AVIFAUNAL IMPACT ASSESSMENT: SCOPING

Merino Wind Farm, Northern Cape Province (WEF2)

September 2021

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EXECUTIVE SUMMARY

Great Karoo Renewable Energy (Pty) Ltd is proposing the development of a commercial wind farm and associated infrastructure on a site located approximately 35km south-west of Richmond and 80km south-east of Victoria West, within the Ubuntu Local Municipality and the Pixley Ka Seme District Municipality in the Northern Cape Province. The project is planned as part of a larger cluster of renewable energy projects, which include three (3) 100MW PV facilities (known as the Moriri Solar PV, Kwana Solar PV, and Nku Solar PV), an additional 140MW Wind Energy Facility (known as the Angora Wind Farm), as well as grid connection infrastructure connecting the renewable energy facilities to the existing Eskom Gamma Substation.

A preferred project site with an extent of ~29 909ha and a development area of ~5 516ha within the project site has been identified by Great Karoo Renewable Energy (Pty) Ltd as a technically suitable area for the development of the Merino Wind Farm with a contracted capacity of up to 140MW that can accommodate up to 45 turbines. The development area consists of the four (4) affected properties, which include:

- Portion 9 of Farm Bult and Rietfontein 96
- Portion 0 of Farm Vogelstruisfontein 84
- Portion 1 of Farm Rondavel 85
- Portion 0 of Farm Rondavel 85

The Merino Wind Farm project site is proposed to accommodate the following infrastructure, which will enable the wind farm to supply a contracted capacity of up to 140MW:

- Up to 45 wind turbines with a maximum hub height of up to 170m. The tip height of the turbines will be up to 250m.
- Concrete turbine foundations to support the turbine hardstands.
- Inverters and transformers.
- Temporary laydown areas which will accommodate storage and assembly areas.
- Cabling between the turbines, to be laid underground where practical.
- A temporary concrete batching plant.
- 33/132kV onsite facility substation.
- Underground cabling from the onsite substation to the 132kV collector substation.
- Electrical and auxiliary equipment required at the collector substation that serves that wind energy facility, including switchyard/bay, control building, fences, etc.
- Battery Energy Storage System (BESS).
- Access roads and internal distribution roads.
- Site offices and maintenance buildings, including workshop areas for maintenance and storage.

The wind farm is proposed in response to the identified objectives of the national and provincial government and local and district municipalities to develop renewable energy facilities for power generation purposes. It is the developer's intention to bid the Merino Wind Farm under the Department of Mineral Resources and Energy's (DMRE's) Renewable Energy Independent Power Producer Procurement (REIPPP) Programme, with the aim of evacuating the generated power into the national grid. This will aid in the diversification and stabilisation of the country's electricity supply, in line with the objectives of the Integrated Resource Plan (IRP) with the Merino Wind Farm set to inject up to 140MW into the national grid.

The SABAP2 data indicates that a total of 165 bird species could potentially occur within the broader area – Appendix 1 provides a comprehensive list of all the species. Of these, 24 species are classified as priority species (see definition of priority species in section 4) and 12 of these are South African Red List species. Of the priority species, 17 are likely to occur regularly in the development area.

Summarised scoping level assessment of the anticipated impacts

Impact	Nature of Impact	Extent of Impact	Significance (pre-mitigation)	No-Go Areas	Mitigation measures
During construction: Displacement due to disturbance associated with the construction of the wind turbines and associated infrastructure.	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, Northern Black Korhaan and Spotted Eagle-Owl. Some raptors might also be affected, e.g, Greater Kestrel which often breeds on crow nests which have been constructed on wind pumps. Some species might be able to recolonise the area after the completion of the construction phase, but for some species this might only be partially the case, resulting in lower densities than before once the WEF is operational, due to the disturbance factor of the operational turbines. In summary, the following species could be impacted by disturbance during the construction phase: Blue Crane, Karoo Korhaan, Ludwig's Bustard, Northern Black Korhaan, Spotted Eagle-Owl and Greater Kestrel.	Local	High	No avifaunal no-go areas were determined necessary for the mitigation of this anticipated impact.	Construction activity should be restricted to the immediate footprint of the infrastructure as far as possible. Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of priority species. Measures to control noise and dust should be applied according to current best practice in the industry.
During construction: Displacement of priority species due to habitat transformation associated with construction of the wind turbines and associated infrastructure.	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, Northern 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 development site. The building infrastructure and substations will all be situated in the same habitat, i.e., Karoo scrub. The habitat is not particularly sensitive, as far as avifauna is concerned, therefore the impact of the habitat transformation will be low given the extent of available habitat and the small size of the	Local	Low	No avifaunal no-go areas were determined necessary for the mitigation of this anticipated impact.	Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum. The mitigation measures proposed by the vegetation specialist, including rehabilitation, must be strictly implemented.

	footprint. In summary, the following species are likely to be affected by habitat transformation: Blue Crane, Karoo Korhaan, Northern Black Korhaan, Ludwig's Bustard.				
During operation: Mortality of priority species due to collisions with wind turbines.	The proposed development 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, Northern Black Korhaan, Ludwig's 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 Tawny Eagle, Cape Vulture, Martial Eagle, Pale Chanting Goshawk, Lanner Falcon, Booted Eagle, Verreaux's Eagle, Greater Kestrel and Black Stork 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 Fish Eagle, African Harrier-Hawk, Black Harrier, Black Stork, Black-winged Kite, Blue Crane, Booted Eagle, Common Buzzard, Greater Flamingo, Greater Kestrel, Jackal Buzzard, Karoo Korhaan, Lanner Falcon, Lesser Kestrel, Ludwig's Bustard, Martial Eagle, Northern Black Korhaan, Pale Chanting Goshawk, Secretarybird, Spotted Eagle-Owl, Tawny Eagle, Verreaux's Eagle, Western Barn Owl and Cape Vulture.	Local	High	A 3.7km No-Go zone should be implemented around the Verreaux's nest (FPVE2) (-31.543776° 23.597448°). A 3.7km No-Go zone should be implemented around the Verreaux's nest (FPVE4) (-31.540635° 23.716886°) A 3km No-Go zone should be implemented around the Tawny Eagle nest (FPTE1) (-31.445988° 23.583921°) A 3km No-Go zone should be implemented around the Tawny Eagle nest (FPTE4) (-31.507460° 23.550963°) A 5km No-Go zone should be implemented around the Martial Eagle nest (FPME1) (-31.524550° 23.534279°) An 800m turbine exclusion zone should be implemented at the large dams situated at -31.463982° 23.653370° and at -31.505297° 23.624400° A 500m turbine exclusion zone should be implemented at the medium-sized dam situated at -31.468068° 23.613909° A 200m turbine exclusion zone should be implemented	It is recommended that suitable pro-active mitigation be implemented at all turbines within a 5.2 km radius around all Verreaux's Eagle nests during daylight hours, once the wind farm commences with operations, to reduce the risk of collisions of Verreaux's Eagles with the turbines. Suitable pro-active mitigation measures should be selected prior to commencement of operation, informed by best-available information at the time of implementation. All infilling for road construction should be compacted and all lose rock piles at the base or periphery of such infilling should be covered and packed down so as to eliminate all potential crevices and shelter for small mammals such as Rock Hyraxes (the primary source of food for the Verreaux's Eagles). Live-bird monitoring and carcass searches should be implemented in the operational phase, as per the most recent edition of the Best Practice Guidelines at the time (Jenkins *et al.* 2015) to assess collision rates.

				around the following boreholes: -31.543646° 23.641418° -31.524881° 23.648011° -31.512977° 23.608149° -31.512790° 23.590034° -31.485982° 23.606518° -31.478371° 23.603843°	If estimated annual collision rates indicate unacceptable mortality levels of priority species, i.e., if it exceeds the mortality threshold determined by the avifaunal specialist after consultation with other avifaunal specialists and BirdLife South Africa, additional measures will have to be implemented which could include shut down on demand or other proven mitigation strategies.
During operation: Mortality of priority species due to electrocution on the medium voltage internal reticulation network	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 are expected to be vulnerable to electrocution: Spotted Eagle-Owl, Greater Kestrel, Pale Chanting Goshawk, Jackal Buzzard, Martial Eagle, Tawny Eagle, Verreaux's Eagle, African Fish Eagle, African Harrier-Hawk, Black Stork, Black-winged Kite, Booted Eagle, Common Buzzard, Lanner Falcon, Lesser Kestrel, Western Barn Owl and Cape Vulture.	Regional	High	No avifaunal no-go areas were determined necessary for the mitigation of this anticipated impact.	A raptor -friendly pole design must be used, and the pole design must be approved by the avifaunal specialist.
During operation: Mortality of priority species due to collisions with the medium voltage internal reticulation network	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 most at risk of collisions with the medium voltage powerlines are the following: Black Stork, Blue Crane, Karoo Korhaan, Northern Black Korhaan, Ludwig's Bustard, Greater Flamingo, Secretarybird.	Regional	High	No reticulation lines should be constructed within 300m of the large dam at -31.463982° 23.653370° .	All internal medium voltage lines must be marked with Eskom approved Bird Flight Diverters according to the Eskom standard.

Environmental sensitivities

The following specific environmental sensitivities were identified from an avifaunal perspective:

- **Large dams: 800m turbine No-Go zone**

  Surface water in this semi-arid habitat is crucially important for priority avifauna and many non-priority species. It is important to leave open space with no turbines for birds to access and leave the surface water area unhindered. Blue Cranes are also likely to at times roost in the larger dams and could fly in and out of these areas before dawn/after dusk which further necessitates a sufficient buffer around the dams.

- **Boreholes: 200m turbine No-Go zone**

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- **Verreaux's Eagle nests: 3.7km all infrastructure No-Go zone and 5.2km medium sensitivity zone**

  A 3.7km infrastructure free buffer zone must be implemented around the Verreaux's Eagle (SA status: Vulnerable) nests at (-31.543776° 23.597448°) and (-31.540635° 23.716886°). This is to reduce the turbine collision risk. It is recommended that suitable pro-active mitigation be implemented at all turbines within a 5.2 km radius around the Verreaux's Eagle nest during daylight hours, once the wind farm commences with operations, to reduce the risk of collisions of Verreaux's Eagles with the turbines. Suitable pro-active mitigation measures should be selected prior to commencement of operation, informed by best-available information at the time of implementation.

- **Tawny Eagle nests: 3km all infrastructure No-Go zone**

  A 3km infrastructure free buffer zone must be implemented around the Tawny Eagle (SA status: Endangered) nests at (-31.540635° 23.716886°) and (-31.445988° 23.583921°). This is to reduce the turbine collision risk.

- **Martial Eagle nests: 5km all infrastructure No-Go zone**

  A 5km infrastructure free buffer zone must be implemented around the Martial Eagle (SA status: Endangered) nest at (-31.524550° 23.534279°). This is to reduce the turbine collision risk.

See Figure 6 for the avifaunal sensitivities identified from a PV solar perspective.

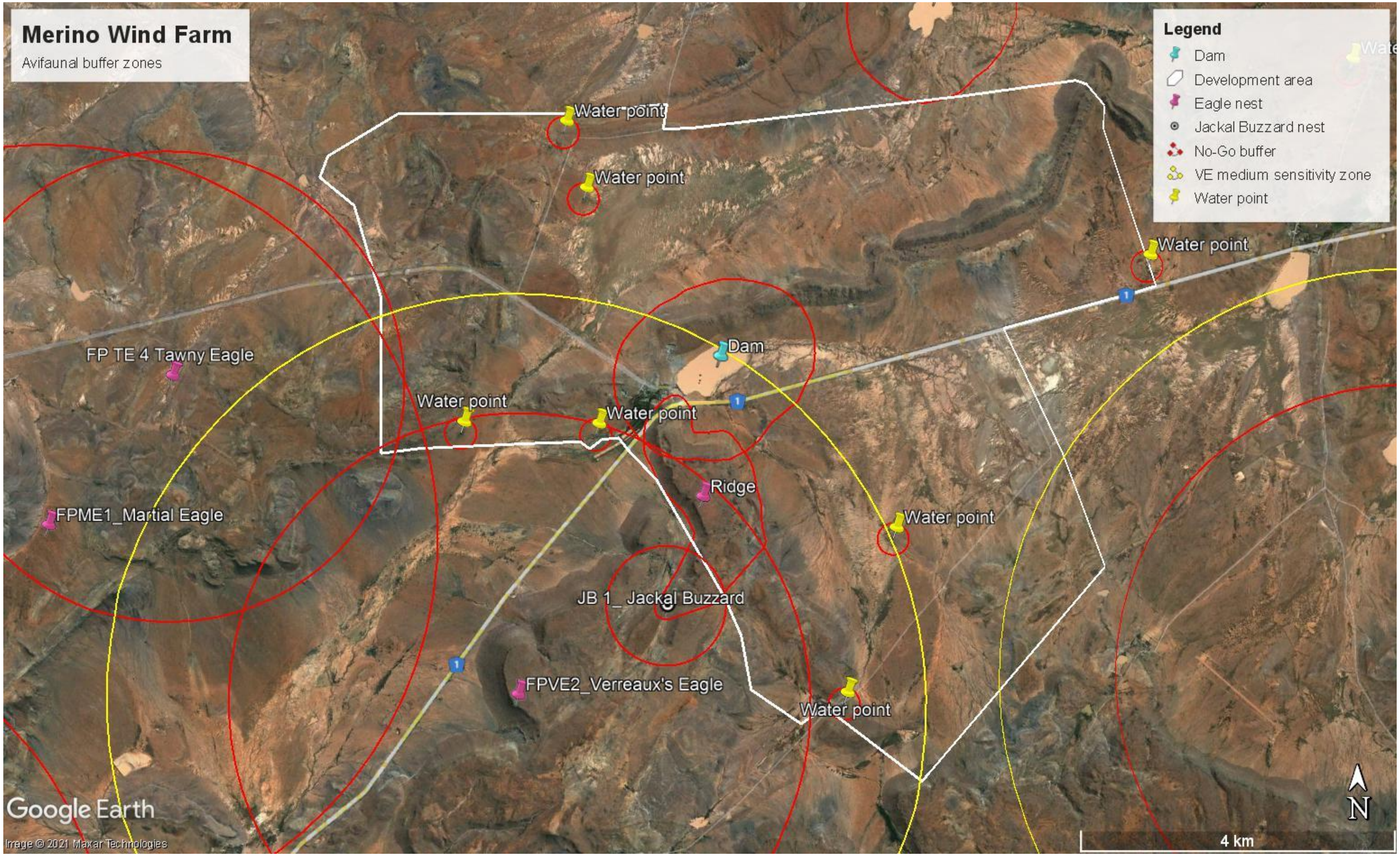

Figure 6: Avifaunal sensitivities (PV solar) at the Merino Wind Farm and associated infrastructure.

PRELIMINARY CONCLUSIONS

The proposed 140 MW Merino Wind Farm will have an anticipated high and low pre-mitigation negative impact on priority avifauna, which is expected to be reduced to medium and low with appropriate mitigation. No fatal flaws are expected to be discovered during the investigations.

CONTENTS

DETAILS OF THE SPECIALIST

Chris van Rooyen (Bird Specialist)

Chris has 22 years' experience in the management of wildlife interactions with electricity infrastructure. He was head of the Eskom-Endangered Wildlife Trust (EWT) Strategic Partnership from 1996 to 2007, which has received international acclaim as a model of co-operative management between industry and natural resource conservation. He is an acknowledged global expert in this field and has worked in South Africa, Namibia, Botswana, Lesotho, New Zealand, Texas, New Mexico and Florida. Chris also has extensive project management experience and has received several management awards from Eskom for his work in the Eskom-EWT Strategic Partnership. He is the author of 15 academic papers (some with co-authors), co-author of two book chapters and several research reports. He has been involved as ornithological consultant in numerous power line and wind generation projects. Chris is also co-author of the Best Practice for Avian Monitoring and Impact Mitigation at Wind Development Sites in Southern Africa, which is currently (2016) accepted as the industry standard. Chris also works outside the electricity industry and had done a wide range of bird impact assessment studies associated with various residential and industrial developments.

Albert Froneman (Bird and GIS Specialist)

Albert has an 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). 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 he is 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.

1. INTRODUCTION

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Please see Figures 1 and 2 for a map of the proposed development.

Figure 1: Locality map of the development area of the proposed Merino Wind Farm

Figure 2: Close-up of proposed Merino Wind Farm development area.

2 PROJECT SCOPE

The purpose of the Scoping Report is to determine the main issues and potential impacts of the proposed project/s during the scoping phase at a desktop level based on existing information, or field assessments as required:

- Describe the affected environment from an avifaunal perspective
- Discuss gaps in baseline data and other limitations and describe the expected impacts associated with the wind farm and associated infrastructure
- Identify potential sensitive environments and receptors that may be impacted on by the proposed wind farm and the types of impacts (i.e. direct, indirect and cumulative) that are most likely to occur.
- Determine the nature and extent of potential impacts during the construction and operational phases.
- Identify 'No-Go' areas, where applicable.
- Summarise the potential impacts that will be considered further in the EIA Phase through specialist assessments.
- Recommend mitigation measures to reduce the impact of the expected impacts.

3 OUTLINE OF METHODOLOGY AND INFORMATION REVIEWED

The following information sources were consulted to conduct this study:

- Bird distribution data from the Southern African Bird Atlas Project 2 (SABAP 2) was obtained (http://sabap2.adu.org.za/), in order to ascertain which species occur in the pentads where the proposed development is located. A pentad grid cell covers 5 minutes of latitude by 5 minutes of longitude (5' × 5'). Each pentad is approximately 8 × 7.6 km. To get a more representative impression of the birdlife, a consolidated data set was obtained for a total of 6 pentads some of which intersect and others that are near the development area, henceforth referred to as "the broader area". The decision to include multiple pentads around the development area was influenced by the fact that many of the pentads in the area have few completed full protocol surveys. The additional pentads and their data augment the bird distribution data. The 6 pentad grid cells are the following: 3125_2330, 3125_2335, 3125_2340, 3130_2330, 3130_2335, and 3130_2340 (see Figure 33). A total of 48 full protocol lists (i.e. bird listing surveys lasting a minimum of two hours each) and 66 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 development area is located. The SABAP2 data was therefore regarded as a reliable reflection of the avifauna which occurs in the area, but the data was also supplemented by data collected during the site surveys and general knowledge of the area.
- A classification of the vegetation types in the development area was obtained from the Atlas of Southern African Birds 1 (SABAP1) and the National Vegetation Map compiled by the South African National Biodiversity Institute (Mucina & Rutherford 2006).
- The national threatened status of all priority species was determined with the use of the most recent edition of the Red List Book of Birds of South Africa, Lesotho and Swaziland (Taylor *et al.* 2015), and the latest authoritative summary of southern African bird biology (Hockey *et al.* 2005).
- The global threatened status of all priority species was determined by consulting the latest (2021.2) 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 © 2021) was used in order to view the broader area on a landscape level and to help identify bird habitat on the ground.
- The South African National Biodiversity BGIS map viewer was used to determine the locality of the development area relative to National Protected Areas.
- The DFFE National Screening Tool was used to determine the assigned avian sensitivity of the development area.

- The following sources were consulted to determine the investigation protocol that is required for the site:
    - 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 om avifaunal species by onshore wind energy generation facilities where the electricity output is 20MW or more (Government Gazette No. 43110 – 20 March 2020).
    - Verreaux's Eagle Best Practice Guidelines (Ralston-Patton S. 2017. Verreaux's Eagles and Wind Farms. Guidelines for impact assessment, monitoring and mitigation. BirdLife South Africa, March 2017).
- The main source of information on the avifaunal diversity and abundance at the project site and development area is an integrated pre-construction monitoring programme which is currently being implemented at the project site, covering three proposed PV projects and two proposed wind energy projects (three of six surveys have been completed completed) (See Appendix 3).

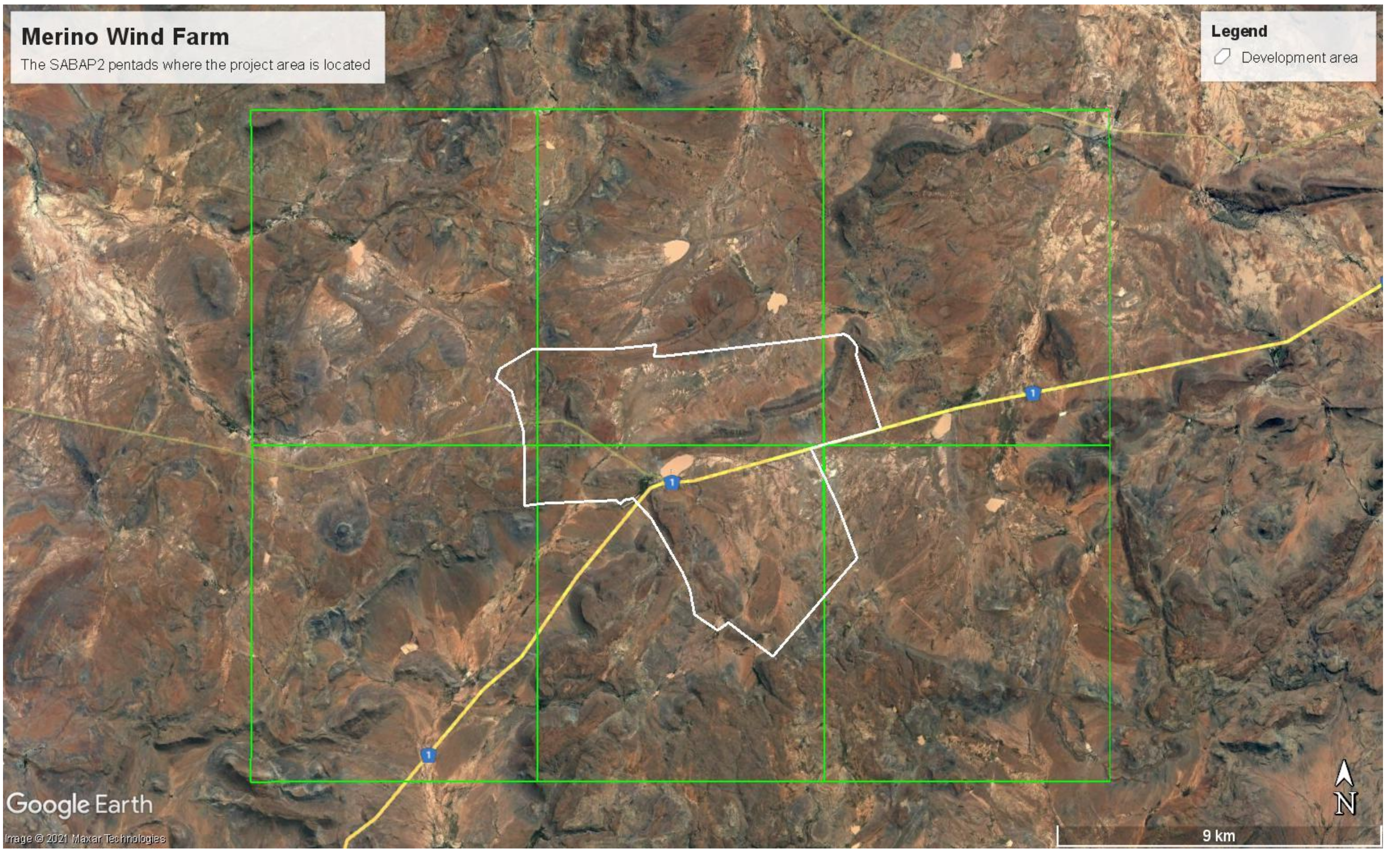


Figure 3: Area covered by the six SABAP2 pentads.

4 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 which is currently being conducted.
- Conclusions in this scoping report are based on experience of these and similar species at wind farm developments in different parts of South Africa. However, bird behaviour can never be predicted with absolute certainty.

- To date, only one peer-reviewed scientific paper has been published on the impacts wind farms have on birds in South Africa (Perold *et al*. 2020). The precautionary principle was therefore applied throughout. The World Charter for Nature, which was adopted by the UN General Assembly in 1982, was the first international endorsement of the precautionary principle. 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 that identified area (located within the project site) where the Merino Wind Farm 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 ~5 516ha in extent.
- The broader area refers to the area covered by the six SABAP2 pentads (see Figure 3).
- Priority species for wind development were identified from the updated list of priority species for wind farms compiled for the Avian Wind Farm Sensitivity Map (Retief *et al*. 2012).

5 LEGISLATIVE CONTEXT

5.1 Agreements and conventions

Table 1 below lists agreements and conventions which South Africa is party to and which is relevant to the conservation of avifauna[1].

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 biological diversity The fair and equitable sharing of the benefits arising out of the utilization of genetic resources.	Global
Convention on the Conservation of Migratory Species of Wild Animals, (CMS), Bonn, 1979	As an environmental treaty under the aegis of the United Nations Environment Programme, CMS provides a global platform for the conservation and sustainable use of migratory animals and their habitats. CMS brings together the States through which migratory animals pass, the Range States, and lays the legal foundation for internationally coordinated conservation measures throughout a migratory range.	Global

[1] (BirdLife International (2021) Country profile: South Africa. Available from: http://www.birdlife.org/datazone/country/south_africa. Checked: 2021-09-20).

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

5.2 National legislation

5.2.1 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.

5.2.2 The National Environmental Management Act 107 of 1998 (NEMA)

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

5.2.3 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.

5.3 Provincial Legislation

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

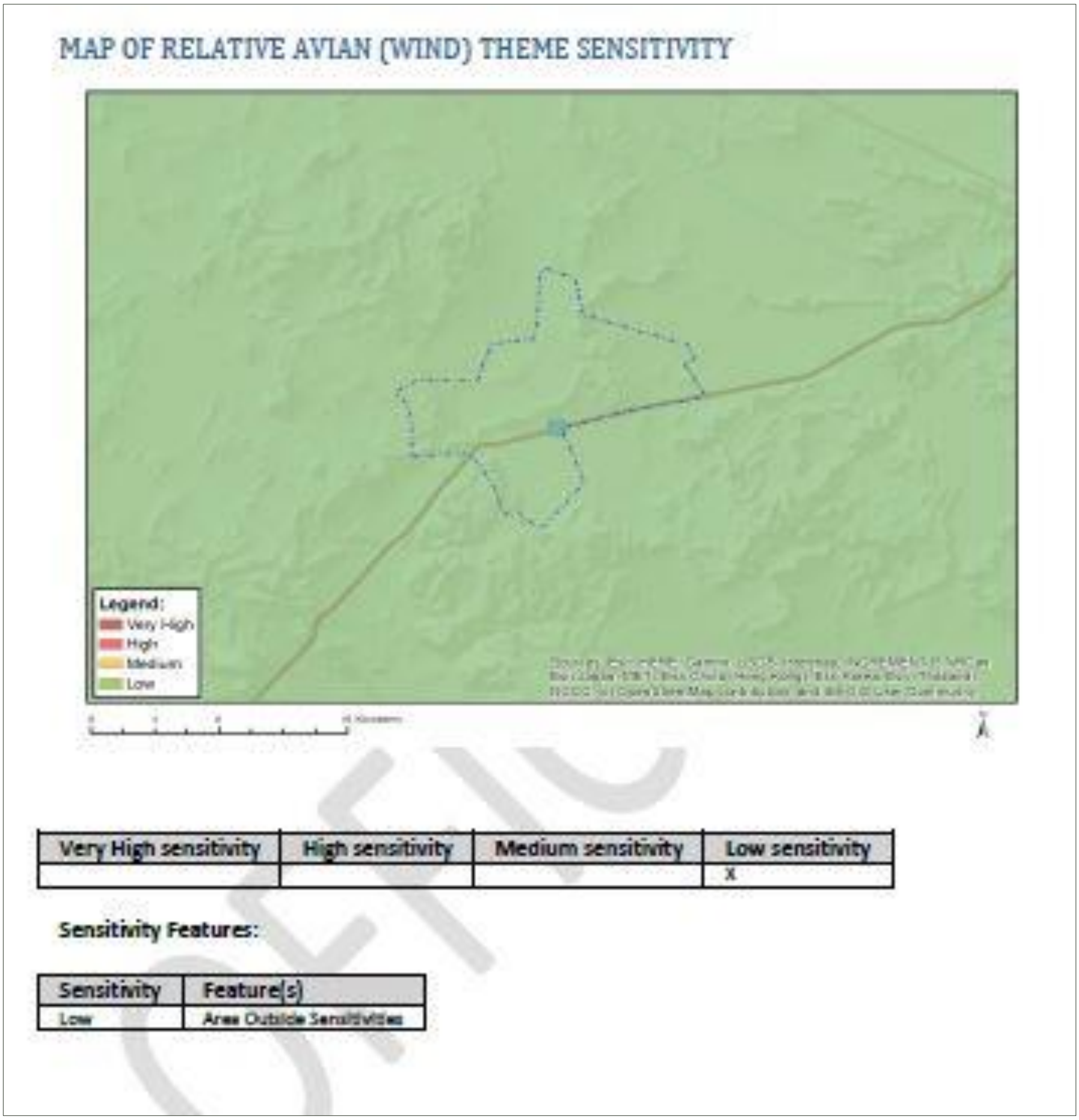
6 BASELINE ASSESSMENT

6.1 Important Bird Areas

There are no Important Bird Areas (IBA) within a 50km radius around the proposed Merino wind Farm. The closest IBA to the project site is the Platberg-Karoo Conservancy IBA SA037, which is just over 50km away. It is therefore highly unlikely that the proposed development will have a negative impact on any IBA due to the distance from the project site.

6.2 DFFE National Screening Tool

According to the DFFE national screening tool, the habitat within the development site is classified as **Low** sensitivity for birds according to the Avian Wind theme (see Figure 4). This classification is not accurate as far as the impact of the proposed WEF is concerned, based on actual conditions recorded on the ground during the 12 months of pre-construction monitoring. The classification should be **High** based on the presence of a Verreaux's Eagle nest within 3.7km from the development area.



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
			X

Sensitivity	Feature(s)
Low	Area Outside Sensitivities

Figure 4: The National Web-Based Environmental Screening Tool map of the project site, indicating sensitivities for the Avian Wind theme. The classification should be changed to High sensitivity based on the presence of a Verreaux's Eagle nest within 3.7km from the development area.

6.3 Protected Areas

The project site does not fall within a formally protected area.

6.4 Biomes and vegetation types

The project site, within which the development area is located, falls within the Nama Karoo biome (Mucina & Rutherford 2006). It consists of a flat plain with a number of inselbergs containing steep, boulder-strewn slopes, exposed rocky ridges and low cliffs. Two vegetation types are found in the development site, the dominant one being Eastern Upper Karoo, which is found on the plains and Upper Karoo Hardeveld occurring on the ridges (Mucina & Rutherford 2006). Eastern Upper Karoo is dominated by dwarf mycrophyllus shrubs, with white grasses of the genera Aristida and Eragrostis. On the steep slopes, mountain ridges and koppies, Upper Karoo Hardeveld is found which is characterised by dwarf Karoo scrub with drought tolerant grasses of genera such as Aristida, Eragrostis and Stipagrostis (Mucina & Rutherford 2006). The project site contains several large earth dams.

The Merino Wind Farm development area itself is located on a plain and contains a number of ridges. There are two large earth dams on the development area that hold water periodically. The only permanent sources of surface water are a number of boreholes with water troughs.

Temperatures in the project site range between 30˚C in January (summer) and 0˚C in July (winter), and average rainfall happens mostly between November and April and averages about 400mm per year, which makes for a fairly arid climate. Winters are very dry. The land is used for sheep and game farming.

Whilst the distribution and abundance of the bird species in the development area are typical of the broad vegetation type, it is also necessary to examine bird habitats in more detail as it may influence the distribution and behaviour of priority species. These are discussed in more detail below. The priority species most likely associated with the various bird habitat features are listed in Table 2.

6.5 Bird habitat

6.5.1 Nama Karoo

The vegetation at the development area consists of Karoo shrub.

6.5.2 Surface water

The development area contains one source of permanent surface water, namely boreholes with water troughs. There are also two large dams and a smaller dam in the development area. The dams contain water periodically. When they did contain water, flocks of Blue Cranes were observed roosting in them at night, as well as several Greater Flamingos.

6.5.3 High voltage lines

There are a number of high voltage lines that run to the north-west of the development area. Transmission lines are an important breeding substrate for raptors in the Karoo, due to the lack of large trees (Jenkins *et al.* 2013). There is a Tawny Eagle nest (FPTE1) (-31.445988° 23.583921°) situated approximately 3.5km from the development area border on the Droërivier – Hydra 2 400kV transmission line. The nest was last inspected in July 2021, when an adult bird was recorded on the nest. There is another Tawny Eagle nest (FPTE4) (-31.507460° 23.550963°) located approximately 3.1km away from the border of the development area on the Droërivier-Hydra 1 400kV transmission line. The nest was last inspected in July 2021, when an adult bird was recorded on the nest. There is also a Martial Eagle nest (FPME1) (-31.524550° 23.534279°) located approximately 5km away from the border of the development area on the Droërivier-Hydra 1 400kV transmission line. The nest was last inspected in July 2021, when an adult bird was recorded in the vicinity of the nest.

6.5.4 Rocky ridges

The development area ridges contain a low ridge with steep, boulder-strewn slopes and exposed rock faces. There are also rocky ridges outside the development area that contain Verreaux's Eagle nests. There are two Verreaux's Eagle pairs which may be impacted by the proposed development - the one nest (FPVE2) (-31.543776° 23.597448°) is situated approximately 3km from the border of the development area, the second nest (FPVE4) (-31.540635° 23.716886°) is situated approximately 4km from the border of the development area.

6.5.5 Agricultural lands

Cultivation in the development area is limited to a few irrigated lands near the N1 national road where lucerne is cultivated.

6.5.6 Alien trees

The development area is largely devoid of trees, except for alien trees which have been planted in rows between the lucerne fields and at the homestead.

See Appendix 2 for photographic record of habitat features in the development area and immediate surroundings.

7 AVIFAUNA IN THE DEVELOPMENT AREA

7.1 South African Bird Atlas Project 2

The SABAP2 data indicates that a total of 165 bird species could potentially occur within the broader area – Appendix 1 provides a comprehensive list of all the species. Of these, 24 species are classified as priority species (see definition of priority species in section 4) and 12 of these are South African Red List species. Of the priority species, 17 are likely to occur regularly in the development area (see Table 2 below).

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

- NT = Near threatened
- VU = Vulnerable
- EN = Endangered

Table 2: Priority species potentially occurring at the development area (Red List species are shaded).

Species	Taxonomic name	SABAP2 reporting rate		Conservation status		Recorded during surveys	Likelihood of regular occurrence	Habitat feature						Potential impact				
		Full protocol reporting rate	ad hoc protocol reporting rate	Global status	Regional status			Nama Karoo	Surface water	Agriculture	Ridges	Alien trees	HV lines	Collisions with turbines	Displacement: Disturbance	Displacement: Habitat transformation	Electrocution: MV lines	Collisions: MV OHL
African Fish Eagle	*Haliaeetus vocifer*	2.08	0.00				L		x			x		x			x	
African Harrier-Hawk	*Polyboroides typus*	6.25	3.03			x	M	x	x			x		x			x	
Black Harrier	*Circus maurus*	2.08	0.00	EN	EN		L	x	x					x				
Black Stork	*Ciconia nigra*	4.17	0.00	LC	VU	x	M		x		x			x			x	x
Black-winged Kite	*Elanus caeruleus*	2.08	0.00				L	x		x		x		x			x	
Blue Crane	*Grus paradisea*	62.50	18.18	VU	NT	x	H	x	x	x				x	x	x		x
Booted Eagle	*Hieraaetus pennatus*	6.25	0.00			x	M	x	x			x		x			x	
Common Buzzard	*Buteo buteo*	2.08	7.58			x	M	x	x	x		x	x	x			x	
Greater Flamingo	*Phoenicopterus roseus*	4.17	1.52	LC	NT	x	M		x					x				x
Greater Kestrel	*Falco rupicoloides*	31.25	3.03			x	H	x				x	x	x			x	
Jackal Buzzard	*Buteo rufofuscus*	43.75	16.67			x	H	x	x		x	x	x	x			x	
Karoo Korhaan	*Eupodotis vigorsii*	52.08	7.58	LC	NT	x	H	x						x	x	x		x
Lanner Falcon	*Falco biarmicus*	2.08	3.03	LC	VU	x	M	x	x	x	x	x	x	x			x	
Lesser Kestrel	*Falco naumanni*	2.08	1.52			x	L	x		x		x	x	x			x	
Ludwig's Bustard	*Neotis ludwigii*	45.83	7.58	EN	EN	x	H	x		x				x	x	x		x
Martial Eagle	*Polemaetus bellicosus*	10.42	1.52	VU	EN	x	H	x	x			x	x	x			x	
Northern Black Korhaan	*Afrotis afraoides*	72.92	21.21			x	H	x						x	x	x		x
Pale Chanting Goshawk	*Melierax canorus*	45.83	13.64			x	H	x	x			x	x	x			x	
Secretarybird	*Sagittarius serpentarius*	12.50	6.06	VU	VU		L	x	x					x				x
Spotted Eagle-Owl	*Bubo africanus*	8.33	0.00				M	x				x		x	x		x	
Tawny Eagle	*Aquila rapax*	12.50	3.03	VU	EN	x	H	x	x			x	x	x			x	
Verreaux's Eagle	*Aquila verreauxii*	18.75	1.52	LC	VU	x	H		x		x		x	x			x	
Western Barn Owl	*Tyto alba*	2.08	0.00				L			x		x		x			x	
Cape Vulture	*Gyps coprotheres*	0.00	0.00	EN	EN	x	L	x			x		x	x			x	

8 IMPACT ASSESSMENT

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 medium voltage overhead lines
- Mortality due to collisions with the medium voltage overhead lines

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

8.1 Collision mortality on wind turbines[2]

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 infrastructure, 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).

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[2] 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.

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

Information on the wing loading of the priority species potentially occurring regularly at the Merino Wind Farm 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, making them less manoeuvrable (Keskin *et al.* 2019).

- Sensorial perception

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

Some of the regularly occurring priority species at the proposed Merino Wind Farm have high resolution vision areas found in the lateral fields of view, rather than frontally, e.g., the vultures, 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 Merino Wind Farm 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, Cape Vulture and Greater Flamingo. 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, very few bustard collisions with wind turbines have been reported to date, all 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 Merino Wind Farm can be classified as either terrestrial species, soaring species or occasional long-distance fliers. Terrestrial species spend most of the time foraging on the ground. They do not fly often and when they do, they generally fly for short distances at low to medium altitude. At the application site, Ludwig Bustard 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 Greater Flamingo. 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., Cape Vulture, Lanner Falcon, Booted Eagle, Martial Eagle, Greater Kestrel, Pale Chanting Goshawk, Tawny Eagle, 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 Merino Wind Farm 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 wind farm is unlikely for any of the priority species likely to occur at the proposed 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 Merino Wind Farm will fluctuate depending on the season of the year, and especially in response to rainfall e.g., Ludwig's Bustard, Greater Flamingo, Lesser 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 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 ground dams (when full) and drinking troughs. Surface water attracts many birds, including Red List species such as Martial Eagle, Tawny Eagle, Blue Crane, Greater Flamingo, 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).

There is a Tawny Eagle nest (FPTE1) (-31.445988° 23.583921°) situated approximately 3.5km from the development area border on the Droërivier – Hydra 2 400kV transmission line. There is another Tawny Eagle nest (FPTE4) (-31.507460° 23.550963°) located approximately 3.1km away from the border of the development area on the Droërivier-Hydra 1 400kV transmission line. There is also a Martial Eagle nest (FPME1) (-31.524550° 23.534279°) located approximately 5km away from the border of the development area on the Droërivier-Hydra 1 400kV transmission line. There are also two Verreaux's Eagle pairs which may be impacted by the proposed development - the one nest (FPVE2) (-31.543776° 23.597448°) is situated approximately 3km from the border of the development area, the second nest (FPVE4) (-31.540635°

23.716886°) is situated approximately 4km from the border of the development area. The nests are the hub of the flight activity for the breeding pairs of eagles. The dams are likely to act as a focal point for flight activity as birds converge on the dam, e.g. Blue Crane to roost and Greater Flamingo to forage.

- 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).

The occurrence of Cape Vultures at the project site could be linked to the availability of food.

- Summary

The proposed Merino Wind Farm 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, Northern Black Korhaan, Ludwig's 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 Tawny Eagle, Cape Vulture, Martial Eagle, Pale Chanting Goshawk, Lanner Falcon, Booted Eagle, Verreaux's Eagle, Greater Kestrel and Black Stork 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 Fish Eagle, African Harrier-Hawk, Black Harrier, Black Stork, Black-winged Kite, Blue Crane, Booted Eagle, Common Buzzard, Greater Flamingo, Greater Kestrel, Jackal Buzzard, Karoo Korhaan, Lanner Falcon, Lesser Kestrel, Ludwig's Bustard, Martial Eagle, Northern Black Korhaan, Pale Chanting Goshawk, Secretarybird, Spotted Eagle-Owl, Tawny Eagle, Verreaux's Eagle, Western Barn Owl and Cape Vulture.

8.2 Displacement due to disturbance

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

Unfortunately, few studies of displacement due to disturbance are conclusive, often because of the lack of before- and-after and control-impact (BACI) assessments. Indications are that Great Bustard *Otis tarda* could be displaced by wind farms up to one kilometre from the facility (Langgemach 2008). An Austrian study found displacement for Great Bustards up to 600m (Wurm & Kollar as quoted by Raab *et al.* 2009). However, there is also evidence to the contrary; information on Great Bustard received from Spain points to the possibility of continued use of leks at operational wind farms (Camiña 2012b). The same situation seems to prevail at wind farms in the Eastern Cape where Denham's Bustard are still using wind farm sites as leks.[3] Research on small grassland species in North America indicates that permanent displacement is uncommon and very species specific (e.g. see Stevens et.al 2013, Hale et.al 2014). There also seems to be little evidence for a persistent decline in passerine populations at wind farm sites in the UK (despite some evidence of turbine avoidance), with some species, including Skylark, showing increased populations after wind farm construction (see Pierce-Higgins et. al 2012). Populations of Thekla Lark *Galerida theklae* were found to be unaffected by wind farm developments in Southern Spain (see Farfan *et al*. 2009).

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

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

summary, the following species could be impacted by disturbance during the construction phase: Blue Crane, Karoo Korhaan, Ludwig's Bustard, Northern Black Korhaan, Spotted Eagle-Owl and Greater Kestrel.

8.3 Displacement due to habitat loss

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

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

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, Northern 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 development site. The building infrastructure and substations will all be situated in the same habitat, i.e., Karoo scrub. The habitat is not particularly sensitive, as far as avifauna is concerned, therefore the impact of the habitat transformation will be low given the extent of available habitat and the small size of the footprint. In summary, the following species are likely to be affected by habitat transformation: Blue Crane, Karoo Korhaan, Northern Black Korhaan, Ludwig's Bustard.

8.4 Electrocution on the 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 are expected to be vulnerable to electrocution: Spotted Eagle-Owl, Greater Kestrel, Pale Chanting Goshawk, Jackal Buzzard, Martial Eagle, Tawny Eagle, Verreaux's Eagle, African Fish Eagle, African Harrier-Hawk, Black Stork, Black-winged Kite, Booted Eagle, Common Buzzard, Lanner Falcon, Lesser Kestrel, Western Barn Owl and Cape Vulture.

8.5 Collisions with the medium voltage network

Collisions are the biggest threat posed by transmission 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 (see Figure 5 below).

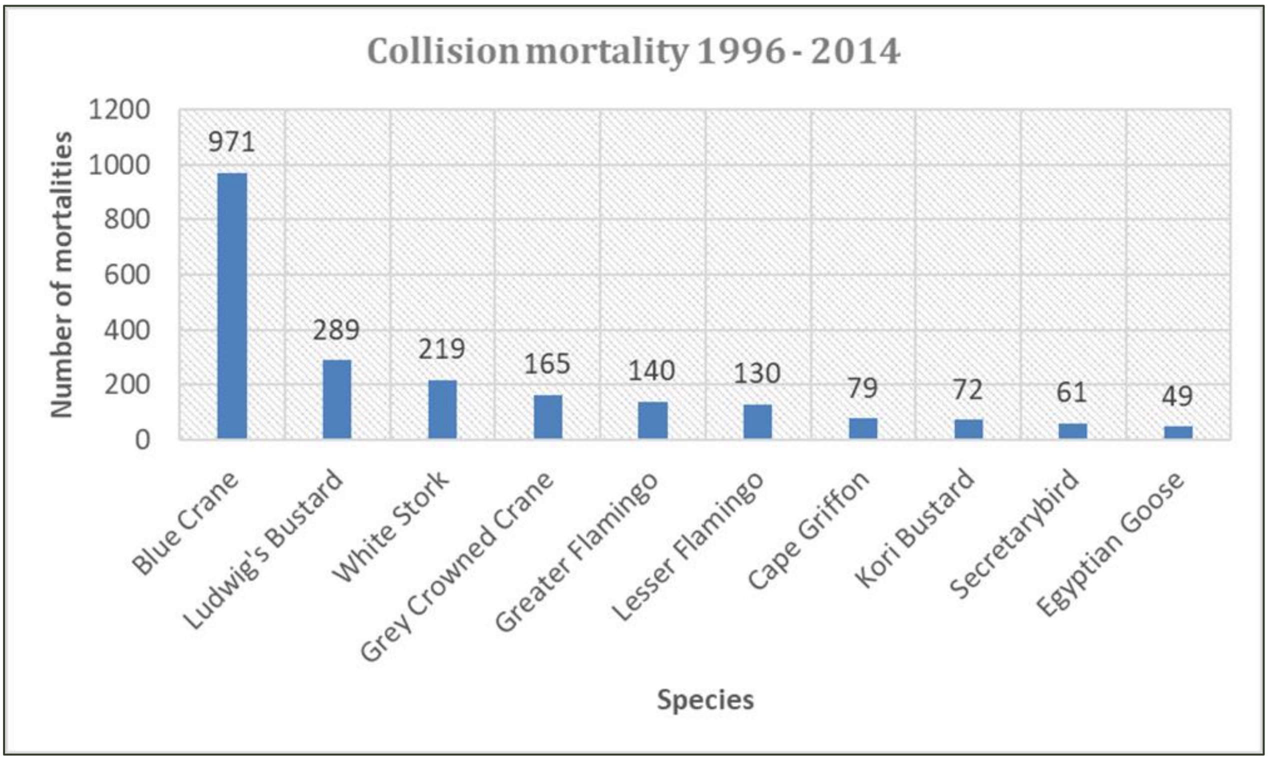

Figure 5: The top 10 collision prone bird species in South Africa, in terms of reported incidents contained in the Eskom/Endangered Wildlife Trust Strategic Partnership central incident register 1996 - 2014 (EWT unpublished data)

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

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

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 most at risk of collisions with the medium voltage powerlines are the following: Black Stork, Blue Crane, Karoo Korhaan, Northern Black Korhaan, Ludwig's Bustard, Greater Flamingo, Secretarybird. Large dams and agricultural fields are particular high-risk areas.

9 IMPACT RATING

Table 3 below is a summarised scoping level assessment of the anticipated impacts.

Table 3: Summarised scoping level assessment of the anticipated impacts

Impact	Nature of Impact	Extent of Impact	Significance (pre-mitigation)	No-Go Areas	Mitigation measures
During construction: Displacement due to disturbance associated with the construction of the wind turbines and associated infrastructure.	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, Northern Black Korhaan and Spotted Eagle-Owl. Some raptors might also be affected, e.g, Greater Kestrel which often breeds on crow nests which have been constructed on wind pumps. Some species might be able to recolonise the area after the completion of the construction phase, but for some species this might only be partially the case, resulting in lower densities than before once the WEF is operational, due to the disturbance factor of the operational turbines. In summary, the following species could be impacted by disturbance during the construction phase: Blue Crane, Karoo Korhaan, Ludwig's Bustard, Northern Black Korhaan, Spotted Eagle-Owl and Greater Kestrel.	Local	High	No avifaunal no-go areas were determined necessary for the mitigation of this anticipated impact.	Construction activity should be restricted to the immediate footprint of the infrastructure as far as possible. Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of priority species. Measures to control noise and dust should be applied according to current best practice in the industry.
During construction: Displacement of priority species due to habitat transformation associated with construction of the wind turbines and associated infrastructure.	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, Northern 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	Local	Low	No avifaunal no-go areas were determined necessary for the mitigation of this anticipated impact.	Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum. The mitigation measures proposed by the vegetation specialist, including rehabilitation,

	development site. The building infrastructure and substations will all be situated in the same habitat, i.e., Karoo scrub. The habitat is not particularly sensitive, as far as avifauna is concerned, therefore the impact of the habitat transformation will be low given the extent of available habitat and the small size of the footprint. In summary, the following species are likely to be affected by habitat transformation: Blue Crane, Karoo Korhaan, Northern Black Korhaan, Ludwig's Bustard.				must be strictly implemented.
During operation: Mortality of priority species due to collisions with wind turbines.	The proposed development 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, Northern Black Korhaan, Ludwig's 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 Tawny Eagle, Cape Vulture, Martial Eagle, Pale Chanting Goshawk, Lanner Falcon, Booted Eagle, Verreaux's Eagle, Greater Kestrel and Black Stork 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 Fish Eagle, African Harrier-Hawk, Black Harrier, Black Stork, Black-winged Kite, Blue Crane, Booted Eagle, Common Buzzard, Greater Flamingo, Greater Kestrel, Jackal Buzzard, Karoo Korhaan, Lanner Falcon, Lesser Kestrel, Ludwig's Bustard, Martial Eagle, Northern Black Korhaan, Pale Chanting Goshawk, Secretarybird, Spotted Eagle-Owl, Tawny Eagle, Verreaux's Eagle, Western Barn Owl and Cape Vulture.	Local	High	A 3.7km No-Go zone should be implemented around the Verreaux's nest (FPVE2) (-31.543776° 23.597448°). A 3.7km No-Go zone should be implemented around the Verreaux's nest (FPVE4) (-31.540635° 23.716886°) A 3km No-Go zone should be implemented around the Tawny Eagle nest (FPTE1) (-31.445988° 23.583921°) A 3km No-Go zone should be implemented around the Tawny Eagle nest (FPTE4) (-31.507460° 23.550963°) A 5km No-Go zone should be implemented around the Martial Eagle nest (FPME1) (-31.524550° 23.534279°)	It is recommended that suitable pro-active mitigation be implemented at all turbines within a 5.2 km radius around all Verreaux's Eagle nests during daylight hours, once the wind farm commences with operations, to reduce the risk of collisions of Verreaux's Eagles with the turbines. Suitable pro-active mitigation measures should be selected prior to commencement of operation, informed by best-available information at the time of implementation. All infilling for road construction should be compacted and all lose rock piles at the base or periphery of such infilling should be covered and packed down so as to eliminate all potential crevices and shelter for small mammals such as

				An 800m turbine exclusion zone should be implemented at the large dams situated at -31.463982° 23.653370° and at -31.505297° 23.624400° A 500m turbine exclusion zone should be implemented at the medium-sized dam situated at -31.468068° 23.613909° A 200m turbine exclusion zone should be implemented around the following boreholes: -31.543646° 23.641418° -31.524881° 23.648011° -31.512977° 23.608149° -31.512790° 23.590034° -31.485982° 23.606518° -31.478371° 23.603843°	Rock Hyraxes (the primary source of food for the Verreaux's Eagles). Live-bird monitoring and carcass searches should be implemented in the operational phase, as per the most recent edition of the Best Practice Guidelines at the time (Jenkins *et al.* 2015) to assess collision rates. If estimated annual collision rates indicate unacceptable mortality levels of priority species, i.e., if it exceeds the mortality threshold determined by the avifaunal specialist after consultation with other avifaunal specialists and BirdLife South Africa, additional measures will have to be implemented which could include shut down on demand or other proven mitigation strategies.
During operation: Mortality of priority species due to electrocution on the medium voltage internal reticulation network	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 are expected to be vulnerable to electrocution: Spotted Eagle-Owl, Greater Kestrel, Pale	Regional	High	No avifaunal no-go areas were determined necessary for the mitigation of this anticipated impact.	A raptor -friendly pole design must be used, and the pole design must be approved by the avifaunal specialist.

	Chanting Goshawk, Jackal Buzzard, Martial Eagle, Tawny Eagle, Verreaux's Eagle, African Fish Eagle, African Harrier-Hawk, Black Stork, Black-winged Kite, Booted Eagle, Common Buzzard, Lanner Falcon, Lesser Kestrel, Western Barn Owl and Cape Vulture.				
During operation: Mortality of priority species due to collisions with the medium voltage internal reticulation network	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 most at risk of collisions with the medium voltage powerlines are the following: Black Stork, Blue Crane, Karoo Korhaan, Northern Black Korhaan, Ludwig's Bustard, Greater Flamingo, Secretarybird.	Regional	High	No reticulation lines should be constructed within 300m of the large dam at -31.463982° 23.653370° .	All internal medium voltage lines must be marked with Eskom approved Bird Flight Diverters according to the Eskom standard.

9.1 Environmental sensitivities

The following specific environmental sensitivities were identified from an avifaunal perspective:

- **Large dams: 800m turbine No-Go zone**

  Surface water in this semi-arid habitat is crucially important for priority avifauna and many non-priority species. It is important to leave open space with no turbines for birds to access and leave the surface water area unhindered. Blue Cranes are also likely to at times roost in the larger dams and could fly in and out of these areas before dawn/after dusk which further necessitates a sufficient buffer around the dams.

- **Boreholes: 200m turbine No-Go zone**

  Surface water in this semi-arid habitat is crucially important for priority avifauna and many non-priority species. It is important to leave open space with no turbines for birds to access and leave the surface water area unhindered.

- **Verreaux's Eagle nests: 3.7km all infrastructure No-Go zone and 5.2km medium sensitivity zone**

  A 3.7km infrastructure free buffer zone must be implemented around the Verreaux's Eagle (SA status: Vulnerable) nests at (-31.543776° 23.597448°) and (-31.540635° 23.716886°). This is to reduce the turbine collision risk. It is recommended that suitable pro-active mitigation be implemented at all turbines within a 5.2 km radius around the Verreaux's Eagle nest during daylight hours, once the wind farm commences with operations, to reduce the risk of collisions of Verreaux's Eagles with the turbines. Suitable pro-active mitigation measures should be selected prior to commencement of operation, informed by best-available information at the time of implementation.

- **Tawny Eagle nests: 3km all infrastructure No-Go zone**

  A 3km infrastructure free buffer zone must be implemented around the Tawny Eagle (SA status: Endangered) nests at (-31.540635° 23.716886°) and (-31.445988° 23.583921°). This is to reduce the turbine collision risk.

- **Martial Eagle nests: 5km all infrastructure No-Go zone**

  A 5km infrastructure free buffer zone must be implemented around the Martial Eagle (SA status: Endangered) nest at (-31.524550° 23.534279°). This is to reduce the turbine collision risk.

See Figure 6 for the avifaunal sensitivities identified from a PV solar perspective.

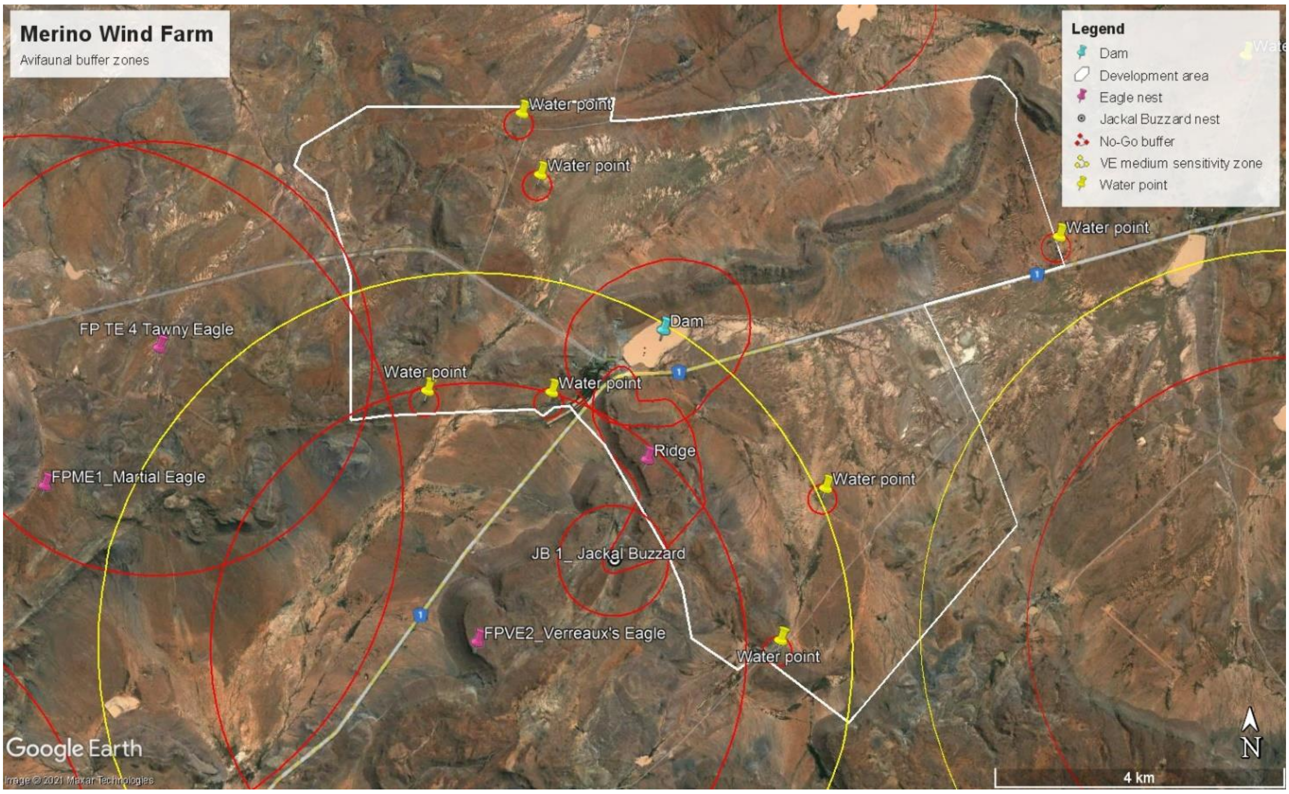

Figure 6: Avifaunal sensitivities (PV solar) at the Merino Wind Farm and associated infrastructure.

10 EIA PHASE

10.1 Plan of study

The following are proposed for the EIA Phase:

- The implementation of six avifaunal surveys, utilising transects, vantage point watches, focal points and incidental counts, to inform the assessment of the potential impacts of the planned infrastructure within the development footprint (see Appendix 3)[4]. The monitoring protocol is guided by the following:
  - 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 om avifaunal species by onshore wind energy generation facilities where the electricity output is 20MW or more (Government Gazette No. 43110 – 20 March 2020).
  - Verreaux's Eagle Best Practice Guidelines (Ralston-Patton S. 2017. Verreaux's Eagles and Wind Farms. Guidelines for impact assessment, monitoring and mitigation. BirdLife South Africa, March 2017).
- The avifaunal specialists report will be structured around the following terms of reference:
  - Description of the affected environment from an avifaunal perspective.
  - Discussion of gaps in baseline data and other limitations.
  - Description of the methodology that was used for the field surveys.

[4] This is currently ongoing with three of the six surveys having been completed to date.

- Comparison of the site sensitivity recorded in the field with the sensitivity classification in the DFFE National Screening Tool and adjustment if necessary.
- Provision of an overview of all applicable legislation.
- Provision of an overview of assessment methodology.
- Identification and assessment of the potential impacts of the proposed development on avifauna including cumulative impacts.
- Provision of sufficient mitigation measures to include in the Environmental Management Programme (EMPr).
- Conclusion with an impact statement whether the PV facility is fatally flawed or may be authorised.

10.2 Environmental Management Programme

For each anticipated impact, management recommendations for the design, construction, and operational phase (where appropriate) will be drafted for inclusion in the project EMPr.

11 PRELIMINARY CONCLUSIONS

The proposed 140 MW Merino Wind Farm will have an anticipated high and low pre-mitigation negative impact on priority avifauna, which is expected to be reduced to medium and low with appropriate mitigation. No fatal flaws are expected to be discovered during the investigations.

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APPENDIX 1: SABAP 2 SPECIES LIST FOR THE BROADER AREA

Species	Taxonomic name	Full protocol reporting rate	ad hoc protocol reporting rate	Global status	Regional status
Acacia Pied Barbet	*Tricholaema leucomelas*	50.00	9.09		
African Fish Eagle	*Haliaeetus vocifer*	2.08	0.00		
African Harrier-Hawk	*Polyboroides typus*	6.25	3.03		
African Hoopoe	*Upupa africana*	16.67	3.03		
African Palm Swift	*Cypsiurus parvus*	8.33	3.03		
African Pipit	*Anthus cinnamomeus*	20.83	3.03		
African Red-eyed Bulbul	*Pycnonotus nigricans*	60.42	13.64		
African Reed Warbler	*Acrocephalus baeticatus*	10.42	0.00		
African Rock Pipit	*Anthus crenatus*	8.33	0.00	NT	NT
African Sacred Ibis	*Threskiornis aethiopicus*	12.50	0.00		
African Spoonbill	*Platalea alba*	6.25	4.55		
African Stonechat	*Saxicola torquatus*	2.08	0.00		
Alpine Swift	*Tachymarptis melba*	4.17	0.00		
Ant-eating Chat	*Myrmecocichla formicivora*	62.50	25.76		
Barn Swallow	*Hirundo rustica*	29.17	12.12		
Black Harrier	*Circus maurus*	2.08	0.00	EN	EN
Black Stork	*Ciconia nigra*	4.17	0.00	LC	VU
Black-eared Sparrow-Lark	*Eremopterix australis*	18.75	3.03		
Black-headed Canary	*Serinus alario*	25.00	0.00		
Black-headed Heron	*Ardea melanocephala*	12.50	0.00		
Blacksmith Lapwing	*Vanellus armatus*	37.50	4.55		
Black-throated Canary	*Crithagra atrogularis*	25.00	1.52		
Black-winged Kite	*Elanus caeruleus*	2.08	0.00		
Black-winged Stilt	*Himantopus himantopus*	12.50	1.52		
Blue Crane	*Grus paradisea*	62.50	18.18	VU	NT
Bokmakierie	*Telophorus zeylonus*	56.25	13.64		
Booted Eagle	*Hieraaetus pennatus*	6.25	0.00		
Brown-hooded Kingfisher	*Halcyon albiventris*	4.17	0.00		
Brown-throated Martin	*Riparia paludicola*	14.58	0.00		
Buffy Pipit	*Anthus vaalensis*	6.25	0.00		
Cape Bunting	*Emberiza capensis*	37.50	4.55		
Cape Canary	*Serinus canicollis*	12.50	3.03		
Cape Crow	*Corvus capensis*	8.33	4.55		
Cape Penduline Tit	*Anthoscopus minutus*	29.17	4.55		
Cape Robin-Chat	*Cossypha caffra*	31.25	3.03		
Cape Shoveler	*Spatula smithii*	2.08	1.52		
Cape Sparrow	*Passer melanurus*	83.33	16.67		
Cape Teal	*Anas capensis*	4.17	3.03		
Cape Turtle Dove	*Streptopelia capicola*	62.50	6.06		
Cape Wagtail	*Motacilla capensis*	64.58	4.55		
Cape Weaver	*Ploceus capensis*	4.17	1.52		
Cape White-eye	*Zosterops virens*	10.42	1.52		
Capped Wheatear	*Oenanthe pileata*	20.83	4.55		

Species	Taxonomic name	Full protocol reporting rate	ad hoc protocol reporting rate	Global status	Regional status
Chat Flycatcher	*Melaenornis infuscatus*	54.17	7.58		
Chestnut-vented Warbler	*Curruca subcoerulea*	16.67	1.52		
Common Buzzard	*Buteo buteo*	2.08	7.58		
Common Greenshank	*Tringa nebularia*	10.42	1.52		
Common Moorhen	*Gallinula chloropus*	2.08	0.00		
Common Sandpiper	*Actitis hypoleucos*	2.08	0.00		
Common Swift	*Apus apus*	2.08	1.52		
Common Waxbill	*Estrilda astrild*	14.58	1.52		
Desert Cisticola	*Cisticola aridulus*	22.92	3.03		
Diederik Cuckoo	*Chrysococcyx caprius*	10.42	1.52		
Double-banded Courser	*Rhinoptilus africanus*	4.17	0.00		
Dusky Sunbird	*Cinnyris fuscus*	25.00	0.00		
Eastern Clapper Lark	*Mirafra fasciolata*	70.83	21.21		
Egyptian Goose	*Alopochen aegyptiaca*	37.50	6.06		
European Bee-eater	*Merops apiaster*	16.67	0.00		
Fairy Flycatcher	*Stenostira scita*	12.50	1.52		
Familiar Chat	*Oenanthe familiaris*	27.08	6.06		
Fiscal Flycatcher	*Melaenornis silens*	33.33	3.03		
Fork-tailed Drongo	*Dicrurus adsimilis*	6.25	1.52		
Greater Flamingo	*Phoenicopterus roseus*	4.17	1.52	LC	NT
Greater Kestrel	*Falco rupicoloides*	31.25	3.03		
Greater Striped Swallow	*Cecropis cucullata*	33.33	10.61		
Grey Heron	*Ardea cinerea*	8.33	1.52		
Grey Tit	*Melaniparus afer*	18.75	4.55		
Grey-backed Cisticola	*Cisticola subruficapilla*	29.17	6.06		
Grey-backed Sparrow-Lark	*Eremopterix verticalis*	39.58	15.15		
Grey-winged Francolin	*Scleroptila afra*	8.33	1.52		
Hadada Ibis	*Bostrychia hagedash*	33.33	1.52		
Hamerkop	*Scopus umbretta*	8.33	1.52		
Helmeted Guineafowl	*Numida meleagris*	12.50	1.52		
House Sparrow	*Passer domesticus*	22.92	3.03		
Jackal Buzzard	*Buteo rufofuscus*	43.75	16.67		
Karoo Chat	*Emarginata schlegelii*	25.00	6.06		
Karoo Eremomela	*Eremomela gregalis*	2.08	6.06		
Karoo Korhaan	*Eupodotis vigorsii*	52.08	7.58	LC	NT
Karoo Lark	*Calendulauda albescens*	2.08	0.00		
Karoo Long-billed Lark	*Certhilauda subcoronata*	54.17	9.09		
Karoo Prinia	*Prinia maculosa*	43.75	7.58		
Karoo Scrub Robin	*Cercotrichas coryphoeus*	83.33	19.70		
Karoo Thrush	*Turdus smithi*	39.58	3.03		
Kittlitz's Plover	*Charadrius pecuarius*	6.25	1.52		
Lanner Falcon	*Falco biarmicus*	2.08	3.03	LC	VU
Large-billed Lark	*Galerida magnirostris*	50.00	13.64		
Lark-like Bunting	*Emberiza impetuani*	72.92	19.70		
Laughing Dove	*Spilopelia senegalensis*	35.42	7.58		
Layard's Warbler	*Curruca layardi*	25.00	1.52		
Lesser Kestrel	*Falco naumanni*	2.08	1.52		
Lesser Swamp Warbler	*Acrocephalus gracilirostris*	12.50	0.00		
Levaillant's Cisticola	*Cisticola tinniens*	6.25	0.00		

Species	Taxonomic name	Full protocol reporting rate	ad hoc protocol reporting rate	Global status	Regional status
Little Bittern	*Ixobrychus minutus*	2.08	0.00		
Little Grebe	*Tachybaptus ruficollis*	4.17	0.00		
Little Stint	*Calidris minuta*	4.17	0.00		
Little Swift	*Apus affinis*	22.92	3.03		
Long-billed Crombec	*Sylvietta rufescens*	14.58	0.00		
Ludwig's Bustard	*Neotis ludwigii*	45.83	7.58	EN	EN
Malachite Sunbird	*Nectarinia famosa*	8.33	0.00		
Marsh Sandpiper	*Tringa stagnatilis*	2.08	0.00		
Martial Eagle	*Polemaetus bellicosus*	10.42	1.52	VU	EN
Mountain Wheatear	*Myrmecocichla monticola*	43.75	6.06		
Namaqua Dove	*Oena capensis*	14.58	10.61		
Namaqua Sandgrouse	*Pterocles namaqua*	29.17	3.03		
Neddicky	*Cisticola fulvicapilla*	0.00	1.52		
Nicholson's Pipit	*Anthus nicholsoni*	14.58	1.52		
Northern Black Korhaan	*Afrotis afraoides*	72.92	21.21		
Orange River White-eye	*Zosterops pallidus*	4.17	0.00		
Pale Chanting Goshawk	*Melierax canorus*	45.83	13.64		
Pale-winged Starling	*Onychognathus nabouroup*	62.50	3.03		
Pearl-breasted Swallow	*Hirundo dimidiata*	4.17	0.00		
Pied Avocet	*Recurvirostra avosetta*	16.67	6.06		
Pied Crow	*Corvus albus*	81.25	48.48		
Pied Starling	*Lamprotornis bicolor*	35.42	9.09		
Pink-billed Lark	*Spizocorys conirostris*	2.08	0.00		
Pin-tailed Whydah	*Vidua macroura*	16.67	1.52		
Plain-backed Pipit	*Anthus leucophrys*	18.75	1.52		
Pririt Batis	*Batis pririt*	2.08	1.52		
Red-billed Quelea	*Quelea quelea*	29.17	3.03		
Red-billed Teal	*Anas erythrorhyncha*	14.58	3.03		
Red-capped Lark	*Calandrella cinerea*	20.83	0.00		
Red-eyed Dove	*Streptopelia semitorquata*	35.42	4.55		
Red-faced Mousebird	*Urocolius indicus*	14.58	3.03		
Red-headed Finch	*Amadina erythrocephala*	4.17	9.09		
Red-knobbed Coot	*Fulica cristata*	6.25	0.00		
Red-winged Starling	*Onychognathus morio*	20.83	4.55		
Reed Cormorant	*Microcarbo africanus*	2.08	0.00		
Rock Kestrel	*Falco rupicolus*	41.67	3.03		
Rock Martin	*Ptyonoprogne fuligula*	58.33	7.58		
Rufous-cheeked Nightjar	*Caprimulgus rufigena*	4.17	0.00		
Rufous-eared Warbler	*Malcorus pectoralis*	75.00	28.79		
Sabota Lark	*Calendulauda sabota*	52.08	9.09		
Scaly-feathered Weaver	*Sporopipes squamifrons*	0.00	3.03		
Secretarybird	*Sagittarius serpentarius*	12.50	6.06	VU	VU
Short-toed Rock Thrush	*Monticola brevipes*	2.08	1.52		
Sickle-winged Chat	*Emarginata sinuata*	56.25	7.58		
South African Cliff Swallow	*Petrochelidon spilodera*	12.50	6.06		
South African Shelduck	*Tadorna cana*	47.92	4.55		
Southern Fiscal	*Lanius collaris*	62.50	7.58		

Species	Taxonomic name	Full protocol reporting rate	ad hoc protocol reporting rate	Global status	Regional status
Southern Double-collared Sunbird	*Cinnyris chalybeus*	2.08	0.00		
Southern Grey-headed Sparrow	*Passer diffusus*	35.42	4.55		
Southern Masked Weaver	*Ploceus velatus*	66.67	10.61		
Southern Red Bishop	*Euplectes orix*	31.25	7.58		
Speckled Pigeon	*Columba guinea*	54.17	10.61		
Spike-heeled Lark	*Chersomanes albofasciata*	77.08	18.18		
Spotted Eagle-Owl	*Bubo africanus*	8.33	0.00		
Spotted Thick-knee	*Burhinus capensis*	2.08	1.52		
Spur-winged Goose	*Plectropterus gambensis*	8.33	4.55		
Tawny Eagle	*Aquila rapax*	12.50	3.03	VU	EN
Three-banded Plover	*Charadrius tricollaris*	33.33	0.00		
Tractrac Chat	*Emarginata tractrac*	2.08	4.55		
Verreaux's Eagle	*Aquila verreauxii*	18.75	1.52	LC	VU
Wattled Starling	*Creatophora cinerea*	4.17	0.00		
Western Barn Owl	*Tyto alba*	2.08	0.00		
Western Cattle Egret	*Bubulcus ibis*	2.08	0.00		
White-backed Mousebird	*Colius colius*	45.83	7.58		
White-breasted Cormorant	*Phalacrocorax lucidus*	4.17	0.00		
White-necked Raven	*Corvus albicollis*	35.42	10.61		
White-rumped Swift	*Apus caffer*	14.58	9.09		
White-throated Canary	*Crithagra albogularis*	62.50	10.61		
White-throated Swallow	*Hirundo albigularis*	14.58	1.52		
Yellow Canary	*Crithagra flaviventris*	16.67	4.55		
Yellow-bellied Eremomela	*Eremomela icteropygialis*	39.58	9.09		
Yellow-billed Duck	*Anas undulata*	20.83	3.03		

APPENDIX 2: HABITAT FEATURES AT THE PROJECT SITE

Figure 1: Typical Nama Karoo habitat in the development area, which comprises the vast majority of the project site.

Figure 2: A Tawny Eagle nest (FPTE1) on the Droërivier Hydra 400kV transmission line.


Figure 3: An example of a large dam at the project site.


Figure 4: An example of alien trees at the development area.


Figure 5: Rocky ridges and inselbergs at the project site


Figure 6: A borehole with a water reservoir at the project site

APPENDIX 3: PRE-CONSTRUCTION MONITORING

Monitoring is conducted in the following manner:

- Two drive transects were identified totalling 14km on the development site and one drive transect in the control site with a total length of 7.59km.
- 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, 8 walk transects of 1km each were identified at the wind development areas, and 9 transects of 1km each at the solar development area, and two at the control site. The wind transects are counted 4 times per each seasonal sampling season. The PV transects are counted 4 times in spring and then again 4 times in autumn. 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)
    - 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 in order to measure potential displacement by the wind and solar farm activities.

- Eight 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 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. above rotor height; medium i.e. rotor height; low i.e. below rotor height)
    - Flight mode (soar; flap; glide; kite; hover) and
    - Flight time (in 15 second intervals).

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

A total of twelve potential focal points (FPs) of bird activity were identified and are being monitored. The focal points are as follows:

- FP ME1: Martial Eagle nest on Droërivier - Hydra 1 400kV
- FPME 2: Martial Eagle nest on Droërivier - Hydra 1 400kV
- FP TE1: Tawny Eagle nest on Droërivier – Hydra 2 400kV
- FP TE2: Tawny Eagle nest on Droërivier – Hydra 1 400kV
- FP TE3: Tawny Eagle nest on Droërivier – Hydra 2 400kV
- FP TE4: Tawny Eagle nest on Droërivier – Hydra 1 400kV
- FP VE1: Verreaux's Eagle nest on cliff
- FP VE2: Verreaux's Eagle nest on cliff
- FP VE3: Verreaux's Eagle nest on cliff
- FP VE4: Verreaux's Eagle nest on cliff
- CFP VE: Verreaux's Eagle nest on cliff at control site
- FP5 – FP9: Earth dams

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

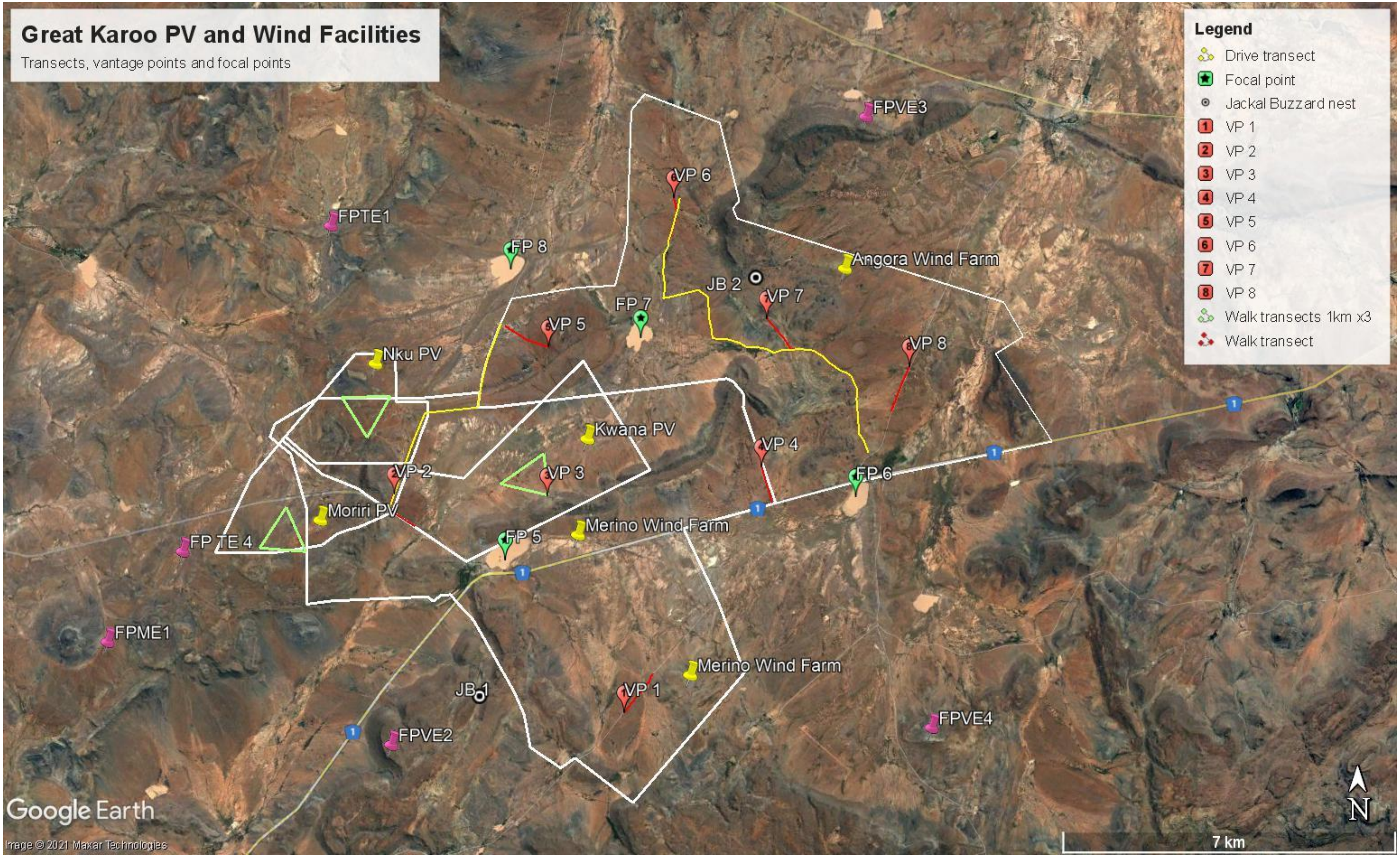

Figure 1: Area where monitoring is taking place, with position of VPs, focal points, drive transects, walk transects and development areas.