Appendix H-2

AVIFAUNA STUDY

Confidential

AVIFAUNAL SPECIALIST ASSESSMENT REPORT

Environmental Impact Assessment (EIA) Processes for the Proposed Development of the up to 200MW Impumelelo Wind Energy Facility and associated infrastructure, near Secunda, Mpumalanga Province

December 2022

Executive summary

The Project Applicant, Impumelelo RF (Pty) Ltd, is proposing to develop the Impumelelo Wind Energy Facility of up to 200 MW (hereinafter referred to as Impumelelo WEF), together with associated electrical grid infrastructure (EGI), near Greylingstad in the Gert Sibande District Municipality of Mpumalanga. Site access will be from the east via the R547 (R23) road and Boschmansfontein road. The proposed WEF and associated infrastructure are subject to a full scoping and EIA process in terms of the 2014 NEMA EIA Regulations, as amended.

The proposed WEF will be constructed on the following farm portions:

- Portion 0 of Farm No. 677
- Portions 0, 5 of Farm Grootvley No. 579
- Portions 0, 6, 9, 10, 25, and 27 of Farm Hartebeestfontein No. 522
- Portions 0, 4, 7, and 8 of Farm Mahemsfontein No. 544
- Portions 0, 2, 4, 5, 9, 10, and 11 of Farm Platkop No. 543
- Portions 0, 4, and 23 of Farm Weltevreden No. 580
- Portions 0 and 6 of Farm Witpoort No. 545

This report serves as the Avifaunal Specialist Assessment Report input that was prepared as part of the Scoping and Environmental Impact Assessment (S&EIA) for the proposed development. The EGI components would be subjected to a separate Environmental Assessment process.

1 Avifauna

A total of 248 species could potentially occur within the broader area where the project site is located (see Appendix E). Of these, 91 are classified as priority/sensitive species – 35 wind turbine priority species, and 73 powerline sensitive species (see Table 5 below). Of these 91 priority/sensitive species, 50 have a medium to very high probability of occurring in the PAOI. Of these 50 regularly occurring priority/sensitive species, 42 were recorded during Site Sensitivity Verification field surveys.

Fourteen Red Data List species are associated with the broader area (see Table 5 below). Six Red List species have a medium to high probability of occurrence within the PAOI – Blue Crane, Blue Korhaan, Lanner Falcon, Greater Flamingo, Maccoa Duck, and Secretarybird.

The remaining eight Red List species have a low probability of occurrence – African Marsh Harrier, Black Harrier, Lesser Flamingo, Martial Eagle, Pallid Harrier, Red-footed Falcon, White-bellied Bustard, and Yellow-billed Stork.

2 Identification of Potential Impacts/Risks on priority/sensitive avifauna

The potential impacts identified during the study are listed below.

Construction phase

- Total or partial displacement due to noise disturbance and habitat transformation associated with the construction of the wind turbines and associated infrastructure.

Operation phase

- Total or partial displacement due to habitat transformation associated with the presence of the wind turbines and associated infrastructure.
- Collisions with the wind turbines.
- Electrocutions in the onsite substations and on the internal 33kV network.
- Collisions with the internal 33kV network.

Decommissioning phase

- Total or partial displacement due to disturbance associated with the decommissioning of the wind plants and associated infrastructure.

Cumulative impacts

- Total or partial displacement due to disturbance and habitat transformation associated with the construction and decommissioning of the wind energy facilities and associated infrastructure.
- Displacement due to habitat transformation associated with the presence of the wind turbines.
- Collisions with the wind turbines.
- Collisions with the internal 33kV network.
- Electrocutions in the onsite substations and on the internal 33kV network.

Sensitivities identified by the National Web-Based Environmental Screening Tool

Based on the field surveys conducted, habitat within the project site appears suitable for Blue Crane, Blue Korhaan, Greater Flamingo, Lanner Falcon, Maccoa Duck, and Secretarybird. Therefore, the classification of **high sensitivity** for avifauna in the screening tool for the Terrestrial Animal Species theme is confirmed for the project site.

Specialist Sensitivity Analysis and Verification

Very high sensitivity: Turbine exclusion zone around drainage lines, wetlands and dams

An exclusion zone precluding wind turbines (including the rotor swept area) should be implemented within a 100 m buffer around drainage lines, wetlands, and dams. Wetlands (including dam margins) are important breeding, roosting and foraging habitat for a variety of Red List priority species, most notably for African Marsh Harrier (Globally Least Concern, Regionally Endangered), African Grass-owl (Globally Least Concern, Regionally Vulnerable), Blue Crane (Globally Vulnerable, Regionally Near Threatened), Caspian Tern (Globally Least Concern, Regionally Vulnerable), Greater Flamingo (Globally Least Concern, Regionally Near Threatened), and Maccoa Duck (Globally Vulnerable, Regionally Near Threatened). Road and grid line crossings across these features should be restricted to what is unavoidable.

High sensitivity: Limited infrastructure zone

High sensitivity grassland: natural grassland on shallow soils, rocky grassland, and undisturbed grassland. Development in the remaining high sensitivity grassland in the project site must be limited as far as possible. Where possible, infrastructure must be located near margins, with shortest routes taken from the existing roads. The grassland is vital breeding, roosting and foraging habitat for a variety of Red List priority species, including several Species of Conservation Concern (SCC). These include African Grass-owl (Globally Least Concern, Regionally Vulnerable), Blue Crane (Globally Vulnerable, Regionally Near Threatened), Blue Korhaan (Globally Vulnerable, Regionally Near Threatened), Lanner Falcon (Globally Least Concern, Regionally Vulnerable), Secretarybird (Globally Endangered, Regionally Vulnerable), and White-bellied Bustard (Globally Least Concern, Regionally Vulnerable).

Medium sensitivity: Limited infrastructure zone

Medium sensitivity grassland: disturbed or degraded grassland and fallow land. As with high sensitivity undisturbed grassland (see Section 5.6.2), development in the disturbed grassland in the project site must be limited as far as possible. Although disturbed, these grassland areas provide roosting and foraging habitat for a variety of Red List priority species, including several SCC. These include Blue Crane (Globally Vulnerable, Regionally Near Threatened), Blue Korhaan (Globally Vulnerable, Regionally Near Threatened), Lanner Falcon (Globally Least Concern, Regionally Vulnerable), Secretarybird (Globally Endangered, Regionally Vulnerable), and White-bellied Bustard (Globally Least Concern, Regionally Vulnerable).

3 Impact assessment summary

The overall impact significance is provided in the table below, in terms of pre- and post-mitigation.

Executive summary table: overall Impact Significance (Pre- and Post-Mitigation)

Phase	**Overall Impact Significance (Pre-Mitigation)**	**Overall Impact Significance (Post Mitigation)**
Construction	Moderate	Low
Operational	Moderate	Low
Decommissioning	Moderate	Low

4 Mitigation

The mitigation measures that are proposed for the Project are listed below.

Planning and design phase

- A 100m turbine exclusion zone (including the rotor swept area) must be implemented around wetlands, dams, pans and drainage lines to prevent collision mortality of priority bird species. Development of other infrastructure in these buffers should be restricted to what is essential.
- The medium voltage cable should be buried as far as possible. Overhead lines should only be considered if technical constraints to trenching are present.
- Where the use of overhead lines is unavoidable due to technical reasons, the Avifaunal Specialist must be consulted to ensure that a raptor friendly pole design is used.
- Development in the remaining high sensitivity grassland must be limited as far as possible. Where possible, infrastructure must be located near margins, with shortest routes taken from the existing roads.
- Construction of new roads should only be considered if existing roads cannot be upgraded.

Construction phase

- Conduct a pre-construction inspection to identify Red List species that may be breeding within the project footprint to ensure that the impacts on breeding species (if any) are adequately managed.
- Construction activity should be restricted to the immediate footprint of the infrastructure as far as possible. The recommendations of the ecological and botanical specialist studies must be strictly implemented, especially as far as limitation of the activity footprint is concerned).
- Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of priority species. Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum.
- Measures to control noise and dust should be applied according to current best practice in the industry.

- Bird flight diverters should be installed on all overhead medium voltage power lines (according to the relevant Eskom Engineering Instruction). These devices must be installed as soon as the conductors are strung.

Operational phase

- It is recommended that all turbines have 2/3 of one blade painted in signal red or black, if feasible. It is acknowledged that blade painting as a mitigation strategy is still in an experimental phase in South Africa, but research indicates that it has a very good chance of reducing avian mortality (Simmons, et al., 2021) and if the painting is done during the manufacturing of the turbines, the costs are negligible.
- The mitigation measures proposed by the vegetation specialist must be strictly enforced, including rehabilitation of disturbed areas. This will benefit all avifauna as it will limit the extent of habitat transformation and therefore the extent of potential displacement.
- Live-bird monitoring and carcass searches to 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 compare the abundance of avifauna during the pre-construction monitoring with the abundance post-construction. Operational monitoring and carcass searches to be implemented for a minimum of two years, and then again in Year 5 and every fifth year after that.
- If estimated annual collision rates indicate unacceptable mortality levels of priority species i.e. exceeding mortality thresholds as determined by the avifaunal specialist in consultation with other experts e.g. BLSA, additional measures will have to be implemented which could include shut down on demand or other proven measures (if available at the time).

De-commissioning phase

- Decommissioning activity should be restricted to the immediate footprint of the infrastructure as far as possible.
- Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of priority species.
- Measures to control noise and dust should be applied according to current best practice in the industry.
- Maximum use should be made of existing access roads.

5 Conclusion and impact statement

The proposed Impumelelo WEF could have a **moderate to high** impact on avifauna which, in most instances, could be reduced to **low** through appropriate mitigation, although some **moderate** residual impacts will still be present after mitigation. No fatal flaws were discovered during the onsite investigations. The proposed WEF development is therefore supported, provided the mitigation measures listed in this report are strictly implemented.

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List of abbreviations

BLSA	BirdLife South Africa
DFFE	Department of Forestry, Fisheries and Environment
NEMA	National Environmental Management Act 107 of 1998 (as amended)
REDZ	Renewable Energy Development Zone
S&EIA	Assessment and Environmental Impact Assessment
SABAP	South African Bird Atlas Project
SACNASP	South African Council for Natural and Scientific Professions
SANBI	South African National Biodiversity Institute
SCC	Species of Conservation Concern
WEF	Wind Energy Facility

Table 1: Definitions of key terminology in this assessment report

Definitions	
Wind priority species	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 (Ralston-Paton et al., 2017; Retief et al., 2012).
Powerline sensitive species	Powerline sensitive species were defined as species which could potentially be impacted by powerline collisions or electrocutions, based on their morphology. Larger birds, particularly raptors and vultures, are more vulnerable to electrocution as they are more likely to bridge the clearances between electrical components than smaller birds. Large terrestrial species and certain waterbirds with high wing loading are less manoeuvrable than smaller species and are therefore more likely to collide with overhead lines.
Broader area	The area encompassed by the four pentads where the project site is located.
Project site	The area covered by the land parcels where the project will be located, totalling approximately 2870 hectares. This is where the actual development will be located, i.e., the footprint containing the wind turbines and associated infrastructure.
Project area of impact (PAOI)	The primary impact zone of the wind energy facility, encompassing the 2870 hectares of the project site.
Pentad	A pentad grid cell covers 5 minutes of latitude by 5 minutes of longitude (5'× 5'). Each pentad is approximately 8 × 7.6 km.

1. Project description

The Project Applicant, Impumelelo RF (Pty) Ltd, is proposing to develop the Impumelelo Wind Energy Facility of up to 200 MW (hereinafter referred to as Impumelelo WEF), together with associated electrical grid infrastructure (EGI), near Greylingstad in the Gert Sibande District Municipality and Dipaleseng Local Municipality of Mpumalanga. Site access will be from the east via the R547 (R23) road and Boschmansfontein Road. The proposed WEF and associated infrastructure are subject to a full assessment and EIA process in terms of the 2014 NEMA EIA Regulations, as amended.

The proposed WEF will be constructed on the following farm portions:

- Portions 6 & 25 of the Farm 522 Hartbeesfontein;
- Portions 2, 4, 5 and 9 of the Farm 543 Platkop;
- Portions 0, 7 and 8 of the Farm 544 Mahemsfontein

This report serves as the Avifaunal Specialist Assessment Report input that was prepared as part of the Assessment and Environmental Impact Assessment (S&EIA) for the proposed development. The EGI components would be subjected to a separate Environmental Assessment process.

The proposed Impumelelo WEF and associated infrastructure include the following components:

- Up to 28 wind turbine generators (WTGs) with a maximum capacity of up to 200 MW
- Turbines with a hub height of up to 200 m and a rotor diameter of up to 200 m.
- Hardstand areas of approximately 1 500 m^2 per turbine.
- Temporary construction laydown and storage area of approximately 4 500 m^2 per turbine.
- Medium voltage cabling connecting the turbines will be laid underground where practical.
- A Lithium-ion Battery Energy Storage System (BESS) with a capacity of up to 200 MW/800 MWh, comprising of several utility scale battery modules within shipping containers or an applicable housing structure on a concrete foundation.
- Internal roads with a width of up to 8 m providing access to each turbine, the BESS, on-site substation, stepdown substation, and laydown area. The roads will accommodate cable trenches and stormwater channels (as required) and will include turning circle/bypass areas of up to 20 m at some sections during the construction phase. As such, the roads and cables will be positioned within a 20 m wide corridor. Existing roads will be upgraded wherever possible, although new roads will be constructed where necessary.
- A temporary construction laydown/staging area of approximately 2 500 m^2 which will also accommodate the operation and maintenance (O&M) buildings.
- A 33/132kV on-site substation to feed electricity generated by the proposed Impumelelo WEF via a 132 kV overhead power line into the step-down substation at the Sasol Zandfontein substation facility which is about 37 km to the northeast of the site. The electricity generated by the project will be fed into the proposed Green Hydrogen Electrolyser facility located at Sasol Secunda which is between 5 and 10 km

from the substation. The proposed electrical grid infrastructure, including the 132 kV gridline and step-down Substation at Sasol facility, as well as the Battery Energy Storage System (BESS) at the Sasol facility which will be assessed as part of a separate Basic Assessment (BA) process.

The key project details for the Impumelelo WEF and associated infrastructure are in Table 2 below:

Table 2: Key project details for the Impumelelo WEF and associated infrastructure

Component	**Description / Dimensions**
Site coordinates (centre point)	Lat 26° 39' 52.8" S; Long 28° 50' 57.0" E
Affected farms	Portions 6 & 25 of the Farm 522 Hartbeesfontein; Portions 2, 4, 5 and 9 of the Farm 543 Platkop; Portions 0, 7 and 8 of the Farm 544 Mahemsfontein
Application site area	Approximately 2800 hectares
Total Wind Energy Facility capacity	Up to 200 MW
Proposed technology	Horizontal axis wind turbines and associated infrastructure
Number of turbines	Up to 28 wind turbine generators (WTGs) with a maximum capacity of up to 200 MW.
On-site Substation area	Approximately 10 ha
Temporary construction laydown area	A temporary construction laydown/staging area of approximately 2 500 m^2 which will also accommodate the operation and maintenance (O&M) buildings
Permanent laydown area	To be determined based on the final layout
O&M building area	Part of the temporary construction laydown area
Width of internal access roads	Up to 8 m, including turning circle/bypass areas of up to 20 m. The roads and cables will be positioned within a 20 m wide corridor.
Length of internal access roads	To be determined based on the final layout
Site access	R547 and Boschmansfontein Road
Type of fencing	Galvanized steel

This report serves as the Avifaunal Specialist Assessment Report input that was prepared as part of the Scoping and Environmental Impact Assessment (S&EIA) for the proposed development. The EGI components would be subjected to a separate Environmental Assessment process.

See Figure 1 for the lay-out of the proposed WEF.

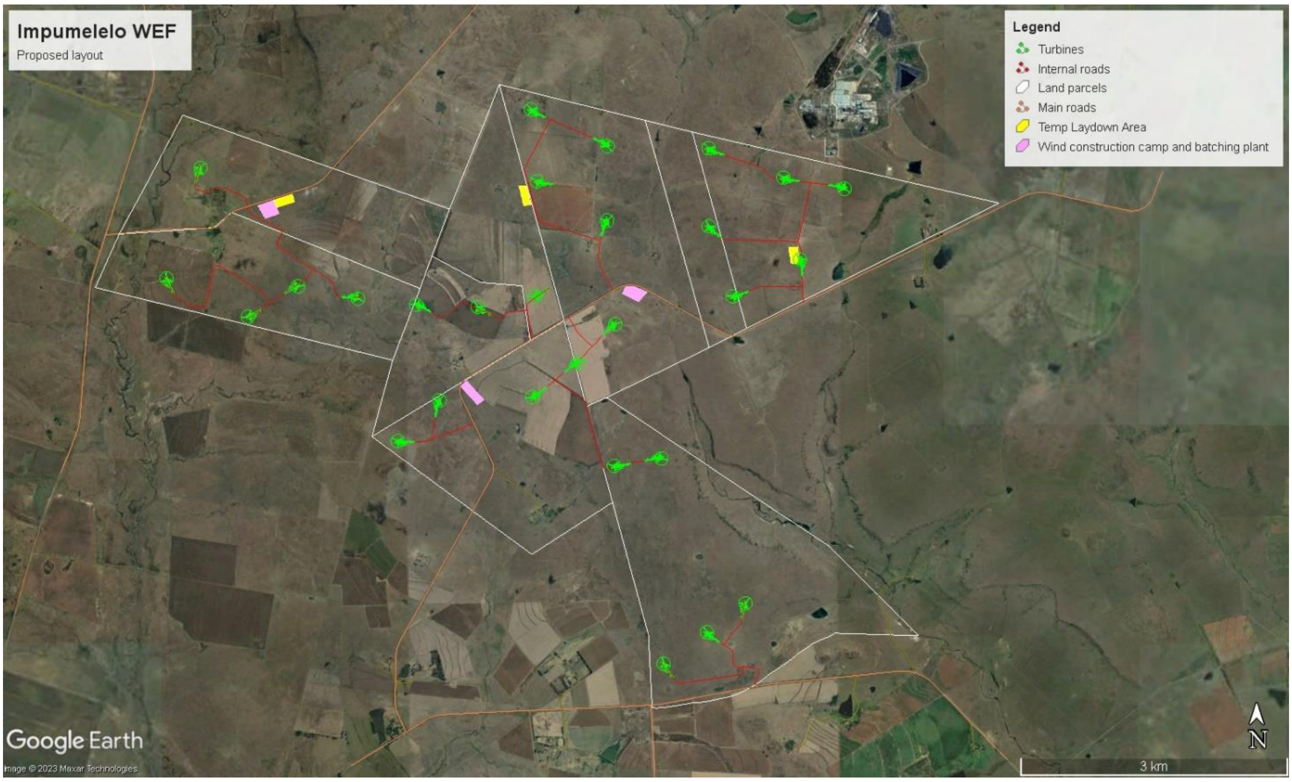

Figure 1: The layout of the proposed Impumelelo WEF

2. Legislative context

2.1. Legislative and Permit Requirements

The schedule to the National Environmental Management Act 107 of 1998, as amended (NEMA) prescribes general requirements for undertaking site sensitivity verification and for protocols for the assessment and minimum report content requirements of environmental impacts for environmental themes for activities requiring environmental authorisation, The Protocol for the specialist assessment and minimum report content requirements for environmental impacts avifaunal species by onshore wind energy generation facilities where the electricity output is 20MW or more (Government Gazette No. 43110 – 20 March 2020) is applicable in the case of wind developments.

2.2. Agreements and conventions

Table 3: below lists agreements and conventions which South Africa is party to, and which is relevant to the conservation of avifauna1.

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

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

2.3. National legislation

2.3.1. 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

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

2.3.1. The National Environmental Management Act 107 of 1998, as amended (NEMA)

The National Environmental Management Act 107 of 1998, as amended, (NEMA) creates the legislative framework for environmental protection in South Africa and is aimed at giving effect to the environmental right in the Constitution. It sets out several guiding principles that apply to the actions of all organs of state that may significantly affect the environment. Sustainable development (socially, environmentally, and economically) is one of the key principles, and internationally accepted principles of environmental management, such as the precautionary principle and the polluter pays principle, are also incorporated. NEMA also provides that a wide variety of listed developmental activities, which may significantly affect the environment, may be performed only after an environmental impact assessment or basic 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.

The Protocol for the specialist assessment and minimum report content requirements for environmental impacts avifaunal species by onshore wind energy generation facilities where the electricity output is 20MW or more (Government Gazette No. 43110 – 20 March 2020) is applicable in the case of wind developments.

2.3.3. 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 (as amended) (NEMBA) read with the Threatened or Protected Species Regulations, February 2007 (TOPS Regulations). Chapter 1 sets out the objectives of the Act, and they are aligned with the objectives of the Convention on Biological Diversity, which are the conservation of biodiversity, the sustainable use of its components, and the fair and equitable sharing of the benefits of the use of genetic resources. The Act also gives effect to CITES, the Ramsar Convention, and the Bonn Convention on Migratory Species of Wild Animals. The State is endowed with the trusteeship of biodiversity and has the responsibility to manage, conserve and sustain the biodiversity of South Africa.

2.3.4. Provincial legislation

The current legislation applicable to the conservation of fauna and flora in Mpumalanga is the Mpumalanga Nature Conservation Act (Act No. 10 of 1998). 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.

3. Assumptions and limitations

This study assumed that the sources of information used in this report are reliable. In this respect, the following must be noted:

- The SABAP2 data is regarded as an adequate indicator of the avifauna which could occur at the PAOI, and it was further supplemented by data collected during the on-site surveys.
- The focus of the study was on the potential impacts of the proposed wind facility on wind priority species.
- 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 (Ralston-Paton et al., 2017; Retief et al., 2012).
- Powerline sensitive species were defined as species which could potentially be impacted by powerline collisions or electrocutions, based on their morphology. Larger birds, particularly raptors and vultures, are more vulnerable to electrocution as they are more likely to bridge the clearances between electrical components than smaller birds. Large terrestrial species and certain waterbirds with high wing loading are less manoeuvrable than smaller species and are therefore more likely to collide with overhead lines.
- Despite the growing body of peer reviewed literature investigating the collision risks of birds with wind turbines and overhead powerlines in South Africa (see Section 6), relevant information for many individual species remains limited. 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: "to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall be not used as a reason for postponing cost-effective measures to prevent environmental degradation."
- The assessment of impacts is based on the baseline environment as it currently exists at the PAOI.
- Conclusions drawn in this study are based on experience of the specialists on the species found on site and similar species in different parts of South Africa. Bird behaviour can never be entirely reduced to formulas that will be valid under all circumstances.

- The **broader area** is defined as the area encompassed by the four pentads where the project is located (see Figure 1).
- The **project area of impact** (PAOI) is defined as the area where the primary impacts on avifauna are expected and encompassing the project site.
- The **project site** is the where the actual development will be located, i.e., the footprint containing the wind turbines and associated infrastructure.

4. Description of methodology

4.1. Scope and objectives of this specialist input to the assessment report

The purpose of the report is to determine the main issues and potential impacts of the proposed project/s on avifauna, through a combination of desktop analysis and field work. The report was prepared to provide inputs to the Draft Environmental Impact Report for the projects as required by the EIA Regulations promulgated in terms of the National Environmental Management Act 107 of 1998, as amended, (NEMA).

4.2. Details of specialists

This specialist assessment has been undertaken by Jake Mulvaney, Chris van Rooyen and Albert Froneman of Chris van Rooyen Consulting. Jake Mulvaney and Chris van Rooyen works in association with, and under the supervision of, Albert Froneman, who is registered with the South African Council for Natural and Scientific Professions (SACNASP), with Registration Number 400177/09 in the field of Zoological Science.

A curriculum vitae is included in Appendix A of this specialist input report.

4.3. Terms of reference

The terms of reference for this assessment report are as follows:

- 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, operational and decommissioning phases.
- Identify ‘No-Go’ areas, where applicable.
- Recommend mitigation measures to reduce the impact of the expected impacts, and
- Provide an impact statement on whether the project should be approved or not.

4.4. Approach and methodology

The following methods were used to compile this report:

- Bird distribution data of the South African Bird Atlas 2 (SABAP 2) was obtained from the University of Cape Town, to ascertain which species occurs within the broader area of four pentad grid cells each within which the proposed projects are situated (see Figure 2). A pentad grid cell covers 5 minutes of latitude by 5 minutes of longitude (5'× 5'). Each pentad is approximately 8 × 7.6 km. From 2007- present, a total of 189 full protocol lists (i.e., surveys of at least two hours each) have been completed for this area. In addition, 180 *ad hoc* protocol lists (i.e., surveys lasting less than two hours but still yielding valuable data) have been completed.
- The national threatened status of all priority species was determined with the use of the most recent edition of the Red Data Book of Birds of South Africa (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 (2022.1) International Union for Conservation of Nature (IUCN) Red List of Threatened Species (http://www.iucnredlist.org/).
- A classification of the habitat in the PAOI was obtained from the Atlas of Southern African Birds 1 (SABAP 1) (Harrison et al., 1997a, 1997b) and the National Vegetation Map (2018) from the South African National Biodiversity Institute (SANBI) BGIS map viewer (http://bgisviewer.sanbi.org/) (Mucina & Rutherford, 2006; SANBI, 2018). The PAOI is the area where the primary impacts on avifauna are expected and includes the land parcels where the project will be located.
- The Important Bird Areas of Southern Africa (Marnewick et al., 2015) was consulted for information on potentially relevant Important Bird Areas (IBAs).
- Satellite imagery (Google Earth ©2022) was used to view the PAOI and broader area on a landscape level and to help identify sensitive bird habitat.
- 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 (Ralston-Paton et al., 2017; Retief et al., 2012).
- The 2022 South Africa Protected Areas Database compiled by the Department of Environment, Forestry and Fisheries (DFFE) was used to identify Nationally Protected Areas, National Protected Areas Expansion Strategy (NPAES) near the PAOI (DFFE, 2022).
- The Department of Forestry, Fisheries, and the Environment (DFFE) National Screening Tool was used to determine the assigned avian sensitivity of the PAOI.
- Data collected during previous site visits to the broader area was also considered as far as habitat classes and the occurrence of priority species are concerned.
- The following sources were used to determine the investigation protocol that is required for the site:
    - Protocol for the specialist assessment and minimum report content requirements for environmental impacts on avifaunal species by onshore wind energy generation facilities where the electricity output is 20MW or more (Government Gazette No. 43110 – 20 March 2020).

- BirdLife South Africa's (BLSA) 'Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa' (Jenkins et al., 2015) – hereafter referred to as the 'Windfarm Guidelines' – were consulted to determine the level of survey effort that is required.

- The main source of information on the avifaunal diversity and abundance at the PAOI and broader area is an integrated pre-construction monitoring programme which was implemented at the project site in 2021 – 2022 over a period of four seasons.

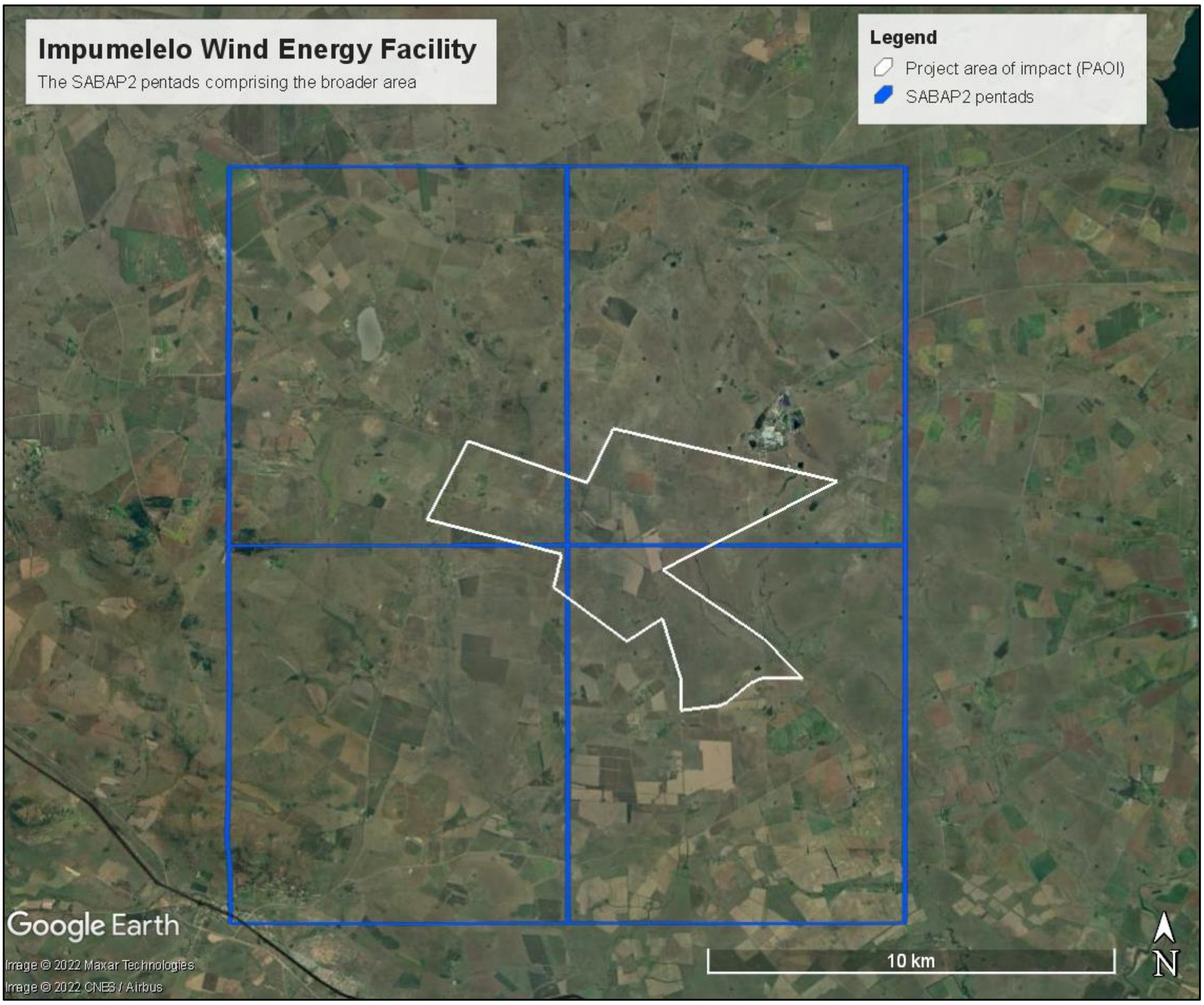

Figure 2: The four SABAP2 pentads (blue squares) comprising the broader area of project area of impact (PAOI) (white delineation).

4.5. Information sources

The following data sources were used to compile this report:

Table 4: Data sources employed in the assessment report for the proposed Impumelelo WEF

Data / Information	Source	Date	Type	Description
South African Protected Areas Database (SAPAD)	Department of Forestry, Fisheries, and the Environment (DFFE)	2022, Q3	Spatial	Spatial delineation of protected areas in South Africa. Updated quarterly
Atlas of Southern African Birds 1 (SABAP1)	University of Cape Town	1987-1991	Spatial, reference	SABAP1, which took place from 1987-1991.
South African Bird Atlas Project 2 (SABAP2)	University of Cape Town	Sept 2022	Spatial, database	SABAP2 is the follow-up project to the SABAP1. The second bird atlas project started on 1 July 2007 and is still growing. The project aims to map the distribution and relative abundance of birds in southern Africa.
National Vegetation Map	South African National Biodiversity Institute (SANBI) (BGIS)	2018	Spatial	The National Vegetation Map Project (VEGMAP) is a large collaborative project established to classify, map, and sample the vegetation of South Africa, Lesotho, and Swaziland.
Red Data Book of Birds of South Africa, Lesotho, and Swaziland	BirdLife South Africa	2015	Reference	The 2015 Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland is an updated and peer-reviewed conservation status assessment of the 854 bird species occurring in South Africa undertaken in collaboration between BirdLife South Africa, the Animal Demography Unit of the University of Cape Town, and the SANBI.

Data / Information	Source	Date	Type	Description
IUCN Red List of Threatened Species (2022.1)	IUCN	2022.1	Online reference source	Established in 1964, the International Union for Conservation of Nature's Red List of Threatened Species is the world's most comprehensive information source on the global extinction risk status of animal, fungus and plant species.
Important Bird and Biodiversity Areas of South Africa	BirdLife South Africa	2015	Reference work	Important Bird and Biodiversity Areas (IBAs), as defined by BirdLife International, constitute a global network of over 13 500 sites, of which 112 sites are found in South Africa. IBAs are sites of global significance for bird conservation, identified nationally through multi-stakeholder processes using globally standardized, quantitative, and scientifically agreed criteria.
Strategic Environmental Assessment for wind and solar photovoltaic energy in South Africa	Department of Environmental Affairs, 2015. Strategic Environmental Assessment for wind and solar photovoltaic energy in South Africa. CSIR Report Number: CSIR/CAS/EMS/ER/2015/0001/B. Stellenbosch.	2015	SEA	The SEA identifies areas where large scale wind and solar energy facilities can be developed in terms of Strategic Infrastructure Project (SIP) and in a manner that limits significant negative impacts on the natural environment, while yielding the highest possible socio-economic benefits to the country. These areas are referred to as Renewable Energy Development Zones (REDZs).

Data / Information	Source	Date	Type	Description
The National Screening Tool	Department of Forestry, Fisheries and Environment	May 2022	Spatial	The National Web based Environmental Screening Tool is a geographically based web-enabled application which allows a proponent intending to apply for environmental authorisation in terms of the Environmental Impact Assessment (EIA) Regulations 2014, as amended to screen their proposed site for any environmental sensitivity.
National Protected Areas and National Protected Areas Expansion Strategy (NPAES)	DFFE	2016	Spatial	The goal of NPAES is to achieve cost effective protected area expansion for ecological sustainability and adaptation to climate change. The NPAES sets targets for protected area expansion, provides maps of the most important areas for protected area expansion, and makes recommendations on mechanisms for protected area expansion.
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	NEMA	2020	Legislation	This protocol provides the criteria for the specialist assessment and minimum report content requirements for impacts on avifaunal species associated with the development of onshore wind energy generation facilities, where the electricity output is 20 megawatts or more, which require environmental authorisation. This protocol

Data / Information	Source	Date	Type	Description
Gazette No. 43110 – 20 March 2020).				replaces the requirements of Appendix 6 of the Environmental Impact Assessment Regulations8
Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa (2015). Jenkins, A., van Rooyen, C. S., Smallie, J. J., Anderson, M. D., & Smit, A. H.	BirdLife South Africa	2017	Guidelines	These guidelines were developed to ensure that any negative impacts on threatened, or potentially threatened bird species are identified and effectively mitigated using structured, methodical. and scientific methods. The guidelines prescribe the best practice approach to gathering bird data at proposed utility-scale wind energy plants, primarily for the purposes of accurate and effective impact assessment.

5. Description of baseline environment – including sensitivity mapping

5.1. Biomes and vegetation types

The PAOI is located within the Soweto Highveld Grassland (Gm8) vegetation ecotype within the Mesic Highveld Grassland Bioregion (SANBI, 2018). This vegetation type covers 14 513 km² of Mpumalanga and Gauteng (and to a very small extent also in the neighbouring Free State and North-West provinces) and occurs at an altitude ranging from 1420 m to 1760 m above sea level (Mucina et al., 2006). The site does not fall within any Centre of Endemism (Van Wyk & Smith, 2001).

Soweto Highveld Grassland is a summer rainfall vegetation (662 mm per annum, mostly September to April), which experiences a cool-temperate climate (mean annual temperature 14.8°C) with continental thermality. Temperature ranges between 28°C (January) to -0.6°C (July). Frost and frequent grass fires during winter play an important role in limiting the occurrence of trees and shrubs in the region (Mucina et al., 2006).

The landscape of the PAOI comprises gently undulating plains on the Highveld plateau, ranging 1600 m in the west to 1640 m in the northeast. There are two north-south flowing drainage systems present in the PAOI: Grootspruit and its tributaries in the west and the Ouhoutspruit and its tributaries in the east.

Undisturbed areas in the PAOI are mostly dense tufted grasslands dominated by *Themeda triandra*, with a notable herbaceous forb component (see Figure 2). Scattered wetlands, narrow stream alluvia associated with the drainage systems and occasional minor ridges interrupt the grassland cover. The most prominent ridgelines occur along the ravines associated with the Ouhoutsptruit drainage system.

Although the conservation status of this vegetation type was listed as ‘Endangered’ by (Mucina & Rutherford (2006) it is listed as “Vulnerable” by the updated NEMA of 2011 (see 7.2.2.). Very few statutorily conserved areas occur in this vegetation type and almost half has been transformed mostly by cultivation, plantations, mining, and urbanisation.

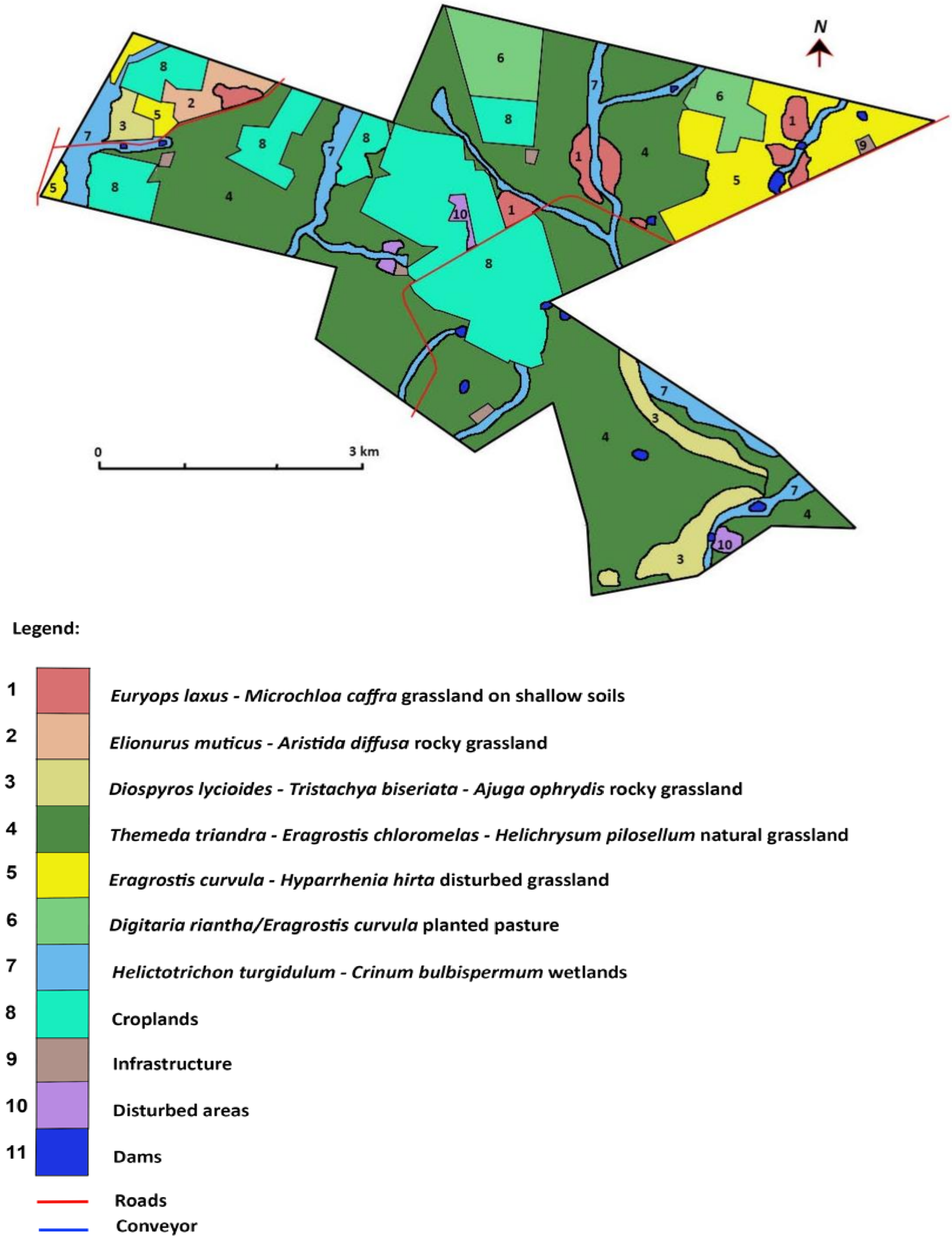

Figure 3: Vegetation map of the Impumelelo project site (Source: Ekotrust, 2022).

5.2. Habitat classes and land-use within the PAOI

The proposed Impumelelo WEF PAOI is situated within gently undulating plains of the Mpumalanga Highveld countryside. The avian habitat types in the Impumelelo WEF were identified as:

(i) Natural grassland
(ii) Natural drainage lines (Grootspruit and Ouhoutspruit river systems) and herbaceous wetlands
(iii) Artificial dams
(iv) Agriculture
(v) Alien tree stands
(vi) High voltage powerlines

Ostensibly undisturbed natural grassland tracts occupy most the terrestrial environment within the PAOI, mosaiced between agricultural tracts (Figure 3 and Figure 4); disturbed grassland represents only a minor portion of the PAOI. Most of the PAOI sits atop dolerite bedrock, resulting in deep dark-brown clayey soils. Sandstone, shale, and coal beds are localised to the west and southeast of the PAOI. Some alluvium occurs along the drainage lines.

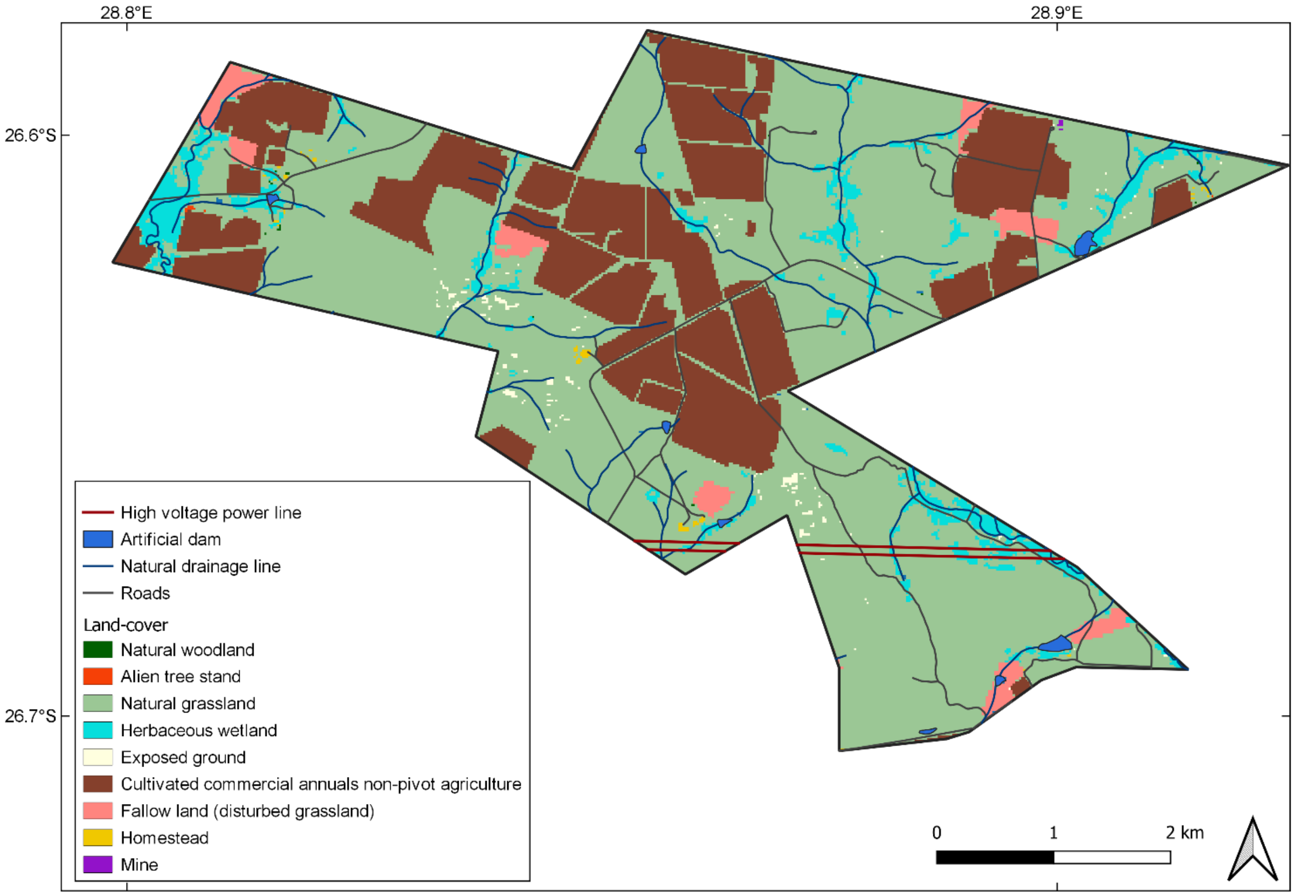

Figure 4: Landcover classes within the PAOI, according to the DEA and DALRRD (2019).

5.2.1. Natural grassland

This habitat feature is described above under Section 5.1 (see Figure 3 & 4).

Figure 5: Natural grassland tracts within the proposed project site. (a) undisturbed *Themeda triandra -Eragrostis chloromelas-Helichrysum pilosellum* natural grassland; (b) disturbed *Eragrostis curvula-Hypparrhenia hirta* grassland; (c) undisturbed *Elionurus muticus-Aristida diffusa* rocky grassland.

5.2.2. Drainage lines and herbaceous wetlands

Two southward flowing drainage systems intersect the PAOI: Grootspruit and its tributaries in the west and the Ouhoutspruit and its tributaries in the east. Marshlands (vleis) are discontinuously established along these drainage systems, and surround the few dams present within the PAOI (see below). Additionally, the grasslands within the PAOI are prone to inundation during the summer wet season, forming ephemeral wetlands (Figure 5). Surface rocks are present in some places along the streams. The alluvial soils are mostly deep dark brown to black clayey soils derived from the dolerite bedrock.

Figure 6: wetland and drainage systems within the PAOI. (a) A stream and associated riparian vegetation; (b) established perennial herbaceous wetland (marshland/vlei) along a stream (highlighted by the red arrow); (c) inundated grassland forming ephemeral wetlands in the rainy season (Oct-March).

5.2.3. Dams and pans

There are several small and moderately sized dams, as well as a few small pans, mostly associated with Grootspruit, Ouhoutspruit, and associated tributaries (Figure 3, 4 & 7) (DEA & DALRRD, 2019).

Figure 7: Various the earth-embankment dams located within the project site.

5.2.4. Agriculture

Agricultural activity present within the Impumelelo WEF comprises cultivated commercial annuals non-pivot cropland (DEA & DALRRD, 2019), predominately dedicated towards maize production, although planted pastures are also present (Figure 8). Additionally, livestock (cattle) farming is also practiced on lands not dedicated to cereal agriculture.

Figure 8: Agricultural land-use within the project site. (a) maize production; (b) planted pasture; (c) cattle farming.

5.2.5. Alien trees

Alien trees are present on the Impumelelo project site as windbreaks either between agricultural fields or between homesteads (DEA & DALRRD, 2019) (Figure 8). Alien trees provide breeding sites for several priority species, especially raptors.

Figure 9: Alien trees are interspersed throughout the proposed Impumelelo project site.

5.2.6. High voltage powerlines

High voltage powerlines are present within the PAOI, providing roosting and nesting opportunities for some priority raptor species.

Figure 10: High voltage power lines intersecting the southern portions of the project site.

5.3. Protected areas in/around the PAOI

5.3.1. Important bird areas (IBAs)

The 766 hectares over the western portions of the PAOI overlaps with the Devon Grasslands Important Bird Area (IBA) (IBA SA130 (Marnewick et al., 2015). The Devon Grassland IBA was established in 2014 for the protection of Blue Crane (250-300 individuals as of 2015) (Globally Vulnerable, Regionally Near Threatened), Secretarybird (20-25 breeding individuals) (Globally Endangered, Regionally Vulnerable), Blue Korhaan (Globally Vulnerable, Regionally Least Concern), Black Harrier (Globally Endangered, Regionally Endangered), and Black-winged Pratincole (Globally Near Threatened, Regionally Near Threatened). The PAOI shares highly similar habitat conditions with the Devon Grassland IBA, and it is anticipated that some of these Red List species from this IBA could on occasion utilize the grasslands and wetlands within the PAOI, and so would be vulnerable to the WEF development.

Two additional IBAs occur within 60 km of the PAOI: Blesbokspruit (IBA SA021) (43 km west) and Suikerbosrand (IBA SA022) (49 km west). However, it is not envisaged that the proposed WEF will significantly impact on avifauna in these IBAs due to the distance from the PAOI.

5.3.1. National Protects Areas and National Protected Areas Expansion Strategy (NPAES) focus areas

The PAOI does not fall within a protected area or an NPAES focus area, although is within 15 km of the nationally protected Devon Protected Environment, which itself is within the Devon Grassland IBA.

5.3.2. The Renewable Energy Development Zones (REDZ)

The PAOI is not located in a REDZ.

5.4. Avifauna present within the PAOI

A total of 248 species could potentially occur within the broader area where the project site is located (see Appendix E). Of these, 91 are classified as priority/sensitive species – 35 wind turbine priority species, and 73 powerline sensitive species (see Table 5 below). Of these 91 priority/sensitive species, 50 have a medium to very high probability of occurring in the PAOI. Of these 50 regularly occurring priority/sensitive species, 42 were recorded during Site Sensitivity Verification and pre-construction field surveys.

Fourteen Red Data List species are associated with the broader area (see Table 5 below). Six Red List species have a medium to high probability of occurrence within the PAOI – Blue Crane, Blue Korhaan, Lanner Falcon, Greater Flamingo, Maccoa Duck, and Secretarybird.

The remaining eight Red List species have a low probability of occurrence – African Marsh Harrier, Black Harrier, Lesser Flamingo, Martial Eagle, Pallid Harrier, Red-footed Falcon, White-bellied Bustard, and Yellow-billed Stork.

See Appendix E for a list of species potentially occurring in the broader area. The possibility of priority/sensitive species occurring in the PAOI, and potential long-term impacts are listed in Table 5 below.

Table 5: Wind and powerline sensitive species with a medium to high potential for regular occurrence in the broader area, and those recorded during Site Sensitivity Verification and pre-construction field surveys

Global and Regional (South African) Red List status: CR = Critically Endangered; EN = Endangered; VU = Vulnerable; NT = Near Threatened; LC = Least concern

Nomenclature		Reporting rate		Red List status		Priority species			Habitat features						Wind turbine impact			Powerline impact	
Species name	Scientific name	SABAP2 Full protocol	SABAP2 Ad hoc protocol	Global (IUCN)	Regional	Wind priority species	Powerline sensitive species	Recorded during monitoring	Grassland	Agriculture	Drainage lines and wetlands	Dams and pans	Alien trees	HV powerlines	WEF Collision with turbines	Habitat transformation	Displacement from disturbance	Electrocution 33kV MV lines	Collision 33kV MV lines
African Harrier-Hawk	*Polyboroides typus*	1.59	0.00	-	-	x	x	x				x	x		x	x	x	x	
Amur Falcon	*Falco amurensis*	20.11	7.22	-	-	x	x	x	x	x			x	x	x	x		x	
Black Sparrowhawk	*Accipiter melanoleucus*	1.59	0.00	-	-	x	x	x					x		x	x	x	x	
Black-chested Snake Eagle	*Circaetus pectoralis*	2.12	0.56	-	-	x	x	x	x			x	x	x	x	x	x	x	
Black-winged Kite	*Elanus caeruleus*	69.84	27.22	-	-	x	x	x	x	x			x	x	x	x	x	x	
Blue Crane	*Grus paradisea*	16.40	5.00	VU	NT	x	x	x	x	x	x	x			x	x	x		x
Blue Korhaan	*Eupodotis caerulescens*	33.33	16.67	NT	LC	x	x	x	x						x	x	x		x
Common Buzzard	*Buteo buteo*	13.76	5.00	-	-	x	x		x	x		x	x	x	x	x		x	
Greater Flamingo	*Phoenicopterus roseus*	8.99	4.44	-	NT	x	x	x				x			x				x
Greater Kestrel	*Falco rupicoloides*	16.93	7.78	-	-	x	x	x	x				x	x	x	x	x	x	
Jackal Buzzard	*Buteo rufofuscus*	14.29	3.33	-	-	x	x		x	x		x	x	x	x	x	x	x	
Lanner Falcon	*Falco biarmicus*	3.70	2.22	-	VU	x	x	x	x	x		x	x	x	x	x	x	x	
Marsh Owl	*Asio capensis*	8.99	1.11	-	-	x	x	x	x		x				x	x	x	x	x
Northern Black Korhaan	*Afrotis afraoides*	24.34	7.78	-	-	x	x	x	x						x	x	x		x
Secretarybird	*Sagittarius serpentarius*	10.05	9.44	EN	VU	x	x	x	x			x	x		x	x	x		x
Spotted Eagle-Owl	*Bubo africanus*	6.35	0.00	-	-	x	x	x		x			x		x	x	x	x	x
White Stork	*Ciconia ciconia*	3.17	1.11	-	-	x	x		x	x	x	x	x	x	x				x

5.5. Pre-construction monitoring

The following section presents the results of the integrated pre-construction monitoring conducted at the Impumelelo turbine sites and control area.

These monitoring surveys were conducted at the proposed WEF sites in the following time periods:

1. 18 – 26 August 2020
2. 18 – 24 November 2020
3. 27 July – 04 August 2021
4. 21 September– 03 October 2021
5. 15 - 21 November 2021
6. 9 -10 January 2022
7. 23 - 27 March 2022

5.5.1. Transects

The summary results of the drive transects and walk transects counts are tabled in **Table** 6**6**. From these transect counts, an Index of Kilometric Abundance (IKA = birds/km) was calculated for each priority species recorded during transects over all four seasons. Error! Reference source not found.**11** and Error! Reference source not found.**12** show the IKA results from the drive transects and walk transects, respectively.

Table 6: The result of the drive transects and walk transect counts

Turbine site	
Species composition	**Number of records**
All Species	126
Priority Species 10%	12
Non-Priority Species	114
Total count	
Drive transects	8048
Walk transects	5412
Total	13460
Control site	
Species composition	**Number of records**
All Species	114
Priority Species 9%	10
Non-Priority Species	104
Total count	
Drive transects	4285
Walk transects	5241

	Total	9526

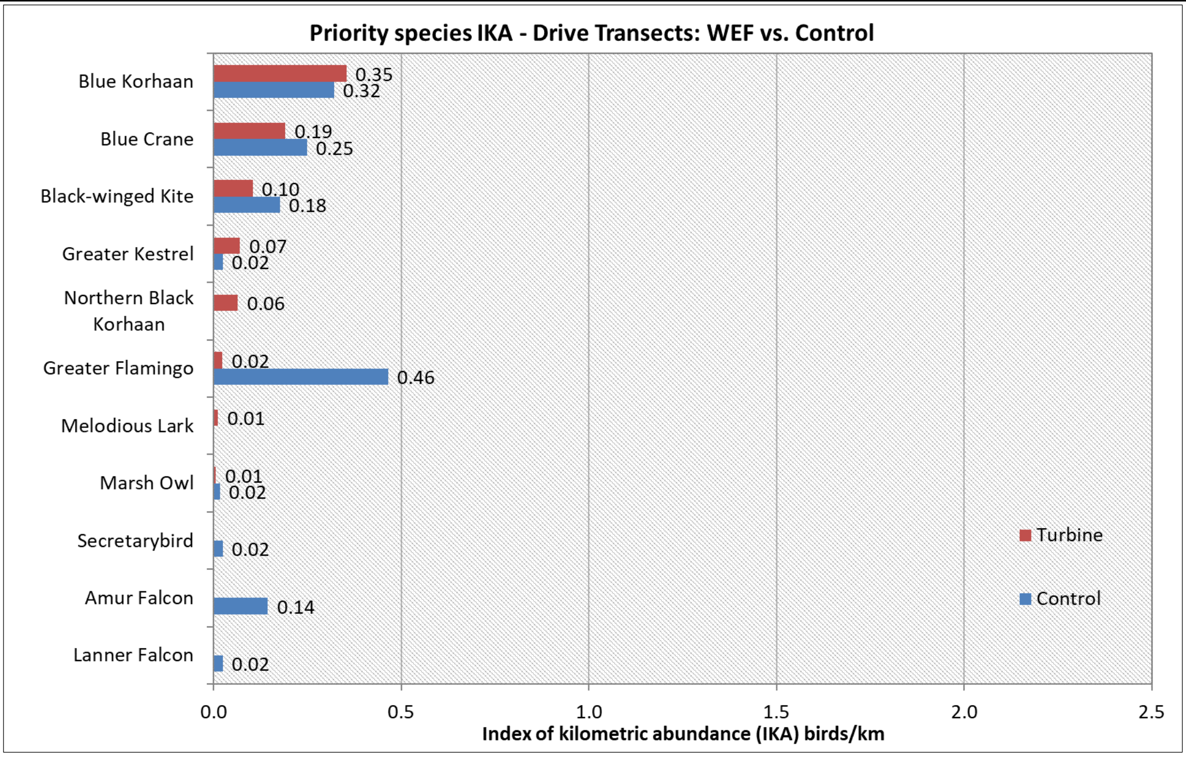

Figure 11: The results of the drive transect counts at PAOI and the control area

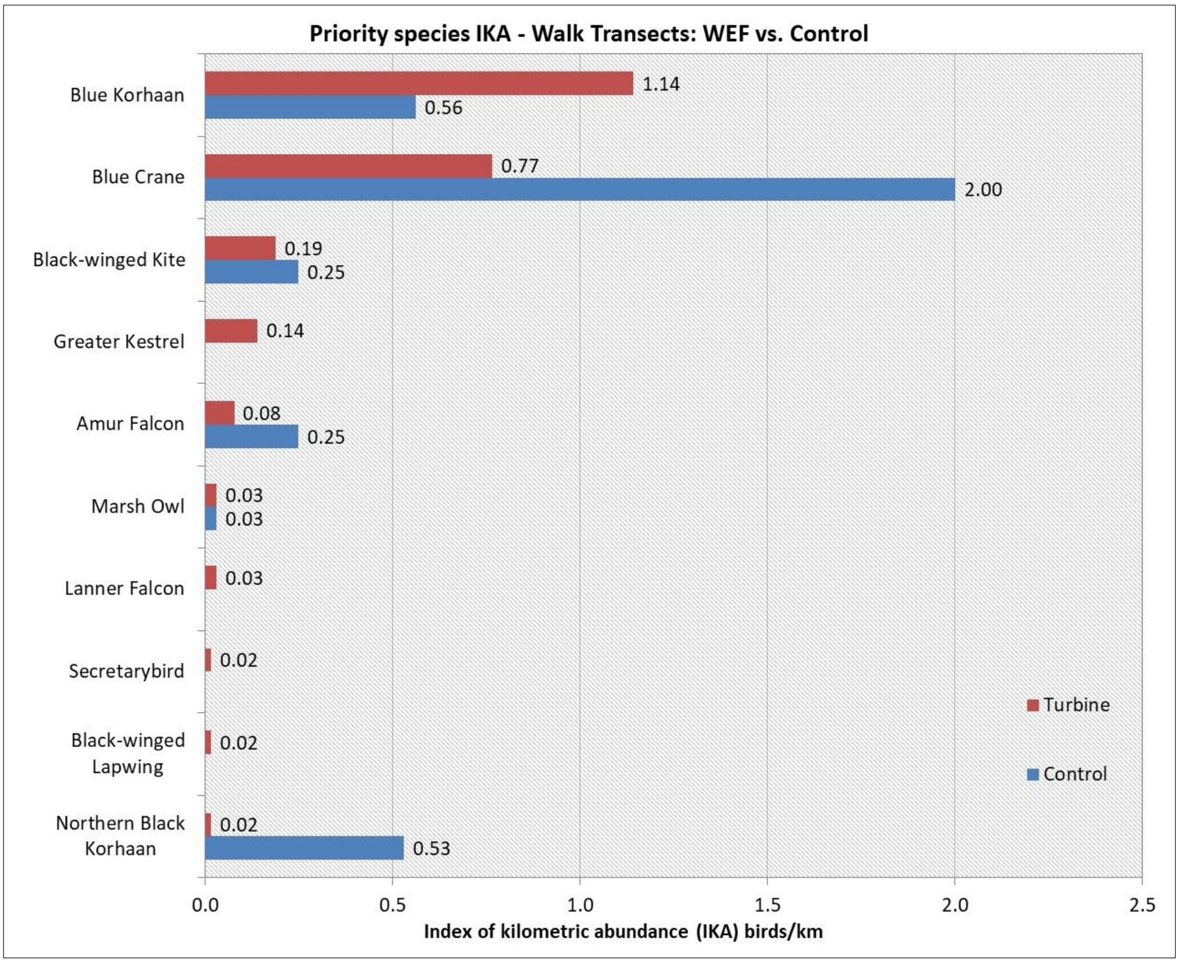

Figure 12: The results of the walk transect counts at PAOI and the control area

Figure 13 shows the spatial distribution of the priority species recorded during transect counts and incidental sightings in the course of the pre-construction monitoring.

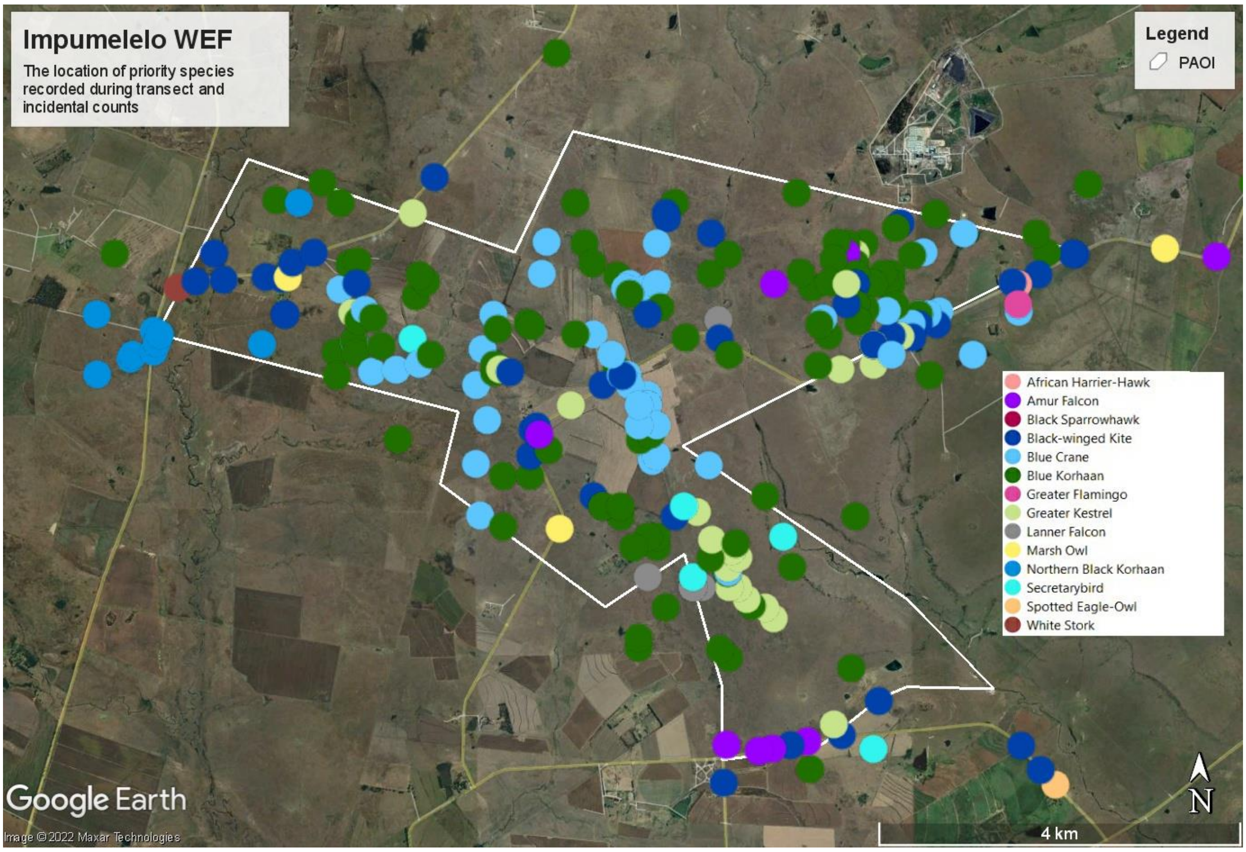

Figure 13: The location of priority species recorded during transect and incidental counts

5.5.2. Focal points

Two focal points (FPs) of bird activity were identified at the PAOI and monitored. The focal points are as follows:

- FP1: A pan/wetland in a drainage line
- FP2: Two small pans in the application site

A total of 151 birds were counted at the two focal points over four seasons during four counts. Only four priority species, i.e. Blue Crane (1), Amur Falcon (1), Blue Korhaan (3) and Greater Kestrel (were), were recorded during focal point counts. The results of focal point counts are displayed in

Table 7**7**.

Table 7: Species recorded at focal points counts made during the pre-construction monitoring.

Focal point	Species
FP1: Farm dam Counted: July 2021 October 2021 November 2021 March 2022	**Amur Falcon** **Blue Crane** **Blue Korhaan** **Greater Kestrel** African Darter African Sacred Ibis African Stonechat African Wattled Lapwing Ant-eating Chat Barn Swallow Blacksmith Lapwing Black-throated Canary Cape Crow Cape Shoveler Cape Wagtail Cloud Cisticola Common Greenshank Crowned Lapwing Dark-capped Bulbul Egyptian Goose Fan-tailed Widowbird Glossy Ibis Hadeda Ibis House Sparrow Levaillant's Cisticola Little Grebe Little Stint Long-tailed Widowbird Pink-billed Lark Red-billed Quelea Red-capped Lark Red-knobbed Coot South African Cliff Swallow South African Shelduck Southern Masked Weaver Southern Red Bishop Spike-heeled Lark Spotted Thick-knee Spur-winged Goose Three-banded Plover White-backed Duck White-breasted Cormorant White-throated Swallow Wood Sandpiper Yellow-billed Duck Yellow-crowned Bishop
FP2: 2 x small pans Counted: July 2021 September 2021 January 2022 March 2022	African Pipit African quail-finch Black-headed Heron Black-winged Stilt Brown-throated Martin Cape Longclaw Cape turtle dove Common Quail

Focal point	Species
	Common Waxbill Greater Striped Swallow Grey Heron Lesser Swamp Warbler Orange River Francolin Red-billed Teal Red-eyed Dove Reed Cormorant Western Cattle Egret Whiskered Tern Wing-snapping Cisticola

See Error! Reference source not found.**F** for the location of the focal points.

5.5.3. Incidental counts

Table 8 and Error! Reference source not found.**14** provide an overview of the incidental sightings of priority species during the pre-construction surveys.

Table 8: Incidental sightings of priority species made during the pre-construction monitoring.

Priority Species (Incidentals)		**Winter**	**Spring**	**Summer**	**Autumn**	**Grand Total**
African Harrier-Hawk	*Polyboroides typus*	1	0	0	0	**1**
Amur Falcon	*Falco amurensis*	0	0	0	22	**22**
Black Sparrowhawk	*Accipiter melanoleucus*	0	1	0	0	**1**
Black-winged Kite	*Elanus caeruleus*	16	12	1	9	**38**
Blue Crane	*Grus paradisea*	22	33	25	2	**82**
Blue Korhaan	*Eupodotis caerulescens*	48	39	21	9	**117**
Greater Flamingo	*Phoenicopterus roseus*	0	14	20	0	**34**
Greater Kestrel	*Falco rupicoloides*	5	3	0	4	**12**
Lanner Falcon	*Falco biarmicus*	3	5	0	0	**8**
Marsh Owl	*Asio capensis*	1	0	0	1	**2**
Northern Black Korhaan	*Afrotis afraoides*	4	0	0	0	**4**
Secretarybird	*Sagittarius serpentarius*	6	1	0	0	**7**
Spotted Eagle-Owl	*Bubo africanus*	0	1	0	0	**1**
White Stork	*Ciconia ciconia*	0	0	0	1	**1**

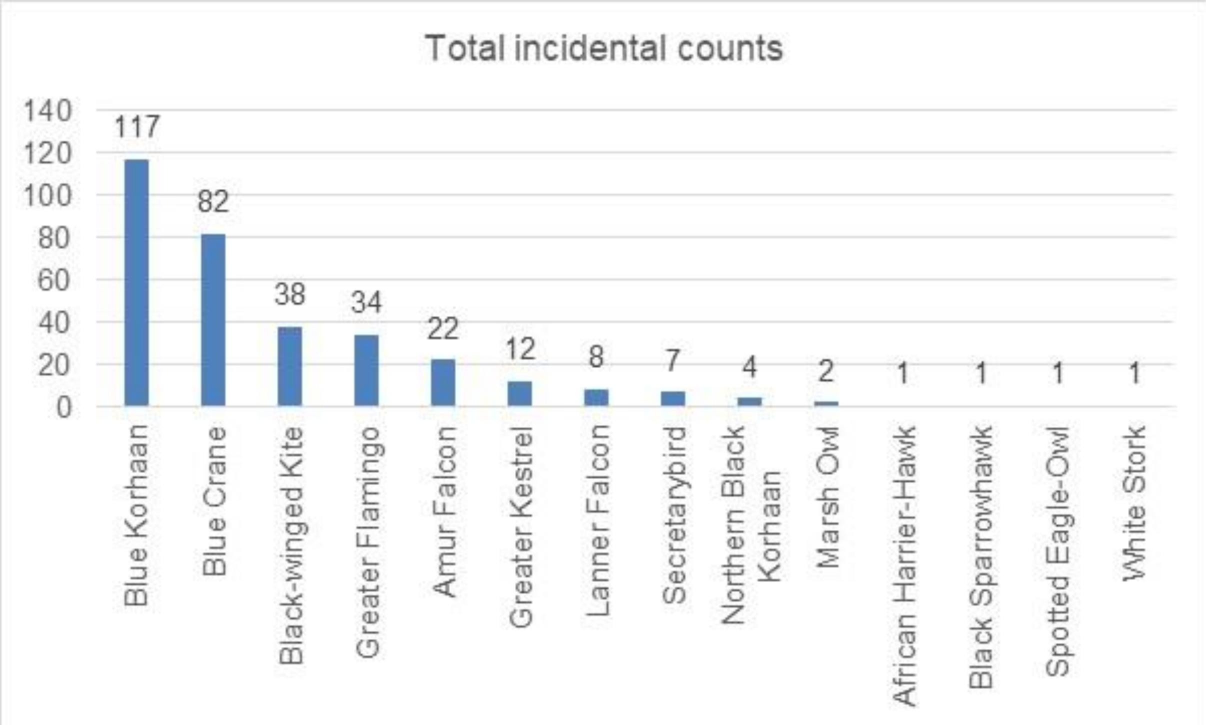

Figure 14: Incidental counts of priority species during the pre-construction monitoring

See Error! Reference source not found.**E** for a list of all species recorded during the pre-construction monitoring.

5.5.4. Vantage point observations

A total of 192 hours of vantage point watches were completed at four vantage points to record flight patterns of priority species in the development areas. Across the sampling periods, the duration of priority species flights at the turbine site amounted to 9 hours, 35 minutes, and 18 seconds. A total of 435 individual flights were recorded at the turbine site. The passage rate for priority species was 1.33 birds/hour. This amounts to approximately 17.33 priority birds per day.[2] See Error! Reference source not found. below for the duration of flights for each priority species.[3]

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

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

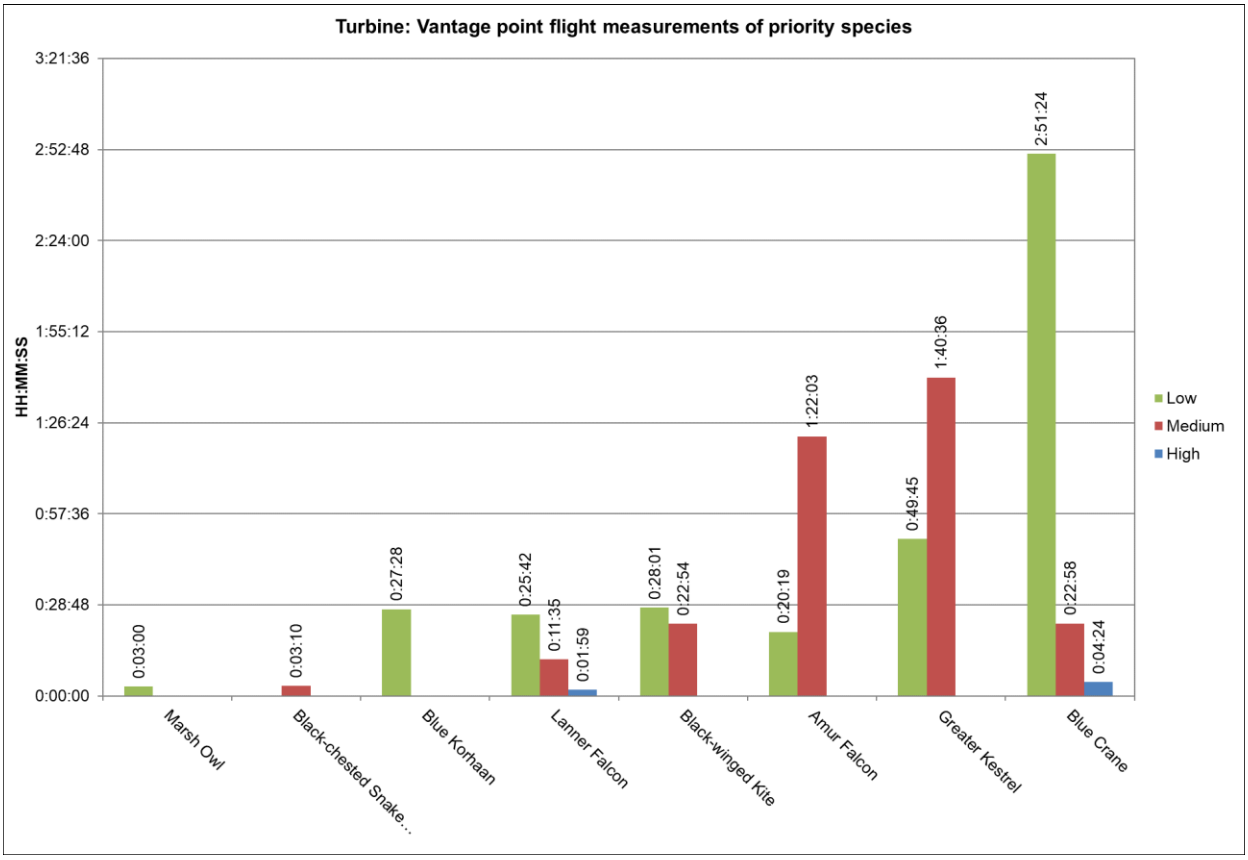

Figure 15: Flight time and altitude recorded for all individuals of priority species to at the project site (192 hours of observation). Time is indicated in hours: minutes: seconds. Flight height is indicated as low (green/below rotor altitude, red/within rotor altitude).

5.5.5. Site specific collision risk rating

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

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

This was done to gain insights into which species are likely to be most at risk of collision. The formula used is as follows[4]:

Duration of medium altitude flights (in decimal hours) x collision ratings in the Avian Wind Farm Sensitivity Map x number of turbines ÷100. The results are presented in **Table** 9**9** and Error! Reference source not found.**16** below.

Table 9: Site-specific collision risk ratings calculated from vantage point observations during pre-construction monitoring at the proposed Impumelelo WEF.

Species	Duration of rotor altitude flights (hr)	Avian Wind Farm Sensitivity Map collision susceptibility rating	Site specific collision risk rating
Blue Korhaan	0.000	70	0.00
Marsh Owl	0.000	65	0.00
Black-chested Snake Eagle	0.002	85	0.05
Lanner Falcon	0.008	85	0.19
Black-winged Kite	0.016	57	0.32
Blue Crane	0.016	85	0.47
Greater Kestrel	0.070	57	1.39
Amur Falcon	0.057	75	1.50
Average	*0.21*	***72***	*0.49*

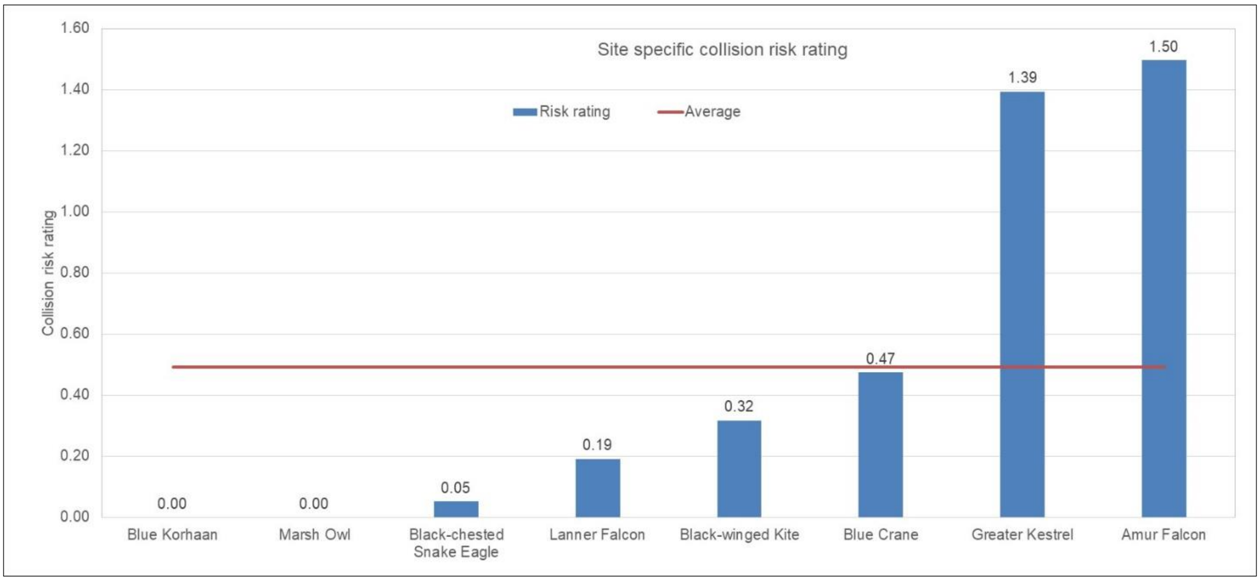

Figure 16: Site specific collision risk rating for priority species

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

5.5.6. Spatial distribution of flights over the turbine area

Flight maps were prepared for all priority species, indicating the spatial distribution of flights observed from the various vantage points. This was done by overlaying a 100m x 100m grid over the survey area. Each grid cell was then given a weighting score (i.e., Very High; High; Medium; Low) considering the flight intensity i.e., the duration and distance of individual flight lines through a grid cell and the number of individual birds associated with each flight crossing the grid cell, to give an indication where the observed flight activity was most concentrated (see Appendix H).

5.6. Identification of environmental sensitivities

The PAOI and project site is classified largely as **high sensitivity** for terrestrial animals according to the Terrestrial Animal Species Theme of the National Web-Based Environmental Screening Tool (Figure 10)[5].

The **high sensitivity** classification is linked to the potential occurrence of African Marsh Harrier (Globally Least Concern, Regionally Endangered), White-bellied Bustard (Globally Least Concern, Regionally Vulnerable), Caspian Tern (Globally Least Concern, Regionally Vulnerable), Martial Eagle (Globally Endangered, Regionally Endangered), Secretarybird (Globally Endangered, Regionally Vulnerable), and Yellow-billed Stork (Globally Least Concern, Regionally Endangered). **Medium sensitivity** is linked to African Grass-owl (Globally Least Concern, Regionally Vulnerable), and the aforementioned African Marsh Harrier and Caspian Tern, among other sensitive fauna (Figure 10).

The project site contains confirmed habitat for these species of conservation concern (SCC) as defined in the Protocol for the specialist assessment and minimum report content requirements for environmental impacts on terrestrial animal species (Government Gazette No 43855, 30 October 2020), namely listed on the IUCN Red List of Threatened Species or South Africa's National Red List website as Critically Endangered, Endangered, Vulnerable, Near Threatened, and Data Deficient species.

The occurrence of Secretarybird (Globally Endangered, Regionally Vulnerable) and additional SCC was confirmed during the surveys, namely Blue Crane (Globally Vulnerable, Regionally Near Threatened), Blue Korhaan (Globally Vulnerable, Regionally Least Concern), Greater Flamingo (Globally Least Concern, Regionally Near Threatened), Lanner Falcon (Globally Least Concern, Regionally Vulnerable), and Maccoa Duck (Globally Vulnerable, Regionally Near Threatened) were recorded in the project site.

The recorded presence of some of the above SCC in the project site requires the site to be classified as **high sensitivity** according to the protocol for birds and wind energy (20 March 2020), namely habitat (i) habitat likely to be of importance to priority bird species sensitive to wind energy developments, Critically

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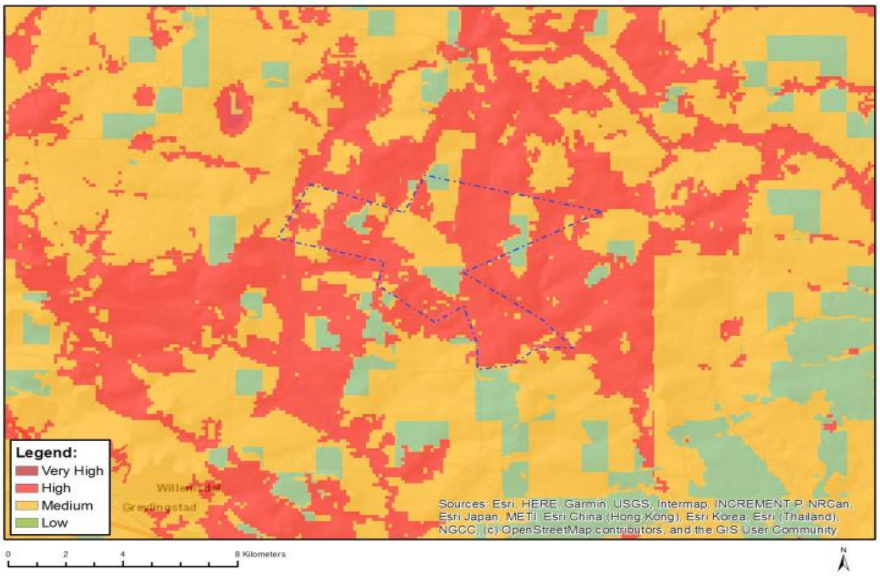
[5] The wind theme in the National Web-Based Environmental Screening Tool is only applicable to sites in a REDZ.

Endangered, Endangered bird species and/or Vulnerable bird species. These areas are potentially sensitive for development.

In summary, based on the Site Sensitivity Verification and pre-construction field surveys conducted, habitat within the project site appears suitable for Blue Crane, Blue Korhaan, Greater Flamingo, Lanner Falcon, Maccoa Duck, and Secretarybird. Therefore, a classification of **high sensitivity** for avifauna in the screening tool for the Terrestrial Animal Species theme is suggested for the project site.

MAP OF RELATIVE ANIMAL SPECIES THEME SENSITIVITY



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

Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
	X		

Sensitivity Features:

Sensitivity	Feature(s)
High	Aves-Circus ranivorus
High	Aves-Eupodotis senegalensis
High	Aves-Hydroprogne caspia
High	Aves-Polemaetus bellicosus
High	Aves-Sagittarius serpentarius
High	Aves-Mycteria ibis
Low	Subject to confirmation
Medium	Aves-Tyto capensis
Medium	Aves-Circus ranivorus
Medium	Aves-Hydroprogne caspia
Medium	Aves-Eupodotis senegalensis
Medium	Insecta-Lepidochrysops procera
Medium	Mammalia-Crocidura maquassiensis

Figure 17: The National Web-Based Environmental Screening Tool map of the project site, indicating sensitivities for the Terrestrial Animal Species theme. High sensitivity is linked to African Marsh Harrier (*Circus ranivorus*), White-bellied Bustard (*Eupodotis senegalensis*), Caspian Tern (*Hydroprogne caspia*), Martial Eagle (*Polemaetus bellicosus*) Secretarybird (*Sagittarius serpentarius*). Medium sensitivity is linked to African Grass-owl (*Tyto capensis*), African Marsh Harrier and Caspian Tern.

5.7. Specialist sensitivity analyses and verification

5.7.1. Very high sensitivity: Turbine exclusion zone around drainage lines and dams

An exclusion zone precluding wind turbines (and their rotor swept area) should be implemented within a 100 m buffer around drainage lines, wetlands, and dams (see Figure 3). Wetlands (including dam margins) are important breeding, roosting and foraging habitat for a variety of Red List priority species, most notably for African Marsh Harrier (Globally Least Concern, Regionally Endangered), African Grass-owl (Globally Least Concern, Regionally Vulnerable), Blue Crane (Globally Vulnerable, Regionally Near Threatened), Caspian Tern (Globally Least Concern, Regionally Vulnerable), Greater Flamingo (Globally Least Concern, Regionally Near Threatened), and Maccoa Duck (Globally Vulnerable, Regionally Near Threatened). Road and grid line crossings across these features should be restricted to what is unavoidable.

5.7.2. High sensitivity: Limited infrastructure zone

High sensitivity grassland: natural grassland on shallow soils, rocky grassland, and undisturbed grassland. Development in the remaining high sensitivity grassland in the project site must be limited as far as possible. Where possible, infrastructure must be located near margins, with shortest routes taken from the existing roads. The grassland is vital breeding, roosting and foraging habitat for a variety of Red List priority species, including several SCC. These include African Grass-owl (Globally Least Concern, Regionally Vulnerable), Blue Crane (Globally Vulnerable, Regionally Near Threatened), Blue Korhaan (Globally Vulnerable, Regionally Near Threatened), Lanner Falcon (Globally Least Concern, Regionally Vulnerable), Secretarybird (Globally Endangered, Regionally Vulnerable), and White-bellied Bustard (Globally Least Concern, Regionally Vulnerable).

5.7.3. Medium sensitivity: Limited infrastructure zone

Medium sensitivity grassland: disturbed or degraded grassland and fallow land. As with high sensitivity undisturbed grassland (see Section 5.6.2), development in the disturbed grassland in the project site must be limited as far as possible. Although disturbed, these grassland areas provide roosting and foraging habitat for a variety of Red List priority species, including several SCC. These include Blue Crane (Globally Vulnerable, Regionally Near Threatened), Blue Korhaan (Globally Vulnerable, Regionally Near Threatened), Lanner Falcon (Globally Least Concern, Regionally Vulnerable), Secretarybird (Globally Endangered, Regionally Vulnerable), and White-bellied Bustard (Globally Least Concern, Regionally Vulnerable).

Figure 18 below is a sensitivity map, indicating very high, high, and medium sensitivity areas identified for development.

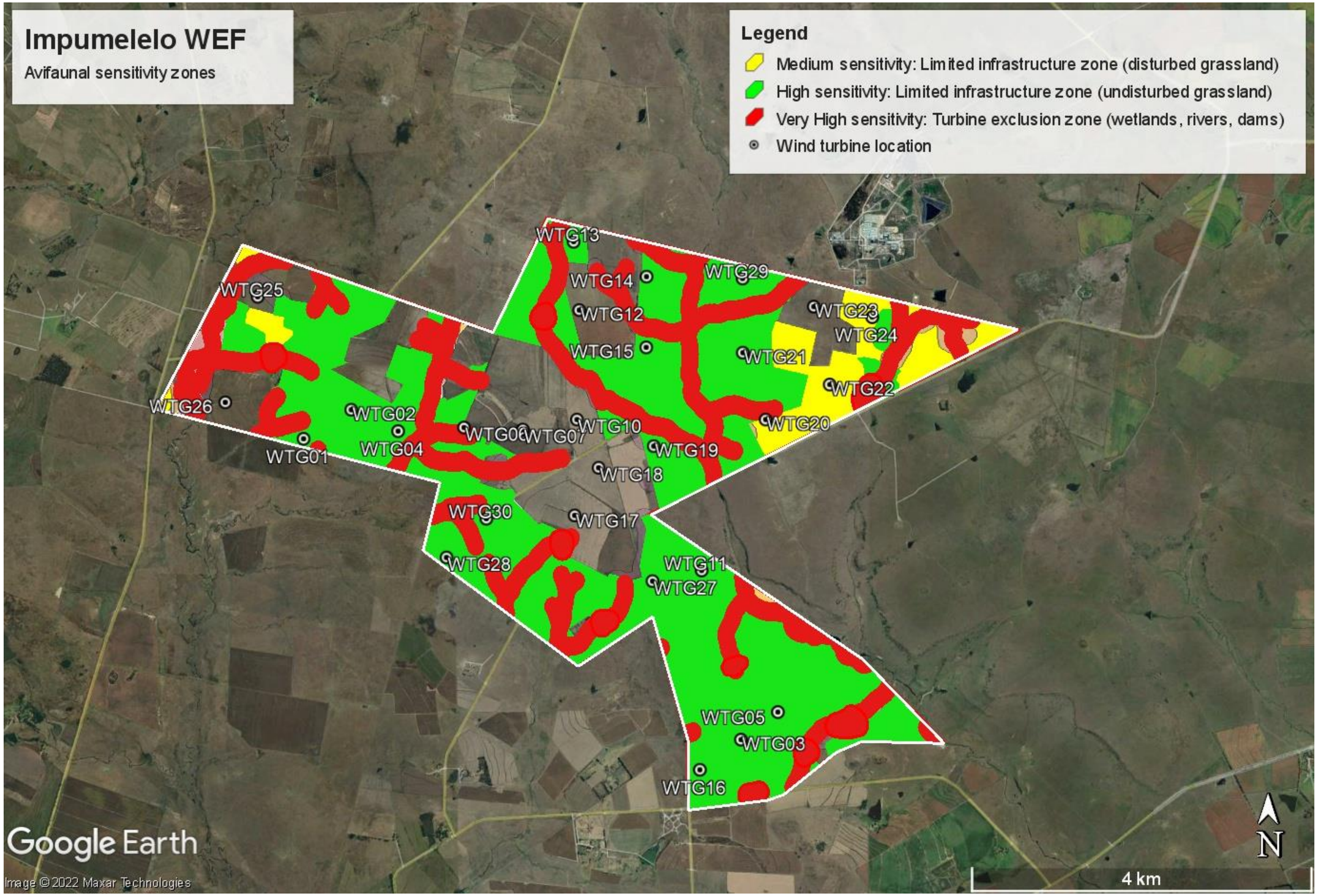


Figure 18: Avifaunal sensitivity zones within the proposed Impumelelo project site. The white delineation shows the extent of the project area of impact (PAOI). Red areas represent turbine exclusion zones of 100m buffers around all drainage lines, wetlands, and dams. Roads and crossings in these areas should be limited to what is essential. Green regions represent undisturbed natural grassland representing high sensitivity areas where construction should be limited. Yellow regions represent disturbed grassland of medium sensitivity where construction similarly should be limited.

5.8. Sensitivity analysis summary statement

Based on the Site Sensitivity Verification field surveys, a classification of High Sensitivity for avifauna is suggested for the PAOI, given the reliable detection of suitable habitat for Secretarybird, and other SCCs, namely Blue Crane, Blue Korhaan, Greater Flamingo, Lanner Falcon, and Maccoa Duck.

6. Identification of impacts

6.1. Identification of potential impacts/risks

The potential impacts identified during the study (i.e., Assessment Phase) are listed below.

6.1.1. Construction phase

- Total or partial displacement due to noise disturbance and habitat transformation associated with the construction of the wind turbines and associated infrastructure.

6.1.2. Operation phase

- Total or partial displacement due to habitat transformation associated with the presence of the wind turbines and associated infrastructure.
- Collisions with the wind turbines
- Electrocutions in the onsite substations and internal 33kV network
- Collisions with the internal 33kV network.

6.1.3. Decommissioning phase

- Total or displacement due to disturbance associated with the decommissioning of the wind turbines and associated infrastructure.

6.1.4. Cumulative impacts

- Total or partial displacement due to disturbance and habitat transformation associated with the construction and decommissioning of the WEF and associated infrastructure.
- Total or partial displacement due to habitat transformation associated with the operation of the wind turbines.
- Collisions with the wind turbines.
- Electrocutions and collisions with the onsite substations and internal 33kV network.

6.2. Impact assessment

The impacts wind farms have on bird populations are dependent upon range of factors, including the specification of the development, the local/regional topography, the habitats affected, the abundance, species diversity, and characteristics of birds present.

Potential impacts can be:

- discrete – acting in isolation of other impacts (i.e., priority species response to wind farms are idiosyncratic).
- cumulative – exacerbating other the severity of other impacts (i.e., wind turbines and overhead powerlines may pose similar collision risks to a given bird population).
- counter-active – reducing the severity of other impacts (i.e., bird population reduction through habitat loss lowers collision mortality rates)

The multi-faceted impacts that wind farms have on bird populations necessitates that new developments should be assessed on a case-by-case basis. The major concerns surrounding the impacts of wind farms on birds are detailed below:

- 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 and collisions with the medium voltage overhead lines

It should be noted that environmental impact assessments are localised to the present-day pre-construction conditions of a given development sites. Impacts to the regional landscape are not considered as the extent and nature of future developments (not only wind energy development) are unknown at this stage. It is, however, highly unlikely that the land use will change in the foreseeable future due to climatic limitations.

6.3. Construction phase - displacement due to disturbance associated with the construction of the wind turbines and associated infrastructure

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)], with a further 3-14% of airspace altered by turbines (Marques et al., 2020) (see Section 6.5). The effects of habitat loss 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 transformation following the development of the Altamont Pass Wind Farm in California led to increased mammal prey availability for some species of raptor, such as higher abundance of Pocket Gophers *Thomomys bottae* burrows around turbine bases), although this may also have increased collision risk [Thelander et al., (2003) as cited by Drewitt & Langston (2006)].

Despite overall habitat loss resulting from wind farm development may be limited, the associated infrastructure such as roads and powerlines fragment previously continuous tracts of habitat. Beyond the increased mortality risks to local bird populations posed by such infrastructure, the resulting habitat fragmentation can degrade adjacent habitats, potentially changing the way birds interact with the immediate (Fletcher et al., 2018). It remains disputed whether habitat fragmentation is always an environmental detriment (Fahrig et al., 2019), yet the effects of this landscape change have been observed in bird species vulnerable to wind farms. Lane et al. (2001) noted that Great Bustard *Otis tarda* flocks in Spain were significantly larger further from power lines than at control points. Shaw (2013) found that Ludwig's Bustard *Neotis ludwigii* in South Africa generally avoid the immediate proximity of roads within a 500m buffer. Bidwell (2004) found that Blue Cranes in South Africa select nesting sites away from roads.

The physical encroachment increases the disturbance and barrier effects that contribute to the overall habitat fragmentation effect of the infrastructure (Raab et al., 2011). 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 (Allan et al., 1997).

The species that could be most affected by this impact are listed in Table 5. The recommended mitigation measures are detailed in Table 10 in Section 6.9 below.

6.4. Operation phase – total or partial displacement of avifauna due to habitat transformation associated with the operation of the wind turbines and associated infrastructure

This impact relates to the total or partial displacement of avifauna due to habitat transformation associated with the presence of the horizontal-axis wind turbines and associated infrastructure. This impact is rated as negative, with a site-specific spatial extent and a long-term duration due to the extended timeframe of the operational phase (lifetime estimated at 20 years).

The displacement of birds away from areas in and around wind farms due to visual intrusion and airspace disturbance can be considered functional habitat loss. This disturbances can be detrimental to migratory bird population if wind farms disrupt migration routes (Marques et al., 2020, 2021), or if impact the breeding productivity and population sizes of species which avoidance behaviour of wind farms.

The population displacement effect of wind turbines is observable across avian taxonomic orders, and has been better studied in raptors (Accipitriformes and Falconiformes), landfowl (Galliformes), shorebirds (Charadriiformes), waterfowl (Anseriformes), and songbirds (Passeriformes) (Marques et al., 2021).

Three types of avoidance have been described (Cook et al., 2018; May, 2015):

- Macro-avoidance’ or displacement, whereby the density of birds reduced around a wind farm due to long-term distrubance (Desholm & Kahlert, 2005; Furness et al., 2013; Plonczkier & Simms, 2012; Villegas-Patraca et al., 2014; Walker et al., 2005).
- ‘Meso-avoidance’ or anticipatory/impusive evasion, whereby flying birds anticapte anticipate a perceived threat from a wind farm, or segments thereof and alter their flight paths to avoid theses threats (Desholm & Kahlert, 2005; Healy & Braithwaite, 2010; Mueller & Fagan, 2008)
- ‘Micro-avoidance’ or escape, whereby birds in close proximity to the rotor swept zone perform last-second evasion maneuvers, possibly reflexively, away from the rotors (Everaert, 2014; Frid & Dill, 2002; Mueller & Fagan, 2008).

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 (Scottish Natural Heritage, 2010).

Displacement may occur during both the construction and operation phases of wind farms, manifesting from turbines themselves through visual, noise and vibration impacts, as well as vehicle and personnel movements related to site construction and maintenance (Campedelli et al., 2014; May, 2015). Disturbance magnitude varies across sites and species, necessitating assessments on a site-by-site basis (Dohm et al., 2019; Drewitt & Langston, 2006). A recent meta-analysis study found that of long-term studies into avian displacement around wind farms found that half ~50% of studies reported limited displacement from wind turbines, 46% reported a decrease in some bird populations, and 7.7% found an increased abundance of certain species around wind farms (Marques et al., 2021). Unfortunately, few studies provide comprehensive before- and-after and control-impact (BACI) assessments, limiting current insights.

The operational phase is thought to impose the greatest displacement threat to bird populations, although these impacts may in temporary (Dohm et al., 2019; Pearce-Higgins et al., 2012). Local raptor populations around wind farms may rebound within 7-8 years post-construction (Dohm et al., 2019). Bustards may retain high affinity for historic lek sites (courtship display areas) on wind farms, as has been document in Great Bustard in Spain (A. Camiña, *personal communications*, 17 November 2012) and Denham’s Bustard in South Africa (Ralston-Paton et al., 2017). It should be noted that Great Bustard elsewhere in Europe can be displaced by 0.6km [Wurm & Kollar (2000), as quoated by Raab et al. (2009)] to 1km (Langgemach, 2008) of an operational wind farm, although Denham’s Bustards populations do not appear to be displaced by wind farms in South Africa (Ralston-Paton et al., 2017). It should be noted that for raptors and large terrestrial species, site-fidelity and species longevity may mask short- and medium-term impacts that wind farms may have on these species, and that the true impact severity may only manifest in the long-term – such as through diminishing recruitment of new individuals over the course of multiple generations (Ferrer et al., 2012; Santos et al., 2020). Blue Cranes seem to have adapted well to the presence of wind turbines and even breed in operational wind farms in agricultural areas in the Western Cape (personal observation). It is expected that the same will be valid for Blue Cranes utilising agricultural fields in the Mpumalanga Highveld.

The limited research into shorter-lived bird species around wind farms may offer insights into the long-term response of birds more generally. Leddy et al., (1999) reported increased densities of breeding grassland passerines with increased distance (>80m) from wind turbines, and review study by (Hötker et al. (2006) found that the minimum avoidance distances of eleven breeding passerines species ranged 14–93m of wind turbines. However, Hale et al. (2014) and Stevens et al. (2013) found limited evidence for permanent displacement of grassland passerines in North America. Passerine resilience to wind farms is further observed in the UK in species such Skylark (despite some evidence of turbine avoidance) (Pearce-Higgins et al., 2012), and Thekla Lark populations in Southern Spain (Farfán et al., 2009). Across nine wind farms in Scotland, seven out of twelve birds species across a range of taxa exhibited significantly lower frequencies of occurrence close to the turbines, after accounting for habitat variation, with demonstrable turbine avoidance behaviour in a further two species (Pearce-Higgins et al., 2009). No species preferentially occurred close to the turbines, and breeding pair densities decreased 15-53% within 500m of wind turbines for several species. Follow-up monitoring reported breeding densities of certain species (such as Red Grouse) recovered post-construction, whereas others (such as Snipe and Curlew) did not. Conversely, breeding densities of certain species (such as Skylark and Stonechat) increased on wind farms during construction.

Species response to wind farm construction and operation appears highly idiosyncratic, and although the local populations of many bird species may recover, the long-term impacts of wind farms on bird populations remains to be better elucidated.

The impact is rated with a high reversibility (meaning that the potential impact is highly reversible at end of the project life); and low irreplaceability (meaning there is a low irreplaceability of avifaunal species). The potential impact is allocated a severe consequence and very likely probability, which will render the impact significance as high without the implementation of mitigation measures. With the implementation of mitigation measures, the significance of the impact is reduced to moderate.

The species that could be most affected by this impact are listed in Table 5. The recommended mitigation measures are detailed in in Table 10 in Section 6.9 below.

6.5. Operation phase – bird mortality and injury from collisions with the wind turbines[6]

This impact relates to the bird mortalities because of potential collisions with the wind turbines. This impact is rated as negative, with a site-specific spatial extent and a long-term duration due to the extended timeframe of the operational phase (lifetime estimated at 20 years).

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

Wind 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 major ecological drawback to wind energy (Drewitt & Langston, 2006).

Collisions with wind turbines kill fewer birds than collisions with other man-made infrastructure, such as power lines, buildings or even traffic (Erickson et al., 2005). Nevertheless, estimates of bird deaths from collisions with wind turbines worldwide range from 0-40 deaths per turbine per year (Sovacool, 2013). Bird mortality rates vary across sites, as do the number of sensitive bird species impacted (Hull et al., 2013; May, 2015). Estimated mortalities are likely lower than true number of bird deaths from wind farm infrastructure, given that studies may fail to account for detection biases caused by scavenging, search efficiency and search radius (Bernardino et al., 2013; Erickson et al., 2005; Huso et al., 2015, 2021). Additionally, even for low mortality rates, collisions with wind turbines may disproportionately affect certain species. For long-lived species with low reproductivity and slow maturation rates (e.g. raptors), even low mortality rates can have a significant impact at the population level (Carrete et al., 2009; De Lucas et al., 2008; Drewitt & Langston, 2006). The situation is even more critical for species of conservation concern and those with restricted distributions, which sometimes are most at risk (Osborn et al., 1998).

High bird mortality 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 *Larus* gulls and *Sterna* terns (Barrios & Rodríguez, 2004; Drewitt & Langston, 2006; Huso et al., 2015; Stienen et al., 2008; Thelander et al., 2003). Due to their specific features and location, and characteristics of their bird communities, these wind farms have been responsible for many 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; Marques et al., 2014) 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. In southern Africa, vultures – followed by larger eagle species – are highlighted as being especially susceptible to collisions with wind turbines (McClure et al., 2021).

The impact is rated with a high reversibility (meaning that the potential impact is highly reversible at end of the project life); and low irreplaceability (meaning there is a low irreplaceability of avifaunal species). The potential impact is allocated a severe consequence and very likely probability, which will render the impact significance as high without the implementation of mitigation measures. The severity of impact for this risk will vary according to species- and site-specific factors, as detailed in Sections 6.5.1 and Sections 6.5.2.

The species that could be most affected by this impact are listed in Table 5. The recommended mitigation measures are detailed in in Table 10 in Section 6.9 below.

6.5.1. Species-specific factors

6.5.1.1. 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 & Rodríguez, 2004; De Lucas et al., 2008). High wing-loading is associated with low flight maneuverability (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 Impumelelo Wind Energy Facility was not available at the time of writing. However, based on general observations, and research on related species, it can be confidently assumed that regularly occurring priority species that could potentially be vulnerable to wind turbine collisions due to morphological features (high wing loading) are bustards, cranes and flamingos, making them less maneuverable (Keskin et al., 2019).

6.5.1.2. 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 & Langston, 2006; 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 (Guichard, 2017; Krijgsveld et al., 2009; May et al., 2015; Mitkus et al., 2018). The visual acuity of birds seems to be slightly superior to that of other vertebrates (Martin et al., 2010; McIsaac, 2001; Mitkus et al., 2018). 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 et al., 2010, 2012; Mitkus et al., 2018). Relatively small frontal binocular fields have been described for several species that are particularly vulnerable to power line collisions, such as vultures (Gyps spp.) cranes and bustards (Martin, 2011; Martin et al., 2010, 2012; Martin & Katzir, 1999). Furthermore, for some species, their high resolution vision areas are often found in the lateral fields of view, rather than frontally (Martin, 2011; Martin et al., 2010, 2012; O'Rourke et al., 2010; Päckert et al., 2012). 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).

Some of the regularly occurring priority species at the project site have high resolution vision areas found in the lateral fields of view, rather than frontally, e.g., the bustards, korhaans, and cranes. The exceptions to this are the priority raptors which all have wider binocular fields, although as pointed out by Martin et al. (2010), this does not necessarily result in these species being able to avoid obstacles better.

6.5.1.3. Phenology

Turbine collision mortalities within raptors may be higher for resident than for migratory birds of the same species/taxon group. This disparity is possible due to resident birds frequenting areas occupied by wind farms more readily that migratory birds, which typically cross these wind farms *en route* to destinations further afield (Krijgsveld et al., 2009). However, factors like bird behaviour remain 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 (Martín et al., 2018), such as the African Rift Valley or Mediterranean Red Sea flyways, is not a feature of the landscape. The migratory priority species which could occur regularly at the PAOI with some regularity (e.g., Amur Falcon) will behave much the same as the resident birds once they arrive in the area.

6.5.1.4. 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, California (Hoover & Morrison, 2005), and could also be a factor in contributing to the high collision rate for Jackal Buzzards in South Africa (Ralston-Patton & 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 & Rodríguez, 2004). This may also explain the high mortality rate of Rock Kestrels *Falco rupicolus* at wind farms in South Africa (Ralston-Patton & Camagu, 2019). Kiting and hovering are associated with strong winds, which often produce unpredictable gusts that may suddenly change a bird's position (Hoover & 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 (Carrete et al., 2012; Janss, 2000), and territoriality and courtship displays may override aversion to wind turbines (Walker et al., 2005). 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, personal communications, 12 April 2012). Similarly, in South Africa, very few bustard collisions with wind turbines have been reported to date, all Ludwig's Bustards (Ralston-Patton & Camagu, 2019). No Denham's Bustards *Neotis denhami* turbine fatalities have been reported to date, despite the species occurring at several wind farm sites.

6.5.1.5. Avoidance behaviour

See Section 6.4. for further details on avoidance behaviour.

It is anticipated that most birds at the PAOI will avoid the wind turbines, as is generally the case at all wind farms (Scottish Natural Heritage, 2010). Exceptions already mentioned are raptors that engage in hunting behaviour which may serve to distract them and place them at risk of collision, birds engaged in display behaviour or inter- and intraspecific aggressive interaction. It is unlikely that the entire regional/local population of each priority species present around the proposed WEF will engage in complete meso- and macro-avoidance strategies of the wind energy infrastructure.

6.5.1.6. Bird abundance

Some authors suggest that fatality rates are related to bird abundance, density or site utilization rates (Carrete et al., 2012; Kitano & Shiraki, 2013; Smallwood & Karas, 2009), while others highlight as birds utilize territories in non-random ways, and so mortality rates do not depend on bird abundance alone (Ferrer et al., 2012; Hull et al., 2013). Instead, fatality rates depend on other factors such as discriminatory use of specific areas within a wind farm (De Lucas et al., 2008). For example, at Smøla, Norwary, White-tailed Eagle flight activity is correlated with collision fatalities (Dahl et al., 2013). In the APWRA, California, 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).

6.5.2. Site-specific factors

6.5.2.1. 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 & Rodríguez, 2004; Drewitt & Langston, 2008; Healy & Braithwaite, 2010; Katzner et al., 2012; Thelander et al., 2003). In South Africa, Verreaux's Eagle Aquila verreauxii is expected to incur higher fatality rates from at higher elevations and along steeper slopes (Murgatroyd et al., 2021). In Lesotho, Bearded Vultures Gypaetus barbatus preferentially forage upper mountain slopes and high ridges which are favourable sites for wind turbine construction (Rushworth & Krüger, 2014).

In APWRA, California, 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 & 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.

Landscape features are unlikely to play a major role at the Impumelelo WEF site as the proposed development is located on a flat area.

6.5.2.2. Flight paths

The foraging behaviour of breeding, or otherwise territorial, raptors is often constrained to the vicinity nearest to the nest/home range (Watson et al., 2018). For example, in Scotland 98% of Golden Eagle *Aquila chrysaetos* 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, 2008).

There are relatively few telemetry studies the foraging behaviour of breeding raptors in South Africa. Breeding Verreaux's Eagles largely forage within 3.7km of their nest (Brink, 2020), with turbine collision risk potential falling substantially further away from the nest, becoming a negligible concern after 8km (Murgatroyd et al., 2021). Breeding African Crowned Eagles demonstrate more restrictive foraging behaviour largely confined to 1.62km of their nest, whereas breeding Martial Eagle *Polemaetus bellicosus* forage generally forage within 5.39km of their nests (Brink, 2020). Male Black Sparrowhawks *Accipiter melanoleucus* have been observed to display year-round territoriality, mostly foraging within 2.27 (breeding) and 2.43km (non-breeding) of the nest (Brink, 2020; Sumasgutner et al., 2016). The home range size for foraging female Long-crested Eagles

Lophaetus occipitalis in KwaZulu-Natal undergo substantial contractions to within a close vicinity of the nest (<25ha for one observed female) during the breeding season (Maphalala et al., 2020). Breeding Black Harrier *Circus maurus* pairs forage further afield (within 7.1–33.4km of their nests) (Garcia-Heras et al., 2019), as do Bearded Vultures (10km of their nests), and especially Lappet-faced Vultures (110.98km of their nest) (Brink, 2020).

No raptor nests have been recorded prior to, or during pre-construction monitoring surveys. The most likely flight concentration of priority species at the proposed WEF site would be associated with drainage lines, wetlands, and dams. High voltage lines might also attract certain species e.g. Amur Falcon.

6.5.2.3. 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, California, 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 & Morrison, 2005; Smallwood et al., 2009). 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 suggested 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).

Depending on the availability of insect prey in the natural grassland at the proposed Impumelelo WEF site, flocks of Amur Falcons of varying sizes might be present in the summer months.

6.6. Operation phase – electrocution of priority species in the onsite substations and internal 33kV network

This impact deals with the potential electrocution of priority species in the onsite substations and any overhead sections of the 33kV powerlines. This impact is rated as negative, with a local spatial extent and a long-term duration due to the extended timeframe of the operational phase (lifetime estimated at 20 years).

Electrocution refers to instances where birds perch, or attempt to perch, upon electrical structure in a manner that physically bridges the air gap between live components and/or live and earthed components, causing a fatal electrical short circuit through the birds (Bevanger, 1994; van Rooyen, 2000). The electrocution risk is largely determined by the design of the electrical hardware, with medium voltage electricity poles posing a potential electrocution risk to raptors (Cole & Dahl, 2013; Haas et al., 2006; Loss et al., 2014).

The impact is rated with a high reversibility (meaning that the potential impact is highly reversible at end of the project life); and low irreplaceability (meaning there is a low irreplaceability of avifaunal species). The potential impact is allocated a severe consequence but unlikely probability, which will result in an impact significance of moderate, without the implementation of mitigation measures. With the implementation of mitigation measures (i.e., reactive insulation of electrical hardware), the significance of the impact is reduced to very low.

The species that could be most affected by this impact are listed in Table 5. The recommended mitigation measures are detailed in in Table 10 in Section 6.9 below.

6.7. Operation phase – collision of priority species with the internal 33kV network

A related concern to that addressed in Section 6.6 is bird collisions with medium voltage overhead powerlines. Overhead line collisions are arguably the greatest threat posed by overhead lines to birds in southern Africa (van Rooyen, 2004). Most heavily impacted upon are bustards, storks, cranes and various species of waterbirds, and to a lesser extent, vultures (Shaw et al., 2010; van Rooyen, 2004). These species are mostly heavy-bodied birds with limited maneuverability, which makes it difficult for them to take the necessary evasive action to avoid colliding with transmission lines (van Rooyen, 2004).

Power line collisions are generally accepted as a key threat to bustards (Barrientos et al., 2012; Jenkins et al., 2010; Raab et al., 2009, 2011; 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 Neotis ludwigii 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 Eupodotis vigorsii 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 (Shaw et al., 2018). Marking was highly effective for Blue Cranes *Grus paradisea*, 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., 2018).

The impact is rated with a high reversibility (meaning that the potential impact is highly reversible at end of the project life); and low irreplaceability (meaning there is a low irreplaceability of avifaunal species). The potential impact is allocated a severe consequence but unlikely probability, which will result in an impact significance of moderate, without the implementation of mitigation measures. With the implementation of mitigation measures (i.e., marking of line with bird flight diverters), the significance of the impact is reduced to low.

The species that could be most affected by this impact are listed in Table 5. The recommended mitigation measures are detailed in in Table 10 in Section 6.9 below.

6.8. Decommissioning phase - displacement due to disturbance associated with the decommissioning of the wind turbines and associated infrastructure

The noise and movement associated with the potential decommissioning activities will be a source of disturbance which would lead to the displacement of avifauna from the area. This impact is rated as negative, with a site-specific spatial extent and a short-term duration. The impact is rated with a high reversibility (meaning that the potential impact is highly reversible at end of the project life); and low irreplaceability (meaning there is a low irreplaceability of avifaunal species). The potential impact is allocated a substantial consequence and very likely probability, which will render the impact significance as moderate, without the implementation of mitigation measures. With the implementation of mitigation measures, the significance of the impact is reduced to low.

The species that could be most affected by this impact are listed in Table 5. The recommended mitigation measures are detailed in in Table 10 in Section 6.9 below.

7. IMPACT RATING

7.1. Impact criteria

See Error! Reference source not found.**D** for the assessment criteria employed to assess the impacts of the proposed WEF.

7.2. Impact tables

Construction phase

Table 10, **Operational phase**

Table 11, and **Table** 12 contain a summary of the impact assessment and proposed mitigation measures for the identified impacts:

<u>Construction phase</u>

- Displacement of priority avifauna due to disturbance during construction of the wind farm
- Displacement of priority avifauna due to habitat change and loss at the wind farm

<u>Operational phase</u>

- Mortality of priority avifauna due to collisions with the wind turbines

- Mortality of priority avifauna due to electrocution on the medium voltage overhead lines
- Mortality of priority avifauna due to collisions with the medium voltage overhead lines

Decommissioning phase

- Displacement of priority avifauna due to disturbance during dismantling of the wind farm

Error! Reference source not found.**13** shows the cumulative avifaunal impact assessment throughout the project's life.

7.2.1. Construction phase

Table 10: [Construction phase] Displacement of priority avifauna due to disturbance associated with the construction of the wind turbines and associated infrastructure.

Impact number	Aspect	Description	Stage	Character	Ease of Mitigation	Pre-Mitigation							Post-Mitigation						
						M	E	R	D	P	S	Rating	M	E	R	D	P	S	Rating
Impact 1:	Construction of the turbines and associated infrastructure	Displacement of priority avifauna due to disturbance associated with the construction of the wind turbines and associated infrastructure	Construction	Negative	Moderate	4	1	1	2	5	**40**	**N3**	3	1	1	2	4	**28**	**N2**
Significance						**N3 - Moderate**							**N2 - Low**						
Impact 2:	Construction of the turbines and associated infrastructure	Displacement of priority species due to habitat transformation as a result of the construction of the wind turbines and associated infrastructure	Construction	Negative	Moderate	3	1	3	2	4	**36**	**N3**	2	1	1	2	4	**24**	**N2**
Significance						**N3 - Moderate**							**N2 - Low**						

7.2.2. Operational phase

Table 11: [Operational phase]: Displacement and mortality risks of wind priority bird species associated with the operational phase of the wind turbines and associated infrastructure

Impact number	Aspect	Description	Stage	Character	Ease of Mitigation	Pre-Mitigation							Post-Mitigation						
						M	E	R	D	P	S	Rating	M	E	R	D	P	S	Rating
Impact 1:	Operation of the wind turbines	Collision mortality of priority species caused by the wind turbines in the operational phase.	Operational	Negative	Moderate	5	2	3	4	5	**70**	**N4**	3	2	3	4	4	**48**	**N3**
Significance						**N4 - High**							**N3 - Moderate**						
Impact 2:	Medium voltage overhead lines	Electrocution mortality caused by the medium voltage reticulation lines	Operational	Negative	Moderate	5	2	3	4	4	**56**	**N3**	1	2	3	4	1	**10**	**N1**
Significance						**N3 - Moderate**							**N1 - Very Low**						
Impact 3:	Medium voltage overhead lines	Collision mortality caused by the medium voltage reticulation lines	Operational	Negative	Moderate	5	2	3	4	4	**56**	**N3**	1	2	3	4	1	**10**	**N1**
Significance						**N3 - Moderate**							**N1 - Very Low**						

7.2.3. Decommissioning phase

Table 12: [Decommissioning phase]: Displacement of priority avifauna due to disturbance associated with the dismantling of the wind turbines and associated infrastructure.

Impact number	**Aspect**	**Description**	**Stage**	**Character**	**Ease of Mitigation**	**Pre-Mitigation**							**Post-Mitigation**						
						M	**E**	**R**	**D**	**P**	**S**	**Rating**	**M**	**E**	**R**	**D**	**P**	**S**	**Rating**
Impact 1:	Dismantling of the turbines and associated infrastructure	Displacement of priority avifauna due to disturbance associated with the dismantling of the wind turbines and associated infrastructure.	Construction	Negative	moderate	4	1	1	2	5	**40**	**N3**	3	1	1	2	4	**28**	**N2**
					Significance	**N3 - Moderate**							**N2 - Low**						

7.3. Cumulative impacts

"Cumulative Impact", in relation to an activity, means the past, current, and reasonably foreseeable future impact of an activity, considered together with the impact of activities associated with that activity, that may not be significant, but may become significant when added to existing and reasonably foreseeable impacts eventuating from similar or diverse activities.

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

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

The potentially low impact of this development should be contextualised alongside related local/regional developments. According to the official database of DFFE and other documents in the public domain, there are currently at least four planned wind and solar energy facilities within a 30km radius around the proposed development (see Error! Reference source not found.). These are the following:

- The 65.9MW Tutuka Photovoltaic PV Energy Facility (approximately 52km southeast) (*approved*).
- The 300MW Vhuvhili Solar PV Energy Facility (approximately 40km northeast) (*pending approval*)
- The 300MW Mukondeleli WEF (approximately 33km east) (*pending approval*)
- The 75MW Grootvlei Solar PV Energy Facility (*approved*)

The proposed Impumelelo WEF will consist of up to 28 turbines in total. According to information that that is available, there is only one additional proposed wind turbine facility (the 300MW Mukondeleli WEF) that is planned within a 55km radius in broadly similar habitat. The 300MW Mukondeleli WEF is intended to comprise 46 wind turbines, and as such, the Impumelelo WEFs' contribution of approximately 37% of the total number of confirmed turbines, and by implication to the cumulative impact of all the planned turbines, is **moderate**.

The total area of similar habitat (mosaic of grassland, wetlands, and agriculture, but excluding opencast mining and urban areas) available to birds in the 55 km radius (9 503 km²) around the project sites is approximately 8 971 km² (Figure 19). Given the total of 74 proposed wind turbines within this region, this translates into approximately 1 turbine/118 km², which is a low density. The turbine density, if all the turbines are constructed, and by implication the cumulative impact on avifauna of the currently planned wind energy projects within this area, is therefore considered to be **low**, pending diligent implementation of recommended mitigation measures.

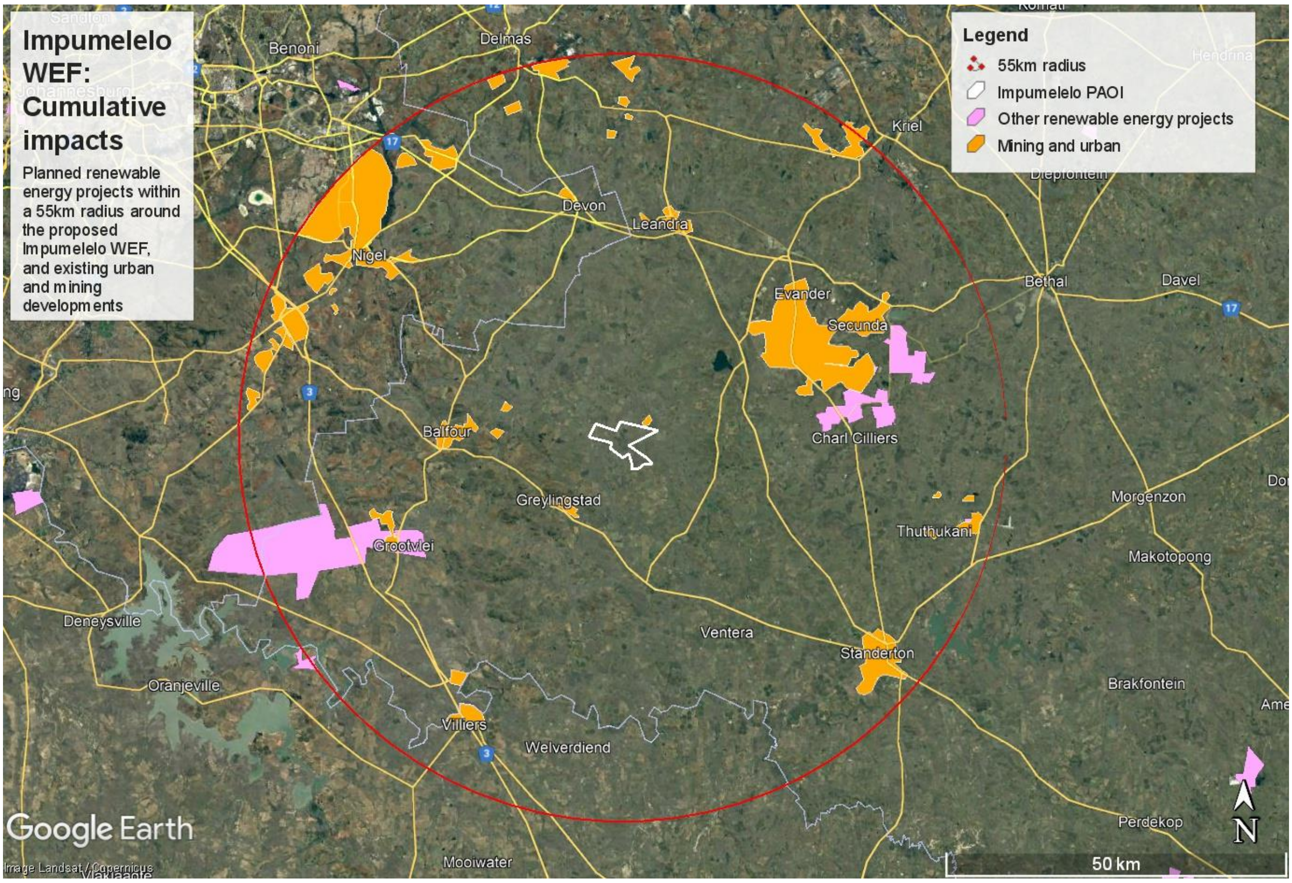

Figure 19: Other renewable energy projects and existing mining and urban developments within a 55km radius around the proposed Impumelelo WEF.

8. MITIGATION MEASURES

The impact significance without mitigation measures is assessed with the design controls in place. Impacts without mitigation measures in place are not representative of the proposed development's actual extent of impact and are included to facilitate understanding of how and why mitigation measures were identified. The residual impact is what remains following the application of mitigation and management measures and is thus the final level of impact associated with the Project. Residual impacts also serve as the focus of management and monitoring activities during Project implementation to verify that actual impacts are the same as those predicted in this report.

The mitigation measures chosen are based on the mitigation sequence/hierarchy which allows for consideration of five (5) different levels, which include avoid/prevent, minimise, rehabilitate/restore, offset and no-go in that order. The idea is that when project impacts are considered, the first option should be to avoid or prevent the impacts from occurring in the first place if possible, however, this is not always feasible. If this is not attainable, the impacts can be allowed, however they must be minimised as far as possible by considering reducing the footprint of the development for example so that little damage is encountered. If impacts are unavoidable, the next goal is to rehabilitate or restore the areas impacted back to their original form after project completion. Offsets are then considered if all the other measures described above fail to remedy high/significant residual negative impacts. If no offsets can be achieved on a potential impact, which results in full destruction of any ecosystem for example, the no-go option is considered so that another activity or location is considered in place of the original plan.

The mitigation sequence/hierarchy is shown in **Figure** 20**20**.

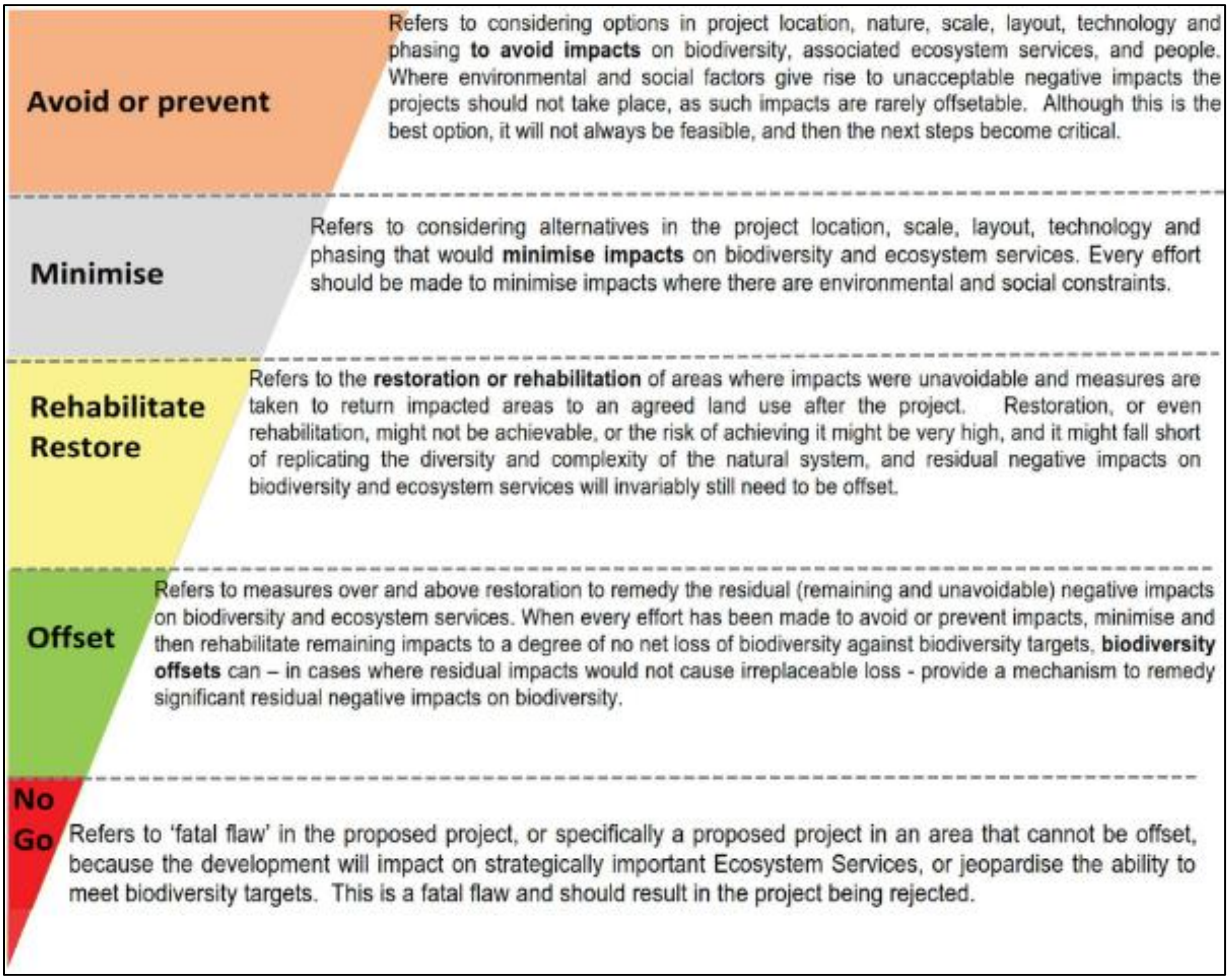

Figure 20: Mitigation sequence/hierarchy

The mitigation measures that are proposed for the Project are listed below.

8.1. Planning and design phase

- A 100m turbine exclusion zone must be implemented around wetlands, dams, pans and drainage lines to prevent collision mortality of priority bird species. Development of other infrastructure in these buffers should be restricted to what is essential.
- The medium voltage cable should be buried as far as possible. Overhead lines should only be considered if technical constraints to trenching are present.
- Where the use of overhead lines is unavoidable due to technical reasons, the Avifaunal Specialist must be consulted to ensure that a raptor friendly pole design is used.
- Development in the remaining high sensitivity grassland must be limited as far as possible. Where possible, infrastructure must be located near margins, with shortest routes taken from the existing roads.

- Construction of new roads should only be considered if existing roads cannot be upgraded.

8.2. Construction phase

- Conduct a pre-construction inspection to identify Red List species that may be breeding within the project footprint to ensure that the impacts on breeding species (if any) are adequately managed.
- Construction activity should be restricted to the immediate footprint of the infrastructure as far as possible. The recommendations of the ecological and botanical specialist studies must be strictly implemented, especially as far as limitation of the activity footprint is concerned.
- Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of priority species. Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum
- Measures to control noise and dust should be applied according to current best practice in the industry.
- Bird flight diverters should be installed on all overhead medium voltage power lines (according to the relevant Eskom Engineering Instruction). These devices must be installed as soon as the conductors are strung.

8.3. Operational phase

- It is recommended that all turbines have 2/3 of one blade painted in signal red or black, if feasible. It is acknowledged that blade painting as a mitigation strategy is still in an experimental phase in South Africa, but research indicates that it has a very good chance of reducing avian mortality (Simmons, et al., 2021) and if the painting is done during the manufacturing of the turbines, the costs are negligible.
- The mitigation measures proposed by the vegetation specialist must be strictly enforced, including rehabilitation of disturbed areas. This will benefit all avifauna as it will limit the extent of the habitat transformation and therefore reduce the significance of potential displacement.
- Live-bird monitoring and carcass searches to 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 compare the abundance of avifauna during the pre-construction monitoring with the abundance post-construction. Operational monitoring and carcass searches to be implemented for a minimum of two years, and then again in Year 5 and every fifth year after that.
- If estimated annual collision rates indicate unacceptable mortality levels of priority species i.e. exceeding mortality thresholds as determined by the avifaunal specialist in consultation with other experts e.g. BLSA, additional measures will have to be implemented which could include shut down on demand or other proven measures (if available at the time).

8.4. De-commissioning phase

- Decommissioning activity should be restricted to the immediate footprint of the infrastructure as far as possible.
- Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of priority species.
- Measures to control noise and dust should be applied according to current best practice in the industry.
- Maximum used should be made of existing access roads.

9. CONDITIONS FOR INCLUSION IN THE EMPR

Please see Error! Reference source not found.**G** for the monitoring requirements to be included in the EMPr for the WEF project.

10. 'NO-GO' ALTERNATIVES

The 'no-go' alternative is the option of not constructing the Impumelelo WEF and associated infrastructure, where the *status quo* of the current status and/or activities on the project sites would prevail. This alternative would result in no additional impact on the receiving environment.

Should the 'no-go' alternative be considered, there would be no impact on the existing environmental baseline and no benefits to the local economy and affected communities. The alternative also bears the opportunity cost of missed socio-economic benefits to the local community that would otherwise realise from establishing the farms which form part of the project sites. The option of not developing also entails that the bid to provide renewable/clean energy to the national grid and contribute to meeting the country's energy demands will be forfeited.

However, from a strictly avifaunal perspective, the 'no-go' alternative will result in the current *status quo* being maintained. The 'no-go' option would eliminate any additional impact on the ecological integrity of the proposed WEF development site, as far as avifauna is concerned.

11. SUMMARY AND CONCLUSION

The proposed Impumelelo WEF could have several potential impacts on priority avifauna. These impacts are the following:

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

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

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

It is inevitable that a measure of displacement will take place at the WEF 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 in the remaining high-quality grassland, wetlands and wetland fringes the most, as this could temporarily disrupt their reproductive cycle. 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 WEFs are operational, due to the disturbance factor of the operational turbines, and the habitat fragmentation. In summary, the wind priority bird species which may regularly occur at the development area that could be impacted by disturbances during the construction phase are: African Harrier-Hawk, African Rock Pipit, Black Sparrowhawk, Black-chested Snake Eagle, Black-winged Kite, Blue Crane, Blue Korhaan, Greater Kestrel, Grey-winged Francolin, Jackal Buzzard, Lanner Falcon, Marsh Owl, Northern Black Korhaan, Melodious Lark, Secretarybird, Spotted Eagle-Owl.

The impact is rated as **moderate** pre-mitigation and **low** post-mitigation.

11.2 Displacement of priority species due to habitat transformation in the construction phase

The existing network of roads at the WEF has already resulted in significant habitat fragmentation. The new road network will add to this existing impact. This, together with the disturbance factor of the operating turbines, could influence the density of several species, particularly larger terrestrial species and owls which would utilise the remaining high-quality grassland, wetlands, and wetland fringes as breeding habitat. Given the conceptual turbine layout and associated road infra-structure, it is not expected that any priority species will be permanently displaced from the development site, but densities may be reduced. In summary, the wind priority bird species which may regularly occur at the development area that could be impacted by habitat transformation associated with the development of the WEF are: African Harrier-Hawk, African Rock Pipit, Amur Falcon, Black Sparrowhawk, Black-chested Snake Eagle, Black-winged Kite, Blue Crane, Blue Korhaan, Common Buzzard, Greater

Kestrel, Grey-winged Francolin, Jackal Buzzard, Lanner Falcon, Marsh Owl, Northern Black Korhaan, Melodious Lark, Secretarybird, Spotted Eagle-Owl.

The impact is rated as **moderate** pre-mitigation and **low** post-mitigation.

11.3 Collision mortality of priority species caused by the wind turbines in the operational phase

The proposed Impumelelo Wind Energy Facilities 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 and occasional long-distance fliers i.e., Cranes, Flamingos, Korhaans, Secretarybird, and Storks, although Korhaans (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 a variety of raptors, including several species of eagles, are highly vulnerable to the risk of collision. In summary, the following wind priority bird species which may regularly occur at the development area are at risk of collisions with the turbines: African Harrier-Hawk, Amur Falcon, Black Sparrowhawk, Black-chested Snake Eagle, Black-winged Kite, Blue Crane, Blue Korhaan, Common Buzzard, Greater Flamingo, Greater Kestrel, Grey-winged Francolin, Jackal Buzzard, Lanner Falcon, Marsh Owl, Northern Black Korhaan, Melodious Lark, Secretarybird, Spotted Eagle-Owl, White Stork.

The impact is rated as **high** pre-mitigation, but it could be reduced to **moderate** post-mitigation.

11.4 Electrocution of priority species on the medium voltage overhead lines (if any) in the operational phase

While the intention is to place the 33kV reticulation network underground where possible, there are areas where the lines might have to run above ground, for technical reasons. In these instances, the poles could potentially pose an electrocution risk to several priority species that could on occasion perch on these poles. In summary, the following wind priority bird species which may regularly occur at the development area are vulnerable to electrocution in this manner: African Harrier-Hawk, Amur Falcon, Black Sparrowhawk, Black-chested Snake Eagle, Black-winged Kite, Common Buzzard, Greater Kestrel, Jackal Buzzard, Lanner Falcon, Marsh Owl, Spotted Eagle-Owl.

The impact is rated as **moderate** pre-mitigation and **very low** post-mitigation.

11.5 Collisions of priority species with the medium voltage overhead lines (if any) in the operational phase

While the intention is to place the 33kV reticulation network underground where possible, there are areas where the lines might have to run above ground, for technical reasons. In these instances, the line could potentially pose a collision risk to various priority species. In summary, the following wind priority bird species which may regularly occur at the development area are particularly vulnerable to risk of collisions with the medium voltage powerlines: Blue Crane, Blue Korhaan, Greater Flamingo, Marsh Owl, Northern Black Korhaan, Secretarybird, Spotted Eagle-Owl, White Stork.

The impact is rated as **moderate** pre-mitigation and **very low** post-mitigation.

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

The impact is likely to be similar in nature and extent to the construction phase of the proposed WEF. The impact is rated as **moderate** pre-mitigation and **low** post-mitigation.

11.7 Cumulative impacts

The proposed Impumelelo WEF will consist of up to 28 turbines in total. According to information that that is available, there is only one additional proposed wind turbine facility (the 300MW Mukondeleli WEF) that is planned within a 55km radius in broadly similar habitat. The 300MW Mukondeleli WEF is intended to comprise 46 wind turbines, and as such, the Impumelelo WEFs' contribution of approximately 37% of the total number of confirmed turbines, and by implication to the cumulative impact of all the planned turbines, is **moderate**.

The total area of similar habitat (mosaic of grassland, wetlands, and agriculture, but excluding opencast mining and urban areas) available to birds in the 55 km radius (9 503 km²) around the project sites is approximately 8 971 km² (Figure 19). Given the total of 74 proposed wind turbines within this region, this translates into approximately 1 turbine/118 km², which is a low density. The turbine density, if all the turbines are constructed, and by implication the cumulative impact on avifauna of the currently planned wind energy projects within this area, is therefore considered to be **low**, pending diligent implementation of recommended mitigation measures.

12. CONCLUSION AND IMPACT STATEMENT

The proposed Impumelelo WEF could have a **moderate to high** impact on avifauna which, in most instances, could be reduced to a **low** through appropriate mitigation, although some moderate residual impacts will still be present after mitigation. No fatal flaws were discovered during the onsite investigations. The proposed WEF development is therefore supported, provided the mitigation measures listed in this report are strictly implemented.

13. POST CONSTRUCTION PROGRAMME

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

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Appendix A – Specialist expertise

Curriculum vitae: Chris van Rooyen

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

Key experience

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

Key project experience

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

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

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

60. Great Karoo Wind Energy Facility, Northern Cape, 12-month pre-construction monitoring (African Green Ventures).
61. Mpumalanga & Gauteng Wind and Hybrid Energy Facilities (6x), pre-construction monitoring (Enertrag SA)
62. Dordrecht Wind Energy Facilities, Eastern Cape, Screening Report (Enertrag SA)
63. Dordrecht Wind Energy Facilities, Eastern Cape, Screening Report (ACED)
64. Nanibees North & South Wind Energy Facilities, Northern Cape, Screening Report (juwi)
65. Sutherland Wind Energy Facilities, Northern Cape, Screening Report (WKN Windcurrent)
66. Pofadder Wind Energy Facility, Northren Cape, Screening Report (Atlantic Energy)
67. Haga Haga Wind Energy Facility, Eastern Cape, Amendment Report (WKN Windcurrent)
68. Banken Wind Energy Facility, Northern Cape, Screening Report (Atlantic Energy)
69. Hartebeest Wind Energy Facility, Western Cape, 12-month pre-construction monitoring (juwi).

Bird impact assessment studies for solar energy plants:

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

Bird impact assessment studies for the following overhead line projects:

1. Chobe 33kV Distribution line
2. Athene - Umfolozi 400kV
3. Beta-Delphi 400kV
4. Cape Strengthening Scheme 765kV
5. Flurian-Louis-Trichardt 132kV
6. Ghanzi 132kV (Botswana)
7. Ikaros 400kV
8. Matimba-Witkop 400kV
9. Naboomspruit 132kV
10. Tabor-Flurian 132kV
11. Windhoek - Walvisbaai 220 kV (Namibia)
12. Witkop-Overyssel 132kV
13. Breyten 88kV

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

67. Kudu Gas Power Station: Associated power lines
68. Steenberg Booysendal 132kV
69. Toulon Pumps 33kV
70. Thabatshipi 132kV
71. Witkop-Silica 132kV
72. Bakubung 132kV
73. Nelsriver 132kV
74. Rethabiseng 132kV
75. Tilburg 132kV
76. GaKgapane 66kV
77. Knobel Gilead 132kV
78. Bochum Knobel 132kV
79. Madibeng 132kV
80. Witbank Railway Line and associated infrastructure
81. Spencer NDP phase 2 (5 lines)
82. Akanani 132kV
83. Hermes-Dominion Reefs 132kV
84. Cape Pensinsula Strengthening Project 400kV
85. Magalakwena 132kV
86. Benficosa 132kV
87. Dithabaneng 132kV
88. Taunus Diepkloof 132kV
89. Taunus Doornkop 132kV
90. Tweedracht 132kV
91. Jane Furse 132kV
92. Majeje Sub 132kV
93. Tabor Louis Trichardt 132kV
94. Riversong 88kV
95. Mamatsekele 132kV
96. Kabokweni 132kV
97. MDPP 400kV Botswana
98. Marble Hall NDP 132kV
99. Bokmakiere 132kV Substation and LILO lines
100. Styldrift 132kV
101. Taunus – Diepkloof 132kV
102. Bighorn NDP 132kV
103. Waterkloof 88kV
104. Camden – Theta 765kV
105. Dhuva – Minerva 400kV Diversion
106. Lesedi –Grootpan 132kV
107. Waterberg NDP
108. Bulgerivier – Dorset 132kV
109. Bulgerivier – Toulon 132kV
110. Nokeng-Fluorspar 132kV
111. Mantsole 132kV
112. Tshilamba 132kV
113. Thabamoopo - Tshebela – Nhlovuko 132kV
114. Arthurseat 132kV
115. Borutho 132kV MTS
116. Volspruit - Potgietersrus 132kV
117. Neotel Optic Fibre Cable Installation Project: Western Cape
118. Matla-Glockner 400kV
119. Delmas North 44kV
120. Houwhoek 11kV Refurbishment

121. Clau-Clau 132kV
122. Ngwedi-Silwerkrans 134kV
123. Nieuwehoop 400kV walk-through
124. Booysendal 132kV Switching Station
125. Tarlton 132kV
126. Medupi - Witkop 400kV walk-through
127. Germiston Industries Substation
128. Sekgame 132kV
129. Botswana – South Africa 400kV Transfrontier Interconnector
130. Syferkuil – Rampheri 132kV
131. Queens Substation and associated 132kV powerlines
132. Oranjemond 400kV Transmission line
133. Aries – Helios – Juno walk-down
134. Kuruman Phase 1 and 2 Wind Energy facilities 132kV Grid connection
135. Transnet Thaba 132kV

Bird impact assessment studies for the following residential and industrial developments:

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

Professional affiliation

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

Curriculum vitae: Albert Froneman

Profession/Specialisation	:	Avifaunal Specialist
Highest Qualification	:	MSc (Conservation Biology)
Nationality	:	South African
Years of experience	:	20 years

Key Qualifications

Albert Froneman **(**Pr.Sci.Nat) has more than 18 years' experience in the management of avifaunal interactions with industrial infrastructure. He holds a M.Sc. degree in Conservation Biology from the University of Cape Town. He managed the Airports Company South Africa (ACSA) – Endangered Wildlife Trust Strategic Partnership from 1999 to 2008 which has been internationally recognized for its achievements in addressing airport wildlife hazards in an environmentally sensitive manner at ACSA's airports across South Africa. Albert is recognized worldwide as an expert in the field of bird hazard management on airports and has worked in South Africa, Swaziland, Botswana, Namibia, Kenya, Israel, and the USA. He has served as the vice chairman of the International Bird Strike Committee and has presented various papers at international conferences and workshops. At present he is consulting to ACSA with wildlife hazard management on all their airports. He also an accomplished specialist ornithological consultant outside the aviation industry and has completed a wide range of bird impact assessment studies. He has co-authored many avifaunal specialist studies and pre-construction monitoring reports for proposed renewable energy developments across South Africa. He also has vast experience in using Geographic Information Systems to analyse and interpret avifaunal data spatially and derive meaningful conclusions. Since 2009 Albert has been a registered Professional Natural Scientist (reg. nr 400177/09) with The South African Council for Natural Scientific Professions, specialising in Zoological Science.

Key Project Experience

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

1. Jeffrey's Bay Wind Farm – 12-months preconstruction avifaunal monitoring project
2. Oysterbay Wind Energy Project – 12-months preconstruction avifaunal monitoring project
3. Ubuntu Wind Energy Project near Jeffrey's Bay – 12-months preconstruction avifaunal monitoring project
4. Bana-ba-Pifu Wind Energy Project near Humansdorp – 12-months preconstruction avifaunal monitoring project
5. Excelsior Wind Energy Project near Caledon – 12-months preconstruction avifaunal monitoring project
6. Laingsburg Spitskolakte Wind Energy Project – 12-months preconstruction avifaunal monitoring project
7. Loeriesfontein Wind Energy Project Phase 1, 2 & 3 – 12-months preconstruction avifaunal monitoring project
8. Noupoort Wind Energy Project – 12-months preconstruction avifaunal monitoring project
9. Vleesbaai Wind Energy Project – 12-months preconstruction avifaunal monitoring project
10. Port Nolloth Wind Energy Project – 12-months preconstruction avifaunal monitoring project
11. Langhoogte Caledon Wind Energy Project – 12-months preconstruction avifaunal monitoring project
12. Lunsklip – Stilbaai Wind Energy Project – 12-months preconstruction avifaunal monitoring project
13. Indwe Wind Energy Project – 12-months preconstruction avifaunal monitoring project
14. Zeeland St Helena bay Wind Energy Project – 12-months preconstruction avifaunal monitoring project
15. Wolseley Wind Energy Project – 12-months preconstruction avifaunal monitoring project
16. Renosterberg Wind Energy Project – 12-months preconstruction avifaunal monitoring project
17. De Aar – North (Mulilo) Wind Energy Project – 12-months preconstruction avifaunal monitoring project (2014)
18. De Aar – South (Mulilo) Wind Energy Project – 12-months bird monitoring
19. Namies – Aggenys Wind Energy Project – 12-months bird monitoring
20. Pofadder - Wind Energy Project – 12-months bird monitoring

21. Dwarsrug Loeriesfontein - Wind Energy Project – 12-months bird monitoring
22. Waaihoek – Utrecht Wind Energy Project – 12-months bird monitoring
23. Amathole – Butterworth Utrecht Wind Energy Project – 12-months bird monitoring & EIA specialist study
24. De Aar and Droogfontein Solar Pre- and Post-construction avifaunal monitoring
25. Makambako Wind Energy Faclity (Tanzania) 12-month bird monitoring & EIA specialist study (Windlab)
26. R355 Wind Energy Facility 12-month bird monitoring (Mainstream)
27. Groenekloof Wind Energy Facility 12-month bird monitoring & EIA specialist study (Mulilo)
28. Tsitsikamma Wind Energy Facility 24-months post-construction monitoring (Cennergi)
29. Noupoort Wind Energy Facility 24-months post-construction monitoring (Mainstream)
30. Kokerboom Wind Energy Facility 12-month bird monitoring & EIA specialist study (Business Venture Investments)
31. Kuruman Wind Energy Facility 12-month bird monitoring & EIA specialist study (Mulilo)
32. Mañhica Wind Energy Facility 12-month bird monitoring & EIA specialist study (Windlab)
33. Kwagga Wind Energy Facility, Beaufort West, 12-months pre-construction monitoring (ABO)
34. Pienaarspoort Wind Energy Facility, Touws River, Western Cape, 12-months pre-construction monitoring (ABO). Koup 1 and 2 Wind Energy Facilities, BeaufortWest, Western Cape, 12 months pre-construction monitoring (Genesis Eco-energy)
35. Duiker Wind Energy Facility, Vredendal, Western Cape 12 months pre-construction monitoring (ABO)
36. Perdekraal East Wind Energy Facility, Touws River, Western Cape, 18 months construction phase monitoring (Mainstream).
37. Swellendam Wind Energy Facility, Western Cape, 12-month pre-construction monitoring (Veld Renewables)
38. Lombardskraal Wind Energy Facility, Western Cape, 12-month pre-construction monitoring (Enertrag SA)
39. Mainstream Kolkies & Heuweltjies Wind Energy Facilities, Western Cape, 12-month pre-construction monitoring (Mainstream)
40. Great Karoo Wind Energy Facility, Northern Cape, 12-month pre-construction monitoring (African Green Ventures).
41. Mpumalanga & Gauteng Wind and Hybrid Energy Facilities (6x), pre-construction monitoring (Enertrag SA)
42. Dordrecht Wind Energy Facilities, Eastern Cape, Screening Report (Enertrag SA)
43. Dordrecht Wind Energy Facilities, Eastern Cape, Screening Report (ACED)
44. Nanibees North & South Wind Energy Facilities, Northern Cape, Screening Report (juwi)
45. Sutherland Wind Energy Facilities, Northern Cape, Screening Report (WKN Windcurrent)
46. Pofadder Wind Energy Facility, Northren Cape, Screening Report (Atlantic Energy)
47. Haga Haga Wind Energy Facility, Eastern Cape, Amendment Report (WKN Windcurrent)
48. Banken Wind Energy Facility, Northern Cape, Screening Report (Atlantic Energy)
49. Hartebeest Wind Energy Facility, Western Cape, 12-month pre-construction monitoring (juwi).

Bird Impact Assessment studies and / or GIS analysis:

1. Aviation Bird Hazard Assessment Study for the proposed Madiba Bay Leisure Park adjacent to Port Elizabeth Airport.
2. Extension of Runway and Provision of Parallel Taxiway at Sir Seretse Khama Airport, Botswana Bird / Wildlife Hazard Management Specialist Study
3. Maun Airport Improvements Bird / Wildlife Hazard Management Specialist Study
4. Bird Impact Assesment Study - Bird Helicopter Interaction – The Bitou River, Western Cape Province South Africa
5. Proposed La Mercy Airport – Bird Aircraft interaction specialists study using bird detection radar to assess swallow flocking behaviour.
6. KwaZulu Natal Power Line Vulture Mitigation Project – GIS analysis
7. Perseus-Zeus Powerline EIA – GIS Analysis
8. Southern Region Pro-active GIS Blue Crane Collision Project.
9. Specialist advisor ~ Implementation of a bird detection radar system and development of an airport wildlife hazard management and operational environmental management plan for the King Shaka International Airport
10. Matsapha International Airport – bird hazard assessment study with management recommendations

11. Evaluation of aviation bird strike risk at candidate solid waste disposal sites in the Ekurhuleni Metropolitan Municipality
12. Gateway Airport Authority Limited – Gateway International Airport, Polokwane: Bird hazard assessment; Compile a bird hazard management plan for the airport
13. Bird Specialist Study - Evaluation of aviation bird strike risk at the Mwakirunge Landfill site near Mombasa Kenya
14. Bird Impact Assessment Study - Proposed Weltevreden Open Cast Coal Mine Belfast, Mpumalanga
15. Avian biodiversity assessment for the Mafube Colliery Coal mine near Middelburg Mpumalanga
16. Avifaunal Specialist Study - SRVM Volspruit Mining project – Mokopane Limpopo Province
17. Avifaunal Impact Assessment Study (with specific reference to African Grass Owls and other Red List species) Stone Rivers Arch
18. Airport bird and wildlife hazard management plan and training to Swaziland Civil Aviation Authority (SWACAA) for Matsapha and Sikhupe International Airports
19. Avifaunal Impact Assessment & EIA Study - Renosterberg Wind Farm and Solar site
20. Bird Impact Assessment Study - Proposed 60-year Ash Disposal Facility near to the Kusile Power Station
21. Avifaunal pre-feasibility assessment for the proposed Montrose dam, Mpumalanga
22. Bird Impact Assessment Study – Proposed ESKOM Phantom Substation near Knysna, Western Cape
23. Habitat sensitivity map for Denham's Bustard, Blue Crane and White-bellied Korhaan in the Kouga Municipal area of the Eastern Cape Province
24. Swaziland Civil Aviation Authority – Sikhuphe International Airport – Bird hazard management assessment
25. Avifaunal monitoring – extension of Specialist Study - SRVM Volspruit Mining project – Mokopane Limpopo Province
26. Avifaunal Specialist Study – Rooikat Hydro Electric Dam – Hope Town, Northern Cape
27. The Stewards Pan Reclamation Project – Bird Impact Assessment study
28. Airports Company South Africa – Avifaunal Specialist Consultant – Airport Bird and Wildlife Hazard Mitigation

Geographic Information System analysis & maps

1. ESKOM Power line Makgalakwena EIA – GIS specialist & map production
2. ESKOM Power line Benficosa EIA – GIS specialist & map production
3. ESKOM Power line Riversong EIA – GIS specialist & map production
4. ESKOM Power line Waterberg NDP EIA – GIS specialist & map production
5. ESKOM Power line Bulge Toulon EIA – GIS specialist & map production
6. ESKOM Power line Bulge DORSET EIA – GIS specialist & map production
7. ESKOM Power lines Marblehall EIA – GIS specialist & map production
8. ESKOM Power line Grootpan Lesedi EIA – GIS specialist & map production
9. ESKOM Power line Tanga EIA – GIS specialist & map production
10. ESKOM Power line Bokmakierie EIA – GIS specialist & map production
11. ESKOM Power line Rietfontein EIA – GIS specialist & map production
12. Power line Anglo Coal EIA – GIS specialist & map production
13. ESKOM Power line Camcoll Jericho EIA – GIS specialist & map production
14. Hartbeespoort Residential Development – GIS specialist & map production
15. ESKOM Power line Mantsole EIA – GIS specialist & map production
16. ESKOM Power line Nokeng Flourspar EIA – GIS specialist & map production
17. ESKOM Power line Greenview EIA – GIS specialist & map production
18. Derdepoort Residential Development – GIS specialist & map production
19. ESKOM Power line Boynton EIA – GIS specialist & map production
20. ESKOM Power line United EIA – GIS specialist & map production
21. ESKOM Power line Gutshwa & Malelane EIA – GIS specialist & map production
22. ESKOM Power line Origstad EIA – GIS specialist & map production
23. Zilkaatsnek Development Public Participation –map production
24. Belfast – Paarde Power line - GIS specialist & map production
25. Solar Park Solar Park Integration Project Bird Impact Assessment Study – avifaunal GIS analysis.
26. Kappa-Omega-Aurora 765kV Bird Impact Assessment Report – Avifaunal GIS analysis.
27. Gamma – Kappa 2nd 765kV – Bird Impact Assessment Report – Avifaunal GIS analysis.
28. ESKOM Power line Kudu-Dorstfontein Amendment EIA – GIS specialist & map production.
29. Proposed Heilbron filling station EIA – GIS specialist & map production

30. ESKOM Lebatlhane EIA – GIS specialist & map production
31. ESKOM Pienaars River CNC EIA – GIS specialist & map production
32. ESKOM Lemara Phiring Ohrigstad EIA – GIS specialist & map production
33. ESKOM Pelly-Warmbad EIA – GIS specialist & map production
34. ESKOM Rosco-Bracken EIA – GIS specialist & map production
35. ESKOM Ermelo-Uitkoms EIA – GIS specialist & map production
36. ESKOM Wisani bridge EIA – GIS specialist & map production
37. City of Tswane – New bulkfeeder pipeline projects x3 Map production
38. ESKOM Lebohang Substation and 132kV Distribution Power Line Project Amendment GIS specialist & map production
39. ESKOM Geluk Rural Powerline GIS & Mapping
40. Eskom Kimberley Strengthening Phase 4 Project GIS & Mapping
41. ESKOM Kwaggafontein - Amandla Amendment Project GIS & Mapping
42. ESKOM Lephalale CNC – GIS Specialist & Mapping
43. ESKOM Marken CNC – GIS Specialist & Mapping
44. ESKOM Lethabong substation and powerlines – GIS Specialist & Mapping
45. ESKOM Magopela- Pitsong 132kV line and new substation – GIS Specialist & Mapping

Professional affiliations

South African Council for Natural Scientific Professions (SACNASP) registered Professional Natural Scientist (reg. nr 400177/09) – specialist field: Zoological Science. Registered since 2009.

Curriculum vitae: Jake Mulvaney

Profession/Specialisation	:	Postdoctoral researcher/Avifaunal Specialist
Highest Qualification	:	PhD in Zoology
Nationality	:	South African
Years of experience	:	0.5 years

Key experience

Jake Mulvaney is a postdoctoral researcher in ornithology at Stellenbosch University. He is author and/or co-author of four academic papers involving bird population assessments and GIS modelling and is a licensed South African bird ringer. From 2021, he assists Chris van Rooyen Consulting with environmental impact assessments of wind and solar energy facility developments.

Key project experience

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

1. Highlands Wind Energy Facility, Dordrecht, Eastern Cape
2. Duiker Wind Energy Facility, Vredendal, Western Cape
3. Taaibosch Wind Energy Complex, Postmasburg, Northern Cape
4. Lunsklip Wind Energy Facility, Still Bay, Western Cape

Bird impact assessment studies for solar energy plants:

1. Taaibosch Solar Energy Complex, Postmasburg, Northern Cape
2. Vhuvhili Solar Energy Facility, Secunda, Mpumalanga

Professional affiliation

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

Appendix B – Specialist statement of independence

To be inserted

Appendix C – Site sensitivity verification

Prior to commencing with the specialist assessment in accordance with Appendix 6 of the National Environmental Management Act (Act 107 of 1998, as amended) (NEMA) Environmental Impact Assessment (EIA) Regulations of 2014, a site sensitivity verification was undertaken to confirm the current land use and environmental sensitivity of the proposed project area as identified by the National Web-Based Environmental Screening Tool (Screening Tool). The Protocol for the specialist assessment and minimum report content requirements for environmental impacts avifaunal species by onshore wind energy generation facilities where the electricity output is 20MW or more (Government Gazette No. 43110 – 20 March 2020) is applicable in the case of wind developments.

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

Date of Site Visits	23 July - 04 August 2021 13 September -1 October 2021.
Supervising Specialist Name	Albert Froneman
Professional Registration Number	MSc Conservation Biology (SACNASP Zoological Science Registration number 400177/09)
Specialist Affiliation / Company	Chris van Rooyen Consulting

C1. Methodology

The following methods were used to compile this report:

- Bird distribution data of the South African Bird Atlas 2 (SABAP 2) was obtained from the University of Cape Town, as a means to ascertain which species occurs within the broader area i.e., within a block consisting of six pentad grid cells each within which the proposed projects are situated (see Figure 1). A pentad grid cell covers 5 minutes of latitude by 5 minutes of longitude (5'× 5'). Each pentad is approximately 8 × 7.6 km. From 2011 to date, a total of 82 full protocol lists (i.e., surveys lasting a minimum of two hours each) have been completed for this area. In addition, 34 *ad hoc* protocol lists (i.e., surveys lasting less than two hours but still yielding valuable data) have been completed.
- The national threatened status of all priority species was determined with the use of the most recent edition of the Red Data Book of Birds of South Africa (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 (2021.3) International Union for Conservation of Nature (IUCN) Red List of Threatened Species (http://www.iucnredlist.org/).
- A classification of the habitat in the PAOI was obtained from the Atlas of Southern African Birds 1 (SABAP 1) (Harrison et al., 1997a, 1997b) and the National Vegetation Map (2018) from the South African National Biodiversity Institute (SANBI) BGIS map viewer (http://bgisviewer.sanbi.org/) (Mucina & Rutherford, 2006; SANBI, 2018). The PAOI is the area where the primary impacts on avifauna are expected and includes the land parcels where the project will be located.
- The Important Bird Areas of Southern Africa (Marnewick et al., 2015) was consulted for information on potentially relevant Important Bird Areas (IBAs).

- Satellite imagery (Google Earth ©2021) was used in order to view the PAOI and broader area on a landscape level and to help identify sensitive bird habitat.
- 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 (Ralston-Paton et al., 2017; Retief et al., 2012).
- The 2022 South Africa Protected Areas Database compiled by the Department of Environment, Forestry and Fisheries (DFFE) was used to identify Nationally Protected Areas, National Protected Areas Expansion Strategy (NPAES) near the PAOI (DFFE, 2022).
- The Department of Forestry, Fisheries and the Environment (DFFE) National Screening Tool was used to determine the assigned avian sensitivity of the PAOI.
- Data collected during previous site visits to the broader area was also considered as far as habitat classes and the occurrence of priority species are concerned.
- The following sources were used to determine the investigation protocol that is required for the site:
    - Protocol for the specialist assessment and minimum report content requirements for environmental impacts on avifaunal species by onshore wind energy generation facilities where the electricity output is 20MW or more (Government Gazette No. 43110 – 20 March 2020).
    - BirdLife South Africa's (BLSA) 'Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa' (Jenkins et al., 2015) – hereafter referred to as the 'Windfarm Guidelines' – were consulted to determine the level of survey effort that is required.

The main source of information on the avifaunal diversity and abundance at the PAOI and broader area is an integrated pre-construction monitoring programme which is being implemented at the project site in 2021 – 2022 over a period of four seasons.

C2. Results of site assessment

The proposed Impumelelo WEF PAOI is situated within gently undulating plains of the Mpumalanga Highveld countryside. The avian habitat types in the Impumelelo WEF were identified as:

(i) Natural grassland

(ii) Natural drainage lines (Grootspruit and Ouhoutspruit river systems) and herbaceous wetlands

(iii) Artificial dams

(iv) Agriculture

(v) Alien tree stands

(vi) High voltage powerlines

Ostensibly undisturbed natural grassland tracts occupy most the terrestrial environment within the PAOI, mosaiced between agricultural tracts (Figure 2 and Figure 3); disturbed grassland represents only a minor portion of the PAOI. Most of the PAOI sits atop dolerite bedrock, resulting in deep dark-brown clayey soils. Sandstone, shale, and coal beds are localised to the west and southeast of the PAOI. Some alluvium occurs along the drainage lines.

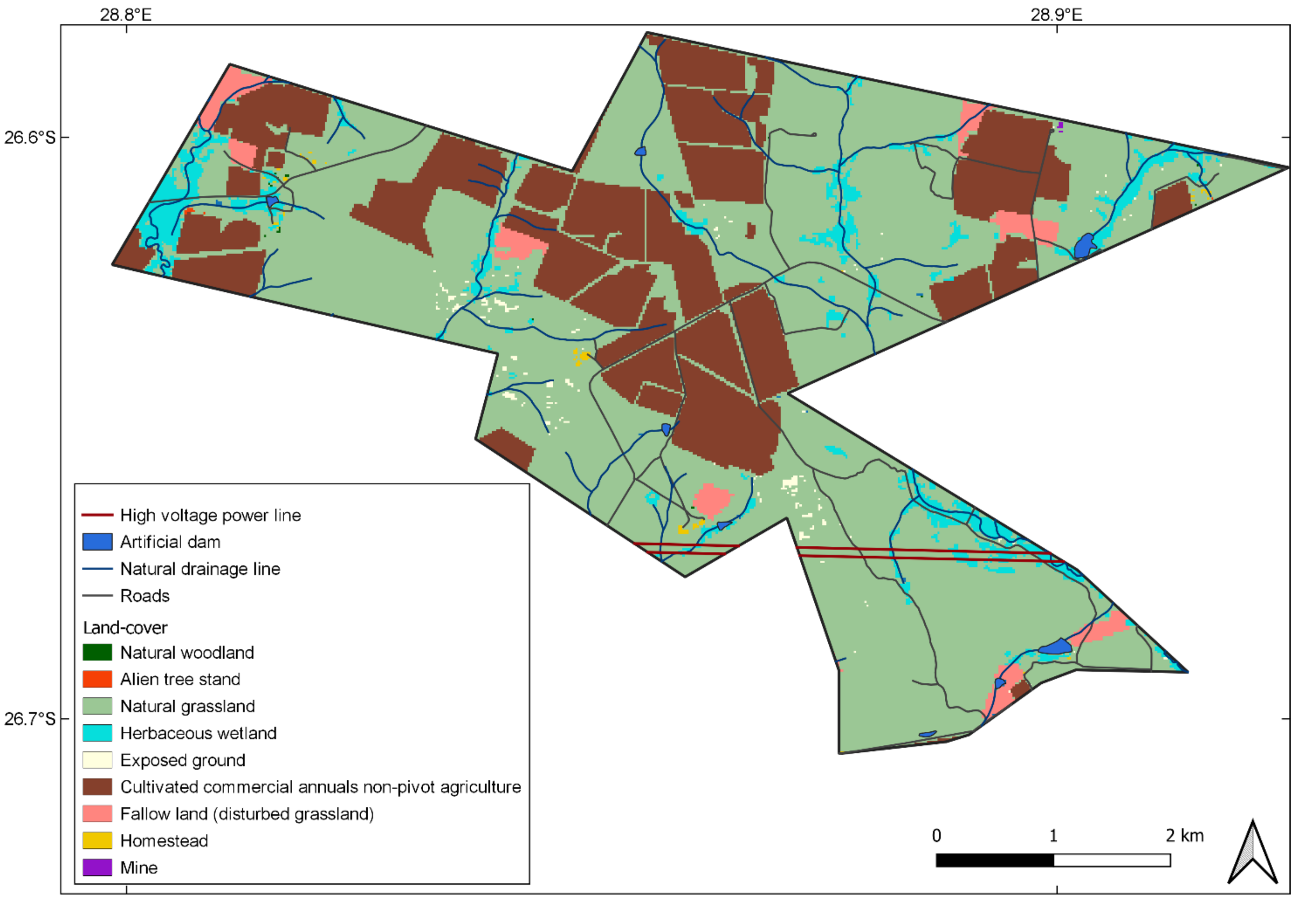

Figure 21: Landcover classes within the PAOI, according to the DEA and DALRRD (2019).

The PAOI and project site is classified largely as **high sensitivity** for terrestrial animals according to the Terrestrial Animal Species Theme of the National Web-Based Environmental Screening Tool (Figure 10). [7]

The **high sensitivity** classification is linked to the potential occurrence of African Marsh Harrier (Globally Least Concern, Regionally Endangered), White-bellied Bustard (Globally Least Concern, Regionally Vulnerable), Caspian Tern (Globally Least Concern, Regionally Vulnerable), Martial Eagle (Globally Endangered, Regionally Endangered), Secretarybird (Globally Endangered, Regionally Vulnerable), and Yellow-billed Stork (Globally Least Concern, Regionally Endangered). **Medium sensitivity** is linked to African Grass-owl (Globally Least Concern, Regionally Vulnerable), and the aforementioned African Marsh Harrier and Caspian Tern, among other sensitive fauna (Figure 10).

The project site contains confirmed habitat for these species of conservation concern (SCC) as defined in the Protocol for the specialist assessment and minimum report content requirements for environmental impacts on terrestrial animal species (Government Gazette No 43855, 30 October 2020), namely listed on the IUCN Red List of Threatened Species or South Africa's National Red List website as Critically Endangered, Endangered, Vulnerable, Near Threatened, and Data Deficient species.

The occurrence of Secretarybird (Globally Endangered, Regionally Vulnerable) and additional SCC was confirmed during the surveys, namely Blue Crane (Globally Vulnerable, Regionally Near Threatened), Blue Korhaan (Globally Vulnerable, Regionally Least Concern), Greater Flamingo (Globally Least Concern, Regionally Near Threatened), Lanner Falcon (Globally Least Concern, Regionally Vulnerable), and Maccoa Duck (Globally Vulnerable, Regionally Near Threatened) were recorded in the project site.

The recorded presence of certain SCC in the project site requires the site to be classified as **high sensitivity** according to the protocol for birds and wind energy (20 March 2020), namely habitat (i) habitat likely to be of importance to priority bird species sensitive to wind energy developments, Critically Endangered, Endangered bird species and/or Vulnerable bird species. These areas are potentially sensitive for development.

In summary, based on the Site Sensitivity Verification field surveys conducted, habitat within the project site appears suitable for Blue Crane, Blue Korhaan, Greater Flamingo, Lanner Falcon, Maccoa Duck, and Secretarybird. Therefore, the classification of **high sensitivity** for avifauna in the screening tool for the Terrestrial Animal Species theme is confirmed for the project site.

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[7] The wind theme in the National Web-Based Environmental Screening Tool is only applicable to projects in a REDZ.

MAP OF RELATIVE ANIMAL SPECIES THEME SENSITIVITY

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

Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
	X		

Sensitivity Features:

Sensitivity	Feature(s)
High	Aves-Circus ranivorus
High	Aves-Eupodotis senegalensis
High	Aves-Hydroprogne caspia
High	Aves-Polemaetus bellicosus
High	Aves-Sagittarius serpentarius
High	Aves-Mycteria ibis
Low	Subject to confirmation
Medium	Aves-Tyto capensis
Medium	Aves-Circus ranivorus
Medium	Aves-Hydroprogne caspia
Medium	Aves-Eupodotis senegalensis
Medium	Insecta-Lepidochrysops procera
Medium	Mammalia-Crocidura maquassiensis

Figure 22: The National Web-Based Environmental Screening Tool map of the project site, indicating sensitivities for the Terrestrial Animal Species theme. High sensitivity is linked to African Marsh Harrier (*Circus ranivorus*), White-bellied Bustard (*Eupodotis senegalensis*), Caspian Tern (*Hydroprogne caspia*), Martial Eagle (*Polemaetus bellicosus*) Secretarybird (*Sagittaius serpentarius*). Medium sensitivity is linked to African Grass-owl (*Tyto capensis*), African Marsh Harrier and Caspian Tern.

Appendix D – Impact assessment methodology

Appendix 2 of GNR 982, as amended, requires the identification of the significance of potential impacts during assessment. To this end, an impact screening tool has been used in the assessment phase. The screening tool is based on two criteria, namely probability (Figure D1); and consequence (Figure D2), where the latter is based on general consideration to the intensity, extent, and duration.

SCORE	DESCRIPTOR
4	**Definite**: The impact will occur regardless of any prevention measures
3	**Highly Probable**: It is most likely that the impact will occur
2	**Probable**: There is a good possibility that the impact will occur
1	**Improbable:** The possibility of the impact occurring is very low

Figure D1: Probability scores and descriptors

SCORE	NEGATIVE	POSITIVE
4	Very severe: An irreversible and permanent change to the affected system(s) or party(ies) which cannot be mitigated.	Very beneficial: A permanent and very substantial benefit to the affected system(s) or party(ies), with no real alternative to achieving this benefit.
3	Severe: A long term impacts on the affected system(s) or party(ies) that could be mitigated. However, this mitigation would be difficult, expensive or time consuming or some combination of these.	Beneficial: A long term impact and substantial benefit to the affected system(s) or party(ies). Alternative ways of achieving this benefit would be difficult, expensive or time consuming, or some combination of these.
2	Moderately severe: A medium to long term impacts on the affected system(s) or party (ies) that could be mitigated.	Moderately beneficial: A medium to long term impact of real benefit to the affected system(s) or party(ies). Other ways of optimising the beneficial effects are equally difficult, expensive and time consuming (or some combination of these), as achieving them in this way.
1	Negligible: A short to medium term impacts on the affected system(s) or party(ies). Mitigation is very easy, cheap, less time consuming or not necessary.	Negligible: A short to medium term impact and negligible benefit to the affected system(s) or party(ies). Other ways of optimising the beneficial effects are easier, cheaper and quicker, or some combination of these.

Figure D2: Consequence score descriptions

The impact assessment includes:

- Impact magnitude
- Impact extent
- Impact reversibility
- Impact duration
- Probability of impact occurrence
- Impact significance

CRITERIA	SCORE 1	SCORE 2	SCORE 3	SCORE 4	SCORE 5
Impact Magnitude (M) The degree of alteration of the affected environmental receptor	Very low: No impact on processes	Low: Slight impact on processes	Medium: Processes continue but in a modified way	High: Processes temporarily cease	Very High: Permanent cessation of processes
Impact Extent (E) The geographical extent of the impact on a given environmental receptor	Site: Site only	Local: Inside activity area	Regional: Outside activity area	National: National scope or level	International: Across borders or boundaries
Impact Reversibility (R) The ability of the environmental receptor to rehabilitate or restore after the activity has caused environmental change	Reversible: Recovery without rehabilitation		Recoverable: Recovery with rehabilitation		Irreversible: Not possible despite action
Impact Duration (D) The length of permanence of the impact on the environmental receptor	Immediate: On impact	Short term: 0-5 years	Medium term: 5-15 years	Long term: Project life	Permanent: Indefinite
Probability of Occurrence (P) The likelihood of an impact occurring in the absence of pertinent environmental management measures or mitigation	Improbable	Low Probability	Probable	Highly Probability	Definite
Significance (S) is determined by combining the above criteria in the following formula:	$[S = (E + D + R + M) \times P]$ $Significance = (Extent + Duration + Reversibility + Magnitude) \times Probability$				
IMPACT SIGNIFICANCE RATING					
Total Score	**4 to 15**	**16 to 30**	**31 to 60**	**61 to 80**	**81 to 100**
Environmental Significance Rating (Negative (-))	**Very low**	**Low**	**Moderate**	**High**	**Very High**
Environmental Significance Rating (Positive (+))	**Very low**	**Low**	**Moderate**	**High**	**Very High**

Figure D3: Impact assessment scoring metric used in this assessment report.

As per the DFFET Guideline 5: Assessment of Alternatives and Impacts, the following methodology is applied to the prediction and assessment of impacts and risks. Potential impacts and risks have been rated in terms of the direct, indirect, and cumulative:

- Direct impacts are impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity. These impacts are usually associated with the construction, operation or maintenance of an activity and are generally obvious and quantifiable.

- Indirect impacts of an activity are indirect or induced changes that may occur as a result of the activity. These types of impacts include all the potential impacts that do not manifest immediately when the activity is undertaken or which occur at a different place as a result of the activity.
- Cumulative impacts are impacts that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities. Cumulative impacts can occur from the collective impacts of individual minor actions over a period of time and can include both direct and indirect impacts.

The impact assessment methodology includes the following aspects:
Nature of impact/risk - The type of effect that a proposed activity will have on the environment.

- Impact status - whether the impact/risk on the overall environment will be:
  - Positive - environment overall will benefit from the impact/risk
  - Negative - environment overall will be adversely affected by the impact/risk; or
  - Neutral - environment overall not be affected.
- Impact spatial extent – The size of the area that will be affected by the impact/risk:
  - Site specific
  - Local (<10 km from site)
  - Regional (<100 km of site)
  - National; or
  - International (e.g. Greenhouse Gas emissions or migrant birds).
- Impact reversibility - the ability of the environmental receptor to rehabilitate or restore after the activity has caused environmental change:

  - Reversible (recovery without pro-active rehabilitation)
  - Recoverable (recovery with pro-active rehabilitation)
  - Irreversible (not possible despite action)

- Impact duration – the timeframe during which the impact/risk will be experienced:
  - Very short term (instantaneous);
  - Short term (0-5 year);
  - Medium term (5- 15 years);
  - Long term (the impact will cease after the operational life of the activity (i.e., the impact or risk will occur for the project duration)); or
  - Permanent/indefinite (mitigation will not occur in such a way or in such a time span that the impact can be considered transient (i.e., the impact will occur beyond the project decommissioning)).
- Probability of impact occurrence:
  - Improbable (little to no chance of occurring)
  - Low Probability (<30% chance of occurring)
  - Probable (30-50% chance of occurring)
  - Highly Probability (51 – 90% chance of occurring); or

- Definite (>90% chance of occurring regardless of prevention measures).

- Impact significance – the product of the impact occurrence probability with the sum of impact magnitude, extent, duration, and reversibility

  $Significance = (Extent + Duration + Reversibility + Magnitude) \times Probability$:

IMPACT SIGNIFICANCE RATING					
Total Score	**4 to 15**	**16 to 30**	**31 to 60**	**61 to 80**	**81 to 100**
Environmental Significance Rating (Negative (-))	**Very low**	**Low**	**Moderate**	**High**	**Very High**
Environmental Significance Rating (Positive (+))	**Very low**	**Low**	**Moderate**	**High**	**Very High**

Figure D4: Impact significance rating

- Significance – Will the impact cause a notable alteration of the environment?
  - Very low (the risk/impact may result in very minor alterations of the environment and can be easily avoided by implementing appropriate mitigation measures, and will not have an influence on decision-making);
  - Low (the risk/impact may result in minor alterations of the environment and can be easily avoided by implementing appropriate mitigation measures, and will not have an influence on decision-making);
  - Moderate (the risk/impact will result in moderate alteration of the environment and can be reduced or avoided by implementing the appropriate mitigation measures, and will only have an influence on the decision-making if not mitigated);
  - High (the risk/impact will result in major alteration to the environment even with the implementation on the appropriate mitigation measures and will have an influence on decision-making); and
  - Very high (the risk/impact will result in very major alteration to the environment even with the implementation on the appropriate mitigation measures and will have an influence on decision-making (i.e., the project cannot be authorised unless major changes to the engineering design are carried out to reduce the significance rating)).

With the implementation of mitigation measures, the residual impacts/risks are ranked as follows in terms of significance:

- Very low = 5
- Low = 4
- Moderate = 3
- High = 2
- Very high = 1.

Confidence – The degree of confidence in predictions based on available information and specialist knowledge:

- Low
- Medium
- High.

Appendix E – Species list for the broader area and project site

Avifauna recorded by SABAP2 in the broader area			
Common name	**Scientific name**	**SABAP 2 Full protocol reporting rate**	**SABAP 2 Ad hoc protocol reporting rate**
Acacia Pied Barbet	*Tricholaema leucomelas*	34.92	3.33
African Black Duck	*Anas sparsa*	5.29	0.56
African Black Swift	*Apus barbatus*	1.06	0.00
African Darter	*Anhinga rufa*	7.94	0.56
African Harrier-Hawk	*Polyboroides typus*	1.59	0.00
African Hoopoe	*Upupa africana*	8.99	0.56
African Marsh Harrier	*Circus ranivorus*	1.06	1.67
African Openbill	*Anastomus lamelligerus*	0.53	0.00
African Palm Swift	*Cypsiurus parvus*	14.81	1.11
African Paradise Flycatcher	*Terpsiphone viridis*	7.41	0.00
African Pipit	*Anthus cinnamomeus*	79.37	32.22
AfricanRed-eyed Bulbul	*Pycnonotus nigricans*	40.74	3.33
African Reed Warbler	*Acrocephalus baeticatus*	5.29	0.00
African Rock Pipit	*Anthus crenatus*	11.64	2.78
African Sacred Ibis	*Threskiornis aethiopicus*	32.80	7.22
African Snipe	*Gallinago nigripennis*	19.58	2.22
African Spoonbill	*Platalea alba*	28.57	7.78
African Stonechat	*Saxicola torquatus*	86.77	42.78
African Wattled Lapwing	*Vanellus senegallus*	14.81	1.67
Alpine Swift	*Tachymarptis melba*	1.59	0.00
Amethyst Sunbird	*Chalcomitra amethystina*	20.11	1.67
Amur Falcon	*Falco amurensis*	20.11	7.22
Ant-eating Chat	*Myrmecocichla formicivora*	66.67	24.44
Baillon's Crake	*Zapornia pusilla*	0.00	0.56
Banded Martin	*Riparia cincta*	6.88	3.33
Barn Swallow	*Hirundo rustica*	31.75	11.11
Bar-throated Apalis	*Apalis thoracica*	12.70	0.00
Black Harrier	*Circus maurus*	0.00	1.11
Black Sparrowhawk	*Accipiter melanoleucus*	1.59	0.00
Black-chested Prinia	*Prinia flavicans*	58.20	5.56
Black-chested Snake Eagle	*Circaetus pectoralis*	2.12	0.56
Black-collared Barbet	*Lybius torquatus*	49.21	3.89

Avifauna recorded by SABAP2 in the broader area			
Common name	**Scientific name**	**SABAP 2 Full protocol reporting rate**	**SABAP 2 Ad hoc protocol reporting rate**
Black-crowned Night Heron	*Nycticorax nycticorax*	1.06	0.00
Black-headed Heron	*Ardea melanocephala*	66.14	25.00
Black-headed Oriole	*Oriolus larvatus*	1.59	0.56
Black-necked Grebe	*Podiceps nigricollis*	1.06	0.00
Blacksmith Lapwing	*Vanellus armatus*	84.66	32.22
Black-throated Canary	*Crithagra atrogularis*	68.78	12.22
Black-winged Kite	*Elanus caeruleus*	69.84	27.22
Black-winged Pratincole	*Glareola nordmanni*	4.76	0.56
Black-winged Stilt	*Himantopus himantopus*	4.76	1.67
Blue Crane	*Grus paradisea*	16.40	5.00
Blue Korhaan	*Eupodotis caerulescens*	33.33	16.67
Blue Waxbill	*Uraeginthus angolensis*	0.53	0.00
Bokmakierie	*Telophorus zeylonus*	52.38	4.44
Booted Eagle	*Hieraaetus pennatus*	0.53	0.00
Brown Snake Eagle	*Circaetus cinereus*	0.53	0.00
Brown-backed Honeybird	*Prodotiscus regulus*	4.76	2.22
Brown-crowned Tchagra	*Tchagra australis*	3.17	1.11
Brown-throated Martin	*Riparia paludicola*	18.52	3.33
Brubru	*Nilaus afer*	4.23	0.00
Buffy Pipit	*Anthus vaalensis*	0.53	0.56
Cape Bunting	*Emberiza capensis*	34.92	1.11
Cape Canary	*Serinus canicollis*	15.87	0.56
Cape Crow	*Corvus capensis*	26.46	14.44
Cape Grassbird	*Sphenoeacus afer*	1.06	0.00
Cape Longclaw	*Macronyx capensis*	87.83	37.22
Cape Robin-Chat	*Cossypha caffra*	41.27	2.78
Cape Shoveler	*Spatula smithii*	23.28	2.22
Cape Sparrow	*Passer melanurus*	80.95	23.89
Cape Starling	*Lamprotornis nitens*	53.44	13.89
Cape Teal	*Anas capensis*	1.06	0.00
Cape Turtle Dove	*Streptopelia capicola*	83.60	18.89
Cape Wagtail	*Motacilla capensis*	59.79	13.33
Cape Weaver	*Ploceus capensis*	1.06	0.00
Cape White-eye	*Zosterops virens*	40.74	3.33
Capped Wheatear	*Oenanthe pileata*	33.33	19.44

Avifauna recorded by SABAP2 in the broader area			
Common name	**Scientific name**	**SABAP 2 Full protocol reporting rate**	**SABAP 2 Ad hoc protocol reporting rate**
Cardinal Woodpecker	*Dendropicos fuscescens*	10.58	0.00
Caspian Tern	*Hydroprogne caspia*	0.00	0.56
Chestnut-backed Sparrow-Lark	*Eremopterix leucotis*	11.11	0.00
Chestnut-vented Warbler	*Curruca subcoerulea*	0.53	0.56
Cinnamon-breasted Bunting	*Emberiza tahapisi*	20.63	1.67
Cloud Cisticola	*Cisticola textrix*	30.69	12.78
Common Buttonquail	*Turnix sylvaticus*	1.59	0.00
Common Buzzard	*Buteo buteo*	13.76	5.00
Common Greenshank	*Tringa nebularia*	5.82	0.56
Common House Martin	*Delichon urbicum*	8.47	0.56
Common Moorhen	*Gallinula chloropus*	16.40	0.00
Common Myna	*Acridotheres tristis*	54.50	10.00
Common Ostrich	*Struthio camelus*	2.65	1.11
Common Quail	*Coturnix coturnix*	17.99	6.11
Common Ringed Plover	*Charadrius hiaticula*	0.53	0.00
Common Sandpiper	*Actitis hypoleucos*	0.53	0.00
Common Swift	*Apus apus*	2.65	0.56
Common Waxbill	*Estrilda astrild*	28.04	6.11
Crested Barbet	*Trachyphonus vaillantii*	47.62	5.00
Crowned Lapwing	*Vanellus coronatus*	84.13	29.44
Cuckoo Finch	*Anomalospiza imberbis*	1.06	0.00
Dark-capped Bulbul	*Pycnonotus tricolor*	21.16	3.33
Desert Cisticola	*Cisticola aridulus*	1.06	0.56
Diederik Cuckoo	*Chrysococcyx caprius*	23.81	4.44
Domestic Goose	*Anser anser domesticus*	0.53	1.67
Eastern Clapper Lark	*Mirafra fasciolata*	1.59	0.00
Eastern Long-billed Lark	*Certhilauda semitorquata*	13.76	0.00
Egyptian Goose	*Alopochen aegyptiaca*	69.31	21.11
European Bee-eater	*Merops apiaster*	1.06	0.00
European Honey-buzzard	*Pernis apivorus*	1.06	0.00
European Roller	*Coracias garrulus*	0.53	1.11
Fairy Flycatcher	*Stenostira scita*	16.93	1.67
Familiar Chat	*Oenanthe familiaris*	12.17	0.56
Fan-tailed Widowbird	*Euplectes axillaris*	10.05	2.78

Avifauna recorded by SABAP2 in the broader area			
Common name	**Scientific name**	**SABAP 2 Full protocol reporting rate**	**SABAP 2 Ad hoc protocol reporting rate**
Fiscal Flycatcher	*Melaenornis silens*	46.56	3.33
Giant Kingfisher	*Megaceryle maxima*	2.65	0.00
Glossy Ibis	*Plegadis falcinellus*	17.99	2.78
Golden-tailed Woodpecker	*Campethera abingoni*	0.53	0.00
Goliath Heron	*Ardea goliath*	1.59	0.00
Great Crested Grebe	*Podiceps cristatus*	1.59	0.00
Great Egret	*Ardea alba*	2.12	0.00
Greater Flamingo	*Phoenicopterus roseus*	8.99	4.44
Greater Honeyguide	*Indicator indicator*	1.59	0.00
Greater Kestrel	*Falco rupicoloides*	16.93	7.78
Greater Striped Swallow	*Cecropis cucullata*	46.03	11.11
Green Wood Hoopoe	*Phoeniculus purpureus*	26.46	2.78
Green-winged Pytilia	*Pytilia melba*	4.23	0.56
Grey Go-away-bird	*Crinifer concolor*	3.17	0.56
Grey Heron	*Ardea cinerea*	24.34	4.44
Grey-headed Gull	*Chroicocephalus cirrocephalus*	1.06	0.00
Grey-winged Francolin	*Scleroptila afra*	11.64	0.56
Hadada Ibis	*Bostrychia hagedash*	89.42	33.89
Hamerkop	*Scopus umbretta*	10.58	1.67
Helmeted Guineafowl	*Numida meleagris*	64.02	13.33
Horus Swift	*Apus horus*	1.59	0.56
House Sparrow	*Passer domesticus*	50.26	9.44
Icterine Warbler	*Hippolais icterina*	0.53	0.00
Intermediate Egret	*Ardea intermedia*	14.81	2.78
Jackal Buzzard	*Buteo rufofuscus*	14.29	3.33
Jacobin Cuckoo	*Clamator jacobinus*	0.53	0.00
Karoo Thrush	*Turdus smithi*	29.63	3.89
Kittlitz's Plover	*Charadrius pecuarius*	2.65	0.56
Knob-billed Duck	*Sarkidiornis melanotos*	1.06	0.00
Lanner Falcon	*Falco biarmicus*	3.70	2.22
Lark-like Bunting	*Emberiza impetuani*	0.53	0.00
Laughing Dove	*Spilopelia senegalensis*	88.36	25.00
Lesser Flamingo	*Phoeniconaias minor*	1.59	1.67
Lesser Grey Shrike	*Lanius minor*	2.12	0.00

Avifauna recorded by SABAP2 in the broader area			
Common name	Scientific name	SABAP 2 Full protocol reporting rate	SABAP 2 Ad hoc protocol reporting rate
Lesser Honeyguide	*Indicator minor*	3.17	0.56
Lesser Kestrel	*Falco naumanni*	2.12	0.00
Lesser Striped Swallow	*Cecropis abyssinica*	0.00	0.56
Lesser Swamp Warbler	*Acrocephalus gracilirostris*	3.17	0.00
Levaillant's Cisticola	*Cisticola tinniens*	60.85	12.78
Lilac-breasted Roller	*Coracias caudatus*	0.53	0.00
Little Egret	*Egretta garzetta*	14.81	1.67
Little Grebe	*Tachybaptus ruficollis*	49.21	10.00
Little Rush Warbler	*Bradypterus baboecala*	2.12	0.00
Little Stint	*Calidris minuta*	1.59	0.00
Little Swift	*Apus affinis*	21.69	0.56
Long-tailed Paradise Whydah	*Vidua paradisaea*	2.12	0.00
Long-tailed Widowbird	*Euplectes progne*	79.89	30.00
Maccoa Duck	*Oxyura maccoa*	2.65	0.00
Malachite Kingfisher	*Corythornis cristatus*	6.35	0.00
Malachite Sunbird	*Nectarinia famosa*	19.05	1.67
Marsh Owl	*Asio capensis*	8.99	1.11
Marsh Warbler	*Acrocephalus palustris*	0.53	0.00
Martial Eagle	*Polemaetus bellicosus*	1.06	0.56
Melodious Lark	*Mirafra cheniana*	2.65	0.00
Montagu's Harrier	*Circus pygargus*	2.65	1.67
Mountain Wheatear	*Myrmecocichla monticola*	42.33	2.78
Namaqua Dove	*Oena capensis*	14.29	1.67
Neddicky	*Cisticola fulvicapilla*	26.46	1.67
Nicholson's Pipit	*Anthus nicholsoni*	21.16	1.67
Northern Black Korhaan	*Afrotis afraoides*	24.34	7.78
Orange River Francolin	*Scleroptila gutturalis*	49.21	20.56
Orange-breasted Waxbill	*Amandava subflava*	2.65	1.67
Pale-crowned Cisticola	*Cisticola cinnamomeus*	1.59	2.22
Pallid Harrier	*Circus macrourus*	1.59	0.00
Pied Avocet	*Recurvirostra avosetta*	5.29	2.22
Pied Crow	*Corvus albus*	9.52	2.22
Pied Kingfisher	*Ceryle rudis*	6.35	1.67
Pied Starling	*Lamprotornis bicolor*	0.53	0.56
Pink-billed Lark	*Spizocorys conirostris*	19.05	8.33

Avifauna recorded by SABAP2 in the broader area			
Common name	**Scientific name**	**SABAP 2 Full protocol reporting rate**	**SABAP 2 Ad hoc protocol reporting rate**
Pin-tailed Whydah	*Vidua macroura*	41.27	9.44
Plain-backed Pipit	*Anthus leucophrys*	2.65	0.00
Purple Heron	*Ardea purpurea*	5.82	0.00
Quailfinch	*Ortygospiza atricollis*	51.32	16.67
Red-backed Shrike	*Lanius collurio*	5.29	1.11
Red-billed Firefinch	*Lagonosticta senegala*	0.53	0.00
Red-billed Quelea	*Quelea quelea*	64.02	18.89
Red-billed Teal	*Anas erythrorhyncha*	33.86	4.44
Red-capped Lark	*Calandrella cinerea*	70.37	31.11
Red-chested Cuckoo	*Cuculus solitarius*	4.76	0.00
Red-collared Widowbird	*Euplectes ardens*	8.47	2.22
Red-eyed Dove	*Streptopelia semitorquata*	71.43	10.00
Red-faced Mousebird	*Urocolius indicus*	43.39	2.78
Red-footed Falcon	*Falco vespertinus*	0.00	0.56
Red-headed Finch	*Amadina erythrocephala*	21.16	2.22
Red-knobbed Coot	*Fulica cristata*	68.25	18.33
Red-throated Wryneck	*Jynx ruficollis*	31.75	5.56
Red-winged Francolin	*Scleroptila levaillantii*	1.06	0.00
Red-winged Starling	*Onychognathus morio*	28.04	1.67
Reed Cormorant	*Microcarbo africanus*	64.55	16.11
Rock Dove	*Columba livia*	33.86	1.67
Rock Kestrel	*Falco rupicolus*	15.34	10.00
Rock Martin	*Ptyonoprogne fuligula*	19.58	2.22
Ruff	*Calidris pugnax*	1.59	0.00
Rufous-naped Lark	*Mirafra africana*	40.21	8.33
Secretarybird	*Sagittarius serpentarius*	10.05	9.44
Sentinel Rock Thrush	*Monticola explorator*	10.05	2.78
Sickle-winged Chat	*Emarginata sinuata*	1.06	0.00
South African Cliff Swallow	*Petrochelidon spilodera*	48.68	12.78
South African Shelduck	*Tadorna cana*	9.52	1.67
Southern Boubou	*Laniarius ferrugineus*	4.23	1.11
Southern Fiscal	*Lanius collaris*	95.24	31.67
Southern Grey-headed Sparrow	*Passer diffusus*	49.74	10.56
Southern Masked Weaver	*Ploceus velatus*	87.30	19.44

Avifauna recorded by SABAP2 in the broader area			
Common name	Scientific name	SABAP 2 Full protocol reporting rate	SABAP 2 Ad hoc protocol reporting rate
Southern Pochard	*Netta erythrophthalma*	9.52	1.67
Southern Red Bishop	*Euplectes orix*	80.95	33.33
Speckled Mousebird	*Colius striatus*	20.63	0.56
Speckled Pigeon	*Columba guinea*	77.78	20.00
Spike-heeled Lark	*Chersomanes albofasciata*	40.74	16.11
Spotted Eagle-Owl	*Bubo africanus*	6.35	0.00
Spotted Flycatcher	*Muscicapa striata*	7.41	0.56
Spotted Thick-knee	*Burhinus capensis*	32.28	3.33
Spur-winged Goose	*Plectropterus gambensis*	20.11	7.78
Squacco Heron	*Ardeola ralloides*	0.53	0.00
Streaky-headed Seedeater	*Crithagra gularis*	27.51	0.56
Swainson's Spurfowl	*Pternistis swainsonii*	77.78	17.78
Tawny-flanked Prinia	*Prinia subflava*	4.76	1.11
Three-banded Plover	*Charadrius tricollaris*	33.33	5.56
Violet-backed Starling	*Cinnyricinclus leucogaster*	3.17	0.00
Wailing Cisticola	*Cisticola lais*	39.15	2.78
Wattled Starling	*Creatophora cinerea*	4.76	0.00
Western Barn Owl	*Tyto alba*	5.29	0.00
Western Cattle Egret	*Bubulcus ibis*	47.09	12.22
Whiskered Tern	*Chlidonias hybrida*	8.47	3.89
White Stork	*Ciconia ciconia*	3.17	1.11
White-backed Duck	*Thalassornis leuconotus*	6.35	0.00
White-backed Mousebird	*Colius colius*	1.59	0.00
White-bellied Bustard	*Eupodotis senegalensis*	1.06	0.00
White-bellied Sunbird	*Cinnyris talatala*	23.28	0.00
White-breasted Cormorant	*Phalacrocorax lucidus*	12.17	2.78
White-browed Sparrow-Weaver	*Plocepasser mahali*	77.78	24.44
White-crested Helmetshrike	*Prionops plumatus*	1.06	0.00
White-faced Whistling Duck	*Dendrocygna viduata*	7.41	0.00
White-rumped Swift	*Apus caffer*	30.69	3.33
White-throated Swallow	*Hirundo albigularis*	36.51	2.78
White-winged Tern	*Chlidonias leucopterus*	1.06	0.00
White-winged Widowbird	*Euplectes albonotatus*	19.05	7.78
Willow Warbler	*Phylloscopus trochilus*	5.29	0.00

Avifauna recorded by SABAP2 in the broader area			
Common name	**Scientific name**	**SABAP 2 Full protocol reporting rate**	**SABAP 2 Ad hoc protocol reporting rate**
Wing-snapping Cisticola	*Cisticola ayresii*	17.99	5.56
Wood Sandpiper	*Tringa glareola*	9.52	0.56
Yellow Canary	*Crithagra flaviventris*	50.26	17.22
Yellow-billed Duck	*Anas undulata*	62.96	12.22
Yellow-billed Kite	*Milvus aegyptius*	0.53	0.00
Yellow-billed Stork	*Mycteria ibis*	0.53	0.00
Yellow-breasted Pipit	*Anthus chloris*	0.53	0.56
Yellow-crowned Bishop	*Euplectes afer*	31.75	13.89
Yellow-fronted Canary	*Crithagra mozambica*	6.35	1.11
Zitting Cisticola	*Cisticola juncidis*	34.39	11.67

Avifauna recorded during the pre-construction monitoring		Transects WEF	Transects control	Focal points	VP	VP control	Incidental
Priority Species							
African Harrier-Hawk	*Polyboroides typus*						*
Amur Falcon	*Falco amurensis*	*	*	*	*	*	
Black Sparrowhawk	*Accipiter melanoleucus*					*	*
Black-chested Snake Eagle	*Circaetus pectoralis*				*		
Black-winged Kite	*Elanus caeruleus*	*	*	*	*	*	*
Black-winged Lapwing	*Vanellus melanopterus*	*					
Blue Crane	*Grus paradisea*	*	*	*	*	*	*
Blue Korhaan	*Eupodotis caerulescens*	*	*	*	*	*	*
Denham's Bustard	*Neotis denhami*			*			
Greater Flamingo	*Phoenicopterus roseus*	*	*				*
Greater Kestrel	*Falco rupicoloides*	*	*	*	*		*
Lanner Falcon	*Falco biarmicus*	*	*		*	*	*
Marsh Owl	*Asio capensis*	*	*		*	*	*
Melodious Lark	*Mirafra cheniana*	*					
Northern Black Korhaan	*Afrotis afraoides*	*	*	*			*
Secretarybird	*Sagittarius serpentarius*	*	*				*
Spotted Eagle-Owl	*Bubo africanus*						*
17		**12**	**10**	**7**	**8**	**7**	**12**

Non-Priority Species		Transects WEF	Transects control	Focal points
African Darter	*Anhinga rufa*	*	*	*
African Palm Swift	*Cypsiurus parvus*		*	
African Pipit	*Anthus cinnamomeus*	*	*	*
African Quail-finch	*Ortygospiza atricollis*	*	*	*
African Sacred Ibis	*Threskiornis aethiopicus*	*	*	*
African Snipe	*Gallinago nigripennis*	*		
African Spoonbill	*Platalea alba*	*	*	*
African Stonechat	*Saxicola torquatus*	*	*	*
African Wattled Lapwing	*Vanellus senegallus*	*	*	*
Ant-eating Chat	*Myrmecocichla formicivora*	*	*	*
Baillon's Crake	*Porzana pusilla*	*		
Banded Martin	*Riparia cincta*	*		
Barn Swallow	*Hirundo rustica*	*	*	*
Black Crake	*Amaurornis flavirostra*		*	
Black-chested Prinia	*Prinia flavicans*	*	*	*
Black-collared Barbet	*Lybius torquatus*	*		
Black-headed Heron	*Ardea melanocephala*	*	*	*
Black-necked Grebe	*Podiceps nigricollis*	*		
Blacksmith Lapwing	*Vanellus armatus*	*	*	*
Black-throated Canary	*Crithagra atrogularis*	*	*	*
Black-winged Red Bishop	*Euplectes hordeaceus*		*	
Black-winged Stilt	*Himantopus himantopus*		*	*
Bokmakierie	*Telophorus zeylonus*	*		*
Brown-throated Martin	*Riparia paludicola*	*	*	*
Cape Crow	*Corvus capensis*	*	*	*
Cape Glossy Starling	*Lamprotornis nitens*	*	*	
Cape Longclaw	*Macronyx capensis*	*	*	*
Cape Robin-Chat	*Cossypha caffra*		*	
Cape Shoveler	*Spatula smithii*	*	*	*
Cape Sparrow	*Passer melanurus*	*	*	*
Cape Teal	*Anas capensis*		*	
Cape turtle dove	*Streptopelia capicola*	*	*	*
Cape Wagtail	*Motacilla capensis*	*	*	*
Capped Wheatear	*Oenanthe pileata*	*	*	
Cloud Cisticola	*Cisticola textrix*	*	*	*
Common Buttonquail	*Turnix sylvaticus*		*	
Common Greenshank	*Tringa nebularia*	*		*
Common Myna	*Acridotheres tristis*	*	*	
Common Ostrich	*Struthio camelus*		*	
Common Quail	*Coturnix coturnix*	*	*	*

Non-Priority Species		Transects WEF	Transects control	Focal points
Common Waxbill	*Estrilda astrild*	*	*	*
Crested Barbet	*Trachyphonus vaillantii*	*		
Crowned Lapwing	*Vanellus coronatus*	*	*	*
Dark-capped Bulbul	*Pycnonotus tricolor*	*	*	*
Desert Cisticola	*Cisticola aridulus*	*		
Diederik Cuckoo	*Chrysococcyx caprius*	*	*	*
Eastern Clapper Lark	*Mirafra fasciolata*	*		
Eastern Long-billed Lark	*Certhilauda semitorquata*	*		
Egyptian Goose	*Alopochen aegyptiaca*	*	*	*
Fan-tailed Widowbird	*Euplectes axillaris*	*	*	*
Fork-tailed Drongo	*Dicrurus adsimilis*	*		
Glossy Ibis	*Plegadis falcinellus*	*	*	*
Goliath Heron	*Ardea goliath*		*	
Great Crested Grebe	*Podiceps cristatus*	*		
Great Egret	*Ardea alba*	*	*	
Greater Striped Swallow	*Cecropis cucullata*	*	*	*
Grey Heron	*Ardea cinerea*	*	*	*
Hadeda Ibis	*Bostrychia hagedash*	*	*	*
Hamerkop	*Scopus umbretta*	*	*	
Helmeted Guineafowl	*Numida meleagris*	*	*	*
House Sparrow	*Passer domesticus*	*	*	*
Intermediate Egret	*Ardea intermedia*	*	*	*
Kittlitz's Plover	*Charadrius pecuarius*		*	
Kurrichane Thrush	*Turdus libonyana*	*		
Laughing Dove	*Spilopelia senegalensis*	*	*	*
Lesser Grey Shrike	*Lanius minor*	*	*	
Lesser Honeyguide	*Indicator minor*		*	
Lesser Swamp Warbler	*Acrocephalus gracilirostris*		*	*
Levaillant's Cisticola	*Cisticola tinniens*	*	*	*
Levaillant's Cuckoo	*Clamator levaillantii*		*	
Little Egret	*Egretta garzetta*	*	*	
Little Grebe	*Tachybaptus ruficollis*	*	*	*
Little Rush Warbler	*Bradypterus baboecala*	*		*
Little Stint	*Calidris minuta*			*
Little Swift	*Apus affinis*	*	*	
Long-tailed Widowbird	*Euplectes progne*	*	*	*
Maccoa Duck	*Oxyura maccoa*	*		
Mountain Wheatear	*Myrmecocichla monticola*	*		
Orange River Francolin	*Scleroptila gutturalis*	*	*	*
Orange River White-eye	*Zosterops pallidus*	*		

Non-Priority Species		Transects WEF	Transects control	Focal points
Pied Avocet	*Recurvirostra avosetta*		*	
Pied Crow	*Corvus albus*	*	*	
Pied Kingfisher	*Ceryle rudis*	*		
Pink-billed Lark	*Spizocorys conirostris*	*	*	*
Pin-tailed Whydah	*Vidua macroura*	*	*	*
Purple Heron	*Ardea purpurea*	*	*	
Red-backed Shrike	*Lanius collurio*	*		
Red-billed Quelea	*Quelea quelea*	*	*	*
Red-billed Teal	*Anas erythrorhyncha*	*	*	*
Red-capped Lark	*Calandrella cinerea*	*	*	*
Red-capped Robin-Chat	*Cossypha natalensis*	*	*	
Red-chested Flufftail	*Sarothrura rufa*		*	
Red-collared Widowbird	*Euplectes ardens*	*		
Red-eyed Dove	*Streptopelia semitorquata*	*	*	*
Red-headed Finch	*Amadina erythrocephala*	*		
Red-knobbed Coot	*Fulica cristata*	*	*	*
Red-throated Wryneck	*Jynx ruficollis*	*	*	*
Reed Cormorant	*Microcarbo africanus*	*	*	*
Rock Kestrel	*Falco rupicolus*		*	
Ruff	*Calidris pugnax*	*		
Rufous-naped Lark	*Mirafra africana*	*		*
Sedge Warbler	*Acrocephalus schoenobaenus*	*		
South African Cliff Swallow	*Petrochelidon spilodera*	*	*	*
South African Shelduck	*Tadorna cana*	*	*	*
Southern Fiscal	*Lanius collaris*	*	*	*
Southern Grey-headed Sparrow	*Passer diffusus*	*	*	*
Southern Masked Weaver	*Ploceus velatus*	*	*	*
Southern Pochard	*Netta erythrophthalma*	*		
Southern Red Bishop	*Euplectes orix*	*	*	*
Speckled Pigeon	*Columba guinea*	*	*	*
Spike-heeled Lark	*Chersomanes albofasciata*	*	*	*
Spotted Thick-knee	*Burhinus capensis*	*	*	*
Spur-winged Goose	*Plectropterus gambensis*	*	*	*
Swainson's Spurfowl	*Pternistis swainsonii*	*	*	*
Tawny-flanked Prinia	*Prinia subflava*	*	*	*
Three-banded Plover	*Charadrius tricollaris*	*	*	*
Wailing Cisticola	*Cisticola lais*	*		
Western Cattle Egret	*Bubulcus ibis*	*	*	*
Whiskered Tern	*Chlidonias hybrida*	*	*	*
White-backed Duck	*Thalassornis leuconotus*			*
White-breasted Cormorant	*Phalacrocorax lucidus*	*	*	*
White-browed Sparrow-Weaver	*Plocepasser mahali*	*	*	*

Non-Priority Species		Transects WEF	Transects control	Focal points
White-rumped Swift	*Apus caffer*	*	*	*
White-throated Swallow	*Hirundo albigularis*	*	*	*
White-winged Tern	*Chlidonias leucopterus*	*	*	*
Wing-snapping Cisticola	*Cisticola ayresii*	*	*	*
Wood Sandpiper	*Tringa glareola*			*
Yellow Canary	*Crithagra flaviventris*	*	*	*
Yellow-billed Duck	*Anas undulata*	*	*	*
Yellow-crowned Bishop	*Euplectes afer*	*	*	*
Zitting Cisticola	*Cisticola juncidis*	*	*	*
134	Subtotal	**114**	**104**	**83**
	Grand total	**126**	**114**	**90**

Appendix F – Pre-construction monitoring

1. Objectives

The objective of the pre-construction monitoring at the proposed Impumelelo Wind Energy Facility was to gather baseline data over a period of four seasons on the following aspects pertaining to avifauna:

- The abundance and diversity of priority species to measure the potential displacement effect of the facility.
- Flight patterns of priority species to assess the potential collision risk with the turbines.

2. Methods

2.1 Guidelines

The monitoring protocol for the site was designed according to the following set of guidelines:

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

The wind guidelines are applicable to all wind energy facilities that require environmental authorisation. The wind guidelines usually require a minimum of four site visits a year.

Wind priority species were identified using the latest (November 2014) BirdLife SA (BLSA) list of priority species for wind farms.

We did not foresee the regular occurrence of Verreaux's Eagle, Cape Vulture or Black Harriers at the sites, the application of species-specific guidelines were thus not necessary.

2.2 Surveys

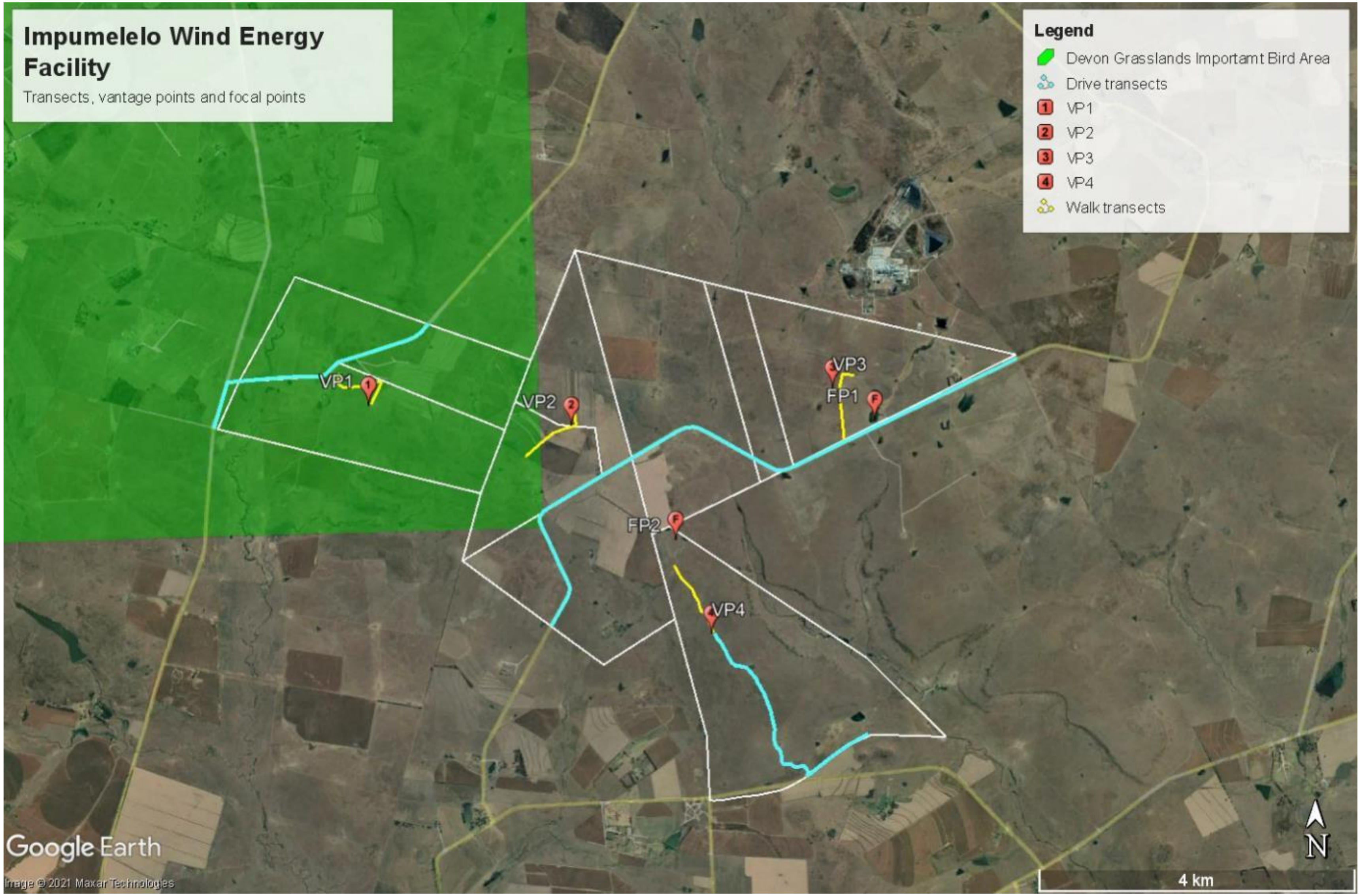


Figure 1: Area where monitoring was implemented, with position of VPs, drive transects, walk transects and focal points.

Appendix G : ENVIRONMENTAL MANAGEMENT PROGRAMME

Environmental Management Programme (EMPr): WEF Management Plan for the Planning and Design Phase

Impact	Mitigation/Management Objectives and Outcomes	Mitigation / Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
Avifauna: Mortality due to collisions with the turbines					
Mortality of priority avifauna due to collisions with the wind turbines	Prevent mortality of priority avifauna	1. It is recommended that all turbines have 2/3 of one blade painted in signal red or black, if feasible. It is acknowledged that blade painting as a mitigation strategy is still in an experimental phase in South Africa, but research indicates that it has a very good chance of reducing avian mortality (Simmons, et al., 2021) and if the painting is done during the manufacturing of the turbines, the costs are negligible. 2. A 100m turbine exclusion zone must be implemented around wetlands, dams, drainage lines and pans.	1. Design the facility taking into account the avifaunal all infrastructure exclusion zones.	Once-off during the planning phase.	Project Developer
Avifauna: Mortality due to electrocution					
Electrocution of raptors on the internal 33kV poles	Prevent mortality of priority avifauna	1. Use underground cabling as much as is practically possible. 2. Where the use of overhead lines is unavoidable due to technical reasons, the Avifaunal Specialist must be consulted to ensure that a raptor friendly pole design is used, and that appropriate mitigation is implemented pro-actively for complicated pole structures e.g. insulation of live components to prevent electrocutions on terminal structures and pole transformers.	1. Design the facility with underground cabling. 2. Consult with Avifaunal Specialist during the design phase of the overhead lines.	Once-off during the planning phase.	Project Developer
Avifauna: Displacement due to disturbance					
Displacement of priority avifauna due to disturbance	Prevent displacement of priority avifauna	1. Development in the remaining high sensitivity grassland must be limited as far as possible. Where possible, infrastructure must be	3. Design the facility taking into account the avifaunal all infrastructure exclusion zones.	Once-off during the planning phase.	Project Developer

Impact	Mitigation/Management Objectives and Outcomes	Mitigation / Management Actions	Monitoring		
			Methodology	*Frequency*	*Responsibility*
		located near margins, with shortest routes taken from the existing roads			

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

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	*Frequency*	*Responsibility*
Avifauna: Displacement due to disturbance					
The noise and movement associated with the construction activities at the development footprint will be a source of disturbance which would lead to the displacement of avifauna from the area	Prevent unnecessary displacement of priority avifauna by ensuring that contractors are aware of the requirements of the Construction Environmental Management Programme (CEMPr.)	1. Driving is only permitted in designated roads. 2. Measures to control noise and dust according to latest best practice. 3. Restricted access to the rest of the property outside the designated construction area. 4. Strict application of all recommendations in the botanical specialist report pertaining to the limitation and rehabilitation of the footprint.	1. Ensure that construction personnel are made aware of the impacts relating to off-road driving. 2. Construction access roads must be demarcated clearly. Undertake site inspections to verify. 3. Monitor the implementation of noise control mechanisms via site inspections and record and report non-compliance. 4. Ensure that the construction area is demarcated clearly and that construction personnel are made aware of these demarcations. 5. Monitor via site inspections and report non-compliance.	1. Monthly 2. Monthly 3. Monthly 4. Monthly 5. Monthly	1. Contractor and ECO 2. Contractor and ECO 3. Contractor and ECO 4. Contractor and ECO 5. Contractor and ECO
Avifauna: Displacement due to habitat transformation					
Total or partial displacement of avifauna due to habitat transformation associated with the vegetation clearance and the presence of the wind turbines and associated infrastructure.	Prevent unnecessary displacement of avifauna by ensuring that the rehabilitation of transformed areas is implemented by an appropriately qualified rehabilitation specialist, according to the recommendations of the biodiversity specialist study.	1. Monitor rehabilitation via site audits and site inspections to ensure compliance. Record and report any non-compliance. 2. Vehicle and pedestrian access to the site to be controlled and restricted to the facility footprint as much as possible to prevent	1. Appointment of specialist to supervise the rehabilitation 2. Site inspections to monitor progress.	1. Once-off 2. Once a year	1. Operations Manager 2. SHE Manager 3. SHE Manager 4. Operations Manager

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
		unnecessary destruction of vegetation.			

Management Plan for the Operational Phase

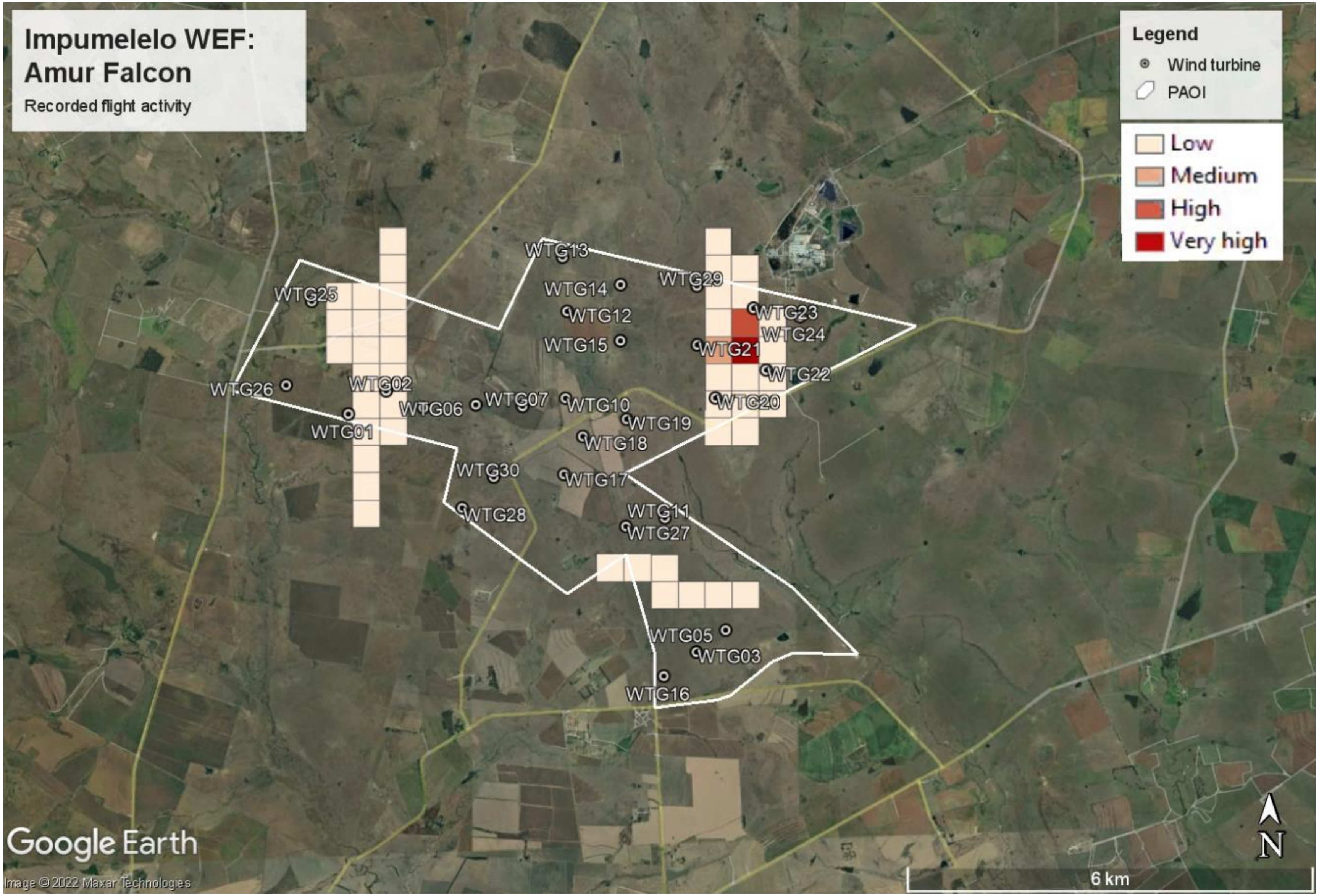
Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
Avifauna: Mortality due to collisions with the wind turbines					
Bird collisions with the wind turbines	Prevention of collision mortality on the wind turbines.	1. Formal live-bird monitoring and carcass searches to be implemented at the start of the operational phase, as per the most recent edition of the Best Practice Guidelines at the time (Jenkins *et al*., 2015), to assess collision rates. The exact time when operational monitoring is to commence, will depend on the construction schedule, and must commence when the first turbines start operating. The Best Practice Guidelines require that, as an absolute minimum, operational monitoring is to be undertaken for the first two (preferably three) years of operation, and then repeated again in year 5, and again every five years thereafter for the operational lifetime of the facility. 2. If estimated annual collision rates indicate unacceptable mortality levels of priority species i.e. exceeding mortality thresholds as determined by the avifaunal specialist in consultation with other experts	1. Appoint Avifaunal Specialist to compile operational monitoring plan, including live bird monitoring and carcass searches. 2. Implement operational monitoring plan. 3. Compile quarterly and annual progress reports detailing the results of the operational monitoring and progress with any recommended mitigation measures.	1. Once-off 2. Years 1,2, 5 and every five years after that for the duration of the operational lifetime of the facility. 3. Years 1 and 2, and then after evaluation, annually as long as it is deemed necessary in the opinion of the avifaunal specialist in consultation with the WEF management.	1. Operations Manager 2. Operations Manager 3. Operations Manager 4. Operations Manager

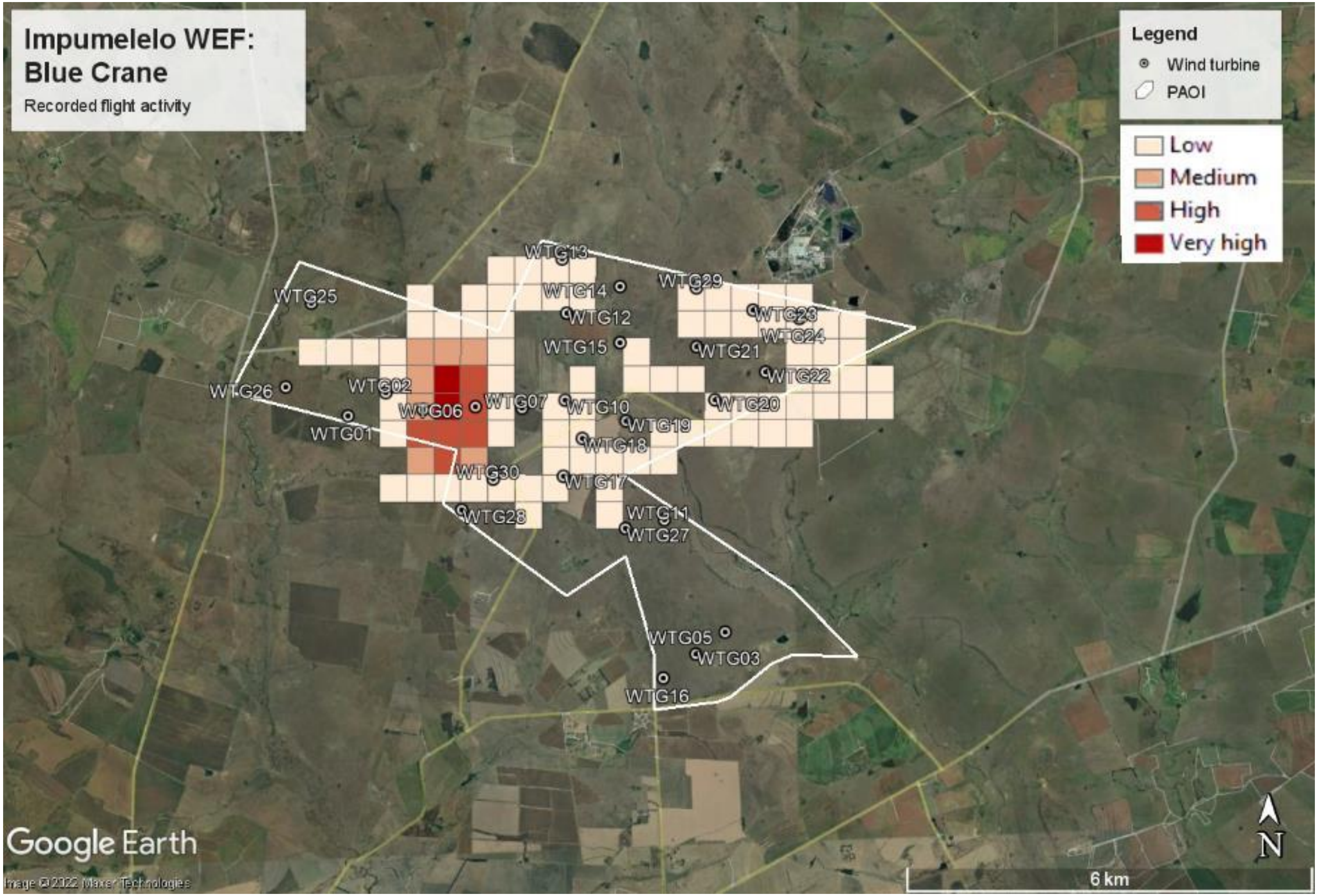
Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	*Frequency*	*Responsibility*
		e.g. BLSA, additional measures will have to be implemented which could include shut down on demand or other proven measures (if available at the time).			
Avifauna: Mortality due to collisions and electrocutions on the 33kV network					
Bird electrocutions on the overhead sections of the internal 33kV cables	Prevention of electrocution mortality on the overhead sections of the 33kV internal cable network.	1. Conduct regular inspections of the overhead sections of the internal reticulation network to look for carcasses.	1. Carcass searchers under the supervision of the Avifaunal Specialist. 2. Design and implement mitigation measures if mortality thresholds are exceeded. 3. Compile quarterly and annual progress reports detailing the results of the operational monitoring and progress, with any recommended mitigation measures.	1. At least once every two months.	1. Operations Manager

Management Plan for the Decommissioning Phase

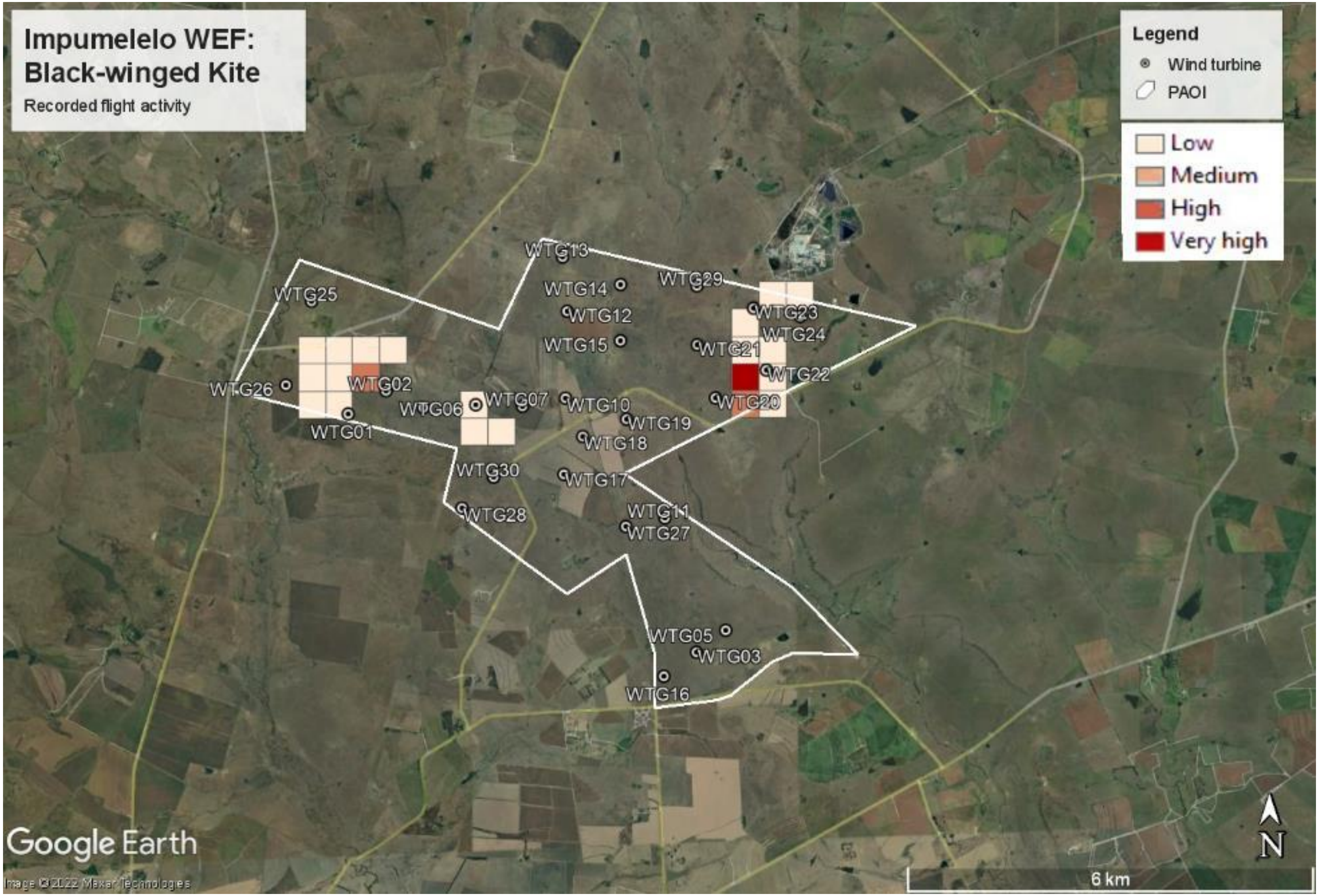
Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
Avifauna: Displacement due to disturbance associated with the dismantling activities					
The noise and movement associated with the de-commissioning activities at the WEF footprint will be a source of disturbance which would lead to the displacement of avifauna from the area	Prevent unnecessary displacement of avifauna by ensuring that contractors are aware of the requirements of the EMPr.	A site-specific EMPr must be implemented, which gives an appropriate and detailed description of how construction activities must be conducted. All contractors are to adhere to the EMPr and must apply good environmental practice during construction. The EMPr must specifically include the following: 1. Driving only permitted on designated roads. 2. Maximum use of existing roads. 3. Measures to control noise and dust according to latest best practice. 4. Restricted access to the rest of the property. 5. Strict application of all recommendations in the botanical specialist report pertaining to the limitation of the footprint.	**1.** Implementation of the EMPr. Oversee activities to ensure that the EMPr is implemented and enforced via site audits and inspections. Report and record any non-compliance. 2. Ensure that construction personnel are made aware of the impacts relating to off-road driving. 3. Access roads must be demarcated clearly. Undertake site inspections to verify. 4. Monitor the implementation of noise control mechanisms via site inspections and record and report non-compliance. 5. Ensure that the footprint area is demarcated and that construction personnel are made aware of these demarcations. Monitor via site inspections and report non-compliance.	1. Monthly 2. Monthly 3. Monthly 4. Monthly 5. Monthly	1. Contractor and ECO 2. Contractor and ECO 3. Contractor and ECO 4. Contractor and ECO 5. Contractor and ECO

Appendix H – Flight maps





Impumelelo WEF:
Blue Crane
Recorded flight activity
Legend
Wind turbine
PAOI
Low
Medium
High
Very high
WTG13
WTG14
WTG12
WTG29
WTG23
WTG24
WTG25
WTG15
WTG21
WTG22
WTG26
WTG02
WTG06
WTG07
WTG10
WTG20
WTG01
WTG19
WTG18
WTG30
WTG17
WTG28
WTG11
WTG27
WTG05
WTG03
WTG16
Google Earth
Image © 2022 Maxar Technologies
6 km
N


Impumelelo WEF:
Black-winged Kite
Recorded flight activity
Legend
Wind turbine
PAOI
Low
Medium
High
Very high
WTG13
WTG14
WTG29
WTG25
WTG12
WTG23
WTG24
WTG15
WTG21
WTG22
WTG26
WTG02
WTG07
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WTG20
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WTG16
Google Earth
Image © 2022 Maxar Technologies
6 km
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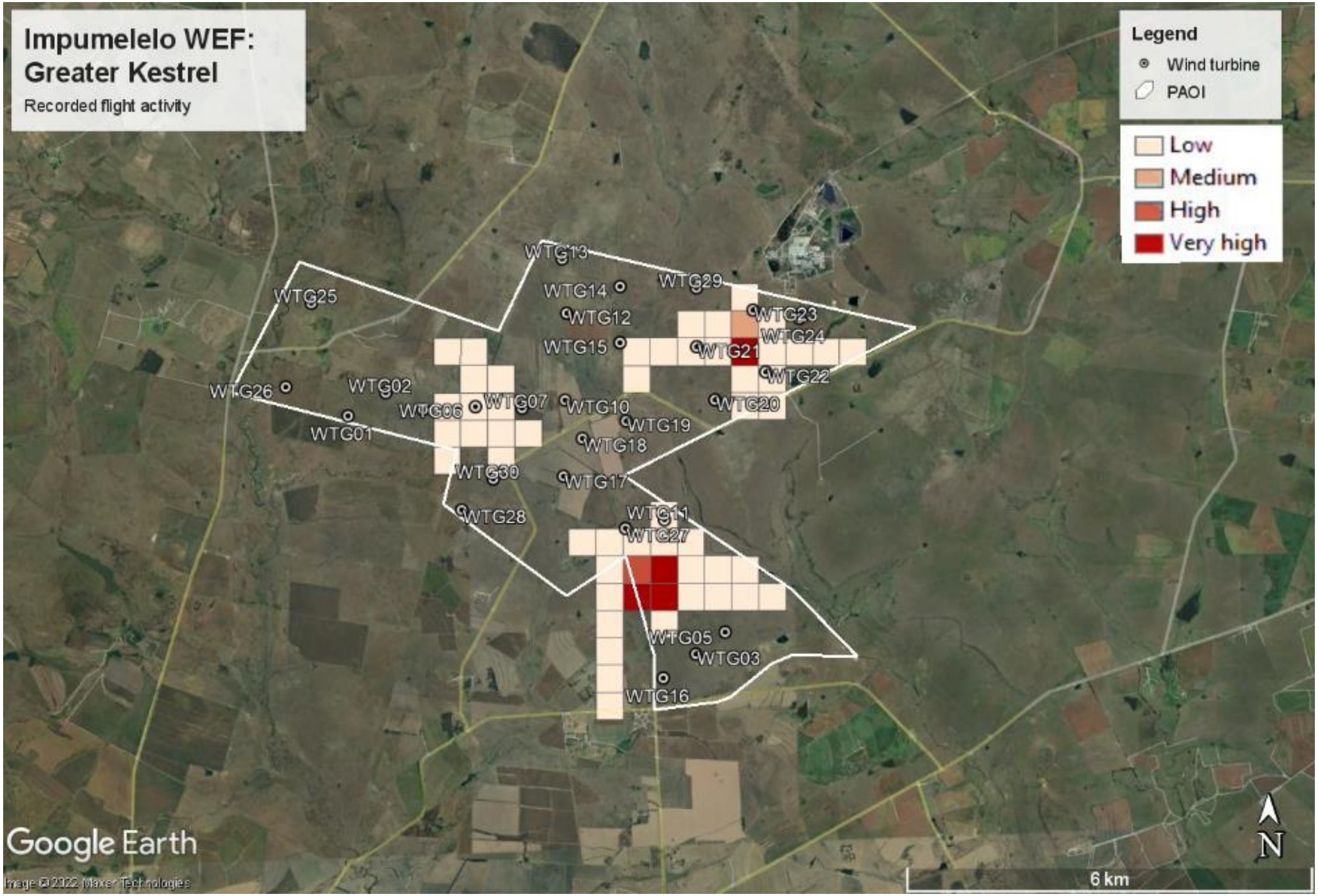

Impumelelo WEF:
Greater Kestrel
Recorded flight activity
Legend
Wind turbine
PAOI
Low
Medium
High
Very high
WTG13
WTG14
WTG29
WTG25
WTG12
WTG23
WTG24
WTG15
WTG21
WTG22
WTG26
WTG02
WTG06
WTG07
WTG10
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WTG16
Google Earth
Image © 2022 Maxar Technologies
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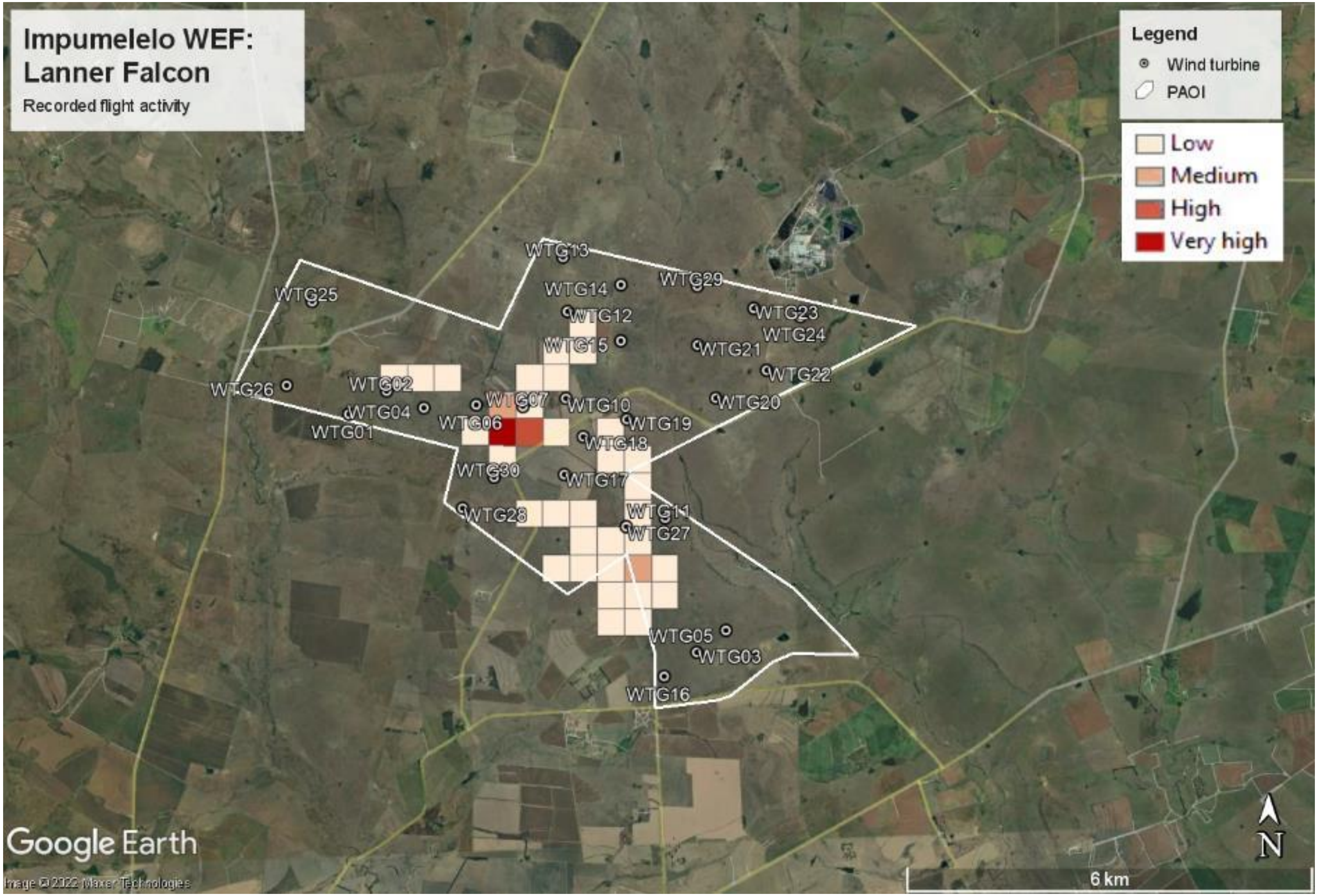
Impumelelo WEF:
Lanner Falcon
Recorded flight activity
Legend
Wind turbine
PAOI
Low
Medium
High
Very high
WTG13
WTG14
WTG29
WTG25
WTG12
WTG23
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WTG16
Google Earth
Image © 2022 Maxar Technologies
6 km
N

Appendix I : OPERATIONAL MONITORING PLAN

1 Introduction

The avifaunal post-construction monitoring at the proposed Impumelelo WEF must be conducted in accordance with the latest version (2015) of the '*Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa'* (Jenkins *et al*., 2015)[8].

2 Aim of Post-Construction Monitoring

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

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

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

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

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

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

3 Timing

Post-construction monitoring should commence as soon as possible after the first turbines become operational to ensure that the immediate effects of the facility on resident and passing birds are recorded, before they have time to adjust or habituate to the developments. However, it should be borne in mind that it is also important to obtain an understanding of the impacts of the facility as it would be over the lifespan of the facility. Over time

---

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

the habitat within the WEF may change, birds may become habituated to, or learn to avoid the facility. It is therefore necessary to monitor over a longer period than just an initial one year.

4 Duration

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

5 Habitat Classification

Any observed changes in bird numbers and movements at the WEF may be linked to changes in the available habitat. The avian habitats available must be mapped once a year for the first two years, then in Year 5 and thereafter in 5-yearly intervals.

6 Bird Numbers and Movements

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

7 Collisions

The collision monitoring must have three components:

- Experimental assessment of search efficiency and scavenging rates of bird carcasses on the site.
- Regular searches in the immediate vicinity of the WEF turbines for collision casualties (see Section 9).
- Estimation of collision rates.

8 Searcher Efficiency and Scavenger Removal

The value of surveying the area for collision victims is only valid if some measure of the accuracy of the survey method is developed. The probability of a carcass being detected and the rate of removal / decay of the carcass must be accounted for when estimating collision rates. This must be addressed in the form of searcher and scavenger trails which must be conducted by the avifaunal specialists at least twice a year during each year of post-construction monitoring to arrive at an estimated annual collision mortality rate.

9 Collision Victim Surveys

9.1 Aligning carcass search protocols

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

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

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

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

9.2 Estimation of collision rates

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

10 Deliverables

10.1 Annual report

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

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

10.2 Quarterly reports

Concise quarterly reports must be compiled by the avifaunal specialist for the WEF operator with basic statistics and recommendations for the management of impacts that need to be addressed.