife Society Bulletin, 37: 19–33.
- 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. 2000. An overview of Vulture Electrocutions in South Africa. Vulture News, 43: 5-22. (Vulture Study Group, Johannesburg, South Africa).

- 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 A: PRE-CONSTRUCTION MONITORING

Objectives

The objective of the pre-construction monitoring at the proposed Aberdeen FE Kudu Wind Energy Facility was to gather baseline data over a period of one year on the following aspects pertaining to avifauna:

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

Methods

The monitoring was designed according to the following best practice guidelines (hereafter referred to as the wind guidelines):

- 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 Project Sites in southern Africa.* Produced by the Wildlife & Energy Programme of the Endangered Wildlife Trust & BirdLife South Africa.

The wind guidelines form the basis of the protocol for the assessment of avifaunal related impacts by wind energy facilities of 20MW or higher, that was gazetted in March 2020.[11] Wind priority species were identified using the latest (November 2014) BirdLife SA (BLSA) list of priority species for wind farms. Pre-construction monitoring at the FE Kudu WEF Project Site and a Control Site was conducted during the following time periods:

- Survey 1: 21 – 25 January 2021
- Survey 2: 24 – 30 April 2021
- Survey 3: 06 – 12 September 2021
- Survey 4: 21 – 30 November 2021, and 08 – 11 January 2022

Monitoring was conducted in the following manner:

- One (1) drive transect was identified totalling 15.2km on the Project Site and one drive transect in the Control Site with a total length of 10.2km.
- Two monitors travelling slowly (± 10km/h) in a vehicle record all birds on both sides of the transect. The observers stop at regular intervals (every 500m) to scan the environment with binoculars. Drive transects are counted three times per sampling session.
- In addition, six (6) walk transects of 1km each were identified at the Project Site and two (2) at the control site. The transects are counted four (4) times per survey. All birds are 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)

[11] Government Gazette No 320, 20 March 2020. 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 National Environmental Management Act, 1998, when applying for environmental authorisation.

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

- Six (6) vantage points (VPs) were identified from which the majority of the wind buildable area can be observed, to record the flight altitude and patterns of priority species. One (1) VP was also identified on the control site. The following variables are 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. >220m; medium i.e. 30m – 220m; low i.e. <30m)
  - Flight mode (soar; flap; glide; kite; hover) and
  - Flight time (in 15 second intervals).

The objective of vantage point counts is to measure the potential collision risk with the turbines.

No focal points of bird activity at or close to the Site were identified during the surveys. Areas of potential Verreaux's Eagle habitat was inspected as best as possible for nests, but none were found.

Figure 1 below indicates the location of the transects and VPs where monitoring took place.

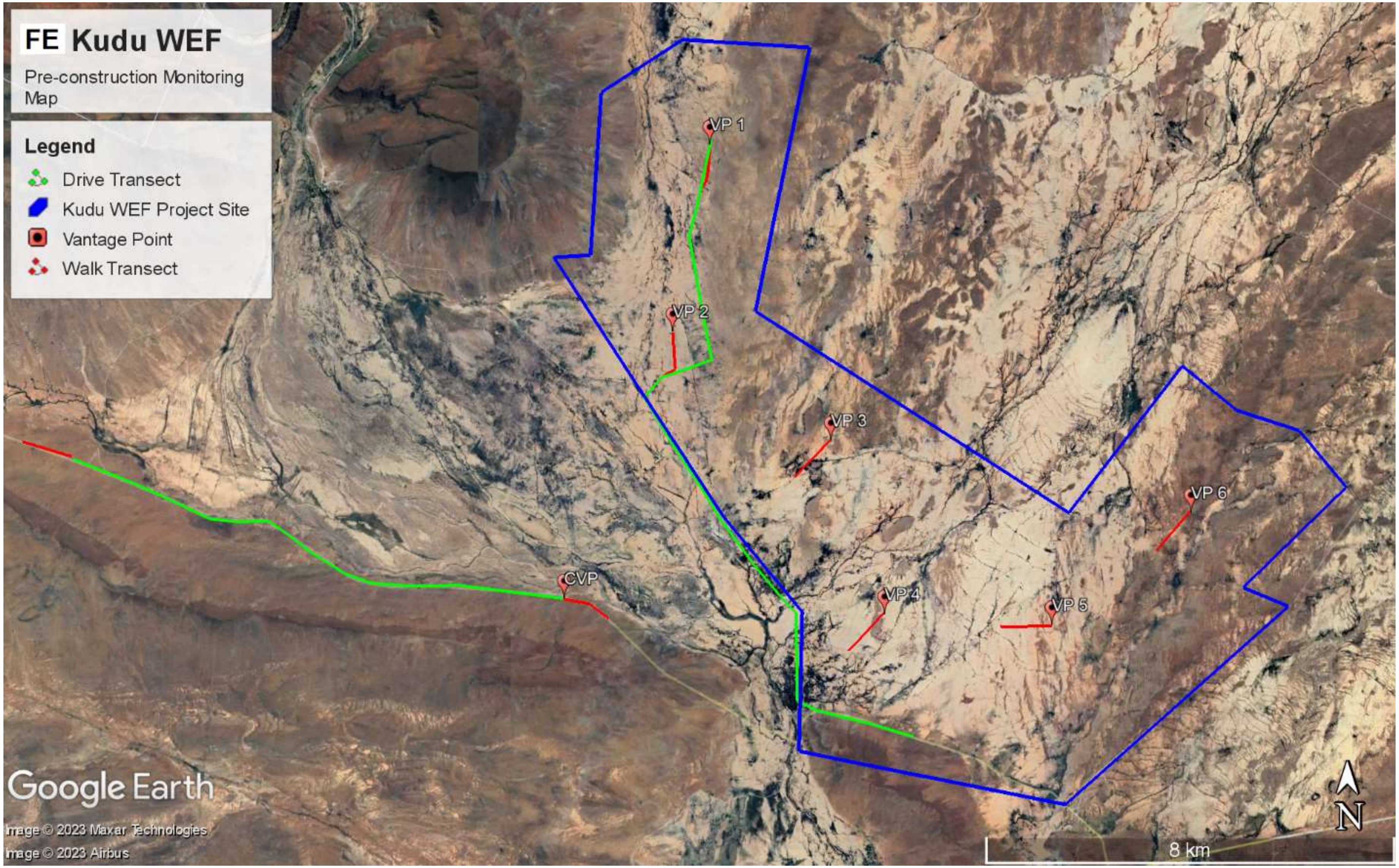


Figure 1: Area where pre-construction monitoring was conducted, indicating the location of vantage points, drive transects, and walk transects. The area to the west of the Project Site is the Control Site.

APPENDIX B: BIRD HABITAT

Figure 1: Typical Nama-Karoo shrubland habitat in the Project Site.

Figure 2: Drainage line woodland near the Project Site.

Figure 3: Alien trees near the Project Site.

Figure 4: Borehole (surface water) in the Project Site.

Figure 5: Agriculture (planted pastures) near the Project Site.

Figure 6: Nama-Karoo shrubland habitat in the Project Site.

APPENDIX C: SPECIES LIST FOR BROADER AREA

RR = Reporting Rate %

Common Name	Scientific Name	Full Protocol RR%	Ad hoc Protocol RR%	Recorded during Monitoring
Acacia Pied Barbet	Tricholaema leucomelas	48,31	9,18	x
African Black Swift	Apus barbatus	5,08	2,04	
African Harrier-Hawk	Polyboroides typus	0,85	0,00	
African Hoopoe	Upupa africana	22,88	3,06	x
African Pipit	Anthus cinnamomeus	43,22	8,16	x
African Red-eyed Bulbul	Pycnonotus nigricans	52,54	11,22	x
African Reed Warbler	Acrocephalus baeticatus	5,08	2,04	
African Rock Pipit	Anthus crenatus	3,39	0,00	
African Sacred Ibis	Threskiornis aethiopicus	2,54	2,04	
African Spoonbill	Platalea alba	3,39	0,00	
Alpine Swift	Tachymarptis melba	5,08	2,04	
Amethyst Sunbird	Chalcomitra amethystina	0,85	0,00	
Amur Falcon	Falco amurensis	1,69	0,00	
Ant-eating Chat	Myrmecocichla formicivora	33,90	8,16	x
Barn Swallow	Hirundo rustica	23,73	10,20	x
Bar-throated Apalis	Apalis thoracica	32,20	9,18	
Black Harrier	Circus maurus	2,54	0,00	
Black Stork	Ciconia nigra	0,85	0,00	
Black-eared Sparrow-Lark	Eremopterix australis	8,47	1,02	
Black-headed Canary	Serinus alario	32,20	12,24	x
Black-headed Heron	Ardea melanocephala	3,39	1,02	
Blacksmith Lapwing	Vanellus armatus	4,24	4,08	
Black-throated Canary	Crithagra atrogularis	21,19	7,14	x
Black-winged Kite	Elanus caeruleus	0,85	3,06	
Black-winged Stilt	Himantopus himantopus	0,00	1,02	
Blue Crane	Grus paradisea	17,80	15,31	x
Bokmakierie	Telophorus zeylonus	16,95	5,10	x
Booted Eagle	Hieraaetus pennatus	5,08	0,00	x
Brown Snake Eagle	Circaetus cinereus	0,00	0,00	x
Brown-hooded Kingfisher	Halcyon albiventris	7,63	2,04	
Brown-throated Martin	Riparia paludicola	6,78	2,04	
Burchell's Courser	Cursorius rufus	3,39	1,02	
Cape Bunting	Emberiza capensis	9,32	3,06	x

Common Name	Scientific Name	Full Protocol RR%	Ad hoc Protocol RR%	Recorded during Monitoring
Cape Canary	Serinus canicollis	2,54	0,00	
Cape Crow	Corvus capensis	47,46	18,37	x
Cape Longclaw	Macronyx capensis	0,85	0,00	
Cape Penduline Tit	Anthoscopus minutus	11,02	1,02	x
Cape Robin-Chat	Cossypha caffra	26,27	5,10	x
Cape Rock Thrush	Monticola rupestris	1,69	0,00	
Cape Sparrow	Passer melanurus	58,47	20,41	x
Cape Turtle Dove	Streptopelia capicola	56,78	19,39	x
Cape Wagtail	Motacilla capensis	36,44	11,22	x
Cape Weaver	Ploceus capensis	1,69	0,00	
Cape White-eye	Zosterops virens	17,80	2,04	x
Capped Wheatear	Oenanthe pileata	19,49	3,06	x
Cardinal Woodpecker	Dendropicos fuscescens	5,93	1,02	x
Chat Flycatcher	Melaenornis infuscatus	23,73	5,10	x
Chestnut-vented Warbler	Curruca subcoerulea	51,69	25,51	x
Cinnamon-breasted Bunting	Emberiza tahapisi	4,24	0,00	
Cinnamon-breasted Warbler	Euryptila subcinnamomea	3,39	2,04	
Common Buttonquail	Turnix sylvaticus	0,85	0,00	
Common Buzzard	Buteo buteo	5,93	8,16	x
Common Greenshank	Tringa nebularia	0,00	1,02	
Common Ostrich	Struthio camelus	1,69	0,00	
Common Quail	Coturnix coturnix	10,17	3,06	
Common Swift	Apus apus	5,08	0,00	x
Common Waxbill	Estrilda astrild	6,78	1,02	
Crowned Lapwing	Vanellus coronatus	2,54	0,00	x
Desert Cisticola	Cisticola aridulus	19,49	2,04	
Diederik Cuckoo	Chrysococcyx caprius	4,24	2,04	
Double-banded Courser	Rhinoptilus africanus	27,12	4,08	x
Dusky Indigobird	Vidua funerea	0,00	1,02	
Dusky Sunbird	Cinnyris fuscus	38,98	8,16	x
Eastern Clapper Lark	Mirafra fasciolata	21,19	6,12	x
Eastern Long-billed Lark	Certhilauda semitorquata	0,85	0,00	
Egyptian Goose	Alopochen aegyptiaca	22,88	13,27	x
European Bee-eater	Merops apiaster	1,69	1,02	
Fairy Flycatcher	Stenostira scita	24,58	2,04	x

Common Name	Scientific Name	Full Protocol RR%	Ad hoc Protocol RR%	Recorded during Monitoring
Familiar Chat	Oenanthe familiaris	46,61	7,14	x
Fiery-necked Nightjar	Caprimulgus pectoralis	7,63	1,02	
Fiscal Flycatcher	Melaenornis silens	16,95	7,14	x
Fork-tailed Drongo	Dicrurus adsimilis	11,02	0,00	x
Gabar Goshawk	Micronisus gabar	10,17	1,02	
Golden-breasted Bunting	Emberiza flaviventris	5,08	1,02	
Greater Honeyguide	Indicator indicator	0,85	0,00	
Greater Kestrel	Falco rupicoloides	8,47	3,06	x
Greater Striped Swallow	Cecropis cucullata	30,51	7,14	x
Green-winged Pytilia	Pytilia melba	0,85	0,00	
Grey Heron	Ardea cinerea	4,24	1,02	
Grey Tit	Melaniparus afer	11,86	2,04	x
Grey-backed Cisticola	Cisticola subruficapilla	18,64	5,10	x
Grey-backed Sparrow-Lark	Eremopterix verticalis	42,37	17,35	x
Grey-winged Francolin	Scleroptila afra	0,85	0,00	
Hadada Ibis	Bostrychia hagedash	28,81	10,20	x
Hamerkop	Scopus umbretta	0,85	0,00	
Helmeted Guineafowl	Numida meleagris	20,34	5,10	x
House Sparrow	Passer domesticus	19,49	6,12	x
Jackal Buzzard	Buteo rufofuscus	2,54	0,00	x
Jacobin Cuckoo	Clamator jacobinus	0,85	0,00	
Karoo Chat	Emarginata schlegelii	26,27	11,22	x
Karoo Eremomela	Eremomela gregalis	0,85	0,00	
Karoo Korhaan	Eupodotis vigorsii	65,25	23,47	x
Karoo Lark	Calendulauda albescens	2,54	3,06	
Karoo Long-billed Lark	Certhilauda subcoronata	16,95	5,10	x
Karoo Prinia	Prinia maculosa	42,37	11,22	x
Karoo Scrub Robin	Cercotrichas coryphoeus	51,69	12,24	x
Karoo Thrush	Turdus smithi	11,86	0,00	x
Kittlitz's Plover	Charadrius pecuarius	3,39	1,02	
Kori Bustard	Ardeotis kori	16,10	2,04	x
Lanner Falcon	Falco biarmicus	10,17	7,14	x
Large-billed Lark	Galerida magnirostris	21,19	3,06	x
Lark-like Bunting	Emberiza impetuani	55,08	22,45	x
Laughing Dove	Spilopelia senegalensis	45,76	8,16	x

Common Name	Scientific Name	Full Protocol RR%	Ad hoc Protocol RR%	Recorded during Monitoring
Layard's Warbler	Curruca layardi	6,78	0,00	
Lesser Kestrel	Falco naumanni	0,85	2,04	
Lesser Striped Swallow	Cecropis abyssinica	0,85	0,00	
Levaillant's Cisticola	Cisticola tinniens	3,39	0,00	
Little Grebe	Tachybaptus ruficollis	0,85	0,00	
Little Swift	Apus affinis	12,71	6,12	x
Long-billed Crombec	Sylvietta rufescens	19,49	6,12	x
Long-tailed Paradise Whydah	Vidua paradisaea	0,00	1,02	
Ludwig's Bustard	Neotis ludwigii	33,90	5,10	x
Malachite Kingfisher	Corythornis cristatus	0,85	0,00	
Malachite Sunbird	Nectarinia famosa	18,64	4,08	
Marsh Warbler	Acrocephalus palustris	0,85	0,00	
Martial Eagle	Polemaetus bellicosus	0,85	0,00	x
Monotonous Lark	Mirafra passerina	2,54	0,00	
Mountain Wheatear	Myrmecocichla monticola	8,47	6,12	
Namaqua Dove	Oena capensis	49,15	14,29	x
Namaqua Sandgrouse	Pterocles namaqua	28,81	5,10	x
Namaqua Warbler	Phragmacia substriata	8,47	2,04	
Neddicky	Cisticola fulvicapilla	20,34	7,14	x
Nicholson's Pipit	Anthus nicholsoni	3,39	3,06	
Pale Chanting Goshawk	Melierax canorus	50,00	6,12	x
Pale-winged Starling	Onychognathus nabouroup	4,24	3,06	x
Pearl-breasted Swallow	Hirundo dimidiata	11,86	4,08	x
Pied Avocet	Recurvirostra avosetta	0,85	0,00	
Pied Crow	Corvus albus	64,41	36,73	x
Pied Starling	Lamprotornis bicolor	31,36	10,20	x
Pink-billed Lark	Spizocorys conirostris	11,02	1,02	
Pin-tailed Whydah	Vidua macroura	5,93	2,04	
Plain-backed Pipit	Anthus leucophrys	5,93	2,04	x
Pririt Batis	Batis pririt	42,37	12,24	x
Quailfinch	Ortygospiza atricollis	6,78	2,04	
Red-backed Shrike	Lanius collurio	2,54	0,00	
Red-billed Firefinch	Lagonosticta senegala	16,10	7,14	
Red-billed Quelea	Quelea quelea	33,90	10,20	x
Red-billed Teal	Anas erythrorhyncha	0,85	0,00	

Common Name	Scientific Name	Full Protocol RR%	Ad hoc Protocol RR%	Recorded during Monitoring
Red-capped Lark	Calandrella cinerea	30,51	6,12	x
Red-eyed Dove	Streptopelia semitorquata	23,73	1,02	
Red-faced Mousebird	Urocolius indicus	12,71	1,02	x
Red-headed Finch	Amadina erythrocephala	20,34	2,04	x
Red-knobbed Coot	Fulica cristata	0,00	1,02	
Red-winged Starling	Onychognathus morio	8,47	2,04	
Rock Dove	Columba livia	1,69	2,04	
Rock Kestrel	Falco rupicolus	7,63	9,18	
Rock Martin	Ptyonoprogne fuligula	39,83	14,29	x
Rufous-cheeked Nightjar	Caprimulgus rufigena	0,85	0,00	
Rufous-eared Warbler	Malcorus pectoralis	52,54	18,37	x
Rufous-naped Lark	Mirafra africana	0,85	0,00	
Sabota Lark	Calendulauda sabota	50,85	14,29	x
Scaly-feathered Weaver	Sporopipes squamifrons	30,51	7,14	x
Sclater's Lark	Spizocorys sclateri	6,78	3,06	x
Secretarybird	Sagittarius serpentarius	6,78	1,02	
Short-toed Rock Thrush	Monticola brevipes	5,08	2,04	x
Sickle-winged Chat	Emarginata sinuata	25,42	7,14	x
South African Shelduck	Tadorna cana	11,86	1,02	x
Southern Black Korhaan	Afrotis afra	21,19	4,08	x
Southern Boubou	Laniarius ferrugineus	2,54	0,00	
Southern Double-collared Sunbird	Cinnyris chalybeus	4,24	2,04	
Southern Fiscal	Lanius collaris	30,51	4,08	x
Southern Grey-headed Sparrow	Passer diffusus	32,20	3,06	x
Southern Masked Weaver	Ploceus velatus	32,20	4,08	x
Southern Red Bishop	Euplectes orix	2,54	1,02	
Southern Tchagra	Tchagra tchagra	0,85	0,00	
Speckled Pigeon	Columba guinea	30,51	8,16	x
Spike-heeled Lark	Chersomanes albofasciata	49,15	9,18	x
Spotted Eagle-Owl	Bubo africanus	13,56	5,10	x
Spotted Flycatcher	Muscicapa striata	3,39	0,00	
Spotted Thick-knee	Burhinus capensis	19,49	2,04	x
Spur-winged Goose	Plectropterus gambensis	5,08	2,04	
Three-banded Plover	Charadrius tricollaris	17,80	11,22	
Tractrac Chat	Emarginata tractrac	0,00	0,00	x

Common Name	Scientific Name	Full Protocol RR%	Ad hoc Protocol RR%	Recorded during Monitoring
Verreaux's Eagle	Aquila verreauxii	3,39	3,06	
Village Indigobird	Vidua chalybeata	1,69	2,04	
Wattled Starling	Creatophora cinerea	13,56	2,04	x
Western Barn Owl	Tyto alba	1,69	1,02	
Western Cattle Egret	Bubulcus ibis	0,85	0,00	
White Stork	Ciconia ciconia	0,85	0,00	
White-backed Mousebird	Colius colius	7,63	2,04	x
White-browed Sparrow-Weaver	Plocepasser mahali	0,85	0,00	
White-necked Raven	Corvus albicollis	15,25	6,12	x
White-rumped Swift	Apus caffer	12,71	3,06	x
White-throated Canary	Crithagra albogularis	34,75	12,24	x
White-throated Swallow	Hirundo albigularis	11,02	4,08	
Willow Warbler	Phylloscopus trochilus	2,54	1,02	
Yellow Bishop	Euplectes capensis	0,85	0,00	
Yellow Canary	Crithagra flaviventris	4,24	1,02	x
Yellow-bellied Eremomela	Eremomela icteropygialis	33,05	8,16	x
Yellow-billed Duck	Anas undulata	6,78	0,00	
Yellow-billed Kite	Milvus aegyptius	0,85	0,00	
Yellow-fronted Canary	Crithagra mozambica	0,85	0,00	
Yellow-throated Bush Sparrow	Gymnoris superciliaris	11,86	2,04	x
Zitting Cisticola	Cisticola juncidis	0,85	0,00	

APPENDIX D: ASSESSMENT CRITERIA

Assessment of Impacts

Direct, indirect and cumulative impacts associated with the projects must be assessed in terms of the following criteria:

- » The **nature**, which shall include a description of what causes the effect, what will be affected and how it will be affected.
- » The **extent**, wherein it will be indicated whether the impact will be local (limited to the immediate area or site of development) or regional, and a value between 1 and 5 will be assigned as appropriate (with 1 being low and 5 being high):
- » The **duration**, wherein it will be indicated whether:
  - ∗ the lifetime of the impact will be of a very short duration (0–1 years) – assigned a score of 1;
  - ∗ the lifetime of the impact will be of a short duration (2-5 years) - assigned a score of 2;
  - ∗ medium-term (5–15 years) – assigned a score of 3;
  - ∗ long term (> 15 years) - assigned a score of 4; or
  - ∗ permanent - assigned a score of 5;
- » The **magnitude**, quantified on a scale from 0-10, where 0 is small and will have no effect on the environment, 2 is minor and will not result in an impact on processes, 4 is low and will cause a slight impact on processes, 6 is moderate and will result in processes continuing but in a modified way, 8 is high (processes are altered to the extent that they temporarily cease), and 10 is very high and results in complete destruction of patterns and permanent cessation of processes.
- » The **probability** *of occurrence*, which shall describe the likelihood of the impact actually occurring. Probability will be estimated on a scale of 1–5, where 1 is very improbable (probably will not happen), 2 is improbable (some possibility, but low likelihood), 3 is probable (distinct possibility), 4 is highly probable (most likely) and 5 is definite (impact will occur regardless of any prevention measures).
- » the **significance**, which shall be determined through a synthesis of the characteristics described above and can be assessed as low, medium or high; and
- » the **status**, which will be described as either positive, negative or neutral.
- » the degree to which the impact can be reversed.
- » the degree to which the impact may cause irreplaceable loss of resources.
- » the *degree* to which the impact can be *mitigated.*

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

S=(E+D+M)P

S = Significance weighting
E = Extent
D = Duration
M = Magnitude
P = Probability

The **significance weightings** for each potential impact are as follows:

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

Assessment of impacts must be summarised in the following table format. The rating values as per the above criteria must also be included.

Example of Impact table summarising the significance of impacts (with and without mitigation)

Nature: **[Outline and describe fully the impact anticipated as per the assessment undertaken]**		
	Without mitigation	**With mitigation**
Extent	High (3)	Low (1)
Duration	Medium-term (3)	Medium-term (3)
Magnitude	Moderate (6)	Low (4)
Probability	Probable (3)	Probable (3)
Significance	**Medium (36)**	**Low (24)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	
Mitigation: “Mitigation“, means to anticipate and prevent negative impacts and risks, then to minimise them, rehabilitate or repair impacts to the extent feasible. Provide a description of how these mitigation measures will be undertaken keeping the above definition in mind		
Residual Impacts: “Residual Risk”, means the risk that will remain after all the recommended measures have been undertaken to mitigate the impact associated with the activity (Green Leaves III, 2014).		

Assessment of Cumulative Impacts

As per DEA’s requirements, specialists are required to assess the cumulative impacts. In this regard, please refer to the methodology below that will need to be used for the assessment of 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, which in itself may not be significant, but may become significant when added to existing and reasonably foreseeable impacts eventuating from similar or diverse activities[12].

The role of the cumulative assessment is to test if such impacts are relevant to the proposed project in the proposed location (i.e. whether the addition of the proposed project in the area will increase the impact). This section should address whether the construction of the proposed development will result in:

- Unacceptable risk
- Unacceptable loss
- Complete or whole-scale changes to the environment or sense of place
- Unacceptable increase in impact

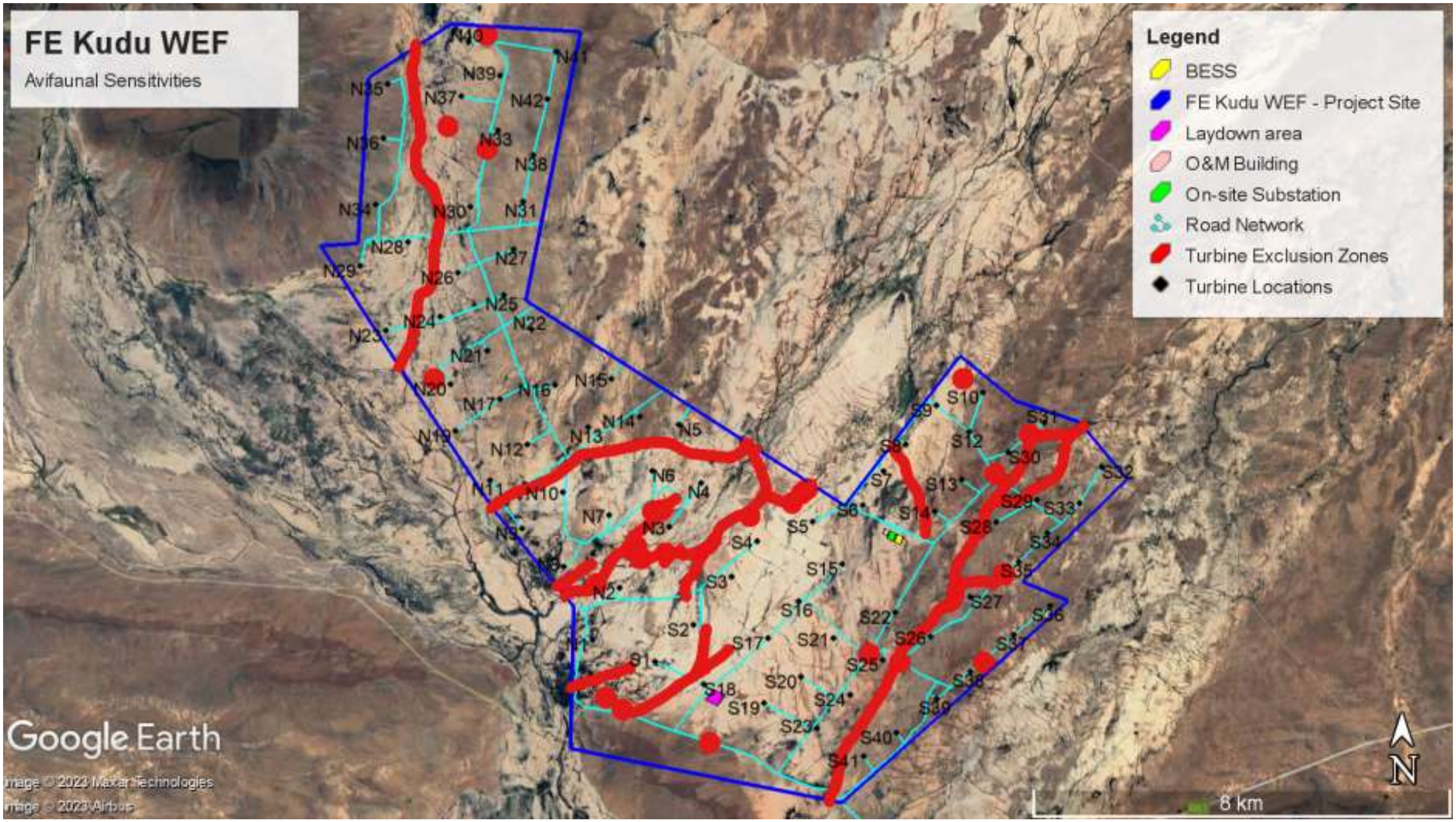
The specialist is required to conclude if the proposed development will result in any unacceptable loss or impact considering all the projects proposed in the area.

Example of a cumulative impact table:
Nature: Complete or whole-scale changes to the environment or sense of place (example)

Nature: **[Outline and describe fully the impact anticipated as per the assessment undertaken]**		
	Overall impact of the proposed project considered in isolation	***Cumulative impact of the project and other projects in the area***
Extent	Low (1)	High (3)
Duration	Medium-term (3)	Medium-term (3)
Magnitude	Low (4)	Moderate (6)
Probability	Probable (3)	Probable (3)
Significance	**Low (24)**	**Medium (36)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	No	Yes
Can impacts be mitigated?	Yes	Yes
Mitigation: “Mitigation“, means to anticipate and prevent negative impacts and risks, then to minimise them, rehabilitate or repair impacts to the extent feasible. Provide a description of how these mitigation measures will be undertaken keeping the above definition in mind		
Residual Impacts: “Residual Risk”, means the risk that will remain after all the recommended measures have been undertaken to mitigate the impact associated with the activity (Green Leaves III, 2014).		

[12] Unless otherwise stated, all definitions are from the 2014 EIA Regulations, GNR 326.

APPENDIX E: AVIFAUNAL SENSITIVITY MAP



APPENDIX F: POST-CONSTRUCTION MONITORING

1 INTRODUCTION

The avifaunal post-construction monitoring at the proposed FE Kudu WEF must be conducted in accordance with the latest version of the *Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy Project Sites in southern Africa* (Jenkins *et al*. 2011)[13].

2 AIM OF POST-CONSTRUCTION MONITORING

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

- Confirm as far as possible what the actual impacts of the wind farm 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 wind farm changed?
- How has the number of birds and species composition changed?
- How have the movements of priority species changed?
- How has the wind farm 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, 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 wind farm 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

[13] Jenkins, A.R., Van Rooyen, C.S., Smallie, J.J., Anderson, M.D., & A.H. Smit. 2011. 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.

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 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 wind farm 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

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 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;
- Regular 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 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 sent to the specialist on a weekly basis:

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

When a carcass is found, it must be bagged, labeled, 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 wind farm changed?
- How has the number birds and species composition changed?
- How have the movements of priority species changed?
- How has the wind farm 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 red flagged.

OBJECTIVE: Minimizing the displacement of priority species due to disturbance during the construction phase

Project component/s	All infrastructure
Potential Impact	Displacement of priority species
Activity/risk source	Construction activities resulting in the displacement of priority species due to disturbance
Mitigation: Target/Objective	Reducing sources of disturbance to the absolute minimum to minimise the potential displacement of priority species

Mitigation: Action/control	**Responsibility**	**Timeframe**
A site-specific Environmental Management Plan (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 should include the following directives: • Construction activity should be restricted to the immediate footprint of the infrastructure as far as possible, and in particular to the proposed road network. Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of priority species. • Removal of vegetation must be restricted to a minimum and must be rehabilitated to its former state where possible after construction. • Construction of new roads should only be considered if existing roads cannot be upgraded. • Vehicle and pedestrian access to the site should be controlled and restricted as much as possible to prevent unnecessary disturbance of priority species.	Contractor	Construction Phase

Performance Indicator	Audit reports by the Environmental Control Officer (ECO)
Monitoring	Weekly inspections by the ECO to assess if the requirements of the EMPr are adhered to by the Contractor

OBJECTIVE: Preventing the displacement of priority species due to habitat transformation during the operational phase

Project component/s	Infrastructure footprint, including the turbines, roads and buildings
Potential Impact	Displacement of priority species

Activity/risk source	Operational activities resulting in the displacement of priority species due to habitat transformation
Mitigation: Target/Objective	Reducing sources of habitat transformation to the absolute minimum to minimise the potential displacement of priority species

Mitigation: Action/control	**Responsibility**	**Timeframe**
A site-specific Environmental Management Plan (EMPr) must be implemented, which gives appropriate and detailed description of how operational activities must be conducted. All operational staff and contractors are to adhere to the EMPr and should apply good environmental practice during operations. The EMPr should include the following directives: • Once operational, vehicle and pedestrian access to the site should be controlled and restricted to prevent unnecessary destruction of vegetation. • Formal live-bird monitoring should be resumed once the turbines have been constructed, as per the most recent edition of the Best Practice Guidelines (Jenkins et al. 2015). The purpose of this would be to establish if displacement of priority species has occurred and to what extent. 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 year 5, and again every five years thereafter for the operational lifetime of the facility. • The mitigation measures proposed by the botanical specialist, including rehabilitation, must be strictly implemented. • Excavated rocks should be removed, or 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 to eliminate all potential crevices and shelter for small mammals such as Rock Hyraxes (the primary source of food for the Verreaux's Eagles).	Wind farm operator	Operation Phase

Performance Indicator	Quarterly and annual reports by vegetation and avifaunal specialists
Monitoring	Weekly carcass searches under turbines and quarterly live bird surveys

OBJECTIVE: Preventing the mortality of priority species due to turbine collisions during the operation phase

Project component/s	Wind turbines
Potential Impact	Mortality of priority species
Activity/risk source	Operational activities resulting in the mortality of priority species due to collisions with the turbines
Mitigation: Target/Objective	Keeping the annual estimated mortality of local populations of priority species due to turbine collisions to below the threshold determined by the avifaunal specialist in consultation with other avifaunal experts e.g., BLSA.

Mitigation: Action/control	**Responsibility**	**Timeframe**
A site-specific Environmental Management Plan (EMPr) must be implemented, which gives appropriate and detailed description of how operational activities must be conducted. All operational staff and contractors are to adhere to the EMPr and should apply good environmental practice during operations. The EMPr should include the following directives: • A 200m turbine (including the rotor-swept area) exclusion zone should be implemented around boreholes and dams and a 100m turbine (including the rotor-swept area) exclusion zone on either side of drainage lines (**Appendix E**) – a KMZ with coordinates of dams can be provided. • Carcass searches must commence to establish mortality rates, as per the most recent edition of the Best Practice Guidelines (Jenkins et al. 2015). 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 year 5, and again every five years thereafter for the operational lifetime of the facility. • If annual estimated collision rates indicate unsustainable mortality levels of priority species, i.e. if natural background mortality together with the estimated mortality caused by turbine collisions exceeds a critical mortality threshold as determined by the avifaunal specialist in consultation with other experts e.g. BLSA, additional measures will have to be implemented which could include shutdown on demand. This must be undertaken in consultation with a qualified avifauna specialist.	Contractor Wind farm operator	Operational phase 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 in year 5, and again every five years thereafter for the operational lifetime of the facility.

Performance Indicator	Quarterly and annual reports by avifaunal specialist
Monitoring	Weekly carcass searches under turbines

OBJECTIVE: Preventing the mortality of priority species on the 33kV overhead lines and substations

Project component/s	MV network and substation
Potential Impact	Mortality of priority species
Activity/risk source	Operational activities resulting in the mortality of priority species due to electrocution and collisions
Mitigation: Target/Objective	Keeping the annual estimated mortality of local populations of priority species due to powerline mortality to below the threshold determined by the avifaunal specialist in consultation with other avifaunal experts e.g. BLSA.

Mitigation: Action/control	**Responsibility**	**Timeframe**

• Overhead lines should be restricted to an absolute minimum and should only be allowed if underground cabling is unfeasible due technical (not financial) constraints.
• The final pole designs must be signed off by the bird specialist to ensure that a bird-friendly design is used, where relevant.
  • Bi-monthly inspections of the overhead sections of the MV network must be conducted to look for carcasses under the poles.
  • With regards to the infrastructure within the substation yard, the hardware is too complex to warrant any mitigation for electrocution at this stage. It is rather recommended that if any impacts are recorded once operational, site specific mitigation be applied reactively. This must be undertaken in consultation with the avifauna specialist.
  • Bird flight diverters should be installed on all 33kV overhead lines on the full span length on the earthwire (according to Eskom guidelines - five metres apart). Light and dark colour devices must be alternated to provide contrast against both dark and light backgrounds respectively. These devices must be installed as soon as the conductors are strung.
	Wind farm developer
	
	Wind farm operator
		Design phase and Operational Phase
		
		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 in year 5, and again every five years thereafter for the operational lifetime of the facility. This should include the monthly inspections of the overhead sections of the MV network, where relevant.

Performance Indicator	Quarterly and annual reports by avifaunal specialist
Monitoring	Bi-monthly powerline inspections